El Dorado County
West Slope Agricultural Development Feasibility Assessment

WRDMP Agricultural Advisory Group

Projected Cropping Pattern and Agricultural Water Demands Workshop

9:30 a.m. to 11:30 a.m.
September 9, 2019
Placerville, CA

Meeting Topics

- Brief Review of Four Prior Meetings
- Projected Cropping Pattern
  - Review multivariate regression tool & refinements
  - Review crop placement results
  - Discussion
- Projected Agricultural Water Demands
  - Review preliminary projected water demands
  - Discussion
- Concluding Discussion/Remarks

Meeting #1 – 12/13/2018

- Review study objectives:

1) Delineate West Slope lands that are:
   a) Consistent with the County's General Plan 2015 Update Ag land use designations,
   b) Physically suitable for agricultural development, and
   c) Economical to develop
2) Develop projections of agricultural water demand on developable lands

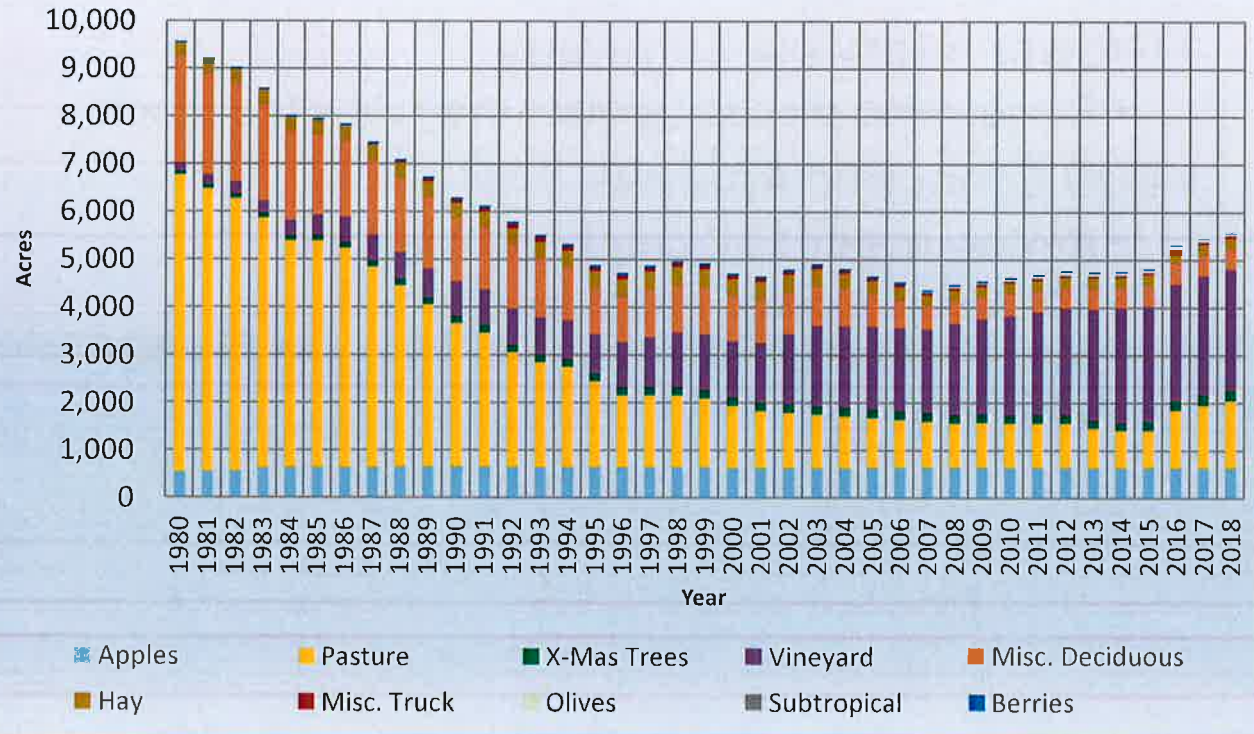
Meeting #1 – 12/13/2018

- Discuss tasks comprising Consultant's Scope of Work:
  1) Meetings/Coordination
  2) Analyze Historical Agricultural Development
  3) Estimate Crop Applied Water Requirements
  4) Conduct Economic Market Analysis
  5) Integrate Findings from Tasks (3) and (4) to Conduct West Slope Ag Development and Water Demand Analysis
- Discuss the role and engagement with the Agriculture Advisory Group

Meeting #2 – 2/20/2019

- Review historical cropping to identify "major crops" and specialty crops
- Initial discussion of crop factors (field size, elevation, slope, soil quality) for major crops
- Review of initial crop budgets and market conditions
- Review grower interview plans

Reconciled Historical Cropping Record



Selection of Major and Alternative Crops

- Five selected major crops are:
  1) Vineyards
  2) Apples
  3) Miscellaneous Deciduous (walnuts as proxy)
  4) Pasture
  5) Christmas Trees
- These five crops account for 93% of the total existing West Slope cropped area (2016)
- Alternative crops include berries, small vegetable farms, and mandarins

Meeting #3 – 5/21/2019

- Grower Interview Summary
  - Review and discuss grower interview feedback
- EDC Economic Analysis
  - Review major EDC crops and markets
  - Review economic analysis approach
  - Receive AAG input on revised crop and market definitions
- Preliminary Land Suitability Analysis (subsequently revised)
  - Review crop factor analysis
  - Receive AAG input on crop factor analysis

EDC Crops for Economic Analysis

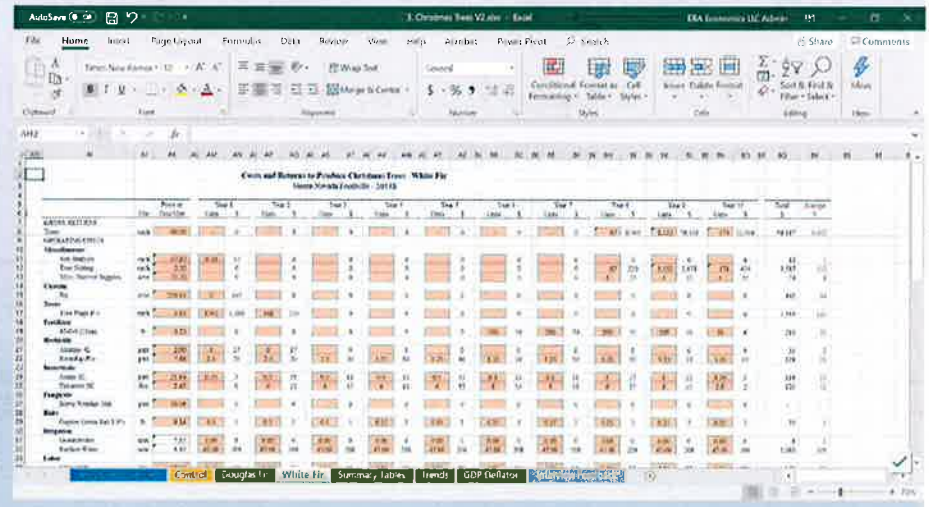
- Expanded total crops from 5 major crops and 2 alternatives to 9 major crops and 3 alternatives

Initial Major Crops
Apples
Pasture
Grapes
Misc. Deciduous
X-Mas Trees
Alt 1 (TBD)
Alt 2 (TBD)

Revised Major Crops	Market Type	Current Acres
Apples	DTC (Apple Hill)	587
Apples	Specialty Wholesale	65
Pasture	DTC (Specialty Meat)	813
Pasture	Wholesale	813
Grapes	DTC (Wine)	1,519
Grapes	Wholesale (Export)	1,012
Misc. Deciduous	DTC (Peaches)	229
Misc. Deciduous	Wholesale (Walnuts)	200
X-Mas Trees	DTC (You-Cut)	227
(Alt) Berries	DTC (Farmers Markets)	9
(Alt) Small Veg	DTC (Specialty Markets)	41
(Alt) Mandarins	Wholesale	56

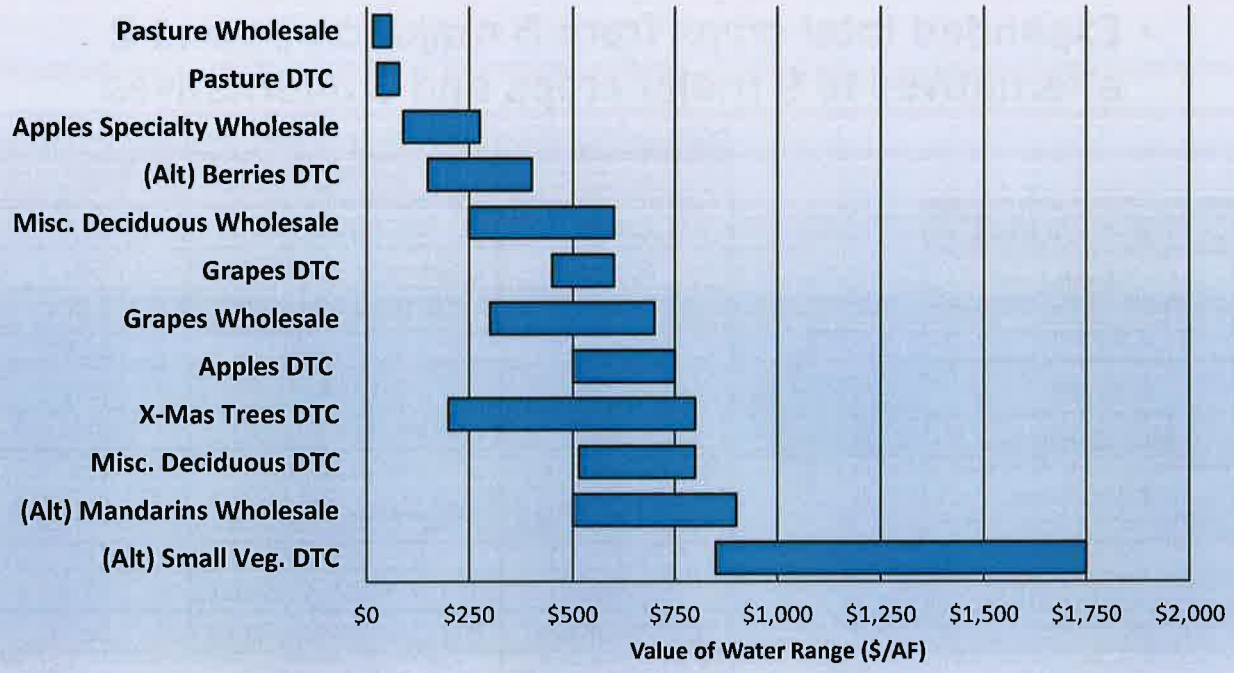
EDC Crop Markets, Costs, and Returns

- Each crop is characterized by:
  - Itemized operating costs
  - Itemized capital costs



  - Full cost of "unpriced" inputs (owner-operator time, return to management, return to risk)
  - Developed as series of crop budget models tailored to EDC conditions

Current Value of Water Estimates



Preliminary Assessment of Markets and Potential for EDC Expansion

1. EDC crops that face a large consumer market can expand with little effect on value of water

2. EDC crops that are a small share of total market supply can expand acreage with moderate decrease in value of water

3. Value of water falls quickly as acreage expands for EDC crops that are a significant share of supply and sell to local consumers

Meeting #4 – 8/7/2019

- Updated Land Suitability Analysis
  - Review updates to analysis
  - Review and discuss updated results
- Crop Assignment using Multivariate Analysis
  - Review multivariate regression tool
  - Review and discuss crop assignment results
- Evapotranspiration and Applied Water Analysis
  - Review crop ET and applied water analysis
  - Review and discuss applied water results

Factors in ParcelField Database

Current Factors

- Ownership
- General Plan land use designation and zoning
- Elevation (max and min)
- Average slope
- Slope variability
- Size (1 ac min)
- Land capability classification
- Shape (P/A ratio)

Factors for Future Refinement

- Exposure (aspect)
- Existing land use/cover
- Oak Woodland designation
- In/out of surface water purveyor area
- Proximity to closest:
  - Primary road
  - Secondary road
  - Existing irrigated field
- Crop on closest irrigated field

"Coarse" Screening Criteria

Characteristic	Preliminary (05/21/2019)	Updated (08/07/2019)
Land Ownership	Private	Private
Land Use Designation and Zoning	Appropriate for Agricultural Development	Appropriate for Agricultural Development (Redefined)
Elevation	4,000 feet above mean sea level or lower	4,000 feet above mean sea level or lower
Slope	15 degrees or less	15 degrees or less
Slope Variability	Not used	5 degrees or less
Land Capability Classification	8 or less	6 or less
ParcelField Acreage	1 acre or greater	1 acre or greater
Perimeter/Area Ratio	Not used	1,050 or less

ParcelField "Fine" Crop-Specific Screening Preliminary Factors

- Screening factors generally defined by 5th and 95th percentiles of existing ag fields

Crop	Lower Elevation	Upper Elevation	Average Slope	Slope Variability
Apples	1,700	3,200	11	4.1
Miscellaneous Deciduous	0	2,700	12	4.4
Pasture	0	2,500	8	3.3
Vineyard	0	2,900	14	4.6
X-mas Trees	2,600	3,400	14	4.1

ParcelField "Fine" Crop-Specific Screening Results

Crop	ParcelField Count	Total Acres
Apples	2,579	27,707
Miscellaneous Deciduous	3,356	37,915
Pasture	1,174	14,281
Vineyard	3,936	42,620
X-mas Trees	879	7,996

- Substantial overlap exists because many ParcelFields are suitable for multiple crops
- Discrete results (overlap accounted for):
  - 4,277 ParcelFields
  - 45,231 total acres
  - Average 10.6 acres/ParcelField

Crop Evapotranspiration and Applied Water Analysis: Objective

- Establish average applied water (AW) requirements ("duties") for major crops
- AW is the amount of water needed in addition to precipitation to grow a crop

Crop Evapotranspiration and Applied Water Analysis: Approach

- Analyze actual crop water use using remote sensing based energy balance methodology (METRIC Model—2017 crop season)
- Derive crop coefficients for crop water use modeling
- Apply DWR's IDC root zone water balance model to estimate total crop ET, ET_{AW}, and ET_{precip} over a representative period of years (1998 – 2018)
- Divide ET_{AW} by irrigation efficiency to determine average AW duties

Average ET_{AW} and AW Results (1998 through 2018)

Preliminary

Crop	Area (acres)	ET_{AW} (inches) Historical	ET_{AW} (inches) Climate Change	ET_{AW} (inches) No Stress	Applied Water (inches) Historical	Applied Water (inches) Climate Change	Applied Water (inches) No Stress
Apples	505	10.2	12.2	12.5	12.8	15.3	15.6
Christmas Trees	273	11.8	13.9	13.7	14.8	17.4	17.1
Irrigated Pasture	440	23.5	26.8	28.8	29.4	33.5	36.0
Misc. Deciduous	475	11.1	13.2	14.1	13.9	16.5	17.6
Vineyard	2503	6.0	7.4	8.2	7.5	9.3	10.3
Area Wtd. Avg.	4196	9.3	11.1	11.9	11.6	13.9	14.9

Assumed Applied Water Fraction (irrigation efficiency) = 80%

Average ET_{AW} and AW values by crop are for all ETo zones and soils types in the model domain.

Average ET_{AW} and AW Results (1998 through 2018)

- Some concerns expressed about preliminary ET_{AW} and AW values
- Parallel process launched with UCCE to review methodology and results
- Possible refinements based on review
- A major challenge is the lack of applied water data for validation of modeling

Meeting #5 – Today

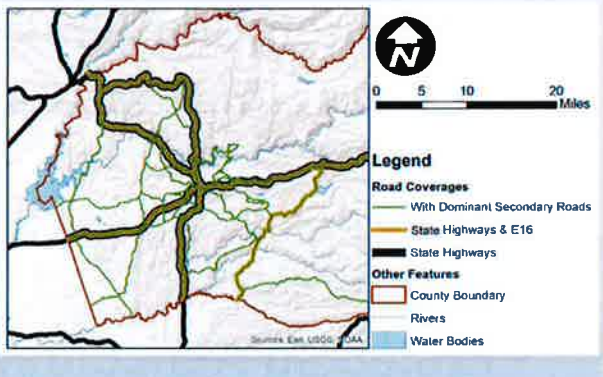
- Projected Cropping Pattern
  - Review multivariate regression tool & refinements
  - Review crop placement results
  - Discussion
- Projected Agricultural Water Demands
  - Review applied water analysis and results
  - Review overall water demands
  - Discussion
- Concluding Comments/Discussion

Crop Placement

- Multivariate regression analysis calculates the probability of each crop type based on potentially developable ParcelFields characteristics
  - Maximum of 45,231 acres based on coarse screening criteria
- Economic analysis determines how the value of water changes as production expands, and the maximum economically developable footprint
  - Maximum economic footprint depends on the cost of water and new land development
- Crops are "placed" based on land suitability and consistent with market conditions

Crop Placement Refinements

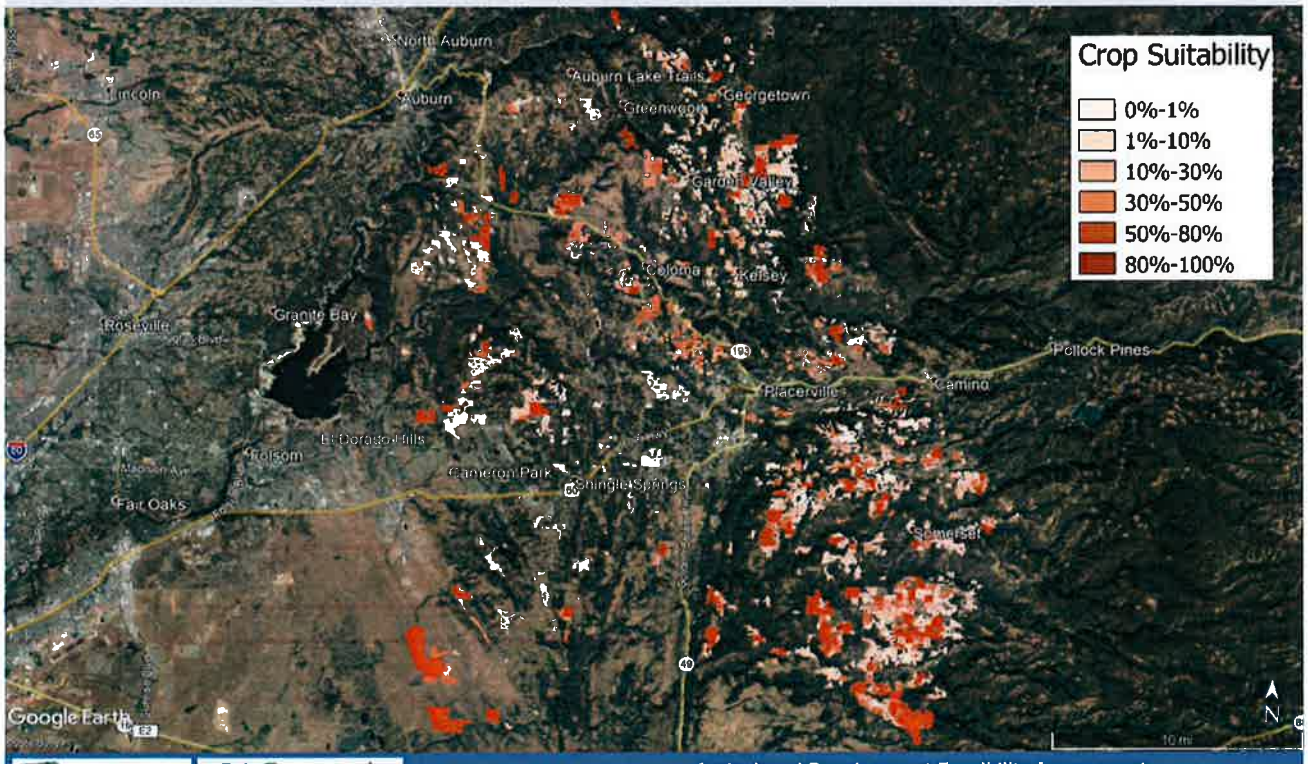
- Multivariate regression includes additional major roadways
- Developed link between major crop categories and all crop markets and alternative crops



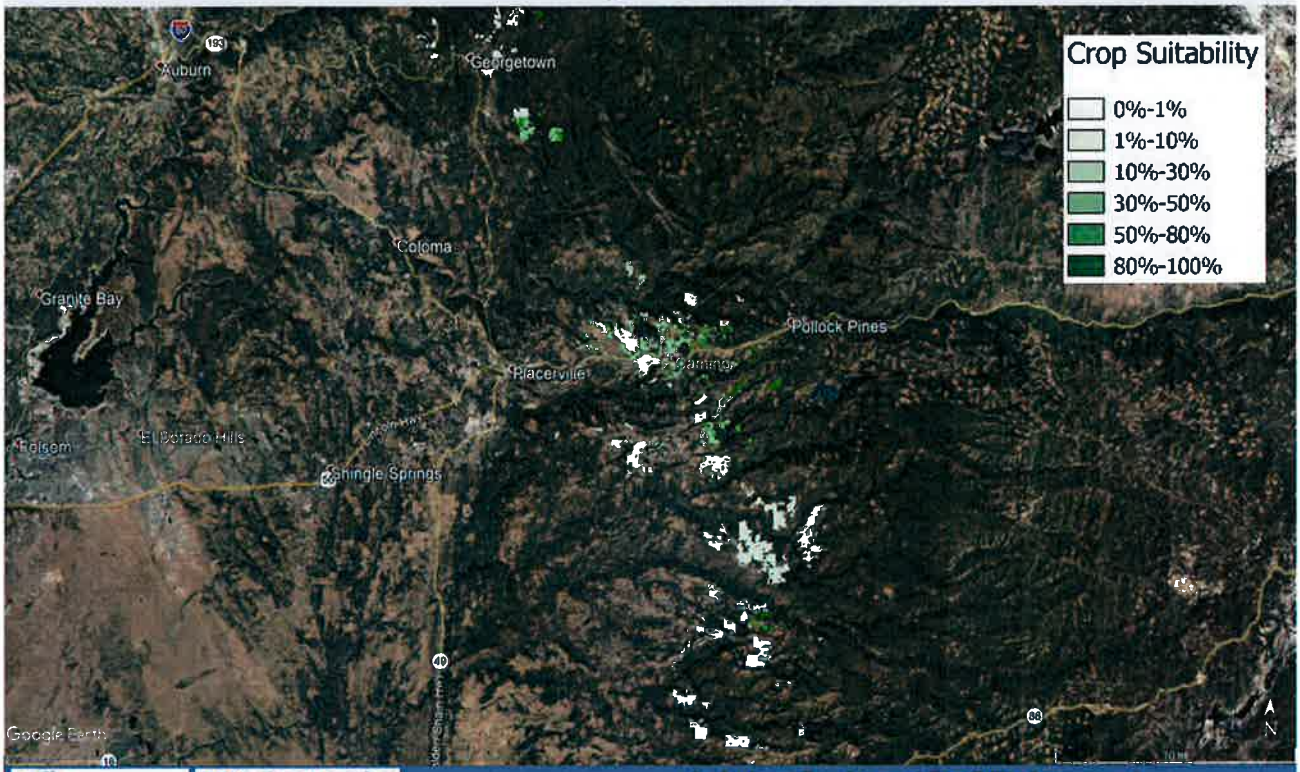
- Coarse and fine screening criteria revised
  - Set minimum elevation to EDC minimum elevation
  - Remove lower elevation limit for all crops and set equal to EDC minimum elevation

Apple Crop Map

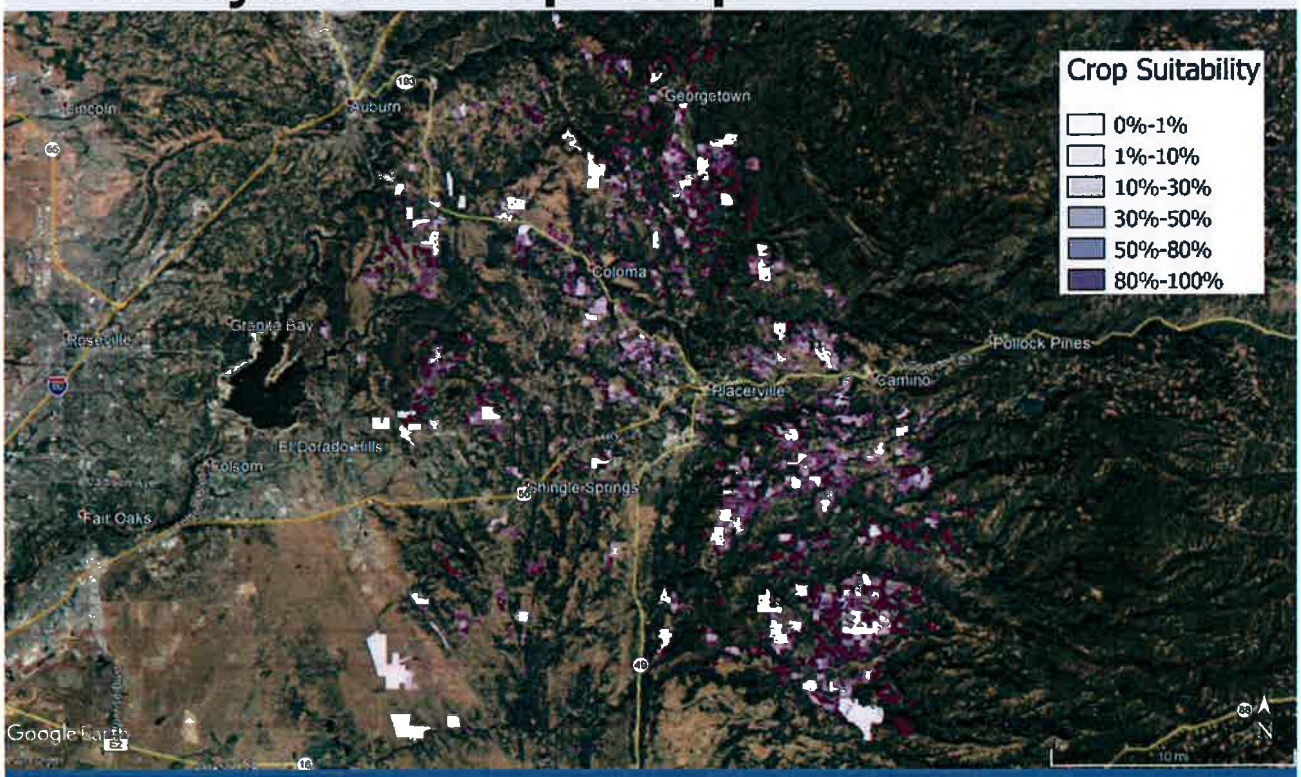
Other Deciduous Crop Map



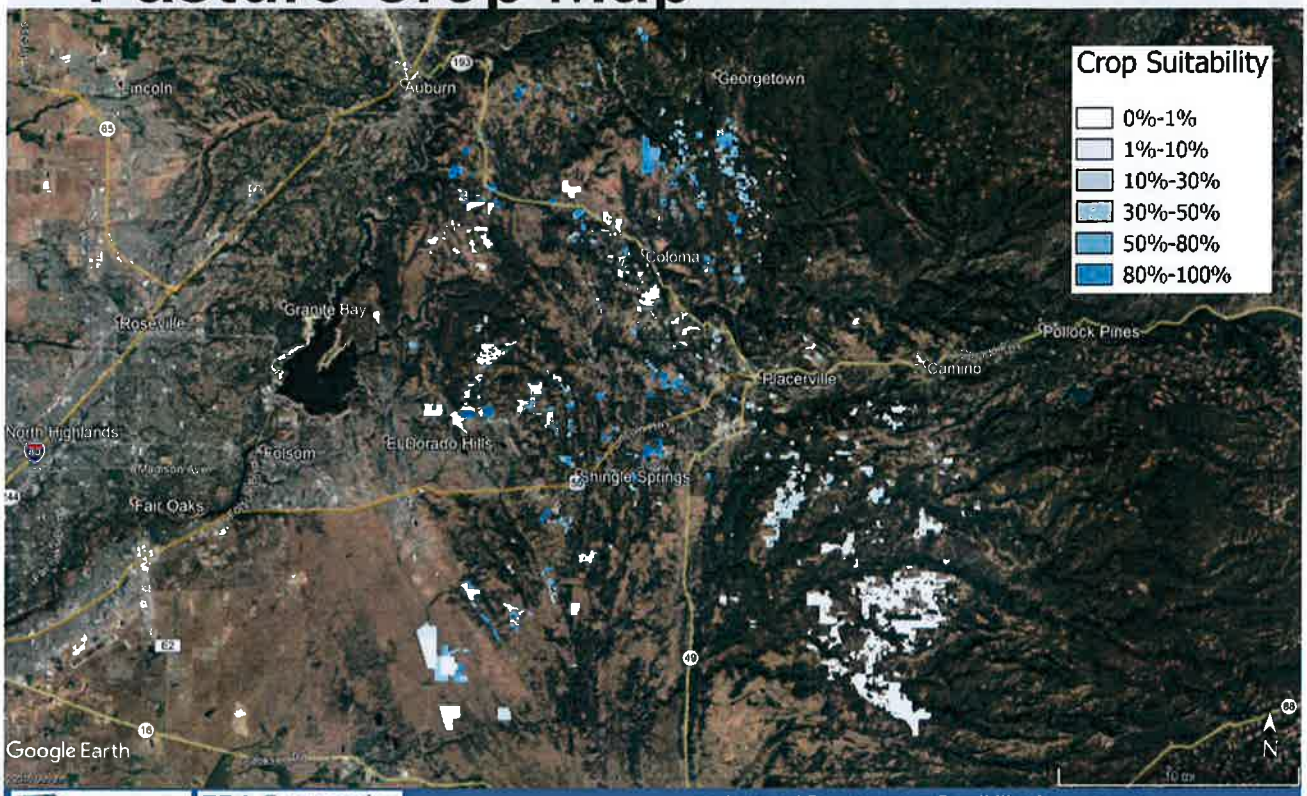
Xmas Trees Crop Map



Vineyards Crop Map



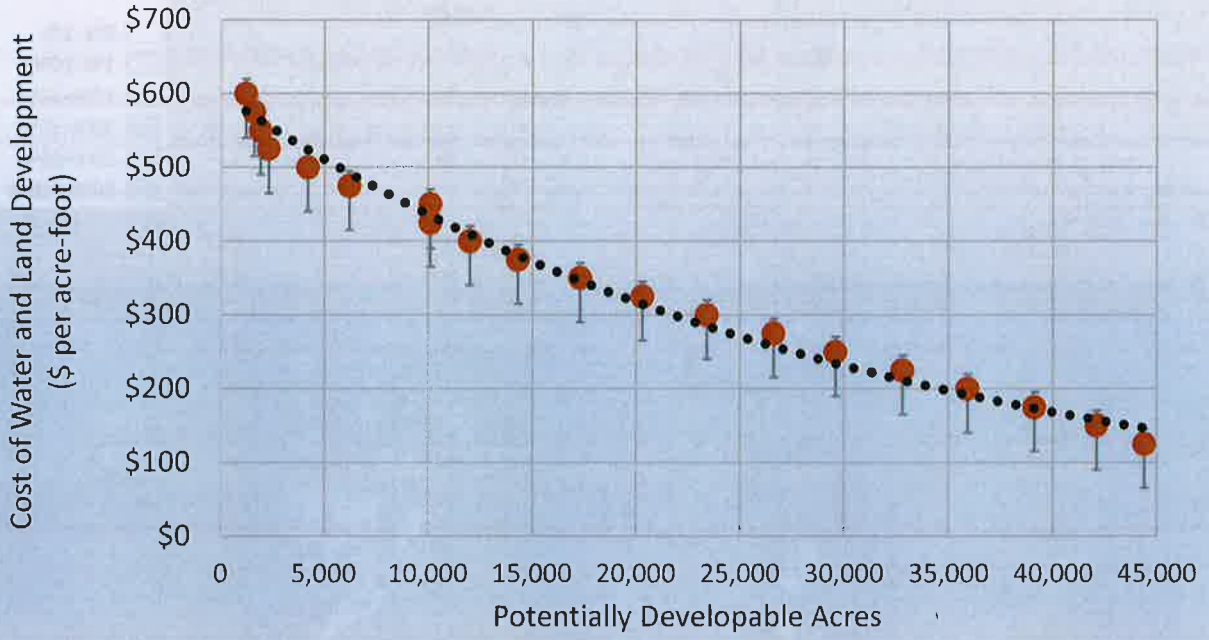
Pasture Crop Map



Economic Analysis

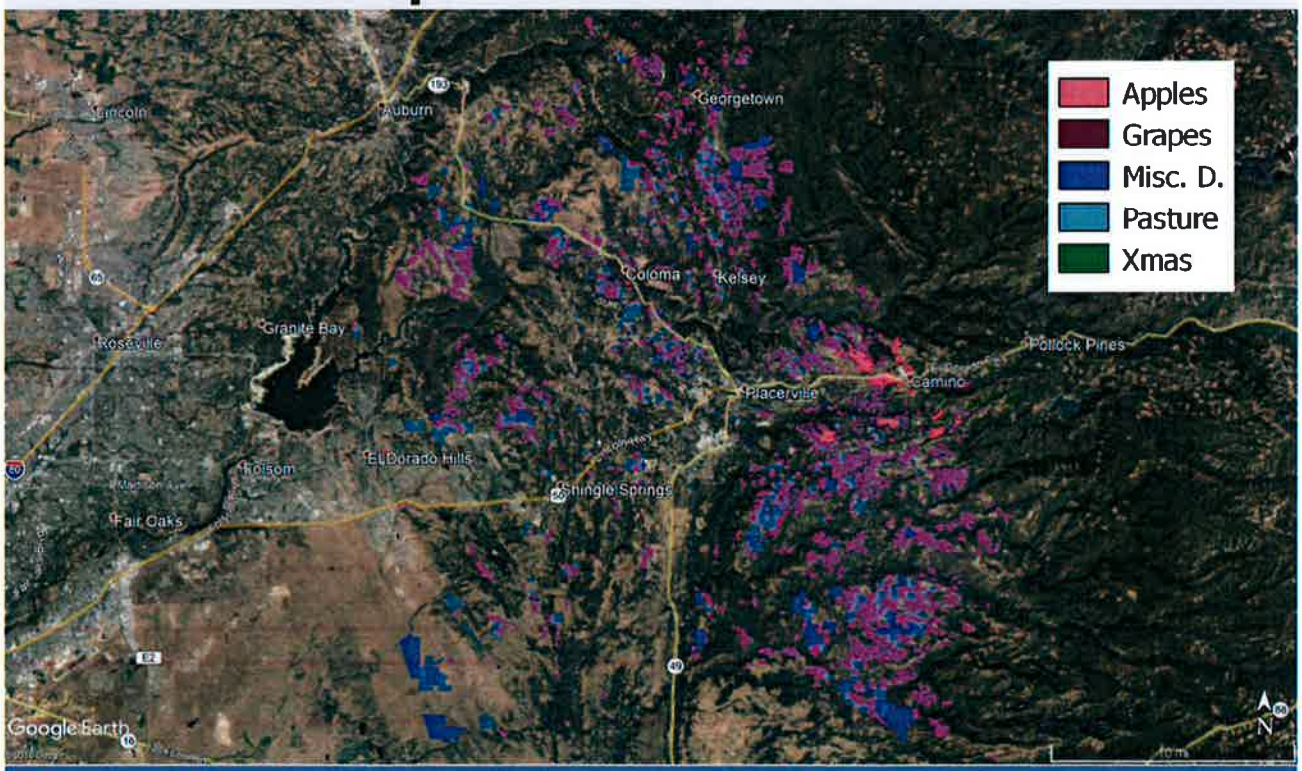
- Economic analysis of each crop and market is used to determine the value of water
- The value of water changes as the potentially developable ParcelFields footprint expands
  - The mix of crops (over 12 crop-market combinations) changes as the footprint expands
- The maximum economic footprint depends on the cost of developing new land and water supply

Parametric Economic Evaluation



Note: error bars show example +15/-35% (will be updated in final analysis)

Initial Crop Placement



Draft Max Developable Footprint

Apples	Vineyard	Pasture	Misc. Deciduous	Xmas Trees	Total
1,031	24,269	8,171	7,276	278	41,024

- Crops are aggregated from 12 crop-market combinations into 5 major crop types
- Preliminary analysis with no new development or water costs shows just over 40,000 acres of potentially developable ParcelFields
- Initial maximum footprint sensitivity analysis
  - 34,500 – 41,000 acres

Finalizing Economic Analysis and Crop Placement

- QA/QC
- Finalize regression and economic analyses
- Perform sensitivity analyses of key parameters in the economic analysis
  - Show range of water values by crop
  - Calculate EDC aggregate water demand under a range of water supply development costs
- Support rollout of information and complete additional scenario analyses if requested

Maximum Footprint Discussion

- Vineyards (24,000 acres)
  - Limited DTC expansion (< 500 acres)
  - Expansion in the wholesale market because EDC is a small share of production and demand for mid-priced grapes is relatively elastic
  - Infrastructure and support industries affect expansion
- Pasture (8,000 acres)
  - Relatively low water value means developable footprint is very sensitive to water cost
- Misc. Deciduous (7,000 acres)
  - Includes a mix of DTC orchards, berries, and misc. vegetables (< 1,000 acres)
  - Wholesale market includes citrus and (proxy crop) walnuts (~ 6,000 acres)

Projected Agricultural Water Demands

Projected Future Ag Water Demands

- Six climate change scenarios provided by the Bureau of Reclamation

Climate Change Scenario	Projection Horizon	
	2040-2069	2055-2084
Hot-Dry	*	*
Central Tendency	*	*
Warm-Wet	*	*

Projected Future Ag Water Demands

- Central Tendency 2055-2084 Scenario
  - Reference evapotranspiration (ET_o) approximately 9% **greater** than historical (1998-2017), on average
  - Precipitation approximately 2% **less** than historical (1998-2017), on average

Projected Future Ag Water Demands for Central Tendency 2055-2084 Scenario

Crop	Area	CT2055				
	(acres)	ETcrop	ETaw	ETaw	AW	AW
		(in)	(in)	(ft)	(ft)	(AF)
Apples	1,031	34.4	15.3	1.3	1.6	1,641
Christmas Trees	278	39.9	17.6	1.5	1.8	510
Irrigated Pasture	8,171	51.8	34.2	2.9	3.6	29,138
Misc. Deciduous	7,276	35.9	17.9	1.5	1.9	13,596
Vineyard	24,269	26.3	7.8	0.7	0.8	19,764
Total	**41,025**					**64,649**
Average (AF/acre)						**1.6**

Assumptions:

1) Vineyard growers will irrigate to achieve the same levels of stress as they currently do
2) All other crops will be more adequately irrigated relative to historical conditions (represented by 75th percentile historical ET level)
3) 80% irrigation efficiency for all crops

Preliminary

Projected Future Ag Water Demands under Historical ET Conditions

Crop	Area	Historical Avg. ET				
	(acres)	ETcrop	ETaw	ETaw	AW	AW
		(in)	(in)	(ft)	(ft)	(AF)
Apples	1,031	29.4	10.2	0.8	1.1	1,093
Christmas Trees	278	33.8	11.8	1.0	1.2	341
Irrigated Pasture	8,171	42.1	23.5	2.0	2.5	20,026
Misc. Deciduous	7,276	29.7	11.1	0.9	1.2	8,435
Vineyard	24,269	24.3	6.0	0.5	0.6	15,217
Total	**41,025**					**45,113**
Average (AF/acre)						**1.1**

Assumptions:

1) No climate change
2) All crops irrigated the same as they have been historically
3) 80% irrigation efficiency for all crops

Preliminary

Next Steps

- Perform QA/QC on analysis and results
- Complete review with UCCE; make revisions to analysis as appropriate
- Make final model runs for six climate change scenarios (provided by Reclamation)
- Provide final agricultural applied water demands to Stantec for incorporation into WRDMP system modeling

Concluding Discussion/Remarks

- Is the AAG comfortable with the work performed to establish the projected ag footprint and ag water demands?
- Are there any lingering concerns that should be addressed?
- Other thoughts?
- Thanks to the AAG members for their time and expert guidance!