

# Assessment of Geomorphic Impacts of Vegetation Removal on the Colorado River



**Gigi Richard, Ph.D.**  
Director  
**FOUR CORNERS WATER CENTER**  
at FORT LEWIS COLLEGE

 **COLORADO MESA UNIVERSITY**  
RUTH POWELL HUTCHINS WATER CENTER





2012



2001



2007





2008



2012

# Colorado River, Grand Valley, CO



-  2012 Colorado River Active Channel (Asay, 2014)
-  2012 Tamarisk Coverage (Tamarisk Coalition, 2012)

# Tamarisk-Russian Olive (TRO) removal areas

~525 hectares  
(~1300 acres)  
TRO Removal



- Colorado & Gunnison Rivers
- Removal areas through 2015 (Tamarisk Coalition, 2015)

## Property owners:

- Audubon
- City of Grand Junction
- Clifton Sanitation District
- Colo. Parks and Wildlife
- Mesa County
- NRCS
- US Bureau of Reclamation

## Purpose of study:

Measure geomorphic adjustment following vegetation removal

- GIS/Aerial photo analysis: Measure rates of channel change pre/post-removal
- Field surveying: Cross-section survey pre/post-removal
- Standardize methods

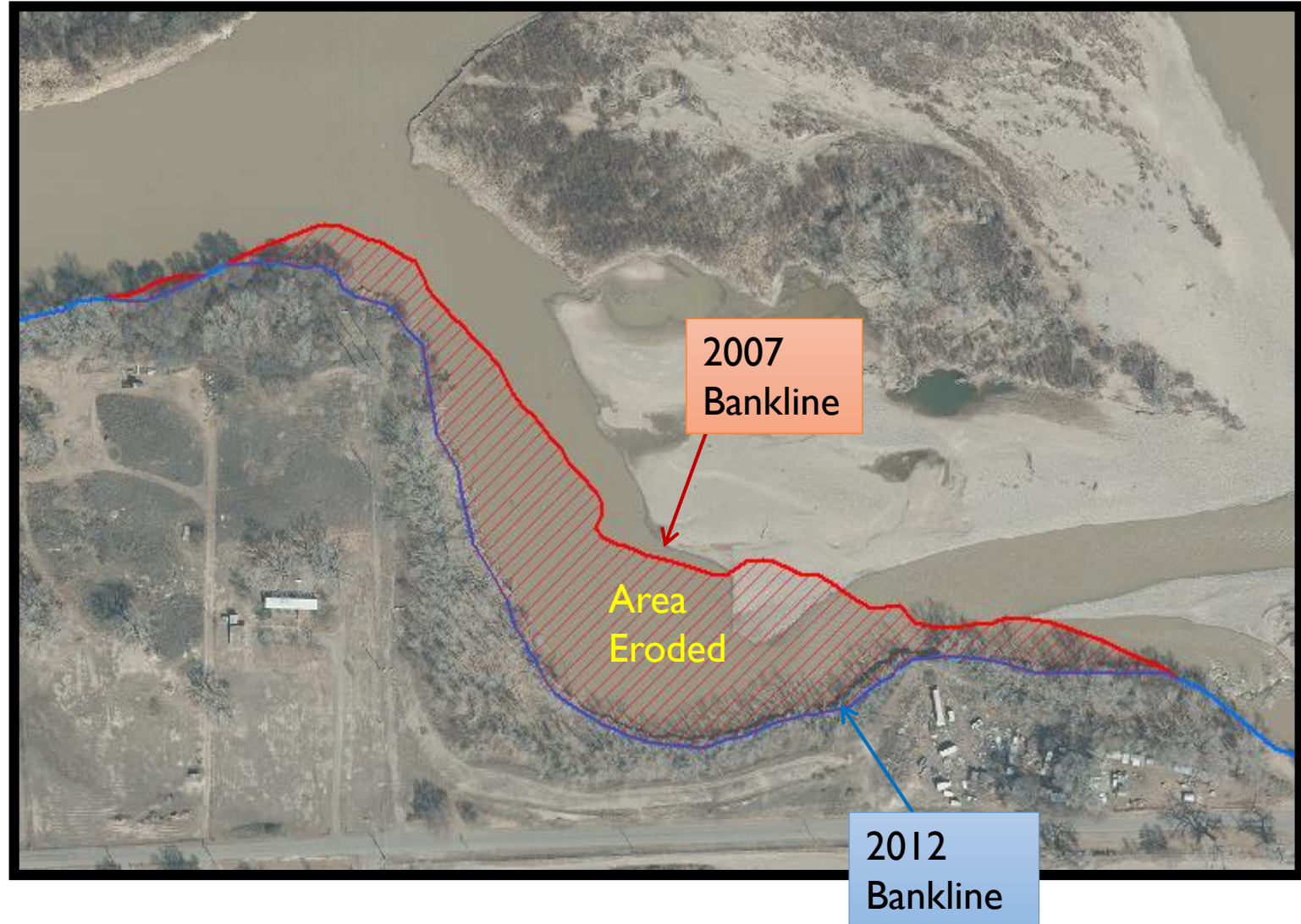


# GIS Analysis of Channel Change

~50 km reach

Analyzed four  
time periods

Year	Date	Imagery
2002	March 2002	0.2-m color
2007	April 2007	6-in color
2012	March 2012	6-in color
2015	March 2015	6-in color
2016	March 2016	6-in color



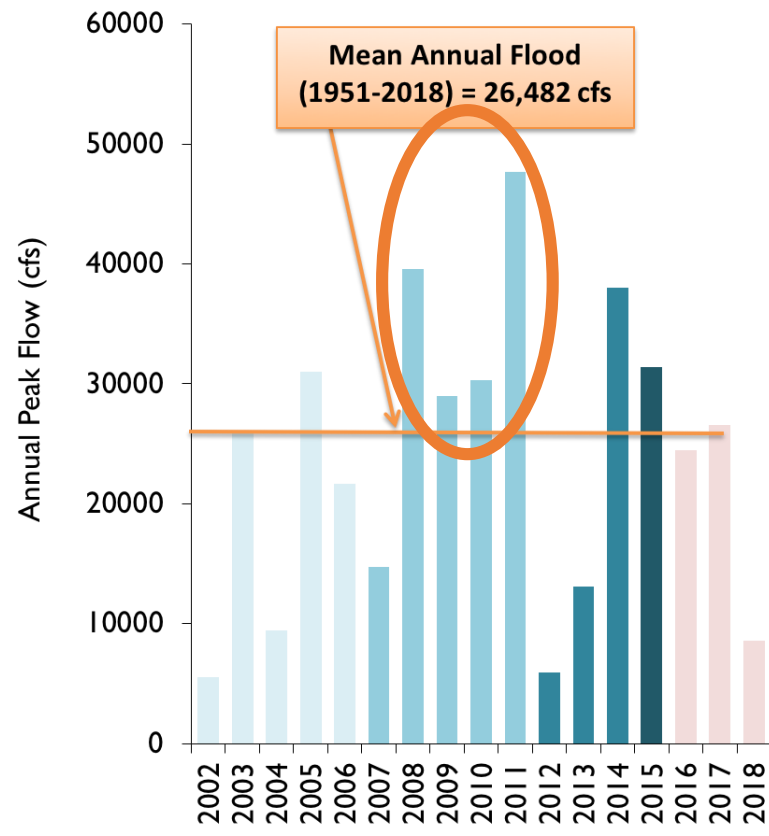
# Annual Peak Flow

During study periods

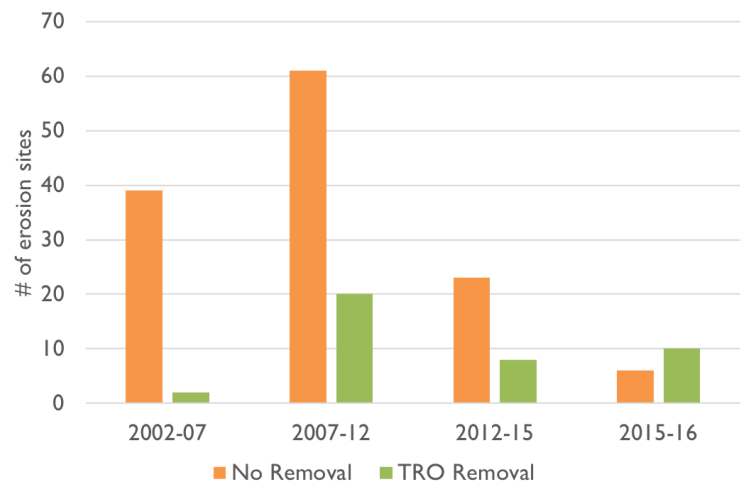
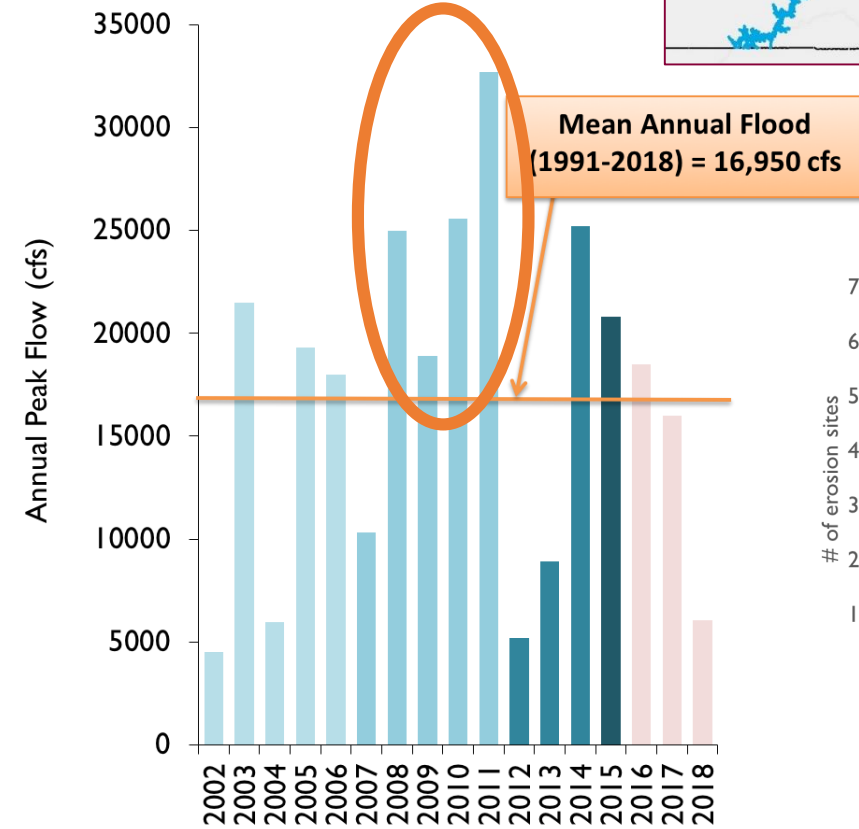
Four years of peak flow above the mean annual flood between 2007 and 2012



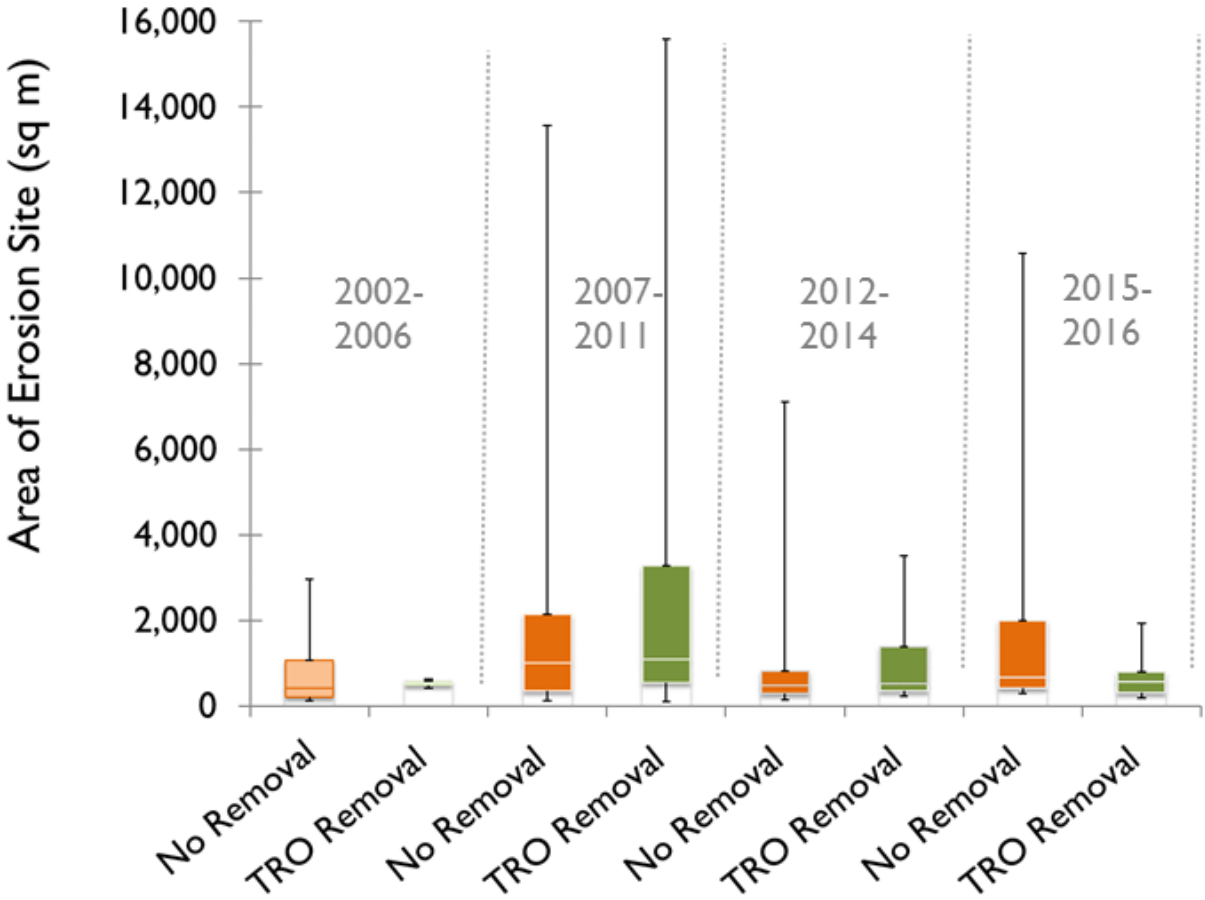
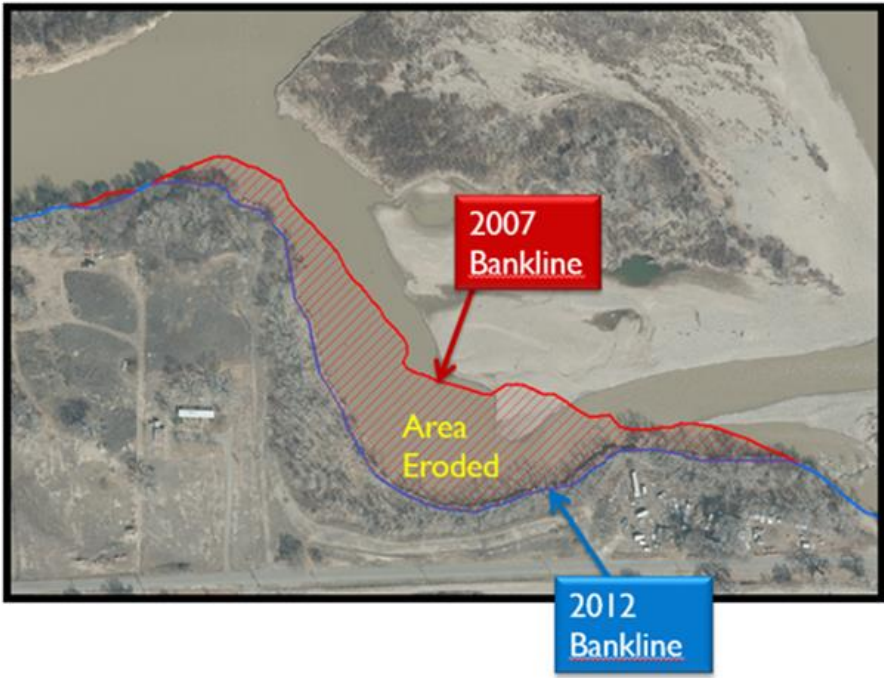
Colorado River Near CO-UT State Line



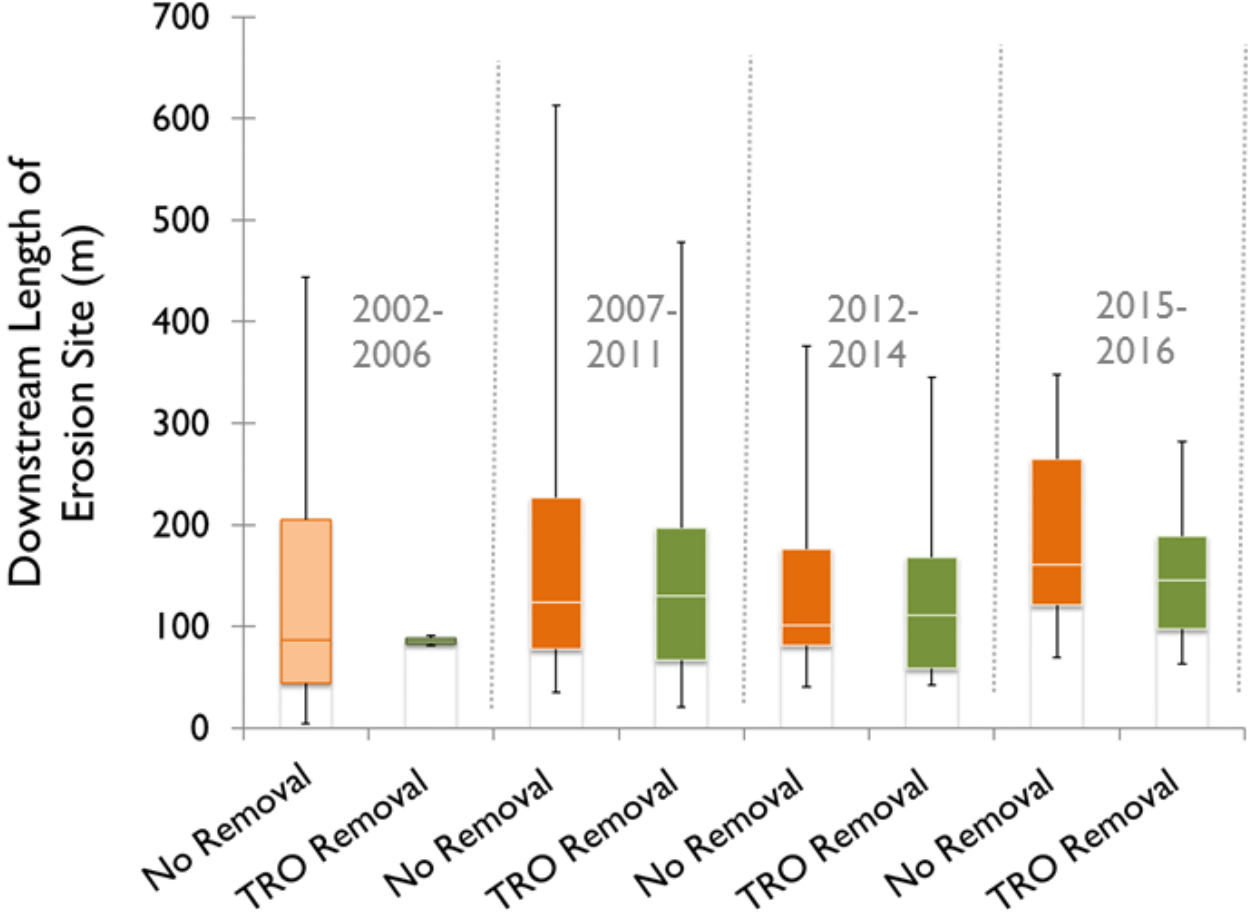
Colorado River near Palisade



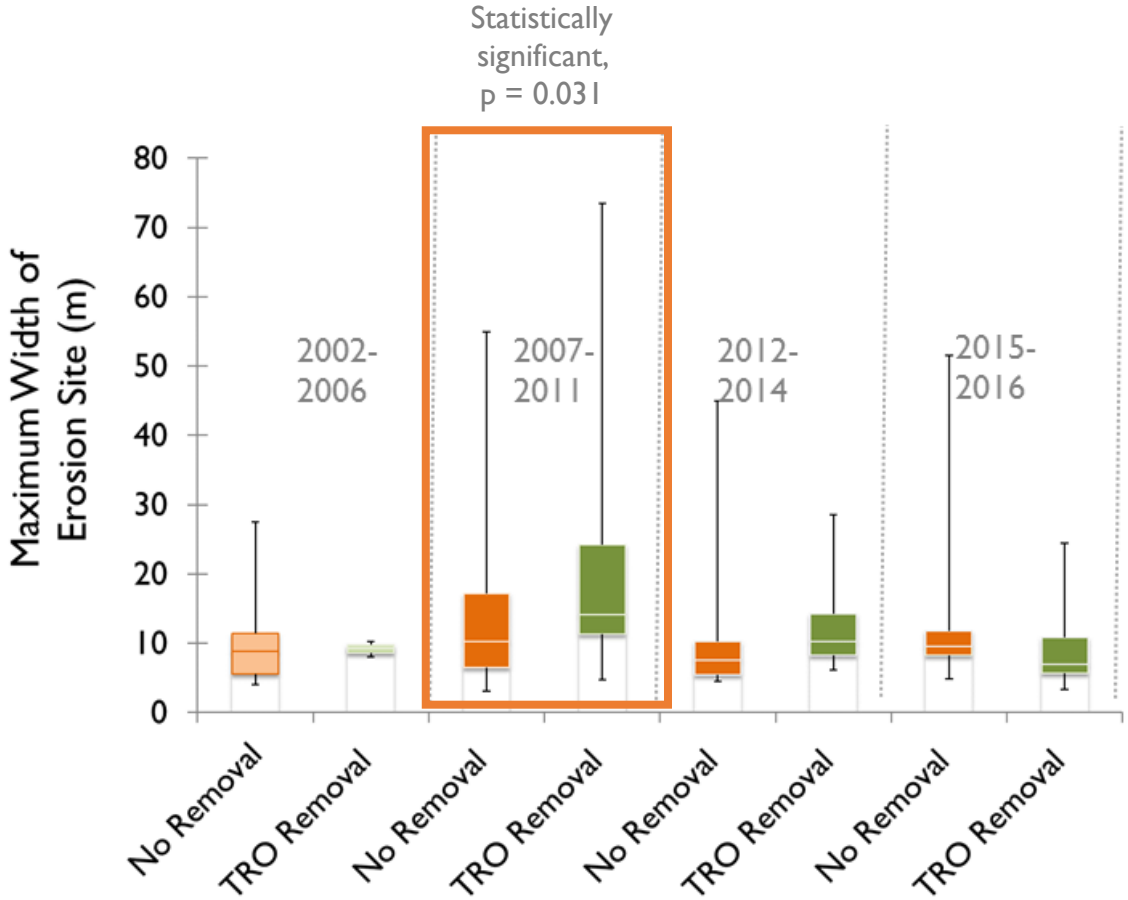
# GIS Analysis Results



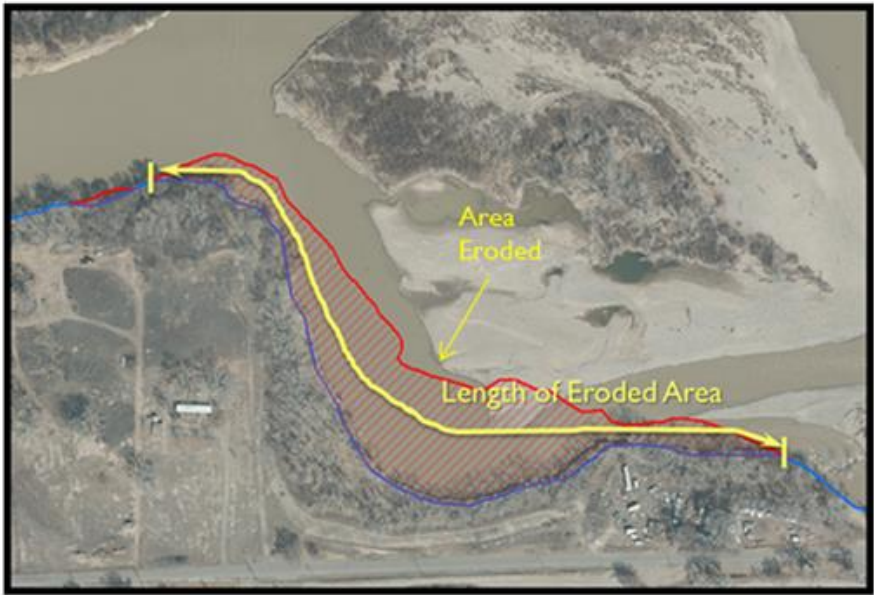
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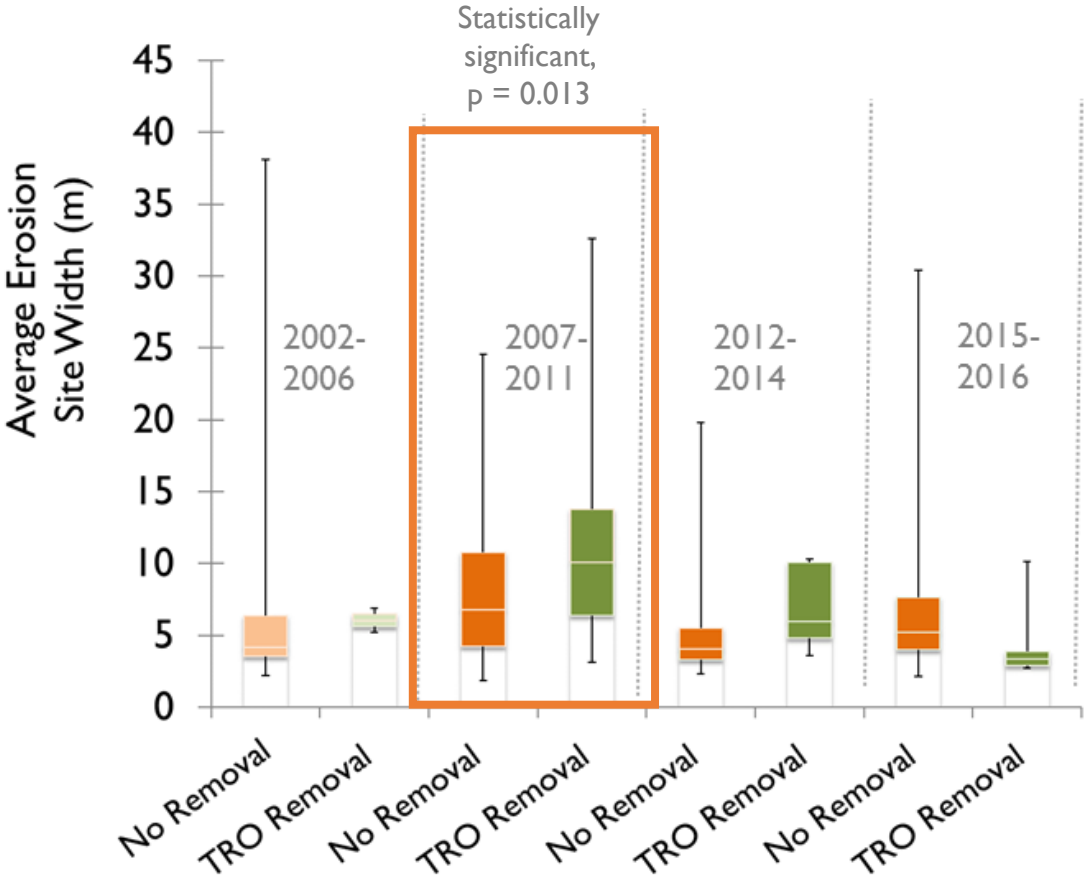
# GIS Analysis Results



# GIS Analysis Results



$$\text{Avg. Width of Eroded Area} = \frac{\text{Area Eroded}}{\text{Length of Eroded Area}}$$



Let's look at an example...



8/2/1993

Image U.S. Geological Survey

Google earth



11/24/2003

11/23/2003

Image © 2014 DigitalGlobe

Google earth





8/26/2006

8/26/2006

Image © 2014 DigitalGlobe

Google earth



8/6/2011

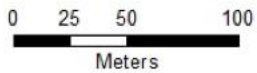
8/6/2011

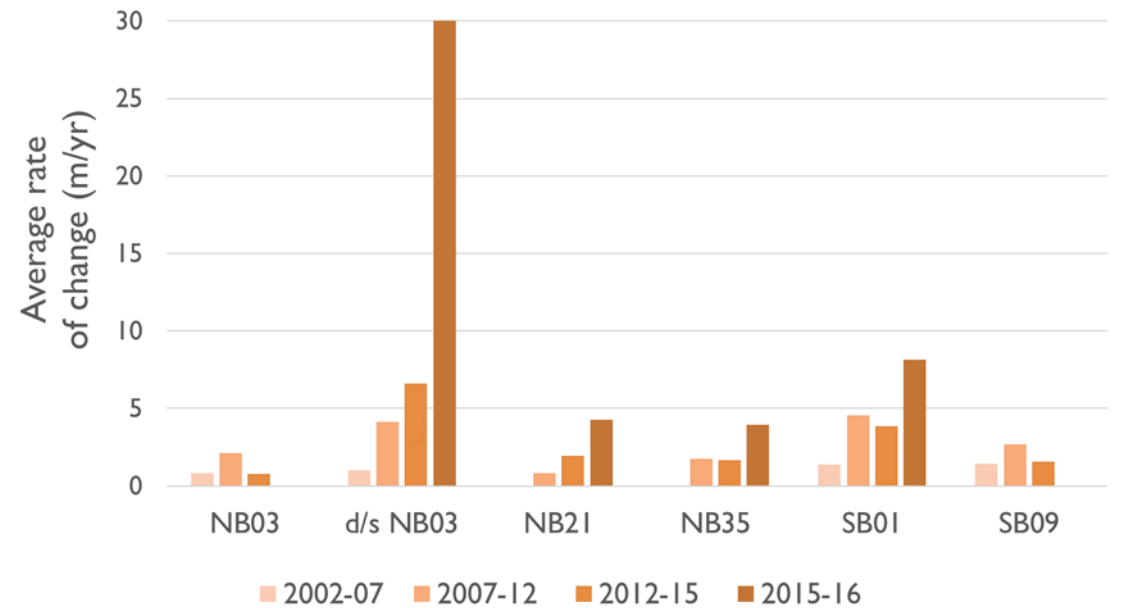
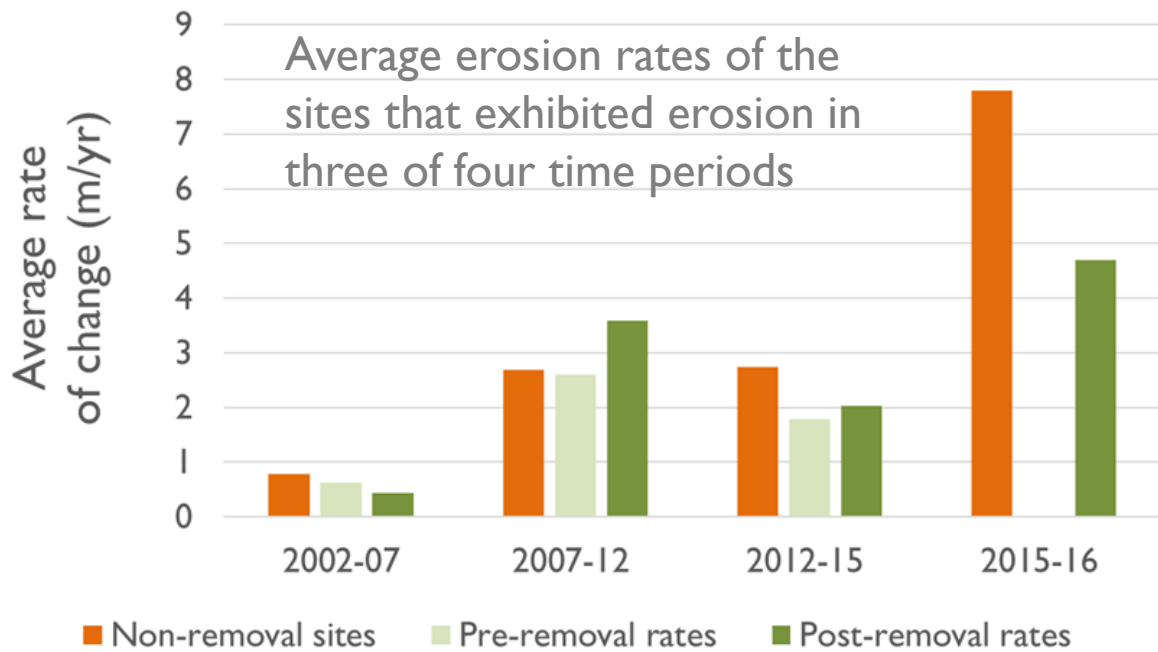
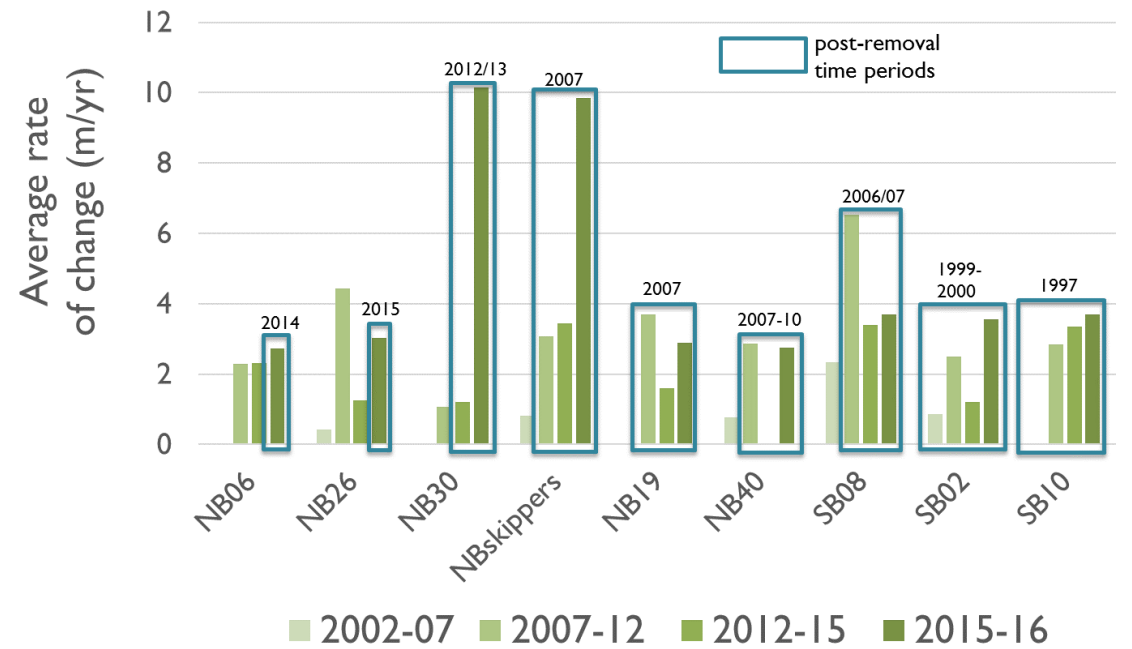
Google earth

Removal 2006/07  
Grand Valley Audubon Society  
Cut-stump



Background Image: 2012 Mesa County





# Vegetation removal and regrowth

TRO Removal by mastication, Jan 2015

Photos taken 3 April 2015

Colorado River Island



Colorado River Island, August 2015



Rapid post-removal reveg

- Secondary weeds
- Tamarisk re-sprout
- Native vegetation

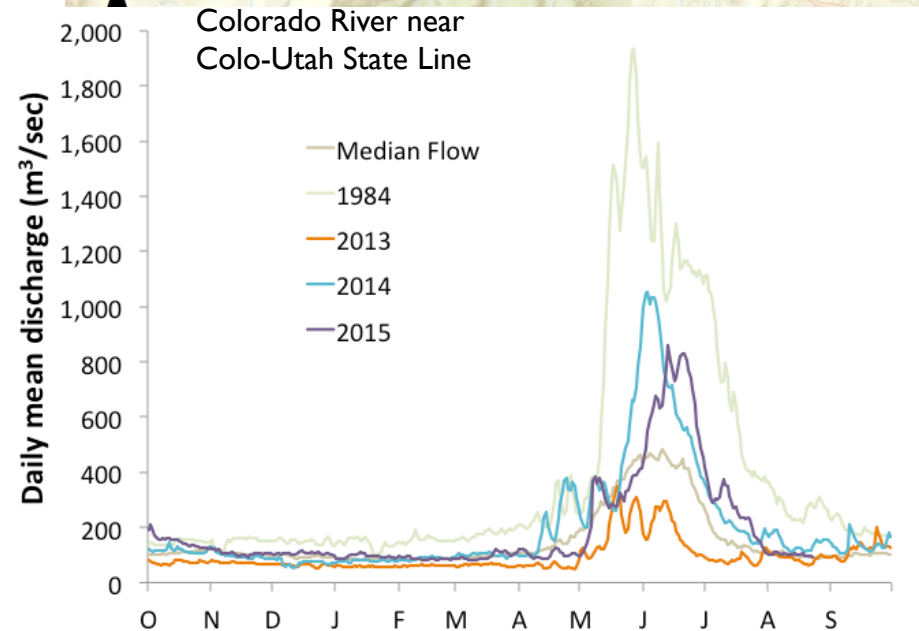
# Field study sites



	Month of Survey	Franklin Island	Colorado River Island	Walker SWA
Pre-removal	Aug-13	X		X
	Aug-14	X		X
	Apr-15		X	
Post-removal	Aug-15	X	X	X
	Apr-18	X	X	
	Jun-18			X



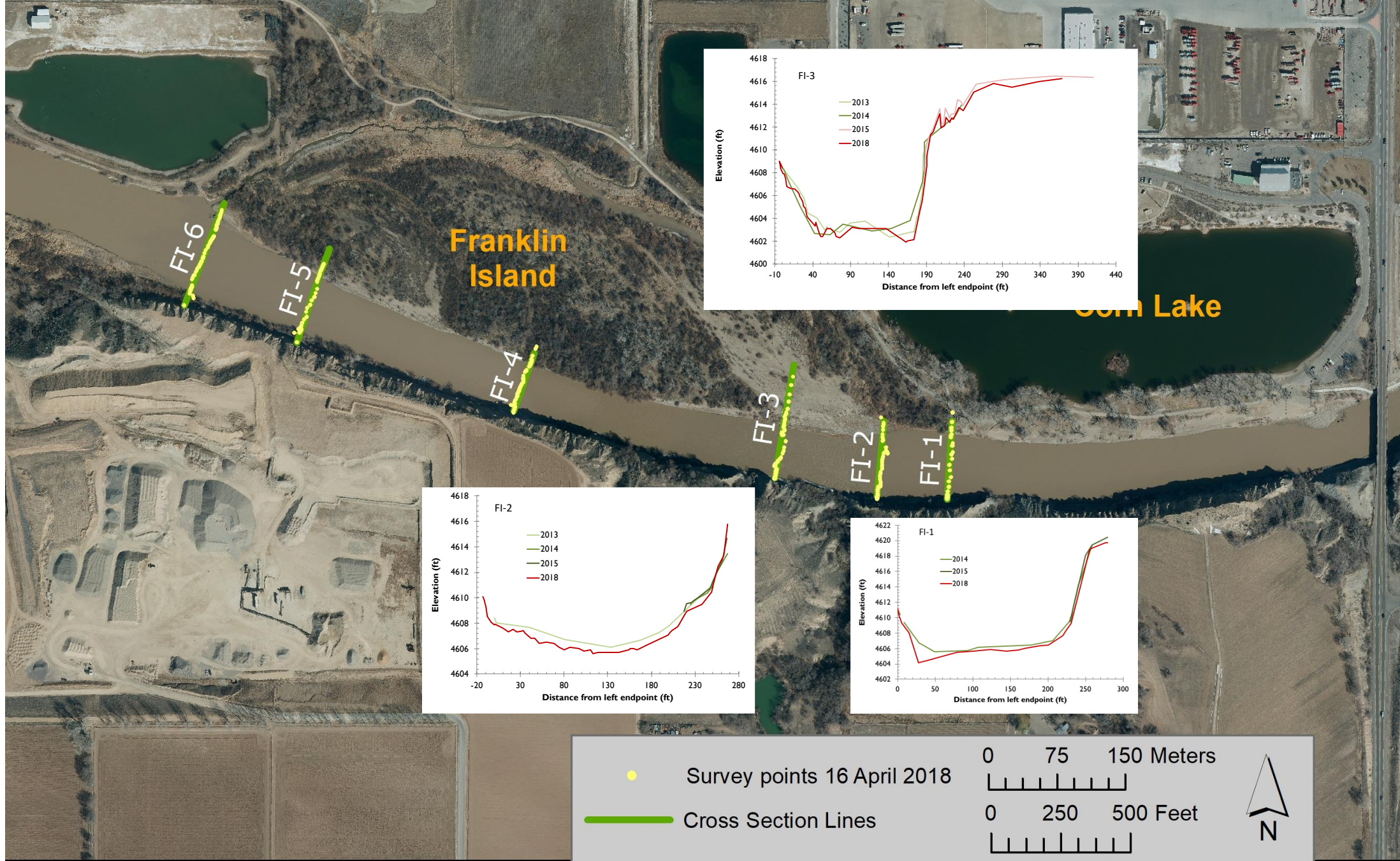
Trimble Survey-grade GPS w/ Real-Time Virtual Reference Network (RTVRN)





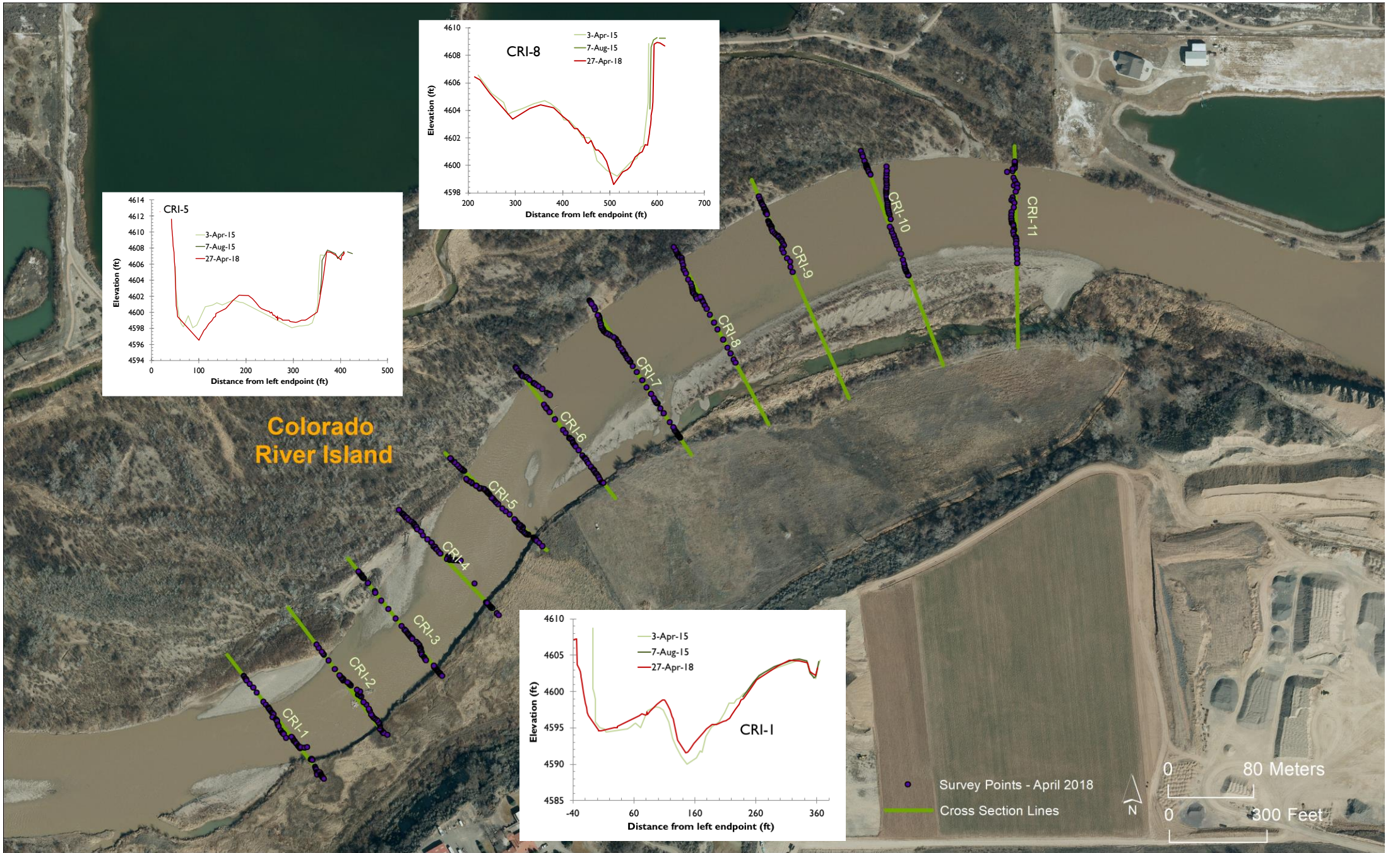
# Field Methods



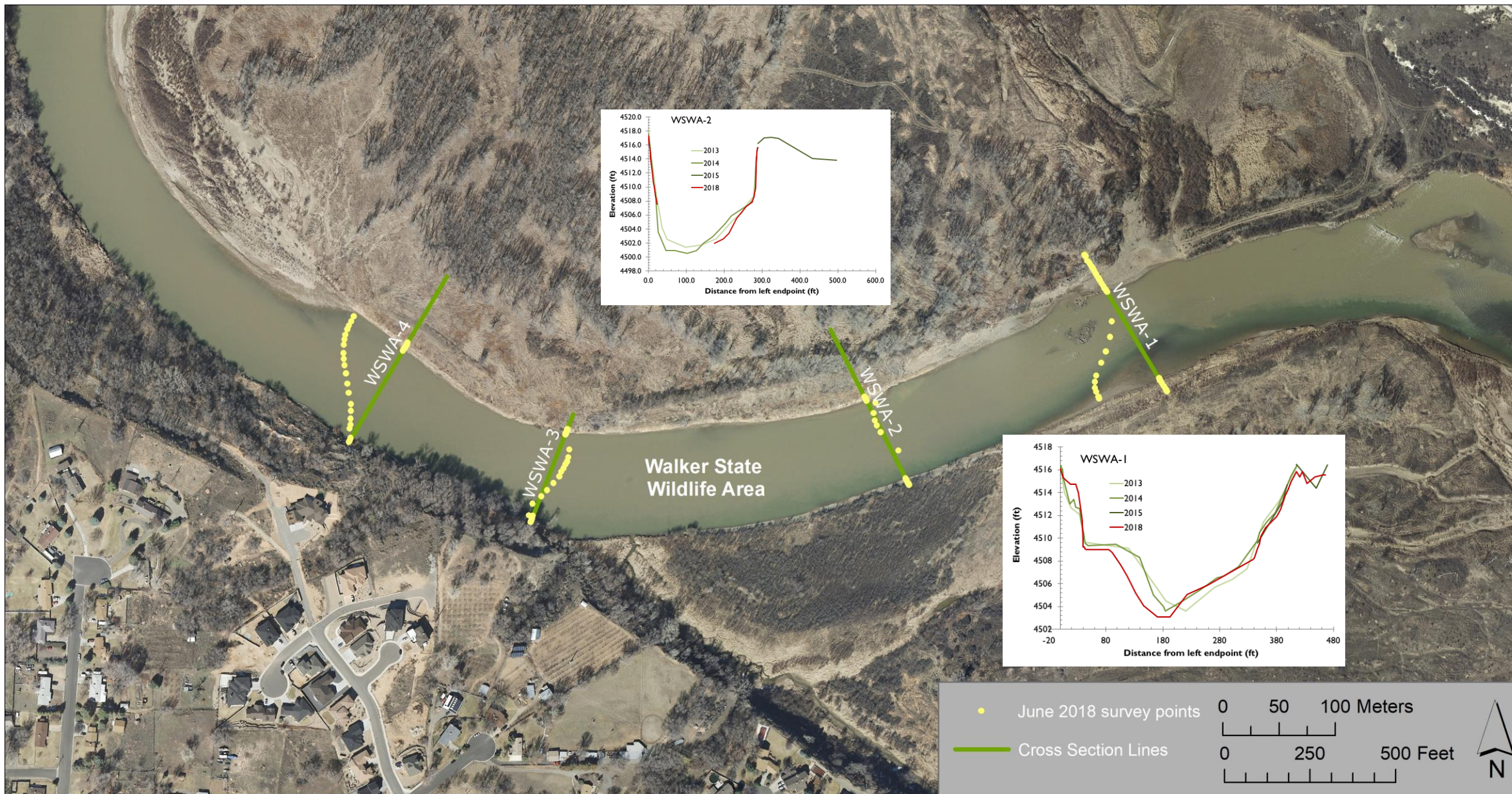


Background Image: 2012 Mesa County Aerial Photo





Background Image: 2012 Mesa County



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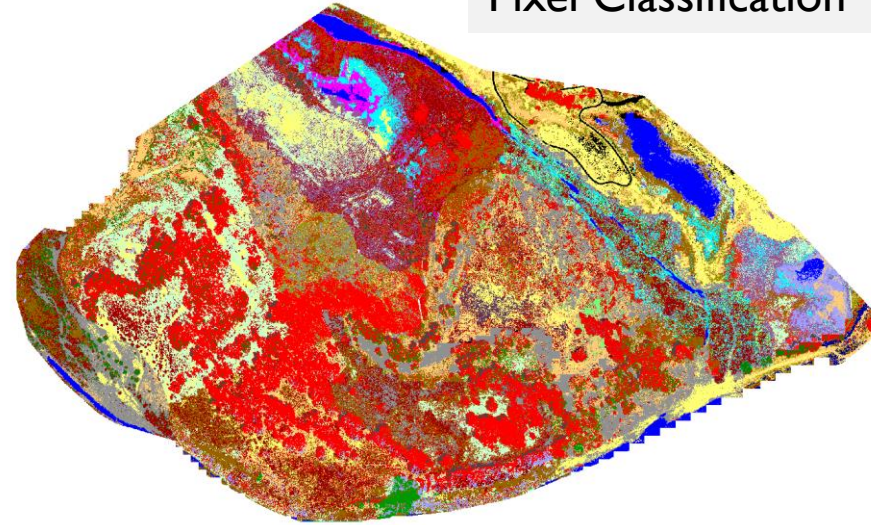
# Experimental Drone Survey

Remote sensing for assessment of secondary invasive weed growth



2017 - three study sites flown  
Firefly Pro 6 w/ Multispectral camera – RGB, red edge, near infrared, 7cm resolution

## Pixel Classification



Tamarisk	Dark Red
Russian Olive	Light Blue
Kochia	Purple
Cottonwood	Red
Elm	Green
Coyote Willow	Brown
Reed Canary	Light Green
Common Rush	Cyan
Rabbitbrush	Yellow
Sedge	Magenta
Water	Blue
Shadow	Grey
Litter	Light Grey
Concrete	Black
Herbaceous	Orange
Bare Ground	Yellow

Walker State Wildlife Area - 50 hectare

Individual Species	CW	EL	WL	TM	RO	RB	SD	RD	RS	KC
Cottonwood ( <i>Populus spp.</i> )	22	1	0	2	3	3	0	2	1	2
Elm ( <i>Ulmus pumila</i> )	2	36	0	0	2	0	0	0	0	0
Willow ( <i>Salix exigua</i> )	1	1	41	2	1	0	0	4	1	1
Tamarisk ( <i>Tamarix spp.</i> )	1	0	18	33	1	1	0	2	0	0
Russian olive ( <i>Elaeagnus angustifolia</i> )	0	0	0	1	22	0	0	0	1	0
Rabbitbrush ( <i>Ericameria nauseosa</i> )								0	0	2
Sedge ( <i>Carex spp.</i> )								0	2	0
Reed Canary Grass ( <i>Phalaris arundinacea</i> )								19	0	3
Rush ( <i>Juncus spp.</i> )								1	21	0
Kochia ( <i>Kochia scoparia</i> )								2	0	17
<b>Total</b>	26	38	60	40	30	30	33	30	26	25
<b>Producer's Accuracy (%)</b>	85	94	68	83	73	87	97	63	81	68
<b>Relative Commission Error (%)</b>	15	6	32	17	27	13	3	37	19	32

Willow were mistakenly identified as tamarisk 30% of the time

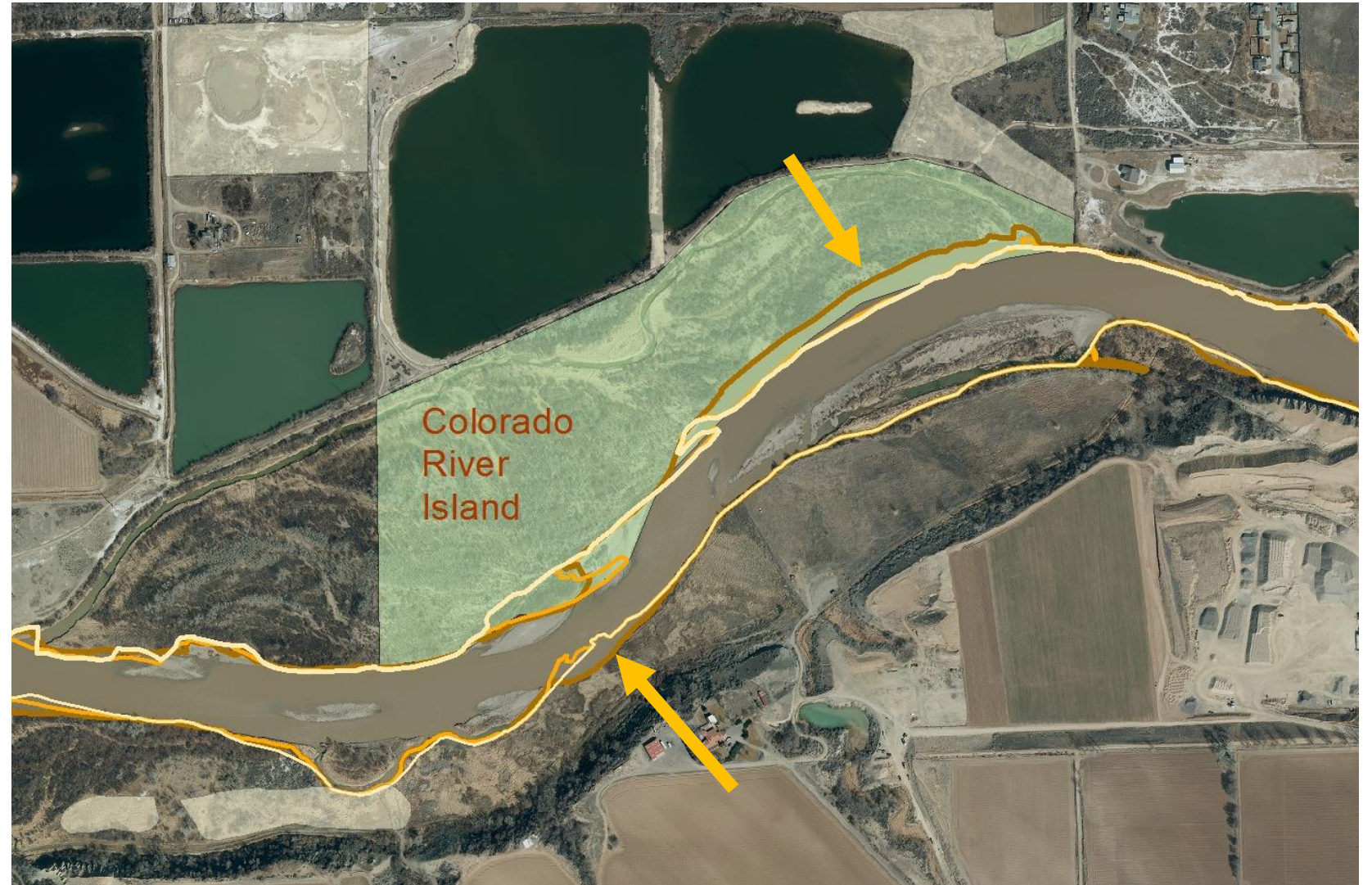
# What does all of this mean...

The river is dynamic and moved regardless of vegetation removal efforts

Higher peak flows led to more bank erosion

During the 2007-12 time period, time period with most high flow, erosion sites were wider (nearly 50%,  $p < 0.05$ ) at vegetation removal sites

No clear trend emerged to indicate that erosion increased or decreased with time after TRO removal



# Thank you! Questions?

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