DESIGN REPORT

FOR

KAHLE WATER QUALITY BASIN IMPLEMENATION PROJECT

STATELINE, NEVADA

March 2018

*Approved by:*_____

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1.0 INTRODUCTION

PROJECT DESCRIPTION

The Kahle Water Quality Basin Implementation Project proposes to redesign and expand the existing Kahle Basin to a larger wet basin and improve conveyance capacity along Kahle Drive. The Project will increase the treatment capacity and effectiveness by installing a treatment suited to the site conditions. The Project will replace the undersized pipe along Kahle Drive with a pipe capable of conveying the 25-year peak flow (design storm) to meet current Douglas County design standards.

PROJECT LOCATION

The project is located along Kahle Drive and at the location of the existing Kahle Dry Basin in Rabe Meadow on United States Forest Service (USFS) land, between Kahle Drive and Burke Creek in Stateline, Nevada within Douglas County. The pipe alignment is located in Douglas County right-of way. The existing and proposed basins are located within USFS parcel 1318-22-001-009.

Figure 1.1 Project Area Location.

PROJECT BACKGROUND

The original Kahle dry basin and associated conveyance was constructed in 1992 as part of the Burke Creek/Kahle Ditch Restoration Project implemented by Douglas County and funded by the USFS. It was constructed as a dry basin having a capacity of 12,000 cu ft and depth of 12 inches. The basin receives stormwater runoff from Douglas County, NDOT, private business and homeowners from along Kahle Drive, US Highway 50 (US-50), and Nevada State Route 207 (SR-207). Its location within a wetland meadow 200 feet from Kahle Drive makes routine

maintenance without impacts to the surrounding meadow challenging. Since its construction, 26 years ago, maintenance activities have not been performed due to access issues; as a result, the basin is filled to capacity with captured sediment and no longer functioning as a stormwater treatment system. Stormwater exits the basin via a vegetated swale and then travels approximately 50 feet to Burke Creek, which then flows into Lake Tahoe.

In June 2014, a Master Plan for the Burke Creek watershed was created that prioritized projects starting at Kahle Community Center downstream to Lake Tahoe. The Master Plan identified 4 projects considered a priority for their environmental benefits:

1. Burke Creek Restoration
2. Kahle Drive Stormdrain and Basin Improvements
3. Lower Kahle Drive Improvements
4. Invasive Weed Treatments in Rabe Meadow

The portion of Burke Creek identified for restoration was restored in 2016 and 2017 as part of the Burke Creek Hwy 50 Crossing and Realignment Project and another portion is slated to be restored in 2018 by US Forest Service. Invasive weed treatments are also underway in Rabe Meadow via the US Forest Service. The second and third priority projects identified in the Master Plan have been combined into a larger project called "Burke Creek Watershed Stormwater Improvements" which includes elements to improve stormwater capture along Kahle Drive consistent with the *South Shore Area Plan* and *Kahle Drive Vision* adopted in 2014. This project is Phase 1 of that larger multi-benefit project. Phase 2 (Kahle Complete Street) will reconstruct Kahle Drive into a "complete street" to improve drainage, public safety, and aesthetics. As part of this project, 50 percent design plans will be prepared for Phase 2 in order to coordinate the design of Phase 1 and share costs on tasks that are necessary for the design of both phases. Phase 3 (Kahle Ditch) will restore the "Kahle Ditch," located downstream of phases 1 and 2, to a functioning riparian zone and decommission the existing ditch that conveys street runoff directly to Lake Tahoe.

The *Final Burke Creek-Rabe Meadow Complex Master Plan, Development of Capital Improvement Projects and Alternatives Evaluation Report*, dated November 2014 (Master Plan Document) (NTCD and Wood Rodgers, 2014) identified three alternatives to improve stormwater treatment in this area which all entail reconstructing the Kahle Basin to a larger size and incorporating pre-treatment and maintenance access to allow better future maintenance. The project background, need, conceptual design alternatives, and preliminary hydrology/hydraulics are discussed in detail in the Section 8 of the Master Plan Document.

The Lake Tahoe Total Maximum Daily Load (TMDL) was approved by the United States Environmental Protection Agency in August 2011 with the intent of providing a plan for restoring Lake Tahoe water clarity. The focus of the Lake Tahoe TMDL is on pollutant control strategies to reduce fine sediment particles (FSP, defined as particles less than 16µm in diameter), nitrogen and phosphorus loads reaching Lake Tahoe from urban areas. To implement the Lake Tahoe TMDL, each Nevada jurisdiction entered into individual Interlocal Agreements (ILAs) with the Nevada Division of Environmental Protection (NDEP) to implement the TMDL. Each jurisdictional ILA included the development of a stormwater load reduction plan (SLRP) which identified strategies for achieving the 5, 10 and 15-year Clarity Challenge milestones. Expanding and redesigning the Kahle Basin to a functioning wet basin stormwater treatment system will play an important role in NDOT and Douglas County meeting their TMDL milestones. The basin's outfall is considered directly connected to Lake Tahoe via Burke Creek. The Project is also identified in the Tahoe Regional Planning Environmental Improvement Program (EIP Number 01.01.01.0084) as improving water quality, soil conservation, and recreation thresholds.

GOALS AND OBJECTIVES

The goal of the Kahle Water Quality Basin Implementation Project is to improve treatment of stormwater runoff in Kahle Basin by increasing basin treatment capacity and effectiveness and improving conveyance capacity along Kahle Drive. There are four objectives:

1 Complete the first phase of a larger multi-benefit project identified in the Burke Creek-Rabe Meadow Complex Master Plan.
2 Improve the long-term performance of the water quality basin by constructing adequate pre-treatment and access for maintenance equipment.
3 Maximize Lake Clarity Credits for NDOT and Douglas County while balancing construction cost and maintenance need considerations.
4 Design stormwater treatment that blends with the existing recreational uses of Rabe Meadow.

Figure 2. Left: Kahle Drive has undersized drainage that is constantly inundated with groundwater therefore stormwater cannot be captured and delivered to a treatment facility. Right: Kahle Basin is undersized and full of dense woody vegetation.

PROJECT FUNDING

The project received funding from the US Forest Service (USFS) Southern Nevada Public Land Management Act Erosion Control Funds, Douglas County TRPA SEZ Water Quality Mitigation Funds, Nevada Division of State Lands (NDSL) Water Quality and Erosion Control Grants Program, and the Nevada Department of Transportation (NDOT). Smaller contributions from the South Shore Transportation Management Association and the Oliver Park General Improvement District (OPGID) of $5,000 and $25,000 respectively will be set aside for Phase 2 to continue progress while funding is sought out.

Table 1.1. Funding Sources and Amounts for the Kahle Water Quality Basin Implementation Project**.**

Agency	Funding
NDSL Water Quality and Erosion Control Grants Program	$185,000
Douglas County SEZ Mitigation Funds	$118,000
Douglas County Water Quality Mitigation Funds	$142,000
US Forest Service Southern Nevada Public Land Management Act Funds	$548,000
Nevada Department of Transportation	$250,000
TOTAL	$1,243,000

PROJECT PARTNERS

Nevada Tahoe Conservation District (NTCD) is the project sponsor and lead agency responsible for planning, designing, and implementation of the Kahle Water Quality Basin Implementation Project. Additionally, a number of other important partners will continue to participate in the process to ensure successful project delivery. Project partners include:

Table 1.2. Project Partners and Roles

Agency or Entity	Role
Nevada Tahoe Conservation District	Project Proponent and Manager
United States Forest Service	Funder, Landowner
Nevada Department of Transportation	Funder, Landowner
Nevada Division of State Lands	Funder
Douglas County	Funder, Regulatory, Landowner, Asset Owner and Special Use Permit Holder
Oliver Park GID	Land manager, Future Funder
Nevada Department of Environmental Protection	Regulatory
Tahoe Regional Planning Agency	Regulatory
South Shore Transportation Management Association	Stakeholder, Funder
Tahoe Beach Club	Stakeholder, Potential Funder

BACKGROUND DOCUMENTS

The main documents utilized in the planning on the project are the documents associated with the Burke Creek-Rabe Meadow Complex Master Plan including:

- Burke Creek-Rabe Meadow Complex Master Plan Existing Conditions Report (NTCD and Wood Rodgers, 2014)
- Burke Creek-Rabe Meadow Complex Master Plan CIP Alternatives Evaluation Report (NTCD and Wood Rodgers, 2014)

Project planning also utilizes a TAC with current project partners and gathers input from the TAC to shape design. Comments were received from TAC members on the 50% design and the 90% design. Responses to comments are provided in Appendices A and B.

2.0 DRAINAGE AND HYDROLOGY

EXISTING CONDITIONS

The hydrology produced for the 2014 Burke Creek-Rabe Meadow Complex Master Plan Existing Conditions Report (ECAM) (NTCD and Wood Rodgers, June 2014) was used as existing conditions hydrology for the Project. The current and proposed basins receive stormwater runoff from Douglas County, NDOT, private business and homeowners from along Kahle Drive, US Highway 50 (US-50), and Nevada State Route 207 (SR-207). Figure 3 illustrates the sub-watersheds flowing to the existing basin which will remain unchanged for the proposed basin. NTCD reviewed the 2014 report as well as the existing hydrologic HEC-HMS model (Wood Rodgers 2014) and 111.8 cfs was selected as a conservative number for the 25 year, 24 hour storm. NTCD selected 178.4 cfs for the 100 year, 24 hour storm. More information can be found in the Section 3.0 of the ECAM and the associated figures.

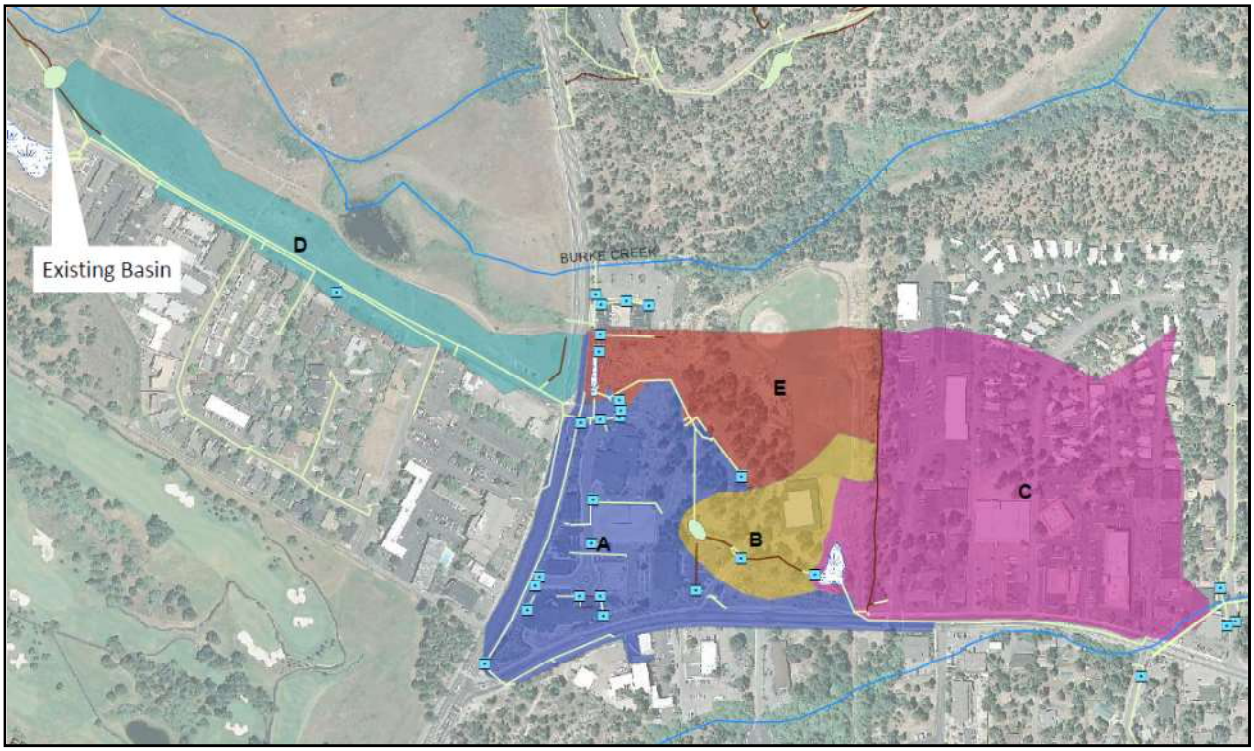

Figure 3. Sub-watershed boundaries for Existing and Proposed Hydrology.

Table 2.1. Estimated Peak Flow for 24 hr storm at Kahle Basin

Return Interval	2 yr	25 yr	50 yr	100 yr
Peak Discharge (CFS)	36.7	111.8	137.5	178.4

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 1b, 6, and 7. Minimal grading is proposed in the mapped 1b. Land capability in relation to project location is shown in Figure 4.

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 (Welsh Hagen and Associates, 2017)
- Parcel boundaries for Right of Way (Lumos and Associates, 2014)

3.0 DESIGN

BASIN DESIGN

NTCD met with US Forest Service (USFS) staff at the project site in June 2015 to discuss increasing the footprint of the existing basin and updating the basin to a more effective treatment type; specifically changing the basin from a dry basin to a wet basin. The onsite meeting revealed the USFS's preference for screening the view of the basin from adjacent residential and recreation uses as much as possible. During subsequent meetings, the USFS has also expressed the desire for the basin to blend in with the surrounding meadow as much as possible. A conceptual design was developed by NTCD with the USFS preferences in mind had a treatment capacity of 1.0 acre-feet and utilized wet basin design features.

The location of the basin proposed in the conceptual design was close to Burke Creek and into an area with a historically higher groundwater table. Through a groundwater depth study completed by NTCD and the Natural Resource Conservation Service in 2014 (NTCD, 2014), the seasonally high groundwater table was found to be 6 to 9 inches below the surface in this area. Additionally, this shift moved the basin closer to land with a TRPA Class 1B Land Capability, which is considered highly sensitive land. The design team visited the site and looked for opportunities to shift the basin away from these sensitive lands and blend the basin in with the surrounding environment. The proposed 50% design basin represented a compromise between the conceptual design proposed in the Master Plan Document and the conceptual design proposed after the June 2015 meeting with the USFS.

Following a 50 percent design TAC, USFS and NTCD visited the basin location and made other alterations based on input from recreational planners, biologists, and other resource managers. The final basin footprint allowed for ample screening from adjacent recreation facilities, preservation of habitat, and the future restoration of a man-made ditch within Rabe Meadow. The project will also fill a portion of this ditch with the excess cut from creating the basin.

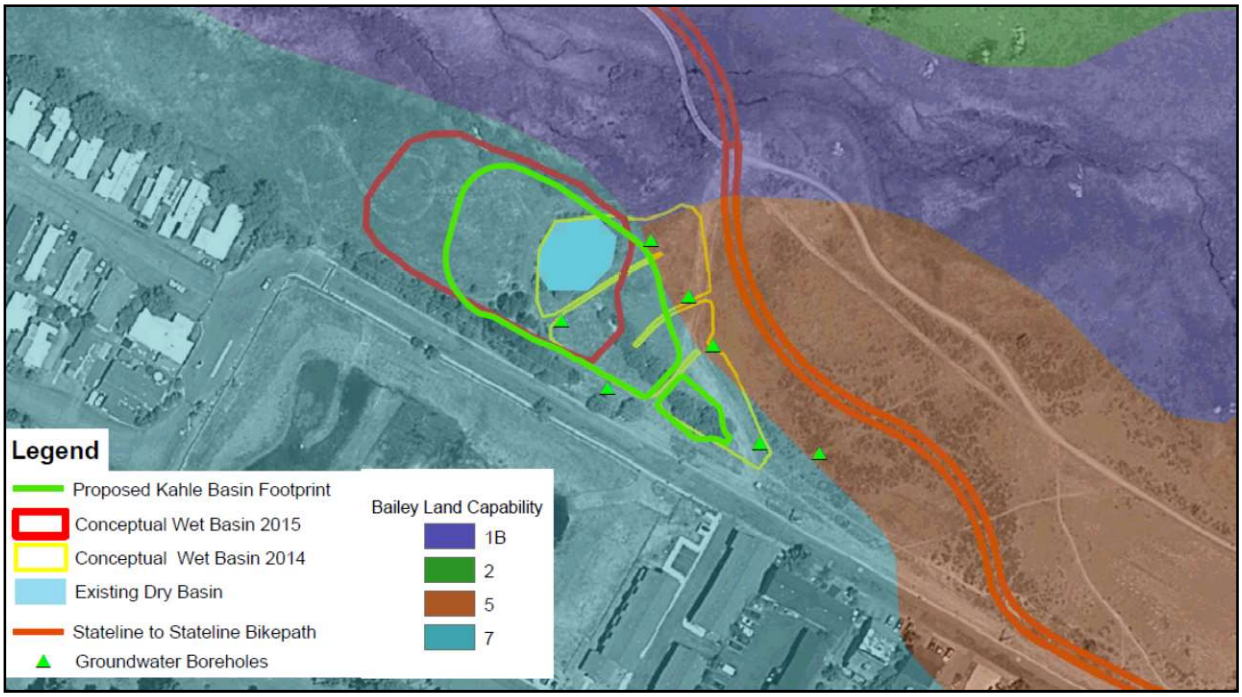

Figure 4. Final design basin location relative to existing basin and conceptual design basins.

Because of the shallow groundwater table, the basin is being designed as a wet basin using components of constructed wetland design. Constructed wetlands have been found to be one of the most effective treatment methods for achieving reduction of pollutants identified in the Tahoe TMDL (Qualls and Hayvaert, 2017, Tahoe Regional Planning Agency, 2014). Multi-stage treatment that includes elements like filtration, retention, soil processes, microorganisms, and plant uptake are effective in capturing both fine sediment and nutrients (Greene, 2006, Hayvaert, 2006). Design elements that should be included in a wet basin design include pretreatment, filtration, and detention that facilitate physical, biological, and chemical processes. A constructed wetland designed for the 20 year, 1 hour storm in Tahoe City had a design life of 16 years without any major maintenance and provided a substantial reduction in nutrients during this time.

Design elements for the Kahle Basin include a pretreatment forebay with a capacity grater than ten percent of total basin capacity (approximately 6,680 cubic feet). The forebay is designed as a hardened surface (open cell pavers or articulated blocks) for straightforward annual maintenance. The forebay is located in an area with an existing gated access point and will maintain a user-created trail in the area. The open cell pavers will be planted with native grasses in order to blend into the surrounding meadow, but the hard surface makes it easy for a maintenance crew to remove the accumulated course sediments with customary equipment. Adequate pre-treatment will prolong period of time between major maintenance endeavors within the wet basin. Forebay calculations can be found in Appendix C.

From the forebay, stormwater enters the wet basin across a shallow filtration area. This area is designed to have dense wetland vegetation with groundwater at or below the surface. From the filtration area, the water flows into the deep pool retention area. Constructed shallow islands provide additional filtration as well as help the basin blend into the surrounding topography. Because excavation in the deep pool is below the seasonally high groundwater table, this area will be wet during high groundwater years. To ensure the pond drains at least annually to prevent undesirable species (American Bullfrog), a low flow drain is proposed to connect the bottom of the pond to the outlet structure with a manual gate valve. This structure design is discussed in greater detail under in the Basin Outlet Design section of this report.

The final treatment is a wetland bench that provides additional filtration and nutrient uptake before the treated water enters an outlet structure and exits into the adjacent meadow. The overall length of treatment is nearly 300 feet while the width of the basin is approximately 100 feet on average providing a length to width ratio of 3:1 as recommended by the TRPA BMP Toolkit.

Because of the shallow depth to groundwater, excavation in the area is limited and a berm is necessary to create basin capacity. To maintain the meadows character, this berm is limited to under 4 feet in height at the end of the basin and tapers off as it moves towards the inlet. The berm has 4:1 slopes with the exception of the access area which has 6:1 slopes per Douglas County Standards.

The proposed design resulted in a net cut volume of 1,120 cubic yards. The basin deep pool is approximately 3 feet deep. The capacity of the proposed basin is approximately 1.3 acre-feet (34,330 cubic feet) with the treatment surface area being 26,750 square feet.

BASIN OUTLET DESIGN

A basin outlet structure that conveys the 25 year, 24 hour flow is proposed at the far end of the wetland bench. This structure outlets to a rock dissipator within the adjacent meadow before the water is slowed further by installed willow wattles. The willows will also provide screening for the dissipator.

An emergency spillway is proposed in line with the outlet structure in the event the outlet structure fails and per Douglas County standards. This spillway conveys the 100 year, 24 hour design storm peak flow. A gate near the western end of the basin is proposed to be relocated to provide access to the basin outlet area for any maintenance needs. This access is expected to be less frequent (every 5 to 10 years) and a temporary mat road is suggested for access as to minimize the impacts to the meadow.

A manually operated low flow pond drain is proposed so that the basin can be drained for maintenance or to eliminate subsequent years of ponding, if necessary. A gate valve will be accessible from a valve box near the outlet structure to drain the pond within 2 hours if operated.

An existing overflow ditch from the existing dry basin will be filled using the excess cut from constructing the basin to the extents that are accessible from construction of the proposed basin. USFS staff will fill the remainder of the ditch at a later time. The ditch will no longer be needed as an outflow and is an undesirable manmade feature in Rabe Meadow. The willows currently located in the existing ditch will be preserved to the degree possible while filling this ditch to maintain screening and habitat.

CONVEYANCE DESIGN

This project is the first phase of a larger multi-phase project that will update Kahle Drive into a "Complete Street" that provides multimodal access and on-street parking. Although the Kahle Drive Complete Street Project is not fully funded, an assumption was made that the project will eventually increase the width of Kahle Drive. Currently the storm drain pipe feeding Kahle Basin is an average of five feet behind the back of the curb along Kahle Drive's north side. Improvements to Kahle Drive will result in the pipe eventually being under a paved portion of Kahle Drive. Coverage on the existing pipe is currently adequate and cover is expected to increase if the elevation of Kahle Drive is increased as proposed. Therefore, the proposed pipe uses a similar alignment as the existing undersized pipe, gaining slope on flatter sections where cover is adequate.

As discussed in existing conditions and the Master Plan Document, the current 30 inch and 36 inch RCP cannot convey the 24 hour, 25 year peak flow as required by the Douglas County Standards. For pipes 48 inches and larger, the Douglas County standards require RCP, however, for pipes less than 48 inches, plastic pipe may be used. Using the existing pipe profile and manholes and replacing the existing 36 inch RCP with 42 inch gasketed plastic pipe provides the required conveyance for the section of pipe near the inlet. The 30 inch pipe upstream of this can be replaced with a 34 inch or 36 inch plastic pipe and meet the County standards so 36 inch HDPE was selected for ease of construction. 42" RCP is used at the downstream most end of the pipe run, which flows into the forebay and wetbasin. RCP was selected for this portion due to the shallow cover. The County standards adopted in 2017 also require 72" manholes for pipes between 30 and 48" so all manholes will be upgraded to this size. The existing vault will remain in place and be retrofit with new pipe and watertight gaskets. The vault will be cleaned as part of the project. Calculations for conveyance are available in Appendix C.

REVEGETATION

Existing vegetation surrounding the basin will be maintained whenever possible for screening. To the north of the basin, salvage plantings such as willow and woods rose are proposed to screen the basin from the bike trail. The design team coordinated on site with USFS botanists and recreation staff to choose desirable screening vegetation. Vegetation within the basin was chosen to match the surrounding native vegetation as well as promote wet basin treatment processes. A mixture of emergent, floating and submerged macrophytes will be utilized within the treatment area. Sod from the site will be salvaged and reused. A native seed mix will be applied to areas when sod

is not available or practical and covered with salvaged mowing from the sod transplant process. The benchmark condition for basin vegetation cover shall be 60 percent plus or minus 15 percent.

Revegetation proposed for the disturbance caused by the pipe installation and access to the site is a native seed mix covered by a layer of mulch for temporary erosion protection. The seed mixes are listed in Table 3.

Table 3. Seed mixes for project revegetation.

Seed Mix 1 (Basin)		
Species (Scientific Name)	Species (Common Name)	PLS LBS per Acre
Deschampsia cespitosa	Tufted hairgrass	0.50
Carex praegracilis	Slender sedge	0.50
Elymus glaucus	Blue Wildrye 'Stanislaus'	3.00
Hordeum brachyantherum[1]	Meadow barley	2.00
Juncus balticus	Baltic rush	0.10
Leymus triticoides	Creeping wildrye	3.00
Lupinus polyphyllus	Tahoe lupine	1.00
Penstemon rydbergii	Rydberg's penstemon	0.25
Poa pratensis[2]	Kentucky bluegrass	1.00
Potentilla gracilis	Slender cinquefoil	0.50
Total		11.85
Seed Mix 2 (Pipeline and Access)		
Species (Scientific Name)	Species (Common Name)	PLS LBS per Acre
Bromus carinatus	California Sierra Brome	4.00
Elymus elymoides	Squirreltail	2.00
Elymus trachycaulus	Slender wheatgrass 'Revenue', or 'Pryor'	4.00
Poa secunda	Sandberg bluegrass 'Sherman'	1.00
Total		11.00

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

[1] Sources above 6,000 ft. in elevation

[2] Local collections only

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.

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. Only preliminary PLRM analyses have been completed to assist with selecting the final basin size. Final analyses will be done upon registration of the project.

Table 3. Summary of Preliminary PLRM Results.

Entity	Potential Lake Clarity Credits
NDOT	25
Douglas County	25

4.0 PROJECT PERMITTING

USFS SPECIAL USE PERMIT

A modification to the existing Douglas County Special Use Permit (TOI100604) is needed to construct improvements on USFS lands. The existing permit allows maintenance for the project constructed in 1992 as well as the Kahle Drive Water Quality Improvement Project outfall constructed in 2005.

TRPA EIP PROJECT PERMIT

The TRPA EIP Project Review Application and Initial Environmental Checklist were submitted to the TRPA at the 90% design level. The 100% plans, specifications, and design report are required for permit acknowledgement.

DOUGLAS COUNTY PERMITS

A Douglas County grading permits must be obtained prior to construction. 100 percent plans will be submitted to Douglas County prior to solicitation of bids.

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 to construction.

5.0 PROJECT MAINTENANCE

Assets will be maintained by Douglas County with contributions from NDOT as necessary. An agreement between the two jurisdictions is yet to be finalized. Maintenance requirements were considered during design to make the installed assets maintainable using equipment currently owned by the responsible entities. The TRPA BMP

Handbook (May 2014) and the BMP Rapid Assessment Methodology User Manual V.2 (August 2015) was used to inform design and recommend maintenance practices.

Douglas County will maintain the installed conveyance along Kahle Drive as well as the installed wet basin. Pipe maintenance or sediment buildup in pipe or manholes should not be an issue as slopes are much greater than the minimum 0.5 percent requirement. The existing drainage inlets conveying stormwater to the basin have sump for coarse sediment to collect and should be maintained using a vactor truck at least annually. The existing vault, just prior to the sediment forebay, will also capture coarse sediment and should be cleaned annually.

The open-cell paver sediment forebay should be cleaned annually or when the depth of sediment reaches the 1.5 feet and all sediment shall be disposed of offsite. A staff plate will be installed that will read depths up to the 2.5 foot maximum and should be referenced to see if maintenance is needed. The hard pavers will allow for simplistic sediment removal while protecting the roots of the native vegetation that screens the appearance and maintains pore space in the soil for infiltration. The inlet of the 42 inch pipe to the forebay/wet basin shall be checked for any signs of clogging and cleaned if necessary.

Adequate pre-treatment is installed to limit the amount of access necessary to the wet basin itself. A long-term study of the Tahoe City Wetland showed an annual sediment accumulation of 3 cm/year (Qualls and Heyvaert, 2017). Maintenance to the deep pool would be recommended at 10 year minimum intervals or 12” of accumulated sediment. The pool could be drained using the low flow drainage in the outlet structure to access the basin and remove sediment or vegetation. Vegetation in excess of 75 percent cover per the TRPA BMP Handbook shall be removed. Vegetation shall be removed as needed annually to prevent an excess of 75% cover. The manually operated low flow pond drain should be used drain the basin for maintenance or to eliminate subsequent years of ponding (the basin should not hold standing water for 2 years in a row), if necessary. A gate valve will be accessible from a valve box near the outlet structure to drain the pond within 2 hours if operated.

Access paths to the basin shall be re-seeded and mulched after use if there is considerable damage to the vegetation.

All outlet structure components should be inspected for structural damage and repaired as necessary on an annual basis. Woody vegetation shall be removed from the toe and sides of the berm to prevent comprise of the berm’s structural integrity. Woody vegetation shall also be removed from any inlets or outlets to prevent clogging. See the “Wet Basin Inspection and Maintenance Table in Chapter 4 of the TRPA BMP Handbook for additional information on maintenance.

6.0 REFERENCES

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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

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APPENDIX A: RESPONSES TO 50% COMMENTS

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Douglas County

Comment #	Document/Page	Comment	Commenter	Response
1	C-1	Show proposed maintenance access for forebay	Courtney Walker	Maintenance access for the forebay will be shown on 90% design plans.
2	iv	DC Design Criteria 3.9.14 Improved Maintenance Access: "In no case shall permanent maintenance access roads for publicly owned facilities be paved with less than 3 inches of Type 2 or Type 3 asphalt concrete pavement on 6 inches of aggregate base, or as approved by utility." Send a plan and will send to DC maintenance staff	Courtney Walker	Need approval from USFS to pave access into meadow.
3	iv	"Construction limit fence. +- 1,500 LF…" is called out as Detail 4 Sheet D-1. Should be Detail 3. In addition the approximate stationing of the fencing should be provided	Erik Nilssen	Call out has been changed. Approximate quantities of fence will be provided in lieu of stationing. NTCD engineer will layout fence for construction
4	iv	"Add fiber rolls as necessary…" this should have an approximate LF as well.	Erik Nilssen	Approximate length of fiber rolls to be shown in 90% design.
5	iv	You may add staging over the paved drive area of the other Wet Basin if you wish.	Erik Nilssen	Staging in the paved drive area will be added.
6	C-1 through C-4	Everything needs to be dimension. The right of way limits, the centerline of the roadway, the dimension from the centerline of the roadway to all existing utilities, edge of pavement, curb and gutter, etc.	Erik Nilssen	Dimensions to CL of roadway will be provided on the 100% plan set.
7	C-1 through C-4	I have objections to the construction centerline. It is arbitrary and based no field verifiable monuments. The centerline should be the center of the roadway which (ideally) would be based on roadway monuments found in the pavement. If you keep the current centerline it must be identified as the "construction centerline" but this must be related back to the roadway centerline with stations and offsets.	Erik Nilssen	Construction centerline will have stationing points in relation to Kahle roadway centerline. Unfortunately there are no roadway monuments in the pavement of Kahle Drive.
8	C-1	Need detail or additional information on the rock dissipator	Erik Nilssen	Detailed design and corresponding information will be on the 90% plan set.
9	C-1	Add minor axis lines on the profile. There should also be additional cross sections with stations and elevations to make the basin constructible.	Erik Nilssen	Minor axis lines added to the profile. Additional cross sections to be added at the 100% design level once the final basin configuration is approved by the TAC and permitters.
10	C-2	Provide detail for "FES and Rock Dissipator"	Erik Nilssen	Shown on 90% Plans
11	C-4	Will need additional data on the connection to the storm drain in the parking lot. There is lots of concrete both driveway connections and curb and gutter that will need to be detailed since a straight trench cannot occur through concrete. Preference would be not to cut up the driveway entrance, but we understand if it is required.	Erik Nilssen	According to the pipe analysis, this is one of the most undersized portions of the pipeline since the bike is only 24" diameter. Once the 90% engineers estimate is complete, we will discuss this section in the TAC meeting.
12	D-2	Water Stop and Pipe Trench Details need to be replaced with the updated 2017 Douglas County Standard Details. These details should include the Douglas County Title Block.	Erik Nilssen	Current Douglas County Standard Details shown on 90% plans

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Douglas County

Comment #	Document/Page	Comment	Commenter	Response
13	D-2	Detail 2 - "temporary mat road detail". More clarification needs to be provided on the "timber or composite map". Is there additional information in the specifications? Perhaps it would be good to callout a specific brand "or approved equal" so the contractors have a base line on what they are supposed to install.	Erik Nilssen	Duramat or equivalent called out on plans. Additional information provided in the specifications
14	D-3, Forebay	Forebay Detail - Do we have the scour depth? Is this applicable with this design? Seems more for open channel	Erik Nilssen	Scour depth and length were calculated at pipe outlet and found to not be an issue. Additional information in design report. Cutoff wall has been removed from detail.
15	D-3, Forebay	"Channel Width Variable" - is it in this case?	Erik Nilssen	The overall width is variable. Updated to "Channel Width per plan"
16	D-3, Forebay	Need dimensions on this forebay detail	Erik Nilssen	Dimensions provided for 90%
17	D-3, Forebay	Upper right of the detail there is a 4-inch drainage layer option and a no drainage layer option. How does the contractor know which will be required?	Erik Nilssen	Detail was updated for 90%
	50% Design Memorandum			
18	2	Top paragraph states that RCP will be installed while the plans state HDPE will be used. If RCP will be used it needs to be RGRCP "rubber gasket reinforced concrete pipe."	Erik Nilssen	Top paragraph is talking about the conceptual design proposing RCP. The 50 percent design proposes HDPE
19	3	Paragraphs 3 states "constructed shall islands provide additional filtration." Could this be elaborated on?	Erik Nilssen	Two treatment processes are being used in the wet basin, filtration and sedimentation. The islands are filtration areas within the sedimentation pond.
20	3	Remove reference to temporary mat road.	Erik Nilssen	Will be updated in 90% design report and maintenance plan.
21	4	Remove statement that existing manholes will be left unchanged	Erik Nilssen	Will be updated in 90% plans and design report

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Nevada Division of Environmental Protection

Comment #	Document/Page	Comment	Commenter	Response
1	sheet c-1	Does inline configuration of the forebay and wet basin increase risk of damage - when higher flows pass through? What factors get considered to weigh offline, inline, or partial bypass configuration? Will scour occur with higher flows through basin? Given a relatively high percentage of impervious area, is the drainage area unusually flashy (rapid gathering of runoff)? Recently, some stormwater drainage systems and BMPs have been damaged by unexpectedly high runoff rates. Since runoff reaching the end of Kahle currently drains via the Kahle Ditch and to the lake (or beach at times), it seems an accommodation could be made to route some flow to bypass to the Kahle Ditch in a controlled conveyance in order to manage potential or risk for unexpected damage. Did I hear that the master plan for the area includes a project to improve the Kahle Ditch?	Ed Skudlarek	Wet basins are usually designed as part of an in-line treatment so that adequate base flow is maintained in the system. Scour calculations have been completed using 100 year velocities and scour has been found to not be an issue in the forebay or the basin. At the outflow, scour is mitigated for using an energy dissipator and appropriately sized rock. The time of concentration for the 24 hr storm is 14.7 minutes, so the drainage area is considered to be "flashy." Phase 3 of the project will fill Kahle Ditch which was created when Burke Creek was relocated in the 40s to flow along Kahle Drive, therefore, it would be unwise to route excess flow to this ditch. When the ditch is rehabilitated, it will receive the outflow from the Oliver Park Wet Basin and safely convey it to Burke Creek.
2	sheet c-1	Has the existing drainage channel from the basin outlet to Burke Creek been examined and assessed to estimate whether it has the appropriate dimensions and properties to convey a range of flows from the basin without significant change in erosion or downcutting? After project is built, will project owner or land owner periodically inspect this channel to track condition of the channel and restore where needed?	Ed Skudlarek	The 90% plans have been revised to eliminate overflow into the channel after meeting with USFS staff on site and agreeing to fill the channel as a portion of the overall watershed restoration. The channel was created with the construction of the original Kahle Basin and is a highly engineered feature within the meadow. This project will now fill a portion of the channel and the USFS staff will fill the remainder.
3	Permitting	Might the project require a nationwide permit from the USACOE? What permit(s) might be required by NDEP's Bureau of Water Pollution Control?	Ed Skudlarek	We do not believe these permits will be required as the project is not within a jurisdictional wetland. If groundwater is encountered, a permit may be required from NDEP.
4	Sand/Oil Separator	Given the land use of the drainage area, installing and maintaining an appropriately sized sand/oil water separator is prudent. Lot of parking lot area in Lower Kingsbury drainage area. Maybe the major property owners have installed oil capture BMPs in existing vaults or catch basins (Douglas County, NDOT, Lakeside Inn-Casino) - this might be investigated with TRPA Stormwater Management Program. Might be other ways to contain costs to budget limits.	Ed Skudlarek	Noted. Douglas County is strongly against the installation of a sand/oil separator which has to be maintained annually. The 3 treatment processes of the installed project should be adequate to treat oils and greases of concern.
5	Maintenance	Designing to maximize Lake Clarity Credits could include consideration of having the means to inspect and maintain the wet basin. Staff plates are needed to measure material accumulation in the wet basin and settling basin (forebay). Suggestions for maintenance access include installing an underdrain to lower water levels for vegetation removal or sediment removal. Extending the functioning life of expensive stormwater treatment BMPs, given limits to grant funding compared to recent past, gives support to a strategy to regularly maintain the wet basin. Has maintenance plan and efficient access been evaluated yet and will it before 90% design is completed?	Ed Skudlarek	A maintenance plan is provided in the draft design report. A pond drain has been added for both maintenance and habitat considerations. NTCD and Douglas County will meet prior to finalizing the plans to consider staff plate installation.

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Nevada Division of Environmental Protection

Comment #	Document/Page	Comment	Commenter	Response
6	Hydraulic residence time	Hydraulic residence time is a factor in the calculation of pollutant load reduction (credits) using PLRM. Literature on wet basins and constructed wetlands indicate length to width ratio of 3:1 is preferred over 2:1 and so on for maximizing particle settling. What is the length to width ratio of the 50% basin design? Can that be increased to extend detention of the water quality flow and volume? Looking at a diagram of the Tahoe City wetland (see attached pdf), it appears that constructed wetland was designed to optimize length:width relationship and to lengthen the forebay to optimize sedimentation in the settling basin.	Ed Skudlarek	The length to width ratio is 3 to 1. The basin length is approximately 300 feet and the average width is under 100 feet. While the design incorporates elements of the Tahoe City Wetland design, the design has been altered to improve the ability to conduct maintenance.
7	Tahoe City constructed wetland study	I was looking for the 2005 DRI study report on the Tahoe City constructed wetland (it is referenced in the TRPA BMP Handbook section on Wet Basin - which by the way is a good summary resource for design and maintenance considerations) and instead found a collection of studies related to the Tahoe City constructed wetland for the same BMP published in 2016. The recent study is attached to the email transmitting NDEP comments and contains the diagram of the constructed wetland mentioned above. It contains information worth considering in the design of the wet basin and preparing a maintenance plan that is incorporated into design.	Ed Skudlarek	Thank you for this information. This document was referenced for the 50 percent design and its content was considered. Alan Heyvaert from DRI also reviewed the 50 percent design.

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Nevada Division of State Lands

Comment #	Document/Page	Comment	Commenter	Response
1	General	Does the new basin outfall and pipe lead to the drainage along Kahle Drive (that will be improvised in Phase 2) or a drainage that leads to Burke Creek?	Meredith Gosejohan	The new outfall in the 50% design leads to an existing ditch that flows to Burke Creek (we think that ditch was created as part of the original basin construction in 1992). The 90% design will be updated to fill in this ditch per USFS direction and outlet the basin into the well vegetated meadow to surface flow to Burke Creek.
2	General	Is the trail a social or formalized USFS trail?	Meredith Gosejohan	The trail is a social trail. USFS has given us guidance that these trails do not need to be preserved but our design should consider that they might be reestablished by people after construction.

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Tahoe Regional Planning Agency

Comment #	Document/Page	Comment	Commenter	Response
1	General	A 10" travel lane is more appropriate given the use of the road and the speed limit (currently posted at 15, probably should change to 20 mph once the complete streets project is implemented.	Shannon Friedman	Noted. Need to discuss with Douglas County.
2	General	The on-street parking should not start until approximately sta. 29 (after the parking lot). I do not see a need for it adjacent to the parking lot.	Shannon Friedman	Noted. This additional space will likely be used for turn lanes as described below.
3	General	The Kahle Dr./Highway 50 intersection should be improved to include a right turn/straight lane and left turn lane. The sidewalk by the light is torn up, it would be great to re-pave that sidewalk cleaning up this intersection a bit.	Shannon Friedman	Noted. This will be added to the Complete Streets concept design alternatives.
4	C-1	Will the sidewalk/path going on top of the water quality basin encourage more volunteer trails along the basin berm, affecting the integrity of the berm and more disturbance to the basin in general? There are so many dogs in the area, if people are walking on the basin berm with their dogs, dogs will probably go into the basin and do their business and we know how irresponsible some dog owners are.	Shannon Friedman	Placement of the future Kahle Complete Streets sidewalk in coordination with the proposed basin will need to be analyzed further before 90% design.
5	C-4	There is an existing basin here, is there any opportunity to enlarge it and send a little bit more stormwater here?	Shannon Friedman	If so, this would be part of the Complete Streets Design since the basin would likely be altered with the street being widened.
6	R-1	I think the specs should include monitoring and maintenance of the vegetation in the basin to stay on top of it and make sure if there is encroachment of undesirable species, it is eradicated early rather than waiting until it is a major undertaking. Also vegetation maintenance helps with nutrient removal in a wet system such as this that relies on nutrient removal/settling vs. infiltration.	Shannon Friedman	The Contractor may not be able to monitor the vegetation as well as NTCD. NTCD will set aside funding to do this type of monitoring. The Contractor will be under a revegetation maintenance bond to ensure success of planted species. NTCD will work collaboratively with the USFS and Douglas County to weed the basin so that the correct species can thrive.
7	R-1	Detail 3/D-3 shows articulated block in bottom and portion of side slopes yet this is showing all re-veg so inconsistent with detail. I was under the impression it would be articulated block, for maintenance purposes.	Shannon Friedman	We are planning on revegetating the articulated block with a seed mix. The detail will be updated for 90% to show proper subgrades for revegetation of articulated block.
8	R-1	Seems like there may be a need for screening vegetation here as well, since vegetation here may be destroyed during construction.	Shannon Friedman	NTCD is working closely with the USFS to dial in screening locations. R-1 has been updated for 90%

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
US Forest Service

Comment #	Document/Page	Comment	Commenter	Response
1	General	**Cultural Evaluation:** Is the Complete Street project dependent on the Kahle Basin project, or could the Street project be completed even if the basin project did not go forward? The answer to this question will determine the level of analysis needed for cultural resources and could change the amount of time needed by the FS.	Staff	We would like more clarification on this question. The Kahle Basin is phase 1 of a larger project. The Complete Street is phase 2. Some aspect of Phase 2 needs to be completed for Phase 1 to be a fully functional stormwater project as currently the drainage inlets feeding the proposed pipeline for Phase 1 are not functional due to groundwater inundation.
2	General	**Size and Location**: Instead of asking for the size of the basin to be increased, as we discussed during the TAC meeting, we would like to ask for further explanation of how the size of the basin was determined. E.g., is the basin designed to handle large amounts of stormwater or is its purpose to reduce erosion?	Staff	The basin is designed to handle over 35,000 cubic feet of stormwater runoff. This is greater than the 25 year, 1 hour storm and the 2 year, 24 hour storm. Various methods exist and could give you different results - these results are basin the SCS TR-55 method. The Pollutant Load Reduction Model was used to look at increases in volume and nominal improvement in the capture of fine sediment was observed. Therefore, the final size chosen remained close to the original size with adjustments to limit visibility from adjacent trails and limit damages to resources.
3	General	**Wet Basin Design:** We are concerned that invasive bullfrog habitat could be created with a wet basin. Please inform us as to whether there are design features that would allow the basin to dry thoroughly at least once annually or otherwise address this concern.	Staff	We have added a 6" PVC pond drain to the outlet structure. The pond drain can be activated with a manual gate valve. This can assure that the pond does not pond in subsequent years and also provide better access for maintenance.
4	General	**Bike Path:** The design drawing sent 1/30/2018 shows a new path cutting into the berm on the south side of the basin: a new path is not preferred on FS lands in this area, but rather in the right of way. Since this path was not included in the initial proposal for this project, it has not been screened or otherwise analyzed.	Staff	Noted. Will pass along this information at February 22nd meeting.
5	General	**ROW:** we would like to see a drawing that clearly shows the right of way, not just the property boundary.	Staff	The right-of-way will be clearly labeled in 90% design - in the case of Kahle the R/W is the property boundary and this has been confirmed with Douglas County
6	General	**Maintenance:** if the project is authorized, detailed information on anticipated maintenance, including schedule, access and treatment will need to be included in an operating plan. A paved access road for maintenance is not likely to be approved. If the Complete Street project results in the aspens and other vegetation between the basin and Kahle Drive being removed, the access for maintenance vehicles should use the shortest route directly from Kahle instead of through the existing gate, as proposed.	Staff	90% plans have been revised to move the gate and have a short access path. Paving is proposed to the R/W. A maintenance plan is provided in the Draft Design Report.

Comments on 50% Design and Cost Estimate for Kahle Water Quality Basin Implementation
US Forest Service

Comment #	Document/Page	Comment	Commenter	Response
7	General	**Outflow:** the plans for the outflow channel should include further analysis.	Staff	The outflow has been revised for 90% plans per our discussions and engineering design principles.
8	General	**Interpretive sign:** a sign placed on the existing multi-use path that describes the basin and its purpose was described early in the planning process, and we would like to see that included in the plans.	Staff	An interpretive sign similar to the one placed at Burke Creek has been added to the plans. The sign's content should be discussed at the 90% TAC meeting.

APPENDIX B: RESPONSES TO 90% COMMENTS

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Douglas County

Comment #	Document/Page	Comment	Commenter	Response
1	ii	Please see Table 2.1 of the Douglas County Design Criteria and Improvement Standards Manual for General Notes required to be added to the plan set. Not all notes are applicable and the Design Engineer omit the notes that do not apply to the project (i.e. Douglas County Water Utility or Douglas County Wastewater Utility Notes).	Erik Nilssen	Applicable notes have been added.
2	ii	General Note 27 – Add “any road closures require the contractor to obtain a road closure permit from Douglas County.”	Erik Nilssen	Added.
3	C-1	Everything needs to be dimensioned. The right of way limits, the centerline of the roadway, the dimension from the centerline of the roadway to all existing utilities, edge of pavement, curb and gutter, etc. (Sheets C-1 through C-6). See DCIS 2.2.5 Stationing and Orientation. The existing utilities size and material should be noted on the plan set.	Erik Nilssen	We added this to the best of our ability, however, some stationing seemed to make it confusing to read the plans so was left off.
4	C-1	The construction centerline needs to correspond to the roadway centerline. STA 0+00 of the construction centerline should correspond to a STA of the roadway centerline (STA10+98 ~60L?). The construction centerline should then have bearings and the STA of the angle points should be called out or each angle point should reference a STA from the roadway centerline. Roadway centerline needs to be based on a locatable field reference (CL monuments are not available unfortunately) but the STA 10+00 appears to be arbitrary.	Erik Nilssen	Construction centerline is labeled with corresponding stations to existing Kahle Drive centerline. A line curve table has been added to the index sheet and labels have been added to the construction centerline on the corresponding C sheets.
5	D-3	Concrete Block Forebay Access – detail 4 Sheet D-3. I don’t believe this detail addresses the construction of the forebay access, just the forebay itself.	Erik Nilssen	Additional detail was added for the construction of the forebay access.
6	C-3	Manhole spacing may be 400-feet for storm drains less than 48-inches in diameter (See DCDCIS 6.5.5.8). The concrete vault can also be used as a manhole (I believe). This may allow for the elimination of some manholes in order to help project costs.	Erik Nilssen	One manhole has been removed (STA 07+66.2) from the plans. Other manholes could not be removed to maintain cover or the 400' distance. One additional manhole could be removed if a spacing of 403 feet were allowed.
7	C-3	I am nervous about the proximity of the new stormdrain to the overhead electric lines. It appears the storm drain trench will require the removal of some of the guy wires for the power poles. Temporary bracing of the poles may be necessary and include in the bid item.	Erik Nilssen	Temporary bracing of power poles is included in the bid item/cost estimate "Protect Existing Utilities in Place." The specs detail this requirement and the estimate used 7 poles at $4,000 each for bracing.
8	C-3	Need rim and invert elevations of catch basins and manholes on the plan sheet.	Erik Nilssen	Added to 100% Plans.
9	C-6	Dimension the width of the proposed pavement cut	Erik Nilssen	Width of proposed cut is now shown on plans.
10	C-6	The exit of the parking lot needs additional detail. It appears a large portion of the driveway is concrete, yet plans show it all as asphalt. The costs and construction methods are different for concrete versus asphalt replacement.	Erik Nilssen	Concrete is now shown in the driveway.Existing conditions have been verified using as-builts and a field visit.
11	C-6	Any concrete construction note should read “Sawcut, remove, and replace existing curb to nearest joint +_ 8LF.” We want to make sure we don’t get extra joints.	Erik Nilssen	Note has been added to plans.
12	C-6	There are detectable warnings in this area which need to be shown on the plan set. If removal and replacement of detectable warnings is necessary it needs to be called out.	Erik Nilssen	Detectable warning signs are called out on plans. No removal or replacement is expected.
13	C-6	Callout existing pipe diameter and material	Erik Nilssen	Existing pipe diameter and material is called out on plans.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Douglas County

Comment #	Document/Page	Comment	Commenter	Response
14	D-2	If Douglas County has standard details (5, 6, 7 D-2; 1, 2, 3 D-4; 3 D-5) the Douglas County Standard Detail in its entirety should be used. This includes the border and the Douglas County Standard Detail Number and effective date. If any changes are made to the detail the proposed change should be identified by a cloud.	Erik Nilssen	Douglas County Standard Details are used where applicable. In order for clarity for the contractor and to keep the number of plan sheets reasonable (and thus keep costs down) the border is not included. Per NTCD Standards, revision clouds are only used if there is a change after the contract has been awarded.
15	Specifications	Section 102 – I would remove this section from the specifications. I only require qualifications if it's a large project or if it is unique. This project is pretty ordinary and anyone with a Class A contractors license should be able to complete the work.	Erik Nilssen	NTCD thinks being in the Tahoe Basin and on USFS lands makes the project not ordinary. The following requirement was removed: "The Contractor and his/her designated Foreman is required to have successfully performed and completed up to one (1) project, within the past five (5) years, which involved working within the Lake Tahoe basin. "
16	Specifications	Section 120.01 first paragraph last line states "requires the issuance of a USFS Special Use Permit." Does it, or is the existing permit ok?	Erik Nilssen	Changed to "modification of an existing USFS Special Use Permit "
17	Specifications	Section 140 Make clear that no staging or storage of material is allowed within the County Right-of-Way.	Erik Nilssen	Added "No staging will be allowed in the Douglas County or NDOT right-of-way" to second paragraph
18	Specifications	Section 145.02- Under submittals, they are required to submit the Qualifications of the materials testing firm and individuals. See DCDCIS 11.2.4.2 for additional information.	Erik Nilssen	Added a bullet "Qualifications of the materials testing firm or personnel to be used"
19	Specifications	Section 150.02 Put in bold that any closure of the Douglas County Right of Way requires a "Road Closure Permit" from Douglas County.	Erik Nilssen	Added "Any closure of the Douglas County right-of-way requires a "Road Closure Permit" from Douglas County and the contractor is responsible for obtaining this permit." in bold to 150.02.
20	Specifications	Section 165 – Does the contractor need a DeMinimus Permit from NDEP?	Erik Nilssen	No a deminimus permit is needed as no discharging to surface water is allowed to take place.
21	Specifications	Section 235.02 – 42-inch RCP must be called out to be bell and spigot with water tight joints or must have external sealing bands per ASTM C877.	Erik Nilssen	Added "Pipe shall be joined bell & spigot with water-tight joints or must have external sealing bands per ASTM C877." to 42" RCP spec.
22	Specifications	Section 235.03 - 36-inch HDPE Pipe – all specifications should be removed and it should just say "Shall meet the specifications outlined in Section 708 of the 2014 NDOT Standard Specifications for Road and Bridge Construction."	Erik Nilssen	Change made.
23	DesignReport	Page 2 – 2nd to last sentence in the Project Background Section states that Douglas County needs this basin to meet our 10 year TMDL milestone (2021). We already have this milestone locked down with the completion of Burke Creek. We need this to meet our 2026 milestone.	Erik Nilssen	Changed the sentence to say "Expanding and redesigning the Kahle Basin to a functioning wet basin stormwater treatment system will play an important role in NDOT and Douglas County meeting their TMDL milestones." since I'm not sure on NDOT's status.
24	DesignReport	Table 1.2 – Should Douglas County also be listed as the entity responsible for maintenance?	Erik Nilssen	Yes, perhaps "Asset owner and special use permit holder" to reflect that DC holds the USFS SUP?
25	DesignReport	Table 3 – Summary and Results update the potential clarity and credits.	Erik Nilssen	Updated per Courtney and NTCD preliminary work.
26	C-1	As we discussed, if ther berm around the perimeter of the wet basin can be increased from a four foot width to a five or six feet width, that would be better for maintenance access.	Courtney Walker	The berm width has been increased to six feet.
27	DesignReport	Per Erik's comment on TMDL milestones, this project helps meet the 2021 milestone, and contributes to the 2026 milestone. We essentially need it to meet both milestones, but it's not a slam dunk for either measure.	Courtney Walker	Noted, made sentence less specific for flexibility.
28	DesignReport	Page 3 in caption for Figure 2 - should say undersized in first sentence.	Courtney Walker	Thank you. Changed.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Douglas County

Comment #	Document/Page	Comment	Commenter	Response
29	DesignReport	Page 5, Figure 3 - The sub-watershed boundaries need to be updated. I have been basing catchment boundaries on the DCA catchment and adding on what you have outlined here as "D". Table 2.1 will nee to be updated based on the revised estimated flow estimates for the area draining to the basin.	Courtney Walker	The sub-watersheds are valid for the hydrology we did for the project and should not be updated or we have to redo the hydrology which we'd like to keep as is because it is accurate enough for design. The subwatersheds should be re-done for PLRM.
30	DesignReport	Page 9 under revegetation, second paragraph: "The seed mixes are listed in Table 3" not "X".	Courtney Walker	Thank you. Changed.
31	DesignReport	Page 10 Table 3 - NDOT and Douglas County potential credits 25 each.	Courtney Walker	Updated.
32	DesignReport	Page 11 under Project Maintenance: Will a staff plate be installed in the forebay or is that something I should do after the project is completed? Add some language about maintenance and vegetation removal should occur as needed annually, to prevent an excess of 75% vegetation. The benchmark should be 60% vegetation +/-15%.	Courtney Walker	Added installation of a staff plate to detail 4 on sheet D-3. Added language to the maintenance section to remove vegetation annually. Added benchmark language to the revegetation section.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Tahoe Regional Planning Agency

Comment #	Document/Page	Comment	Commenter	Response
1	Design Report	Bottom of page 1, if the basin was constructed it 1992, that was 26 years ago, not 23 years ago.	Shannon Friedman	Changed. Thank you.
2	Design Report	In the project background you should mention the project also implemented the Lake Tahoe EIP, (EIP # 01.01.01.0084). The tracker states that it will improve water quality, soil conservation, and recreation threshold categories.	Shannon Friedman	Added "The Project is also identified in the Tahoe Regional Planning Environmental Improvement Program (EIP Number 01.01.01.0084) as improving water quality, soil conservation, and recreation thresholds."
3	Design Report	Cannot tell the land capability districts because the image is in black and white.	Shannon Friedman	Replaced the image with a better image. LCV districts are also on the engineering plans.
4	Design Report	Basin Outlet Design – There should be specific criteria developed for when the low flow pond drain needs to be opened. Who is responsible for monitoring the basin and operating the low flow drain? Based on the project maintenance section it is inferred that Douglas County will control this, but it is not explicitly stated.	Shannon Friedman	Douglas County will control this. This will become language in the USFS Special Use Permit based on USFS biologist recommendation.
5	Specifications	Pg. 7 – noxious weed requirements - Does NTCD verify the contractor is complying with these requirements or is it trust? Given the widespread weed issue within proximity to the project area I want to make sure we are diligent about this.	Shannon Friedman	As the resident engineer, NTCD will verify that the contractor is adhering to the noxious weed specifications. NTCD will do weed control after the project is constructed for 1 year and then relinquish responsibilities to the landowners (USFS and Douglas County)
6	Specifications	Page 14 – Staging and Storage – Any staging other than what is on the TRPA approved plans shall be approved by TRPA prior to staging on the site (this will be a condition of the TRPA permit, so it is up to you if you want to add it to the specs as well).	Shannon Friedman	Added language to make contractor responsble for obtaining TRPA approval. Engineer (NTCD) will not approve additional staging without TRPA approval.
7	C-1	Sheet C-1 – TRPA is ok with not paving the 12' wide access at station 11+50 and instead placing duradeck or similar product down when the basin needs to be maintained. Paving seems unnecessary here since this portion of the basin will only need to be maintained every 10 – 15 years. Then the USFS gate will not need to be removed. Combined this is a small cost savings overall.	Shannon Friedman	We would still move the USFS gate since it is not needed in the location it is in. We have not resolved this with Dougals County yet and will put the paving as a bid alternate item while we await resolution. We will call out clearing a 15' wide swath of willows and revegetating with Type 3 revegetation
8	D-1	Sheet D-1 – Coordinate with the TRPA Graphic Designer to ensure the sign is consistent with EIP messaging (I think you already have the template from recent projects that you can use).	Shannon Friedman	We plan on having the TRPA Graphic Designer provide the sign graphics.
9	Cost Estimate	Weed Control - I have a note on the plans to coordinate the USFS as they already are undergoing these efforts in Rabe Meadow, perhaps they could do this as part of there existing efforts.	Shannon Friedman	We agree but do not want to leave it out of the bid in the event USFS staff cannot complete the weed treatment prior to our construction.
10	Cost Estimate	AC Pavement – Cost may go down if the AC access road at station 11+50 is not constructed, which I believe means the USFS gate does not need to be removed which would yield additional cost savings.	Shannon Friedman	AC will be expensive as it is going to be in a small batch. AC access at 11+50 has been moved to a bid alternate.
11	Cost Estimate	Interpretive Sign - I recall this being a USFS request but I do not see it as s high priority (also not high cost so does not put in much of a dent)	Shannon Friedman	Will have to resolve with USFS as they are funding this and it is on their land.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Nevada Division of State Lands

Comment #	Document/Page	Comment	Commenter	Response
1	C-1	In regards to your note below and new C-1 plan sheet, I like the idea of constructing a microbasin and connection to the existing vault at the end of Kahle with the Tahoe Beach Club paying for paving. We are on board with this option.	Meredith Gosejohan	Noted. In order to get project out to bid, this needs to be tabled for furthur discussion with Project funders and permitters.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
US Forest Service

Comment #	Document/Page	Comment	Commenter	Response
1	C-1	We would rather not have paving in the right of way near the gates, and it seems like it is not required since there is not paving beyond the gates. Let's discuss.	USFS	Plans can be revised to only have paved access to the forebay. The other area could just be cleared of willow, over-excavated 12", and reseeded with treatment type 3 so that it is vegetation that can be driven over eventually.
2	Permits	Archeological surveys are needed for the entire area based on the codependence of Phases 1 and 2. Provide a brief description of the proposed Complete Street project and a GIS shapefile of the entire project area (both phases including staging areas)	USFS	Can you explain this more? Phase 2 is depended on Phase 1 but Phase 1 is not dependent on Phase 2, so I would not call them co-dependent. How will this delay the project? The project must be constructed by the end of August and therefore we must have all permits by the end of June.
3	Design Report	Bullfrog questions a. How will the water level in the basin be monitored to determine when the drain is needed? b. How is the opening/closing of the drain going to be monitored? c. Will drain become clogged? Is there a screen? How will this be monitored?	USFS	Added this sentance to the maintenance plan in the design report: "The manually operated low flow pond drain should be used drain the basin for maintenance or to eliminate subsequent years of ponding (the basin should not hold standing water for 2 years in a row), if necessary." (a) USFS would be responsible for this monitoring and conveying whether the pond needs to be drained to Douglas County. (b) Douglas County would be responsible for opening and closing the drain. (c) A screen would make the drain more likely to clog so no screen is planned. The drain should only be operated with personnel present.
4	C-1	Follow up on ditch construction details for FS vs contractor duties with Theresa Cody and Stephanie Heller	USFS	We have followed up with USFS and the plans will be revised for our ditch fill to stop at the first plug.
5	R-1	Ensure break in screening vegetation for potential use of concrete block as user created trail	USFS	Ok, a break is shown on the plans.
6	Specifications	Salvage all sod from areas of disturbance.	USFS	Specifications have been updated to remove references to specific quantities of sod and to direct the contractor to salvage sod that is cohesive, contiguous material of sedges, Baltic rush, and other wetland and mesic meadow species.
7	Specifications	Construction plan needs weed prevention info – let us know if you need standard language regarding washing vehicles, using clean fill, etc.	USFS	Section 120 has the following language which I believe is USFS language The Contractor shall comply with all noxious weed requirements per the United States Forest Service (USFS) and other regulatory agencies. These requirements include but are not limited to the following: • All tools, equipment and vehicles used for project implementation are required to be weed-free. • All tools, equipment and vehicles will be cleaned of all attached mud, dirt, and plant parts. This will be done at a vehicle washing station or steam cleaning facility (power or high pressure cleaning) before the equipment and vehicles enter the project area, and before vehicles enter the Lake Tahoe Basin (if they originate from outside the Basin). • All soil, fill, gravel, rock, mulch, seed, organic matter or other imported materials are required to be weed-free. Use onsite soils, gravel, rock, or organic matter when possible. Otherwise, obtain materials from pits, quarries, nurseries, and other sources that are certified or have been determined to be weed-free by the noxious weed coordinator of the USFS Lake Tahoe Basin Management Unit. • Minimize the amount of ground and vegetation disturbance in the construction areas. Reestablish vegetation on all disturbed bare ground to minimize weed establishment and infestation. • Use weed-free mulches, and seed sources. Salvage topsoil from project area for use in
8	Specifications	Water for temporary irrigation should be sourced from a hydrant and not from creek or other water on site.	USFS	Yes, this is clear in the specifications as water must be sourced from KGID (waterline tap) or Douglas County (hydrants)
9	Specifications	Contact USFS prior to any ditch work to discuss potential fish salvage.	USFS	Ok, but the specifications say no work will be allowed in the ditch unless it is dry. (Section 210.02: Work shall occur when the ditch is free of surface water)
10	Specifications	Articulated block and concrete apron should utilize integral color concrete in a dark earth-toned color and articulated block that is tan or brown. Gray block is not preferred.	USFS	Section 240.02 calls out buff tan for the block color

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
US Forest Service

Comment #	Document/Page	Comment	Commenter	Response
11	R-1	Screening revegetation should include a row between the forebay and ROW, and extend the north edge to meet existing vegetation. See attached photo showing areas for additional revegetation.	USFS	Ok, change will be made.
12	R-1	Interpretative sign is no longer needed.	USFS	Ok, thank you.
13	Specifications	For above-ground metal, avoid galvanized steel and/or treat metal to reduce reflectivity and glare-producing impacts.	USFS	All above ground metal is called out to be treated with Natina, see 220.04 of specifications.
14	Specifications	Regarding tree and vegetation removal: Removal of trees and shrubs should be conducted outside the avian nesting season (April 1 through August 15). If vegetation removal cannot occur outside of this period, a qualified biologist (USFS or qualified consultant) must perform a survey to determine whether nesting is occurring. This survey shall consist of a qualified biologist conducting a pre-construction survey for active nest sites of all migratory birds within a 1/8 mile radius prior to the onset of construction activities initiated during the nesting season (i.e. within 15 days). If surveys indicate that any bird nest occurs within the survey area, a no-disturbance buffer will be established around the nest site to avoid disturbance or destruction of the nest site. Generally, the buffer zone would be 50 feet for nesting passerine birds and 500 feet for nesting raptors. The extent of these buffers for specific nests will be determined through coordination with USFS and will likely depend on the level of noise or construction disturbance, line of sight between the nest and the disturbance, ambient levels of noise and other disturbances, and other topographical or artificial barriers. If	USFS	Specifications were updated to prohibit any tree removal without the necessary migratory bird surveys and clearance. If birds are found in the area, removal of trees will begin on or after August 16.
15	Specifications	All trash created during construction must be properly contained (wildlife-proof containers) and removed from the site at the end of each day.	USFS	Added this language to section 120 of the specifications.
16	C-1	Retain downed wood where feasible for native amphibian and small mammal species.	USFS	Added a note to C-1 to retain downed wood for placement on filter areas or islands.
17	Plans	vage/retain large trees for wildlife habitat, future large wood recruitment, and to create snags in the future, unless removal is necessary for implementation.	USFS	Only trees necessary for removal are being removed. All others will be protected in place. Note 16 on page ii saws “all existing vegetation shall be preserved unless specifically identified by the engineer for removal”
18	Specifications	Consult with LTBMU Botanist for pre-treatment and monitoring requirements for invasive plants which are not included in the Draft Revegation Spec for Kahle Basin for IDT. For example, additional invasive plant species that are in or adjacent to the project analysis area include bull thistle, Dalmatian toad flax, and sulfur cinquefoil.		Added bull thistle, dalmatian toad flax and sulfur cinquefoil to the specifications with treatment. Will consult with USFS botanist prior to removal.

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
US Forest Service

Comment #	Document/Page	Comment	Commenter	Response
19	Specifications	a) All equipment and vehicles (Forest Service and contracted) used for project implementation must be free of invasive plant material before moving into the project area. Equipment will be considered clean when visual inspection does not reveal soil, seeds, plant material or other such debris. Cleaning shall occur at a vehicle washing station or steam-cleaning facility before the equipment and vehicles enter the project area. b) When working in known invasive plant infestations or designated weed units, equipment shall be cleaned before moving to other National Forest Service system lands. These areas will be identified on project maps. Early Detection—Any infestation discovered prior to or during project implementation should be reported to the Forest Botanist or their designated appointee for prioritization and assessment for treatment. Treatment – If any invasive plant sites are found during implementation or within the duration of the permit, the Forest Service should be notified to coordinate treatment. Infestations prioritized for treatment will be treated in accordance with Forest Service management direction and the design features of the LTBMU 2010 Terrestrial Invasive		Already in Section 120 of Specifications
20	Specifications	Seed mix – Poa pratensis is a not native to the Lake Tahoe Basin and not allowable in the seed mix.		Removed from seed mix

Comments on 90% Design and Cost Estimate for Kahle Water Quality Basin Implementation
Nevada Division of Environmental Protection

Comment #	Document/Page	Comment	Commenter	Response
1	General	NDEP is interested in reviewing the preliminary PLRM set up and inputs and outputs for baseline and expected conditions scenarios. If NTCD, Douglas County, and NDOT are willing to provide that information, we would be glad to screen it and provide review comments.	Ed Skudlarek	We only ran PLRM for design purposes and did not save our set ups. We will likely do something more formal in the fall once the project construction is wrapped up. We need to focus on construction with the strict USFS deadline of September 30, 2018.
2	General	Are staff plates needed to measure and track material accumulation in forebay and pond?	Ed Skudlarek	Only a staff plate in the forebay is proposed.
3	General	What is the engineer's estimated cost for the installation of the micro-basin at west end of Kahle Drive?	Ed Skudlarek	The estimate for the paving (paid for by Beach Club) is $80,000. The estimate for the remainder of the work, grading, microbasin, curb, pipe connections, di relocation) is $40,000. If Beach Club will pay for curb, cost could be as little as $10,000.

APPENDIX C: CALCULATIONS

Kahle Basin Volume Calculations using Hydrology from HEC HMS (2014)

24 Hour Storms	**value**	**notes**
Q2 (cfs)	**36.7**	**ECAM HEC-HMS**
Q10 (cfs)	**83.9**	**ECAM HEC-HMS**
Q25 (cfs)- from Table 2b of 2014 ECAM	**109.00**	**or could be up to 116.1 from HEC-HMS**
Q100 (cfs)- from Table 2b of 2014 ECAM	**167.60**	**or could be up to 178.5 from HEC-HMS**
tc (min)	14.7	min
tc (sec)	882	seconds
Volume, 2 year, ft^3	32,369.40	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 10 year, ft^3	73,999.80	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 25 year, ft^3	96,138.00	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 100 year, ft^3	147,823.20	V = tc * Qpeak
1 Hour Storms	**value**	**notes**
Q5, 1 hr, (cfs)	**8.60**	used NOAA and an estimate derived from
Q10, 1hr (cfs)	**16.50**	24 hour storms
Q25, 1 hr (cfs)	**23.2**	
Q100, 1 hr (cfs)	**34**	
tc (min)	14.7	min
tc (sec)	882	seconds
Volume, 2 year, ft^3	7,585.20	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 10 year, ft^3	14,553.00	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 25 year, ft^3	20,462.40	V = tc * Qpeak, per Truckee Meadows RDM
Volume, 100 year, ft^3	29,988.00	V = tc * Qpeak

Kahle Drive Conveyance Design

Summary: Recommend 42" plastic gasketed pipe at downstream end and 36" plastic for manhole connections

25 YEAR Storm peak flow

(source: Wood Rodgers ECAM 2014) = 111.8 cfs

Slopes and pipe sized obtained form 1992 JWA asbuilts plans for Burke Creek/Kahle Ditch Restoration Project and checked with survey of manholes where possible.

Starting with Downstream most pipe leading into Kahle Basin:

Q25 36" RCP - Existing - 250 ft long

Mannings Calculator for Pipes more than 1/2 full

input	value	units	NOTES
depth of water (y)	3	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	7.068583471	ft2	
wetted perimeter (P)	9.424777961	ft	
Pipe slope (S)	0.01	ft/ft	
hydraulic radius (R)	0.75	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	9.4358921	ft/s	
flow (Q)	66.69839093	cfs	NO

Q25 42" RCP -proposed - need RCP due to cover

Mannings Calculator for Pipes more than 1/2 full

input	value	units	NOTES
depth of water (y)	3.2305	ft	92.3% is pipe's most efficient flo
D (inches)	42	in	
D (ft)	3.5	ft	
R	1.75		
theta = 2arccos(R-D/R)	1.124716824		
cross sectional area (A_c)	9.280315099	ft2	
wetted perimeter (P)	9.027319845	ft	
Pipe slope (S)	0.011	ft/ft	
hydraulic radius (R)	1.028025511	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		RCP mannings
mean velocity (v)	12.21165129	ft/s	
flow (Q)	113.3279719	cfs	OK, use 42" RCP

Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches

flow (Q)	**105.51**	cfs
mean velocity (v)	11.37	ft/s

Q25 30" RCP - Existing - 80 ft long

Mannings Calculator for Pipes more than 1/2 full

input	value	units	NOTES
depth of water (y)	2.5	ft	
D (inches)	30	in	
D (ft)	2.5	ft	
R	1.25		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	4.908738521	ft2	
wetted perimeter (P)	7.853981634	ft	
Pipe slope (S)	0.031	ft/ft	
hydraulic radius (R)	0.625	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	14.71215581	ft/s	
flow (Q)	72.21812594	cfs	NO

Q25 36" Plastic -proposed

Mannings Calculator for Pipes more than 1/2 full

input	value	units	NOTES
depth of water (y)	2.8333	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	0.951861509		
cross sectional area (A_c)	6.914048289	ft2	
wetted perimeter (P)	7.996985697	ft	
Pipe slope (S)	0.021	ft/ft	check final plans
hydraulic radius (R)	0.8645818	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	16.28613149	ft/s	
flow (Q)	112.6030996	cfs	OK, use 36"

Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches

flow (Q)	**104.70**	cfs
mean velocity (v)	15.14	ft/s

Q25 30" RCP - Existing - 117 ft long			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.5	ft	
D (inches)	30	in	
D (ft)	2.5	ft	
R	1.25		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	4.908738521	ft2	
wetted perimeter (P)	7.853981634	ft	
Pipe slope (S)	0.048	ft/ft	
hydraulic radius (R)	0.625	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	18.30695388	ft/s	
flow (Q)	89.8640497	cfs	NO

Q25 36" Plastic -proposed			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.8333	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	0.951861509		
cross sectional area (A_c)	6.914048289	ft2	
wetted perimeter (P)	7.996985697	ft	
Pipe slope (S)	0.024	ft/ft	
hydraulic radius (R)	0.8645818	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	17.41	ft/s	
flow (Q)	120.38	cfs	OK, use 36" to match others
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches			
flow (Q)	**111.93**	cfs	
mean velocity (v)	16.19	ft/s	

Q25 30" RCP - Existing - 215 ft long			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.5	ft	
D (inches)	30	in	
D (ft)	2.5	ft	
R	1.25		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	4.908738521	ft2	
wetted perimeter (P)	7.853981634	ft	
Pipe slope (S)	0.021	ft/ft	
hydraulic radius (R)	0.625	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	12.10891181	ft/s	
flow (Q)	59.43948183	cfs	NO

Q25 36" Plastic -proposed			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.833333333	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	0.951764499		
cross sectional area (A_c)	6.914094103	ft2	
wetted perimeter (P)	7.997131212	ft	
Pipe slope (S)	0.023	ft/ft	
hydraulic radius (R)	0.864571797	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	17.0438953	ft/s	
flow (Q)	117.843096	cfs	OK, use 36" to match others
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches			
flow (Q)	**109.57**	cfs	
mean velocity (v)	15.85	ft/s	

Q25 30" RCP - Existing - 10+184+106 ft long			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.5	ft	
D (inches)	30	in	
D (ft)	2.5	ft	
R	1.25		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	4.908738521	ft2	
wetted perimeter (P)	7.853981634	ft	
Pipe slope (S)	0.029	ft/ft	
hydraulic radius (R)	0.625	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	14.22965818	ft/s	
flow (Q)	69.84967124	cfs	NO

Q25 36" Plastic -proposed			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.666666667	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	1.359347638		
cross sectional area (A_c)	6.63926126	ft2	
wetted perimeter (P)	7.385756504	ft	
Pipe slope (S)	0.031	ft/ft	
hydraulic radius (R)	0.898927721	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	20.30805164	ft/s	
flow (Q)	134.8304605	cfs	OK, use 36" to match others
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches			
flow (Q)	**127.21**	cfs	
mean velocity (v)	19.16	ft/s	

Q25 24" RCP - Existing - 185 ft long			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2	ft	
D (inches)	24	in	
D (ft)	2	ft	
R	1		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	3.141592654	ft2	
wetted perimeter (P)	6.283185307	ft	
Pipe slope (S)	0.046	ft/ft	
hydraulic radius (R)	0.5	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	15.44428151	ft/s	
flow (Q)	48.51964134	cfs	NO

Q25 36" Plastic -proposed			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	1.9	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	2.601727062		
cross sectional area (A_c)	4.719913818	ft2	
wetted perimeter (P)	5.522187368	ft	
Pipe slope (S)	0.048	ft/ft	
hydraulic radius (R)	0.854718158	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	24.43468825	ft/s	
flow (Q)	115.3296227	cfs	OK, use 36" to match others
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches			
flow (Q)	**158.29**	cfs	
mean velocity (v)	33.54	ft/s	

Q25 24" RCP - Existing - 90+179 ft long			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2	ft	
D (inches)	24	in	
D (ft)	2	ft	
R	1		
theta = 2arccos(R-D/R)	0		
cross sectional area (A_c)	3.141592654	ft2	
wetted perimeter (P)	6.283185307	ft	
Pipe slope (S)	0.014	ft/ft	
hydraulic radius (R)	0.5	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.013		
mean velocity (v)	8.520259284	ft/s	
flow (Q)	26.76718397	cfs	NO

Q25 36" Plastic -proposed			
Mannings Calculator for Pipes more than 1/2 full			
input	value	units	NOTES
depth of water (y)	2.83333	ft	
D (inches)	36	in	
D (ft)	3	ft	
R	1.5		
theta = 2arccos(R-D/R)	0.951774201		
cross sectional area (A_c)	6.914089522	ft2	
wetted perimeter (P)	7.99711666	ft	
Pipe slope (S)	0.018	ft/ft	
hydraulic radius (R)	0.864572797	ft	
conversion (C_1)	1.486		
Mannings roughness (n)	0.012		WT ADS Mannings
mean velocity (v)	15.07792321	ft/s	
flow (Q)	104.2501109	cfs	OK, use 36" to match others
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches			because pipe is at upstream end and 111.8 is too
flow (Q)	**96.93**	cfs	conservative
mean velocity (v)	14.02	ft/s	

w

Kahle Basin Calculations - Forebay Calculations

Forebay Calculations - Pipe Velocities and Scour	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**ECAM 2014**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**ECAM 2014**
Manning's n	0.012	ADS HDPE Specs
Pipe Diameter (f)	42	assume rock channel
Pipe Slope (ft/ft)	0.01	
Area of Pipe	9.621127502	ft^2
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches		
flow (Q)	**114.30**	cfs
mean velocity (v)	11.88062401	ft/s
length of flow	35	Calculating Scour using HEC 14
Froude number = v/(sqrt(g)*L)	0.353897336	subcritcal - no scour likely
scour time	14.7	min
Scour depth, sigma	1.87	sand,conservative
Scour depth, alpha	2.27	hec14
Scour depth, Beta	0.39	hec14
Scour depth, theta	0.06	hec14
C(h), depth	1	no drop
C(s), depth	1.03	slope ~1.5%
Rc (ft)	0.875	D/4
hs (dissipator pool depth)	5.039951942	ft, conservative
Scour length, sigma	1.87	sand,conservative
Scour length, alpha	17.1	hec14
Scour length, Beta	0.47	hec14
Scour length, theta	0.1	hec14
C(h), length	1	no drop
C(s), **depth**	1.03	slope ~1.5%
Rc	0.875	D/4
Ls (dissipator pool depth)	43.77854842	ft, conservative
Cutoff wall not necessary - scour depth of 5 ft at outlet and length of 44' - forebay is 90' long		

Forebay Calculations - Notch to Basin	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**ECAM 2014**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**ECAM 2014**
Length (ft)		
Upper Elevation (ft)		
Lower Elevation (ft)		
Slope (ft/ft)	1.50%	1.5%
Channel Size: Trap	?? 'top, 25' bttm, 1 ft deep,	
Manning's n	0.025	natural channel good condition, Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	trapezoidal	
Bottom Width (ft), b	25	assume rock channel
Side Slope (xH:1V)	3:1	
angle of Incline, θ, degrees	18.40	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	1.00	
P= Wetted Perimeter [ft]	20.40	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	22.93	(b+(d/tanq))*d
R= Hydraulic Radius = A/P	1.12	
Velocity [ft/sec]	7.9	velocity should be no more than 11 ft/s for western interlock turfstone. Can be 23 ft/sec for enviroflex
Maximum Q [cfs]	**180.9**	passes 100 year

Kahle Basin Outlet Structure and Overflow Sizing

proposed rock overflow from basin	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**or could be up to 116.1 from HEC-HMS**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**or could be up to 178.5 from HEC-HMS**
Length (ft)		
Upper Elevation (ft)		
Lower Elevation (ft)		
Slope (ft/ft)	25.00%	4:1
Channel Size: Trap	42.5'top, 35' bttm, 1.25 ft deep	
Manning's n	0.035	veg and stone channel; Appendix 19.A, Lindeburgh: Civil Engineering Reference Manual, Tenth Edition
Shape	trapezoidal	
Bottom Width (ft), b	35	assume rock channel
Side Slope (xH:1V)	3:1	
angle of Incline, θ, degrees	18.40	1:1 = 45deg; 2:1 = 26.6deg; 3:1 = 18.4deg
wetted depth, d	0.41	
P= Wetted Perimeter [ft]	33.11	b+ 2*(d/sin θ)
A= Cross sectional flow area [ft^2]	14.00	(b+(d/tanq))*d
R= Hydraulic Radius = A/P	0.42	
Velocity [ft/sec]	12.0	
Maximum Q [cfs]	**167.9**	Exceeds 100 year with at least 1' freeboard

proposed rock overflow from basin	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**or could be up to 116.1 from HEC-HMS**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**or could be up to 178.5 from HEC-HMS**
Length of Weir (b or L)	35	Length of Weir
Cw	2.6	Weir Coeff 2.6 min
head (H)	0.85	still 0.4' freeboard
Q (cfs)	201.7041224	Q=CwL(H)^3/2
check with Spillway Eqn from Lindburg	91.33572205	Q = CssbH^3/2 where Cs is 3.33
	too low, increase H	
head (H)	1.25	
check with Spillway Eqn from Lindburg	162.8835767	still too low - increase width to 35
check with USBR 1987 Design of Small Dams	190.7645493	Q = CdLHd^3/2, where Cd is 3.9
		Ok, using 1.25' of head

Outlet Structure - Rectangle	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**or could be up to 116.1 from HEC-HMS**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**or could be up to 178.5 from HEC-HMS**
Rectangular Inlet Box (B)	4	ft
Rectangular Inlet Box (D)	5	ft
Rectangular Inlet Box (L)	18	L = 2B + 2D for rectangle, but slanted so B+D
Cw	2.6	Weir Coeff 2.6 min - conservative
head (h)	0.1	
gravitational constant	32.2	
Q (cfs)	764.8471524	Q=CwL(2gh)^3/2
cross sectional A of outlet	20	A0 = D*B
C0, orifice coeff	0.6	C0=0.6 for square edge
transition head	0.256410256	ht = C0A0/CwL, no orifice flow calculation necessary

Outlet Structure - Standpipe	value	notes
Q25 (cfs)- from Table 2b of 2014 ECAM	**111.80**	**or could be up to 116.1 from HEC-HMS**
Q100 (cfs)- from Table 2b of 2014 ECAM	**178.40**	**or could be up to 178.5 from HEC-HMS**
Standpipe (D)	4	ft
Circular Standpipe (L)	12.57	L = PI()*D
Cw	2.6	Weir Coeff 2.6 min
head (h)	0.1	
gravitational constant	32.2	
Q (cfs)	533.9640434	Q=CwL(2gh)^3/2
cross sectional A of outlet	12.56637061	A0 = D*B
C0, orifice coeff	0.6	C0=0.6 for square edge
transition head	0.230769231	ht = C0A0/CwL, no orifice flow calculation necessary
Max pipe out OD	33.9	0.707 x ID of standpipe

Choose Rectangular Inlet Box for Pipe size of 30" (OD 36")

Manhole Sizing	value	notes
60" ID MH, Max pipe out OD	42.4	0.707 x ID of standpipe
72" ID MH, Max pipe out OD	50.9	0.707 x ID of standpipe

Use 60" Manholes for all 36" HDPE pipes since OD is 42"

Kahle Basin Outlet Structure and Overflow Sizing

Overflow Pipe from Standpipe	**value**	**notes**
CIRCULAR MANNINGS CALCULATOR FOR NON-PRESSURE FLOW		
input	value	units
depth of water (y)	2.73	ft
D (inches)	36	in
D (ft)	3	ft
R	1.5	
theta = 2arccos(R-D/R)	1.218770616	
cross sectional area (A_c)	6.753477223	ft2
wetted perimeter (P)	7.596622037	ft
Pipe slope (S)	0.015	ft/ft
hydraulic radius (R)	0.889010562	ft
conversion (C_1)	1.486	
Mannings roughness (n)	0.013	
mean velocity (v)	12.94371773	ft/s
flow (Q)	87.41510291	cfs
volume exceeds 100 year flow of 3.7 cfs at 60% full		
Check using full pipe eqn: Q = 0.0006138 x (d^8/3 x S^0.5)/n where d is in inches		
flow (Q)	**81.68**	cfs
mean velocity (v)	12.09484176	ft/s, fast!
Exit Loss (ft)	0.038645467	H = 1.0((V0^2/2g)-(Vd^2/2g))

Rock Dissipator Design - assume cohesionless soils	**value**	**notes**
length of flow	35	Calculating Scour using HEC 14
Froude number = v/(sqrt(g)*L)	0.360278406	supercritical, <3
scour time	14.7	min
Scour depth, sigma	1.87	sand,conservative
Scour depth, alpha	2.27	hec14
Scour depth, Beta	0.39	hec14
Scour depth, theta	0.06	hec14
C(h), depth	1	no drop
C(s), depth	1.03	slope ~1.5%
Rc	0.75	D/4
hs (dissipator pool depth)	6.0242698	ft, conservative
Scour length, sigma	1.87	sand,conservative
Scour length, alpha	17.1	hec14
Scour length, Beta	0.47	hec14
Scour length, theta	0.1	hec14
C(h), length	1	no drop
C(s), **depth**	1.03	slope ~1.5%
Rc	0.75	D/4
Ls (dissipator pool depth)	56.02282148	ft, conservative
Dissipator must be 6' deep by 30' long, see rock calcs for D50		
Add'l Energy Dissipation with Willow Wattles		

Could use an elliptical RCP that is equivalent of 36" round pipe		
Height, ID	29	in
Width, ID	45	in
wall thickness	4.5	in
H, OD	38	in
W, OD	54	in
W in feet	4.5	ft
Need 6' wide outlet box		

SDR 35

Max diametric deflection 7.50% http://www.jmeagle.com/sites/default/files/TB06DepthofBurialforPVC.pdf

for SD/Sewer Pipes per jmeagle specs

Use modified Iowa Equation to calc deflection			
% Deflection = 0.1(W'+P)100/(0.149(PS)+0.061E')			
W' (live load), 1' of cover		12.5	H20
W' (live load), 2' of cover		5.56	H20
W' (live load), 3' of cover		4.17	H20
P (prism load or dead load), 1' of cover		0.76	choose soil weight of 110 lbs/ft^3 - conservative
P (prism load or dead load), 2' of cover		1.53	choose soil weight of 110 lbs/ft^3 - conservative
P (prism load or dead load), 3' of cover		2.29	choose soil weight of 110 lbs/ft^3 - conservative
PS, pipe stiffness in PSI		46	for SDR 35
PS, pipe stiffness in PSI		35	for 42" ADS HDPE
E', modulus of soil reaction (PSI)		2000	for class 2 soils
SDR 35	% deflection, 1' cover	1.029072	max deflection << 7.5%
	% deflection, 2' cover	0.550235	max deflection << 7.5%
	% deflection, 3' cover	0.501343	max deflection << 7.5%
ADS HDPE	% deflection, 1' cover	1.04233	max deflection << 7.5%
	% deflection, 2' cover	0.557324	max deflection << 7.5%
	% deflection, 3' cover	0.507802	max deflection << 7.5%

min cover per Douglas County is 18" without a written certification

Rock Channel Sizing

Project: Kahle Basin
Date: 2/15/2018
Calculated by: MK

Emergency Overflow

Inputs	Value	Unit	Notes
Design Flow	174	cfs	100 year storm
XS A	85	sq ft	
q =	2.047058824	cu ft/sec ft	
Vavg	11.8	ft/sec	from overflow calculations
g	32.2	ft/sec^2	
S	0.25	ft/ft	

2. Eqns to Calculate particle size

USACE Riprap Design		
developed for:	slope (2 to 20%)	
	low unit discharge?	
D30 = (1.95S^0.555(1.3q)^(2/3))/g^1/3		
D30 =	0.18	
D50 = 1.22D50 =	0.22	
D84 = 1.5D30		
D84 =	0.26	

NRCS, 2001		
D50weir = 2 x D50riprap		
D100weir = 2 x D50weir		
D50min-weir = 0.75 x D50riprap		
D50weir =	0.43	
D100weir =	0.86	
D50min-weir =	0.32	

Isbash (1936)		
rounded stones in running water		
Dmin = V^2/(1.479g((SGs-SGw)/SQw))		
SG (spec gravity)	2.65	
C =	0.86	turbulent
Dmin =	1.77	ft

Costa (1983)		
empirical, CO front range streams		
Dmin = (Vavg/9.571)^2.05		
Dmin =	1.54	ft

Average = 0.97

County Specs dictate Class 300 Riprap, D50 = 12"

Choose Class 550 rock for both for simplicity

Rock Channel Sizing

Project: Kahle Basin
Date: 2/15/2018
Calculated by: MK

Outlet Pipe

Input	Value	Unit	Notes
Design Flow	174	cfs	100 year storm
XS A	7.06858347	sq ft	
q =	24.6159645	cu ft/sec ft	
Vavg	13	ft/sec	higher than channel calcs
g	32.2	ft/sec^2	
S	0.25	ft/ft	

2. Eqns to Calculate particle size

USACE Riprap Design		
developed for:	slope (2 to 20%)	
	low unit discharge?	
D30 = (1.95S^0.555(1.3q)^(2/3))/g^1/3		
D30 =	0.93	
D50 = 1.22D50 =	1.13	
D84 = 1.5D30		
D84 =	1.39	

NRCS, 2001		
D50weir = 2 x D50riprap		
D100weir = 2 x D50weir		
D50min-weir = 0.75 x D50riprap		
D50weir =	2.26	
D100weir =	4.52	
D50min-weir =	1.69	

Isbash (1936)		
rounded stones in running water		
Dmin = V^2/(1.479g((SGs-SGw)/SQw))		
SG (spec gravity)	2.65	
C =	0.86	turbulent
Dmin =	2.15	ft

Costa (1983)		
empirical, CO front range streams		
Dmin = (Vavg/9.571)^2.05		
Dmin =	1.87	ft

Average = 1.78

County Specs dictate Class 550 Riprap, D50 = 24"

1) Natural Resources Conservation Service. 2001. Design of Rock Weirs. Technical Notes - Engineering - No. 13, U.S. Department of Agriculture, Boise, ID. 6 pp.
2) USACE. 1994. Hydraulic Design for Flood Control Channels, EM-1110-2-1601