

Prioritizing Stream Protection, Restoration and Management Actions Using Landscape Modeling and Spatial Analysis

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Southern California Coastal Water Research Project (SCCWRP)



Need For A Cohesive Management Strategy

- Pervasive stress effects streams throughout California
- Need a tool to help prioritize restoration and management actions within watersheds
 - What actions?
 - Where within the watershed?
 - How to make all the pieces fit together to promote overall watershed health?

Overall Objectives

- Develop a **statewide** tool to:
 - ✓ Assess general condition at the **NHD reach scale**
 - ✓ Identify key stressors
 - ✓ Recommend management actions
 - ✓ Account for local priorities
- Demonstrate application in six pilot watersheds
 - Full prioritization process
- Support the larger HWP objectives
- Support WRP implementation
 - Projects
 - Regional strategy



Healthy Watersheds Partnership - Assessment Guidance

Watersheds are inherently integrated and complex systems. Because of this, successfully conducting a watershed scale assessment can be quite a challenge. Here we provide step-by-step guidance on how to go about conducting such an assessment. Doing so involves six phases, including: planning; developing goals, objectives, and expected outcomes; assessment preparation; condition assessment; communicating results; and data acquisition, monitoring and management.



Flow-chart depicting the six phases of conducting a watershed assessment. Click on each phase in the [Toolbox](#) to be taken directly to the guidance for that phase.

1. Condition Assessment

- (CSCI, ASCI) or (CSCI, ASCI, Biotic Structure, Physical Structure)
- Threshold = 10th percentile of indicators at reference sites
- Any indicator below threshold = Degraded

Intact

Degraded

2. Assess Stressor Rating

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Good

Bad

Good

Bad

Action:
Protect

Action:
Risk Reduction

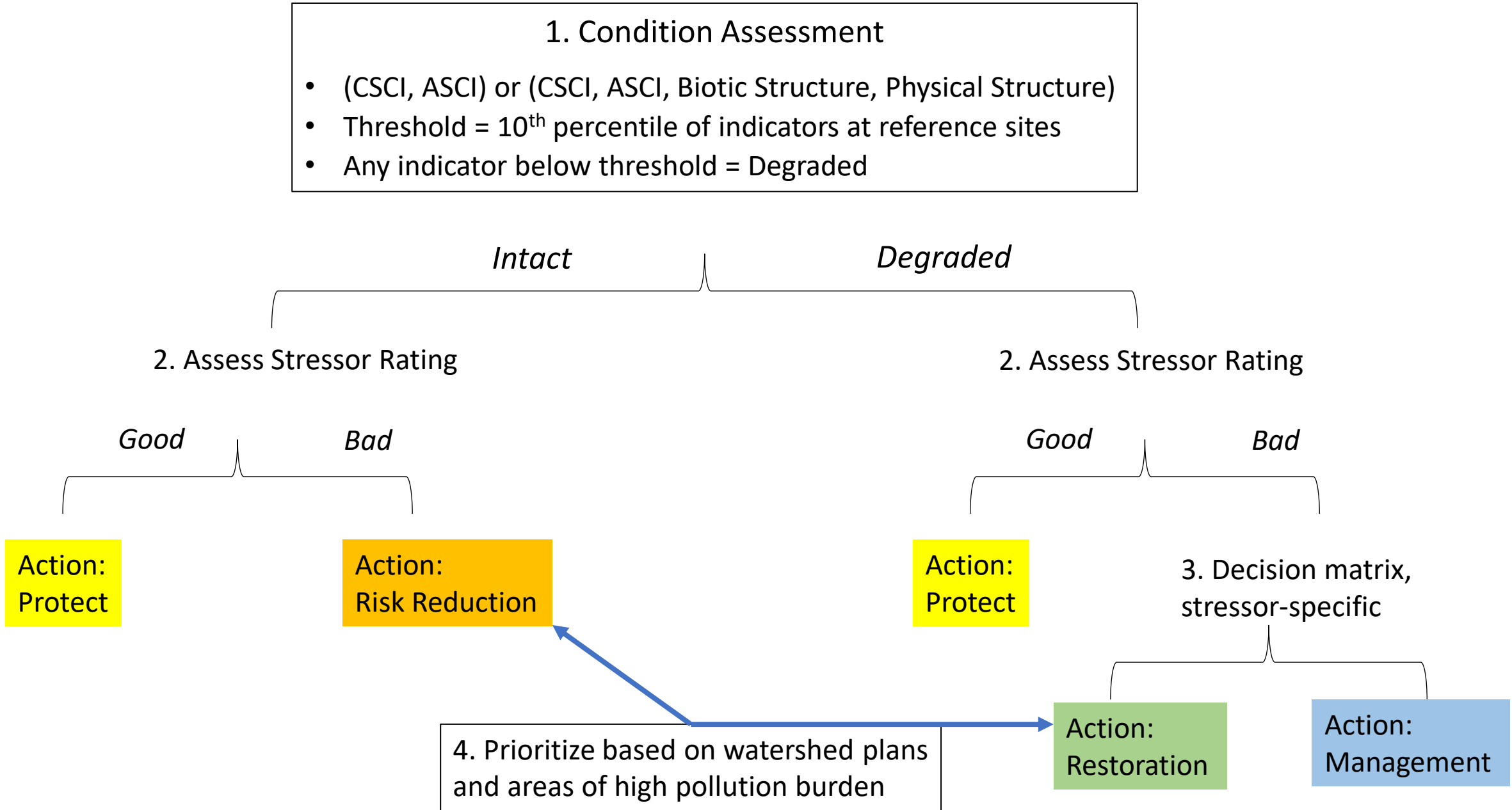
Action:
Protect

3. Decision matrix,
stressor-specific

Action:
Restoration

Action:
Management

4. Prioritize based on watershed plans
and areas of high pollution burden



Condition Assessment

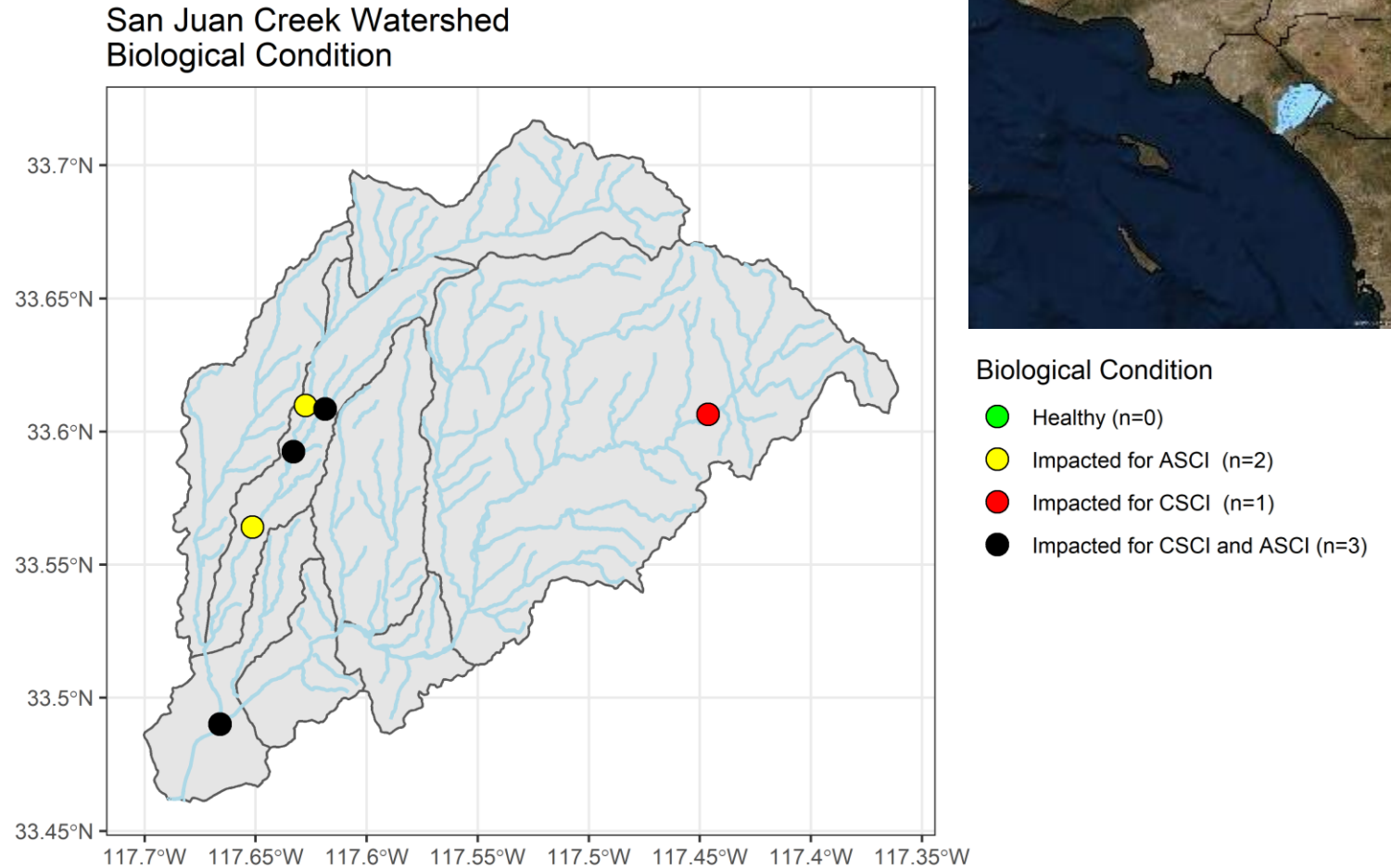


- Biological indices (CSCI, ASCI)
- Biotic structure & Physical structure from CRAM

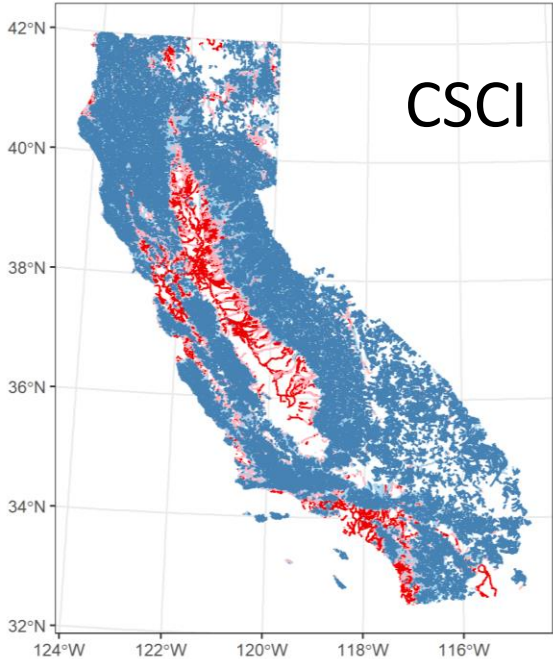
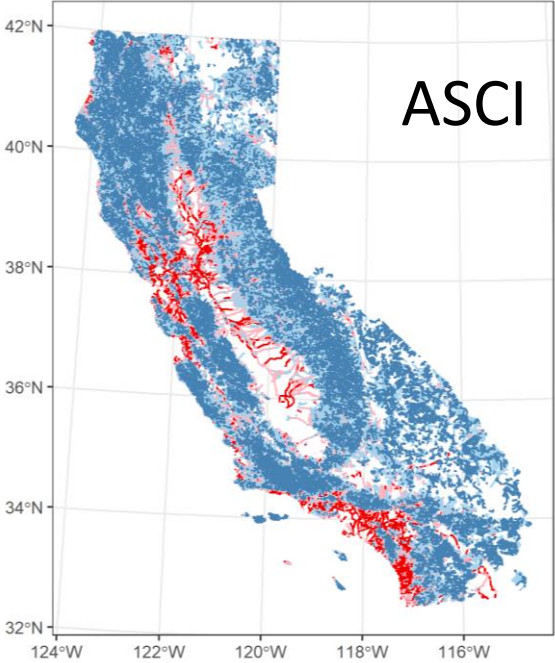


Condition of Stream Reaches in The Watershed

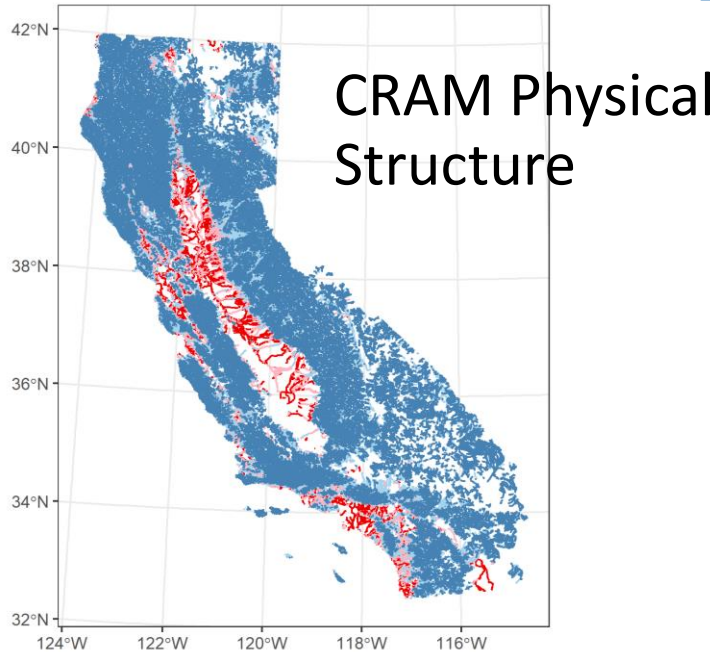
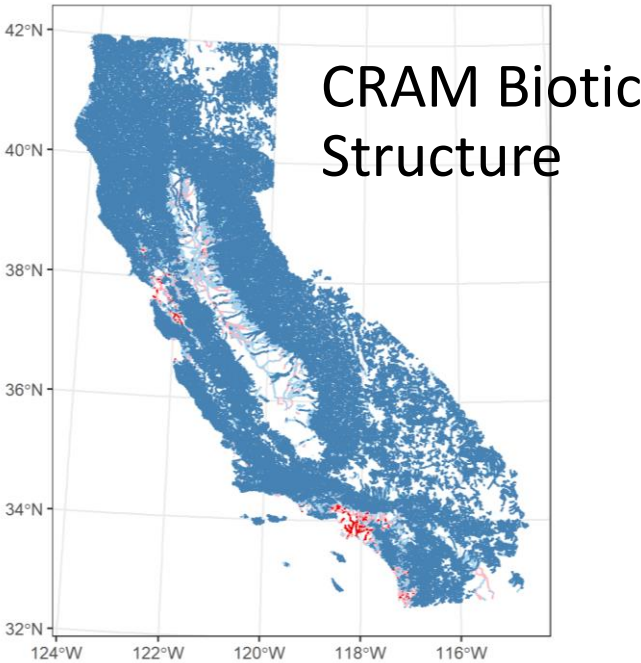
- Bioassessment indicators of overall condition
- Need to extrapolate condition assessments to stream reaches not sampled



Statewide Condition Assessment



Very Likely Altered
Likely Altered
Possibly Altered
Likely Unaltered



Integration of Condition Scores

- Followed approach used in Stream Quality Index
 - Degraded stream = Any condition score < 10th percentile reference threshold

		Biological condition	
		CSCI high	CSCI low
ASCI high		Healthy	Impacted for CSCI
ASCI low		Impacted for ASCI	Impacted for CSCI and ASCI

Approach used by SQI

Similar approach:

If any indicator is below threshold, then the stream reach is considered degraded

- Overall rating = Intact or Degraded

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Stress & Vulnerability



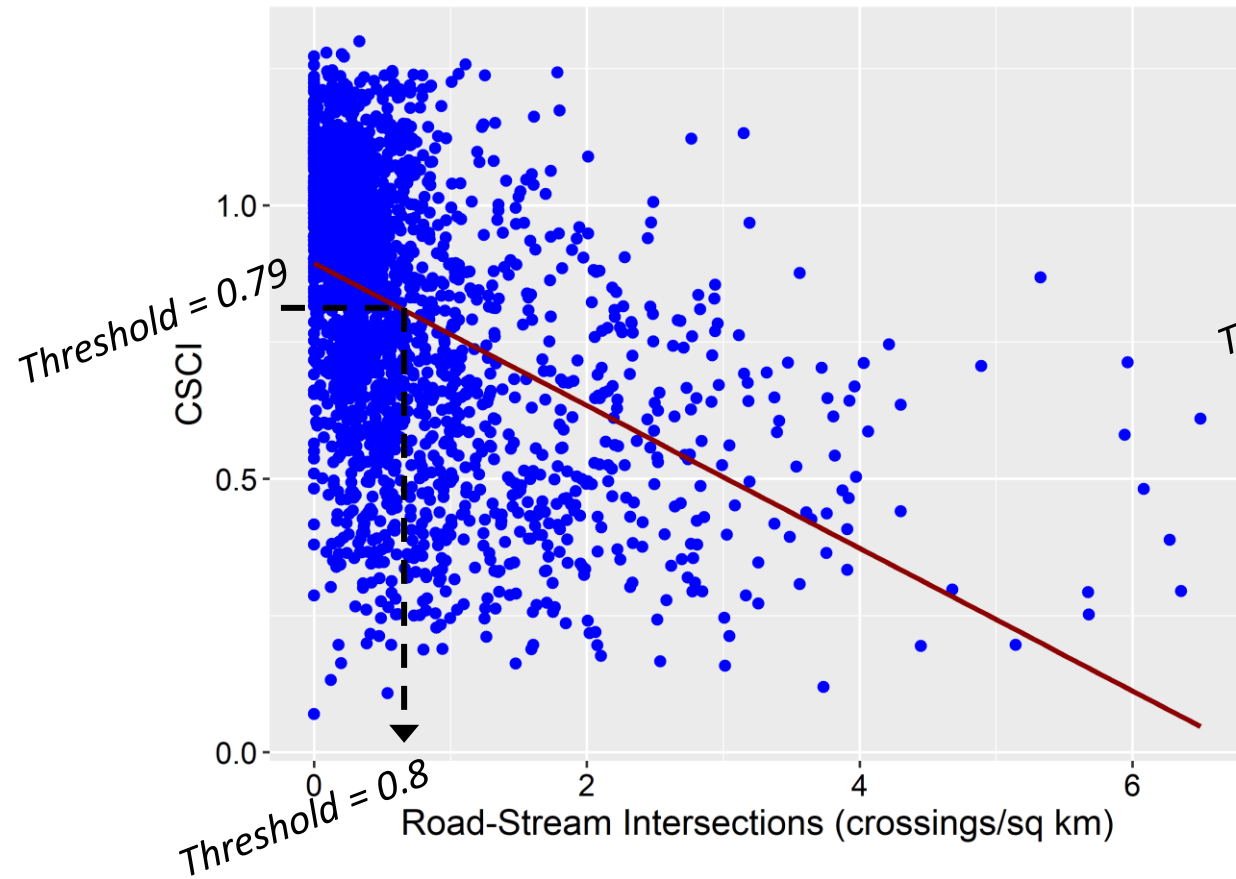
StreamCat

- Hydrological, Physical, Chemical stressors
- Results readily available for 140,835 stream reaches in California

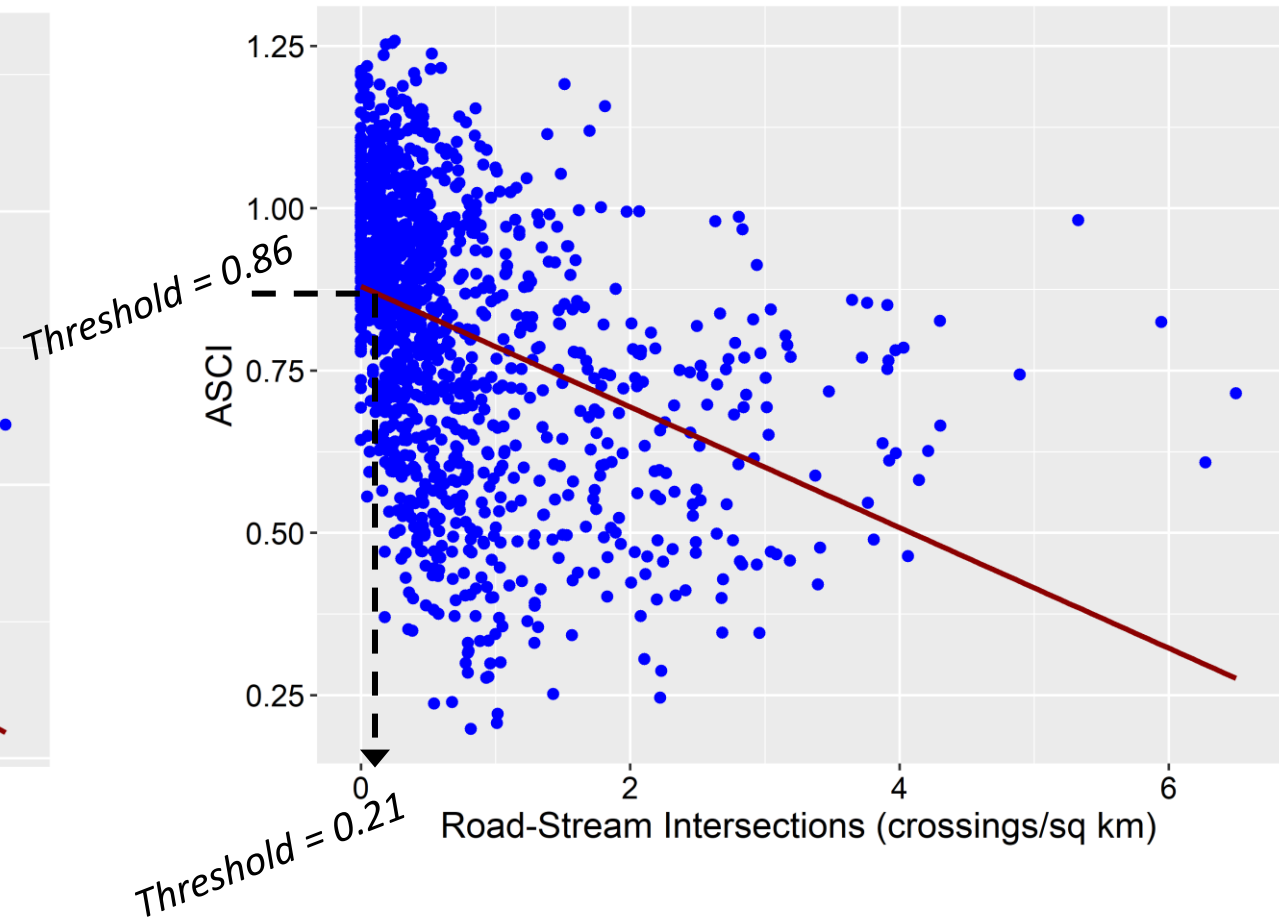


Example Stressor Threshold Calculation from Regression Analysis

Road-Stream Intersections vs CSCI



Road-Stream Intersections vs ASCI



Stressor Thresholds Derived from Regression Analysis

Stressor	Stressor Descriptor	Median Threshold
AgKffactCat	Soil erodibility on agricultural land (catchment)	0.028
AgKffactWs	Soil erodibility on agricultural land (watershed)	0.010
CanalDensWs	Canal, ditch, or pipeline density (watershed)	0.039
CBNFWs	Biological nitrogen fixation from cultivation of crops (watershed)	1.18
DamDensWs	Dam density (watershed), based on National Inventory of Dams	0
FertWs	Synthetic N fertilizer application to agricultural land (watershed)	6.5
MineDensWs	Mine density (watershed)	0.006
NABD_DensWs	Density of dams (catchment), based on National Anthropogenic Barrier Dataset	0
PctAgCat	Agriculture (catchment)	9.1
PctAgWs	Agriculture (watershed)	2.9
PctAgWsRp100	Agriculture (watershed, within 100m buffer of streams)	2.8
PctImp2011Cat	Imperviousness (catchment)	10.8
PctImp2011CatRp100	Imperviousness (catchment, within 100m buffer of streams)	10.5
PctImp2011Ws	Imperviousness (watershed)	7.0
PctImp2011WsRp100	Imperviousness (watershed, within 100m buffer of streams)	6.5
PctUrbCat	Urbanization (catchment)	23.9
PctUrbCatRp100	Urbanization (catchment, within 100m buffer of streams)	27.8
PctUrbWs	Urbanization (watershed)	17.8
PctUrbWsRp100	Urbanization (watershed, within 100m buffer of streams)	17.0
RdCrsCat	Roads-stream intersections (catchment)	2.3
RdCrsWs	Roads-stream intersections (watershed)	0.86
RdDensCat	Road density (catchment)	3.8
RdDensCatRp100	Road density (catchment, within 100m buffer of streams)	4.0
RdDensWs	Road density (watershed)	2.8
RdDensWsRp100	Road density (watershed, within 100m buffer of streams)	2.7

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Management Recommendations

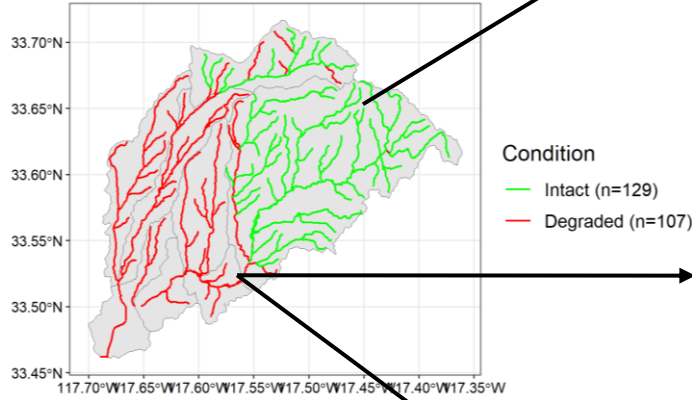
Table 2. Recommended action matrix. “X” indicates the recommended action is relevant to the stressor, and shaded boxes indicate priority actions (yellow = Risk Reduction Priority, green = Restoration Priority, blue = Management Priority).

Major Stressors	Recommended Actions			specific action
	Risk Reduction	Restoration	Management	
Soil erodibility on agricultural land (catchment or watershed)	X	X	X	<i>buffers and upland revegetation</i> to reduce sediment input to streams
Canal, ditch, or pipeline density (watershed)		X		<i>tributary restoration</i> to daylight channelized streams and improved infiltration
Biological nitrogen fixation from cultivation of crops (watershed)	X	X	X	<i>buffers and runoff control</i> to reduce nitrogen input and reduce eutrophication
Dam density (watershed), based on National Inventory of Dams ¹	X	X	X	<i>channel and flood plain restoration</i> to remedy hydromodification effects
Synthetic N fertilizer application to agricultural land (watershed)	X	X	X	<i>buffers and runoff control</i> to reduce nitrogen input and reduce eutrophication
Mine density (watershed)	X	X	X	<i>buffers and runoff control</i> to reduce input of contaminants to streams
Agriculture (catchment or watershed)			X	<i>buffers and runoff control</i> to reduce input of sediment and contaminants to streams
Agriculture (within 100m buffer of streams)	X	X	X	<i>floodplain restoration</i> to enhance stream function and habitat connectivity
Imperviousness (catchment within 100m buffer of streams)	X	X	X	<i>channel restoration with buffers</i> to remedy hydromodification & floodplain encroachment
Urbanization (catchment)		X	X	<i>runoff management</i> to reduce sediment and contaminant input to streams
Urbanization (within 100m buffer of streams)	X	X	X	<i>floodplain restoration</i> to enhance stream function and habitat connectivity
Roads-stream intersections (catchment or watershed)	X	X	X	<i>culvert retrofit</i> to improve sediment flux, flow, and biological passage/connections
Road density (catchment or watershed)	X	X	X	<i>runoff management</i> to reduce hydromodification and contaminant input to streams

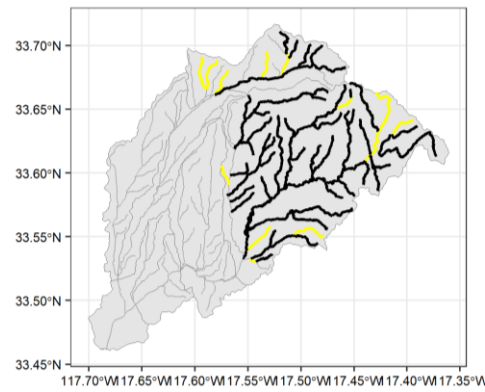
Developed in coordination with HWP; Revised based on feedback/review from the TAC

Integrating Prioritization Recommendations

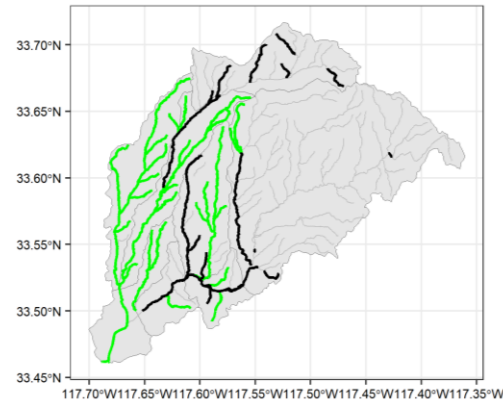
San Juan Creek Watershed
Condition of CSCI, ASCI, Biotic, Physical



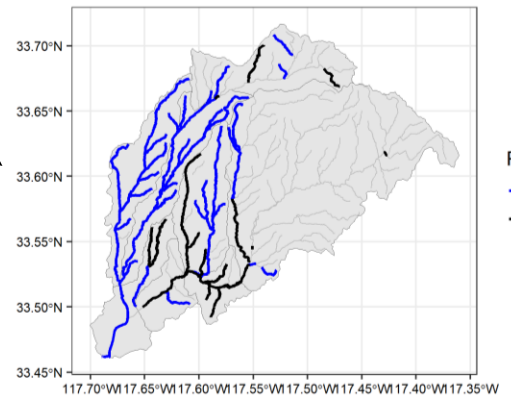
San Juan Creek watershed, Intact streams
RdCrsws, Median threshold used



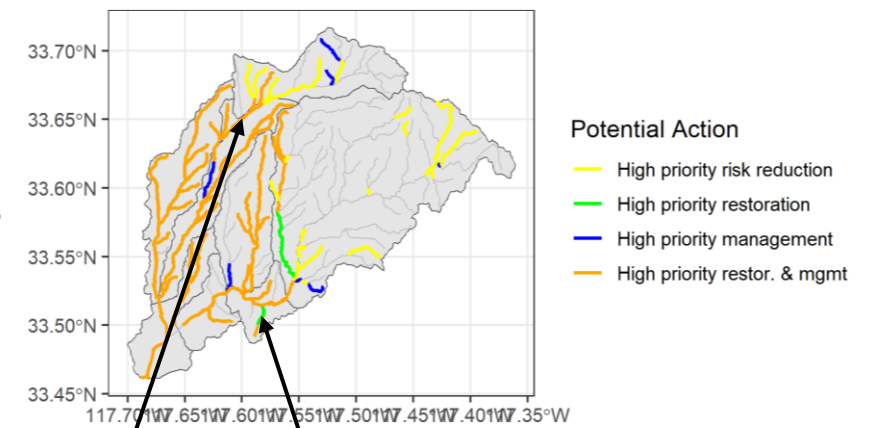
San Juan Creek watershed, Degraded streams
PctImp2011WsRp100, Median threshold used



San Juan Creek watershed, Degraded streams
RdCrsws, Median threshold used



San Juan Creek watershed
Potential actions for stressed streams



Stressors: % ag, % impervious and % urban within 100m buffer

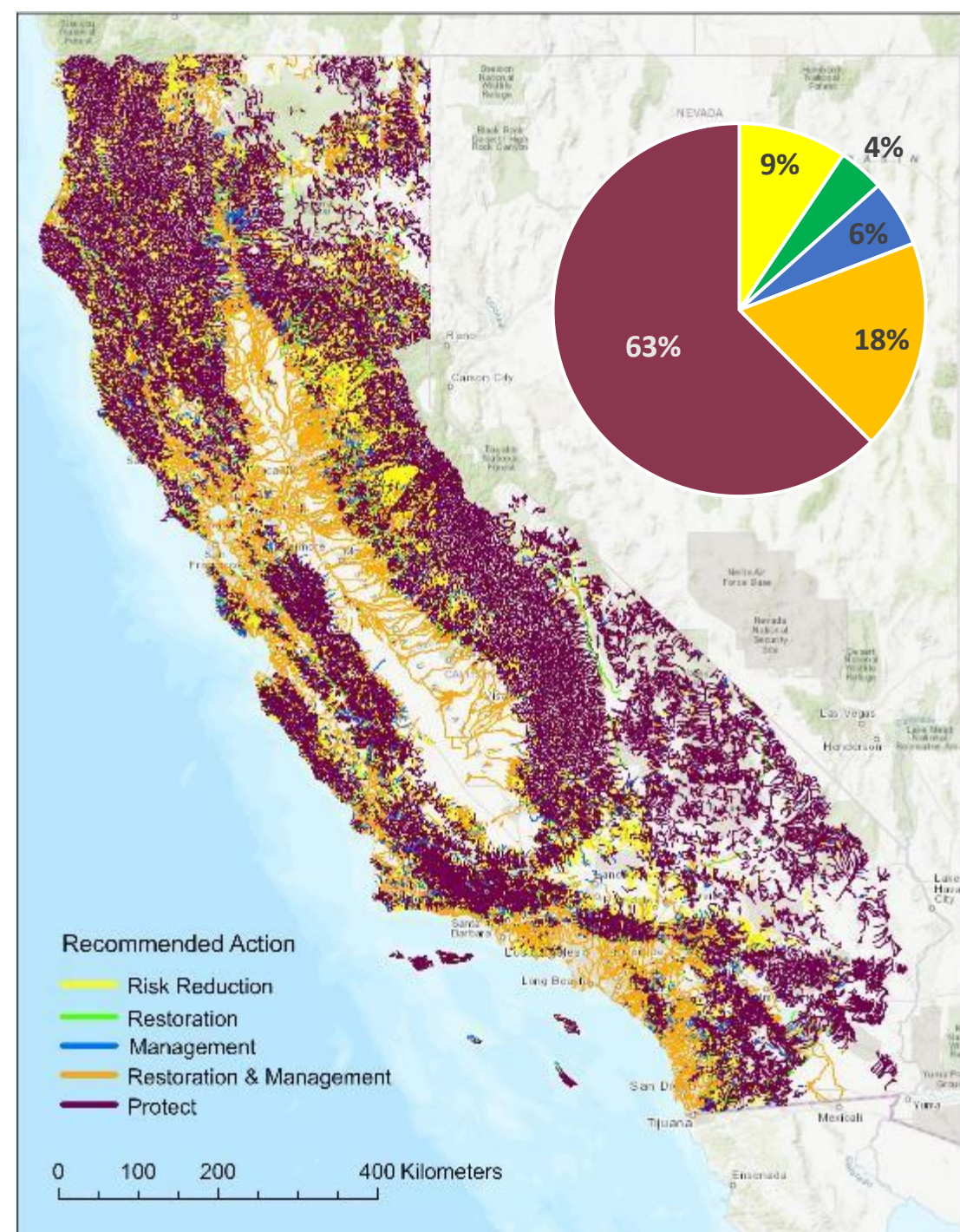
Recommended action:
- Floodplain restoration

Stressors: % impervious, % urban, road-stream intersections

Recommended actions:
- Buffer & runoff management (management)
- culvert retrofit (restoration)

Statewide Assessment

- Identified the 28% of streams that should be highest priority for restoration and management
- Approximately 9% of stream are intact, but most at risk of future degradation
- Majority of stream reaches (63%) were identified for protection and continued monitoring

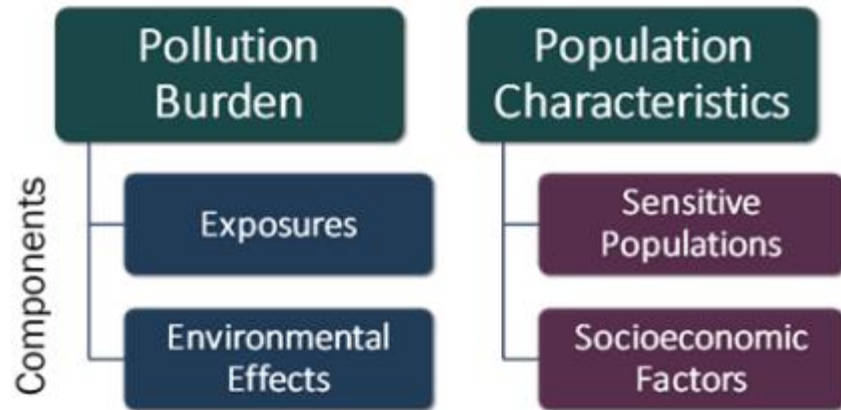


Incorporation of Local Priorities

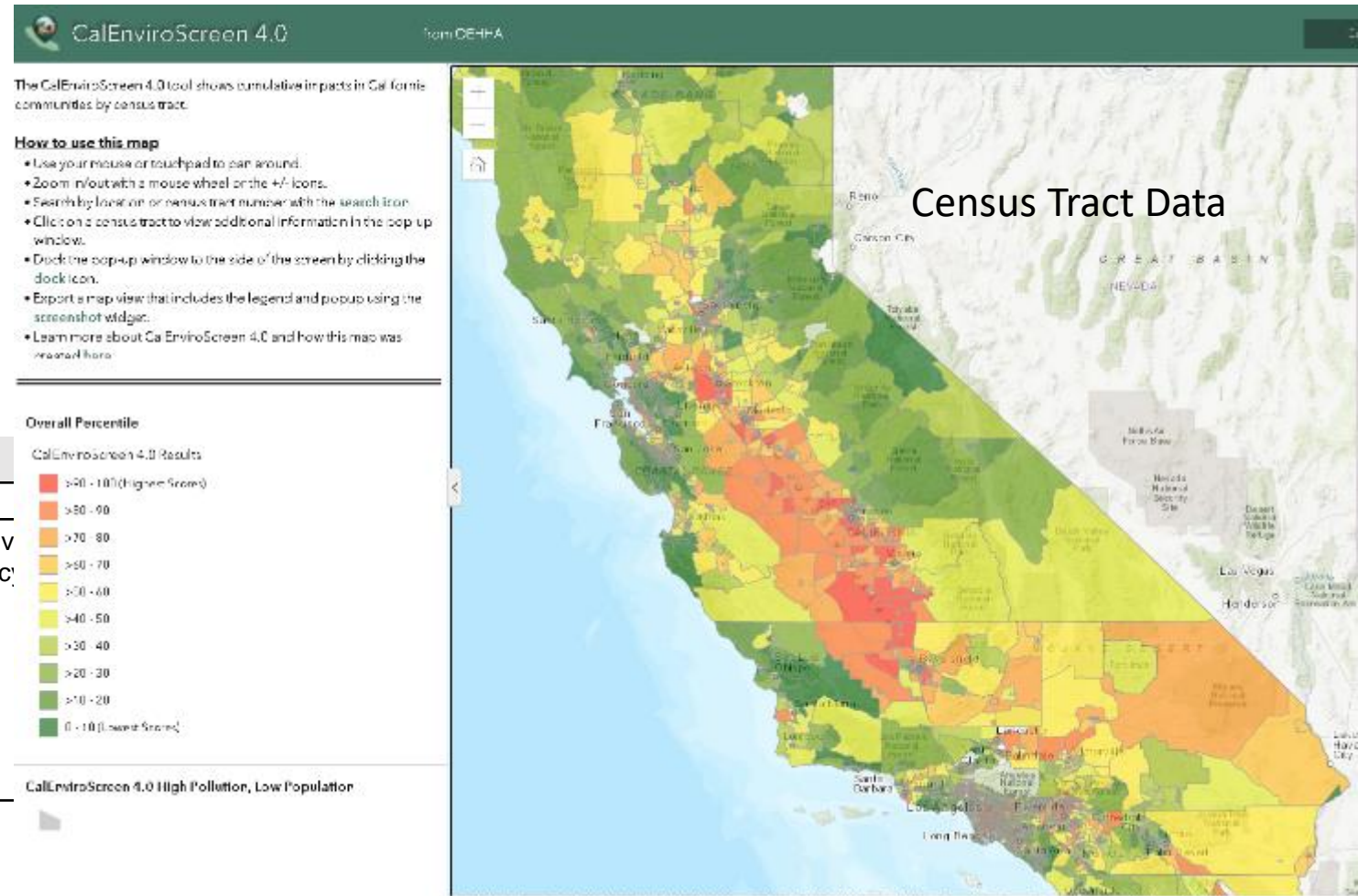
- Demonstrated in six pilot watersheds
- Prioritization based on two factors
 - Prioritization based on environmental justice considerations using CalEnviroScreen
 - Prioritization based on opportunities to coordinate with existing plans



Environmental Justice - CalEnviroScreen



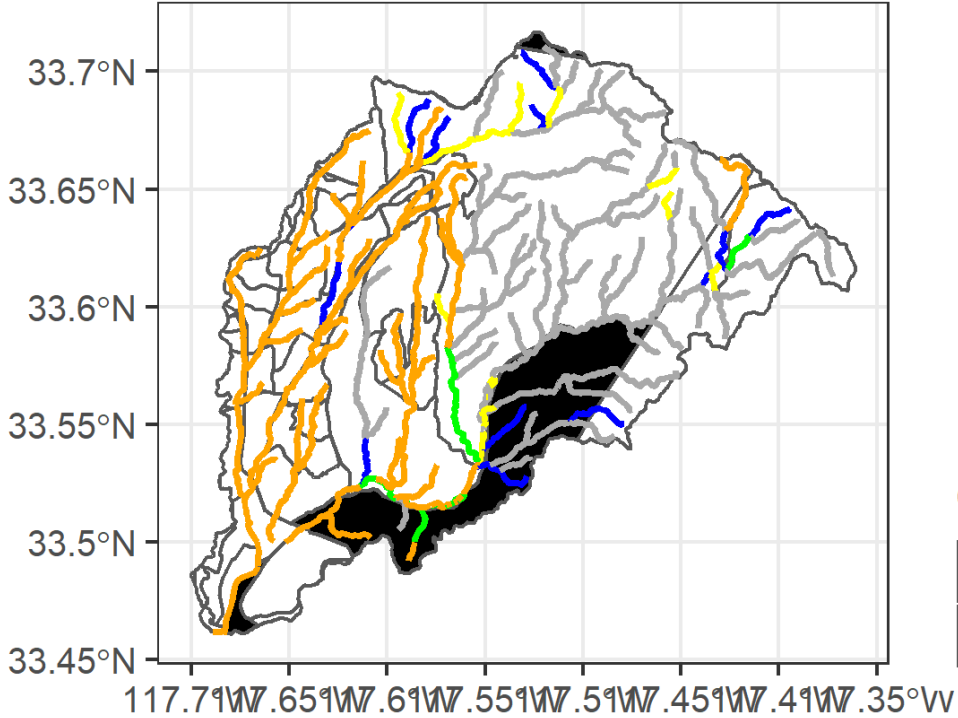
Pollution Burden	Population Characteristics
Exposures	Sensitive Populations
Ozone Concentrations	Asthma related emergency room v
PM 2.5 Concentrations	Cardiovascular disease emergenc
Diesel PM Emissions	visits
Pesticide Use	Low birth weight - infants
Toxic Releases	
Traffic Density	
Environmental Effects	Socioeconomic Factors
Cleanup Sites	Educational Attainment
Groundwater Threats	Low Income Households
Hazardous Waste	Poverty Index
Impaired Waterbodies	Unemployment
Solid Waste Sites	



Prioritized locations with the highest 20%-ile pollution burden scores

Incorporation of Environmental Justice Considerations

San Juan Creek watershed
Potential actions for stressed streams &
consensus tract pollutant burden exceedances

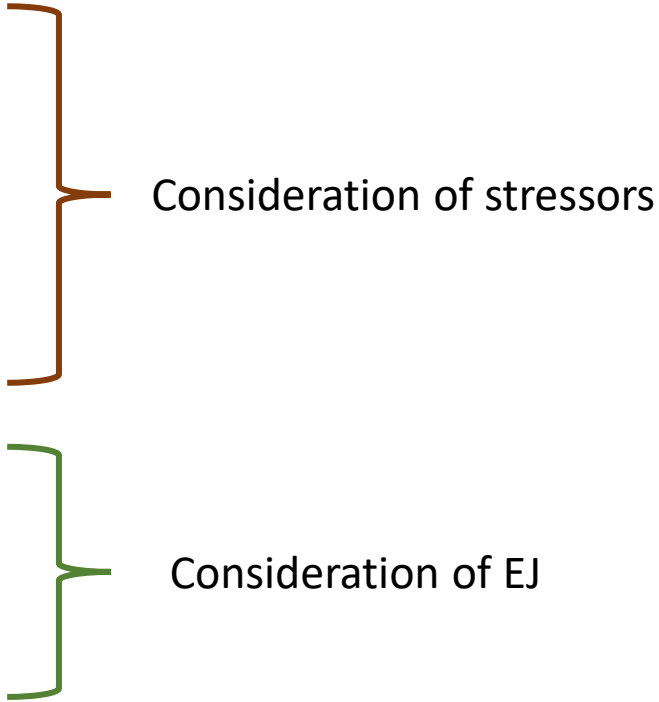


Potential Action

- High priority protection (n=21)
- High priority restoration (n=17)
- High priority management (n=17)
- High priority restor. & mgmt (n=79)
- None (n=102)

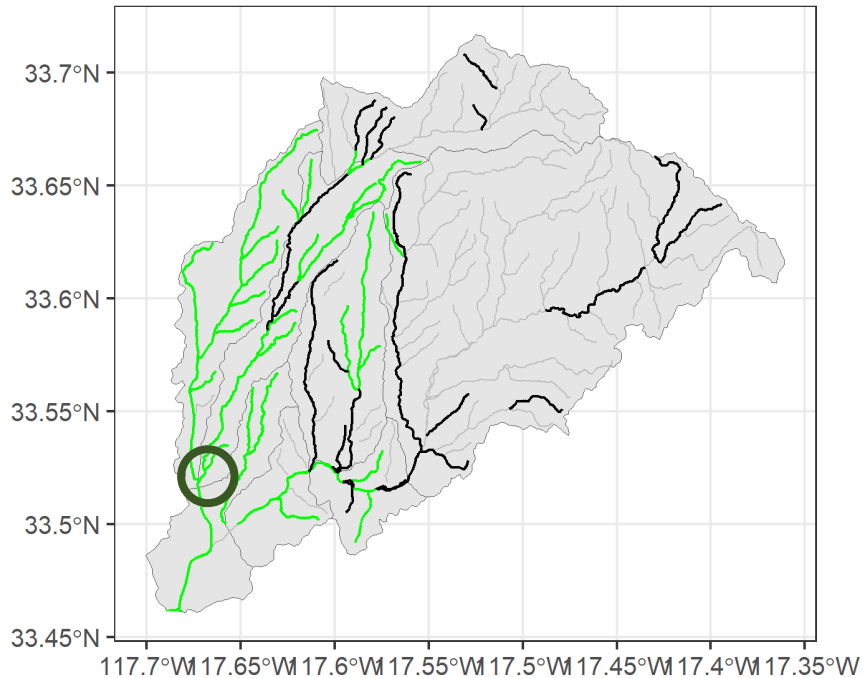
Census Tract Pollutant Burden

- Not Exceeded (n=57)
- Exceeded (n=3)



Consideration of Local Priorities

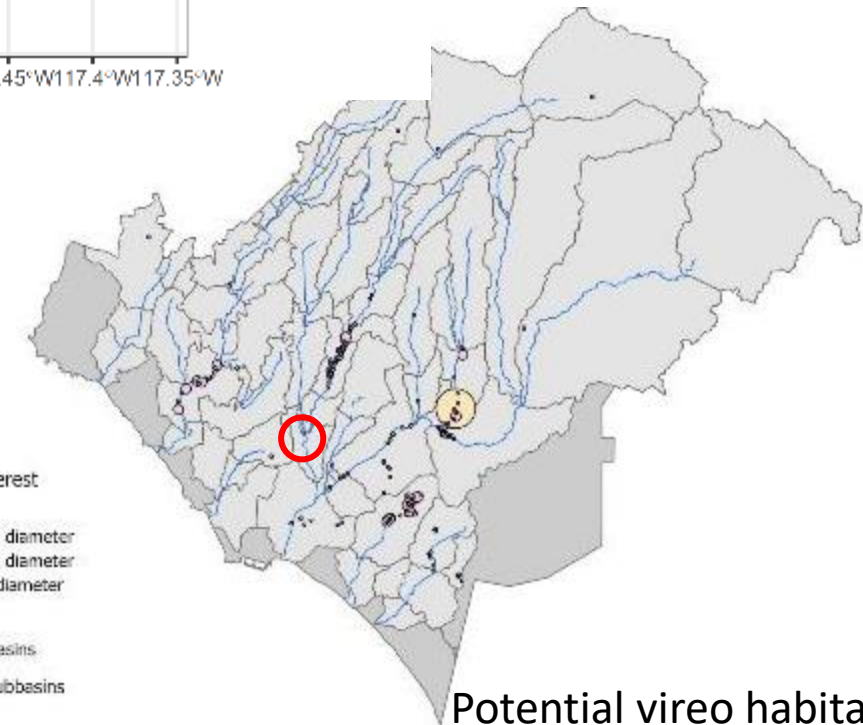
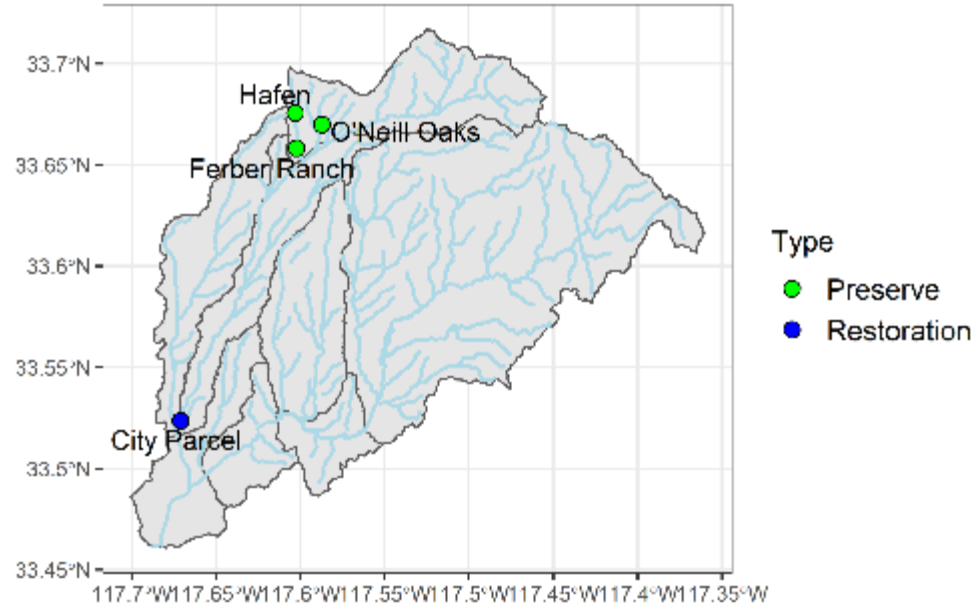
Actions identified for imperviousness



Potential Action

- High priority restoration (n=59)
- Low priority restoration (n=60)

San Juan Creek Watershed
Natural Community Conservation Plan

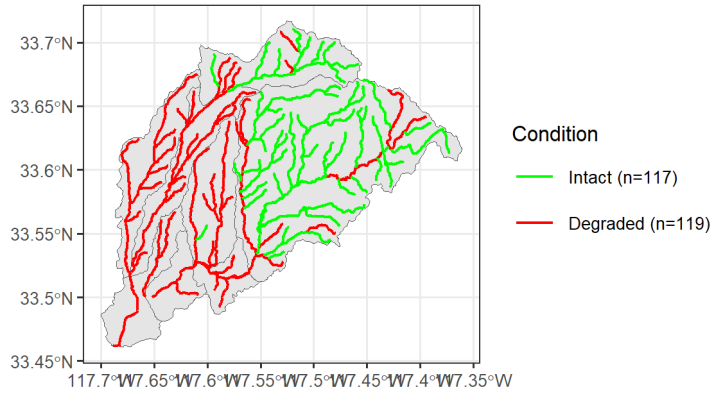


High stress area near key confluence → stream + buffer restoration
Potential vireo habitat + NCCP restoration area → HIGH priority

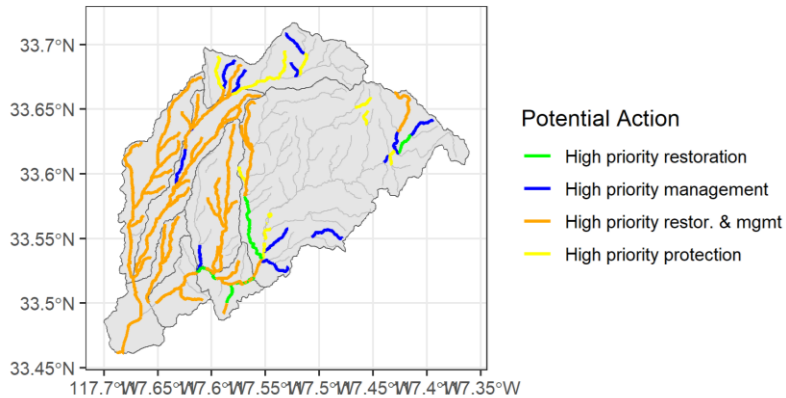
Potential vireo habitat

Overall Assessments

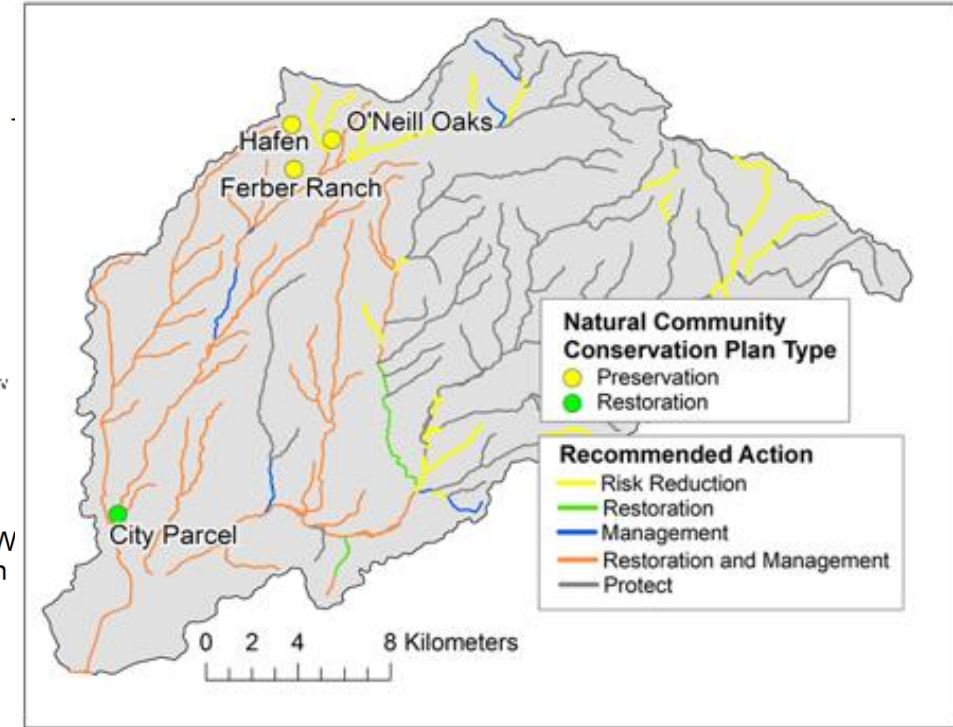
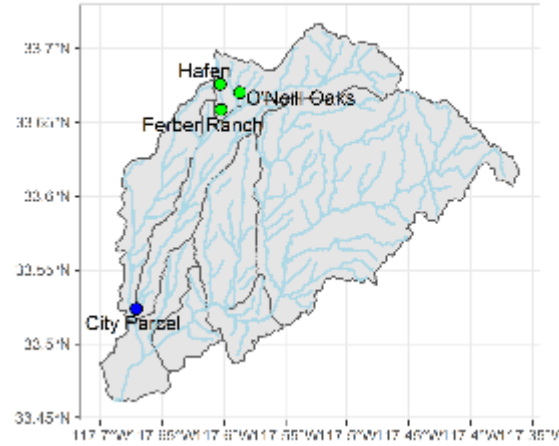
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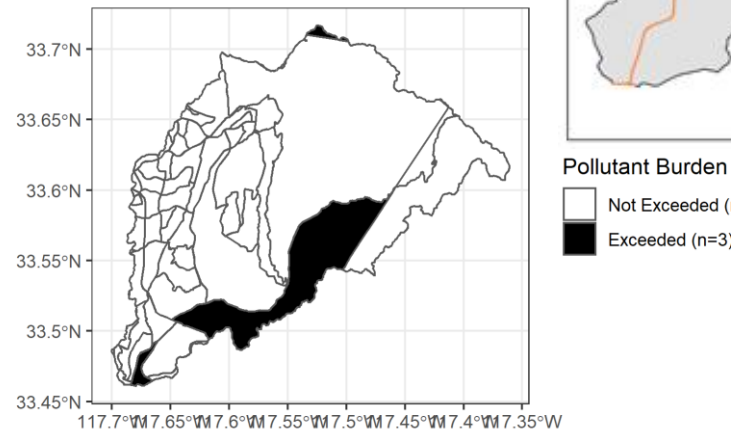
San Juan Creek watershed
Potential actions for stressed streams



San Juan Creek Watershed
Natural Community Conservation Plan



Census tracts within San Juan Creek W
Pollutant Burden exceeding upper 20th



How Can The Watershed Prioritization Products Be Used?

- Incorporation into EcoAtlas and Healthy Watersheds Partnership data layers
- Aid in prioritizing proposed restoration projects
- Help prioritize actions or areas where activities are necessary to promote climate resiliency
- Develop case studies of use in watershed planning

Questions

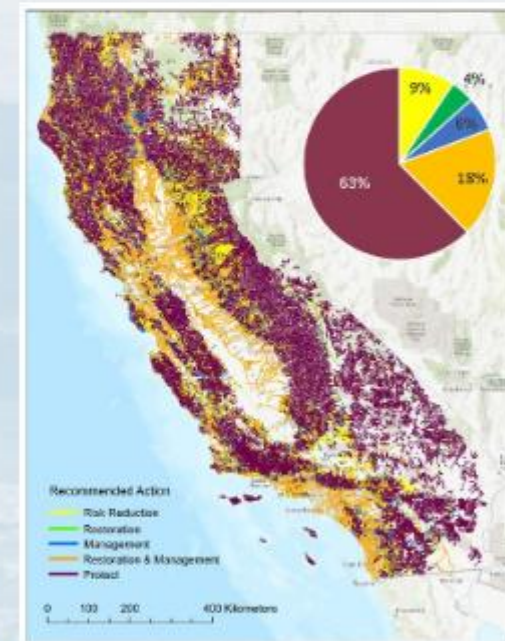
- Models and code: https://github.com/SCCWRP/healthy_watershed_random_forest
- Geodatabase and associated metadata: <https://dataportal.sccwrp.org/datasets/watershed-prioritization-recommended-actions-2021-raw-data>
- Summary map of statewide recommended actions: <https://dataportal.sccwrp.org/maps/d9d52815c7dc4eebbcbca802ed5558b9/explore?location=36.846409%2C-119.370200%2C6.94>

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Southern California Coastal Water Research Project
Technical Report 1246



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EXTRA SLIDES