Technical Memorandum

To:	Colorado Department of Transportation
From:	Atkins North America, Inc.
Ref.:	I-70 Floyd Hill to Veterans Memorial Tunnels Project
Subject:	SELDM Technical Memorandum
Date:	October 20, 2020

Introduction

The Stochastic Empirical Loading and Dilution Model (SELDM) is a random process model that uses Monte Carlo methods to understand the impact of risk and uncertainty in prediction and forecasting models—in this case, to determine the effect of runoff on receiving waters. It is used primarily as a screening mechanism for environmental impacts of various projects. Its use in the Interstate 70 (I-70) Floyd Hill to Veterans Memorial Tunnels Project (Project) guides the design of water quality control measures (CMs) for treatment of constituents of concern in Clear Creek.

SELDM was chosen as the best method for guiding CM design after an evaluation of the Water Quality Model Program Decision Tree in the Colorado Department of Transportation (CDOT) *National Environmental Policy Act (NEPA) Manual*. The criteria considered when choosing SELDM were: (1) the increase in impervious surface is substantial or moderate, and (2) the Project has the potential to increase the total maximum daily load (TMDL) or impairment level of a constituent listed on the Section 303(d) list. Since the Project meets both criteria, SELDM was determined to be the most relevant water quality model to inform water quality mitigation strategies.

Additionally, the Federal Highway Administration (FHWA) recommends SELDM for Stormwater Runoff-Quality Modeling.

Project Description

CDOT and the Federal Highway Administration (FHWA) propose improvements along approximately 8 miles of the I-70 Mountain Corridor from the top of Floyd Hill through the Veterans Memorial Tunnels to the eastern edge of the City of Idaho Springs. The purpose of the Project is to improve travel time reliability, safety, and mobility, and address the deficient infrastructure through this area.

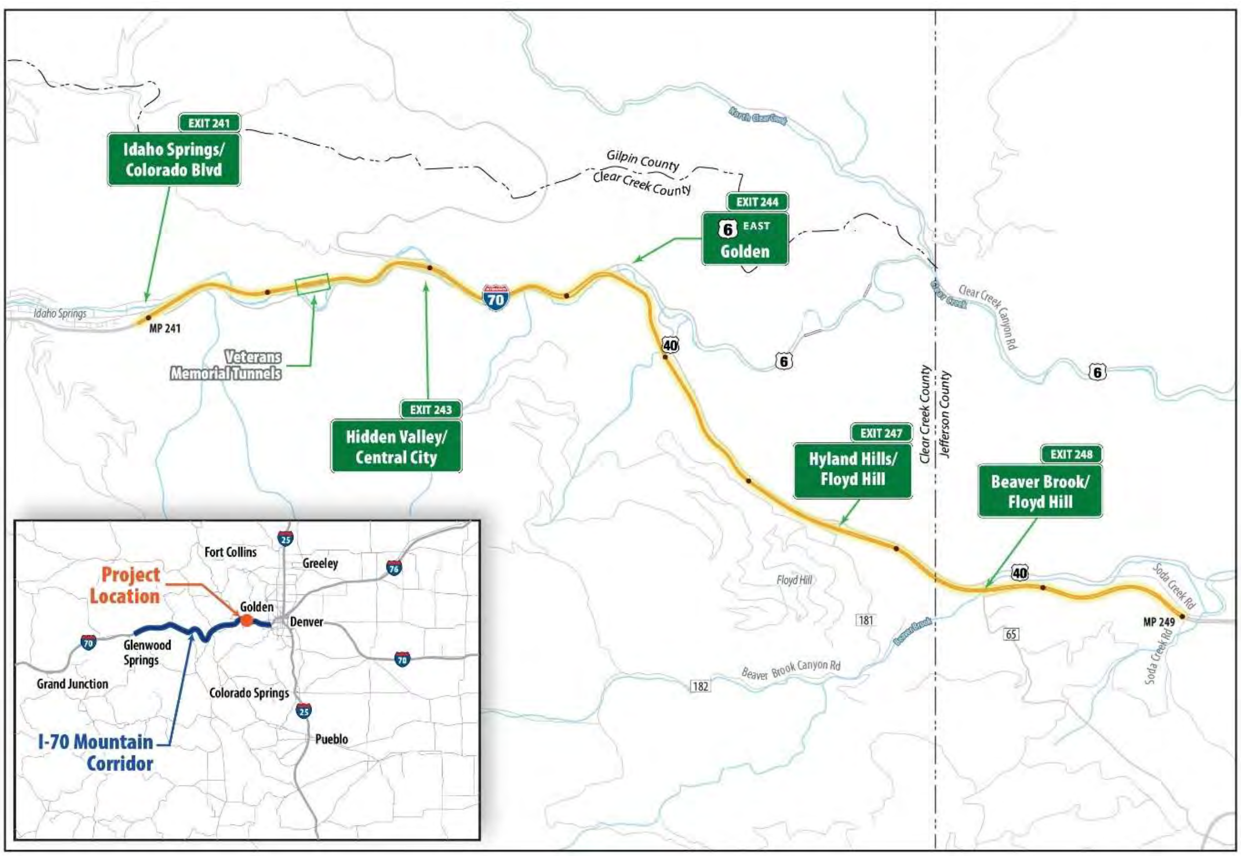
The major Project elements include:

- Adding a third westbound travel lane to the two-lane section of I-70 from the current three-lane to two-lane drop (approximately milepost (MP) 246) through the Veterans Memorial Tunnels
- Constructing a new frontage road between the U.S. Highway 6 (US 6) interchange and the Hidden Valley/Central City interchange
- Improving interchanges and intersections throughout the Project Area
- Improving design speeds and stopping sight distance on horizontal curves
- Adding an eastbound auxiliary lane to I-70 on Floyd Hill between the US 6 interchange and the Hyland Hills/Floyd Hill interchange

- Improving the multimodal trail (Clear Creek Greenway) between US 6 and the Veterans Memorial Tunnels
- Reducing animal-vehicle conflicts and improving wildlife connectivity with new and/or improved wildlife passages
- Adding a one-mile eastbound auxiliary (climbing) lane from the bottom of Floyd Hill at US 6 to the top of Floyd Hill at the Floyd Hill/Hyland Hills interchange.
- Providing two permanent air quality monitors at Floyd Hill and Idaho Springs to collect data on local air quality conditions and trends
- Coordinating rural broadband access with local communities, including providing access to conduits and fiber in the interstate right-of-way

The Project is located on I-70 between MP 249 (east of the Beaver Brook/Floyd Hill interchange) and MP 241 (Idaho Springs/Colorado Boulevard), west of the Veterans Memorial Tunnels. It is located mostly in Clear Creek County, with the eastern end in Jefferson County (see Exhibit 1). The primary roadway construction activities would occur between County Road (CR) 65 (the Beaver Brook/Floyd Hill interchange) and the western portals of the Veterans Memorial Tunnels (MP 247.6 and MP 242.3, respectively), with the Project area extended east and west to account for signing, striping, and fencing.

Exhibit 1 Project Location



Three alternatives are being evaluated in the EA: (1) No Action Alternative, (2) Tunnel Alternative (with two design options for the frontage road alignment), and (3) Canyon Viaduct Alternative. A sensitivity analysis performed on the two action alternatives, the Tunnel Alternative and the Canyon Viaduct Alternative, found that the change in imperviousness between the two action alternatives was not significant enough to warrant different SELDM models. Consequently, the Tunnel Alternative, North Frontage Road Option design was used in developing the SELDM model and is representative of both alternatives (and frontage road design options). More information on the design alternatives and the locations of CMs in each is available in the 20% Design Floyd Hill Drainage Exhibits in Attachment B.

Study Area

The Study Area is defined by the area of physical highway improvements that affect highway runoff, which stretch 6 miles from MP 247.2 (eastbound) and MP 246.8 (westbound) to the east end of the Veterans Memorial Tunnels at MP 242.35. I-70 parallels Clear Creek through the Study Area; the reach of Clear Creek that receives runoff within the Study Area runs from Doghead Rail Bridge, just south of the Veterans Memorial Tunnels, to the Albert Frei & Sons/Walstrum Quarry.

The Study Area is located within Clear Creek Canyon. This area has extremely steep grades with slopes steeper than 1:1 and even sheer cliffs. The grade of Clear Creek through the Study Area ranges between 1 percent and 2 percent. The roadways that contribute runoff to Clear Creek within the Study Area include I-70, US 6, Central City Parkway, and CR 314, as well as several miles of residential roads on Saddleback Mountain. See Exhibit 2 for preliminary offsite watersheds.

The Project is not within CDOT's or Clear Creek County's Municipal Separate Storm Sewer System (MS4) Permit area; therefore, water quality measures are not required. However, the Stream and Wetland Ecological Enhancement Program (SWEEP) Memorandum of Understanding, signed in 2011, designated a commitment to improve stream health along the I-70 Mountain Corridor with future transportation-related projects. To that end, the *I-70 Clear Creek Corridor Sediment Control Action Plan* (SCAP) was completed in 2014 and provides recommended CMs and locations along the corridor where CDOT committed to improve stream health (CDOT, 2013). The results of the SELDM analysis were used to inform the conceptual water quality CMs with a focus on treating pollutants of concern and on sediment runoff control.

SELDM uses a predefined hydrologic, water quality, and stream data based on the regional inputs and the nearby sites. The coordinates used for SELDM are longitude 39.744401, latitude -105.47315, which is at the west end of the Project in Clear Creek. Regional inputs determine precipitation, pre-storm flow, and water quality and is based on the ecoregion as defined by the U.S. Environmental Protection Agency (EPA) Level III Ecoregions. The ecoregion was determined from the to be 21: Southern Rockies. A map showing the study area in relation to the ecoregion and MS4 permit boundary area is shown in Exhibit 3.

Exhibit 2 Offsite Watersheds

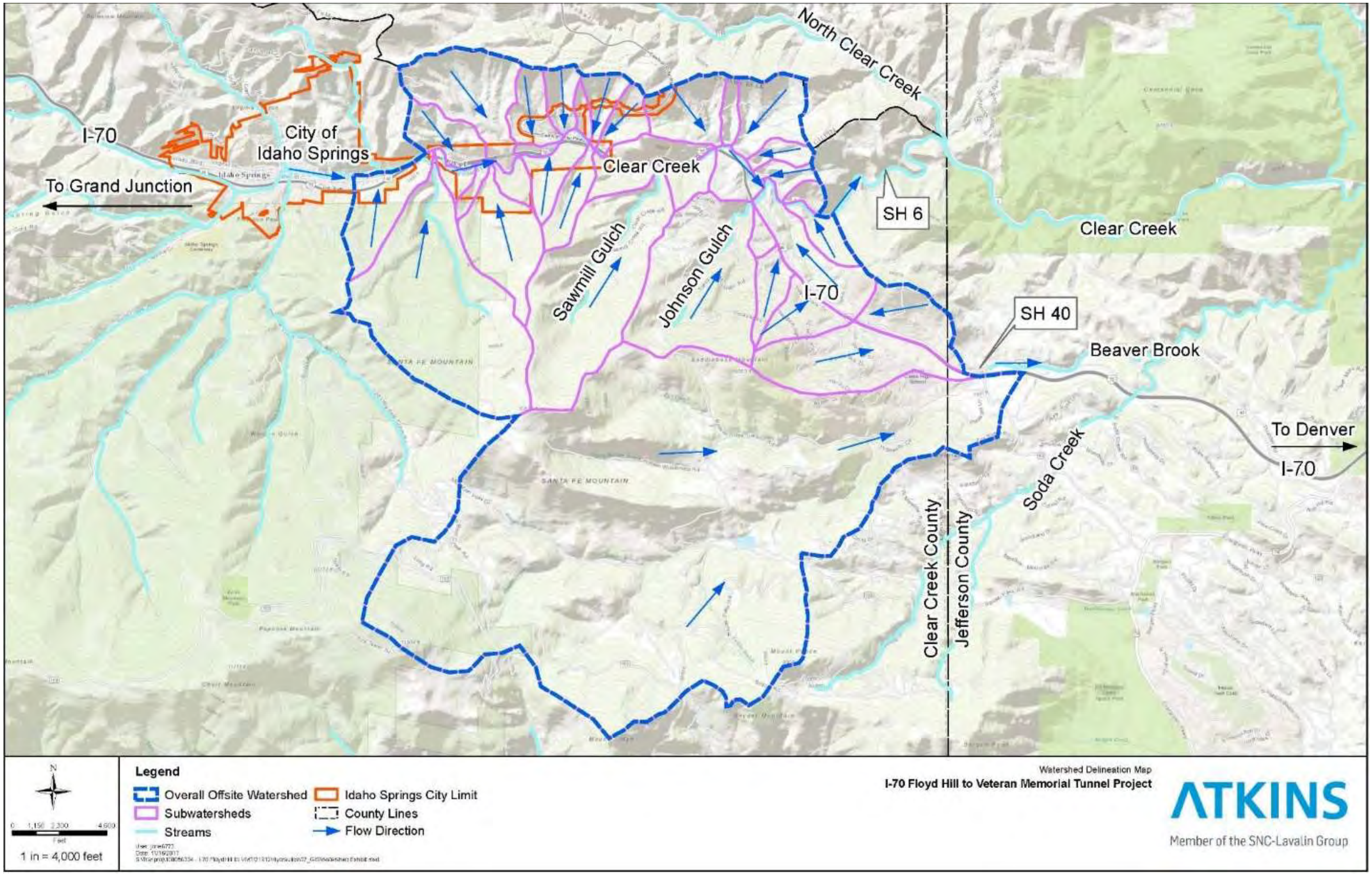
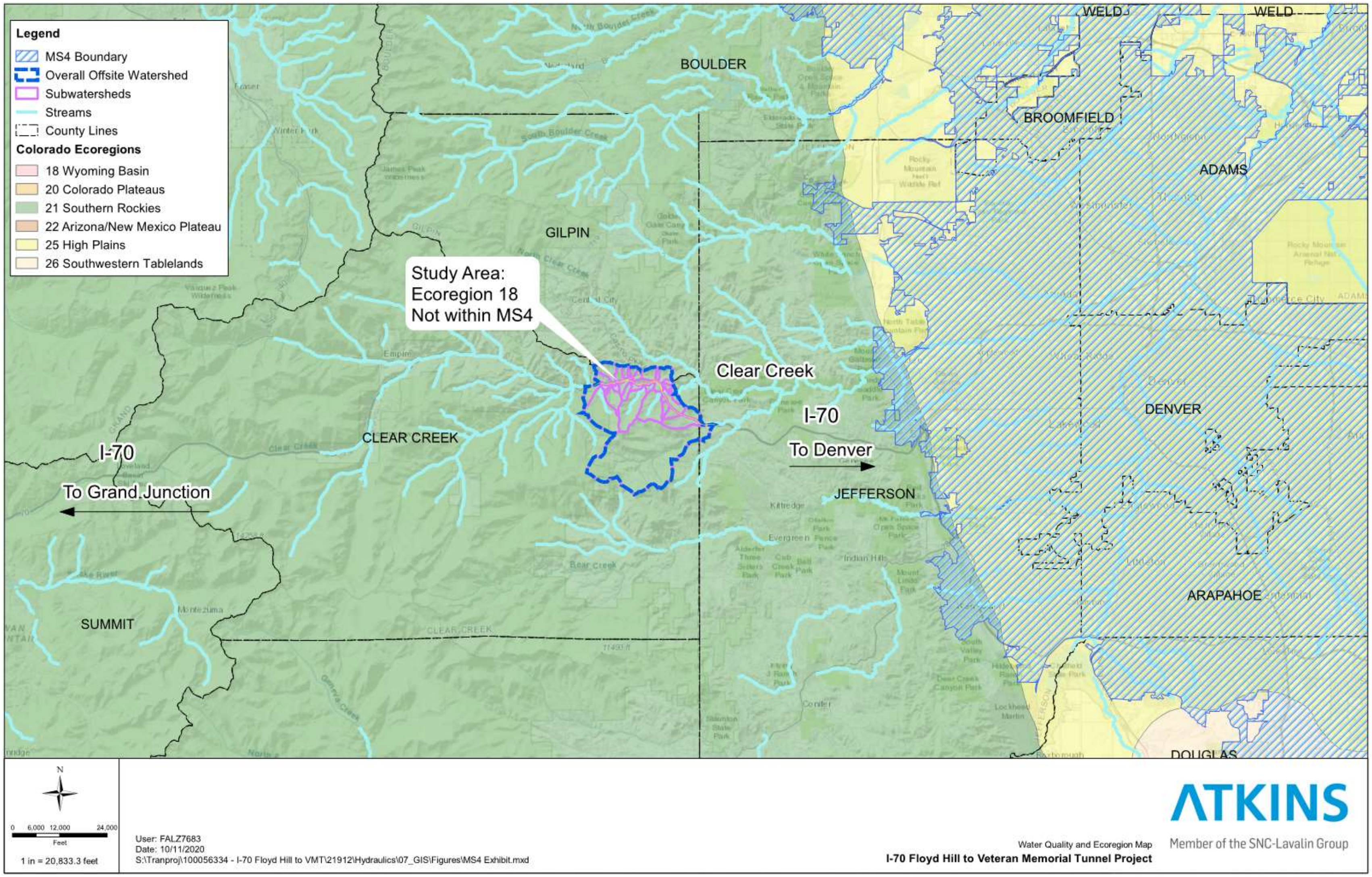


Exhibit 3 MS4 Boundary and EPA Level III Ecoregions of Colorado Map



Maintenance Practices

Two CDOT maintenance issues emerged between the completion of the SCAP and the development of the Floyd Hill Project: traction sand use for winter maintenance and hydrodynamic separators as a water quality CM. Traction sand used in the winter months was revealed to have a major environmental impact in the Project Area. At this time, CDOT is not applying traction sand in the Project Area, and it has been replaced with deicing agent. CDOT Maintenance applies de-icing agent in two ways: as ice slicer (in tons) and as liquid deicer (in gallons). Although CDOT provided data on the amounts of deicing agent used in the winter, without winter storm event data, the deicing agent data could not be used for SELDM modeling purposes.

Additionally, CDOT Maintenance requested that hydrodynamic separators not be used on future projects to remove sediments and pollutants from stormwater runoff because of their difficulty to maintain. CDOT Maintenance prefers to use extended detention basins (EDBs) and vegetated swales to perform these removal functions. Currently, existing hydrodynamic separators installed during other projects are in use and maintained.

Agency Coordination

Several interagency meetings were held during the planning and preliminary design stages of the Project regarding water quality. The water quality approach, including the results of SELDM, were presented to the Project's SWEEP Issue Task Force (ITF). The SWEEP ITF meetings were used to help seek feedback and approval on the water quality approach for the Project. Exhibit 4 details the date and agency representation for each of the SWEEP meetings.

Exhibit 4 Project SWEEP ITF Meetings

Meeting	Meeting Date	List of Agency Representation
SWEEP ITF Meeting (SWEEP Meeting No. 1)	April 17, 2018	• U.S Fish and Wildlife Service (USFWS) • CDOT Headquarters • CDOT Region 1 • EPA Region 8 • Colorado Parks and Wildlife (CPW) • Colorado Department of Public Health and Environment (CDPHE) • Colorado Technical University (CTU) • Clear Creek County • Clear Creek Water Foundation • Atkins • Pinyon Environmental
SWEEP ITF Meeting #2	October 25, 2018	• USFWS • CDOT Headquarters • CDOT Region 1 • EPA Region 8 • CPW • CDPHE • CTU • Clear Creek County • Clear Creek Water Foundation • Atkins • Peak Consulting Group • Pinyon Environmental
SWEEP ITF Meeting #3	May 14, 2020	• U.S. Forest Service (USFS) • U.S. Army Corps of Engineers (USACE) • USFWS • CDOT • EPA • Federal Highway Administration (FHWA) • CPW • CDPHE • Clear Creek County • City of Black Hawk • Trout Unlimited • Upper Clear Creek Watershed Association • Atkins • Pinyon Environmental • Peak Consulting Group • THK and Associates

Meeting notes for all three SWEEP meetings can be found in Attachment C.

Methodology and Model Development

Methodology

SELDM is used to evaluate impacts of runoff within the Project corridor along Clear Creek and inform water quality mitigation strategies. The water quality considerations include: (1) the change in impervious surface within the highway site, and (2) the change the constituent loading to receiving waters. For the highway site, SELDM modeling considered the existing conditions as well as the proposed Tunnel Alternative (North Frontage Road Option) design. For stream health, SELDM modeling used water quality statistics based on stream monitoring data. For water quality mitigation, the analysis considered three options: (1) no water quality CMs, use of (2) ponds and the use of (3) swales as the proposed water quality CMs.

SELDM does not have the capability of modeling several CMs in combination with each other. Therefore, SELDM results for each CM is used to inform the Project's water quality mitigation strategy based on a comparison of the level of reduction each CM has on specific constituents of concern for each section of the Project. The CM type should be proposed at appropriate locations along the Project to best improve stream health.

Model Conditions

Exhibit 5 shows the four conditions analyzed in SELDM.

Exhibit 5 SELDM Conditions

SELDM Run	SELDM Condition	Water Quality CMs
1	Existing Conditions	No CMs
2	Proposed Alternative	No CMs
3	Proposed Alternative	Water Quality Ponds
4	Proposed Alternative	Water Quality Swales

Existing Conditions

The Existing Conditions—No CMs scenario was created as a baseline existing conditions model to determine the differences the proposed designs would make. No CMs were used as a baseline because it best represented existing conditions across the Project limits. Even though there are existing sediment traps along the Project, they do not represent the entire Project corridor. Two additional scenarios were considered, but not used, when designing the Existing Conditions:

- The first scenario was running the model using the two existing sediment traps. Because the sediment traps only treat a small portion of highway runoff, this scenario was not used.
- The second scenario, CM treatment statistics, was adjusted using weighted averages so that one-fifth of the area would be treated by the sediment traps and four-fifths would go untreated. The "treated" statistics came from Granato (2014) and the "untreated" statistics came from the Clear Creek streamflow constituent data. Due to differences in Clear Creek data and the CM statistics from Granato (2014), the minimum irreducible concentration—a measure of CM effectiveness—was lower for some constituents in the one-fifth model than the fully effective model. Since this scenario could not work for all constituents, it was ruled out as well.

Proposed Conditions

Three proposed conditions scenarios were created to analysis the difference between water quality CMs:

- Proposed-No CMs - Scenario provides a baseline of impacts that the Project creates when compared to existing conditions.
- Proposed with CMs – Two CMs which are the most likely to be designed for the Project and used in the analysis to compare the treatment effectiveness for various pollutants.
    - Proposed with Swale
    - Proposed with Pond

The analysis of proposed conditions did not include other CMs such as constructed wetlands, infiltration ponds, and bioretention. These CMs are not preferred by CDOT maintenance and would require maintenance access and additional right-of-way along the Project corridor.

Model Source Data

Several sources were used for the SELDM input data and analysis. Constituents analyzed included a combination Clear Creek's EPA Section 303(d) listed impairment constituents, and the SWEEP committee recommended constituents. Clear Creek has a 303(d) listed impairment for temperature, but it was not considered as part of the SELDM analysis. Clear Creek constituent data was collected at two stations: (1) CC-3, located east of the Twin Tunnels in the West Section of the Project, and (2) CC-4, located above Johnson Gulch in the East Section of the Project.

CM performance data includes water quality and hydraulic parameters. All constituents, with the exception of chloride, used CM performance statistics found in the *Statistics for Stochastic Modeling of Volume Reduction, Hydrograph Extension, and Water-Quality Treatment by Structural Stormwater Runoff Best Management Practices (BMPs) (*Granato, 2014) which provides SELDM-specific input data for each constituent, based on empirical data. CM performance statistics related to chloride was developed based on the National Cooperative Highway Research Program (NCHRP) *Synthesis 449—Strategies to Mitigate the Impacts of Chloride Roadway Deicers on the Natural Environment* (NCHRP, 2013). However, the NCHRP report does not contain empirical data for the treatment of chlorides, so assumptions were drawn based on relative effectiveness for CMs. CM performance data is discussed further in the CMs section.

Exhibit 6 shows how source data was used in SELDM.

Exhibit 6 SELDM Source Data

Source	SELDM Analysis

Waterbody Report (EPA, 2016)	• Constituent Selection (based on Section 303(d) listed impairment
	  ○ Cadmium
	  ○ Lead
	  ○ Zinc

Project Stakeholders	• Constituent Selection (based on Agency Coordination)
	  ○ Chloride
	  ○ Copper
	  ○ Sediment
	• CM Selection
	  ○ Water Quality Pond
	  ○ Water Quality Swale

Project Data	• Project location (latitude and longitude) • EPA Ecoregion • Highway site characteristics • Upstream Basin characteristics
SELDM regional database	• Hydrograph recession statistics • Rain zone / Storm Event statistics • Streamflow statistics (based on Ecoregion) • Runoff coefficients for Highway Site • Runoff coefficients for Upstream Basin • Clear Creek constituent statistics[1]
Clear Creek Data – CDOT Twin Tunnels Database for Station CC-3 and CC-4 (2012-2019)	• Clear Creek constituent statistics
Granato (2014) Report	• CM Water Quality Parameters • CM Hydraulic Parameters
NCHRP (2013) Report	• CM Water Quality Parameters for Chlorides • CM Hydraulic Parameters for Chlorides

[1]Used regional data for constituents when Clear Creek sample data was not applicable.

Model Development

Hydrograph Recession Factors

Regional data values were used for hydrograph recession factors to determine the proportion of upstream storm flow that reaches the highway discharge point while the highway site is contributing storm discharge. These values appropriately define a range of triangular storm event hydrographs when compared to Clear Creek and surrounding area hydrography. The following values were derived from SELDM regional database using the Project location data and were used for all SELDM conditions:

- Recommended minimum factor = 1
- Most probable value = 1.85
- Maximum = 4.4

Highway Site and Upstream Basin Characteristics

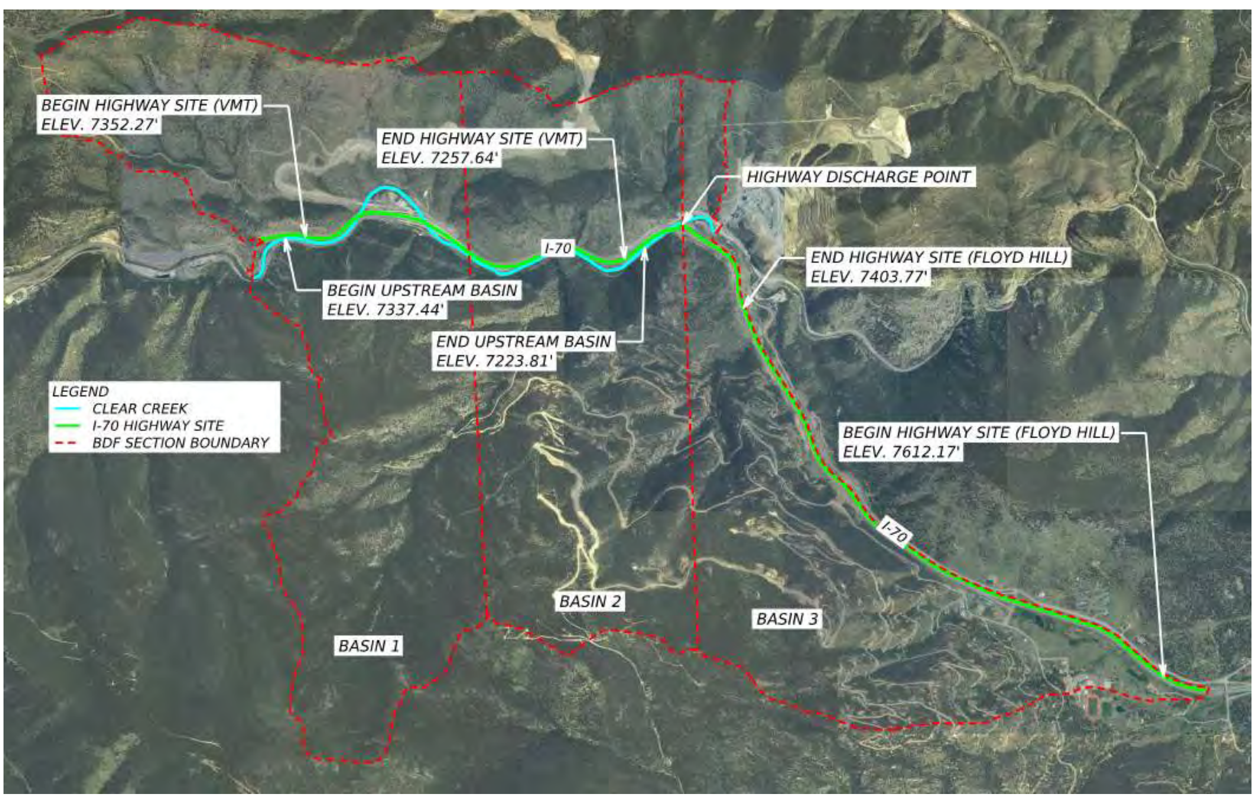
SELDM uses highway site characteristics and upstream basin characteristics to model the environment. Proposed improvements occur along the interstate; therefore, the upstream basin characteristics remain the same for both conditions. The analysis reflects stream impacts as they relate to the change in roadway runoff between existing and proposed conditions. The highway site for the Project is all the area contributing highway runoff to Clear Creek upstream from the highway discharge point. The upstream basin is all the area that contributes pre-storm streamflow and stormwater runoff to Clear Creek upstream of the highway discharge point, excluding the highway site area. In SELDM, highway site and upstream basin characteristics use the same input parameters which include:

- Drainage Area (sq. mi)
- Drainage Length (ft)
- Mean Basin Slope (ft/mi)
- Impervious Fraction
- Basin Development Factor (BDF)

To calculate the highway site drainage length, the length upstream of the highway discharge point to the Veterans Memorial Tunnels and the length between the highway discharge point and the top of Floyd Hill were added, since both sections run off to the discharge point. The mean basin slope was calculated by determining the slope of the same distances, using 10 percent and 85 percent of the drainage length, as per SELDM recommendations, and averaging them. The upstream basin drainage length was measured along Clear Creek from Doghead Rail Bridge to the highway discharge point. The mean basin slope was calculated using 10 percent and 85 percent of the drainage length.

Exhibit 87 shows Highway Site and Upstream Basin.

Exhibit 7 Highway Site and Upstream Basin



The BDF for both highway site and upstream basin was calculated based on SELDM guidelines. The guidelines recommend dividing the basin into three parts, then assigning each section a code of 0 or 1 for four characteristics, resulting in 12 codes. The sum of the codes yields the BDF. The codes are assigned for channel improvements, channel linings, storm drains or storm sewers, and curb-and-gutter streets. See Attachment A for detailed highway site and upstream basin characteristic descriptions.

Water Quality Statistics

Both CDOT data and regional data generated by the SELDM database were used for the model and compared in the Results section. For CDOT data, the storm event data collected between 2012 and 2019 and reported in the *CDOT Twin Tunnels Clear Creek Database Report* were used to generate the highway random constituent concentrations. The Database Report provided both ambient data and storm event data for Clear Creek constituents. To determine the highway runoff concentrations for each constituent, the mean concentration was found for both the ambient and the storm event datasets, then the ambient mean was subtracted from the storm event mean. Since the values in the datasets were statistically independent from one another (there were twice as many values in the ambient dataset as the storm event dataset and there were no points in one dataset that were taken on the same day as the other dataset), the highway runoff standard deviation was determined by finding the variance of each dataset, adding them, then finding the square root of the sum. The skew was determined by finding the skew of both datasets, then using the larger one.

Exhibit 8 shows Clear Creek constituent data.

Exhibit 8 Clear Creek Constituent Statistics

	TSS	Chloride	Cadmium	Copper	Lead	Zinc
Mean (mg/L)	767.58	11.94	0.01	0.16	0.68	0.53
Std. Dev. (mg/L)	1,511.14	13.98	0.03	0.23	1.28	0.63
Skew Coefficient	6.35	2.86	6.12	3.81	3.70	2.67

Exhibit 89 shows SELDM regional database constituent data.

Exhibit 9 SELDM Regional Database Constituent Statistics

	TSS	Chloride	Cadmium	Copper	Lead	Zinc
Mean (mg/L)	40.93	N/A	0.243	26.92	8.73	123.03
Std. Dev. (mg/L)	3.436	N/A	2.99	2.388	3.18	2.55
Skew Coefficient	1.43	N/A	5.78	1.055	1.603	2.28

Compared to the Clear Creek data, the SELDM regional data shows a much higher concentration of Cadmium, Copper, and Zinc in the waterbody than was measured in Clear Creek. The sediment (TSS) and chloride concentrations are measured higher in Clear Creek than SELDM regional data.

The significant standard deviation and skew for sediment (TSS) concentration in the Clear Creek data is due to the large discrepancy in concentration for each storm event record, with a minimum value of 50 mg/L and a maximum value of 11,300 mg/L. To measure suspended solids, SELDM recommends using the suspended sediment concentration (SSC), which is calculated based on an equation using total suspended solids (TSS), because the SSC empirical results are often more reliable than TSS results. However, it is only possible to use SSC when using the TSS values from regional data. Since the model was run using CDOT data for TSS, SSC was not used.

It is generally more appropriate to use the measured data than the SELDM regional data. However, the analysis will be comparing existing and proposed conditions so the most reasonable dataset will be used for each constituent.

Since the purpose of the SELDM model is to determine the effects of runoff from the highway, only highway random constituents were selected. No constituents for upstream random, upstream transport curve, upstream dependent, or downstream pairs were selected.

Model Inputs

To create the model, the base scenarios Existing Conditions—No CMs and Proposed Alternative—No CMs were built. Then, the proposed analyses using CMs were created by copying the base proposed analysis and adding CMs.

Existing Conditions Model User Inputs

The drainage area characteristics, made up of the highway site and the upstream basin, were determined using the existing survey and model files. Highway site areas were pulled from shapes created by roadway linework. The highway site area is made up of all the highway area, within the Project and offsite, that contributes runoff to Clear Creek within the Project limits and includes sections of I-70, US 6, Central City Parkway, and CR 314. The total combined area is 105.18 acres (0.16 square miles [sq. mi.]). I-70 contributes 78.63 acres, Central City Parkway contributes 19.13 acres, US 6 contributes 3.41 acres, and CR 314 contributes 4.00 acres. Residential roads on Saddleback Mountain were not included in the highway site.

The drainage length is 28,875.74 ft and the mean basin slope is 71.27 ft/mile (1.6 percent). The impervious fraction was determined to be 0.9, assuming that all highway surfaces included were impervious but some of Central City Parkway (an estimated 10 percent of total impervious area) runs off to adjacent pervious area. The BDF was calculated based on the upper two thirds of the Project having channel improvements but no sections meeting the requirements for impervious channel linings, maintained storm drains, or curb-and-gutter, resulting in a BDF of 2.

Exhibit 8 shows Existing Conditions Basin Development Factor.

Exhibit 10 Existing Conditions Basin Development Factor

Basin	Channel Improvements	Channel Lining	Storm Drains	Curb-and-Gutter Streets	Basin Development Factor
Section 1	1	0	0	0	1
Section 2	1	0	0	0	1
Section 3	0	0	0	0	0
Existing Condition BDF					2

To determine the total existing upstream basin drainage area, drainage areas used to compute runoff to roadways for storm drain design were modified to include all areas that would contribute runoff to Clear Creek within the Project limits, excluding highways. The total area was 7.46 square miles, the drainage length was 13,970.51 feet, and the mean basin slope was 57.26 ft/mile (1.1 percent). The impervious fraction was determined to be 0.03, calculated by dividing the total impervious area that is not highway area by the total upstream basin area. The BDF calculation was the same between highway site and upstream basin, so the BDF was also 2. These values area summarized in Exhibit 11.

Exhibit 11 Existing Conditions Highway Site and Upstream Basin Inputs

Scenario	Drainage Area (sq. mi.)	Drainage Length (ft)	Mean Basin Slope (ft/mi)	Impervious Fraction	Basin Development Factor
Highway Site	0.16	28,875.74	71.27	0.90	2
Upstream Basin	7.46	13,970.51	57.26	0.03	2

Proposed Alternative Model User Inputs

The drainage area boundaries remained the same from the Existing Conditions scenario to the Proposed Alternative scenario. Roadway design files from the Project were used to redraw the highway site and upstream basin areas to match the proposed design. When delineating the highway site, CR 314 and US 6 were combined. Together, they contribute 12.42 acres, I-70 contributes 93.20 acres, and Central City Parkway contributes 19.15 acres. The total proposed highway site area is 124.77 acres (0.195 sq. mi.), an increase of 19.57 acres compared to the Existing Conditions scenario. The drainage length is 28,692.79 feet and the mean basin slope is 71.27 feet/mile (1.6 percent), both using the I-70 eastbound lanes and not the westbound lanes through the tunnel. The impervious fraction remained at 0.9, due to all highway surfaces being impervious but some of Central City Parkway (an estimated 10 percent of total impervious area) runoff going to adjacent pervious area. The BDF increased to 5 as a result of storm drains and ponds being added in all three sections of the Project, in addition to two-thirds of the Project having channel improvements.

Exhibit 12 shows Proposed Conditions Basin Development Factor.

Exhibit 12 Proposed Conditions Basin Development Factor

Basin	Channel Improvements	Channel Lining	Storm Drains	Curb-and-Gutter Streets	Basin Development Factor
Section 1	1	0	1	0	2
Section 2	1	0	1	0	2
Section 3	0	0	1	0	1
Proposed Condition BDF					5

The total upstream basin area is 7.44 square miles, the drainage length is 13,970.51 feet, and the mean basin slope is 57.26 feet per mile (1.1 percent). The impervious fraction was determined to be 0.03, calculated by dividing the total impervious area that is not highway area by the total upstream basin area. The BDF calculation is the same between highway site and upstream basin, so the BDF is also 5. The highway site and upstream basin input values are summarized in Exhibit 13.

Exhibit 13 Proposed Conditions Highway Site and Upstream Basin Inputs

Scenario	Drainage Area (sq. mi.)	Drainage Length (ft)	Mean basin Slope (ft/mi)	Impervious Fraction	Basin Development Factor
Highway Site	0.20	28,692.79	71.27	0.90	5
Upstream Basin	7.44	13,970.51	57.26	0.03	5

CMs

Statistics and Pollutant Removal Efficiencies

The Granato (2014) report provides hydraulic statistics and water quality parameters related to various CMs and constituents. This report is used for all constituents of concern in the analysis except for chloride. The study does not have water quality parameters for chloride. The chloride water quality parameters chosen for this analysis were sourced from the NCHRP report. The NCHRP report does not offer empirical data on the water quality parameters for chloride. The parameters were based on a rating of structural CM removal of dissolved pollutants, with dry ponds having a rating of "N/A" and vegetated swales having a rating of "Low." Exhibit 14 and Exhibit 15 shows correlation made between the NCHRP report CM ratings and the pond and swale performance parameters for the treatment of chloride.

Exhibit 14 Chloride Treatment - Pond CM Performance

CM	Chloride (Cl-)	Removal of Dissolved Pollutant Rank	Comments
Min Irreducible Concentration (mg/l)	10		Ambient concentration (CC-4)
Outflow to Inflow Concentration (MPV)		N/A	0-2% reduction in concentration attributed due to the removal rank of N/A
Min	0.98	N/A	
Lower MPV	0.99	N/A	
Upper MPV	1	N/A	
Max	2.5	N/A	Accounts for constituent build up in pond over time
Rank Correlation	-0.3		Moderate correlation chosen similar to behavior of other dissolved constituents

Exhibit 15 Chloride Treatment - Swale[1] CM Performance

CM	Chloride (Cl-)	Removal of Dissolved Pollutant Rank	Comments
Min Irreducible Concentration (mg/l)	10		Ambient concentration (CC-4)
Outflow to Inflow Concentration (MPV)		Low	12-20% reduction in concentration attributed due to the removal rank of Low
Min	0.8	Low	
Lower MPV	0.82	Low	
Upper MPV	0.88	Low	
Max	1.2	Low	Assumes minor amounts of constituent build up in swale
Rank Correlation	-0.5		Moderate correlation chosen similar to behavior of other dissolved constituents

[1]Note from NCHRP report: Check dams improve performance.

Extended Detention Basins

The Proposed Alternative—Ponds scenario has ponds along the length of I-70 within the Project that treat all constituents of concern. There are five ponds, one located west of the Hidden Valley/Central City interchange, one located east of the Hidden Valley/Central City interchange, one at the west bend of I-70, one at the east bend of I-70, and one at the Albert Frei & Sons/Walstrum Quarry. (The Canyon Viaduct Alternative ponds are similarly located to the Tunnel Alternative ponds so a separate SELDM analysis was not performed). See the 20% Design Floyd Hill Drainage Exhibits in Attachment B for pond details. Pond effectiveness statistics were referenced from Tables 2 and 3 in Granato (2014). Exhibit 16 shows the pond hydraulics statistics and Exhibit 17 shows the water quality parameters.

Exhibit 16 SELDM Pond Hydraulics Statistics

	CM Runoff Volume Reduction	CM Hydrograph Extension
Min Ratio[1]	0.147	0.0
Lower Ratio MPV[2]	0.147	0.0
Upper Ratio MPV	0.660	0.0
Max Ratio	1.232	18.0
Rank Correlation[3]	0.070	0.5

[1]The ratio of CM outflow to inflow
[2]MPV = Most Probable Value
[3] The rank correlation defines the relation between the volume of inflow and the volume reduction ratio

Exhibit 17 SELDM Pond Water Quality Parameters

	Chloride (Cl-)	Sediments (TSS)	Cadmium (Cd)	Copper (Cu)	Lead (Pb)	Zinc (Zn)
Min Irreducible Concentration (mg/l)	10.00	2.20	0.08	3.50	1.10	13.00
Min Ratio[1]	0.98	0.06	0.20	0.15	0.06	0.06
Lower Ratio MPV[2]	0.99	0.07	0.44	0.42	0.28	0.10
Upper Ratio MPV	1.00	0.11	0.57	0.63	0.34	0.21
Max Ratio	2.50	1.68	1.76	1.22	1.17	1.07
Rank Correlation[3]	-0.30	-0.51	-0.47	-0.37	-0.29	-0.56

[1]The ratio of CM outflow to inflow
[2]MPV = Most Probable Value
[3]The rank correlation defines the relation between the inflow concentration and the water-quality treatment parameters

Vegetated Swales

The Proposed Alternative—Swales scenario uses vegetated swales to treat stormwater runoff. While vegetated swales would not be treating the entirety of the Project, the CM input form in SELDM can only assume that all runoff is treated by the CM, so—to understand the effectiveness of vegetated swales—a separate model had to be run using swales exclusively. See the 20% Design Floyd Hill Drainage Exhibits in Attachment B for details on vegetated swale locations.

Vegetated swale effectiveness statistics were referenced from Tables 2 and 3 in Granato (2014). Exhibit 18 shows the swale hydraulics statistics and Exhibit 19 shows the swale water quality parameters.

Exhibit 18 SELDM Swale Hydraulics Statistics

	CM Runoff Volume Reduction	CM Hydrograph Extension
Min Ratio[1]	0.060	0.0
Lower Ratio MPV[2]	0.306	0.0
Upper Ratio MPV	0.495	0.0
Max Ratio	1.085	3.0
Rank Correlation[3]	0.290	0.4

[1]The ratio of CM outflow to inflow
[2]MPV = Most Probable Value
[3] The rank correlation defines the relation between the volume of inflow and the volume reduction ratio

Exhibit 19 SELDM Swale Water Quality Parameters

	Chloride (Cl-)	Sediments (TSS)	Cadmium (Cd)	Copper (Cu)	Lead (Pb)	Zinc (Zn)
Min Irreducible Concentration (mg/l)	10.00	2.60	0.10	3.30	0.87	5.10
Min Ratio[1]	0.80	0.00	0.02	0.07	0.00	0.11
Lower Ratio MPV[2]	0.82	0.02	0.08	0.13	0.09	0.17
Upper Ratio MPV	0.88	0.21	0.09	0.63	0.14	0.18
Max Ratio	1.20	1.97	0.58	1.47	2.00	1.05
Rank Correlation[3]	-0.50[4]	-0.50	-0.50[4]	-0.58	-0.52	-0.34

[1]The ratio of CM outflow to inflow
[2]MPV = Most Probable Value
[3] The rank correlation defines the relation between the inflow concentration and the water-quality treatment parameters
[4]Estimated based on constituent behavior

SELDM Limitations

For all the modeling conditions, there are some limitations with SELDM:

- Routing all treatment through one CM: Although the Project is proposing multiple CMs in the Project corridor, SELDM can only interpret one CM. This limitation would not allow for analysis at each point discharge into Clear Creek. Even with this limitation, SELDM proves beneficial by providing a comparison of CM performance based on the total Project.
- Chlorides: Currently, there is minimal research and data providing guidance on collection and treatment of chlorides. Research has found that chlorides cannot be treated easily using typical water quality CMs because they are dissolved in water and do not settle. Overall, CDOT maintains the goal to slow down the release of chlorides by using plant uptake, check dams, and detention, along with providing opportunities to dilute with offsite runoff. Based on the assumed inputs, the analysis supports interpreted research, warranting more dilution along heavily concentrated de-icing agent areas. However, this limitation on chlorides is not exclusive to SELDM.
- Roadway emphasis: As noted earlier, project improvements only impact the roadway corridor. As a result, the modeling concentrated on highway site, as the upstream watershed had no modifications. Therefore, the modeling only reports the impacts of roadway improvements. Upstream and offsite elements such as past mining activities and sedimentation are not captured in constituents or treatment. The analysis only considers and provides results of the increased impervious area and resulting maintenance activities because of the roadway improvements. Within the framework of the Project improvements, SELDM summarizes the differences between pre and post projects that are aligned with engineers' assumptions.

Other CM Considerations

Research shows swales and ponds have a limited impact on the treatment of dissolved pollutants such as chlorides. Constructed wetlands, infiltration, and bioretention may provide a higher concentration reduction for chlorides and should be considered as the Project progresses. Should these be considered, the designer must coordinate with:

- CDOT Environmental Staff: To determine appropriate media, seeding plan, etc.
- CDOT Maintenance Staff: To determine if expertise and equipment is available
- CDOT ROW: To determine if additional ROW may be required
- Intergovernmental Agreement (IGA) with Clear Creek County depending on CM and offsite treatment.
- Future master planning of the area

Additionally, SELDM does not account for site constrained areas of the Project, of which the runoff cannot be routed to a CM. For site constrained areas, riprap aprons should be considered in areas under bridges or in concentrated flow paths to avoid direct discharge of pollutants to Clear Creek.

Results

SELDM outputs Highway Runoff-Quality results into a text file with a table for each constituent in the analysis. SELDM uses Monte Carlo methods to produce random combinations of input variables, which produces a stochastic population of results based on possible inputs. As a result, each constituent in each of the four output files has almost 1,200 possible events.

To analyze the data, the discharge load (the runoff load discharged to the stream during the event, in pounds) for each constituent in each scenario was averaged. This was done twice, once using the SELDM database highway random constituent data, shown in Exhibit 20, and once using the CDOT Clear Creek Report data, shown in Exhibit 21, along with the 95-percent confidence interval for each dataset.

Exhibit 20 Discharge Load and Confidence Intervals (source: SELDM regional database)

Constituent	Existing No CM (lb)	95% CI	Proposed No CM (lb)	95% CI	Proposed with Pond (lb)	95% CI	Proposed with Swale (lb)	95% CI
TSS	678.29	113.96	804.66	135.20	430.79	66.40	429.61	68.48
SSC	1,432.99	315.99	1,699.75	374.82	321.34	51.54	340.29	59.49
Cl	71.28	5.33	85.20	6.70	72.80	5.97	57.07	4.41
Cd	0.00360	0.0006	0.00427	0.00071	0.00188	0.00054	0.00069	0.00016
Cu	0.264	0.021	0.313	0.025	0.101	0.010	0.083	0.008
Pb	0.133	0.022	0.158	0.026	0.049	0.020	0.050	0.019
Zn	1.489	0.200	1.767	0.238	0.941	0.122	0.927	0.128

Exhibit 21 Discharge Load and Confidence Intervals (source: CDOT Clear Creek Report 2012-2018)

Constituent	Existing No CM (lb)	95% CI	Proposed No CM (lb)	95% CI	Proposed with Pond (lb)	95% CI	Proposed with Swale (lb)	95% CI
TSS	5,462.47	815.53	6,552.07	976.59	1,493.05	220.33	1,581.47	238.31
Cl	81.93	8.12	98.26	9.18	87.64	7.67	66.76	5.65
Cd	7.27E-05	1.40E-05	7.83E-05	1.38E-05	3.81E-04	2.19E-05	4.66E-04	2.82E-05
Cu	0.0011	0.00011	0.0014	0.00016	0.016	0.00093	0.015	0.00093
Pb	0.00541	0.00073	0.0064	0.00095	0.0056	0.00042	0.0045	0.00037
Zn	0.0038	0.0004	0.0044	0.0004	0.0612	0.0035	0.0238	0.0014

The best analysis of the Project’s water quality impact to Clear Creek is to compare the Existing Conditions SELDM results to the results of the Proposed Conditions with the three CM options, No CMs, Pond, and Swale. The following exhibits present this comparison as a percentage change in constituent concentration. Exhibit 22 compares the constituent loads discharged to Clear Creek based on the SELDM regional database data, and Exhibit 23 compares the constituent loads discharged to Clear Creek based on CDOT Clear Creek data.

Exhibit 22 Percent Changes between Analyses (source: SELDM regional database)

Constituent	% Change from Existing No CM			% Change from Proposed No CM	
	Proposed No CM	Proposed with Pond	Proposed with Swale	Proposed with Pond	Proposed with Swale
TSS	18.63%	-36.49%	-36.66%	-46.46%	-46.61%
SSC	18.62%	-77.58%	-76.25%	-81.10%	-79.98%
Cl	19.52%	2.14%	-19.93%	-14.55%	-33.01%
Cd	18.64%	-47.86%	-80.90%	-56.05%	-83.90%
Cu	18.65%	-61.61%	-68.49%	-67.65%	-73.45%
Pb	18.59%	-63.34%	-62.11%	-69.09%	-68.05%
Zn	18.64%	-36.83%	-37.73%	-46.75%	-47.51%

Exhibit 23 Percent Changes between Analyses (source: CDOT Clear Creek Report 2012-2018)

Constituent	% Change from Existing No CM			% Change from Proposed No CM	
	Proposed No CM	Proposed with Pond	Proposed with Swale	Proposed with Pond	Proposed with Swale
TSS	19.95%	-72.67%	-71.05%	-77.21%	-75.86%
Cl	19.93%	6.97%	-18.51%	-10.81%	-32.06%
Cd	7.66%	423.90%	540.96%	386.63%	495.36%
Cu	31.09%	1433.11%	1329.83%	1069.46%	990.69%
Pb	18.86%	3.23%	-16.31%	-13.15%	-29.59%
Zn	17.44%	1520.05%	528.62%	1279.52%	435.29%

The results shown in Exhibit 23 for cadmium, copper, and zinc are not reasonable. The CM statistics used were generic from Granato (2014) and the model could not handle that, for these three constituents, since the minimum irreducible concentration of the CM was higher than the concentration of the constituent entering the CM. If the model generates a concentration lower than the minimum irreducible concentration in its calculations, it defaults to the minimum irreducible concentration, resulting in what looks like the CMs causing the constituent loading to increase significantly. Since these data were unreasonable, constituent loading values for cadmium, copper, and zinc generated by the SELDM database data were substituted in the actual comparisons, shown in Exhibit 24.

Exhibit 24 Percent Changes between Analyses

Constituent	% Change from Existing No CM			% Change from Proposed No CM	
	Proposed No CM	**Proposed with Pond**	**Proposed with Swale**	**Proposed with Pond**	**Proposed with Swale**
TSS	19.95%	-72.67%	-71.05%	-77.21%	-75.86%
Cl	19.93%	6.97%	-18.51%	-10.81%	-32.06%
Cd*	18.64%	-47.86%	-80.90%	-56.05%	-83.90%
Cu*	18.65%	-61.61%	-68.49%	-67.65%	-73.45%
Pb	18.86%	3.23%	-16.31%	-13.15%	-29.59%
Zn*	18.64%	-36.83%	-37.73%	-46.75%	-47.51%

**SELDM regional database data used in calculations*

Based on the SELDM modeling results, the Design Team recommends using ponds and swales to treat constituents of concern. These water quality design features are described in further detail in the *I-70 Floyd Hill to Veterans Memorial Tunnels Drainage and Water Quality Report* (Atkins, 2020).

Conclusions

SELDM modeling incorporated stream monitoring data, research data, and stakeholder input, yielding results that informed the CM type and appropriate locations of CM to best improve stream health. During design and construction of the Project, the guidelines of this report shall be used to inform water quality design and no additional modeling, using SELDM, would be necessary.

Exhibit 25 shows the Selection Criteria for CMs on the Project.

Exhibit 25 Selection Criteria for CMs on the Project

CM	Targeted Constituents	Concentration Reduction	Functional Design Intent
Swale	**Cl, Cd, & Pb**	Low - Moderate	Reduce of high concentration discharge to Clear Creek by diluting onsite pollutant loading with offsite runoff; vegetation and check dams improve performance
Pond	**TSS, Cu, & Zn**	High	Standard use of detention pond for onsite runoff; if site constraints permit, longer detention time and offsite runoff mixing will improve performance on dissolved pollutants such as chloride.

The water quality approach for the Project is to design water quality CMs to address the primary pollutant of concern for each section.

- East Section - Floyd Hill's average slope is 6 percent and CDOT Maintenance acknowledged the roadway requires heavier application of chloride-rich deicing agents. Chloride is treated by allowing roadway runoff to combine with offsite runoff and flow over existing or proposed vegetation to filter pollutants. Runoff from I-70 eastbound would travel through vegetated shoulders and side slopes to allow for vegetation uptake and dilution.
- Central and West Section - A lesser application of deicing agents allows the design of water quality ponds to settle out sediments and metals, along with slowing down the release of highly concentrated dissolved chloride.

The SELDM results determined that the pollutants of concern could be addressed using water quality ponds and vegetated swales. In addition, CMs not modeled in SELDM such as constructed wetlands, infiltration, and bioretention may provide a higher concentration reduction for chlorides and should be considered as the Project progresses. For site constrained areas, riprap aprons should be used to reduce point discharges and allow for continued maintenance. SELDM analysis, research data, maintenance activities, site constraints, and contaminants of concern were targeted, yielding the following CMs for water quality mitigation:

- East Section - Vegetated swales target chloride. Consider constructed wetland, infiltration, and bioretention CMs for highest concentration reduction of chloride.
- West and Central Section – Water quality ponds target metals and sediment.
- Site-Constrained - Riprap aprons in areas under bridges or concentrated flow paths to avoid direct discharge of pollutants to Clear Creek.

Based on the proposed improvements, SELDM modeling confirmed the CM type at the appropriate locations would improve Clear Creek stream health along the project corridor.

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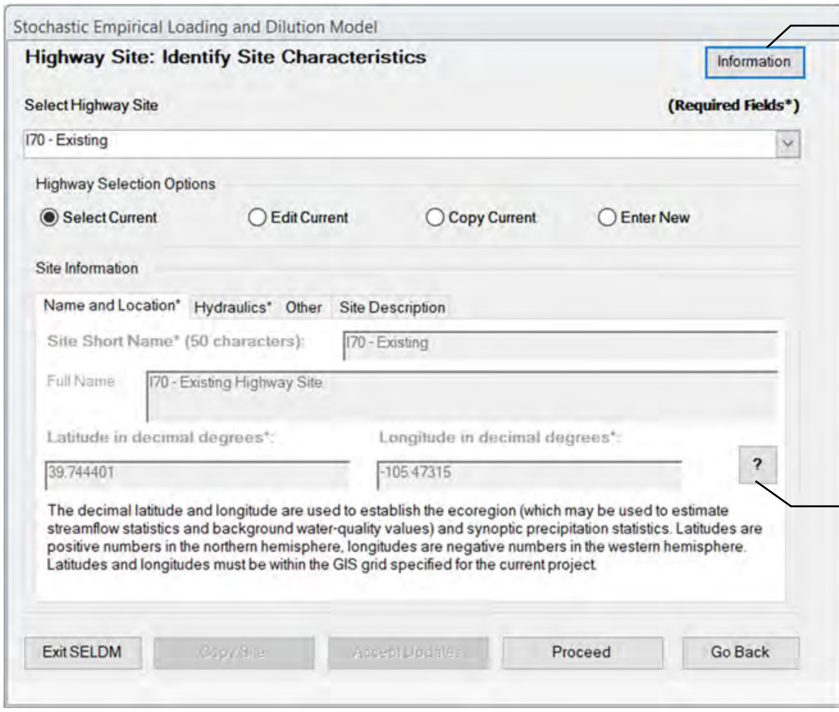
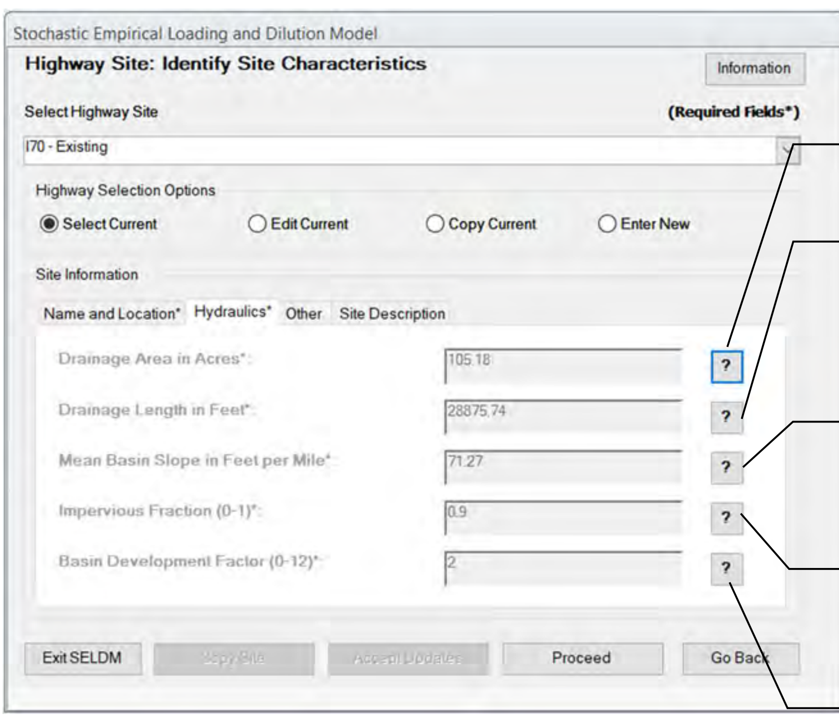
Attachment A: Highway Site and Upstream Basin Characteristics

Highway Site Characteristics



"The highway site is the description of the area contributing highway runoff to the receiving water. Each highway site may be associated with one or more analyses. The required fields are used for runoff quality and quantity calculations. The remaining fields are for documentation and highway-site comparisons. This information will be printed as heading information in output files and in reports generated as the results of analysis."

"The decimal latitude and longitude are used to establish the ecoregion (which may be used to estimate streamflow statistics and background water-quality values) and synoptic precipitation statistics."



"Total drainage area in acres"

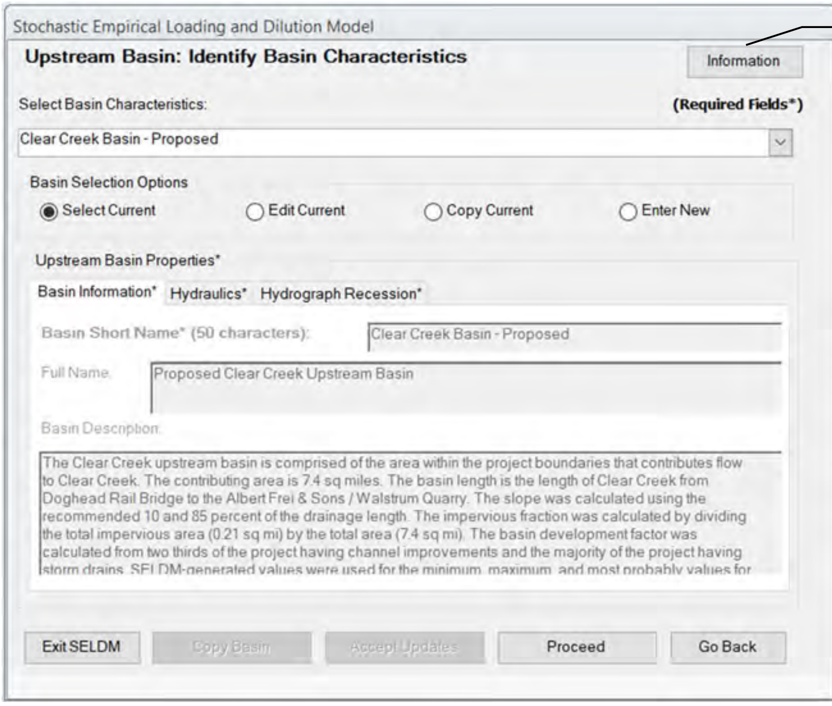
"Longest length of the roadway drainage basin along the main drainage channel from the highway outfall to the drainage divide (feet)."

"Mean basin slope measured between points which are 10 and 85 percent of the drainage length, in feet per mile."

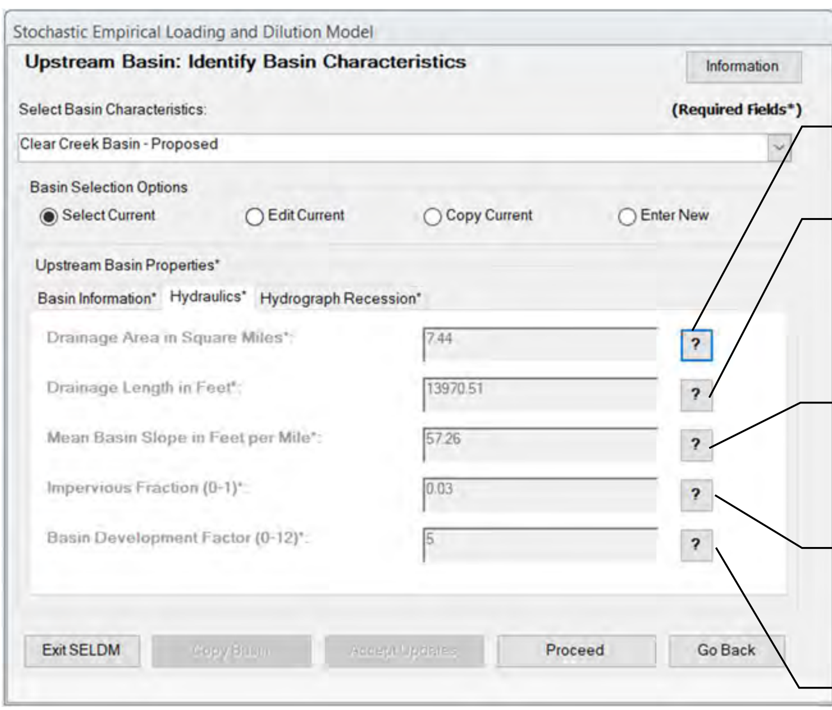
"The fraction of the drainage area that is impervious (in the range from 0 to 1 inclusive)."

"The basin development factor (BDF) provides a measure of the efficiency of the drainage basin."

Upstream Basin Characteristics



"The upstream-basin is the description of the area contributing pre-storm streamflow and storm-water runoff to the stream above the highway discharge point. Each upstream-basin description may be associated with one or more analyses. The required fields are used for runoff quality and quantity calculations. The remaining fields are for documentation and highway-site comparisons. This information will be printed as heading information in output files and in reports generated as the results of analysis."



"Total drainage area in acres"

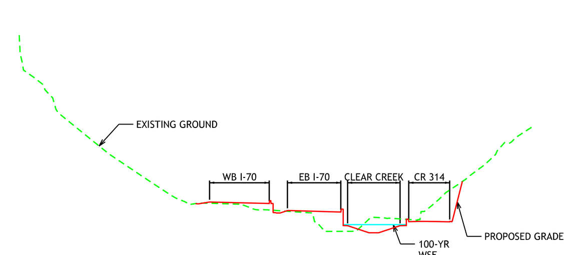
"Longest length of the roadway drainage basin along the main drainage channel from the highway outfall to the drainage divide (feet)."

"Mean basin slope measured between points which are 10 and 85 percent of the drainage length, in feet per mile."

"The fraction of the drainage area that is impervious (in the range from 0 to 1 inclusive)."

"The basin development factor (BDF) provides a measure of the efficiency of the drainage basin."

Attachment B: 20% Design Floyd Hill Drainage Exhibits



SECTION
A EB I-70 STATION 1008+00 A

Inlet ID	Structure Type	Height of Structure (ft)	Notes
CC-IN-001	Double Vane Grate	7.74	
CC-IN-002	Double Vane Grate	7.59	
CC-IN-003	Double Vane Grate	7.12	
CC-IN-004	Double Vane Grate	6.73	
CC-IN-005	Double Vane Grate	6.80	
CC-IN-006	Double Vane Grate	5.48	
CC-IN-007	Double Vane Grate	5.50	
CC-IN-008	Double Vane Grate	6.00	
CC-IN-009	Double Vane Grate	4.02	
CC-IN-010	Double Vane Grate	7.80	
CC-IN-011	Double Vane Grate	3.05	
CC-IN-012	Single Vane Grate	5.14	
CC-IN-013	Single Vane Grate	12.18	
CR-IN-001	Single Type R	5.73	
CR-IN-002	Single Type R	5.34	
CR-IN-003	Single Type R	5.14	
CR-IN-004	Single Type R	4.72	
CR-IN-005	Single Type R	5.15	
CR-IN-006	Single Type R	6.82	
CR-IN-007	Single Type R	5.79	
CR-IN-008	Single Type C	5.87	
CR-IN-009	Single Type R	6.30	
CR-IN-010	Single Type R	5.20	
CR-IN-011	Single Type R	7.02	
CR-IN-012	Single Type R	5.20	
CR-IN-013	Single Type R	5.00	
CR-IN-014	Single Type R	5.20	
CR-IN-015	Single Type R	5.00	
CR-IN-016	Single Type R	5.20	
CR-IN-017	Single Type R	5.00	
CR-IN-018	Single Type R	5.20	
CR-IN-019	Single Type R	1.60	
WB-IN-026	Single Vane Grate	4.61	
WB-IN-027	Single Vane Grate	4.80	
CCP-IN-001	Double Vane Grate	4.50	BRIDGE DECK INLET - FYI ONLY
CCP-IN-002	Double Vane Grate	4.50	
CCP-IN-003	Double Vane Grate	6.16	
CCP-IN-004	Double Vane Grate	3.85	
CCP-IN-005	Single Type C	9.19	IN SAG
CCP-IN-006	Double Vane Grate	9.79	
CCP-IN-007	Single Vane Grate	9.59	
CCP-IN-008	Single Type C	4.75	
CCP-IN-009	Single Type R	5.60	
CCP-IN-010	Single Vane Grate	4.58	
CCP-IN-011	Single Type R	17.01	
CCP-IN-012	Single Type R	4.50	
CCP-IN-013	Single Type C	4.50	IN SAG
CCP-IN-014	Single Type R	10.71	
CCP-IN-015	Single Type C	10.49	IN SAG
CCP-IN-016	Single Type C	7.18	IN SAG
CCP-IN-017	Single Type R	5.50	
CCP-IN-018	Single Type R	4.50	
CCP-IN-019	Single Type R	8.50	
CCP-IN-020	Single Type C	3.71	IN SAG
CCP-IN-021	Single Type C	7.08	IN SAG
CCP-IN-022	Single Type C	4.75	IN SAG
CCP-IN-023	Triple Type R	4.50	IN SAG
CCP-IN-024	Single Type R	5.29	IN SAG
CCP-IN-025	Single Type R	4.50	
CCP-IN-026	Single Type R	4.50	

Manhole ID	Height of Structure (ft)	Notes
CC-MH-001	6.22	
CC-MH-002	8.83	
CC-MH-003	7.34	
CC-MH-004	6.96	
CC-MH-005	6.01	
CC-MH-006	6.19	
CC-MH-007	6.13	
CC-MH-008	4.36	
CC-MH-009	6.67	
CC-MH-010	8.42	
CC-MH-011	9.37	
CC-MH-012	12.71	
CC-MH-013	10.57	
CC-MH-014	7.55	
CC-MH-015	9.97	
CR-MH-001	5.97	
CR-MH-002	5.49	
CR-MH-003	5.20	
CR-MH-004	5.20	
CR-MH-005	5.20	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-CC-FES-004	Concrete	18	19.33	0.55	1.41	
P-CC-IN-001	Concrete	24	78.69	5.27	9.53	
P-CC-IN-002	Concrete	24	129.84	5.33	9.62	
P-CC-IN-003	Concrete	18	132.84	4.73	8.62	
P-CC-IN-004	Concrete	18	117.55	3.87	7.32	
P-CC-IN-005	Concrete	18	107.92	3.43	6.47	
P-CC-IN-006	Concrete	18	43.15	0.75	1.05	
P-CC-IN-007	Concrete	18	54.35	1.56	2.56	
P-CC-IN-008	Concrete	18	43.38	1.48	2.43	
P-CC-IN-009	Concrete	18	46.69	1.83	2.08	
P-CC-IN-010	Concrete	18	61.03	1.58	2.60	
P-CC-IN-011	Concrete	18	41.86	0.31	0.51	
P-CC-IN-012	Concrete	18	12.31	0.57	1.45	
P-CC-IN-013	Concrete	30	42.33	25.42	56.69	
P-CC-MH-001	Concrete	24	26.17	5.11	9.30	
P-CC-MH-002	Concrete	24	236.79	5.23	9.48	
P-CC-MH-003	Concrete	18	141.98	4.68	8.53	
P-CC-MH-004	Concrete	18	114.22	3.83	7.19	
P-CC-MH-005	Concrete	18	52.89	2.73	5.26	
P-CC-MH-006	Concrete	18	63.73	3.17	5.17	
P-CC-MH-007	Concrete	18	142.49	3.29	5.34	
P-CC-MH-008	Concrete	18	12.03	3.26	5.52	
P-CC-MH-009	Concrete	18	100.32	3.09	5.20	
P-CC-MH-010	Concrete	18	148.56	1.50	2.47	
P-CC-MH-011	Concrete	18	92.35	2.84	4.69	
P-CC-MH-012	Concrete	18	212.09	1.57	2.58	
P-CC-MH-013	Concrete	18	141.18	1.44	2.37	
P-CC-MH-014	Concrete	18	154.08	1.47	2.40	
P-CC-MH-015	Concrete	18	236.50	2.81	4.65	
P-CC-OS-001	Concrete	18	45.54	0.00	0.00	POND OUTFLOW NOT CALCULATED
P-WB-IN-026	Concrete	18	220.95	4.08	6.23	
P-WB-IN-027	Concrete	18	54.00	2.08	3.19	
P-CCP-IN-016	Concrete	36	67.52	25.68	54.61	
EX-P-EX-CCP-IN-007	Concrete	18	91.10	0.74	1.75	
EX-P-EX-CCP-IN-008	Concrete	18	57.80	1.13	1.70	DIAMETER ASSUMED
EX-P-EX-CCP-IN-009	Concrete	18	33.85	2.41	3.58	DIAMETER ASSUMED
EX-P-EX-CCP-IN-010	Concrete	18	57.20	0.54	0.90	
EX-P-EX-CCP-IN-011	Concrete	18	49.25	1.05	1.83	
P-CCP-IN-002	Concrete	18	146.39	1.18	1.93	
P-CCP-IN-003	Concrete	18	83.44	3.53	5.83	
P-CCP-IN-004	Concrete	18	61.54	1.00	1.64	
P-CCP-IN-005	Concrete	18	11.81	2.49	4.64	
P-CCP-IN-006	Concrete	18	182.69	2.75	5.12	
P-CCP-IN-007	Concrete	18	78.57	3.78	6.84	
P-CCP-IN-008	Concrete	24	8.92	6.49	8.34	
P-CCP-IN-009	Concrete	18	70.13	0.39	0.53	
P-CCP-IN-010	Concrete	18	239.90	1.37	2.16	
P-CCP-IN-011	Concrete	24	22.21	0.36	0.52	
P-CCP-IN-012	Concrete	18	15.29	0.37	0.51	
P-CCP-IN-013	Concrete	18	13.35	0.85	1.63	
P-CCP-IN-014	Concrete	24	16.78	17.65	40.01	
P-CCP-IN-015	Concrete	18	121.13	3.03	5.14	
P-CCP-IN-017	Concrete	24	47.34	17.46	39.78	
P-CCP-IN-018	Concrete	24	31.42	3.52	5.54	
P-CCP-IN-019	Concrete	18	63.07	0.56	0.75	
P-CCP-IN-020	Concrete	30	91.30	20.10	44.00	
P-CCP-IN-021	Concrete	18	28.67	2.56	4.20	
P-CCP-IN-022	Concrete	30	16.80	21.11	45.64	
P-CCP-IN-023	Concrete	36	75.66	23.42	50.20	
P-CCP-IN-024	Concrete	36	25.94	24.69	52.33	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-CCP-IN-025	Concrete	36	54.11	0.90	1.24	
P-CCP-IN-026	Concrete	36	22.01	1.12	1.56	
P-CCP-IN-027	Concrete	18	34.93	0.47	1.12	
P-CCP-IN-028	Concrete	18	48.81	0.86	1.66	
P-CCP-IN-029	Concrete	18	72.74	0.51	0.75	
P-CCP-IN-030	Concrete	24	99.19	0.63	0.88	
P-CCP-IN-031	Concrete	48	22.04	3.16	5.41	
P-CCP-IN-032	Concrete	36	60.31	1.18	1.94	
P-CCP-IN-033	Concrete	42	101.72	3.00	5.12	
P-CCP-IN-034	Concrete	36	33.84	22.36	47.50	
P-CCP-IN-035	Concrete	18	58.25	0.28	0.39	
P-CCP-IN-036	Concrete	24	104.16	17.34	39.70	
P-CCP-MH-001	Concrete	18	103.09	1.13	1.86	
P-CCP-MH-002	Concrete	18	76.58	0.98	1.61	
P-CCP-MH-003	Concrete	18	135.79	2.48	4.64	
P-CCP-MH-004	Concrete	18	169.45	2.45	4.58	
P-CCP-MH-005	Concrete	24	48.33	4.49	8.33	
P-CCP-MH-006	Concrete	24	27.82	6.75	12.47	
P-CCP-MH-008	Concrete	18	179.27	3.91	6.70	
P-CCP-MH-009	Concrete	18	180.51	2.39	3.55	
P-CCP-MH-010	Concrete	36	11.25	9.77	18.28	
P-CCP-MH-011	Concrete	36	111.19	7.79	14.72	
P-CCP-MH-012	Concrete	48	54.84	25.79	54.70	
P-CCP-MH-013	Concrete	48	274.27	26.40	55.80	
P-CCP-MH-014	Concrete	18	104.62	3.09	4.90	
P-CCP-MH-016	Concrete	18	63.02	0.50	0.74	
P-CCP-MH-017	Concrete	18	128.77	0.28	0.39	
P-CCP-OS-001	Concrete	30	110.05	7.15	13.46	

ID	Material	Diameter (in)	Length (ft)	Q25 (cfs)	Notes
P-CR-FES-001	Concrete	18	19.61	5.34	
P-CR-FES-006	Concrete	36	33.47	29.85	
P-CR-IN-001	Concrete	18	69.09	5.49	
P-CR-IN-002	Concrete	18	34.40	0.35	
P-CR-IN-003	Concrete	30	207.74	0.84	
P-CR-IN-004	Concrete	18	34.41	0.50	
P-CR-IN-005	Concrete	36	245.33	1.82	
P-CR-IN-006	Concrete	36	40.27	24.44	
P-CR-IN-007	Concrete	36	34.37	23.89	
P-CR-IN-008	Concrete	18	6.94	22.17	
P-CR-IN-009	Concrete	36	22.70	30.27	
P-CR-IN-010	Concrete	30	30.26	1.49	
P-CR-IN-011	Concrete	18	89.54	4.03	
P-CR-IN-012	Concrete	18	34.28	3.85	
P-CR-IN-013	Concrete	18	34.39	0.28	
P-CR-IN-014	Concrete	18	46.73	2.81	
P-CR-IN-015	Concrete	18	35.00	0.19	
P-CR-IN-016	Concrete	18	100.04	1.45	
P-CR-IN-017	Concrete	18	34.37	0.17	
P-CR-IN-018	Concrete	18	108.52	0.37	
P-CR-MH-001	Concrete	30	23.50	5.09	
P-CR-MH-002	Concrete	18	112.26	3.94	
P-CR-MH-003	Concrete	18	99.81	2.75	
P-CR-MH-004	Concrete	18	85.83	2.78	
P-CR-MH-005	Concrete	18	88.48	1.42	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
CC-CH-001	Trapezoidal Ditch	16.89	Grass	16.59	40.06	
CC-CH-002	Trapezoidal Ditch	18.07	Grass	15.75	38.53	
CC-CH-003	Trapezoidal Ditch	15.15	Grass	11.31	26.83	
CC-CH-004	Trapezoidal Ditch	18.04	Grass	10.56	25.48	
CC-CH-005	Trapezoidal Ditch	17.3	Grass	10.82	25.95	
CC-CH-006	Trapezoidal Ditch	15.09	Grass	10.98	26.23	
CC-CH-007	Trapezoidal Ditch	10.55	Grass	7.63	18.29	
CC-CH-008	Trapezoidal Ditch	9.11	Grass	7.65	18.33	
CC-CH-009	Trapezoidal Ditch	10.12	Grass	8.97	21.93	
CC-CH-010	Trapezoidal Ditch	3.1	Grass	1.29	2.16	
CC-CH-011	Trapezoidal Ditch	3.33	Grass	1.39	2.32	
CC-CH-012	Trapezoidal Ditch	2.15	Grass	0.91	1.51	
CC-CH-013	Trapezoidal Ditch	3.78	Grass	0.99	1.58	
CC-CH-014	Trapezoidal Ditch	11.41	Grass	9.26	22.53	
CC-CH-015	Trapezoidal Ditch	9.48	Grass	6.89	16.96	
CC-CH-016	Trapezoidal Ditch	8.21	Grass	4.04	9.58	
CC-CH-017	Trapezoidal Ditch	3.72	Grass	1.28	2.76	
CC-CH-018	V Ditch	8.36	Grass	0.50	0.84	
WB-CH-014	Trapezoidal Ditch	0.36	Grass	0.70	1.61	
CCP-CH-001	V Ditch	0.34	Grass	0.73	1.74	
CCP-CH-002	Trapezoidal Ditch	0.15	Grass	0.74	1.70	
CCP-CH-003	V Ditch	0.28	Grass	0.33	0.76	
CCP-CH-004	Trapezoidal Ditch	0.41	Grass	0.28	0.67	

ID	Shape	Depth of flow (ft)	Lining	Q25 (cfs)	Notes
CR-CH-001	V Ditch	0.56	Grass	2.81	
CR-CH-002	V Ditch	1.10	Grass	8.28	
CR-CH-003	V Ditch	1.06	Grass	11.96	
CR-CH-004	V Ditch	1.08	Grass	22.58	
EX-CR-CH-002	V Ditch	0.68	Grass	2.78	EXISITNG DITCH - SIZE AND DEPTH ASSUMED
EX-CR-CH-003	V Ditch	0.75	Grass	3.75	EXISITNG DITCH - SIZE AND DEPTH ASSUMED
EX-CR-CH-004	V Ditch	0.60	Grass	3.91	EXISITNG DITCH - SIZE AND DEPTH ASSUMED

ID	Size (in)	Notes
CC-FES-001	18	
CC-FES-002	30	
CC-FES-003	18	
CC-FES-004	18	
CR-FES-001	18	
CR-FES-002	18	
CR-FES-003	36	
CR-FES-004	36	
CR-FES-005	30	
CCP-FES-002	48	
EX-CCP-FES-002	24	
CCP-FES-001	24	

Legend

Existing / Proposed

- Type R Inlet
- Single Vane Grate Inlet
- Double Vane Grate Inlet
- Type C Inlet
- Type 13 Inlet
- Flared End Section
- Manhole
- Ditch
- Pipe
- 100-Yr Floodplain
- Removal
- 1' Contour
- Type 3 Guardrail
- Type 9 Barrier
- Bridge
- Right of Way
- Wall
- Ditch Check Dam
- Concrete Slope Paving
- Riprap (D50 = 12")

0' 25' 100' 200'

Pipe Size Color Table

Proposed

- 18 inch
- 24 inch
- 30 inch
- 36 inch
- 42 inch
- 48 inch
- 54 inch
- 60 inch
- 66 inch
- 72 inch

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS
Station 2000+00 to Station 2043+50

Design by: S. Crimmins Exhibit: 1 of 8
Drawn by: S. Crimmins Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

NOTE 1: Canyon Viaduct Alternative Extents. See Exhibits 7-8 for more details.

Inlet ID	Structure Type	Height of Structure (ft)	Notes
EB-IN-002	Single Vane Grate	4.79	
EB-IN-004	Single Type C	9.01	
EB-IN-005	Single Vane Grate	4.50	
EB-IN-006	Single Type C	11.20	
EB-IN-008	Single Vane Grate	4.50	
EB-IN-009	Single Vane Grate	4.50	
EB-IN-010	Single Vane Grate	4.50	
EB-IN-011	Single Vane Grate	4.50	
EB-IN-013	Single Vane Grate	4.60	
EB-IN-014	Single Vane Grate	4.50	
EB-IN-015	Single Vane Grate	4.50	
EB-IN-016	Single Vane Grate	4.63	
EB-IN-017	Single Vane Grate	4.73	
EB-IN-019	Single Type C	4.60	
EB-IN-020	Double Vane Grate	7.63	
EB-IN-024	Single Vane Grate	4.50	
EB-IN-025	Single Vane Grate	4.50	
EB-IN-026	Double Vane Grate	10.17	
EB-IN-027	Double Vane Grate	12.37	
EB-IN-028	Double Vane Grate	4.61	
EB-IN-029	Double Vane Grate	4.50	
EB-IN-031	Single Vane Grate	6.04	
EB-IN-038	Single Type C	4.60	
WB-IN-010	Single Vane Grate	9.16	
WB-IN-011	Single Vane Grate	8.50	
WB-IN-012	Single Vane Grate	4.50	
WB-IN-013	Single Vane Grate	6.42	
WB-IN-014	Single Vane Grate	4.50	
WB-IN-015	Single Vane Grate	5.98	
WB-IN-016	Single Vane Grate	6.15	
WB-IN-017	Single Vane Grate	4.63	
WB-IN-018	Single Vane Grate	5.47	
WB-IN-019	Single Vane Grate	5.13	
WB-IN-020	Single Vane Grate	4.50	
WB-IN-021	Single Vane Grate	5.60	
WB-IN-022	Single Vane Grate	5.52	
WB-IN-023	Single Vane Grate	5.03	
WB-IN-024	Single Vane Grate	6.18	
WB-IN-025	Single Vane Grate	4.61	
WB-IN-028	Double Vane Grate	7.53	
WB-IN-029	Double Vane Grate	4.64	
WB-IN-033	Double Vane Grate	7.93	
WB-IN-036	Double Vane Grate	4.66	
WB-IN-038	Single Vane Grate	4.66	

Inlet ID	Structure Type	Height of Structure (ft)	Notes
WB-IN-039	Single Vane Grate	4.66	
WB-IN-040	Single Vane Grate	4.82	
WB-IN-041	Single Vane Grate	5.23	
WB-IN-043	Single Vane Grate	4.50	Bridge Deck Inlet "FYI Only"
WB-IN-044	Single Type C	4.17	
WB-IN-045	Single Vane Grate	4.50	
WB-IN-046	Single Vane Grate	3.55	
WB-IN-048	Single Vane Grate	5.00	Bridge Deck Inlet "FYI Only"

Manhole ID	Height of Structure (ft)	Notes
EB-MH-007	12.65	
EB-MH-012	4.60	
EB-MH-018	10.29	
EB-MH-021	4.61	
EB-MH-022	6.76	
EB-MH-023	7.67	
EB-MH-034	5.19	
EB-MH-037	10.05	
WB-MH-002	8.81	
WB-MH-006	9.16	
WB-MH-007	9.26	
WB-MH-008	9.47	
WB-MH-032	4.78	
WB-MH-034	4.78	
WB-MH-035	4.64	
WB-MH-037	4.68	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-EB-IN-002	Concrete	18	52.70	0.53	0.84	
P-EB-IN-004	Concrete	30	230.18	13.74	24.39	
P-EB-IN-005	Concrete	18	62.02	0.73	1.08	
P-EB-IN-006	Concrete	30	282.96	13.52	23.83	
P-EB-IN-008	Concrete	18	43.90	0.69	1.11	
P-EB-IN-009	Concrete	18	52.78	0.54	0.91	
P-EB-IN-010	Concrete	18	59.15	0.84	1.46	
P-EB-IN-011	Concrete	18	39.26	0.62	0.95	
P-EB-IN-013	Concrete	18	257.09	3.39	5.38	
P-EB-IN-014	Concrete	18	39.28	0.41	0.63	
P-EB-IN-015	Concrete	18	23.11	0.74	1.29	
P-EB-IN-016	Concrete	18	32.25	0.92	1.38	
P-EB-IN-017	Concrete	18	106.55	1.86	2.76	
P-EB-IN-019	Concrete	18	18.24	6.15	11.53	
P-EB-IN-020	Concrete	30	223.22	10.86	18.96	
P-EB-IN-024	Concrete	18	55.92	1.21	1.80	
P-EB-IN-025	Concrete	18	45.98	0.75	1.16	
P-EB-IN-026	Concrete	30	162.50	11.74	20.59	
P-EB-IN-027	Concrete	30	10.17	13.06	23.02	
P-EB-IN-028	Concrete	18	89.49	1.28	2.11	
P-EB-IN-029	Concrete	18	67.09	0.45	0.74	
P-EB-IN-031	Concrete	48	211.99	54.71	130.19	
P-EB-IN-038	Concrete	18	68.89	3.46	5.84	
P-EB-MH-007	Concrete	30	202.78	11.84	20.84	
P-EB-MH-012	Concrete	18	20.62	2.86	4.46	
P-EB-MH-018	Concrete	18	29.65	3.84	6.11	
P-EB-MH-021	Concrete	18	234.93	4.37	7.20	
P-EB-MH-022	Concrete	18	232.96	4.50	7.38	
P-EB-MH-023	Concrete	18	172.19	4.06	6.76	
P-EB-MH-034	Concrete	18	140.26	2.95	4.59	
P-EB-MH-037	Concrete	18	253.52	3.40	5.75	
P-EB-OS-001	Concrete	24	159.22	73.37	162.79	
P-WB-IN-010	Concrete	36	174.36	25.44	42.28	
P-WB-IN-011	Concrete	30	144.72	15.48	24.95	
P-WB-IN-012	Concrete	18	36.00	0.31	0.53	
P-WB-IN-013	Concrete	24	215.77	15.18	24.36	
P-WB-IN-014	Concrete	18	36.00	0.69	1.24	
P-WB-IN-015	Concrete	24	10.27	14.14	22.59	
P-WB-IN-016	Concrete	24	256.28	13.34	21.29	
P-WB-IN-017	Concrete	18	48.57	1.32	2.07	
P-WB-IN-018	Concrete	24	254.93	11.27	18.01	
P-WB-IN-019	Concrete	18	68.74	1.13	1.73	
P-WB-IN-020	Concrete	18	52.23	1.68	2.52	
P-WB-IN-021	Concrete	24	104.51	9.05	14.43	
P-WB-IN-022	Concrete	18	141.00	7.20	11.57	
P-WB-IN-023	Concrete	18	141.00	0.40	0.60	
P-WB-IN-024	Concrete	18	42.45	6.49	10.46	
P-WB-IN-025	Concrete	18	55.31	1.47	2.50	
P-WB-IN-026	Concrete	18	220.95	4.08	6.23	
P-WB-IN-028	Concrete	30	74.28	10.08	17.16	
P-WB-IN-029	Concrete	24	22.98	3.47	5.62	
P-WB-IN-033	Concrete	24	296.97	5.10	8.75	
P-WB-IN-036	Concrete	18	46.08	3.20	5.28	
P-WB-IN-038	Concrete	18	33.25	0.72	1.08	
P-WB-IN-039	Concrete	18	35.98	0.28	0.51	
P-WB-IN-040	Concrete	18	37.25	0.37	0.80	
P-WB-IN-041	Concrete	18	38.65	0.71	1.11	
P-WB-IN-044	Concrete	48	279.86	79.63	183.74	
P-WB-IN-045	Concrete	18	72.01	1.07	1.64	
P-WB-IN-046	Concrete	18	71.66	1.08	1.56	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-WB-MH-002	Concrete	36	31.29	22.88	38.51	
P-WB-MH-006	Concrete	36	155.31	23.49	39.41	
P-WB-MH-007	Concrete	36	116.32	23.95	40.08	
P-WB-MH-008	Concrete	36	207.01	24.77	41.28	
P-WB-MH-032	Concrete	30	58.12	8.08	13.66	
P-WB-MH-034	Concrete	18	64.97	4.20	7.09	
P-WB-MH-035	Concrete	18	48.75	3.54	6.04	
P-WB-MH-037	Concrete	18	80.50	0.71	1.07	
P-WB-OS-001	Concrete	24	164.33	21.86	39.07	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
EB-CH-001	Trapezoidal Ditch	0.17	Grass	0.85	1.95	
EB-CH-002	Trapezoidal Ditch	0.10	Grass	0.36	0.84	
EB-CH-003	Trapezoidal Ditch	1.15	Grass	15.88	36.53	
EB-CH-004	Trapezoidal Ditch	1.29	Grass	14.62	34.16	
EB-CH-005	Trapezoidal Ditch	1.48	Grass	22.40	52.44	
EB-CH-006	Trapezoidal Ditch	1.51	Grass	26.25	61.32	
EB-CH-007	Trapezoidal Ditch	1.28	Grass	29.59	69.57	
EB-CH-008	Trapezoidal Ditch	1.21	Grass	26.12	58.94	
EB-CH-009	Trapezoidal Ditch	1.23	Grass	12.27	27.61	
EB-CH-039	Trapezoidal Ditch	0.37	Grass	3.07	5.17	
EB-CH-040	Trapezoidal Ditch	0.54	Grass	2.36	3.92	
EB-CH-041	Trapezoidal Ditch	0.37	Grass	1.40	2.30	
WB-CH-002	Trapezoidal Ditch	0.23	Grass	1.42	2.73	
WB-CH-003	Trapezoidal Ditch	0.28	Grass	0.96	1.84	
WB-CH-004	Trapezoidal Ditch	0.25	Grass	0.33	0.62	
WB-CH-005	Trapezoidal Ditch	0.11	Grass	0.09	0.20	
WB-CH-008	Trapezoidal Ditch	0.17	Grass	0.86	1.32	
WB-CH-010	Trapezoidal Ditch	1.12	Grass	21.67	51.95	
WB-CH-011	Trapezoidal Ditch	1.36	Grass	15.71	36.69	
WB-CH-012	Trapezoidal Ditch	0.98	Grass	9.97	22.79	
WB-CH-013	Trapezoidal Ditch	0.80	Grass	1.69	3.33	
WB-CH-014	Trapezoidal Ditch	0.36	Grass	0.70	1.61	
WB-CH-015	Trapezoidal Ditch	1.53	Grass	58.59	135.68	
WB-CH-016	Trapezoidal Ditch	1.70	Grass	55.53	129.31	
WB-CH-017	Trapezoidal Ditch	1.66	Grass	51.23	118.84	
WB-CH-018	Trapezoidal Ditch	1.61	Grass	46.79	108.22	
WB-CH-019	Trapezoidal Ditch	1.55	Grass	44.72	104.04	
WB-CH-020	Trapezoidal Ditch	1.53	Grass	45.28	104.34	
WB-CH-021	Trapezoidal Ditch	1.60	Grass	40.88	93.83	
WB-CH-022	Trapezoidal Ditch	1.64	Grass	9.52	22.27	
WB-CH-023	Trapezoidal Ditch	1.02	Grass	10.38	23.88	

ID	Size (in)	Notes
EB-HW-001	24	
EB-HW-002	18	
EB-HW-003	48	
EB-HW-004	30	
WB-HW-001	24	
WB-HW-002	36	
WB-HW-003	18	
WB-HW-004	18	
WB-HW-006	48	

Legend

Existing / Proposed

- Type R Inlet
- Single Vane Grate Inlet
- Double Vane Grate Inlet
- Type C Inlet
- Type 13 Inlet
- Flared End Section
- Manhole
- Ditch
- Pipe
- 100-Yr Floodplain
- Removal
- 1' Contour
- Type 3 Guardrail
- Type 9 Barrier
- Bridge
- Right of Way
- Wall
- Ditch Check Dam
- Concrete Slope Paving
- Riprap (D50 = 12")

N

0' 25' 100' 200'

Pipe Size Color Table

Proposed

- 18 inch
- 24 inch
- 30 inch
- 36 inch
- 42 inch
- 48 inch
- 54 inch
- 60 inch
- 66 inch
- 72 inch

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS

Station 2043+50 to Station 2087+50

Design by: E. Vega-Bazan Exhibit: 2 of 8
Drawn by: E. Vega-Bazan Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

Inlet ID	Structure Type	Height of Structure (ft)	Notes
EB-IN-032	Double Vane Grate	4.60	
EB-IN-033	Double Vane Grate	4.76	
JG-IN-016	Double Vane Grate	4.50	
JG-IN-017	Double Vane Grate	7.50	
US6-IN-001	Single Type C	4.50	
US6-IN-010	Double Vane Grate	4.50	
US6-IN-011	Double Vane Grate	15.83	
AFS-IN-001	Single Type C	8.00	
AFS-IN-002	Double Vane Grate	4.50	
AFS-IN-003	Single Type C	8.50	
AFS-IN-004	Double Vane Grate	4.50	
AFS-IN-005	Single Type C	4.50	
AFS-IN-006	Single Type C	5.50	
AFS-IN-007	Double Vane Grate	4.50	
AFS-IN-008	Single Type C	5.50	
AFS-IN-009	Double Vane Grate	3.29	BRIDGE DECK DRAIN - FYI ONLY
AFS-IN-010	Double Vane Grate	5.00	BRIDGE DECK DRAIN - FYI ONLY
AFS-IN-011	Double Vane Grate	5.20	
AFS-IN-012	Double Vane Grate	4.50	
AFS-IN-013	Double Vane Grate	7.31	
AFS-IN-014	Double Vane Grate	8.80	
AFS-IN-015	Double Vane Grate	7.00	
AFS-IN-016	Double Vane Grate	6.50	
AFS-IN-017	Double Vane Grate	4.50	
AFS-IN-018	Double Vane Grate	3.87	IN SAG
AFS-IN-019	Double Vane Grate	3.91	BRIDGE DECK DRAIN - FYI ONLY
AFS-IN-021	Single Vane Grate	8.71	
AFS-IN-022	Single Vane Grate	3.29	BRIDGE DECK DRAIN - FYI ONLY
AFS-IN-023	Single Vane Grate	3.28	BRIDGE DECK DRAIN - FYI ONLY

Manhole ID	Height of Structure (ft)	Notes
JG-MH-016	11.05	
US6-MH-002	6.51	
AFS-MH-003	6.96	
AFS-MH-008	6.96	
AFS-MH-009	6.96	
AFS-MH-010	6.96	
AFS-MH-013	7.96	
AFS-MH-014	7.44	
AFS-MH-016	6.95	
AFS-MH-017	6.96	
AFS-MH-018	6.96	
AFS-MH-019	54.02	
AFS-MH-020	40.50	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-EB-IN-032	Concrete	18	62.12	0.80	1.30	
P-EB-IN-033	Concrete	18	60.00	0.29	0.46	
P-JG-IN-016	Concrete	18	63.83	1.65	2.62	
P-JG-IN-017	Concrete	36	62.13	6.03	9.89	
P-JG-MH-016	Concrete	72	111.70	5.99	9.82	
P-US6-IN-001	Concrete	18	53.80	2.78	5.08	
P-US6-MH-002	Concrete	18	26.67	2.74	5.03	
P-AFS-HW-002	Concrete	60	129.01	44.93	108.78	
P-AFS-HW-004	Concrete	42	113.12	57.96	139.81	
P-AFS-IN-001	Concrete	18	231.95	1.40	2.31	
P-AFS-IN-002	Concrete	18	59.11	0.59	1.04	
P-AFS-IN-003	Concrete	24	173.99	4.04	6.77	
P-AFS-IN-004	Concrete	18	60.04	1.25	2.21	
P-AFS-IN-005	Concrete	24	161.14	4.50	7.62	
P-AFS-IN-006	Concrete	24	174.89	4.64	7.91	
P-AFS-IN-007	Concrete	18	89.72	0.74	1.32	
P-AFS-IN-008	Concrete	24	45.18	5.58	9.63	
P-AFS-IN-011	Concrete	18	167.09	2.84	4.56	
P-AFS-IN-012	Concrete	18	66.95	1.80	2.86	
P-AFS-IN-013	Concrete	18	97.89	6.37	10.47	
P-AFS-IN-014	Concrete	18	147.51	7.74	12.95	
P-AFS-IN-015	Concrete	18	142.09	9.78	16.51	
P-AFS-IN-016	Concrete	24	161.73	10.51	17.95	
P-AFS-IN-017	Concrete	24	46.97	2.09	3.52	
P-AFS-IN-018	Concrete	18	84.75	3.03	5.87	
P-AFS-IN-021	Concrete	18	77.49	0.10	0.18	
P-AFS-MH-003	Concrete	24	133.83	3.97	6.67	
P-AFS-MH-008	Concrete	24	199.84	5.56	9.59	
P-AFS-MH-009	Concrete	24	95.08	5.45	9.44	
P-AFS-MH-010	Concrete	30	86.10	5.41	9.38	
P-AFS-MH-013	Concrete	18	82.14	6.31	10.39	
P-AFS-MH-014	Concrete	18	92.31	7.75	12.99	
P-AFS-MH-016	Concrete	24	141.52	10.38	17.76	
P-AFS-MH-017	Concrete	36	145.07	12.18	20.77	
P-AFS-MH-018	Concrete	18	99.74	2.98	5.79	
P-AFS-MH-019	Concrete	42	56.98	67.35	156.41	
P-AFS-MH-020	Concrete	42	153.28	67.28	156.27	
P-AFS-PO-001	Concrete	60	99.81	73.75	167.68	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
AFS-CH-001	V Ditch	1.87	Grass	5.34	9.28	
EB-CH-009	Trapezoidal Ditch	1.23	Grass	12.27	27.61	
EB-CH-010	Trapezoidal Ditch	1.14	Grass	0.79	1.28	
US6-CH-011	Trapezoidal Ditch	0.86	Grass	3.34	5.47	
US6-CH-012	Trapezoidal Ditch	0.58	Grass	6.86	12.52	
OFF-CH-005	Rectangular Channel	0.49	Concrete	-	5.70	1ft x 1ftdepth

ID	Size (in)	Notes
EB-HW-005	18	
EB-HW-006	18	
JG-HW-001	72	
US6-HW-003	18	
AFS-FES-001	30	
AFS-HW-002	60	
AFS-HW-003	60	
AFS-HW-004	42	
AFS-HW-005	42	
AFS-HW-006	60	

Legend

	Existing	Proposed
Type R Inlet		
Single Vane Grate Inlet		
Double Vane Grate Inlet		
Type C Inlet		
Type 13 Inlet		
Flared End Section		
Manhole		
Ditch		
Pipe		
100-Yr Floodplain		
Removal		
1' Contour		
Type 3 Guardrail		
Type 9 Barrier		
Bridge		
Right of Way		
Wall		
Ditch Check Dam		
Concrete Slope Paving		
Riprap (D50 = 12")		

0' 25' 100' 200'

Pipe Size Color Table

	Proposed
18 inch	
24 inch	
30 inch	
36 inch	
42 inch	
48 inch	
54 inch	
60 inch	
66 inch	
72 inch	

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS

Station 2087+50 to Station 2144+00

Design by: S. Mehdi Exhibit: 3 of 8
Drawn by: S. Mehdi Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

Inlet ID	Structure Type	Height of Structure (ft)	Notes
EFH-IN-007	Double Vane Grate	6.31	
EFH-IN-008	Double Vane Grate	6.43	
EFH-IN-009	Double Vane Grate	6.50	
EFH-IN-010	Double Vane Grate	8.50	
EFH-IN-011	Double Vane Grate	8.40	
EFH-IN-012	Double Vane Grate	4.50	
EFH-IN-013	Double Vane Grate	9.74	
EFH-IN-014	Double Vane Grate	4.50	
EFH-IN-015	Double Vane Grate	4.50	
EFH-IN-016	Double Vane Grate	5.50	
EFH-IN-017	Double Vane Grate	6.20	
JG-IN-001	Double Vane Grate	6.80	
JG-IN-002	Double Vane Grate	5.65	
JG-IN-003	Double Vane Grate	5.46	
JG-IN-004	Double Vane Grate	8.93	
JG-IN-006	Double Vane Grate	5.65	
JG-IN-007	Double Vane Grate	4.93	
JG-IN-008	Double Vane Grate	5.24	
JG-IN-009	Double Vane Grate	9.07	
JG-IN-011	Single Vane Grate	8.03	
JG-IN-012	Single Vane Grate	4.94	
JG-IN-013	Single Vane Grate	4.01	
JG-IN-014	Double Vane Grate	4.50	
JG-IN-015	Double Vane Grate	4.50	
JG-IN-018	Double Vane Grate	4.50	
JG-OS-001	Needs Update	9.00	
JG-OS-001	Needs Update	9.00	

Manhole ID	Height of Structure (ft)	Notes
EFH-MH-008	5.04	
EFH-MH-009	6.96	
EFH-MH-012	6.96	
EFH-MH-013	6.25	
EFH-MH-016	6.37	
EFH-MH-017	7.79	
JG-MH-005	10.54	
JG-MH-009	5.36	
JG-MH-012	8.43	
JG-MH-013	4.50	
JG-MH-014	6.35	
JG-MH-015	5.18	
JG-MH-016	11.05	
OFF-MH-010	14.00	
OFF-MH-011	14.00	
OFF-MH-012	14.00	
OFF-MH-013	14.00	
OFF-MH-014	14.00	
OFF-MH-015	14.00	
OFF-MH-016	14.00	
OFF-MH-017	14.00	
OFF-MH-018	14.00	
OFF-MH-019	14.00	
OFF-MH-020	14.00	
OFF-MH-021	14.00	
OFF-MH-022	14.00	
OFF-MH-023	14.00	
OFF-MH-024	14.00	
OFF-MH-025	14.00	
OFF-MH-026	14.00	
OFF-MH-027	14.00	
OFF-MH-028	14.00	
OFF-MH-029	14.00	
OFF-MH-030	14.00	
OFF-MH-031	14.00	
OFF-MH-032	14.00	
OFF-MH-033	14.00	
OFF-MH-034	14.00	
OFF-MH-035	14.00	
OFF-MH-036	14.00	
OFF-MH-037	14.00	
OFF-MH-038	14.00	
OFF-MH-039	14.00	
OFF-MH-040	14.00	
OFF-MH-041	14.00	
OFF-MH-042	14.00	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-EFH-IN-007	Concrete	24	162.68	9.76	16.38	
P-EFH-IN-008	Concrete	24	98.10	11.49	19.05	
P-EFH-IN-009	Concrete	24	133.47	12.47	20.89	
P-EFH-IN-010	Concrete	24	298.38	13.55	22.89	
P-EFH-IN-011	Concrete	36	151.53	13.78	23.41	
P-EFH-IN-012	Concrete	18	55.61	0.45	0.78	
P-EFH-IN-013	Concrete	36	294.51	17.57	29.52	
P-EFH-IN-014	Concrete	24	65.51	2.82	4.17	
P-EFH-IN-015	Concrete	24	59.44	1.66	3.04	
P-EFH-IN-016	Concrete	36	13.73	18.32	30.88	
P-EFH-IN-017	Concrete	36	91.50	21.13	35.46	
P-EFH-MH-007	Concrete	24	163.65	9.10	15.24	
P-EFH-MH-008	Concrete	24	115.22	11.39	18.92	
P-EFH-MH-009	Concrete	24	159.28	12.34	20.71	
P-EFH-MH-012	Concrete	36	11.90	13.59	23.08	
P-EFH-MH-013	Concrete	36	117.70	13.60	23.15	
P-EFH-MH-016	Concrete	36	224.49	19.52	33.18	
P-EFH-MH-017	Concrete	36	182.57	19.26	32.68	
P-JG-IN-001	Concrete	18	149.44	2.09	3.15	
P-JG-IN-002	Concrete	18	160.11	3.22	5.26	
P-JG-IN-003	Concrete	18	212.23	4.34	7.14	
P-JG-IN-004	Concrete	18	9.76	5.48	8.91	
P-JG-IN-006	Concrete	24	154.50	5.86	9.58	
P-JG-IN-007	Concrete	24	245.87	7.48	12.28	
P-JG-IN-008	Concrete	30	67.59	4.06	6.06	
P-JG-IN-009	Concrete	30	80.10	12.21	19.64	
P-JG-IN-011	Concrete	30	99.80	12.79	20.64	
P-JG-IN-012	Concrete	18	248.19	0.66	1.02	
P-JG-IN-013	Concrete	18	68.61	0.80	1.23	
P-JG-IN-014	Concrete	18	56.58	1.94	3.15	
P-JG-IN-015	Concrete	18	55.77	0.42	0.65	
P-JG-IN-018	Concrete	18	55.16	0.57	0.96	
P-JG-MH-005	Concrete	18	260.96	5.47	8.90	
P-JG-MH-009	Concrete	30	90.01	12.11	19.50	
P-JG-MH-012	Concrete	18	292.53	1.40	2.17	
P-JG-MH-013	Concrete	24	107.23	1.35	2.10	
P-JG-MH-014	Concrete	18	101.60	1.92	3.13	
P-JG-MH-015	Concrete	18	257.96	2.83	4.62	
P-JG-MH-018	Concrete	18	109.98	2.45	4.03	
P-JG-OS-001	Concrete	18	33.14	--	--	
P-JG-OS-002	Concrete	18	38.44	--	--	
P-OFF-FES-002	Concrete	18	11.78	--	--	
P-OFF-HW-004	Concrete	54	66.21	--	--	
P-OFF-MH-010	Concrete	36	145.00	--	--	
P-OFF-MH-011	Concrete	36	145.00	--	--	
P-OFF-MH-012	Concrete	36	145.00	--	--	
P-OFF-MH-013	Concrete	36	70.59	--	--	
P-OFF-MH-014	Concrete	36	135.23	--	--	
P-OFF-MH-015	Concrete	36	145.11	--	--	
P-OFF-MH-016	Concrete	36	145.07	--	--	
P-OFF-MH-017	Concrete	36	145.12	--	--	
P-OFF-MH-018	Concrete	36	144.38	--	--	
P-OFF-MH-019	Concrete	36	144.43	--	--	
P-OFF-MH-020	Concrete	36	145.00	--	--	
P-OFF-MH-021	Concrete	36	145.00	--	--	
P-OFF-MH-022	Concrete	36	84.17	--	--	
P-OFF-MH-023	Concrete	36	65.51	--	--	
P-OFF-MH-024	Concrete	54	147.58	--	--	
P-OFF-MH-025	Concrete	54	145.08	--	--	
P-OFF-MH-026	Concrete	54	145.05	--	--	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-OFF-MH-027	Concrete	54	145.05	--	--	
P-OFF-MH-028	Concrete	54	145.05	--	--	
P-OFF-MH-029	Concrete	54	145.39	--	--	
P-OFF-MH-030	Concrete	54	146.10	--	--	
P-OFF-MH-031	Concrete	54	158.83	--	--	
P-OFF-MH-032	Concrete	66	135.09	--	--	
P-OFF-MH-033	Concrete	66	145.00	--	--	
P-OFF-MH-034	Concrete	66	145.00	--	--	
P-OFF-MH-035	Concrete	66	145.00	--	--	
P-OFF-MH-036	Concrete	72	77.09	--	--	
P-OFF-MH-037	Concrete	72	149.86	--	--	
P-OFF-MH-038	Concrete	72	145.95	--	--	
P-OFF-MH-039	Concrete	72	145.00	--	--	
P-OFF-MH-040	Concrete	72	145.00	--	--	
P-OFF-MH-041	Concrete	72	145.00	--	--	
P-OFF-MH-042	Concrete	72	162.25	--	--	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
OFF-CH-002	Rect Channel	0.71	Concrete	--	22.60	2ft x 1ftdepth
OFF-CH-003	Rect Channel	0.54	Concrete	--	18.70	2ft x 1ftdepth
OFF-CH-004	Rect Channel	0.63	Concrete	--	22.70	2ft x 1ftdepth

ID	Size (in)	Notes
EFH-FES-001	36	
JG-FES-001	30	
JG-FES-002	24	
OFF-FES-002	18	
OFF-FES-003	42	
OFF-FES-004	54	

Legend

	Existing	Proposed
Type R Inlet		
Single Vane Grate Inlet		
Double Vane Grate Inlet		
Type C Inlet		
Type 13 Inlet		
Flared End Section		
Manhole		
Ditch		
Pipe		
100-Yr Floodplain		
Removal		
1' Contour		
Type 3 Guardrail		
Type 9 Barrier		
Bridge		
Right of Way		
Wall		
Ditch Check Dam		
Concrete Slope Paving		
Riprap (D50 = 12")		

0' 25' 100' 200'

Pipe Size Color Table

Proposed

18 inch
24 inch
30 inch
36 inch
42 inch
48 inch
54 inch
60 inch
66 inch
72 inch

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS

Station 2144+00 to Station 2197+00

Design by: S. Criminski Exhibit: 4 of 8
Drawn by: S. Criminski Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

Inlet ID	Structure Type	Height of Structure (ft)	Notes
EFH-IN-001	Double Vane Grate	4.19	
EFH-IN-002	Double Vane Grate	4.50	
EFH-IN-003	Double Vane Grate	4.50	
EFH-IN-004	Double Vane Grate	4.52	
EFH-IN-005	Double Vane Grate	4.50	
EFH-IN-006	Double Vane Grate	4.50	

Manhole ID	Height of Structure (ft)	Notes
EFH-MH-003	4.06	
EFH-MH-004	5.95	
EFH-MH-005	5.99	
EFH-MH-006	5.97	
EFH-MH-007	4.65	
OFF-MH-001	14.00	
OFF-MH-002	14.00	
OFF-MH-003	14.00	
OFF-MH-004	14.00	
OFF-MH-005	14.00	
OFF-MH-006	14.00	
OFF-MH-007	14.00	
OFF-MH-008	14.00	
OFF-MH-009	14.00	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-EFH-IN-001	Concrete	18	289.02	2.33	3.64	
P-EFH-IN-002	Concrete	18	196.95	3.79	6.14	
P-EFH-IN-003	Concrete	18	184.23	4.72	7.79	
P-EFH-IN-004	Concrete	18	57.80	2.32	3.79	
P-EFH-IN-005	Concrete	18	59.44	1.67	2.76	
P-EFH-IN-006	Concrete	24	59.44	1.69	2.77	
P-EFH-MH-003	Concrete	18	258.34	4.64	7.67	
P-EFH-MH-004	Concrete	18	293.90	6.64	11.00	
P-EFH-MH-005	Concrete	18	293.26	7.96	13.25	
P-EFH-MH-006	Concrete	24	171.02	9.23	15.43	
P-EFH-MH-007	Concrete	24	163.65	9.10	15.24	
P-OFF-HW-001	Concrete	36	12.32	--	--	
P-OFF-MH-001	Concrete	36	179.44	--	--	
P-OFF-MH-002	Concrete	36	145.00	--	--	
P-OFF-MH-003	Concrete	36	145.00	--	--	
P-OFF-MH-004	Concrete	36	145.00	--	--	
P-OFF-MH-005	Concrete	36	145.00	--	--	
P-OFF-MH-006	Concrete	36	145.00	--	--	
P-OFF-MH-007	Concrete	36	145.00	--	--	
P-OFF-MH-008	Concrete	36	145.00	--	--	
P-OFF-MH-009	Concrete	36	145.00	--	--	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
OFF-CH-000a	Rectangular Channel	1.6	Concrete	--	26.40	2ft x 2ftdepth
OFF-CH-000b	Rectangular Channel	0.92	Concrete	--	18.30	2ft x 1ftdepth
OFF-CH-001	Rectangular Channel	0.91	Concrete	--	31.20	2ft x 1ftdepth

ID	Size (in)	Notes
OFF-HW-001	36	Concrete Headwall

Legend

	Existing	Proposed
Type R Inlet		
Single Vane Grate Inlet		
Double Vane Grate Inlet		
Type C Inlet		
Type 13 Inlet		
Flared End Section		
Manhole		
Ditch		
Pipe		
100-Yr Floodplain		
Removal		
1' Contour		
Type 3 Guardrail		
Type 9 Barrier		
Bridge		
Right of Way		
Wall		
Ditch Check Dam		
Concrete Slope Paving		
Riprap (D50 = 12")		

0' 25' 100' 200'

N

Pipe Size Color Table

	Proposed
18 inch	
24 inch	
30 inch	
36 inch	
42 inch	
48 inch	
54 inch	
60 inch	
66 inch	
72 inch	

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS

Station 2197+00 to Station 2252+00

Design by: S. Mehdi Exhibit: 5 of 8
Drawn by: S. Mehdi Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

THIS SPACE IS INTENTIONALLY LEFT BLANK

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS

Station 2252+00 to Station 2309+00

Design by: S. Mehdi Exhibit: 6 of 8
Drawn by: S. Mehdi Date: August 17, 2020
Checked by: M. Tilko

Tunnel Alternative

Legend

	Existing	Proposed
Type R Inlet		
Single Vane Grate Inlet		
Double Vane Grate Inlet		
Type C Inlet		
Type 13 Inlet		
Flared End Section		
Manhole		
Ditch		
Pipe		
100-Yr Floodplain		
Removal		
1' Contour		
Type 3 Guardrail		
Type 9 Barrier		
Bridge		
Right of Way		
Wall		
Ditch Check Dam		
Concrete Slope Paving		
Riprap (D50 = 12")		

0' 25' 100' 200'

N

Pipe Size Color Table

	Proposed
18 inch	
24 inch	
30 inch	
36 inch	
42 inch	
48 inch	
54 inch	
60 inch	
66 inch	
72 inch	

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

Inlet ID	Structure Type	Height of Structure (ft)	Notes
CA1-IN-001	Double Vane Grate	4.50	
CA1-IN-002	Double Vane Grate	4.50	
CA1-IN-003	Double Vane Grate	4.50	
CA1-IN-004	Double Vane Grate	4.50	
CA1-IN-005	Double Vane Grate	21.28	
CA1-IN-007	Double Vane Grate	13.88	
CA1-IN-008	Double Vane Grate	12.84	
CA1-IN-009	Double Vane Grate	13.27	
CA1-IN-010	Double Vane Grate	4.50	
CA1-IN-011	Single Type C	9.29	
CA1-IN-012	Single Vane Grate	7.81	
CA1-IN-013	Single Vane Grate	15.25	
CA1-IN-014	Double Vane Grate	3.81	BRIDGE DECK INLET - FYI ONLY
CA1-IN-015	Single Vane Grate	11.37	
CA1-IN-016	Single Vane Grate	4.50	
CA1-IN-017	Double Vane Grate	20.26	
CA1-IN-018	Double Vane Grate	4.05	
CA1-IN-019	Double Vane Grate	3.35	
CA1-IN-020	Single Vane Grate	6.76	
CA1-IN-021	Single Vane Grate	4.50	
CA1-IN-022	Single Vane Grate	4.50	
CA1-IN-023	Single Vane Grate	6.46	
CA1-IN-024	Single Vane Grate	5.69	
CA1-IN-025	Double Vane Grate	5.29	
CA1-IN-026	Double Vane Grate	5.25	
CA1-IN-027	Double Vane Grate	3.82	BRIDGE DECK INLET - FYI ONLY
CA1-IN-028	Double Vane Grate	5.01	BRIDGE DECK INLET - FYI ONLY
CA1-IN-029	Double Vane Grate	5.02	BRIDGE DECK INLET - FYI ONLY
CA1-IN-030	Double Vane Grate	7.51	
CA1-IN-032	Double Vane Grate	5.71	
CA1-IN-035	Single Type C	4.56	
CA2-IN-001	Double Vane Grate	3.81	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-002	Double Vane Grate	3.97	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-003	Double Vane Grate	3.84	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-004	Double Vane Grate	3.89	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-005	Double Vane Grate	3.82	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-006	Double Vane Grate	3.81	BRIDGE DECK DRAIN - FYI ONLY
CA2-IN-007	Single Type C	7.13	
CA2-IN-008	Single Vane Grate	7.89	
CA2-IN-009	Single Vane Grate	4.88	
CA2-IN-010	Single Vane Grate	8.07	
CA2-IN-011	Single Vane Grate	5.32	
CA2-IN-012	Single Vane Grate	5.45	
CA2-IN-013	Double Vane Grate	5.71	
CA2-IN-014	Single Type C	7.47	
CA2-IN-015	Double Vane Grate	8.82	
CA2-IN-016	Single Type C	10.01	
CA2-IN-017	Single Type C	4.50	
CA3-IN-001	Single Vane Grate	3.81	BRIDGE DECK DRAIN - FYI ONLY

Manhole ID	Height of Structure (ft)	Notes
CA1-MH-001	4.60	
CA1-MH-002	4.60	
CA1-MH-003	14.35	
CA1-MH-004	10.28	
CA1-MH-005	15.95	
CA1-MH-006	6.58	
CA1-MH-007	5.62	
CA1-MH-013	6.55	
CA1-MH-014	16.72	
CA2-MH-003	9.32	
CA2-MH-009	14.50	
CA2-MH-010	8.48	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-CA1-FES-007	Concrete	36	28.04	0.00	0.00	CROSS FLOW NOT CALCULATED
P-CA1-IN-001	Concrete	18	132.75	1.63	2.67	
P-CA1-IN-002	Concrete	18	301.61	1.58	2.60	
P-CA1-IN-003	Concrete	18	26.84	3.15	5.23	
P-CA1-IN-004	Concrete	18	77.46	0.65	1.06	
P-CA1-IN-005	Concrete	18	49.36	1.55	2.54	
P-CA1-IN-007	Concrete	18	73.49	2.71	4.90	
P-CA1-IN-008	Concrete	18	22.19	7.53	13.14	
P-CA1-IN-009	Concrete	18	33.20	0.66	1.08	
P-CA1-IN-010	Concrete	18	32.52	0.63	1.03	
P-CA1-IN-011	Concrete	24	87.69	21.84	50.40	
P-CA1-IN-012	Concrete	18	5.24	1.06	1.62	
P-CA1-IN-013	Concrete	30	16.48	23.14	52.92	
P-CA1-IN-015	Concrete	30	277.14	30.56	60.75	
P-CA1-IN-016	Concrete	18	34.49	0.28	0.45	
P-CA1-IN-017	Concrete	18	80.11	0.99	1.47	
P-CA1-IN-018	Concrete	18	79.02	1.24	2.04	
P-CA1-IN-019	Concrete	18	77.88	0.83	1.36	
P-CA1-IN-020	Concrete	30	79.61	30.85	61.43	
P-CA1-IN-021	Concrete	18	34.29	0.45	0.69	
P-CA1-IN-022	Concrete	18	33.54	0.22	0.39	
P-CA1-IN-023	Concrete	30	208.50	31.11	62.05	
P-CA1-IN-024	Concrete	30	142.85	31.34	62.65	
P-CA1-IN-025	Concrete	30	205.96	31.50	63.12	
P-CA1-IN-026	Concrete	30	80.76	31.74	63.75	
P-CA1-IN-030	Concrete	18	14.41	0.85	1.35	
P-CA1-IN-032	Concrete	18	130.85	0.68	1.11	
P-CA1-IN-035	Concrete	18	72.82	1.02	2.22	
P-CA1-MH-001	Concrete	18	69.52	1.59	2.62	
P-CA1-MH-002	Concrete	18	103.21	5.15	8.55	
P-CA1-MH-003	Concrete	18	188.78	7.98	13.90	
P-CA1-MH-004	Concrete	18	142.83	8.22	14.26	
P-CA1-MH-005	Concrete	24	53.54	21.53	50.11	
P-CA1-MH-006	Concrete	30	84.12	30.90	61.62	
P-CA1-MH-007	Concrete	30	79.65	31.64	63.66	
P-CA1-MH-013	Concrete	18	120.59	1.00	2.18	
P-CA1-MH-014	Concrete	18	99.61	2.09	3.49	
P-CA1-OS-001	Concrete	24	196.78	0.00	0.00	POND OUTLET FLOW NOT CALCULATED
P-CA2-FES-001	Concrete	36	74.72	0.00	0.00	
P-CA2-FES-003	Concrete	36	112.13	16.65	38.30	
P-CA2-FES-005	Concrete	18	14.52	4.19	9.64	
P-CA2-FES-007	Concrete	36	137.06	41.29	94.90	
P-CA2-FES-009	Concrete	36	138.64	11.81	27.17	
P-CA2-FES-011	Concrete	36	127.72	15.74	36.22	
P-CA2-FES-013	Concrete	36	144.41	10.86	24.96	
P-CA2-FES-015	Concrete	36	174.57	10.81	29.20	
P-CA2-IN-007	Concrete	18	15.55	0.52	0.63	
P-CA2-IN-008	Concrete	18	165.85	0.48	0.61	
P-CA2-IN-009	Concrete	18	34.80	0.00	0.00	
P-CA2-IN-010	Concrete	18	92.67	0.46	0.59	
P-CA2-IN-011	Concrete	18	34.00	0.00	0.00	
P-CA2-IN-012	Concrete	18	147.85	0.00	0.00	
P-CA2-IN-013	Concrete	18	39.47	0.00	0.00	
P-CA2-IN-014	Concrete	18	13.85	0.00	0.00	
P-CA2-IN-015	Concrete	18	47.81	0.00	0.00	
P-CA2-IN-016	Concrete	18	38.11	0.00	0.00	
P-CA2-IN-017	Concrete	18	53.83	3.08	6.01	
P-CA2-MH-003	Concrete	18	235.31	0.52	0.63	
P-CA2-MH-009	Concrete	36	76.96	10.74	28.99	
P-CA2-MH-010	Concrete	36	100.61	2.89	4.91	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-CA2-OS-001	Concrete	18	63.61	0.00	0.00	POND OUTLET FLOW NOT CALCULATED

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
CA1-CH-001	V Ditch	0.45	Grass	0.96	1.89	
CA1-CH-002	V Ditch	0.42	Grass	1.11	2.37	
CA1-CH-003	V Ditch	9.29	Grass	2.20	3.80	
CA1-CH-004	V Ditch	1.11	Grass	2.07	3.61	
CA1-CH-005	V Ditch	1.18	Grass	10.35	22.93	
CA1-CH-006	V Ditch	1.42	Grass	12.16	26.78	
CA1-CH-007	V Ditch	1.42	Grass	19.38	44.85	
CA1-CH-008	V Ditch	9.29	Grass	19.87	46.16	
CA1-CH-009	V Ditch	1.11	Grass	0.81	1.33	
CA1-CH-010	V Ditch	1.18	Grass	1.22	2.00	
CA1-CH-011	V Ditch	1.42	Grass	0.87	1.34	
CA1-CH-017	V Ditch	6.38	Grass	1.45	2.37	
CA1-CH-018	V Ditch	0.71	Grass	3.39	5.70	
CA1-CH-019	V Ditch	2.93	Grass	0.61	1.00	
CA1-CH-021	V Ditch	17.00	Grass	2.33	3.83	
CA1-CH-023	V Ditch	6.07	Grass	3.79	6.25	
CA2-CH-001	V Ditch	0.33	Grass	0.51	0.84	
CA2-CH-002	V Ditch	0.31	Grass	0.44	0.51	
CA2-CH-003	V Ditch	0.84	Grass	1.76	3.20	
CA2-CH-004	V Ditch	0.88	Grass	3.21	5.99	
CA2-CH-005	V Ditch	0.70	Grass	3.29	6.26	
CA2-CH-006	V Ditch	0.88	Grass	0.34	0.78	
CA2-CH-007	V Ditch	0.72	Grass	3.55	7.15	
CA2-CH-008	V Ditch	0.00	Grass	0.00	0.00	
CA2-CH-009	V Ditch	0.00	Grass	0.00	0.00	
CA2-CH-010	V Ditch	6.19	Grass	0.00	0.00	
CA2-CH-011	V Ditch	6.49	Grass	0.00	0.00	
CA2-CH-012	V Ditch	1.51	Grass	0.00	0.00	
CA2-CH-013	V Ditch	4.56	Grass	6.02	13.84	
CA2-CH-014	V Ditch	1.06	Grass	9.27	23.87	
CA2-CH-015	V Ditch	0.58	Grass	2.23	3.61	
CA2-CH-016	V Ditch	3.32	Grass	4.56	7.46	
CA2-CH-017	V Ditch	0.89	Grass	0.00	0.00	
CA2-CH-018	V Ditch	8.96	Grass	2.46	3.93	
CA2-CH-019	V Ditch	0.00	Grass	0.00	0.00	
CA2-CH-020	V Ditch	4.88	Grass	3.01	5.95	
CA2-CH-021	V Ditch	6.96	Grass	0.00	0.00	
CA3-CH-001	V Ditch	0.31	Grass	0.43	0.71	
CA3-CH-002	V Ditch	3.79	Grass	1.77	2.71	
CA3-CH-004	V Ditch	0.38	Grass	2.04	2.98	

ID	Size (in)	Notes
CA1-FES-002	18	
CA1-FES-003	18	
CA1-FES-004	18	
CA1-FES-005	30	
CA1-FES-006	24	
CA1-FES-007	36	
CA1-FES-008	36	
CA1-FES-009	18	
CA1-FES-010	18	
CA2-FES-001	36	
CA2-FES-002	36	
CA2-FES-003	36	
CA2-FES-004	36	
CA2-FES-005	18	
CA2-FES-006	36	
CA2-FES-007	36	
CA2-FES-008	36	
CA2-FES-009	36	
CA2-FES-010	36	
CA2-FES-011	36	
CA2-FES-012	36	
CA2-FES-013	36	
CA2-FES-014	36	
CA2-FES-015	36	
CA2-FES-026	18	

Legend

Existing / Proposed

- Type R Inlet
- Single Vane Grate Inlet
- Double Vane Grate Inlet
- Type C Inlet
- Type 13 Inlet
- Flared End Section
- Manhole
- Ditch
- Pipe
- 100-Yr Floodplain
- Removal
- 1' Contour
- Type 3 Guardrail
- Type 9 Barrier
- Bridge
- Right of Way
- Wall
- Ditch Check Dam
- Concrete Slope Paving
- Riprap (D50 = 12")

0' 25' 100' 200'

Pipe Size Color Table

Proposed

- 18 inch
- 24 inch
- 30 inch
- 36 inch
- 42 inch
- 48 inch
- 54 inch
- 60 inch
- 66 inch
- 72 inch

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS
Station 5043+50 to Station 5095+00

Design by: S. Criminski Exhibit: 7 of 8
Drawn by: S. Criminski Date: August 17, 2020
Checked by: M. Tilko

Canyon Viaduct Alternative

Inlet ID	Structure Type	Height of Structure (ft)	Notes
CA3-IN-002	Single Vane Grate	12.11	
CA3-IN-003	Single Vane Grate	4.50	
CA3-IN-004	Double Vane Grate	10.12	
CA3-IN-005	Single Type C	7.08	
CA3-IN-006	Single Type C	6.64	
CA3-IN-007	Double Vane Grate	12.83	
CA3-IN-008	Double Vane Grate	20.60	
CA3-IN-009	Single Type C	15.72	
CA3-IN-010	Single Vane Grate	14.84	
CA3-IN-011	Single Vane Grate	7.56	
CA3-IN-012	Single Vane Grate	7.11	
CA3-IN-014	Double Vane Grate	3.82	BRIDGE DECK DRAIN - FYI ONLY
CA3-IN-015	Double Vane Grate	3.81	BRIDGE DECK DRAIN - FYI ONLY
CA3-IN-016	Double Vane Grate	3.81	BRIDGE DECK DRAIN - FYI ONLY
CA3-IN-017	Double Vane Grate	3.82	
CA3-IN-018	Double Vane Grate	3.82	BRIDGE DECK DRAIN - FYI ONLY
CA3-IN-019	Double Vane Grate	3.82	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-003	Single Vane Grate	6.91	
CAFS-IN-004	Double Vane Grate	4.80	
CAFS-IN-005	Single Vane Grate	7.75	
CAFS-IN-006	Double Vane Grate	4.03	
CAFS-IN-007	Single Vane Grate	6.63	
CAFS-IN-008	Double Vane Grate	5.23	
CAFS-IN-009	Double Vane Grate	4.72	
CAFS-IN-010	Double Vane Grate	9.56	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-011	Double Vane Grate	2.84	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-012	Double Vane Grate	12.81	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-013	Double Vane Grate	2.83	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-014	Single Vane Grate	3.32	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-015	Double Vane Grate	2.83	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-016	Double Vane Grate	76.27	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-017	Double Vane Grate	3.28	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-018	Double Vane Grate	48.35	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-019	Double Vane Grate	3.28	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-020	Double Vane Grate	36.09	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-021	Double Vane Grate	5.25	
CAFS-IN-022	Double Vane Grate	3.37	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-023	Single Vane Grate	3.27	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-024	Single Vane Grate	3.27	BRIDGE DECK DRAIN - FYI ONLY
CAFS-IN-025	Double Vane Grate	4.50	

Manhole ID	Height of Structure (ft)	Notes
CA3-MH-001	6.95	
CA3-MH-002	9.79	
CA3-MH-003	20.48	
CA3-MH-004	20.56	
CA3-MH-005	17.86	
CA3-MH-006	9.78	
CAFS-MH-002	4.69	
CAFS-MH-005	8.23	

ID	Material	Diameter (in)	Length (ft)	Q10 (cfs)	Q100 (cfs)	Notes
P-CA3-FES-004	Concrete	36	59.60	16.04	36.86	
P-CA3-IN-002	Concrete	18	28.11	0.57	0.89	
P-CA3-IN-003	Concrete	18	7.11	0.42	0.68	
P-CA3-IN-004	Concrete	18	31.49	3.43	5.85	
P-CA3-IN-005	Concrete	18	15.48	3.42	5.85	
P-CA3-IN-006	Concrete	18	21.42	0.82	1.34	
P-CA3-IN-007	Concrete	18	71.86	0.14	0.22	
P-CA3-IN-008	Concrete	18	28.35	1.34	2.95	
P-CA3-IN-009	Concrete	18	114.74	1.07	2.20	
P-CA3-IN-010	Concrete	18	27.33	0.23	0.44	
P-CA3-IN-011	Concrete	18	49.72	0.39	0.62	
P-CA3-IN-012	Concrete	18	57.52	0.00	0.00	
P-CA3-MH-001	Concrete	36	89.25	16.04	37.48	
P-CA3-MH-002	Concrete	18	76.89	3.41	5.83	
P-CA3-MH-003	Concrete	18	30.50	1.27	2.79	
P-CA3-MH-004	Concrete	18	19.29	1.26	2.76	
P-CA3-MH-005	Concrete	18	156.00	0.98	2.13	
P-CA3-MH-006	Concrete	18	158.60	0.31	0.54	
P-CAFS-FES-008	Concrete	42	115.21	48.32	115.89	
P-CAFS-IN-003	Concrete	18	126.82	1.27	2.24	
P-CAFS-IN-004	Concrete	18	62.25	0.63	1.11	
P-CAFS-IN-005	Concrete	24	185.47	3.94	6.84	
P-CAFS-IN-006	Concrete	18	64.98	1.45	2.49	
P-CAFS-IN-007	Concrete	24	166.91	6.74	11.62	
P-CAFS-IN-008	Concrete	30	113.50	9.24	16.48	
P-CAFS-IN-009	Concrete	18	70.26	0.85	1.49	
P-CAFS-IN-021	Concrete	24	132.92	7.86	14.07	
P-CAFS-IN-025	Concrete	18	67.02	1.22	2.23	
P-CAFS-MH-002	Concrete	18	107.35	1.25	2.21	
P-CAFS-MH-005	Concrete	24	108.99	5.02	8.86	
P-CAFS-OS-001	Concrete	24	236.35	11.79	24.91	

ID	Shape	Depth of flow (ft)	Lining	Q10 (cfs)	Q100 (cfs)	Notes
CA3-CH-003	V Ditch	5.58	Grass	1.80	2.98	
CA3-CH-005	V Ditch	2.35	Grass	0.57	0.89	
CA3-CH-006	Trapezoidal Ditch	5.71	Grass	2.58	4.00	
CA3-CH-007	V Ditch	4.43	Grass	2.59	4.01	
CA3-CH-008	V Ditch	0.37	Grass	0.42	0.68	
CA3-CH-009	V Ditch	0.37	Grass	0.41	0.66	
CA3-CH-010	V Ditch	1.33	Grass	7.09	16.31	
CA3-CH-011	V Ditch	5.79	Grass	10.72	26.90	
CA3-CH-012	V Ditch	0.54	Grass	1.96	3.18	
CA3-CH-013	Trapezoidal Ditch	0.41	Grass	0.40	0.64	
CAFS-CH-001	Trapezoidal Ditch	0.62	Grass	9.09	19.20	
CAFS-CH-002	V Ditch	1.56	Grass	11.51	24.43	
CAFS-CH-003	Trapezoidal Ditch	1.73	Grass	11.96	25.43	
CAFS-CH-004	V Ditch	3.13	Grass	50.72	125.92	
CAFS-CH-005	V Ditch	1.73	Grass	14.87	31.20	
CAFS-CH-006	V Ditch	2.79	Grass	55.59	138.24	
CAFS-CH-007	V Ditch	0.70	Grass	2.41	4.26	
CAFS-CH-008	V Ditch	2.90	Grass	55.17	137.81	
CAFS-CH-009	V Ditch	0.67	Grass	2.23	3.98	
CAFS-CH-010	V Ditch	1.68	Grass	14.87	31.22	
CAFS-CH-011	Trapezoidal Ditch	3.22	Grass	9.12	16.30	

ID	Size (in)	Notes
CA3-FES-002	18	
CA3-FES-003	18	
CA3-FES-004	36	
CA3-FES-005	36	
CA3-FES-007	18	
CAFS-FES-001	30	
CAFS-FES-002	24	
CAFS-FES-008	42	
CAFS-FES-009	42	

Legend

	Existing	Proposed
Type R Inlet		
Single Vane Grate Inlet		
Double Vane Grate Inlet		
Type C Inlet		
Type 13 Inlet		
Flared End Section		
Manhole		
Ditch		
Pipe		
100-Yr Floodplain		
Removal		
1' Contour		
Type 3 Guardrail		
Type 9 Barrier		
Bridge		
Right of Way		
Wall		
Ditch Check Dam		
Concrete Slope Paving		
Riprap (D50 = 12")		

0' 25' 100' 200'

Pipe Size Color Table

Proposed

18 inch
24 inch
30 inch
36 inch
42 inch
48 inch
54 inch
60 inch
66 inch
72 inch

Naming Convention

Structure/Channel Name:
(System Name)-(Structure Type)-###

Pipe Name:
P-(Upstream Structure Name)

CCP-IN-001
P-CCP-IN-001

I-70 Floyd Hill to Veterans Memorial Tunnels

PRELIMINARY DRAINAGE EXHIBITS
Station 5095+00 to Station 5144+00

Design by: S. Criminski Exhibit: 9 of 9
Drawn by: S. Criminski Date: August 17, 2020
Checked by: M. Tilko

Canyon Viaduct Alternative

Attachment C: SWEEP Meeting Notes

Meeting Notes

ATKINS

I-70 Floyd Hill to Veterans Memorial Tunnels

Project:	I-70 Floyd Hill to VMT
Meeting:	**SWEEP Issues Task Force Meeting**
Date:	**April 17, 2018; 1:00 pm to 3:00 pm**
Location:	**CDOT Region 1, 425 Corporate Circle, Golden, CO**

Attendees:
See Attached Sign-in Sheet

Summary of Action Items	Responsibility	Status
1. Obtain information/figure on wetland area preserved by development approval near Floyd Hill/CR 65	Fred	Complete
2. Follow up to see if there are site specific locations that may still be using sand for treatment	Neil	In progress

SUMMARY OF DISCUSSION

[Note: Action items are in **blue**.]

1) Welcome / Introductions

Self-introductions were done by the group

2) Project Overview

Vanessa Henderson (CDOT) gave a project overview as shown in the attached presentation.

Lisa Lloyd (EPA): Is there a summary of the project description? The summary will be included with the notes for this meeting, and will be available on the website (https://www.codot.gov/projects/i-70-floyd-hill-to-veterans-memorial-tunnels-improvements).

Chase Taylor (Pinyon) reviewed the Stream and Wetland Ecological Enhancement Program (SWEEP) committee and the SWEEP Memorandum of Understanding (MOU) (January 2011). https://www.codot.gov/projects/i-70-old-mountaincorridor/final-peis/final-peis-documents/20_App_D_SWEEP_MOU_Signed_01_2011_Rev50.pdf

Clear Creek Sediment Control Action Plan (SCAP) https://www.codot.gov/projects/i-70-old-mountaincorridor/documents/clear-creek-scap-final-report.pdf

Other planning documents/elements considered include:

- A Regional Ecosystem Framework for Terrestrial and Aquatic Wildlife along the I-70 Mountain Corridor (https://www.codot.gov/projects/i70twintunnels/other-documents/plt-technical-team/issued-task-forces/waterresources/A%20Regional%20Ecosystem%20Framework%20for%20Terrestrial%20and%20Aquatic%20Wildlife%20Along%20the%20I-70%20Mountain%20Corridor.pdf)
- Guidelines for Improving Connectivity for Terrestrial and Aquatic Wildlife in the I-70 Mountain Corridor (https://www.codot.gov/projects/contextsensitivesolutions/docs/pdfs/i-70-guidelines-for-enhancing-wildlife.pdf)

Other relevant projects include:

- Veterans Memorial Tunnels (https://www.codot.gov/library/studies/i70twintunnels-environmental-assessment)
- Westbound I-70 Peak Period Shoulder Lane (https://www.codot.gov/projects/i-70-westbound-peak-period-shoulder-lane)

3) Fisheries, Wetlands, and Mining Issues and Concerns

Chase Taylor (Pinyon) reviewed fisheries, wetlands and wildlife concerns as shown in the attached presentation.

4) Mitigation Recommendations

Chase Taylor (Pinyon) discussed the mitigations as identified in the SCAP.

5) Map Review

Maps of the corridor were reviewed by the group. An overview of the discussion for each of the four maps is described below.

Neil Ogden (CDOT): Areas treated by traction sand recently changed – now being used from Empire Junction to 241 interchange (east Idaho Springs), magnesium chloride is being used from 241 to Denver. **Neil will follow up to see if there are site specific locations that may still be using sand.**

Holly Huyck (Clear Creek Watershed Foundation): Traction sand still exists in this area, ponds should be able to capture historic sand and erosion.

Lisa: Design of the corridor needs to keep some flexibility for future decisions (sand vs magnesium chloride)

Map 1

Anthony Pisano (Atkins): Options in the west include tunnel or rock cut. Rock cut would involve moving the creek slightly to the south. Does not change the angle of the road going into the tunnels.

Map comment: look at moving the creek north of the highway

Scott Haas (USFS): Need to be careful and consider geology when moving the creek. Issues were not encountered when work was done for Twin Tunnels.

Holly: Would rather have the tunnel option from a water quality perspective.

Map 2

Allison Michael (USFWS): Can the creek be moved north of the highway? Rather than kept between. May end up being a double move of the creek (move south to build the road, then relocate north).

Gary Frey (Trout Unlimited): Concerned about increased use of magnesium chloride going into the stream, and if that's really worse than the sand. Would like to see a study of comparison between the two.

Holly: Magnesium chloride has impacts on vegetation and reduces what will grow, need a buffer between the road and the stream.

Fred Rollenhagen (CCC): Frontage road issues with sanding/traction, this section of the creek may start to see more activity (potential for more sedimentation into the creek).

Map 3

Fred: a lot of erosion in this area, maybe there would be some opportunities for erosion mitigation coming off of I-70 and onto US 40.

Map 4

Holly: Preble's Meadow Jumping Mouse trapped here in 2004 (NE corner of CR 65).

*Fred: Wetlands on the south side of I-70, county approved development and attempted to preserve wetlands (**try to get figure**) between Floyd Hill and CR 65 (protected in the approval of the subdivision).*

Map comment: provide erosion control

6) Next Steps

Next steps for the project include:

- Next SWEEP meeting (late summer/early fall)
- Field Reconnaissance (wetlands)
- Agency Coordination
- Identify Mitigation
- Coordination with Design Team
- Partnership Opportunities

7) Project Schedule

Upcoming dates for future tasks include:

- Existing Conditions/Data Collection
  - Fall 2017 through 2018
- NEPA/30% Design
  - Winter 2017/2018 through Spring 2020
- Final Design followed by Construction (pending funding availability)
  - Spring/Summer 2020
  - Construction 2021-2024

8) Remaining Questions

Neil: Next meeting is after we have design, will there be more SWEEP meetings? Likely will have more meetings and more information from the field surveys.

Gary: Will the group get to see the field study report/methodology document? Will be included in a short presentation at an upcoming tech team meeting.

Gary: Are there any drinking water concerns with the additional chemicals in the creek? Not that we are aware of.

Sign-In Sheet

ATKINS

I-70 Floyd Hill to Veterans Memorial Tunnels

Project: I-70 Floyd Hill to Veterans Memorial Tunnels EA

Meeting: **SWEEP Issues Task Force Meeting**

Date/Time: **April 17, 2018; 1:00 pm to 3:00 pm**

Location: CDOT Region 1, 425 Corporate Circle, Golden, CO

Initial	Name	Agency	Address	Phone	E-Mail
CAT	Chase Taylor	Piñyon Env.	3222 S. Vance street 5200 Lakewood, CO 80227	303-980-5200	Taylor@pinyon-env.com
HH	Holly Huyck	Clear Creek Watershed Foundation		720-472-1511	hhuyck@phoenixgeoscienceagroup.com
AM	Alison Michael	USFWS		303 236-4758	alison_michael@fws.gov
RMP	Becky Pierce	CDOT HQ		303-512-4051	rebecca.pierce@state.co.us
CW	Carrie Wallis	Atkins			carrie.wallis@atkinsglobal.com
AP	Anthony Pisano	Atkins	7604 Technology way Suite 400, Denver 80237	720-475-7013	Anthony.Pisano@atkinsglobal.com
NO	NEIL OGDEN	CDOT R1	425A CORP CIRCLE GOLDEN CO 80401	(720) 497-6928	neil.ogden@state.co.us
JG	Josh Giovannetti	CDOT R1	South Holly	303 757 9925	josh.giovannetti@state.co.us
JRB	Jacob Beedle	Atkins	7604 technology way	707-373-7618	Jacob.Beedle@Atkinsglobal.com
LB	Lauren Boyle	CDOT R1	425A Corporate Cir	720.930.8604	Lauren.Boyle@state.co.us
LL	Lisa Lloyd	EPA R8	1595 Wynkoop Denver, Co	303-232-7604	lloyd.lisa@epa.gov
JJW	Joe Walter	CPW	6060 Broadway Denver CO	303-916-1180	joseph.walter@state.co.us
SPG	Scott Garncarz	CDPHE	4300 Cherry Creek Drive S. Denver, Co 80246	303-692-2374	scott.garncarz@state.co.us

Sign-In Sheet

ATKINS

I-70 Floyd Hill to Veterans Memorial Tunnels

Project: I-70 Floyd Hill to Veterans Memorial Tunnels EA

Meeting: **SWEEP Issues Task Force Meeting**

Date/Time: **April 17, 2018; 1:00 pm to 3:00 pm**

Location: CDOT Region 1, 425 Corporate Circle, Golden, CO

Initial	Name	Agency	Address	Phone	E-Mail
G	Gary Frey	CTU		3.986.0104	gbfrey@msn.com
FRh.	Fred Rollenhagen	Clear Creek County	POB 2000 Georgetown, CO 80444	3-679-2360	frollenhagen@co.clear-creek.co.us
VH	Vanessa Henderson	CDOT		7/497-6924	vanessa.henderson@state.co.us

I-70 Floyd Hill to Veterans Memorial Tunnels

ATKINS

SWEEP Meeting

April 17, 2018

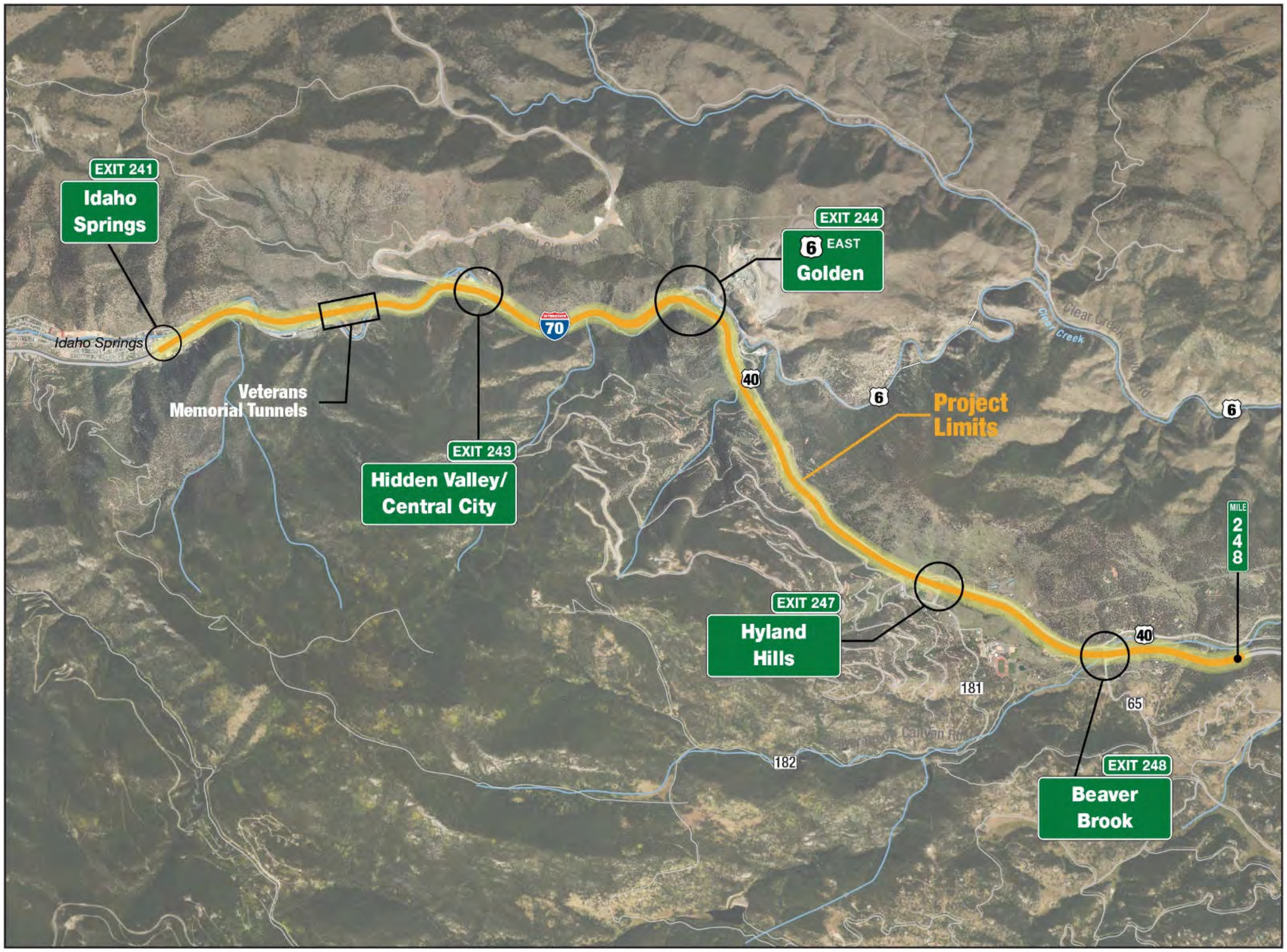
I-70 Floyd Hill to Veterans Memorial Tunnels

Agenda

- Welcome/Introductions
- Project Overview
- Fisheries, Wetlands, and Mining Issues and Concerns
- Mitigation Recommendations
- Next Steps
- Project Schedule
- Questions

I-70 Floyd Hill to Veterans Memorial Tunnels

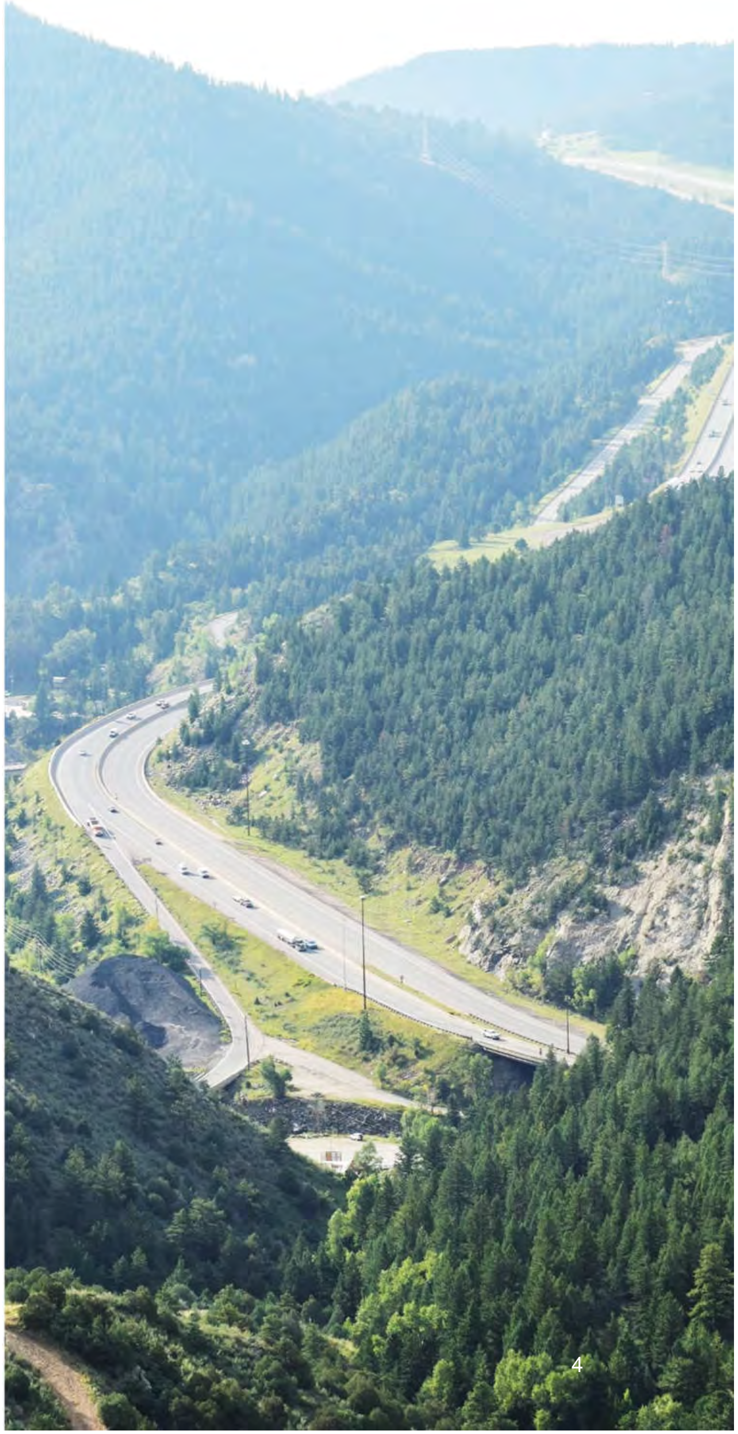
Project Overview and Background



Purpose

The purposes of the I-70 Floyd Hill to Veterans Memorial Tunnels project are to:

- Improve travel time reliability, safety, and mobility and address the deficient infrastructure on westbound I-70 through the Floyd Hill area of the I-70 Mountain Corridor.
- Improve multimodal connectivity and provide an alternate route parallel to the interstate mainline in case of emergency or severe weather conditions.



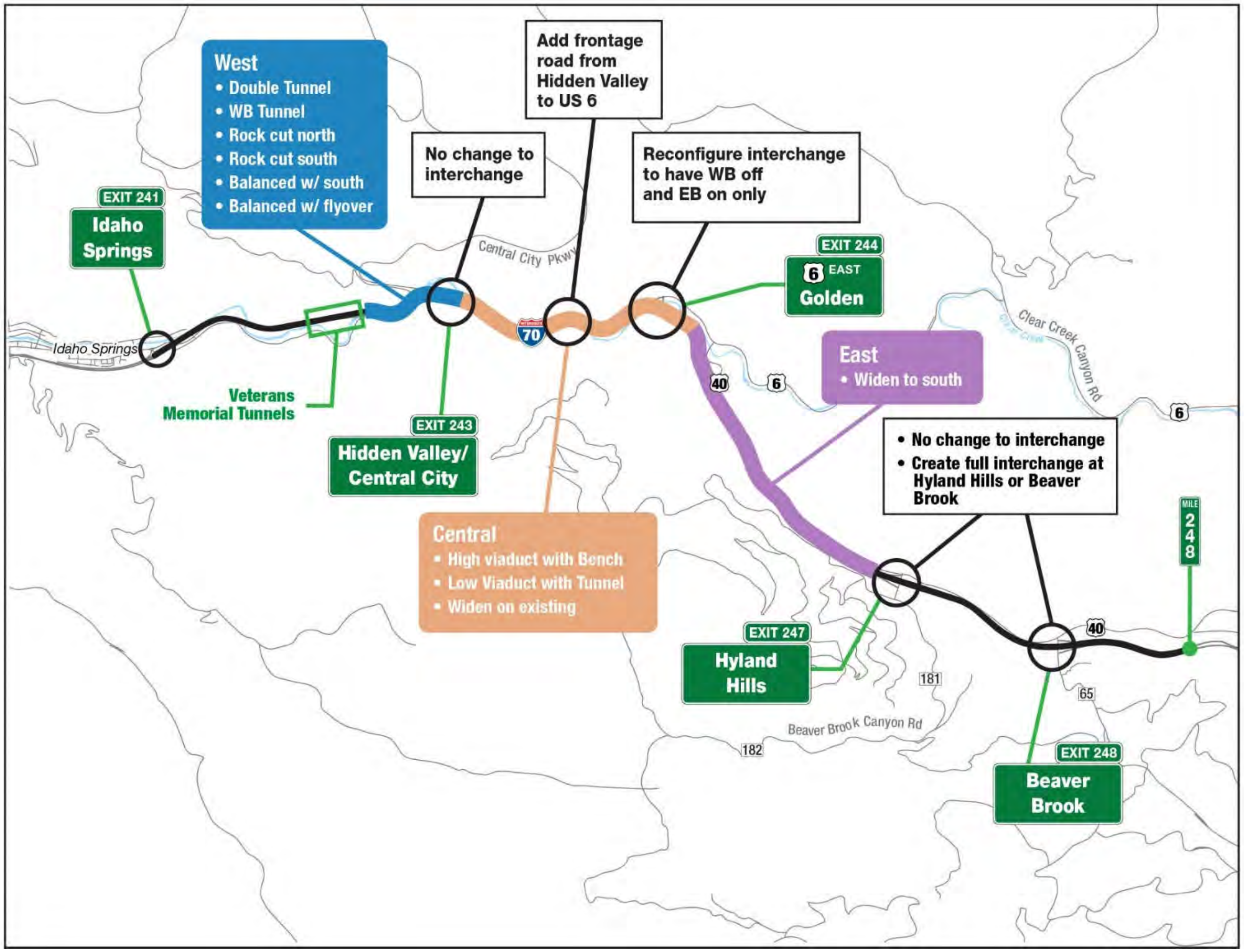
I-70 Floyd Hill to Veterans Memorial Tunnels

Proposed Action

- Provides a 3rd lane from the top of Floyd Hill through the tunnel (2011 ROD)
  - Evaluating options for tunneling, rock cuts, and benches at two locations (bottom of Floyd Hill and just west of Hidden Valley)
  - Evaluating west terminus (dropping 3rd lane and tie-in with WB PPSL)
  - Evaluating need for truck climbing/acceleration lane with eastbound on-ramp addition at US 6
  - Evaluating additional intersection and interchange improvement needs throughout
- Addition of trail and frontage road between tunnel and US 6 (2011 ROD)
- Evaluating eastbound curve safety improvements

I-70 Floyd Hill to Veterans Memorial Tunnels

Design Options



I-70 Floyd Hill to Veterans Memorial Tunnels

SWEEP Committee

The I-70 Mountain Corridor passes through several watersheds that support numerous aquatic resources.

- I-70 impacts water quality and viability of watershed ecology.
- Lead agencies formed a working group to address these issues through the Stream and Wetland Ecological Enhancement Program (SWEEP) committee.
- The committee works to identify and recommend appropriate mitigation strategies
- The SWEEP Memorandum of Understanding (MOU) (January 2011)
- This allows for holistic consultation and documentation by streamlining this process for all projects along the corridor.

I-70 Floyd Hill to Veterans Memorial Tunnels

Planning Elements

Clear Creek Sediment Control Action Plan (SCAP) finalized in 2013

- SCAP study area covers 33 mile Clear Creek I-70 Corridor from EJMT to Beaver Brook
- Recommends sediment control BMPs for highway-related impacts
- Three areas identified as higher priority for highway sediment and nutrient loading (FH).
- Areas with highly mineralized rock cuts or mine waste residuals were identified
- Other areas in general should use sediment control improvements as detailed in the SCAP




Photos: CDOT

Planning Elements

- SWEEP MOU and Implementation Matrix
- A Regional Ecosystem Framework for Terrestrial and Aquatic Wildlife along the I-70 Mountain Corridor
- Guidelines for Improving Connectivity for Terrestrial and Aquatic Wildlife in the I-70 Mountain Corridor

Photos: CDOT

I-70 Floyd Hill to Veterans Memorial Tunnels

SWEEP Implementation Matrix

Considerations during project development:

- Sediment management
- CWA Section 303 (d) list
- Mine workings in I-70 right-of-way
- Mine waste as road bed
- Wetlands protection
- Special status species
- Aquatic species as a recreation resource
- Information and research needs.

Other Relevant Projects

Veterans Memorial Tunnels

- Completion date 2015
- Implemented Clear Creek water quality monitoring program for Hidden Valley segment

Westbound I-70 Peak Period Shoulder Lane

- Environmental Evaluation and Analysis in Progress
- Approximately Fall 2018 for final design followed by construction

I-70 Floyd Hill to Veterans Memorial Tunnels

SWEEP Issues Discussion

Identify:

- Initial list of issues and concerns
- Information and data needs
- Initial mitigation recommendations

Graphic: Google Images

I-70 Floyd Hill to Veterans Memorial Tunnels

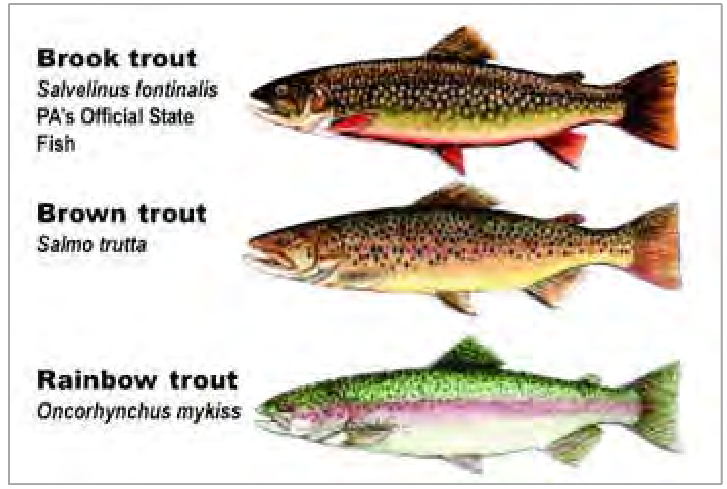
Initial Stakeholder Concerns

- Clear Creek is a high value fishery
- Channelization of Clear Creek
- Clear Creek Sediment Control Action Plan
- Minimize wetlands impacts
- Stream Cross Drains should be fish friendly
- Mining waste and mineralization
- Recreational Use and Quality of Experience
- Maintain fishing access

Issue: Fishery and Aquatic Species

Fish

- Brown trout
- Rainbow trout
- Brooke trout
- Cutthroat trout
- Various Suckers
- Benthic Invertebrates



Graphic: www.fishandtrout.com

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Fishery and Aquatic Species

Construction and Maintenance Elements

- Increased storm water runoff from impervious surface
- Drainage Pattern Changes
- Petroleum discharge from spills and vehicles
- Maintain fish passage upstream/downstream during construction
- Sedimentation

Photo: www.streamcontinuity.org

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Wetlands

- Multiple potential wetlands identified in the project area
- Primarily associated with Clear Creek and Beaver Brook (eastern end)
- Potential for wetlands along Sawmill Gulch, Johnson Gulch and unnamed tributaries
- Potential for impacts

Photo: Google Images

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Mine Waste & Mineralization

- Mine Waste Residuals
- Mineralized Rock Cuts
- Historic Mining Claims and Shafts

Photo: www.mindat.org

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Water Quality

- Floyd Hill identified in SCAP as one of three higher priority areas for erosion and sediment control
- High sedimentation rates resulting from slope erosion and traction sand from Beaver Brook (MP 248) to MP 244 (US 6)

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Water Quality

- Impacted streams include Beaver Brook, Johnson Gulch, and Clear Creek
- SCAP integrates westbound and eastbound drainage and sediment control BMPs
- SCAP improvements also specified for 2-mile Hidden Valley segment.

I-70 Floyd Hill to Veterans Memorial Tunnels

Issue: Water Quality

- Baseline water quality data available for Clear Creek in Hidden Valley area for highway-related sediment/salt loading.
- Clear Creek is identified as 303(d) listed water body requiring TMDL's (COSPCL11 Mainstem of Clear Creek from a point just above the Argo Tunnel discharge to the Farmers Highline Canal diversion in Golden, Colorado)
  - Cadmium (Dissolved) High Priority (Roadway Pollutant of Concern per CDOT's MS4 Permit)
  - Temperature High Priority

I-70 Floyd Hill to Veterans Memorial Tunnels

Mitigation Recommendations

- Implement improvements identified in the SCAP as appropriate
- SCAP for Floyd Hill area identifies the following:
  - 32 sediment basins
  - Inlet sediment traps
  - Culvert pipe rundowns to prevent slope erosion
  - Implement standard construction BMPs
  - Develop a construction Materials Management Plan
- Aquatic permeability should be improved if culverts are replaced

I-70 Floyd Hill to Veterans Memorial Tunnels

MAP REVIEW

- Considerations for Central Section
- Considerations for West Section

I-70 Floyd Hill to Veterans Memorial Tunnels

Next Steps

- Next SWEEP meeting (late summer/early fall)
- Field Reconnaissance (wetlands)
- Agency Coordination
- Identify Mitigation
- Coordination with Design Team
- Partnership Opportunities

I-70 Floyd Hill to Veterans Memorial Tunnels

Schedule

- **Existing Conditions/Data Collection**
    - Fall 2017 through 2018
- **NEPA/30% Design**
    - Winter 2017/2018 through Spring 2020
- **Final Design followed by Construction***
    - Spring/Summer 2020
    - Construction 2021-2024

**Pending funding availability*

I-70 Floyd Hill to Veterans Memorial Tunnels

Questions

Meeting Notes

I-70 Floyd Hill to Veterans Memorial Tunnels

SNC·LAVALIN | ATKINS Member of the SNC-Lavalin Group

Project: I-70 Floyd Hill to Veterans Memorial Tunnels NEPA and 30% Design
Meeting: 21912 Floyd Hill SWEEP #2
Date: October 25, 2018
Location: CDOT Golden Region 1, Lookout Mountain

Summary of Action Items	Responsibility
1. Complete wetlands functional assessment.	Atkins
2. Set up meeting with CDOT Maintenance to determine existing vehicles and dimensions, maintenance activities and requests, traction sand application rates.	Atkins
3. Discuss BMP locations with CDOT Maintenance.	CDOT
4. Confirm that CDOT maintenance is aware of fire suppression emergency vault and procedures for closing the valve.	
5. Confirm BMP ponds will drain within 24 hours as required (to mitigate against standing water).	Atkins
6. Determine and map groundwater elevations to aid in impact analysis and design	Atkins
7. Review as-builts and incorporate existing BMP locations into proposed design as applicable.	Atkins
8. Evaluate impacts of snow plowing over creek locations and consider opportunities to reduce snow from entering creek directly.	Atkins
9. Note that the curve modifications reduce the potential for truck overtopping and hazardous spills and need for sand oil separators. This note should be incorporated into the sediment control design and hazmat section of the EA and technical report.	Atkins
10. Provide project update to the Upper Clear Creek Watershed Association	CDOT
11. Show wetland areas in roll plots for future meetings.	Atkins
12. Provide total impervious area and the capture volume of the BMPs.	Atkins

Summary of Discussion

The SWEEP Issue Task Force meeting #2 followed the attached agenda and presentation followed by a roll plot discussion of specific sediment control recommendations. Attendees are indicated in the sign-in sheet. The Blue notes indicate decisions made during the meeting. *Green* notes indicate notes and discussions after the meeting.

1. Introductions

2. Issues and Actions from SWEEP Meeting No. 1

- a) Water Quality Concerns Raised Previously
  - i) Creek geology and moving the Creek
  - ii) Sediment generated with moving the Creek and associated turbidity
  - iii) Wetland complex at Beaver Brook
  - iv) Methodology for Environmental Assessment
    - a) Project location is outside of a MS4 Permit area
    - b) Concern with Magnesium Chloride (MgCl) and other salts that cannot be captured; monitoring shows an overall increase in chlorides in the Creek
- b) Status of Action Items from Meeting No. 1
  - i) Complete wetland investigations
    - a) Wetland delineation completed
    - b) Wetland functional assessment will be completed
    - c) Potential fen wetlands tested in the Beaver Brook area; while soil testing (conducted by Colorado State University laboratory per USACE standards) showed organic soils, the testing did not support fen designation
  - ii) Confirm maintenance use of traction sand
    - a) Maintenance continues to use sand, especially on Floyd Hill due to steep grades. *After the SWEEP meeting, Maintenance confirmed that they no longer use sand east of the Veterans Memorial Tunnel (VMT) (even for traction) and only use Ice Slicer*
    - b) Warmer winters leads to less application of sand, sand is weather dependent
    - *c)* Design team intends to meet with Maintenance to document application rates *After the SWEEP meeting, Maintenance confirmed the application rate for sand is zero (the SCAP assumptions are too high)*
  - iii) Concern about effects if chlorides from deicers entering the Creek
      - (a) Sand is more natural and preferred (Jim Ford) since the Black Hawk treatment plant can filter out the sand
      - (b) There are no readily available BMPs to capture chlorides
      - (c) CDOT continues to do research on deicers
    - b) Need to continue coordination with Black Hawk regarding potential effects of chlorides on town water supply (intake located within the project area)

3. Proposed Action Updates: Design proposes moving approximately 1,000 feet of the Creek between VMT and Hidden Valley approximately 50 feet to the south. In this reach:

- a) Highly channelized; no spawning habitat per CPW
- b) EA needs to evaluate impacts to fishing and rafting; these may be in conflict
- c) Creek modifications could provide opportunity for enhancements
- d) 404 permitting could not rely on restoration NWP as the primary purpose is for transportation
- e) SWEEP ITF is interested in reviewing and providing input to the tunnel and creek realignment designs as these elements are advanced.

4. Water Resources Updates

- a) Wetlands and waters of the U.S.

i) Field delineations conducted for most of study area. In cases where properties were inaccessible (right of entry not granted), an advanced desktop review was conducted for properties.
ii) Organic material was identified within two wetland complexes at the top of Floyd Hill: High-quality wetlands; however, not classified as fen wetlands based on CSU lab results—7% Total Organic Compound (TOC) versus the 12% TOC required to classify as fen.
iii) Wetland and waters of the U.S. are associated Clear Creek and Beaver Brook

b) Streams and Riparian Areas
i) CPW monitored fish populations in the stretch of Clear Creek east of the VMT from 2012 to 2017 (associated with the Twin Tunnels project commitments)
a) No spawning areas in the area east of the improved section (after the bend at the doghouse rail bridge): Mostly resulting from channelization (the channelized section is favorable to rafting)
ii) Boreal toads are not present in the project area based to Mandy or Chase's knowledge. *After the meeting, Mandy consulted with the wildlife discipline lead and confirmed that boreal toad habitat has been mapped by Colorado Parks and Wildlife, and the eastern edge of suitable habitat is about 10 miles west of the Floyd Hill Project study area.* Channelization of Clear Creek is a challenge for stream health as channelization increases stream erosion, transports more sediment, accelerates velocity of the water, and reduces vegetation along the stream bank resulting in poor habitat.
a) Gary Frey provided input to the factors needed to assess stream health and habitat potential, such as water quality, flow, and stream structure, such as sinuosity and presence of pools, shelters, and barriers.
iii) Sedimentation
a) Sediment enters streams in the Project area from erosion generated from offsite sources and rock/landslides, winter maintenance of the highway, and mining influences, including metal runoff from mill sites
b) Upper Clear Creek Watershed Association has water quality information for reference. The Upper Clear Creek Watershed Association would also be in interested in a project update. CDOT will coordinate an update for them.
iv) Response to hazmat spills has not yet been determined or coordinated with the state Fire Marshall. No determination has been made whether Hazmat vehicles will be allowed though the proposed tunnel or need to detour around on the frontage road. Additional discussion and coordination to occur in later design phases.
v) Stream enhancements must consider rafting, fishing, and water recreation, including access to minimize impacts to channel health and function

c) Winter Maintenance
i) SWEEP would prefer the use of sands instead of salt
ii) Plowing practices and associated snow storage need to be considered and incorporated into the design

5. Sediment Control

a) Sediment Control Action Plan (SCAP) Recommendations

i) The SCAP is a planning-level document that provides a menu and identification of potential BMPs that could be incorporated into future I-70 projects in the Clear Creek watershed, as appropriate

ii) Within the Floyd Hill Project Area, numerous BMPs are identified (as described later in the meeting)

b) Project Approach and BMP Recommendations

The design team developed a venn diagram to illustrate the three overlapping considerations in developing sediment control facilities: engineering, maintenance, and environmental. Each of these factors is important to ensuring feasible facilities that can be maintained and integrated into the landscape into the future.

i) Engineering: Feasibility, efficiency, size and cost:

a) Effectiveness is most important feature of a BMP

(a) Holly Huyck indicated that a facility that works may not be aesthetically pleasing is preferable to one that does not work as well but looks nice.

(b) Need to capture sediment and drain properly

(i) The basin design at the east end of the Lawson bridge does not drain, and standing water has attracted mosquitos.

(ii) Jo Ann Sorenson receives annual reports on the structures from the EB PPSL project that show the structures are not capturing sediment. Need to design them so that they work. *Based on discussions with Maintenance after the meeting, the lack of sediment may also be due to the lack of sand use in the area.*

ii) Maintenance

a) Maintenance of sediment control facilitites is critical to their long-term effectiveness.

b) Maintenance prefers fewer facilities that can be safely accessed within existing environments

c) Ideally maintenance would occur on an annual schedule (i.e., the facilities are large enough to hold a full season of sediment)

iii) Environmental: Natural looking, effective

a) BMP location and sizing should consider resiliency; proposed location should not be too close to Clear Creek. If they are within the 100-year floodplain, they need to be designed to withstand flooding impacts

b) It was recommended that grass not be planted adjacent to the roadway because it attracts wildlife closer to the roadway and may increase wildlife vehicle collisions

c) BMP Menu Overview: SCAP proposed versus Floyd Hill Conceptual Proposed BMP Design

i) Based on a review of the various criteria within the engineering, maintenance, and environmental categories, the design team has proposed two primary BMP types (basins and swales) that best balance the needs.

ii) Sediment Basins:

a) 27 shown in the SCAP

b) 12 Proposed with the Project design

iii) Roadside Swales

a) Proposed with the Project due to limited right-of-way and trying to limit the Project's disturbed area.
b) The swales will provide some treatment of runoff prior to being discharged into Clear Creek

iv) Loading Dock Traps:
a) 3 shown in the SCAP
b) 1 proposed with the Project because there is no room for a sediment basin in that area.
c) The location is not in a highly visible area based on the current proposed design and the design will ensure that it is as minimally visible as possible

v) Inlet Sediment Traps:
a) 26 in the SCAP
b) None proposed for the Project
c) Dangerous and difficult to maintain because Maintenance has to do a lane closures at night to clean them
d) Not effective because they are not maintained

6. Open Discussion: Walk through roll plot: See notes on attached roll plot pdf

a) Jo Ann noted that the sediment basin installed at the east end of the EB PPSL project holds water and generates mosquito larvae. Josh Giovannetti believes it's because the BMP is not working correctly. Note that the WB PPSL project will be fixing the Lawson sediment basin.
b) Loading dock trap at the east end of the VMT is for spills, materials used during fires in the tunnels, and sediment capture; this one needs to be noted and maintained in the design
c) Recommended communication and hand off; provide a map of BMPs to:
   i) Maintenance
   ii) Fire response
d) Design considerations/review:
   i) Station 1022+00: Capture area (tunnel to bridge) sediment basin is just upstream of the intake: Proposed design must not impact or modify the existing water intake for the Black Hawk water treatment facility
   ii) Permanent Water Quality (PWQ) Outlet Structure must have a well screen to mitigate clogging and ensure better performance
      a) May need to modify existing PWQ feature from Central City and treat some of I-70
         (a) Approximate location is north of the highway and may be in between I-70 and CC Pkwy to the west of the treatment plant
         (b) Need to coordinate with Central City because this location is one of their PWQ features.
      b) Tunnel hazmat containment will be taken care of in future phases of design
      c) Existing pond east of the proposed loading dock is filled with water (is not functioning properly)
      d) Acquire groundwater information at all proposed sediment basin locations in future phases of the project.

iii) Three informal ponds just west of U.S. Highway 6 (US 6); Atkins to investigate further. *After the SWEEP meeting, Atkins reviewed as-builts and conducted field investigations to locate these informal ponds; however, the review and field investigation could not identify these ponds. As a result, the "three informal ponds" will not be considered in design.*
iv) Step/tier ditches: Coordinate design to ensure that CDOT Maintenance vehicles are accommodated
v) Clean outs: Adhere to CDOT criteria for manhole spacing
vi) Possibility to have a PWQ facility east of US 6 where the rafters currently pull out of the Creek; however, there's a concern that trying to make something work within the site constraints will remove efficiency of a small PWQ facility.
vii) Wildlife crossing: One large one at the top of Floyd Hill East of project and will add separated benches whenever the opportunity arises under bridges to allow for better crossings such at the US 6 interchange
viii) Coordinate future development work at east end of the project
ix) Review as-builts and incorporate existing conditions into the proposed design
x) West end by the bridges:
    a) Shoulder width is 6 ft inside and 10 ft outside
    b) Storage cannot occur on bridges, lanes and medians must be clear for vehicle access
    c) Specific areas for snow storage not included in the design but can consider snow capture options for specific areas such as bridges and over the Greenway/creek
    d) Ensure that snow does not get plowed onto the Greenway and limit use of the recreational area
xi) Sand Oil Separators: Concerns with spills from overturned trucks going into Clear Creek
    a) Just east of the VMT, trucks frequently overturn; Proposed improvements will smooth that curve out, which should help with trucks overturning
    b) Provide verbiage that indicates the design smooths out curves, which reduces the potential for track overtopping and spills. As a result, sand oil separators are not anticipated. This should occur within sediment control design and hazmat section of the environmental documents.
    c) Considering providing an Incident Management Plan in future phases of the project.

Summary of Decisions Made

1. Stream enhancements must consider rafting, fishing, and water recreation, including access to minimize impacts to channel health and function.
2. Best management practice (BMP) sizing should consider erosion coming off the mountains, winter maintenance activities, and mining influences/metal runoff.
3. BMP location and sizing should consider resiliency. Proposed location should not be too close to Clear Creek, within the 100-year floodplain, and designed to withstand flooding impacts.
4. BMP design must place grass on the non-highway side so that animals refrain from eating grass adjacent to the highway.
5. Focus on maximizing snow capture abilities for specific areas such as bridges and over the Greenway.
6. Sand oil separators are not required as proposed roadway alignment smooths out curves, which reduces the potential for track overtopping and spills.

COLORADO
Department of Transportation
Region 1

Region 1 West Program
425 A Corporate Circle
Golden, CO 80401

Floyd Hill – SWEEP Committee Meeting #3

Meeting Summary

May 14, 2020, 1:00 PM to 4:00 PM

Virtual Meeting – Google Hangouts

1. Welcome and Agenda Review

Vanessa Henderson, CDOT, welcomed the group, explained some basics of the online format and Google Hangouts platform, and did a roll call of participants:

- Amy Saxton, Clear Creek County
- Anthony Pisano, Atkins
- Billy Bunch, Environmental Protection Agency (EPA)
- Carol Coates, Atkins
- Chase Taylor, Pinyon Environmental
- Gary Frey, Trout Unlimited
- Holly Huyck, Upper Clear Creek Watershed Association
- Jim Ford, Black Hawk
- Jordan Falzetti, Atkins
- Joe Walter, Colorado Parks and Wildlife (CPW)
- Josh Giovannetti, CDOT
- Keith Hidalgo, Atkins
- Kevin Shanks, THK
- Kristin Salamack, US Fish and Wildlife Service (CDOT liaison)
- Mandy Whorton, Peak Consulting Group
- Matt Hubner, EPA
- Matt Montgomery, US Army Corps of Engineers (USACE)
- Melinda Urban, Federal Highway Administration (FHWA)
- Neil Ogden, CDOT
- Paul Winkle, CPW
- Becky Pierce, CDOT
- Scott Garncarz, Colorado Department of Public Health and Environment, Water Quality Control Division
- Stephanie Gibson, FHWA
- Tammy Eggers, Atkins
- Tom Matthews, US Forest Service
- Valerie Thompson-Van Ryzin, US Forest Service

Region 1 West Program
425 A Corporate Circle
Golden, CO 80401

Vanessa reviewed the agenda and thanked everyone for the robust participation. The presentation from the meeting is attached to these notes for reference.

2. Project Status and Alternatives

Vanessa reviewed project updates since the SWEEP Committee met in October 2018 ahead of the 109/110 ballot initiatives. After the failure of those initiatives, CDOT reassessed and regrouped in 2019, completing existing conditions surveys and reports and continuing to pursue Project funding. CDOT also developed a new alternative, the Canyon Viaduct Alternative. The new CDOT Administration also conducted a 10-year project planning effort to identify a 10-year pipeline of priority projects for the state. The Floyd Hill Project was validated as a priority through this process, and in late 2019, CDOT obtained funding to complete the EA including both the Tunnel and Canyon Viaduct Alternatives. The EA is expected to be released in Fall 2020 with a public hearing in late Fall 2020/early Winter 2021. A decision document would be released in Spring 2021 if construction funding for the Project is identified.

Vanessa reviewed the Project alternatives. She explained that the major Project elements are the same in both alternatives but differ in how they are implemented between US 6 and Hidden Valley interchanges (referred to as the central section of the Project).

Gary Frey asked about the current thinking on the tunnel design length. Vanessa said it was about 2,200 feet.

3. Water Quality and Aquatic Conditions

Mandy Whorton reviewed the existing conditions in the Project area and reviewed the SWEEP framework and issues raised in the previous 2017 and 2018 meetings. Clear Creek, Beaver Brook, Sawmill Gulch, and Johnson Gulch are all located within the Project Area, and Clear Creek is located adjacent to I-70 throughout the western portion of the project from US 6 to the Veterans Memorial Tunnels. Clear Creek through the Project area is highly valued for rafting, fishing, and recreation. While there are some areas with wetlands and riparian habitat, much of the creek is channelized and constrained. Beaver Brook crosses I-70 in the eastern portion of the project and, within the project area, supports high-quality wetland and riparian habitat, including potential Preble's Meadow Jumping Mouse habitat. Both Clear Creek and Beaver Brook have regulated floodplains and fall under Section 404 jurisdiction and Senate Bill 40 (SB 40) certification. Sawmill Gulch and Johnson Gulch flow to Clear Creek and are under Section 404 jurisdiction. Neither has a regulated floodplain, and Sawmill Gulch lacks riparian habitat under SB 40 certification requirements.

The SWEEP MOU and Implementation Matrix considerations for project development nearly all apply to the Project. Issues raised at previous SWEEP meetings include water quality, including coordination of best management practices (BMPs) with maintenance practices; wetlands; and issues associated with realigning Clear Creek.

Question: In the stream relocation area will you be reducing the width of the creek?

Answer: No, the width won't change. But the stream channel takes up most of the space so there isn't a lot of room to widen the channel or do any bank mitigation in this area. Tammy Eggers confirmed that the flow would be the same and that to meet peak flows, the channel could not narrow.

Question: What is planned for the wetlands around Black Hawk intake? Are you planning to construct additional wetlands in this area?

Answer: This is identified as an area where there is potential for mitigation to occur, but the team is aware that any work in the area cannot affect Black Hawk's water intake.

4. Water Quality

Stochastic Empirical Loading and Dilution Model (SELDM) Modeling

Jordan Falzetti provided an overview of the SELDM model and its use for the Project to inform the design and water quality approach.

Question: How were the differences between the alternatives analyzed with respect to the proposed scenario?

Answer: The Project was not analyzed separately for the different alternatives because the model is not detailed enough for that. The existing conditions were compared to the results for the Project (both alternatives).

Josh Giovannetti explained that CDOT hasn't had a lot of experience using SELDM modeling and for this project, it is being used primarily as a guideline to look at treatment effectiveness.

Holly Huyck said she is very familiar with the model based on her previous experience at CDOT in helping to develop and implement it. She suggested that the differences for the total impervious surface for each alternative should be calculated, and if it is more than 10 percent, additional analysis/modeling may be appropriate. She offered that an offline discussion might be beneficial. Josh said he would work with Vanessa to set up a meeting to discuss the details offline. (Subsequent to the meeting, Atkins provided impervious surface numbers. The existing is 68 acres, the Tunnel Alternative is 90 acres, and the Canyon Viaduct Alternative is 89 acres.)

BMP Selection

Jordan reviewed the Project's pollutant-focused, tiered approach to water quality. The approach incorporates formal water quality BMPs, such as detention basins, to mitigate the majority of roadway runoff and informal water quality BMPs, such as vegetated ditches, to mitigate roadway runoff with site constraints. He noted that, as discussed at the last SWEEP meeting in October 2018, the Sediment Control Action Plan (SCAP)-recommended BMPs focused on traction sand treatment and numerous, small facilities that were difficult for CDOT maintenance to access and maintain. The proposed BMPs reflect the new approach and have been updated to reflect changes in Project alternatives.

Jordan reviewed the water quality needs and proposed BMPs by Project section. In the east section (Floyd Hill), the main issue is chlorides, and because of the steep grade at Floyd Hill, this area receives both high and frequent application of de-icers. The primary treatment is through vegetated shoulders and engineered ditches. Constructed wetlands are also being considered in the area where de-icing agents concentrate; if they are successfully established, they can be very effective with uptake of chlorides.

In the central and west sections (Clear Creek), sediments, including metals, and chlorides need to be treated. In this area, larger basins could be included and are proposed under both the Tunnel and Canyon Viaduct Alternatives. The Tunnel Alternative has opportunities for larger basins in comparison to the Canyon Viaduct Alternative.

Question: What was the percentage of chloride reduction assumed for the BMPs in the model?

Answer: Between 1 and 10 percent for ponds and between 10 and 20 percent for swales

Question: How will the swales be maintained?

Answer: CDOT maintenance would maintain swales. Because pollutants would flow over natural vegetation on the way to swales to help removal (vegetation uptake), so even if swales are not well maintained, the system would still reduce pollutants and concentration of chloride. Josh stated that these are initial recommendations that will be refined in the next level of design.

Question: Is there evidence of arsenic in the area that would make it a concern? It was an issue on the Superfund site upstream.

Answer: Josh reviewed the Twin Tunnels Monitoring Report and noted that arsenic was not monitored, and after double checking the list of pollutants, said arsenic is listed on the MS4 Permit. Holly said the Colorado Water Quality Control Commission (CWQCC) is holding off on standards for arsenic because it is naturally occurring and found in almost every watershed in the state. Further, if arsenic was being treated, the same recommendations would apply as to other metals that are being captured in sediment ponds.

Holly expressed support for including larger detention facilities in the design because they are easier and more efficient for CDOT maintenance to clear out, which makes them more effective.

(Subsequent to the meeting, Atkins provided criteria in how pollutants were selected as project area in not in CDOT's municipal separate storm sewer system (MS4) Permit area. Pollutant selection was based on the EPA's 2016 Waterbody Report, with this section of Clear Creek having a 303(d) listed impairment for cadmium, lead, temperature, and zinc. Upon further review, stakeholder coordination recommended additional pollutants to review which finalize the pollutants of concern as cadmium, chloride, copper, lead, sediment (total suspended solids), and zinc.

Question: Did you consider the potential for airborne chlorides? University of Northern Colorado (UNC) did a study on Straight Creek in 2007 that indicated that airborne chlorides disturbed from vehicles driving on dry roads were aerosolizing and damaging the pine forest up to 100 yards away.

Answer: This would be similar to other re-entrained particles that CDOT has BMPs, like street sweeping, to mitigate. Holly explained that CDOT has sponsored at least three different studies, and they don't all agree with each other. A common conclusion is that avoiding overspray in the application is one of the most effective ways to reduce chlorides in roadside vegetation. Also, it appears mag chloride affects riparian and aspens less than the evergreen trees, probably because it is applied during winter when plants and trees are dormant.

5. Wetlands and Waters of the US

Chase Taylor reviewed preliminary Project direct impacts for wetlands and open waters. The Tunnel and Canyon Viaduct Alternatives have slightly different impacts, as do the North and South frontage road options for the Tunnel Alternative. The largest Project impact is from relocation of Clear Creek at the west end of the Project, which is common to the alternatives and both design options.

Small impacts, less than an acre total, to many of the delineated waters would occur under all Project alternatives and design options. Wetland impacts are less than one-thousandth of an acre under all alternatives (40 to 44 square feet).

The proposed relocation of Clear Creek under both Project alternatives and design options represents the majority of Project impacts and is the focus of further discussion in this meeting regarding mitigation and enhancement opportunities.

Question: The numbers in the tables are hard to read. Is information presented in linear feet for the streams? That is usually how impacts are presented.

Answer: Matt said that the USACE likes to see acres and square feet as well, particularly in comparing alternatives. Chase confirmed the impacts are presented with all three metrics.

Question: Billy Bunch asked if the relocation of Clear Creek was considered a permanent or temporary impact, and is a full loss of those stream segments expected? Would mitigation be proposed?

Answer: These are considered permanent impacts because the creek would be relocated but the volume of water and width of the channel are not changing. The team is planning to mitigate for this as permanent impact but unlikely to be able to include much mitigation in the direct impact area.

Question: Is FACWet being performed for adjacent wetlands to inform the indirect impacts?

Answer: FACWet was performed for all delineated wetlands, not just those affected so that information is available. Indirect impacts associated with ground disturbance would be avoided with CDOT standard specifications for keeping a distance from known wetlands.

Section 404 Permitting

Becky Pierce reviewed Section 404 permitting.

The relocation of Clear Creek does not appear to fall under any Nationwide permit, and CDOT is planning for an Individual Permit. Matt confirmed that an Individual Permit would be needed.

Matt and Vanessa discussed permitting in preparation for the SWEEP meeting, and USACE recommended an informal Section 404/NEPA Merger process be followed. Vanessa provided the draft purpose and need and other background materials to Matt, and he indicated that he thought the documentation would be sufficient for the informal Merger process and would be able to be used by USACE in its permitting. Becky said since this is an EA, it is the choice of CDOT and the USACE to determine whether to follow the Merger process, and CDOT agrees that an informal process makes sense.

Other impacts of the Project meet Nationwide permit conditions, but Matt clarified that if any of the single crossings for a linear project result in a need for an Individual Permit, USACE expects all impacts would be permitted under that Individual Permit.

Becky mentioned that the Colorado Stream Quantification Tool (CSQT) may be applicable since impacts are primarily to open waters. Billy and Matt both said that the CQST may be helpful in determining the amount of mitigation required. Depending on the scores for the CSQT, it is unlikely that the linear feet of impact would result in a 1:1 mitigation requirement because it is unlikely that all would be considered "functional feet" units in the assessment.

Both USACE and EPA expressed interest and availability to be involved in the early Project planning to advise on permitting.

Scott Gancarz noted that if an Individual Permit is required, a Section 401 water quality certification will also be needed, and CDOT will need to work with the Water Quality Control Division to obtain that. Becky said this was an oversight not to mention; CDOT does very few Individual Permits, usually 1 to 2 per year, and thanked him for the reminder.

6. Relocation of Clear Creek

Mandy provided an overview of the relocation area, and Antony Pisano described the design reasons for the relocation. The team looked at a number of options but due to the design speeds of the existing curves, stopping sight distance around the curves, location of the Veterans Memorial Tunnels, and the canyon constraints and large required rock cuts, there are no feasible avoidance alternatives that can meet purpose and need and highway design and safety criteria.

Mandy showed a simulation of the creek relocation, which mostly affects the north bank of the creek, which is a steep riprap embankment. Downstream, there are several areas with wider existing riparian areas that present opportunities for enhancements. Paul Winkle provided an overview of his work monitoring trout populations in the Project area over the past 5 years. He said that this stretch of Clear Creek supports a wild brown trout population and that CPW stocks rainbow trout in the area, but they have not taken hold, which is common in areas where brown trout are dominant. The number of fish has continued to increase as the habitat has improved, which has been a result of habitat enhancement and improvements in water quality. Although the numbers are up, the trout are not large

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compared to those downstream of reservoirs; large trout in Clear Creek might be 12 to 14 inches. In 2014, Paul conducted a redd survey, and identified almost 50 redds in the stretch of Clear Creek between US 6 and Veterans Memorial Tunnels; he plans to do another survey in the fall, which could also inform enhancement opportunities.

Additionally, areas where the I-70 footprint is smaller present opportunities to lay back slopes and open up the floodplain. Kevin Shanks stated that the Canyon Viaduct Alternative presented the most opportunities for creek enhancements because there was less highway infrastructure next to the creek. Holly asked for clarification about the potential differences in terms of percentage. Kevin said he had not calculated percentages, but estimated it was substantial – maybe 50 percent more. Billy noted that the CSQT could help quantify and compare options. Mandy showed the area in Google Earth, and Kevin reviewed specific locations of potential for enhancements, particularly at the bends. Kevin described the Twin Tunnels mitigation and working with CPW. Unlike the Project relocation area, one of the issues with the Twin Tunnels section was that it was too wide to provide pool-riffle-run sequences. Paul explained that the pools are particularly important for winter habitat. Holly asked how deep the pools were and if they had filled in. The deepest pools in that section are six feet deep or so, and they have not filled in with material. The spring runoff seems to flush them out. Kevin explained that the CPW biologist had carefully considered rock placement and direction to flow to ensure that they flushed naturally. Paul noted that the willow plantings had not survived but otherwise, the design was holding up well.

Kevin described several of the mitigation details from the Twin Tunnels project that were being reviewed for application on downstream Floyd Hill improvements.

Matt and Billy both stated that enhancements to riparian and aquatic habitat would be appropriate for Section 404 compensatory mitigation. The Project will need to show a functional lift for the stream, not necessarily a 1:1 linear foot of improvements. For instance, for the 1,200 feet of affected creek, perhaps the functional units may be 700 feet, which would establish the mitigation target. Billy asked to be included in 404 mitigation discussions.

Question: Gary asked about shading and if there were opportunities to develop riparian habitat that would have less sun exposure.

Answer: Right now, the north side of bank doesn’t have much vegetation; if a bench could be added where willows, cottonwoods, and other plants could establish, this would create shading. Kevin said that although the Twin Tunnels project willow plantings failed, maybe there were lessons in including more diverse plantings and selecting willows that are better suited to higher elevations. The willows at the Black Hawk Sanitation District may be better, and Jim can help coordinate. Becky said the willows came from the mitigation site, which is just 300 feet higher in elevation, so she did not think this was an issue.

Question: If improved, would this stretch qualify for a re-stocking program?

Answer: CPW currently stocks rainbow trout in the Project area. While it is difficult for other species to compete with a strong brown trout population, creek enhancements might help the stocked rainbows establish.

7. Wrap-Up and Action Items

Mandy asked the group if there were any additional comments or thoughts. Gary and Holly said that they liked what was presented and thought things were on the right track. No one voiced any concerns.

Mandy summarized the next steps. Next week, there will be a site visit led by CPW to look at some of the mitigation opportunities. The mitigation plan will be developed further, and the team will continue to coordinate with the USACE and EPA on Section 4040 permitting and with CPW for SB 40 certification. It is anticipated that the planned enhancements can serve multiple mitigation commitments as well as the intention of the SWEEP MOU to improve aquatic and water quality conditions when possible. By mid-summer, the team should have a good handle on impacts and mitigation, which will be discussed with the Technical Team before completing the EA.

Action Items

- Hold an offline meeting to discuss SELDM (Josh, Vanessa, Holly, Jordan, and others)
- Conduct initial site visit to review mitigation opportunities (Paul, Kevin, and others)
- Conduct redd survey in fall 2020 (Paul)
- Prepare CSQT to inform mitigation requirements and effectiveness (timing and responsibility TBD)

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Department of Transportation

I-70 Floyd Hill SWEEP Meeting #3

May 14, 2020

Agenda

- Project Updates and Status
- Overview of Project Alternatives
- Existing Conditions and SWEEP Issues
- Water Quality
- Wetlands and Waters of the US
- Clear Creek Relocation
- Next Steps and Action Items

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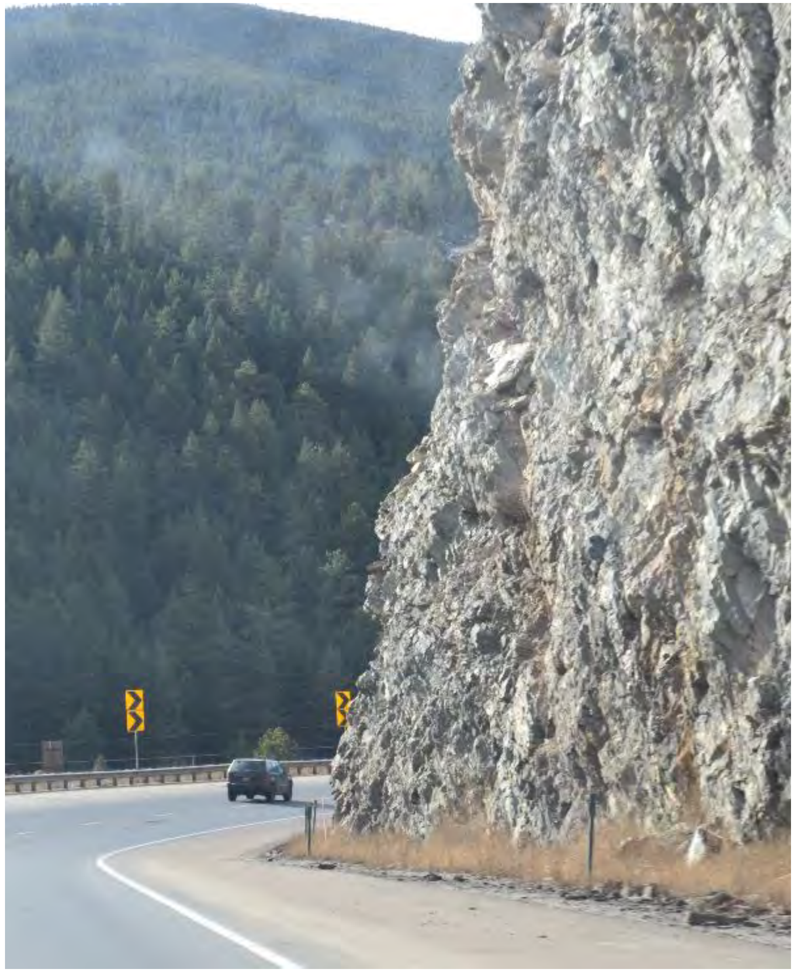
Project Updates

Project Updates

- Environmental Assessment initiated in summer 2017
- Developed Tunnel Alternative in 2018 as proposed action for ballot initiates 109/110
  - SWEEP meetings in April and October 2018
- Reassessed and regrouped in 2019
  - Completed existing conditions surveys and reports
  - Developed Canyon Viaduct Alternative as additional alternative
  - Confirmed project priority in 10-year plan through statewide planning effort with new CDOT administration
  - Continued to pursue funding; HPTE initiated financial study
- EA funded and resumed in late 2019/early 2020
  - Public Meeting #2 – February 2020
  - Environmental Assessment – Fall 2020
  - Public Hearing – Late Fall 2020/early Winter 2021
  - Decision document – Spring 2021 (if construction funding is identified)

Alternatives Overview: Major Project Elements

- Add third westbound I-70 travel lane from top of Floyd Hill through the Veterans Memorial Tunnels
- New frontage road connection between US 6 and Hidden Valley interchanges
- Improve traffic operations at interchanges and intersections within the project limits
- Enhance safety by flattening curves to improve design speeds and stopping sight distance
- Improve the Clear Creek Greenway
- Reduce animal-vehicle conflicts and improve wildlife connectivity



Environmental Assessment Alternatives

- No Action Alternative
  - Replace westbound I-70 bridge in its current location, and continue regular highway maintenance
- Tunnel Alternative
  - Major elements
  - New tunnel for westbound I-70 near US 6 interchange
  - Realign eastbound I-70 on the current highway footprint
  - Construct a frontage road between US 6 and Hidden Valley, either north or south of Clear Creek
- Canyon Viaduct Alternative
  - Major elements of the Proposed Action
  - Realign both eastbound and westbound I-70 between US 6 and Hidden Valley on a viaduct
  - Construct the frontage road on the current I-70 alignment

East Section: Floyd Hill to US 6

Central Section: US 6 to Hidden Valley
TUNNEL ALTERNATIVE

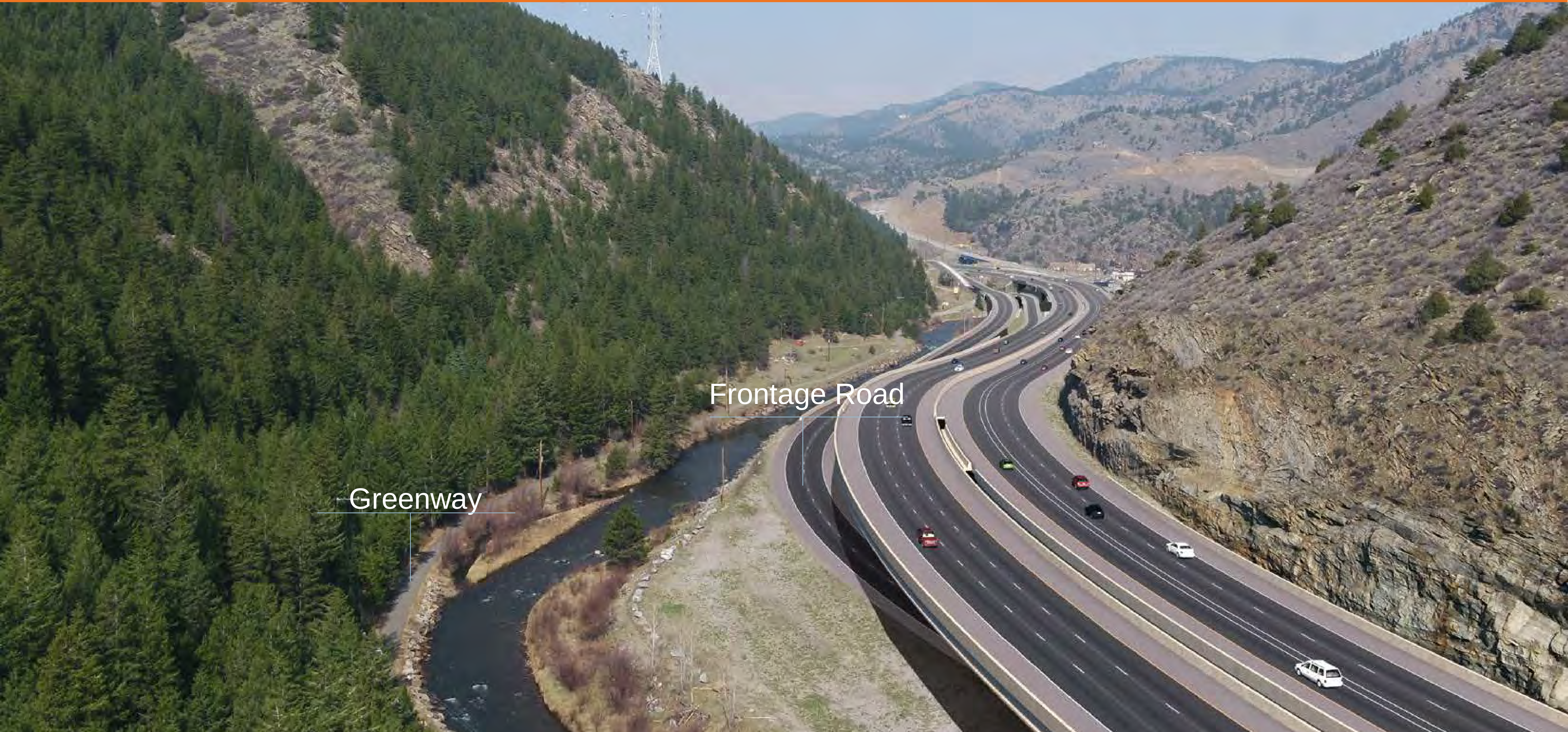
Central Section: US 6 to Hidden Valley
TUNNEL ALTERNATIVE, North Frontage Road

Central Section: US 6 to Hidden Valley
TUNNEL ALTERNATIVE, South Frontage Road

Central Section: US 6 to Hidden Valley
CANYON VIADUCT ALTERNATIVE

Central Section: US 6 to Hidden Valley
CANYON VIADUCT ALTERNATIVE

Central Section: US 6 to Hidden Valley
CANYON VIADUCT ALTERNATIVE



West Section: Hidden Valley to Veterans Memorial Tunnels

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Water Quality and Aquatic Conditions

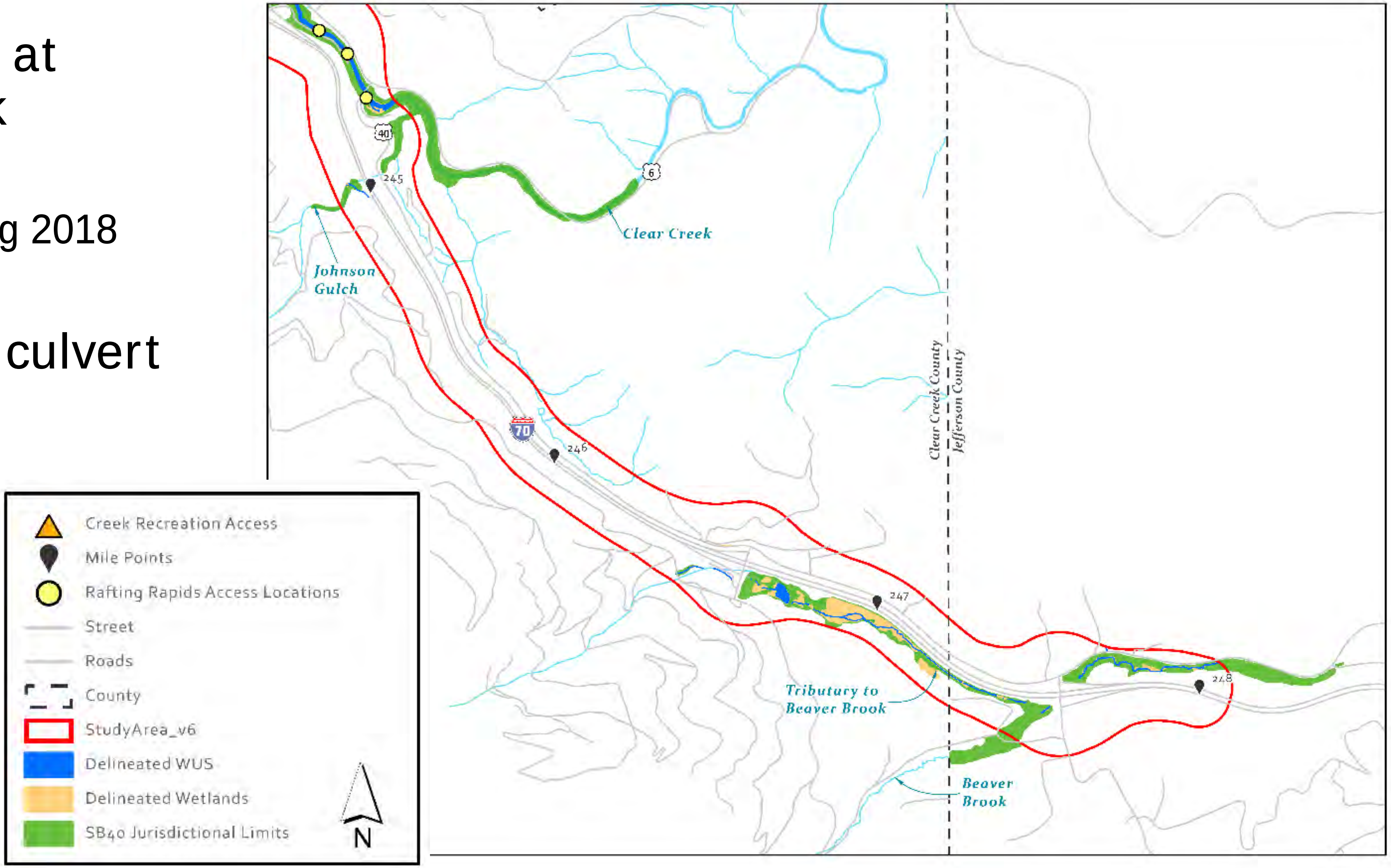
Water Quality and Aquatic Conditions

- Clear Creek water quality
  - Impaired for metals from mining and naturally occurring metals in soils/mineralized rock
  - Black Hawk drinking water intake
  - Decreasing use of traction sand and increased use of deicers
  - SCAP BMPs implemented for projects upstream; one existing WQ pond in Project area (near Black Hawk water intake)
- Clear Creek condition
  - Areas of significant channelization throughout
  - Wider floodplain areas support riparian habitat/wetlands
  - Regulated floodplain
- Clear Creek fishery
  - Clear Creek is a high value fishery
  - Brown trout spawning upstream; increasing density
  - Aquatic connectivity is not an issue

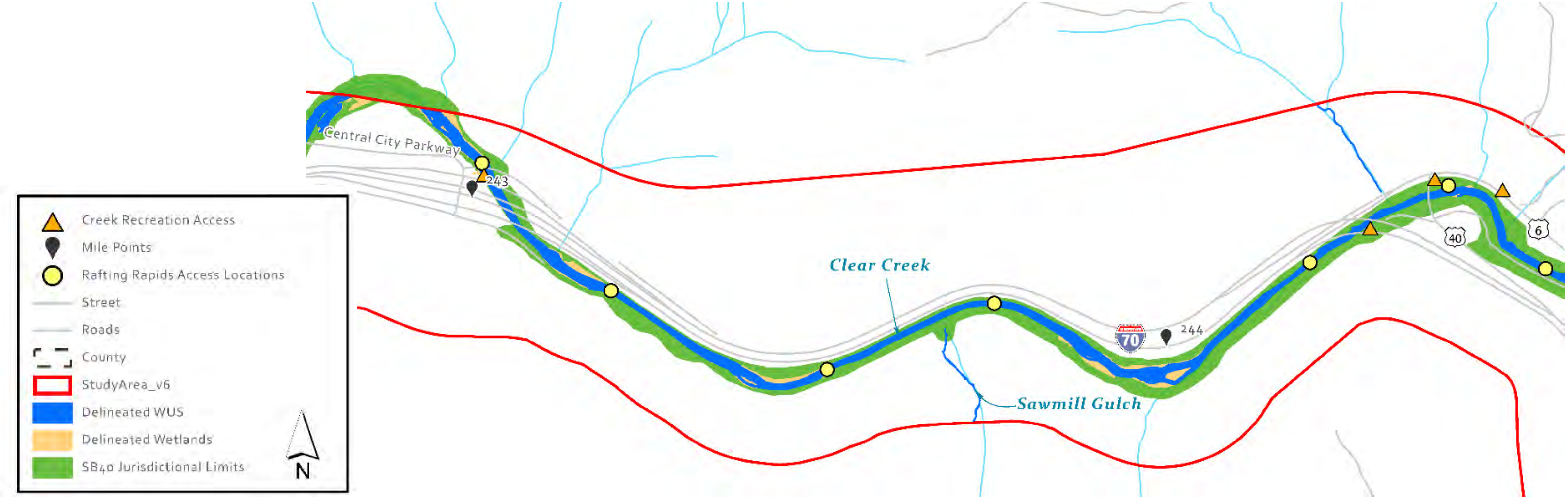
- Other streams and gulches
  - Johnson Gulch, Sawmill Gulch, Beaver Brook also impaired for metals
  - Sawmill Gulch lacks riparian vegetation for SB 40
  - Beaver Brook
    - Brook trout spawning 1-mile upstream of Project
    - Regulated Floodplain

Existing Conditions: East Section

- Wetland complex at Beaver Brook (elk meadows)
  - Fen testing in Aug 2018 (negative)
- Johnson Gulch in culvert under I-70

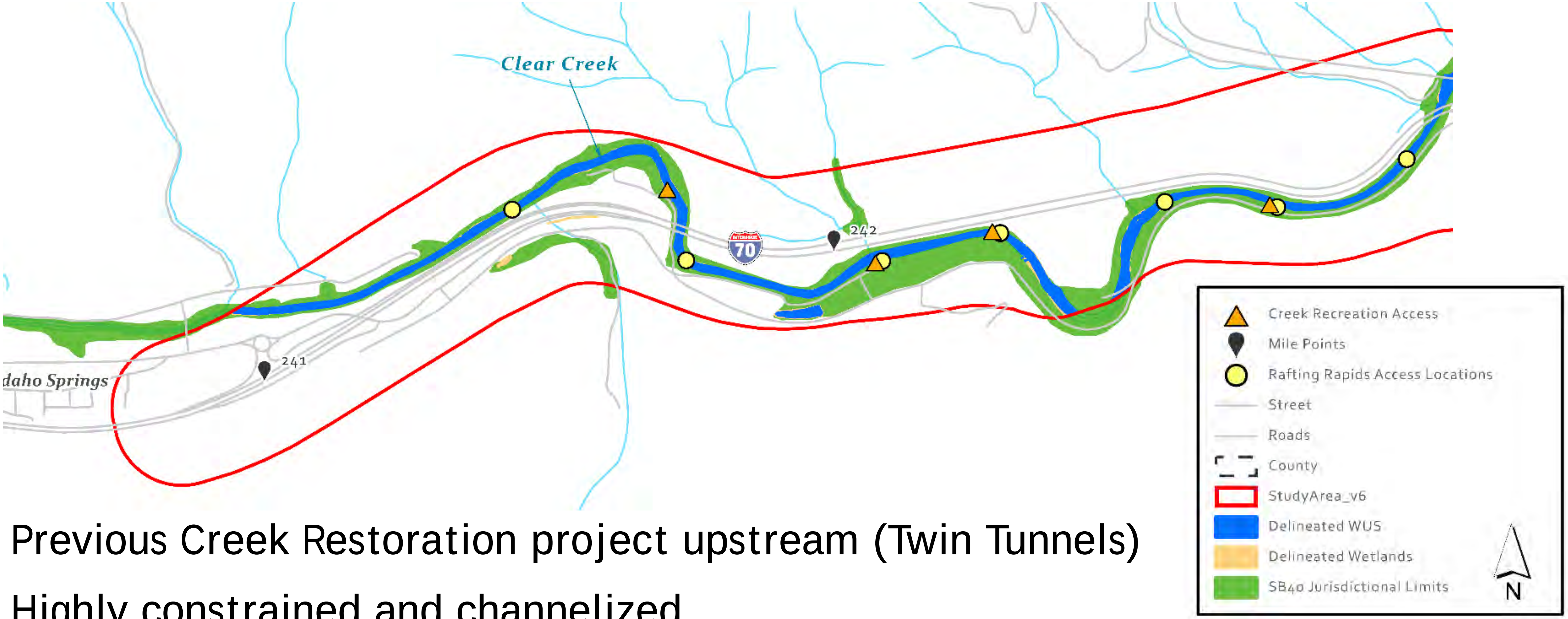


Existing Conditions: Central Section



- Numerous recreational points, including rafting rapids and fishing accesses
- Greatest potential for creek enhancement in the Project area
- Areas near Black Hawk intake and Sawmill Gulch are wider and support wetlands

Existing Conditions: West Section



- Previous Creek Restoration project upstream (Twin Tunnels)
- Highly constrained and channelized
- Area of Clear Creek realignment

SWEEP Commitments and Considerations

SWEEP MOU and Implementation Matrix considerations in project development

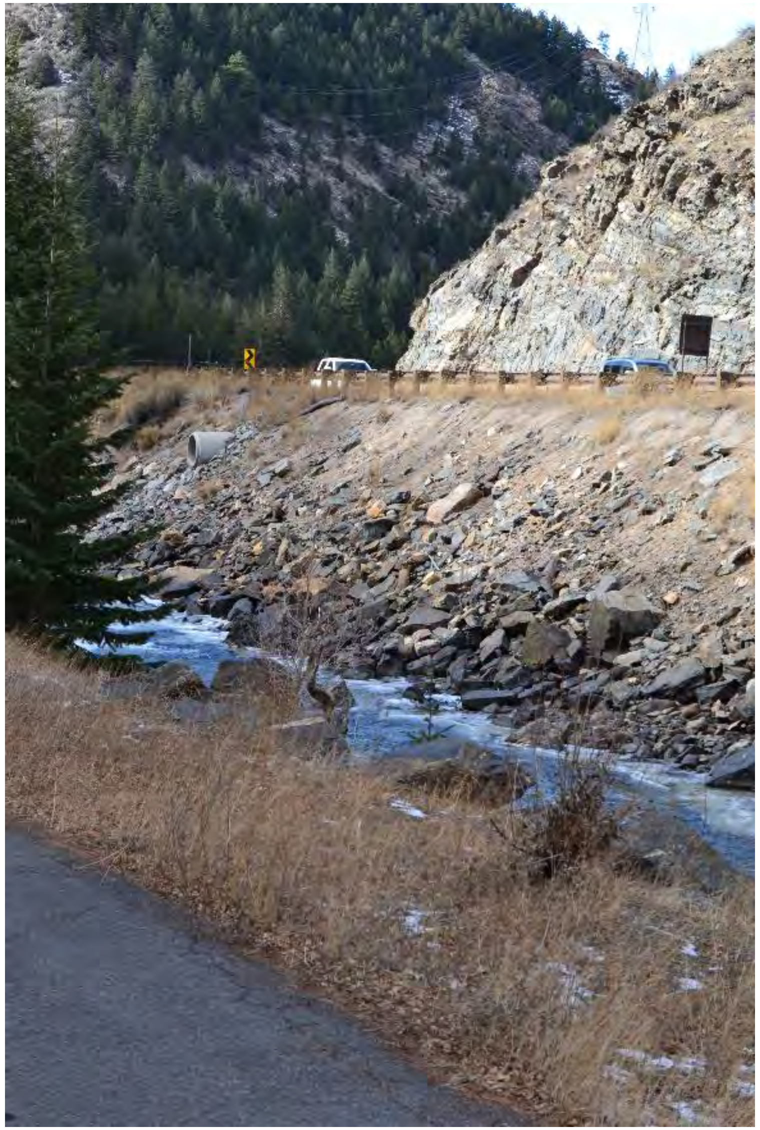
- Sediment management
- Section 303(d) impaired waters
- Mining wastes and mineralized rock
- Wetlands protection
- Special status species
- Aquatic species as recreational resource
- Information and research needs

PEIS Commitments for Tier 2 Projects

- Delineate wetlands using the latest approved USACE methodology
- Identify and analyze impacts to fens if applicable
- Functional Assessment of wetlands using FACWet
- Determine jurisdictional and non-jurisdictional wetlands
- More detailed analysis of direct and indirect impacts on aquatic resources
- Develop specific and detailed mitigation strategies and measures
- Develop specific best management practices

Issues Raised at Previous SWEEP Meetings

- Water quality
  - Chlorides and effects on water quality and vegetation
  - Increased sedimentation / contaminants from frontage road maintenance, rock cut areas, snow plowing over the creek
  - Potential for truck overturning and hazmat spills
- Coordination with maintenance
  - BMP design, location, and maintenance
  - Winter maintenance practices
- Wetlands
  - Complex at Beaver Brook (elk meadows)
  - Wetland functional assessment
- Realigning Clear Creek
  - Creek geology
  - Sediment and turbidity



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Water Quality

Water Quality: SELDM

I-70 Floyd Hill to Veterans Memorial Tunnel

SELDM Model Factsheet

The Stochastic Empirical Loading and Dilution Model (SELDM) is a stochastic model that uses Monte Carlo methods to determine the effect of runoff on receiving waters. It is primarily used as a screening mechanism for projects' environmental impacts.

Four Scenarios:

- Existing Conditions
- Proposed Conditions, using no BMPs
- **Proposed Conditions, using extended detention basins (EDB)**
- **Proposed Conditions, using vegetated swales.**

Highway site inputs

- Drainage area = Combined area of I-70, US 6, Central City Parkway, and CR314.
- Drainage length = Veteran's Memorial Tunnel to the top of Floyd Hill
- Basin Development Factor = Proposed improvements cause an increase in peak runoff potential on a scale of 0 to 12.

Scenario	Drainage Area (ac)	Drainage Length (ft)	Basin Development Factor
Existing	105.18	28875.74	2
Proposed	124.77	28875.74	5

Preliminary Results:

Constituent	Existing vs Proposed No BMP (%)	Existing vs Proposed with Ponds (%)	Existing vs Proposed with Swales (%)
TSS	+18.62	-68.91	-66.67
Chloride	+18.65	+0.95	-20.19
Cadmium*	+18.64	-47.86	-80.90
Copper*	+18.65	-61.61	-68.9
Lead	+18.65	-9.44	-25.97
Zinc*	+18.64	-36.83	-37.73

*Used regional pollutant loading data

Loading Concentration Data:

- CDOT report Interstate 70 Mountain Corridor Storm Event/Snowmelt Water Quality Monitoring.

Data on the efficiency of applicable BMPs:

- USGS Statistical Study for SELDM Inputs

Data on the efficiency of BMPs on chlorides.

- Transportation Research Board *Synthesis 449: Strategies to Mitigate the Impacts of Chloride.*

Water Quality Approach:

- **Application of SCAP recommendations is no longer applicable**
- **No MS4 Permit.**
- **Focus on addressing specific pollutants of concern.**

- Modeling Goals
- Inputs
- Results inform design
  - Define WQ Approach
  - SCAP
  - No MS4

Water Quality: BMP Selection

Pollutant Focused, Tiered Approach to Water Quality

- Formal WQ BMPs proposed to mitigate the majority of the Roadway Runoff
  - Extended Detention Basins: Highly effective for sediment and metal removal
  - Constructed Wetlands: Highly effective for treatment of de-icing agents as it dilutes Chlorides and maximizes uptake

Extended Detention Basin - Sediment and Metals

Constructed Wetlands - Deicing Agents / Chlorides via Dilution and Uptake)

Water Quality : BMP Selection

Pollutant Focused, Tiered Approach to Water Quality

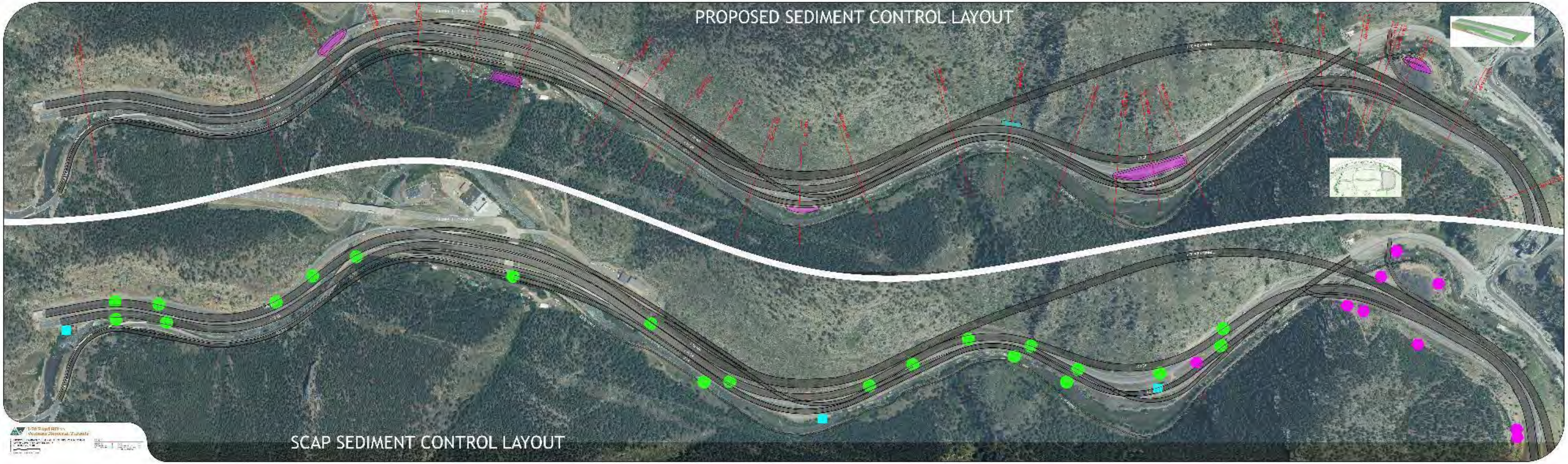
- Informal WQ BMPs proposed to mitigate roadway runoff with site constraints
  - Vegetated ditches
  - Stilling Basins
  - Engineered ditches with check dams
- Effective removal for sediment and metals and diluting chlorides

Vegetated Ditch w/ Stilling Basins (Bridge Sections) - Sediments and Metals

Engineered Ditch with check dams – Deicing agents

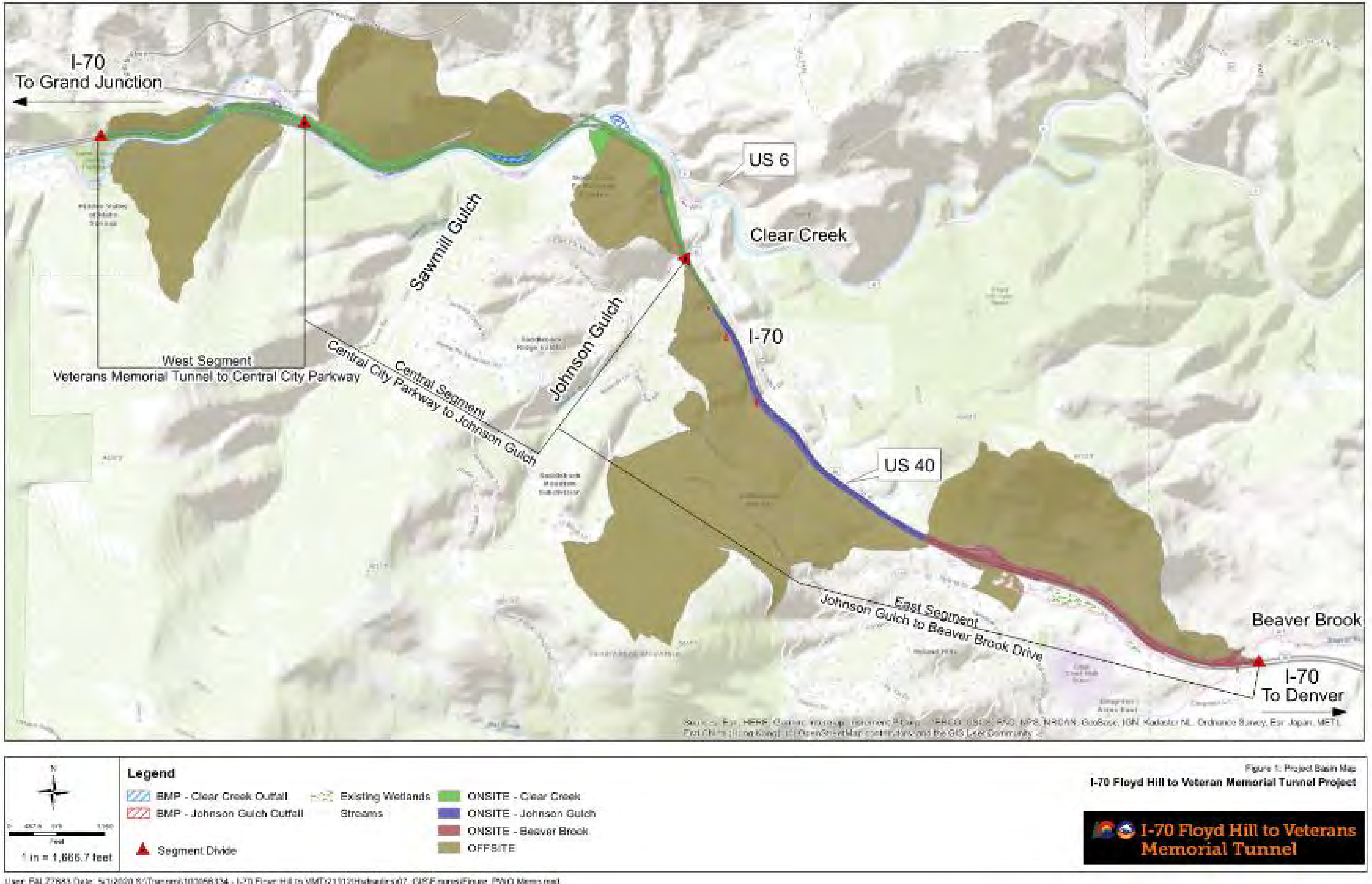
Water Quality : BMP Selection

- SWEEP Meeting No. 2 (October 25, 2018): Review of materials presented
  - CDOT transitioned to using de-icing agents in lieu of traction sand
  - SCAP-recommended BMPs focused on traction sand and present maintenance challenges
- Proposed BMPs have been updated to reflect changes in Design Options



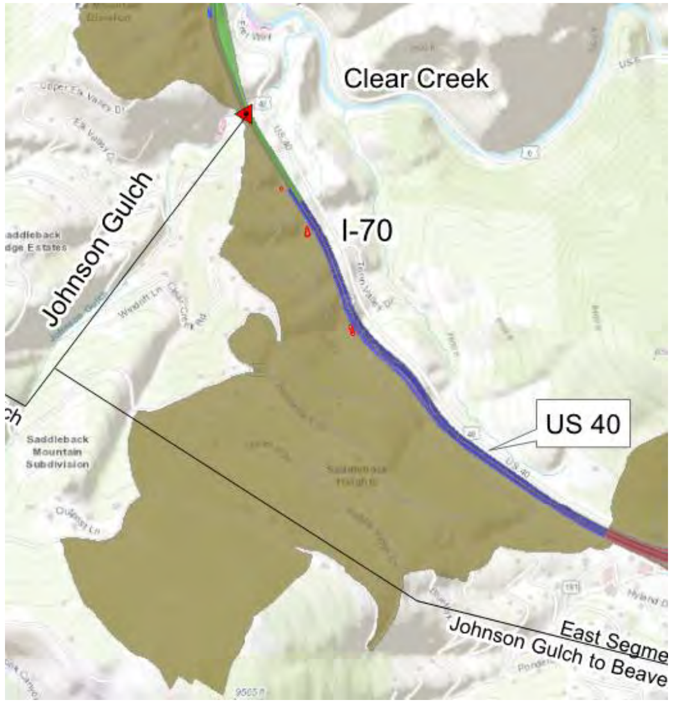
Water Quality : BMP Selection

- Project Section
  - East
  - Central
  - West
- WQ Watersheds
  - Floyd Hill
  - Clear Creek
    - Tunnel
    - Canyon



Water Quality: East Section (Floyd Hill)

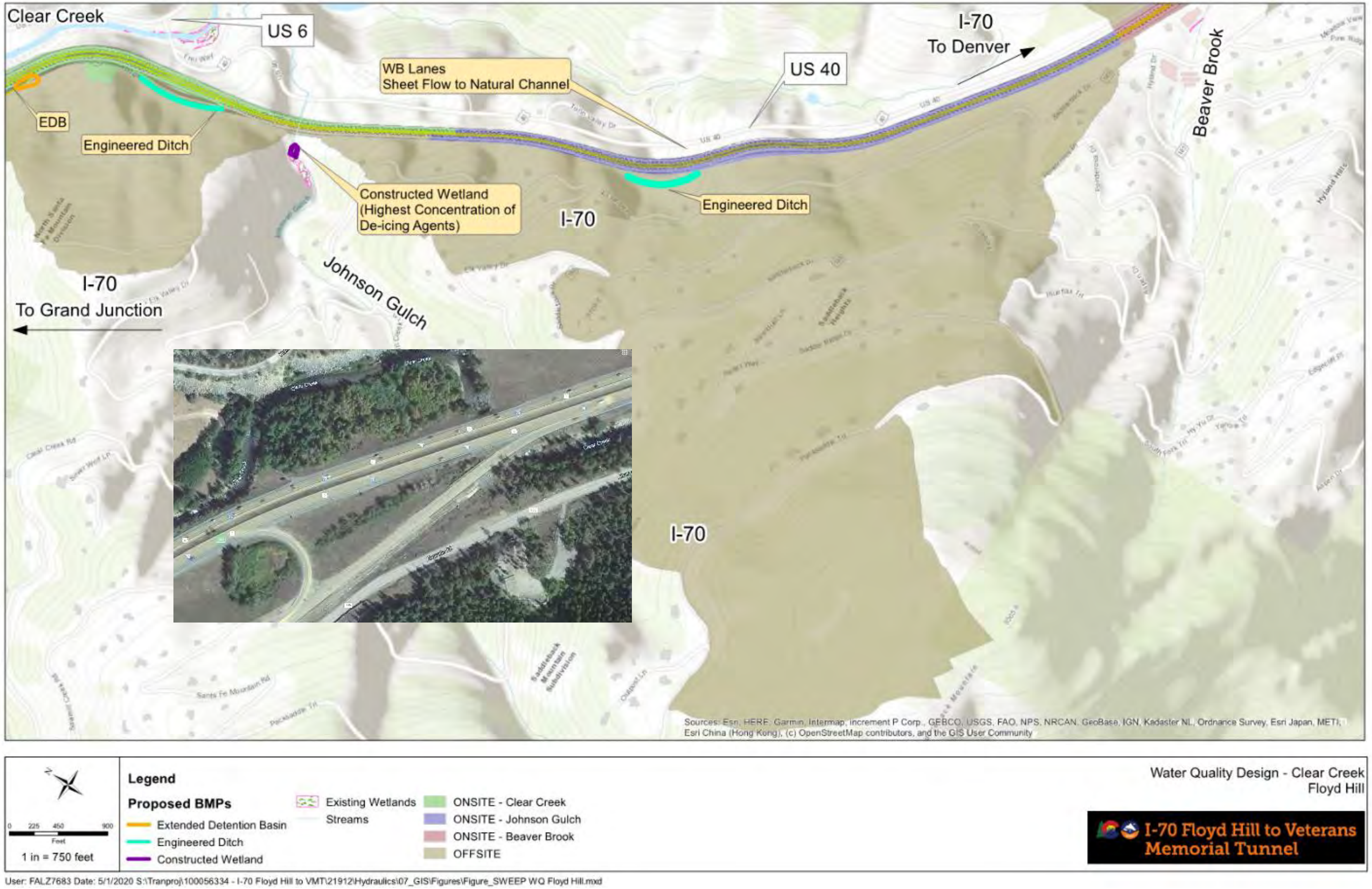
- Chlorides and Sediment
- Vegetated shoulders/slopes provide natural treatment over flowpaths
- Engineered Ditches provide dilution and uptake
- Constructed Wetlands provide dilution and uptake



Vegetated Shoulders/slopes

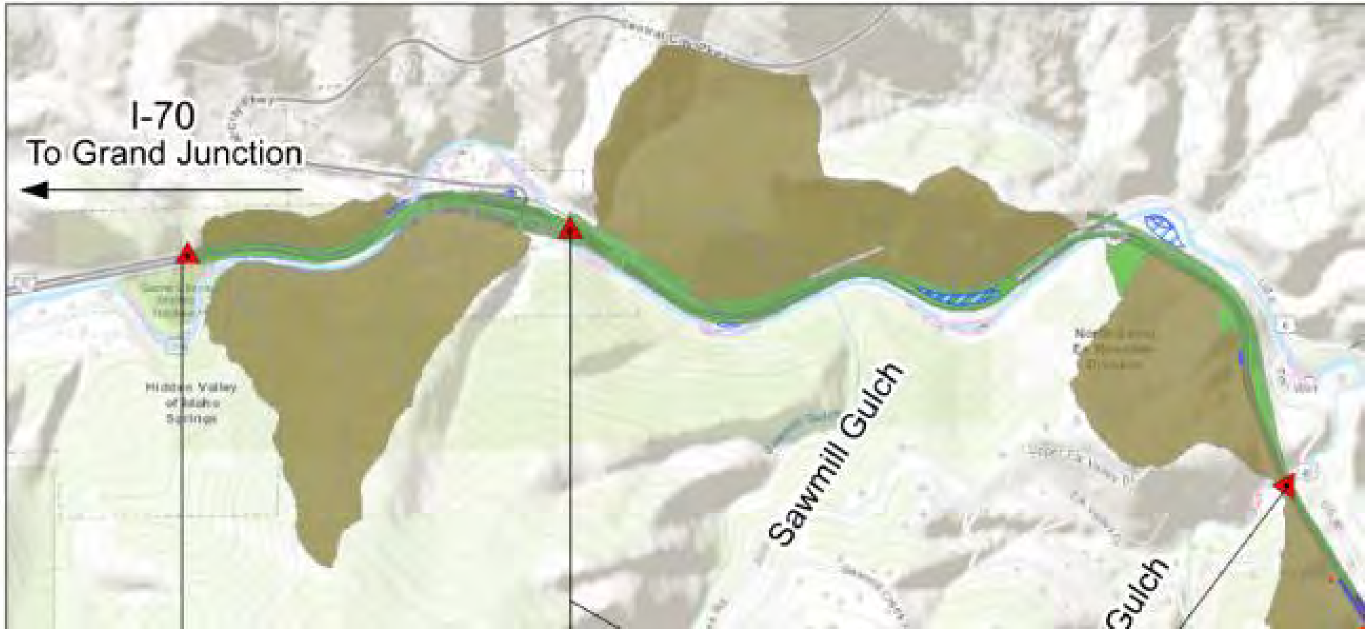
Constructed Wetlands and Engineered Ditches

Water Quality: East Section (Floyd Hill)



Water Quality: Central and West Sections (Clear Creek)

- Sediment, Metals, Chlorides
- Extended Detention Basins captures sediments and treats metals
- Sediment Basins captures sediment
- Vegetated ditches provide natural treatment over flowpaths
- Engineered Ditches provide dilution and uptake



Extended Detention Basins

Sediment Basins

Water Quality: BMP Locations, Clear Creek: Tunnel Alternative

N

0 250 500 1,000 Feet

1 in = 841.7 feet

Legend

SCAP Recommendation
- Inlet Sediment Trap
- Sediment Basin
- Loading Dock Trap

- Existing Wetlands
- Streams

Proposed BMPs
- Extended Detention Basin

Water Quality Design - Clear Creek
Option 1 - Tunnel Alternative

I-70 Floyd Hill to Veterans Memorial Tunnel

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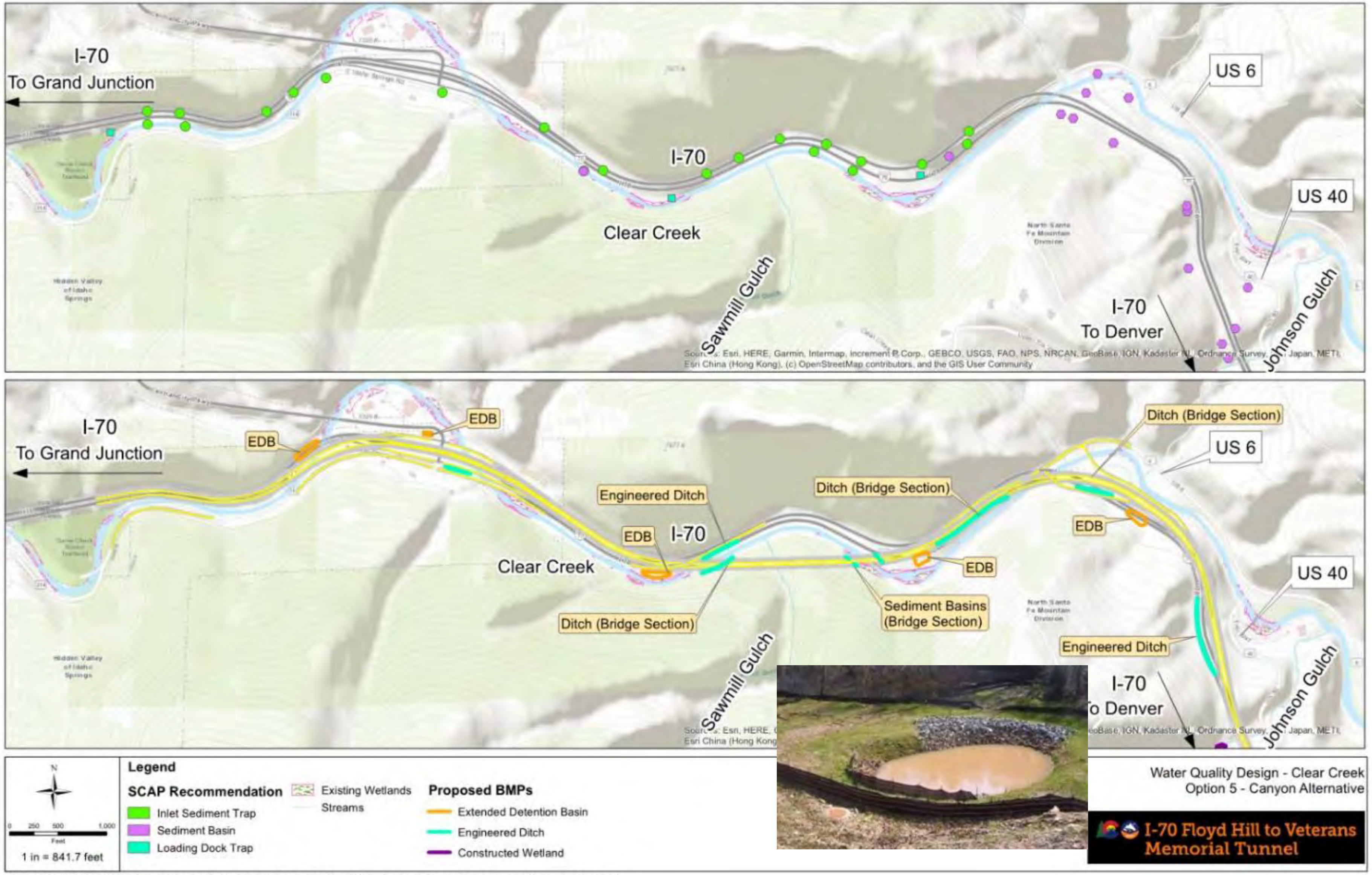
Water Quality: BMP Locations, Clear Creek: Canyon Alternative



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Wetlands and Waters of the US

Wetlands and Waters of the US

Permanent Impacts

- Impacts based on project design as of May 5, 2020.
- Permanent impacts would result from the widening and realignment of I-70 and Frontage Road, replacement of existing bridges, installation of bridge piers, and bank stabilization associated with roadway reconfiguration.

Alternative	Permanent Impact (Acres)	Permanent Impacts (Square Feet)	Linear Feet of Impact	Assumed Jurisdictional Status[1]
Tunnel Alternative (North Frontage Road Option)	0.908	39,565	1,575	Jurisdictional
Tunnel Alternative (South Frontage Road Option)	0.912	39,746	1,652	Jurisdictional
Canyon Viaduct Alternative	0.929	40,458	1,835	Jurisdictional

[1]Jurisdictional status assumed based on conditions in the field and review of maps and aerial imagery. Only the U.S. Army Corps of Engineers (USACE) has the authority to determine what is jurisdictional.

Wetlands

Alternative	Permanent Impact (Acres)	Permanent Impacts (Square Feet)	Classification[1]	Assumed Jurisdictional Status[2]
Tunnel Alternative (North Frontage Road Option)	0.001	44	PEM and PSS	NA
Tunnel Alternative (South Frontage Road Option)	0.001	40	PEM	NA
Canyon Viaduct Alternative	0.001	44	PEM and PSS	NA

[1]Cowardin et al., 1979

[2]Jurisdictional status assumed based on conditions in the field and review of maps and aerial imagery. Only USACE has the authority to determine what is jurisdictional.

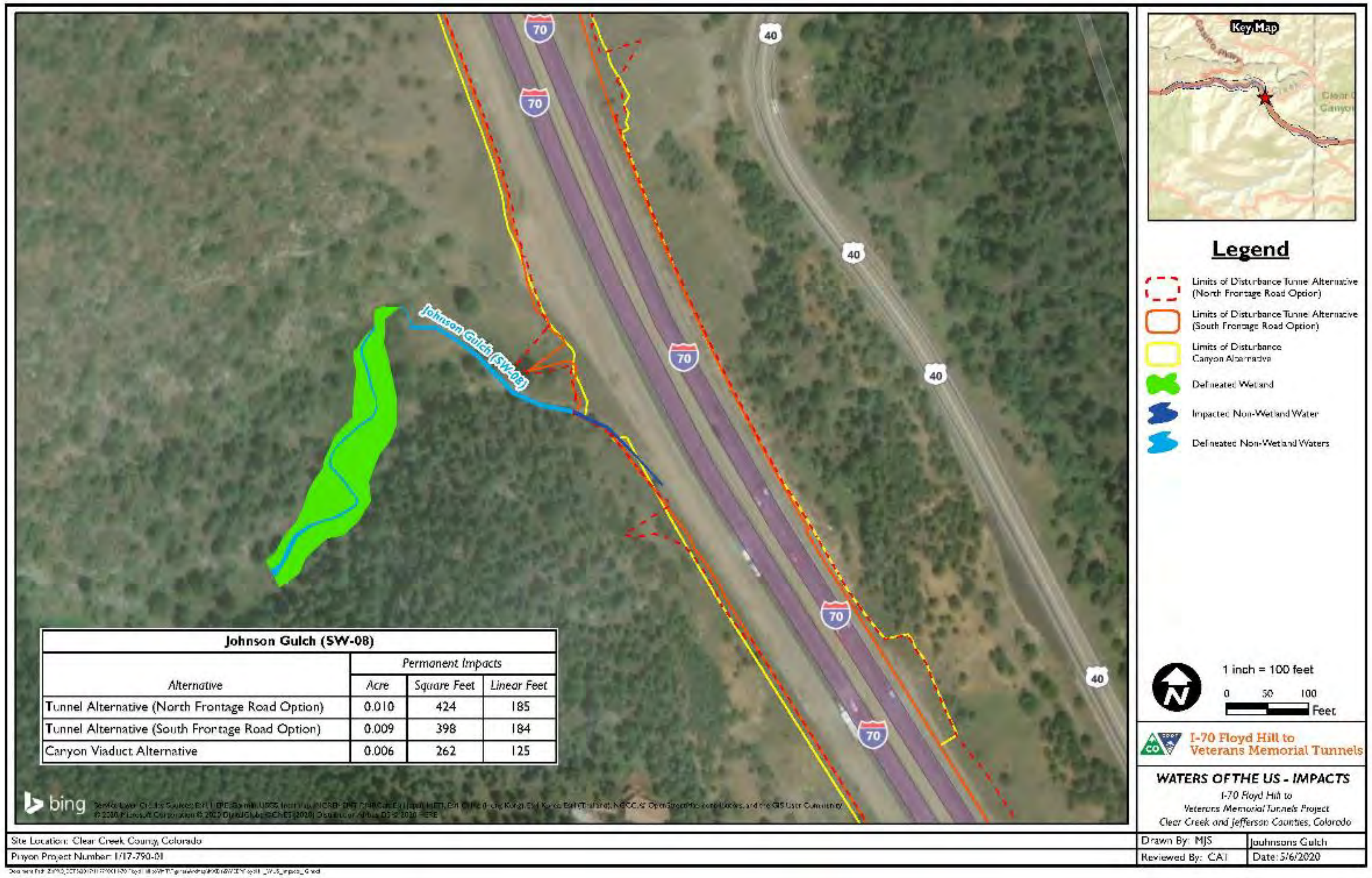
Notes:

PEM = palustrine emergent
PSS = palustrine scrub-shrub

Wetlands and Waters of the US

Johnson Gulch (SW-08)

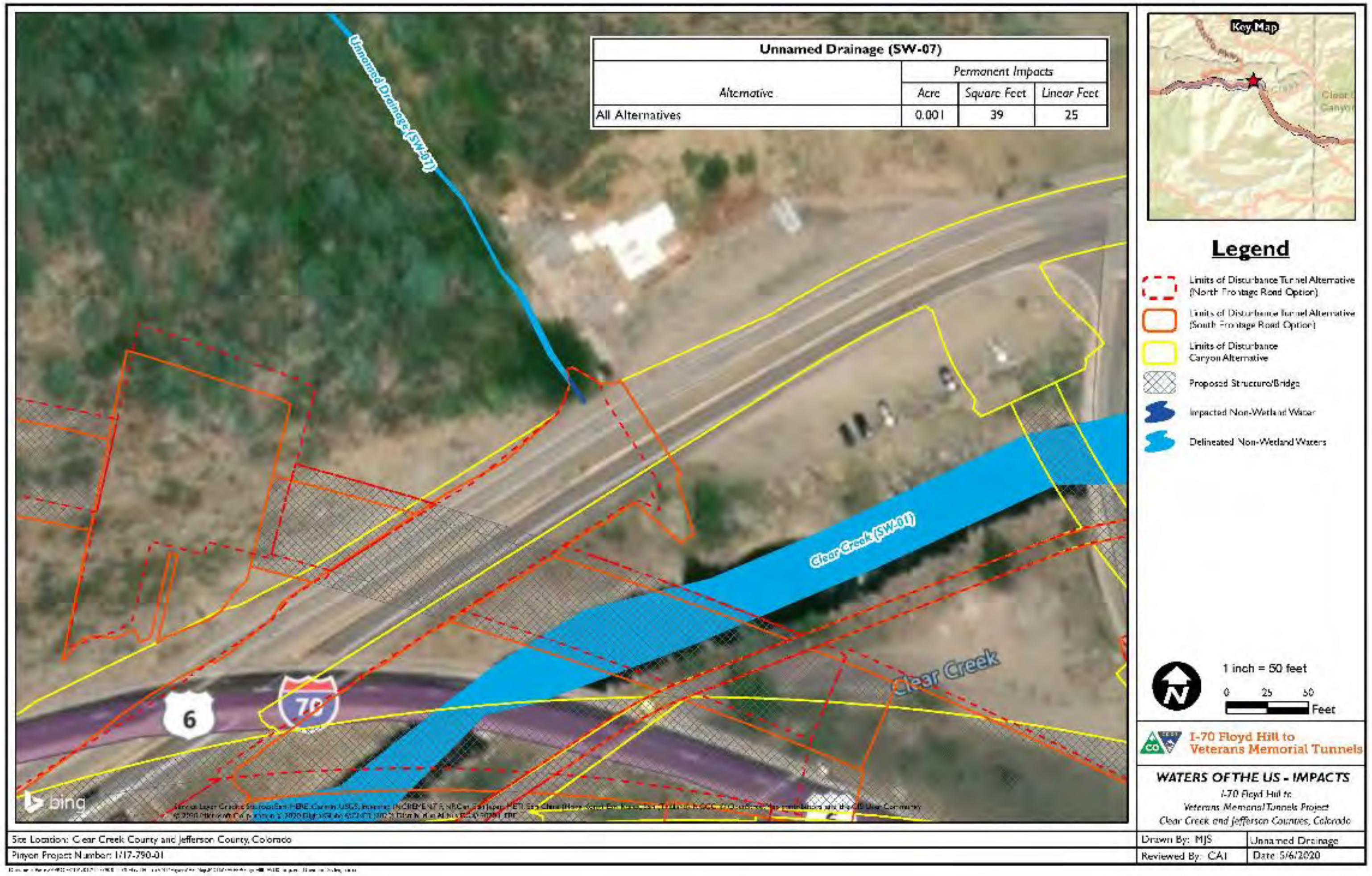
- Impacts vary slightly between action alternatives
- Impacts from:
  - Road widening
  - Grading for toe-of-slope
  - Road stabilization



Johnson Gulch (SW-08)			
	Permanent Impacts		
Alternative	Acre	Square Feet	Linear Feet
Tunnel Alternative (North Frontage Road Option)	0.010	424	185
Tunnel Alternative (South Frontage Road Option)	0.009	398	184
Canyon Viaduct Alternative	0.006	262	125

Unnamed Drainage (SW-07)

- Impacts are the same for action alternatives
- Impacts from:
  - Slope stabilization for US 6

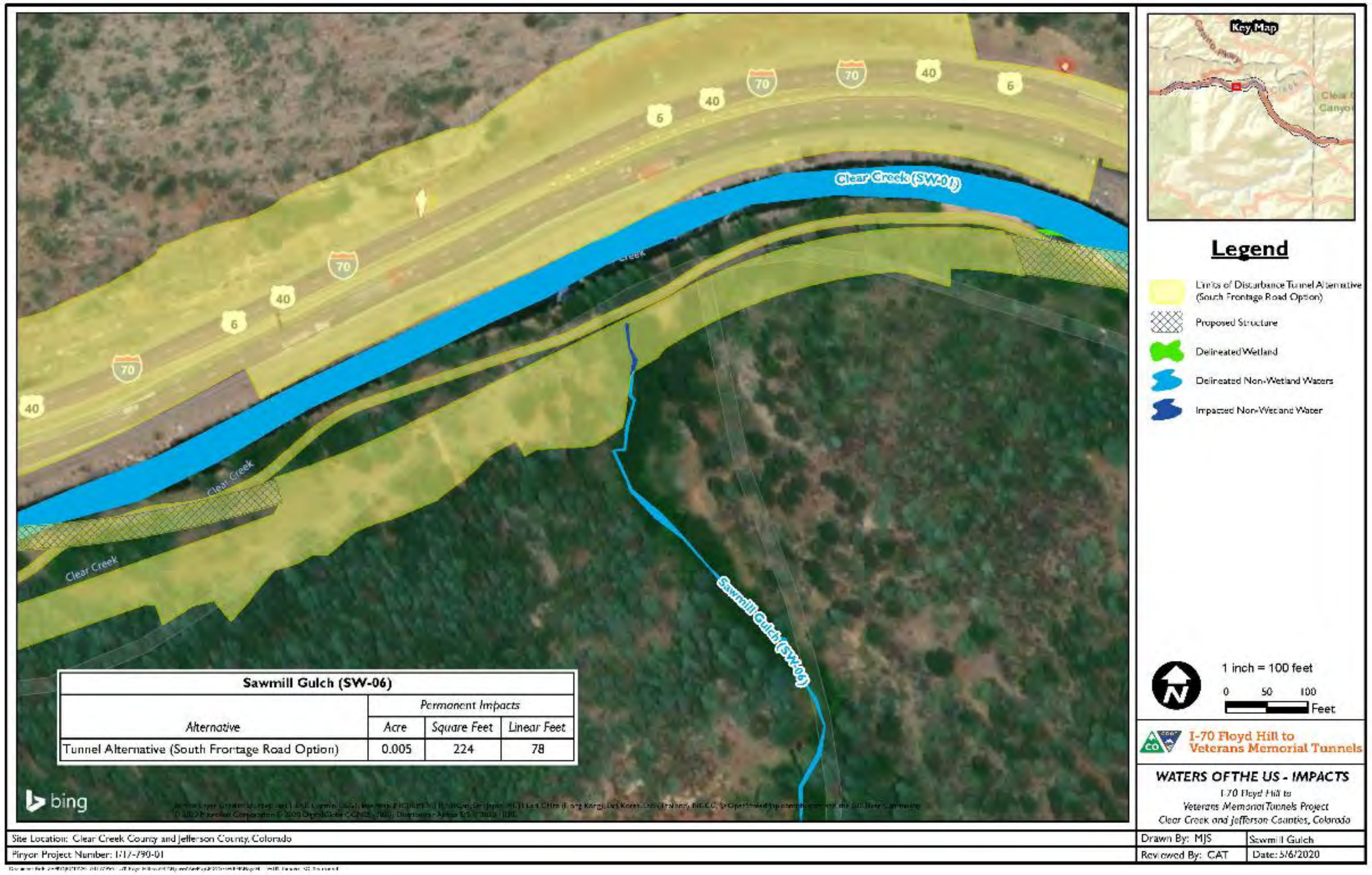


Wetlands and Waters of the US

Sawmill Gulch (SW-06)

Tunnel Alternative, South Frontage Road Option

- Impacts from:
  - Grading activities
  - New road alignment
  - Slope stabilization



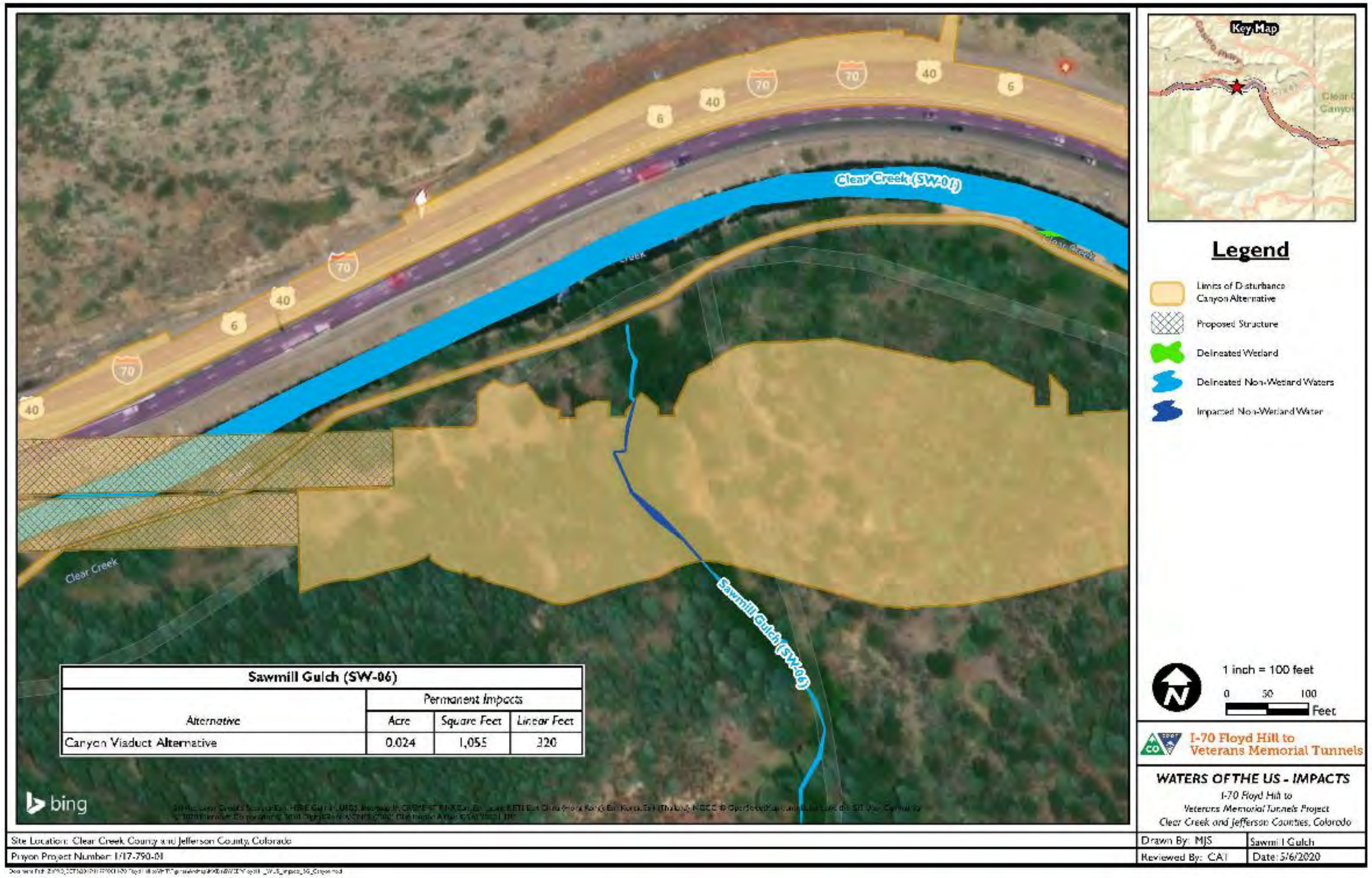
Sawmill Gulch (SW-06)			
	Permanent Impacts		
Alternative	Acre	Square Feet	Linear Feet
Tunnel Alternative (South Frontage Road Option)	0.005	224	78

Wetlands and Waters of the US

<u>Sawmill Gulch (SW-06)</u>

Canyon Viaduct Alternative

- Impacts from:
  - Grading activities
  - New road alignment
  - Slope stabilization

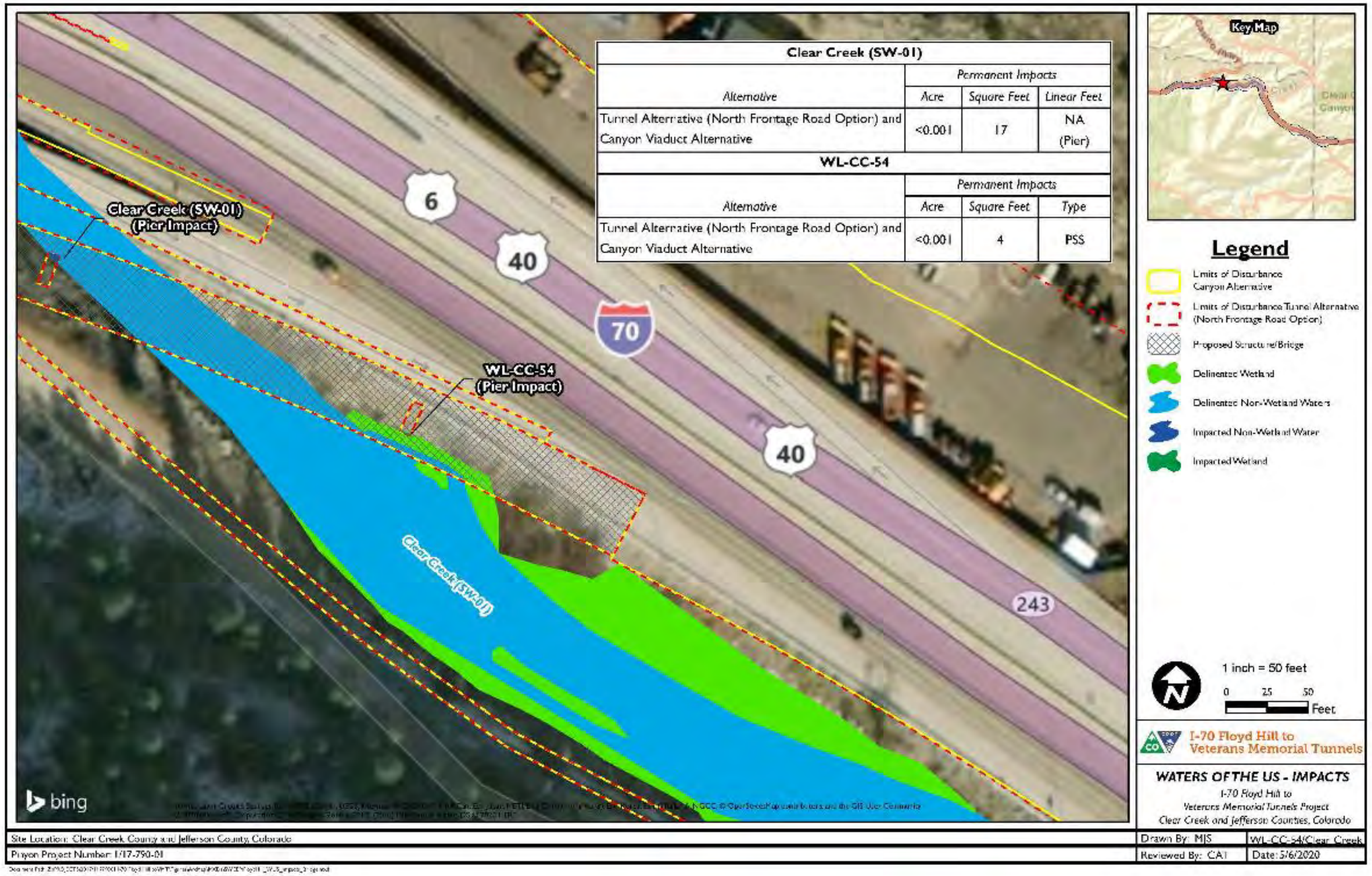


Wetlands and Waters of the US

Clear Creek (SW-01/WL-CC-54)

Tunnel Alternative, North Frontage Road Option) and Canyon Viaduct Alternative

- Impacts from
  - Installation of new Bridge Piers

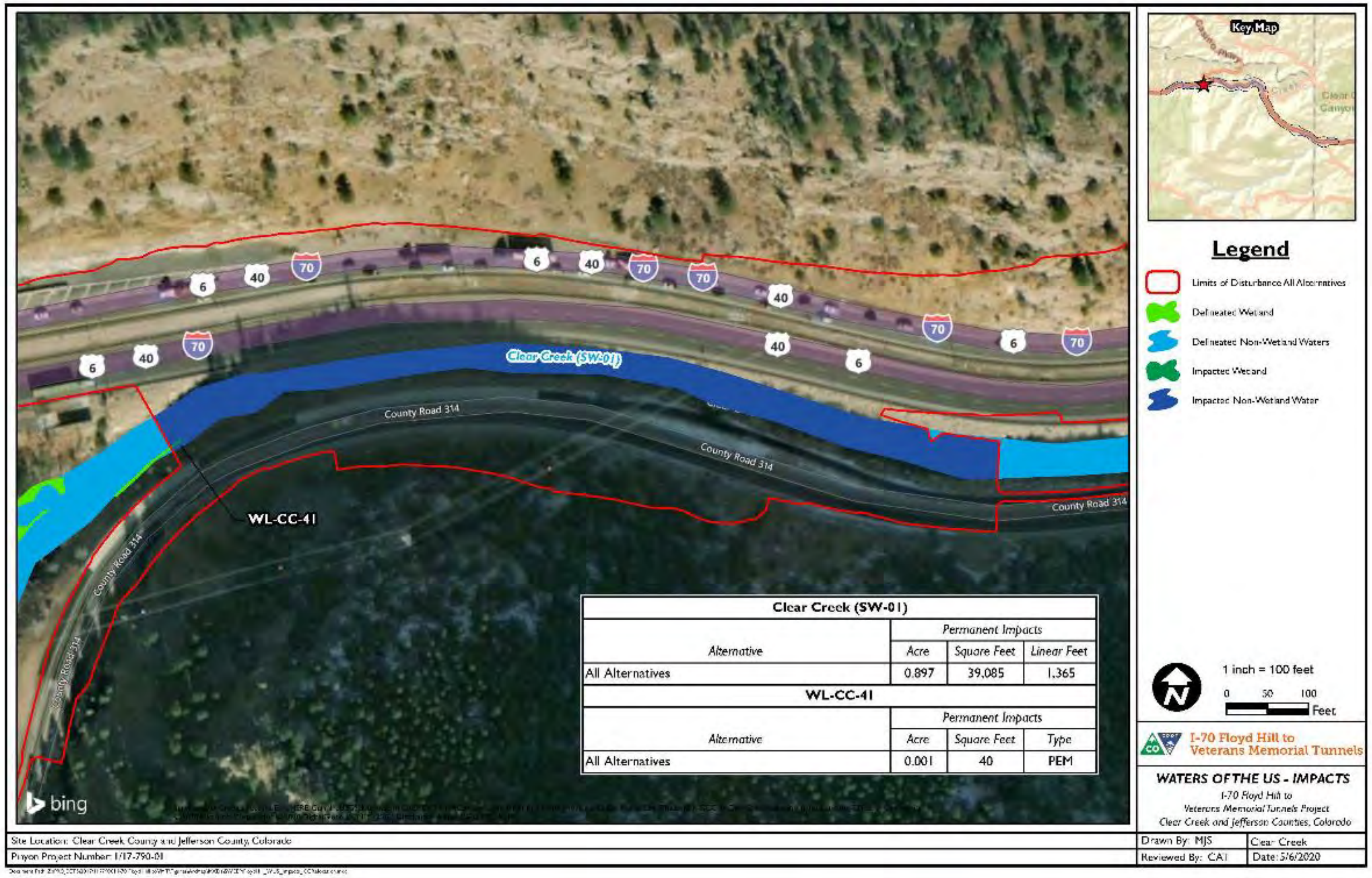


Wetlands and Waters of the US

Clear Creek (SW-01/WL-CC-41)

All Action Alternatives

- Impacts are the same for action alternatives
- Realignment of Clear Creek for new road layout (I-70 and CR 314)



Wetlands and Waters of the US

Temporary Impacts

- Vegetation removal
- Earthmoving
- Bridge demolition
- Grading activities
- Surface runoff during construction

Wetlands and Waters of the US

Indirect Impacts

- Shading over Clear Creek
- Noxious weeds
- Increased impervious surfaces post construction
- Water Quality

Section 404 Permitting

- Relocation of Clear Creek does not appear to fall under any Nationwide Permit; an Individual Permit is anticipated
- Other impacts could meet Nationwide Permit conditions if permitted separately
- Permitting discussion
  - Informal NEPA/404 Merger process
  - Single vs multiple permits
  - Stream Quantification Tool

COLORADO
Department of Transportation

Relocation of Clear Creek

February 13, 2020

Relocation of Clear Creek

Need for Realignment

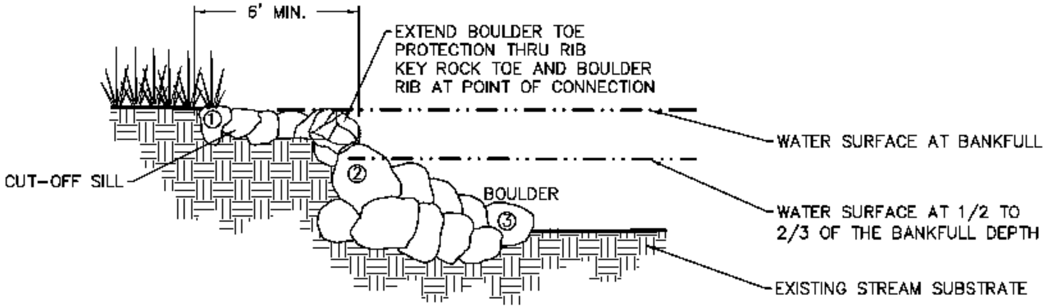
- I-70 Alignment
  - 55-mph design speed (curve radii)
  - Stopping sight distance
  - Rock cuts
  - Alignment with existing tunnels
- County Road 314/Greenway alignment
  - Minimal cross section width
  - Rock cuts to the south
- Hydraulics and floodplain

Limited Opportunities for Enhancements within Realignment Area

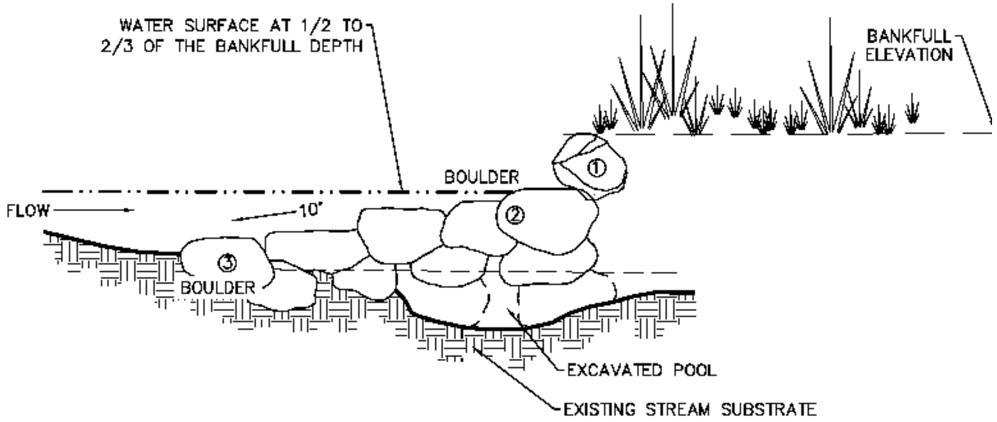
Downstream Enhancement Opportunities

- Wider existing riparian areas
- Areas where I-70 footprint is smaller and can be reclaimed (differs by alternative); open up floodplain and lay back slopes
- Other opportunities to improve (and balance) rafting and creek access

Potential Mitigation Details for Direct Relocation Area (from Twin Tunnels)

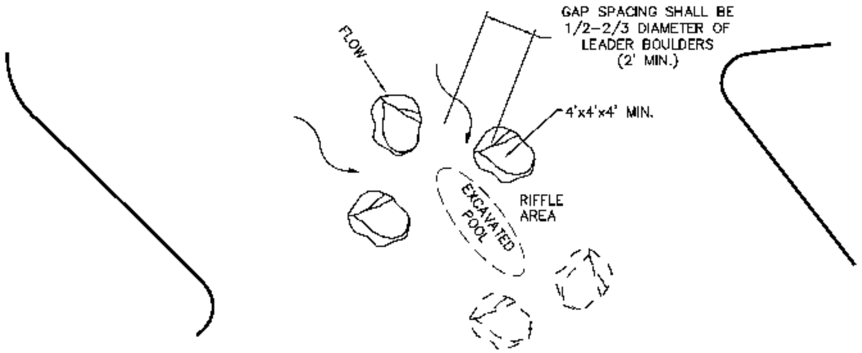


BOULDER RIB – CROSS SECTION
N.T.S.



BOULDER RIB – PROFILE VIEW
N.T.S.

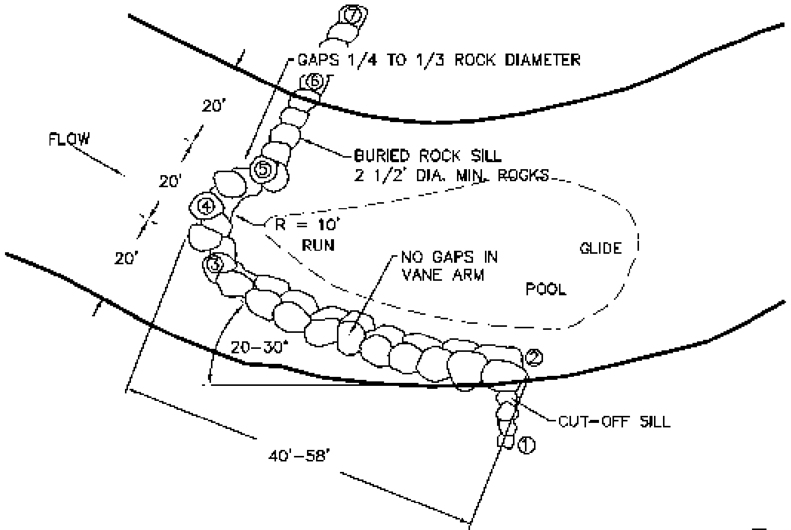
- EACH BOULDER PLACED INTO THE ACTIVE CHANNEL MOVING OUT FROM THE BANK SHOULD BE SET AT A LOWER ELEVATION USING A SLOPE OF 10%
- GAPS BETWEEN BOULDERS SHOULD BE ½ TO ⅔ OF THE BOULDER DIAMETER
- RIBS SHOULD ALTERNATE FROM ONE SIDE OF THE CHANNEL TO THE OTHER AT A SPACING OF 0.5 BANKFULL WIDTHS RESULTING IN INCREASED SINUOSITY.
- BOULDER SHALL BE KEYED INTO THE BANK
- MINIMUM BOULDER SIZE SHALL BE APPROXIMATELY 3'X3'X4'
- PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASED ON INDIVIDUAL ROCK CHARACTERISTICS



1. BOULDER CLUSTERS SHALL BE PLACED ADJACENT TO THE THALWEG.

BOULDER CLUSTER – PLAN VIEW
N.T.S.

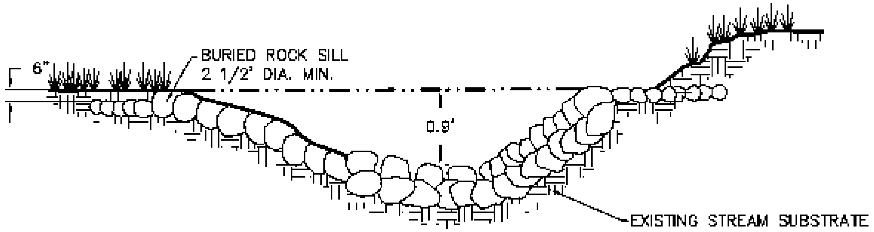
Potential Mitigation Details for Downstream Enhancements (from Twin Tunnels)



ROCK J-HOOK VANE – PLAN VIEW
N.T.S.

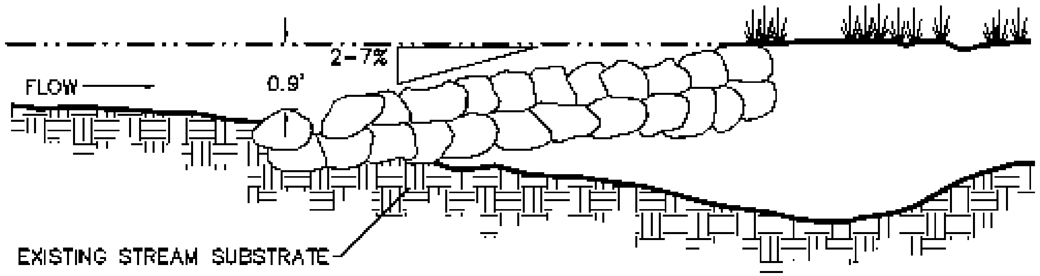
X
XX

NOTES:
1. J-HOOK POINTS 3, 4 AND 5 SHALL BE PLACED AT A RADIUS OF 10'
2. PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASE ON INDIVIDUAL ROCK CHARACTERISTICS.
3. J-HOOK ROCKS SHALL BE 4-5' DIA. X 2-3' HEIGHT.



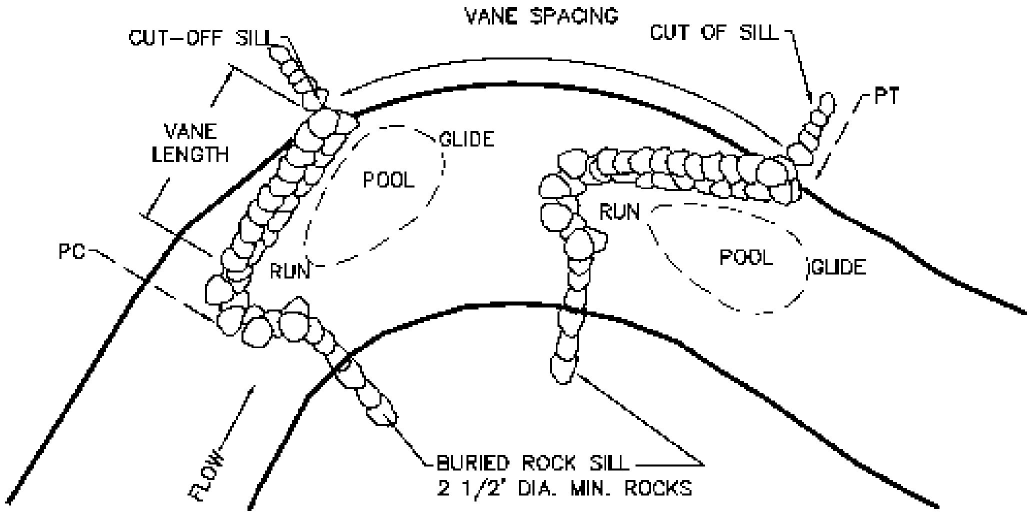
ROCK J-HOOK VANE – CROSS SECTION VIEW
N.T.S.

X
XX



ROCK J-HOOK VANE – PROFILE VIEW
N.T.S.

X
XX



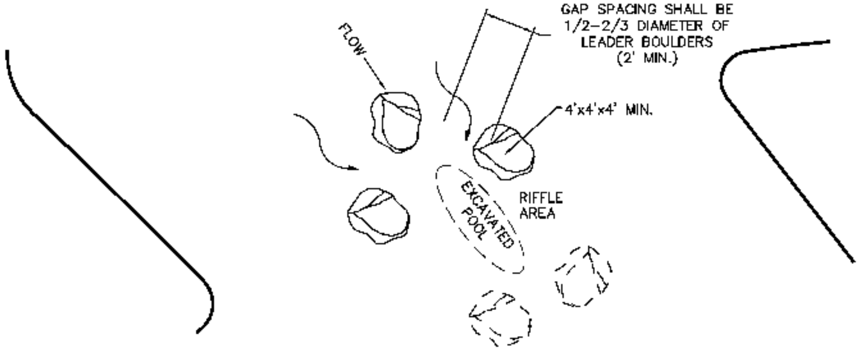
ROCK J-HOOK VANE SPACING
N.T.S.

X
XX

COLORADO
Department of Transportation

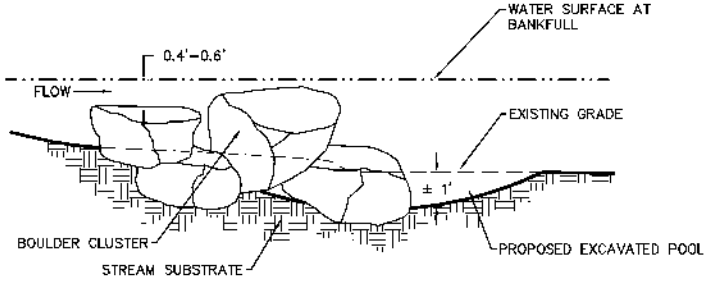
Questions / Comments?

Twin Tunnels Mitigation Project Details



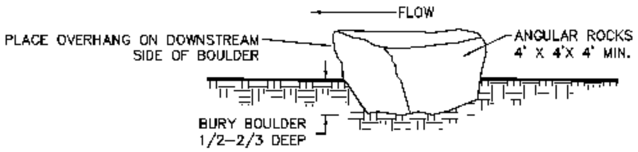
1. BOULDER CLUSTERS SHALL BE PLACED ADJACENT TO THE THALWEG.

BOULDER CLUSTER – PLAN VIEW
N.T.S.



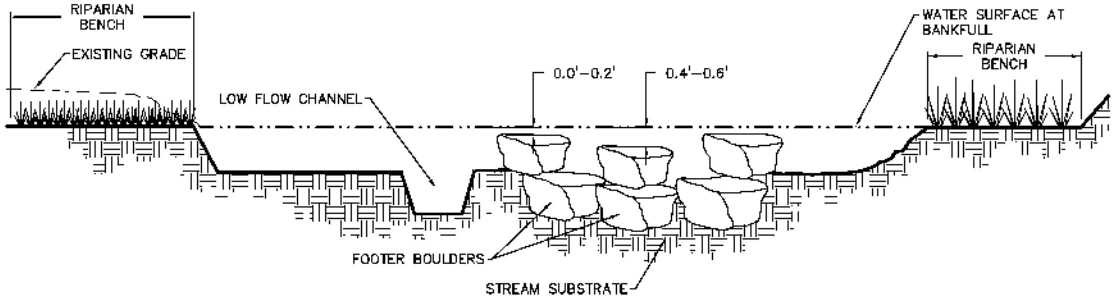
1. BOULDER CLUSTERS SHALL BE OF VARIABLE HEIGHT AND AT THE DISCRETION OF THE ENGINEER (FIELD DIRECTED).

BOULDER CLUSTER – PROFILE
N.T.S.



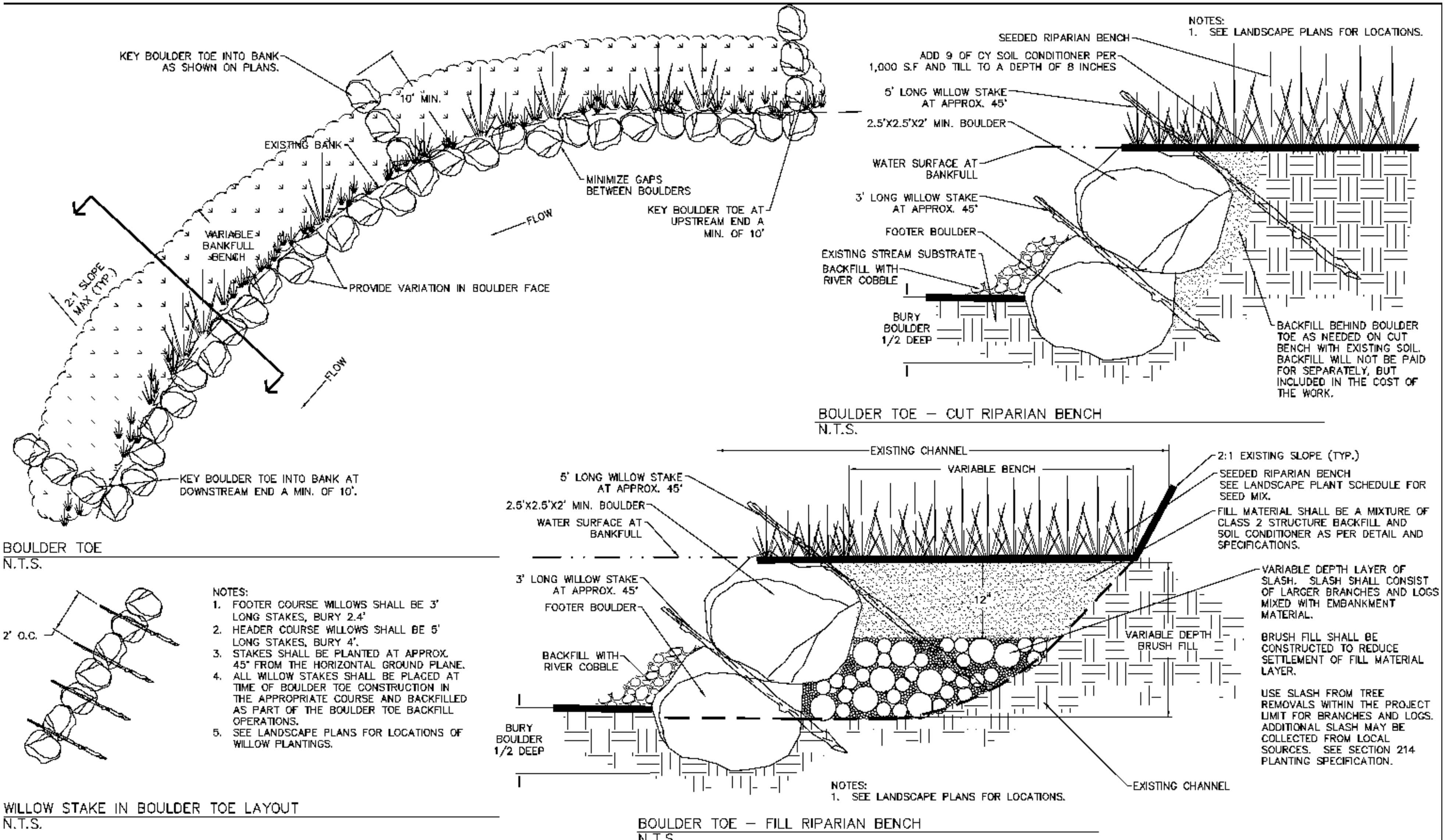
1. SEE PLANS FOR BOULDER PLACEMENT LOCATIONS.
2. BOULDER CLUSTERS MAY CONSIST OF 3–5 ROCK CLUSTERS. (FIELD DIRECTED).
3. PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASED ON INDIVIDUAL ROCK CHARACTERISTICS.

BOULDER PLACEMENT
N.T.S.

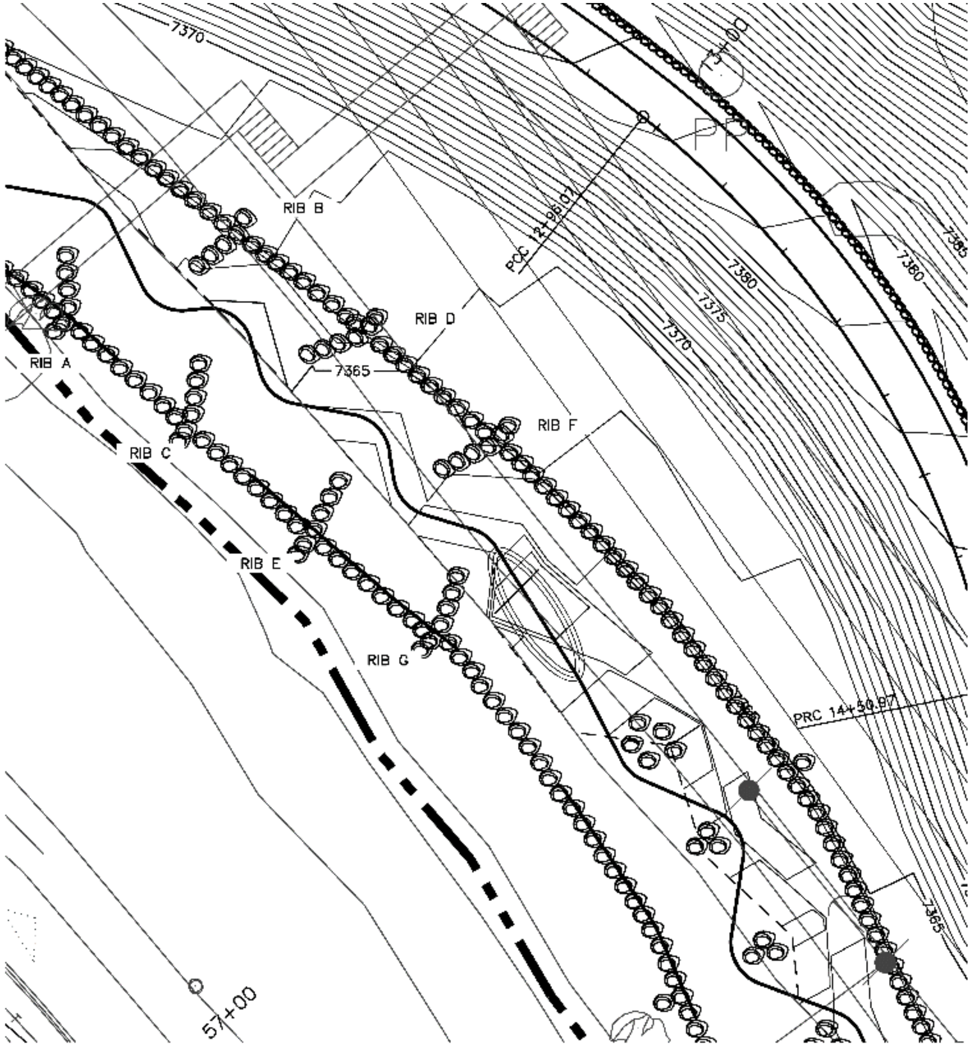


BOULDER CLUSTER – CROSS SECTION
N.T.S.

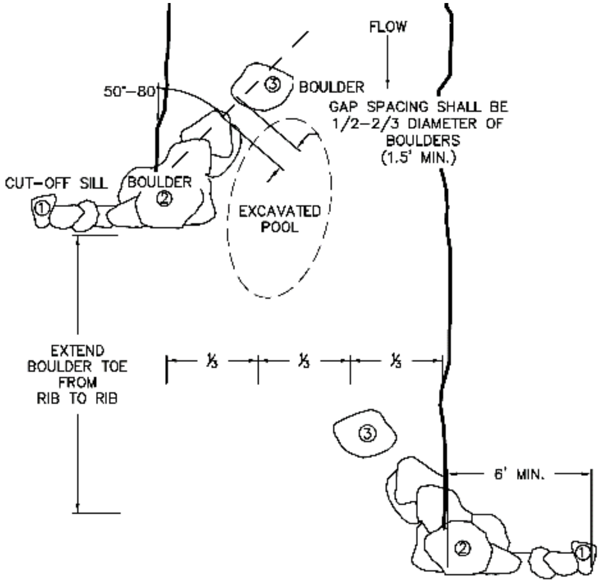
Twin Tunnels Mitigation Project Details



Twin Tunnels Mitigation Project Details



BOULDER RIB – PLAN VIEW
1"=30'–0"

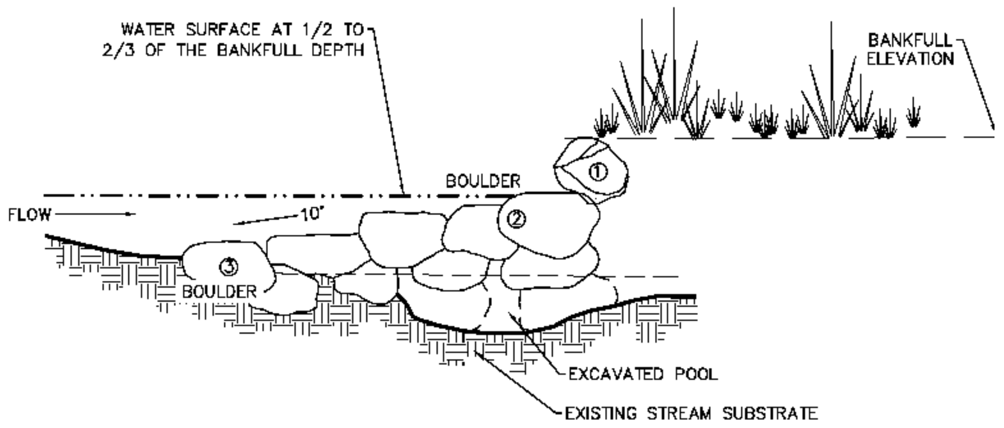


BOULDER RIB (TYP.)
N.T.S.

BOULDER RIB INFORMATION

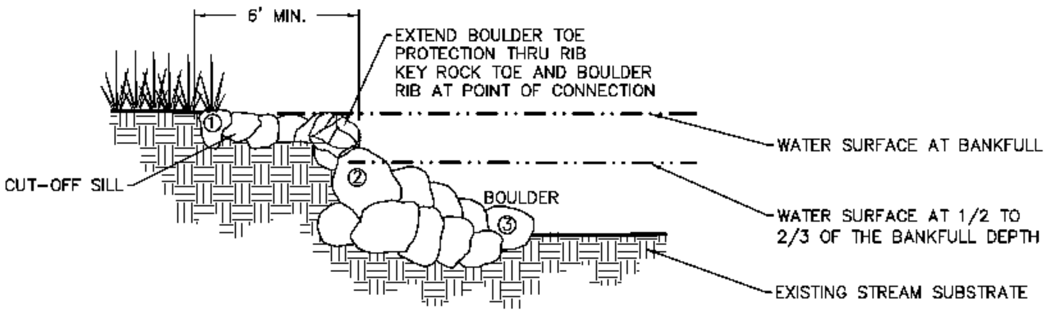
RIB No.	OVERALL LENGTH	ANGLE FROM BANK (DEGREES)	BOULDER① ELEV. BACK ROCK OF TOE		BOULDER② ELEV. ROCK AT BANK		BOULDER③ ELEV. END ROCK IN CHANNEL	
			Elevation	North/East	Elevation	North/East	Elevation	North/East
A	15.8'	50	7368.90	695840.57 1006708.952	7368.08	695845.233 1006715.677	7366.50	695861.072 1006712.170
B	13.4'	78.5	7368.50	695896.657 1006752.182	7367.21	695864.206 1006750.694	7365.87	695855.458 1006740.505
C	15.5'	57	7367.80	6958163.396 1006736.557	7366.97	695821.277 1006740.415	7365.42	695836.609 1006742.623
D	15.8'	58.5	7367.40	695846.585 1006783.067	7366.55	695841.335 1006780.050	7364.97	695836.106 1006765.164
E	14.4'	74.5	7366.90	695792.545 1006764.206	7365.94	695768.207 1006768.207	7364.50	695810.022 1006774.440
F	15.3'	66.5	7366.30	695821.887 1006885.584	7365.53	695816.773 1006809.316	7364.00	695809.910 1006795.665
G	15.4'	60.5	7365.90	695769.124 1006792.116	7365.04	695773.588 1006796.174	7363.50	695788.190 1006801.213

Twin Tunnels Mitigation Project Details



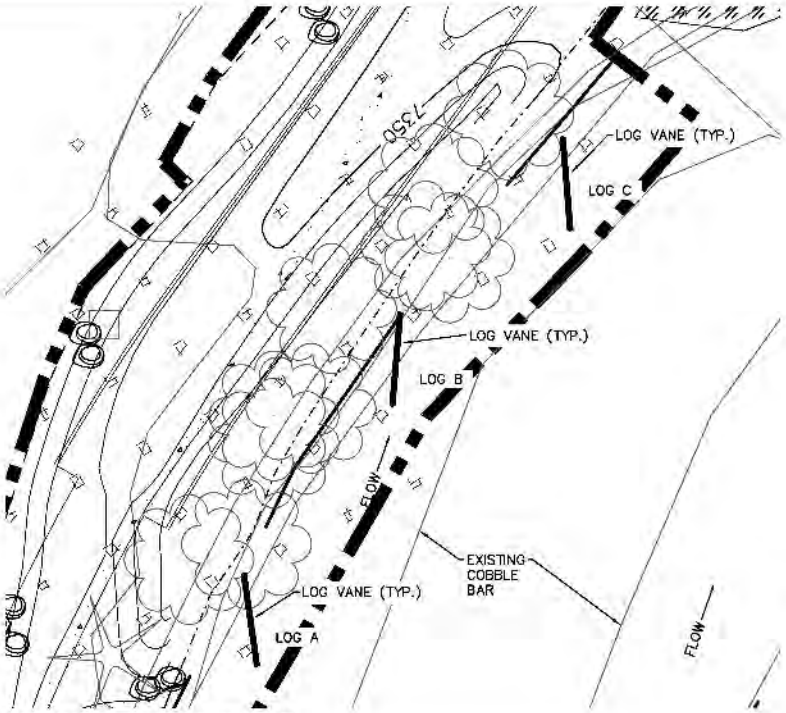
BOULDER RIB – PROFILE VIEW
N.T.S.

- EACH BOULDER PLACED INTO THE ACTIVE CHANNEL MOVING OUT FROM THE BANK SHOULD BE SET AT A LOWER ELEVATION USING A SLOPE OF 10%
- GAPS BETWEEN BOULDERS SHOULD BE ½ TO ⅔ OF THE BOULDER DIAMETER
- RIBS SHOULD ALTERNATE FROM ONE SIDE OF THE CHANNEL TO THE OTHER AT A SPACING OF 0.5 BANKFULL WIDTHS RESULTING IN INCREASED SINUOSITY.
- BOULDER SHALL BE KEYED INTO THE BANK
- MINIMUM BOULDER SIZE SHALL BE APPROXIMATELY 3'X3'X4'
- PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASED ON INDIVIDUAL ROCK CHARACTERISTICS

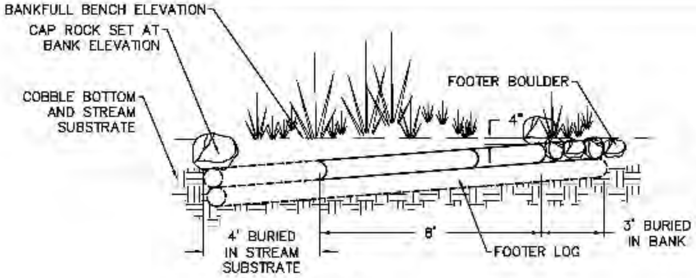


BOULDER RIB – CROSS SECTION
N.T.S.

Twin Tunnels Mitigation Project Details

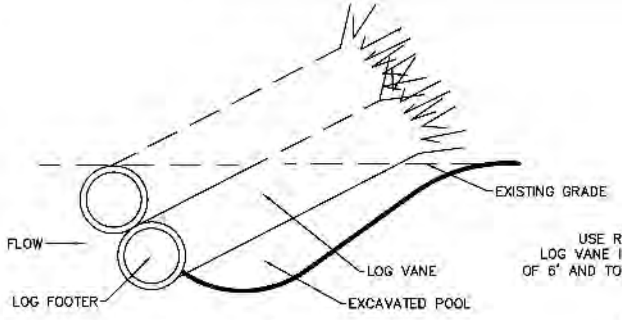


LOG VANE – LOCATION PLAN
N.T.S.

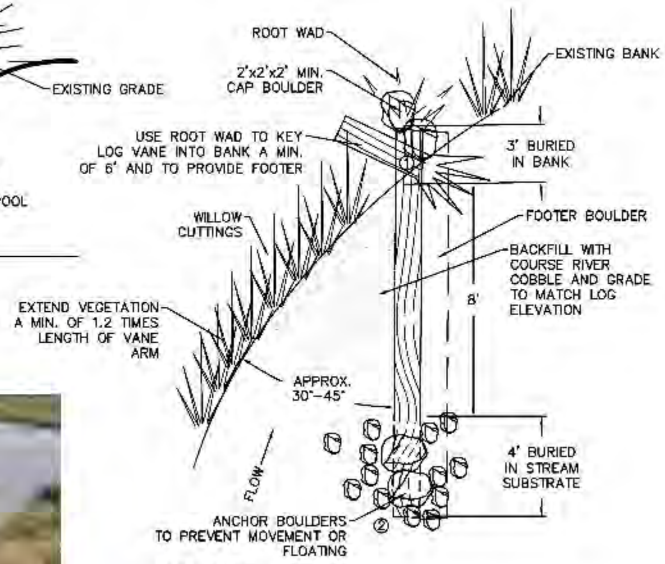


LOG VANE – ELEVATION
N.T.S.

- LOGS SHALL BE 12" DIA. MIN.
- ROOT WAD SHALL BE COVERED IN BANK BY CAP ROCKS.
- LOGS SHALL BE DE-LIMBED AND FREE OF BRANCHES.
- ELEVATIONS SHALL BE DETERMINED IN THE FIELD BASED ON EXISTING CHANNEL ELEVATIONS.
- FISH SPAWNING AREAS SHALL BE FLAGGED BEFORE CONSTRUCTION BEGINS AND WILL BE A NON-DISTURBANCE ZONE.
- LOG VANE LOCATIONS MAY BE ADJUSTED OR ELIMINATED IN THE FIELD TO ACCOUNT FOR FISH SPAWNING AREAS AND BEDROCK CONDITIONS AT THE DISCRETION OF THE ENGINEER (FIELD DIRECTED).



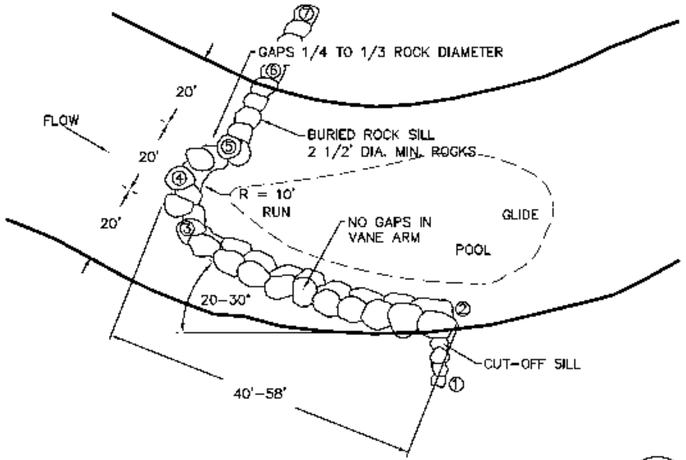
LOG VANE – PROFILE
N.T.S.



LOG VANE – PLAN
N.T.S.

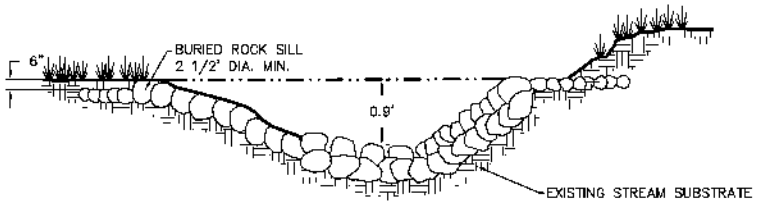
LOG VANE No.	LOG LENGTH	ANGLE FROM BANK	LOG	
			Elevation	North/East
A	15	35 Deg.	① 696062.616	1007544.651
			② 696047.665	1007593.869
B	15	30 Deg.	① 696034.726	1007566.751
			② 696019.779	1007565.488
C	15	45 Deg.	① 695993.056	1007541.788
			② 695978.206	1007543.905

Twin Tunnels Mitigation Project Details

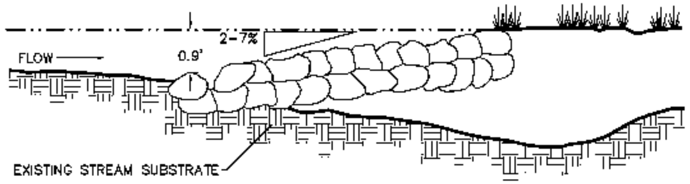


ROCK J–HOOK VANE – PLAN VIEW
N.T.S.
X
XX

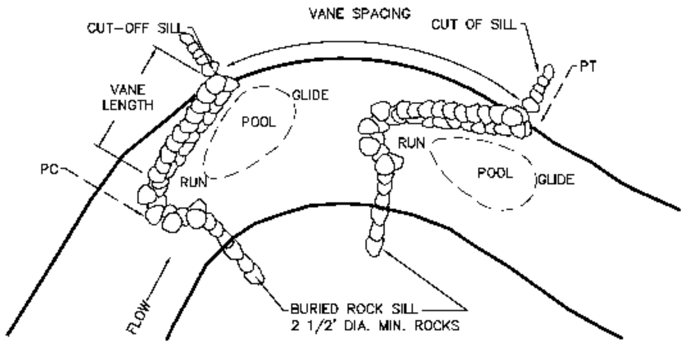
NOTES:
1. J–HOOK POINTS 3, 4 AND 5 SHALL BE PLACED AT A RADIUS OF 10'
2. PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASE ON INDIVIDUAL ROCK CHARACTERISTICS.
3. J–HOOK ROCKS SHALL BE 4–5' DIA. X 2–3' HEIGHT.



ROCK J–HOOK VANE – CROSS SECTION VIEW
N.T.S.
X
XX



ROCK J–HOOK VANE – PROFILE VIEW
N.T.S.
X
XX

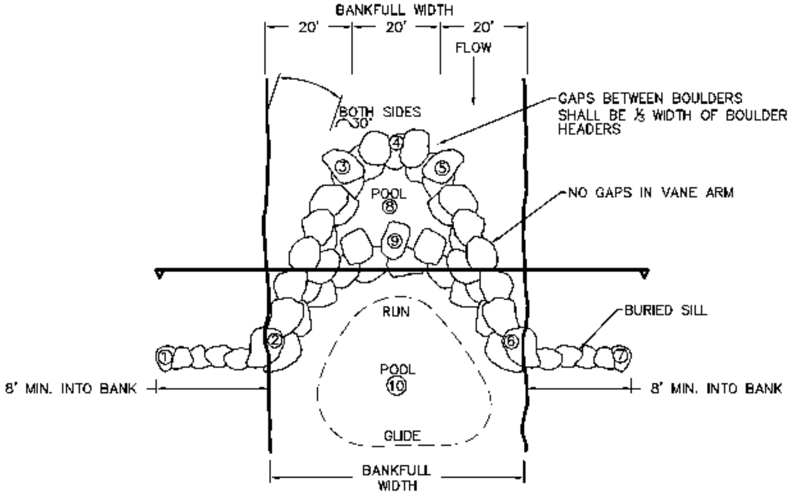


ROCK J–HOOK VANE SPACING
N.T.S.
X
XX

J-HOOK INFORMATION

J-HOOK No.	VANE ARM LENGTH	ANGLE FROM BANK								
			BOULDER 1		BOULDER 2		BOULDER 3		BOULDER 4	
			Elevation	North/East	Elevation	North/East	Elevation	North/East	Elevation	North/East
1	40	30 Degrees	7362.0	695342.984 / 1007104.201	7362.0	695346.297 / 1007106.018	7359.9	695375.712 / 1007092.443	7359.4	695391.434 / 1007092.068
			BOULDER 5		BOULDER 6		BOULDER 7			
			Elevation	North/East	Elevation	North/East	Elevation	North/East		
			7359.9	695391.761 / 1007106.709	7360.1	695406.642 / 1007117.410	7360.3	695419.512 / 1007124.709		
			BOULDER 1		BOULDER 2		BOULDER 3		BOULDER 4	
			Elevation	North/East	Elevation	North/East	Elevation	North/East	Elevation	North/East
2	40	30 Degrees	7355.0	695389.223 / 1007473.715	7355.0	695390.757 / 1007470.338	7354.6	695376.565 / 1007438.944	7354.1	695379.852 / 1007425.903
			BOULDER 5		BOULDER 6		BOULDER 7			
			Elevation	North/East	Elevation	North/East	Elevation	North/East		
			7354.6	695391.849 / 1007426.432	7356.0	695414.896 / 1007409.482	7358.5	695442.622 / 1007389.962		

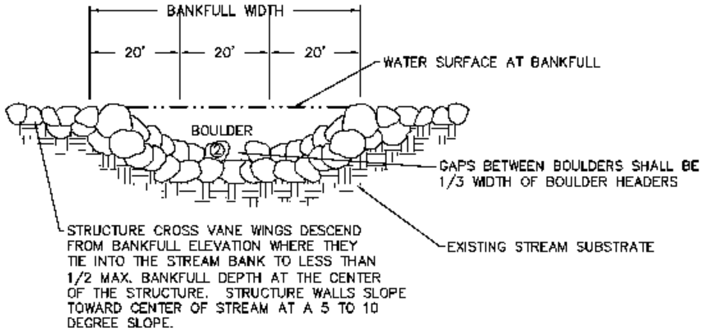
Twin Tunnels Mitigation Project Details



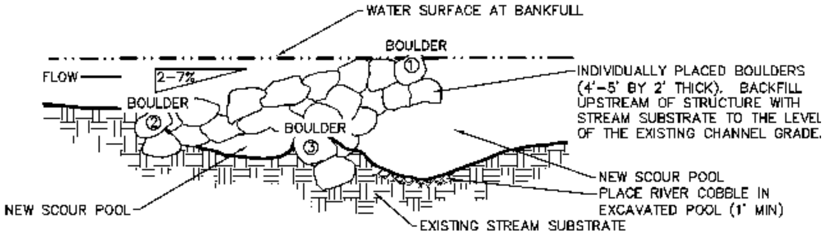
INDIVIDUALLY PLACED FOOTER ROCKS 4' TO 5' BY 2' THICK (MIN. TWO ROWS OF FOOTER ROCKS PLACED TIGHTLY TOGETHER WITH INTERSTITIAL SPACES FILLED WITH COBBLE AND GRAVEL).

CROSS VANE – PLAN VIEW
N.T.S.

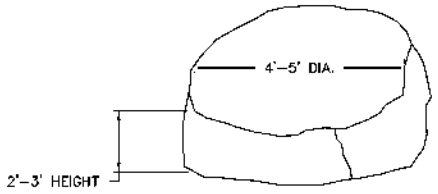
POINT	Northing	Easting	Elevation
1	695752.253	1007484.138	7349.0
2	695751.960	1007492.149	7349.0
3	695699.272	10047509.4	7348.0
4	695695.573	1007518.726	7347.9
5	695696.538	1007528.212	7348.0
6	695749.985	1007551.516	7349.0
7	695749.588	1007559.564	7349.0
8	695701.581	1007520.927	7347.0
9	695707.465	1007520.152	7347.5
10	695717.802	1007520.397	7345.0



CROSS VANE – CROSS SECTION
N.T.S.



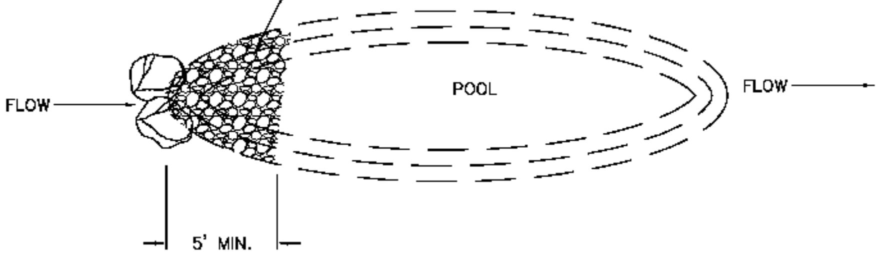
CROSS VANE – PROFILE
N.T.S.



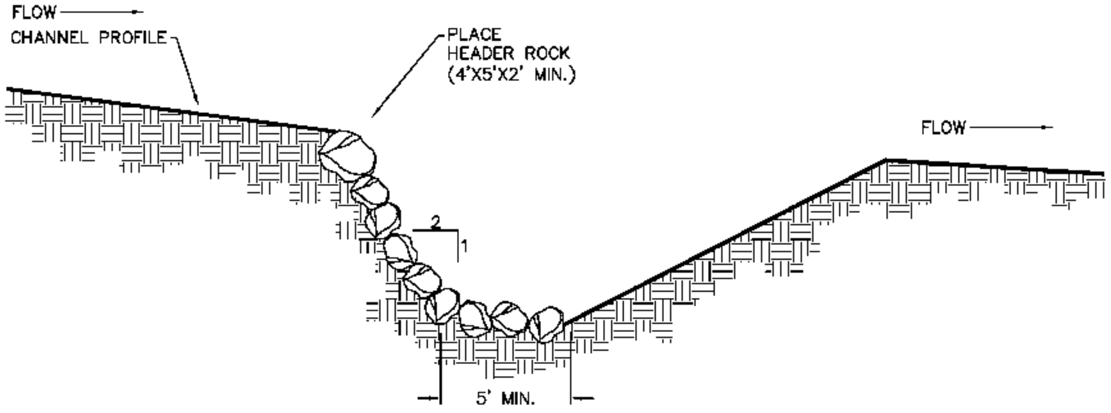
PLACEMENT OF ROCK WILL BE FIELD DIRECTED BASED ON INDIVIDUAL ROCK CHARACTERISTICS.

TYPICAL BOULDER HEADER/FOOTER
N.T.S.

Twin Tunnels Mitigation Project Details



TYPICAL POOL PLAN VIEW
N.T.S.



NOTE:
1. POOL ARMORING IS TO BE USED ONLY UNDER FIELD DIRECTION.

TYPICAL POOL PROFILE VIEW
N.T.S.