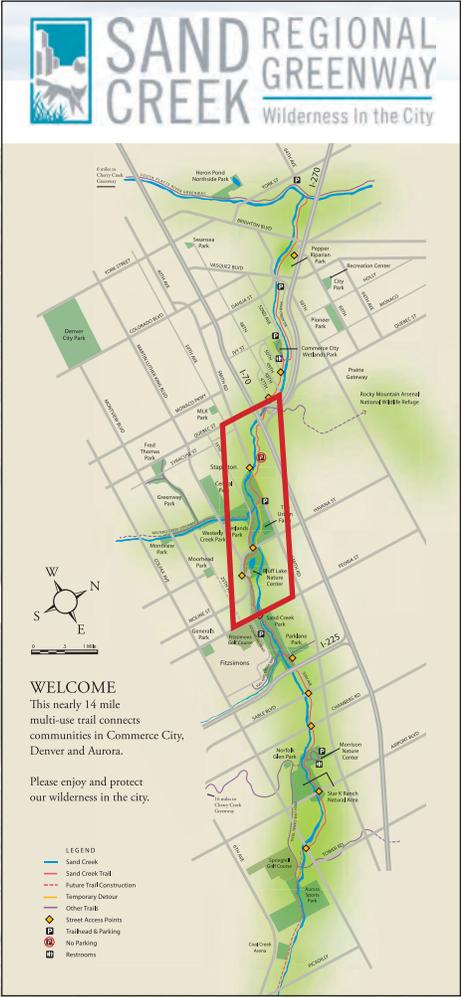


Sand Creek Regional Greenway Trail

Denver Segment Master Plan

May 2016



City and County of Denver Trail Alignment and Connectivity Recommendations

Supplement to the 1996 Sand Creek Regional Greenway Master Plan



Acknowledgments

The City and County of Denver

Department of Parks and Recreation

Happy Haynes - Executive Director

Scott Gilmore - Deputy Executive Director

Jay Henke - Project Manager



The Sand Creek Regional Greenway Partnership

Kate Kramer - Director

Mollie Hayden - Partnership and Program Manager



The Great Outdoors Colorado (GOCO)



Stapleton Parks Advisory Group (PAG)

Metro Wastewater Reclamation District

Marc Flatt - Transmission System Division Head



Bluff Lake Nature Center

Jeff LaMontagne - Executive Director



Urban Drainage and Flood Control District (UDFCD)

The Colorado Department of Transportation (CDOT)



Consultants

Stream Design Landscape Architecture

(Lead Consultant)

Jesse Clark

Paul Thomas

Claire Kesecker



Muller Engineering Company

(Civil Engineering and Floodplain)

Chris Kroeger

Jim Watt



ERO Resources Corporation

(Environmental)

Moneka Worah



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Introduction and Purpose of the Project

The most recent Master Plan for the Sand Creek Regional Greenway (prior to this update) was prepared in 1996 with the intention of providing a vision for the full length of the greenway trail through Aurora, Denver, and Commerce City. This effort by The Sand Creek Regional Greenway Partnership and the City and County of Denver (CCD) is intended to re-visit the Master Plan, and specifically, to evaluate and address trail segments within the Denver city limits for experience, safety, alignment, operational sustainability, contemporary appropriateness and needs, and community desires.

In recent years, impacts from erosion and increased use have escalated damage to the existing soft surface trail resulting in elevated demands for maintenance of degrading trail conditions, repairs, and in some cases repeated reconstruction. In addition to meeting Denver’s modern operational and recreational needs, experiential desires, and technical specifications for Denver, a primary goal of the project is to evaluate and improve safety along the corridor. Safety issues include flooding and erosion (safe egress during flood events, stream bank collapse risks, trail surface conditions, etc.), increased users and transportation modes (road bikes and other wheeled transport modes), and perceived personal comfort and security (while in more isolated areas). The project is aimed at identifying and improving, safety along the trail.

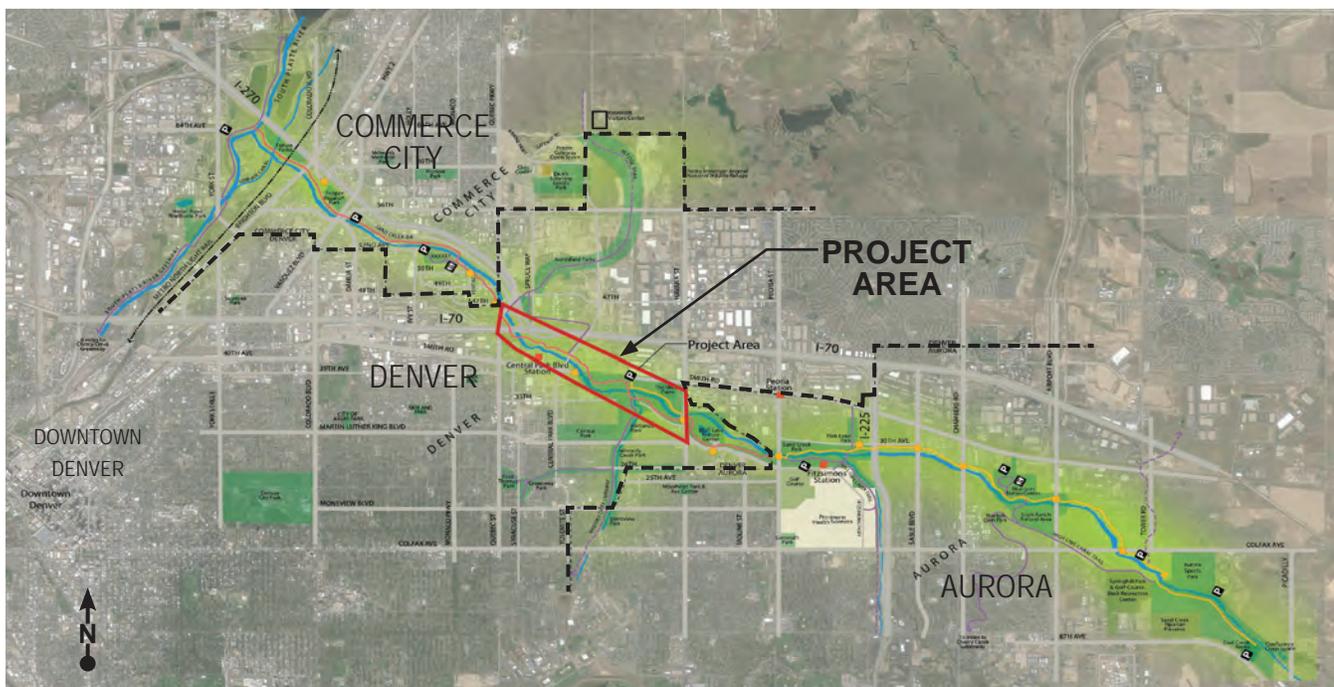
In 2015, the City and County of Denver received Great Outdoors Colorado (GOCO) grant funding for planning and design of un-improved trail segments (not already under construction) in order to provide a continuous and sinuous connection of the trail through Denver. Additionally, in recent years, Community members have expressed the desire for continued “momentum” of improvements to

the overall regional trail systems, increased trail capacity, better connections to neighborhoods and other trails, and to address areas that have recently re-developed (i.e. Stapleton). It is important that the final implemented Denver portions of the trail be consistent with each other, while helping to provide a unified experience along the Greenway from Aurora through Commerce City - and that these isolated projects be integrated/coordinated with the other Denver projects already in progress. This project aims to build on the intent of the 1996 Master Plan, the Sand Creek Regional Greenway Partnership’s past and current efforts (the “look” of the greenway- signage, interpretive opportunities, encouraging stewardship, etc.), and other plans that impact the planning and implementation of the trail projects.

It is likely that individual implementation projects within the Denver segment will be phased over time as land use development and political will evolves, and as funding becomes available. As with any Master Plan, this plan should be continually evaluated as these changes occur to assure that the plan remains appropriate and addresses contemporary needs and desires while providing an adaptable framework for the future.

Site and Context

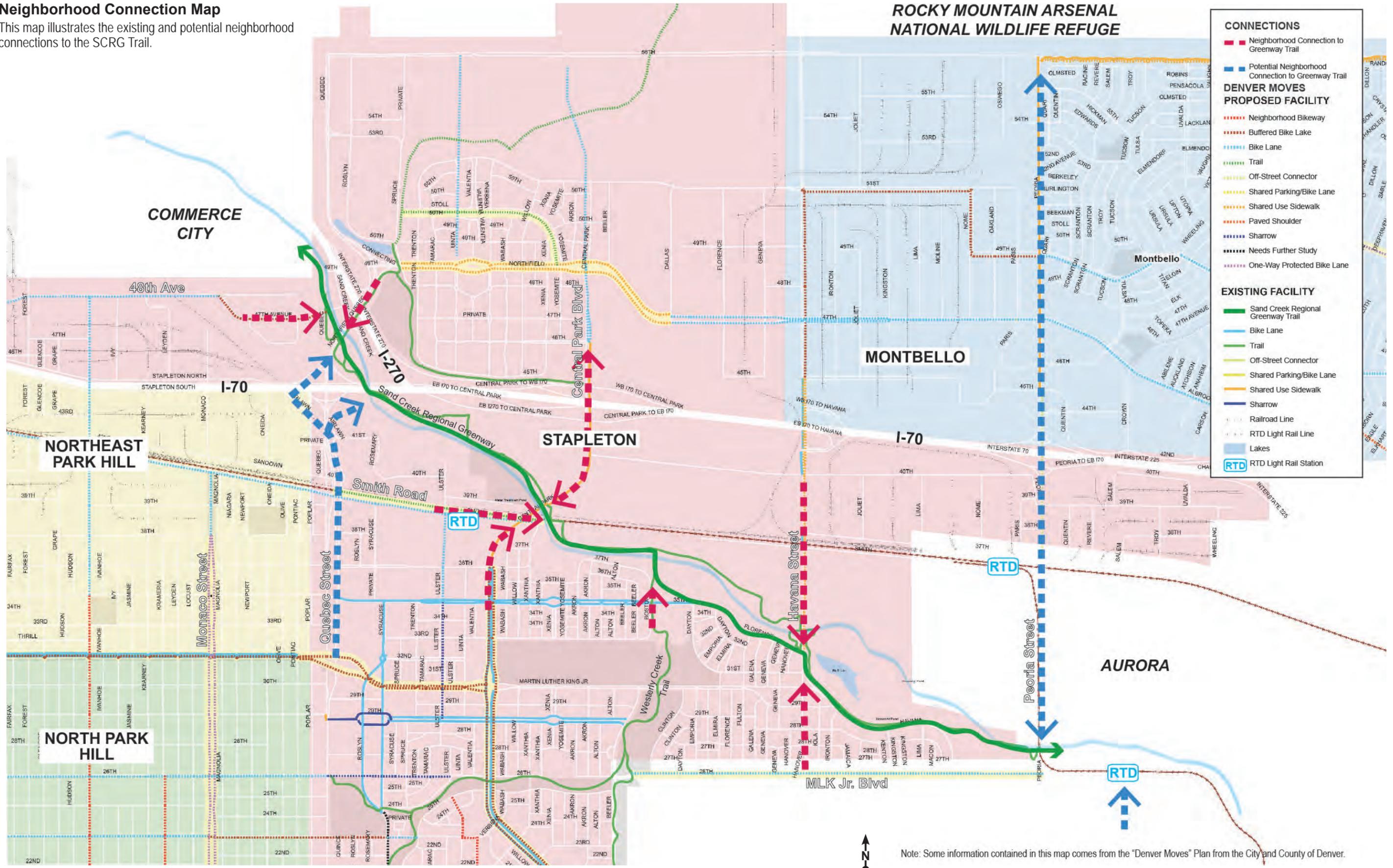
The Sand Creek Regional Greenway Trail (SCRG Trail) meanders through varied landscapes, multiple communities, and a vast mixture of land owners – ultimately reaching more than 14 miles from the current south eastern limits in Aurora to the north western limit where Sand Creek confluences with the South Platte Greenway near the intersection of 64th Avenue and York Street in Commerce City. The public trail serves as a major leg of the Colorado Front Range Trail, and increasingly provides recreational users and commuters more flexibility for walking, biking, and transit connectivity to Denver and the Front Range.



Neighborhood Connection Map

This map illustrates the existing and potential neighborhood connections to the SCRГ Trail.

ROCKY MOUNTAIN ARSENAL NATIONAL WILDLIFE REFUGE



CONNECTIONS

- Red dashed line: Neighborhood Connection to Greenway Trail
- Blue dashed line: Potential Neighborhood Connection to Greenway Trail

DENVER MOVES PROPOSED FACILITY

- Red dotted line: Neighborhood Bikeway
- Orange dotted line: Buffered Bike Lake
- Blue dotted line: Bike Lane
- Green dotted line: Trail
- Yellow dotted line: Off-Street Connector
- Yellow dashed line: Shared Parking/Bike Lane
- Orange dashed line: Shared Use Sidewalk
- Blue dashed line: Paved Shoulder
- Blue dashed line: Sharrow
- Black dotted line: Needs Further Study
- Purple dashed line: One-Way Protected Bike Lane

EXISTING FACILITY

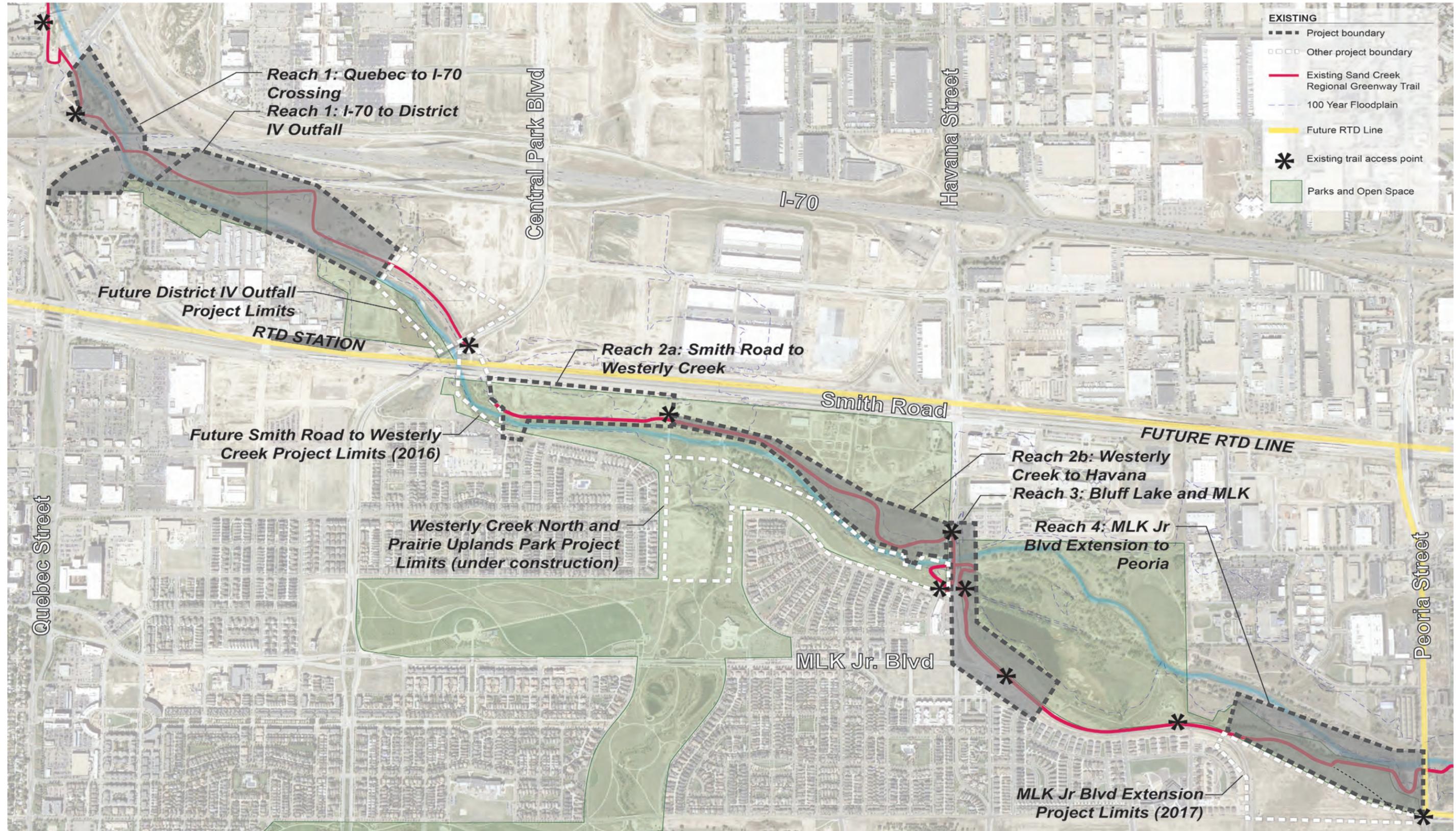
- Green solid line: Sand Creek Regional Greenway Trail
- Blue solid line: Bike Lane
- Green solid line: Trail
- Yellow solid line: Off-Street Connector
- Yellow dashed line: Shared Parking/Bike Lane
- Orange dashed line: Shared Use Sidewalk
- Blue dashed line: Sharrow
- Black dashed line: Railroad Line
- Blue dashed line: RTD Light Rail Line
- Blue circle: Lakes
- Blue square: RTD Light Rail Station

Note: Some information contained in this map comes from the "Denver Moves" Plan from the City and County of Denver.

Project Locations Map

The Denver segments of the Sand Creek Regional Greenway reach from the eastern limit at Peoria Street and the CCD/Aurora boundary, to just northwest of I-70 near 47th Street, where the path continues into Commerce City. At the time of this project's commencement, the project limits included 4 specific areas/reaches that had been identified for planning and design with anticipated phased construction

(outlined in GREY in the exhibit below). The remaining areas of trail and greenway between these reaches have been completed or are in the process of being completed by other projects (outlined in WHITE in the exhibit below). For more information regarding the other projects, refer to the public meeting #1 presentation and meeting minutes located in the appendix of this document.





Stakeholder and Public Process

As the trail is improved, and nearby development increases, a broader variety of users will be attracted to the Greenway and the number of users will likely rise. Throughout the project's planning process, coordination and engagement with various governmental organizations, agencies, and the local community has been a critical step taken in order to identify potential issues, constraints, opportunities, and desires for improving conditions, operational sustainability and configuration, and connectivity to the Greenway.



Participants described concerns and ideas at the first public meeting.

A partial list of public engagement and stakeholder interviews and meetings includes the following:

- Denver Parks and Recreation (DPR) and Greenway Partnership workshop (8.17.2015)
- Public Meetings (#1 on 10.1.2015 and #2 on 11.18.2015)
- Stapleton Parks Advisory Group presentation (11.12.2015)
- Meetings with CDOT (1.6.2016), Metro (1.8.2016) Bluff Lake Nature Center (10.20.2015)

*Minutes and summary presentations for the public meetings can be found in the Appendix of this document.

Planning Considerations

As a result of the comprehensive stakeholder involvement and site analysis/evaluation process, the design team has developed a thorough list of considerations for trail criteria, community desires, and operational/implementation needs which can be organized into groups related to: 1) Property Ownership and Easements 2) Trail Configuration and Surfacing 3) Adjacent and Future Development 4) Floodplain 5) Environmental.

Property Ownership and Easements – The City of Denver does not own all of the property along the Greenway and in some cases will require acquisition or easement for future trail development improvements in desired locations. These specific instances are identified in the Issues, Opportunities, and Alternatives section of this report.

Trail Configuration and Surfacing – A variety of trail surface options, widths, and adjacency configurations have been evaluated for the corridor in order to respond to diverse uses, maintenance requirements, and preferences. The Sand Creek Regional Greenway encourages “All non-motorized uses of the trail...” to include bicycling, horseback riding, walking, running, and pets on leashes. As a result, a “dual” surface solution is desired (i.e. hard paved surface and adjacent soft surface trail) or “split” dual surfacing where a hard paved surface follows one alignment, and soft is either separated by vegetation, or follows another route – ultimately leading to the same destination. Specific trail alignment and configuration recommendations are illustrated in the Issues, Opportunities, and Alternatives section of this report.

Adjacent and Future Development– As development plans evolve over time and create varying needs, the ultimate plan for the Greenway should be flexible and accommodating for future growth. New transit routes and stations, commercial/mixed use and residential development, and community desires will likely advance over time requiring new or altered trail alignments, connections, and configurations.

Floodplain - Much of the current trail alignment in Denver is inside the 100 year floodplain, most of which is not frequently inundated, however some parts of the trail (primarily in Reach 1 near the I-70/270 interchange) lie in areas more frequently inundated in 2-5 year flood events. Because the existing pedestrian bridge is undersized and Sand Creek is a very dynamic stream experiencing both aggradation (deposition of sediment) and degradation (erosion or removal of sediment), frequent inundation creates ongoing trail maintenance and safety issues related to erosion and deposition of sediment. Additionally, strong consideration should be made for safe passage and egress by trail users in areas prone to flooding or inundation. Although it is likely that more significant channel improvements will be implemented in the near or long-term future that would reduce some flood related maintenance and safety issues, coordinated efforts are being made whenever possible with City and County of Denver wastewater and floodplain management staff, the Colorado Department of Transportation (CDOT), the Urban Drainage and Flood Control District (UDFCD), and

the Army Corps of Engineers to optimize funding and project phasing. Additionally, certain areas may require additional work related to FEMA map revisions in order to achieve the desired results. Specific floodplain related issues are further described in the Issues, Opportunities, and Alternatives section of this report.

Environmental – Vegetation and wildlife characteristics for trail alignments and construction activity along the Greenway will need to be considered and continually monitored in every phase of project work. This project includes a Natural Resources Assessment performed by ERO (consultant) for review of potential wetlands areas, identification of potential federally threatened and endangered species habitat, and identification of other natural resources. The consultant team did not conduct jurisdictional wetland delineations during this assessment. The following excerpts from the report illustrate some of the findings:

Wetlands and Other Waters of the U.S. – Sand Creek flows northwest through the study area and contains fringes to wide benches of wetlands along its banks. Sand Creek is a tributary to the South Platte River and is considered a jurisdictional water of the U.S. Any activity that would require placing dredged or fill material into Sand Creek, its tributaries, or wetlands must comply with Section 404 of the Clean Water Act. ERO recommends placing the trail away from Sand Creek where possible to create a buffer for the wetland and riparian habitat. There are several areas along the creek where improvements could be recommended to increase wetland and/or riparian habitat along the stream.

Threatened and Endangered Species – There is no suitable habitat present for any federal threatened or endangered species in the study area. Suitable habitat is present for several Colorado state-listed threatened and endangered species, including the black-tailed prairie dog, bald eagle, ferruginous hawk, and common garter snake.

Migratory Birds and Other Wildlife – Several inactive raptor nests were observed during the 2015 site visit. If any active nests are found in the study area, any work that would destroy the nests should not be conducted until the birds have abandoned the nests. If possible, ground-clearing activities should occur outside of the April 1 through August 31 migratory bird breeding season. If construction activities would occur during the migratory bird breeding season, a nest survey should be conducted immediately prior to construction.

In several areas noxious weeds, and non-native grasslands present management challenges for near term construction as well as long term management of the corridor. It will also be necessary to develop a prairie dog management plan for portions of the trail for construction activities.

* For more information regarding the Natural Resources Assessment and full-sized maps, refer to the full report located in the appendix of this document.



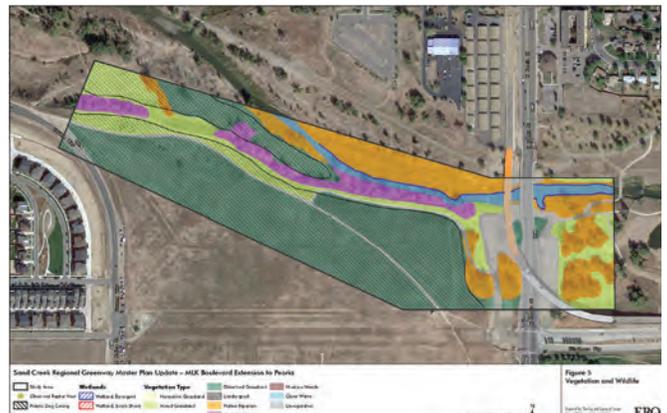
Reach 1 environmental mapping.



Reach 2 environmental mapping.



Reach 3 environmental mapping.



Reach 4 environmental mapping.

Concept Development

This section of the report identifies specific issues, opportunities, and coordination requirements - as well as concepts for design of trail alignment, surface type, and additional amenities for each reach.

DESIGN CRITERIA

The criteria used to develop and evaluate concept alternatives is as follows:

- **Safety** - The alternative reduces flood and inundation risks and improves trail safety through improved trail alignment and reduced maintenance requirements.
- **Maintenance** - The alternative is more easily maintained and/or requires less maintenance (i.e. less trail inundation resulting in less debris on trail and fewer repairs to surfacing and structures due to erosion, more durable trail).
- **Experience** - The alternative improves connectivity to regional and local destinations; enhances the trail aesthetic and sense of enjoyment for users; provides a more sinuous trail; fewer impacts to trail users during or just after storm/flood events.
- **Costs and Value** - The alternative provides value by allowing for phased construction with the availability of funding; including construction feasibility/efficiencies that result in cost savings; lowering maintenance and operations costs; addressing issues and capitalizing on opportunities.

*Order of magnitude level opinions of construction cost are included with each alternative.

EVALUATION OF CONCEPTS AND ALTERNATIVES

In the unique case of Reach 1, flooding and frequent inundation are the most important issues to address to provide a sustainable trail solution. Additionally, this area has sufficient land available to explore solutions that adequately address flooding and erosion related issues as well as recreational opportunities, thus several concept alternatives are presented for 1) the main creek crossing near the I-70 underpass, and 2) trail configuration for the entire reach. In order to evaluate the options, each alternative in Reach 1 was evaluated for its ability to address individual criterion as illustrated in a matrix (similar to the sample below) associated with each alternative. A single dot indicates that the alternative could moderately address the criterion whereas 3 dots indicates that the alternative could fully address the criterion. A "preferred" alternative is indicated at the end of the Reach 1 section as the option that best addresses the most criteria and provides the best opportunity for value in the long run.

For Reaches 2-4, the same design criteria were used in the development of the trail alignment and configuration, however there are much stricter limitations on alignment and configuration due to the lack of developable land area and existing adjacent private property and roadways, thus only one concept is shown for each of these reaches.

Evaluation Criteria	Option A	
Safety		
Flood/Inundation	●	In this example, the Option would moderately address safety associated with flooding/inundation in the area.
General Safety		
Maintenance		
Reduced maintenance	●●●	In this example, the Option would best address ease of maintenance or require the least amount of maintenance.
Trail durability		
Reduced flooding/erosion/debris on trail		
Experience		
Improved connectivity		
Enhanced aesthetic and enjoyment		
More sinuous trail		
Usable more frequently during/just after flood events		
Costs and Value		
Phased construction with available funding		
Construction feasibility/efficiency results in cost savings		
Lower maintenance/operations costs		
Addresses issues and capitalizes on opportunities		

Moderately Addressed ← - - - - - → Fully Addressed

EXAMPLE EVALUATION MATRIX

Trail Types and Configurations

Through a vetting process involving the public, stakeholders, and City planning and maintenance/operations staff, three basic trail types have been agreed upon as standards for implementation of the Greenway trail segments in Denver: 1) Primary Paved Trail, 2) Secondary Soft Surface Trail, and 3) Multi-use Single Track Trail. These trail types may be used solitarily, or in conjunction with other trail types to result in a variety of configurations that suit unique site conditions while maintaining continuity of experience and ease of maintenance. Cross sectional diagrams of proposed trail configurations are included for each reach in the alternatives section of this document.

The SCRG Trail invites and accommodates a wide variety of users including walkers, runners, dog walkers, families, outdoor enthusiasts, cyclists and non-motorized wheeled users of all types, and equestrians. All users are permitted on each of the different trail types, but each user might find one of the trail types more suitable than the other.

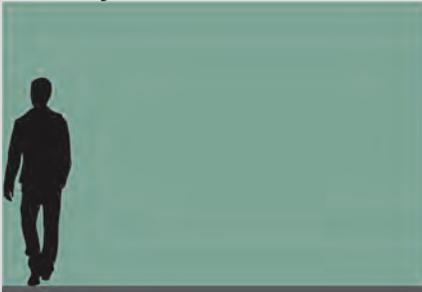


Pedestrians

Cyclist

Equestrian

Primary Paved Trail



12' Wide Concrete Surface

- Primary route along the Sand Creek Greenway
- Uniform width the entire length of the Greenway in Denver
- Used by all recreational and commuter users
- Accommodates varying speeds, abilities, and types of users (from walkers to road-cyclists)
- Usable in all weather/seasonal conditions (To be plowed during snowy months)
- ADA accessible grades
- Includes recovery shoulder

Secondary Soft Surface Trail



3'-5' Wide Granite Crusher Fines Surface

- Either adjacent to (attached) or detached from the primary paved trail - generally follows primary paved trail alignment
- Flexible trail width adapts to unique site requirements
- Accommodates slower speed users as refuge from or alternative to primary paved trail (from walkers and runners to casual cyclists)
- Conditional useability based on weather/seasons (Not plowed during snowy months)

Multi-Use Single Track Trail



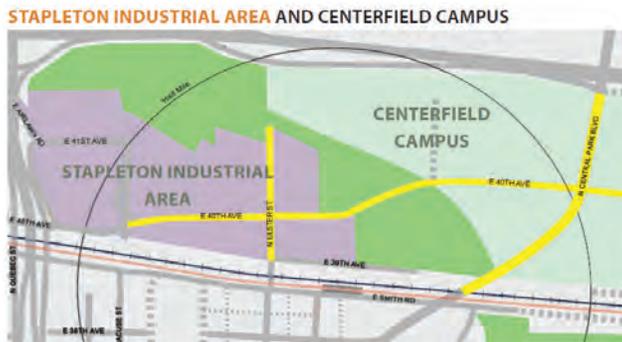
18" - 2' Wide Compacted Native Soils Surface

- Alternative route to primary and secondary trails for access to more remote areas where resources allow
- Adaptable alignments respond to existing grade and features
- Provides more secluded trail experience
- Accommodates mountain biking, trail running, hiking, and horseback riding
- Conditional useability based on weather/seasons (Not plowed during snowy months)



Flooding and flows from detention area at I-270

June 5, 2015 - Apparent spill or seep flows from the stormwater detention area adjacent to I-270 sometimes inundate the trail nearing the I-70 underpass - adding to the stability and drainage issues of an area already impacted by flooding of the Creek.



Central Park Station Area Plan

Future development plans indicate opportunities for connecting workers from future office and industrial areas to the Greenway.



Bridge Crossing

The existing pedestrian bridge is thought to pass less than a 2 year flood event, meaning that most storms will create backwaters that contribute to erosion of the trail approaching the bridge just upstream of I70.

Reach 1 has significant challenges associated with flooding from creek related events as well as other possible contributing factors including a local CDOT stormwater detention area and an existing pedestrian bridge that is estimated to pass less than a 2 year flood event. Complex flow hydraulics related to the undersized pedestrian bridge crossing and the I-70 bridge contribute to more frequent bank overtopping, debris jams, and scour immediately upstream of the bridges. Modifications in this area will also need to take into account major utility locations (gas and sanitary sewer), adjacent private properties, and rights-of-way/ expansion plans for both I-70 and I-270. The east approach to the existing pedestrian bridge is not often inundated, but impacted by flood events because of backwater conditions created by the undersized bridge and potential overflows from the aforementioned detention area. The trail in this area is subject to significant ongoing erosion and damage in addition to reduced service of the trail due to impassibility and associated maintenance issues. Possible solutions identified and evaluated include an improved bridge crossing solution, a hardened trail, grading changes, and enhanced erosion protection (armoring, cutoff walls, etc.). Because the area is almost entirely within the 100 year floodplain, all alternatives that address major hydraulic and erosion issues will likely require a Federal Emergency Management Agency (FEMA) Conditional Letter of Map Revision/ Letter of Map Revision (CLOMR/LOMR) process.

The majority of the potential trail improvements in Reach 1 are located within CDOT R.O.W. with exception to one area that is privately owned (which the current trail alignment avoids). Plans will need to be coordinated with the Colorado Department of Transportation (CDOT) for future improvement of I-70 and the I-270 interchange at the Sand Creek Crossing, where right-of-way limits are close to trail alignment options. Trail access from nearby development, future roadways, and trail connections are primary considerations in this reach - for instance the RTD future connections plan shows a "through" connection to Ulster St. - and the Central Park Station Area Plan identifies future Office ("Centerfield") and Industrial areas (Stapleton Industrial Area). These types of plans should continue to be revisited to evaluate the need for future Greenway connections that could provide excellent trail amenities for residents, workers, and others who will occupy these large scale developments. Additionally, this area will require strong connections and enhanced access to/ from the new Central Park Station (commuter rail).

Trail configuration through Reach 1 could include a combination of "adjacent" and "split" dual trails for multi-use and alternative modes. There are also opportunities for improved physical and visual access to the Creek and other areas of interest. In particular, at the private property, there are opportunities to capitalize on views of the creek and the Front Range, and to align the trail closer to the Creek if easement is granted or acquisition by the City occurs. Finally, various (bridge) crossing alternatives may provide additional benefits for experience, implementation feasibility, and compatibility with future CDOT plans for I-70 and the I-270 interchange.

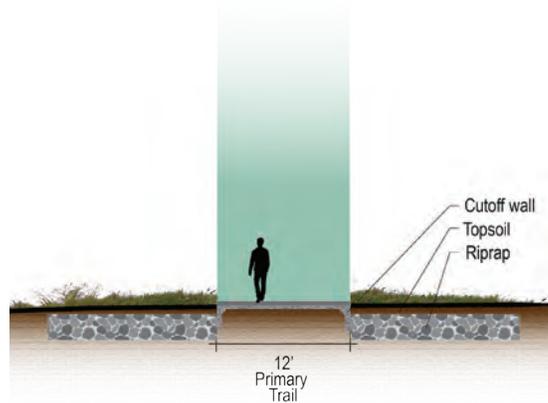
OPTION A CONCEPT SUMMARY

Crossing Option A preserves the existing pedestrian/bike bridge in place, however a portion of the approaching trail to the east would be hardened and reinforced in order to reduce damage to the trail from flooding. The day-to-day user's experience will be virtually unchanged, and the primary trail will require less frequent maintenance related to erosion on and around the trail and bridge abutments. This option does not address or improve the trail inundation frequency or debris aggradation that occurs as a result of the existing undersized pedestrian bridge, rather simply addresses durability of the trail surface.

North Park Hill users do not currently have safe and direct access to the Greenway, thus each crossing option includes a connector trail link to Quebec Street (shown as A1). Additionally, there is an opportunity for a potential connection via the Denver Rock Island Railroad Bridge under I-70. This connection has not been reviewed and would require partnership with Denver Rock Island Railroad and trail easements (not included in cost estimate).

Note: As a short term option, the City may choose not to harden or improve the existing trail as shown in this alternative (continuing to maintain and repair the trail and bridge abutments as in the past with the intent to implement another preferred crossing alternative when funding is available.)

Evaluation Criteria	Option A
Safety	
Flood/Inundation	●
General Safety	●
Maintenance	
Reduced maintenance	●
Trail durability	●●
Reduced flooding/erosion/debris on trail	●
Experience	
Improved connectivity	●●*
Enhanced aesthetic and enjoyment	●
More sinuous trail	●
Usable more frequently during/just after flood events	●
Costs and Value	
Phased construction with available funding	●
Construction feasibility/efficiency results in cost savings	●
Lower maintenance/operations costs	●
Addresses issues and capitalizes on opportunities	●



This cross section illustrates the potential structure of the trail hardening. The concrete trail would be flanked with cutoff walls and riprap protecting each side.

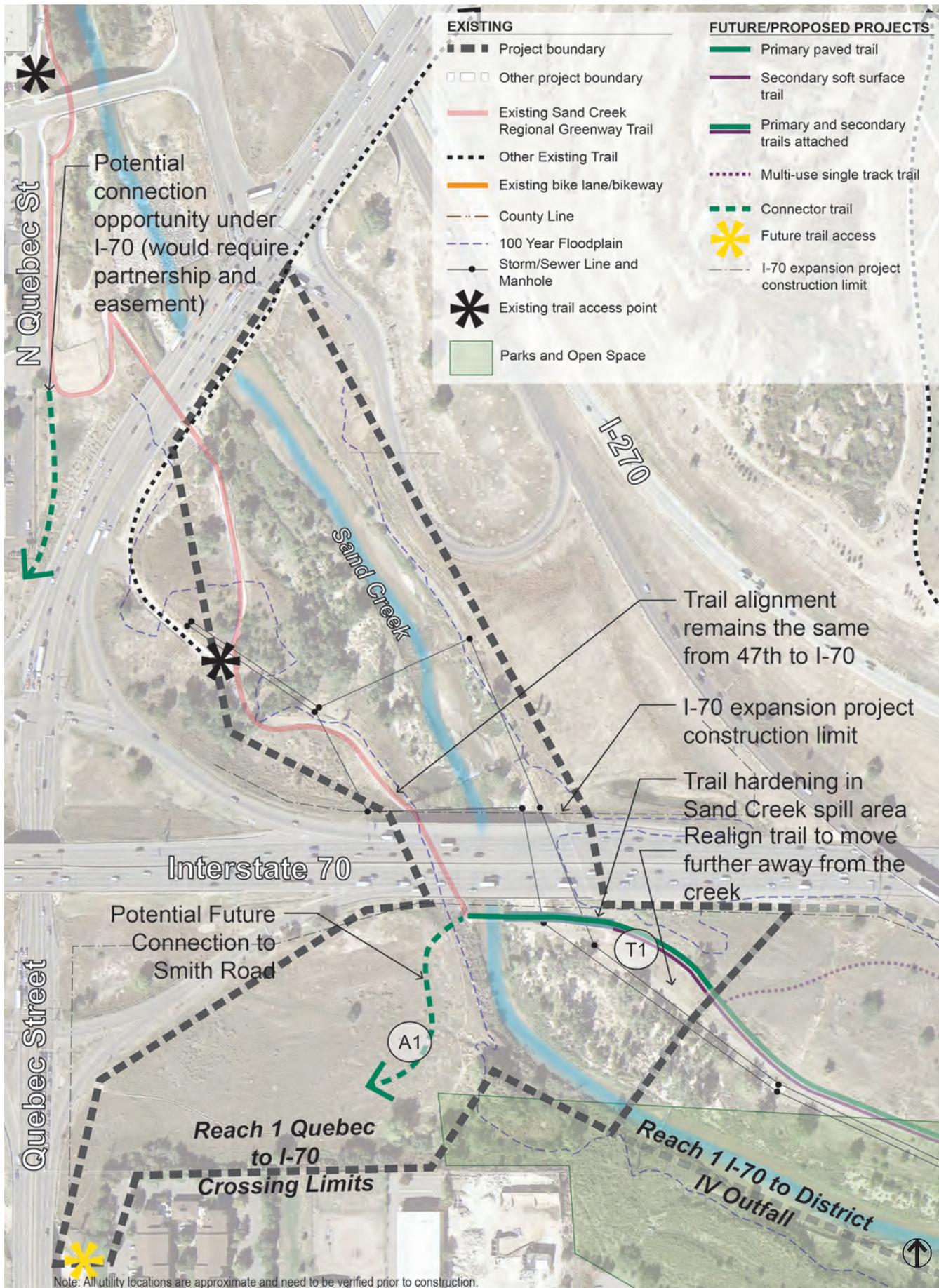
*Assumes that the future access west towards Quebec is implemented.



OPTION A COST OPINION SUMMARY

*Refer to the Appendix for detailed cost estimates.

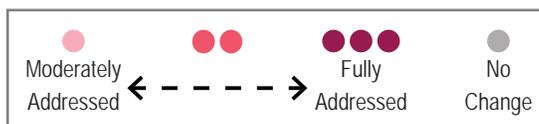
T1: Primary trail and attached secondary trail with trail hardening approaching bridge	\$414,300
A1: Potential future trail connection to Smith Road	\$1,074,000



OPTION B CONCEPT SUMMARY

Crossing Option B proposes removal of the existing pedestrian bridge in favor of a new bike/pedestrian bridge further downstream on the north side of I-70. The new bridge would likely be designed to span the 100 year floodplain (or appropriately sized as determined necessary) to reduce damage to the banks and trail caused by flooding due to the undersized pedestrian bridge. This option would create a hardened primary route on the east side of the I-70 underpass (currently on the west), while maintaining the west underpass route for the Quebec Street connector trail. In addition to the hydraulic advantages to this option, the new bridge would improve the user experience by providing views of the creek and a more sinuous trail route. Additionally, trail maintenance would be drastically reduced as a result of the reduction in inundation frequency.

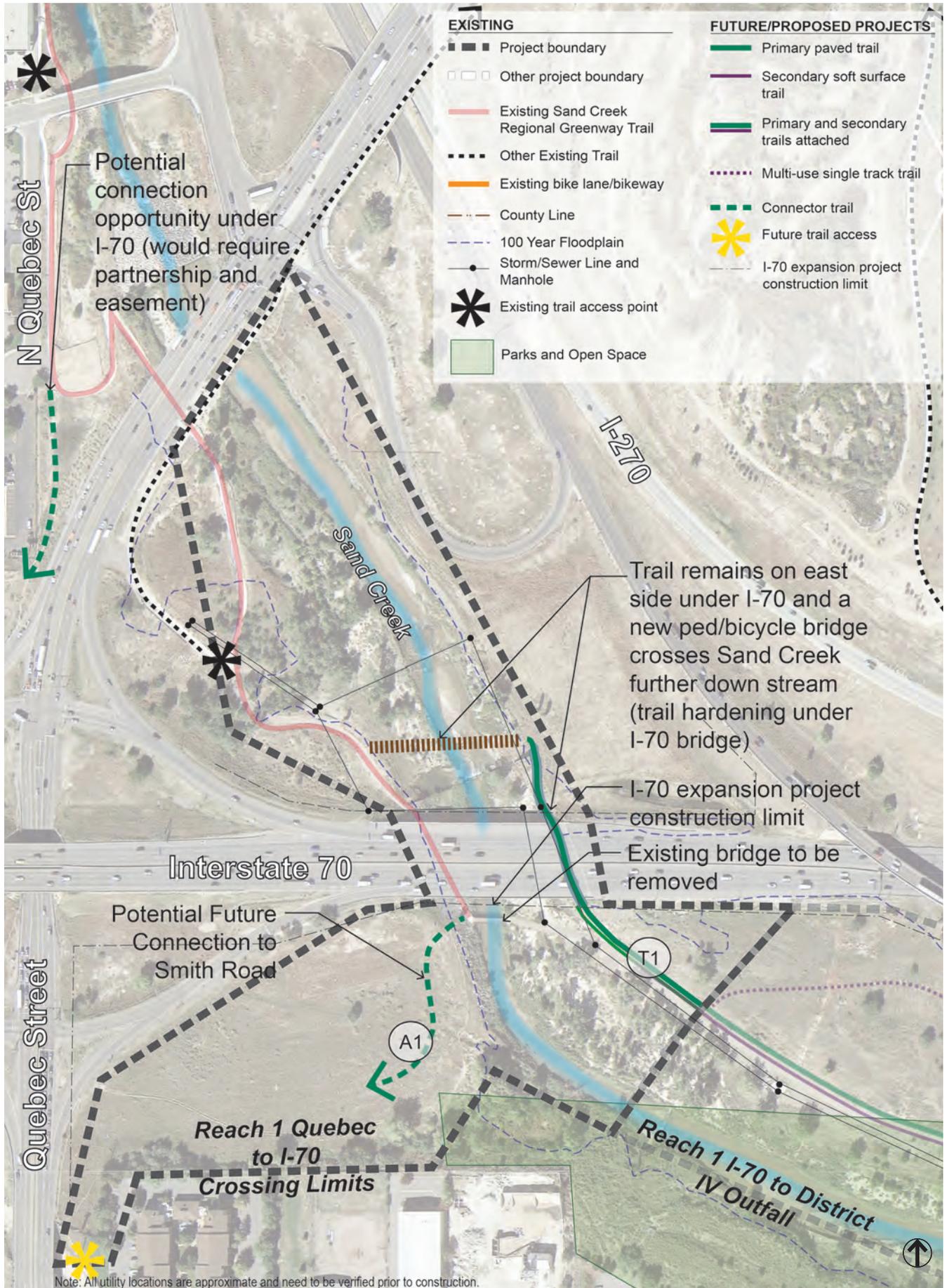
Evaluation Criteria	Option B
Safety	
Flood/Inundation	●●●
General Safety	●●●
Maintenance	
Reduced maintenance	●●●
Trail durability	●●●
Reduced flooding/erosion/debris on trail	●●●
Experience	
Improved connectivity	●●
Enhanced aesthetic and enjoyment	●●●
More sinuous trail	●●
Usable more frequently during/just after flood events	●●●
Costs and Value	
Phased construction with available funding	●●
Construction feasibility/efficiency results in cost savings	●●
Lower maintenance/operations costs	●●●
Addresses issues and capitalizes on opportunities	●●●



OPTION B COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Primary trail and attached secondary trail with trail hardening under I-70 approaching new bike/pedestrian bridge	\$1,934,250
A1: Potential future trail connection to Smith Road	\$1,074,000



OPTION C CONCEPT SUMMARY

Crossing Option C proposes to remove the existing pedestrian bridge, re-routing the trail along the north bank of the creek between I-70 and Quebec Street, and use the existing pedestrian bridge at and directly adjacent to Quebec Street (which passes the 100 year storm event). The trail would re-connect to the existing trail segment on the south side of the creek at Quebec. As in Option B, Option C creates a hardened primary route on the east side of the I-70 underpass (currently on the west), while maintaining the west underpass route for the Quebec Street connector trail. Also as in Option B, the removal of the undersized pedestrian bridge would drastically reduce trail maintenance as a result of the reduction in inundation frequency. Although there could be a cost advantage to utilizing an existing bridge, the cost of building the additional new trail from I-70 to Quebec would likely be expensive, and the trail experience would likely be less enjoyable as the trail would direct users away from the creek to an alignment directly adjacent to the busy and congested Quebec Street and I-270 off-ramp.

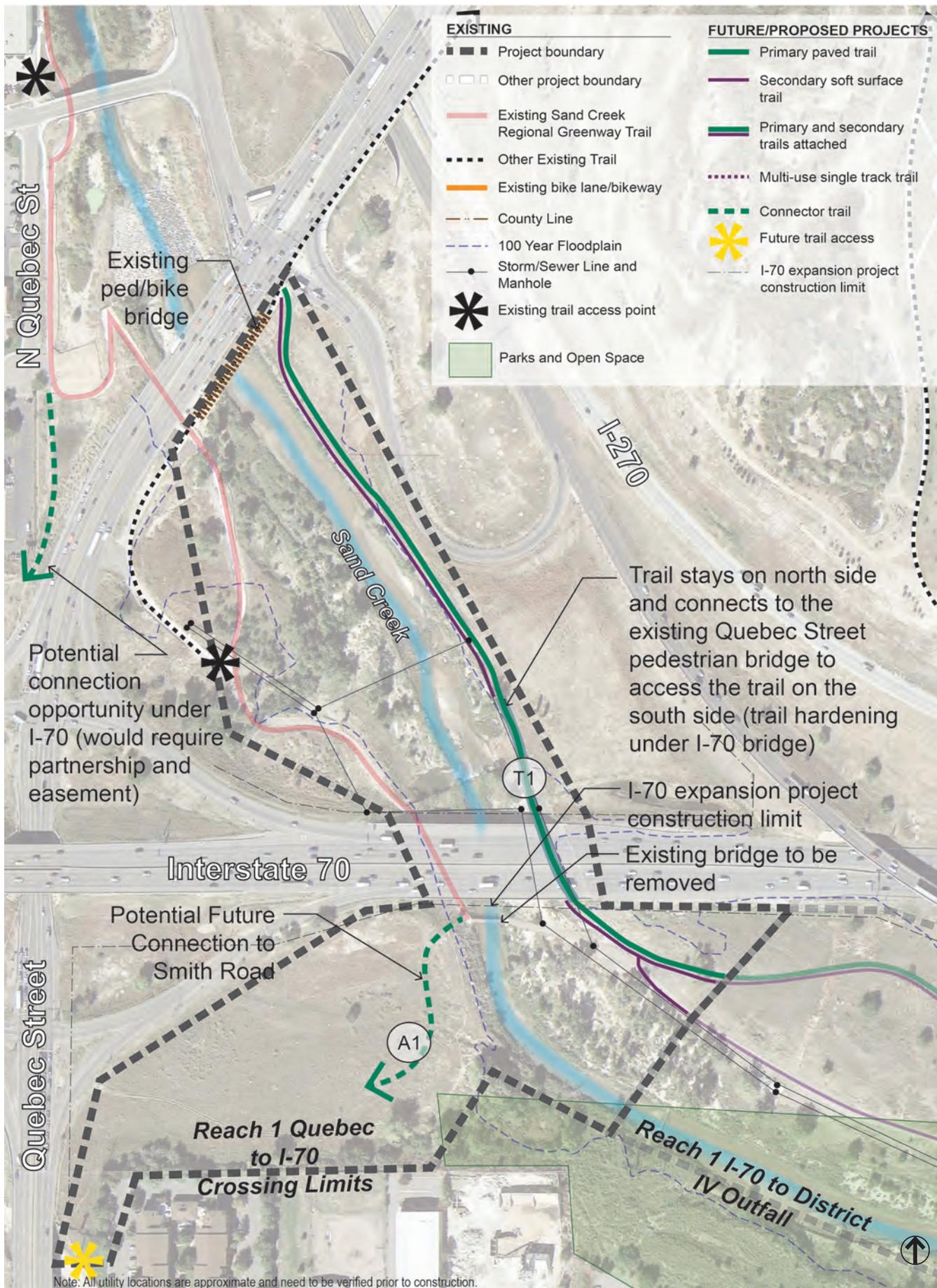
Evaluation Criteria	Option C
Safety	
Flood/Inundation	●●●
General Safety	●●●
Maintenance	
Reduced maintenance	●●●
Trail durability	●●●
Reduced flooding/erosion/debris on trail	●●●
Experience	
Improved connectivity	●●
Enhanced aesthetic and enjoyment	●
More sinuous trail	●
Usable more frequently during/just after flood events	●●●
Costs and Value	
Phased construction with available funding	●●
Construction feasibility/efficiency results in cost savings	●
Lower maintenance/operations costs	●●
Addresses issues and capitalizes on opportunities	●●



OPTION C COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Primary trail and attached secondary trail with trail hardening under I-70 connecting to Quebec Street pedestrian bridge	\$942,750
A1: Potential future trail connection to Smith Road	\$1,074,000



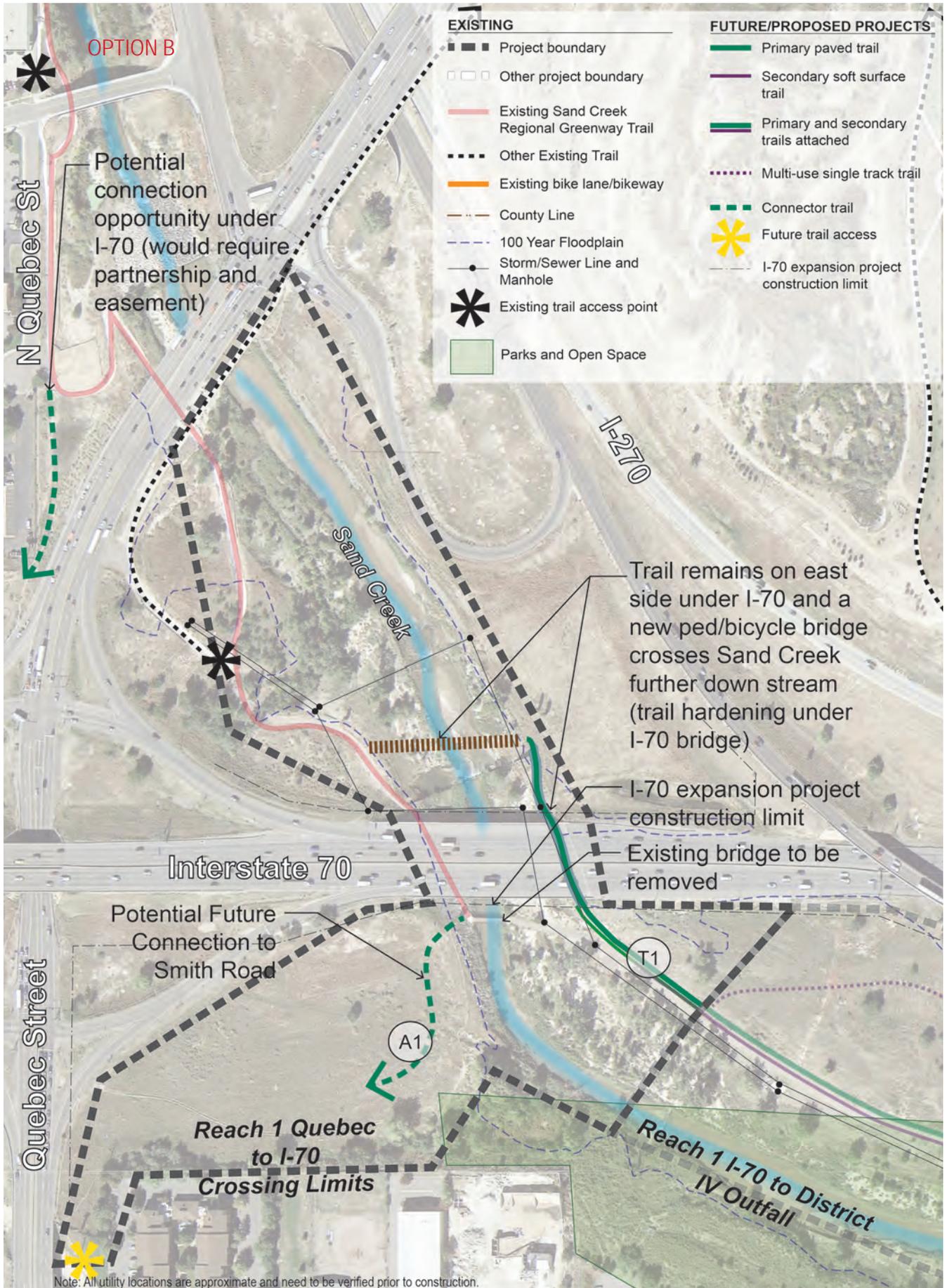
ALTERNATIVE EVALUATION AND RECOMMENDATIONS SUMMARY

Due to the overwhelming benefits in safety, maintenance, and user experience, Option B is the preferred alternative for the main creek (bridge) crossing. Although implementation costs will likely be higher due to design, the required FEMA Conditional Letter of Map Revision (CLOMR) process, and construction of the bridge itself - Option B would provide long term value to the Greenway in reduced operation costs, flexibility for future CDOT improvements to I-70 and I-270, flexibility for future channel improvements by the UDFCD, and a greatly improved experience for trail users.

Evaluation Criteria	Option A	Option B	Option C
Safety			
Flood/Inundation	●	●●●●	●●●●
General Safety	●	●●●●	●●●●
Maintenance			
Reduced maintenance	●	●●●●	●●●●
Trail durability	●●	●●●●	●●●●
Less flooding/erosion/debris on trail	●	●●●●	●●●●
Experience			
Improved connectivity	●●	●●	●●
Enhanced aesthetic and enjoyment	●	●●●●	●
More sinuous trail	●	●●	●
Usable more frequently during/just after flood events	●	●●●●	●●●●
Costs and Value			
Phased construction with available funding	●	●●	●●
Construction feasibility/efficiency results in cost savings	●	●●	●
Lower maintenance/operations costs	●	●●●●	●●
Addresses issues and capitalizes on opportunities	●	●●●●	●●

Moderately Addressed ← - - - - → Fully Addressed No Change

= Preferred Alternative



Note: All utility locations are approximate and need to be verified prior to construction.

OPTION A CONCEPT SUMMARY

Reach 1 Option A maintains a very similar trail alignment as the existing trail. The trails are required to squeeze between the private property and I-270 right-of-way, and remains distant from the creek. In preparation for the future expansion of I-70, the trails would be located outside of the proposed I-70 construction limits, as well as future I-70 expansion limits. The primary trail includes an attached secondary trail to accommodate multiple users which, in addition to reducing grading and earthwork associated with a new alignment provides value by reducing mobilization efforts for construction. As an alternative experience, a multi-use single track trail is proposed to veer off of the primary trail into the open space away from the creek meeting the primary trail at the pinch point between the private property and 270 right-of-way. Two overlook areas provide trail users with a safe and enjoyable place to sit, rest, and take in the views. On the east end of Reach 1, the primary trail ties into the future District IV Outfall Project area, which may eventually serve as trail connection access point for future development areas to the north.

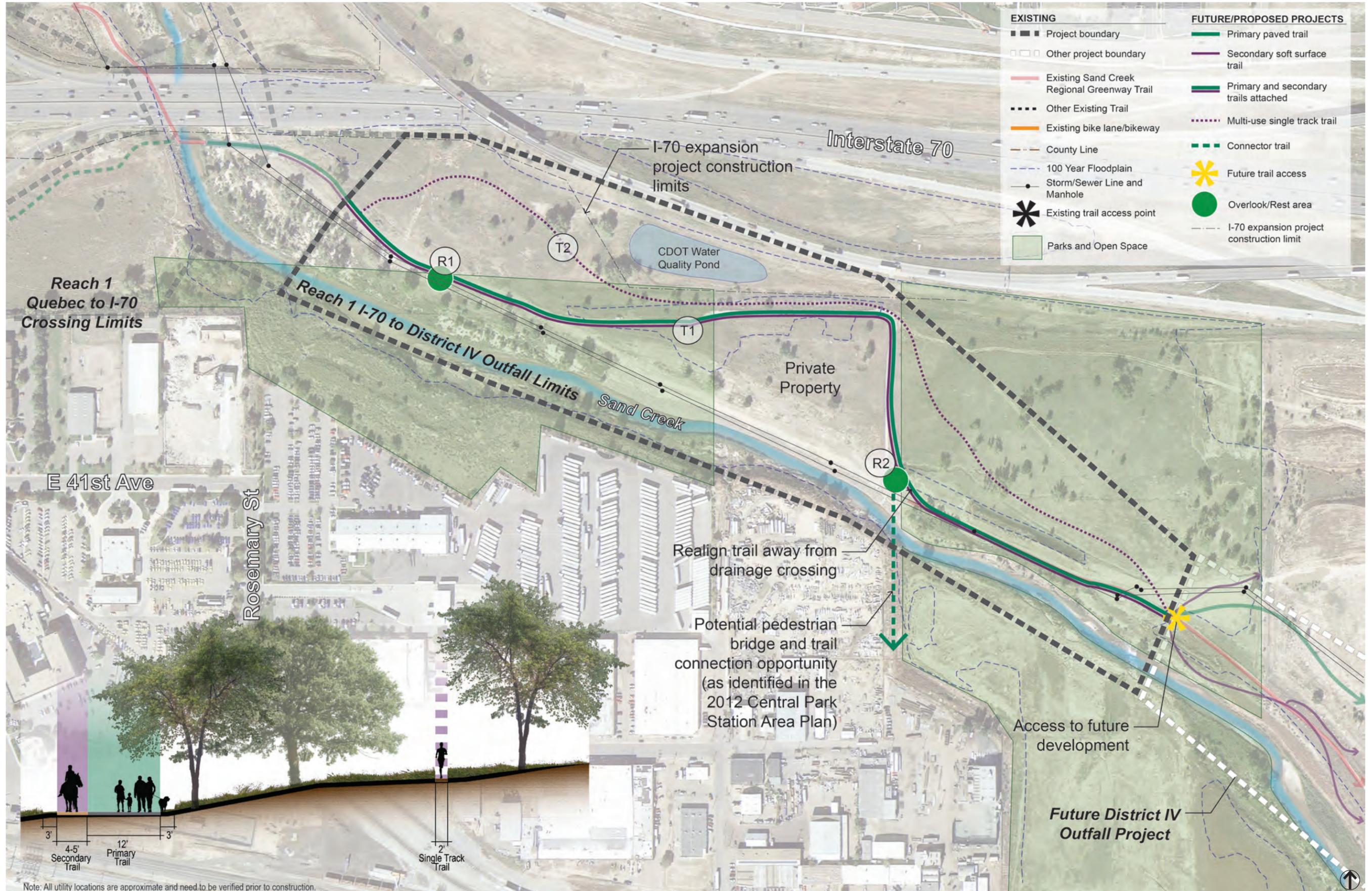
Evaluation Criteria	Option A
Safety	
Flood/Inundation	●
General Safety	●
Maintenance	
Reduced maintenance	●●●
Trail durability	●●●
Reduced flooding/erosion/debris on trail	●
Experience	
Improved connectivity	●●
Enhanced aesthetic and enjoyment	●
More sinuous trail	●
Usable more frequently during/just after flood events	●
Costs and Value	
Phased construction with available funding	●●●
Construction feasibility/efficiency results in cost savings	●●●
Lower maintenance/operations costs	●●●
Addresses issues and capitalizes on opportunities	●

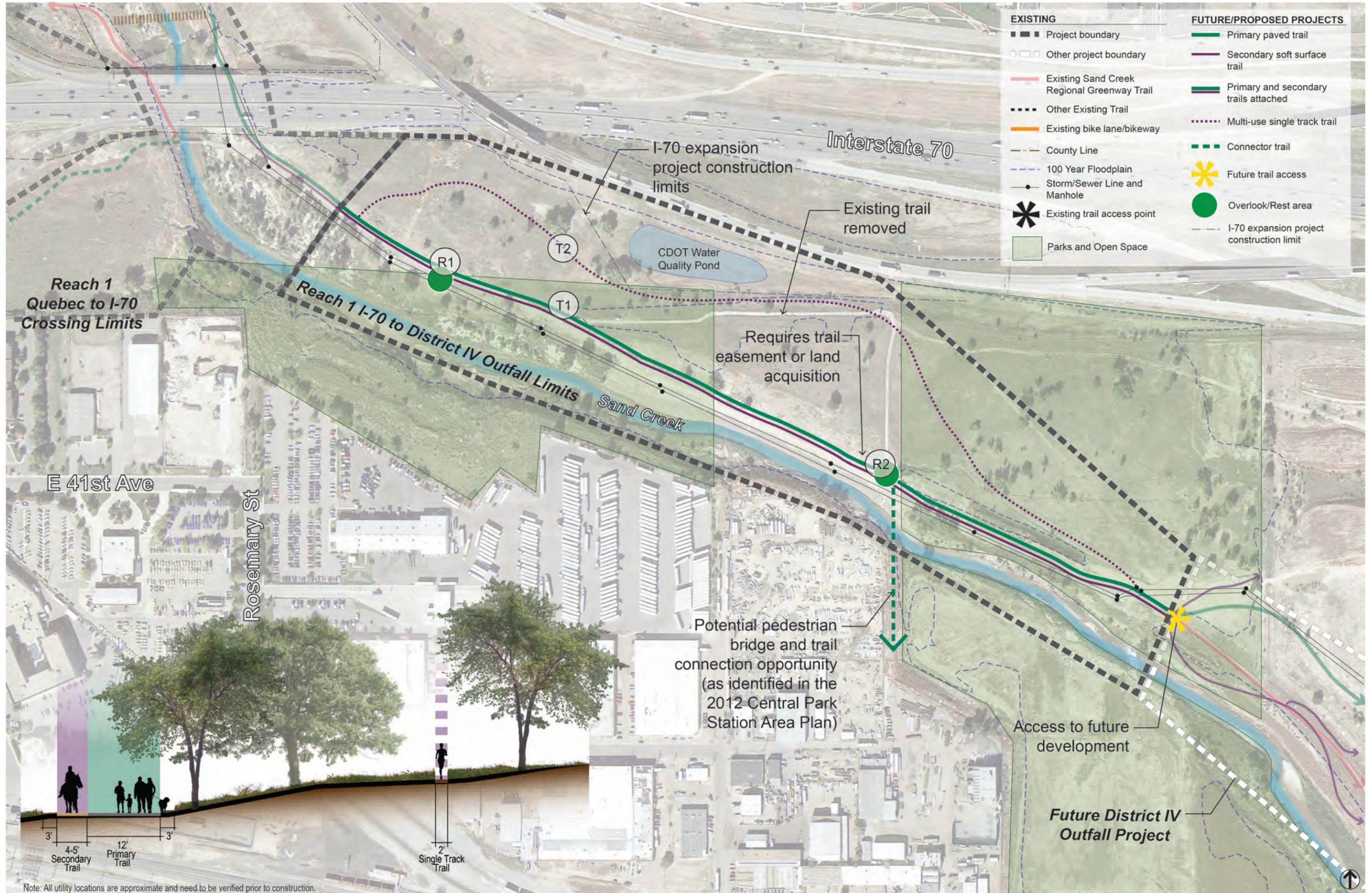


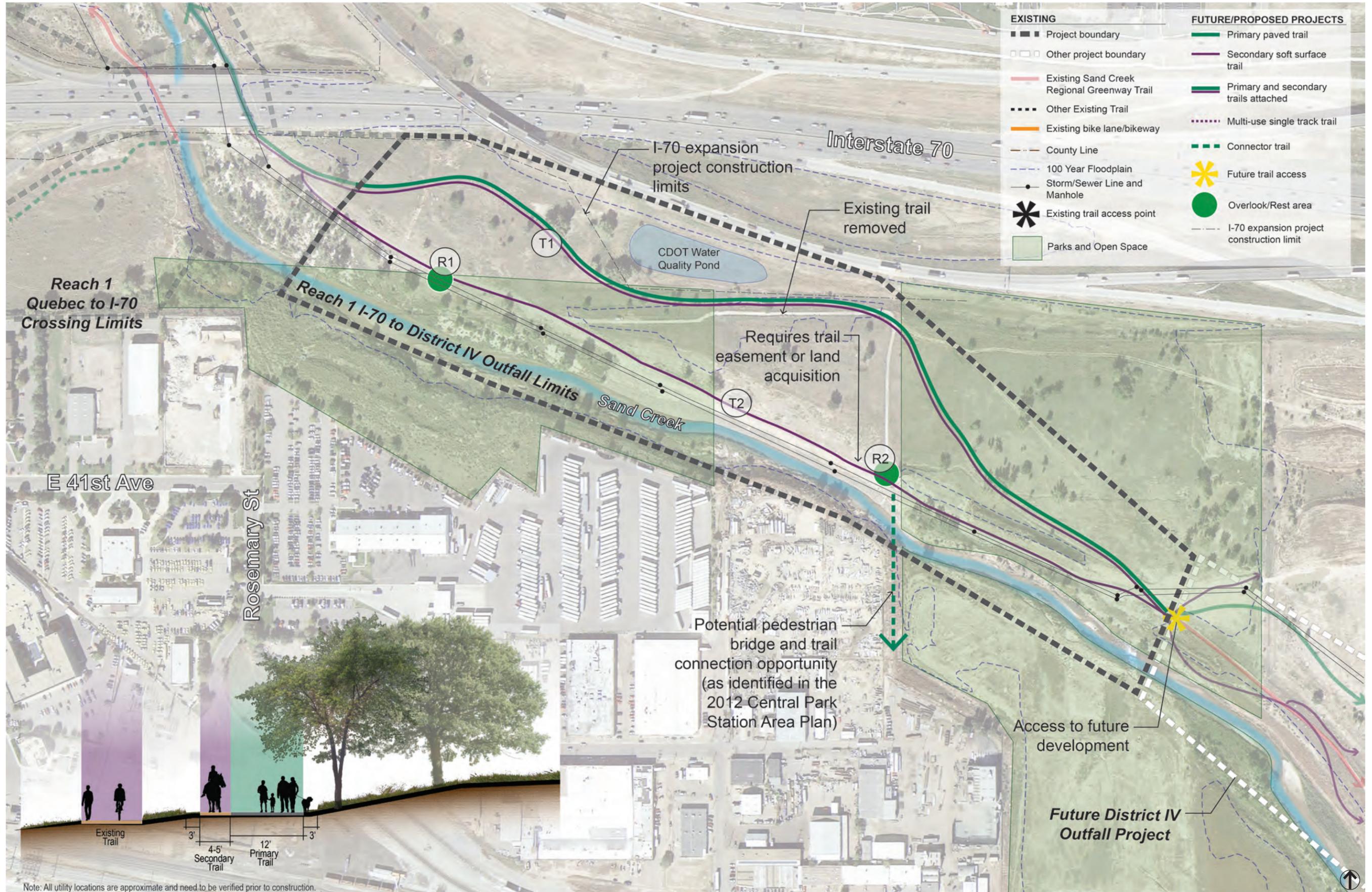
OPTION A COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Primary trail and attached secondary trail	\$989,800
T2: Multi-use single track trail	\$107,450
R1: Crusher fines seating area with benches	\$3,920
R2: Crusher fines seating area with benches	\$15,820





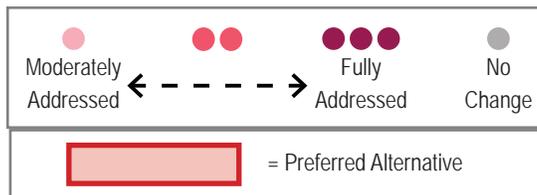


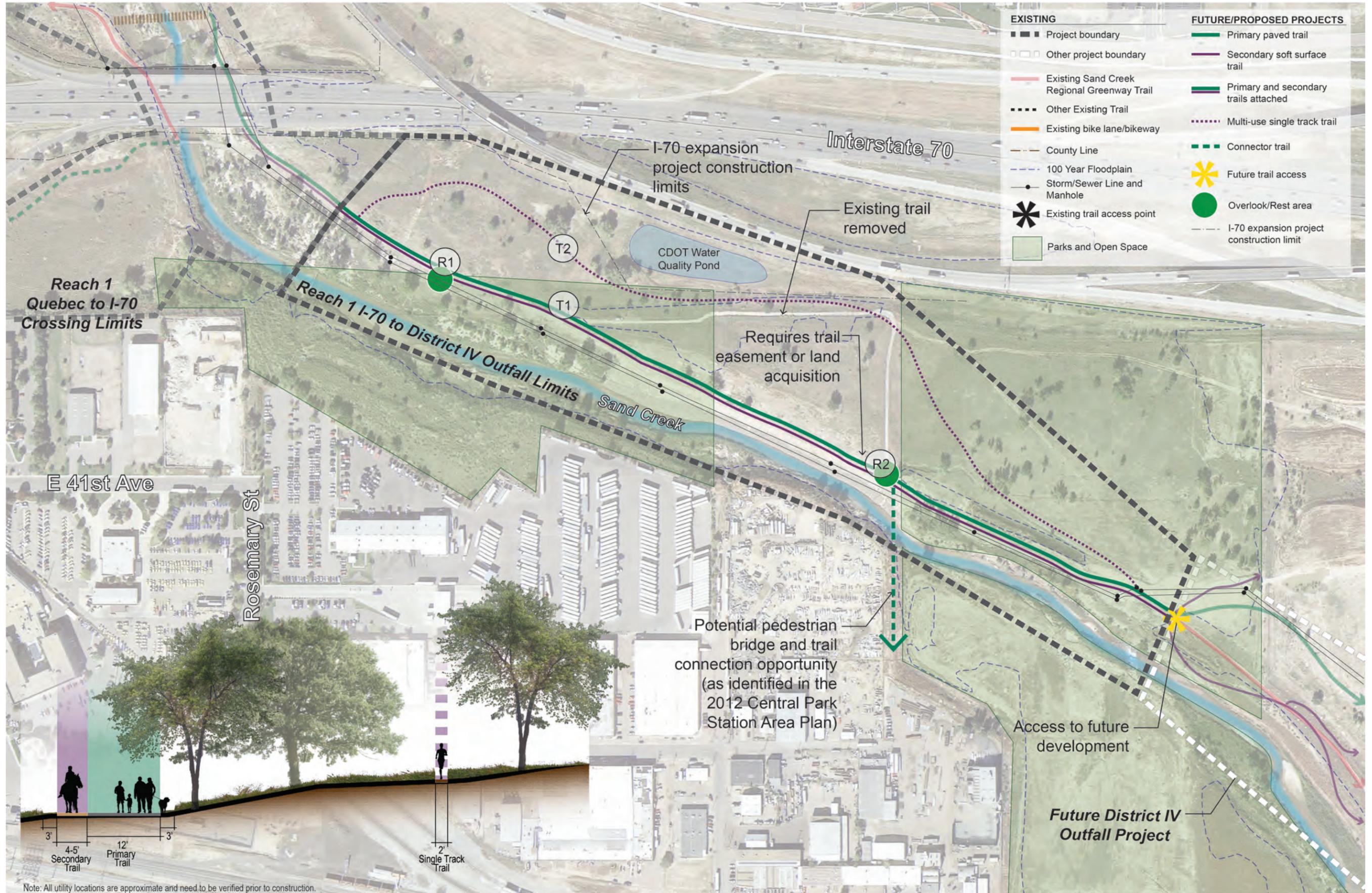
ALTERNATIVE EVALUATION AND RECOMMENDATIONS SUMMARY

Due to the overall experiential benefits, Option B ranks highest for the preferred trail configuration for Reach 1. Although this alternative requires easement through or acquisition of the private property, there is strong community support for aligning the primary trail close to the creek in order to capitalize on the beauty of the natural resources found along the channel. This alignment also resonates strongly with the goals of the Greenway Partnership to “preserve, improve, and promote the natural and recreational resources... and... to increase utilization of the scenic, natural, historic, cultural and recreational resources within the Sand Creek Regional Greenway”. As with the options A and C, combining an improved trail alignment with the preferred (bridge) crossing option, Option B can provide a high level of safety (and with attention paid to trail details, impacts from the detention area runoff can be mitigated in order to minimize maintenance efforts associated with erosion and sediment deposition). The largest factor in cost differentials between the options is related to the easement or acquisition of the private property, which could be somewhat offset by the cost savings associated with a shorter primary trail distance to construct.

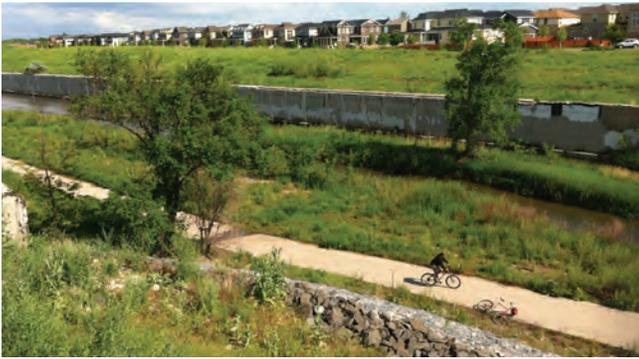
If easement or acquisition of the private property is unachievable, the recommendation is to implement Option A, which more closely reflects the sentiment for experiential benefits found attractive in Option B.

Evaluation Criteria	Option A	Option B	Option C
Safety			
Flood/Inundation	●	●	●
General Safety	●	●●	●●
Maintenance			
Reduced maintenance	●●●	●●●	●●●
Trail durability	●●●	●●●	●●●
Less flooding/erosion/debris on trail	●	●	●
Experience			
Improved connectivity	●●	●●	●●
Enhanced aesthetic and enjoyment	●	●●●	●●
More sinuous trail	●	●●●	●●●
Usable more frequently during/just after flood events	●	●	●
Costs and Value			
Phased construction with available funding	●●●	●●●	●●●
Construction feasibility/efficiency results in cost savings	●●●	●●●	●●
Lower maintenance/operations costs	●●●	●●●	●●
Addresses issues and capitalizes on opportunities	●	●●●	●●●





SITE ANALYSIS - REACH 2A SMITH RD TO WESTERLY CREEK



Runway Walls

In the area of the runway walls, there are drainage challenges related to frequent inundation, sediment aggradation, and a constrained floodplain.



Uplands Park Project

Coordination with the Uplands project will help to maintain a unified experience along the Sand Creek Greenway, and provide a more versatile experience through this reach and with Westerly Creek.

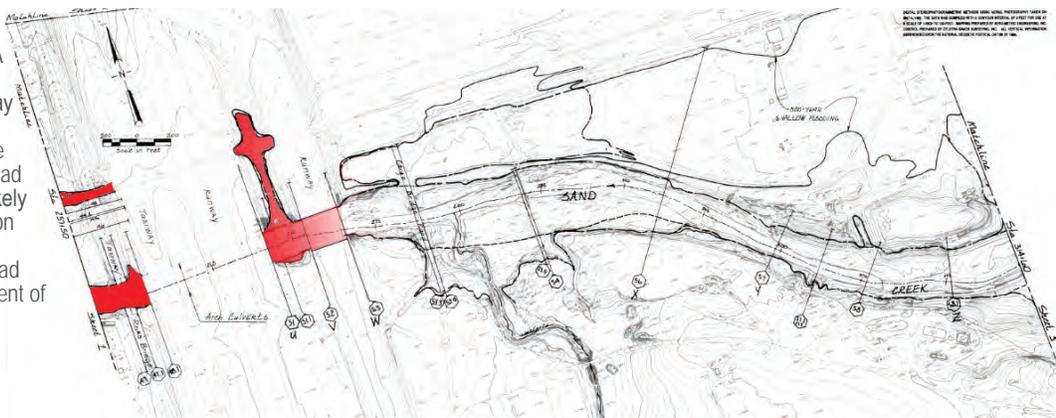


Trail Surfaces and Alignment

The trail portion between the flood walls is constantly inundated, requiring hardening or a lesser expectation for maintenance standards.

Flood Dynamics and Aggradation

The existing LOMR, and FEMA maps indicate some split flows of flood waters in the old runway area down stream of the old "cargo bridge" and between the old runways and old taxiway road bridge. This flow pattern has likely been impacted by a combination of aggradation and removal of infrastructure (i.e. the old railroad culvert) during the redevelopment of the Stapleton Airport.



Although there are significant challenges related to flooding and maintenance in Reach 2 (trail maintenance, tagging, etc.), there is tremendous potential for this area to serve as a versatile open space amenity. One particular challenge of this area lies in the two vertical concrete flood-walls left over from the old Stapleton runways. The current trail (which is likely a remnant of a maintenance drive from the old runway tunnel), runs adjacent to the Creek between the remaining walls, and is located very close in elevation to the average daily water surface of the creek. The area appears to be subjected to repeated flooding and sediment aggradation has occurred adjacent to the trail which has raised the water levels, and requires maintenance to remove sediment from the trail. Furthermore, in several areas, sediment along the trail edge prevents local cross drainage from flowing off the trail - creating standing pools of water on the trail. This condition creates a hazardous situation and a perpetual maintenance issue, in particular in cold months when ice can develop from standing water.

Hydraulic modeling confirms that the trail is frequently inundated in relatively small storm events which prevents safe and enjoyable use of the trail during or just after storm events. Relocation of the trail to an elevated location with improved creek site lines will increase safety by reducing inundation frequency and will improve trail conditions by improving drainage and reducing sediment deposition on or adjacent to the trail. An elevated trail alignment will also enable enhancements to the overall aesthetics and habitat value of the riparian corridor. For instance, the trail could potentially be taken out of the flood plain and aggradation zone by shifting it to the north into an area that could also be used to support numerous park or open space uses. Stream bank improvements would enable people to safely access the creek and could provide shade and refuge, overlooks, and possibly even seating and picnic areas.

There are also opportunities to make better connections from the south side of the creek to the main trail and the Central Park transit station. An extension of the existing soft surface trail on the south side of the creek in combination with a low flow or stepping stone crossing at the west end of the runway walls could provide a walking circuit, better egress, and a soft surface alternative for "off-road" biking, horse riding, dog walking, and jogging as well as a shorter route for commuters from the adjacent neighborhood to access the Central Park station.



ISSUES

- Runway infrastructure is a target for tagging, a safety concern, and contributes to sediment aggradation
- The trail is a safety and maintenance concern due to frequent inundation and poor drainage
- Vegetation and weeds grow in aggradation area
- Lack of connection to future RTD FasTracks station
- Unused open space on the north side of the creek is largely occupied by weeds

- Enhance connection to Westerly Creek Trail and Greenway at the old cargo bridge by creating a more sinuous alignment
- Utilize existing alignment through Uplands portion as a secondary route through the corridor.

OPPORTUNITIES

- Re-align the main trail above the runway walls to avoid/reduce flood impacts and to be adjacent to future open space area to be accessed by Smith Road extension.
- Connect to future Smith road and rail underpass route
- Integrate walls creatively through the use of overlooks, murals, and shade
- Include better trail connection on south side of the creek for access to the RTD transit station
- Investigate the inclusion of a small low-flow or stepping stone crossing to improve connectivity from the south neighborhood
- Preserve lower trail between walls as a secondary route and maintenance access

COORDINATION

- Uplands Park Project -trail sinuosity and access/egress at Havana
- Coordinate trail alignment with underpass and/or crossing locations for Smith Road and RTD FasTracks

REACH 2A RECOMMENDATIONS SUMMARY

The primary trail and attached secondary trail will be realigned to run above the former runway walls for better views of the corridor and to remove the primary route from the main floodway. On the east end of the reach, the primary trail will be adjusted to provide a more sinuous connection with the new pedestrian bridge over Westerly Creek in the Uplands project area, and to the west, the trail will connect with a new Smith Road and rail underpass trail. With considerable feedback from the community and trail users, the existing trail between the walls should remain intact as a secondary multi-use route. An additional secondary trail is planned to circumnavigate the multi-use open space area in order to provide better access from Smith Road (once extended), to provide experiential diversity through the reach, and to enhance use of the existing Smith Road trailhead which provides parking for trail users arriving from the east. An additional trailhead on the west side of the reach is planned to provide additional future parking for the Greenway. Although construction could be challenging, a low-flow creek crossing at the west end of the runway walls could provide neighborhood access to the Greenway while also providing another option for interaction with the water. Two overlook/rest areas are located along the primary trail at the edge of the wall to allow for dramatic views and a nice place to rest.

REACH 2A COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Primary trail and attached secondary trail above wall	\$1,770,750
T2: Secondary trail in open space next to Smith Road	\$181,688
T3: Multi-use single track trail along creek	\$84,375
TH: Trail head at Smith Road	\$11,700
A1: Trail access and creek crossing from Stapleton neighborhood	\$281,100
R1: Crusher fines seating area with benches	\$65,700
R2: Crusher fines seating area with benches	\$34,350

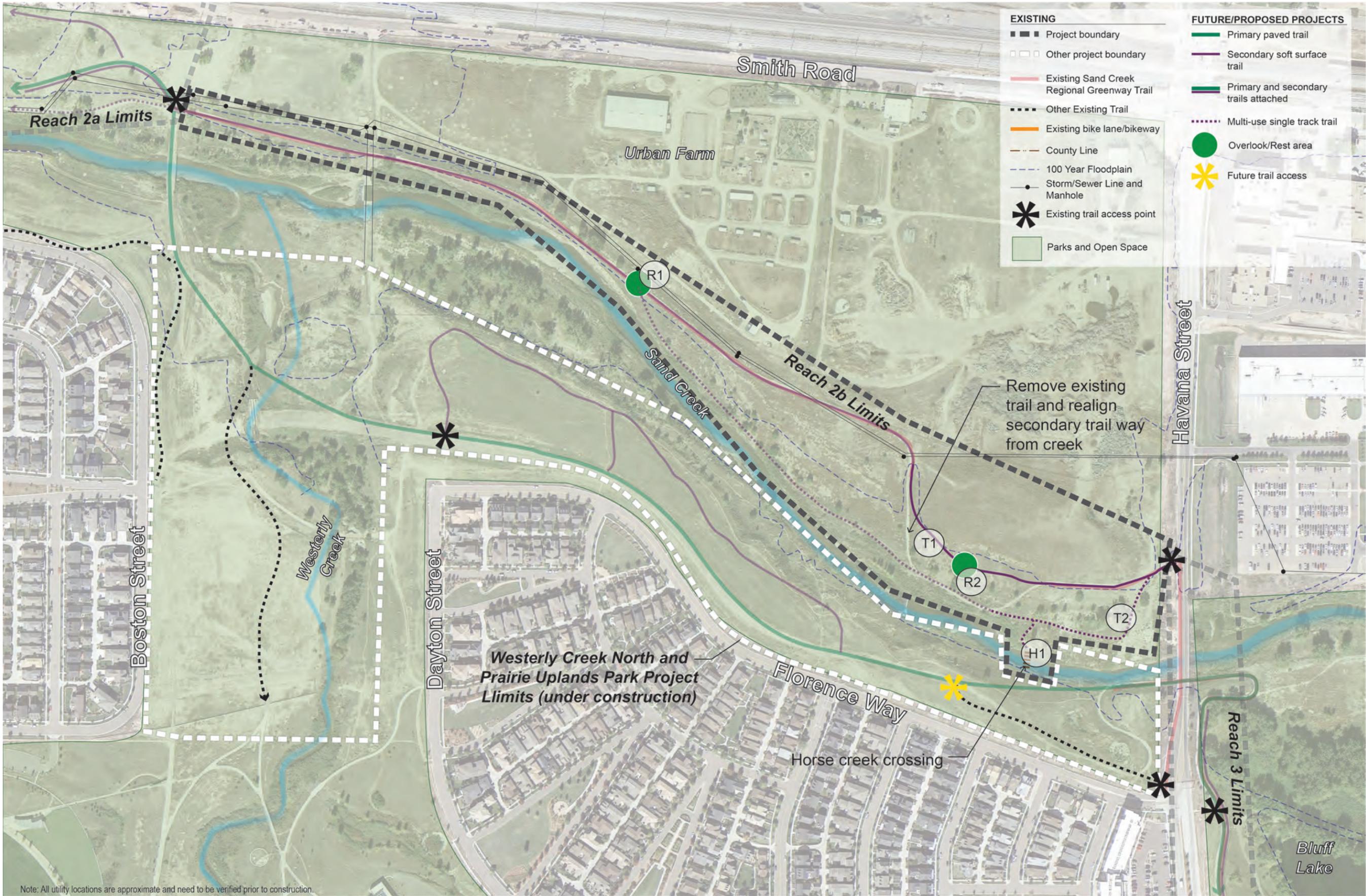
REACH 2B RECOMMENDATIONS SUMMARY

This area is outside of the four primary project reaches and as of the time of this study, the primary trail has been relocated to the south side of the creek with the construction of the Uplands project which includes a new bridge crossing of Westerly Creek just upstream of the Westerly Creek and Sand Creek confluence. As part of a corridor-wide evaluation, it was determined that within this reach, there are a few improvements that can be made to improve the Greenway. The primary recommendation for this reach is to moderately renovate, and utilize the previous primary trail alignment, which remains as a soft surface trail that runs along the north side of the creek. This section of trail would provide function similar to the “secondary trail” configuration recommendations illustrated in this report. The trail also connects to Havana Street which has a functional pedestrian connection across the creek enabling additional access to the south side of the Greenway. Additionally, this section of trail is utilized by the Urban Farm for equestrian access on the north side of the Creek, and can access an informal single track trail that is widely used for access to the creek. An additional recommendation for this reach includes the construction of an equestrian friendly creek crossing that connects to the single track trail to enable horse traffic to utilize the Havana underpass for access to the eastern leg of the Greenway trail. Two overlook areas are recommended on the secondary trail along the creek to provide an area to rest and take in the views.

REACH 2B OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Secondary trail	\$125,825
T2: Multi-use single track trail along creek	\$22,750
H1: Horse creek crossing	\$12,600
R1: Crusher fines seating area with benches	\$3,920
R2: Crusher fines seating area with benches	\$3,920



SITE ANALYSIS - REACH 3 BLUFF LAKE AND MLK



Views into Bluff Lake

The trail should continue to capitalize on opportunities like this view of fringe wetlands and Bluff lake at Florence Way.

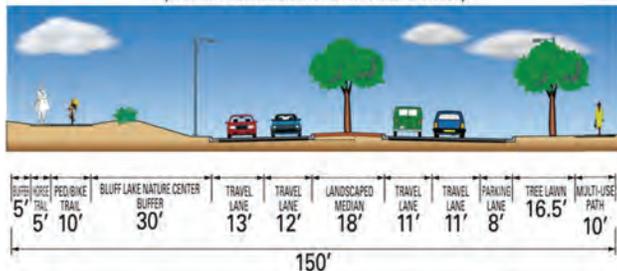


Stapleton Land Use Map

The Stapleton Land Use Map shows a future "Town Center" at Havana and Martin Luther King Jr. Blvd.



MLK JR. BLVD TYPICAL SECTION
(LOOKING EAST, IOLA STREET TO PEORIA STREET)



Integration With the MLK Extension Project

The MLK extension project will set a precedence for a cross section that will correct drainage and buffer concerns and will provide for a more pleasant experience.

While Reach 3 is very limited by the amount of available land area for re-alignment and the development of additional amenities, there are some basic requirements for bringing the trail connection up to Denver standards with regard to trail alignment, grade, and surfacing. Additionally, the trail development will need to be tightly coordinated with the Martin Luther King Boulevard (MLK) extension project planned for the area in order to maintain a consistent cross section, streetscape, and sinuous trail experience as the trail makes its way towards Reach 4. Primary issues to be addressed include design for proper local drainage and resolution of erosion problems along MLK, which can be corrected by re-grading the adjacent areas so that the trail has proper cross drainage. Adding vegetation to enhance the buffer between the road and trail will enhance user experience and reduce erosion, but should be considered with attention to a prairie dog colony in the area that has diminished most valuable vegetation in the area and is causing damage in the area of the trail alignment.

Another important element of this reach is the interface at the Iola St. crossing, which will need to be designed with proper pedestrian refuge and infrastructure, Greenway identity elements, and appropriate space for queuing so as not to interfere with trail traffic while users wait for the crossing signal. There are several opportunities for enhancement of this section of trail in coordination with the MLK extension project, coordination with the Bluff Lake Nature Center, and in recognizing the planned future developments at the Havana and MLK "Town Center". Additionally, the trail should acknowledge and capitalize on views into the Bluff Lake area and Sand Creek corridor wherever possible. Because this area is relatively limited in its alignment options, an adjacent "dual" trail is likely the best way to accommodate the many user types anticipated.



Crossing at Iola St

The new crossing/trail access at Iola St. will need to be designed with proper refuge, identity, and typical crossing infrastructure.

REACH 3 RECOMMENDATIONS SUMMARY

Due to the confines of the Bluff Lake Nature Center property line, the primary trail in Reach 3 remains in the same relative alignment as the existing trail. To the west, the trail connects under Havana Street to the Prairie Uplands North trail where an overlook/ rest area is recommended at the switchback point near the Bluff Lake fence line. To the east the primary trail and attached secondary trail will connect to the future MLK Boulevard expansion project. An improved crossing at the lola Street stop light intersection will include proper pedestrian infrastructure and refuge from MLK traffic, Greenway identity elements, and appropriate space for queuing so as not to interfere with trail traffic while users wait for the crossing signal. The lola crossing will effectively become a safe and visible "gateway" to the Greenway for adjacent neighbors and trail users. Additional collaboration is anticipated in order to provide controlled access to the Bluff Lake Nature Center, while helping to restrict access to bicycles which are restricted from the Nature Center.

REACH 3 COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

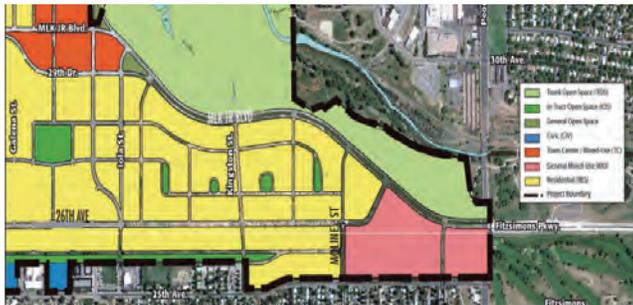
T1: Primary trail with attached secondary trail	\$761,390
R1: Crusher fines seating area with benches	\$3,920
R2: Crusher fines seating area with benches	\$3,920



Note: Bikes, dogs and horses are not allowed on Bluff Lake Nature Center trails.

Note: All utility locations are approximate and need to be verified prior to construction.

SITE ANALYSIS - REACH 4 MLK EXTENSION TO PEORIA



Stapleton Land Use Map

The route for the new four lane MLK Boulevard will go from Havana to Peoria connecting to Fitzsimons Pkwy.



Prairie Dogs

Prairie dogs are prevalent at this site and are burrowing in and around the trail.



Cliff Bank Erosion

Portions of the trail in this section are aligned close to the cliff edges and may be contributing to bank instability due to cross drainage.



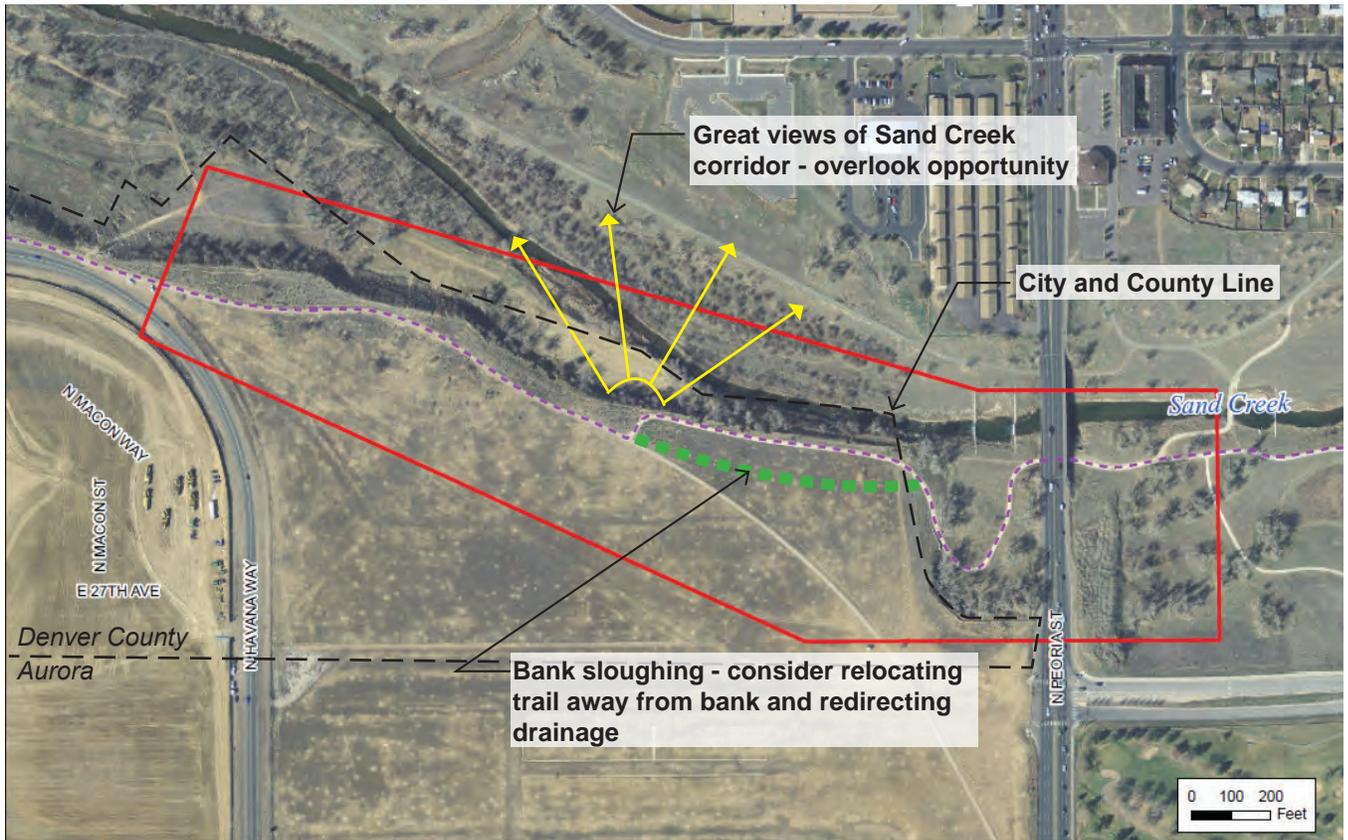
Views of the Corridor

Views into the creek corridor from this section could provide excellent spots for overlooks and resting spots.

Most of the issues within Reach 4 stem from cross trail drainage and longitudinal erosion of the trail. In general, the alignment of the existing trail is efficient, and pleasant. Erosion and associated drainage issues can be corrected by managing cross-drainage and trail realignment in conjunction with appropriate paving choices. There are two locations where significant cliff erosion is present adjacent to the trail. Because stabilizing the cliffs is not a feasible solution (as it could result in loss of habitat and high costs), a likely solution would be to slightly realign the trail a safe distance away from the cliffs and better manage the overland flows which currently lead to the cliffs. Coordination with the City of Aurora has been ongoing for a trail connection to Sand Creek Park after it crosses under Peoria.

Once MLK connects through to Fitzsimons Blvd, it may be prudent to plan for a short spur pedestrian connection to this intersection to avoid social trails that may occur in the future by users who walk from Fitzsimons Blvd. As is the case in Reach 3, a plan to manage prairie dogs may be necessary (if it has not already occurred by the time of construction) for both implementation and maintenance reasons. There are several opportunities to provide nice overlooks and/or resting spots along this reach, as the views into the corridor include large expanses of natural riparian corridor and habitat areas. A dual surface trail system is recommended in this area.

Lastly, this particular portion of the trail has signs that it has been a preferred location for "camping", and so consideration should be made for perceived personal safety to help provide a sense of security to those traveling along the trail alone, or at dusk. As in many other sections of trail, and due to the very large prairie dog colony, high quality vegetation has been significantly diminished and weeds are an issue that should be managed to aid in maintaining trail conditions.



ISSUES

- Prairie dogs have diminished high quality vegetation and burrow in the trail and adjacently
- Weed management should be considered for quality of the experience, and to help with erosion control along the corridor
- Cross drainage trail erosion should be addressed to help mitigate erosion of the trail and adjacent cliffs where severe cut banks are eroding the trail and creating a safety hazard
- Lack of connection to future Fitzsimons Parkway

COORDINATION

- MLK roadway project - continuity of streetscape and provision of proper buffer, intersections, etc.
- City of Aurora / Adams County

OPPORTUNITIES

- Capitalize on views into open space and creek corridor through the use of overlook rest areas
- Provide a dual surface trail (hard and soft surfaces)
- Potential for spur connection to MLK Boulevard/Fitzsimons Parkway

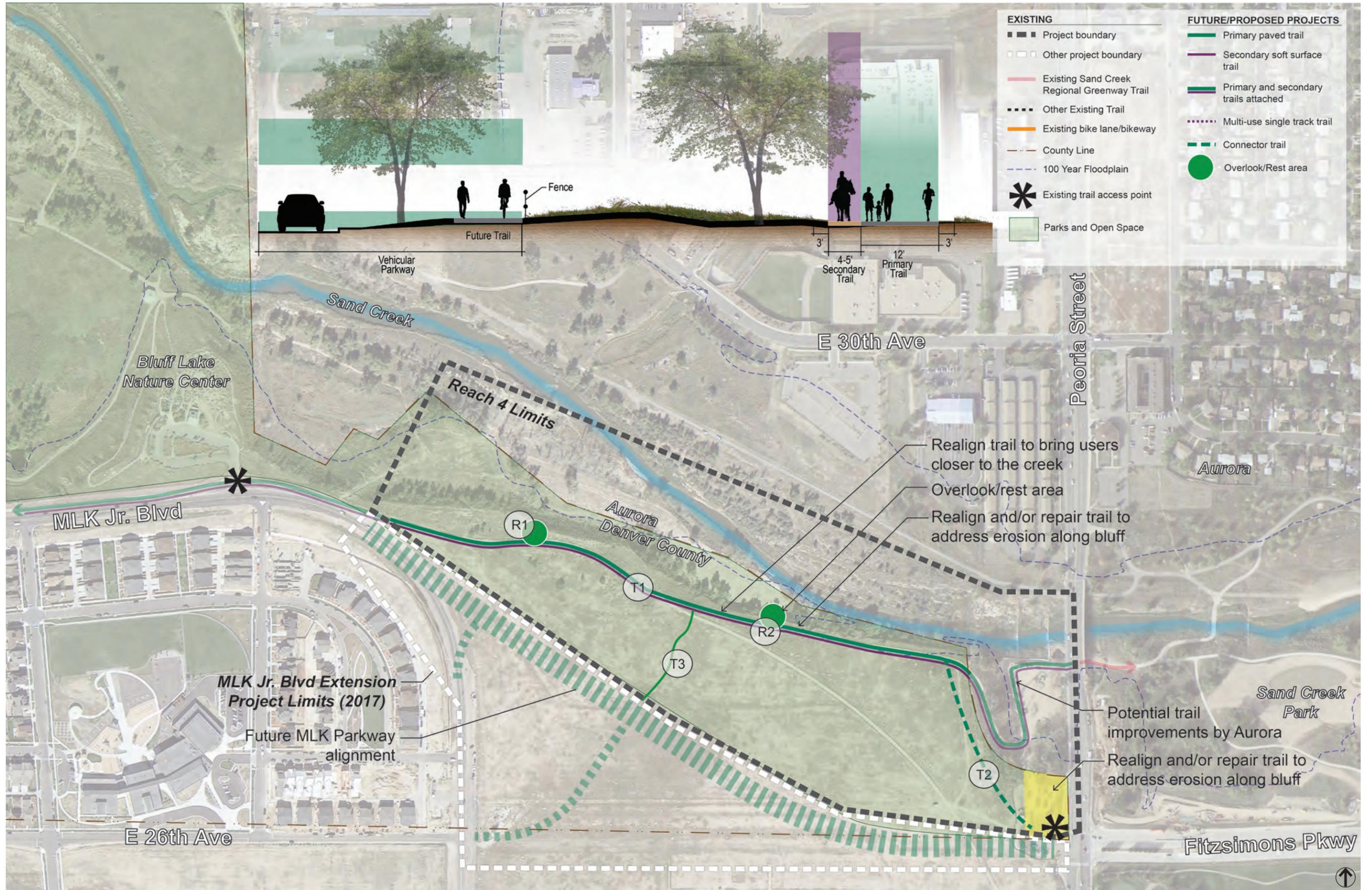
REACH 4 RECOMMENDATIONS SUMMARY

The Reach 4 trail alignment will primarily remain in the same location as it currently runs, with exception to areas that will be realigned to help manage erosion impacts at the cliffs. A dual surface trail with two overlooks will connect through to Sand Creek Park in Aurora, and pedestrian spurs will enable easy access to and from the new Fitzsimons intersection, and at a future intersection along MLK. The trail will be coordinated with the future MLK Boulevard extension project as the Greenway trail will likely function as a detached trail for pedestrians moving along MLK Boulevard. Because the Adams County and Aurora boundary makes up the eastern limit of Reach 4, additional coordination will be required for appropriate transition of the primary trail segment that connects under Peoria Street.

REACH 4 COST OPINION SUMMARY

**Refer to the Appendix for detailed cost estimates.*

T1: Primary trail with attached secondary trail	\$774,200
T2: Primary trail connection to Fitzsimons Parkway	\$153,720
T3: Secondary trail connection to MLK Boulevard extension	\$25,725
R1: Crusher fines seating area with benches	\$3,920
R2: Crusher fines seating area with benches	\$3,920



IMPLEMENTATION AND PHASING APPROACH

As funding for implementation has not been secured at the time of this study, and as mentioned earlier in this report, specific projects have not been prioritized for implementation, it is likely that the trail improvements and recommendations within this plan will be phased over time as land uses, commercial and residential development, and community desires evolve; Sand Creek channel improvements are made; improvements and expansion to I-70 and 270 are planned and implemented; and as funding becomes available via capital improvement budgets, grants, or via partnership funding arrangements.

This plan should be continually evaluated as these evolutions occur to ensure that the plan remains appropriate and addresses contemporary needs and desires while providing an adaptable framework for the future.

APPENDIX



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