DRAFT Technical Memorandum

2301 Lucien Way, Suite 250
Maitland, FL 32751

T: 407.6619500

Prepared for: Suwannee River Water Management District

Project Title: Independent Technical Peer Review of the Recommended Minimum Flows for the Upper and Middle Segments of the Suwannee River

Project No: 159817

Subject: Draft Suwannee River Upper and Middle Segments Minimum Flows and Levels Peer Review Report

Date: June 19, 2023

To: Sean King, MFL Office Chief, Office of Minimum Flows and Minimum Water Levels

From: Gregg Jones, Senior Hydrogeologist

Prepared by: _____
Gregg W. Jones, Ph.D., P.G.
Senior Hydrogeologist
HDR, Inc.

Reviewed by: _____
Martin Hamel, Ph.D.
Associate Professor, Warnell School of Forestry and Natural Resources
University of Georgia

Reviewed by: _____
Instructional Associate Professor, Warrington College of Business
University of Florida

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List of Abbreviations

AMO	Atlantic Multidecadal Oscillation
cfs	cubic foot/feet per second
COOP	NOAA's Cooperative Observer Network
District	Suwannee River Water Management District
F.A.C.	Florida Administrative Code
FAS	Floridan Aquifer System
FAWN	Florida Automated Weather Network
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
F.S.	Florida Statutes
HEC-RAS	River Analysis System
LOESS	Locally Estimated Scatterplot Smoothing
MAE	Mean Absolute Error
ME	Mean Error
MFL	minimum flow and level
MSR	Middle Segment of the Suwannee River
NAVD88	
NFSEG	North Florida Southeast Georgia
NOAA	National Oceanographic and Atmospheric Administration
Panel	Peer Review Panel
PRISM	Parameter-elevation Relationships on Independent Slopes Model
RTF	Relative Timeframe
SPSS	Statistical Package for Social Sciences
SRWMD	Suwannee River Water Management District
SWFWMD	Southwest Florida Water Management District
UFA	Upper Floridan Aquifer
USGS	U.S. Geological Survey
USR	Upper Segment of the Suwannee River
WMD	Water Management District
WRV	Water Resource Value
WY	Water Year

Executive Summary

The Suwannee River Water Management District (District) contracted technical experts to provide independent scientific peer review of the reports titled "*Minimum Flows and Levels Assessment for the Upper Suwannee River*" and "*Minimum Flows and Levels Assessment for the Middle Suwannee River*" (MFL Reports).

The Peer Review Panel (Panel) received the MFL Reports and their appendices in early March 2023 and began its review. The Panel participated in an in-person public kickoff meeting with District staff and members of various stakeholder groups at the District's headquarters in Live Oak, Florida, on March 15, 2023. District staff delivered a presentation on all aspects of the process to develop minimum flows for the river segments. Following the meeting, the Panel reviewed the MFL Reports, appendices, and other pertinent documents, and prepared its reviews. Four additional virtual public meetings were held on April 19, May 2, May 16, and June 23. During the public meetings, the Panel members discussed various aspects of the report, asked questions of District staff, and heard public comment. The Panel also worked through a publicly accessible web board that was opened for two-hour sessions during several noticed times.

The Panel Chair compiled the reviews into a single document, which was reviewed and edited by all Panel members and the Panel Chair into the Draft Peer Review Report. Peer Review comment forms, which are a compilation of the comments each Panel member included in the Peer Review Report, were also submitted to the District.

Peer Review Panel

The District assembled a Panel consisting of the following scientists with expertise in hydrology, hydrogeology, statistics, modeling, riverine and wetlands ecology, water quality, and fisheries:

- Gregg Jones, Ph.D., P.G.: (Panel Chair): karst hydrogeology, groundwater quality, hydrology
- Adam Munson, Ph.D.: hydrology, statistics, modeling, and
- Martin Hamel, Ph.D. fisheries, ecology, water quality.

Major Findings

After a thorough review of the MFL Reports, appendices, and supporting documents, the Panel concludes provisionally that the District's proposed minimum flows for the Upper and Middle Suwannee River are scientifically valid and sufficiently protective of the priority Water Resource Values (WRVs) from significant harm. The Panel has arrived at this conclusion with no disagreements on any of the issues relevant to the establishment of the minimum flows. However, the Panel has identified technical deficiencies that should be investigated in the near term to determine whether additional data should be collected, and studies initiated that could result in modifications to the proposed minimum flows. The Panel has also made recommendations as to how these issues might be addressed.

Supporting Data and Interpretation

The Panel concludes, with only a few minor comments, that the District and their cooperators properly collected, compiled, performed reasonable quality assurance, analyzed, and interpreted the massive amount of data used to support the minimum flows determinations.

Technical Assumptions

Overall, the Panel concludes the District's assumptions are clearly stated, reasonable and consistent with the best information available and they were eliminated to the extent possible based on available information. The Panel's most significant concern is the District's implicit assumption of the validity of the

Reference Timeframe (RTF). Although the Panel supports the District's approach to developing the RTF and recognizes the significant complexity of the task, there is concern about the potential compounding of error throughout the process.

Procedures and Analyses

Overall, the Panel concludes the District's procedures and analyses were appropriate and reasonable, based on the best information available, repeatable, and supported by the data. They incorporated appropriate factors, were correctly applied, and limitations and imprecision in the information were reasonably handled.

Priority Water Resource Values

Priority WRVs were established as the critical metrics evaluated for protection via minimum flow assessments. The Panel considered the priority WRVs to be appropriate and they appeared to represent the fundamental components of the Suwannee River basin. There was sufficient data available to develop relationships between these WRVs and the river system. The District sufficiently evaluated the range of flows likely to occur on the Upper and Middle Suwannee River through the analysis of the priority WRVs and metrics used to evaluate significant harm against the RTF. The District focused on minimum flow requirements but also evaluated the range of flows necessary to protect high-flow WRVs such as floodplain habitats from significant harm due to flow reductions.

Although the Panel agrees with the District's selection of priority WRVs, there are concerns with *Fish and Wildlife Habitats and Passage of Fish* and *Maintenance of Freshwater Storage and Supply* WRVs. Although the District did not consider *Maintenance of Freshwater Storage and Supply* to be a priority WRV, the panel is concerned that it is not appropriately evaluated.

- *Fish and Wildlife Habitats and the Passage of Fish*: The Panel agrees with the District's selection of Gulf sturgeon passage during the fall spawning period as the WRV most likely to be limiting across the range of flows to develop the recommended minimum flow for the Upper and Middle Suwannee River; However, it is recommended that that *Fish and Wildlife Habitats and the Passage of Fish*, which Gulf sturgeon passage is a subset of, should also include three additional components to ensure its protection: 1) Gulf sturgeon holding areas (Middle Suwannee River), 2) fish passage (Upper and Middle Suwannee River), and 3) flow requirements for recently hatched Gulf sturgeon.
- *Maintenance of Freshwater Storage and Supply*: The Panel is concerned that the District does not place sufficient importance on this WRV for the Floridan Aquifer System (FAS). There is more text devoted to floodplain storage (which is seasonal, and a relatively small volume compared to the FAS) than to FAS storage. In addition, managing FAS storage by setting MFLs for springs may not be sufficient.

Section 1: Introduction

1.1 Background

The Suwannee River Water Management District (District) is mandated by the Florida Statutes (F.S.) to establish minimum flows and levels (MFLs) for priority surface waters and aquifers within its boundaries for the purpose of protecting the water resources and ecology of the aquatic ecosystems from "significant harm" (F.S. §373.042, 1972 as amended). This report reviews the minimum flows proposed for the Upper Segment of the Suwannee River (USR), which extends approximately 79 miles from the Florida/Georgia Border to the confluence of the Withlacoochee River at Ellaville, and for the Middle Segment of the Suwannee River (MSR), which extends from approximately 92 miles from Ellaville to Wilcox.

Under the statutes, MFLs are defined as follows:

- A minimum flow is the flow of a watercourse below which further water withdrawals will cause significant harm to the water resources or ecology of the area
- A minimum level is the level of water in an aquifer or surface water body at which further water withdrawals will cause significant harm to the water resources of the area

The statutes require the District to annually develop and update a list of priority water bodies for which MFLs are to be established and identify those that will be subjected to a voluntarily independent scientific review. The District's Governing Board is committed to voluntarily submit MFLs determinations for independent scientific peer review.

The Florida Statutes also provide for the MFLs to be established using the "best available information," for the MFLs "to reflect seasonal variations," and for the District's Governing Board, at its discretion, to provide for "the protection of non-consumptive uses." In addition, F.S. §373.0421 states that the District's Governing Board "*shall consider changes and structural alterations to watersheds, surface waters and aquifers, and the effects such changes or alterations have had, and the constraints such changes or alterations have placed on the hydrology of the affected watershed, surface water, or aquifer....*"

The State Water Resources Implementation Rule (Florida Administrative Code [F.A.C.] Chapter 62-40.473) contains additional guidance for the establishment of MFLs, providing that

> "...consideration shall be given to the protection of water resources, natural seasonal fluctuations, in water flows or levels, and WRVs associated with coastal, estuarine, aquatic and wetlands ecology, including:
>
> 1. Recreation in and on the water;
> 2. Fish and wildlife habitats and the passage of fish;
> 3. Estuarine resources;
> 4. Transfer of detrital material;
> 5. Maintenance of freshwater storage and supply;
> 6. Aesthetic and scenic attributes;
> 7. Filtration and absorption of nutrients and other pollutants;
> 8. Sediment loads;
> 9. Water quality; and
> 10. Navigation."

1.2 Peer Review Panel

The District assembled a Peer Review Panel (Panel) consisting of the following scientists with expertise in hydrology, hydrogeology, water quality, statistics, modeling, fisheries, and riverine and wetlands ecology:

- Gregg Jones, Ph.D.: P.G. (Panel Chair): karst hydrogeology, hydrology, groundwater quality
- Adam Munson, Ph.D.: hydrology, statistics, modeling
- Martin Hamel, Ph.D.: fisheries, aquatic ecology, water quality

Per the task order, the Panel has prepared a report of the findings and recommendations related to the peer review of the Recommended Minimum Flows (titled "*Minimum Flows and Levels Assessment for the Upper Suwannee River*" and "*Minimum Flows and Levels Assessment for the Middle Suwannee River*") for the USR and MSR, as reported herein.

1.3 Review Required by the District

The Panel followed the review requirements presented on the District's Peer Review Comment Form:

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 methods and 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
   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.
2. If a proposed method used in the MFL report is not scientifically reasonable, the reviewer 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.

1.4 Review Constraints

The Peer Reviewer shall acknowledge the statutory constraints and conditions (F.S. §373.042 and 373.0421) affecting the District's development of MFLs. The Peer Reviewer shall also acknowledge that review of certain assumptions, conditions, and established legal and policy interpretations of the Governing Board is not included in the scope of work. These include:

1. The selection of waterbodies or aquifers for which minimum flow and/or levels have been proposed;
2. The consideration given to changes and structural alterations to watersheds, surface waters, and aquifers, and the effects and constraints that such changes or alterations have had on the hydrology of a given watershed, surface water, or aquifer;
3. The method(s) used for establishing MFLs for other waterbodies and aquifers;

4. The selection and determination of the best available models used for MFL analyses such as the HEC-RAS surface water model and North Florida Southeast Georgia (NFSEG) regional groundwater model; and
5. 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.

The Panel received the MFL Reports and their appendices in early March 2023 and began its review. The Panel participated in an in-person public kickoff meeting with District staff and members of various stakeholder groups at the District's headquarters in Live Oak, Florida, on March 15, 2023. District staff delivered a presentation on all aspects of the process to develop minimum flows for the river segments. Following the meeting, the Panel reviewed the MFL Reports, appendices, and other pertinent documents, and prepared its reviews. Four additional virtual public meetings were held on April 19, May 2, May 16, and June 23 (planned). During the public meetings, the Panel members discussed various aspects of the report, asked questions of District staff, and heard public comment. The Panel also worked through a publicly accessible web board that was opened for two-hour sessions during several noticed times.

The Panel Chair compiled the reviews into a single document, which was reviewed and edited by all Panel members and the Panel Chair into the Draft Peer Review Report. Peer Review comment forms, which are a compilation of the comments each Panel member included in the Peer Review Report, were also submitted to the District (provided in Appendices A, B, and C).

The Panel has evaluated the information that pertained to data collection, use, quality assurance, and availability that was included in the Minimum Flow Reports and their appendices. The following is the Panel's assessment of the data in terms of the District's evaluation criteria listed above.

Section 2: Major Findings

After a thorough review of the MFL Reports, appendices, and supporting documents, the Panel concludes provisionally that the District's proposed minimum flows for the Upper and Middle Suwannee River are scientifically valid and sufficiently protective of the priority Water Resource Values (WRVs) from significant harm. The Panel has arrived at this conclusion with no disagreements on any of the issues relevant to the establishment of the minimum flows. However, the Panel has identified technical deficiencies that should be investigated in the near term to determine whether additional data should be collected, and studies initiated that could result in modifications to the proposed minimum flows. The Panel has also made recommendations as to how these issues might be addressed. The following is a summary of the Panel's principal findings including some of the most important deficiencies.

2.1 Supporting Data and Interpretation

The Panel concludes, with only a few minor comments, that the District and their cooperators properly collected, compiled, performed reasonable quality assurance, analyzed, and interpreted the massive amount of data used to support the minimum flows determinations.

2.2 Technical Assumptions

Overall, the Panel concludes that the District's assumptions are clearly stated, reasonable and consistent with the best information available and they were eliminated to the extent possible based on available information. The Panel's most significant concern is the District's implicit assumption of the validity of the Reference Timeframe (RTF). Although the Panel supports the District's approach to developing the RTF and

recognizes the significant complexity of the task, there is concern about the potential compounding of error throughout the process. Developing the RTF required a number of steps, each of which required development of estimates based on data records that were incomplete to varying degrees. Gaps in data records were reconstructed or hindcasted using various statistical techniques. The assumption inherent in each step was that sufficient accuracy was obtained to allow the results to be used in the NFSEG model (which has its own inherent error) and that the results of the model calculation would also be sufficiently accurate. The Panel's concern is that error inherent in each step is carried forward and compounded in subsequent steps. The Panel concludes that because RTF flows are integral to the development of the proposed minimum flows, the District should conduct an analysis to evaluate the error inherent in the process to determine whether the degree to which the error affects the calculation of the minimum flows is or is not significant.

2.3 Procedures and Analyses

Overall, the Panel concludes the District's procedures and analyses were appropriate and reasonable, based on the best information available, repeatable, and supported by the data. They incorporated appropriate factors, were correctly applied, and limitations and imprecision in the information were reasonably handled. However, the Panel has a number of concerns related especially to the Fish and Wildlife Habitats and the Passage of Fish Water Resource Value that should be addressed in the MFL Reports. These are presented below.

2.3.1 Priority Water Resource Values

Priority WRVs were established as the critical metrics evaluated for protection via minimum flow assessments. the Panel considers these WRVs to be appropriate and they appear to represent the fundamental components of the Suwannee River basin. There was sufficient data available to develop relationships between these WRVs and the river system. The District sufficiently evaluated the range of flows likely to occur on the Upper and Middle Suwannee River through the analysis of the priority WRVs and metrics used to evaluate significant harm against the Reference Timeframe. The District focused on minimum flow requirements but also evaluated the range of flows necessary to protect high-flow WRVs such as floodplain habitats from significant harm due to flow reductions. The priority WRVs are:

- Upper Suwannee River
  - Recreation In and On the Water,
  - Fish and Wildlife Habitats and the Passage of Fish,
  - Sediment Loads,
  - Water Quality.
- Middle Suwannee River
  - Recreation In and On the Water,
  - Fish and Wildlife Habitats and the Passage of Fish
  - Sediment Loads.

The Panel agrees with the District's selection of priority WRVs but has concerns with *Fish and Wildlife Habitats and Passage of Fish*, as summarized below and *Maintenance of Freshwater Storage and Supply*. Although the District did not consider *Maintenance of Freshwater Storage and Supply* to be a priority WRV, the panel is concerned that it is not appropriately evaluated.

2.3.2 Fish and Wildlife Habitats and the Passage of Fish

The Panel agrees with the District's selection of Gulf sturgeon passage during the fall spawning period as the WRV most likely to be limiting across the range of flows to develop the recommended minimum flow for the Upper and Middle Suwannee River; However, it was determined that that *Fish and Wildlife Habitats and the Passage of Fish*, which Gulf sturgeon passage is a subset of, should also include three additional components to ensure its protection: 1) Gulf sturgeon holding areas (Middle Suwannee River), 2) fish passage (Upper and Middle Suwannee River), and 3) flow requirements for recently hatched Gulf sturgeon.

Gulf Sturgeon Holding Areas. These were introduced as an important habitat component for immature fish, non-spawning adults, and for reproductively active adult fish following their spawning. These habitats have been documented as important habitat components for Gulf sturgeon in the Suwannee River, but also in other river systems that anadromous sturgeon inhabit. Despite the documented use (and perceived importance) of holding area habitat, flow requirements that are needed to maintain the habitat throughout the year were not incorporated into the MFL assessment. These holding areas, critical habitat for adult sturgeon post-spawn, may be altered under different flow regimes (i.e., low-flow periods) and should be a component of the minimum flow. In addition, there is text in the document that suggests high flow periods (i.e., bankfull and flood events) are needed to scour the stream bed and create or maintain deep holes, a key component for holding area habitat development. Admittedly, physical habitat descriptions of holding areas are ambiguous or not fully understood. Without clear habitat definitions, it may be challenging to establish critical threshold values that can be incorporated into the MFL assessment. It is recommended that the District work with its collaborators to collect new or synthesize existing data so that the minimum flow can be updated in the future.

Fish Passage. Fish passage was evaluated by incorporating the minimum depth and width of the river to facilitate fish movement over obstacles. Although these metrics are essential components of fish passage, velocity was not included in the assessment. This is an essential component for upstream passage and may be a limiting factor under certain flow regimes when flow is constricted to areas typically used for passage (i.e., sufficient depth). Flow velocity at various depth profiles should exist from the data collected for the HEC-RAS model. These data can be used to determine if velocity exceeds the critical swimming speed (0.21 m/s) of juvenile Gulf sturgeon determined by Wilkens *et al.* (2015) at various flow adjustments. There is a paucity of information relating to swimming capabilities for sturgeon and how confounding factors (e.g., size, temperature, and dissolved oxygen) might influence performance. It is recommended that a critical flow threshold of 0.21 m/s be adopted as a conservative measure until additional research can be conducted and incorporated into future MFL iterations.

Flow requirements for recently hatched sturgeon. Flow requirements for the larval/young-of-year life stage were absent in the upper and middle Suwannee River reports. Specific flows in the month(s) following spawning have been shown to influence recruitment success. For example, Randall and Sulak (2007) found that higher mean monthly flows in September and December were related to increased recruitment (i.e., year class strength) in the Suwannee River. These two time periods may correspond to critical young-of-year sturgeon development periods for sturgeon spawned during the spring and fall. Incorporating flow requirements for this vulnerable stage of life is warranted and should be incorporated into *the Fish and Wildlife Habitats and the Passage of Fish* WRV in the Middle Suwannee River report. It is recommended that a conservative critical flow threshold for the months of September and December be adopted. These values should be selected by the District after consulting with the USGS Wetland and Aquatic Research Center until additional research can be conducted and incorporated into future MFL iterations.

2.3.3 Maintenance of Freshwater Storage and Supply

The Panel is concerned that the District does not place sufficient importance on this WRV for the Floridan Aquifer System (FAS). There is more text devoted to floodplain storage (which is seasonal, and a relatively small volume compared to the FAS) than to FAS storage. Second, managing FAS storage by setting MFLs for springs may not be sufficient. The Panel would like to see a discussion of why the District thinks it would be.

River levels have a major impact on FAS water storage. Lower river levels allow the FAS to drain more quickly through springs and diffuse discharge. Higher river levels back water up into the spring runs, which reduces Floridan aquifer discharge, resulting in more storage in the aquifer. The District's proposal to maintain aquifer storage by establishing springs MFLs may have the opposite effect. For example, determining that the flow of a spring needs to be greater to maintain the ecology of the spring run will cause aquifer storage to be depleted more quickly, which will result in lower groundwater levels in the region.

This is a complex issue that should be addressed with at least some discussion. The Panel recommends the District place more emphasis on this WRV as it pertains to the FAS. Before concluding that this WRV for the FAS can be protected by establishing minimum flows for springs, the District should consider creating a conceptual model of what the complex equilibrium was between river flow, spring flow, and aquifer levels prior to development. Because of the magnitude of current groundwater withdrawals and other modifications to the system, it may not be possible to manage the system in a way that even remotely mimics the predevelopment equilibrium. However, having this information may better inform the process of establishing MFLs for both river and springs. The Panel recommends addressing this in the adaptive management section as an important consideration for future revisions of river and springs MFLs

Section 3: Panel Comments

Panel comments are organized below according to the review requirements presented on the District's Peer Review Comment Form (see Section 1.3). The major review categories are 1) Supporting Data and Information, 2) Technical Assumptions, and 3) Procedures and Analyses. For each of these categories, comments are further organized by the section structure of the MFL Reports:

- Hydrology
- Biology
- Approach to Setting MFLs
- Evaluation of Water Resource Values
- River MFLs
- Appendices

Within each review category, the sections above are not included if the Panel had no comments on them. Furthermore, it should be assumed by the readers that when an aspect of the methodology is not specifically commented on, the Peer Review Panel members identified no deficiencies. Finally, comments pertaining to a specific subject are further subdivided by those that pertain to the Upper Suwannee River MFL Report, the Middle Suwannee River MFL Report, or both reports.

3.1 Supporting Data and Information

The Panel review covered the following requirements:

Review the data and information that supports the methods 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.*

River flow and stage data were collected by the USGS, which sets the standard for data collection. Groundwater level data was collected by the USGS and the District. Surface water quality data were collected by the USGS, the District, and the Florida Department of Environmental Protection (FDEP). Parameter-elevation Relationships on Independent Slopes Model (PRISM) monthly time series rainfall data for the USR watershed were provided by the District. This gridded dataset was developed by the PRISM Climate Group at Oregon State University (PRISM Climate Group, 2014) using local and national resources such as the Florida Automated Weather Network (FAWN) and NOAA's Cooperative Observer Network (COOP). Monthly average temperature data also were obtained using PRISM for a location near Fargo, Georgia for general background climate information and for another location near the Nutrien phosphate mine near White Springs, Florida.

The Panel concludes that based on the documentation in the reports, the data used in the District's analyses was the best available. The Panel believes the acknowledged expertise and long-term experience of the agencies and organizations listed above that were involved in the collection of data ensures the data are of high quality. The following are the Panel's specific comments on the quality of supporting data and information.

3.1.1 Hydrology

The following are the Panel's comments on the supporting data and information related to hydrology.

Upper Suwannee River MFL Report

Gregg Jones

1. Page 31: The report states: *"The USR has cut a channel that gradually deepens from about 20 feet near Benton to about 45 feet near Ellaville".* I assume this is referring to 20 feet below land surface to 45 feet below land surface? This should be specified in the MFL report.
2. Page 39, Figure 30, Caption for Figure 30: *"Estimated net yearly groundwater withdrawal impacts to the Suwannee River at five USGS gages [Fargo, Benton, and White Springs plot near or at zero and are indistinguishable from one another…"*. How can the impact be near zero at the White Springs gage given that White Sulphur Springs has mostly ceased flowing? Apparently, it is because the gage is upstream of where White Sulphur Springs discharge enters the river. Because it is upstream, it has not recorded the flow of White Sulphur Springs so the influence of the historic decline in spring flow on river flow wouldn't have been recorded. This is important because the District has concluded that this reach of the river downstream of the Cody Scarp is a losing reach but the historic data at the White Springs gage does not support this. Recommend the District include this information in the report. Figure 30 should be modified or at least explained better because what it currently depicts is misleading.

Middle Suwannee River MFL Report

Gregg Jones

1. Mikel Clifton Well Data, Page 38 Figure 2-27: Mikel Clifton groundwater well data is supposed to start in 1977 but it appears the graph contains no data prior to about 1982. Check figure and revise if necessary.
2. Page 39, Figure 2-28: Figure caption states: "Annual Water Level" but each individual graph refers to it as annual average. I assume it is annual average? Address in MFL report if necessary.
3. Shallow Groundwater Monitor Wells, Page 39, Figure 2-28: In paragraph 1 it is stated that: *"The second groundwater data source includes 20 shallow monitoring wells established throughout the*

MSR floodplain to assess floodplain hydroperiods for a single annual period (November 2013 through November 2014) (Figure 2-21). Floodplain well data were examined in concert with 16 surface water staff gages, also described in more detail in Appendix V. The monitoring well and concurrent USGS streamflow data confirmed statistically significant hydroperiod differences among wetland types in the floodplain, and added direct weight of evidence that fairly frequent floods (those occurring at least once every five years rising well-above the groundwater table are important drivers in existing plant community distributions".

If the wells were only monitored for 1 year, how did they provide useful information for floods that occur once every 5 years? Recommend revising the MFL report to address this comment.

3.1.2 Water Resource Values

The following are the Panel's comments on the supporting data and information for the District's priority WRVs that were used to develop the minimum flow.

Upper and Middle Suwannee River MFL Reports

Adam Munson

1. Fish and Wildlife Habitats and the passage of fish: For purposes of the MFL assessment, the District contends that sufficient data exist to determine critical flows for a variety of metrics including general fish passage, Gulf sturgeon fish passage, fish passage into and out of select spring runs, instream habitat suitability for various species and life stages, riparian habitat, and floodplain wetland habitat communities. They have also considered seasonally specific need for passage. Specifically, the District has defined general fish passage as the elevation at which at least 0.8 foot of water would collectively cover 25% of the channel width, with single increments in width no less than 10% of the channel. This is consistent with other MFLs developed in the District. At least 3 feet of water covering at least 15 feet of streambed was identified as the criteria protective of Gulf sturgeon passage.

   For instream habitat the District collected data including necessary survey, velocity, discharge, water depth, and substrate/cover values (based on the Gore classification system) at transects established to assure the natural variability in habitat substrates and meso-habitats (pools, riffles, runs). The habitat suitability curves used in the analysis were provided by the District and the Florida Fish and Wildlife Conservation Commission (FWC).

3.1.3 Appendices

The following are the Panel's comments on the supporting data and information presented in the Appendices, specifically with respect to the Hydrodynamic Model development and calibration (Appendix D – HEC-RAS Model).

Upper Suwannee River MFL Report

Adam Munson

1. The development of the HEC-RAS models for both the Upper and Middle Suwannee River MFL Reports have been developed and reviewed over time. The data is agglomerated from many sources including USGS, FEMA, and specific additions by the District for this specific use.

   The Panel concludes that based on the documentation in the MFL reports, the data used in the development of the HEC-RAS models on the Upper and Middle Suwannee River has been collected by professionals of the agencies and consultants and are of high quality. Further, the professional engineers that built and calibrated the models (both steady and unsteady states) seem to have achieved reasonable calibrations.

3.2 Technical Assumptions

The Panel review covered the following requirements:
Review the technical assumptions inherent in the methodology and determine:

1. *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.*

The Panel concludes that with the exceptions listed below, the technical assumptions *were* clearly stated, reasonable and consistent with the best information available and were eliminated to the extent possible based on available information.

3.2.1 Approach to Setting MFLs

The following are panel comments related to assumptions in Section 4 of the MFL Reports: Approach to Setting MFLs.

Upper Suwannee River MFL Report

Martin Hamel

1. 1. Page 66, Section 4.2, Table 10: Gulf sturgeon holding areas were introduced as an important habitat component for adult fish following spawning, as well as for immature fish and non-spawning adults. These habitats have been identified as important habitat components for Gulf Sturgeon in the Suwannee River, but also in other river systems that anadromous sturgeon inhabit. There is text in the document that suggests high flow periods (i.e., bankfull and flood events) are needed to scour the stream bed and create deep holes. This assumption is valid and is likely an important component for holding area habitat development. However, there is no discussion about the potential flow requirements that are needed to maintain the habitat throughout the year, particularly when sturgeon are using the habitat. These holding areas – critical habitat for adult sturgeon post-spawn – may be altered under different flow regimes (i.e., low-flow periods).

3.2.2 Evaluation of Water Resource Values

The following are panel comments related to assumptions in Section 5 of the MFL Reports: Evaluation of Water Resource Values.

Upper Suwannee River MFL Report

Martin Hamel

1. Fish Passage and Gulf Sturgeon, Section 5.2.1, Page 101: The focus on fish passage is depth and width of river. However, velocity is an essential component for upstream passage and may be a limiting factor under certain flow regimes when flow is constricted to areas typically used for passage.

3.2.3 Appendices

The following are the Panel's comments on assumptions in the Appendices, specifically with respect to development of the Reference Timeframe (RTF) (Upper Suwanee River report Appendix C and Middle Suwanee River Report Appendix VII) and water use hindcasting (Upper Suwanee River report Appendix B and Middle Suwanee River Report Appendix VI).

A critical component of establishing a minimum flow for the USR was to develop baseline flow and Upper Floridan Aquifer (UFA) groundwater level records that reflect unimpacted or minimally impacted historical conditions over representative long-term hydrometeorological cycles. RTF is a time-series of Suwannee River flow from which any impacts of groundwater withdrawals are removed. To assist with estimating the impacts

of withdrawals on historical flows and water levels, the District and the St. Johns River Water Management District developed the NFSEG regional groundwater model.

Upper and Middle Suwannee River MFL Reports

Gregg Jones

1. RTF Error Analysis: Developing the RTF required a number of steps, each of which required development of estimates based on data records that were incomplete to varying degrees. Gaps in data records were reconstructed or hindcasted using various statistical techniques. The assumption inherent in each step was that sufficient accuracy was obtained to allow the results to be used in the NFSEG model (which has its own inherent error) and that the results of the model calculation would also be sufficiently accurate. The concern is that error inherent in each step is carried forward and compounded in subsequent steps.

   Because the RTF flows are integral to the development of the proposed minimum flow, the District should conduct an analysis to evaluate the error inherent in the process and determine the degree to which the error effects the calculation of the minimum flows.

2. Illustration of RTF Development Process**:** The statement is made: "To help with illustration of the process of the development of RTF time-series, numerical values from the analysis conducted at the USGS gage on Santa Fe River Near Ft. White will be used as an example" (USR Appendix C, page C-4).

   I assume the District developed the RTF flow for the four USR/MSR MFL gages using river flow data, groundwater use data, and groundwater-level data that was specific to the USR and MSR regions. What is confusing is that in both appendices, the process for the development of the RTF is illustrated using the analysis conducted at the Ft. White gage. I assume this was done to reduce the effort that would have been dedicated to develop all the text and graphics specific to the USR and MSR regions to use for examples. If this is the case, I understand the District's desire to do this. However, it should be made very clear where I have cited the reference above, why examples specific to the MSR/USR were not used and that the RTF analysis was actually completed for the MSR/USR regions.

3. Injection Well Hindcasting Appendix B, Part 2: Appendix B describes how the historic volume of reclaimed water injected/recharged into the FAS in Alachua County was determined for the NFSEG model. The text in the Appendix implies that recharge/injection only occurred in Alachua County. Is this county the only place in the entire NFSEG model domain where injection/recharge occurred? I'm assuming the NFSEG model considers recharge to the FAS from agricultural irrigation where the FAS is unconfined? This is probably a significant source of recharge.

   If Alachua is the only county in the NFSEG model domain where artificial injection/recharge occurs, It should be stated in the introduction to the Appendix. Also, there should be a brief discussion that explains the difference between recharge from artificial injection and recharge from agricultural irrigation in unconfined areas and how they are dealt with differently in the NFSEG model.

Adam Munson

1. For all metrics the District relies on the Reference Timeframe Flows (RTF): The RTF flows are constructed with the help of ground water models and reconstructed historic records. This is reasonable and has been implemented often in MFL development. I believe the error in gap filling and hindcasting is inherent in the process. However, these reports would benefit from greater specificity regarding the hindcasting of some records, especially well data, and the use of the NESEG model
2. Illustration of RTF Development Process, RTF Appendices MSR Report 2.7 and USR Report 2.9*:* It is confounding to me that we see the Estimated flow reductions from the NESEG model in the reports but the data presented in the Appendix is for Ft. White. I appreciate the logic and agree this is a

reasonable approach. It has been employed previously but it seems generating a report specific to the MSR and USR would be easy since you have a template from Ft. White and you have already performed the model runs. Recommend expanding details of RTF adjustment either in appendix or main body.

3.3 Procedures and Analyses

The Panel review covered the following requirements:
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; and*
6. *Conclusions based on the procedures and analyses are supported by the data.*

The Panel concludes that with the exceptions listed below, the procedures and analyses were appropriate and reasonable, based on the best information available, incorporated appropriate factors, were correctly applied, limitations and imprecision in the information were reasonably handled, were repeatable, and conclusions were based on the procedures and analyses are supported by the data.

3.3.1 Hydrology

The following are the Panel's comments on the procedures and analysis related to hydrology.

Upper Suwannee River MFL Report

Adam Munson

1. Page 16, Paragraph 3: You have chosen a smoothing parameter of 0.33 for All LOESS curves. The choice feels arbitrary. From a hydrologic perspective the choice should be explained as it represents a choice to smooth over a considerable period of time. The curves do not play a central role in the MFL development, but they are a visual queue to the reader. By contrast in the MSR I do not think you ever mention what your smoothing parameter is. Recommend adding a sentence or a few explaining the choice and why is it the same regardless of the data it is used on.
2. Page 28, 2.7.3: The Lake city well has a record back to 1948. It is the longest record and you extended the records of other wells using linear association between their records and the Lake City FDOT well. These are presented in Figure 22 and records seem to generally be extended about 30 years. I was unable to find (perhaps I missed it in some appendix) the linear relation that was use or any description of its validity. I do note from the graphs some concerns. For example, the Peter Deas well is often measured higher than the Lake City well in observations, but in the extension never once exceeds the Lake City well. Hilward Morgan on the other hand is extended to be above White Springs when it has not been observed to exceed white springs. This might all make sense but is unexplained. Recommend providing a discussion of the hindcasting for these wells to 1948.
3. Page 39: Figure 2-21 is cited but figure 2-21 is average rainfall. I believe 2-26 was intended. Recommend the reference be corrected.

3.3.2 Biology

The following are the Panel's comments on the procedures and analysis related to biology.

Upper Suwannee River MFL Report

Martin Hamel

1. 1. Page 46, Table 7: Table 7 provides generalized categories for fish assemblages and indicates that three different guilds are present in the USR. However, there is no reference to these categories (i.e., the development of them), or the diversity/richness of species from each of the guild classifications. Please provide additional information.

Middle Suwannee River MFL Report

Martin Hamel

1. Page 66: Holding areas are a critical habitat type for adult Gulf sturgeon that are used post-spawn. The definition of holding areas is perhaps a bit vague due to the lack of knowledge on the specific attributes that make up these habitats. Generally speaking, holding areas are deep water habitats with slow velocity. Flow reductions did not consider changes to holding area habitats – specific to depth and velocity – and should be considered in future iterations. Identify holding area depth and velocity information (if available) and incorporate that into the Gulf Sturgeon habitat criteria assessed for flow requirements.
2. Page 66: In the second to last paragraph, it was stated "It is unclear whether the newly identified spawning locations are a result of spawning range expansion or advancements in technology allowing for enhanced biological inference." Please explain what technological advancements were being used.
3. Page 69: There was a sentence in the second paragraph that indicates "preferred habitat" for Suwannee Bass was neutral or basic water occurring near springs. Please see Strong et al. (2010), Nagid et al. (2015), and Yeager (2022) for an actual description of habitat preference or associations. Please elaborate on habitat preferences. The pH of the river may be an important attribute that dictates their presence in this particular river, but it isn't a habitat they are selecting.
4. Page 69, Table 3-3: In Table 3-3: there are X's that indicate fry seasonality. I am not sure why fry seasonality cannot be inferred for Suwannee Bass and Gulf sturgeon as well. Please update.

3.3.3 Approach to Setting MFLs

The following are panel comments related to procedures and analyses in Section 4 of the MFL Reports: Approach to Setting MFLs.

Upper Suwannee River MFL Report

Martin Hamel

1. Indicators and response functions, Page 64, Last Sentence: This sentence indicates that habitat suitability curves were created for Gulf Sturgeon and published in a technical report (ICF Jones and Stokes, 2009). I could not gain access to this report, but the title suggests that the report was evaluating water withdrawals on the Pascagoula River in Mississippi. HSC development on a different river system could result in very different preferences for depth/velocity combinations than the Suwannee River. Please provide additional information on the development and use of HSC's for Gulf sturgeon. Were habitat data from the Pascagoula River used in developing habitat preference in the Suwannee River? How were the habitat data collected in the Pascagoula River and how similar are these two river systems?

2. Fish Passage: was focused on minimum depth and river width but fails to account for velocity. Although sturgeon are fluvial dependent species, they are not particularly adept at swimming in high velocity environments, particularly when traversing structures requiring burst swimming speeds. Little information exists on sturgeon burst speeds (particularly with adults), but research has been conducted examining critical swimming speeds (i.e., endurance or maximum aerobic swimming capacity) of various juvenile sturgeon. Wilkens et al. (2015) determined that the juvenile Gulf Sturgeon critical swimming speed was 0.21 meters per second, providing a framework for evaluating velocity changes under different flow regimes. Finally, multiple studies have examined critical swimming speed at varying temperature regimes, indicating that swimming speeds slow at lower temperatures. This should be accounted for by looking at the mean monthly water temperature for the time period when passage occurs.

Middle Suwannee River MFL Report

Martin Hamel

1. Holding Areas in the Middle Suwannee River are a critical habitat type for adult Gulf Sturgeon that are used post-spawn: Generally speaking, holding areas are deep water habitats with ***slow velocity***. Flow reductions did not consider changes to holding area habitats – specific to depth and velocity – and should be considered in future iterations. This should be a specific focal area similar to fish passage.
2. Page 79, Table 4-1: In the table there is a column labeled "General Flow Regime". What do the Low, Medium, and High levels refer to? Please provide a range of flows for each category.

Upper and Middle Suwannee River MFL Reports

Martin Hamel

1. Flow Requirements for the larval/young-of-year life stage are absent in the upper and middle Suwannee River reports. Specific flows in the month(s) following spawning have been shown to influence recruitment success. For example, Randall and Sulak (2007) found that higher mean monthly flows in September and December were related to increased recruitment (i.e., year class strength) in the Suwannee River. These two time periods may correspond to critical young-of-year sturgeon development periods for sturgeon spawned during the spring and fall. Similarly, D'Ercole *et al*. (unpublished data) found that high flows that inundate the floodplain during the summer period increased recruitment success in the Apalachicola River, FL. Incorporating flow requirements for this vulnerable stage of life is warranted and should be incorporated into Water Resource Values 2: Fish and Wildlife Habitats and the Passage of Fish in the Middle Suwannee River report.
2. Uncertainty and Adaptive Management, Page 92, Section 4.7: I found this section of the report to be valuable and warrants inclusion. However, I found that the list is not exhaustive and there are several uncertainties, in particular with Gulf Sturgeon, that were not addressed. These include the uncertainty associated with flow requirements to promote survival of young of year sturgeon, velocity limitations for fish passage, and habitat suitability in the Suwannee River using habitat preferences from other river systems. Finally, this section should similarly be included in the Middle Suwannee River report.
3. Uncertainty and Adaptive Management, Page 93: I appreciate being transparent about the uncertainty in the data acquisition and analyses that went into this report. This list is not exhaustive though and there are several uncertainties surrounding Gulf Sturgeon that were not addressed. This may be more of a concern in the MSR, but they are still relevant in the USR. Include additional uncertainties surrounding Gulf Sturgeon (these issues are brought up in other review comments).

3.3.4 Evaluation of Water Resource Values

The following are panel comments related to procedures and analyses in Section 5 of the MFL Reports: Evaluation of Water Resource Values.

Middle Suwannee River MFL Report

Martin Hamel

1. Fish and Wildlife Habitat and Passage of Fish, Page 132, Tables 5-2 and 5-3: In the tables the analyses refer to the number of days per year that a particular type of flow exceeded. However, for the Gulf Sturgeon passage during a specific month(s) of the year, this is not relevant. These results need to be scaled to the total number of days of exceedance compared to the number of days within the season. I believe the USR report did this. Please adjust to scale the number of days of exceedance for the length of the season identified.

Upper and Middle Suwannee River MFL Reports

Martin Hamel

1. Fish and Wildlife Habitat and Passage of Fish: Flow requirements for the larval/young-of-year life stage are largely absent in these reports. Specific flows in the month(s) following spawning have been shown to influence recruitment success. For example, Randall and Sulak (2007) found that higher mean monthly flows in September and December were related to increased recruitment in the Suwannee River. These two time periods may correspond to critical young-of-year sturgeon development periods for sturgeon spawned during the spring and fall. Similarly, D'Ercole *et al*. (unpublished data) found that high flows that inundate the floodplain during the summer period increased recruitment success in the Apalachicola River, FL. Additional research is needed to gain a better understanding at the hydrologic conditions that influence Gulf Sturgeon young-of-year survival. However, the previous research outlined in Randall and Sulak (2007) does provide evidence that high flows in September and December were related to recruitment success. The monthly flows during this time period were provided and could be used as a starting point for establishing minimum flows during post-spawn development periods until additional research could be conducted.

Middle Suwannee River MFL Report

Adam Munson

1. Fish and Wildlife Habitat and Passage of Fish, Page 90: I am comfortable that the 3ft of depth is the reasonable and that the 15ft width is at least logical if somewhat untested. I remain concerned that the only WRV that is limiting is fish passage and it is based on a relatively undocumented standard. My concern is narrow. It is that once a peer review panel endorses something as reasonable it can be cited as evidence of reasonableness. I would rather our report say this is best available information which I believe is accurate but leave the door more broadly open when it comes time for re-evaluation.

Upper And Middle Suwannee River MFL Reports

Gregg Jones

1. Maintenance of Freshwater Storage and Supply: The USR/MSR Reports undervalue the importance of WRV 5, Maintenance of Freshwater Storage and Supply, as it relates to the FAS. The USR report devotes just a brief paragraph to the subject – page 63: The USR MFL Report states: *"Spring flow is an indicator of* groundwater *storage; hence, WRV 5 is relevant primarily to the spring MFLs that are being developed and will be presented in a separate document".*

   The MSR Report only states: *"the FAS is identified as "a major regional freshwater storage feature"*, and does not elaborate further. It is then explained that the river's floodplain provides storage for at

least several weeks following flood pulses, and then states: *"the proposed river MFL protects floodplain communities against adverse dewatering via WRVs 1, 2, and 8; and is therefore assumed to prevent significant harm to the maintenance of freshwater storage in the region."* The next sentence states: *"Additionally, MSR priority springs MFLs, which will be addressed in a separate document, will protect spring flows by maintaining critical aquifer levels."* It is not clear but apparently only assumed in both reports that MFLs for springs will protect WRV 5 as it pertains to the FAS.

First, the District does not place sufficient importance on WRV 5 for the FAS. There is more text devoted to floodplain storage (which is seasonal, and a relatively small volume compared to the FAS) than to FAS storage. Second, managing FAS storage by setting MFLs for springs may not be sufficient – I would like to see a discussion of why the District thinks it would be.

River levels have a major impact on FAS water storage. Lower river levels allow the FAS to drain more quickly through springs and diffuse discharge. Higher river levels back water up into the spring runs, which reduces Floridan aquifer discharge, resulting in more storage in the aquifer.

The District's proposal to maintain aquifer storage by establishing springs MFLs may have the opposite effect. For example, determining that a spring needs to flow at a higher level to maintain the ecology of the spring run will cause aquifer storage to be depleted more quickly, which will result in lower groundwater levels in the region.

This is a complex issue that should be addressed with at least some discussion. Recommend the District place more emphasis on WRV 5 as it pertains to the FAS. Before concluding that WRV 5 for the FAS can be protected by establishing minimum flows for springs, consider creating a conceptual model of what the complex equilibrium was between river flow, spring flow, and aquifer levels prior to development. Because of the magnitude of current groundwater withdrawals and other modifications to the system, it may not be possible to manage the system in a way that even remotely mimics the predevelopment equilibrium. However, having this information may better inform the process of establishing MFLs for both river and spring minimum flows. Recommend addressing this in the adaptive management section as an important consideration for future revisions of river and springs MFLs.

3.3.5 River MFLs

The following are panel comments related to procedures and analyses in Section 6 of the MFL Reports: Evaluation of Water Resource Values.

Middle Suwannee River MFL Report

Adam Munson

1. Appendix X, Page 3**:** You state "The underlying premise of applying a single-value flow reduction below median flows is the assumption that regional withdrawals are from groundwater pumping. If surface water diversions are proposed in the future, then larger volumes of water would be available without causing significant harm when flows are above median conditions." Please clarify this statement. Specifically, is the "Median condition" an important delineator and, if so, why?

Gregg Jones

1. Availability of Water for Water Supply at High Flows. Page 83, Figure 4-3: Within the box in the lower left corner of the graph in Figure 4-3, it is stated that the amount available for withdrawal is "H". I don't see H anywhere on the graph, but I assume H is the vertical difference between where the dashed green RTF line intersects the y axis and where the dashed orange critical flow line intersects the y axis and H should equal 545 cfs.

Referring to the distance between those lines as the "amount available for withdrawal" is confusing. It should be referred to as the amount of water available when the flow equals 2,461 cfs. I believe if the flow is above 2,461 cfs, the amount of water available would be the difference between that flow and 1,916 cfs critical flow. I'm concerned the way it is currently presented gives the mistaken impression that the largest amount of water available for water supply will never be more than 545 cfs. Of course, 545 cfs is a very large volume of water (352 million gallons per day (mgd)). The following is an example of what this means in terms of water supply.

The Peace River/Manasota Regional Water Supply Authority in DeSoto County Florida has an off-stream reservoir with a capacity of 6 billion gallons. Their pump/intake system can move 120 mgd from the river to the reservoir, which, based on the proposed minimum flow for the MSR, is only 36 percent of the 352 mgd available for water supply in the Suwannee River when the flow is 2,461 cfs. The 120 mgd pumping capacity could fill a reservoir with 6-billion-gallon capacity in just 50 days. When considered that the RTF flow of 2,461 cfs is exceeded 70.4 percent of the time, it becomes apparent that a very large volume of water can be harvested from the Suwannee River with very minimal impact to the WRVs.

2. Establishing a high flow minimum level, Page 140: The last sentence in the paragraph states: "While it is possible to designate MFLs for multiple flow conditions for a particular gage, prescribing a single MFL flow condition at a gage provides efficacy from a water management perspective".

   My interpretation of this it that the District wants to use the most restrictive WRV to produce a low-flow minimum flow that would protect all other WRVs, so it would not be necessary to establish high flow minimums. But this makes no provision for water withdrawals at high flows. My previous comments have expressed the importance of establishing high flow minimum flows to identify volumes of water that could be harvested for water supply during high flow periods. So even though setting only a low flow MFL may simplify the water management process, it does not provide sufficient guidance for determining water availability over the full range of flows. Recommend the District provide a better explanation in the text of what this sentence means and/or revise it to indicate that it is beneficial to determine the available amount of water for water supply at the full range of flows.

3. High Flows and Water Supply, Figures 72, 73 USR Report & Figures 6-1, 6-2 MSR Report: It is important to determine some level of understanding of the availability of water at high flows for water supply in these MFL reports. The SWFWMD assisted with the development of two large off-stream reservoirs that only filled from rivers during periods of high flow. To ensure that harvesting water at high flows did not cause significant harm to the river, SWFWMD established high flow minimum levels in addition to low flow minimum levels.

   The Suwannee River frequently flows at very high levels. During these periods, water could be pumped from the river and stored in an off-stream reservoir for municipal, agricultural, or mining water supply, which could offset groundwater pumping, or it could be pumped to high recharge areas to recover depressed groundwater levels in the Floridan aquifer. Something like this could be part of a recovery/prevention strategy if one is necessary.

4. Development of MFL Criteria, Appendix X. 2.0: The text is as follows: "*It was determined that a single value flow reduction approach would be taken, using the most restrictive or limiting critical flows. In the case of both Ellaville and Branford, this corresponds with Gulf sturgeon fall passage and results in a reduction of 346 cfs across the flow duration curve for Ellaville and 400 cfs for Branford. The underlying premise of applying a single-value flow reduction below median flows is the assumption that regional withdrawals are from groundwater pumping. If surface water diversions are proposed in the future, then larger volumes of water would be available without causing significant harm when flows are above median conditions*".

First, what is meant by regional withdrawals? Is the District saying that regional withdrawals is the same thing as baseflow/springflow that was prevented from reaching the river as the result of regional groundwater withdrawals? If so, it then follows that the historic river flow reductions are the result of regional groundwater withdrawals. If I am correct about all this, I recommend rewording the sentence, because when it refers to *"regional withdrawals",* I think it means reductions in river flow since there are no significant surface water withdrawals. Recommend changing the sentence to read: "The underlying premise of applying a single-value flow reduction below median flows is the assumption that historic declines in river flow are caused by groundwater pumping that has reduced the amount of baseflow and springflow reaching the river."

Upper And Middle Suwannee River MFL Reports

Gregg Jones

1. Figures 72 and 73 and Figures 6-1 and 6-2 in the USR and MSR reports, respectively: It is possible I am not understanding these figures, but it appears to me that at the 5% exceedance flow, which is a very high flow, the dashed red limiting WRV line is coincident with the RTF flow condition. This appears to me to indicate that no water is available at this high level of flow. I doubt this is the District's intent.

   Recommend the referenced figures be reevaluated or better explained to ensure they do not convey the message that significant water volumes are not available at high flows for water supply. In addition, a brief discussion should be added regarding water availability at high flows. In the adaptive management section, consider a discussion of the need to eventually establish high flow minimum levels and the types of data that would need to start being collected in the near future to establish such levels.

3.3.6 Appendices

The following are the Panel's comments on procedures and analyses in the Appendices, specifically with respect to record extension and gap filling (Upper Suwanee River report Appendix A and Middle Suwanee River Report Appendix I) and RTF (Upper Suwanee River report Appendix C and Middle Suwanee River Report Appendix VII).

Upper Suwannee River MFL Report

Adam Munson

1. Appendix A, Section 2.4. Record Extension and Gap Filling: The discussion of record extension and gap filling in the USR report could be improved. The text has only a brief outline and makes claims of *"appropriate techniques", "good agreement"*, and *"rigorous relations".* Little evidence or definition is added. The supporting appendix is (I believe) SPSS output and not very consumable for most readers. Regression is a reasonable tool for data extension and alternatives (regressions) were explored. The evidence in the appendix does support the use of the regression model. Predictions closer to actual at a higher rate than expected by a gaussian distribution but still symmetric. However, the report (especially the appendix) would greatly benefit from actual discussion of the statistics and not just a lot of screen captures. This issue is more noticeable because the District in the MSR has provided a more informative text and used alternate methods.

   Suggest adding at least some discussion in Appendix A supporting claims in the main text or expanded discussion of the main text reducing expectations of the appendix.

2. Appendix A: I would have liked to have seen calibration and validation data sets. Graphs like Figure 6 (A and B) in Appendix 1 of the MSR would have been welcome. Bias would be more easily examined.

Thank you for presenting regression results, p-p plots, residual plots, VIF, etc. Distillation of the information is typically the job of the authors. This presentation seems an afterthought rather than a report on the procedure and results. Recommend including these data in reports developed for future updates of the MFLs.

Middle Suwannee River MFL Report

Adam Munson

1. Page 19 and Appendix I: The difference in gap filling and record extensions between the two reports is notable. As is often the case that multiple numeric methods are available to reasonably complete the same task and decisions must be made. I believe the USR and MSR have both used reasonable methods and I do not find logical flaw with either, through greater evidence supporting the conclusions and contentions of each would be welcome (USR noted above). Specific to the MSR are figure 6a and 6b or Appendix I. The mean absolute error (MAE) and mean error (ME) are about the same (.26 and .2 ft). The model seems to routinely underpredict stage, albeit by less than a half foot. The Flow is better with an MAE of 187 cfs while the ME is only 21 cfs suggesting less bias in the flow imputations.
2. Page 35, Section 2.5: I note in section 2.5 of the MSR that no record extensions of the wells seem to have been undertaken even though they are shorter. It is unclear what these well records are used for but coming right before the RTF discussion I presume they were used in the creation of the RTF adjustment factor. If so, I feel any recreated record warrants discussion from the USR and if one was made in the MSR. Also, if it was used in the RTF should the recreation go back to the start of the RTF adjustment in 1933 (assumed from appendix VII). I completely defer to Dr. Jones on this topic, but I feel as if the inclusion of the generalized Appendix VII in lieu of study specific details is hampering my ability to fully evaluate the accuracy of the RTF adjustment. Recommend an explanation of why in the USR Report the well records were extended and in the MSR Report they were not. Explain if both were extended for use in the RTF adjustment. The use of the short-term ones in the flood plain studies was made evident in Appendix V. Please clarify any additional use of these wells.

Middle and Upper Suwannee River MFL Reports

Gregg Jones

1. USR MFL Report Appendix B and C and MSR MFL Report Appendix VI and VII (Reference Time Frame and NFSEG Groundwater Model): The use of a groundwater flow model to determine long-term impacts on flow from groundwater withdrawals was a recommendation of the Peer Review Panel that conducted the original review of the MSR proposed minimum flow in 2017. The current panel is pleased to see that this recommendation was implemented and that it was implemented through a cooperative effort between the Districts, the USGS, the State of Georgia, and other entities.

3.4 Deficiencies and Remedies

The panel assessed the following requirements:

If a proposed method used in the MFL report is not scientifically reasonable, the reviewer 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.

The following is a compilation of deficiencies in the District's MFL Report and Appendices identified by the Panel and deemed to be significant. The Panel identified numerous minor issues that include changes to text and figures to provide clarity, editorial and readability comments, etc. These are listed on the Peer Review Comment forms for each Panel member but are not included in this section.

3.4.1 Supporting Data and Information

Upper Suwannee River MFL Report

Gregg Jones

1. **Deficiency**: *Report States: "The USR has cut a channel that gradually deepens from about 20 feet near Benton to about 45 feet near Ellaville. The updip limit of the Floridan aquifer system occurs at about river mile 170; i.e., near White Springs"* (page 31*).* I assume this is referring to 20 feet below land surface to 45 feet below land surface?

   Remedy: Specify in the MFL Report.

2. **Deficiency**: Page 39, Fig 30. Caption for Figure 30**:** "*Estimated net yearly groundwater withdrawal impacts to the Suwannee River at five USGS gages [Fargo, Benton, and White Springs plot near or at zero and are indistinguishable from one another…"*. How can the impact be near zero at the White Springs gage given that White Sulphur Springs has mostly ceased flowing? Apparently, it is because the gage is upstream of where White Sulphur Springs discharge enters the river. Because it's upstream, it has not recorded the flow of White Sulphur Springs so the influence of the historic decline in spring flow on river flow wouldn't have been recorded.

   Remedy: Recommend the District include this information in the report. Figure 30 should be modified or at least explained better because what it currently depicts does not tell the full story.

Middle Suwannee River MFL Report

Gregg Jones

1. **Deficiency**: Mikel Clifton Well Data Page 38 Figure 2-27: Mikel Clifton groundwater well data is supposed to start in 1977 but it appears the graph contains no data prior to about 1982.

   Remedy: Check the figure to determine if modifications are necessary.

3.4.2 Technical Assumptions

3.4.2.1 Reference Time Frame

Upper and Middle Suwannee River MFL Reports

Gregg Jones

1. **Deficiency:** Establishing the MFLs for the USR/MSR required the development of baseline river flows that reflect minimally impacted historical conditions over representative long-term hydrometeorological cycles. To facilitate this, the Suwannee and St. Johns WMDs developed the NFSEG regional groundwater model. Use of a groundwater flow model to determine long-term impacts on river flow from groundwater withdrawals was a recommendation of the Peer Review Panel that conducted the original review of the USR proposed minimum flow in 2017. I am pleased to see this recommendation was implemented.

   I support the District's approach to developing the RTF and recognize the significant complexity of the task. However, developing the RTF required a number of steps, each of which required development of estimates based on data records that were incomplete to varying degrees. Gaps in data records were reconstructed or hindcasted using various statistical techniques. The assumption inherent in each step

was that sufficient accuracy was obtained to allow the results to be used in the NFSEG model (which has its own inherent error) and that the results of the model calculation would also be sufficiently accurate. My concern is that error inherent in each step is carried forward and compounded in subsequent steps.

Remedy: Because RTF flows are integral to the development of the proposed minimum flow, the District should conduct an analysis to evaluate the error inherent in the process to determine whether the degree to which the error affects the calculation of the minimum flows is or is not significant.

2. **Deficiency:** In the RTF Appendices for both reports, it is stated: *"To help with illustration of the process of the development of RTF time-series, numerical values from the analysis conducted at the USGS gage on Santa Fe River Near Ft. White will be used as an example".*

   I assume the District developed the RTF flow for the four USR/MSR MFL gages using river flow data, groundwater use data, and groundwater-level data that was specific to the USR and MSR regions. What is confusing is that in the appendices for both MFL reports, the process for the development of the RTF is illustrated using the analysis conducted for the Ft. White gage for the Santa Fe River. Is it correct to assume this was done to reduce the effort that would have been required to produce all the text and graphics specific to the development of the RTF for the USR and MSR regions to use for the example?

   Remedy: If what I stated above is the case, I understand the District's desire to reduce the effort. However, it should be made very clear where I have cited the reference above, why examples specific to the MSR/USR were not used and to reassure readers that the RTF analysis was actually completed for the MSR/USR regions.

3 **Deficiency:** Injection Well Hindcasting, Appendix B, Part 2: Appendix B describes how the historic volume of reclaimed water injected/recharged into the FAS in Alachua County was determined for the NFSEG model. The text in the Appendix does not specify whether artificial recharge/injection only occurred in Alachua County. Is this county the only place in the entire NFSEG domain where artificial injection/recharge occurred? What about recharge from agricultural irrigation where the FAS is unconfined? This is probably very significant. I'm assuming the NFSEG model includes this?

Remedy: If Alachua is the only county in the NFSEG model domain where injection/recharge occurs, it should be stated in the introduction to the Appendix. Also, there should be a brief discussion that explains the difference between recharge from artificial injection and recharge from agricultural irrigation where the FAS is unconfined and how these two sources of recharge are dealt with differently in the NFSEG model.

Adam Munson

1 **Deficiency:** Illustration of RTF Development Process, RTF Appendices MSR Report 2.7 and USR Report 2.9: It is confounding to me that we see the Estimated flow reductions from the NESEG model in the reports, but the data presented in the Appendix is for Ft. White. I appreciate the logic and agree this is a reasonable approach. It has been employed previously.

Remedy*:* It seems generating a report specific to the MSR and USR would be easy since you have a template from Ft. White and you have already preformed the model runs. Recommend expanding details of RTF adjustment either in appendix or main body.

3.4.2.2 Water Resource Values

Middle Suwannee River MFL Report

Martin Hamel

1 **Deficiency:** Page 79, Table 4-1: In the table there is a column labeled "General Flow Regime"

Remedy: What do the Low, Medium, and High levels refer to? Please provide a range of flows for each category.

2 **Deficiency:** Page 132, Tables 5-2 and 5-3: In the tables the analyses refer to the number of days per year that a particular type of flow exceeded. However, for the Gulf Sturgeon passage during a specific month(s) of the year, this is not relevant.

Remedy: These results need to be scaled to the total number of days of exceedance compared to the number of days within the season. I believe the USR report did this. Please adjust to scale the number of days of exceedance for the length of the season identified.

Upper and Middle Suwannee River MFL Reports

Martin Hamel

1. **Deficiency**: Flow requirements for the larval/young-of-year life stage are largely absent in these reports. Specific flows in the month(s) following spawning have been shown to influence recruitment success. For example, Randall and Sulak (2007) found that higher mean monthly flows in September and December were related to increased recruitment in the Suwannee River. These two time periods may correspond to critical young-of-year sturgeon development periods for sturgeon spawned during the spring and fall. Similarly, D'Ercole *et al*. (unpublished data) found that high flows that inundate the floodplain during the summer period increased recruitment success in the Apalachicola River, FL.

   Remedy: Additional research is needed to gain a better understanding at the hydrologic conditions that influence Gulf Sturgeon young-of-year survival. However, the previous research outlined in Randall and Sulak (2007) does provide evidence that high flows in September and December were related to recruitment success. The monthly flows during this time period were provided and could be used as a starting point for establishing minimum flows during post-spawn development periods until additional research could be conducted.

Upper Suwannee River MFL Report

Martin Hamel

1. **Deficiency:** Page 102: Fish passage was focused on minimum depth and river width but fails to account for velocity. Although sturgeon are fluvial dependent species, they are not particularly adept at swimming in high velocity environments, particularly when traversing structures requiring burst swimming speeds. Little information exists on sturgeon burst speeds, but research has been conducted examining critical swimming speeds (i.e., endurance or maximum aerobic swimming capacity) of various juvenile sturgeon. Little information exists for adult sturgeon due to size constraints in flume-tested experiments. Wilkens et al. (2015) determined that the juvenile Gulf Sturgeon critical swimming speed was 0.21 meters per second. Finally, multiple studies have examined critical swimming speed at varying temperature regimes.

   Remedy: This should be accounted for by looking at the mean monthly water temperature for the time period when passage occurs. Although there is a knowledge gap for critical swimming and burst speeds on adult Gulf Sturgeon, additional analyses to show the change in velocity profiles under low flow conditions is warranted. Low flow (or future flow reductions) may constrict flow to the passage areas, increasing velocity and limiting passage. Do these velocities surpass the critical swimming speeds of juvenile Gulf Sturgeon (0.21 m/s)?

Upper and Middle Suwannee River MFL Reports

Gregg Jones

1. **Deficiency**: Maintenance of Freshwater Storage and Supply: The USR report devotes just a brief paragraph to the subject (page 63), stating: *"Spring flow is an indicator of groundwater storage; hence,*

WRV 5 is relevant primarily to the spring MFLs that are being developed and will be presented in a separate document".

The MSR Report only states: *"the FAS is identified as "a major regional freshwater storage feature",* and does not elaborate further. It is then explained that the river's floodplain provides storage for at least several weeks following flood pulses, and then states: *"the proposed river MFL protects floodplain communities against adverse dewatering via WRVs 1, 2, and 8; and is therefore assumed to prevent significant harm to the maintenance of freshwater storage in the region."* The next sentence states: *"Additionally, MSR priority springs MFLs, which will be addressed in a separate document, will protect spring flows by maintaining critical aquifer levels."* It is not clear but apparently only assumed in both reports that MFLs for springs will protect WRV 5 as it pertains to the FAS.

My concern is that first, the District does not place sufficient importance on WRV 5 for the FAS. There is more text devoted to floodplain storage (which is seasonal, and a relatively small volume compared to the FAS) than to FAS storage. Second, managing FAS storage by setting MFLs for springs may not be sufficient. I would like to see a discussion of why the District thinks it would be.

River levels have a major impact on FAS water storage. Lower river levels allow the FAS to drain more quickly through springs and diffuse discharge. Higher river levels back water up into the spring runs, which reduces Floridan aquifer discharge, resulting in more storage in the aquifer.

The District's proposal to maintain aquifer storage by establishing springs MFLs may have the opposite effect. For example, determining that the flow of a spring needs to be greater to maintain the ecology of the spring run will cause aquifer storage to be depleted more quickly, which will result in lower groundwater levels in the region.

Remedy: This is a complex issue that should be addressed with at least some discussion. Recommend the District place more emphasis on WRV 5 as it pertains to the FAS. Before concluding that WRV 5 for the FAS can be protected by establishing minimum flows for springs, consider creating a conceptual model of what the complex equilibrium was between river flow, spring flow, and aquifer levels prior to development. Because of the magnitude of current groundwater withdrawals and other modifications to the system, it may not be possible to manage the system in a way that even remotely mimics the predevelopment equilibrium. However, having this information may better inform the process of establishing MFLs for both river and springs. Recommend addressing this in the adaptive management section as an important consideration for future revisions of river and springs MFLs.

3.4.2.3 Uncertainty and Adaptive Management

Upper Suwannee River MFL Report

Martin Hamel

1. Deficiency: Page 93: I appreciate being transparent about the uncertainty in the data acquisition and analyses that went into this report. This list is not exhaustive though and there are several uncertainties sur-rounding Gulf Sturgeon that were not addressed. This may be more of a concern in the MSR, but they are still relevant in the USR.

   Remedy: Include additional uncertainties surrounding Gulf Sturgeon (these issues are brought up in other review comments).

3.4.3 Procedures and Analyses

3.4.3.1 Hydrology

Upper and Middle Suwannee River MFL Reports

Adam Munson

1. **Deficiency:** Atlantic Multidecadal USR 2.5.2 and MSR 2.4.1. Both reports have the same graph, but the USR identifies the AMO as a cool/wet phase from WY 1970-1999 and the MSR identifies the middle cool period as 1960-2000. The interpretation of the same graph should be the same in both reports. More importantly, the Wet/cool and warm/dry interpretation present only in the USR is perhaps too generalized to peninsular Florida. The Continental US reverses the wet/cool warm/dry and much of the USR basin is in southern Georgia.

   Remedy: Change one so the dates are consistent.

3.4.3.2 Biology

Upper Suwannee River MFL Report

Martin Hamel

1. **Deficiency**: Page 46, Table 7: Table 7 provides generalized categories for fish assemblages and indicates that three different guilds are present in the USR. However, there is no reference to these categories (i.e., the development of them), or the diversity/richness of species from each of the guild classifications.

   Remedy: Please provide additional information.

2. **Deficiency:** Page 64, Last Sentence: This sentence indicates that habitat suitability curves were created for Gulf Sturgeon and published in a technical report (ICF Jones and Stokes, 2009). I could not gain access to this report, but the title suggests that the report was evaluating water withdrawals on the Pascagoula River in Mississippi. HSC development on a different river system could result in very different preferences for depth/velocity combinations than the Suwannee River. Please provide additional information on the development and use of HSC's for Gulf Sturgeon.

   Remedy: Were habitat data from the Pascagoula River used in developing habitat preference in the Suwannee River? If so, please provide additional information on how the habitat data were collected in the Pascagoula River, as well as information describing the similarities and differences between the two river systems (e.g., mean annual discharge, mean/median depth, mean river width, etc.). The use of HSC's developed from another system should be described in the section on assumptions. Future research to develop a Suwannee River specific HSC for Gulf Sturgeon is warranted and should be incorporated into future iterations of the Upper and Middle Suwannee River MFL assessment.

Middle Suwannee River MFL Report

Martin Hamel

1. **Deficiency:** Page 66: Holding areas are a critical habitat type for adult Gulf Sturgeon that are used post-spawn. The definition of holding areas is perhaps a bit vague due to the lack of knowledge on the specific attributes that make up these habitats. Generally speaking, holding areas are deep water habitats with slow velocity. Flow reductions did not consider changes to holding area habitats – specific to depth and velocity – and should be considered in future iterations.

   Remedy: Identify holding area depth and velocity information (if available) and incorporate that into the Gulf Sturgeon habitat criteria assessed for flow requirements.

2. **Deficiency**: Page 66: In the second to last paragraph, it was stated *"It is unclear whether the newly identified spawning locations are a result of spawning range expansion or advancements in technology allowing for enhanced biological inference."*

   Remedy: Please explain what technological advancements were being used.

3. **Deficiency:** Page 68**:** There was a sentence in the second paragraph that indicates "preferred habitat" for Suwannee Bass was neutral or basic water occurring near springs. Please see Strong et al. (2010), Nagid et al. (2014), and Yeager (2022) for an actual description of habitat preference or associations.

   Remedy: Please elaborate on habitat preferences. The pH of the river may be an important attribute that dictates their presence in this particular river, but it isn't a habitat they are selecting.

4. **Deficiency:** Page 69, Table 3-3**:** In the table there are X's that indicate fry seasonality. I am not sure why fry seasonality cannot be inferred for Suwannee Bass and Gulf Sturgeon as well.

   Remedy: Please update.

3.4.3.3 Approach to Setting MFLs

Upper Suwannee River MFLs Report

Adam Munson

1. **Deficiency:** Appendix A, Section 2.4**:** The discussion of record extension and gap filling in the USR report could be improved. The text has only a brief outline and makes claims of "appropriate techniques", "good agreement", and "rigorous relations". Little evidence or definition is added. The supporting appendix is (I believe) SPSS output and not very consumable for most readers. Regression is a reasonable tool for data extension and alternatives (regressions) were explored. The evidence in the appendix does support the use of the regression model. Predictions closer to actual at a higher rate than expected by a gaussian distribution but still symmetric. However, the report (especially the appendix) would greatly benefit from actual discussion of the statistics and not just a lot of screen captures. This issue is more noticeable because the District in the MSR has provided a more informative text and used alternate methods.

   Remedy: Suggest adding at least some discussion in Appendix A supporting claims in the main text or expanded discussion of the main text reducing expectations of the appendix.

2. **Deficiency:** Appendix A**:** I would have liked to have seen calibration and validation data sets. Graphs like Figure 6 (A and B) in Appendix 1 of the MSR would have been welcome. Bias would be more easily examined. Thank you for presenting regression results, p-p plots, residual plots, VIF, etc. Distillation of the information is typically the job of the authors. This presentation seems an afterthought rather than a report on the procedure and results.

   Remedy: Recommend including these data in reports developed for future updates of the MFLs.

3. **Deficiency:** Page 28, 2.7.3: The Lake city well has a record back to 1948. It is the longest record and you extended the records of other wells using linear association between their records and the Lake City FDOT well. These are presented in Figure 22 and records seem to generally be extended about 30 years. I was unable to find (perhaps I missed it in some appendix) the linear relation that was use or any de-scription of its validity. I do note from the graphs some concerns. For example, the Peter Deas well is often measured higher than the Lake City well in observations, but in the extension never once exceeds the Lake City well. Howard Morgan on the other hand is extended to be above White Springs when it has not been observed to exceed white springs. This might all make sense but is unexplained.

   Remedy: Recommend providing a discussion of the hindcasting for these wells to 1948.

3.4.3.4 Historical Streamflow

Adam Munson

1. **Deficiency:** Page 16, Paragraph 3: You have chosen a smoothing parameter of .33 for All LOESS curves. The choice feels arbitrary. From a hydrologic perspective the choice should be explained as it represents a choice to smooth over a considerable period of time. The curves do not play a central role in the MFL development, but they are a visual queue to the reader. By contrast in the MSR I do not think you ever mention what your smoothing parameter is.

   Remedy: Recommend adding a sentence or a few explaining the choice and why is it the same regardless of the data it is used on.

Middle Suwannee River MFLs Report

Adam Munson

1. **Deficiency:** Page 35, Section 2.5**:** I note in section 2.5 of the MSR that no record extensions of the wells seem to have been undertaken even though they are shorter. It is unclear what these well records are used for but coming right before the RTF discussion I presume they were used in the creation of the RTF adjustment factor. If so, I feel any recreated record warrants discussion from the USR and if one was made in the MSR. Also, if it was used in the RTF should the recreation go back to the start of the RTF adjustment in 1933 (assumed from appendix VII). I completely defer to Dr. Jones on this topic, but I feel as if the inclusion of the generalized Appendix VII in lieu of study specific details is hampering my ability to fully evaluate the accuracy of the RTF adjustment.

   Remedy: Recommend an explanation of why in the USR Report the well records were extended and in the MSR Report they were not. Explain if both were extended for use in the RTF adjustment. The use of the short-term ones in the flood plain studies was made evident in Appendix V. Please clarify any additional use of these wells.

2. **Deficiency:** Page 39: Figure 2-21 is cited but figure 2-21 is average rainfall. I believe 2-26 was intended.

   Remedy: Recommend the reference be corrected.

Upper and Middle Suwannee River MFL Reports

Adam Munson

1. **Deficiency:** MSR Page 19 and Appendix 1: The difference in gap filling and record extensions between the two reports is notable. As is often the case that multiple numeric methods are available to reasonably complete the same task and decisions must be made. I believe the USR and MSR have both used reasonable methods and I do not find logical flaw with either, through greater evidence supporting the conclusions and contentions of each would be welcome (USR noted above). Specific to the MSR are figure 6a and 6b or Appendix I. The MAE and ME are about the same (.26 and .2 ft). The model seems to routinely underpredict stage, albeit by less than a half foot. The Flow is better with an MAE of 187 cfs while the ME is only 21 cfs suggesting less bias in the flow imputations.

   Remedy: The practical answer is the error is small and no action is necessary. But, I think the report would be improved by acknowledging what the graph suggests. It might be enough to say it is small and only related to stage, not flow, and we (The District) do not think it is a salient issue. I just saw it and wondered why they presented it but did not mention it in the text.

3.4.3.5 Water Resource Values

Middle Suwannee River MFL Report

Adam Munson

1. **Deficiency**: Fish Passage, Page 90: I am comfortable that the 3ft of depth is the reasonable and that the 15ft width is at least logical if somewhat untested. I remain concerned that the only WRV that is limiting is fish passage and it is based on a relatively undocumented standard. My concern is narrow. It is that once a peer review panel endorses something as reasonable it can be cited as evidence of reasonableness.
   Remedy: This peer review report endorses the continued use of fish passage as a criteria and acknowledge that currently the Districts proposed sturgeon criteria is based on the best available data. However, I think (and at this point with all of Marty's comments I think we have gotten here, I wrote this around our first meeting) the best available data is not very well developed for sturgeon passage and the District should engage in efforts to more carefully vet the adequacy of the passage. Marty has talked a lot about adding velocity and I think that is excellent. I also feel like the seasonality of it is a bit roughhewn and feel like something more granular might ultimately be obtainable (just a thought for the future), not a known flaw here.

3.4.3.6 Other Fish and Wildlife Habitat Considerations

Middle Suwannee River MFL Report

Martin Hamel

Priority water resource values were established as the critical metrics evaluated for protection via minimum flow level assessments. These WRVs were appropriate and appeared to represent the fundamental components of the Suwannee River basin. However, I determined that the WRV 2 - Fish and Wildlife Habitats and the Passage of Fish should include three additional components to ensure protection of this WRV. These include: 1.) Gulf Sturgeon holding areas (Middle Suwannee River report), 2.) fish passage (both the Upper and Middle Suwannee River report), and 3.) flow requirements for recently hatched Gulf Sturgeon.

Gulf Surgeon holding areas

Gulf Sturgeon holding areas were introduced as an important habitat component for immature fish, non-spawning adults, and for reproductively active adult fish following their spawning. These habitats have been documented as important habitat components for Gulf Sturgeon in the Suwannee River, but also in other river systems that anadromous sturgeon inhabit. Despite the documented use (and perceived importance) of holding area habitat, flow requirements that are needed to maintain the habitat throughout the year were not incorporated into the MFL assessment. These holding areas – critical habitat for adult sturgeon post-spawn – may be altered under different flow regimes (i.e., low-flow periods) and should be a component of the MFL. In addition, there is text in the document that suggests high flow periods (i.e., bankfull and flood events) are needed to scour the stream bed and create or maintain deep holes, a key component for holding area habitat development. Admittingly, physical habitat descriptions of holding areas are ambiguous or not fully understood. Without clear habitat definitions, it may be challenging to establish critical threshold values that can be incorporated into the MFL assessment. I recommend the District work with its collaborators on collecting new or synthesizing existing data so that the minimum flow can be updated in the future.

Fish passage

Fish passage was evaluated by incorporating the minimum depth and width of the river to facilitate fish movement over obstacles. Although these metrics are essential components of fish passage, velocity was not included in the assessment. This is an essential component for upstream passage and may be a limiting factor under certain flow regimes when flow is constricted to areas typically used for passage (i.e., sufficient depth). Flow velocity at various depth profiles should exist from the data collected for the HEC-RAS model. These data can be used to determine if velocity exceeds the critical swimming speed (0.21 m/s) of juvenile Gulf Sturgeon determined by Wilkens et al. (2015) at various flow adjustments. There is a paucity of information relating to swimming capabilities for sturgeon and how confounding factors (e.g., size,

temperature, and dissolved oxygen) might influence performance. I recommend adopting a critical flow threshold of 0.21 m/s as a conservative measure until additional research can be conducted and incorporated into future MFL iterations.

Flow requirements for recently hatched sturgeon

Flow requirements for the larval/young-of-year life stage were absent in the upper and middle Suwannee River reports. Specific flows in the month(s) following spawning have been shown to influence recruitment success. For example, Randall and Sulak (2007) found that higher mean monthly flows in September and December were related to increased recruitment (i.e., year class strength) in the Suwannee River. These two time periods may correspond to critical young-of-year sturgeon development periods for sturgeon spawned during the spring and fall. Incorporating flow requirements for this vulnerable stage of life is warranted and should be incorporated into Water Resource Values 2: Fish and Wildlife Habitats and the Passage of Fish in the Middle Suwannee River report. I recommend adopting a conservative critical flow threshold for the months of September and December. These values should be selected by the District after consulting with the USGS Wetland and Aquatic Research Center until additional research can be conducted and incorporated into future MFL iterations.

3.4.3.7 River MFLs and Development of MFL Criteria

The following are Procedures and Analysis issues related to the River MFLs section.

Middle Suwannee River MFL Report

Adam Munson

1. **Deficiency:** Appendix X, Page 3: You state *"The underlying premise of applying a single-value flow reduction below median flows is the assumption that regional withdrawals are from groundwater pumping. If surface water diversions are proposed in the future, then larger volumes of water would be available without causing significant harm when flows are above median conditions."*

   Remedy: Please clarify this statement. Specifically, is the "Median condition" an important delineator and if so why?

Gregg Jones

1. **Deficiency:** Establishing a high flow minimum level, page 140: The last sentence in the paragraph states: *"While it is possible to designate MFLs for multiple flow conditions for a particular gage, prescribing a single MFL flow condition at a gage provides efficacy from a water management perspective".* It is not clear what this means. I think it means the District wants to use the most restrictive WRV to produce a low-flow minimum flow that would protect all other WRVs, so it would not be necessary to establish high flow minimums. But this makes no provision for water withdrawals at high flows. Other comments I have made have expressed the importance of establishing high flow minimum flows to identify volumes of water that could be harvested for water supply during high flow periods. So even though setting only a low flow MFL may simplify the water management process, it does not provide sufficient guidance for determining water availability over the full range of flows.

   Remedy: Provide a better explanation in the text of what this sentence means and/or revise it to indicate that it is beneficial to determine the available amount of water for water supply at the full range of flows.
2. **Deficiency:** Availability of Water for Water Supply at High Flows. Page 83, Figure 4-3. Within the box in the lower left corner of the graph in Figure 4-3, it is stated that the amount available for withdrawal is "H". I don't see H anywhere on the graph, but I assume H is the vertical difference between where the dashed green RTF line intersects the y axis and where the dashed orange critical flow line intersects the y axis and H should equal 545 cfs.

Referring to the distance between those lines as the "amount available for withdrawal" is confusing. It should be referred to as the amount of water available when the flow equals 2,461 cfs. If the flow is above 2,461 cfs, would the amount of water available be the difference between that flow and 1,916 cfs critical flow? I'm concerned the way it is currently presented gives the impression that the largest amount of water available for water supply will never be more than 545 cfs. Of course, 545 cfs is a very large volume of water (352 million gallons per day (mgd)). The following is an example of what this means in terms of water supply.

The Peace River/Manasota Regional Water Supply Authority in DeSoto County Florida has an off-stream reservoir with a capacity of 6 billion gallons. Their pump/intake system can move 120 mgd from the river to the reservoir, which, based on the proposed minimum flow for the MSR, is only 36 percent of the 352 mgd available for water supply in the Suwannee River when the flow is 2,461 cfs. The 120 mgd pumping capacity could fill a reservoir with 6-billion-gallon capacity in just 50 days. When considered that the RTF flow of 2,461 cfs is exceeded 70.4 percent of the time, it becomes apparent that a very large volume of water could be harvested from the Suwannee River with very minimal impact to the Water Resource Values.

Remedy: Recommend revising the graph to include "H". Consider revising the wording of the "amount available for withdrawals" on the graph as stated in the comment. Place more emphasis on the fact that a great deal of water is available at high flows and that harvesting it for water supply would result in very minimal impacts to the limiting Water Resource Values.

3. **Deficiency:** Appendix X, 2.0 Development of MFL Criteria**:** The text is as follows: *"It was determined that a single value flow reduction approach would be taken, using the most restrictive or limiting critical flows. In the case of both Ellaville and Branford, this corresponds with Gulf sturgeon fall passage and results in a reduction of 346 cfs across the flow duration curve for Ellaville and 400 cfs for Branford. The underlying premise of applying a single-value flow reduction below median flows is the assumption that regional withdrawals are from groundwater pumping. If surface water diversions are proposed in the future, then larger volumes of water would be available without causing significant harm when flows are above median conditions".*

   What is meant by regional withdrawals? Since there are no significant surface water withdrawals from the river, I assume the District is saying that regional withdrawals is the same as baseflow/springflow that was prevented from reaching the river as the result of regional groundwater withdrawals. If so, it then it follows that the historic river flow reductions are the result of regional groundwater withdrawals.

   Remedy: If I am correct about all this, recommend rewording the sentence, because when it says, "regional withdrawals", it implies significant surface water withdrawals. Recommend changing the sentence to read: "The underlying premise of applying a single-value flow reduction below median flows is the assumption that historic declines in river flow are caused by groundwater pumping that has reduced the amount of baseflow and springflow reaching the river."

Section 4: References

[REFERENCE SECTION TO BE COMPLETED IN FINAL REPORT]

Florida Administrative Code [F.A.C.] Chapter 62-40.473

Sections 373.042 and 373.0421, Florida Statutes/F.S. §373.042, 1972 as amended

PRISM Climate Group, 2014

Randall and Sulak (2007)

Wilkens *et al.* (2015)

Appendix A: Peer Review Panel Comment Form – Gregg Jones

Appendix B: Peer Review Panel Comment Form – Martin Hamel

Appendix C: Peer Review Panel Comment Form – Adam Munson