Edisto Basin Water-Demand Projections

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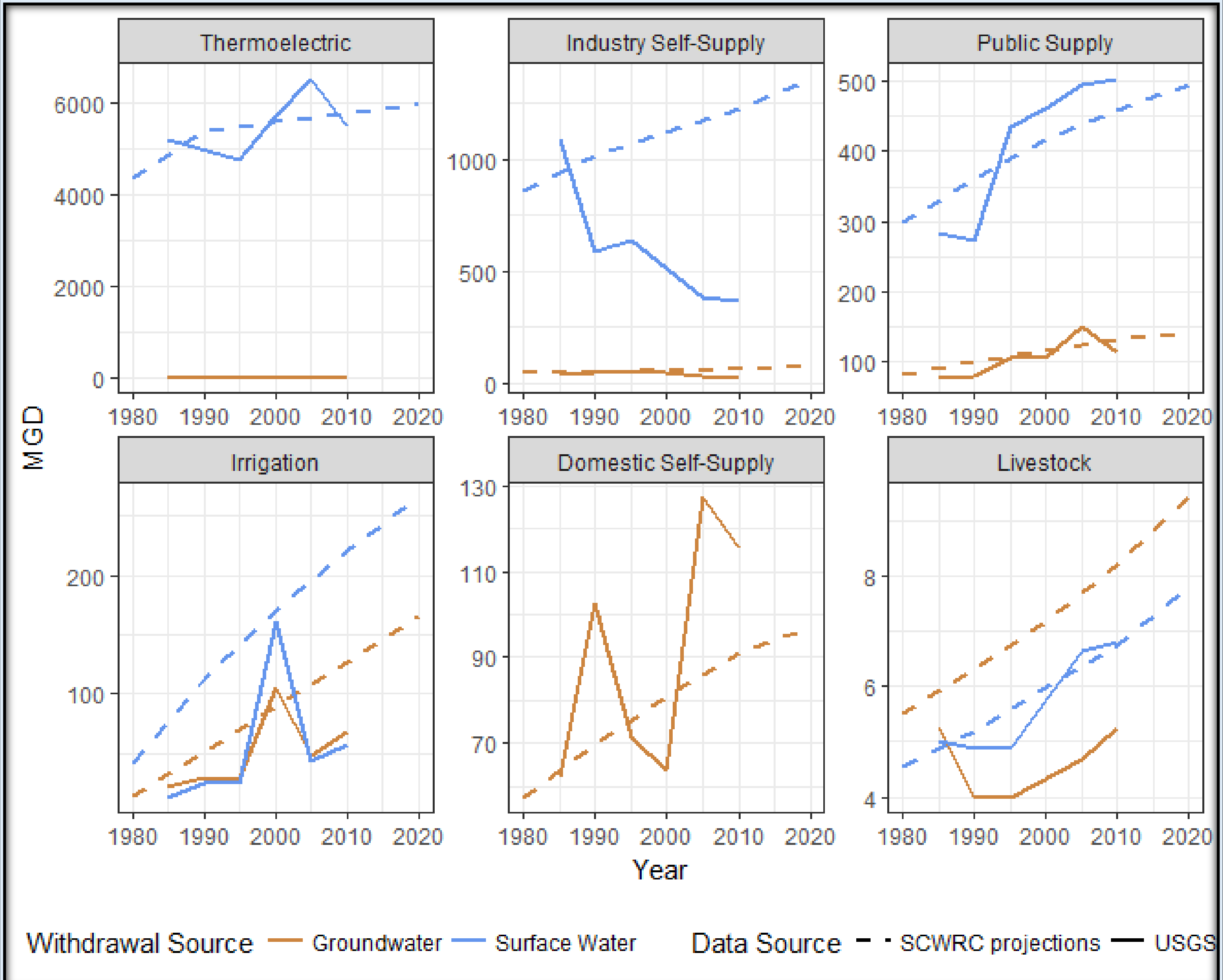
Outline

- What are water-demand projections?
- How did we come up with these?
  - Stakeholder input
  - Drivers of water demand
  - Projection scenarios
- Draft Results
- Future work

1980 Water Demand Projections



What are projections?

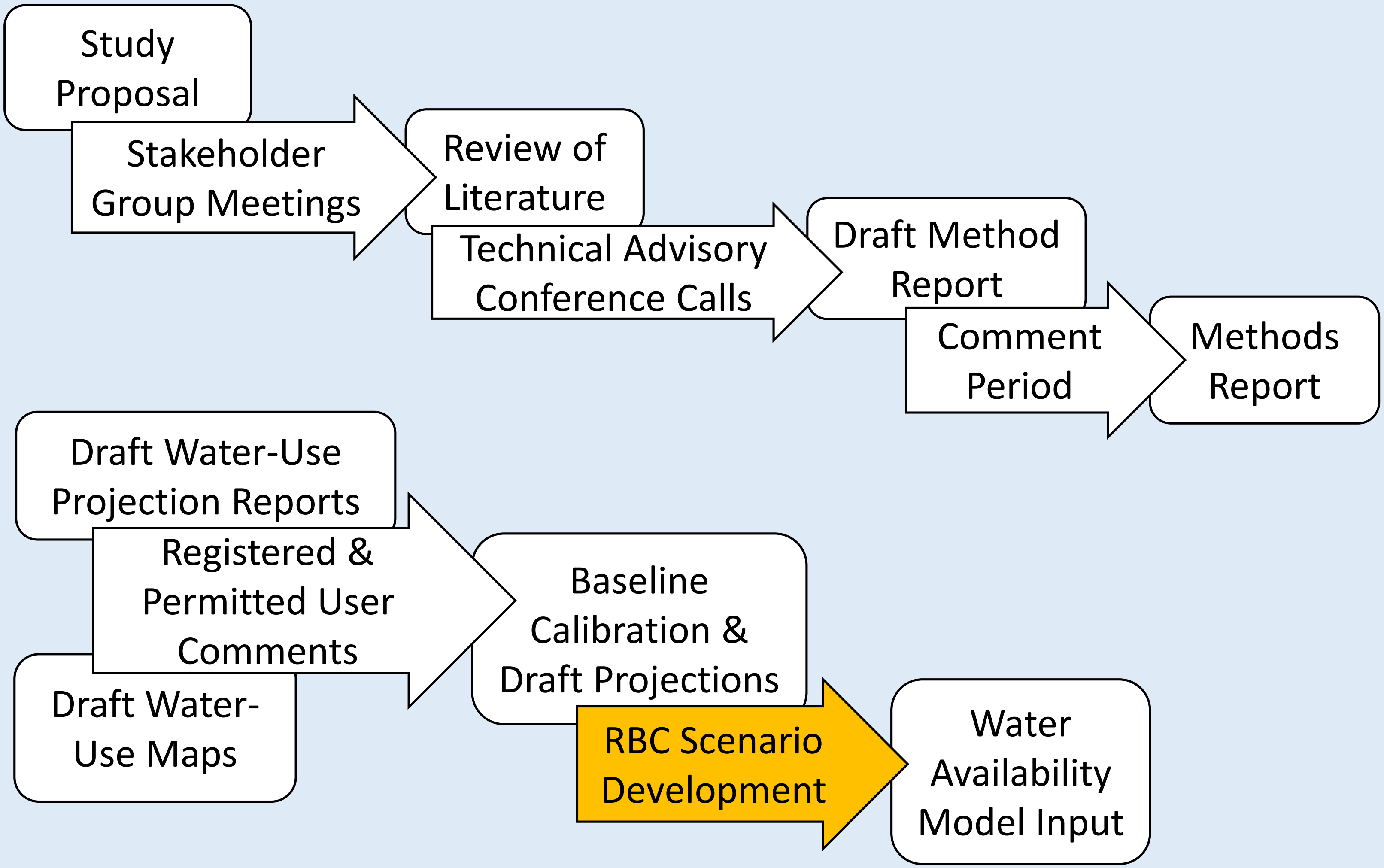
Forecast

- Educated guess.
- Based on expected conditions.
- 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 Process



Stakeholder Feedback

- **SCAWWA Water Utility Council –** use weather and demographic variables for long term forecasts.
- **SC Water Quality Association** – some systems are highly interconnected.
- **SC Farm Bureau Water Committee –** not all cropland can be profitably irrigated.
- **Chamber of Commerce Environmental Technical Committee –** provide information on a stream reach scale.
- **SC Water Planning Process Advisory Committee (PPAC)**
  - keep it simple,
  - improve over time,
  - consider business-as-usual and high-demand scenarios.

Stakeholder Feedback

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

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

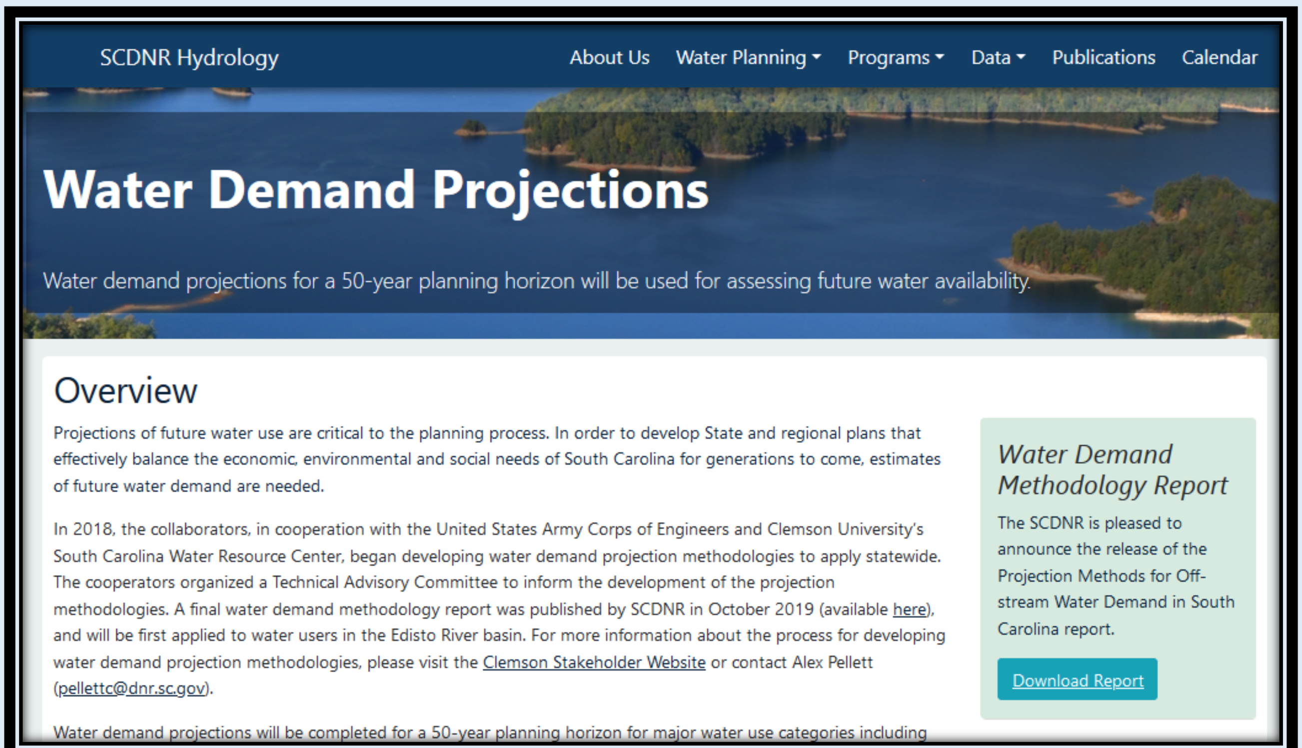
Technical Advisory Recommendations

- Provide draft projections to local stakeholders.
- Provide opportunity for feedback.
- Do not rely on overly complex methods.
- **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.

Methods Report

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.

http://hydrology.dnr.sc.gov/pdfs/basin-planning/Projection_Methods.pdf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Water Demand Projections

Water demand projections for a 50-year planning horizon will be used for assessing future water availability.

Overview

Projections of future water use are critical to the planning process. In order to develop State and regional plans that effectively balance the economic, environmental and social needs of South Carolina for generations to come, estimates of future water demand are needed.

In 2018, the collaborators, in cooperation with the United States Army Corps of Engineers and Clemson University's South Carolina Water Resource Center, began developing water demand projection methodologies to apply statewide. The cooperators organized a Technical Advisory Committee to inform the development of the projection methodologies. A final water demand methodology report was published by SCDNR in October 2019 (available here), and will be first applied to water users in the Edisto River basin. For more information about the process for developing water demand projection methodologies, please visit the Clemson Stakeholder Website or contact Alex Pellett (pellettc@dnr.sc.gov).

Water demand projections will be completed for a 50-year planning horizon for major water use categories including

Water Demand Methodology Report

The SCDNR is pleased to announce the release of the Projection Methods for Off-stream Water Demand in South Carolina report.

Download Report

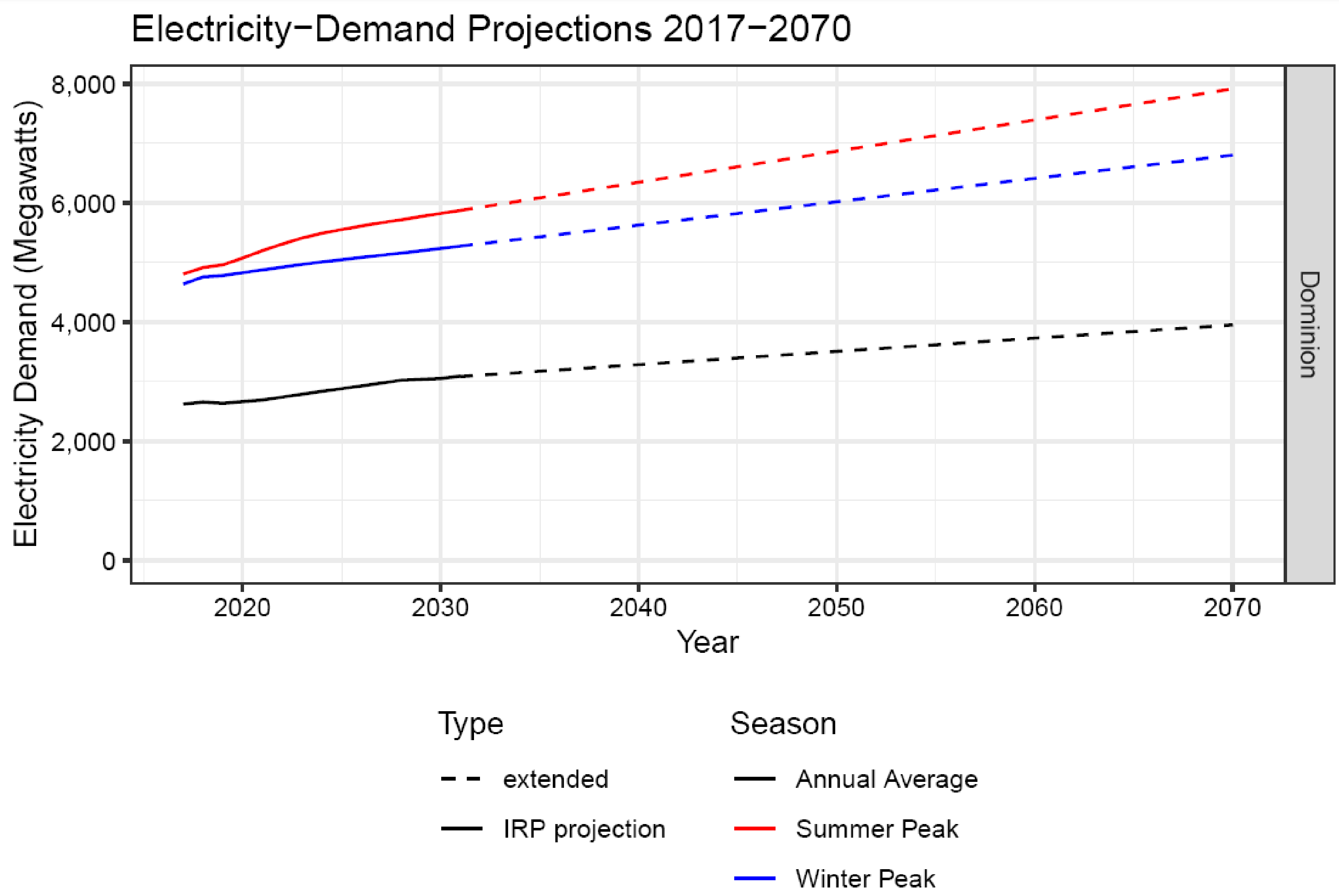
Drivers of Water Demand

Category	Driver Variable	Source for Driver Projection	Business-As-Usual	High-demand
Thermo-electric Power	Electricity production	Integrated Resource Plans.	Extend straight-line growth.	
Public and domestic supply	Population	SC Office of Revenue and Fiscal Affairs	Extend flat or straight-line growth.	Project using state-wide or county growth rate, increased by 10%.
Manufacturing	Economic production	US Energy Information Agency Annual Energy Outlook	Adjust annual growth rate to minimum of 0.	Adjust annual growth rate to minimum of 2%.
Agriculture	Irrigated area	National-scale studies	Annual growth rate of 0.65%.	Annual growth rate of 0.72%.

Thermo-electric Electricity Demand

- Electricity-demand projections are developed by teams of professionals, using econometric models of electricity demand.
- Utility-wide projection is assumed to apply uniformly to each electricity generation facility.
- Extended to 2070 as a straight-line from the last 2 years of the projection in the Integrated Resource Plan (IRP).
- The draft water-demand projections use the 2017 IRP; the 2020 IRP is now available.

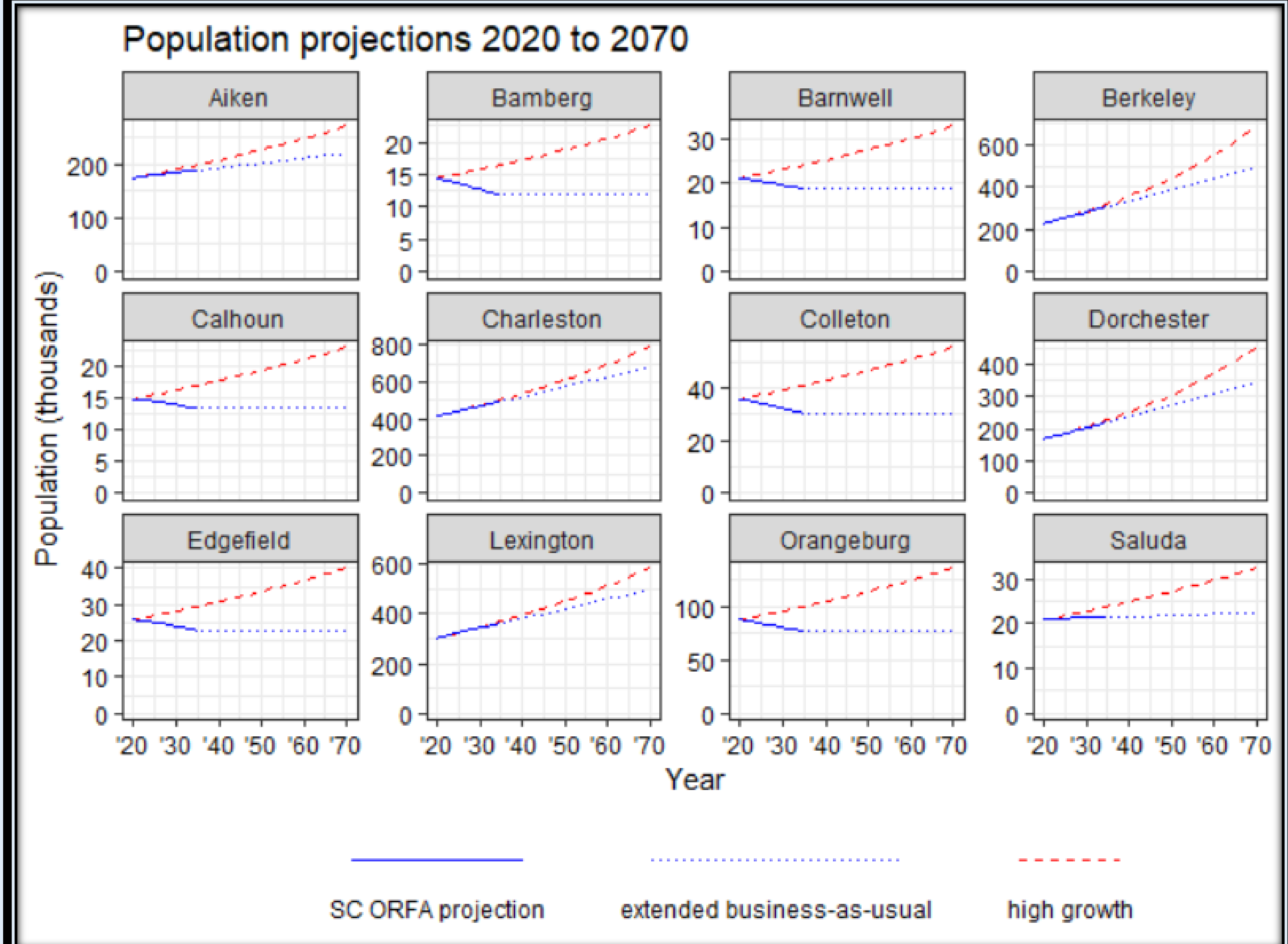
Thermo-electric Electricity Demand



Public Supply Population Projections

- County-wide population projections developed by the South Carolina Office of Revenue and Fiscal Affairs.
- Cohort-component method applied to 2000 and 2010 Census data.
- Growth is driven by migration.
- Rural counties lose population as young migrate towards jobs and older folks migrate towards recreation and healthcare.
- Business-as-usual scenario:
  - Extend to 2070 as straight-line, but set a minimum growth of 0.
- High-demand scenario:
  - Assume exponential growth.
  - Calculate annual growth rate as the average annual projected growth rate.
  - If the county annual growth rate is less than the state-wide average annual growth rate, use the state-wide average (0.8%).
  - Then, increase the annual growth rate by 10%.
  - This results in growth rates ranging from 0.89% to 2%.

Public Supply Population Projections



Manufacturing Productivity

- National economic growth rates for each subsector from the U.S. Energy Information Agency's "Annual Energy Outlook" report.
- Both scenarios apply annual growth rates for exponential growth.
- Business-as-usual scenario uses a minimum growth rate of 0%.
- High-demand scenario uses a minimum growth rate of 2%.
- Draft projections use the 2018 report; the 2020 report is now available.

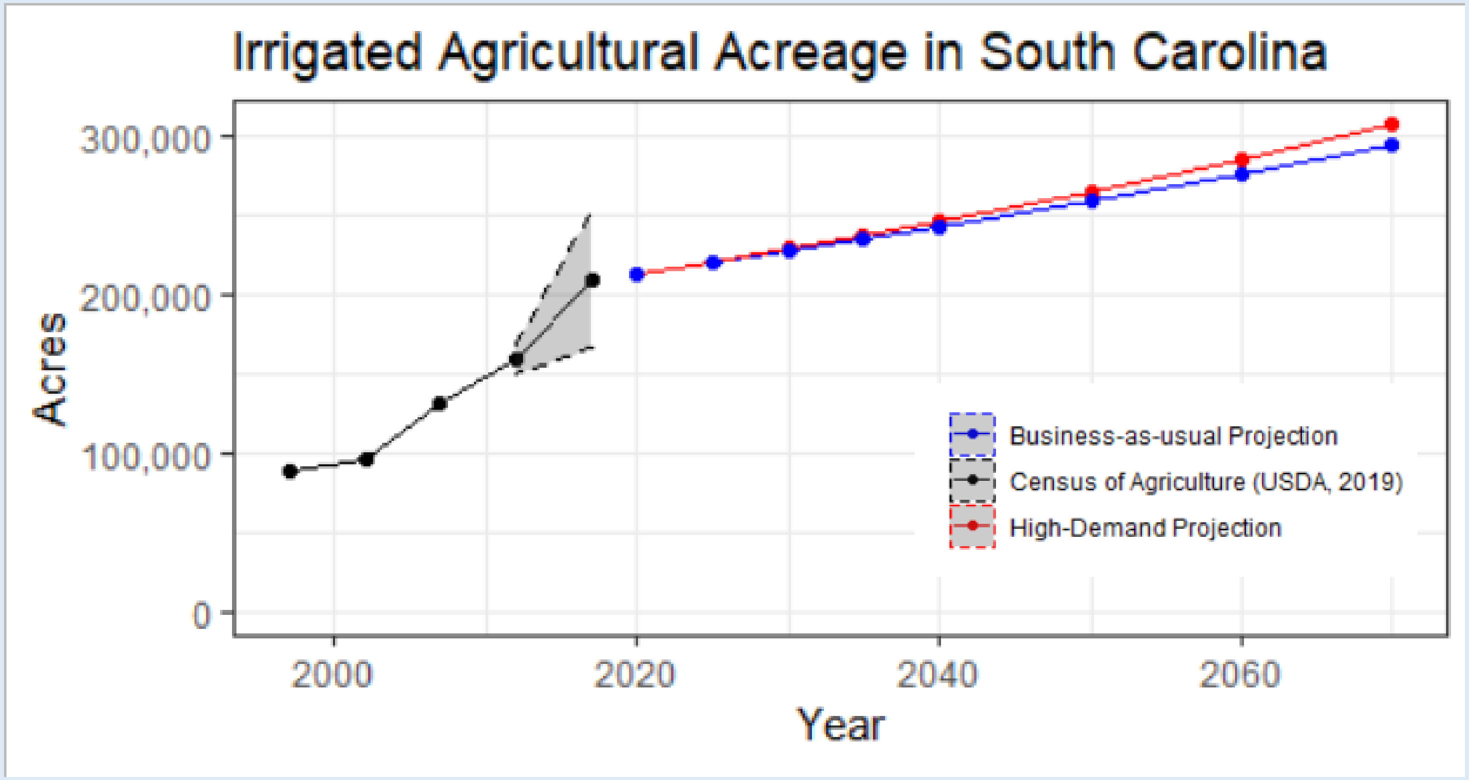
Projected Annual Growth Rate 2017-2050	
Paper Products	0.7%
Wood Products	1.7%
Chemical Manufacturing	1.7%
Bulk Chemicals	1.6%
Inorganic	-0.1%
Organic	2.1%
Resin	1.6%
Plastics and Rubber Products	2.5%
Other Chemical Products	1.7%
Other Petroleum and Coal Products	-0.8%
Textile Mills and Products	-2.2%
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

Agricultural Irrigation



- Business-as-usual scenario increases 38% from 2020 – 2070 (~0.65% annually).
- High-demand scenario increases 44% from 2020 – 2070 (~0.73% annually).

Scenarios

Business-as-usual Scenario

Water Demand = Driver * Rate * Seasonality

High-Demand Scenario

Water Demand = Driver * Rate * Seasonality * High Impact Factor

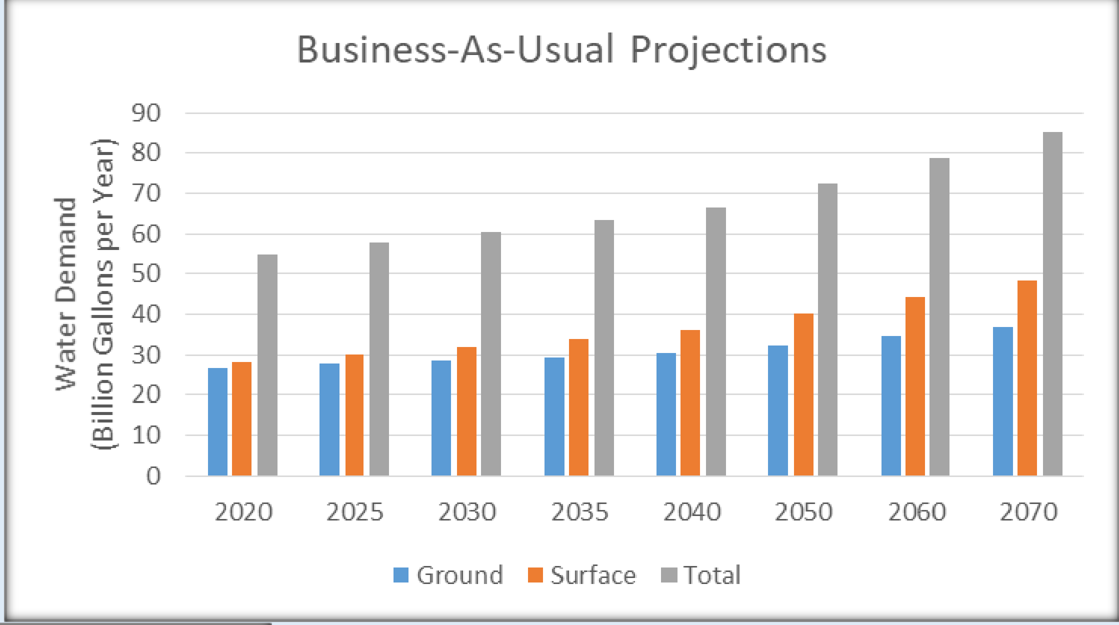
High Impact Factor is not used for groundwater model input.

High Impact Factor is calculated as:

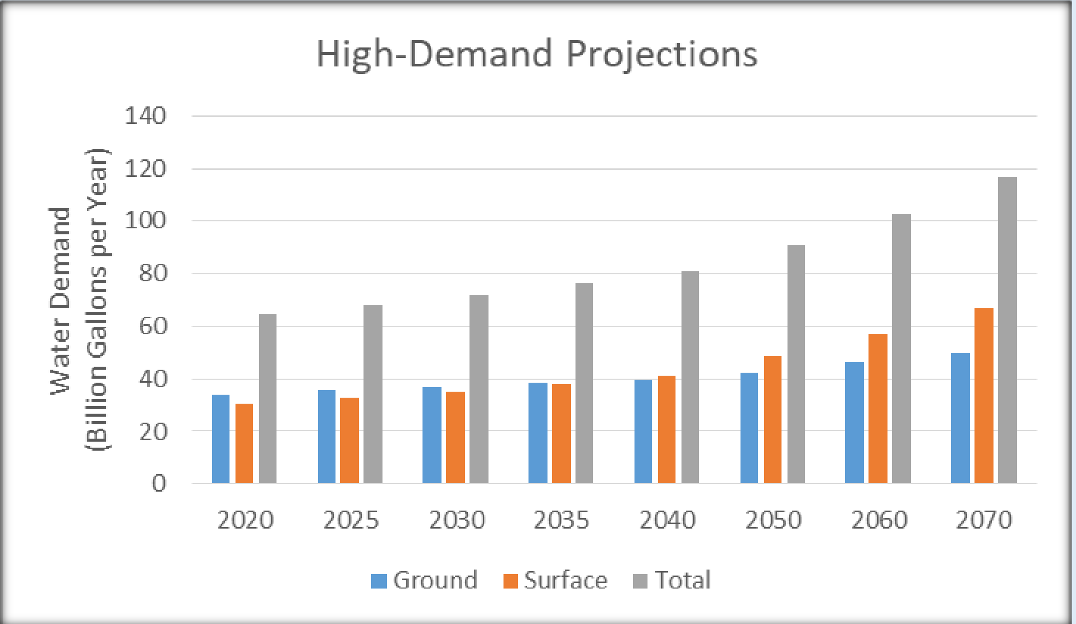
- Monthly 90th percentile impact of weather
  - As described in the methodology report.
  - Used for agriculture, and any water-use systems for which weather was found to have a significant impact on water demand.
- Seasonal 90th deviation from baseline median rate
  - Weather was not found to have a significant impact on all water-use systems.
  - Calculated this way, the High Impact Factor is “agnostic” to the cause of high demand.
  - Described in upcoming addendum to the methodology report.

Edisto Basin Results

2018 total annual withdrawal: 23.4 BGY (64 MGD) groundwater and 29.4 BGY (80 MGD) surface water.

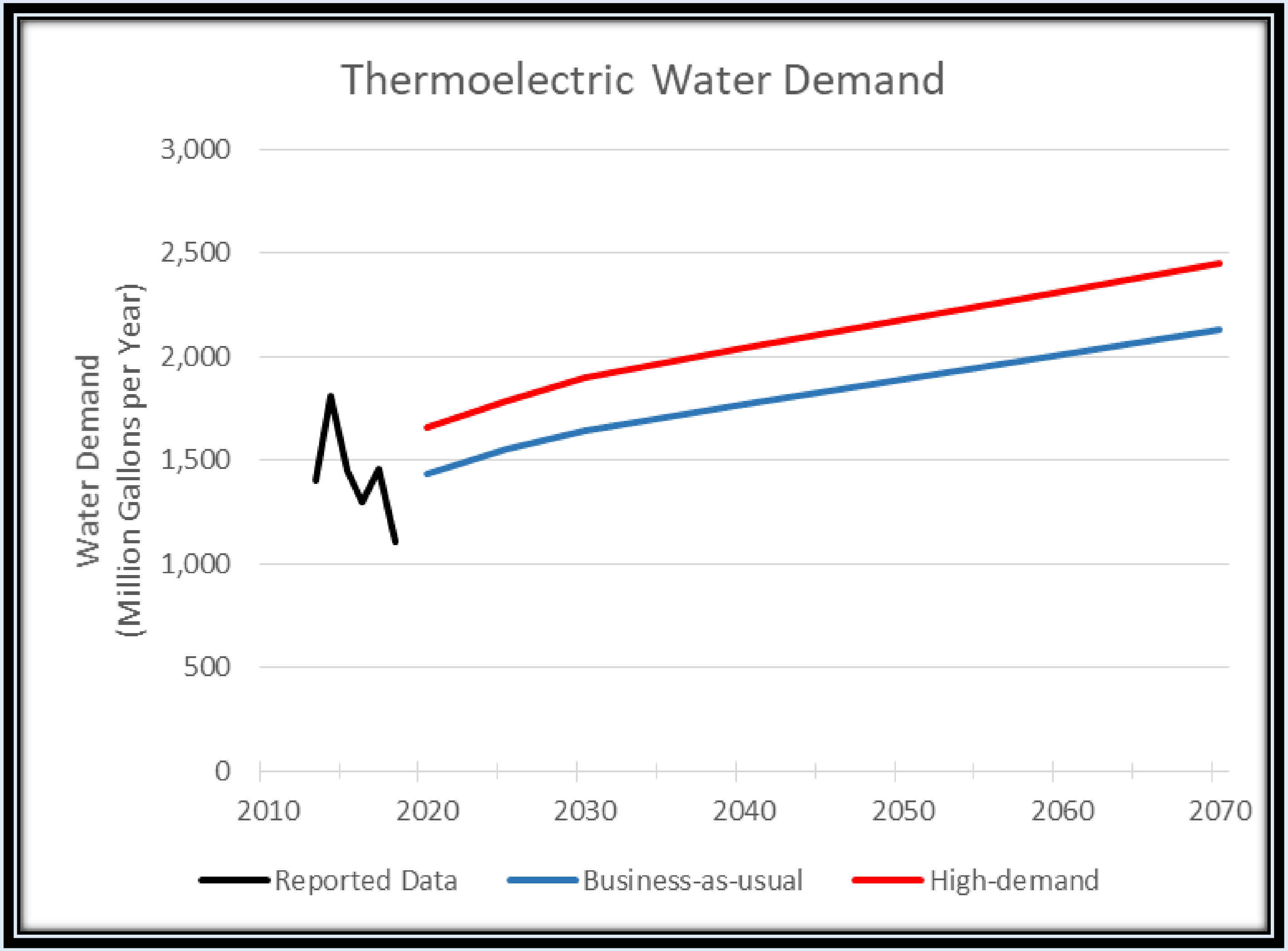


In the business-as-usual scenario, groundwater increases 57% and surface water increases 65% by 2070.



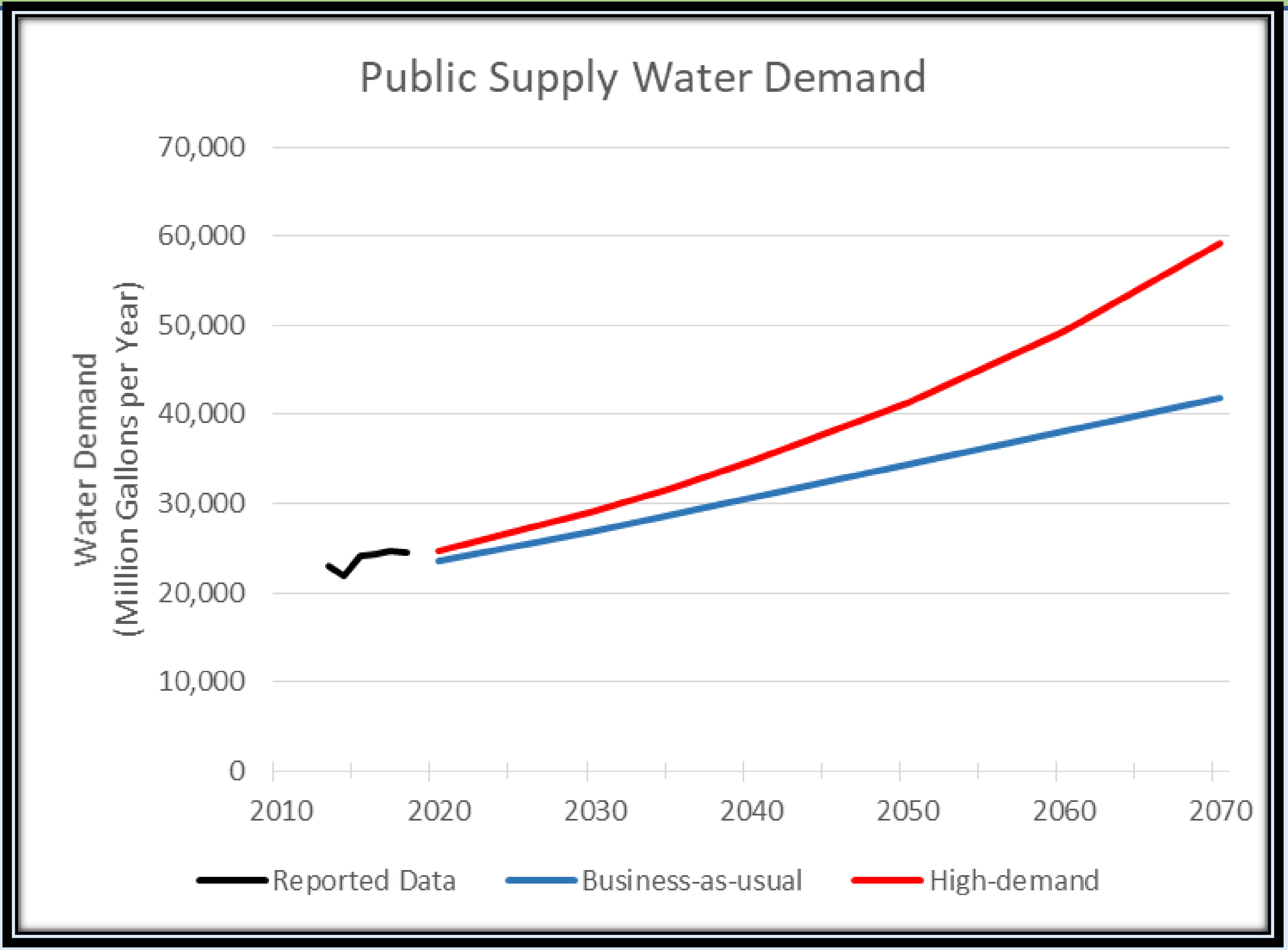
In the high-demand scenario, groundwater increases 112% and surface water increases 128% over the 50-year planning horizon.

Edisto Thermo-electric Results



Cope Station represents almost all of this water demand. Currently, it is planned to use surface water by 2027.

Edisto Public Supply Results

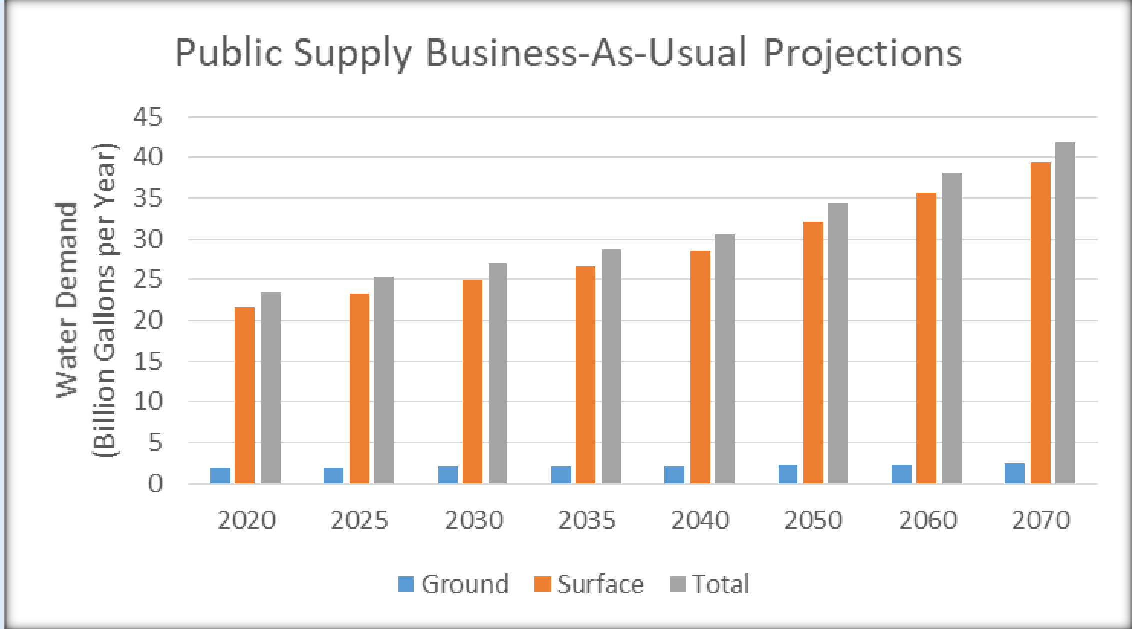


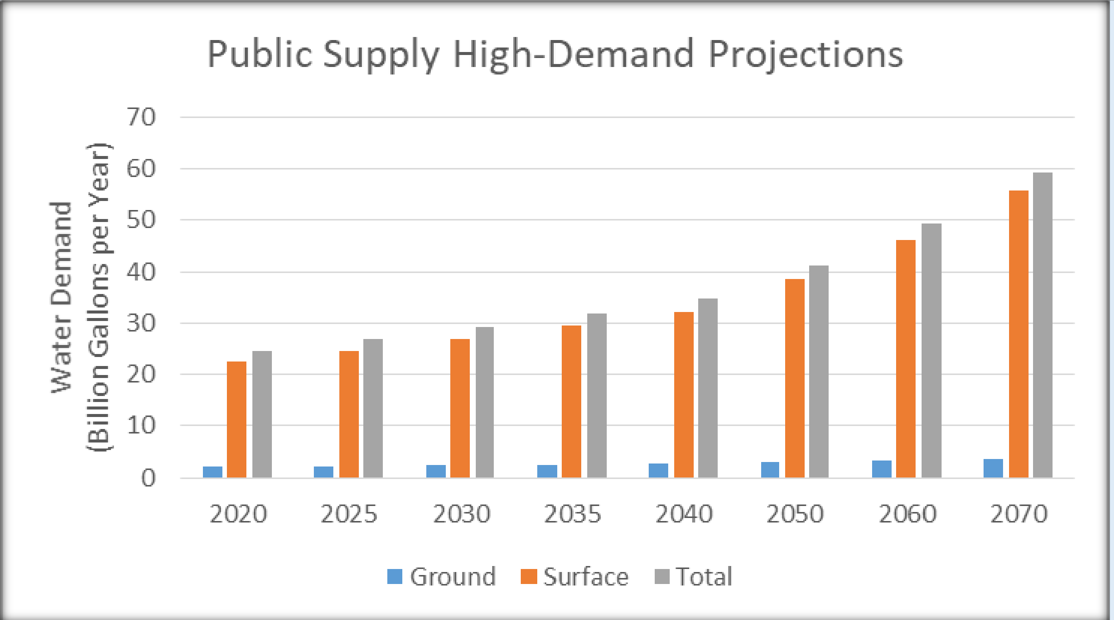
The Charleston Water withdrawal at Ghivans Ferry is the majority here (~80%).

Edisto Public-Supply Results

In the business-as-usual scenario, surface water demand for public supply is projected to increase 83% from 2020 to 2070.

Groundwater demand is projected to increase 29% from 2020 to 2070.

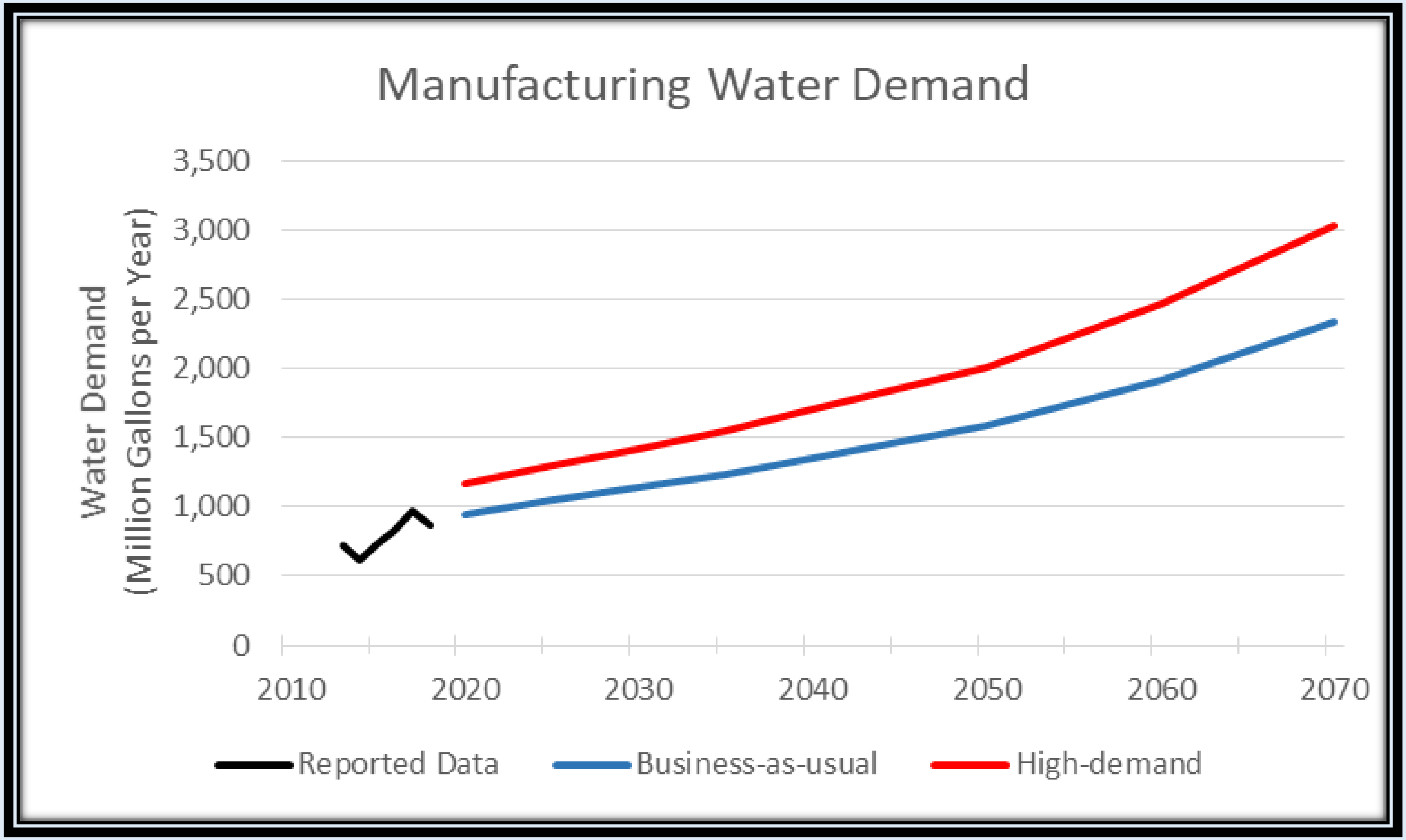




In the high-demand scenario, surface water demand for public supply is projected to increase 145% from 2020 to 2070.

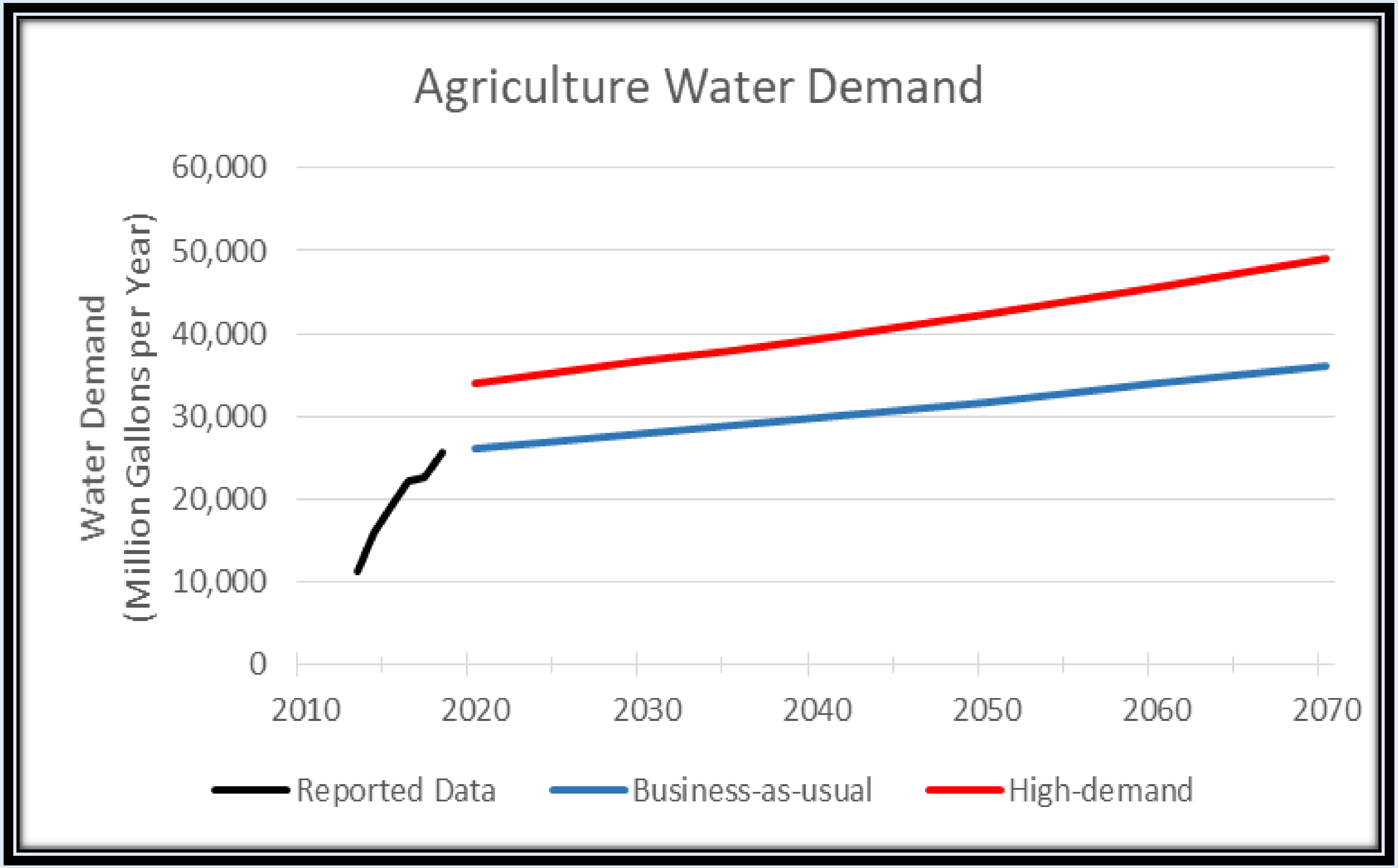
Groundwater demand is projected to increase 71% from 2020 to 2070.

Edisto Manufacturing Results



Almost entirely groundwater, so the high-demand scenario will be a bit less when input in to the groundwater model.

Edisto Agriculture Results

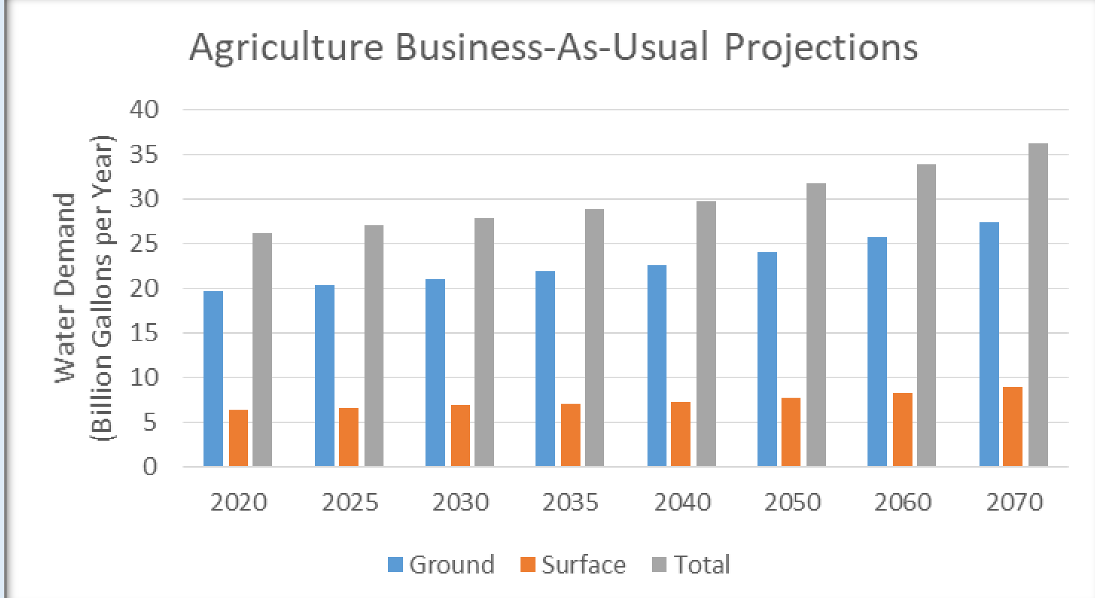


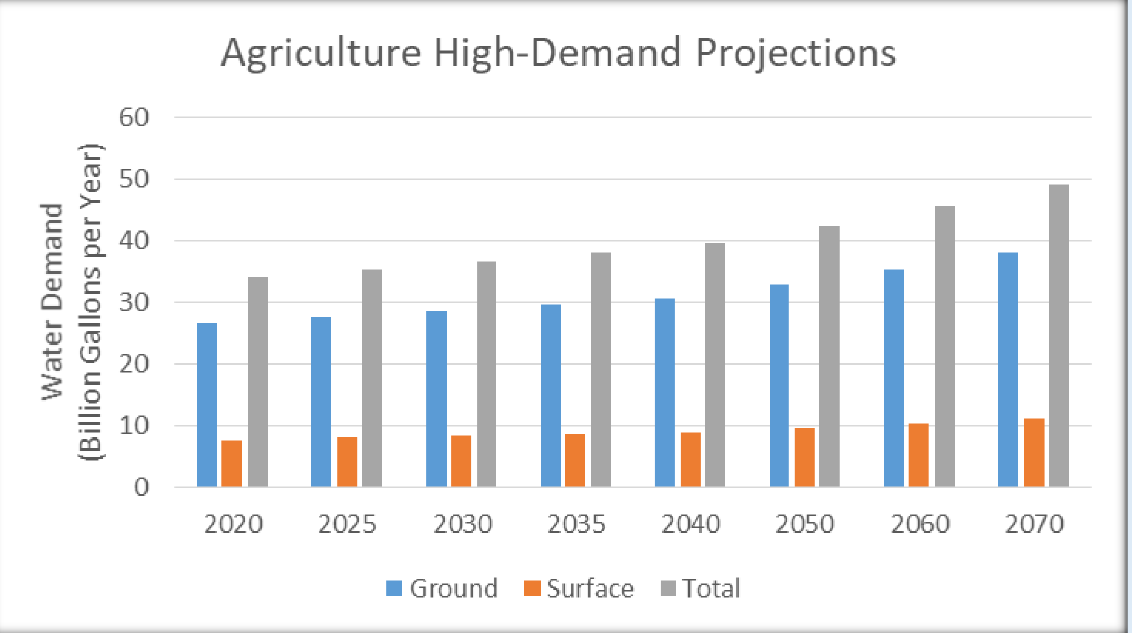
Over 75% is groundwater demand. These plots represent results of the high-demand scenario including the monthly high-impact factor. It is not realistic to apply the monthly high-impact factor continuously over time, so the high-demand scenario input for the groundwater model will not be this high.

Edisto Agriculture Results

Over 75% of agricultural water-demand in the Edisto basin is met with groundwater.

In the business-as-usual scenario, agriculture water demand is projected to increase 38% from 2020 to 2070.





In the high-demand scenario, agriculture water demand is projected to increase 44% from 2020 to 2070.

Water Availability Model Input

Surface Water Model Input:

- Water demands for each year of each scenario are input and run across the entire model period.
- For high-demand scenario, constant high demand every month of every year.
- For agriculture, don't project changes at existing intakes, distribute to sub-basin (RBC input?)

Groundwater Model Input:

- The projection years are interpolated to every year using a step function.
- The model is run once for each scenario, with the water demands changing over time.
- For high-demand scenario, include high driver projection, but drop the 90th percentile high-impact factor.

Future Work

Routine updates:

- Update electricity projections from 2020 IRP.
- Update industry projections from 2020 EIA AEO.
- Use annual projections instead of step function interpolation for groundwater model input.
- Publish projections summary and detailed reports.

Recommended adjustments:

- Agriculture irrigated area in the high-demand scenario could grow faster.
- Consider using additive high-impact factor instead of multiplicative.
    - High-impact for public supply is low.
    - High-impact factor for agriculture is high in some cases.

Other Potential Enhancements

- Adjust projections by survey questions (privacy issue?).
- Re-send custom reports to permittees.
- Model return flows, discharges, and consumptive use.
- Aquifer Storage and Recovery, Wastewater Reuse, De-watering.
- Efficiency Improvements.
- Public Supply
    - Service area population projections.
    - Distinguish different kinds of water use.
    - Consider impacts of outdoor use restrictions.
- Agriculture
    - Field-scale irrigation modelling.
    - Econometric modelling of different crops.
    - Constraints on irrigated area.