A Review of

"Proposed Minimum Flows and Levels for the Gum Slough Spring Run"

May 26, 2011 – Peer Review Draft

by

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September 2011

EXECUTIVE SUMMARY

This is a summary of the Scientific Peer Review Panel's ("Panel") evaluation of the scientific and technical data, assumptions, and methodologies used by the Southwest Florida Water Management District (District) in the development of proposed minimum flows and levels (MFLs) for Gum Slough Spring Run ("Proposed Minimum Flows and Levels for the Gum Slough Spring Run," SWFWMD 2011). In general, the review panel supports the approaches and conclusions found in the draft report. The methods used to set the proposed minimum flows and levels for the Gum Slough Spring Run have been tested in other rivers and springs and have been found appropriate for the tasks. The proposed flows and levels are based on solid science and should provide good protection for this valuable aquatic ecosystem.

INTRODUCTION

The Southwest Florida Water Management District (SWFWMD) under Florida statutes provides for peer review of methodologies and studies that address the management of water resources within the jurisdiction of the District. The SWFWMD has been directed to establish minimum flows and levels (designated as MFLs) for priority water bodies within its boundaries. This directive is by virtue of SWFWMD's obligation to permit consumptive use of water and a legislative mandate to protect water resources from *significant harm*. According to the Water Resources Act of 1972, *minimum flows* are defined as "the minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area" (Section 373.042 F.S.). A *minimum level* is defined as "the level of groundwater in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area." Statutes provide that MFLs shall be calculated using the *best available* information.

This review follows the organization of the Charge to the Peer Review Panel and the structure of the draft report and is based both on our collective review of documents provided and on a field visit of the Gum Slough Spring Run during a period of low flow. It is the job of the Peer Review Panel to assess the strengths and weaknesses of the overall approach, its conclusions, and recommendations. This review is provided to the District with our encouragement to continue to enhance the scientific basis that is firmly established for the decision-making process by the SWFWMD. Comments and recommendations are given for the basic approach for analyzing and setting MFLs on Gum Slough Spring Run. Editorial comments and suggestions, which the review panel believes would help improve the draft report on the Gum Slough Spring Run, are provided in the Appendix.

1.0 THE CHARGE

The charge to the Peer Review Panel contains five basic requirements:

1. Review the draft District documents used to develop provisional minimum levels and flows for the Gum Slough Spring Run.
2. Review documents and other materials supporting the concepts and data presented in the draft documents.

3. Participate in a field trip to the Gum Spring Slough Run for the purpose of viewing the site and discussing directly all issues and concerns regarding the draft report with District personnel.
4. Provide to the District a written report that includes a review of the data, methodologies, analyses, and conclusions outlined in the draft report.
5. Render follow-up services where required.

We understand that some statutory constraints and conditions affect the District's development of MLFs and that the Governing Board may have also established certain assumptions, conditions and legal and policy interpretations. These *givens* include:

1. the selection of water bodies or aquifers for which minimum levels have initially been set;
2. the determination of the baseline from which "significant harm" is to be determined by the reviewers;
3. the definition of what constitutes "significant harm" to the water resources or ecology of the area;
4. 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 or placed on the hydrology of a given watershed, surface water, or aquifer; and
5. the adopted method for establishing MFLs for other water bodies and aquifers.

2.0 COMMENTS OF THE PEER REVIEW PANEL

2.1 Setting Minimum Flows and Levels

The summary of the approach used by the Southwest Florida Water Management District (SWFWMD) provided in sections 1.5 and 1.6 follows the peer-reviewed and -supported approaches used in the past to set flows and levels for springs and rivers within the District. The review panel supports the approaches utilized in these studies to make flow and level determinations. The District has been a nationwide leader in setting flow criteria, and this report continues to use scientifically defensible procedures.

The review panel does encourage the personnel of SWFWMD to remain current and cognizant of recent scientific publications concerning the setting of flow criteria for rivers and springs. For example, Petts (2009) has reviewed the current state of setting flow criteria and strongly endorsed the PHABSIM methodology used by SWFWMD. In addition, Carlisle et al. (2010) have carried out a detailed analysis of stressors on streams and rivers throughout the United States. The authors conclude that flow alteration involving minimum and maximum flows is the stressor most widely viewed as negatively affecting fish and aquatic invertebrates. References like these should be added to the text justifying the approaches used by the District in setting flows and levels.

2.2 Basin Description

The general basin description for the geographic location of the study site is adequate. Figure 2.4 (showing land ownership patterns) has components of the map that cannot be differentiated and requires improvements. This section also would be much improved by a discussion of the geology and stratigraphy of the region with a focus on recharge, discharge, and baseflow. The following section of the report provides details on this need.

2.2.1 Geology and stratigraphy and their relationships to recharge, discharge, and baseflow separation

Characterization of the watershed is a critical component of determining the MFL. Because Gum Slough is a spring run, with much discharge derived from the Floridan Aquifer System, complete assessment of groundwater contributions, potential variations in these contributions, and the causes of potential variations are critical to variations of flow in the river. The local hydrogeology and stratigraphy is described well in section 4.2.2 “Hydrogeologic system” where is it made clear that the Surficial Aquifer and the confining unit (the Miocene Hawthorne Group; Scott, 1988; 1992) separating the Surficial Aquifer from the underlying Floridan Aquifer is missing from the region. As pointed out in the report, sources of groundwater to the springs thus must originate from the Upper and/or Lower Floridan Aquifer. The review panel believes that this section (i.e., Section 4.2.2 up to, but not including Section 4.2.2.1 onward) would be more appropriate if it were moved to Chapter 2 immediately after Section 2.1 Geographic Location. This re-organization would allow a more complete description of the basin (the topic of Chapter 2), including the important aspect of geology, stratigraphy, karstification, and potential sources of water to the springs sourcing Gum Creek Slough. The panel also believes this reorganization would benefit the report by elevating subsections 4.2.2.1 through 4.2.2.4 to a higher level description of the critical data in support of the point emphasized in Section 4.2, which is to describe the analysis and modeling of decadal long records of decline in precipitation, recharge, and by inference of flow in the slough. The panel suggests that a brief reiteration of the stratigraphy would be appropriate within Chapter 4, but that the main emphasis within this section should be on the descriptions of groundwater withdrawals, discharge history, rainfall, baseflow separation, and rainfall changes in support of Section 4.3, which follows and describes results from regional numerical models of groundwater flows.

Separation of sources of water from the two portions of the Floridan Aquifer System is important to assessments of the impact of groundwater withdrawals and climate change and variability of discharge from the Gum Slough springs. Prior work has shown that the “flashiness” of springs, (essentially the magnitude of the rates of change of spring hydrographs) in response to storm events depends on the flow paths to the springs and aquifer characteristics (Florea et al., 2007). The high matrix porosity of the Floridan Aquifer System (e.g., eogenetic karst, Vacher and Mylroie, 2002) tends to mute its response to storms, particularly in large springs with sources derived from the full thickness of the Floridan Aquifer. The Gum Slough springs’ discharge, as measured at the Holder gauging station displays a large variation in flow, ranging from 24 to 520 cfs over the period of record (2003 to 2010). This large range of flow for springs suggests that much of the flow is from the Upper Floridan Aquifer and has rapid connection to recharge. Although as stated in the report “the summer rainy season flow can typically exceed 200 cfs”, these high flow rates are actually rare, apparently occurring only during short periods of one to several days in late 2004 and 2005 and one day in 2008, as shown in Figures 4-1 and 4-6. The other high flow event occurred in 2010, but that event took place early in the year, rather than during the typical rainy season and did not exceed 200 cfs.

The Gum Slough report does a good job of providing information about long-term trends in precipitation to provide a background framework for modeling of the limited discharge records available to the study. These long-term records clearly show that the cumulative rainfall has declined over the past 40 year and are valuable to set the stage for regional flow models used to estimate drawdown in the Upper Floridan Aquifer. This analysis is important to estimates of baseflow prior to groundwater withdrawals. Additional information about the functioning of the basin could be derived from comparison of historical flow averages compared to rainfall over the period of record. Although most rainfall occurs during the summer rainy season, much of this precipitation does not recharge the aquifers and instead is lost to the atmosphere through evapotranspiration (Martin and Gordon, 2000). Only during large rainfall events does precipitation recharge the aquifer in the high ET summer period. The flashiness of Gum Slough suggests that the springs are responding to specific rainfall events, most likely the hurricanes that crossed the region in late summer 2004, 2005, and 2008, rather than reflecting the impact of seasonal rainfall patterns. Comparison of rainfall data over the period of record of flow, in addition to the long-term rainfall records, could be used to assess whether Gum Slough springs have shallow and/or deep sources and thus will be more responsive to recharge events (as suggested by the flashy nature of flow) or will have a greater response to long-term climatic changes such as the Atlantic Multidecadal Oscillation.

Since Gum Slough is predominately a spring-fed river, the baseflow separation is critical to the assessment of water flow to the river. Baseflow separation has been determined through a technique reported in Perry (1995) that utilizes a low-pass filter with a window of 121 days. As stated in the report, this approach has been utilized previously by the district and thus should be comparable to prior studies. Numerous methods are available to estimate baseflow (e.g., Gonzales et al., 2009) and thus justification for using this approach for baseflow separation could be enhanced in the report in addition to its utility in comparison with prior studies. Particular description should be provided to justify why a ±60-day window was used to estimate the low flow. The choice of this length of time suggests that effects from precipitation events do not exceed this length of time. This inference may be true, but the reasoning behind the choice of this time frame should be made clear, for example, by describing time windows previous studies used or whether other information is available to indicate that the low flow within a 121 day window represents baseflow.

2.3 Land Use

The land use section of the report provides a helpful overview of landscape condition and changing conditions through time. There are some slightly different numeric values in the text versus the tables that need to be made consistent. A summary paragraph at the end of the land use changes section would be welcome.

2.4 Hydrology

Lots of useful information is included in the hydrology section of the report. A few questions and concerns are noted. First, the large flow event in 2004 should be discussed and explained. This flow is more than double any other flow during the seven-year record for Gum Springs. The series of dissipating hurricanes during this time period is the likely cause, but the text needs to acknowledge this unusual event and provide explanation. Similarly, the text also should describe in greater detail the climatic conditions that resulted in the low baseflow in 2009.

The text on page 4-7 was confusing. The separation technique by Perry (1995) is published in a doctoral thesis. This is not an easily accessed reference. The text needs to do a better job of explaining this technique and the results for baseflow spring contributions. Average baseflow from the springs during this period of record is important information, and the description in the text does not allow the reviewers to fully evaluate the methodology used.

2.5 Water Chemistry

The report makes the valid point that adoption of minimum flows is unlikely to affect water quality, although the converse could be true – that changes in flow, particularly to values below minimum flow levels, could change the chemical composition of the stream, thereby causing "significant harm" which minimum flows are designed to prevent. Consequently, because some limited water quality data are available, they could be used as constraints on understanding processes within the system, such as groundwater-surface water mixing, potential sources of discharge from the springs, and to improve estimates of baseflow. The report does correctly state that water chemistry data are available at an insufficiently high temporal resolution (data currently available include only a maximum of 41 measurements over a 13-year period, collected on a quarterly basis) to provide constraints on baseflow based on natural chemical tracers. Additional water chemistry data focused on better understanding of contributions of different source waters to baseflow is an ongoing need.

All data reported were measured for samples collected from the Gum Springs Main, but no mention is made of whether additional chemical data are available from other springs in the system. If those data are available, they would provide useful and valuable information on the subsurface flow paths of water to the various springs, particularly whether the spring water has reacted with different lithologies, which possibly could be used to identify origins from different sections of the stratigraphy. Of particularly significance could be SO_4 concentrations, since elevated SO_4 concentrations would reflect interactions with the units within and below the Lower Floridan Aquifer, primarily the Avon Park, Oldsmar, or Cedar Key formations. Both SO_4 and Mg have been used previously as tracers for upward flow from the Lower Floridan Aquifer in the Tampa Bay region and Santa Fe River basin assuming dissolution of gypsum and anhydrite and dedolomitization reactions within the Avon Park Formation (Jones et al., 1993; Moore et al., 2010; 2011). Comparing the average values and standard deviations from average values at different springs would allow an assessment of whether each spring is connected to similar sources or if they have unique sources.

The analyses of the chemistry data is a tabulated statistical description (mean, median, minimum, and maximum) of water physical and chemical characteristics (Table 5-1). This table provides a good frame of reference for the water quality, but care should be taken with presentation of the data. Each parameter should have units associated with the parameter, and some of the extreme values should be checked. For example, a pH of 15.50 is impossible in a system buffered with carbonate minerals such as Gum Creek Slough. A range of Sr concentrations from 0 to 808 ug/L is also unlikely because of the more-or-less constant source of Sr from carbonate mineral dissolution. Within the discussion of P concentrations, the value of 0.444 mg/L is suggested to be an outlier. A value of 43.70 for dissolved silica also is far above the solubility for this constituent. Similar quality control and assurance analyses could be done for other components to limit the misuse of these data in the future and to better allow for analyses of chemical compositions of future measurements to the values in the table.

In general, the chemistry section of the report is the weakest section of the draft report. Water quality, linked with flows in the spring run, seems to be having a significant impact on the biota of the spring run. Nutrient concentrations reported for in spring water suggest an input of water with higher than previous background levels. Nutrient loading clearly is an issue based considering the growth of aquatic vegetation and algae observed near the source spring. This criticism should not prevent approval of the current document, but should inform the District of a critical need to further delve into chemical compositions of the springs in the future. A more thorough evaluation and discussion of the limited chemical data is recommended for this document.

2.6 Goals, Ecological Resources, and Habitat Indicators

The section of the draft report where goals, ecological resources of concern, and key habitat indicators are discussed is well done. The selection of the 15% threshold to indicate significant harm has stood up to past peer reviews, and represents a defensible value. Ultimately, experimental studies that examine the effects of a variety of percentage losses of habitat on multiple species of interest would test the assumption that 15% is protective, but until such research is completed the current value in use has merit.

2.7 MFLs Technical Approach – Gum Slough

2.7.1 Inundation of Floodplain

The Gum Slough report does a thorough job of providing information and evaluating data that were used as part of the PHABSIM model. Great care was taken in developing the PHABSIM cross sections and characterization of habitats and elevations (most of these data are contained in the appendix). In addition, the application and use of the HEC-RAS model for flow analyses appear to utilize the most appropriate available data. The report makes the valid point that flow records for the slough are limited. The report also states that intra-annual variations are 40 cfs or less, which limits the value of utilizing seasonal blocks in the analyses of inundation of floodplain features. Several years show much greater changes than 40 cfs, and as discussed previously, these changes are likely the result of hurricane activity, although elevated flow in 2010 results from other sources. The short period of record of stream discharge, however, strongly supports not separating the year into blocks for development of MFLs. Considering that the period of record follows a 40 year decline in precipitation (as shown in Figure 4-7), a return to elevated precipitation could increase the intra-annual range of flow. With future reviews and revisions of the MFLs, it will be important to revisit the need to separate flows into blocks and in particular how these changes in flow affect inundation of floodplain features.

Records of elevated flow on Gum Creek Slough suggest the possibility of backflooding during elevated flow of the Withlacoochee River, particularly considering the flashy nature of the increases in flow, which are unlikely on a stream sourced solely from springs from the Floridan Aquifer, with limited surface runoff. Such hydraulic damming is common on many rivers and springs in north-central Florida (Gulley et al., 2011), and even if flow reversals do not occur on Gum Slough, increases in base level during flooding of the Withlacoochee River could be sufficient to cause increases in river stage that would be converted to high discharge if the rating curve used to convert stage to discharge did not take into account hydraulic damming. Future analyses that could be important to assess controls of flow would be improved rating curves for the slough, following collection of additional data that considered water levels in the Withlacoochee River. Such analyses are difficult to prepare and the limited data currently available are likely to restrict the accuracy of analyses now. Nonetheless, simple qualitative analyses could be accomplished with data currently available through cross plots of elevations on the Withlacoochee River and Gum Creek Slough that would indicate variations in longitudinal gradients downstream in the slough. A comparison of these gradients with discharge of the Gum Creek Slough may reflect the impact on flow from elevated levels in the Withlacoochee River.

2.8 Results and Recommended Minimum Flows

The unique attributes of this small isolated system suggests the need for another approach with respect to addressing ecological integrity. Fish passage may not be the most important metric for describing the ecological integrity of the Gum Springs Slough aquatic ecosystem. The fish we observed during the field visit and those additional species listed are relatively opportunistic with respect to movement up- or downstream to spawn. If sturgeon used this habitat, fish passage would be a good metric. Inundation of the floodplain habitat that is discussed in section 8.4 and or gains and loss of snags as habitat would fit the fish needs more than water depth and flow. Fortunately, the District’s use of the latter makes the panel willing to accept the former. Duration of flooding and the corresponding availability of food for fish in the adjacent floodplain during floods would be a more important metric than water depth and flow rates for this segment.

Observations of the floodplain during the field visit suggest that water levels or saturation of floodplain soils was greater in the past than currently exists. This may be related to the long-term trend of lower rainfall. However, clear subsidence of the organic soil matrix around tree trunks and roots on the adjacent floodplain is strong evidence that a long-term change in flooding of soils has occurred. Without accurate dating it is difficult to determine if this was recent or decades ago. The age of floodplain trees, however, suggests this has occurred within 50 years. It is unfortunate the period of record for flows and water levels in the past are limited. Given the isolation of this stream segment, the District is to be commended for getting data at all.

In summary, the review panel supports both the low flow threshold (35 cfs) and the allowable percentage of flow removal (9%) recommended in the draft report. The need for reassessment of these criteria in a decade after more flow data are available for Gum Springs Slough also is strongly supported.

2.9 Literature Cited (Additional References)

Carlisle, D.M., Wolock, D.M., and Meador, M.R., 2010. Alteration of streamflow magnitudes and potential ecological consequences: a multiregional assessment. Frontiers in Ecology and the Environment, 9: 264-270.

Florea, L.J. and Vacher, H.L., 2007. Eogenetic karst hydrology: Insights from the 2004 hurricanes, peninsular Florida. Ground Water, 45: 439-446.

Gonzales, A.L., Nonner, J., Heijkers, J. and Uhlenbrook, S., 2009. Comparison of different base flow separation methods in a lowland catchment. Hydrol. Earth Syst. Sci. Discuss., 6: 3483-3515.

Gulley, J., Martin, J.B., Screaton, E.J. and Moore, P.J., 2011. River reversals into karst springs: A model for cave enlargement in eogenetic karst aquifers. Geological Society of America Bulletin, 123: 467.

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Scott, T.M., 1988. The lithostratigraphy of the Hawthorn Group (Miocene of Florida), No. 59. Florida Geological Survey Bulletin, 147 pp.

Scott, T.M., 1992. A Geological Overview of Florida, Open File Report No. 50. Florida Geological Survey, 78 pp.

Vacher, H.L. and Mylroie, J.E., 2002. Eogenetic karst from the perspective of an equivalent porous medium. Carbonates and Evaporites, 17: 182-196.

2.10 Glossary of Terms

This is a useful component to the report. We appreciate the diligence of the report writers to carefully define their terms. A few minor changes are recommended in the errata.

APPENDIX - ERRATA/COMMENTS

By Page Number in 05-26-11 Gum Slough Spring Run Draft Report

Overall, the report is well crafted with minimal problems with writing style. The following points, keyed by page number, refer to places in the text that have typos, grammatical errors, or are unclear. Additional suggestions for corrections to figures and tables are also included. These are pointed out in the spirit of trying to improve the readability of the report.

p. iv. Figure description for 4-13 – define UVA (not defined in glossary either).

p. v. Figure description for Figure 8-1 (3rd line) - remove space after 0._6.

p. 1-1. Add reference to “Glossary” – perhaps as a footnote to Minimum Flows and Levels in first paragraph.

p. 1-3. No comma after “Although.”

p. 1-4. Flannery et al., (2002) is not included in reference list.

p. 1-8. First paragraph – “fluctuations”

p. 1-8. Figure 1-1 - Expand figure description to include year(s) data were collected.

p. 1-8. Figure 1-1 - Was the spike in flow around day 276 caused by a single event? Explain in the text on p 1-8.

p. 2-1. Extra period on first line.

p. 2-1. Space after “15,000.”

p. 2-1. Helpful if there is a latitude and longitude on maps with locations.

p. 2-2. Rather than a star to indicate Gum Slough Spring Run, an outline of the location of Figs. 2-2 and 2-3 would convey more information about the location of the spring run and the scale of the run.

p. 2-5. The colors on the map and in the legend differ and some of the patterns are difficult to discern, particularly with the SWFWMD Acquired Fee and SWFWMD Acquired Less than Fee. The legend shows as yellow SWFWMD Acquired Perpetual Easement, but this color doesn’t appear on the map.

p. 2-5. The bottom line cites figure 1-1 for a rainfall curve, but this figure is for discharge from the slough. A figure of rainfall (daily or cumulative) over the period of record would be valuable to include in the report.

p. 3-1. A citation to Table 3-1 would be appropriate in the bottom paragraph.

p. 3-2. A citation to Figure 2-3 would be useful to compare with the land-use maps.

p. 3-4. Do not allow the legend for Figure 3-3 to wrap to the next page.

p. 3-5. Label the y axis.

p. 4-2. Could a map similar to Figure 7-3 be included here with more detailed locations? Scale does not allow a good perspective.

p. 4-3. Bottom paragraph. Use of the word "age" after the age designation is unnecessary, e.g., simply state "Eocene Ocala Limestone".

p. 4-4. Upper paragraph. A simple stratigraphic column with the hydrostratigraphic units would help clarify the discussion.

p. 4-4. First paragraph on line 11 – change "then" to "than."

p. 4-4. Third full paragraph. "…does not exist AT this location…"

p. 4-4. Fourth paragraph on line 1 – insert a comma after rainwater.

p. 4-4. Last paragraph – is it necessary to include "cfs" with the term itself?

p. 4-5. The discussion of spring discharge and groundwater withdrawal here alternates units between million and billion gallons per day and cfs. Although discussions of groundwater withdrawals are typically referred to in units of gallons per day, it would be useful to provide conversion to cfs to ease comparisons between the different sources of groundwater.

p. 4-5. Figure 4-3 only shows the location of Gum Springs, but the legend indicates the symbol represents springs. If the point is to reflect the location of Gum Springs, the legend should be modified. Alternatively if the point is to locate springs within the region, the other springs should be included in the map. Since the text describe flow from Rainbow Springs, it may be useful to indicate their location along with Gum Springs.

p. 4-6. Figures 4-1 and 4-5 are identical, although 4-5 is a semi-log plot. Are both figures necessary?

p. 4-8. First paragraph. "departure" rather than "department".

p. 4-11. In section 4.2.3.1, insert the following [Refer to Figure 4-12 for the geographical distribution of NDM].

p. 4-13. It would be useful to include a box on Fig. 4-12 indicating the boundaries of Figure 4-13.

p. 4-13. Add a space before “mgd” after 438.1.

p. 5-1. Fifth paragraph. “Phosphorous has BEEN measured…”

p. 5-2. Nitrogen paragraph. The mean value of nitrogen is reported to be 1.31 mg/L, but the table lists the mean for N- total and nitrate-nitrate (total) as 1.33 mg/L.

p. 5-2. In section 5.2.2, suggest adding EPA standards for nitrogen and define background conditions for N similar to P.

p. 5-3. Use Ortho-phosphate rather than “OPO4” in the table. Use “Total NH3(N) instead of NH3(N), and add a space after “Alk.”

p. 7-1, first paragraph. “…determined that the fluctuationS are…”

p. 7-1, bottom line. “ Figure 7-1 illustrates the LOCATIONS OF THE cross sections…”

p. 7-3. The first paragraph indicates that PHABSIM cross-sections were established at 4 sites, but figure 7-2 reflects only two.

p. 7-3. Bottom paragraph. It would be helpful to include a description of the frequency and the number of times the measurements were made.

p. 7-4. Figure 7-2 could include a box that would represent the outline of Fig. 7-3.

p. 7-5. Second paragraph. The length of the longitudinal woody habitats should be described. “Belt transects” needs a definition.

p. 7-5. It might be worth mentioning that these are the same transects in Figure 7-1, HEC-RAS.

p. 7-9. Could someone clarify the error of 0.27 feet? How would this affect the interpretation of the model predictions?

p. 7-11, fig. 7-5. The x-axis could be extended to 50% to demonstrate that 40% is the maximum value.

p. 7-14. “inflection” instead of “infection.”

p. 7-15 and 7-16. The discussion comparing Gum Slough to Peace River could include a very brief discussion of the similarity between these systems and whether Peace River is a useful analogue to Gum Slough and why.

p. 7-16 first paragraph. “record flow records” is awkward and could be changed to “Daily flow records over the period of record…”

p. 7-16. There might need to be some additional consideration of the impact snag exposure could have. After a certain period of time, attached algae and macrofauna would die and re-colonization would require time, magnifying the impact exposure beyond just the time of exposure.

p. 8-1 second paragraph. It is unclear what "historically appropriate" means in this instance.

p. 8-2. What is the function of Figure 8-1? See next comment!

p. 8-3. Could Figure 8-2 be combined with 8-1? This would eliminate the confusion when just viewing the first figure in this section. Some references in the text referencing wetland flooding might clarify that the lowest wetted points were outside of the main stream channel.

p. 8-3. Under section 8.3.1, the first paragraph refers to four sites in Figure 7-3, where only two sites are identified.

p. 8-4. Rewrite the first sentence in the first paragraph and explain why.

p. 8-5. Table 8-1 – add "…based on 15% flow reduction." The table, as is, is confusing.

p. 8-8. The axes could be switched on Fig. 8-5 so that elevation would be vertical as a way to match figure 8-4.

p. 8-8. Add "along" before "Transect 2."

p. 8-9. "…sectionS 8.4.2.1 and … WERE taken…"

p. 8-9. Put "2010" in parentheses.

p. 8-10. The acronyms for the Wetland Status in Table 8-3 should be defined in footnotes to the table.

p. 8-13. Change the first paragraph to reference table 8-5 instead of table 8-3 (wrong table identified).

p. 8-13. "106-200 cfs"

p. 8-15. Figure 8-6 should include definitions to the legend (e.g., %ER, %WD etc.). These acronyms could also be defined on page 8-14 where they are described. It would also be good to enlarge the legend.

p. 8-17. In figure 8-8, some transects show floating aquatic vegetation that is at an elevation below the bottom habitats. This arrangement seems unlikely and should be explained.

p. 8-20. Table 8-7 lists the “Maximum Allowable Flow Reduction”, but this title makes it sound like flow cannot be decreased by more the 35 cfs rather than the flow cannot be decreased below 35 cfs. The title is reasonable for the percentage reduction, but not for the absolute flows.

p. 8-20. “Figure 8-9 illustrates.”

p. 8-21. “Theshold” is misspelled in Figure 8-9.

p. 9-1. In reference section – Andrey et al. The Villages.

p. 9-3. Insert “FGS” after “Florida Geological Society.”

p. 9-3. In the next reference, spell out the abbreviations for consistency.

p. 9-3. “Friedemann” and “13 pp.” for the first reference by this author.

p. 9-4. “Hood, J.L.”

p. 9-5 and 9-6. Add periods after the second, third, and fourth “Kelly” references.

p. 9-7. “Mumma, M.”

p. 9-7. Lower case for the title of the paper by Munson in JAWRA journal.

p. 9-9. Space between “Florida” and Water” in the second SWFWMD reference.

p. 9.9. Space between “Assessment” and “Project” in the third SWFWMD reference.

p. 9.9. Change “Orignin” to “Origin.”

p. 9.10. Clean up the “Stewart et al. 1971” reference.

p. 9-11. Move initials in the secondary authors of the “Trommer” reference to before the surname.

p. 9-11. Change “Chronlogy” to “Chronology.”

p. 10-3. Add a comma before “therefore” in the definition of “High Flow Step.”

p. 10-4. Change “feed” to “feeds” in the definition for “Tributary.”