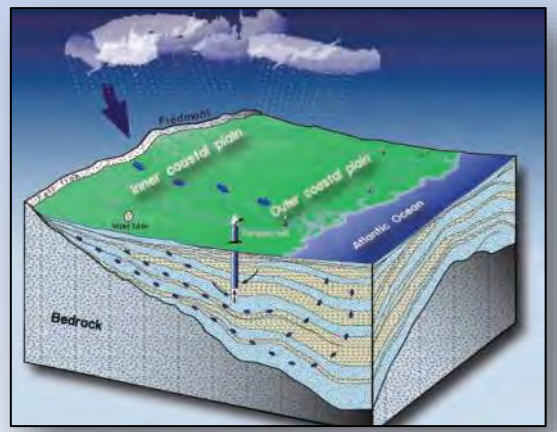
Simulation of Groundwater Flow in the Edisto River Basin, South Carolina

Greg Cherry and Matt Petkewich

US Geological Survey – South Atlantic Water Science Center



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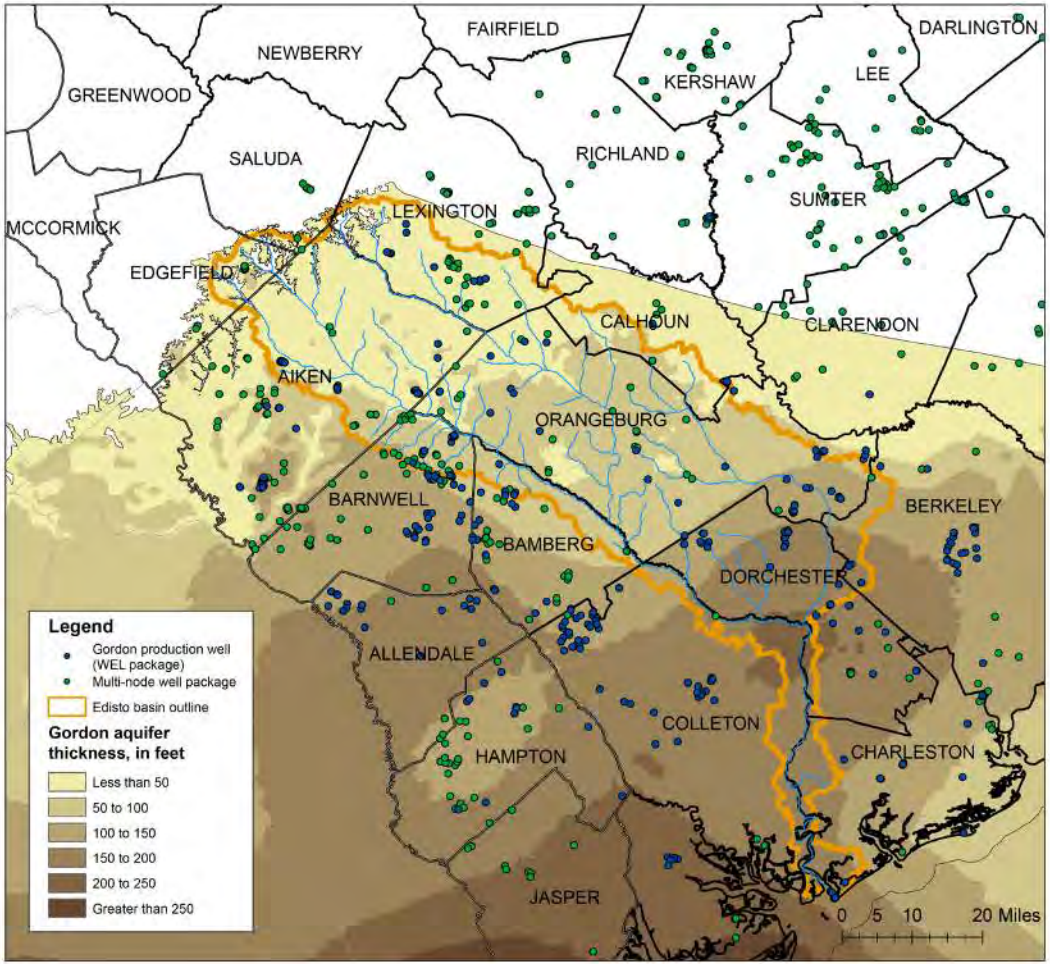
Thickness of Gordon aquifer (model layer 7)

Median – 35 ft
Mean – 78 ft
Maximum – 353 ft

(Gellici and Lautier, 2010)



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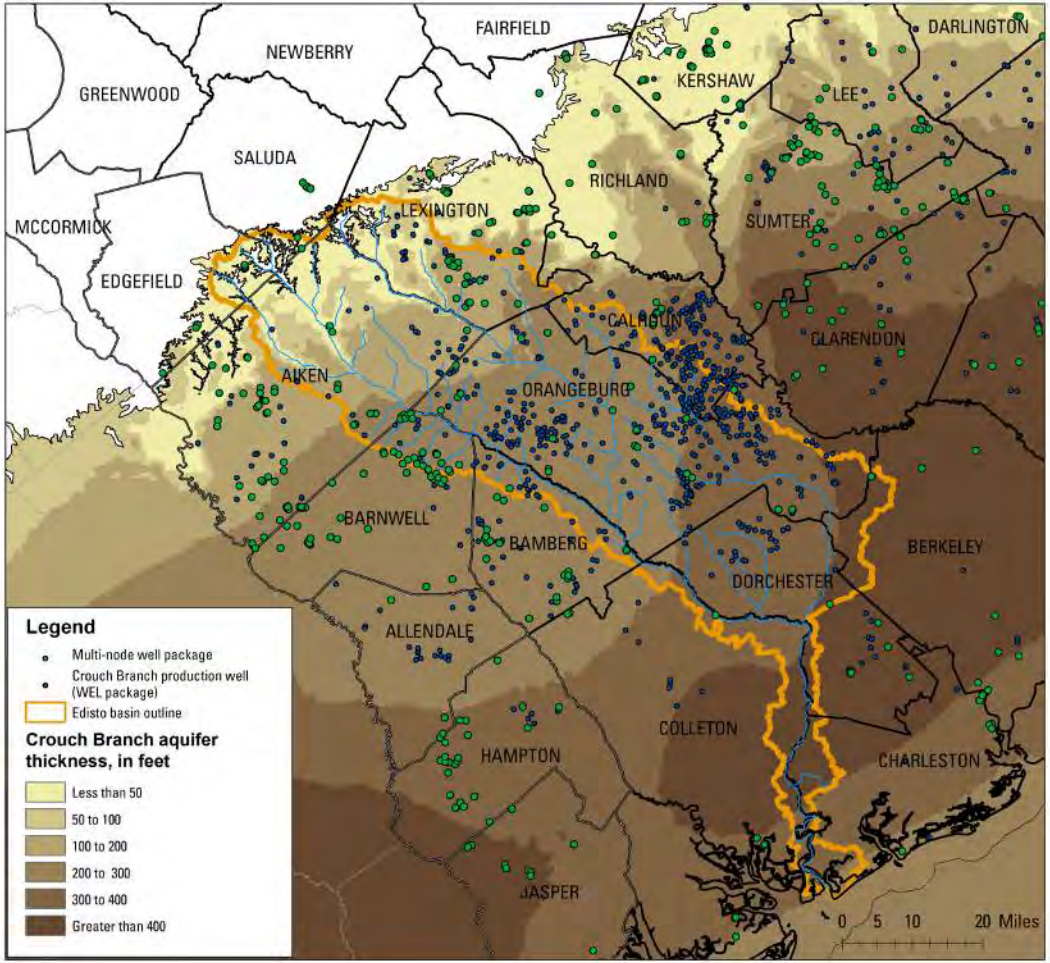
Thickness of Crouch Branch aquifer (model layer 9)

Median – 309 ft
Mean – 273 ft
Maximum – 690 ft

(Gellici and Lautier, 2010)



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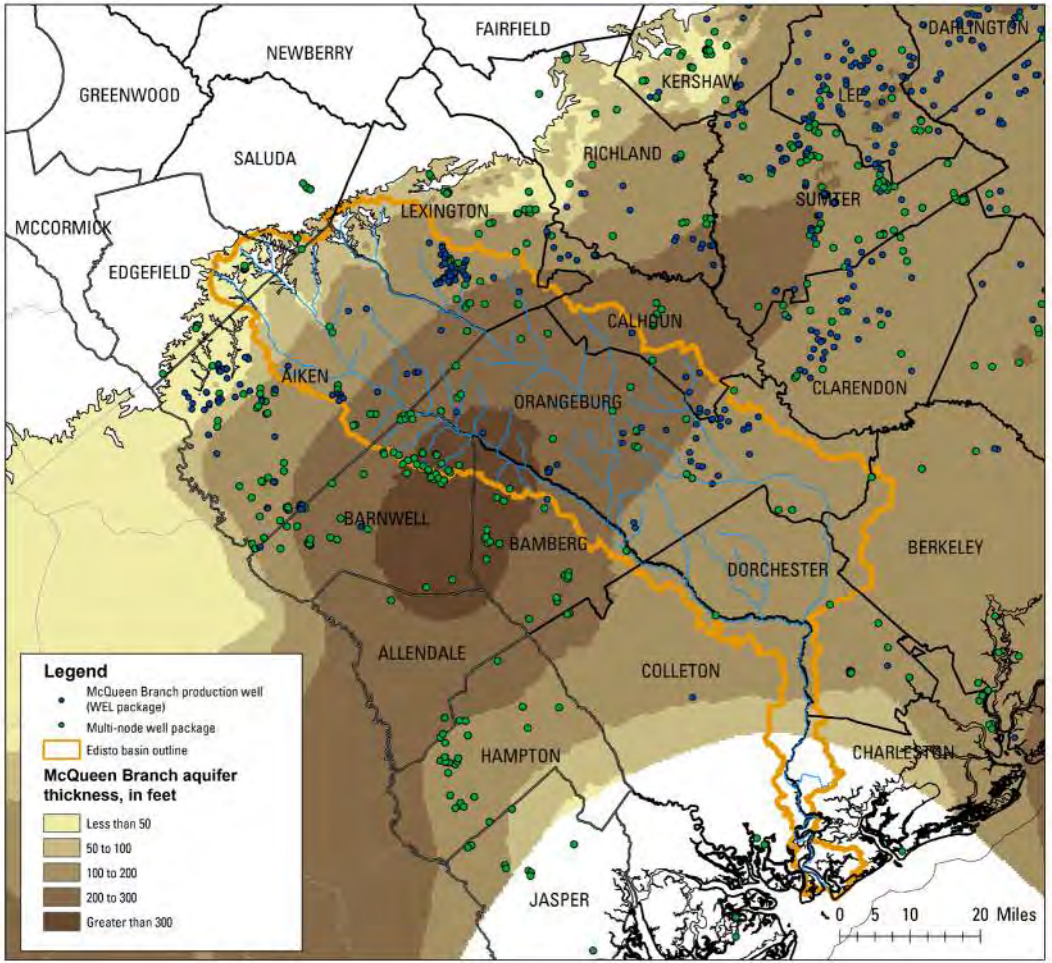
Thickness of McQueen Branch aquifer (model layer 11)

Median – 130 ft
Mean – 120 ft
Maximum – 432 ft

(Gellici and Lautier, 2010)



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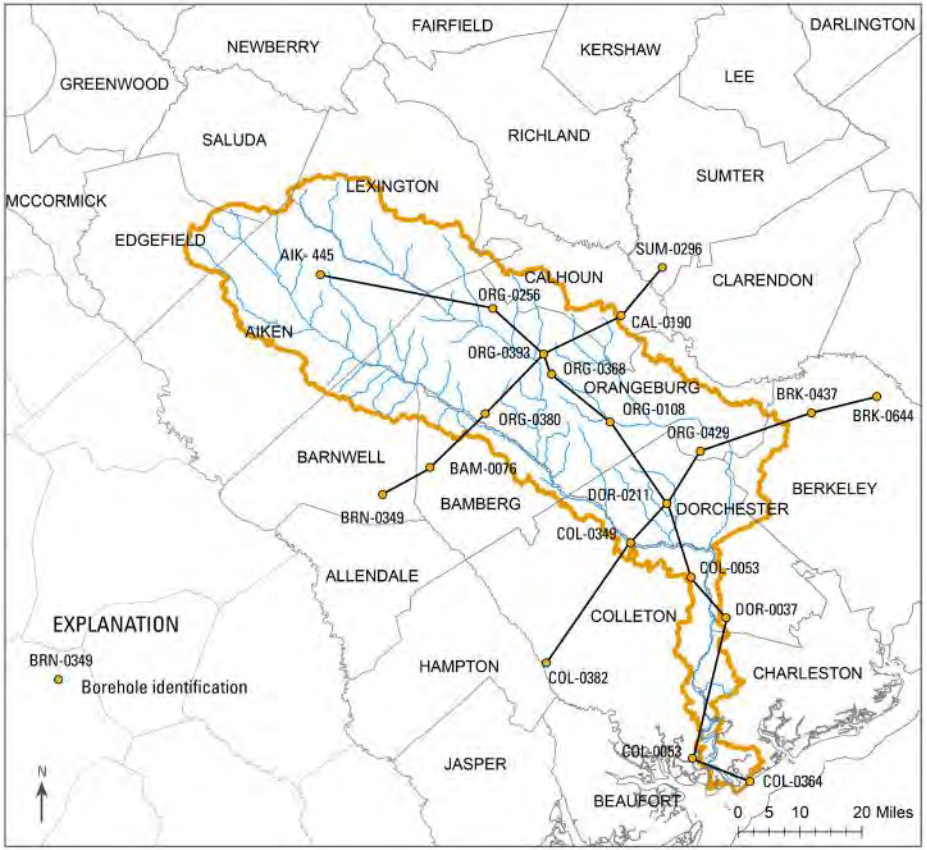
Hydrogeologic Framework



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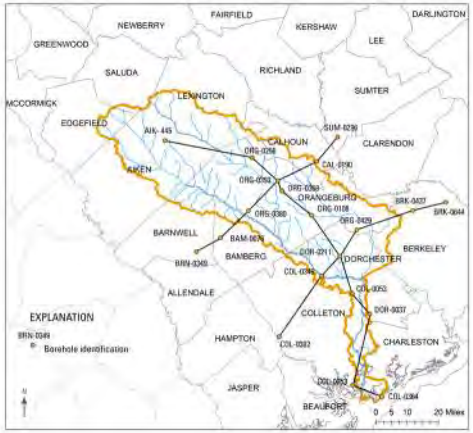
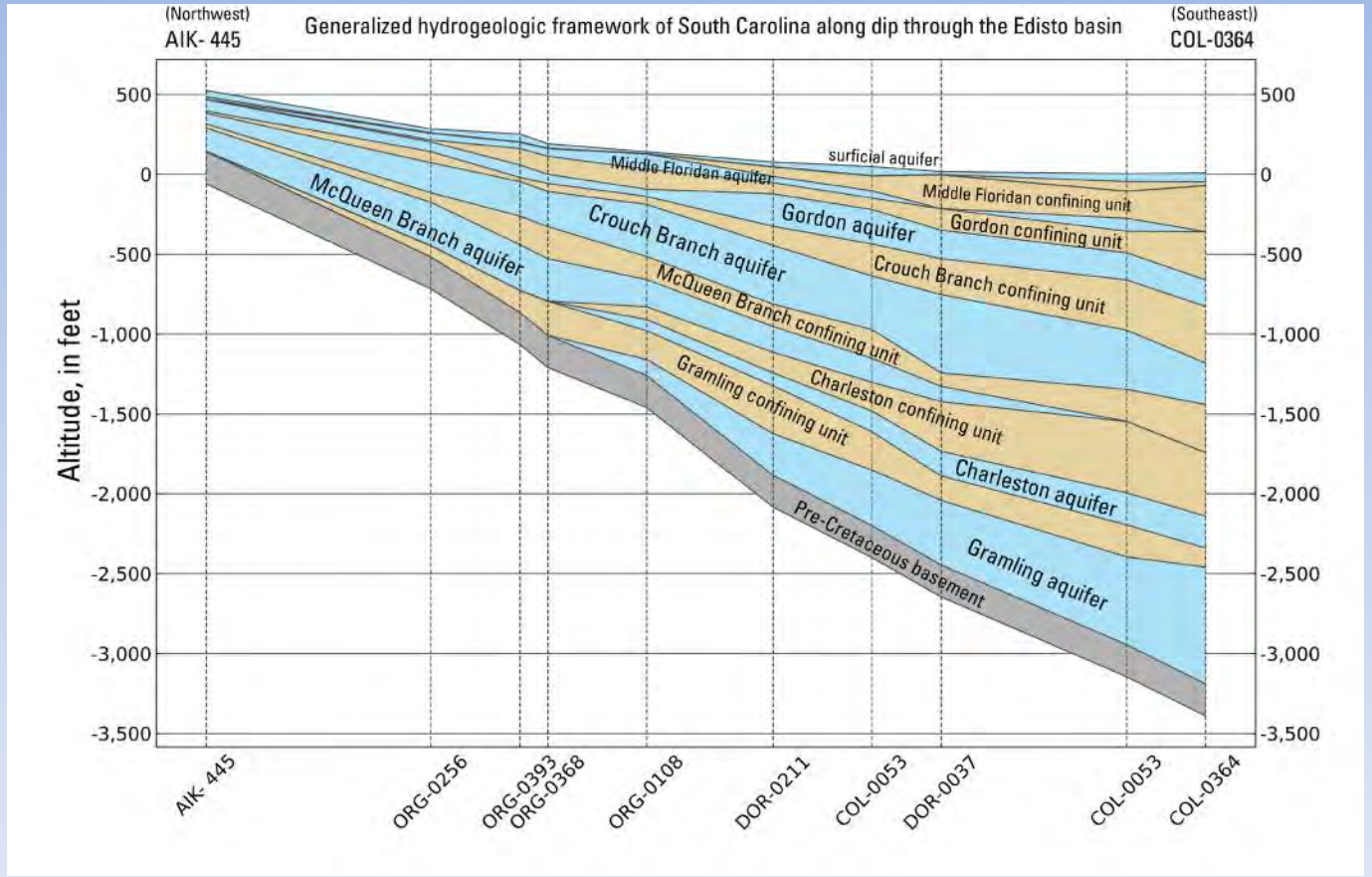
Hydrogeologic Framework





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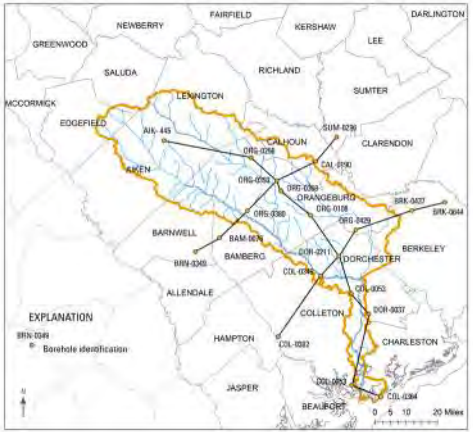
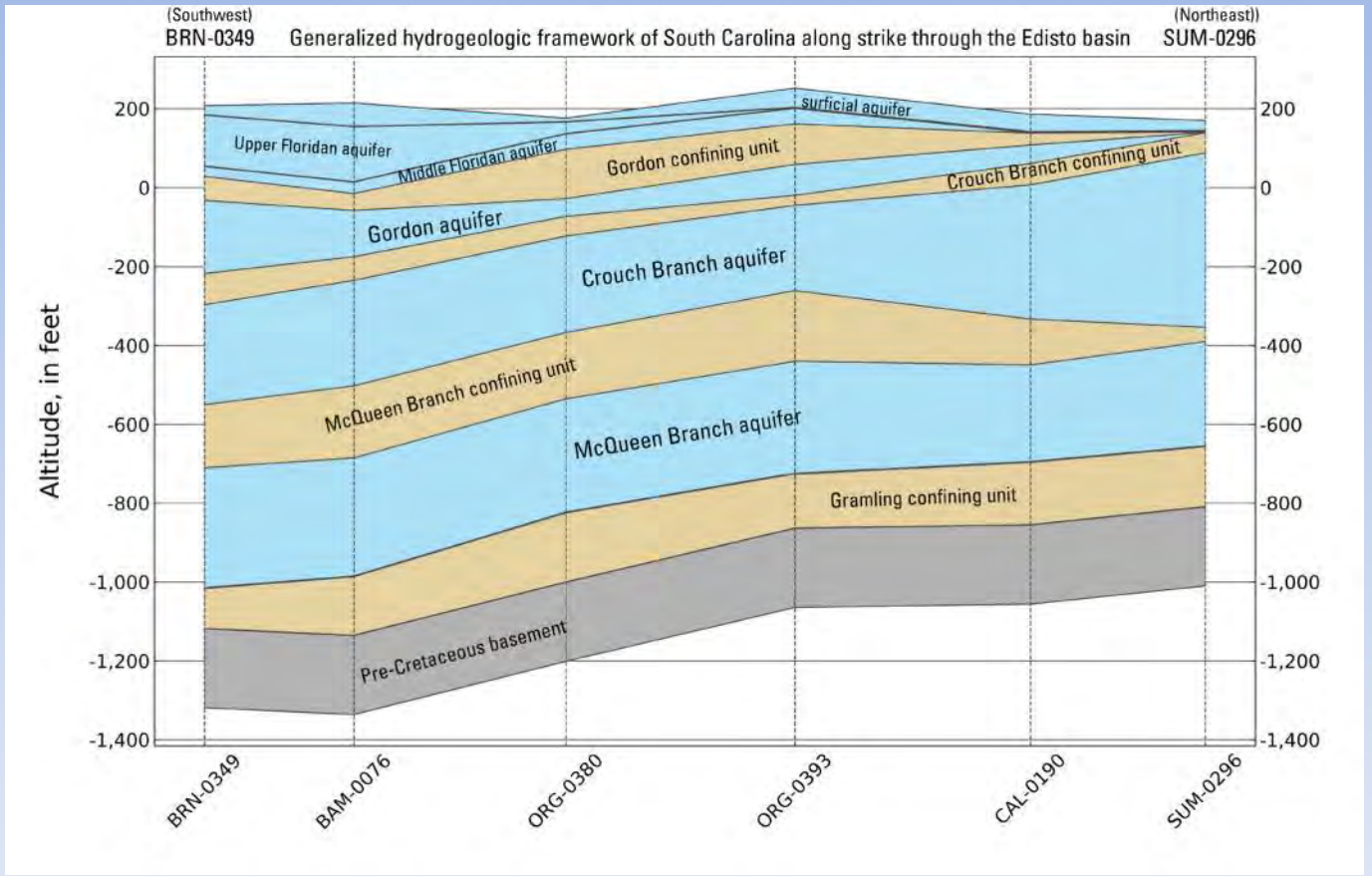
Hydrogeologic Framework





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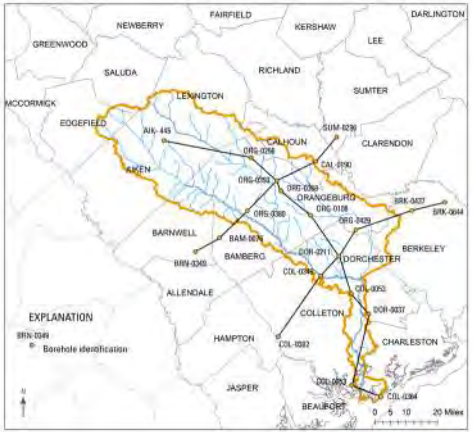
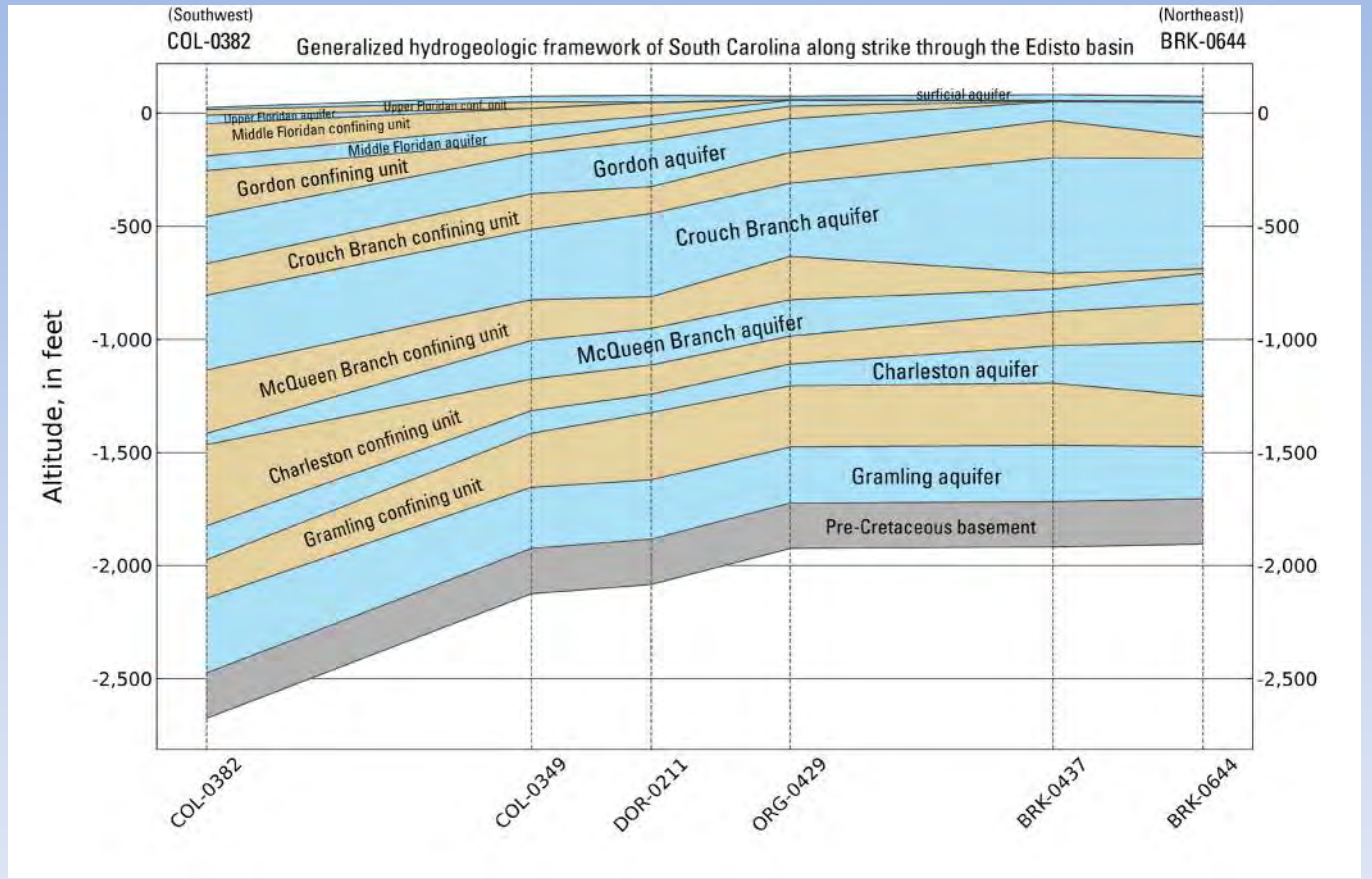
Hydrogeologic Framework





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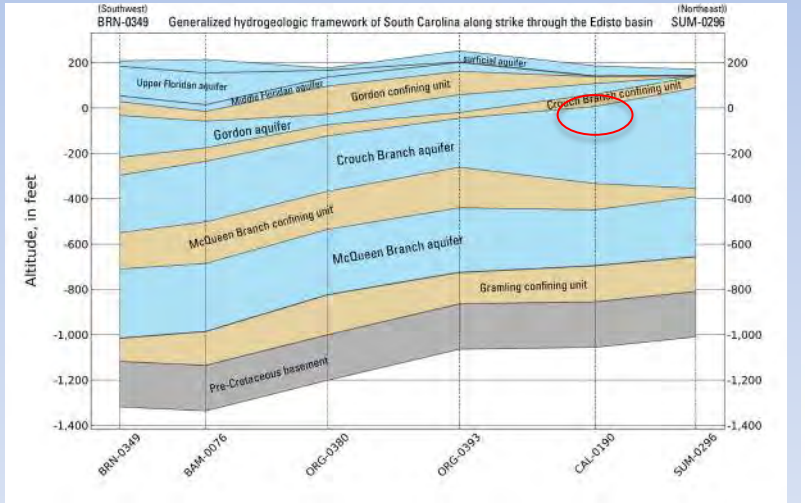
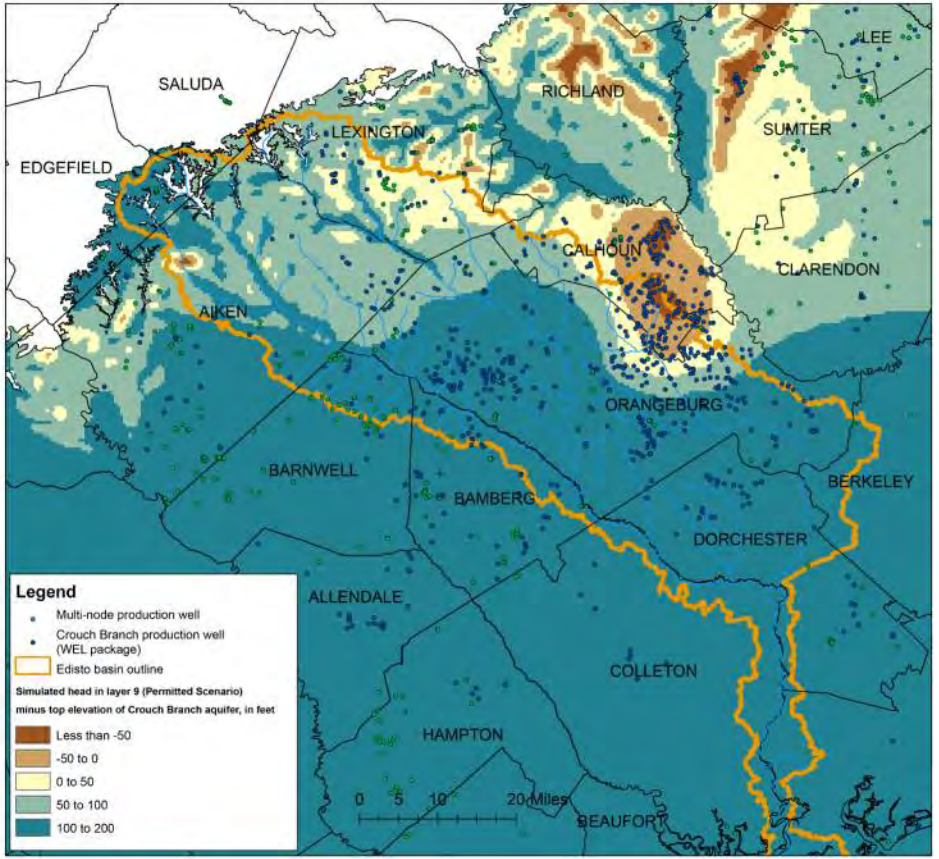
Simulated heads below top of aquifer in Crouch Branch (layer 9)

Permitted Scenario (2070)





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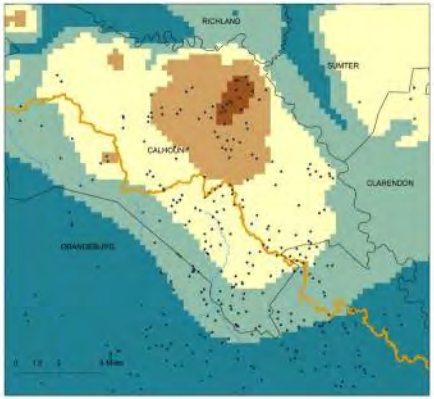
Simulated heads below top of aquifer in Crouch Branch (layer 9)

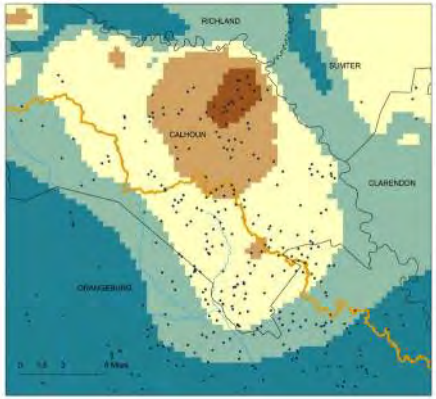
Calhoun County area

2070

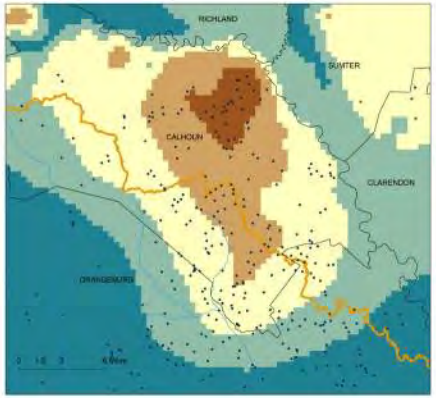
Current Scenario



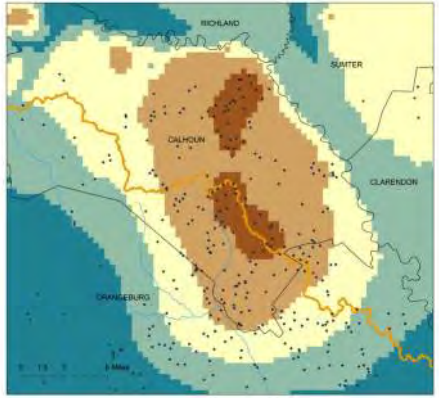
Moderate Growth Scenario



High Growth Scenario



Permitted Scenario



Legend

- Multi-node production well
- Crouch Branch production well (WEL package)
- Edisto basin outline

Simulated head in layer 9 (Permitted Scenario) minus top elevation of Crouch Branch aquifer, in feet

- Less than -50
- -50 to 0
- 0 to 50
- 50 to 100
- 100 to 200

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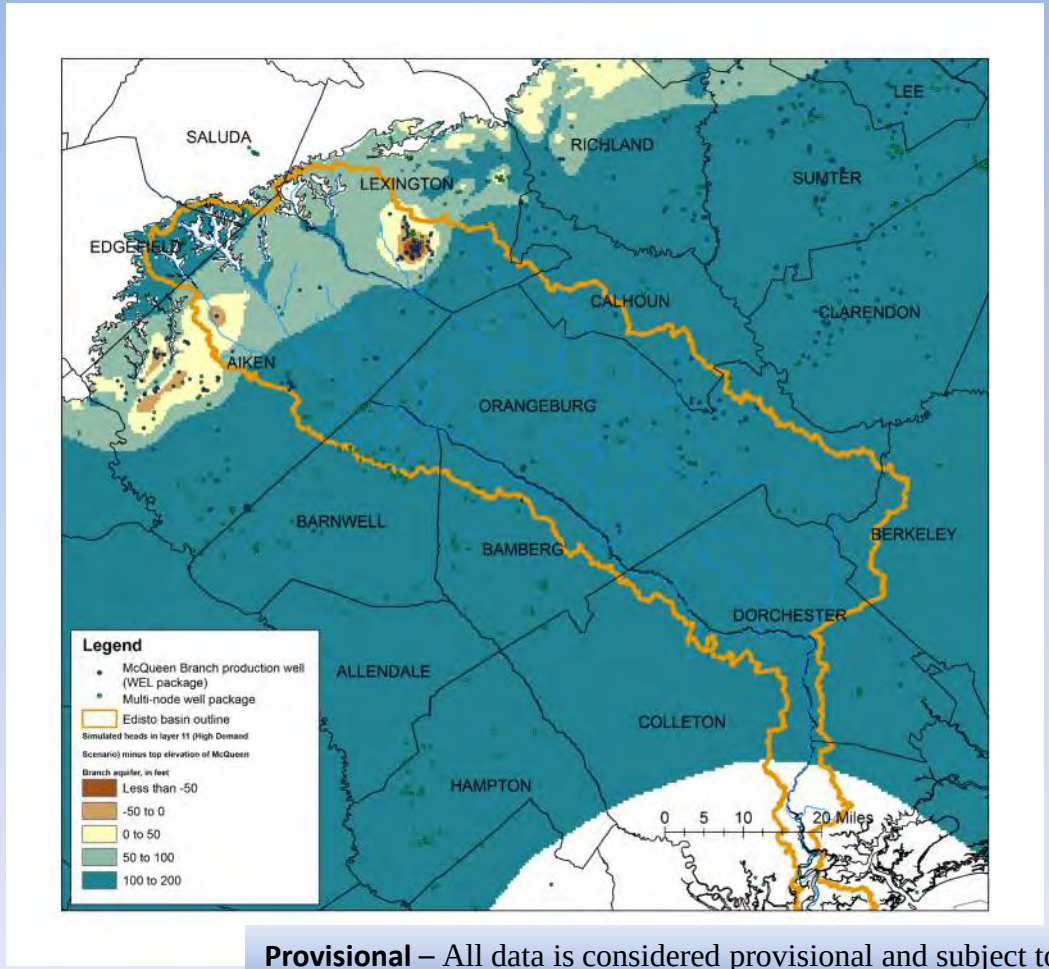
Simulated heads below top of aquifer in McQueen Branch (layer 11)

Moderate Growth Scenario (2070)



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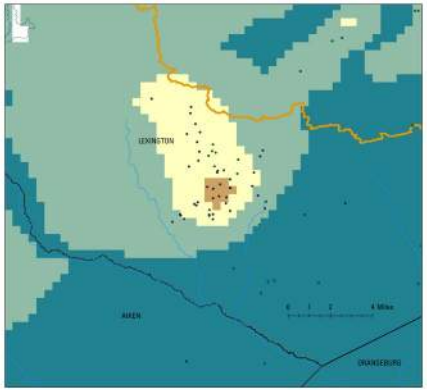
Simulated heads below top of aquifer in McQueen Branch (layer 11)

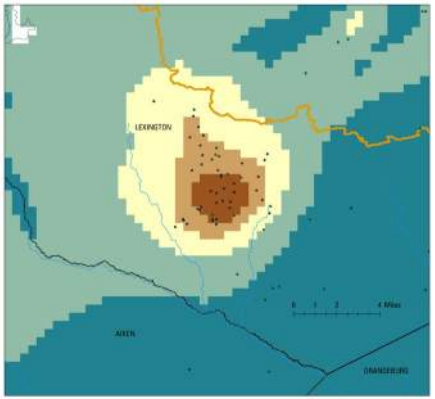
Lexington County area

2070

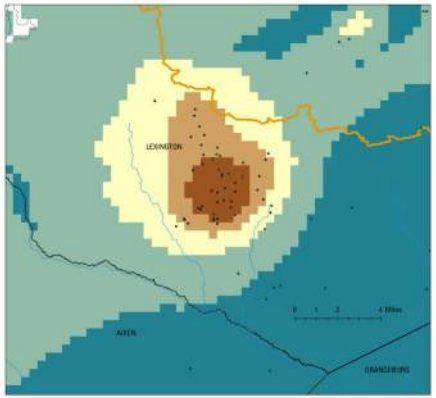
Current Scenario



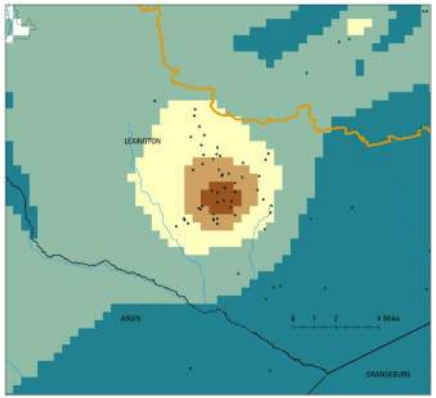
Moderate Growth Scenario

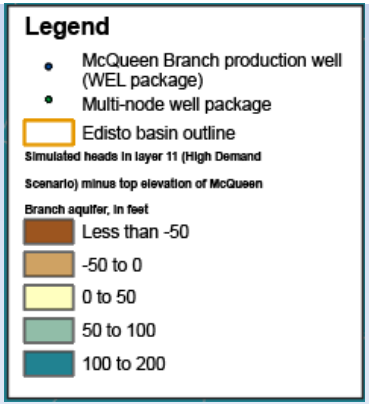


High Growth Scenario



Permitted Scenario





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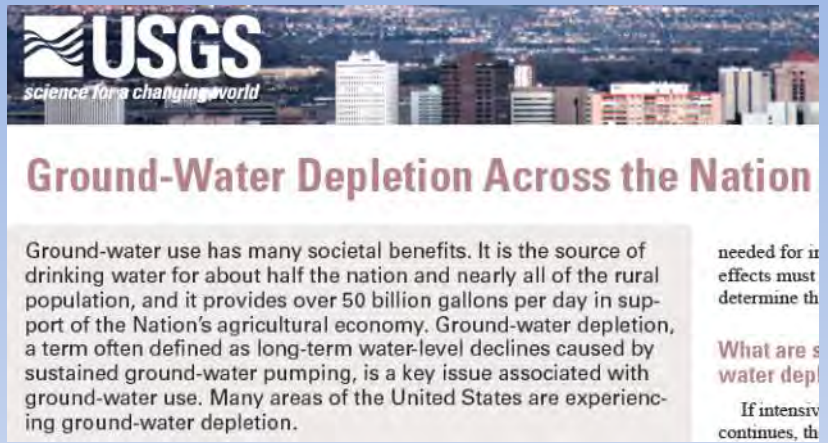
Groundwater Depletion

- Water-well problems
  - Power costs increase as groundwater levels decline
  - Expense of lowering pump, deepening well, or drilling a deeper replacement well
  - Yield of the well may decline below usable rates
- Reduced surface-water flows
  - Groundwater pumping can alter how water moves between an aquifer and a stream
  - Disconnection of an aquifer and a stream
- Subsidence
  - More than 80 percent of subsidence in the United States is related to the withdrawal of groundwater (Galloway and others, 1999)
- Deterioration of water quality
  - Areas of saltwater intrusion in coastal aquifers

Resources on Groundwater Depletion

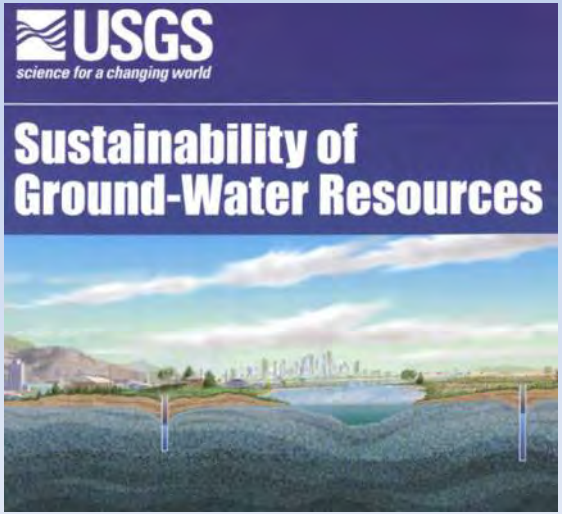
Ground-Water Depletion Across the Nation
U.S. Geological Survey Fact Sheet 103-03
November 2003

https://pubs.usgs.gov/fs/fs-103-03/



Sustainability of Ground-Water Resources
U.S. Geological Survey Circular 1186
1999

Circular 1186 (usgs.gov)



Groundwater Scenarios

Current groundwater use

- Constant pumping rates from 2021-2070 using average pumping rates derived from groundwater use from 2016-2020

Permitted groundwater use

- Constant pumping rates from 2021-2070 using fully permitted pumping rates

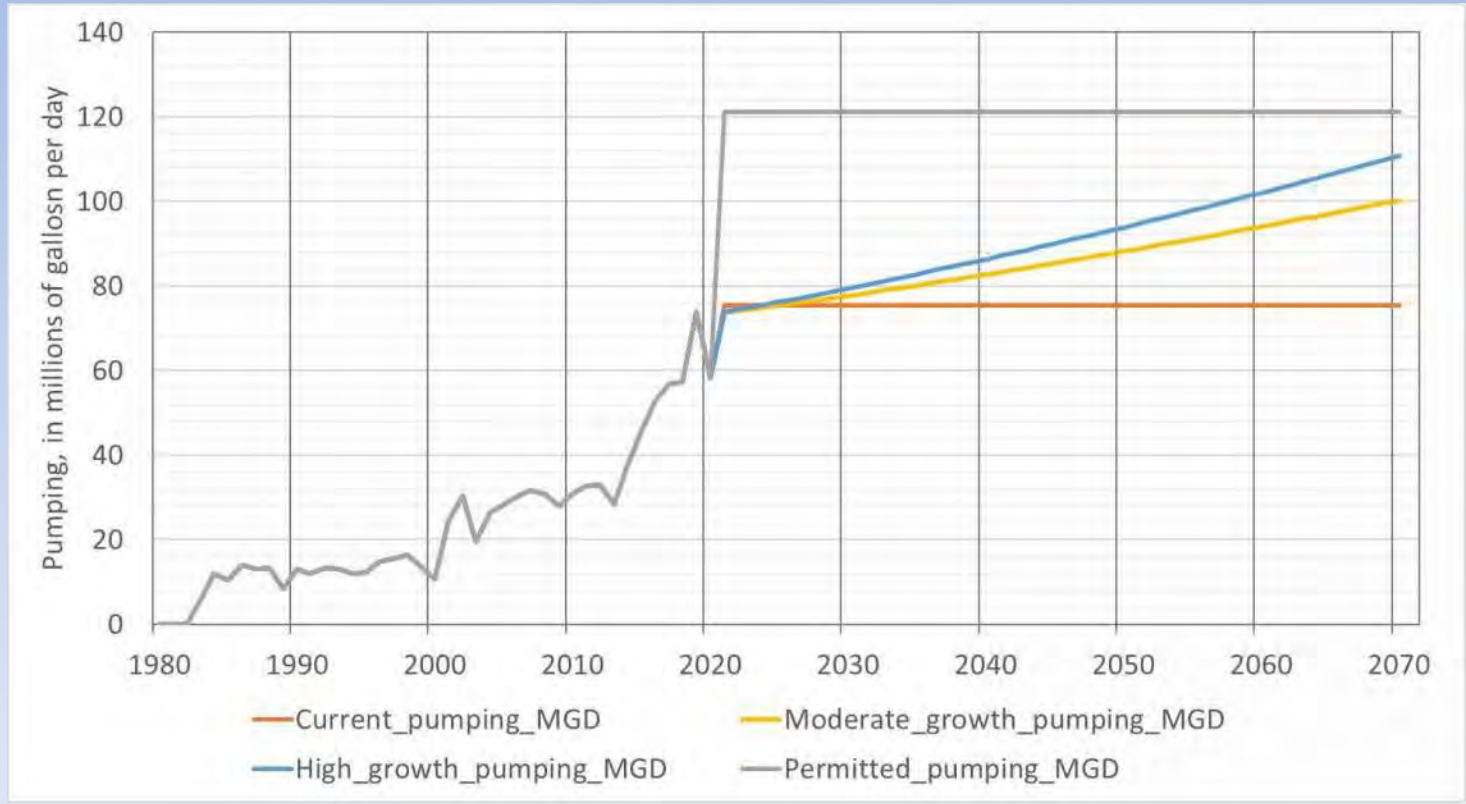
Business-as-usual water demand (Moderate Growth)

- Projections from 2021-2070 based on assumption moderate population and economic growth

High water demand trend (High Growth)

- Projections from 2021-2070 based on assumption high population and economic growth

Simulated pumping in the Edisto Basin



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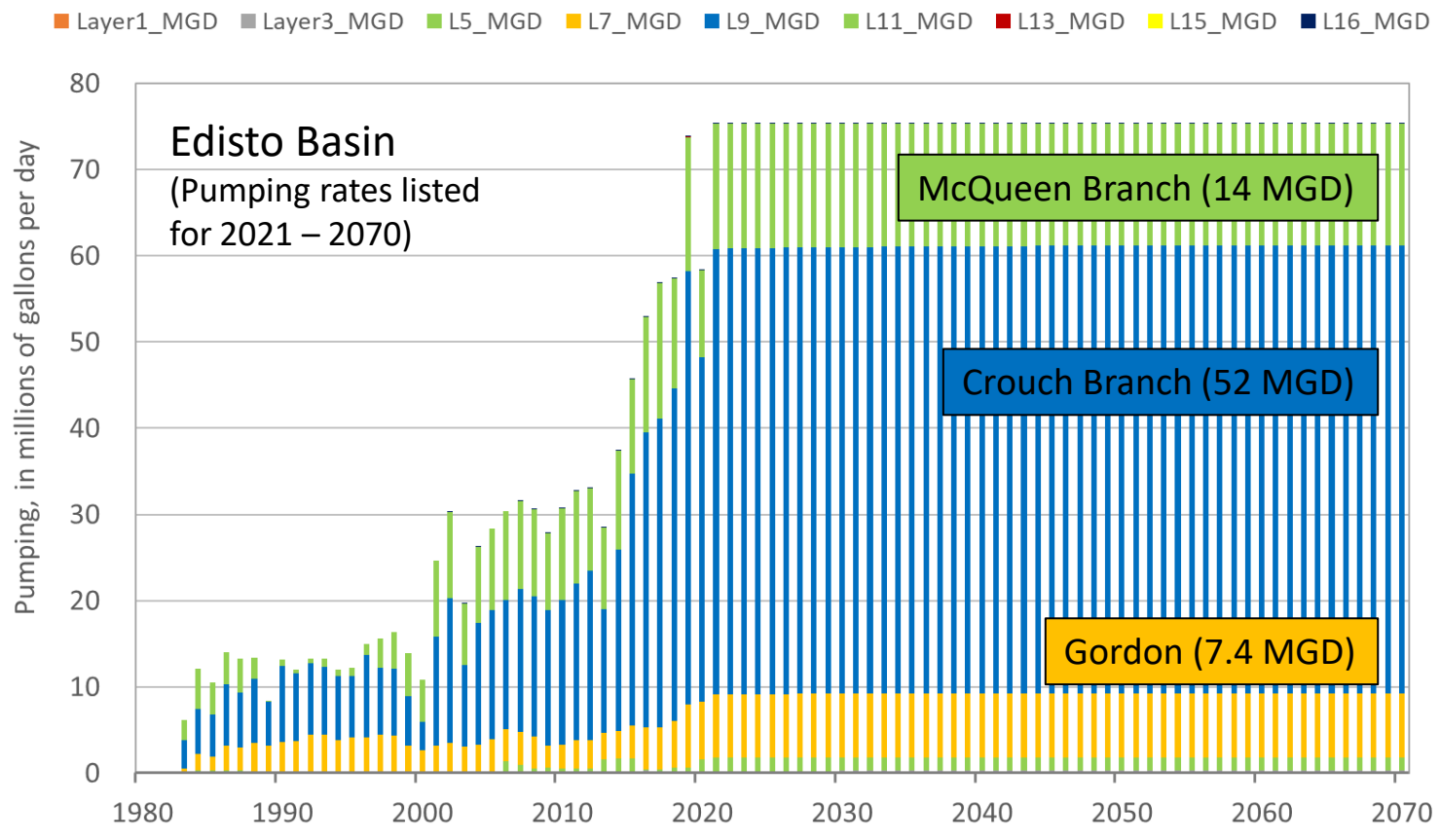
Simulated pumping – Current Scenario



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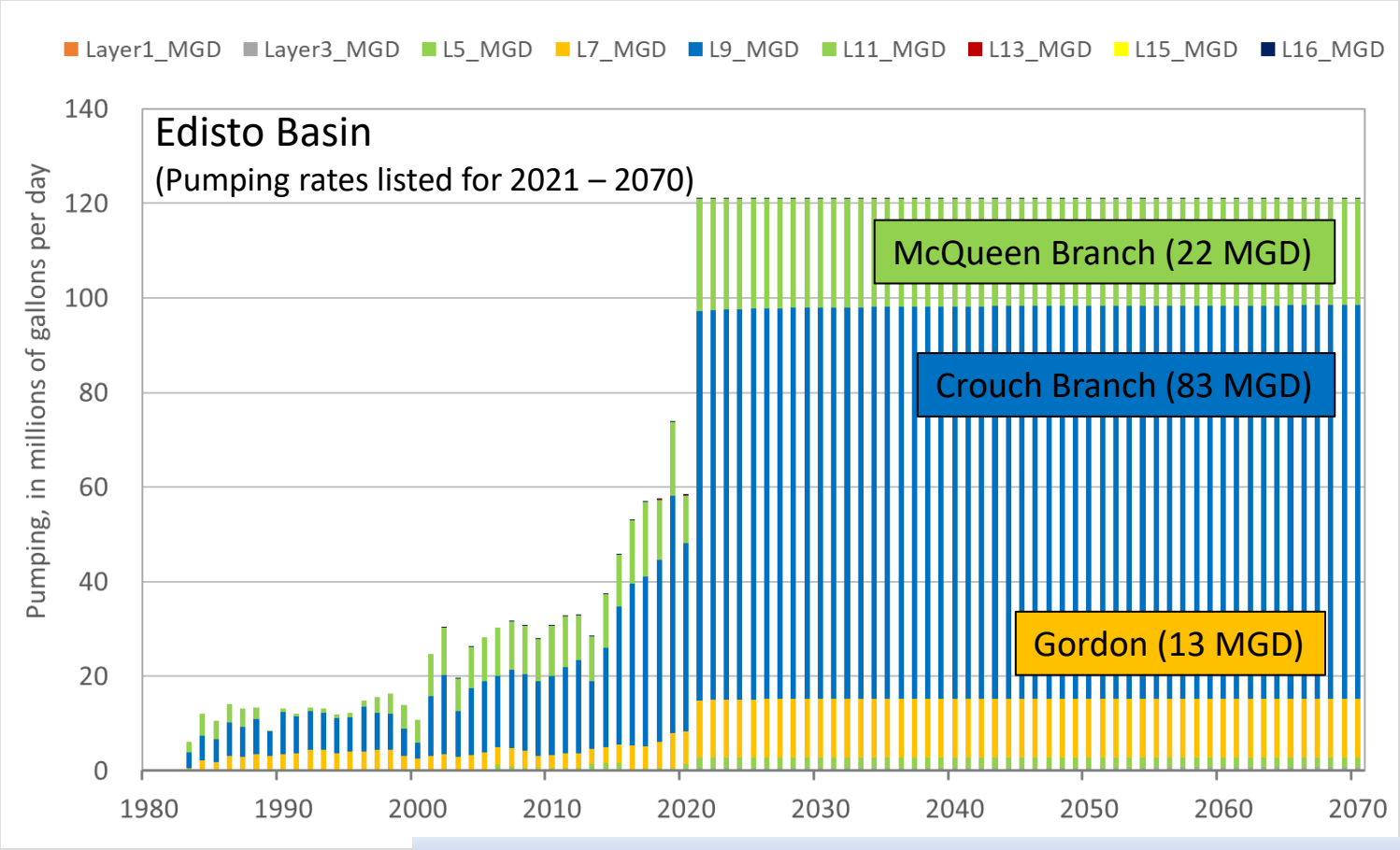
Simulated pumping – Permitted Scenario



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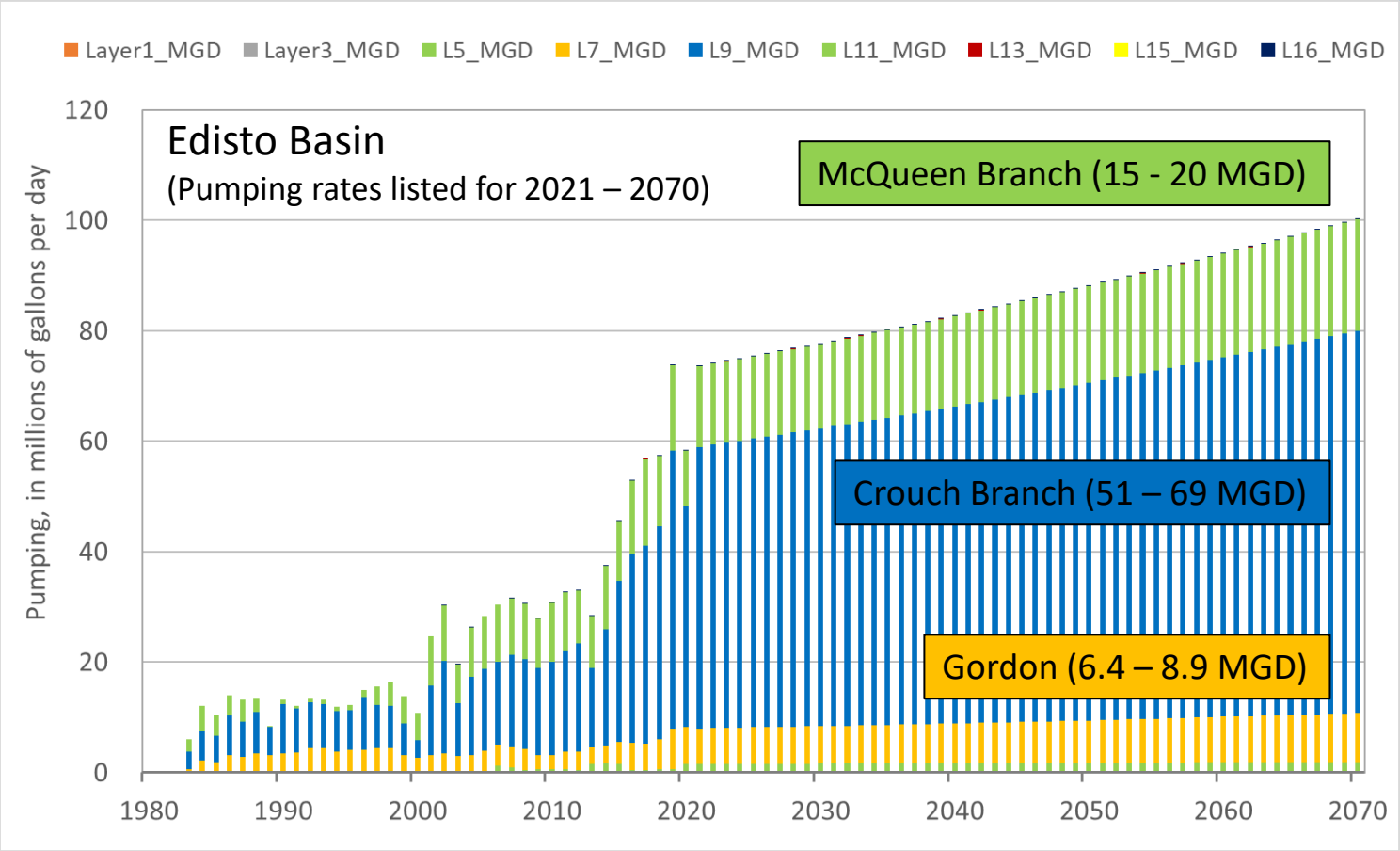
Simulated pumping – Moderate Growth Scenario



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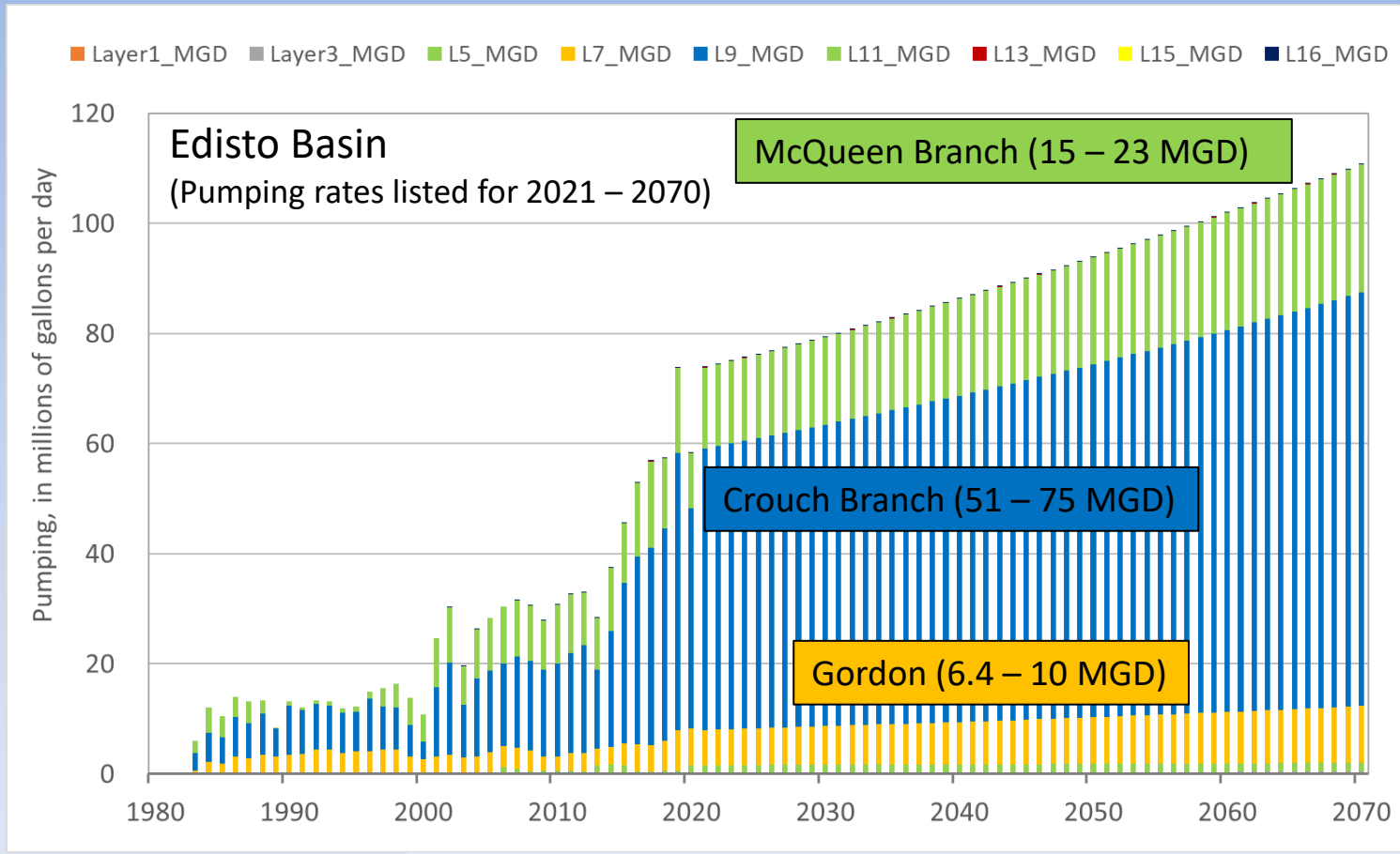
Simulated pumping – High Growth Scenario



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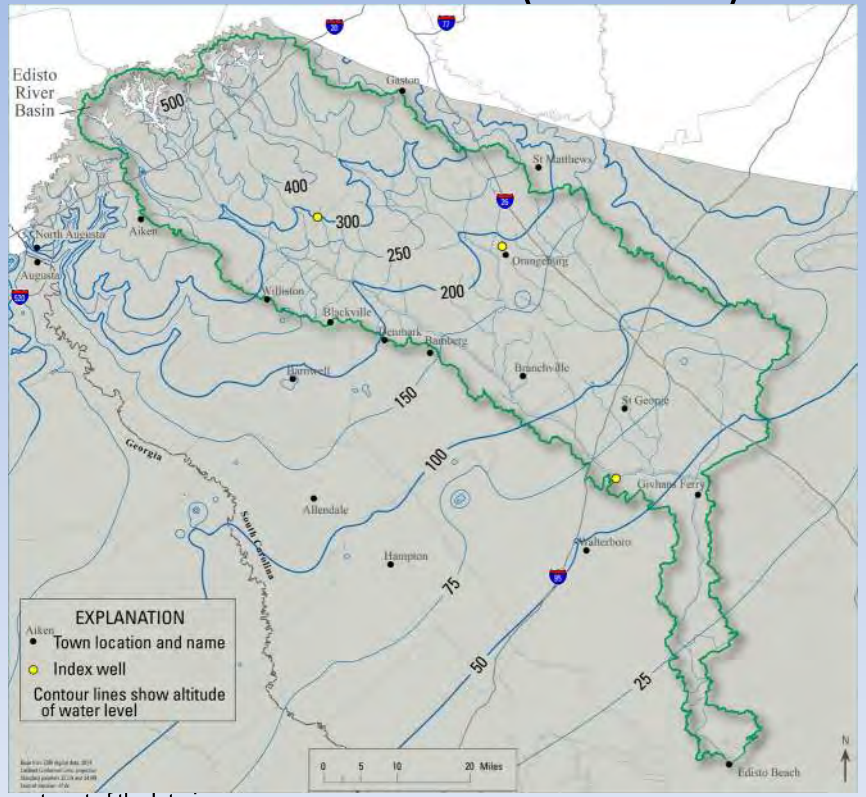
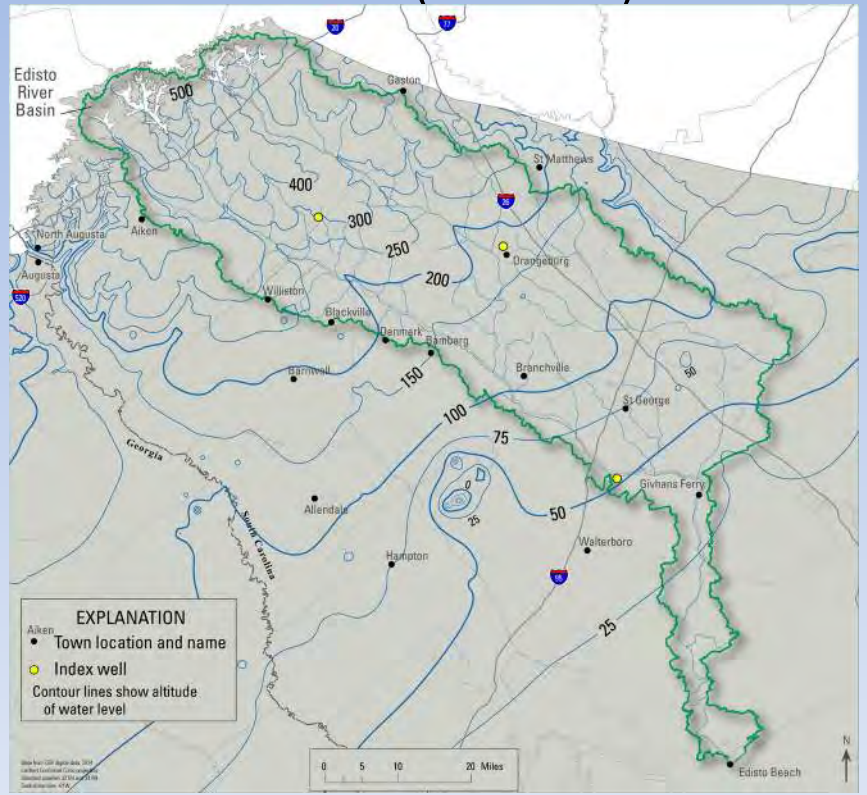
Moderate Growth Scenario - Gordon aquifer (layer 7)

2020 (6.7 MGD)



2070 (8.9 MGD)



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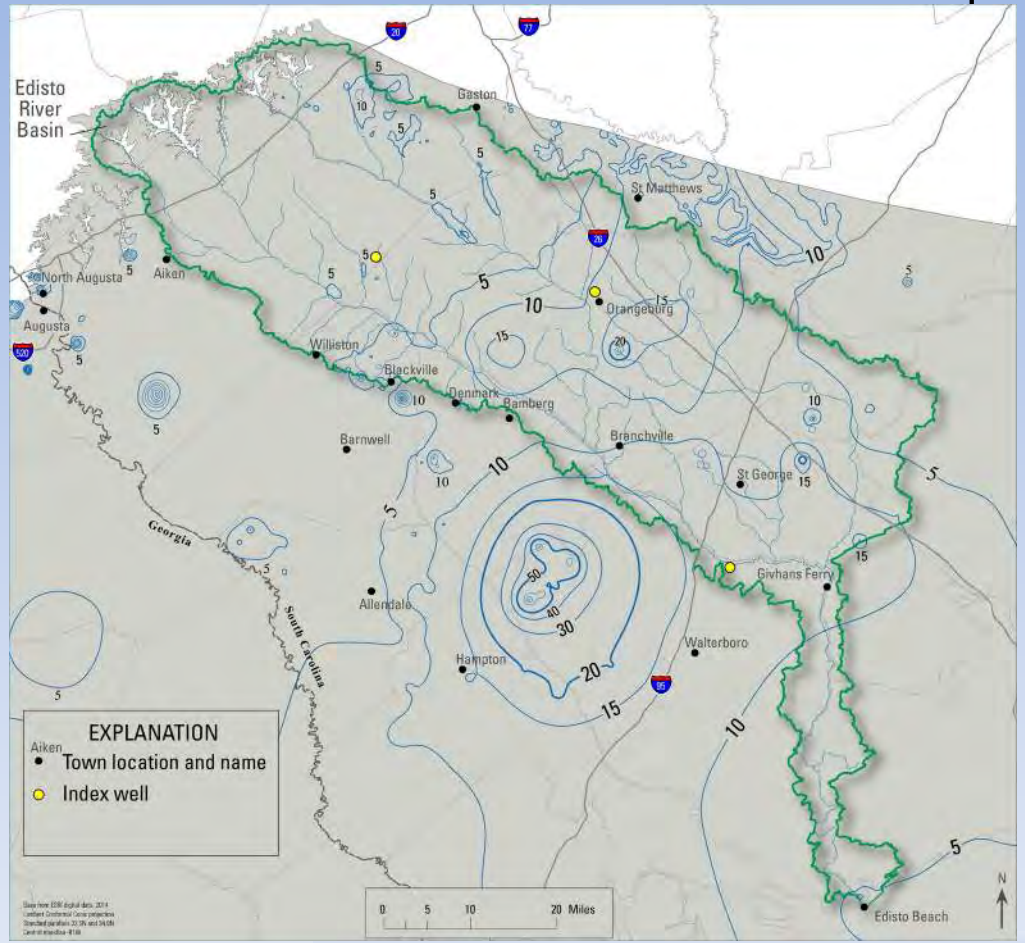
Drawdown Moderate Growth Scenario - Gordon aquifer (layer 7)

2020-2070



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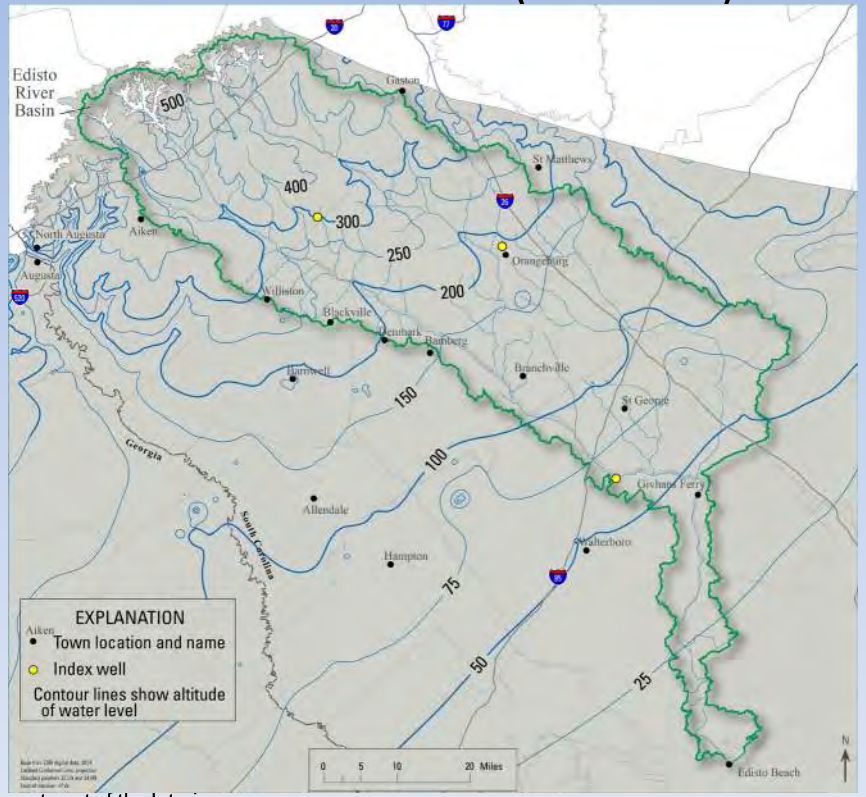
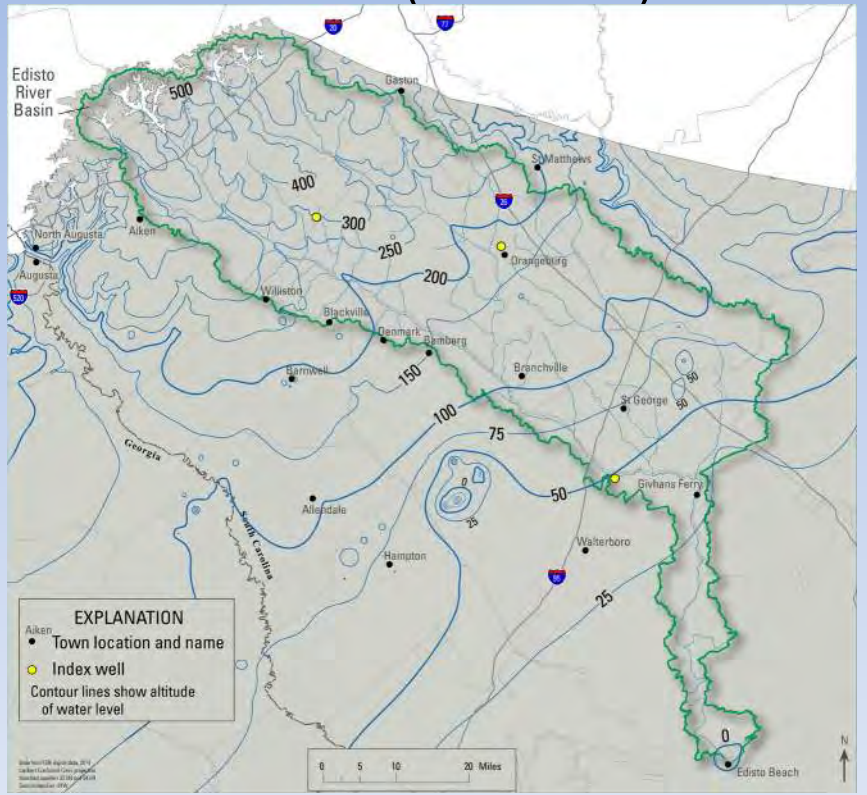
High Growth Scenario - Gordon aquifer (layer 7)

2020 (6.7 MGD)



2070 (10.0 MGD)



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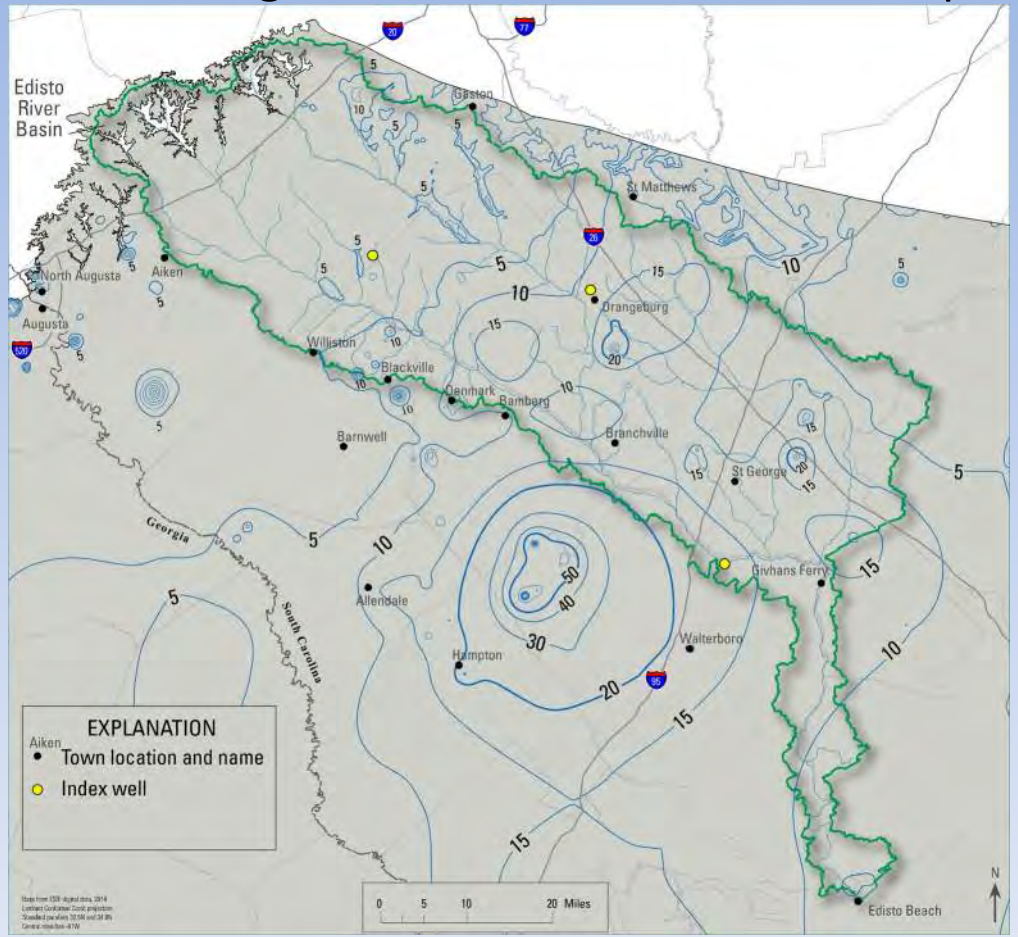
Drawdown High Growth Scenario - Gordon aquifer (layer 7)

2020-2070



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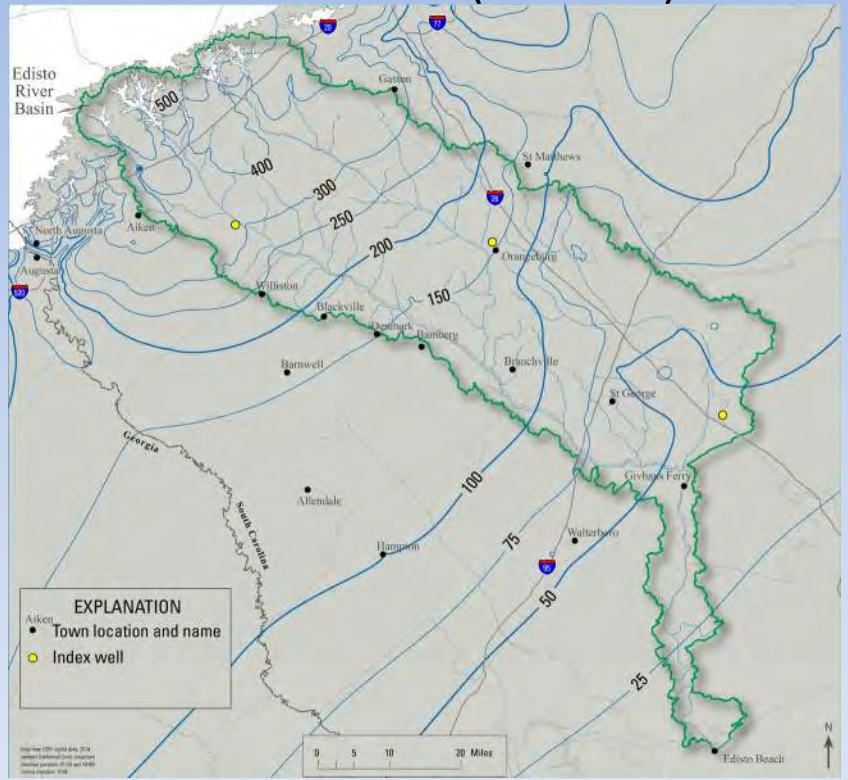
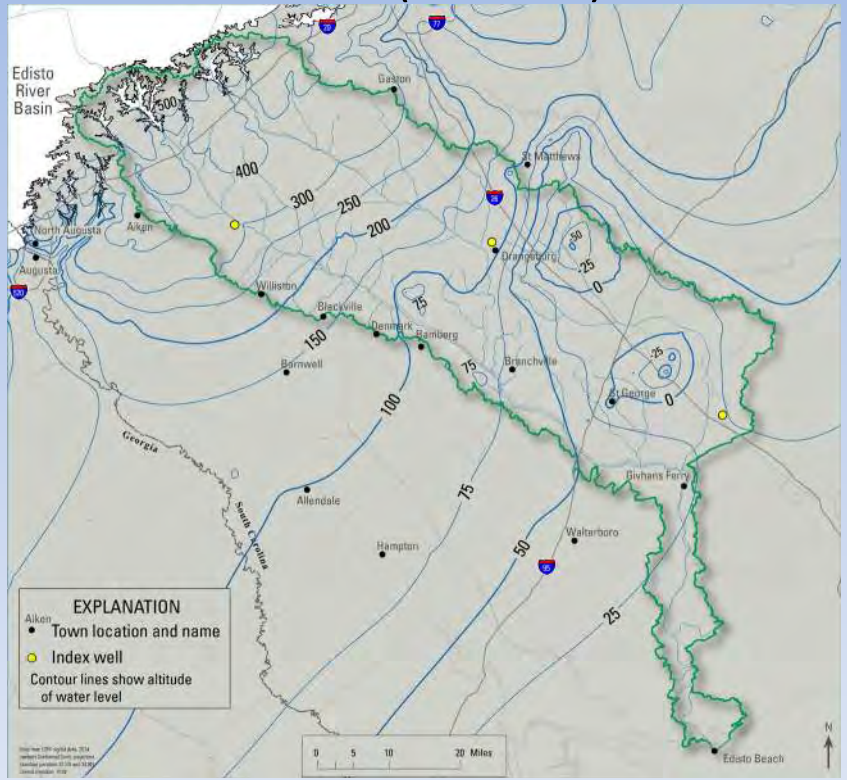
Moderate Growth Scenario – Crouch Branch aquifer (layer 9)

2020 (40 MGD)



2070 (69 MGD)



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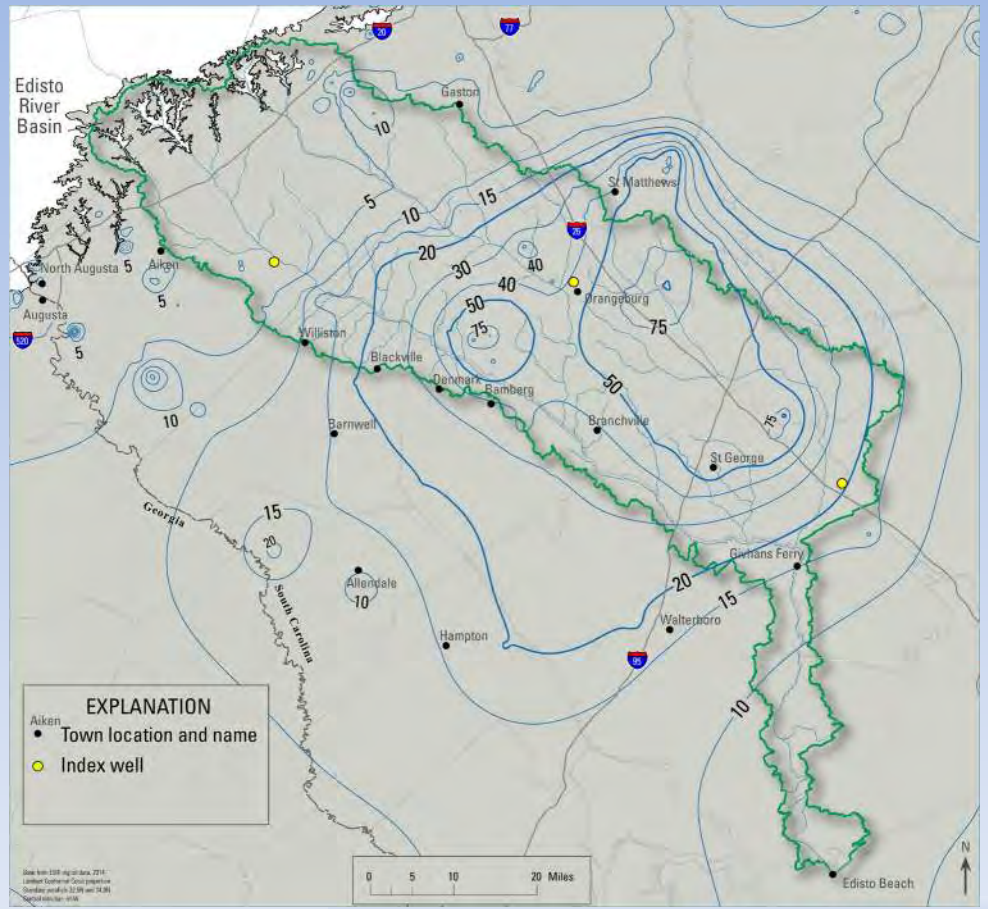
Drawdown Moderate Growth Scenario – Crouch Branch aquifer (layer 9)

2020-2070



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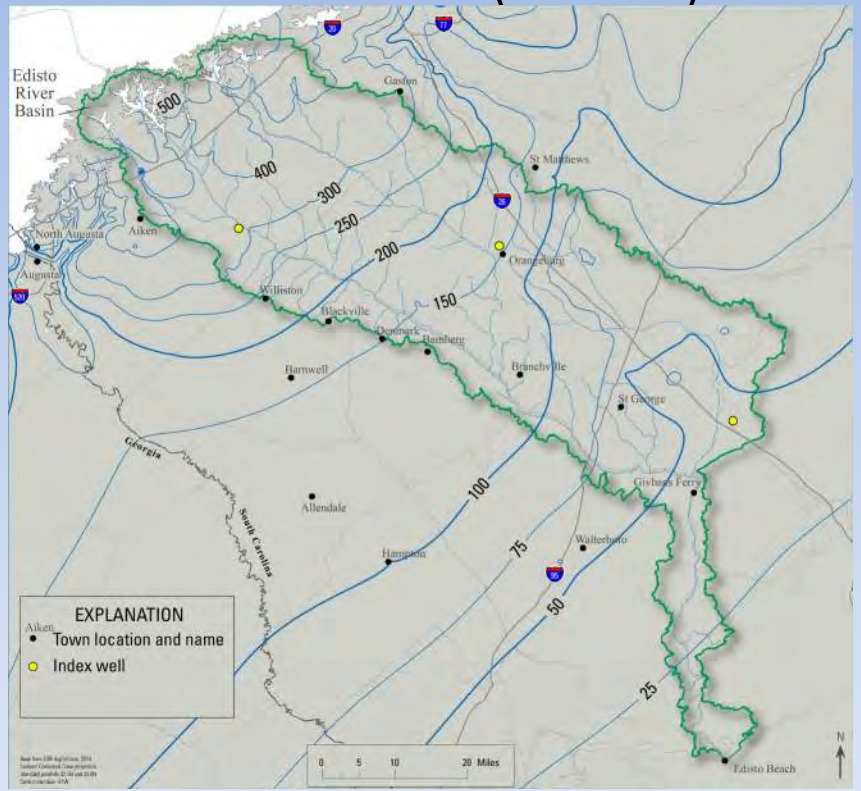
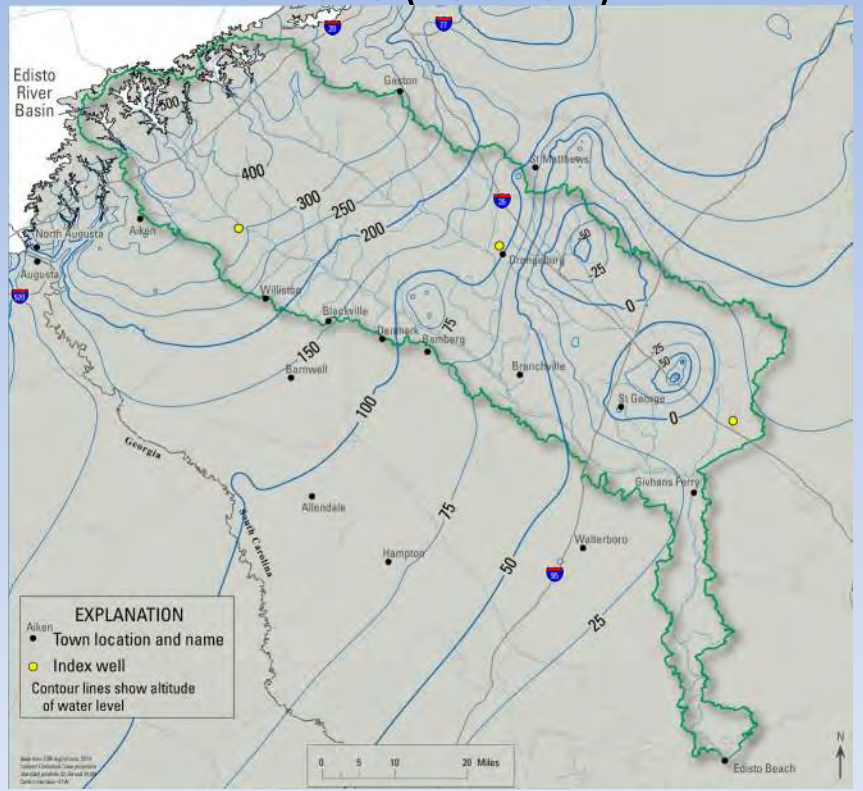
High Growth Scenario – Crouch Branch aquifer (layer 9)

2020 (40 MGD)



2070 (75 MGD)



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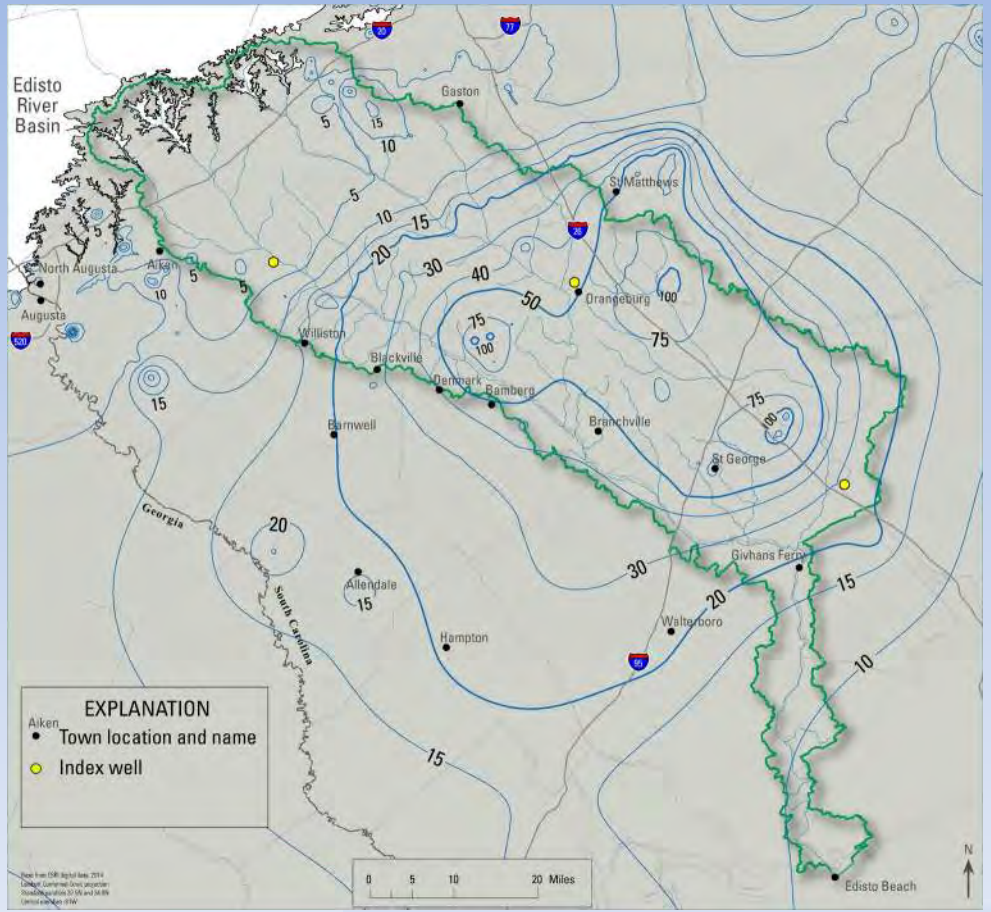
Drawdown High Growth Scenario – Crouch Branch aquifer (layer 9)

2020-2070



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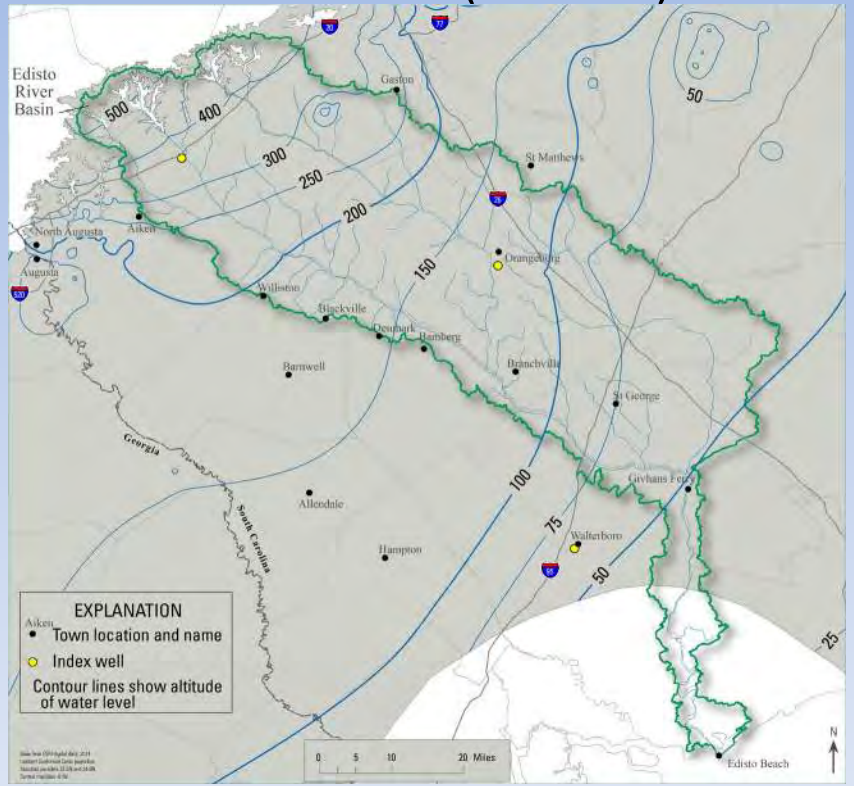
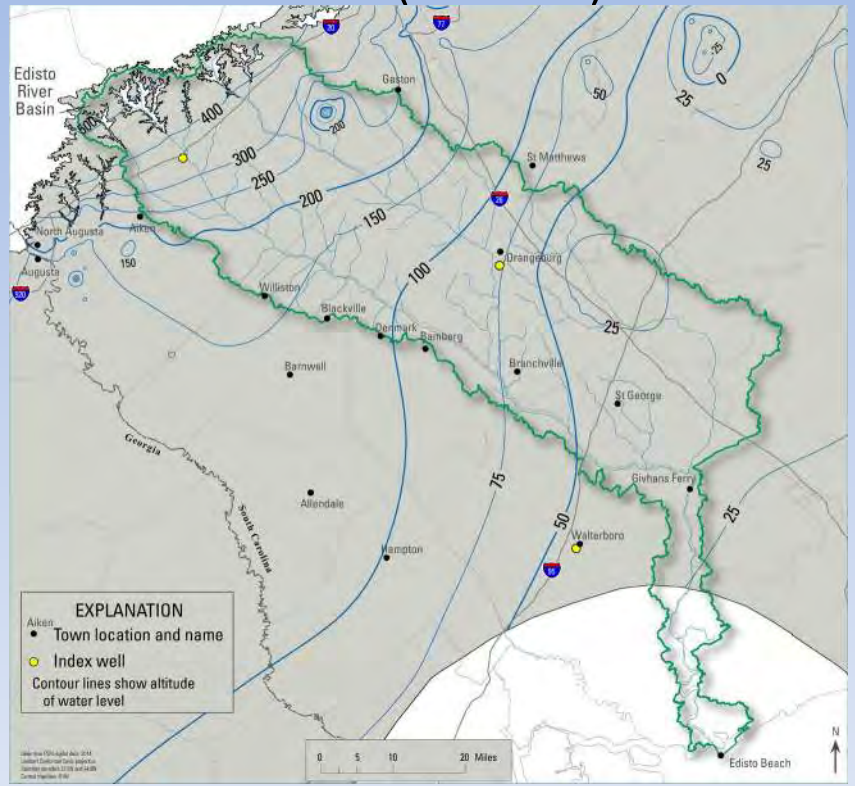
Moderate Growth Scenario – McQueen Branch aquifer (layer 11)

2020 (10 MGD)



2070 (20 MGD)



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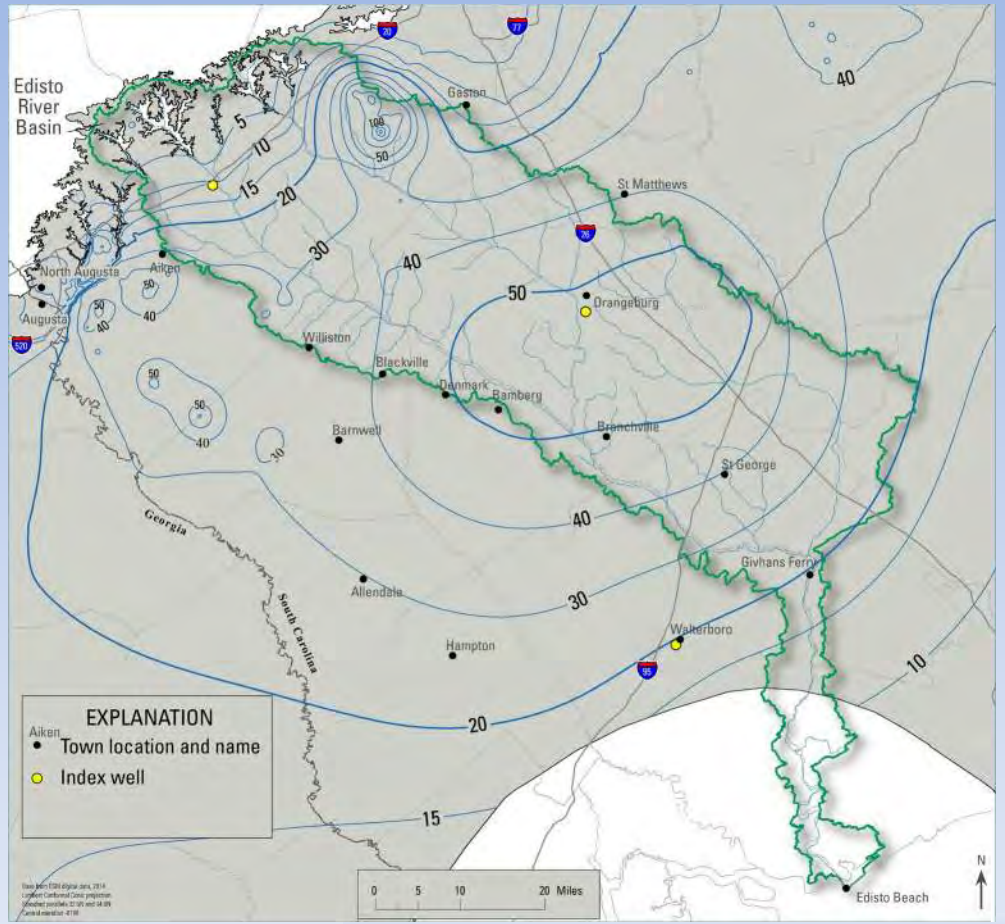
Drawdown Moderate Growth Scenario - McQueen Branch aquifer (layer 11)

2020-2070



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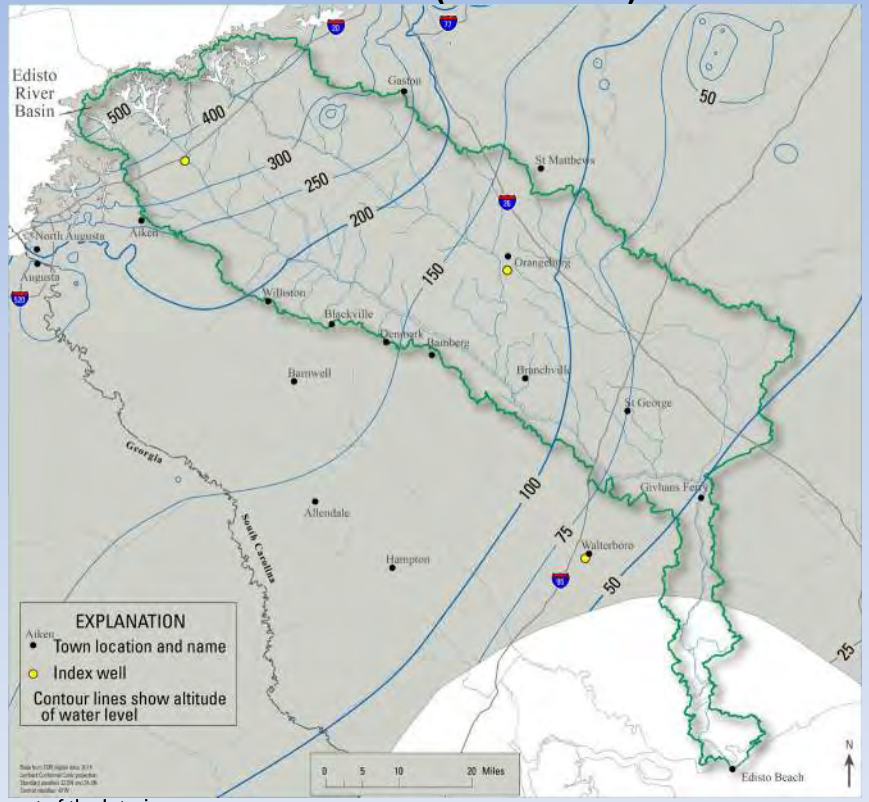
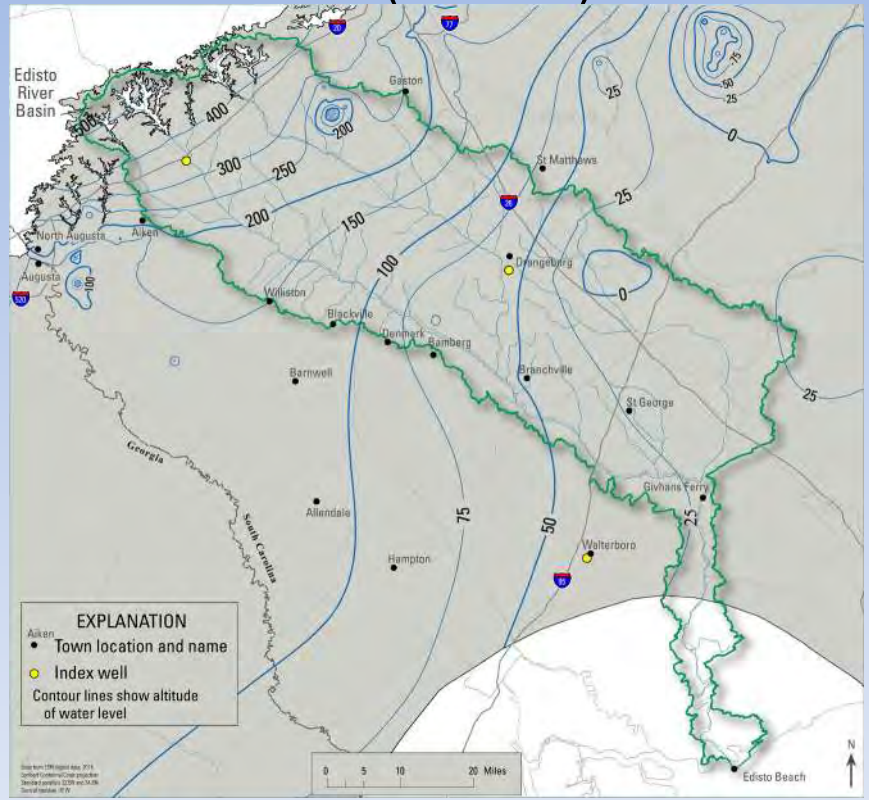
High Growth Scenario – McQueen Branch aquifer (layer 11)

2020 (10 MGD)



2070 (23 MGD)



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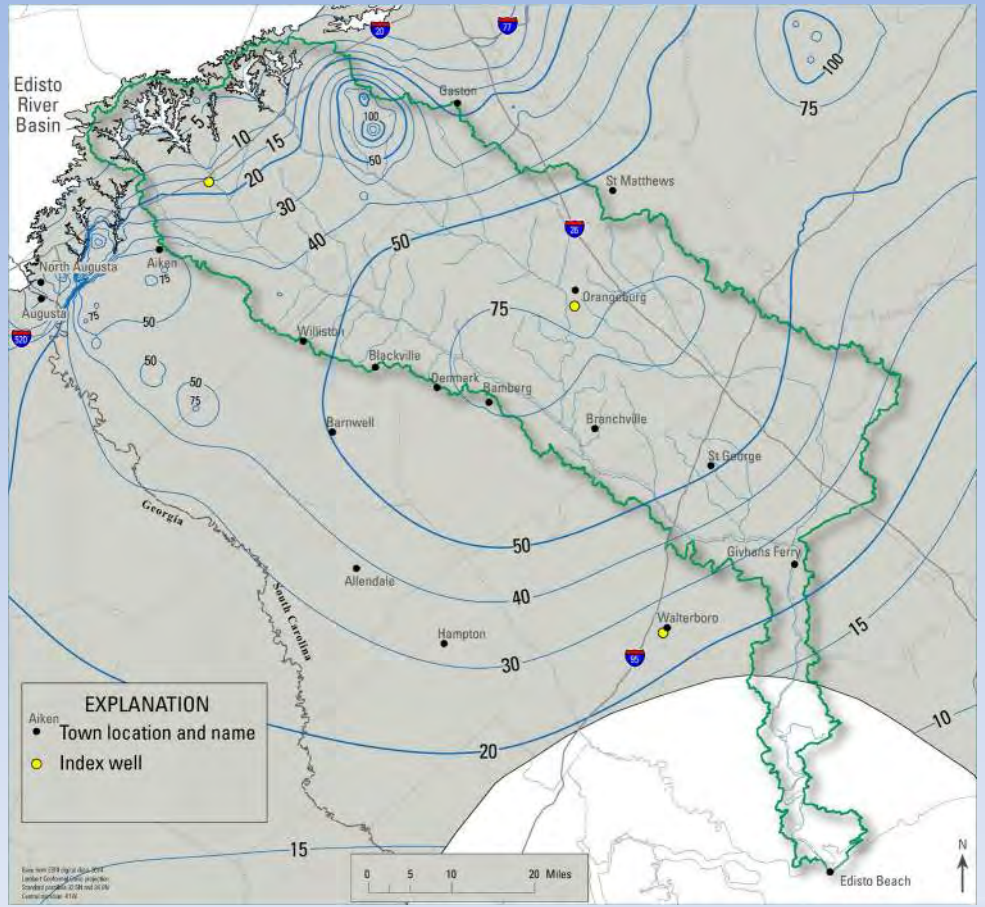
Drawdown High Growth Scenario – McQueen Branch aquifer (layer 11)

2020-2070



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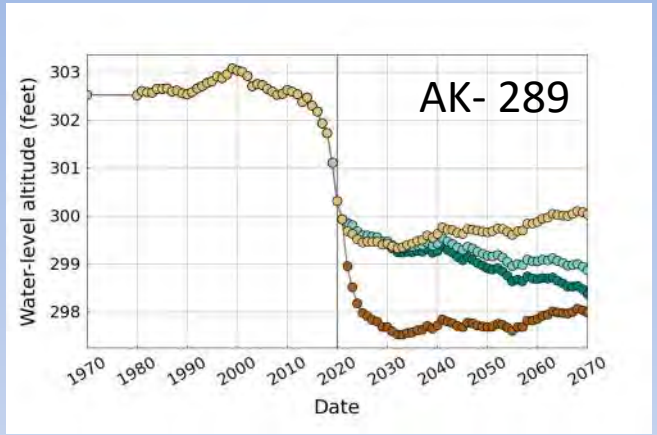
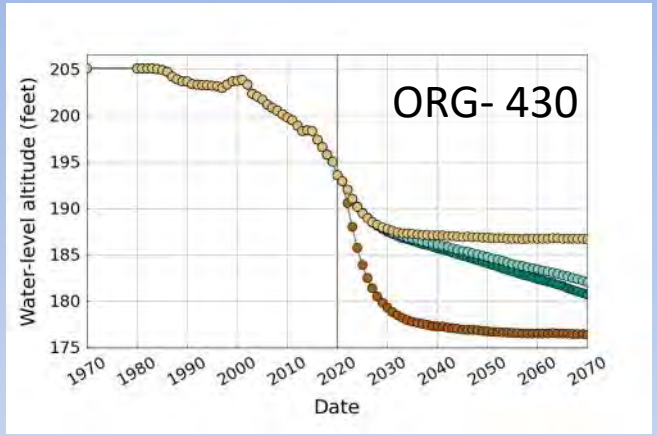
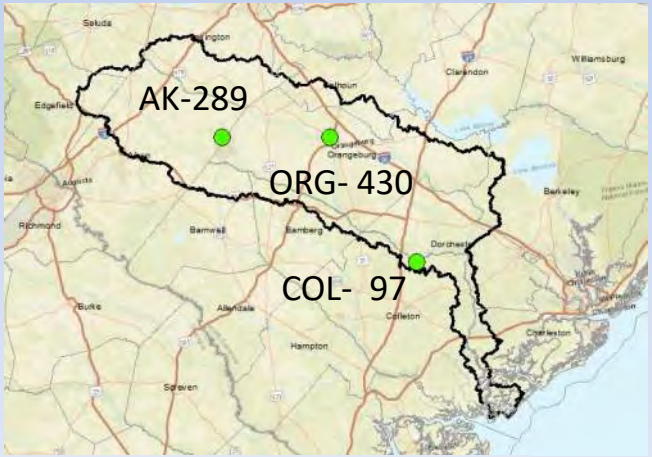
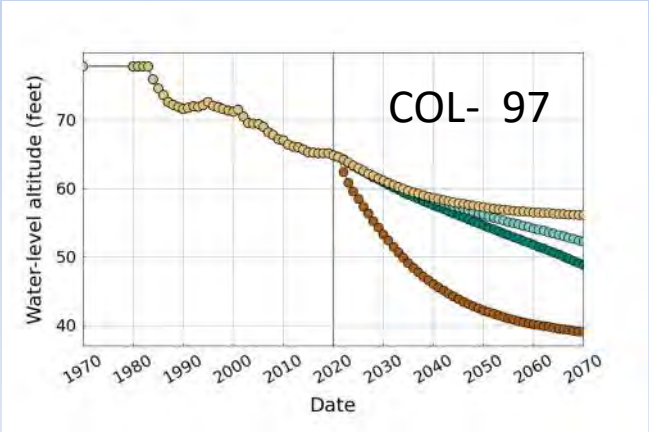
Simulated water levels in the Gordon aquifer









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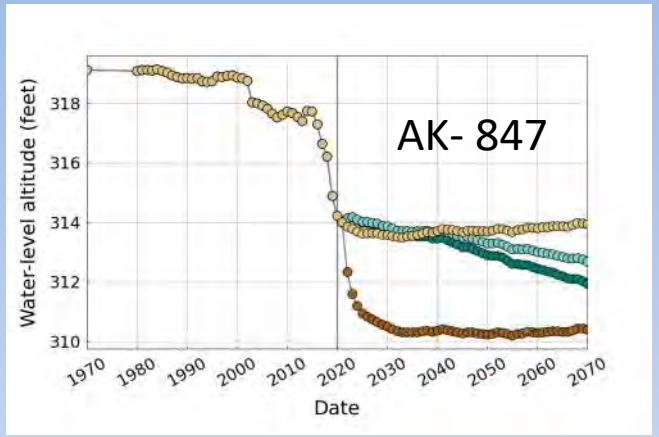
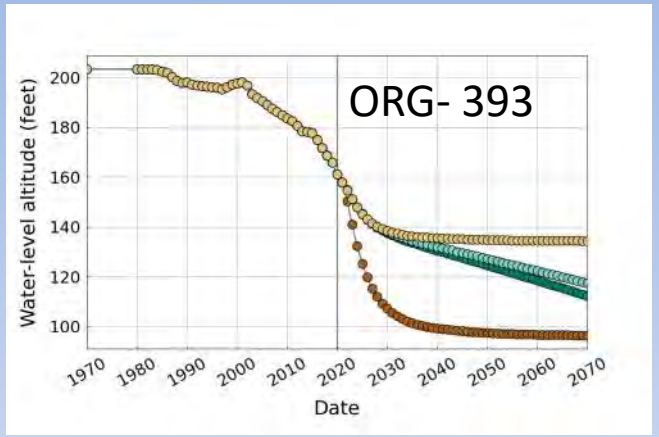
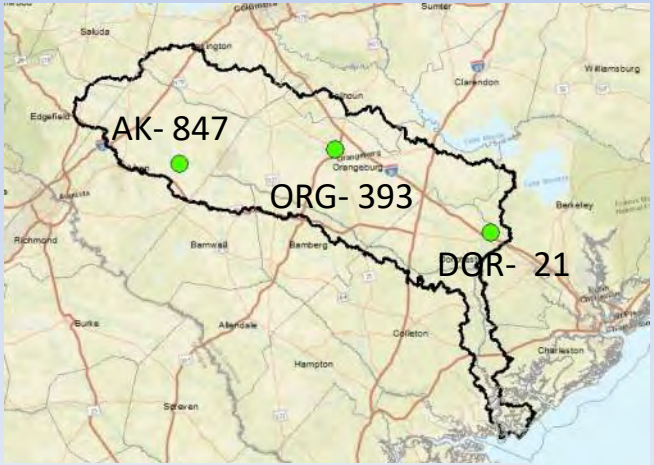
Simulated water levels in the Crouch Branch aquifer

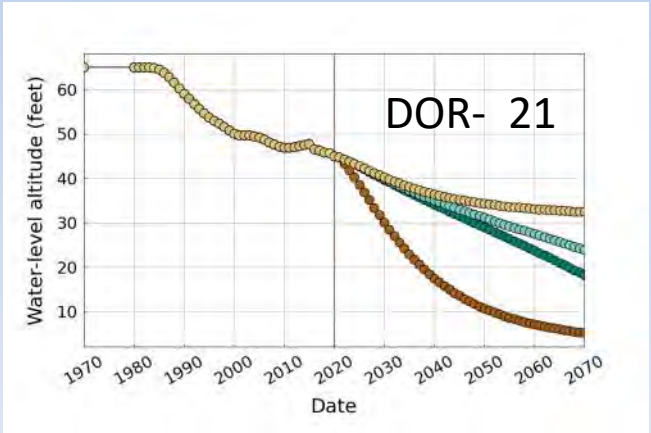




EXPLANATION

- Current
- Permitted
- Moderate Growth
- High Growth





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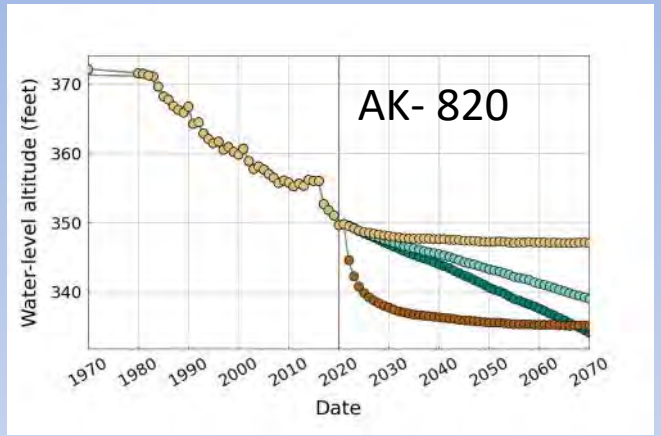
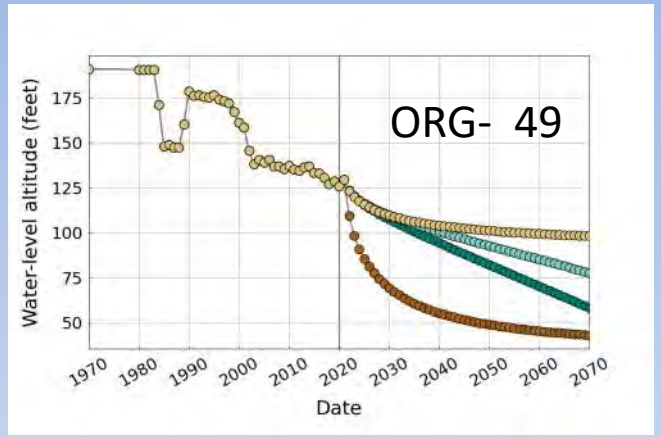
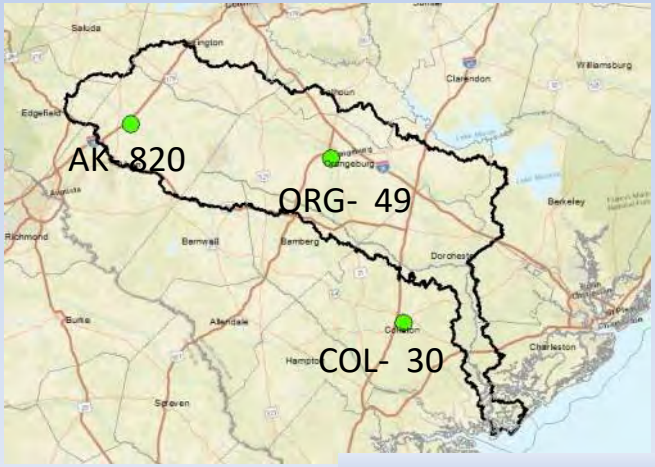
Simulated water levels in the McQueen Branch aquifer

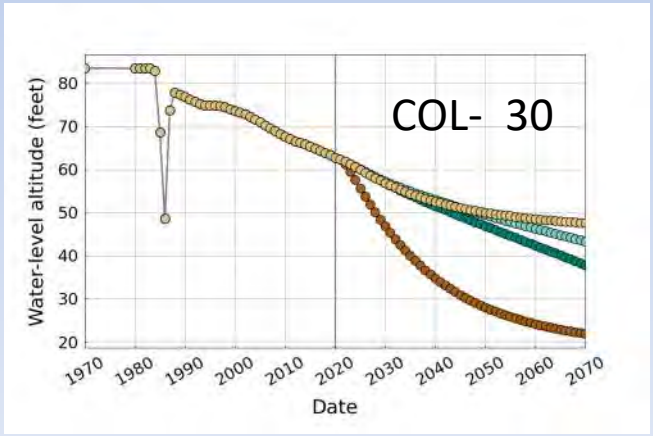




EXPLANATION

- Current
- Permitted
- Moderate Growth
- High Growth





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Simulated 2070 water budget in the Surficial aquifer (Edisto Basin)

Inflow from recharge
405 for all

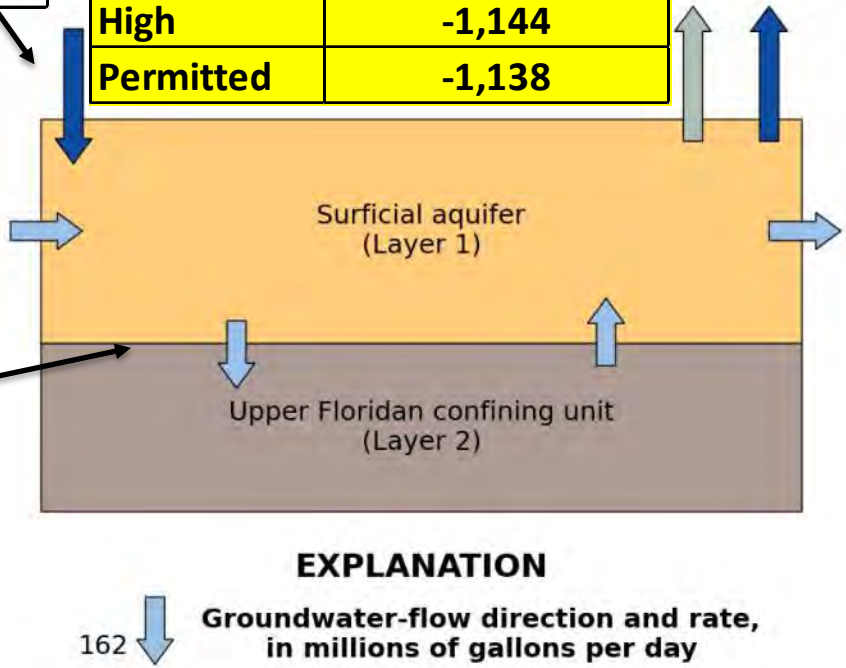
Scenario	Inflow
Current	994
Moderate	1,007
High	1,012
Permitted	1,018

Scenario	NET vertical
Current	-90
Moderate	-106
High	-113
Permitted	-126

Scenario	Outflow to streams
Current	-1,149
Moderate	-1,145
High	-1,144
Permitted	-1,138

Scenario	Discharge to wells
Current	-0.13
Moderate	-0.23
High	-0.30
Permitted	-0.44

Scenario	Outflow
Current	-160
Moderate	-160
High	-160
Permitted	-159



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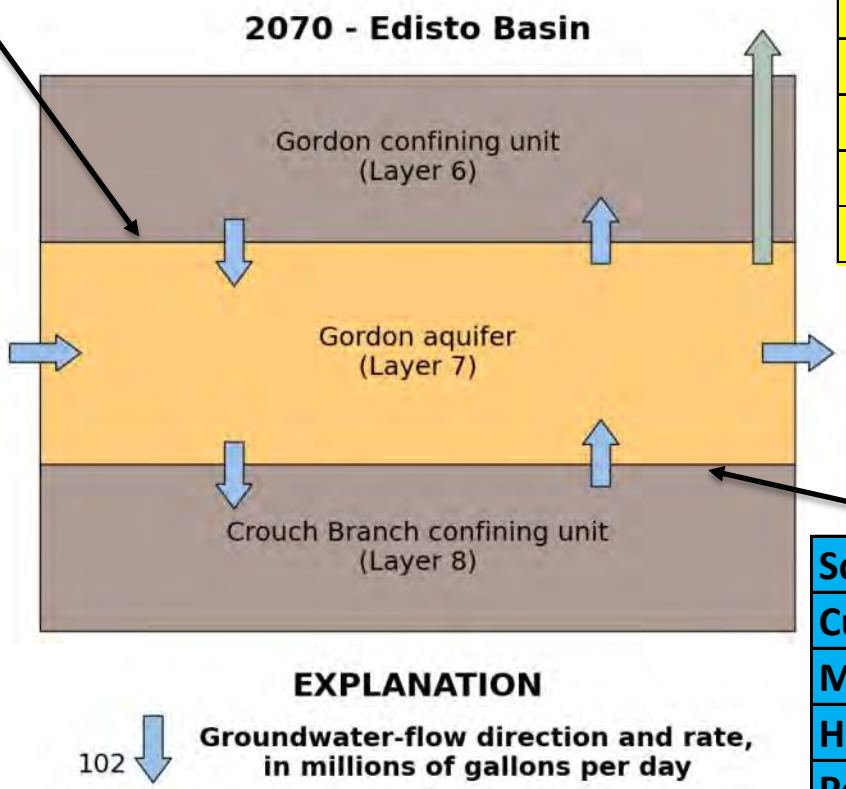
Simulated 2070 water budget in the Gordon aquifer (Edisto Basin)

Scenario	NET
Current	85
Moderate	101
High	108
Permitted	121

Scenario	Discharge to wells
Current	-7.4
Moderate	-8.9
High	-10
Permitted	-13

Scenario	Inflow
Current	4.4
Moderate	4.1
High	4.4
Permitted	4.7



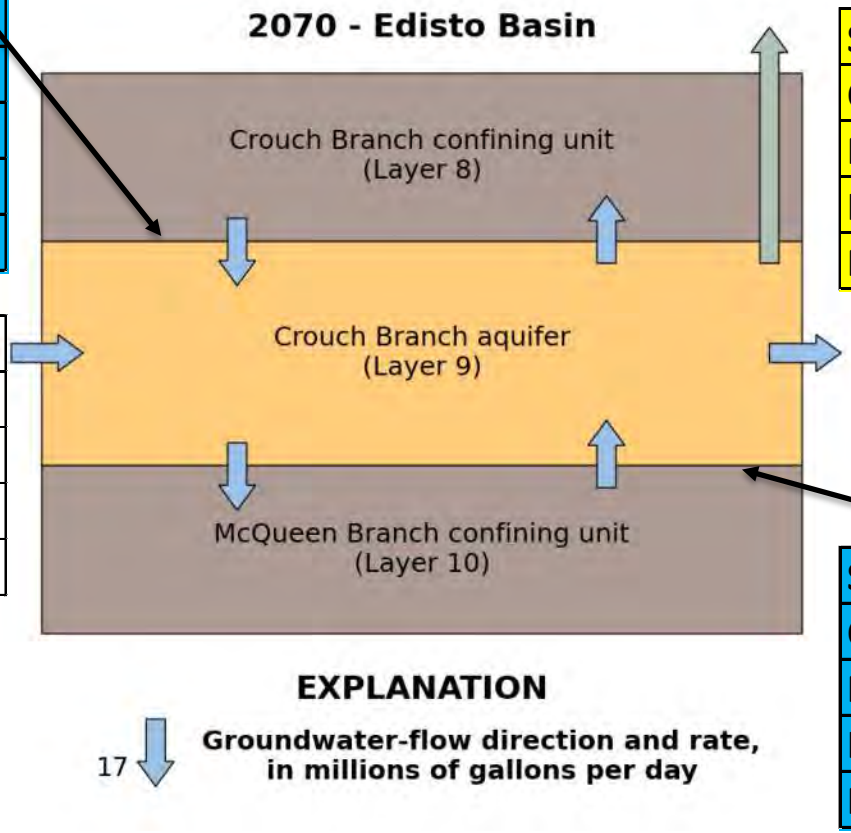
Scenario	Outflow
Current	-8.9
Moderate	-8.9
High	-9.0
Permitted	-9.4

Scenario	NET
Current	-73
Moderate	-87
High	-93
Permitted	-104

Provisional – All data is considered provisional and subject to revision.

Simulated 2070 water budget in the Crouch Branch aquifer (Edisto Basin)

Scenario	NET
Current	73
Moderate	87
High	93
Permitted	104



Scenario	Discharge to wells
Current	-52
Moderate	-69
High	-75
Permitted	-83

Scenario	Inflow
Current	14
Moderate	19
High	21
Permitted	20

Scenario	Outflow
Current	-20
Moderate	-19
High	-20
Permitted	-21

Scenario	NET
Current	-15
Moderate	-18
High	-20
Permitted	-19

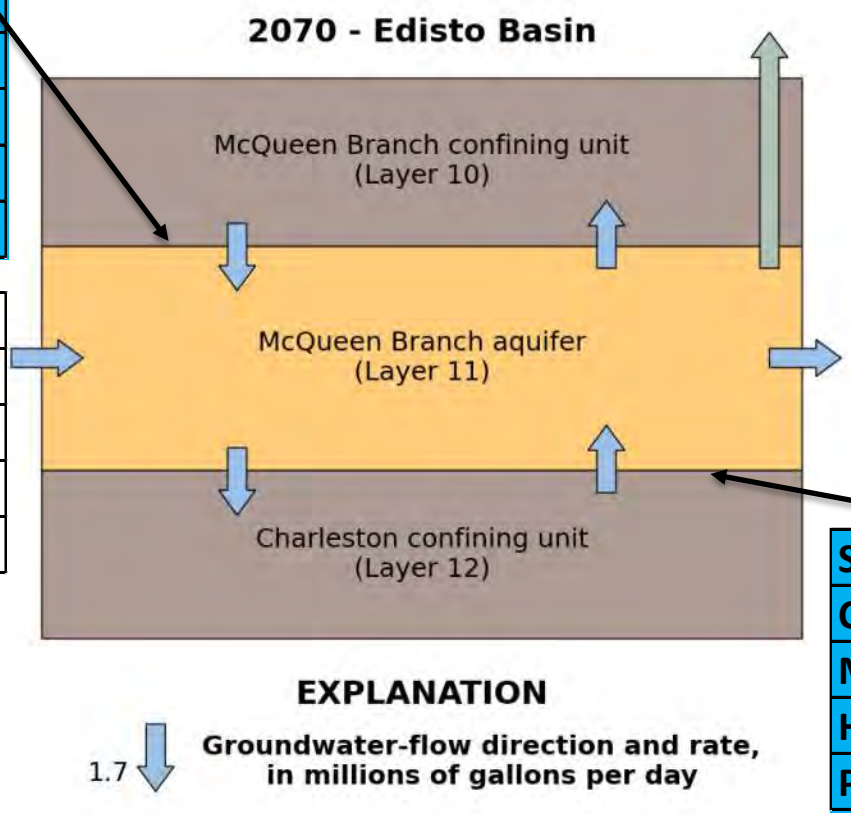
Provisional – All data is considered provisional and subject to revision.

Simulated 2070 water budget in the McQueen Branch aquifer (Edisto Basin)

Scenario	NET
Current	15
Moderate	18
High	20
Permitted	19

Scenario	Discharge to wells
Current	-14
Moderate	-20
High	-23
Permitted	-22

Scenario	Inflow
Current	9.1
Moderate	12
High	13
Permitted	13



Scenario	Outflow
Current	-9.9
Moderate	-9.9
High	-11
Permitted	-9.7

Scenario	NET
Current	-0.3
Moderate	0.4
High	0.9
Permitted	0.5

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Summary

- Simulated recharge rates were estimated with the Soil-Water Balance (SWB) model output. Rates varied from 0.09 to 1.22 feet per year.
- The number of simulated wells in the SC aquifers: Gordon (330), Crouch Branch (1,128), and McQueen Branch (648), and 700 wells in the multi-node package.
- The number of simulated wells in the SC aquifers for the Edisto Basin: Gordon (113), Crouch Branch (493), and McQueen Branch (97), and 91 wells in the multi-node package.

Summary – continued

Simulated pumping rates (MGD) in Edisto Basin (2021-2070)

	Current	Moderate Growth	High Growth	Permitted
Gordon	7.4	6.4 to 8.9	6.4 to 10	13
Crouch Branch	52	51 to 69	51 to 75	83
McQueen Branch	14	15 to 20	15 to 23	22
Total of all aquifers*	75	74 to 100	74 to 111	121

*includes aquifers not listed in this table

Maximum Drawdown (feet) in Edisto Basin (2070)

	Current	Moderate Growth	High Growth	Permitted
Gordon	10	45	50	100
Crouch Branch	50	105	150	150
McQueen Branch	75	155	170	100

Provisional – All data is considered provisional and subject to revision.

Summary – continued

- Simulated results indicate declines below the top of the aquifer for **all** scenarios in the McQueen Branch aquifer (Lexington County) and Crouch Branch aquifer (Calhoun County).