



Water Level Trends & Consumptive Use on the R9 Ranch

WATER PACK CONSULTANT PRESENTATION

ANDREW KELLER, PHD, P.E. – KELLER-BLIESNER ENGINEERING, LLC

HAYS-DWR PUBLIC MEETING JUNE 21, 2018 – GREENSBURG, KANSAS



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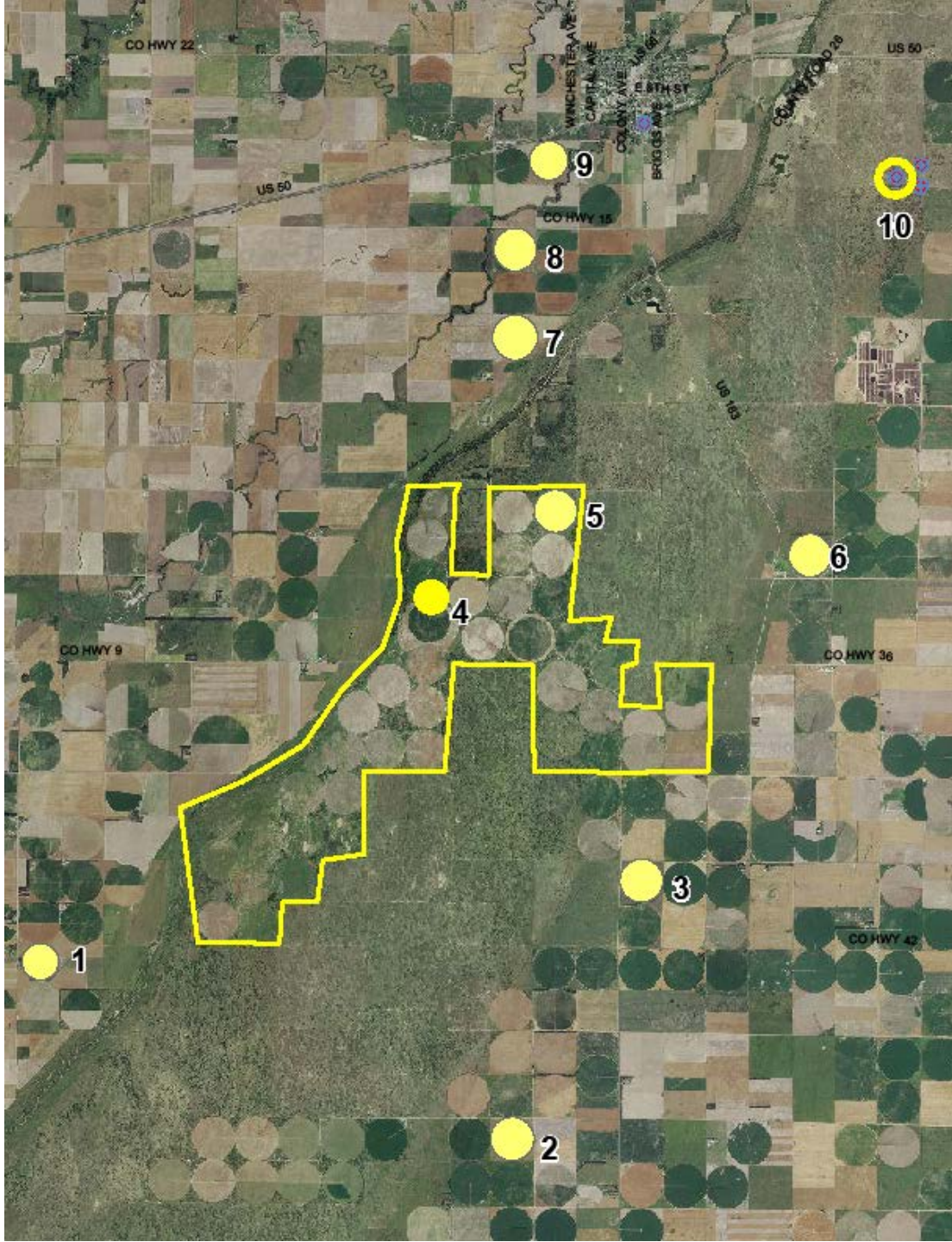
Cause for Concern

- ▶ Groundwater levels in R9 Ranch vicinity are declining
 - ▶ Despite reduction in pumping on the Ranch
- ▶ Spatial analysis and water budget show historical groundwater storage declines
- ▶ Not sustainable
- ▶ Any increase in water consumption will further stress the finite water resource



Groundwater Level Trends

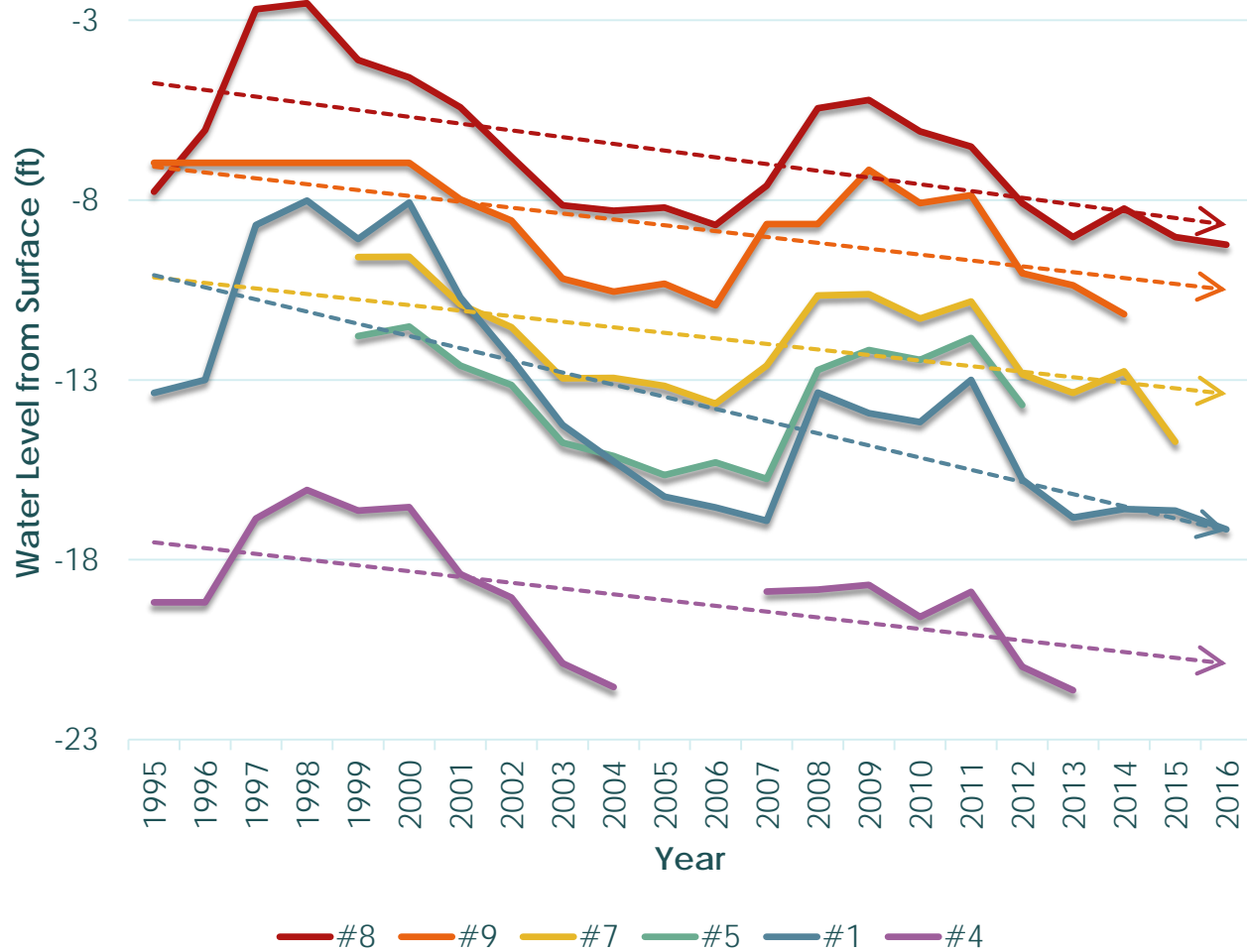




Placement of Wells On and Surrounding R-9 Ranch

Water Levels
Measured by KGS,
DWR, and GMD#5



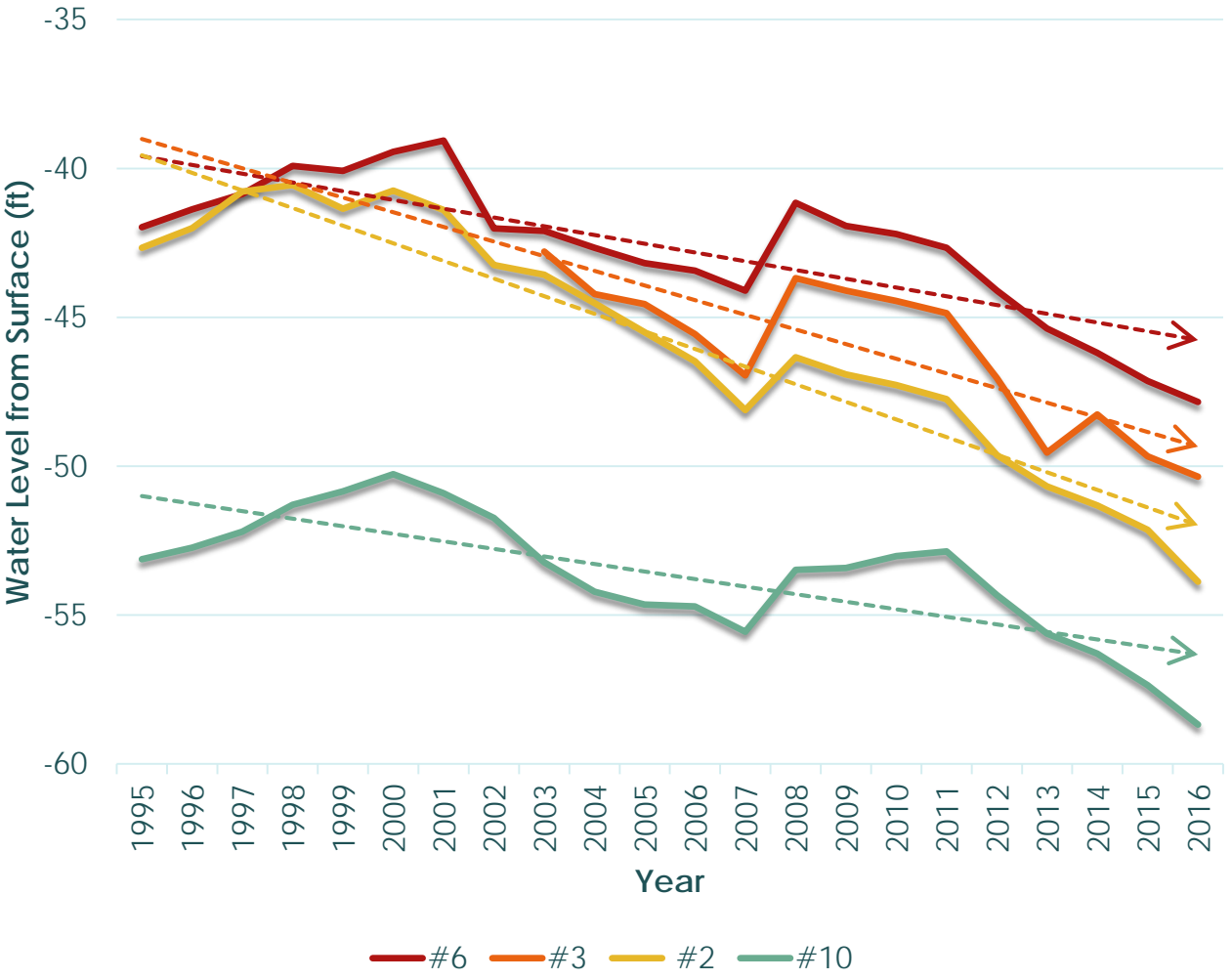


Historical Water Levels of Wells in and around R-9 Ranch 1995-2016





Historical Water Levels of Wells in and around R-9 Ranch 1995-2016



R-9 Water Usage

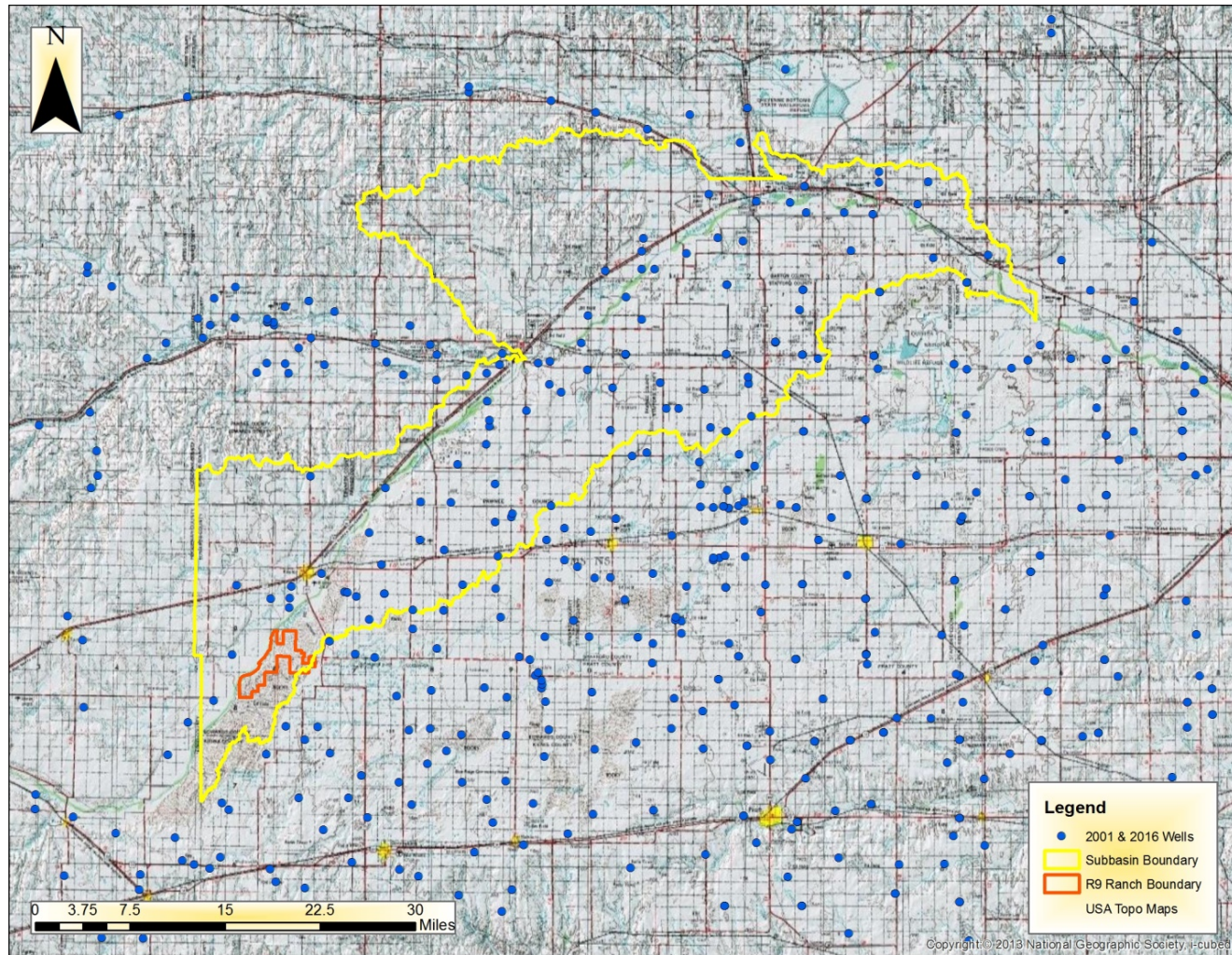


Historical
Water Usage
on R-9 Ranch
1995 - 2014



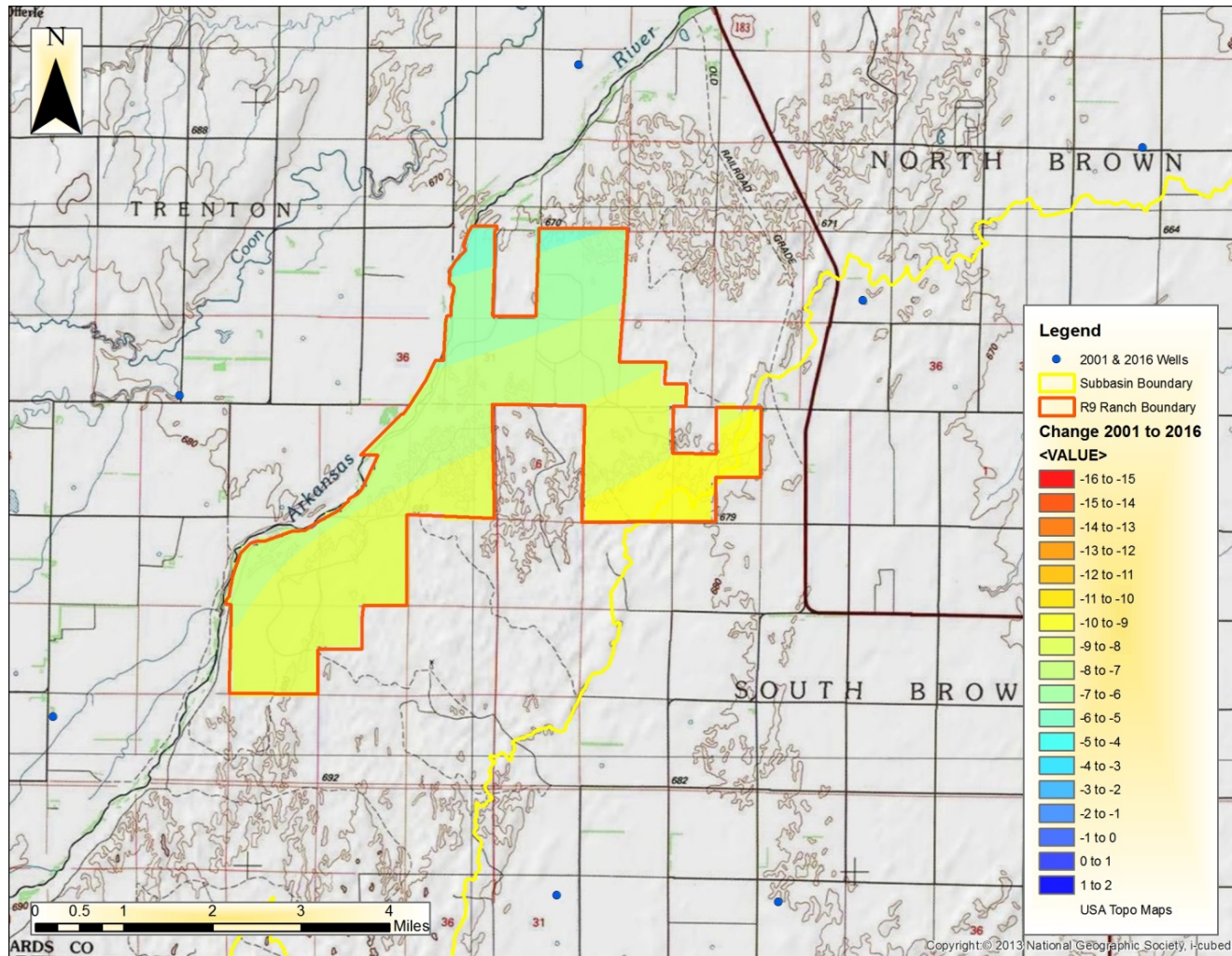
Spatial Analysis of Water Levels





Middle Arkansas River Subbasin, R9 Ranch, and 521 Wells





Change in depth-to-water in feet from 2001 to 2016 clipped to the R9 Ranch boundary

Mean decline of 7.9 feet in 15 years (0.53 ft/y) nearly double the average decline for the Middle Arkansas over the same period and six times the subbasin mean decline for 1988 to 2001.



R9 Ranch Consumptive Use Analysis



Basis for R9 Ranch Consumptive Use Analysis

Criteria for change in use– Net consumptive use (CU) must not be greater than original irrigation net CU (K.A.R. 5-5-9 (a))

If unrealistic then site-specific net consumptive use analysis (K.A.R. 5-5-9 (c))

METRIC evapotranspiration (ET) analysis using 1984-1985 satellite imagery and 30-year climatology



Rules and Regulations

Kansas Water Appropriation Act

April, 2014

- ▶ **Kansas Administrative Regulations (K.A.R.) 5-5-9:** Criteria for change in use from irrigation to any other type of beneficial water use
 - ▶ K.A.R. 5-5-9 (a): **Net** consumptive use (CU) must not be greater than original irrigation net CU
 - ▶ **Maximum** annual quantity of water shall be the net irrigation requirement (NIR) for the 50% chance rainfall for the county of origin, as set forth in K.A.R. 5-5-12, multiplied by the maximum acreage legally irrigated under the authority of the water right in **any one calendar year during the perfection period.**
 - ▶ K.A.R. 5-5-12 NIR for 50% chance rainfall = 13 inches = 1.08 feet
 - ▶ K.A.R. 5-5-9 (c): If quantity by K.A.R. 5-5-9 (a) appears unrealistic or could impair other water rights the chief engineer shall make a **site-specific net consumptive use analysis.**
 - ▶ **This is the basis for the R9 Ranch site-specific net consumptive use analysis we conducted for Water PACK**



R9 Ranch CU not on par with other irrigated properties in Edwards County

Sporadic
farming
history

Very low
water-holding
capacity soils



Irrigation Net Consumptive Use

Actual evapotranspiration (ET)
with irrigation minus effective
precipitation

Effective precipitation will be
greater under post-transfer
dryland/natural grassland
conditions than under pre-transfer
irrigated conditions



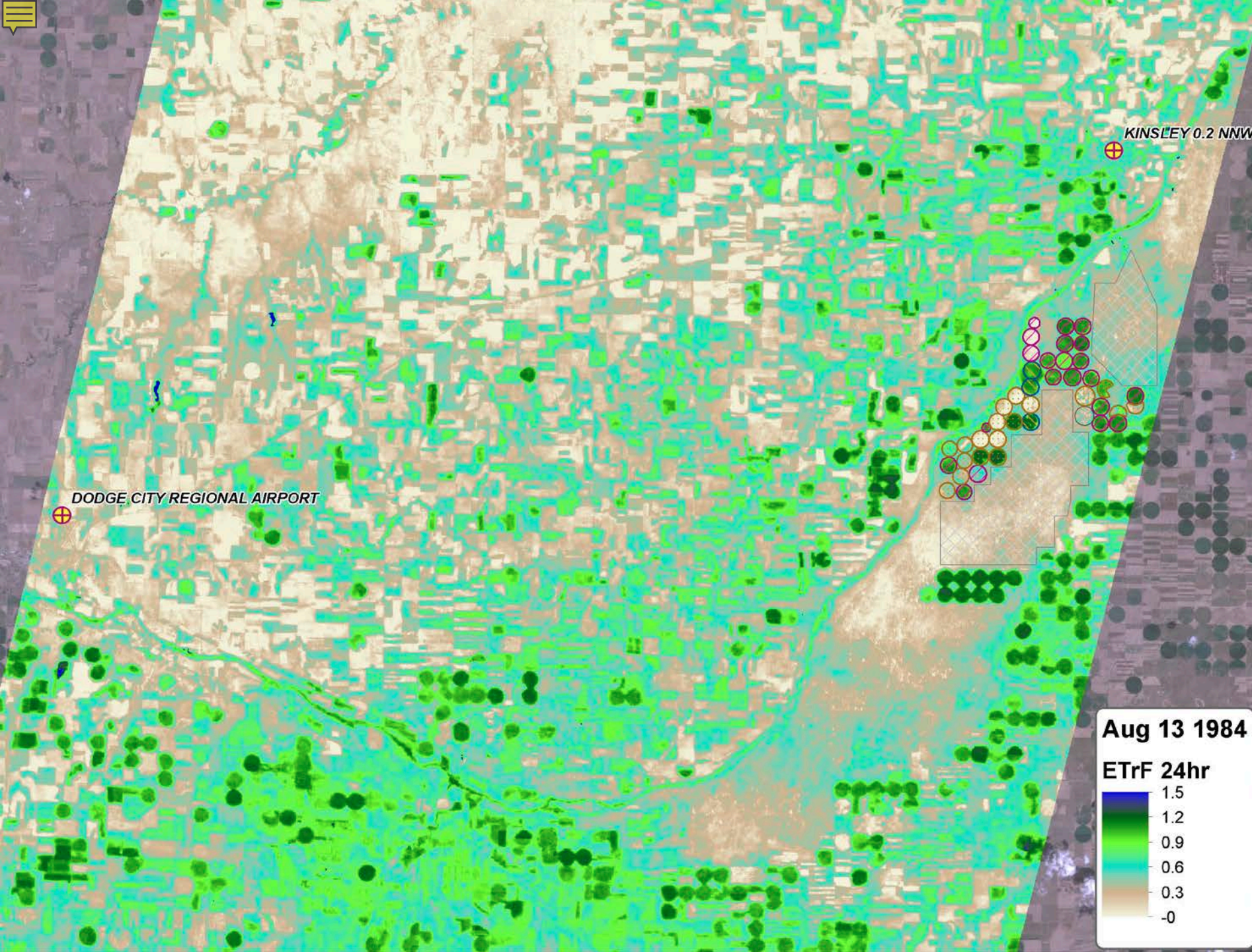


Evapotranspiration Calculation for R9 Ranch Irrigation



- ▶ 30-year (1980-2009) average
- ▶ Alfalfa and grain corn ET under reference conditions near Kinsley
- ▶ Quality-controlled, daily climate data from Dodge City and Kinsley
- ▶ ASCE standard method recognized by SCOTUS in Kansas vs Colorado
- ▶ Adjusted for R9 Ranch actual ET conditions
 - ▶ Using METRIC ET mapping
 - ▶ 1984 and 1985 (perfection period) Landsat satellite data





ETrF Map from
METRIC Model
for Aug 13, 1984
Landsat 5
row 29 path 34





ETrF Map for the R9 Ranch from METRIC Model for May 25, 1984 Landsat 5 row 29 path 34



Net Transferable CU Results

Alfalfa

- ▶ $ET_c = 46.0$ inch
- ▶ Mean $ET_rF = 0.72$
- ▶ $ET_a = 46.0 \times 0.72 = 33.1$ inch
- ▶ 50% Prob. Eff. Precip. = 15.4 inch
- ▶ N.I.R. = $33.1 - 15.4 = 17.7$ inch
- ▶ Grassland CU of Precip = 21.1 inch
- ▶ Net Change CU = $33.1 - 21.1 = 12.0$ inch

Grain Corn

- ▶ $ET_c = 35.9$ inch
- ▶ Mean $ET_rF = 0.72$
- ▶ $ET_a = 35.9 \times 0.72 = 25.8$ inch
- ▶ 50% Prob. Eff. Precip. = 12.2 inch
- ▶ N.I.R. = $25.8 - 12.2 = 13.6$ inch
- ▶ Grassland CU of Precip = 21.1 inch
- ▶ Net Change CU = $25.8 - 21.1 = 4.7$ inch



Total Net Transferable CU for R9 Ranch

Alfalfa

- ▶ Net Change CU = 12.0 inch = 1.00 ft
- ▶ 2,901 acre alfalfa x 1.00 ft = 2,901 AF

Grain Corn

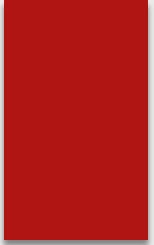
- ▶ Net Change CU = 4.7 inch = 0.40 ft
- ▶ 2,247 acre corn x 0.40 ft = 889 AF

Maximum transferable water by net consumptive use analysis from drying up irrigation on the R9 Ranch = 2,901 AF + 889 AF = 3,790 AF





In summary

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- ▶ Groundwater levels in R9 Ranch vicinity are declining despite reduction in Ranch pumping
 - ▶ Not sustainable
 - ▶ Any increase in water consumption will cause further stress
 - ▶ Hays has right to use its water according to Kansas Administrative Regulations (K.A.R.)
 - ▶ K.A.R. Criteria for change in use: **no increase in net CU**
 - ▶ K.A.R. allows for **site-specific net CU analysis**
 - ▶ Site-specific net CU analysis of R9 Ranch indicates **maximum change in use volume of 3,790 AF per year**



Thank you

