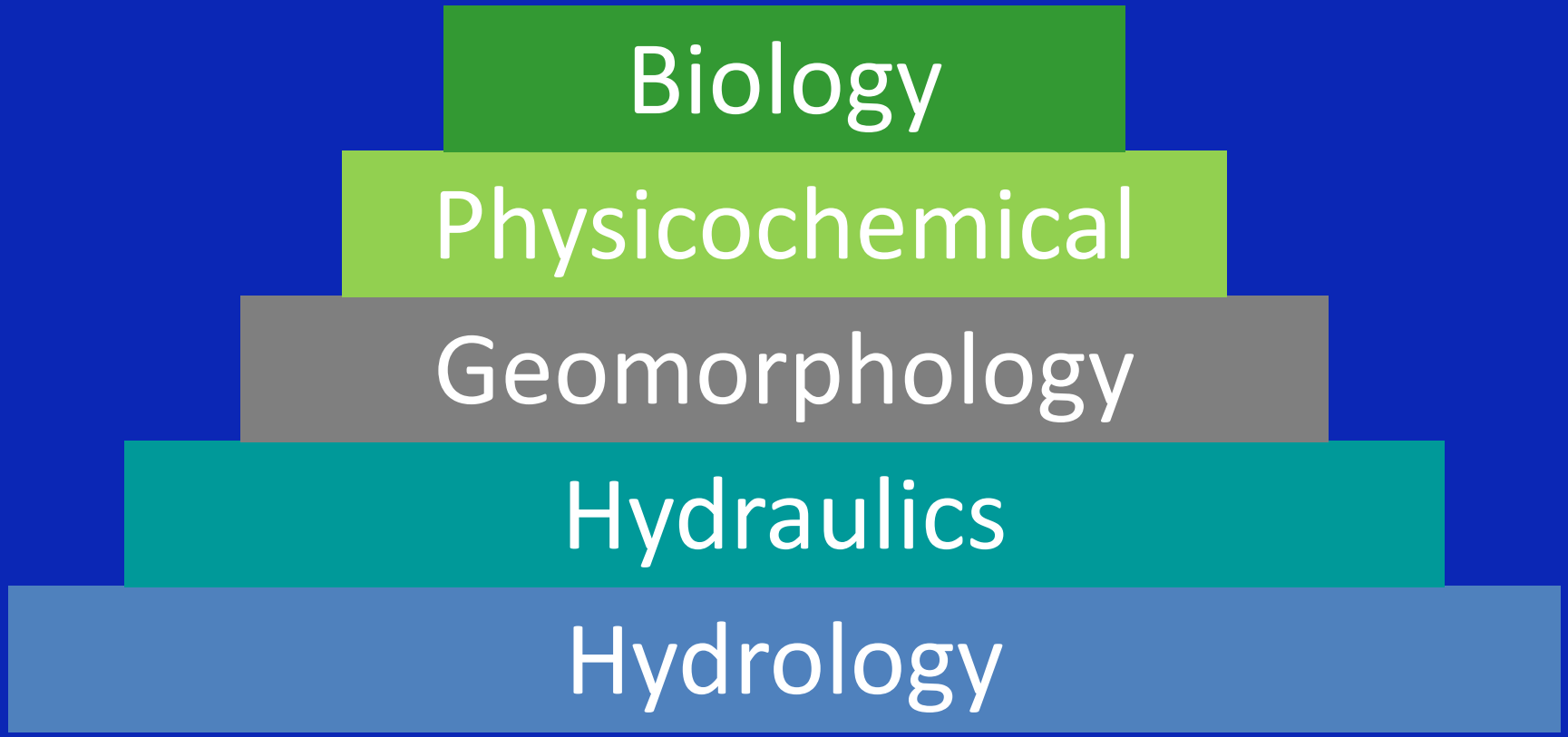
Long- Term Monitoring of Fish Populations from NCD Project Sites

Matt Kondratieff
Aquatic Research Scientist

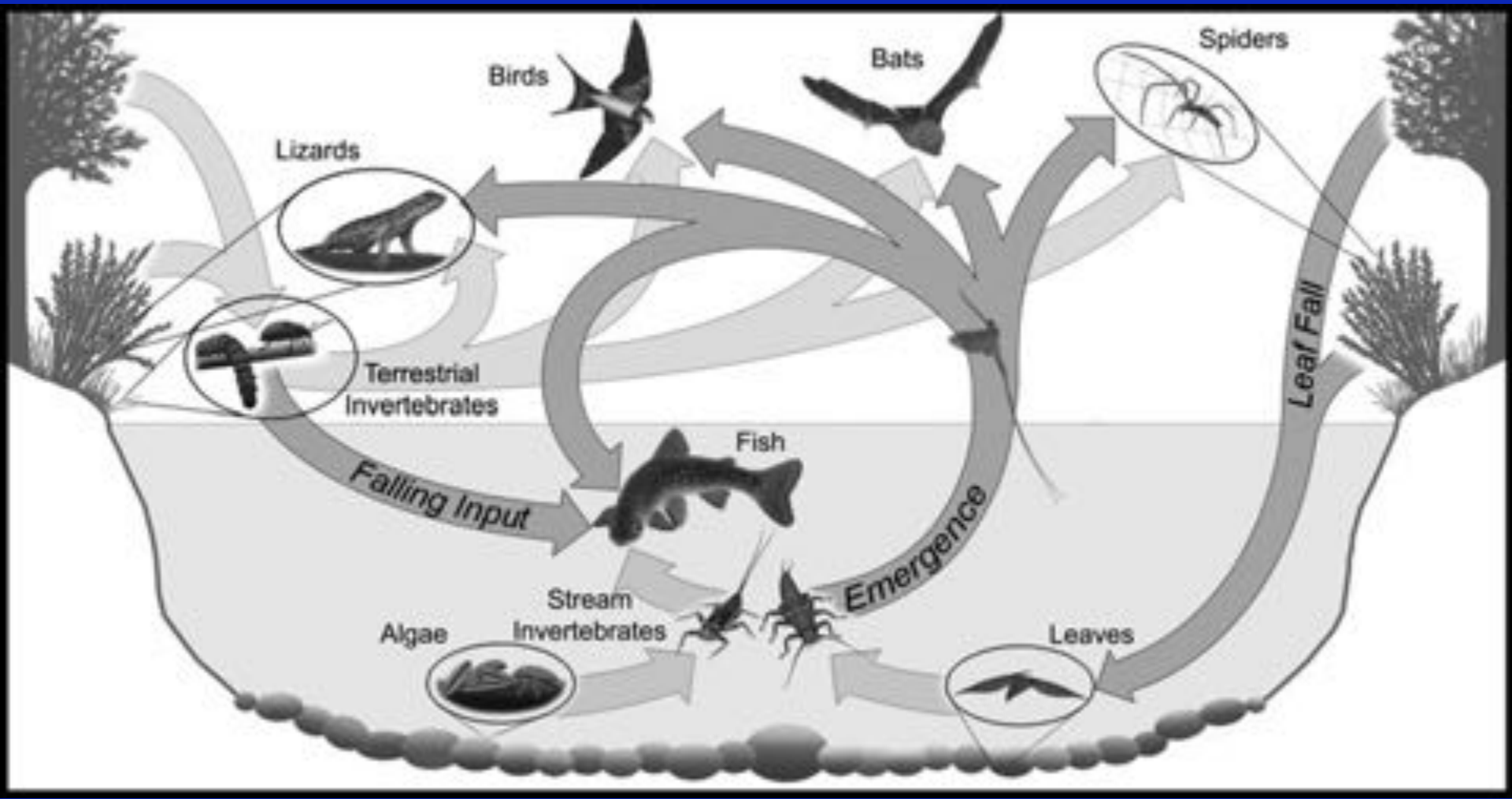
ELI Webinar Series
Fort Collins, CO
May 16, 2019

Limiting Factors & Ecological Function



Courtesy Will Harmon, USFWS

Fish populations= Ecological Indicator



Colden et al. 2005

How do you improve a fish population?

Stocking

How do you improve a fish population?

Stocking

Regulations

How do you improve a fish population?

Stocking

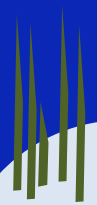
Regulations

Habitat

Basics of Stream Habitat

Modified from Schlosser and Angermeier 1995

Basics of Stream Habitat



Spawning Habitat

Feeding Habitat

Modified from Schlosser and Angermeier 1995


CO
COLORADO
PARKS • WILDLIFE

Basics of Stream Habitat

Modified from Schlosser and Angermeier 1995


CO
COLORADO
PARKS • WILDLIFE


CO
COLORADO
PARKS • WILDLIFE

Basics of Stream Habitat

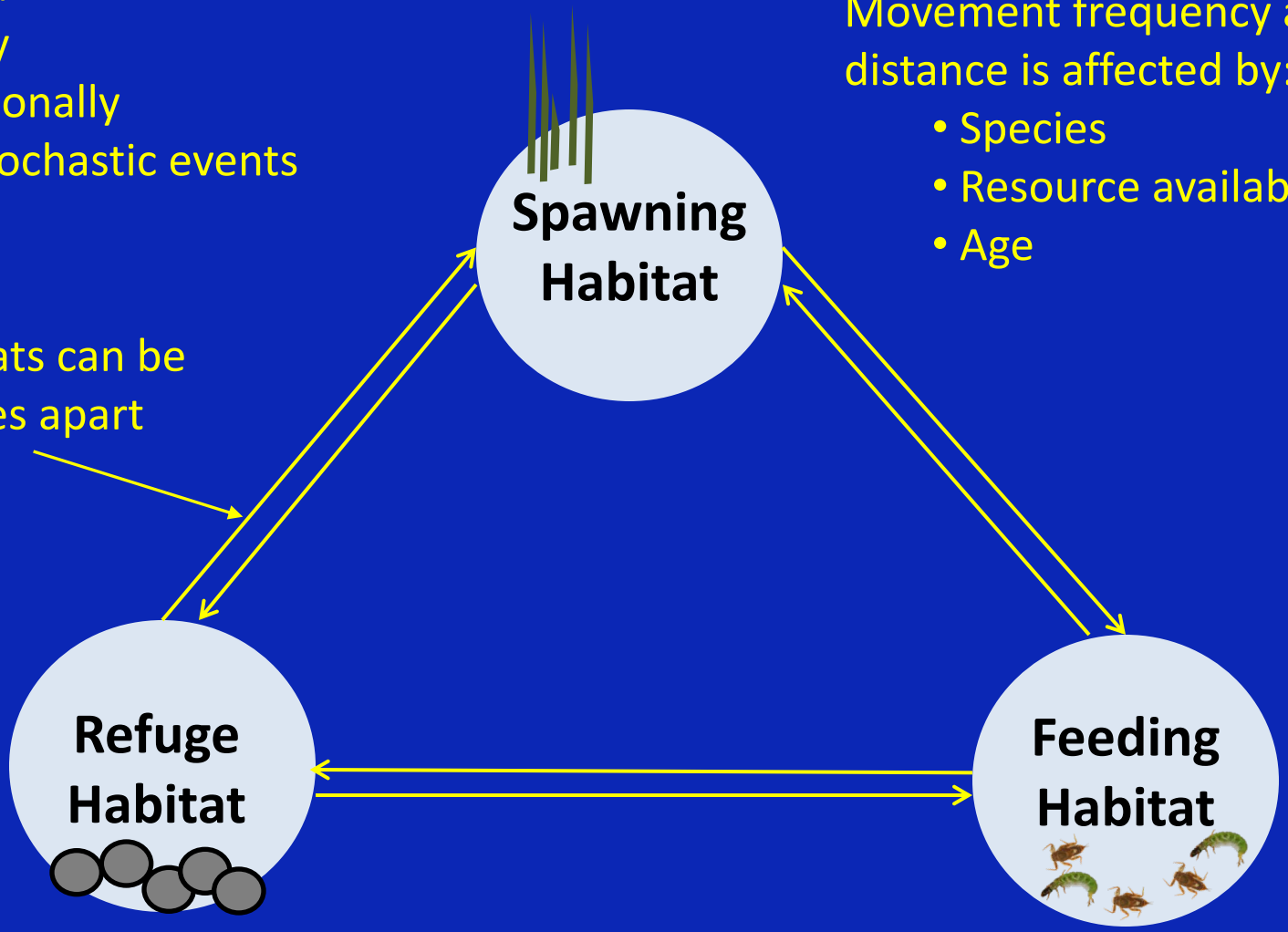
Fish move:

- Daily
- Seasonally
- In stochastic events

Movement frequency and distance is affected by:

- Species
- Resource availability
- Age

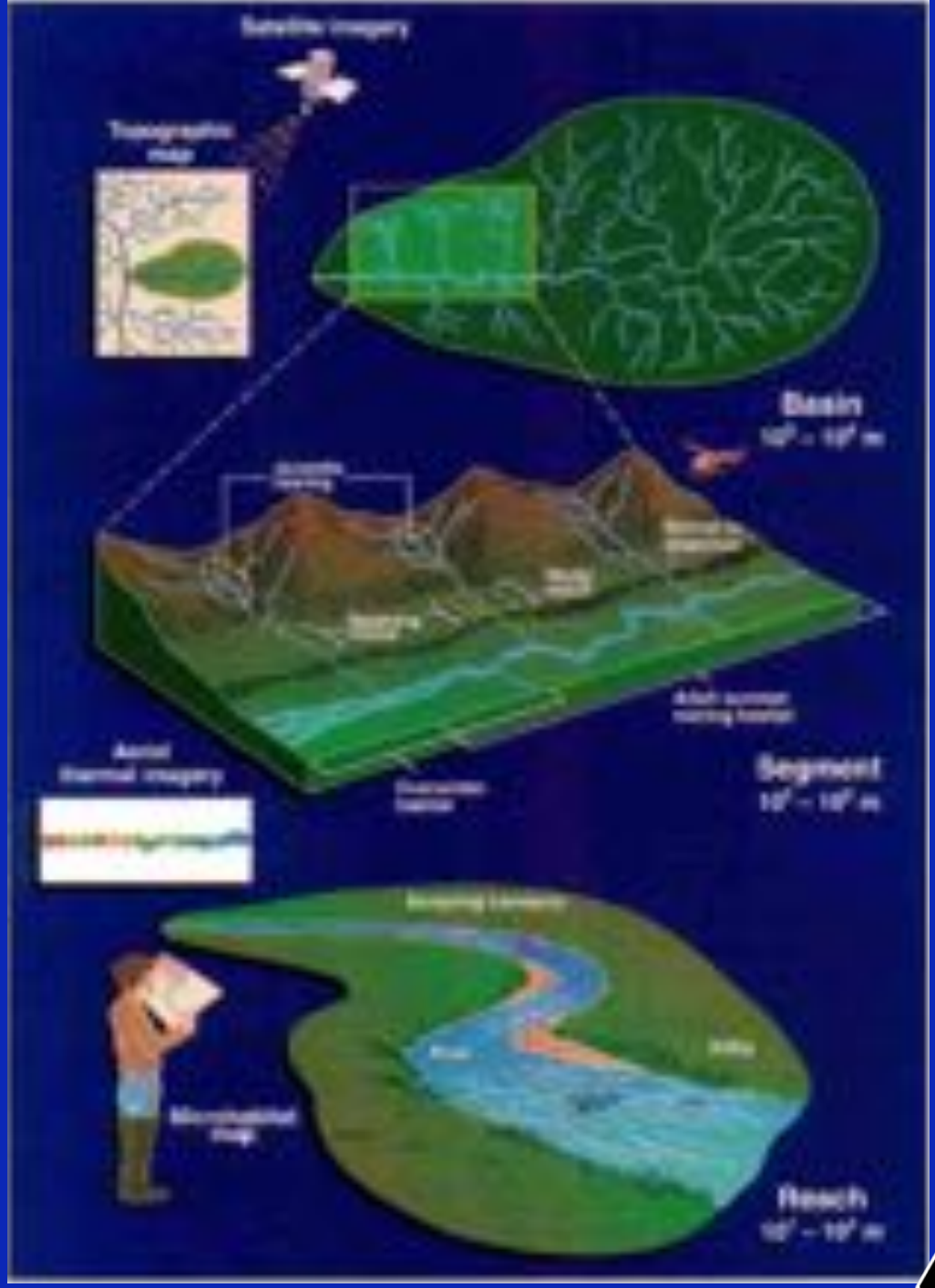
Habitats can be miles apart



Modified from Schlosser and Angermeier 1995

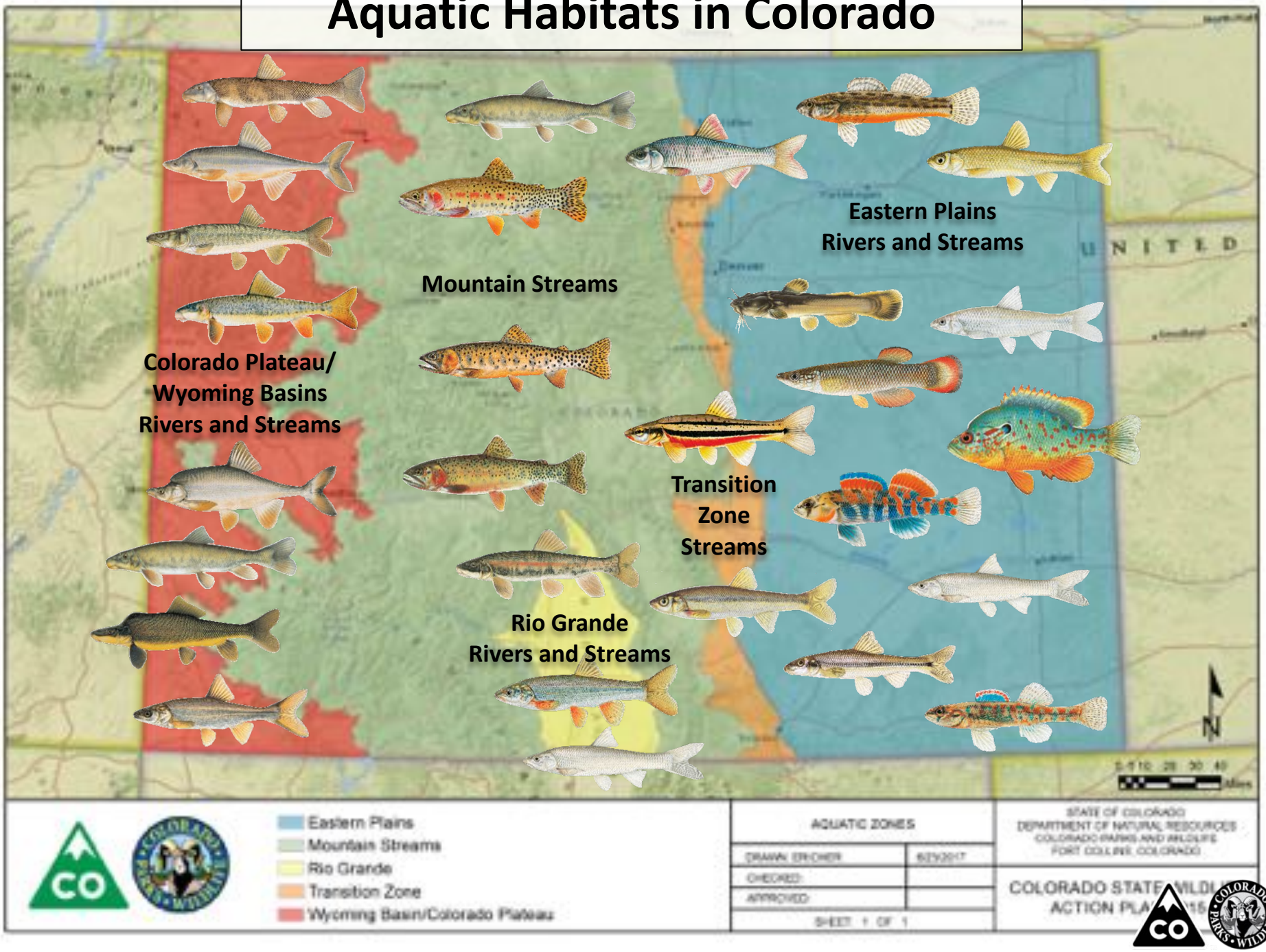
Basics of Stream Habitat

Scale



Fausch et al. 2002

Aquatic Habitats in Colorado



Critical Trout Habitat Functions

1) Salmonid Forage Production Areas
2) High Flow Refugia
3) Low Flow & Winter Refugia
4) Spawning Habitat
5) Rearing Habitat
6) Adult Cover

Courtesy Dave Rosgen, Wildland Hydrology

Natural Channel Design: Reference Reach

Natural Channel Design: Fundamentals

Existing

Natural Channel Design: Fundamentals

Existing

Reference

Natural Channel Design: Fundamentals

Existing

Reference

Proposed

Monitoring Results: Buckley Ranch

BACI study

C. Toewood

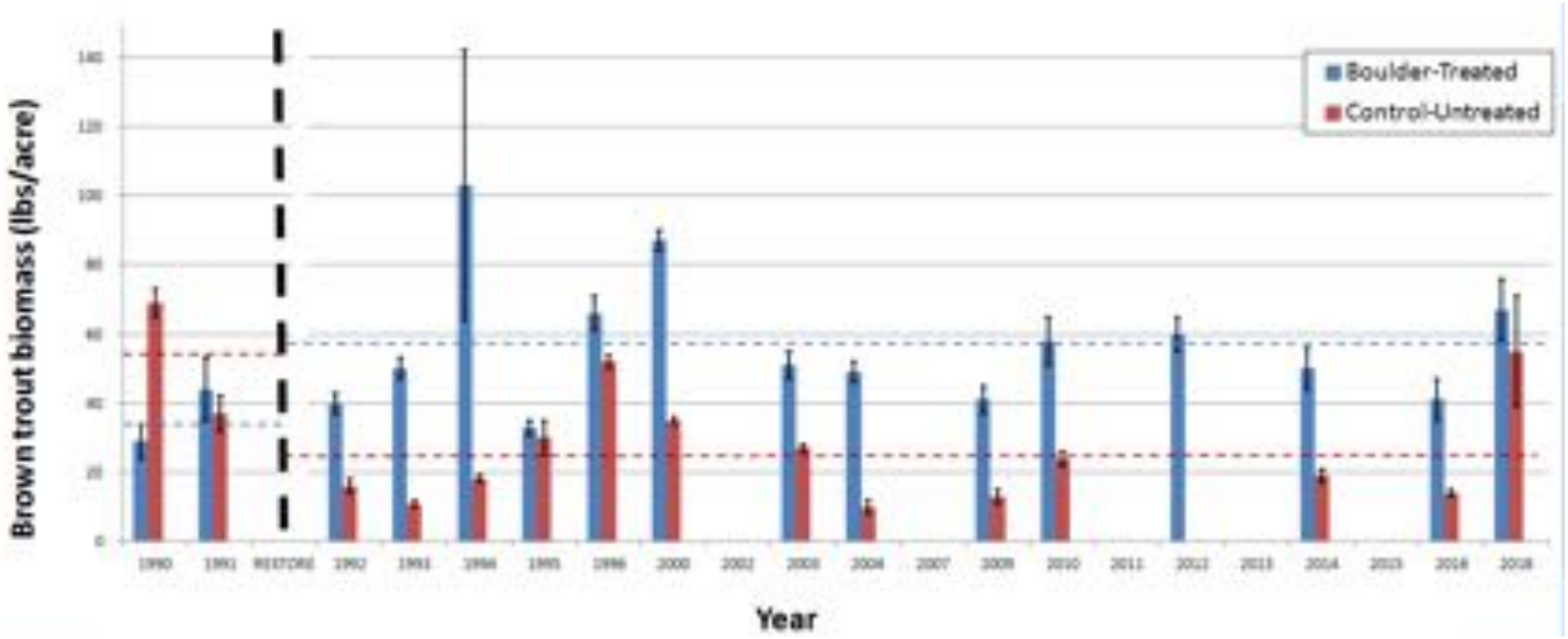
B. Boulder

A. Unimproved

Control-Untreated

Boulder-Treated

Boulder-Treated Vs Control-Untreated



Boulder-Treated Vs Control-Untreated

Monitoring Period:

1990-2018: 28 YEARS!

Pre- vs Post:

- Boulder-Treated: Brown Trout biomass increased 56% compared with pre-project baseline.

- Control-Untreated: Brown Trout Biomass declined 53% over the same time 26-year post-monitoring period.

Boulder-Treated Vs Control-Untreated

Monitoring Period:

1990-2018: 28 YEARS!

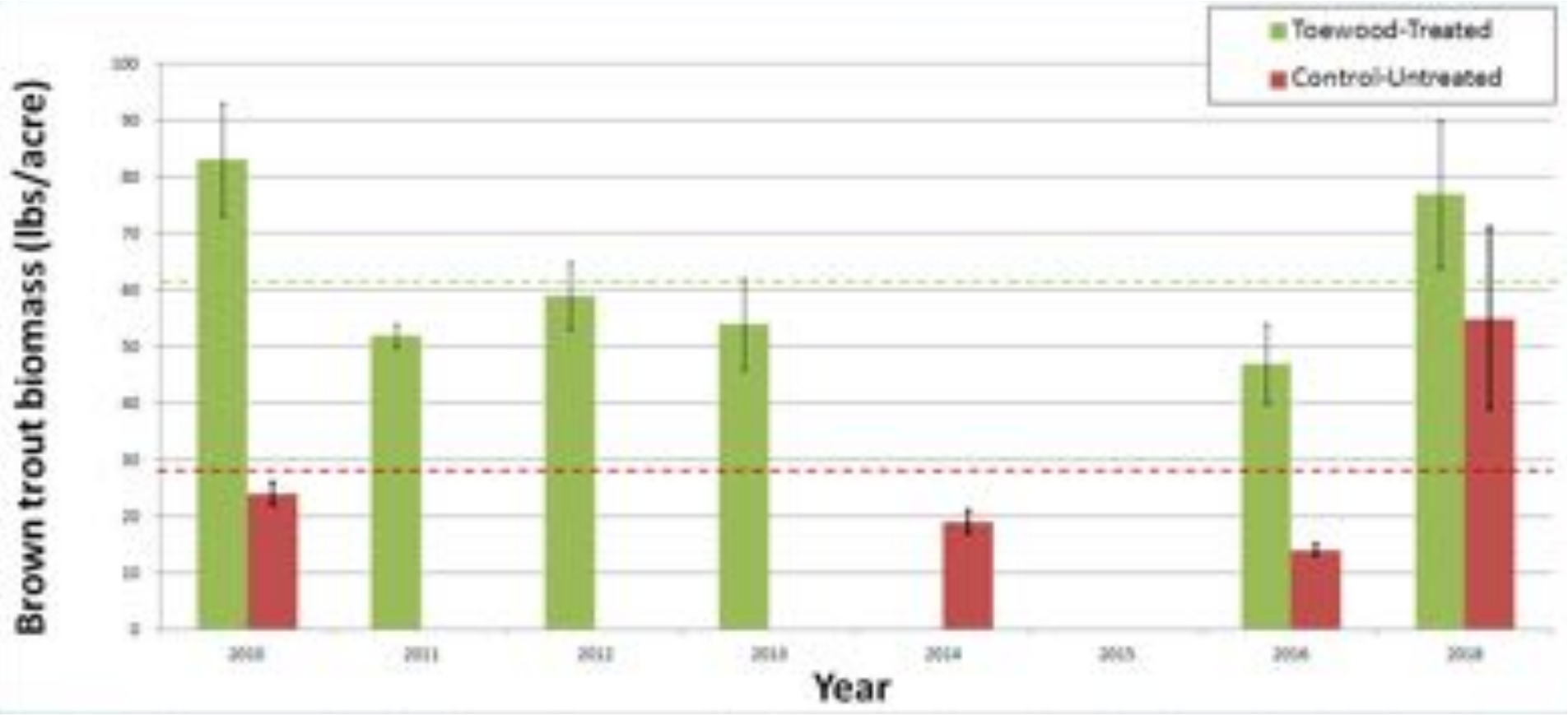
Boulder vs Control:

- Brown Trout biomass in the boulder -treated averaged 32% higher over the control-untreated reach for entire monitoring period

- Average difference in biomass (within year) was 183% (range 10-472 %) boulder over control

Toewood-Treated

Toewood-Treated Vs Control-Untreated



Toewood-Treated Vs Control-Untreated

Monitoring Period:

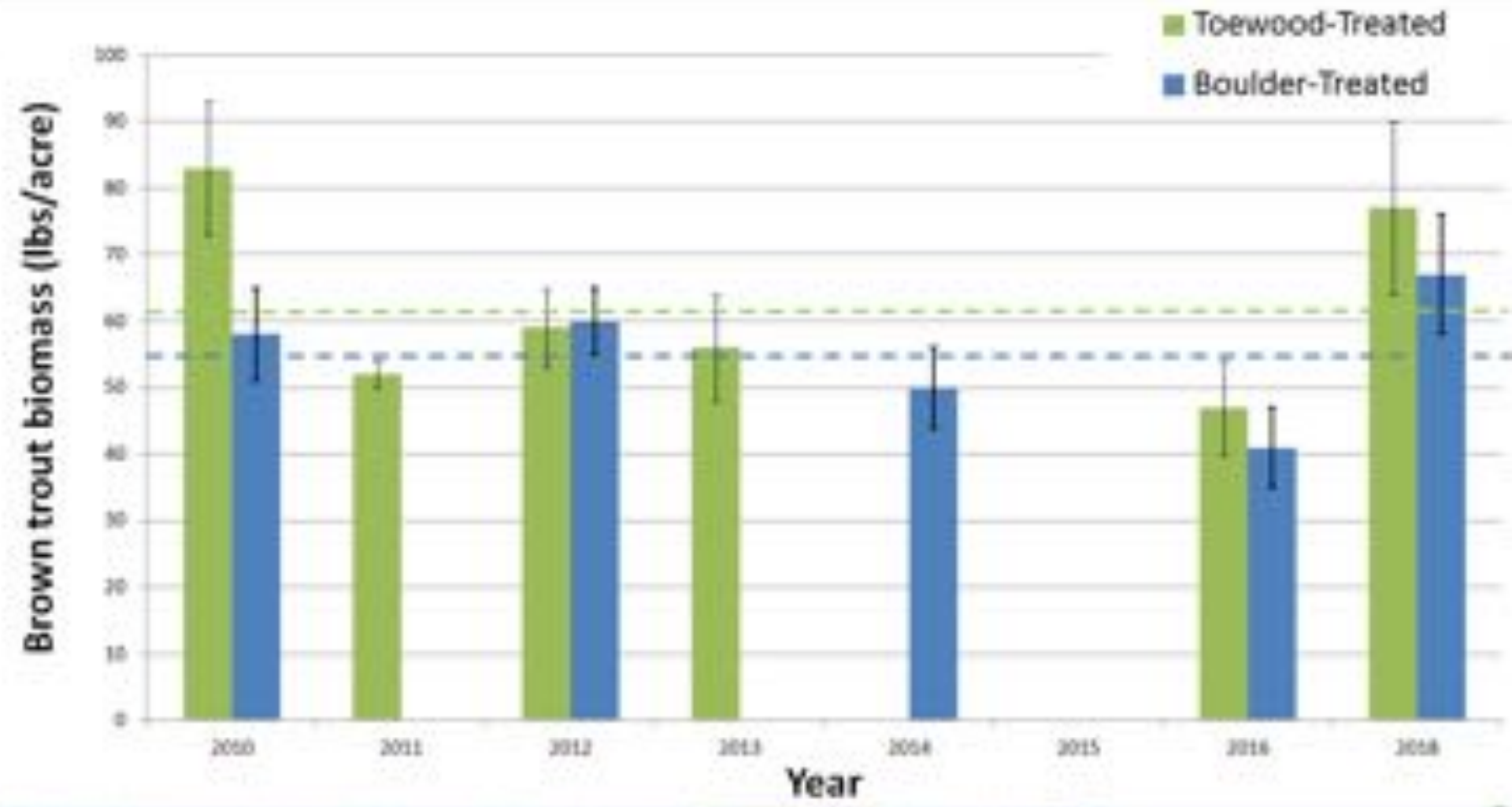
2010-2018: 8 YEARS

Toewood-Treated vs Control:

- Brown Trout biomass in the toewood -treated reach averaged 34% higher over the control-untreated reach for entire monitoring period

- Average difference in biomass (within year) was 173% (range 40-245 %) toewood over control

Toewood-Treated Vs Boulder-Treated



Toewood-Treated Vs Boulder-Treated

Monitoring Period:

2010-2018: 8 YEARS

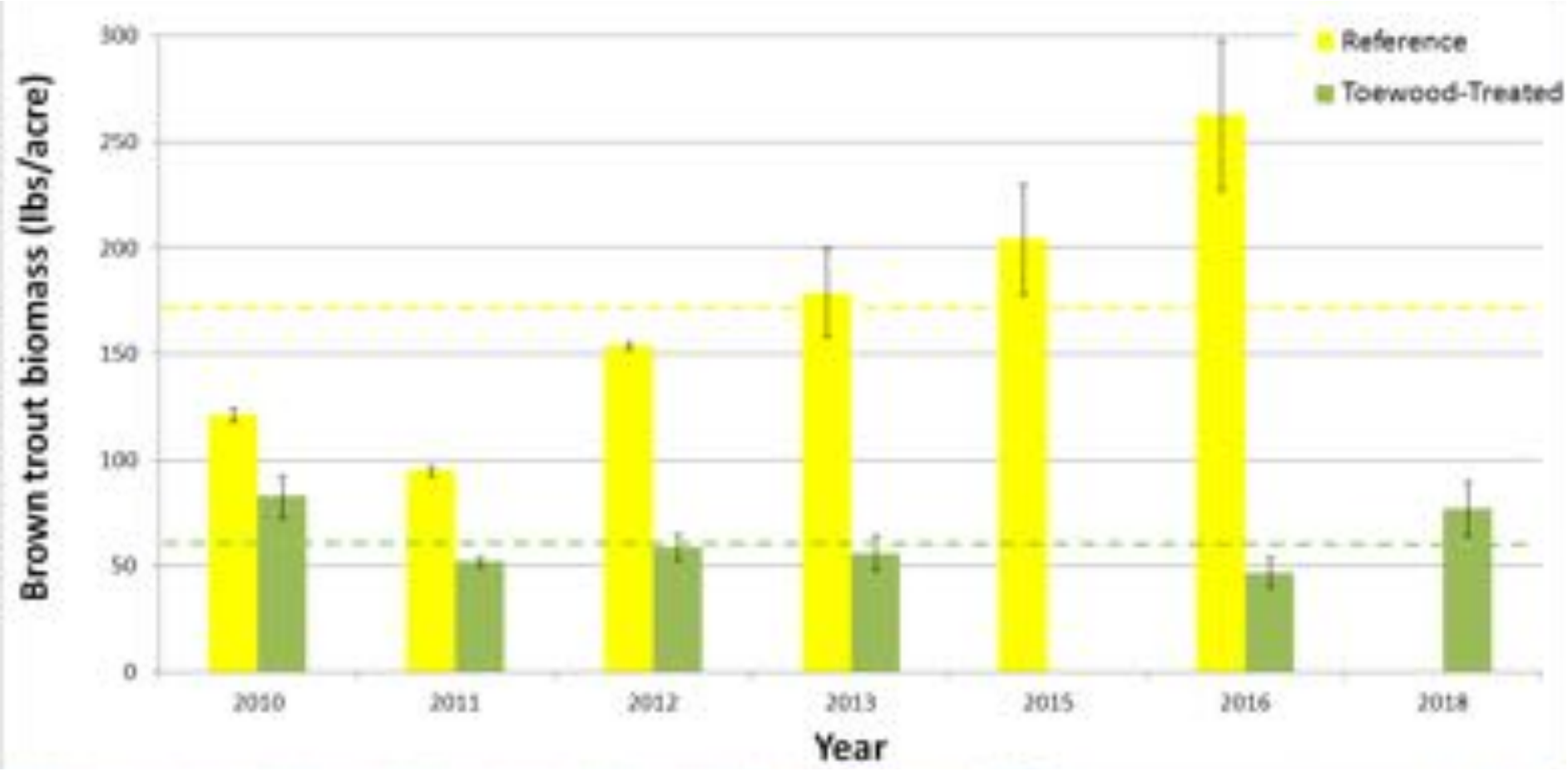
Toewood-Treated vs Boulder-Treated:

- Brown trout biomass in the toewood-treated reach averaged 7% higher over the boulder-treated for entire monitoring period

- Average difference in biomass (within year) was 18% (range -2-43 %) toewood over boulder

Reference

Toewood-Treated Vs Reference



Toewood-Treated Vs Reference

<u>Monitoring Period:</u>

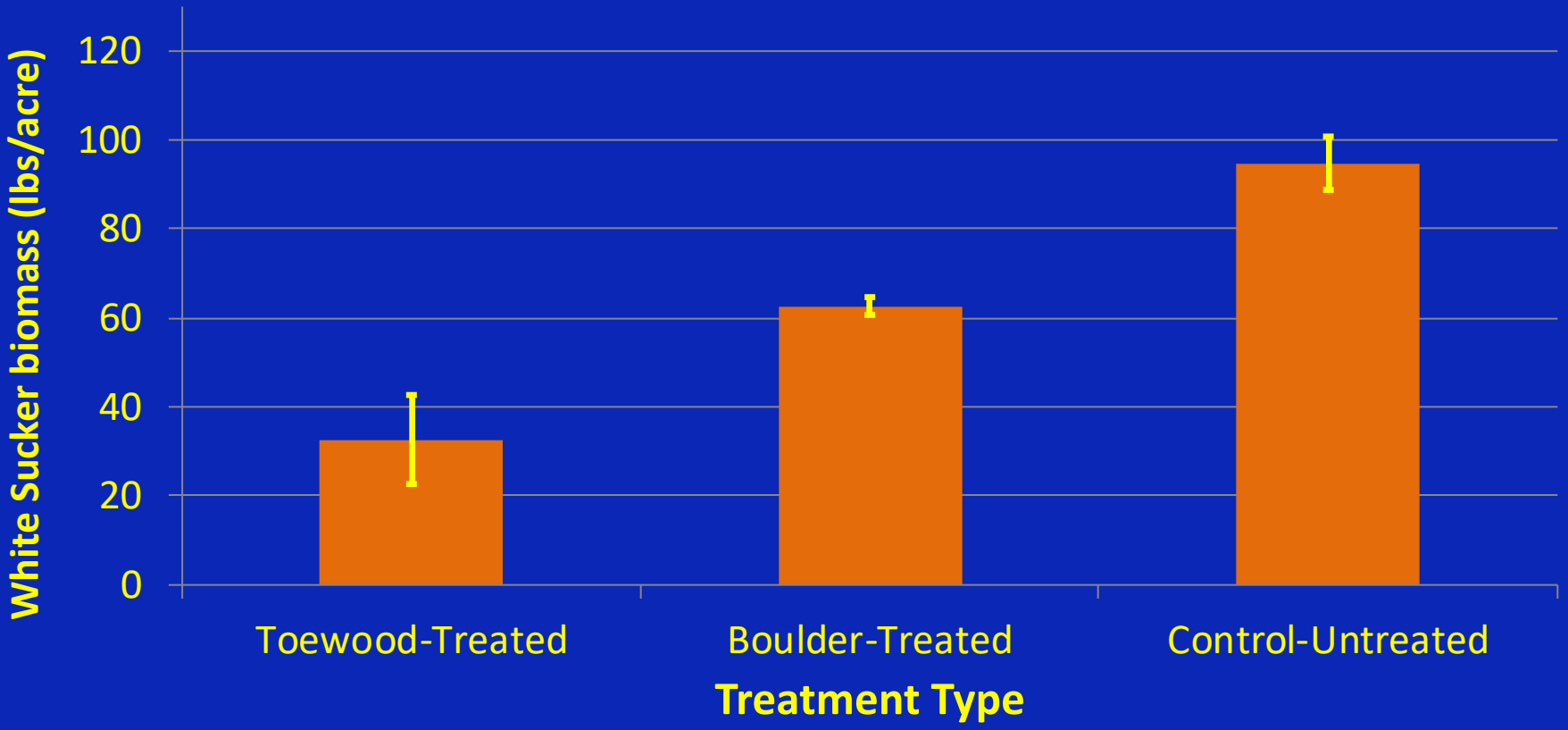
2010-2018: 8 YEARS

- Brown trout biomass in the reference reach averaged 107% higher over the toewood-treated for entire monitoring period

- Average difference in biomass (within year) was 194% (range 46-460%) reference over toewood

Does Toewood Create More Sucker-Holes?

Does Toewood Create More Sucker-Holes?



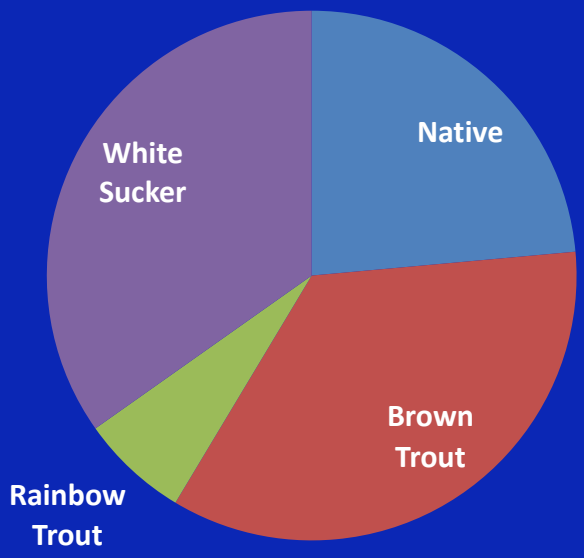
Species Composition

Toewood-Treated

Species Composition

Toewood-Treated

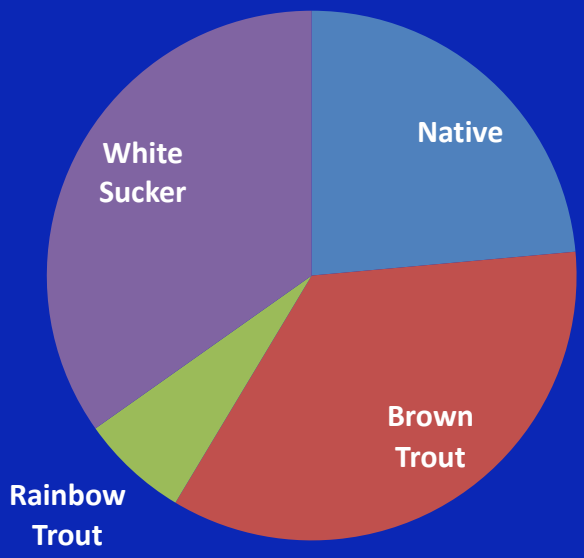
Boulder-Treated



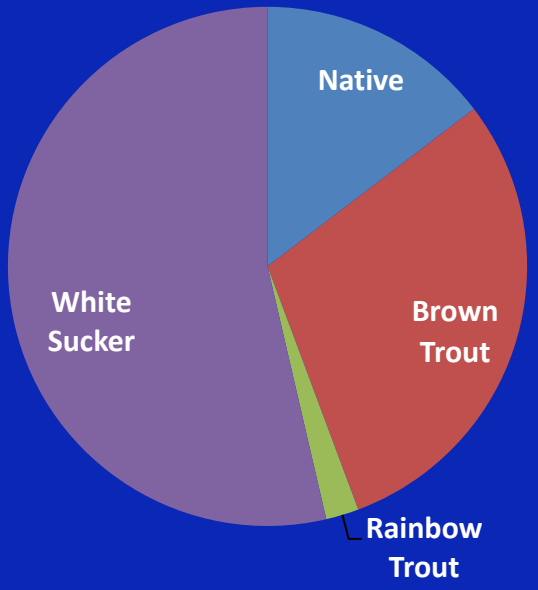
Species Composition

Toewood-Treated

Boulder-Treated



Control-Untreated




Clear Creek

Goals

1) Remove armored rip rap

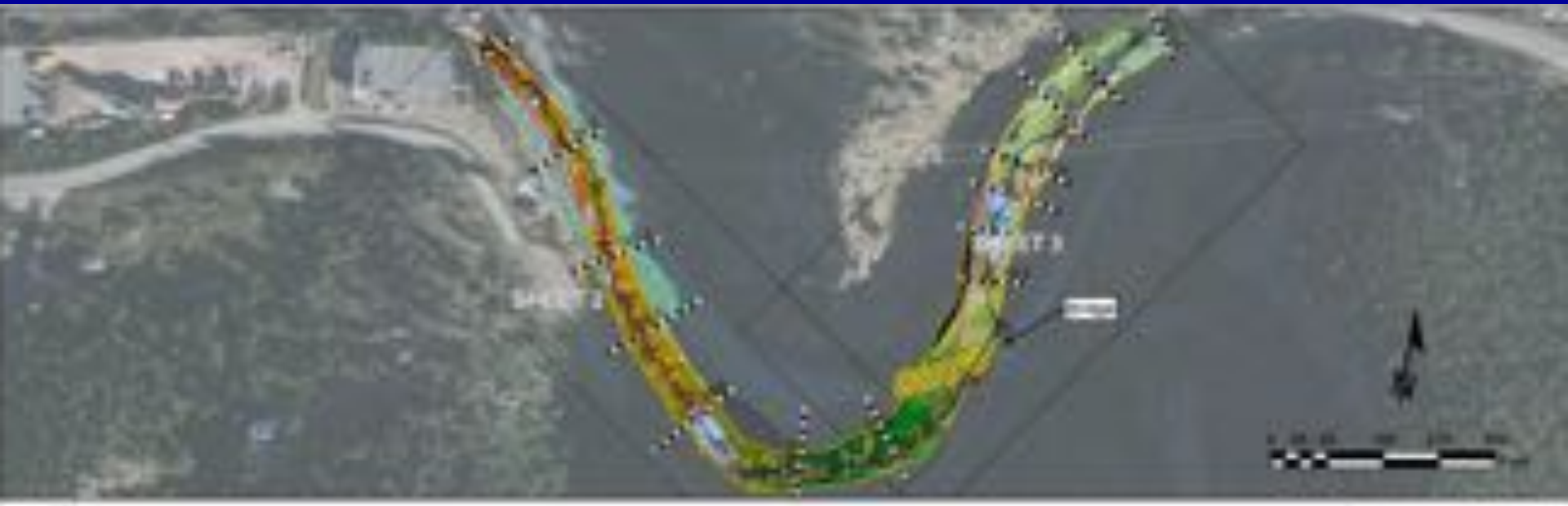
2) Improve floodplain connectivity

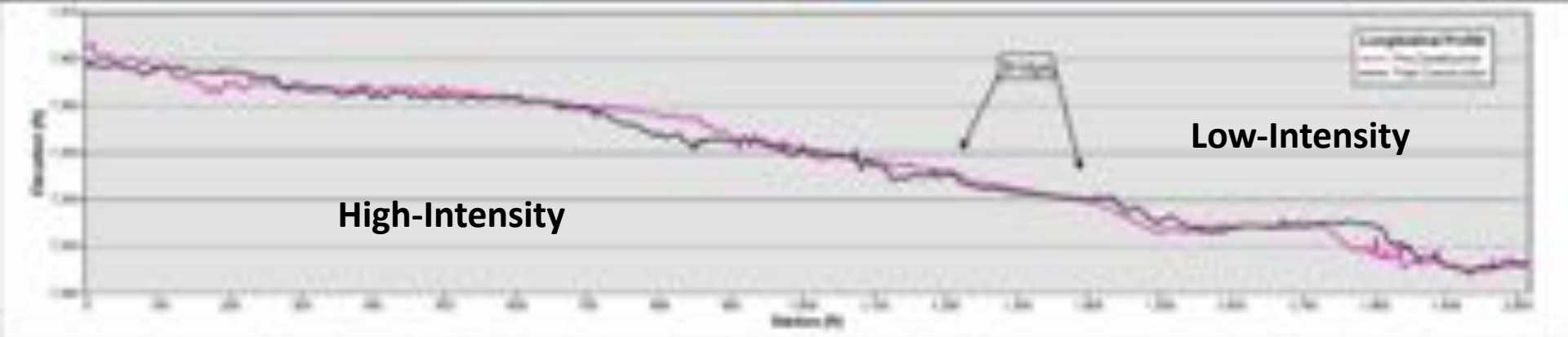
3) Convert single stage to three-stage

4) Establish riparian vegetation

5) Enhance in-channel bedform features (i.e. spawning area development and depth cover)

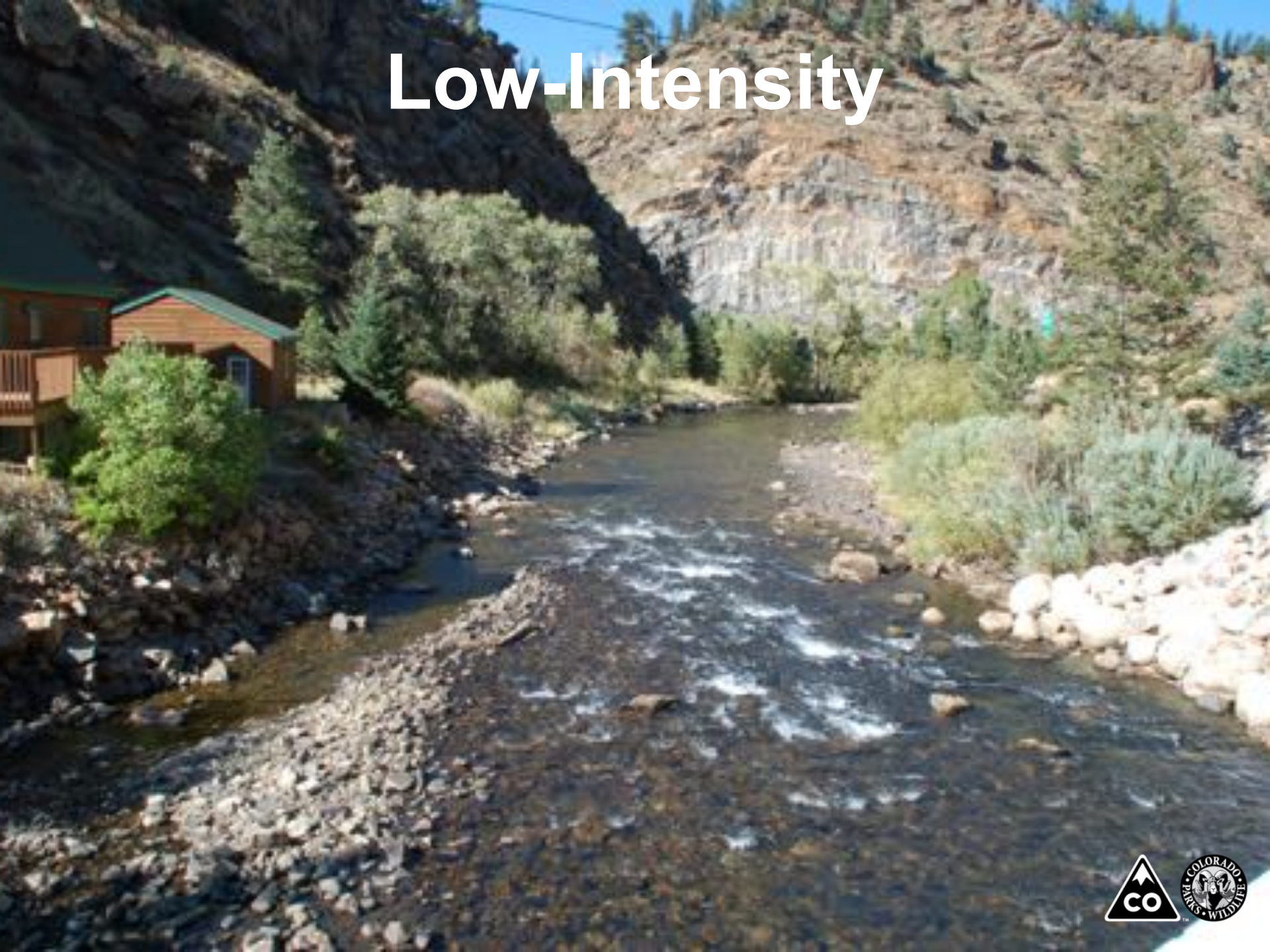
Overview

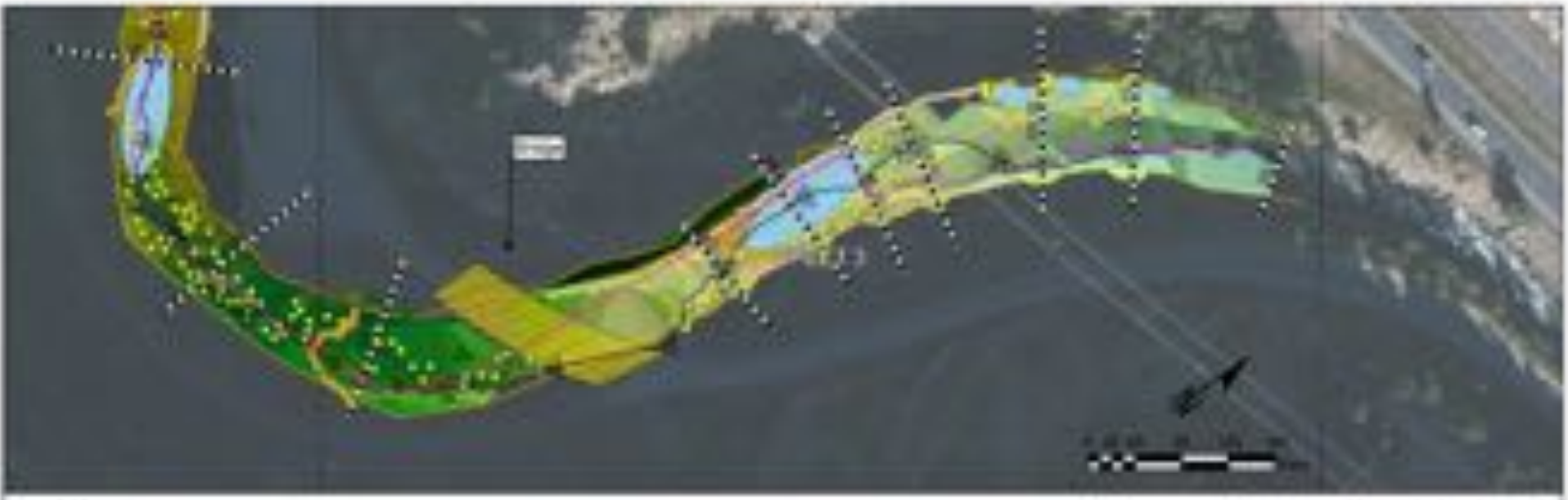


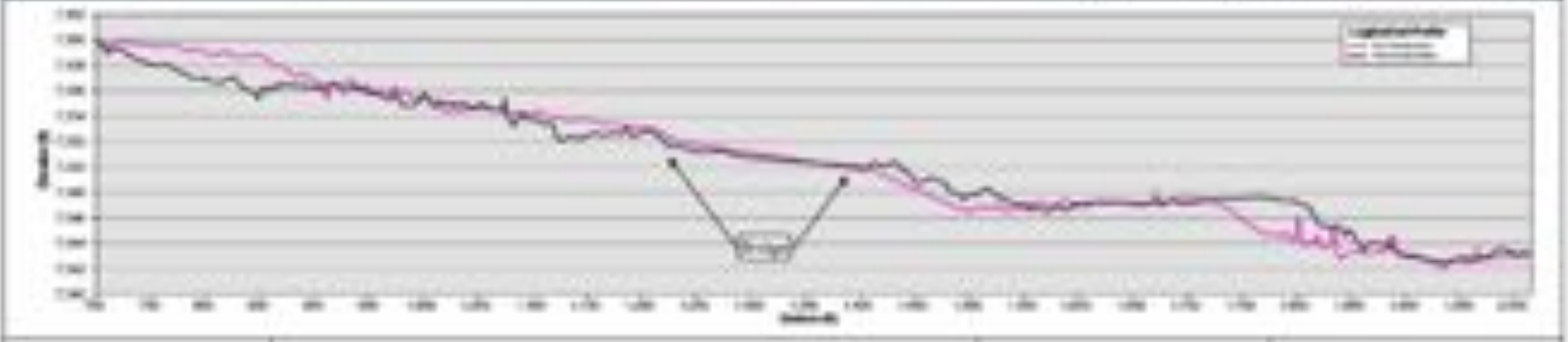

Low-Intensity
High-Intensity


CO
CLEAR CREEK
TWIN TUNNELS
AS-BUILT DRAWINGS

Low-Intensity



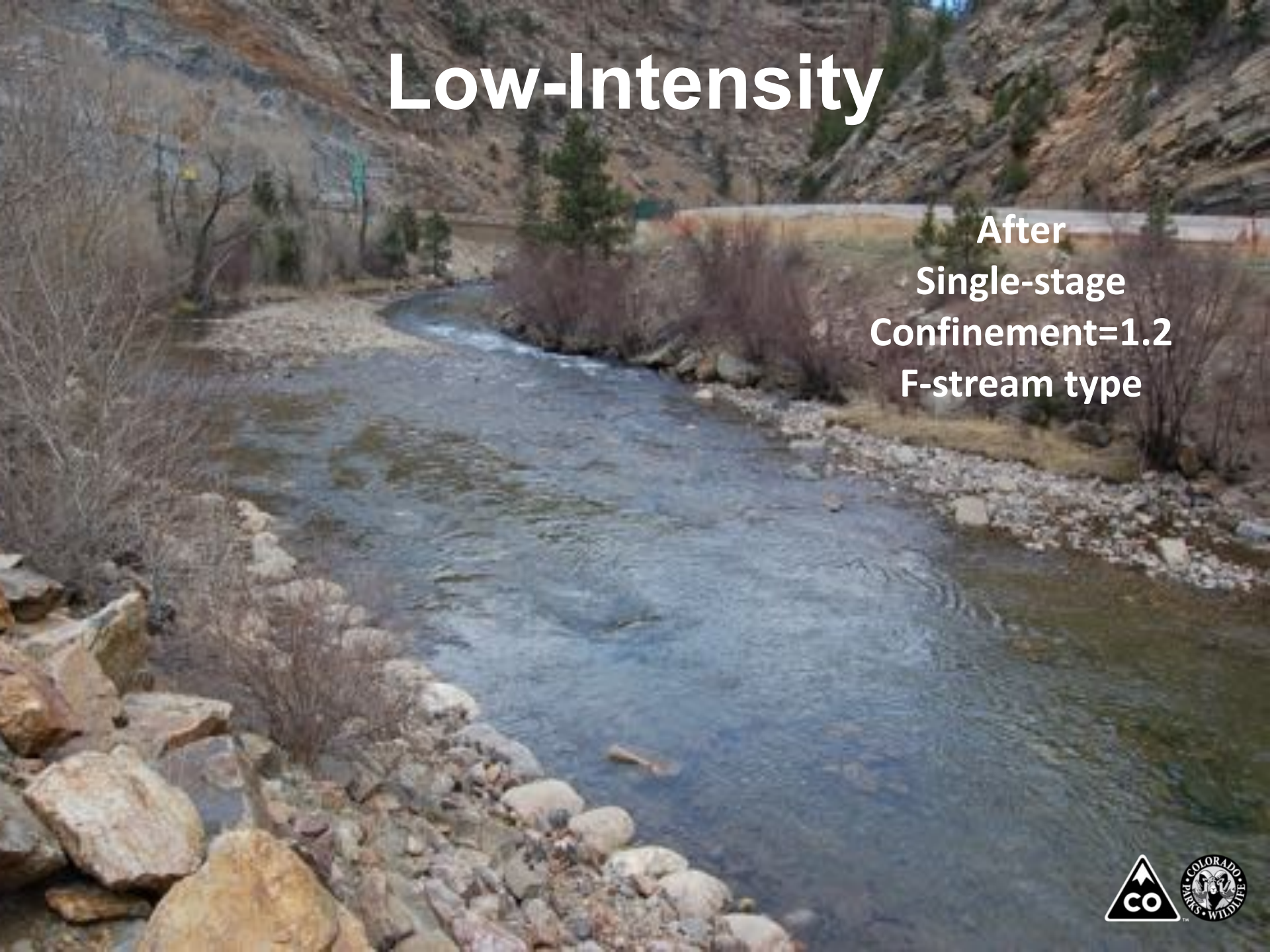


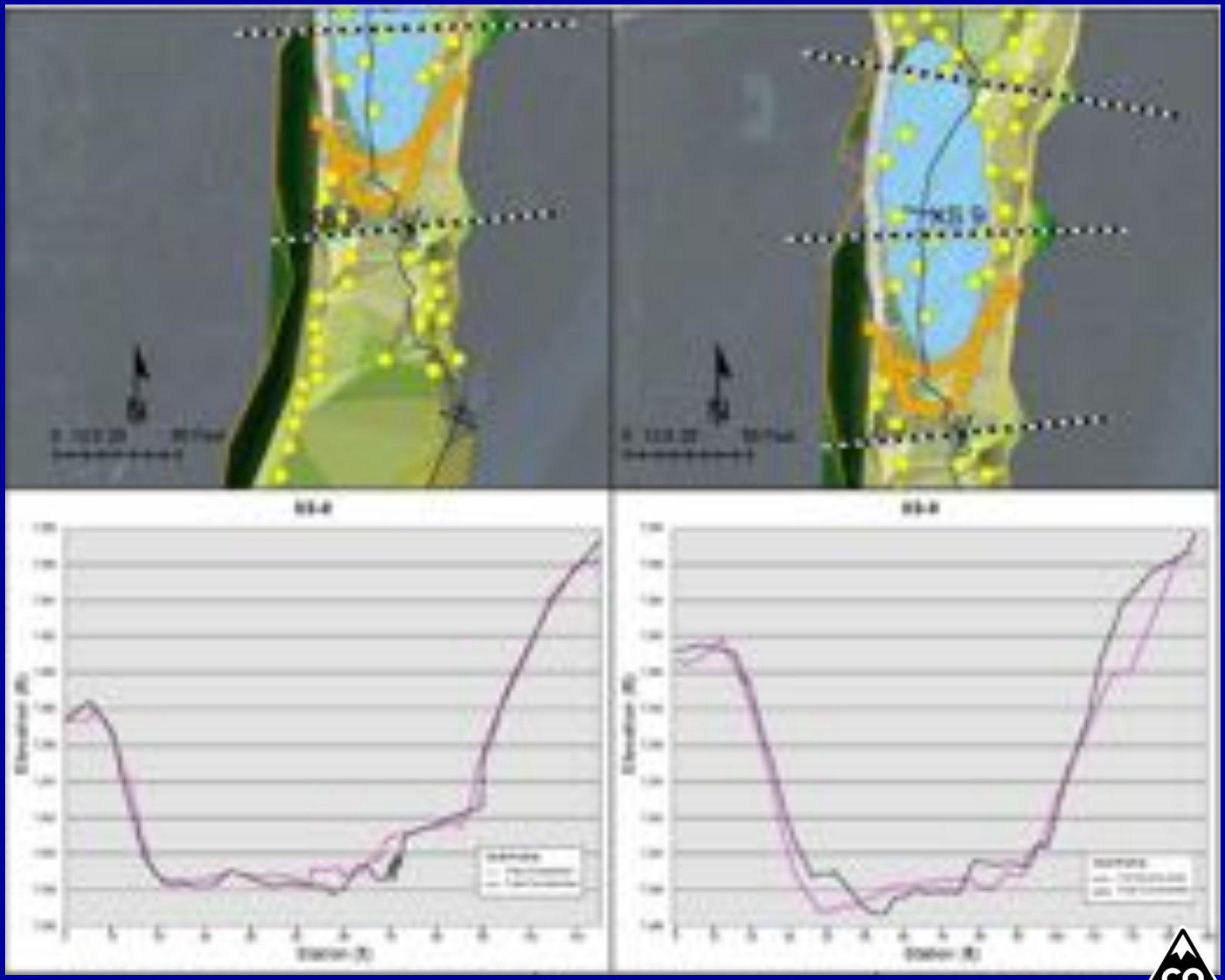


CLEAR CREEK
TWIN TUNNELS
AS-BUILT DRAWINGS

Low-Intensity

Low-Intensity

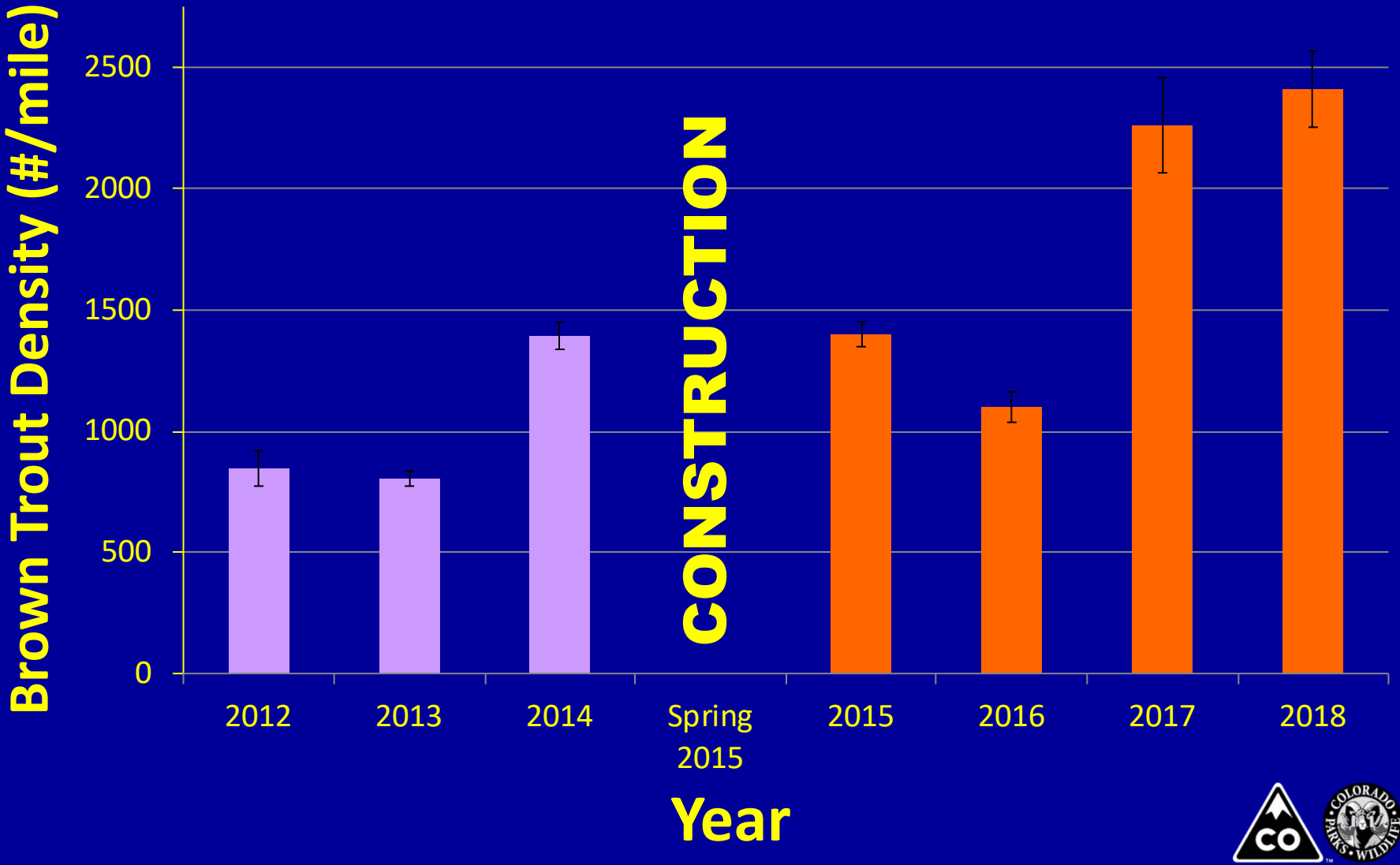




Low-Intensity

Treatment	Quantity	Units	Total	% of Total Project
Habitat Boulder	81	Each	234	35%
Boulder Structure	1	Each	9	11%
Boulder Toe	250	LF	2,708	9%
Pool Development	4	Each	14	29%
Point-Bar Development	0	SF	5,420	0%
Floodplain Development	0	SF	18,775	0%

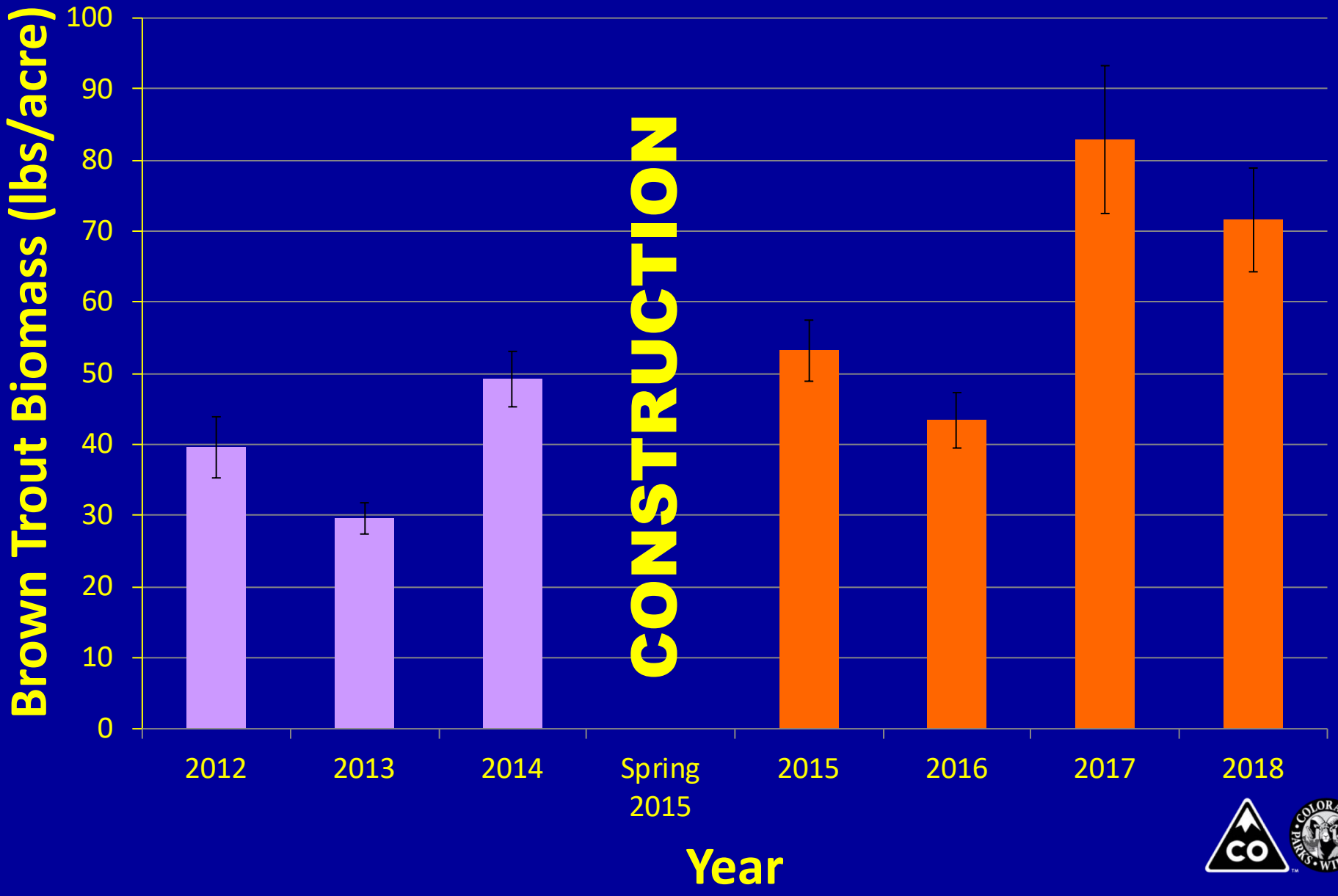
Low-Intensity Treatment: Trout Density (#/mile)



Low-Intensity Treatment: Trout Density (#/mile)

77% increase

Low-Intensity Treatment: Trout Biomass (lbs/acres)



Low-Intensity Treatment: Trout Density (#/mile)

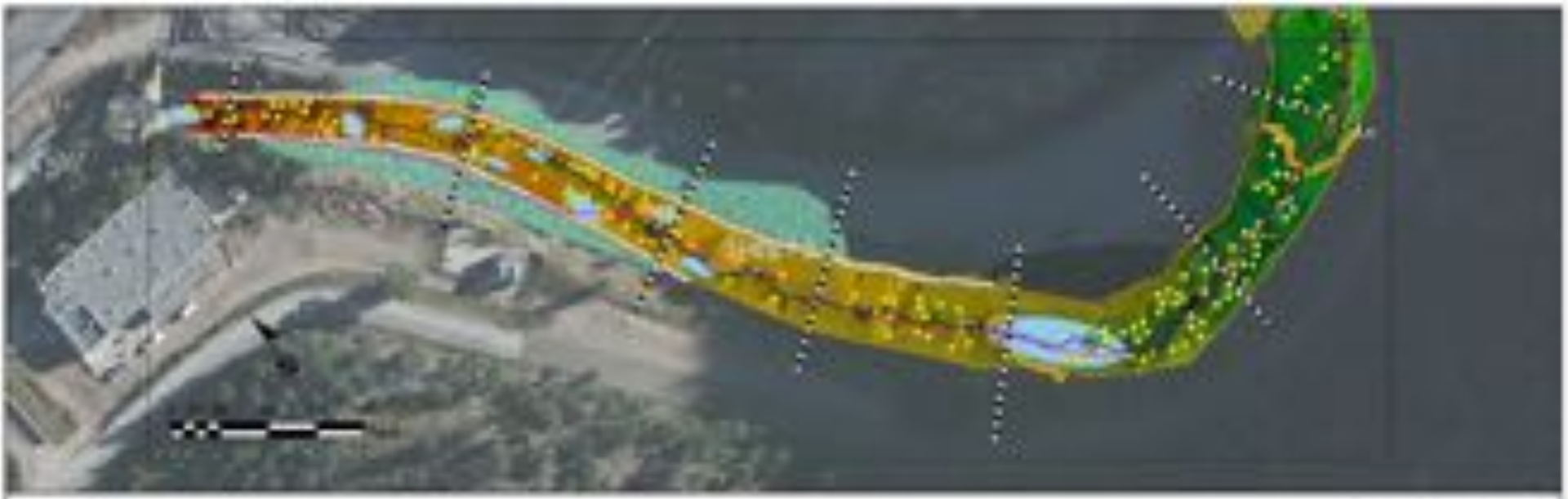
77% increase

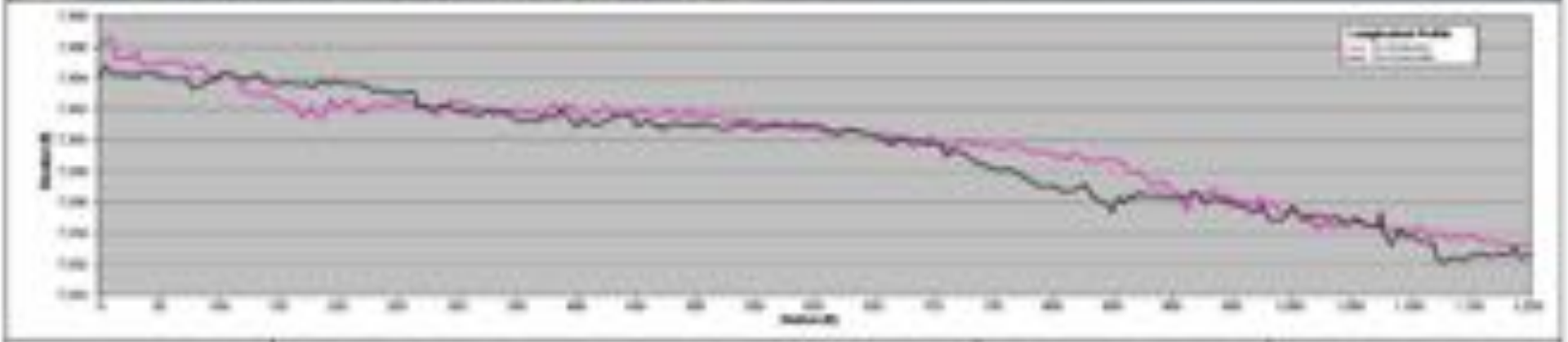
Low-Intensity Treatment: Trout Biomass (lbs/acres)

59% increase


High-Intensity
Before
Single-stage
Confinement=1.2
F3/2-stream type


High-Intensity
After
Three-stage
Confinement=2.0
Bc3/2 -Stream Type



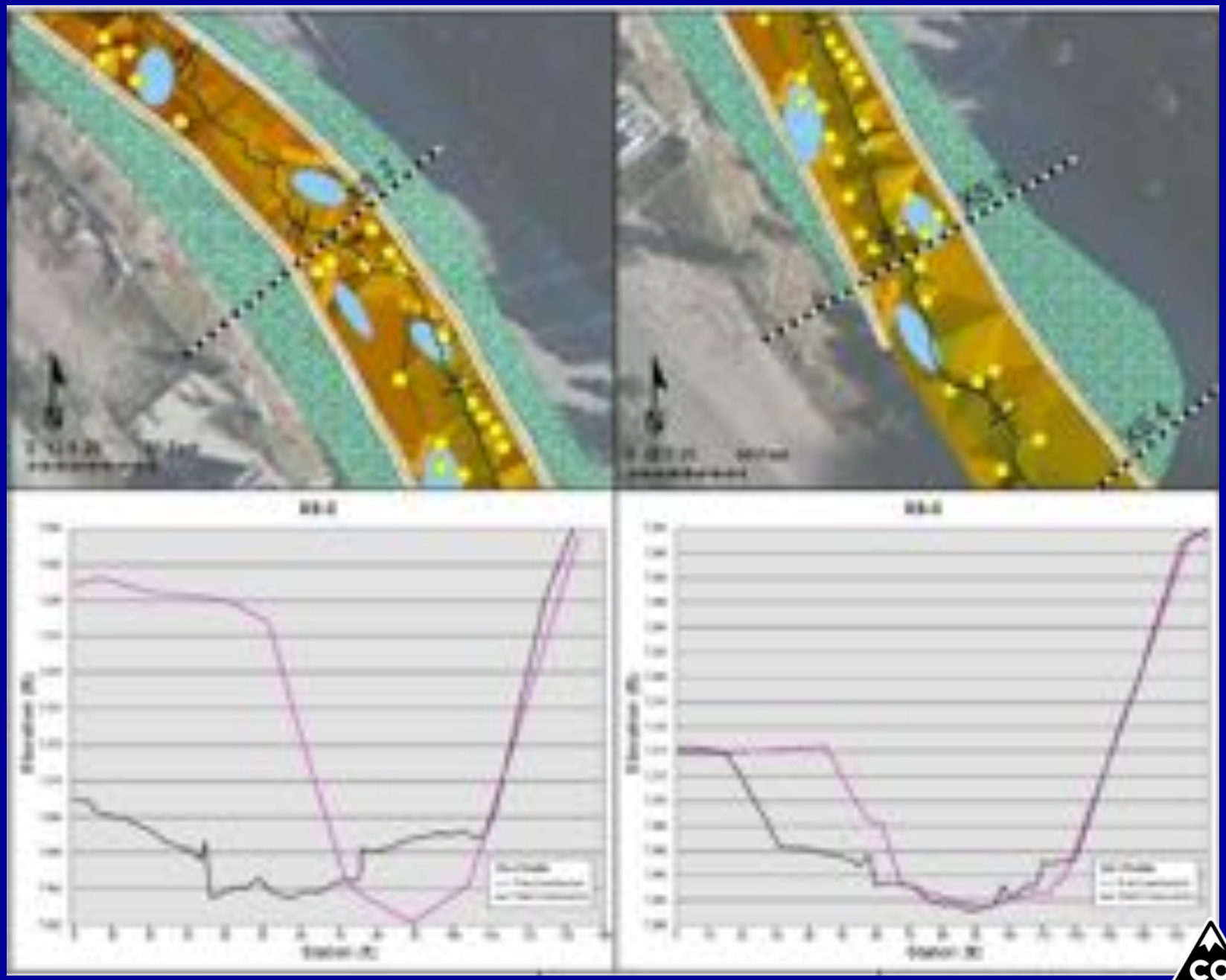


CLEAR CREEK
TWIN TUNNELS
AS-BUILT DRAWINGS


High-Intensity
Before


High-Intensity
After

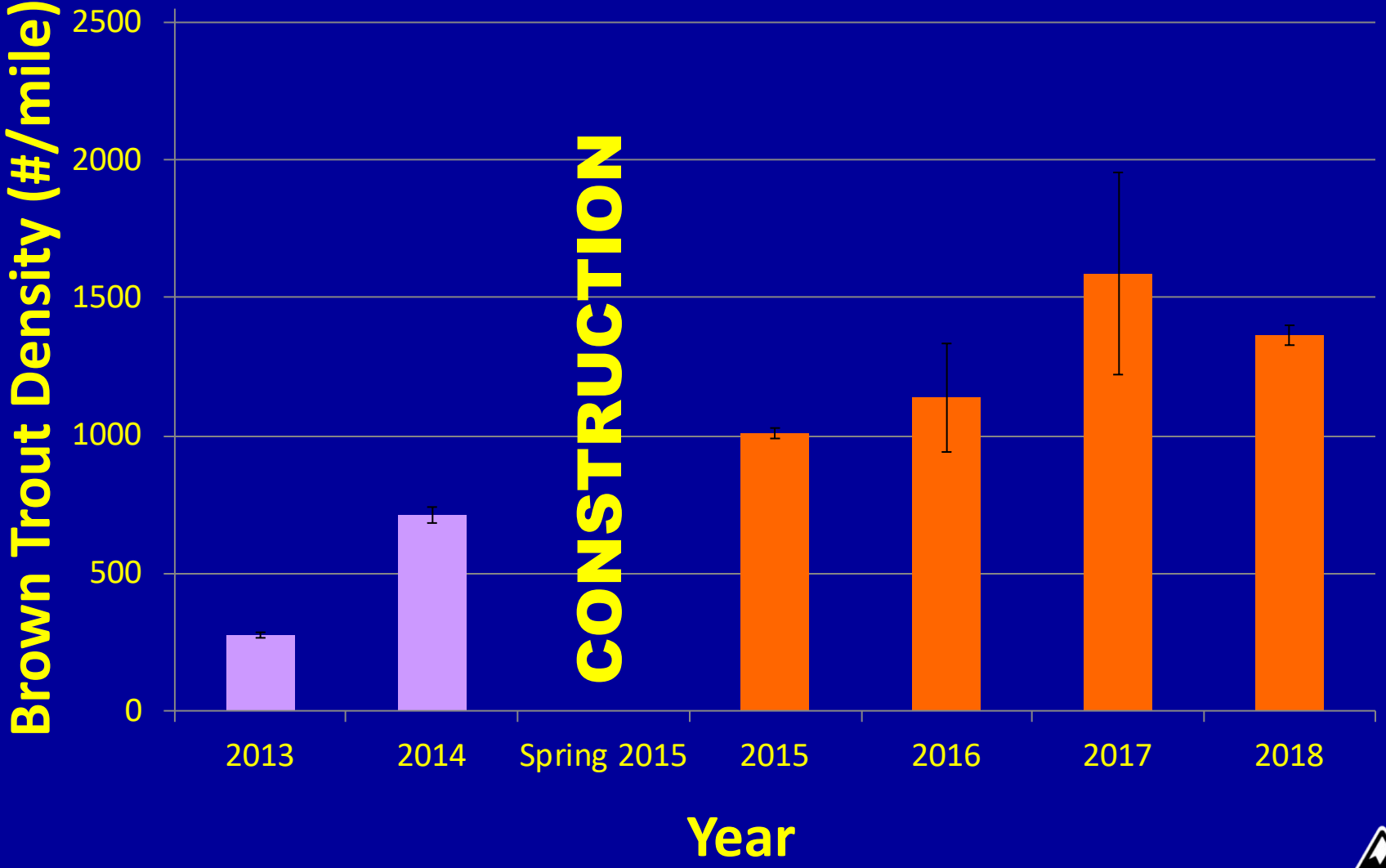

After



High-Intensity

Treatment	Quantity	Units	Total	% of Total Project
Habitat Boulder	153	Each	234	65%
Boulder Structure	8	Each	9	89%
Boulder Toe	2,458	LF	2,708	91%
Pool Development	10	SF	14	71%
Point-Bar Development	5,420	SF	5,420	100%
Floodplain Development	18,775	SF	18,775	100%

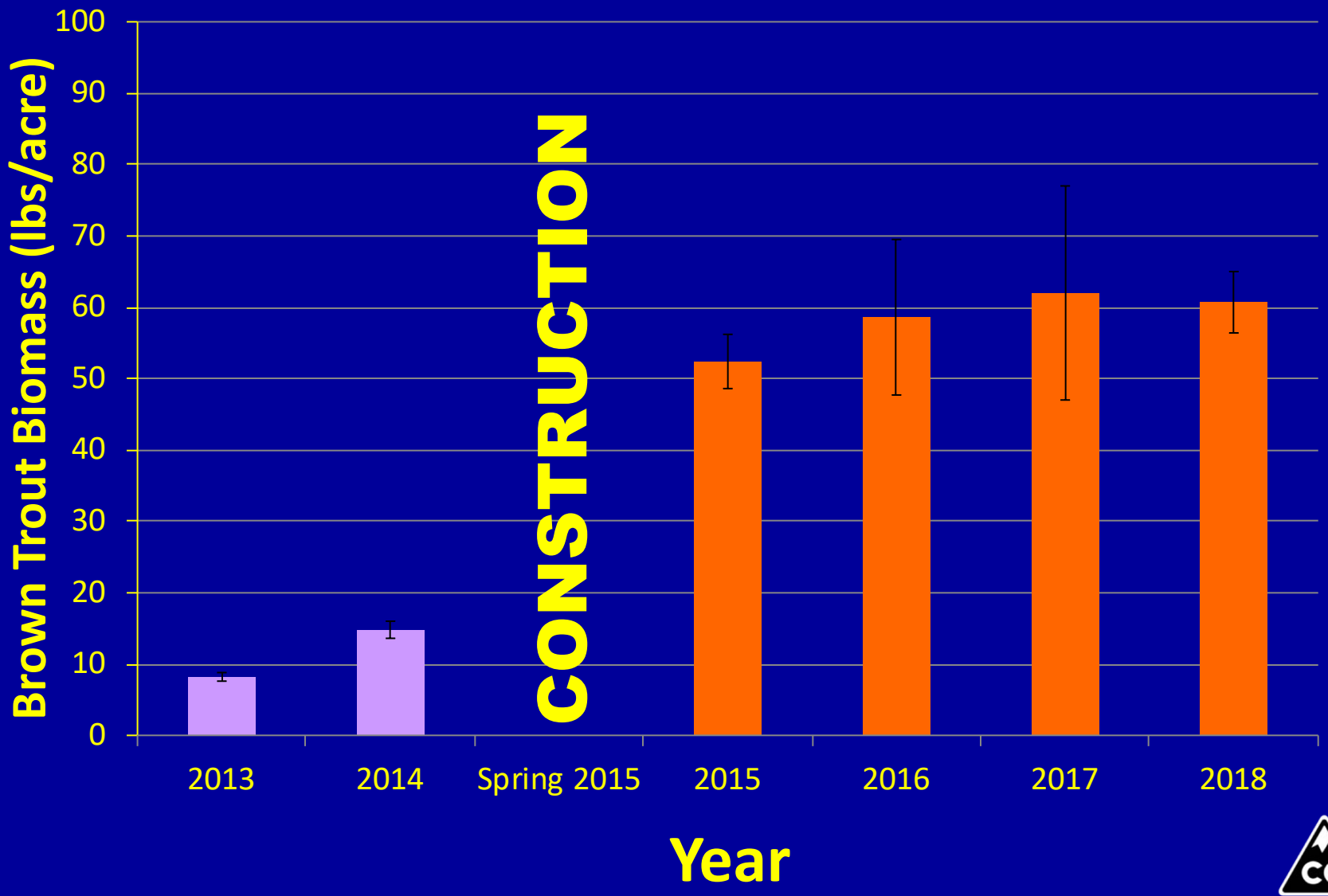
High-Intensity Treatment: Trout Density (#/mile)



High-Intensity Treatment: Trout Density (#/mile)

160% increase

High-Intensity Treatment: Trout Biomass (lbs/acres)



High-Intensity Treatment: Trout Density (#/mile)

160% increase

High-Intensity Treatment: Trout Biomass (lbs/acres)

408% increase

Summary

- Restoration of natural stream forms (NCD) may restore natural habitats that provide the functions necessary for improving fish populations over time

Summary

- Restoration of natural stream forms (NCD) may restore natural habitats that provide the functions necessary for improving fish populations over time
- Departure from reference conditions may have negative consequences to fish populations that may not recover without physical intervention

Summary

- Restoration of natural stream forms (NCD) may restore natural habitats that provide the functions necessary for improving fish populations over time
- Departure from natural conditions may have negative consequences to fish populations that may not recover without physical intervention
- Assess limiting factors that may occur outside of geomorphology (channel forms) including departures from natural hydrologic regimes, hydraulics, physicochemical properties, and barriers

Summary

- Not all treatment alternatives are equal. Some treatments will accomplish a “bigger bang for the buck”

Summary

- Not all treatment alternatives are equal. Some treatments will accomplish a “bigger bang for the buck”
- Carefully consider selection of reference reaches for biological monitoring. Use an average of multiple reference sites if possible