

# **Section 15**

## **Sub-Regional Groundwater Modeling for Cretaceous Aquifer Sustainable Yield Assessment**

### **15.1 Groundwater Modeling Approach for Sustainable Yield Assessment**

Consistent with Section 11 of this report, two criteria were used to evaluate sustainable yield in the Cretaceous Aquifer System of the Coastal Plain Aquifer System within Georgia. These criteria were groundwater level drawdown and reduction of groundwater contribution to stream baseflow. Reasonable metrics, which have been applied elsewhere, for these two criteria are no more than 30 feet of drawdown in the targeted aquifer and no more than a 40 percent reduction of groundwater contribution to stream baseflow.

As discussed in Section 11.3, groundwater modeling simulations were performed under a steady-state condition in order to evaluate whether the groundwater withdrawals from the aquifers are sustainable and to estimate the ultimate groundwater level drawdown and reduction of groundwater contribution to stream baseflow due to increased pumping once the aquifer has reached a new equilibrium. Therefore, a steady-state sub-regional Cretaceous Aquifer model was developed based on the calibrated sub-regional transient Cretaceous Aquifer model discussed in Section 10. For the prioritized portion of the Cretaceous Aquifer System, the steady-state model was used to: (1) estimate Cretaceous Aquifer sustainable yields and (2) evaluate the potential effects on the groundwater and surface water systems (rivers and streams) due to increased pumping from the Cretaceous Aquifer sustainable yields.

Groundwater flow modeling simulations were performed using the steady-state sub-regional Cretaceous Aquifer model. These simulations were conducted to estimate the range of sustainable yields that could occur from existing and simulated new wells in the Cretaceous Aquifer without creating unacceptable impacts to the environment.

For this analysis, two simulation scenarios were performed with pumping from the prioritized portion of the Cretaceous Aquifer System increasing until either the groundwater level drawdown criteria of 30 feet was exceeded over a fairly large area, or reduction of groundwater contribution to stream baseflow exceeded 40 percent.

In these simulations, pumping from both underlying and overlying aquifers was maintained at the baseline pumping rates, and pumping from two hydrogeologic units of the Cretaceous Aquifer (Providence Sand-Peedee-Dublin Aquifer and Eutaw-Midville Aquifer) was simulated simultaneously. There are no existing pumping wells in the lower hydrogeologic unit of the Cretaceous Aquifer (Upper Atkinson

Aquifer), likely due to its great depth below land surface (from 700 to 3,100 feet below land surface) and poorer water quality compared to overlying aquifers. These simulations are described below.

- **Simulation 1:** Pumping was uniformly increased from the existing wells in the Providence Sand-Peedee-Dublin Aquifer (Layer 5) and the Eutaw-Midville Aquifer (Layer 6) that comprise the upper units of the Cretaceous Aquifer (lower end of sustainable yield range);
- **Simulation 2:** Pumping from the simulated new wells along with non-uniformly increased pumping from the existing wells in both Cretaceous Aquifer System units. For the existing wells, pumping from existing large user wells was capped, and pumping from the remaining existing wells was uniformly increased (upper end of sustainable yield range).

**Figure 15-1** shows the locations of the existing and simulated new wells in the Cretaceous Aquifer. As shown on Figure 15-1, the distance between the simulated wells is approximately 10,000 feet. A total of 3,433 new wells were simulated for the Providence Sand-Peedee-Dublin Aquifer (1,703 new wells) and the Eutaw-Midville Aquifer (1,730 new wells).

## 15.2 Groundwater Modeling Results for Cretaceous Aquifer Sustainable Yield Assessment

The results of the groundwater modeling for the Cretaceous Aquifer System sustainable yield assessment are presented in **Table 15-1**. Rather than discuss the results of each simulation, the range of sustainable yields for the Cretaceous Aquifer will be discussed in this section.

As shown on Table 15-1, the existing permitted pumping rate from the Cretaceous Aquifer is approximately 124 mgd, with 100 mgd pumped from the Providence Sand-Peedee-Dublin Aquifer and 24 mgd pumped from the Eutaw-Midville Aquifer. Uniformly increased pumping from the existing wells in the Cretaceous Aquifer represents the low end of the range of sustainable yields, whereas non-uniformly increased pumping from the existing wells and pumping from simulated new wells represents the high end of the range of sustainable yields.

Baseline pumping from the Cretaceous Aquifer can be increased from 124 mgd to 198 mgd resulting in an increased withdrawal of 74 mgd. This pumping scenario results in exceedance of the 30-foot groundwater level drawdown criterion and a corresponding reduction of groundwater contribution to stream baseflow of 39 percent. This result suggests that there is probably very limited additional water available before the baseflow reduction criterion is exceeded.

Table 15-1 Summary of Sustainable Yields in Cretaceous Aquifer under Different Withdrawal Conditions for an Average Rainfall Year under Different Withdrawal Conditions for an Average Rainfall Year using the Steady-State Cretaceous Aquifer Sub-Regional Groundwater Model<sup>1</sup>

Pumping Conditions and Potential Impacts	Existing Pumping Conditions (Baseline)			Existing Wells Pumping (Simulation 1)						Simulated New Wells Pumping with Increased Pumping from Existing Wells (Simulation 2)			
	Providence Aquifer Wells (Layer 5)	Eutaw-Midville Aquifer Wells (Layer 6)	Total from Providence & Eutaw-Midville Aquifers <sup>3</sup>	Uniform Increased Pumping from All Providence Aquifer Wells	Uniform Increased Pumping from All Eutaw-Midville Aquifer Wells	Total Increase in Pumping from the Providence and Eutaw-Midville Aquifers <sup>3</sup>	% Increase in Pumping from Cretaceous Aquifer Wells	Non-Uniform Increased Pumping from All Providence Aquifer Wells <sup>2</sup>	Non-Uniform Increased Pumping from All Eutaw-Midville Aquifer Wells <sup>2</sup>	Pumping from Simulated New Wells & Non-Uniform Increased Pumping from Existing Providence Aquifer Wells <sup>2</sup>	Pumping from Simulated New Wells & Non-Uniform Increased Pumping from Existing Eutaw-Midville Aquifer Wells <sup>2</sup>	Total Increase in Pumping from the Providence and Eutaw-Midville Aquifers <sup>3</sup>	% Increase in Pumping from Cretaceous Aquifer Wells
No. of Existing Pumping Wells	330	301	631	330	301	631	-			330	301	631	-
No. of Simulated New Wells	-	-	-	-	-	-	-			1,703	1,730	3,433	-
Pumping from the Cretaceous Aquifer hydrogeologic units (mgd)	100	24	124	140	58	198	-	151	51	130	71	201	-
Total pumping from all aquifers in the model domain (mgd)	292			366			-	370		369			-
Additional withdrawals from each Cretaceous Aquifer hydrogeologic unit (mgd) <sup>3</sup>	0	0	0	40	34	74	59%	51	-73	30	47	77	62%
Simulated groundwater level drawdown (ft) <sup>4</sup>	-		-	30			-	30		21			-
Simulated river baseflow reduction (mgd) <sup>5</sup>	-		-	39%			-	40%		40%			-

<sup>1</sup> The Cretaceous Aquifer System is comprised of three different hydrogeologic units in descending order: 1) the Providence Aquifer, 2) the Eutaw-Midville Aquifer and 3) the Atkinson Aquifer.

<sup>2</sup> Pumping from existing wells is increased uniformly except for existing large users, which are capped at existing pumping rates.

<sup>3</sup> There is no existing or proposed pumping from the lower portion of the Cretaceous Aquifer System (i.e., the Atkinson Aquifer.)

<sup>4</sup> Simulated groundwater level drawdown was calculated by subtracting the groundwater elevations for each simulation from the corresponding values in the baseline condition.

<sup>5</sup> The baseflow reduction was estimated for streams and rivers in the outcrop area from a model-wide water budget for each simulation.

% increase is the increase in additional withdrawals divided by the total existing withdrawals from the Cretaceous Aquifer.

If pumping is non-uniformly increased from the existing wells and simulated new wells (Simulation 2), total pumping withdrawals could be slightly increased. As indicated in the table, withdrawals can be increased by up to approximately 62 percent, resulting in exceedance of the 30-foot groundwater level drawdown criterion and an exceedance of the baseflow reduction criterion of 40 percent. For this scenario, baseline pumping from the Cretaceous Aquifer can be increased from 124 mgd to 201 mgd, resulting in an increased withdrawal of approximately 77 mgd from the Cretaceous Aquifer.

### **15.3 Potential Impacts on Groundwater Levels Due to Increased Groundwater Withdrawals in Cretaceous Aquifer**

Groundwater modeling results showing potential impacts due to increased groundwater withdrawals from the Cretaceous Aquifer are presented in the form of groundwater level drawdown contours. Groundwater elevation contours and groundwater level drawdown contours for the Upper Floridan Aquifer (Layer 2) through the Upper Atkinson Aquifer (Layer 7) are provided for both simulations. The simulated groundwater elevations and groundwater level drawdown contours for Simulation 1 (lower end of sustainable yield range) and Simulation 2 (upper end of sustainable yield range) are presented and discussed in this section.

#### **15.3.1 Baseline Condition**

For comparison, the groundwater elevations in the Upper Floridan Aquifer (Layer 2) through the Upper Atkinson Aquifer (Layer 7) under existing baseline conditions are presented on **Figures 15-2 through 15-7**. From Figures 15-2 through 15-4, the direction of regional groundwater flow in the Upper Floridan Aquifer (Layer 2), Claiborne-Gordon Aquifers (Layer 3), and Clayton-Dublin Aquifers (Layer 4) in the Coastal Plain of Georgia is primarily from northwest to southeast. As shown on Figures 15-5 through 15-7, the direction of groundwater flow in the Providence Sand-Peedee-Dublin Aquifer (Layer 5), Eutaw-Midville Aquifer (Layer 6), and Upper Atkinson Aquifer (Layer 7) of the Cretaceous Aquifer System is also from northwest to southeast although the hydraulic gradients in these aquifers are much flatter than the overlying aquifers due to lower recharge to the Cretaceous Aquifer System.

#### **15.3.2 Potential Impacts with the Lower End of the Range of Sustainable Yield**

**Figures 15-8 through 15-13** show the groundwater elevations for Layers 2 through 7 under uniformly increased pumping from the existing wells in the Cretaceous Aquifer (Simulation 1). As shown on Figures 15-8 through 15-10, there is little change to groundwater elevations in the Upper Floridan Aquifer, Claiborne-Gordon Aquifers, and Clayton-Dublin Aquifers due to an approximate 74 mgd increase in pumping from the Cretaceous Aquifer. As shown on Figures 15-11 and 15-12, there is steepening of gradients in the Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers due to increased pumping from these aquifers.



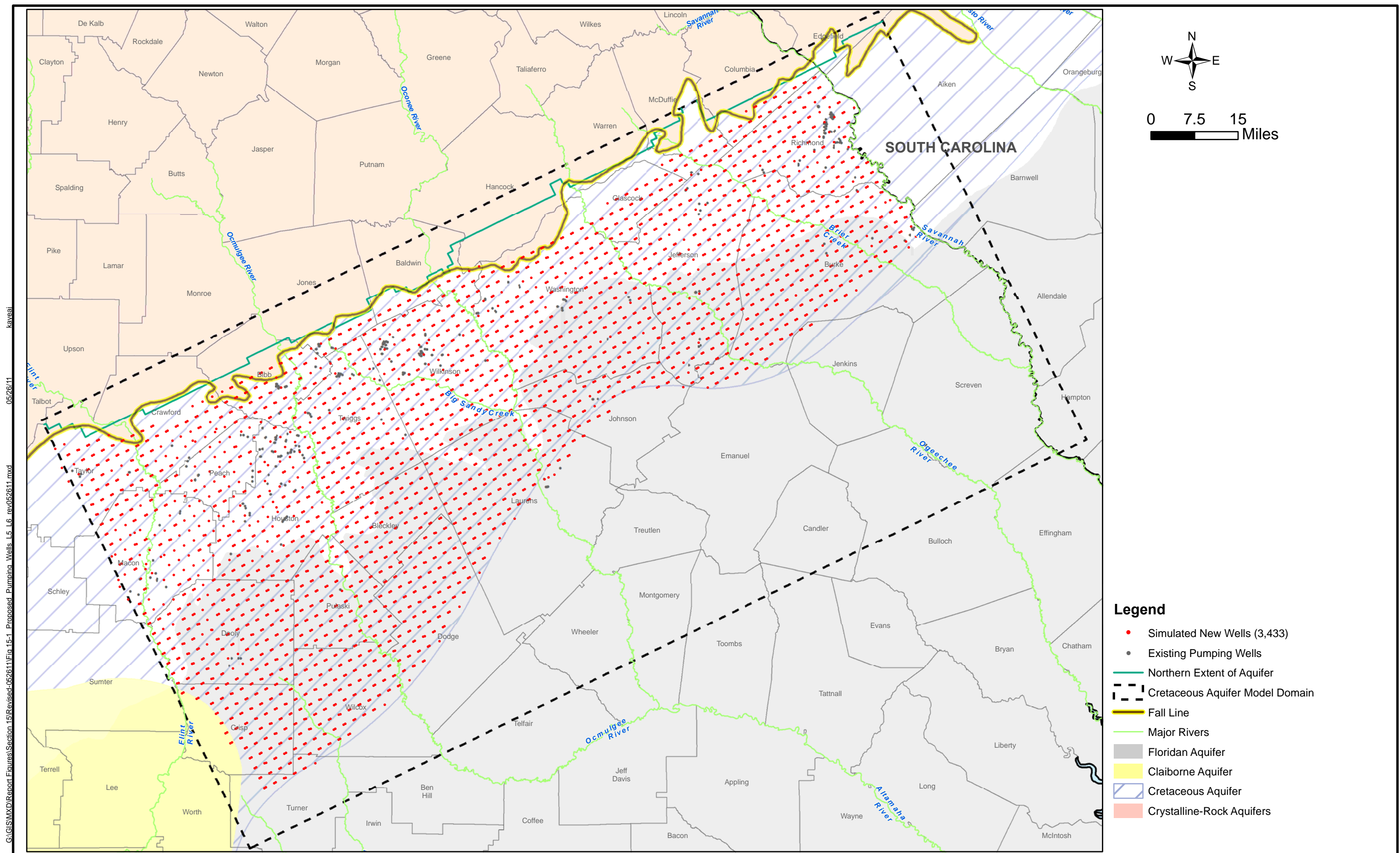
The groundwater level drawdown for Layers 2 through 7 under uniformly increased pumping from the existing wells in the Cretaceous Aquifer is presented on **Figures 15-14** through **15-19**, respectively. As shown on Figures 15-14 and 15-15, there is approximately 1 to 9 feet of additional groundwater level drawdown in the Upper Floridan Aquifer (Layer 2) and approximately 1 to 30 feet of additional drawdown in the Gordon Aquifer (Layer 3) due to 74 mgd of additional pumping from the Cretaceous Aquifer System. The groundwater level drawdown in these aquifers occurs between the major rivers (Flint, Ocmulgee, Oconee, Ogeechee, and Savannah Rivers). From Figure 15-16, there is model-wide groundwater level drawdown (approximately 1 to 35 feet) due to recharge from the Clayton-Dublin Aquifers (Layer 4) to the underlying Cretaceous Aquifer System. As shown on Figures 15-17 and 15-18, there is substantial groundwater level drawdown in both the Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers due to the 74 mgd pumping increase from these aquifers.

Some simulated drawdowns may have been locally greater than 30 feet in the vicinity of pumping wells, which did not exceed the sustainable yield criterion that drawdowns not exceed 30 feet between pumping wells. The criterion of no more than 40 percent of groundwater contributions to baseflow was almost reached in the simulations of the lower end of the range of sustainable yield. Although this criterion was not exceeded, the fact that the reduction in groundwater contribution to stream baseflow was at 39% suggests that there is very little additional water available above the lower end of the sustainable yield. Simulations with different combinations of pumping from the Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers would result in the same upper end of the range of sustainable yield.

### **15.3.3 Potential Impacts with the Upper End of the Range of Sustainable Yield**

**Figures 15-20** through **15-25** show the groundwater elevations for Layers 2 through 7 for non-uniformly increased pumping from the existing wells in the Providence Sand-Peedee-Dublin Aquifer and Eutaw-Midville Aquifer of the Cretaceous Aquifer System (Simulation 2). As shown on **Figures 15-26** and **15-27**, there is approximately 1 to 7 feet of additional drawdown in the Upper Floridan Aquifer and 1 to 30 feet of additional drawdown in the Claiborne-Gordon Aquifers due to the 77 mgd of additional pumping from the Cretaceous Aquifer System. The drawdown in these aquifers occurs between the major rivers (Flint, Ocmulgee, Oconee, Ogeechee and Savannah Rivers). From **Figure 15-28**, there is model-wide drawdown (approximately 1 to 35 feet) due to recharge from the Clayton-Dublin Aquifers (Layer 4) to the underlying Cretaceous Aquifer System. As shown on **Figures 15-29** and **15-31**, there is substantial drawdown in both the Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers due to the 77 mgd pumping increase from these aquifers.

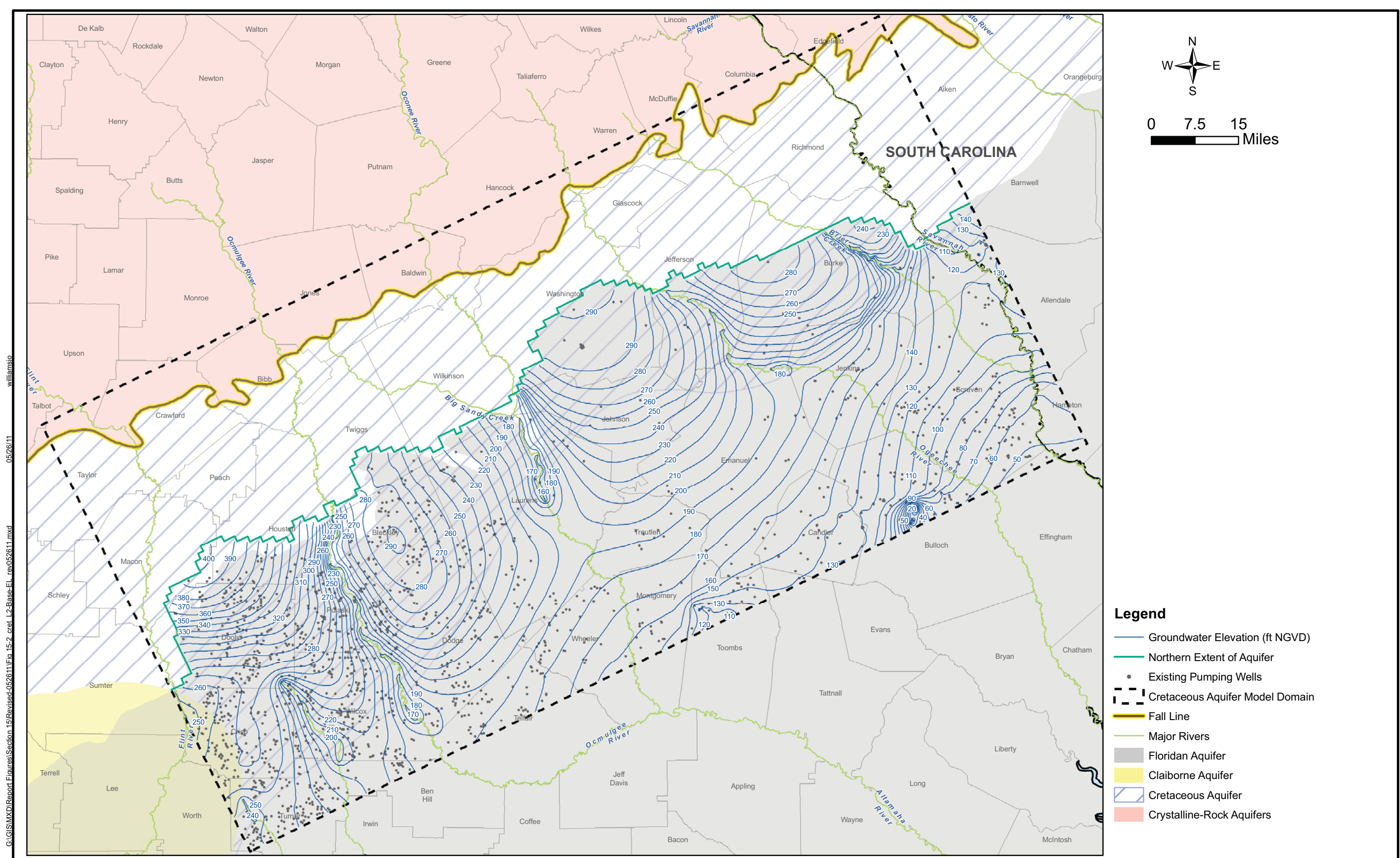
Some simulated drawdowns may have been locally greater than 30 feet in the vicinity of pumping wells, which did not exceed the sustainable yield criterion that drawdowns not exceed 30 feet between pumping wells. The criterion of no more than 40 percent of groundwater contributions to baseflow was reached in the simulations of the upper end of the range of sustainable yield.



G:\GIS\MXD\Report Figures\Section 15\Revised-052611\Fig 15-1 Proposed Pumping Wells\_L5\_L6\_rev052611.mxd 05/26/11 kaveai

**CDM** **Figure 15-1**  
**Locations of Existing and Simulated New Wells in Providence Sand-Peedee-Dublin Aquifers (Layer 5) and Eutaw-Midville Aquifer (Layer 6) (Cretaceous Aquifer System)**  
**Used in Sub-Regional Cretaceous Aquifer Model**



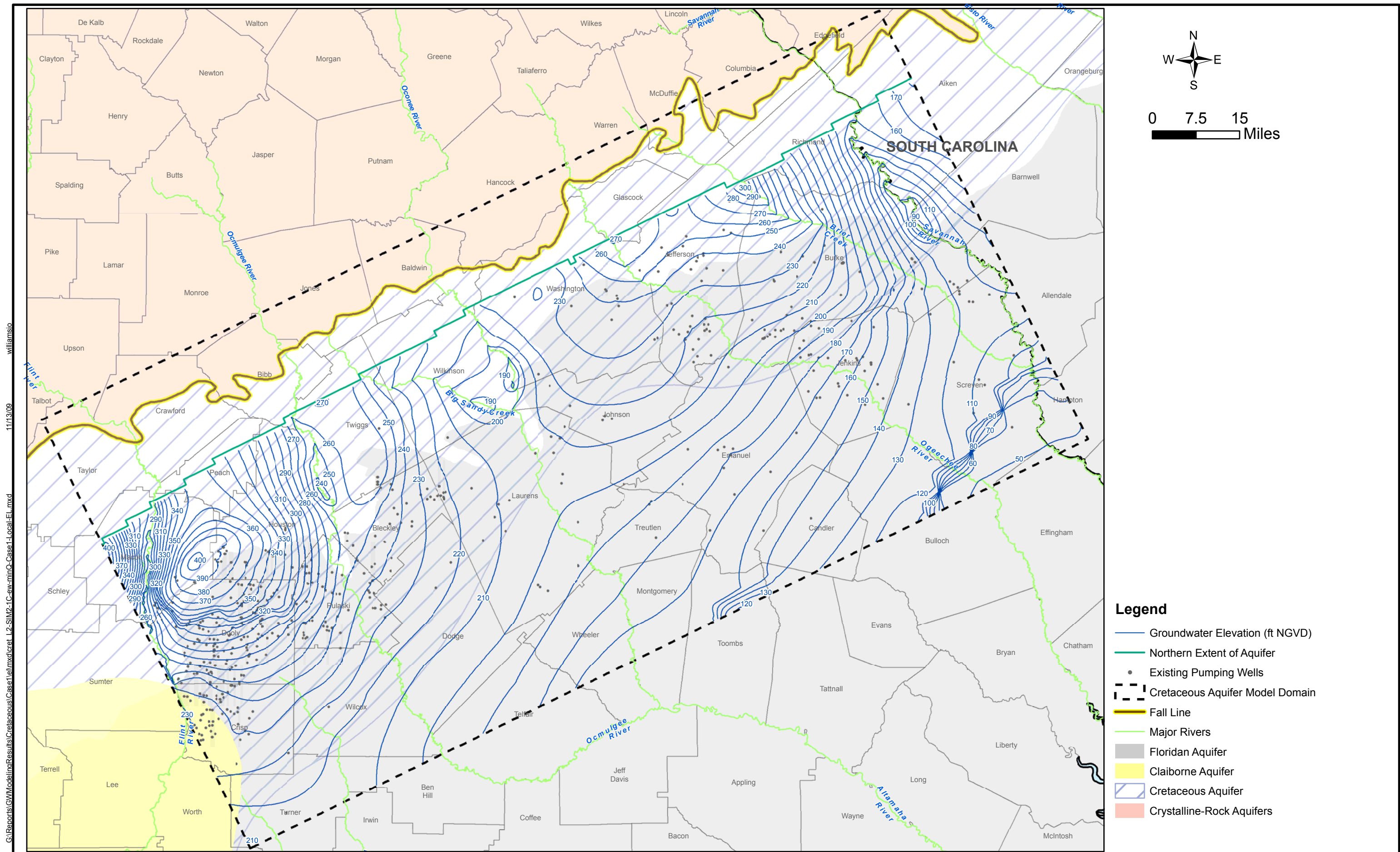


G:\GIS\MXD\Report Figures\Section 15\Revised-052611\Fig 15-2\_cret\_L2\_Base-EL\_rev052611.mxd 05/26/11 williamsio

**Figure 15-2**  
**Simulated Groundwater Elevations in Upper Floridan Aquifer (Layer 2)**  
**At Current Pumping Condition Using Sub-Regional Cretaceous Aquifer Model**



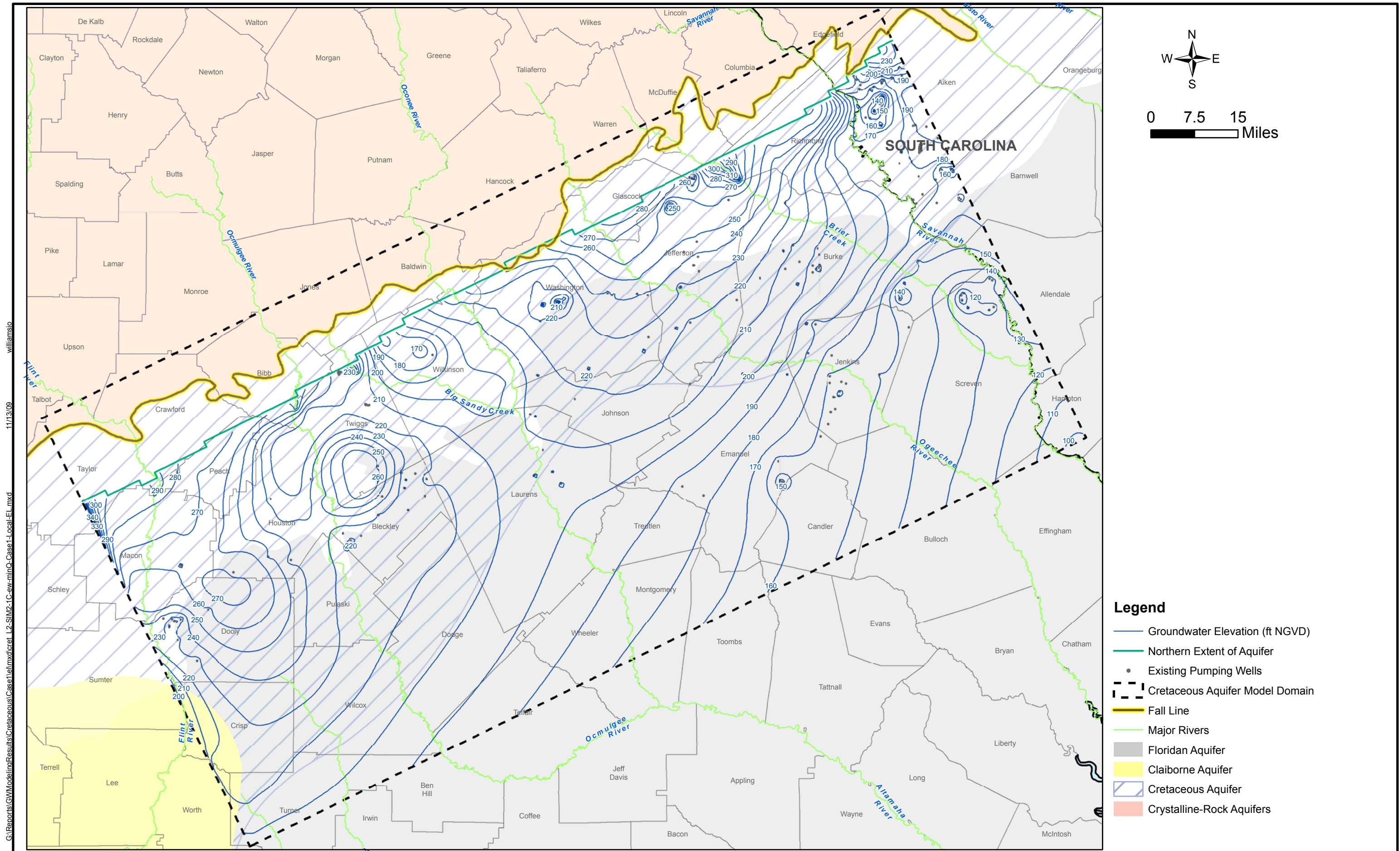




G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio

**Figure 15-3**  
**Simulated Groundwater Elevations in Claiborne/Gordon/Lower Floridan Aquifers (Layer 3)**  
**At Current Pumping Condition Using Sub-Regional Cretaceous Aquifer Model**



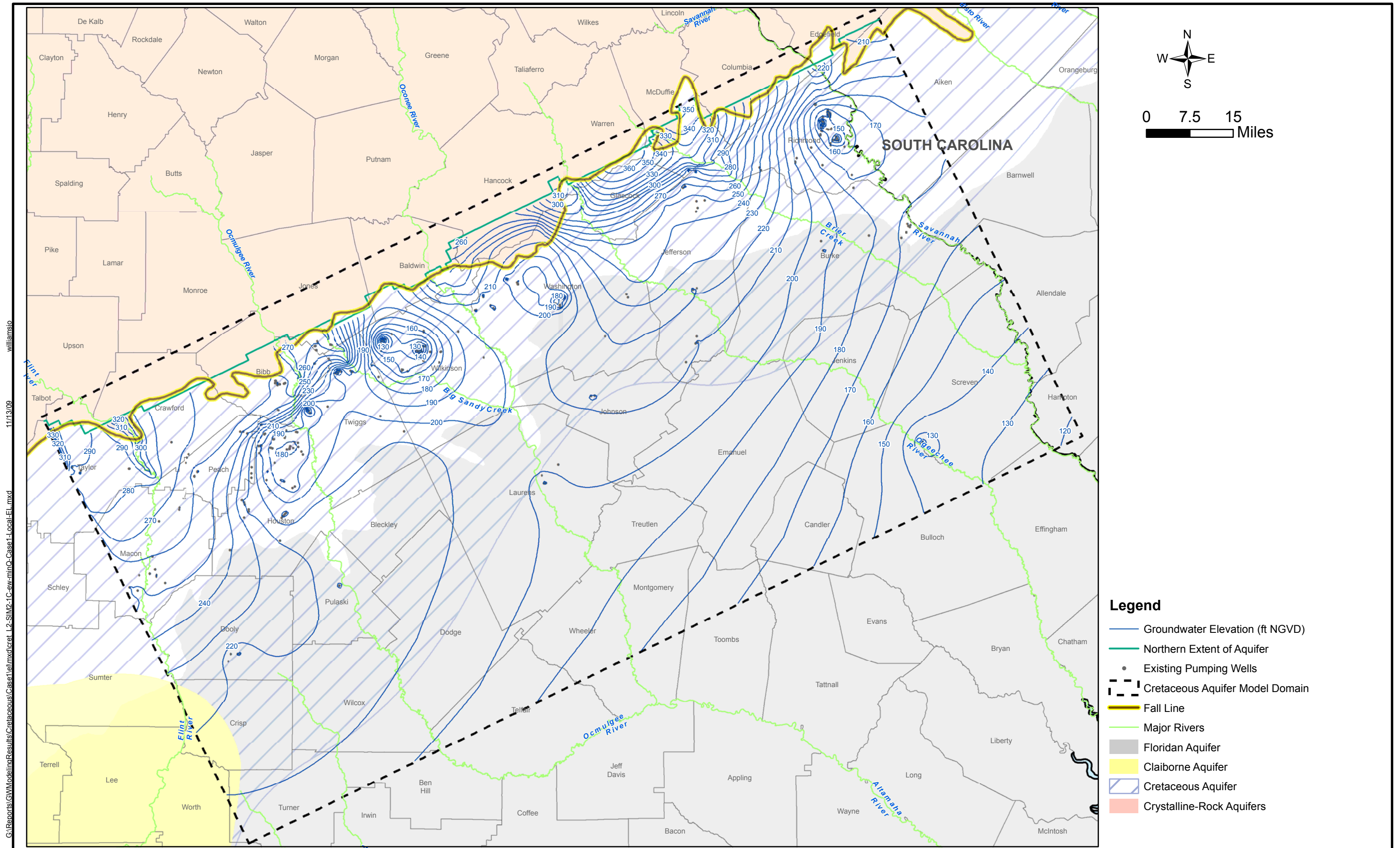


G:\Reports\GWM\modelingResults\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-locLEL.mxd 11/13/09 williamsio

**Figure 15-4**  
**Simulated Groundwater Elevations in Clayton-Dublin Aquifers (Layer 4)**  
**At Current Pumping Condition Using Sub-Regional Cretaceous Aquifer Model**



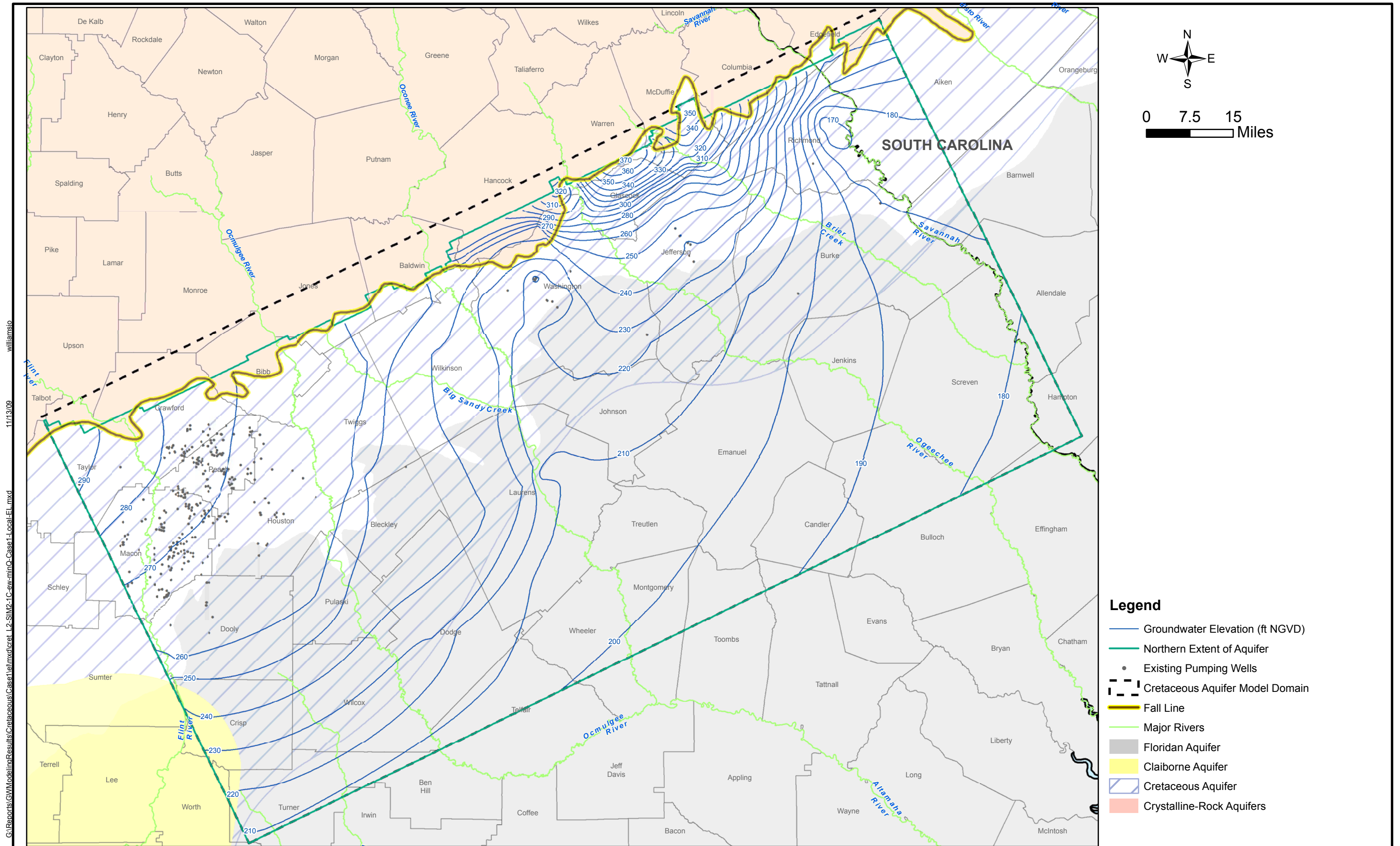




**CDM**

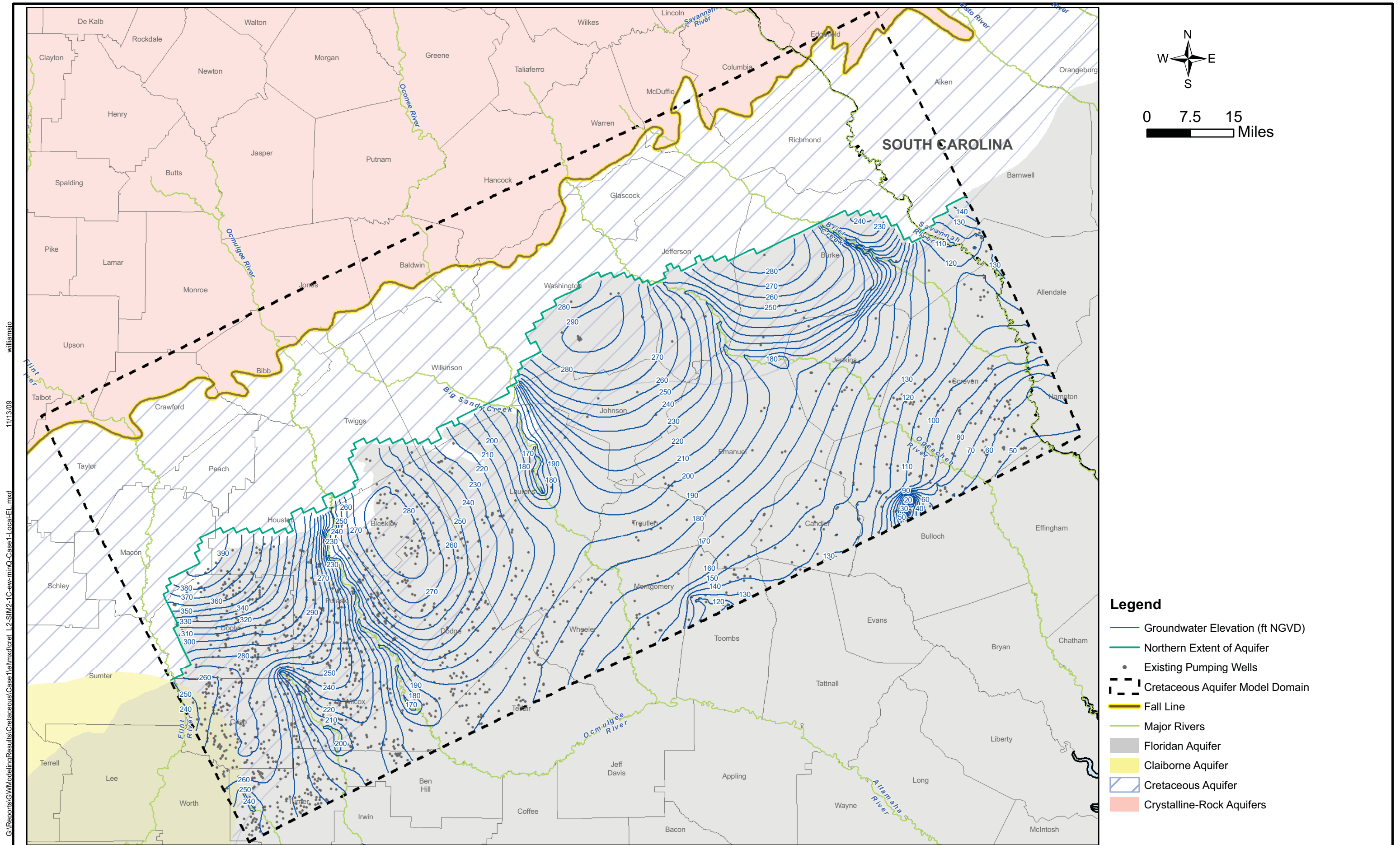
**Figure 15-5**  
**Simulated Groundwater Elevations in Providence Sand-Peedee-Dublin Aquifers (Layer 5)**  
**At Current Pumping Condition Using Sub-Regional Cretaceous Aquifer Model**







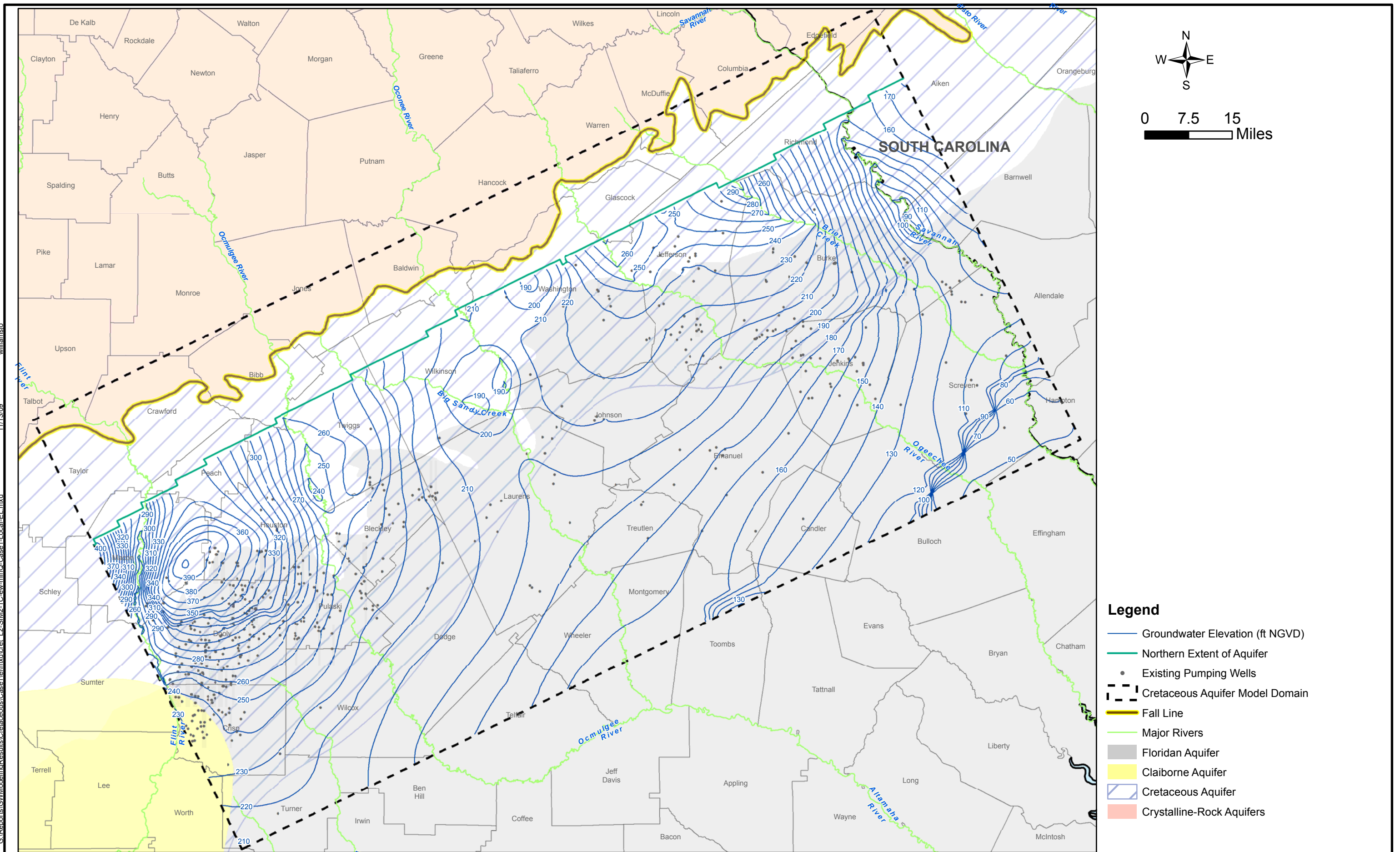




**Figure 15-8**  
**Simulated Groundwater Elevations in Upper Floridan Aquifer (Layer 2)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**



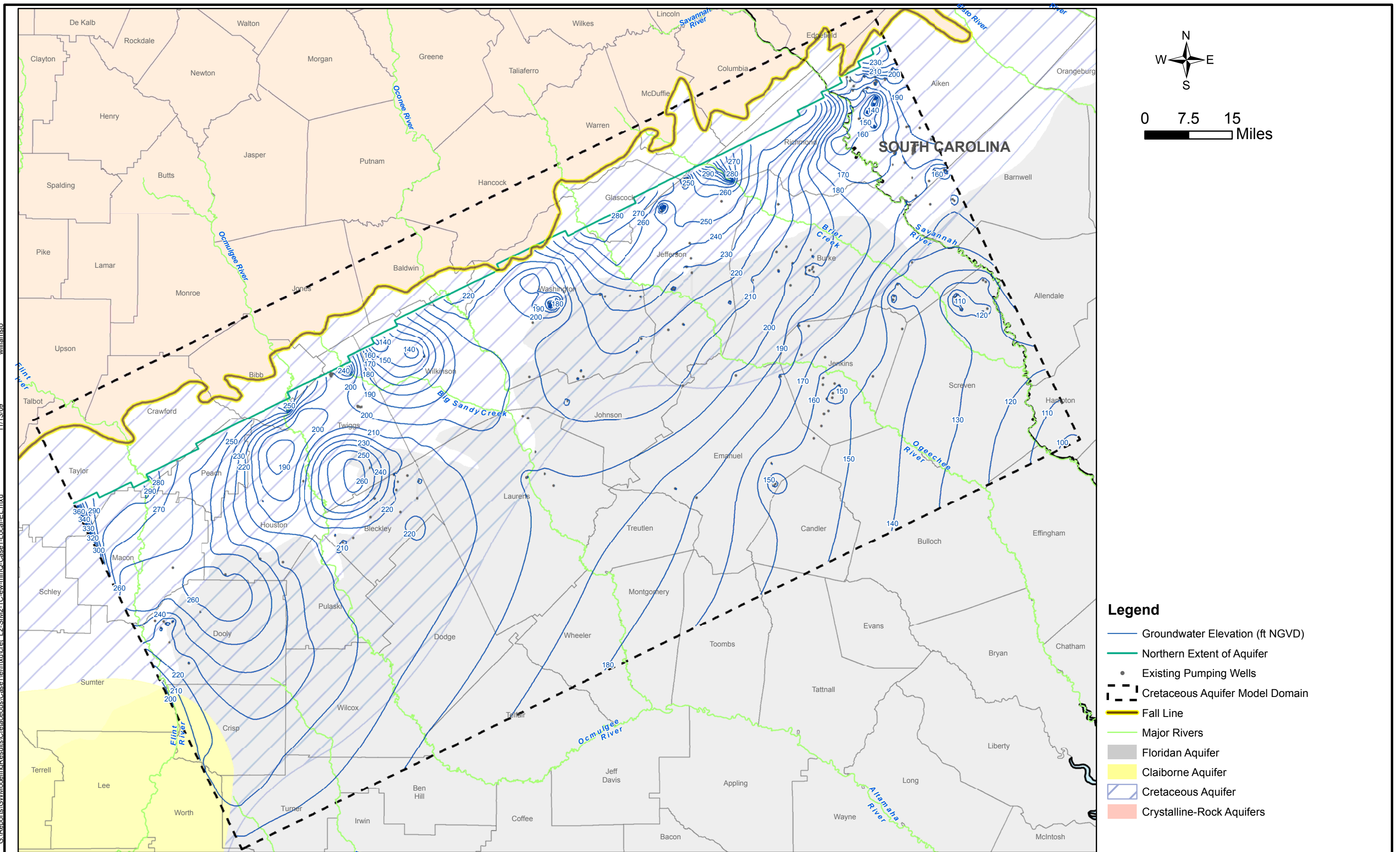
G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\crt L2\_S1M2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio



**Figure 15-9**  
**Simulated Groundwater Elevations in Claiborne/Gordon/Lower Floridan Aquifers (Layer 3)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

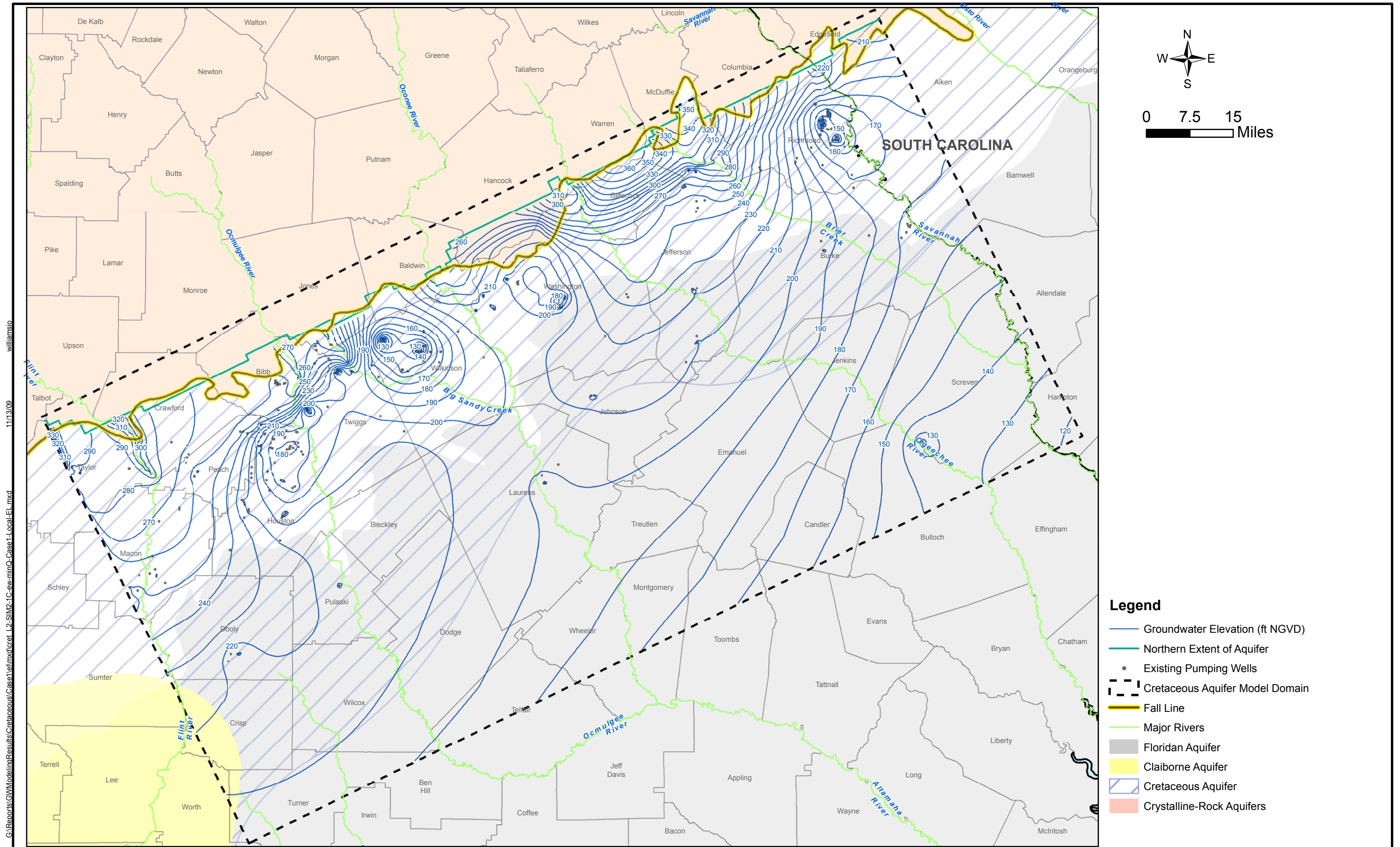


G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\crat\_L2\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio



**Figure 15-10**  
**Simulated Groundwater Elevations in Clayton-Dublin Aquifers (Layer 4)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

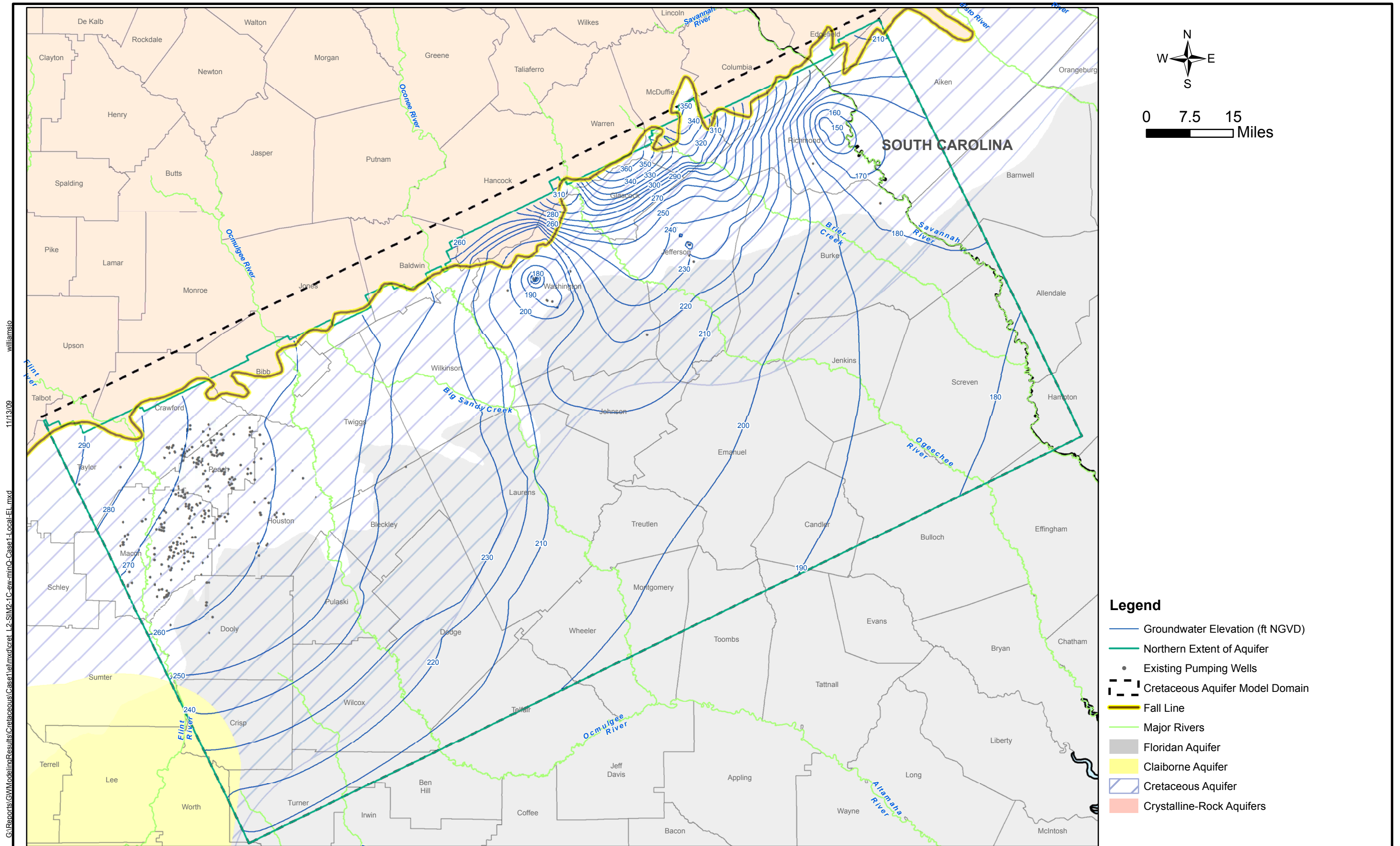




**CDM**

**Figure 15-11**  
**Simulated Groundwater Elevations in Providence Sand-Peedee-Dublin Aquifers (Layer 5)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

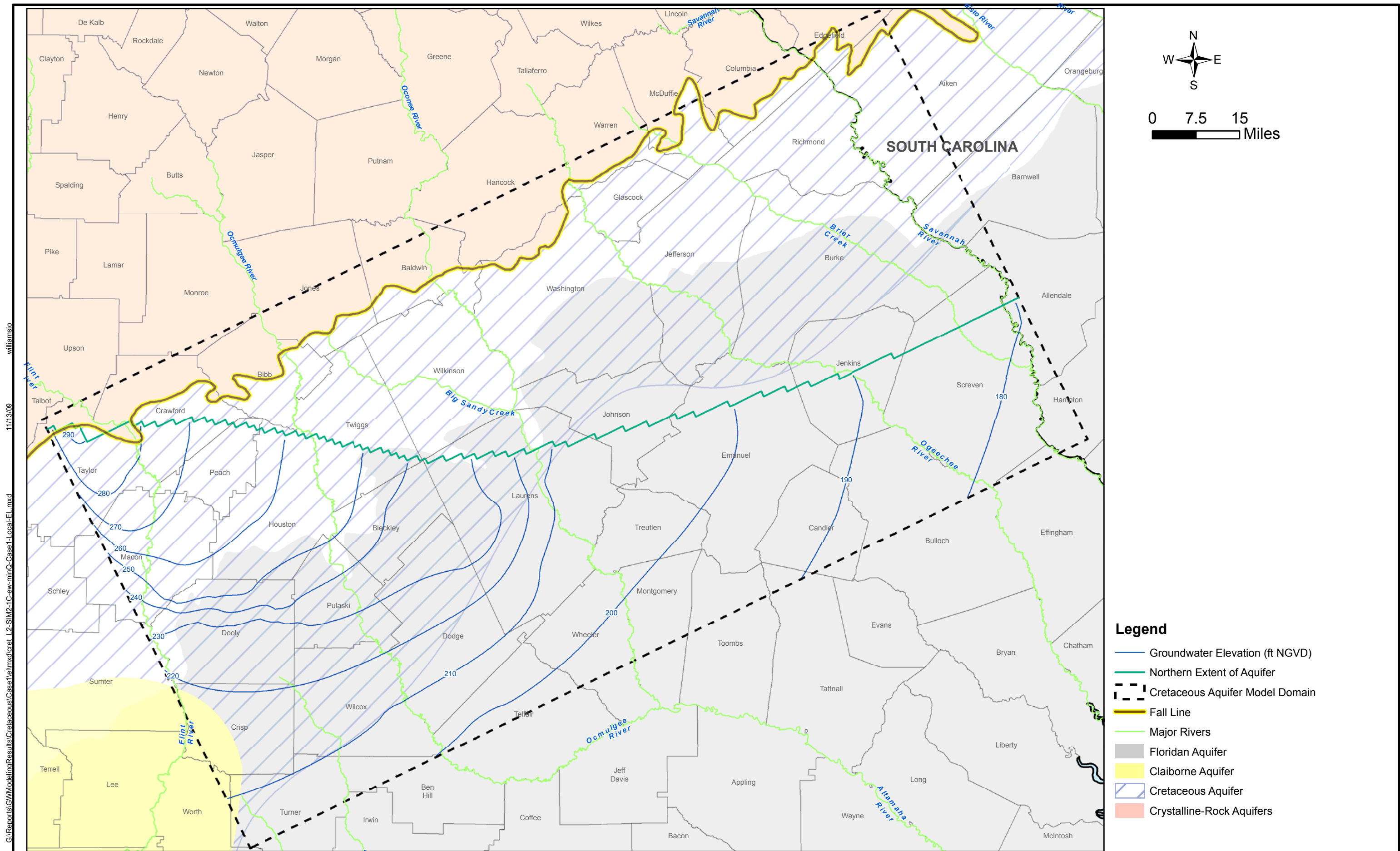




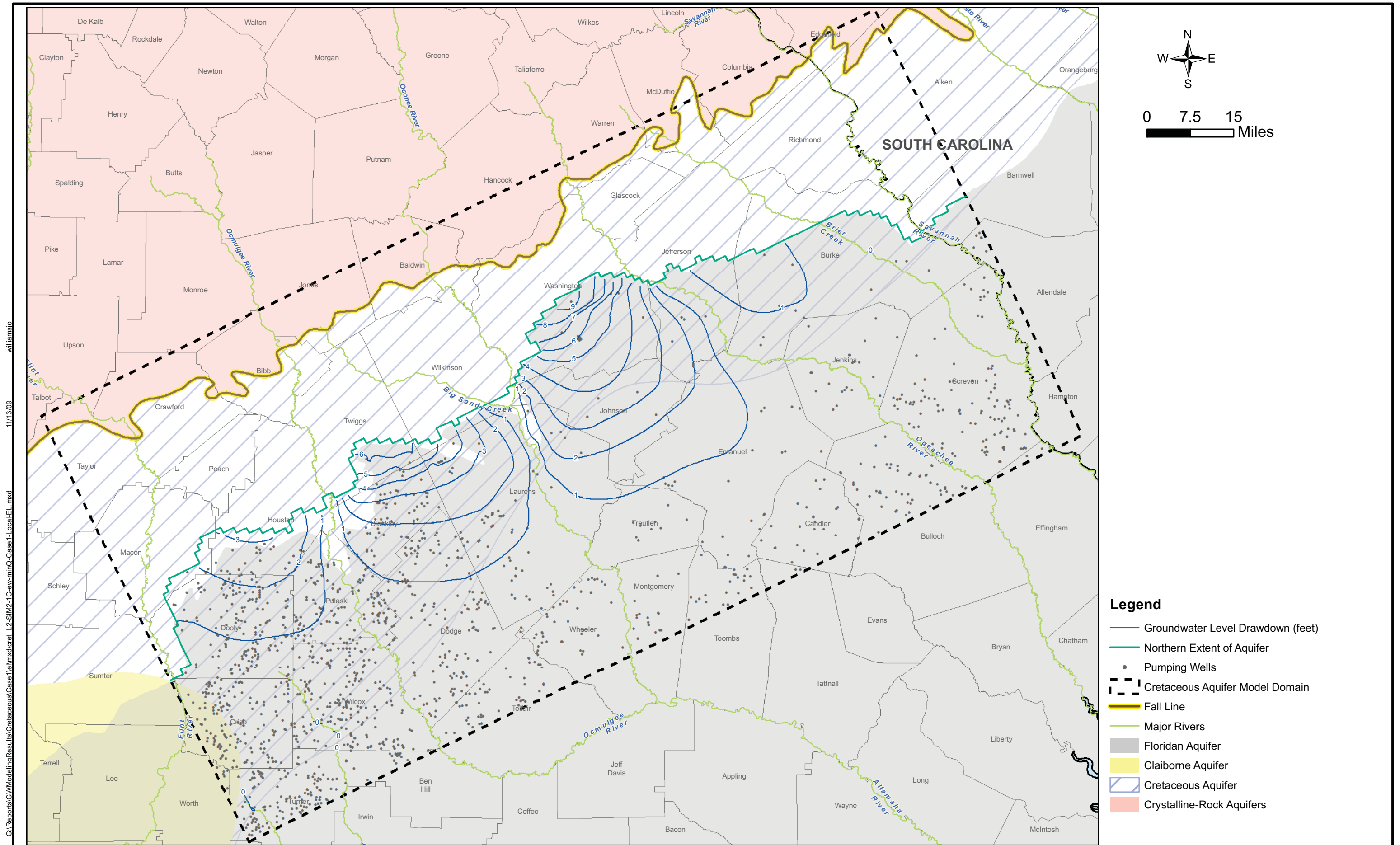
**CDM**

**Figure 15-12**  
**Simulated Groundwater Elevations in Eutaw-Midville Aquifer (Layer 6)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

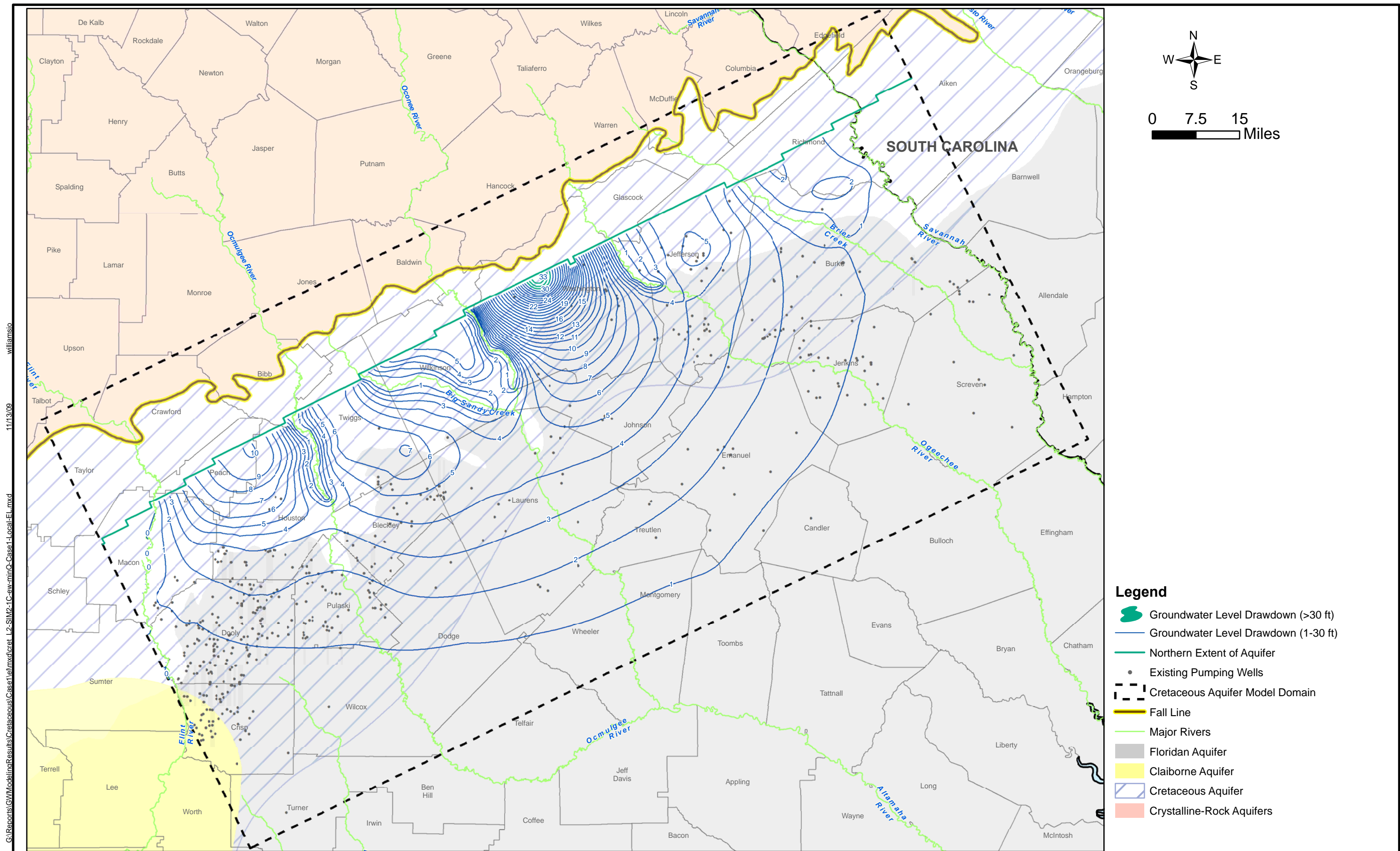




**Figure 15-13**  
**Simulated Groundwater Elevations in Upper Atkinson-Upper Tuscaloosa Aquifers (Layer 7)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**



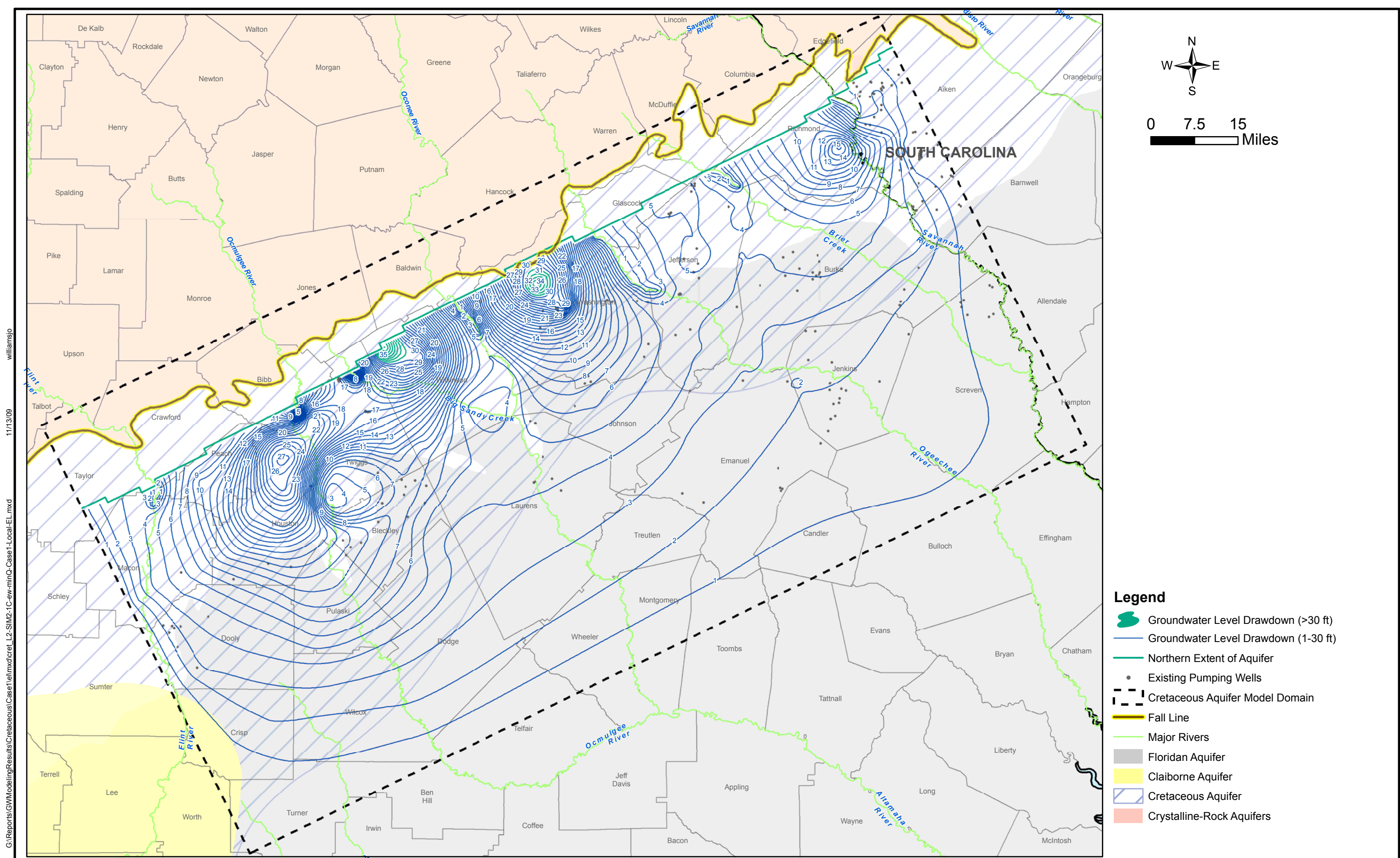




G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\creat\_12\_SIM2-1C-ew-minO-Case1-localLEL.mxd 11/13/09 williamsio

**CDM** **Figure 15-15**  
**Simulated Groundwater Level Drawdown in Claiborne/Gordon/Lower Floridan Aquifers Aquifer (Layer 3)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**



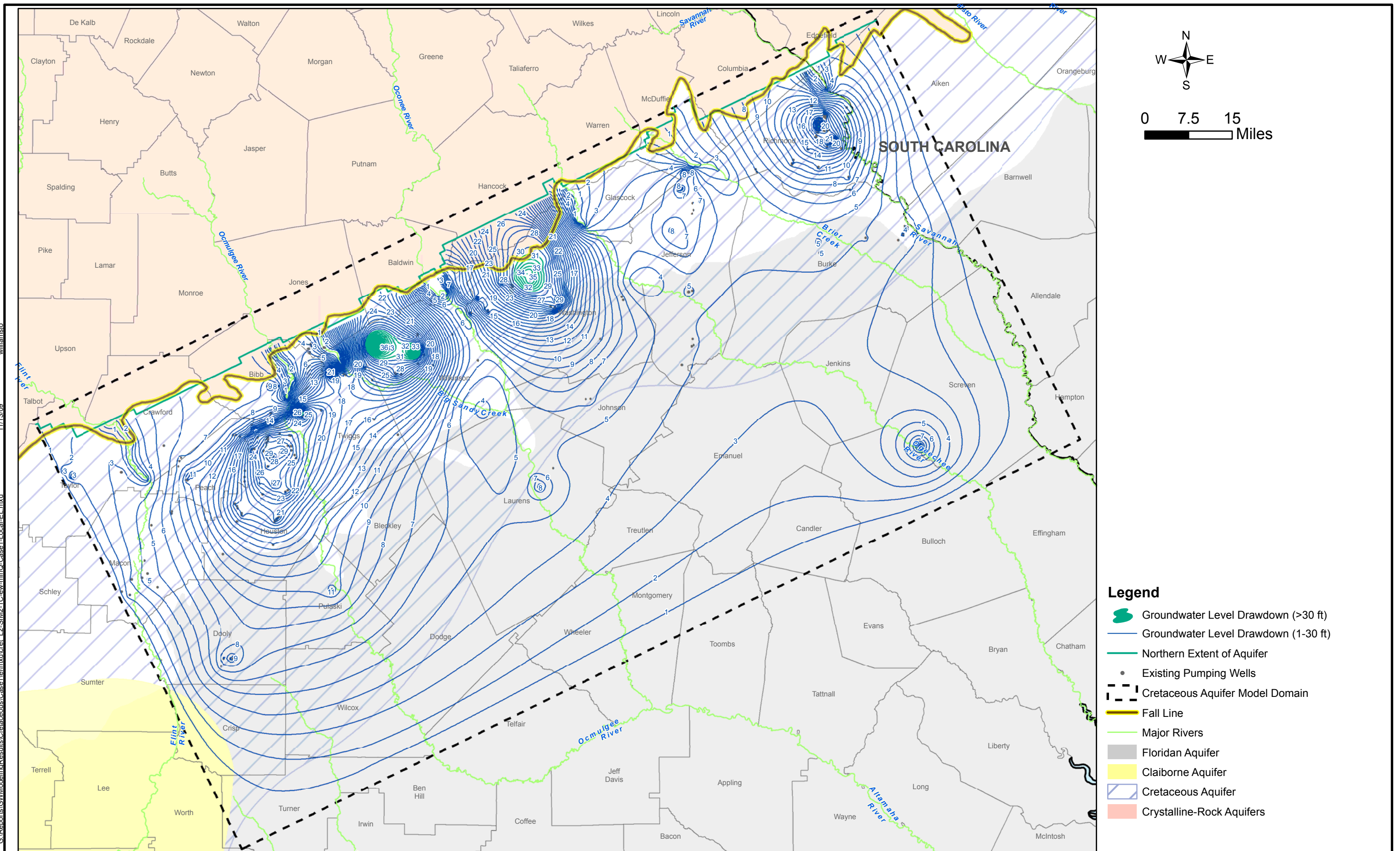


**CDM**

**Figure 15-16**  
**Simulated Groundwater Level Drawdown in Clayton-Dublin Aquifers (Layer 4)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifer ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

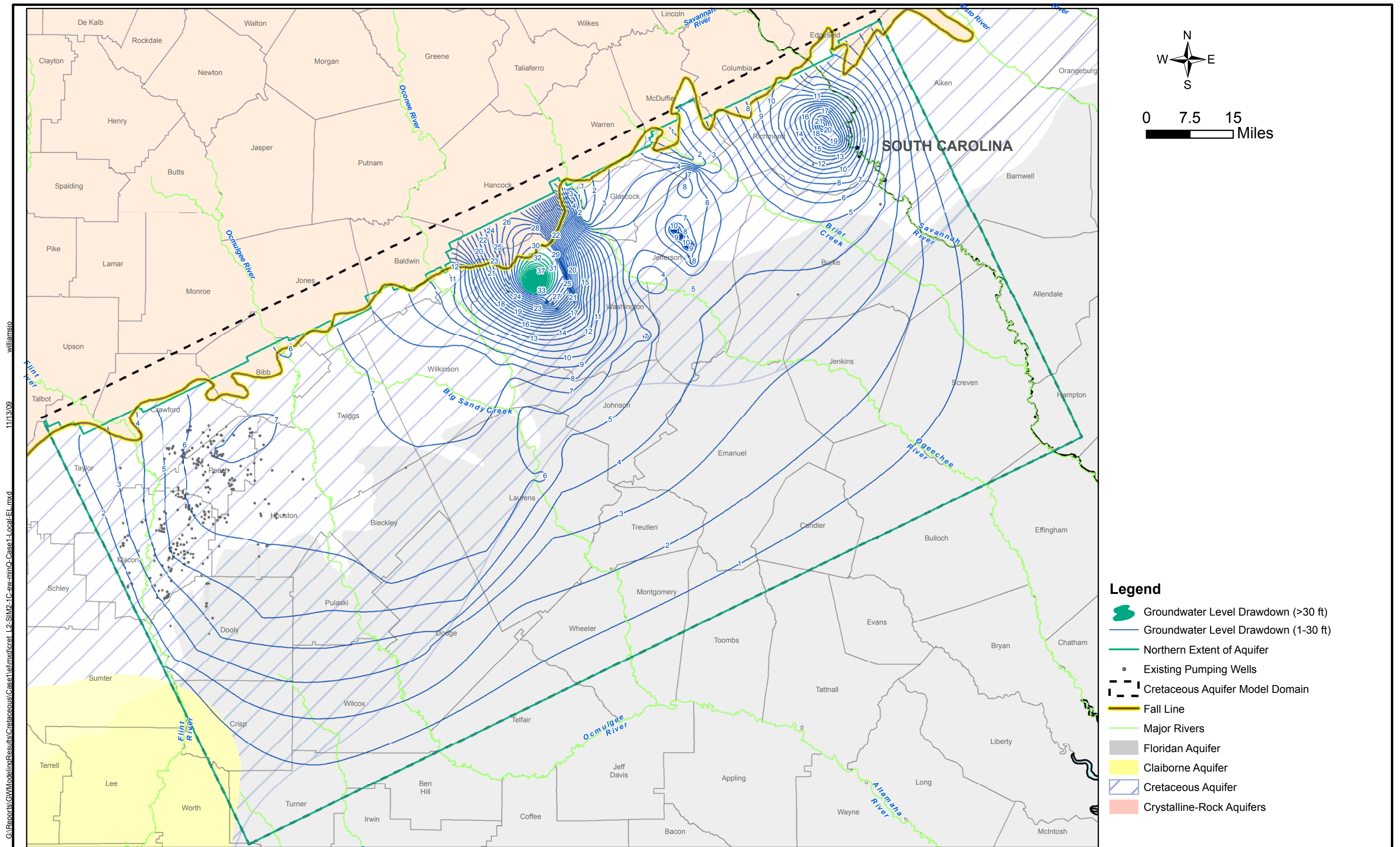


G:\Reports\GWM\modelingResults\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio



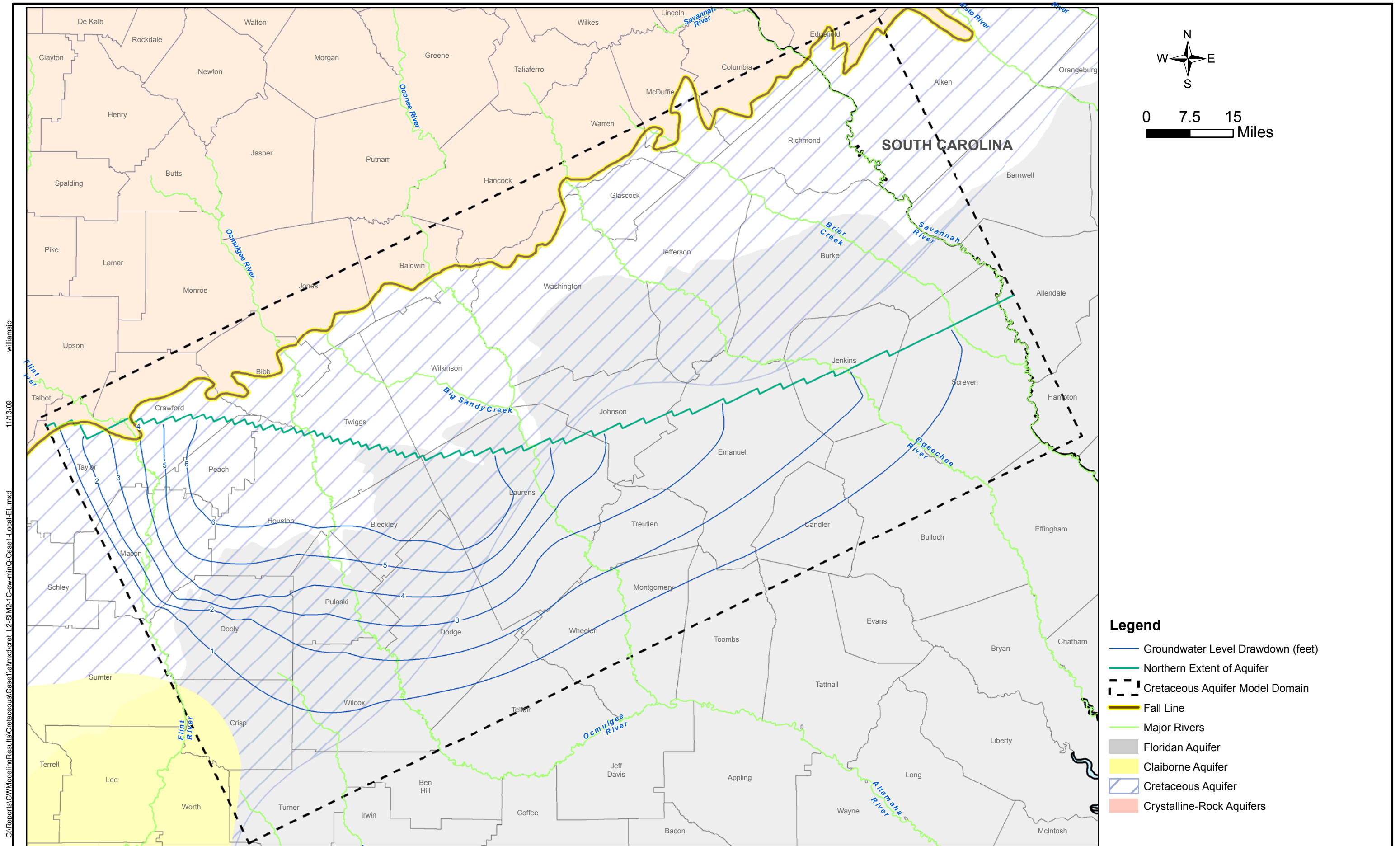
**Figure 15-17**  
**Simulated Groundwater Level Drawdown in Providence Sand-Peedee-Dublin Aquifers (Layer 5)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





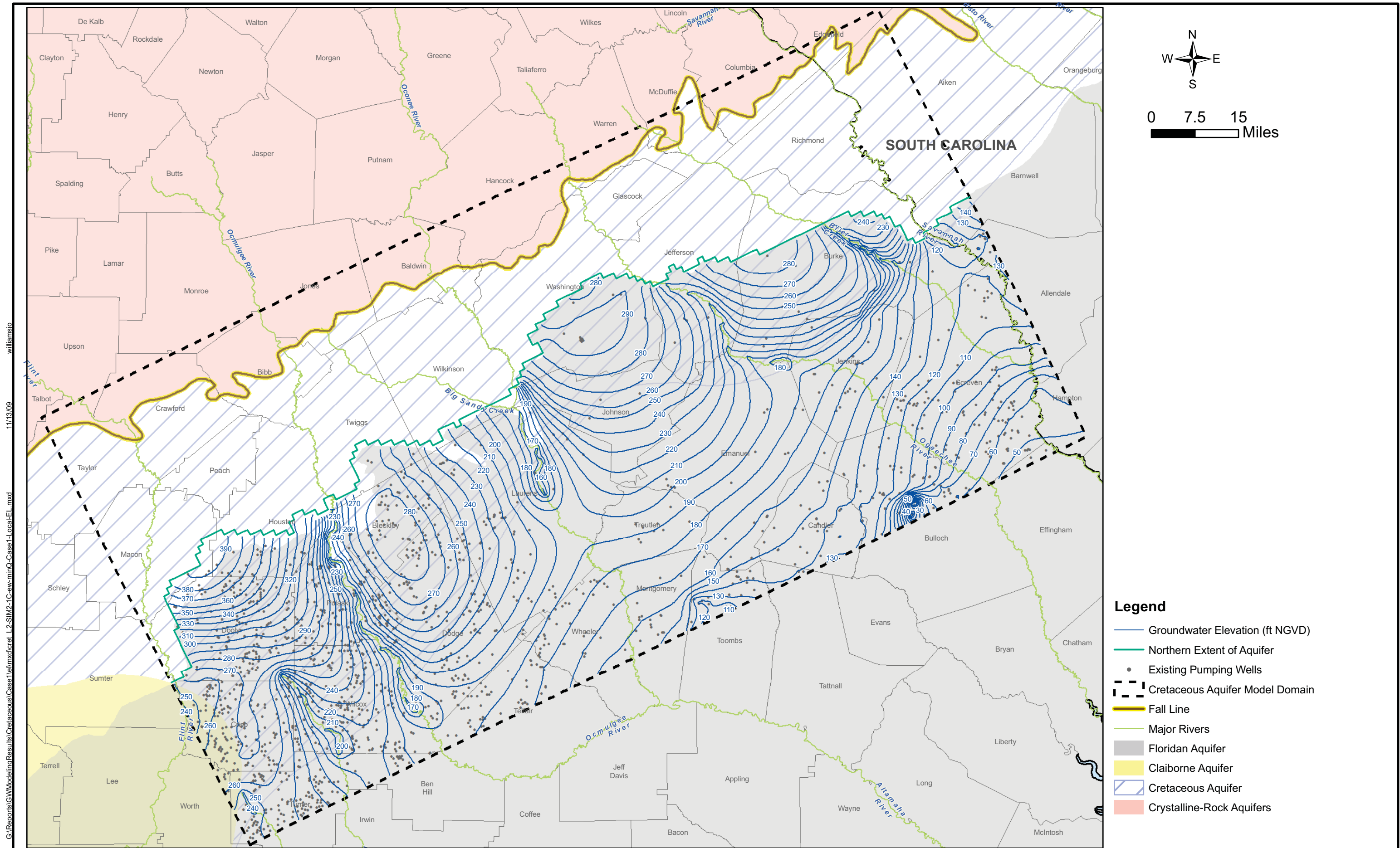
G:\Reports\GWM\modelingResults\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-Local-EL.mxd 11/13/09 williamsio





**Figure 15-19**  
**Simulated Groundwater Level Drawdown in Upper Atkinson-Upper Tuscaloosa Aquifers (Layer 7)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 74$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

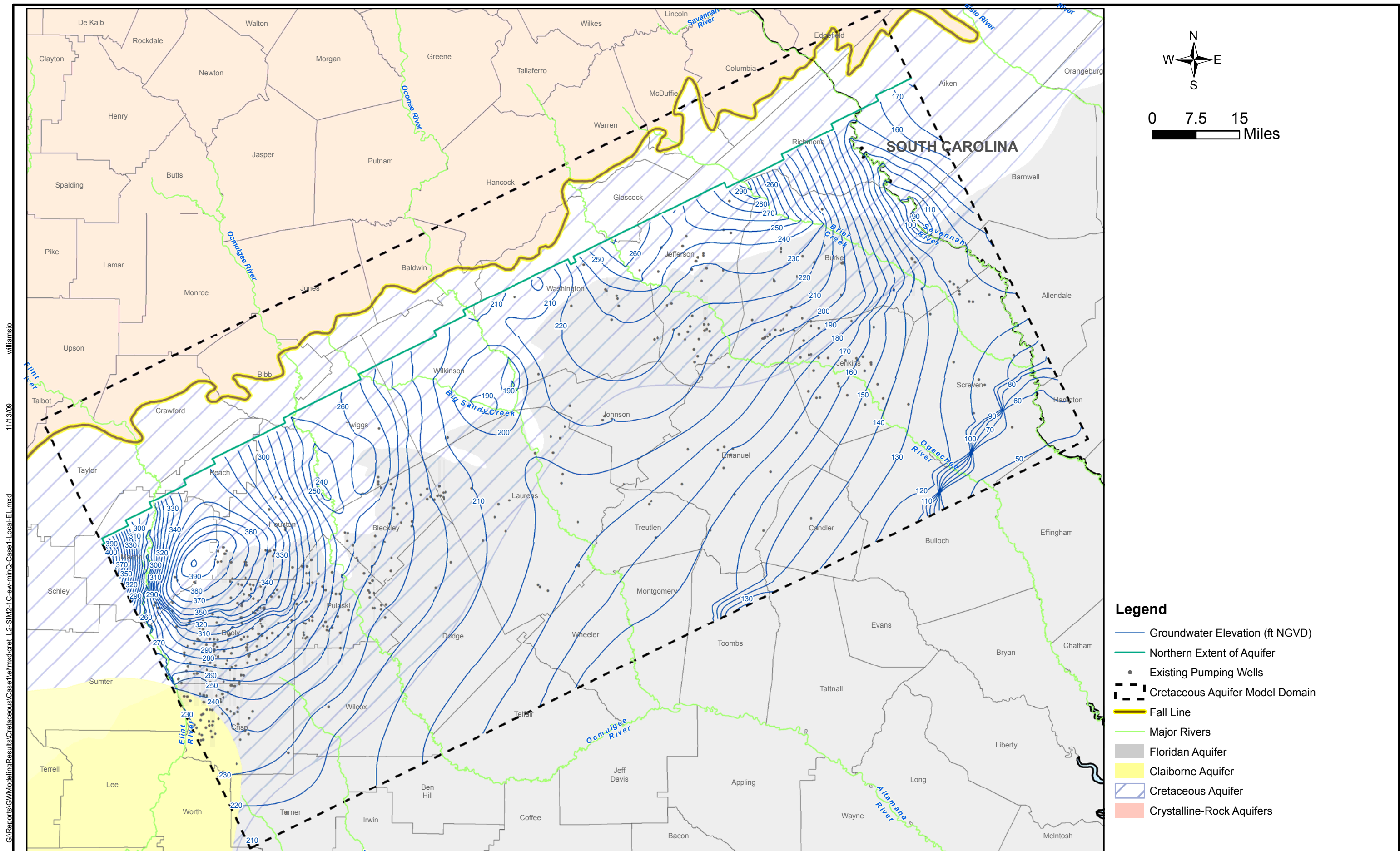




G:\Reports\GWMModelingResults\CretaceousCase1\ellmxd\craet\_L2\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio

**CDM** **Figure 15-20**  
**Simulated Groundwater Elevations in Upper Floridan Aquifer (Layer 2)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

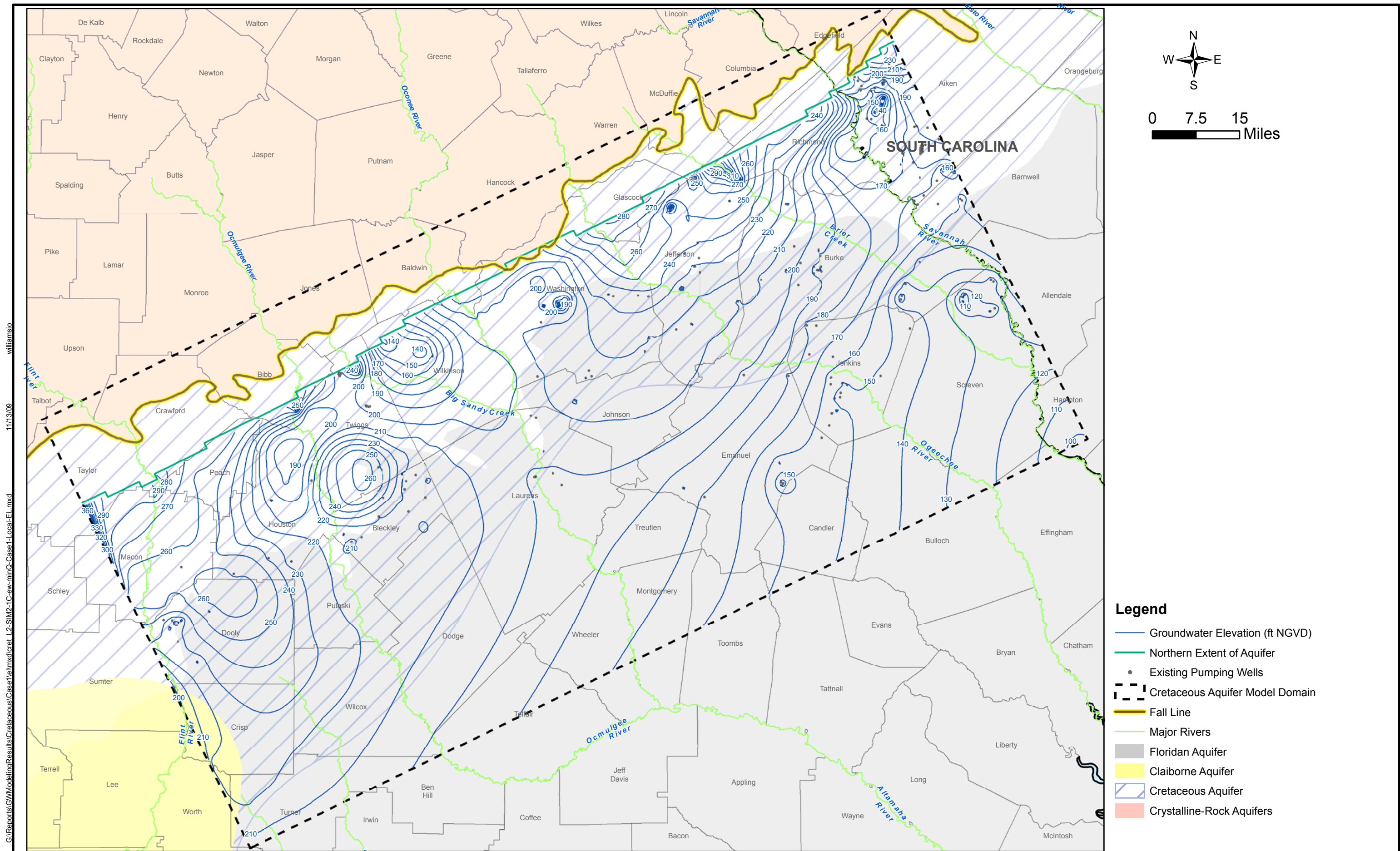




G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-Local-EL.mxd 11/13/09 williamsio

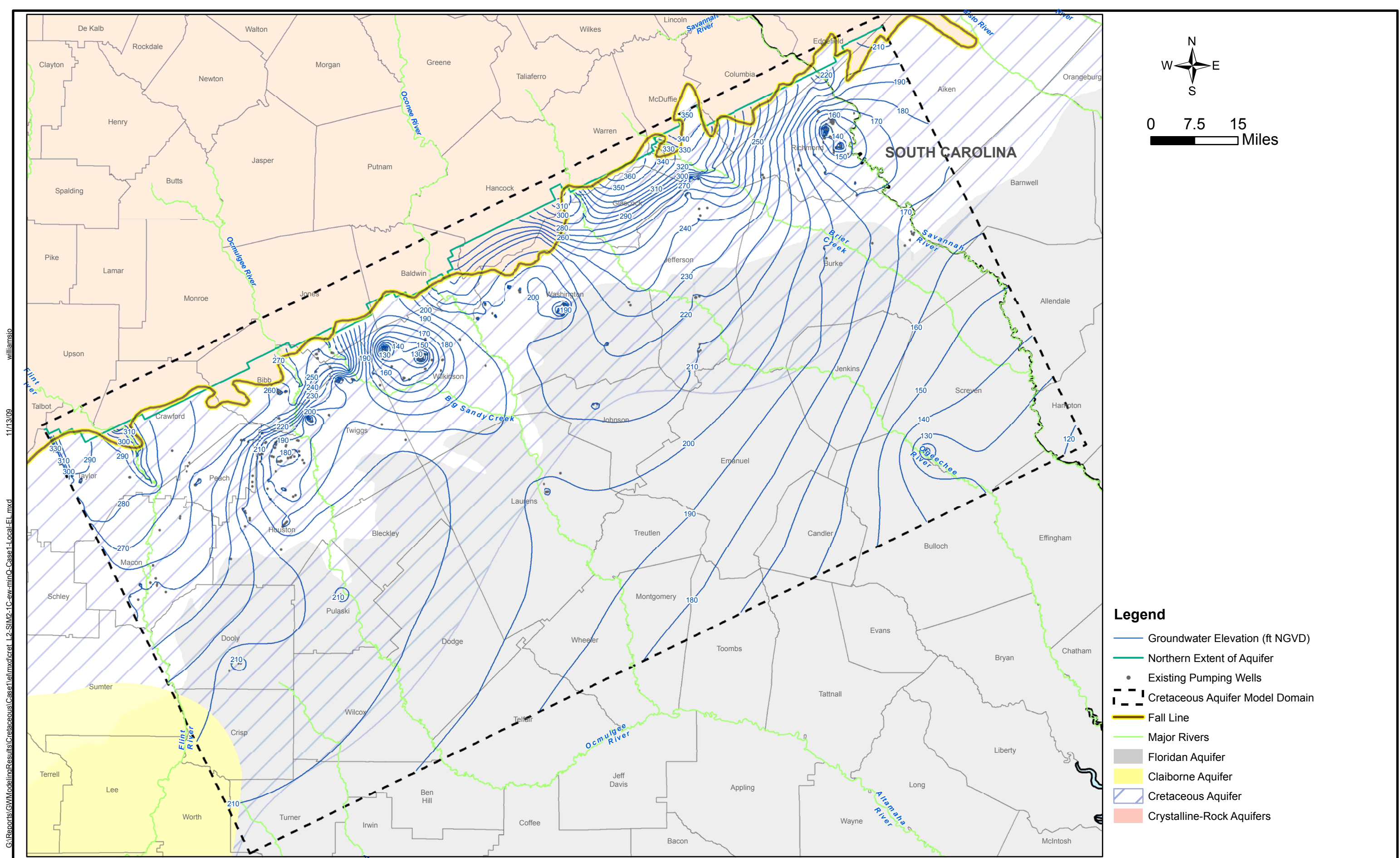
**CDM** **Figure 15-21**  
**Simulated Groundwater Elevations in Claiborne/Gordon/Lower Floridan Aquifers (Layer 3)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





**Figure 15-22**  
**Simulated Groundwater Elevations in Clayton-Dublin Aquifers (Layer 4)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**



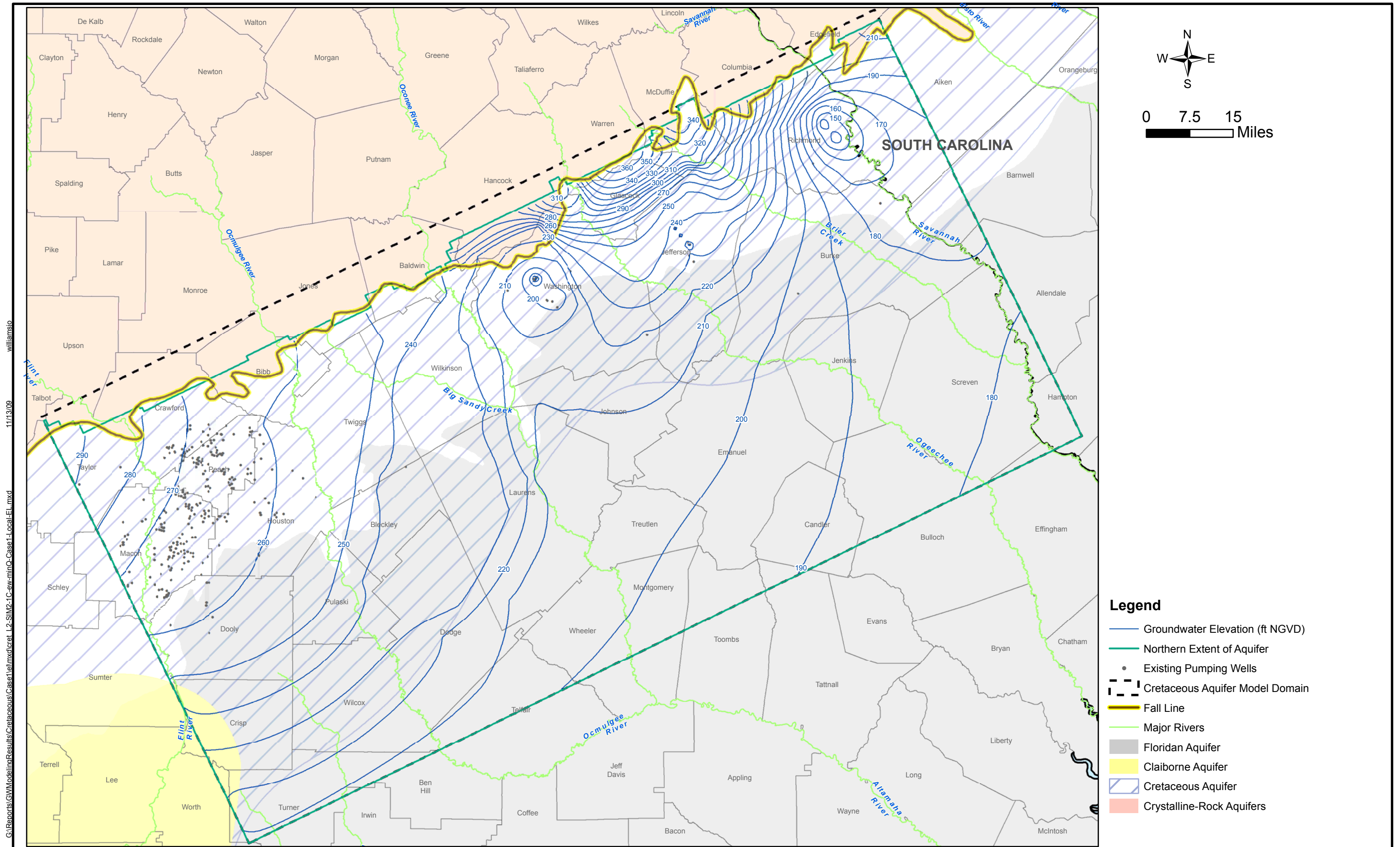


G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\lret\_12\_SIM2-1C-ew-minO-Case1-local-EL.mxd 11/13/09 williamsio

**Figure 15-23**  
**Simulated Groundwater Elevations in Providence Sand-Peedee-Dublin Aquifers (Layer 5)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

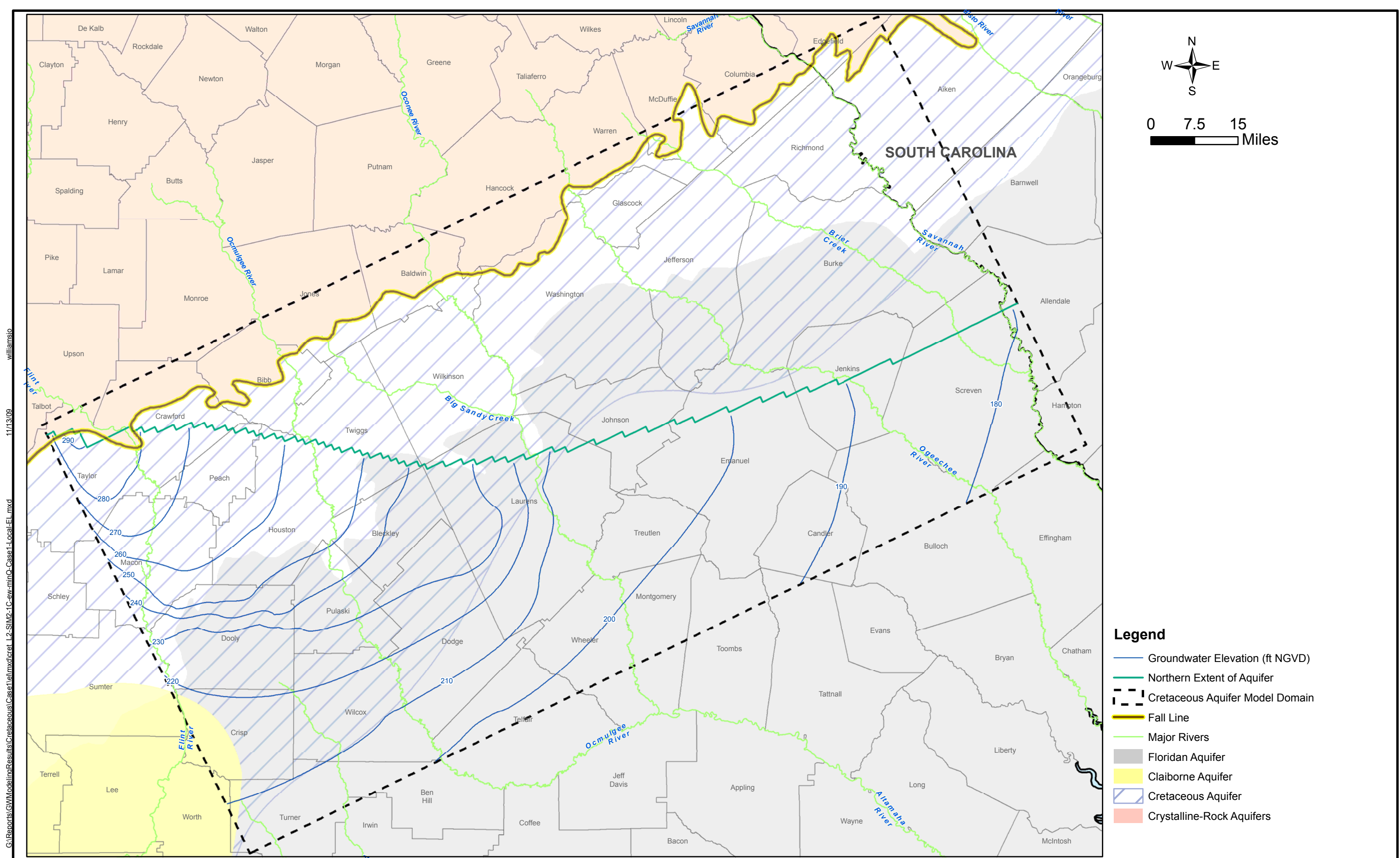






**CDM**

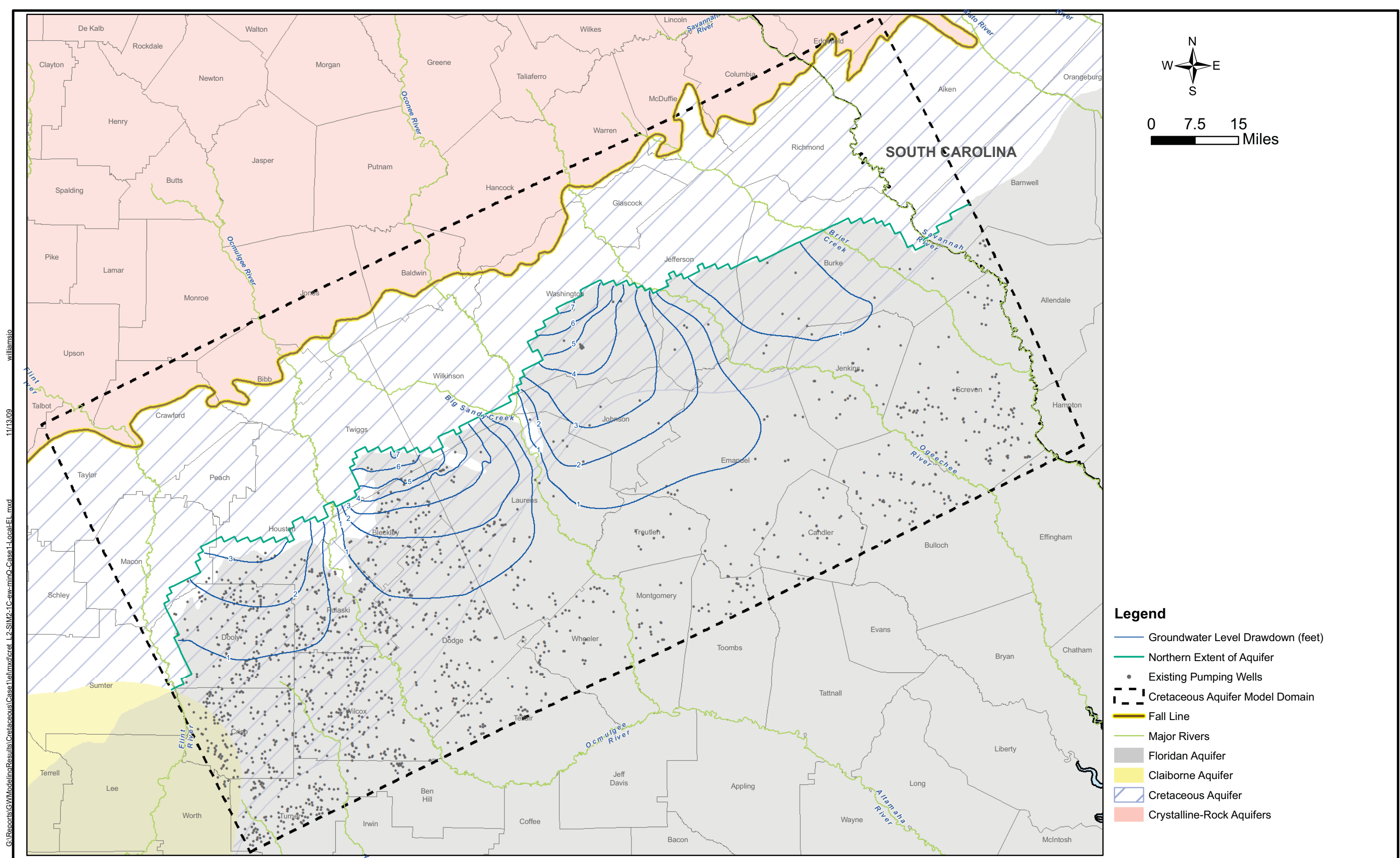
**Figure 15-24**  
**Simulated Groundwater Elevations in Eutaw-Midville Aquifer (Layer 6)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**



G:\Reports\GWM\modelling\Results\Cretaceous\Case1\ellmxd\creat\_12\_SIM2-1C-ew-minO-Case1-local-EL.mxd 11/13/09 williamsio

**CDM** **Figure 15-25**  
**Simulated Groundwater Elevations in Upper Atkinson-Upper Tuscaloosa Aquifers (Layer 7)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

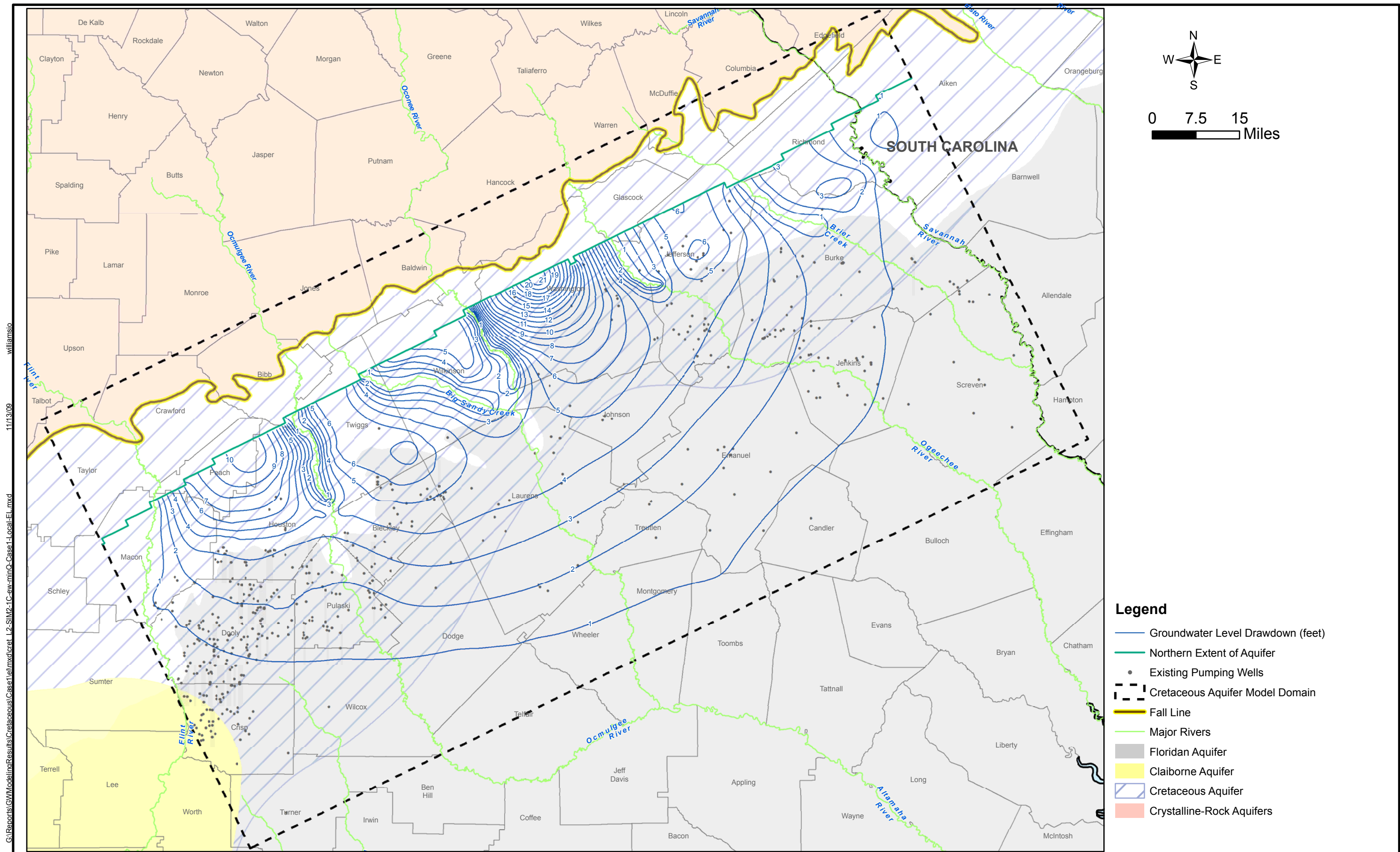




G:\Reports\GWM\ModelingResults\Cretaceous\Case1\ellmxd\craet\_12\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio

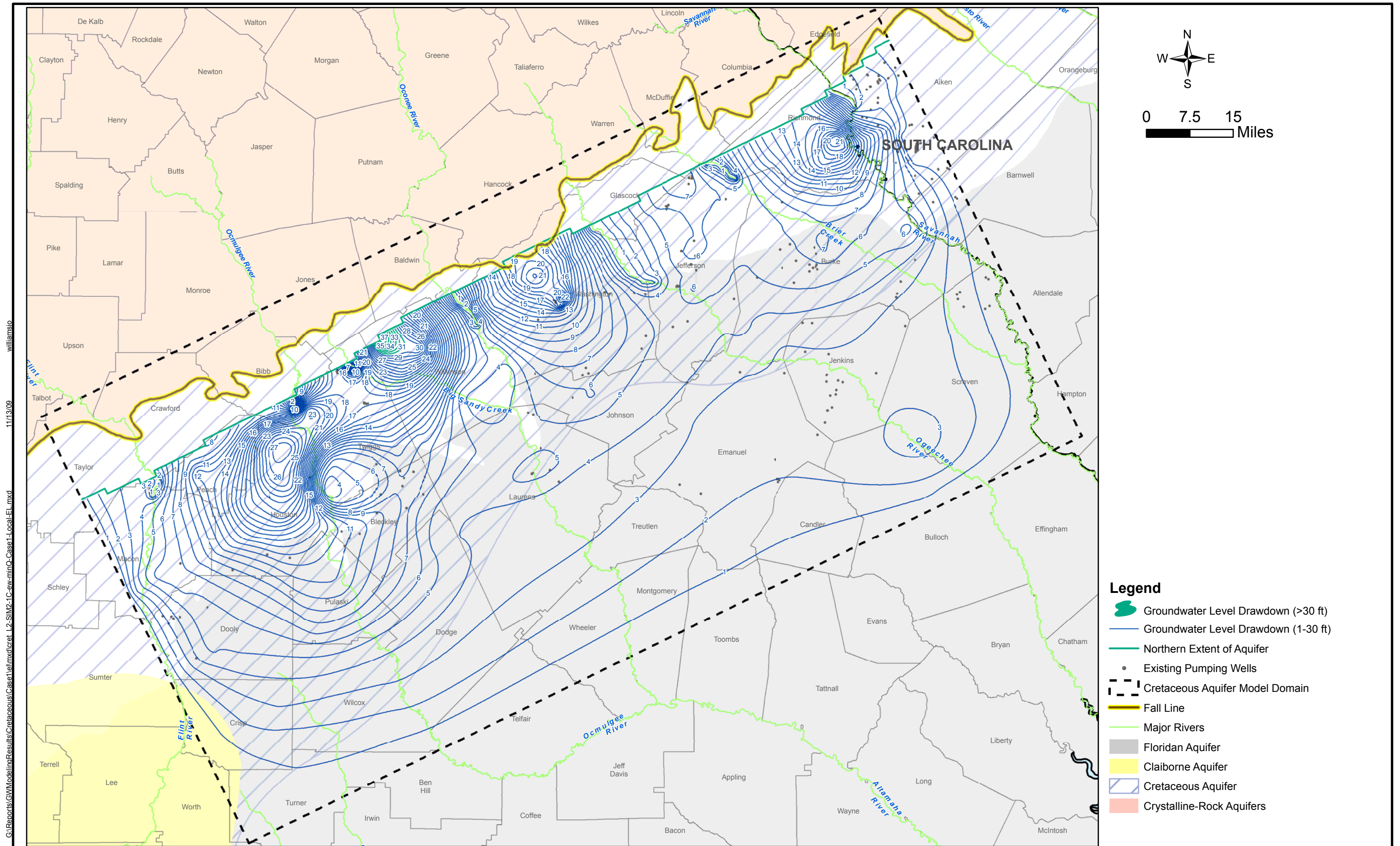
**CDM** **Figure 15-26**  
**Simulated Groundwater Level Drawdown in Upper Floridan Aquifer (Layer 2)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





**Figure 15-27**  
**Simulated Groundwater Level Drawdown in Claiborne/Gordon/Lower Floridan Aquifers (Layer 3)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**

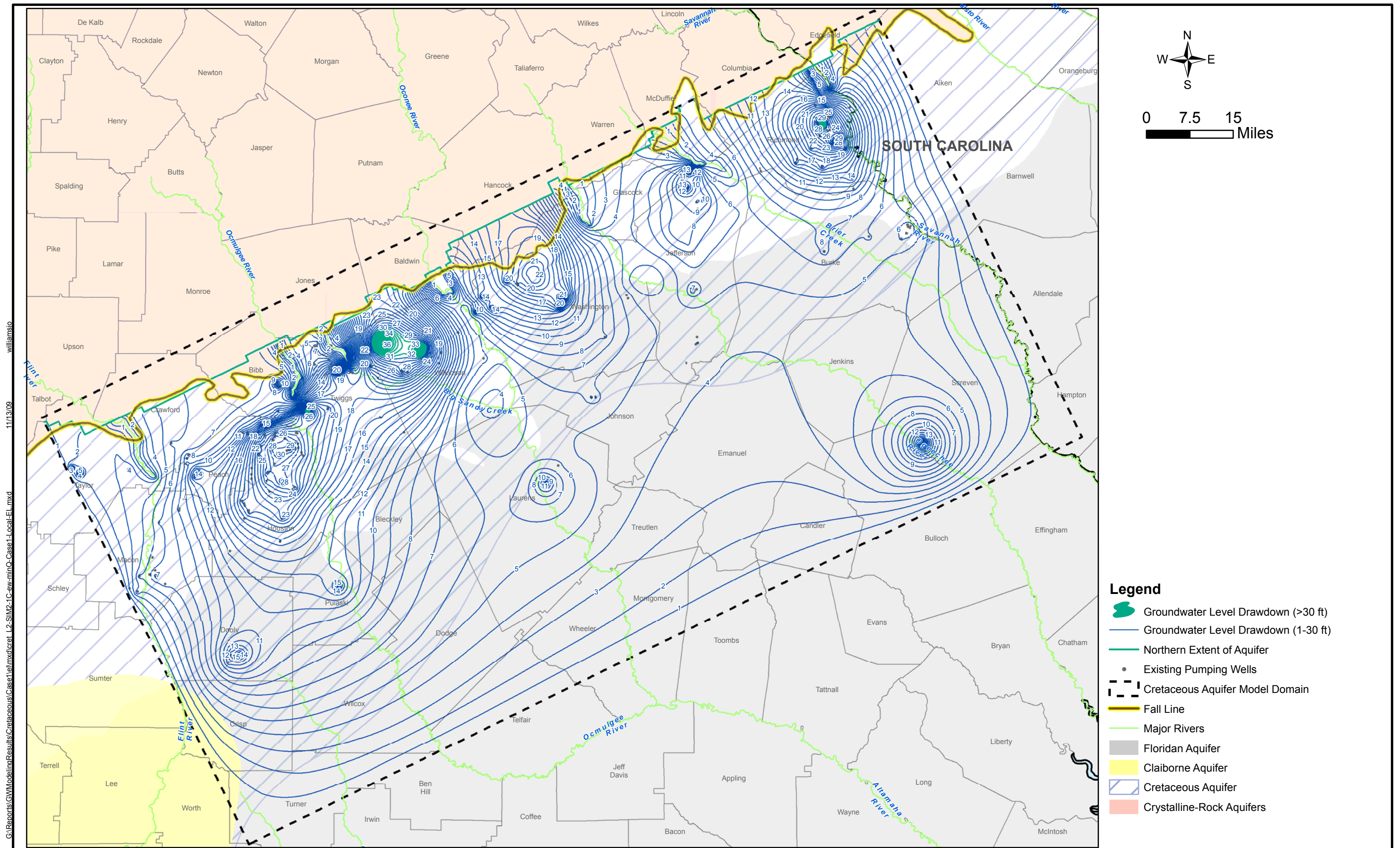




G:\Reports\GWM\modeling\Results\Cretaceous\Case1\ellmxd\crt L2\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio

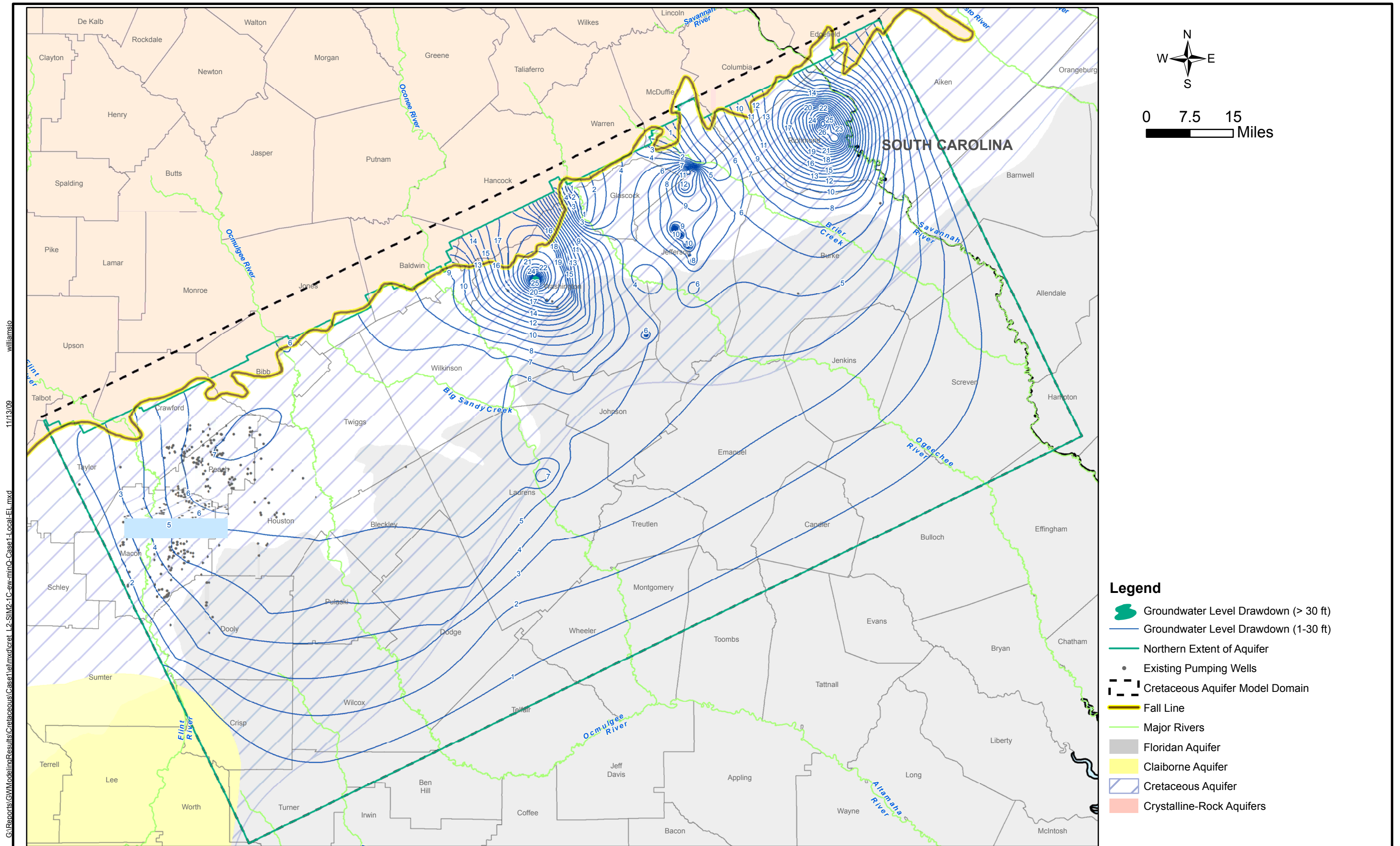
**Figure 15-28**  
**Simulated Groundwater Level Drawdown in Clayton-Dublin Aquifers (Layer 4)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifer ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





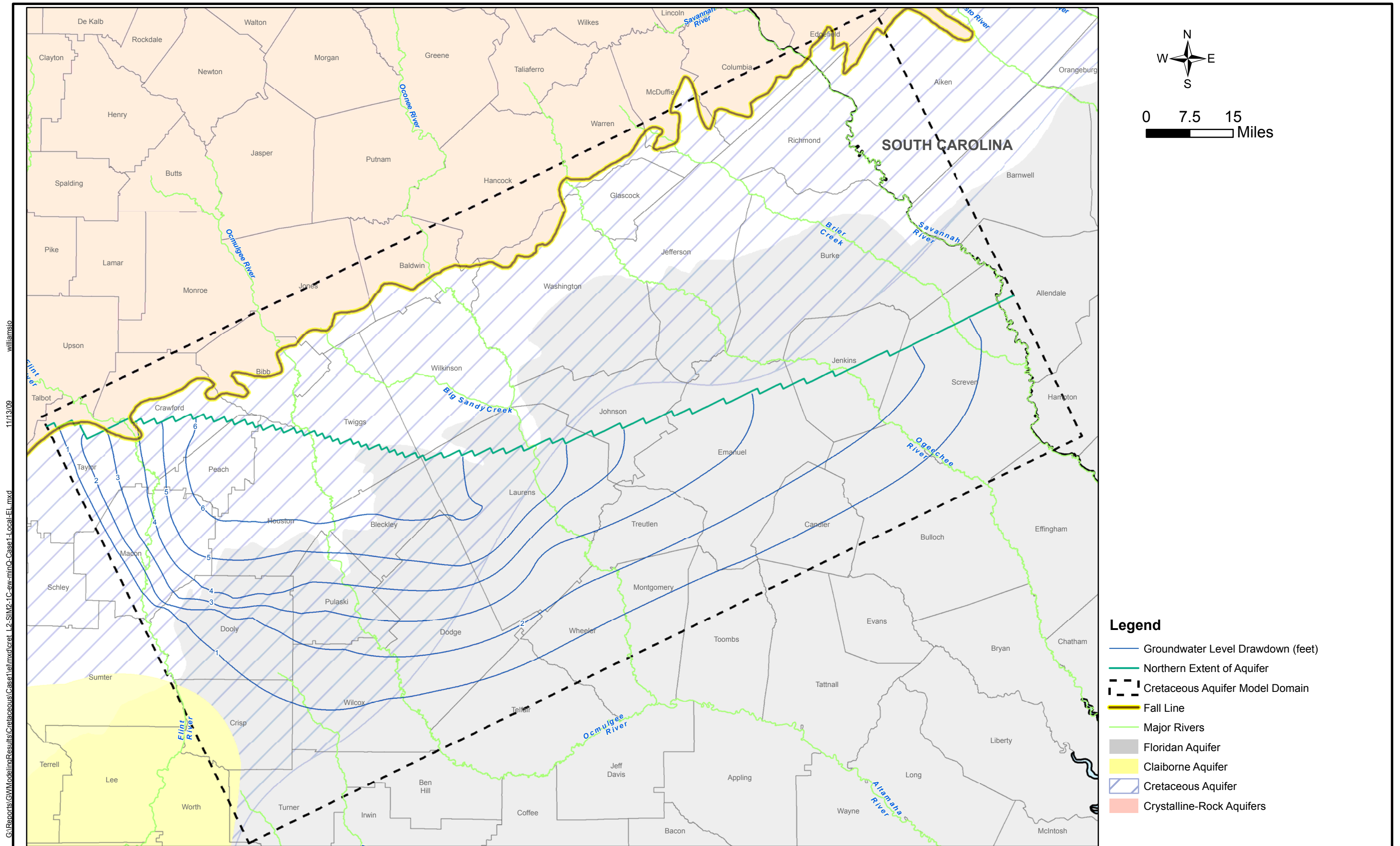
**Figure 15-29**  
**Simulated Groundwater Level Drawdown in Providence Sand-Peedee-Dublin Aquifers (Layer 5)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifer ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





**Figure 15-30**  
**Simulated Groundwater Level Drawdown in Eutaw-Midville Aquifer (Layer 6)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**





G:\Reports\GWM\modellingResults\Cretaceous\Case1\ellmxd\creat\_12\_SIM2-1C-ew-minO-Case1-LocalLEL.mxd 11/13/09 williamsio

**CDM** **Figure 15-31**  
**Simulated Groundwater Level Drawdown in Upper Atkinson-Upper Tuscaloosa Aquifers (Layer 7)**  
**Due to Increasing Existing Well Pumping in Providence Sand-Peedee-Dublin and Eutaw-Midville Aquifers ( $\Delta Q = 77$  mgd) Using Sub-Regional Cretaceous Aquifer Model**