Appendix C

Simulated Change in Groundwater Levels within the North Florida-Southeast Georgia Regional Groundwater Flow Model (NFSEG)

Introduction

The North Florida-Southeast Georgia regional groundwater flow model (NFSEG) is a tool developed as a requirement of the North Florida Regional Water Supply Partnership (Charter for SJRWMD-SRWMD Cooperative Groundwater Model Development Project). For consistency in water supply planning, establishment and assessment of MFLs, and permitting decisions, the Partnership agreed to implement a joint regional groundwater flow model. Spanning larger areas within a single model enables improved representation of the aquifer system on a regional basis.

Technical experts from the Districts and other key stakeholders worked collaboratively to develop the next generation regional-scale groundwater flow model for north Florida. The technical team's mandate was to ensure appropriate science is applied to the modeling and data analysis to support decision-making, and that the work completed is defensible, understood by the team, and collaboratively developed, as described in the Partnership's charter, available at northfloridawater.com. The current version of NFSEG is referred to as NFSEG v1.1 (Durden et al., 2019).

The NFSEG v1.1 was used to simulate changes in the potentiometric surface of the Floridan aquifer system due to projected groundwater withdrawals. The focus of this effort is to assess the effect of groundwater withdrawals in the NFRWSP region.

NFSEG Overview

The NFSEG is a porous-equivalent, three-dimensional, steady-state, groundwater flow model covering approximately 60,000 square miles (Figure C1). The model is vertically discretized into seven layers representing, from top to bottom: (1) the surficial aquifer system (SAS), (2) the intermediate confining unit (ICU), where present; (3) the Upper Floridan aquifer (UFA); (4) the middle semi-confining unit (MSCU), where present; (5) the Lower Floridan aquifer (LFA) where present; (6) the lower semi-confining unit, where present; and (7) the Fernandina permeable zone of the LFA, where present. The model is horizontally discretized into uniform grid cells measuring 2,500 feet by 2,500 feet. Calibration of the NFSEG v1.1 was based on hydrologic conditions occurring during calendar years 2001 and 2009 (Durden et al., 2019).

Prior to development of the NFSEG, the groundwater models of the Floridan Aquifer System (FAS) in north Florida and southeast Georgia used by staff focused on specific geographic regions relative to each District. The primary design objective of the NFSEG model was to develop a tool capable of making assessments that span District and state boundaries at required levels of accuracy and reliability. To this end, a considerable effort has been expended in the development and compilation of required data sets, in the model calibration, and in collaboration between affected Districts and other stakeholders.

The following, which comes from USGS Scientific Investigations Report 2016-5116 (Kuniansky, 2016), is a general statement regarding modeling of the Floridan Aquifer System using porous-equivalent media models.

> "The USGS, multiple State water management districts, and other agencies and consultants have frequently used porous-equivalent media models for water-management problems to simulate the Biscayne aquifer and the FAS in Florida. The Biscayne aquifer and FAS are composed of karstified carbonate rocks that can be characterized as dual porosity continua. As of 2015, more than 30 models developed by the USGS have used a single-continuum porous-equivalent (SCPE) model approach to meet necessary calibration criteria for the study objectives. Many of the water management districts in Florida use a SCPE model approach for groundwater management and resource evaluation. Most of these SCPE models are applied to water-supply studies and are regional or subregional in scale and water budgets are desired; this is an appropriate application of such models."

NFSEG v1.1 meets requirements for use in water supply planning, regulatory evaluation, and MFL-related evaluation within the NFSEG domain and is currently being utilized in support of these types of evaluations.

Methodology

NFSEG v1.1 was used to simulate groundwater levels and evaluate differences resulting from simulations of the 2009 "pumps-off" scenario (PO), the average 2014-2018 scenario, which is referred to as current pumping (CP), and the 2045 scenario. The "pumps off" scenario does not represent a historic or predevelopment condition; rather, it approximates a condition where no groundwater pumping is taking place. The CP and 2045 scenarios used the 2009 "pumps off" calibrated hydrologic conditions and only withdrawals were updated for CP and 2045. The water budget parameters were held to the 2009 "pumps off" calibrated condition, assuming the natural variability in the CP and 2045 scenarios was the same as 2009. This approach enables the effects of changes in pumping on groundwater levels to be isolated with respect to other influences.

Water use estimates used as inputs to the NFSEG were updated from the 2017 NFRWSP and vetted through a thorough public review process. Simulations included groundwater level changes in the SAS and the UFA and LFA. The scenarios were utilized to estimate potential impacts of existing and projected groundwater withdrawals with respect to adopted MFLs (including OFSs), waterbodies without MFLs, and wetlands in the NFRWSP area (see Appendices F, G, and H).

Results

Decreases in simulated groundwater levels (aquifer drawdown) were predicted across the planning region for the SAS, UFA, and LFA (Figures C1 to C4). Small areas of increase in the simulated potentiometric surface (aquifer rebound) were associated with reductions in pumping between CP and 2045. Cones of depression were more apparent in the eastern portion of the planning region where the UFA and LFA tend to be confined. Conversely, lower magnitudes of drawdown were observed in the western portion of the planning region where the Floridan aquifer tends to be semi-confined or unconfined. However, the heightened transmissivity of the aquifer in these areas increases the potential for spring flow changes induced by groundwater withdrawals.

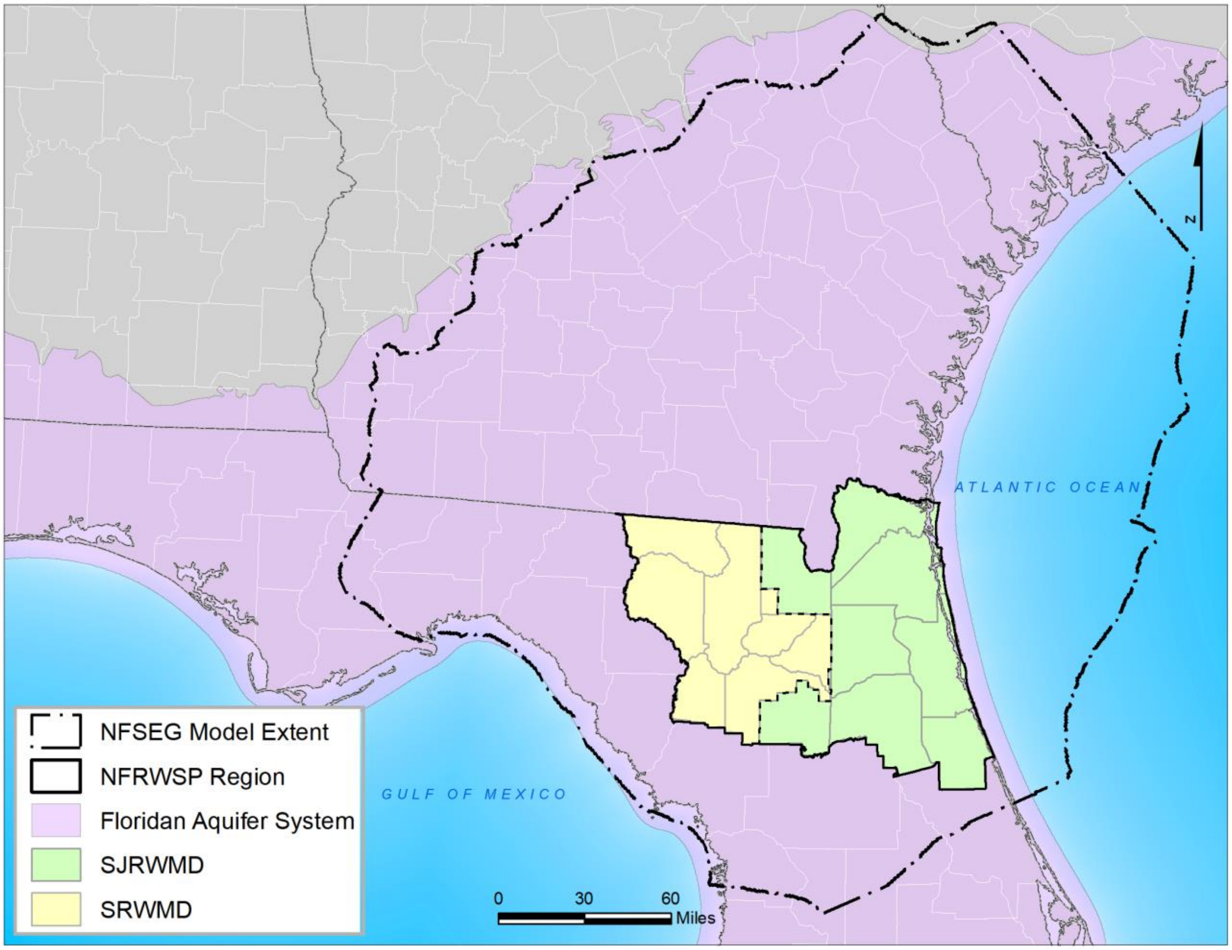

Figure C1. NFSEG domain

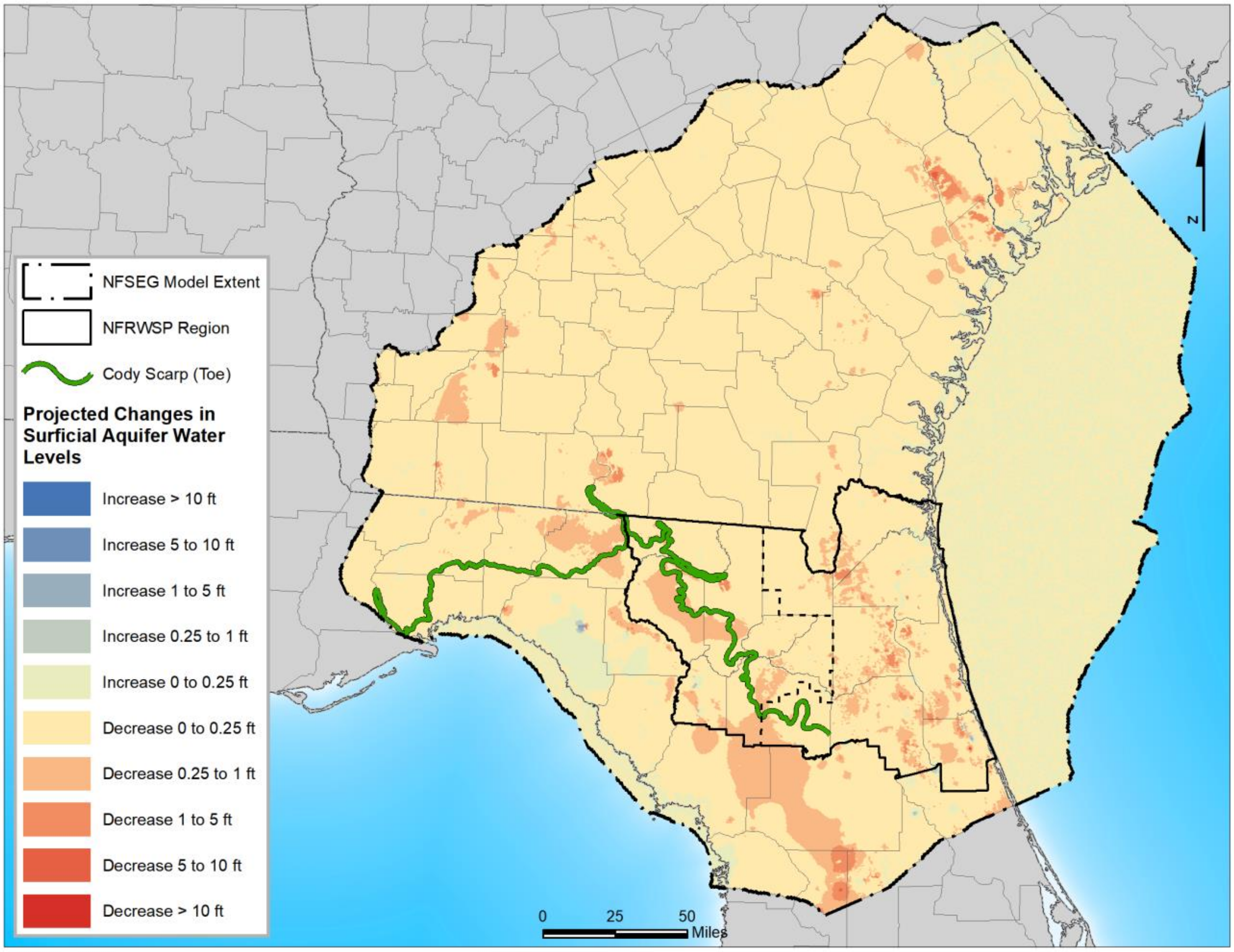

Figure C2. Changes in SAS water levels from current pumping to 2045 within the NFSEG domain

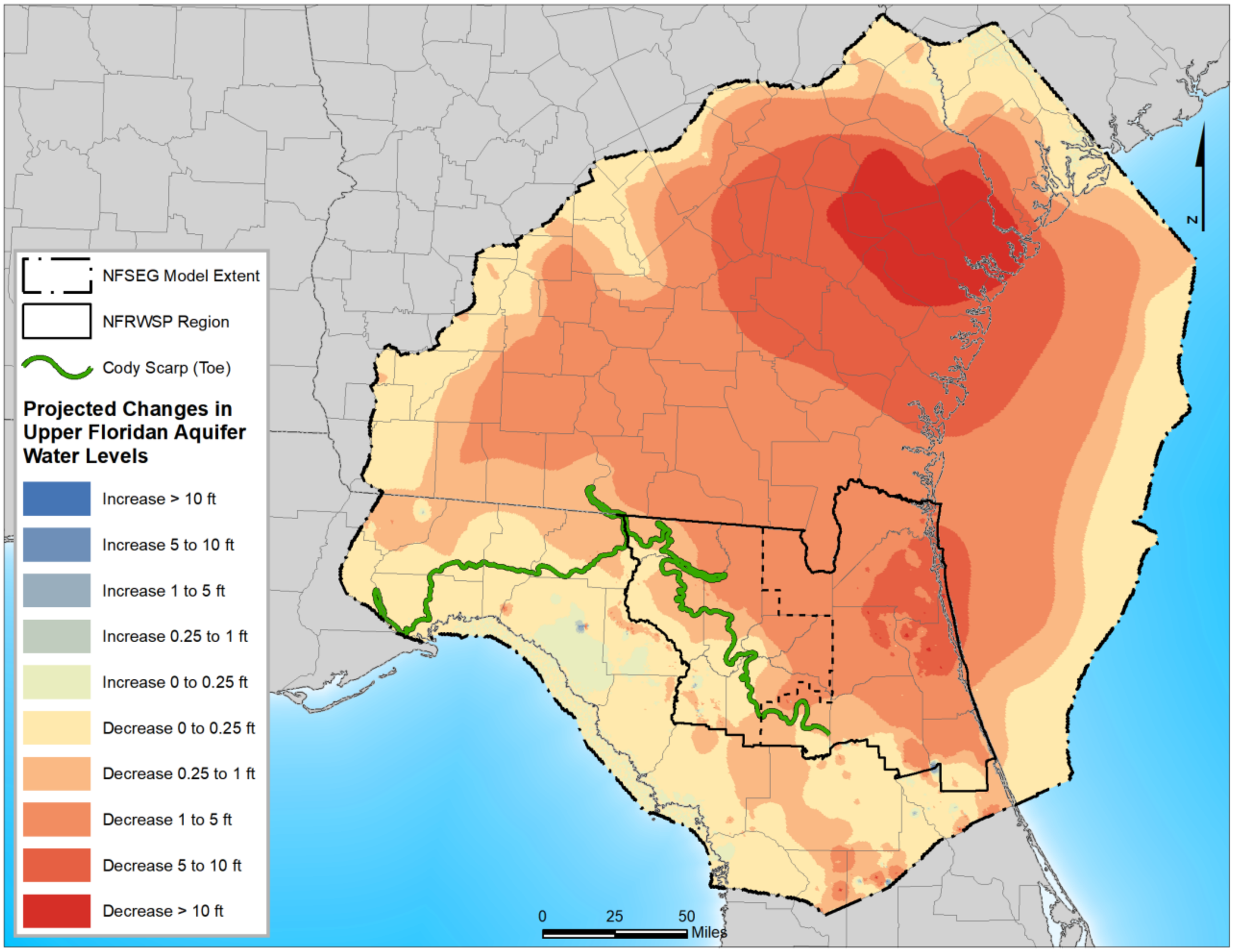

Figure C3. Changes in UFA water levels from current pumping to 2045 within the NFSEG domain

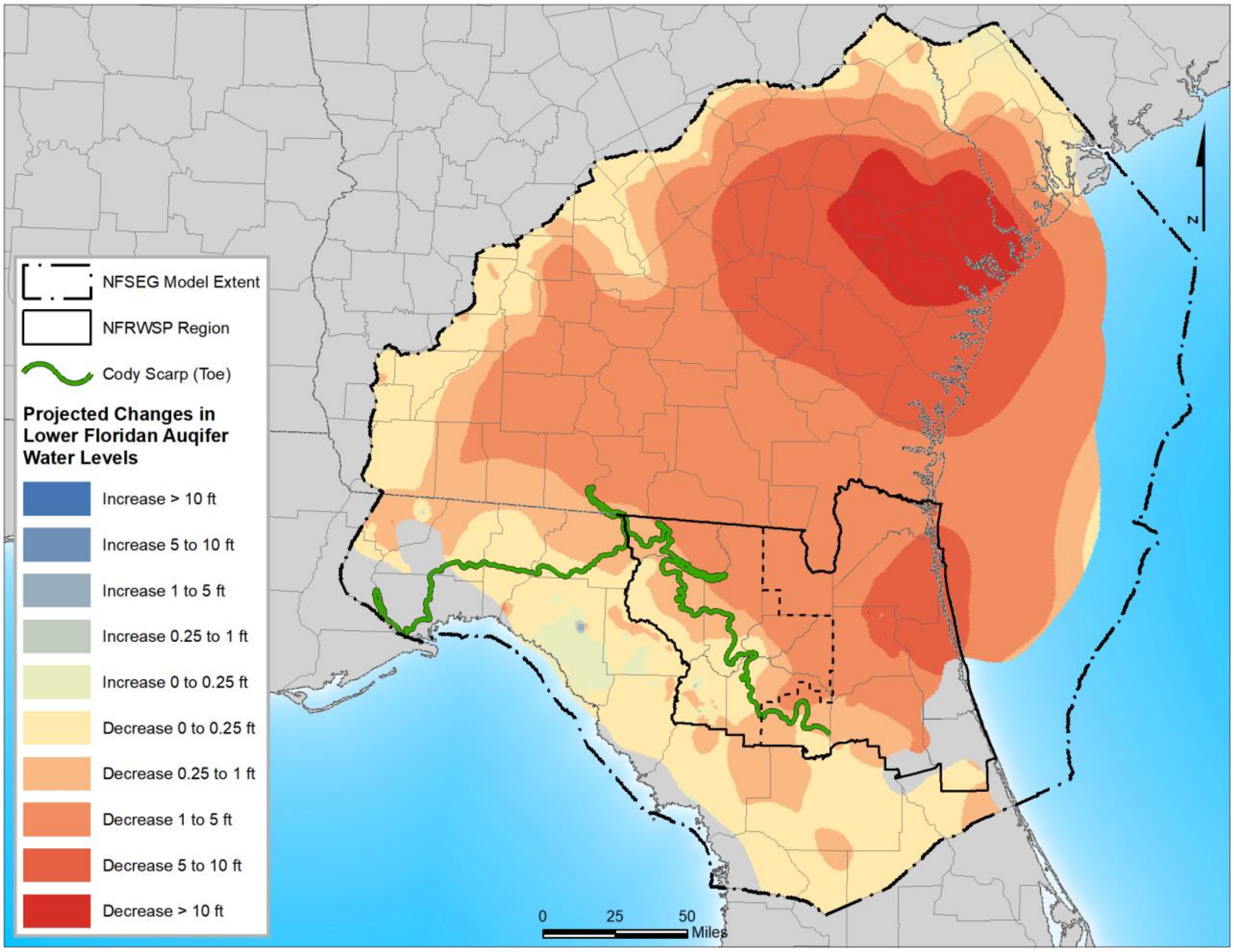

Figure C4. Changes in LFA water levels from current pumping to 2045 within the NFSEG domain

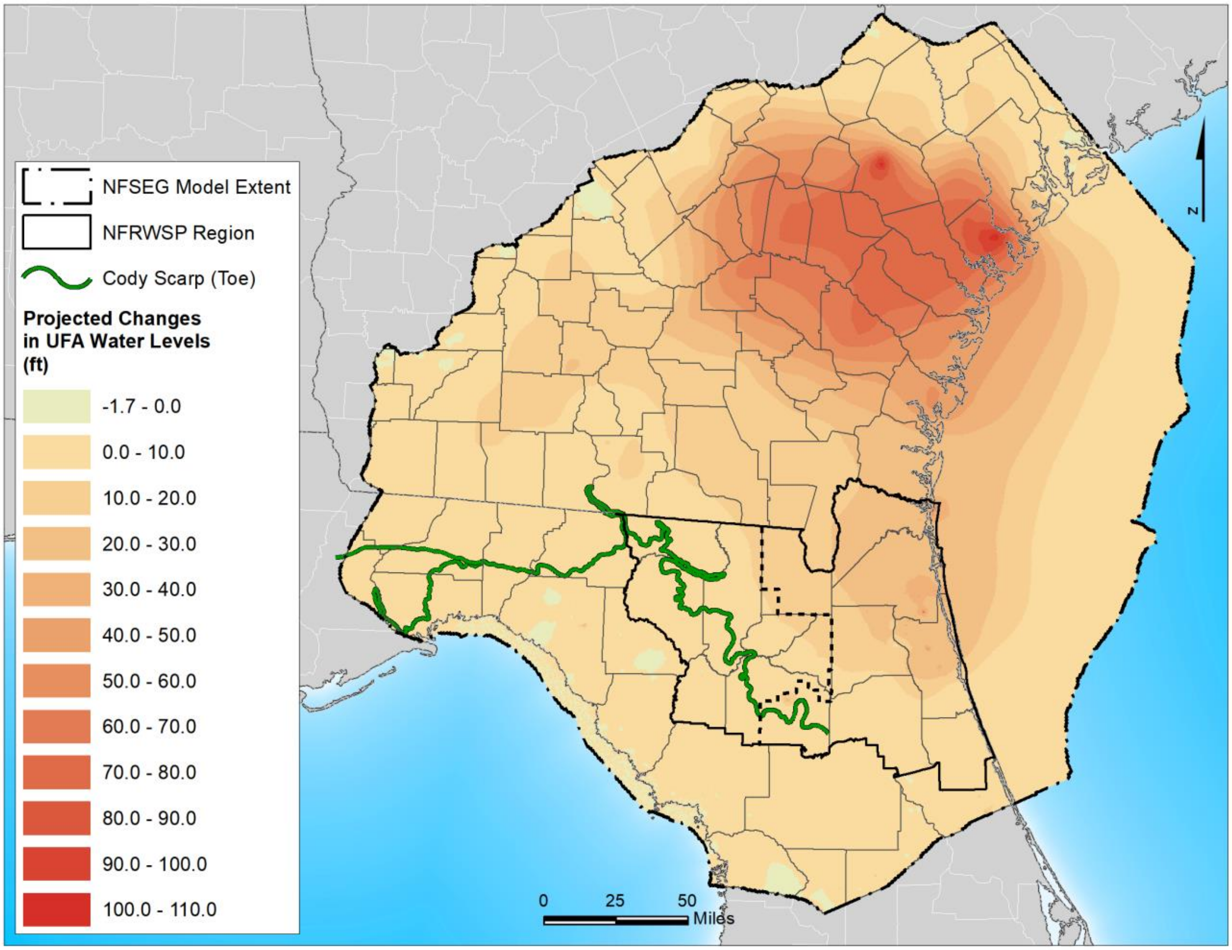

Figure C5. Changes in UFA water levels from 2009 pumps off to 2045 projections within the NFSEG domain

References

Durden, D., F. Gordu, Hearn, D., Cera, T., Desmarais, T., Meridth, L., Angel, A., Leahy, C., Oseguera, J., and Grubbs, T. (2019). *North Florida-Southeast Georgia Groundwater Model (NFSEG v1.1)*. St. Johns River Water Management District Technical Publication SJ2019-01. Palatka, Fla.: St. Johns River Water Management District. 513 pp.

Kuniansky, E. (2016). *Simulating Groundwater Flow in Karst Aquifers with Distributed Parameter Models – Comparison of Porous-Equivalent Media and Hybrid Flow Approaches*. USGS Scientific Investigations Report 2016-5116.