CARCD 72nd Annual Conference
"Dynamic Partnerships, Relevant Results"
November 2017 – Sacramento, CA

RESOURCE
CONSERVATION DISTRICTS

Farm Climate Risk Assessments:

A Potential Driver for Conservation Planning

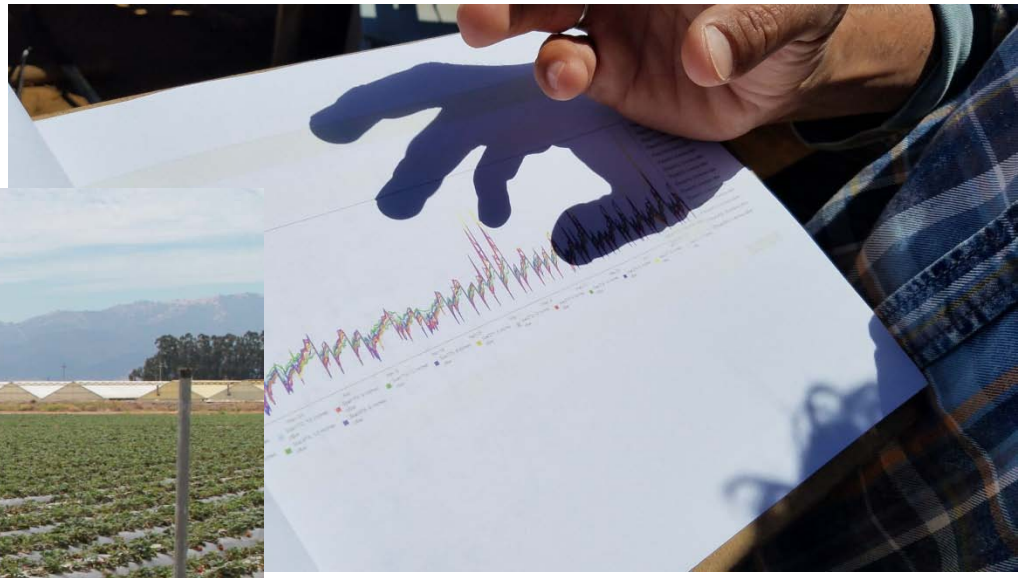
And Carbon Farming?

Coastal Conservancy

RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

Sacha Lozano and Lisa Lurie
slozano@rcdsantacruz.org
2017 CARCD Conference

Climate…?



Premise: Risk Analysis can link climate change theory, evidence and projections to a specific farm operation, AND serve as driver for Conservation / Carbon Farming Planning…

1. Farm Risk Assessment Protocol

Farm Risk Assessment Protocol

Step 1: Regional and Local Climate Info Gathering (Pre-Field Visit)

- Compile relevant data/analyses/models on projected regional climate change impacts to agriculture.

Step 2: Site-specific Conditions, Management Info, and Grower Input

- **Listen –** Grower survey: threats, perceptions, conditions, practices, goals.
- **Share –** Talk with grower about regional climate change context in which they are farming. Do this context and projections resonate with what they are observing on their ranch?
- **Observe and Document –** Inventory site-specific conditions to assess on-farm climate change risks (NRCS-WSS maps and reports, and local MAR and Runoff spatial analysis).

Step 3: Risk Analysis and Reporting to Grower

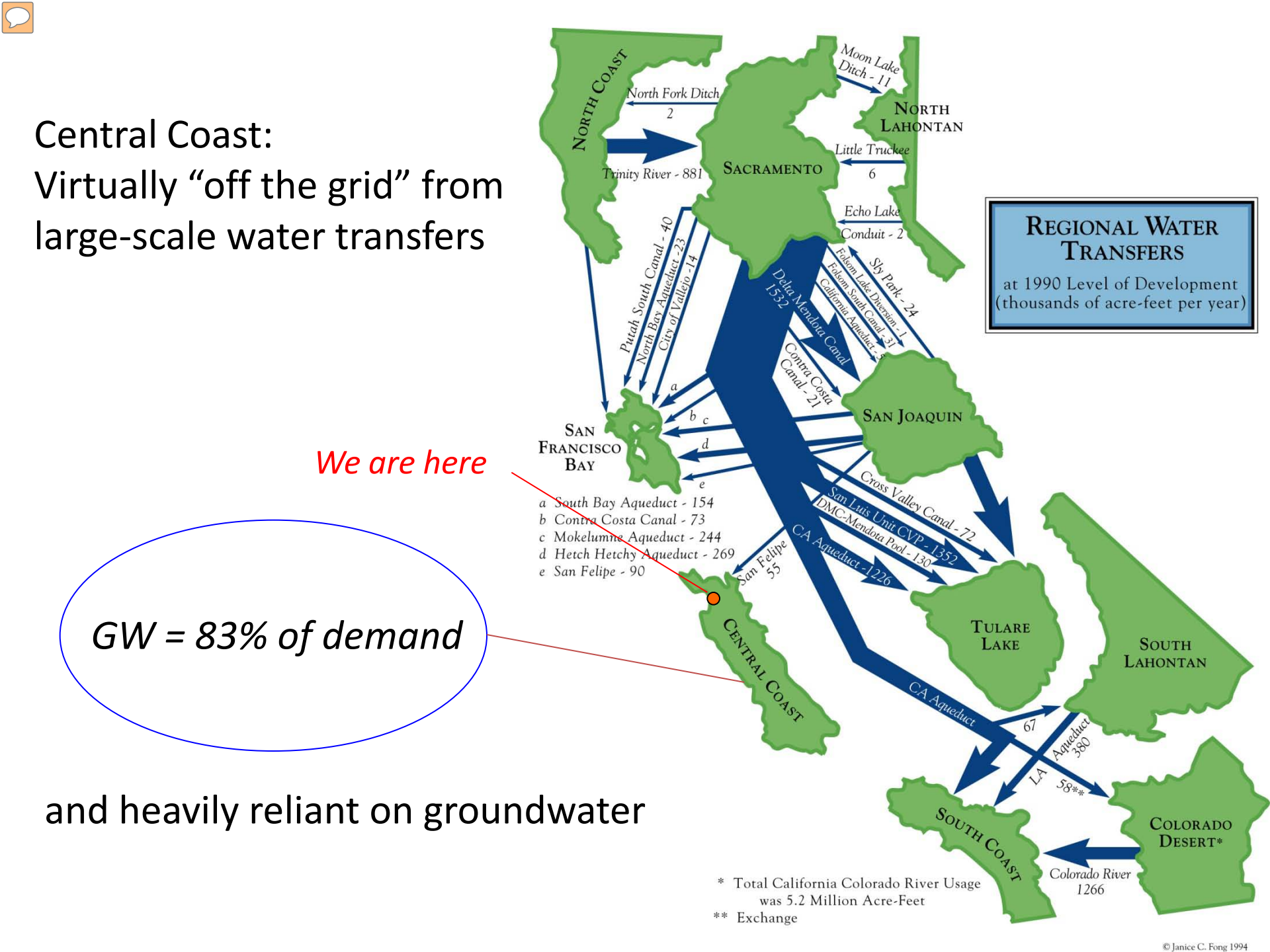
- **Review –** Site visit notes, observations, and inventory of site-specific conditions.
- **Assess Risks –** Score level of risk by category (soil vulnerability to extreme weather and erosion, water supply, and flooding risk) based on regional and site-specific factors.
- **Discuss –** Talk with the grower about climate change risks and alternative conservation practices to help minimize those risks and improve farm resiliency.

…Step 4: Planning (Conservation / Carbon Farming)

- **Brainstorm and Select Practices –** Develop a list of potential practices to mitigate risks and improve farm resiliency. Work with grower to select what (if any) action they choose to take .
- **Sketch out a Conservation Plan –** Evaluate and tentatively place alternative practices to address climate change risks on the farm (develop carbon farm plan).
- **Support** – Discuss available technical and financial assistance and refer grower to appropriate technical support (RCD, NRCS, UCCE, SWEEP, CDFA's Healthy Soils Initiative, other).

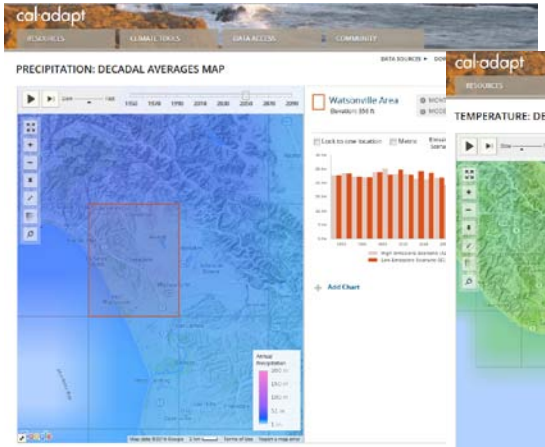
2. Regional conditions and climate change effects

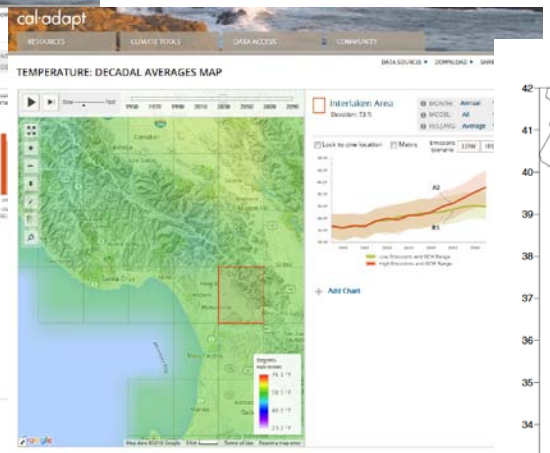
Central Coast:
Virtually “off the grid” from large-scale water transfers



and heavily reliant on groundwater

Regional Climate Models and Historical data





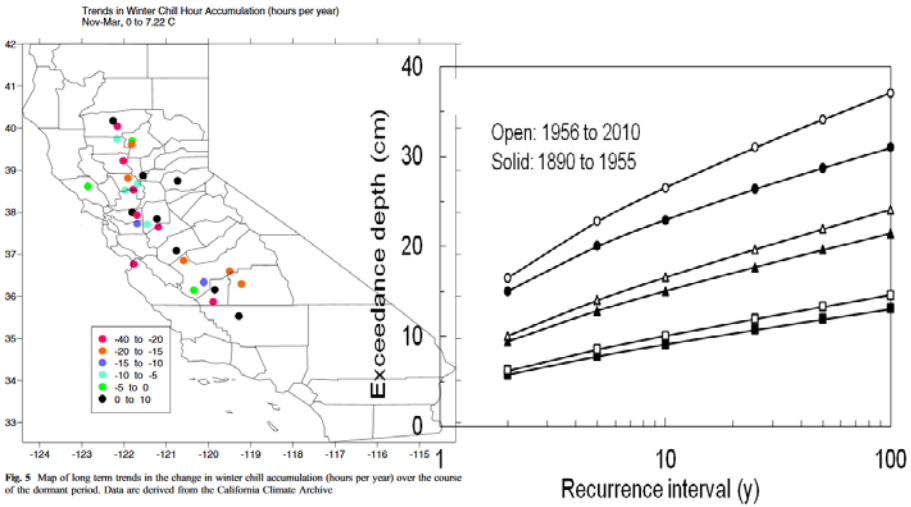
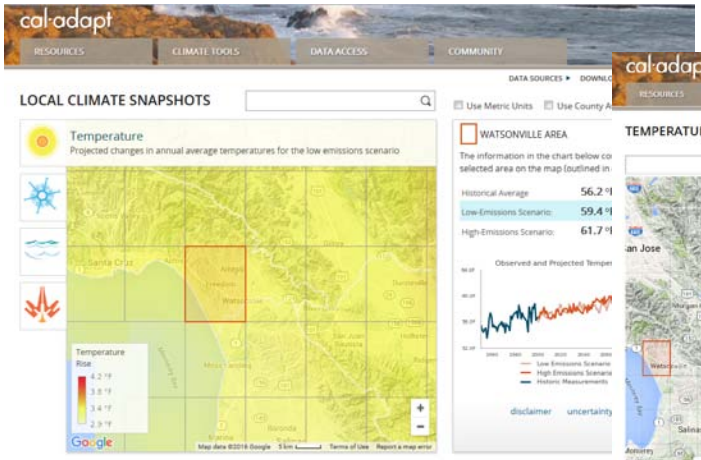
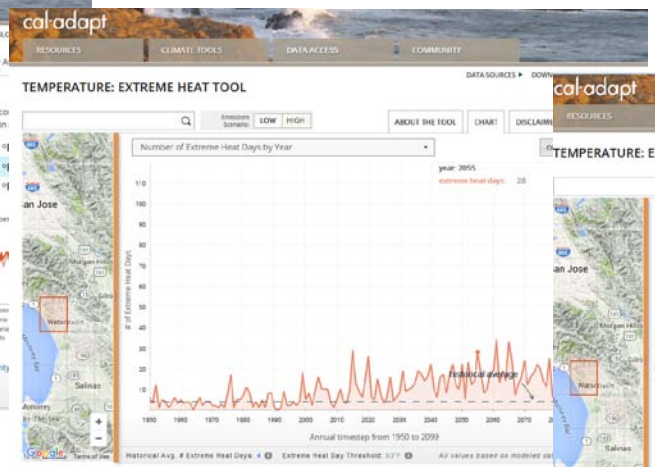
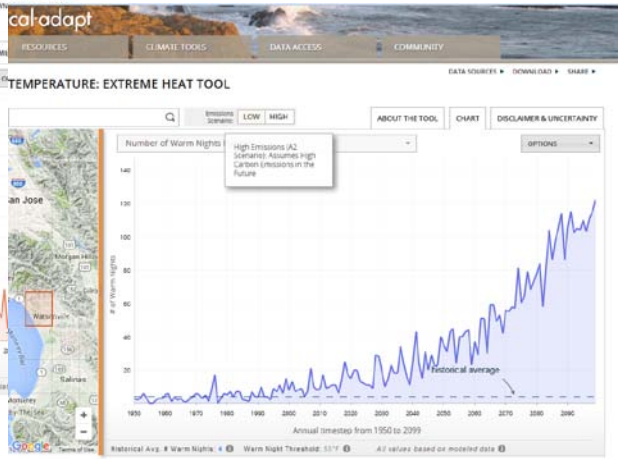


Fig. 5 Map of long term trends in the change in winter chill accumulation (hours per year) over the course of the dormant period. Data are derived from the California Climate Archive



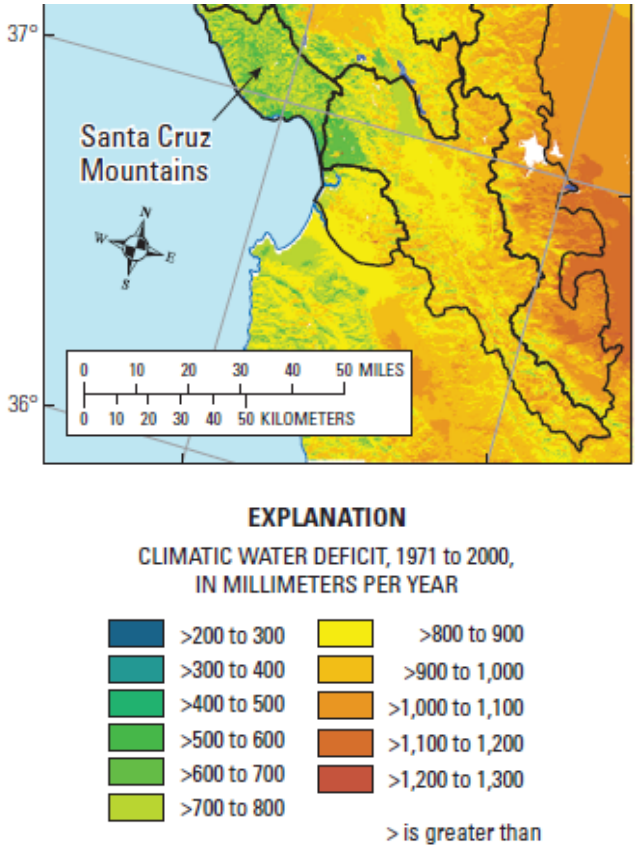




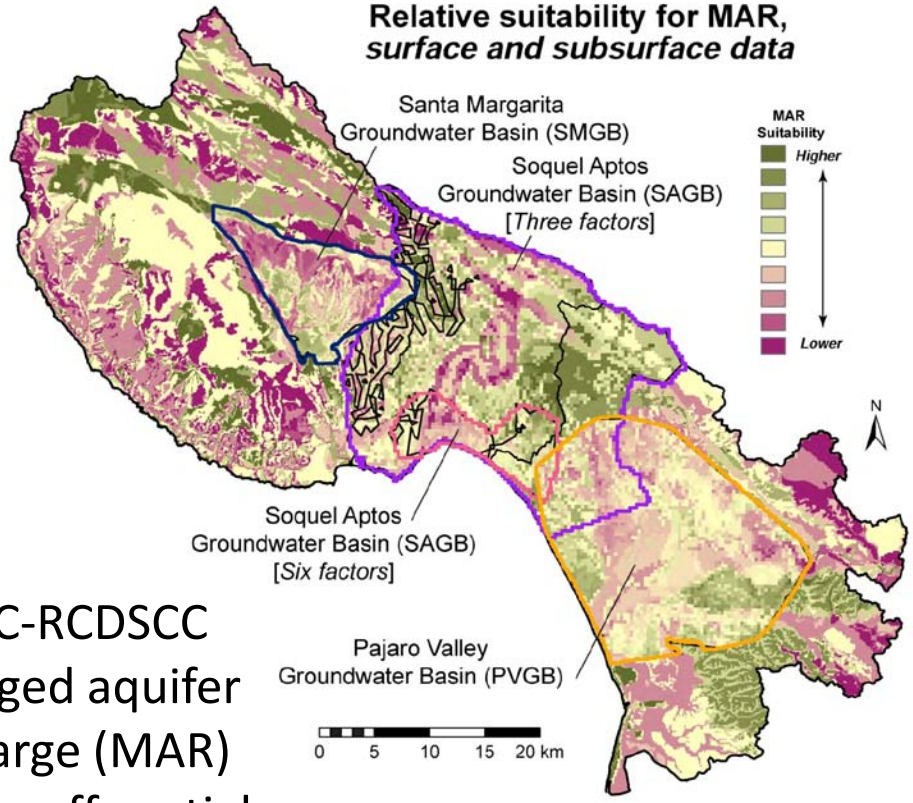
Finer Resolution Spatial Data:

Climatic Water Deficit

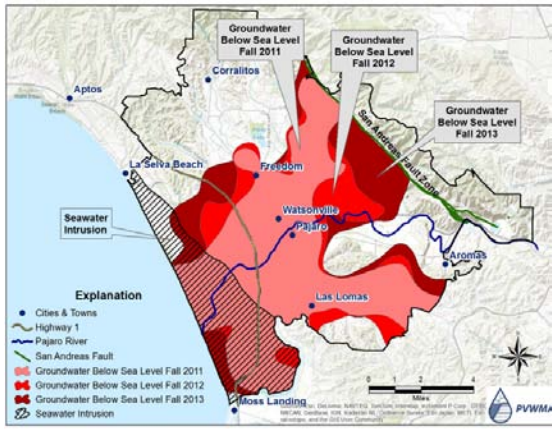
(Flint&Flint 2012)



- *Longer dry periods*
- *Higher solar radiation*
- *Higher ET*
- *More water demand*
- *Higher drought stress on soils and plants*

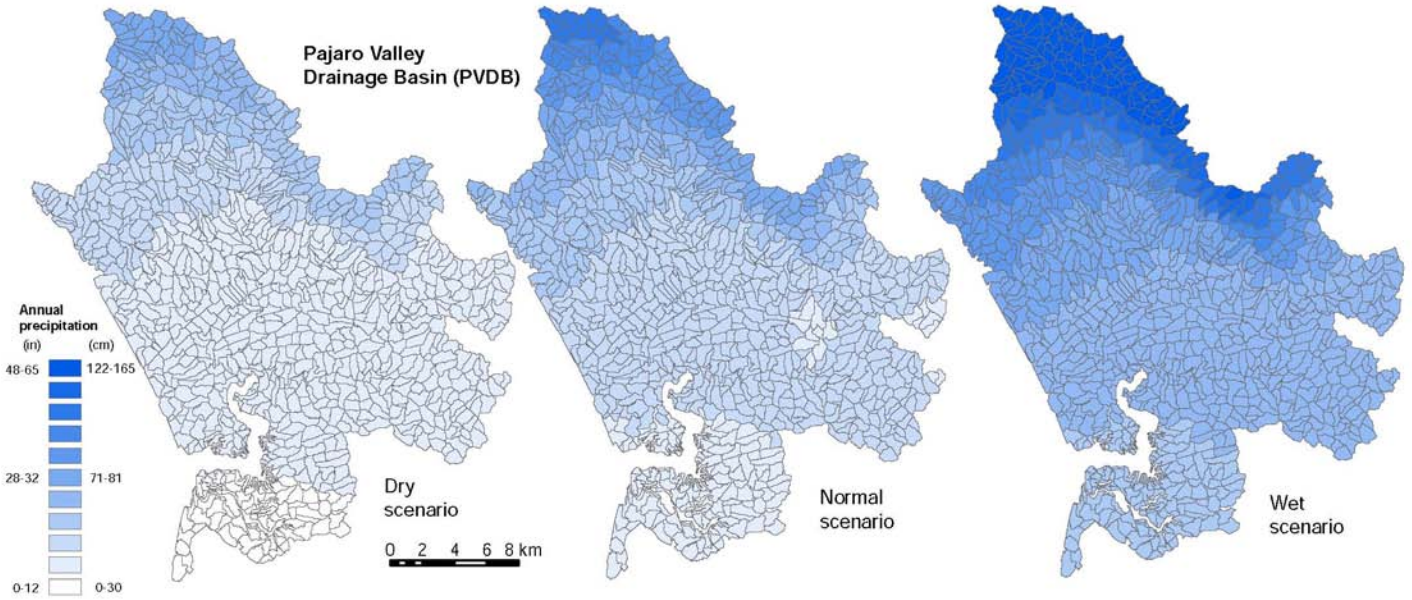


UCSC-RCDSCC Managed aquifer Recharge (MAR) and Runoff spatial analysis

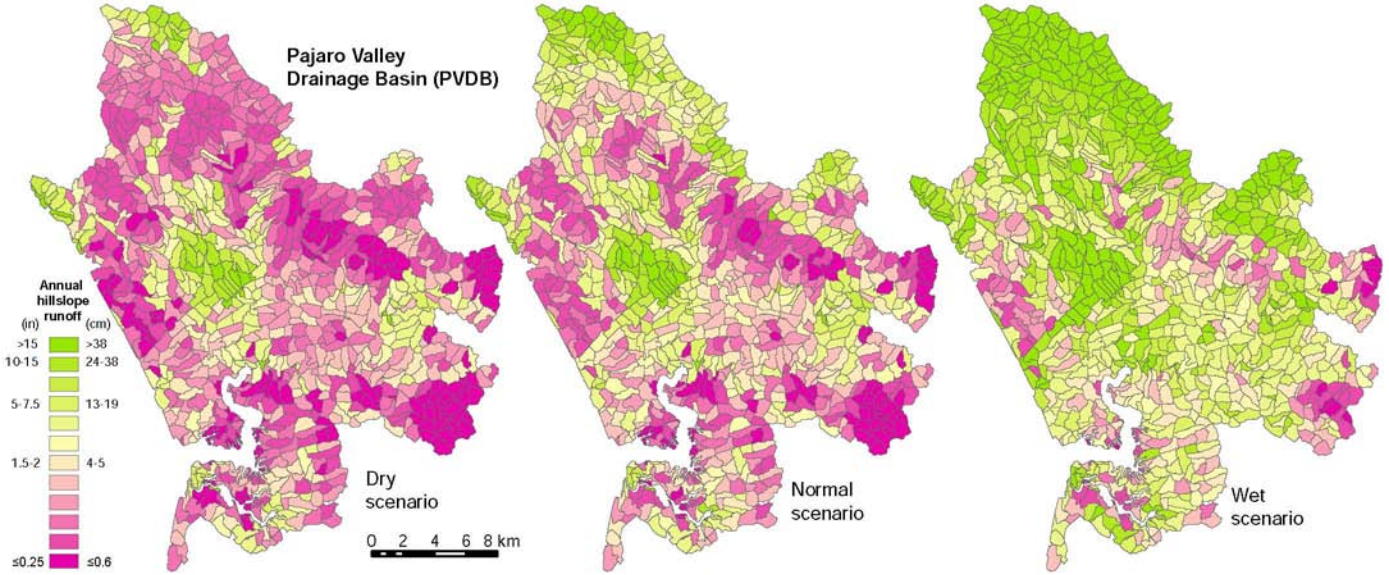


Seawater Intrusion and GW level

Precip



Runoff



3. Site-specific Assessment Tools and Farm Risk Assessment Template

C. On-Farm Risk Factors - Detailed

1. Vulnerability to extreme weather events and erosion

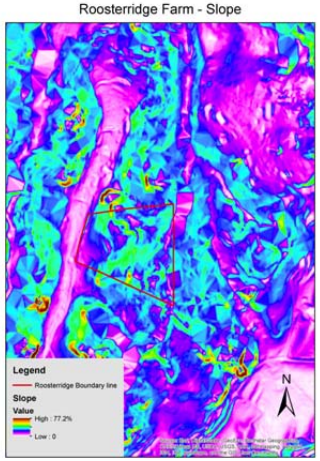
a) Soil texture: predominantly sand and loamy sand

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
105	Baywood loamy sand, 2 to 15 percent slopes	0.3	1.7%
106	Baywood loamy sand, 15 to 30 percent slopes	2.5	12.6%
107	Baywood loamy sand, 30 to 50 percent slopes	0.9	4.6%
112	Ben Lomond sandy loam, 50 to 75 percent slopes	2.5	12.7%
183	Zayante coarse sand, 30 to 50 percent slopes	13.7	68.3%
Totals for Area of Interest		20.0	100.0%

b) Soil Organic Matter: 1.5 -2.5% NRCS WSS baseline

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
105	Baywood loamy sand, 2 to 15 percent slopes	2.50	0.3	1.7%
106	Baywood loamy sand, 15 to 30 percent slopes	2.50	2.5	12.6%
107	Baywood loamy sand, 30 to 50 percent slopes	2.50	0.9	4.6%
112	Ben Lomond sandy loam, 50 to 75 percent slopes	2.00	2.5	12.7%
183	Zayante coarse sand, 30 to 50 percent slopes	1.50	13.7	68.3%
Totals for Area of Interest			20.0	100.0%

c) Terrain Slope: Steep, predominantly 15-40 % slope



d) Erosion Hazard (Off-road, off-trail): Severe

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
105	Baywood loamy sand, 2 to 15 percent slopes	Slight	Baywood (85%)		0.3	1.7%
106	Baywood loamy sand, 15 to 30 percent slopes	Moderate	Baywood (85%)	Slope/erodibility (0.50)	2.5	12.6%
107	Baywood loamy sand, 30 to 50 percent slopes	Severe	Baywood (85%)	Slope/erodibility (0.75)	0.9	4.6%
112	Ben Lomond sandy loam, 50 to 75 percent slopes	Very severe	Ben Lomond (85%)	Slope/erodibility (0.95)	2.5	12.7%
183	Zayante coarse sand, 30 to 50 percent slopes	Severe	Zayante (85%)	Slope/erodibility (0.75)	13.7	68.3%
Totals for Area of Interest					20.0	100.0%

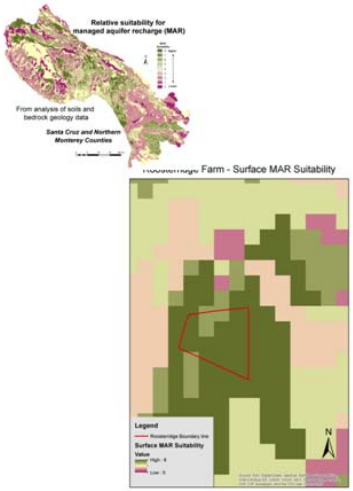
Rating	Acres in AOI	Percent of AOI
Severe	14.5	72.4%
Very severe	2.5	12.7%
Moderate	2.5	12.6%
Slight	0.3	1.7%
Totals for Area of Interest	20.0	100.0%

c) Soil infiltration Capacity: High

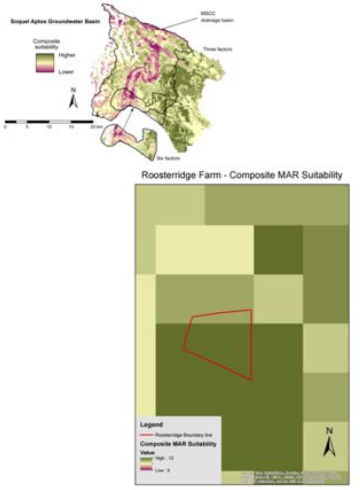
d) Soil Available Water Capacity: Low to moderate

Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
105	Baywood loamy sand, 2 to 15 percent slopes	0.09	0.3	1.7%
106	Baywood loamy sand, 15 to 30 percent slopes	0.09	2.5	12.6%
107	Baywood loamy sand, 30 to 50 percent slopes	0.09	0.9	4.6%
112	Ben Lomond sandy loam, 50 to 75 percent slopes	0.11	2.5	12.7%
183	Zayante coarse sand, 30 to 50 percent slopes	0.07	13.7	68.3%
Totals for Area of Interest			20.0	100.0%

g) Managed Aquifer Recharge (MAR) suitability (surface): High



h) MAR Suitability (surface + sub-surface): High



D. Full Baseline Soil Quality Test Report

Soil Quality Test Report

Prepared by:

Sacha Lozano*, RCD of Santa Cruz County
*Contact information: (831) 224-0293, slozano@rcdsantacruz.org

Reviewed by:

Ken Oster, Soil Scientist USDA-NRCS
Roger Tompkins, Acting District Conservationist USDA-NRCS

*All the field testing procedures, descriptions of soil quality parameters, and result interpretation contained in this report are based on the USDA Soil Quality Test Kit Guide (2001)

USDA NRCS Natural Resources Conservation Service RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

g) Soil Loss Potential (RUSLE output)

Field name	Soil	Slope T Value	Slope length (ft)	Slope steepness (%)
Stone Fruit Orchard	106 Baywood loamy sand, 15 to 30 % slopes	5.0	250	20.0
Lower Veg. & Flower field	106 Baywood loamy sand, 15 to 30 % slopes	5.0	100	10.0
Upper field - Vineyard	183 Zayante coarse sand, 30 to 50 % slopes	5.0	97	24.0
Upper field - Avocados	183 Zayante coarse sand, 30 to 50 % slopes	5.0	150	17.0

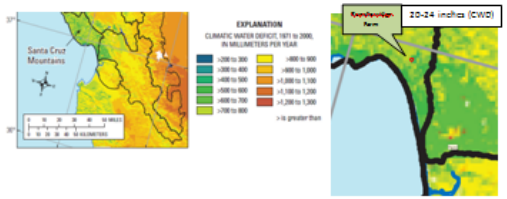
Field name & Soil Type	Description	Contouring system	Cons. plan. soil loss (Rac/yr)	Sed. delivery (Rac/yr)	Soil conditioning Index (SCI)	STIR value
Stone Fruit Orchard (Baywood loamy sand)	Stone Fruit Orchard with grassed cover	contour-systems\d. rellative row grade 5 percent of slope grade	1.7	1.7	0.31	0
Stone Fruit Orchard (Baywood loamy sand)	Brome cover crop	contour-systems\c. perfect contouring no row grade	0.037	0.037	0.94	0.15
Stone Fruit Orchard (Baywood loamy sand)	Clover cover crop	contour-systems\c. perfect contouring no row grade	9.8	9.8	-0.30	11
Stone Fruit Orchard (Baywood loamy sand)	Rye Grass cover crop	contour-systems\c. perfect contouring no row grade	60	60	-5.3	240
Lower Veg. & Flower field (Baywood loamy sand)	Beans, green or snap	contour-systems\c. perfect contouring no row grade	2.3	2.3	-0.10	90

Summary Report:

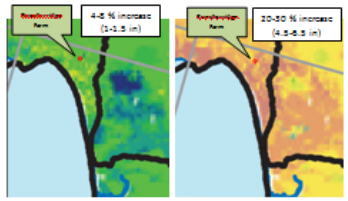
Site: Rooster Ridge Farm (Nancy Abramson) 04/05/17	Vegetables Plot	Orchard Plot
Soil Respiration (lbs CO2-C/acre/day)	96.3	130.9
Standardized resp. to 25C (lbs CO2-C/acre/day)	147.0	185.2
Infiltration: 1st inch (in/hr)	93.3	240.0
Infiltration: 2nd inch (in/hr)	36.7	60.0
Bulk Density (g/cm3)	1.0	1.2
Water-filled Pore Space - WFPS (%)	22.6	36.6
EC (dS/m)	0.3	nd
Water Content (g/g)	0.1	nd
pH	5.5	nd
0-3" Exact Soil NO3-N (lb NO3-N/acre)	17.9	nd
water stable aggregates (%)	nd	nd
Average soil slake rating	5.3	nd
Total Earthworms	nd	nd
Soil Structure Index	nd	nd
Top Soil Depth (cm)	nd	nd
Soil temp. (Celsius)	18.9	20.0

c) Climatic Water Deficit (modeled historic and projected change)

Historic (1971 – 2000)



Future (2070 – 2100), on two alternative climate scenarios



f) Crop water demand and Min irrigation need - from historic weather data (CIMIS) on evapotranspiration and precipitation

Baseline (from historic data)

CIMIS Data	Total ETo (in/yr)	Precip (in/yr)	Avg crop Kc during summer	Avg ETc (crop water demand)	Min irrigation need* (in/yr)
10yr Annual Avg (2007-2017)	41	19	0.8	32.8	21.9
Min	22	3	0.8	17.6	17.45
Max	48	44	0.8	38.4	26.2

* "Min irrigation need" estimated as the Avg ETc minus 5% of precipitation received (in/yr)

Projected crop water demand and Min irrigation need based on modeled changes in Climatic Water Deficit (CWD) under alternative climate change scenarios:

Climate Scenario	Future Avg ETc (crop water demand, in/yr)	Future Min irrigation need (in/yr)
PCM-A2 (+1.25in)	34.1	33.2
GFDL-A2 (+6.5 in)	36.5	37.4
Avg	35.2	35.3

Farm Climate Risk Assessment

Roosterridge Farm

February 2017

RESOURCE
CONSERVATION DISTRICT
OF SANTA CRUZ COUNTY

I. Table of Contents

2. Ranch Map B – Multi-crop farmed area (6 acres)

- Winegrapes
- Avocado orchard
- Fruit trees (Apple, Plum, Peach)
- Olive orchard
- Row vegetable crops
- Protea flowers
- Citrus
- Cutflowers

B. On-Farm Risk Factors

1. Farm Risk Factors - Score Summary

On-Farm Risk Categories	Assessed Value	Risk score
a. Vulnerability to extreme weather events and erosion		(scale 1-3)
Soil texture:	Predominantly sand and loamy sand	3
Soil Organic Matter:	1.5-2.5% (NRCS WSS baseline)	2
Terrain Slope:	Steep, predominantly 15-40 % slope	3
Erosion Hazard (Off-road, off-trail):	Severe	3
Wind Erodibility:	Intermediate	2
Average/typical area (%) of bare soil per year/season:	None; Cover crops annually planted and plant residues incorporated	1
RUSLE output	Stone fruit Orchard = 1-60 (ton/ac/yr) Veg and Flower field = 2-7 (ton/ac/yr) Vineyard and Avocado fields < 1 ton/ac/yr	2
Sub-total Score (scale 0-21)		16
b. Limited water supply		
Water source / depth to groundwater	Soquel-Aptos Groundwater Basin	3
Precipitation and Runoff (PRMS) modeled projections under different annual weather scenarios:	Runoff: data not available Precipitation: Proxy from PVGB – Dry yr = 20in, Normal yr = 28in, Wet yr = 41in	1
Soil infiltration Capacity:	High	1
Soil Available Water Capacity:	Low to moderate	2
Climatic Water Deficit (Flint&Flint 2012)	Up to 30% increase (1.5 - 6.5 inches of additional ETo demand, relative to projected available soil moisture)	2-3
Crop water demand and Min irrigation need	Avg ETc 33in, Min irrig need 32in (increased by 1.5-6.5in depending on climate scenario)	
Managed Aquifer Recharge (MAR) suitability (surface):	High	1
MAR Suitability (surface + sub-surface):	High	1
Seawater Intrusion Threat:	Insufficient data (presumably low)	1
Sub-total Score (scale 0-27)		13
c. Flooding or sea level rise		
Elevation (above sea level)		1
Distance to nearest stream		1
Distance to coastline		1
Sub-total Score (scale 0-9)		3

Risk Assessment (summary score)

Risk category	Regional risk factors	On-farm risk factors	Farm Risk Score	Types of Practices
Vulnerability to extreme weather and erosion	Frequency and duration of extreme storms, increase in temperature and number of exceedingly hot days/nights, winter chill hours	Soil texture Soil Organic Matter Terrain Slope Erosion Hazard Wind Erodibility Average/typical area (%) of bare soil crop type		Erosion control and soil health building practices
Limited water supply	Frequency and duration of drought events, aquifer overdraft, seawater intrusion, climatic water deficit, heat waves	Water source Depth to groundwater Soil Infiltration Available Water Capacity Precipitation and Runoff Climatic Water Deficit Crop water demand and Min irrigation need Managed Aquifer Recharge (MAR) suitability Seawater Intrusion		Water use efficiency practices, irrigation scheduling, alternative water supply practices, groundwater recharge, soil health building practices
Flooding or sea level rise	Sea level rise, flood risk, groundwater elevation	Farm location (elevation) relative to projected sea level rise or flooding risk zones Distance to nearest stream Distance to coastline		Practices to improve wetland/riparian area function and drainage

4. Conservation Practices

Management Practice	Description	Project Goals Addressed		
		Reduce groundwater demand	Retain soil on farm (protect water quality)	Improve soil organic carbon for multiple benefits
Irrigation Water Management (NRCS 449)	The process of determining and controlling the volume, frequency, and application rate of irrigation water	X		
Irrigation Land Leveling (NRCS 464)	Reshaping the surface of land to be irrigated, to planned lines and grades	X	X	X
Contour Farming (NRCS 330)	Aligning ridges, furrows, and roughness formed by tillage, planting and other operations to alter velocity and/or direction of water flow to around the hillslope	X	X	X
Row Arrangement (NRCS 557)	Row Arrangement is a system of crop rows on planned directions, grades and lengths.	X	X	
Cover crop (NRCS 340)	Grasses, legumes, and forbs planted for seasonal vegetative cover	X	X	X
Mulching (NRCS 484)	Applying plant residues or other suitable materials produced off site, to the land surface	X	X	X
Conservation crop rotation (NRCS 328)	A planned sequence of crops grown on the same ground over a period of time (i.e. the rotation cycle)	X	X	X
Nutrient Management (NRCS 590)	Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments (including compost).	X		X
Field Borders (NRCS 386)	A strip of permanent vegetation established at the edge or around the perimeter of a field.		X	X
Riparian Herbaceous Cover (NRCS 390)	Grasses, sedges, rushes, ferns, legumes, and forbs tolerant of intermittent flooding or saturated soils, established or managed as the dominant vegetation in the transitional zone between upland and aquatic habitats		X	X
Filter Strips (NRCS 393)	A strip or area of herbaceous vegetation that removes contaminants from overland flow.		X	X
Grassed Waterways (NRCS 412)	A shaped or graded channel that is established with suitable vegetation to convey surface water at a non-erosive velocity using a broad and shallow cross section to a stable outlet	X	X	X
Critical Area Planting (NRCS 342)	Establishing permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices		X	X
Residue and Tillage Management - Reduced Till (NRCS 345)	Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting	X	X	X
Residue and Tillage Management - No Till (NRCS 329)	Limiting soil disturbance to manage the amount, orientation and distribution of crop and plant residue on the soil surface year around	X	X	X
Conservation Cover (NRCS 327)	Establishing and maintaining permanent vegetative cover (minimizing bare soil, including roads)	X	X	X
Salinity and Sodic Soil Management (NRCS 610)	Management of land, water and plants to reduce accumulations of salts and/or sodium on the soil surface and in the crop rooting zone.			X
Water use tracking	Use of flowmeter(s) and record keeping tools to track volume of water applied per cultivated area unit	X		
Soil moisture/tension monitoring	Use of technology to track soil moisture and promptly respond to plant water stress	X		X
Irrigation System evaluations and upgrades	Assessing (and correcting if needed) the distribution uniformity and potential leakages of irrigation system	X	X	

…Alternative Approaches, Common Goal

Risk Assessment → Why should I get involved? (react to a problem)

Carbon Farming → Recognize opportunity and engage (be part of the solution)

Questions?

Sacha Lozano
slozano@rcdsantacruz.org

Lisa Lurie
llurie@rcdsantacruz.org

RESOURCE
CONSERVATION DISTRICT
OF SANTA CRUZ COUNTY