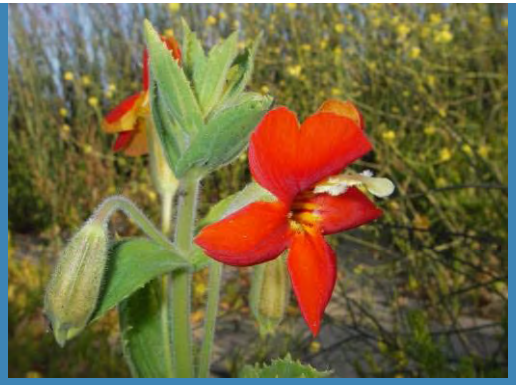


A Strategic Plan for Treatment of *Arundo donax* and Restoration of Riparian Vegetation in the Santa Clara River Parkway

Bruce Orr and Zooey Diggory
STILLWATER SCIENCES

Santa Clara River Parkway Workshop

8 September 2011

Stillwater Sciences

WATERSHED IMPACTS

- Invasion by giant reed (*Arundo donax*)

FLOOD DYNAMICS

- Vegetation infilling (encroachment) during ‘normal’ or drier periods

pre-high flow

FLOOD DYNAMICS: El Niño Rules!

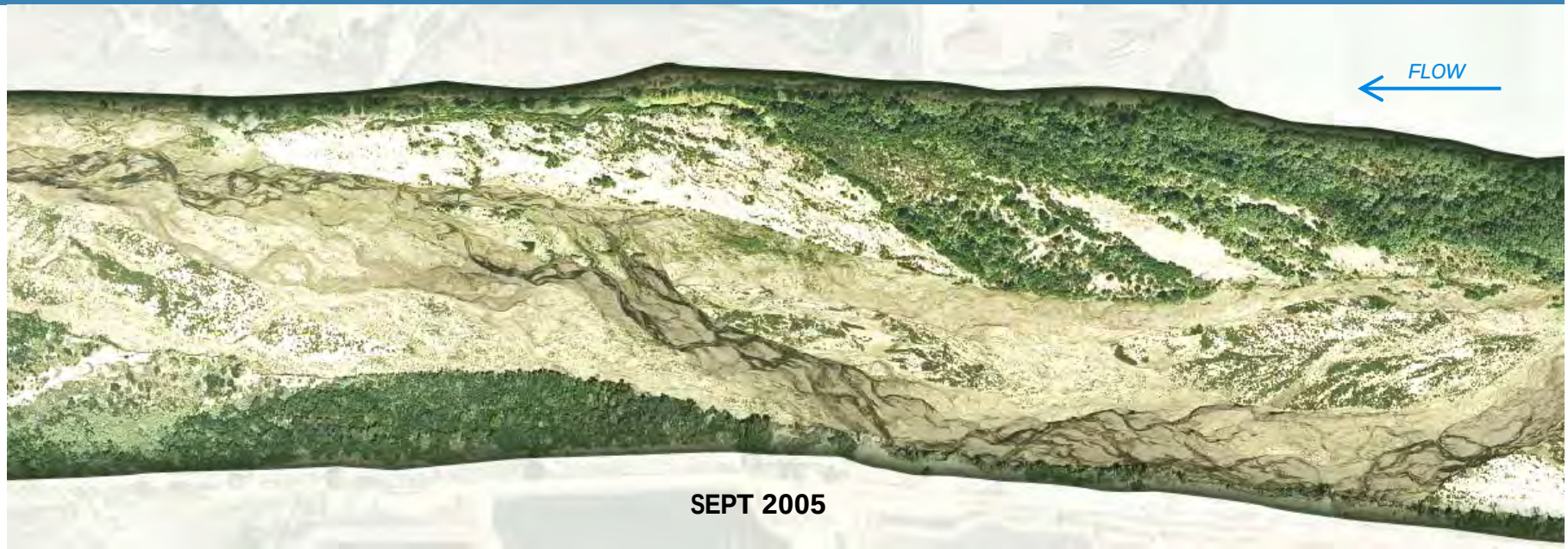
- Vegetation reset after large floods in El Niño years

high flow

FLOOD DYNAMICS: Post-flood Response

- Rapid vegetation response after large resetting floods

post-high flow

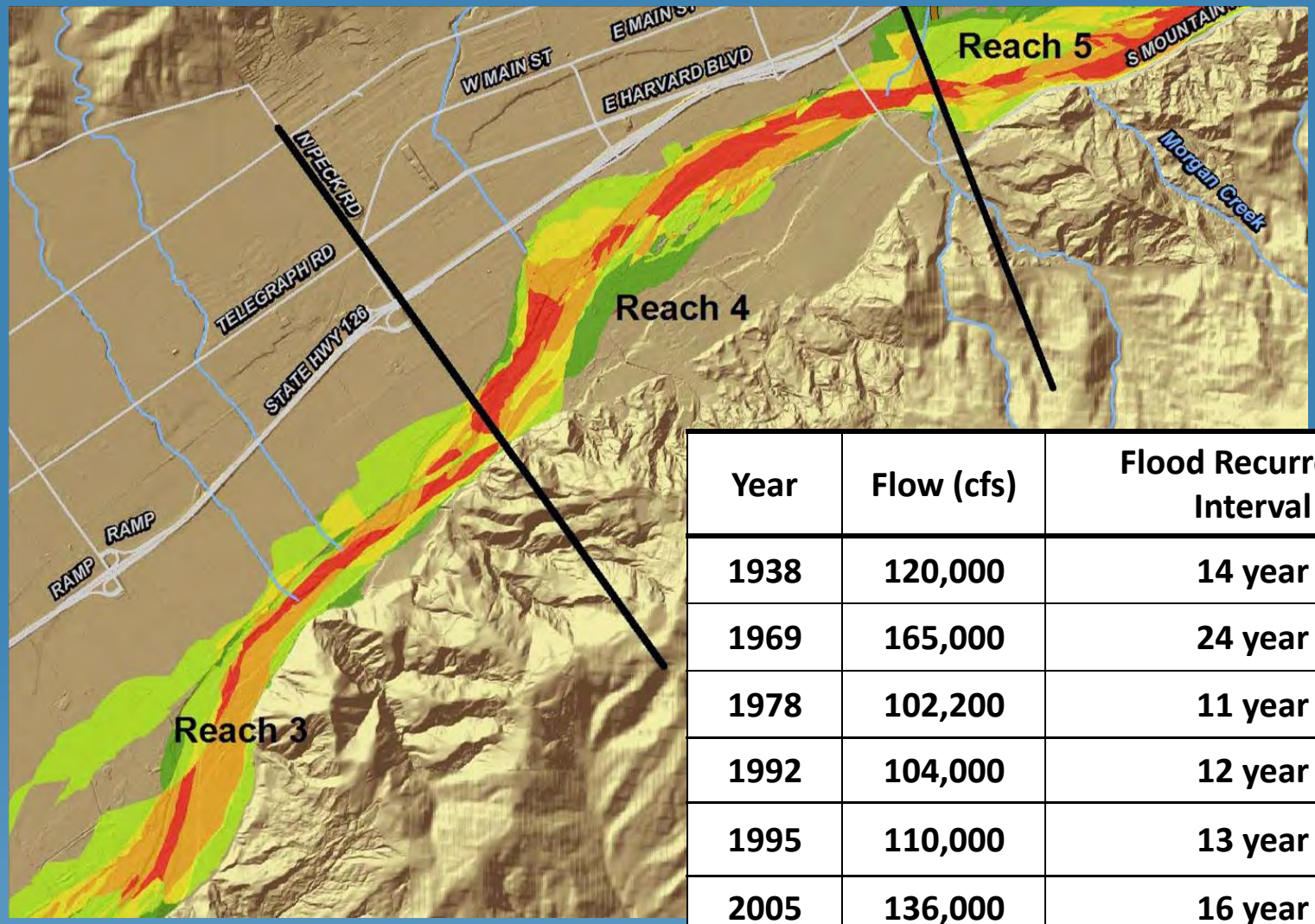


FLOOD DYNAMICS

- Back to vegetation infilling

FLOOD MAPPING

- Highly dynamic mainstem



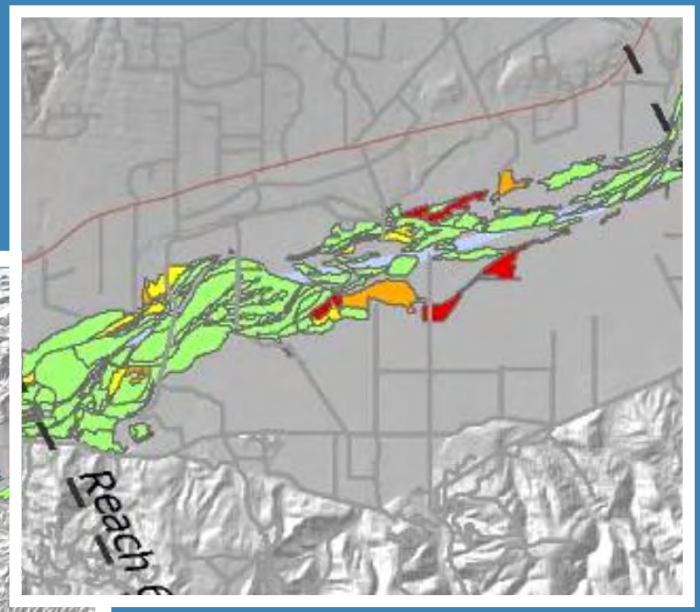
Year	Flow (cfs)	Flood Recurrence Interval
1938	120,000	14 year
1969	165,000	24 year
1978	102,200	11 year
1992	104,000	12 year
1995	110,000	13 year
2005	136,000	16 year

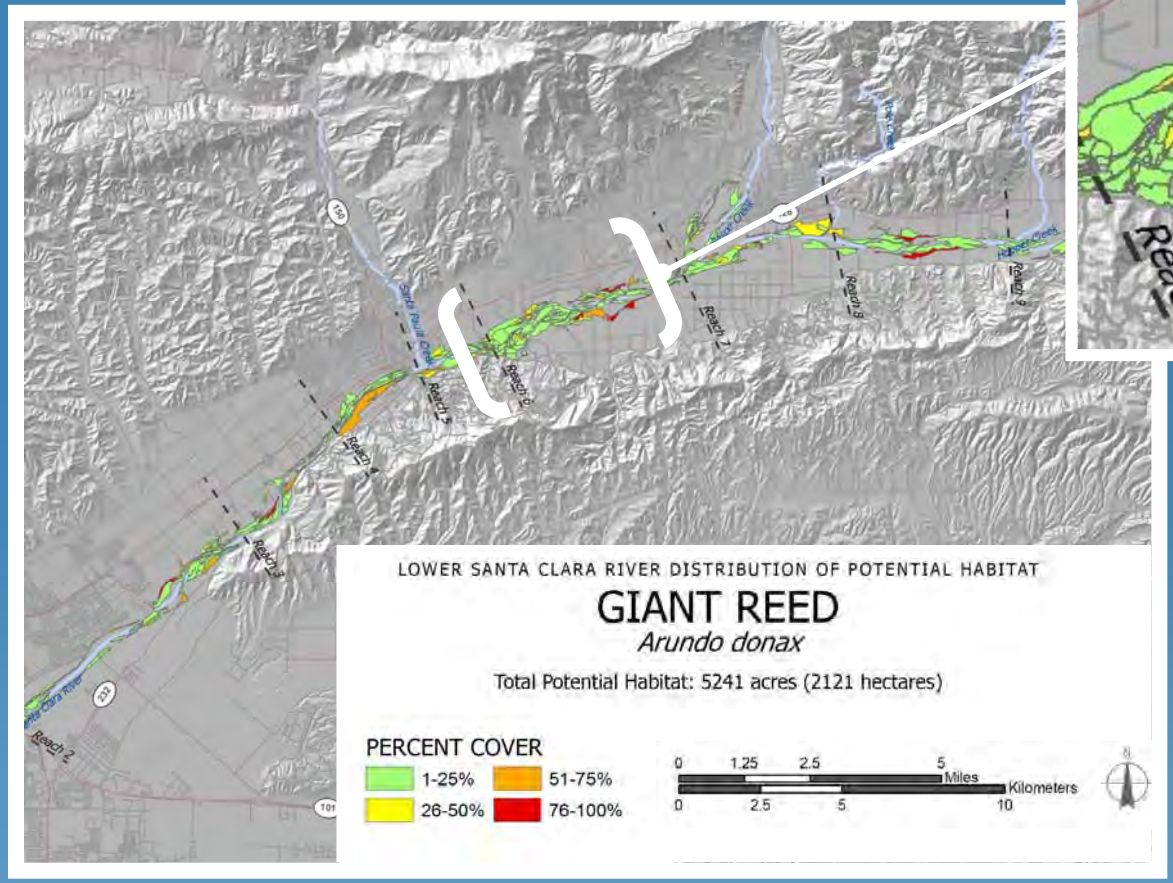
RIPARIAN VEGETATION MAPPING & CLASSIFICATION

- Diverse and dynamic riparian vegetation
  - "Classic" cottonwood-willow types plus more xeric alluvial scrub types
  - 58 alliances and 130 map unit types

RIPARIAN VEGETATION MAPPING & CLASSIFICATION

- Invasion by Arundo
  - Replaces native vegetation
  - Alters ecosystem processes
  - >5,000 acres





RESTORATION OPPORTUNITIES & CONSTRAINTS

- Floods and dynamic channel and vegetation are both the asset and the hazard

RESTORATION & CONSERVATION STRATEGIES

1. Acquire Floodplain Lands from Willing Sellers
2. Increase & Improve Floodplain Connectivity
3. Promote Revegetation via Natural Recruitment & Active Planting (in appropriate areas)
4. Implement Strategic Actions to Control Arundo

STRATEGIC ACTIONS TO CONTROL ARUNDO

Multi-scale Top-Down Approach

- Upstream to downstream (watershed, main river corridor, tributaries)
- Upslope to downslope (corridor, reach, site)

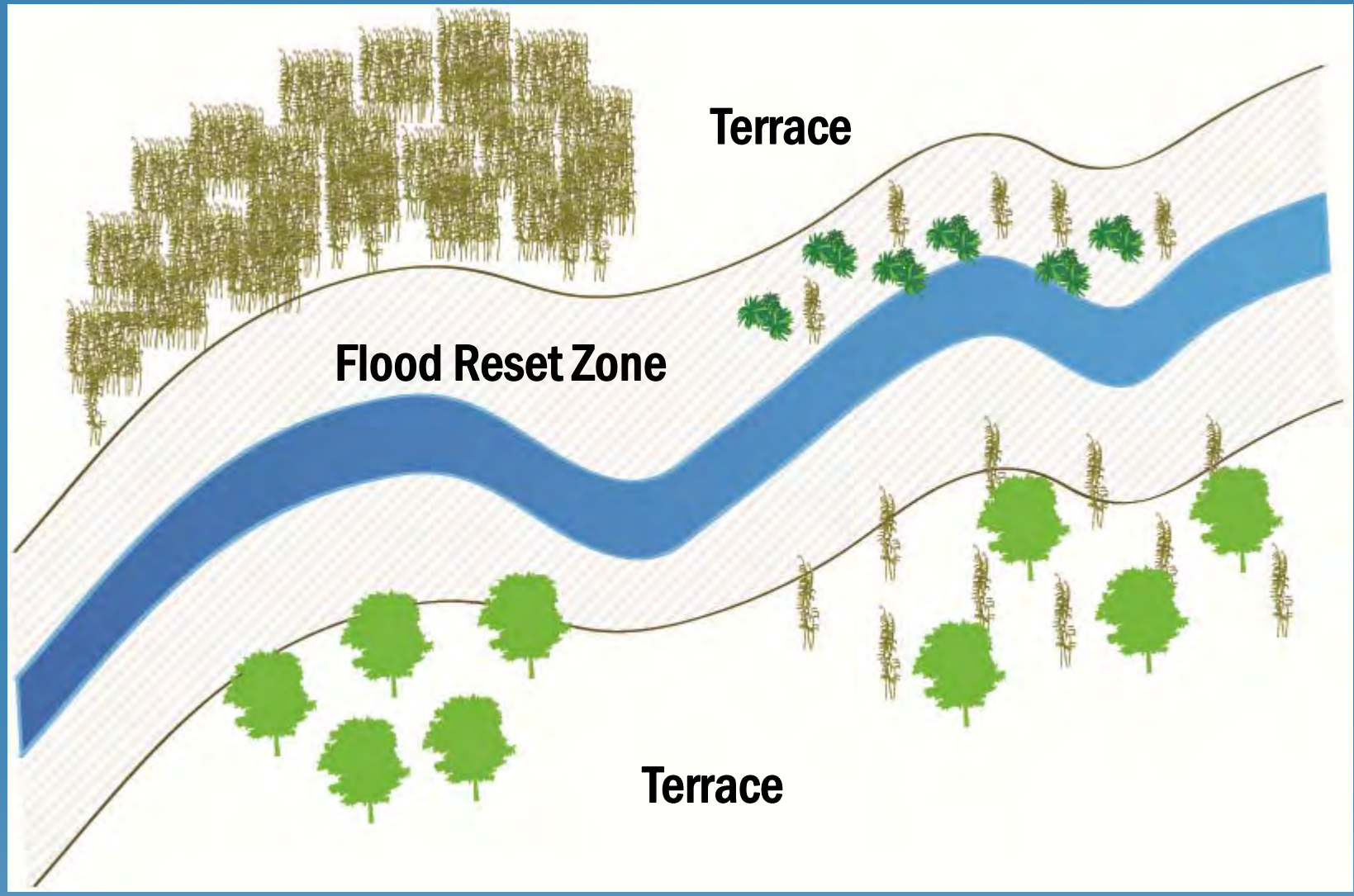
Priorities based on economic cost, ecological benefit, & feasibility

- Protect & enhance high quality habitat
- Reduce fire and flood risk to infrastructure and habitat

Contingency Plans

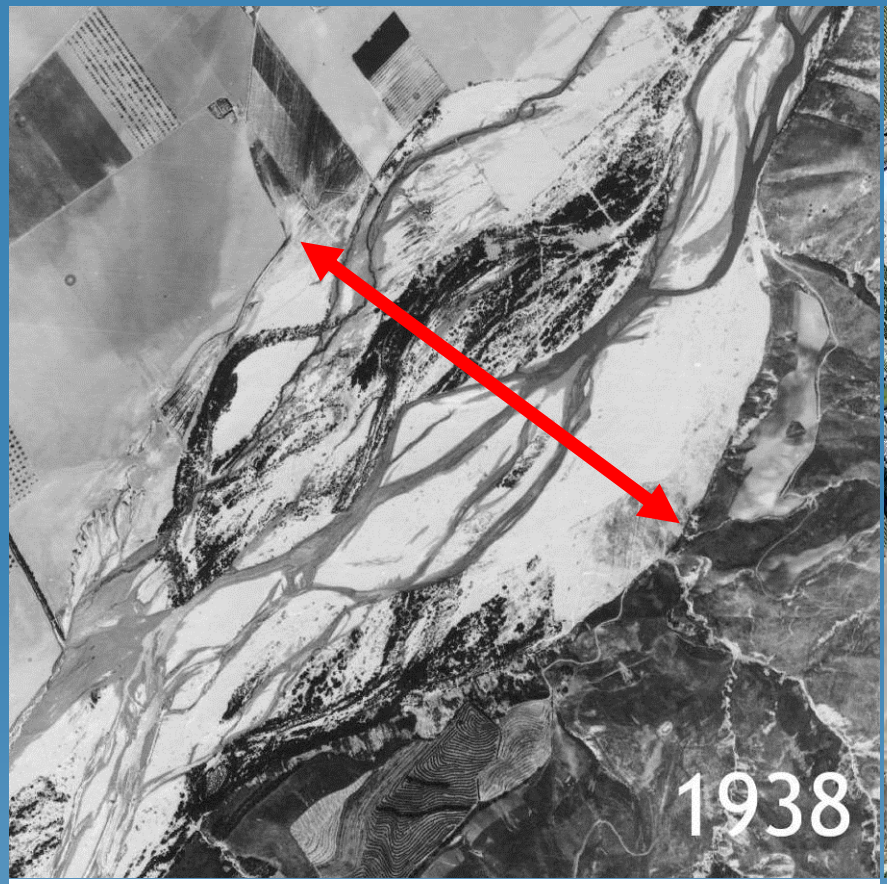
- Post-flood control actions in flood reset zone
- Post-fire actions to promote native plant recovery

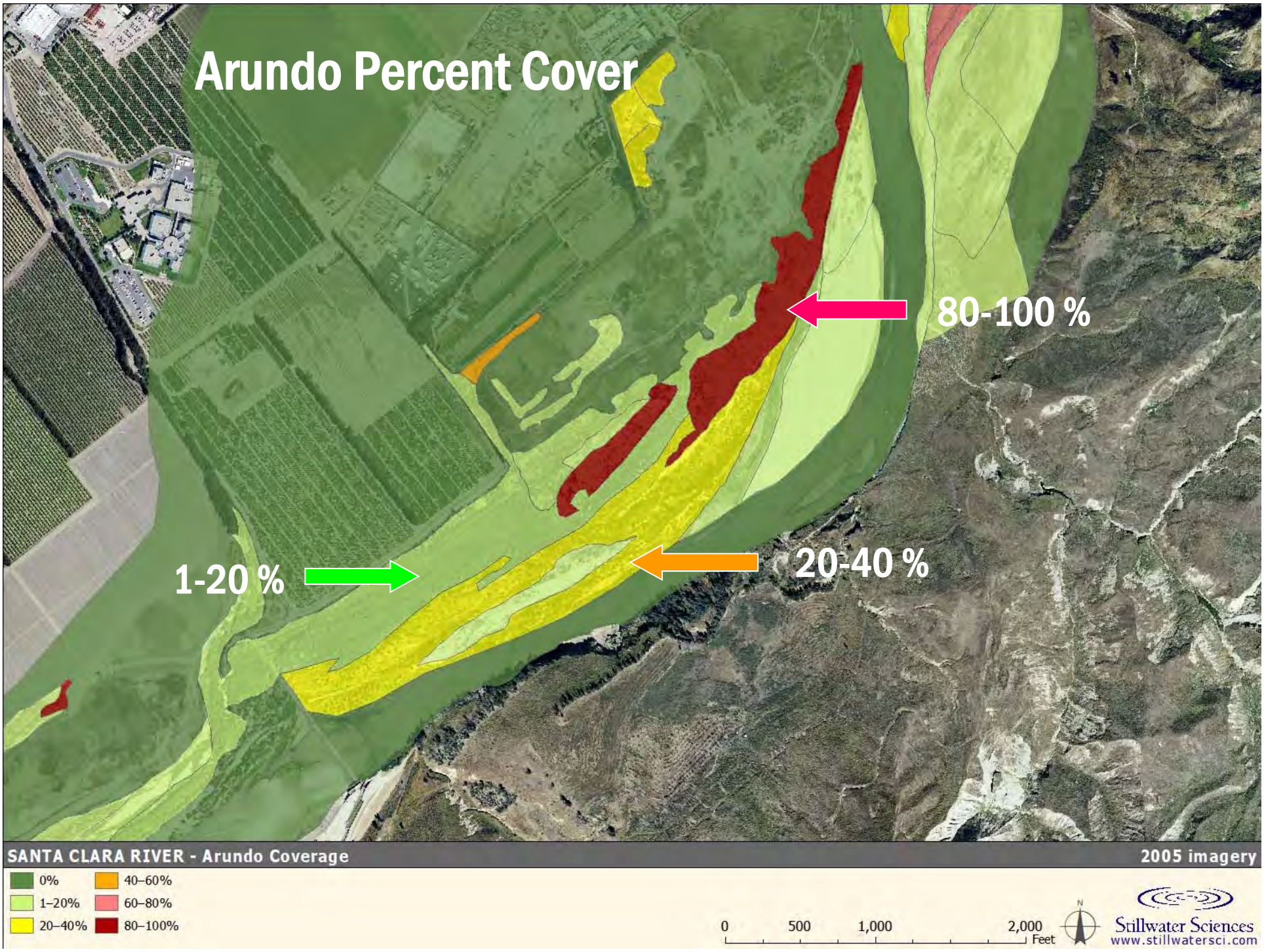
APPLICATION OF APPROACH

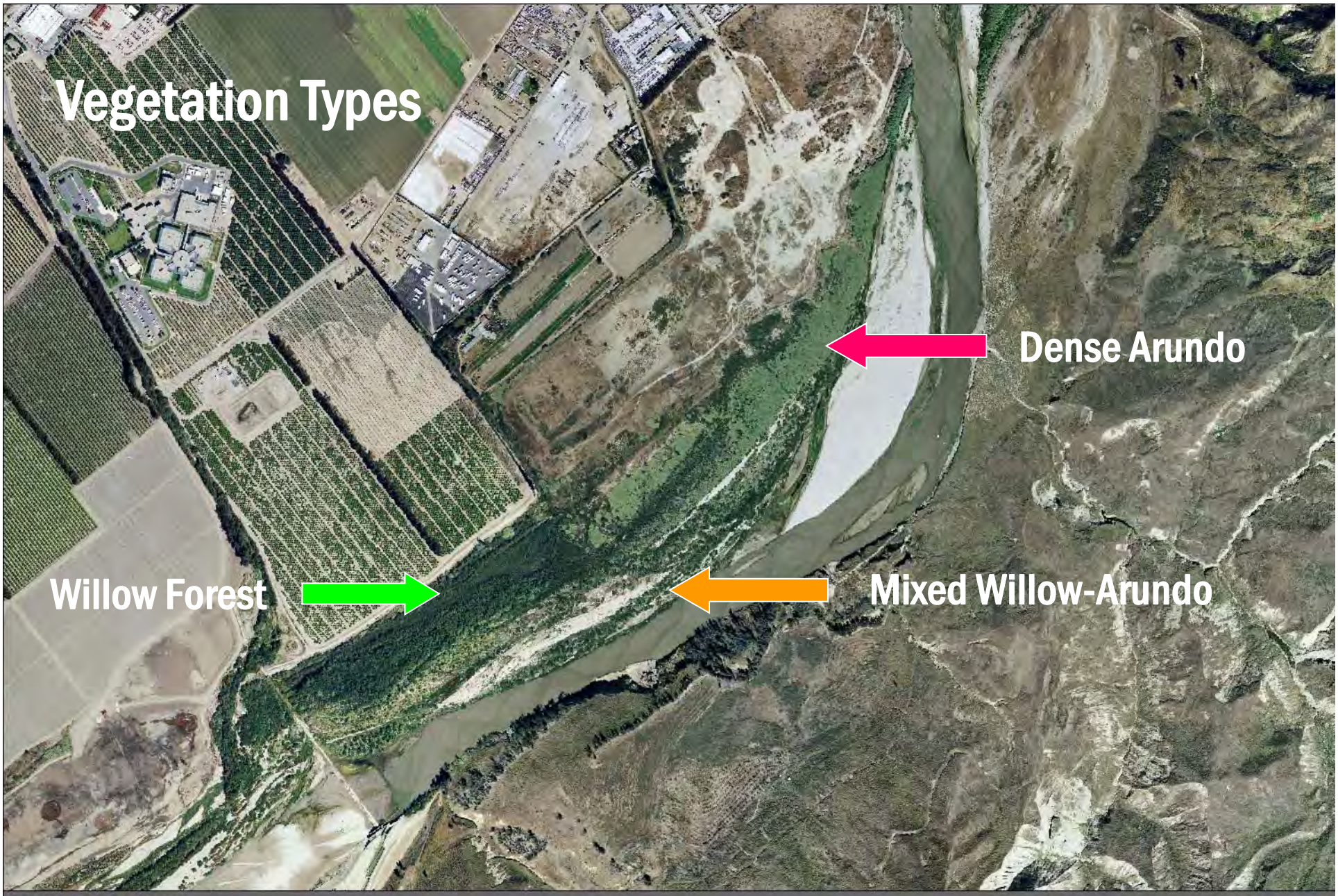


EXAMPLE APPLICATION AT SITE SCALE

- Severely constrained floodplain and limited extent of riparian vegetation




Arundo Percent Cover
80-100 %
20-40 %
1-20 %
SANTA CLARA RIVER - Arundo Coverage
2005 imagery
0%
1–20%
20–40%
40–60%
60–80%
80–100%
0
500
1,000
2,000
Feet
N
Stillwater Sciences
www.stillwatersci.com


Vegetation Types
Dense Arundo
Willow Forest
Mixed Willow-Arundo
SANTA CLARA RIVER
2005 imagery
0
500
1,000
2,000
Feet
N
Stillwater Sciences
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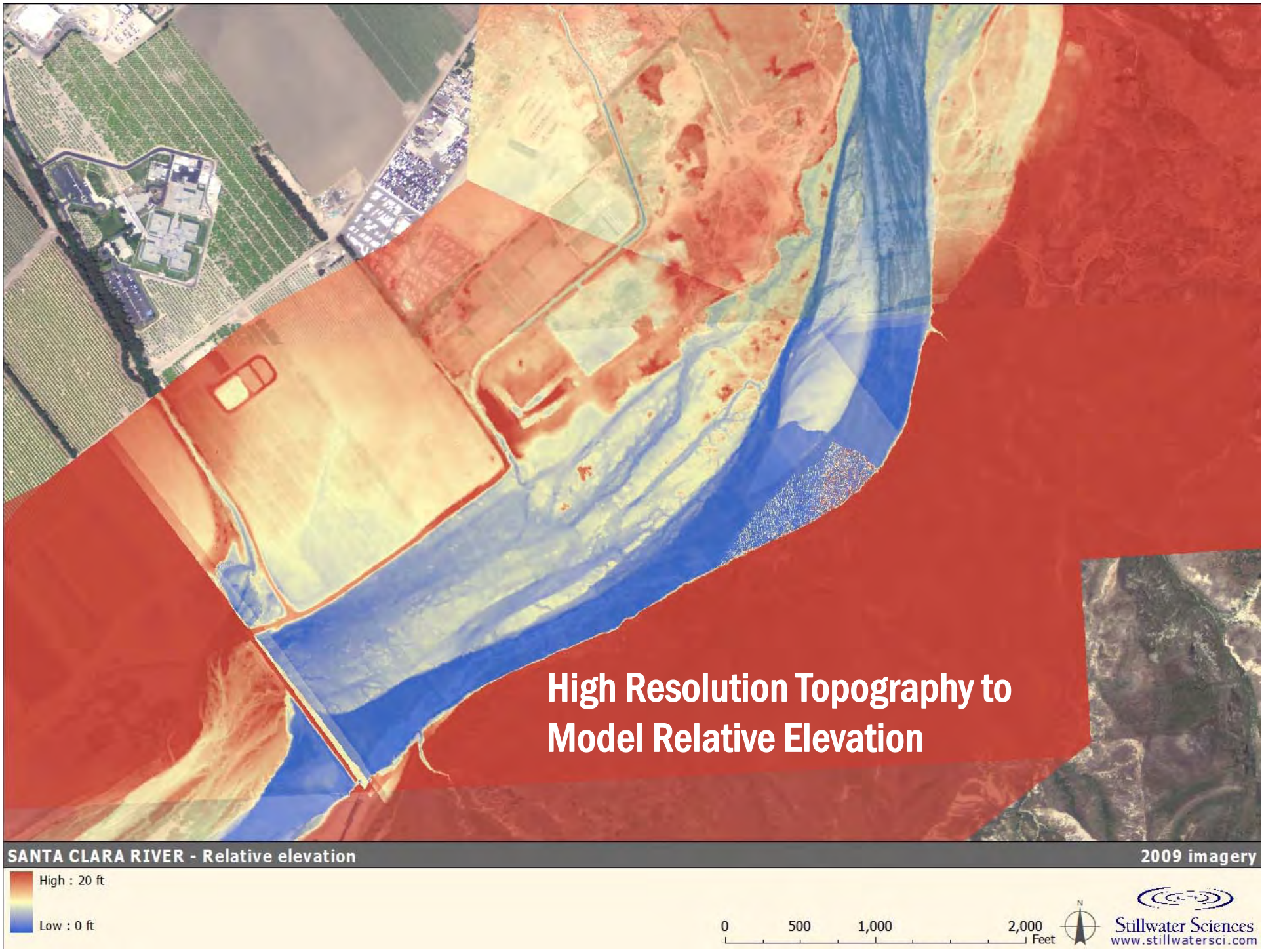
High Resolution Topography to
Model Relative Elevation
SANTA CLARA RIVER - Relative elevation
2009 imagery
High : 20 ft
Low : 0 ft
0
500
1,000
2,000
Feet
N
Stillwater Sciences
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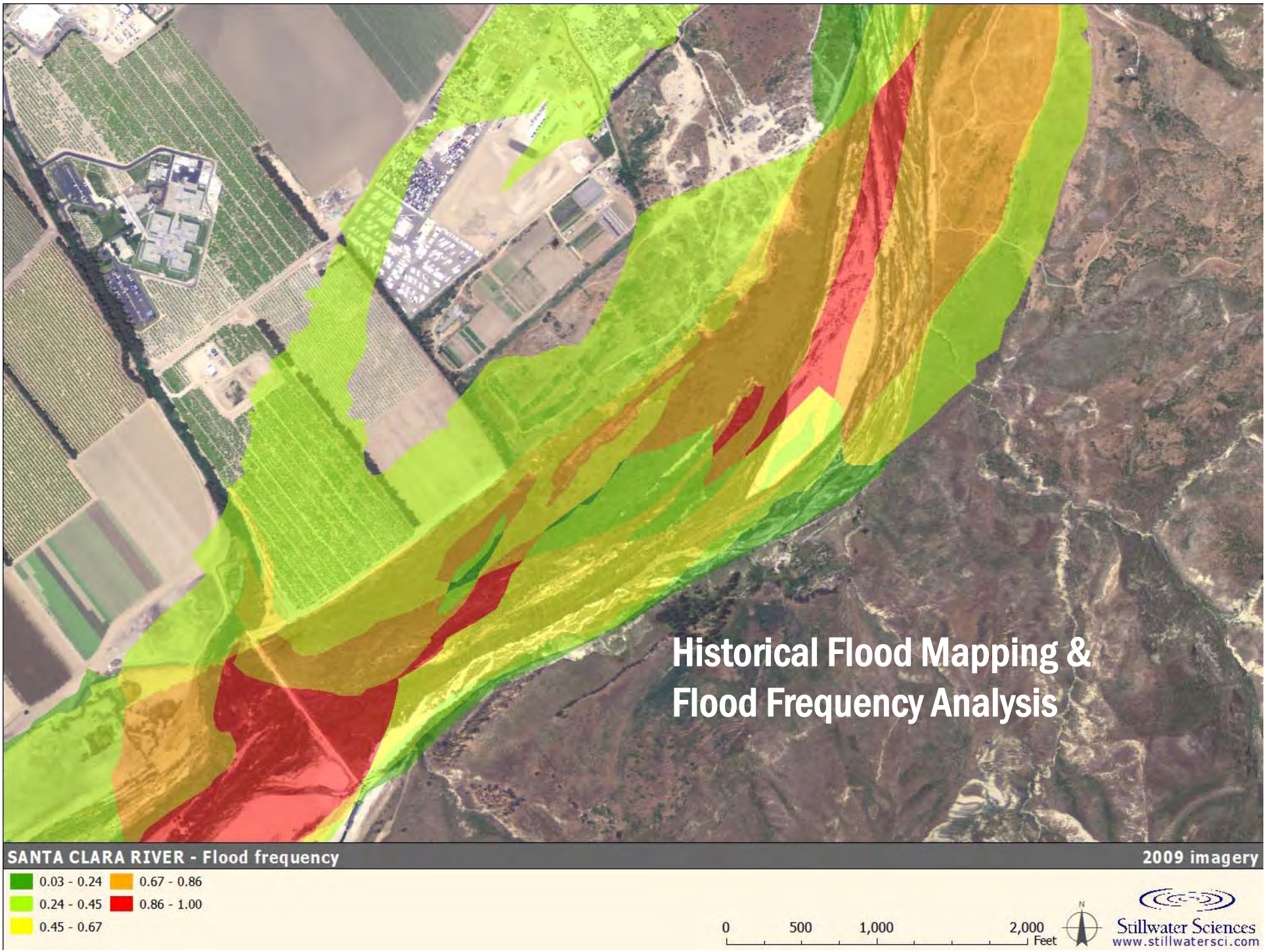
Historical Flood Mapping &
Flood Frequency Analysis
SANTA CLARA RIVER - Flood frequency
2009 imagery
0.03 - 0.24
0.24 - 0.45
0.45 - 0.67
0.67 - 0.86
0.86 - 1.00
0
500
1,000
2,000
Feet
N
Stillwater Sciences
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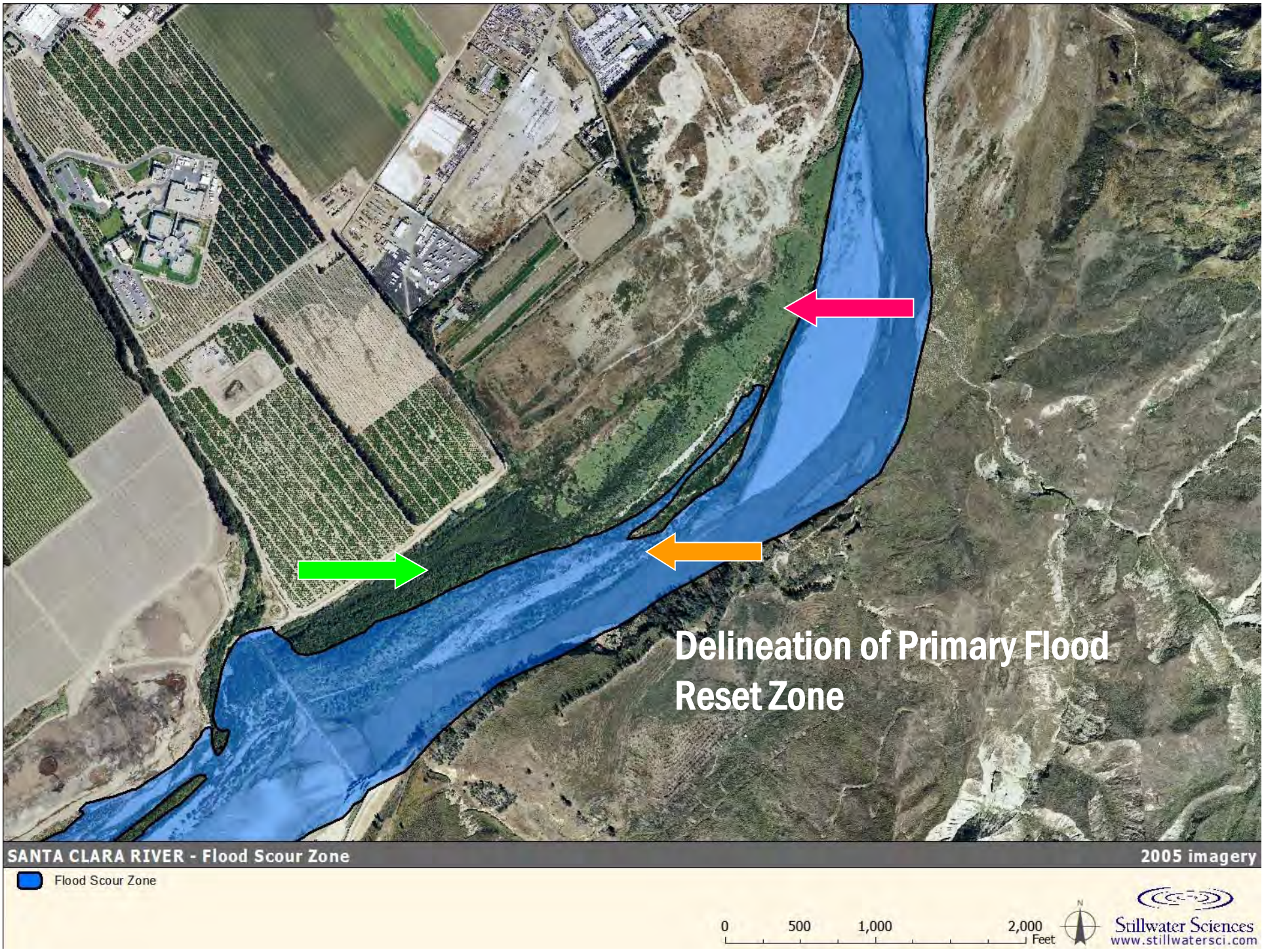
Delineation of Primary Flood Reset Zone
SANTA CLARA RIVER - Flood Scour Zone
2005 imagery
Flood Scour Zone
0
500
1,000
2,000
Feet
N
Stillwater Sciences
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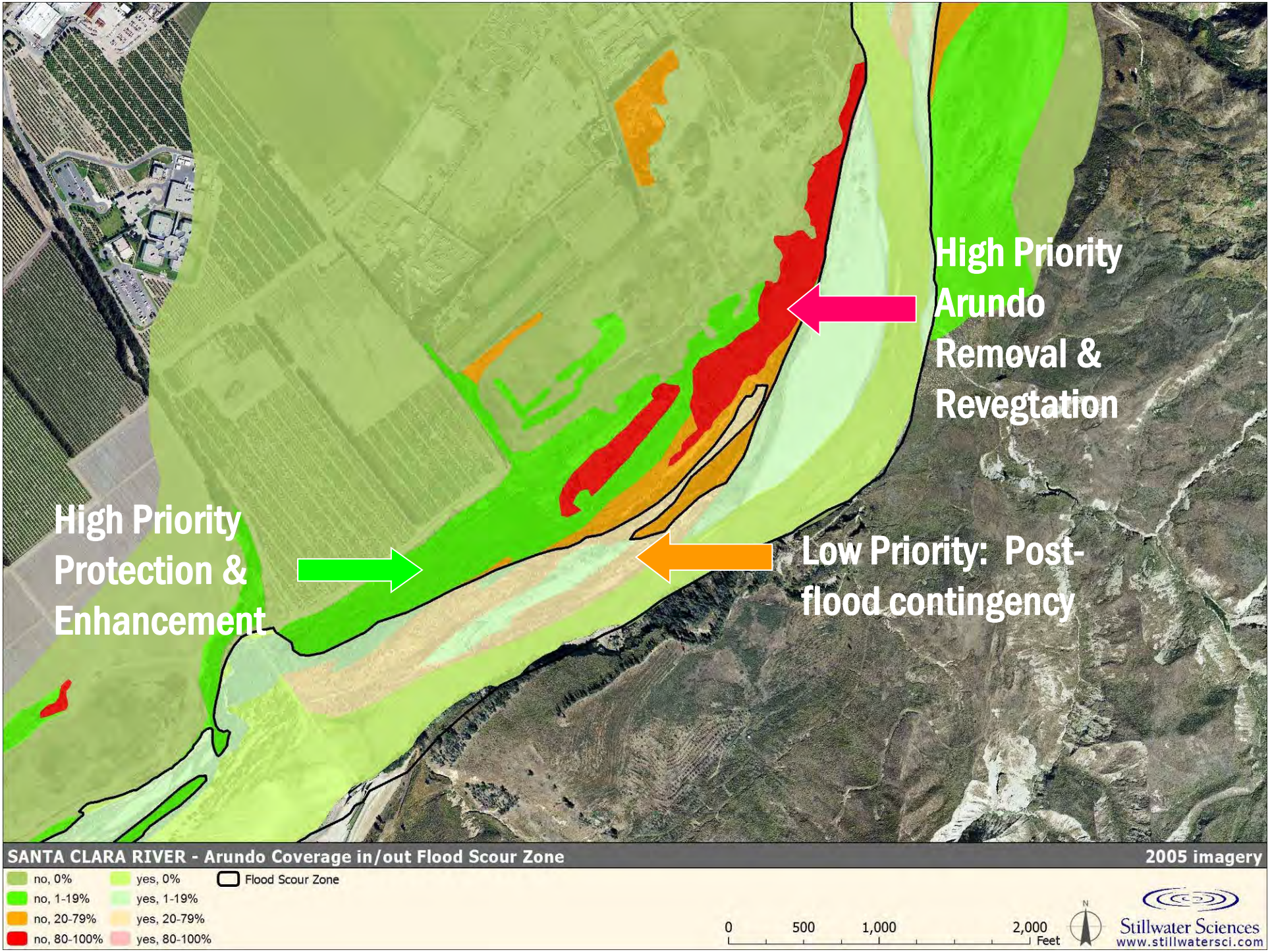
High Priority
Arundo
Removal &
Revegtation
High Priority
Protection &
Enhancement
Low Priority: Post-
flood contingency
SANTA CLARA RIVER - Arundo Coverage in/out Flood Scour Zone
2005 imagery
no, 0%
no, 1-19%
no, 20-79%
no, 80-100%
yes, 0%
yes, 1-19%
yes, 20-79%
yes, 80-100%
Flood Scour Zone
0
500
1,000
2,000
Feet
N
Stillwater Sciences
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LINK TO ON-THE-GROUND PROJECTS

Decision Rule	Treatment Type
Arundo inside flood reset zone	Flood contingent

- Herbicide application following floods, and potentially fire
- Price range: $1,000–$2,000/acre
- Revegetation: passive
- Permitting: 1600 & USFWS/NMFS no take concurrence
- Priority: Low, unless there is a flood!

LINK TO ON-THE-GROUND PROJECTS

Arundo outside flood reset zone

Decision Rule	Treatment Type
No biomass removal required?	Spray only

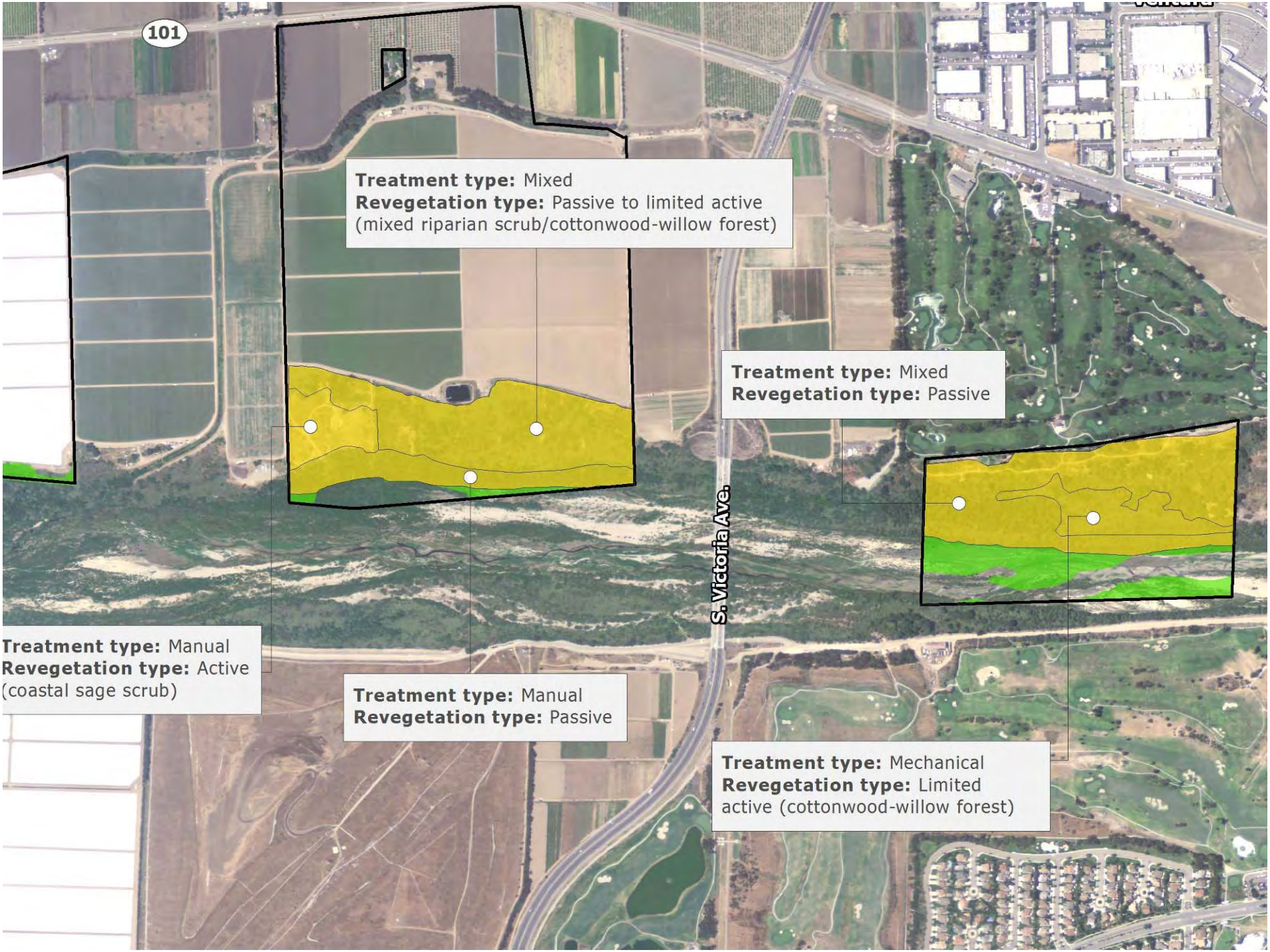
- Herbicide application on standing canes
- Price range: $3,000–$6,000/acre
- Revegetation: passive to active
- Permitting: 1600 & USFWS no take concurrence
- Priority: High to Medium

LINK TO ON-THE-GROUND PROJECTS

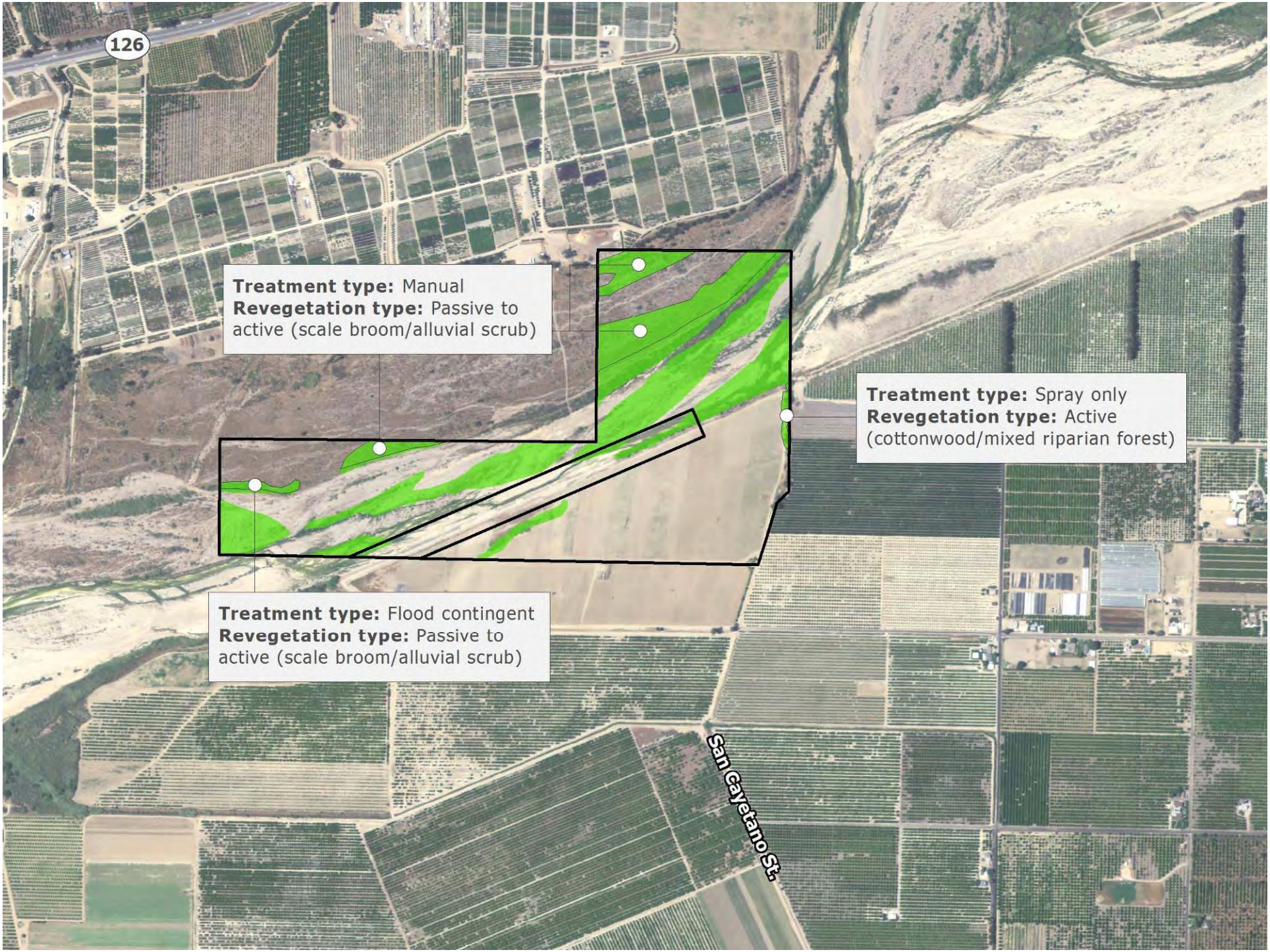
Arundo outside flood reset zone & biomass removal required

Decision Rule (e.g.)	Treatment Type
Arundo % cover > 80	Mechanical
Arundo % cover <80, >20	Mixed
Arundo % cover <20	Hand

- Biomass removal by mowing, hand, or a mixture prior to herbicide application
- Price range: $4,000–$9,000/acre
- Revegetation: active to passive
- Permitting: 1600, USFWS no take concurrence, and potential USACE RGP
- Priority: High to low


101
Treatment type: Mixed
Revegetation type: Passive to limited active (mixed riparian scrub/cottonwood-willow forest)
Treatment type: Mixed
Revegetation type: Passive
S. Victoria Ave.
Treatment type: Manual
Revegetation type: Active (coastal sage scrub)
Treatment type: Manual
Revegetation type: Passive
Treatment type: Mechanical
Revegetation type: Limited active (cottonwood-willow forest)


Treatment type: Mixed
Revegetation type: Passive to limited active (mixed willow forest)
Treatment type: Mixed
Revegetation type: Active (mixed willow forest)
101
Treatment type: Mixed
Revegetation type: Active (coastal sage scrub/oak savannah)
Treatment type: Mixed
Revegetation type: Active (coastal sage scrub)
Treatment type: Mechanical
Revegetation type: Passive to limited active (mixed willow forest)
Treatment type: Mixed
Revegetation type: Passive to limited active (mixed willow scrub)
Treatment type: Mixed
Revegetation type: Passive to limited active (mixed willow/cottonwood forest)
Treatment type: Mixed
Revegetation type: Passive to limited active (giant wildrye)
Treatment type: Mixed
Revegetation type: Passive to limited active (mixed willow scrub)
Treatment type: Manual
Revegetation type: Active (mixed willow scrub/oak savannah)
Treatment type: Mixed
Revegetation type: Passive to limited active (giant wildrye)
Treatment type:
Revegetation typ
limited active (mixe


126
Treatment type: Manual
Revegetation type: Passive to active (scale broom/alluvial scrub)
Treatment type: Spray only
Revegetation type: Active (cottonwood/mixed riparian forest)
Treatment type: Flood contingent
Revegetation type: Passive to active (scale broom/alluvial scrub)
San Cayetano St

ESTIMATED COSTS

Arundo treatment type	Cost/acre		
	Best-case Scenario	Worse-case Scenario	Maintenance
Flood contingent	$1,000	$2,000	$1,500
Spray only	$3,000	$6,000	
Manual	$9,000	$150,000	
Mixed	$6,500	$78,500	
Mechanical	$4,000	$7,000	

ESTIMATED COSTS

Area	Treatment Type	Acres	Cost
Parkway Parcels	Various	1,278	$3.3-30 million
Flood Reset Zone	Flood contingent	2,210	$3.3 million
Outside Primary Flood Reset Zone			
1-19% arundo	Spray only	461	$1.4 million
	Hand	461	$4.1 million
20-79% arundo	Mixed	649	$4.2 million
80-100% arundo	Mechanical	170	$681,000
Grand Total		5,229	$17-44 million

STRATEGIC PLAN FOR ARUNDO TREATMENT

- Multi-scale top-down approach
- Priorities based on economic cost, ecological benefit, & feasibility (including permitting)
- Contingency plans

ACKNOWLEDGEMENTS

- Primary funding provided by Coastal Conservancy
- Additional funding for vegetation mapping provided by Santa Clara River Trustee Council
- Technical assistance on various component studies provided by Tom Dudley, Adam Lambert, Sebastian Araya, Amy Merrill, Gretchen Coffman, Bill Sears, Pete Downs, & Tami Cosio
- We thank the following for sharing their knowledge of arundo treatment and permitting: Tom Dudley, Adam Lambert, Bill Neil, Kevin Russell, Arielle Simmons, Jenny Marek, Antzal Szijj, Dan Blankenship, and Pam Lindsesy

FOR MORE INFORMATION

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Santa Clara River Parkway Website
(includes project reports plus data layers viewable with Google Earth)

www.santaclarariverparkway.org

Stillwater Sciences Website
www.stillwatersci.com