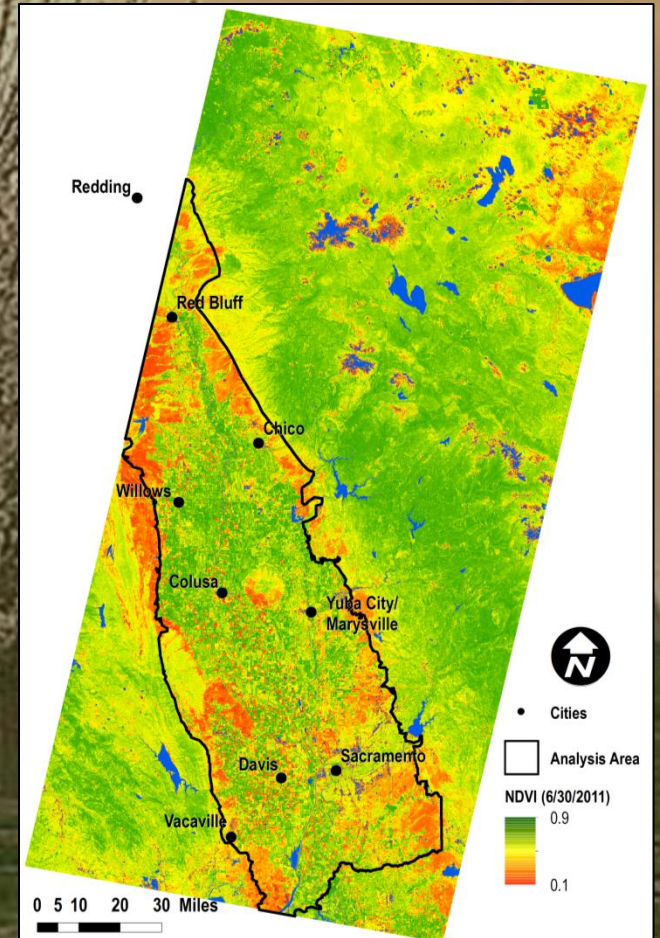


INDICATORS OF LAND USE CHANGES AND INCREASED CONSUMPTIVE WATER USE IN GLENN COUNTY

Grant Davids and Byron Clark
Davids Engineering, Inc.
Davis and Chico, CA



July 8, 2013

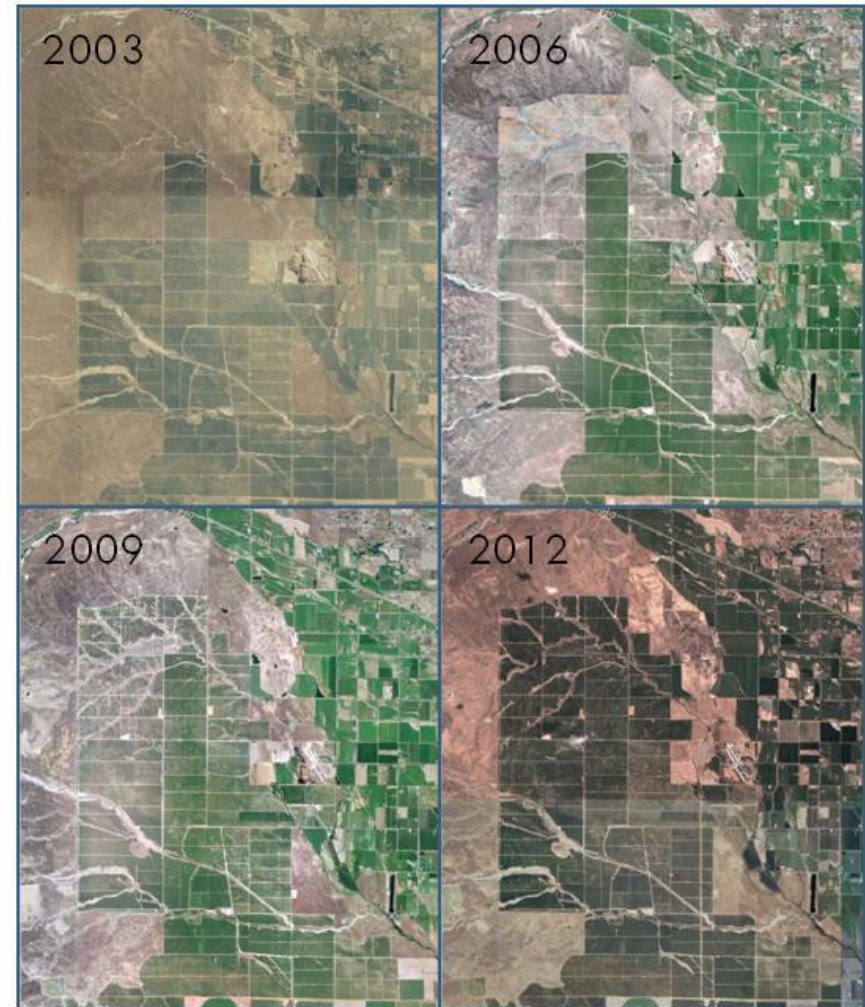
Glenn County Water Advisory Committee

Overview

2

- Background
- Technical Approach
- Changes in Extent of Consumptive Use
- Changes in Intensity of Consumptive Use
- Discussion

Almond Orchard West of Orland



Background

3

- Maintaining groundwater levels is the Sacramento Valley's most challenging water management issue
 - ▣ Indications of declining groundwater levels in certain areas
 - ▣ Threatens economic, social and environmental sustainability
- Contributing factors:
 - ▣ Expanding and intensifying irrigated agriculture
 - ▣ Pressures to provide more surface water for the Delta

Analytical Approach

4

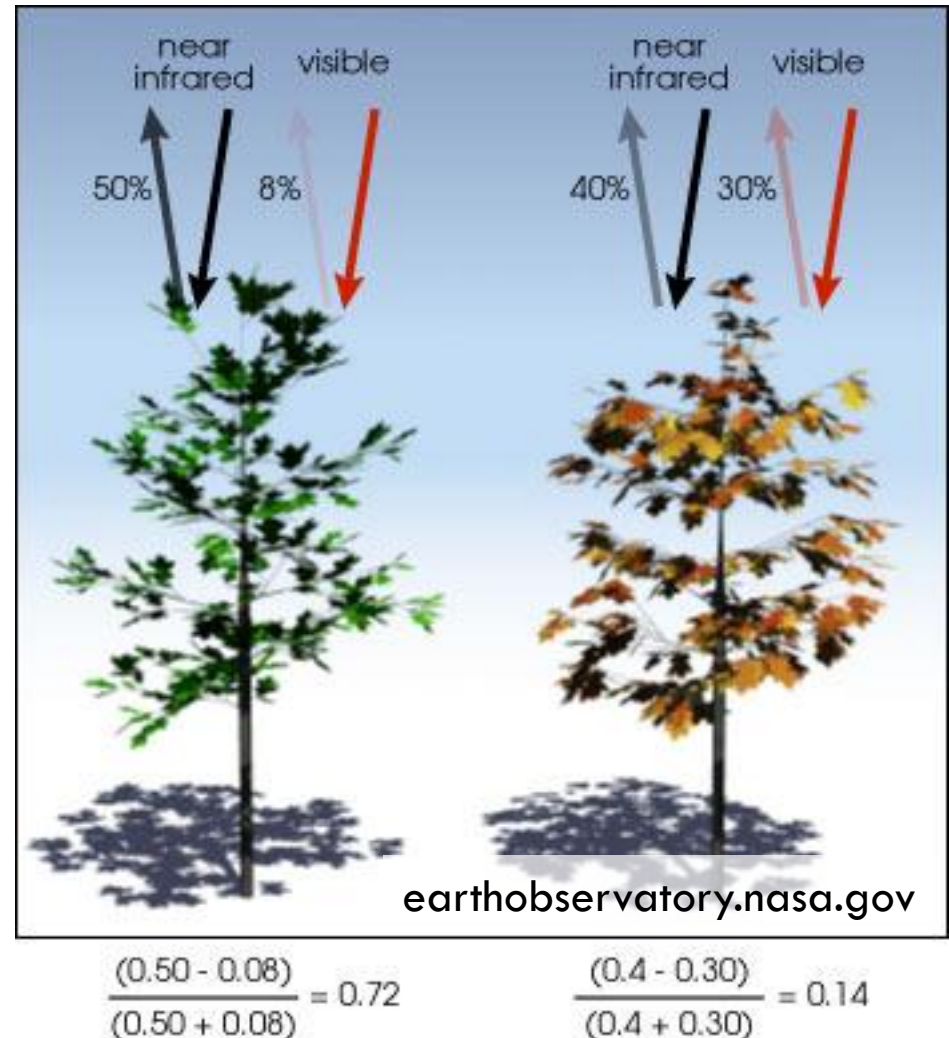
- Stitching together Valley-wide land use from DWR land use surveys and pesticide use reports is time consuming and challenging
- Instead, using satellite data, estimate Valley-wide changes in:
 - ▣ The **extent** of the water using (“irrigated”) area
 - ▣ The **intensity** of consumptive water use within the core agricultural area

Key Measure of Consumptive Water Use: NDVI

5

- Presence and amount of green vegetation during mid-summer using satellite-based Normalized Difference Vegetation Index (NDVI)

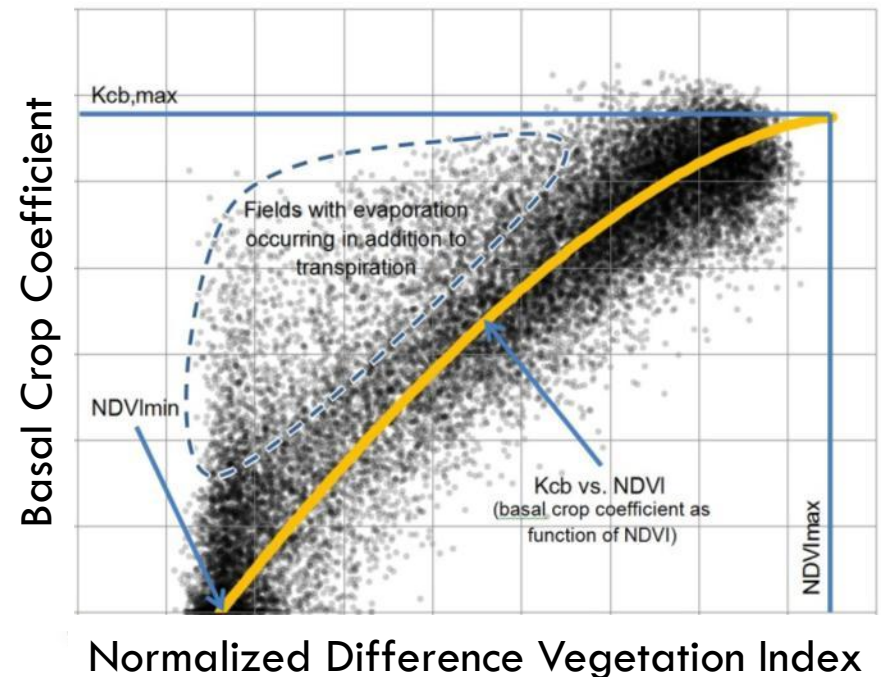
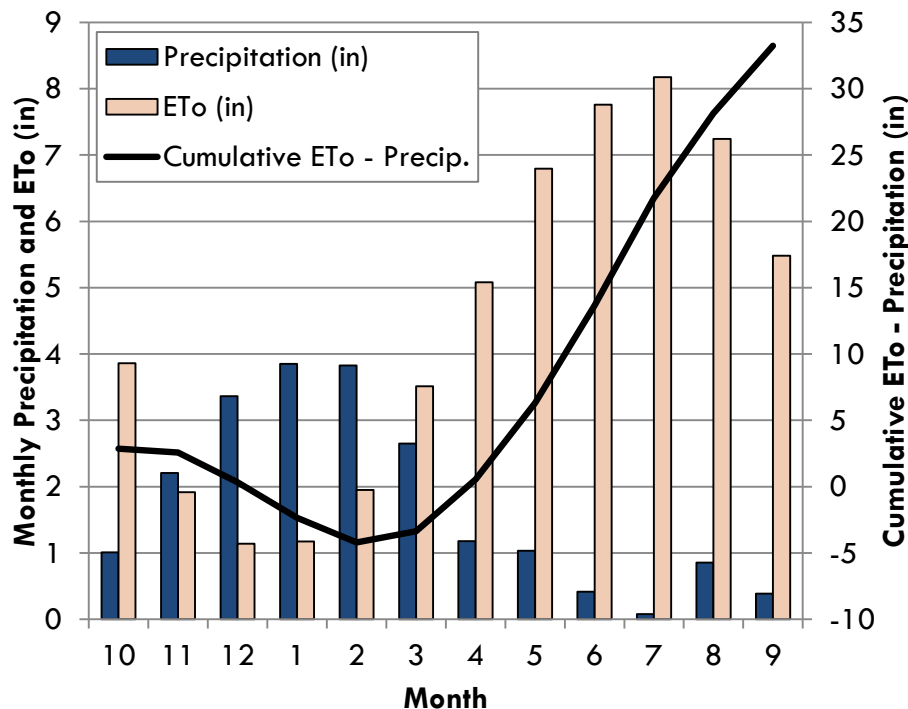
$$NDVI = \frac{\rho_{NIR} - \rho_{red}}{\rho_{NIR} + \rho_{red}}$$



Analytical Rationale

6

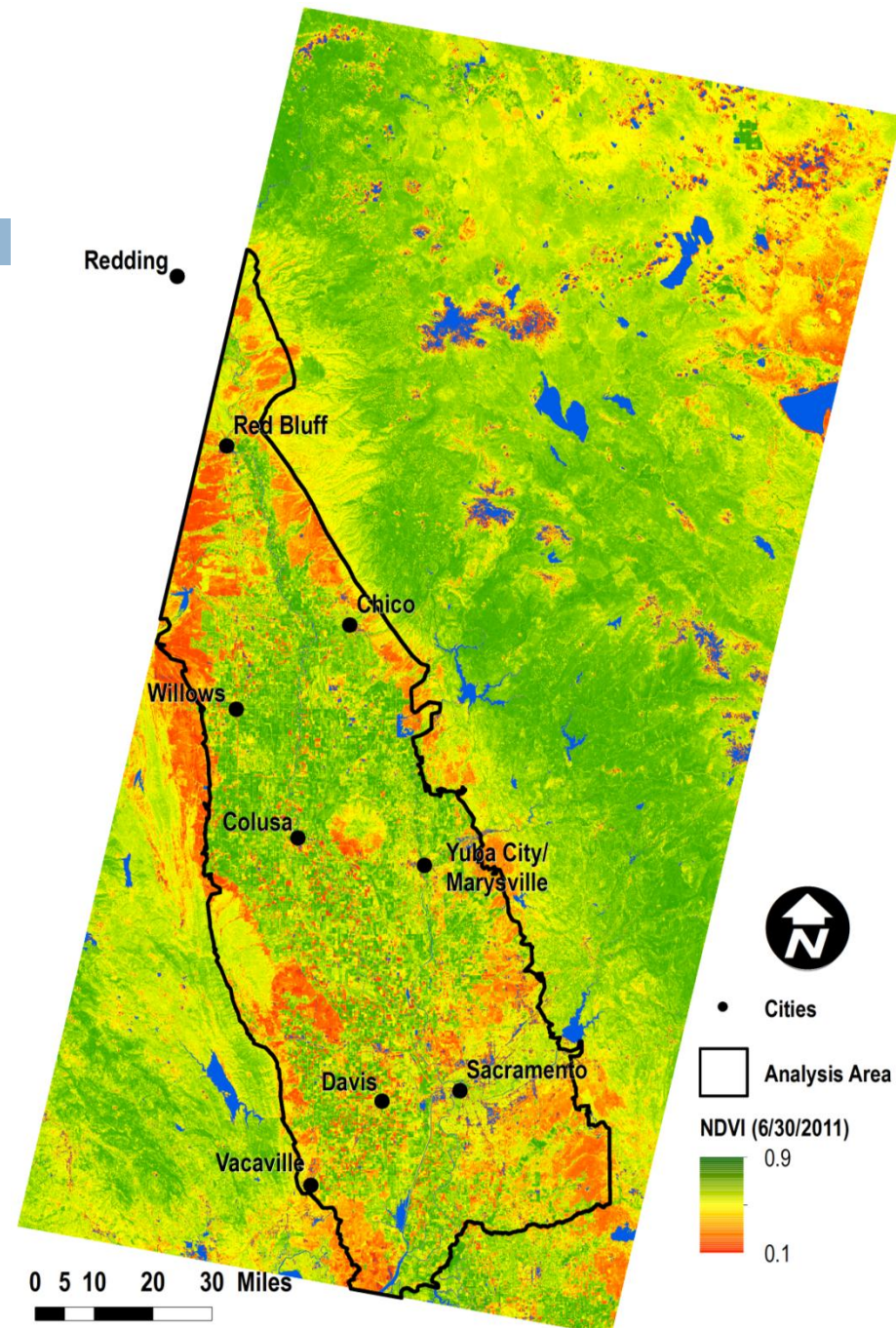
- Most areas with green vegetation during mid-Summer are irrigated (or sub-irrigated)
- As the amount of green vegetation increases, evapotranspiration (ET) increases



Satellite Data

7

- Twelve images from 1985 to 2011
- Selected between July 21 and August 17 based on cumulative Growing-Degree Days (GDD)



Threshold NDVI Values for Analysis

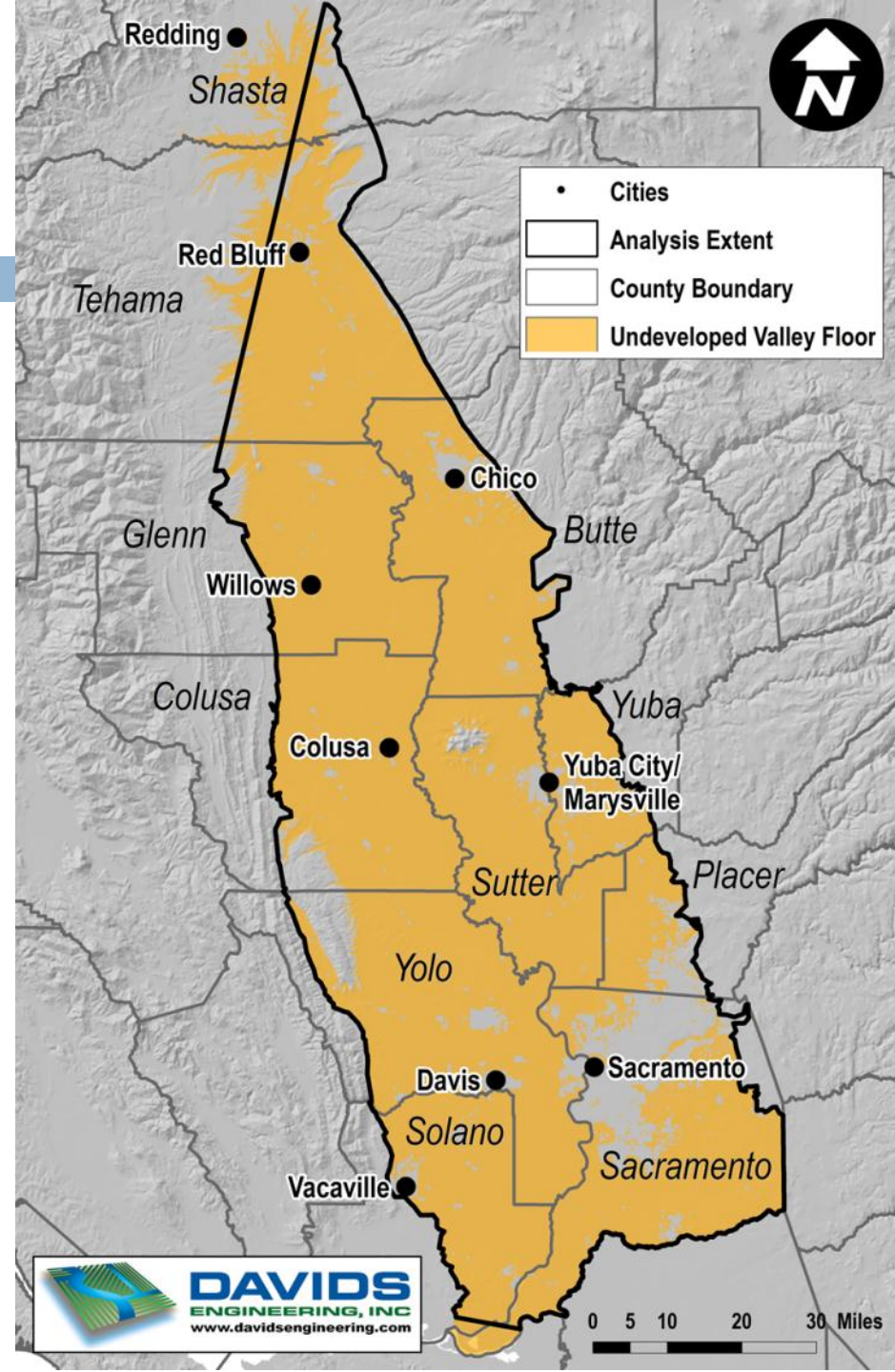
8

- Water Using (“Irrigated”) Area in a Given Year:
 - ▣ $\text{NDVI} \geq 0.25$
- Continuous (i.e., Consistent) Water Using Area for Analysis Period:
 - ▣ $\text{NDVI} \geq 0.25$ in at least 9 of 12 images for individual “pixels”

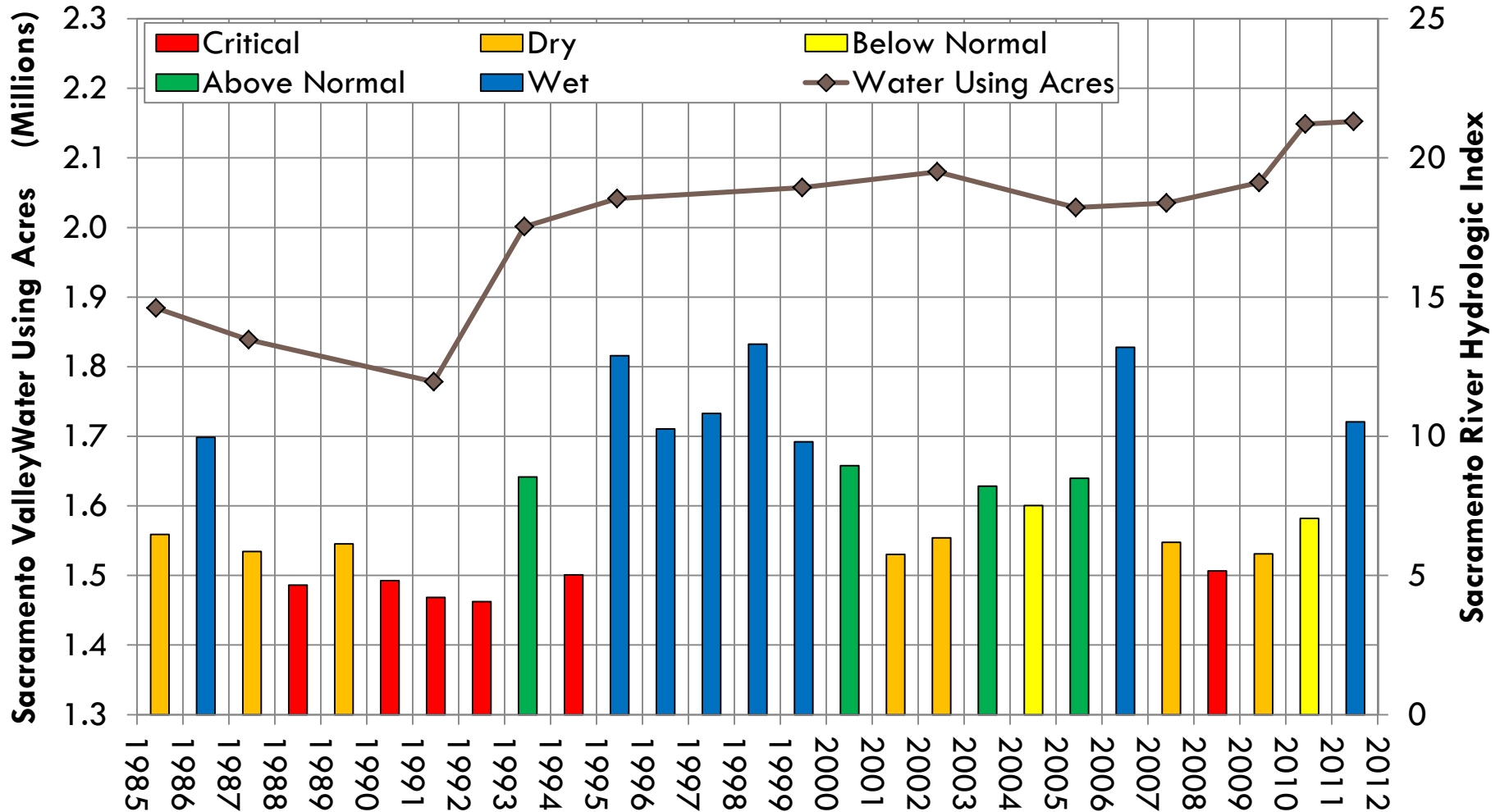
Analysis Area

9

- Portions of 11 Sacramento Valley Counties
- 3.8 million gross acres
- Limited Somewhat by Landsat Image Extent

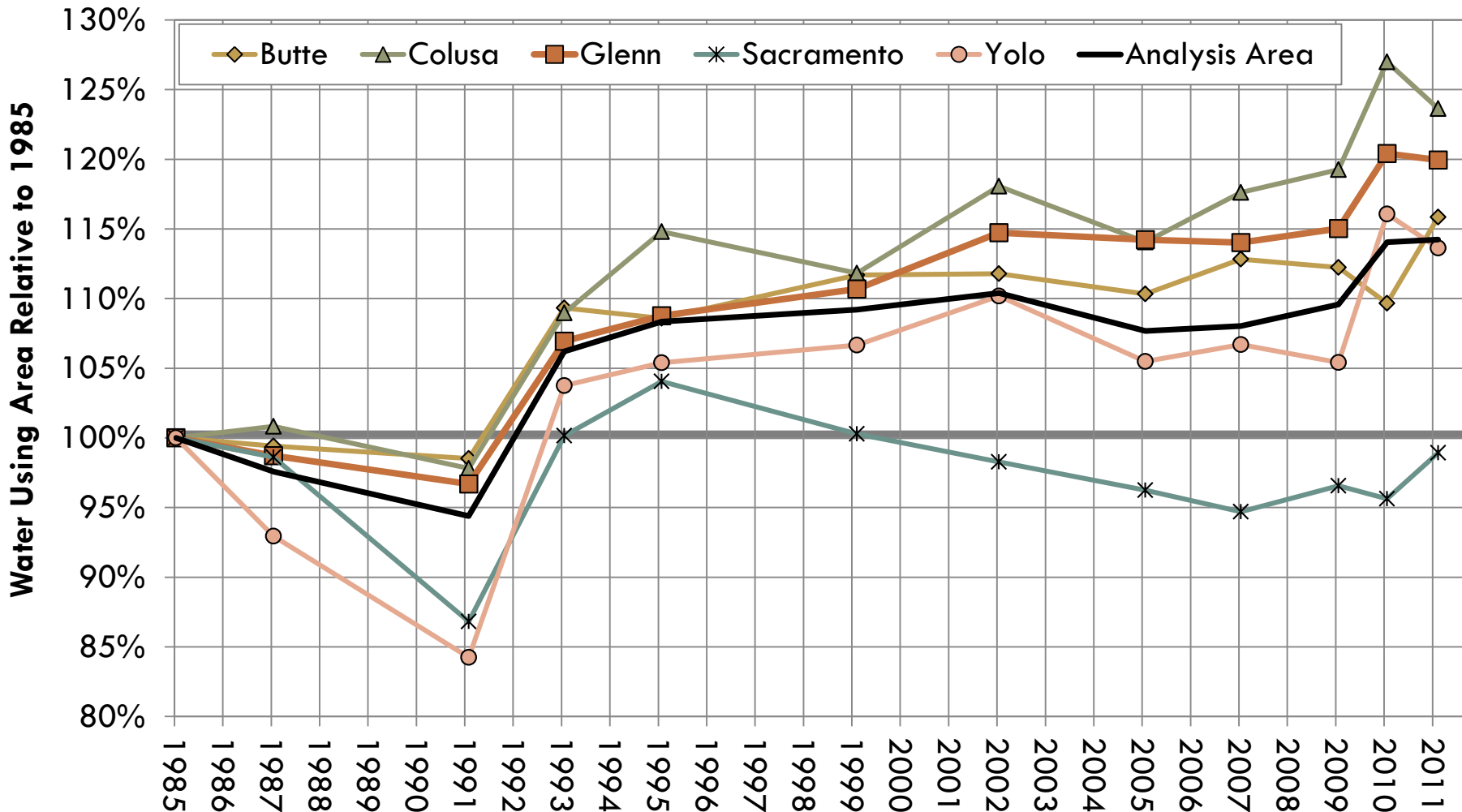


Water-Using Area and Hydrologic Year Type



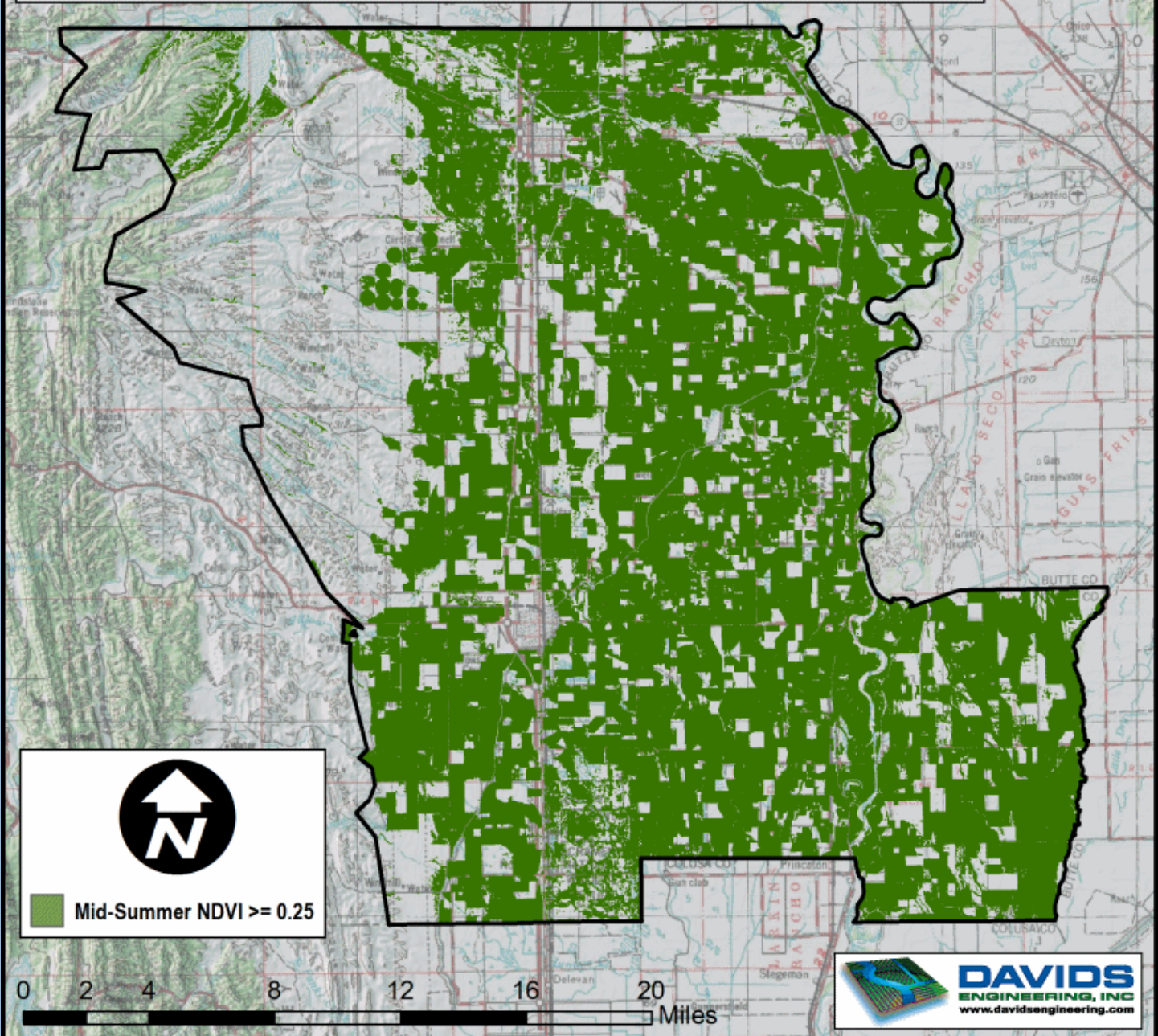
Water-Using Area for Selected Counties, Relative to 1985

11



Glenn County Valley Floor Area with Mid-Summer Green Vegetation

July 24, 1985
231,800 Acres



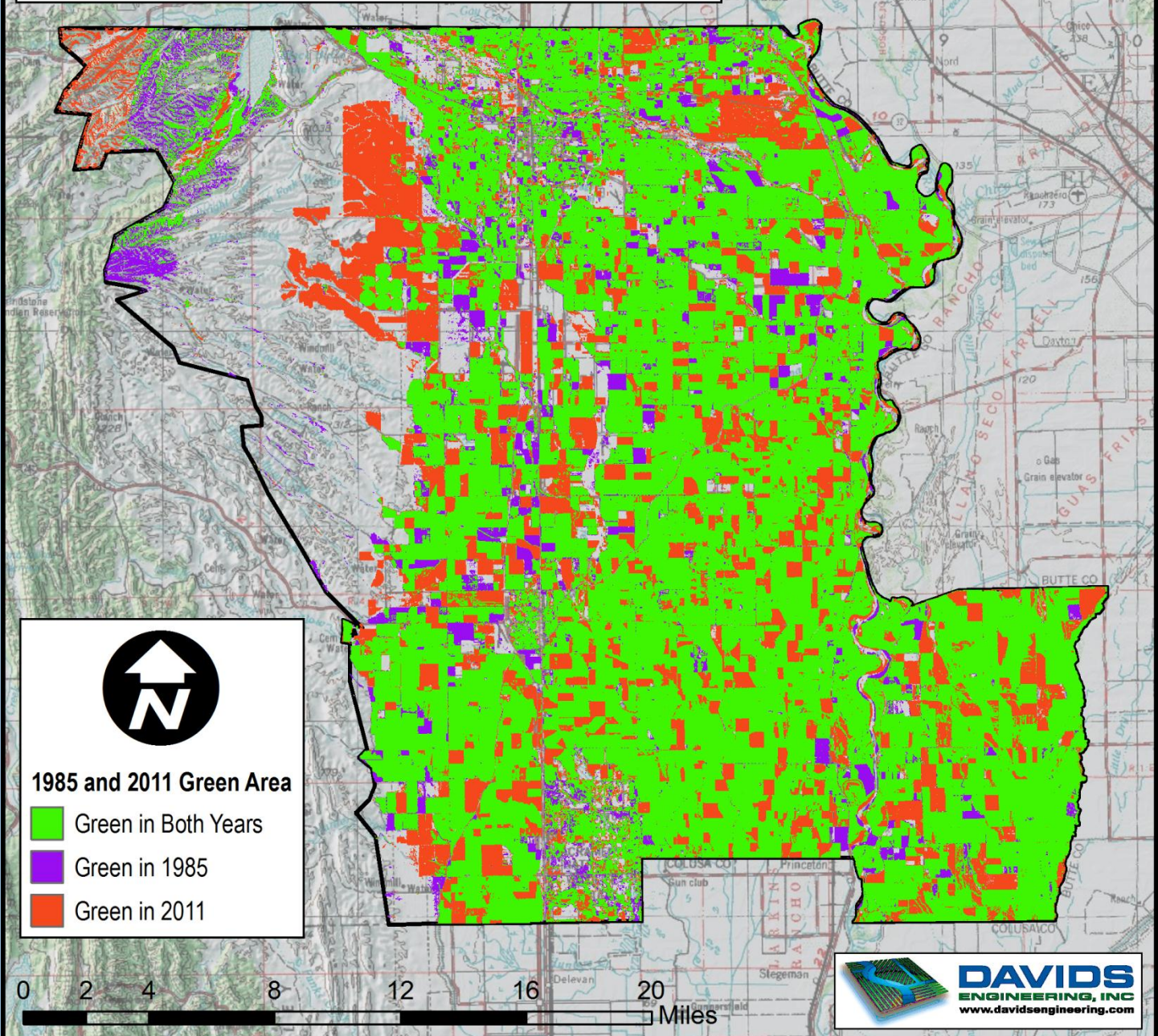
Mid-Summer NDVI >= 0.25

0 2 4 8 12 16 20 Miles

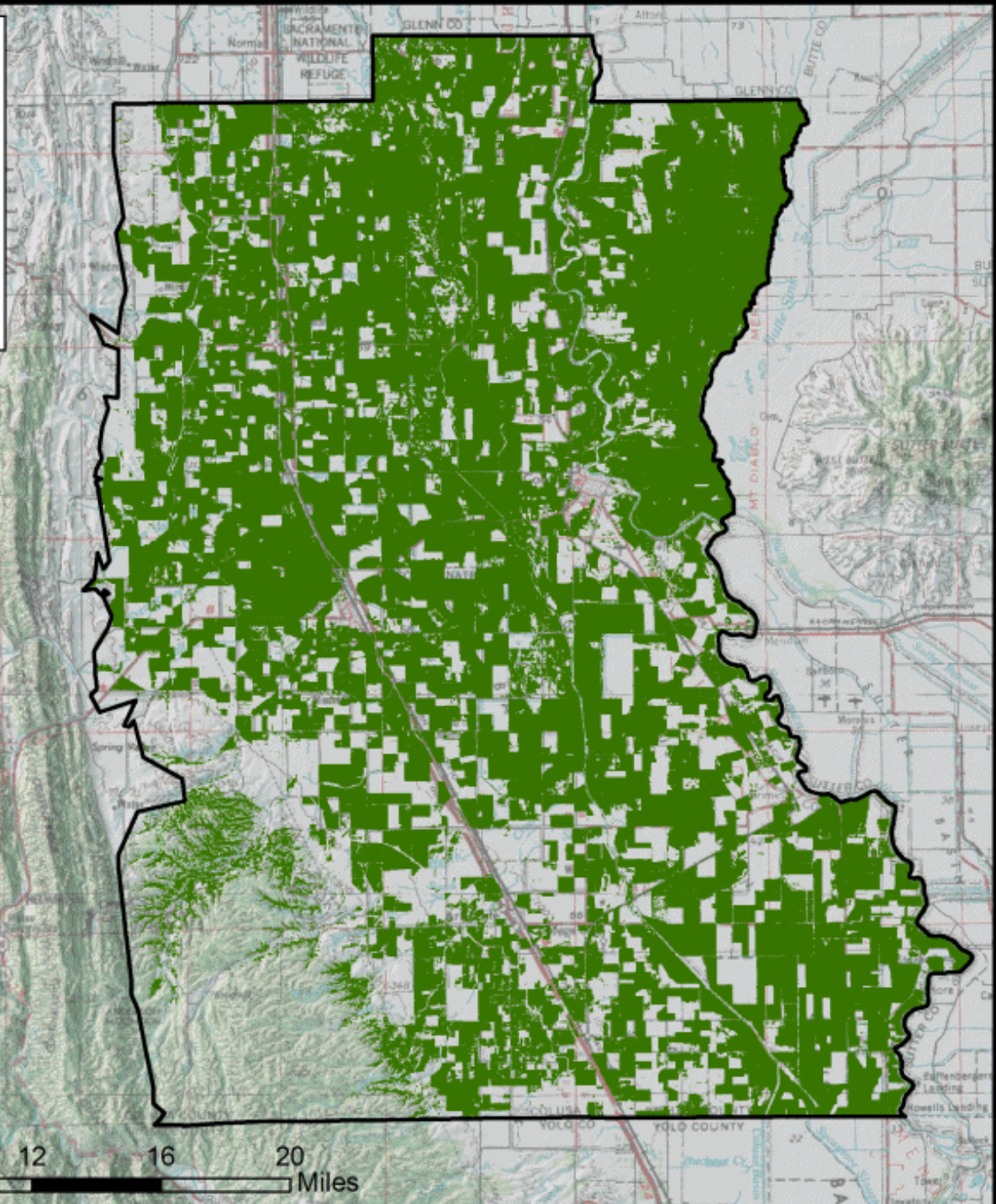


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ENGINEERING, INC
www.davidsengineering.com

Comparison of Glenn County Valley Floor 1985 and 2011 Mid-Summer Green Area



**Colusa County
Valley Floor
Area with Mid-
Summer Green
Vegetation
July 24, 1985
270,000 Acres**

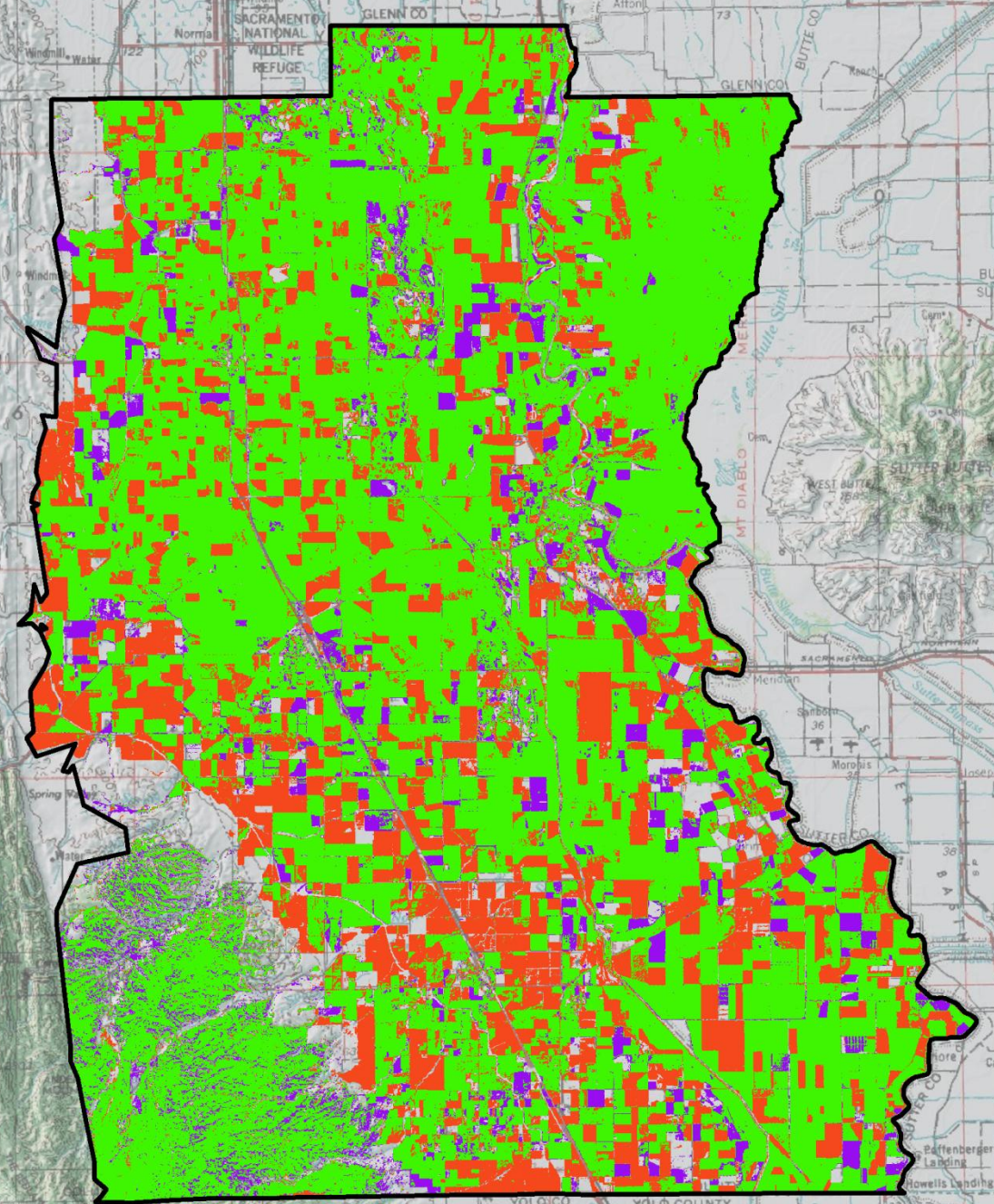


Mid-Summer NDVI ≥ 0.25



0 2 4 8 12 16 20 Miles

Comparison of Colusa County Valley Floor 1985 and 2011 Mid-Summer Green Area



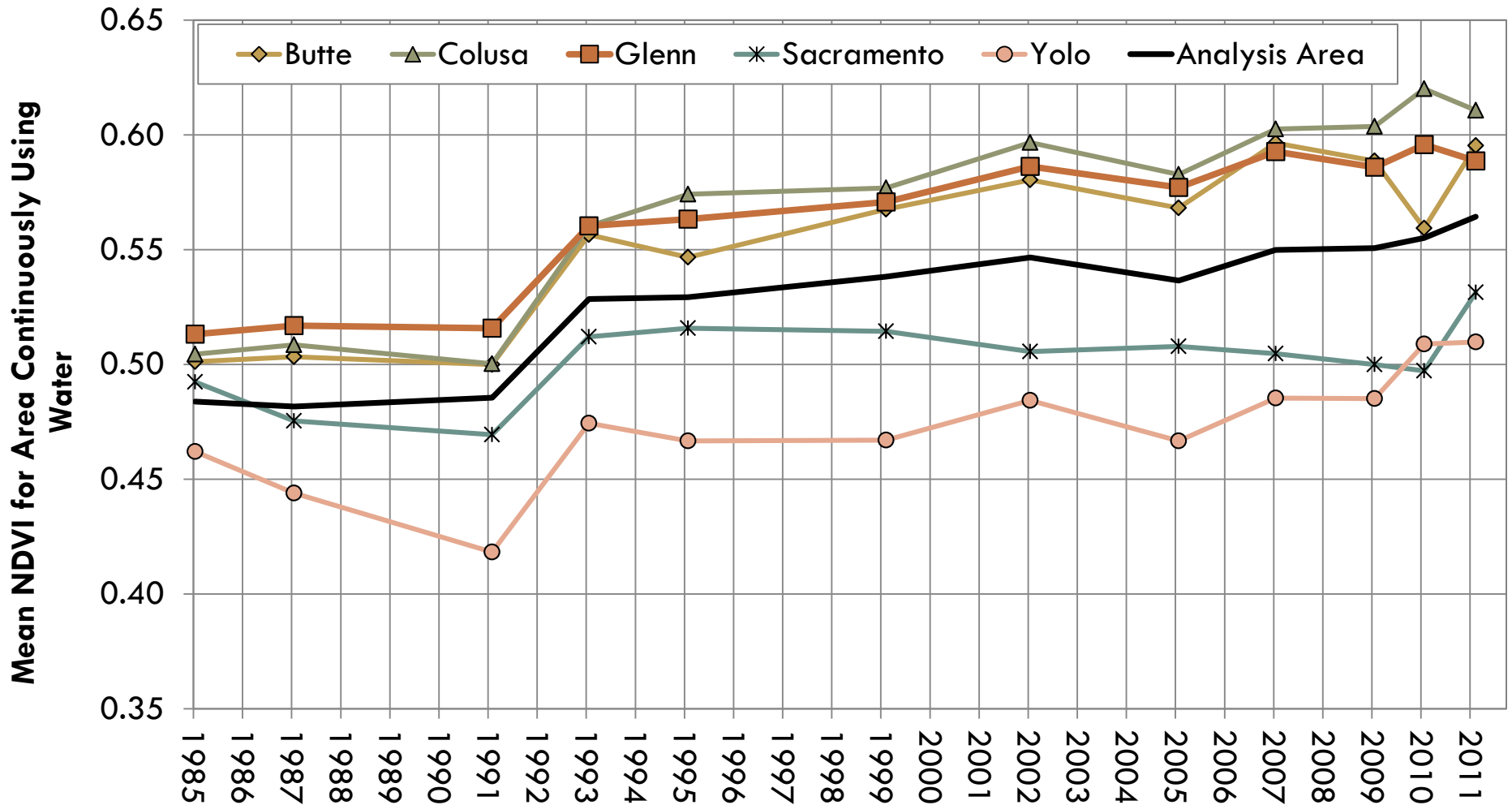
1985 and 2011 Green Area

-  Green in Both Years
-  Green in 1985
-  Green in 2011



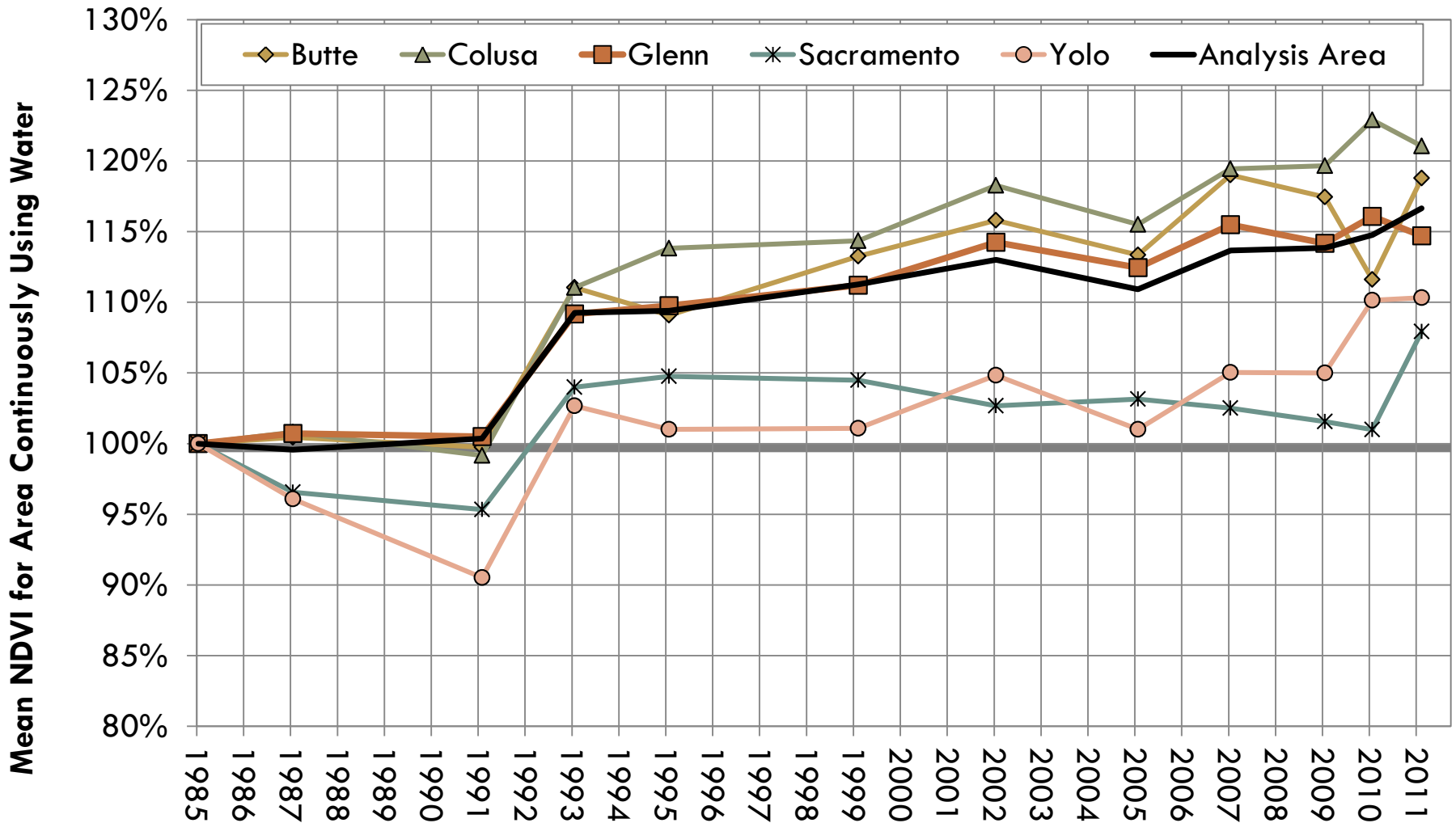
Mean NDVI for Area Continuously Using Water for Selected Counties

16

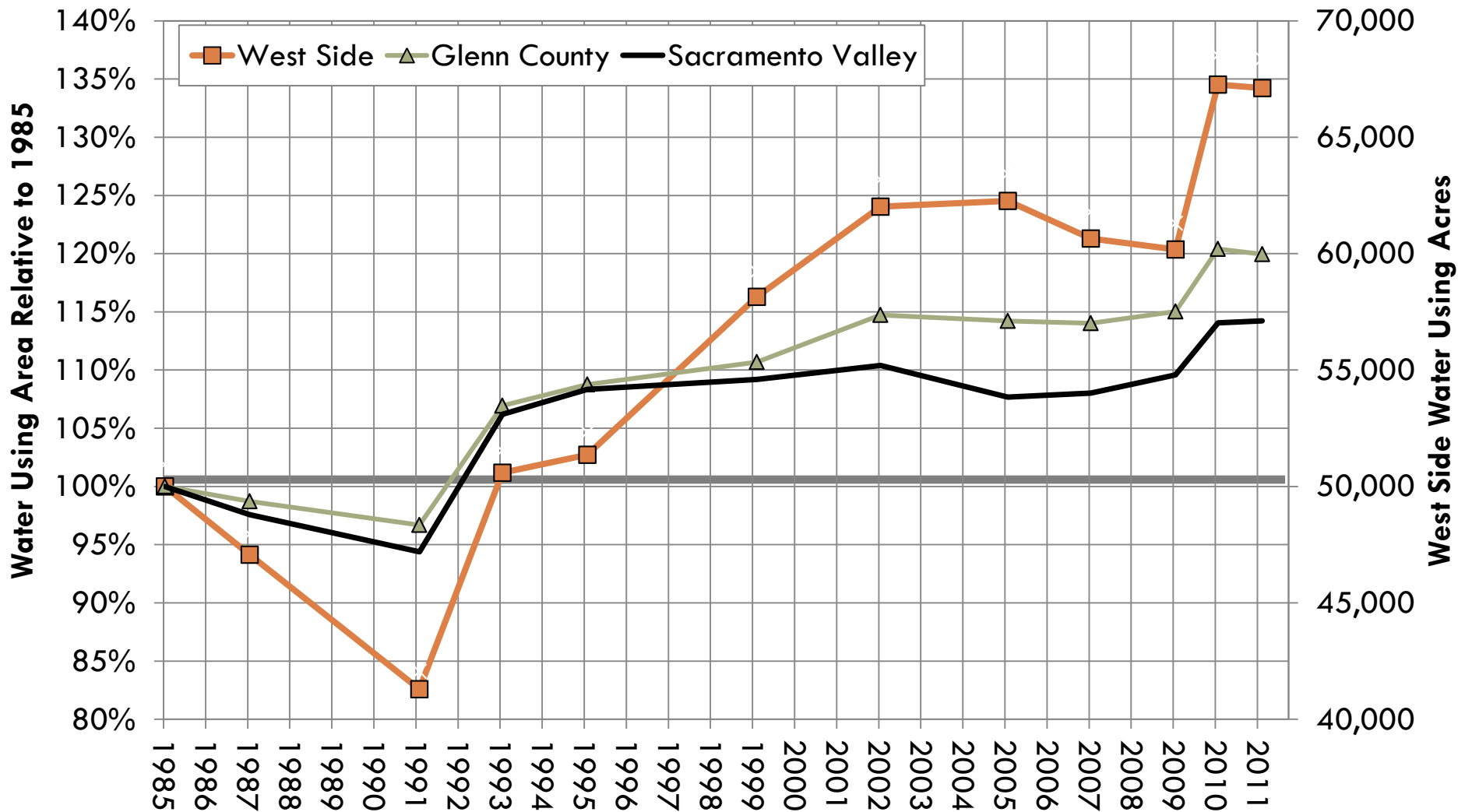


Mean NDVI for Area Continuously Using Water for Selected Counties Relative to 1985

17

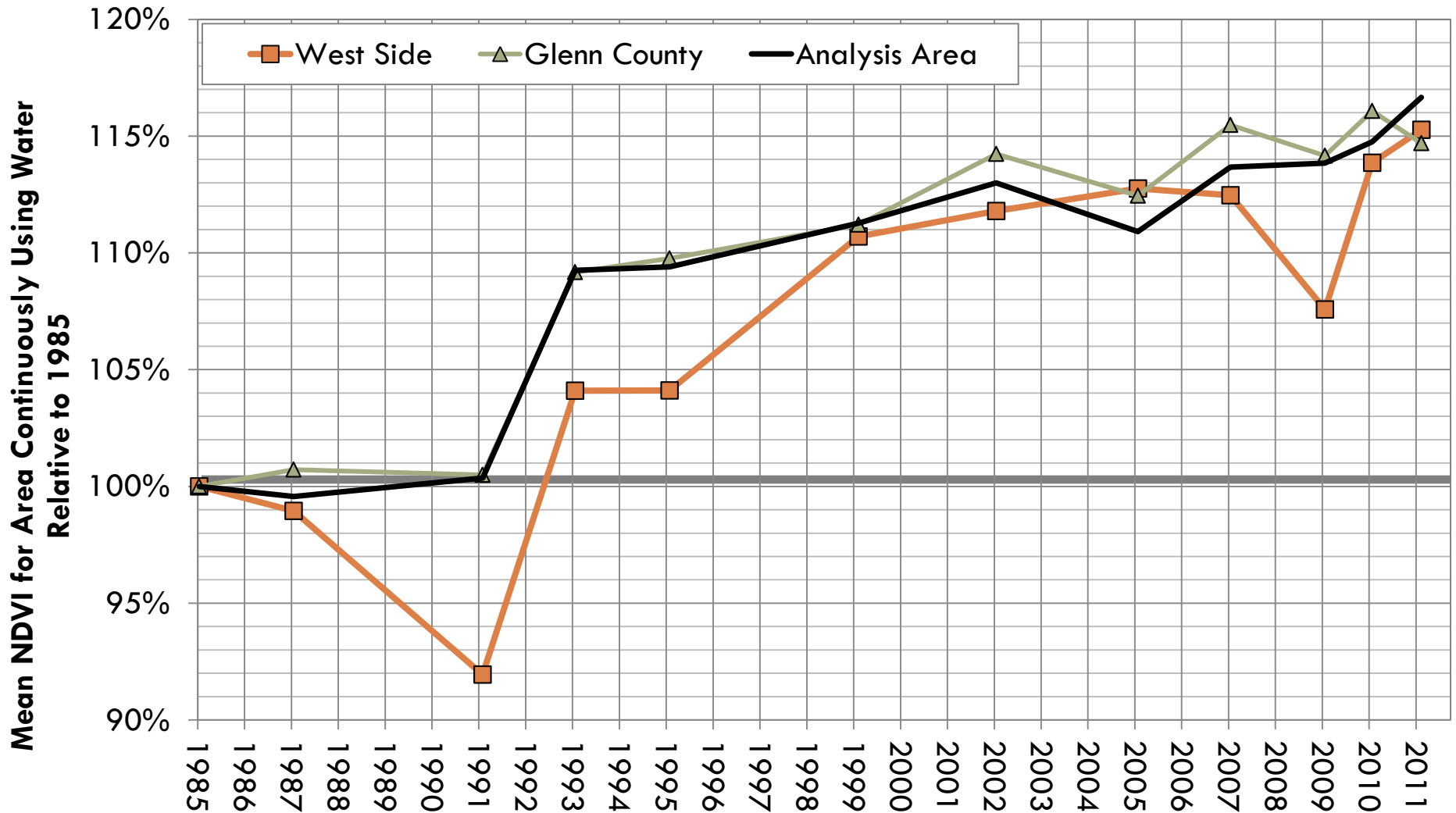


Water-Using Area for West Side Area, Glenn County, and Sacramento Valley Relative to 1985

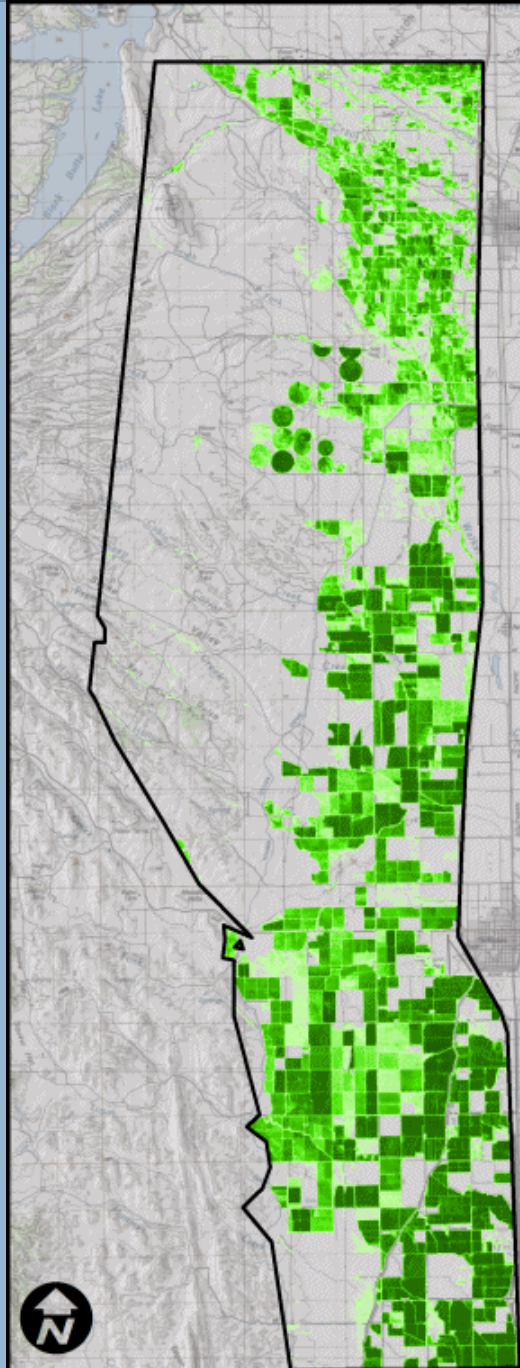


Relative NDVI for West Side Area, Glenn County, and Sacramento Valley Relative to 1985

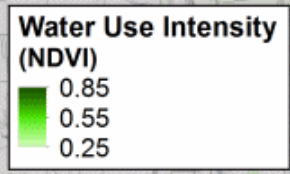
19



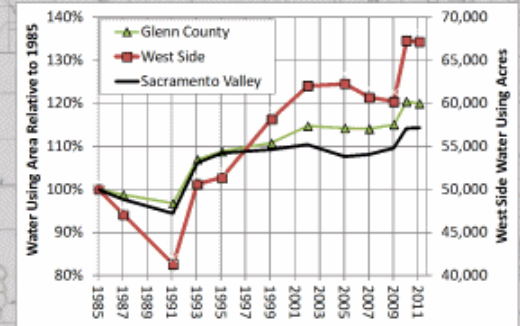
Evolution of Water-Using Area in West Side Area



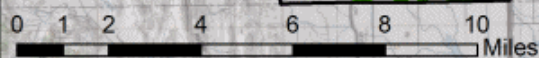
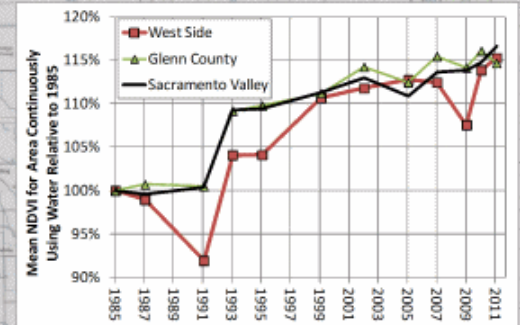
Glenn County West Side Valley Floor Mid-Summer Vegetation Index
July 24, 1985
50,900 Acres



Water Using Area Relative to 1985



Water Use Intensity Relative to 1985

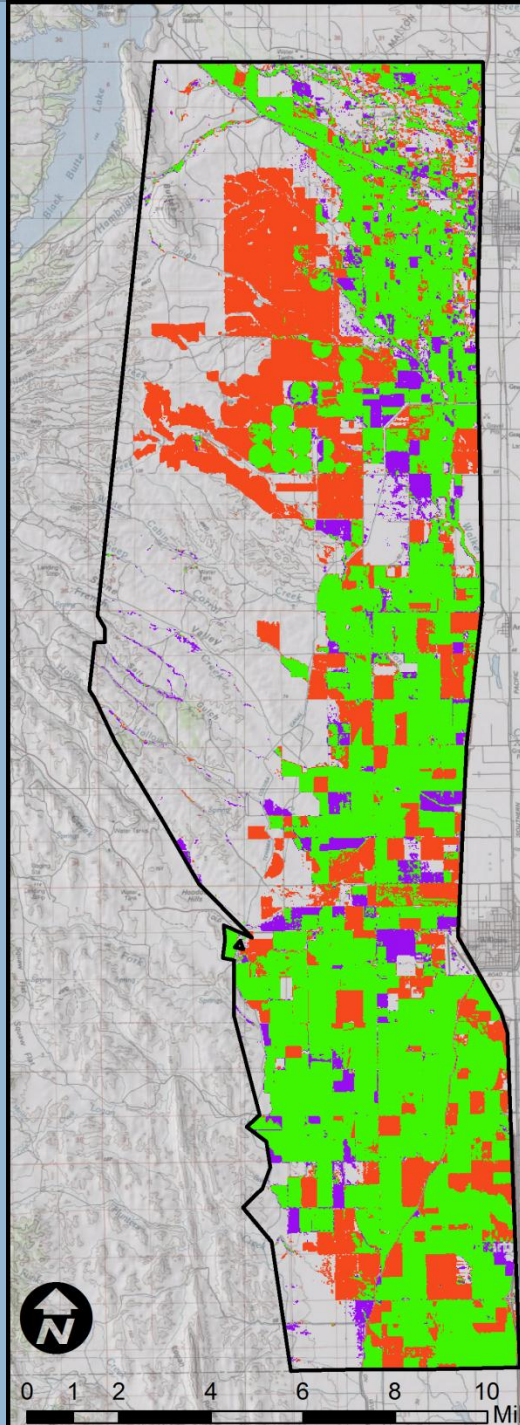


Comparison of 1985 and 2011 Water-Using Area

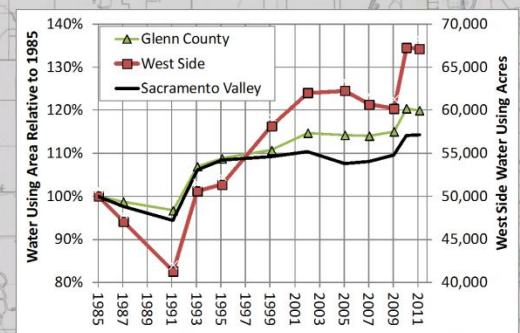
Comparison of West Side 1985 and 2011 Mid-Summer Green Vegetation

1985 and 2011 Green Area

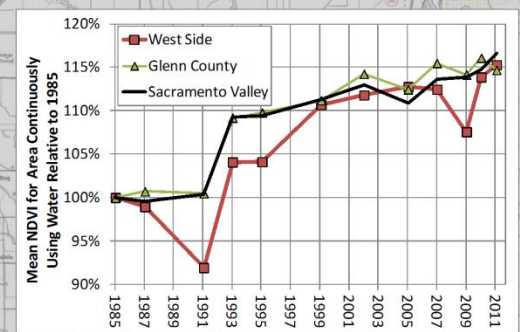
- Green in Both Years
- Green in 1985
- Green in 2011



Water Using Area Relative to 1985



Water Use Intensity Relative to 1985



Summary

- In Glenn County Relative to 1985:
 - ▣ Water using area has increased by about 20%
 - ▣ Per-acre water use intensity has increased by about 15%
 - ▣ Combined, consumptive use has increased by roughly 35%

Summary

- In Glenn County West Side Area Relative to 1985:
 - ▣ Water using area has increased by about 35%
 - ▣ Per-acre water use intensity has increased by about 15%
 - ▣ Combined, consumptive use has increased by roughly 50%

Thank You!

Discussion

