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

- Thermoelectric
- Industry Self-Supply
- Public Supply
- Irrigation
- Domestic Self-Supply
- Livestock

Withdrawal Source: Orange = Groundwater, Blue = Surface Water

Data Source: Dashed line = SCWRC projections, Solid line = USGS
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

- Study Proposal
- Stakeholder Group Meetings
- Review of Literature
- Technical Advisory Conference Calls
- Draft Method Report
- Comment Period
- Methods Report
- Draft Water-Use Projection Reports
- Registered & Permitted User Comments
- Draft Water-Use Maps
- Baseline Calibration & Draft Projections
- RBC Scenario Development
- Water Availability Model Input
• **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.
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.
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
## Drivers of Water Demand

<table>
<thead>
<tr>
<th>Category</th>
<th>Driver Variable</th>
<th>Source for Driver Projection</th>
<th>Business-As-Usual</th>
<th>High-demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public and domestic supply</td>
<td>Population</td>
<td>SC Office of Revenue and Fiscal Affairs</td>
<td>Extend flat or straight-line growth.</td>
<td>Project using state-wide or county growth rate, increased by 10%.</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>Economic production</td>
<td>US Energy Information Agency Annual Energy Outlook</td>
<td>Adjust annual growth rate to minimum of 0.</td>
<td>Adjust annual growth rate to minimum of 2%.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Irrigated area</td>
<td>National-scale studies</td>
<td>Annual growth rate of 0.65%.</td>
<td>Annual growth rate of 0.72%.</td>
</tr>
</tbody>
</table>
• 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.
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%.
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](https://www.eia.gov/outlooks/aeo/data/browser/#)

Source: U.S. Energy Information Administration

Accessed Aug 7, 2018
• 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.
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.
Cope Station represents almost all of this water demand. Currently, it is planned to use surface water by 2027.
The Charleston Water withdrawal at Ghivans Ferry is the majority here (~80%).
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.
Almost entirely groundwater, so the high-demand scenario will be a bit less when input into 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.