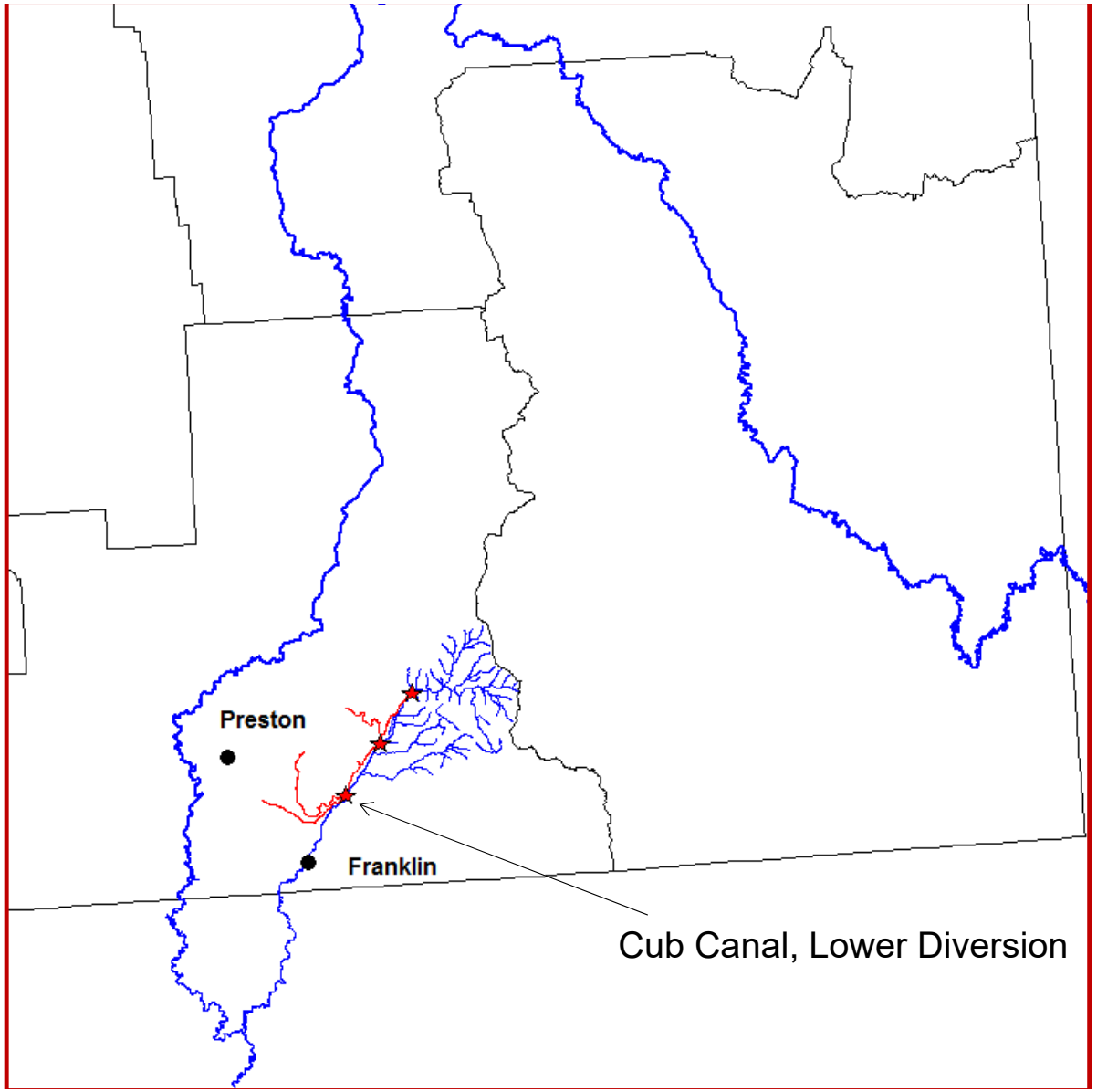
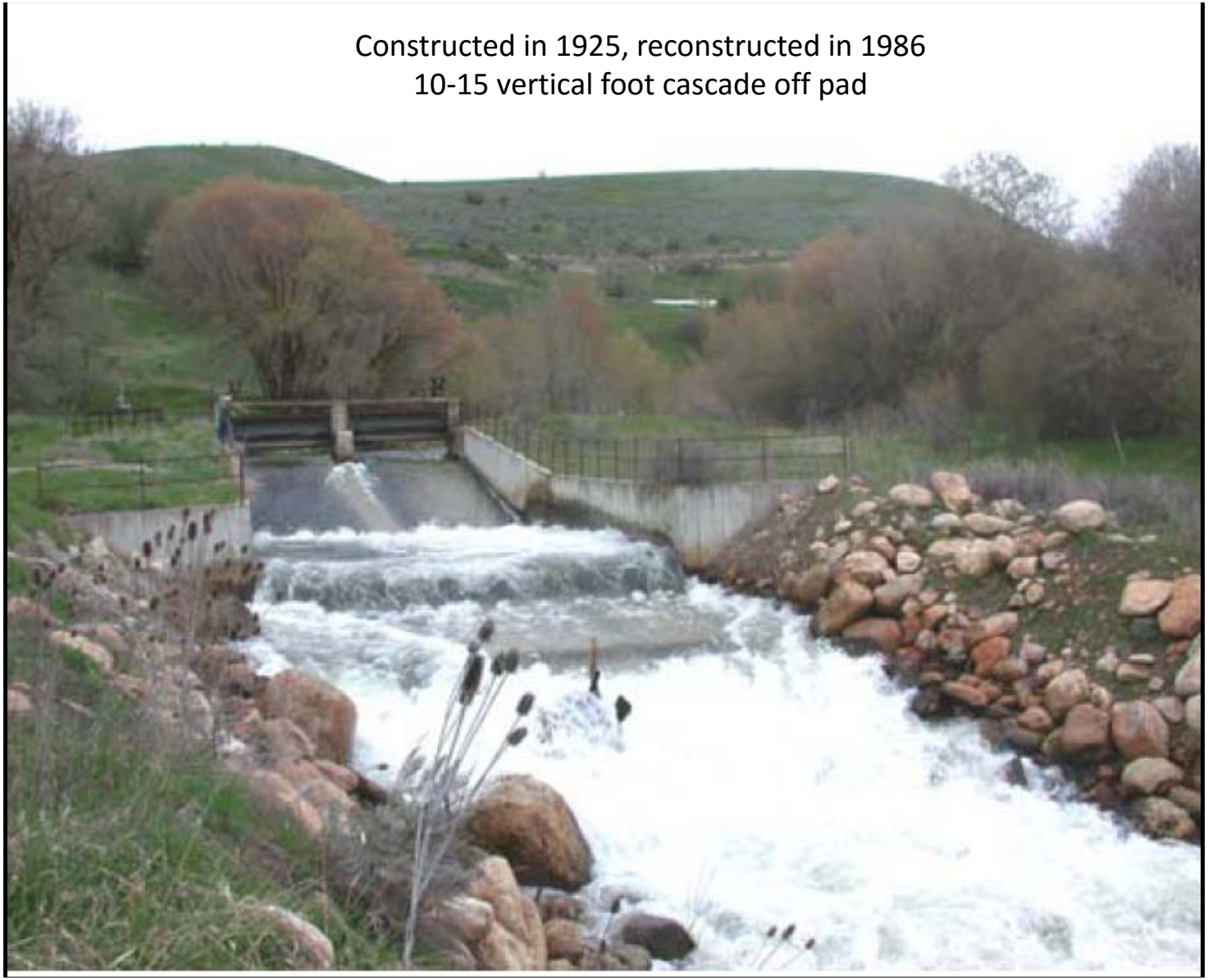

Preston
Franklin
Cub Canal, Lower Diversion

Constructed in 1925, reconstructed in 1986
10-15 vertical foot cascade off pad

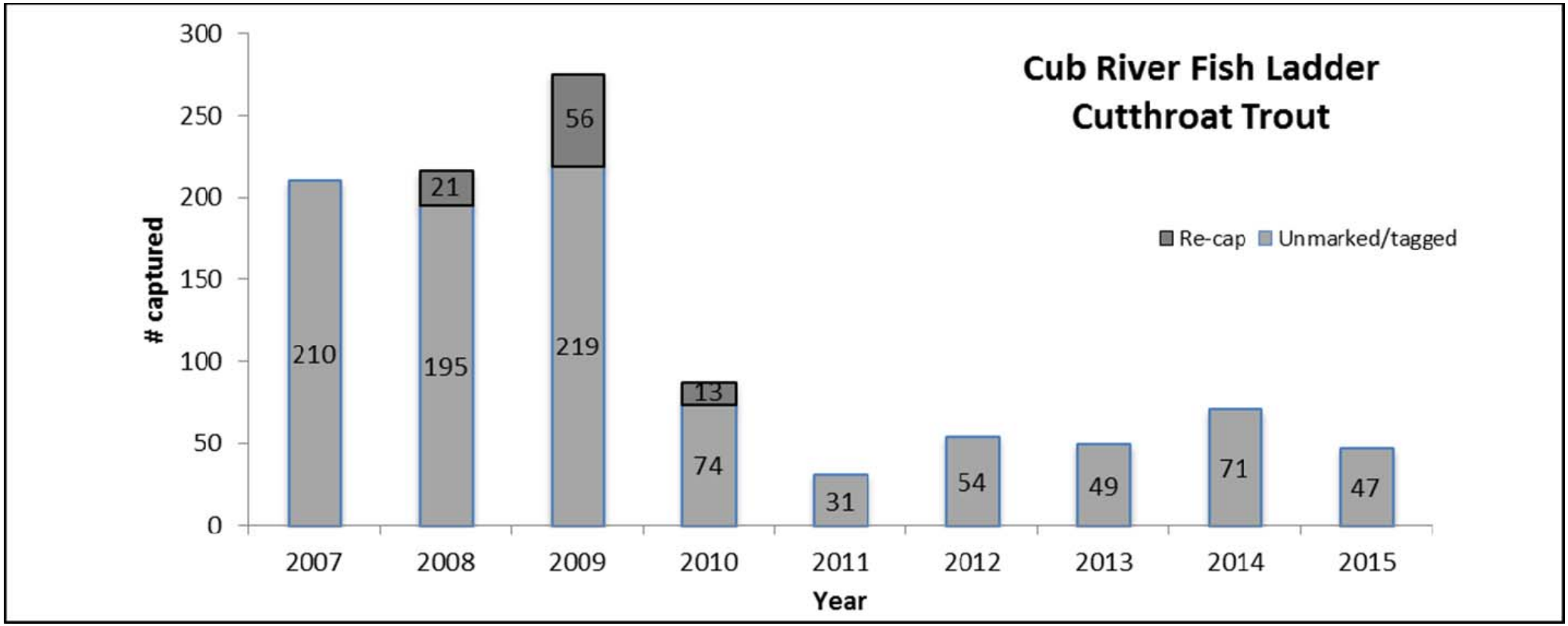


GeoEngineers report

Cub River Fish Ladder

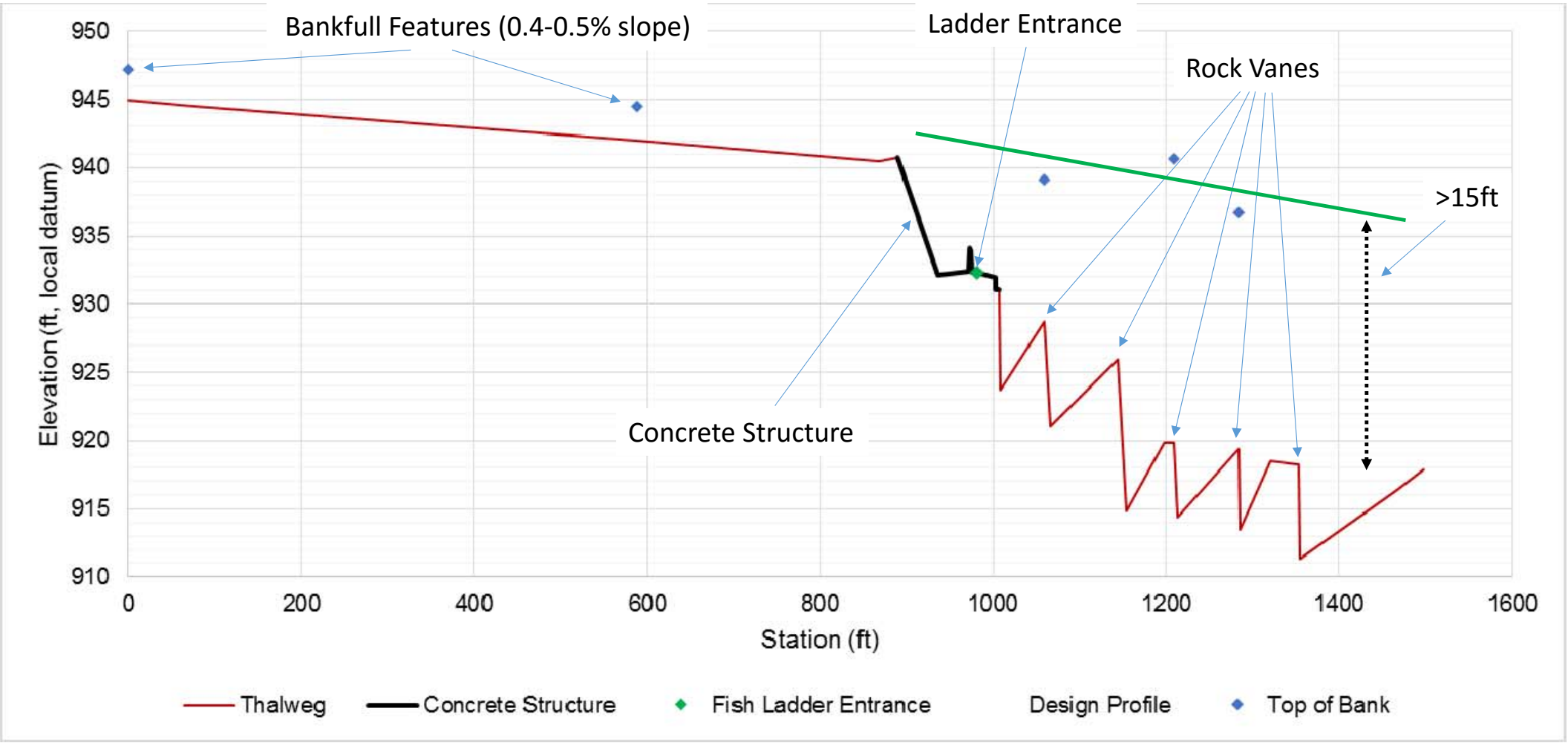
- Fish ladder: 172 ft long over 9 ft of drop
- Ladder operated during CT spawning migration
- Fish trapped and only native fishes passed upstream
- Fish marked (2007 – 2011) and released upstream

Cub River Fish Ladder




High Water: June 1, 2014
(~bankfull peakflow that year)

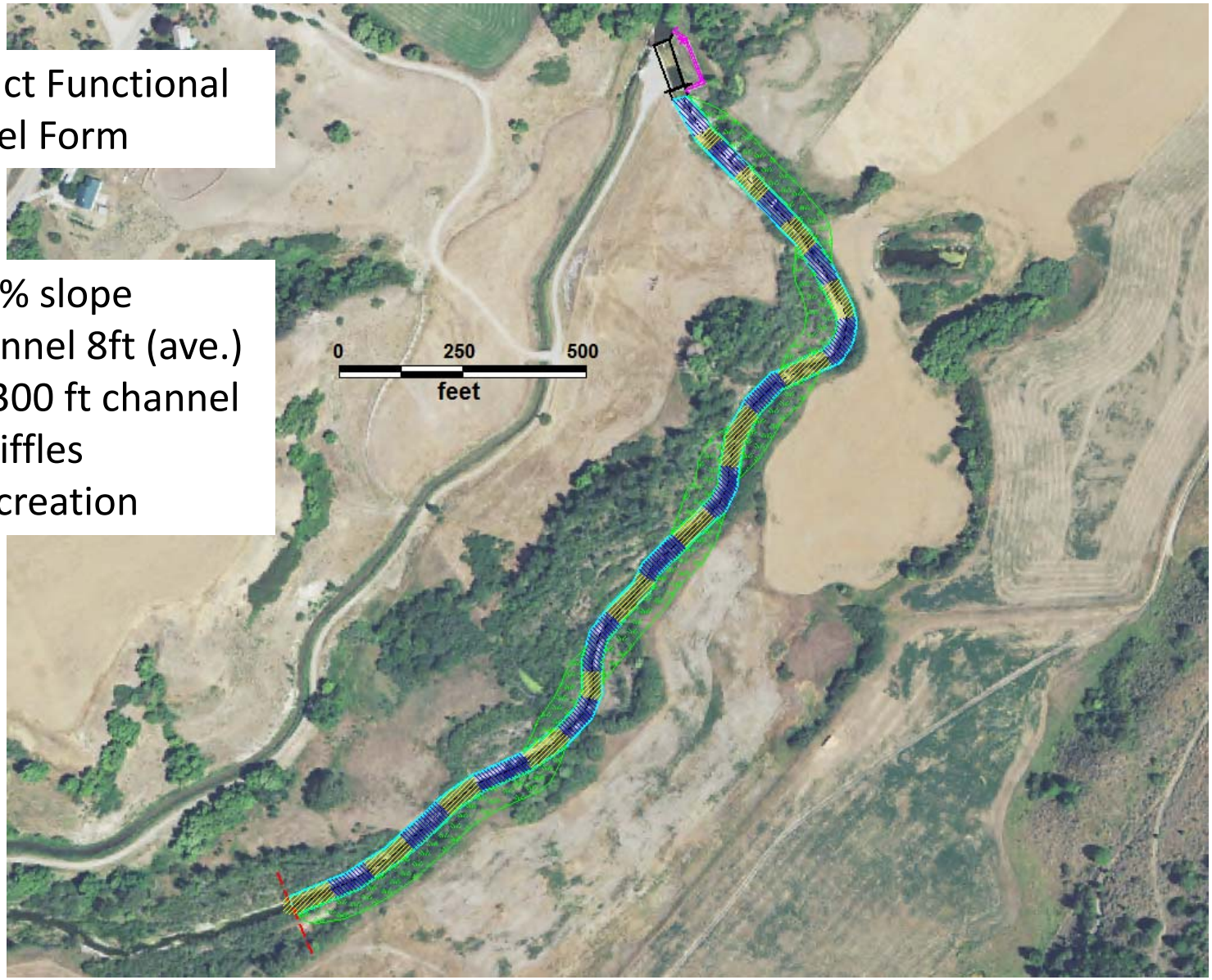

High Water: May 18, 2013
(~2/3 bankfull peakflow that year)

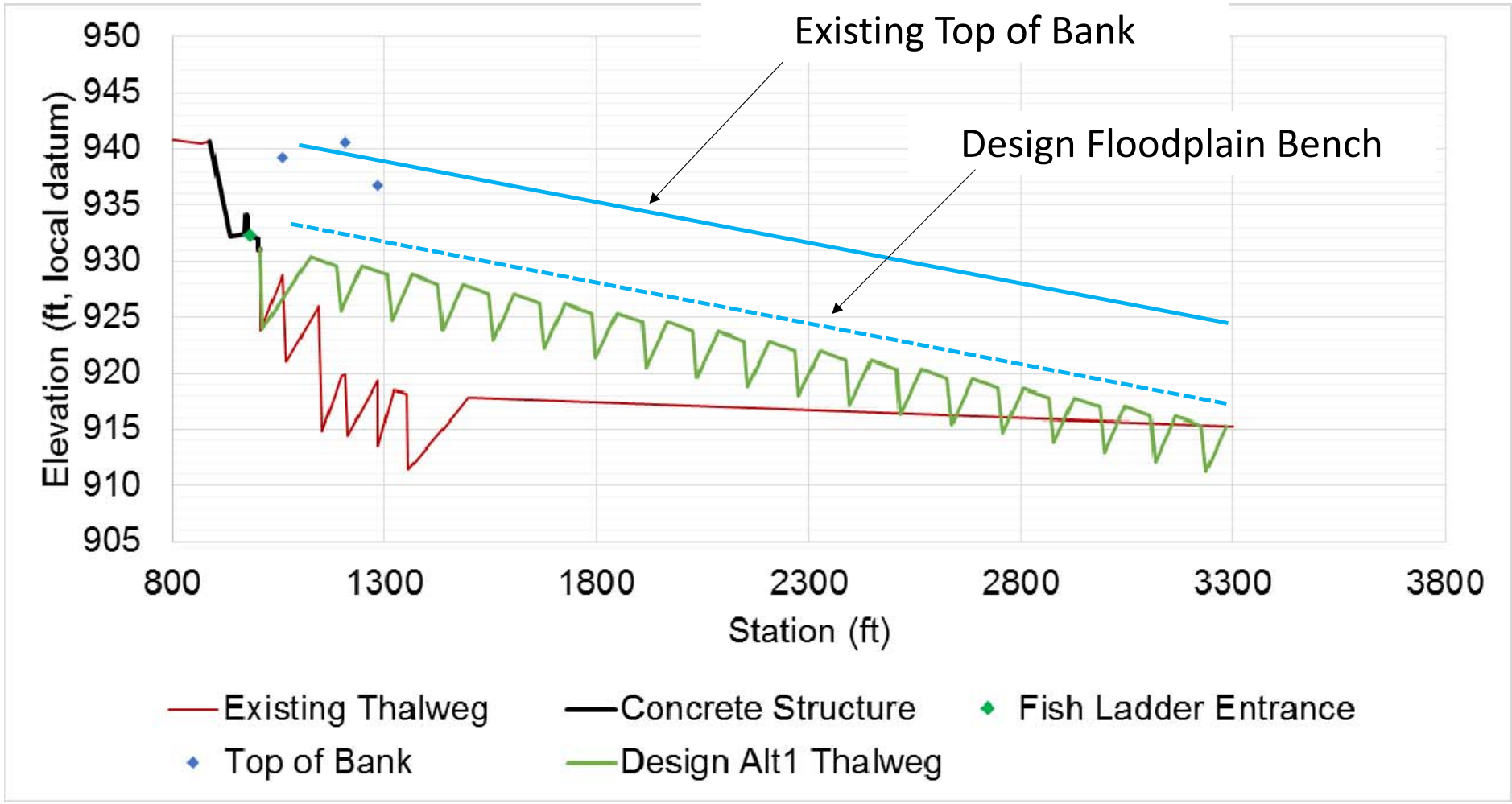

Bankfull Features (0.4-0.5% slope)
Ladder Entrance
Rock Vanes
>15ft
Concrete Structure
Elevation (ft, local datum)
950
945
940
935
930
925
920
915
910
0
200
400
600
800
1000
1200
1400
1600
Station (ft)
Thalweg
Concrete Structure
Fish Ladder Entrance
Design Profile
Top of Bank


Downstream
Incision (>15 ft)
Alluvial Bars
Clay Banks

1. Reconstruct Functional Channel Form

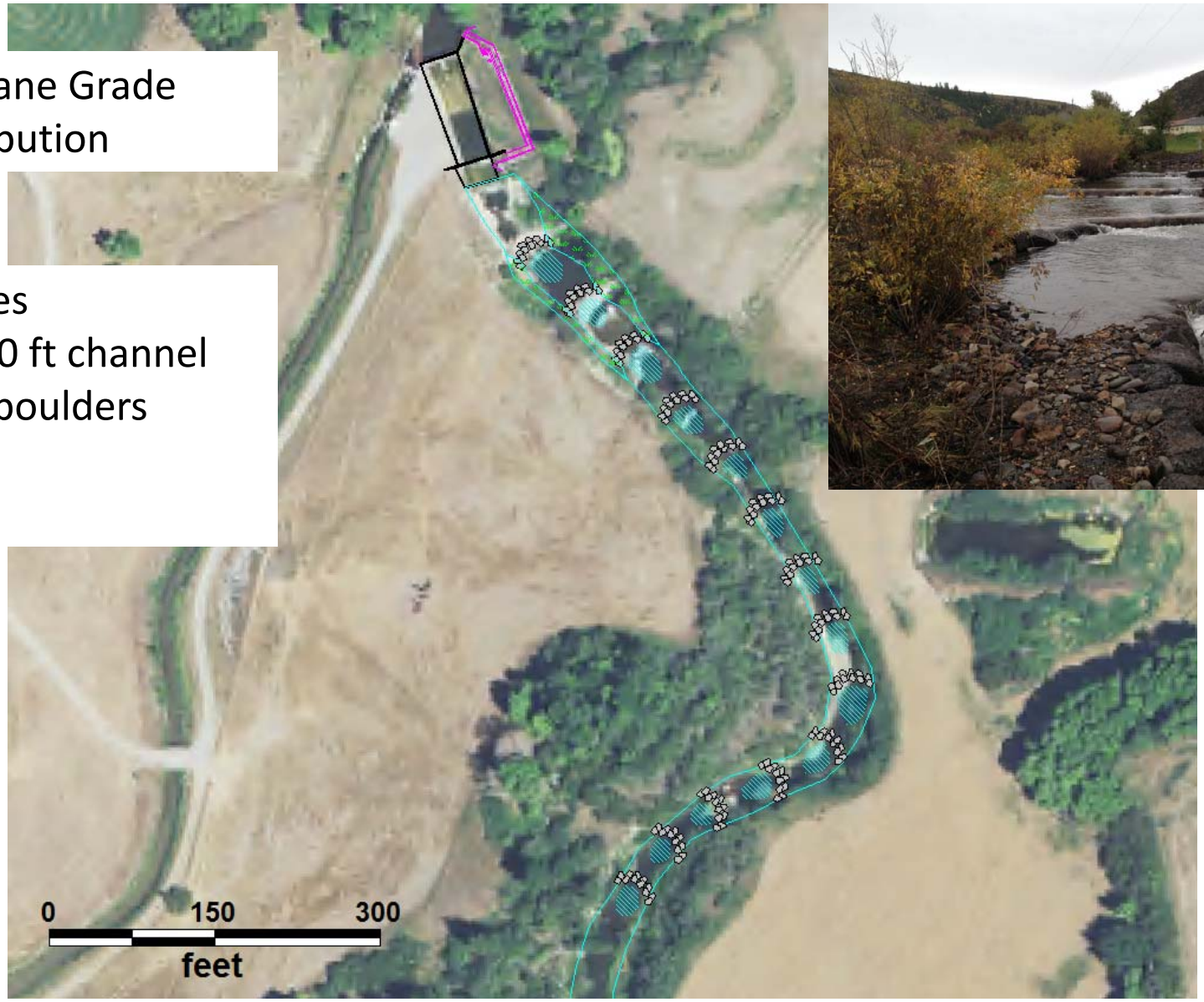
- Restore 0.7% slope
- Elevate channel 8ft (ave.)
- Re-work 2,300 ft channel
- Hardened riffles
- Floodplain creation

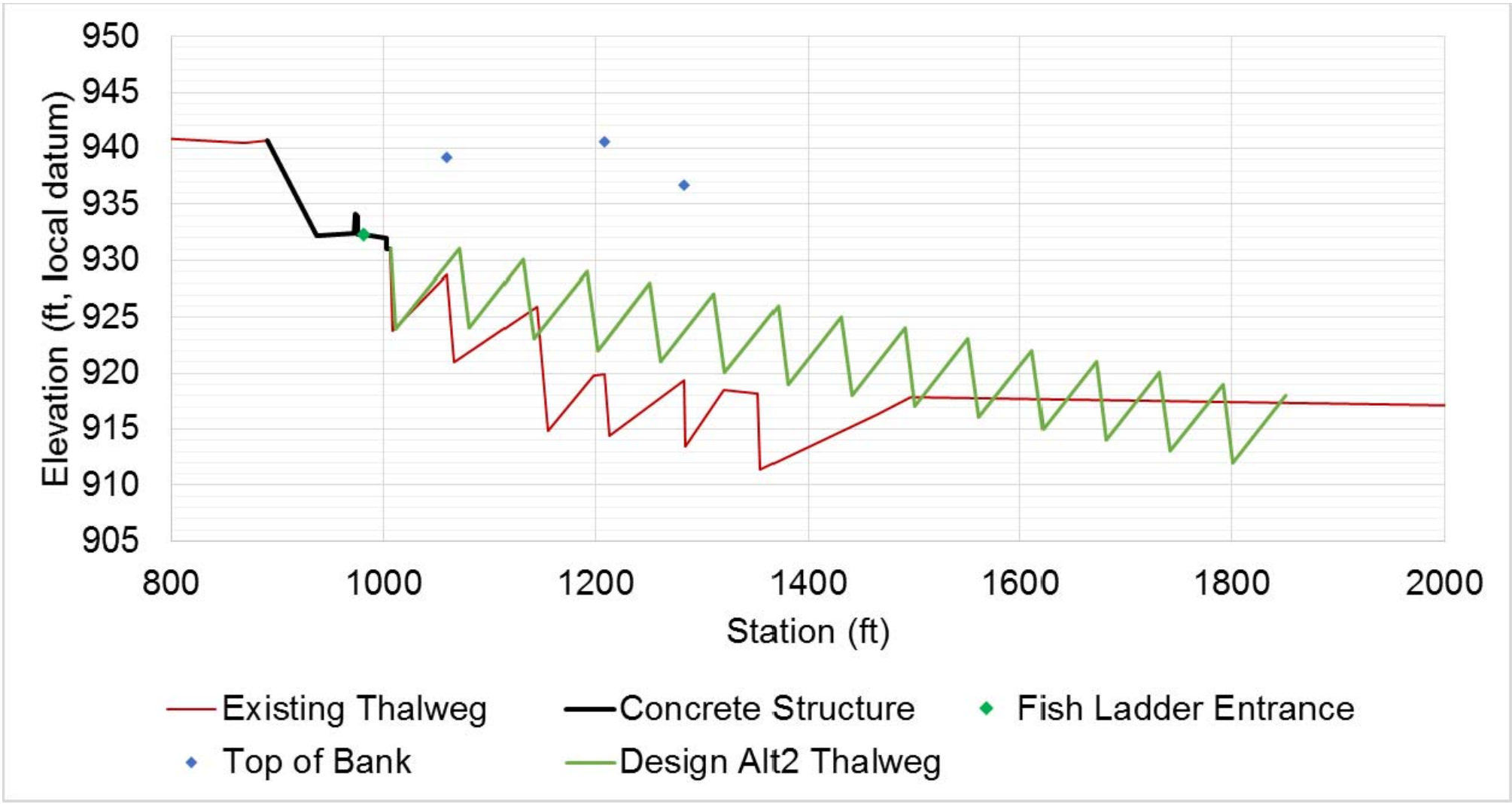



Existing Top of Bank
Design Floodplain Bench
Elevation (ft, local datum)
950
945
940
935
930
925
920
915
910
905
800
1300
1800
2300
2800
3300
3800
Station (ft)
Existing Thalweg
Concrete Structure
Fish Ladder Entrance
Top of Bank
Design Alt1 Thalweg

2. Rock Vane Grade Distribution

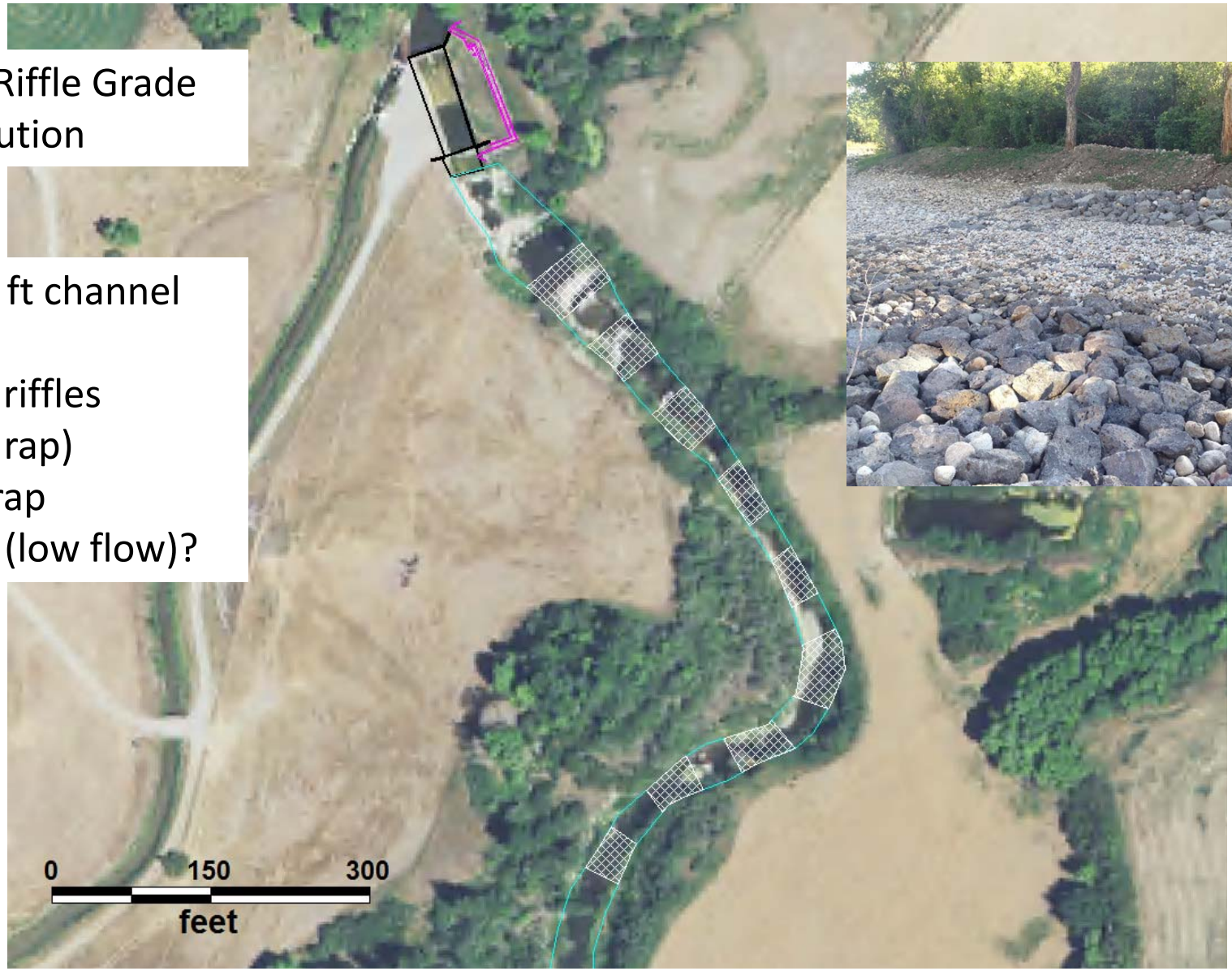
- 14 structures
- Re-work 800 ft channel
- 1,500 tons boulders
- Suitability?
- Bank keys?



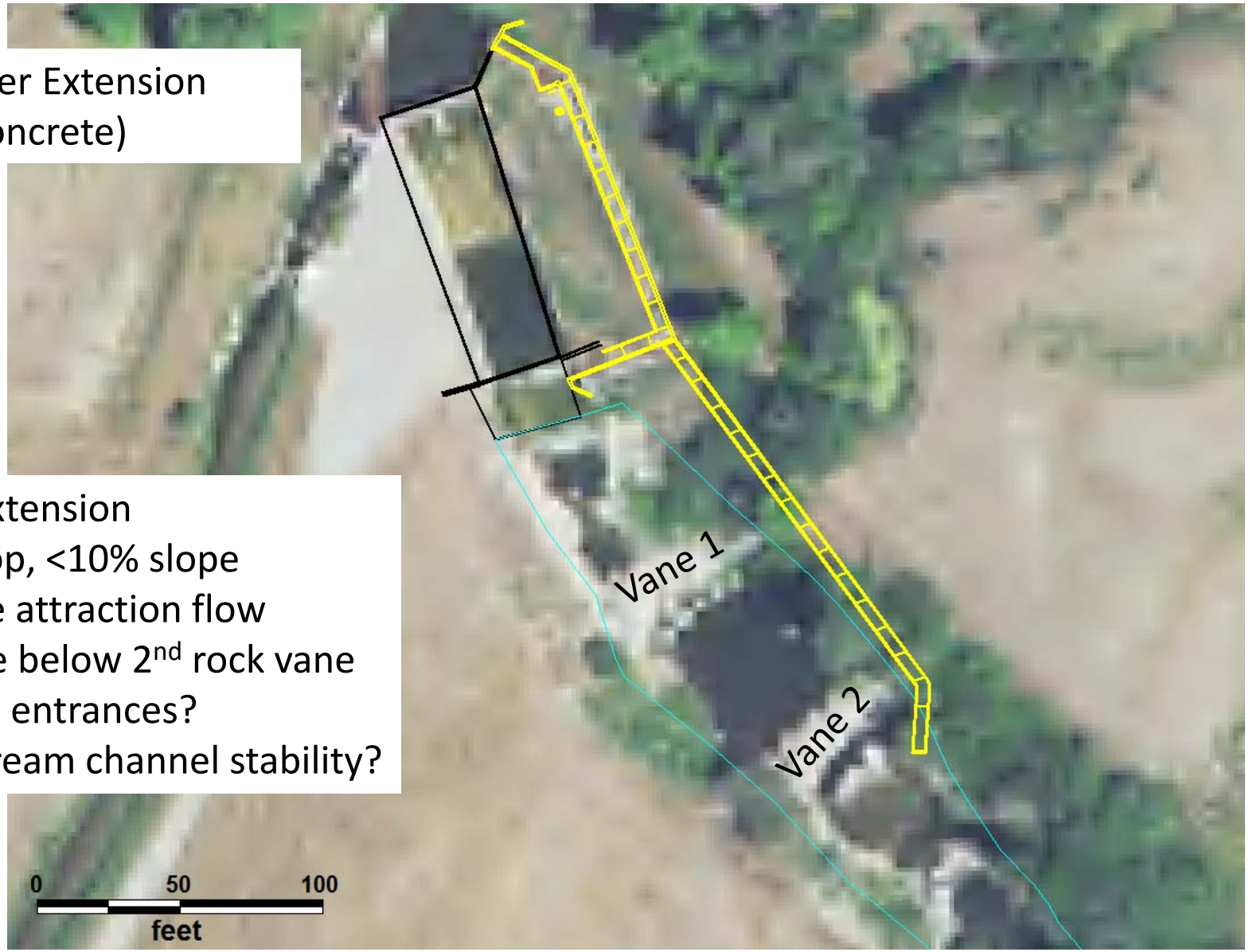

950
945
940
935
930
925
920
915
910
905
Elevation (ft, local datum)
800
1000
1200
1400
1600
1800
2000
Station (ft)
Existing Thalweg
Concrete Structure
Fish Ladder Entrance
Top of Bank
Design Alt2 Thalweg

3. Hardened Riffle Grade Distribution

- Re-work 800 ft channel
- 9 structures
- 3% grade on riffles
- 1-ft rock (rip rap)
- 1,200 cy rip rap
- Fish passage (low flow)?



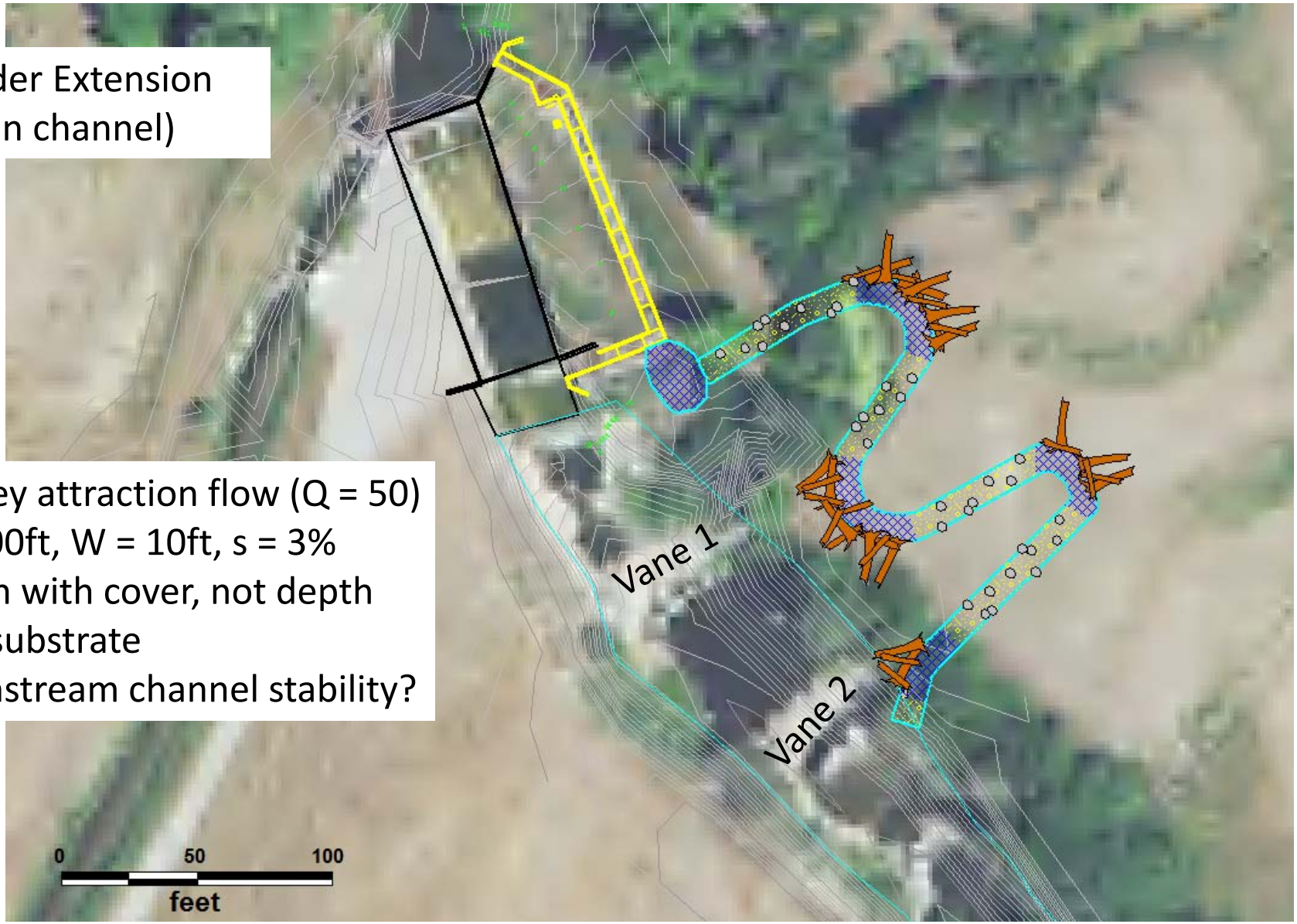
4. Ladder Extension (concrete)



- 175 ft extension
- 13 ft drop, <10% slope
- Re-route attraction flow
- Entrance below 2nd rock vane
- Multiple entrances?
- Downstream channel stability?

5. Ladder Extension (open channel)

- Convey attraction flow (Q = 50)
- L = 400ft, W = 10ft, s = 3%
- Rough with cover, not depth
- >9in substrate
- Downstream channel stability?

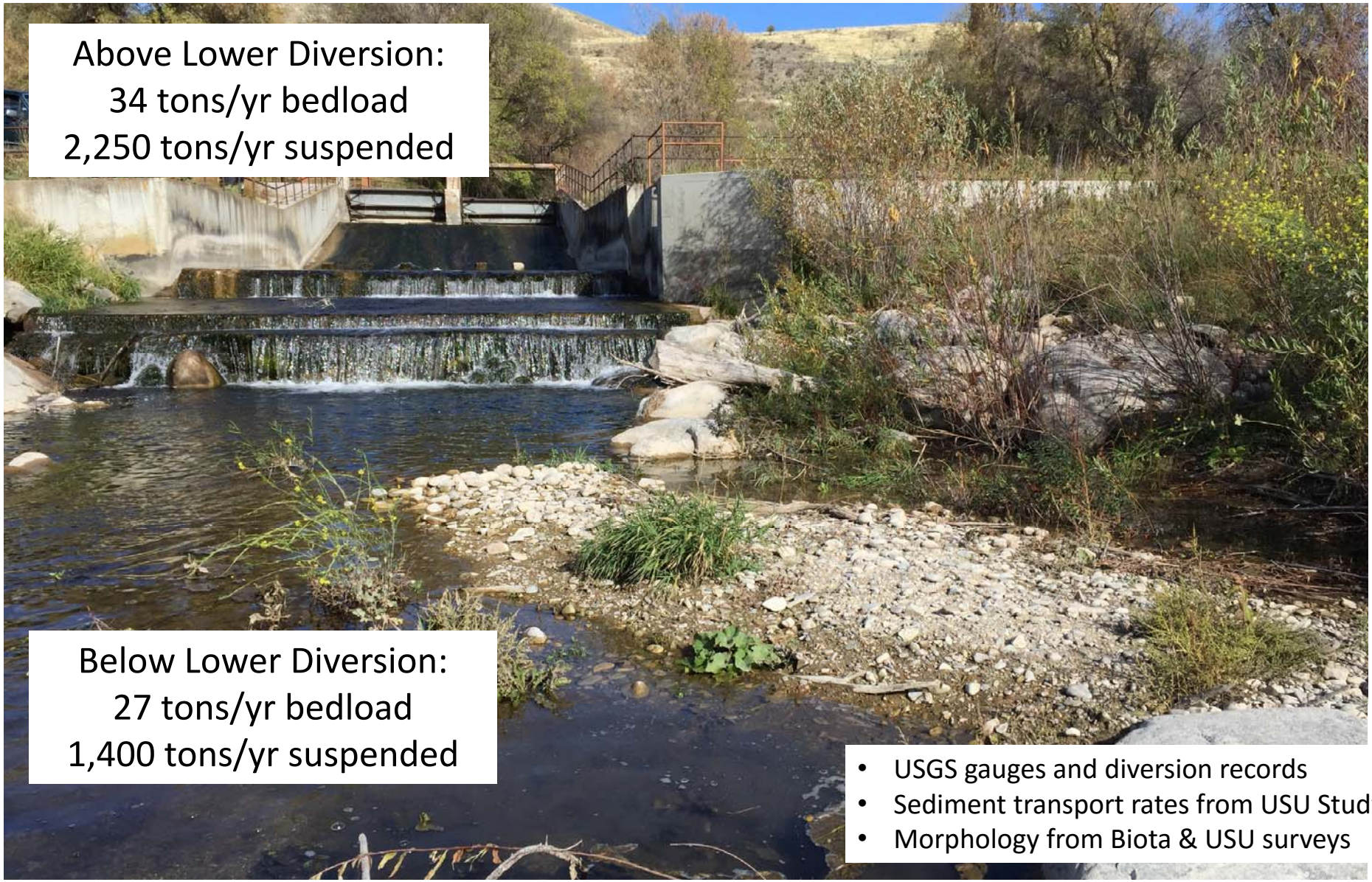


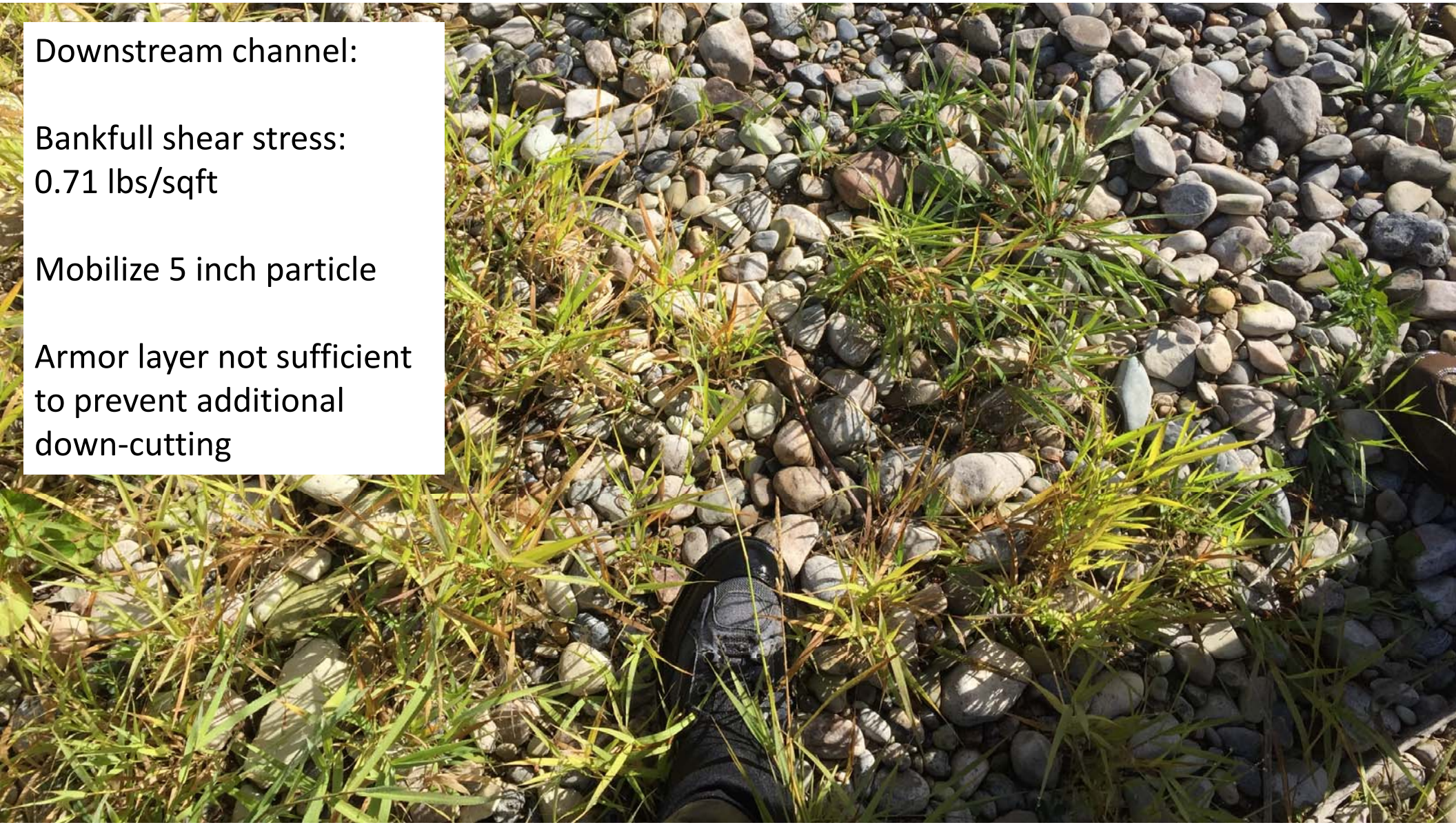
6. Modify Rock Structures

- Suitability?
- Fish passage (low flow)?
- Maintenance? Sediment movement?
- Channel stability?

6b. Modify Rock Structures

- Maintenance?
- Sediment movement?
- Life span?
- Channel stability?


Above Lower Diversion:
34 tons/yr bedload
2,250 tons/yr suspended
Below Lower Diversion:
27 tons/yr bedload
1,400 tons/yr suspended
• USGS gauges and diversion records
• Sediment transport rates from USU Study
• Morphology from Biota & USU surveys


Downstream channel:
Bankfull shear stress:
0.71 lbs/sqft
Mobilize 5 inch particle
Armor layer not sufficient to prevent additional down-cutting

Alternative	Project Cost	Footprint	Treatment Lifespan	Maintenance	Vertical Channel Instability	Lateral Channel Instability	Fish Passage	Cost Estimate
Channel Restoration								$1,500,000
Rock Vanes (n=14)								$ 250,000
Hard Riffles (n=9)								$ 200,000
Ladder Extension (concrete)								$ 250,000
Ladder Extension (open channel)								$ 100,000
Modify Existing Rock Structures								$ 75,000