WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP
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Terrestrial Sequestration Options for the West Coast Region

Reforestation, Forest Management and Reducing Emissions from Uncharacteristically Severe Wild Fires

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Phase II Terrestrial Sequestration Overview

- Objectives
- Shasta County Pilot
  - Reforestation – about 550,000 acres of rangeland in Shasta County appear to have potential
  - Fuel treatments to reduce uncharacteristically severe fires – more than 850,000 acres of forest land in Shasta County could benefit
  - Conservation management on timberlands
- Lake County Pilot
  - Fuel treatments to reduce uncharacteristically severe fires
  - Assess sequestration potential for hybrid poplars
- Potential for Linkage with Geologic Sequestration

Phase II Objectives: Terrestrial Sequestration

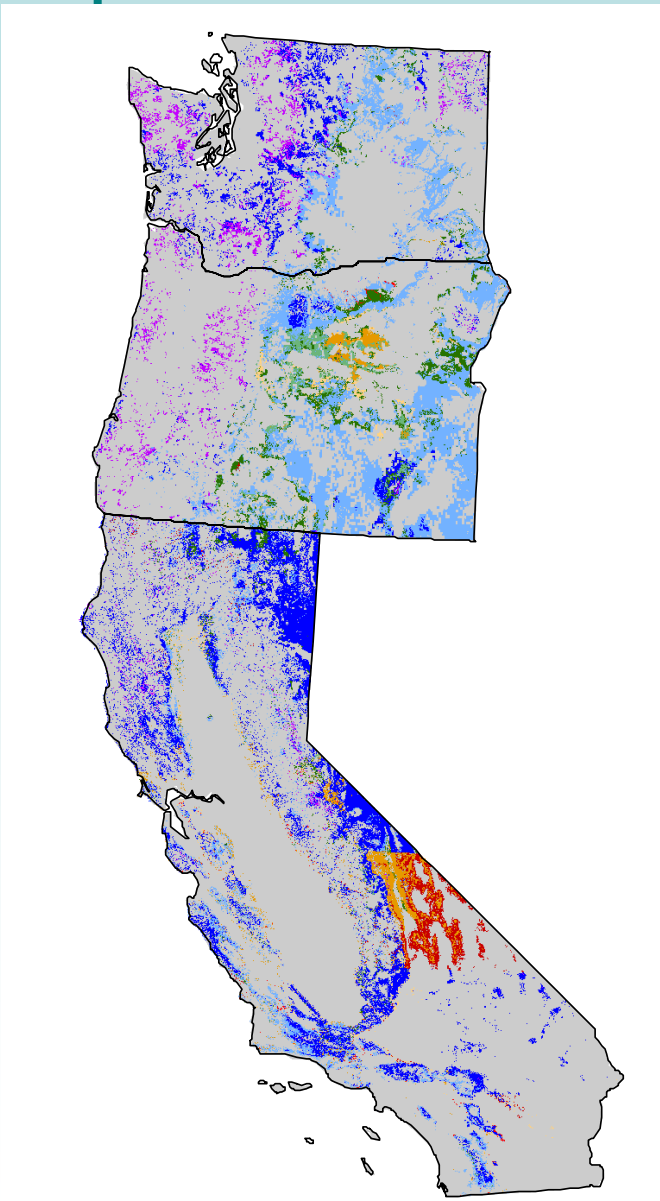
- Validate reforestation potential for rangelands
- Develop and implement methodology for determining credits for reducing emissions from uncharacteristically severe fires
- Implement project to reduce emissions through conservation and sustainable management of forest lands

Shasta County Partners

- Western Shasta RCD
- WM Beaty and Associates
- Pacific Forest Trust
- Wheelabrator Shasta
- California Climate Action Registry
- Climate Trust
- California Department of Forestry and Fire Protection
- California Energy Commission
- California Forest Products Commission
- US Forest Service
  - Pacific Southwest Research Station
  - Pacific Northwest Research Station (Pacific Wildland Fire Sciences Laboratory, FERA)
  - Shasta Trinity National Forest
- National Park Service
  - Whiskeytown National Recreation Area
  - Lassen Volcanic National Park
- Bureau of Land Management
- Pacific Gas & Electric
- Bascom Pacific LLC

Lake County Partners

- Lake County Resources Initiative
- Oregon Department of Forestry
- Oregon State University
- Greenwood Resources
- California Climate Action Registry
- Climate Trust
- Oregon Forest Resources Institute
- Collins Company
- Jeld-Wen Timber and Ranch
- US Forest Service, Fremont National Forest
- Bureau of Land Management



Carbon Sequestration on Suitable Rangelands after 40 Years

	Rangelands (million acres)	Suitable Rangelands (million acres)	Total t CO_2 <$20/t CO_2 (million metric tons)
California	59.3	21.9 (37%)	3,344
Oregon	26.9	19.1 (71%)	1,419
Washington	11.7	9.1 (78%)	1,218

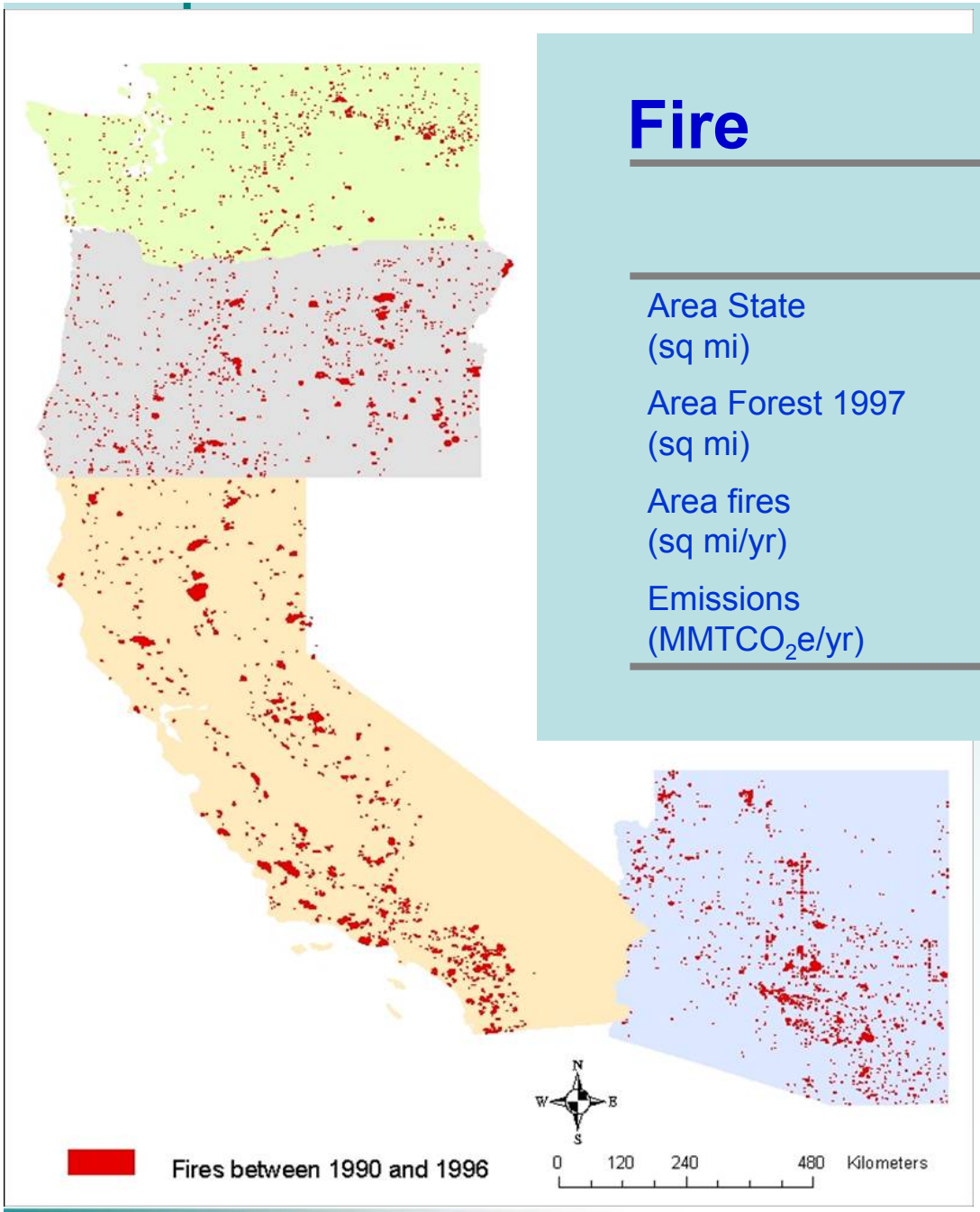
$/Tons C

- < $5.00
- $5.01 - $15.00
- $15.01 - $25.00
- $25.01 - $35.00
- $35.01 - $45.00
- $45.01 - $55.00
- $55.01 - $65.00
- $65.01 - $75.00
- > $75.01

Fire

(1990 – 1996)

	CA	OR	WA	AZ
Area State (sq mi)	163,707	98,386	71,303	114,006
Area Forest 1997 (sq mi)	60,228	46,438	34,208	31,134
Area fires (sq mi/yr)	484	21*	4.6*	24*
Emissions ($MMTCO_2e/yr$)	1.46**	1.03	0.18	0.47



* Fire data is missing for 1994 in Oregon, Washington and Arizona due to satellite failure.

**Analysis from LCMMP dataset in California, 3 regions represent 84 % of total forests in State, 42 % of rangelands.

California Emissions from Biomass Burning

10 year annual average tons/day	Reactive Organic Gases	CO	NOx	SOx	PM10
Agriculture	19.3	216	5.6	0.2	25.6
Range	23.5	309	3.7		45.3
Forest	28.4	720	6		52.1
Wildfire	128.4	2,482	79.4	24.5	253.4
Wood-Fired Boilers	0.37	50	5.1	0.5	1.1

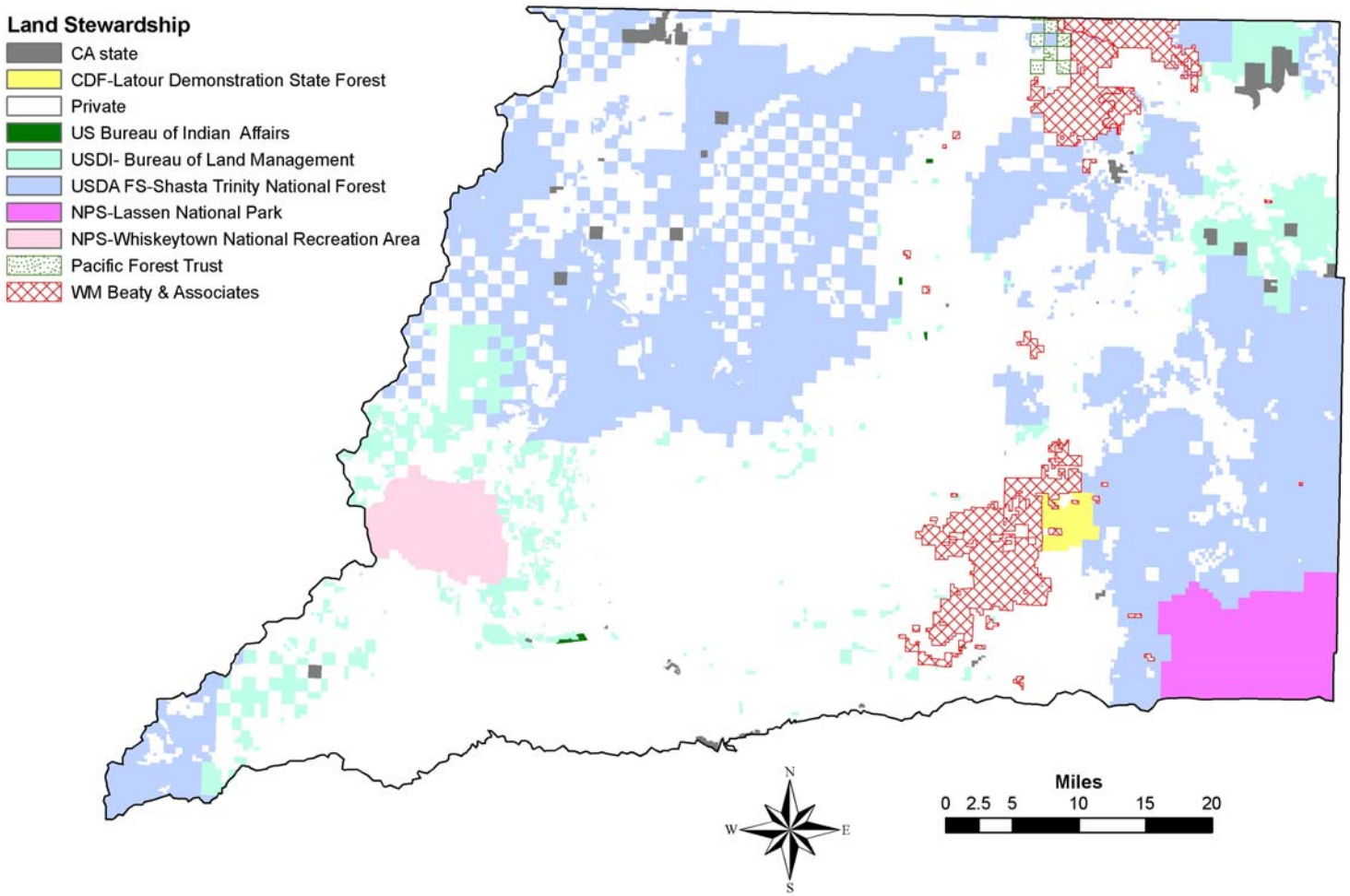
Source – California Air Resources Board Emissions Inventory 2004

Reforestation Sites Differ in Potential for Sequestration

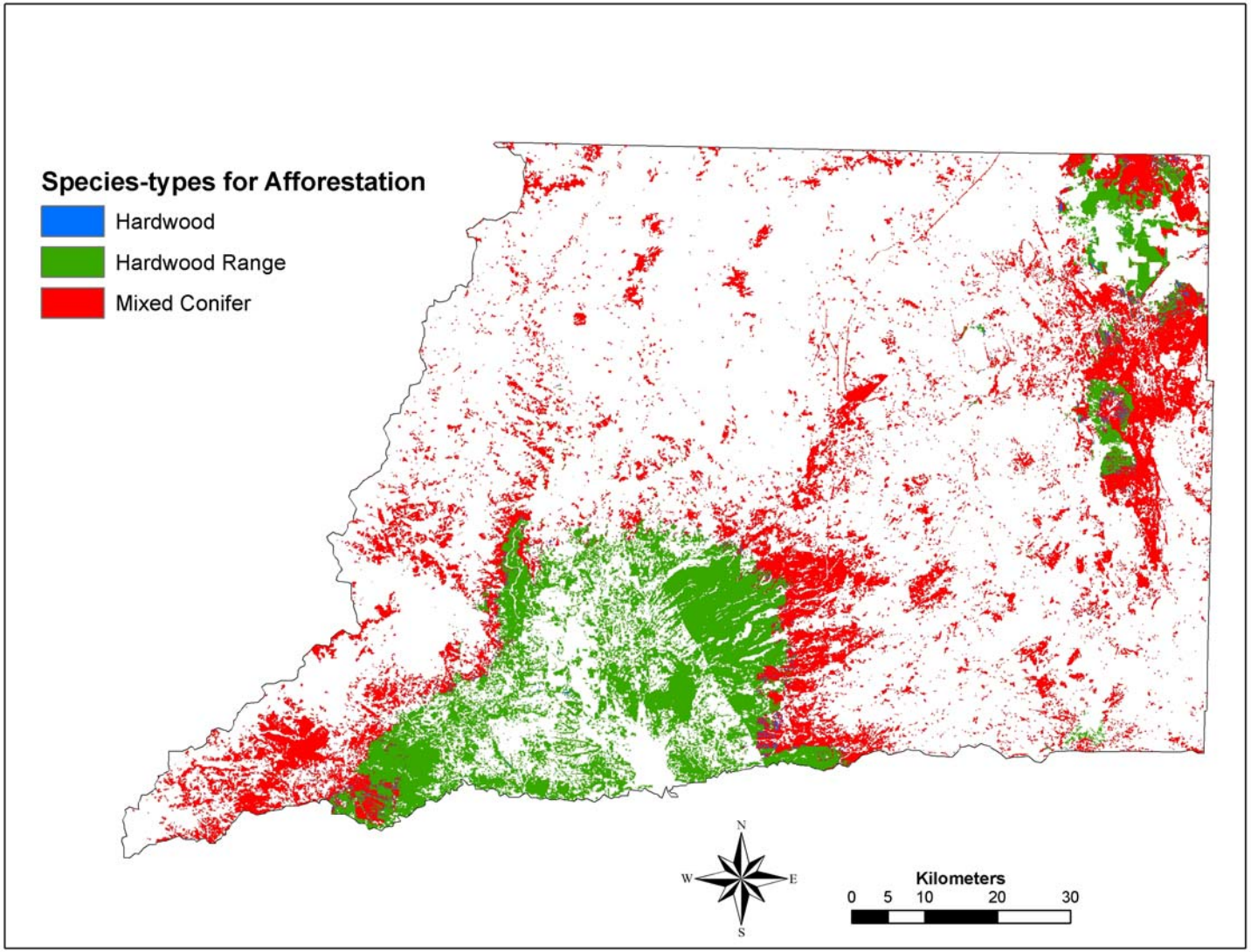
Validate Reforestation Potential of Rangelands

- Classify lands according to potential for reforestation
- Set criteria for distribution of pilot plantings
- Prepare plan for planting
- Convene technical panel to review choices
- Review site history and take initial field measurements (baseline)
- Collect data on establishment and maintenance costs

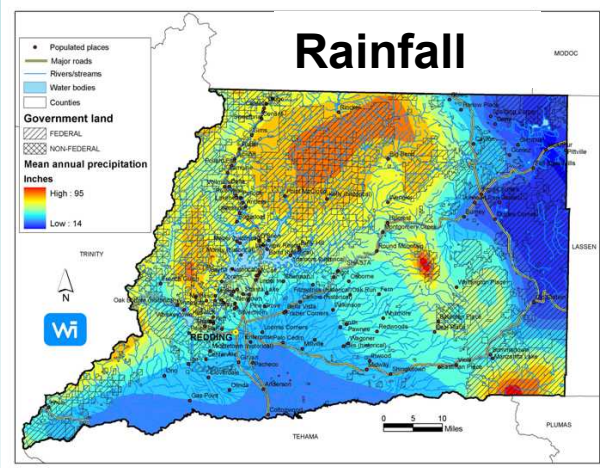
Land Stewardship in Shasta County

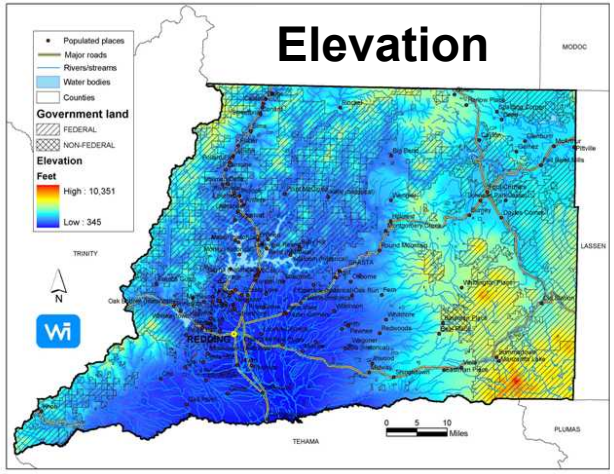


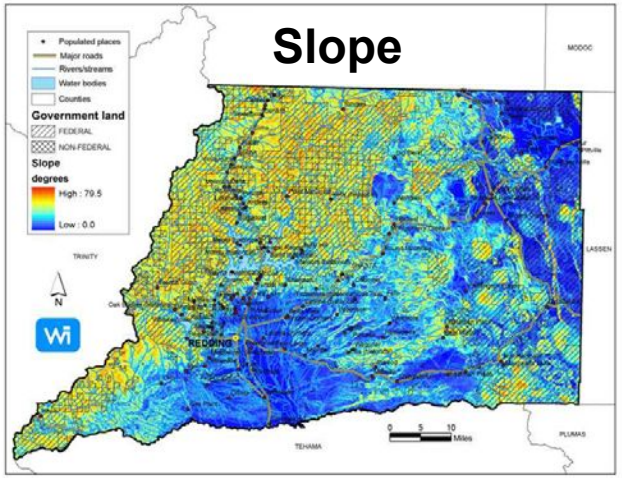
Reforestation by Species

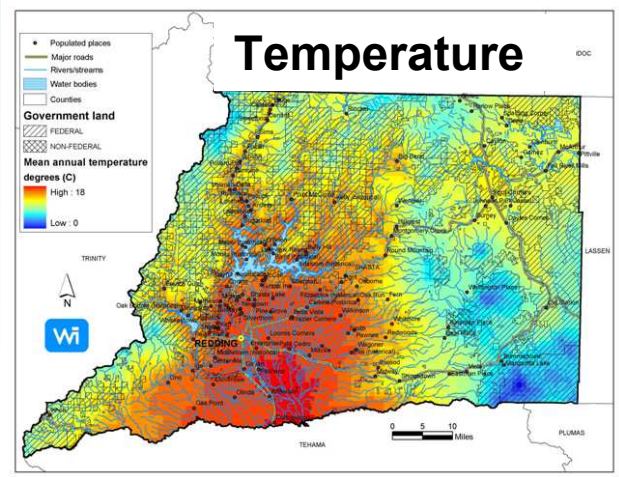


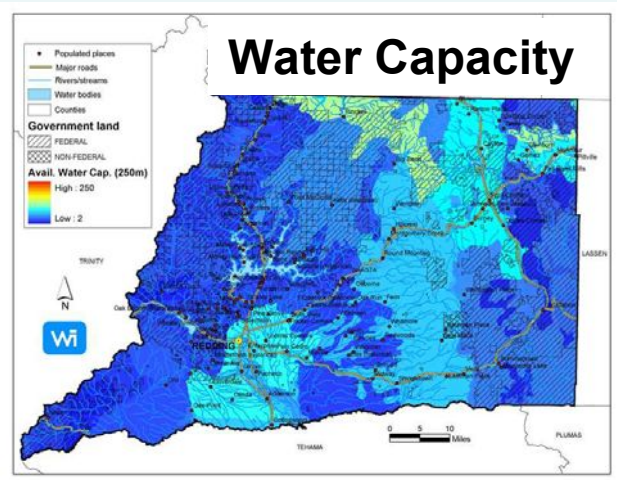
Inputs for Classification



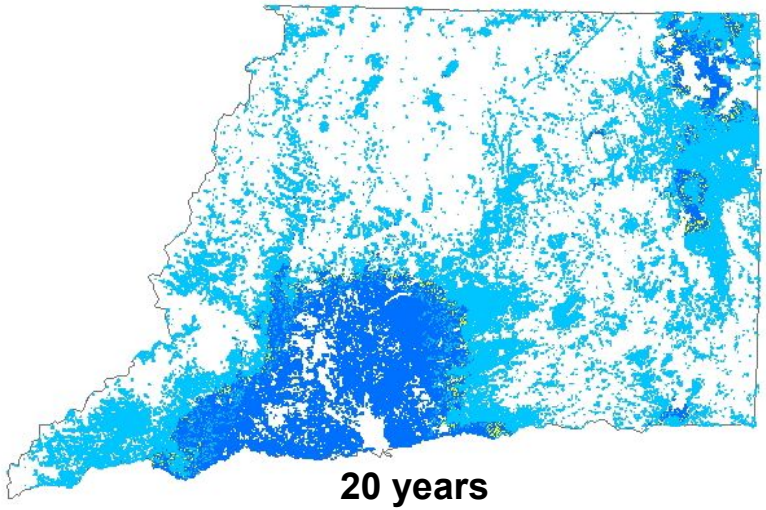


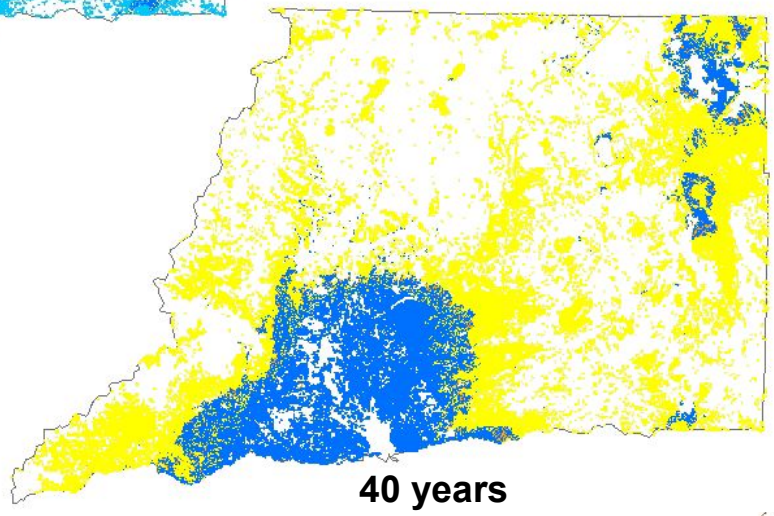


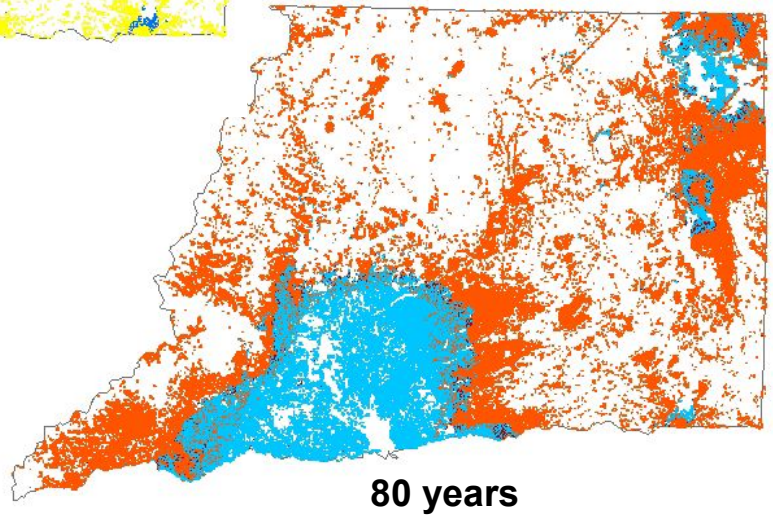




Potential Carbon Sequestration per Hectare from Reforestation



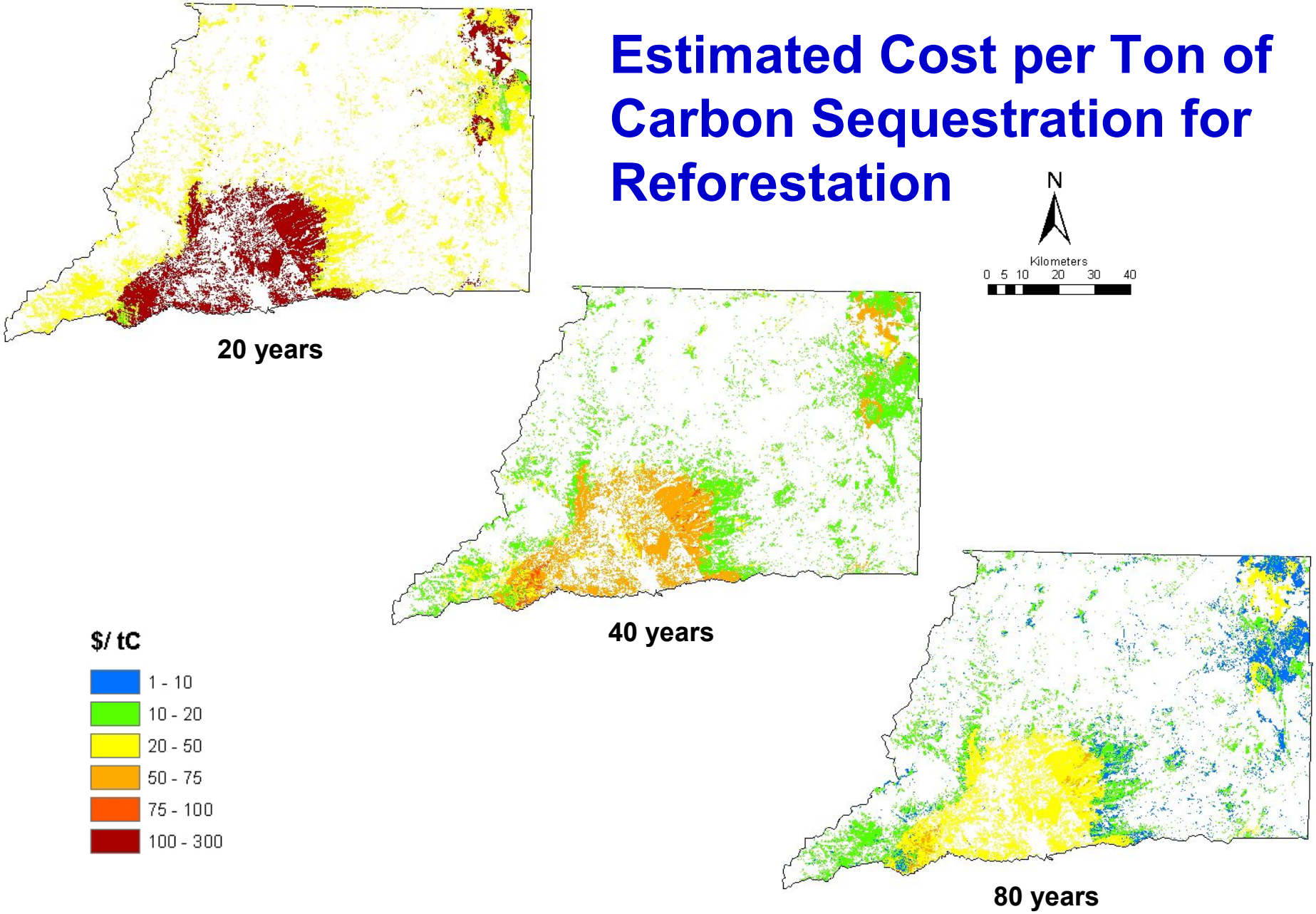




Potential tC/ ha

- 1 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- Non-candidates

Estimated Cost per Ton of Carbon Sequestration for Reforestation



Tree Selection

- Work with private and public partners
- Review science concerning range of expected climate changes in Shasta County
  - Reduced snow pack and change in timing of peak water availability
  - Greater variability in quantity and distribution of rainfall
  - Changes in temperature patterns
  - Changes in pest and disease vectors
- Review native species and assess suitability for afforestation of rangelands
  - Assess establishment and maintenance costs
  - Special attention to dryer sites with variable rainfall
- Convene technical review panel

Additional Characterization Activities

Evaluate sequestration potential for fast-growing species

9 years diameter growth

- ***Douglas Fir*** 4 dry t/acre/yr
  ~50 year rotation
- ***Hybrid Poplar*** 10 dry t/acre/yr
  6-8 year rotation

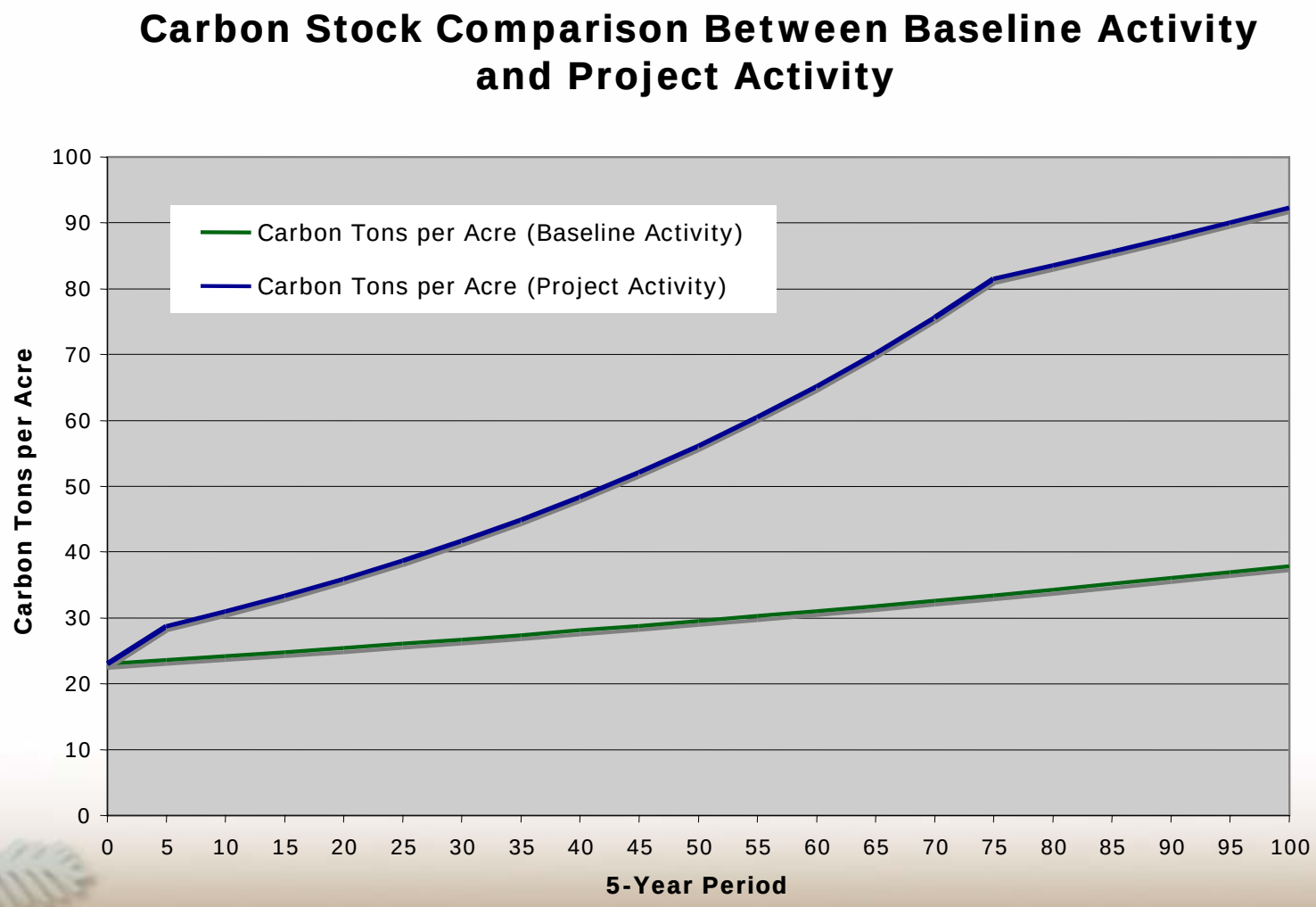
Source: Jon Johnson Associate Professor
Washington State University

Conservation Management

- Harvest 80% of growth until 25 mbf/acre is achieved, then harvest growth.
- Management in watercourse zones focuses on large trees and dense canopies.
- Ensure that all areas capable of sustaining forest vegetation are stocked appropriately.

THE PACIFIC FOREST TRUST

Hypothetical Carbon Gain

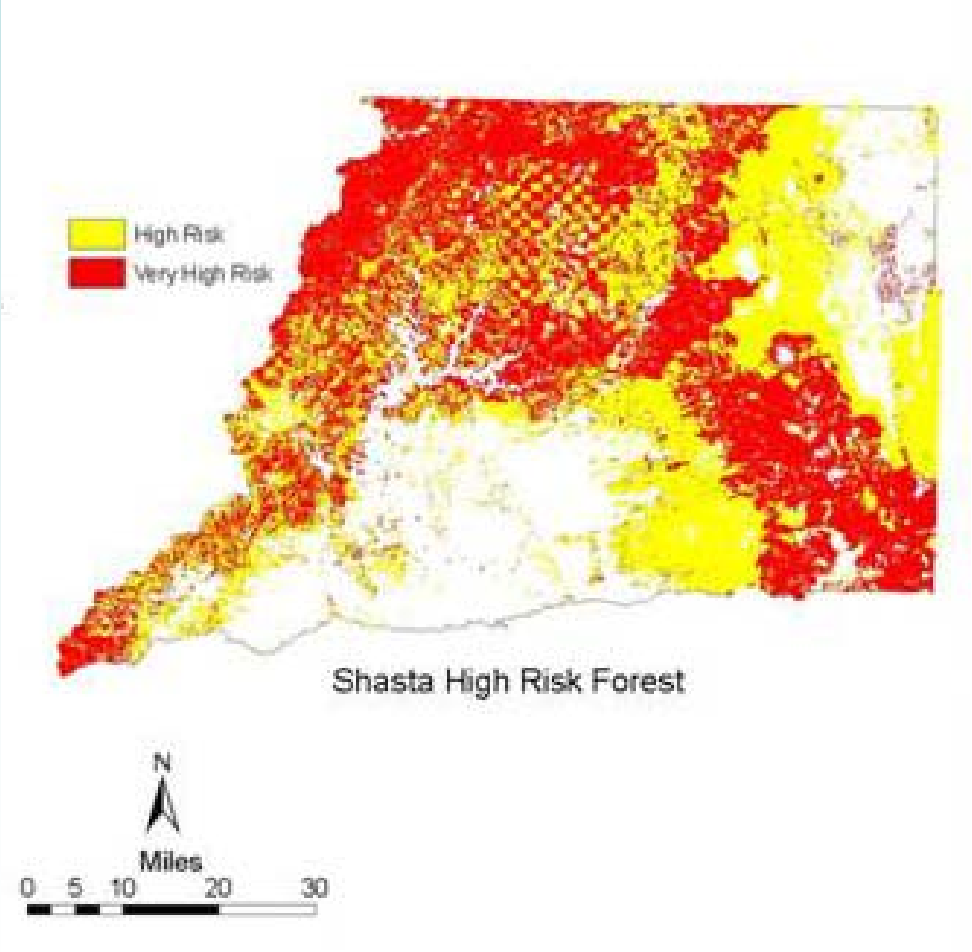


THE PACIFIC FOREST TRUST

Fire Management in Shasta County

Most of Shasta County forests are at high risk for fire and more than half are forest types where reducing fuel loads in the forest should increase terrestrial sequestration

Forest type	Area (acres) Shasta County
Douglas Fir Forest	170,000
Fir-Spruce Forest	80,600
Hardwood Forest	429,400
Other Conifer Forest	877,167
Total	1,557,288



First Challenge—Setting Baseline

2004 French Gulch Fire

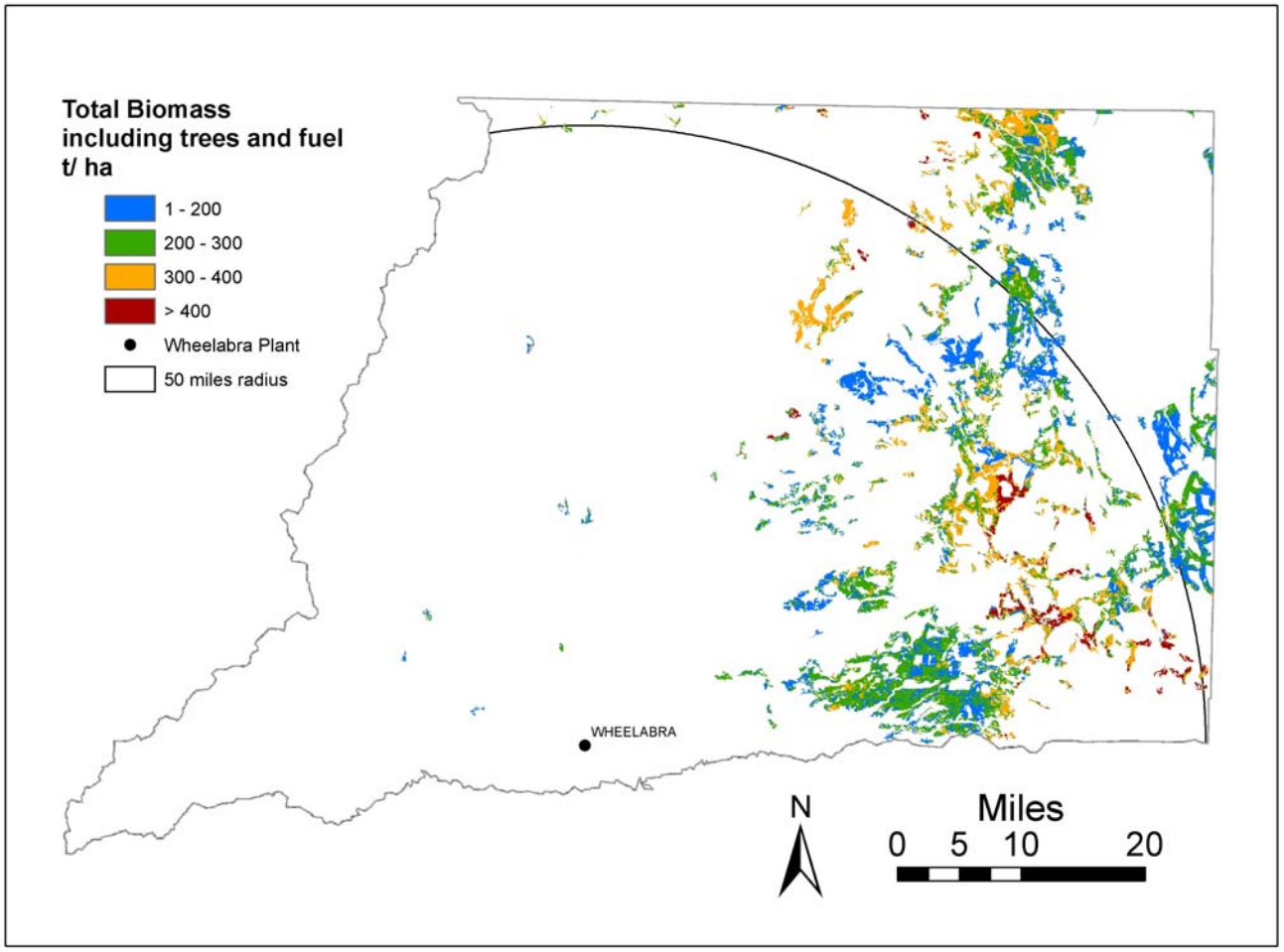
- Assign fire risk and set rules to predict intensity
- Quantify loss of carbon stocks due to fires of different intensities
- Predict fire return intervals
- Determine existing carbon stocks on lands at risk

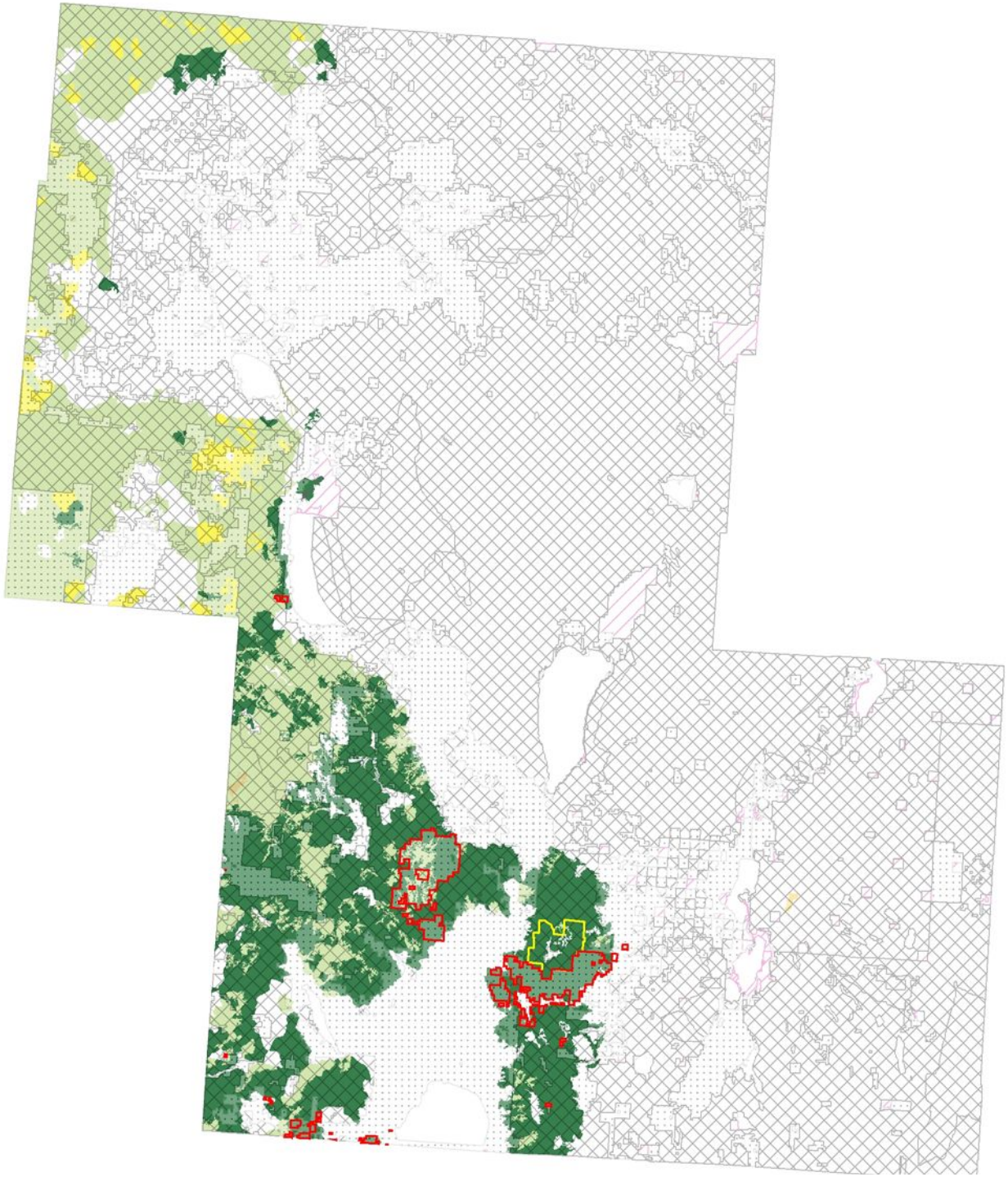
Develop and Test Fire Methodology

- Develop methodology for fire credits from reducing hazardous fuels
- Validate methodology with field data
- Carry out treatments
- Measure carbon stocks and removals
- Collect data on treatment costs
- Transport fuels to Wheelabrator

Identify Suitable Land for Fuel treatments

- Slope
- Distance from road
- Minimum block size





Legend

Stewardship

- Private
- State Government
- US Federal Government
- The Collins Companies
- Fremont/Bull Stewardship Project

Forest Classes

- Lodgepole Pine
- Mesic Deciduous Fore
- Mixed Subalpine Coniferous
- Mixed Xeric Coniferous Forest
- Ponderosa Pine

N
W E
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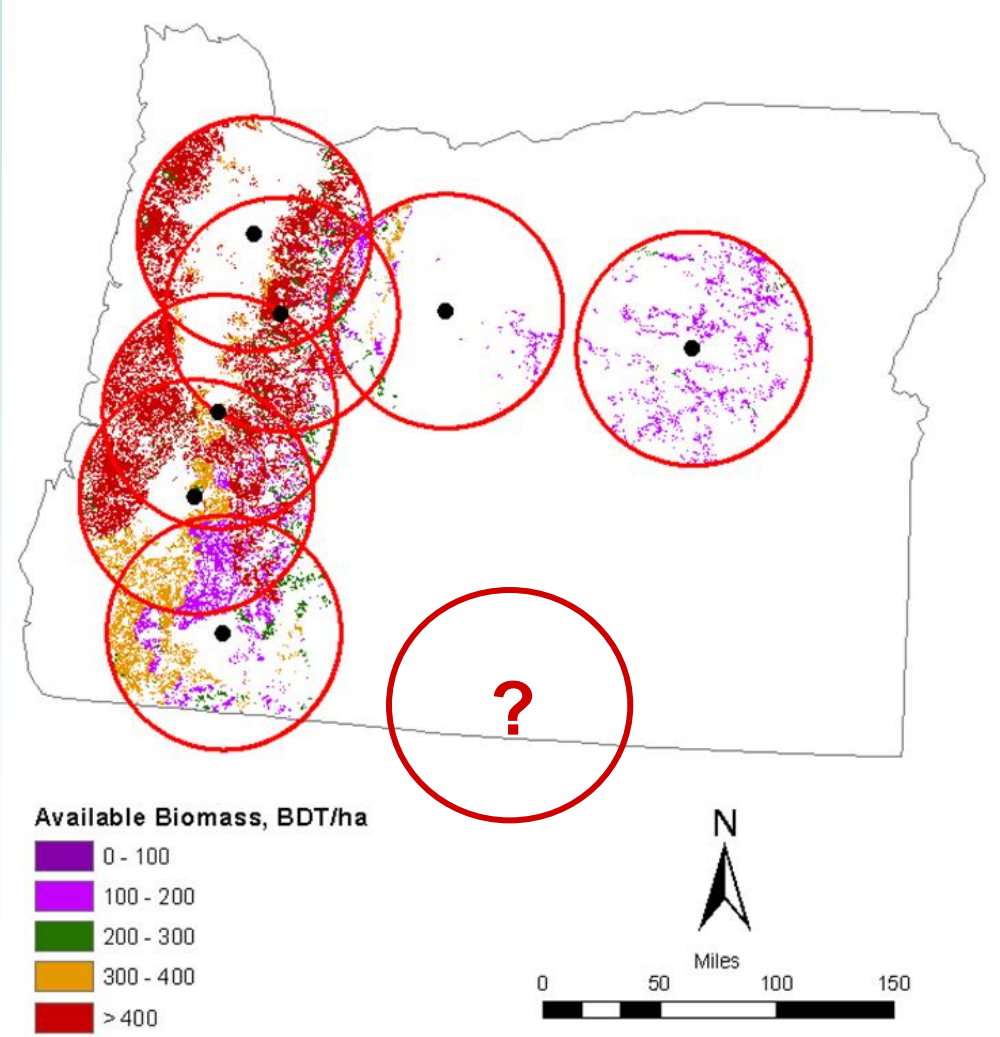
Miles
0 5 10 20 30

Available Biomass Fuels Near Power Plants



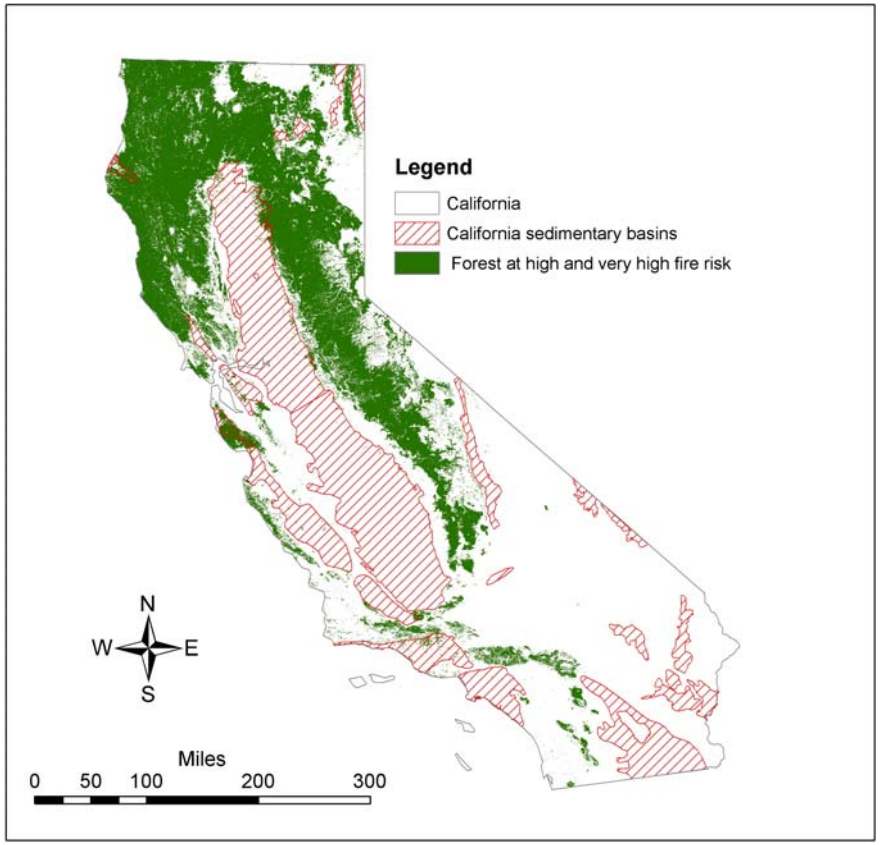
Lake County does not currently have a biomass energy plant. The Oregon Solutions Project is trying to identify sufficient fuel to attract a private investor to build a plant.

Achieve Market Recognition and Validation

- Climate Trust
- California Climate Action Registry

Linking Terrestrial Sequestration with Geologic Sequestration

- Revenues from energy markets can help pay for removal of hazardous fuels from forests at risk of uncharacteristically severe fires
- Some candidate conversion processes produce relatively pure CO_2 streams that could be sequestered in geologic formations



Conclusions

- Terrestrial sequestration activities can remove substantial volumes of CO_2 from the atmosphere and avoid other emissions to the atmosphere at relatively low costs.
- Changes in land management practices could be combined with bioenergy development and geologic sequestration to produce “carbon negative” options for meeting future energy demand.