Consumptive Use Estimation of Irrigated Lands in the Green River Basin of Wyoming

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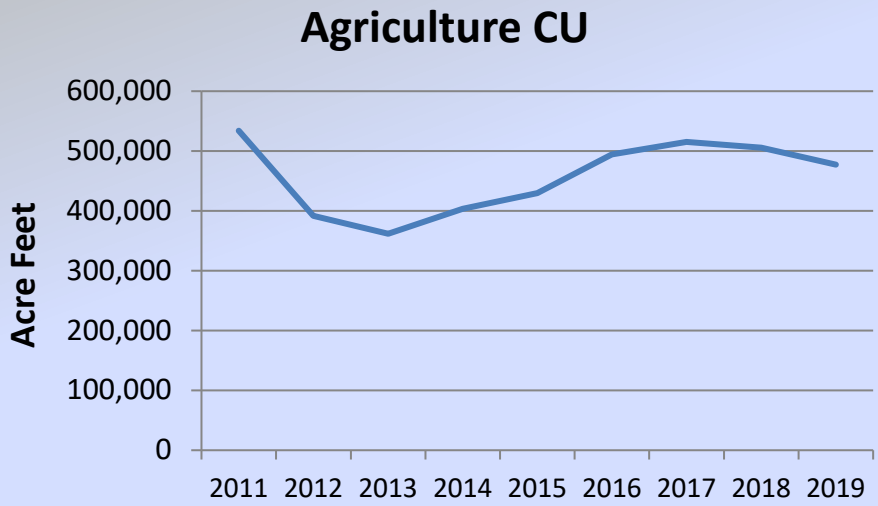
Wyoming State Engineer's Office

Where?


Fremont Lake
Pinedale
Boulder Lake
Green River Basin
Big Sandy Res.
Fontenelle Res.
Kemmerer
Rock Springs
Green River
Little Snake River Basin
Flaming Gorge Res.

Irrigation CU

- Largest and most variable
  - 2011 to 2019: 360k to 530k AF, mean: 457k AF



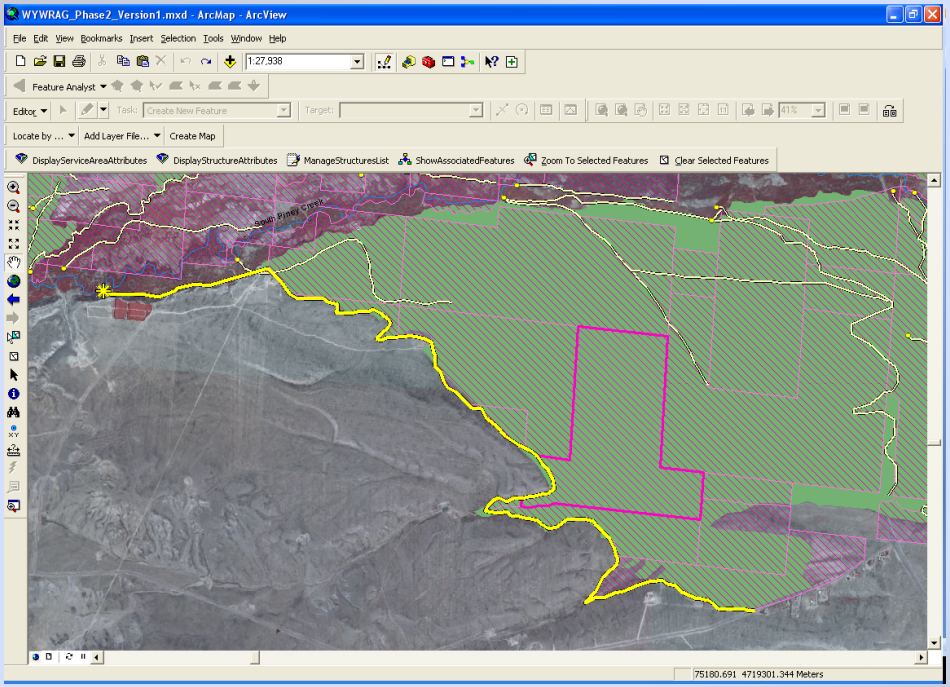
Penman - Monteith estimates

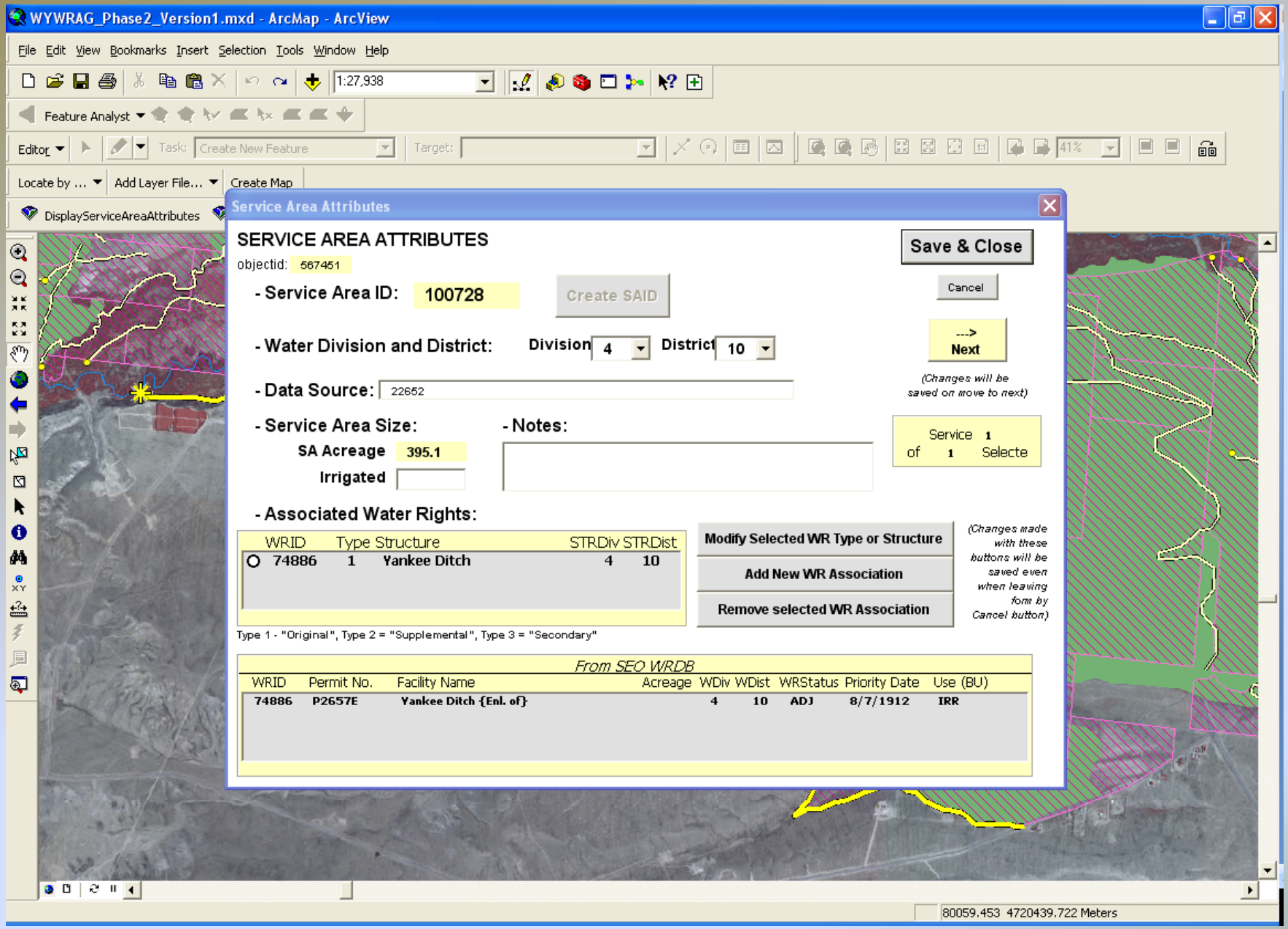
Irrigation

- Green River Basin covers 17,000 sq. miles
- Mostly flood irrigated (88%)
- Mean elevation is just over 7,000 feet
- Growing season of 125 – 150 days (May-Sept)
- Mostly grass hay & mountain pasture to support cattle ranches
- > 2,000 permitted points of diversion

Quantifying CU - Irrigated Acreage

- Measuring irrigated acreage – 2 methods
  1) GIS of water right data
     - WyWRAG: Wyoming Water Rights Attribution Geodatabase.



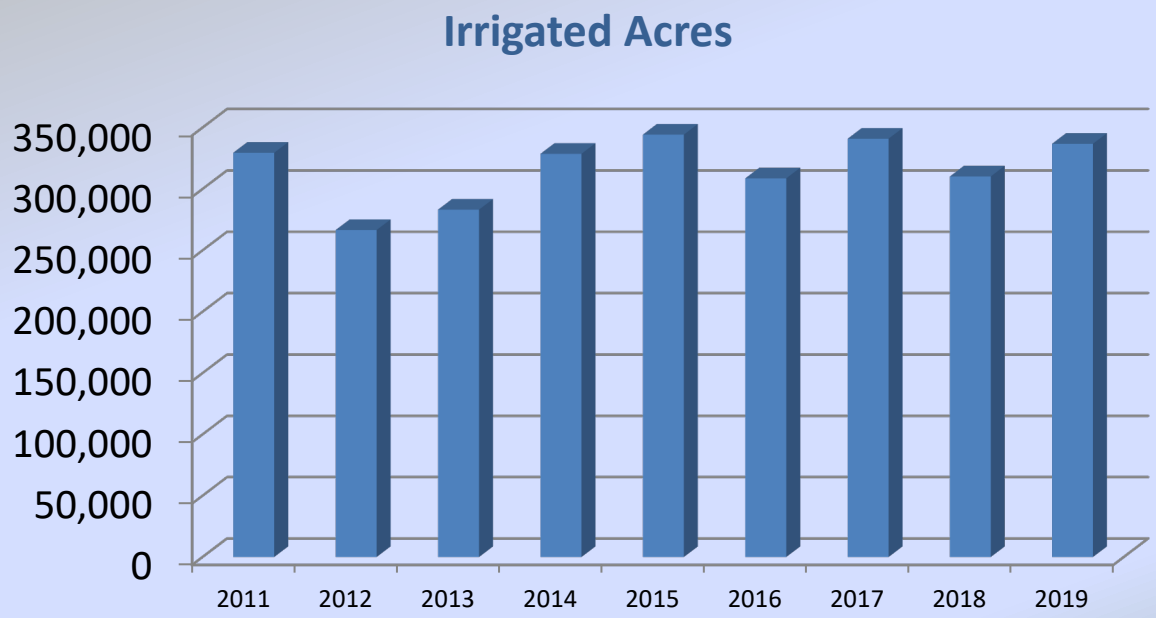

WYWRAG_Phase2_Version1.mxd - ArcMap - ArcView
File Edit View Bookmarks Insert Selection Tools Window Help
1:27,938
Feature Analyst
Editor
Task: Create New Feature
Target:
Locate by ...
Add Layer File...
Create Map
DisplayServiceAreaAttributes
Service Area Attributes
SERVICE AREA ATTRIBUTES
objectid: 567451
- Service Area ID: 100728
Create SAID
Save & Close
Cancel
---> Next
(Changes will be saved on move to next)
- Water Division and District:
Division 4
District 10
- Data Source: 22652
- Service Area Size:
SA Acreage 395.1
Irrigated
- Notes:
Service 1 of 1 Selecte
- Associated Water Rights:
WRID Type Structure STRDiv STRDist
74886 1 Yankee Ditch 4 10
Modify Selected WR Type or Structure
Add New WR Association
Remove selected WR Association
(Changes made with these buttons will be saved even when leaving form by Cancel button)
Type 1 - "Original", Type 2 = "Supplemental", Type 3 = "Secondary"
From SEO WRDB
WRID Permit No. Facility Name Acreage WDiv WDist WRStatus Priority Date Use (BU)
74886 P2657E Yankee Ditch {Enl. of} 4 10 ADJ 8/7/1912 IRR
80059.453 4720439.722 Meters

NDVI – in the GRB

- 2) Remote sensing: NDVI
  - Irrigated area approximation
  - Currently improving
  - Working with other agencies to standardize

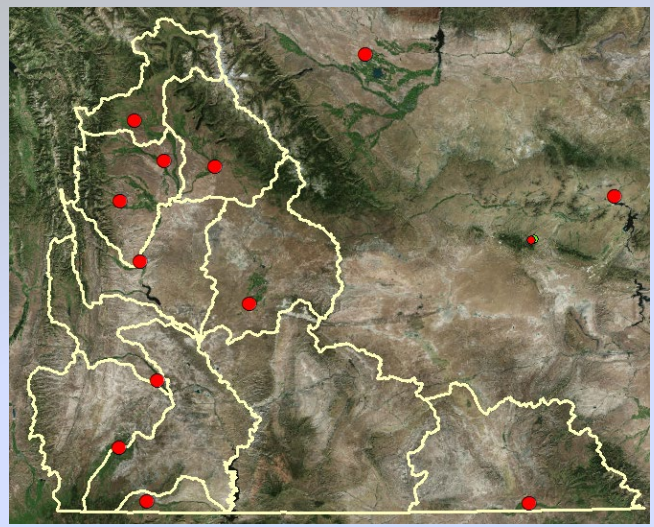
Irrigated Acres

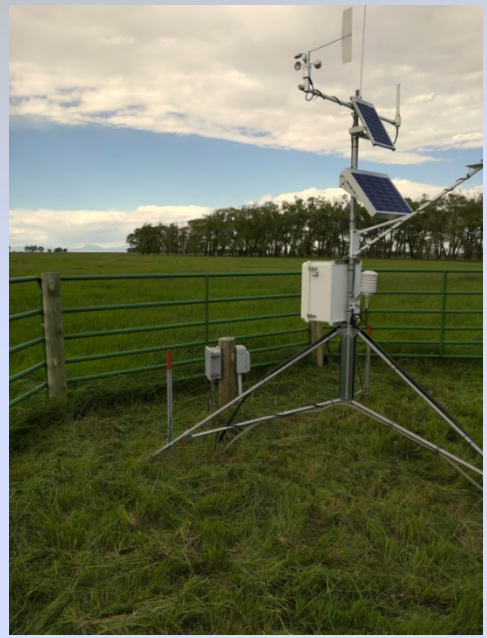
- NDVI results:
  - Variable, dependent on water supply: 265k – 345k (2011-2019)
  - Comparison: WWDC 2001 Basin Plan: 330,410 ac



Climate Data

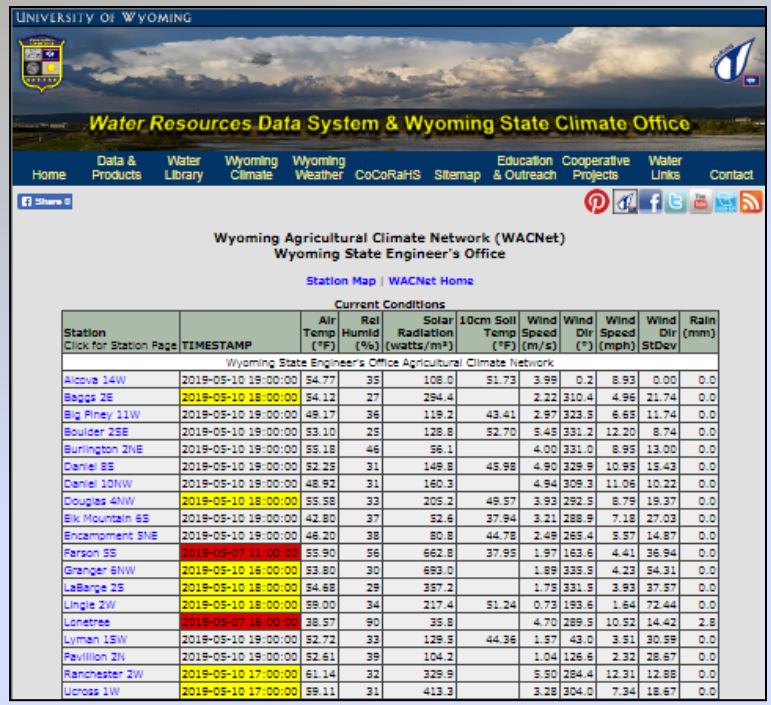
- Penman-Monteith from SEO weather stations
- 10 climate stations in GRB
- Campbell Scientific equipment



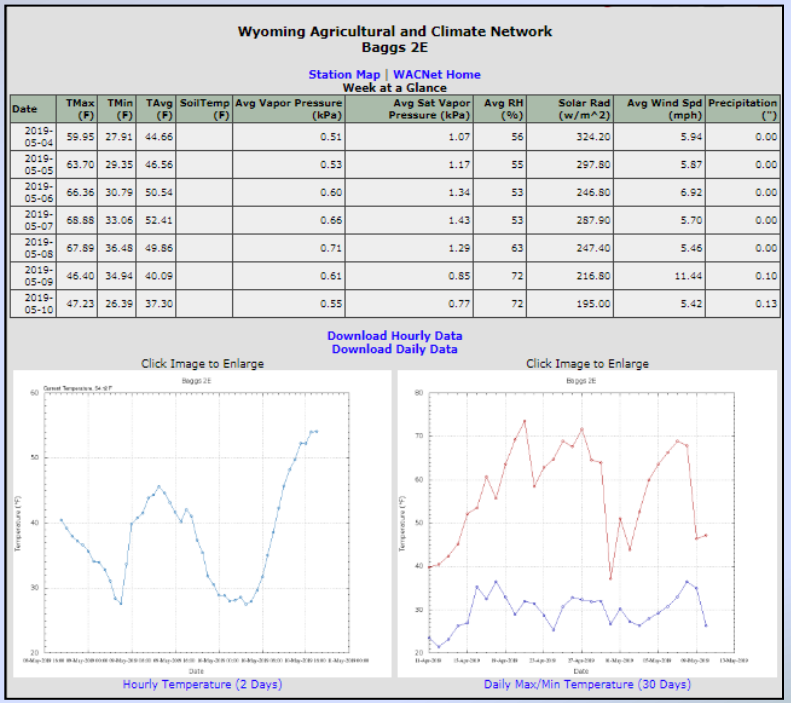


Climate Data

- SEO maintains & manages stations, and QAQCs the data
  - DRI "Dunkerly tool" for QAQC 2011 - 2019
- University houses database and website



Station Click for Station Page	TIMESTAMP	Air Temp (°F)	Rel Humid (%)	Solar Radiation (watts/m²)	10cm Soil Temp (°F)	Wind Speed (m/s)	Wind Dir (°)	Wind Speed (mph)	Wind Dir StDev	Rain (mm)
Wyoming State Engineer's Office Agricultural Climate Network										
Alcova 14W	2019-05-10 19:00:00	54.77	35	108.0	51.73	3.99	0.2	8.93	0.00	0.0
Baggs 2E	2019-05-10 18:00:00	54.12	27	294.4		2.22	310.4	4.96	21.74	0.0
Big Piney 11W	2019-05-10 19:00:00	49.17	36	119.2	43.41	2.97	323.5	6.65	11.74	0.0
Boulder 2SE	2019-05-10 19:00:00	53.10	25	128.8	52.70	5.45	331.2	12.20	8.74	0.0
Burlington 2NE	2019-05-10 19:00:00	55.18	46	56.1		4.00	331.0	8.95	13.00	0.0
Daniel 8S	2019-05-10 19:00:00	52.25	31	149.8	45.98	4.90	329.9	10.95	15.43	0.0
Daniel 10NW	2019-05-10 19:00:00	48.92	31	160.3		4.94	309.3	11.06	10.22	0.0
Douglas 4NW	2019-05-10 18:00:00	55.58	33	205.2	49.57	3.93	292.5	8.79	19.37	0.0
Elk Mountain 6S	2019-05-10 19:00:00	42.80	37	52.6	37.94	3.21	288.9	7.18	27.03	0.0
Encampment 5NE	2019-05-10 19:00:00	46.20	38	80.8	44.78	2.48	265.4	5.57	14.87	0.0
Farson 9S	2019-05-07 11:00:00	55.90	56	662.8	37.95	1.97	163.6	4.41	36.94	0.0
Granger 6NW	2019-05-10 16:00:00	53.80	30	693.0		1.89	335.5	4.23	54.31	0.0
LaBarge 2S	2019-05-10 18:00:00	54.68	29	357.2		1.75	331.5	3.93	37.57	0.0
Lingle 2W	2019-05-10 18:00:00	59.00	34	217.4	51.24	0.73	193.6	1.64	72.44	0.0
Lonetree	2019-05-07 18:00:00	38.57	90	35.8		4.70	289.5	10.52	14.42	2.8
Lyman 15W	2019-05-10 19:00:00	52.72	33	129.5	44.36	1.57	43.0	3.51	30.59	0.0
Pavillion 2N	2019-05-10 19:00:00	52.61	39	104.2		1.04	126.6	2.32	28.67	0.0
Manchester 2W	2019-05-10 17:00:00	61.14	32	329.9		5.50	284.4	12.31	12.88	0.0
Ucross 1W	2019-05-10 17:00:00	59.11	31	413.3		3.28	304.0	7.34	18.67	0.0



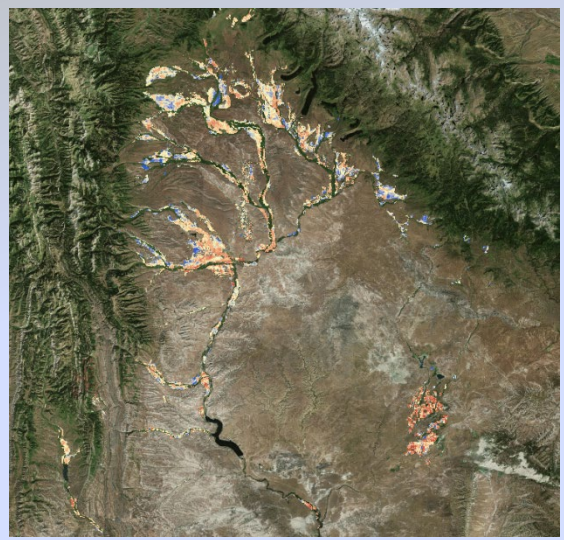
Date	TMax (F)	TMin (F)	TAvg (F)	SoilTemp (F)	Avg Vapor Pressure (kPa)	Avg Sat Vapor Pressure (kPa)	Avg RH (%)	Solar Rad (w/m^2)	Avg Wind Spd (mph)	Precipitation (")
2019-05-04	59.95	27.91	44.66		0.51	1.07	56	324.20	5.94	0.00
2019-05-05	63.70	29.35	46.56		0.53	1.17	55	297.80	5.87	0.00
2019-05-06	66.36	30.79	50.54		0.60	1.34	53	246.80	6.92	0.00
2019-05-07	68.88	33.06	52.41		0.66	1.43	53	287.90	5.70	0.00
2019-05-08	67.89	36.48	49.86		0.71	1.29	63	247.40	5.46	0.00
2019-05-09	46.40	34.94	40.09		0.61	0.85	72	216.80	11.44	0.10
2019-05-10	47.23	26.39	37.30		0.55	0.77	72	195.00	5.42	0.13

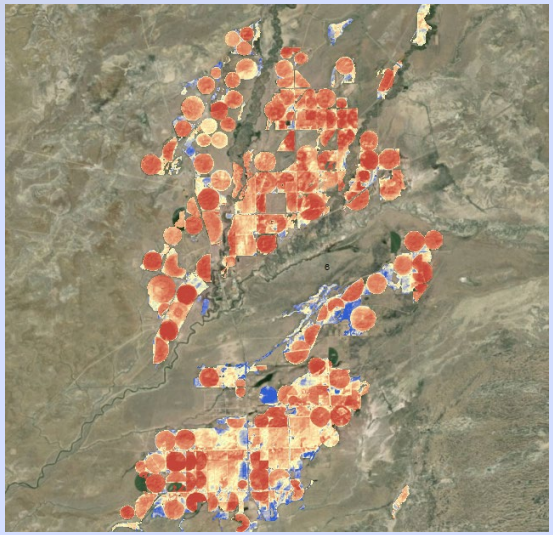
Crop Coefficients

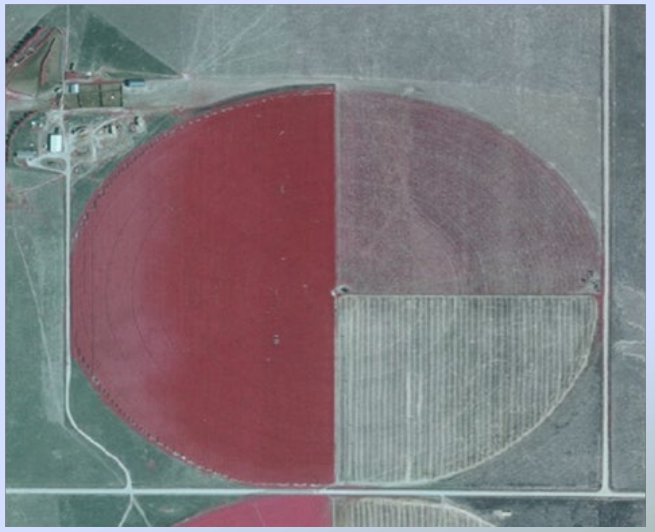
- Crop's ET = Crop Coefficient x Reference ET
  - Coefficient (Kc): Perennial ryegrass & alfalfa
    - ASCE Manual 70 (2016).
    - Grass hay: 1 cutting, Alfalfa: 1 or 2 cuttings
    - May make improvements using METRIC data

CU by Remote Sensing

- Started using remote sensing operationally in the Green River basin in 2011 (METRIC)
  - Consumptive use at both the basin and field scale
  - Various uses: 1) basin CU, 2) water supply shortage, 3) field/water rights CU, 4) Kc estimates…
  - Shared ET field-scale data with ongoing studies

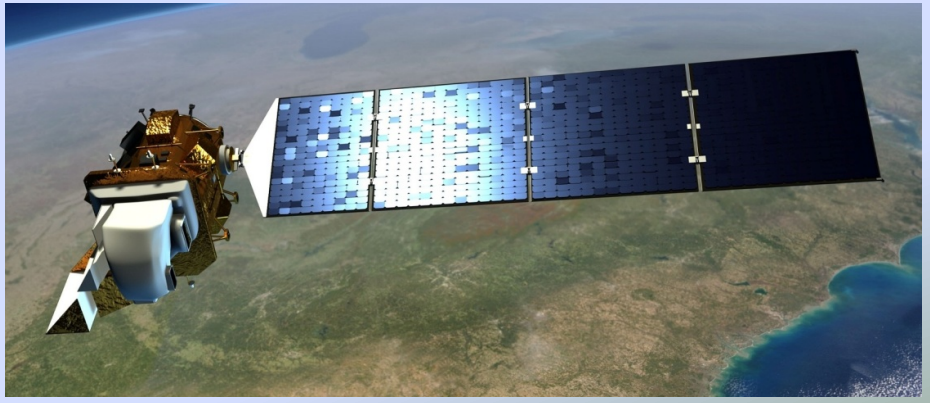






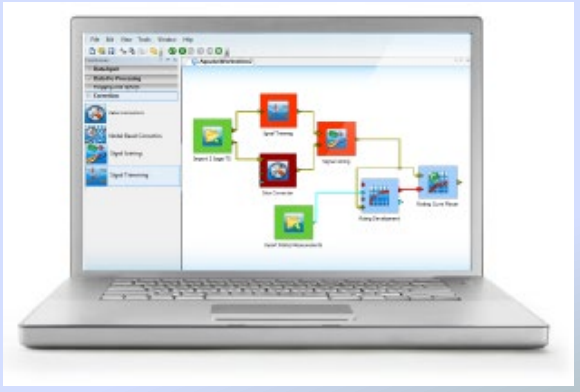
Ongoing Remote Sensing Efforts

- Wyoming's Green River Basin Program
  - Annual estimates of irrigated acreage and CU
- Upper Basin Consumptive Use Project
  - Four UB states & Reclamation
- OpenET
- Progress toward standardized, defendable, available data



Other Data Efforts in Wyoming

- Spreadsheet model that assesses CU based on water rights and water supply condition
- Use remote sensing technologies in other basins in Wyoming
- Increased coordination between Wyoming's water planning efforts and interstate water responsibilities



Thank you!

Former happy location of weather station, Granger, WY

River Basin Planning:

What's Next for Wyoming?

Jodee Pring, Supervisor, River Basin Planning

Wyoming Water Development Office

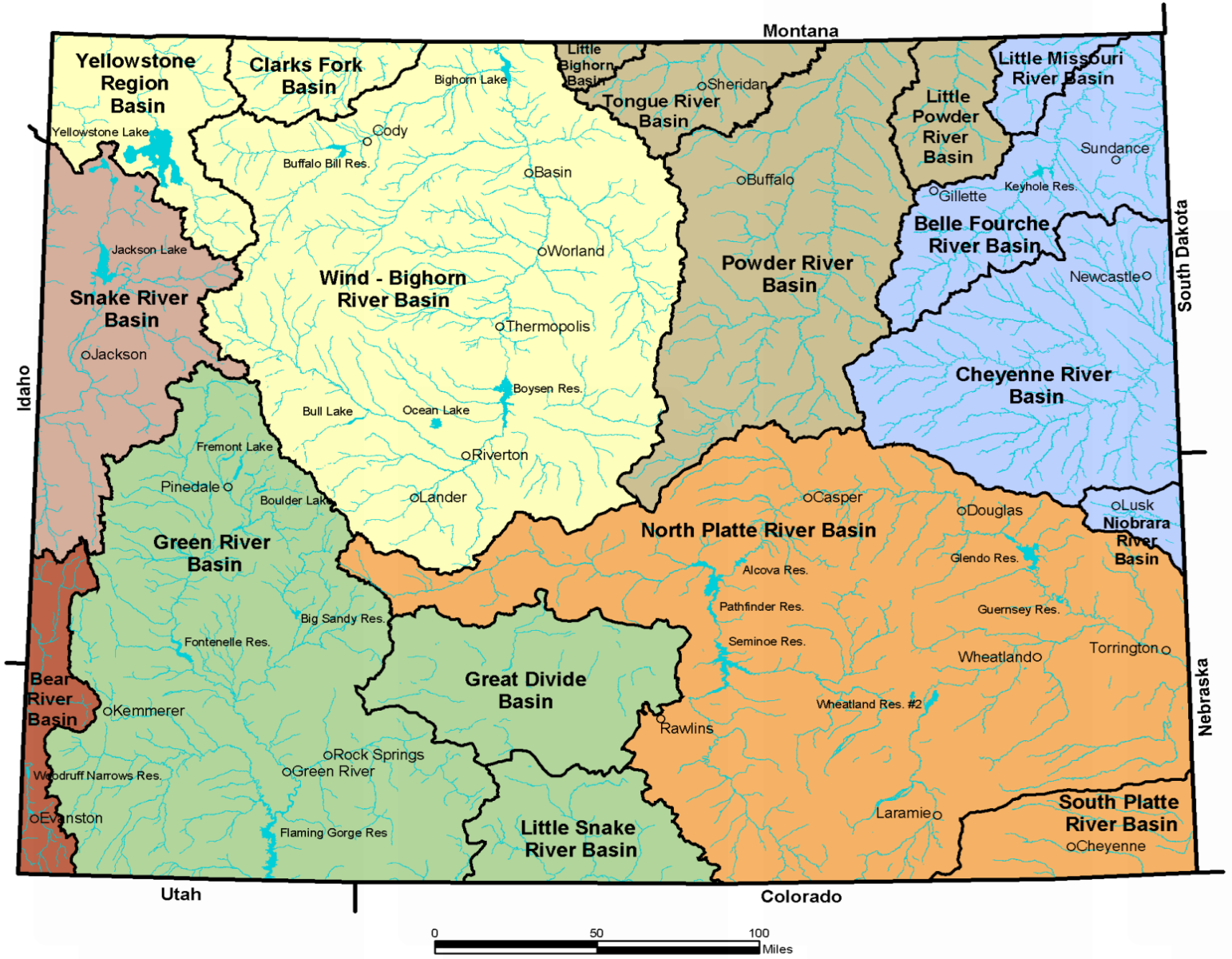
May 28, 2020

Wyoming River Basin Planning

- The River Basin Planning (RBP) section is responsible for water resource planning which includes watershed plans and river basin plans for the state

- The RBP section consists of three employees with assistance from the Water Resources Data System (WRDS) and the State Engineer's Office

Wyoming River Basin Plan Areas



Legend

- Cities
- Major Streams
- Lakes/Reservoirs
- Major River Basins

River Basin Plans

- Bear
- Green/Little Snake
- Northeast
- Platte
- Powder/Tongue
- Snake/Salt
- Wind/Bighorn

N
W
E
S

Mission Statement

Basin Planning Mission Statement: Develop essential information concerning the current status and future availability of water resources in Wyoming

- Inform state water policy and project development
- Provide a proactive stance in the legal arena
- Provide an opportunity for local input on water policy and projects

Why all the Planning?

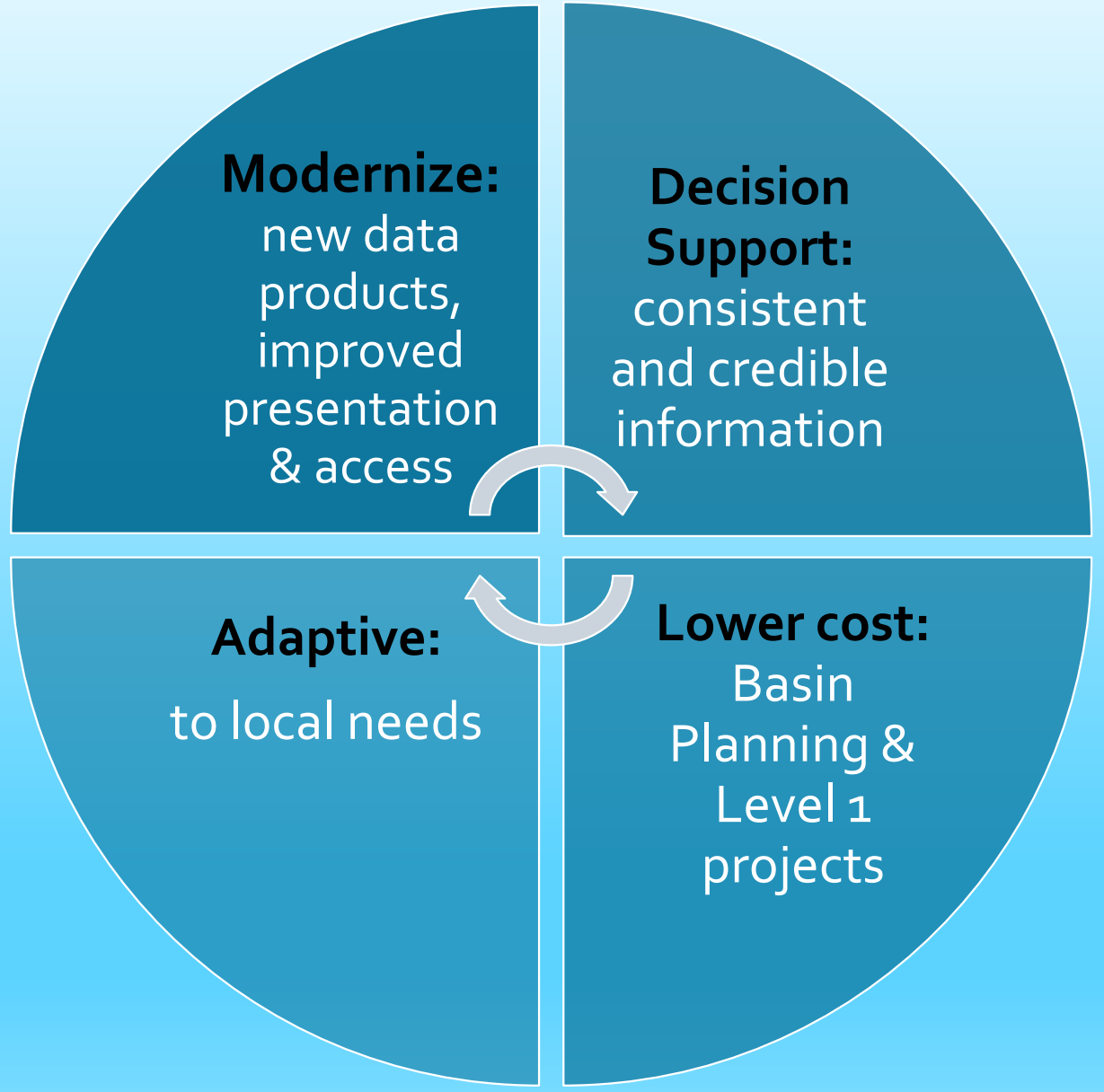
- The State has gone through two cycles of planning.
- First round took place between 2001 – 2006
- Second round took place between 2010 – 2018
- Resulted in lots of valuable information

AND…….

Why all the Planning?

Wyoming WATER Development Office

What Does the Future Hold?



What Does the Future Hold?

- What are the questions we need to be able to answer?
- What tools can help answer those questions?

What Are the Questions We Need To Be Able to Answer?

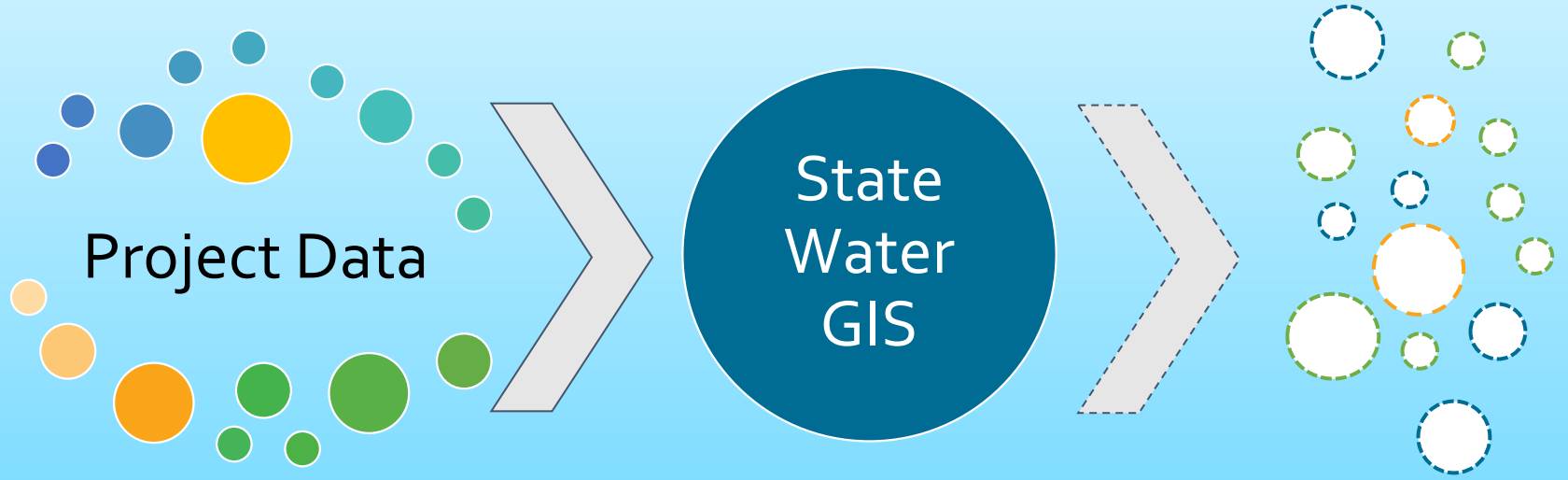
Questions such as:

- What areas are most affected on low water years? Is there a mitigation plan in place?
- How has water use changed in the last 20-30 years? What will it look like 20 years from now?
- How can state resources be invested strategically? How do we reduce costs?
- Is there enough physical water to support a project?
- How does water move across the landscape and what are the conditions of the infrastructure?

Tools To Help Answer Those Questions

- GIS Data Model Implementation
  - Water Infrastructure Mapping
- Water Use Index
  - Supplemental Water Supply Analysis (POU mapping)
  - Water Bulletin and web-based infographics

GIS Data Model Implementation

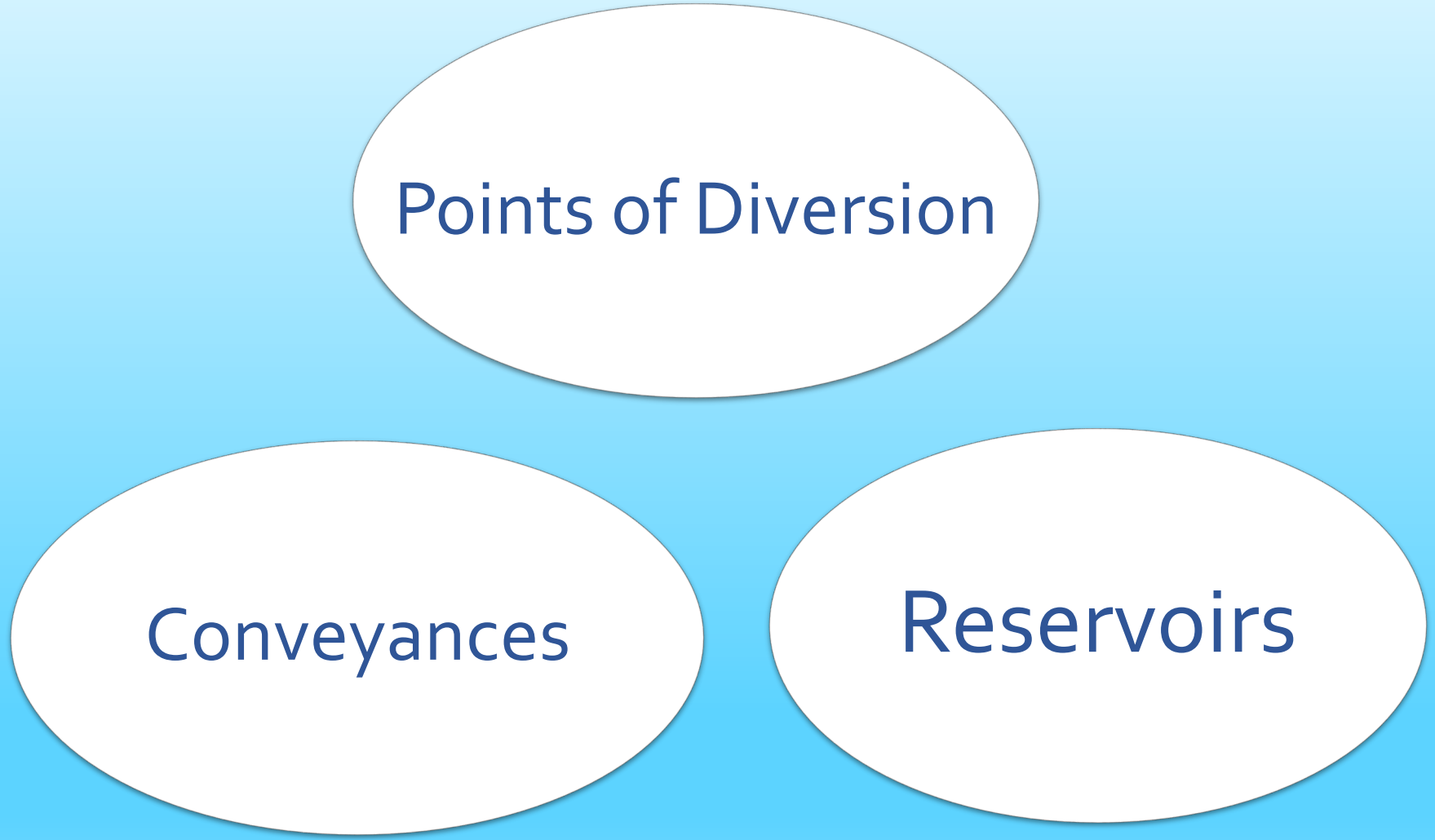


Current

Future

Wyoming WATER Development Office

Water Infrastructure Mapping



Water Use Index

- Review of water supply and use intended to identify trends.
- Statewide index provides an active understanding of water supplies, and highlights areas of change within Wyoming.
- Done in-house this would take the place of RBPs in order to minimize cost and provide current, credible information to assess trends.

Supplemental Water Supply Analysis

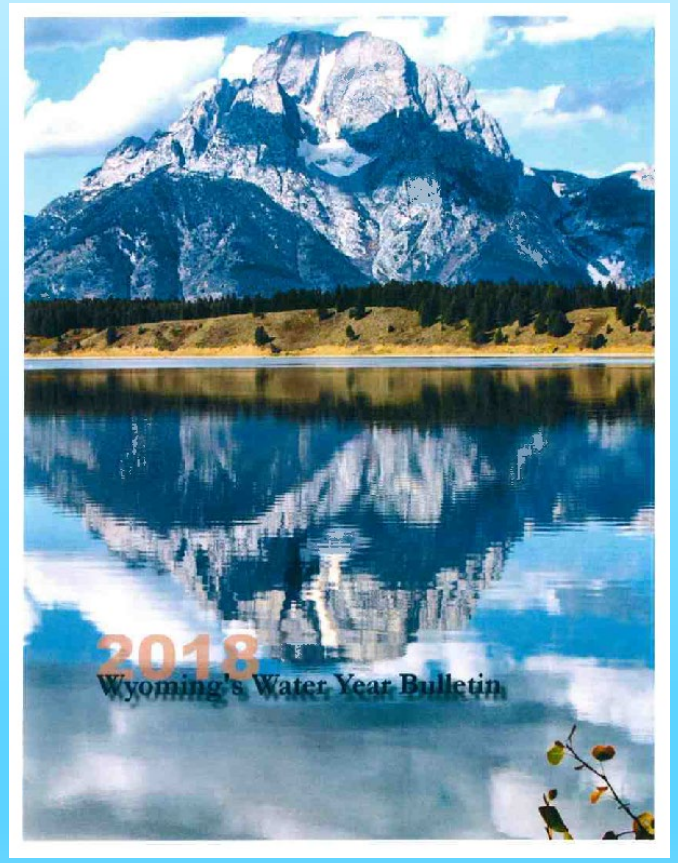
Statewide look into water shortages

Local Assessment of Goals & Opportunities

New Supplies Developed

Water Bulletin and Web-based Infographics

Water Bulletin



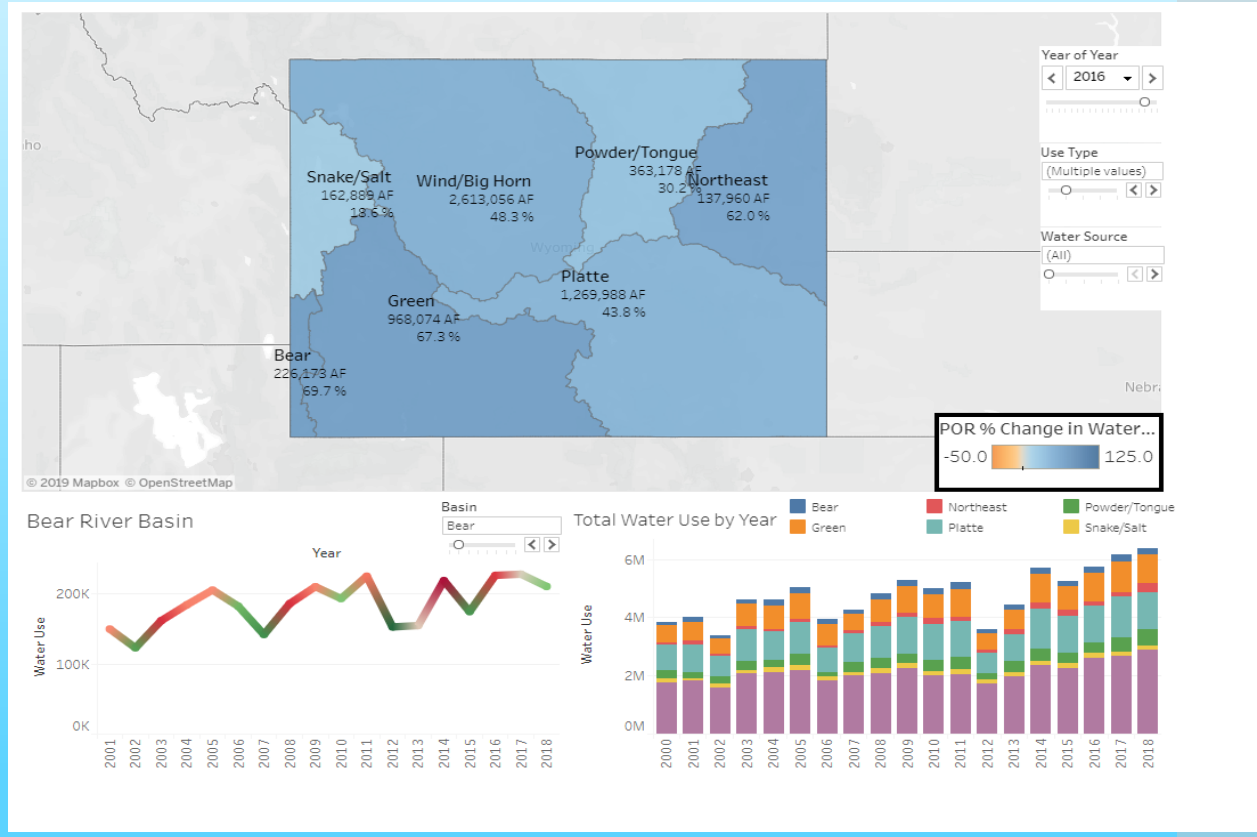


Tableau Data Visualizations

The Future of Wyoming RBP

- New, more focused direction for RBP
- Opportunity to modernize and improve the information needed to guide development and decision-making and lower costs
- Direction that could lead to a basic Decision Support System (DSS) for Wyoming
- Information that is usable and up-to-date

Contact:

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