Green Acres: A collaborative vision for meadow recovery in California

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Context

- Enhanced focus on meadows restoration (last 10 years)
- High level of coordination among stakeholders/ practitioners (5 years)
- New robust datasets on species and habitat condition (2 years)
- Significant new funding for meadows projects (1 year)

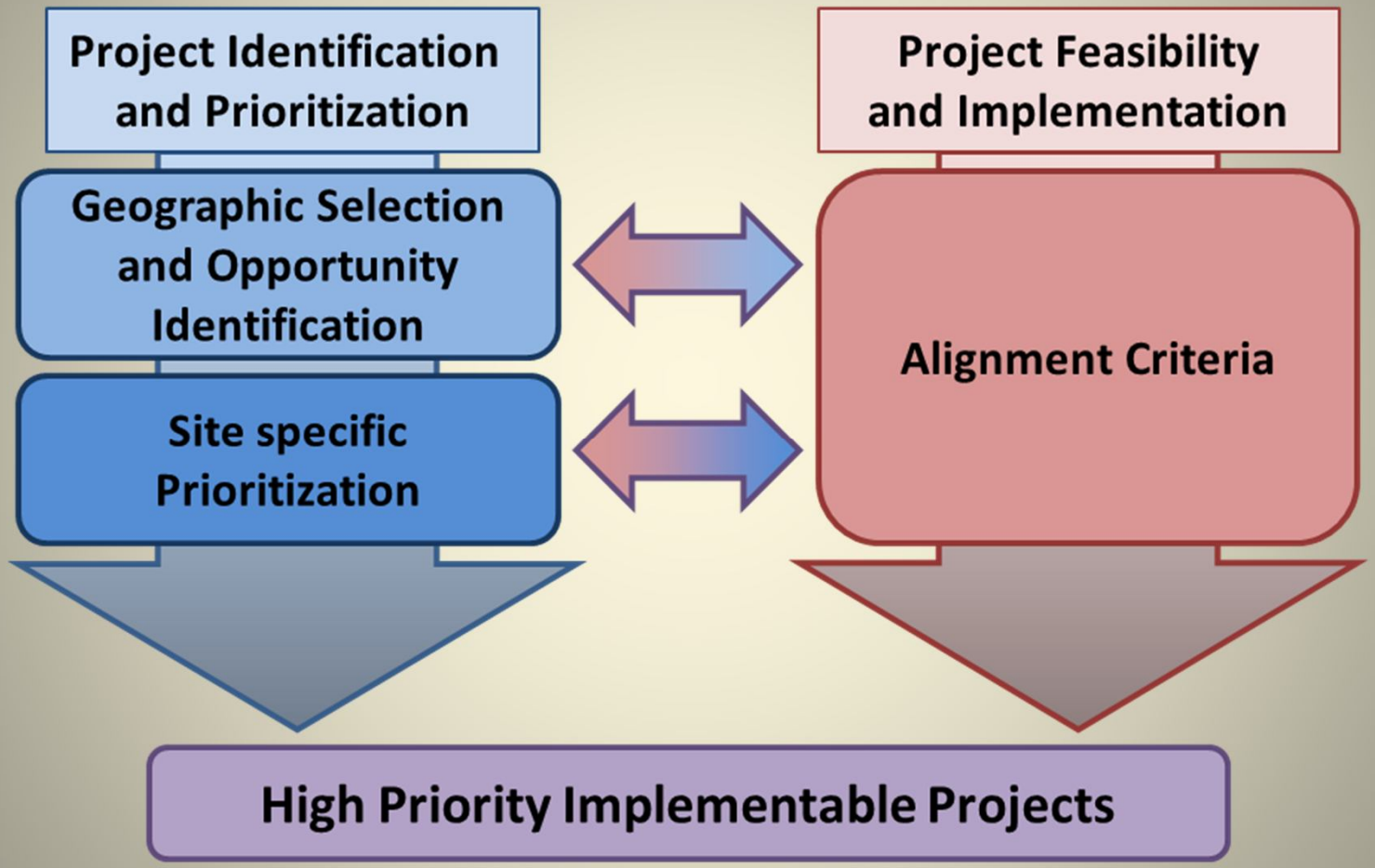
Opportunities

- **Collaborative, structured decision making** applied to meadows restoration
- **Integration of multiple foci/ priorities** (species/ habitat, meadow type, carbon)
- **Design of actions to achieve multiple priorities**
- **Quantification** of progress and adaptive management

Approach

- Application of new data and structured approach to:
  - **Identify needs/ opportunities**
  - **Select and prioritize specific locations**
  - **Design projects for multiple benefits** (e.g. fish, birds, meadows, carbon)

Approach


Project Identification and Prioritization
Project Feasibility and Implementation
Geographic Selection and Opportunity Identification
Alignment Criteria
Site specific Prioritization
High Priority Implementable Projects

Needs and Opportunities

- Geographic Selection and Opportunity Identification
  - Watershed scale geospatial data
    - related to species and habitat condition
    - Applied to identify and prioritize areas of need and assess what specific opportunities exist in those areas.

Needs and Opportunities

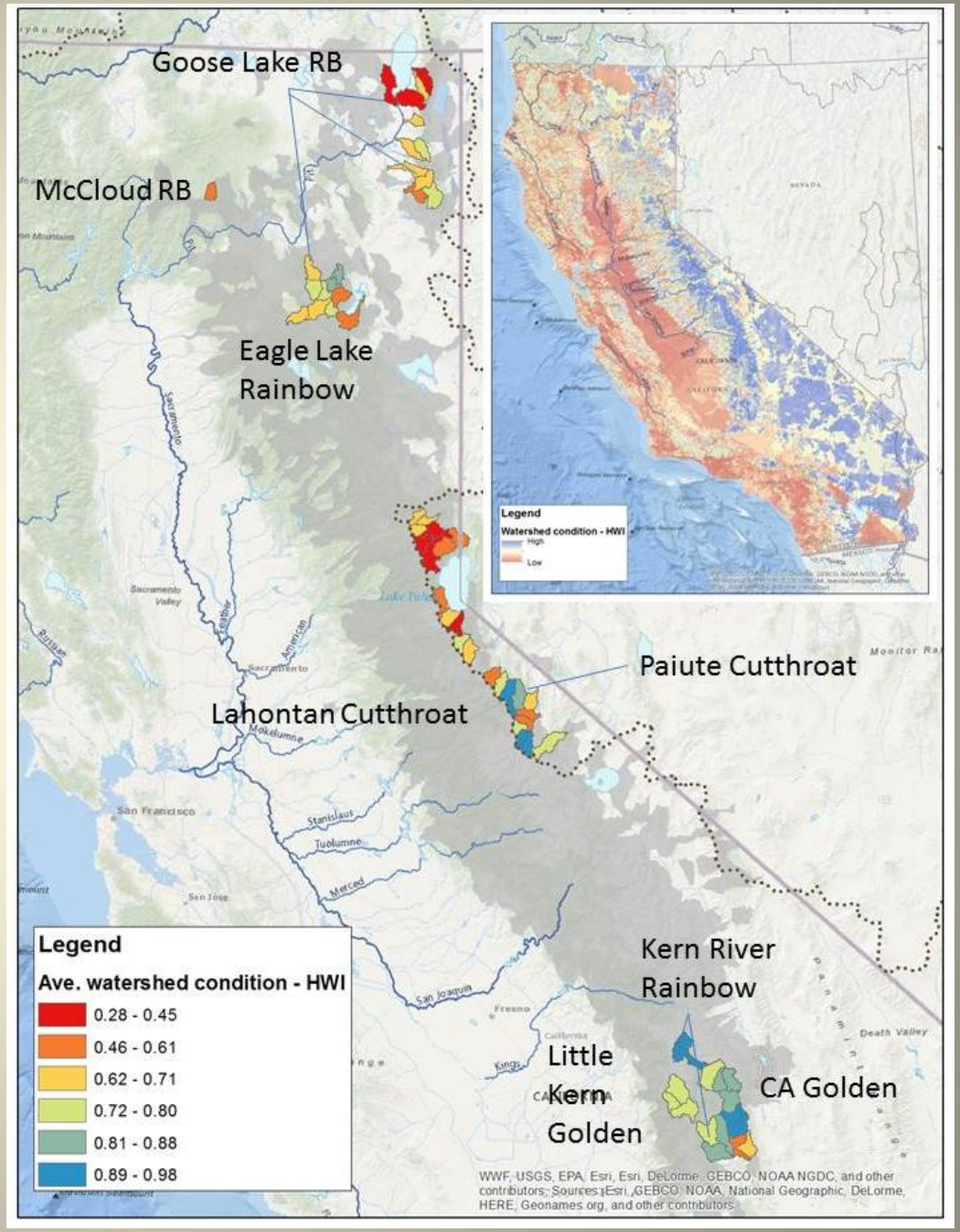
- Resources: Species and Habitat data
  - **Aquarius** - Freshwater species Database
  - **MRFAT, CSI** - Limiting factors for fish
  - **Freshwater Conservation Blueprint** – Habitat condition and species nexus

HUC_12	HUC12_name	Meadow count	Meadow acres	LCT	CGT	LKGT	KRRT	ELRT	HWI condition	HWI health	HWI vulnerabilty	Dam capacity / runoff	Diverted vol. / runoff	Rd. den	FRCC	Prop. Alien fish	Grd.W well count	Pct. Dev. ARA	Pred. change wildfire	Pred. change precip.	Pred. mean temp. change	Pred. snow pack change	Pred. surf. Runoff change	Pct. Protected	Pct GAP 1,2	Pct GAP
60501010301	Big Meadow Creek-Upper Truckee River	54	893.0	1	0	0	0	0	0.77	0.76	0.77	0.01	0.01	0.27	0.52	0.30	5.00	2.21	1.55	0.59	0.91	0.22	0.94	99.70	2.03	97.6
60501010303	Upper Truckee River-Frontal Lake Tahoe	70	2431.7	1	0	0	0	0	0.41	0.56	0.91	0.02	0.13	3.33	0.53	0.33	18.00	20.96	1.52	0.58	0.92	0.28	0.94	66.77	8.91	56.7
60501010401	Fallen Leaf Lake-Frontal Lake Tahoe	50	664.9	1	0	0	0	0	0.69	0.73	0.76	0.17	0.02	1.27	0.40	0.40	10.00	1.53	1.30	0.58	0.92	0.26	0.92	82.55	47.53	34.9
60501010402	General Creek-Frontal Lake Tahoe	47	160.6	1	0	0	0	0	0.59	0.73	0.73	0.00	0.02	0.99	0.52	0.36	8.00	3.78	1.29	0.55	0.92	0.20	0.88	91.84	60.15	31.2
60501020102	Independence Creek	23	356.1	1	0	0	0	0	0.68	0.56	0.68	0.00	2.13	1.08	0.52	0.36	3.00	0.18	1.33	0.64	0.91	0.43	0.96	91.84	4.03	59.3
60501020104	Sagehen Creek	14	175.2	1	0	0	0	0	0.63	0.46	0.84	0.00	0.00	1.80	0.72	0.46	1.00	0.69	1.29	0.63	0.91	0.51	0.94	94.74	20.24	70.8
60501020201	Donner Creek	2	13.4	2	0	0	0	0	0.42	0.49	0.96	0.20	0.30	2.29	0.48	0.42	14.00	12.02	1.14	0.61	0.90	0.25	0.94	45.73	18.24	28.1
60501020202	Squaw Creek-Truckee River	12	119.5	1	0	0	0	0	0.41	0.51	0.95	0.02	0.07	1.76	0.60	0.33	26.00	8.28	1.10	0.59	0.91	0.21	0.94	70.06	0.22	71.3
60501020203	South Fork Prosser Creek	11	834.6	2	0	0	0	0	0.71	0.71	0.58	0.00	0.00	0.97	0.47	0.38	0.00	0.15	1.22	0.63	0.90	0.34	0.95	46.60	0.00	44.2
60501020204	Martis Creek	20	353.2	1	0	0	0	0	0.54	0.47	0.93	0.81	0.16	1.49	0.73	0.36	17.00	8.45	0.53	0.61	0.91	0.30	0.94	14.02	0.00	7.6
60501020205	Prosser Creek	10	932.5	1	0	0	0	0	0.41	0.37	0.91	0.57	0.58	2.87	0.75	0.33	15.00	11.29	1.05	0.62	0.91	0.49	0.93	67.68	0.06	64.9
60501020206	Trout Creek-Truckee River	3	62.6	1	0	0	0	0	0.28	0.25	0.97	0.50	1.09	3.70	0.78	0.38	22.00	26.80	0.80	0.60	0.91	0.36	0.94	10.66	1.90	8.5
60501020501	Gray Creek-Truckee River	5	156.8	1	0	0	0	0	0.51	0.64	0.84	0.48	1.05	1.04	0.77	0.43	11.00	2.97	0.48	0.56	0.91	0.40	0.93	16.80	2.49	9.0
60502010102	Bryant Creek-East Fork Carson River	9	64.8	1	0	0	0	0	0.90	0.88	0.62	0.00	0.00	0.00	0.52	0.33	0.00	0.00	1.84	0.69	0.83	0.17	0.90	100.00	99.61	0.3
60502010103	Wolf Creek	7	165.9	1	0	0	0	0	0.77	0.88	0.67	0.00	0.00	0.23	0.70	0.33	1.00	0.00	1.85	0.58	0.85	0.20	0.88	98.42	91.25	7.1
60502010104	Silver Creek	9	93.9	1	0	0	0	0	0.59	0.82	0.69	0.05	0.00	0.25	0.61	0.33	0.00	6.09	1.88	0.57	0.87	0.20	0.89	97.50	11.19	86.3
60502010301	Upper West Fork Carson River	42	667.5	1	0	0	0	0	0.70	0.61	0.68	0.05	0.03	0.87	0.53	0.30	10.00	2.34	1.67	0.62	0.91	0.19	0.95	95.20	12.98	81.9
60503010109	Buckeye Creek	8	132.8	1	0	0	0	0	0.79	0.87	0.66	0.00	0.00	0.19	0.66	0.36	3.00	0.69	1.83	0.71	0.79	0.12	0.89	90.43	54.78	35.9
60503020101	West Fork Walker River	19	85.3	2	0	0	0	0	0.92	0.78	0.58	0.00	0.00	0.03	0.60	0.38	0.00	0.01	1.85	0.76	0.78	0.12	0.93	99.98	99.83	0.0
60503020102	Cascade Creek-West Walker River	24	164.3	2	0	0	0	0	0.98	0.86	0.59	0.00	0.00	0.00	0.65	0.38	0.00	0.00	1.87	0.74	0.79	0.12	0.92	100.00	100.00	0.0
60503020104	Leavitt Creek-West Walker River	19	93.6	1	0	0	0	0	0.74	0.77	0.73	0.00	0.00	0.47	0.70	0.30	0.00	6.17	1.92	0.77	0.79	0.10	0.91	99.55	12.63	6.4
60503020105	Wolf Creek-West Walker River	18	163.3	1	0	0	0	0	0.54	0.70	0.77	0.01	0.00	0.83	0.82	0.30	0.00	1.58	1.89	0.78	0.80	0.08	0.88	99.44	10.79	26.5
60503020108	Silver Creek-West Walker River	15	423.2	1	0	0	0	0	0.55	0.77	0.79	0.01	0.00	0.69	0.75	0.33	1.00	3.73	1.83	0.77	0.80	0.10	0.87	96.48	2.06	13.0
60503020203	Mill Creek	7	54.7	1	0	0	0	0	0.67	0.78	0.75	0.00	0.00	0.24	0.78	0.42	0.00	1.18	1.75	0.76	0.82	0.13	0.85	96.30	2.95	7.1
80300010204	Golden Trout Creek	58	1432.4	0	1	0	0	0	0.78	0.79	0.35	0.00	0.00	0.00	0.16	0.60	1.00	0.08	1.12	0.20	0.38	0.08	0.63	100.01	90.41	0.0
80300020101	Lewis Stringer-South Fork Kern River	23	9978.1	0	1	0	0	0	0.88	0.65	0.44	0.00	0.00	0.00	0.14	0.60	0.00	0.00	1.06	0.19	0.37	0.14	0.65	99.72	99.72	0.0
80300020102	Mulkey Creek-South Fork Kern River	34	1348.3	0	1	0	0	0	0.83	0.67	0.49	0.00	0.00	0.00	0.07	0.50	0.00	0.00	1.02	0.18	0.37	0.21	0.66	99.98	99.96	0.0
80300020103	Soda Creek-South Fork Kern River	39	491.1	0	1	0	0	0	0.87	0.73	0.59	0.00	0.00	0.19	0.42	0.50	0.00	0.00	0.99	0.13	0.35	0.32	0.57	99.07	64.98	34.0
80300020104	Snake Creek-South Fork Kern River	16	9487.3	0	1	0	0	0	0.93	0.55	0.60	0.00	0.00	0.09	0.64	0.50	0.00	0.00	0.97	0.07	0.34	0.39	0.42	99.86	63.24	36.6
80300020201	Lost Creek-South Fork Kern River	8	383.3	0	1	0	0	0	0.95	0.68	0.56	0.00	0.00	0.10	0.70	0.50	2.00	0.00	0.97	0.03	0.33	0.22	0.22	99.99	99.50	0.4
80300020202	Long Canyon	1	3.9	0	1	0	0	0	0.68	0.90	0.74	0.00	0.00	0.80	0.79	0.50	11.00	1.00	0.96	0.11	0.33	0.24	0.05	69.60	44.31	25.5
80300020203	Fish Creek	31	790.7	0	1	0	0	0	0.86	0.58	0.84	0.00	0.00	1.30	0.75	0.50	4.00	0.17	0.98	0.06	0.33	0.45	0.28	98.80	21.27	77.5
80300020204	Trout Creek	25	151.3	0	1	0	0	0	0.87	0.79	0.54	0.00	0.00	0.43	0.67	0.60	0.00	0.00	0.98	0.05	0.32	0.48	0.27	100.00	57.80	42.2
80300020205	Pine Creek-South Fork Kern River	9	76.6	0	1	0	0	0	0.59	0.84	0.87	0.00	0.00	0.66	0.77	0.40	7.00	2.28	0.96	0.10	0.32	0.19	0.05	90.19	57.61	32.6
80300010301	Alpine Creek	18	104.1	0	0	1	0	0	0.78	0.83	0.62	0.00	0.00	0.02	0.53	0.63	0.00	0.00	1.10	0.19	0.36	0.16	0.36	99.11	97.17	0.9
80300010302	Upper Little Kern River	37	195.8	0	0	1	0	0	0.78	0.89	0.46	0.00	0.00	0.00	0.45	0.63	0.00	0.00	1.17	0.19	0.37	0.03	0.65	99.67	96.81	0.0
80300010303	Lower Little Kern River	44	318.5	0	0	1	0	0	0.80	0.80	0.75	0.00	0.00	0.26	0.72	0.63	1.00	0.00	1.02	0.17	0.35	0.42	0.38	99.62	84.96	14.6
80300010101	Kern-Kaweah River	63	593.5	0	0	0	1	0	0.92	0.86	0.32	0.00	0.00	0.00	0.14	0.80	0.00	0.00	1.43	0.22	0.42	0.03	0.56	99.98	99.98	0.0
80300010201	Upper Big Arroyo	91	639.8	0	0	0	1	0	0.94	0.80	0.35	0.00	0.00	0.00	0.32	0.80	0.00	0.00	1.42	0.21	0.41	0.02	0.73	100.00	100.00	0.0
80300010203	Chagoopa Creek-Kern River	60	270.3	0	0	0	1	0	0.95	0.72	0.35	0.00	0.00	0.00	0.33	0.80	0.00	0.00	1.28	0.21	0.40	0.04	0.59	99.18	99.96	0.0
80300010403	Rattlesnake Creek	22	319.9	0	0	0	1	0	0.75	0.86	0.74	0.00	0.00	1.08	0.84	0.57	2.00	0.00	1.01	0.10	0.33	0.52	0.38	99.42	0.72	98.7
80800030101	Headwaters Pine Creek	10	158.3	0	0	0	0	2	0.67	0.31	0.79	0.00	0.00	1.76	0.70	0.40	0.00	0.52	1.34	0.29	0.95	0.59	0.85	85.13	21.90	63.2
80800030102	Martin Creek	8	214.6	0	0	0	0	2	0.77	0.20	0.94	0.00	0.00	2.02	0.83	0.25	0.00	0.00	1.26	0.41	0.96	0.75	0.74	62.00	0.00	62.0
80800030103	Pine Creek Valley-Pine Creek	18	8780.8	0	0	0	0	1	0.64	0.11	0.92	0.00	0.00	1.77	0.82	0.33	2.00	1.12	1.27	0.35	0.95	0.70	0.80	87.45	0.00	87.4
80800030201	Harvey Valley	15	610.5	0	0	0	0	2	0.80	0.16	0.92	0.00	0.00	1.85	0.84	0.40	0.00	0.00	1.35	0.34	0.96	0.68	0.79	100.00	0.00	100.0
80800030202	Squaw Valley-Pine Creek	14	1130.9	0	0	0	0	1	0.80	0.13	0.90	0.00	0.00	1.46	0.78	0.33	0.00	0.00	1.30	0.41	0.96	0.73	0.76	94.84	0.00	94.8
80800030203	Bullard Lake	20	963.6	0	0	0	0	2	0.85	0.14	0.96	0.00	0.00	1.63	0.84	0.50	0.00	0.00	1.34	0.38	0.96	0.77	0.69	57.98	0.00	57.9
80800030204	Champs Flat-Pine Creek	12	88.3	0	0	0	0	1	0.85	0.12	0.95	0.00	0.00	1.62	0.84	0.33	1.00	0.00	1.34	0.40	0.96	0.76	0.71	95.34	0.00	95.3
80800030301	Antelope Valley-Pine Creek	16	244.7	0	0	0	0	1	0.61	0.16	0.95	0.00	0.00	1.84	0.86	0.33	0.00	0.87	1.31	0.37	0.96	0.73	0.68	99.87	0.00	99.8
80800030305	Merrill Creek-Frontal Eagle Lake	11	338.7	0	0	0	0	1	0.57	0.33	0.91	0.00	0.00	1.86	0.79	0.20	8.00	0.50	1.28	0.36	0.96	0.72	0.66	13.72	5.92	7.8

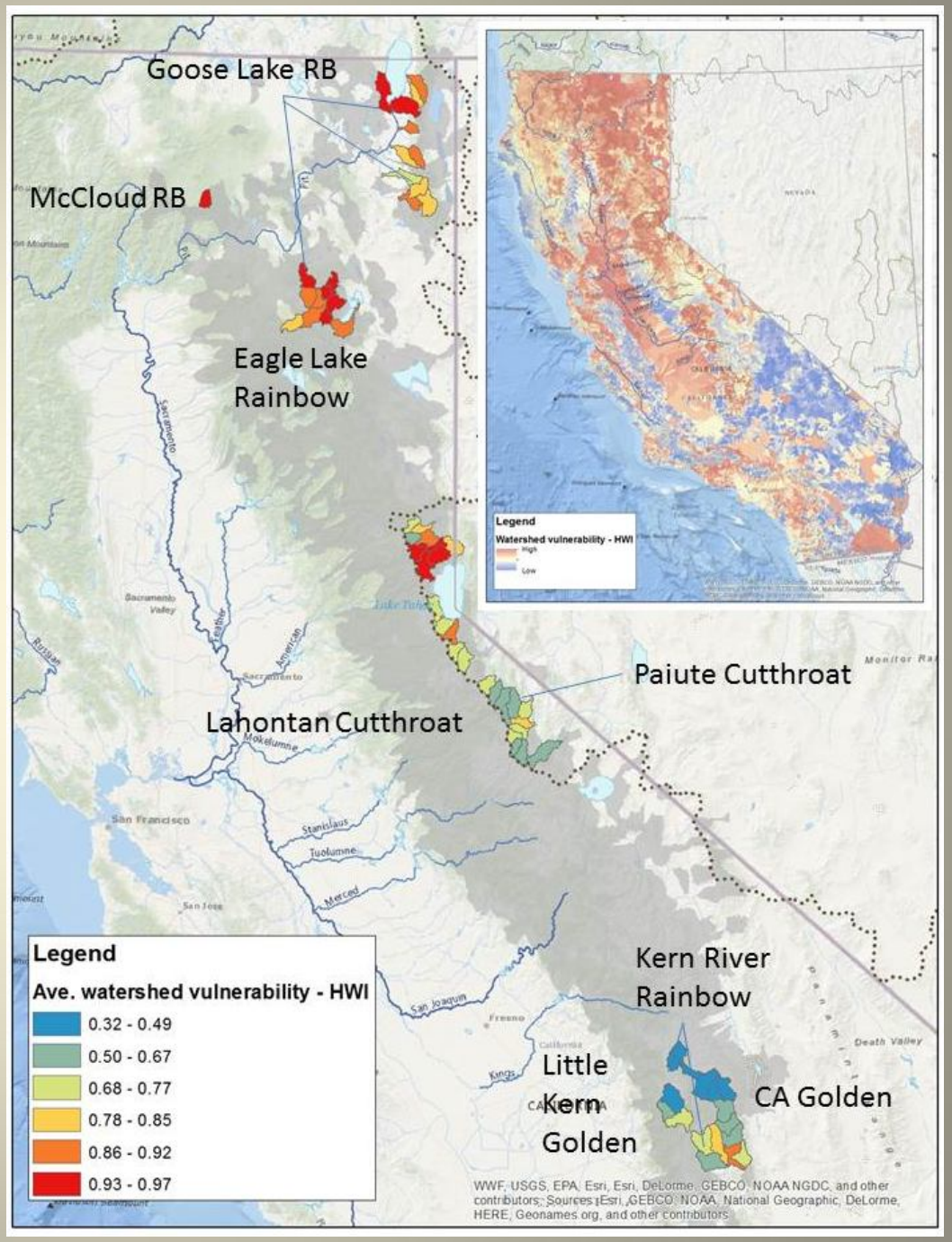
Needs and Opportunities

- Process:
  - **Step 1**: Isolates subwatersheds (HUC12s) with meadows and sensitive fish species
  - **Step 2**: Review landscape scale indicators for watershed condition, vulnerability, etc.
  - **Step 3**: Select high opportunity watersheds/ meadows for a given fish species and identify the appropriate management response based on the relationship between heath and vulnerability
    - Vulnerable, Low Health => **Restore** ecological condition, monitor threats
    - Vulnerable, High Health => **Mitigate** threats and protect existing values
    - High Health, low Vulnerability => **Protect** existing values, monitor threats
    - Low Health, low vulnerability => **Restore** ecological condition, **mitigate** threats
  - **Step 4**: Review limiting factors for fish species to determine nexus with meadow restoration opportunities
  - **Step 5**: Identify a) Fish-Meadow opportunity locations and response metrics, b) Other (non-meadow) fish opportunities and response metrics

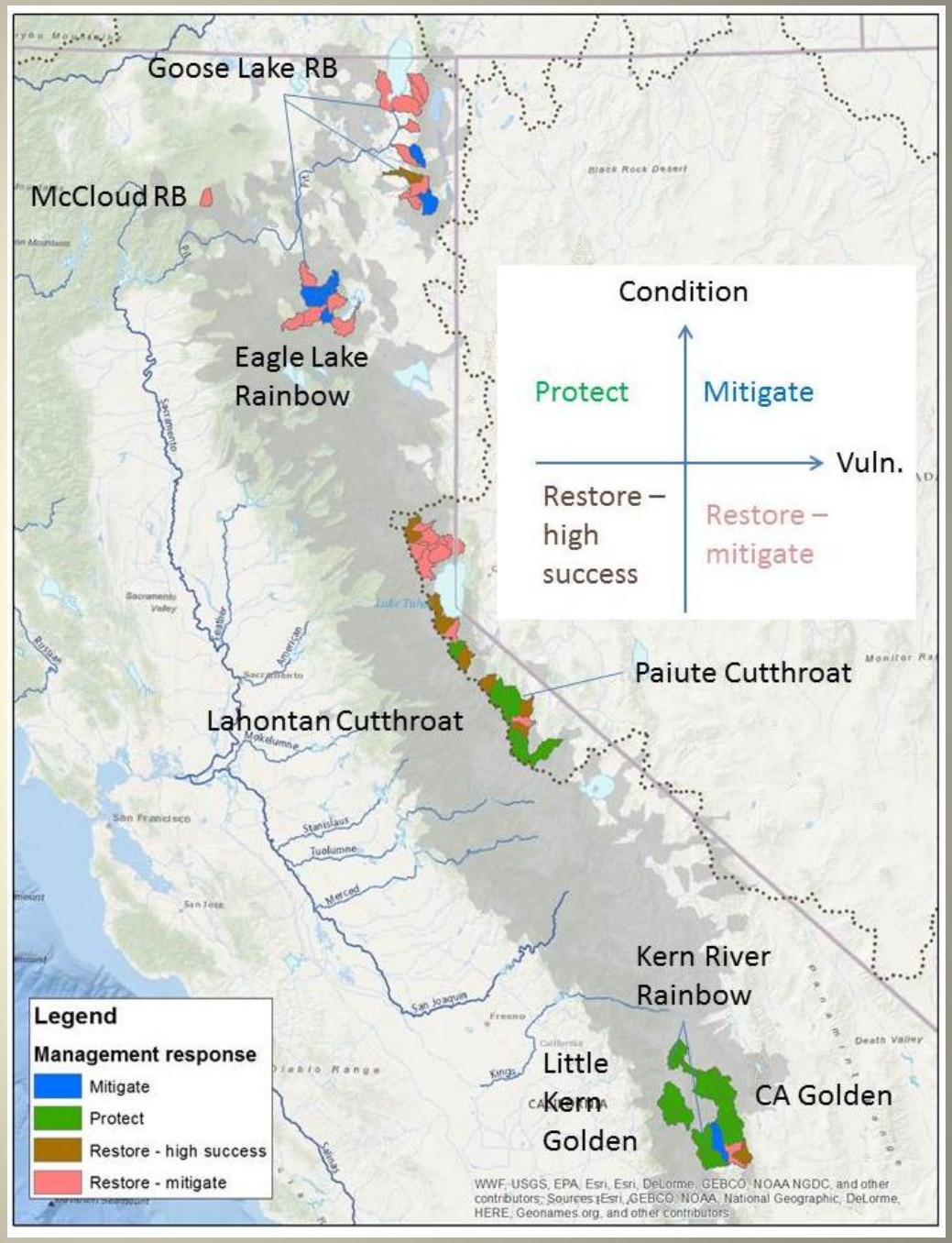
CA Native Trout: Subwatershed Condition



CA Native Trout: Subwatershed Vulnerability



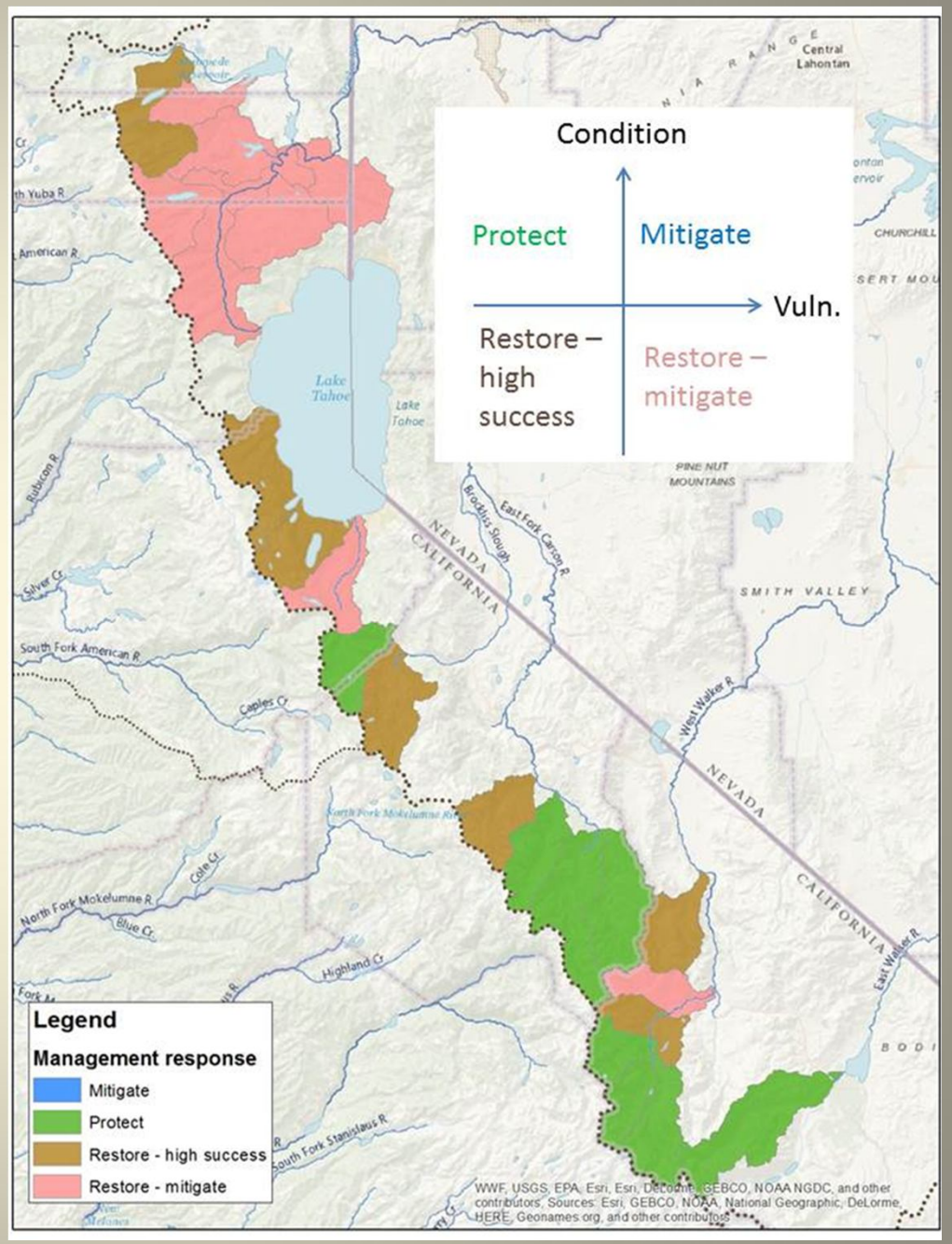
CA Native Trout: Subwatershed Response



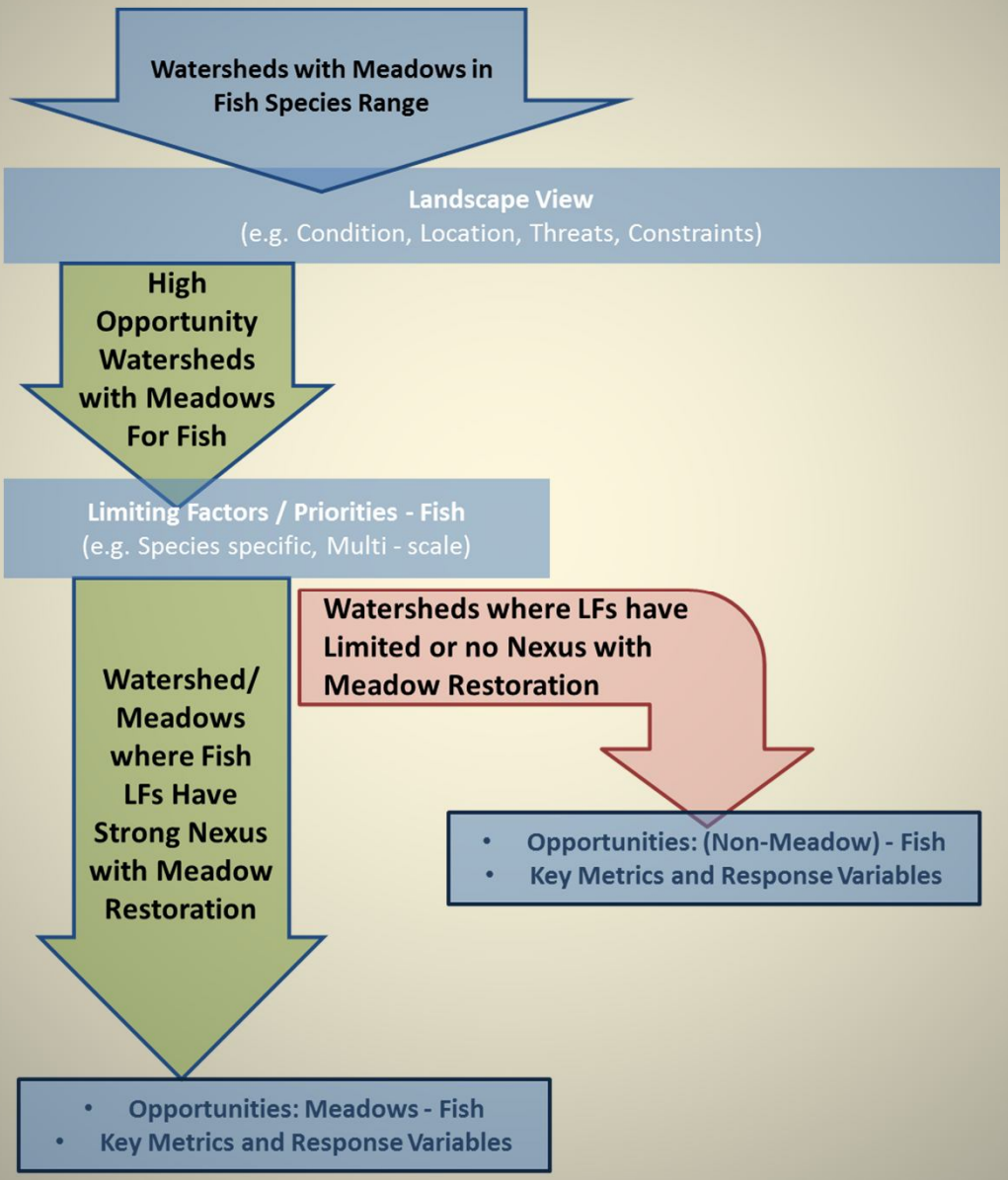
Needs and Opportunities

- Products:
  - **High priority meadow sites** to reduce limiting factors for fish and associated response metrics.
  - **Other high priority needs for fish**, specific to species and geography and unlikely to be achieved through meadow restoration
  - **Vulnerable/ impacted meadows with low nexus between meadow restoration and LFs for fish** (for comparison with other species priorities/ LFs)

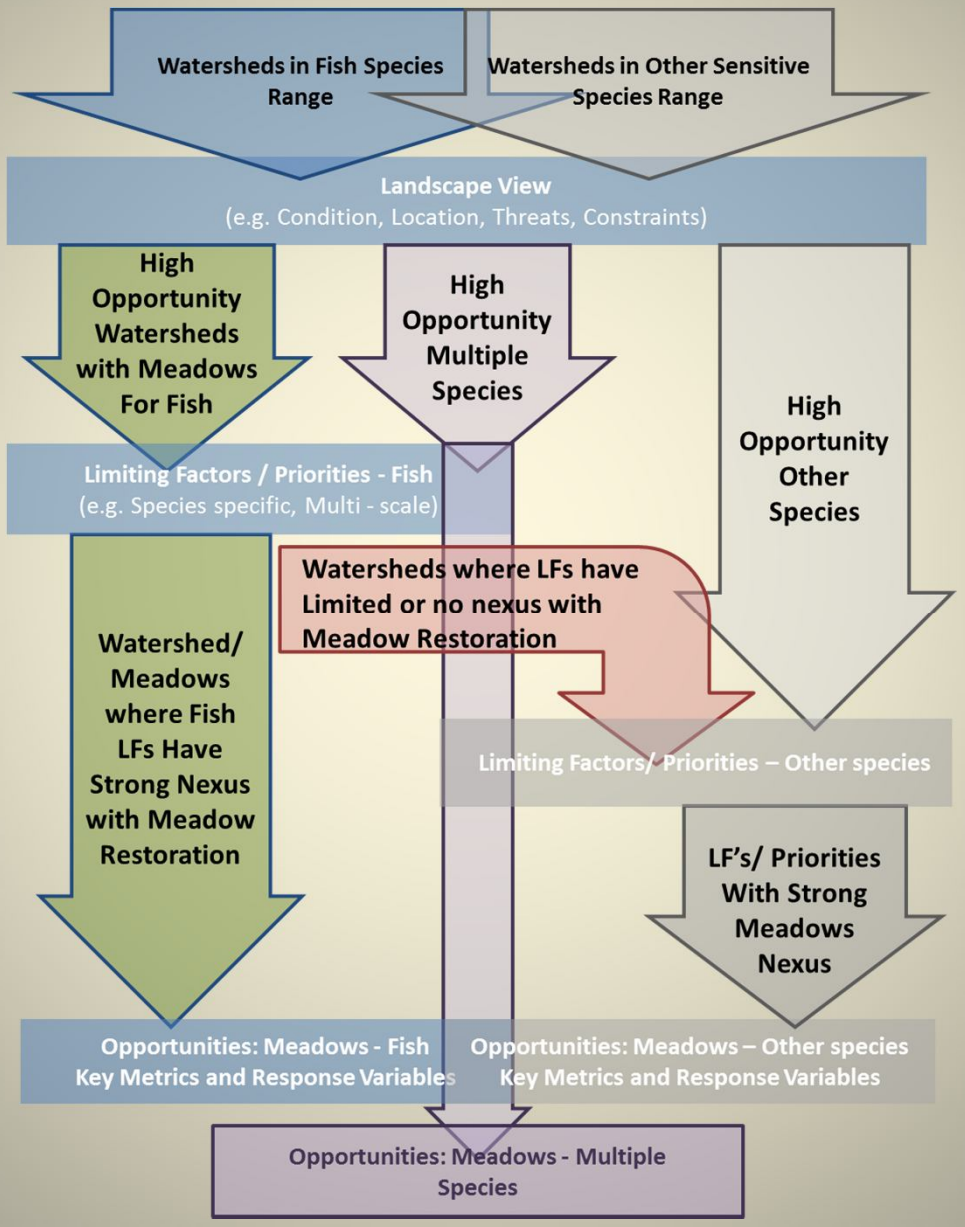
LCT: Subwatershed Response



Process Overview (Fish)



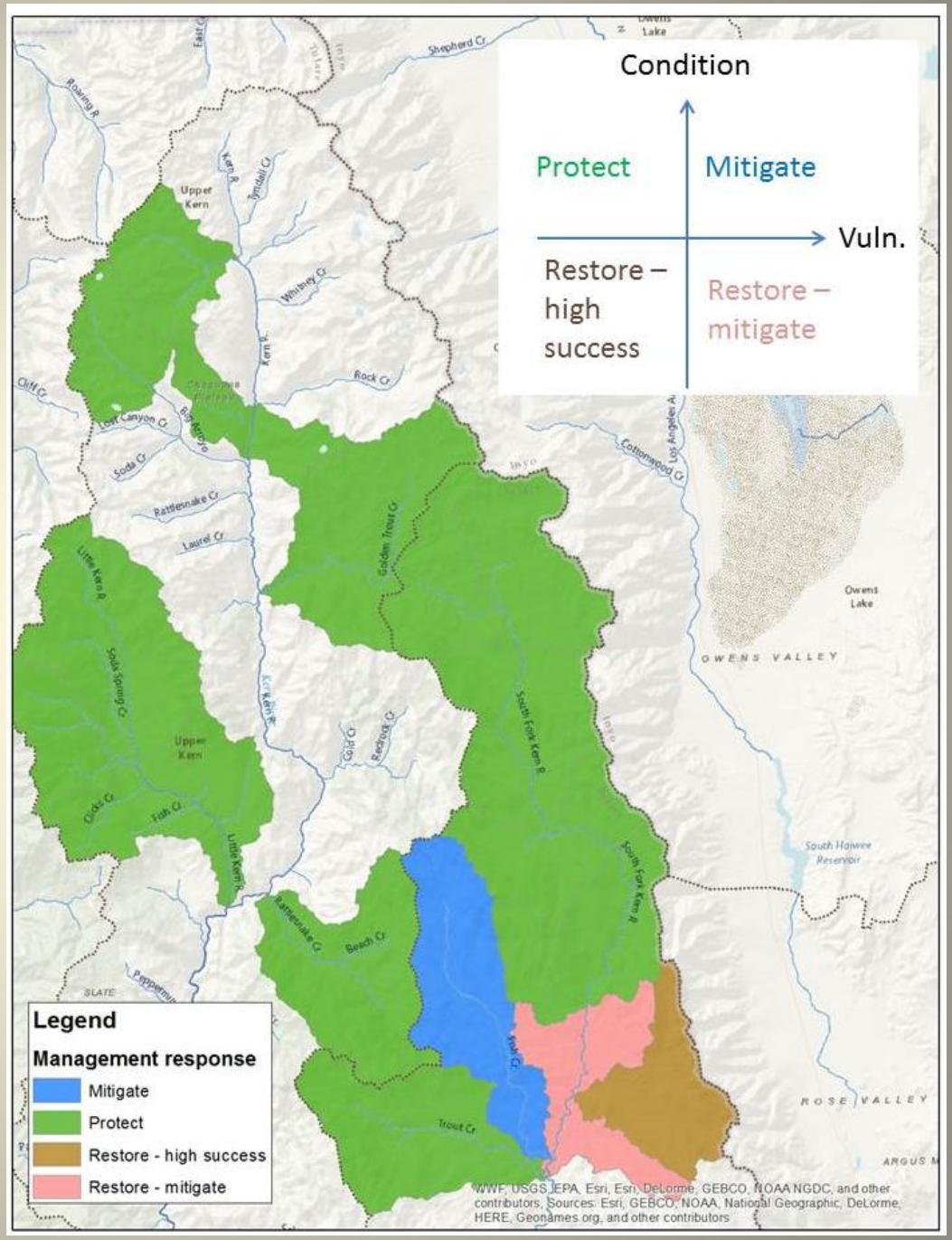
Process Overview (Multi-species)



Prioritization

- **Goals and objectives**
  - Regional/ organizational priorities
  - Desired conditions
- **Baseline habitat and species condition**
  - Assessments and Metrics
  - Meadows Scorecard
- **Threats**
- **Restoration/ remediation opportunities**
  - Measures of success
  - Adaptive management triggers

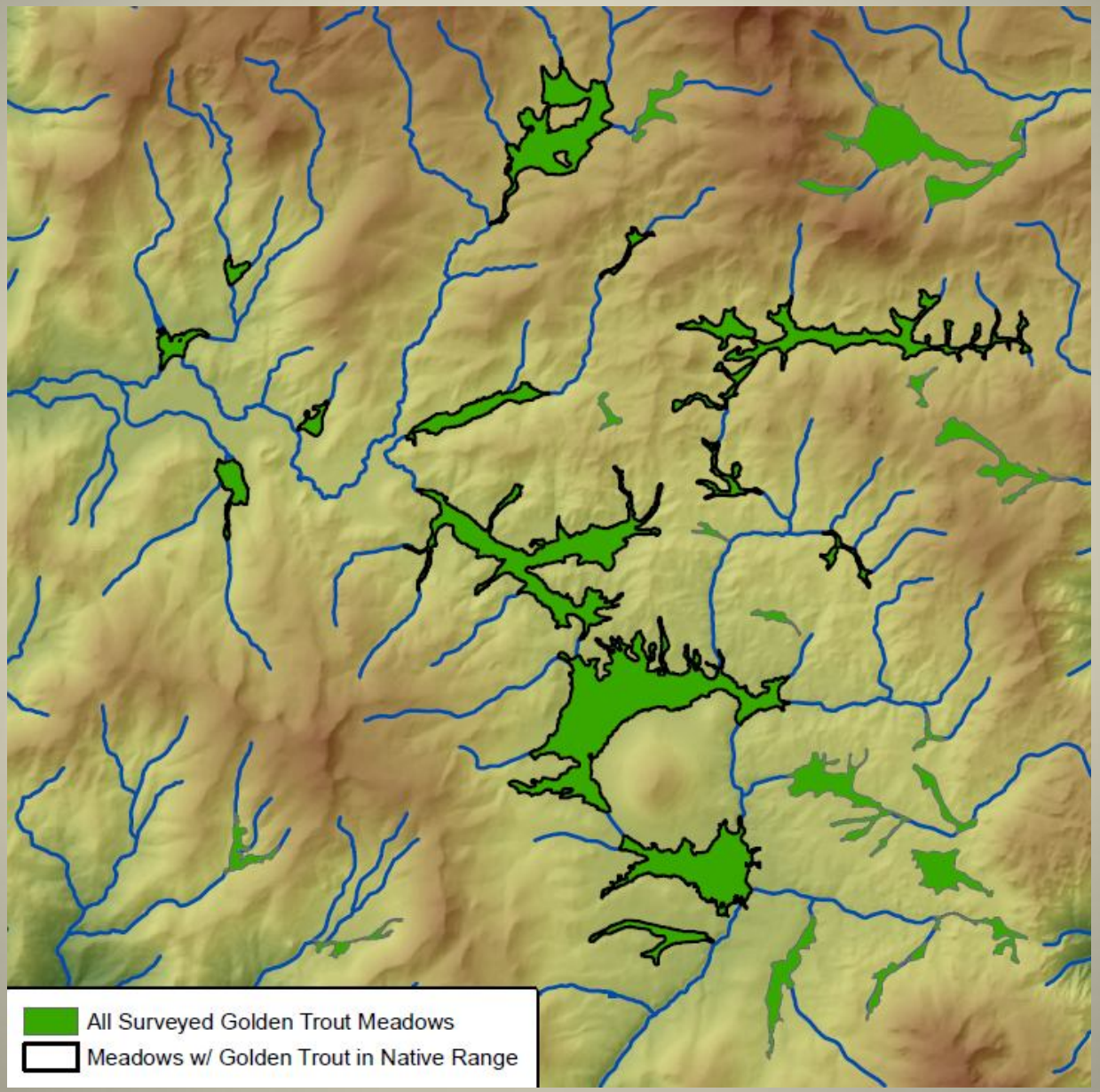
Kern Species: Subwatershed Response



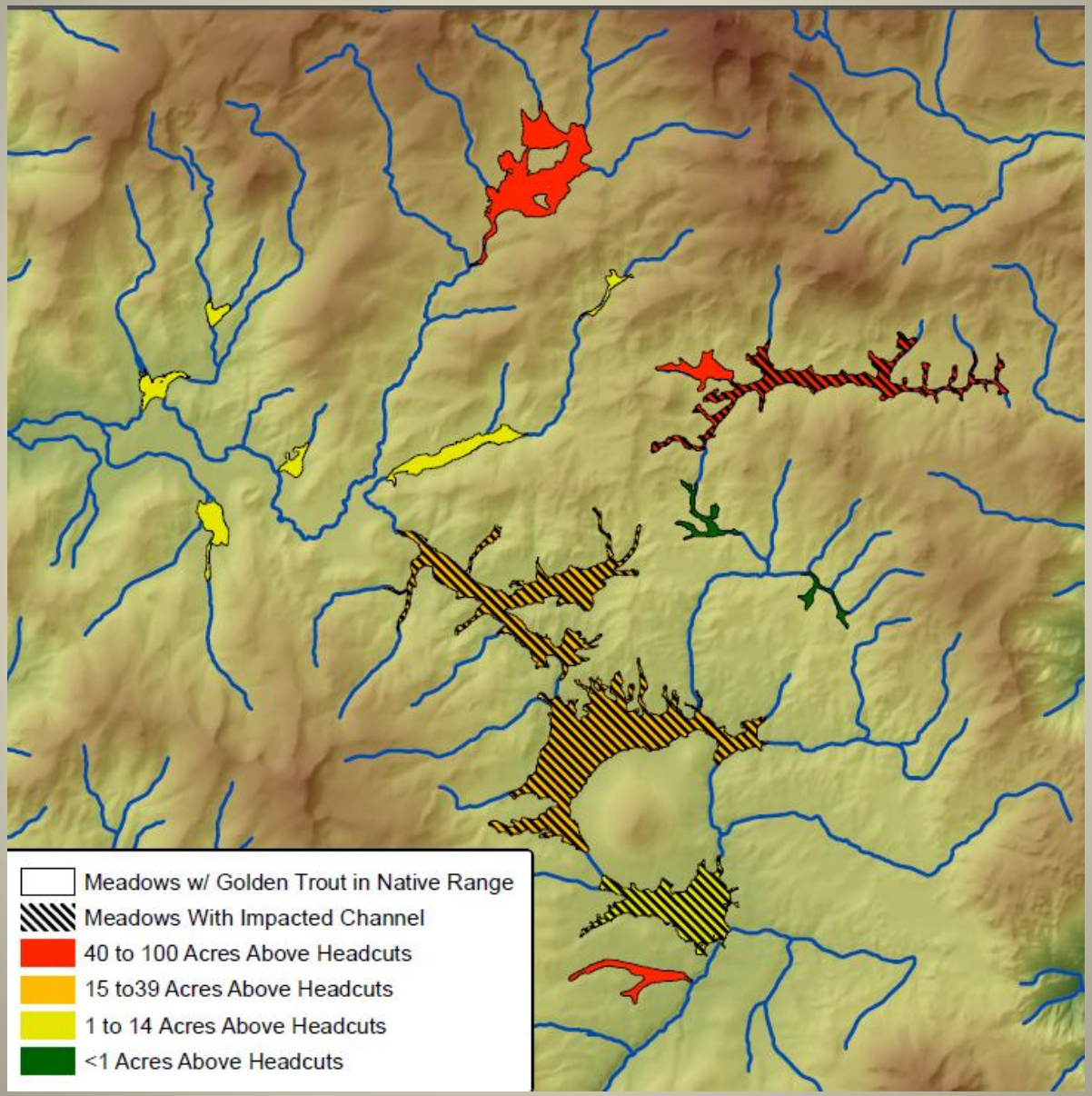
Kern Species: Limiting Factors

Species	Primary Limiting Factors	Potential metric for LF resolution
California Golden Trout	Climate Vulnerability and Threats (Fire, loss of Snow Pack, Sedimentation)	Stream Miles/ Acres enhanced to provide climate refugia (Miles/ acres within subwatewrshed thinned/ treated for fire; Miles of veg and hydrologic function restored)
	Non-native trout or hybrids present within subwatersheds/subbasins	Stream Miles Treated via exclusion or removal
Kern River Rainbow Trout	Adequate Flow and flow associated habitat extent	Stream Miles/ Acres enhanced to increase magnitude and duration of flow; promote water retention in the landscape)
	Climate vulnerability (Drought; Fire)	Stream Miles/ Acres enhanced to provide climate refugia (Miles/ acres within subwatewrshed thinned/ treated for fire; Miles of veg and hydrologic function restored)
Little Kern Golden Trout	Habitat patch size(s) sufficient to support viable populations	Stream Miles/ Acres enhanced to expand habitat patch size; increase magnitude and duration of flow; promote water retention in the landscape)
	Climate vulnerability (Drought; Fire)	Stream Miles/ Acres enhanced to provide climate refugia (Miles/ acres within subwatewrshed thinned/ treated for fire; Miles of veg and hydrologic function restored)

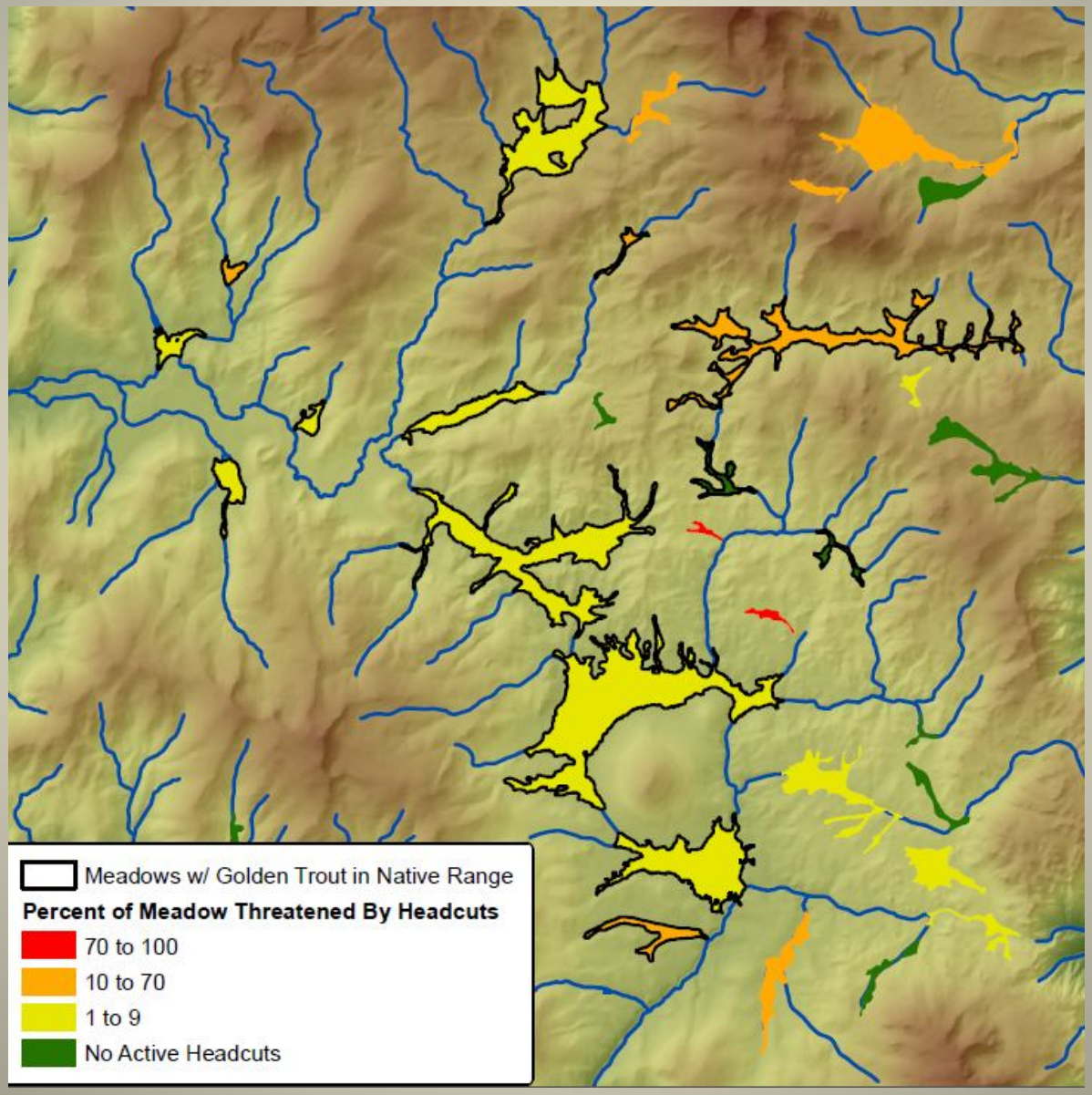
Kern Plateau: Meadows & CGT Species Distribution



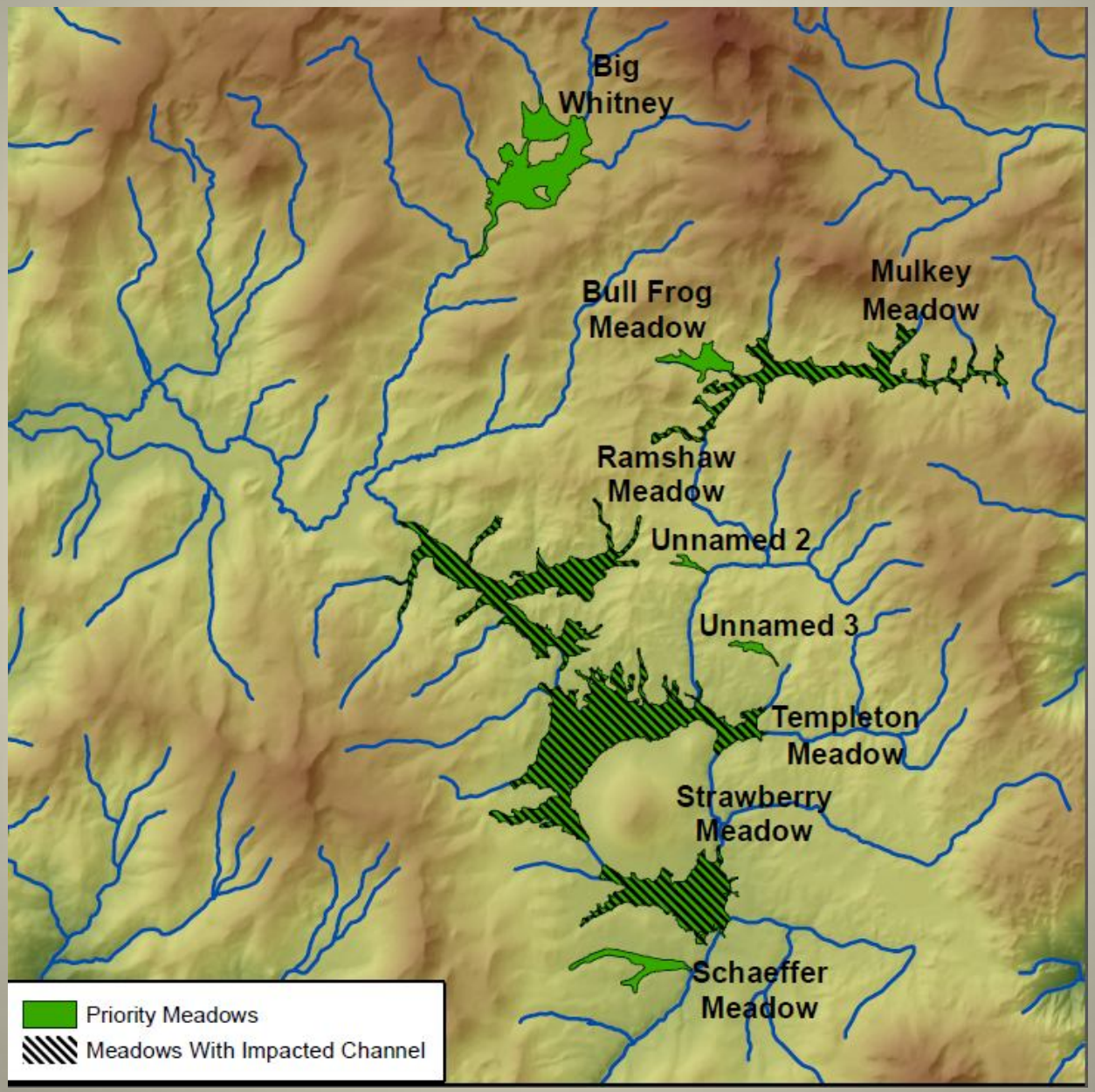
Kern Plateau: Meadows with Condition Overlay



Kern Plateau: Meadows Threatened by Head-cut



Kern Plateau: Restoration Priorities



Implementation

- **Alignment Criteria**
  - Assesses the relative degree of project feasibility and implementability based on the extent of alignment with existing regional, programmatic, regulatory, or funding priorities.

Implementation

- Alignment Criteria – ***Species Priorities & Plans***
  - CA State Wildlife Action Plan?
  - Species recovery plan or Conservation Strategy?
  - Regional Integrated Regional Water Management Plan(s)?
  - Regional Water Control Board Basin Plan(s)?
  - County General Plans?
  - Other?

Implementation

- Alignment Criteria – ***Support (agency, Landowner, Stakeholder)***
  - **Necessary approvals** via permits or otherwise, to implement & complete your proposed project?
  - Do you have a **Letter of Support** for your proposed project from an agency with management authority relevant to the target area (meadow) or species?
  - **Committed required resources** (staff, financial etc) necessary to ensure your project will be completed as presented?
  - **Other Letters of Support** for your project from sources other than direct partners or agencies?

Acknowledgements

- American Rivers
- CalTrout
- TNC
- UC Davis
- UC Merced
- USFS