Kansas Playas – A Past & Future Resource

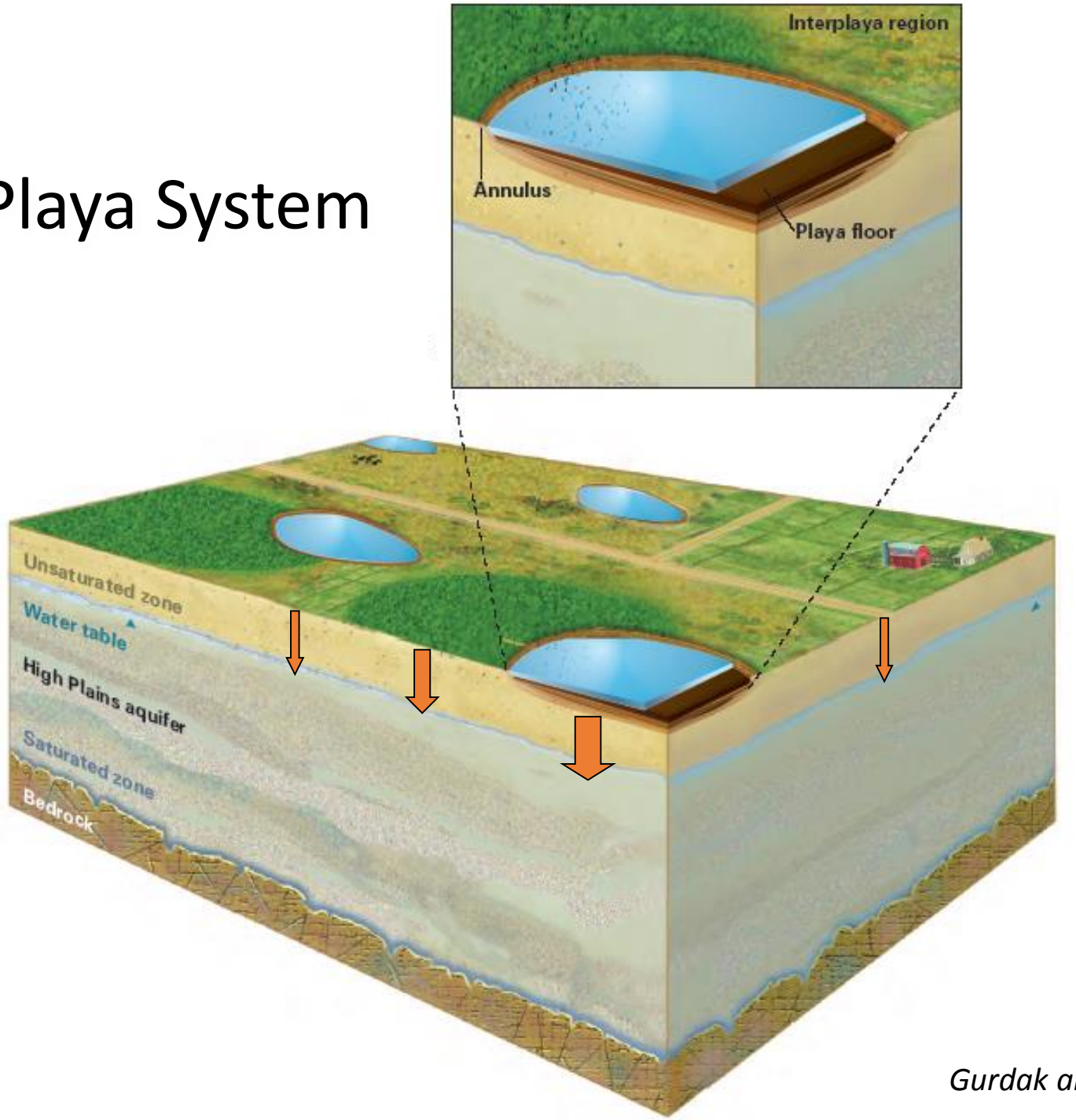
Jude Kastens, Randy Stotler, Debbie Baker & Don Huggins

Future of Water in Kansas | Wichita, KS | November 8, 2019

Rawlins County – June 2018

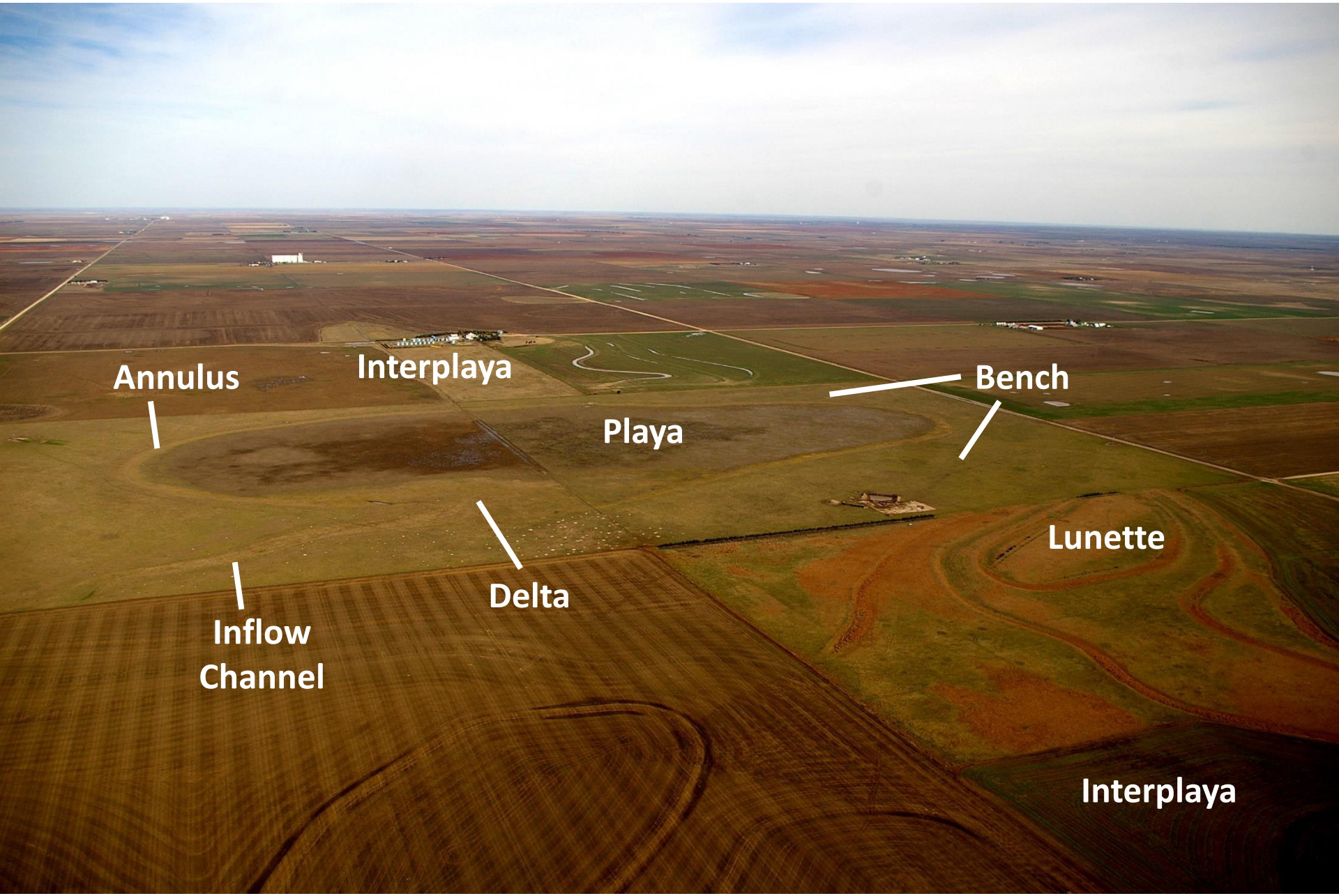
jkastens@ku.edu

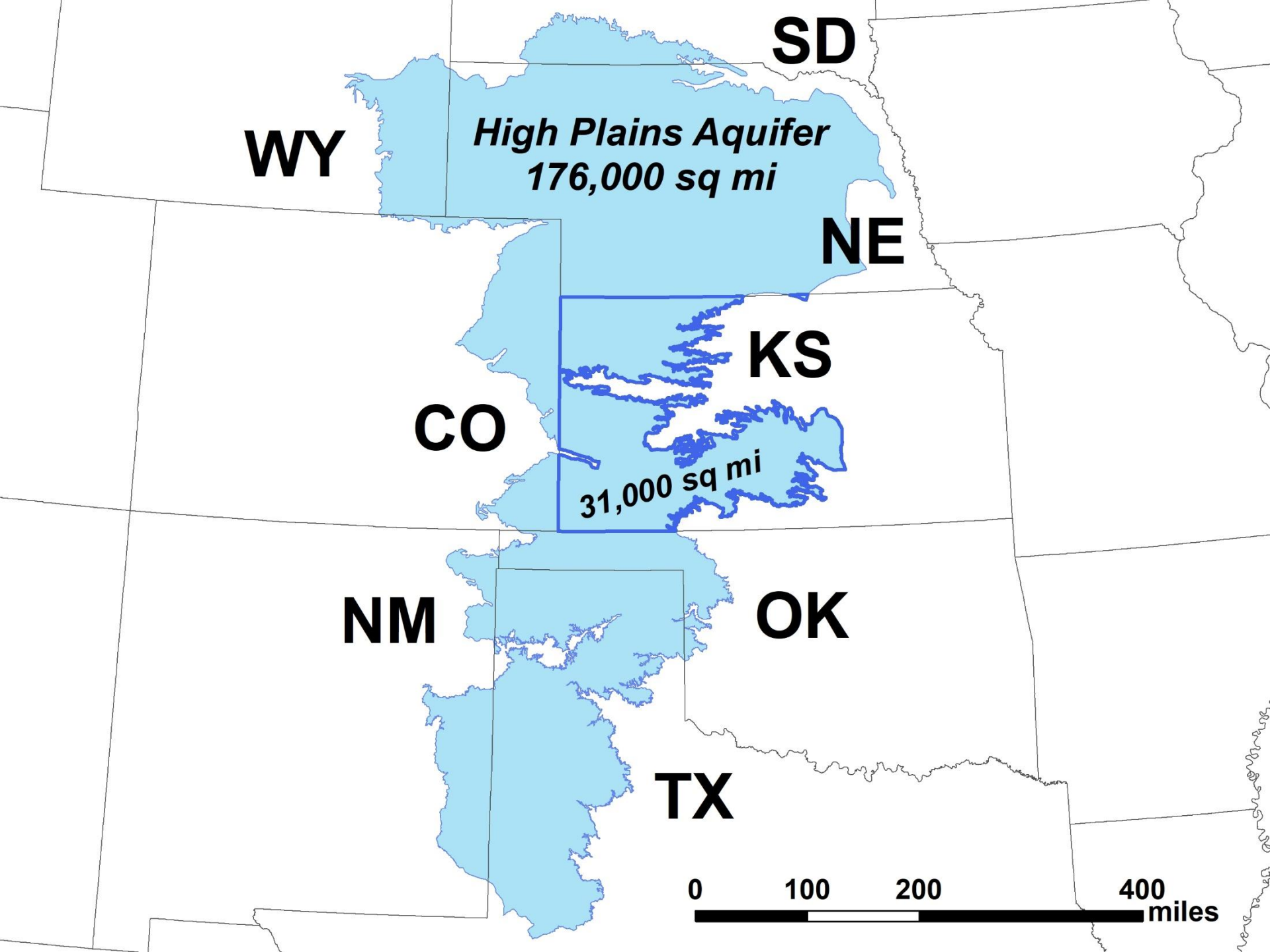
The Playa System



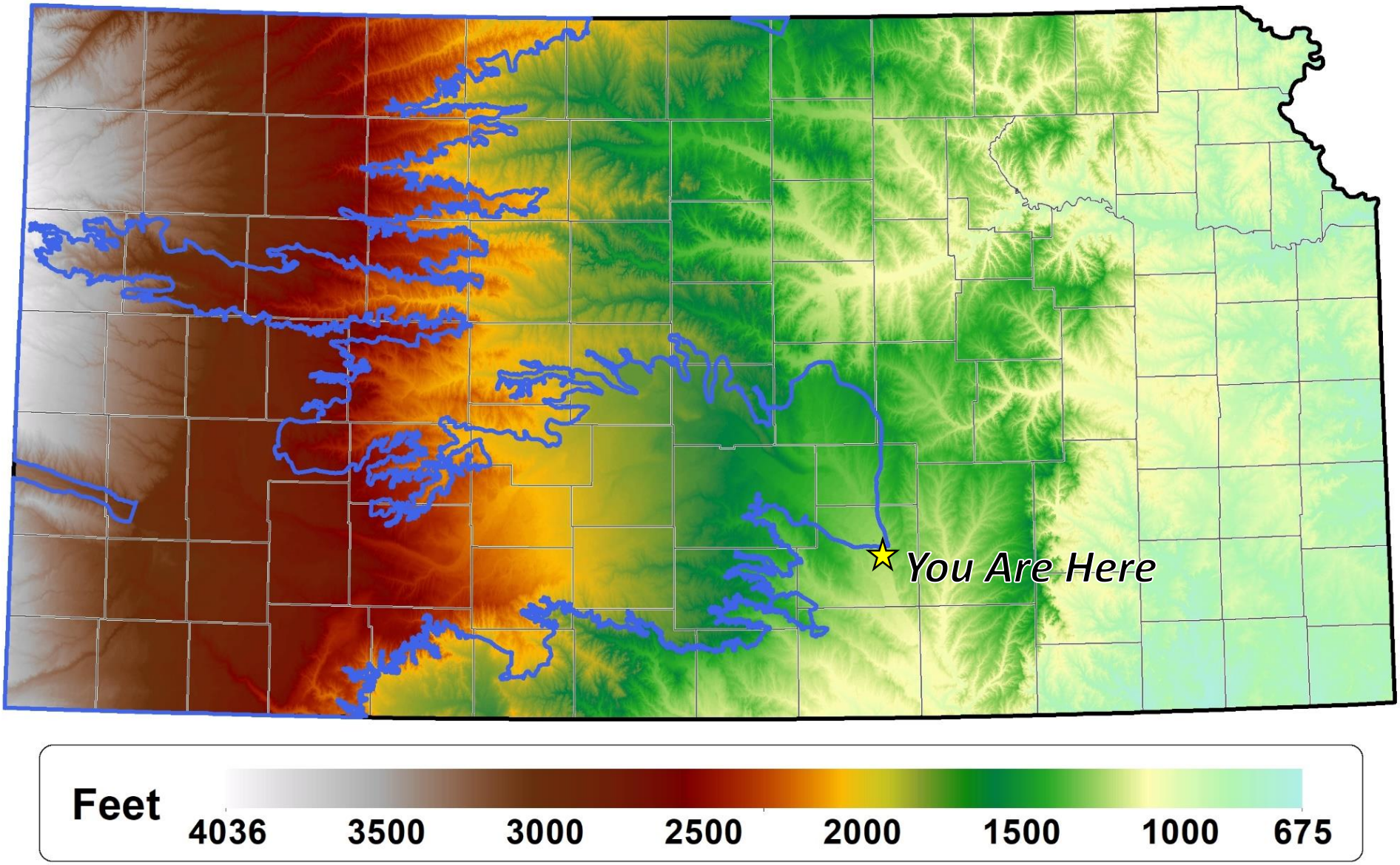
Gurdak and Roe (2009)

The Ehmke Playa

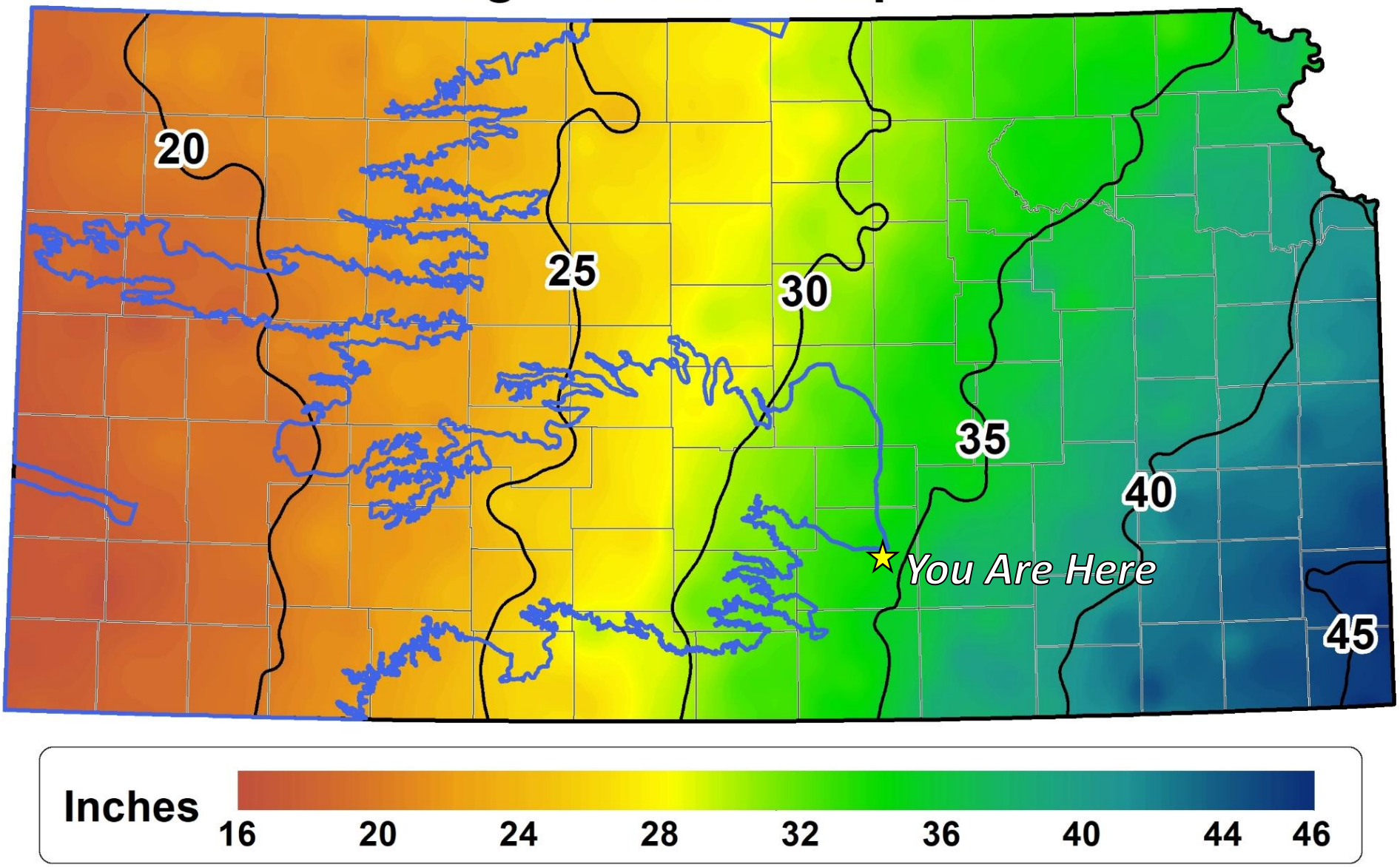



SD
WY
High Plains Aquifer
176,000 sq mi
NE
KS
CO
31,000 sq mi
NM
OK
TX
0
100
200
400
miles

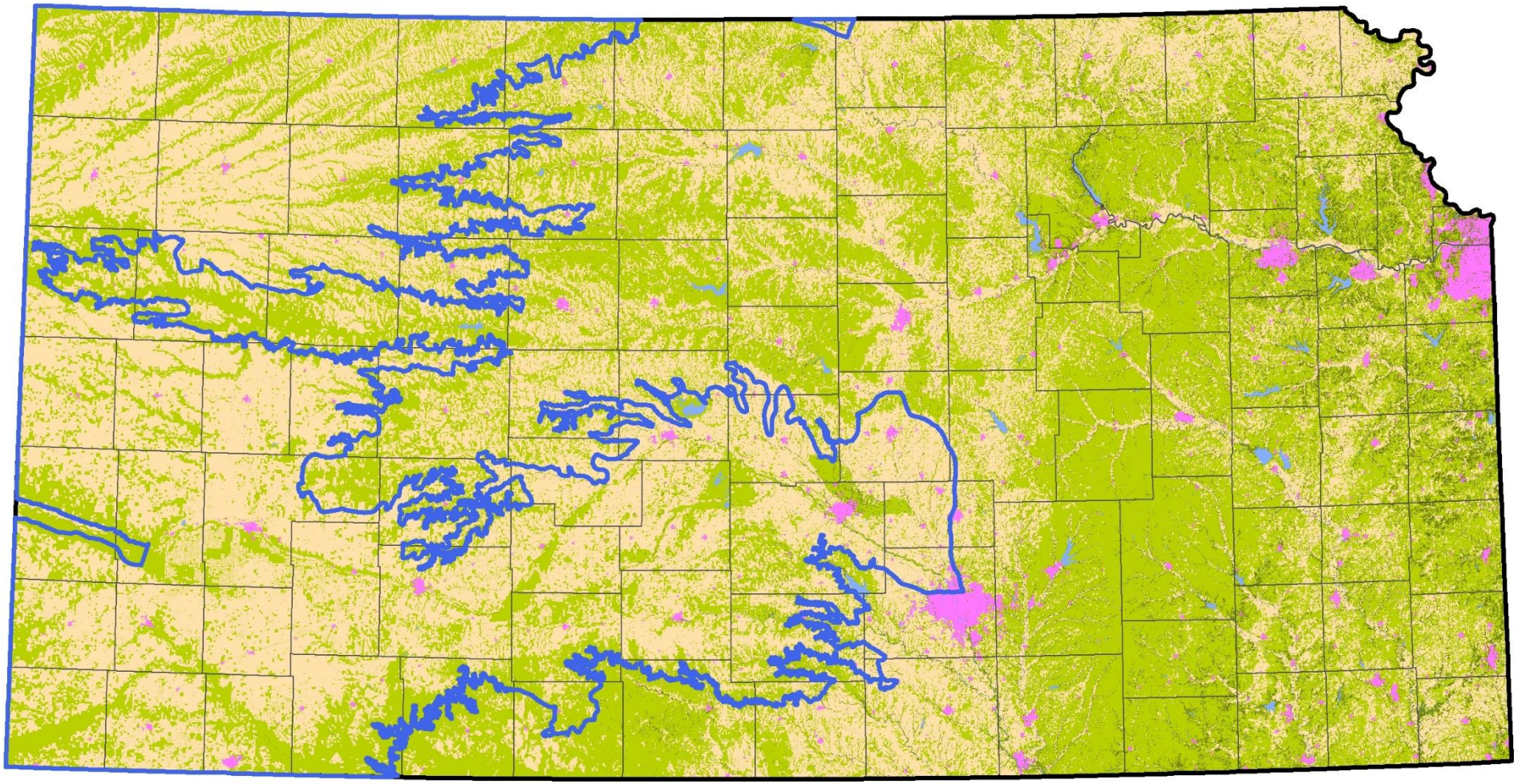
Elevation



Average Annual Precipitation



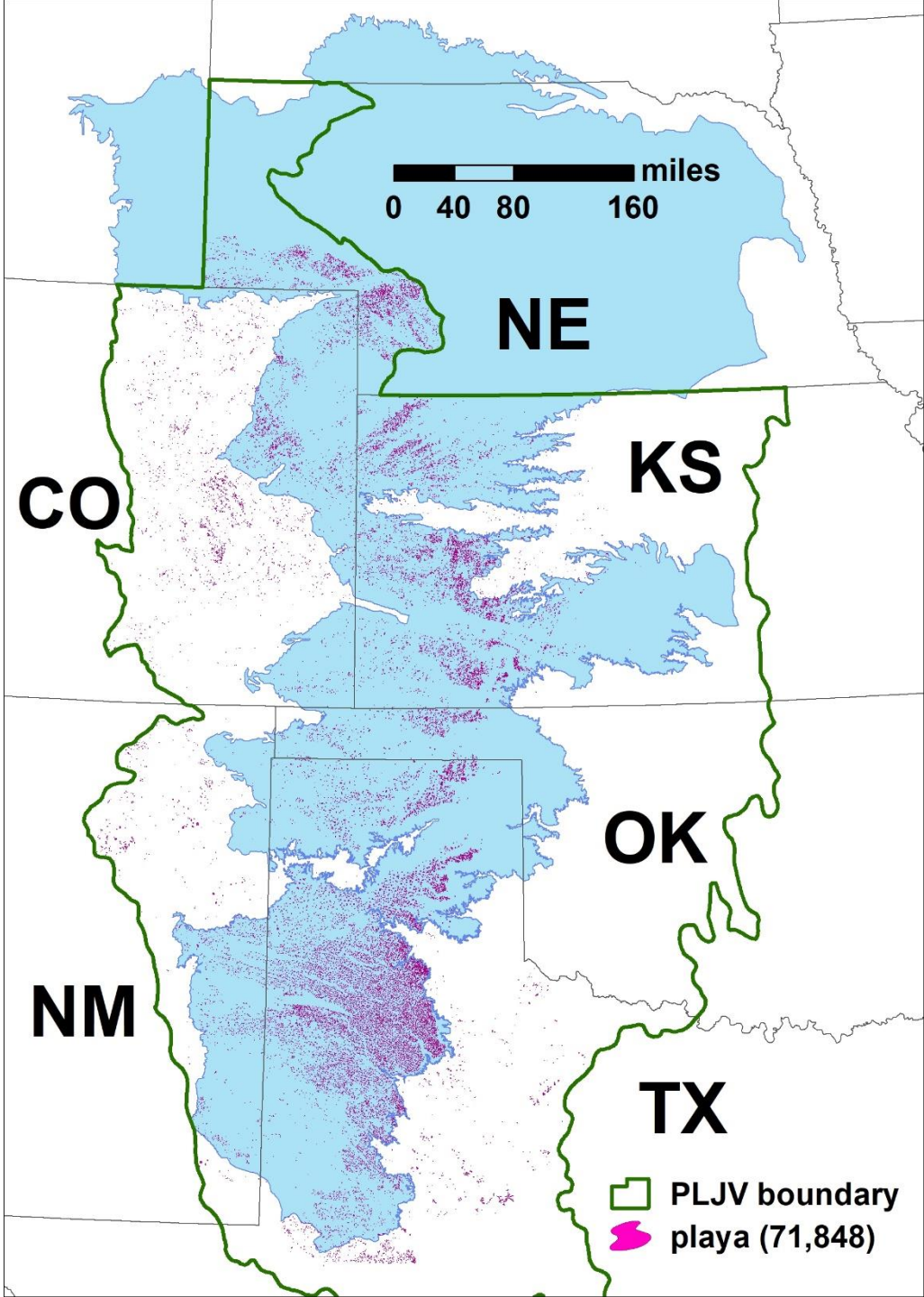
Land Cover / Land Use



Legend

- Grassland
- Woodland
- Cropland
- Urban
- Water

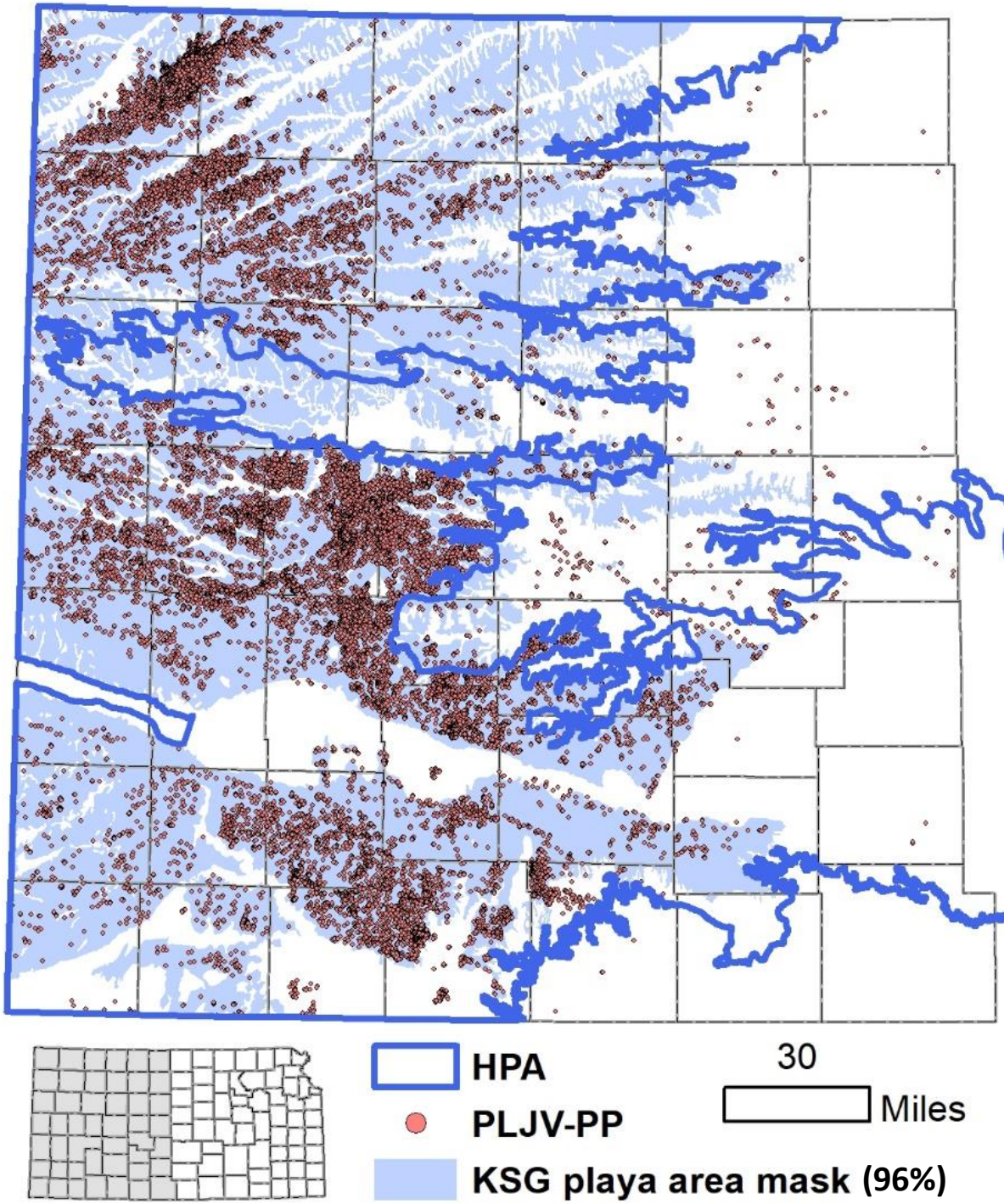
- Playas often referred to as lagoons, sloughs, buffalo wallows
- PLJV region: 72,000 Probable Playas (PLJV-PP), totaling 580,000 ac
- Playa formation somewhat a mystery (hundreds to thousands of years old)
- Typically small, shallow, and frequently dry; fed by rainfall & runoff (sit above the water table)
- Closed basin; often the only surface water to be found (local biodiversity hotspots)
- Hydric, clayey floor supports infiltration, then retention



- Kansas has three primary clusters of playas, located in the major inter-basins of western Kansas

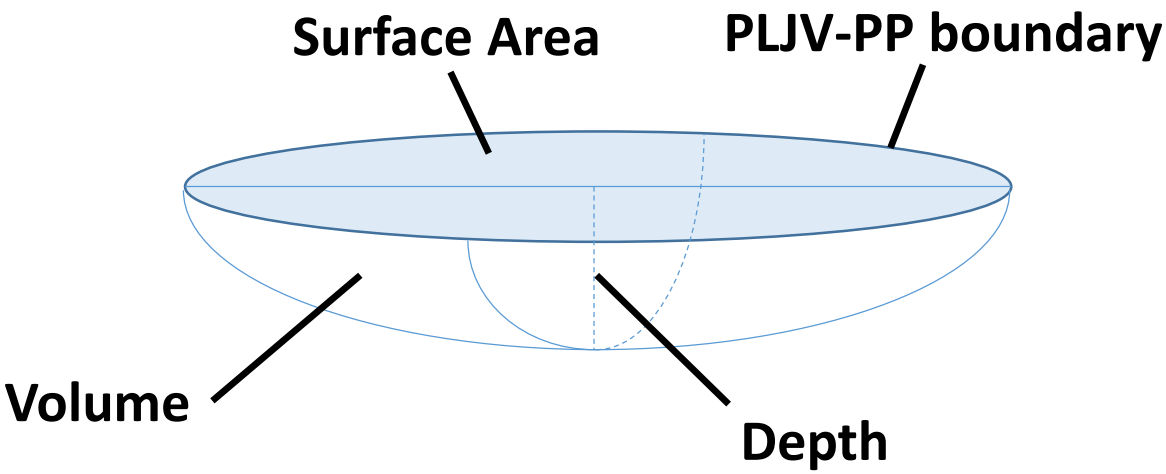
- PLJV-PP dataset for Kansas contains <u>22,000 playa-like features</u> covering 81,000 acres

- Thousands of additional potential playas mapped using LiDAR, with catchments estimated for these & PLJV-PP ***(EPA WPDG 2013 & 2017)***



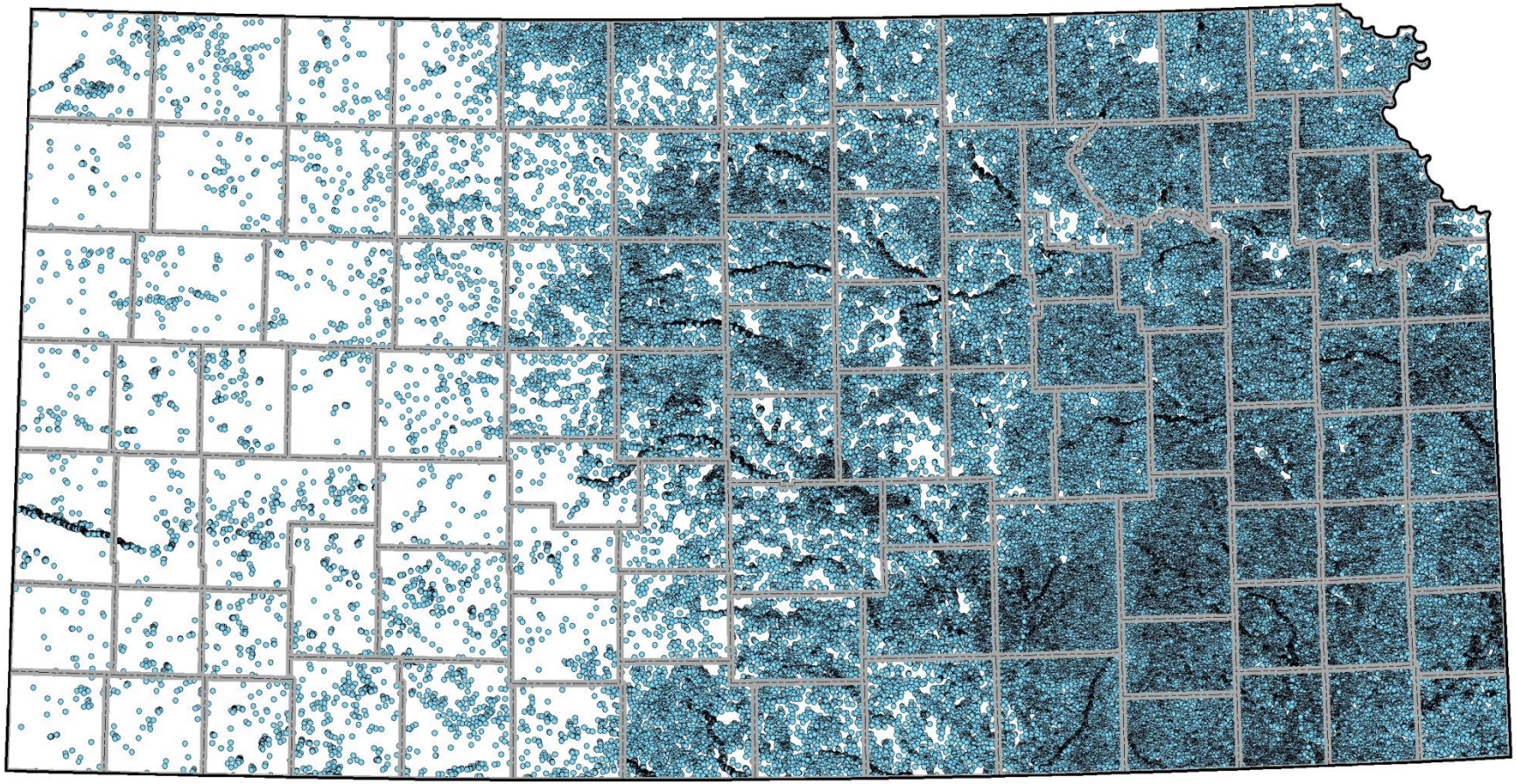
PLJV-PP vertical statistics (from LiDAR)

Statistic	Area (m^2)	Area (ac)	Volume (m^3)	Volume (ac-ft)	Depth (m)
mean	14,938	**3.69**	1502	**1.22**	**0.21**
median	6169	**1.52**	145	**0.12**	**0.14**
minimum	324	0.08	0	0	0
maximum	1,879,227	464	1,618,465	1312	8.75
25th percentile	2725	0.67	36	0.03	0.09
75th percentile	15,056	3.72	567	0.46	0.22



There are >150,000 water bodies in Kansas

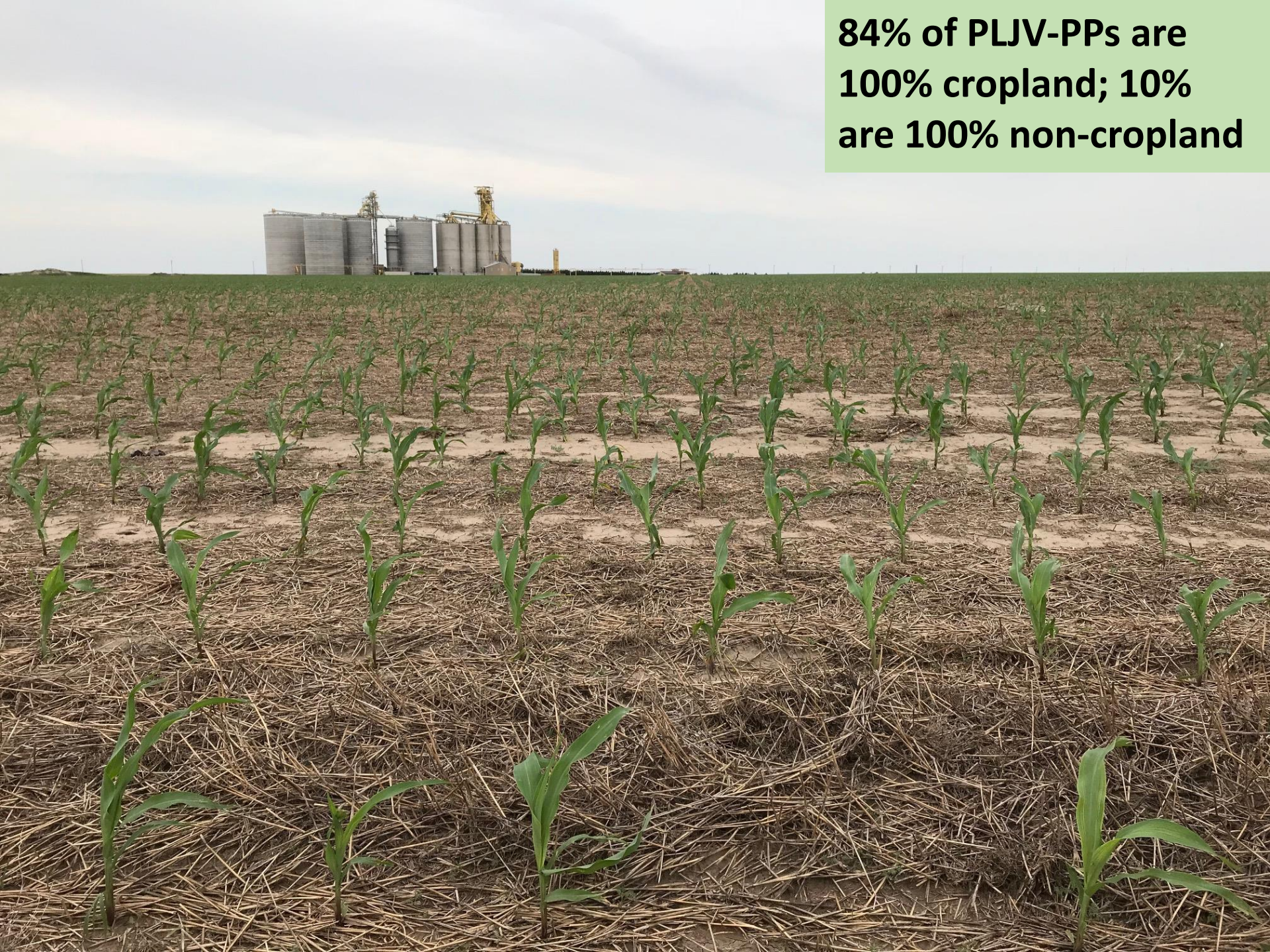
Includes private farm ponds, state & local lakes, federal reservoirs, other



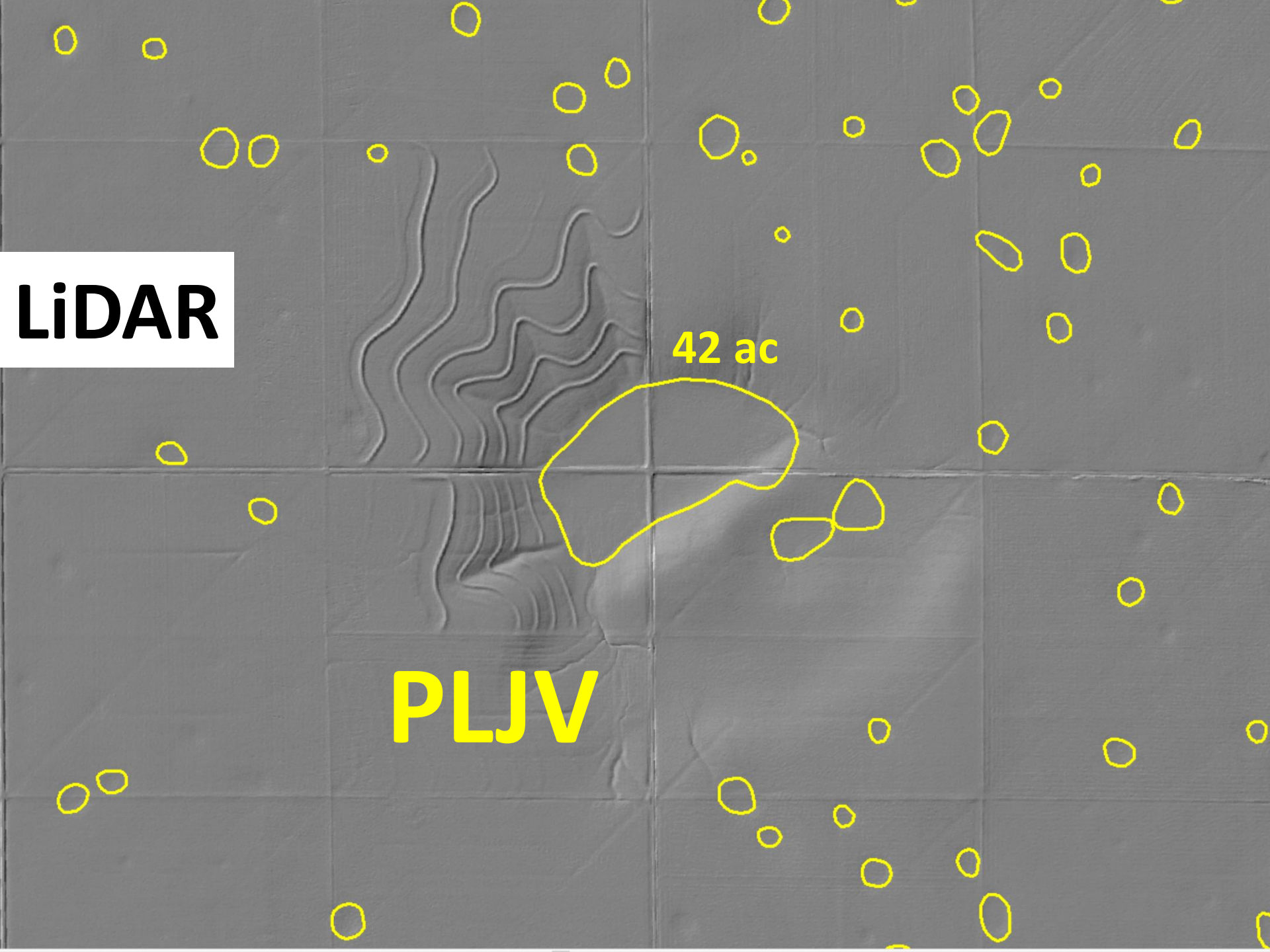
Good thing there are playas in western Kansas

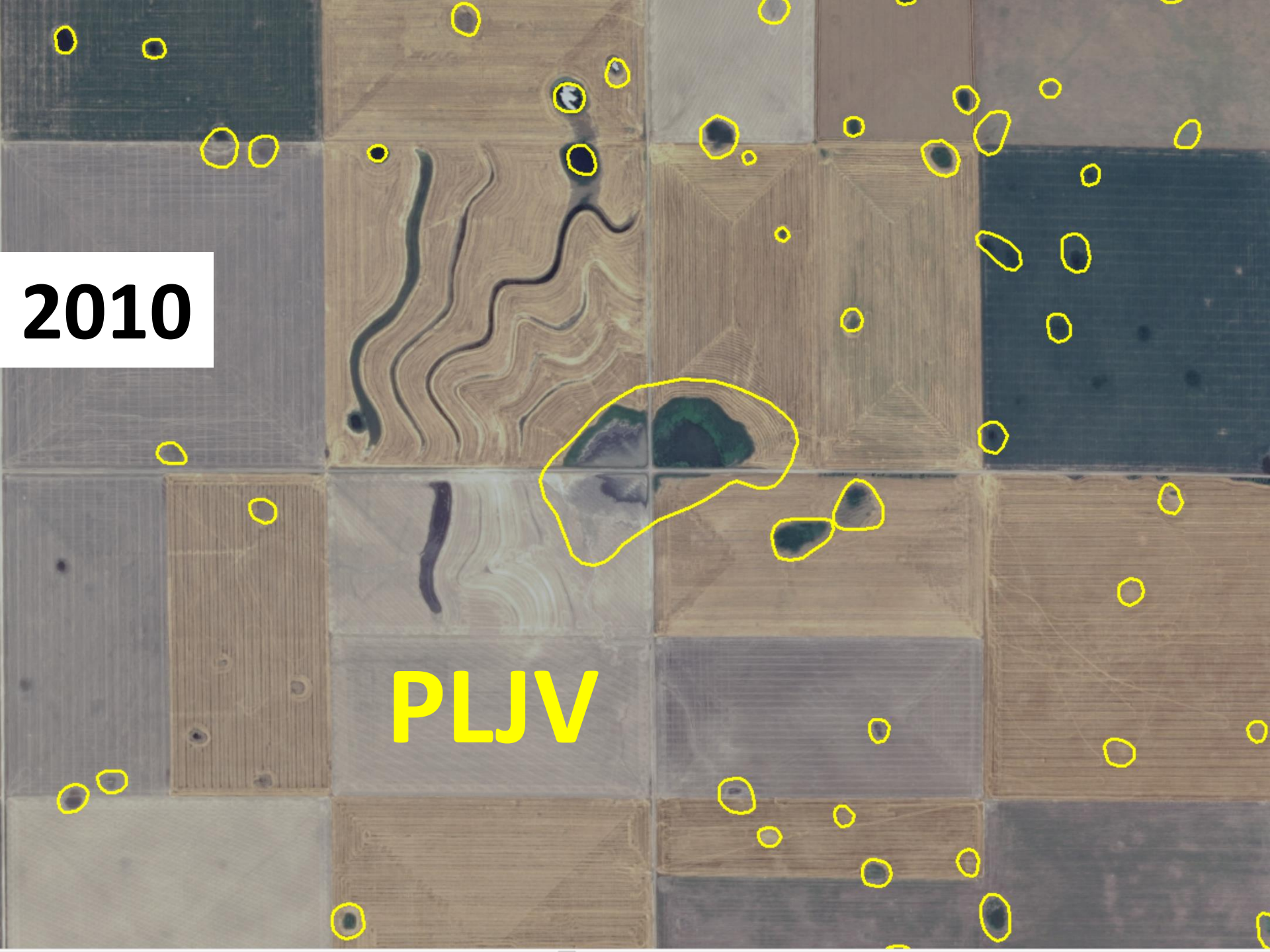
<u>Source:</u> USGS National Hydrography Dataset (count includes water bodies > 0.25 ac)

Source: USFWS


84% of PLJV-PPs are 100% cropland; 10% are 100% non-cropland

2018
N


LiDAR
42 ac
PLJV


2010
PLJV

2017

Example – playas around Ehmke playa

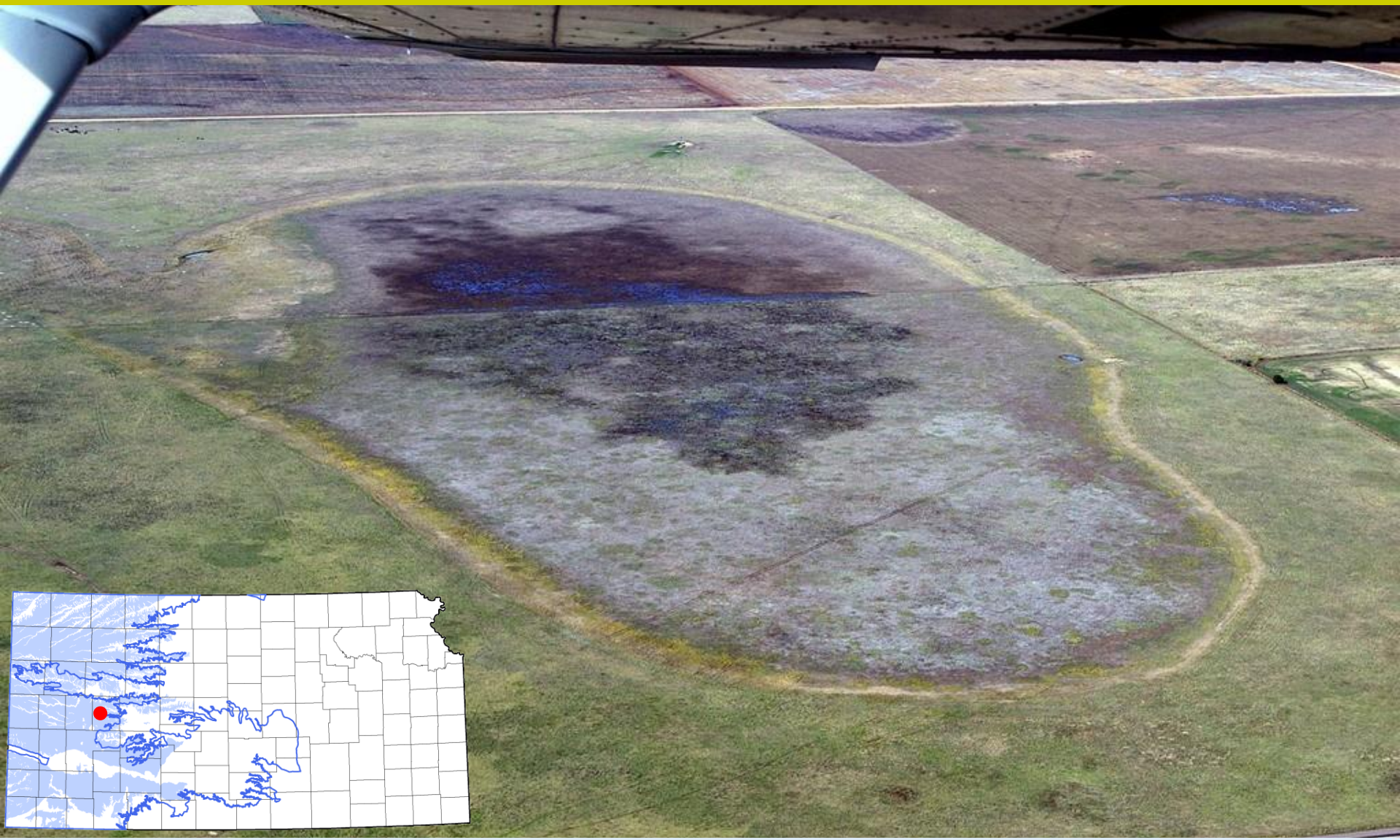
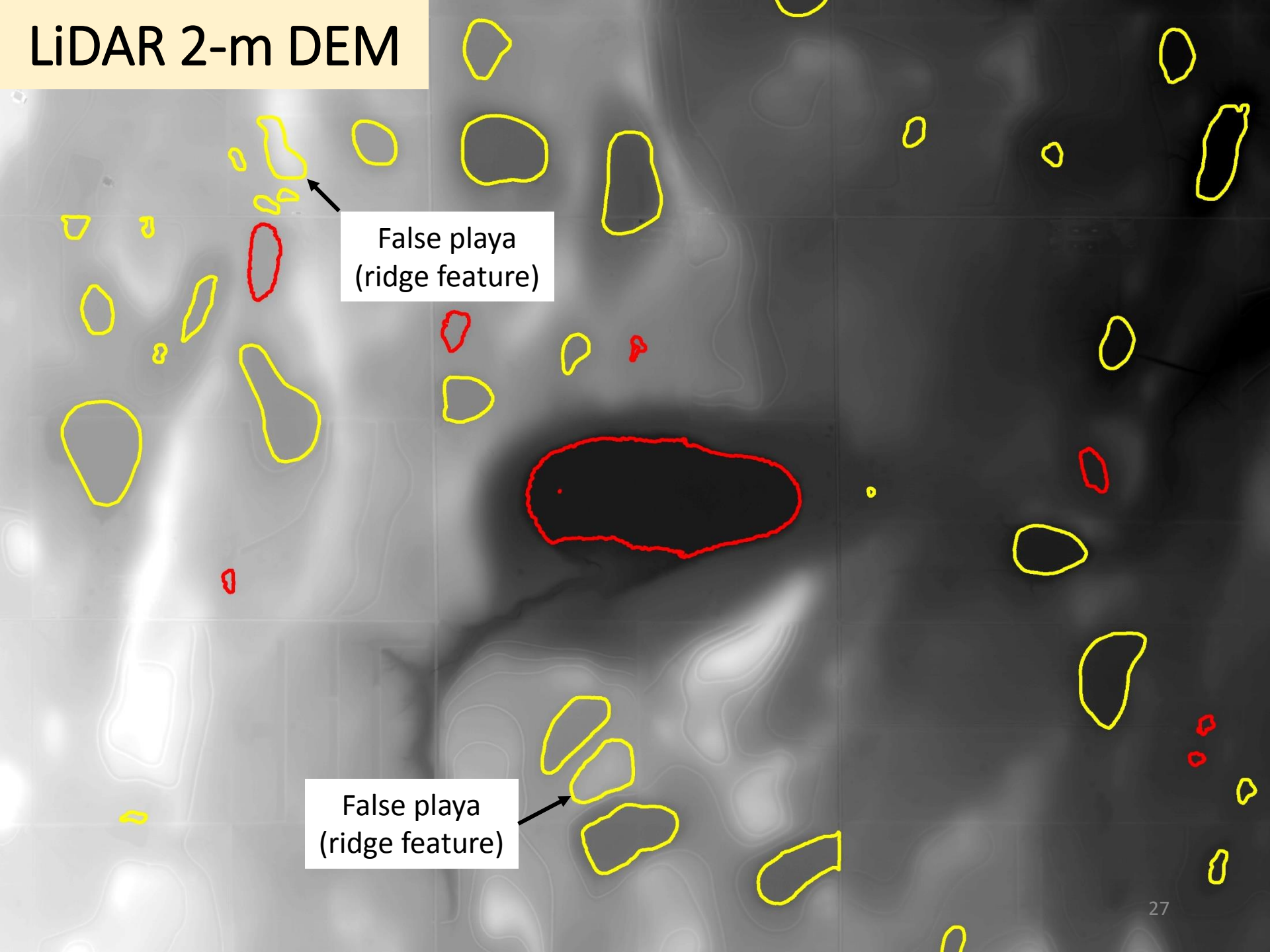


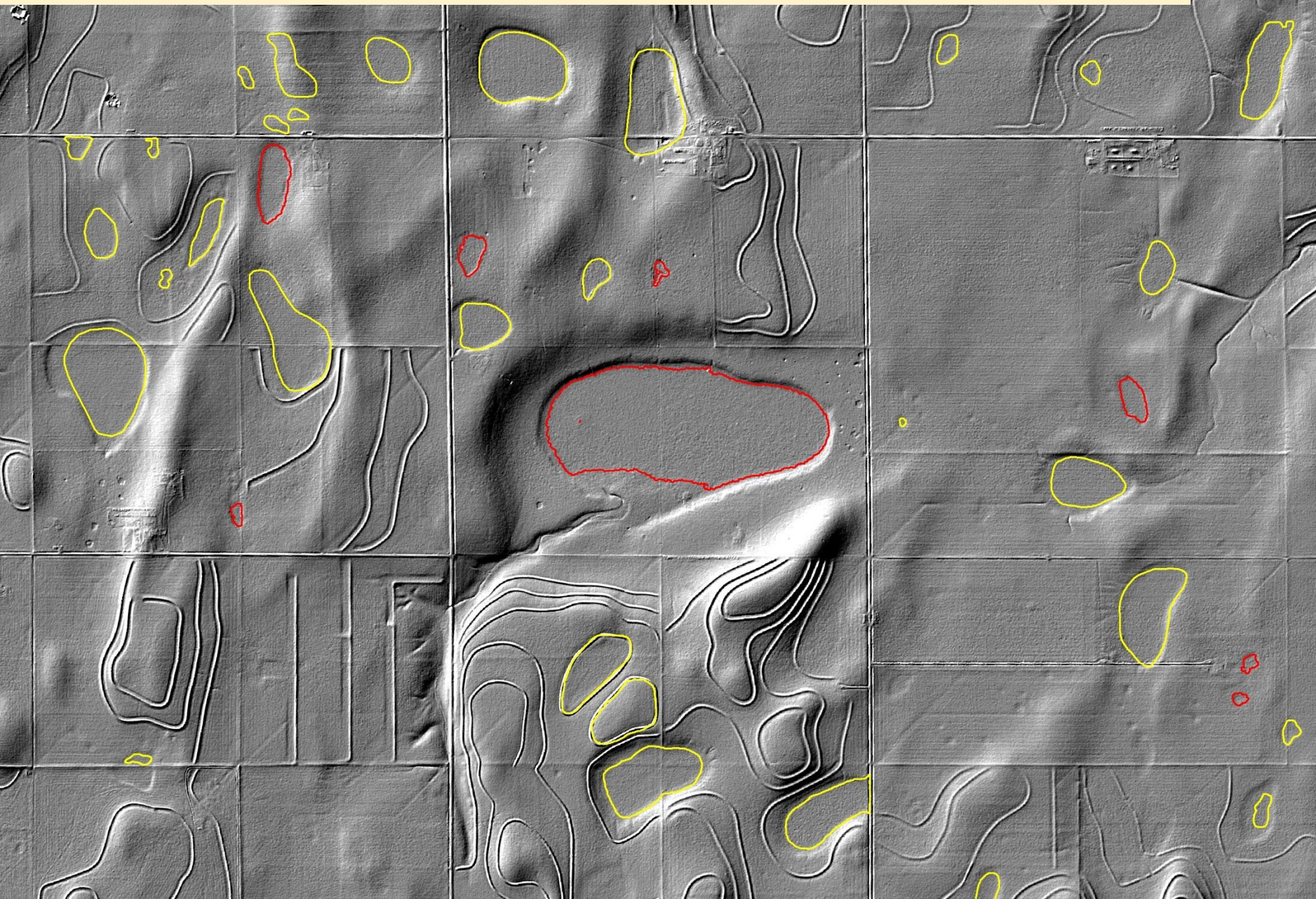
Image source: http://www.uwosh.edu/facstaff/bowenm/Ehmkeplane.JPG/view

NAIP 2010 (PLJV – yellow, LiDAR – red)

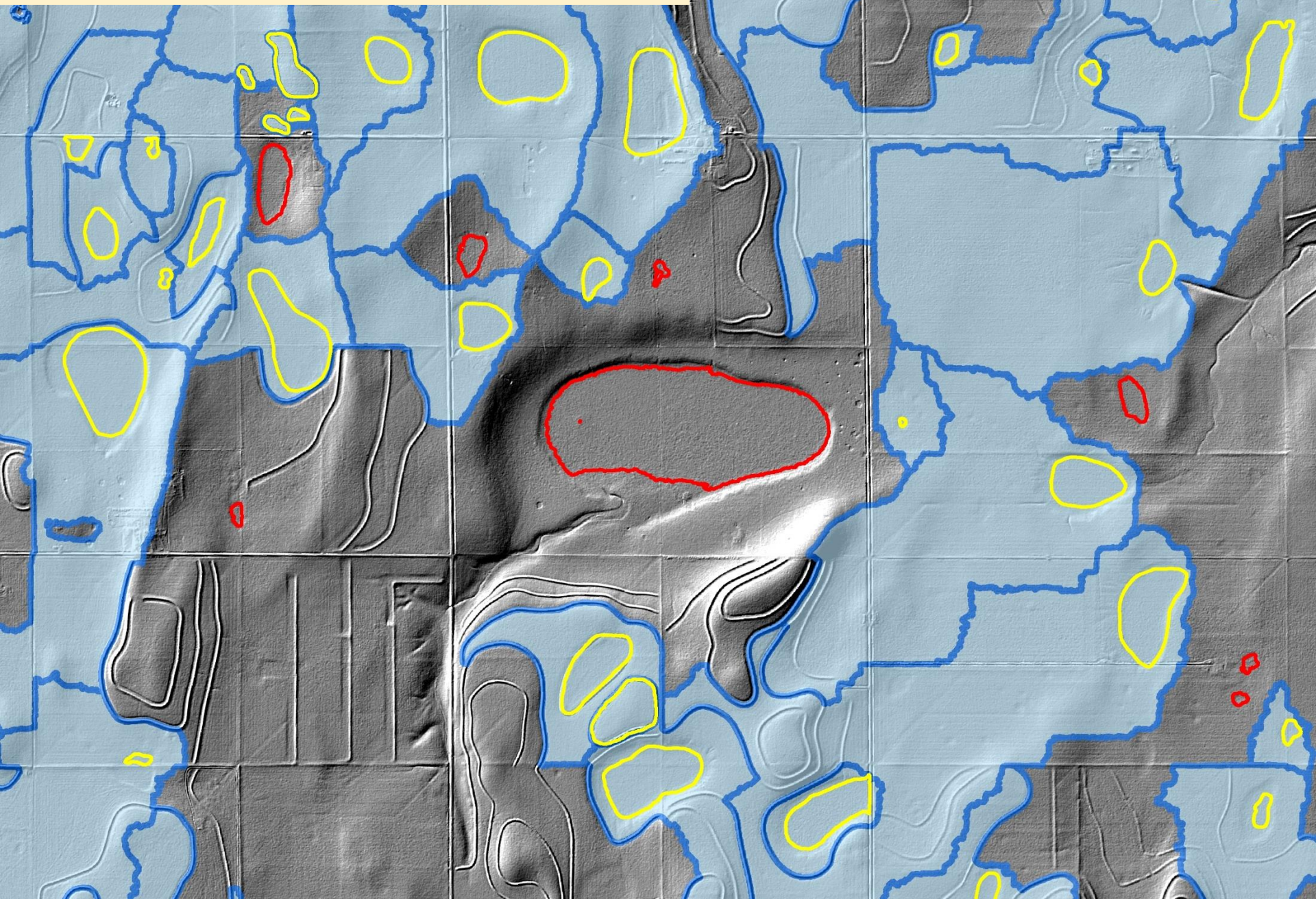
LiDAR 2-m DEM

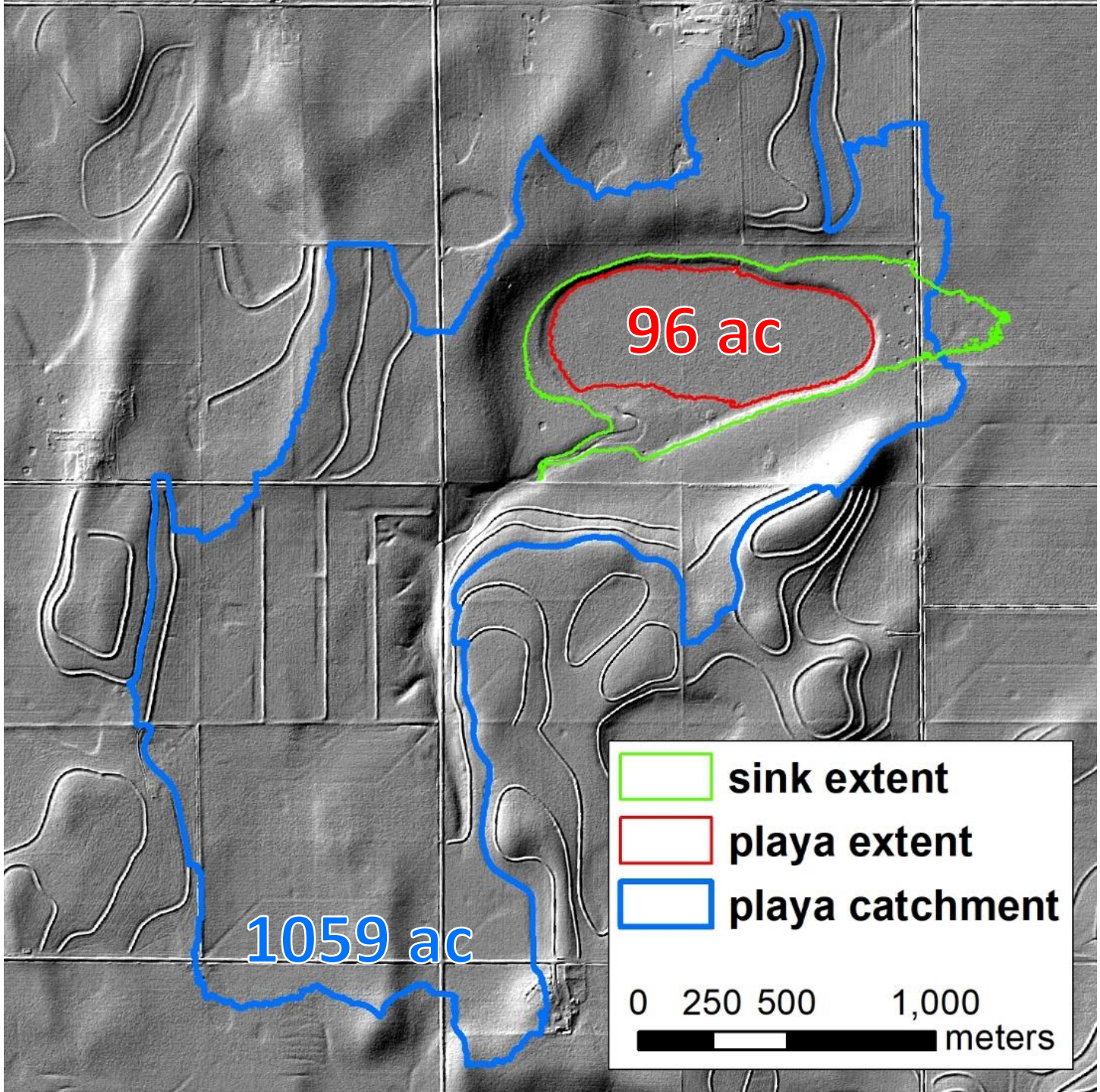


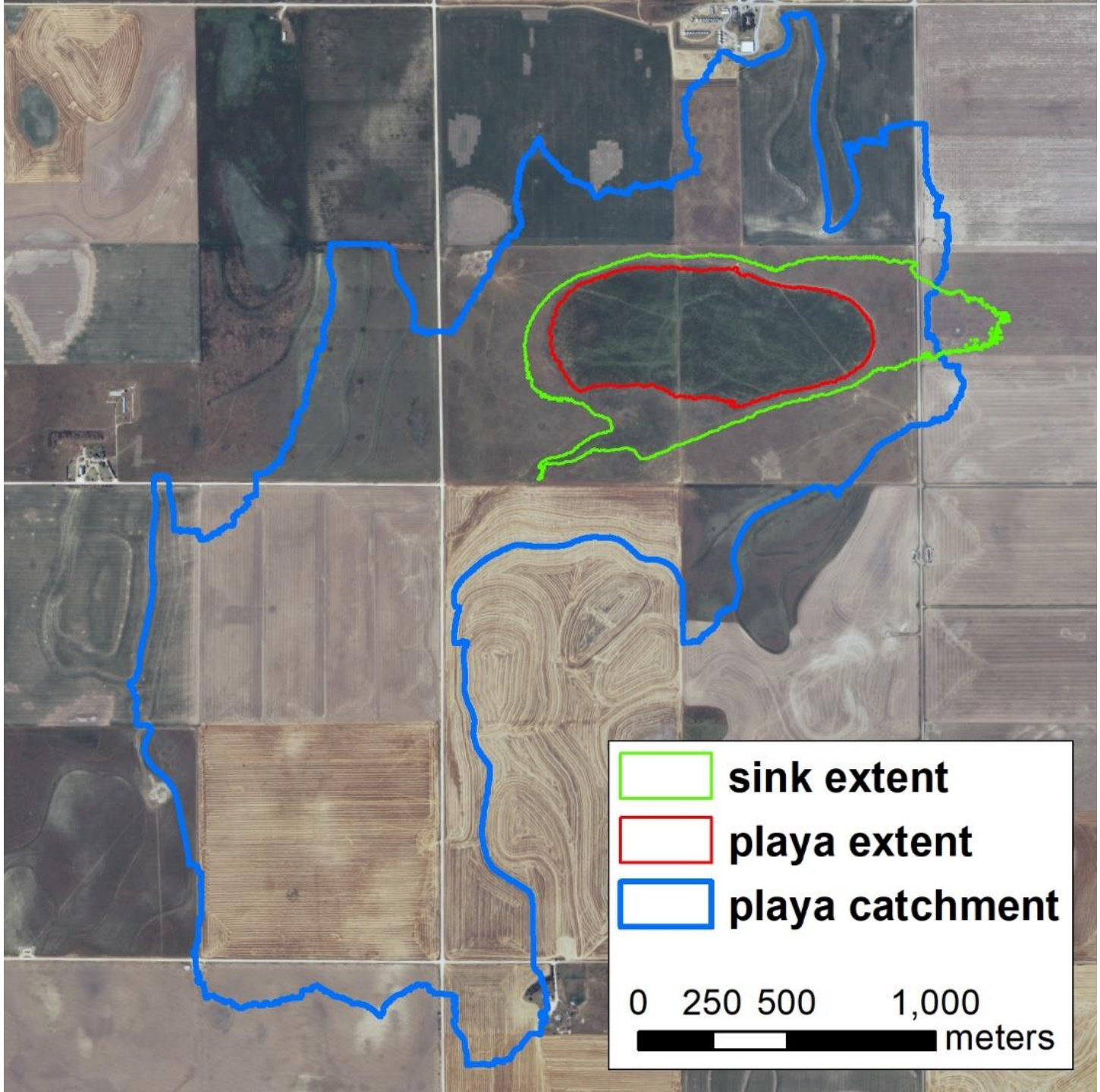
LiDAR shaded relief (PLJV – yellow, LiDAR – red)



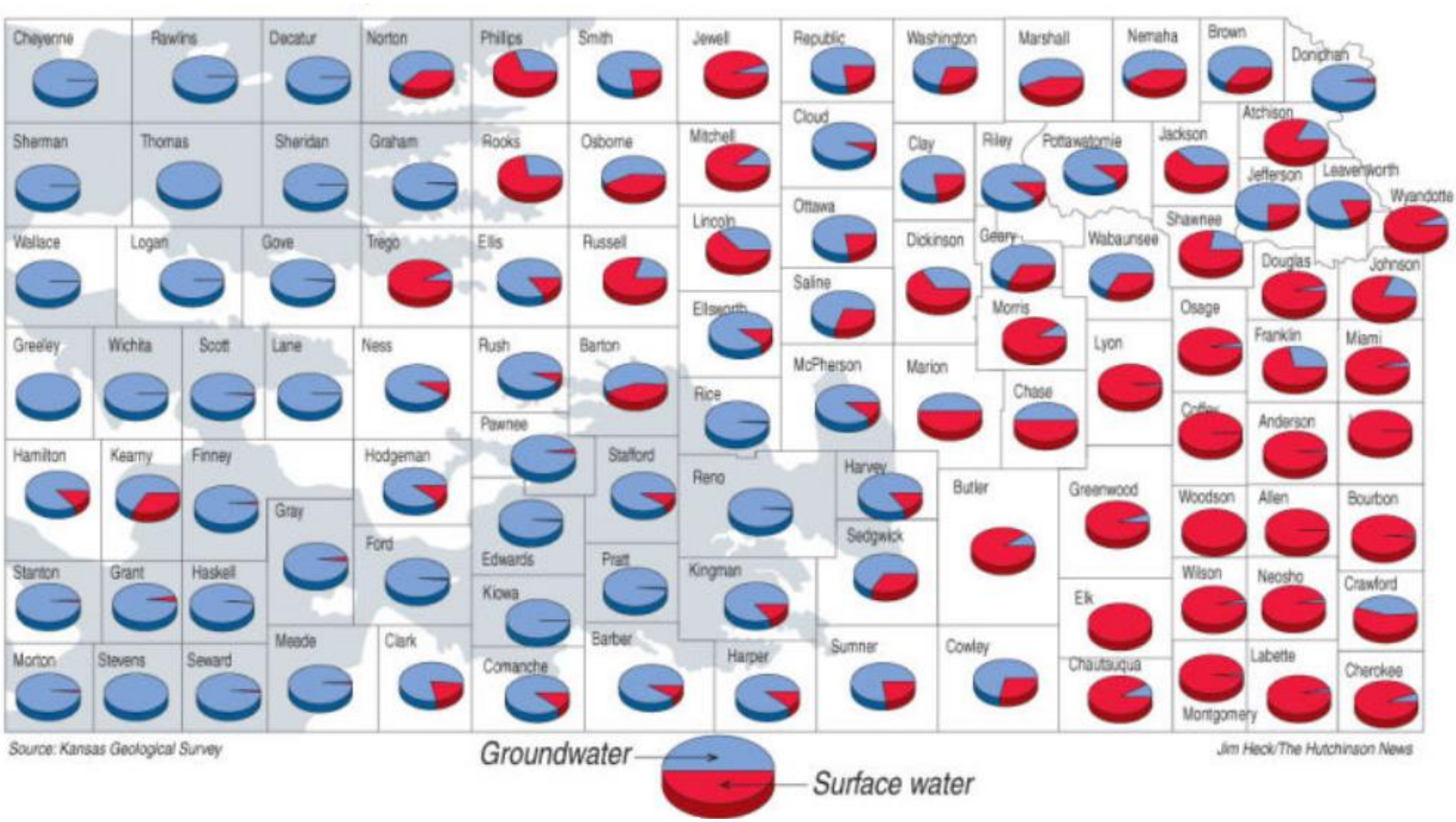
PLJV-PP watersheds (blue)




96 ac
1059 ac
sink extent
playa extent
playa catchment
0 250 500 1,000
meters


sink extent
playa extent
playa catchment
0 250 500 1,000
meters

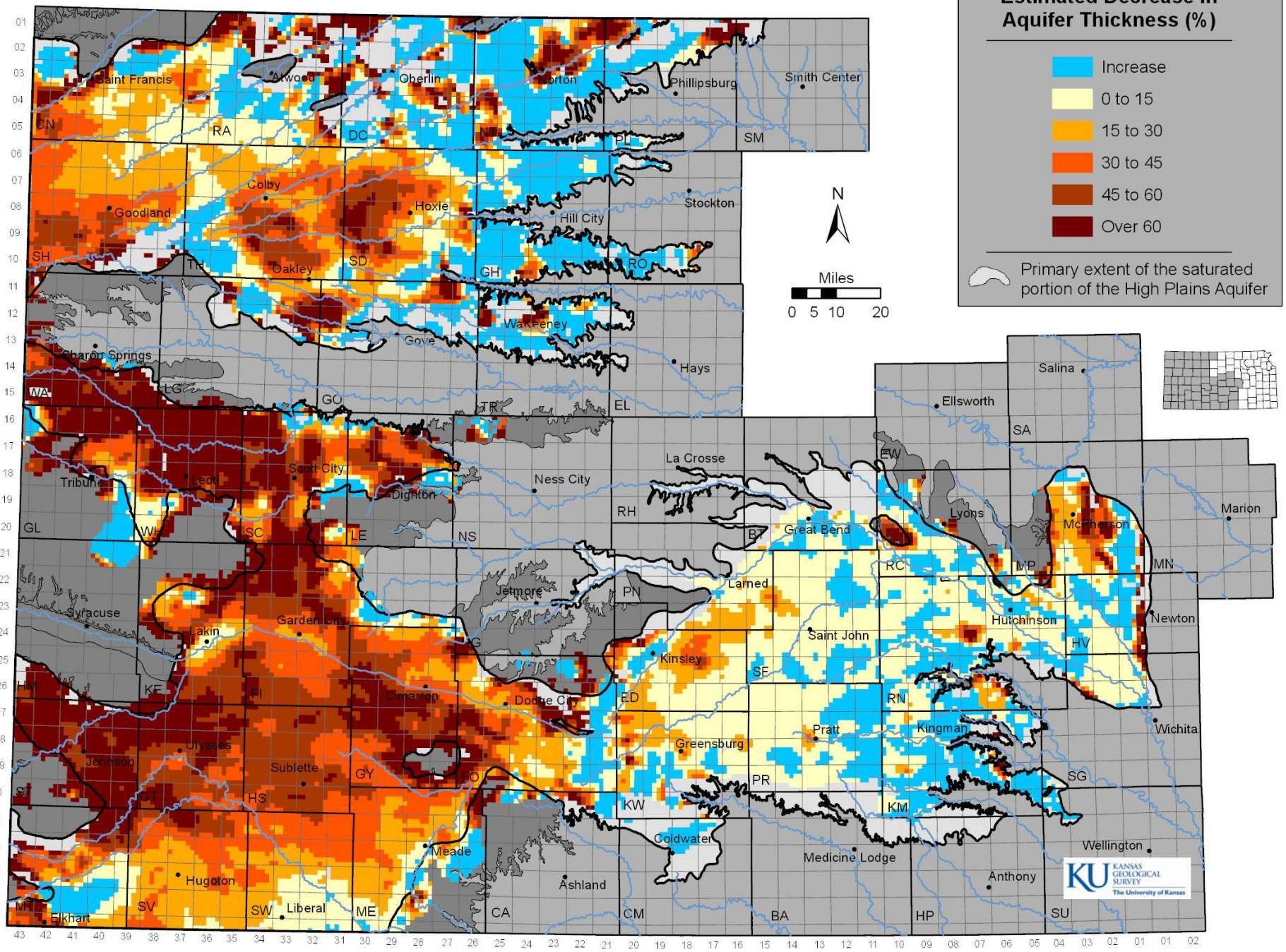
Source of Water – Ground vs. Surface



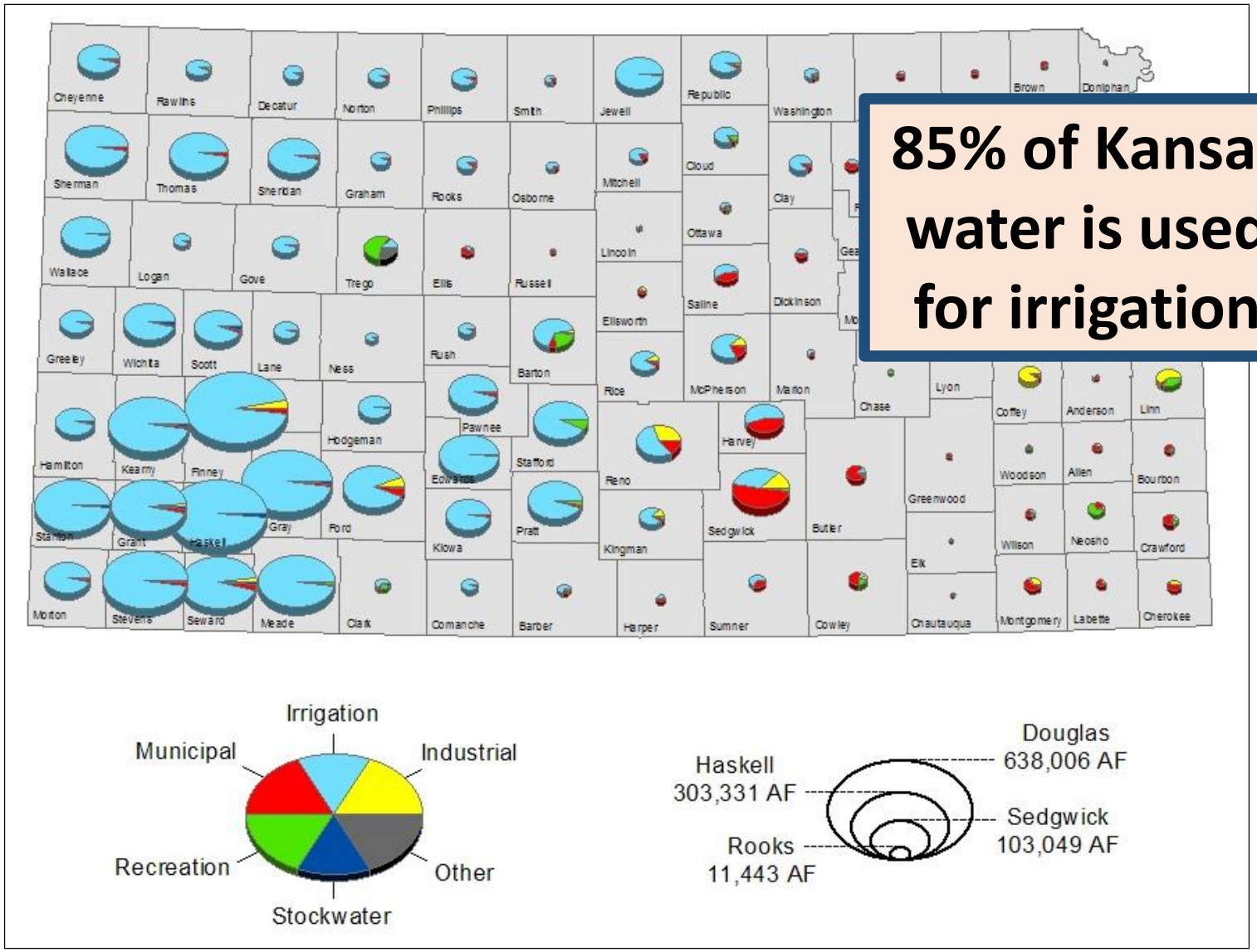
Source: Kansas Geological Survey

Jim Heck/The Hutchinson News

Percent Change in Saturated Thickness, Predevelopment to Average 2017-2019, Kansas High Plains Aquifer

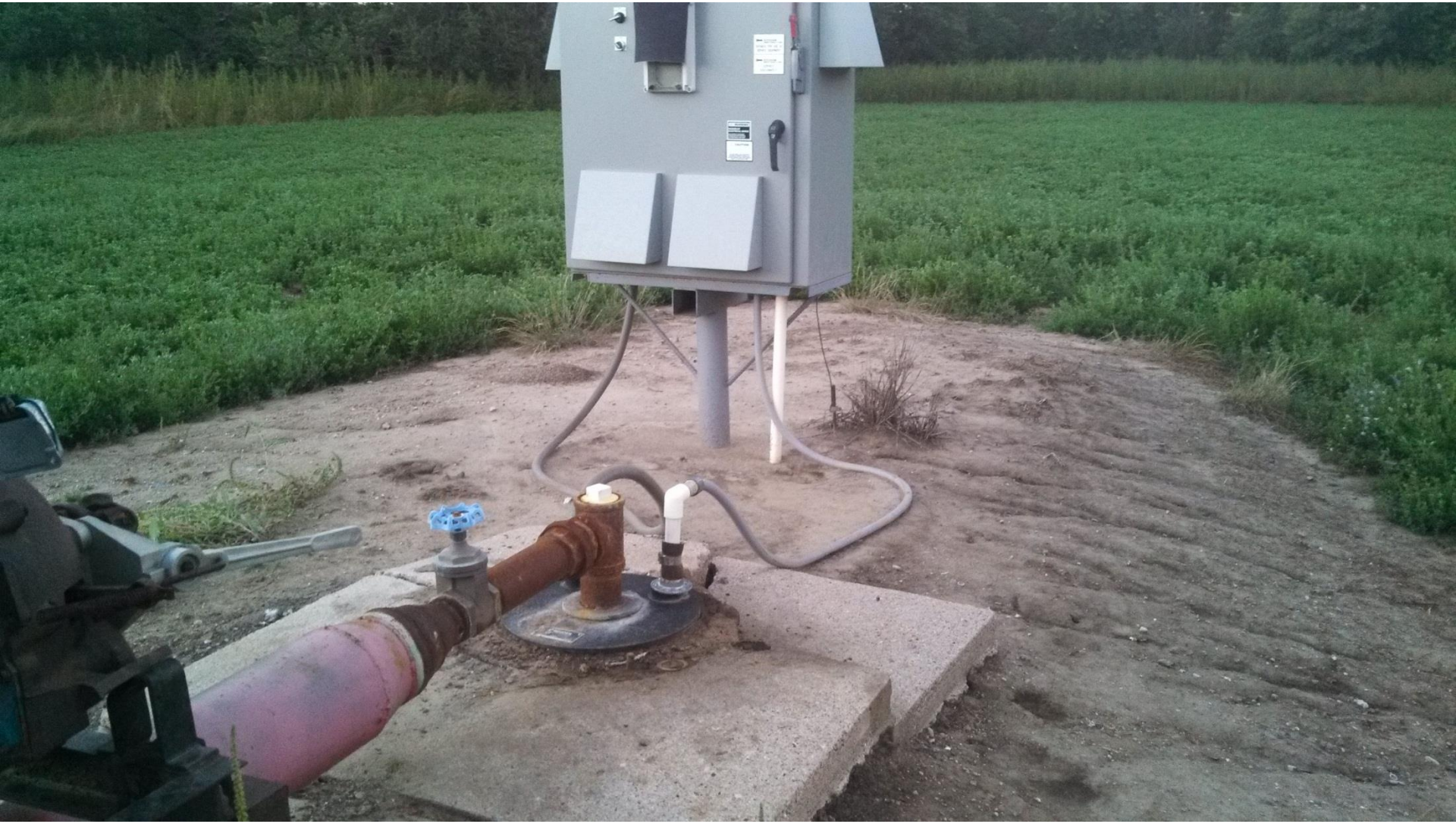


Average Reported Use Made of Water (1990-2010)

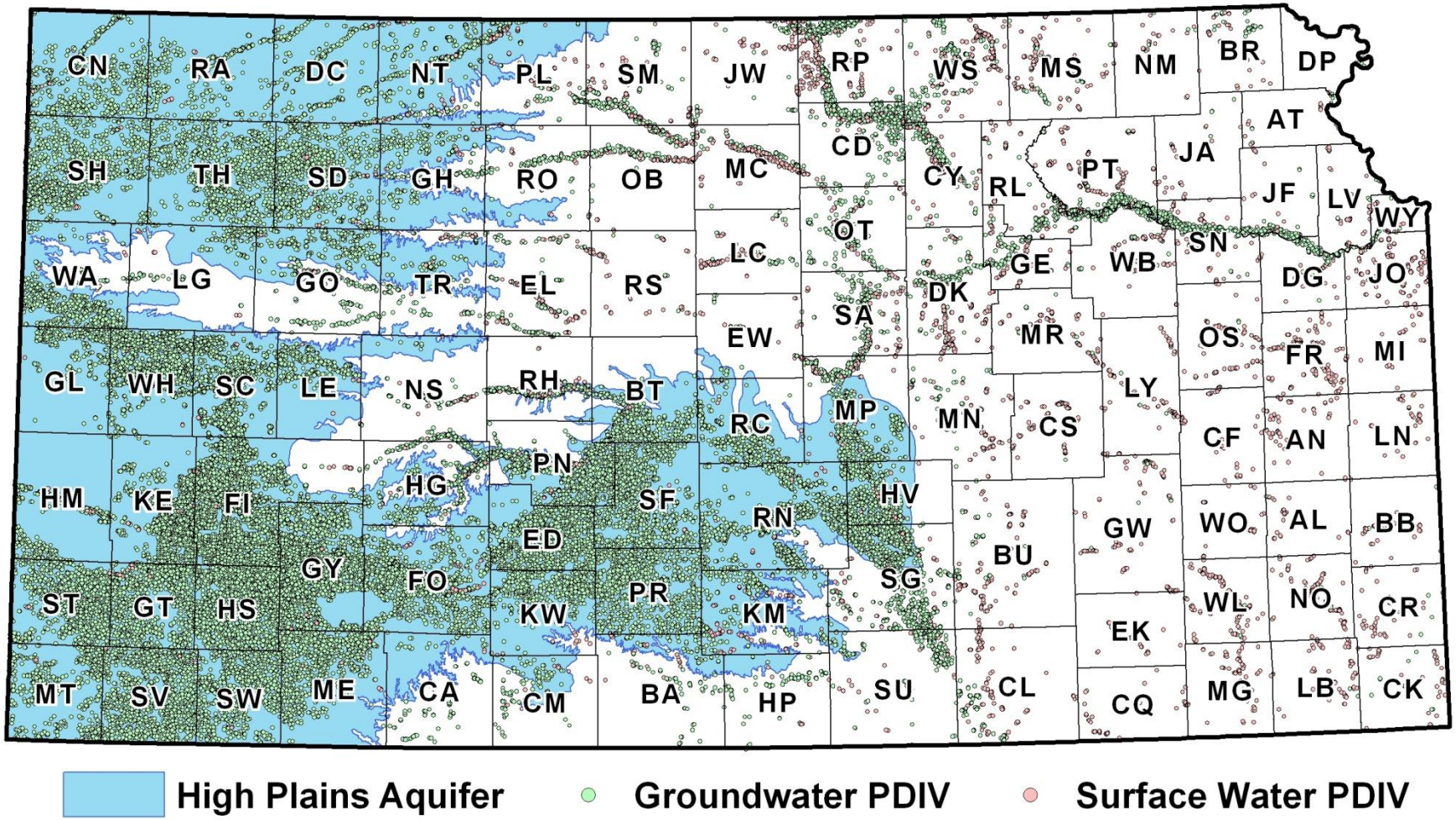


Source: *Kansas Geological Survey*

A typical well head (“Point of Diversion”)



Where are the Points of Diversion?



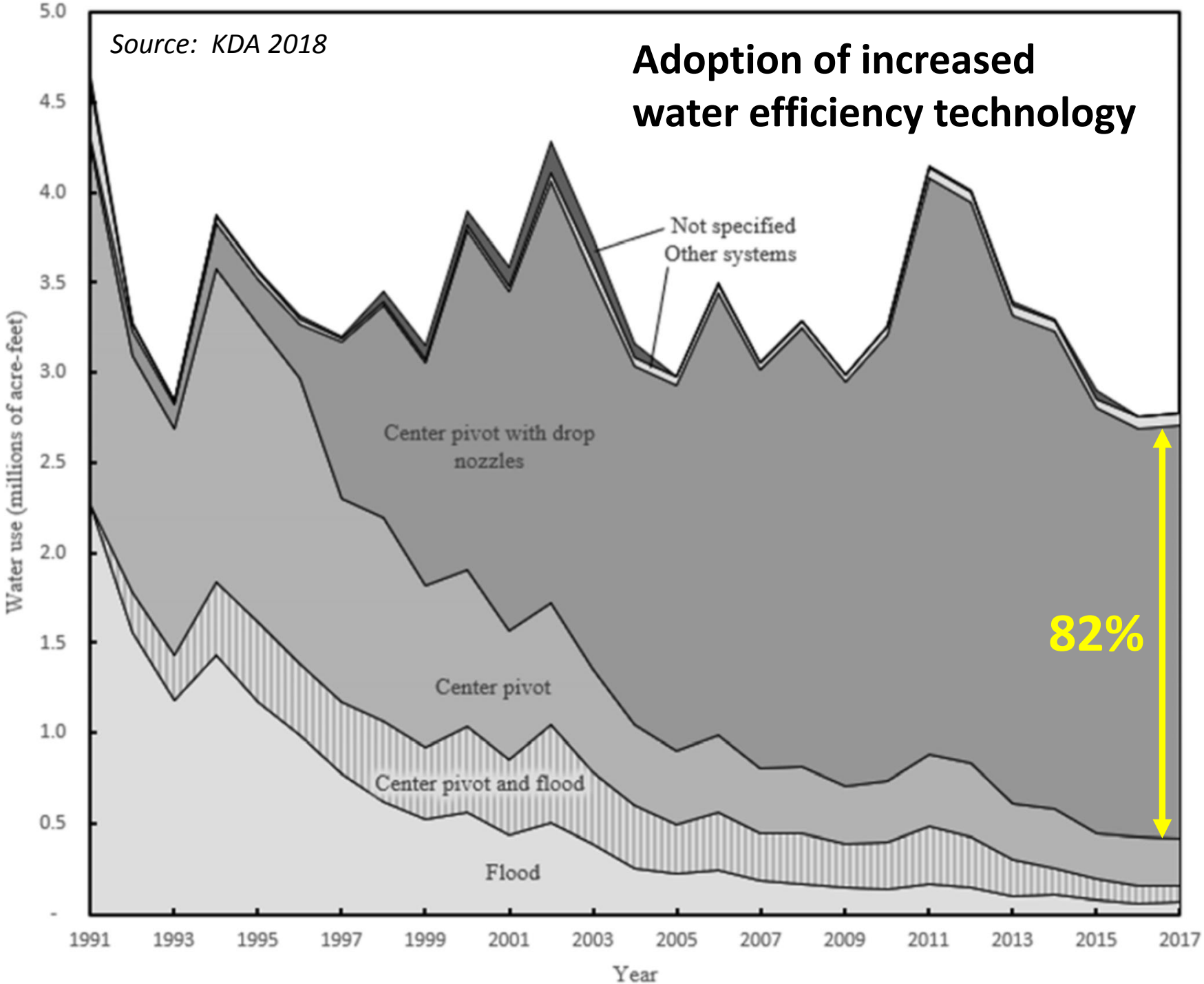
There are nearly 59,000 points of diversion dedicated to irrigation in KS.
Of these, about 52,000 are groundwater and 7000 are surface water.

Kansas Irrigation Facts

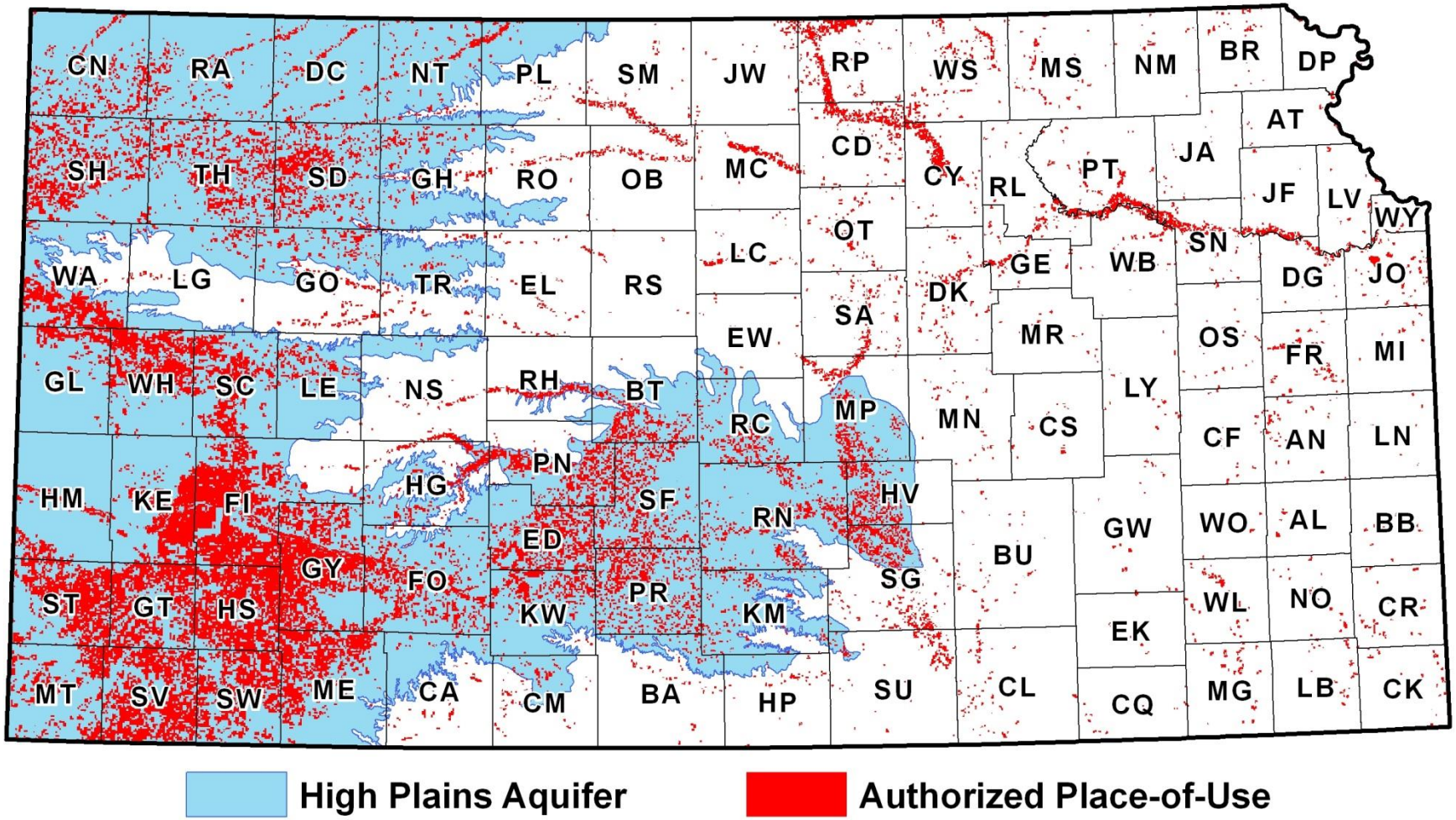
- 3.1 million irrigated cropland acres in the state (5.9% of the state's total area)
  - *Use is authorized on 6 million acres*
  - *2.5 million irrigated ac in 2017 USDA Ag Census, down 13% from 2012 (while total cropland up 4%)*
- 2.8 million acre-feet (0.91 trillion gallons) of irrigation water was applied in 2017 (KDA 2018)
  - *This is about half of the total annual water rights allocated for irrigation*
- More than 95% comes from groundwater *(USGS 2015)*
- Irrigated acres account for 15% of Kansas cropland area *(Rogers & Lamm 2012)*
- Irrigated acres account for 25% of Kansas cropland production *(Rogers & Lamm 2012)*
  - *Southwest region: 70%* *Haskell County: 80%*
- Average irrigation rate is 11.8"/year *(KDA 2018)*
  - *2013-2017:* **13.10 – 12.89 – 11.46 – 10.89 – 10.87**

Drilling a well

Irrigating winter wheat (May 2013)

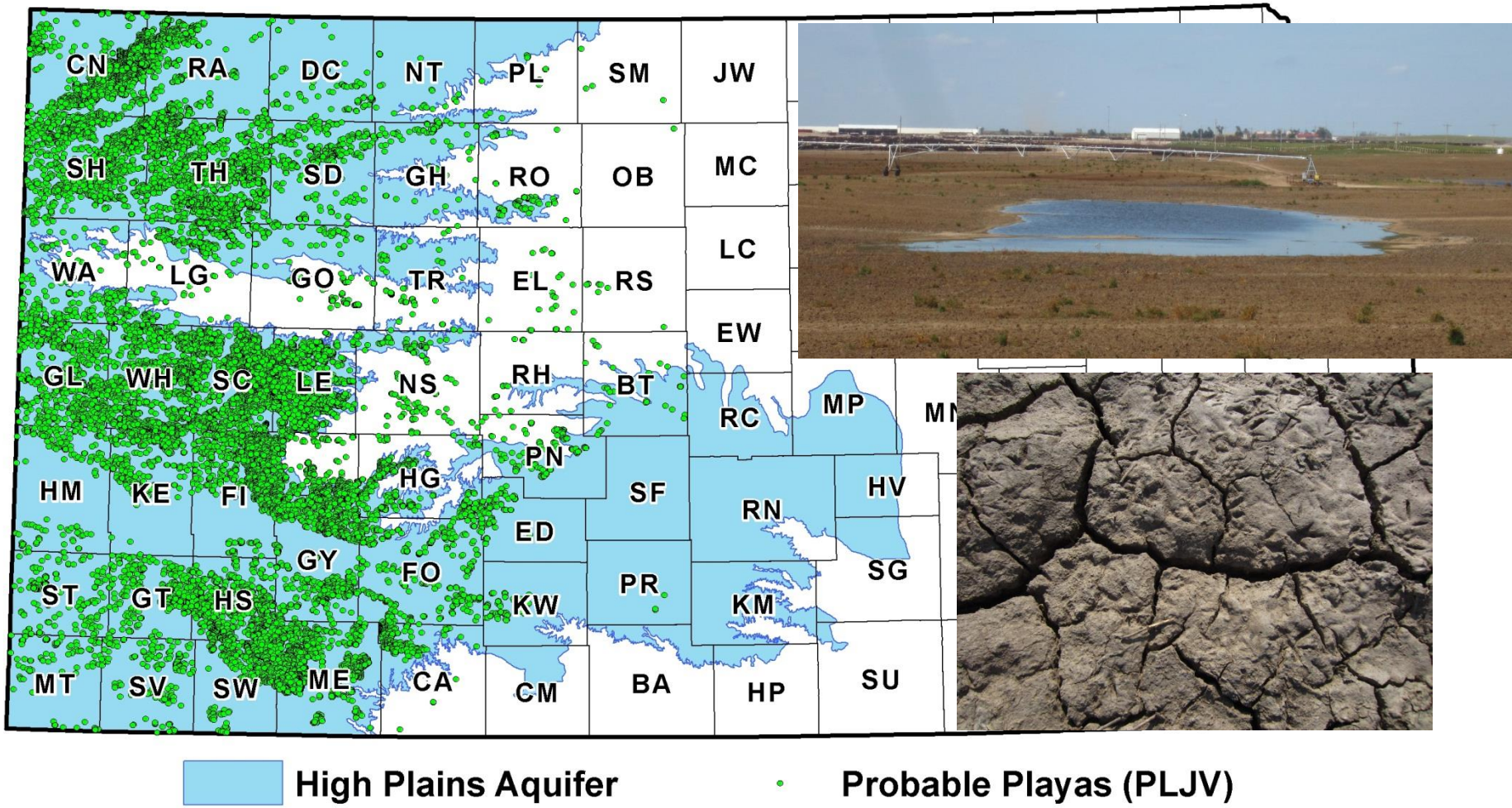

Source: KDA 2018
Adoption of increased water efficiency technology
Not specified
Other systems
Center pivot with drop nozzles
Center pivot
Center pivot and flood
Flood
82%
Water use (millions of acre-feet)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
-
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Year

Where are farmers allowed to irrigate?



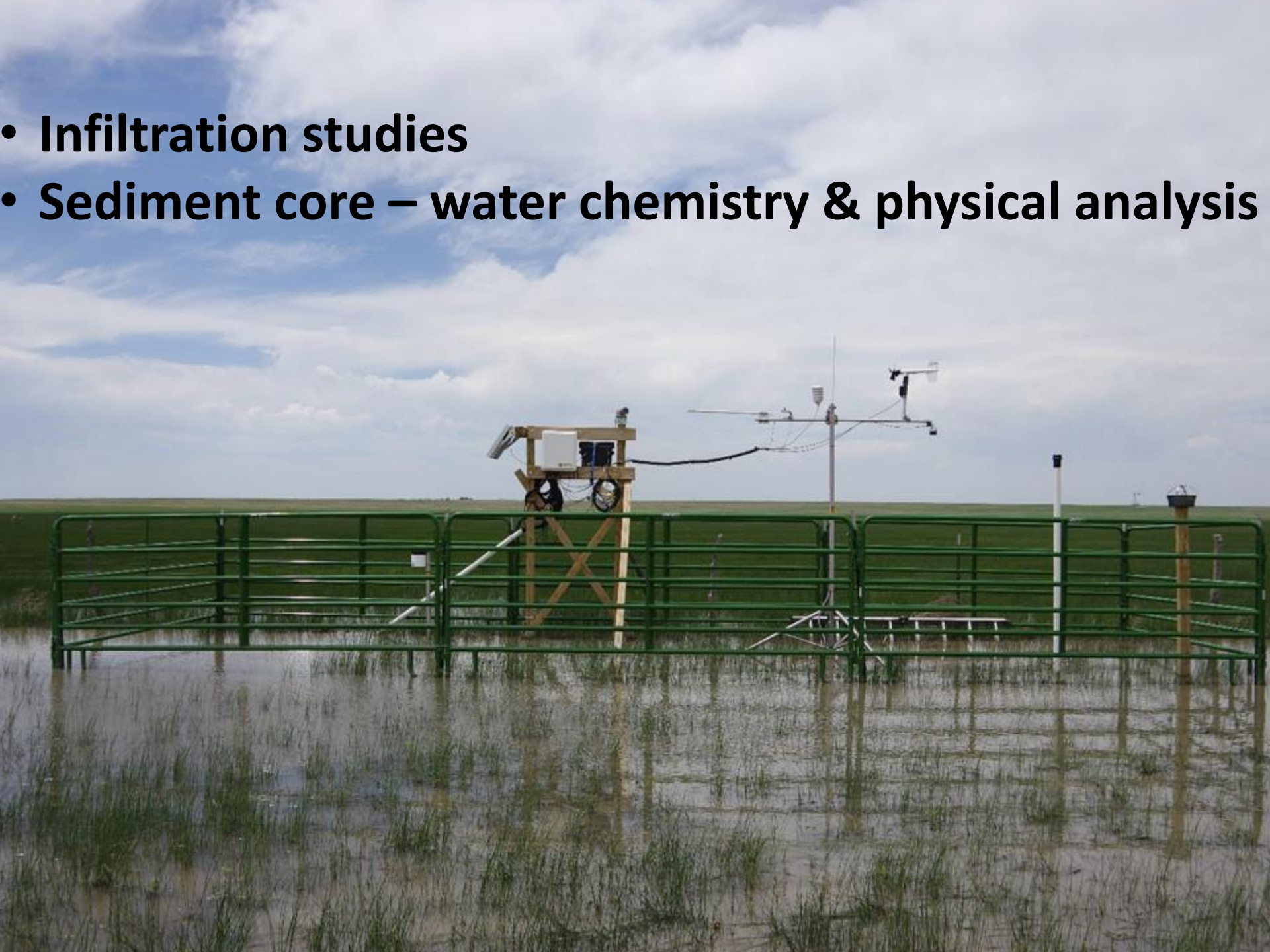
Irrigation occurs on 3 million acres of nearly 6 million POU acres

Playa Wetlands: Potential Aquifer Recharge Hotspots

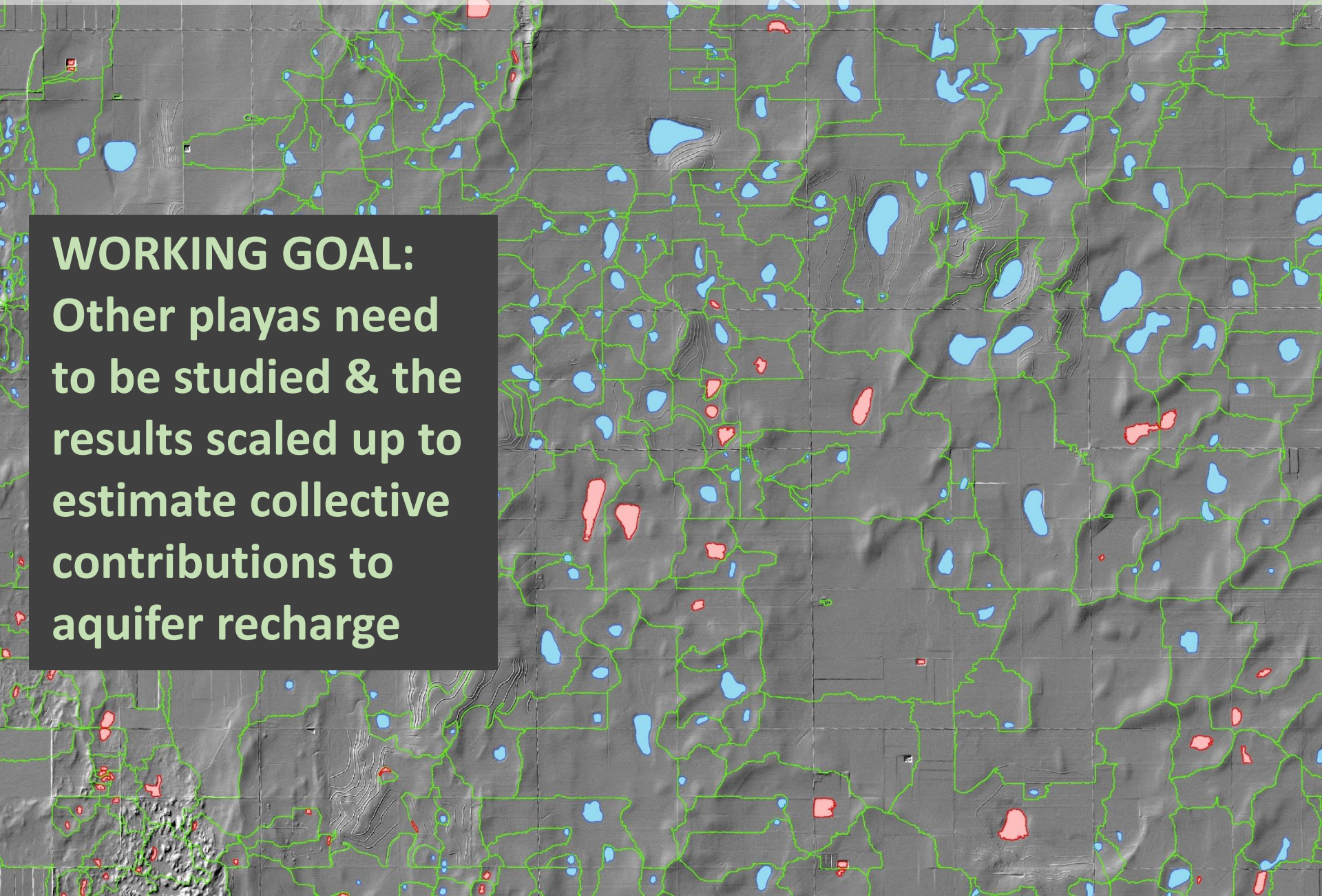


84% of PLJV-PPs are 100% cropland; 10% are 100% non-cropland

- Infiltration studies
- Sediment core – water chemistry & physical analysis



New Project with KWO (EPA WPDG 2019)



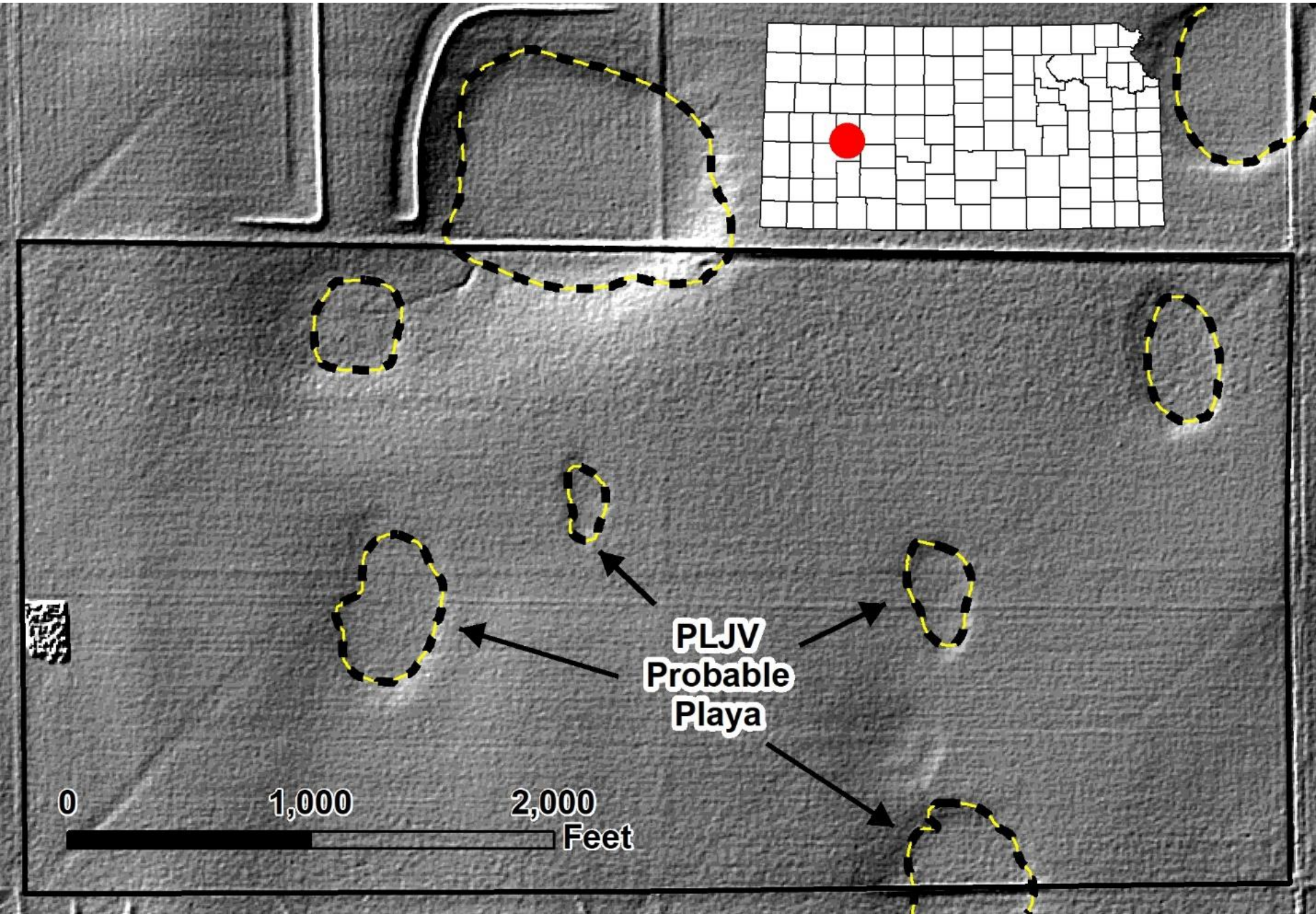
WORKING GOAL:
Other playas need to be studied & the results scaled up to estimate collective contributions to aquifer recharge

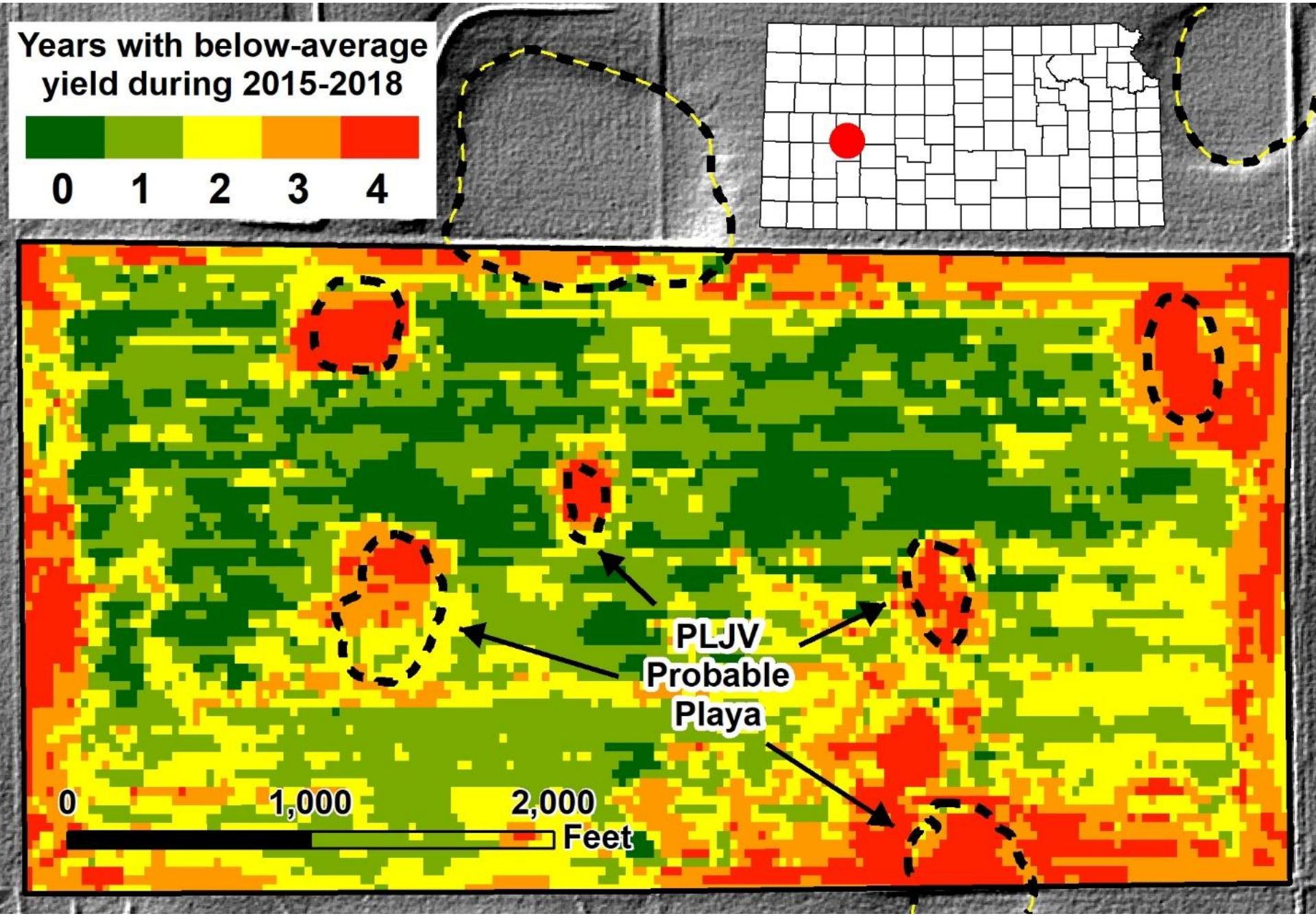
Looking Ahead…

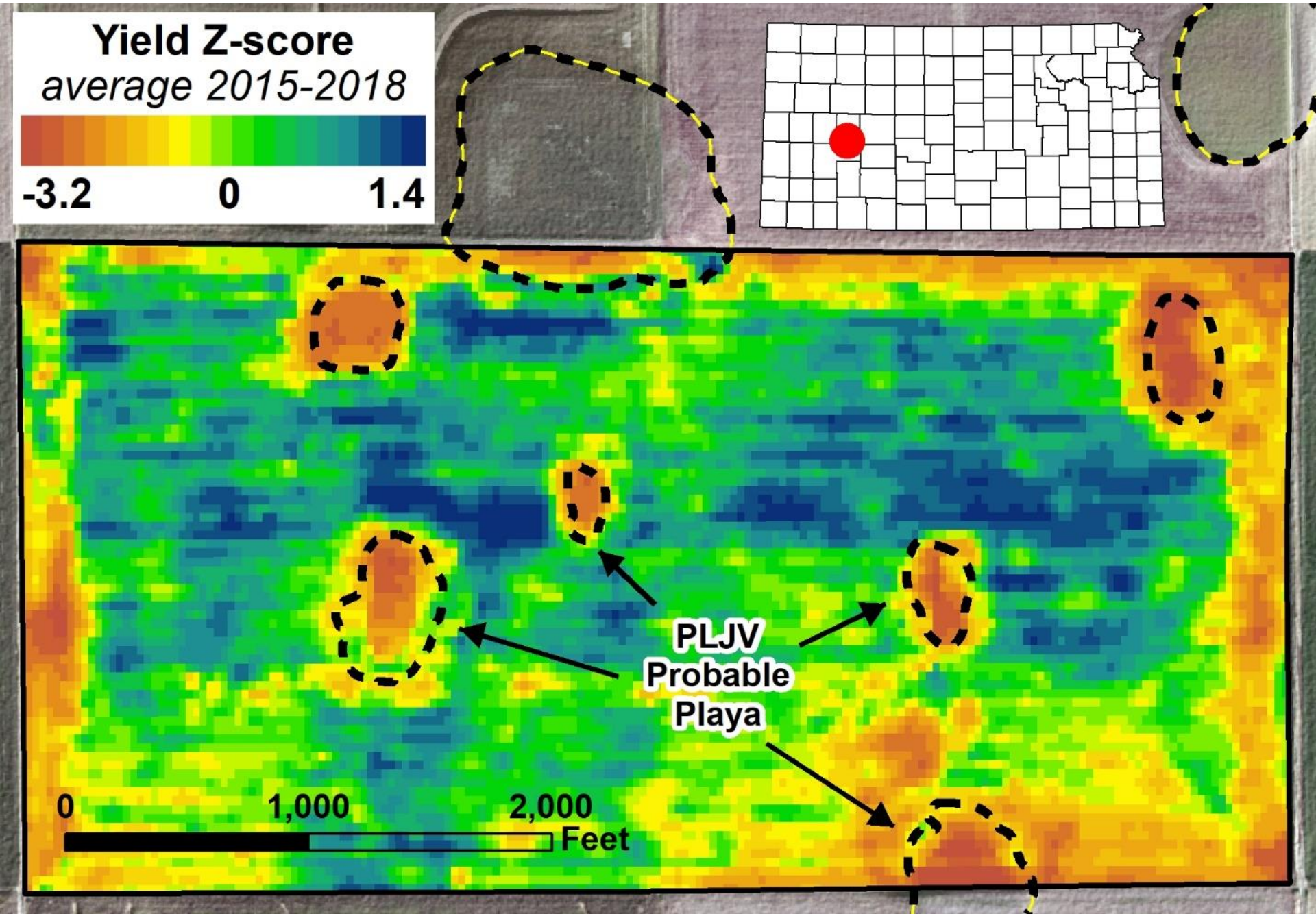
Macropore transmission could be key and needs to be better quantified (e.g. 84% TX study)

New Project with KWO (EPA WPDG 2019)

Does it make financial sense to farm through playas?


PLJV
Probable
Playa
0
1,000
2,000
Feet


Years with below-average yield during 2015-2018
0
1
2
3
4
PLJV Probable Playa
0
1,000
2,000
Feet


Yield Z-score
average 2015-2018
-3.2
0
1.4
PLJV
Probable
Playa
0
1,000
2,000
Feet

Special thanks to Vulgamore Family Farms for sharing their yield map data

jkastens@ku.edu