



## Surface Water Availability Assessment in South Carolina Legislative Quarterly Report, February 2016

### Background

South Carolina currently has limited scientific information about the future demands on and availability of our water supply. As a result, the General Assembly allocated \$1.5M to complement South Carolina's new surface water permitting program administered by SC Department of Health and Environmental Control (DHEC), and to gather the information necessary to update the State Water Plan developed by SC Department of Natural Resources (DNR). The two agencies are in the process of gathering data on South Carolina's eight basins: Broad, Catawba, Edisto, Pee Dee, Salkehatchie, Saluda, Santee, and Savannah.





## Scientific Process for Measurement and Legislative Reporting

The availability assessment will develop a computer-generated model of each of the eight basins to evaluate existing water availability. These analyses will be used to inform the resource agencies and stakeholders if there are areas of the State where there is a “gap” or concern about the amount of water needed to meet our increasing demands over the next 50 years.

The funds appropriated above to the DNR for the State River Basin Study Project must be used for water data collection to provide scientific information on water resources in the state’s eight major river basins. The DNR shall, in cooperation with DHEC, submit to the Senate Finance Committee, the House Ways and Means Committee, the Senate Agriculture and Natural Resources Committee, and the House Agriculture, Natural Resources and Environmental Affairs Committee, a report on the project’s timeline, findings, and expenditure of funds on a quarterly basis. Additionally, this information will be posted electronically on DNR and DHEC websites.

## Summary of Activities During the Past Quarter

CDM Smith’s *Simplified Water Allocation Model (SWAM)* will be used for the project. During the past quarter, revisions were made to the calibration of the Saluda Basin Model and an additional verification analysis is being done for Lakes Murray and Greenwood to assess the model’s ability to reproduce lake levels. A draft of the Edisto Basin Model report was submitted and was posted on the DNR webpage, and the unimpaired (UIF) dataset for the Edisto basin was reevaluated to determine if low flows can more accurately be reproduced. A draft model schematic and framework of the Santee basin was completed and is under review. To date, model frameworks have been completed for the Saluda, Edisto, Broad, Catawba, Pee Dee and Santee basins; UIF datasets have been completed for the Saluda basin, and are under review for the Edisto basin, for the Tyger, Pacolet, and Enoree Rivers of the Broad basin, and for the Lynches, Black Creek, and Black Rivers of the Pee Dee basin; and draft models have been completed for the Saluda and Edisto basins.

The second of two planned stakeholder meetings for the Edisto and Saluda basins were held at the Clemson Research and Education Center in Blackville and at the Greenville downtown library on December 1<sup>st</sup> and 2<sup>nd</sup>, respectively. The first of two planned stakeholder meetings for the Santee basin is scheduled for March 2<sup>nd</sup> at Santee Cooper in Moncks Corner. A second SWAM training session was held in Columbia on December 3<sup>rd</sup>. It was attended by staff from DNR and DHEC and by members of the Technical Advisory Committee.

Progress reports are being provided by CDM Smith at monthly conference calls and at in-person meetings with DNR, DHEC, and the Technical Advisory Committee. CDM Smith and DNR made a presentation to the SC Chamber of Commerce Environmental Committee on February 5<sup>th</sup> in



Columbia. Written monthly progress reports and meeting notes are being posted on the DNR webpage. In addition to the monthly progress reports, CDM Smith is required to prepare quarterly progress reports, the sixth of which is provided below. Financial statements can be found at the end of this report. Additional information on the project can be found at the following websites:

<http://dnr.sc.gov/water/waterplan/surfacewater.html>

<http://www.scwatermodels.com/>

# South Carolina Surface Water Quantity Models Quarterly Progress Report No. 6

November 16, 2015 to February 15, 2016

## Introduction

The South Carolina Departments of Natural Resources (DNR) and Health and Environmental Control (DHEC) have contracted with CDM Smith to develop surface water quantity models in the eight major river basins in South Carolina. Per the requirements of the contract, CDM Smith will prepare and submit Quarterly Progress Reports summarizing work completed on each basin model. This sixth Quarterly Progress Report covers the three month period from November 16, 2015 to February 15, 2016.

The Quarterly Progress Report provides a bulleted summary of activities and accomplishments; identifies upcoming work and deliverables; highlights issues that have the potential to impact scope, schedule or costs; and provides the current project schedule. Activities and accomplishments are presented for the following categories: (1) project planning and management; (2) data collection; (3) data analysis and modeling; and (4) stakeholder involvement.

## Activities and Accomplishments

### Project Planning and Management

- Monthly Progress meetings attended by CDM Smith and DNR/DHEC project staff were held on December 9<sup>th</sup> and January 4<sup>th</sup>, 2015, and February 1<sup>st</sup>, 2016
- Project submittals to date include:
  - Draft and Final Modeling Plan
  - Draft and Final Unimpaired Flow (UIF) Results Technical Memorandum for the Saluda and Edisto basins.
  - Draft UIF Methodology Technical Memorandum for the Broad Basin
  - Draft and Final Modeling Framework for the Saluda, Edisto, Broad, Catawba-Wateree and Pee Dee basins; Draft Modeling Framework for the Santee Basin.
  - Draft and Final Technical Memoranda and model summarizing historical agriculture irrigation withdrawal estimates fall all basins
  - Draft and Final UIF Dataset for the Saluda Basin (not including the Congaree River); Draft UIF Dataset for the Edisto River; Partial Draft UIF Datasets for the Broad and Pee Dee Basins.
  - Draft Modeling Reports for the Saluda and Edisto SWAM Models
  - An updated version of the SWAM User's Manual (v3.0)
  - Various additional memoranda summarizing modeling methodology

## Data Collection

- CDM Smith has substantially finished contacting registered and permitted water users in the Saluda, Edisto, Broad, Catawba, Pee Dee, Salkehatchie and Santee basins to confirm reported withdrawal amounts, sources, and discharge amounts; collect pre-reporting withdrawal amounts (or estimates); and confirm other operational parameters. As work progresses in each basin, certain users are contacted again to clarify data, and seek additional data where necessary.
- Daily average UIFs calculated at Blewett Falls (in North Carolina), and six upstream developments on the Pee Dee River were received from HDR, Inc., covering the period from 1955 through 2013.
- Data requests were made to the Georgia EPD (for Savannah River UIFs) and the Army Corps of Engineers (for the Savannah HEC-RESSIM model reservoir rules).
- The stage-storage curve for Lake Greenwood (Saluda Basin) was received from the Greenwood County Engineer via DNR.

## Data Analysis and Modeling

### Saluda (Pilot Basin Model)

- CDM Smith made revisions to the Saluda Basin Pilot Model and the Saluda Basin Modeling Report, addressing DNR's comments. Revisions included additional, focused model verification during drought periods.
- At DNR's request, CDM Smith initiated an additional verification exercise focusing on Lake Murray. Releases from the lake were being fixed in the model at gage-measured values, and the model's ability to match lake elevations/storage was being assessed. This serves as a check of inflow and evaporation estimates, and confirms that the model is correctly performing reservoir calculations.
- A second SWAM training session was held at CDM Smith's offices on December 3<sup>rd</sup>, 2015. Six Technical Advisory Committee (TAC) members, two DHEC staff, and three DNR staff attended.

### Edisto

- Alternative headwater flows/UIFs for tributaries to the North and South Fork of the Edisto were evaluated in order to improve the model simulated peak flows, eliminate the seasonality observed at select gages, and improve the model's ability to more accurately reproduce low flows. A final set of headwater flows was selected and both daily and monthly calibration workbooks were submitted to DNR and DHEC for review. A final UIF dataset will be submitted once DNR review of the calibration model is complete.

### Broad

- CDM Smith submitted draft UIFs for the Enoree, Tyger, and Pacolet Rivers to DNR. Following receipt of DNR comments, CDM Smith made revisions and began working on the extensions and mainstem UIFs.

### Pee Dee

- Work continued on the Pee Dee Basin UIF Methodology Memorandum and draft UIFs of the Lynches River, Black Creek, and Black River were submitted to DNR for review.

### Catawba-Wateree

- Discussions with DNR, DHEC, and the TAC's Duke Energy representative were held to evaluate the advantages and disadvantages of extending the SWAM model into the North Carolina portion of the basin. Based on the discussion, and after subsequent consideration, DNR directed CDM Smith to proceed as originally planned, and develop the model to represent the South Carolina portion of the basin. Inflows and other input from the CHEOPS model will be used as input into the SWAM model, to account for water management activities in the North Carolina portion.

### Santee

- A Draft SWAM model schematic and framework of the Santee Basin was developed and submitted for DNR, DHEC and TAC review.

### Savannah

- The Keowee-Toxaway Relicensing Agreement, and other pertinent documents were reviewed. Discussions were held with Georgia EPD and the Army Corps of Engineers regarding the existing unimpaired flows and water allocation models.

### Salkehatchie

- CDM Smith began developing the draft model framework for the Salkehatchie basin.

## **Stakeholder Involvement**

- The second of two planned Stakeholder Meetings in the Saluda Basin was held on December 2<sup>nd</sup> at the Greenville Downtown Library.
- The second of two planned Stakeholder Meetings in the Edisto Basin was held on December 1<sup>st</sup> at Clemson Research and Education Center in Blackville.
- The project TAC was included on monthly progress calls and given the opportunity to review and comment on various deliverables and interim work products. The TAC also attended the SWAM training session on December 3<sup>rd</sup>.

## Summary of Upcoming Work

Over the next quarter, the project team will:

- Finalize development of the UIF dataset for the Broad and Pee Dee Basins.
- Finalize development of the Edisto Baseline Model.
- Using the Broad UIF Dataset as input, finalize the Saluda UIF Dataset and Baseline Model.
- Complete draft SWAM calibration and baseline models for the Broad and Pee Dee basins.
- Develop the model framework for the Salkehatchie and Savannah basins.
- Hold the first Stakeholder Meeting in the Santee Basin on March 2<sup>nd</sup>.
- Begin Development of the Catawba Basin UIF dataset and calibration model.

## Issues Impacting Scope, Schedule, or Project Cost

Additional discussions were held between CDM Smith and DNR regarding how reservoir operating rules are incorporated in SWAM. DNR indicated the preference for additional flexibility in SWAM to allow the user to evaluate more complex alternative management rules. CDM Smith prepared a change order request and submitted it to DNR that will allow for increased flexibility with regard to reservoir operating rules. This additional work will result in a minor increase in scope and project cost.

Schedule adjustments were made to reflect the project progress and more accurately account for future deliverables. It is currently anticipated that due to delays in completion of the pilot model, the project schedule will need to be extended approximately six months, to the end of 2016. An updated schedule is attached.

During the project kickoff meeting, and based on DNR and DHEC review of the draft Modeling Plan, several potential out-of-scope model enhancements were identified. These include:

- A “Current Situation Analysis” for quasi-real time operational support. This functionality would provide a probabilistic analysis of current conditions at any future point in time and how conditions are likely to change within 6 or 12 months based on projected use and management patterns.
- The ability to use near-term hydrologic flow forecasts (for example, 60-day streamflow forecasts from NOAA) for month-to-month operational planning.
- Use of HEC DSSVue for and DSS files for results display and analysis.

CDM Smith has presented a scope for implementing these enhancements to DNR and DHEC, and will prepare cost following completion of the pilot (Saluda) model. The decision on whether to implement one or more of these enhancements will likely be made once additional models are completed.





## CDM Smith Invoice Number 15

Invoice Date: December 8, 2015

For Services Between: October 31, 2015 and December 5, 2015

River Basin	Original Contract Amount	Amended Contract Amount <sup>2</sup>	This Invoice	Total Invoiced	Amount Remaining	Percent Complete
Saluda	\$155,926	\$162,489	\$940	\$161,970	\$519	99%
Edisto <sup>1</sup>	\$226,034	\$232,597	\$6,750	\$229,820	\$2,777	99%
Broad	\$132,960	\$170,023	\$12,400	\$134,675	\$35,348	79%
Pee Dee	\$189,865	\$196,428	\$24,890	\$135,850	\$60,578	69%
Catawba	\$141,639	\$164,802	\$8,120	\$58,002	\$106,800	35%
Santee	\$128,775	\$135,338	\$4,300	\$26,390	\$108,948	19%
Savannah	\$154,637	\$161,200	\$1,200	\$14,100	\$147,100	9%
Salkehatchie	\$128,775	\$135,338	\$6,200	\$26,100	\$109,238	19%
<b>Total</b>	<b>\$1,258,611</b>	<b>\$1,358,211</b>	<b>\$64,800</b>	<b>\$786,907</b>	<b>\$571,304</b>	<b>58%</b>

<sup>1</sup> Project startup-activities including the kickoff meeting, modeling plan, model enhancement and other activities were included under the Edisto Basin budget. The Edisto was originally identified as the pilot basin for modeling.

<sup>2</sup> The amended contract amount includes an additional (1) \$30,500 for the Broad River Basin unimpaired flow development; (2) \$16,600 for the Catawba Basin unimpaired flow development; and (3) \$52,500 for additional meetings, divided equally between all eight basins (\$6,562.50 each).

## CDM Smith Invoice Number 16

Invoice Date: January 4, 2016

For Services Between: December 6, 2015 and January 2, 2016

River Basin	Original Contract Amount	Amended Contract Amount <sup>2</sup>	This Invoice	Total Invoiced	Amount Remaining	Percent Complete
Saluda	\$155,926	\$162,489	\$519	\$162,489	\$0	100%
Edisto <sup>1</sup>	\$226,034	\$232,597	\$600	\$230,420	\$2,177	99%
Broad	\$132,960	\$170,023	\$8,400	\$143,075	\$26,948	84%
Pee Dee	\$189,865	\$196,428	\$9,850	\$145,700	\$50,728	74%
Catawba	\$141,639	\$164,802	\$2,100	\$60,102	\$104,700	36%
Santee	\$128,775	\$135,338	\$3,640	\$30,030	\$105,308	22%
Savannah	\$154,637	\$161,200	\$0	\$14,100	\$147,100	9%
Salkehatchie	\$128,775	\$135,338	\$0	\$26,100	\$109,238	19%
<b>Total</b>	<b>\$1,258,611</b>	<b>\$1,358,211</b>	<b>\$25,109</b>	<b>\$812,016</b>	<b>\$546,196</b>	<b>60%</b>

<sup>1</sup> Project startup-activities including the kickoff meeting, modeling plan, model enhancement and other activities were included under the Edisto Basin budget. The Edisto was originally identified as the pilot basin for modeling.

<sup>2</sup> The amended contract amount includes an additional (1) \$30,500 for the Broad River Basin unimpaired flow development; (2) \$16,600 for the Catawba Basin unimpaired flow development; and (3) \$52,500 for additional meetings, divided equally between all eight basins (\$6,562.50 each).



## CDM Smith Invoice Number 17

Invoice Date: February 1, 2016

For Services Between: January 3, 2016 and January 31, 2016

River Basin	Original Contract Amount	Amended Contract Amount <sup>2</sup>	This Invoice	Total Invoiced	Amount Remaining	Percent Complete
Saluda	\$155,926	\$162,489	\$0	\$162,489	\$0	100%
Edisto <sup>1</sup>	\$226,034	\$232,597	\$1,800	\$232,220	\$377	99.8%
Broad	\$132,960	\$170,023	\$4,923	\$147,998	\$22,025	87%
Pee Dee	\$189,865	\$196,428	\$9,825	\$155,525	\$40,903	79%
Catawba	\$141,639	\$164,802	\$3,630	\$63,732	\$101,070	39%
Santee	\$128,775	\$135,338	\$14,000	\$44,030	\$91,308	33%
Savannah	\$154,637	\$161,200	\$4,800	\$18,900	\$142,300	12%
Salkehatchie	\$128,775	\$135,338	\$0	\$26,100	\$109,238	19%
<b>Total</b>	<b>\$1,258,611</b>	<b>\$1,358,211</b>	<b>\$38,978</b>	<b>\$850,994</b>	<b>\$507,218</b>	<b>63%</b>

<sup>1</sup> Project startup-activities including the kickoff meeting, modeling plan, model enhancement and other activities were included under the Edisto Basin budget. The Edisto was originally identified as the pilot basin for modeling.

<sup>2</sup> The amended contract amount includes an additional (1) \$30,500 for the Broad River Basin unimpaired flow development; (2) \$16,600 for the Catawba Basin unimpaired flow development; and (3) \$52,500 for additional meetings, divided equally between all eight basins (\$6,562.50 each).