CALIFORNIA CLIMATE STRATEGY

An Integrated Plan for Addressing Climate Change

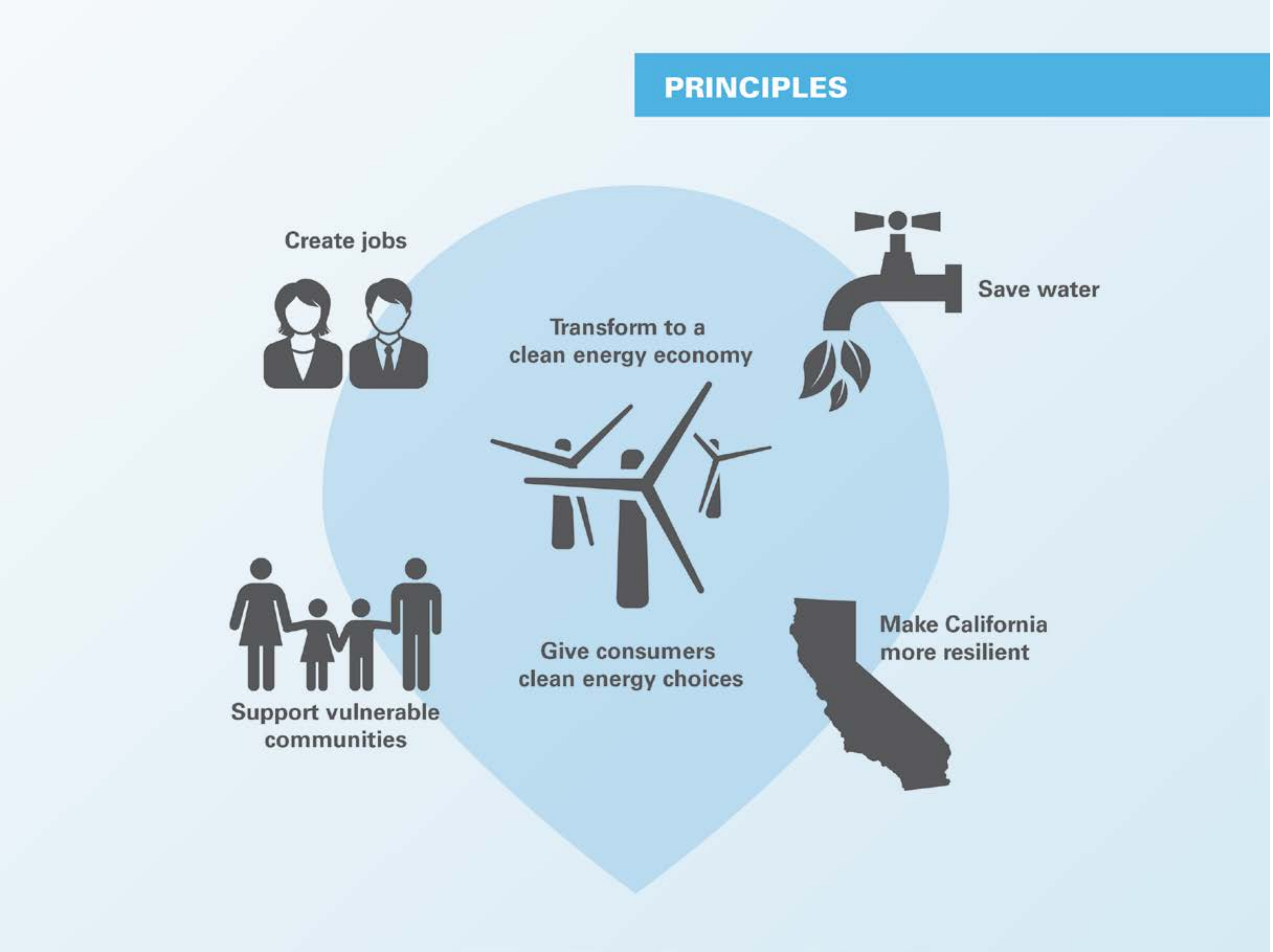
VISION

Reducing Greenhouse Gas Emissions to 40% Below 1990 Levels by 2030

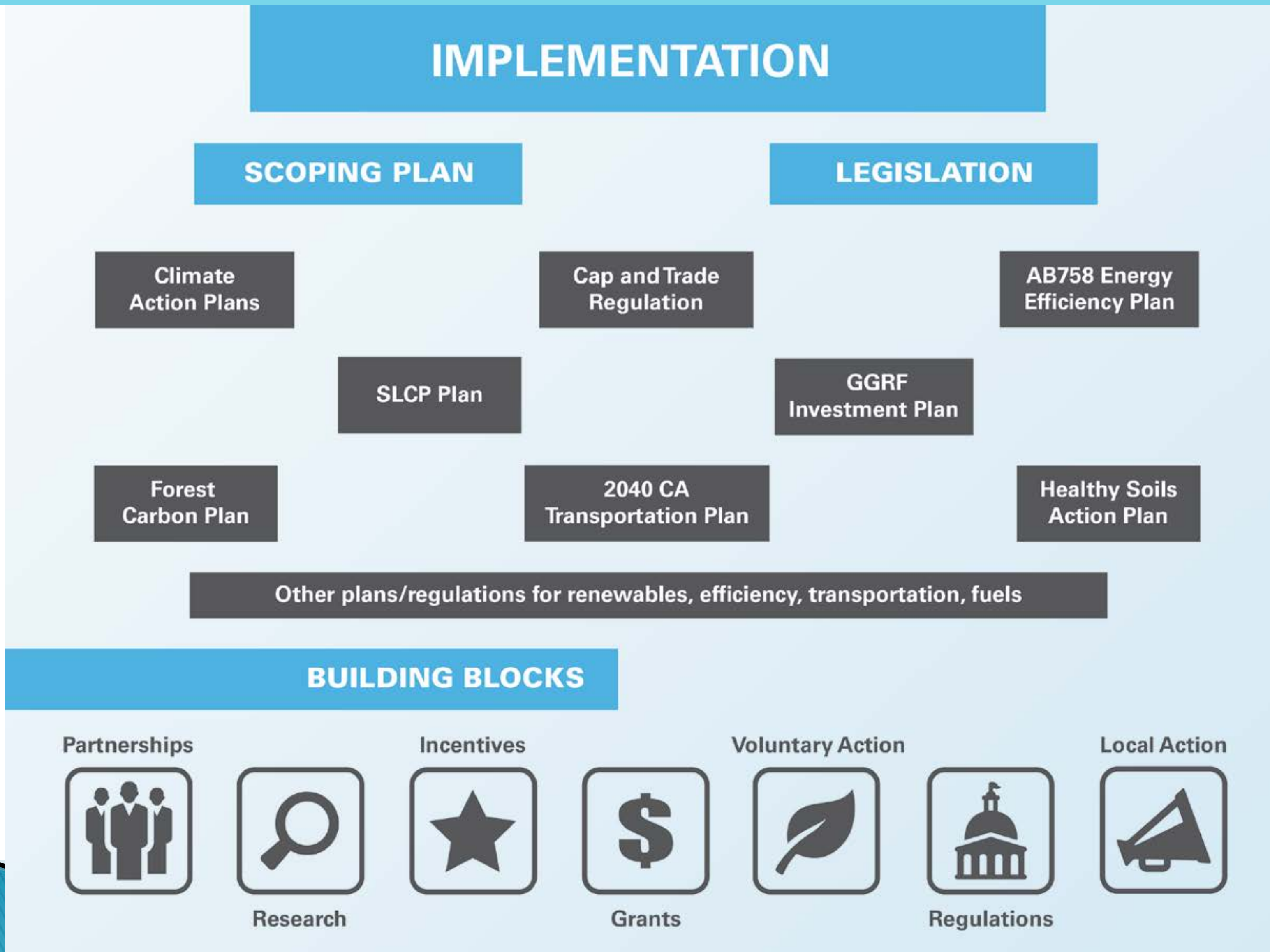
GOALS

- 50% renewable electricity
- 50% reduction in petroleum use in vehicles
- Double energy efficiency savings at existing buildings
- Carbon sequestration in the land base
- Reduce short-lived climate pollutants
- Safeguard California

CALIFORNIA CLIMATE STRATEGY



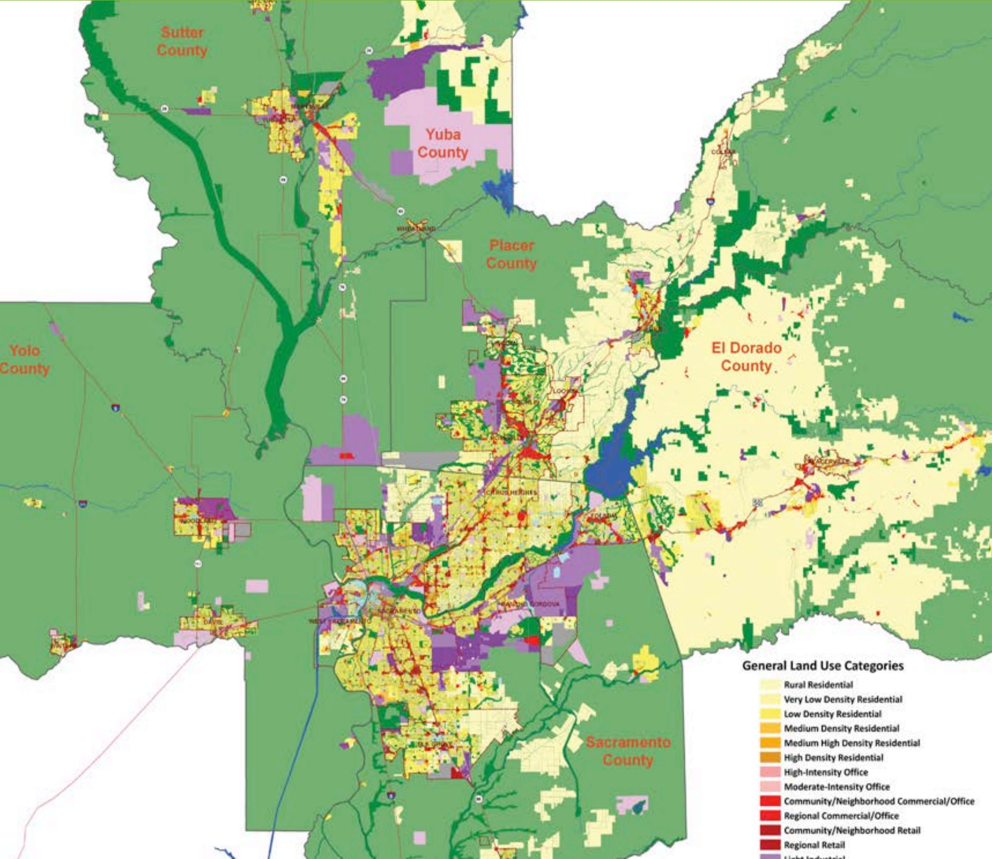
CALIFORNIA CLIMATE STRATEGY

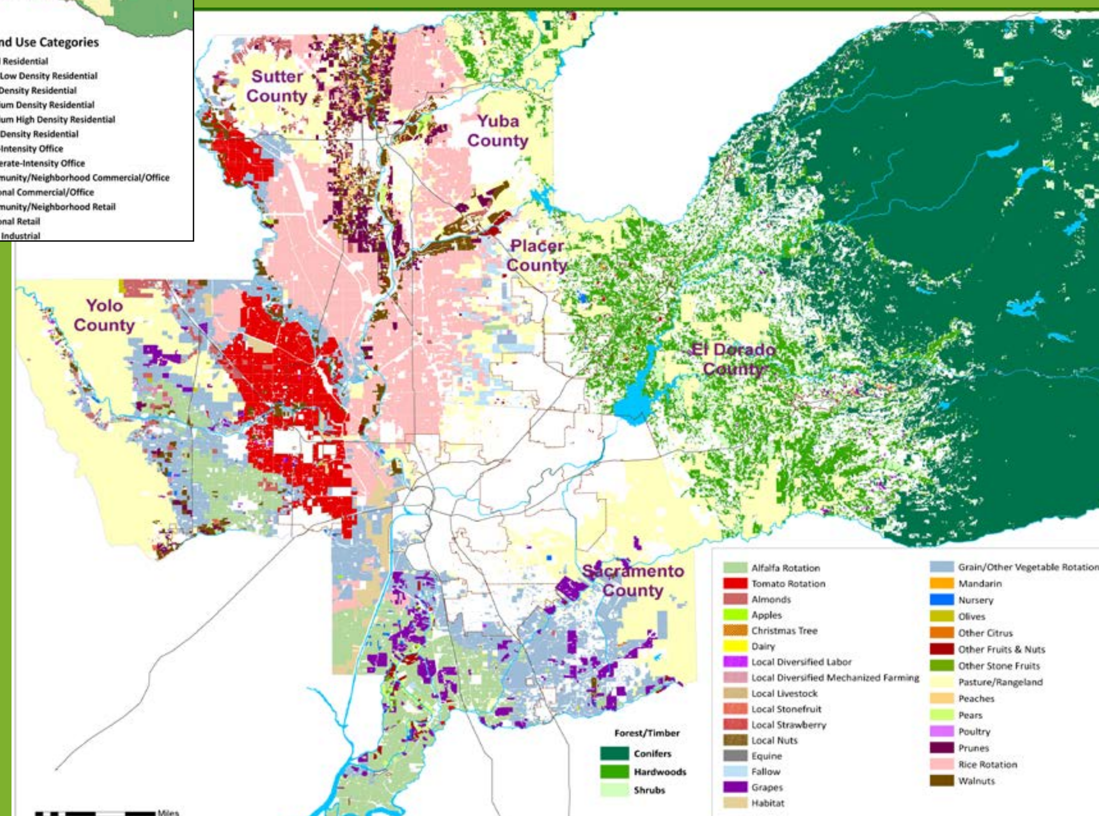


Rural-Urban Connections Strategy

Enhancing rural economic viability and environmental sustainability

Regional Planning: Urban and Rural





RUCS Objectives

- Enhance rural economic viability and environmental sustainability
- Identify rural challenges and opportunities
- Test market and policy changes and strategies
- Determine transportation needs

Land Use and Conservation

Forest Management

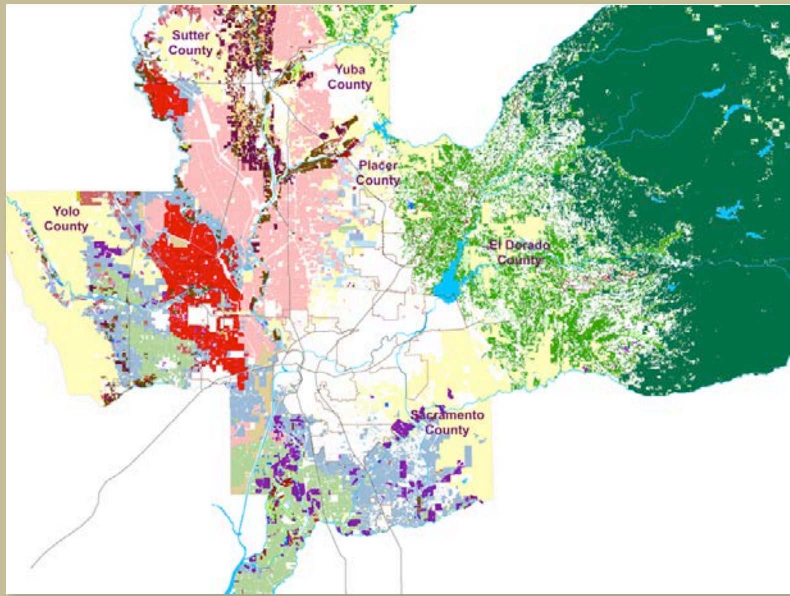
Market Opportunities

Infrastructure for Agriculture

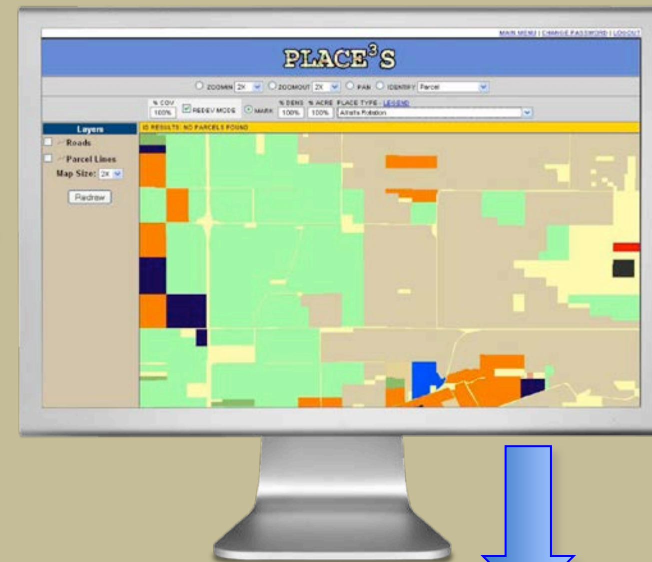
RUCS Topics


New Tools for Understanding Agricultural Viability

RUCS Crop Map

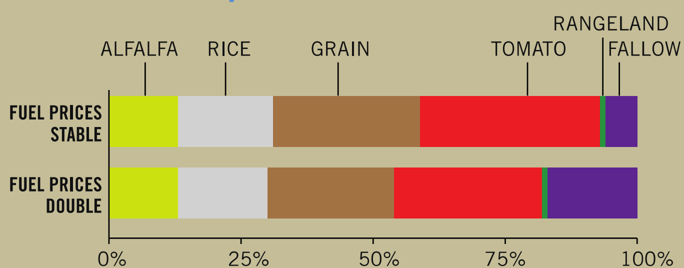


RUCS Scenario Analysis Tool

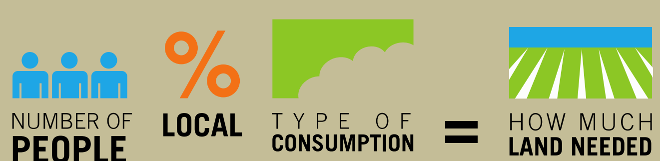


Modules Informing Scenarios

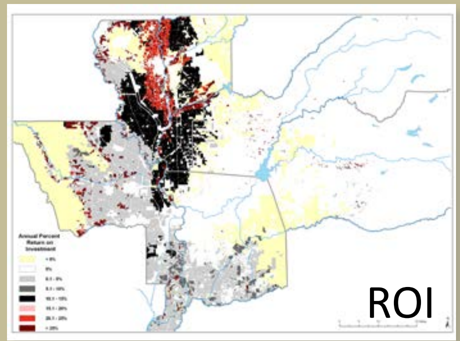
Export Markets

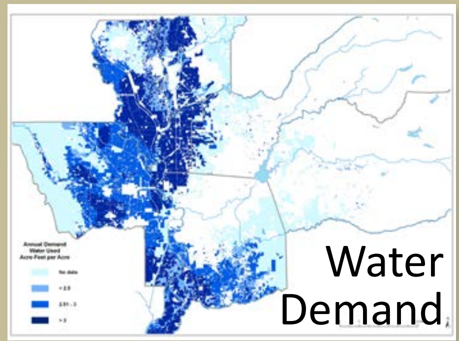


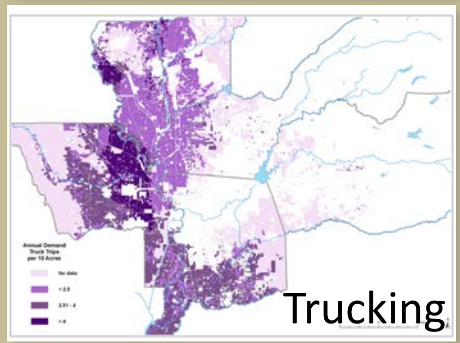
Local Markets

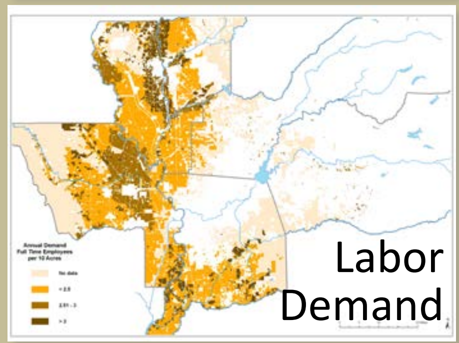


Scenario Results

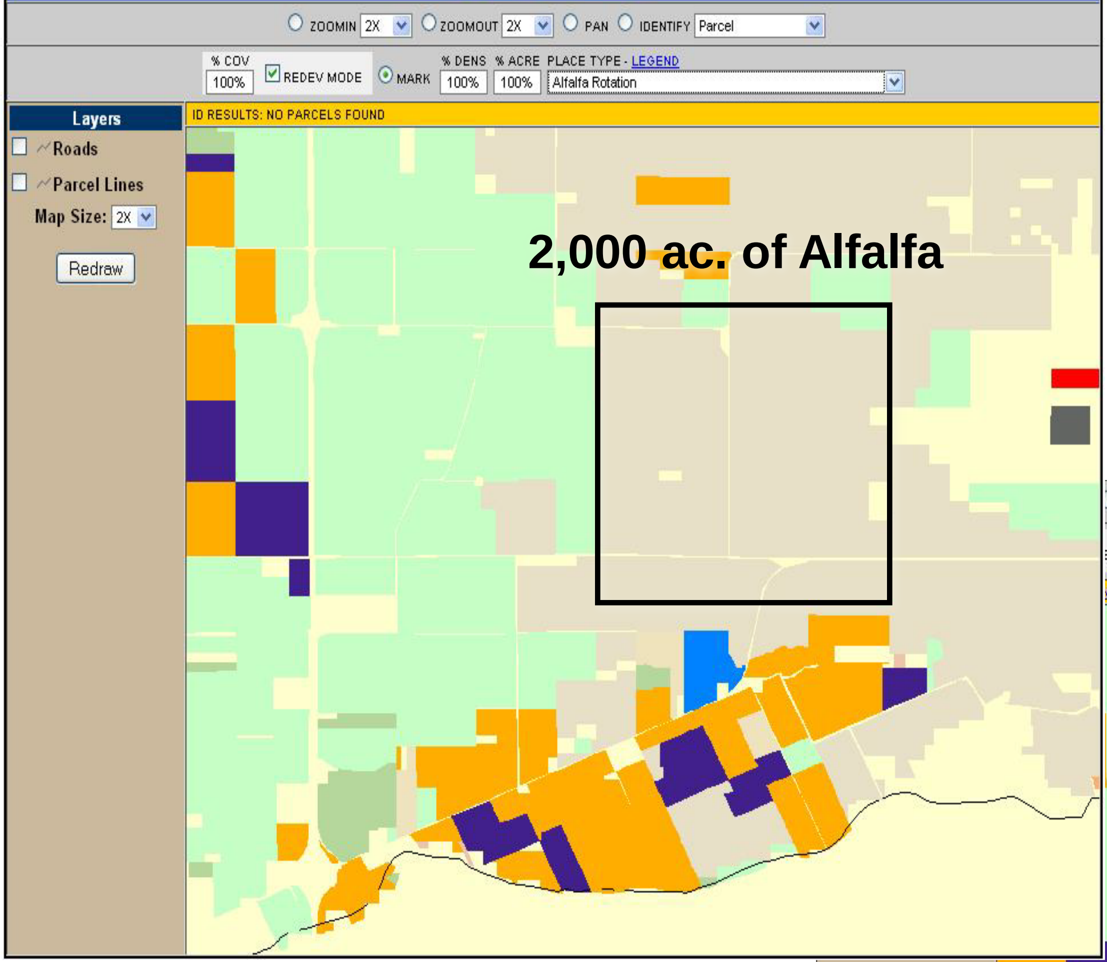


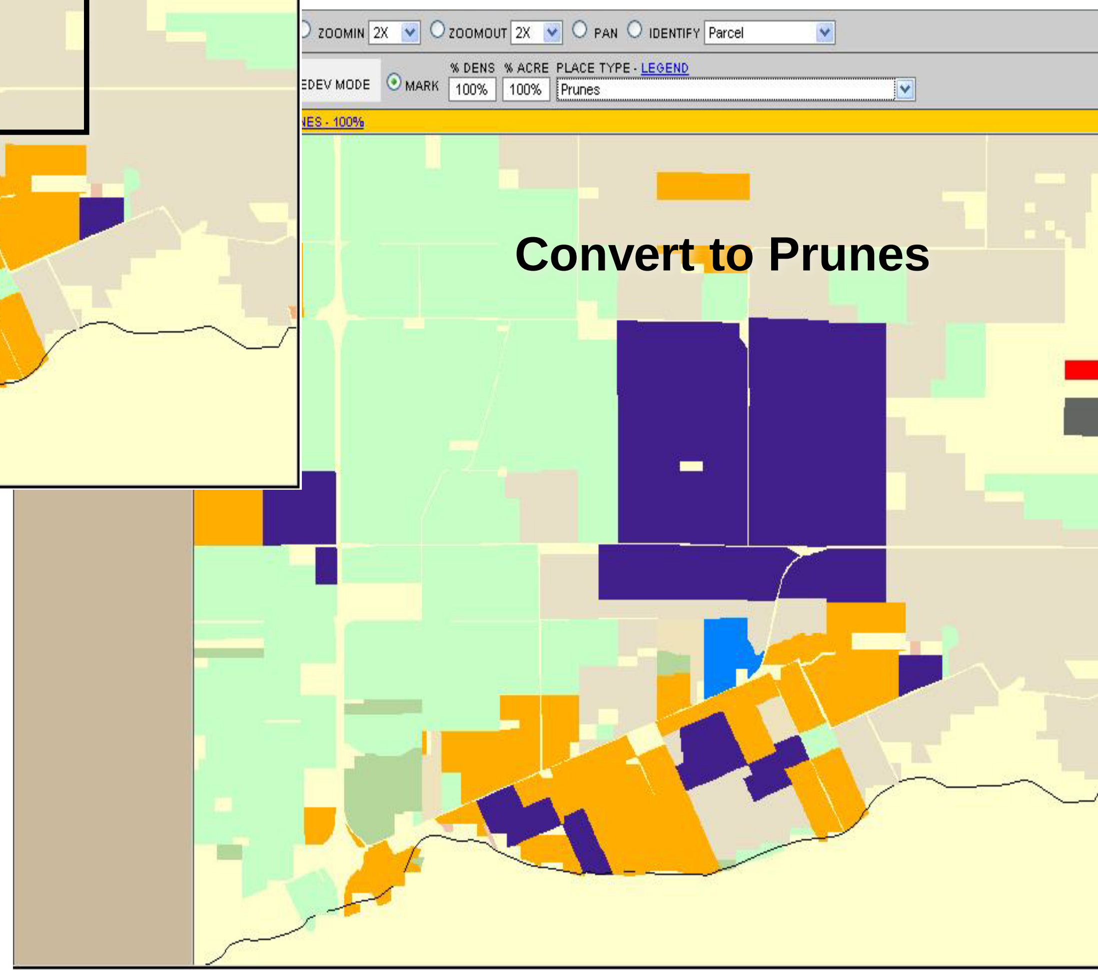






Crop Change Scenario: Alfalfa to Prunes





COMPARE SCENARIOS - RESULTS

CURRENT PROJECT: YOLO SGC SCENARIOS | PROJECT TYPE: NEIGHBORHOOD | LEAD ORGANIZATION: SACOG | STUDY AREA: CUSTOM STUDY SHAPEFILE

CURRENT SCENARIO : *BASE CASE*

SCENARIO COMPARISON

SCENARIO NAME	TOTAL ACRES	AG ACRES	AG VALUE	AG COST	AG RETURN	AG PCT RETURN	AG WATER ACRE / FEET	AG LABOR FTE	AG TRUCK TRIPS
BASE CASE	0	562,360.4	$708,969,323	$567,227,852	$141,741,471	25.0%	995,064	2,677.1	112,912
ALFALFA TO PRUNE	0	562,360.4	$711,029,876	$568,792,417	$142,237,459	25.0%	994,567	2,686.9	112,865

JOB DIVERSITY CHART | HOUSING DIVERSITY CHART

LOGGED IN AS LIBBYOS123 | CONTACT SITE HELPDESK

Value: + $2M

Return: + $500,000

Water: -500 ac-ft

Labor: + 10 workers

Trucks: - 47 trips

→ GHGs?

What's the impact on the region?

Yolo County Processing Tomato Study

Emissions Performance	Tomato Rotation (Base Case)	Tomato Rotation (No PCP)	General Field Crop Rotation	Orchard Blend
Total VMT/year	545,000	5,447,000	220,000	190,000
Transportation CO2	850	8,000	300	300
On-filed CO2	25,000	25,000	11,000	18,000
Tomato Processing CO2	36,000	29,000	--	--
Total CO2	61,850	62,000	11,300	18,300
CO2 Change (Crops + Processing)	--	0.20%	-82%	-70%
CO2 Change (Just Crops)	--	--	-56%	-29%
Economic Performance				
Revenue/year ($million)	$55.6	$55.6	$27.1	$131.0
Water Use (ac-ft)	50,000	50,000	30,000	90,000
Labor (hours)	440,000	440,000	150,000	720,000

Land Use Policies That Support Agriculture

SACRAMENTO REGION
RURAL – URBAN CONNECTIONS STRATEGY

Smaller Lots, Infill and Redevelopment

SACRAMENTO REGION
Blueprint
TRANSPORTATION / LAND USE PLAN

- 230,000 ac. of Farmland Loss

Reduce Urban – Rural Conflicts

- Buffers
- Ag Parks
- Right-to-Farm
- Policy Boundaries
- City-County Agreements

Ag Land Conservation and Viability

- Infrastructure investments
- Supportive Zoning
- Voter Initiatives
- Open Space Plans
- Easements, TDRs, etc.

Land Use-Transportation Plan

For every 1,000 new residents:

1988-2005	2008-2035
333 acres	**42 acres**

D R A F T
2036 MTP/SCS Plan Results

Density Increase →

MTP/SCS Plan Performance [DRAFT]	2012 Baseline	MTP/SCS for 2036 (Proposed Project)	Alternative 1 (Scenario 1)	Alternative 2 (Scenario 2)	Alternative 3 (Scenario 3)
Land Use Characteristics					
Gross Acres of development *(percent increase in developed acres from 2012)*	718,356 n/a	47,563 7%	75,622 11%	48,777 7%	37,350 5%
Performance Outcomes					
Square miles of farmland converted to development	n/a	58	93	61	45
Square miles of vernal pools affected by development	n/a	6	7	5	2
Weekday passenger vehicle CO_2 emissions *(% change per capita from 2005)*	n/a	-16%	-13%	-15%	-20%

Ecosystem Services

- Carbon Sequestration
- Air Quality
- Habitat
- Groundwater Recharge
- Water Resources
- Flood Control
- Market-based solutions
- ***Working Landscapes Project***

Considerations

- Urban AND Rural
- Regulations AND Market Mechanisms
- Reductions AND Avoidance

Planning for Conservation and Climate

tools and data at the scale of land use decision-making

Joint Agency Symposium on Climate Goals and Natural and Working Lands

August 5th, 2015

Tom Robinson, Conservation Planner

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

Climate Benefits of Local Land Conservation


- **Countywide Focus on GHG Emissions Reduction**
  - Early adopters of GHG reduction goals (Climate Protection Campaign's 2005 Climate Action Plan) →
  - County and city leadership: 25% below 1990 by 2015
  - Regional Climate Protection Authority
  - Climate Action 2020 (Multiple Sectors)
  - Sonoma Clean Power
  - Carbon Free Water (SCWA)
  - NASA Carbon Monitoring System (CMS)
- **Sonoma Ag Preservation & Open Space:**
  - quarter cent sales tax/leverage
  - multi-objective: agriculture, open space, biodiversity, water, recreation, health, local economy
  - protection of 106,000 acres to date

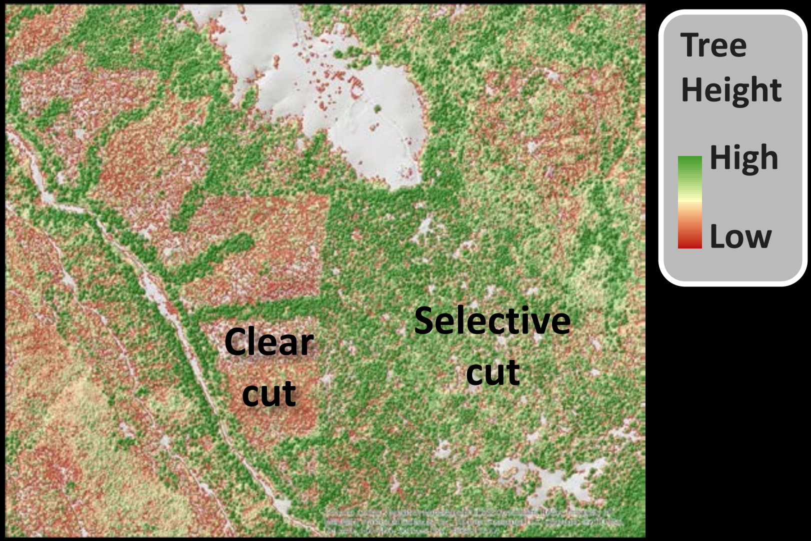


Climate Benefits of Local Land Conservation

Mitigation

Conservation…

- Avoids emissions from conversion of natural land
- Protects long-term sequestration sources
- Promotes management changes and restoration that sequesters more carbon
- Promotes low emission development patterns



Adaptation

Conservation…

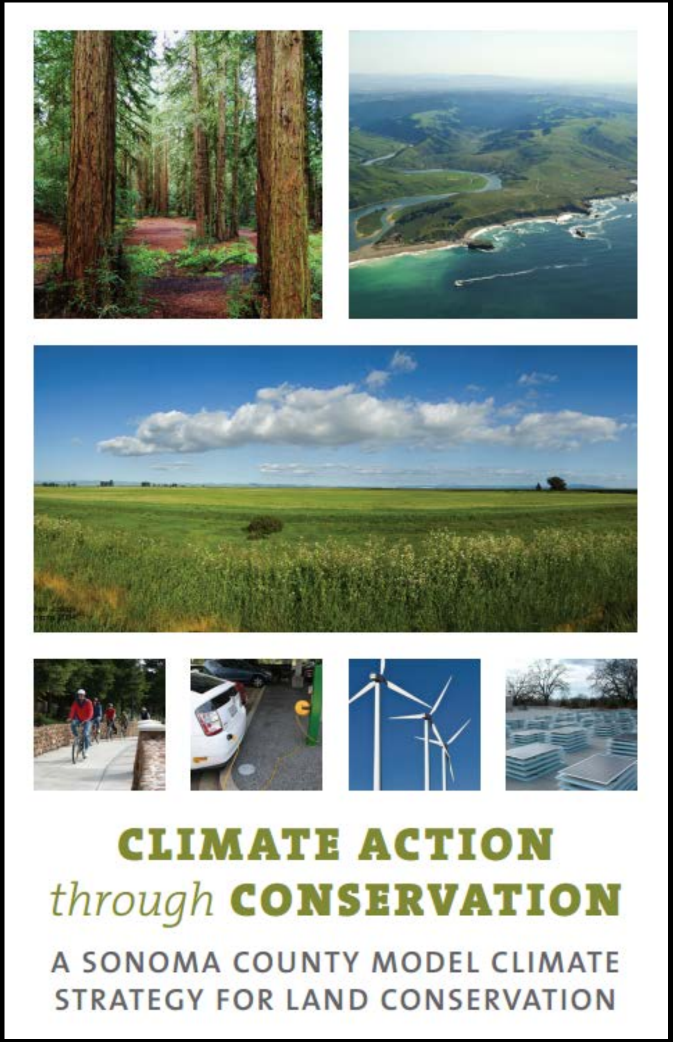
- Secures water supplies
- Protects productive soils and rangeland
- Avoids development in floodplains and coastal zones
- Secures wildlife corridors
- Economy

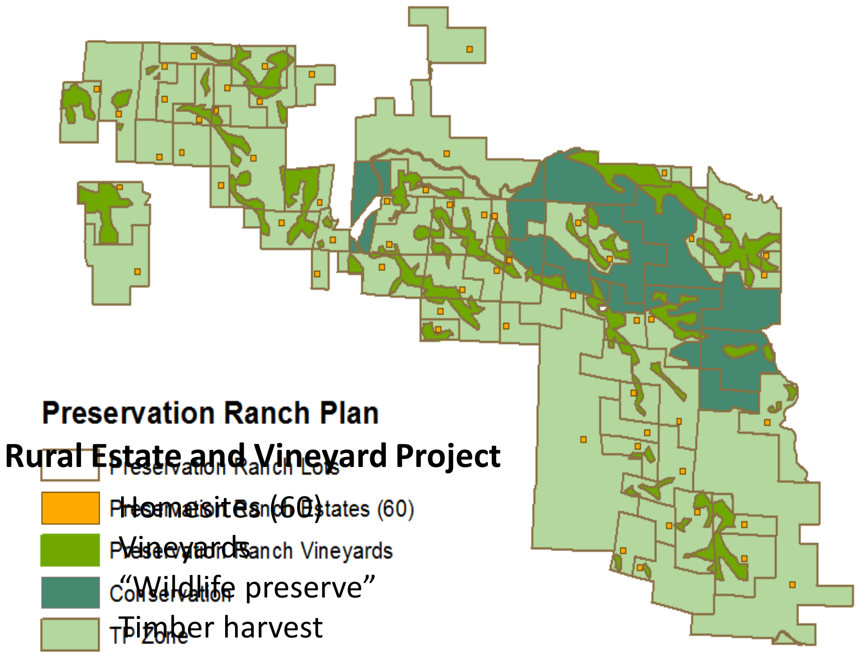
Climate Benefits of Local Land Conservation

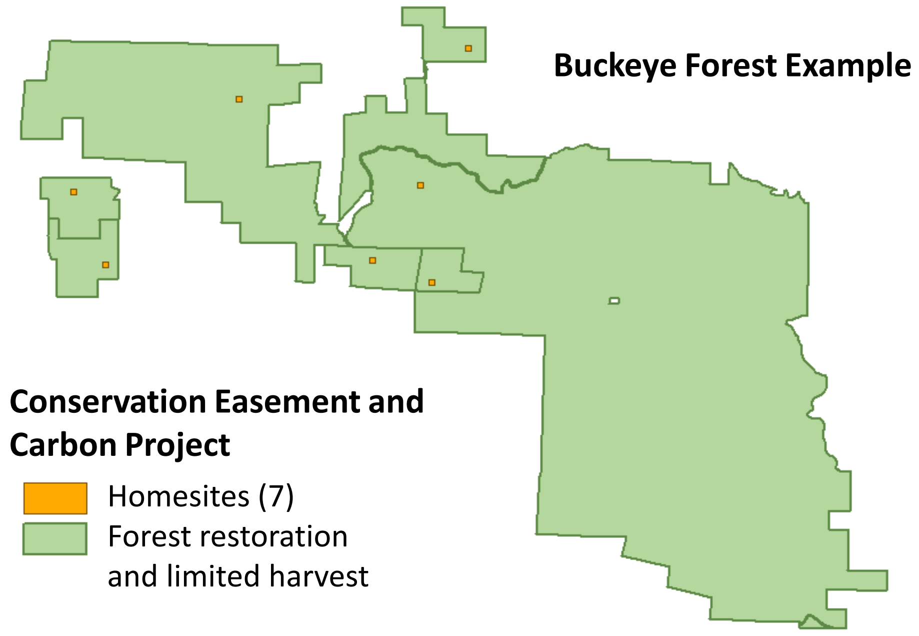
- Local role is unique
- Scale of land use decisions
- Embedded
- Invested

Climate Action Through Conservation

- Scenarios of aggregated conservation activities:
  - Land conservation
  - Forest management
  - Re-vegetation
  - Land use policies
- 20-year time horizon (2010 – 2030)
- Uses data available statewide







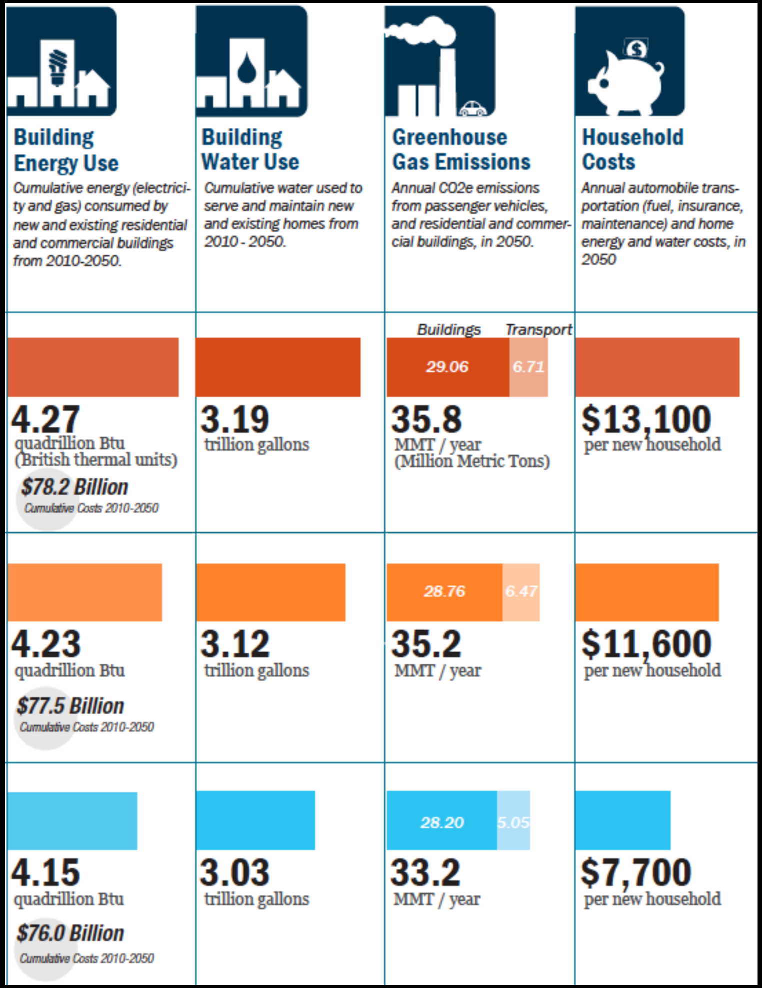
Scenario	Tonnes CO_2e in 2010	Tonnes CO_2e in 2030
Rural Estate and Vineyard Project	8,685,577	8,516,019
Conservation Easement and Carbon Project	8,685,577	9,491,862
		+ 975,843 Tonnes

- Avoiding conversion of sequestration sources
- Does not include additionality from:
  - forest practices
  - avoided emissions from homes or VMT
- Conservative estimate

UrbanFootprint + Rural Conservation Module

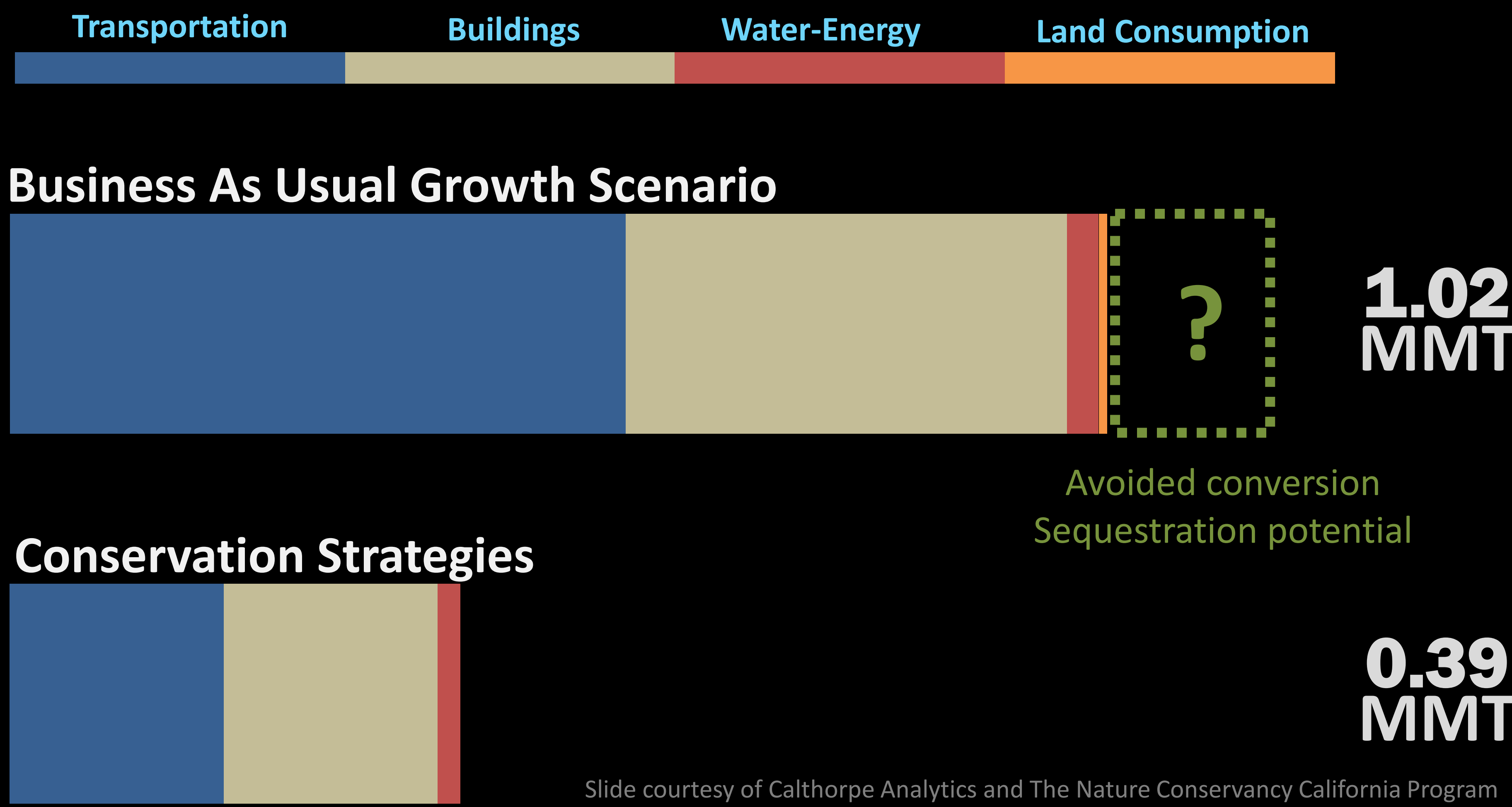
UrbanFootprint

- Integrating with other sectors
- Built environment metrics
- Opportunity to add land-based metrics
- One Bay Area Grant



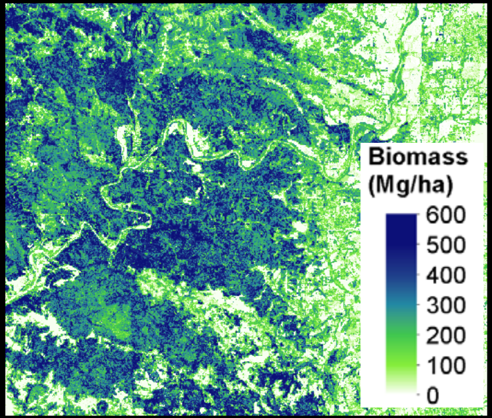
UF in action: Santa Monica Mountains Conservancy

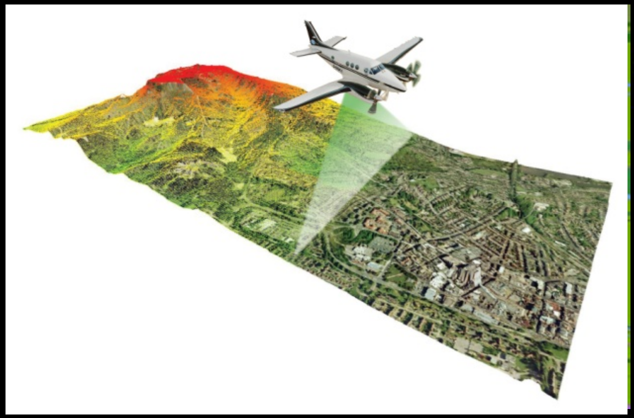
ANNUAL GREENHOUSE GAS EMISSIONS

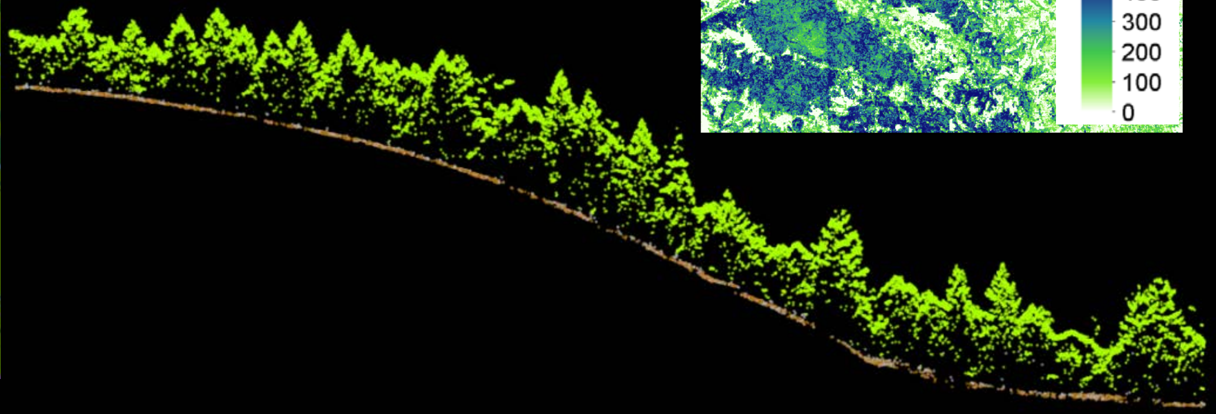


Slide courtesy of Calthorpe Analytics and The Nature Conservancy California Program

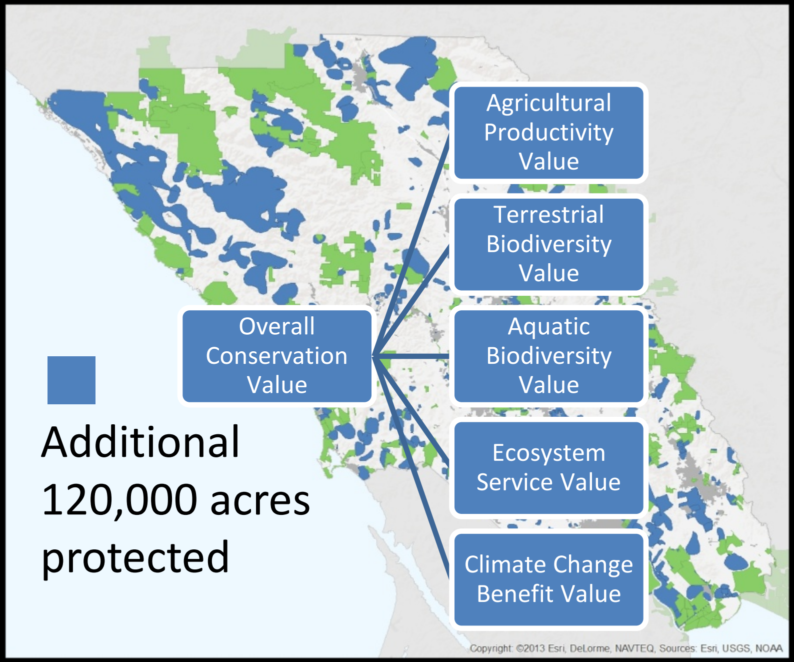
- Biomass carbon estimates from countywide LiDAR
- Applications for site- and county-level MRV (future: spaceborne LiDAR)

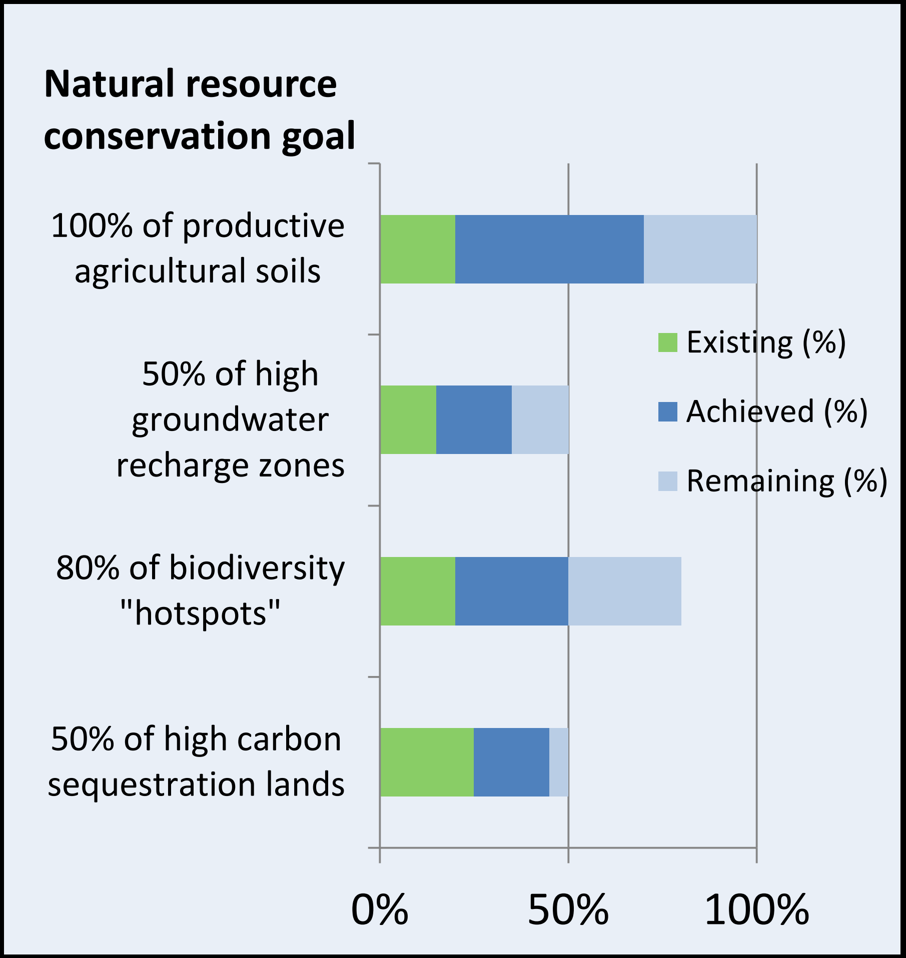






Integrating Climate Goals





- Individual property assessments
- Countywide conservation plan
- Target in county Climate Action Plan (*Climate Action 2020*)

Integrating Local Planning and Action with State Policies and Funding

- Further the data and tools on land-based GHG emissions reductions to empower local jurisdictions/ organizations to:
  - make climate-smart decisions
  - quantify/measure and report reductions

- Integrated, multi-sector countywide climate action plans:
  - Funding and tools for setting natural and working lands GHG reduction goals
  - *Climate Action 2020* sets targets

- Increase funding for successful multi-benefit State conservation programs (e.g., SALCP, Coastal Conservancy, Oak Woodlands, etc.)

Thank you

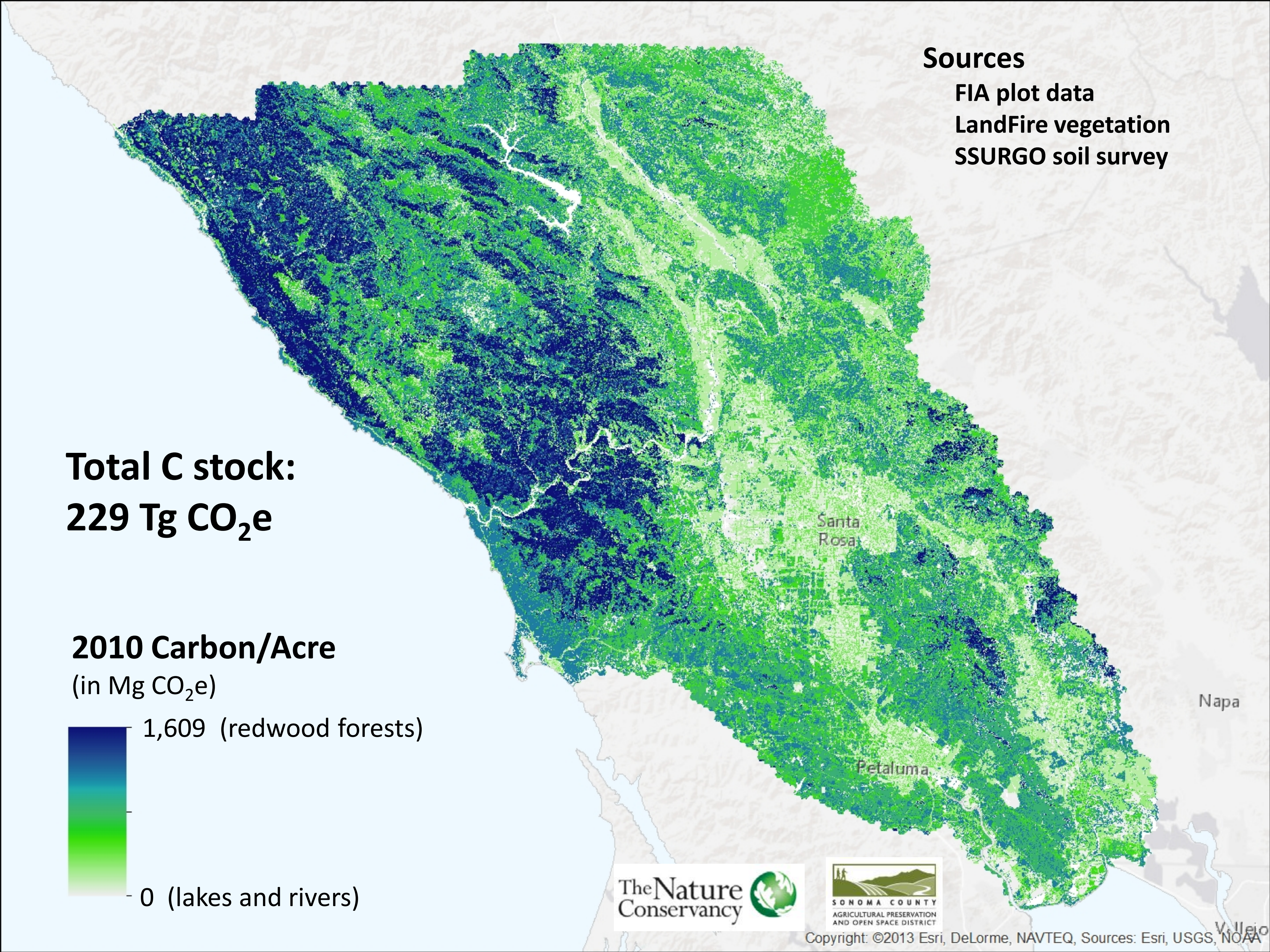
Tom Robinson | tom.robinson@sonoma-county.org

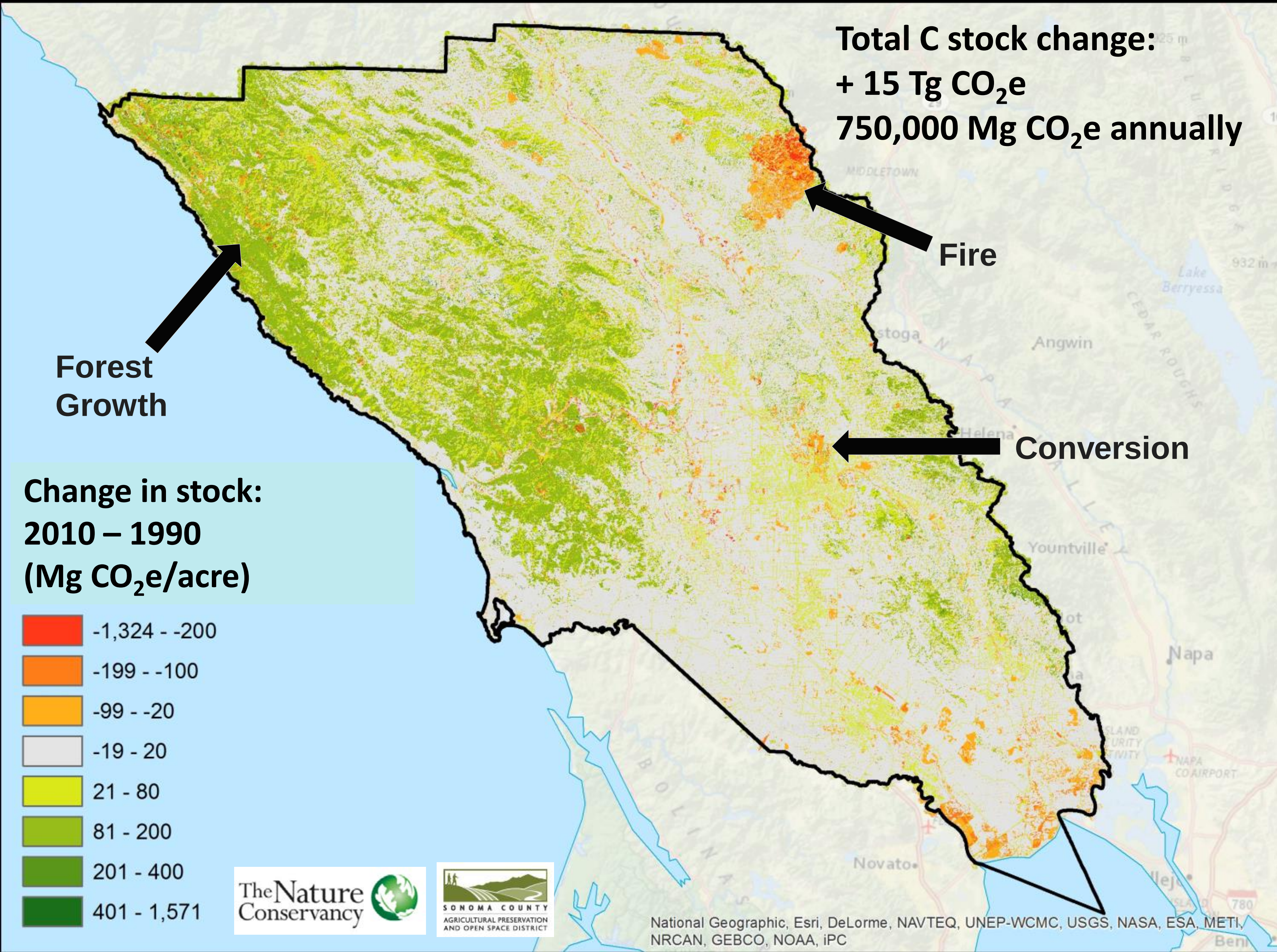
Funding provided by:

The Gordon and Betty Moore Foundation
The Evelyn Tilden Mohrhardt Fund at the San Francisco Foundation

Collaborators

Michelle Passero, The Nature Conservancy
John Nickerson, Climate Action Reserve
Dick Cameron, The Nature Conservancy
Karen Gaffney, Sonoma County Agricultural Preservation and Open Space District
Elizabeth O'Donoghue, The Nature Conservancy
Alexandra Leumer, The Nature Conservancy
Tom Gaman, East West Forestry Associates
Mark Tukman, Tukman Geospatial
Sarah Lewis, EnvisionGeo


Sources
FIA plot data
LandFire vegetation
SSURGO soil survey
Total C stock:
229 Tg CO_2e
2010 Carbon/Acre
(in Mg CO_2e)
1,609 (redwood forests)
0 (lakes and rivers)
Santa Rosa
Napa
Petaluma
Copyright: ©2013 Esri, DeLorme, NAVTEQ, Sources: Esri, USGS, NOAA


Total C stock change:
+ 15 Tg CO_2e
750,000 Mg CO_2e annually
Fire
Forest Growth
Conversion
Change in stock:
2010 – 1990
(Mg CO_2e/acre)
-1,324 - -200
-199 - -100
-99 - -20
-19 - 20
21 - 80
81 - 200
201 - 400
401 - 1,571
The Nature Conservancy
SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC
Middletown
Angwin
Lake Berryessa
Yountville
Napa
Novato

- Additional layer in UrbanFootprint tool
- Will report metrics for four land-based themes

- Agriculture
- Carbon Sequestration
- Water Supply/Services
- Terrestrial Habitat Conservation

The Nature Conservancy
Protecting nature. Preserving life.™

American Farmland Trust
Saving the Land that Sustains Us

SACOG

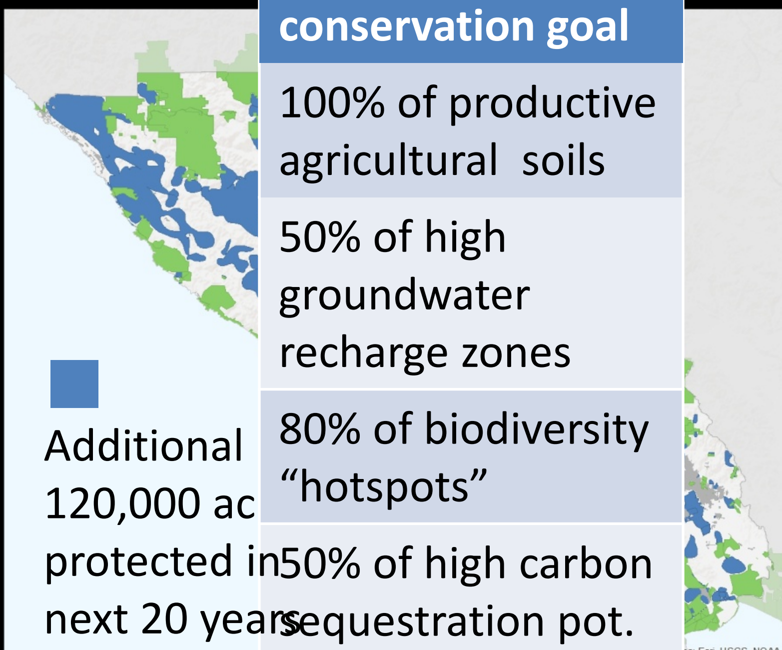
Sonoma County Agricultural Preservation and Open Space District

Calthorpe Associates
Urban Designers, Planners, Architects

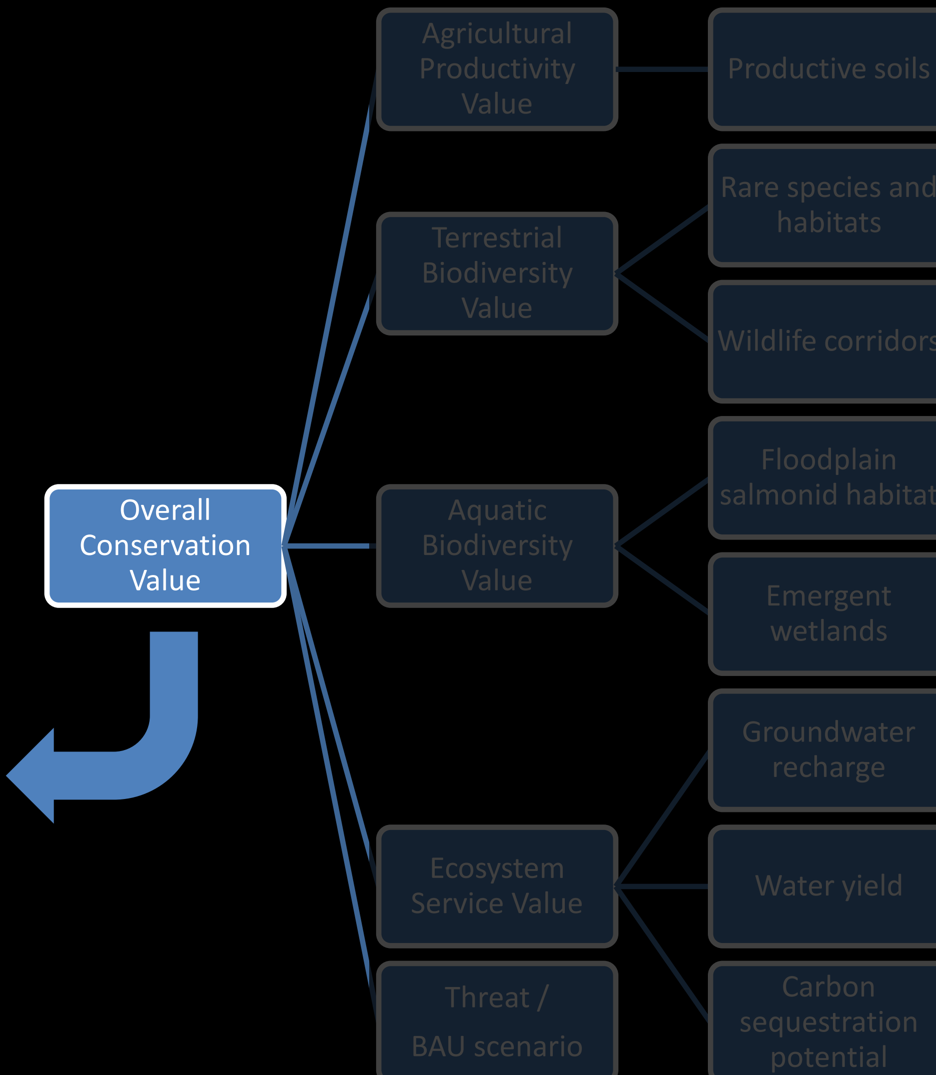
Planning: Integrating Co-benefits and Setting Targets

- Mapped elements
- Themes
- Overall conservation value
- Achieve long-term targets through conservation strategies

Natural resource conservation goal
100% of productive agricultural soils
50% of high groundwater recharge zones
80% of biodiversity "hotspots"
50% of high carbon sequestration pot.



Additional 120,000 ac protected in next 20 years

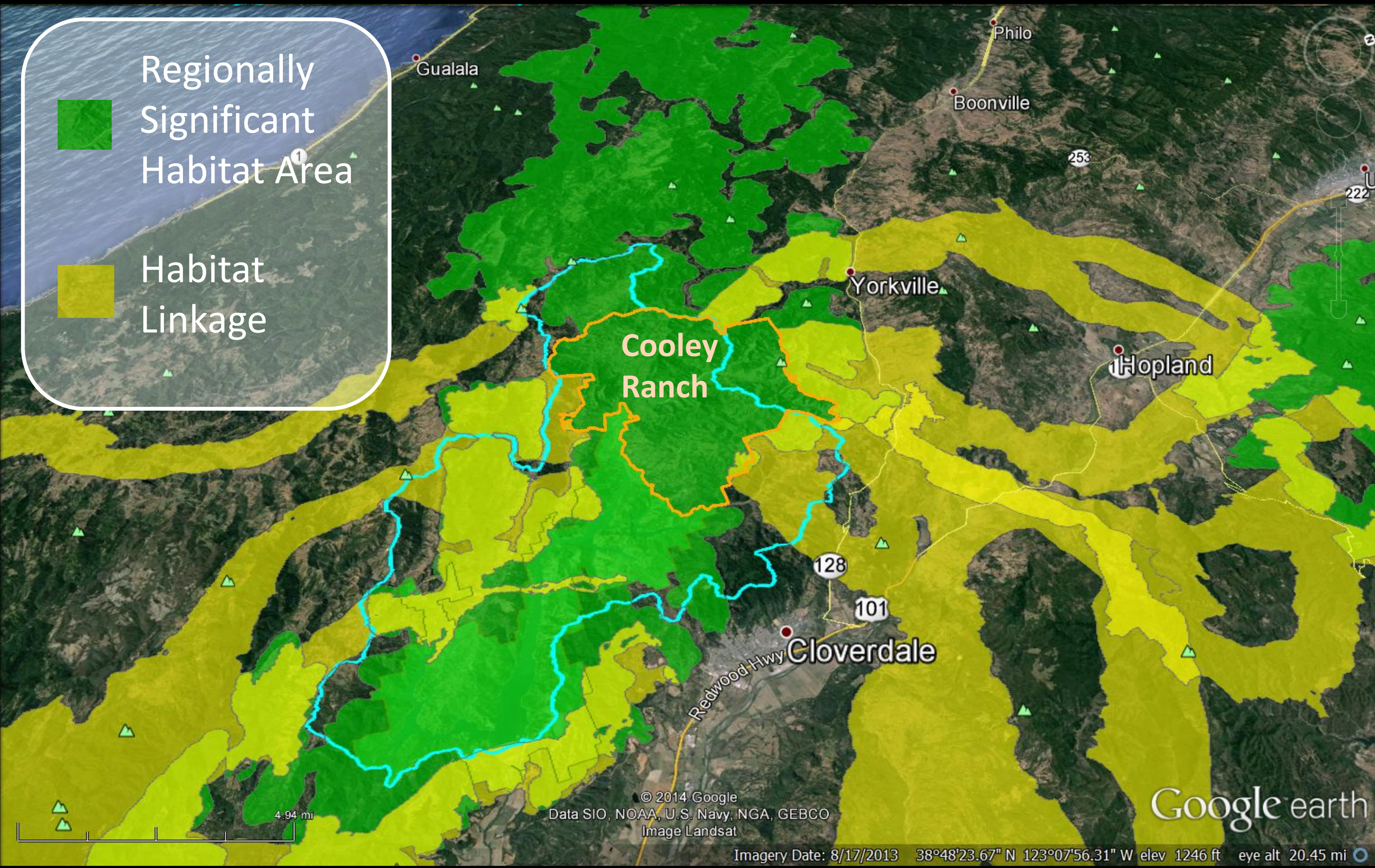


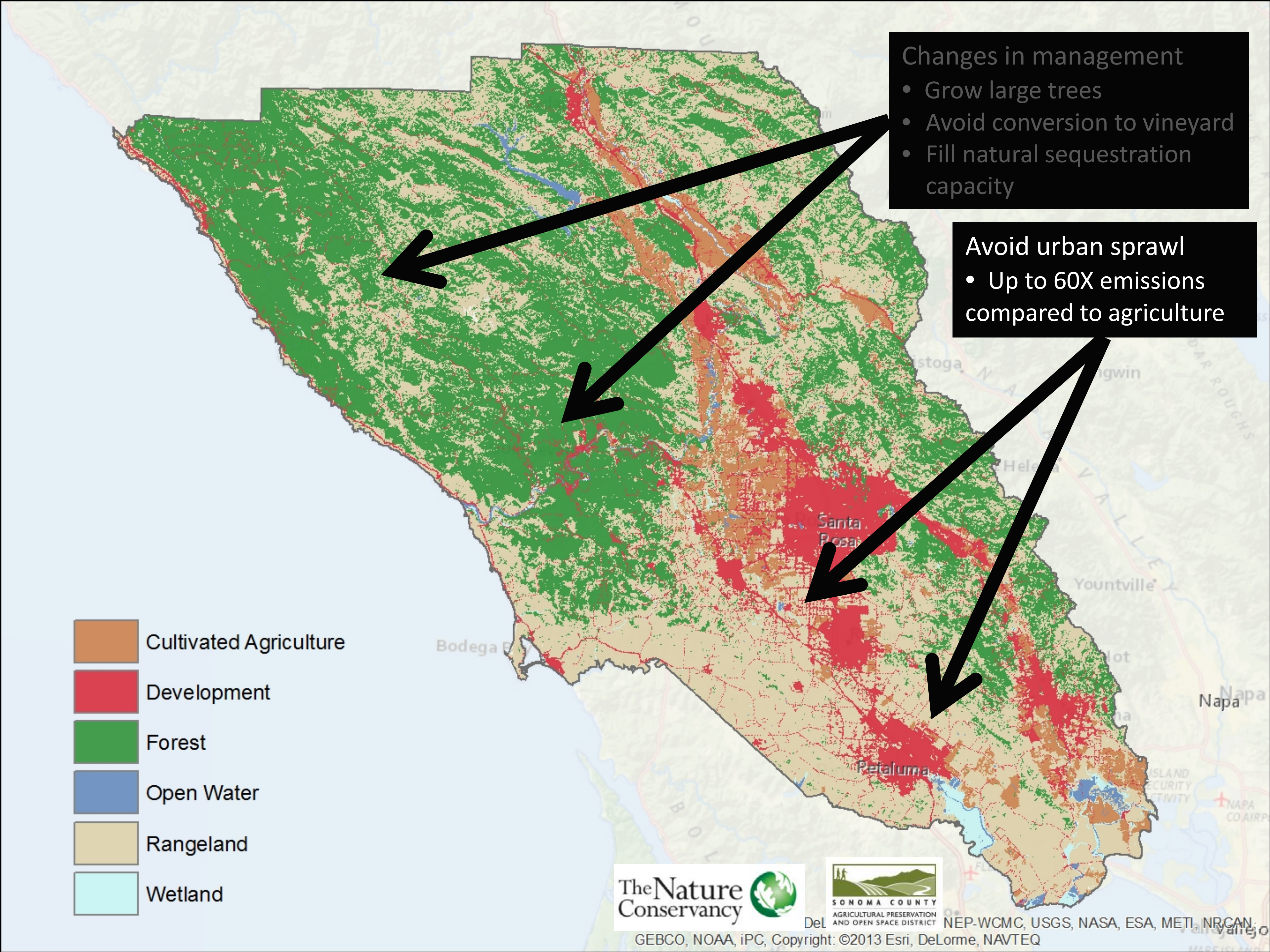
Sequestration potential

Where can conservation and policy actions help the ecosystem fill its natural sequestration capacity?

Avoided emissions

Where can we avoid the most emissions associated with a “no-conservation” future?

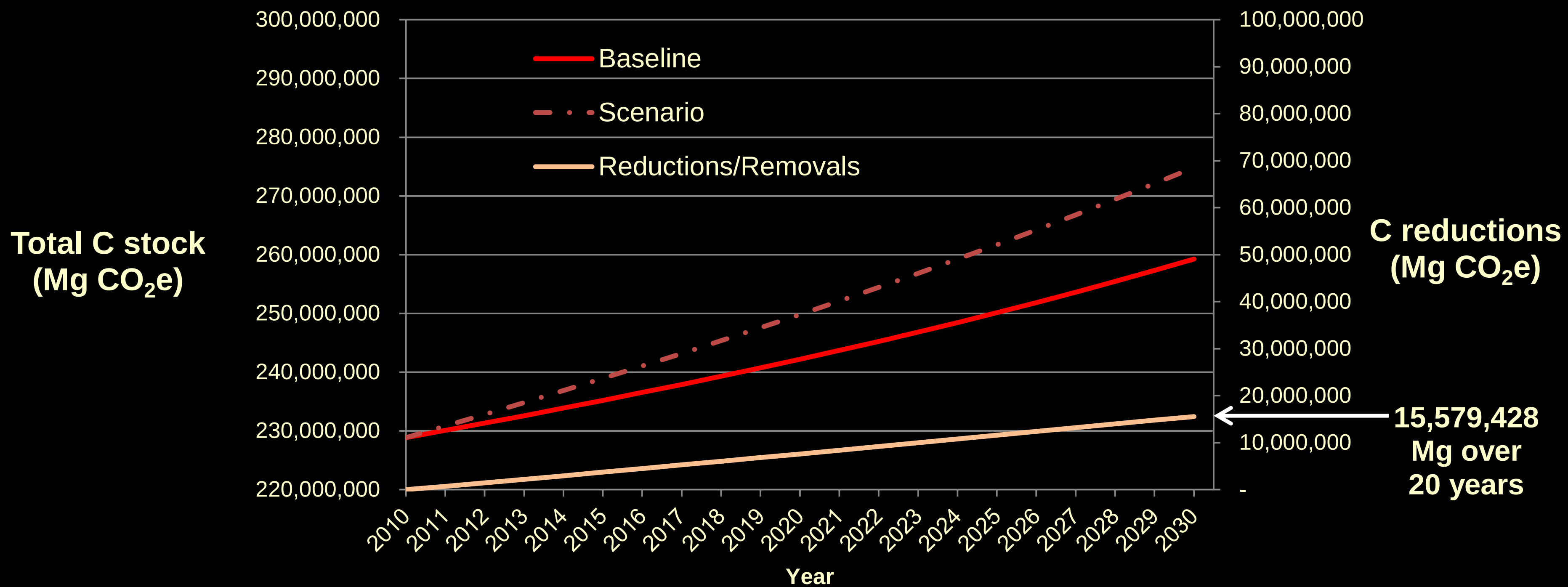

Regionally Significant Habitat Area
Habitat Linkage
Cooley Ranch
Gualala
Philo
Boonville
Yorkville
Hopland
Cloverdale
Redwood Hwy
253
128
101
4.94 mi
© 2014 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Google earth
Imagery Date: 8/17/2013 38°48'23.67" N 123°07'56.31" W elev 1246 ft eye alt 20.45 mi

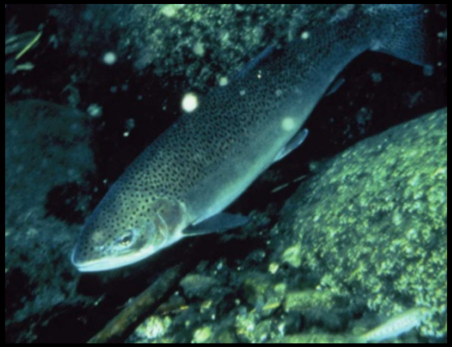


Changes in management
• Grow large trees
• Avoid conversion to vineyard
• Fill natural sequestration capacity
Avoid urban sprawl
• Up to 60X emissions compared to agriculture
Santa Rosa
Petaluma
Yountville
Napa
Cultivated Agriculture
Development
Forest
Open Water
Rangeland
Wetland
The Nature Conservancy
SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
NEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC, Copyright: ©2013 Esri, DeLorme, NAVTEQ

GHG Baseline and Reduction Scenario

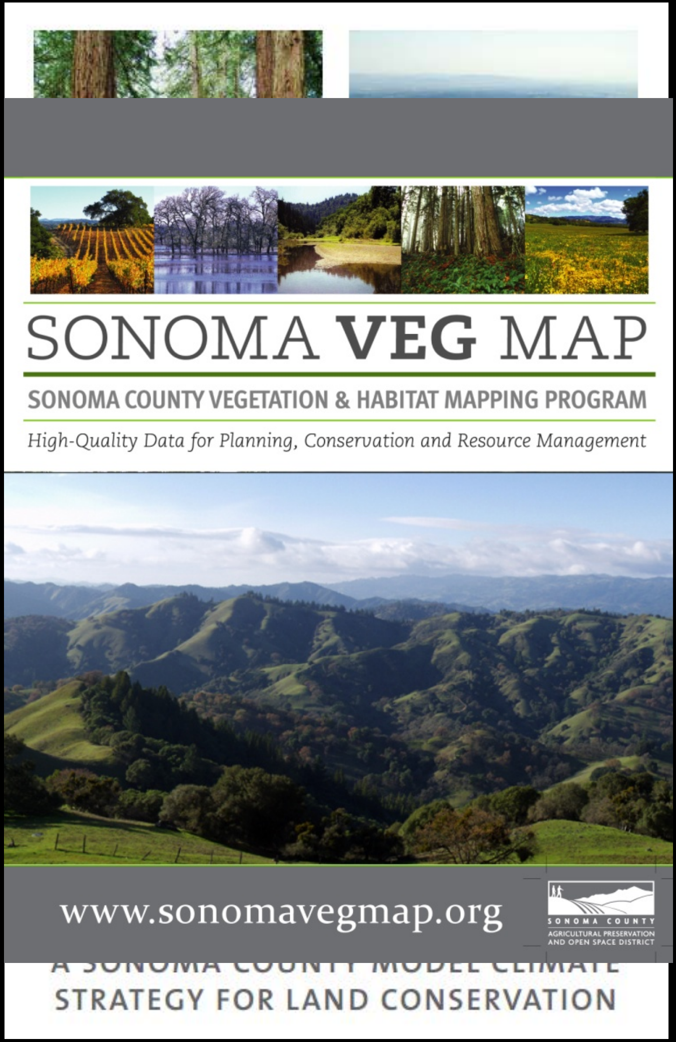
Scenario	Action



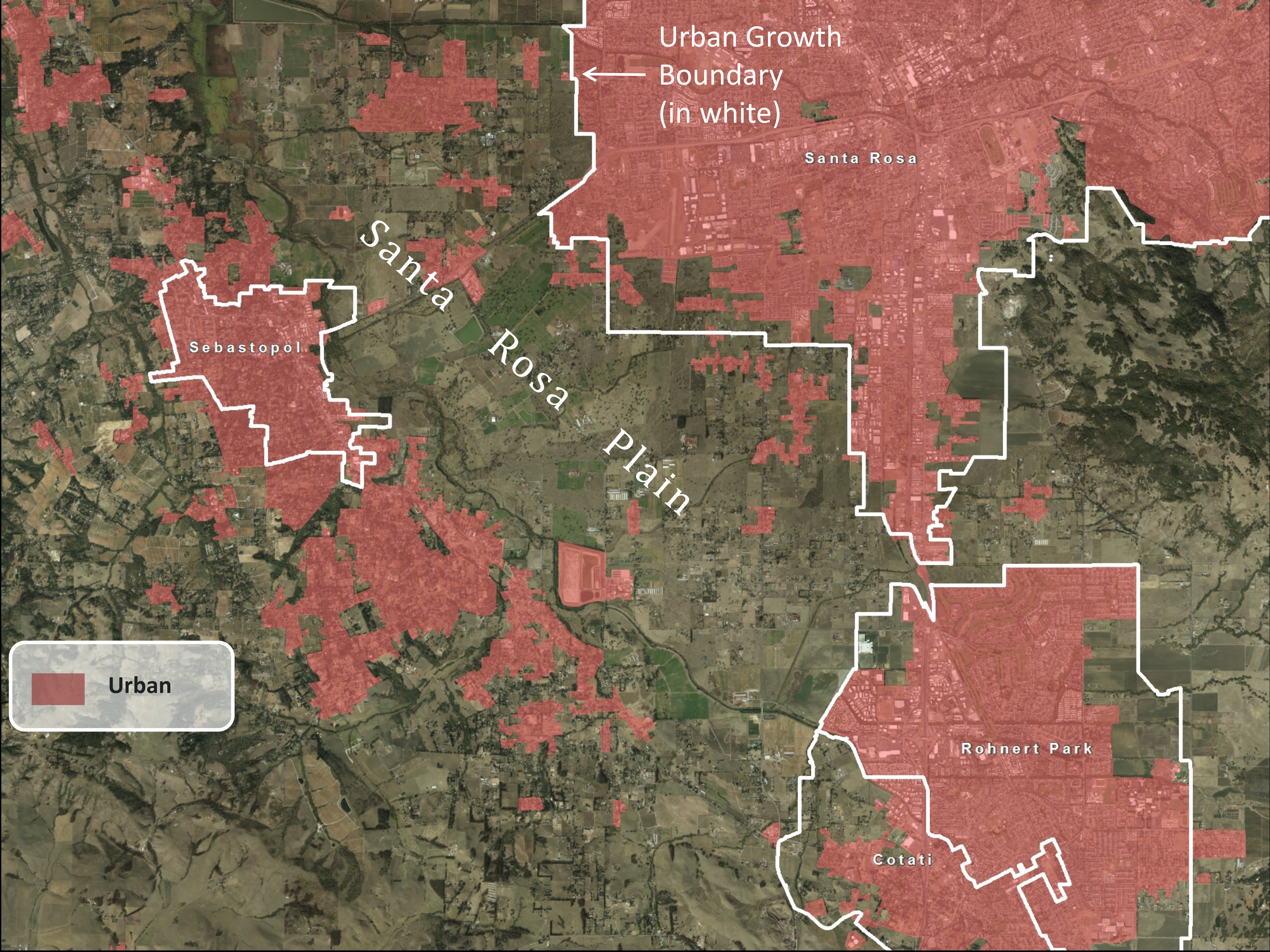


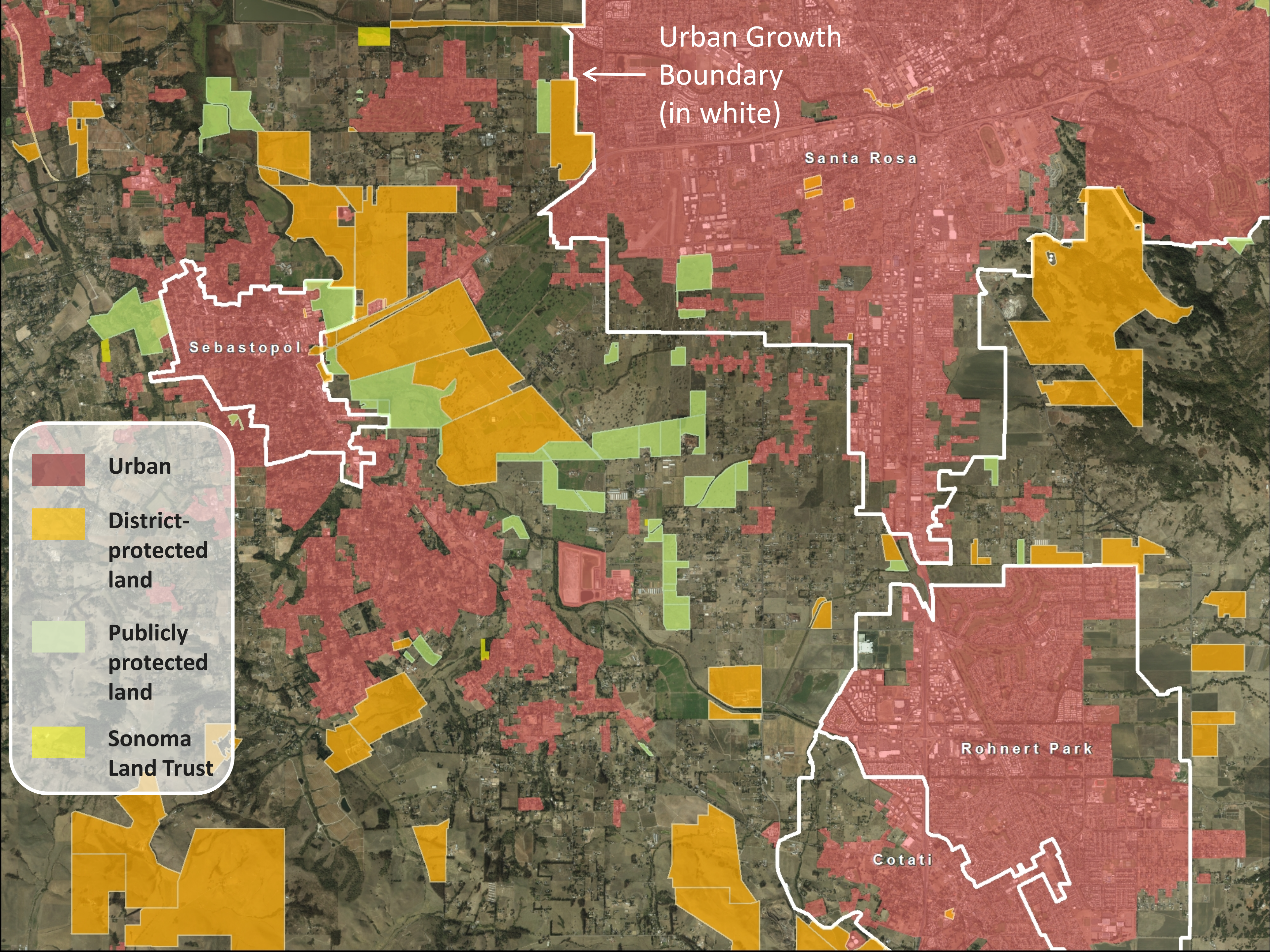
Data and Tools

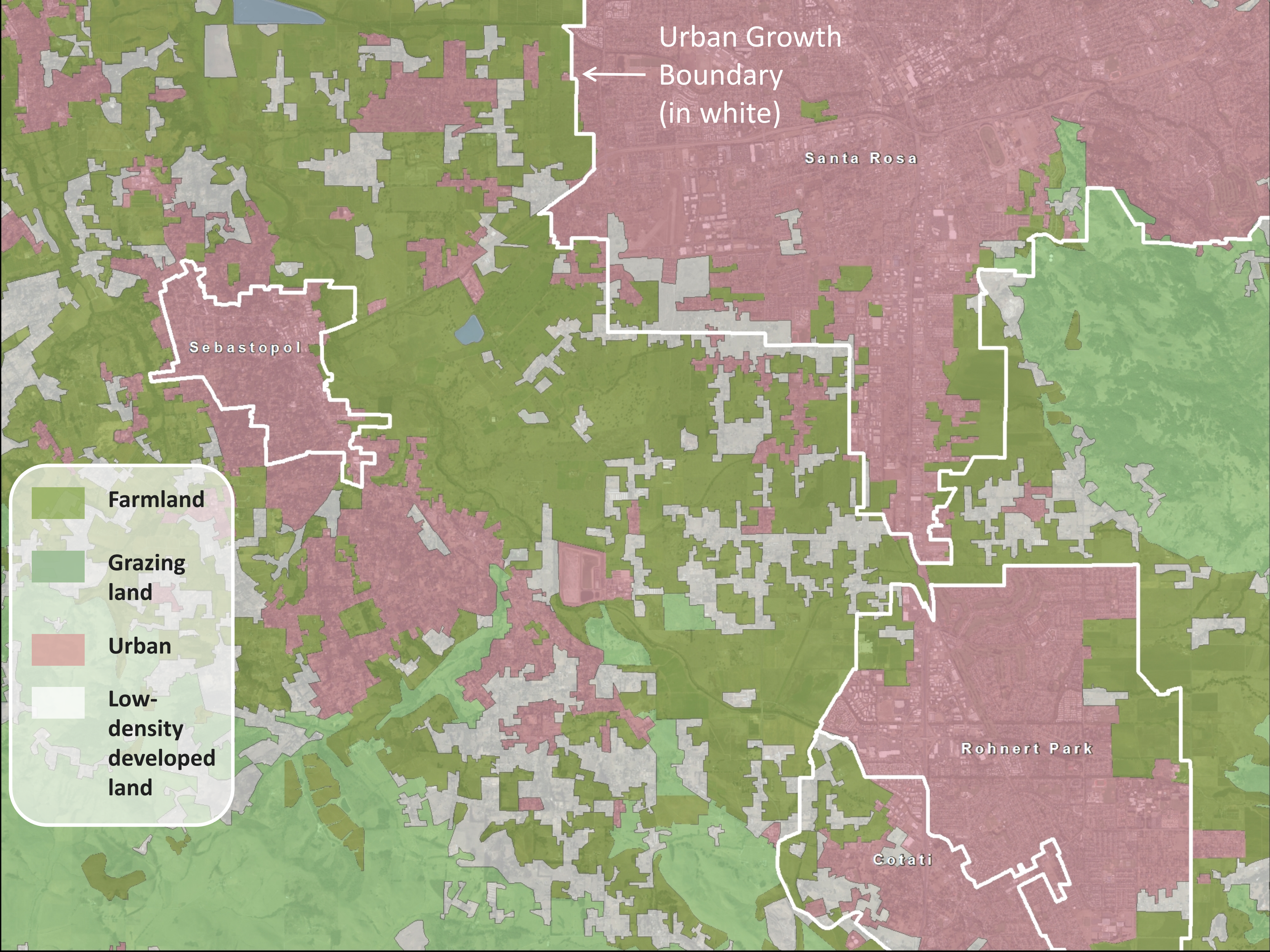
1. Climate Action Through Conservation
2. UrbanFootprint + Rural Conservation Module
3. Sonoma County Vegetation Mapping and LiDAR Program



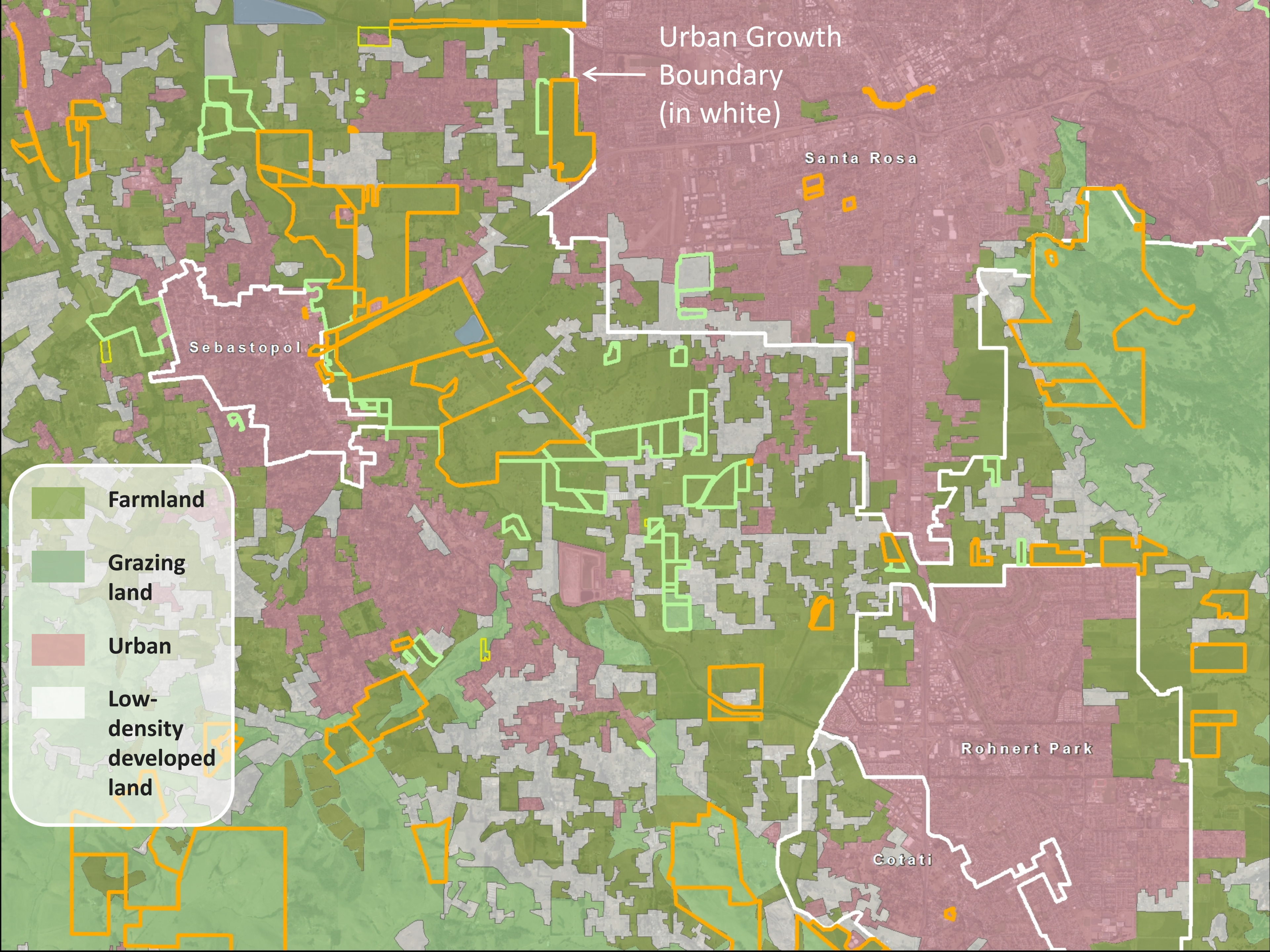
Climate Action Through Conservation


Urban Growth
Boundary
(in white)
Santa Rosa
Sebastopol
Santa Rosa Plain
Rohnert Park
Cotati
Urban

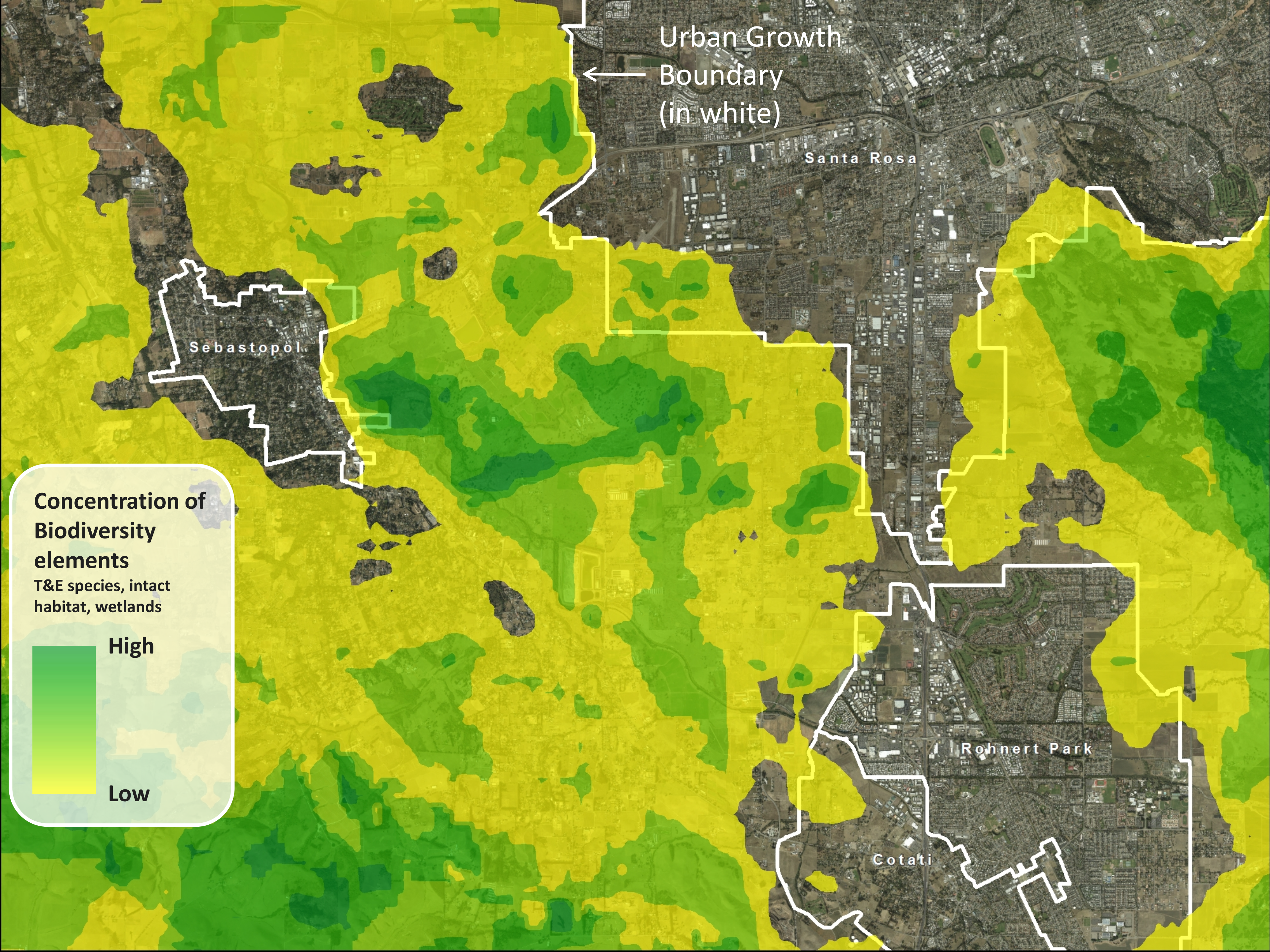

Urban Growth
Boundary
(in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Urban
District-
protected
land
Publicly
protected
land
Sonoma
Land Trust

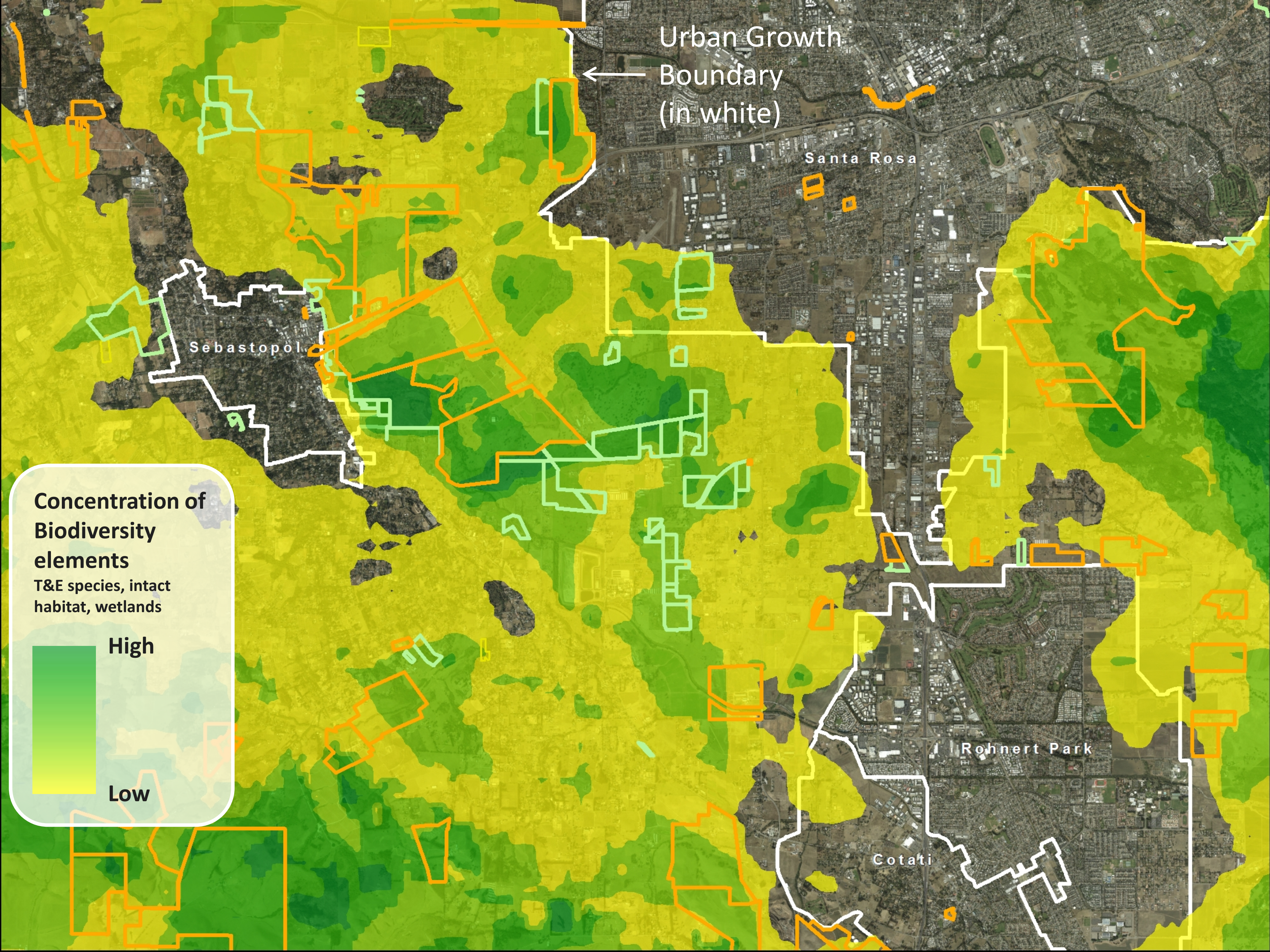


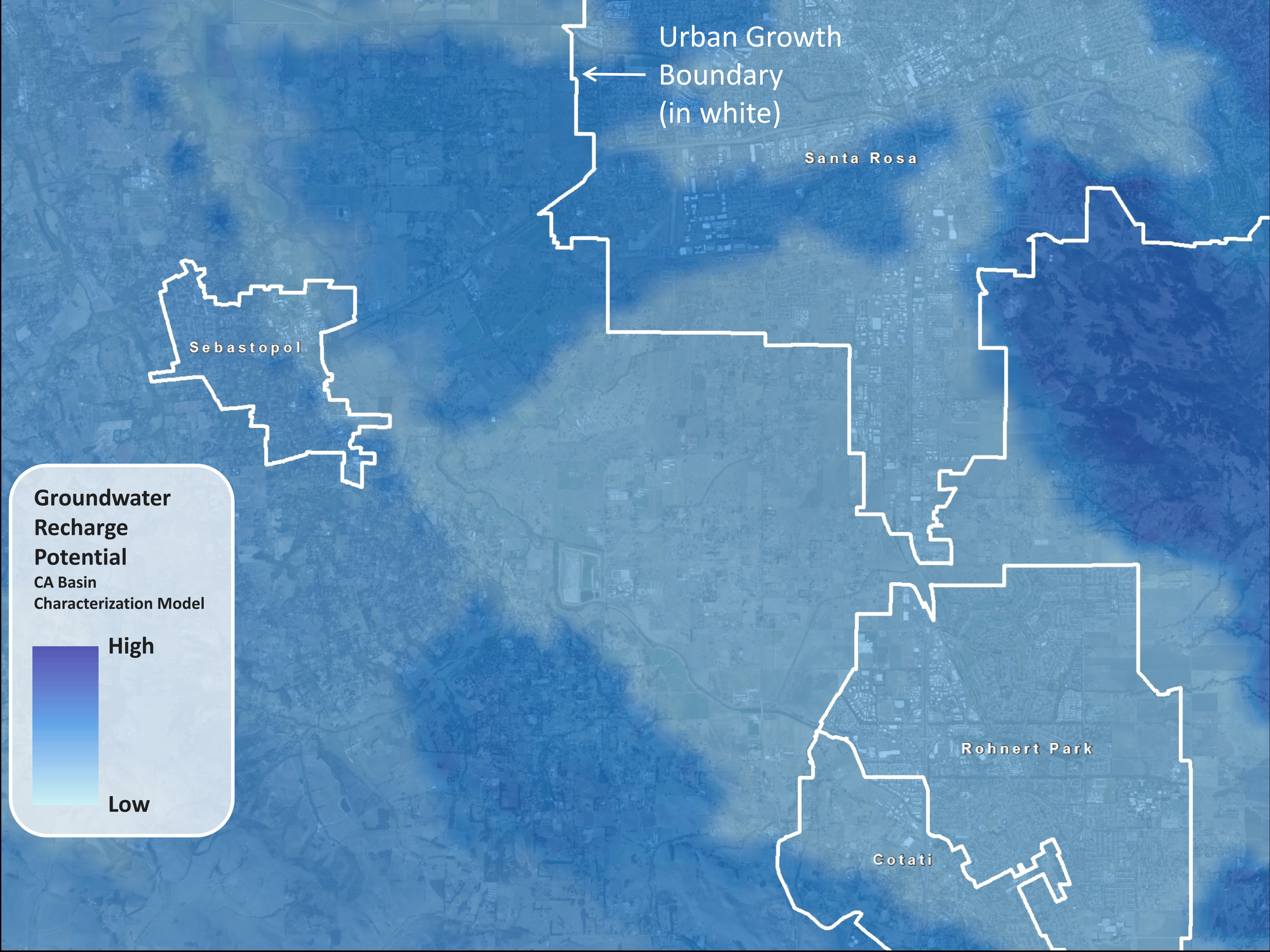
Urban Growth
Boundary
(in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Farmland
Grazing land
Urban
Low-density developed land

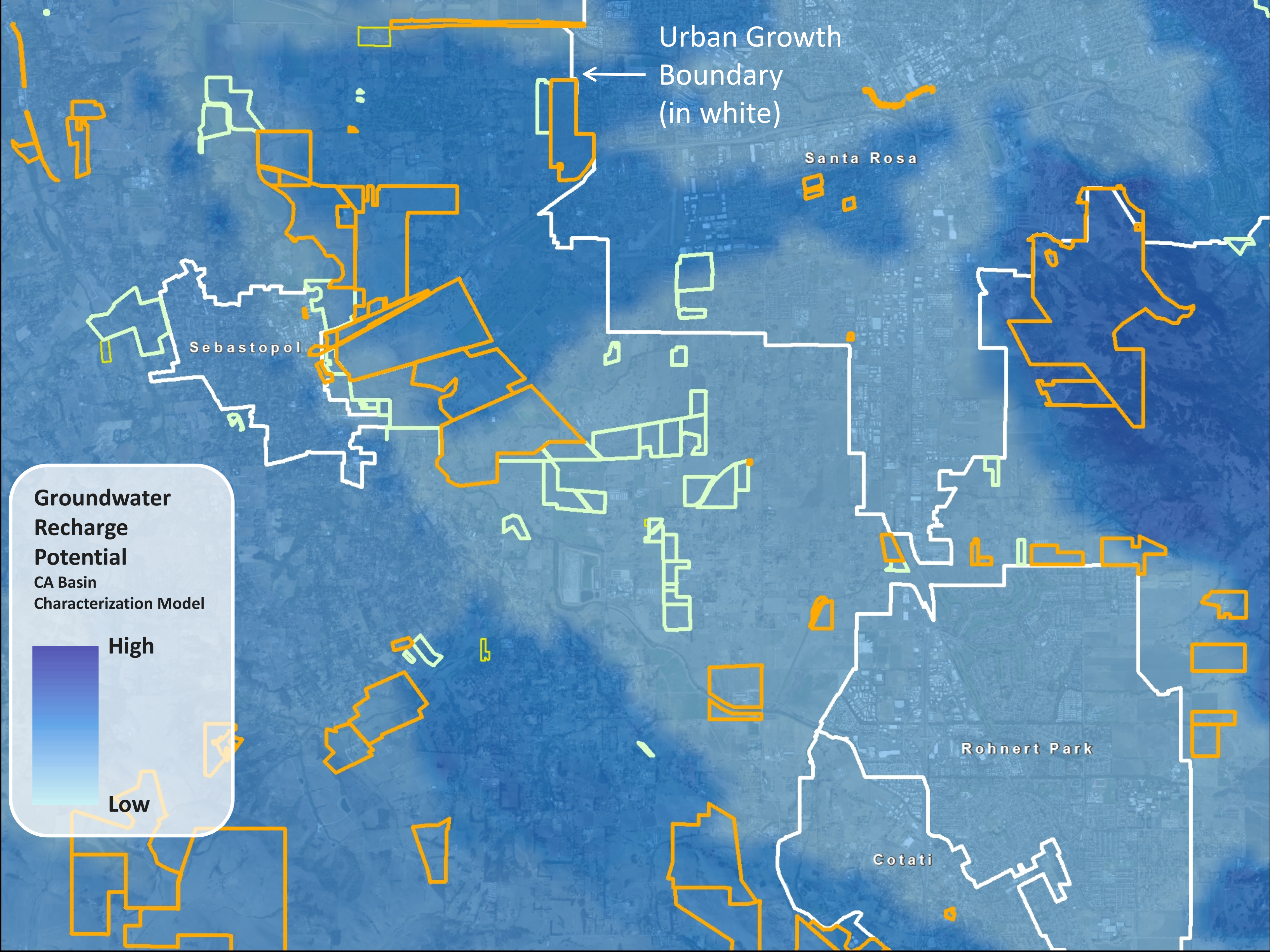


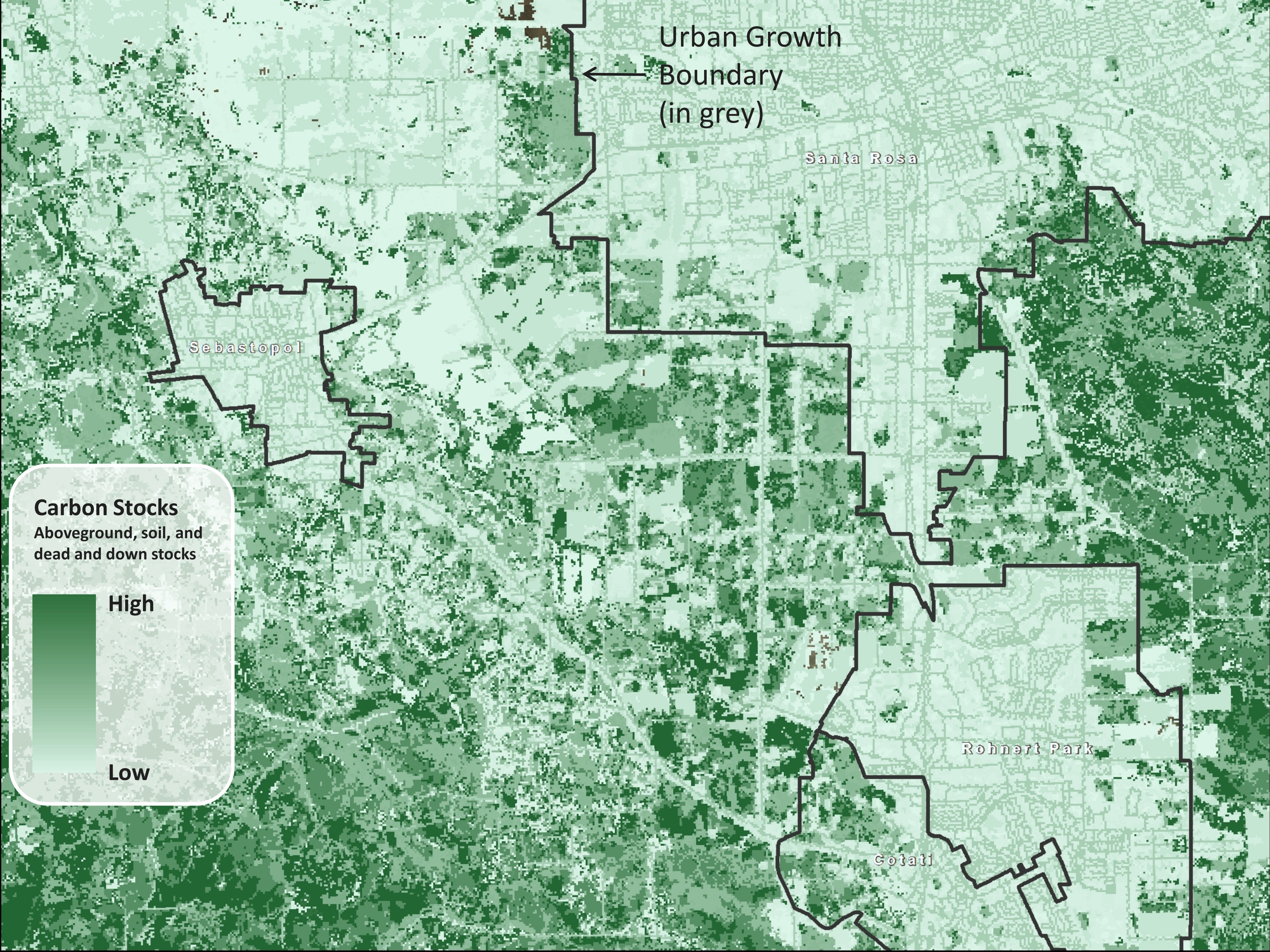
Urban Growth
Boundary
(in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Farmland
Grazing land
Urban
Low-density developed land

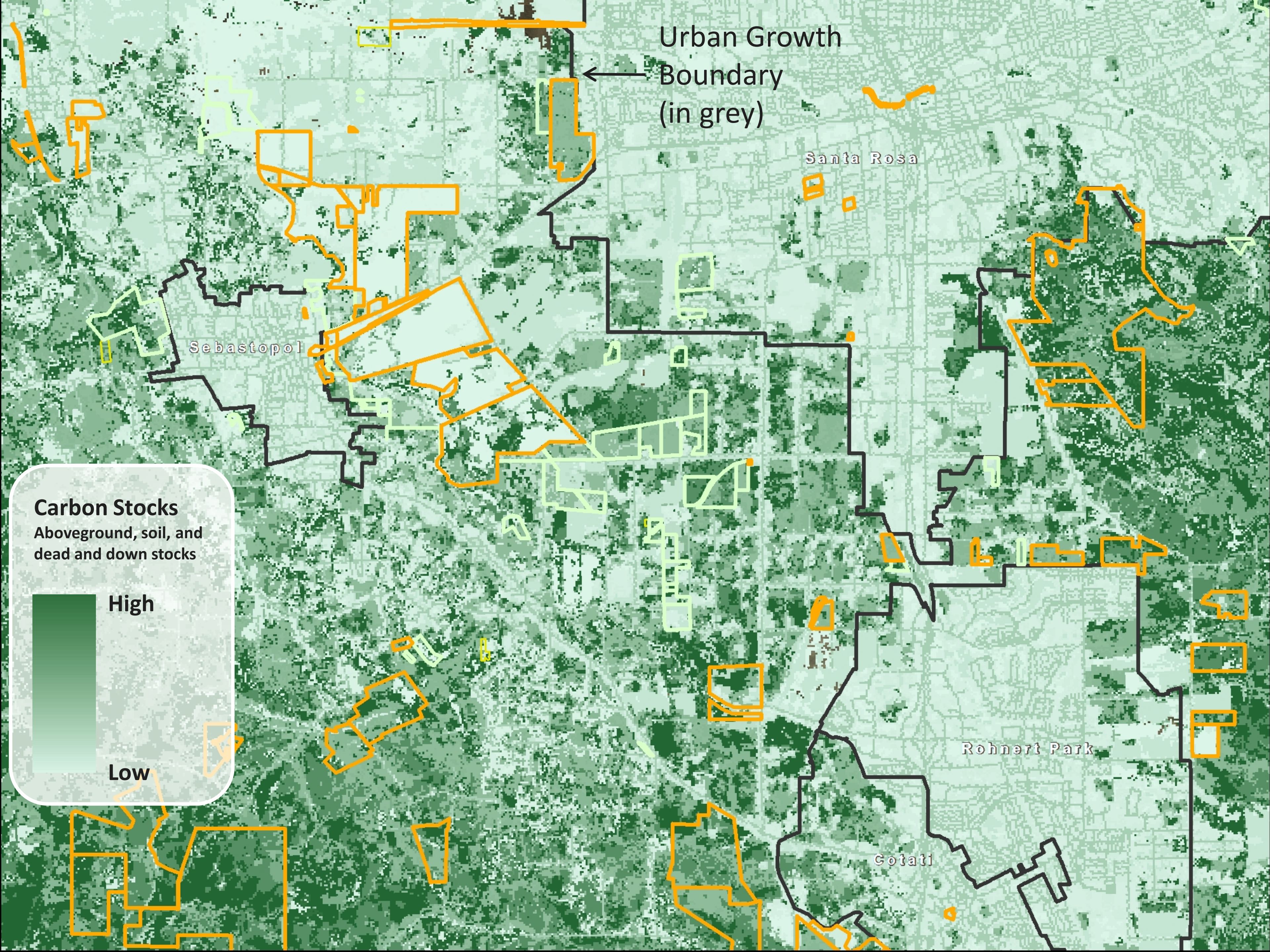

Urban Growth
Boundary
(in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Concentration of
Biodiversity
elements
T&E species, intact
habitat, wetlands
High
Low


Urban Growth Boundary (in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Concentration of Biodiversity elements
T&E species, intact habitat, wetlands
High
Low


Urban Growth Boundary (in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Groundwater Recharge Potential
CA Basin Characterization Model
High
Low


Urban Growth Boundary (in white)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Groundwater Recharge Potential
CA Basin Characterization Model
High
Low

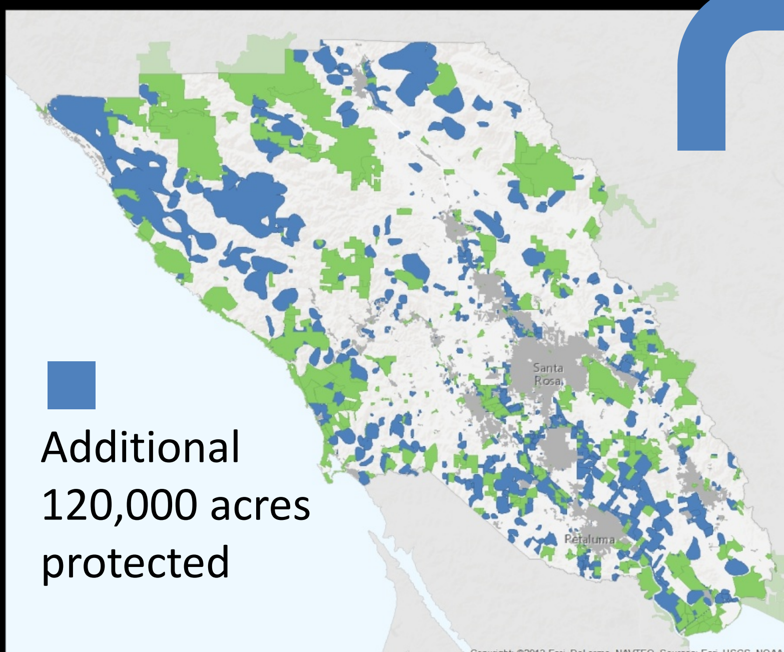

Urban Growth Boundary (in grey)
Santa Rosa
Sebastopol
Rohnert Park
Cotati
Carbon Stocks
Aboveground, soil, and dead and down stocks
High
Low

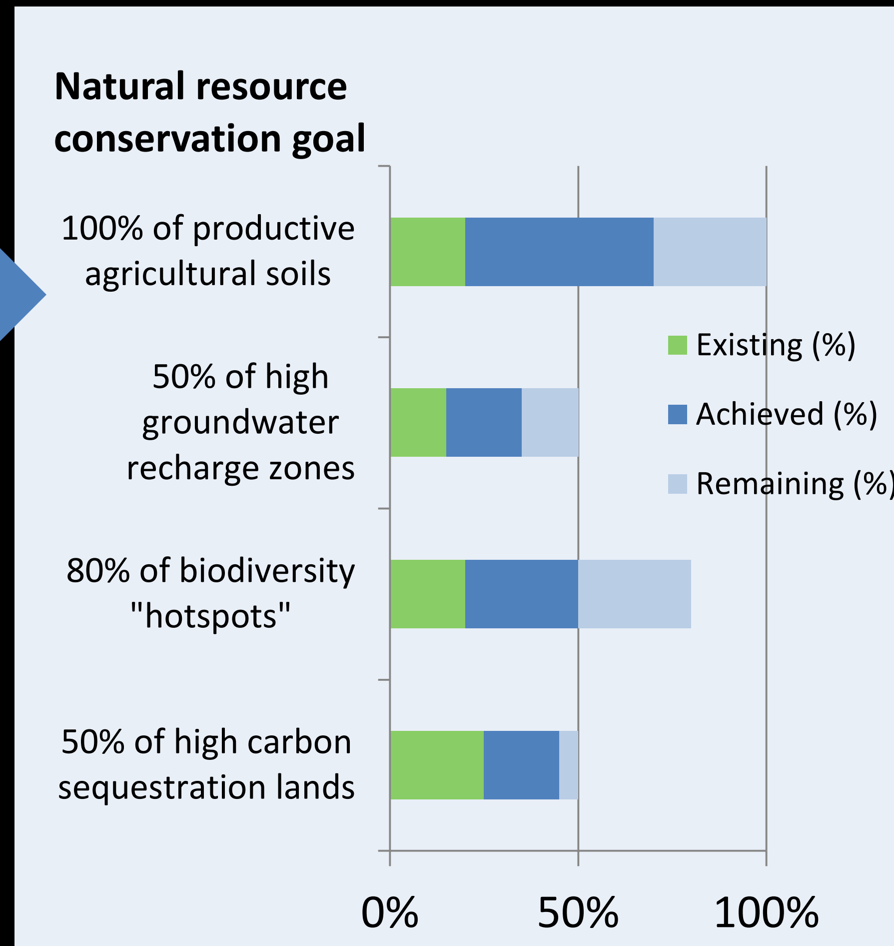


Urban Growth Boundary (in grey)
Santa Rosa
Sebastopol
Carbon Stocks
Aboveground, soil, and dead and down stocks
High
Low
Rohnert Park
Cotati

Reporting – Conservation goals

GIS-based carbon and conservation reporting tool





Uses

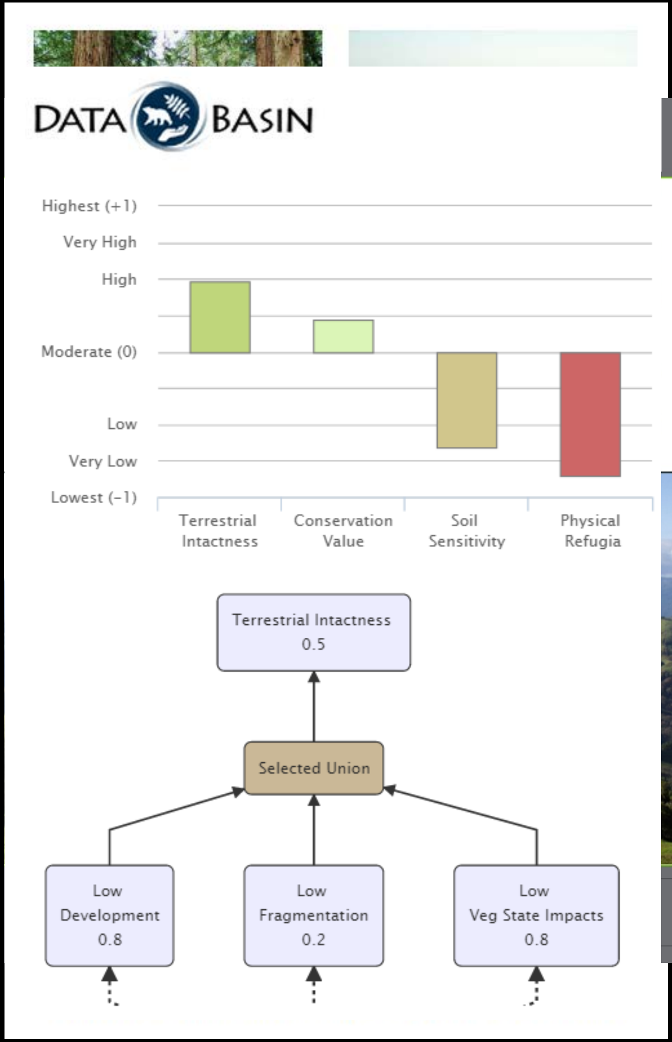
- Quantifying reduction opportunities from conservation activities that also secure the natural resources we need for food production, water, and the local economy <<incentives>>

- Evaluate conservation projects for granting agencies (e.g., SALCP) <<more than checking a box>>

- Setting countywide 2050 GHG reduction targets for natural lands

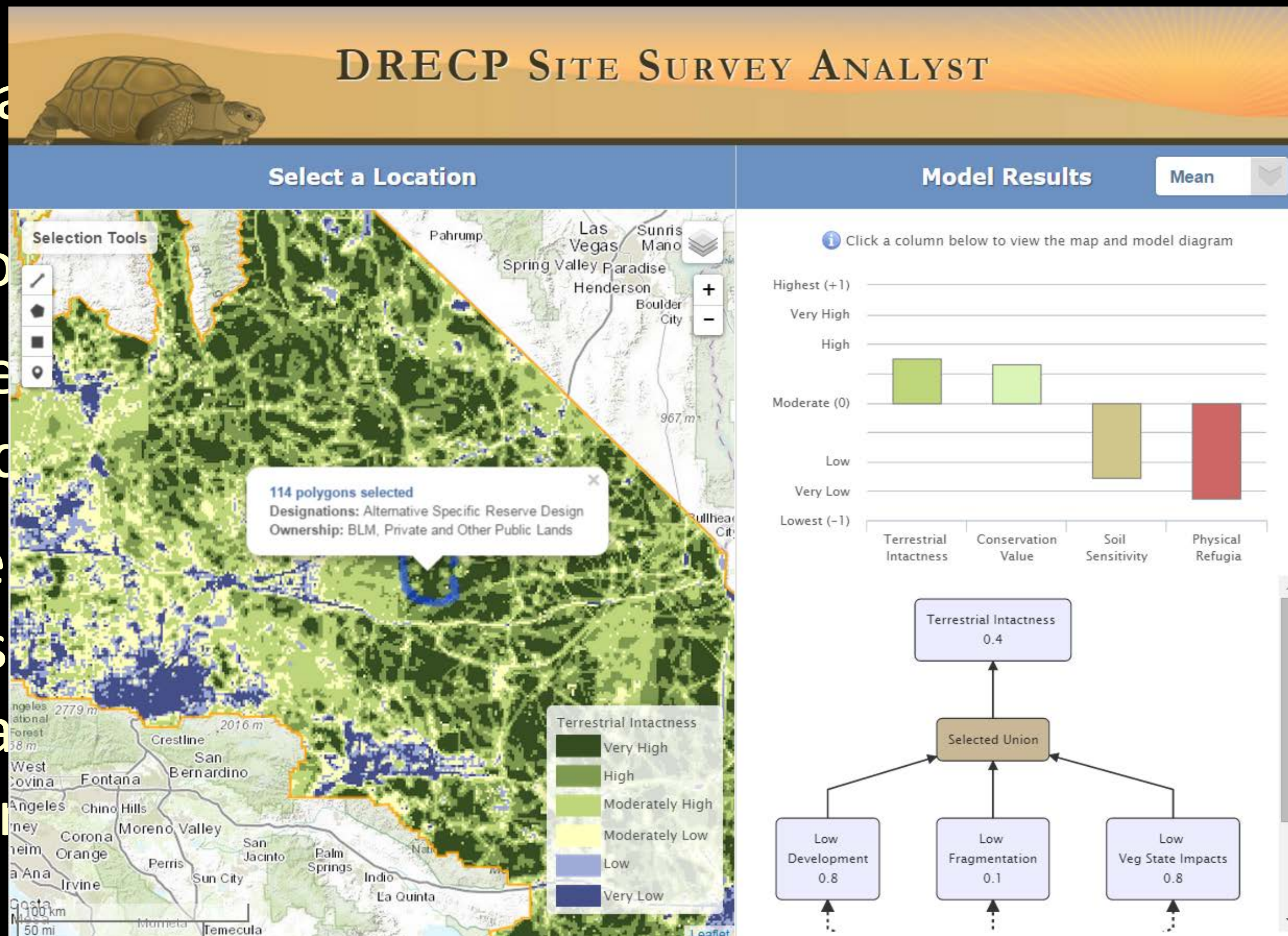
Data and Tools

1. Climate Action Through Conservation
2. UrbanFootprint + Rural Conservation Module
3. Sonoma County Vegetation Mapping and LiDAR Program
4. DataBasin and Environmental Evaluation Modeling System

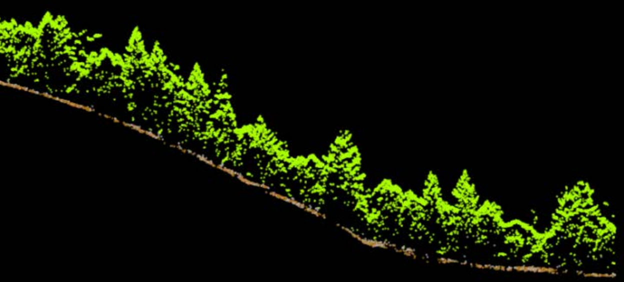


DataBasin and Environmental Evaluation Modeling System (EEMS)

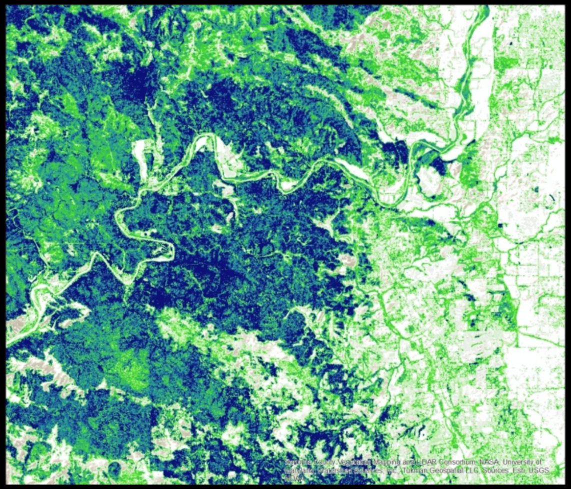
- Open, tra
decision
framewo
- Integrate
data, and
- Helps de
makers s
conserva
and prior



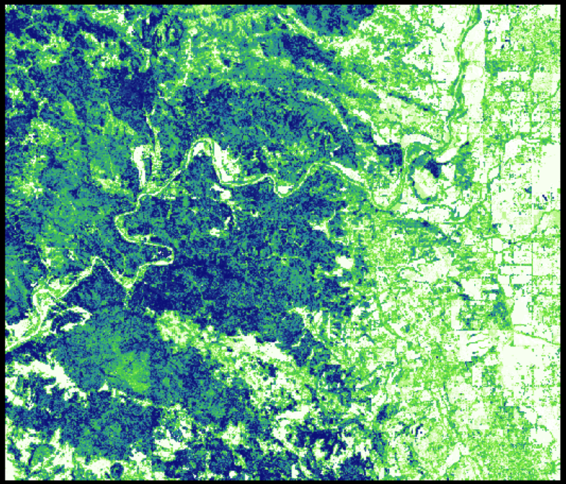
LiDAR-based Biomass Inventory



Point cloud



Vegetation Height



Biomass

- Vegetation height is key factor
- Field plots and relationships of tree dimensions with biomass
- Estimates are based on 1-meter LiDAR data versus 30-meter Landsat-based vegetation classes

+ Rural Conservation Module

- Quantifies the non-built environment
- Captures natural resource & agriculture metrics

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT

SACOG

The Nature Conservancy — Protecting nature. Preserving life.™

American Farmland Trust — Saving the Land that Sustains Us

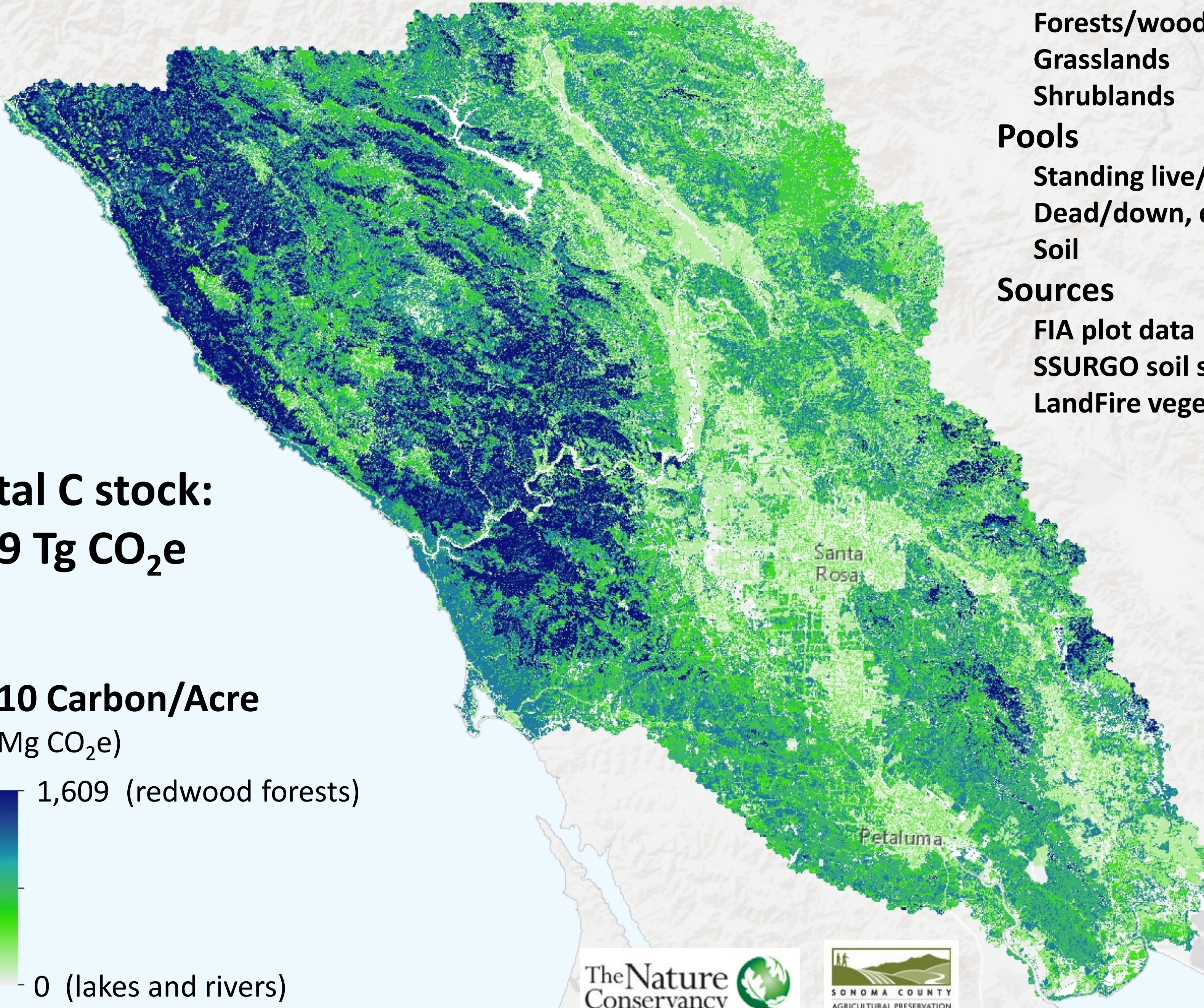
CALTHORPE ASSOCIATES — URBAN DESIGNERS, PLANNERS, ARCHITECTS

Stocks
- Forests/woodlands
- Grasslands
- Shrublands

Pools
- Standing live/dead
- Dead/down, duff, litter
- Soil

Sources
- FIA plot data
- SSURGO soil survey
- LandFire vegetation

Total C stock: 229 Tg CO_2e



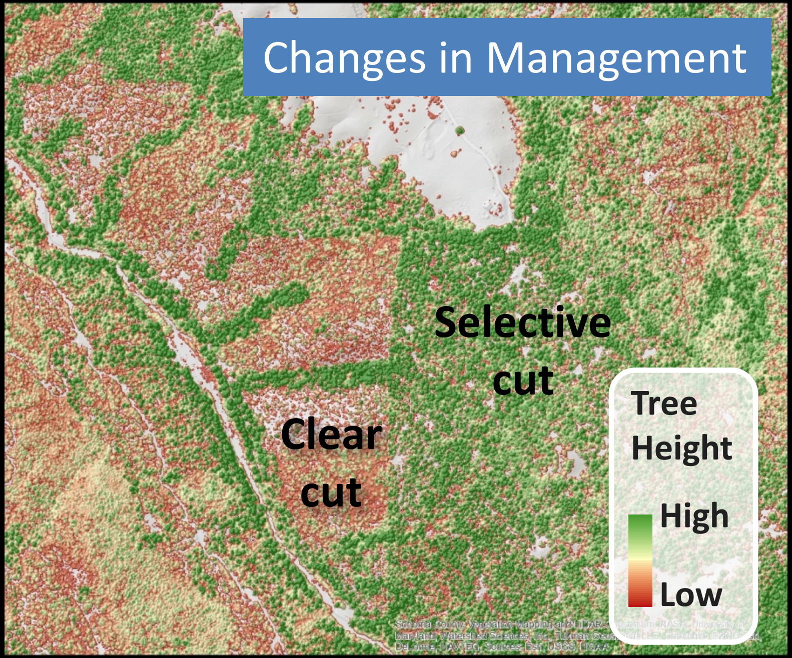
2010 Carbon/Acre
(in Mg CO_2e)

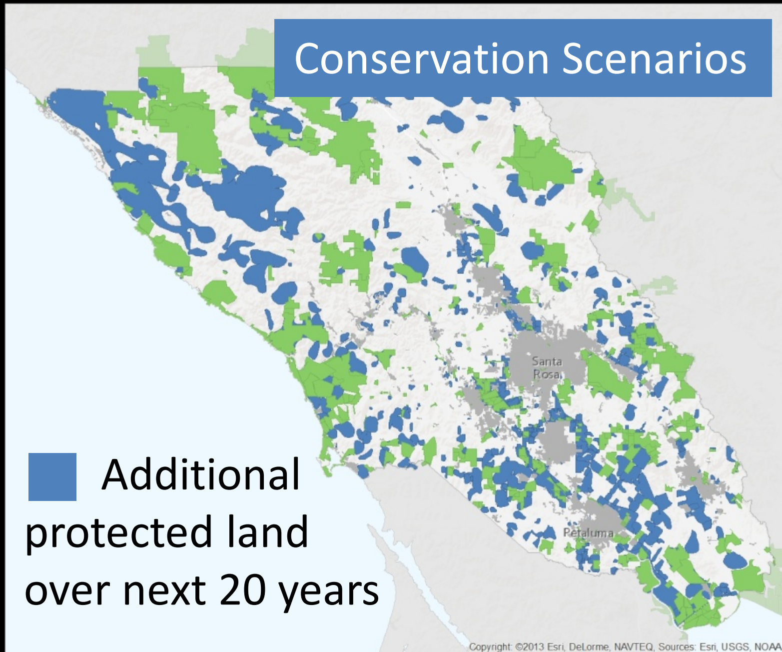
1,609 (redwood forests)

0 (lakes and rivers)

Climate Action Through Conservation

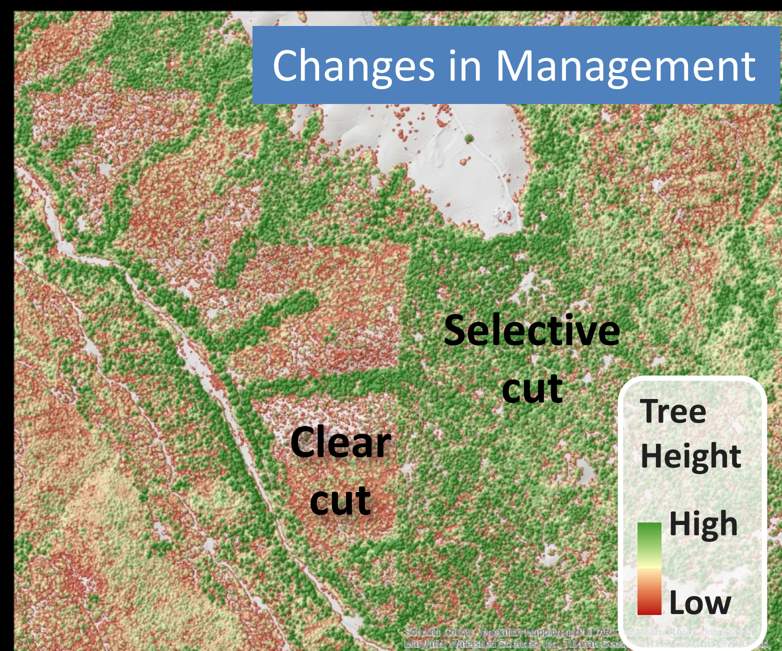
Accounting GHG reductions and sequestration potential of land conservation activities at the jurisdiction-level





Climate Action Through Conservation

Accounting GHG reductions and sequestration potential of land conservation activities at the jurisdiction-level



Conservation Values

Agriculture

+

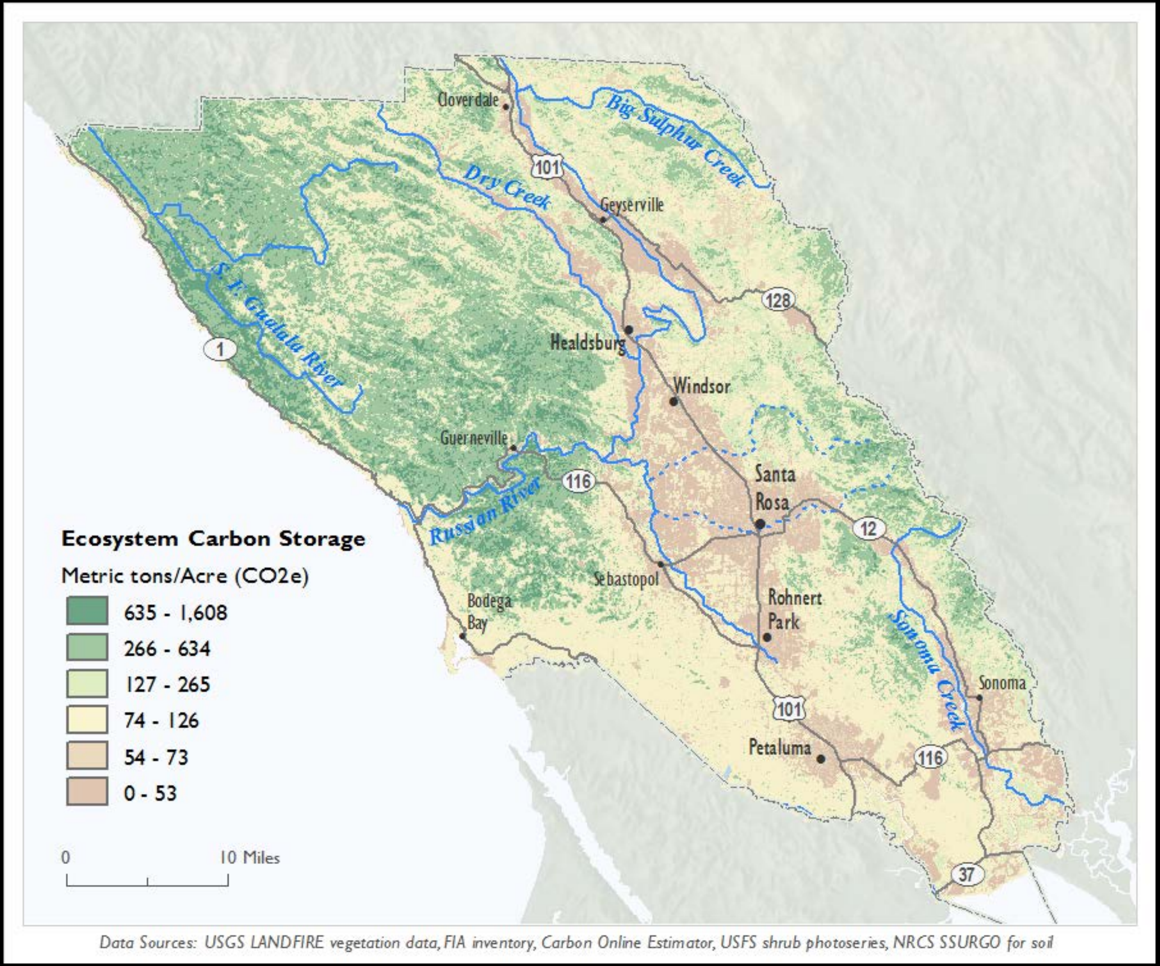
Biodiversity

+

Water resources

+

Carbon sequestration



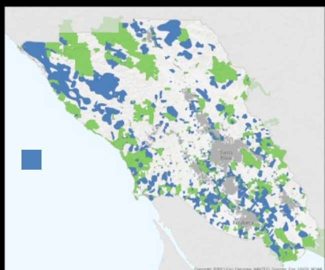
Two integrated analysis elements

Land-based carbon inventory and accounting framework

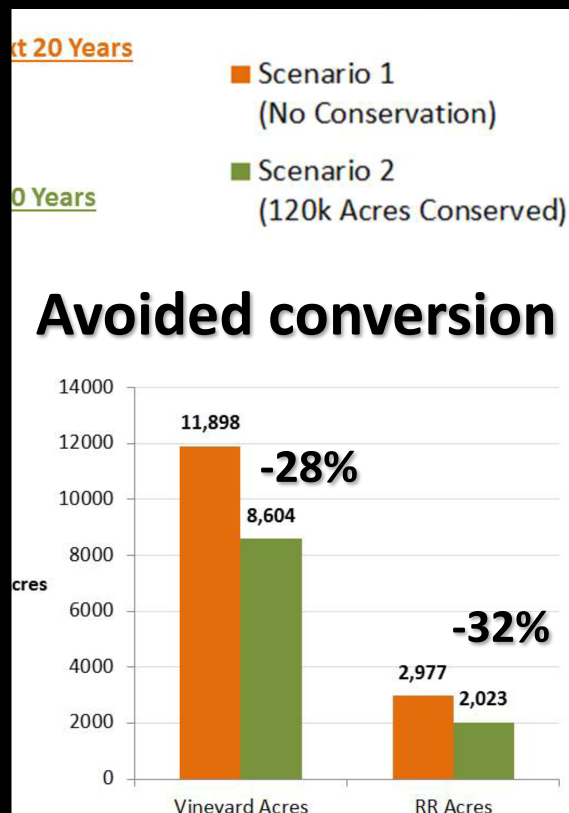
↕

Conservation values assessment (agriculture, water, habitat, recreation)

Reporting – GHG reductions

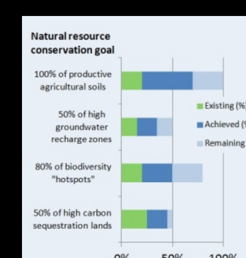


Run scenarios using BAU development patterns



Reports

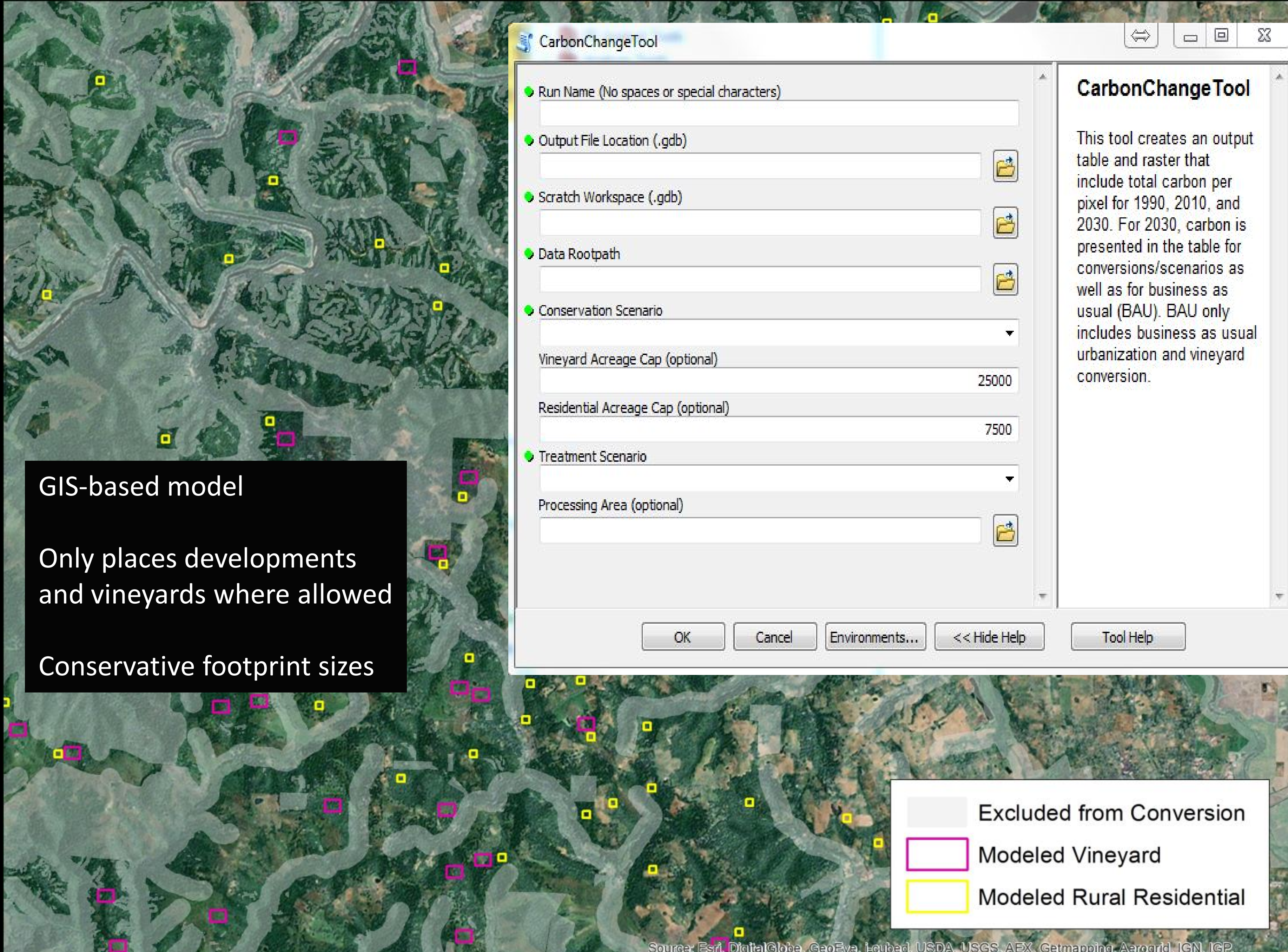
1. GHG reductions: **0.8 Tg** CO_2e over 20 years
2. Conservation co-benefit goals



GIS-based model

Only places developments and vineyards where allowed

Conservative footprint sizes



Planning and Assessment of Forest Resources in a Changing Climate

Chris Keithley, PhD

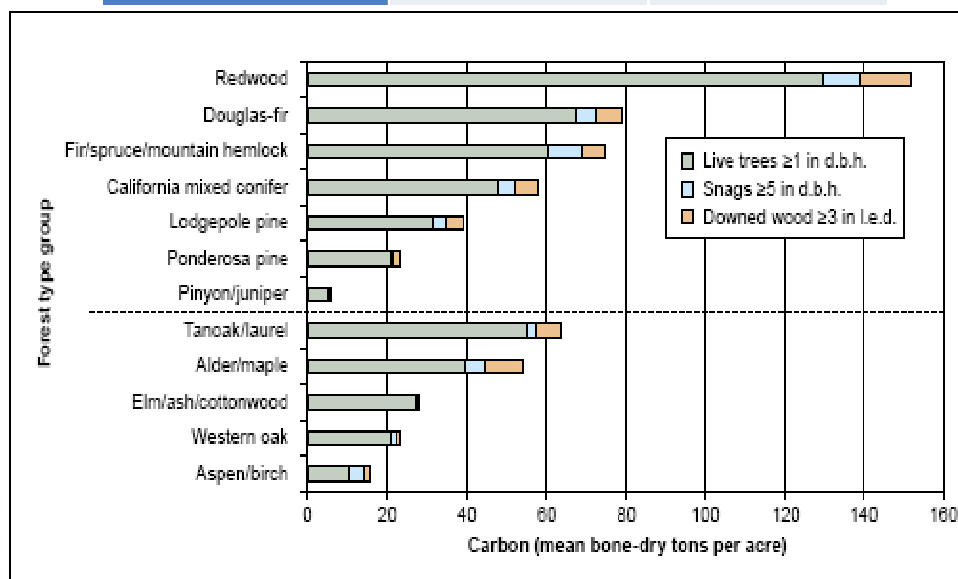
CALFIRE
Fire and Resource Assessment Program

August 5, 2015

California Forest Land Base

California forestland ownership.

Ownership Category	Acres of Forestland	Percentage
Private	13,131,000	39.3 %
Federal	19,171,000	57.4 %
State	711,000	2.1 %
Local	374,000	1.1 %
Total	33,387,000	100 %

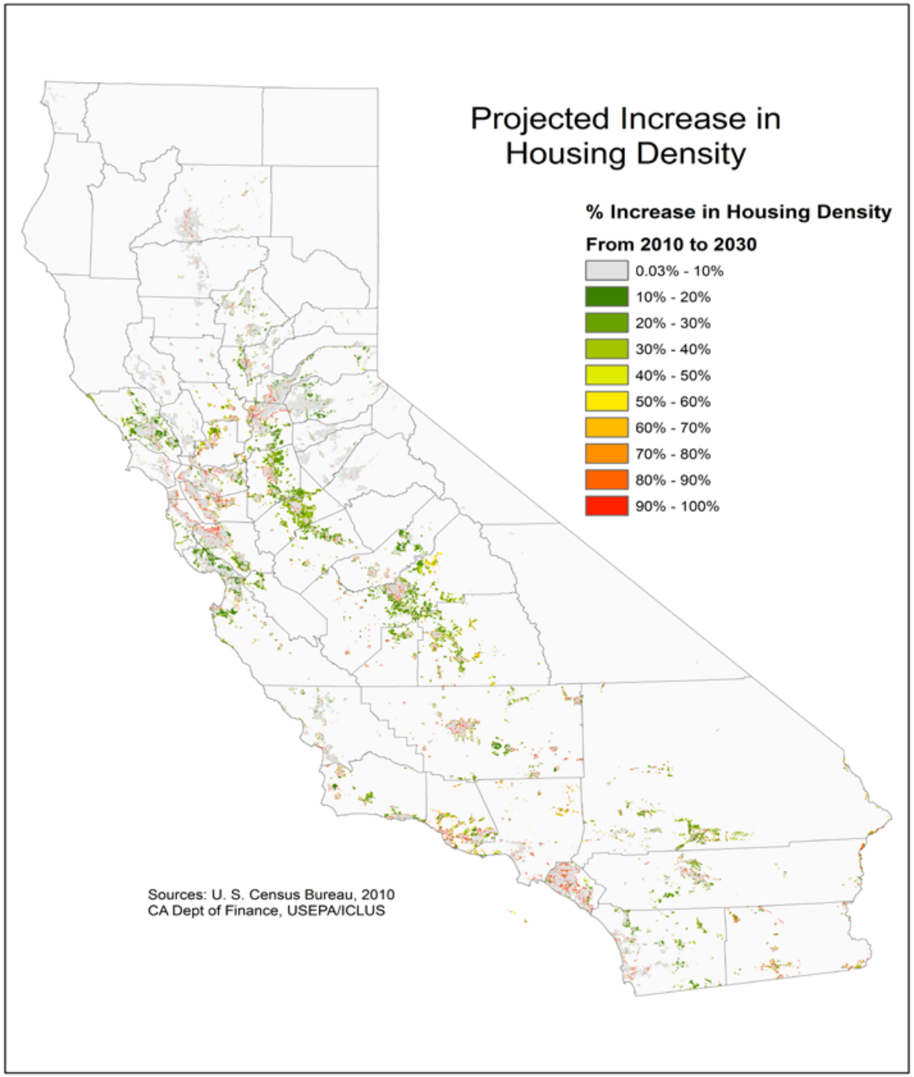


Climate Change Impacts on Forests

FACTOR	DESCRIPTION
Hydrologic	Changes in temperature, precipitation, and hydrologic processes (i.e. decreased snow pack, earlier spring runoff, lower summer base flows).
Fire	Changes in the extent and frequency of disturbances from wildfires, pests, and disease outbreaks.
Biologic	Conditions may favor the spread of invasive species.
Biologic	Tree species expected to move northward or to higher altitudes.
Biologic	Changes in reforestation and regeneration success.
Biologic	Changes in forest productivity affecting growth and carbon storage. The effect of additional CO_2 on forest productivity is uncertain.
Economic	Economic impacts from increased fire damage and fire suppression costs.

Projected Development
(2010 – 2030)

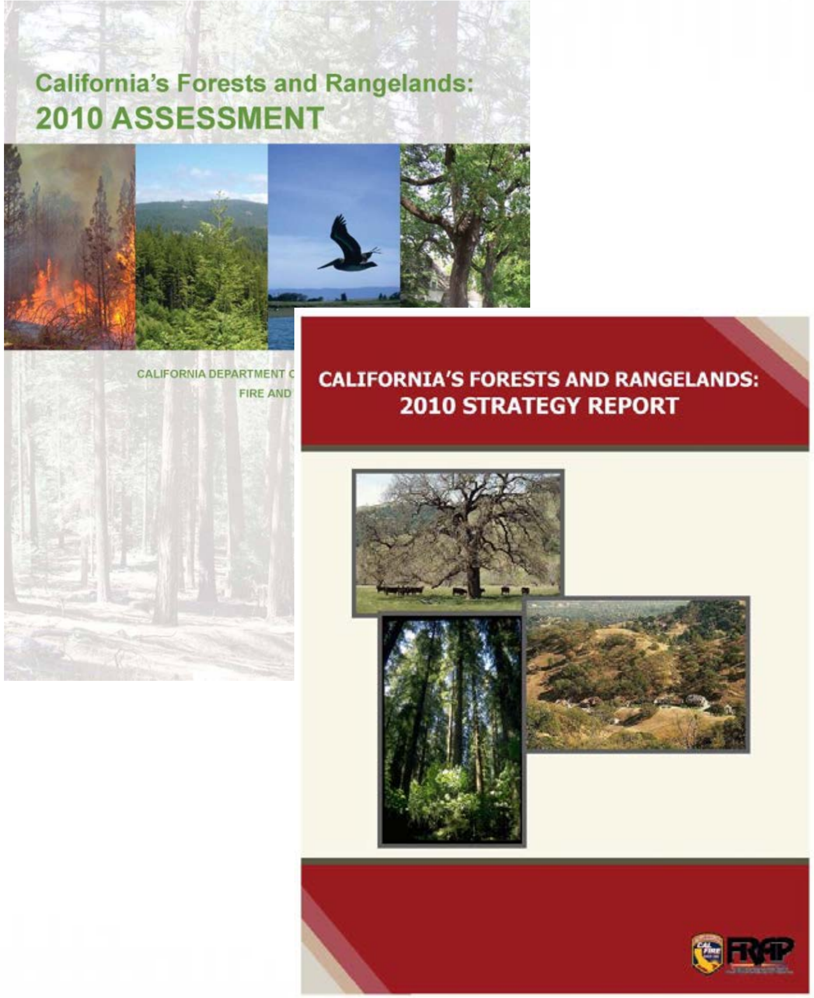
- Areas of projected development (2010 – 2030) are clustered in different regions.
- Projected development is more likely to occur in agriculture and rangelands.
- A strategic framework for investing in conservation lands is needed.



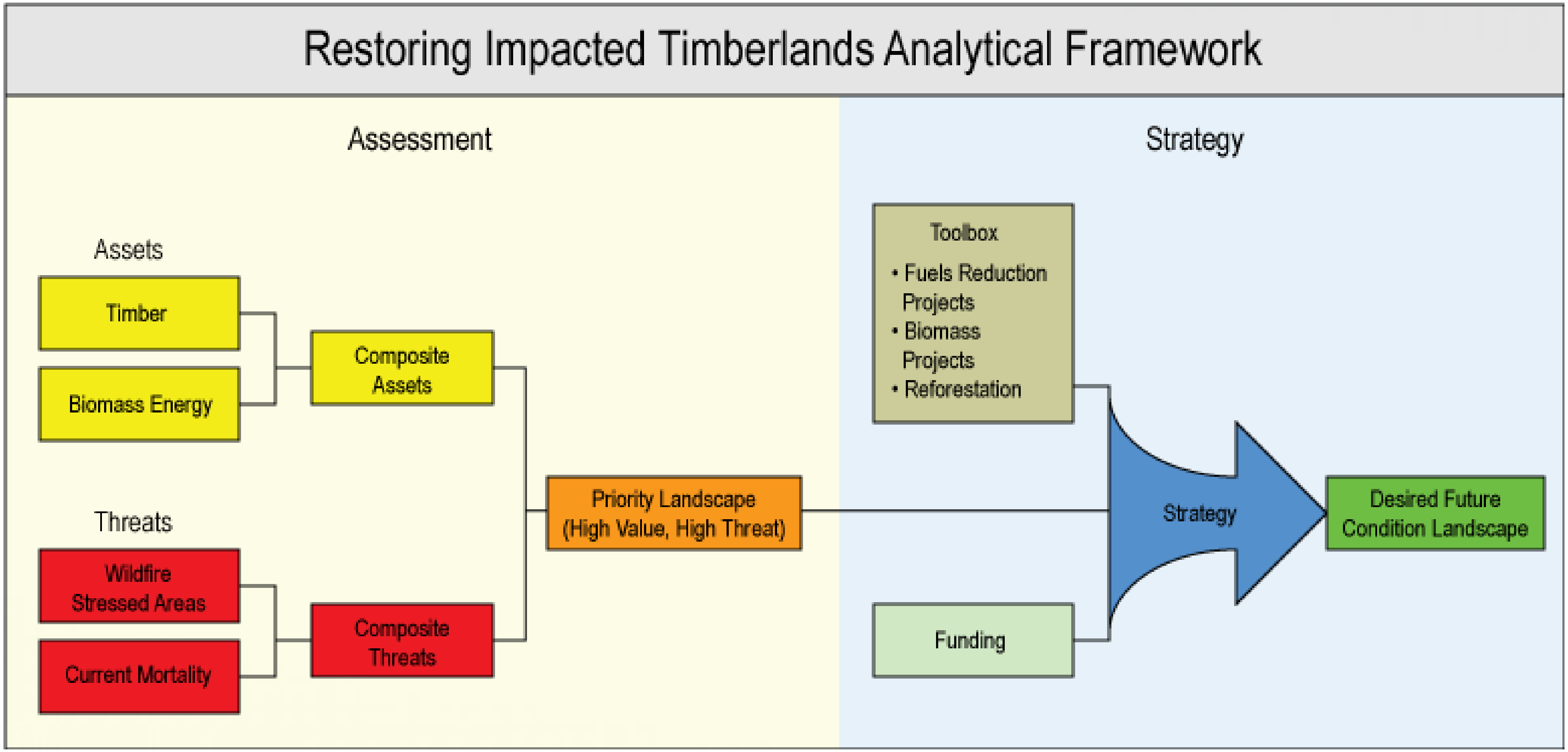
Forest and Range Resource Assessment

http://frap.fire.ca.gov/

- Focus resources
- Analysis that crosses all ownerships
- Identify threats, benefits
- Identify priority areas
- Integrate existing statewide plans
- Identify necessary partner and stakeholder involvement



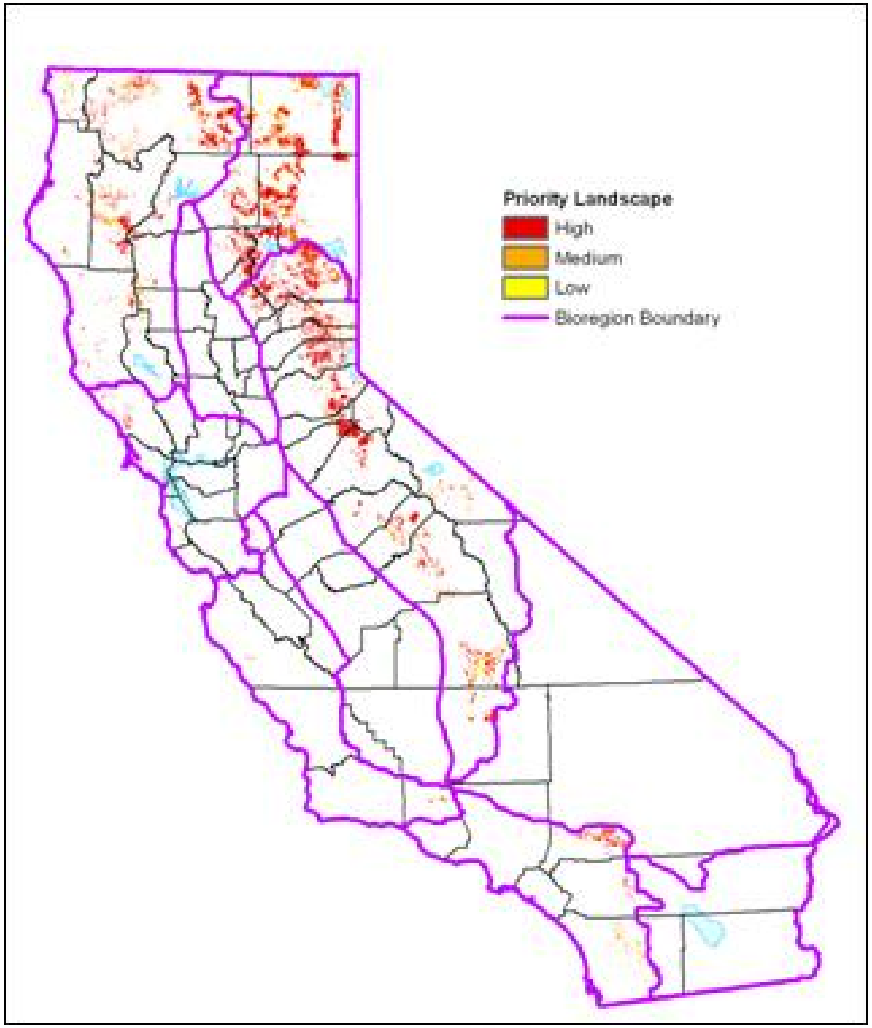
Assessment Analysis Framework Example



Forest Health

Evaluating Trends in Forest Health
Analysis by CAL FIRE of FIA data indicates that there may be as many as 1 - 2 million acres of forested land in California that would benefit from thinning.

In addition, FIA data indicates that there may be as many as 3.1 million acres of timberland in California on which replanting or "reforestation" could occur in order to boost forest sector productivity and carbon storage.



Forest Carbon Plan

http://www.fire.ca.gov/fcat/

Purpose – Required by the AB 32 Scoping Plan Update (2014) to address forest sector needs to improve carbon sequestration and forest health.

Scope – Will evaluate and make recommendations across all forest lands.

Funding – Make recommendations for investment in forest sector.

GhG Targets – Recommendations on short and long-term targets for GhG emissions and carbon sequestration.

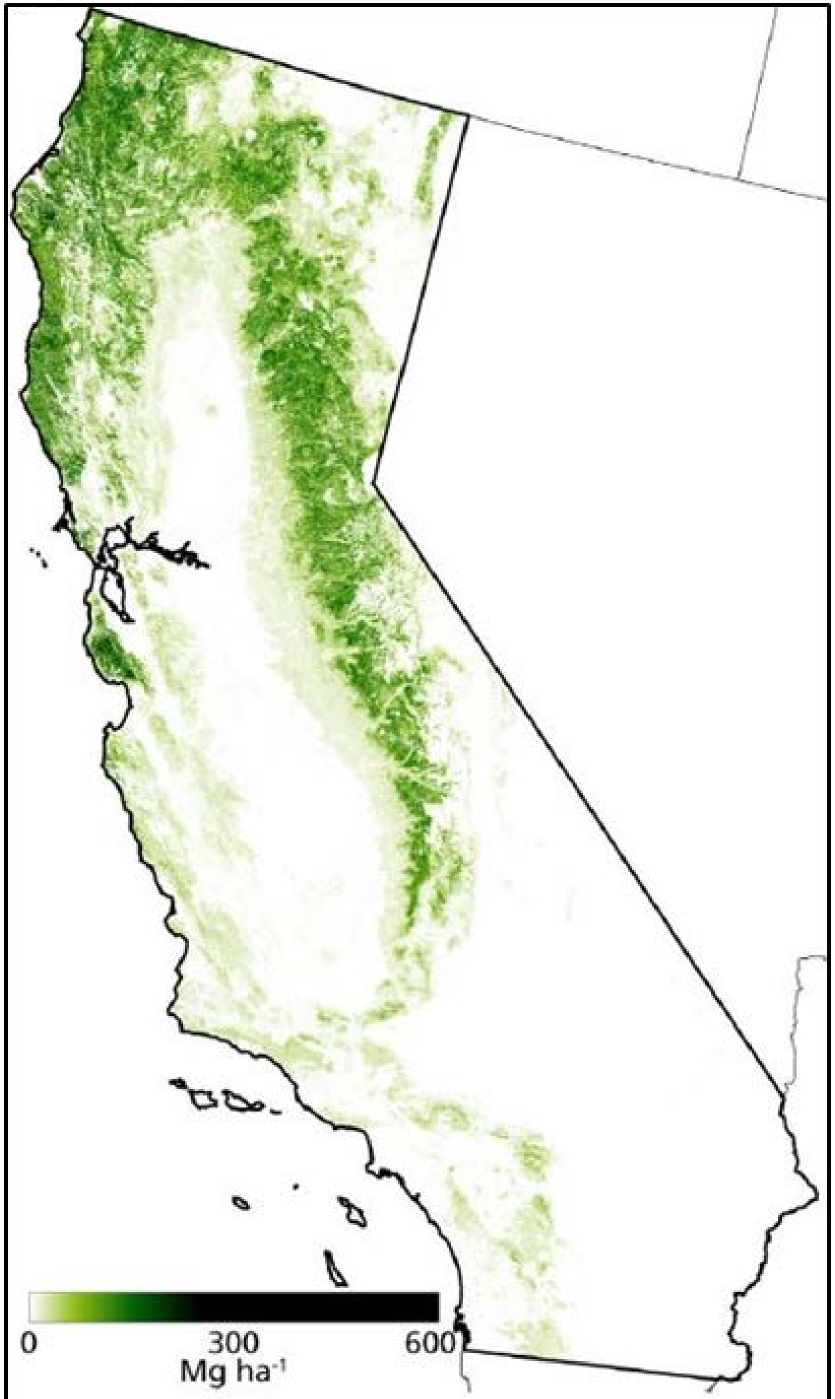
Co-Benefits – Supported by a resource economics study evaluate tradeoffs among forest management actions.

Panel 1: Part 4 **Jim Thorne, UC Davis**

Planning for Sequestration and GHG Emission Reductions

Frameworks for Carbon Sequestration

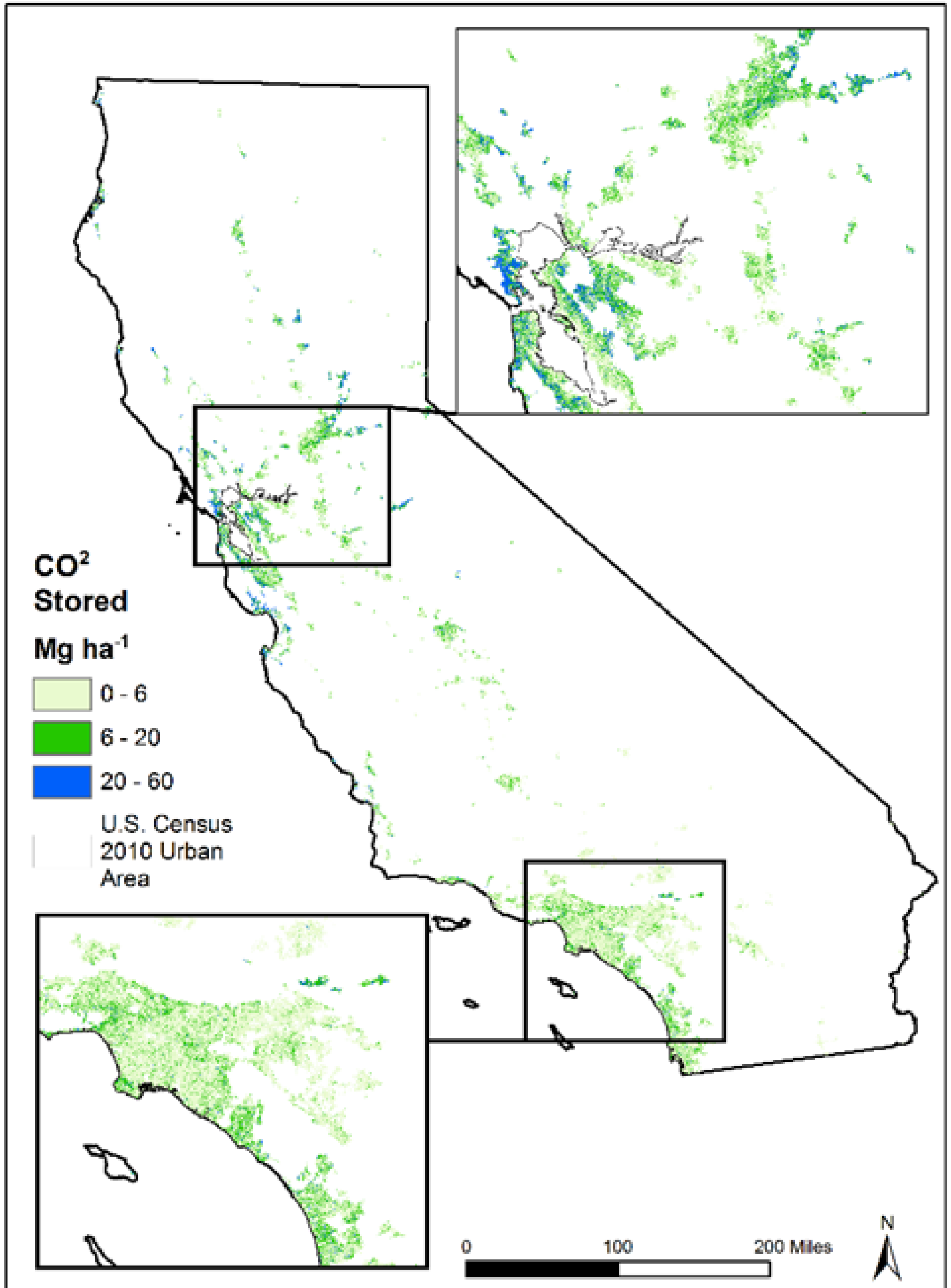
What do we know & what do we need to know
How do we track over time
Implementation Frameworks
Risk minimization



Aboveground live carbon stock changes of California wildland ecosystems, 2001–2010

Gonzalez et al. 2015
http://dx.doi.org/10.1016/j.foreco.2015.03.040

Biomass, Carbon Sequestration, and Avoided Emissions: Assessing the Role of Urban Trees in California



Bjorkman, J., J.H. Thorne, et al. 2015. Information Center for the Environment, University of California, Davis.

Some projects are already underway.

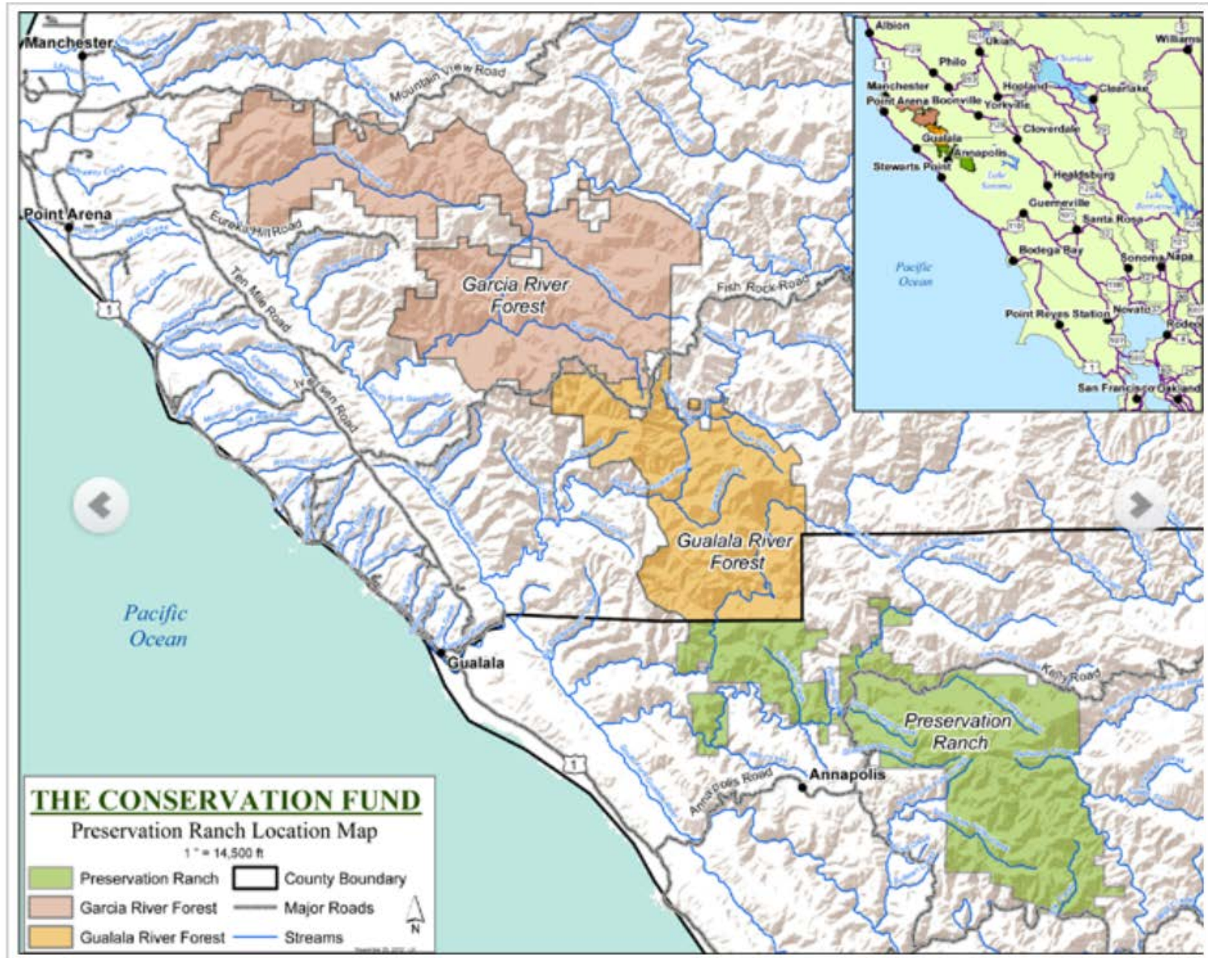
Started in 2004

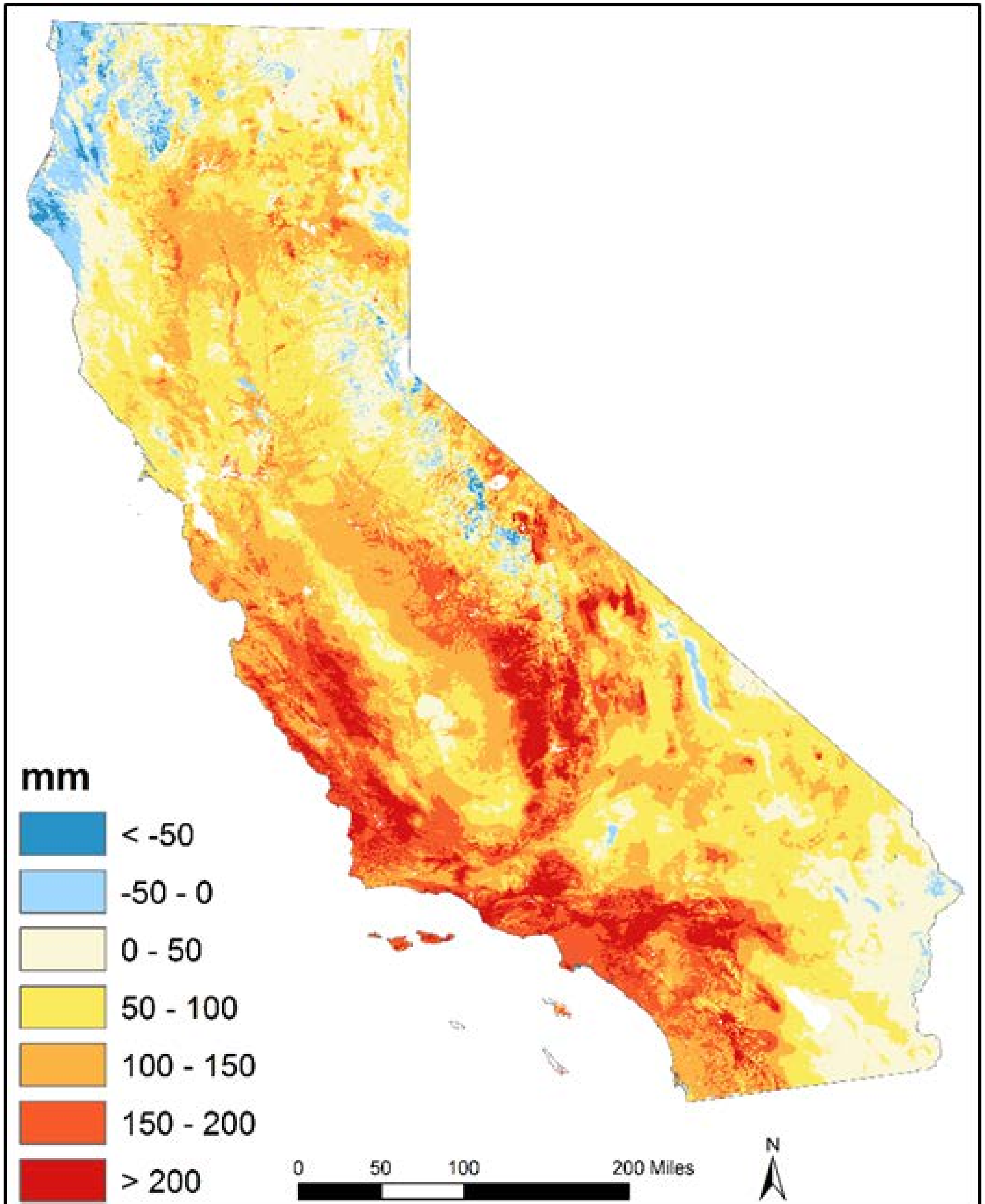
First Carbon verification 2007

60,000 acres under management

Significant workload to document and maintain carbon stocks

Jordan Golinkoff
jgolinkoff@conservationfund.org





Difference in plant stress between an average year (1980-2010) and the 2013-2014 drought years

Derived from Thorne et al. 2015.

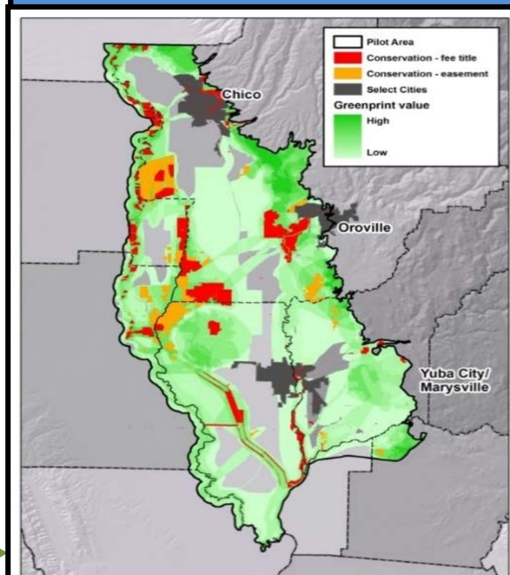
A few mechanisms/frameworks for implementation

RUCs
Market Mechanisms
Regulatory Mechanisms
RAMP
IRCAD
Regional Greenprints
Lessons from other Ecosystem Service Frameworks

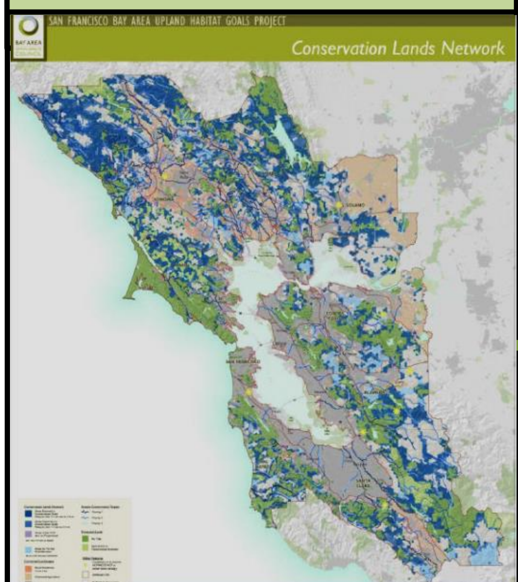
Integrated Regional Conservation and Development (IRCAD)

IRCAD promotes the balanced vision a sustainable development and conservation and provides the methods and tools to implement that vision.

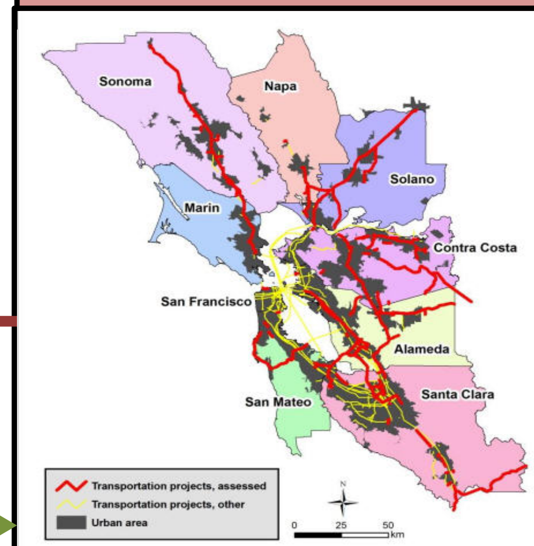
Integrated Regional Plan



Regional Conservation Plan

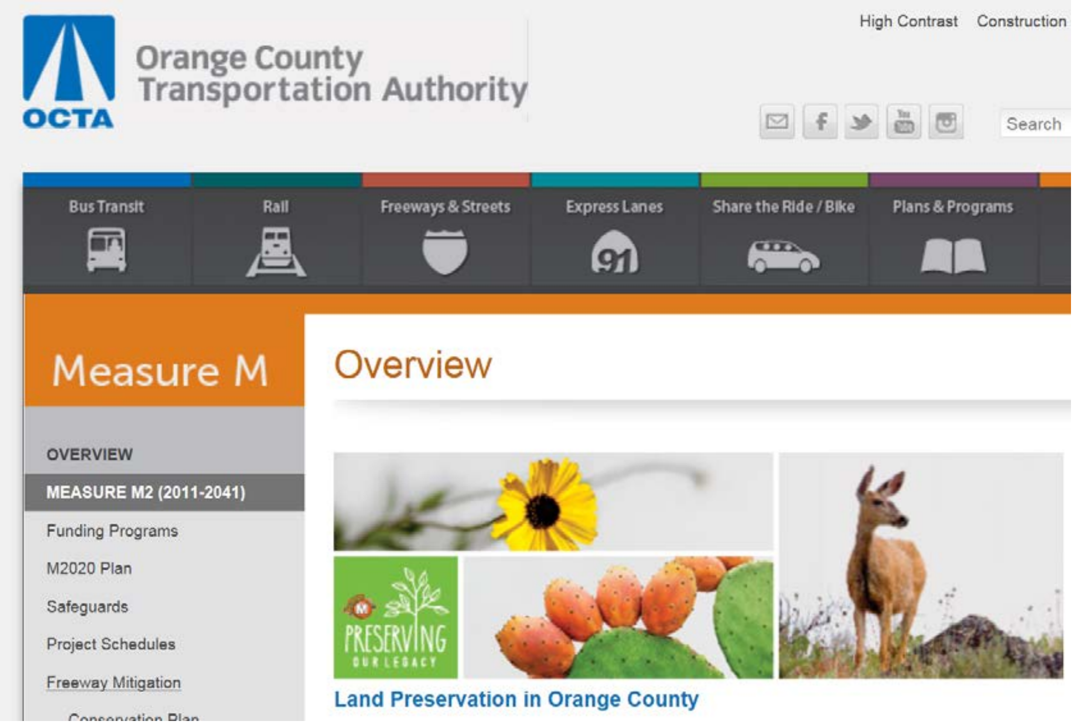


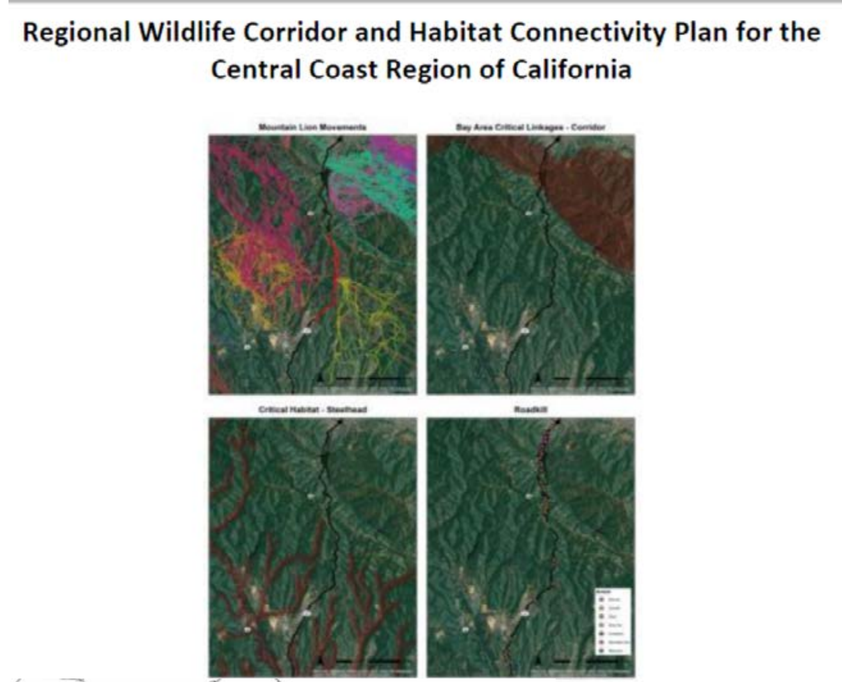
Regional Development Plan

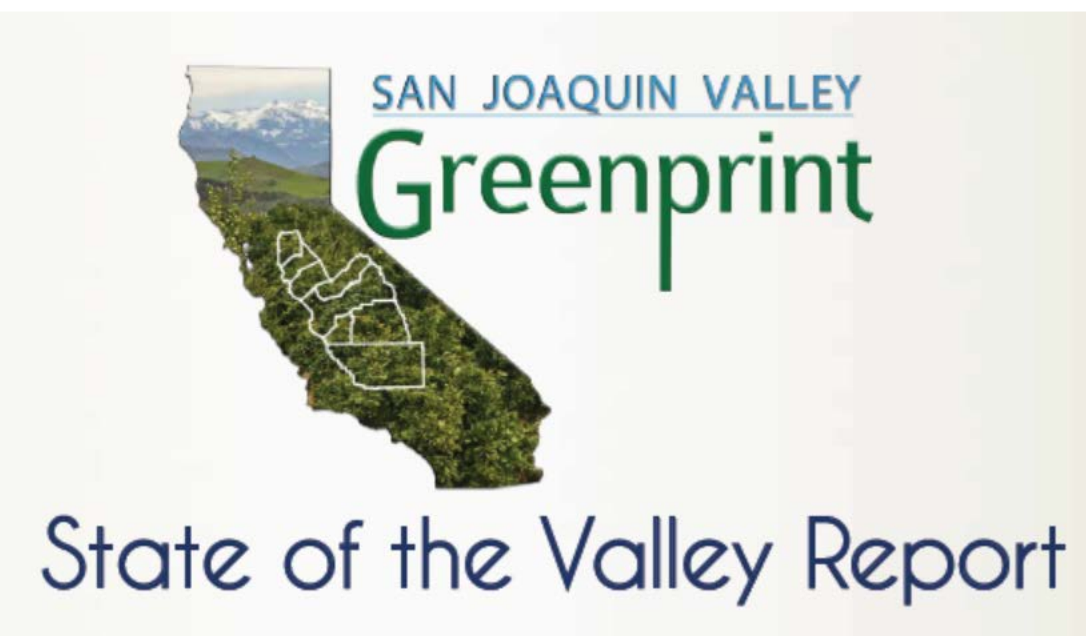


Stewardship / Restoration / Acquisition

Avoidance and Minimization


OCTA
Orange County Transportation Authority
High Contrast
Construction
Search
Bus Transit
Rail
Freeways & Streets
Express Lanes
Share the Ride / Bike
Plans & Programs
Measure M
Overview
OVERVIEW
MEASURE M2 (2011-2041)
Funding Programs
M2020 Plan
Safeguards
Project Schedules
Freeway Mitigation
PRESERVING OUR LEGACY
Land Preservation in Orange County


Regional Wildlife Corridor and Habitat Connectivity Plan for the Central Coast Region of California


SAN JOAQUIN VALLEY
Greenprint
State of the Valley Report

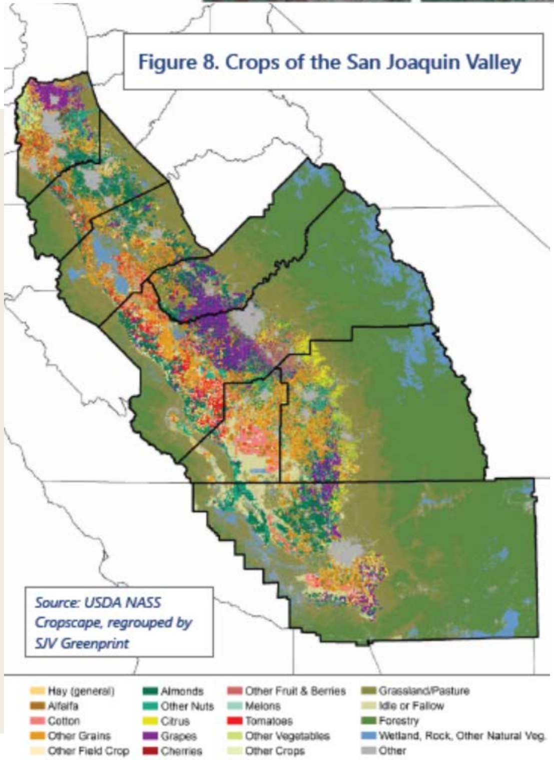
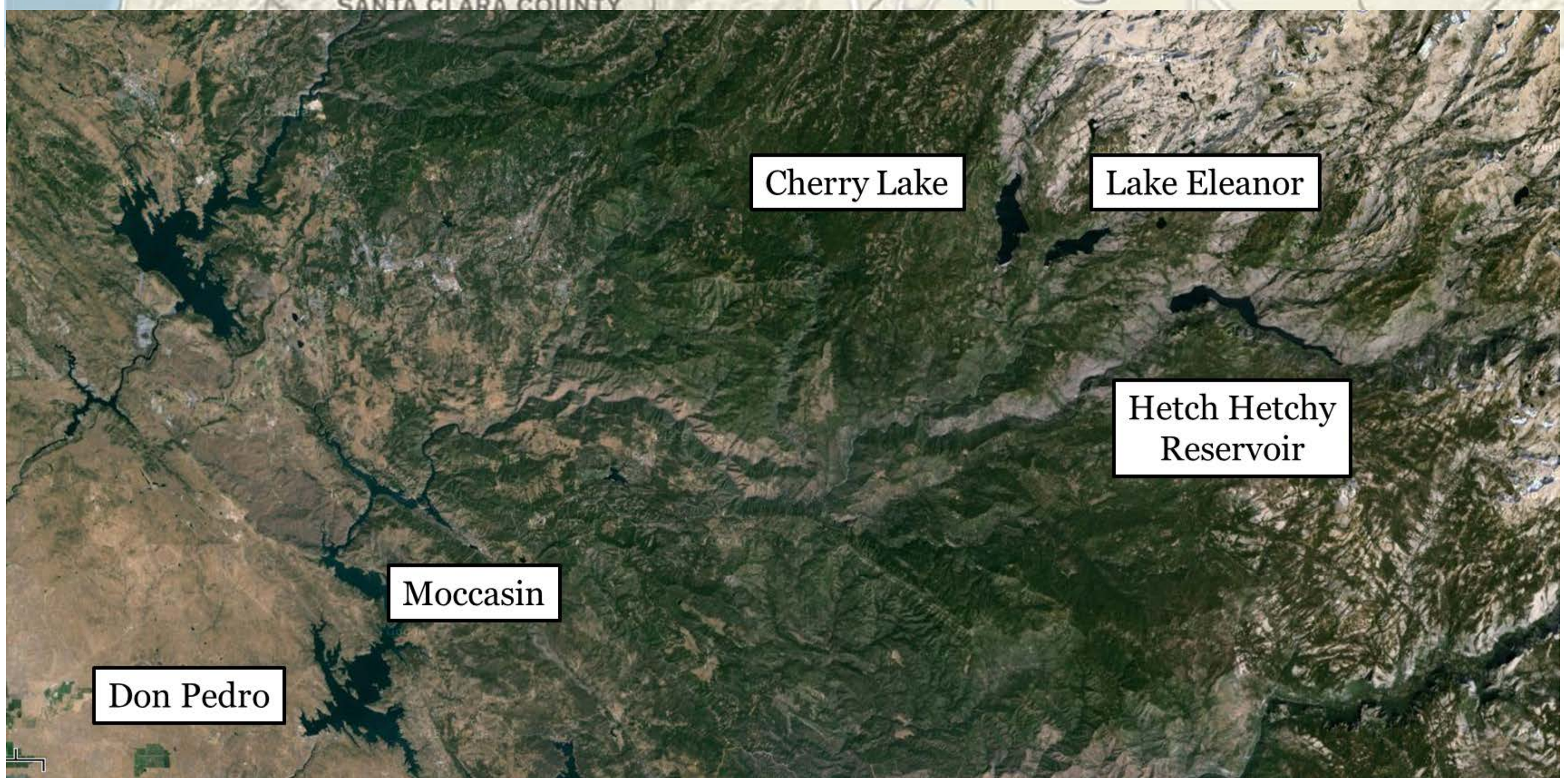


Figure 8. Crops of the San Joaquin Valley
Source: USDA NASS Cropscape, regrouped by SJV Greenprint
Hay (general)
Alfalfa
Cotton
Other Grains
Other Field Crop
Almonds
Other Nuts
Citrus
Grapes
Cherries
Other Fruit & Berries
Melons
Tomatoes
Other Vegetables
Other Crops
Grassland/Pasture
Idle or Fallow
Forestry
Wetland, Rock, Other Natural Veg.
Other

TODD TRUMBULL / The Chronicle

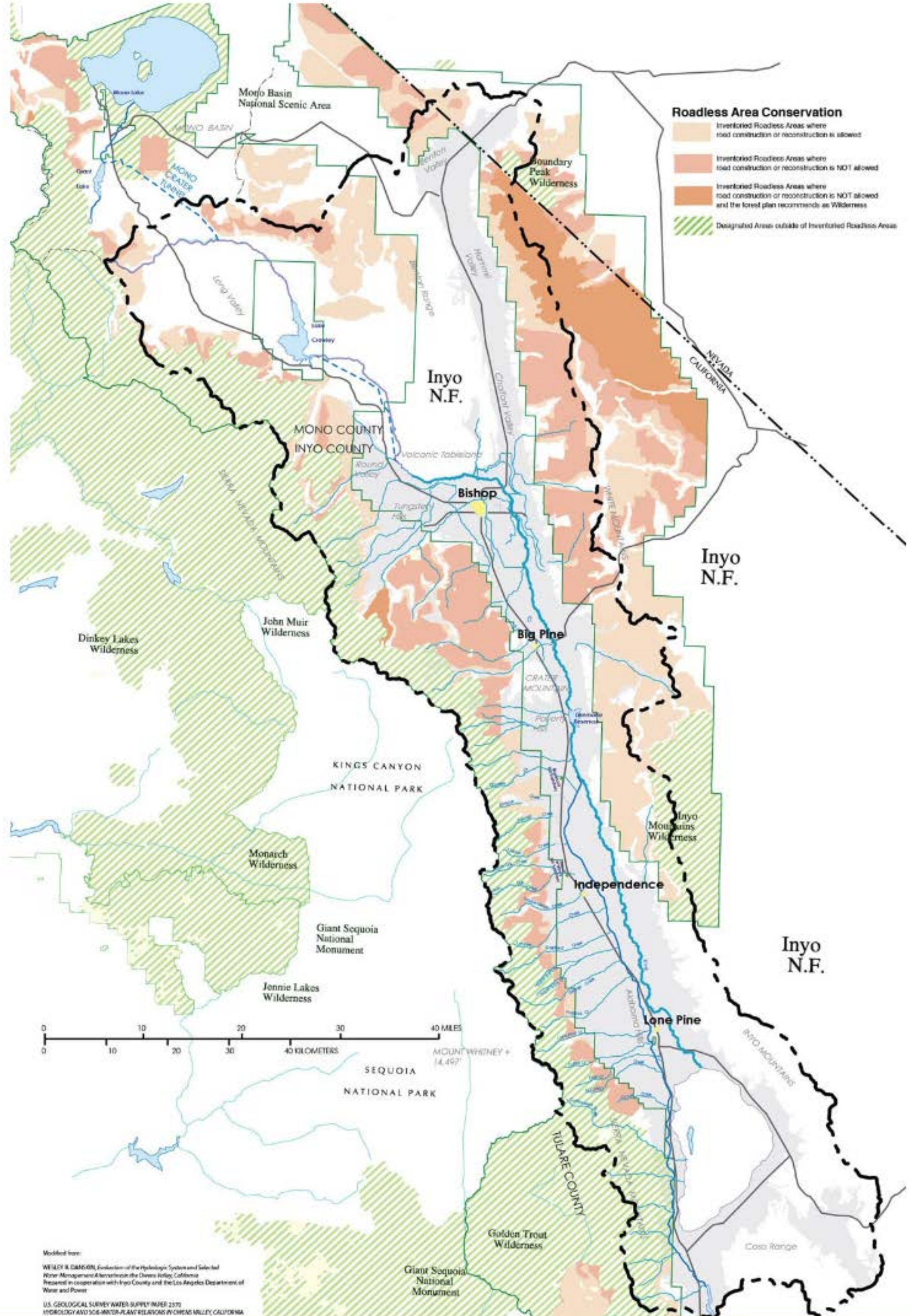


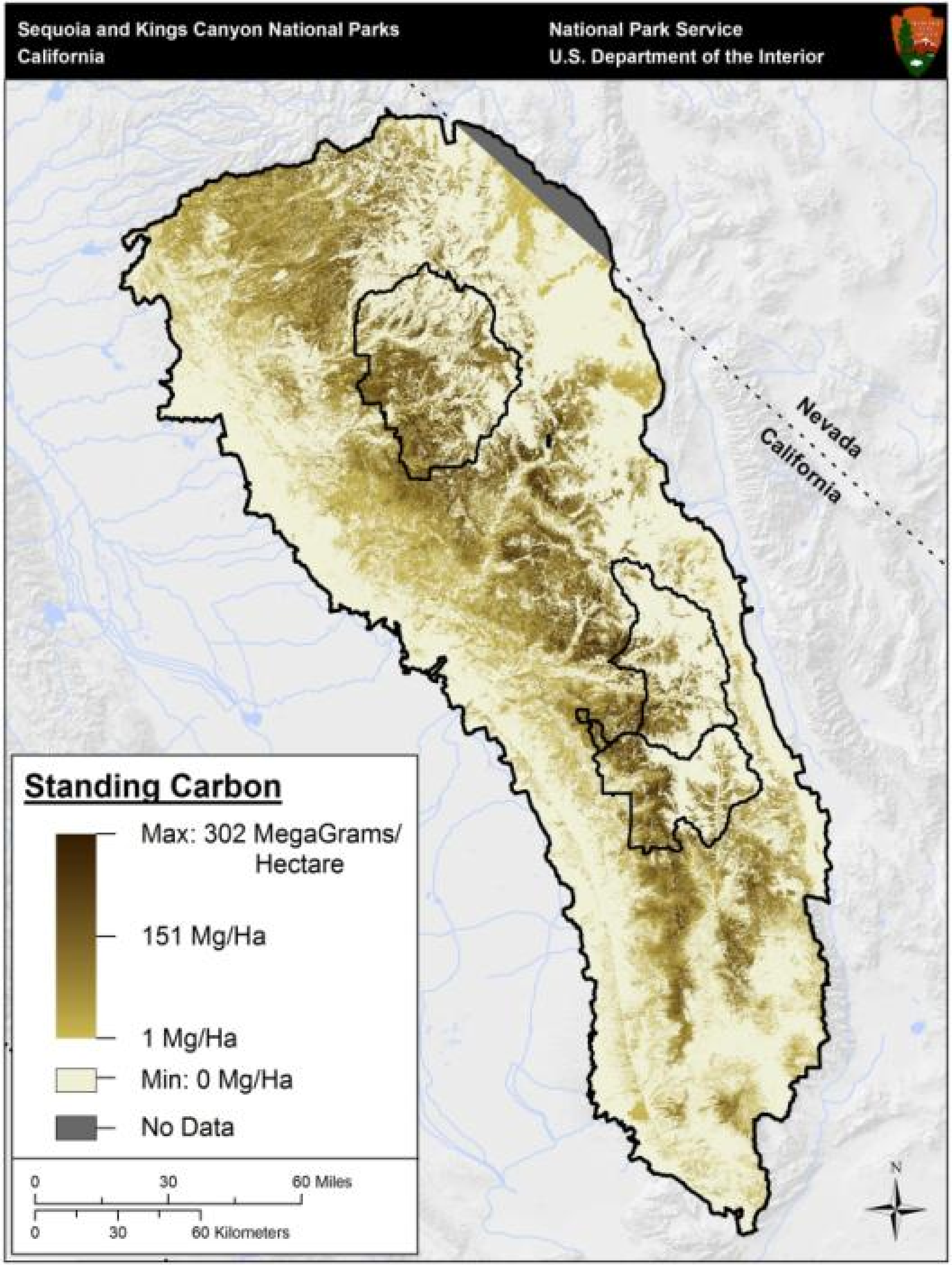
Payments for Federal Land Management

County-level ecosystem service project

Owens Valley

LADWP
Inyo County
Mono County

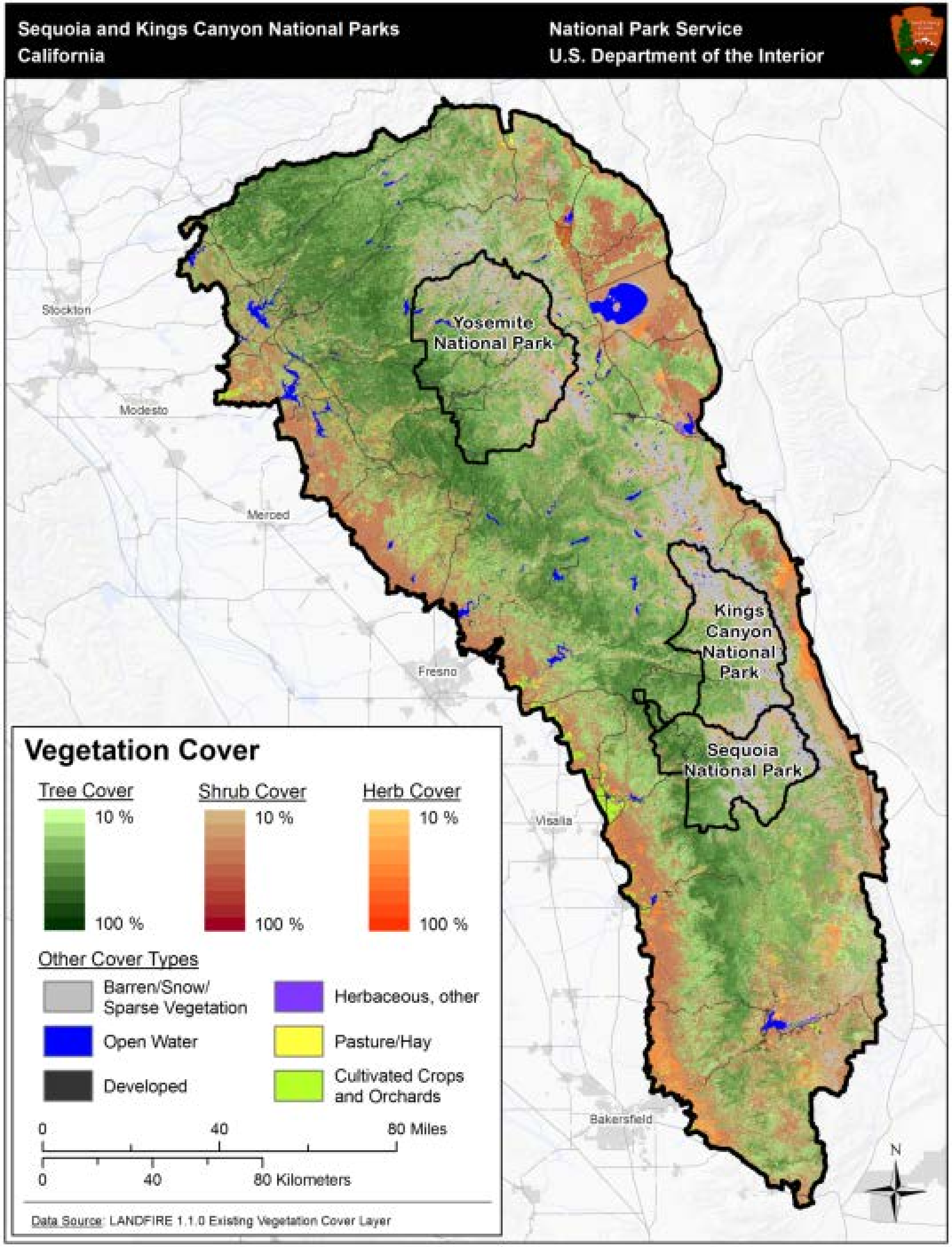




Seeking Multiple Benefits at Regional Scales

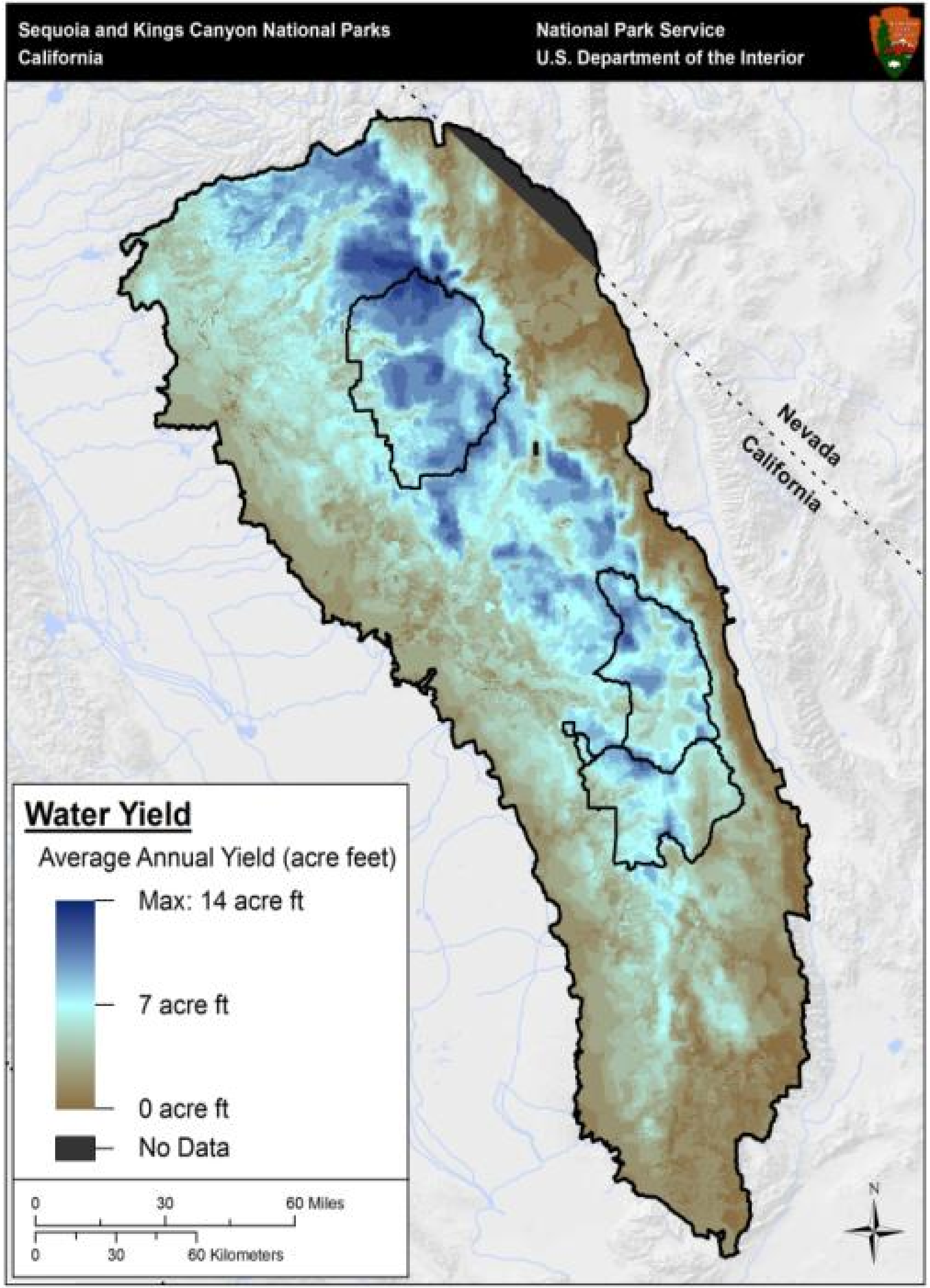
A wide variety of considerations can be portrayed as elements.

For example:
Measures of standing carbon stocks (here for southern Sierra Nevada).



Seeking Multiple Benefits at Regional Scales

Landcover maps (here for southern Sierra Nevada).



Seeking Multiple Benefits at Regional Scales

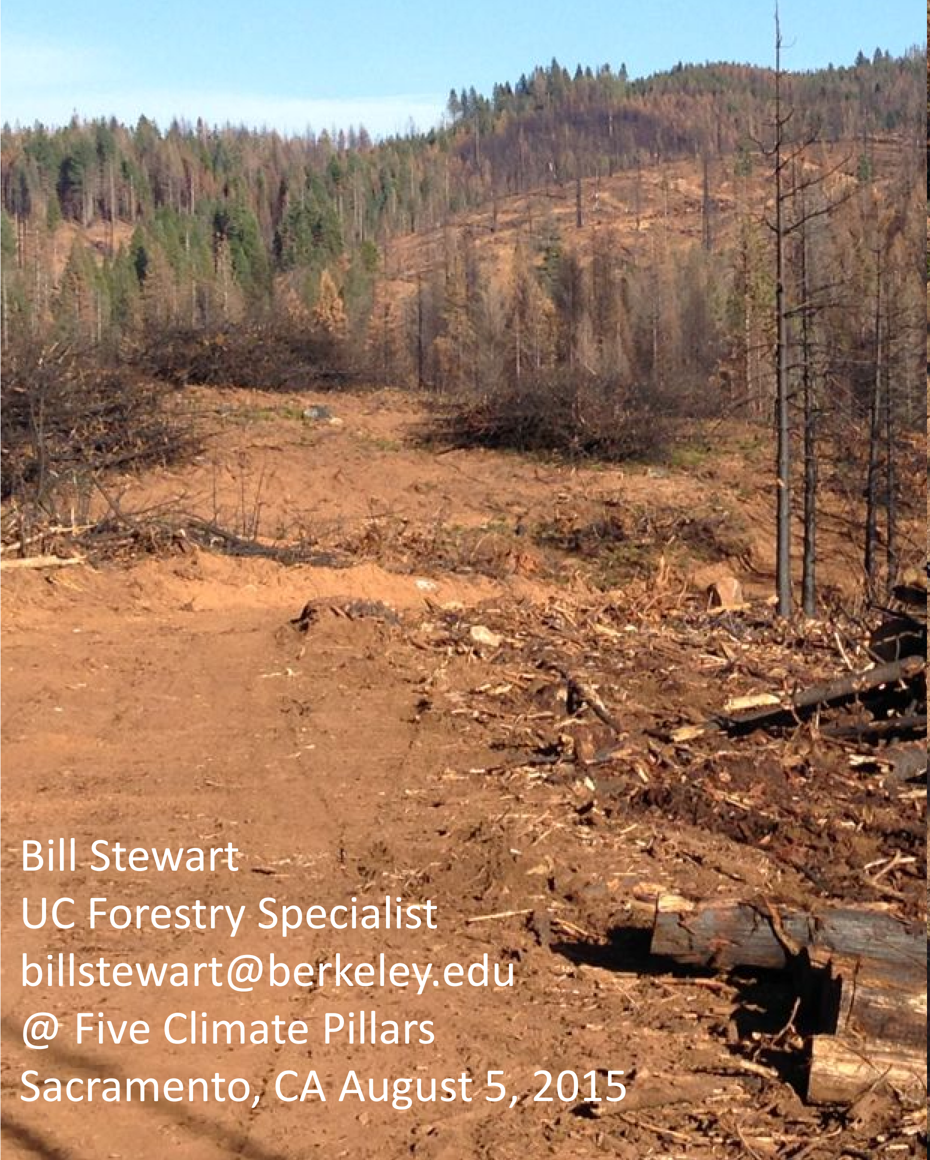
Measures of ecosystem services such as Water Yield (here for southern Sierra Nevada).

Environmental and Biological features need to be considered to identify if they should be, and can be included.

When important elements are identified which are not mapped, these represent next steps needed to have a robust greenprint.

Thank you! Jim Thorne jhthorne@ucdavis.edu

Management Practices to Enhance Sequestration and Related Co-Benefits: Forests

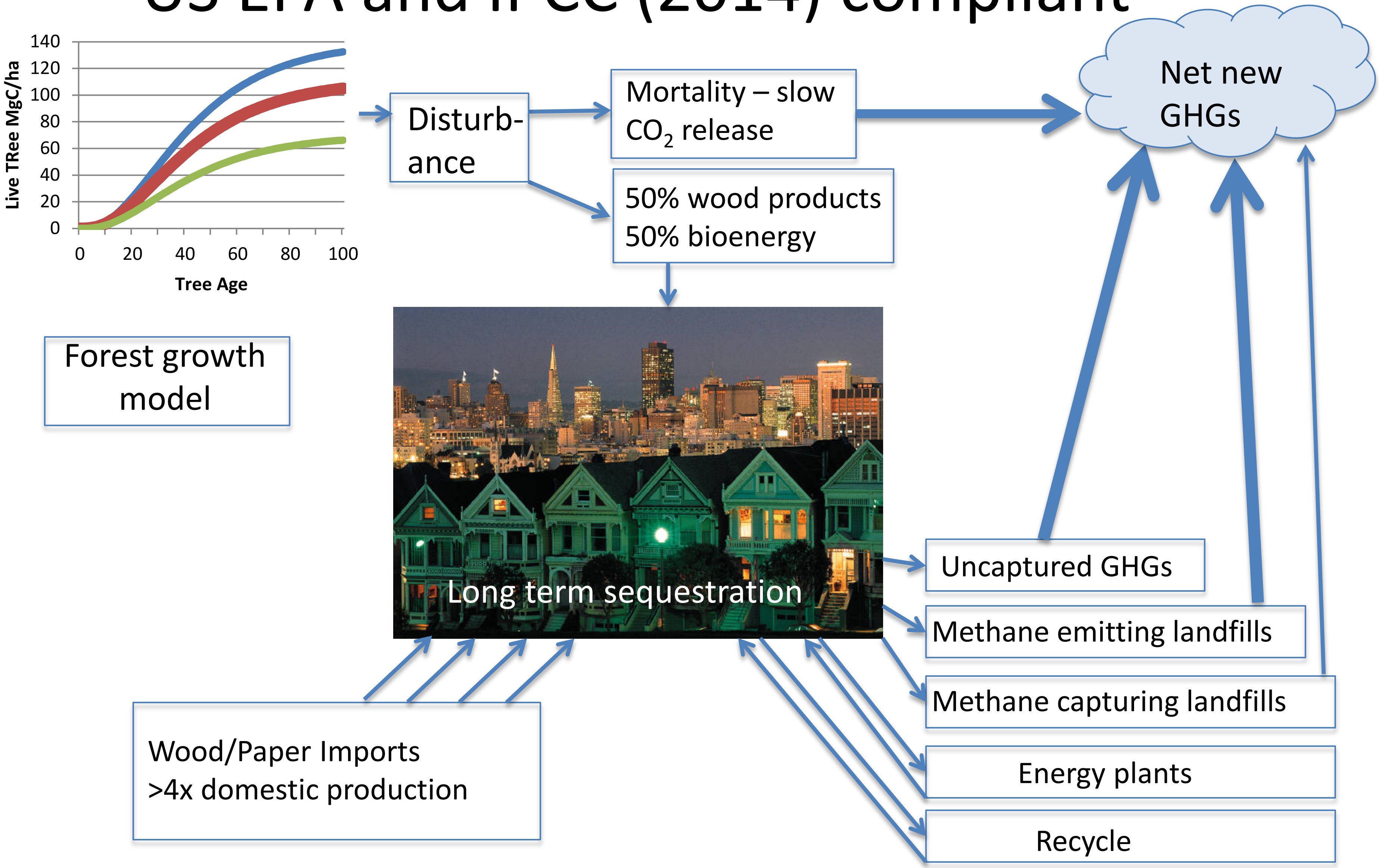


Bill Stewart
UC Forestry Specialist
billstewart@berkeley.edu
@ Five Climate Pillars
Sacramento, CA August 5, 2015

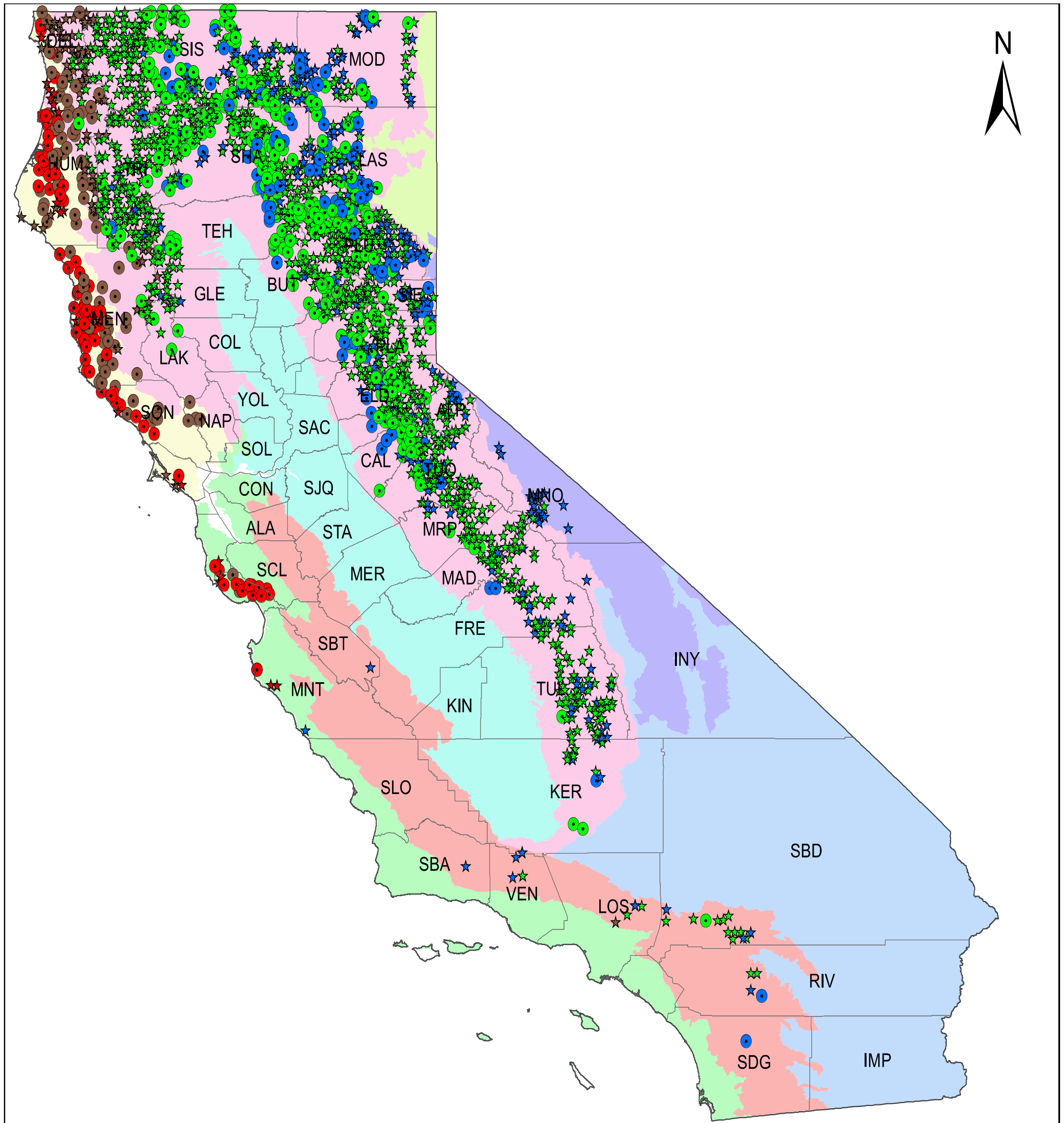
Climate Change Scoping Plan Update (ARB 2014) and Governor's Five Pillars (1)-(5)

Specific Sectors	Forests	Forest Products
Energy (2) (3)		Bioenergy (50% of CA harvest by volume in 2012)
Agriculture		Also produces biomass for fuel
Water	Watershed Protection	
Waste (4)		Wood and paper go to landfills or bioenergy
Natural and Working Lands (5)	**'maximize their carbon benefits while also ensuring landscape resilience'**	CA Forest Practice Rules Sec 897 – Harvest $\leq$ growth while protecting co-benefits
Short-lived Climate Pollutants (4)	Wildfire black carbon emissions	Methane emissions from poorly designed landfills
Green Buildings (3)		C efficient wood buildings – single and multiple units

Enterprise-wide California forest C life cycle US EPA and IPCC (2014) compliant



Remeasuring trees on FIA or ownership specific plots – rather than remeasuring the top of tree canopy height classes with satellites – is the most accurate way to measure change in live and dead tree C in forests



Dominant forest in FIA Timberland Plots

Pvt Fed

- Redwood
- Douglas fir
- Mixed Conifer
- P. Pine

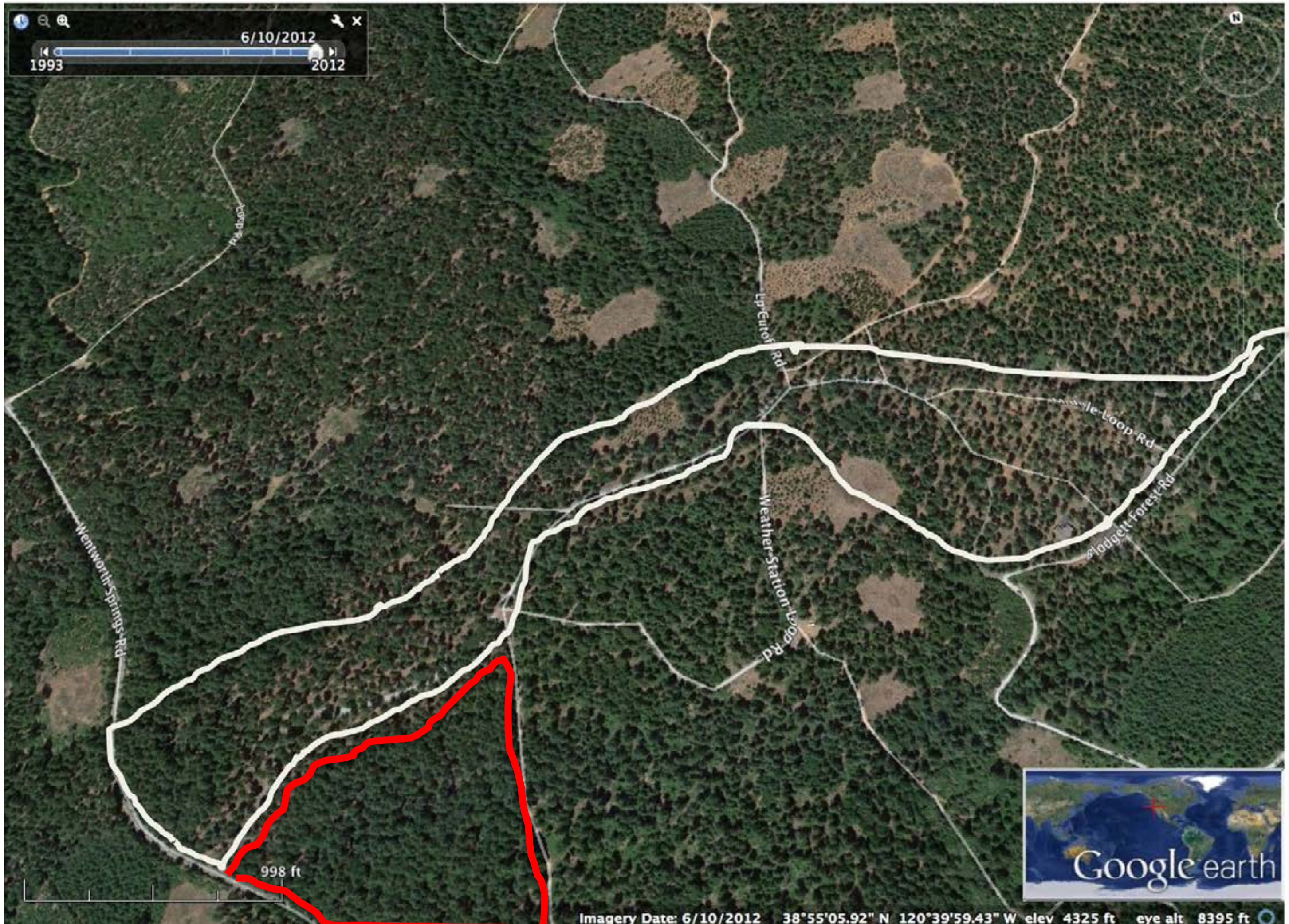
Timberland Forests	Million Acres	FIA plots
Redwood	0.6	118
Douglas fir	0.9	187
Mixed conifer	6.4	1,374
Pond. Pine	1.9	263

Timberlands	10 million acres
Other forests	10 million acres
Woodlands	10 million acres

Stewart et al. 2015. *Forestry* in **Ecosystems of California**. Mooney and Zavleta eds. University of California Press

Blodgett Research Forest Station – White unit harvested every decade, Red unit is reserve unit with no harvesting. You can see the inventories records on our website and see the trees for yourself.

Unit	CoDomin. Tree Ht.
Red	111’
White	110’ pre
White	115’ post



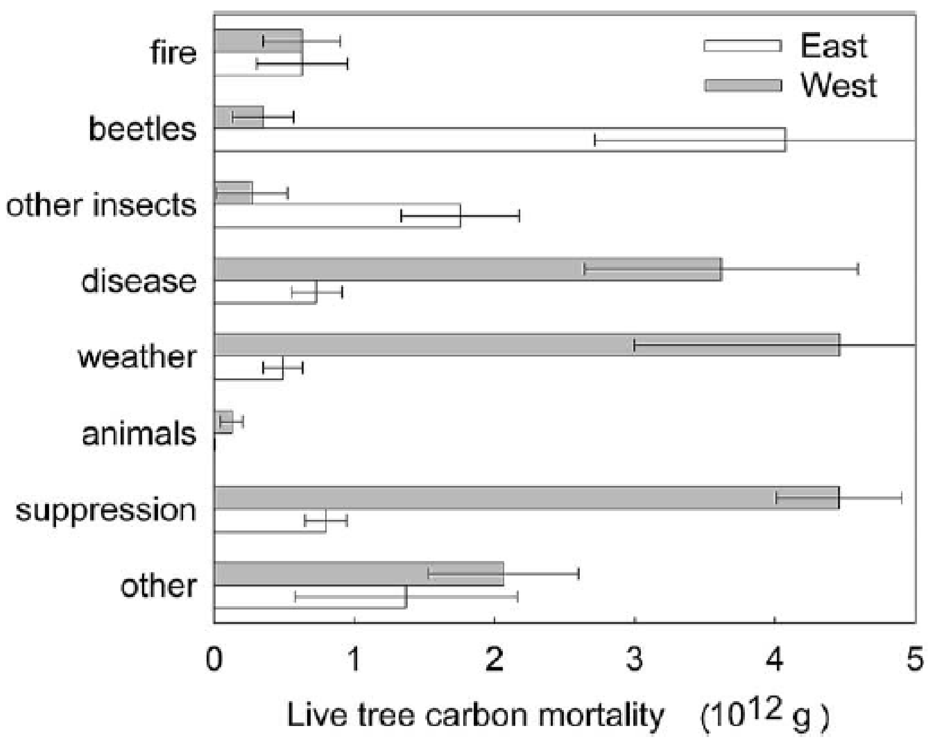
Gonzalez et al. 2015
Tree Ht. classes
0-18’
19-33’
34’-82’
83’-164’ ←
164’+

Blodgett height growth would register zero growth in Gonzalez et al. 2015 tree size class analysis highlighted by ARB on their website

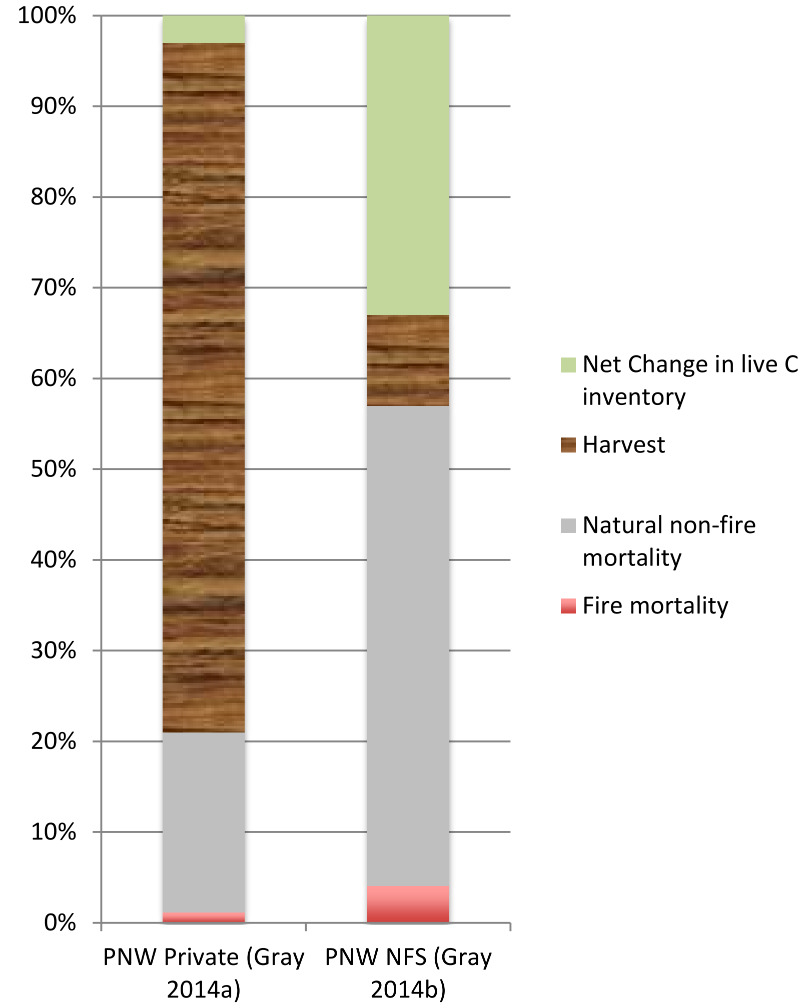
http://forestry-dev.berkeley.edu/blodgett/compartment_map1.html
http://www.arb.ca.gov/cc/inventory/sectors/forest/forest.htm ←

Causes of Mortality Losses on pvt land in OR
Comparison of public v pvt lands in OR

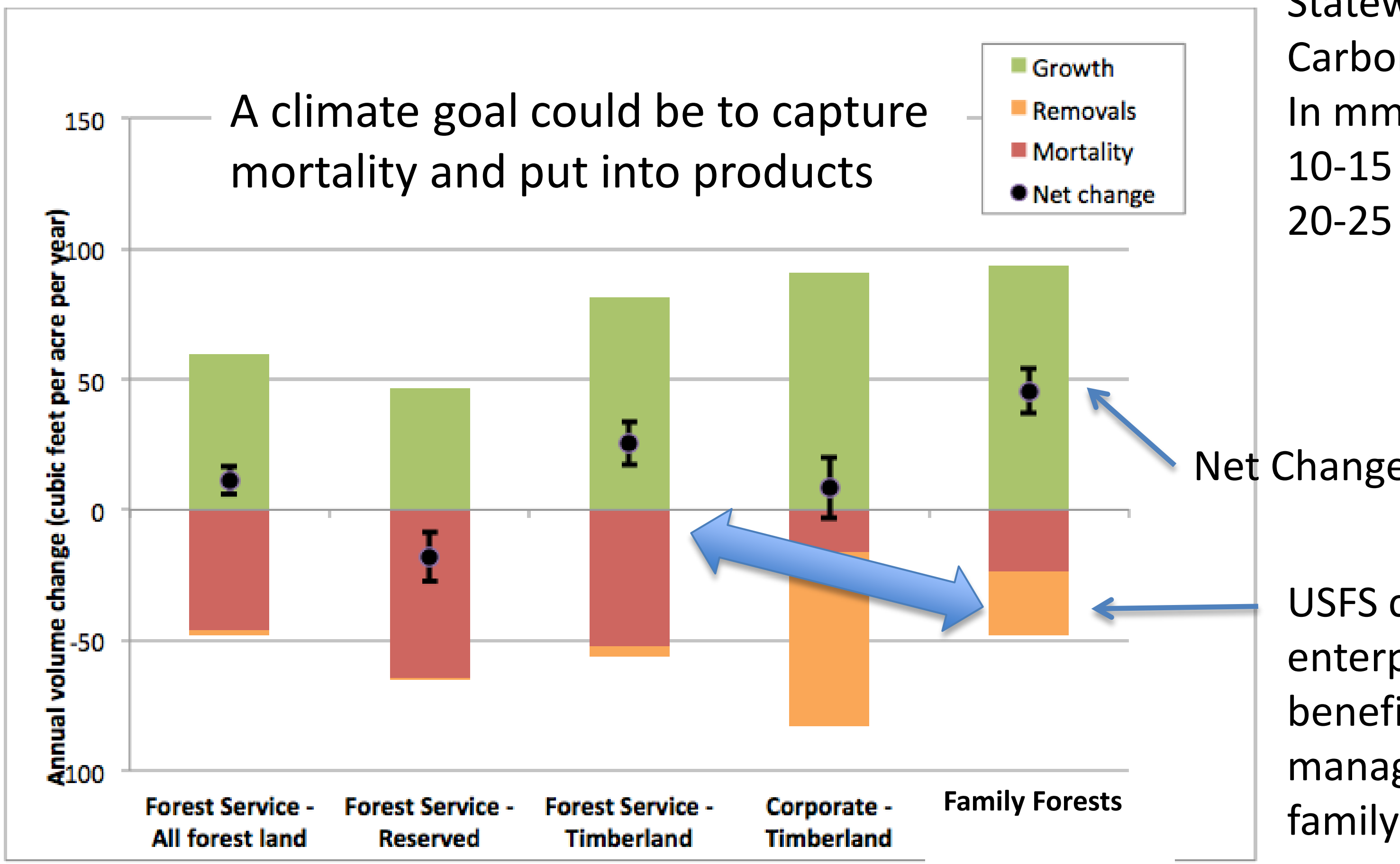
Sources of Mortality on Oregon Private Timberlands



Allocation of Gross Growth Pacific Northwest



Net change is forest C sequestration/ac/yr
Net change + Removals is enterprise-wide forest C sequestration/ac/yr



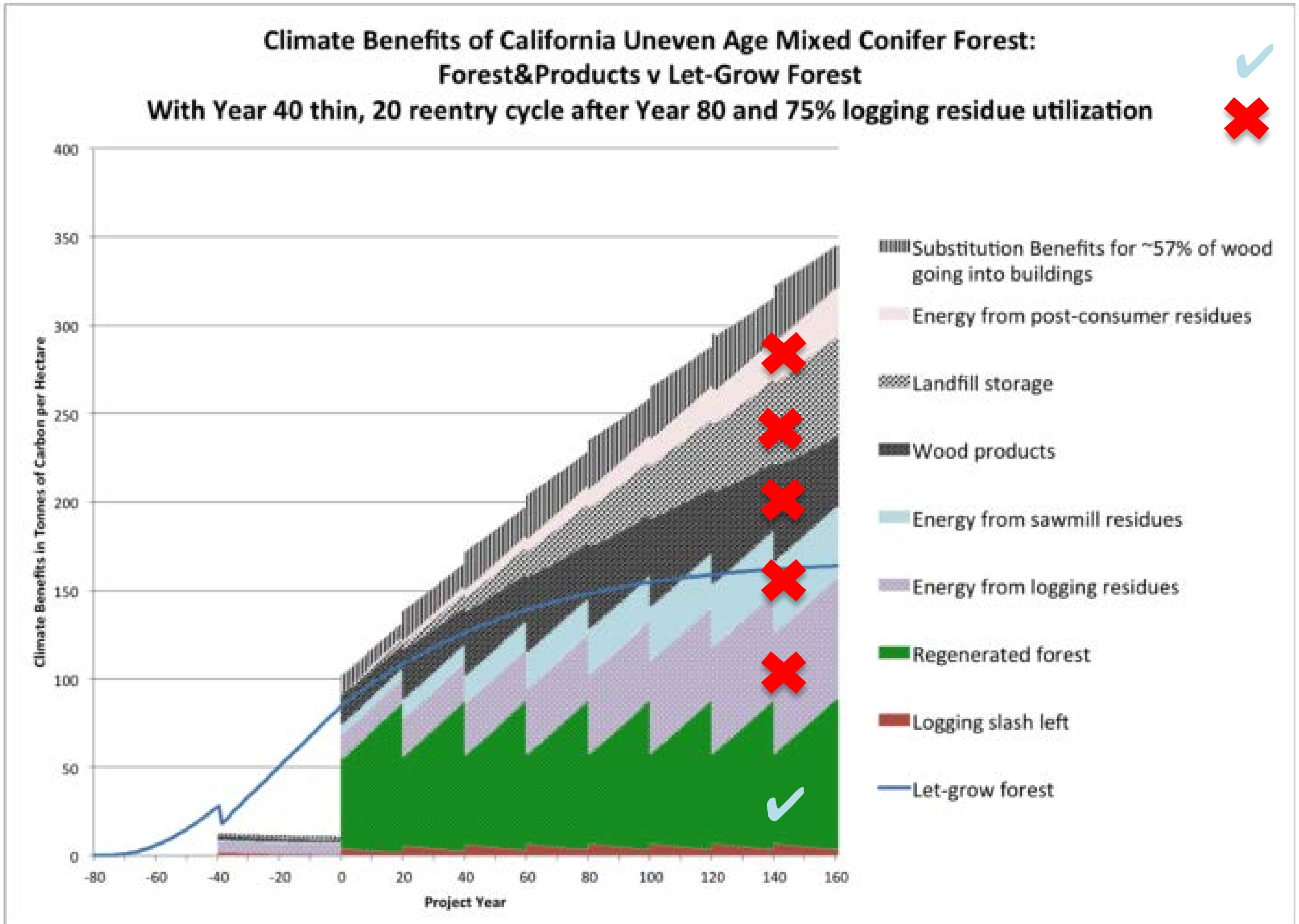
Statewide FIA and TPO
Carbon sequestration
In mmtCO2/yr
10-15 in-forest
20-25 enterprise-wide

USFS could have more enterprise-wide benefits if they managed more like family forests

California's Forest Resources: Forest Inventory and Analysis, 2001-2010. USFS FIA (Christensen, in press)

IPCC 2014 Good Guidance : Developed countries can no longer use 'instantaneous oxidation' and ignore harvested products. If you have empirical data on products and energy, you must use it.

Carbon Sequestration Tool for THPs



✔ ARB = IPCC

✖ ARB ≠ IPCC

http://ucanr.edu/sites/forestry/Carbon_Sequestration_Tool_for_THPs/

Five potential management practices to enhance C sequestration across the full life cycle

1. Family forests – Grants and cost-share programs to reduce future mortality in their forest stands (preferably with low transaction costs for approved practices)
2. Large timber companies – ‘BCAP/Oregon tax credit’ like tools to get more logging residues to energy plants
3. Forest Service – Implement wildlife-friendly silviculture pilot projects to reduce mortality (now 3x the pvt sector)
4. Build more buildings with wood, less with concrete
5. Reduce methane emissions from uncapped landfills (cap them and/or divert waste to energy facilities)

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CARBON FARMING:
Increasing Carbon Capture on California's Working Lands

Lessons from the Marin Carbon Project

MARIN RESOURCE CONSERVATION DISTRICT

MARIN ORGANIC

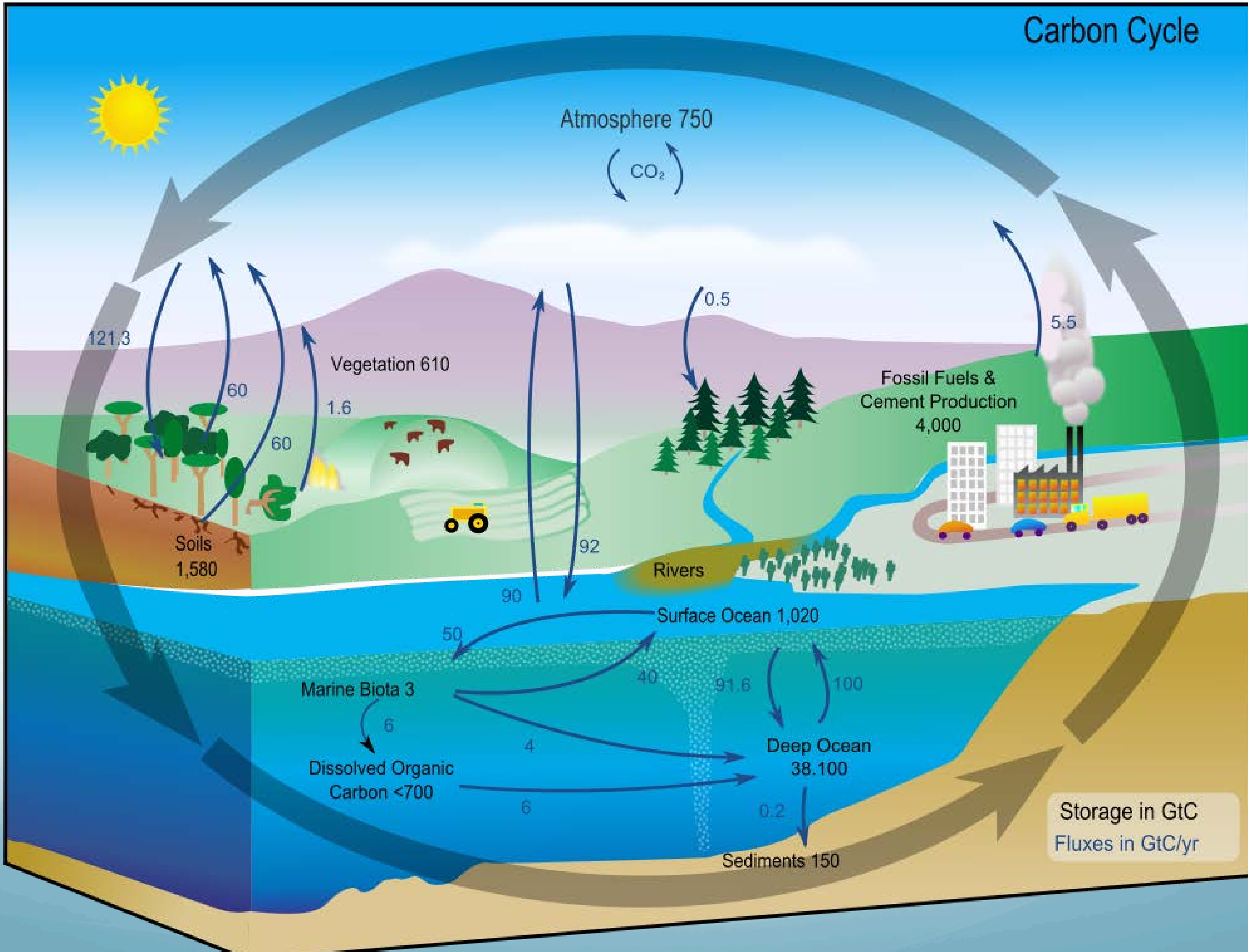
NRCS Natural Resources Conservation Service

ANR UNIVERSITY of CALIFORNIA

Nicasio Native Grass Ranch

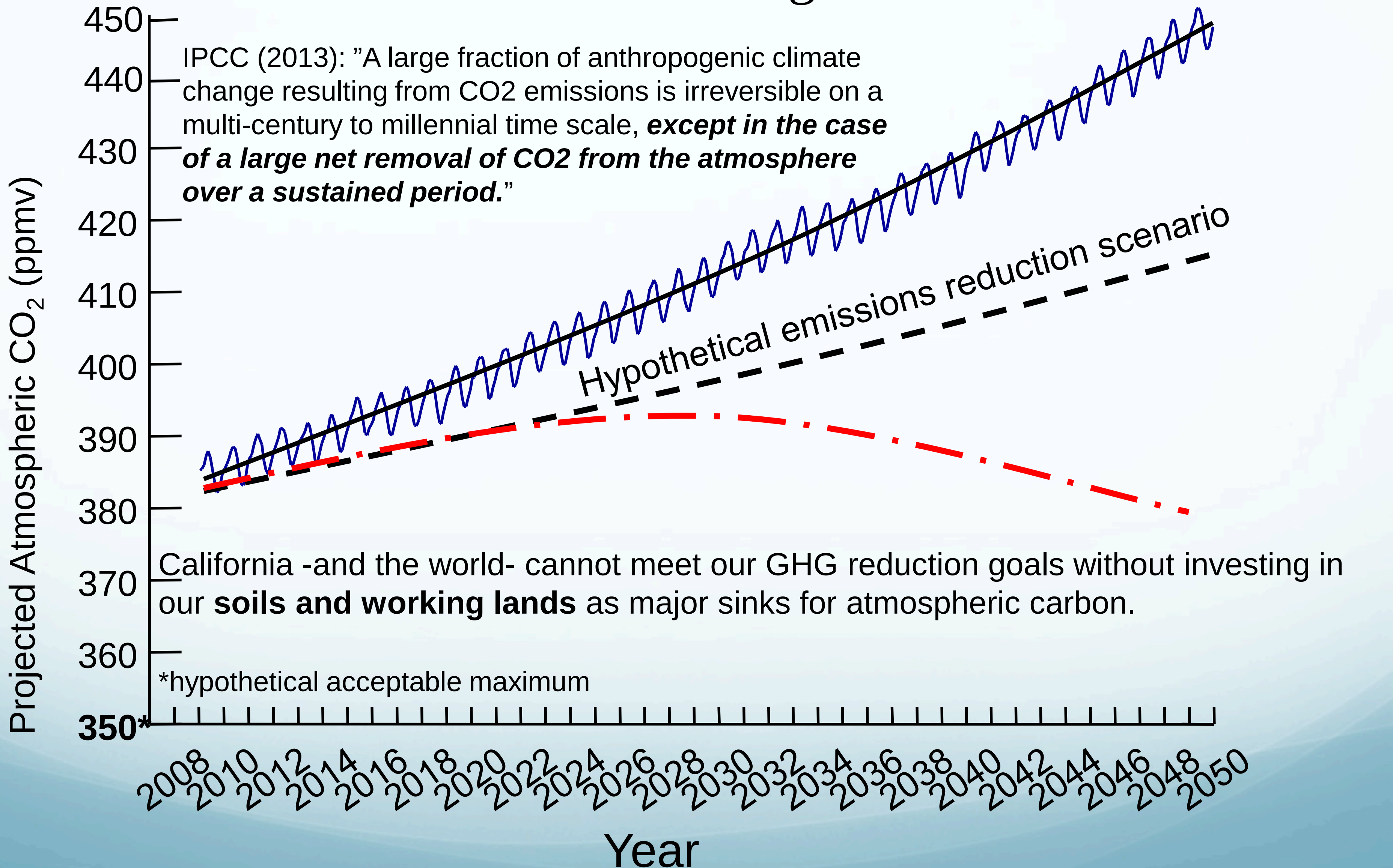
MARIN AGRICULTURAL LAND TRUST

Carbon Cycle Institute
JCreque@carboncycle.org



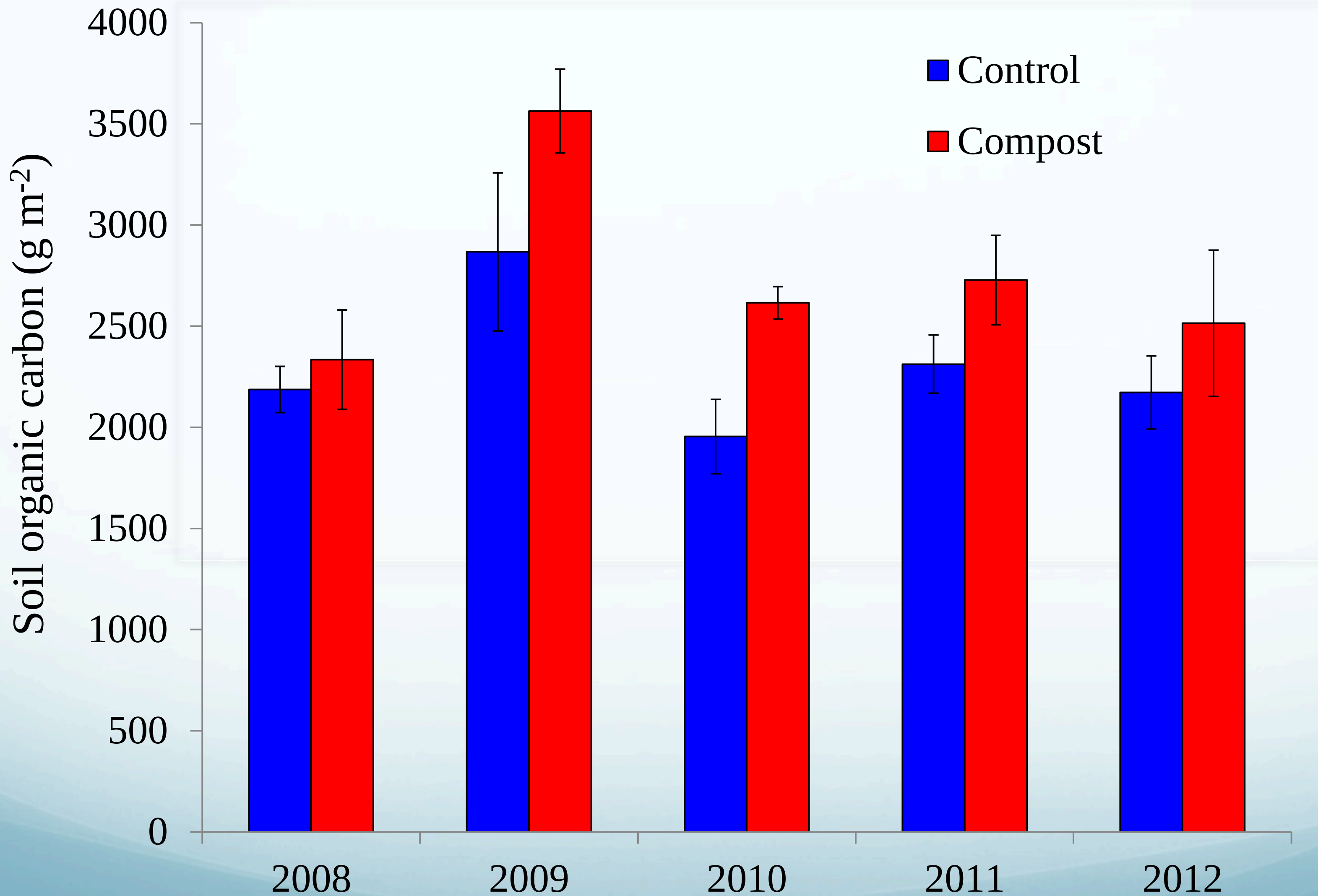
Carbon Cycle
Atmosphere 750
CO₂
121.3
60
60
1.6
Vegetation 610
Soils
1,580
90
92
0.5
5.5
Fossil Fuels &
Cement Production
4,000
Rivers
Surface Ocean 1,020
50
40
91.6
100
Marine Biota 3
6
4
Dissolved Organic
Carbon <700
6
Deep Ocean
38.100
0.2
Sediments 150
Storage in GtC
Fluxes in GtC/yr

Bad News: Reducing emissions alone will not mitigate climate change



H0: Organic matter additions can ***measurably*** increase rangeland soil carbon; ***Then what?***

Compost increased soil C pools



Ryals et al. 2014 Soil Biology & BioChemistry.

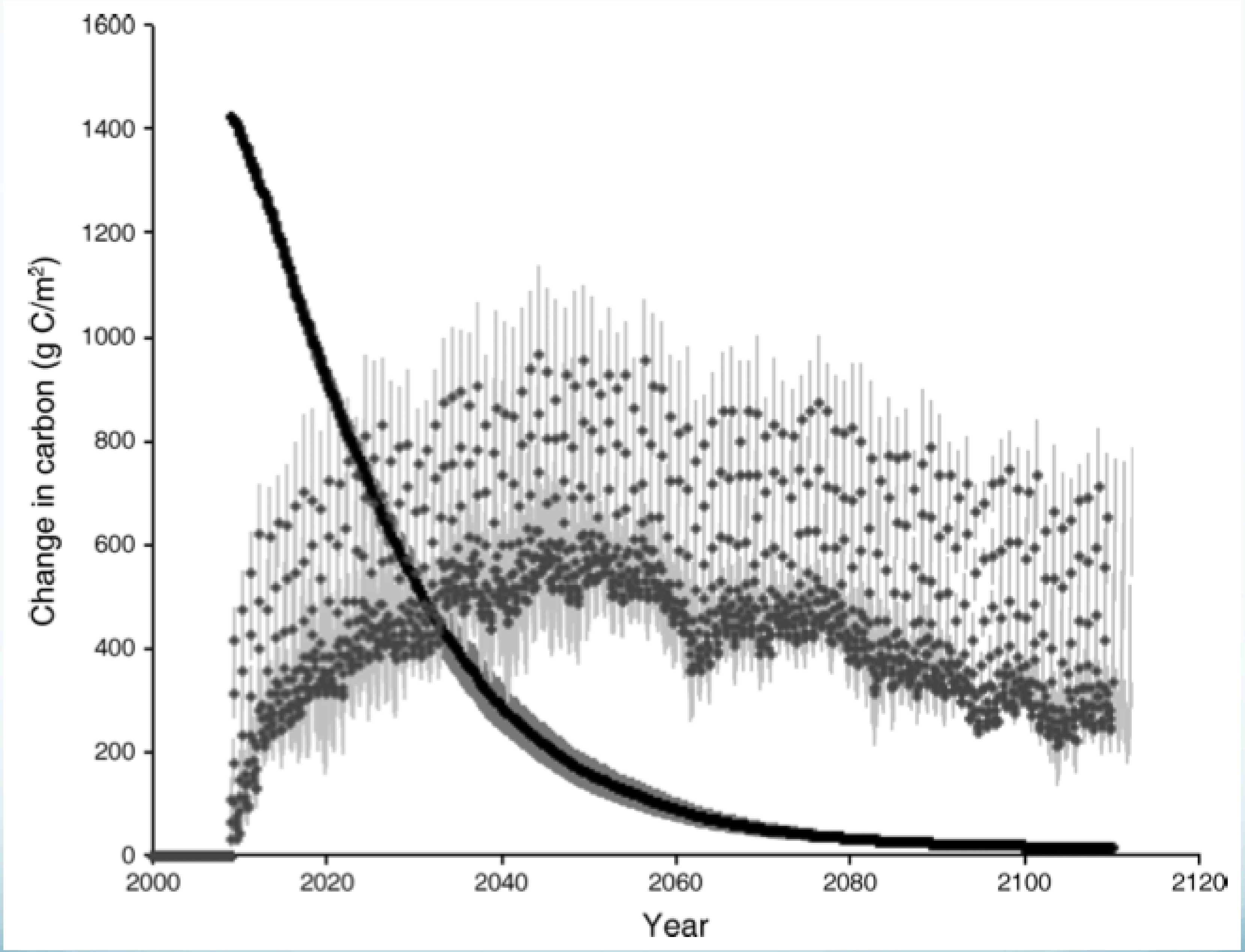
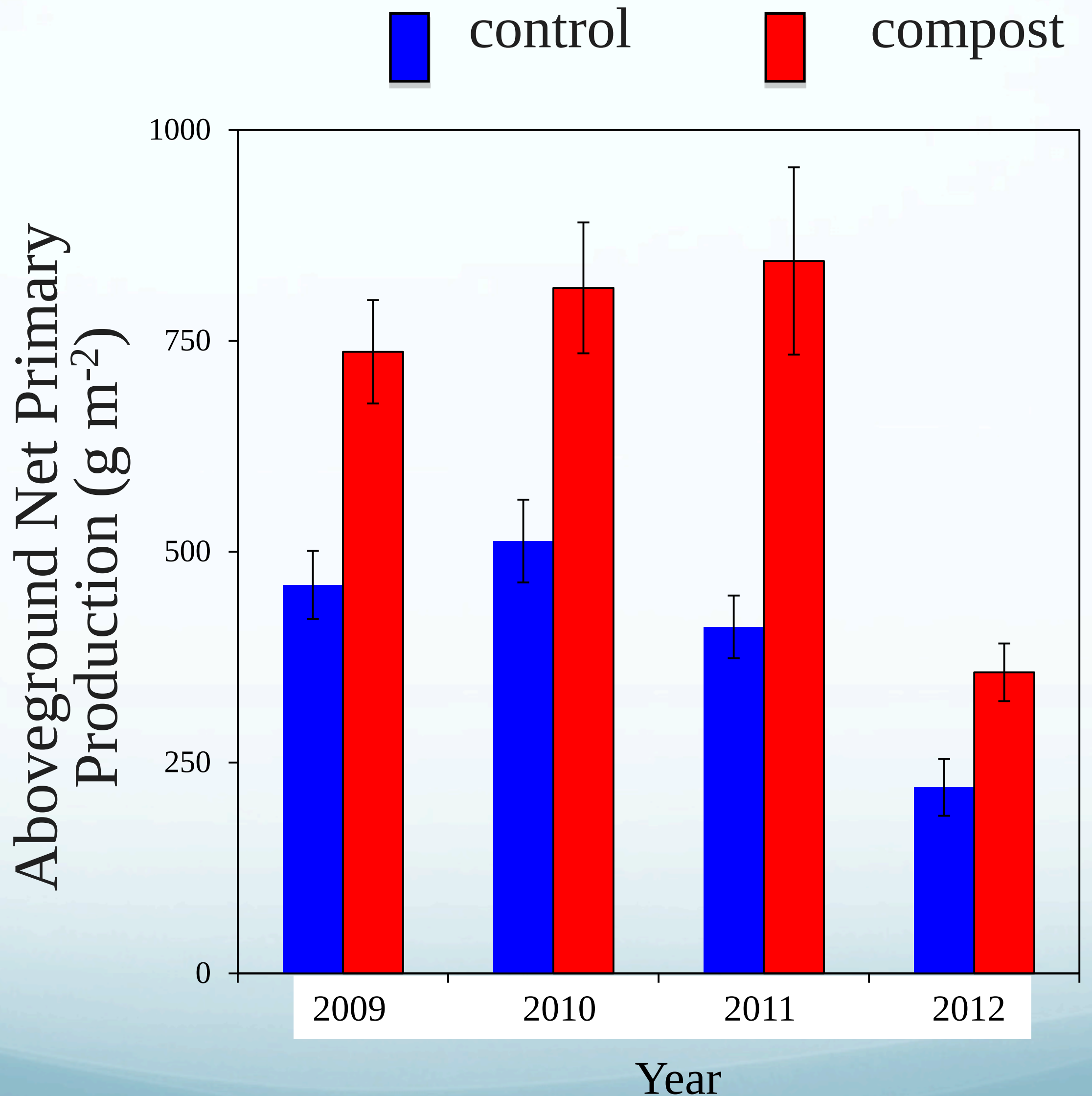


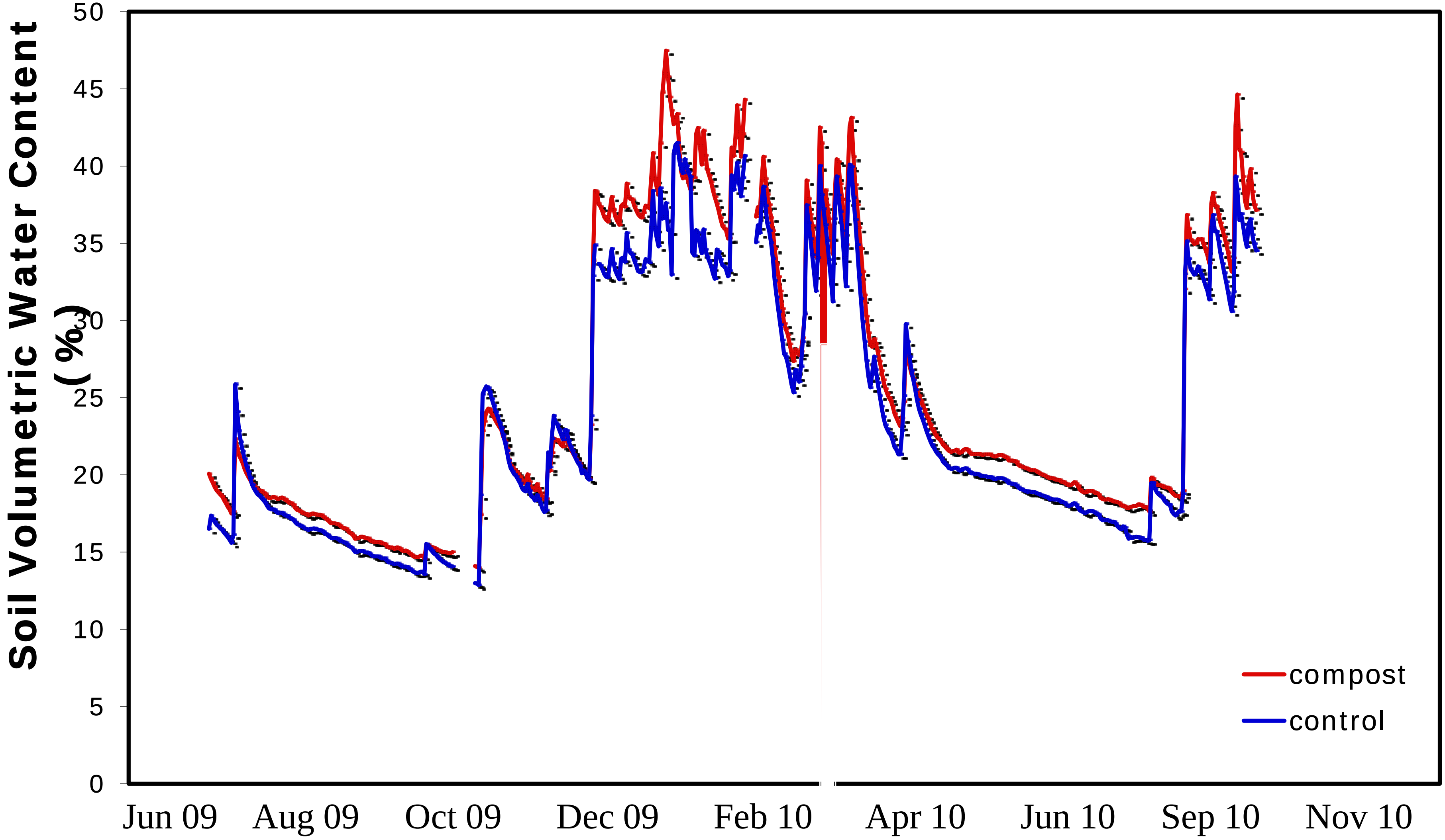
FIG. 3. The black line shows simulated decomposition of the compost following application to grassland soils. Gray circles show the monthly change in total ecosystem carbon, not including compost carbon. Values are averages across site characterizations, with standard error bars in light gray. Ryals et al, 2015. Ecological Applications, 25(2): 531–545.

Results: Above-ground production (forage) has exceeded controls by 40-70% ***every year*** following the single ½” compost application in 2008



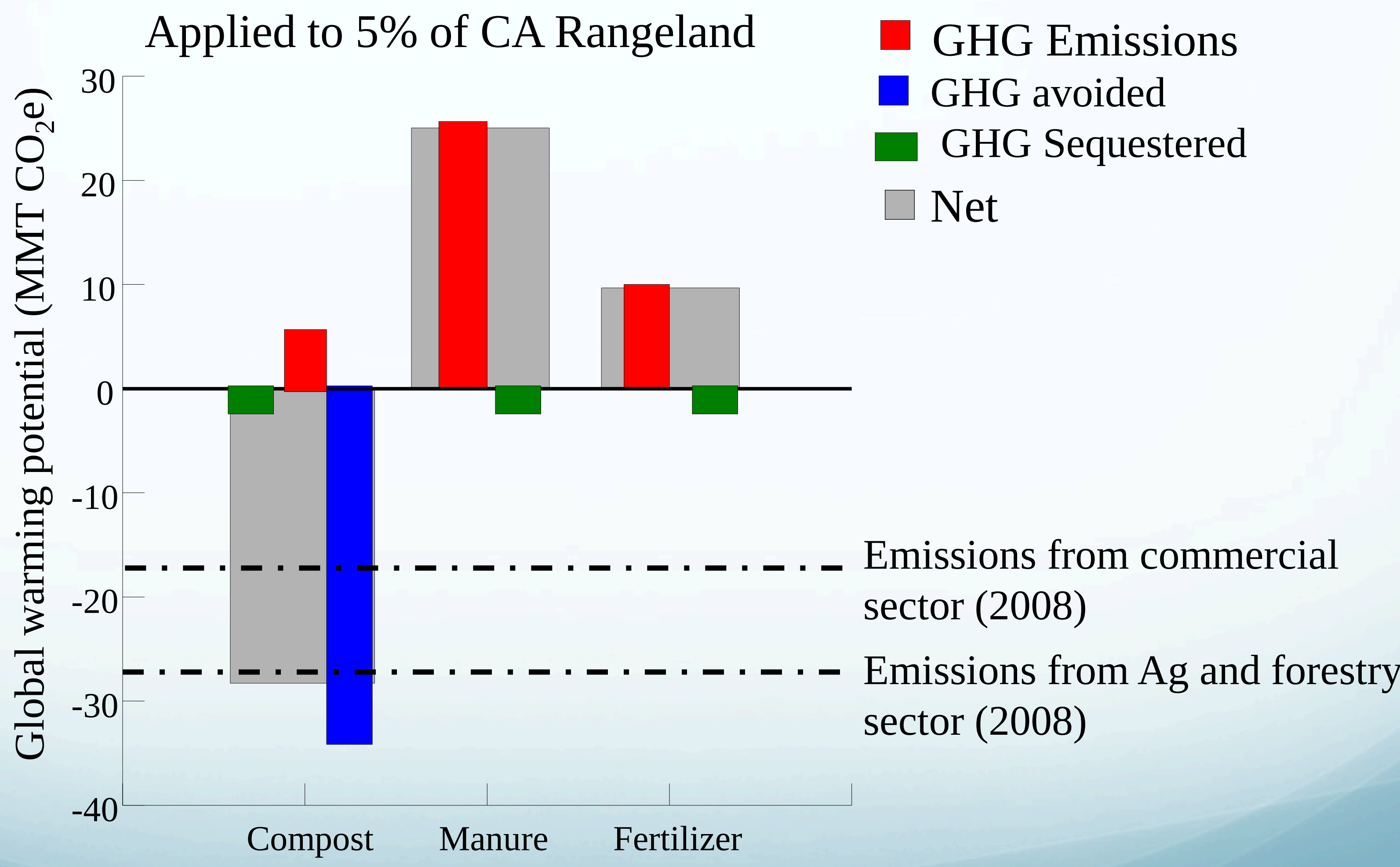
Ryals and Silver 2013.

Compost also increased soil moisture….



UCSFREC, Browns Valley, Ryals and Silver 2013

Life Cycle Assessment suggests significant GHG mitigation potential statewide



DeLonge et al. 2013

American Carbon Registry

The American Carbon Registry™

Methodology for
Compost Additions to Grazed Grasslands

Version 1.0

October 2014


American Carbon Registry

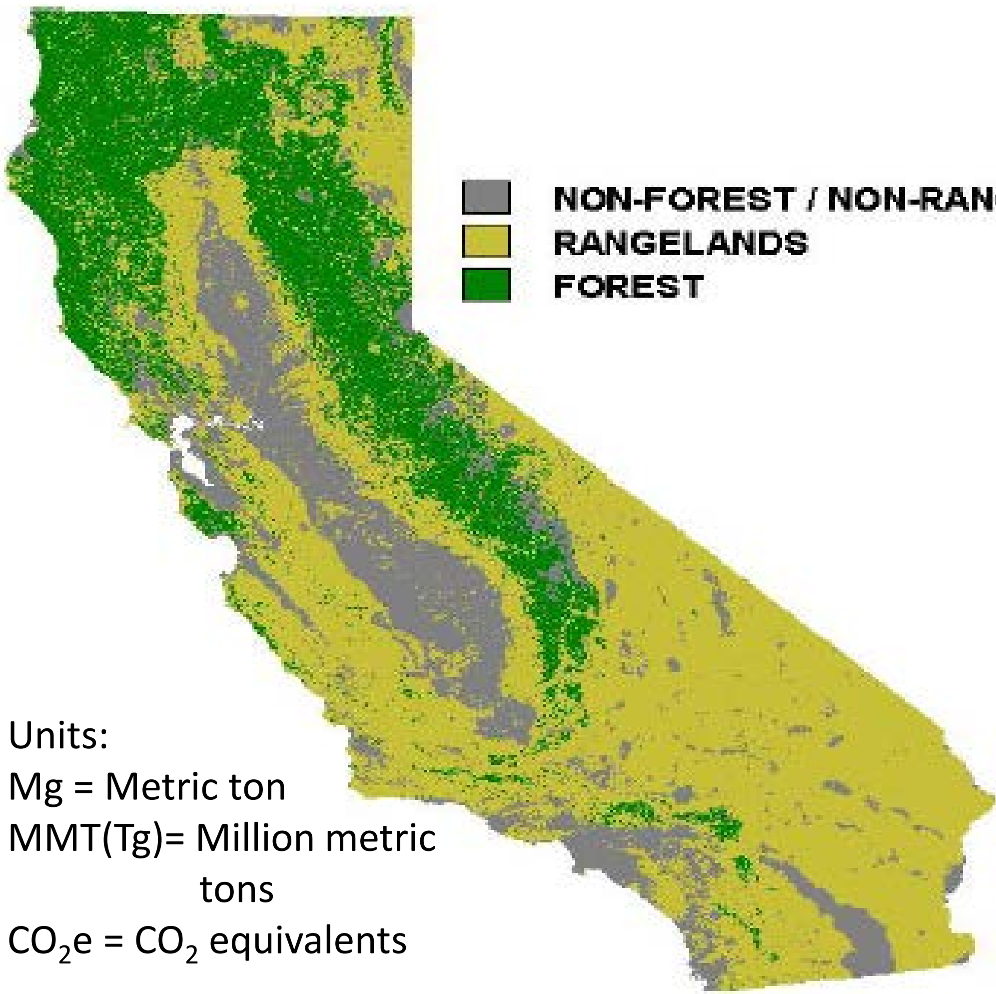
A nonprofit enterprise of

WINROCK INTERNATIONAL

California Rangelands Carbon Sequestration Potential With Compost Additions

23 million hectares (57 million acres) of rangeland in California: 67% (38 million acres) is grasslands and pastures.

(Without avoided landfill methane emissions)



At a rate of 0.5 Mg C ha^{-1} y^{-1}
= 28 MMT(Tg) CO_2e y^{-1}

At a rate of 1 Mg C ha^{-1} y^{-1}
= 56 MMT(Tg) CO_2e y^{-1}

At a rate of 3 Mg C ha^{-1} y^{-1}
= 169 MMT (Tg) of CO_2e y^{-1}

- Livestock
  ~ 15 MMT CO_2e y^{-1}
- Commercial/residential
  ~ 42 MMT CO_2e y^{-1}
- Electrical generation
  ~112 MMT CO_2e y^{-1}

Emissions data: CA GHG Inventory 2010

Units:
Mg = Metric ton
MMT(Tg)= Million metric tons
CO_2e = CO_2 equivalents

Good News: Carbon Dioxide in the Atmosphere Can Be Transformed Into Organic Matter Through Photosynthesis, and into *beneficial Soil Carbon* via Exudation, Deposition ***and*** Decomposition

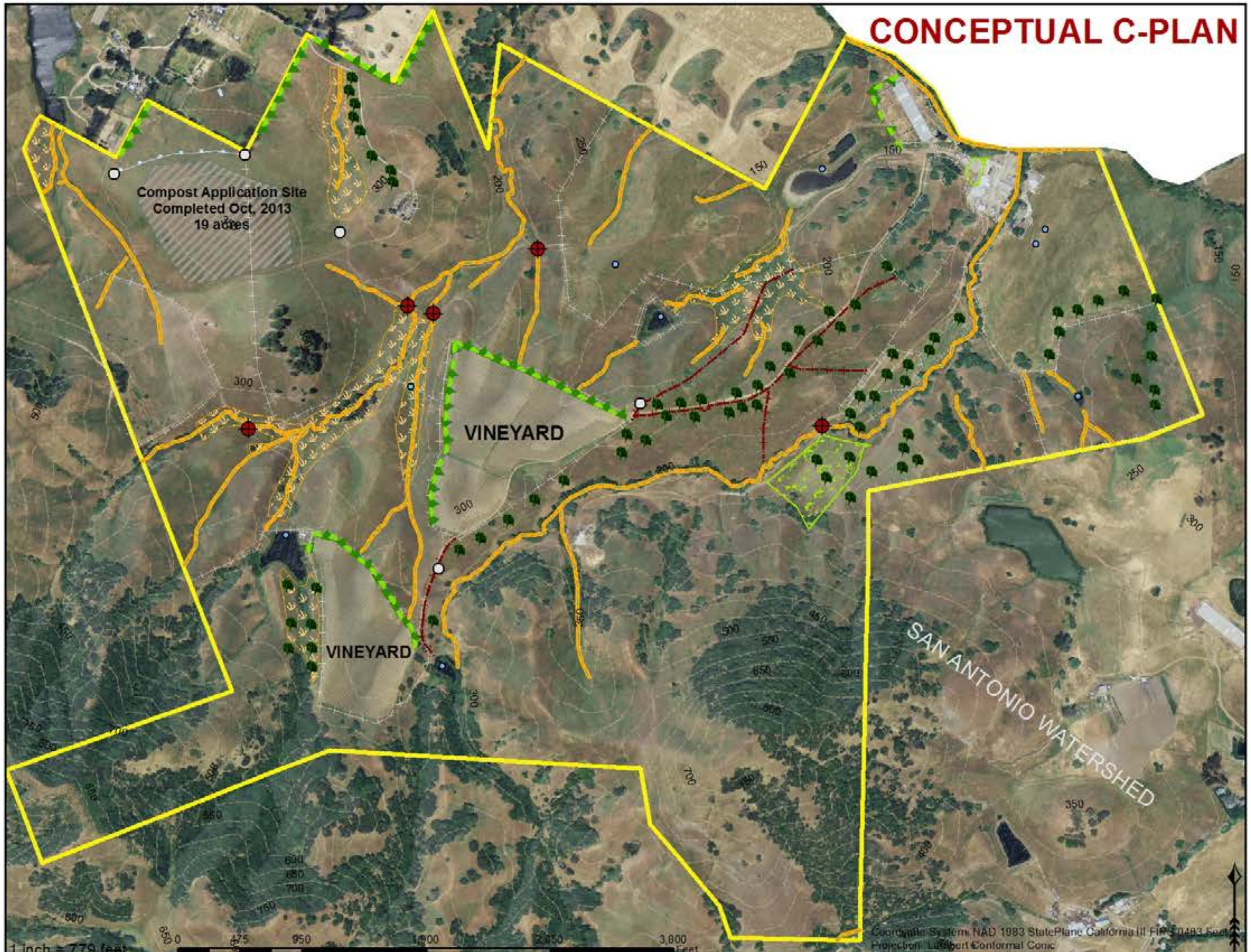
California -and the world- ***can*** meet our GHG reduction goals ***if*** we dramatically reduce emissions ***and*** invest in our **soils and working lands** as major sinks for atmospheric carbon.

Photo: Abe Collins, CarbonFarmersofAmerica.org

Marin Carbon Project
DRAFT
Carbon Farm Plan
CORDA RANCH

MARIN AGRICULTURAL LAND TRUST

MARIN RESOURCE CONSERVATION DISTRICT



Legend

Parcel Boundary

- Corda Ranch: 856 acres

Ranch Infrastructure

- Fencing, Existing
- Water Developments, Existing

Completed Practices

- Compost Application/ Mulching

Planned Practices

- Silvopasture: 6 acres
- Field/Riparian Forest Buffer: 20 acres
- Stream Crossing Repairs: 4
- Stream Restoration and/or Planting: 6.7 miles
- Riparian Buffer Planting: 34 acres
- Hedgerow/Windbreak: 7205 linear ft
- Fencing/Access Control: 6500 linear ft/ 1.2 miles

Water Development

- Pipeline: 1730 linear ft
- Troughs: 4

Proposed Conservation Practices (NRCS Practice #)

1. Compost Application/ Mulching (484) (initiated, fall 2013)
2. Critical Area Planting/Riparian Herbaceous Cover (342/390)
3. Fencing/Access Control (382/472)
4. Field Border (386)
5. Range Management Plan/ Prescribed Grazing (110/528)
6. Hedgerow Planting/ Windbreak/Shelterbelt (422/380/601)
7. Livestock Pipeline/ Water Facility (516/614)
8. Nutrient Management (590)
9. Pasture Planting (512)
10. Range Planting (550)
11. Riparian Forest Buffer (391)
12. Silvopasture: Establish Trees & Native Grasses (381/612)
13. Structure for Water Control (587)
14. Wetland Restoration (657)

Author: Lynette K Niebrugge

Date Saved: 5/20/2014 4:26:29 PM

Quantifying C-Farm Impacts

The COMET-Farm Tool
(http://cometfarm.nrel.colostate.edu)
allows a relatively rapid and thorough assessment of the greenhouse gas benefits of Integrated Carbon Farms

We worked with NRCS and CSU's NREL to refine the methods and models behind the COMET-Farm tool to:

1)calculate the greenhouse gas benefits of implementing proposed conservation practices on our demonstration carbon farms and;

2)Develop a rapid-assessment on-farm conservation practice carbon capture planning tool:

COMET-Planner
(www.comet-planner.com)

CO2e Reduction/Sequestration Potential, Marin C Farm 'A'

Practice	Average Annual CO2e Reduction	20 yr CO2e Reduction	CO2e Reduction at Maturity
Rangeland Compost (XXX)	88 Mg	1,760 Mg	1760 Mg
Range Planting (550)	44Mg	880 Mg	880 Mg
Windbreaks (380)	3.65 Mg	73 Mg	406 Mg
Prescribed Grazing (528)	56 Mg	1,120 Mg	1,120 Mg
Riparian Forest Buffer (391)	77 Mg	1,555 Mg	6,241 Mg
Riparian Herbaceous Cover (390)	36 Mg	720 Mg	720 Mg
No Till (329)	24.5 Mg	490 Mg	490 Mg
Critical Area Planting (342/390)	18.7 Mg	374 Mg	374 Mg
Field Border (386)	12 Mg	240 Mg	966 Mg
Silvopasture (381/612)	49 Mg	991 Mg	3988 Mg
Totals	**408 Mg**	**8,203 Mg**	**16,945 Mg**

The Carbon-Soil-Water-Climate Connection

If the state's 16-30 million acres of Mediterranean rangelands achieved even a modest 1% increase in SOC (2% increase in SOM) in the plow layer (top 6.7") alone, the associated water holding capacity increase would be 2.67 - 5 million acre feet. CO2e sequestered in the increased SOC would be 528 - 990 million metric tons.*

*Calculations are based on the plow layer (top 6.7" of soil) only; including deeper soil strata will increase potentials accordingly;
1% increase in SOM results in 1 acre-inch increase in soil water holding capacity;
1% increase in SOM represents 0.5% increase in SOC;
1 metric ton (2,200 lbs) of soil C represents 3.67 metric tons of CO2e;
1% increase in (plow layer only) SOC is about 10 short tons or 9 metric tons SOC/acre.

Thank You

www.carboncycle.org

www.MarinCarbonProject.org

Photo: http://restlesspilgrim.net

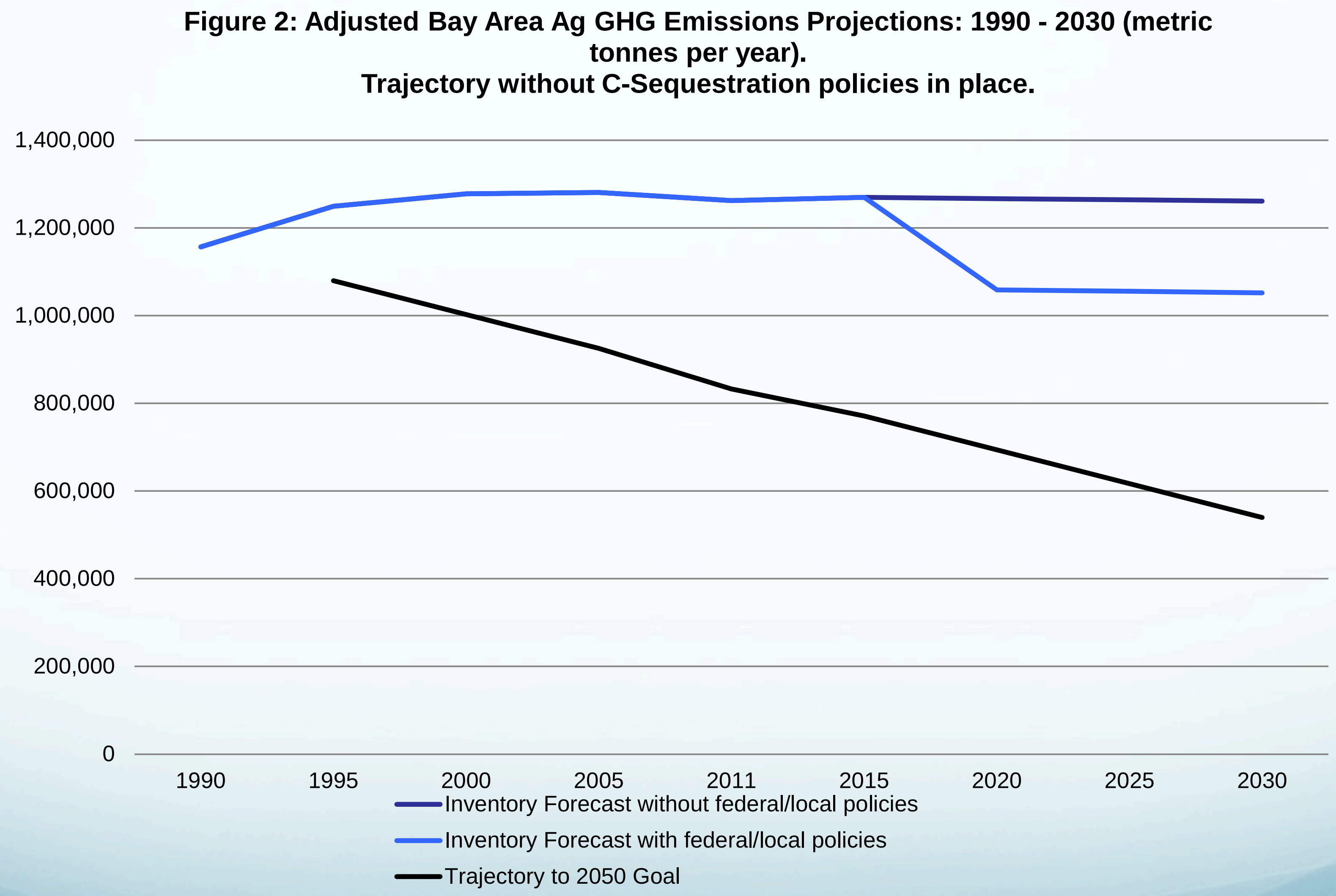


Figure 2: Adjusted Bay Area Ag GHG Emissions Projections: 1990 - 2030 (metric tonnes per year).
Trajectory without C-Sequestration policies in place.
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1990
1995
2000
2005
2011
2015
2020
2025
2030
Inventory Forecast without federal/local policies
Inventory Forecast with federal/local policies
Trajectory to 2050 Goal

Marin CAP: Meeting Marin County's GHG Reduction Goals

Agriculture is expected to achieve a GHG reduction of 579 $MTCO_2e$/year.

MCP research shows that this reduction can be achieved with a single one half inch compost application on 579 acres of Marin's 120,000 acres of grazed rangelands *without including avoided emissions*

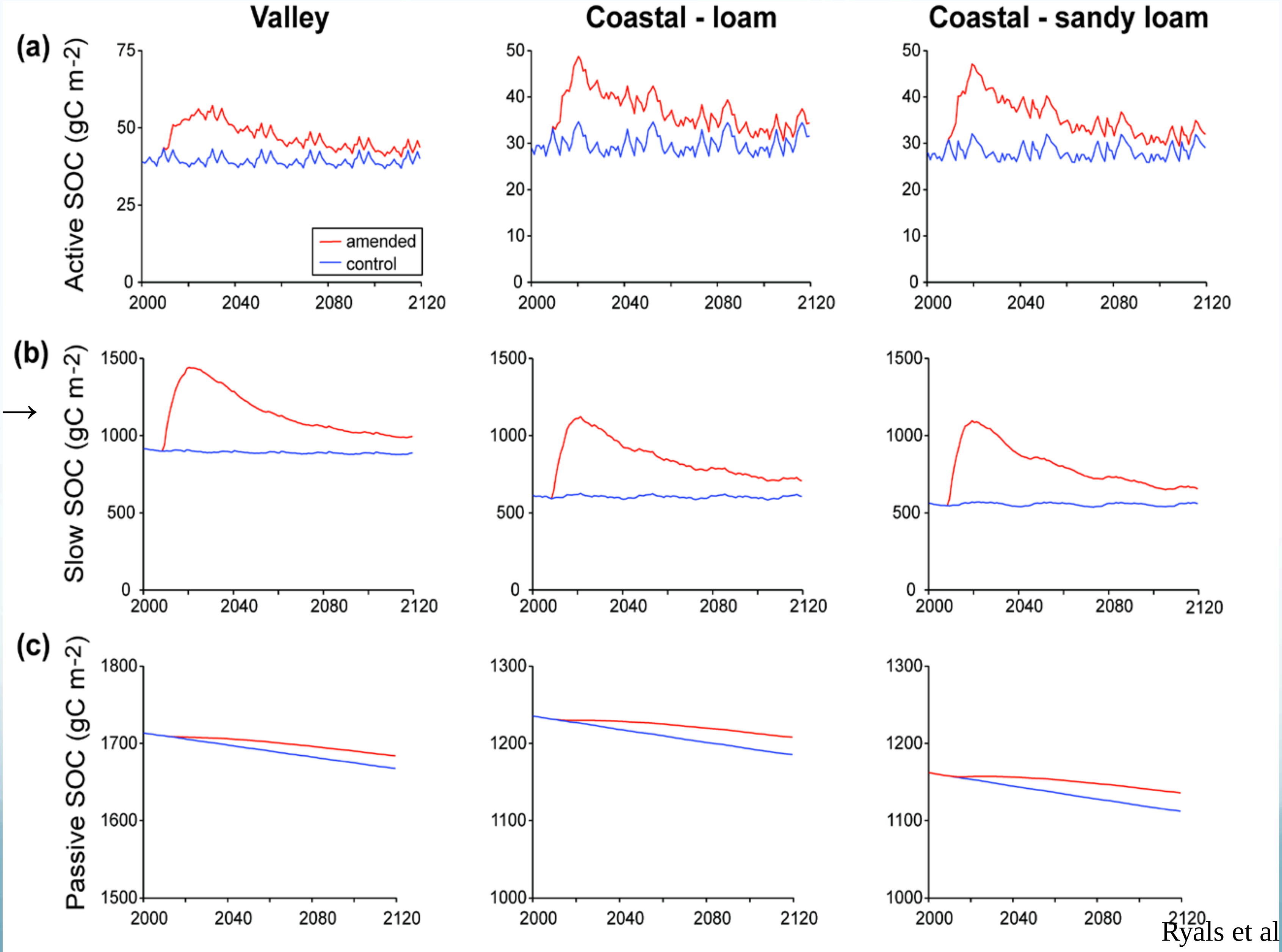
Compare this with the potential reductions achieved through a C-Farm Planning approach

Ag holds the best cards, but is missing from the game!

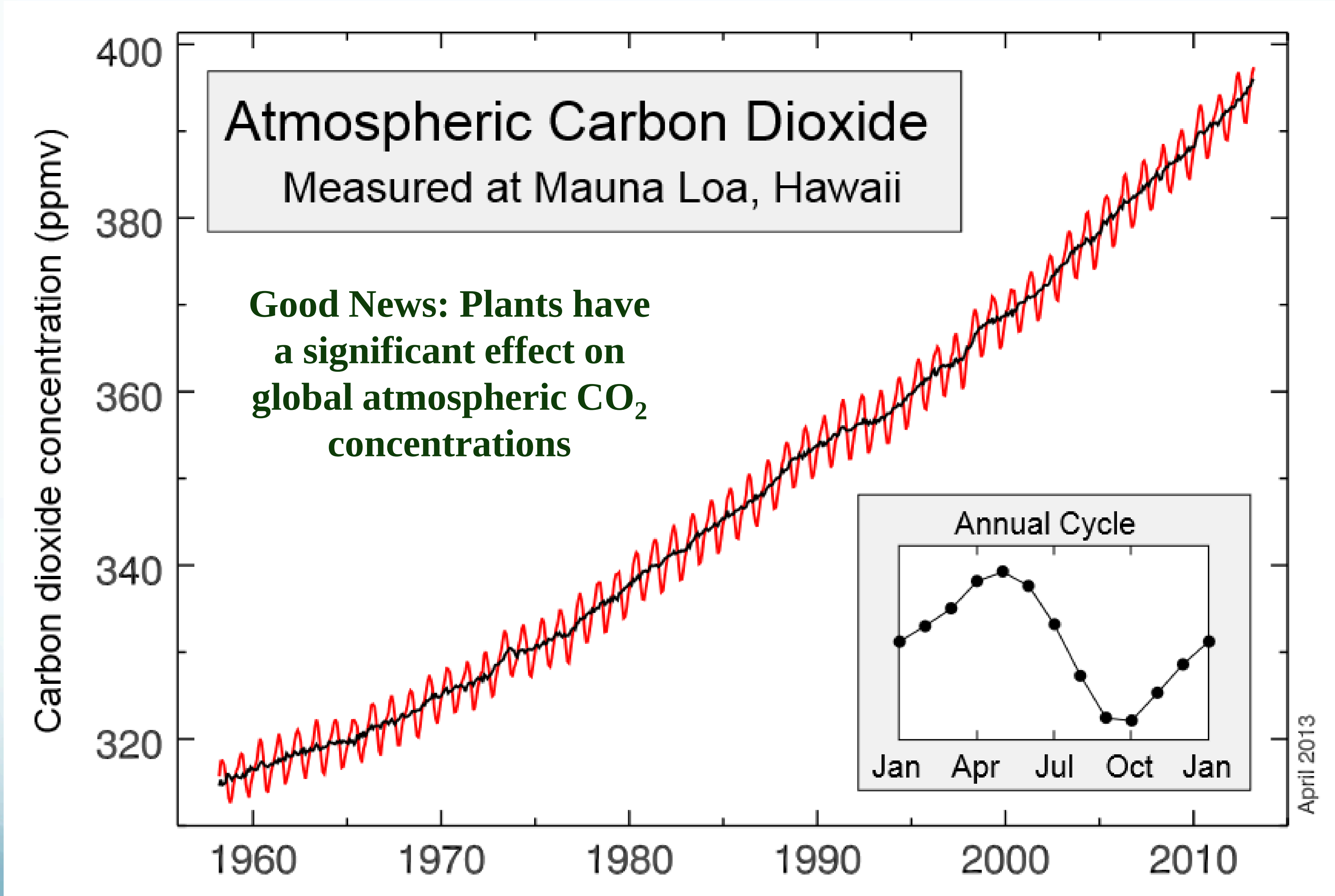
Costs/Benefits

- Example: (1 ton C = 3.67 tons CO2e)
- "True" value of high quality compost is ≥$60/ton, spread.
- ¼" application, 17 tons/acre = $1,020/acre.
- 1 acre = 0.5 ton C/yr = 1.8 tons CO2e/yr.
- 3 year: 5.4 tons: = $189/ton CO2e
- 5 year: 8 tons: = $128/ton CO2e
- 10 year: 18 tons = $57/ton CO2e
- 15 year: 26 tons = $39/ton C02e
- If we add forage value of ½ ton/acre at $200/ton, we cut cost by $100/acre each year:
- 3 year: $1020 - $300 = $720/5.4 tons = $133/ton CO2e
- 5 year: $1020 – $500 = $520/8 tons = $65/ton CO2e
- 6 year: $1020 - $600 = $420/ 10.8 tons = $39/ton CO2e
- 7 year: $1020- $700 = $320/12.6 tons = $25/ton CO2e
- 8 year: $1020 - $800 = $220/ 14.4 tons = $15/ton CO2e
- 9 year: $1020 - $900 = $120/ 16.2 tons = $7.40/ton CO2e.
- 10 year: $1020 - $1000 = $20/ 18 tons= $1.10/ton CO2e.
- Note; does NOT include C in the compost
- (1 ton compost @ 25% C = ± 1 ton CO2e).

Models suggest that the C increase effect persists for 30-100 years

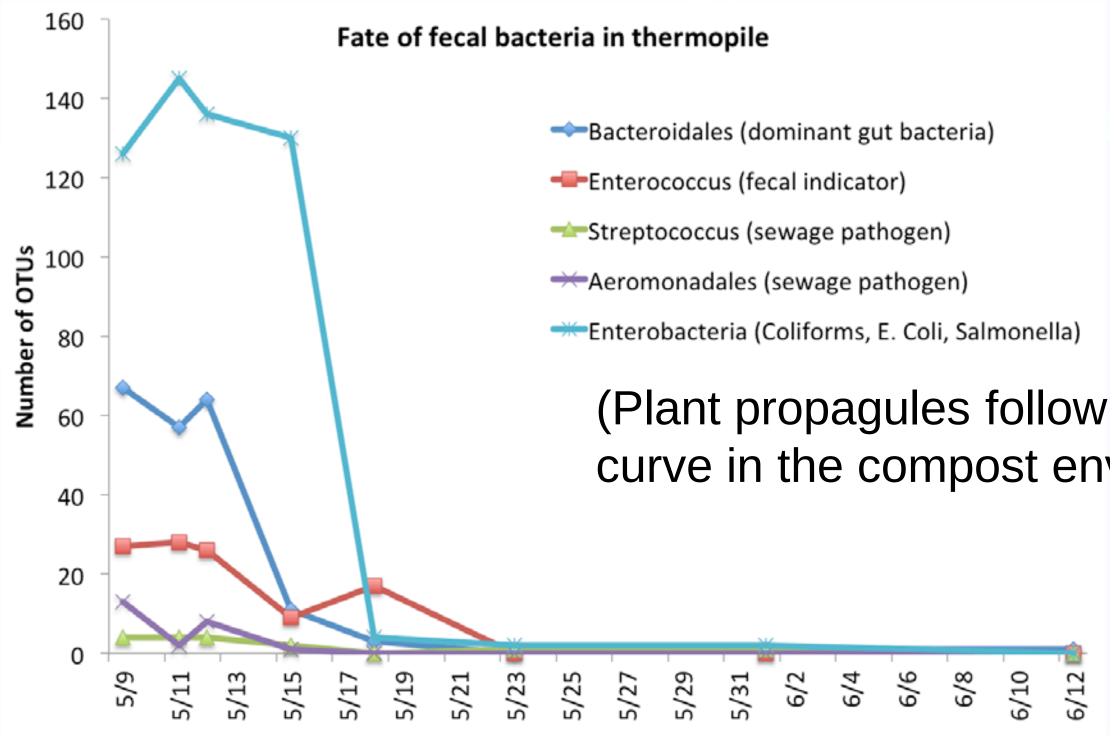


Ryals et al 2013



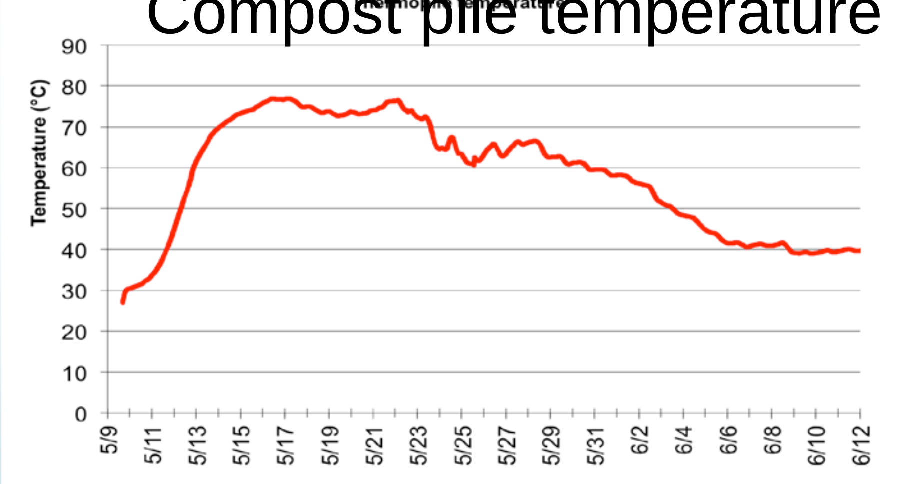
Atmospheric Carbon Dioxide
Measured at Mauna Loa, Hawaii
Good News: Plants have a significant effect on global atmospheric CO_2 concentrations
Carbon dioxide concentration (ppmv)
400
380
360
340
320
1960
1970
1980
1990
2000
2010
Annual Cycle
Jan
Apr
Jul
Oct
Jan
April 2013

Aerobic Thermophilic Composting



(Plant propagules follow a similar decay curve in the compost environment)

Compost pile temperature



Source: Dr. Gary Anderson, Lawrence Berkeley Lab

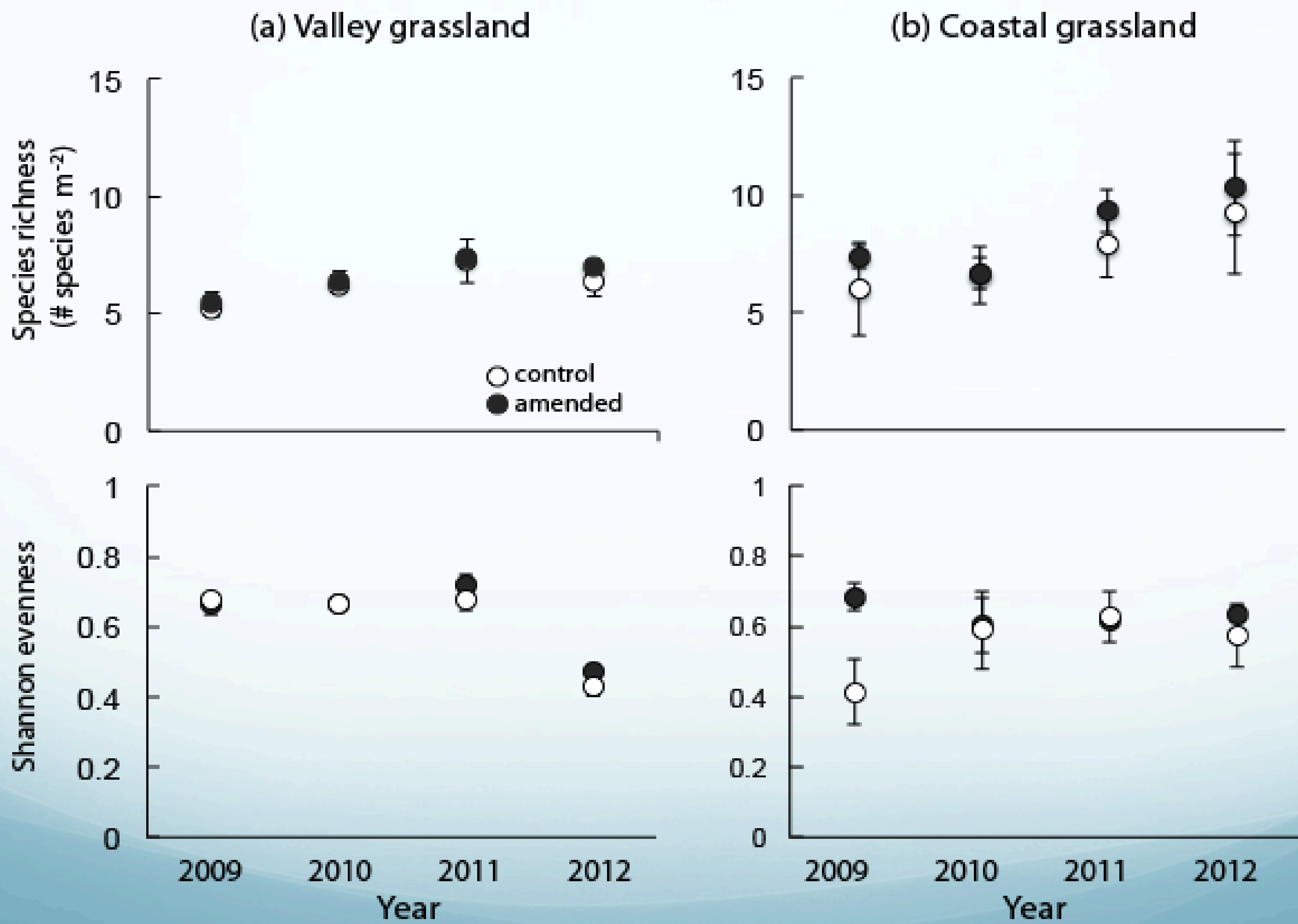
Reactive Nitrogen vs. Organic Nitrogen

Nitrogen is available to plants as either ammonium (NH_4^+) or nitrate (NO_3^-). These inorganic forms of N are commonly found in chemical fertilizer and manures.

Organic N predominates in finished compost. It is relatively stable and not available to plants until broken down into inorganic N.

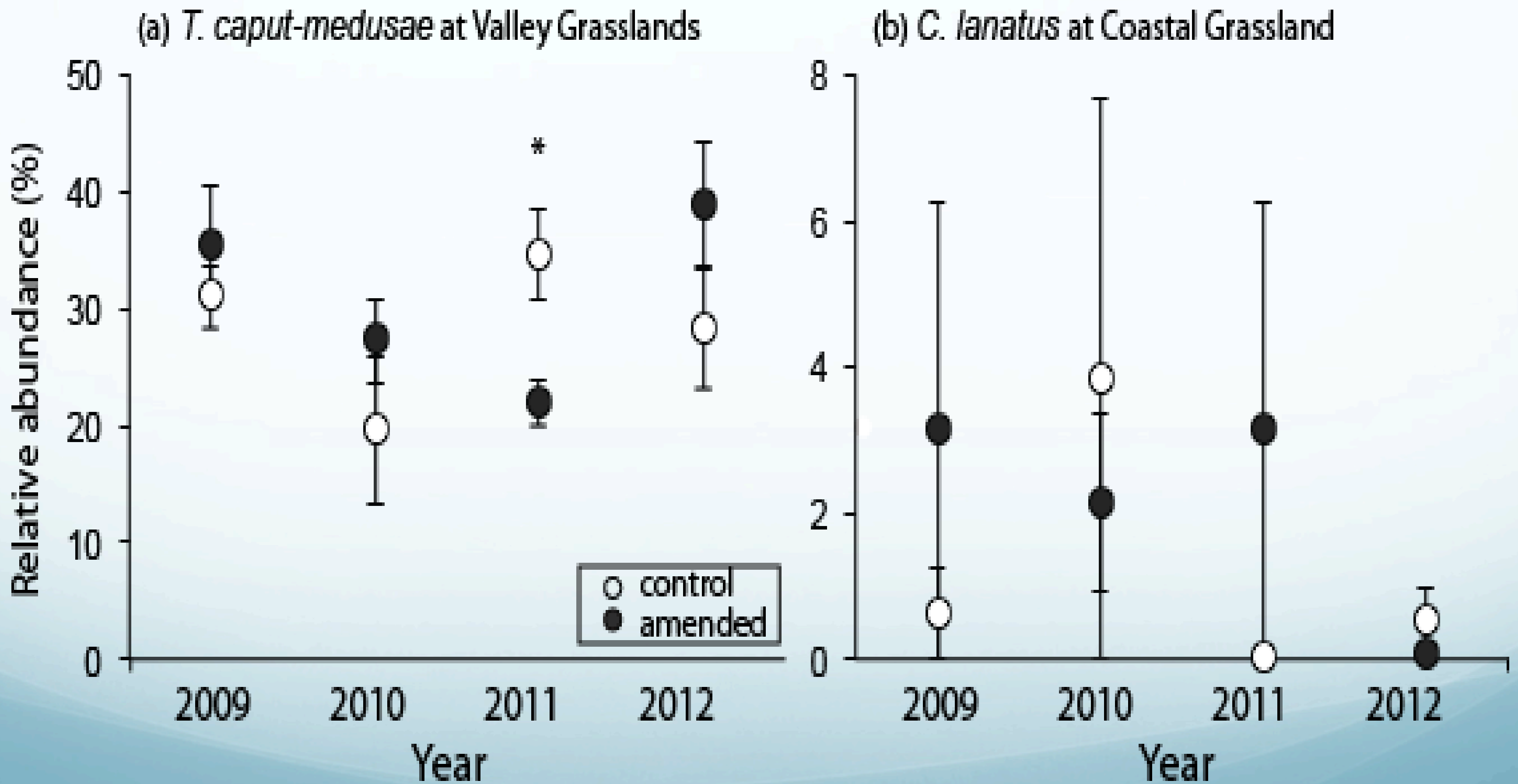
Breakdown of organic N to inorganic N occurs slowly, so that plant available N is released at about the same rate that it is taken up by plants.

No significant changes in plant diversity



Ryals et al. in review

No increase in noxious plants

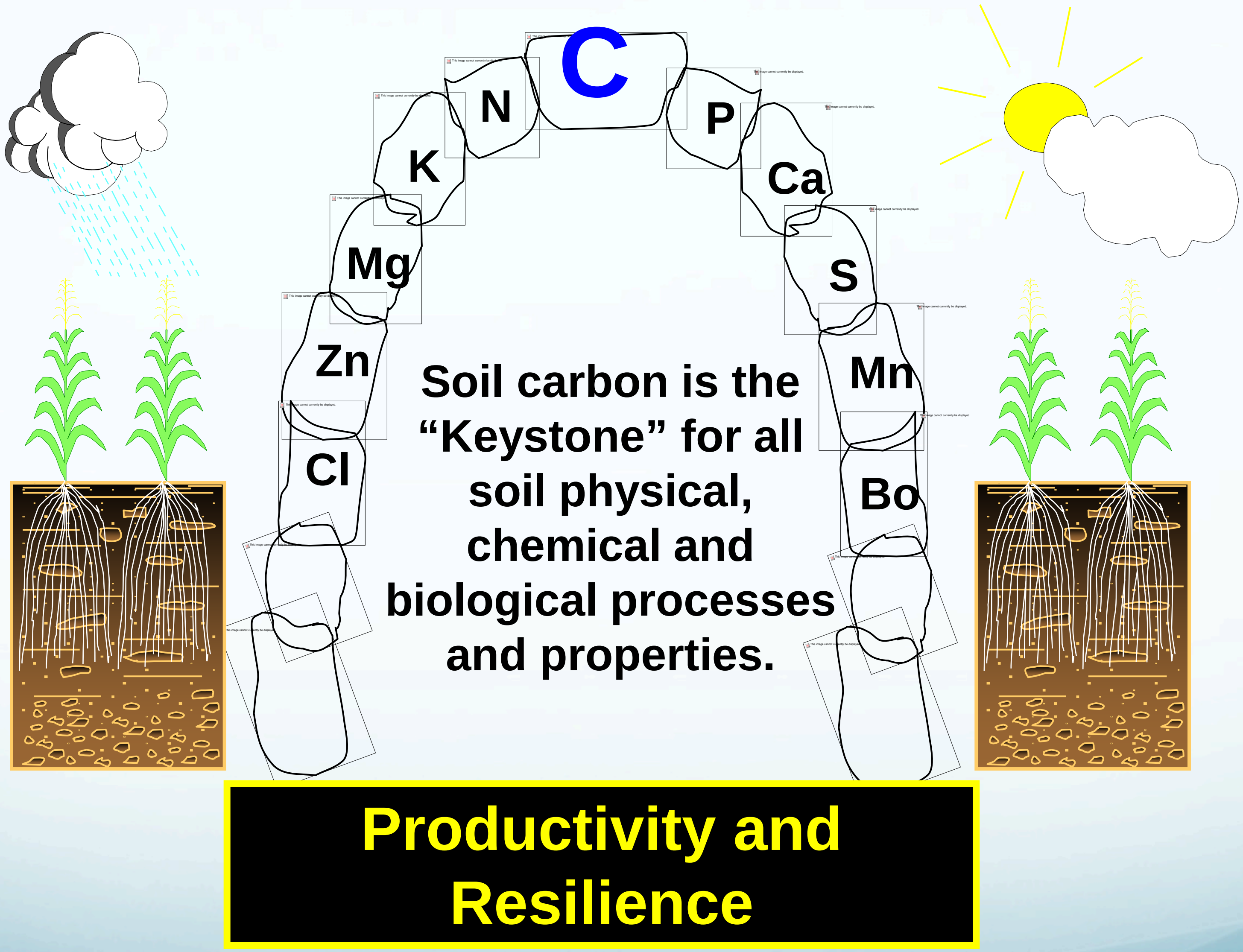


Ryals et al. in review

The Carbon-Soil-Water-Climate Connection

“The most practical way to enhance soil health today is to promote better management of soil organic matter, or carbon…” NRCS, 2011

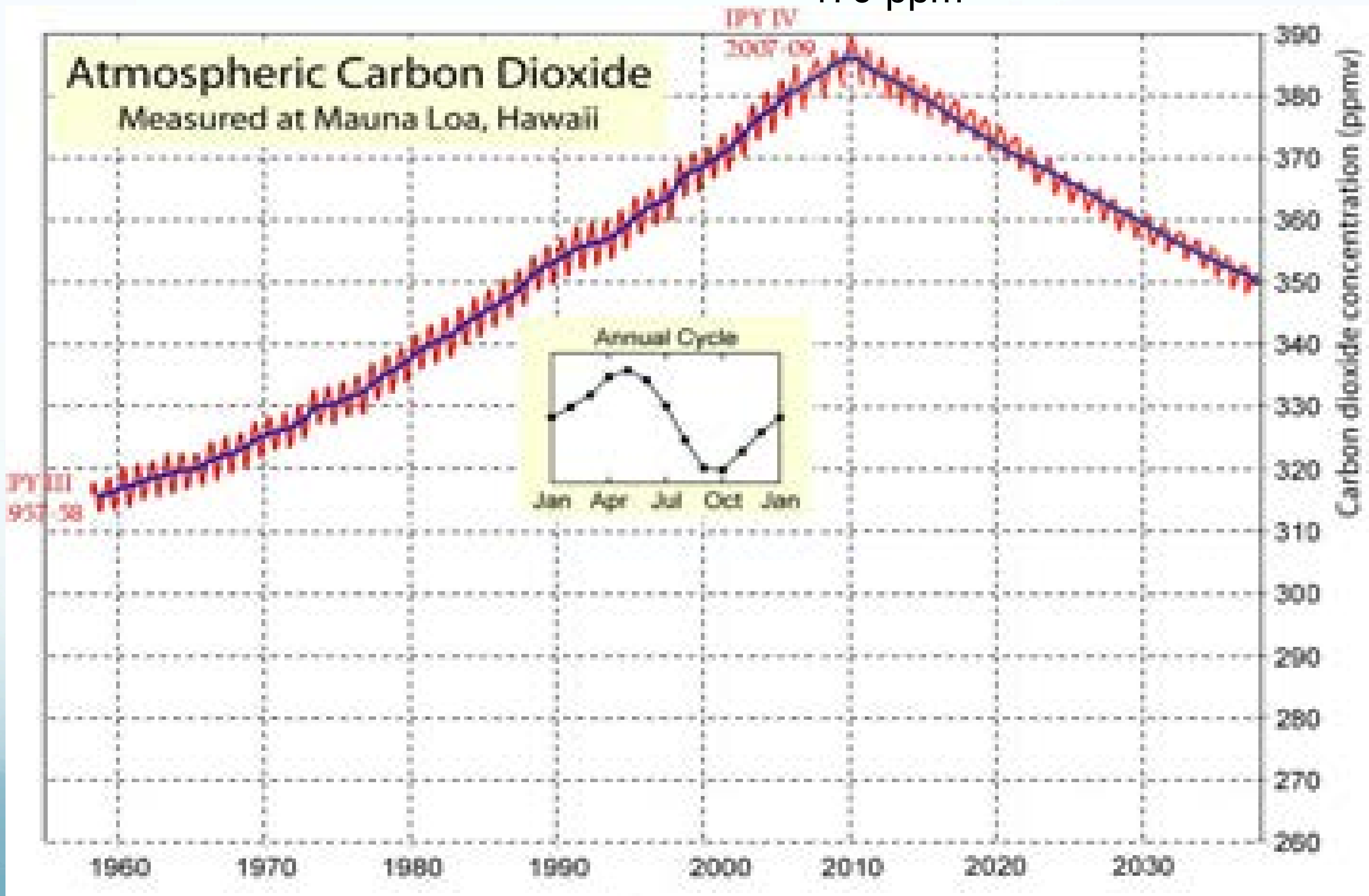
http://soils.usda.gov/sqi/concepts/soil_organic_matter/som.html



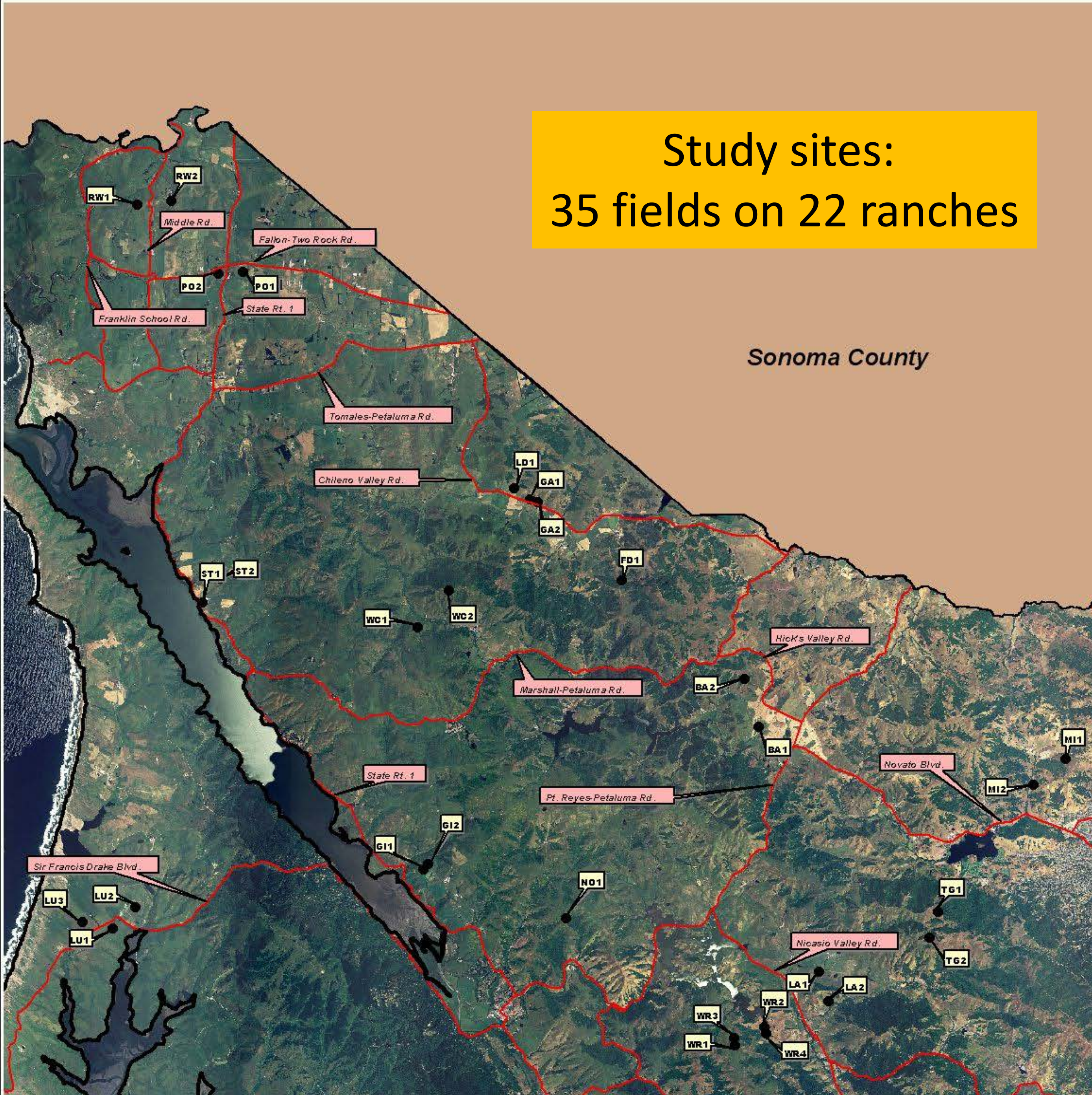
Credit: Dr. D.C. Reicosky, ARS, Morris, MN.

Measured effect of deviation-amplifying positive feedbacks resulting from anthropogenic forcing of global atmospheric C, with hypothetical effect of deviation-amplifying positive feedbacks resulting from anthropogenic forcing of soil organic C at global scale

470 ppm



Study sites:
35 fields on 22 ranches



Marin County

2 0 2 4 Miles

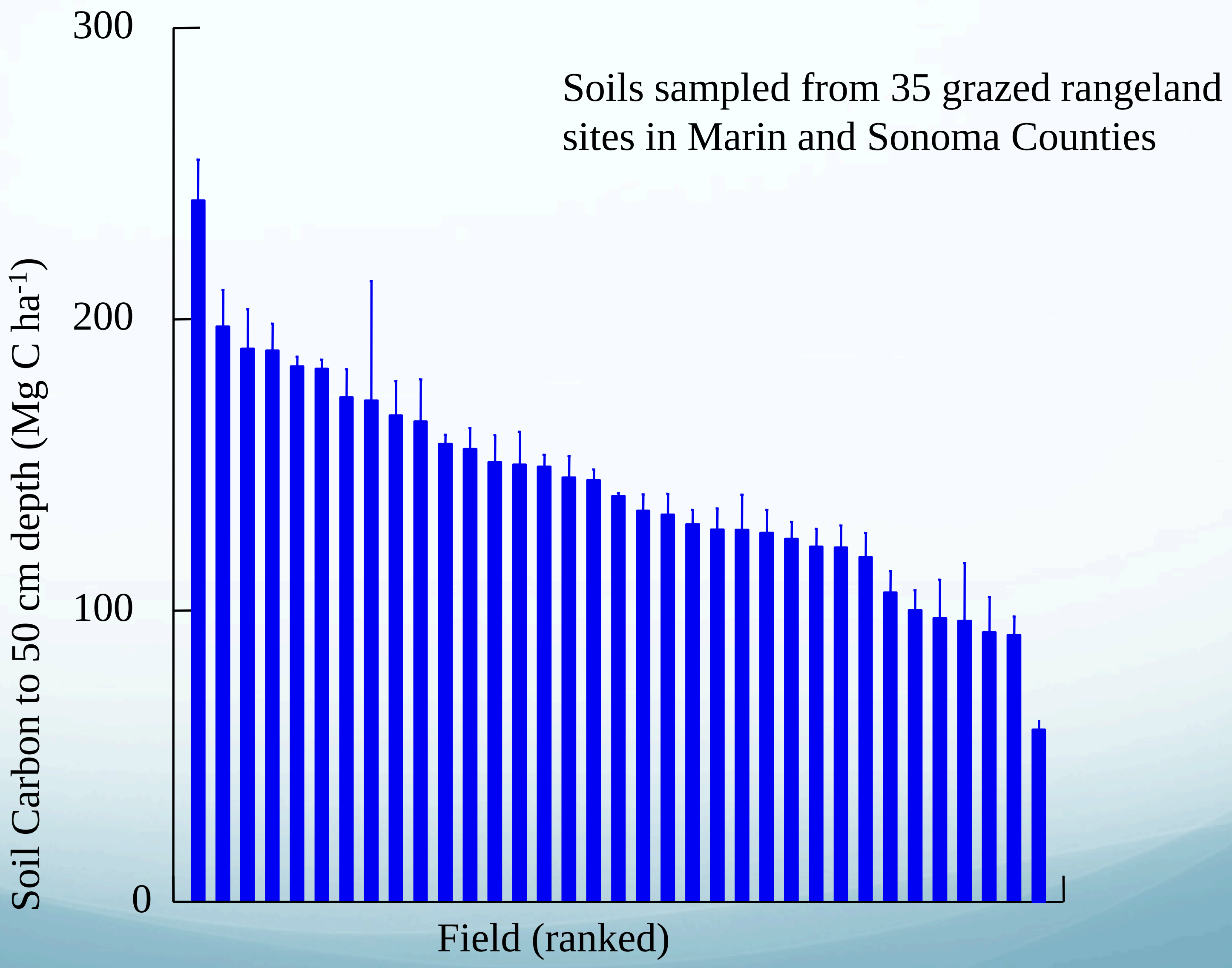
1 inch = 14,000 feet

MARIN AGRICULTURAL LAND TRUST

Map prepared by Marin Agricultural Land Trust
February 2008

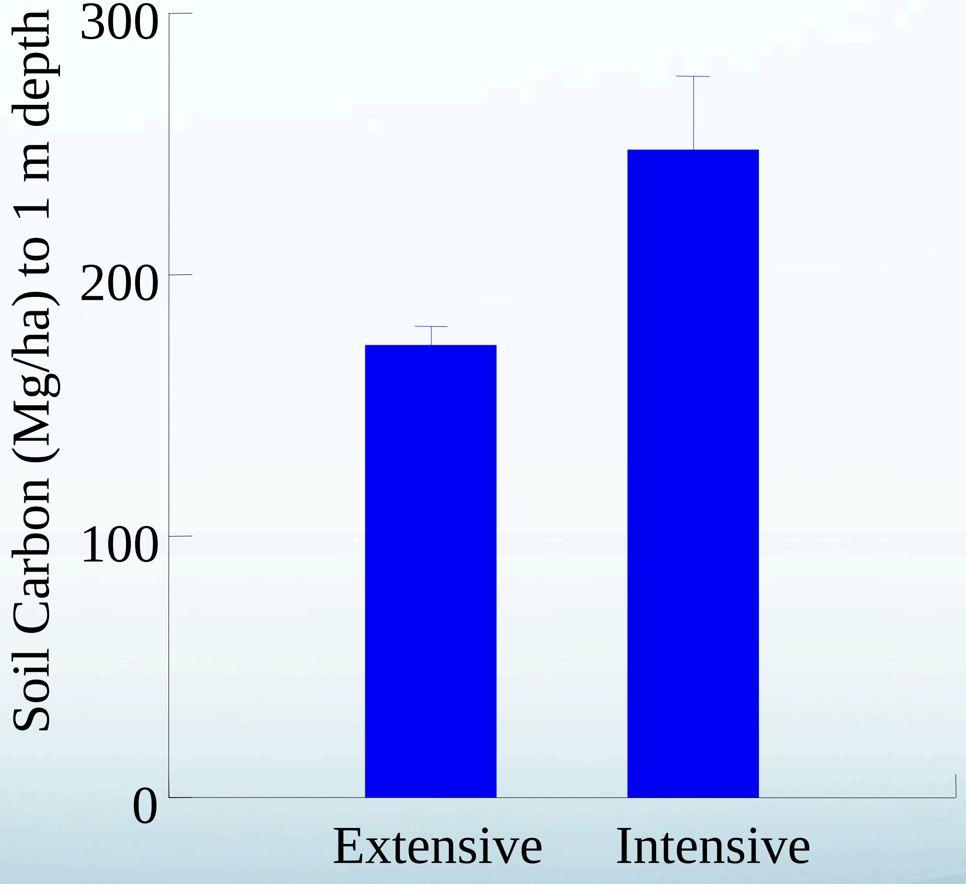
Sample locations approximate and should be field verified

We detected differences in rangeland soil carbon pools linked to differences in management practices



From Silver et al. In prep

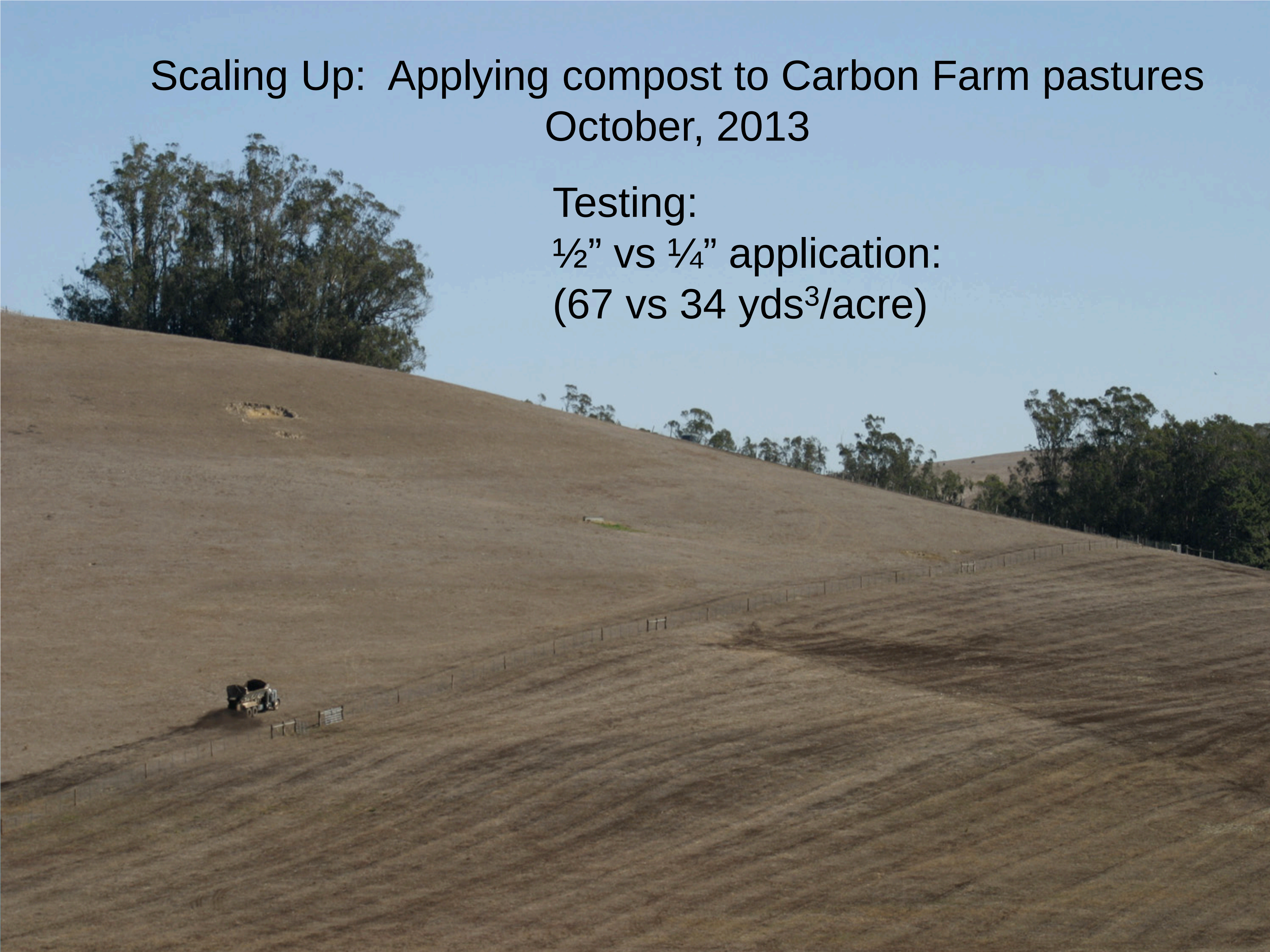
Organic amendments (manure applications) associated with more intensive management (mostly dairies) increased soil carbon by 50 Mg C ha^{-1} in the top meter of soil



Compost

The product of a managed, aerobic, thermophilic process through which microorganisms break down plant and animal materials into relatively stable forms suitable for beneficial application to the soil.

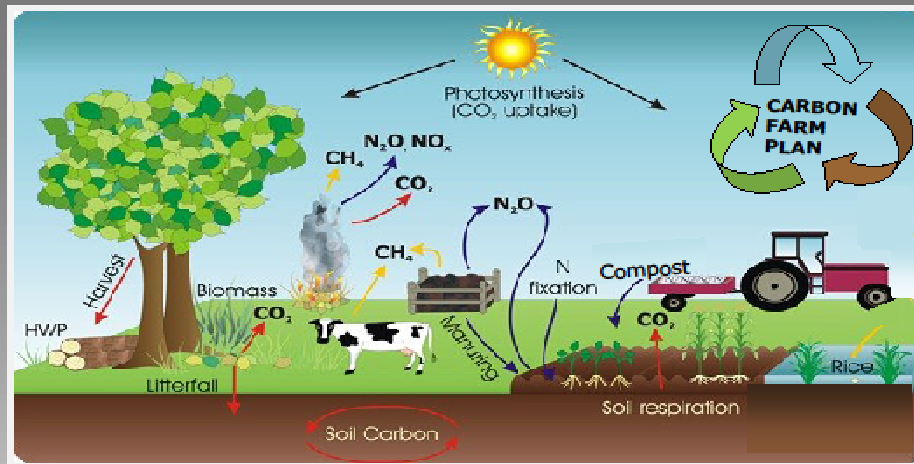
Compost is a source of *energy* for the soil ecosystem that drives soil-plant-water relations and underlies a host of ecosystem processes, including nutrient cycles, biodiversity, hydrology, etc.


Scaling Up: Applying compost to Carbon Farm pastures
October, 2013
Testing:
½” vs ¼” application:
(67 vs 34 yds^3/acre)

Marin Carbon Project: Carbon Farming

- Identify demonstration C-Farms and conduct farm assessments, including soil sampling (2013).
- Apply compost on rangelands at scale (2013)
- Develop list of other carbon beneficial NRCS practices;
- Complete 3 C-Farm Action Plans
- Calibrate GHG accounting models with COMET-Farm/CSU and C-Farm data.
- Provide C-Farm permit assistance, technical expertise, implementation funding and monitoring assistance.
- Implement C-Farming workshops for farmers, ranchers, RCDs (2015)
- Confirm roles of project partners and expand to other counties.

Carbon Farm STEWARDSHIP FUNDING



Sources and sinks of GHG emissions in agriculture, forests, and other land use systems (IPCC 2006)

Carbon Farming:
We are pleased to announce the availability of funds to develop and implement Carbon Farm Action Plans on up to 3 ranches. Projects will focus on the implementation of carbon beneficial practices on predominantly permanent pasture based livestock systems in Marin County.

Participation Requirements:
- Producers must be eligible for USDA Natural Resources Conservation EQIP programs.
- Must maintain interest and involvement throughout project and maintain conservation practices a minimum of 10 years or duration of EQIP contract.
- Willing to be a demonstration Carbon Farm.
- Private land

The Project will Fund:
1) Ranch Planning and Permitting
2) Technical/Engineering Expertise
3) Construction of Conservation Practices

Conservation Practices:
- Compost Application, Purchase
- Erosion Protection Planting: Grasses, Shrubs and Trees
- Crop Rotation and Cover Crop
- Hedgerows and Windbreaks
- Filter Strips and Grassed Waterways
- Forest Establishment
- Nutrient Management, Fertilizer Alternatives
- Pasture and Hay Planting
- Rangeland Management: Prescribed Grazing, Range Planting
- Residue management: No-Till, Strip Till, Seasonal Tillage, Mulch Till
- Creek and Wetland Restoration

DEADLINE IS AUGUST 1ST!!! CONTACT:

Marin Resource Conservation District
Nancy Scolari or Lynette Niebrugge
Phone: (415) 663-1170
Email: marinrcd@marinrcd.org

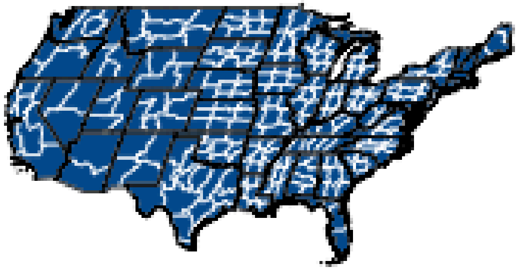
Support for this program was provided by grants from the Marin Community Foundation, Sara and Evan Williams Foundation and the 11th Hour Project.

Evaluate potential carbon sequestration and greenhouse gas reductions from adopting NRCS conservation practices

PROJECT NAME:

State:

County:



NRCS Conservation Practices - Select Your Practice(s)
Name
Cropland Management (8 Items)
Cropland to Herbaceous Cover (10 Items)
Cropland to Woody Cover (7 Items)
Grazing Lands (4 Items)
Restoration of Disturbed Lands (5 Items)

		Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions[1] (tonnes CO_2 equivalent per year)			
	Enter Acreage	CO_2	N_2O	CH_4	Total CO_2-Equivalent
NRCS Conservation Practices					
	Total	0.00	0.00	0.00	0.00

[1]Negative values indicate a loss of carbon or increased emissions of greenhouse gases

[2]Values for this category were not estimated due to limited data on reductions of greenhouse gas emissions from this practice

Overall potential for terrestrial sequestration/avoided GHG emissions, Marin C-Dairy Y

Practice	Average Annual CO2e Reduction	20 yr CO2e Reduction	CO2e Reduction at Maturity
Anaerobic Digester (366)	1,645 Mg	32,900 Mg	32,900 Mg
Pasture Seeding (512)	44 Mg	880 Mg	880 Mg
Windbreaks (380)	10.65 Mg	213 Mg	511 Mg
Prescribed Grazing (528)	42 Mg	840 Mg	840 Mg
Rangeland Compost (XXX)	88 Mg	1760 Mg	1760 Mg
Riparian Forest Buffer (391)	9.85 Mg	197 Mg	791 Mg
Nutrient Management (590)	56.65 Mg	1,133 Mg	2,834 Mg
Riparian Herbaceous Cover (390)	8 Mg	160 Mg	160 Mg
Pasture Planting (512)	44 Mg	880 Mg	880 Mg
Critical Area Planting (342/390)	2.2 Mg	44 Mg	88 Mg
Totals	**1,950.35 Mg**	**39,007 Mg**	**41,564 Mg**

Potential for terrestrial sequestration/avoided GHG emissions ($Mg\ CO_2e$) on 3 Marin County Carbon Farms (Assuming C-Farm Plan Implementation)

Farm Y (Dairy) Anaerobic Digester

1,645 Mg (Annual)*
32,900 Mg (20 year)
32,900 Mg (Maturity)

Farm A (Cattle & Sheep) Totals

266 Mg CO_2e (Annual)
4,923 Mg CO_2e (20 year)
8,918 Mg CO_2e (maturity)

Farm B (Heifers) Totals

408 Mg (Annual)
8,203 Mg (20 year)
16,945 Mg (maturity)

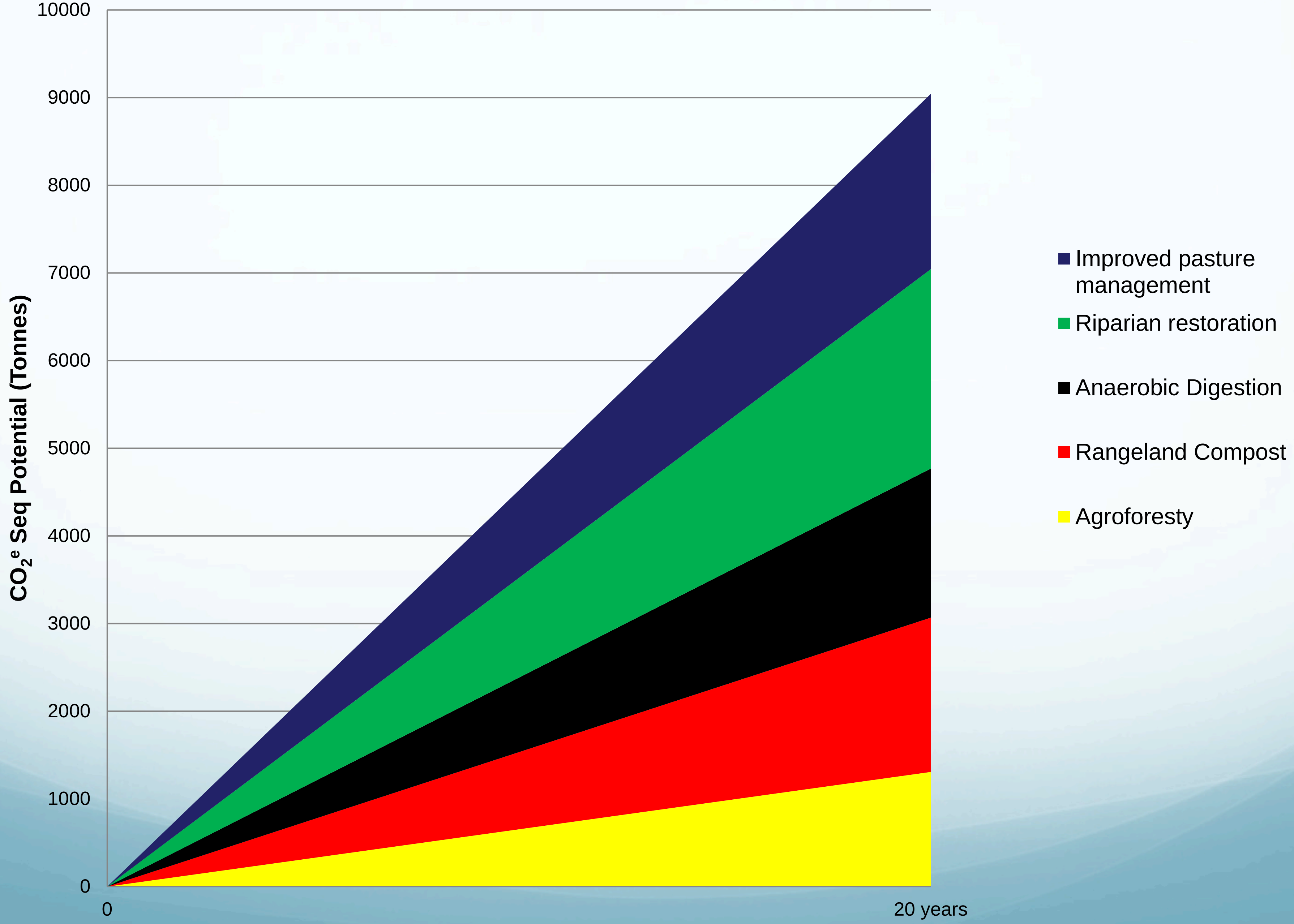
Totals (including Digester)

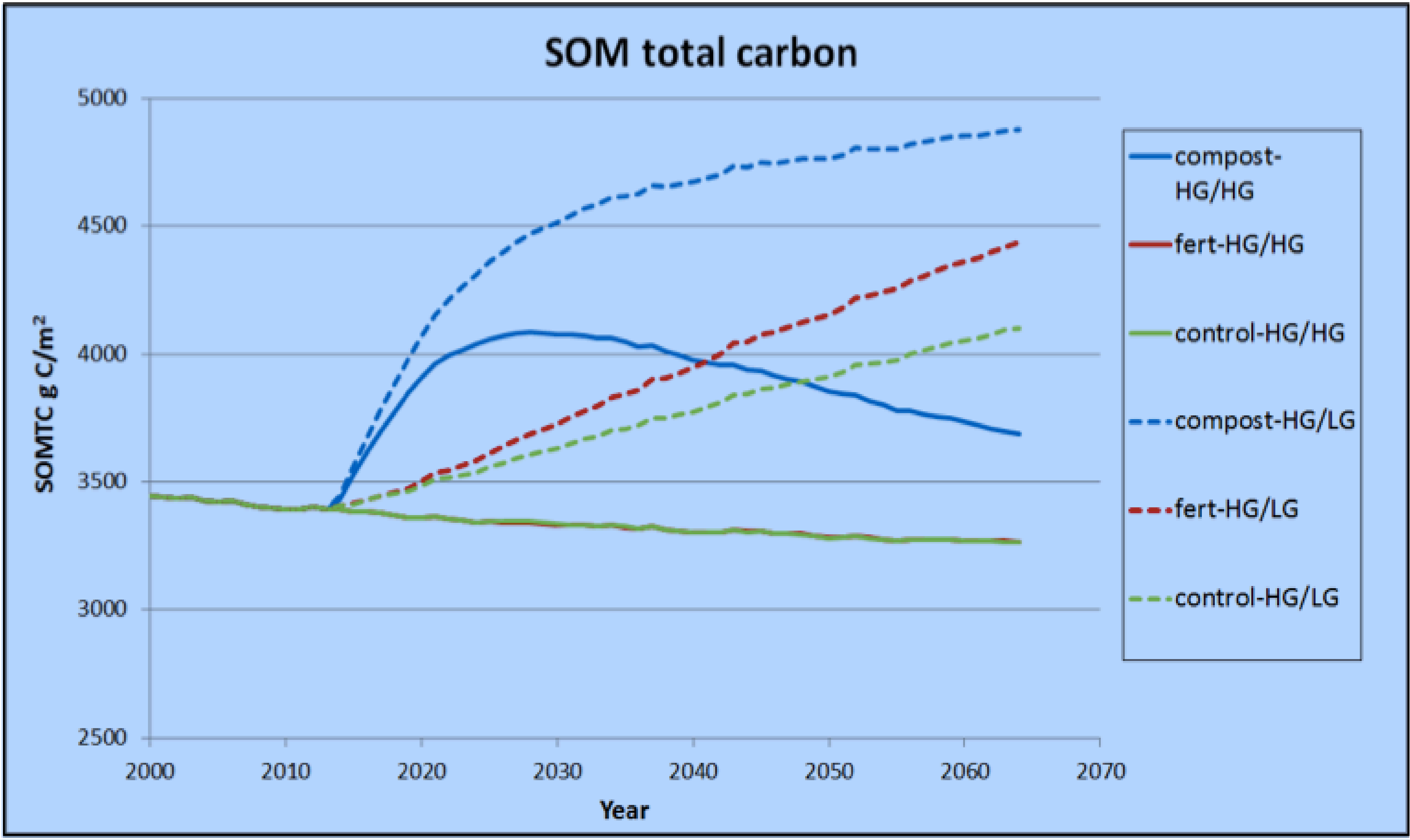
1,950.35 Mg (annual)
39,007 Mg (20 year)
41,564 Mg (maturity)

*CH_4 conversion factor:
34/1 (Myhre, G., D. Shindell, F.M. Breon., 2013. Anthropogenic and natural radiative forcing. In: Climate Change 2013: The Physical Science Basis.

Amount of annual Dairy CH_4 offset in Marin CAP: 4,638 Mg;
(Assumes conversion factor of 28;
At 34 = 5,632 Mg)

CO_2^e Sequestration Potential of One Marin County Carbon Farm (Over 20 years)





Model simulations revealed grazing impact had a large impact on SOC levels, more so than compost in the model. In this scenario a low soil carbon site was created by soil degradation from heavy grazing from 1880-2012. At 2013 the heavy grazing was switched to moderate grazing and respective additions (fertilizer, compost, control) were applied. Dorich et al, CSU-NREL, 2014.

USGS science for a changing world | MARIN CARBON PROJECT | Carbon Cycle Institute

The USDA NRCS has suggested 5% organic matter (OM) as an indicator of healthy soil and that an increase of 1% OM in soils is equivalent to 1” of increased water holding capacity (WHC).

If the OM of *all* soils in California was increased to 5%, the increase in WHC would be almost 28 million acre-feet.

This cannot realistically be achieved on all soils, due to access, land use, management constraints and soil type, but some soils can hold more. Additional research is needed to identify and prioritize soils with the highest probability of responding to efforts to increase OM.

L. Flint, lflint@usgs.gov, ca.water.us

United States Department of Agriculture

Soil Health Conservation Practices that result in Quantifiable GHG Mitigation/Carbon Sequestration Benefits

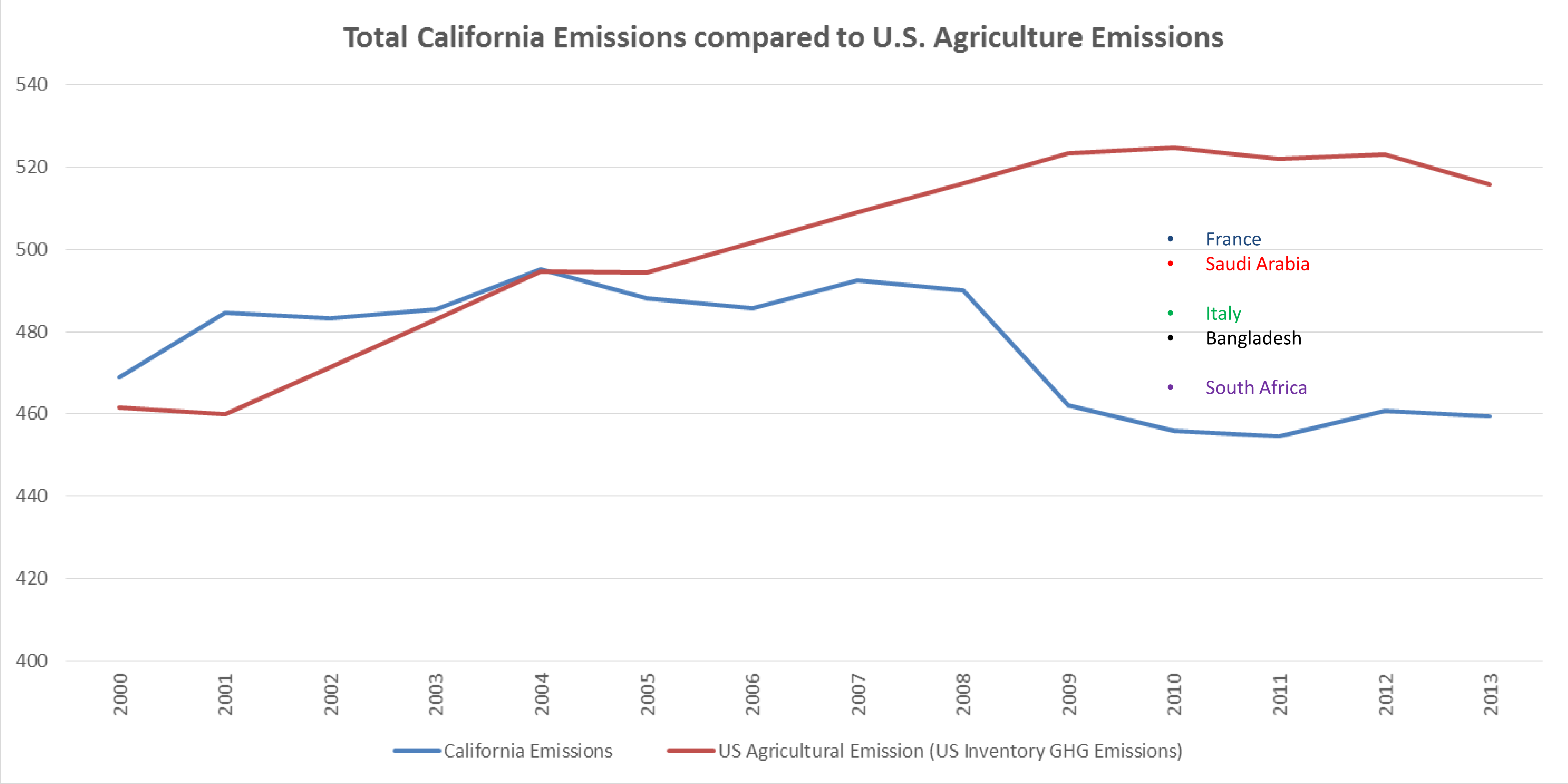
Dr. Adam Chambers
Leader, National Energy and Environmental Markets Team
USDA Natural Resources Conservation Service (NRCS)

GHG Emissions by the Numbers

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Agriculture & Forestry	**32.10**	**32.57**	**34.07**	**34.63**	**34.34**	**35.08**	**36.30**	**36.04**	**36.48**	**34.86**	**34.50**	**35.68**	**36.43**	**36.21**
Ag Energy Use	*3.81*	*3.82*	*4.38*	*4.37*	*4.52*	*4.62*	*5.32*	*3.79*	*3.91*	*2.65*	*2.81*	*3.66*	*3.80*	*3.83*
Ag Residue Burning	*0.08*	*0.06*	*0.06*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.08*	*0.08*	*0.08*	*0.08*
Ag Soil Management	*7.21*	*7.07*	*7.28*	*7.32*	*7.27*	*7.29*	*7.41*	*7.14*	*7.14*	*6.90*	*6.93*	*7.16*	*7.26*	*7.02*
Enteric Fermentation	*10.26*	*10.45*	*10.74*	*10.89*	*10.78*	*11.14*	*11.24*	*11.93*	*11.89*	*11.71*	*11.51*	*11.49*	*11.78*	*11.78*
Histosol Cultivation	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*	*0.15*
Manure Management	*9.40*	*10.00*	*10.32*	*10.75*	*10.28*	*10.67*	*10.98*	*11.80*	*12.20*	*12.17*	*11.84*	*11.89*	*12.14*	*12.14*
Rice Cultivation	*1.19*	*1.02*	*1.14*	*1.10*	*1.28*	*1.14*	*1.13*	*1.15*	*1.12*	*1.20*	*1.20*	*1.26*	*1.22*	*1.21*
Not Specified	1.20	1.07	0.94	0.98	0.87	0.89	0.89	0.87	0.85	0.79	0.82	0.79	0.78	0.79
Solvents & Chemicals	*1.20*	*1.07*	*0.94*	*0.98*	*0.87*	*0.89*	*0.89*	*0.87*	*0.85*	*0.79*	*0.82*	*0.79*	*0.78*	*0.79*

	2000	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***
California Emissions	**469**	**485**	**483**	**486**	**495**	**488**	**486**	**493**	**490**	**462**	**456**	**455**	**461**	**459**
US Agricultural Emission (US Inventory GHG Emissions)	**462**	**460**	*471*	*483*	*495*	**495**	**502**	**509**	**516**	**523**	**525**	**522**	**523**	**516**

USDA
United States Department of Agriculture



USDA United States Department of Agriculture

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CA.GOV

California Environmental Protection Agency

Air Resources Board

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Tuesday, August 4, 2015

UP LINKS

- ARB Programs
  - Climate Change
    - Greenhouse Gas Emission Inventory & Mandatory Reporting
      - **Emission Inventory**

PROGRAM LINKS

- Program Home
- Background
  - Greenhouse Gases
  - GWPs
  - Glossary
- Current GHG Inventory
  - Documentation Index
  - Inventory Query Tool
  - Graphs & Plots
  - Archive
- 1990 Level & 2020 Limit
  - Data & Reports
  - 1990 Inventory Query Tool

Last reviewed on May 6, 2015

California 1990 Greenhouse Gas Emissions Level and 2020 Li

The current 2020 GHG emission limit is 431 MMTCO$_2$e using IPCC Fourth Assessment Rep

Overview

The Global Warming Solutions Act of 2006 (AB 32) requires that the Air Resources Board determine the statewide g gas emissions level in 1990. The act also requires that the Board approve a statewide greenhouse gas emissions lir the 1990 level, as a limit to be achieved by 2020. This limit is an aggregated statewide limit, rather than sector- or fa The 2020 GHG emissions limit is 431 million metric tonnes of carbon dioxide equivalent (MMTCO2e).

ARB Board Approval

Update to the 2020 Limit - 2014

Calculation of the original 1990 limit approved in 2007 was revised using the scientifically updated IPCC 2007 fourth report (AR4) global warming potentials, to 431 MMTCO2e. The Board approved 431 MMTCO2e as the 2020 emissi the approval of the First Update to the Scoping Plan on May 22, 2014.

Original 2020 Limit - 2007

ARB staff constructed a 1990-2004 greenhouse gas emission inventory to determine the 1990 emission level, which approved as the 2020 limit of 427 MMTCO2e. This value was based on IPCC second assessment report global warming potentials. The Board approved the 2020 limit on December 6, 2007. All materials related to 2007 board approval of the original 2020 limit can be found in the board approval page. This value was updated in the 2014 Scoping Plan Update.

Development of the Original 2020 Limit

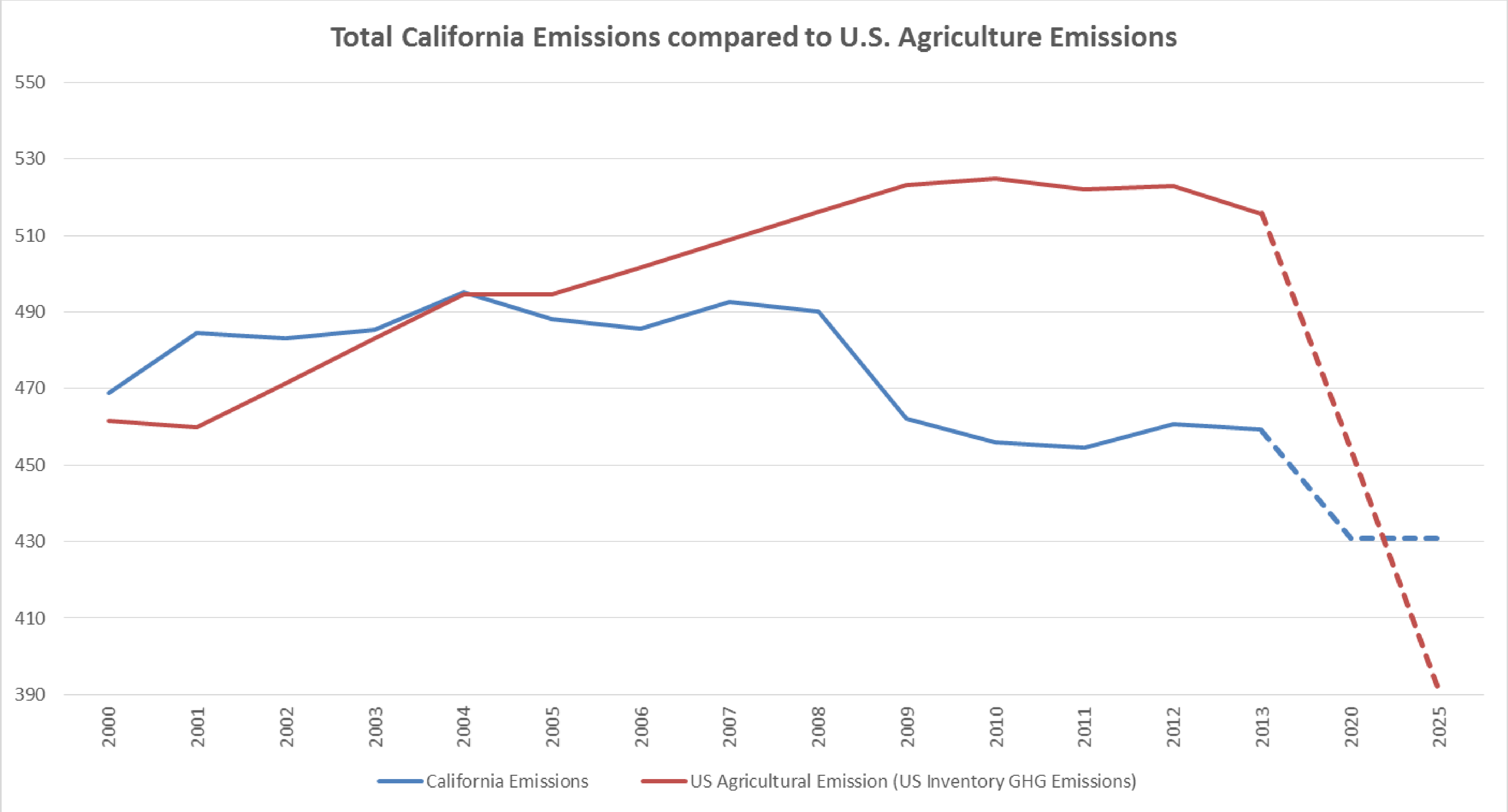
The staff report titled "California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit" discusses the original development of the 1990 statewide emissions level and provides a summary of the key emissions sources, the methodologies used to calculate the emissions, and the sources of data. These methods use the original IPCC second assessment report GWPs.

CLIMATE

The USDA Is Taking On Agriculture's Huge Contribution To Climate Change

BY NATASHA GEILING APR 23, 2015 11:33AM

U.S. Agriculture Secretary Tom Vilsack.


Total California Emissions compared to U.S. Agriculture Emissions
550
530
510
490
470
450
430
410
390
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2020
2025
California Emissions
US Agricultural Emission (US Inventory GHG Emissions)

Secretary Vilsack's Mitigation Building Blocks

DECISION MEMORANDUM FOR THE SECRETARY
Page 4

Building Block	Estimated Annual GHG Reduction by 2025 ($MMTCO_2e$)
Soil Health	4.3 – 17.3
Nitrogen Stewardship	7.0
Livestock Partnerships	18.7
Conservation of Sensitive Lands	3.0 – 3.2
Grazing and Pasture Lands	0.4
Private Forest Growth and Retention	4.8
Stewardship of Federal Forests	0.03
Promotion of Wood Products	5.9
Urban Forests	0.02
Energy Generation and Efficiency	67.0
Total	**111.2 – 124.4**

NRCS Soil Health

NRCS Total Contribution: 100.4 – 113.6

Degrading Agricultural Practices


Erosion


Residue removal


Low Productivity


Intensive tillage

Improved Agricultural Conservation Practices


Cover crops

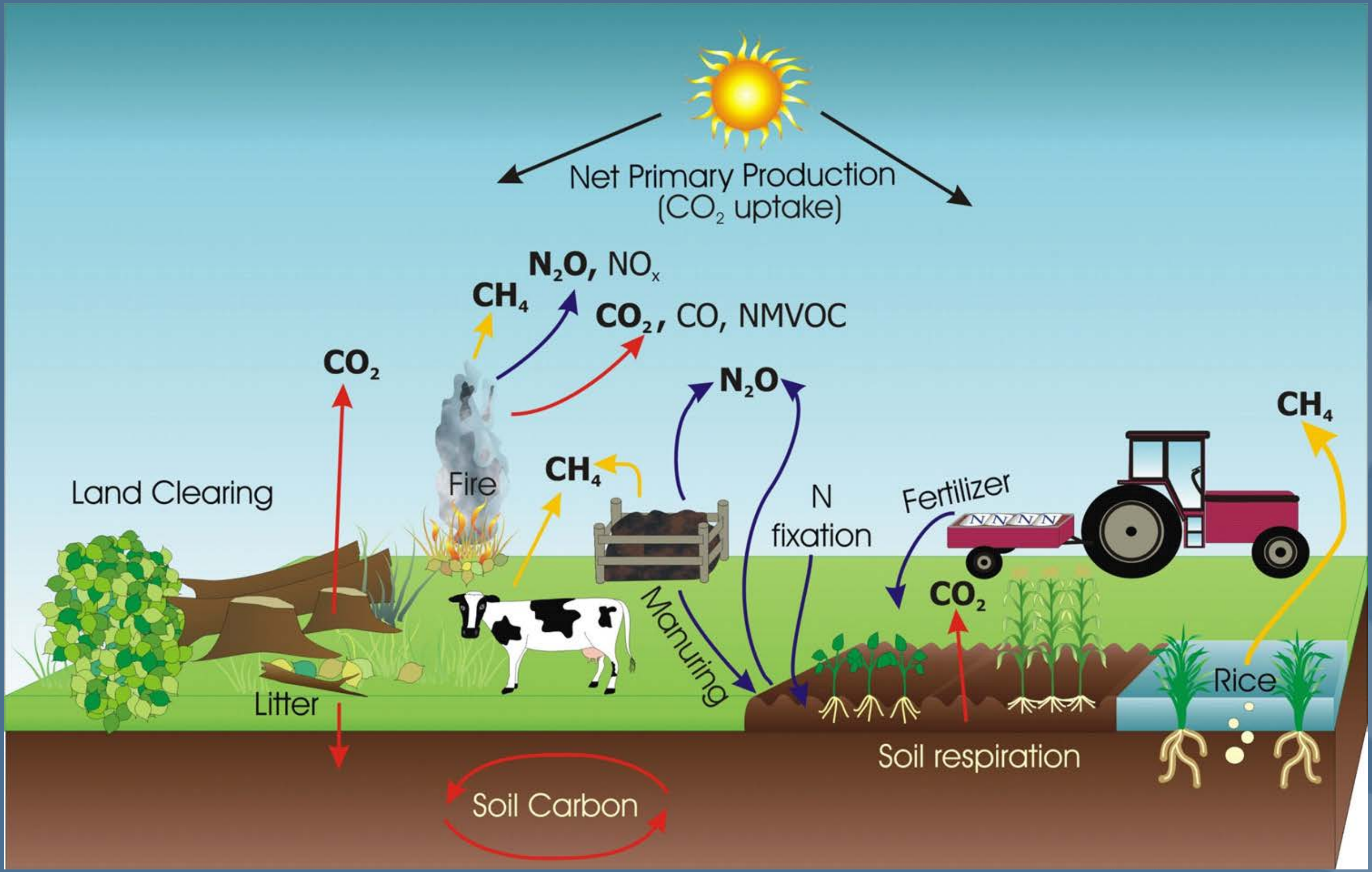

Conservation buffers


Conservation tillage


Improved rotations

Direct Benefits of NRCS Conservation Practices on the Atmosphere

Emissions are reduced and/or carbon sequestered when Conservation Practices are Implemented, contracted, and beyond…



PLANNING WITH PRODUCERS

UTILIZING ATMOSPHERIC-BENEFICIAL PRACTICES

Riparian Forest Buffer Establishment
(Conservation Practice Standard 391)

NRCS Practice Information

DEFINITION: An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

PURPOSE:
- Increase carbon storage in plant biomass and soils
- Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow
- Create or improve riparian habitat and provide a source of detritus and large woody debris
- Reduce pesticide drift entering the water body
- Restore riparian plant communities

CONDITIONS WHERE PRACTICE APPLIES:
Riparian forest buffers are applied on areas adjacent to permanent or intermittent streams, lakes, ponds, and wetlands. They are not applied to stabilize stream banks or shorelines.

COMET-Planner Practice Information

COMET-Planner estimates for Riparian Forest Buffer establishment are constructed from a scenario of replacing conventionally managed and fertilized cropland with unfertilized, woody plants. Impacts on greenhouse gases include woody biomass carbon accumulation, change in soil organic matter carbon due to cessation of tillage and increased carbon inputs from plant residues, and decreased nitrous oxide emissions from synthetic fertilizer.

Approximate Carbon Sequestration and Greenhouse Gas Emission Reductions*

Practice	*Climate zone*	Carbon Dioxide ($Mg\ CO_2\ eq\ ac^{-1}\ y^{-1}$) Average (Range)	Nitrous Oxide ($Mg\ CO_2\ eq\ ac^{-1}\ y^{-1}$) Average (Range)	Methane ($Mg\ CO_2\ eq\ ac^{-1}\ y^{-1}$) Average (Range)
Riparian Forest Buffer Establishment (CPS 391)	Dry/semiarid	1.00 (0.38 – 1.63)	0.08 (0 – 0.15)	Not estimated
	Moist/humid	2.19 (0.96 – 3.26)	0.28 (0 – 0.50)	Not estimated

*Positive values indicate reductions in greenhouse gas emissions and negative values indicate increases in greenhouse gas emissions. Woody biomass carbon estimates were derived from empirical models of woody biomass carbon accumulation in NRCS agroforestry prescriptions that used tree growth increment data from the U.S. Forest Service Forest Inventory and Analysis (FIA) program and allometric equations to allocate biomass

NRCS Practice Standards for Greenhouse Gas Emission Reduction and Carbon Sequestration

Qualitative Ranking N=Neutral	Practice Code	Practice Standard and Associated Information Sheet	Beneficial Attributes
	327	Conservation Cover (Information Sheet)	Establishing perennial vegetation on land retired from agriculture production increases soil carbon and increases biomass carbon stocks.
	329	Residue and Tillage Management, No Till/Strip Till/Direct Seed (Information Sheet)	Limiting soil-disturbing activities improves soil carbon retention and minimizes carbon emissions from soils.
	366	Anaerobic Digester (Information Sheet)	Biogas capture reduces CH_4 emissions to the atmosphere and provides a viable gas stream that is used for electricity generation or as a natural gas energy stream.
	367	Roofs and Covers	Capture of biogas from waste management facilities reduces CH_4 emissions to the atmosphere and captures biogas for energy production. CH_4 management reduces direct greenhouse gas emissions.
	372	Combustion System Improvement	Energy efficiency improvements reduce on-farm fossil fuel consumption and directly reduce CO_2 emissions.
	379	Multi-Story Cropping	Establishing trees and shrubs that are managed as an overstory to crops increases net carbon storage in woody biomass and soils. Harvested biomass can serve as a renewable fuel and feedstock.
	380	Windbreak/Shelterbelt Establishment (Information Sheet)	Establishing linear plantings of woody plants increases biomass carbon stocks and enhances soil carbon.
	381	Silvopasture Establishment	Establishment of trees, shrubs, and compatible forages on the same acreage increases biomass carbon stocks and enhances soil carbon.
	512	Forage and Biomass Planting (Information Sheet)	Deep-rooted perennial biomass sequesters carbon and may have slight soil carbon benefits. Harvested biomass can serve as a renewable fuel and feedstock.

UTILIZING QUANTIFICATION TOOLS

COMET-PLANNER NRCS USDA Colorado State University

Carbon and greenhouse gas evaluation for NRCS conservation practice planning

This tool was developed with the generous support of the Rathmann Family Foundation and the Marin Carbon Project

Click to View Introduction Video

Evaluate potential carbon sequestration and greenhouse gas reductions from adopting NRCS conservation practices

NRCS Conservation Practices included in COMET-Planner are only those that have been identified as having greenhouse gas mitigation and/or carbon sequestration benefits on farms and ranches. This list of conservation practices is based on the qualitative greenhouse benefits ranking of practices prepared by NRCS.

Project Name:

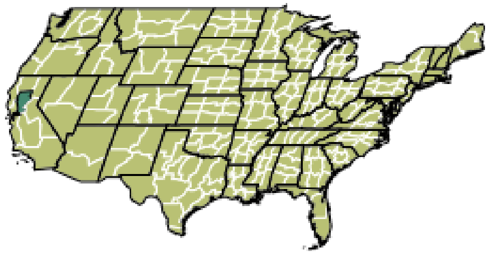
Demo

State:

CA

County:

Sacramento



NRCS Conservation Practices - Select Your Practice(s)

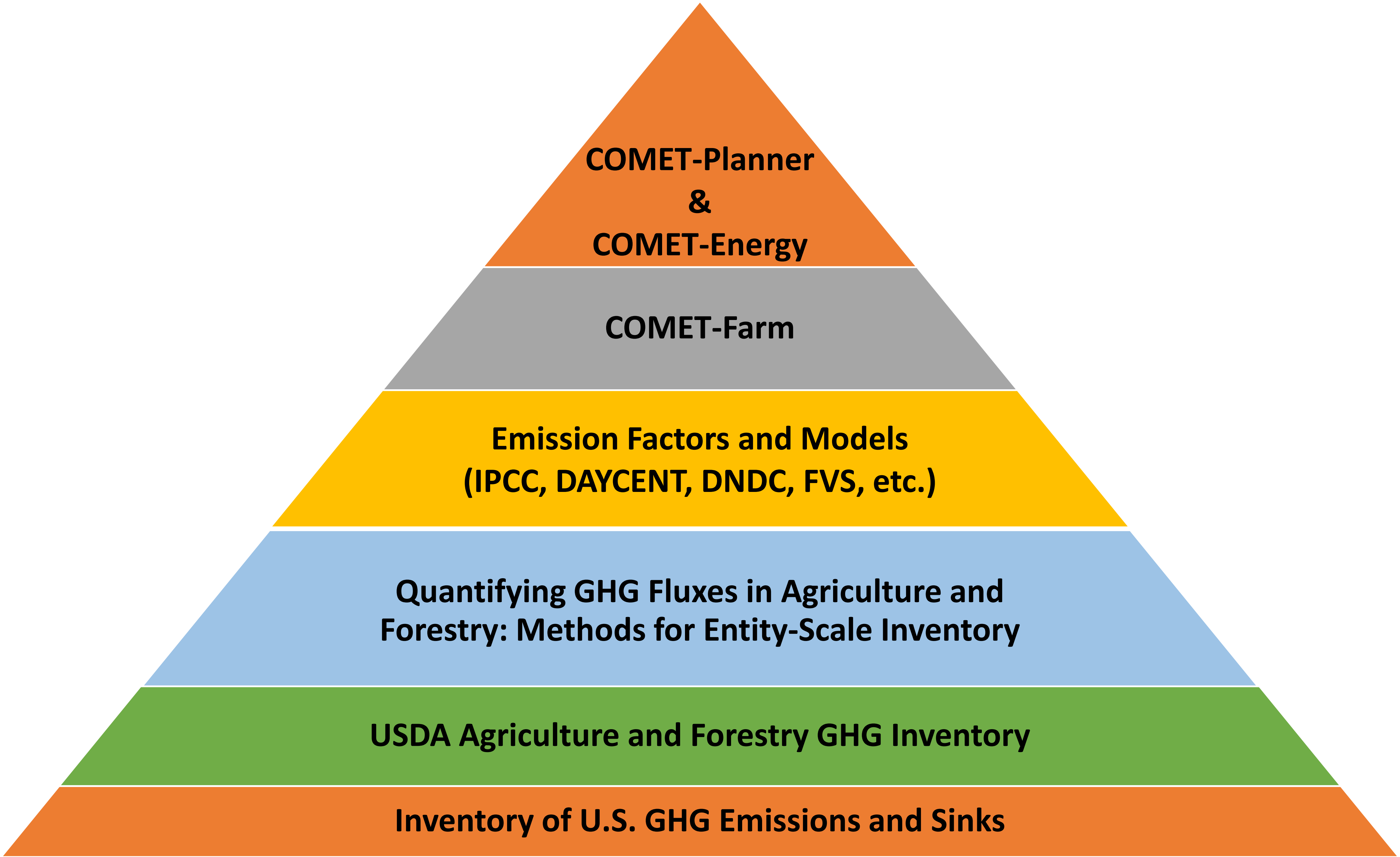
Name CPS (Conservation Practice Standard Number)
+ Cropland to Herbaceous Cover (10 Items)
– Cropland to Woody Cover (7 Items)
Tree/Shrub Establishment - Farm Woodlot (CPS 612)
Windbreak/Shelterbelt Establishment (CPS 380)
Windbreak/Shelterbelt Renovation (CPS 650)
Riparian Forest Buffer (CPS 391)

USDA United States Department of Agriculture

REFLECTING ATMOSPHERIC BENEFITS IN THE **INVENTORIES** (California and U.S.)

(Eighth Edition: 2000 to 2013 - Last updated on 04/24/2015)			*All values in million metric tonne (Tg) of CO2 equivalent*			Sum of the selected categories:	9.85
Type of emissio	IPCC Level 1	IPCC Level 2	IPCC Level 3	IPCC Level 4	Sector & Activity Details	GHG	2013
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Almond	CH4	1.58E-02
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Almond	N2O	3.22E-02
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Barley	CH4	1.76E-04
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Barley	N2O	1.70E-04
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Corn	CH4	8.66E-04
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Corn	N2O	5.90E-04
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Rice	CH4	2.34E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Rice	N2O	7.76E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Walnut	CH4	6.44E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Walnut	N2O	9.37E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Wheat	CH4	3.02E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C1 - Emissions	3C1b - Biomass	Crop acreage burned - Wheat	N2O	1.98E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C2 - Liming		Dolomite applied to soils	CO2	2.22E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C2 - Liming		Limestone applied to soils	CO2	1.87E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Commercial use of nitrogen fertilizer on turf -	N2O	4.24E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Drained histosols	N2O	1.49E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen applied in fertilizer - Organic fertilizers	N2O	2.20E-02
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen applied in fertilizer - Synthetic fertilizers	N2O	2.44E+00
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen in crop residues	N2O	3.75E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen in managed manure	N2O	1.09E+00
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen in unmanaged manure - Cattle, swine,	N2O	1.16E+00
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Nitrogen in unmanaged manure - Sheep, goat,	N2O	1.60E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C4 - Direct N2O		Residential use of nitrogen fertilizer on turf -	N2O	6.25E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Commercial use of nitrogen fertilizer on turf -	N2O	1.38E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Nitrogen applied in fertilizer - Organic fertilizers	N2O	9.36E-03
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Nitrogen applied in fertilizer - Synthetic fertilizers	N2O	7.94E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Nitrogen in managed manure	N2O	4.64E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Nitrogen in unmanaged manure - Cattle, swine,	N2O	2.46E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Nitrogen in unmanaged manure - Sheep, goat,	N2O	6.81E-02
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C5 - Indirect N2O		Residential use of nitrogen fertilizer on turf -	N2O	2.03E-01
Included	3 - Agriculture, Forestry and Other Land Use	3C - Aggregate	3C7 - Rice		Rice crop area	CH4	1.21E+00

US GHG INVENTORY→USDA GHG INVENTORY→USDA METHODS REPORT→COMET-Farm→COMET-Planner

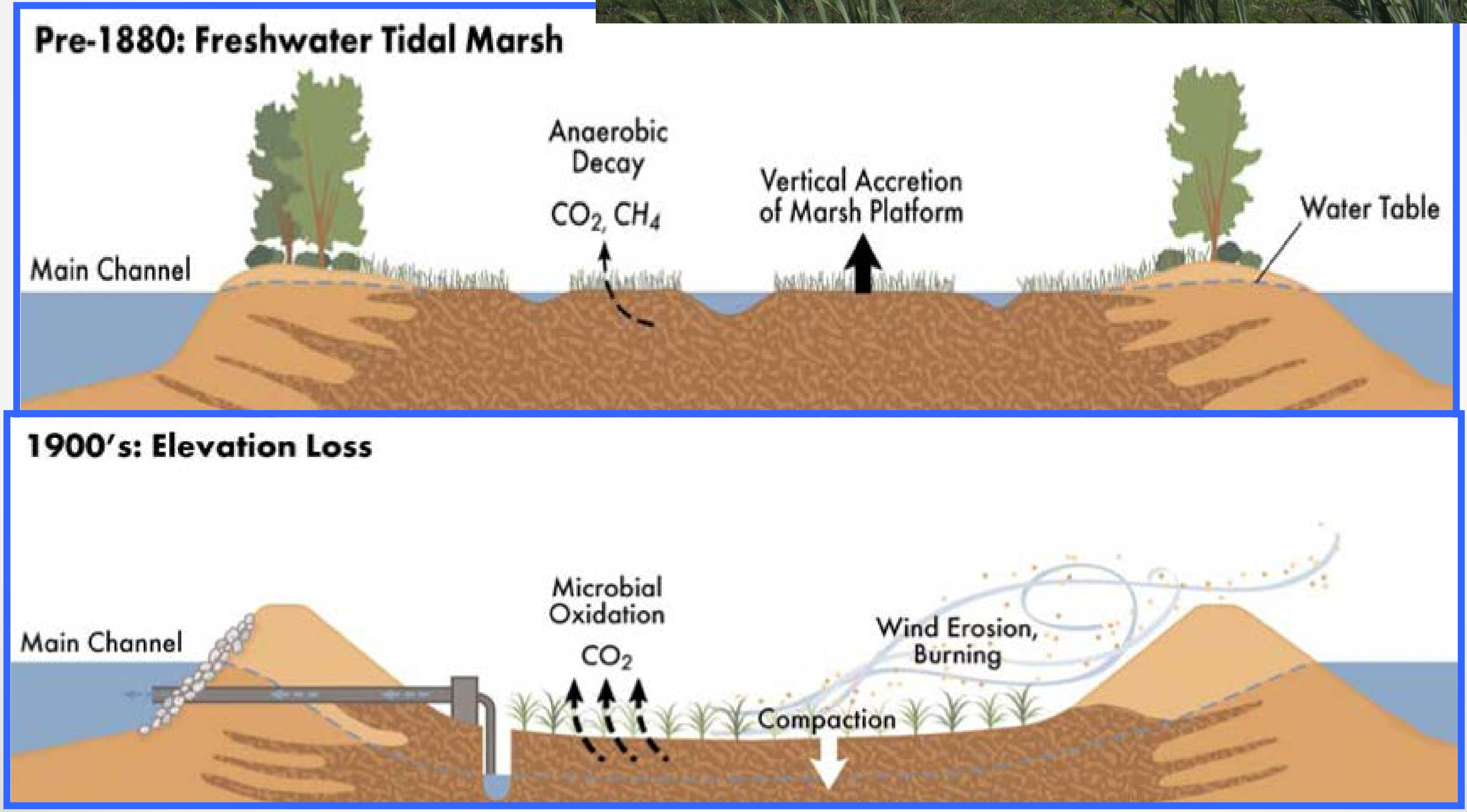


Dr. Adam Chambers (adam.chambers@por.usda.gov)
Leader, National Energy and Environmental Markets Team
USDA Natural Resources Conservation Service (NRCS)

Wetlands for Carbon Sequestration, Subsidence Mitigation and Habitat, Sacramento-San Joaquin Delta

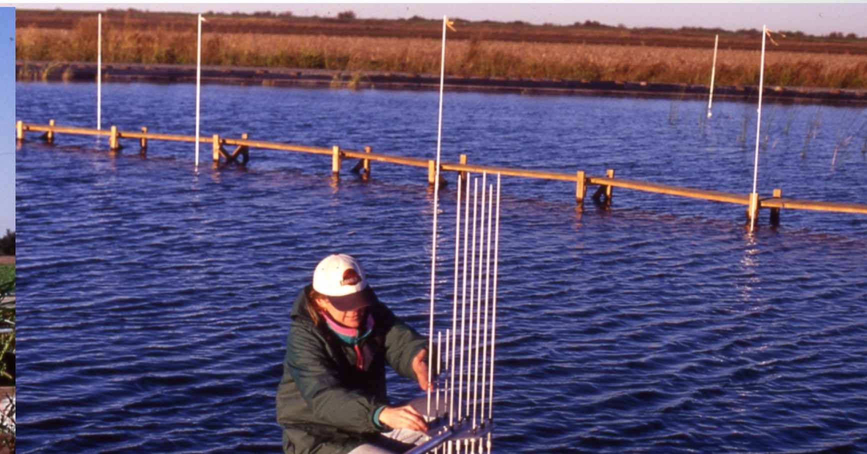
Steve Deverel, HydroFocus, Inc., Davis, CA
sdeverel@hydrofocus.com

Subsidence & Carbon Loss

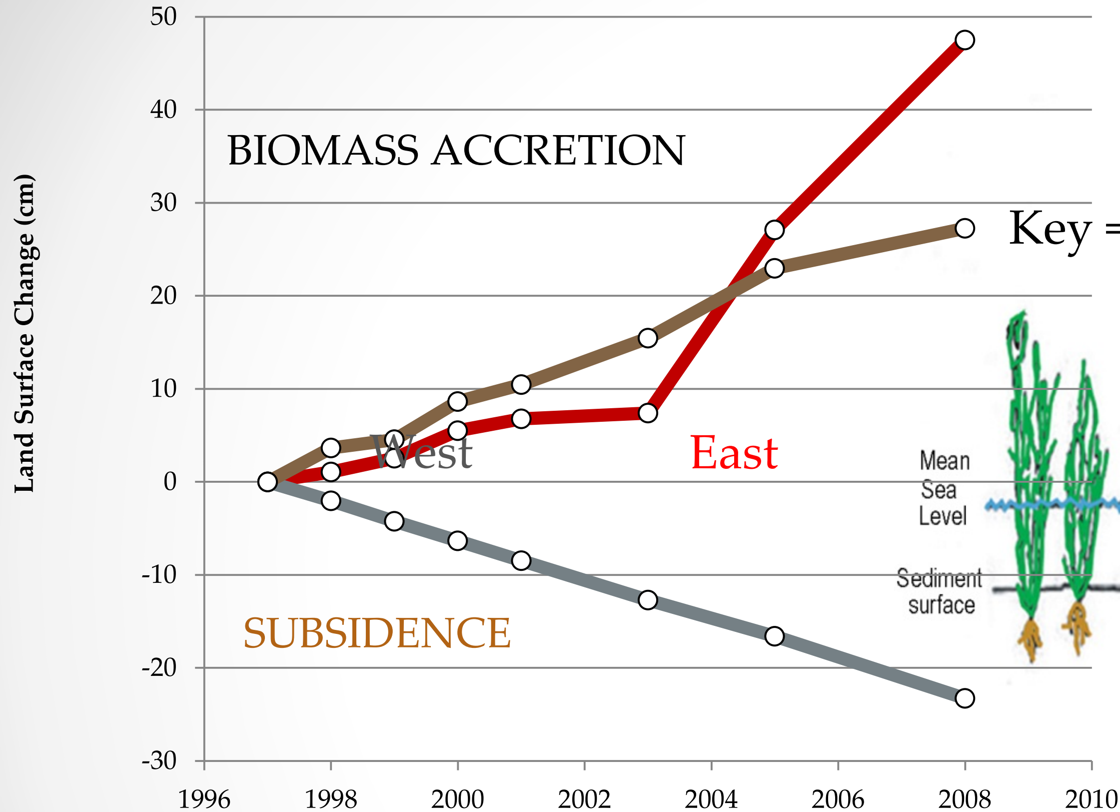


From Mount and Twiss (2005) Subsidence, Sea Level Rise, and Seismicity in the Sacramento–San Joaquin Delta. *San Francisco Estuary and Watershed Science*, 3(1).

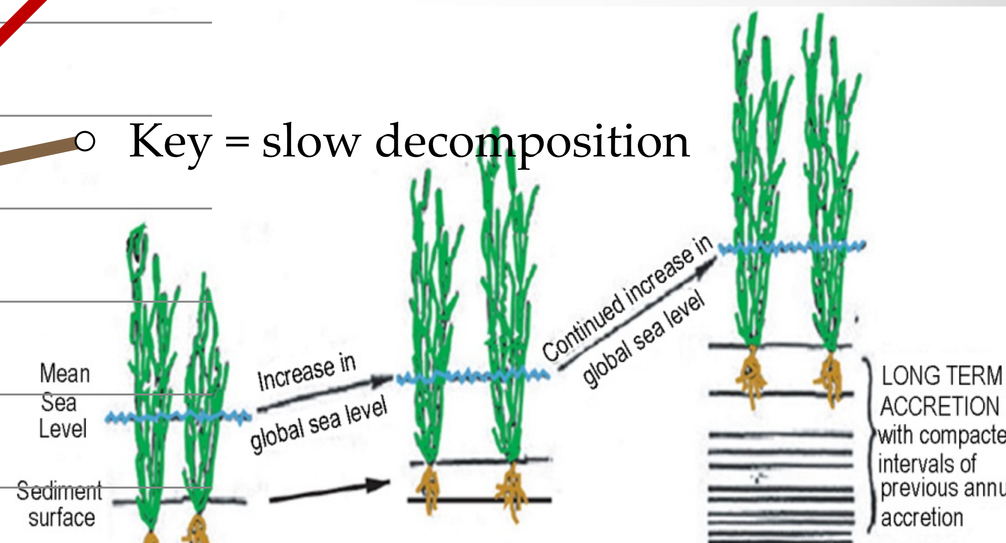
Carbon capture wetlands - Twitchell Island



Wetland accretion



Key = slow decomposition



Miller, R.L., Fram, M.S., Wheeler, G., Fujii, R., 2008. Subsidence reversal in a re-established wetland in the Sacramento-San Joaquin Delta, California, USA. *San Francisco Estuary and Watershed Science*, 6(3).

Deverel, Steven J; & Leighton, David A. (2010). Historic, Recent, and Future Subsidence, Sacramento-San Joaquin Delta, California, USA. *San Francisco Estuary and Watershed Science*, 8(2)

Deverel, Steven J.; Ingrum, Timothy; Lucero, Christina; & Drexler, Judith Z.(2014). Impounded Marshes on Subsided Islands: Simulated Vertical Accretion, Processes, and Effects, Sacramento-San Joaquin Delta, CA USA. *San Francisco Estuary and Watershed Science*, 12(2)

Interdependent and Parallel Processes

Synthesis of available science for methodology

Utilization by producers for trading emission reduction tons of CO_2 equivalents

Ongoing data collection, analysis and modeling

Pilot projects – Twitchell, Sherman islands

Methodology Status

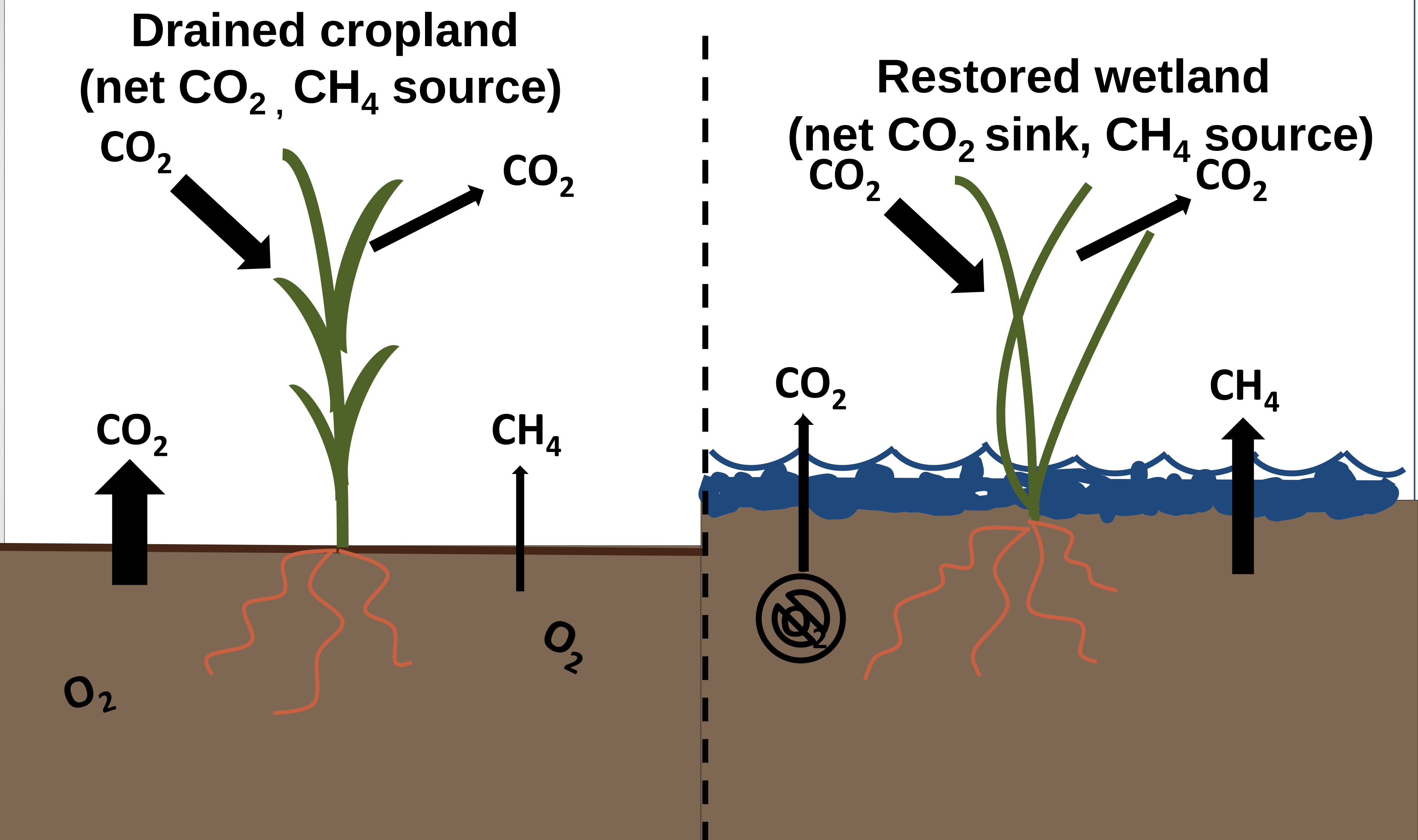
- Currently in internal review within American Carbon Registry
- Public Review to occur during August and September
- Peer-review to follow
- Approval expected in mid-2016

Measuring and monitoring the carbon sequestration potential of restored wetlands in the Sacramento-San Joaquin Delta

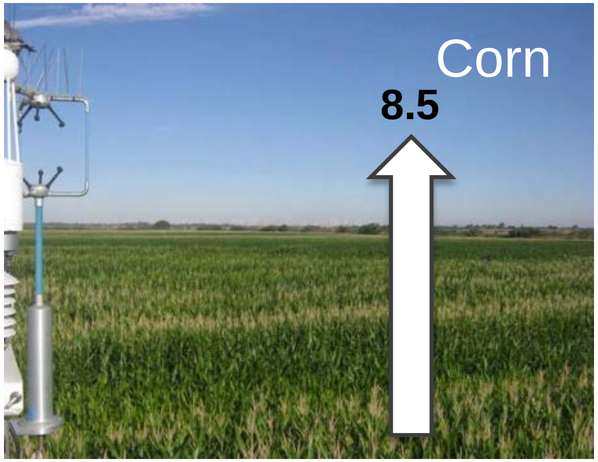
Sara Knox, Cove Sturtevant, Patty Oikawa, Jaclyn Matthes, Joe Verfaillie, Dennis Baldocchi

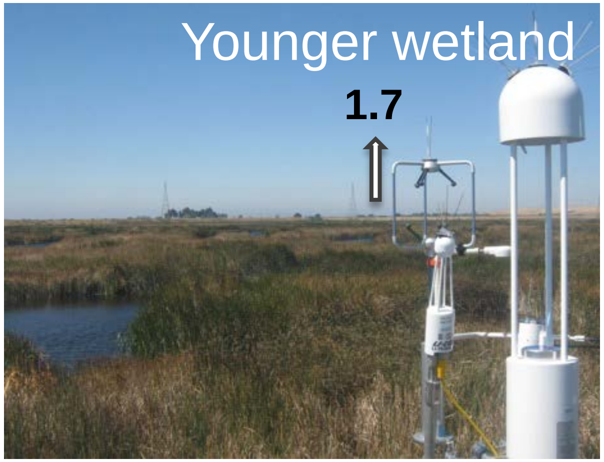
University of California, Berkeley
Dartmouth College

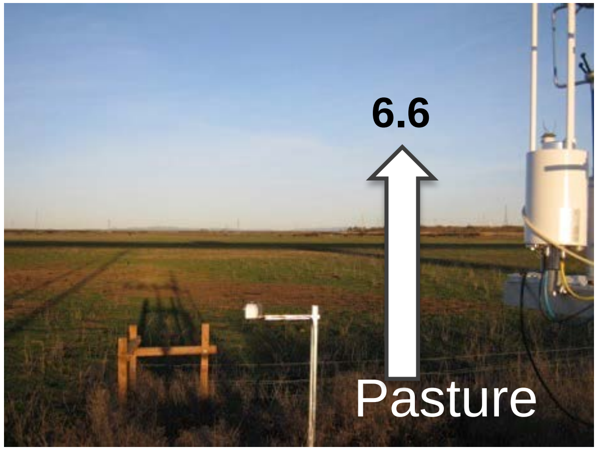
Carbon cycling in restored wetlands vs. drained croplands

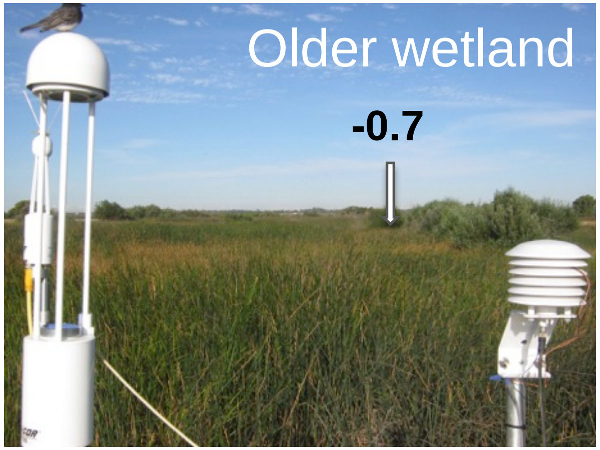


GHG budget (tons acre^{-1} CO_2-eq)





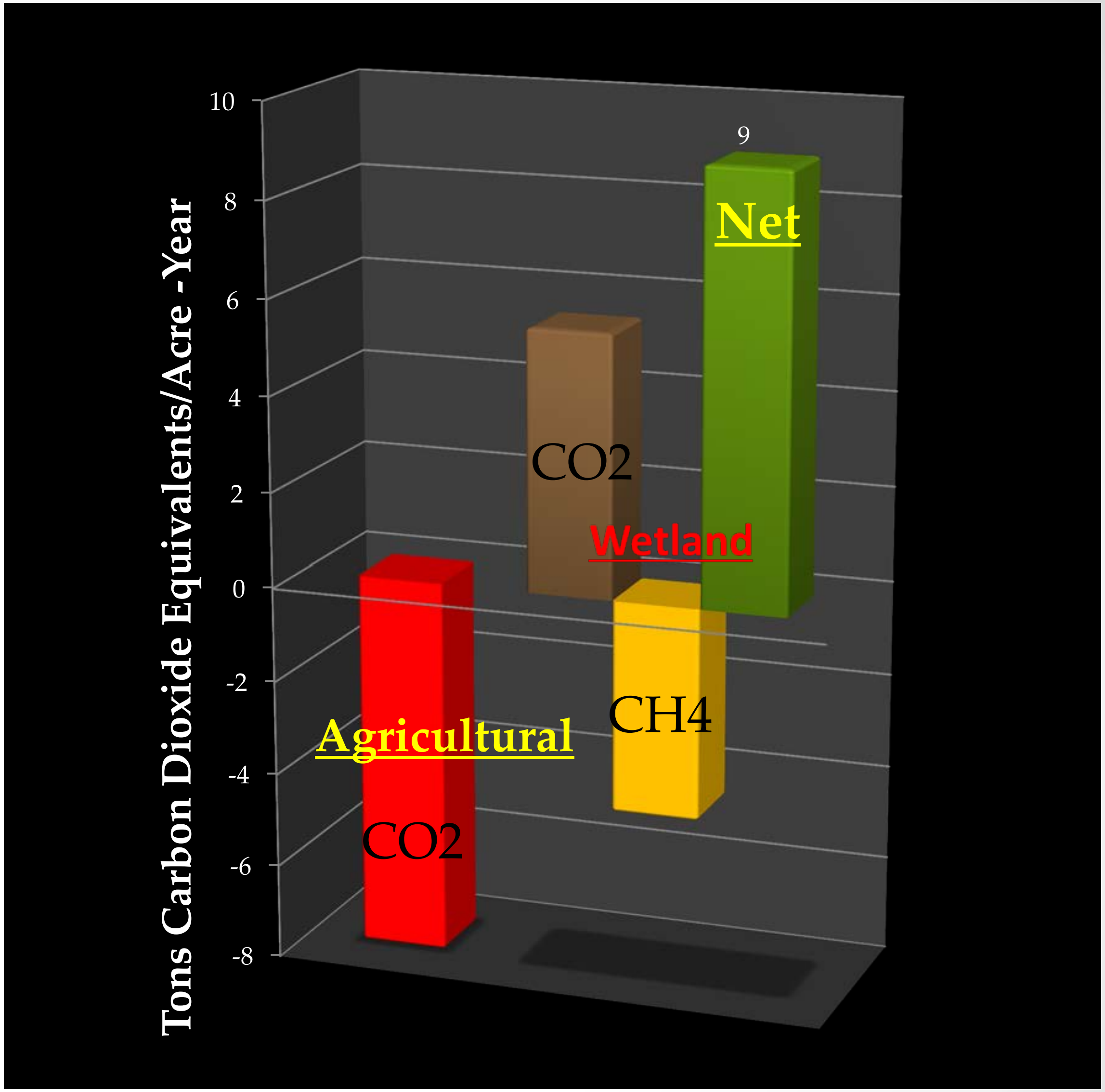




Knox et al. (2015) Global Change Biology

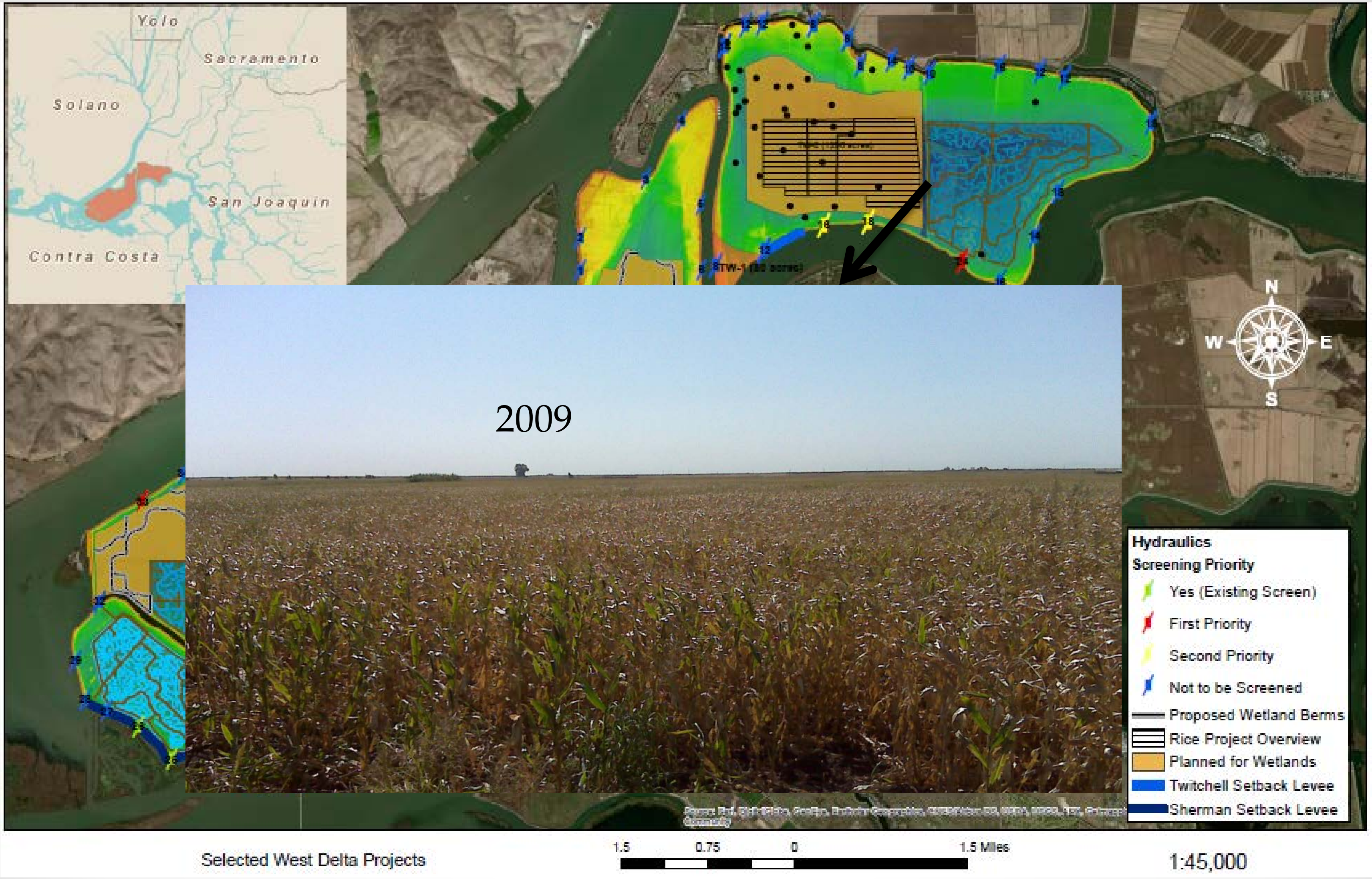
Agricultural Baseline to Wetland Conversion Example

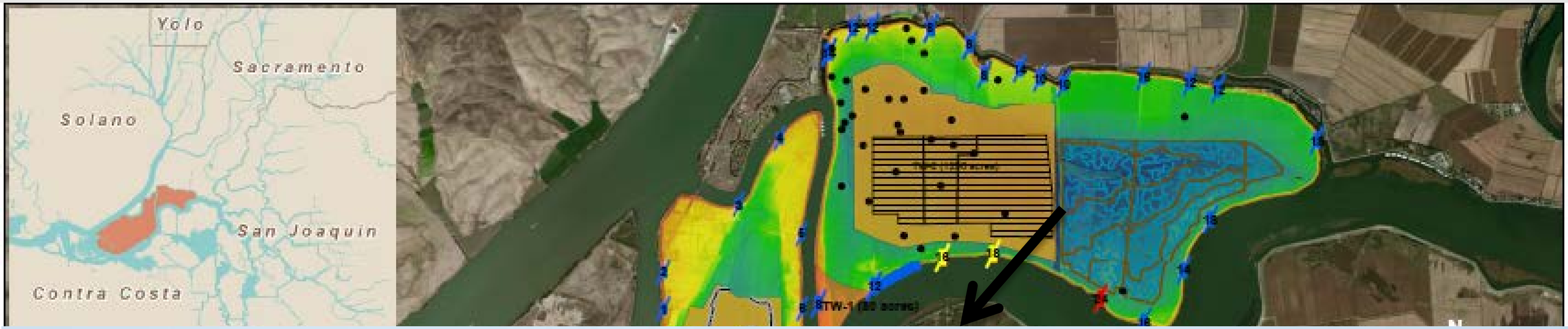
- Net carbon benefit results from stopping current baseline carbon dioxide loss and sequestering carbon dioxide in wetlands.



Project Implementation

Bryan Brock
California Department of Water Resources


Yolo
Sacramento
Solano
San Joaquin
Contra Costa
2009
N
W
E
S
Hydraulics
Screening Priority
Yes (Existing Screen)
First Priority
Second Priority
Not to be Screened
Proposed Wetland Berms
Rice Project Overview
Planned for Wetlands
Twitchell Setback Levee
Sherman Setback Levee
Selected West Delta Projects
1.5
0.75
0
1.5 Miles
1:45,000

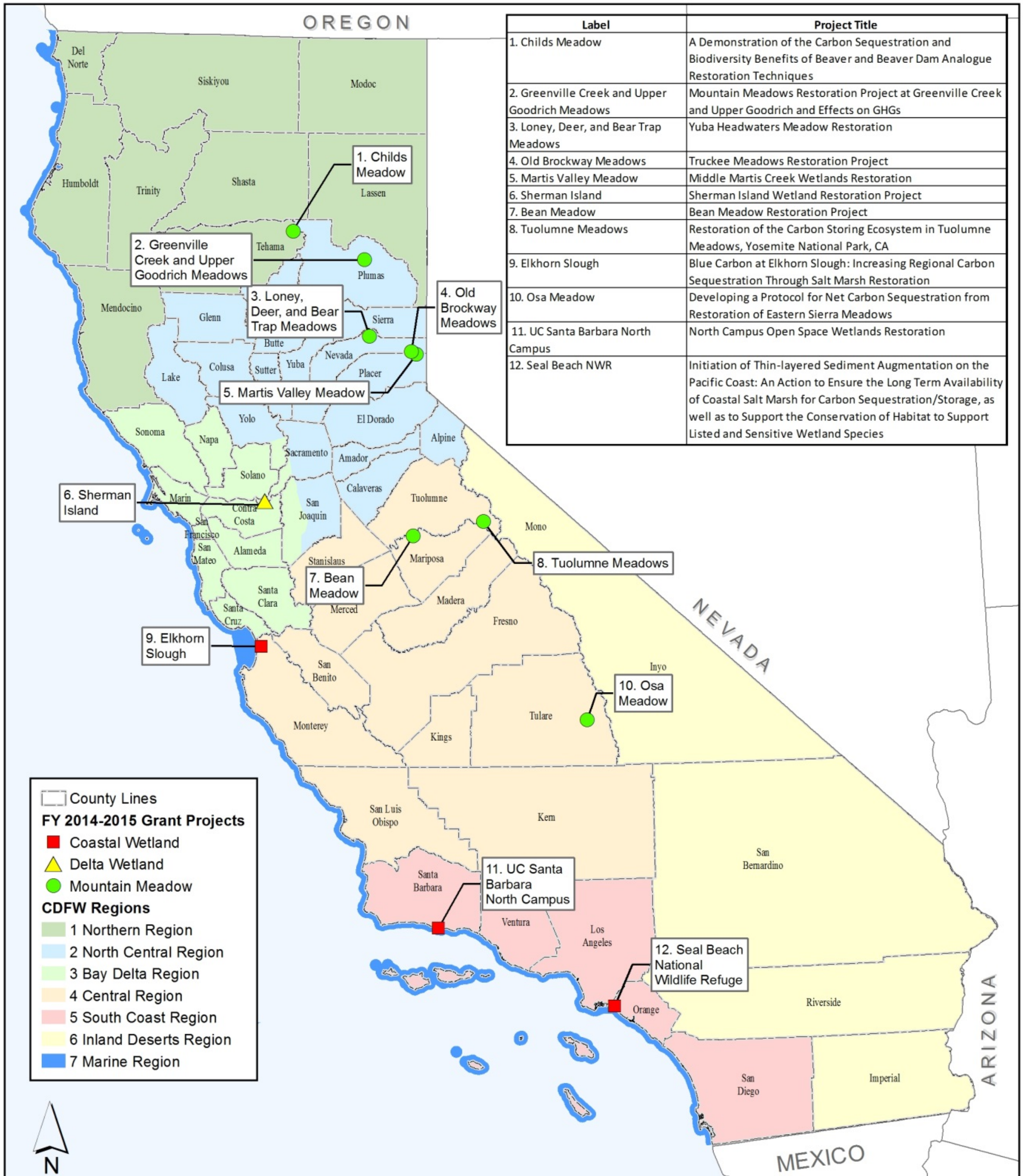

Yolo
Sacramento
Solano
San Joaquin
Contra Costa


2015

Future and Ongoing Efforts

- Continued monitoring of pilot projects
- Quantification of baseline emissions
  - Nitrous oxide emissions
- Models and look up tables
- Expansion

WETLANDS RESTORATION FOR GREENHOUSE GAS REDUCTION GRANTS
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE



Label	Project Title
1. Childs Meadow	A Demonstration of the Carbon Sequestration and Biodiversity Benefits of Beaver and Beaver Dam Analogue Restoration Techniques
2. Greenville Creek and Upper Goodrich Meadows	Mountain Meadows Restoration Project at Greenville Creek and Upper Goodrich and Effects on GHGs
3. Loney, Deer, and Bear Trap Meadows	Yuba Headwaters Meadow Restoration
4. Old Brockway Meadows	Truckee Meadows Restoration Project
5. Martis Valley Meadow	Middle Martis Creek Wetlands Restoration
6. Sherman Island	Sherman Island Wetland Restoration Project
7. Bean Meadow	Bean Meadow Restoration Project
8. Tuolumne Meadows	Restoration of the Carbon Storing Ecosystem in Tuolumne Meadows, Yosemite National Park, CA
9. Elkhorn Slough	Blue Carbon at Elkhorn Slough: Increasing Regional Carbon Sequestration Through Salt Marsh Restoration
10. Osa Meadow	Developing a Protocol for Net Carbon Sequestration from Restoration of Eastern Sierra Meadows
11. UC Santa Barbara North Campus	North Campus Open Space Wetlands Restoration
12. Seal Beach NWR	Initiation of Thin-layered Sediment Augmentation on the Pacific Coast: An Action to Ensure the Long Term Availability of Coastal Salt Marsh for Carbon Sequestration/Storage, as well as to Support the Conservation of Habitat to Support Listed and Sensitive Wetland Species

California Department of Fish and Wildlife Wetlands Branch D Mastalir 20150519

Methodology Provides Guidance for:

- Identification of the project baseline, definition of project boundaries
- Additionality
- Monitoring and estimation of GHG emissions and sequestration
- Calculation of uncertainty and assessment of reversal and termination risk

- **Calculation of emission reduction tons (CO2-e)**

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CLIMATE-SMART CITIES

Restoring Urban Landscapes with Green Infrastructure for Quantifiable Carbon Reductions

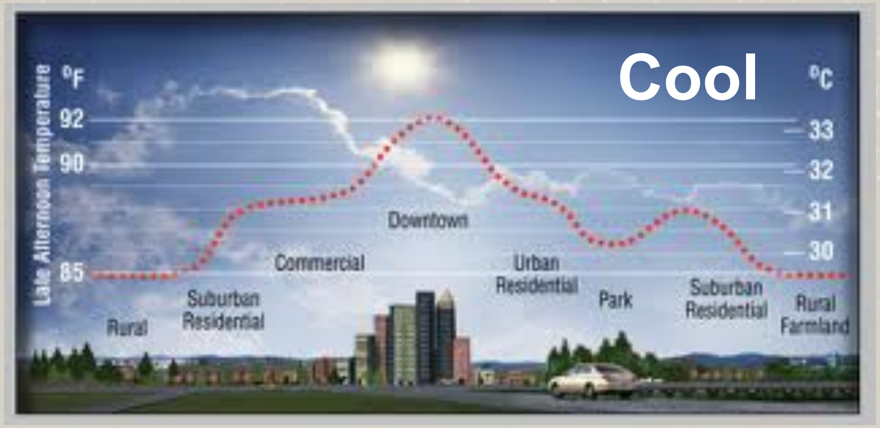
Mary Creasman

Director, California Government Affairs

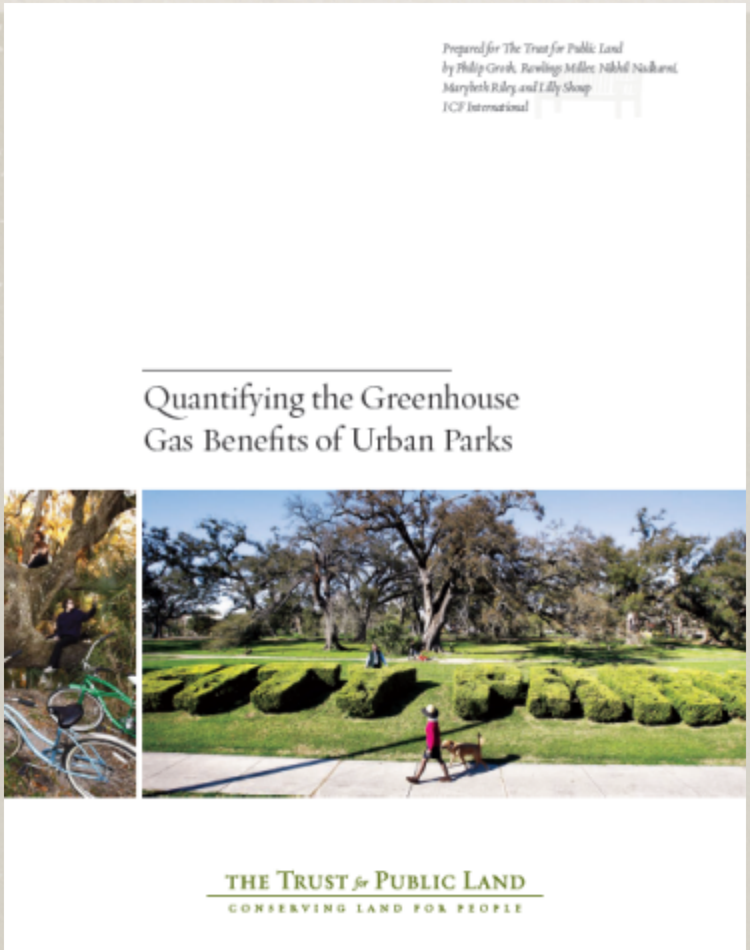
THE TRUST for PUBLIC LAND

LAND FOR PEOPLE

Climate-Smart Cities Framework



Roadmap to Carbon Benefits Quantification—Connect, Cool, & Absorb


Prepared for The Trust for Public Land
by Philip Groth, Rawlings Miller, Nikhil Nadkarni,
Marybeth Riley, and Lilly Shoup
ICF International

Quantifying the Greenhouse Gas Benefits of Urban Parks

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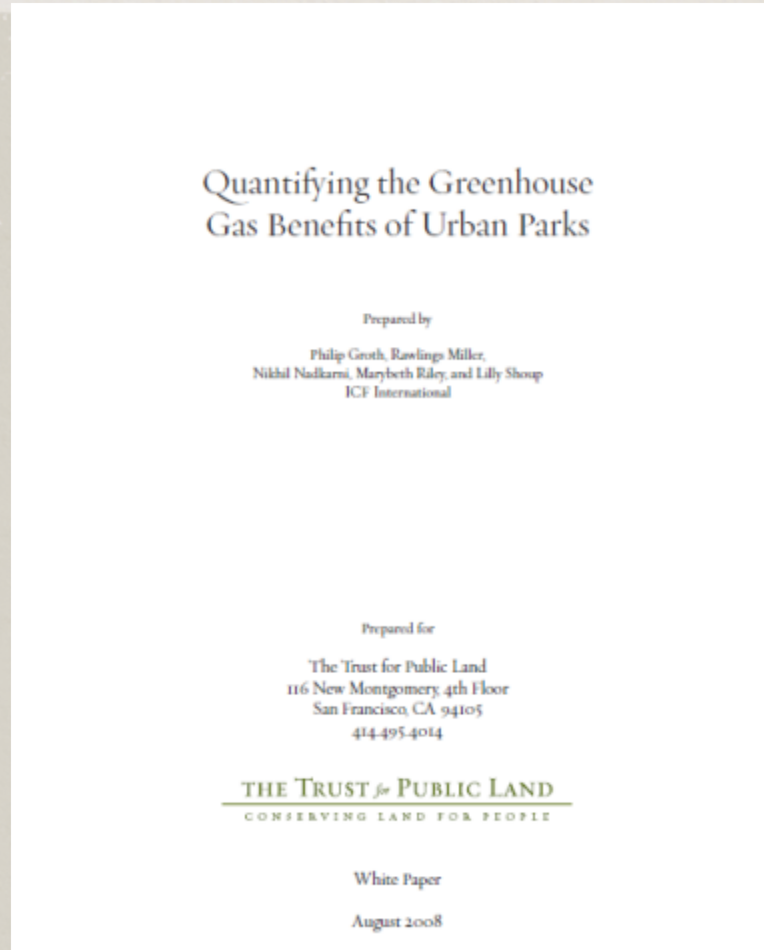

Quantifying the Greenhouse Gas Benefits of Urban Parks

Prepared by

Philip Groth, Rawlings Miller,
Nikhil Nadkarni, Marybeth Riley, and Lilly Shoup
ICF International

Prepared for

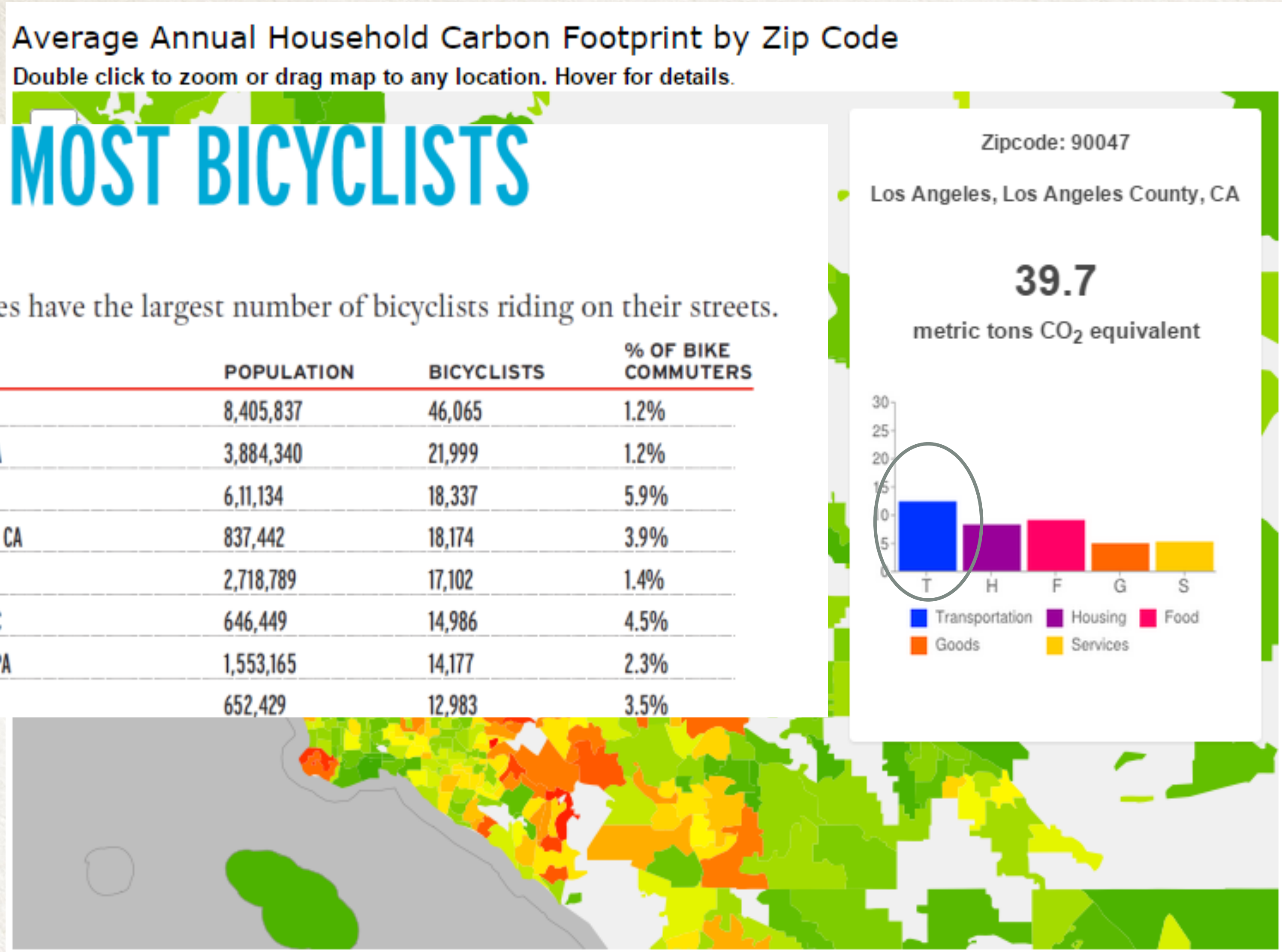
The Trust for Public Land
116 New Montgomery, 4th Floor
San Francisco, CA 94105
414.495.4014

THE TRUST *for* PUBLIC LAND
CONSERVING LAND FOR PEOPLE

White Paper

August 2008

Connect Cities to Reduce Transportation Emissions—
Even Dense CA Zip Codes Have Room for Improvement



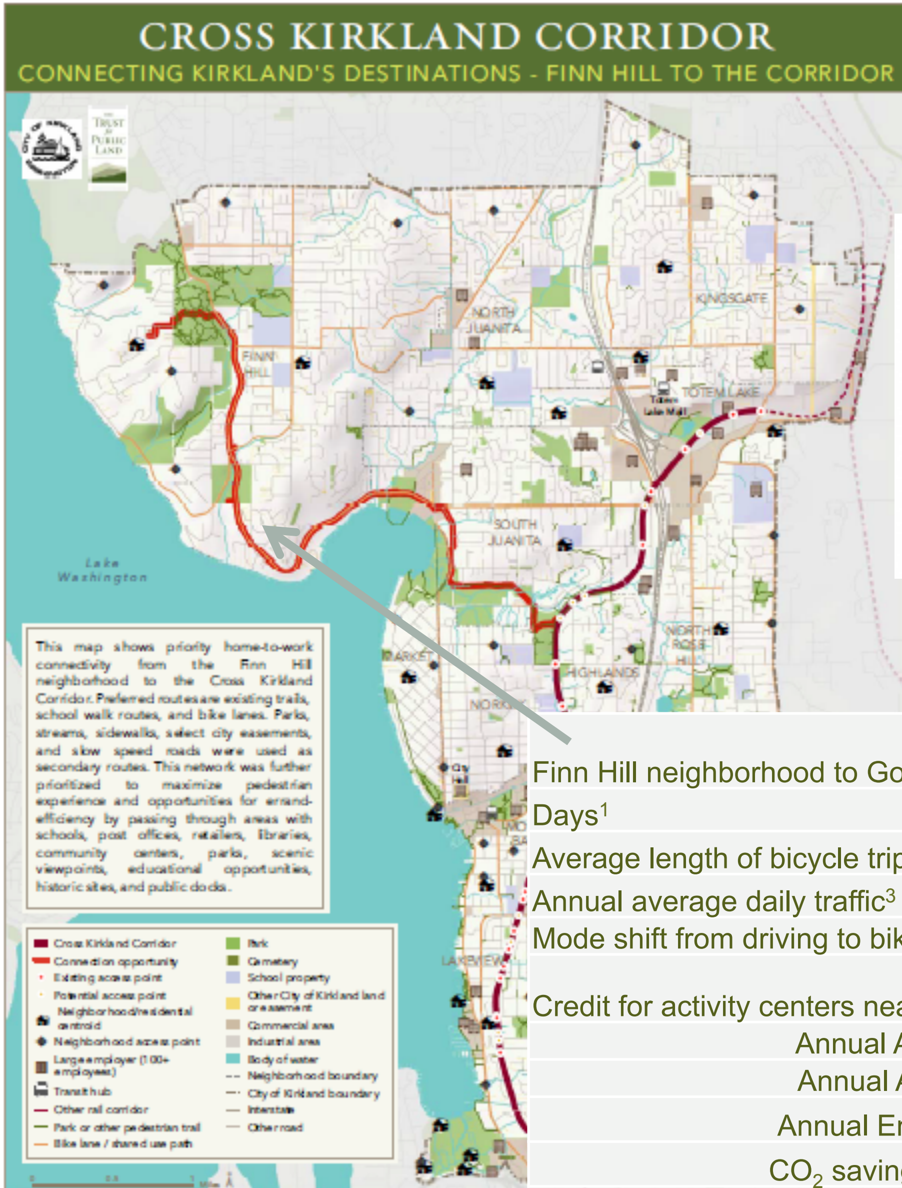
THE MOST BICYCLISTS

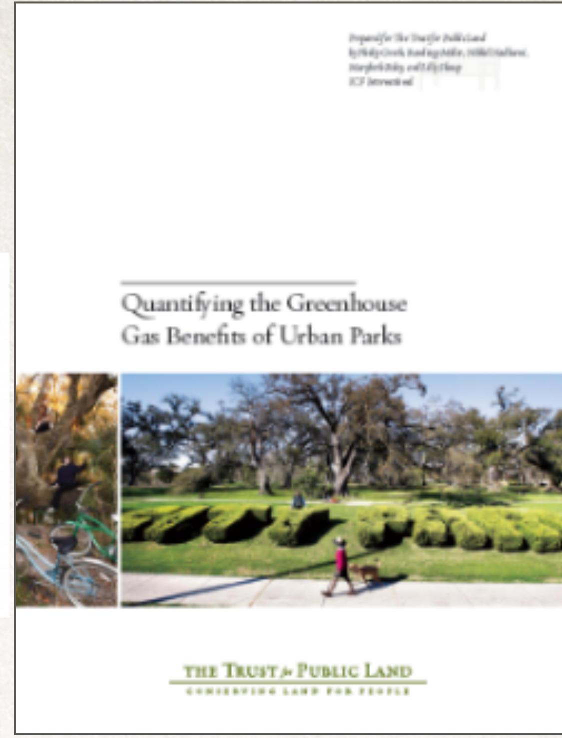
IN 2013

These cities have the largest number of bicyclists riding on their streets.

CITY	POPULATION	BICYCLISTS	% OF BIKE COMMUTERS
NEW YORK, NY	8,405,837	46,065	1.2%
LOS ANGELES, CA	3,884,340	21,999	1.2%
PORTLAND, OR	6,11,134	18,337	5.9%
SAN FRANCISCO, CA	837,442	18,174	3.9%
CHICAGO, IL	2,718,789	17,102	1.4%
WASHINGTON, DC	646,449	14,986	4.5%
PHILADELPHIA, PA	1,553,165	14,177	2.3%
SEATTLE, WA	652,429	12,983	3.5%

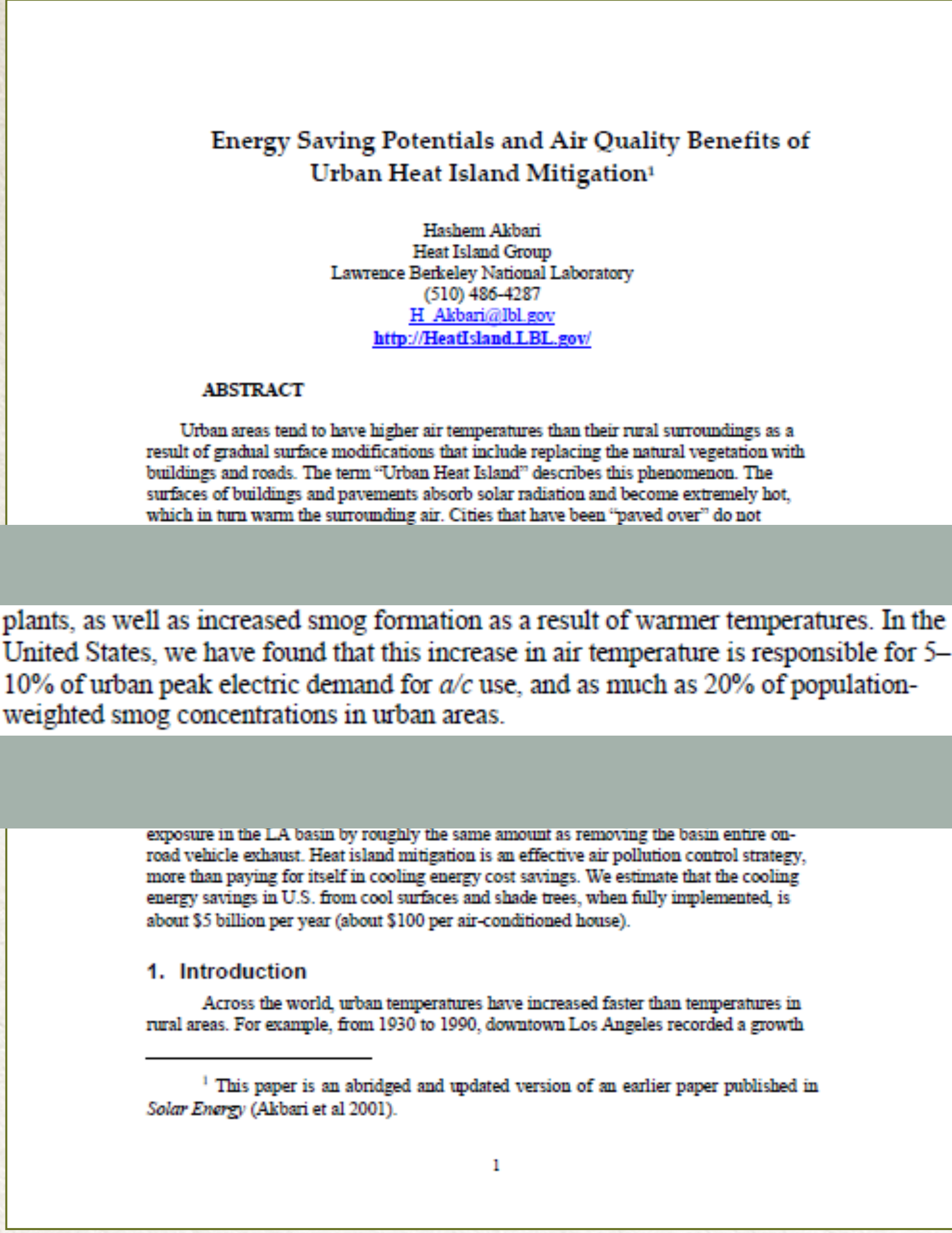
http://coolclimate.berkeley.edu/maps





Finn Hill neighborhood to Google, Inc.	0.38% Mode Shift	2.07% Mode Shift	Units
Days[1]	215	215	days of use/year
Average length of bicycle trips[2]	5.8	5.8	miles
Annual average daily traffic[3]	650	650	trips per day
Mode shift from driving to biking	0.0038	0.0207	
Credit for activity centers near the project[4]	0.002	0.002	
Annual Auto Trips Reduced	810.55	3172.33	trips/year
Annual Auto VMT Reduced	4701.19	18399.49	miles/year
Annual Emission Reductions	4280.09	16751.38	lbs CO_2/year
CO_2 saving per VMT reduced	0.91	0.91	lbs CO_2/mile

We Can Quantify CO2 Benefits for Connect Investments



Energy Saving Potentials and Air Quality Benefits of Urban Heat Island Mitigation[1]

Hashem Akbari
Heat Island Group
Lawrence Berkeley National Laboratory
(510) 486-4287
H_Akbari@lbl.gov
http://HeatIsland.LBL.gov/

ABSTRACT

Urban areas tend to have higher air temperatures than their rural surroundings as a result of gradual surface modifications that include replacing the natural vegetation with buildings and roads. The term "Urban Heat Island" describes this phenomenon. The surfaces of buildings and pavements absorb solar radiation and become extremely hot, which in turn warm the surrounding air. Cities that have been "paved over" do not

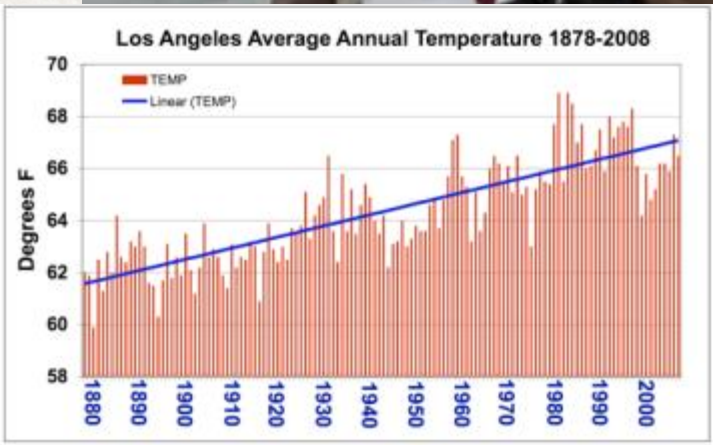
exposure in the LA basin by roughly the same amount as removing the basin entire on-road vehicle exhaust. Heat island mitigation is an effective air pollution control strategy, more than paying for itself in cooling energy cost savings. We estimate that the cooling energy savings in U.S. from cool surfaces and shade trees, when fully implemented, is about $5 billion per year (about $100 per air-conditioned house).

1. Introduction

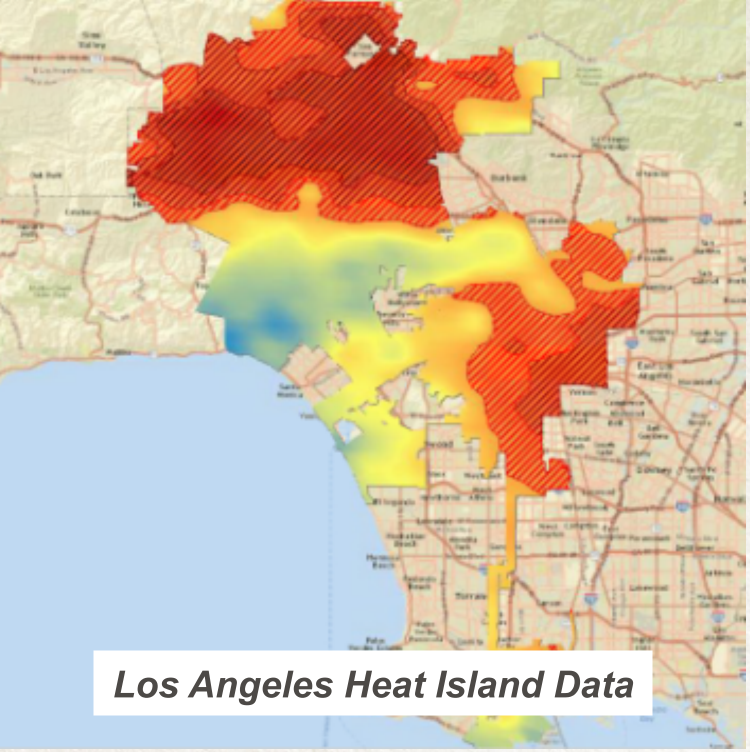
Across the world, urban temperatures have increased faster than temperatures in rural areas. For example, from 1930 to 1990, downtown Los Angeles recorded a growth

[1] This paper is an abridged and updated version of an earlier paper published in *Solar Energy* (Akbari et al 2001).

plants, as well as increased smog formation as a result of warmer temperatures. In the United States, we have found that this increase in air temperature is responsible for 5–10% of urban peak electric demand for *a/c* use, and as much as 20% of population-weighted smog concentrations in urban areas.



Urban Heat Islands = Increased Carbon & Public Health Risk

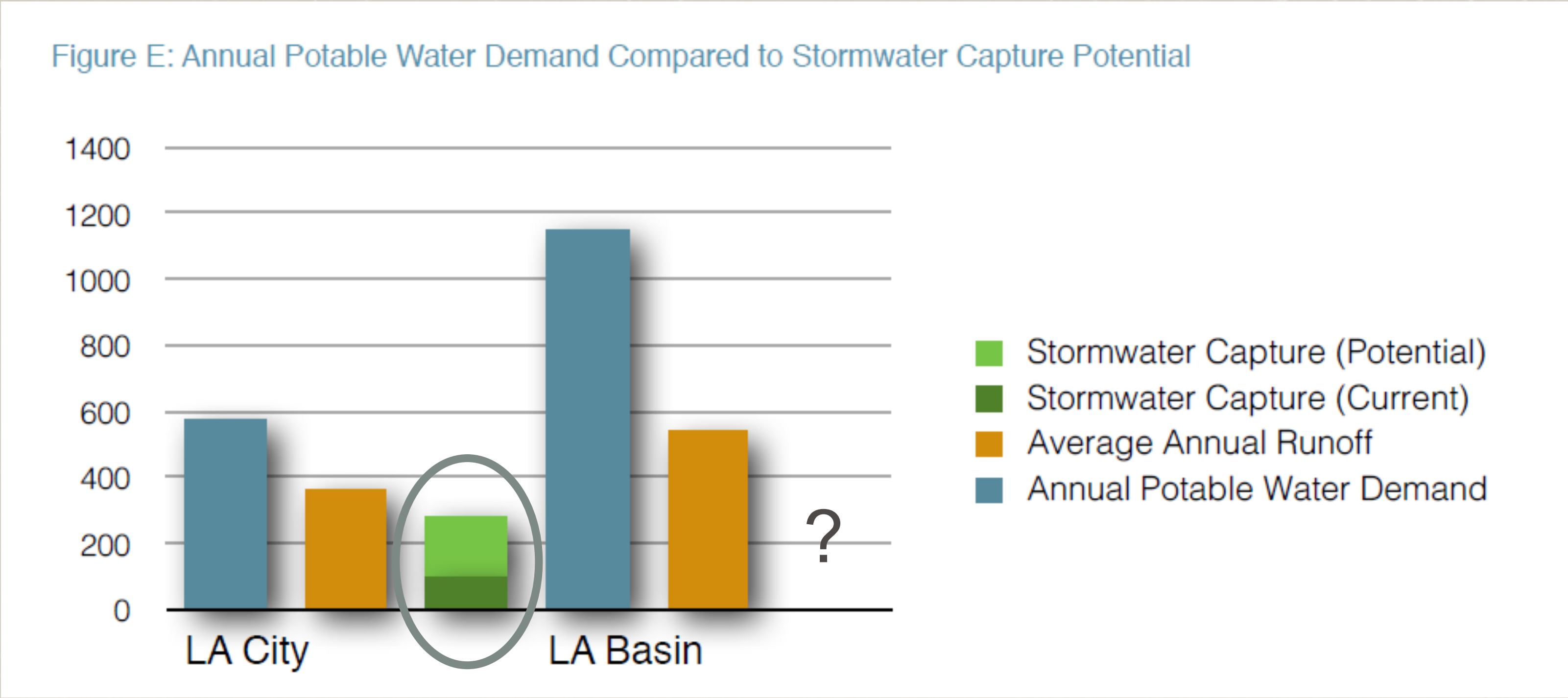


Los Angeles Heat Island Data

MLK Elementary Cool Paving

We Can Map Heat Islands and Quantify CO2 Benefits of "Cool" Interventions

Integrated Water Management to "Absorb"= Carbon Savings



Credit: Tree People, 2015

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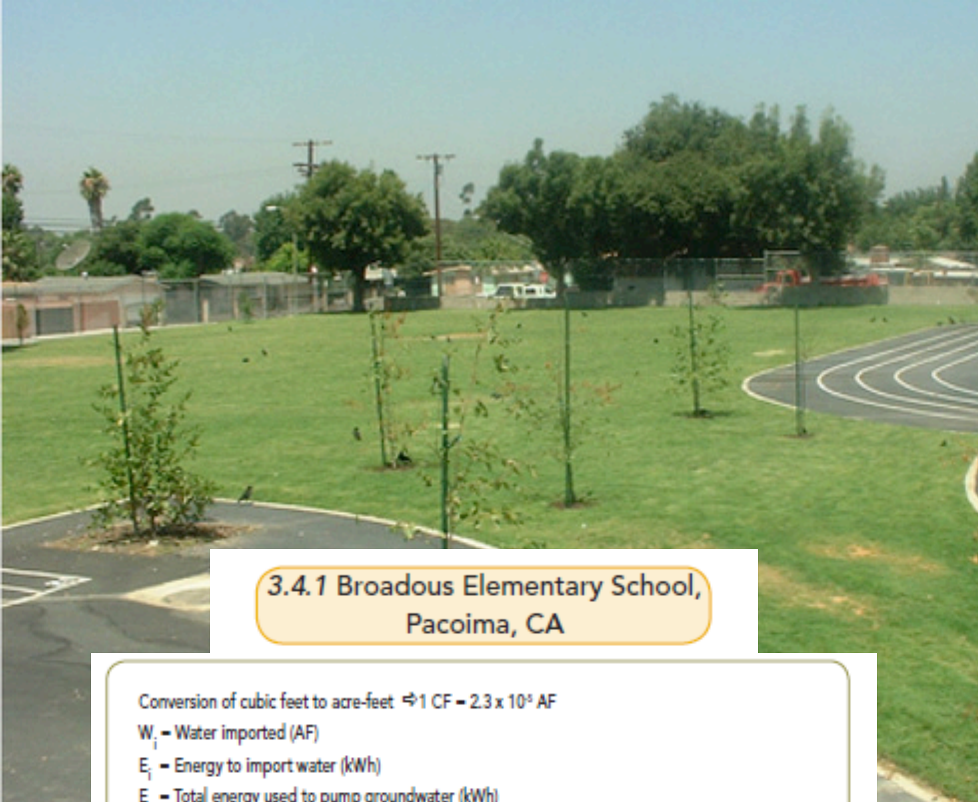

3.4.1 Broadous Elementary School, Pacoima, CA

Conversion of cubic feet to acre-feet ⇨ 1 CF = 2.3×10^{-5} AF

W_i = Water imported (AF)

E_i = Energy to import water (kWh)

E_g = Total energy used to pump groundwater (kWh)

W_g = Groundwater pumped (AF)

E_s = Energy saved by pumping groundwater, rather than importing (kWh)

C = CO2 emission savings from pumping groundwater, rather than importing water (metric tons)

EF_c = CO2 emissions factor (kg/kWh)

W_g = 120,000 CF x 2.3×10^{-5} AF/CF = 2.76 AF

E_i = 2.76 AF x 3,236 kWh/AF = 8,931 kWh

E_g = 2.76 AF x 580 kWh/AF = 1,601 kWh

E_s = 8,931 kWh – 1,601 kWh = 7,330 kWh

C = 7,330 kWh x 0.562 kg/kWh = 4,119 kg

C = 4.11 metric tons of CO_2 emissions, annually

Prepared for The Trust for Public Land
by Philip Groth, Rawlings Miller, Nikhil Nadkarni,
Marybeth Riley, and Lilly Shoup
ICF International

Quantifying the Greenhouse Gas Benefits of Urban Parks

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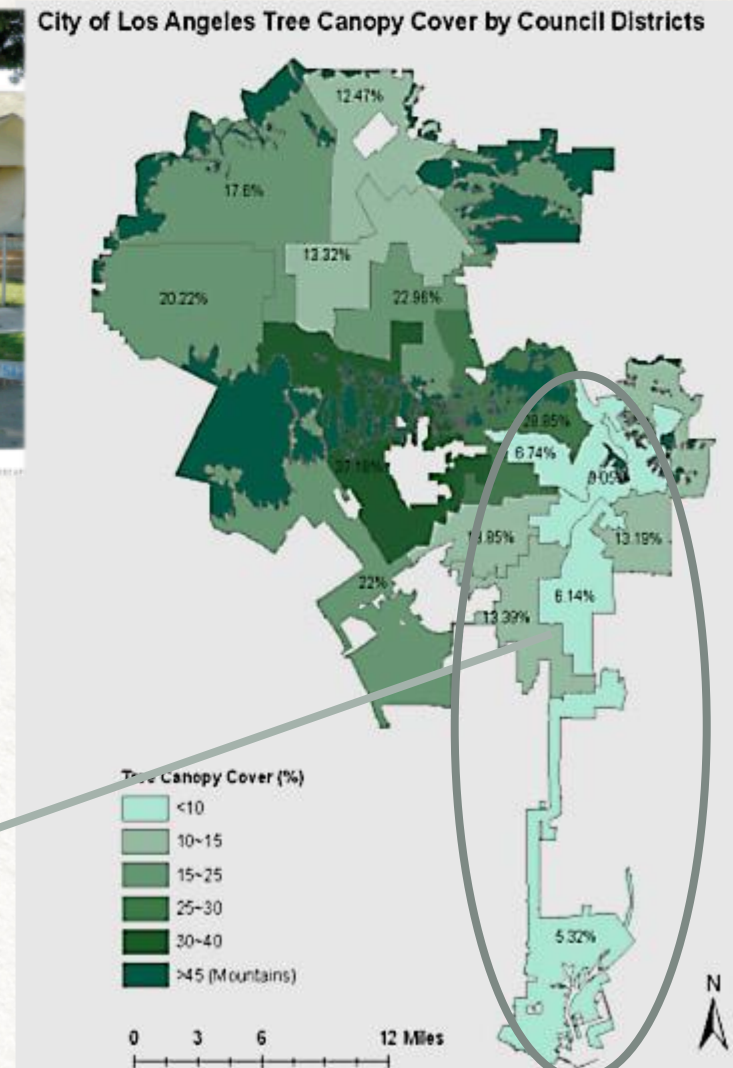
We Can Quantify CO2 Benefits of IWM Actions

Multiple-Benefit Greening Lifts Carbon Reductions

Connect + Cool + Absorb = 3-Way Savings & Climate Justice

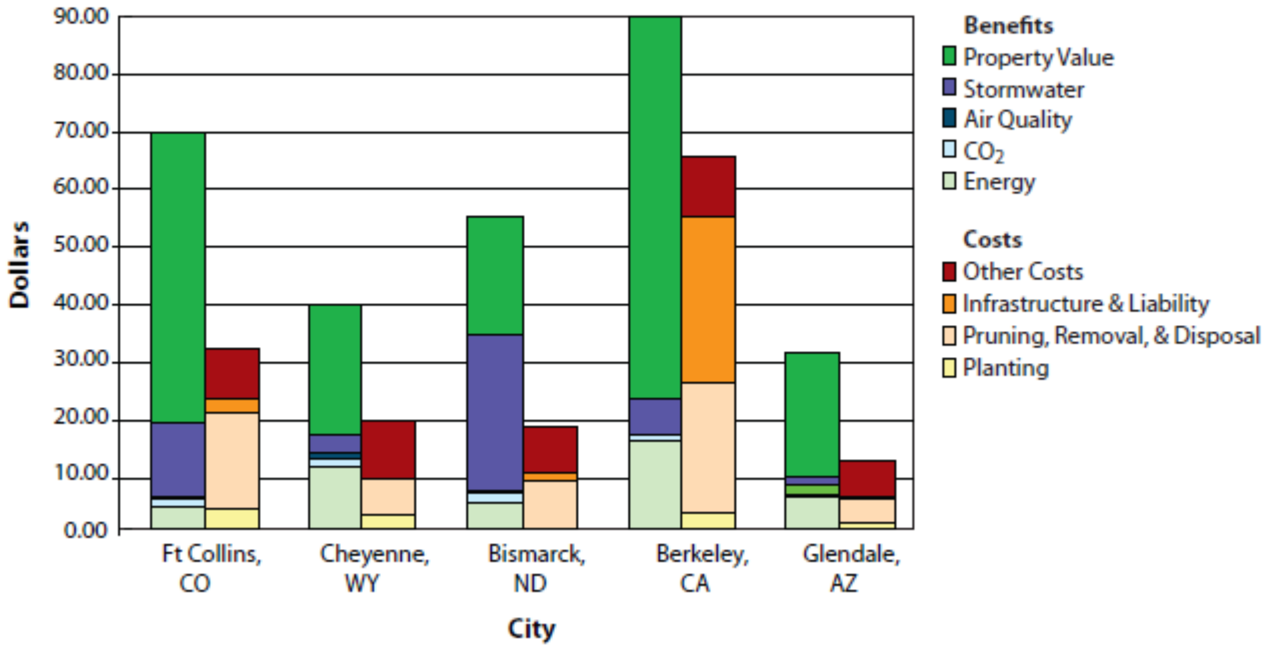
Los Angeles Green Alleys



Target Greening to Vulnerable Populations

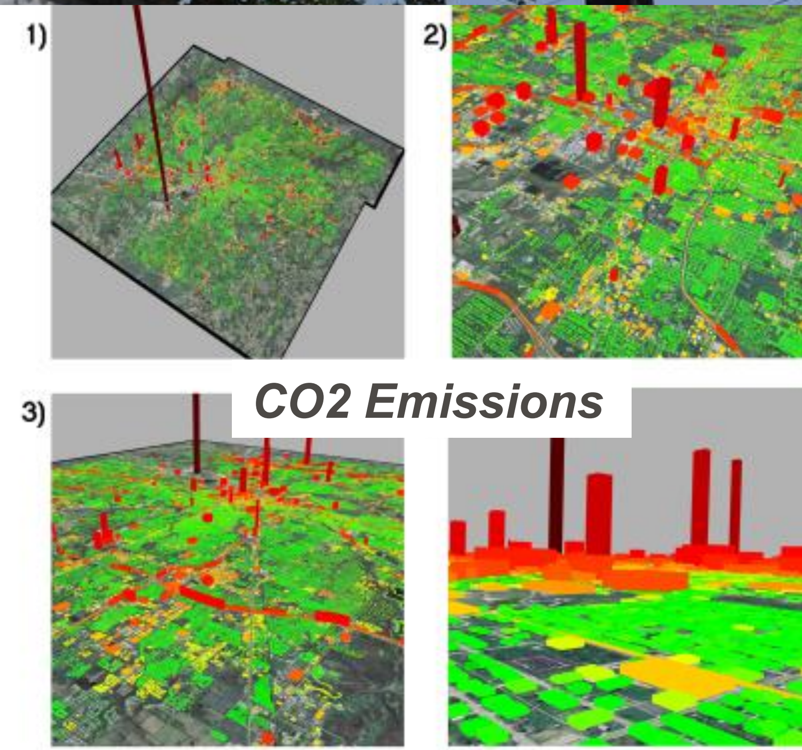
Positive Cost-Benefit Profile, Especially When Delivered to High-Need Populations

Figure 9: Total Annual Benefits versus Costs (Per Tree)



Net benefits were positive for all five cities, ranging from $21 per tree in Cheyenne to $38 per tree in Ft. Collins. Blue and green categories indicate benefits; red, orange, and yellow indicate costs.

Carbon Mapping Can Inform GI Siting and Evaluation



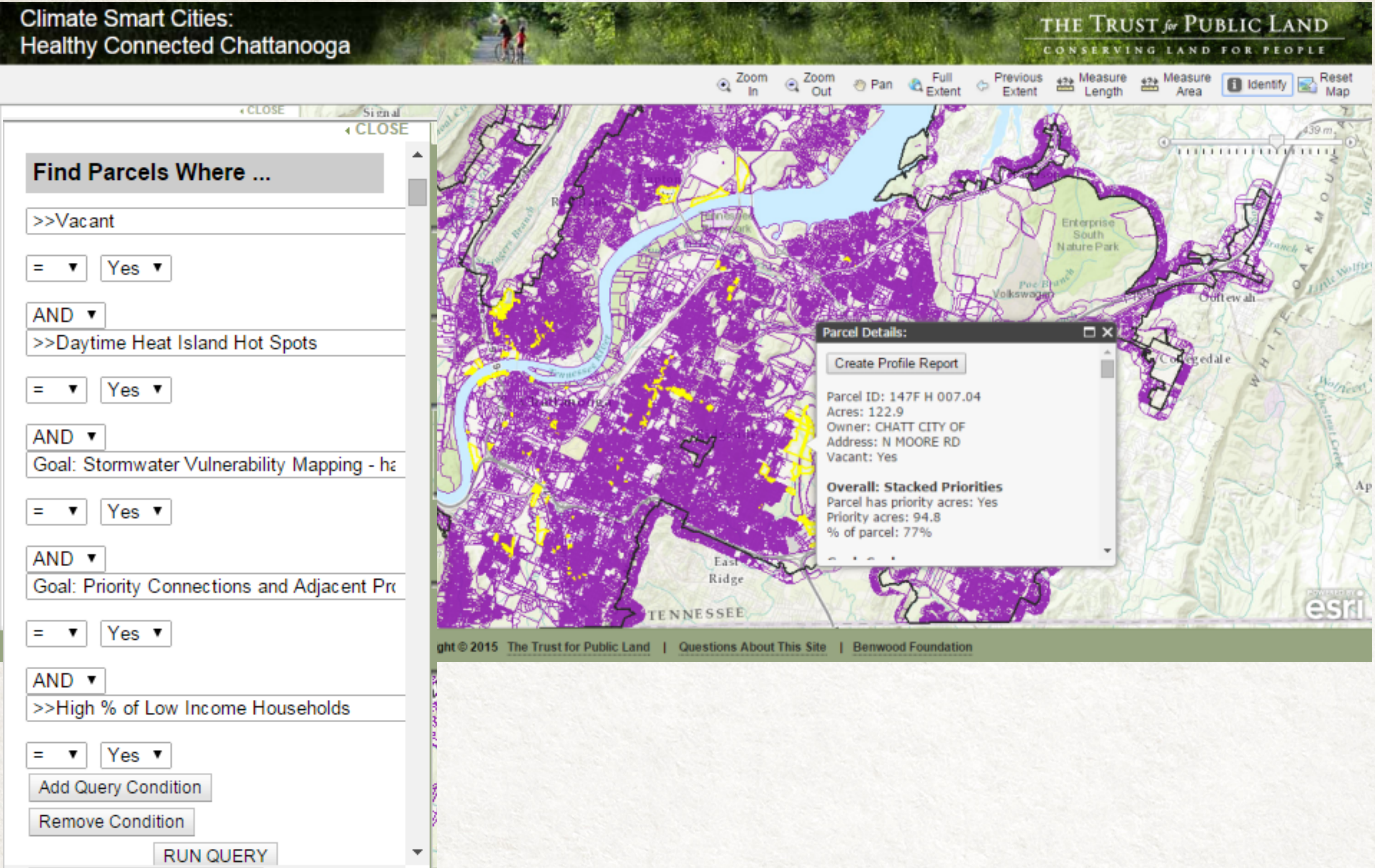
ARIZONA STATE UNIVERSITY · 1885 ·

JPL
Jet Propulsion Laboratory
California Institute of Technology

Avalon Green Alley Network—
Pilot Site Before Implementation

GIS Can Link Relevant Data to Specific GI Projects—

Our Decision Support Tool Coming to L.A. and other CA Cities



Joint Agency Symposium on Climate Goals and Natural and Working Lands

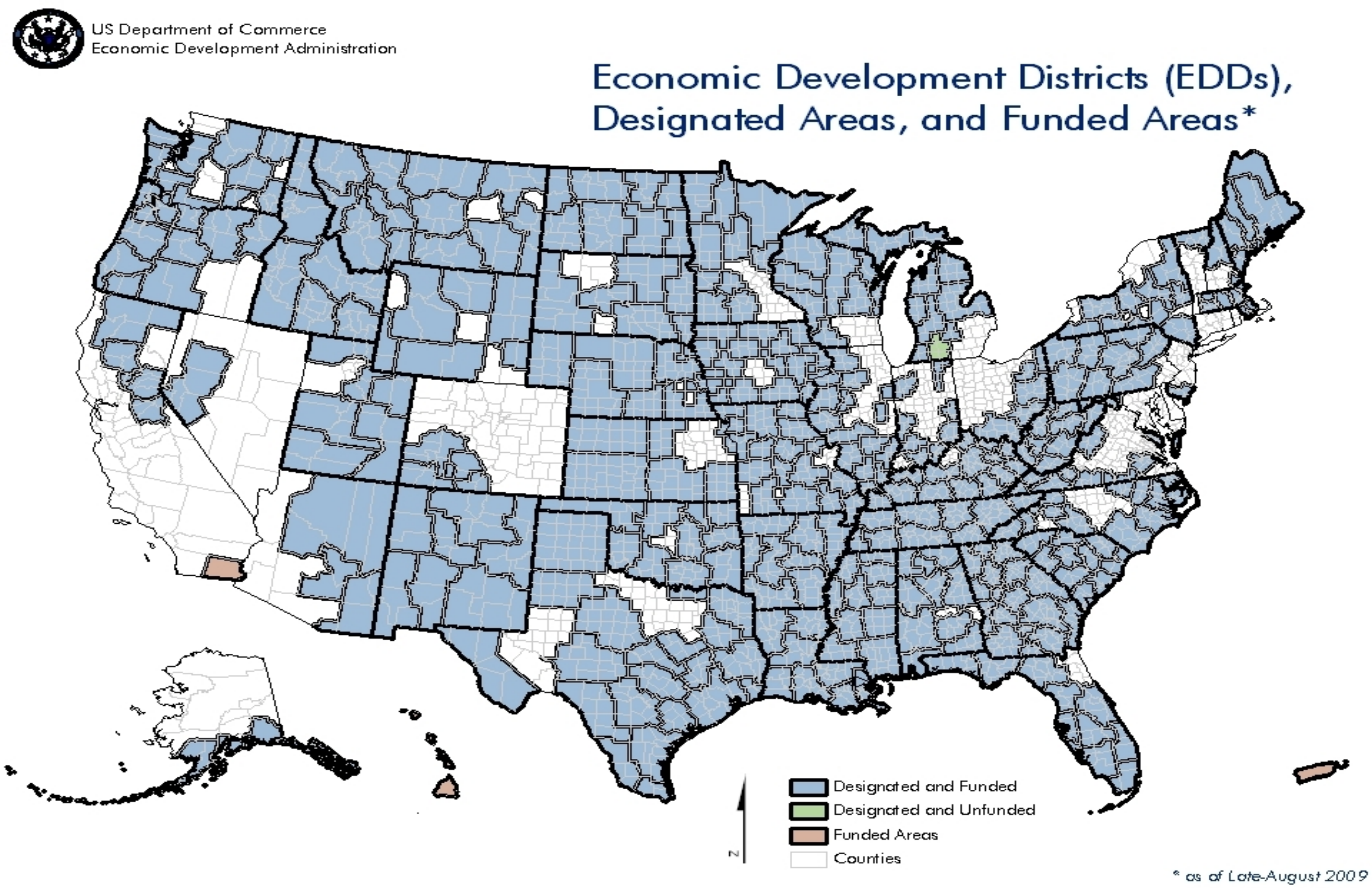
Innovative Rural Opportunities

Marc Nemanic
893-8732 x 204 or mnemanic@3coreedc.org

3CORE Assets

- Economic Development District
- Charitable Tax Exempt Corporation
- Community Development Financial Institution (CDFI)
- Licensed California Finance Lender
- California Finance Consortium (CFC)

Economic Development Districts



Licensed California Finance Lender

- **$4.4** million capital base
- **$2.56** million current loan portfolio (58%)
- **$1.08** million work-in-progress (25%)
- Current Investor Banks
  - Tri-Counties Bank $750,000
  - Rabobank $700,000
  - Wells Fargo Bank $500,000
  - Golden Valley Bank $100,000

Community Development Financial Institution (CDFI)

- A special-purpose financial institution
  - Financial go-between
  - Connects needs with solutions
  - Boots on the ground
  - Market intelligence & prospecting opportunities
- Providing capital & business advising
- Underserved markets & individuals

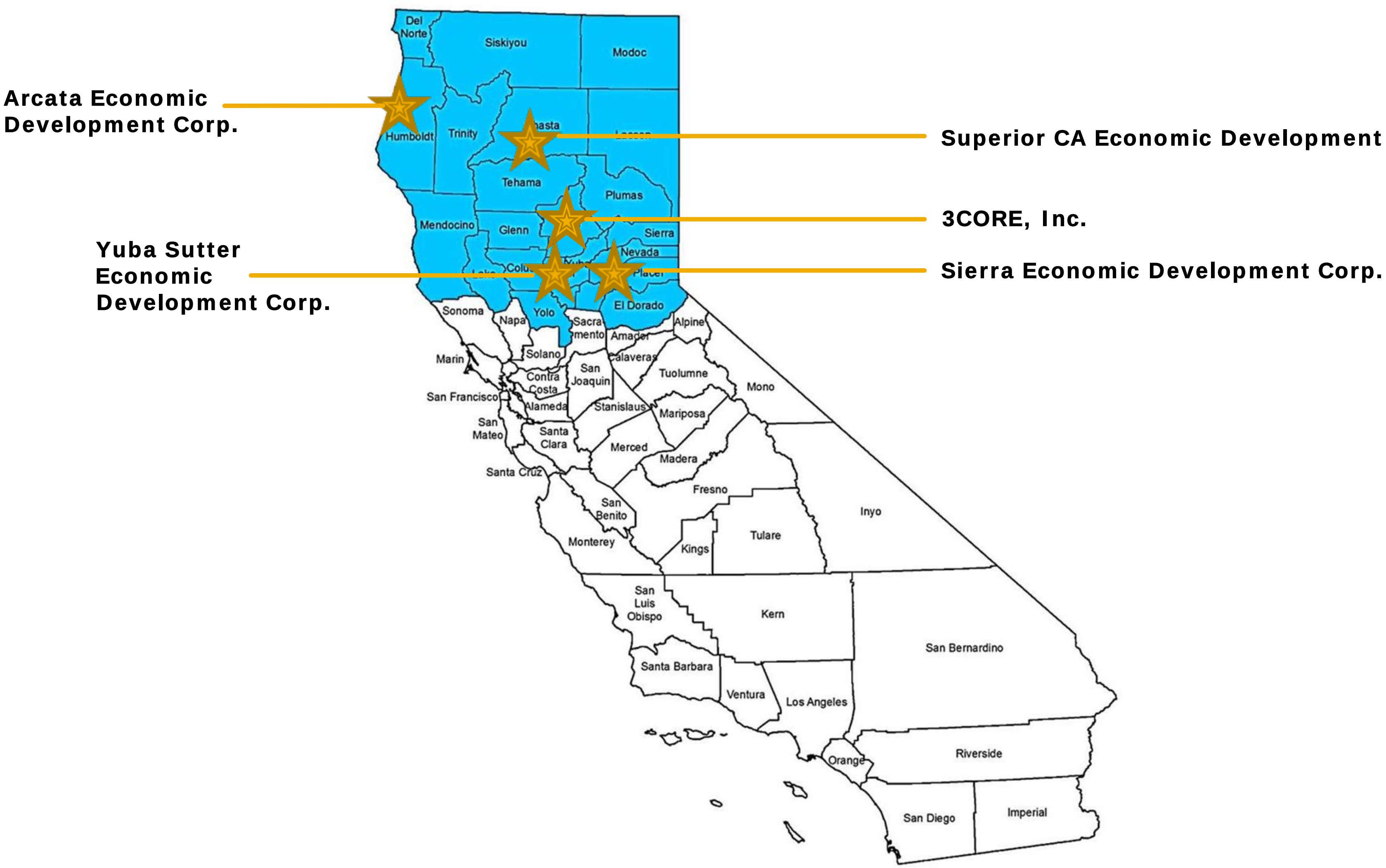
California Finance Consortium(CFC)

- Super regional financial collaborative
  - 3CORE (Chico)
  - Superior California Economic Development (Redding)
  - AEDC (Eureka)
  - Yuba-Sutter EDC (Yuba City)
  - Sierra Economic Development Corp. (Auburn)

CFC approach

- Create scalable lending & advising platform
- Connect expertise with money
- Use spoke & wheel distribution model
  - CFC pools capital & support services from investors/funders
  - Members funnel capital & services to beneficiaries

CFC Service Region



What could CFC do?

- Identify needs
- Craft financial solutions
- Act as a distribution hub
- Qualify financially- feasible projects
- Complete financial due diligence
- Manage investments
- Cultivate local relationships
- Problem-solve
- Build a project pipeline

Project Examples

- New Earth Market ($221,540/$3.6 mil.)
  - LEED building
  - Refrigeration up-grades
- North State Rendering ($150,000/$10.7 mil.)
  - Anaerobic Digester
  - Bio-gas production
- Fire & Light Originals ($268,000/$593,000)
  - Recycled glass

Things to Think About

- **Capacity matters**
  - Build-Measure-Learn
- **Rural areas are hard-to-serve**
  - Minimal mass
  - Wide open spaces
- **Effectiveness by being nimble & adaptive**
  - Relationship based approach
  - Leveraged investment (incentives)
  - Endowment mentality

Ideal Institutional Model

- Investment focus
- Place-based mission-driven institutions
- Public-Private partnerships
- Financial expertise
- Longevity

What Can the State Do?

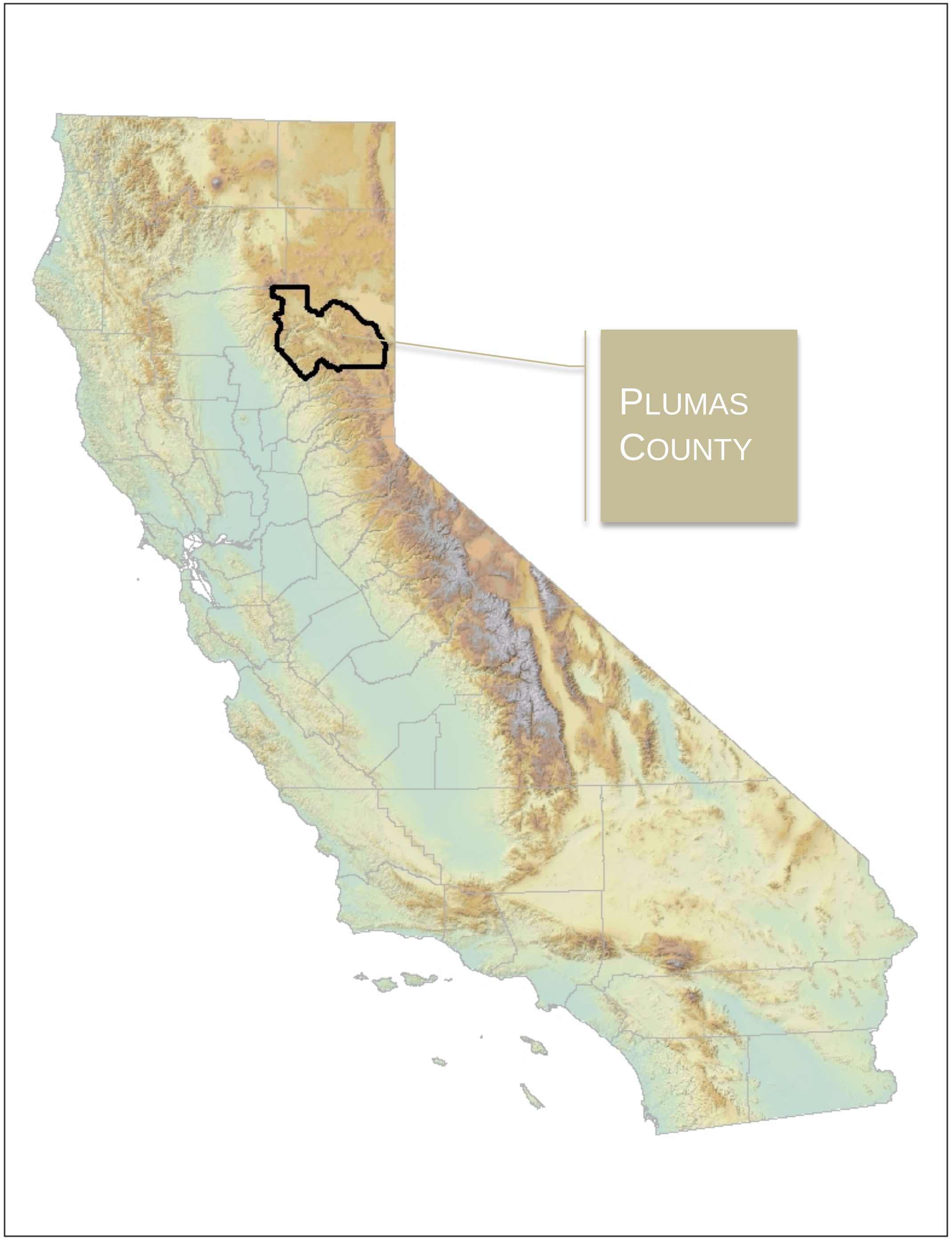
- **Fund capacity**
  - low income community application assistance
- **Decentralize & network assistance**
  - Tap successful local & regional organizations
- **Unlock & incentivize flow of capital**
  - Investor tax credits (COIN model)
  - Interest write-downs
  - Loan guarantees
  - Loan loss reserves
  - Business advisory services (soft collateral)

Plumas Energy Efficiency and Renewables Management Implementation Program

Joint Agency Symposium on Climate Goals and Natural Working Lands
August 5, 2015

Sierra Institute for Community and Environment

Jonathan Kusel, Ph.D.



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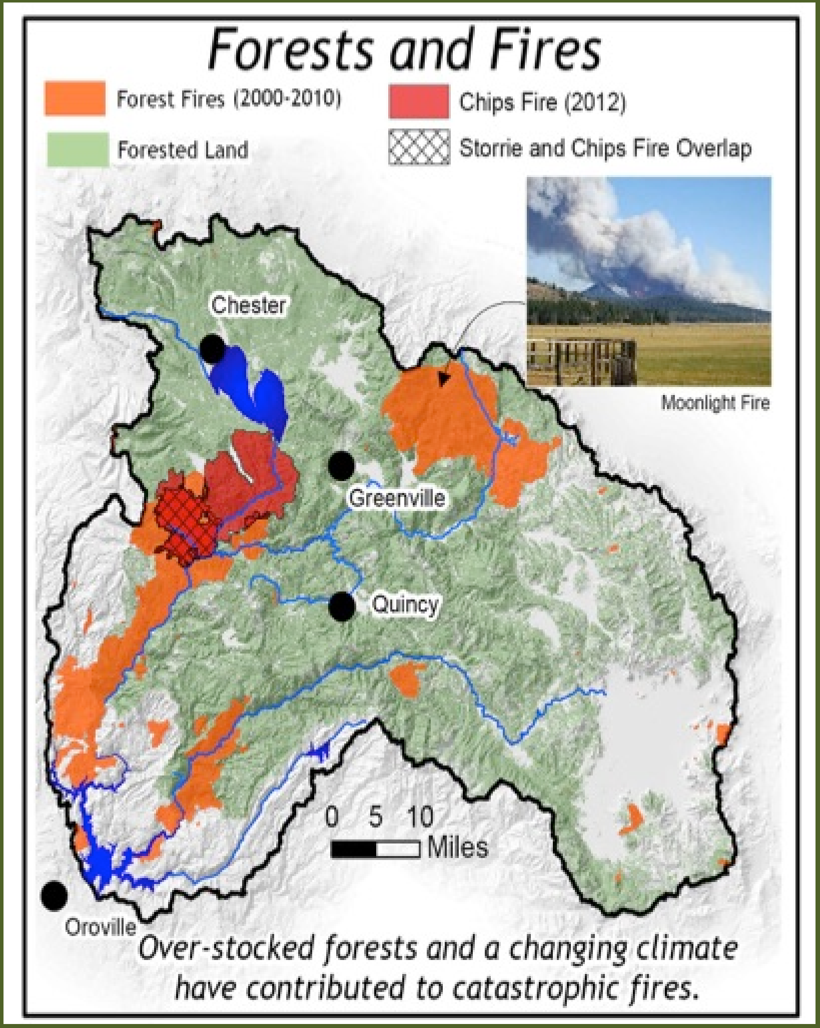
Why Increase Biomass Utilization?



- Reduce fire risk
- Improve forest health
- Improve air quality and reduce black carbon emissions
- Stabilize heating costs
- Create local jobs
- Reduce fossil fuel use
- Utilize abundant, local, renew-able resource

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Stakeholder Engagement / Involvement

Plumas County:

- Plumas Unified School District
- Fire Safe Council
- County Officials
- Hospital Administrators
- Feather River College
- Portola City Council
- Plumas National Forest
- Forestry Professionals

State and federal agencies:

- CEC
- CPUC
- Governors Office
- US Forest Service
- State Wood Energy Team
- Biomass Working Group
- Sierra Nevada Conservancy
- Office of Statewide Health Planning and Development
- Northern Sierra Air Quality Management District
- US EPA/Ecology & Environment
- Plumas County Planning Dept.
- Community Service Districts

Critical Facilities Identification and Assessment

Biomass Thermal Opportunities	Current Heating Costs (annually)	Fuel Type	Gallons Used (annually)	Biomass Used (annually)	Savings (annually)
Portola District Heating Facility					
Eastern Plumas Heath Care	$ 147,500.00	diesel fuel	37,000	400 bdt	$25,075.00
Portola High School	$ 79,500.00	heating oil	22,640	210 bdt	$13,515.00
Portola City Hall	$ 4,700.00	propane	2,582	15 bdt	$799.00
Portola Library	$ 5,500.00	propane	2,750	15 bdt	$935.00
Portola USPS Building	$ 4,000.00	propane	2,300	15 bdt	$680.00
County HHS/FRC	$ 135,000.00	electric/Prop.	17,000	800 bdt	$45,000.00
USFS Supervisors Office	$ 37,000.00	prop/fuel oil	11,500/3,260	100 bdt	$24,500.00
USFS Mt. Hough RD	$ 35,000.00	propane	14,340	115 bdt	$20,625.00
Greenville K-12 School	$ 112,500.00	diesel fuel	30,646	275 bdt	$19,125.00
Chester Heating Facility					
Wildwood Assted. Living Facility	$ 60,000.00	propane	26,000	175 bdt	$38,125.00
Seneca Hospital	$ 80,000.00	diesel Fuel	21,000	210 bdt	$53,750.00

Green Tons/Acre	10 to 15
Bone Dry Tons/Acre	8 to 12
Avg. price of chips (raw mtrl).	$60.00
Retail chips/bdt (thermal)	$125.00
Price of heat	83%

Thermal Network

Total biomass needed	2,330 bdt
Acres treated	200 - 300

3 MW CHP

Total biomass needed	25,000 bdt
Acres treated	2,100 - 3,200

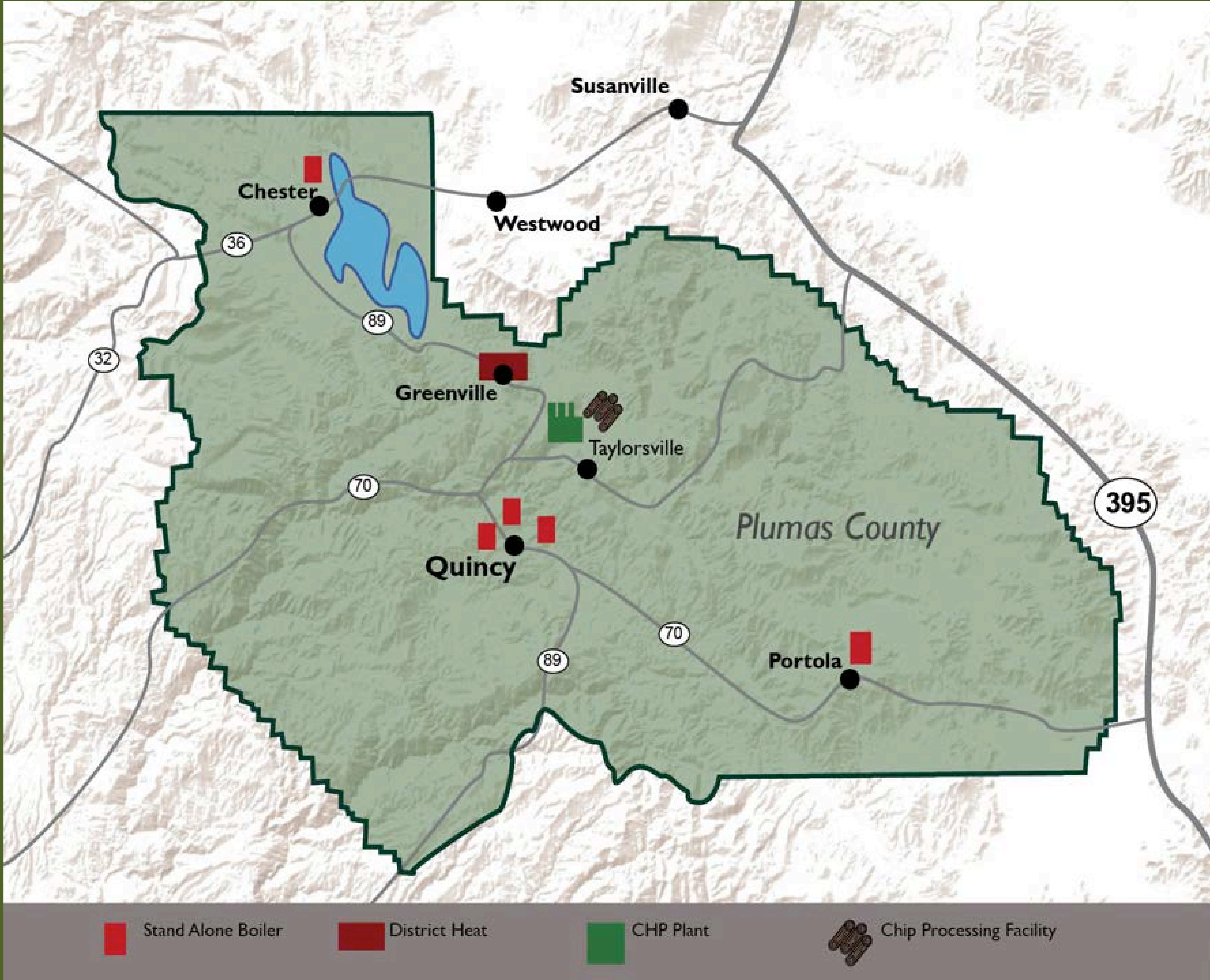
Increased biomass utilization in Plumas County will have the following annual results:

County wide savings	$197,129
Fossil fuel gallons offset	170,018
Homes powered	3,000
Tons of biomass used	27,000
Acres treated	2,300 - 3,500

KEY

bdt: bone dry ton

CHP combined heat and power

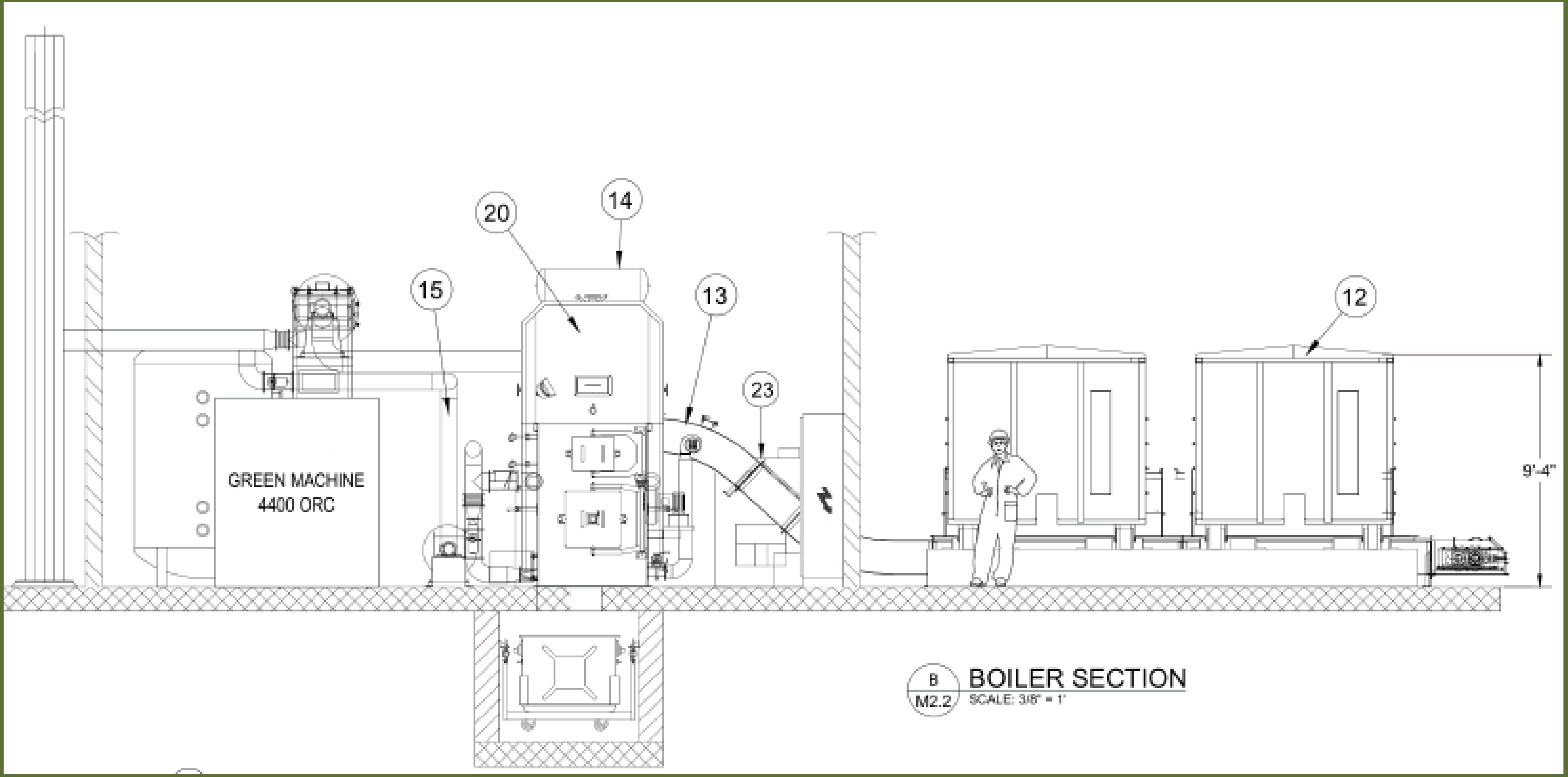


Susanville
Chester
Westwood
36
89
32
Greenville
Taylorsville
70
395
Plumas County
Quincy
70
89
Portola
Stand Alone Boiler
District Heat
CHP Plant
Chip Processing Facility

CHP Boiler in Quincy, CA

Project funded under CEC PON-14-307

Biomass Boiler System



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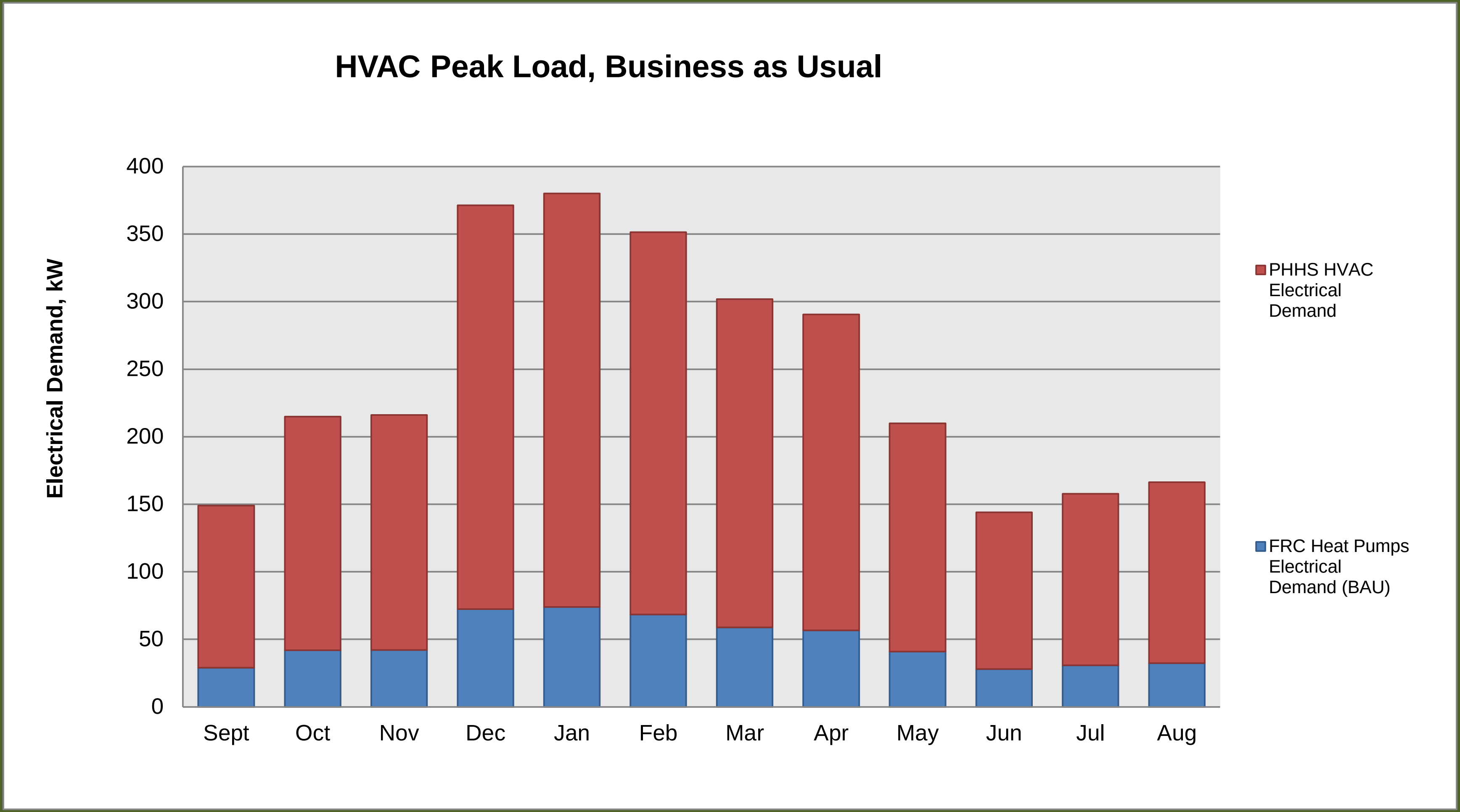
Electrical Demand Reduction



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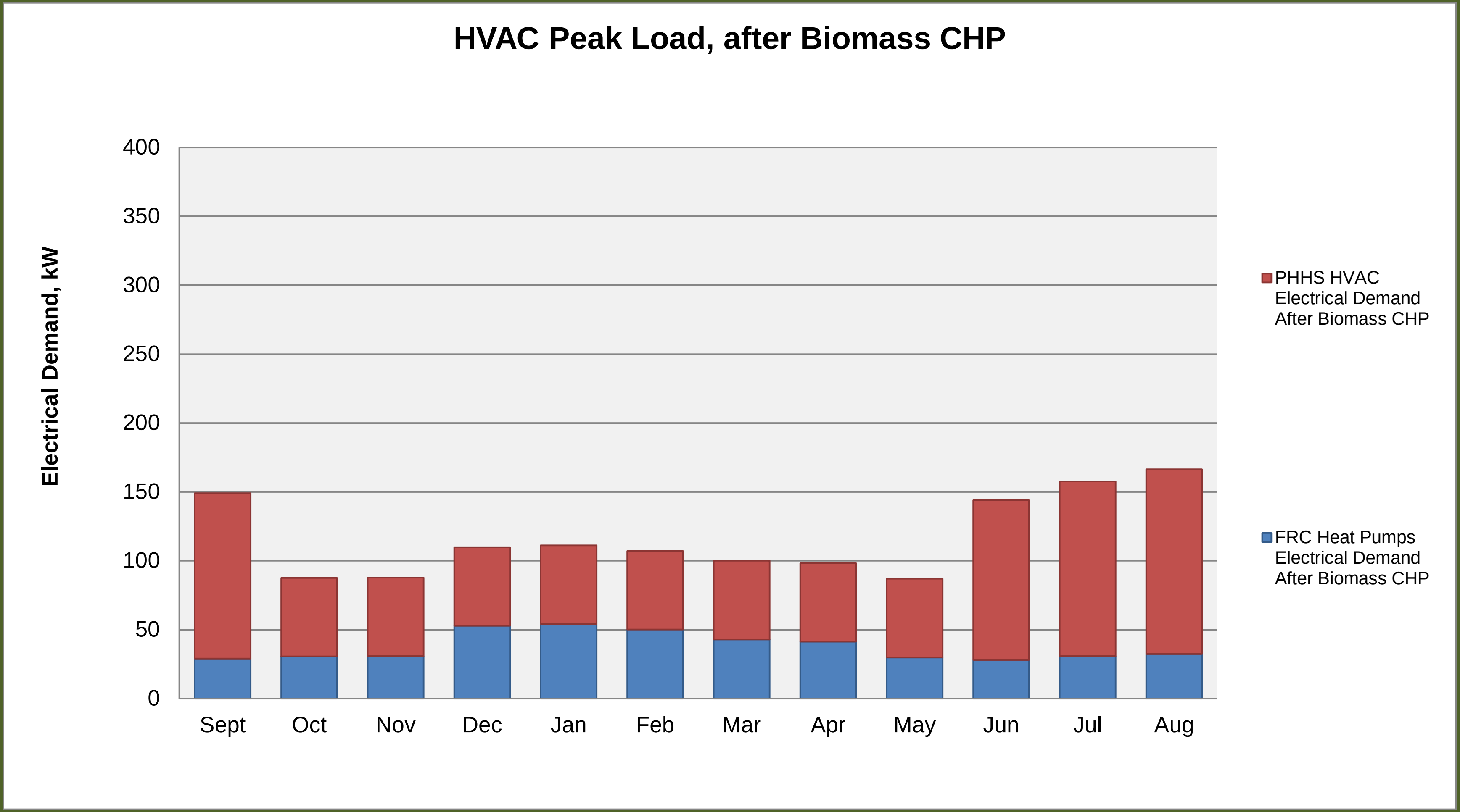
Electrical Demand Reduction



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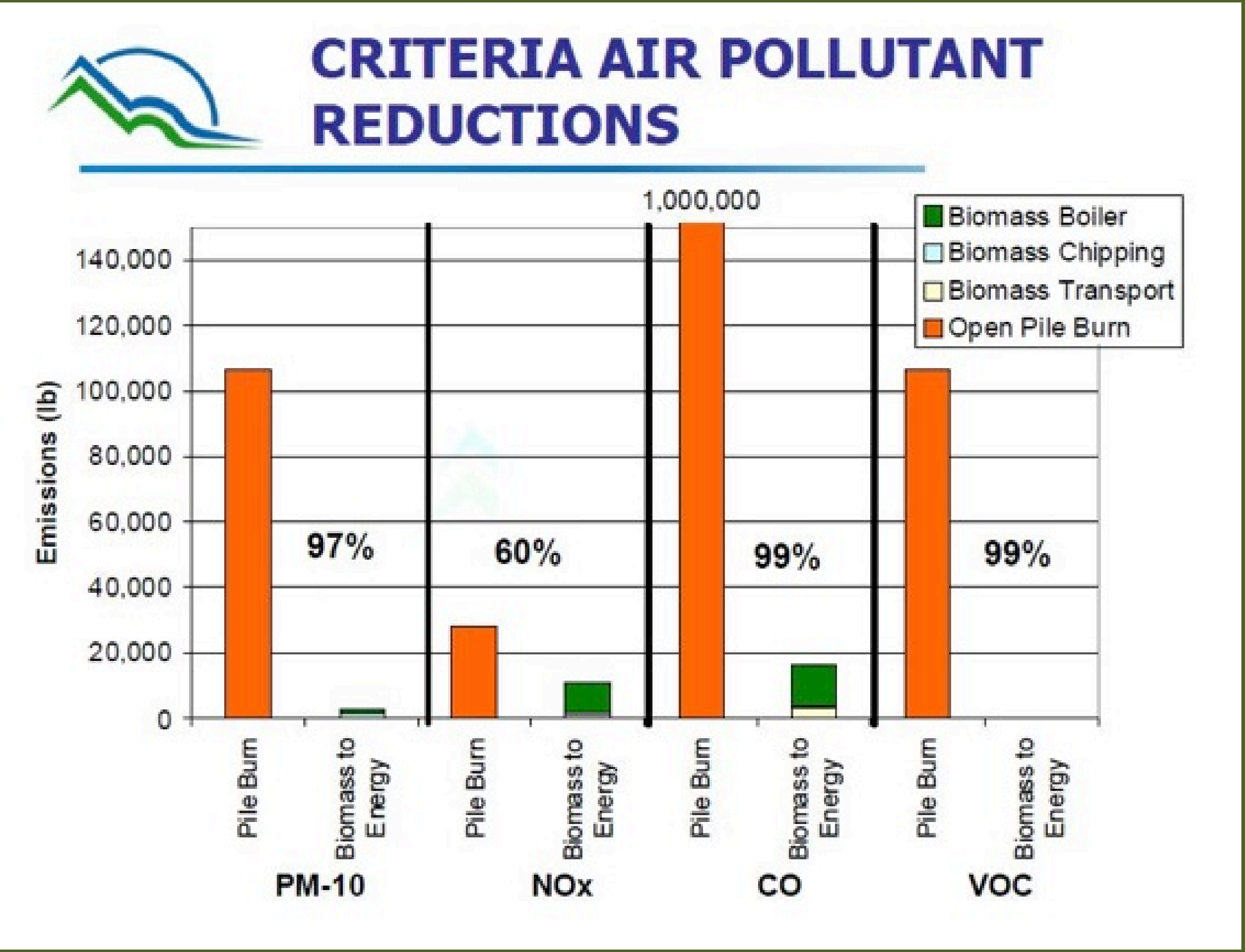
Air Quality



Emissions based on burning 5,000 BDT of biomass, Placer County Air District

Sierra Institute for Community and Environment

Crescent Mills Site

Physical Attributes:

- Former LP mill
- Zoned heavy industrial
- Access off HW 89
- Water and power on site
- PG&E Substation

Due Diligence:

- Community/County support
- Phase I & II Environmental Assessment
- Tanks removed
- Contaminated soil removed
- One year well monitoring
- Contract with landowner

Centrally located

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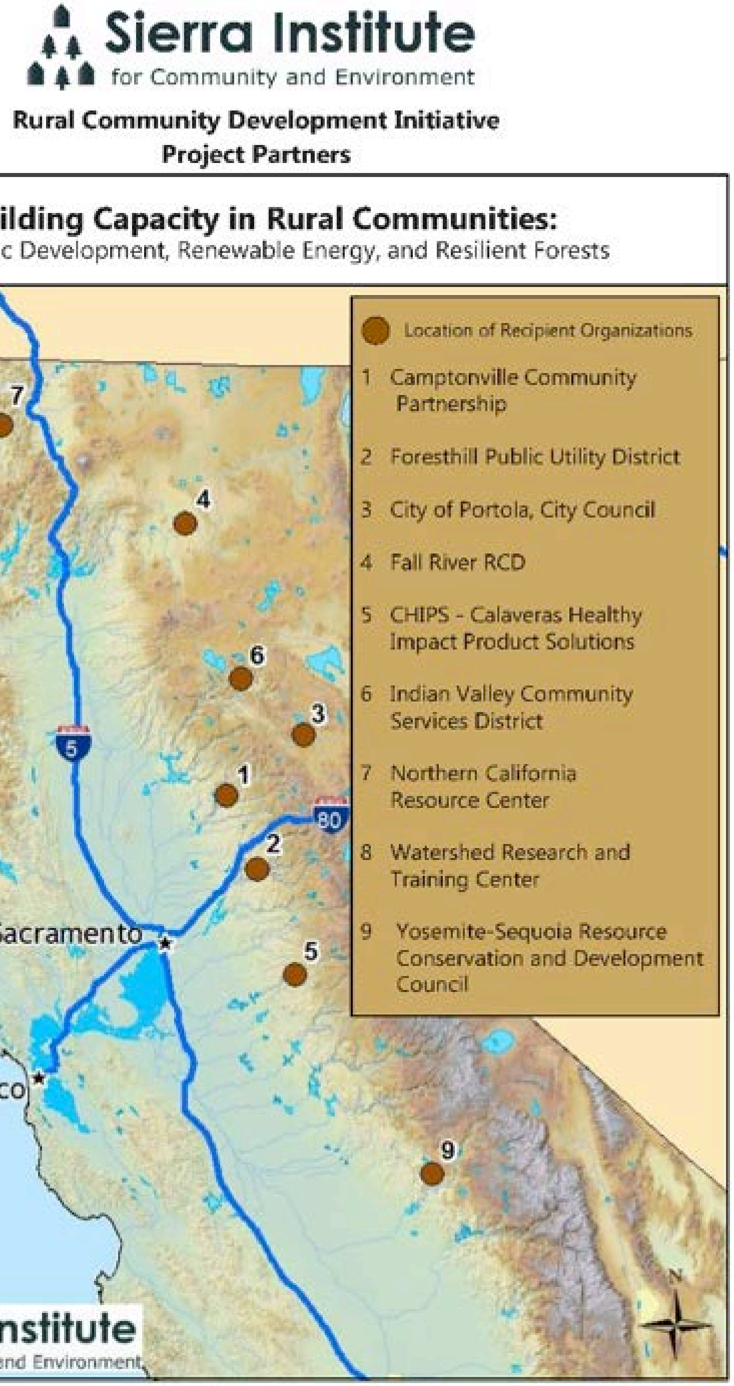
Advancing Replicability Through Dissemination

- Working with other communities (USDA RCDI grant)
- State Wood Energy Team
- Biomass Working Group



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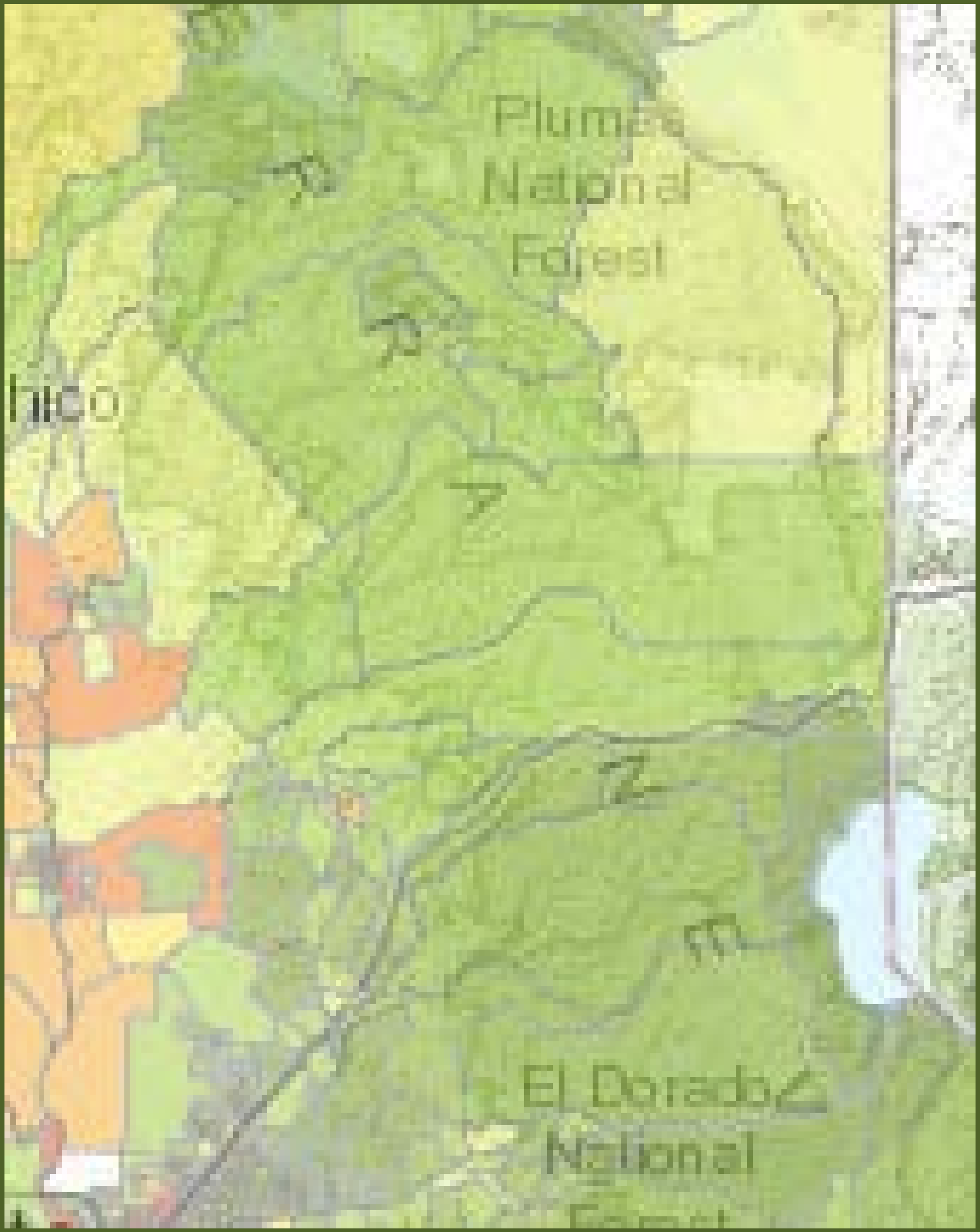
for Community and Environment

CalEnviroScreen 2.0 Results

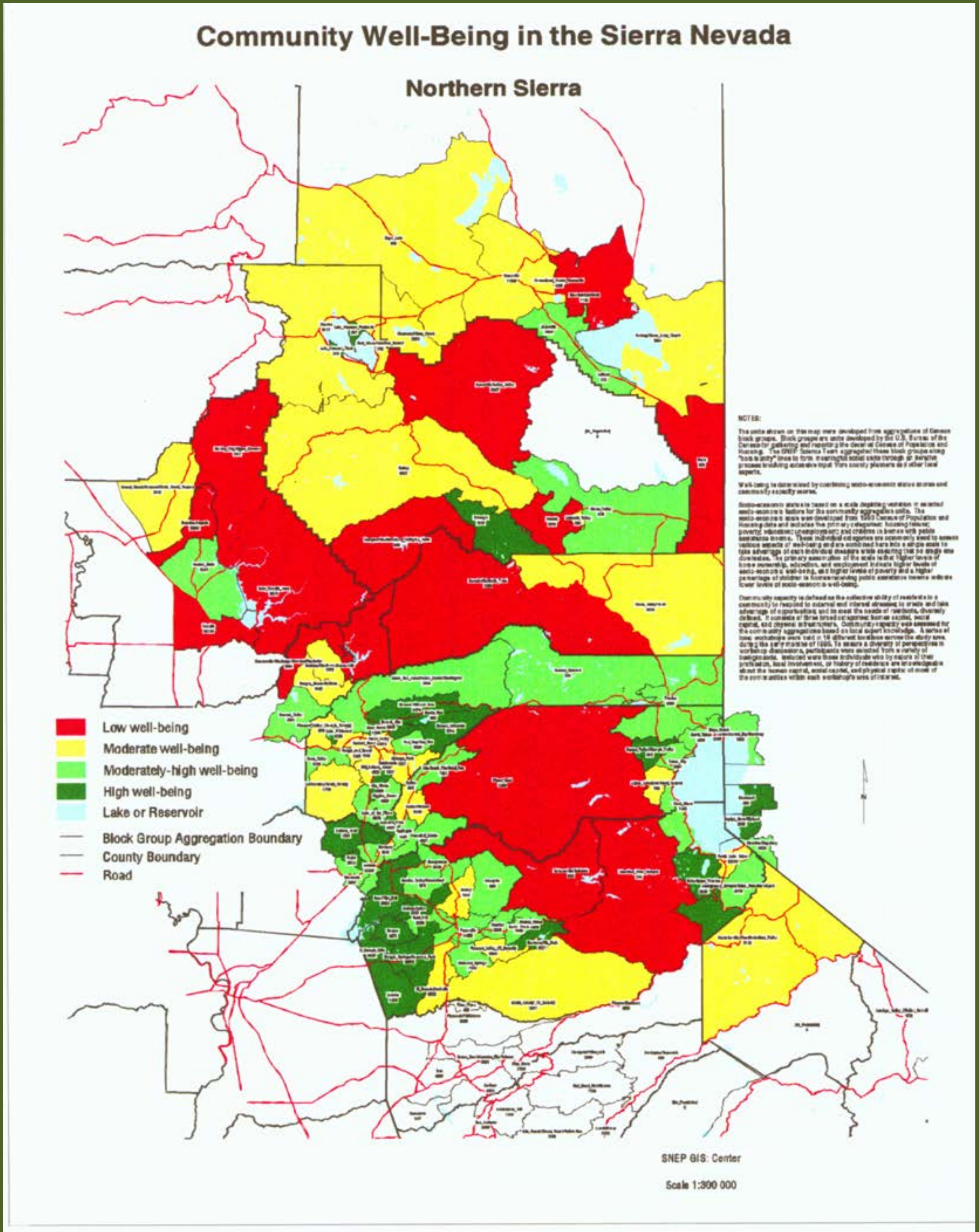


CalEnviroScreen 2.0 results

CalEnviroScreen 2.0 all results

- Lowest Scores (Bottom 10%)
- 11 - 20%
- 21 - 30%
- 31 - 40%
- 41 - 50%
- 51 - 60%
- 61 - 70%
- 71 - 80%
- 81 - 90%
- Highest Scores (91 - 100%)

High pollution, low population



Sierra Nevada Ecosystem Project: Community well-being scores

Sierra Institute for Community and Environment

City	Zip (census tract)	EnviroScreen score	Median Household Income	Unemployment	Families below poverty line in last 12 months
Fresno	93706	89.22	$28,100	9.3%	35.0%
Ontario	91761	80.70	$62,191	9.0%	9.4%
Selma	93662	76.84	$43,760	7.8%	19.3%
Bakersfield	93307	75.50	$34,243	10.3%	29.8%
Colton	92324	72.07	$43,283	9.0%	18.3%
California			**$61,632**	**6.5%**	**10.8%**
Camptonville CDP	95922*	Not included	$17,188	12.8%	17.1%
Portola	96122*	23.10	$33.056	12.0%	23.9%
Hayfork CDP	96041*	11.42	$37,333	13.6%	9.9%
Hoopa CDP	95546*	Not included	$26,818	15.0%	26.6%
Greenville CDP	95947*	Not included	$26,719	3.4%	16.7%

CalEnviroScreen Scores for Highest Scoring Disadvantaged Communities and RCDI Communities

* Data based on CDP or incorporated community designation

Sierra Institute for Community and Environment

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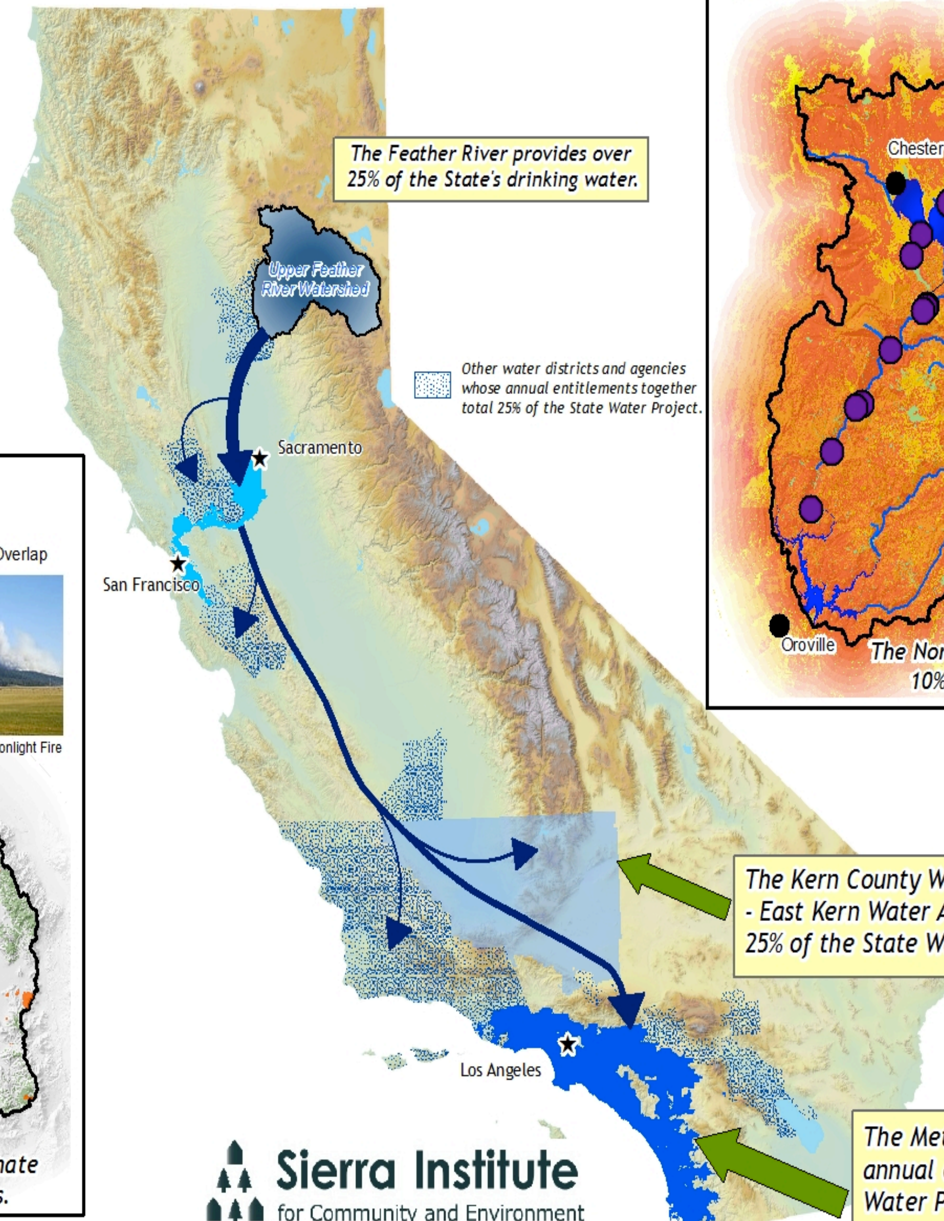
Sierra Institute for Community and Environment

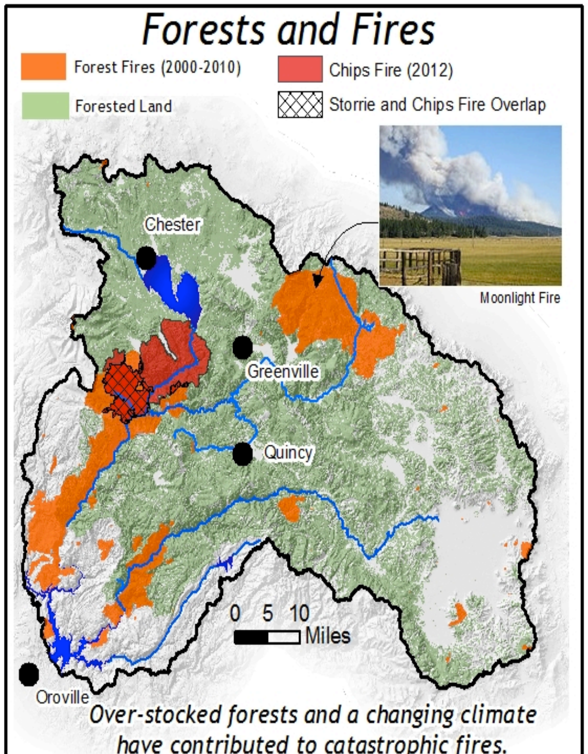
The Upper Feather River: *Fire, Water Supply, and Energy*

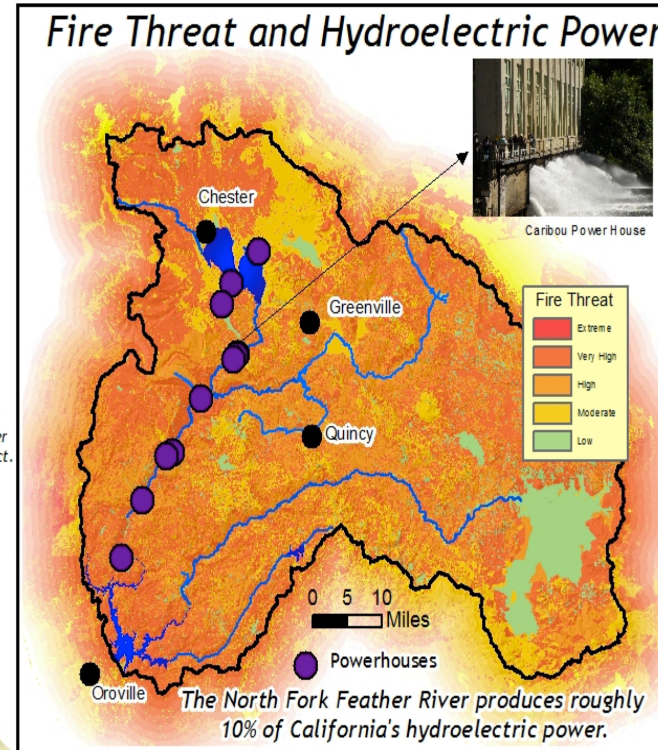
The Upper Feather River Watershed is roughly the size of Yellowstone National Park and fills the principal water storage facility for the State Water Project.

Since 1960, annual flows have decreased by 400,000 acre-feet.

State Water Project deliveries vary from year to year based on supply, but annual entitlements total 4.1 million acre-feet.







Sierra Institute for Community and Environment

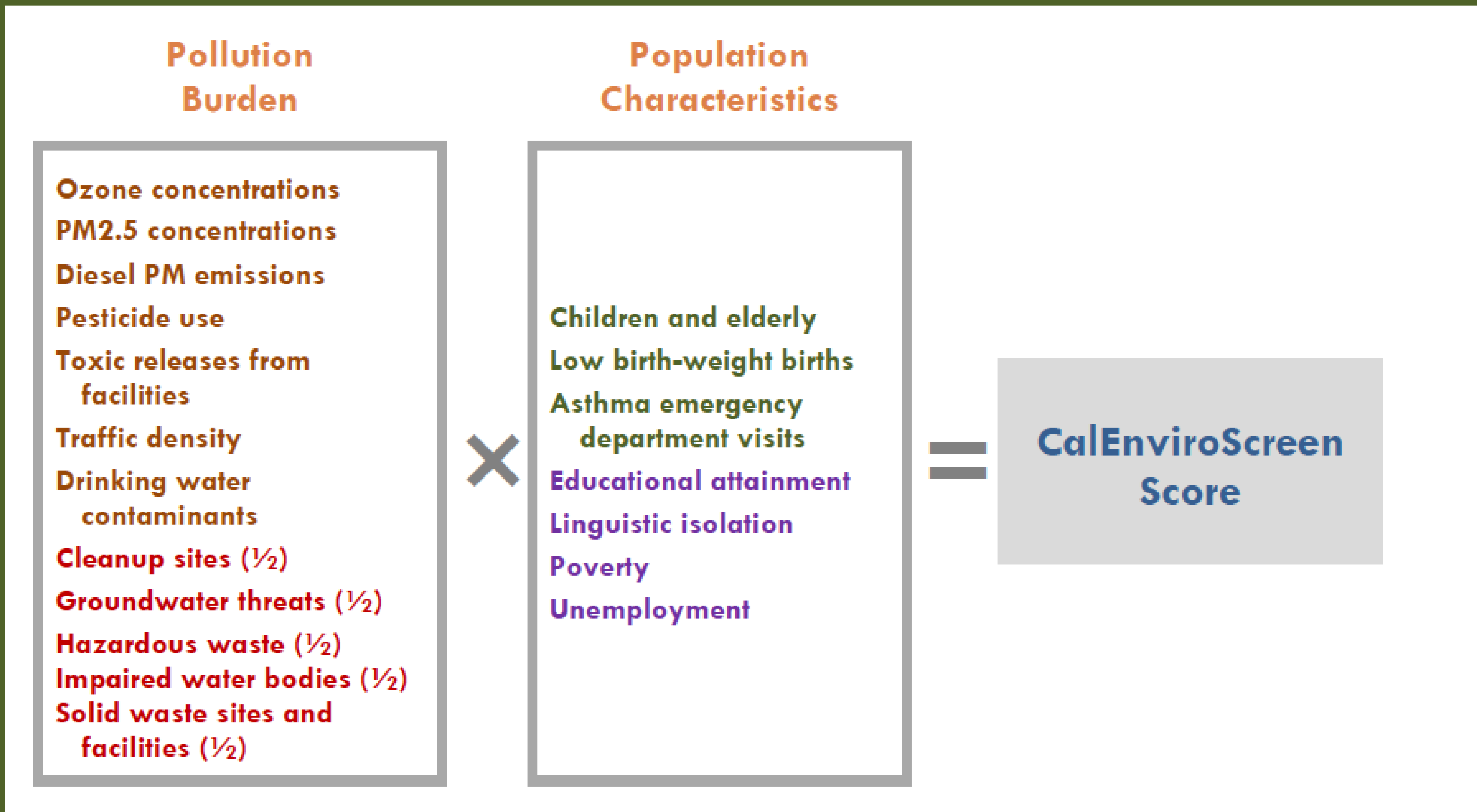
Plumas Energy Efficiency and Renewables Management Implementation Program

Joint Agency Symposium on Climate Goals and Natural Working Lands
August 5, 2015

Sierra Institute for Community and Environment

Jonathan Kusel, Ph.D.

CalEnviroScreen Formula



Aligning forest stewardship and rural economic development

THE WATERSHED CENTER
HAYFORK, CALIFORNIA

Nick Goulette, The Watershed Center - Hayfork, CA

From watershed to woodshop

- Forest stewardship
  - Harvesting, restoration, forestry services, fire management
- Wood utilization
  - Traditional commodities, energy, value-added products

Elegant solutions - fraught with challenges

- Forest stewardship
  - Race to the bottom contracting
  - Reliant on federal subsidy
  - Ancillary benefits not well-monetized
  - Low job quality - seasonality and security
  - Need for workforce training
- Wood utilization
  - Aligning land management and business ops
  - Achieving economies of scale
  - Tight margins
  - High risk
  - Project development requires public subsidy

Statewide opportunities

Communities awarded SWET funds

Community	Organization
Mendocino County - 3 sites	Mendocino Woody Biomass Utilization Group
City of Portola, Plumas County	Sierra Institute for Community and Environment
Camptonville, Yuba County	Camptonville Community Partnership
Burney, Modoc County	Pit River Tribe
Mooretown, Butte County	Mooretown Rancheria, LLC
Weaverville, Trinity County	The Watershed Center
Redway, Humboldt County	Gyppo Ale Mill
Auberry, Fresno County	YSRCDC
Wilseyville, Calaveras County	CHIPS
Beiber, Lassen County	Pit River RCD
Mariposa, Mariposa County	Mariposa Biomass Project
MacArthur, Shasta County	Fall River Resource Conservation District
North Fork, Madera County	North Fork Community Development Council
Yosemite Village, Madera County	Yosemite National Park
Almquist Lumber, Humboldt County	Greenway Partners, Inc
Groveland, Tuolumne County	Tuolumne River Trust

Tule Creek Forest Products

Many thanks!

THE WATERSHED CENTER
HAYFORK, CALIFORNIA

- Contact me:

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530-628-4206
www.thewatershedcenter.com
PO Box 356
Hayfork, CA 96041

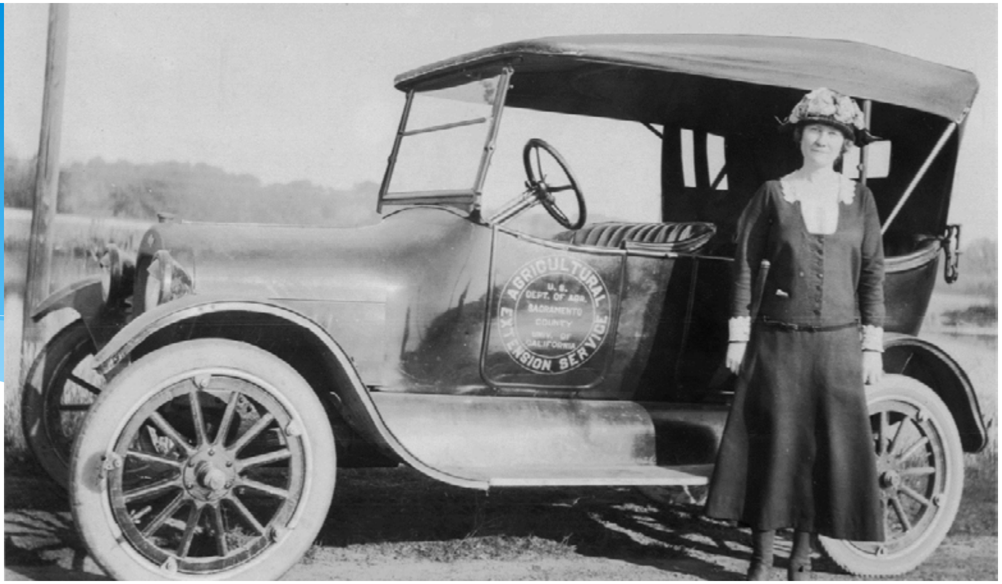
Climate Goals and Natural and Working Lands

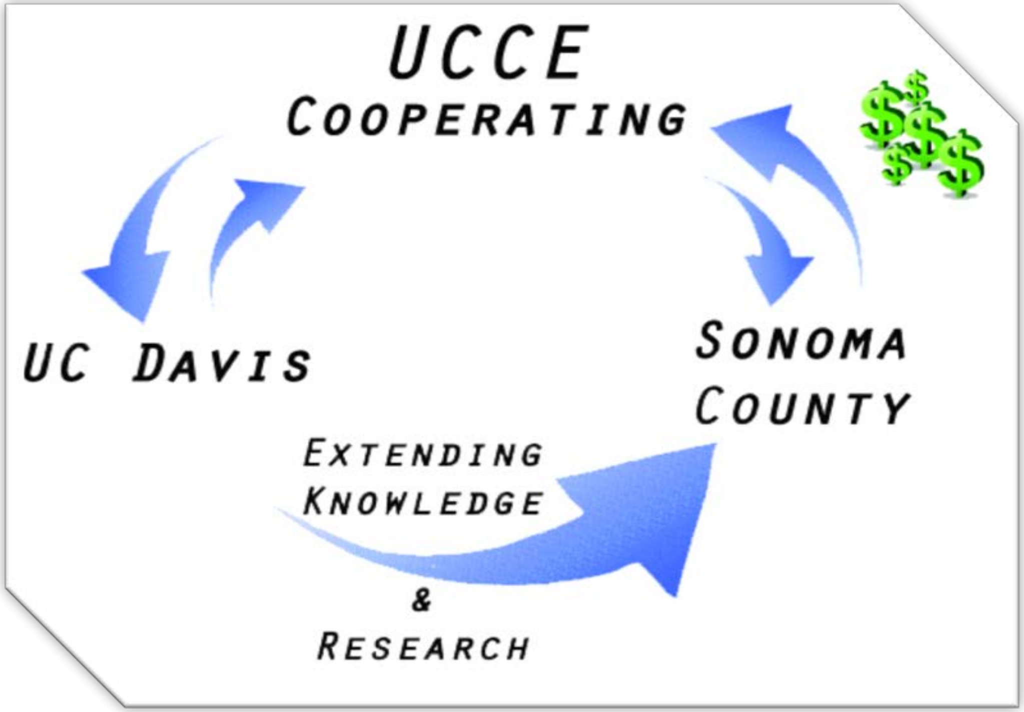
Scaling up & Out

Dr. Stephanie Larson
UC Cooperative Extension
Sonoma & Marin Counties

Cooperative Extension was signed into law in 1914, Smith-Lever Act. It came to Sonoma County in 1918.

Its original intent was to provide an extension of the land grant universities to farmers and home makers.





UC Cooperative Extension academic staff is at the forefront of change

Work to preserve agriculture, helping communities shape wise public policy, and strengthening community development and leadership in our youth and adults

UC Cooperative Extension:
Researchers and educators working with local communities to solve economic, agricultural, natural resource, youth development, and nutrition issues.

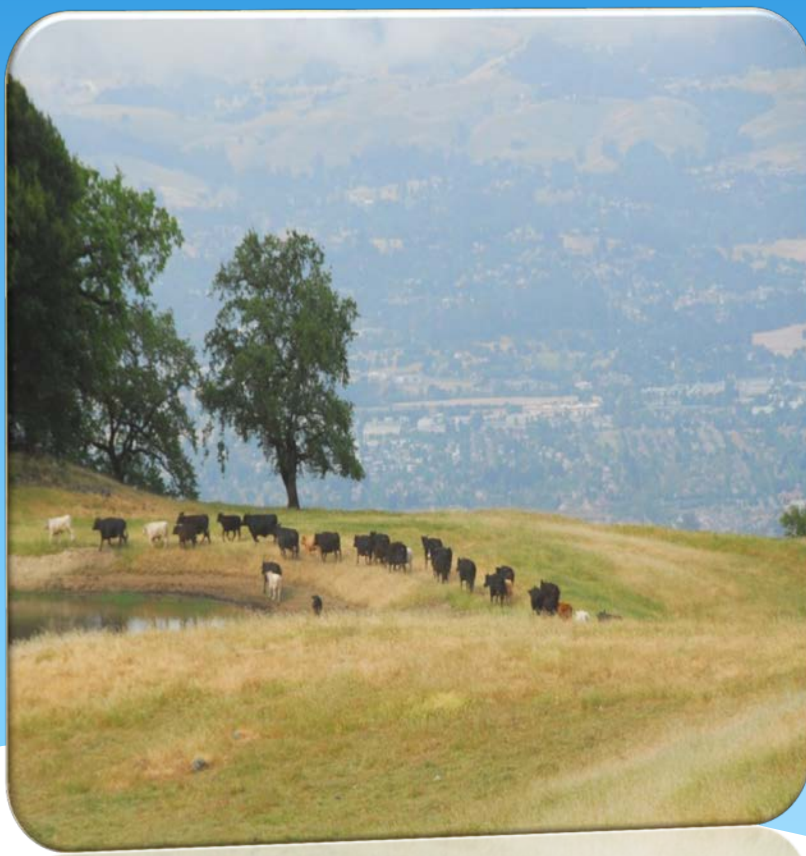
Working Landscapes

Broad term that expresses the goal of fostering landscapes where production of market goods and ecosystem services is mutually reinforcing.

Idea of people working as partners to create landscapes and ecosystems that benefit humanity and the planet.

UC
CE

Ecosystem Services



Rangelands:

Largest land mass in California

Capture water,

Sequester carbon,

Provide biodiversity & habitat,

Produce food,

Recreation,

Grazing to reduce fire hazard,

Cultural & heritage aspects,

Viewshed

Education
Sharing Open Space: What to Expect from Grazing Livestock

Cows & People Coexisting in regional and state parks

Educational materials developed for general public, park personnel and ranchers; to address benefits of using grazing animals as tools to address climate change & ecosystem services

Improved grazing systems, animal distribution and cultural attributes; facilitate practices to advance climate change objectives

SHARE EMAIL PRIN

Ecosystem Categories

Biodiversity
Water
Soil Carbon
Fire Fuel Management
Forage
Culture

Additional Related Topics

Payment for Ecosystem Services
Government Programs
Market and Trade Schemes
Mitigation Banks
General
Valuation Tools

Welcome

California Rangelands provide a multitude of ecosystem services that benefit virtually every Californian. This site includes research and information about these ecosystem services. Click on a category or topic of interest to view a list of articles and websites related to your interest.

Ecosystem services are the functions performed by ecosystems that lead to desirable environmental outcomes. Many are familiar with the economic value that rangelands provide - especially grazing opportunities for livestock. However rangelands, that make up 40% of California's land mass, provide so much more. California rangelands provide benefits to the landowner and to all life forms living or passing through that land.

The benefit of well maintained ecosystem services can be as small as neighbors that benefit from an open viewscape to vast populations benefiting from clean water to worldwide benefits of clean air and carbon sequestration.

This web site provides links to research, websites and projects, addressing the four Categories of Ecosystem Services: Provisioning, Regulating, Supporting and Cultural (Millennium Ecosystem Assessment, 2005).

A Decision Support Matrices addresses specific ecosystem services, based on a compilation of research papers and other documentation categorized, to assist land owners/managers and conservation specialists in directing management decisions to enhance ecosystem services on rangelands.

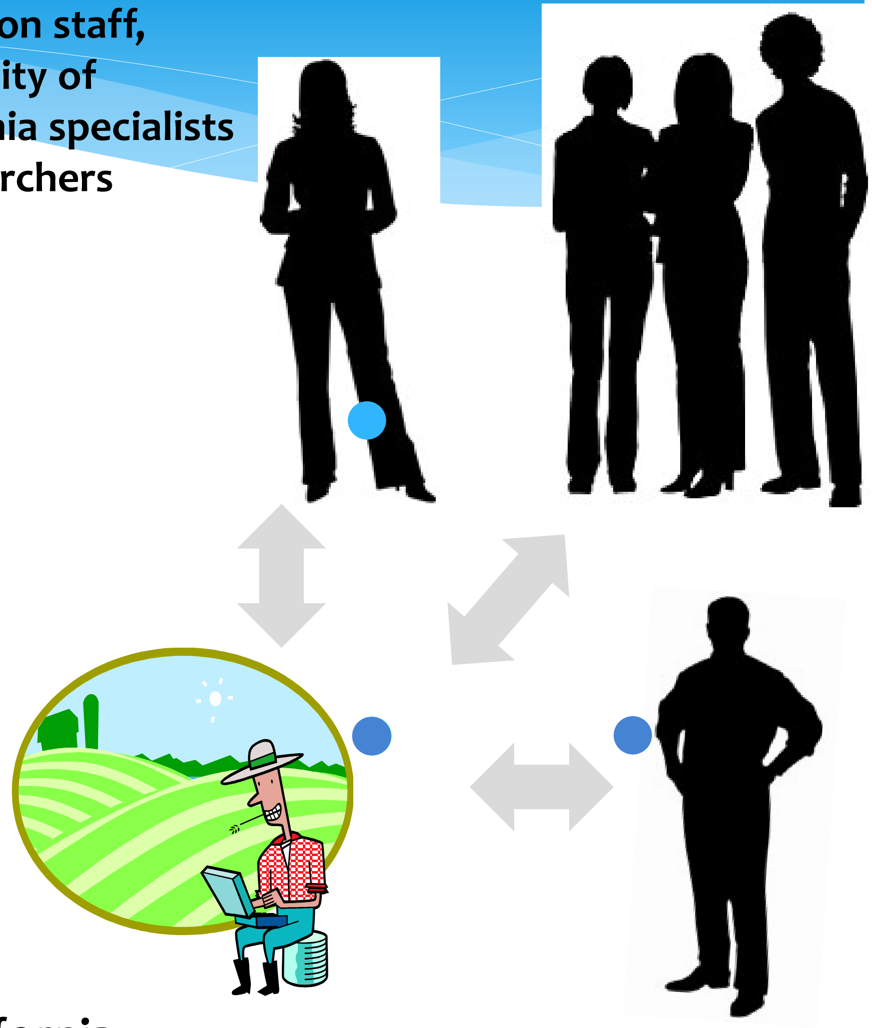
Photo by Sheila Barry

Collaboration

With multiple individuals, agencies, business, government, NGOs, etc.

It's about building partnerships for today and beyond With multiple individuals, agencies, business, government, NGOs, etc.

UC Cooperative Extension is viewed as a leader in educational and research based information



Collaborative Efforts

Connecting landowners with research, education and funding sources

Grazing Systems
Erosion Control
Water Quality/Quantity
Niche Marketing/Food Production
Desired Species/Native/Pollinators
Brush Removal / Reduced Fire Hazards

What is needed – Next Steps

Ecosystem Services Plan

Ecosystem Service Checklist

Scoring system based on carbon sequestration, GHG reduction, etc.

Site specific / Appropriateness

Use Millennial technology but reframe for landowners:

Economics of their operation

Publicly recognized

Validation / Accreditation

Non Production (Non Ecosystem Services) Efforts

Recognize other Landowner Benefits:

Provide security,

Maintain and improve property infrastructure,

Enhance wildlife habitat (reducing fragmentation),

Conduct weed and pest abatement

Maintain economic viability in rural communities

These benefits lead to reaching climate change goals on both public and private lands

Landowner Participation in the Process

Need to change the paradigm

Not regulatory – but Adaptive Management

Economic incentives

UCCE has lead successfully efforts – we can lead them again

UC CE

University of California
Agriculture and Natural Resources

Cooperative Extension

THANK YOU

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UCCE Sonoma

@UCCESonoma

UCCESonoma


Loren and Al Poncia
Stemple Creek Ranch
http://www.carboncycle.org/
draft-carbon-farm-plan/

See USDA-Natural Resources Conservation Service GHG and Carbon Sequestration Ranking Tool for a list of practices

Carbon Sequestration with Compost Application and Windbreaks


Climate Adaptation with Riparian Enhancement
New Fence completed
More Climate Smart
riparian needed

Greenhouse Gas Reduction with a Methane Digester

Rolling out the Carbon Farming Program

1. Marin Carbon Project: NRCS, UCCE, RCD, MALT, MO, CCI, UCB
2. Involved Farmers and Ranchers in the research trails
   - Meaningful Practices
   - Return the Science
3. Selection Criteria and Landowner Application Form
4. Supported applicants with individual site visits
5. Ranking by committee
6. Support Implementation of Plans: Planning, Permitting, Engineering, Construction, Maintenance and Monitoring

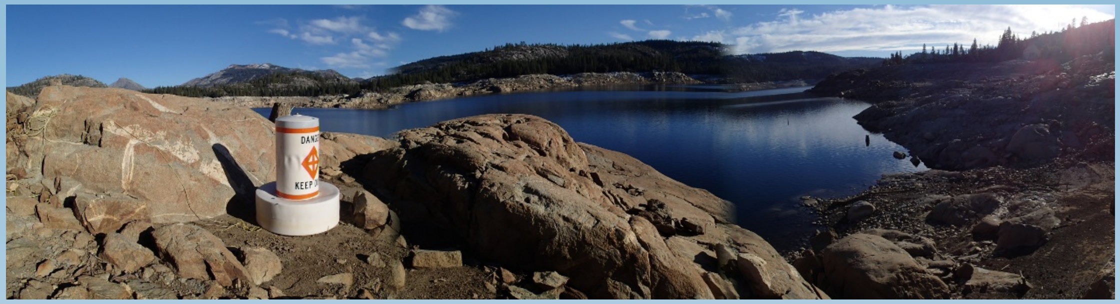
Jim Branham, Executive Officer
Sierra Nevada Conservancy

Jerry Bird, Regional Forester's Representative
US Forest Service

California's Primary Watershed

The Sierra Nevada Region:

- Is the origin of more than 60% of California's developed water supply. Headwaters of the State Water Project and federal CVP
- Is the primary source of fresh water flowing into the Sacramento-San Joaquin Delta
- Is a major urban water source
  - San Francisco → 85% from Tuolumne watershed
  - East Bay → 90% from Mokelumne Watershed



Lake Spaulding, headwaters of the Yuba River, January 2014

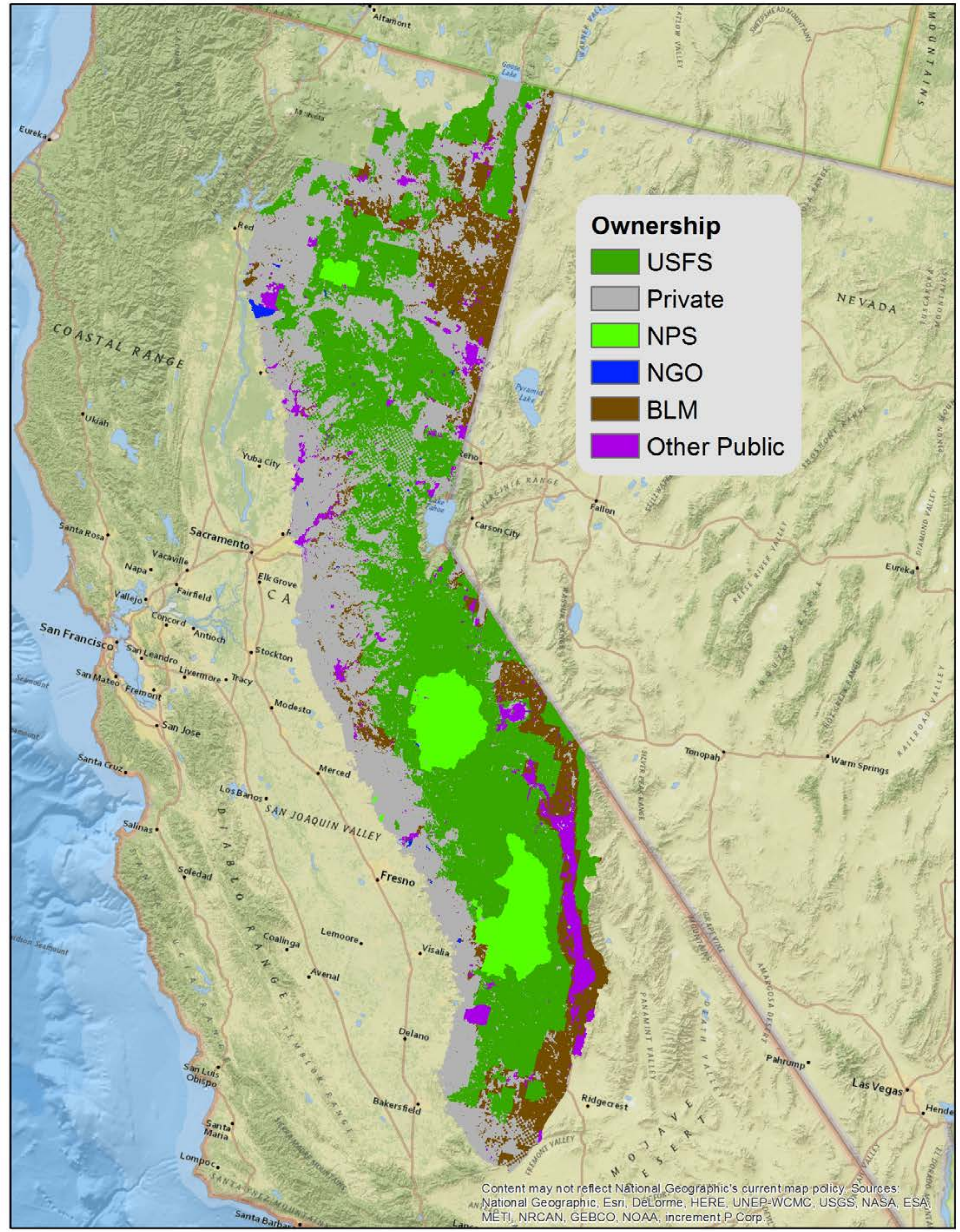
Lake Oroville (fed by the Feather River), May 2014

Many Other Benefits As Well

- ✓ Sierra forests play a key role in storing carbon, assisting in the State's effort to combat climate change
- ✓ Sierra watersheds provide habitat of dozens of species, including those listed and proposed for listing under state and federal ESA

- ✓ The Sierra Nevada provides world class recreation and tourism opportunities
- ✓ Sierra forests and watersheds produce energy, wood products and a variety of ecosystem services

Land Ownership in the region makes large landscape efforts challenging and necessary



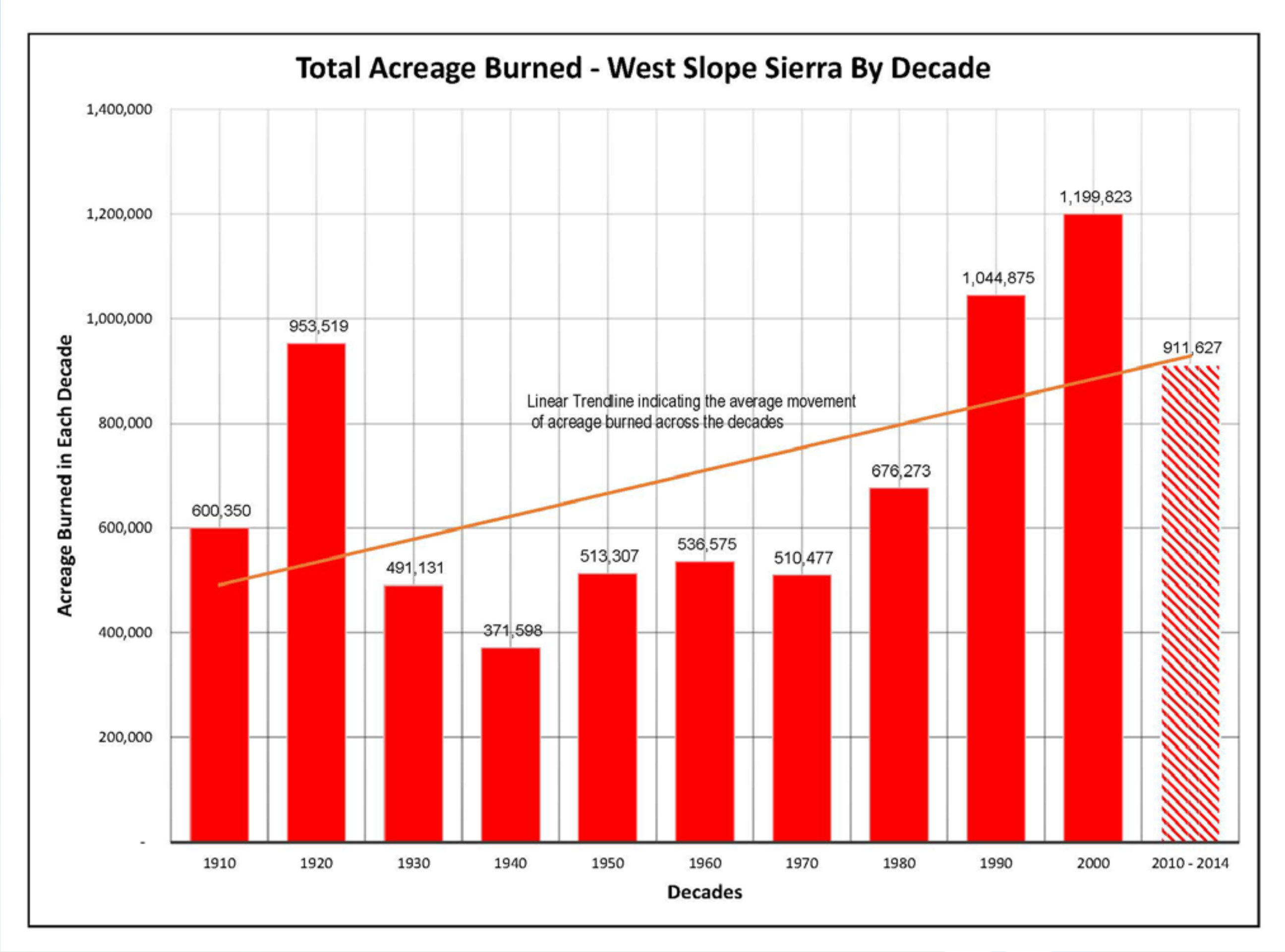
Many Sierra Nevada forests are unhealthy and susceptible to disease and intense fire

Photo: *U.S. Forest Service*

- Megafires like the Rim and King fires may have become the new normal. They are larger and more intense than historical fires.
- The USFS Region 5 estimates that **6 to 9 million acres** of the land they are responsible for managing in California **are in need of restoration**.
- The high cost of fighting fires has often resulted in reducing funds available for critically needed restoration efforts on federal lands.

Wildfire Threat Is Increasing

Wildfires in California have become larger and more extreme over the last two decades and many predict that this trend will continue to increase, unless we change course.



- **More land has burned in the first five years of this decade** than seven entire decades in the past.
- **More acres burned in the two decades of 1990 and 2000** than any other previously recorded decade.
- **Fire Intensity is increasing**, from an average of about 20% high intensity to nearly 30%.

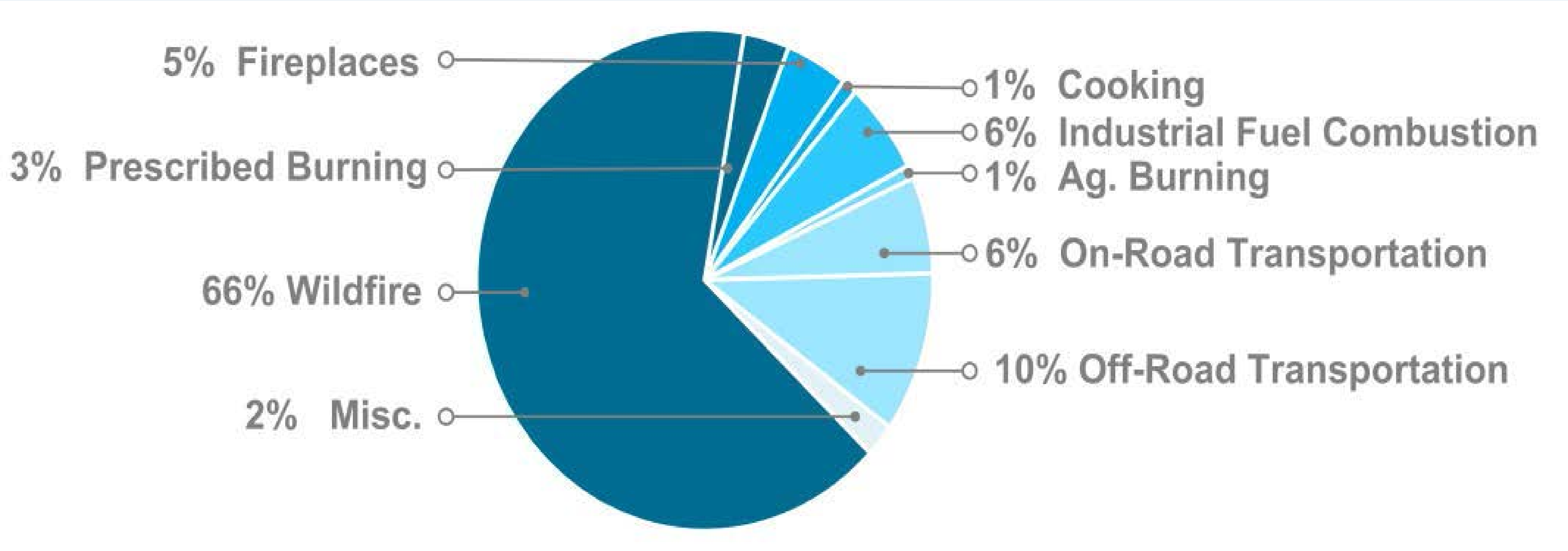
Increased Greenhouse Gas Emissions

- Stand replacing fires that convert conifer to brush result in about a **90% reduction in carbon storage**.
- Research shows that **only 6% of large trees survived large fire events in untreated stands, compared to 87% survivorship of large trees** within the treated stands.
- One megafire can undo the carbon storage benefits these forests provide in a short period of time. For example, the **Rim Fire released greenhouse gas emissions in a few weeks equal to what 2.3 million vehicles would release in a year**.
- High intensity fires such as Rim and King will continue to emit GHGs for decades, **resulting in emissions more than 4 times greater than those during the event.**

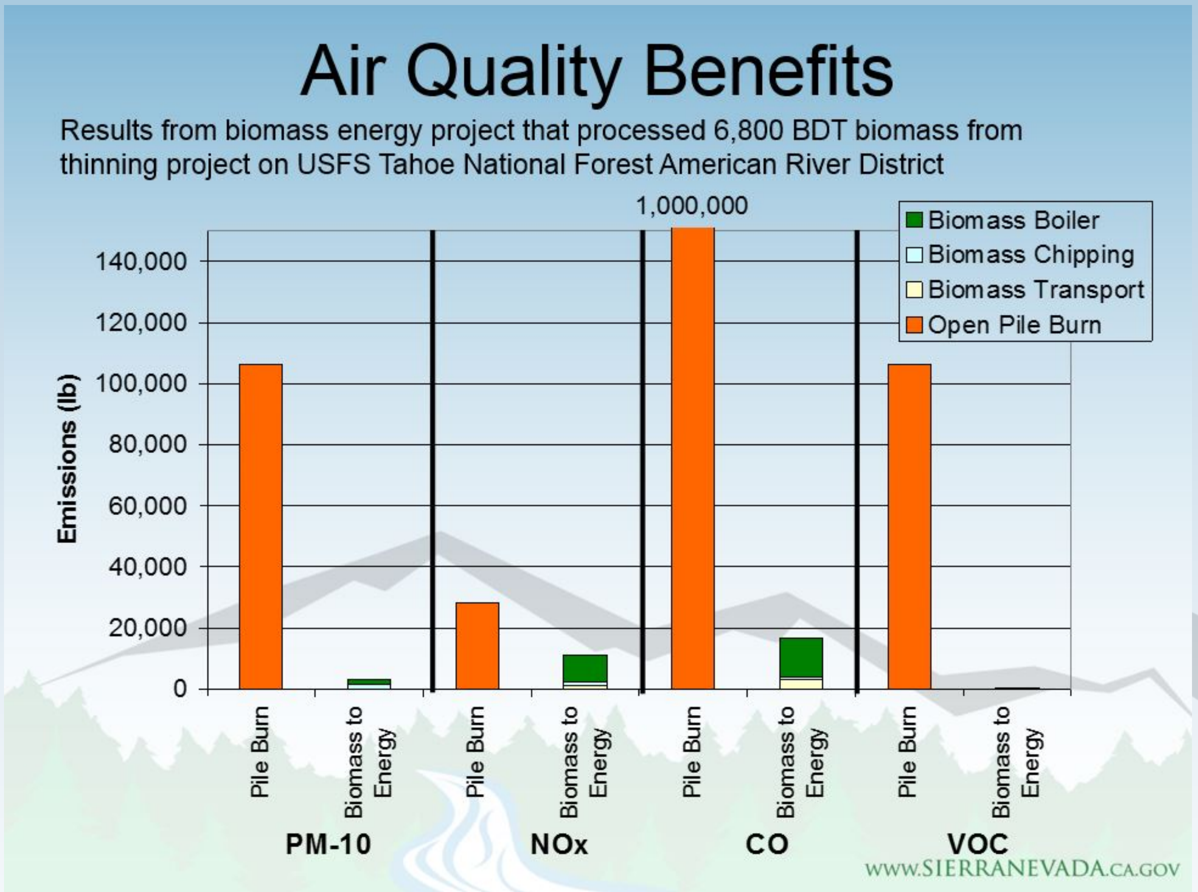
Photo: Rim Fire smoke plume, *Ron West*

Air Quality Impacts

- Large intense wildfires produce massive amounts of particulate matter pollution, creating health hazards for humans.
- Wildfires are overwhelmingly the greatest contributors to black carbon, a major contributor to global warming.



Potential for Improving AQ and Reducing GHG Emissions



It is estimated that about 500,000 acres of annual restoration treatments on USFS lands would restore the health of the forests and help keep pace with future forest growth. Converting biomass from forest restoration efforts into energy rather than piling and burning it **reduces greenhouse gas emissions by over 30%**.

Sierra Nevada Watershed Improvement Program

- Organized and led by SNC and USFS Region 5
  - Broad support and engagement from other state, local and federal agencies and stakeholders
- Primary goal of identifying restoration needs across the Sierra, increasing investment and addressing policy issues.

Watershed Restoration Investment

Examples of Opportunities for Investment

State of CA

- ❖ Proposition 1
- ❖ Greenhouse Gas Reduction Fund

Federal

- ❖ Wildfire Disaster Funding
- ❖ Collaborative Forest Landscape Restoration Act

Beneficiaries

- ❖ Cost Share programs, such as Denver CO
- ❖ Coca-Cola Investment in Meadow Restoration

Policy Issues

Examples of Policy Issues Affecting the Pace and Scale of Watershed Restoration

- ❖ Expanding the Use of Prescribed and Managed Fire (Air Quality regulatory process)
- ❖ Improving the efficiency of CEQA/NEPA process
- ❖ Promoting the use of biomass resulting from restoration activities for energy and other products

CA Headwaters Partnership

One of seven regions named Resilient Lands and Waters

- ❖ Not a formal designation, but shines a spotlight on existing collaboratives within California
- ❖ CHP is only RLW region with state-federal co-leads
  - ❖ Use WIP as foundational analysis to inform effort
  - ❖ Knit together existing efforts; share lessons learned
- ❖ Resilient Lands and Waters objectives
  - ❖ Map initial priority areas for conservation, restoration, or other investments
  - ❖ Build resilience, enhance carbon storage capacity
  - ❖ Develop landscape-scale strategies to assist in advance planning and management activities

A Bold New Approach

- **Sierra Nevada Watershed Improvement Program builds on the significant consensus that exists to restore our watersheds and forests to ecological health**
- **Conflict has been increasingly replaced by collaboration**
- **Now is the time**

Learn more at
www.sierranevada.ca.gov
www.fs.usda.gov/r5

"Only an environmental restoration program of unprecedented scale can alter the direction of current trends…" USFS