Dude, Where's My Cow?
Geographic Distribution of Livestock Across Texas

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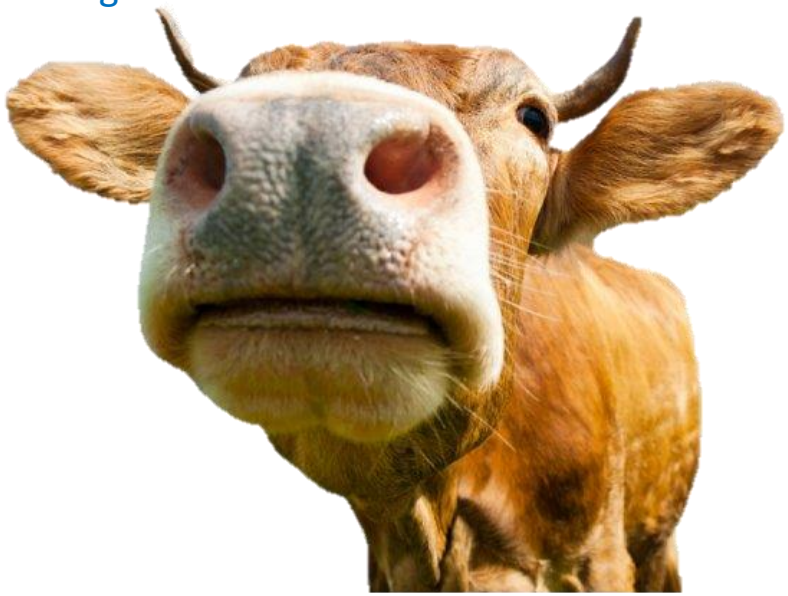
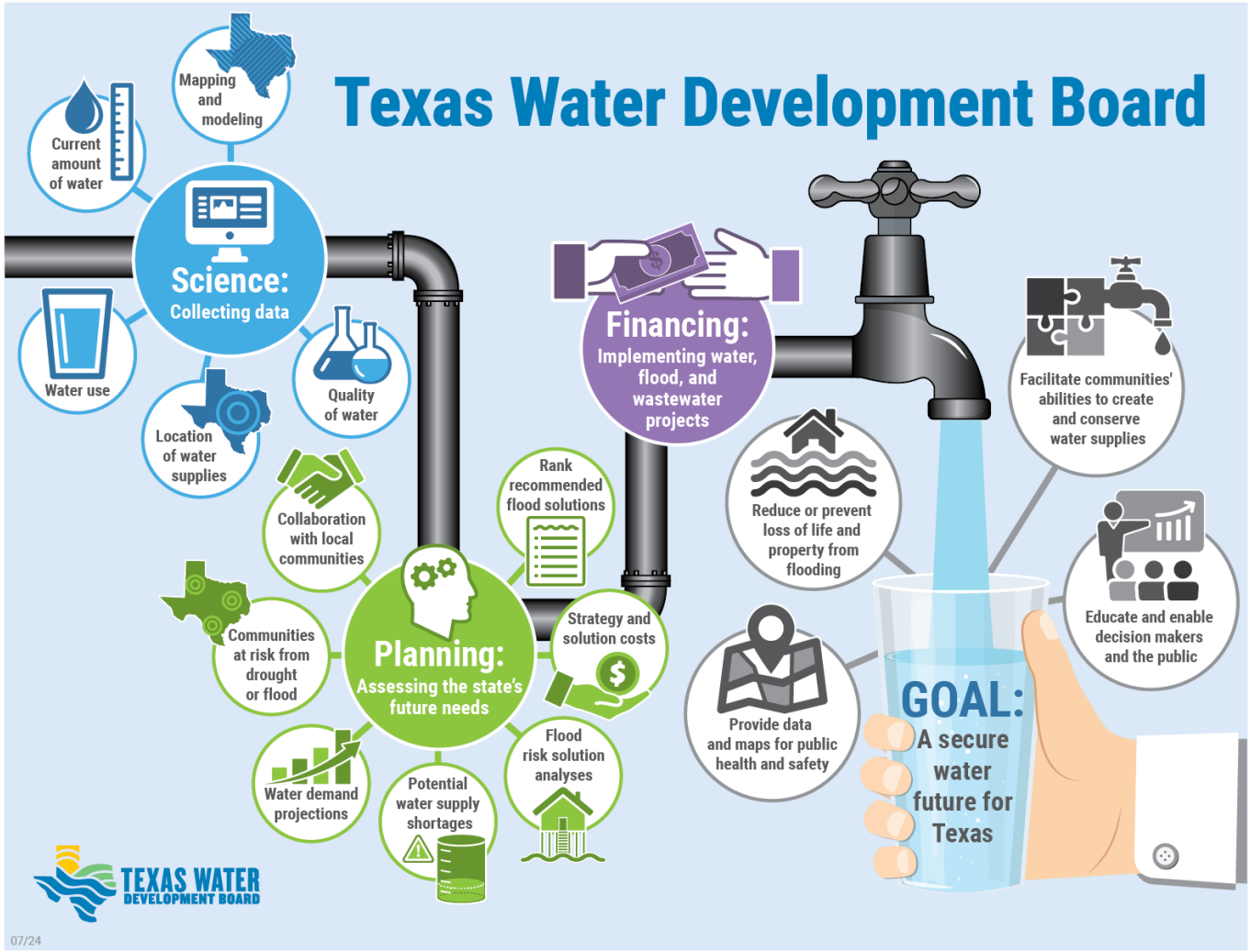


October 23rd, 2024
Texas GIS Forum

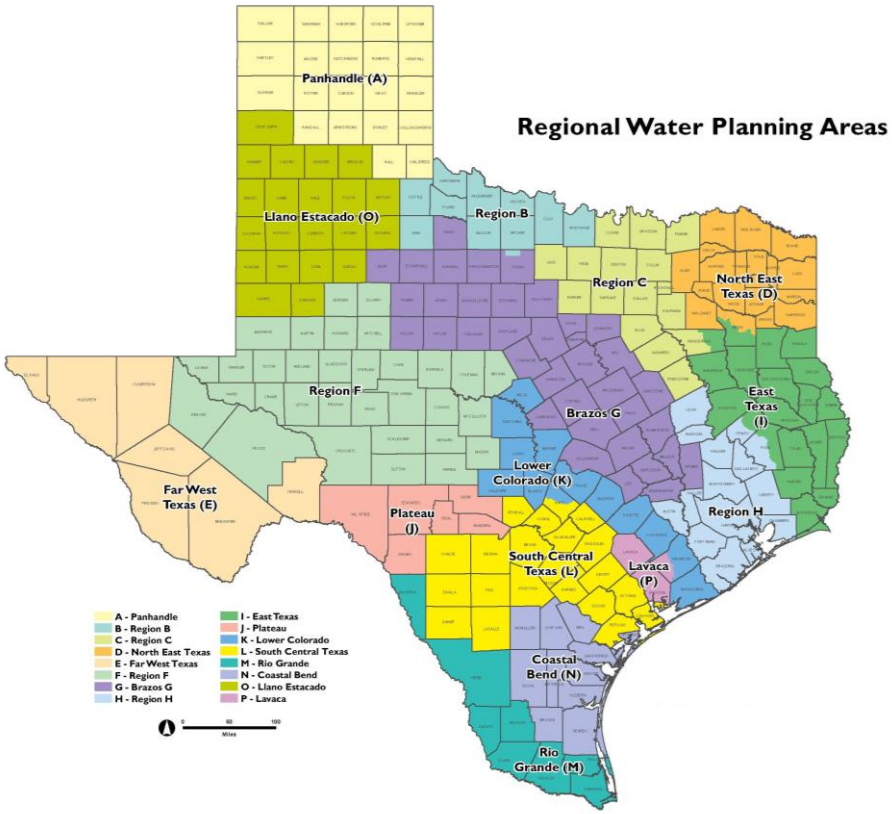
Purpose, Agenda

- How TWDB develops livestock inventory and water use estimates for each planning region, county, and basin.
  - Water Supply Planning
  - Livestock Inventory
  - Livestock Water Use
  - GIS Analysis
    - Region-County-Basin (RCB) & Source Data
    - Confined vs Unconfined
    - Point Location vs Landcover Methodology
    - Geographic Probability Calculations
  - Historical Estimates and Projections

Background – TWDB Overview



Water Supply Planning



16 Regional Water Plans + 1 State Water Plan

5-year planning cycle

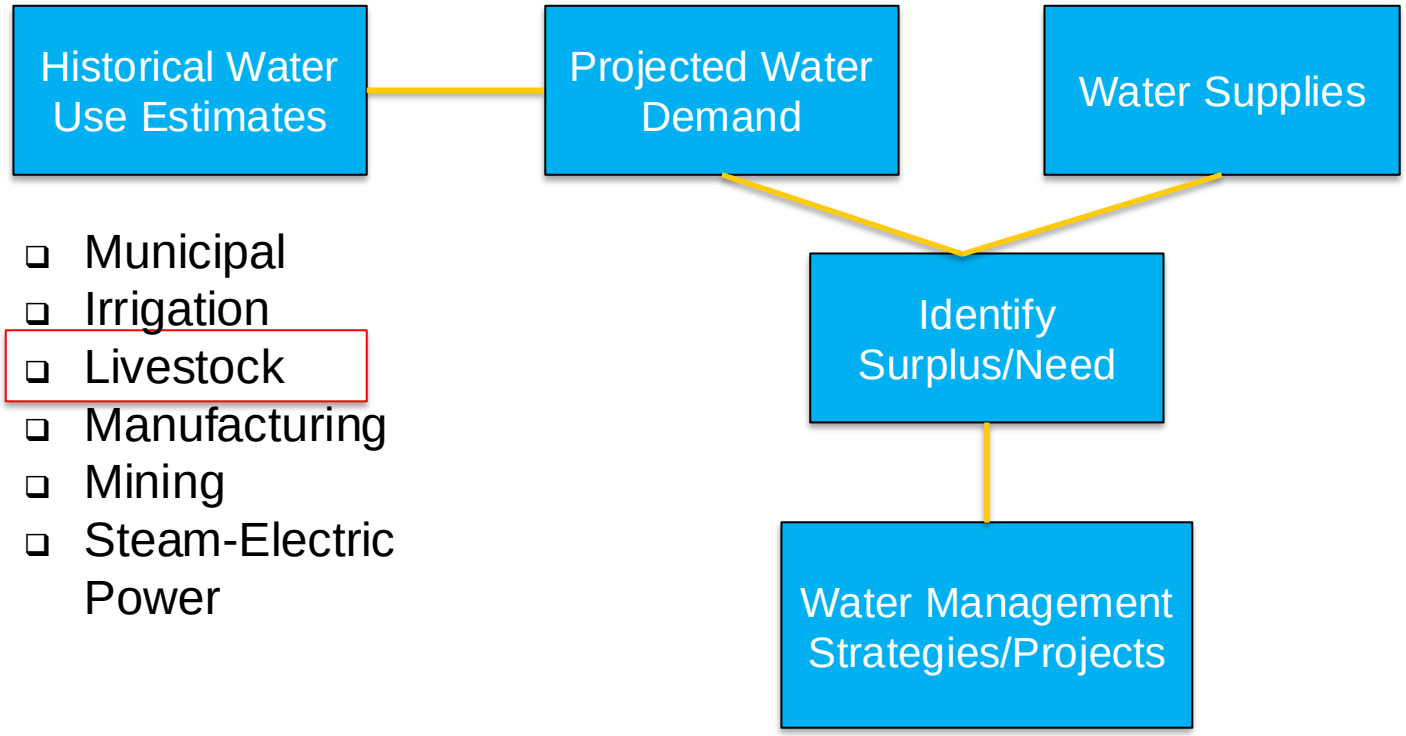
Bottom-up approach

50-year planning horizon

Address future water needs (demands and supplies)

Based on historical water use and trends

Water Supply Planning



- Municipal
- Irrigation
- Livestock
- Manufacturing
- Mining
- Steam-Electric Power

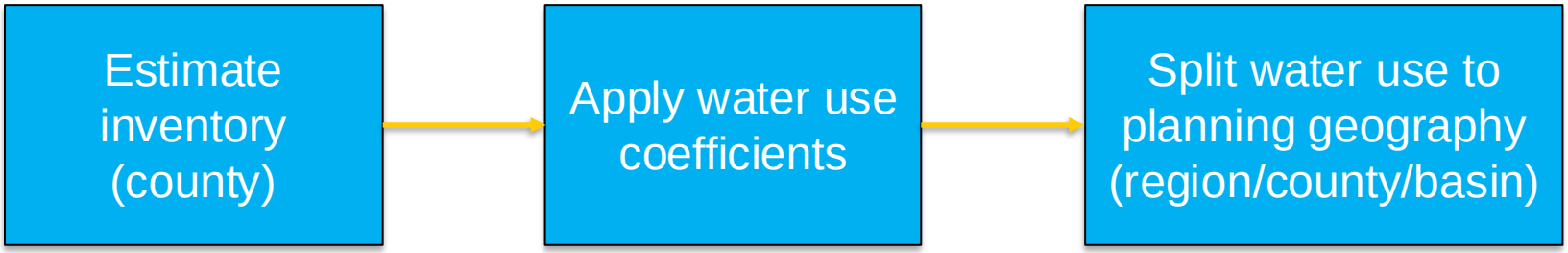
Livestock Water Use

- Surveyed water use (Water Use Survey)
  - fish hatcheries, aquaculture
- Non-surveyed water use

TWDB livestock species	USDA data components
Dairy Cattle	Milk cattle
Fed and Other Cattle	Cattle, including calves, minus milk cattle inventory
Chickens - Broilers	Broiler chickens
Chickens - Non-Broilers	Pullets (replacement), layers, and roosters
Hogs	Hogs
Sheep	Sheep, including lambs
Goats	Milk, meat, and Angora (goats)
Equine	Horses and ponies, and mules, burros, and donkeys
Turkeys	Turkeys

Livestock Estimates Basics

- US Department of Agriculture (USDA)
  - National Agriculture Statistics Service (NASS)
    - Ag Census/Ag Survey



Livestock Inventory Data

- Data Availability
  - Inventory by County
  - Inventory by County and Operation Size
    - Data withheld to avoid disclosing data for individual operations.
- Estimate undisclosed inventory numbers

Inventory:

INVENTORY OF HOGS: (1 TO 24 HEAD)	INVENTORY OF HOGS: (25 TO 49 HEAD)	INVENTORY OF HOGS: (50 TO 99 HEAD)	INVENTORY OF HOGS: (100 TO 199 HEAD)	INVENTORY OF HOGS: (200 TO 499 HEAD)	INVENTORY OF HOGS: (500 TO 999 HEAD)
(D)	(D)				

Operations:

INVENTORY OF OPERATIONS: (1 TO 24 HEAD)	INVENTORY OF OPERATIONS: (25 TO 49 HEAD)	INVENTORY OF OPERATIONS: (50 TO 99 HEAD)	INVENTORY OF OPERATIONS: (100 TO 199 HEAD)	INVENTORY OF OPERATIONS: (200 TO 499 HEAD)	INVENTORY OF OPERATIONS: (500 TO 999 HEAD)
1	1				

Water Use Coefficients

- Based on:
  - liquid water **consumed** directly (consumptive or drinking water),
  - water used for **cleaning** the facilities (including water used during the milking process), and
  - water used for **cooling**.

- Sources:
  - Texas AgriLife specialists
  - Texas Cattle Feeders Association representative
  - Various research publications

Water Use Coefficients

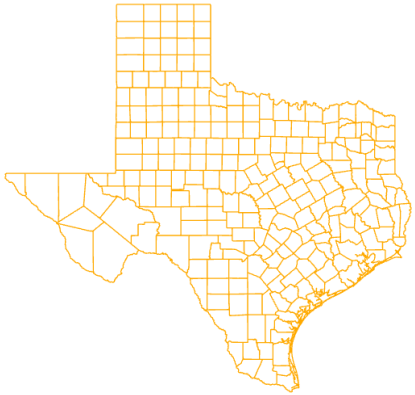
TWDB species	NASS data type	Water use (gallons/head/day)
Cattle	Milk	55
	Fed & other cattle	15
Chickens	Non-broilers	0.09
	Broilers	0.09
Turkeys	Turkeys	0.2
Equine	Horses & ponies	12
	Mules, burros, & donkeys	
Hogs	Hogs	5
Sheep	Sheep	2
Goats	Milk	2
	Meat	
	Angora	

Purpose, Agenda

- Describe how TWDB develops livestock inventory and water use estimates for each geographical planning region, county, and river basin split.
  - Water Supply Planning
  - Livestock Inventory
  - Livestock Water Use
  - GIS Analysis
    - Region-County-Basin (RCB) & Source Data
    - Confined vs Unconfined
    - Point Location vs Landcover Methodology
    - Geographic Splits Summary and Review
  - Historical Estimates and Projections

Region-County-Basin

254 Counties from Census TIGER geodatabase



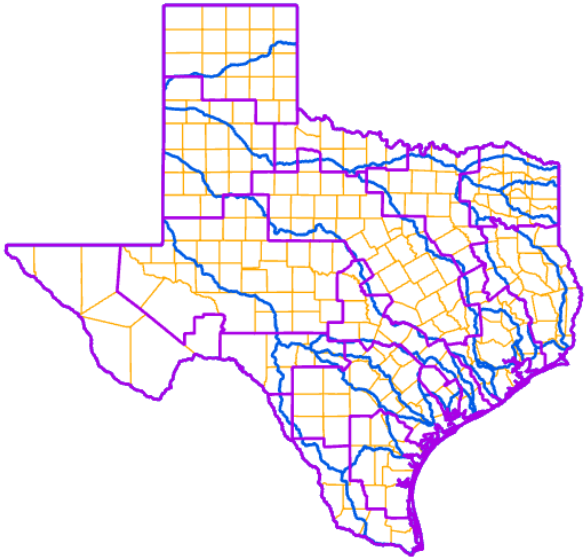
16 Planning Regions

Basin

23 Major Basins (15 river basins and 8 coastal basins) within the state used for water planning purposes.

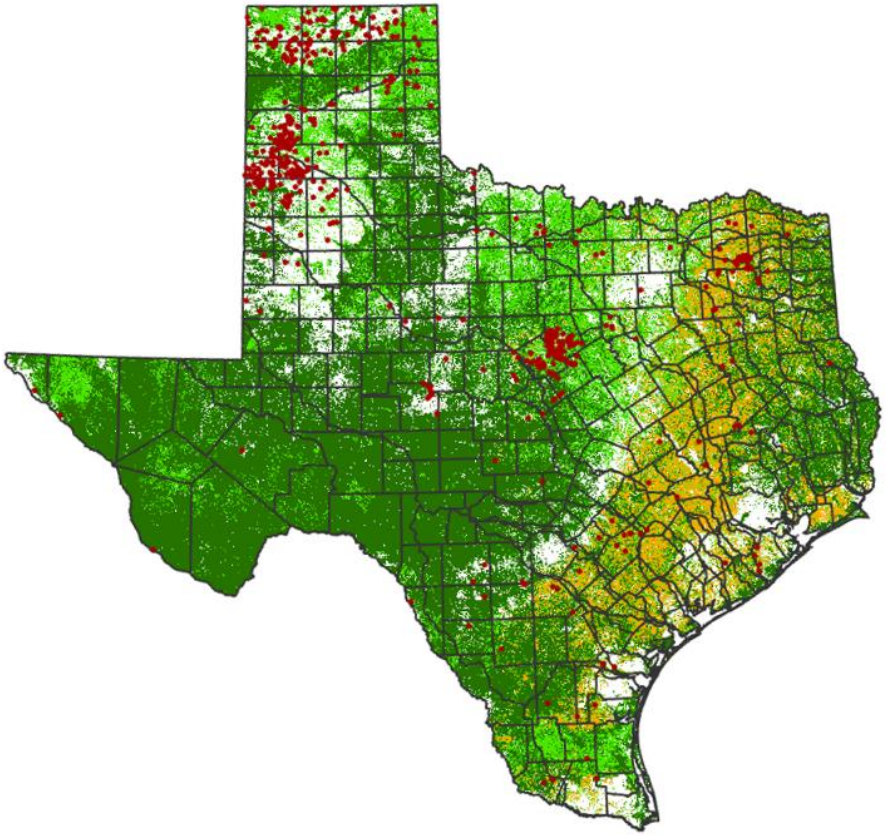
Region – County - Basin

451 Region-County-Basin combinations. Final combinations based on feedback from planning groups (slivers removed).



Source Data

- TWDB/PSA historical estimates using the latest USDA ag census as a proxy
- National Land Cover Dataset (NLCD)
  - USGS and Multi-Resolution Land Characteristics Consortium
  - Updated every 2-3 years
- TCEQ Permit Data
  - Concentrated Animal Feeding Operation (CAFO) species, capacity, and location
  - Request all active permits: snapshot in time
- Stakeholder Feedback
  - Texas Cattle Feeders Association (TCFA)
  - Texas State Soil and Water Conservation Board (TSSWCB)



Confined and Unconfined Inventory

County Total = Confined Inv + Unconfined Inv

Confined Inventory

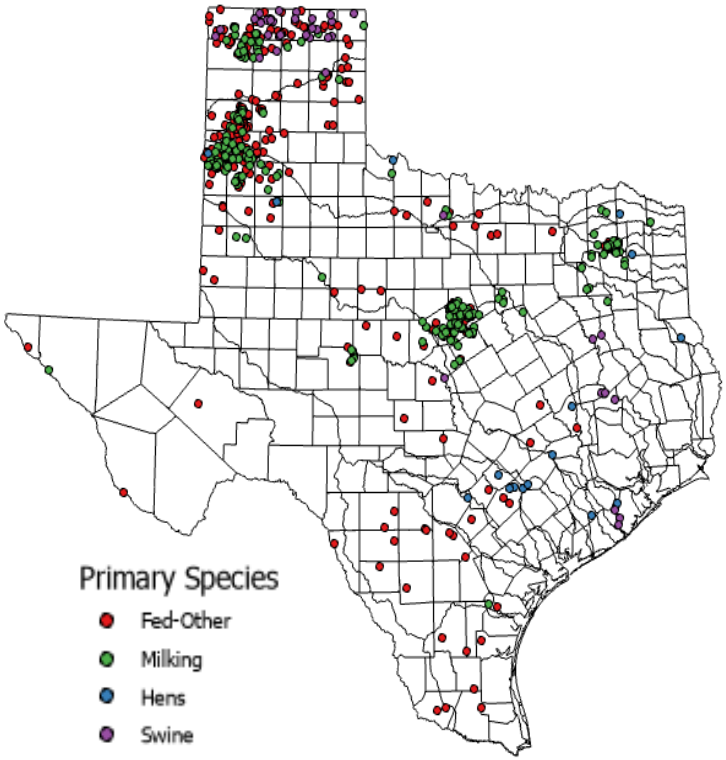
- TCFA provided feedback on operational inventory of fed and dairy cattle as a percent of TCEQ permit capacity for select counties.
- Calculate a state average based on feedback.

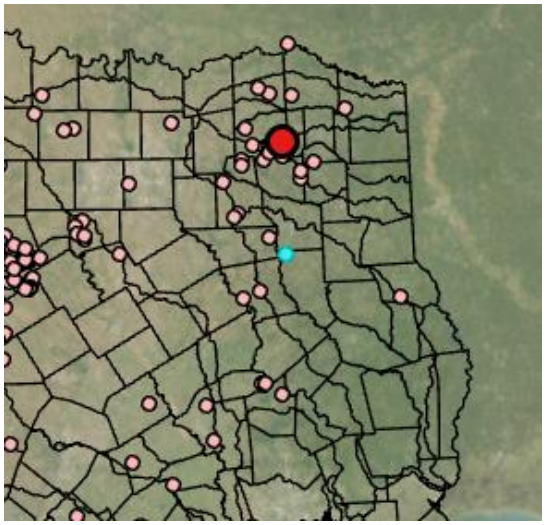
Unconfined Inventory

- PSA county inventory estimate minus the confined inventory value.

Point Location (Vector Data)

All TCEQ CAFO permits are geo-referenced using their reported coordinates. The reported county is compared with the GIS coordinate county and discrepancies are flagged and researched.



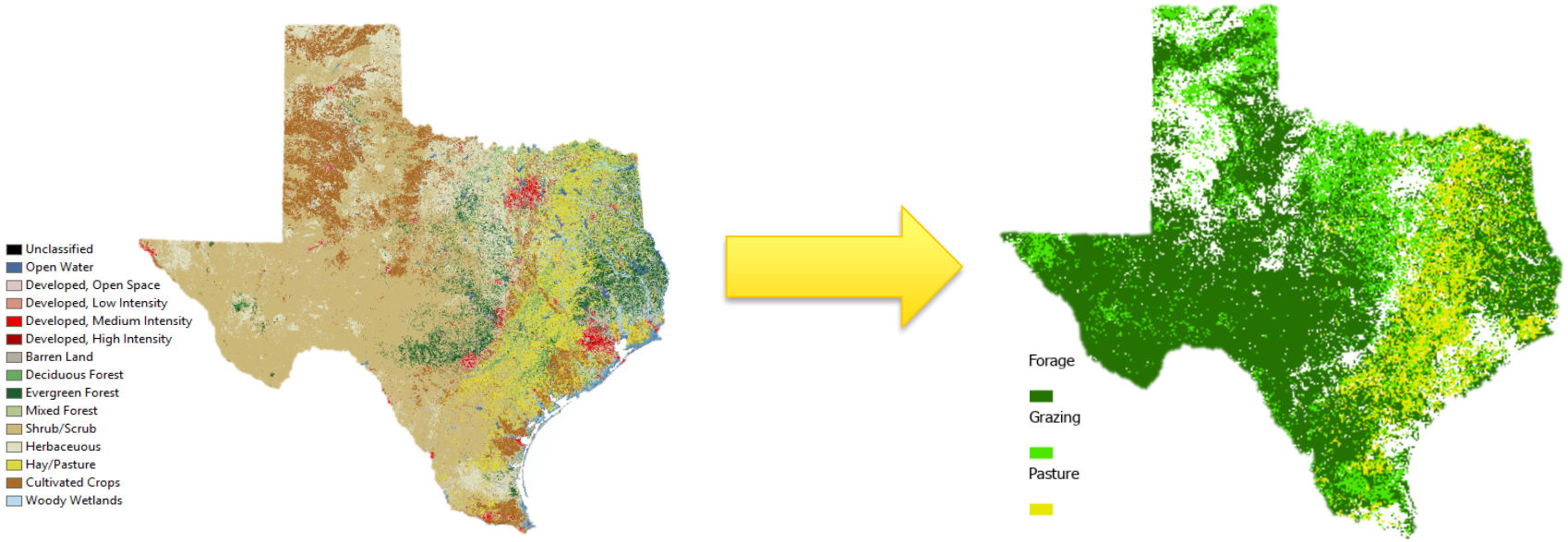


$$\frac{\text{RCB capacity}}{\text{Total county capacity}} = \text{Confined Split}$$

Land Cover (Raster Data)

The Reclassify tool was used to create three new raster layers based on the diet of different livestock species.

Class/ Value	Vegetation Classification	All Grazing (Fed-Other Cattle)	Pasture Only (Milk Cattle & Horses)	All Forage (Sheep & Goats)
41	Deciduous Forest	0	0	1
42	Evergreen Forest	0	0	1
43	Mixed Forest	0	0	1
51	Dwarf Scrub	0	0	1
52	Shrub/Scrub	0	0	1
71	Grassland/ Herbaceous	1	0	1
81	Pasture/Hay	1	1	1
90	Woody Wetlands	0	0	1
95	Emergent Herb. Wetlands	0	0	1
-	All other classes	0	0	0

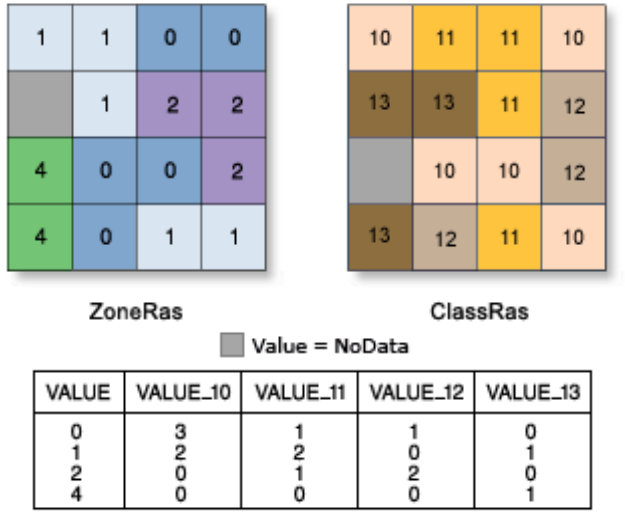


Land Cover (Raster Data)

The Tabulate area tool was used to count the number of cells with the desired vegetation in each RCB for each dietary vegetation class.

$$\frac{\text{Count of vegetated pixels in the RCB}}{\text{Count of vegetated pixels in the whole county}} = \text{Unconfined Split}$$

ESRI Tabulate Area Tool Overview



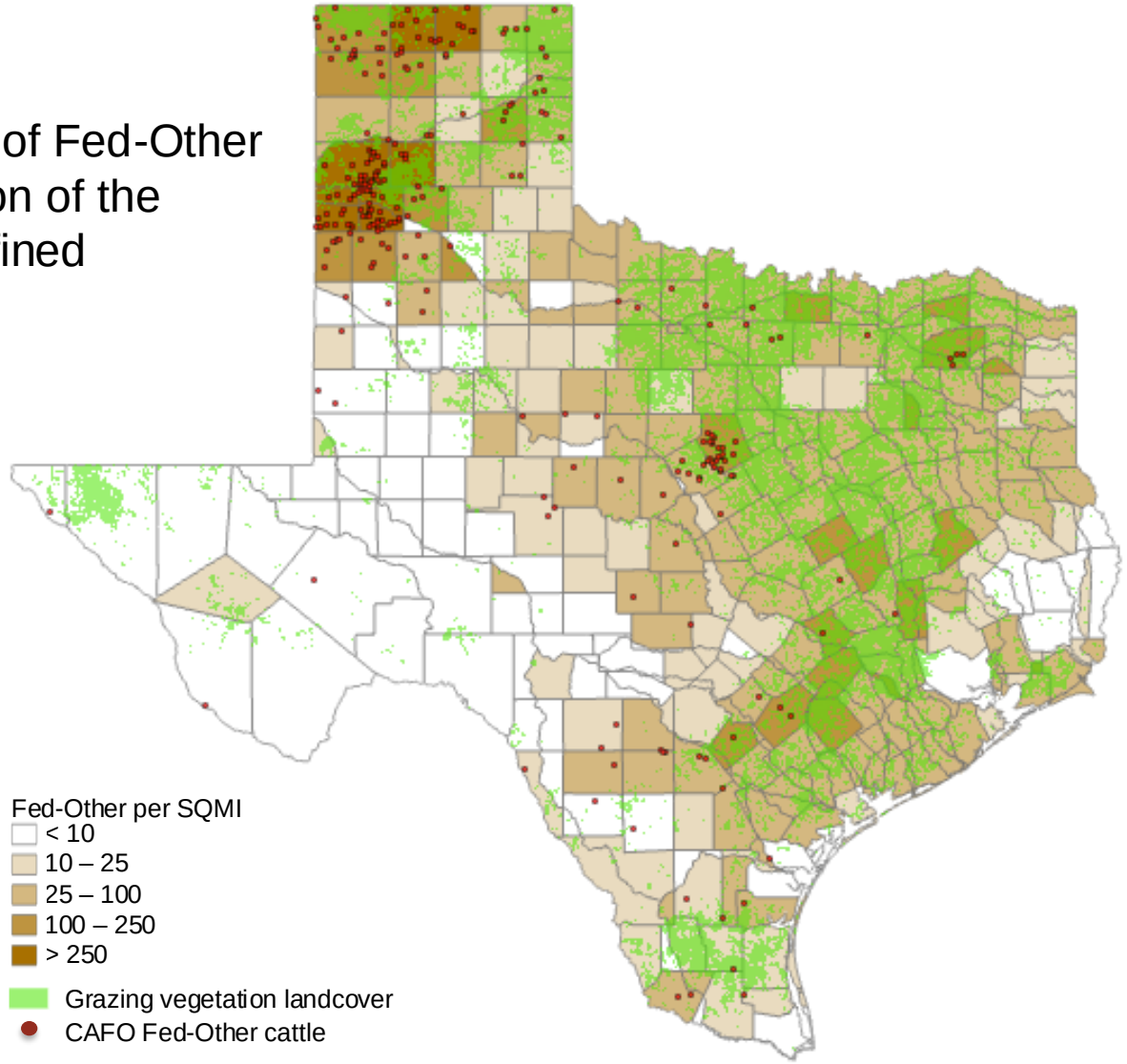
VALUE	VALUE_10	VALUE_11	VALUE_12	VALUE_13
0	3	1	1	0
1	2	2	0	1
2	0	1	2	0
4	0	0	0	1

Splits Summary

Livestock Species	Range Category	Split Name	Split Data Source
Fed-Other Cattle	Confined	Fed-Other CAFO Split	TCEQ CAFO Permit
Fed-Other Cattle	Unconfined	Grazing Split	NLCD
Milking Cattle	Confined	Milking CAFO Split	TCEQ CAFO Permit
Milking Cattle	Unconfined	Pasture Split	NLCD
Hogs	Confined	Hog CAFO Split	TCEQ CAFO Permit, Land Area
Poultry	Confined	Poultry Split	TSSWCB, TCEQ CAFO Permit, Land Area
Goats	Unconfined	Forage Split	NLCD
Sheep	Unconfined	Forage Split	NLCD
Horses	Unconfined	Pasture Split	NLCD

Examine Fed-Other Cattle

Square mile density of Fed-Other cattle after application of the confined and unconfined geographic splits.

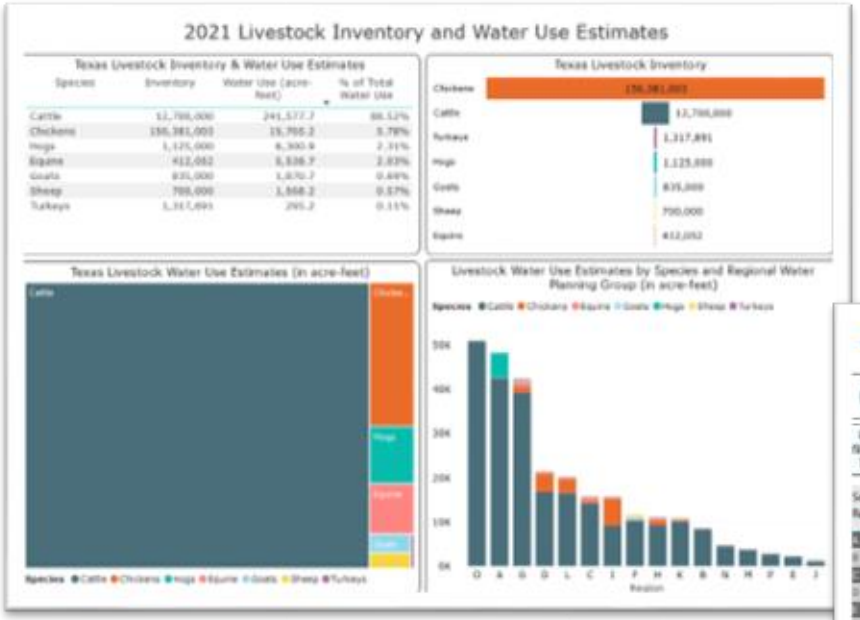


Final Split

- Aggregate water use for all livestock categories by RCB using water use coefficients and inventories from the GIS analysis.
- Calculate the final geographic water use split by dividing RCB water use by county water use.
- New splits applied to annual county-level livestock estimates

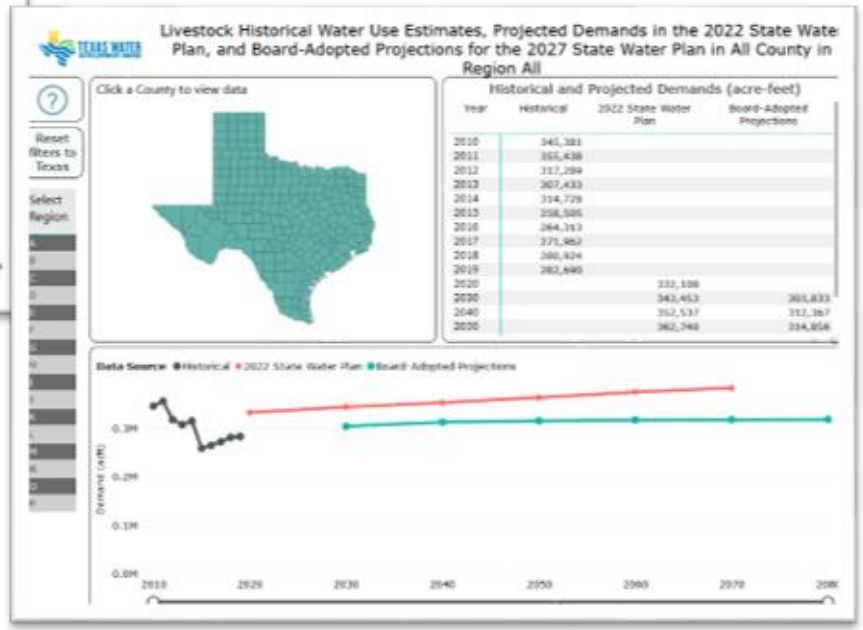
$$\text{RCB Geographic Split} = \frac{\text{RCB Livestock Use}}{\text{County Livestock Use}}$$

Historical Estimates and Projections



https://www.twdb.texas.gov/waterplanning/data/dashboard/index.asp

https://www.twdb.texas.gov/waterplanning/data/projections/2027/projections.asp



Questions

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