# Climate change/land use change scenarios for assessing threats to ecosystem services on California rangelands

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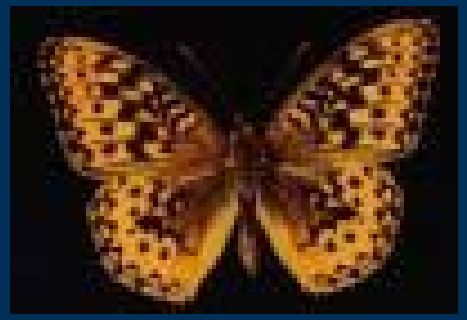
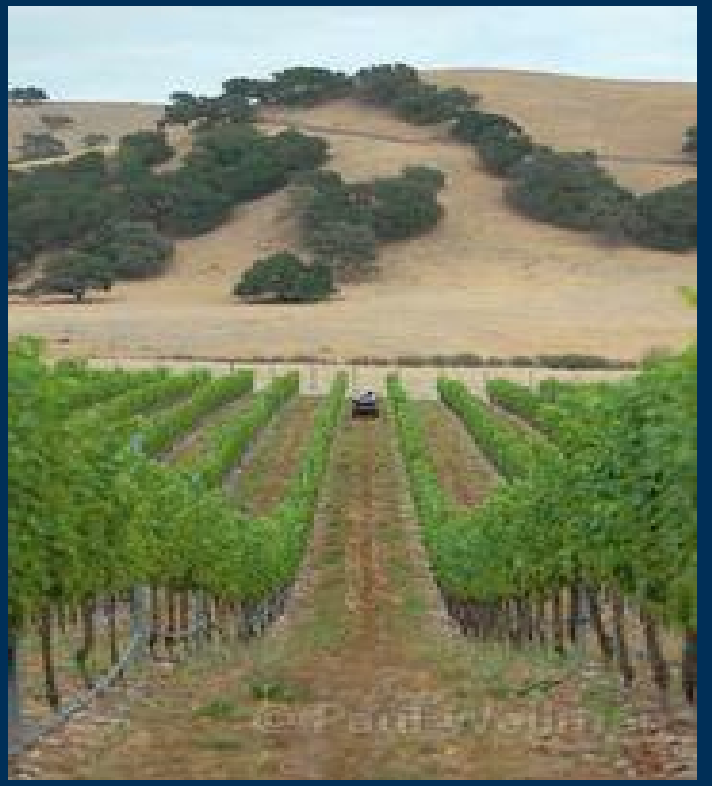
# Ecosystem Services provided by Rangelands

- Food, fiber and fuel
- Wildlife habitat
- Water
- Carbon sequestration
- Adaptation to climate change
- Open space, cultural values

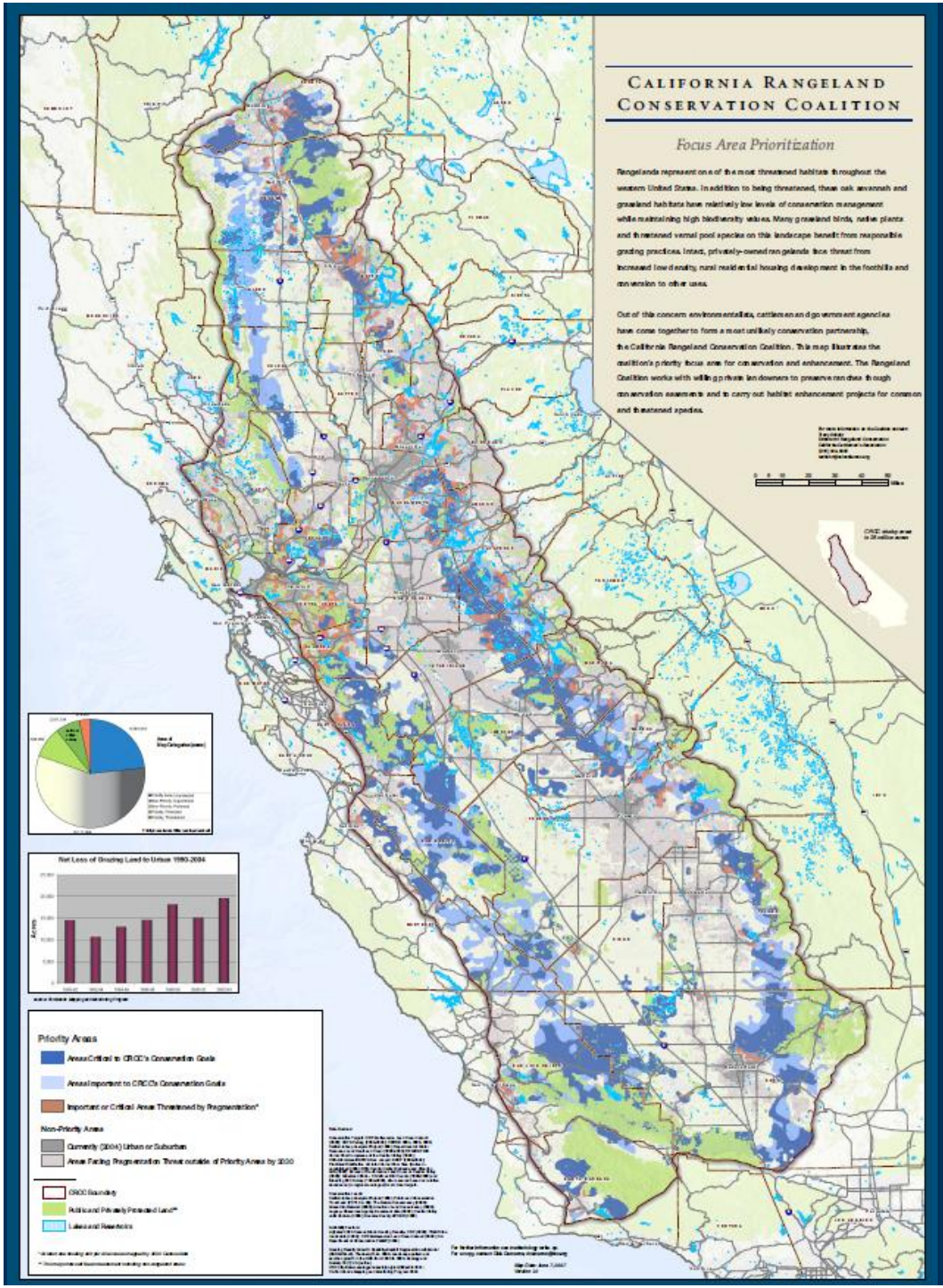


# Integrated Threats to Rangelands

- In California 20,000 acres of rangelands are lost every year
- Privately owned
- Cattle ranching: low profits
- Low levels of protection



Land conversion and climate change lead to loss of grazing land, water availability, and altered species distribution




# Rangeland Coalition Focus Area Map (TNC, 2007)

http://www.carangeland.org/focusarea.html

Dark blue: Critical Conservation Areas

(Privately-owned rangelands that have high biodiversity value and require conservation action in the next 2-10 years.)

Funded by California Landscape Conservation Cooperative

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# Project Goals

- Six spatially-explicit climate change/land use change scenarios from years 2000 – 2100 consistent with three IPCC emission scenarios and two climate models –

**A2, B1, and A1B and**

**PCM (warm, wet future), GFDL (hot, dry future)**

- Assess potential threats to rangeland ecosystem services
    1. wildlife habitat,
    2. water availability, (runoff/recharge) (Lorraine Flint and Alan Flint, USGS)
    3. carbon sequestration

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# Project Goals, continued

3. An economic analysis of scenarios to quantify economic costs and benefits and identify where ecosystem services can be optimized (Frank Casey, USGS)
4. A web-based visualization tool for resource managers to view and compare scenarios in a map format, and
5. An outreach program that will target the Rangeland Coalition network to communicate how results can be applied to conservation and land management decisions. (Pelayo Alvarez, Defenders of Wildlife)

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# Driving Force Assumptions for the United States based on IPCC Emission Scenarios

(table adapted from Ben Sleeter, USGS)

| | A2 | A1B | B1 |
|---|---|---|---|
| **DEMOGRAPHICS** | High growth, sprawl | Medium growth, sprawl | Medium growth, densification |
| **ECONOMICS** | Medium Income | Very High Income | High Income |
| **TECHNOLOGY** | Low rate of innovation | Very High rate of innovation | High rate of innovation |
| **ENERGY** | Fossil fuel intensive | Balanced between several sources | Rapid diffusion of “green” energy resources |
| **CLIMATE** | VERY HOT temperature range: 3.4 °C; 2.0 – 5.4°C | HOT temperature range: 2.8 °C; 1.7 – 4.4 °C | WARM temperature range: 1.8 °C; 1.1 – 2.9°C |
| **ENVIRONMENTAL PROTECTION** | Conservation lower priority | Mixed-use based conservation | Conservation high priority |

# Scenario Narratives for CA Rangelands

Rancher's Focus Group, January 2012, Davis CA

<u>Key Concerns about ranching future:</u>

- Limited availability of grazing land for lease
- Fragmentation of grazing land
- Forage quality and quantity
- High start-up investment

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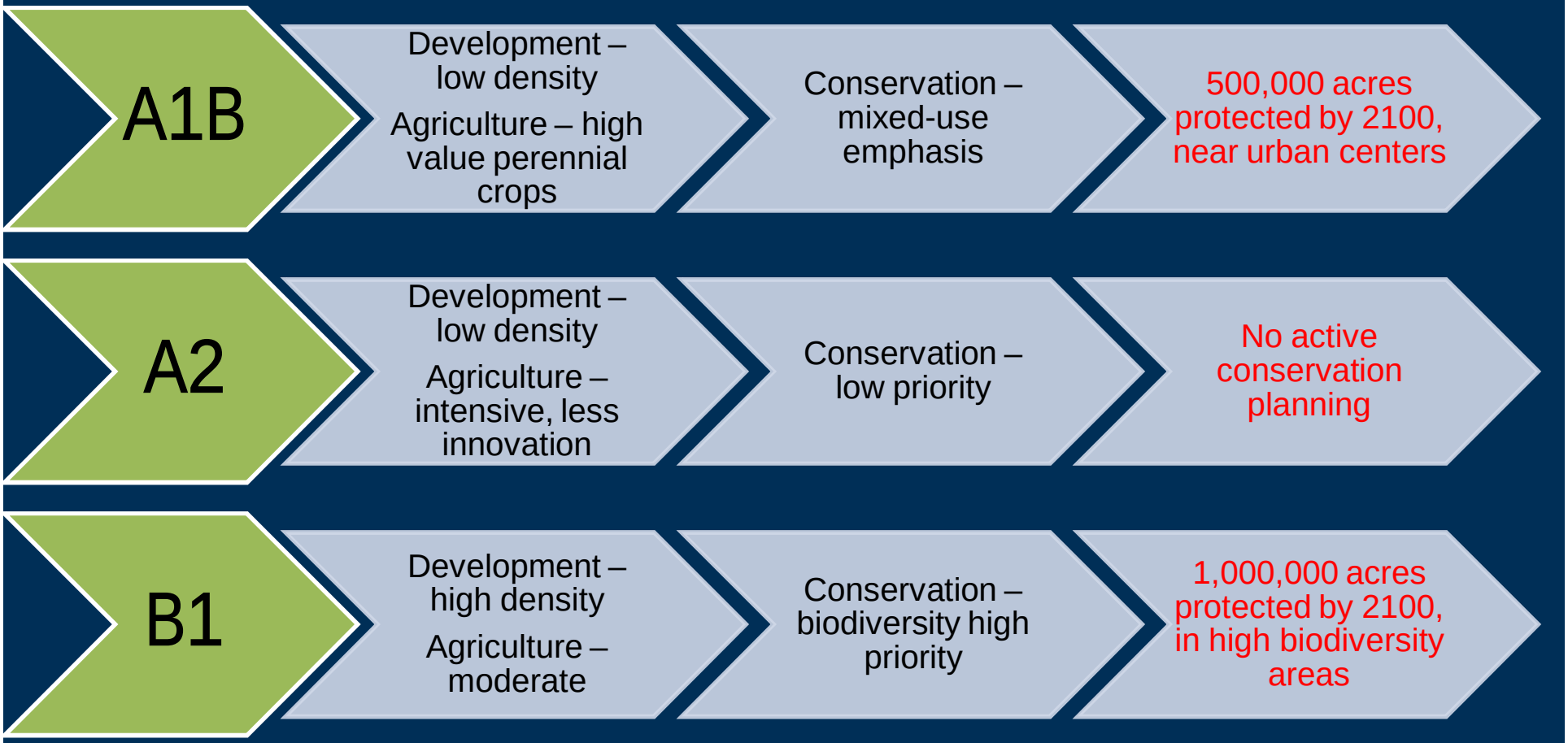
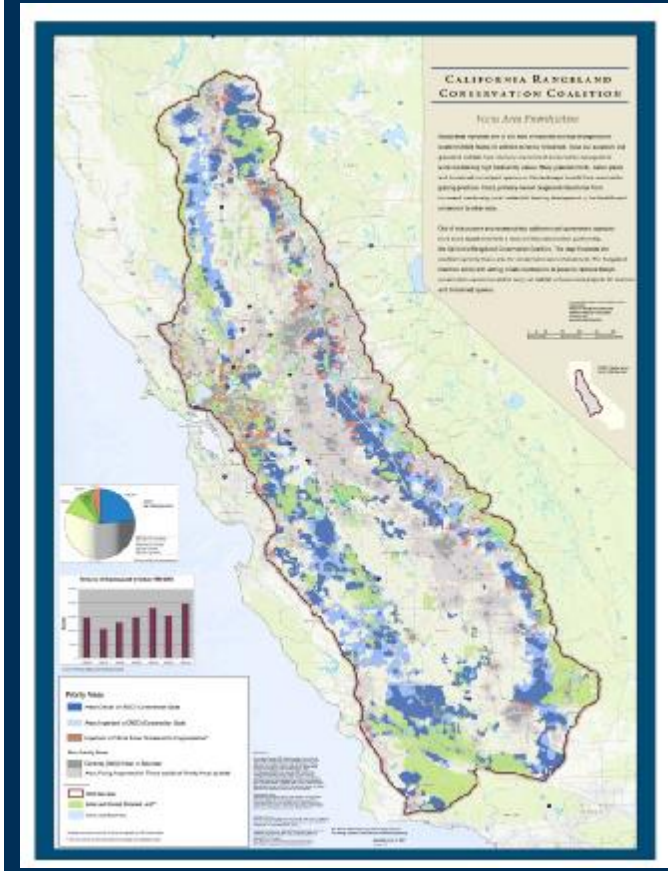
# Scenario Narratives for CA Rangelands

## – Alternative conservation plans



# Integrated Scenarios



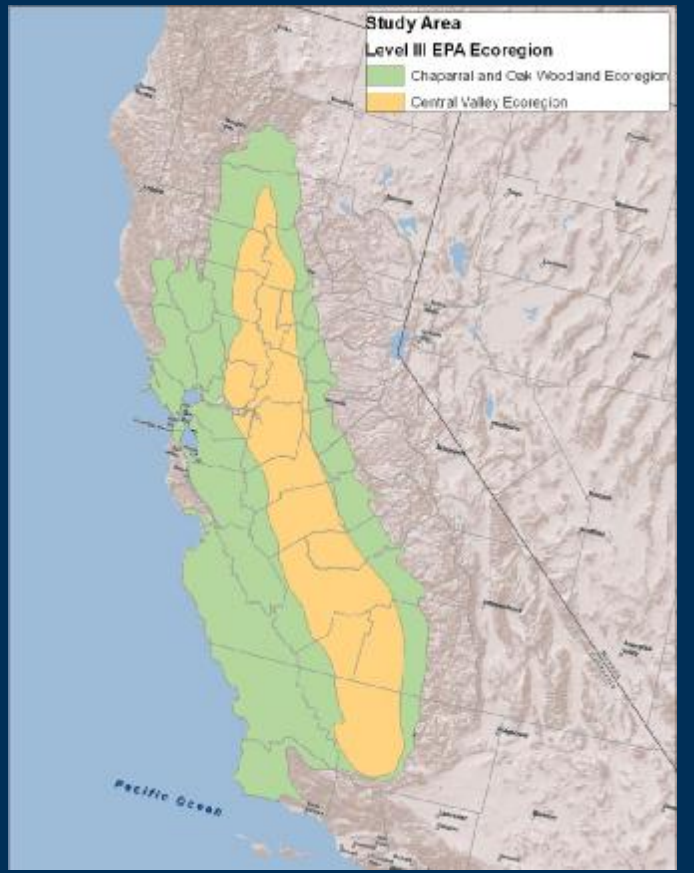

California Rangeland Conservation Coalition Focus Area

Three IPCC scenarios
A1B, A2, B1
Two climate models
PCM, GFDL

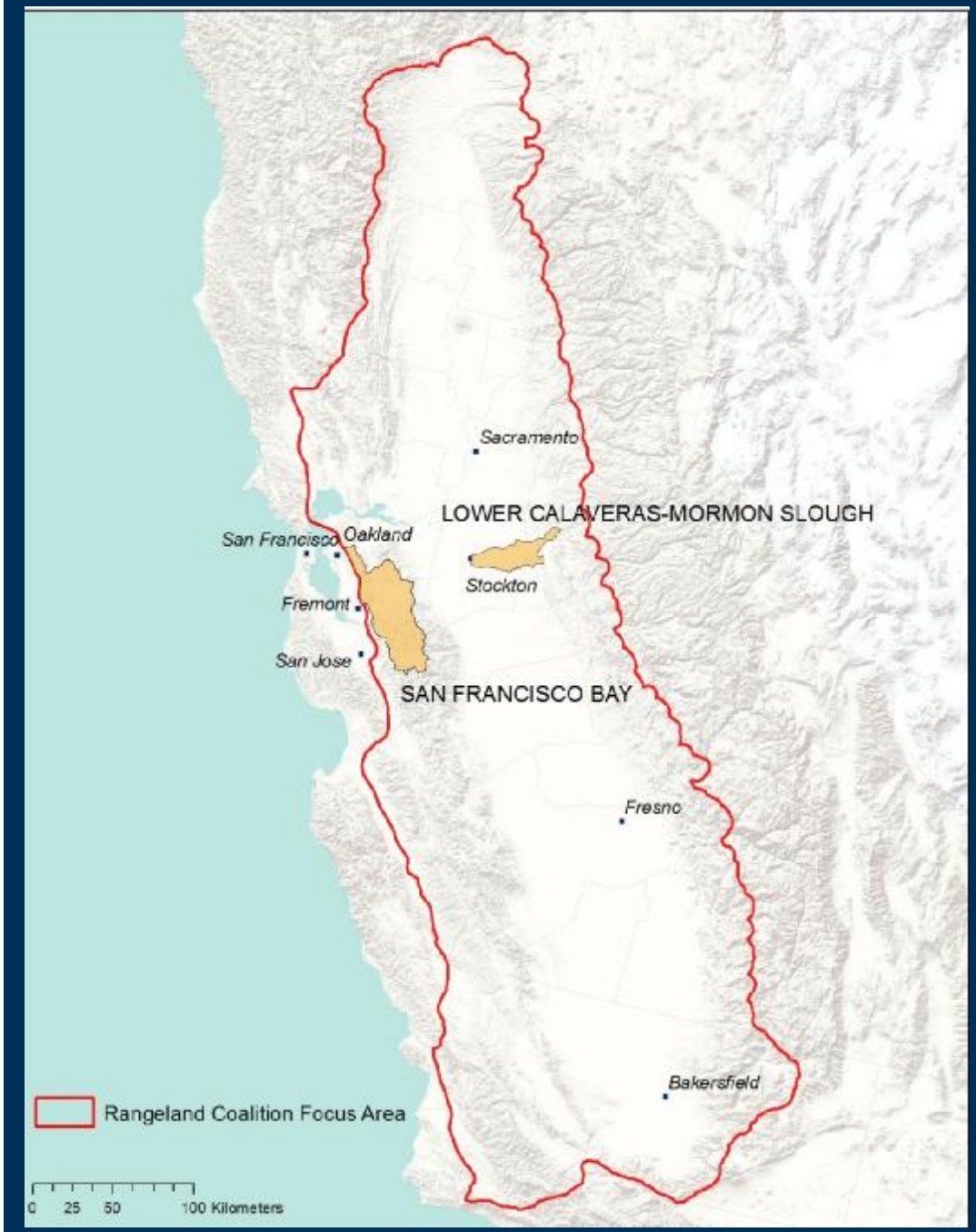
Land use/land cover change +

Climate/hydrology decadal change

Maps by scenario/year to 2100 at ~250 meter resolution




EPA Level III Eco-regions:
Central Valley and
Chaparral and Oak Woodlands




## Case Study of Two Watersheds:

SF Bay-Alameda Creek

Calaveras-Mormon Slough

Habitat, Water, and Carbon

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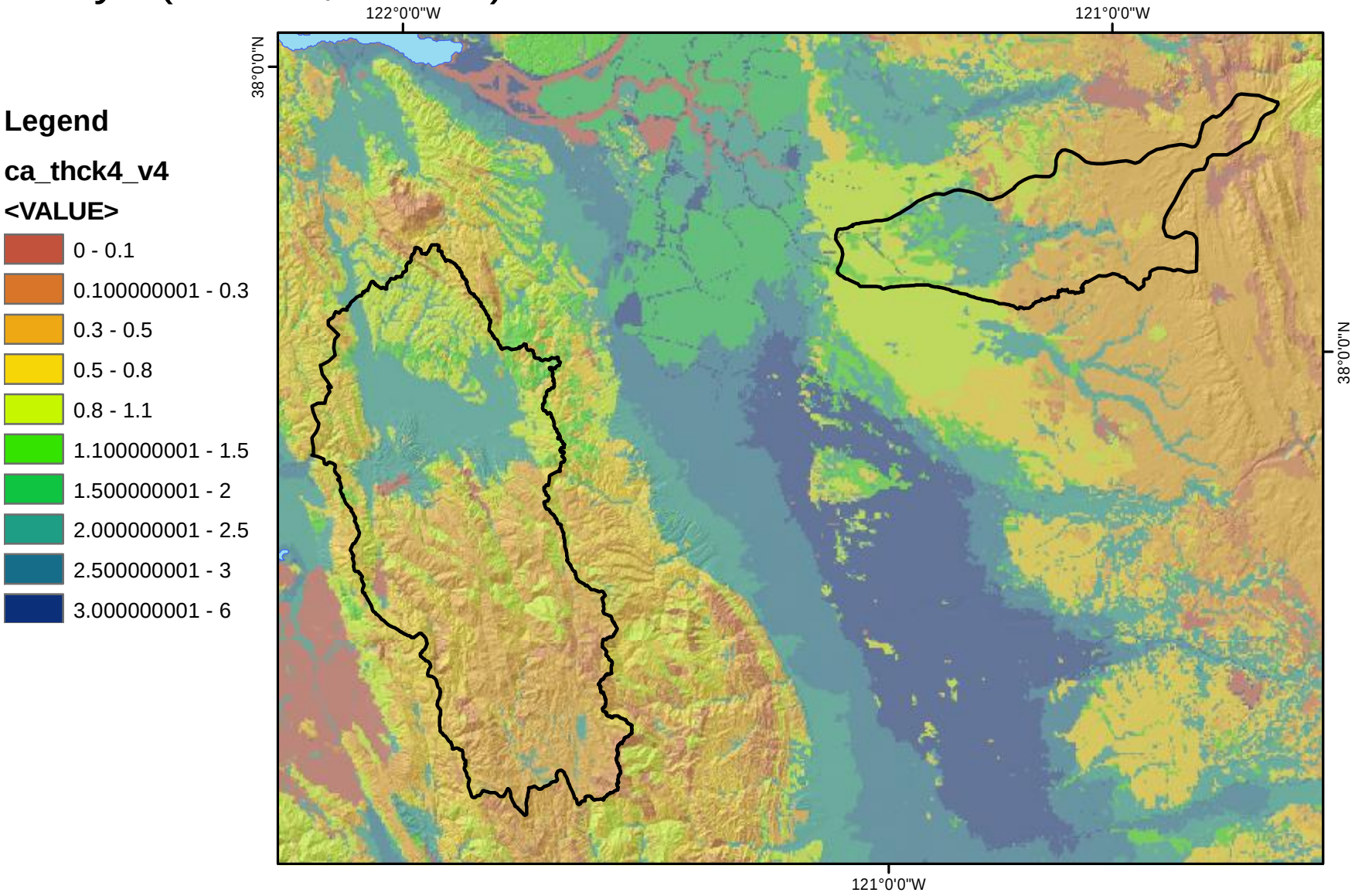
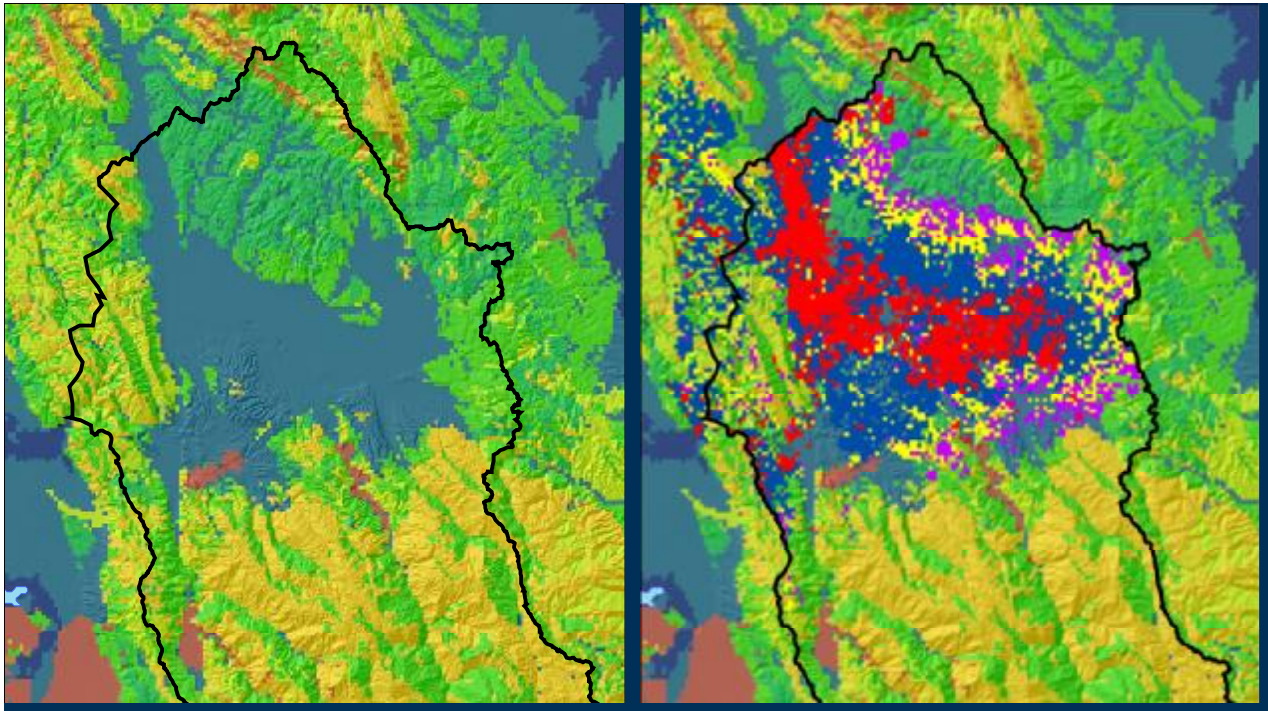
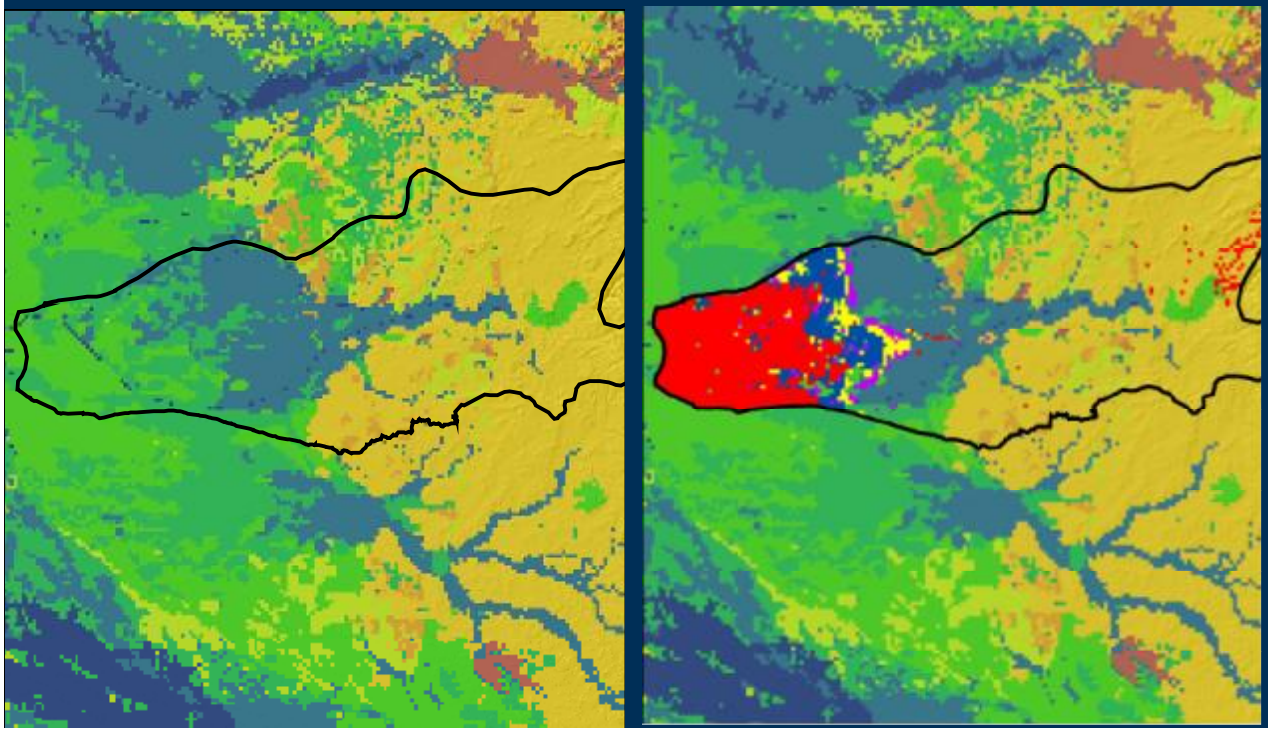
# Soil water storage affected by porosity and depth – New soil thickness dataset – SSURGO county-level soil surveys (L. Flint, USGS)



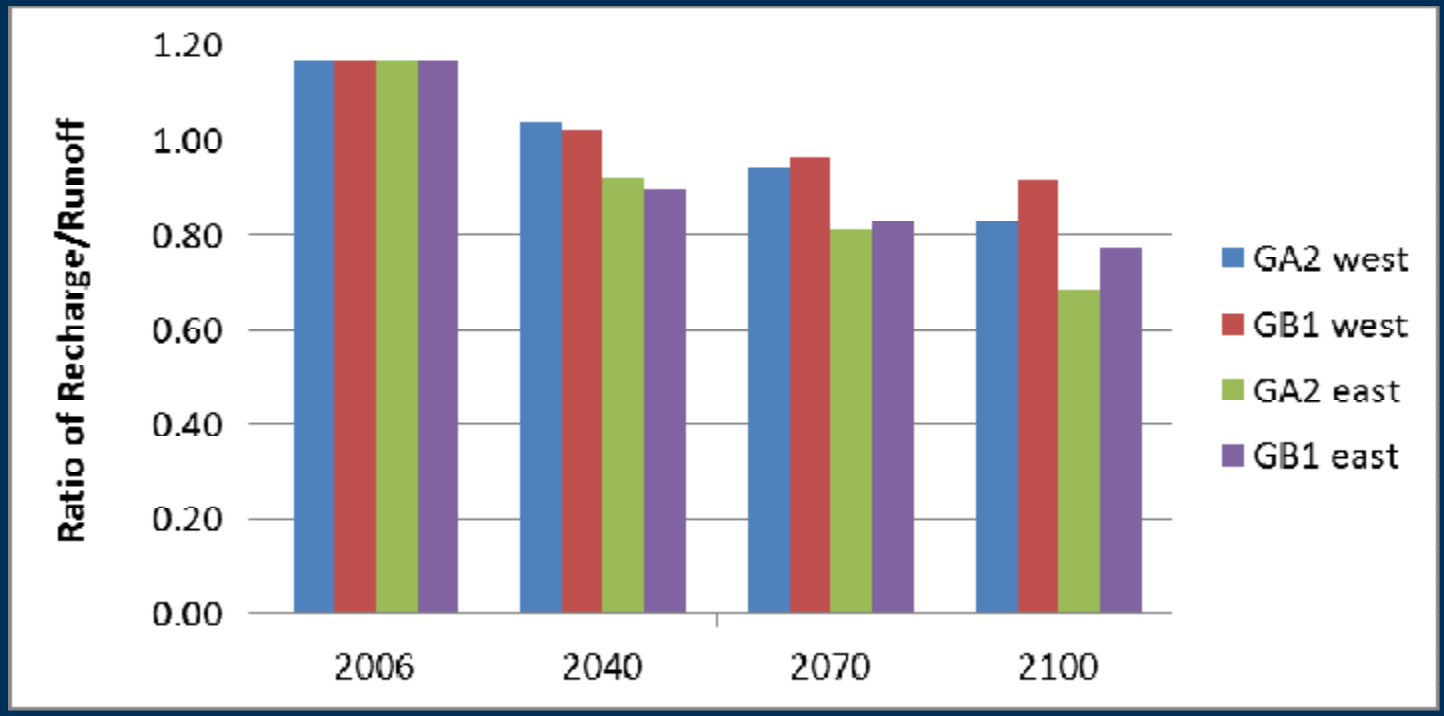




Alameda Creek: Development moves from deep to shallow soils 2006 - 2100

Calaveras: Development moves from shallow to deep soils 2006 - 2100

# Ratio of Recharge to Runoff – More runoff in A2 Scenario, Calaveras Watershed




| | | Ratio (recharge/runoff) | | | |
|---|---|---|---|---|---|
| Basin | Scenario | 2006 | 2040 | 2070 | 2100 |
| West | GA2 | 1.17 | 1.04 | 0.94 | 0.83 |
| | GB1 | 1.17 | 1.02 | 0.97 | 0.92 |
| East | GA2 | 1.17 | 0.92 | 0.81 | 0.69 |
| | GB1 | 1.17 | 0.89 | 0.83 | 0.77 |

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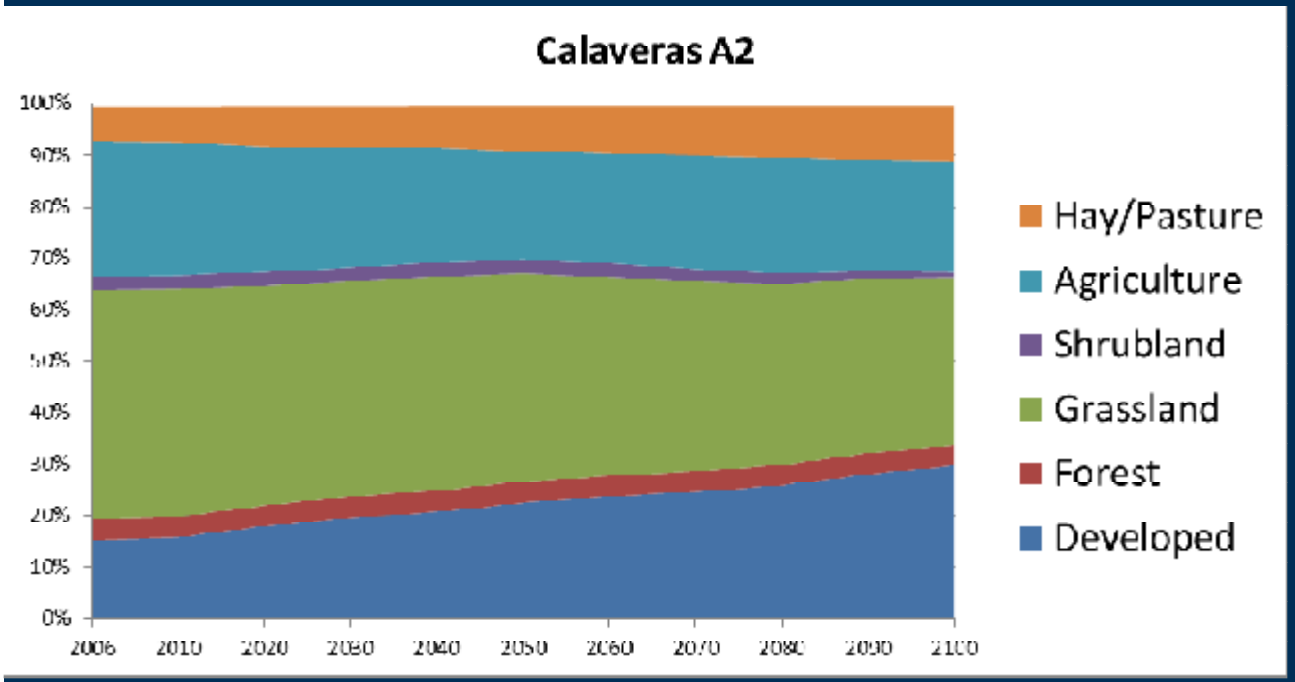


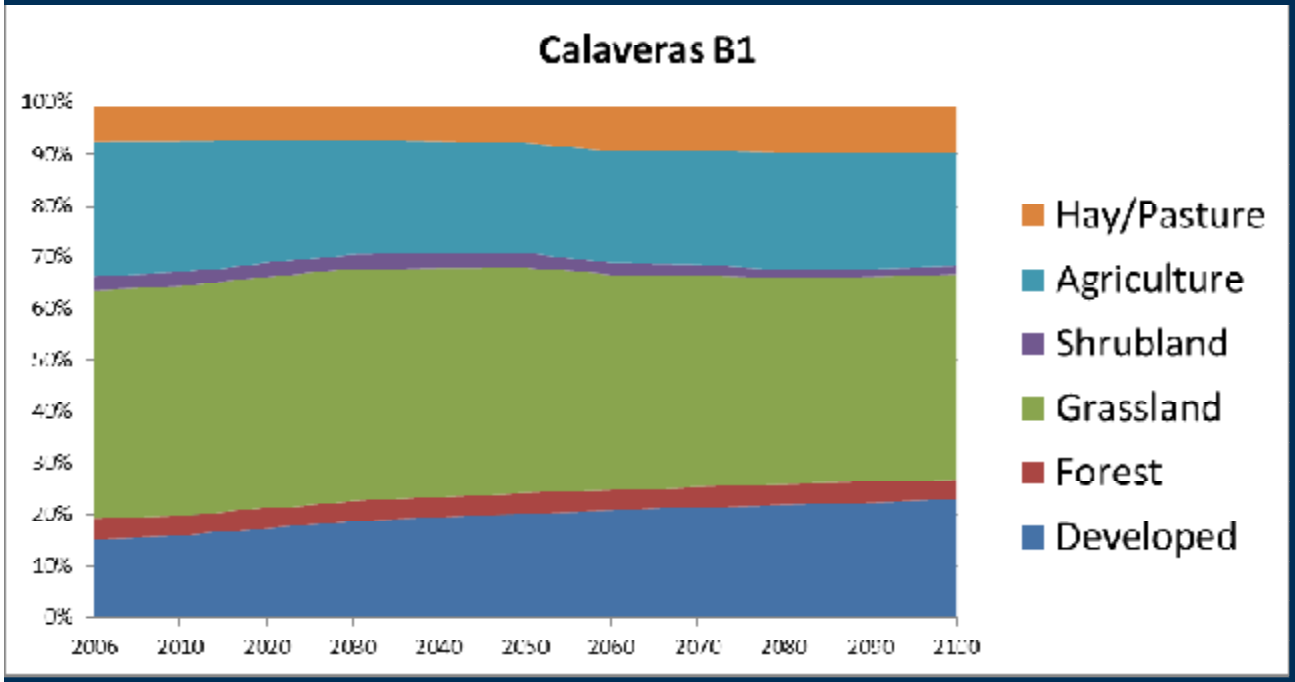


# Calaveras Habitat Change

More grassland/shrub land conversion to agriculture in A2

Carbon?

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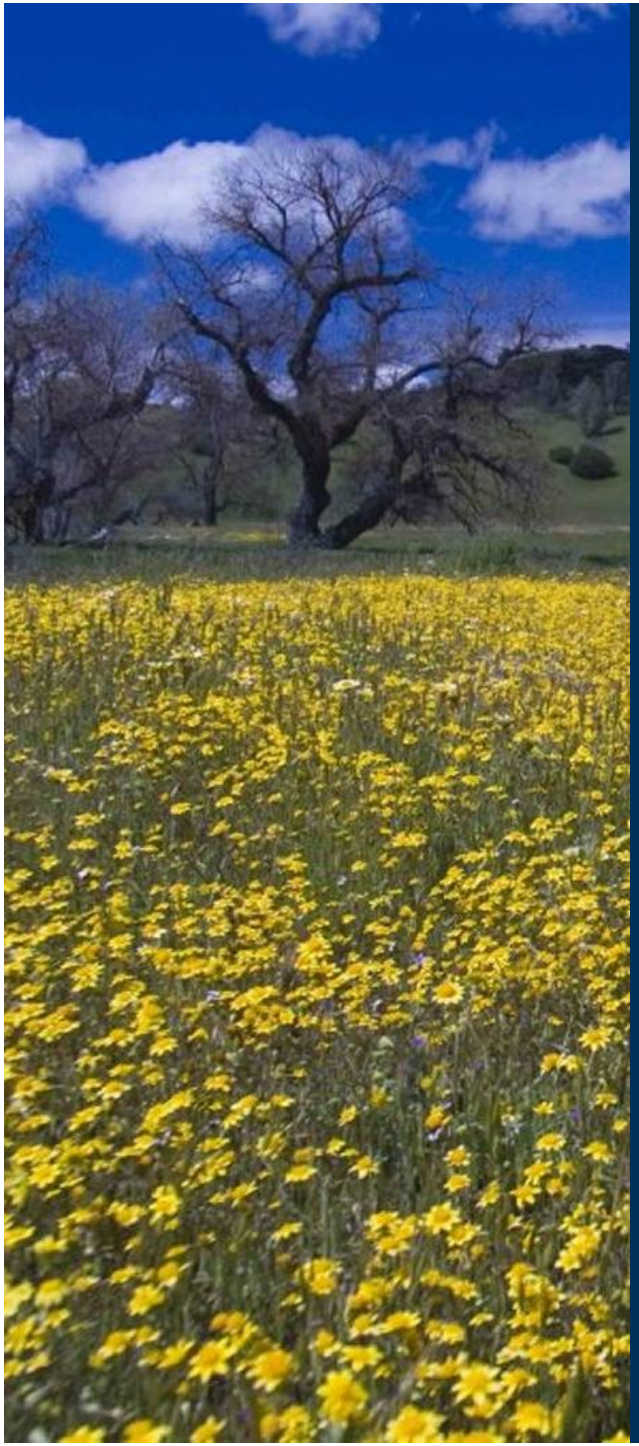

# Carbon

- Social value of carbon : avoided marginal damages from carbon emissions to a society as a whole, that is, of the avoided damage done by an additional ton of carbon released into the atmosphere. In our particular case, if that carbon were released as a result of land conversion” (Kroeger, 2012)

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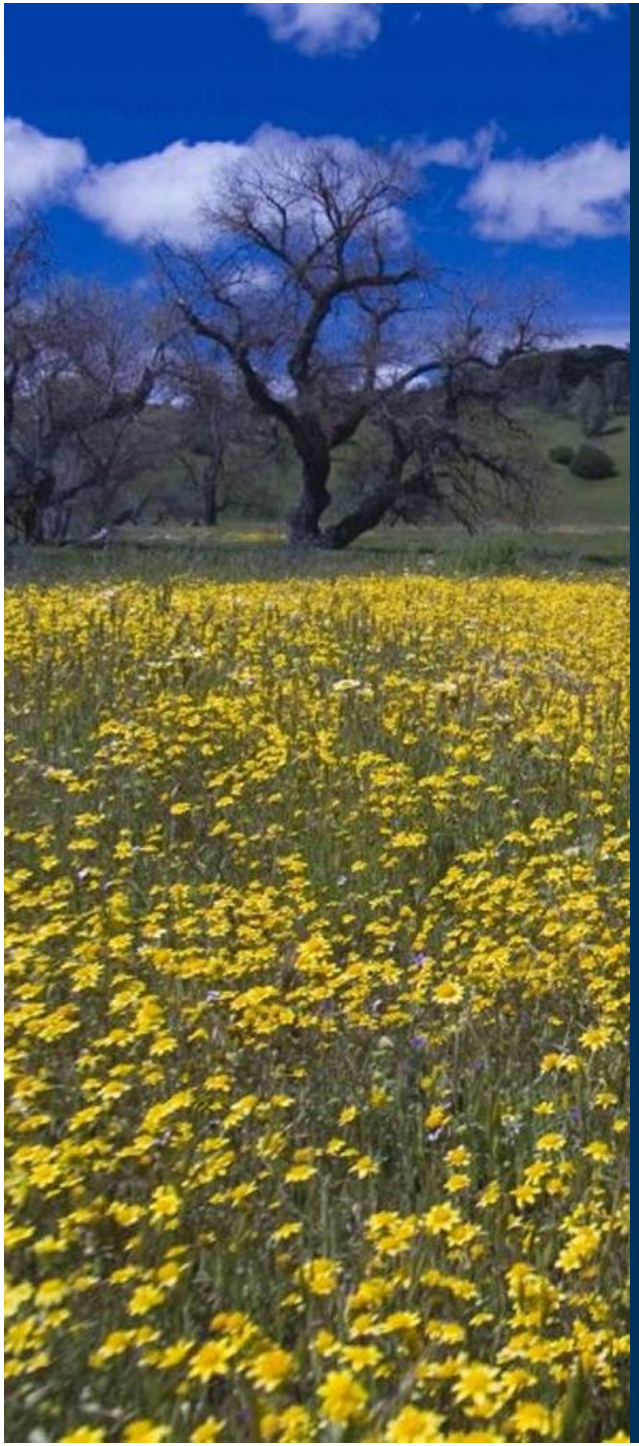

# Carbon (preliminary)

- Over the estimated 5,200 of grassland lost in the Calaveras-Mormon Slough watershed during the 2006-2040 time period, the total social value of soil carbon is estimated to be about $13.2 million.

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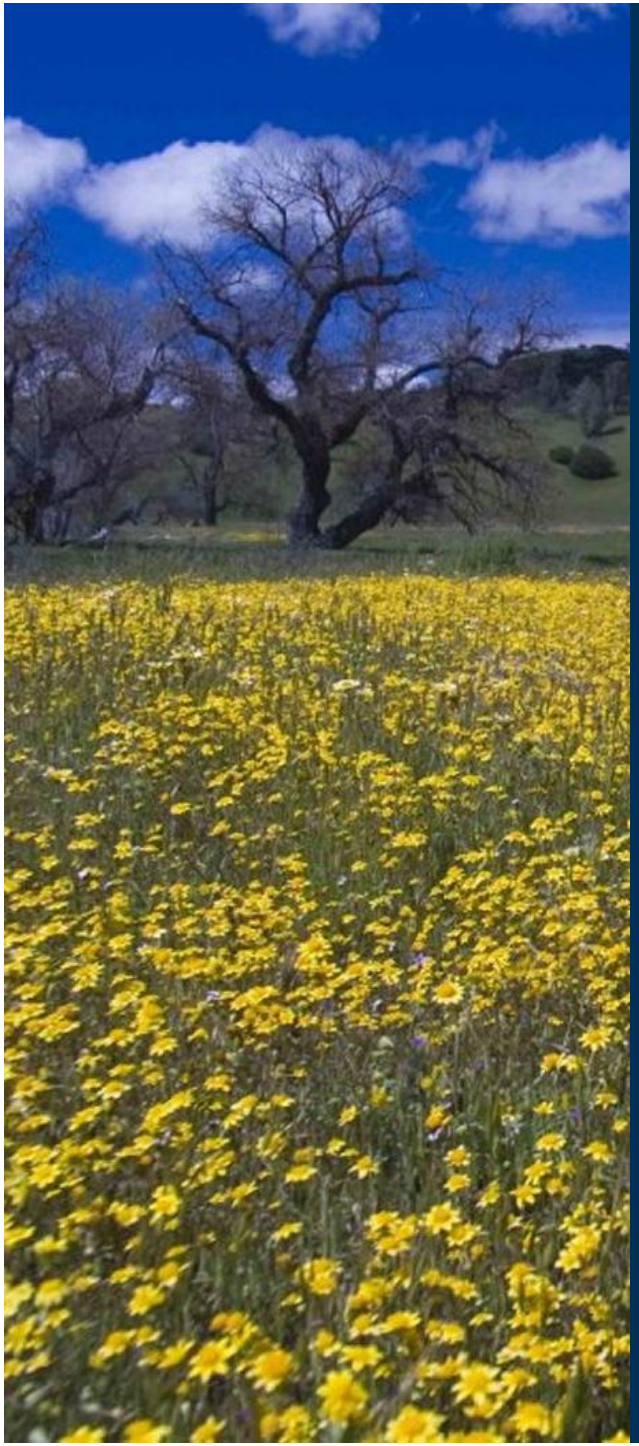

# Potential Applications/Users

A) Decision-making tool for:

- Agencies: Prioritization,
- Non-profits: RCDs, land trusts restoration, easements
- Others: Planners, legislators

B) Research

C) Outreach

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# Next Steps: Metrics and Economic Analysis for Decision Support

- Metrics at landscape and watershed level
- Quantify fragmentation of grazing land
- Change in bioclimatic distribution of oaks, grassland and shrubland
- Change in runoff, recharge and stream discharge
- On-line maps where changes in water availability and wildlife habitat coincide
- Economic analysis of scenarios to quantify costs and benefits to the CRCC focus area

# Thank You!

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