

CASFM 2018 Annual Conference

Water Medley Sessions:

Session1: Oh No! We've got to go under it!

Becky Brock (Brierley Associates), Chris Knott (Btrenchless)

Session2: Planning and Siting of Recreational Whitewater Features

Brooke Seymour & Richard McLaughlin (UDCFD)

Nature Play Design Guidelines: Techniques for Including Nature Play within Floodplains

Cassie Kaslon & Susan Brown (Valerian), Frans Lambrechtsen (CH2M)



Oh No!
We've got to go under it!

2018 CASFM - Snowmass

Google Earth

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ASSOCIATES**

Creating Space Underground

Becky Brock, PE
rbrock@brierleyassociates.com



Chris Knott
chris.knott@btrenchless.com

Agenda



- Criteria for Stormwater Tunnels
- Subsurface Conditions
- Contracting Preferences
- Trenchless Comparisons
- Trenchless Methods
- Pipe Materials

Oh No! We've got to go under it!



Stormwater Tunnels



Fixed Criteria:

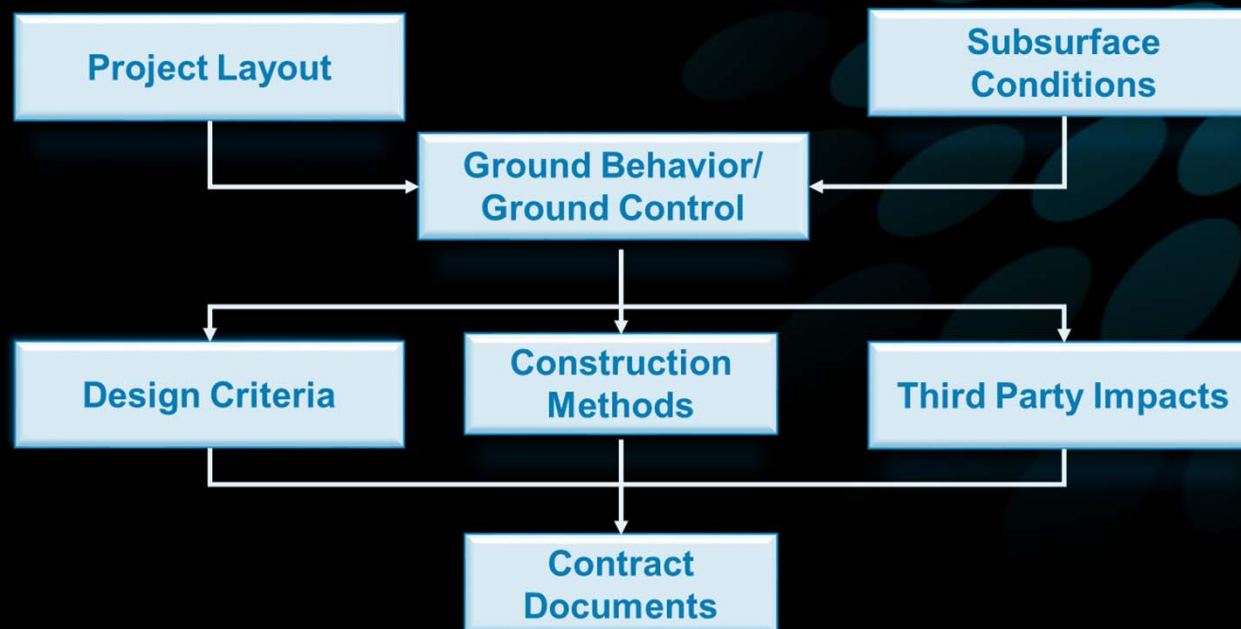
- Flow requirements:
 - Depth, length, diameter, and grade
 - Maintaining grade is critical for gravity flow
- Limited access / Impacts to 3rd parties
- Subsurface conditions



Subsurface Conditions



Design Approach:



Subsurface Conditions

Ground Behavior Dictates!!!



Subsurface Conditions



Ground Behavior Dictates!!!



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Subsurface Conditions



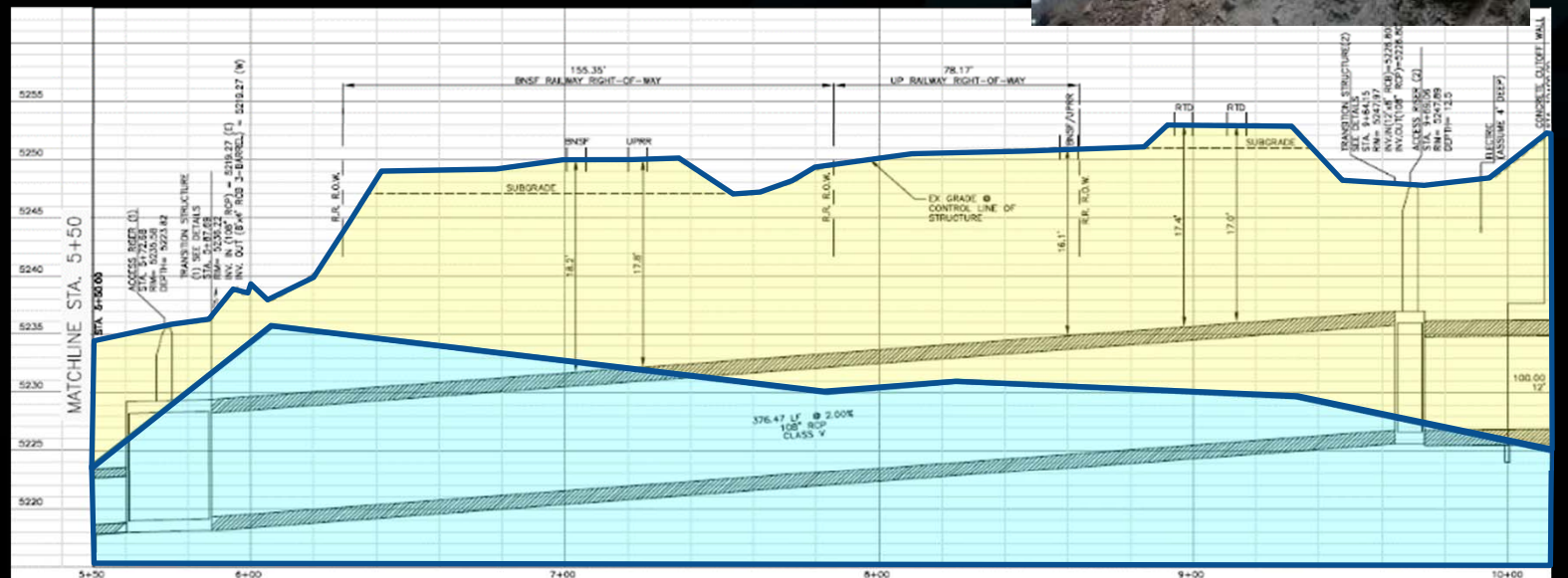
Subsurface Investigation:

- Crucial to project success
- Challenges of limited access
- Cost – Benefit ratio
- Quality investigation



A composite image showing two different sediment samples. The left panel shows a hand holding a pile of brown, granular sediment, likely a type of mud or silt. The right panel shows a close-up of a dark, textured sediment surface, possibly a different type of sediment or a different layer within the same sample.

- 



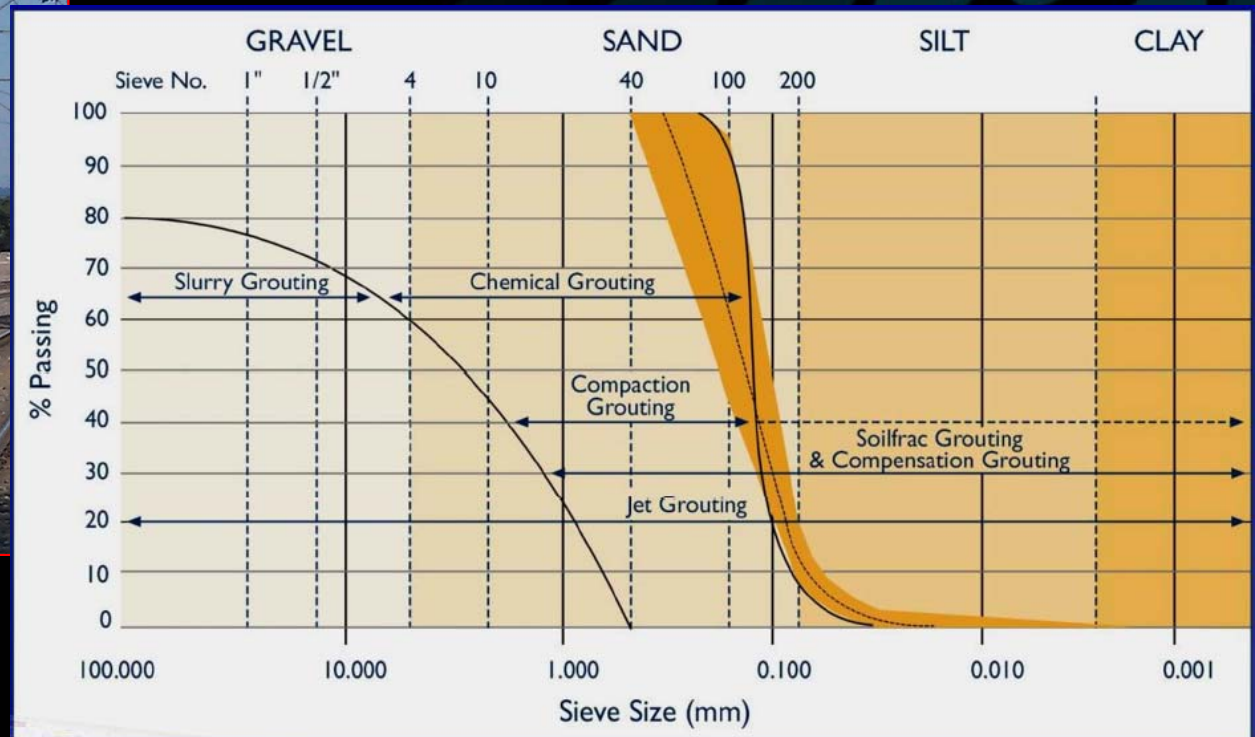
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Subsurface Conditions



Mitigation Measures:

- Improves unfavorable ground conditions and reduce risk of damage
- Technique dependent on soil type and gradation



Contracting Preferences



The owner owns the ground:

- Contractor pre-qualification
- Geotechnical Baseline Report (GBR)
- Typical Specifications:
 - Trenchless Construction
 - Contact Grouting
 - Shaft Excavation and Support
 - Geotechnical Instrumentation and Monitoring

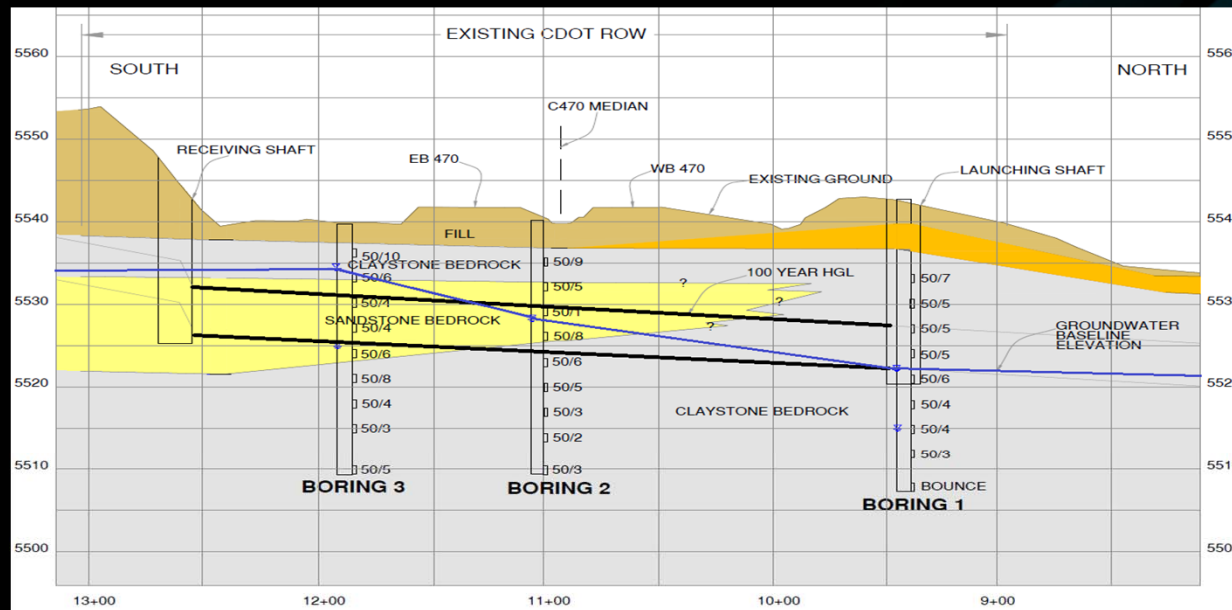


Contracting Preferences



Geotechnical Baseline Report:

- Establishes a contractual baseline of subsurface conditions for bidding:
 - Baselines are contractual assumptions and not necessarily geotechnical fact
 - Anticipated physical and behavioral conditions
 - Included in the contract documents



Geotechnical Baseline Reports for Construction

SUGGESTED GUIDELINES

The Technical Committee on Geotechnical Reports of the Underground Technology Research Council



Randall J. Essex, P.E.

ASCE



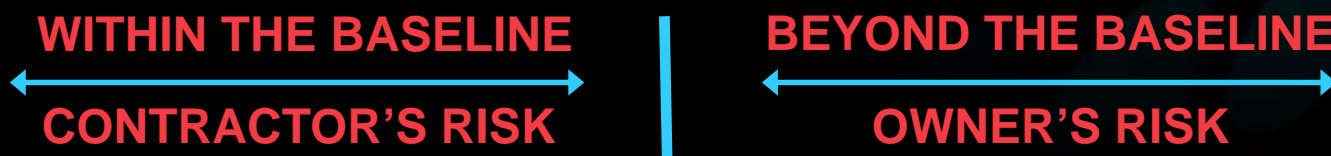
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Contracting Preferences



Geotechnical Baseline Report:

- Manages risk allocation
- Bids are comparable
- Provides a basis for DSC claims
- Commonly used in trenchless projects



TRENCHLESS COMPARISONS

Method	Diameter (in)	Length (ft)	Usable Under Water?	Line & Grade Control	Cost
Auger Bore	8" - 72"	250'	N	Vertical	\$
Pilot Tube	5"	500'	N	Y	\$\$
McLaughlin	20" – 48"	400'	N	Y	\$\$
Hand Tunnel	42" – 15'	100' >	N	Y	\$\$\$
Pipe Ramming	12" – 144"	400'	Y	N	\$\$\$
TBM Pipe Jacking	51" – 129"	1000'	N	Y	\$\$\$\$
Microtunneling	36" – 96"	1000'	Y	Y	\$\$\$\$\$

Auger Bores



Advantages:

- Relatively inexpensive
- Suitable for a variety of soil types
- Drives up to 250 ft, capable of longer drives with reduced accuracy
- Wide range of sizes: 12" – 72" diameter casing – (non-welded casing option for larger diameters and bores with ground water)



Guided Boring Machine



Advantages:

- Grade and alignment precision
- Can increase the length and accuracy of other trenchless methods, such as Auger, Hand Tunnel and Hammer, for varying soil and grade concerns.



A

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McLaughlin Head



Description:

McLaughlin steering head is used to install bore for drives up to 400 feet. Its guidance system is equipped with a water level for checking and maintaining grade, along with the ability to check and maintain the line throughout the bore with twin line projection halogen lights enclosed in the steering head.

The cutting path— grade and lateral movement of the steering head is controlled by hydraulic actuated flaps that open and close to keep the head on the intended path.



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Hand Tunnel

Description:

Utilizes manual labor for excavating material while hydraulic jacks advance the tunnel.



Hammer or Pipe Ramming



Advantages:

- Well suited for cobbles and running sands
- Lowest probability of surface subsidence



Pipe Jacking (TBM)



Advantages:

- Suitable for a wide variety of soil types
- Drives of over 1000 ft possible
- Allows for removal of obstructions
- Adaptable to changing soil conditions

Limitations:

- Ground water
- Cobble
- Minimum tunnel diameter of 51"



Microtunnel



Advantages:

- Large Diameters (>36")
- All Ground Types
- Continuous Face Support
- Long Distances
- Above or Below Water Table
- EXTREMELY Accurate
- Can be used in areas with hazardous materials/soils with minimal exposure to personnel



Microtunnel



Akkerman Jacking Frame

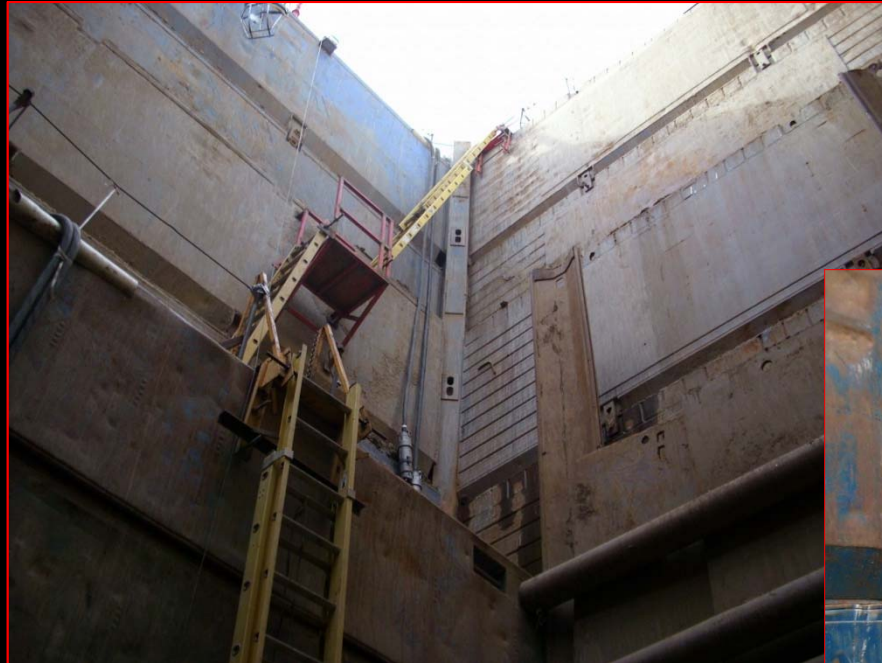


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Microtunnel



Slide Rail System

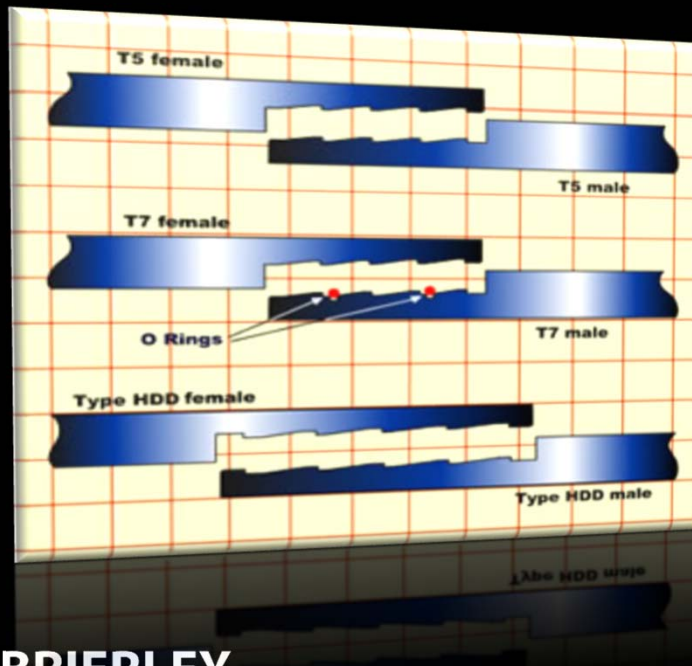


Exit / Entry Seal



Permalok

The Permalok Interlocking Pipe Joining System features a precision machined joint connection which is completed in the field using the existing jacking frame on trenchless equipment or the force from the ramming machine. It eliminates the need for welding the steel pipe, and uses a time-saving 5-step installation process.



HOBAS

HOBAS (CCFRPM) Pipes are centrifugally cast, glass-fiber-reinforced, polymer mortar.

These large diameter pipes are ideally suited for nearly all corrosive piping applications.

HOBAS pipes may be installed by a variety of installation methods. HOBAS pipes can be economically designed for non-pressure and pressure service by varying the quantity, placement, and orientation of the glass-fiber reinforcements.



RCP

(Reinforced Concrete Pipe)

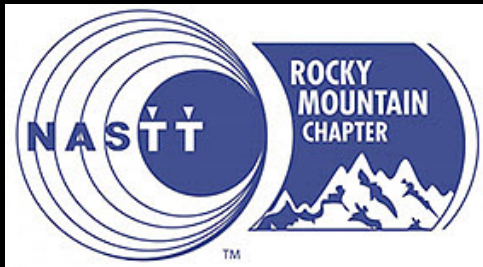


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Join Us!

Trenchless Elevated 2018



Date: November 1, 2018

Time: 7:30am – 5:00pm

Location: PPA Event Center - 2105

Decatur Street, Denver 80211

Who should attend?

Owners, utilities, municipalities, as well as engineers and contractors involved in the repair and replacement of aging underground infrastructure.

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Questions?

BRIERLEY ASSOCIATES

Creating Space Underground

Becky Brock, PE

rbrock@brierleyassociates.com

Phone: 303-703-1405

www.brierleyassociates.com



Chris Knott

chris.knott@btrenchless.com

Phone: 303-286-0202

www.BTrenchless.com

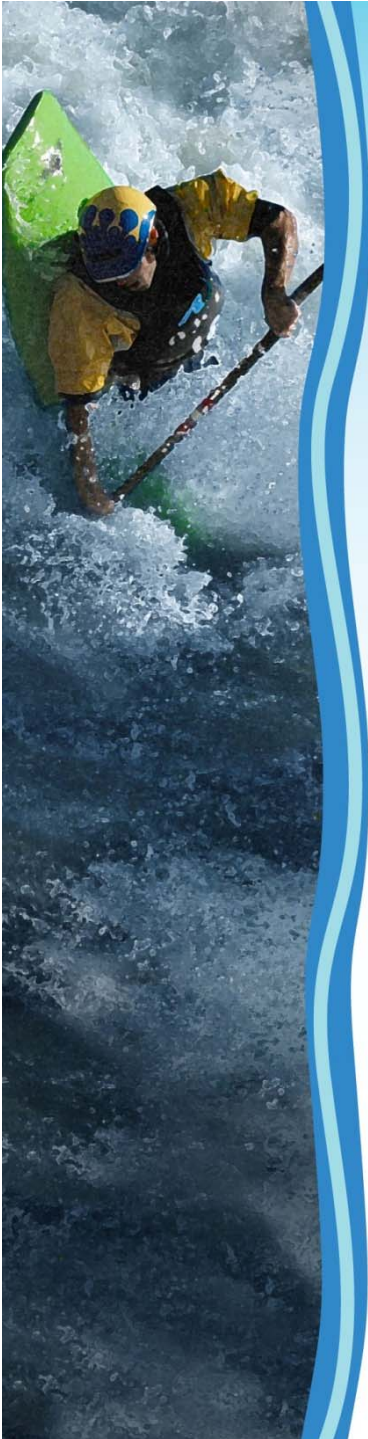




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Dewberry®



Planning and Siting of Recreational Whitewater Features

Presented to

CASFM

2018 Annual Conference

September 2018



Presentation Outline

1. Why Whitewater?
2. Planning
3. Design



Why Whitewater

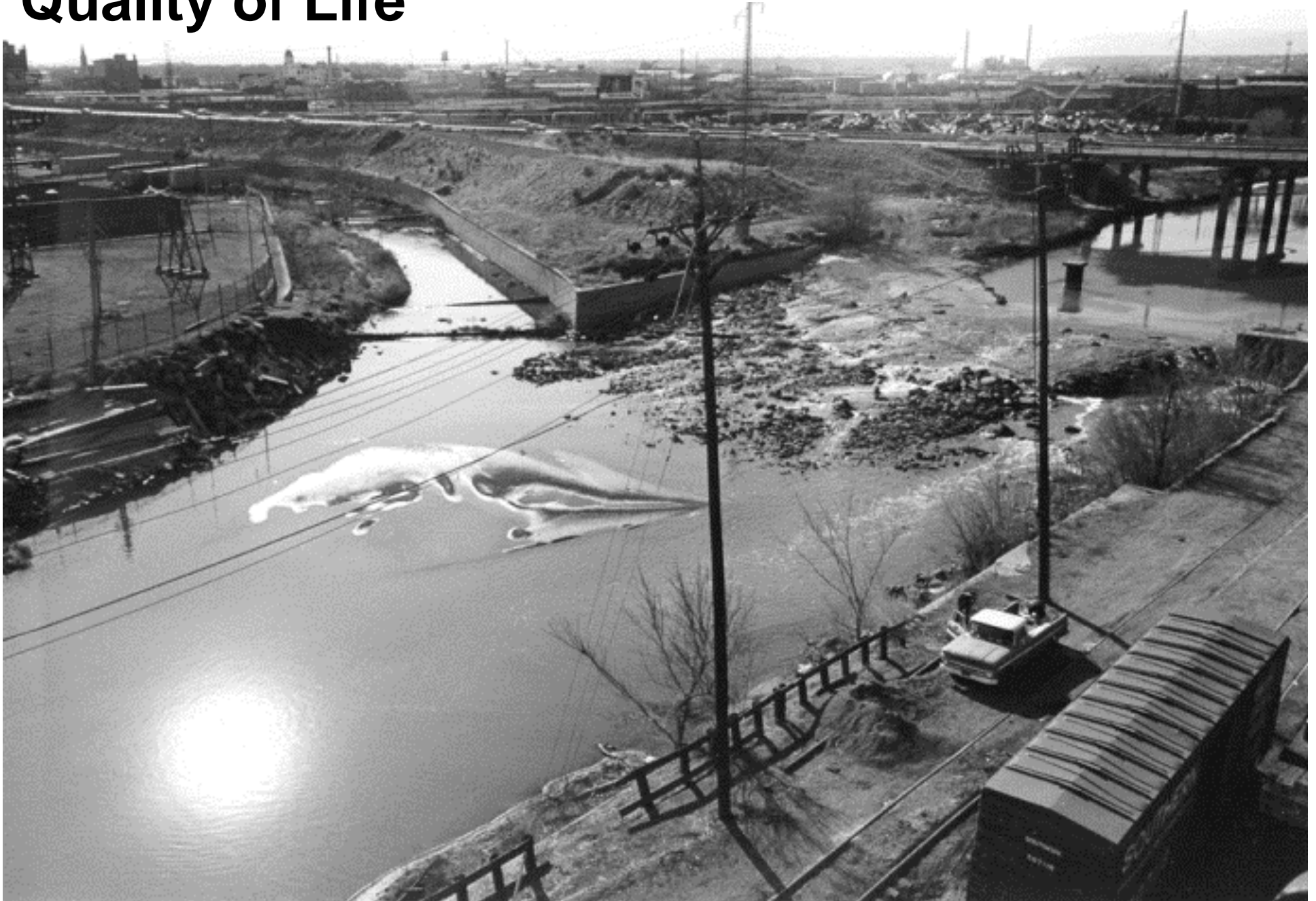
Quality of Life

Economic Impact

Public Safety



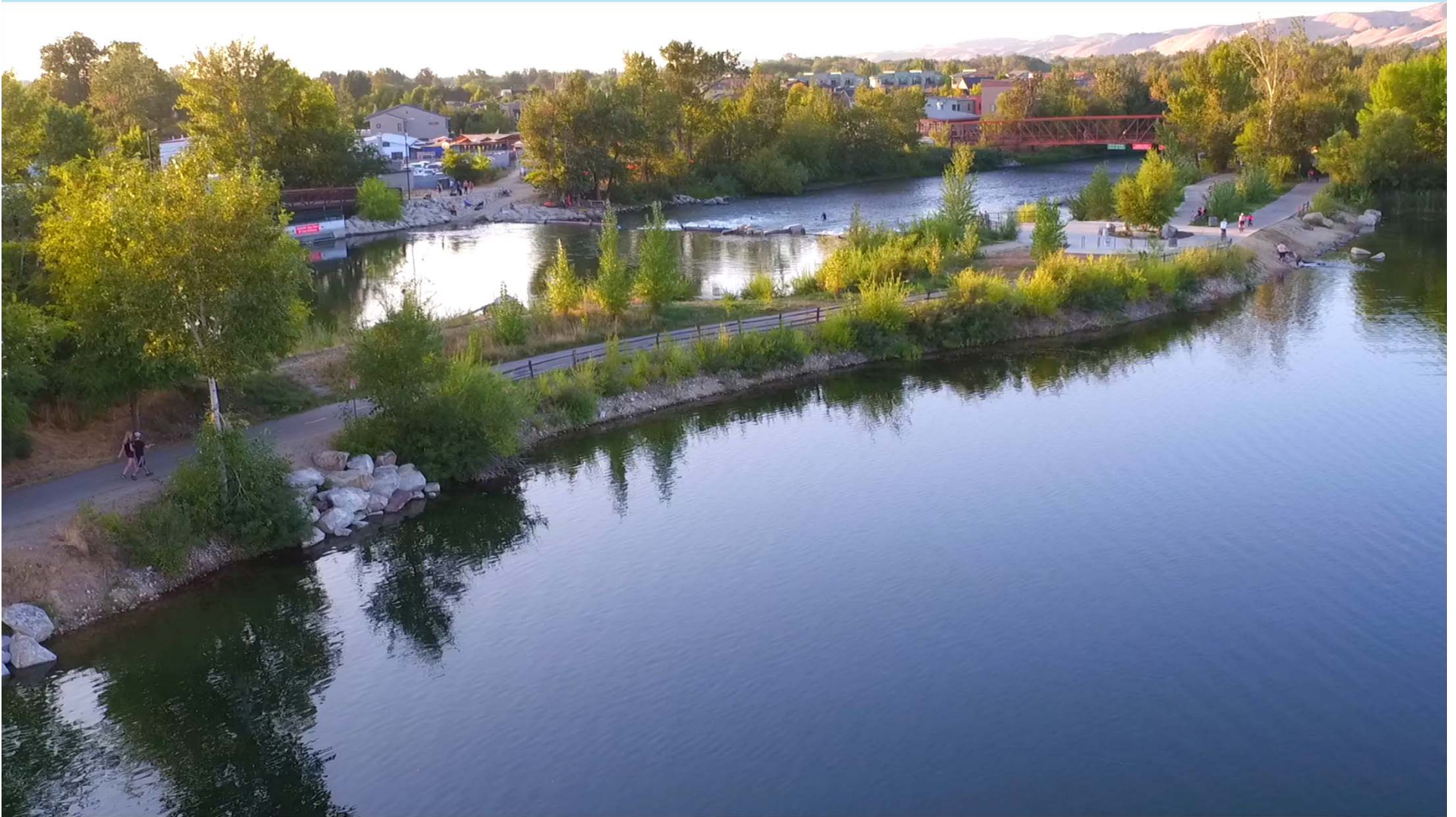
Quality of Life



Quality of Life



Quality of Life



Economic Impacts

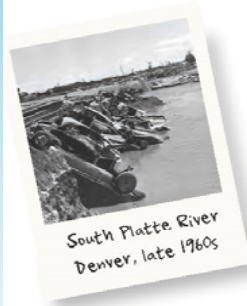
South Platte

1

In 1970, properties within a ½ mile of the South Platte River and Cherry Creek were valued

17% LOWER

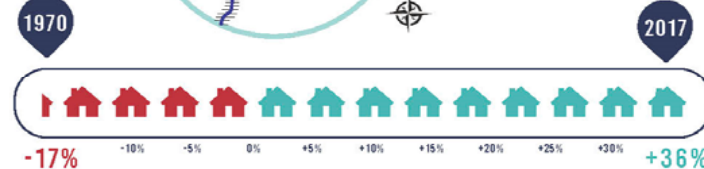
than the property values outside that boundary in Denver.



In 2017, properties within a ½ mile of the South Platte River and Cherry Creek were valued

36% HIGHER

than properties outside that boundary in Denver.



2

\$18 BILLION

PROPERTY VALUE



As of FY 2017, approximately \$18 Billion in property value has been created that would not exist if the conditions of 1970 persisted today along Denver's waterways.

3

As a result of this increased property value, the City and County of Denver receives **\$64 Million** in additional annual funding and Denver Public Schools receives **\$100 Million** in additional annual funding.

ADDITIONAL FUNDS RECEIVED

\$64 MILLION



\$100 MILLION



This money accounts for 15% of overall property taxes collected by Denver.

4

**ALMOST \$14 BILLION IN
ADDITIONAL ANNUAL BENEFITS
RECEIVED FROM**



TOURISM



TRANSPORTATION



RECREATION



HEALTH BENEFITS

ARE ATTRIBUTABLE TO THE IMPROVED
CONDITION OF THE WATERWAYS.



**DENVER REALIZES COST SAVINGS FROM THE
ECOSYSTEM SERVICES PROVIDED BY THE
IMPROVED LANDSCAPES, LIKE**



NATURAL STORMWATER FILTRATION



AIR POLLUTANT CAPTURE



WATER POLLUTANT CAPTURE



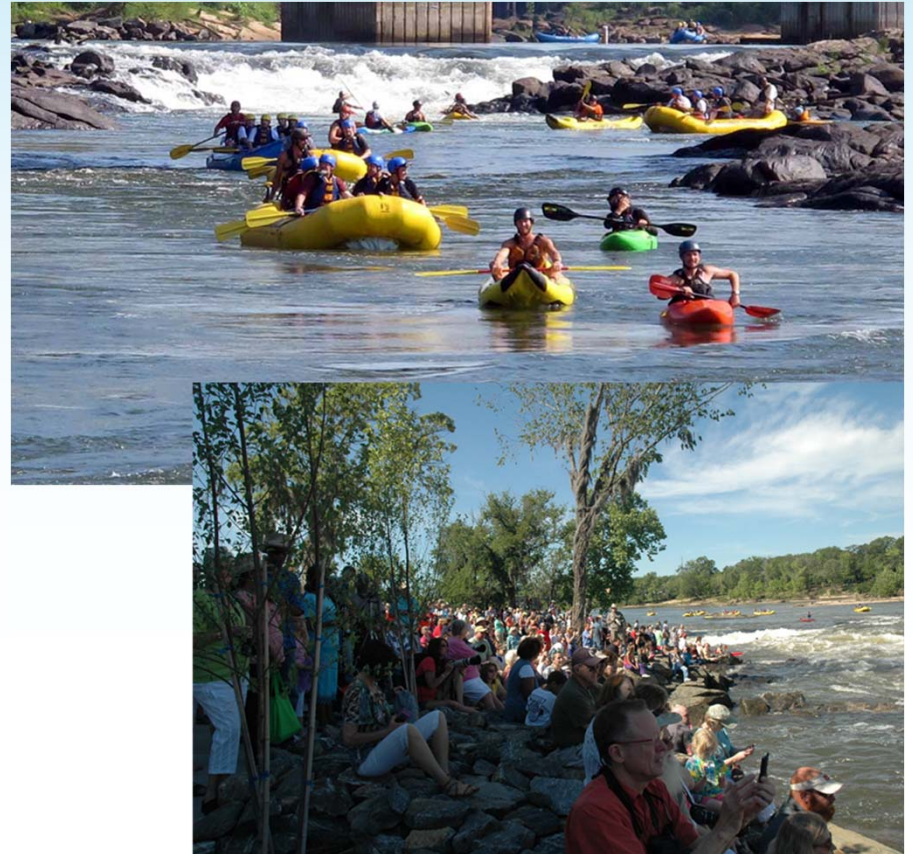
HEAT CAPTURE

THAT OTHERWISE WOULD REQUIRE
NON-NATURAL AND EXPENSIVE SOLUTIONS.

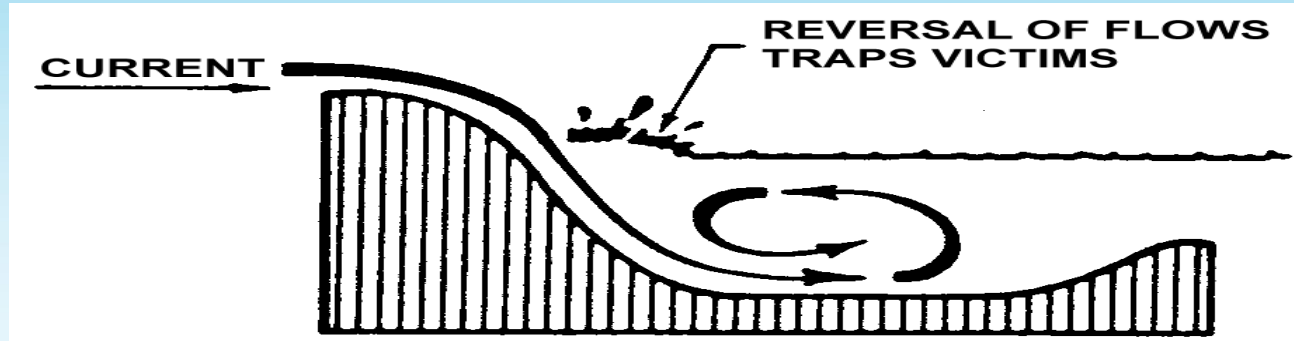
Economic Impacts

Chattahoochee River Restoration

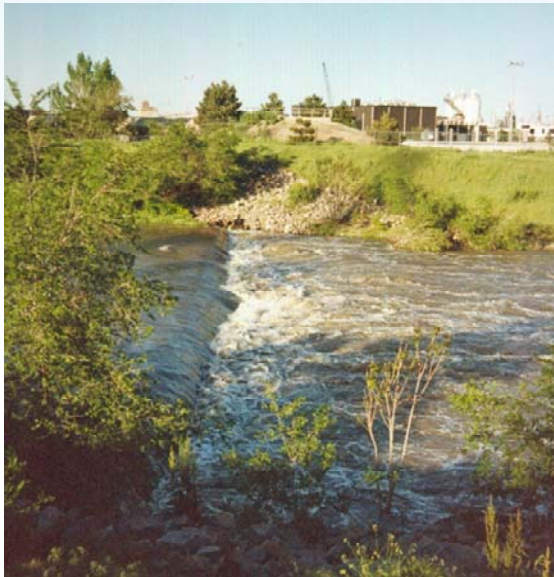
- Economic Impact
 - 50,000 paying rafting customers and zip line customers a year
 - \$74m in capital investment
 - 42 new businesses; several university extensions
 - \$24m in gross revenues.
 - 400 new jobs
 - Gross tax receipts 2012 to 2017 up 45%.



Public Safety



Overly retentive hydraulics of a conventional dam



Clear Creek drop of 1.8 feet was proven fatal



Union Avenue Dam
Selected "milder" sloped proved hazardous



Presentation Outline

1. Why Whitewater

2. Planning

- Who are the Users
- Site Factors
- Recreational Intent

3. Design



Who Uses Whitewater River Parks?



Cooling Off in Engineered River Parks

User Survey Results

Spectators

- ✓ Most visitors recreated on the streambanks (76%)

Children

- ✓ (43%) Recreating in the water compared to teens (27%), adults (20%), or seniors (4%)

Kayakers

- ✓ Represented **only 2%** of summer park activities



Site Evaluation or Site Factors

1. Available Flow
2. Vertical Drop
3. Adjacent Area/Access

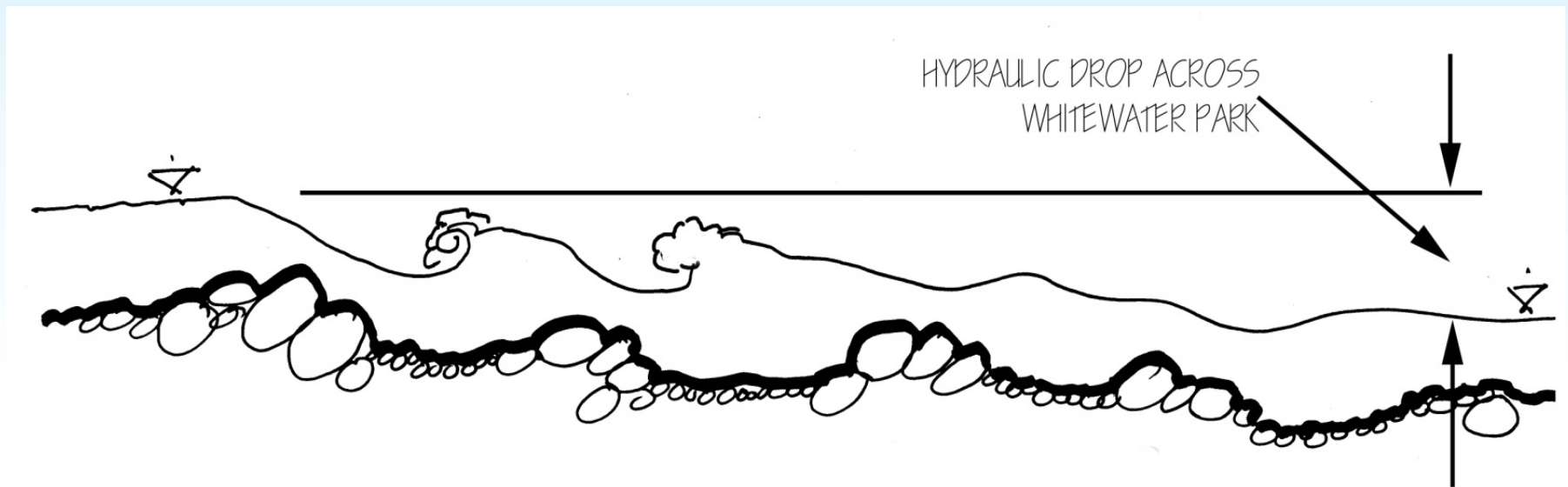


Site Factor 1 - Flow



Site Factor 2 – Vertical Drop

Often conflict between developing the hydraulic drop and impacting the floodplain.

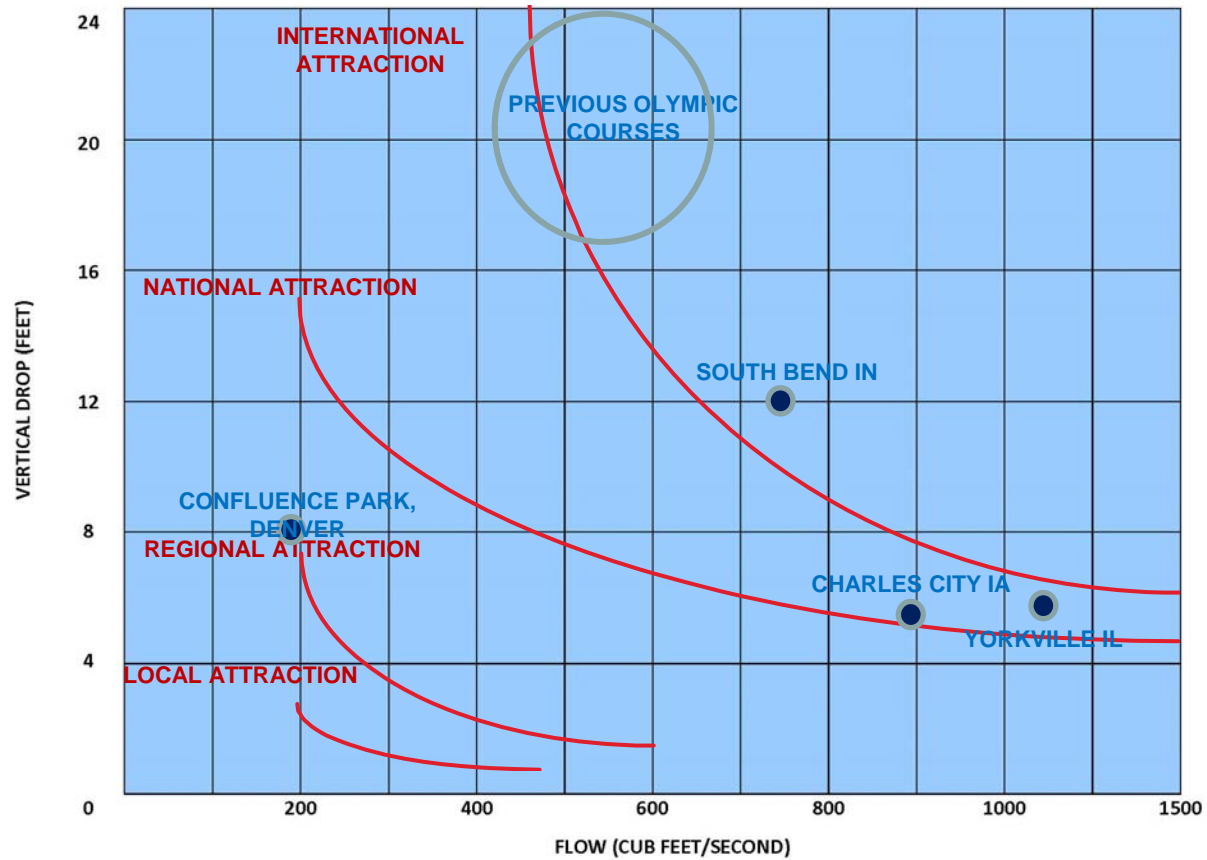


Site Factor 2 – Vertical Drop

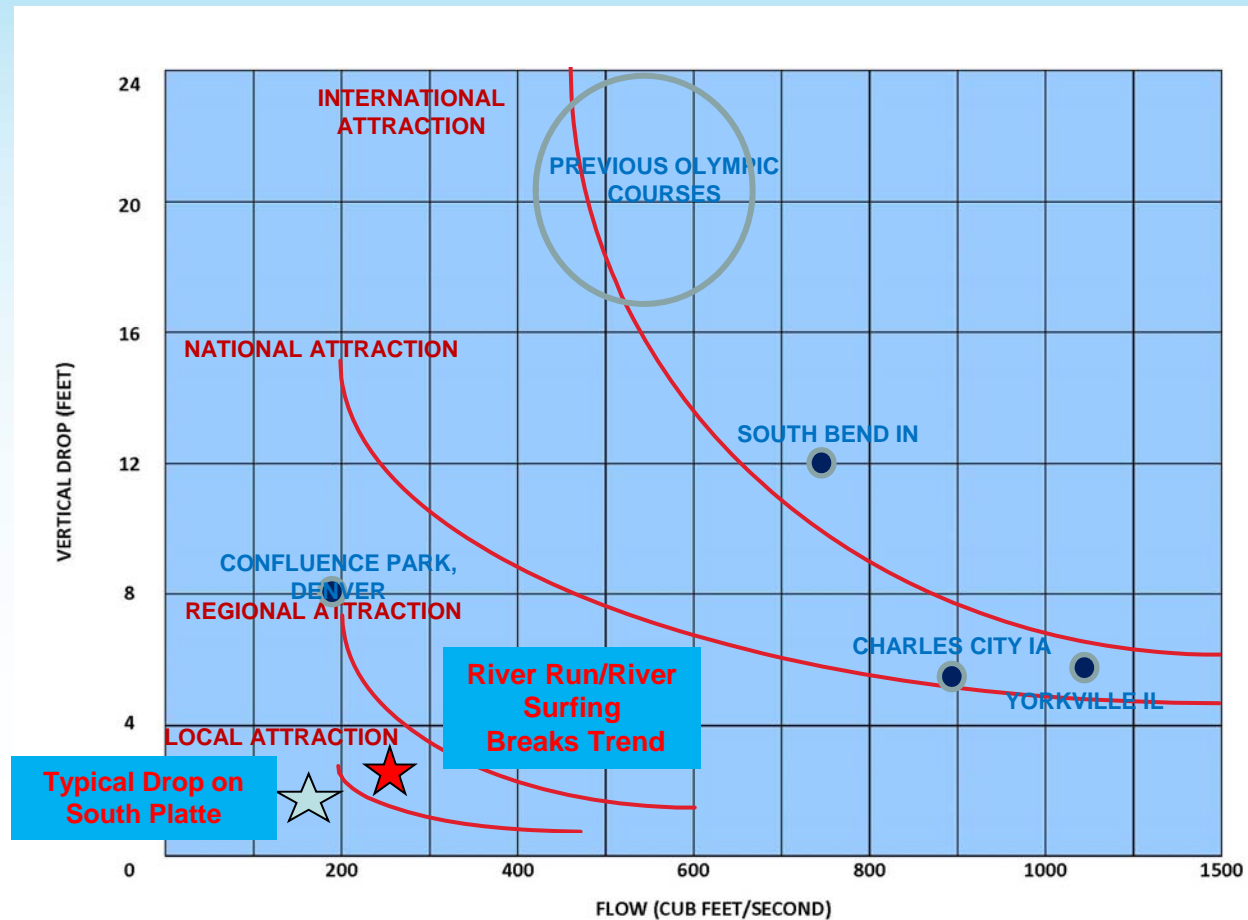
Look for existing dams, diversions, and drop structures.



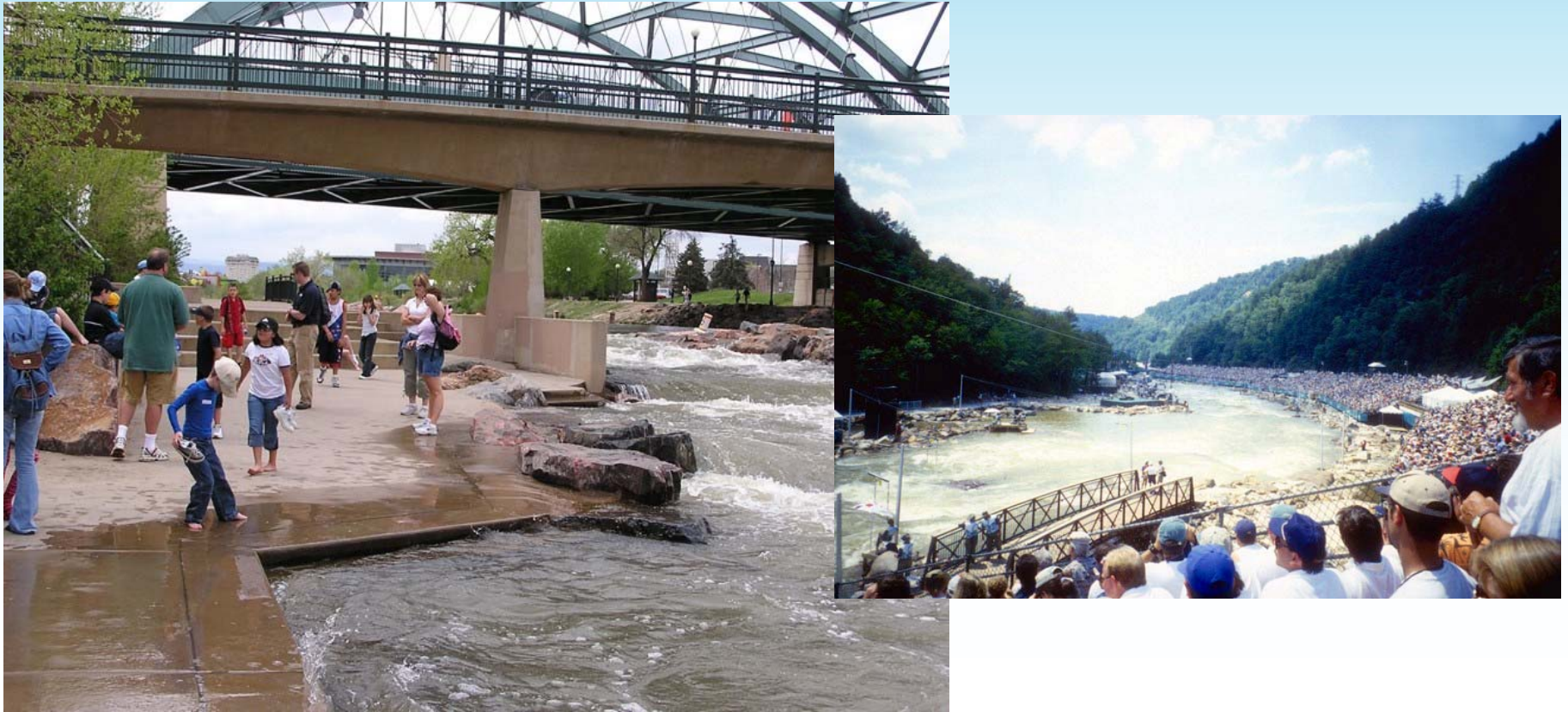
Flow and Drop are Related



Flow and Drop are Related



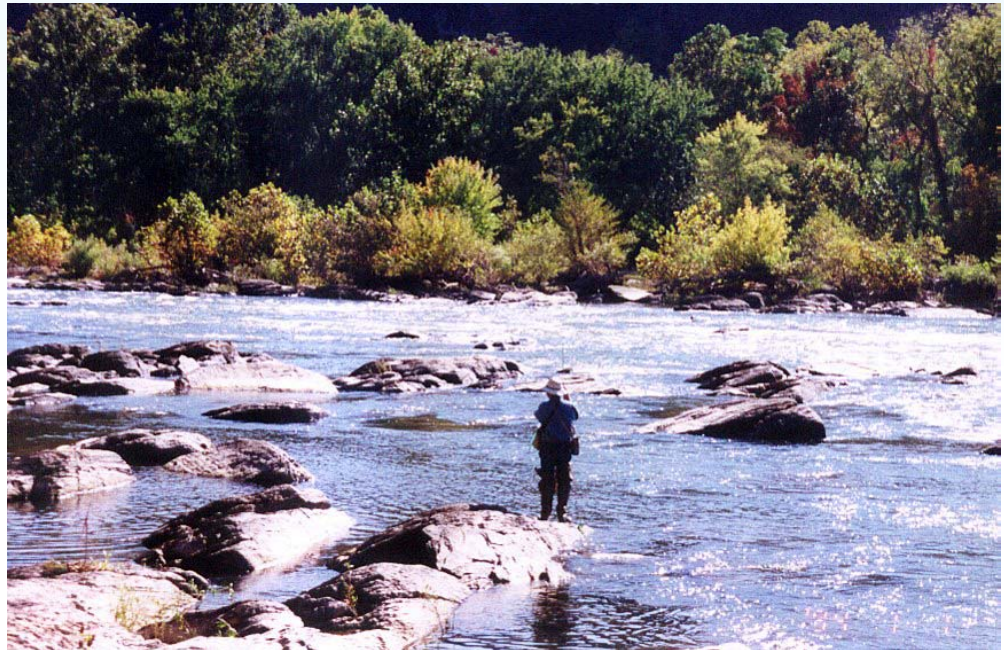
Site Factor 3 – Adjacent Area/Access



Whitewater parks are for spectators.

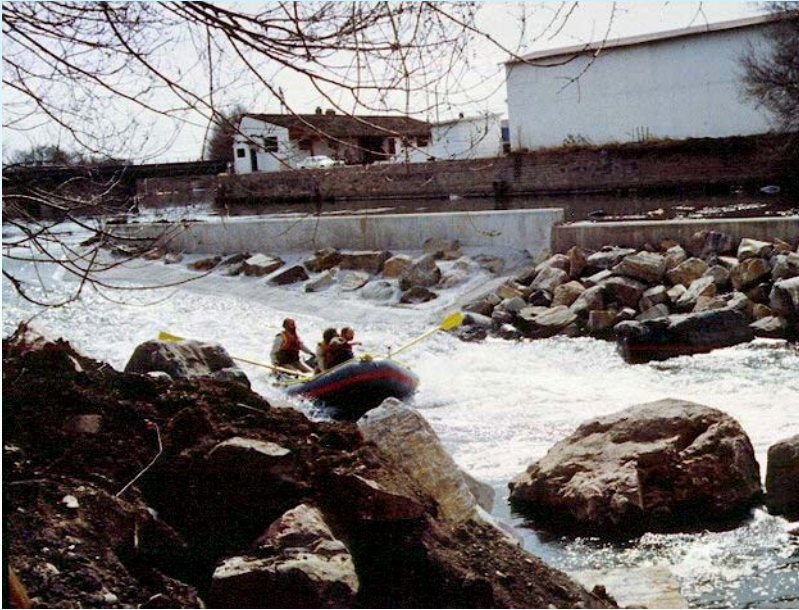
Site Factors - Others

- Floodplain
- River Morphology
- Fish Habitat and Passage
- Water Quality



Recreational Intent

Water trails



Creation of a Water Trail

Early Whitewater Bypasses, South Platte

Recreational Intent

Traditional



The Adventure Sports Course in Maryland has hosted both slalom and freestyle world cups yet is mostly enjoyed by the general public.

Recreational Intent

Surfing



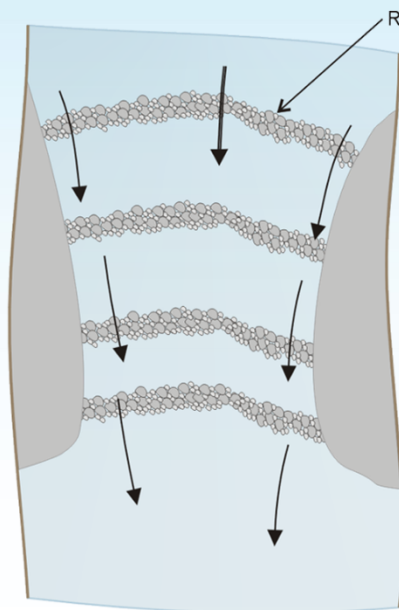


Presentation Outline

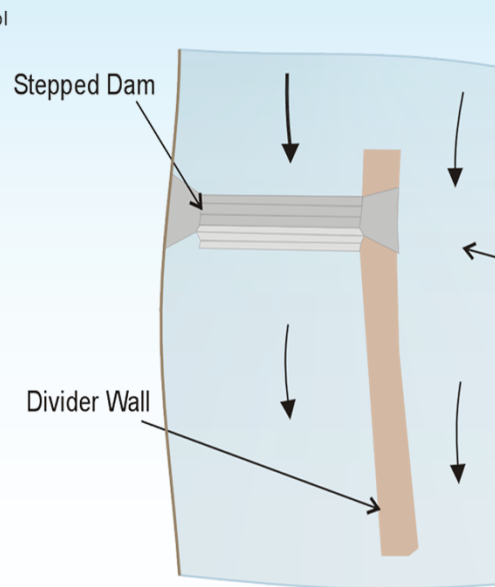
1. Why Whitewater?
2. Planning
3. Design
 - Types
 - Durability
 - Engineering Aspects
 - Safety Considerations
 - Costs



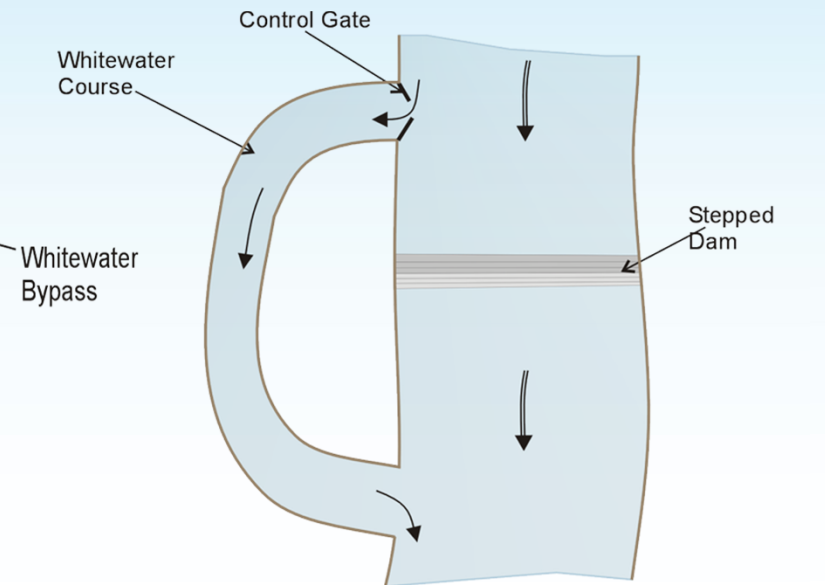
Types of Whitewater Courses and Parks



Route Full River Through
Low Gradient Drop or "Rapid"



Route Low & Moderate Flows Through Bypass
Around Adjacent Stepped Dam



Route Controlled Flow
Through Hydraulically Disconnected Side Channel

Durability



Nantahala – 2013 World Cup Venue



1996 Olympic Venue



Newly-changed Calgary weir still dangerous for rafters

Harvie Passage repair to cost millions | Alberta | News | Calgary Sun

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Harvie Passage repair to cost millions

Calgary's weir facing massive repair bill due to massive damage from high flood waters

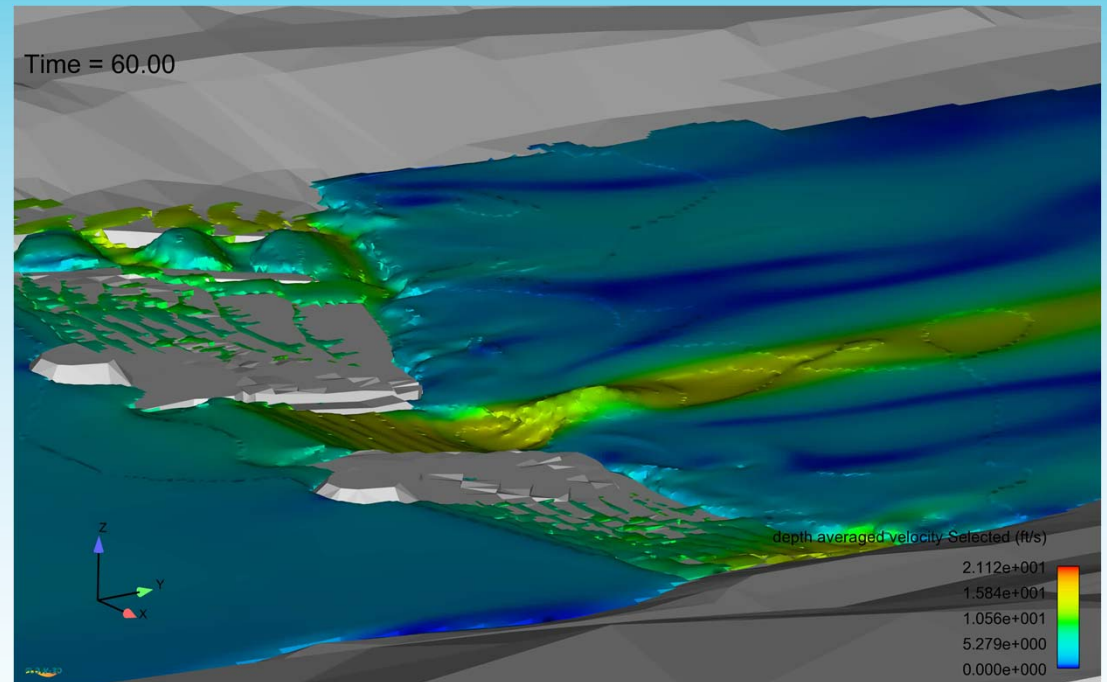
Engineering Aspects

- Safety and Recreational Performance
- Floodplain Impacts and Conveyance
- Functioning of Integrated Purpose
- Structure Stability
- Lowest Life-Cycle Costs
- Permitting
- Fish Passage
- Natural Appearance

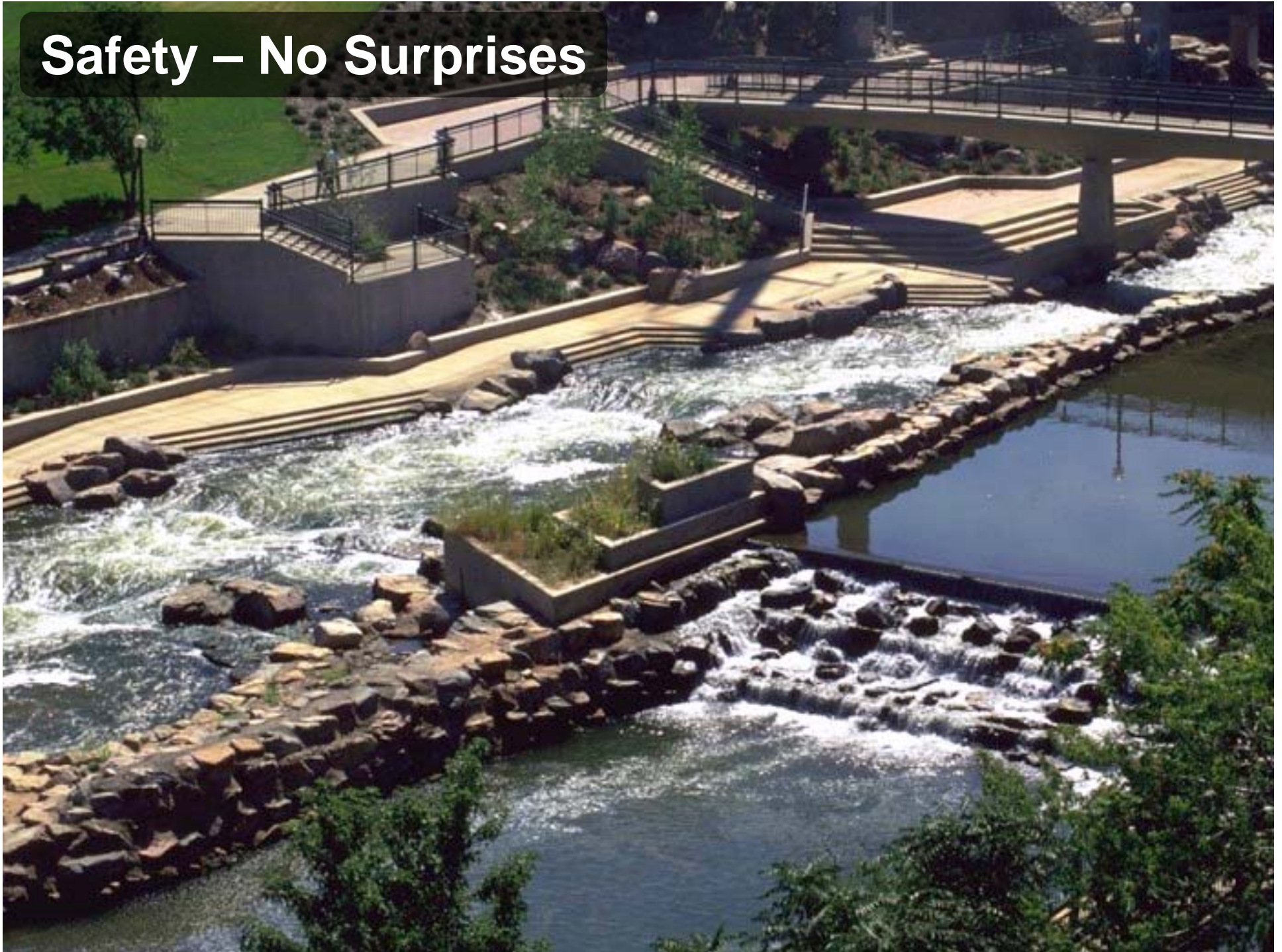


CFD Modeling

River Run Park



Safety – No Surprises



Costs

Estimated Percent Increase in Costs Related to Safety and Recreation*.

Scenario	Percentage Increase Based upon Entire Project Costs.
Conventional Drop (Hazardous Hydraulics)	Base
Low-Hazard Drop	10%
Recreational/Aesthetic Drop (River Run) – Non Adjustable	13%
WaveShaper Surf Feature	18%

**Based upon costs from River Run Project : 2017-2018, South Platte River.*



Thank You!



Misc slides

Site Factor 1 – Available Flow

USGS Surface Water data fo... x

Google usgs streamgage

Click to hide News Bulletins

- Please see news on new formats
- Full News

USGS Surface-Water Monthly Statistics for the Nation

The statistics generated from this site are based on approved daily-mean data and may not match those published by the USGS in official publications. The user is responsible for assessment and use of statistics from this site. For more details on why the statistics may not match, [click here](#).

USGS 06710247 SOUTH PLATTE RIVER BELOW UNION AVE, AT ENGLEWOOD, C

Available data for this site Time-series: Monthly statistics GO

Arapahoe County, Colorado
Hydrologic Unit Code 10190002
Latitude 39°37'57", Longitude 105°00'52" NAD27
Drainage area 3,098 square miles
Gage datum 5,290 feet above NGVD29

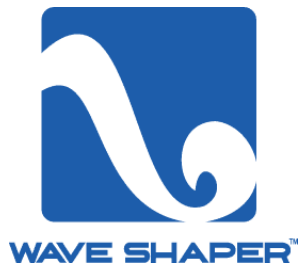
Output formats

- HTML table of all data
- Tab-separated data
- Reselect output format

00060, Discharge, cubic feet per second, Monthly mean in ft ³ /s (Calculation Period: 1996-03-01 -> 2017-04-30)												
YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996			27.1	103.8	157.9	205.1	212.7	107.0	80.8	30.5	57.0	23.5
1997	12.7	46.1	47.7	89.8	194.3	516.2	310.0	364.8	80.5	81.9	83.5	76.4
1998	73.6	66.6	111.7	402.8	931.8	346.5	490.4	463.7	96.0	111.3	28.5	14.7
1999	21.9	20.1	53.5	178.3	745.1	1,222	550.1	484.6	74.4	49.5	76.0	66.8
2000	64.2	57.6	76.6	146.6	259.5	248.4	171.5	107.5	41.7	42.4	33.8	39.5
2001	61.8	81.7	70.3	79.2	200.2	160.0	190.9	104.0	58.7	20.1	14.5	14.9
2002	19.2	31.7	60.2	23.4	45.0	70.6	22.4	10.8	19.6	21.7	9.95	9.67
2003	9.91	11.7	103.4	308.9	263.5	211.6	131.7	93.7	114.4	25.0	17.6	20.5
2004	23.4	38.7	27.6	132.2	143.5	142.1	288.2	191.3	58.3	58.1	59.6	26.9
2005	19.4	23.0	33.5	258.6	518.5	351.4	94.0	178.4	50.6	66.1	71.9	22.7
2006	14.3	29.0	38.7	47.9	138.6	134.6	333.9	245.5	109.6	161.5	56.6	26.4
2007	27.9	82.2	392.5	572.7	1,716	873.5	439.5	371.2	194.2	87.9	78.2	60.1
2008	32.2	69.2	134.3	192.2	258.5	345.2	376.7	213.9	88.8	40.2	17.1	22.0
2009	55.2	23.1	36.3	178.1	388.0	938.8	368.9	121.9	58.0	129.4	39.0	67.7
2010	56.8	61.7	92.6	374.3	461.0	389.7	149.0	302.0	28.7	31.0	53.8	43.7
2011	58.8	65.0	47.7	59.8	60.2	149.2	513.0	185.8	48.5	31.1	21.9	20.6
2012	55.0	60.9	58.7	48.6	39.7	47.6	44.6	25.5	35.7	29.3	17.4	15.0
2013	14.9	20.2	28.9	58.3	115.7	65.9	61.5	78.4	84.1	27.3	26.1	54.6
2014	43.9	51.0	62.1	186.0	198.5	695.5	324.5	200.6	63.0	91.4	67.0	65.7
2015	74.1	89.4	106.8	226.2	1,674	2,414	1,454	276.0	52.5	38.7	34.1	61.5
2016	61.7	80.0	112.9	536.0	1,028	564.7	248.6	119.5	47.9	22.5	32.0	41.5
2017	55.1	56.4	70.3	69.9								
Mean of monthly Discharge	41	51	82	194	454	481	323	202	71	57	43	38

*** No Incomplete data have been used for statistical calculation

Who Uses Whitewater Parks – New Trend.....Surfing



Safety

- Safety improvements – Union Avenue boat chutes; Sheridan, CO



Before



After

Recreational Intent

Performance & Engineering - Fun Equation

$$RE(\text{fun}) \propto f(\text{SQ}, \$, \text{Power}, \text{Design})$$

RE= Quality of Recreational Experience

SQ= Site Quality = Access and Location

Power = Flow and Drop

\$ = Life Cycle Costs

The background of the slide is a photograph of a river with two young girls walking across large, flat rocks. The girl on the left is wearing a purple long-sleeved shirt and purple pants, carrying a backpack. The girl on the right is wearing a black shirt and blue jeans, also carrying a backpack. The water is calm, reflecting the surrounding greenery and the children. In the upper center, there is a circular inset showing a person wearing a hat and a white shirt crouching on a rock, looking down at the water. In the lower right, there is another circular inset, this one in black and white, showing a close-up of a child's hand holding a small, dark, segmented object, possibly a worm or a small insect.

Nature Play Design Guidelines:

Techniques for Including Nature Play
within Floodplains

CASFM 2018 Annual Conference Presentation



Cassie Kaslon
Managing Principal
Valerian

Susan Brown
Founding Principal
Valerian

Frans Lambrechtsen
Water Resource Engineer
Jacobs (CH2M)



NATURE PLAY IN THE BUILT ENVIRONMENT

DESIGN STANDARDS AND GUIDELINES



PREPARED FOR:

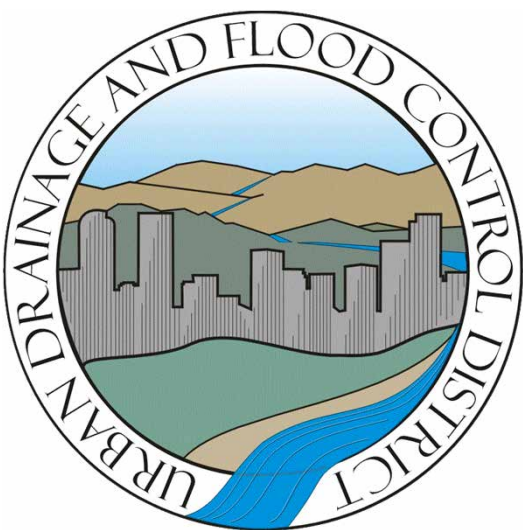


DENVER
PARKS & RECREATION





DENVER
PARKS & RECREATION



Design Guidelines





What's in the Guidelines

- **Nature Play Benefits**
- **Site Selection**
- **Public Engagement**
- **Inclusion in Nature Play**
- **Design Development**
- **Construction Document Guidelines**
- **Project Construction Period**
- **Post Occupancy**
- **Case Studies**

- **Over 70 pages of riveting information!**



Why Nature Play Matters

Recent findings from GOCO indicate that 80% of Denver Public School students have never been to the Rocky Mountains

Denver Office of Children's Affairs estimates that 54% of Denver's children live in families at or below poverty level

Benefits include:

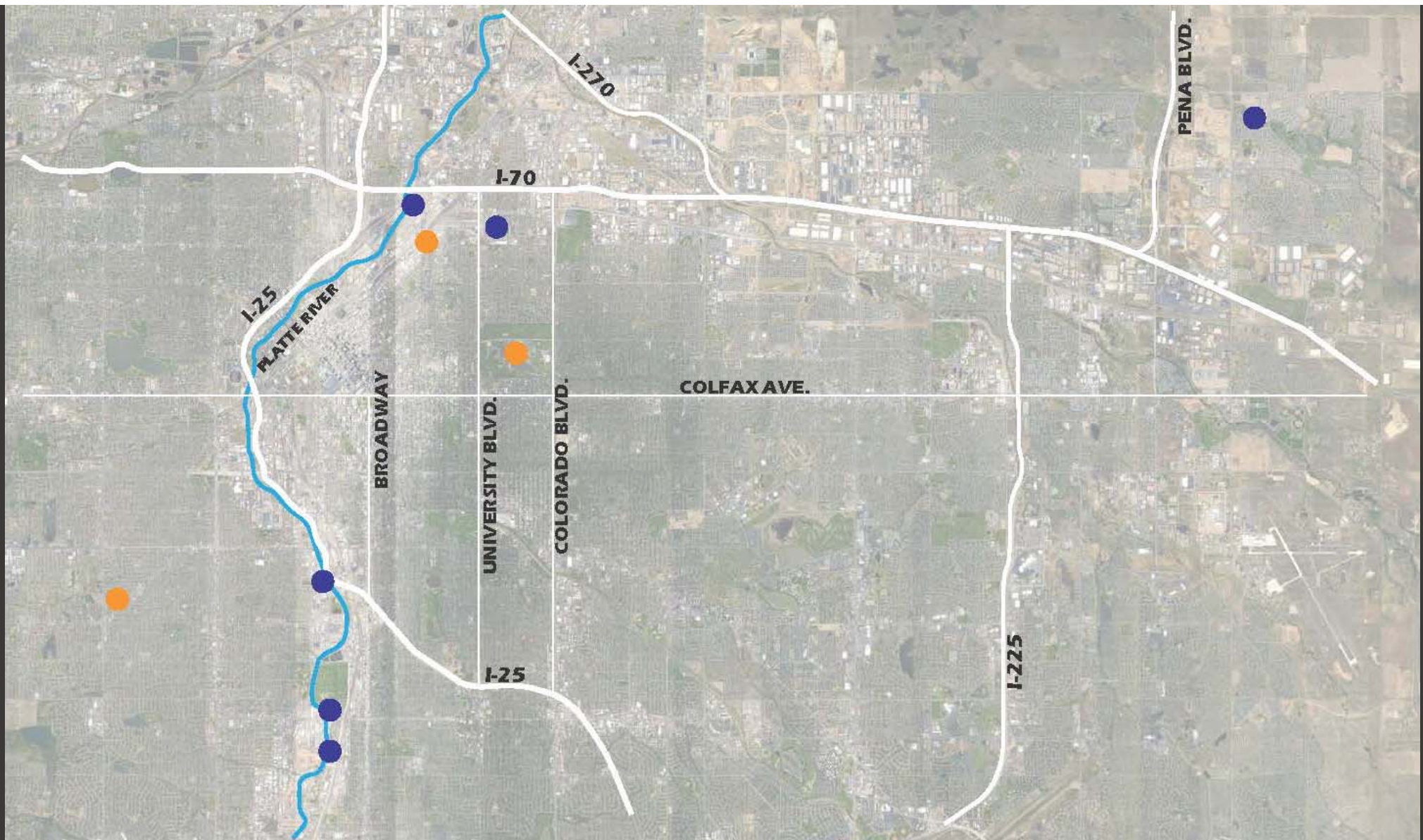
- **Environmental Stewardship**
- **Socio Economic**
- **Developmental/Health**
- **Economic**



Why Nature Play Matters

The Denver Parks and Recreation Game Plan outlines the following key values for future park planning:

- **Sustainable Environments**
- **Equity**
- **Engagement**
- **Sound Economics**





Globeville Landing Park



39th Ave GREENWAY



ST.CHARLES PARK



CITY PARK



WESTWOOD PARK



JOHNSON HABITAT PARK



PASQUINEL'S LANDING



GRANT FRONTIER PARK



FIRST CREEK PARK

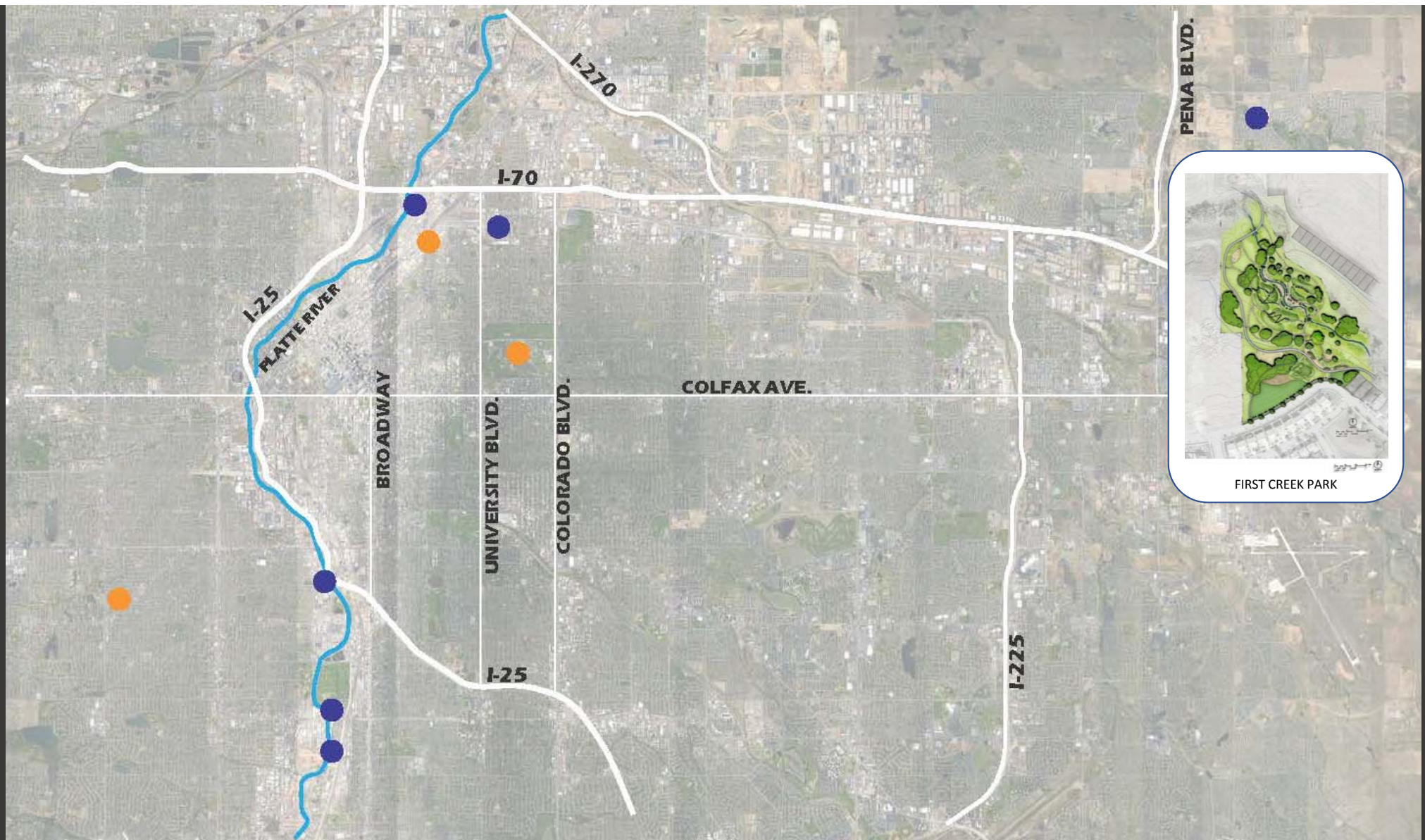
I-70

COLFAX AVE.

COLORADO BLVD.

I-225

PENA BLVD.





FIRST CREEK PARK



Site Selection



What Makes a Good Site

- **Proximity to waterways/floodplains**
- **Existing mature vegetation**
 - **Shade trees — preserved and utilized**
 - **If removed, vegetation can be repurposed into seating and climbing features**
- **Plant inventory and weed management strategies**



What Makes a Good Site

- **Existing landforms – hills and slopes should be preserved or developed**
 - **Embankment slides, caves, or climbing areas**
- **Accessible to multi-modal systems**
- **Proximity to regional trails**

What Makes a Good Site

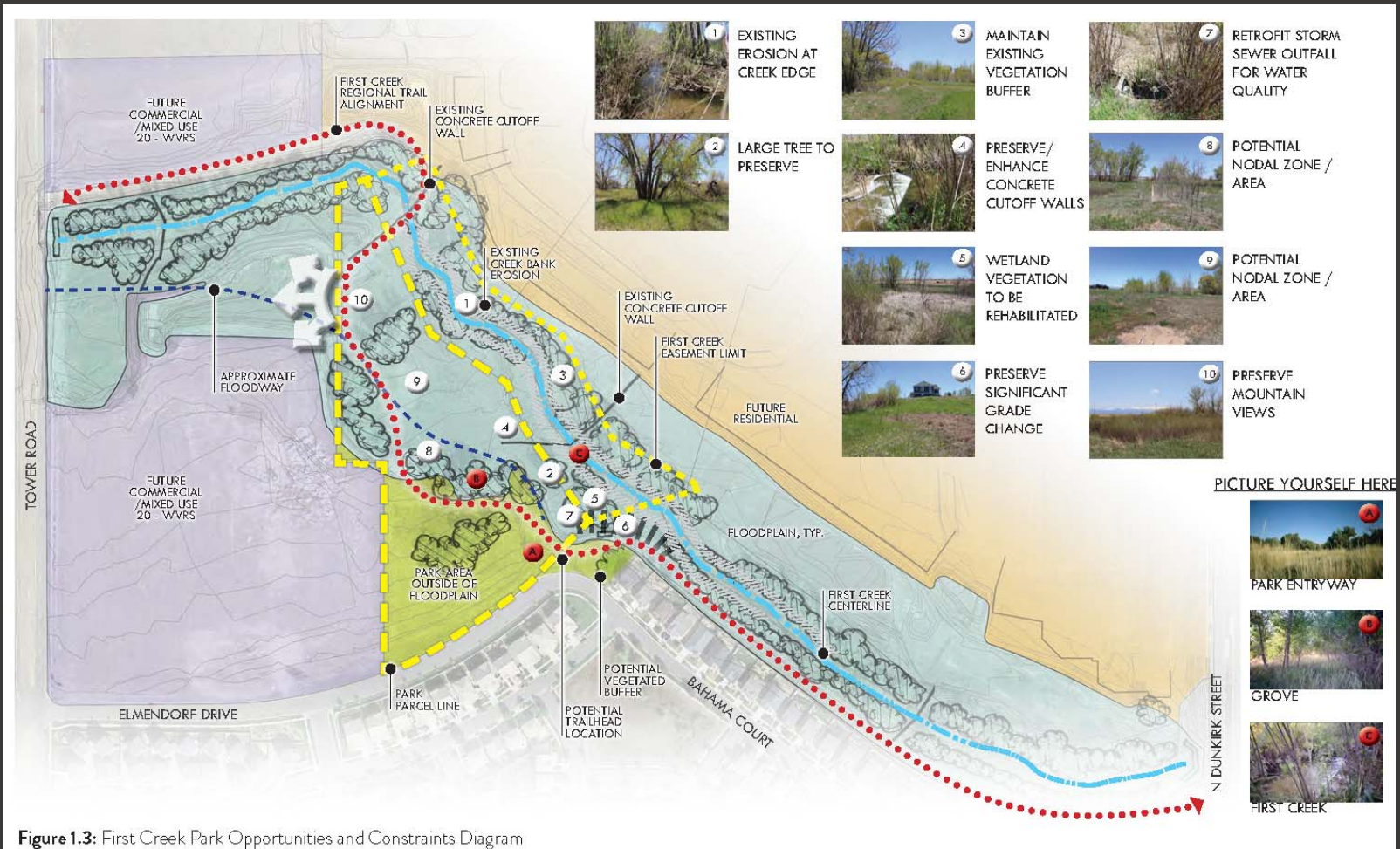


Figure 1.3: First Creek Park Opportunities and Constraints Diagram



Public
Engagement
Process



Community Context

**Gather community input through creative measures.
Include hands on and collaborative activities: asset mapping,
community commitment boards, sandbox charettes**





Hidden
Elements of
Play





What You Wont See

- **Large Play Structures**
- **Play Features That Require Fall Zones and Safety Surfacing**



What You Wont See

- **Large Play Structures**
- **Play Features That Require Fall Zones and Safety Surfacing**



But You May See This!

- **Water**
- **Boulders**
- **Logs**
- **Plants**
- **Animals**
- **Dirt!**



Enhance the Existing

View the site from the eyes of the future user... children

Connect the element of fun into the existing site features

- **Landforms**
- **Vegetation**
- **Waterways**

Use The Trail System



Use Subtle Prompts



Use Landforms



Use Vegetation



Don't Forget the Shade



Include All 5 Senses



Repurposing Material





Longevity and
Maintenance





How to Make it Last (Longer)

Allegory of “The Car”

Two recent grads from a university just got their new “big boy (or girl)” job, and were buying new cars to go with their new jobs.

One grad did his *research* before buying the car, knew what *kind* of car, *how much* he was paying, *where* he was buying it, and created a *maintenance plan* for when to get it serviced.

The other grad did none of these things and bought the coolest imported car the salesman told him he should buy.

What happened?

Making it Last

1. **Develop a planting plan to withstand heavy use appropriate to the site**
- 2. **Educate users on how to use the space**
3. **Work with maintenance staff to develop a maintenance plan**
4. **Follow through after construction and make necessary changes**





Change Will
Happen

The Ideal Person Who Handles Change

The first person you think about who is great with change is an Engineer right?



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How to Deal With Change?

1. Know and expect change to happen
2. Identify what changes you can be okay with
 -
3. Let change happen – the users will know, better than we will, how to use nature for play





What Can and Can't Change

Things that CAN'T change

- **Volume of the floodplain**
- **Locations of structures that cross the low flow channel**
- **Channel geometry**

Things that CAN change

- **Vegetation (within reason)**
- **Locations of nature play areas inside of the floodplain**
- **Alignments of secondary/tertiary trails**



Educate Others

- Engage the community in the discussion of the area
- Use signage to educate users on how the area may change over time – and that's OK



More than A
Fad





Please visit the following for additional
resources:

www.valerianllc.com

www.naturalplaygrounds.ca

www.goco.org

www.thegreenwayfoundation.org

<https://udfcd.org/>