Cherry Creek at 12-Mile Park
DRAFT Alternatives Evaluation Report

Prepared For:

CHERRY CREEK BASIN WATER QUAILTY AUTHORITY

Prepared By:

CH2MHILL

April 2011

Table of Contents

List of Appendices

List of Acronyms

ADA	Americans with Disabilities Act
CCBWQA	Cherry Creek Basin Water Quality Authority
CCSP	Cherry Creek State Park
DTM	Digital Terrain Model
DOLA	Dog Off Leash Area
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
HEC-RAS	Hydrologic Engineering Center – River Analysis System
MSE	Mechanically Stabilized Earth
TAC	Technical Advisory Committee
UDFCD	Urban Drainage and Flood Control District
ULTO	Ute Ladies'-Tresses Orchid
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

Exhibits

Figures

Tables

1. Purpose and Scope

The purpose of this Alternatives Evaluation Report (Report) is to document and present alternatives for restoring Cherry Creek located at 12-Mile Park, at the upstream end of Cherry Creek State Park. Exhibit A shows the project area. The Alternatives Evaluation for Cherry Creek is part of a larger scope of work for the Cherry Creek Stream Reclamation at 12-Mile Park Project (Project), which is contracted between CH2M HILL and Cherry Creek Basin Water Quality Authority. The existing eastern or right bank of the channel has degraded in locations resulting in active erosion. The channel has also experienced a breakout or breach of the right bank of the low flow channel into the floodplain resulting in overbank erosion and additional environmental damage. This Project aims to develop a recommended plan to stabilize the eroded banks and restore the channel to the historic alignment. Objectives are to develop a plan for the project area that:

- Reclaims Cherry Creek in a way that enhances water quality benefits of stream bank stabilization by protecting and improving riparian vegetation and providing more frequent connections between the main channel and the floodplain, called stream reclamation
- Stabilizes the bed profile and outer channel banks to prevent bank erosion from migrating further downstream
- Identifies bank restoration requirements for the breached area of the creek to allow for temporary or permanent repairs in a timely fashion that are consistent with the overall Stream Reclamation Plan and that restores the creek flow to the pre-breached alignment
- With the approval of the Authority Representatives, evaluates and assesses the pertinent information by others and acknowledges the information and source in the Stream Reclamation Plan
- Minimizes erosion, sediment transport, and bacterial contamination from the Dog Off Leash Area (DOLA) and integrates CCSP dog management plan into the Stream Reclamation Plan
- Minimizes operation and maintenance requirements while preserving long term performance

EXHIBIT 1-1
Project Location Map
Cherry Creek Stream Reclamation at 12-Mile Park Project

2. Study Area

Cherry Creek is a major drainageway serving as the principal means of conveying runoff from south to north through Douglas, Arapahoe, and Denver Counties to the South Platte River. Cherry Creek Reservoir was constructed by the United States Army Corps of Engineers (USACE) as a flood control facility to protect downstream communities from catastrophic flooding. Since the construction of the reservoir, Cherry Creek State Park has become a premier recreational facility for the State of Colorado. The reservoir can experience significant nutrient loading from the contributing watershed that damages the health of the reservoir. The contributing area of the watershed from the upper reaches of Cherry Creek to the upstream limits of Cherry Creek State Park is approximately 361 square miles.

The project area is located at the 12-Mile Park Dog Off Leash Area (DOLA) located at the southern end of Cherry Creek Reservoir State Park. The project includes approximately 3,000 feet of stream bank restoration adjacent to the DOLA.

3. Site Assessment

This section provides a brief summary of the findings of the Site Assessment Report. Additional information can be found in the Cherry Creek at 12-Mile Park Site Assessment Report (CH2M HILL, 2010).

Park Use Characteristics

The 12-Mile Park DOLA was originally utilized as a sports dog training facility. As development around the park increased the park use changed to primarily an off leash dog park. Adjacent to the DOLA is an equestrian concessions area where many horses are stabled and horse owners can access the parks trails from the area.

As the park has seen an increase in usage there has been an increase in channel bank degradation as well as conflicts between dogs and horses. In an effort to improve the recreational experience at the park, Colorado State Parks is working to develop a plan for improving the DOLA. The plan, as of the date of this document, includes new dog waste stations, strategic fencing, improved trails, and new creek crossings.

Accessibility to the waters of Cherry Creek from the DOLA along much of the channel length is currently limited in that any access must be made on foot over fairly steep and uneven terrain. Vertical or steep banks become more difficult or impossible to traverse when wet. There are no formal access points for users with limited mobility or who would qualify under the Americans with Disabilities Act (ADA). It is the Cherry Creek State Park (CCSP) policy that any new facility must have at least one ADA accessible access point. In the opinion of CCSP, one of the goals of the stream reclamation project is to provide access to the creek for park users and that one of the access points needs to be ADA accessible.

Survey

To provide an accurate plan on which to develop comprehensive solutions, a field survey of the project area was performed in August of 2010. The survey limits include the 3,000 feet of Cherry Creek from the existing trail on the east side to the west channel bank.

Geotechnical Evaluation

CH2M HILL engaged the services of CTL Thompson Inc. to perform a geotechnical evaluation of the project area. CTL Thompson Inc. performed five borings along the eastern channel bank and took soil samples on the channel bank for total phosphorus testing. The geotechnical investigation determined that the borings contained 20 feet to more than 40 feet of silty to very clayey fine to medium grained sand with variable amounts of gravel. Sandstone bedrock was found in the southern most borings around 39 feet below the channel bank elevation.

ACZ Laboratories, Inc. performed phosphorus testing on the topsoil at each boring location. Using the EPA Method to calculate total phosphorus, the total phosphorus varies from 290 to 590 ppm (0.6 to 1.2 lbs/ton).

Recommendations and additional geotechnical detail can be found in the geotechnical report in the Cherry Creek at 12-Mile Park Site Assessment Report (2010).

Site Review

Cherry Creek was observed for channel degradation, channel bank erosion and instability, and extreme degradation. There are no existing channel improvements or hydraulic structures within the project reach.

In general, Cherry Creek through the project area can be distinguished by three different channel reaches. The reaches were selected due to the similarities of channel characteristics through the channel reach. The east bank of Cherry Creek has experienced loss of vegetation and soil as a

result of heavy traffic from park users through the entire project area. The project reaches are described below and shown on the recommended plan summary figure:

Reach 1: Upstream Reach – Characterized by a groundwater fed secondary channel that has a lower invert than the mainstem of Cherry Creek. The east bank is characterized by steep to near vertical banks that are 15 – 20 feet above the invert of the secondary channel with vegetation loss due to park use.

EXHIBIT 1-2
Reach 1: Upstream Reach
Cherry Creek Stream Reclamation at 12-Mile Park Project

Reach 2: Downstream Reach – Downstream of Reach 1, the groundwater fed channel joins with the mainstem of Cherry Creek. The eastern bank decreases in height to between five and fifteen feet above the breakout area and approximately three feet downstream of the breakout area. The lowered eastern bank provides easier access to the channel, and as a result there are numerous areas where the vegetation has been trampled and soil erosion has resulted.

EXHIBIT 1-3
Reach 2: Downstream Reach
Cherry Creek Stream Reclamation at 12-Mile Park Project

Reach 3: Channel Breakout Reach – Within reach 2, Cherry Creek has experienced a breach of the eastern bank resulting in Cherry Creek leaving the historic flow path and flowing north rather than turning to the west as it has for the last 70 years. Based on discussion with State Park staff and Park Concessionaires, it appears that the loss of vegetation in the area due to heavy park use resulted in the vulnerable east bank. The east bank overtopped during a large runoff event in 2009. The overtopping caused localized erosion washing out the east bank created a new channel with an invert lower than the historic flow path. This is the most significant problem identified in the site assessment.

EXHIBIT 1-4
Reach 3: Channel Breakout Reach
Cherry Creek Stream Reclamation at 12-Mile Park Project

Environmental Evaluation

Through and in the vicinity of the project reach, Cherry Creek consists of a very active stream system with several braided channels, areas of sand deposition, vertical cut banks, several well-developed wetlands, and densely forested riparian areas. The various elements of the stream system create a mosaic of diverse habitat types.

As previously described, the project area consists of three stream reaches. In Reach 1, wetlands extend across a broad, active floodplain. Wetlands in this reach are dominated by cattail (*Typhus latifolia*) and bulrush (*Schoenoplectus* spp.). Sandbar willow (*Salix exigua*), plains cottonwood (*Populus deltoides* subsp. *monilifera*) and peachleaf willow (*Salix amygdaloides*) create a dense overstory in places.

In Reach 2, wetlands on the northeast bank are more confined to narrow margins along the channel and are dominated by sandbar willow and reed canarygrass (*Phalaroides arundanaceae)*. Wider sandbar willow and plains cottonwood wetlands occur along the southwest bank and along the toe of the south bank of a groundwater-fed channel just upstream of Reach 2. West of the new breakout channel, surface water no longer consistently flows and shallow-rooted wetland vegetation along the historic channel will likely decrease. Deeper-rooted trees and shrubs will likely persist, but the number of new seedlings and saplings may decrease over time. Although, currently the damp sandy channel bottom provides an excellent growth medium for the establishment of willow and cottonwood seedlings.

The new channel in Reach 3 flows through an area that was previously a cattail/bulrush wetland and a small pond surrounded by a broad sandbar willow wetland. Sediment deposited by the new channel has buried wetland vegetation along its length and in a wetland at its northern

extent. If sediment deposition is eliminated and the sediment is not too deep, wetland vegetation will reestablish in the deposition areas. A more detailed environmental discussion is provided in the Site Assessment Report (2010).

The Cherry Creek riparian corridor provides potential habitat for two species listed as threatened under the Endangered Species Act: Ute ladies'-tresses orchid (ULTO) (*Spiranthes diluvialis*) and Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Although conditions along Cherry Creek in Douglas and Arapahoe counties appear to be suitable for ULTO, it is not known to be present. Along Colorado's Front Range, Preble's is found below 7,800 feet in elevation, generally in lowlands with medium to high moisture along permanent or intermittent streams. Preble's is known to occur along Cherry Creek in Douglas County and was captured on Cherry Creek about four miles south of the project area in 2000. Although known to be present on Cherry Creek in Douglas County, Preble's has not been captured on Cherry Creek in Arapahoe County.

Hydrologic Evaluation

No new hydrologic modeling was performed as part of this site assessment. Rather, existing hydrologic data was reviewed to determine the most appropriate flow rates on which to base the design. Documents reviewed as part of this study are listed below:

- Cherry Creek Corridor – Reservoir to Scott Road Major Drainageway Planning Preliminary Design Report by URS (2004).
- FEMA FIS (as reported by URS Cherry Creek Corridor Study)
- Channel Forming Discharge (Ruzzo, 2010)

Table 3-2 shows a comparison of the hydrology within the project area.

TABLE 3-1

Comparison of Existing Hydrologic Data for Cherry Creek at 12-Mile Park

Recurrence Interval	Cherry Creek Corridor Report[2]	FEMA FIS
2-Year Existing	2,142	-
2-Year Developed	4,429	-
5-Year Existing	5,892	-
5-Year Developed	9,537	-
10-Year Existing	10,071	10,300
10-Year Developed	14,655	-
25-Year Existing	20,200	-
25-Year Developed	25,821	-
50-Year Existing	31,217	31,000
50-Year Developed	36,946	-
100-Year Existing	49,021	51,000
100-Year Developed	54,285	-
500-Year Existing	-	150,000

[1] Peak flow rates presented in cubic feet per second.
[2] Peak flow rates from URS (2004) at UDSWM Design Point 286, at the Cherry

TABLE 3-1

Comparison of Existing Hydrologic Data for Cherry Creek at 12-Mile Park

Recurrence Interval	Cherry Creek Corridor Report[2]	FEMA FIS
2-Year Existing	2,142	-
2-Year Developed	4,429	-

Creek Reservoir.

In addition to the existing hydrologic data for Cherry Creek at 12-Mile Park, the mean annual flow, bank full flow, and base flow were determined for the project reach. The results of the mean annual flow analysis were presented in a Technical Memorandum by William P. Ruzzo titled *Cherry Creek at 12-Mile Park – Channel Forming Discharge*. The results of this analysis suggest a range for the mean annual flow. The results are presented in Table 3-2.

TABLE 3-2

Mean Annual Flow for Cherry Creek at 12-Mile Park

	Peak Flow (cfs)
Mean Annual Flow (min)	300
Mean Annual Flow (max)	800

The bank full flow is defined as the flow contained in the low flow channel from top of bank to top of bank and was determined for representative cross sections within the project reach using the Hydrologic Engineering Center River Analysis System (HEC-RAS). Where one bank is at a higher elevation than the other bank, the bank full flow extends to the top of the lower bank. The bank full flow rates are presented in Table 3-3.

TABLE 3-3

Bank Full Flow Analysis for Cherry Creek at 12-Mile Park

River Station	Model	Q Total (cfs)
3119.66	Historic/Breakout	505
2821.608	Historic/Breakout	570
2490.509	Historic/Breakout	345
2367.207	Historic/Breakout	335
2042.742	Historic/Breakout	405
1605.955	Historic/Breakout	385
1303.384	Historic/Breakout	585
1150.922	Historic/Breakout	810
459.4117	Historic	70
343.4038	Historic	20
730.4002	Breakout	520
497.3197	Breakout	255

The base flow for the project area varies from approximately 5 cfs to 20 cfs. As shown in Table 3-2, the mean annual flow is in the range of 300 cfs to 800 cfs. As shown in Table 3-3, the bank full flow varies from approximately 300 cfs to 800 cfs upstream of the breakout area and is typically less downstream of the breakout.

Hydraulic Evaluation

A hydraulic model was created using the Hydrologic Engineering Center River Analysis System (HEC-RAS) published by the US Army Corps of Engineers (USACE 2008). Two HEC-RAS models were created.

The values for flow depth and velocity from the hydraulic analysis are presented in Table 3-4. The values presented in Table 3-4 represent a range of values since the flow characteristics change between cross sections. The cross sections downstream of the breakout area, both along the historic flow path and the breakout flow path, have more variability in the depths and velocities than the cross sections upstream.

TABLE 3-4
Typical Depth and Velocity Values from HEC-RAS Analysis

	2-Year Existing	2-Year Developed	Mean Annual Min	Mean Annual Max	Bank Full
Depth (ft)	2 - 4	4 - 5	1 - 3	2 - 4	2 - 3
Velocity (ft/s)	3 - 4	4 - 6	2 - 6	2 - 6	3 - 6

Stream Stability Analysis

The existing channel slope varies throughout the project reach from 0.015 ft/ft to 0.0015 ft/ft with an average channel slope through the project reach of approximately 0.003 ft/ft. A qualitative and quantitative analysis was performed to determine the sediment transport rate and stable sediment transport rate for Cherry Creek at 12-Mile Park. Based on a review of aerial photographs and an analytical analysis to determine the stable slope based on a stable slope sediment transport rate, it has been determined that the project reach for Cherry Creek at 12-Mile Park is currently at a stable slope for the existing channel geometry and flow conditions. The average results of the stable slope analysis are presented in Table 3-5. The results are the average of the stable slope determined using the bank full, 2-year existing, and 2-year future peak flows.

TABLE 3-5
Average Stable Slope for Cross Section for Cherry Creek at 12-Mile Park

Cross Section	Average Stable Slope (%)
28+21	0.37%
27+18	0.28%
16+05	0.35%
13+03	0.47%
4+59	0.56%
4+97	0.90%

TABLE 3-5
Average Stable Slope for Cross Section for Cherry Creek at 12-Mile Park

Cross Section	Average Stable Slope (%)
28+21	0.37%
27+18	0.28%
Average by Cross Section	***0.48%***
Average without 4+97	**0.41%**

The stable slope analysis using the stable sediment transport rate for Cherry Creek at 12-Mile Park suggests that the stable slope along the historic flow path is approximately 0.4%. It must be understood that the concepts used for the computation of sediment transport innately include a margin of error and in general, the methods used in this analysis result in a slope that will reduce the degradation and aggradation of the main channel. Although the project reach as a whole has been determined to be at a stable condition, there may still be local areas of degradation and aggradation within the project reach caused by local changes in the main channel geometry and flow conditions. According to the *Cherry Creek Corridor – Reservoir to Scott Road Major Drainageway Planning Preliminary Design Report* (URS, 2004), the slope of this reach is 0.41% and the channel condition is aggrading to stable, which is consistent with the results of the analytical stable slope analysis performed for this study.

Because the historic channel has been determined to be in a stable condition, the downcutting observed directly upstream of the breakout area is a result of the breakout flow path attempting to reach a stable slope. This is consistent with the aerial photography review which shows that the main channel has experienced little horizontal channel meandering over the last 20 years before the breakout occurred. The conclusion that the historic flow path is at a stable slope is also consistent with recent site visits in which the downcutting was not observed before the breakout occurred.

4. Alternatives Analysis

Alternatives were developed for the project area to address problems identified during the site assessment. The primary needs identified in the site assessment were repair of the breakout area, bank stabilization of the east bank, water quality enhancements, and specific creek access points along the east bank for park users. This section discusses alternatives considered to address those problems identified.

Status Quo

The Status Quo alternative assumes that no improvements will be implemented within the project area, with the exception of the repair of the breakout area to restore the alignment of Cherry Creek. Under this alternative, there are no improvements to address the existing problems identified in the site assessment plan. This alternative results in increased erosion reducing the water quality of the creek. For these reasons this alternative is considered infeasible and will not be carried further.

Bank Stabilization Alternatives

For the Cherry Creek at 12-Mile Park project area, seven bank stabilization alternatives were identified and considered. Three of these alternatives are considered non-structural bank stabilization alternatives and four of the alternatives are considered structural bank stabilization alternatives. See below for descriptions of each of the bank stabilization alternatives. A typical section showing each bank stabilization alternative is also presented in Appendix B.

Throughout the Cherry Creek at 12-Mile Park project reach there are two typical existing bank sections. From the upstream limit of the project area to approximately 200 feet downstream of the confluence of the mainstem with the groundwater fed secondary channel, the bank can be characterized as between 10 and 15 feet high with steep side slopes. The second bank conditions exists from approximately 200 feet downstream of the confluence of the mainstem of Cherry Creek with the groundwater fed secondary channel downstream to the breakout area. The bank is approximately 5 feet high with approximately 2:1 (H:V) side slopes. Exhibits 4-1 and 4-2 show the two typical existing bank sections for the project area.

EXHIBIT 4-1
Typical Existing Bank Conditions Upstream of Confluence with Secondary Channel
Cherry Creek at 12-Mile Park Alternatives Analysis

EXHIBIT 4-2
Typical Existing Bank Conditions Downstream of Confluence with Secondary Channel
Cherry Creek at 12-Mile Park Alternatives Analysis

Non-Structural Alternatives

The non-structural alternatives for bank stabilization listed below provide bank stabilization without use of a hardened structure such as soil cement, sculpted concrete, stacked boulders, or MSE walls. These alternatives rely on re-vegetation and other non-structural measures to enhance bank stabilization. Each of the non-structural bank stabilization alternatives is likely to impact a larger park area due to sloping of the bank to a flat slope for vegetation to establish. Buried soil riprap can be included as an element in each of the non-structural alternatives to protect the bank while waiting for the vegetation to establish. Soil riprap should be extended to a point on the bank where velocities are less than 5 feet per second. From the geotechnical investigation report, the maximum slope recommended for the project area is 3:1 (H:V) although 4:1 (H:V) is preferred for some of the alternatives.

Lay Back Slopes

This alternative includes laying back the east bank to a 4:1 (H:V) slope. The bank would then be re-vegetated to minimize further erosion. Trees or shrubs could be planted at various locations along the sloped bank for bank stability, aesthetics, and to deter pedestrians and dogs from accessing the creek along the stabilized bank. In combination with laying back the slopes, because the top of bank has moved further away from the creek, the trail would be relocated. Strategic fencing and upland plantings could be used in combination with this alternative to discourage park users from accessing the creek via the stabilized slope. This alternative has the most benefit where laying back the slope of the east bank would not cause excessive disturbance to the project area. Where the banks are steep or near vertical and where the bank heights exceed ten to twelve feet, laying back the slopes would cause excessive disturbance to the park and one of the other bank treatment alternatives would be preferable. Although this alternative creates an excess volume of embankment material, the excess material can be hauled off site to meet the

USACE requirement that the volume of fill material brought into a project site cannot exceed the volume of fill material removed from a project site. Any excess material beyond that required to balance import material may be disposed of onsite. See Figure B-1 for a typical section showing this alternative.

Boardwalk Toe Protection

The boardwalk toe protection alternative includes a beach area along the creek, a boardwalk adjacent to the creek for toe protection and pedestrian traffic, and laying back the bank at a 3:1 (H:V) slope for bank stabilization purposes. The beach area adjacent to the boardwalk creates a buffer for users to access the creek without the possibility of erosion and without increasing the sediment load in the creek. The boardwalk provides a hardened structure at the toe of slope that includes a wood walking surface with concrete piers extending into the ground to support the walking surface. Riprap is placed underneath the wood walking surface and between the concrete piers to protect the toe of the bank slope. The bank would then be re-vegetated to minimize erosion. In combination with laying back the slopes, because the top of bank has moved further away from the creek, the trail must be relocated. Strategic fencing and upland plantings could be used in combination with this alternative to discourage park users from accessing the creek via the stabilized slope. The boardwalk may be used in combination with one or more of the access points to allow park users access to the creek along an entire reach. See Figure B-1 for a typical section showing the boardwalk toe protection alternative.

Soil Wraps

The soil wraps alternative for bank stabilization includes a combination of soil wraps at the toe of the slope with laying back the slope of the bank to 3:1 (H:V). The soil wraps begin at the toe of slope and extend approximately 30-inches or 2.5 feet. The soil wraps are layered in approximately one foot lifts and staked with willows to hold the wraps together. The bank is then sloped back at 3:1 above the soil wraps. Because the wraps are near vertical for the bottom three feet of the bank, the area impacted by laying back the bank is decreased compared to the alternatives without soil wraps. The three vertical feet at the top of slope and the willow stakes may also provide a physical barrier to deter pedestrians and dogs from accessing the creek from the stabilized slope. With the vertical barrier, dogs and pedestrians may be more likely to continue to a designated access point to access the creek. Strategic fencing and upland plantings could be used in combination with this alternative to discourage park users from accessing the creek via the stabilized slope. Within the Cherry Creek at 12-Mile Park project area, this alternative is best suited for larger, steeper slopes because of the lessened impact compared to laying back the slopes beginning at the toe of slope. See Figure B-2 for a typical section showing the soil wraps alternative.

Terraced Slope

The terraced slope alternative is a modification of the soil wraps alternative. Like the soil wraps alternative, the terraced slope alternative includes soil wraps at the toe of slope. The banks are then sloped back at 3:1 (H:V), but instead of extending to the top of slope, the 3:1 (H:V) slope extends approximately half way between the toe of slope and top of slope, to an approximate 2.5 foot vertical stacked boulder wall. The terraced slope alternative provides all the benefits of the soil wraps alternative while also impacting a lesser area of the park and providing an additional barrier to park users attempting to access the creek along the newly stabilized slope. Where the lay back slope alternative impacts a distance of four times the bank height away from the creek, the terraced slope has five vertical feet of bank stabilization, reducing the distance away from the creek that is impacted during construction. Strategic fencing and upland plantings can be used to

as an additional physical and visual barrier between the upland trail and the creek. Within the Cherry Creek at 12-Mile Park project area, this alternative is best suited for larger, steeper slopes, because of the lessened impact when compared to the lay back slopes alternative or the soil wraps alternative. This alternative is only applicable where the bank height exceeds six feet because the soil wraps have a vertical height of three feet and the grouted boulder wall has a vertical height of three feet. See Figure B-2 for a typical section showing the terraced slope alternative.

Boulder Toe Protection

The boulder toe protection alternative is similar to the lay back slopes alternative, with a boulder wall at the toe of slope. Above the boulder toe, the bank is sloped back at 3:1 (H:V). The flattened slopes would then be re-vegetated to minimize erosion. The boulder toe protection alternative includes a beach area between the boulder wall and the creek. The boulder wall provides a hardened structure at the toe of slope while also providing park users a sitting area adjacent to the creek. The boulders can also be integrated into the natural landscape by creating coves or other natural features. The boulders are stacked near vertical and with grout and vertical rebar behind the boulders for additional support. Strategic fencing on the between the top of slope and the trail combined with upland plantings can be used to prevent park users from accessing the creek along the newly stabilized bank. See Figure B-3 for a typical section showing the boulder toe protection alternative.

Structural Alternatives

The four structural bank stabilization alternatives presented below provide bank stabilization through the use of a hardened structure. Each of these alternatives can be placed at steep to near vertical slopes and allow for bank stabilization while minimizing the amount that the bank must be sloped back. Each of the four structural bank stabilization alternatives reduce the amount of earthwork required to stabilize the east bank because they can be at the steep existing slopes. The structural alternatives presented below are expected to have increased longevity compared to the non-structural alternatives for bank stabilization due to the strength of the materials being used.

Stacked Boulders

The stacked boulders alternative for bank stabilization is a vertical bank treatment alternative that includes wetland plantings adjacent to the creek with grouted boulders stacked nearly vertical. Each boulder is offset by approximately 6 inches from the boulder below it. A fence is required in combination with the stacked boulders to prevent park users from accessing the creek and for safety purposes. The stacked boulders alternative for bank stabilization, like the other vertical or near vertical bank stabilization alternatives, is an option where the banks are high and steep where sloping back the bank to 3:1 or 4:1 (H:V) would cause excessive disturbance to the park. See Figure B-4 for a typical section showing the stacked boulders alternative for bank stabilization.

Sculpted Concrete

In this alternative, sculpted concrete is used for bank stabilization from the toe of the east bank to the top of the bank. The concrete can be colored to match existing soil colors and can be shaped to look more natural. Concrete is non-erosive so additional erosion of the east bank would be prevented with this alternative. Although concrete is non-erosive, the potential for cracking still exists. If the concrete cracks, there is the potential for water to get beneath the surface and undermine the structure. If the structure is undermined, the longevity of the structure is greatly reduced. Sculpted concrete allows for near vertical bank protection without flattening the slope of the bank. This alternative includes wetland plantings adjacent to the creek to reduce the visual

impact of placing concrete in a natural environment. The sculpted concrete alternative for bank stabilization may also include a fence or upland vegetation at or near the top of slope to prevent park users from accessing the creek along the steep slope. As with the other vertical or near vertical bank treatment alternatives, sculpted concrete should be used where the banks are high and steep such that the impact of sloping back the banks to a 3:1 or 4:1(H:V) slope would cause excessive disturbance to the park. See Figure B-4 for a typical section showing the sculpted concrete alternative for bank stabilization.

Soil Cement

The soil cement alternative for bank stabilization is similar to the sculpted concrete alternative. In this alternative, soil cement lifts are stacked one on top of another from the toe of bank to top of bank. Exhibit 4-3 shows soil cement used for bank stabilization along Sand Creek in Colorado Springs, Colorado. Native materials can be used in the soil cement mixture and the soil cement can be colored to match existing soil colors. Although soil cement is non-erosive, the structure can be undermined if cracking occurs and water gets beneath the surface. Cracking greatly reduces the longevity of soil cement. This alternative includes wetland plantings adjacent to the creek to reduce the visual impact of placing soil cement in a natural environment. This alternative may also include a fence or upland vegetation as a barrier to prevent park users from accessing the creek along the steep slope. As with the other vertical or near vertical bank treatment alternatives, soil cement is an option where the banks are high and steep such that the impact of sloping back the banks to a 3:1 or 4:1 (H:V) slope would cause excessive disturbance to the park. See Figure B-4 for a typical section showing the soil cement alternative for bank stabilization.

EXHIBIT 4-3
Example of Soil Cement – Sand Creek, Colorado Springs, Colorado
Cherry Creek at 12-Mile Park Alternatives Analysis

Mechanically Stabilized Earth

Mechanically Stabilized Earth (MSE) is soil constructed with horizontal reinforcing elements and a facing to prevent erosion. The face of the MSE is typically vertical and the horizontal elements typically extend a distance from the facing into the soil. Backfilled soil is used at a distance greater than the length of the horizontal reinforcing elements away from the vertical face. Additional geotechnical and structural evaluation are needed to determine the size of the footer and length of the horizontal reinforcing elements. If the structural analysis shows that the reinforcing elements must be long, this alternative will require more excavation than the other structural bank stabilization alternatives. Concrete blocks or other materials can be used for the facing of the MSE wall. The MSE wall prevents access to the creek because of the vertical face, however, this creates a safety issue. This alternative also includes wetland plantings adjacent to the creek to lessen the visual impact of placing a vertical wall with a hardened face in a natural environment. Similar to the vertical or near vertical bank stabilization alternatives presented above, the MSE wall alternative is an option where the banks are high and steep such that sloping back the bank to a 3:1 or 4:1 (H:V) slope would cause excessive disturbance to the creek and a vertical bank stabilization technique is preferred. See Figure B-5 for a typical section showing the Mechanically Stabilized Earth wall alternative for bank stabilization.

EXHIBIT 4-4
Example of MSE Wall – Interstate 15, Las Vegas, Nevada
Cherry Creek at 12-Mile Park Alternatives Analysis

Comparison of Unit Costs for the Bank Stabilization Alternatives

Throughout the project reach there are two typical existing bank sections. From the upstream boundary of the project area to approximately 200 feet downstream of the confluence of the mainstem of Cherry Creek with the groundwater fed secondary channel, the bank can be characterized as between 10 and 15 feet high with approximately 1.5:1 (H:V) side slopes. From

approximately 200 feet downstream of the confluence of the mainstem of Cherry Creek with the groundwater fed secondary channel downstream to the breakout area, the bank is approximately 5 feet high with approximately 2:1 (H:V) side slopes. Unit costs per linear foot for each bank stabilization alternative were evaluated for both typical existing bank sections and the results are presented in Tables 4-1 and 4-2. These two typical existing bank sections are presented for a comparison and for use in selecting the preferred alternative. In the Preferred Alternative section, the unit costs represent the actual bank conditions at a certain location which may vary slightly from the typical existing sections used for comparison. A more detailed breakdown of the unit cost for each bank stabilization alternative is presented in Appendix A. Unit costs for the bank stabilization alternatives were taken from the Urban Drainage and Flood Control District (UDFCD) bid tabs program, past projects, and various other sources.

TABLE 4-1
Unit Cost Per Linear Foot for 12 Foot High Bank with 1.5:1 Side Slopes

Alternative	$/LF
Lay Back Slopes	$200
Boardwalk Toe Protection	$420
Boulder Toe Protection	$190
Soil Wraps/Lay Back Slope	$220
Terraced Slope	$290
Stacked Boulders	$350
Sculpted Concrete	$1,720
Soil Cement	$650
Mechanically Stabilized Earth	$340

TABLE 4-2
Unit Cost Per Linear Foot for 5 Foot High Bank with 2:1 Side Slopes

Alternative	$/LF
Lay Back Slopes	$80
Boardwalk Toe Protection	$310
Boulder Toe Protection	$110
Soil Wraps/Lay Back Slope	$140
Terraced Slope	N/A
Stacked Boulders	$210
Sculpted Concrete	$570
Soil Cement	$210
Mechanically Stabilized Earth	$120

The results from Table 4-1 and 4-2 suggest that the most cost effective bank stabilization alternatives for both typical sections are the alternatives where the bank is sloped back, including the lay back slopes alternative, the boulder toe protection alternative, the soil wraps alternative,

and the terraced slope alternative. Although these alternatives are the most cost effective alternatives, they also cause the most disturbance to the park. The lay back slope alternative causes the most disturbance to the park and provides park users the easiest access to the creek along the stabilized slope at non-designated locations. In general, the structural bank stabilization alternatives are more costly for both typical sections, although the unit cost differential between the structural and non structural bank stabilization alternatives is less for the typical section with the lower bank height.

For the upstream reaches of the project area where the bank heights are in the range of 10 to 15 feet with approximately 1.5:1 side slopes, the boulder toe protection and the soil wraps alternatives are the first and third most cost effective alternatives and cause less disturbance to the project area than sloping the bank back from the toe of slope. The terraced slope alternative is a less cost effective solution but disturbs less of the park area, and provides an additional barrier for park users attempting to access the creek. For the typical section with the lower bank height, the boulder toe protection alternative is the most cost effective bank stabilization alternative and provides additional protection at the toe of slope. Although the boardwalk toe protection is one of the more expensive alternatives per linear foot, it accomplishes multiple goals including bank stabilization and creek access. The sculpted concrete and soil cement alternatives are clearly more expensive per linear foot than the other alternatives for the upstream reach of the project area. The terraced slope alternative is not applicable for the typical section with a five foot bank height because the combined height of the soil wraps (2.5') and the height of the boulders (2.5') exceeds the height of the bank in many locations.

Water Quality Alternatives

Three water quality alternatives have been identified for the Alternatives Analysis Report; constructed wetlands, upland ponds, and upland bio-swales. Each of the water quality alternatives is designed to address water quality at a different location in reference to the creek. See below for a description of the water quality alternatives for the Cherry Creek at 12-Mile Park project area.

Constructed Wetlands

A constructed wetland is a new or restored wetland vegetative area that acts as a filter to remove sediments and soluble pollutants from water. Constructed wetlands occur within the creek and can also act as a physical barrier where it is unlikely that dogs or pedestrians would pass through the constructed wetland to access a different part of the creek due to the density of the plants. Exhibit 4-5 shows a schematic of a constructed wetlands.

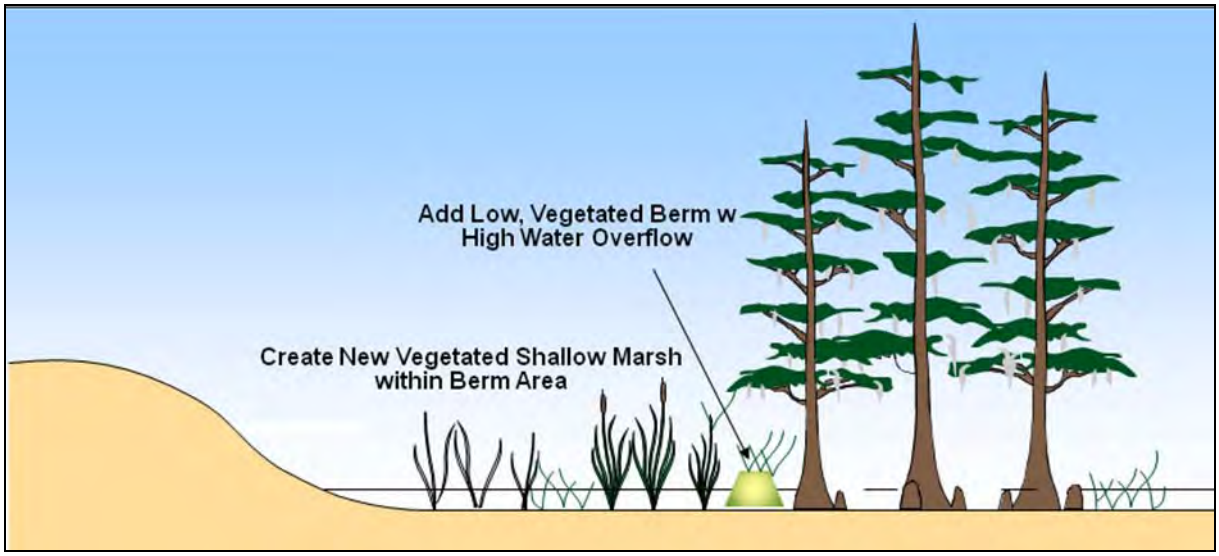


EXHIBIT 4-5
Constructed Wetlands Schematic
Cherry Creek at 12-Mile Park Alternatives Analysis

Upland Ponds

An upland pond is designed to capture stormwater runoff and detain it for many hours after storm runoff ends which allows time for sediment and other pollutants, such as dog waste, to settle out before the stormwater is discharged into Cherry Creek. An upland pond can include a small wetland area within the pond which enhances the removal of soluble pollutants. Specifically for Cherry Creek at 12-Mile Park, an upland pond would reduce the potential for stormwater carrying dog waste and the associated pollutants to discharge into Cherry Creek. The upland pond would be located near the breakout area on the north side of the creek to capture stormwater runoff from the DOLA. The upland pond could be a sand infiltration basin where the water is allowed to infiltrate without a formal outlet structure or an extended detention basin which has a formal outlet structure. In the case of the extended detention basin, the outlet structure would discharge directly to Cherry Creek.

Upland Bio-Swales

Upland bio-swales are vegetated channels with little slope designed to convey runoff while removing sediment and other pollutants. The upland bio swales would be located adjacent to the trail along the east bank of Cherry Creek. Because of the flat side slopes, the water depth is shallow and the velocity is low, allowing for sedimentation and removal of pollutants while preventing erosion.

TABLE 4-3
Unit Cost for Water Quality Alternatives

Alternative	Unit	Unit Cost	Quantity Needed	Total Cost
Constructed Wetlands	SF	$25.00	8,900	$222,500
Upland Bio-Swale	LF	$15.00	2,400	$36,000
Upland Pond	Acre-ft	$47,000	2	$94,000

Access Alternatives

Throughout the Cherry Creek at 12-Mile Park project area, a number of different potential access points have been identified. Some of the potential access points include those areas that are currently popular locations for pedestrian and dog use. Exhibits 4-6 through 4-8 show three existing locations where pedestrians and dogs access the creek. Although the project team has identified a number of existing access points, formalized access points are not limited to the location or number of these existing access points. The alternatives below are separated into ADA accessible and non-ADA accessible.

EXHIBIT 4-6
Former North Access Point at Creek Breakout
Cherry Creek at 12-Mile Park Alternatives Analysis

EXHIBIT 4-7
Existing Middle Access Point
Cherry Creek at 12-Mile Park Alternatives Analysis

EXHIBIT 4-8
Existing South Access Point
Cherry Creek at 12-Mile Park Alternatives Analysis

ADA Accessible Creek Access Alternative

An ADA accessible creek access point meets the requirements of the Americans with Disabilities Act of 1990. To comply with ADA requirements for accessible routes, any ADA accessible creek access must have a longitudinal slope of 5% or flatter, a cross slope of 2% or flatter, a minimum width of 36 inches, and passing spaces at least every 200 feet if the width is less than 60 inches. The surface of any ADA accessible creek access must be stable, firm, and slip-resistant. If there are gratings along the surface, the maximum spacing between gratings in one direction is ½ inch. There are multiple materials that could be used to construct the ADA accessible creek access points including concrete, timber, porous pavers/articulated concrete blocks, or other materials. Because of the longitudinal slope requirement for ADA accessible routes, the ADA accessible creek access point is recommended at an area with a lower bank height to reduce the total disturbance area of the access point. To have an ADA accessible access at an area with a higher bank would require additional grading or switchbacks along the bank to meet the longitudinal slope requirement.

Non-ADA Accessible Creek Access Alternative

A non-ADA accessible creek access point does not need to meet the requirements of the Americans with Disabilities Act of 1990 including the requirements for longitudinal slope, cross slope, access width, or surface material. Because there are no longitudinal slope requirements, any non-ADA compliant access point will likely have a steeper slope and may include a stepped surface to access the creek. Non-ADA compliant access points are recommended in areas with higher, steeper banks where it would be difficult to grade an access route to ADA requirements. Vertical steps can be used to access the creek down steep banks without excessive grading and disturbance to the surrounding area. Any non-ADA accessible creek access point could be constructed of boulders, landscape stone, concrete, or other materials.

Comparison of Unit Costs for the Creek Access Material Alternatives

The typical unit costs for a number of materials considered for the access material are presented in Table 4-4. These costs are presented as per square foot. Unit costs for creek access material alternatives were taken from the UDFCD bid tabs program, recent projects, and various other sources.

TABLE 4-4
Access Material Alternative Unit Cost

Access Material Alternative	Per SQ-FT
Concrete	$ 15.00
Concrete Porous Pavers	$ 4.25
Articulated Concrete Blocks	$ 7.50
Boulders	$ 25.00
Timber	$ 2.50
Landscape Stones	$ 4.00

From Table 4-4, the two most expensive access material alternatives are concrete and boulders. The other access material alternatives shown in Table 4-3 have unit costs within a reasonable range such that selecting one material over another would not have a significant impact on the total cost over a small area. Some of the materials, such as grouted boulders and landscape

stones, may not meet ADA requirements if the gaps between adjacent boulders or stones are greater than ½ inch. The pavers and concrete blocks meet ADA requirements if the gaps between adjacent blocks is less than ½ inch and if each paver or block does not have an internal cut out greater than ½ inch.

5. Recommended Plan

The recommended plan was developed to address the primary needs within the Cherry Creek at 12-Mile Park project area. This section is subdivided into bank stabilization improvements, water quality improvements, creek access improvements, and other improvements.

Bank Stabilization Improvements

The recommended bank stabilization plan is shown in Table 5-1. For a visual of the recommended bank stabilization plan and centerline stationing, see Figure 5-1. The recommended plan includes soil wraps from Station 2+50 to Station 5+00, repairing the breakout area to return Cherry Creek to its historic flow path, the use of the boulder toe protection alternative from the existing north access point to approximate Station 17+00 (approximately 400 feet downstream of the confluence of the mainstem of Cherry Creek with the groundwater fed secondary channel), soil wraps combined with laying back the slopes for approximately 420 feet upstream of the boulder lining and 80 feet of stacked boulders extending from the soil wraps to the approximate location of the existing middle access point. Upstream of the existing middle access point extending to the existing north access the recommended bank stabilization alternative is the terraced slope alternative.

TABLE 5-1
Recommended Plan Bank Stabilization Improvements

Approximate Station	Description
0+00 – 2.50	No bank stabilization
2+50 to 5+00	Soil Wraps with 3:1 (H:V) Slope
5+00 to 8+00	No bank stabilization
8+00	Repair breakout area
8+00 to 17+00	Boulder toe protection bank stabilization alternative
17+00 to 21+20	Soil Wraps with 3:1 (H:V) Slope
21+20 to 22+00	Stacked boulders vertical bank treatment
22+00 to 24+00	Terraced slope bank stabilization alternative with beach area adjacent to creek
24+00 to 26+00	Terraced slope bank stabilization alternative
26+00 to 28+00	Terraced slope bank stabilization alternative
28+00 to 30+00	Terraced slope bank stabilization alternative
30+00 to 33+00	No bank stabilization

The boulder toe protection alternative for bank stabilization is recommended from Station 8+00 to Station 17+00. The boulder toe protection alternative is the most cost effective alternative for the typical section in this location and provides additional bank stabilization and recreational features

when compared to the laying back the slopes. For additional bank stabilization when compared to the lay back slopes alternative, the boulder toe protection alternative provides a hardened feature at the toe of slope while also providing an additional barrier for park users attempting to access the creek along the newly stabilized slope. For recreational purposes, the boulder wall at the toe of slope provides park users within the creek a place to sit. This alternative also impacts less park area than the lay back slopes alternative because the 4:1 (H:V) slope extends for two vertical feet compared to five vertical feet in the lay back slopes alternative.

From Station 2+50 to Station 5+00 and from Station 17+00 to Station 21+20, the recommended bank stabilization alternative is soil wraps. From Station 17+00 to Station 21+20, the soil wraps combined with laying back the slopes alternative is one of the more cost efficient alternatives and allows a transition from the boulder toe protection alternative at the lower bank heights to upstream where the bank become higher and steeper. From Station 2+50 to Station 5+00, the bank height is low such that laying back the bank above the soil wraps is not necessary.

Stacked boulders are recommended from Station 21+20 to Station 22+00 to protect a group of large trees near the confluence of the Cherry Creek mainstem with the groundwater fed secondary channel. The existing trees are a popular location for pedestrian and dog use so the recommended plan aims to protect the trees. The stacked boulders also transition to the proposed access point at Station 22+00.

Upstream of Station 22+00, the recommended bank stabilization plan is the terraced slope alternative. The existing east banks upstream of Station 22+00 range from 10 to 15 feet high with approximately 1.5:1 to 2:1 (H:V) side slopes. The terraced slope alternative is not the most cost effective bank stabilization alternative, but will provide the most protection from park users attempting to access the creek along the newly stabilized slope. The three foot near vertical soil wraps at the toe of slope are planted with willows providing both a physical and visual barrier for park users at the toe of slope and the three foot vertical stacked boulder wall approximately half way up the slope provides a second physical barrier. The soils wraps at the toe of slope planted with willows creates a greater obstacle for park users attempting to access the creek than if the soil wraps were replaced with a boulder wall. The six total feet of vertical barriers combined with strategic fencing and strategic upland plantings will likely deter park users from accessing the creek at non-designated locations. For approximately 200 feet upstream of the middle access point at Station 22+00, the terraced slope bank stabilization alternative includes a beach area adjacent to the creek to encourage park users to access the creek at this location. Using a non-structural bank stabilization alternative upstream of the middle access point keeps the upper reach of the project area in a mostly natural state and more natural than it would appear if a structural bank stabilization alternative were selected.

The total cost for the recommended plan bank stabilization alternatives is included in the recommended plan cost in Table 5-5. The unit cost for bank stabilization per linear foot of channel represents the actual channel section which may vary slightly from the two typical sections presented in the Alternatives Analysis section.

Water Quality Improvements

Water quality in Cherry Creek will be improved by implementation of the bank improvements previously described. The additional water quality improvements are shown in Table 5-2. The water quality improvements recommended for the project area are bio-swales adjacent the trail from the upstream limits of the project area to the approximate location of the breakout at Station 8+00. Station 8+00 to Station 32+00 also corresponds to the limits of the DOLA through the

project area. The water collected in the bio-swales is allowed to infiltrate and will not be discharged to the creek at any point locations.

The general flow direction of runoff from the DOLA is to the north and to the west with most of the runoff occurring as sheet flow. Due to the low percent impervious and soil types for the areas that would drain to the project area, additional upland water quality features are not necessary. There is not a location within the project area that would see enough upland runoff to necessitate an upland extended detention basin or sand infiltration basin. The bio-swales adjacent to the creek are designed to capture and infiltrate all upland runoff that would otherwise reach Cherry Creek through the project area.

Bank stabilization throughout the project area provides instream water quality benefits and eliminates the need for a constructed wetland or other instream water quality features by enhancing the wetland fringe of the channel. The constructed wetlands were also not included in the recommended plan due to possible water rights issues and prohibitive costs. There will be no water rights issues if the project is designed such that natural occurring wetlands develop over time to provide additional instream water quality benefits.

TABLE 5-2
Recommended Plan Water Quality Improvements

Approximate Station	Description
8+00 - 32+00	Bio-swale along upland trail

Creek Access Improvements

The creek access improvements included in the recommended plan are shown in Table 5-3. The recommended plan includes one ADA accessible access point at Station 8+00 (existing breakout area). The ADA access point at Station 8+00 is recommended to be constructed with concrete porous pavers. The pavers meet ADA surface material requirements and are less expensive than either concrete or grouted boulders. Porous pavers also allow for stormwater infiltration. Preliminary and final design will consider possible maintenance issues that may change the recommended surface material for the ADA accessible creek access point. This access point extends further upland than other access points to meet the ADA requirements for longitudinal slope but the bank at this location is low compared to the bank upstream. Upstream of the ADA access, all access points are not ADA compliant. Each access point upstream of the boardwalk is recommended to be constructed from boulder steps. Because the access point at the existing middle access point is at the confluence of multiple trails and is currently a popular area for park users, it is assumed that this area will remain popular. The access point at Station 20+00 is recommended to be the widest boulder steps access point within the project area. The other non-ADA accessible access points will not need to be as wide as the access at Station 20+00. Boulders are one of the more expensive access material alternatives but allow park users easy access to the creek without excessive disruption to the surrounding area. The boulders are also a natural material and fit in with the character of the reach.

TABLE 5-3
Recommended Plan Creek Access Improvements

Approximate Station	Description
8+00	Porous Concrete Pavers ADA accessible north access area
17+00	Row(s) of boulder steps for creek access
20+00	Row(s) of boulder steps for creek access
22+00	Boulder lined middle access area
24+00	Row(s) of boulder steps for creek access
28+00	Row(s) of boulder steps for creek access
30+00	Row(s) of boulder steps for creek access at south access area

Other Improvements

All improvements other than bank stabilization, water quality enhancement, and creek access improvements are shown in Table 5-4. This table includes fencing, trail realignment, and removing material from the groundwater fed pond along the breakout flow path of Cherry Creek as a possible borrow area to meet USACE onsite balancing requirements.

The groundwater fed pond downstream of the project area along the breakout flow path has nearly disappeared due to an increase in sediment load since the breakout occurred. The recommended plan includes removing material from this pond to use as a possible borrow area to meet USACE onsite fill requirements. The USACE requires that the volume of fill material brought into a project site must be equaled by the volume of cut removed from the site. Although the entire project site will likely have a net cut due to the bank stabilization improvements, the repair of the breakout area will likely occur prior to the rest of the project, and the repair of the breakout area may be a net fill. Although the material from the pond may not be used to repair the breakout area due to its soil properties, it can be removed from the site to balance the fill material brought into the project area to repair the breakout area.

For much of the project area, bank stabilization measures push the top of bank further away from the creek, and in some cases, the existing trail must be realigned to account for the bank stabilization measures. One of the additional benefits to pushing the trail further away from the creek is that park users may be less likely to access the creek at non-designated locations.

Strategic fencing is an important part of the recommended plan. Upstream of the existing middle access area, the recommended plan includes upland fencing between designated access points. The designated access points are approximately 200 feet apart for the upstream reach of the project area so park users wouldn't have a long distance without access to the creek. Once the park users use the designated access point to the creek bottom, they are free to move upstream or downstream within the creek bed. The proposed upland fencing prevents the park users from accessing the creek along the newly stabilized east bank. Strategic fencing to prevent park users from accessing the creek at non-designated locations will be included in the stream reclamation plan and will be included in the recommended plan summary cost estimate.

The recommended plan shows fencing for two bullpens areas, one at the south end of the DOLA (Station 33+00) and one at the north end of the DOLA (Station 8+00). These are to be installed by others with the DOLA improvements. The bullpen areas are designed to be a transition from the

DOLA to rest of the park where dogs are required to be on leash. Park users entering the DOLA would bring their dog, on leash, into the bullpen area before unleashing them. Park users leaving the DOLA may bring their dog off leash into the bullpen area before leashing them and leaving the DOLA. The bullpen area and fencing along the perimeter of the DOLA are designed to prevent interaction of DOLA park users with others park users. It is assumed that this will be constructed as part of the parks plan and there will be coordination between the recommended plan and the park plan, but elements of the park plan will not be included in the costs shown in Table 5-4 and Table 5-5.

TABLE 5-4

Recommended Plan Other Improvements

Approximate Station	Description
N/A	Material removal from groundwater fed pond along breakout flow path (borrow area for USACE requirements)
8+00 to 17+00	Realign Trail
8+00 to 17+00	Massive rail fence along trail
17+00 to 20-00	Massive rail fence along trail
20+00 to 22+00	Massive rail fence along trail
22+00 to 34+00	Realign Trail
22+00 to 24+00	Massive rail fence along trail
24+00 to 26+00	Massive rail fence along trail
26+00 to 28+00	Massive rail fence along trail
28+00 to 30+00	Massive rail fence along trail
30+00 to 33+00	Massive rail fence along trail

Recommended Plan Summary

A recommended plan summary figure is included as Figure 5-1. The recommended plan cost summary is shown in Table 5-5. The recommended plan cost summary includes all improvements detailed in this section plus a 30% contingency and 20% for mobilization and permitting support. The current DOLA improvement plans are included as Appendix C for reference.

Recommended Plan Cost

TABLE 5-5

Recommended Plan Cost Summary

Approximate Station	Description	Category	Quantity	Unit	Unit Cost	Total Cost
2+50 to 5+00	Soil Wraps with 3:1 (H:V) Slope	Bank Stabilization	250	LF	$120.00	$30,000.00
8+00	Repair breakout area[1]		1	LS	$90,000.00	$90,000.00
8+00 to17+00	Boulder toe protection including laying back the slopes to 4:1.		900	LF	$110.00	$99,000.00
17+00 to 21+20	Soil Wraps with 3:1 (H:V) Slope		420	LF	$200.00	$84,000.00
21+20 to22+00	Stacked boulders vertical bank treatment[2]		80	LF	$295.00	$24,000.00
22+00 to 24+00	Terraced slope bank stabilization alternative[2]		200	LF	$280.00	$56,000.00
24+00 to 26+00	Terraced slope bank stabilization alternative[2]		200	LF	$295.00	$59,000.00
26+00 to 28+00	Terraced slope bank stabilization alternative[2]		200	LF	$320.00	$64,000.00
28+00 to 30+00	Terraced slope bank stabilization alternative[2]		200	LF	$280.00	$56,000.00
8+00 - 32+00	Bio-swale with infiltration system along upland trail	Water Quality	2,400	LF	$15.00	$36,000.00
8+00	Porous Concrete Pavers ADA accessible north access area	Creek Access	3,000	SF	$4.25	$13,000.00
17+00	Row(s) of boulder steps for creek access		140	SF	$22.00	$3,000.00
20+00	Row(s) of boulder steps for creek access		132	SF	$22.00	$3,000.00
22+00	Boulder lined middle access area		640	SF	$22.00	$14,000.00
24+00	Row(s) of boulder steps for creek access		138	SF	$22.00	$3,000.00
26+00	Row(s) of boulder steps for creek access		144	SF	$22.00	$3,000.00
28+00	Row(s) of boulder steps for creek access		132	SF	$22.00	$3,000.00
30+00	Row(s) of boulder steps for creek access at south access area		192	SF	$22.00	$4,000.00
8+00 to 17+00	Realign Trail	Other	900	LF	$20.00	$18,000.00
8+00 to 17+00	Massive rail fence along trail		900	LF	$18.00	$16,000.00
17+00 to 20-00	Massive rail fence along trail		300	LF	$18.00	$5,000.00

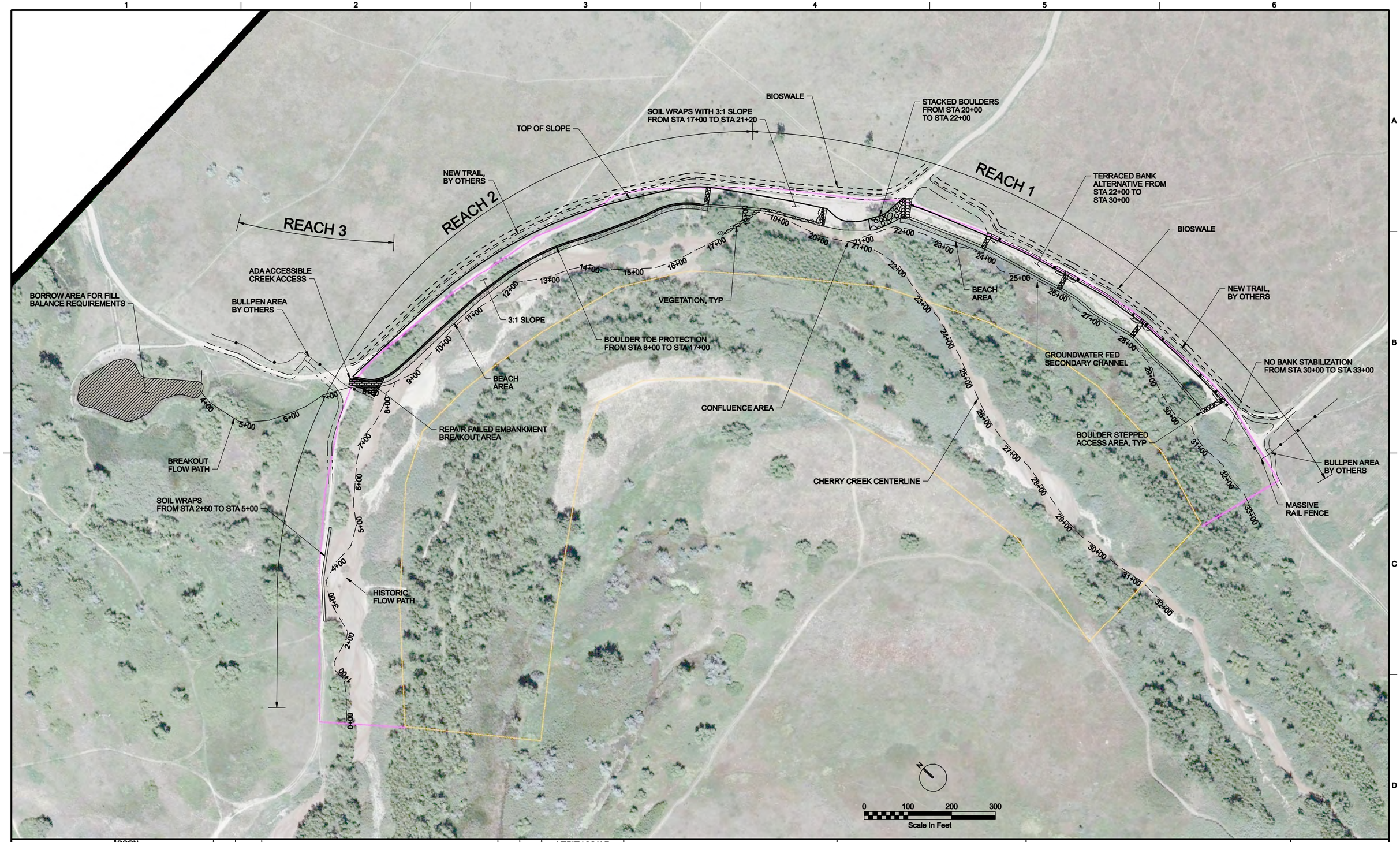
TABLE 5-5

Recommended Plan Cost Summary

Approximate Station	Description	Category	Quantity	Unit	Unit Cost	Total Cost
20+00 to 22+00	Massive rail fence along trail		200	LF	$18.00	$4,000.00
22+00 to 34+00	Realign Trail		800	LF	$20.00	$16,000.00
22+00 to 24+00	Massive rail fence along trail		200	LF	$18.00	$4,000.00
24+00 to 26+00	Massive rail fence along trail		200	LF	$18.00	$4,000.00
26+00 to 28+00	Massive rail fence along trail		200	LF	$18.00	$4,000.00
28+00 to 30+00	Massive rail fence along trail		200	LF	$18.00	$4,000.00
30+00 to 33+00	Massive rail fence along trail		300	LF	$18.00	$5,000.00
N/A	Soil removal from groundwater fed pond along breakout flow path		2,000	CY	$18.00	$36,000.00
N/A	Check Dam		2	EA	$1,500.00	$3,000.00
N/A	Concrete Washout Area		1	EA	$1,000.00	$1,000.00
N/A	Construction Fence		2,400	LF	$2.00	$5,000.00
N/A	Surveying		1	LS	$10,000.00	$10,000.00
N/A	Vehicle Tracking Control		1	EA	$3,000.00	$3,000.00
N/A	Water Control and Dewatering		1	LS	$25,000.00	$25,000.00
	Creek Improvement Total Cost					**$777,000.00**
Mobilization and Permitting Requirements (20% of Total Cost)						$155,000.00
Final Design (20%)						$155,000.00
Construction Observation (5%)						$39,000.00
Administration (3%)						$23,000.00
	Subtotal Cost					**$1,149,000.00**
Contingency (30% of Subtotal Cost)						$345,000.00
	Construction Total Cost					**$1,494,000.00**

[1]The breakout area is currently under design.

[2]See Appendix A for a further breakdown of the bank stabilization alternative costs.



DSGN A COOK	NO	DATE	DESCRIPTION	APVR	N	VERIFY SCALE	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLAMATION	CHERRY CREEK AT 12-MILE PARK FIGURE 5-1: ALTERNATIVES ANALYSIS RECOMMENDED PLAN SUMMARY	SHEET 1
DR A COOK						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DWG 5-1
CHK C HOOPER										DATE APRIL 2011
APVD S YANAGIHARA	NO.	DATE	REVISION	BY	APVD					PROJ 407259

FILENAME: Alt_Analysis_Pref_Alt.dgn PLOT DATE: 4/15/2011 PLOT TIME: 9:46:24 AM

6. References

1. Brown and Caldwell (2009) "Annual Report on Activities" prepared for Cherry Creek Basin Water Quality Authority (CCBWQA), Greenwood Village, CO.
2. Business Research Division, Leeds School of Business, University of Colorado at Boulder (2008) "Off-Leash User Study: Cherry Creek State Park" conducted for Colorado State Parks.
3. CH2M HILL (2010) "Cherry Creek at 12-Mile Park Final Assessment Report" prepared for Cherry Creek Basin Water Quality Authority.
4. Colorado State Parks (2009) "Public Feedback on Chatfield and Cherry Creek State Park Dog Training Areas".
5. Ensight Technical Services, Inc. (2008) "The Effects of Off-Leash Dog Areas on Birds and Small Mammals in Cherry Creek and Chatfield State Parks" submitted to Cherry Creek State Park, Aurora, CO.
6. GEI Consultants, Inc. (2008) "The Influence of Pet Recreation Areas on Soil and Water Quality at Cherry Creek State Park" submitted to Cherry Creek State Park, Aurora, CO.
7. Ruzzo, William P. (2010) "Cherry Creek at 12-Mile Park – Channel Forming Discharge" Cherry Creek Basin Water Quality Authority (CCBWQA), Greenwood Village, CO.
8. Simons and Associates (1981) "Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soil" Written for Urban Drainage and Flood Control District (UDFCD), Denver, CO.
9. Spence, Edward M., Natural Resources Conservation Service (NRCS) (2008) "12-Mile Dog Park Erosion and Compaction Problems" submitted to Cherry Creek State Park, Aurora, CO.
10. United States Geological Survey (1985) "Determination of Roughness Coefficients for Streams in Colorado" Water Resources Investigations Report 85-4004, Lakewood, CO.
11. URS (2004) "Cherry Creek Corridor – Reservoir to Scott Road Major Drainageway Planning Preliminary Design Report" written for Urban Drainage and Flood Control District (UDFCD), Denver, CO.

Appendix A – Cost Breakdown for Bank Stabilization Alternatives

Table A-1

Lay Back Slopes Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	6.6	SY	$4.50	$29.70
Excavation, Fill On-Site	6.7	CY	$5.00	$33.50
Excavation, Haul Off-Site	0	CY	$9.00	$0.00
Seeding, Native-Drilled	5.5	SY	$0.83	$4.57
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	1.8	CY	$60.00	$108.00
Topsoil, Excavate, Stockpile, and Replace	0.9	CY	$15.00	$13.50
	Total			**$199.27**

Table A-2

Boardwalk Toe Protection Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	5.3	SY	$4.50	$23.85
Concrete Piers	0.3	CY	$500.00	$150.00
Excavation, Fill On-Site	11	CY	$5.00	$55.00
Excavation, Haul Off-Site	1.2	CY	$9.00	$11.23
Seeding, Native-Drilled	4.2	SY	$0.83	$3.49
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type M	0.8	CY	$70.00	$56.00
Soil Riprap, Type VL	1.4	CY	$60.00	$84.00
Timber	8	SF	$2.50	$20.00
Topsoil, Excavate, Stockpile, and Replace	0.7	CY	$15.00	$10.50
	Total			**$424.07**

Table A-3

Soil Wraps/Lay Back Slopes Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4.3	SY	$4.50	$19.35
Excavation, Fill On-Site	1.7	CY	$5.00	$8.50
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Seeding, Native-Drilled	3.2	SY	$0.83	$2.66
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	1	CY	$60.00	$60.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.5	CY	$15.00	$7.50
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$223.21**

Table A-4

Terraced Slope Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4.3	SY	$4.50	$19.35
Excavation, Fill On-Site	0.8	CY	$5.00	$4.00
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	2.1	SY	$0.83	$1.74
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type VL	0.8	CY	$60.00	$48.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.4	CY	$15.00	$6.00
Tree	0.02	EA	$400.00	$8.00
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$285.29**

Table A-5

Boulder Toe Protection Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4.3	SY	$4.50	$19.35
Excavation, Fill On-Site	2.2	CY	$5.00	$11.00
Excavation, Haul Off-Site	0	CY	$9.00	$0.00
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	3.2	SY	$0.83	$2.66
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	1	CY	$60.00	$60.00
Topsoil, Excavate, Stockpile, and Replace	0.5	CY	$15.00	$7.50
	Total			**$188.51**

Table A-6

Mechanically Stabilized Earth Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Haul Off-Site	4	CY	$9.00	$36.00
Reinforcement Zone	2.2	CY	$23.00	$50.60
Seeding, Wetlands-Drilled	1.7	SY	$1.45	$2.47
Select Backfill	3.6	CY	$19.00	$68.40
Wall Facing	15	SF	$12.00	$180.00
	Total			**$337.47**

Table A-7

Stacked Boulders Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Grouted Boulders, 36"	1.5	SY	$180.00	$270.00
Excavation, Fill On-Site	4.2	CY	$5.00	$21.00
Excavation, Haul Off-Site	2.1	CY	$9.00	$18.90
Seeding, Wetlands - Drilled	1.3	SY	$1.45	$1.89
Soil Riprap, Type VL	0.6	CY	$65.00	$39.00
	Total			**$350.79**

Table A-8

Sculpted Concrete Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Fill On-Site	7.3	CY	$5.00	$36.50
Excavation, Haul Off-Site	3.3	CY	$9.00	$29.70
Seeding, Wetlands - Drilled	1.1	SY	$1.45	$1.60
Sculpted Concrete	3.3	CY	$500.00	$1,650.00
	Total			**$1,717.80**

Table A-9

Soil Cement Alternative for 12' Bank with 1.5:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Fill On-Site	7.3	CY	$5.00	$36.50
Excavation, Haul Off-Site	3.3	CY	$9.00	$29.70
Seeding, Wetlands - Drilled	1.1	SY	$1.45	$1.60
Soil Cement	3.3	CY	$175.00	$577.50
	Total			**$645.30**

Table A-10

Lay Back Slopes Alternative for 5' Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	3.4	SY	$4.50	$15.30
Excavation, Fill On-Site	0.9	CY	$5.00	$4.50
Excavation, Haul Off-Site	0	CY	$9.00	$0.00
Seeding, Native-Drilled	2.3	SY	$0.83	$1.91
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type VL	0.8	CY	$60.00	$48.00
Topsoil, Excavate, Stockpile, and Replace	0.4	CY	$15.00	$6.00
	Total			**$80.71**

Table A-11

Boardwalk Toe Protection Alternative for 5' Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	2.9	SY	$4.50	$13.05
Concrete Piers	0.3	CY	$500.00	$150.00
Excavation, Fill On-Site	2.4	CY	$5.00	$12.00
Excavation, Haul Off-Site	1.2	CY	$9.00	$11.23
Seeding, Native-Drilled	1.8	SY	$0.83	$1.49
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type M	0.8	CY	$70.00	$56.00
Soil Riprap, Type VL	0.6	CY	$60.00	$36.00
Timber	8	SF	$2.50	$20.00
Topsoil, Excavate, Stockpile, and Replace	0.3	CY	$15.00	$4.50
Total				**$309.28**

Table A-12

Soil Wraps/Lay Back Slopes Alternative for 5 Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	1.8	SY	$4.50	$8.10
Excavation, Fill On-Site	0.2	CY	$5.00	$1.00
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Seeding, Native-Drilled	0.7	SY	$0.83	$0.58
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type VL	0.2	CY	$60.00	$12.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.1	CY	$15.00	$1.50
Willow Stakes	3	EA	$9.50	$28.50
Total				**$143.38**

Table A-13

Boulder Toe Protection Alternative for 5' Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	1.8	SY	$4.50	$8.10
Excavation, Fill On-Site	0.2	CY	$5.00	$1.00
Excavation, Haul Off-Site	0	CY	$9.00	$0.00
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	0.7	SY	$0.83	$0.58
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type VL	0.2	CY	$60.00	$12.00
Topsoil, Excavate, Stockpile, and Replace	0.1	CY	$15.00	$1.50
Total				**$106.18**

Table A-14
Mechanically Stabilized Earth Alternative for 5’ Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Haul Off-Site	0.9	CY	$9.00	$8.10
Reinforcement Zone	0.9	CY	$23.00	$20.70
Seeding, Wetlands-Drilled	1.7	SY	$1.45	$2.47
Select Backfill	1.5	CY	$19.00	$28.50
Wall Facing	5	SF	$12.00	$60.00
	Total			**$119.77**

Table A-15
Stacked Boulders Alternative for 5’ Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Grouted Boulders, 36"	0.8	SY	$180.00	$144.00
Excavation, Fill On-Site	0.9	CY	$5.00	$4.50
Excavation, Haul Off-Site	1.4	CY	$9.00	$12.60
Seeding, Wetlands - Drilled	1.3	SY	$1.45	$1.89
Soil Riprap, Type VL	0.6	CY	$65.00	$39.00
	Total			**$201.99**

Table A-16
Sculpted Concrete Alternative for 5’ Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Fill On-Site	0.9	CY	$5.00	$4.50
Excavation, Haul Off-Site	1.1	CY	$9.00	$9.90
Seeding, Wetlands - Drilled	1.1	SY	$1.45	$1.60
Sculpted Concrete	1.1	CY	$500.00	$550.00
	Total			**$566.00**

Table A-17
Soil Cement Alternative for 5’ Bank with 2:1 Side Slope per Linear Foot of Channel

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Fill On-Site	0.9	CY	$5.00	$4.50
Excavation, Haul Off-Site	1.1	CY	$9.00	$9.90
Seeding, Wetlands - Drilled	1.1	SY	$1.45	$1.60
Soil Cement	1.1	CY	$175.00	$192.50
	Total			**$208.50**

Table A-18

Soil Wraps from Sta 2+50 to Sta 5+00 – Bank Height = 5 ft, SS = 2:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.1	CY	$15.00	$1.50
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$116.70**

Table A-19

Boulder Toe Protection from Sta 8+00 to Sta 17+00 - Bank Height = 5 ft, SS = 2:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	1.8	SY	$4.50	$8.10
Excavation, Fill On-Site	0.2	CY	$5.00	$1.00
Excavation, Haul Off-Site	0	CY	$9.00	$0.00
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	0.7	SY	$0.83	$0.58
Shrub	0.1	EA	$50.00	$5.00
Soil Riprap, Type VL	0.2	CY	$60.00	$12.00
Topsoil, Excavate, Stockpile, and Replace	0.1	CY	$15.00	$1.50
	Total			**$106.18**

Table A-20

Lay Back Slopes from Sta 17+00 to Sta 21+20 - Bank Height = 9 ft, SS = 2:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	3.2	SY	$4.50	$14.40
Excavation, Fill On-Site	1.7	CY	$5.00	$8.50
Excavation, Haul Off-Site	0.7	CY	$9.00	$6.30
Seeding, Native-Drilled	2.1	SY	$0.83	$1.74
Shrub	0.2	EA	$50.00	$10.00
Sol Riprap, Type VL	0.8	CY	$60.00	$48.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.4	CY	$15.00	$6.00
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$198.44**

Table A-21

Stacked Boulders from Sta 20+00 to Sta 22+00 - Bank Height = 9 ft, SS = 1.5:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Grouted Boulders, 36"	1.2	SY	$180.00	$216.00
Excavation, Fill On-Site	4.2	CY	$5.00	$21.00
Excavation, Haul Off-Site	1.8	CY	$9.00	$16.20
Seeding, Wetlands - Drilled	1.3	SY	$1.45	$1.89
Soil Riprap, Type VL	0.6	CY	$65.00	$39.00
Total				**$294.09**

Table A-22

Terraced Slope from Sta 22+00 to Sta 24+00 - Bank Height = 11 ft, SS = 2:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4	SY	$4.50	$18.00
Excavation, Fill On-Site	0.5	CY	$5.00	$2.50
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	1.8	SY	$0.83	$1.49
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	0.6	CY	$65.00	$39.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.3	CY	$15.00	$4.50
Tree	0.02	EA	$400.00	$8.00
Willow Stakes	3	EA	$9.50	$28.50
Total				**$276.69**

Table A-23

Terraced Slope from Sta 24+00 to Sta 26+00 - Bank Height = 12 ft, SS = 1.5:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4.3	SY	$4.50	$19.35
Excavation, Fill On-Site	0.8	CY	$5.00	$4.00
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	2.1	SY	$0.83	$1.74
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	0.8	CY	$65.00	$52.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.4	CY	$15.00	$6.00
Tree	0.02	EA	$400.00	$8.00
Willow Stakes	3	EA	$9.50	$28.50
Total				**$294.29**

Table A-24

Terraced Slope from Sta 26+00 to Sta 28+00 - Bank Height = 15 ft, SS = 1:1

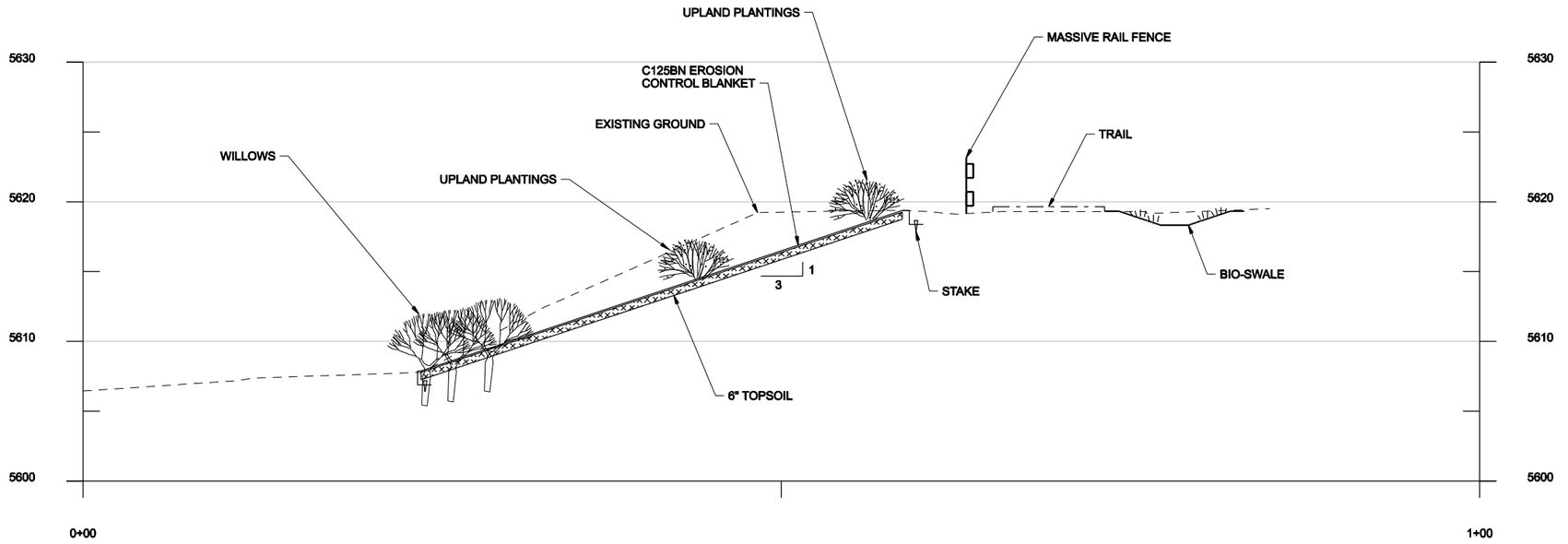
Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	5.4	SY	$4.50	$24.30
Excavation, Fill On-Site	2.2	CY	$5.00	$11.00
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	3.2	SY	$0.83	$2.66
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	1	CY	$65.00	$65.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.5	CY	$15.00	$7.50
Tree	0.02	EA	$400.00	$8.00
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$321.66**

Table A-25

Terraced Slope from Sta 28+00 to Sta 30+00 - Bank Height = 11 ft, SS = 2:1

Items	Quantity	Pay Unit	Unit Price	Total Price
Blanket, 100% Coconut(Coir)	4	SY	$4.50	$18.00
Excavation, Fill On-Site	0.5	CY	$5.00	$2.50
Excavation, Haul Off-Site	1.3	CY	$9.00	$11.70
Grouted Boulders, 24"	1	LF	$78.00	$78.00
Seeding, Native-Drilled	1.8	SY	$0.83	$1.49
Shrub	0.2	EA	$50.00	$10.00
Soil Riprap, Type VL	0.6	CY	$65.00	$39.00
Soil Wraps	1	LF	$75.00	$75.00
Topsoil, Excavate, Stockpile, and Replace	0.3	CY	$15.00	$4.50
Tree	0.02	EA	$400.00	$8.00
Willow Stakes	3	EA	$9.50	$28.50
	Total			**$276.69**

Appendix B – Bank Stabilization Alternatives Cross Sections



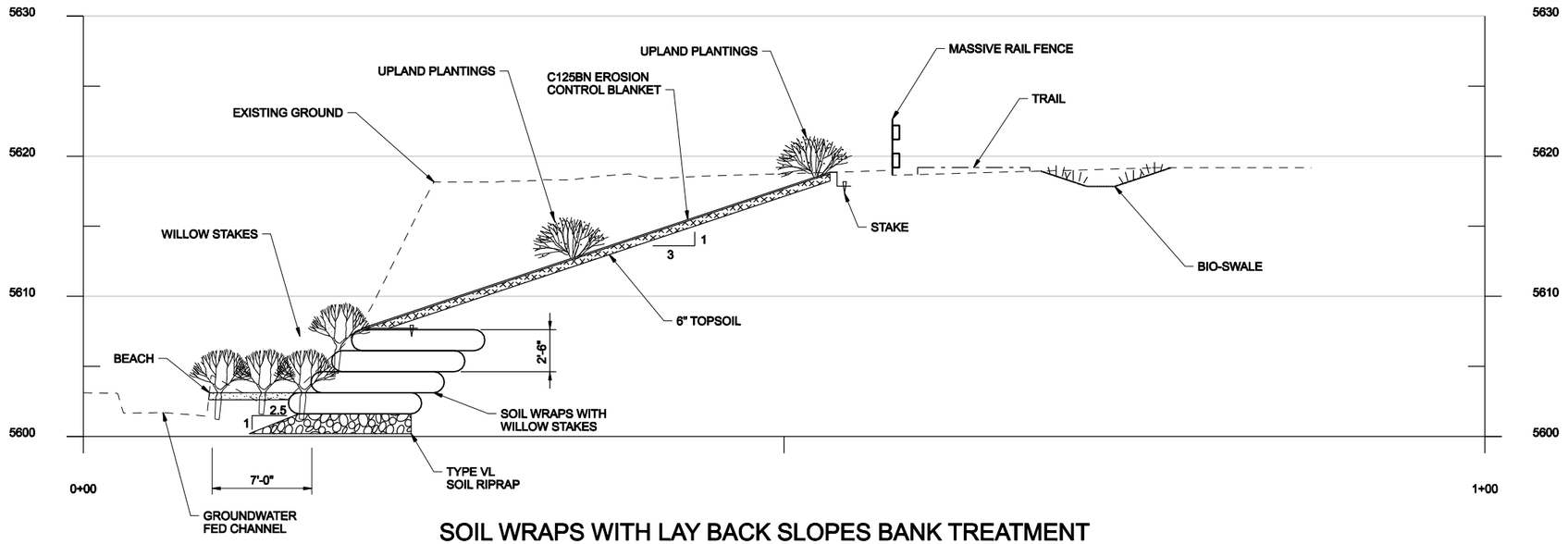
LAY BACK SLOPES

BOARDWALK

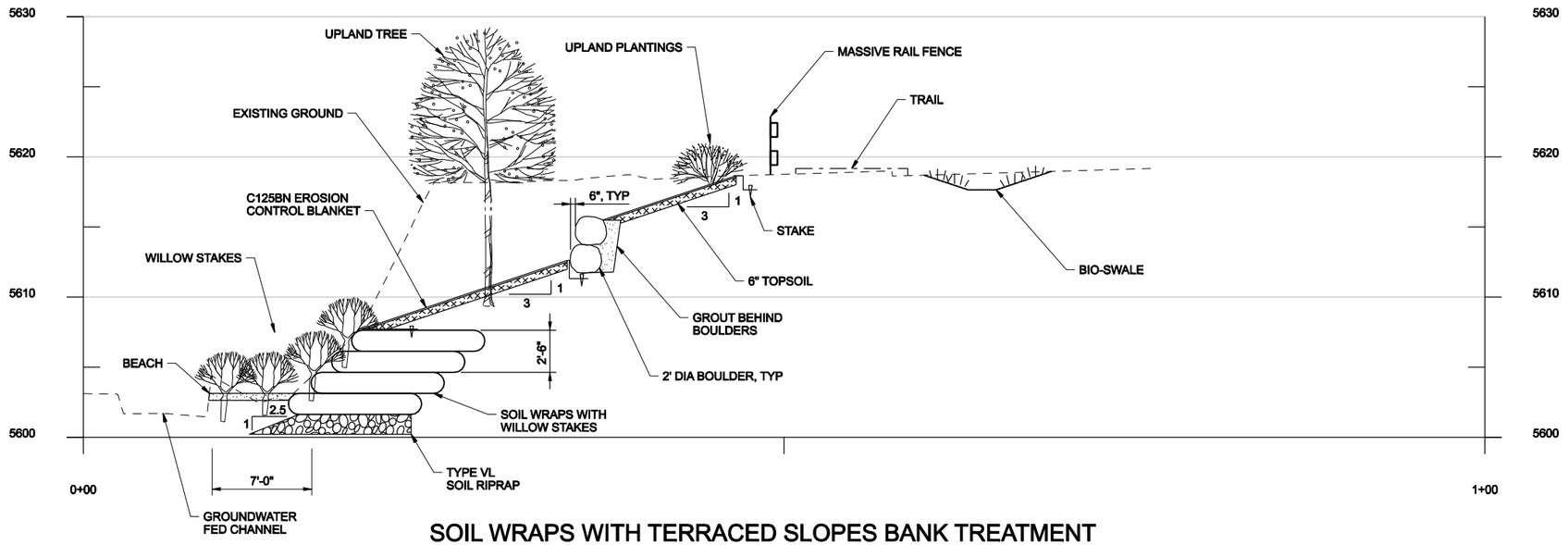
0 5 10 15
Scale In Feet

DSGN A COOK						VERIFY SCALE	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLMATION	CHERRY CREEK AT 12-MILE PARK FIGURE B-1: BANK STABILIZATION SECTIONS	SHEET 1
DR A COOK						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"				DWG B-1
CHK C HOOPER	NO	DATE	DESCRIPTION	APVR	N	IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DATE APRIL 2011
APVD S YANAGIHARA	NO.	DATE	REVISION	BY	APVD					PROJ 407259

FILENAME: cc12dt01.dgn PLOT DATE: 4/14/2011 PLOT TIME: 8:52:57 AM



SOIL WRAPS WITH LAY BACK SLOPES BANK TREATMENT

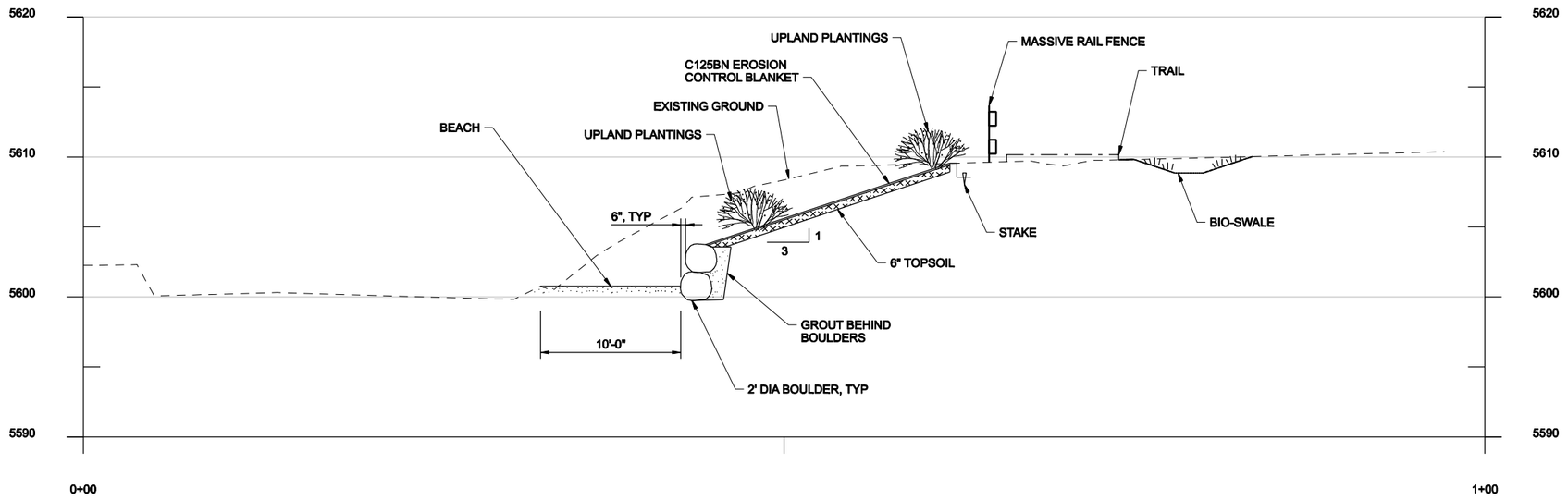


SOIL WRAPS WITH TERRACED SLOPES BANK TREATMENT

0 5 10 15
Scale In Feet

DSGN A COOK						VERIFY SCALE	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLMATION	CHERRY CREEK AT 12-MILE PARK FIGURE B-2: BANK STABILIZATION SECTIONS	SHEET 2
DR A COOK						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"				DWG B-2
CHK C HOOPER	NO	DATE	DESCRIPTION	APVR	N	IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DATE APRIL 2011
APVD S YANAGIHARA	NO.	DATE	REVISION	BY	APVD					PROJ 407259

FILENAME: cc12dt01_3.dgn PLOT DATE: 4/15/2011 PLOT TIME: 10:54:12 AM

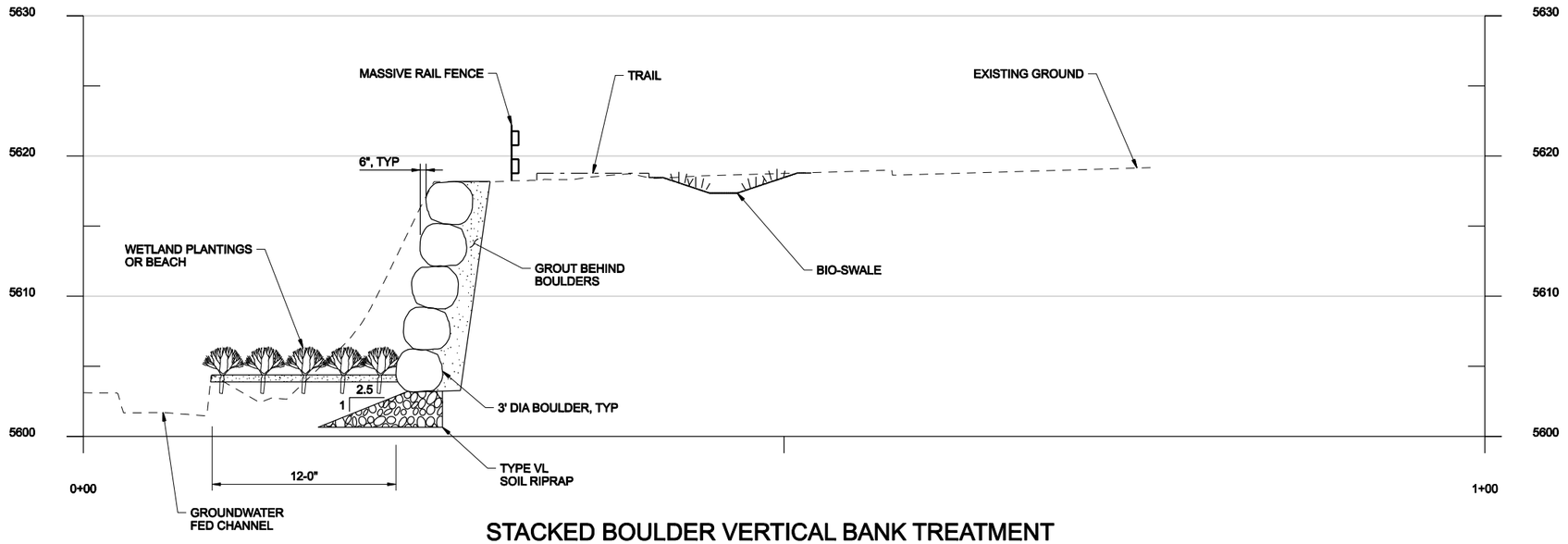


BOULDER WALL TOE PROTECTION

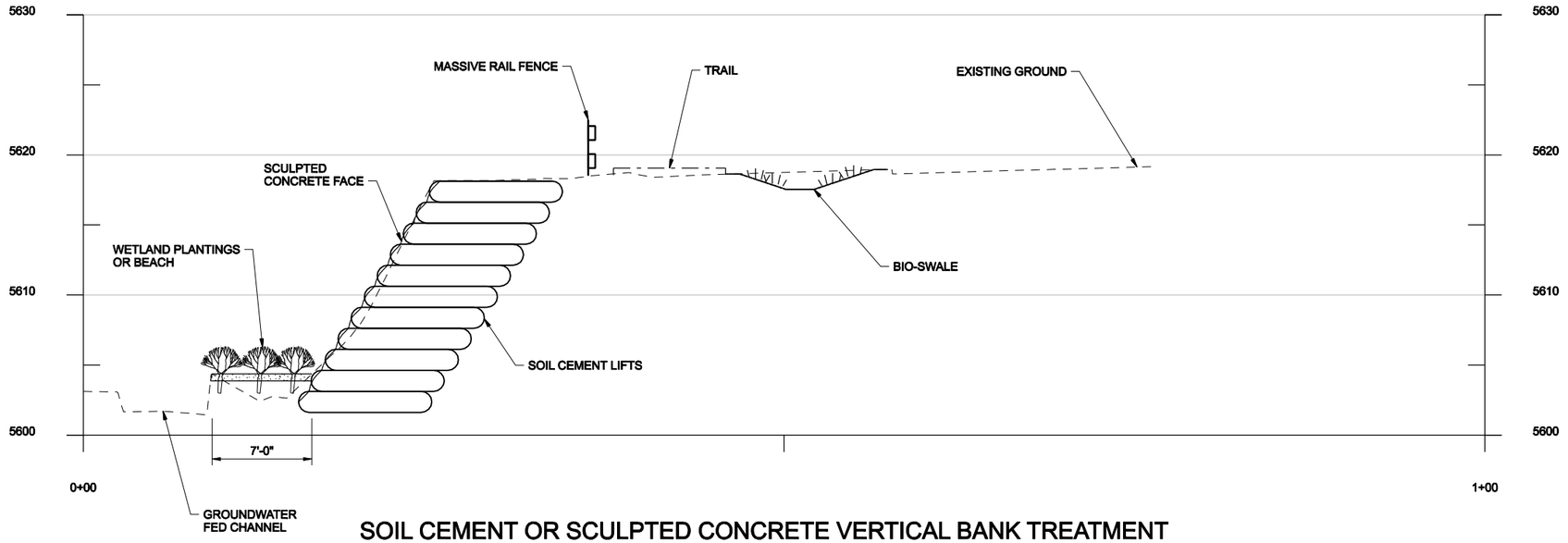
0 5 10 15
Scale In Feet

	DSGN A COOK						VERIFY SCALE	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLMATION	CHERRY CREEK AT 12-MILE PARK FIGURE B-3: BANK STABILIZATION SECTIONS	SHEET 3
	DR A COOK						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"				DWG B-3
	CHK C HOOPER	NO	DATE	DESCRIPTION	APVR	N	IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DATE APRIL 2011
	APVD S YANAGIHARA	NO.	DATE	REVISION	BY	APVD					PROJ 407259

FILENAME: cc12dt01_5.dgn PLOT DATE: 4/14/2011 PLOT TIME: 9:00:02 AM



STACKED BOULDER VERTICAL BANK TREATMENT

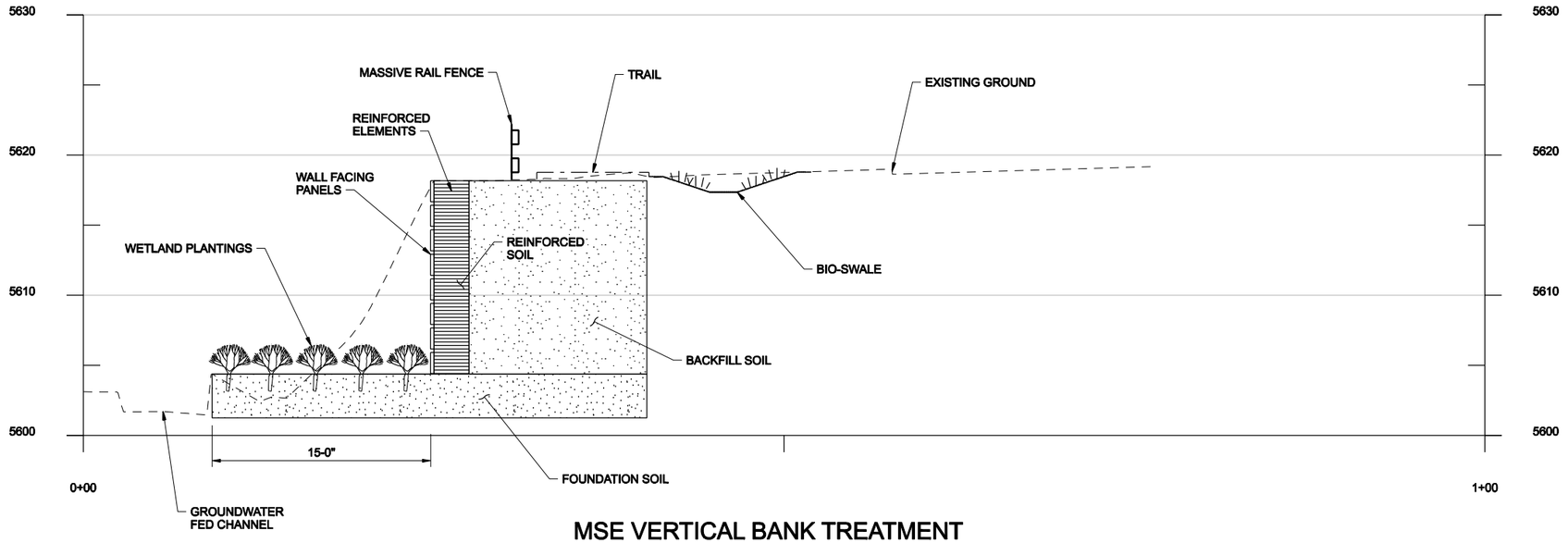


SOIL CEMENT OR SCULPTED CONCRETE VERTICAL BANK TREATMENT

0 5 10 15
Scale In Feet

DSGN A COOK						VERIFY SCALE	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLMATION	CHERRY CREEK AT 12-MILE PARK FIGURE B-4: BANK STABILIZATION SECTIONS	SHEET 4
DR A COOK						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				DWG B-4
CHK C HOOPER	NO	DATE	DESCRIPTION	APVR	N					DATE APRIL 2011
APVD S YANAGIHARA	NO.	DATE	REVISION	BY	APVD					PROJ 407259

FILENAME: cc12dt01_2.dgn PLOT DATE: 4/14/2011 PLOT TIME: 9:02:40 AM



MSE VERTICAL BANK TREATMENT

0 5 10 15
Scale In Feet

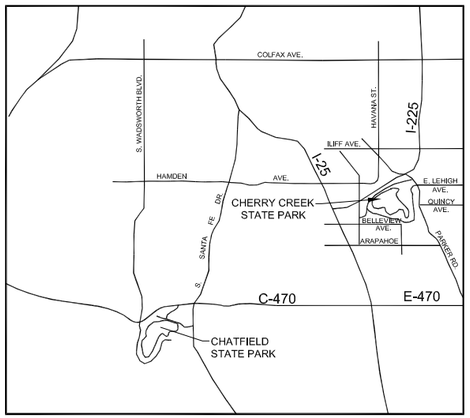
	DSGN A COOK DR A COOK CHK C HOOPER APVD S YANAGIHARA	NO	DATE	DESCRIPTION	APVR	N	VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	CH2MHILL	CHERRY CREEK BASIN WATER QUALITY AUTHORITY CHERRY CREEK AT 12-MILE PARK STREAM RECLMATION	CHERRY CREEK AT 12-MILE PARK FIGURE B-5: BANK STABILIZATION SECTIONS	SHEET 5 DWG B-5 DATE APRIL 2011 PROJ 407259
		NO.	DATE	REVISION	BY	APVD				

FILENAME: cc12dt01_4.dgn PLOT DATE: 4/14/2011 PLOT TIME: 9:03:19 AM

Appendix C – DOLA Improvement Plans

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA

ARAPAHOE COUNTY, COLORADO
FOR
COLORADO DIVISION OF PARKS AND OUTDOOR RECREATION



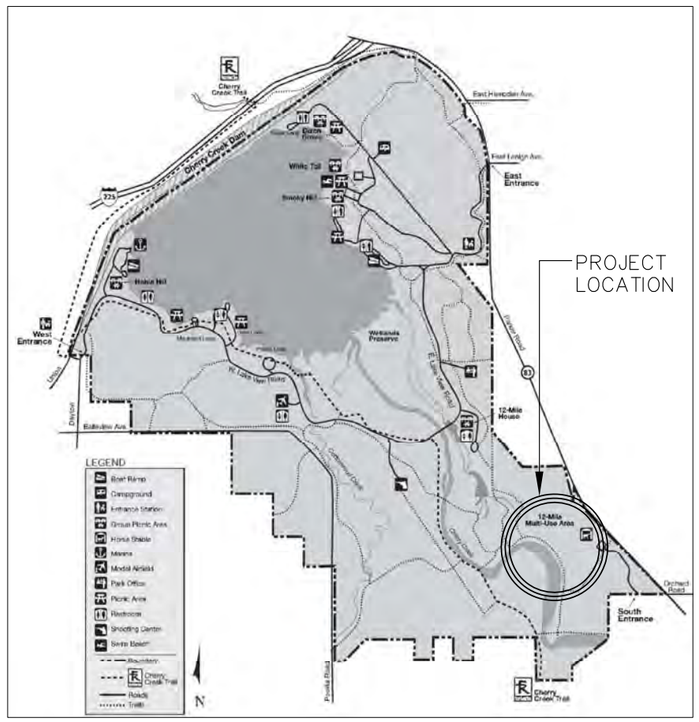
N *VICINITY MAP*
NO SCALE

SHEET INDEX	
SHEET 1	– COVER SHEET
SHEET 2	– DOG OFF–LEASH AREA SITE PLAN
SHEET 3	– DOG OFF–LEASH AREA, ENLARGED PLAN
SHEET 4	– 12 MILE NORTH, ENLARGED PLAN
SHEET 5	– DETAILS
SHEET 6	– DETAILS

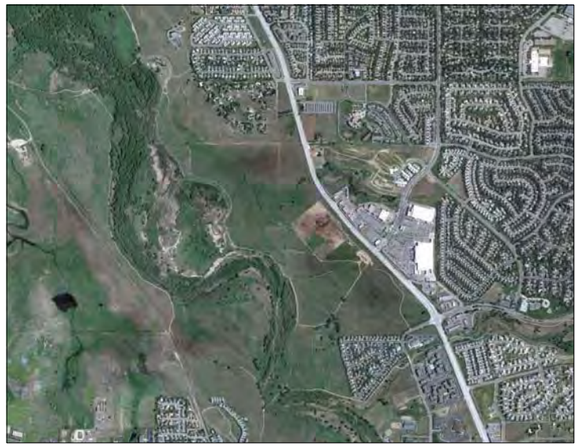
IMPORT/EXPORT CALCULTATIONS

AREA OF DISTURBANCE	IMPORT	EXPORT	ADDITIONAL EXPORT MATERIAL REQUIRED
ITEM #1 Excavation	0 CY	4590 CY	
ITEM #2 Concrete Footer	12 CY	0 CY	
ITEM #3 Sub–base	9 CY	0 CY	
ITEM #4 Flatwork	4569 CY	0 CY	
TOTALS	4590 CY	4590 CY	0 CY

OWNER REP. TO IDENTIFY ADDITIONAL EXPORT MATERIAL DURING CONSTRUCTION IF REQUIRED
PROJECT MANAGER WILL COORDINATE EXPORT SITE.



N *CHERRY CREEK STATE PARK PROJECT LOCATION MAP*
NO SCALE



N *CHERRY CREEK STATE PARK DOG OFF–LEASH AREA – EXISTING AERIAL MAP*
NO SCALE

APPROVAL:
REGIONAL MANAGER: _____
CAPITAL DEVELOPMENT MANAGER: _____

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

STUART WATADA, PROJECT MANAGER
HEATHER DUGAN, REGIONAL MANAGER

DESIGNED: PM
DRAWN: E.H.S.
FILE: ____
DATE: 030911

SHEET 1 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OF–LEASH AREA
COVER SHEET

TO 12 MILE NORTH, SEE AREA PLAN, 1/SH-4

SINGLE BULL PEN & 12' GATE, SEE DETAIL 5/SH-6

CORNER BRACE, TYPICAL FENCE CORNERS, SEE DETAIL 6/SH-5

NEW FOOT TRAIL, 10' WIDE CRUSHER FINES, SEE DETAIL 9/SH-5

REVEGETATE ALL AREAS LOCATED BETWEEN TRAILS & FENCE

TYPICAL, ALL ABANDONED TRAILS. RIP & COVER ABANDONED TRAILS. COVER WITH EXCAVATED MATERIAL FROM NEW TRAILS, TOP SOIL AND SEED, TYP. SEE DETAIL 6/SH-6

FUTURE CREEK CROSSING

100' MIN. HORSE/DOG SEPARATION, TYP

12' GATE, SEE DETAIL 3/SH-6

SERVICE ROAD, SEE DETAIL 9/SH-5

NEW FOOT TRAIL, 10' WIDE CRUSHER FINES, SEE DETAIL 9/SH-5

EXISTING EQUESTRIAN AREA

100' MIN.

PARKER ROAD

1/SH-3

FUTURE EQUESTRIAN PARKING

NEW ROAD TO EQUESTRIAN PARKING, ASPHALT, RE-ALIGN

FLATTEN PARKING AREA, RELOCATE TO THE SOUTHWEST

HORSE CROSSING, SEE DETAIL 8/SH-6

SELF-SERVICE PAY STATION & PULL-OUT AREA, SEE DETAIL 11/SH-7

FUTURE (3) LANE ENTRANCE STRUCTURE

ROAD TREATMENT, ASPHALT, SEE DETAIL 9/SH-5

SINGLE POST SIGN, SEE DETAIL 7/SH-6

SINGLE BULLPEN W/ 12' GATE, SEE DETAIL 5/SH-6, SIM.

SINGLE POST SIGN, SEE DETAIL 7/SH-6

NEW FOOT TRAIL, 10' WIDE CRUSHER FINES, SEE DETAIL 9/SH-5

EXST'G FOOT TRAIL

12' GATE, SEE DETAIL 3/SH-6

SINGLE POST SIGN, SEE DETAIL 7/SH-6

100' MIN.

DUMPSTER

MAINTENANCE GATE

DOUBLE BULLPEN

SINGLE POST SIGN, SEE DETAIL 7/SH-6

NEW FOOT TRAIL, 10' WIDE CRUSHER FINES, SEE DETAIL 9/SH-5

ABANDON EXST'G TRAIL, REVEGETATION BY OTHERS

SINGLE BULLPEN W/ 12' GATE, SEE DETAIL 5/SH-6, SIM.

MONUMENT SIGN, SEE DETAIL 3/SH-5

(E) TREES

(E) BENCH

EXST'G ENTRANCE GATE

LEGEND

- Park Boundary
- Public Road
- Service Road
- Dog Park Fence
- Boundary Fence
- Temporary Fence
- Foot Trail - New
- Foot Trail (Exst'g)
- Water
- Parking (Existing) P
- Restrooms (Existing) RR
- Dumpster D
- Trailhead TH
- Dog Water Station WS
- Dog Service Station SS
- Rules & Pay Station PS
- Trash Can T

1 DOG OFF-LEASH AREA - SITE PLAN

SCALE: 1" = 200'-0"

NORTH

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

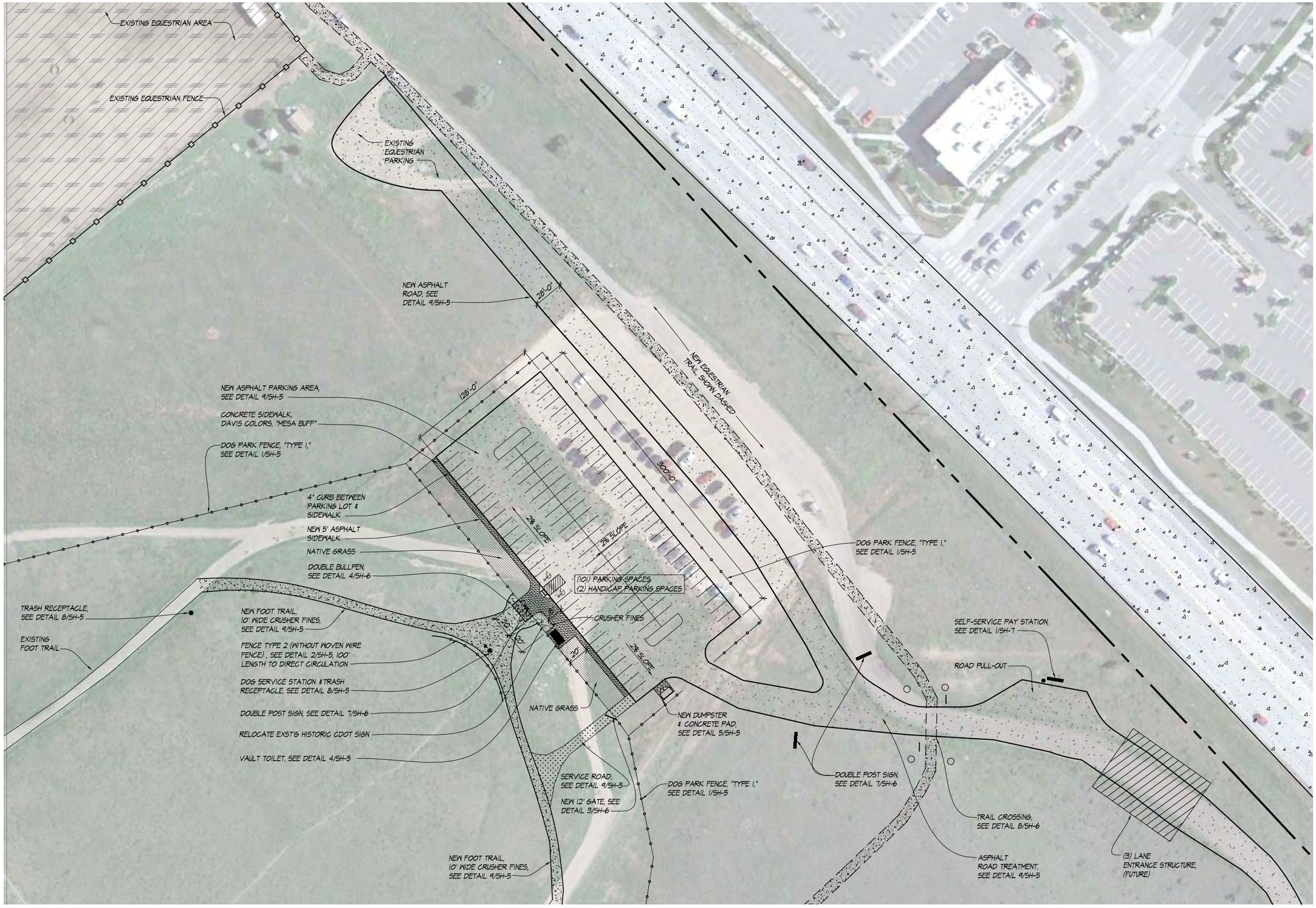
HEATHER DUGAN
PROJECT MANAGER

HEATHER DUGAN
REGIONAL MANAGER

DESIGNED: P.M.
DRAWN: E.H.S.
FILE: _____
DATE: 030911

SHEET 2 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA PROJECT
SITE PLAN



1 DOG OFF-LEASH AREA - ENLARGED PLAN
SCALE: 1" = 40'-0"

NORTH

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

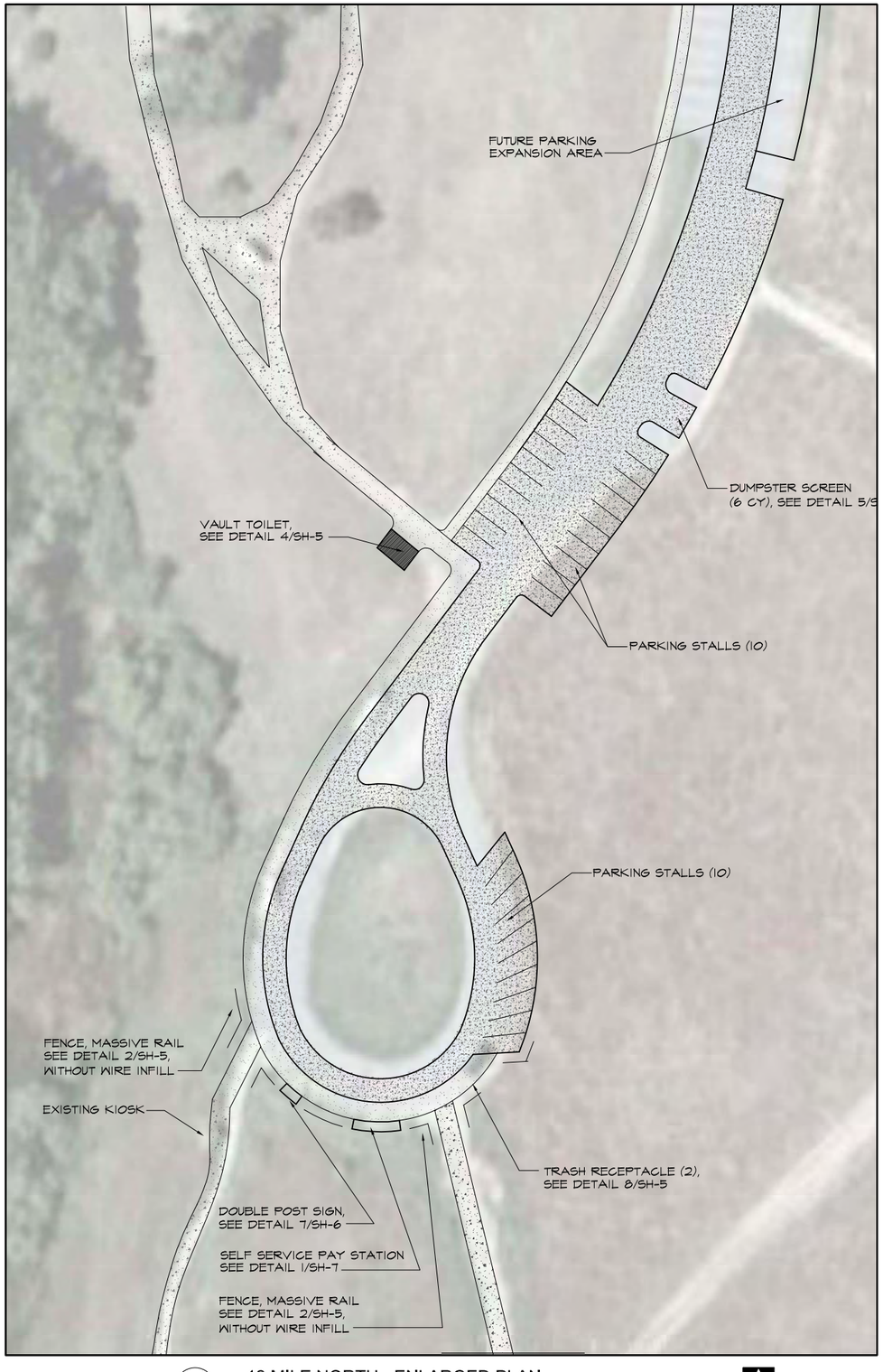
HEATHER DUGAN
PROJECT MANAGER

HEATHER DUGAN
REGIONAL MANAGER

DESIGNED: PM
DRAWN: E.H.S.
FILE: _____
DATE: 030911

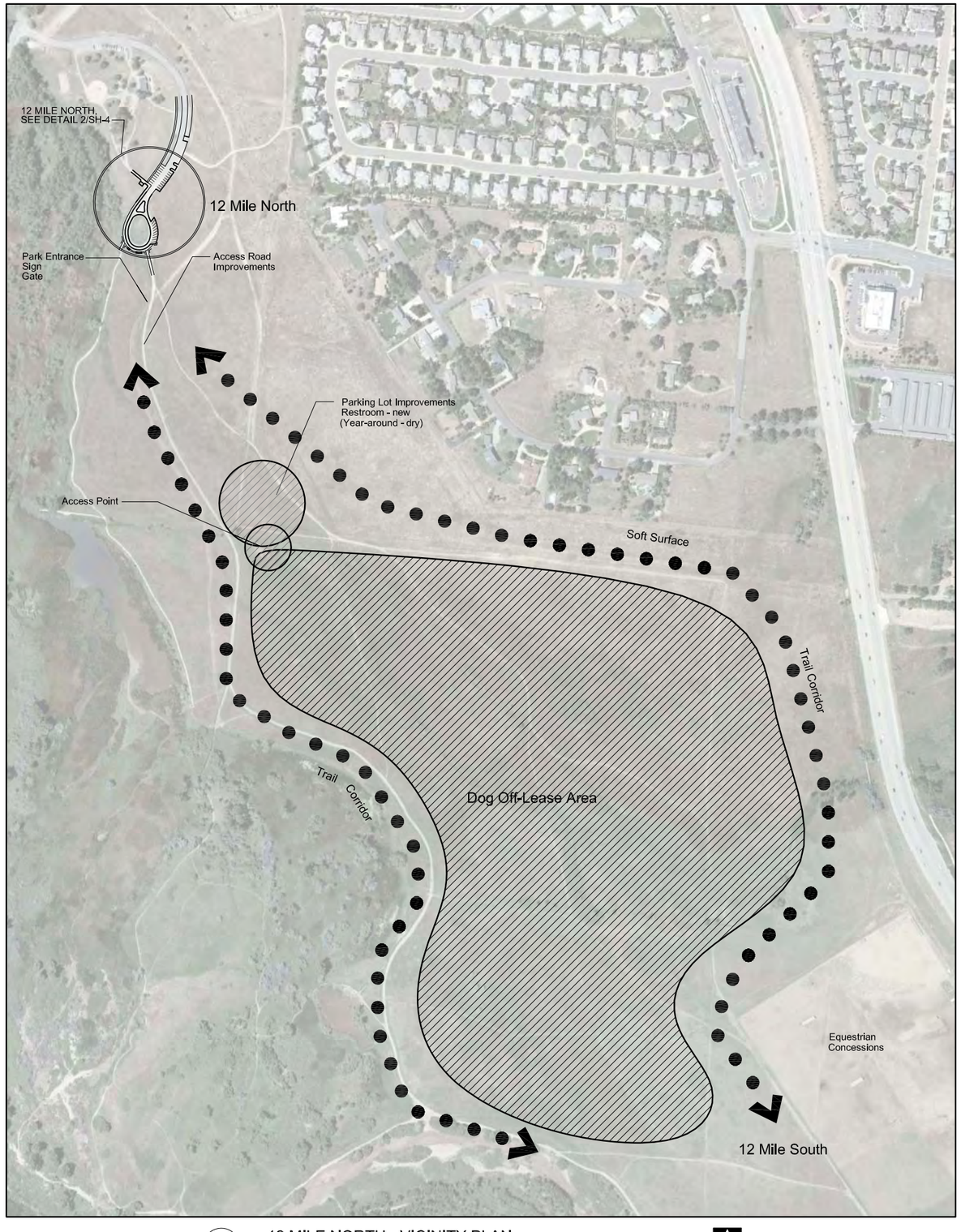
SHEET 3 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA PROJECT
ENLARGED SITE PLAN



2 12 MILE NORTH - ENLARGED PLAN
SCALE: NO SCALE

NORTH



1 12 MILE NORTH - VICINITY PLAN
SCALE: NO SCALE

NORTH

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

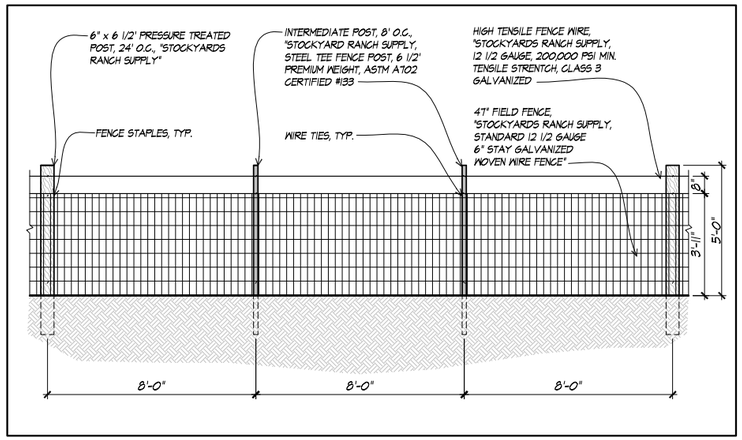
HEATHER DUGAN
PROJECT MANAGER

HEATHER DUGAN
REGIONAL MANAGER

DESIGNED: PM
DRAWN: E.H.S.
FILE: _____
DATE: 030911

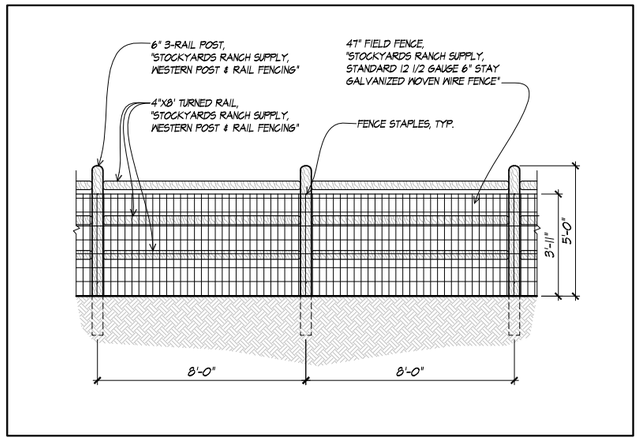
SHEET 4 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA PROJECT
12 MILE NORTH



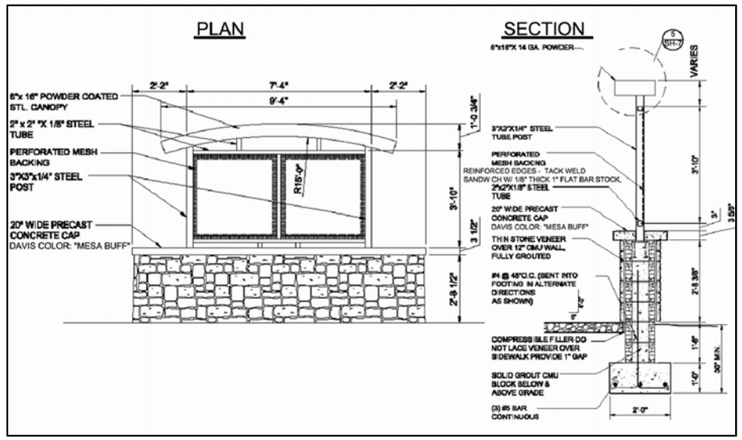
1 DOG PARK FENCE, TYPE 1

SCALE: 3/8" = 1'-0"



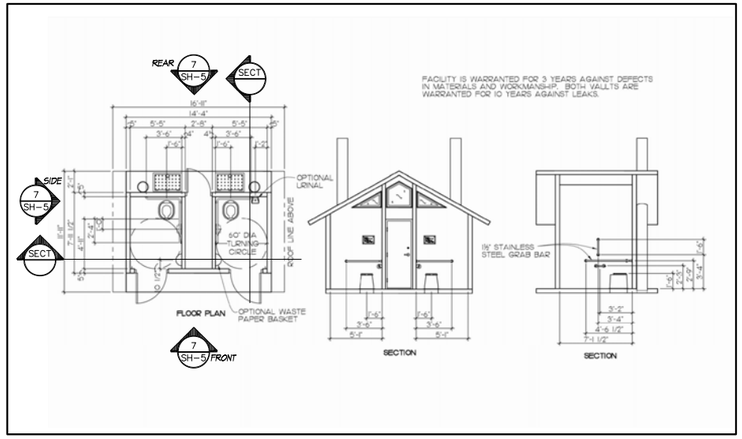
2 BULL PEN FENCE, TYPE 2

SCALE: 3/8" = 1'-0"



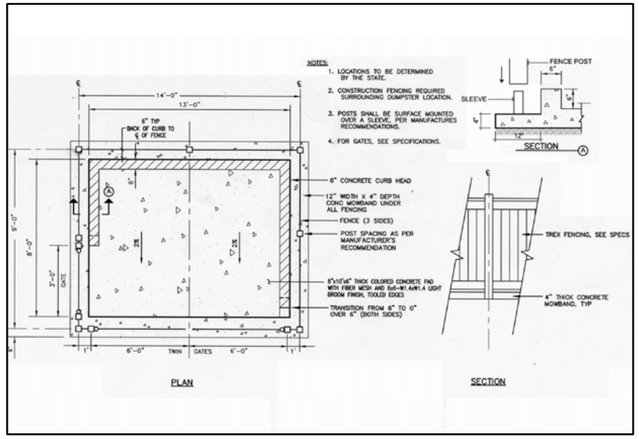
3 MONUMENT SIGN

SCALE: NO SCALE



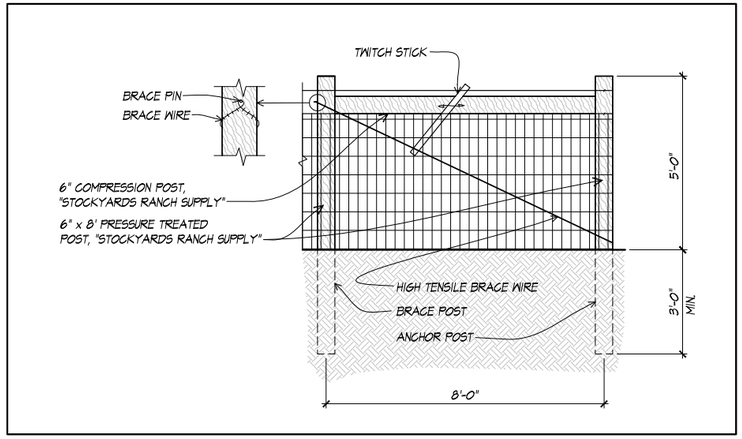
4 VAULT TOILET - PLAN & SECTIONS

SCALE: NO SCALE



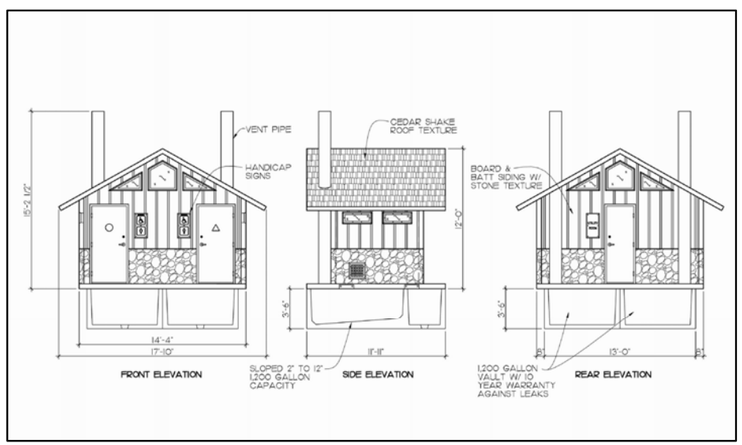
5 DUMPSTER PAD & SCREEN

SCALE: 1/2" = 1'-0"



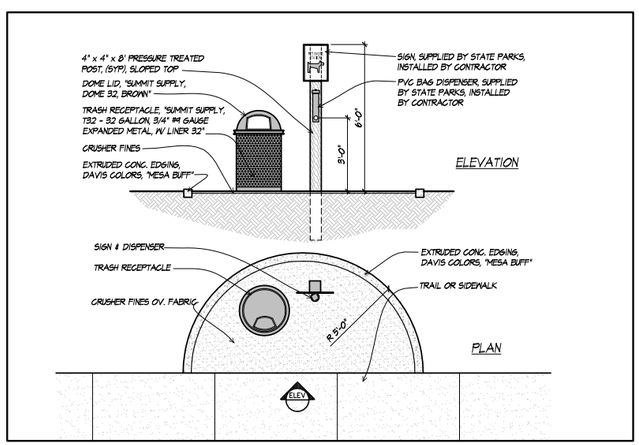
6 FENCE CORNER BRACE DETAIL

SCALE: 1/2" = 1'-0"



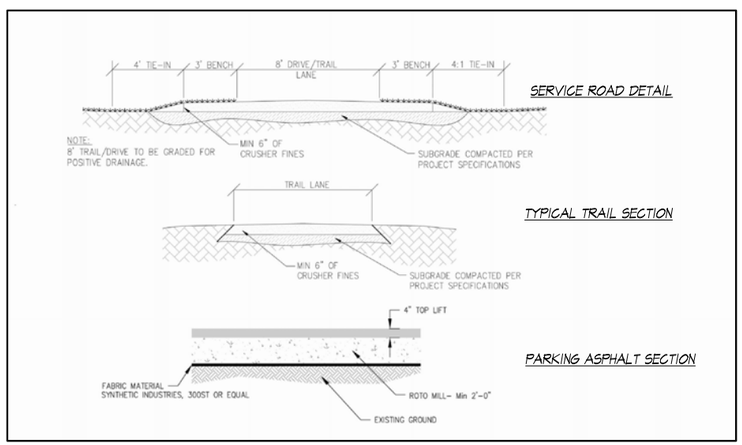
7 VAULT TOILET - ELEVATIONS

SCALE: NO SCALE



8 DOG SERVICE STATION & WASTE RECEPTACLE DETAIL

SCALE: 1/2" = 1'-0"



9 SERVICE ROAD, TYPICAL TRAIL SECTION, & ASPHALT SECTION

SCALE: NO SCALE

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

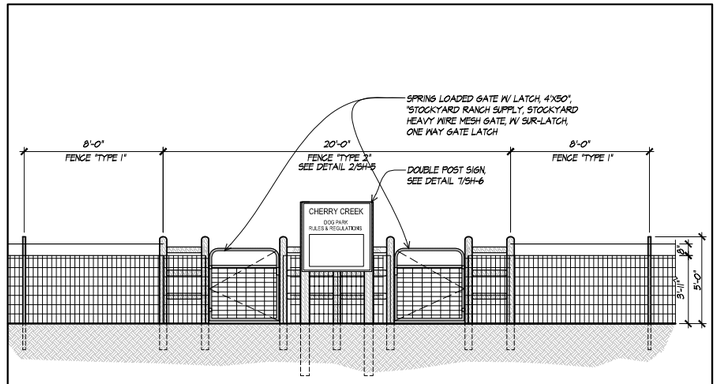
HEATHER DUGAN
PROJECT MANAGER

HEATHER DUGAN
REGIONAL MANAGER

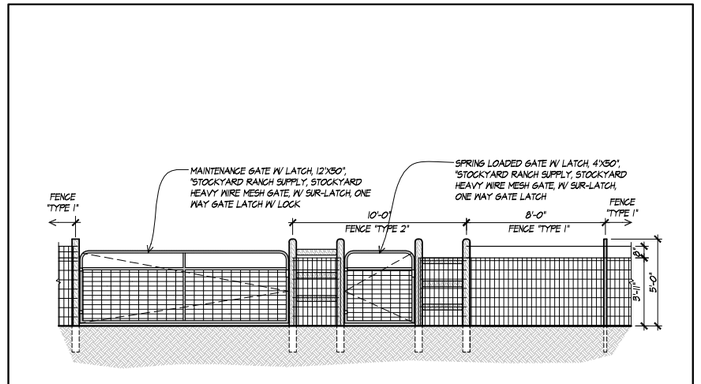
DESIGNED: PM
DRAWN: E.H.S.
FILE: _____
DATE: 030911

SHEET 5 OF 7 SHEETS

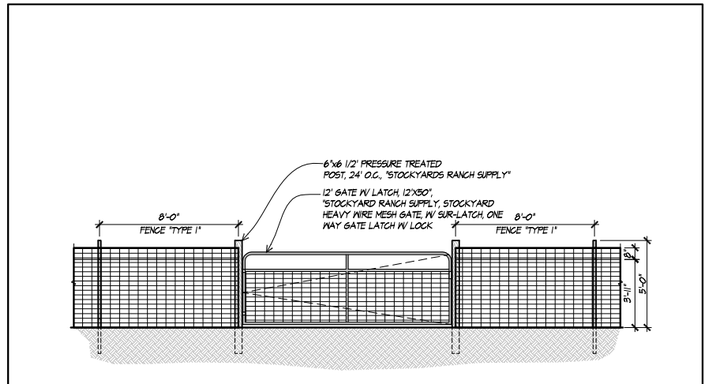
CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA
DETAILS



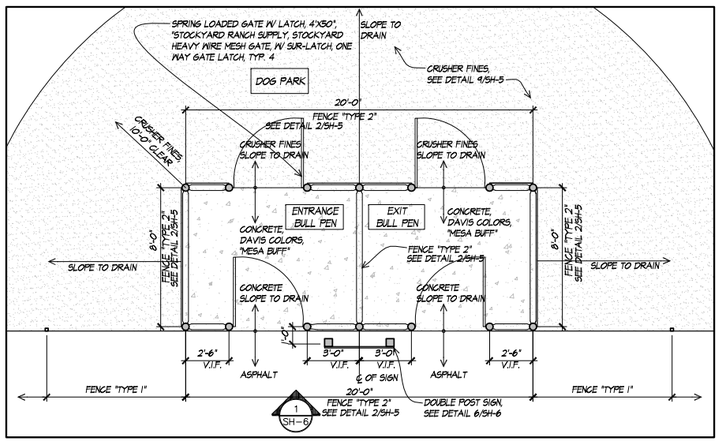
1 DOUBLE BULL PEN ELEVATION
SCALE: 1/4" = 1'-0"



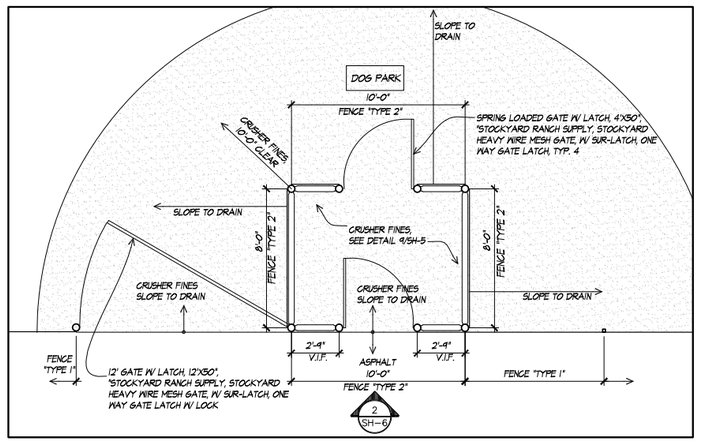
2 SINGLE BULL PEN W/ 12' GATE ELEVATION
SCALE: 1/4" = 1'-0"



3 12' GATE ELEVATION
SCALE: 1/4" = 1'-0"



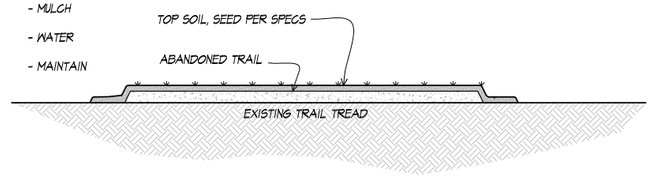
4 DOUBLE BULL PEN PLAN
SCALE: 1/4" = 1'-0"



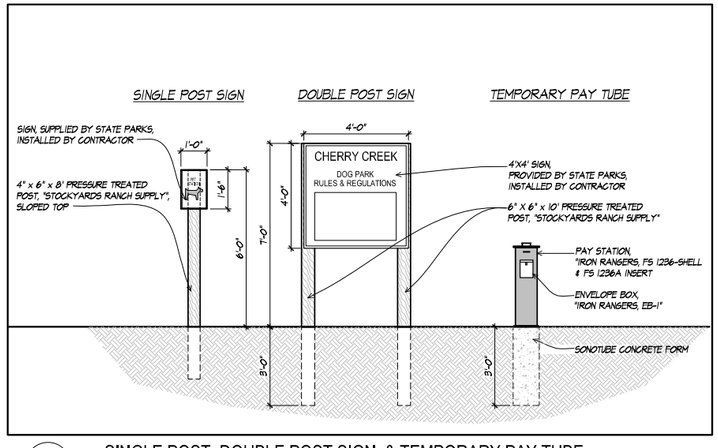
5 SINGLE BULL PEN W/ MAINTENANCE GATE PLAN
SCALE: 1/4" = 1'-0"

TRAIL REVEGETATION PROCEDURE:

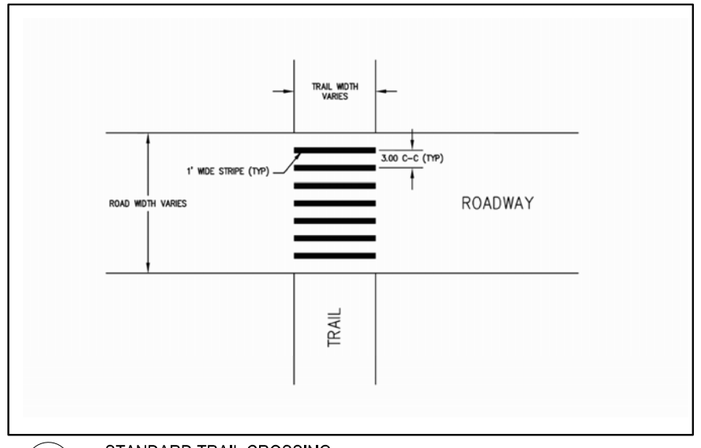
- SCRAPE, & REMOVE EXISTING TRAIL MATERIAL
- RIP COMPACTED TRAIL TREAD, MIN. 4"
- ADD 2" TOP SOIL, AND TILL MIN. 6"
- COMPACT 95%
- SEED PER SPECIFICATIONS
- MULCH
- WATER
- MAINTAIN



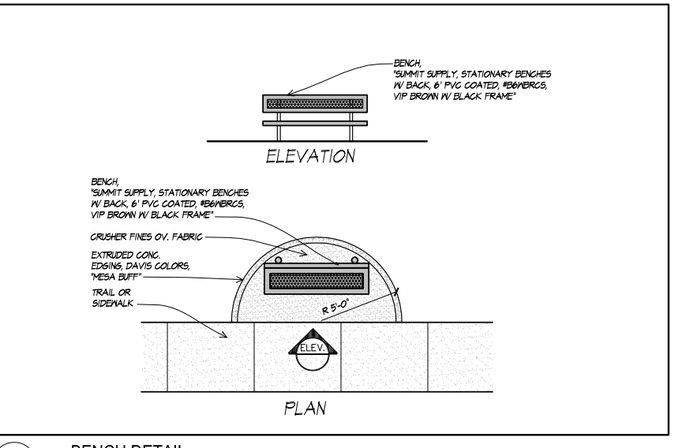
6 ABANDONED TRAIL REVEGETATION
SCALE: 1/2" = 1'-0"



7 SINGLE POST, DOUBLE POST SIGN, & TEMPORARY PAY TUBE
SCALE: 1/2" = 1'-0"



8 STANDARD TRAIL CROSSING
SCALE: NO SCALE



9 BENCH DETAIL
SCALE: 1/4" = 1'-0"

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

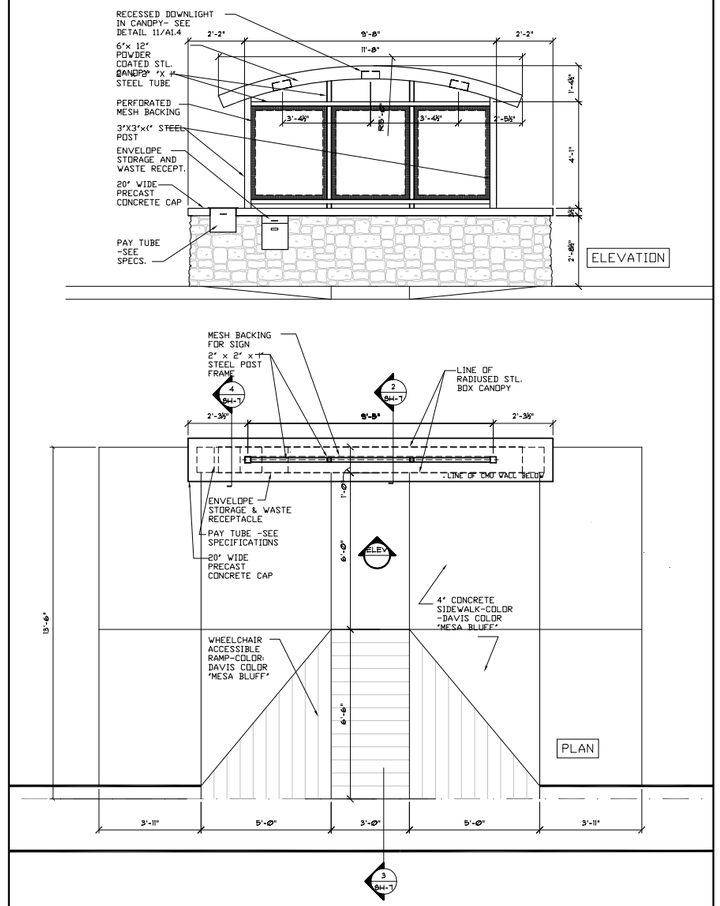
Colorado State Parks

HEATHER DUGAN, PROJECT MANAGER
HEATHER DUGAN, REGIONAL MANAGER

DESIGNED: P.M.
DRAWN: E.H.S.
FILE: _____
DATE: 030911

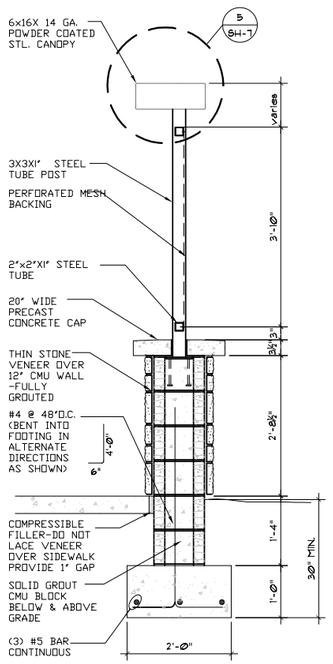
SHEET 6 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA
DETAILS



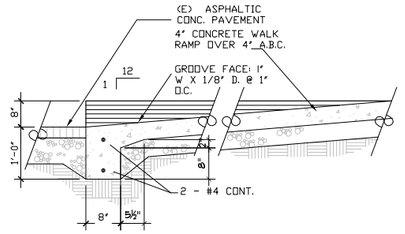
1 SELF-SERVICE PAY STATION - PLAN & ELEVATION

SCALE: 3/8" = 1'-0"



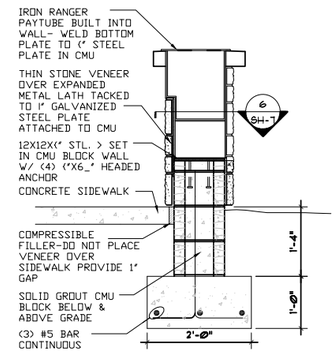
2 SELF-SERVICE PAY STATION - SECTION

SCALE: 3/4" = 1'-0"



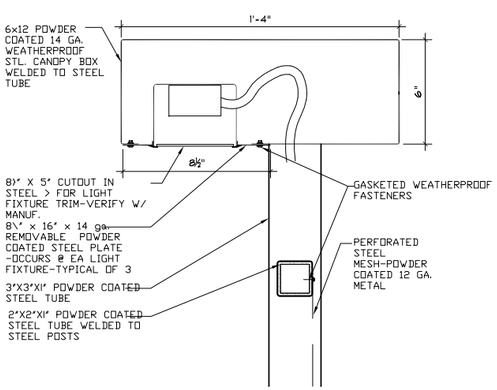
3 DETAIL AT RAMP

SCALE: 3/4" = 1'-0"



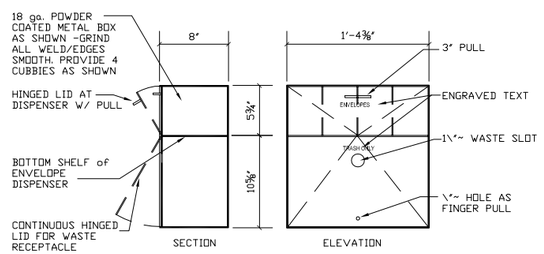
4 DETAIL AT PAY TUBE

SCALE: 3/4" = 1'-0"



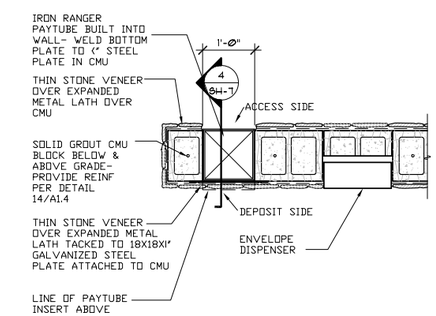
5 DETAIL AT CANOPY

SCALE: 3" = 1'-0"



6 ENVELOPE DISPENSER

SCALE: 1 1/2" = 1'-0"



7 PAY TUBE DETAIL

SCALE: 3/4" = 1'-0"

COLORADO DIVISION OF PARKS & OUTDOOR RECREATION

Colorado State Parks

HEATHER DUGAN
PROJECT MANAGER

HEATHER DUGAN
REGIONAL MANAGER

DESIGNED: PM
DRAWN: E.H.S.
FILE: ____
DATE: 030911

SHEET 7 OF 7 SHEETS

CHERRY CREEK STATE PARK
DOG OFF-LEASH AREA
DETAILS