PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – ***Minimum Flows and Minimum Water Levels Re-Evaluation for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs***

Name and Affiliation of Reviewer: Louis H. Motz, Ph.D., P.E., D.WRE

Discipline specialty covered by this review: Water Resources Engineering

This document is for the use of project peer reviewers retained by the Suwannee River Water Management District (District) for the purpose of providing a technical peer review of a District report, including manuscripts prepared by District staff and consultants.

REVIEW REQUIRED BY THE DISTRICT:

1. **Determine whether the methods used for establishing the minimum flows are scientifically reasonable.**

   A. Supporting Data and Information: Review the data and information that supports the method and the proposed minimum flows, as appropriate. The reviewer shall assume the following:

   1. The data and information used were properly collected;
   2. Reasonable quality assurance assessments were performed on the data and information;

   Note: The reviewers are not expected to provide independent review of standard procedures used as part of institutional programs that have been established for the purpose of collecting data, such as the USGS and SRWMD hydrologic monitoring networks.

   B. Technical Assumptions: Review the technical assumptions inherent in the methodology and determine:

   1. If the assumptions are clearly stated, reasonable and consistent with the best information available; and
   2. Assumptions were eliminated to the extent possible, based on available information.

C. Procedures and Analyses: Review the procedures and analyses used in developing quantitative measures and determine qualitatively whether:

1. The procedures and analyses were appropriate and reasonable, based on the best information available;
2. The procedures and analyses incorporate appropriate factors;
3. The procedures and analyses were correctly applied;
4. Limitations and imprecision in the information were reasonably handled;
5. The procedures and analyses are repeatable;
6. Conclusions based on the procedures and analyses are supported by the data.

Task 2. **If a proposed method used in the MFL report is not scientifically reasonable, the CONTRACTOR shall:**

A. Deficiencies: List and describe scientific deficiencies;
B. Remedies: Determine if the identified deficiencies can be remedied and provide suggested remedies;
C. If the identified deficiencies can be remedied, then describe the necessary corrections and, if possible provide an estimate of time and effort required to develop and implement; and
D. If the identified deficiencies cannot be remedied, then, if possible, identify one or more alternative methods that are scientifically reasonable, based on published literature to the extent feasible.

REVIEW CONSTRAINTS

CONTRACTOR and Peer Reviewers shall acknowledge the statutory constraints and conditions (Sections 373.042 and 373.0421, Florida Statutes) affecting the DISTRICT's development of MFLs. CONTRACTOR and Peer Reviewers shall also acknowledge that review of certain assumptions, conditions, and established legal and policy interpretations of the Governing Board (hereinafter referred to as "givens") is not included in the scope of work. These givens include:

1. The selection of waterbodies or aquifers for which minimum flow and/or levels are to be set;
2. The determination of the baseline from which "significant harm" is to be determined;
3. The definition of what constitutes "significant harm" to the water resources or ecology of the area

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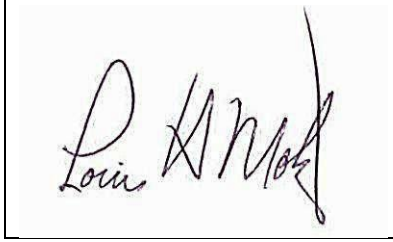
Instructions:

1. The results of this review are for the use of the District and they are not to be revealed to others without the express permission of the District.
2. By signing this form, the reviewer certifies that the peer review was conducted according to the guidelines listed above and that the opinions and recommendations included in the review constitute an independent review per Chapter 373.042(5), in the discipline noted above.
3. The reviewer also certifies that the review was conducted according to the Scope and Conditions specified above.

Signature of Reviewer:	**Date of Peer Review: February 18, 2020**
	

Responders Certification: The comments and criticisms provided by the Peer Reviewer have been addressed as noted in column C in a separate response document, which is attached, and in the report.

Name and Affiliation of Responder to Peer Review Comments:	
Signature of Responder:	**Date of Response:**

PEER REVIEW FORM
SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Project or Report Name: Technical Report – ***Minimum Flows and Minimum Water Levels Re-Evaluation for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs***

Comment No.	Figure, Table, or Page and Paragraph Number	Does Comment Directly and Materially Affect	To be completed by Reviewer(s)		To be completed by report author(s)
			A. Reviewer's Specific Comments	B. Reviewer's Specific Recommended Corrective Action	C. Action to be Taken in Response to Comment
1	p. 1, Section 1	No	"Because these water bodies have the potential to be affected by withdrawals in *an adjacent water management district*…."	Identify the adjacent water management district(s).	
2	p. 9, Head-ing for Table 1	No	"listed by decreasing river mile, per river"	The river miles should be included in Table 1.	
3	p. 11, line 3	No	"A non-parametric regression model, LOESS (LOcal RegrESSion), is fitted…."	Please provide a reference for this model.	
4	p. 12, 2.3.2 Infilling of Ichetucknee River Data at	No	Is "local monitoring well (FDOTS041705001)" on p. 12 the same	If so, use the same name for this well on pp. 12 and 18 and	

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	HWY 27 Near Hildreth Gage, last sentence		well as the "…Florida DOT monitoring well in Lake City…" on p. 18?	elsewhere in the report and appendices.	
5	p. 18, Section 2.3.6, Figure 13	Yes	"Figure 13 …groundwater levels in the UFA at Lake City and near Lake Butler, Florida." Are there any other UFA wells in or adjacent to the Ft. White combined surface and groundwater basins (Figure 10) that could be included in this report?	If data are available, add addition UFA wells to illustrate historical changes in groundwater levels in or adjacent to the Ft. White basin similar to what is shown in Figure 13.	
6	p. 19, Section 2.4, Figure 14	Yes	The timeline of flow measurements at Poe Spring (137 manual measurements)	Plot the flow measurements at Poe Spring and discuss whether there are any long-	

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			indicates measurements that date back nearly to 1915.	term trends in the discharge record.	
7	p. 19, Section 2.4, Figure 14	Yes	The timelines of flow measurements for many of the other springs in Figure 14 indicate that springflow data from the mid-1990's to 2015 may be available.	Evaluate whether there are sufficient data for any of the other springs in Figure 14 to plot and indicate whether there are any trends in the (short-term) discharge records.	
8	p. 22, Section 2.5 Surface Water Quality,	No	These two sentences require editing for clarity: "…nitrate concentrations in the Santa Fe River at US 47 near Ft. White averaged about 0.70 mg/L in 2011 (Figure 16). The average nitrate levels…have not increased significantly at several LSFR	Suggested re-write: "Based on recent data, nitrate concentrations averaged about 0.70 mg/L during 1990-2011 in the Santa Fe River near Ft. White and decreased slightly from about 0.3 mg/L in	

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	second paragraph		USGS stations (High Springs, Ft. White) during the 1990-2011 period (Figure 16)."	1990 to slightly less than 0.2 mg/L in 2011 in the Santa Fe River near High Springs (see Figure 5 for locations of gages)."	
9	p. 22, Section 2.5 Surface Water Quality, last sentence	No	This sentence needs editing for clarity: "Nitrate concentrations are on the rise in two downstream springs including Gilchrist Blue but are declining in the springs that are farther east (upstream) (Figure 17)."	The names of the downstream and upstream springs that are listed in Figure 17 should be specifically identified in this sentence, along with reference to their locations that are shown in Figure 15.	
10	p. 23-25, Section 2.6	Yes	Groundwater use in the NFSEG model area also may have "…potentially	In place of the pumping illustrated for the North Florida Regional Water Supply	

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	Ground-water Use		influence[d] flows along the LSFR and IR." [p. 23].	Planning Area, consider illustrating historical groundwater use in the NFSEG model area in Figures 19 and 20. This would be more consistent with the development of groundwater use for the NFSEG model area described in Appendix B and the use of the NFSEG pumpage used in the development of the reference timeframe (RTF) flow and groundwater head time-series at groundwater monitoring locations, springs, and/or stream gage locations described in Appendix C. Also,	

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				discuss the historical trend of pumpage, particularly recent trends, in the NFSEG model area.	
11	p. 23, Section 2.6 Ground-water Use	Yes	The first part of this section on p. 23 describes groundwater use in the North Florida Regional Water Supply Planning area, in which groundwater use "has stabilized…at about 500 million gallons per day (mgd)", and the last sentence in this section indicates that "Long-term historical water demands are summarized in Appendix B." Long-term historical water demands in Appendix B are described for the entire NFSEG model area in which net groundwater	Similar to comment 10 above, the pumping illustrated for the North Florida Regional Water Supply Planning Area should be replaced by pumpage in the NFSEG model area in Figures 19 and 20, which would be more consistent with the NFSEG model area pumpage described in Appendices B and C.	

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			withdrawals were approximately 1,150 mgd in 2010 (Durden et al., 2019, p. 5-12). It is confusing to the reader for both North Florida Regional Water Supply Planning area pumpage and NFSEG pumpage to be included in the same paragraph, particularly since the last sentence does not indicate which "long-term historical water demands" are summarized in Appendix B.		
12	pp. 24 and 26, Section 2.7 Refer--ence Time-frame Flow	Yes	The RTF's for the rivers were developed using the pumpage for the NFSEG model, not the pumpage for the North Florida Regional Supply Planning area.	This is another reason to consider replacing the North Florida Regional Water Supply Planning Area pumpage in Figures 19 and 29 with the NFSEG pumpage. Also, it	

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				should be indicated that the determination of groundwater use in the NFSEG model area is described in Appendix B.	
13	p. 26, Figure 21. Estimated Impacts at Fort White, US441, and HWY 27 gages	Yes	Figure 21 indicates the impacts of groundwater pumping in terms of combined ($Q_{RTF} - Q_{measured}$) flows for each of the three gages. It would be helpful to be able to see plots that show the Q_{RTF} flows and $Q_{measured\ flows}$ separately for each of the three gages.	Consider adding a figure (or figures) in which the Q_{RTF} flows and $Q_{measured\ flows}$ are plotted separately for each of the three gages.	
14	pp. 24-26, Section 2.7 Reference	Yes	Figure 21 illustrates the estimated impacts of historical groundwater pumping on discharge measured at the Fort White, US441, and Hwy 27 stream	Consider illustrating the impacts of groundwater pumping on groundwater levels by calculating RTF's for	

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	Time-frame Flow		gages, but there are no corresponding results shown for the impacts of pumping on groundwater levels in the Fort White surface-water and groundwater basin (Figure 10).	UFA wells at Lake City and near Lake Butler (Figure 13) and (if data are available) for other UFA wells in the Fort White surface-water and groundwater basin.	
15	pp. 24-26, Section 2.7 Reference Time-frame Flow	Yes	Are there any long-term impacts due to groundwater pumping in the historical discharge measurements for any of the springs listed in Figure 14?	If sufficient data are available for any of the springs listed in Figure 14, consider illustrating the impacts of groundwater pumping on spring discharge by calculating RTF's for a selected spring (or springs).	
16	p. 56, Section 4. Approach to	No	"The technical approach makes use of the RTF flows presented in Section 2."	Consider adding reference to Appendix C in this sentence: "The technical approach	

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	Setting MFLS, first paragraph			makes use of the RTF flows presented in Section 2 ***and described in detail in appendix C."***	
17	p. 63, 4.3.1 HEC-RAS Modeling, Second Paragraph	No	"The SFR portion of the model is composed of ten model reaches (Figure 42)…." Is the Ichetucknee River divided into reaches or treated as one reach?	Indicate whether or not the Ichetucknee River is divided into reaches and, if so, list the names of the reaches.	
18	4.3.1.3, HEC-RAS Steady State Model Develop-ment and Predictive Simulations,	No	"Predictive steady-state simulations were made for the ***49*** RTF flow scenarios…."	Please explain how "49" was obtained, i.e., what does it represent?	

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	p. 68, fourth paragraph				
19	p. 99, Section 6. River MFLs Develop-ment, Second paragraph	Yes	"A[n] RFT time series of daily flows was developed for…the Ft. White and US441 gages on the LSR and for the Hwy 27 gage on the IR…."	Indicate on p. 96 that these flows are plotted in Figures 22 and 23 in Section 2.7.1.	
20	p. 106, Third paragraph	No	Typo: "Richter, et al.	Replace with: "Richter et al. (2011)."	
21	p. 108, last line in text and Table 34	No	The average measured flow of the Santa Fe River Rise is "about 553 cfs" in the text	There should be only one value for these flows.	

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			and its "mean flow" is "552 cfs" in Table 34.		
22	pp. 108-113, Section 7. Priority Springs Assessment and MFLS Develop-ment	Yes	Equations of rating curves developed for 11 of the 17 priority springs are in Table 36, but the plots of the rating curves are not included.	The plots of the rating curves developed for 11 of the 17 priority springs should be included in the text or in an appendix.	
23	p. 108, Table 34	No	"Ten of the 17 Priority Springs on the LSFR and IR are classified as historical first-magnitude springs…." First-, second-, and third magnitude springs are not identified in Table 34.	Add a column to Table 34 identifying first, second, and third magnitude springs.	

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24	p. 111, Section 7.3 Springs MFLs Develop-ment, two paragraphs	Yes	"While it is desirable to designate spring-specific MFLs, it is Impractical to do so at this time." and "These relative uncertainties are substantially greater than the corresponding flow reductions associated with the proposed LSFR and IR MFLs…." These conclusions are not supported by any results.	One or more examples of the results of calculating spring-specific MFL's should be included in the text or an appendix to illustrate and substantiate this conclusion.	
25	p. 113. Table 37, heading for third column	No	Typo: "Flow Rating…from **Table 37** (cfs)" should be **Table 36**.	Make correction.	
26	p. 113, Section 7.3.2	Yes	"…an appropriate way to afford protection from significant harm at this	See comment 24 above. One or more examples of the	

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	Future Considera-tions to Support Spring-Specific MFLs, last paragraph.		time is to treat the Priority Springs collectively for a defined river reach…." This conclusion is not supported by any results.	results of calculating spring-specific MFL's should be included in the text to illustrate and substantiate this conclusion, i.e., that it is necessary to treat the priority springs collectively for a defined river reach.	
27	Appendix B – Water Use Hindcasting and Injection Well Hindcasting	No	Pages in Appendix B – Water Use Hindcasting and Injection Well Hindcasting are not numbered.	Number the pages in Appendix B – Water Use hindcasting and Injection Well Hindcasting.	

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28	Appendix B – Water Use Hindcasting, p. 1	Yes	Groundwater in Appendix B is developed for the NFSEG model area, but groundwater use in the report is illustrated for the North Florida Regional Water Supply Planning Area.	Consider replacing the pumpage for the North Florida Regional Water Supply Planning Area shown in the text in Figures 19 and 20 with the pumpage for the NFSEG model area described in Appendix B. For consistency, the NFSEG pumpage should be described in the report and in Appendix B (and also in Appendix C).	
29	Appendix B – Water Use Hindcasting, p. 11	Yes	"Results…were then merged into one dataset." Where are these results?	The dataset for the 5-year moving average pumpage "for each state, county, and use-type combination in the model	

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	Moving Average Calculation			domain" should be made available, perhaps on a web site.	
30	Appendix B – Water Use Hindcasting, p. 11 Moving Average Calculation	Yes	Where are the quantitative results for pumpage?	The groundwater with-drawals through time and ground-water use by category for a current year such as 2015 should be represented in the report in figures similar to the bar graph and pie chart shown in Figures 19 and 20 or preferably in a line graph illustrating the pumpage versus time for the various water-use categories and total pumpage. It would be more	

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				consistent with appendices B and C if the pumpage for the NFSEG model area were represented in Figures 19 and 20 instead of the pumpage for the planning area (see comment 28 above).	
31	Appendix B – Water Use Hindcasting, p. 11 Moving Average Calculation	Yes	Are the pumpage results in the dataset in agreement with the pumpage in the NFSEG model (Durden et al., 2019, Table 5-1)?	Compare pumpage results in the dataset to pumpage in NFSEG model (Durden et al., 2019, Table 5-1).	

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32	Appendix B – Water Use Hindcasting	Yes	How were well locations determined in previous years when no detailed water use records and well locations were kept?	Explain how individual well locations were determined in previous years.	
33	Appendix B – Water Use Hindcasting, pp. 12-13 References	No	Is each reference listed in this section also indicated in the text where it is used?	Make sure that each reference listed in this section is also indicated in the text where it is used.	
34	Appendix B – Injection Well Hindcasting	Yes	Where are the quantitative results for the injection rates?	The 5-year moving average injection rates for the NFSEG model area versus time should be plotted and discussed.	
35	Appendix B – Injection	Yes	Are the injection rates in the dataset in agreement with the injection rates in the	Compare injection rates in the dataset to pumpage in	

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	Well Hindcasting		NFSEG model (Durden et al., 2019, Table 5-1)?	NFSEG model (Durden et al., 2019, Table 5-1).	
36	Appendix C	Yes	Is "reference timeframe" a concept developed for this project or has it been used before?	Discuss the origin of the reference timeframe process, including references in published reports and peer-reviewed papers and previous water resource investigations that involve setting minimum flows and levels (MFL's).	
37	Appendix C, p.1, 1.Intro-duction, first two paragraphs.	Yes	"This reference time series process incorporated data from two versions of the North Florida Southeast Groundwater Model…." i.e., NFSEGv1.1 (007h) and NFSEGv1.1 (007h1) (first paragraph), and "The response of the groundwater	The text in Section 1. Introduction should more clearly explain how two versions of the NFSEG model were used to produce the	

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			system…was evaluated through application of the NFSEG v1.1 groundwater model…." (second paragraph). Why were two different versions of the NFSEG model used? This suggests that there may be two different results based on whichever version of the NFSEG model is used to develop reference timeframe flows and groundwater heads.	results described in this appendix.	
38	Appendix C, p.1, 1.Introduction, second paragraph.	Yes	"The response of the groundwater system to changes in groundwater use was evaluated through application of the NFSEG v1.1 groundwater model in a manner that did not require development of a transient version of the model."	This is a major assumption that requires further explanation. See comment 40 below.	

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39	Appendix C, p.1, 2. General Approach, first paragraph.	Yes	"Changes in …flows at an MFL site of interest in response to changes in groundwater withdrawals were estimated on a yearly basis from 1933 through 2015." How were changes in surface-water flows calculated using the NFSEG model, which is a groundwater model?	Provide more explanation concerning how changes in river flows were determined using results from the NFSEG model.	
40	Appendix C, p. 4, 2.4 Develop-ment of Reference Time-frame Flow or	Yes	"Thus, the historical groundwater withdrawals time-series used to develop the reference timeframe time-series was smoothed using a five-year moving average." This is a major assumption that does appear to be reasonable. However, the	Provide the graphical results of an analysis that demon-strates whether using a five-year moving average is sufficient to smooth variations in pumpage from 1933 through 2015.	

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	Head Time-Series		validity of this assumption needs to be demonstrated.		
41	Appendix C	Yes	Appendix C describes a very detailed, somewhat confusing process that includes "…estimating historical impacts from groundwater withdrawals…" (p. 1), determining "…flow and head sensitivities…" (p. 2), and developing "…sensitivity maps for each model layer and waterbody of interest." (p. 2). The process by which impacts on river flows are determined using the NFSEG groundwater model needs further explanation as well as the purpose and use of the sensitivity maps.	This process should be more clearly explained in Appendix C, particularly illustrating how impacts on river flows at the three river gages (Santa Fe River near Ft. White and at US HWY 41 and the Ichetucknee River at HWY 27 in Figures 22 and 23, pp. 26-27 were determined from changes in heads and flows in the NFSEG groundwater model. The purpose and use of the sensitivity maps also requires further explanation.	

Comment 42 for Appendices B and C

A major part of the MFL report (Section 6 River MFLS Development) describes using Reference Timeframe (RTF) flows at three river gages (Santa Fe River near Ft. White and at US HWY 41 and the Ichetucknee River at HWY 27 in Figures 22 and 23, pp. 26-27) to determine recommended minimum flows at these gages (p. 106, Section 6.2.2 Proposed MFL Language). The RTF flows are estimates of historical flows from which the impacts of historical groundwater withdrawals have been removed. The historical influence of groundwater withdrawals over time was evaluated using estimates of groundwater usage in the North Florida Southeast Georgia (NFSEG) groundwater model area (Section 2.7 Reference Timeframe Flow, p. 24). Appendix B documents the data and methods used to establish the historical groundwater use throughout the NFSEG groundwater model area by hindcasting groundwater pumpage and injection rates from as far back as 1900 to 2015. Appendix C outlines the process used to develop an RTF flow and/or groundwater-head time-series at groundwater monitoring locations, springs, and/or steam gage locations (Appendix C, p. 1, first paragraph) using modeled data and the estimated time series of historical groundwater withdrawals that are described in Appendix B. In the process to determine RTF flows, increases in river flows in response to decreases in groundwater withdrawals were estimated on a yearly basis from 1933 through 2015, and the resulting estimates were added to observed hydrographs of river flows to obtain hypothetical hydrographs representing the variation in river flows in the absence of groundwater withdrawals during the period from 1933 to 2015 (from Appendix C, p. 1, third paragraph). As discussed below, the historical groundwater withdrawals in the NFSEG model area need to be quantified and plotted in Appendix B and in Figures 19 and 20 (2.7 Reference Timeframe Flow, p. 25). Also, the description of the process used to determine the RTF flows in Appendix C needs to be more focused on describing the development of the RTF flows at the three river gages.

Appendix B

A detailed procedure for determining historical groundwater use in the NFSEG model area based on data sources, water-use types, counties, states (Florida, Georgia, and South Carolina), and injection sites is described in Appendix B along with the use of a five-year moving average to smooth variations in year-to-year pumping rates from 1930 to 2015. The results of this determination of historical groundwater use in the NFSEG model area should be described quantitatively in Appendix B with numerical values for pumping rates over time and by plotting pumpage versus time for the various groundwater uses and total pumpage in a bar graph or (preferably) in a line graph and in a pie chart illustrating groundwater use for a selected year such as 2015. The historical groundwater use in the NFSEG model area also should be plotted in Figures 19 and 20 (2.6 Groundwater Use, p. 25) instead of the pumpage illustrated for the North Florida Regional Water Supply Planning Area, because the NFSEG pumpage is used in the development of the RTF flows described in Section 2.7 Reference Timeframe Flow. Also, any historical trends in groundwater pumpage, particularly recent trends, in the NFSEG model area should be noted and discussed in Appendix B and in Section 2.6 Groundwater Use.

Appendix C

The description in Appendix C of the process used to determine the RTF flows should be more focused on describing and illustrating the development of the RTF flows at the Santa Fe River gages near Ft. White and at US HWY 41 and the Ichetucknee River gage at HWY 27, including details of the calculations used to determine the RTF flows. Determining how "Changes in …flows at an MFL site of interest in response to changes in groundwater withdrawals were estimated on a yearly basis from 1933 through 2015..." (Appendix C, p. 1, 2.

General Approach, first paragraph) involves a major, but unstated, relation between groundwater heads and flows and river flows, i.e., that the increased river flows resulting from decreased groundwater withdrawals represent increases in *base flows* into the rivers. This relation should be explicitly and clearly stated. Also, additional explanation is needed to describe how increases in flows at individual cells in the NFSEG groundwater model in response to decreases in groundwater withdrawals were summed to estimate increased base flows at the three river gages. For each of the three river gages, the locations of the cells in the NFSEG model that represent the reach of the part of the river into which increased base flow occurs should be identified. The cells (i.e., river and drain cells and any other cells) in the NFSEG groundwater model used to calculate the increased base flows should be identified. An additional figure (in plan view) that overlays the locations of the model cells used to represent the river reaches above each river gage onto a map of the Santa Fe and Ichetucknee rivers that supports this additional explanation should be added to Appendix C. The details of the process, including numerical results that illustrate how the Reference Timeframe (RTF) flows (Figures 22 and 23, pp. 26-27) were determined at each of the three river gages, should be included in Appendix C. Figures 22 and 23, pp. 26-27, should be included in Appendix C as well as in Section 2.7.1.

The determination of "flow or head sensitivities" and the use of the "sensitivity maps" described in Appendix C (Section 2.1, p. 2) also needs further explanation. Were the RTF flows for the Santa Fe and Ichetucknee River gages determined using this method? If so, a detailed explanation illustrating how this method was used should be added to Appendix C. Also, were any RTF groundwater heads or spring flows determined for this MFL report? If so, detailed explanations of these determinations should be added to Appendix C as well.