DESIGN REPORT

FOR

BURKE CREEK HIGHWAY 50 CROSSING AND REALIGNMENT PROJECT, PHASE I

STATELINE, NEVADA

May 2016

*Approved by:*_____

Meghan Kelly, P.E., #20851

Prepared by:

Nevada Tahoe Conservation District

Nevada Tahoe Conservation District
400 Dorla Ct.
PO Box 915
Zephyr Cove, NV 89448
(775) 586-1610

TABLE OF CONTENTS

1.0 INTRODUCTION

PROJECT LOCATION

Burke Creek is a small stream in the Lake Tahoe Basin which passes just north of the intersection of Highway 50 and Kahle Drive in Stateline, NV. It has an approximately 4.5 square mile drainage area to Lake Tahoe. The Burke Creek Highway 50 crossing and Realignment Project (Project) area includes a parking lot that infringes on the stream's floodplain and meadow. The Project extends from Highway 50 to approximately 1,000 feet upstream of Highway 50, and is located on property owned by the USFS, private owners (Sierra Colina LCC. and Apartments 801 LCC.), Douglas County and NDOT.

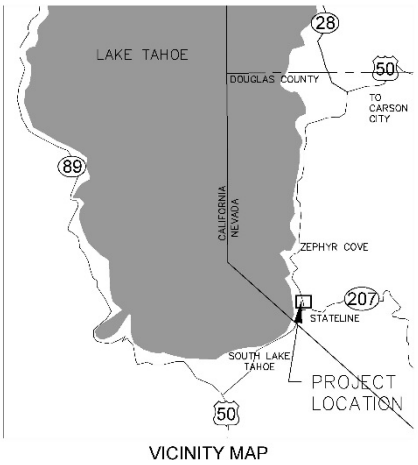


Figure 1.1 Project Area Location.

PROJECT NEED/DESCRIPTION

The Lake Tahoe Total Maximum Daily Load (TMDL) is based on reducing the transport of fine sediment and nutrients from upland, urban catchments. The breakdown of road traction material and road surfaces have been implicated in Fine Sediment Particle (FSP) generation which can be conveyed via stormwater routing to Burke Creek and thence to the Lake. A sediment pond, Jenning's Pond, on Burke Creek is present downstream of Highway 50. Sampling of the pond-bottom does not show FSP settling, suggesting transport of FSP to the Lake is very likely.

As Burke Creek approaches Highway 50 it is impacted by directly connected stormwater runoff from Highway 50, and some Douglas County property (part of Kahle recreation area). An undersized culvert under Highway 50 restricts proper stream function and has potential to back-water Highway 50 travel lanes according to HEC-RAS modeling and observed incidents. Stormwater runoff from private property is also routed to this undersized culvert. Separation of these flows is a part of this project. The proposed project will establish a functional stream crossing under Highway 50 to reduce the possibility of the creek overflowing and back-watering the highway; increase floodplain access; and disconnect untreated stormwater runoff to Burke Creek in the project area.

At the Apartment 801 LLC. Building (formerly Bluth and Tahoe Nugget Casino) entrance and Highway 50, a drop inlet delivers untreated stormwater directly to Burke Creek. Stormwater runoff from a part of the parking lot and

Highway 50 also discharges to Burke Creek via this drop inlet (Photo 1.1). In average water years Burke Creek is directly connected to the Lake (Photo 1.2).

Photo 1.1. Directly Connected Drop Inlet to Burke Creek

Photo 1.2. Burke Creek Connection to Lake Tahoe

Burke Creek has been historically modified and relocated to accommodate development including the former Tahoe Nugget Casino, Highway 50 and other commercial development. This includes parking lots that infringe on its floodplain. It flows through 5 property ownerships including USFS, two private owners, Douglas County and NDOT. The Burke Creek Highway 50 Crossing and Realignment Project generally consists of improving the Burke Creek crossing under Highway 50 (phase 1) and realigning and restoring the reach directly downstream of the crossing (phase 2). The project will improve channel morphology and function of an approximate 4.5 square miles drainage area to Lake Tahoe. The EIP numbers for this project is EIP #01.02.03.01. This document is concerned with Phase 1 of the project to be constructed in 2016. Phase 1 consists of the Highway 50 crossing, upstream creek improvements and Highway 50 drainage improvements.

The Project has also taken the opportunity to work with adjacent land owner Sierra Colina LLC to complete mitigation measures on Sierra Colina LLC property within the Project boundary. Sierra Colina LLC has mandatory mitigation measures associated with their development project. The Burke Creek Project will address these measures within the Project boundary at the cost of Sierra Colina. Benefits include coordinating restoration efforts, avoiding disturbance to the area twice, and realizing cost savings. The integration of mitigation measures have been incorporated as part of the temporary and permanent easement agreements with Sierra Colina LLC.

GOALS AND OBJECTIVES

The goal of the Project is to construct a crossing for Burke Creek under Highway 50 that restores hydrologic and sediment transport continuity, restores wet meadow conditions to Rabe Meadow (Phase 2), and improves drainage on Highway 50. From these goals the following objectives were developed:

1. Realign the stream channel to a natural topographic depression and improve stream function of Burke Creek directly downstream of Highway 50;
2. Reduce the size of the upstream parking lot and relocate the stream through the former parking lot to increase floodplain access and stream function;
3. Treat stormwater in the project area before discharge to Burke Creek and gain Lake Clarity Credits for Douglas County and Nevada Department of Transportation (NDOT) for reducing pollutants of concern including FSP, nitrogen and phosphorus;
4. Develop a project that requires minimal Operations & Maintenance budget; and
5. Enhance stream and alluvial fan functions using geomorphic and hydrologic appropriate design elements

Project constraints including property boundaries and existing utility locations made a few of the original objectives unattainable including Reducing flooding frequency to the adjacent commercial parking lot, providing habitat continuity, and constructing a geomorphically appropriate crossing. The restrictions to completing these objectives are discussed in more detail in Appendix F.

PROJECT FUNDING

The project received funding from the Nevada Division of State Lands Water Quality and Erosion Control Grants Program, the US Forest Service Southern Nevada Public Land Management Act funds, and the Nevada Department of Transportation.

Table 1.1. Funding Sources and Amounts for the Burke Creek Highway 50 Crossing and Realignment Project**.**

Agency	Cash Funding	In Kind Funding	Total Funds
Nevada Division of State Lands Water Quality and Erosion Control Grants Program	$587,172		$587,172
Douglas County SEZ Mitigation Funds	$100,000		$100,000
US Forest Service Southern Nevada Public Land Management Act Funds	$957,896		$957,896
Nevada Department of Transportation	$525,000	$30,000.00	$550,000
TOTAL			**$2,200,068**

PROJECT PARTNERS

Nevada Tahoe Conservation District (NTCD) is the project sponsor and lead agency responsible for planning, designing, and implementation of the Burke Creek Highway 50 Crossing and Realignment Project. NTCD is working closely with project consultants Balance Hydrologics, Inc. and Wood Rodgers, Inc. to design and construct the best project possible. Additionally, a number of other important partners will continue to participate in the process to ensure successful project delivery. Project partners include:

1. Douglas County, Nevada
2. Nevada Division of Environmental Protection (NDEP)
3. Nevada Department of Transportation (NDOT)
4. Nevada Division of State Lands (NDSL)
5. Tahoe Regional Planning Agency (TRPA)
6. USDA – Forest Service, Lake Tahoe Basin Management Unit

BACKGROUND DOCUMENTS

The planning of this project has been ongoing for many years and has encountered several stops and starts. It should be noted that prior to 2009, a technical Advisory Committee (TAC) comprised of project partners was established for a Burke Creek restoration project. Conceptual plans were created for multiple alternatives and a preferred alternative was selected. The Burke Creek-Rabe Meadow Complex Master Plan Project TAC then selected a revised alternative that was advanced to a 50% design by Wood Rodgers Inc. The 50% plans were abandoned after the opportunity for a land swap was taken advantage of by Douglas County in 2014. The land swap allowed the Project to expand the floodplain upstream of the Highway 50 crossing. Current design plans reflect the larger project area made available by the land swap.

Many background documents and data are available. As many prior studies as possible have been utilized in the design of the Project. Below is a list of relevant documents used to inform design:

- Culvert Design Memorandum (Wood Rodgers, 2016) – included as Appendix E
- Design Basis Memorandum (Balance Hydrologics, 2016) – included as Appendix F
- Wood Rogers Burke Creek Highway 50 Crossing and Replacement Project Geotechnical Investigation Report (Carter, 2015) – Included as Appendix D
- Burke Creek Restoration Project Alternatives Analysis Report (Winzler and Kelly and Others, 2009)
- Burke Creek / Rabe Meadows Preliminary Restoration Plans (Wood Rogers, 2012)
- Burke Creek Highway 50 Crossing and Realignment Project Monitoring Plan (NTCD)
- Burke Creek Restoration Potential and Design Concepts (NHC, 2006)
- Burke Creek-Rabe Meadow Complex Master Plan Existing Conditions Report (Wood Rodgers, 2014)
- Burke Creek-Rabe Meadow Complex Master Plan CIP Alternatives Evaluation Report (Wood Rodgers, 2014)

Current Project planning utilizes a TAC with current project partners and gathers input from the TAC to shape design. Comments were received from TAC members and Sierra Colina LLC. On the 50% design. Response to comments is provided in Appendix A.

2.0 DRAINAGE AND HYDROLOGY

EXISTING CONDITIONS

The hydrology provided in the alternatives analysis report for the Burke Creek Restoration project completed in 2009 (Winzler & Kelly, 2009) was used as existing conditions hydrology for the Project. The average summer base flow in the creek is estimated to be 0.22 cfs. Estimated peak flows for Burke Creek during storm events are given in Table 1 below:

Table 2.1. Estimated Peak Flow for Burke Creek above Highway 50*

	Peak Flow for Indicated Return Period [cfs]					
	1.2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**
Burke Creek Above Highway 50	8	32	47	71	94	121

*peak flows given by Winzler & Kelly, 2009

Geomorphic setting, channel patterns, existing soil types, and hydrology are more thoroughly discussed in Balance Hydrologic's Design Basis Memorandum, attached as Appendix F.

LAND CAPABILITY

The U.S. Forest Service and TRPA developed the Bailey land capability system in the early 1970s based primarily on the official USDA soils maps for the Tahoe Region. Each soil type was assigned to a land capability class ranging from 1 to 7, with capability 1 being the most environmentally fragile and sensitive to development. Wherever land was found to be influenced by a stream or high groundwater, it was assigned to capability 1b, also known as "Stream Environment Zone" or SEZ.

The Project is located within TRPA land capabilities classes 1a, 1b, 2, 3, 4, 5 and 7. The Project will remove approximately 8,550 square feet of existing parking lot coverage on Douglas County property and restore to 1b, SEZ.

TOPOGRAPHY

Many topographic surveys have been utilized to inform the Project design including:

- Light detection and ranging (LiDAR) imagery and topographic information (USGS and TRPA, 2010)
- Topographic basemap and right-of way survey (Turner and Associates, 2007)
- Longitudinal Survey and Riparian Mapping (McBain & Trush, 2007)
- Basemap and parcel boundaries of commercial property (Lumos and Associates, 2013)
- Supplemental survey and cross sections (Atkins, 2013)
- Supplemental Survey of monitoring wells and existing infrastructure, (Wood Rodgers, 2015)
- Various utilities potholing by NDOT, NTCD, and Wood Rodgers

3.0 DESIGN

CULVERT DESIGN

The proposed culvert pipe will be a 38-inch by 57-inch corrugated metal arch pipe (CMAP). A CMAP material has a smaller wall thickness compared to a reinforced concrete pipe or box. The CMAP's shape maximizes flow capacities within the given vertical constraints compared to a circular pipe. The CMAP can convey up to 103.6 cfs before overtopping Highway 50, which is just over the 50-year peak flow. Wood Rodgers Inc. is responsible for the culvert design and has detailed design methods in culvert design documentation memorandum included in this report as Appendix E.

UTILITY RELOCATION DESIGN

Existing pothole information obtained from NDOT was utilized to identify possible utility conflicts. Gas, communication, and potable water lines were found to cross the preferred culvert alignment. The culvert alignment/profile was adjusted to accommodate the gravity sewer line and a communications manhole. A communication line in the Douglas county parking lot where floodplain and berm grading will occur will also be relocated to the south to maintain access after project completion. The gas and communication line relocation designs are the responsibility of the utility companies. The sewer utility, Douglas County Sewer Improvement District (DCSID), provided the design for protecting the existing sewer line in place. The potable water relocation design was completed by NTCD with input from the water utility, Kingsbury General Improvement District (KGID).

The water line was designed to cross below the proposed culvert because there was not enough space above the culvert to maintain the required water line pipe cover. The culvert's minimum elevation was set due to the elevation of the gravity sewer. The water line was also relocated to the east of the existing alignment because potholing indicated inadequate separation between the water and sewer lines. Isolation valves were added to either side of the culvert crossing to allow KGID easier repair access. An additional valve north of the relocation was requested to be installed by KGID to allow for ease of construction. The design criteria for the water line was given by KGID as 250 psi with a nominal pressure of 150 psi. The addition of five linear feet of pipe, four elbows, and three gate valves will add less than a foot of head loss at the maximum flow design of the system. This change is considered negligible on the EGL and HGL of the water system.

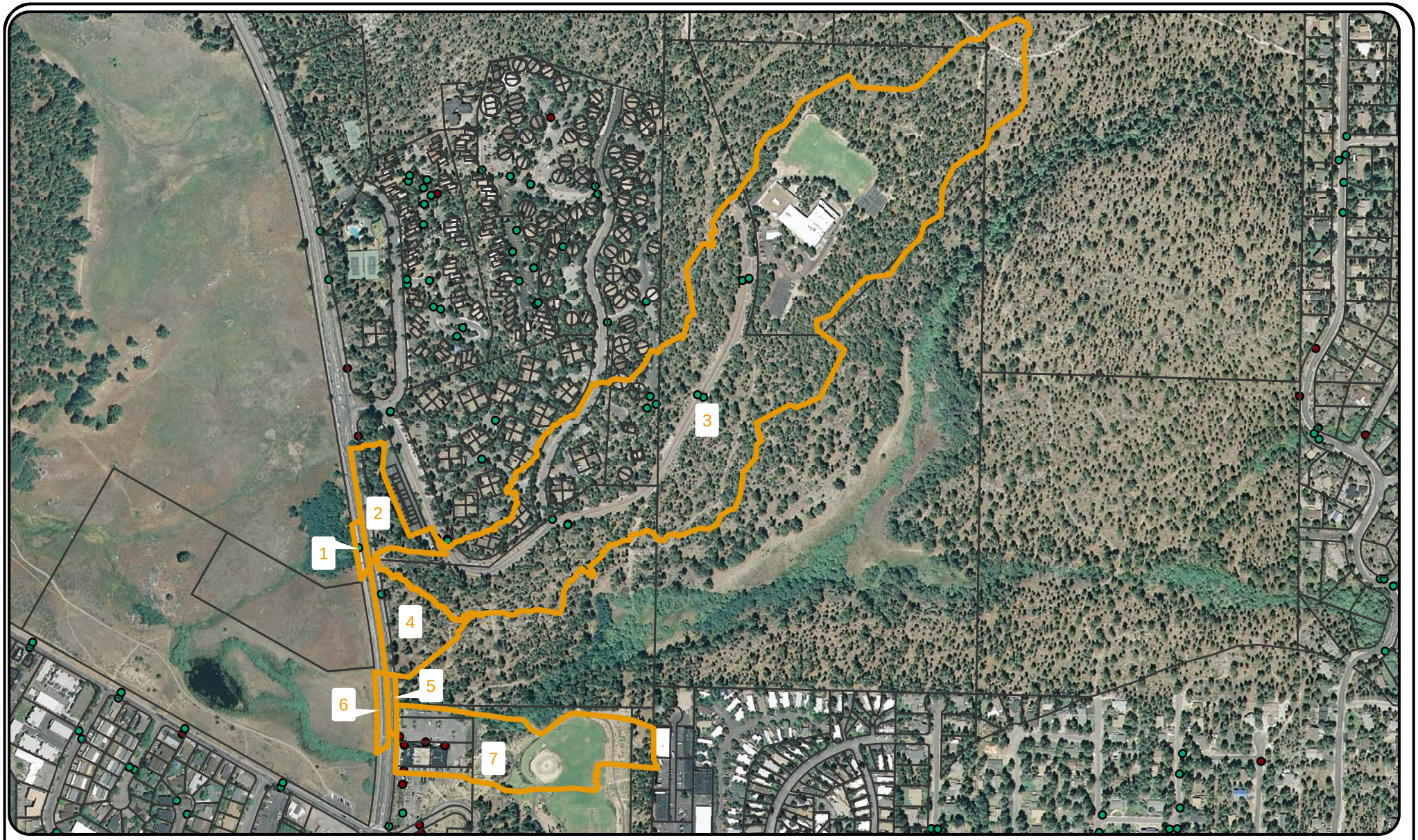
PEAK AND DESIGN FLOW

The 25 year storm was used as the design storm for conveyance as specified in the most current NDOT Drainage Manual (NDOT 2006) for U.S. highways. Peak flow calculations were calculated by the rational method and are summarized in Table 3.1 below. See Appendix B: Highway Drainage Reference and Calculations for full rational method calculations.

Inputs to the rational method included physical drainage area characteristics. Areas and characteristics were determined using ArcGIS. See Figure 3.1: Drainage Improvement Design Subcatchments for the locations of each subcatchment related to table 3.1. Time of Concentration (Tc) was also calculated and determined storm duration as required by the rational method. Rainfall intensities were obtained using National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Precipitation Frequency Atlas of the Western United States, Nevada. See Appendix B: Highway Drainage Reference and Calculations.

Table 3.1. Summary of Peak Flows Q5, Q25, and Q100

Design Subcatchment	Calculation/Improvement Type	Q5	Q25	Q100
1	Trench Drain	0.02	0.06	0.09
2	Trench Drain	0.17	0.31	0.68
3	Trench Drain	6.32	11.15	23.32
4	C&G	0.17	0.32	0.64
5	C&G	0.02	0.05	0.08
6	C&G	0.02	0.06	0.10
7	Existing Culvert Outlet	0.77	1.34	2.63



Legend

- Design Subcatchments
- Parcel Boundaries
- SedimentTraps
- DrainageInlet

FIGURE 3.1
Drainage Improvement Design Subcatchments

0 245 490 980 1,470 1,960 Feet

1 in = 542 ft

N
W E
S

NV West State Plane NAD 83	horiz. units: feet
Prepared by NTCD	March 2016

Nevada Tahoe Conservation District

DRAINAGE DESIGN

PROPOSED TRENCH DRAIN CALCULATIONS

The 50% design planned to install a trench drain in design subcatchment 1 to separate Highway 50 run off from Folsom Spring. Unfortunately the location and type of existing water and sewer piping created a conflict with the trench drain design. Because installing the trench drain would require replacement of over 100 feet of both the existing water and sewer 10" asbestos cement lines, the proposed trench drain was deemed not cost effective and dropped from the design. Conveying the water across the Highway and uphill to existing systems was also considered as an alternative but abandoned. The depth of pipe required to convey the small amount of run off is deeper than current infrastructure and would necessitate redesign and replacement of all storm drain structures, again making improvements not cost effective.

The trench drain associated with design subcatchments 2 and 3 is proposed to alleviate Highway 50 flooding in design subcatchment 2. A flooding problem in this area has been observed by NTCD staff on several occasions and, by visual inspection, has been determined to be caused by a low point on the shoulder. Although the size and associated peak flow of design subcatchment 2 is relatively small, shoulder infiltration alone is not enough to treat the run off. The low point does not allow highway drainage to enter the existing large drainage inlet (DI), which also conveys Lake Village run off. A trench drain was chosen over a DI to connect to the existing system at this location because the existing storm drain infrastructure is shallow and would not allow for a pipe retrofit.

The minimum design return frequency for roadway surface drainage facility design storm on NDOT U.S. highways is 25 years. However, because the area in design subcatchment 2 is in sump, NDOT requires improvements to be sized with a 50% clogging factor, therefore doubling the size of the inlet (NDOT, 2006). The 100 year event must also be considered. The trench drain sizing was calculated using the manufacturer's design guide (ABT Inc., 2015). The sizing spreadsheet is included in Appendix B. The 70' long trench drain with a 6" grate and a 0.7% slope shown on the plans is capable of conveying 1.3 cfs, which is well above the 100 year peak flow for design subcatchment 2.

The capacity of the existing stormdrain system was also considered. Total flows from design subcatchments 2, 3, and 4 were checked against existing pipe diameters and slopes. Calculations given in Appendix B show that the system can handle the additional flows that will be received post project from design subcatchment 2.

PROPOSED CURB AND GUTTER DI CALCULATIONS

The 50% design proposed curb and gutter in three locations. The location at design catchment 5 was dropped from the 90% design because the design depended on the ability to re-grade a driveway on private property. The private property owner did not desire to be a project partner and the curb and gutter could not be brought forward in the design process. The other two locations in design subcatchments 4 and 6 are proposed as drainage improvements.

The curb and gutter in design subcatchment 4 is meant to stabilize and protect an existing dirt shoulder, which shows signs of erosion. Vertical curb is proposed to match the existing curb. Rolled curb and gutter is proposed over the culvert crossing in design subcatchment 6 so that the shoulder may be accessed more easily for maintenance. This rolled curb and gutter is also proposed to stabilize and protect the existing shoulder, which shows signs of rilling. Both locations meet spread criteria for 0' in the roadway at the 25 year event.

Calculations were also preformed to size the DI grate for design subcatchment 6 improvements. A 2' wide by 2' long curved vane grate will be sufficient to capture the 25 year event. See Appendix B for calculations.

PROPOSED CONDITION FOR EXISTING CULVERT OUTLET CALCULATIONS

The existing Burke Creek Culvert will remain in place even though Burke Creek will be redirected into a new culvert. The remaining culvert will convey stormwater flows only, with peak flows of 1.46 cfs for the 25 year event and 2.80 cfs for the 100 year event. Grading is proposed in the remaining Burke Creek channel to disconnect stormwater flows from the proposed Burke Creek channel. These improvements are proposed for Phase 2 of the project.

LAKE CLARITY CREDIT SUMMARY

Lake Clarity Credits (LCC) are accrued by implementing and maintaining projects that reduce the loading of fine sediment particles (FSP). To achieve the greatest amount of LCC, the focus would be on areas that are directly connected or have the highest connectivity score (5). Because Burke Creek flows directly to Lake Tahoe, adjacent roads and properties are directly connected and likely to contribute sediment. Drainage work in the northern area of the project boundary is less connected since Folsom Spring ends in the meadow and does not result in many credits as a result.

The proposed stormwater improvements near the new creek alignment include curb and gutter, sediment traps, and a long vegetated treatment area with willow check dams in the area where Burke Creek used to flow downstream of Highway 50 (to be implemented in Phase 2). The long vegetated area occupying the existing creek's abandoned channel would effectively disconnect stormwater flow from Burke Creek. The size of the area was determined by using the natural topography and inputting the results into the Pollutant Load Reduction Model (PLRM). PLRM results are summarized in Table 3.2 and available in Appendix G.

Table 3.2. Summary of PLRM Results.

Entity	FSP reduction (lb/yr)	Potential Lake Clarity Credits
NDOT	864	4.3
Douglas County	1050	5.3

CHANNEL DESIGN

The new 194 foot channel section upstream of the culvert varies from an average slope of 11.8 percent to 4.6 percent. In order to create a stable channel with high grades, rock and log drop structures were utilized to achieve these slopes. Because the stream will see water almost immediately, rocks and logs are used to construct the entire channel since mature vegetation cannot provide stability for many years. Erosion Control Blanket will be used to provide stability on the banks and floodplain until vegetation takes root and matures. Balance Hydrologics Inc. was responsible for geomorphic design and hydrologic modeling and has detailed design methods in design basis memorandum included in this report as Appendix F. It is important to note that the HEC-RAS model output presented in Appendix F used Reinforced Concrete Box (RCB) culvert from the 50 percent design. The model was updated to include the new CMPA culvert utilized for the final design and no significant changes in the output occurred. The CMPA culvert will be able to pass the 50 year storm and the floodplain and culvert will be able to contain the 100 year storm and therefore will meet regulatory requirements and be an improvement from the existing conditions.

Using the results of the HEC-RAS model, NTCD sized the various types of stream material (Appendix C). Channel bed material was sized by Balance Hydrologics, Inc. and checked by NTCD. Channel bank material (rocks) were sized using a combination of methods and as recommended by the Washington Department of Fish and Wildlife, the largest diameter rock of the resulting gradation was chosen, 2 feet diameter. Logs were sized by estimating the various forces on each log and selecting appropriate rock and soil ballast which is also referred to as "keying in." Scour depths were calculated to account for the depth of rock needed to protect the channel bed from scour after

each rock and log drop. Drops were placed at the intervals necessary to move the channel from its perched location to the proposed floodplain and culvert.

The HEC-RAS results were also used to size the boulders and channel bed material type 2 (CBM2) for the rock cascade downstream of the culvert. Both the boulders and the CBM2 were sized for the 100 year design storm. The smaller size gradation of CBM2 will be expected to have some transport at the 100 year storm but not beyond the D50 sizing.

Upstream of the new channel, the existing channel has numerous head cuts and unstable areas. Due to existing vegetation, access using construction equipment is difficult in this area which dictated low impact hand work as the tool for restoration. Willow Debris Structures were designed as in stream grade control structures. The location of each was selected starting at the downstream end where evidence of a stable bed existed and working upstream using the extent of ponding from the downstream structure to select the spacing. Materials can be harvested nearby and installed completely by hand.

Calculations for sizing of rock slope protection on both the outside of the berm and around the culvert headwalls was determined to be Class D rip rap based on USACE stone stability hydraulic design chart 712-1. The velocity of the 100 year event and density of granite were used in calculations.

REVEGETATION

A seed mix of several native species was chosen to create a healthy and diverse floodplain that mimics the healthy floodplain downstream. Because the new channel will not have a seasoning period and the floodplain will be stabilized by erosion control fabric, shrubs will be installed for community aesthetics.

4.0 PROJECT PERMITTING

USFS SPECIAL USE PERMIT

A Special Use Permit is needed to construct improvements on USFS lands

USACE NWP 3

The US Army Corps of Engineers requires projects within Waters of the United States that are less than 0.1 acres to submit a Pre-Construction Notification (PCN) and obtain a Nationwide Permit 3 (NWP 3) which is for “Maintenance.” The associated Jurisdictional Wetland Study can be found in Appendix C.

TRPA EIP PROJECT PERMIT

The TRPA EIP Project Review Application and Initial Environmental Checklist have been submitted to TRPA.

DOUGLAS COUNTY PERMITS

A Douglas County grading permits must be obtained prior to construction

NDOT ENCHROACHMENT PERMITS

NDOT will require an encroachment permit for the construction project. Existing utility occupation permits will need to be updated where utilities are relocated.

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

The area of disturbance associated with the implementation of the project is expected to be greater than an acre in size, therefore, triggering a Stormwater Pollution Prevention Plan. A draft SWPPP will be authored by NTCD and the Contractor will be required to revise the SWPPP prior it construction.

NDEP PERMITS

Two Nevada Division of Environmental Protection (NDEP) permits are required, a Temporary Working in Waterways Permit and a 401 Permit. NDEP will also need to approve the water main relocation. A DeMinimus permit may also be necessary for the disposal of water associated with the water main relocation.

5.0 PROJECT MAINTENANCE

The NTCD, Douglas County and NDOT are responsible for maintaining the project for the next 20 years. The project is designed to be low maintenance.

IRRIGATION

Irrigation will be provided to establish the vegetation in the project area by the Contractor. The Contractor will maintain the irrigation for one to two growing seasons depending on plant establishment success and then remove temporary irrigation after plant establishment. Maintenance will include periodic checks to ensure proper functioning, coverage, and water delivery of the irrigation system. Plants have been selected to be self-sufficient after establishment. More details are provided in the “Revegetation” section of the Special Technical Provisions.

CULVERT AND FLOODPLAIN

The proposed floodplain is designed to contain 100 year flow. The culvert is designed to be 10 percent bigger than the 50 year flood in order to pass upstream debris. NDOT will inspect the culvert annually for any major obstructions and remove them as necessary.

VEGETATION MANAGEMENT

Willows and alders should also be cleared near the inlet and outlet of the culvert and in the proximity of any structure, such as the flow split structure. The need for this type of management will be assessed every 5 y ears.

6.0 REFERENCES

Douglas County Design Criteria and Improvement Standards. 2007.

Douglas County Design Criteria and Improvement Standards. DRAFT 2013.

Federal Highway Administration. August 2013. HEC-22. Hydraulic Engineering Circular No. 22, Third Edition. Urban Drainage Design Manual. Publication No. FHWA-NHI-10-009. September 2009 (Revised August 2013). U.S. Department of Transportation

Lindberg, Michael R. 2006. Civil Engineering Reference Manual for the PE Exam. 10th Edition. Professional Publications, Inc. Belmont, CA.

Nevada Department of Transportation (NDOT). December 2006. Drainage Manual, 2nd Edition. Prepared by Hydraulics Section. Jeff Fontaine, P.E., Director.

Nevada Department of Transportation (NDOT). Standard Details.

National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Precipitation Frequency Atlas of the Western United States, Nevada.

NTCD and Wood Rodgers. 2014. Burke Creek-Rabe Meadow complex master plan – existing conditions report: consulting report, 24 p. + appendices.

Winzler & Kelley, Michael Love & Associates, and McBain & Trush, Inc. 2009. Burke Creek restoration project alternatives analysis report, Burke Creek at Highway 50, Stateline, Nevada: report prepared for Tahoe Regional Planning Agency, 170 p. + appendices.

APPENDIX A: RESPONSES TO 90% COMMENTS

APPENDIX B: HIGHWAY DRAINAGE CLACULATIONS AND REFERENCE

APPENDIX C: STREAM CHANNEL MATERIAL CALCULATIONS

#

#

#

#

#

#

#

#

#

#

#

#

#

#

APPENDIX D: GEOTECHNICAL REPORT

APPENDIX E: CULVERT DESIGN MEMO

APPENDIX F: BALANCE HYDROLOGICS DESIGN BASIS MEMO

APPENDIX G: PLRM RESULTS MEMO