South Carolina Water-Demand Projections

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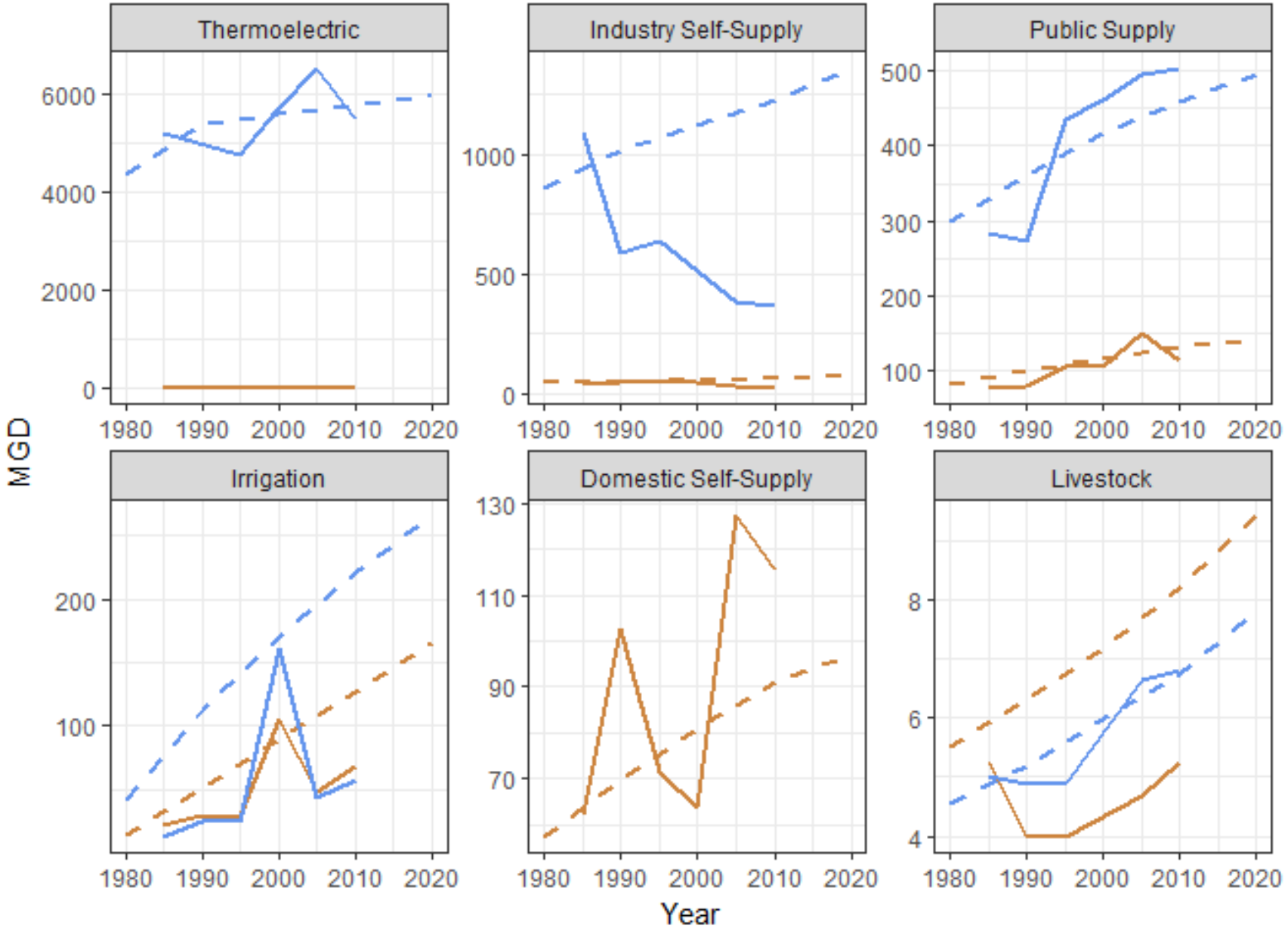

Thermoelectric
Industry Self-Supply
Public Supply
Irrigation
Domestic Self-Supply
Livestock
MGD
Year
Withdrawal Source
Groundwater
Surface Water
Data Source
SCWRC projections
USGS

Projections are not forecasts

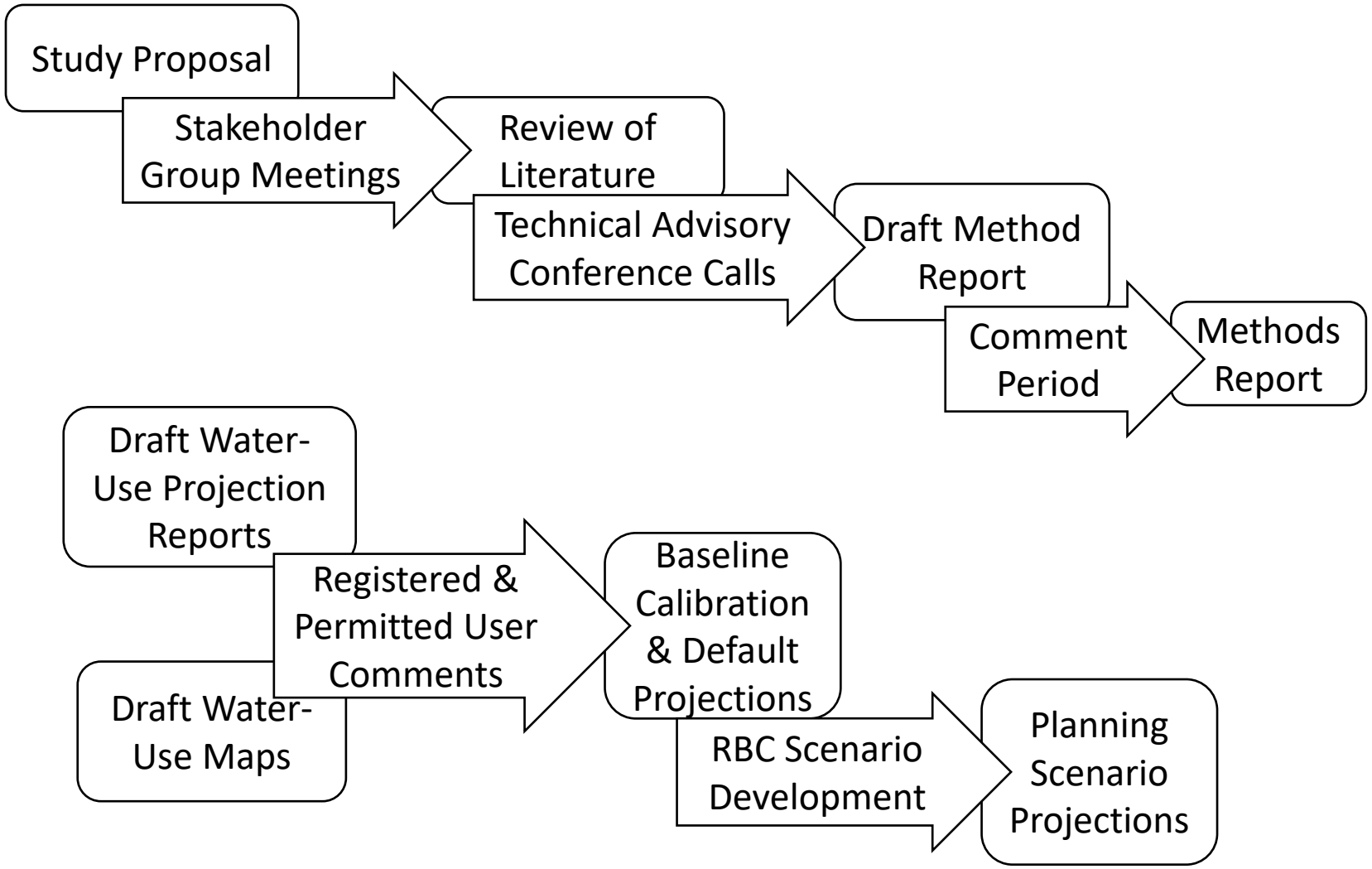
Forecast

- 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)

TAC 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

Equation 1: Water Demand Mass Balance

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

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
ΔStorage	:	Net change in off-stream storage
Shortage	:	Water not available to meet the objectives of water users

Equation 2: Return Flow Mass Balance

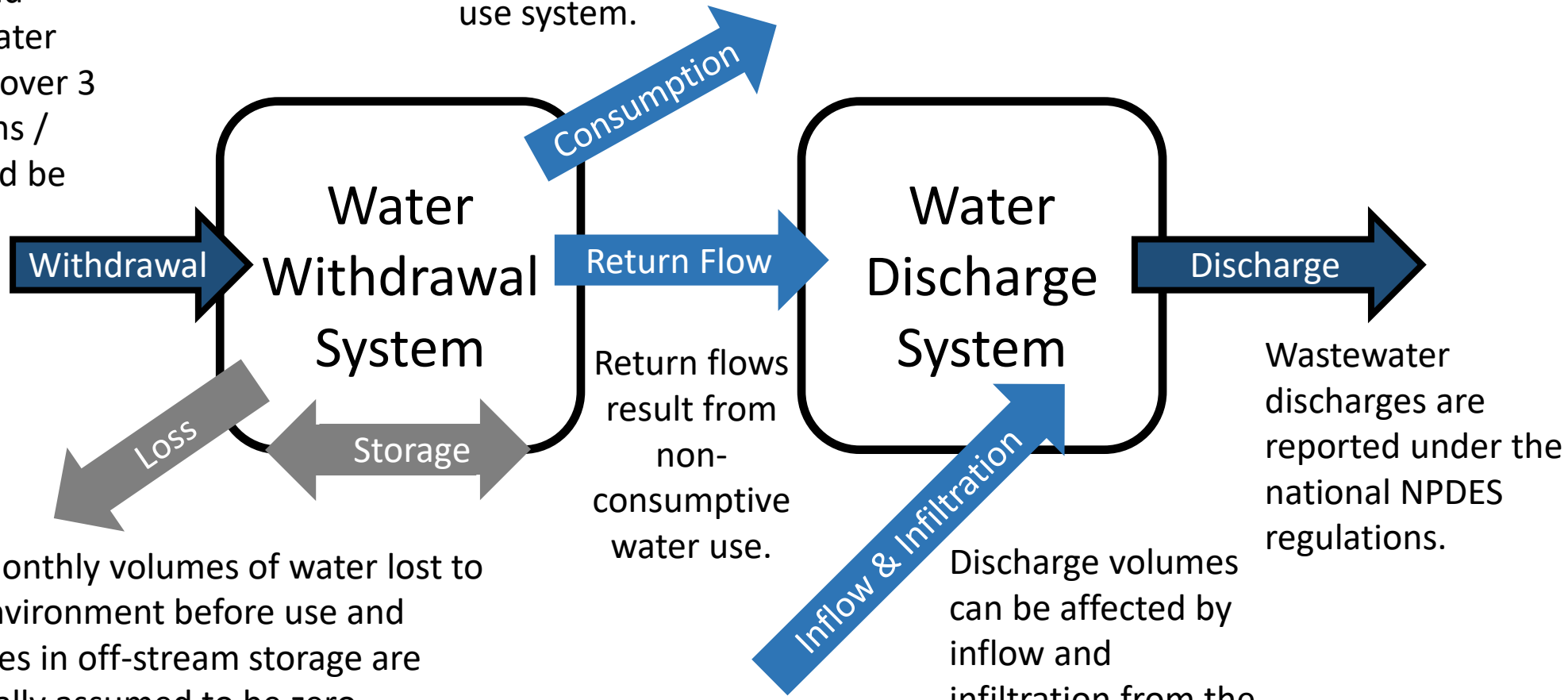
$$Return\ Flow = Discharge - Inflow\ \&\ Infiltration$$

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)

Permitted and registered water withdrawals over 3 million gallons / month should be reported to SCDHEC.

Water that is used and evaporates or transpires to the atmosphere is *consumed* from the water use system.



The monthly volumes of water lost to the environment before use and changes in off-stream storage are generally assumed to be zero.

Return flows result from non-consumptive water use.

Discharge volumes can be affected by inflow and infiltration from the environment.

Wastewater discharges are reported under the national NPDES regulations.

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

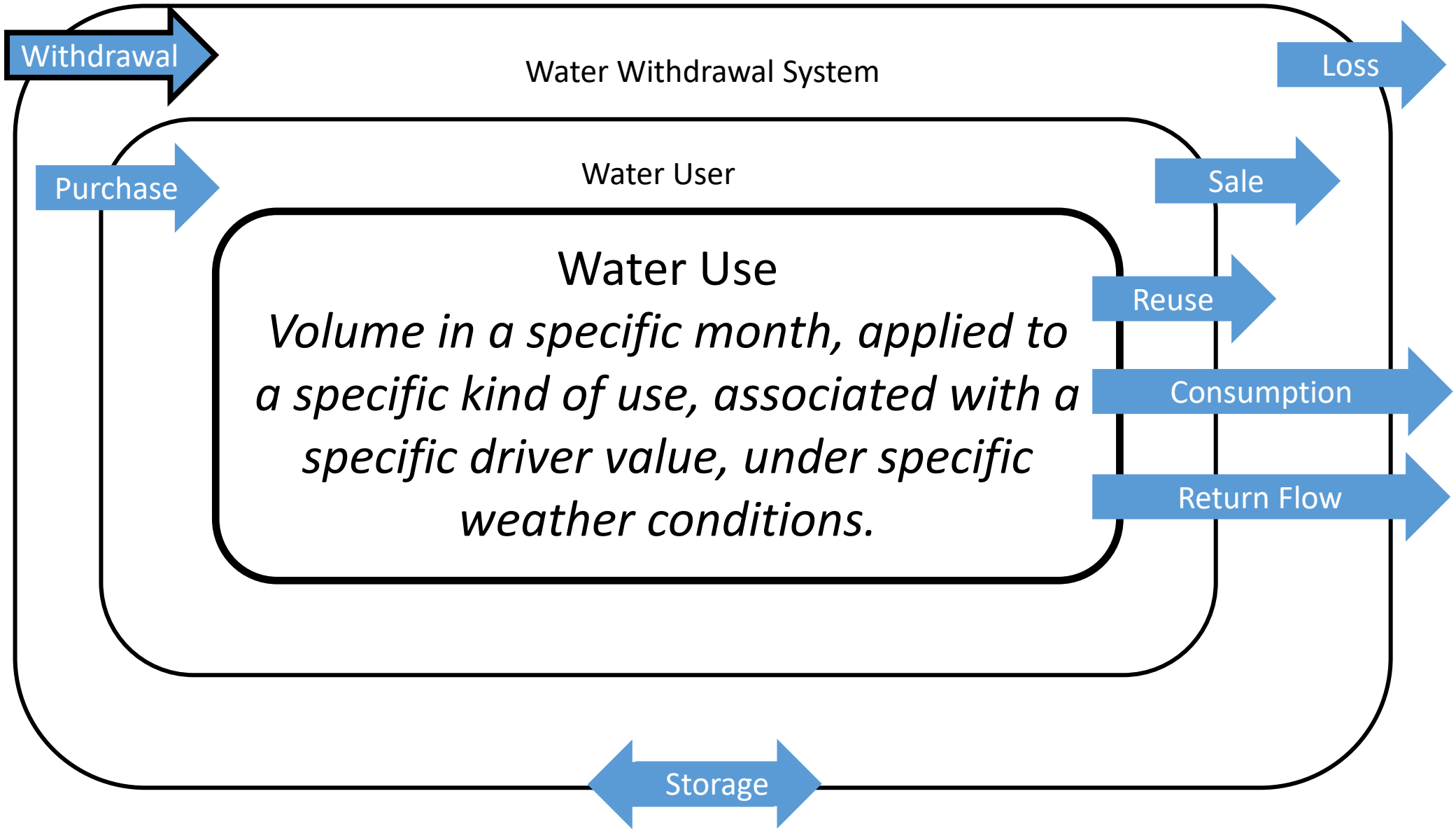
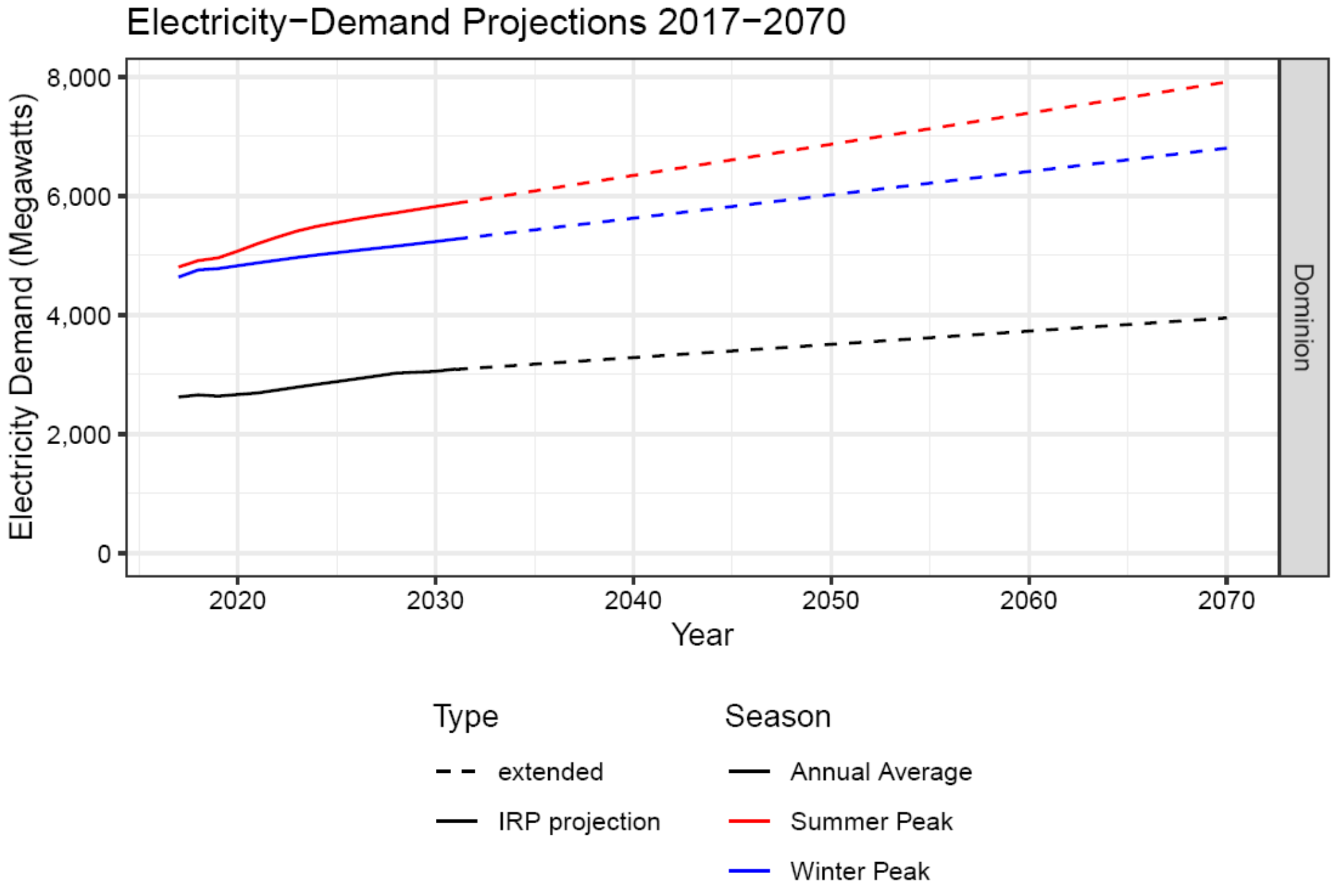

Withdrawal
Water Withdrawal System
Loss
Purchase
Water User
Sale
Water Use
Volume in a specific month, applied to a specific kind of use, associated with a specific driver value, under specific weather conditions.
Reuse
Consumption
Return Flow
Storage

Table 1.1: Drivers of Water Demand

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


Electricity−Demand Projections 2017−2070
Electricity Demand (Megawatts)
8,000
6,000
4,000
2,000
0
2020
2030
2040
2050
2060
2070
Year
Dominion
Type
extended
IRP projection
Season
Annual Average
Summer Peak
Winter Peak

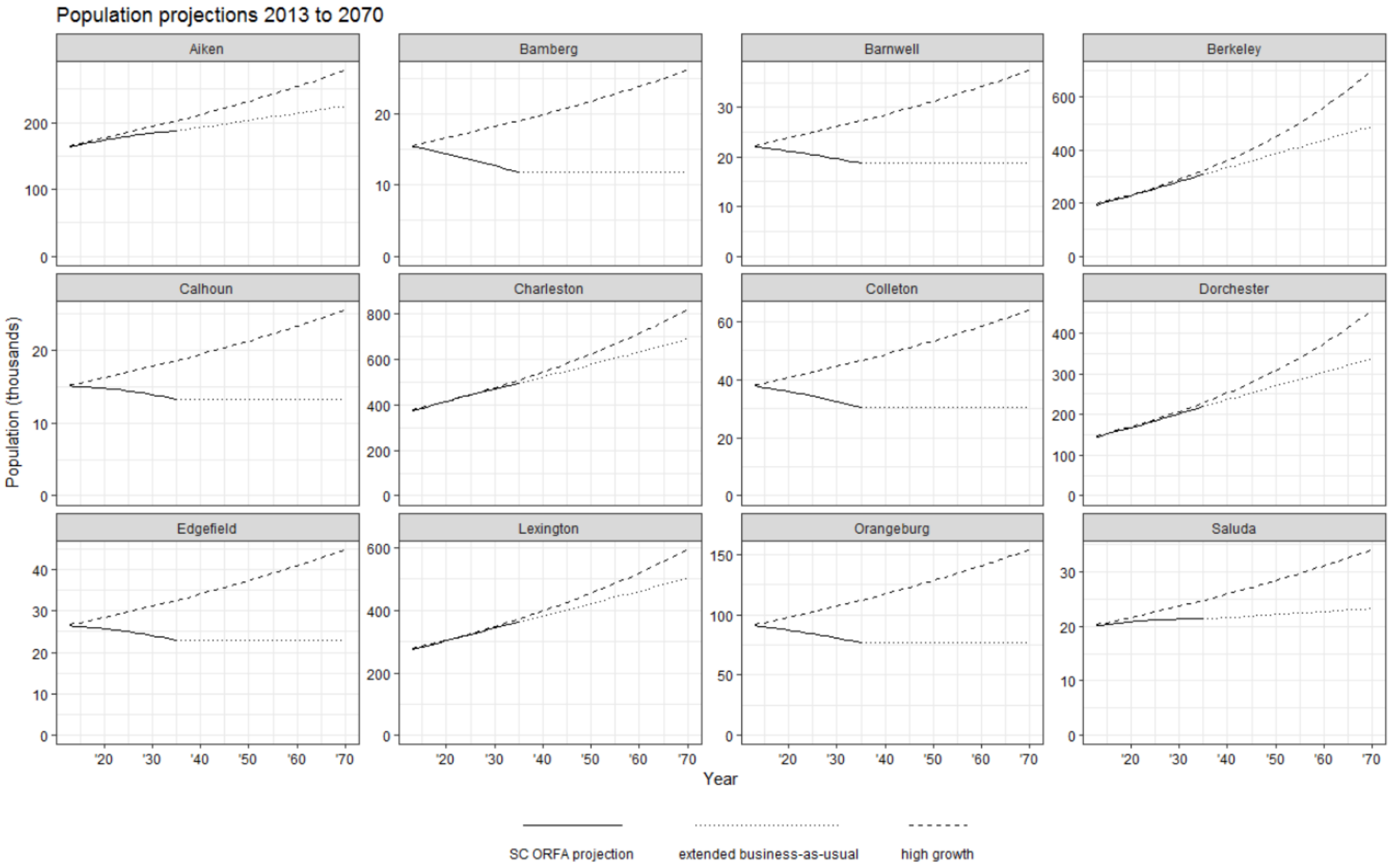

Population projections 2013 to 2070
Aiken
Bamberg
Barnwell
Berkeley
Calhoun
Charleston
Colleton
Dorchester
Edgefield
Lexington
Orangeburg
Saluda
Population (thousands)
Year
'20
'30
'40
'50
'60
'70
SC ORFA projection
extended business-as-usual
high growth

Table B3. Projected Growth Rates for Manufacturing Sectors in South Carolina

	Projected Annual Growth Rate 2017-2050
Paper Products	0.7%
Wood Products	1.7%
Chemical Manufacturing	1.7%
Bulk Chemicals	1.6%
Inorganic	-0.1%
Organic	2.1%
Resin	1.6%
Plastics and Rubber Products	2.5%
Other Chemical Products	1.7%
Other Petroleum and Coal Products	-0.8%
Textile Mills and Products	-2.2%
Primary Metals Industry	1.0%
Iron and Steel Mills and Products	0.4%
Alumina and Aluminum Products	1.2%
Other Primary Metal Products	1.5%
Fabricated Metal Products	2.3%
Machinery	2.3%
Cement and Lime	1.9%
Food Products	1.7%
Miscellaneous Manufacturing	2.8%

Source: U.S. Energy Information Administration
https://www.eia.gov/outlooks/aeo/data/browser/#
Accessed Aug 7, 2018

Projection of Irrigated Area

Moderate Demand

Increase irrigated area by 38% from 2020 - 2070

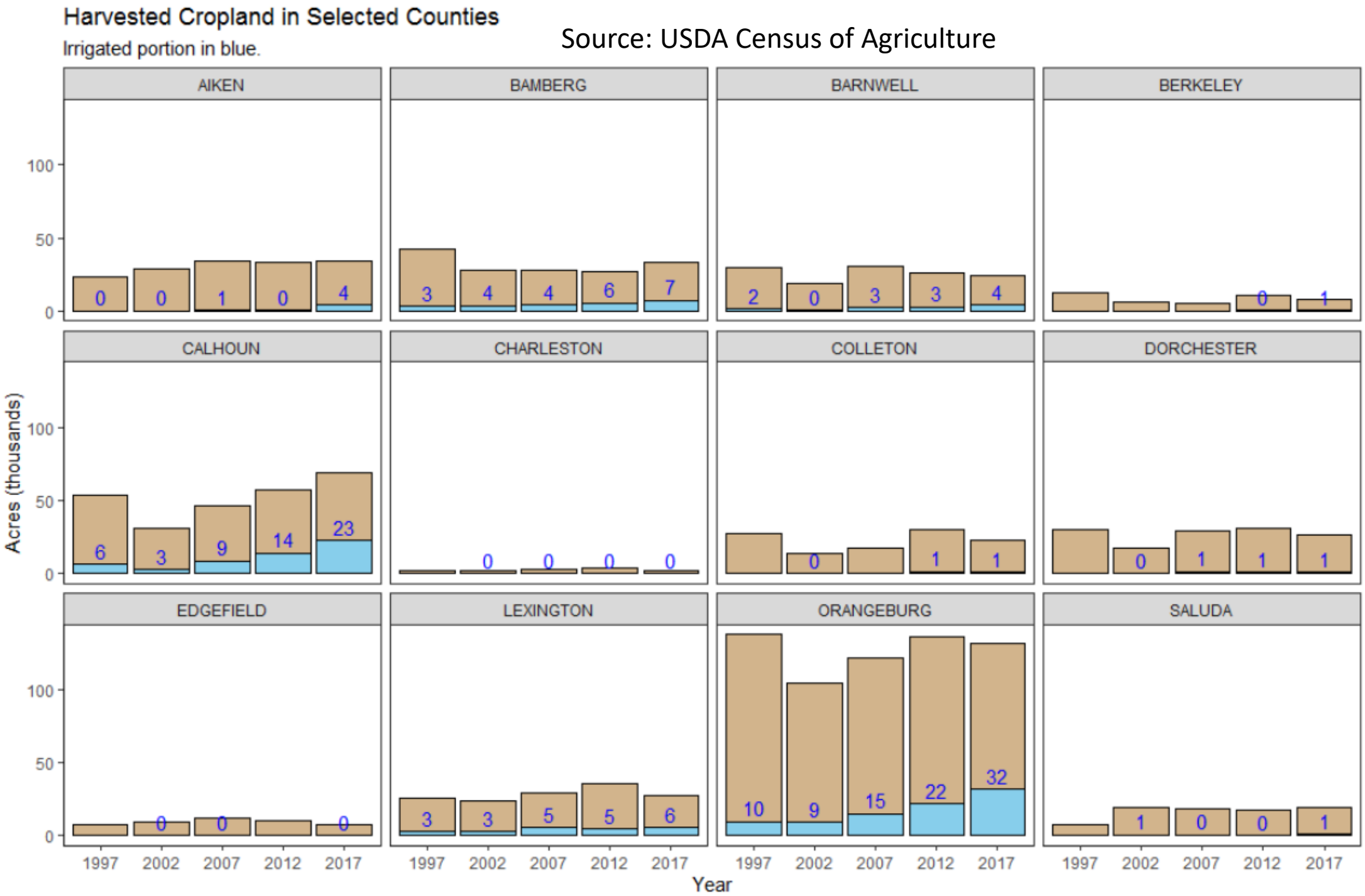
Annual Growth Rate ~0.65%

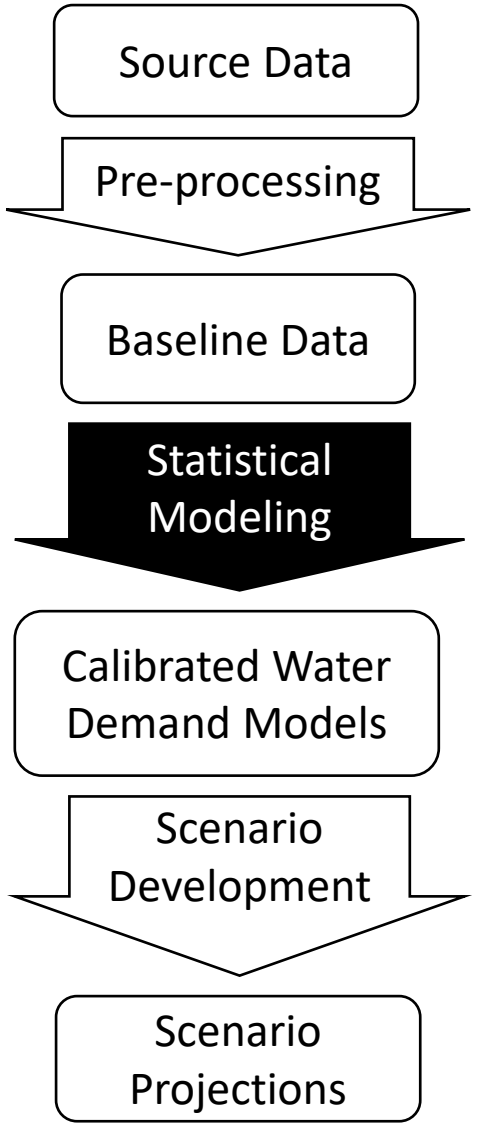
High Demand

Increase irrigated area by 44% from 2020 – 2070

Annual Growth Rate ~0.73%

Add 90th Percentile Weather Impact


Harvested Cropland in Selected Counties
Irrigated portion in blue.
Source: USDA Census of Agriculture
AIKEN
BAMBERG
BARNWELL
BERKELEY
CALHOUN
CHARLESTON
COLLETON
DORCHESTER
EDGEFIELD
LEXINGTON
ORANGEBURG
SALUDA
Acres (thousands)
0
50
100
1997
2002
2007
2012
2017
Year



Equation 3 – General Model of Water Demand

$$Demand_{u,t} = \frac{Driver_{u,t} * Rate_k * Seasonality_{k,m} * Weather_{u,t}}{Efficiency_u}$$

Where:

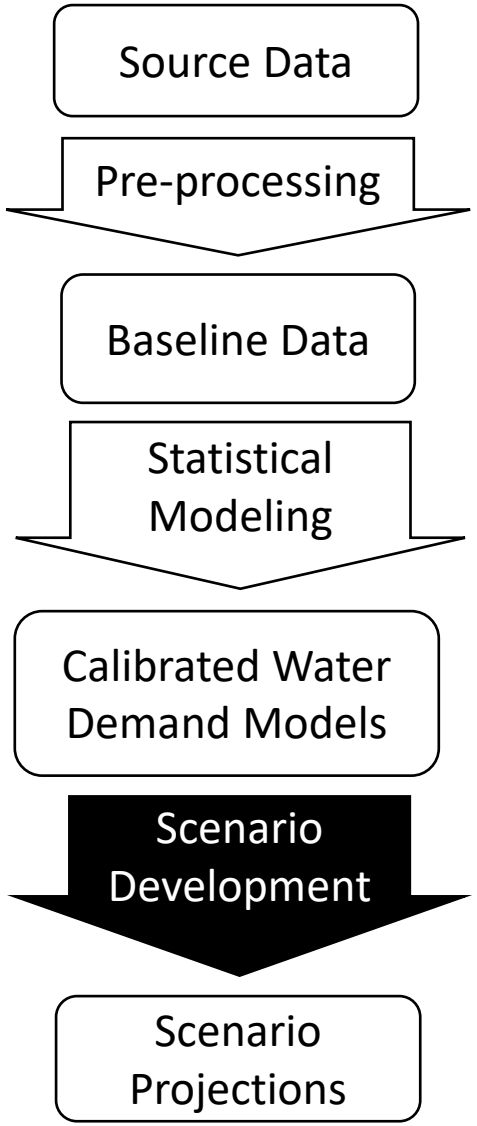
$Demand_u$	:	Modeled water demand for use *u*, expressed in terms of volume per month.
$Driver_u$	:	Primary driver value for use *u*, units vary by category.
$Rate_k$	:	Median rate for kind *k* of water demand, expressed per unit of primary driver.
$Seasonality_{k,m}$	:	Median seasonality coefficient for kind *k* and calendar month *m*, unitless.
$Efficiency_u$	:	Average efficiency coefficient for use *u*, unitless.
$Weather_{u,t}$	:	Weather coefficient for use *u* at time *t*, unitless.

Equation 4 –Simplified Model of Water Demand

$$Demand_{u,t} = Driver_{u,t} * Rate_u * Seasonality_{u,m} + Deviation_{u,t}$$

Where:

$Demand_u$	:	Modeled water demand for use *u*, expressed in terms of volume per month.
$Driver_u$	:	Primary driver value for use *u*, units vary by category.
$Rate_u$	:	Median rate for kind *k* of water demand, expressed per unit of primary driver.
$Seasonality_{u,m}$	:	Median seasonality coefficient for kind *k* and calendar month *m*, unitless.
$Deviation_{u,t}$	:	Deviation for use *u* at time *t*, volume per month.



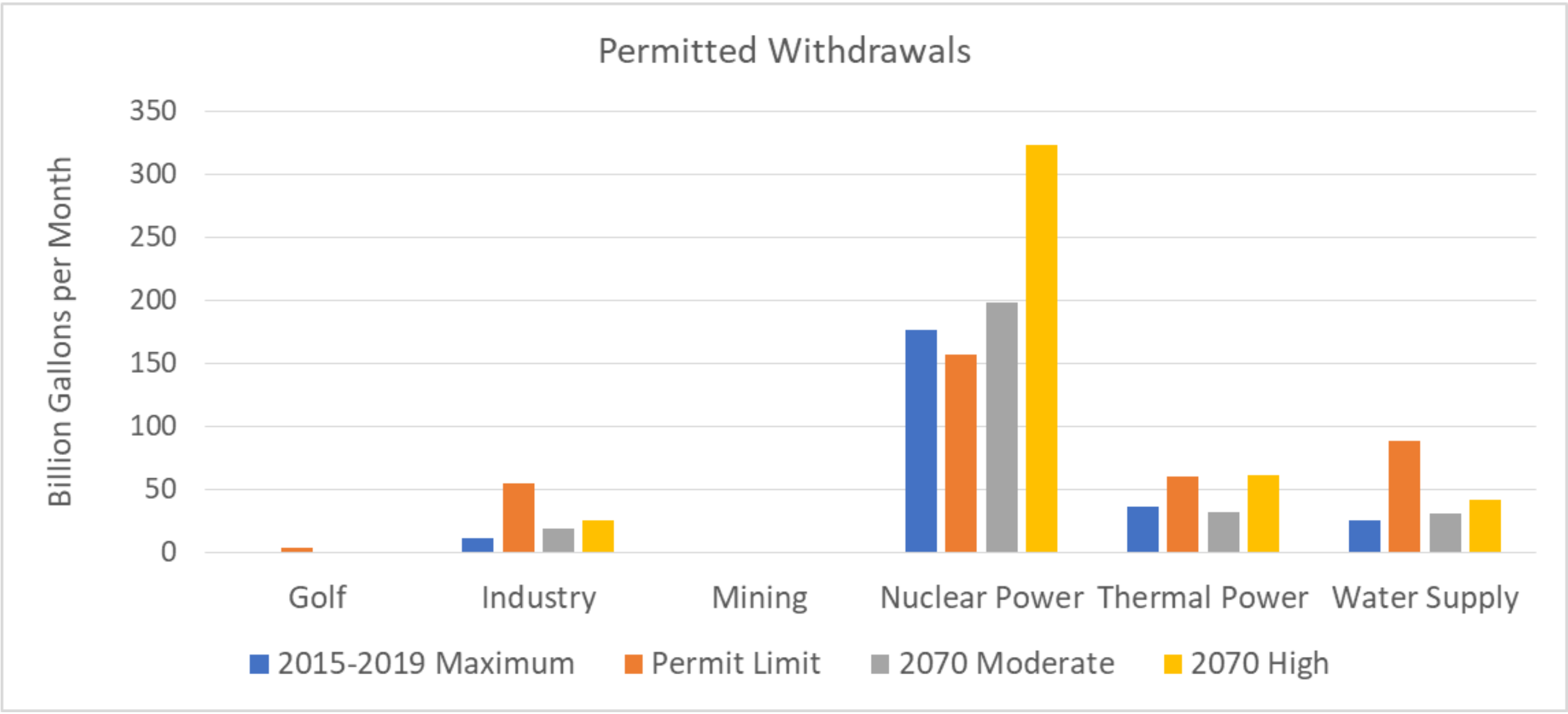
Business-as-usual Projections

- Water demand models derived from 2012-2017 input data will be applied to projected datasets including population, employment, and irrigated acres.
- 'Business as Usual' projections will assume stable linear trends in dynamic factors, and no change in underlying relationships.
- **High-demand scenario assumes high growth and drought impacts.**

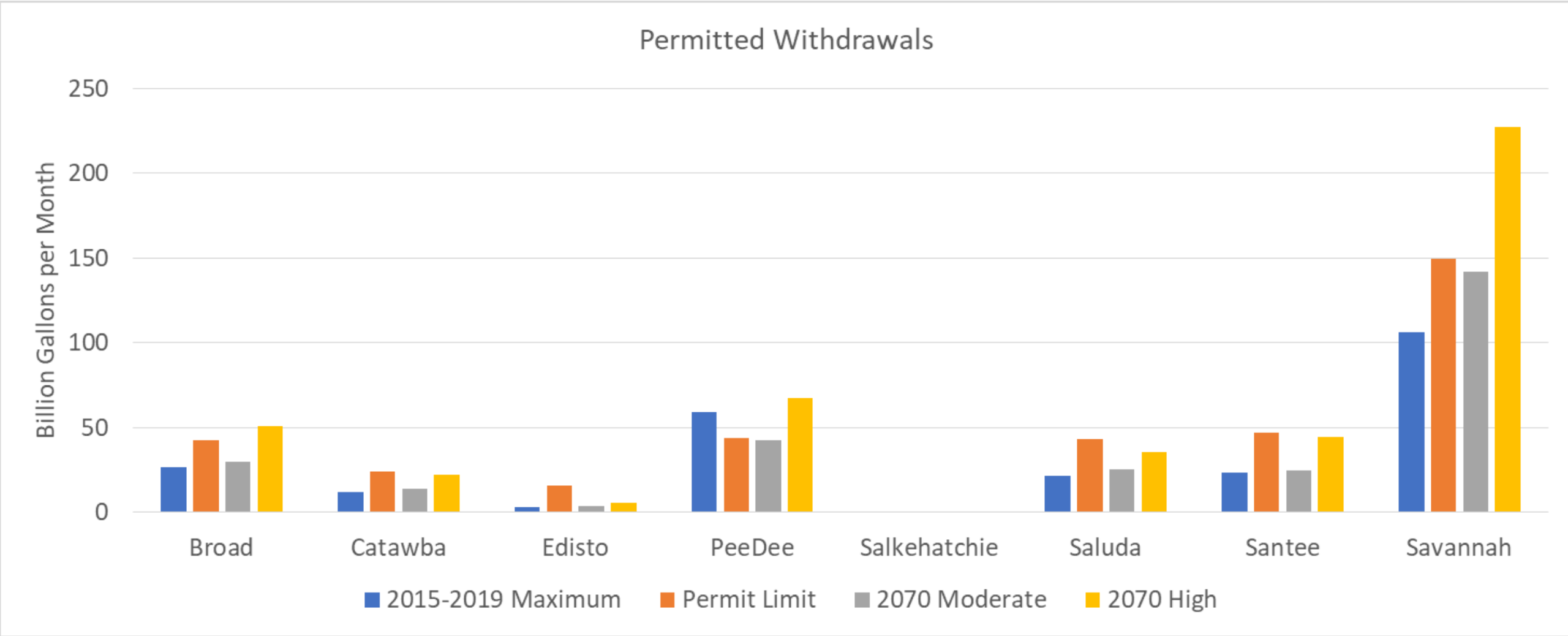
Business-as-usual & High-demand projections will be presented to basin specific stakeholder groups.

Some Draft Results…

- Preliminary draft results, not yet vetted
- For demonstration purposes only
- Only includes surface water
- Comparison of maximum monthly withdrawal rates
- There will be modifications to the projections during the water planning process.


Permitted Withdrawals
Billion Gallons per Month
350
300
250
200
150
100
50
0
Golf
Industry
Mining
Nuclear Power
Thermal Power
Water Supply
2015-2019 Maximum
Permit Limit
2070 Moderate
2070 High


Registered Withdrawals
Billion Gallons per Month
8
7
6
5
4
3
2
1
0
Broad
Catawba
Edisto
PeeDee
Salkehatchie
Saluda
Santee
Savannah
2015-2019 Maximum
Registration Limit
2070 Moderate
2070 High


Permitted Withdrawals
Billion Gallons per Month
250
200
150
100
50
0
Broad
Catawba
Edisto
PeeDee
Salkehatchie
Saluda
Santee
Savannah
2015-2019 Maximum
Permit Limit
2070 Moderate
2070 High

Questions?

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