

# Installation and Maintenance of Artificial Barriers to Exclude Nonnative Trout: The Sun Creek Experience

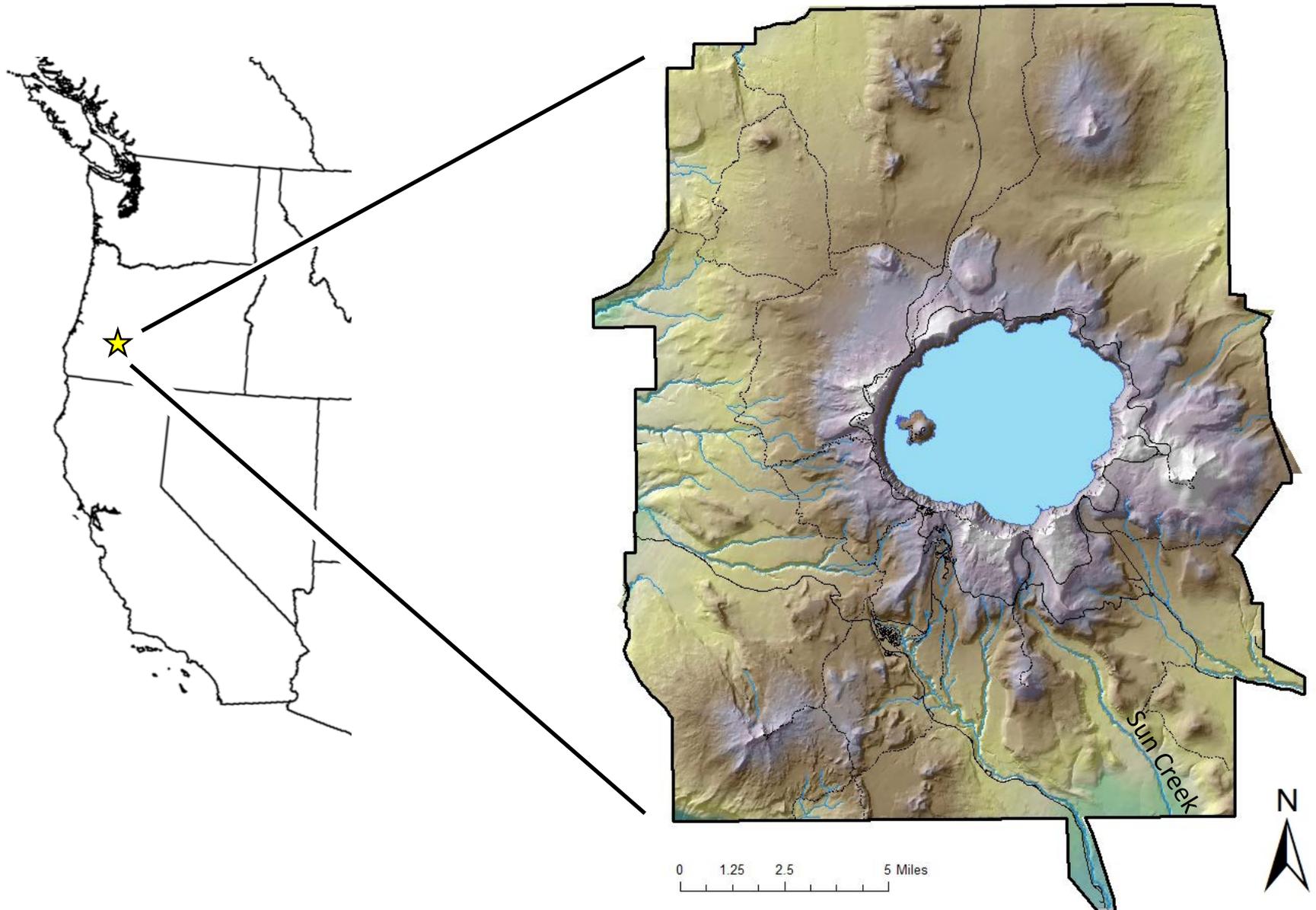


Mark Buktenica and Dave Hering, Crater Lake National Park



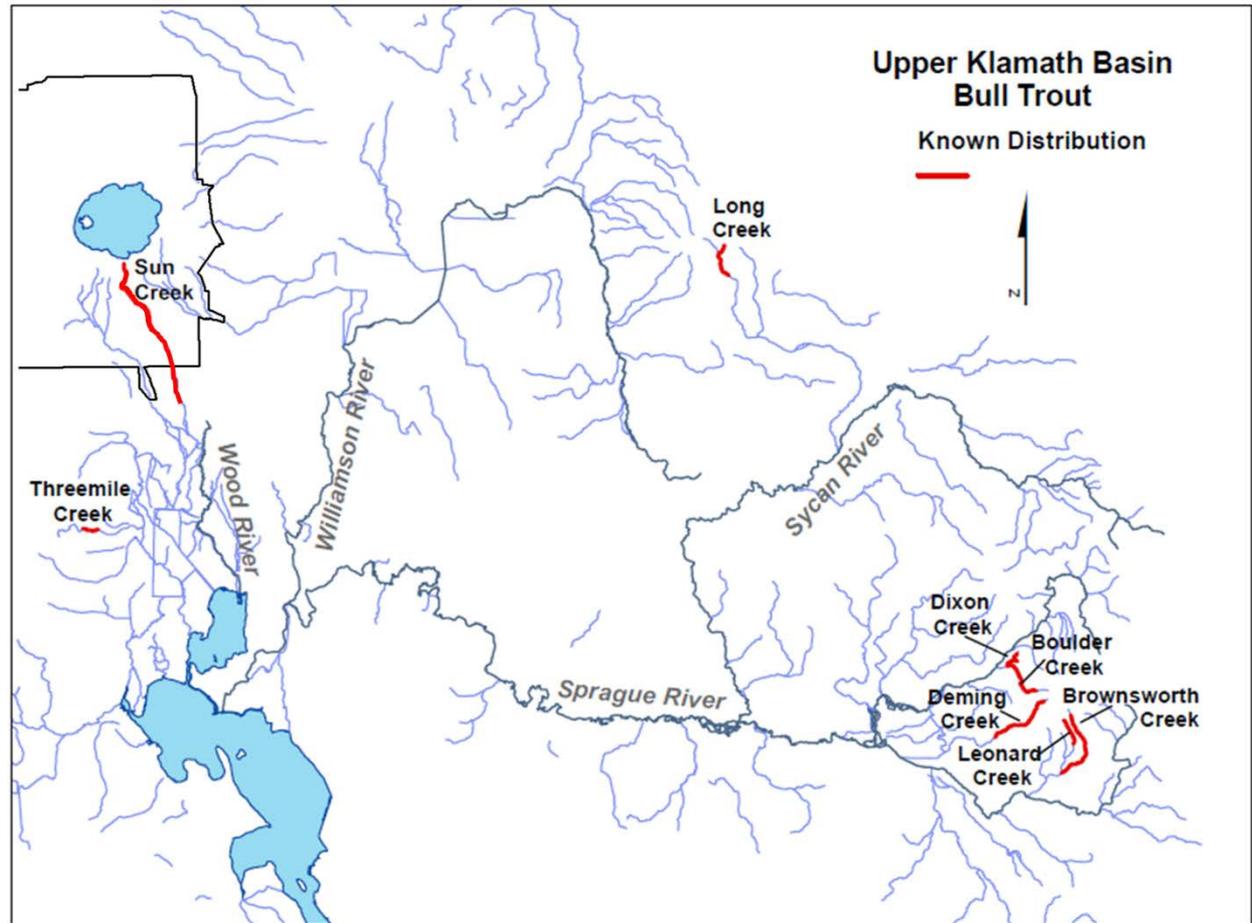


# Crater Lake National Park



# Bull Trout in the Upper Klamath Basin

- Bull trout were once widely distributed, but now mostly extirpated from the Upper Klamath Basin.
- Listed as Threatened under ESA in 1999
- Threats and limiting factors:
  - habitat degradation
  - lack of connectivity
  - **nonnative trout**



(modified from Oregon Department of Fish and Wildlife, Native Fish Investigations Project)

# Upper Sun Creek Restoration Project: 1992-2010

(Buktenica et al. 2013, NAJFM)

## Peer Review Panel (1991)

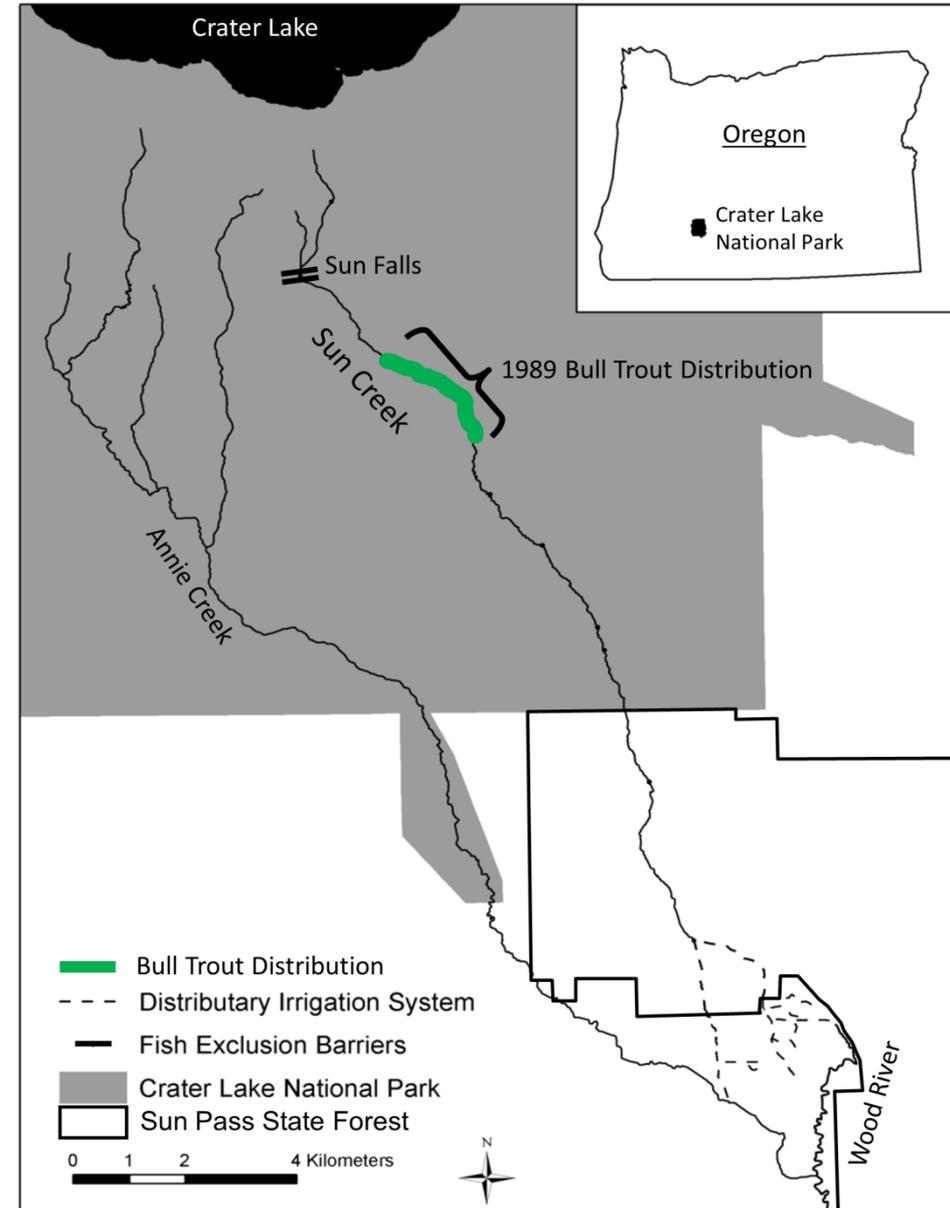
- Phil Pister, Desert Fishes Council
- Bruce Rosenlund USFWS
- Fred Allendorf, Univ. of Montana
- Doug Markle, Norm Anderson OSU
- Bob Hooton, John Fortune, Roger Smith, ODFW
- Steve Moore, NPS
- Tom Felando, USFS

## Objectives

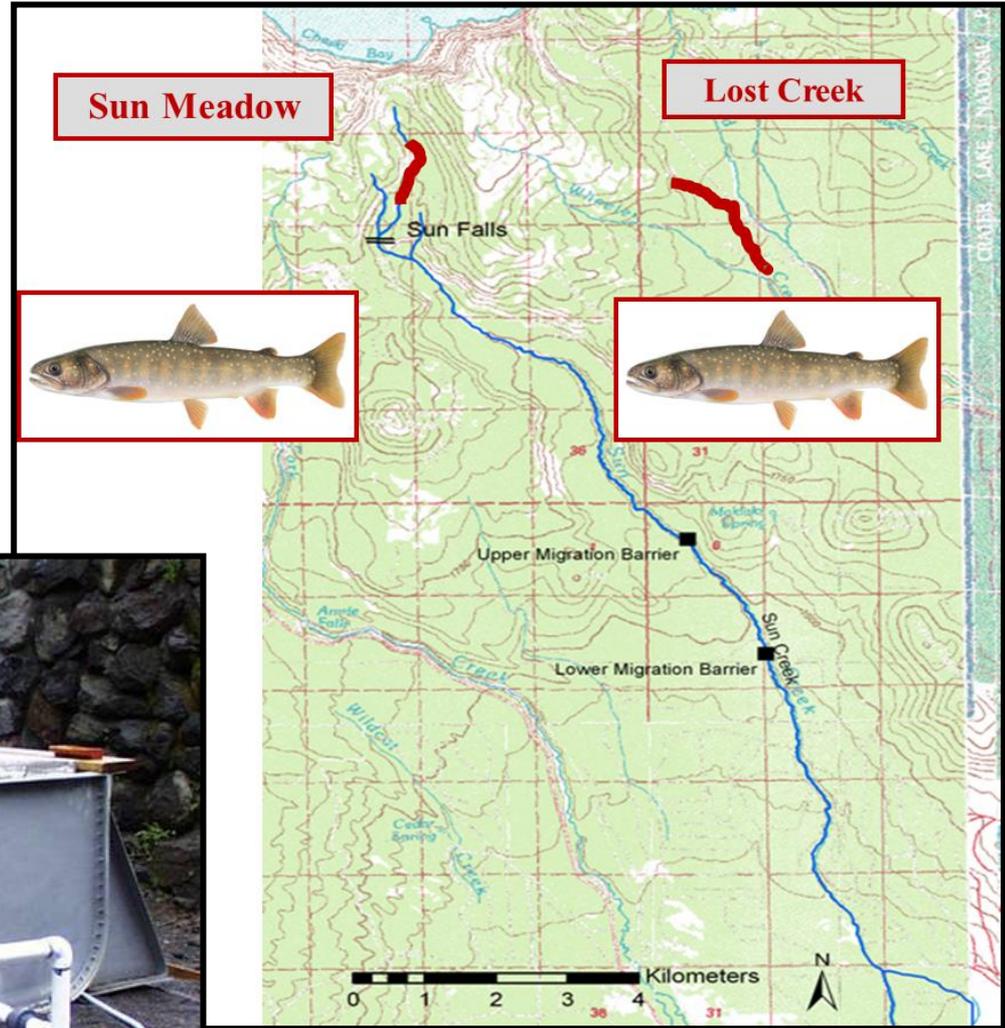
Eradicate nonnative trout and monitor bull trout response.

## Methods

- Artificial barriers installed to exclude nonnatives.
- Multiple years of diver-directed electrofishing removal to increase bull trout abundance.
- Salvage bull trout with trap-net electrofishing
- Established “refuge populations” of bull trout
- Treated targeted reaches in 1992, 1998, 2000, 2004, and 2005 with piscicide Antimycin-A



# Establish Refuge Populations



# Establish Refuge Populations



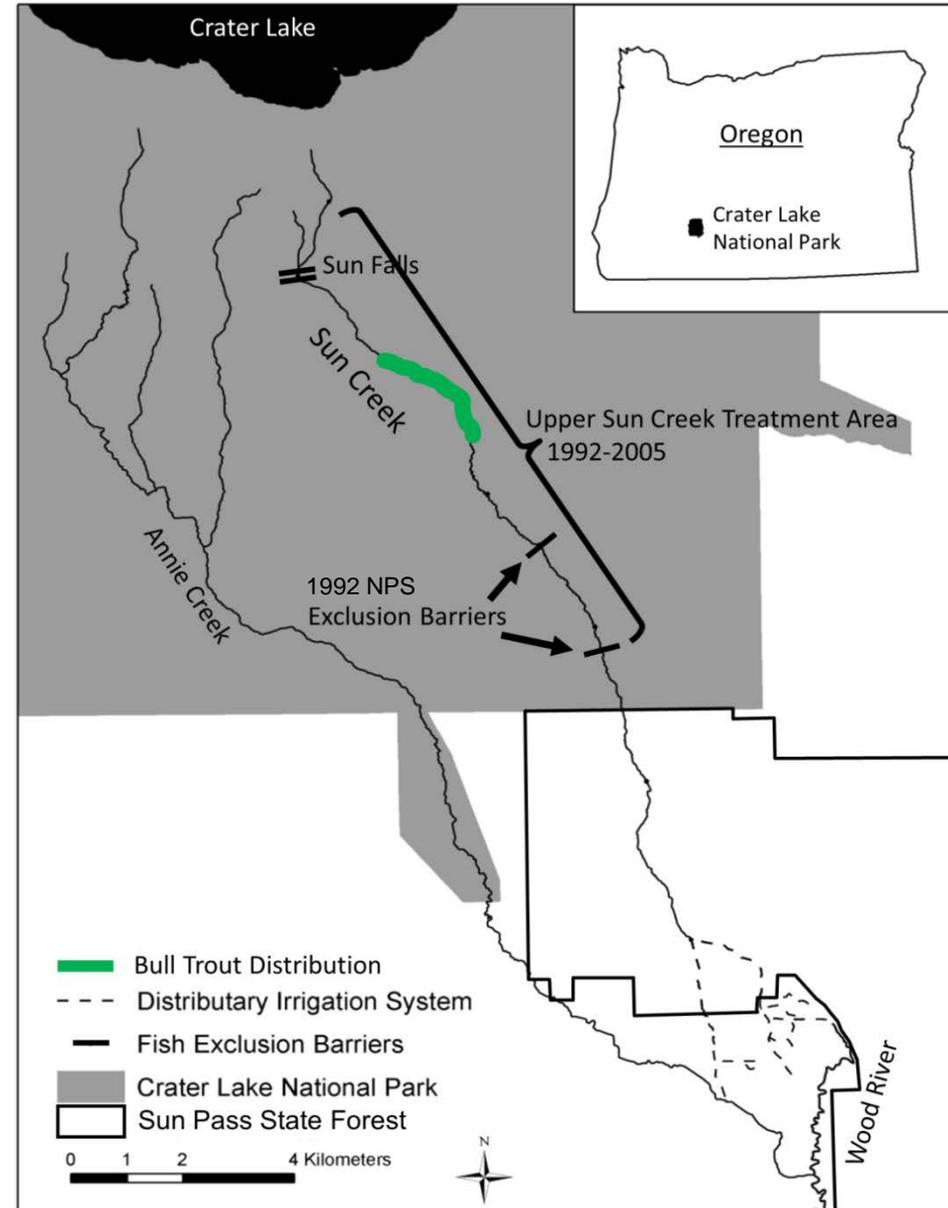
# Salvage bull trout – trap-net electrofishing



	<b>Number of Fish Removed</b>	
<b>Species</b>	<b>Trap-net Electrofishing</b>	<b>Antimycin</b>
Bull Trout	618	27
Brook Trout	298	38
Hybrid Trout	94	8
<b>Total</b>	<b>1010</b>	<b>73</b>

# Upper Sun Creek Restoration Project: 1992-2010

(Buktenica et al. 2013, NAJFM)



# 1992 NPS Barrier Design

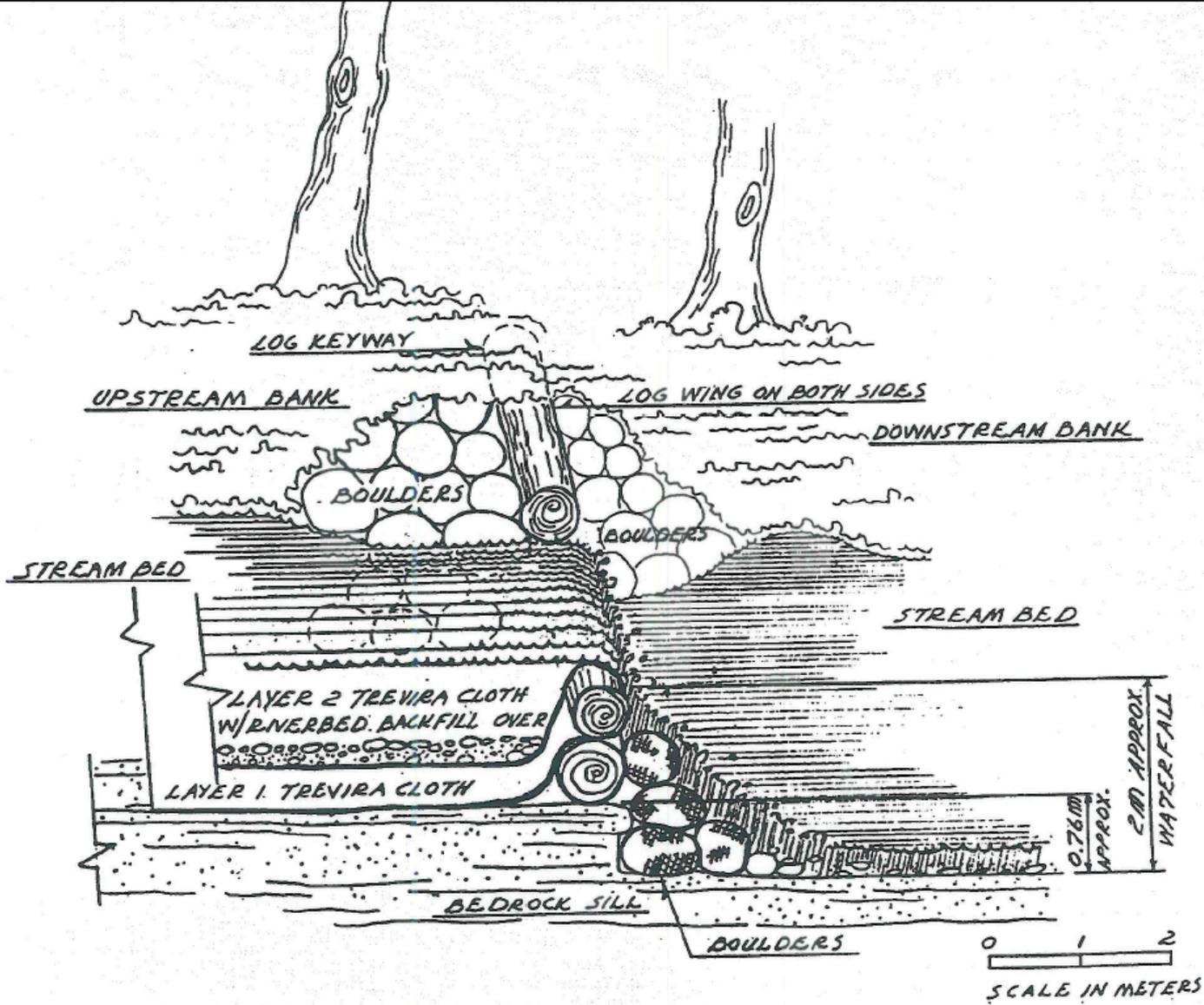


Figure 2. Fish immigration barrier cross-section illustrating design and construction.

# 1992 NPS Barriers



# 1992 NPS Barriers – Upper Barrier Construction



- USFS hand crew
- Smaller timber felled on site for materials
- Minimum Tool?
- Cost ~ 14 days per diem for eight people ~ \$4500

# 1992 NPS Barriers – Lower Construction

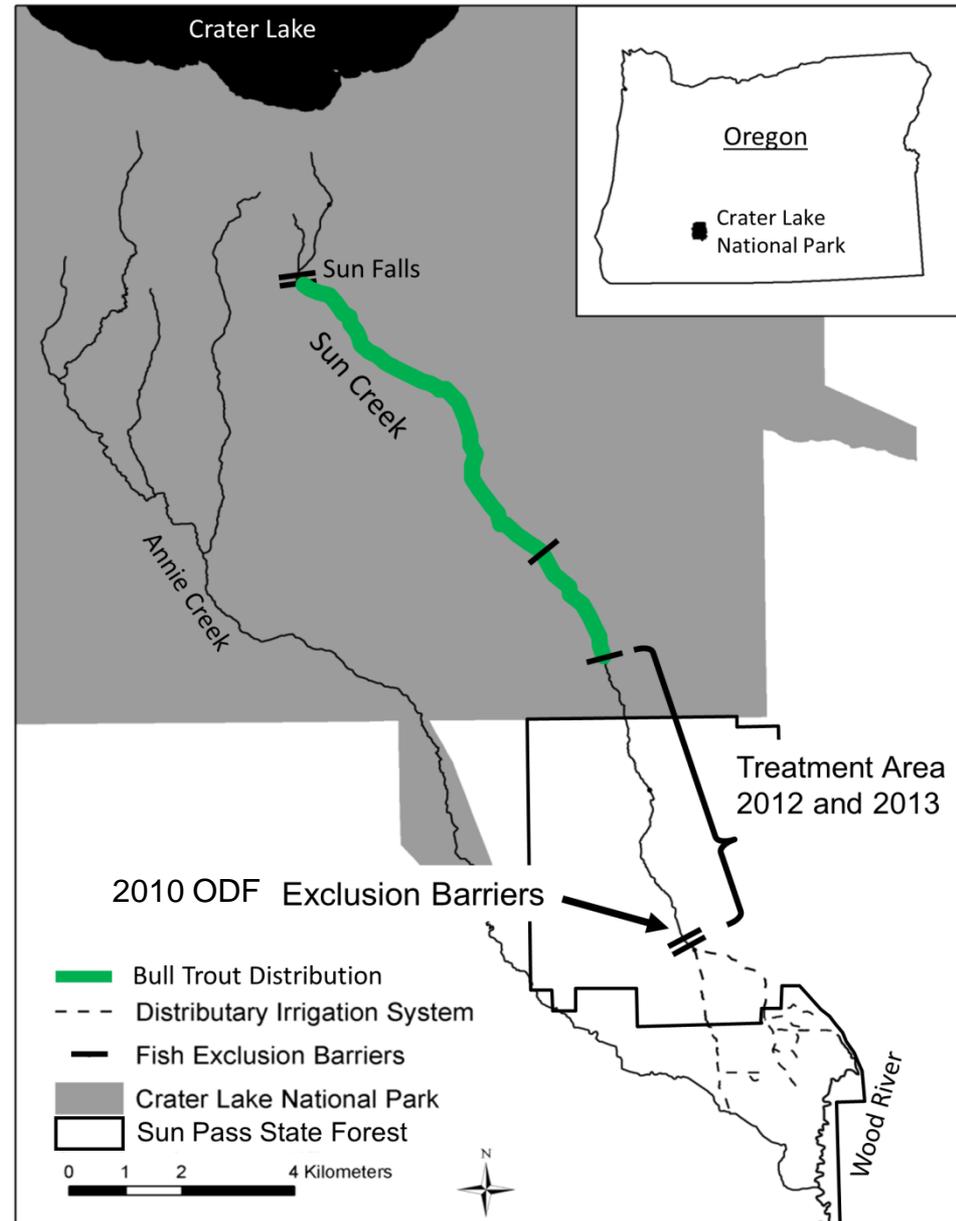


- “Spider” excavator
- Larger timber felled on site for materials
- Minimum Tool?
- Cost ~ 12 hours equipment time and mobilization ~ \$3000

# 1992 NPS Barriers – Lower Barrier Construction



# 2010 ODF Barriers

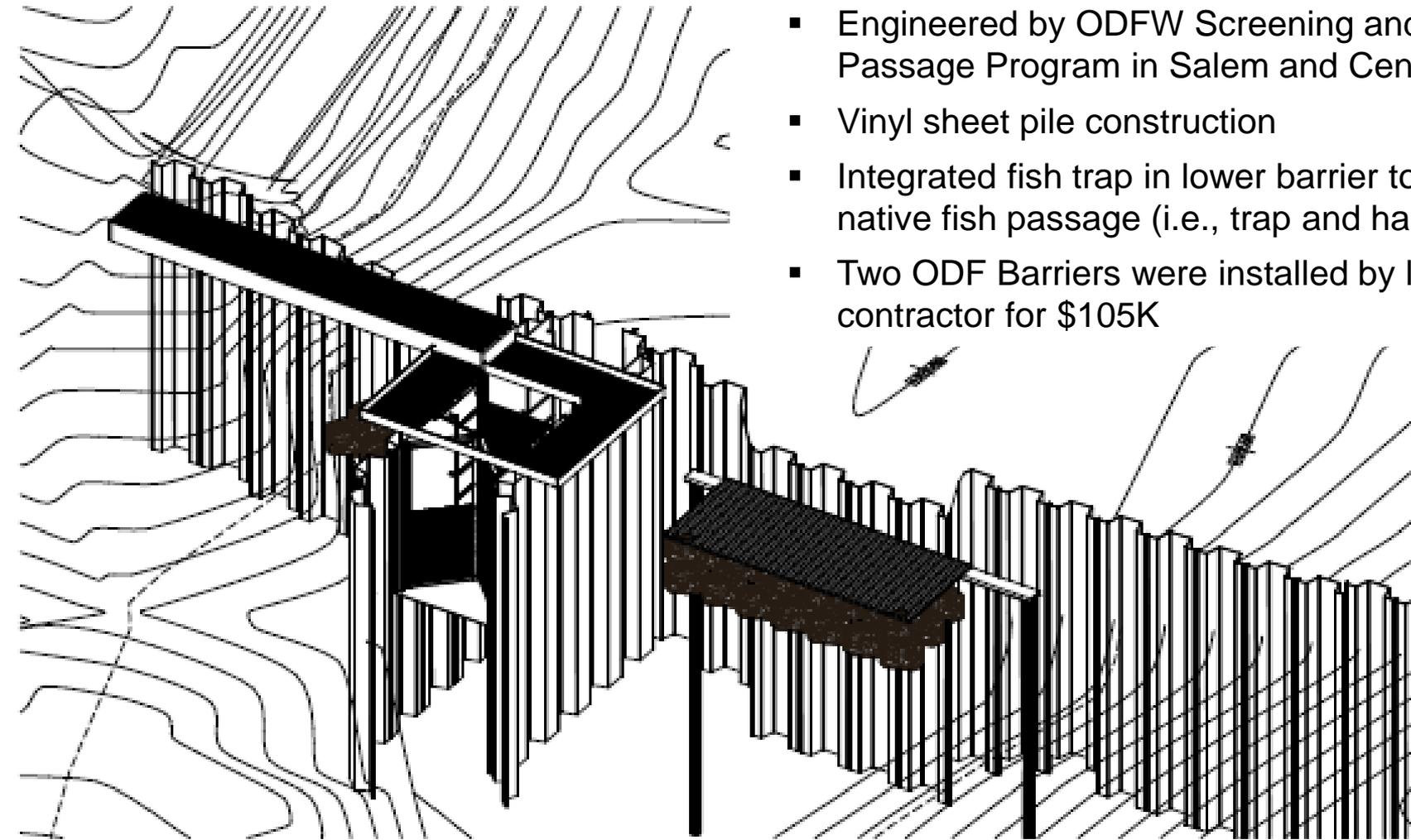


# 2010 ODF Barrier Design

## LOWER SUN CREEK EXCLUSION BARRIER & FISH TRAP

APRIL, 2010

- Engineered by ODFW Screening and Passage Program in Salem and Central Point
- Vinyl sheet pile construction
- Integrated fish trap in lower barrier to facilitate native fish passage (i.e., trap and haul)
- Two ODF Barriers were installed by local contractor for \$105K



# 2010 ODF Barrier Construction

Sheet pile construction



# 2010 ODF Barrier Construction

Earthen levees required in low gradient, unconstrained reach.



# 2010 ODF Barrier Construction



# 2010 ODF Barrier - Trial, Error, and Modification

- Because of sub-optimal barrier elevation in low gradient reach, screens on the crest of the weir were designed to pass the stream through screen to prohibit jumping.
- In practice, screens filled with debris and froze solid in winter, effectively reducing overall jump height
- Screens were removed in 2011.



# 2010 ODF Barrier - Trial, Error, and Modification

- Barriers shifted and leaned downstream after a year or two.
- We added boulders to downstream face of both structures to provide structural support and stabilize channel morphology downstream.



# 2010 ODF Barrier - Winter Conditions

Winter ice and snow change everything!



# 2010 ODF Barrier - Winter Conditions



Fish ladder?

Are fish moving in winter?

# 2010 ODF Barrier - High Flow

- Barrier capacity designed for estimated 100-year flow based on watershed model.
- This was rain-on-snow event in December 2014.
- Probably still a barrier for small brook trout – maybe pass larger migrants?



# Brook Trout Jumping at Barrier



# Conclusion for Sun Creek and Ecological Trade-Offs



- Barriers were “necessary evil”.
- 2010 barriers incorporated fish trap to reduce ecological cost.
- Two barriers are better than one
- Log structures in steep gradient reach have held up for 25 years with minimal maintenance.
- Sheet pile structures in lower gradient system require more maintenance & attention in part because jump height is minimal.
- Probably prohibit small brook trout passage – may allow large migrant passage?
- Winter ice and snow conditions may reduce effectiveness of low barriers.

For more detail on the project methods and results see:

Buktenica, M. W., D. K. Hering, S. F. Girdner, B. D. Mahoney, and B. D. Rosenlund. 2013. Eradication of nonnative brook trout with electrofishing and Antimycin-A and the response of a remnant bull trout population. *North American Journal of Fisheries Management* 33:117-129.

# Regulatory Compliance

- NEPA and ESA
- Wilderness Minimum Tool Requirements
- Fill/Removal Permit (USACE/DSL)
- Fish Passage Waiver (ODFW)
  - Passage plan was a condition of waiver



Oregon

Theodore R. Kulongoski, Governor

Department of Fish and Wildlife

Fish Division  
3406 Cherry Avenue NE  
Salem, OR 97303  
503-947-6200  
Fax: 503-947-6202  
TTY: 503-947-6339  
[www.dfw.state.or.us](http://www.dfw.state.or.us)



December 2, 2010

Craig Ackerman  
Park Superintendent  
Crater Lake National Park  
700 Main Street, Ste. 201A  
Crater Lake, OR 97604

and

Greg Pittman  
Klamath Lake District Forester  
Oregon Department of State Forestry  
Klamath Falls, OR 97603

**Re: Upper and Lower Sun Creek Fish Passage Exclusion Barrier Fish Passage Approval PA-14-0018**

Mr. Ackerman and Mr. Pittman,

Pursuant to Oregon fish passage statutes ORS 509.585 and OAR 635-412-0035(6) and (9)(a)(D), the management decision and design for placing two (Upper and Lower) fish passage exclusion barrier structures and an associated fish trap located at the lower exclusion structure in Sun Creek in the Klamath Lake Basin is approved by the Oregon Department of Fish and Wildlife (ODFW) Fish Screening and Passage Program. The project, co-owned and managed by the Crater Lake National Park (Park Service) and the Oregon Department of Forestry (ODF), was designed by ODFW.

The primary purpose of the two fish passage exclusion barrier structures and corresponding fish trap, constructed as part of the lower exclusion structure, is to prevent the re-distribution of non-native brook and brown trout into occupied bull trout habitat in Sun Creek. Roger Smith, ODFW Klamath Watershed District Fish Biologist is in full support of the management decision to approve the fish passage exclusion structures and the fish trap in Sun Creek, a tributary of the Ammie Creek, a tributary of Upper Klamath Lake in Klamath County Oregon.

Pursuant to OAR 635-412-0035(1)(d) this fish passage approval entails exceptions to OAR 635-412-0035(9)(b), which requires exclusion barriers to conform to the National Marine Fisheries Service's (NMFS) fish passage design criteria. This design exception is