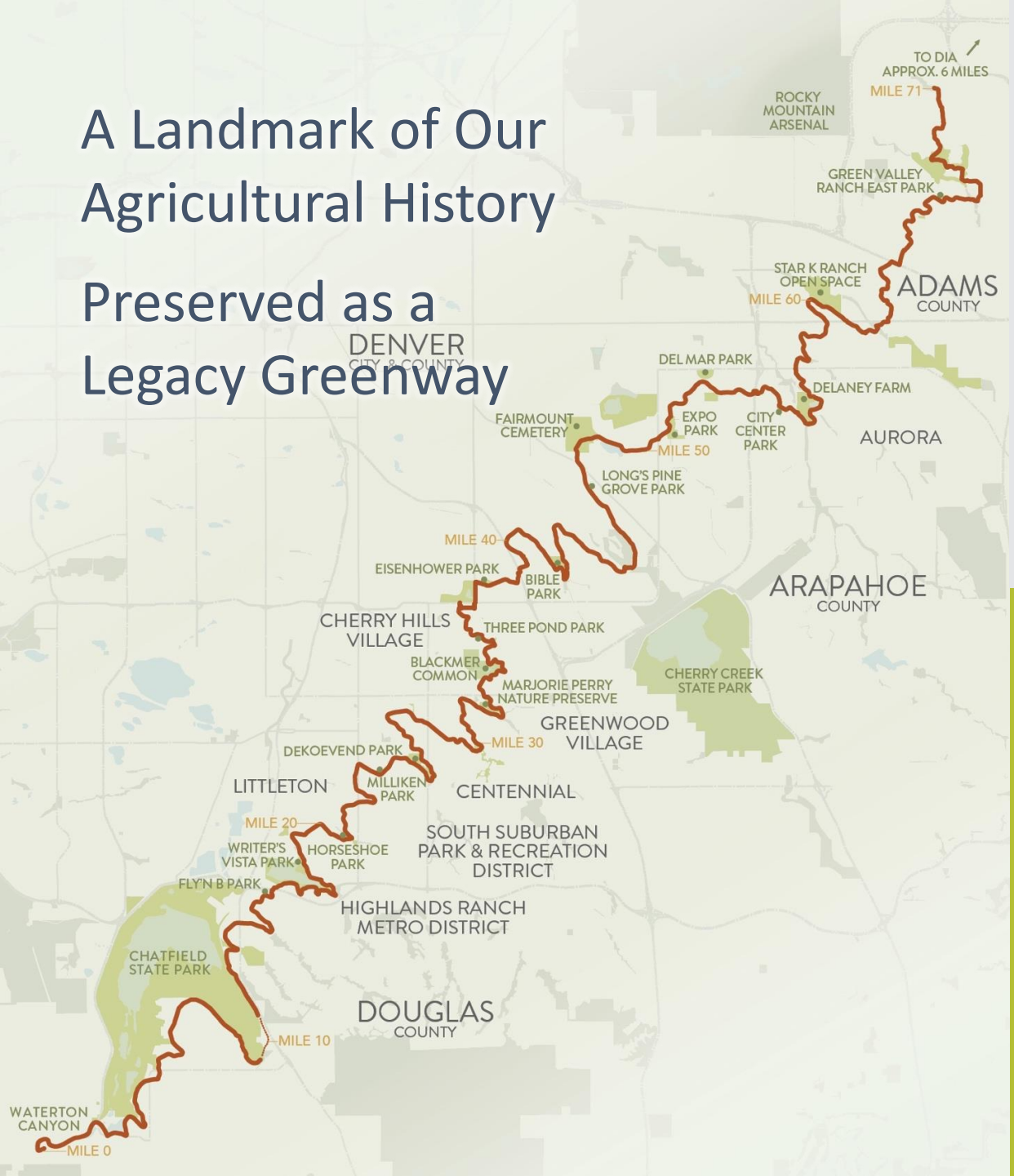
HIGH LINE CANAL

CONSERVANCY

Connecting Communities – Connecting Nature
From the Foothills to the Plains

A Landmark of Our Agricultural History

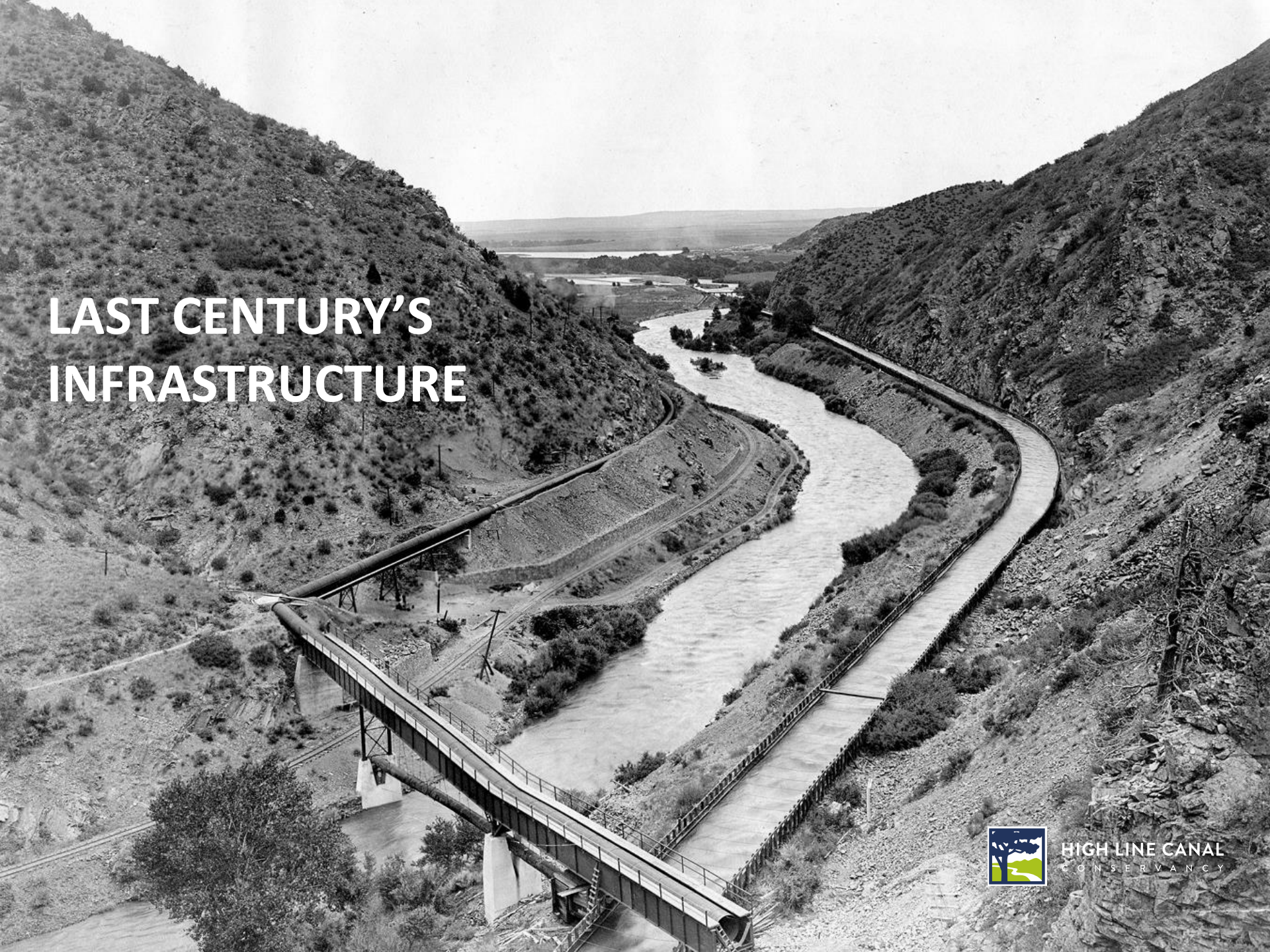
Preserved as a Legacy Greenway



350,000
residents
within one mile

500,000+
trail users
per year


HAND DUG IN 1883
ACQUIRED BY DENVER WATER IN 1924
OPENED TO RECREATION IN 1970
HIGH LINE CANAL
CONSERVANCY



LAST CENTURY'S INFRASTRUCTURE

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THIS CENTURY'S OPEN SPACE NETWORK
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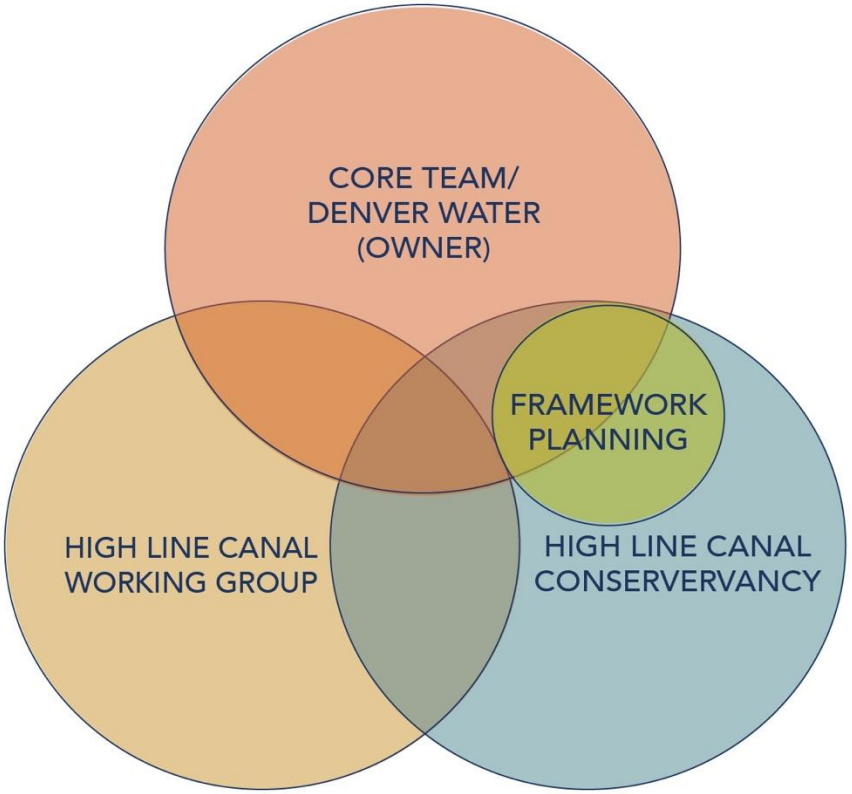
OUR STRATEGY: PARTNERSHIPS



High Line Canal Working Group

- Adams County
- Arapahoe County
- Arapahoe County OSTAB
- City of Aurora
- Aurora Open Space Advisory Board
- Centennial
- Cherry Hills Village
- City and County of Denver
- Denver
- Douglas County
- Greenwood Village
- Highlands Ranch Metro District
- Littleton
- South Suburban Parks and Rec. District
- High Line Canal Conservancy
- HLC Preservation Association
- South Metro Land Conservancy
- Cherry Hills Land Preserve

High Line Canal Core Team

- Arapahoe County
- City of Aurora
- City and County of Denver
- Denver Water
- Douglas County
- High Line Canal Conservancy

High Line Canal Conservancy

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PRESERVE, PROTECT AND ENHANCE THE 71-MILE-LONG CANAL IN PARTNERSHIP WITH THE PUBLIC

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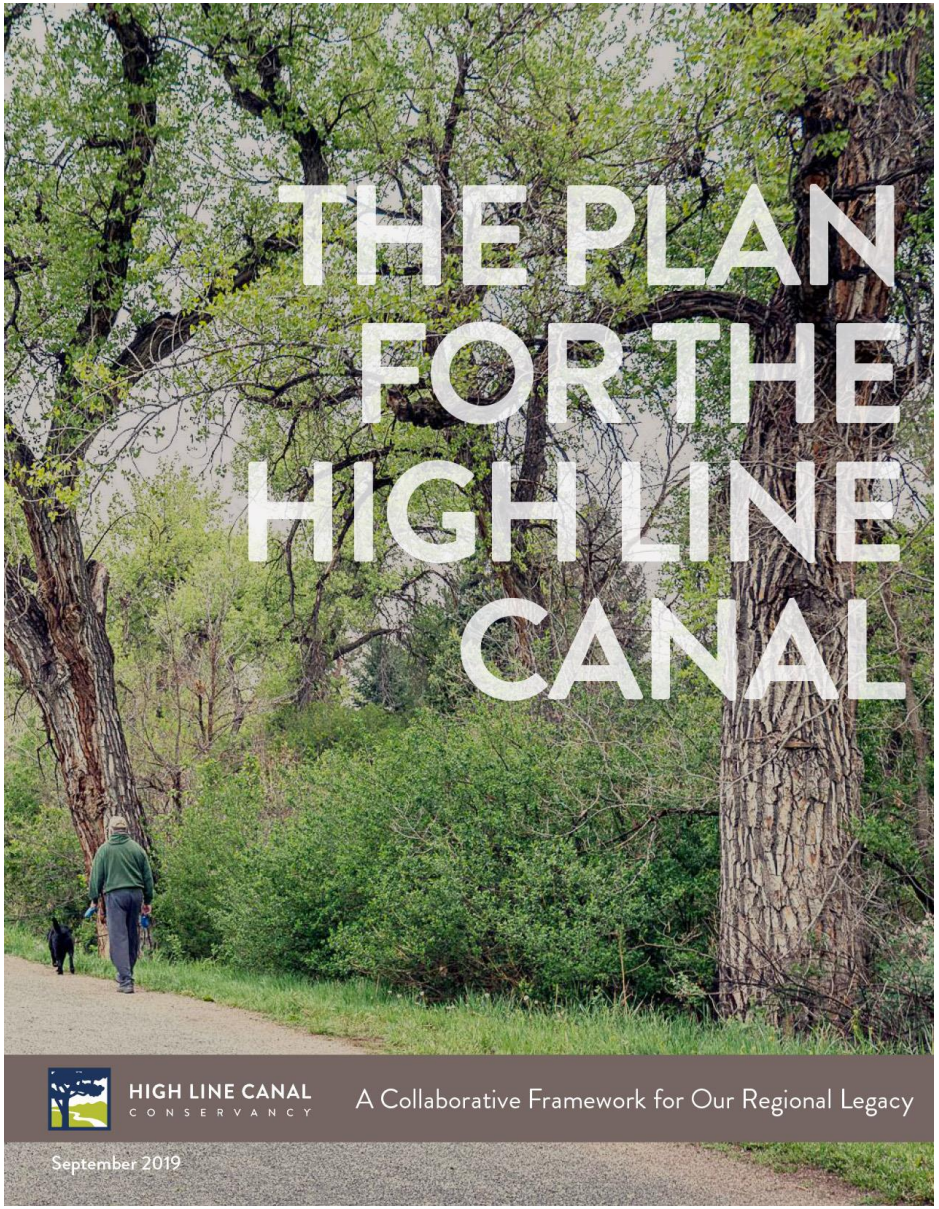
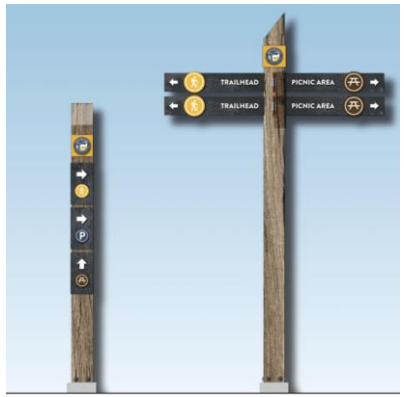
THE
COMMUNITY
VISION PLAN
FOR THE HIGH
LINE CANAL


THE PLAN
FOR THE
HIGH LINE
CANAL
HIGH LINE CANAL
CONSERVANCY
A Collaborative Framework for Our Regional Legacy
September 2019

ACCESS AND SIGNAGE



71 new mile markers

51 new wayfinding signs

5 new trail heads

7 improved access points

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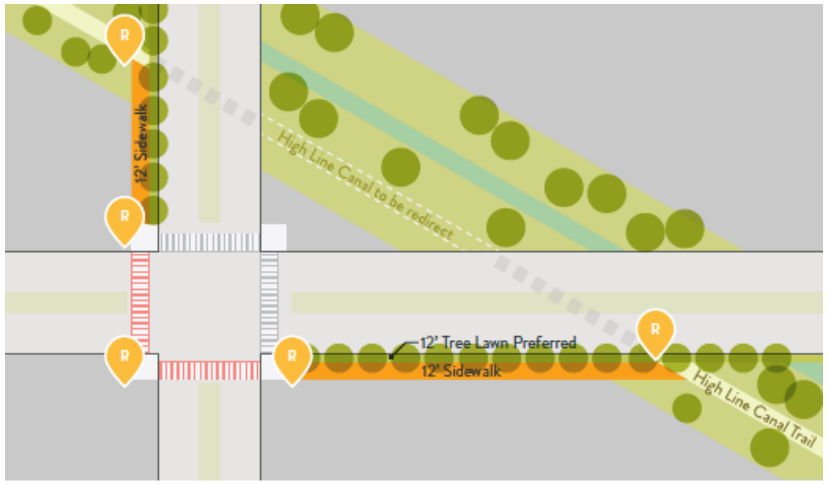
SAFETY AND CROSSING ENHANCEMENTS



4 new underpasses

20 improved crossings

5 trail gaps connected

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NEIGHBORHOOD IMPROVEMENTS

89 new benches

4 new picinic areas

15+ new community spaces

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LANDSCAPE AND TREE CARE

caring for
24,000
mature trees

450
plant species
identified

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STORMWATER MANAGEMENT

40% cleaner water with stormwater management

Canal will be wet **100** more days per year

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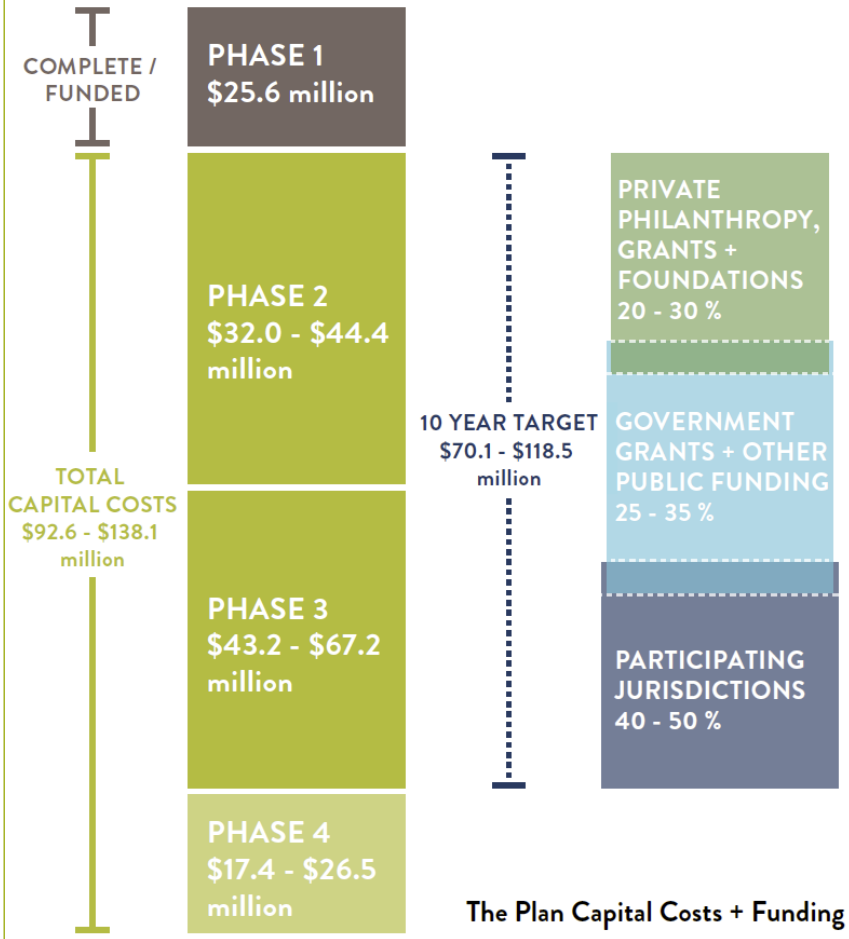
IMPLEMENTING THE PLAN



The Plan Capital Costs + Funding Partners

Projects included in The Plan

Amenities - $1,404,544
Access - $8,443,250
Activation - $805,000
Connectivity - $55,795,000
Stormwater Enhancement - $12,480,000
Landscape Enhancement - $19,190,000
Signage - $967,500

Total $99,085,294

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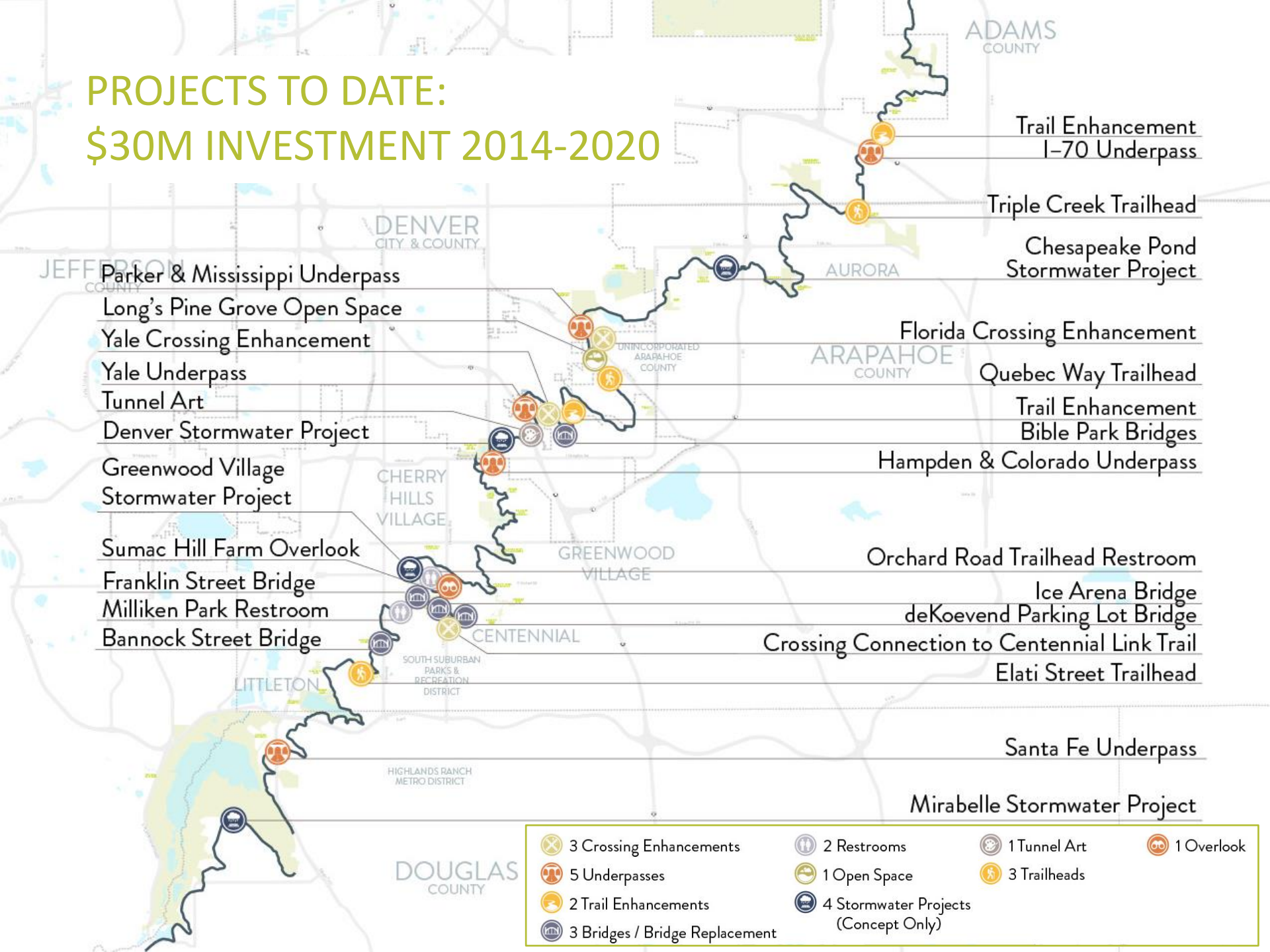
PROJECTS TO DATE:
$30M INVESTMENT 2014-2020



STORMWATER TRANSFORMATION & ENHANCEMENT PROGRAM

HIGH LINE CANAL
CONSERVANCY

HIGH LINE CANAL FEASIBILITY STUDY

FOR STORMWATER RUNOFF REDUCTION & TREATMENT

AUGUST 2014

PREPARED FOR:

URBAN DRAINAGE & FLOOD CONTROL DISTRICT
DENVER WATER
CITY & COUNTY OF DENVER
AURORA WATER
ARAPAHOE COUNTY
DOUGLAS COUNTY

PREPARED BY:

RESPEC CONSULTING & SERVICES
720 SOUTH COLORADO BLVD, SUITE 410S
DENVER, COLORADO, 80246

High Line Canal Stormwater and Operations Master Plan – Final Report

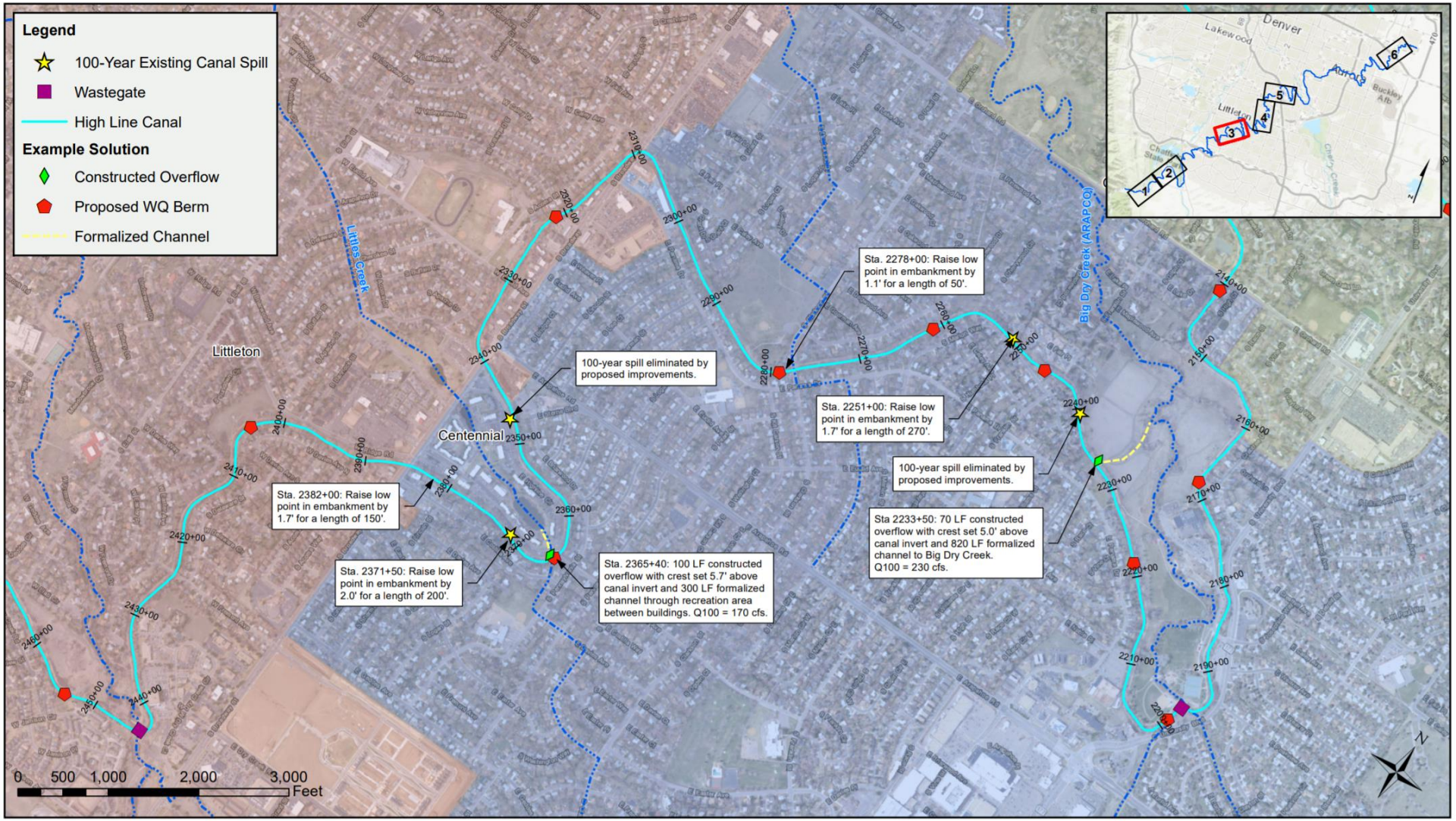
October 2018

Prepared For:

Urban Drainage and Flood Control District
Douglas County
Aurora Water
Cherry Hills Village
Southeast Metro Stormwater Authority
Greenwood Village
Littleton
City and County of Denver
Denver Water

Prepared By:

RESPEC Consulting and Services, Inc.
720 S Colorado Boulevard
Suite 410 S
Denver, CO 80246
303.757.3655



Little's Creek and Big Dry Creek Area Spills

Figure 3

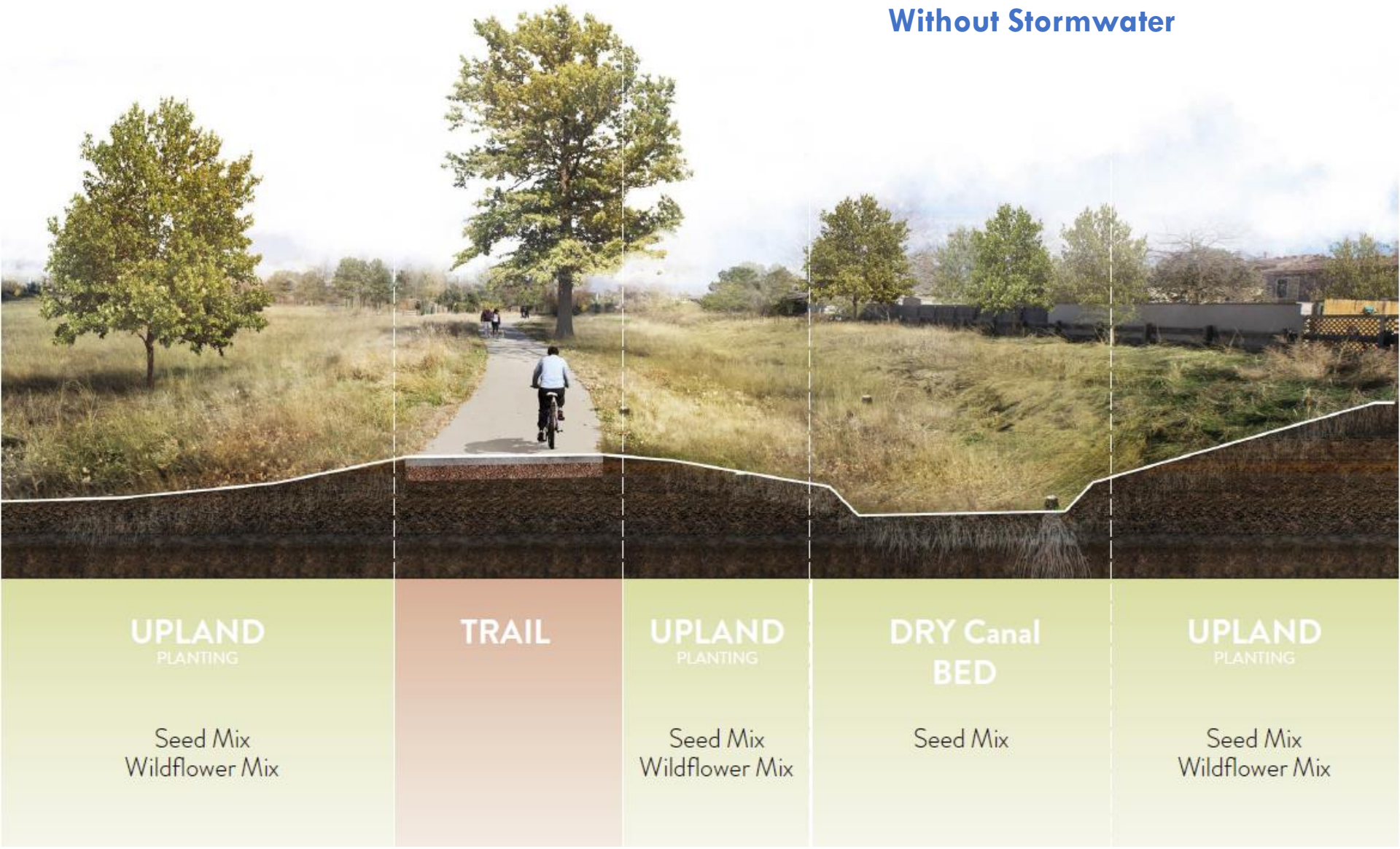
Wooded Landscape Without Stormwater

UPLAND PLANTING	TRAIL	UPLAND PLANTING	DRY Canal BED	UPLAND PLANTING
Low Water Use Trees Shrubs Seed Mix Wildflower Mix		Low Water Use Trees Shrubs Seed Mix Wildflower Mix	Low Water Use Shrubs	Low Water Use Trees Shrubs Seed Mix Wildflower Mix

Wooded Landscape With Stormwater

UPLAND PLANTING	TRAIL	UPLAND PLANTING	RIPARIAN PLANTING	UPLAND PLANTING
Seed Mix Wildflower Mix		Low / Medium Water Use Trees Shrubs Seed Mix Wildflower Mix	Medium / High Water Use Trees Shrubs	Low Water Use Trees Shrubs Seed Mix Wildflower Mix

Prairie Landscape Without Stormwater



Prairie Landscape With Stormwater

UPLAND PLANTING	TRAIL	UPLAND PLANTING	RIPARIAN PLANTING	UPLAND PLANTING
Seed Mix Wildflower Mix		Low / Medium Water Use Trees Shrubs Seed Mix Wildflower Mix	Medium / High Water Use Trees Shrubs	Low Water Use Trees Shrubs Seed Mix Wildflower Mix

STEP TECHNICAL LEADERSHIP TEAM

Multi-disciplinary Stakeholder Team

- Technical Leadership Team (12 members)
  - Cities of Aurora, Cherry Hills Village, Greenwood Village and Littleton
  - City & County of Denver
  - Denver Water
  - Douglas County
  - Highlands Ranch Metro District
  - Mile High Flood District
  - RESPEC Engineering
  - SEMSWA

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Stormwater Projects

1. Douglas County (Solstice Development)

Project Type: Conveyance

2. Littleton

Project Type: Conveyance

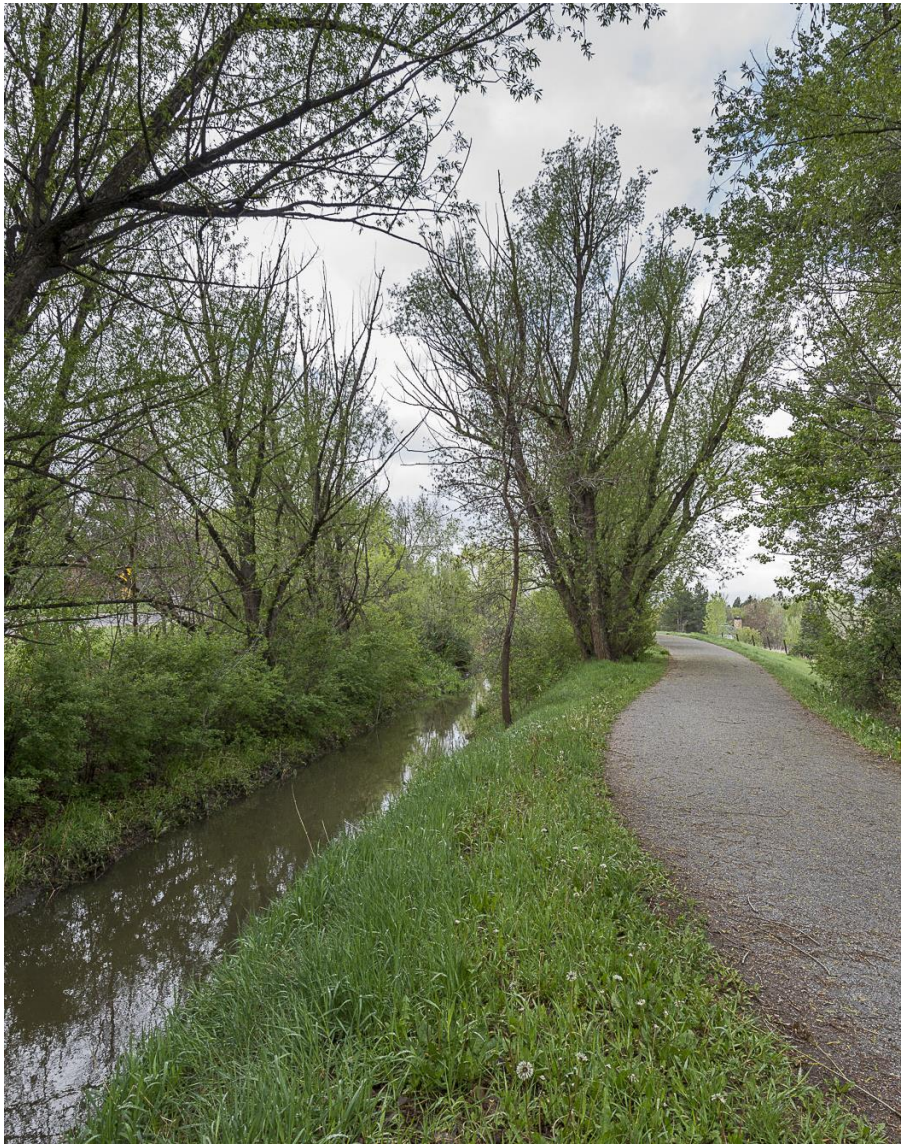
3. Greenwood Village

Project Type: Flood Mitigation

4. Denver

Project Type: Water Quality

Multi-layered Benefits of Green Infrastructure



- **Adaptive and Innovative Reuse**
  - Canal could be wet 100 more days per year
- **Vibrant Canopy**
  - Improves air quality
  - Sequesters carbon
  - Mitigates heat island effect
- **Environmental Health**
  - Stormwater 72-hour hold provides 40% cleaner water
  - Improves habitat
  - Improves community health
- **$30 Million in Potential Savings (Green vs. Gray)**
  - Cost for High Line Canal stormwater system is ~$45m
  - Cost for traditional infrastructure is ~$75m

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Stacked Benefits Analysis

US EPA

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Stacked Benefits Analysis: Inputs

Category	Attribute
Study Framework	Design Reach
	Length
	Tributary Area
	Jurisdication (Location)
	Mile marker
	Ecological zone
	Character Zone
	HUC12
Water-- Quality & Flood Management	Existing Inflow
	Future inflow
	Excess Capacity
	Capacity Shortage
	Impervious surface
	Impaired Water Proximity bonus .5 pt?TBD
	WQ Benefit Type
	WQ Benefit Value (0-4)
	Existing Freeboard
	Overflow Risk (L/M/H)
	Constructed overflow locations
	Flood Mgmt Benefit Value Rank (0-3)

Landscape Natural Environment	communities (CPW wetlands/riparian polys, landuse
	Native plant diversity--Floristic index?
	immediate or 1/4 mile buffer IPAC survey?
	sensitivity) native/total with all nonnative and urban
	communities or open water witihin 1/4 mi
	1-3 / 1-5, weighting?)
Resiliency	*Current heat island area impacted acres*
	Tree Canopy supported?
	Resiliency benefit rank (H/M/L?= 1-3?)
Community Health & Livability	Acres of public open space Canal + immediate buffer
	Acres of nearby public open space 1/4-mibuffer
	TPL Population w/in 10-min walk minute analysis
	Trail (Lft) in immediate buffer
	Trail (Lft) w/in 1/4-mi
	Community Survey data
	location
	mi
	Community benefit rank (H/M/L?= 1-3?)
Costs	*CIP & Maintence Costs in FS 2018: + Maintenance in Op Plan; compare to UDFCD costs?*
	Grey infrastructure costs
	Offset Costs
Scenarios	*Future reduced benefit?*

Biohabitats

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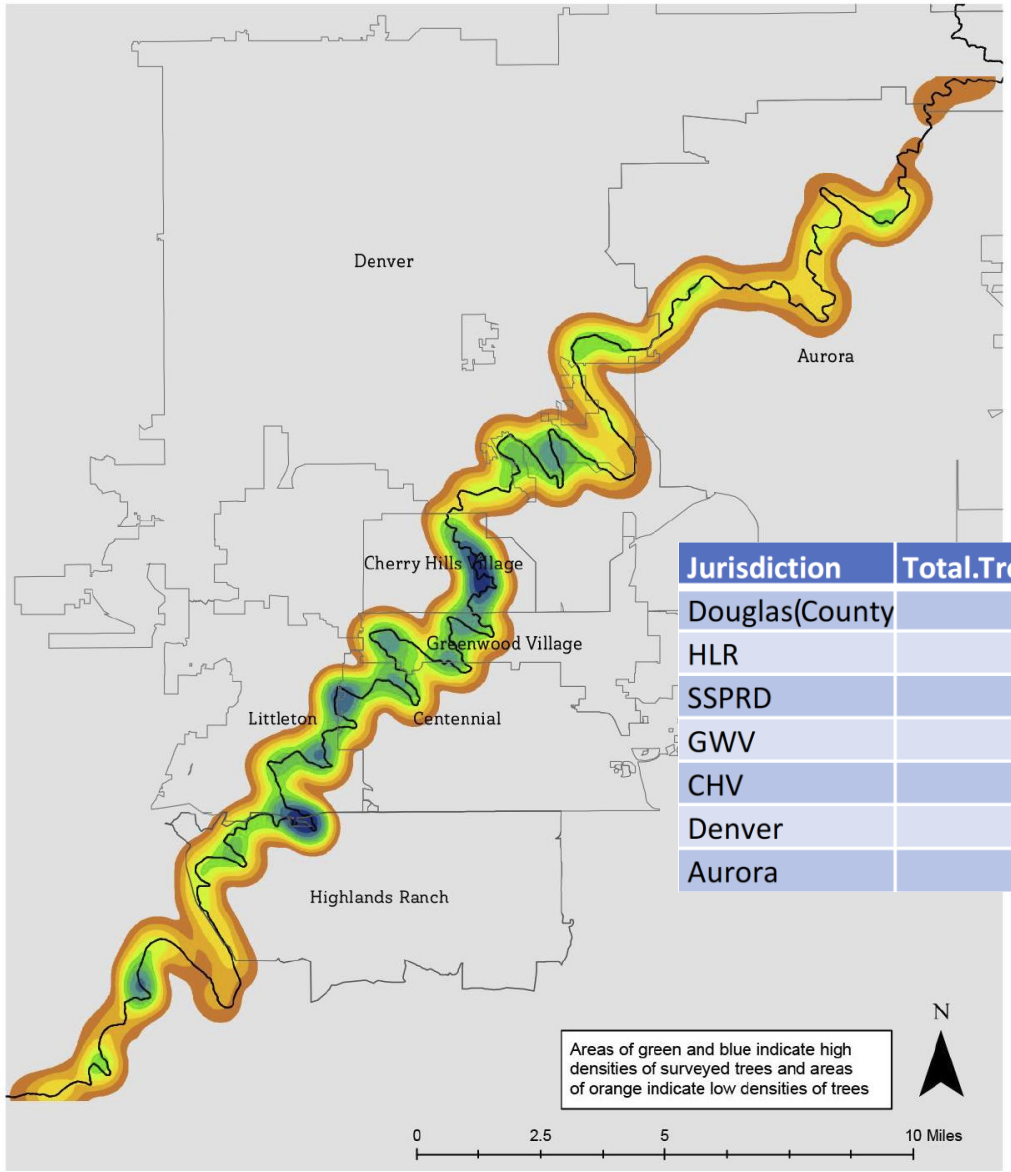
Tree Canopy

High Line Canal Tree Density Map



Tree Type	Count	% of Total Trees
Eastern Cottonwood	7,339	31%
Green Ash	3,317	14%
Siberian Elm	2,821	12%
Lanceleaf Cottonwood	1,777	8%
Peachleaf Willow	1,201	5%
Boxelder	998	4%
Narrowleaf Cottonwood	882	4%
Crack Willow	741	3%
Russian Olive	730	3%
Common Hackberry	516	2%
TOTAL (Top 10)	**20,322**	**86%**

Jurisdiction	Total.Trees	%.of.Total.Trees	Miles.of.Trail	Trees/Mile
Douglas(County	2,735	12%	7.5	365
HLR	2,967	13%	7.2	412
SSPRD	4,839	20%	9.7	499
GWV	2,466	10%	5.6	440
CHV	2,342	10%	3.9	601
Denver	5,144	22%	17.6	292
Aurora	3,184	13%	11.2	284

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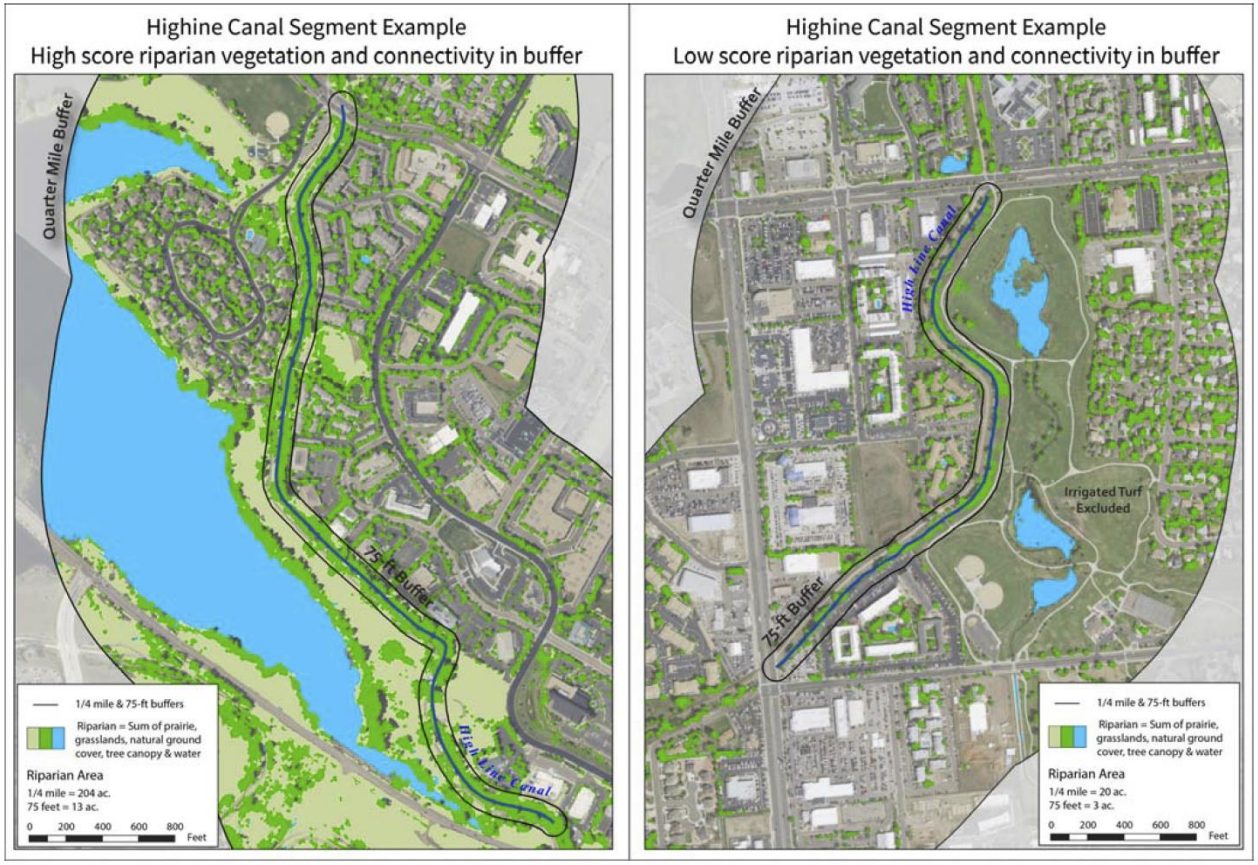
Riparian Habitat and Connectivity

Includes Prairie, grasslands, natural ground cover, tree canopy and water

737 acres in 75 ft buffer

Potential connectivity to 27 acres protected parkland in ¼ mile buffer

Example mapping of riparian vegetation



DRCOG Land Use Land Cover Data

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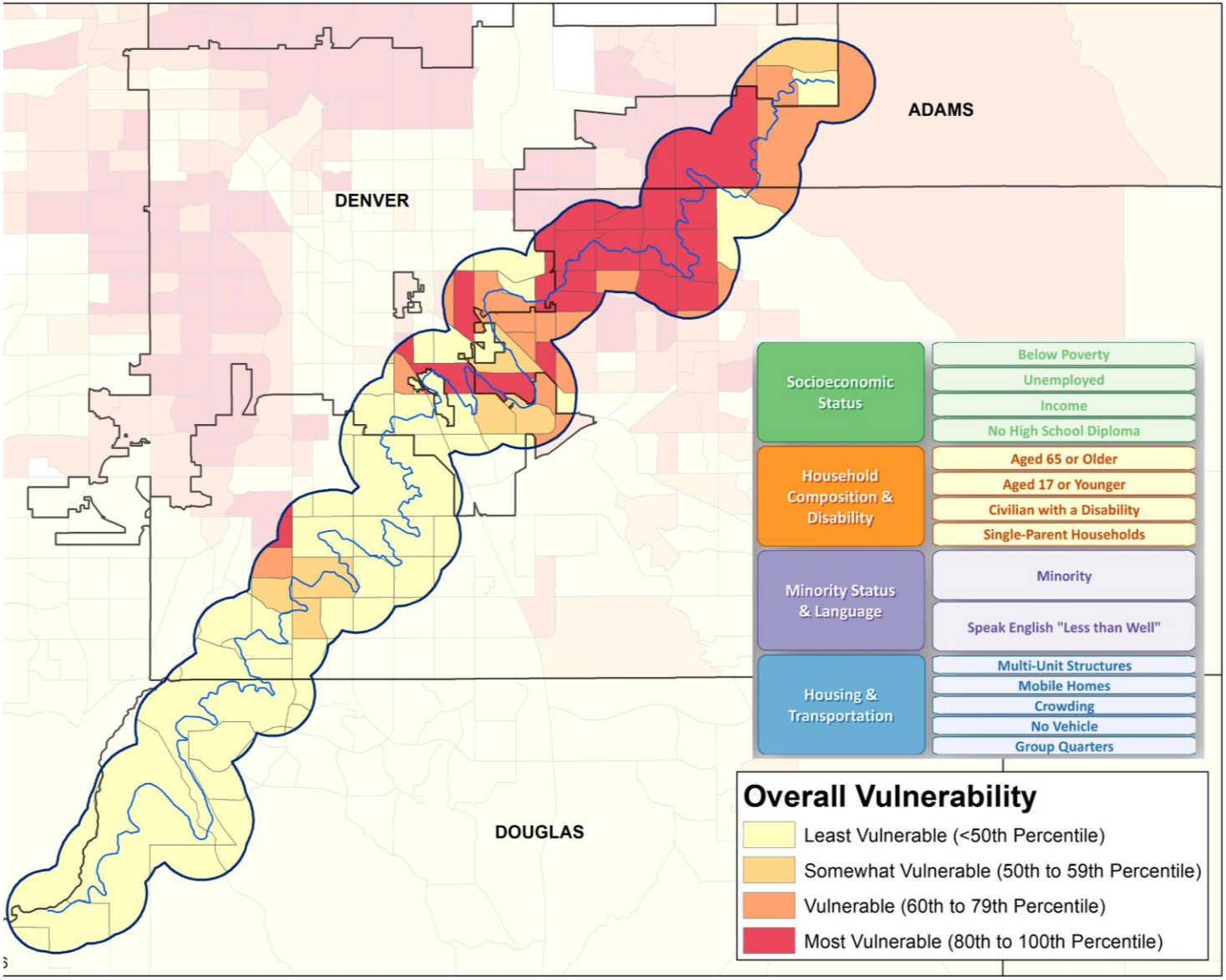
Social Vulnerability



CDC

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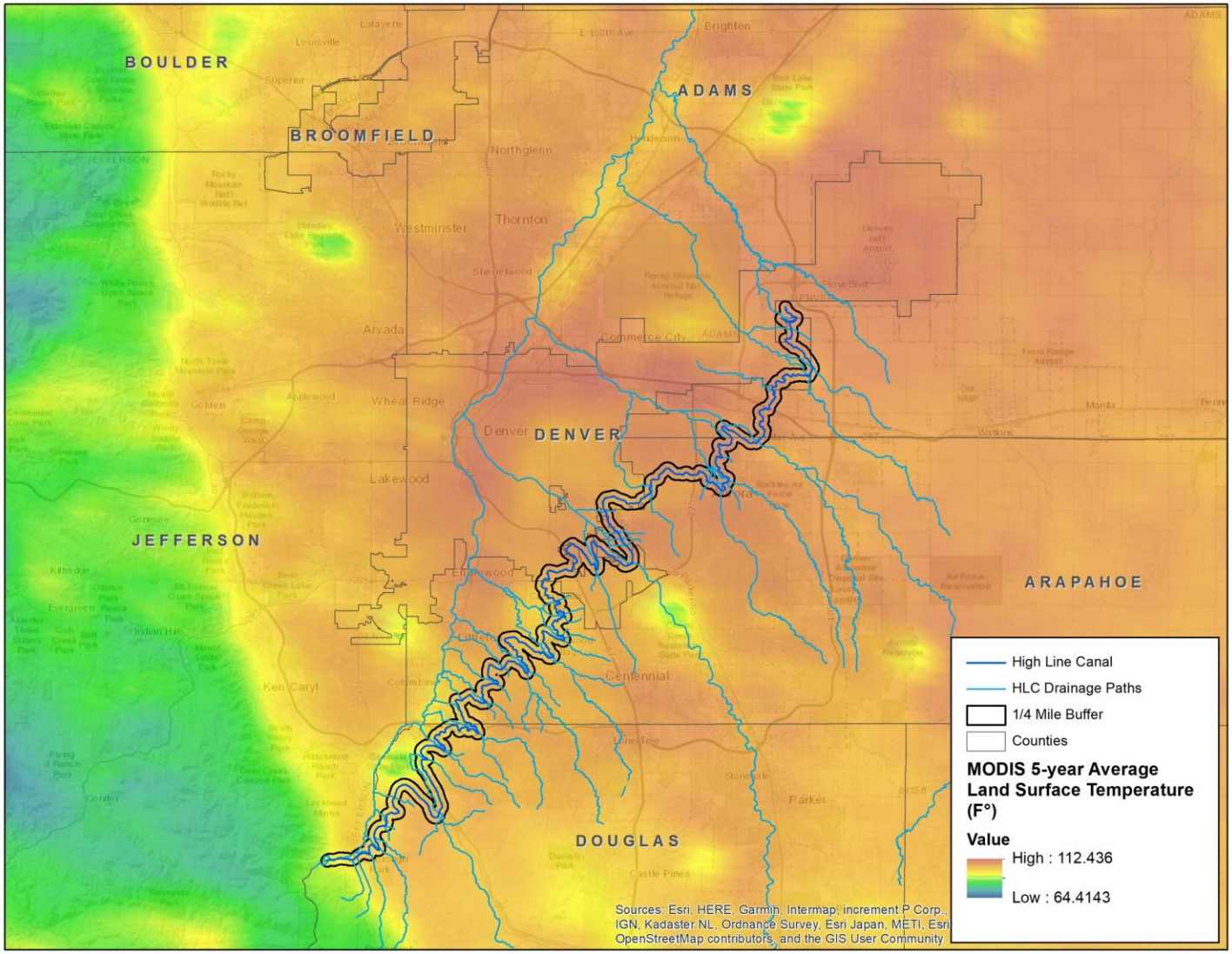
Land Surface Temperatures



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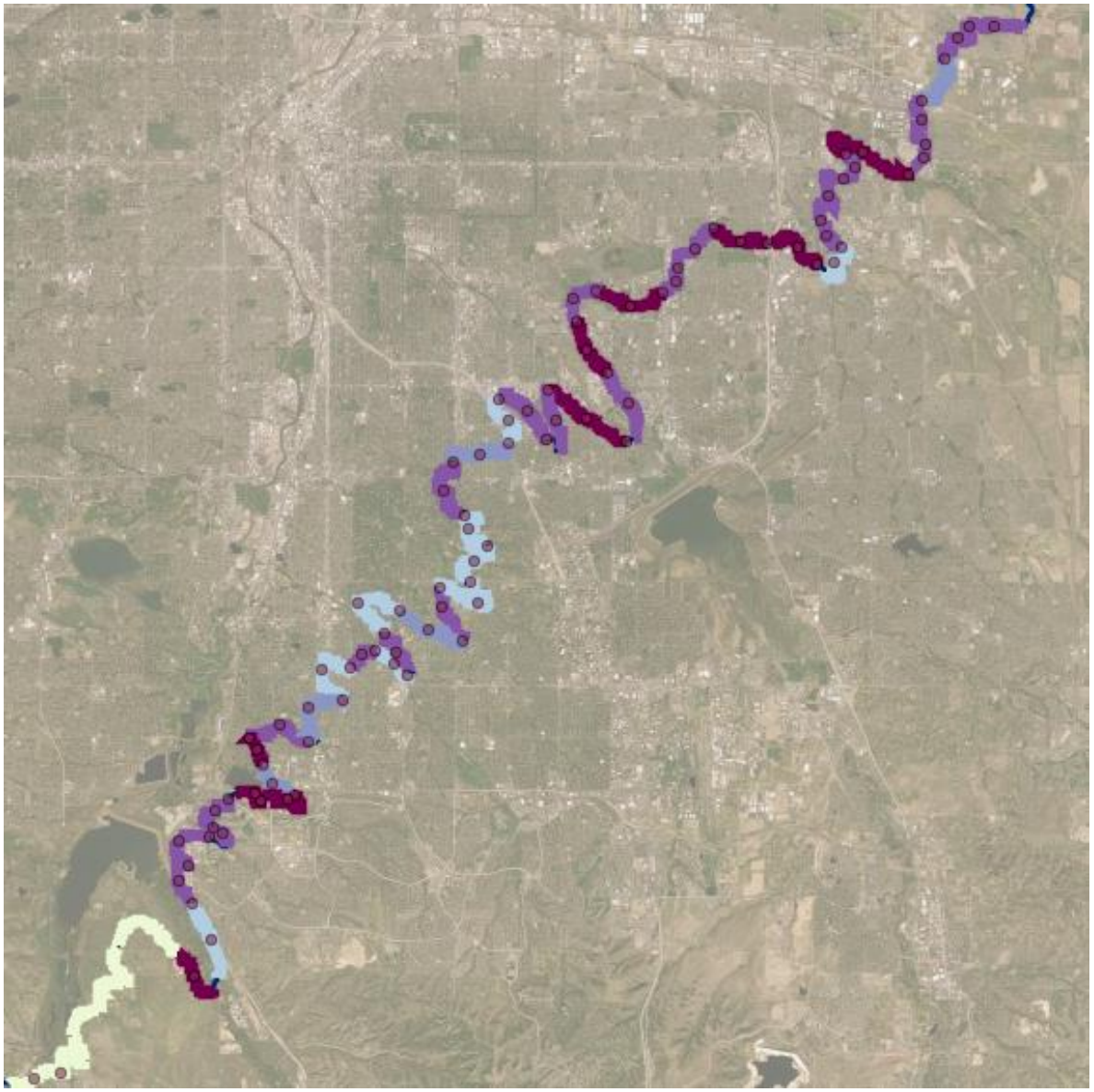
Water Quality Benefits



Design Reaches - Water Quality

WQRANKV2

- 4
- 3
- 2
- 1
- 0

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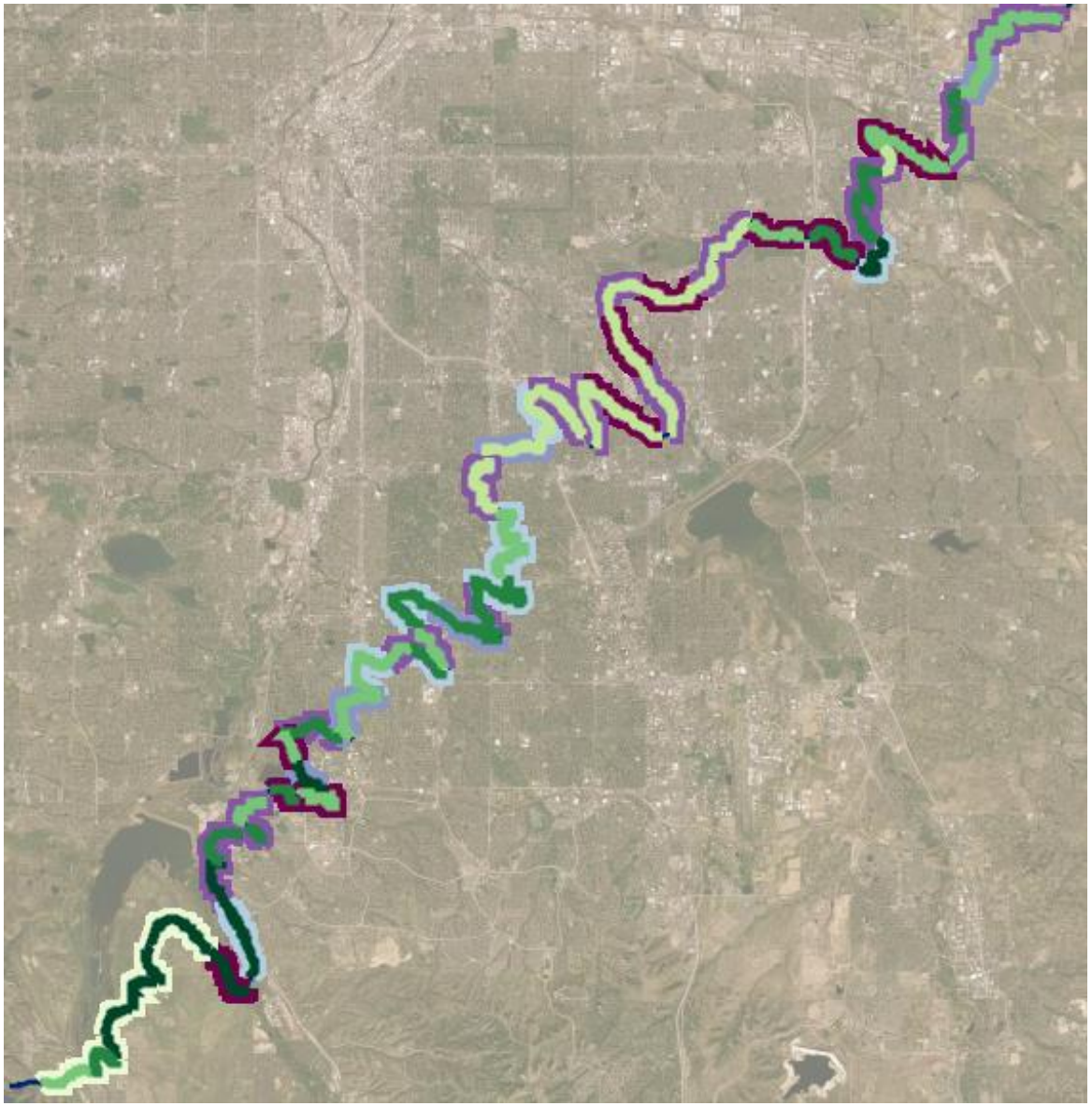
Water Quality Benefits and Riparian Quality



Design Reaches - Riparian

- High
- Moderate
- Fair
- Poor

Design Reaches - Water Quality

WQRANKV2

- 4
- 3
- 2
- 1
- 0

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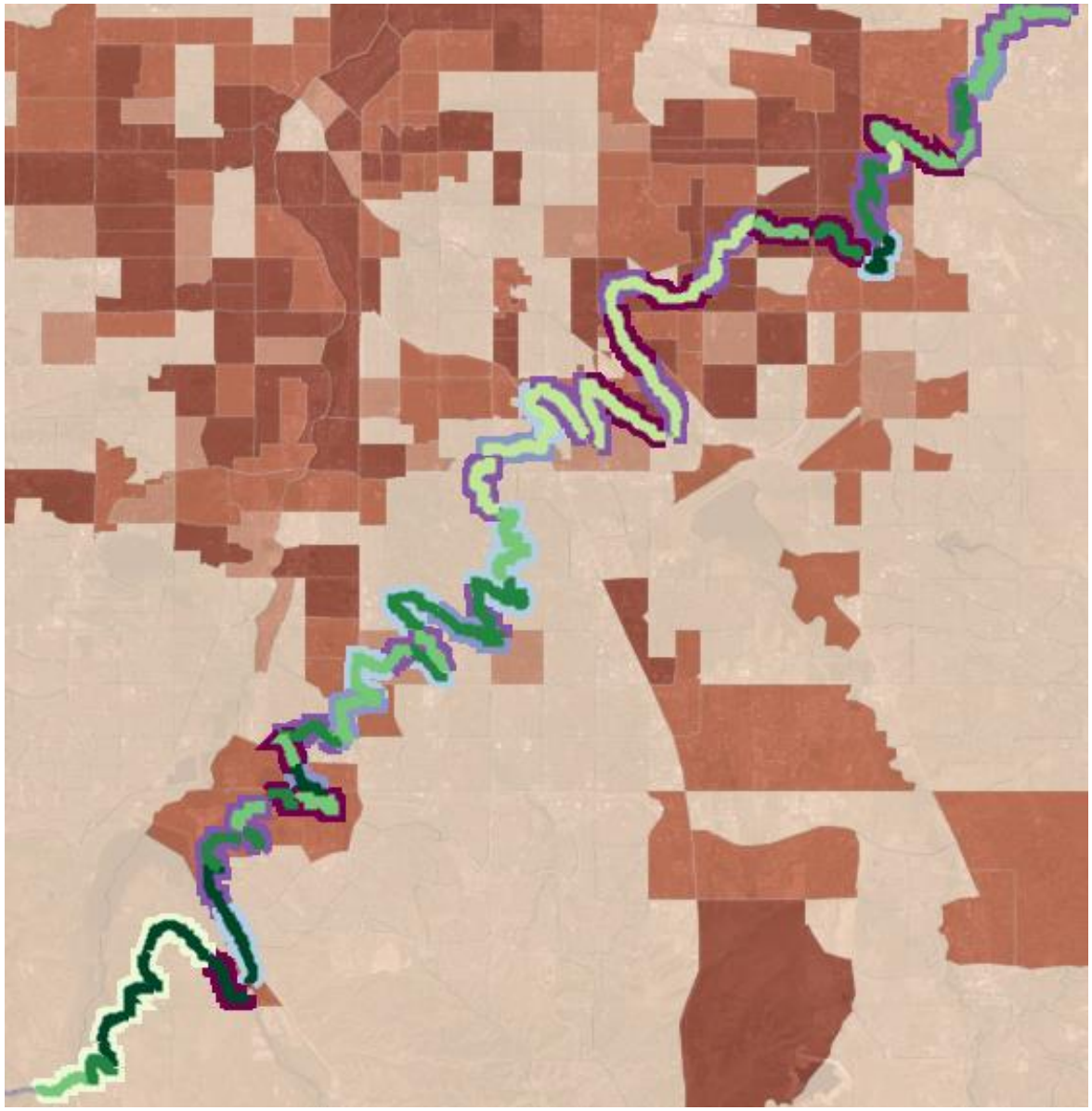
Water Quality Benefits and Riparian Quality in Vulnerable Communities



Design Reaches - Riparian

- High
- Moderate
- Fair
- Poor

Design Reaches - Water Quality

WQRANKV2

- 4
- 3
- 2
- 1
- 0

HIGH LINE CANAL CONSERVANCY

Prioritizing Stacked Benefits

- **Protect high quality riparian** areas by providing supporting stormwater
- **Improve poor quality riparian** areas by providing stormwater and planting

- **Reduce risk of uncontrolled canal overflows** by providing waste gate structures in reaches with little to no freeboard
- **Reduce risk of local flooding** by directing additional stormwater to reaches with moderate to high available freeboard

- **Support the resiliency of vulnerable communities**

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Stacked Benefits Analysis: Scenario Testing

Category	Description
Water-- Quality & Flood Management	Existing inflow Current available/excess capacity Allowable Additional *Peak flow* into canal cfs Added avoided flood risk Proposed water quality features Capital cost O&M w stormwater (includes greenway) O&M without stormwater (includes greenway) Water quality treatment value (based on Parkland + Capital)
Landscape Natural Environment	**Existing Trees & Vegetation** Trees asset value - CO2, energy, Air qualty, rainfall interception, prop values Low quality Prairie/Grassland/Natural Ground Cover Increased O&M for tree loss/removal **Proposed Trees and Vegetation:** Trees Shrubs Herbaceous/seeding cost Tree value (present value) Improved Prairie/Grassland/Natural Ground Cover
Community Health	Health value - improved physical condition of nearby residents
TOTAL CO-BENEFIT	**50 year period (present day dollars)** **Annual**

1. No Stormwater Project

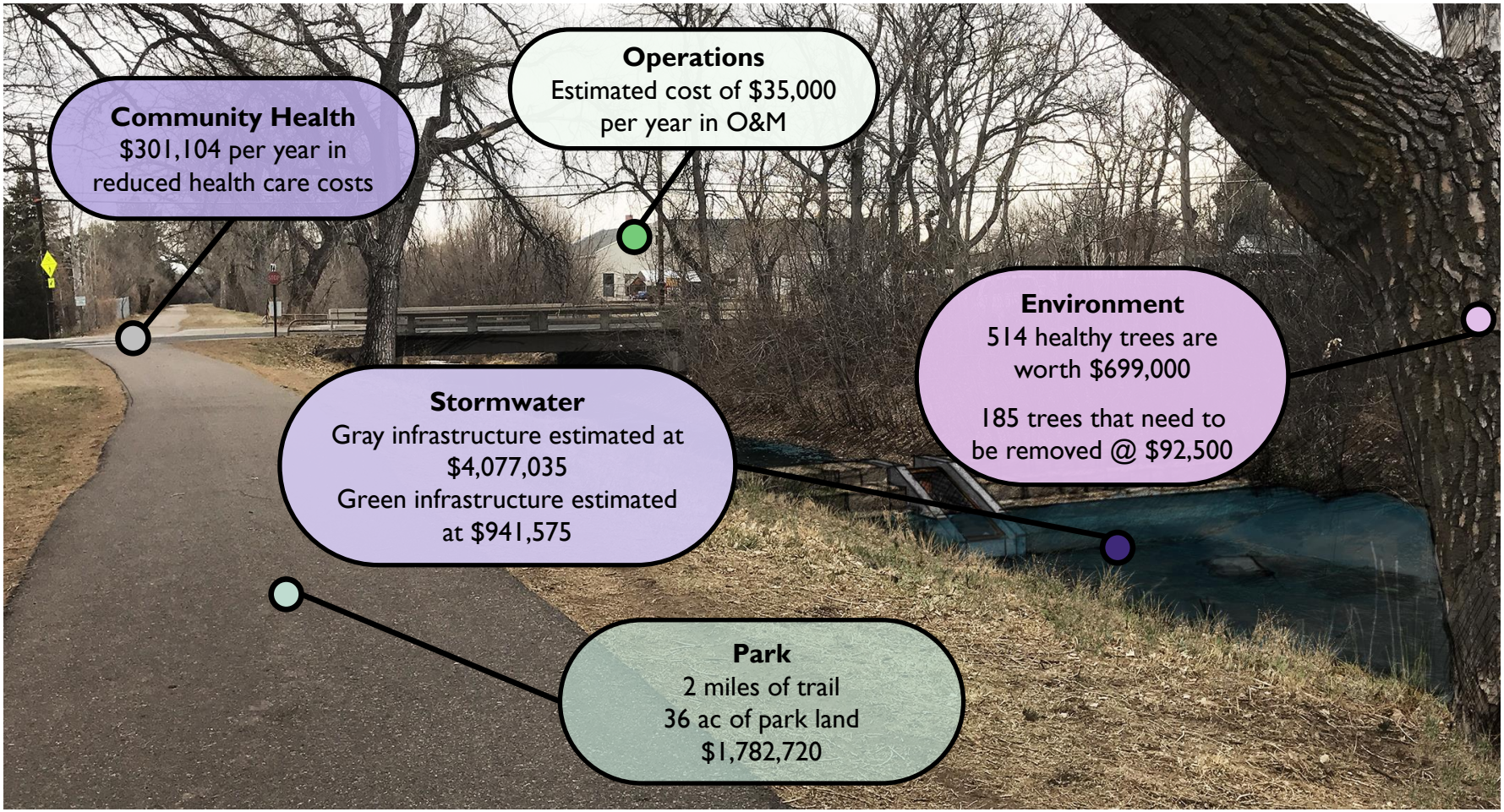
- Offsite infrastructure
- Loss of trees and native veg
- Park value decline/loss

2. Water Quality Treatment Only

3. Full Concept Project

- Water Quality
- Additional trees and veg
- Social amenities

Stacked Benefits Analysis: Eisenhower Park



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Stacked Benefits Analysis: Canal-Wide Benefits

Category	Metric	Canal wide results
Water Quality	Acres existing green infrastructure area	51.3 acres
	Acres proposed green infrastructure area	45 acres
Flood Management	miles/acres of canal currently providing flood control (or current flood storage volume)	12.3mi
	Miles of canal available for future local flood control moderate to high potential (or potential additional volume ?)	45.8 mi
Riparian Habitat	Acres riparian vegetation in entire corridor (75 ft b	737
	No of living trees in entire corridor (75 ft buffer)	19055
	Acres nontree or impermeable riparian vegetatior	416
	No. of living native trees	10787
	High quality acres protected in 1/4-mi buffer	*27*
Community Health	Vulnerable population benefiting from open space	45,785

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Stacked Benefits Analysis: Canal-Wide Benefit Valuation

COBENEFIT EVALUATION				
Description	Unit	Unit value + or (-), negative is cost $	Existing Qty	Existing value
Acres riparian vegetation in entire corridor (75 ft buffer)	acres	$ 34,000	737.2	$ 25,064,800
Trees asset value - CO2, energy, Air qualty, rainfall interception, prop values	no./tree	$ 1,361	$ 19,055	$ 25,933,855
Replacement cost for native trees	$/tree	$ (250)	10787	$ (2,696,750)
Increased O&M for tree loss/removal (native only)	$/tree	$ *(500.00)*	10787	$ (5,393,500)
Water quality treatment value (land only)	ac	$ 34,000	51	$ 1,744,200.00
Proposed Water quality treatment value (land only)		$ 34,000	45	$ 1,530,000.00
Added avoided flood risk	cu ft		na	
Waste gate	no.		na	
Health value - improved physical condition	reduced med$/per	$ 351.00	45800	$ 16,075,800

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Stacked Benefits Analysis: Habitat Values

737 acres (64%) forest/natural riparian habitat in 75-ft buffer → $25M price to purchase riparian habitat replacement acres

19,055 trees along canal → $25.9M value of existing trees

10,055 high value native trees along canal → $5.4 M O&M costs deferred by stormwater prevention of tree loss $2.7M for tree replacement

HIGH LINE CANAL CONSERVANCY

Stacked Benefits Analysis: Water Management Values

51 acres existing green infrastructure for water quality

→

$1.74M avoided costs for land purchase to replace existing green infrastructure

45 acres proposed green infrastructure area for water quality (berm area)

←

$1.5M avoided costs for land purchase for proposed green infrastructure

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Thank you!

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Connecting Communities – Connecting Nature
From the Foothills to the Plains

Josh Phillips
Director of Planning and Implementation
Josh.P@highlinecanal.org