Restoring Montane Wet Meadows in Sequoia and Kings Canyon National Parks

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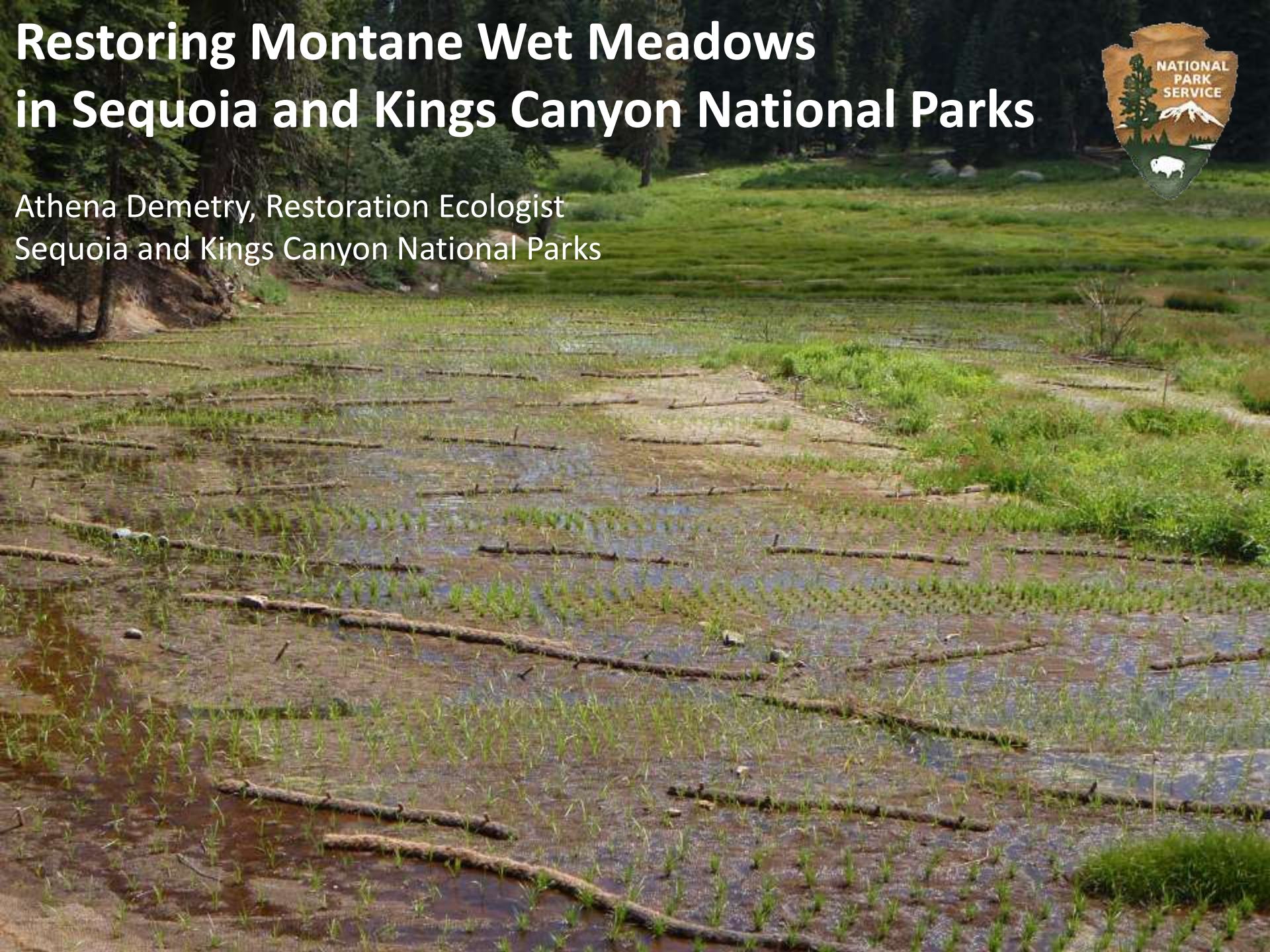
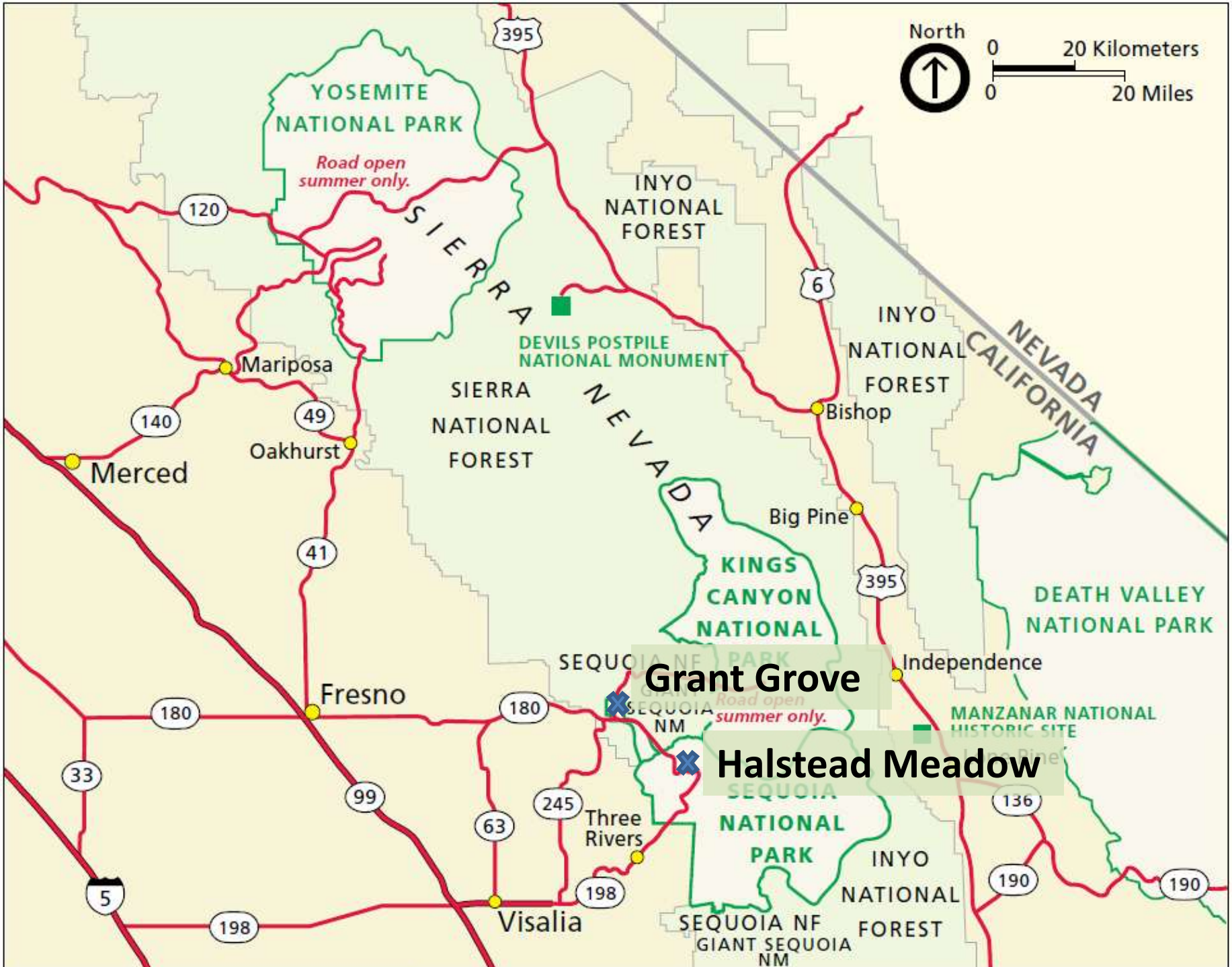
Sequoia and Kings Canyon National Parks

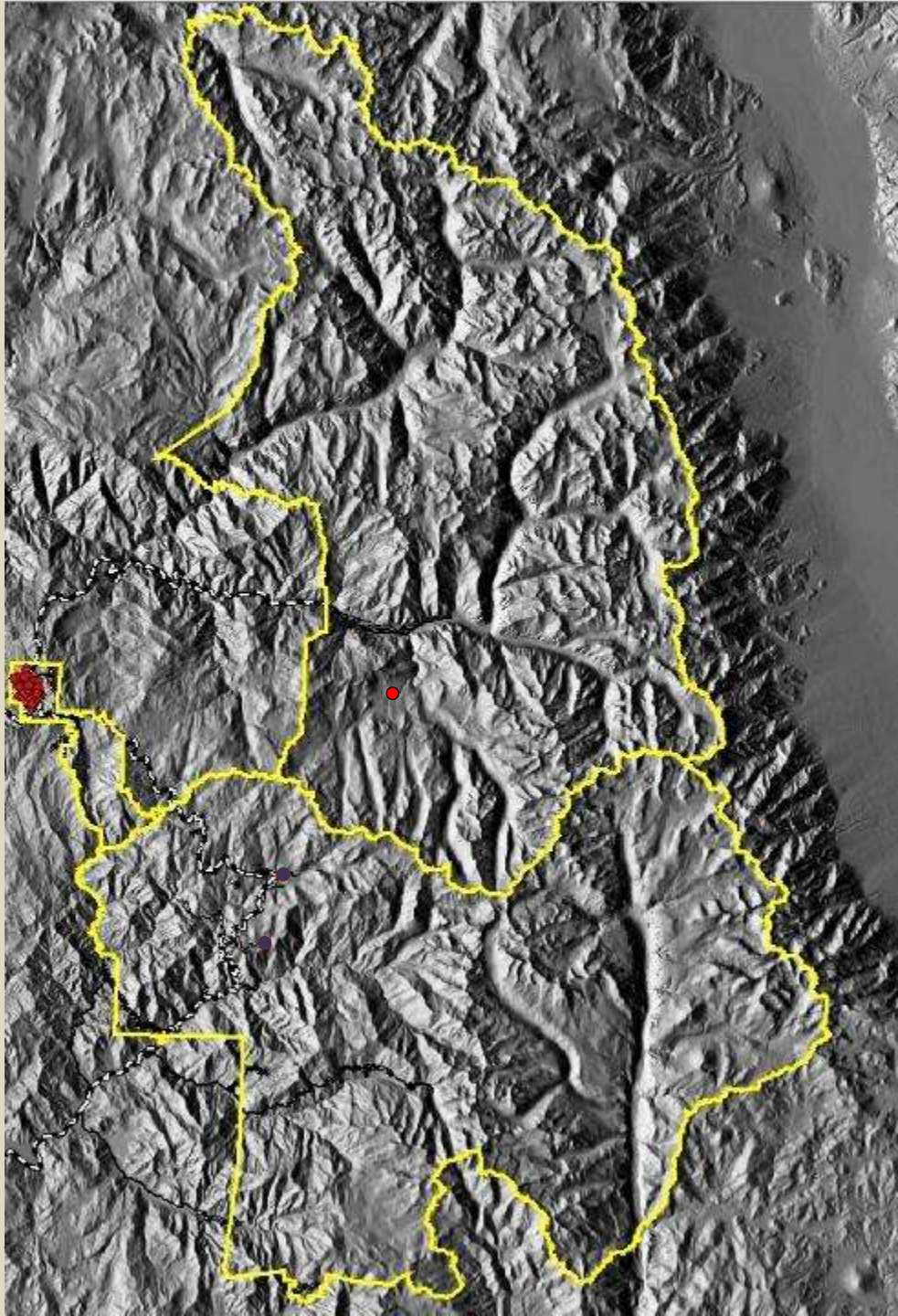



15 Years of Persistence and Learning
. . . in reed canarygrass management

. . . and restoration of deeply eroded wetlands


North
0
20 Kilometers
0
20 Miles
YOSEMITE NATIONAL PARK
Road open summer only.
INYO NATIONAL FOREST
SIERRA NEVADA
DEVILS POSTPILE NATIONAL MONUMENT
SIERRA NATIONAL FOREST
INYO NATIONAL FOREST
NEVADA
CALIFORNIA
Mariposa
Bishop
Merced
Oakhurst
Big Pine
KINGS CANYON NATIONAL
DEATH VALLEY NATIONAL PARK
Independence
Grant Grove
Fresno
Road open summer only.
MANZANAR NATIONAL HISTORIC SITE
Halstead Meadow
SEQUOIA NATIONAL PARK
Three Rivers
INYO NATIONAL FOREST
Visalia
SEQUOIA NF
GIANT SEQUOIA NM
395
120
140
49
41
180
33
99
63
245
198
5
6
136
190

Reed Canarygrass
Phalaris arundinacea
Locations



Reed Canarygrass
Phalaris arundinacea

- Highly productive
- Forms dense monocultures
- Spreads by rhizomes
- Dense thatch clogs waterways, raises distance to water table, and prevents recolonization by native species

Treatment 2003 - 2005

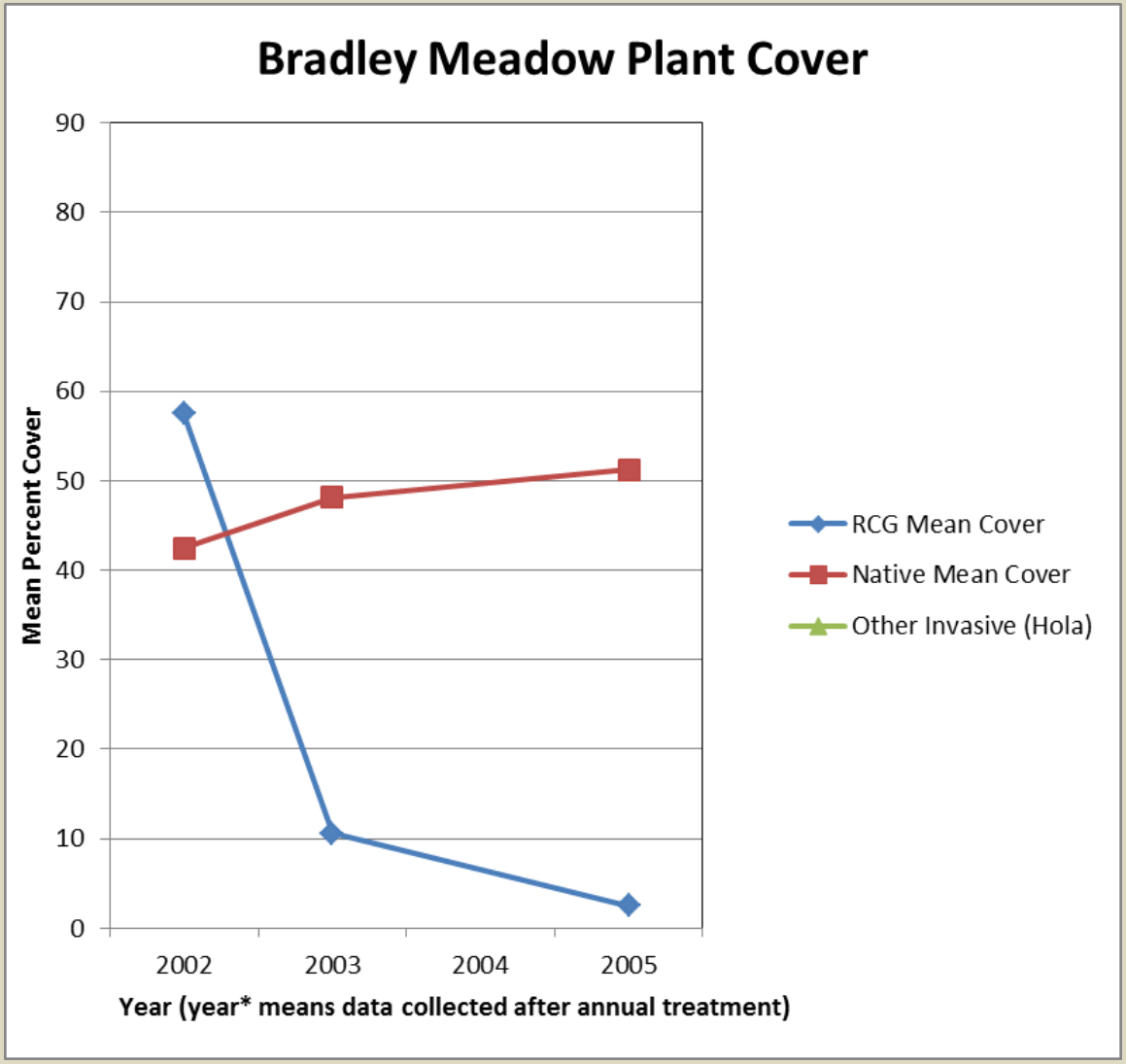
- Cut, resprout, treat with glyphosate years 1 -2
- Year 3, glyphosate plus hand-pull to **preserve native species recolonization**


2003 Before Treatment

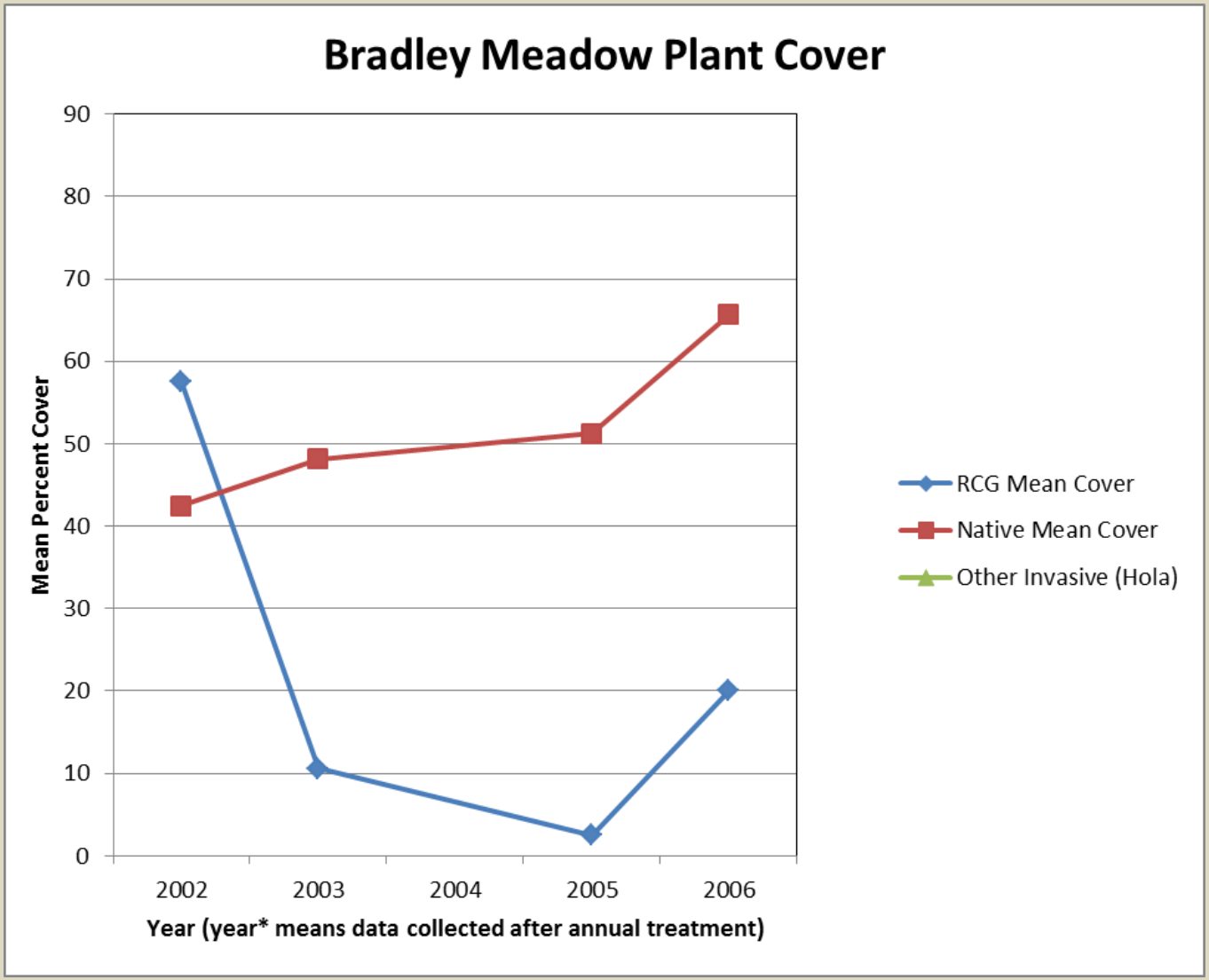

2003 After Treatment


2005

Year 3 : We're Done!



. . .not so fast


Bradley Meadow Plant Cover
Mean Percent Cover
90
80
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
Year (year* means data collected after annual treatment)
RCG Mean Cover
Native Mean Cover
Other Invasive (Hola)


2006

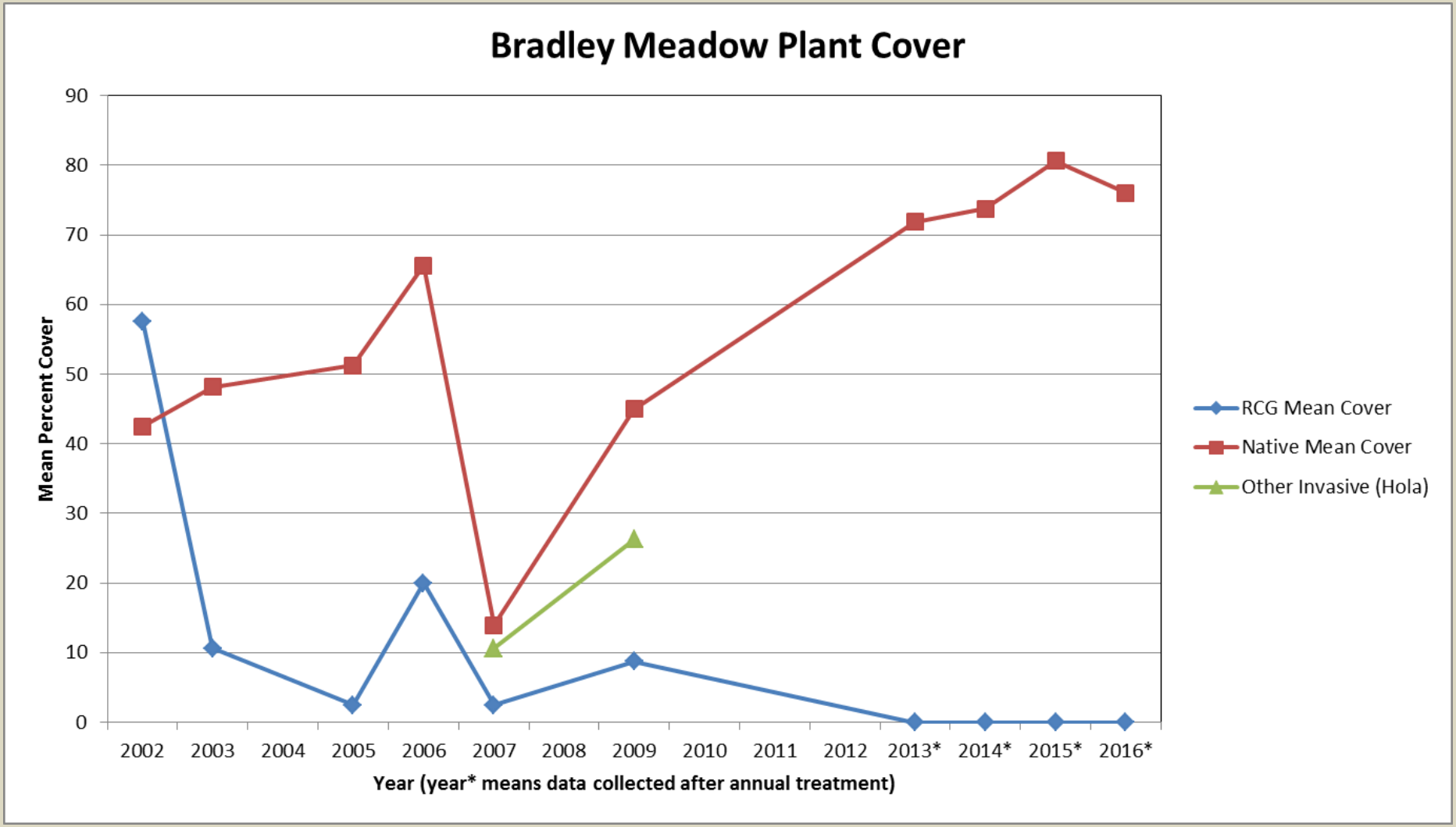
Lessons Learned

- Needed to be more aggressive in exhausting & killing the seed bank, even at expense of native recolonization

- Not just any natives will do
  - Need highly-competitive species
  - *Carex amplifolia*, *Scirpus microcarpus*, *Senecio triangularis*, *Solidago canadensis*
  - Begin propagating and planting

- ~~Paradigm of 3-5 year control project?~~
  - Long-term commitment (7 - 15 years) necessary to make meaningful improvements in wetland condition.

15-Year Commitment




2002


2005


2006


2013


ACE
CONSERVATION
EXPERIENCE
AMERICAN

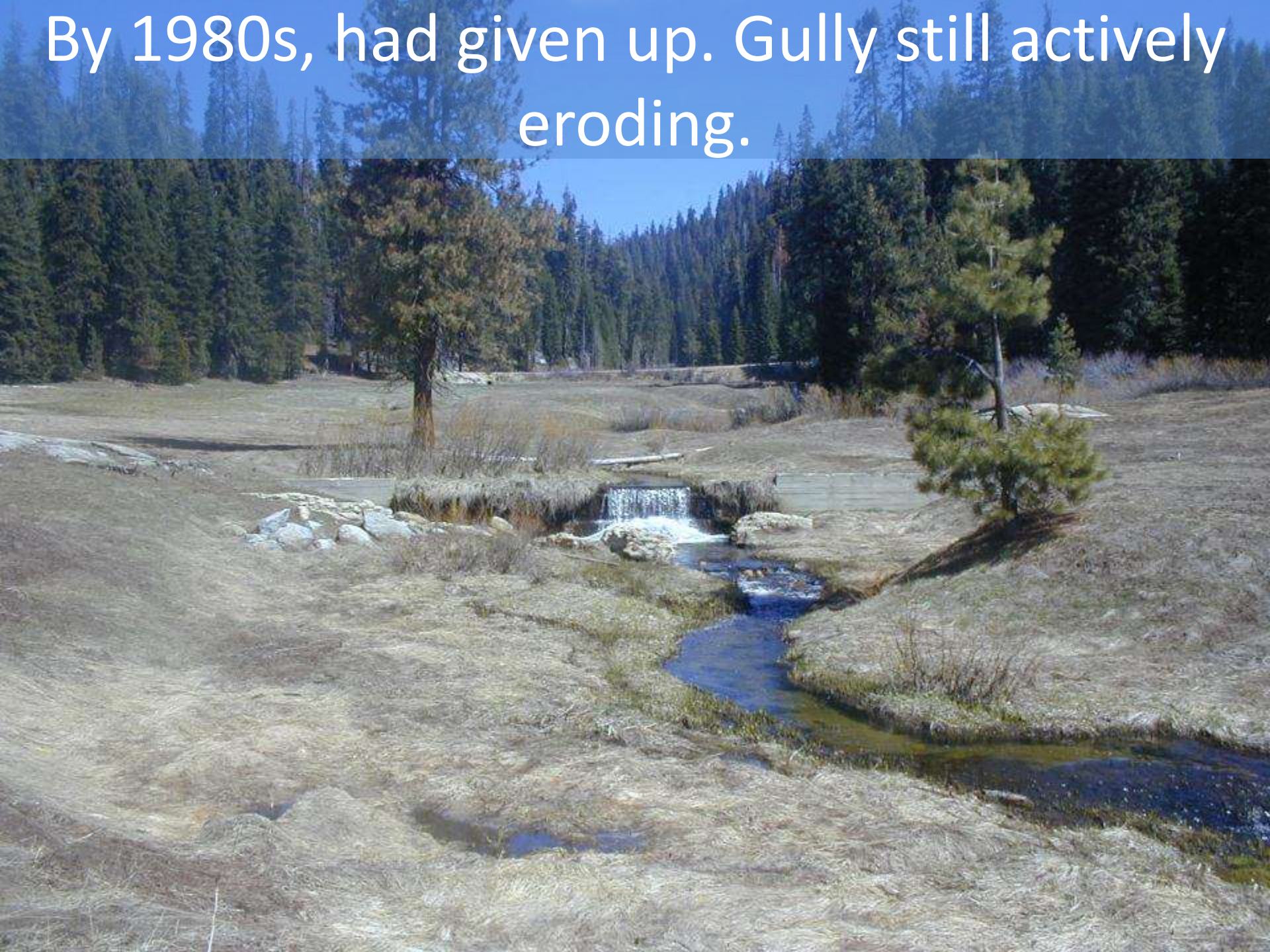
Halstead Meadow


Road completed 1934

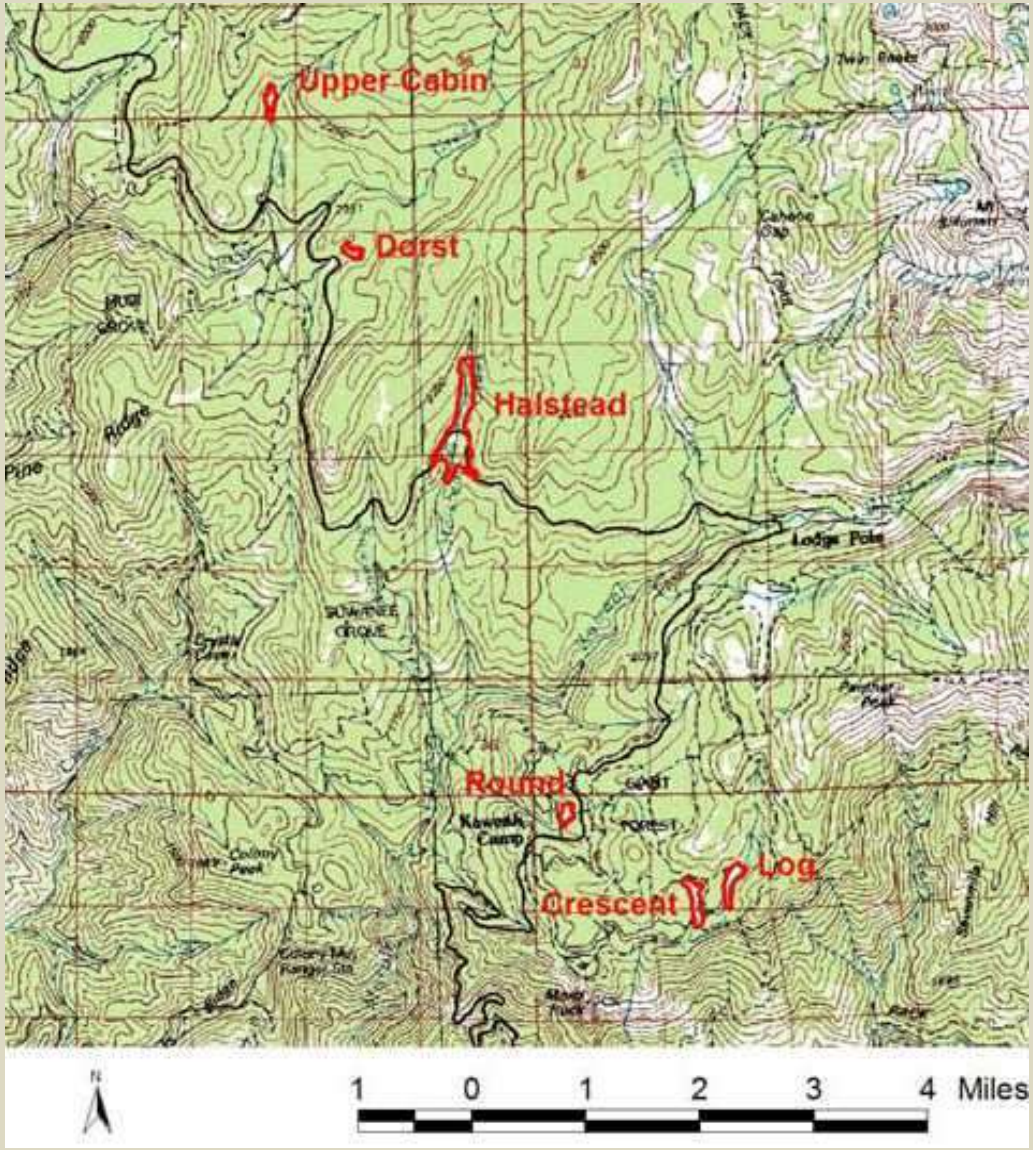
Check dams built 1940s-50s

- Washed out twice by floods and rebuilt
- Localized improvements, but did not stabilize or restore the meadow

By 1980s, had given up. Gully still actively eroding.



Develop reference concepts
Investigate 6 naturally-functioning meadows

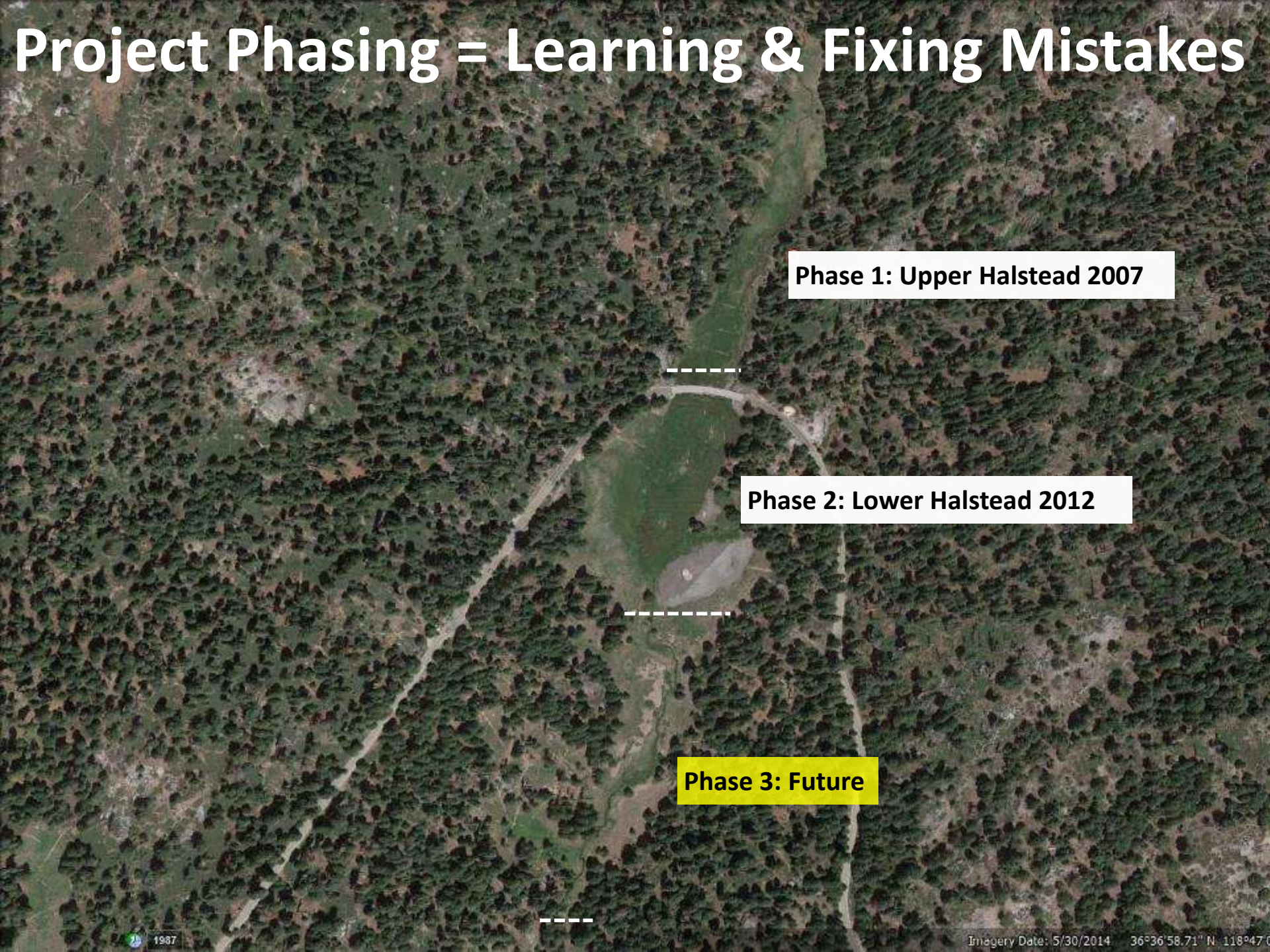


Reference meadows are level in cross section

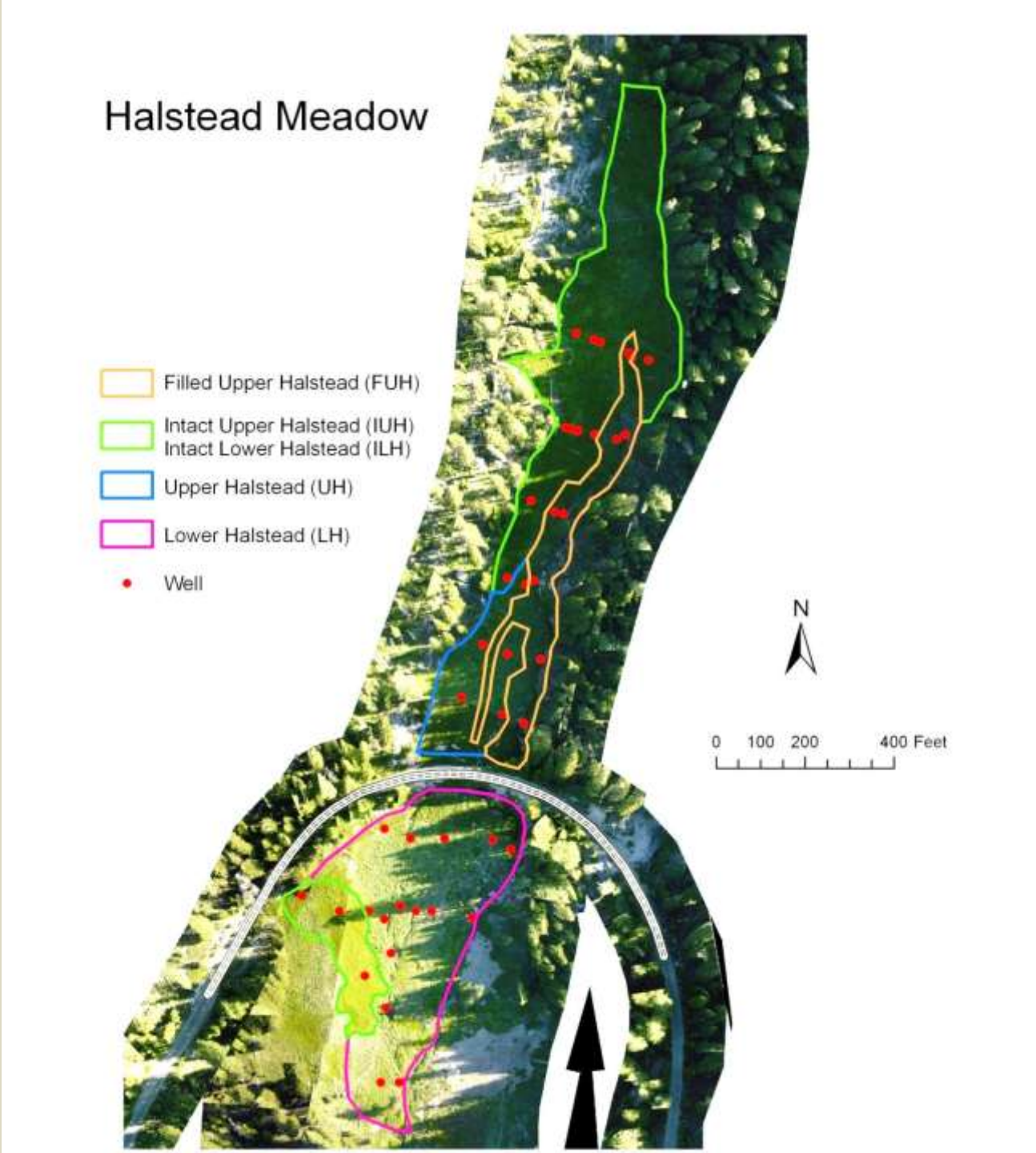
- No deep channels; occasional shallow braided channels
- Water moves as sheet flow and ground water
- Water table near surface most of the summer

Importance of large wood

Project Phasing = Learning & Fixing Mistakes



Phase 1: 2007-2008




Before Restoration, May 28, 2006.


Oct 2007


Jun 2008


Jun 2008

We're Done!

Two years after planting, August 2009


. . . not so fast
Oct 14, 2009


After storm damage, October 2009


TAKEUCHI
TL130

Lessons Learned (partial)

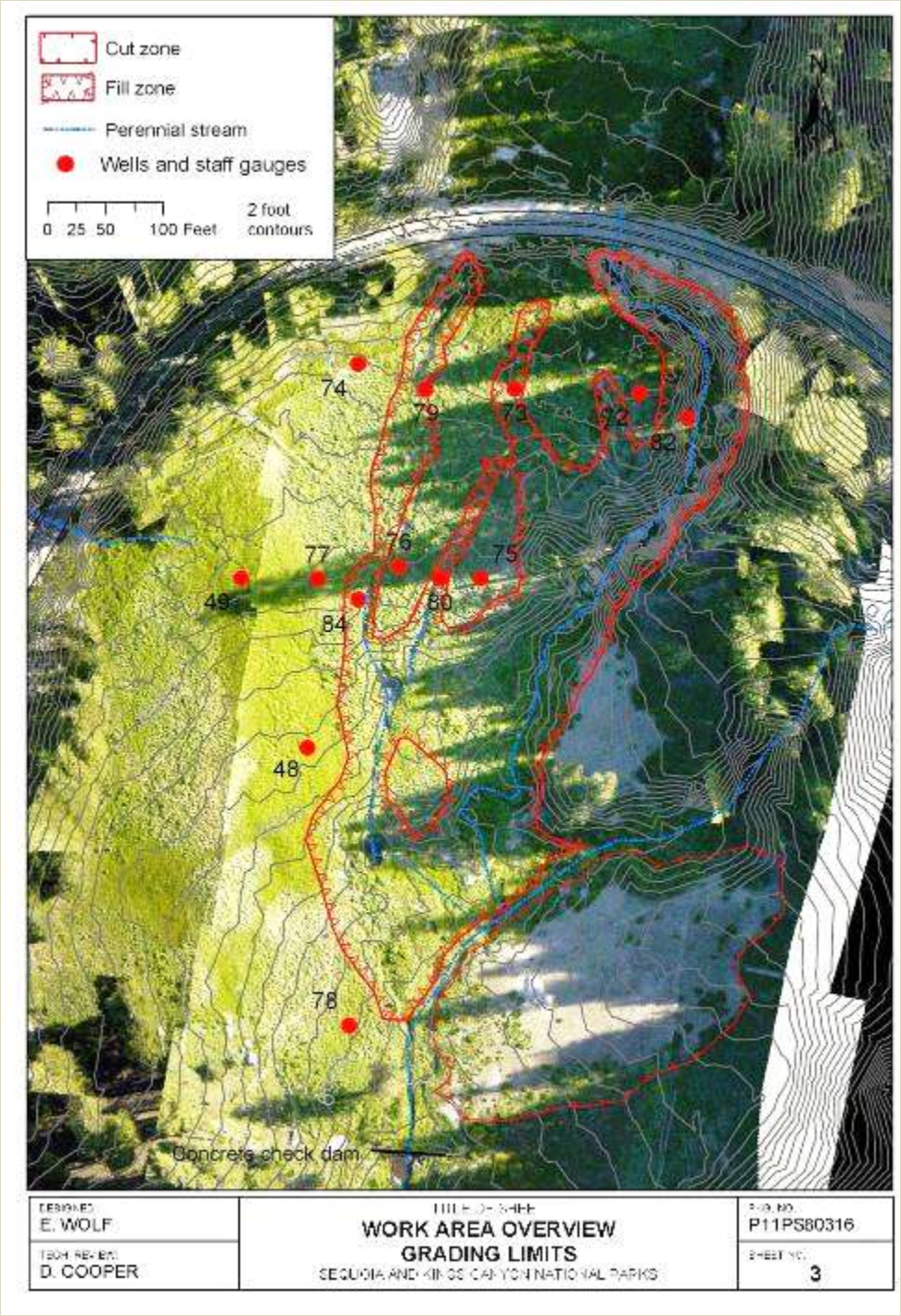
- Logs cause new gullies to form during high water flow
- Overcompaction of fill slowed plant growth
- **Need rapid plant cover to armor against storm damage soon after earth moving**


After storm repair, November 2009


Two months after planting, August 18, 2008


2016

Phase 2: 2012-2013




Before Restoration, July 2006


Year 2 of Bridge Construction, June 2012


Immediately After Restoration, October 2012


Three years after restoration, July 20, 2015


Problem: Over-compaction of fill, slowed plant growth
Solution: Ripped surface soil to loosen; incorporated wood chips

Problem: Low-quality plants, slow spread

Solution: One plant per tube; larger plants rather than more plants

Problem: Need faster plant cover in high-flow areas

Solution: Salvage high-quality sod from gully bottoms before filling…


2012

2013


Problem: Need faster plant cover in high-flow areas
Solution: Use custom-grown wetland sod product


WESTERN


August 2012


December 2012


2013


New Problem: Invasive plants introduced with wetland sod despite contract specifications

Non-native Plant Risk

- Grown in open, artificial ponds in Idaho
- Planned for moderate risk of nonnative plant introduction (3 years survey/control funding).
- Actual risk was higher:
  - Sod held over one year longer than planned
  - Ditch water, not well water used
  - Created a SEED BANK in coir matting

MAKE DETAILED INQUIRY INTO GROWING PRACTICES

		Phase 2 (Lower Halstead)					
	Phase	2011	2012	2013	2014	2015	2016
Invasives newly-introduced to site or parks*:							
Alopecurus arundinaceus &*							
Phalaris arundinacea	2			250	227	114	32
Anthemis cotula	2				12		
*Cirsium arvense**	2				76	100	95
Hordeum sp.	2			10	8		
Lactuca serriola	2					3	
Lolium (multiflorum)	2			10	3		1
Mentha piperata or x *spicata*	2						1
Sonchus spp.	2			50		186	270
Taraxacum officinale	2			not recorded			
*Veronica anagallis-aquatica**	2			50	10		60
Unknown or immature grasses	2			140			
Unknown nightshade	2						4
Newly-introduced intermountain natives:							
Carex hystricina	1				1		5
Carex stipata	2					1	1
Lemna minuta	2						
Scirpus pallidus	1	53	270	9	4	0	0
Possible newly-introduced genotypes:							
Carex nebrascensis?	2					21	10
Epilobium ciliatum ssp. glandulosum	2			20,000			
Invasives already present on site:							
Agrostis gigantea	1 & 2				3	3	
Poa pratensis	1 & 2						
Tragopogon dubius	1 & 2					73	

Conclusions

- Ecological restoration is an experiment.
- Mistakes are inevitable.
- Start small & implement in phases.
- Incorporate formal experiments when possible.
- Be persistent, stick around to observe.

Continuous learning & improvement


2011


July 2012


September 2012


June 2013


July 2015


June 2011


July 2012


July 2015