



# Water Use in the Saluda River Basin

**Saluda River Basin Council – Meeting #5, July 19, 2023**

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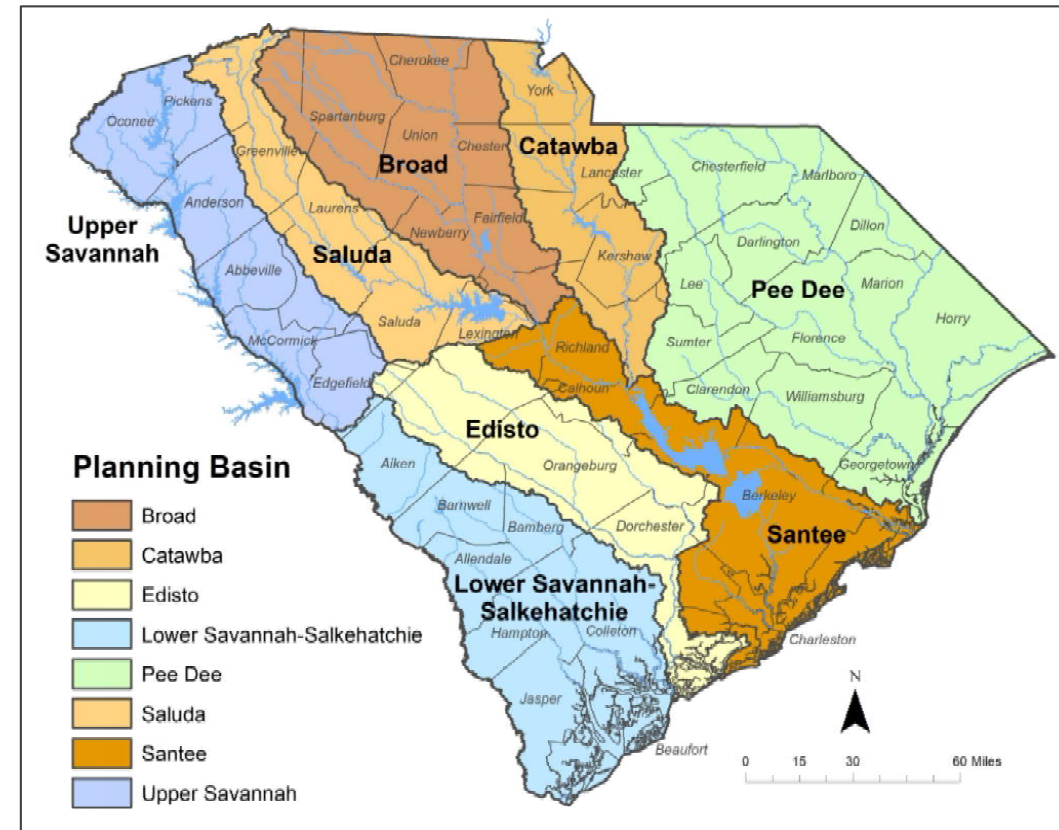
Hydrologist

SC Department of Natural Resources

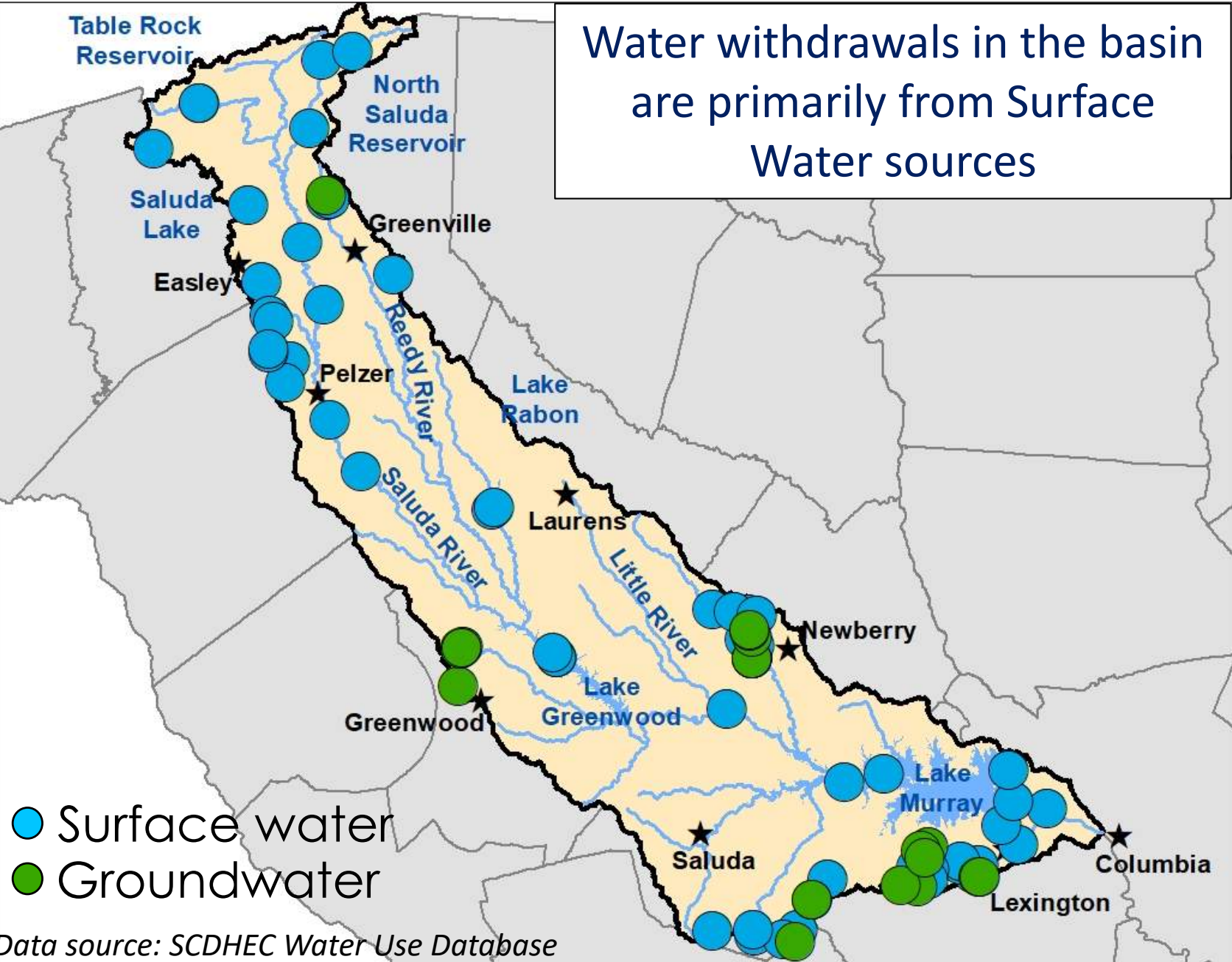


# Water Withdrawal Reporting in SC

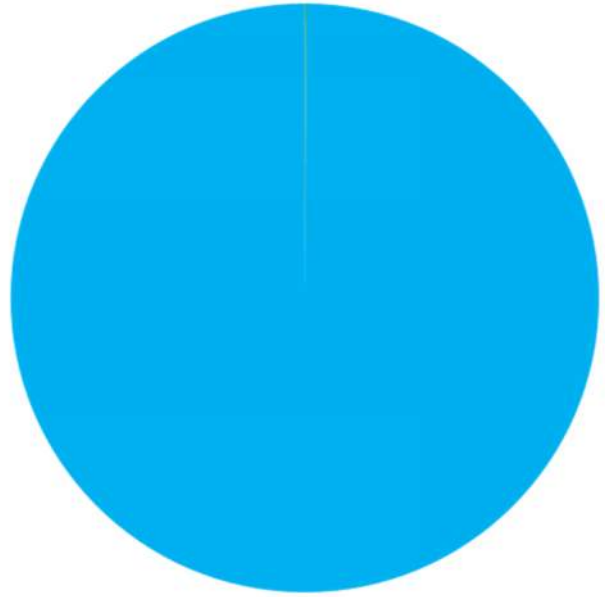
- The South Carolina Department of Health and Environmental Control (SCDHEC) tracks water use through the South Carolina Surface Water Withdrawal and Reporting Act and the South Carolina Groundwater Use and Reporting Act.
- Regulations require water users that withdraw three (3) million gallons or greater in any month to register with and report their use annually to the Water Use Program at SCDHEC.
  - Exemptions include farm ponds, ponds filled only with surface water runoff, and wildlife habitat management (typically duck ponds).



# Surface and Groundwater Withdrawals (2022)



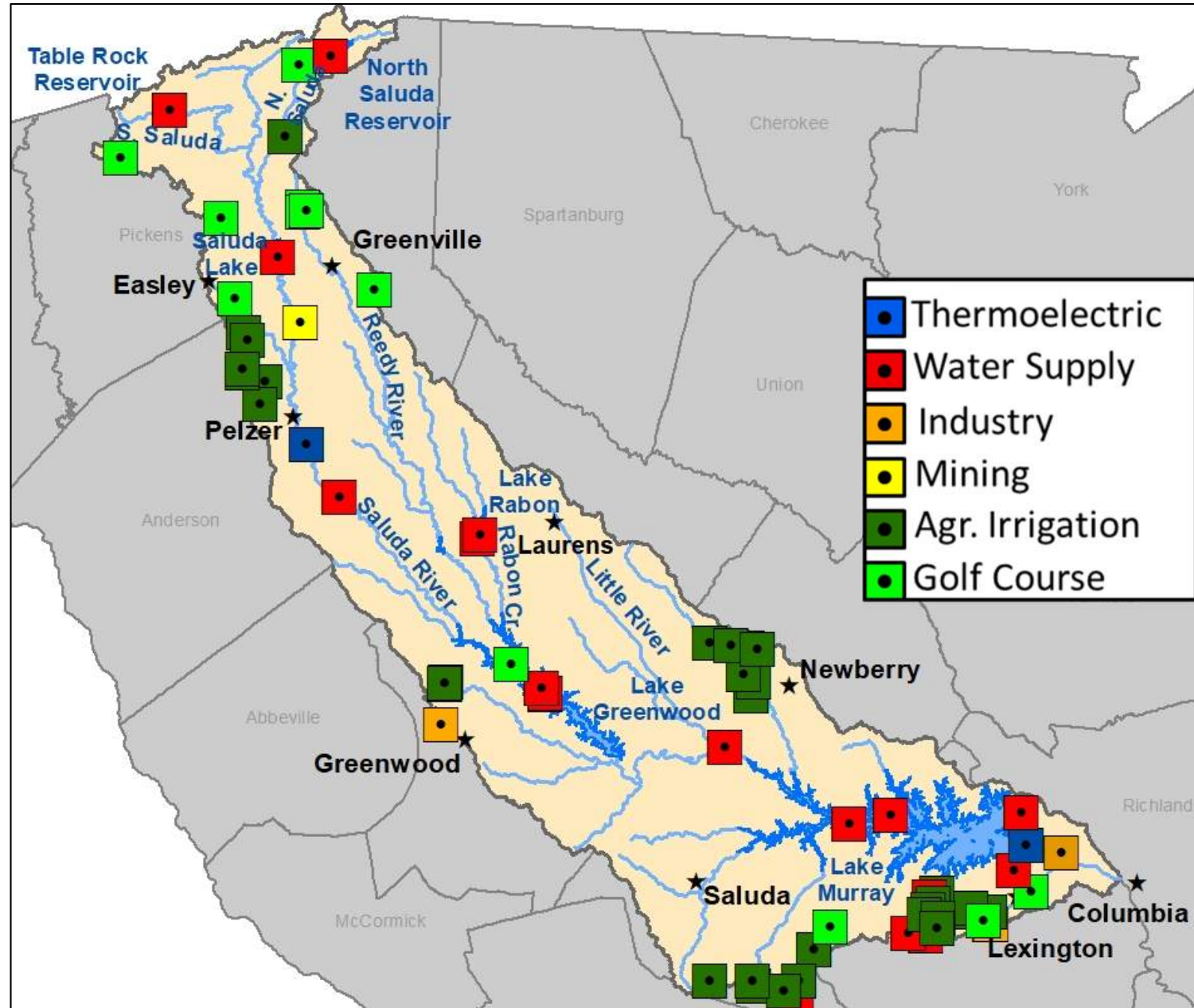
Including and Excluding Energy



■ SW: 99.9%  
■ GW: 0.1%

# Saluda Basin Water Use

- Map shows active permits and registrations under the South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act 2011.
- Planning will focus primarily on the basin's surface water resources (99.9% of withdrawals from surface water sources).

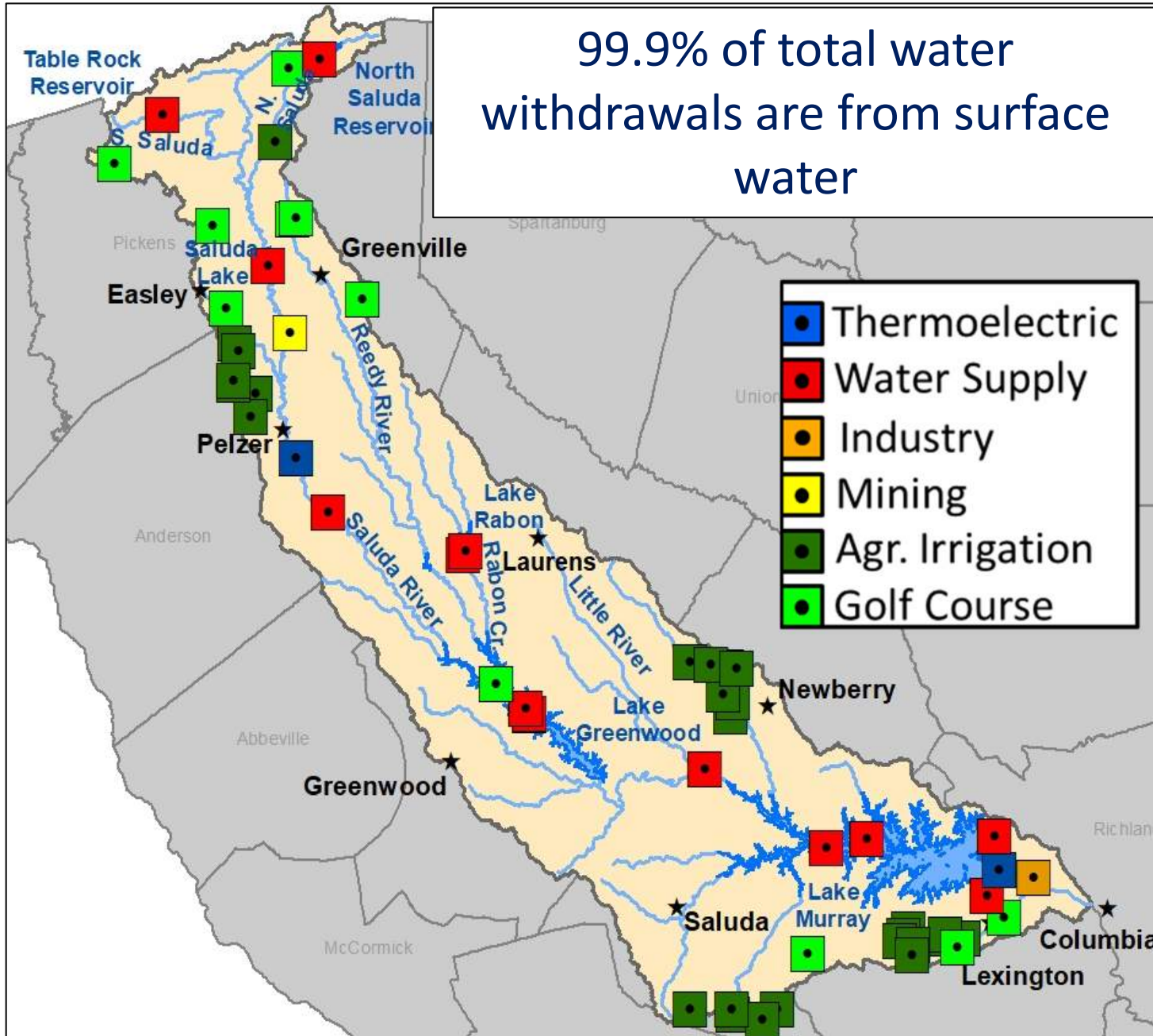


Data source: SCDHEC Watershed Atlas

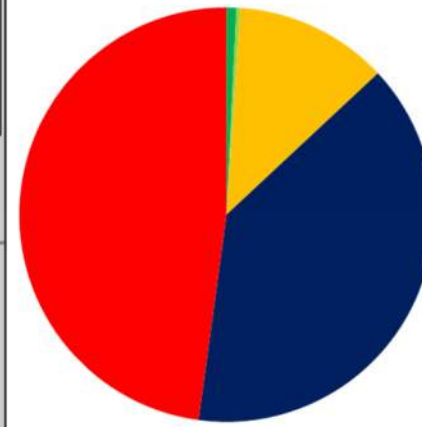
# 2022 Reported Surface Water Withdrawals



99.9% of total water withdrawals are from surface water

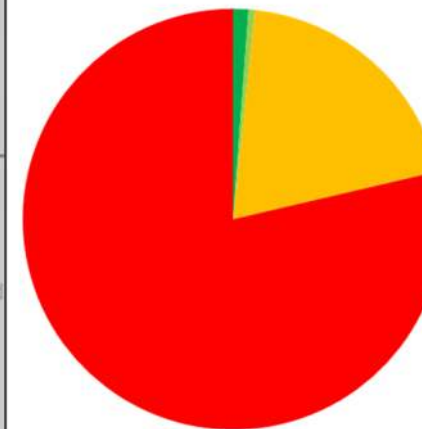


## Including Power



- Thermoelectric (39%)
- Water Supply (48%)
- Industry (12%)
- Agr. Irrigation (< 1%)
- Golf Course (< 1%)

## Excluding Power



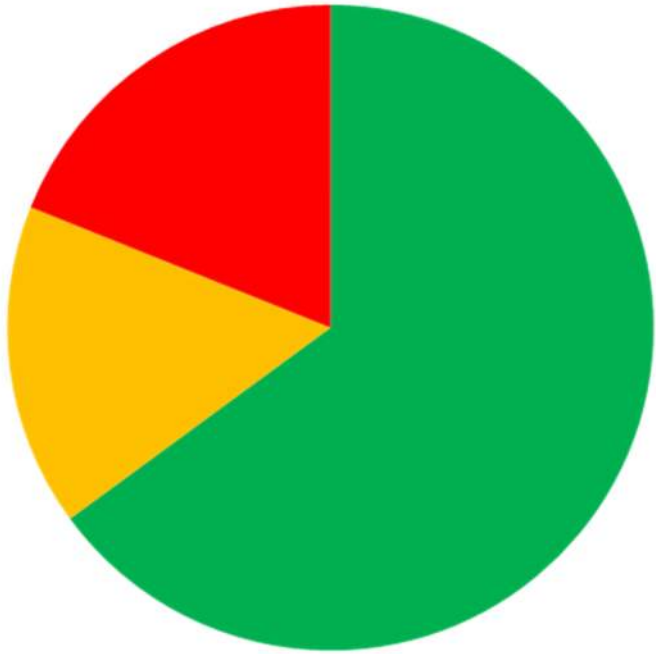
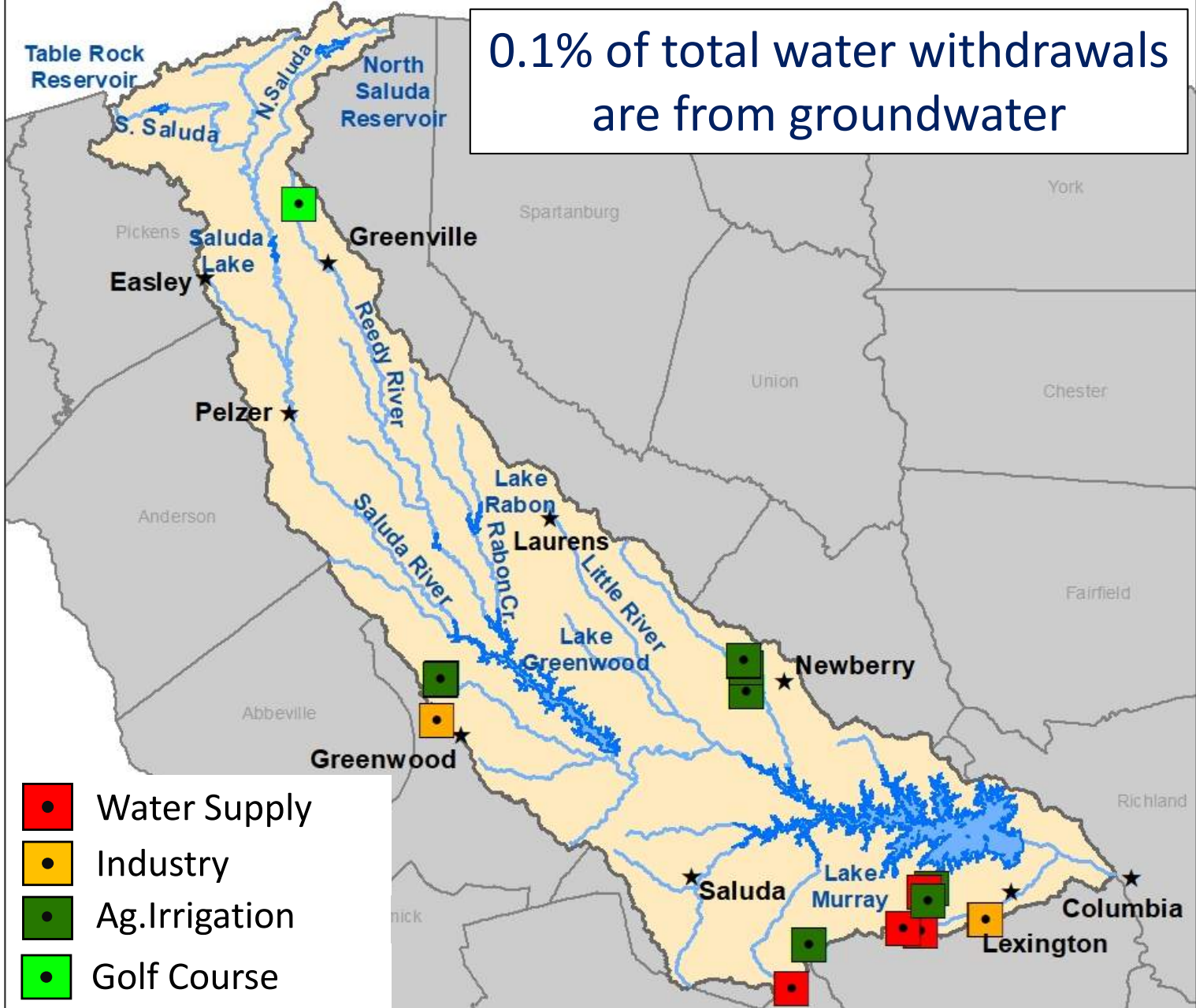
- Water Supply (79%)
- Industry (20%)
- Agr. Irrigation (1%)
- Golf Course (< 1%)

Source: SCDHEC Water Use Database



# 2022 Reported Groundwater Withdrawals

0.1% of total water withdrawals are from groundwater



- Agr. Irrigation (65%)
- Water Supply (19%)
- Industry (16%)

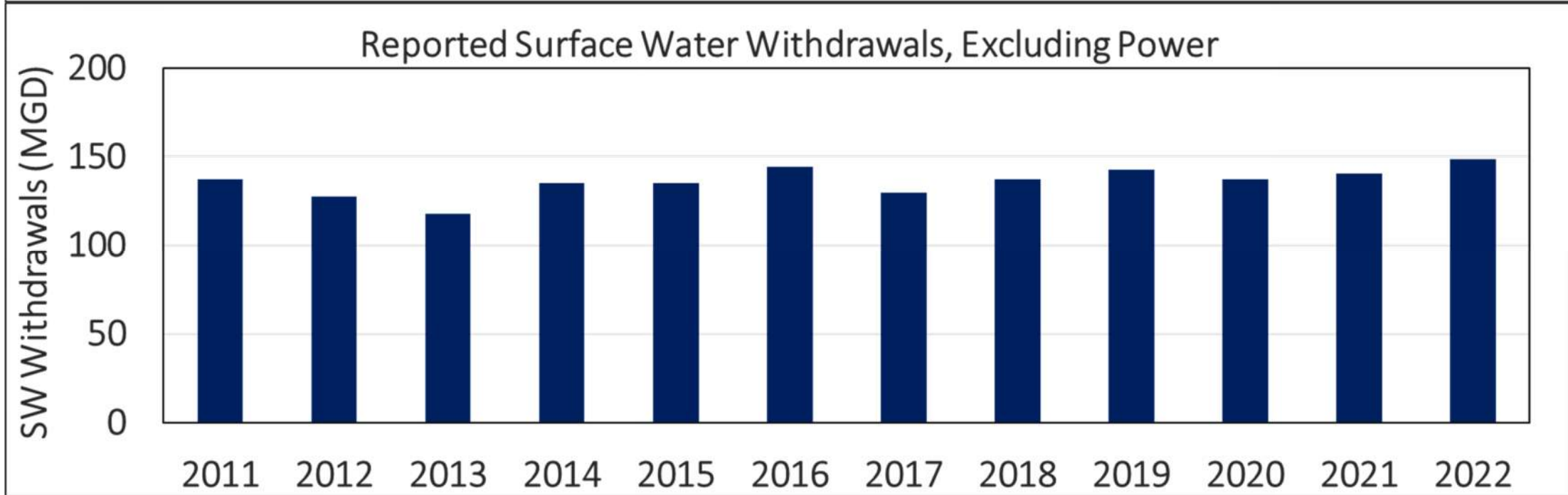
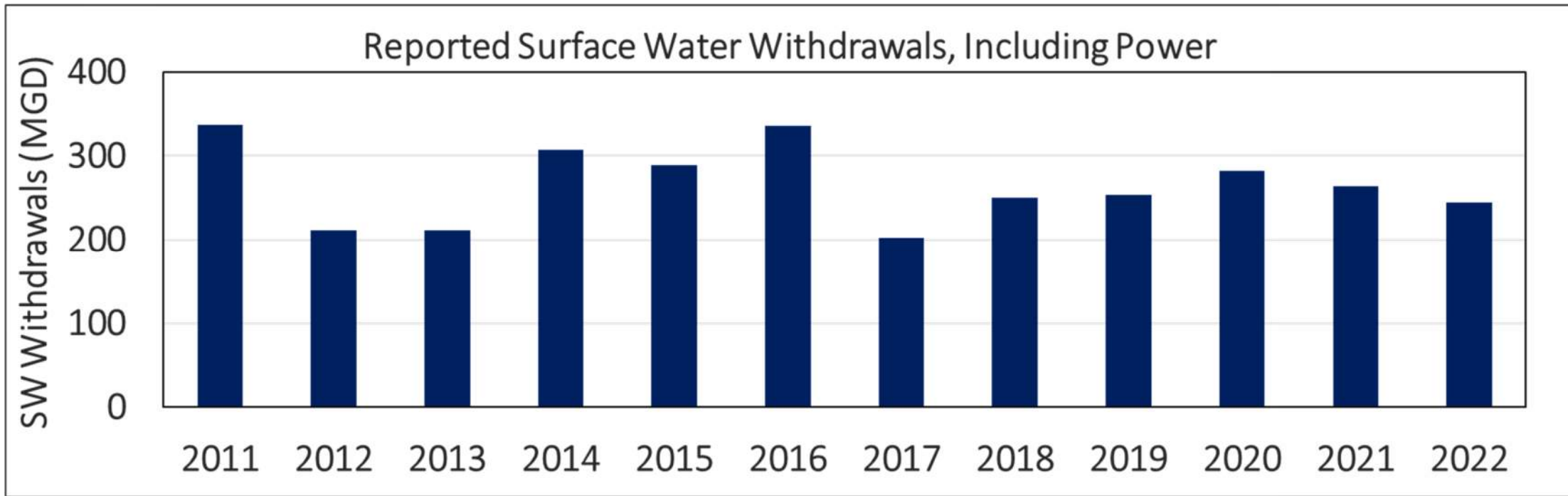
Source: SCDHEC Water Use Database

# Historical Water Use



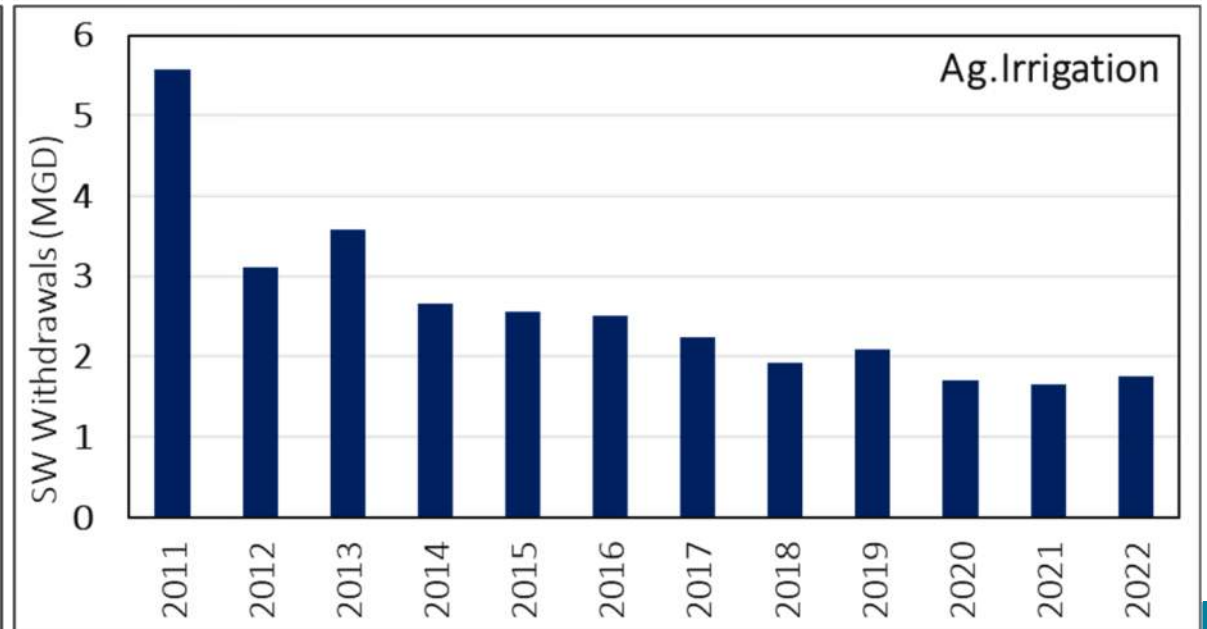
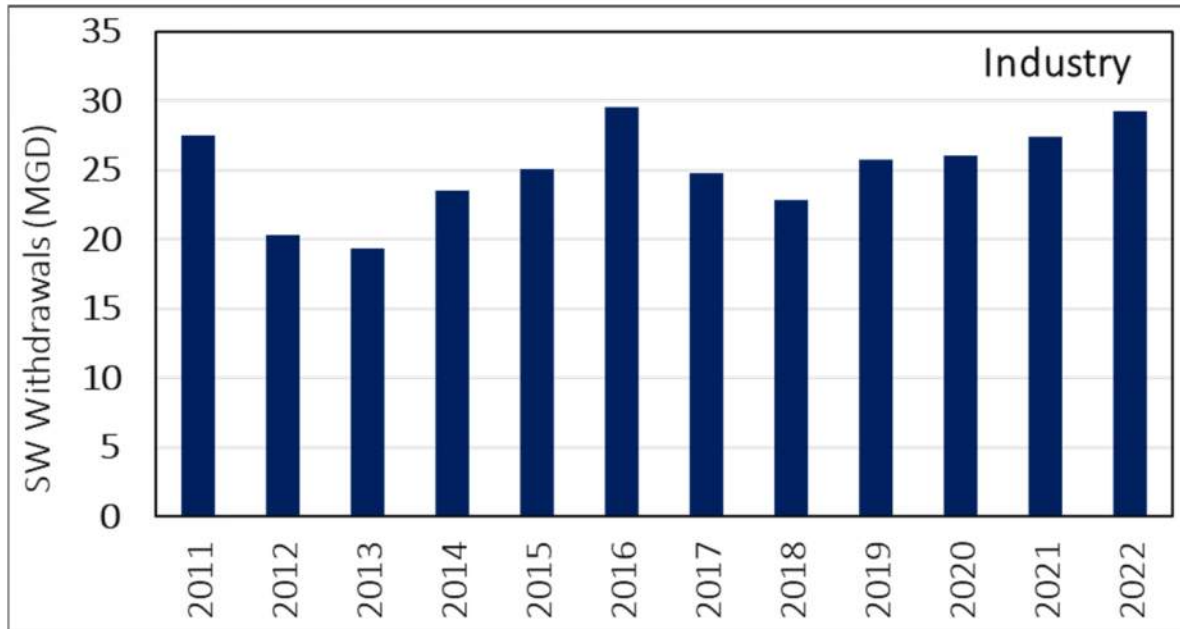
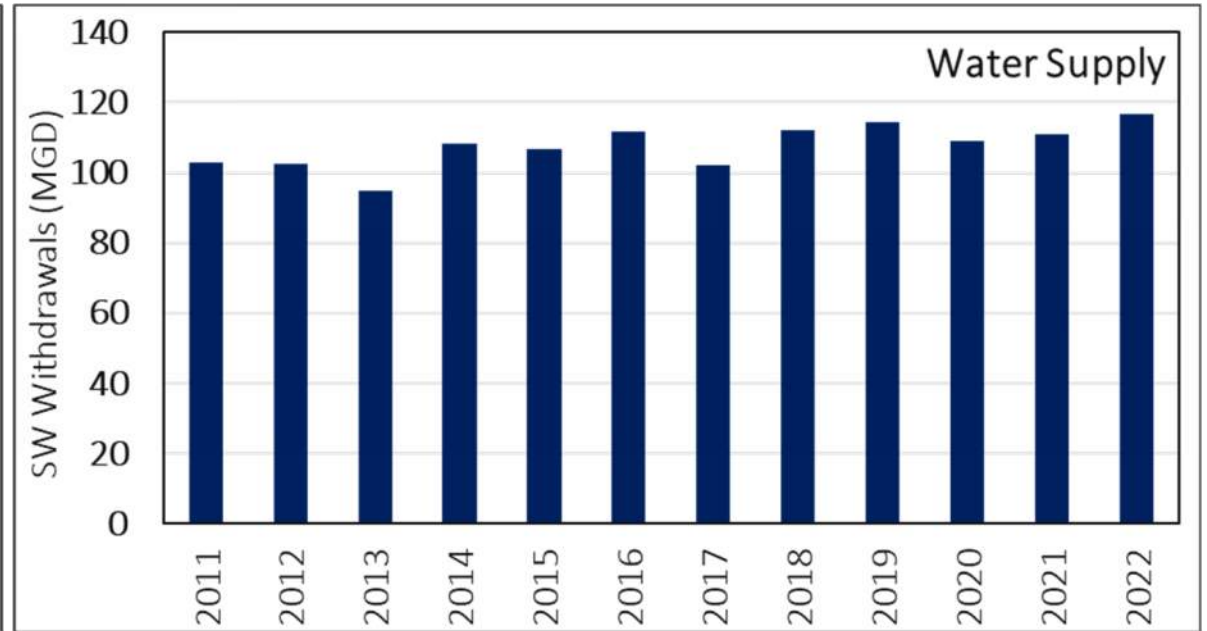
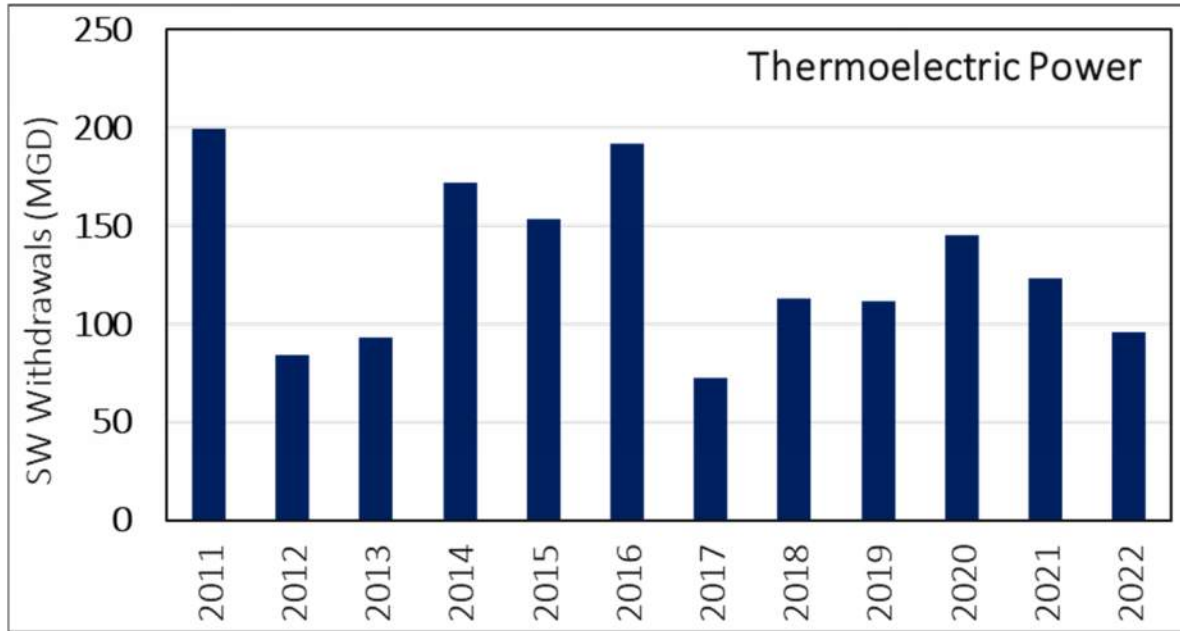
## ■ Data Limitations

- Withdrawals from private domestic wells, small surface water irrigation ponds, and any other water withdrawals less than the reporting threshold of 3 MGM are excluded from the SCDHEC's water-use database.
- After passing of the South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act in 2011, several facilities withdrawing less than the threshold value were not required to report their withdrawals to SCDHEC.
- Increasing trends in reported water withdrawals for some categories (Agriculture, for example) may in part be due to increased reporting compliance over the analysis period.
- Errors in reported water withdrawals or errors introduced during data input.
  - Data quality assessment and quality check of the 2022 Water Use data is in progress.
- Some users fail to add metadata such as longitude, latitude, county, and basin information for a surface water intake or groundwater well withdrawal. This can lead to some inaccuracies in the dataset.

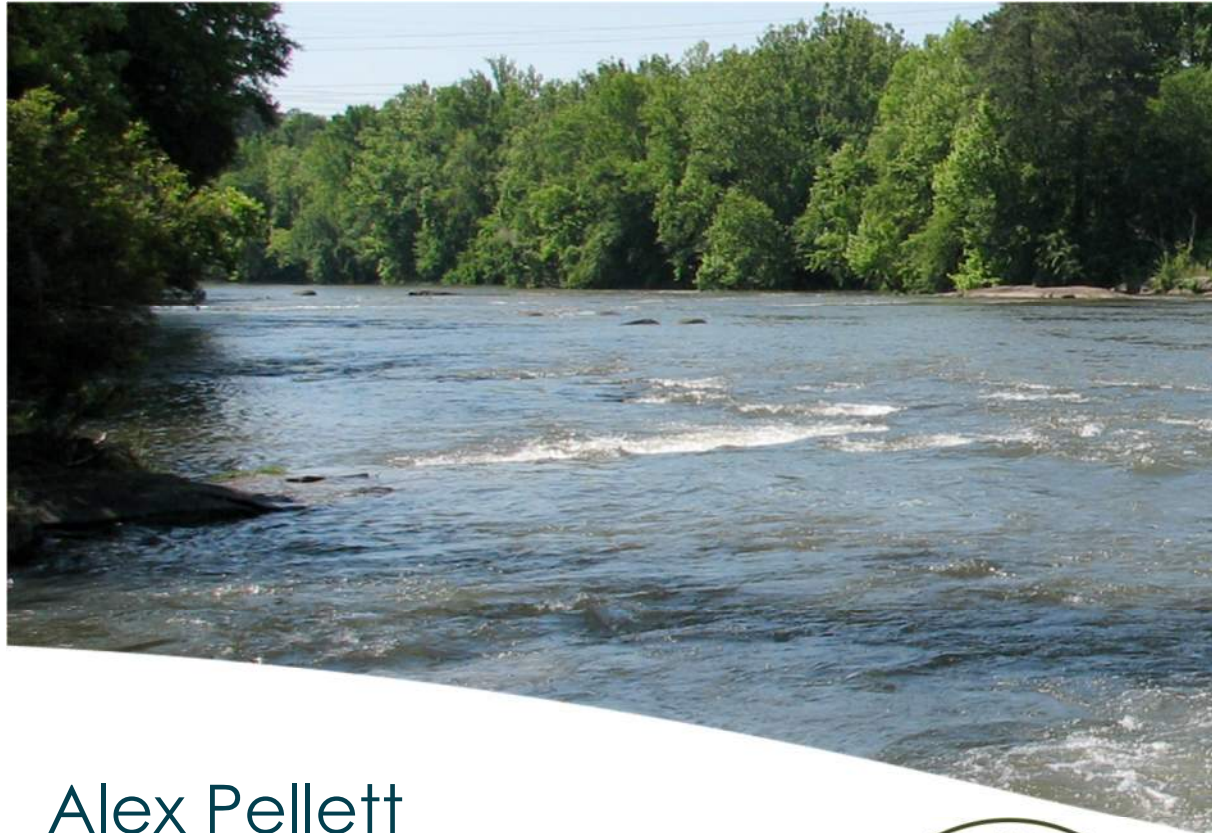




# Surface Water Withdrawals by Categories (2011-2022)



# Summary



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- Planning will focus primarily on the basin's surface water resources.
  - 99.9% withdrawals from surface water source.
- SW top three categories: Water Supply (48%), Thermoelectric (39%), and Industry (12%).
- No significant trends observed in the historical surface water withdrawals, except in the past three years for Industrial and Water Supply categories.

# Saluda Basin Water-Demand Projections

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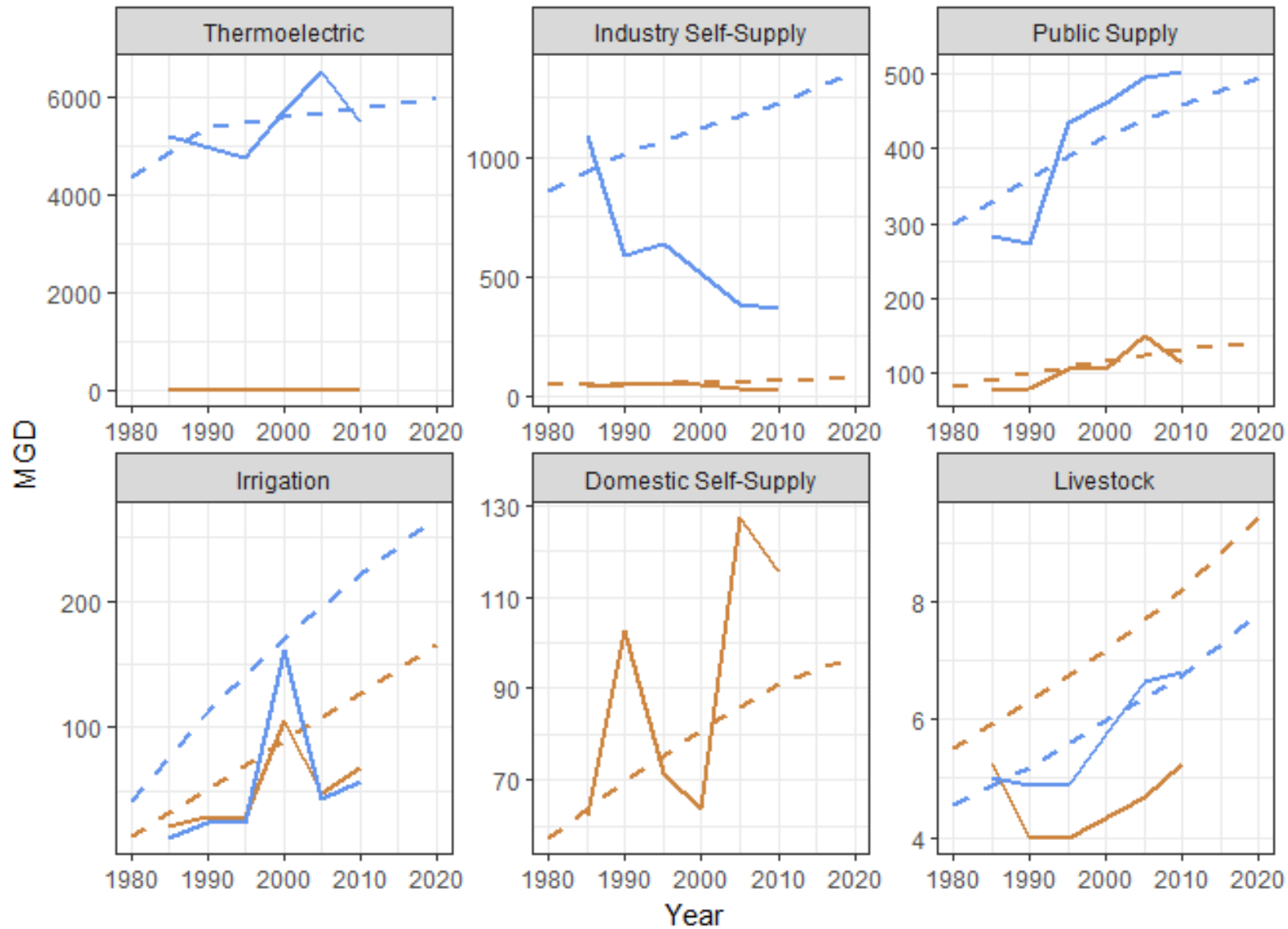


Saluda River Basin Council

July 19<sup>th</sup>, 2023



# Is It Possible to Predict the Future?



A 1970's edition of water demand projections can be compared with historical water use.

Can we expect to perform any better?

Withdrawal Source — Groundwater — Surface Water    Data Source — • — SCWRC projections — — USGS



# Projections are not forecasts

## Forecast

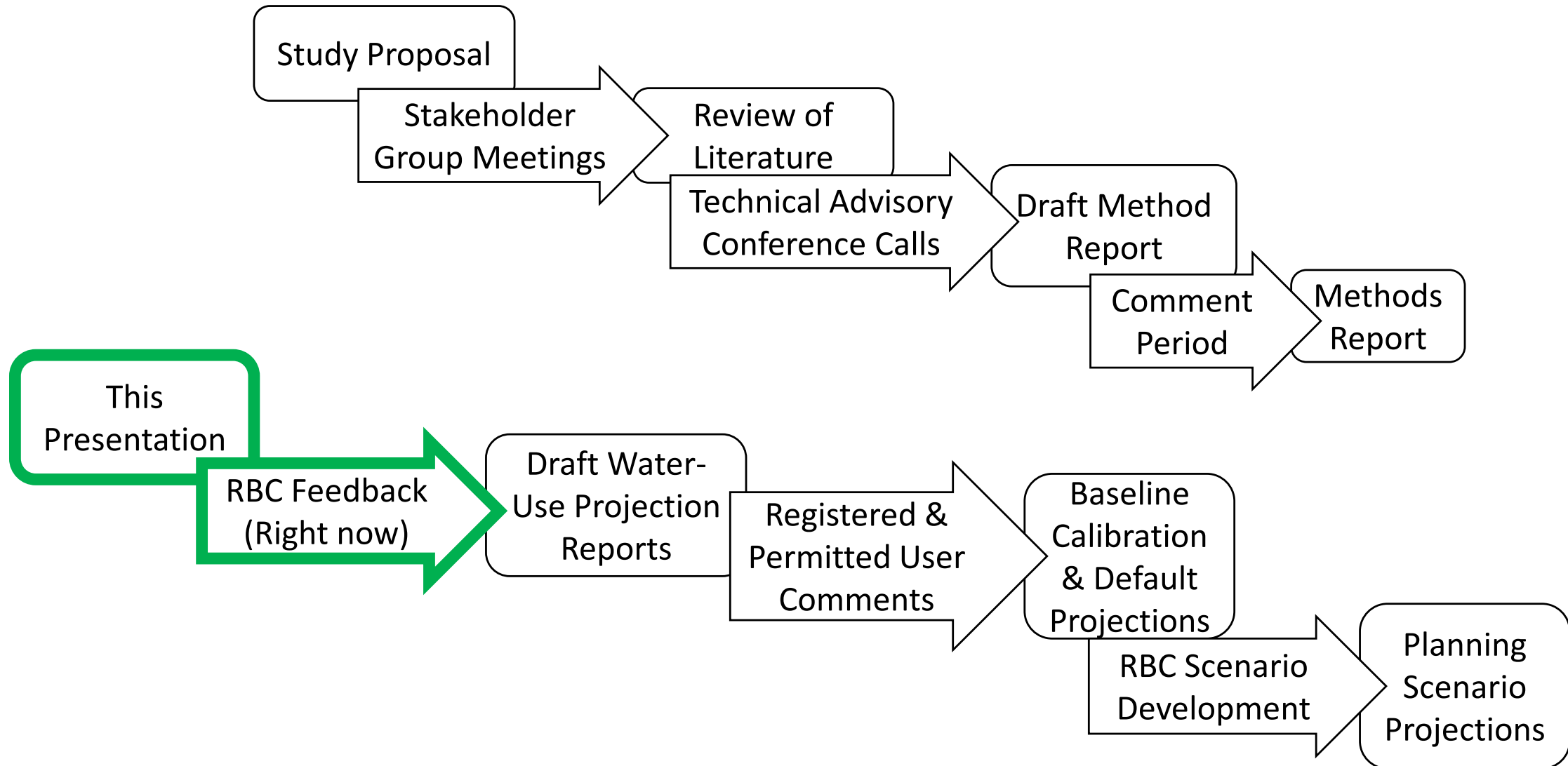
- Educated guess.
- Based on expected conditions and actions.
- Timeframe limited by predictability of future conditions.
- Aim to be accurate.

## Projection

- Extrapolation of trend.
- Based on hypothetical scenarios.
- Timeframe can extend beyond the limits of effective forecasting.
- Aim to be informative.



# Stakeholder Input Throughout the Process





# Development of the Methods

2016 -2017 - meetings with stakeholder interest groups for input on water-demand projection methods and data sources.

- SCAWWA Water Utility Council
- SC Water Quality Association
- SC Farm Bureau Water Committee
- Chamber of Commerce Environmental Technical Committee
- SC Water Planning Process Advisory Committee (PPAC)



# Stakeholder Feedback

- **Water Works Association, Utility Council**
  - Use weather and demographic variables for long term forecasts.
  - Consider impacts of outdoor use restrictions.
- **Chamber of Commerce, Environmental Committee**
  - Provide information on a reach scale for real-world application.
  - Guarantee privacy of survey responses.
- **Farm Bureau, Water Committee**
  - Agricultural return flows can be significant.
  - Not all cropland can be profitably irrigated.
  - Vegetables and hemp production could increase.
- **Water Quality Association**
  - Some systems are highly interconnected.
  - Inflow and Infiltration can be significant.





# Development of the Methods

2018 - technical advisory conference calls with representation from a variety of fields of experience.

- Public water supply (17)
- Thermo-electric power (5)
- Manufacturing (5)
- Government (22)
- Consultants (4)
- Legal (2)
- Golf (2)
- Agriculture (5)
- Environment (4)
- Research & education (11)

Acknowledgements to Chrissa Waite and Stuart Norvell of USACE and Dr. Jeff Allen and Dr. Tom Walker of the SCWRC for their collaboration on developing the water demand projection methods.



# Technical Advisory Committee Feedback

- General recommendations:
  - provide draft projections to local stakeholders.
  - provide an opportunity for feedback.
  - do not rely on overly complex methods.
- Sector specific recommendations:
  - **Thermo-electric:** Contact the utilities directly
  - **Public supply:** Do not rely on complex statistical methods which may underestimate demand.
  - **Industry:** Use economic output, not employment as the driver variable.
  - **Agricultural Irrigation:** A more technical method may be appropriate for projecting irrigated acreage.
  - **Golf:** A simpler projection method was recommended due to the relatively low volume of water use.



# Development of the Methods

2018 – Publication of “Water Users’ Perspectives: Summary of Withdrawal Survey Responses and Commentary” in *Journal of South Carolina Water Resources*.

2019 – Projection Methods for Off-stream Water Demand in South Carolina published online by SCDNR following reviews by an editorial board, the PPAC, and technical advisory conference call participants.

Pellett, C. Alex (2020) "Mapping Center Pivot Irrigation Fields in South Carolina with Google Earth Engine and the National Agricultural Imagery Program," *Journal of South Carolina Water Resources*: Vol. 7 : Iss. 1 , Article 4. Available at: <https://tigerprints.clemson.edu/jscwr/vol7/iss1/4>

Pellett, C. Alex (2024) “Review of Agricultural Water Use in South Carolina,” *Journal of South Carolina Water Resources* (In Review)



# Equations to Define the Terms

## Equation 1: Water Demand Mass Balance

$$\text{Demand} = \text{Withdrawal} + \text{Purchase} + \text{Reuse} - \text{Sales} - \text{Loss} - \Delta\text{Storage} + \text{Shortage}$$

Where:

- Demand* : Off-stream water demand
- Withdrawal* : Total water withdrawal from source water bodies
- Purchase* : Total purchases of water from distributors
- Reuse* : Total reuse of water previously used for another purpose
- Sales* : Total wholesale transfers of water to another user or distributor
- Loss* : Total losses of water preventing it from being put to use
- $\Delta\text{Storage}$  : Net change in off-stream storage
- Shortage* : Water not available to meet the objectives of water users

## Equation 2: Return Flow Mass Balance

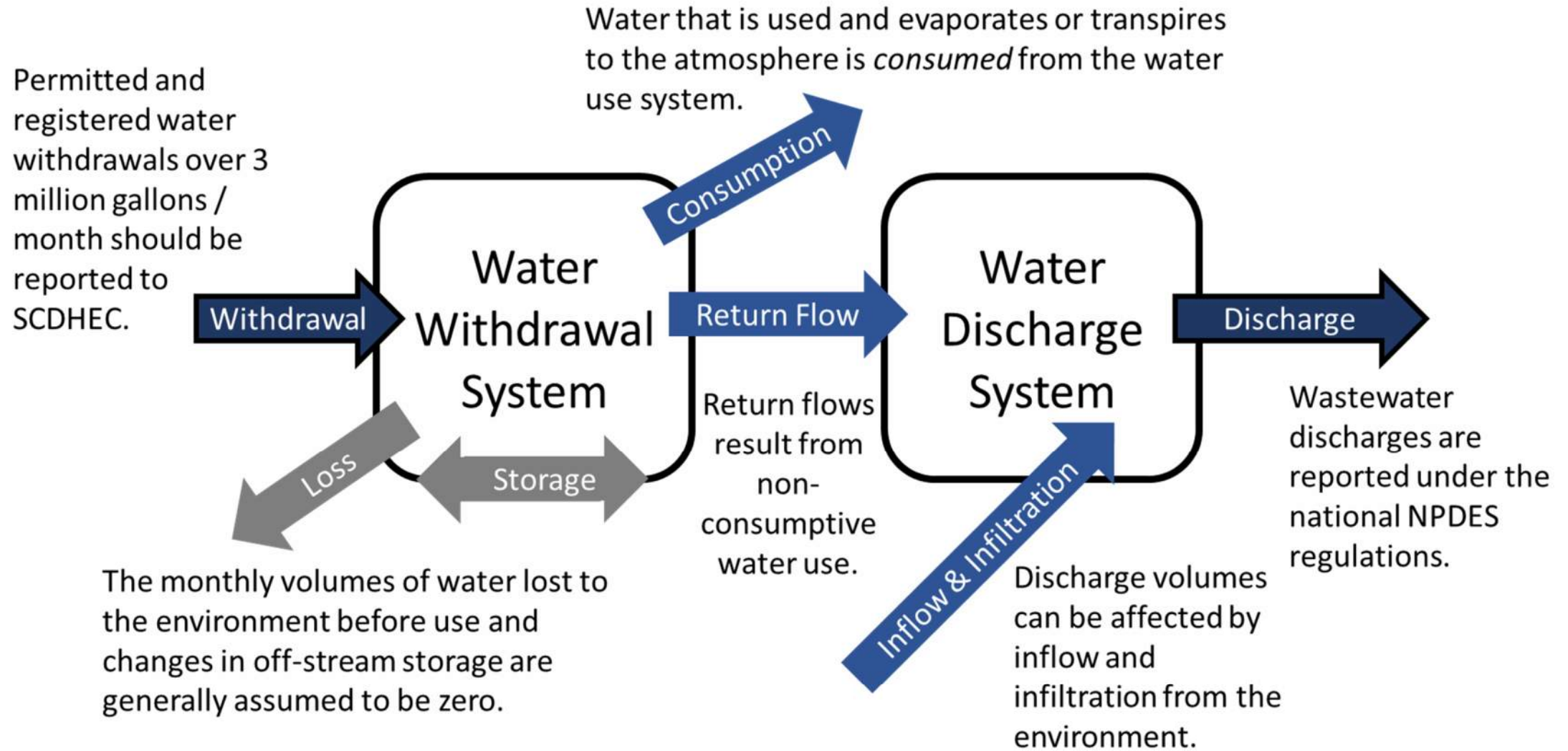
$$\text{Return Flow} = \text{Discharge} - \text{Inflow \& Infiltration}$$

Where:

- Return Flow* : Water returned to the environment after non-consumptive uses
- Discharge* : Concentrated discharges to surface water bodies (NPDES data)
- Inflow & Infiltration* : Waste-water resulting from inflow and infiltration (I/I)



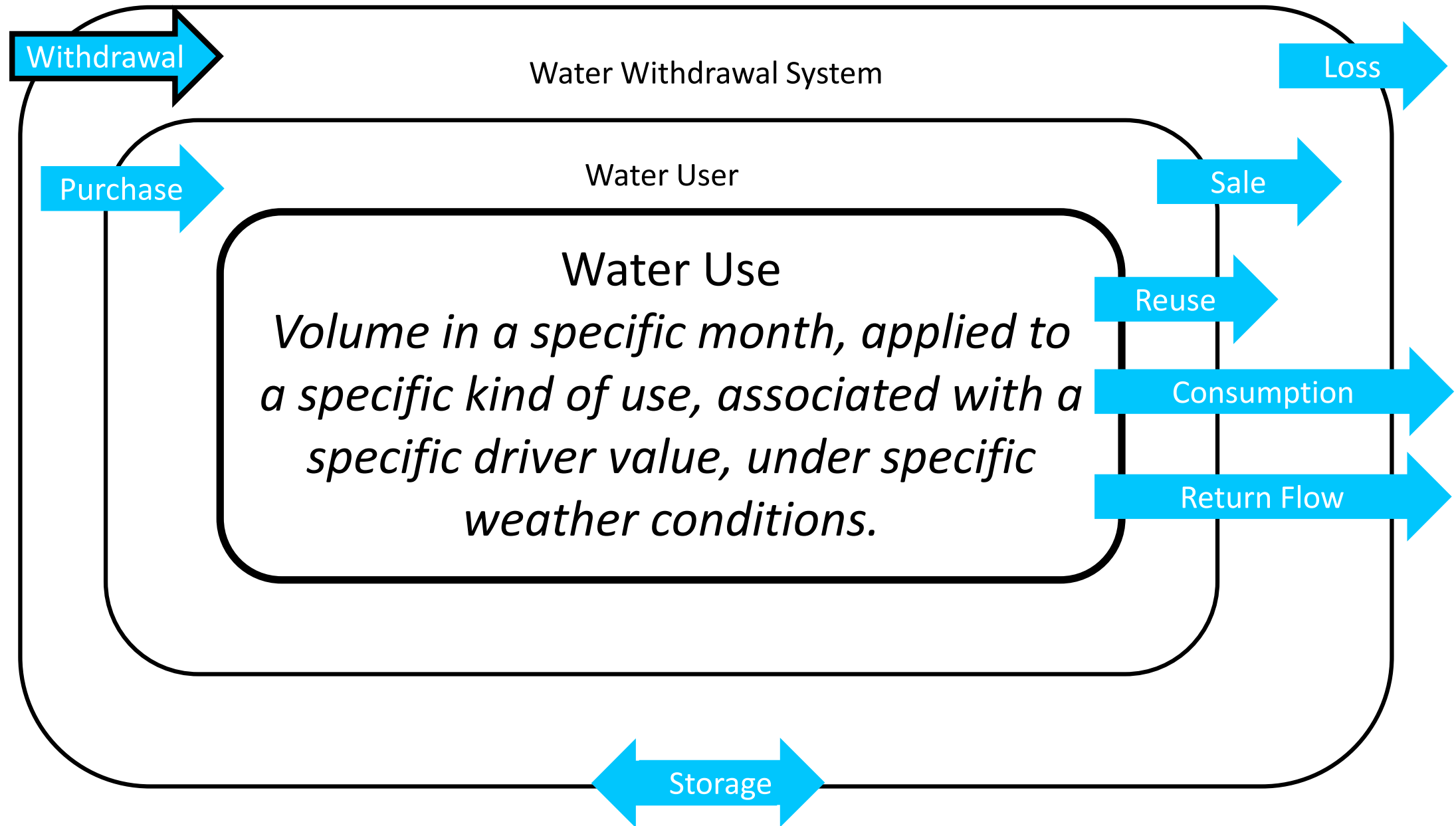
# Mass Balance Illustration



***Consumption, return flow, and inflow & infiltration are estimated over the baseline period to project future non-consumptive use.***



# A More Detailed Model



# Projections

- Water demand models are calibrated for each water user, with water withdrawal data from 2012-2021.
- Moderate calibration is based on the median water demand for each month.
- High calibration is based on the maximum water demand for each month.
- Projections of county population and industrial sector economic growth drive long-term projections of water demand.

Table 1.1: Drivers of Water Demand

<b>Category</b>	<b>Primary driver</b>
Thermo-electric power	Electricity production
Public and domestic supply	Population
Manufacturing	Economic production
Agriculture and Golf Courses	Irrigated acres

From the projection methodology report.



# Draft Water Demand Projections

- Preliminary draft results, not yet vetted.
- For demonstration purposes only.
- There will be modifications to these draft projections based on continued stakeholder feedback.
- All values are plotted as Million Gallons per Month



## Thermoelectric Water Demand

### Calibration

Moderate Scenario is Monthly Median (Blue Line)

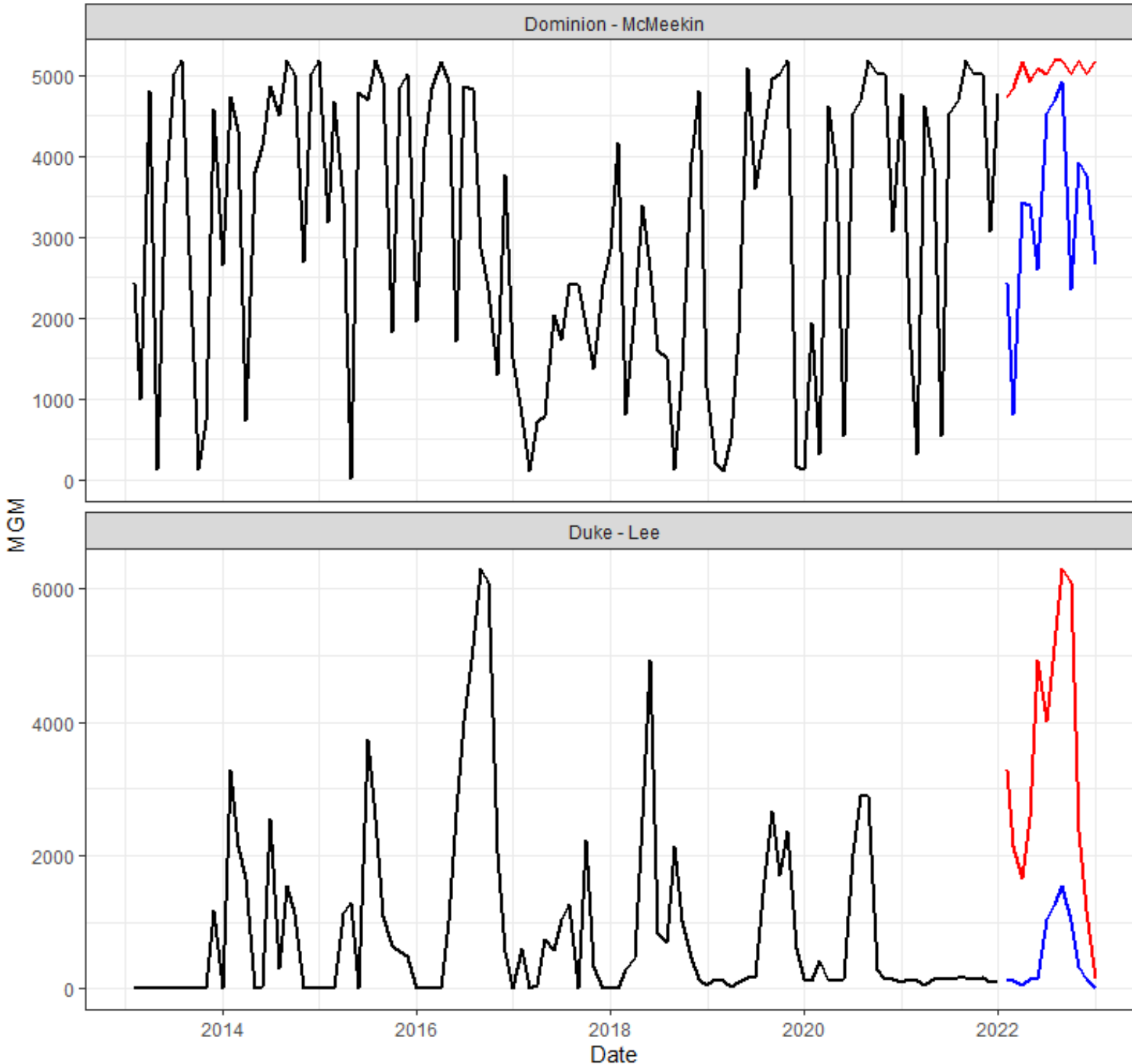
High Scenario is Monthly Maximum (Red Line)

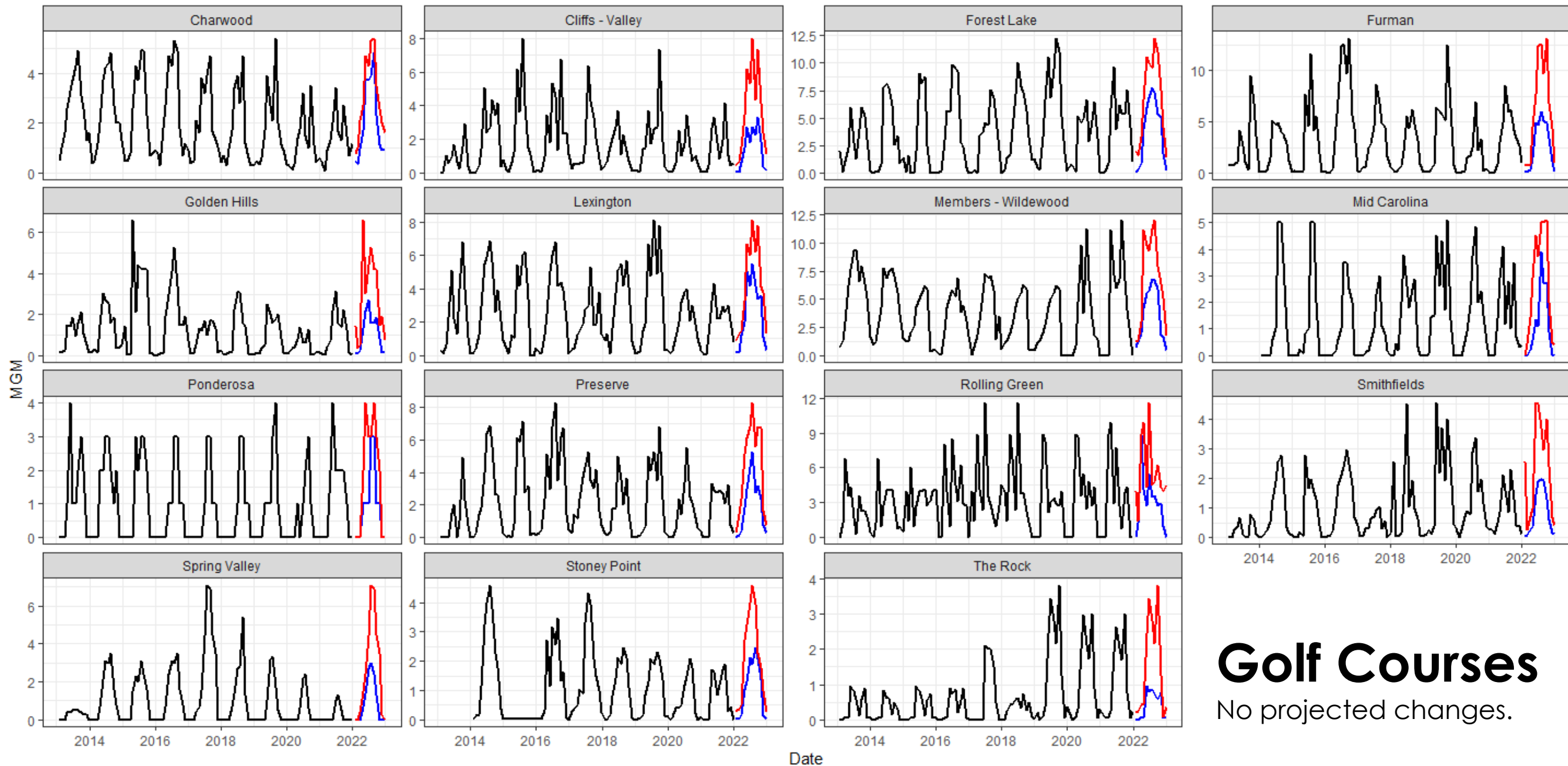
### Projections

According to utility company Integrated Resource Plans and feedback.

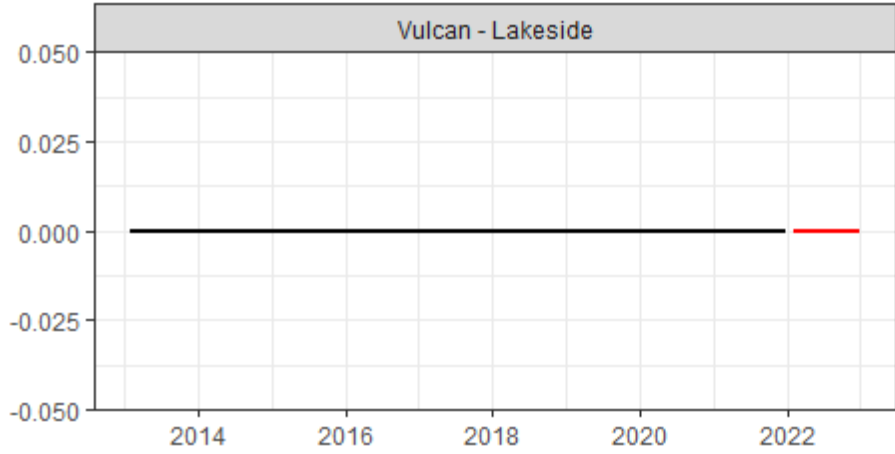
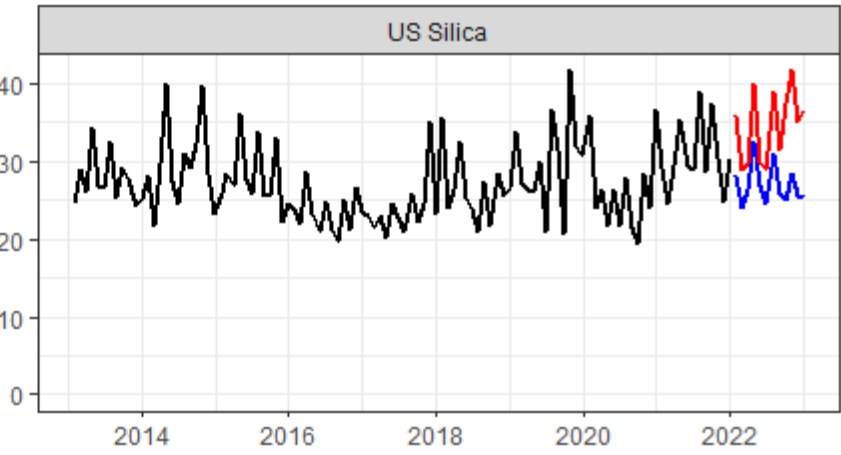
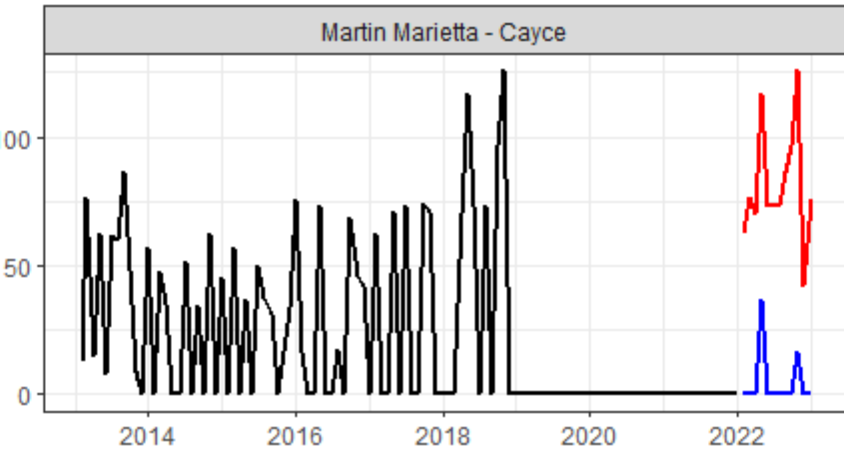
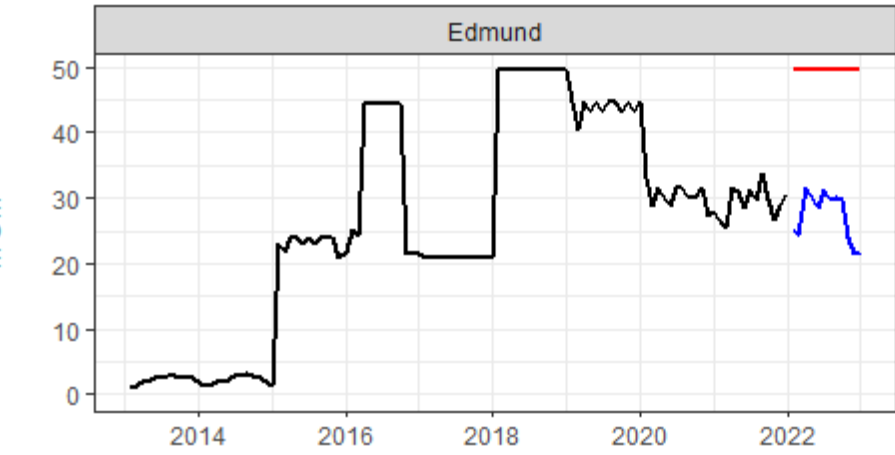
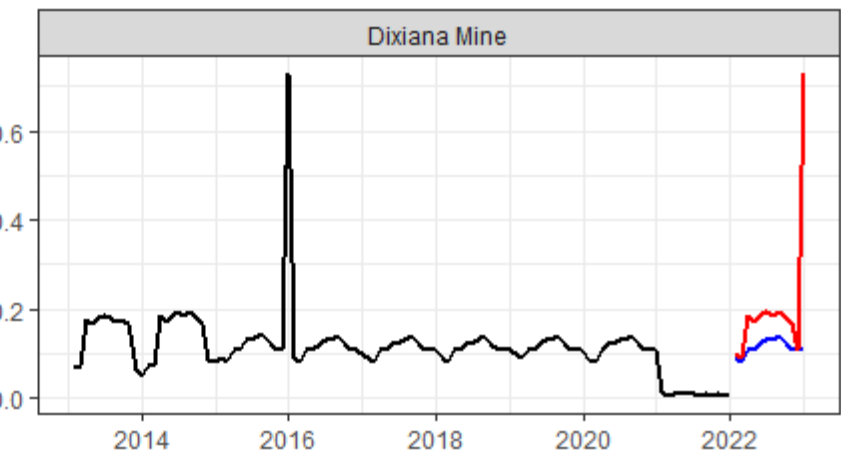
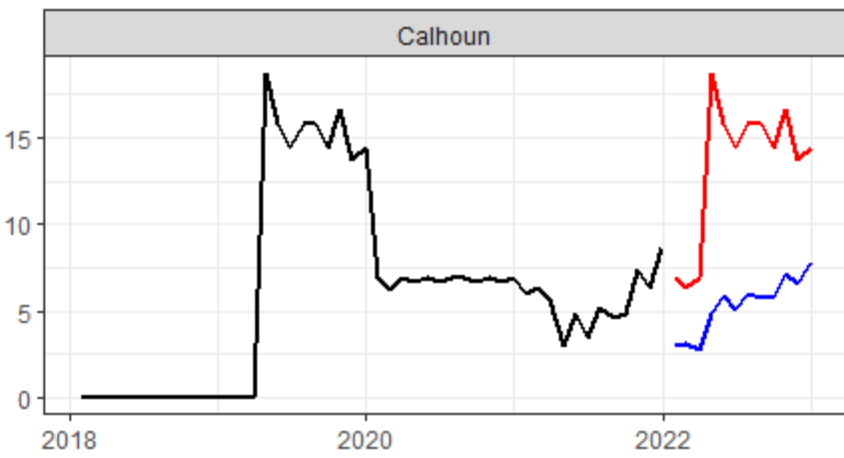
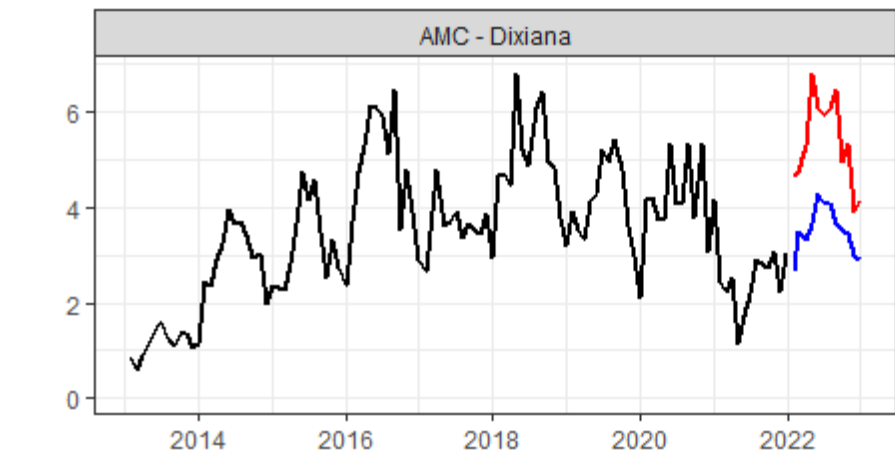
In 2018, an increase in future withdrawals was expected for McMeekin.

In 2018, Lee was expected to maintain withdrawal amounts.





**Golf Courses**  
 No projected changes.



# Water Withdrawals for Mining

No projected changes.

Date





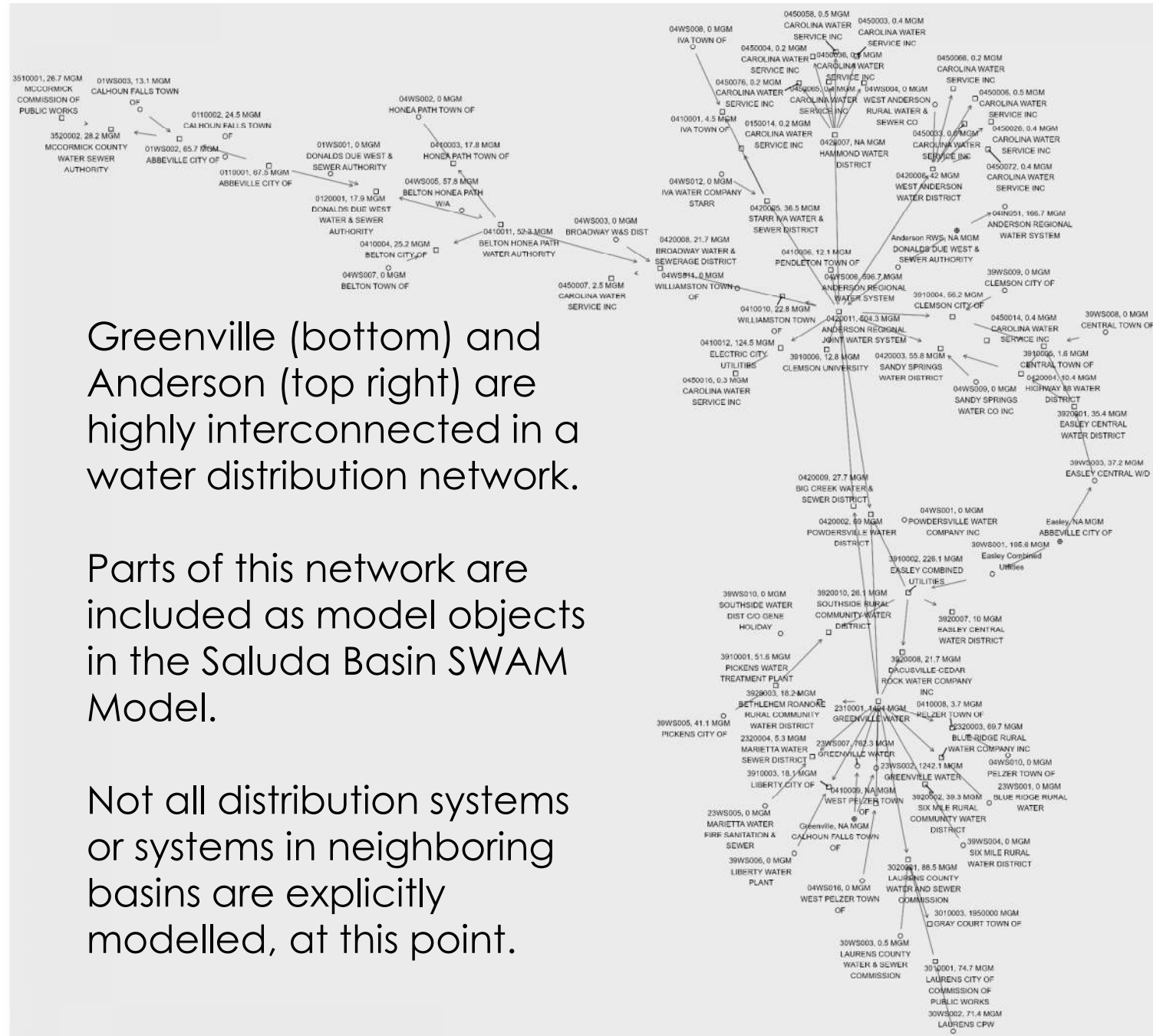
# Public Supply

- Many Drinking Water Distributors are interconnected by wholesale purchases and sales.
- Public Supply Systems are represented as the total of all interconnected withdrawal and distribution permits.
- Population served by each distributor is projected based on the county listed on the distribution permit.

Greenville (bottom) and Anderson (top right) are highly interconnected in a water distribution network.

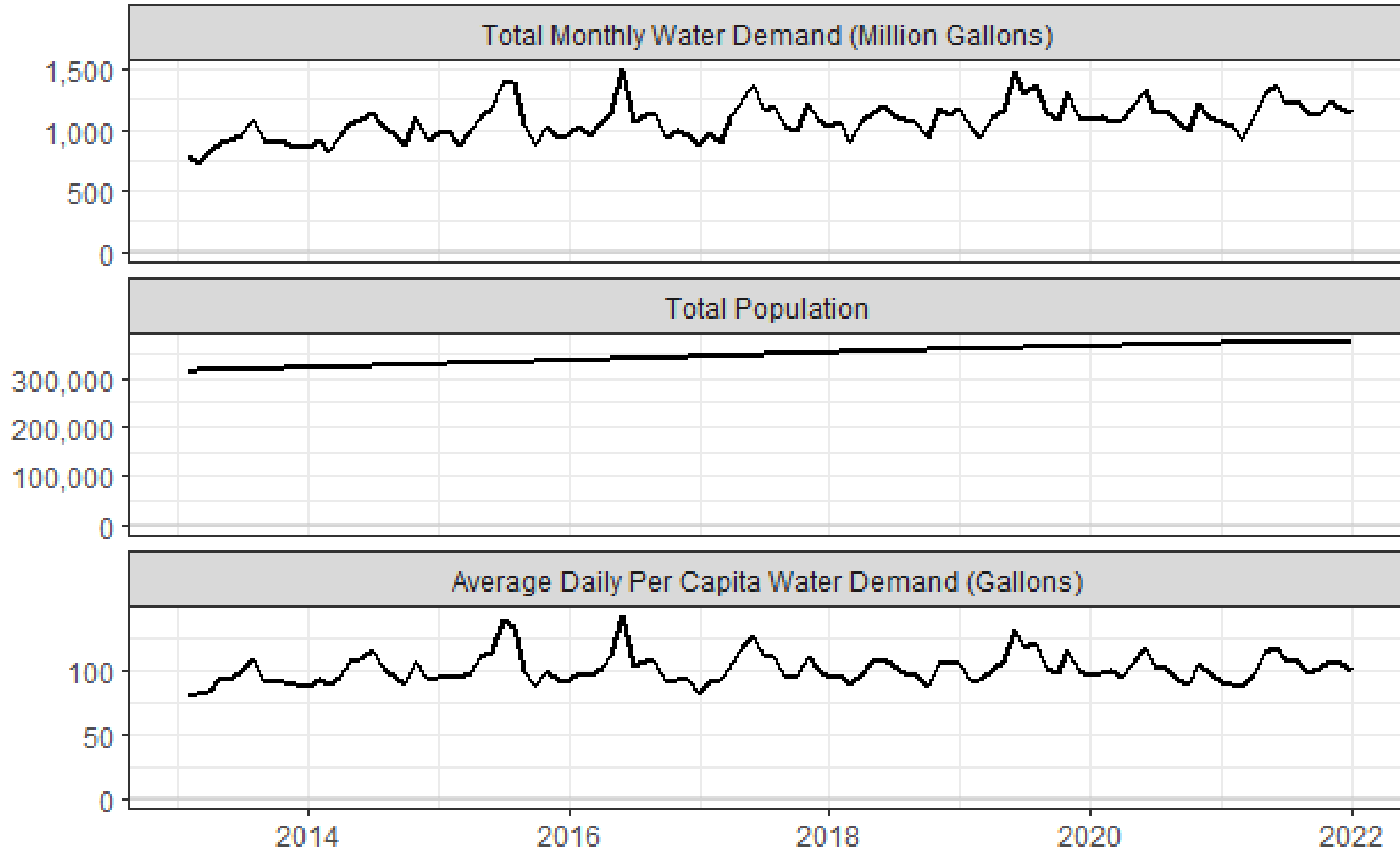
Parts of this network are included as model objects in the Saluda Basin SWAM Model.

Not all distribution systems or systems in neighboring basins are explicitly modelled, at this point.



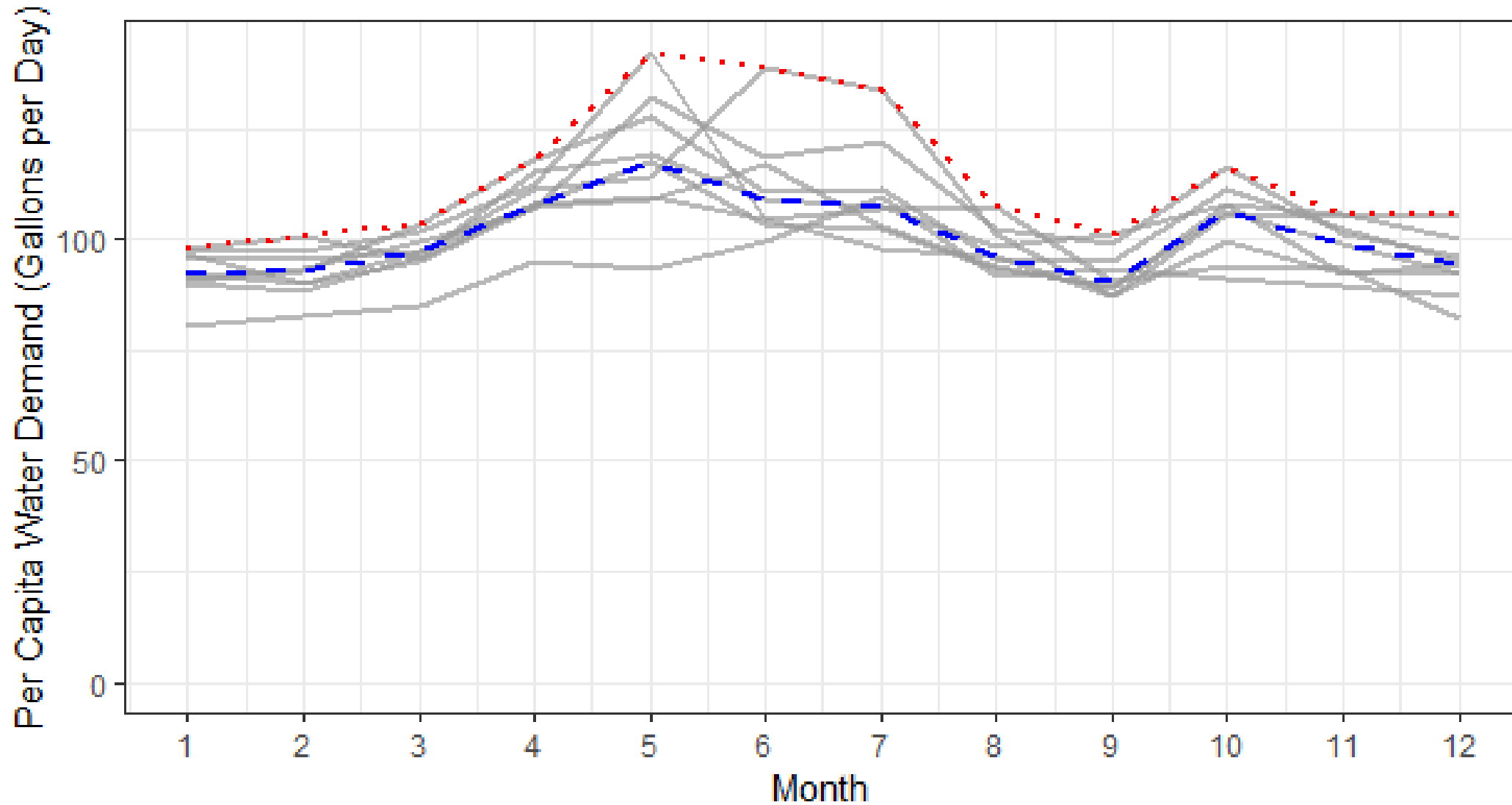


# Public Supply - EXAMPLE





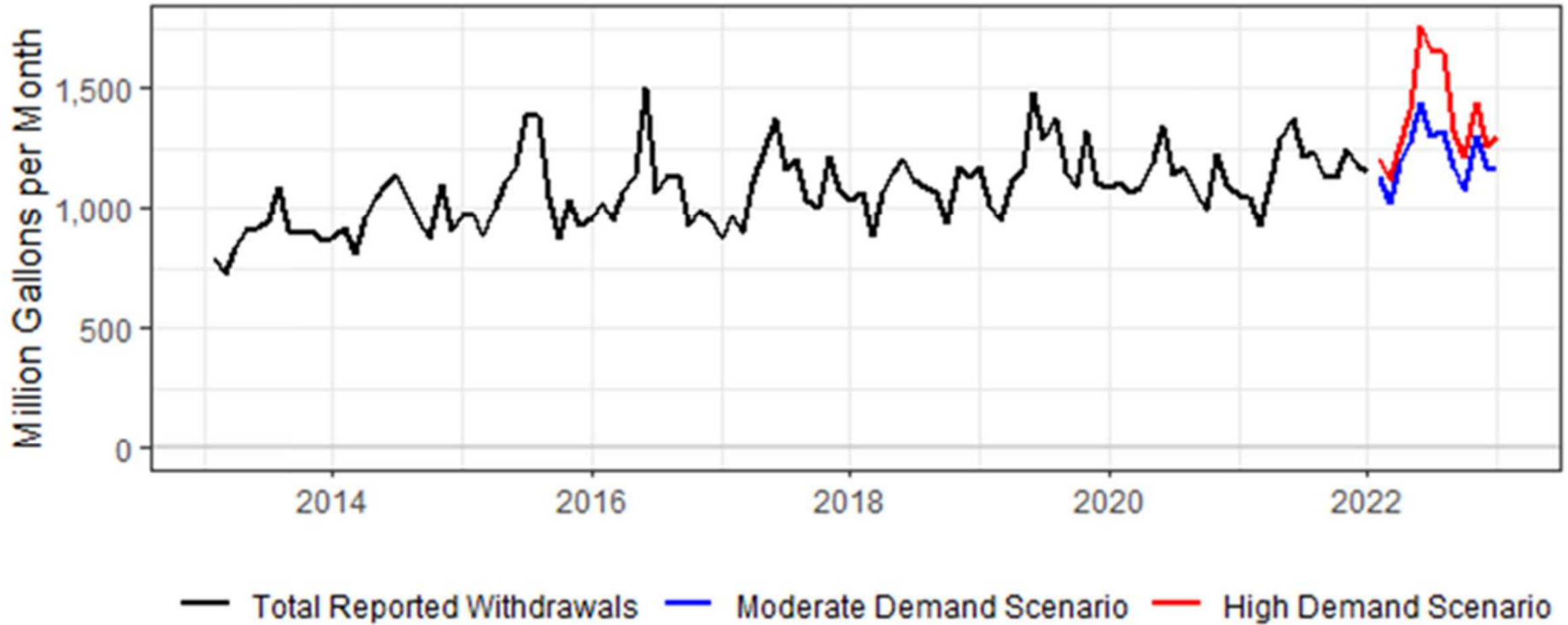
# Public Supply – EXAMPLE



— Estimated from reported values    - · - Monthly median    · · · Monthly maximum

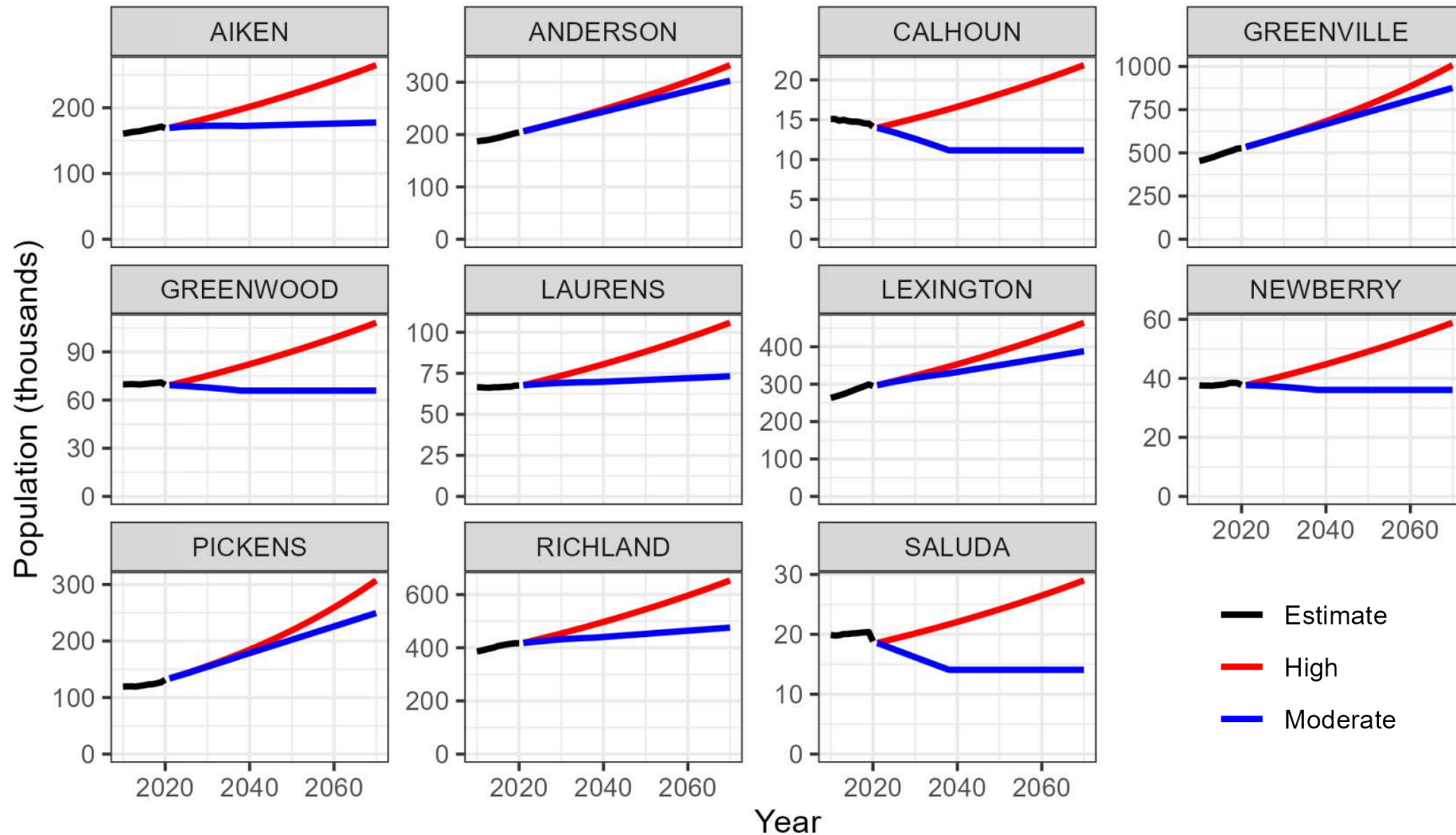


# Public Supply - EXAMPLE





# Population Drives Water Demand for Public Supply

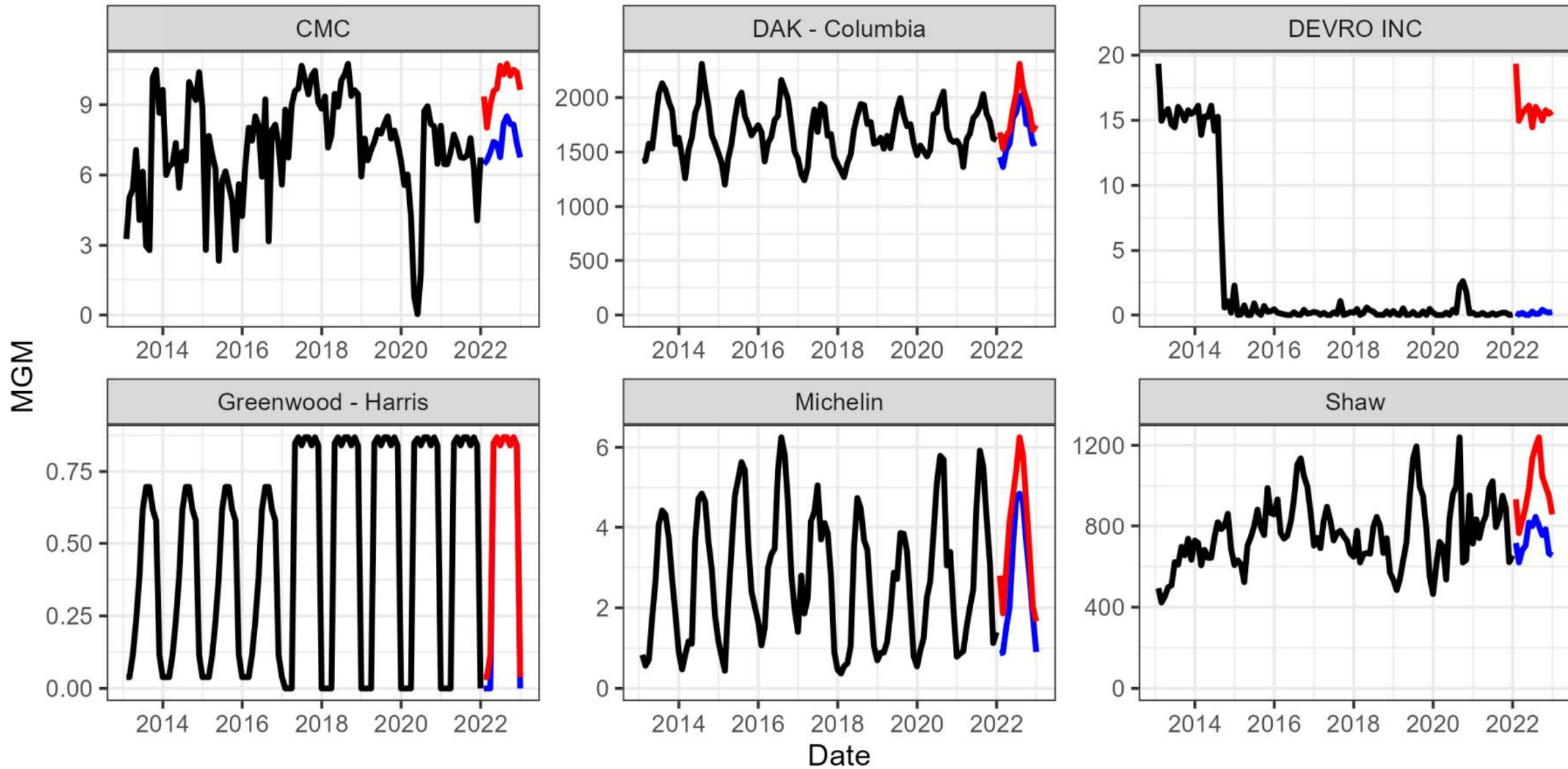


Note: the Y-Axis is scaled differently for each county.





# Manufacturing





# Manufacturing

Projected Annual Economic Growth Rates from the US Energy Information Agency

Food Products	0.9%	Plastics and Rubber Products	1.7%
Beverages and Tobacco Products	0.2%	Stone, Clay, and Glass Products	1.1%
Textile Mills and Products	-0.2%	Glass and Glass Products	1.0%
Wood Products	0.0%	Cement and Lime	1.4%
Furniture and Related Products	1.3%	Other Nonmetallic Mineral Products	1.1%
Paper Products	0.5%	Primary Metals Industry	0.9%
Printing	0.2%	Iron and Steel Mills and Products	0.1%
Chemical Manufacturing	1.6%	Alumina and Aluminum Products	1.3%
Bulk Chemicals	1.5%	Other Primary Metal Products	1.6%
Inorganic	0.3%	Fabricated Metal Products	1.5%
Organic	1.6%	Machinery	1.8%
Resin, Synthetic Rubber, and Fibers	1.7%	Computers and Electronics	2.5%
Agricultural Chemicals	1.0%	Transportation Equipment	1.7%
Other Chemical Products	1.6%	Electrical Equipment	2.5%
Petroleum and Coal Products	0.8%	Miscellaneous Manufacturing	2.8%
Petroleum Refineries	0.8%		
Other Petroleum and Coal Products	1.1%		



# Manufacturing

- Projected annual growth rates range from 0.3% to 3%, depending on the economic sector.
- Over 50 years, that leads to total increase from less than 10% to over 500%.
- In reality, water demand for manufacturing has been declining as industrial processes become more efficient and manufacturers develop higher value products.



# Agricultural Irrigation

- Projected to grow from 38% (Moderate Scenario) to 44% (High Scenario) over the 50 year planning horizon
- That's about 0.7% compounded annually, comparable to recent growth rates.
- Constraints on irrigable land will be investigated.
- Projected growth will be distributed regionally, not assigned to existing withdrawal intakes.
- In the Broad Basin, we assumed no growth...



# Possible Research

**Industrial water purchases from public suppliers.** We can expect residential and commercial use to scale per capita, not so much for industrial purchases. RBC members have indicated that growth in industrial water demand (new facilities) is expected to be met by public suppliers more than self-supply. Getting the historical record straight will improve the per-capita based modelling of residential and commercial use. Currently, new industrial water users are not considered in the water demand projections, and scenario-based modelling of new industry might be appropriate.

**Public supply wholesale distribution.** Anderson Regional Joint Water and Greenville Water have provided over a decade of wholesale data each. Integrating wholesale data into the water demand models will provide increased spatial resolution (each distribution system “utility” modeled separately vs interconnected networks modeled in aggregate). Filling this knowledge gap will inform questions related to source-water portfolios and consumption/return flows.

**Water and sewer service areas GIS layer.** This dataset is rather rough, and could use some cleaning up. Filling this knowledge gap will enable spatial analysis of public supply water use with demographic, housing, and landcover attributes.

**Indoor vs outdoor and residential vs commercial use.** Probably not enough data, at this point, to address this. We could try to come up with: how much data would be needed, what kind of data would be most useful, what kind of relevant data is available, what does this information contribute ...

# Discussion Questions

What trends are currently happening or on the horizon?

What magnitude of impact can we expect?



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