Silver Glen Springs MFL
Peer Review and Resolution Document
Comments from Lee Wilson and Associates
April 12, 2017

Comments from peer reviewer	Resolution from SJRWMD
1. Overall this is a very good report, but one that raises a lot of questions.	We will work to address your questions.
2. I agree with the concept that the MFL regime for Silver Glen should allow no significant decrease in warm-water habitat (for manatees) due to water withdrawals. Given the changes in flow that have already occurred, I suggest a zero change MFL.	Based on the information available, we consider the recent (2011-2017) spring flows at Silver Glen Springs to be only a period of low flows within a longer-term hydrologic regime, rather than a permanent change. This is our current understanding for several reasons, including: 1) Other wells in the region have shown a similar pattern of low groundwater levels in recent years, indicating that the recent period of low flows at Silver Glen Springs is likely not the result of isolated factors at Silver Glen Springs 2) Hydrologic analysis using the groundwater model has shown that the recent period of low flows is likely not the result of impacts from water use. Reductions in spring flow due to water use were slightly lower during 2000-2015 (2.1 cfs) than 1984-1999 (2.4 cfs) The recommended MFL, a mean flow of 99.6 cfs, reflects the fact that we do not consider the recent period of low flows to be a permanent change. The recommended MFL represents an allowable decrease of no more than 2.6 cfs from the no-pumping flow regime due to water use. Although not a zero-change MFL, this MFL represents an allowable decrease of no more than 0.5 cfs from the 2010-pumping flow regime due to water use. The FWC has stated that they have no indication that a 0.4 cfs reduction in spring flow beyond the 2010-pumping flow regime would affect warm-water habitat for manatees.

3. I did not understand how exactly SJRWMD determined that a 2.5% flow reduction from baseline due to depletions would not cause significant harm, whereas harm would result from a 5% reduction. The discussion on p. 17 didn't help, so I'm guessing you may be relying on Appendix D, though that document didn't offer any substance.	The groundwater model estimates that 2010 pumping leads to a reduction in spring flow of 2.1 cfs. Based on the results of the temperature modeling and consultation with resource agencies, additional spring flow reductions in excess of 5% (5.0 cfs) from the current condition would result in a significant decrease in warm water habitat within the spring run and would be considered harmful to manatee, while an additional reduction of 0.5% (.5 cfs) would not cause significant harm to manatee or any other environmental values. Temperature modeling indicates that an additional 1% (1.0 cfs) flow reduction from current conditions may begin to lead to changes in manatee habitat in downstream portions of the spring run, which is less than the 5% (5.0 cfs) reduction that had been determined would result in significant harm. Therefore, the limit at which further consumptive use withdrawals would cause significant harm is between 2.5% (2.6 cfs) and 6.9% (7.1 cfs) of total reduction in spring flow from the no-pumping condition. To ensure the prevention of a significant loss of warm water habitat for the Federally threatened Florida manatee at Silver Glen Springs, due to water withdrawals, SJRWMD recommends a minimum flow regime that is at the lower end of these two values, allowing for no more than a 2.5% (2.6 cfs) reduction from the no-pumping condition. The "no-pumping" condition represents the annual mean spring flow (based on data from 1984 - 2015) in the absence of groundwater withdrawals. Based on a 2.5% allowable flow reduction, the recommended minimum flow for Silver Glen Springs is a mean flow of 99.6 cfs.
4. Annual flow in the last six years (73 cfs) is barely 70% of the long-term flow (102.1 cfs). The report needs to be very clear in explaining how it makes sense to allow a small increase in consumptive use is protective when flows are already so diminished. On the other hand, if there is no stress from such low flows, the MFL can be argued as overly protective. I suggest you consider how best to address this	The purpose of MFLs is to establish the limits "at which further withdrawals would be significantly harmful". Although the recent period of low flows may be causing stress at Silver Glen Springs, the available information indicates that the low flows are likely not the result of impacts from water use. As of 2010, reductions in spring flow due to water use were 2.1 cfs, and have remained similar through 2015. This reduction is small compared to the more than 20 cfs change in flows observed before vs. after 2011.

paradox, and in so doing include some discussion of stationarity.	With the available information, so far we consider the recent period of low flows to be part of a longer-term hydrologic regime, rather than an indication of non-stationarity or a "new normal" for the spring. If additional information becomes available indicating that the longer-term hydrologic regime of the spring has changed for reasons other than withdrawals, it may be appropriate to re-evaluate the MFL and determine whether further withdrawals would be significantly harmful considering the new flow regime.
5. As I understand it the consideration of groundwater use focused on the <2 mgd that occurs in an area that may or may not be the springshed, but ignored "several million gallons per day" (p 7) just to the north of the springs This seems like a major concern in any quantification of future flows, especially given that the allowable increase in groundwater use impacts is only 0.5 cfs (0.3 mgd). If you think this doesn't really matter, then I recommend you explain your logic in some detail.	The determination of the Silver Glen Springs MFL, as described in the technical approach section of the report, was not based on the springshed alone, but rather included all water use in the Northern District model domain. A map of the model domain and springshed are included below and will be included in the report. The description section of the report showed a graph of groundwater use over time only within the springshed. We know that water use beyond the springshed affects spring flow. The model estimated 2010 water use, which includes the area north of the spring, beyond the springshed leads to a 2.1 cfs reduction in spring flow at Silver Glen Springs. The springshed mentioned in the report is not a strict boundary, but an estimate of the geographic area contributing groundwater to the spring. The springshed estimated for Silver Glen Springs extends mainly southwest from the spring and includes relatively little water use – only about 1 mgd as of 2010. The area north of the spring is not within the estimated springshed because the area does not contribute substantial groundwater flows.

6. The air photos in 10-2 and 10-3 of Appendix C show large islands in the spring run that no longer exist. The upper one is still seen (smaller) on a 1999 Google Earth photo. Loss of the islands would seem to indicate significant geomorphic processes that I don't believe are discussed anywhere in the report, but which may be important to understanding the dynamics of this system.	As described below, some of the changes illustrated by these photos are anthropogenic, and some are due to differing SJR water levels, and not due to significant geomorphic processes. Some of what may look like islands in the photos are exposed spring run sediment. The water is very transparent in this run and areas devoid of dark submerged aquatic vegetation can allow stream bed material (sand/limestone) to appear as clear as terrestrial features. Some of those areas may be bare due to shell mining or other disturbance. Extensive shell mining occurred at Silver Glen Springs starting in the 1920s. Large portions of the shell mounds were excavated, including some portions below the water line. The 1941 photo shows where the large shell mound near the mouth of the run was mined. The photo also shows other large areas all around the run where shell mining occurred. The appearance of the mined areas may vary depending on whether they are on land, underneath clear spring water, or underneath dark Lake George water. However, some of the islands in the photos are actual islands. They may be a combination of natural islands and islands that were created from dredged material piled in the run. The three islands toward the mouth of the run today have more plants (even some mature trees) on them. These islands are dramatically different from the 1941 photo, but haven't changed much since the 1999 Google Earth photo (shown for comparison below). Their appearance may also change depending on water levels, and human use may lead to some disturbance. The other three island-like shapes farther up the run may be more like floating mats of plants.

7. As the specific comments indicate, the report presents confusing information about the springshed area. The District's concept on this subject needs to be clearly stated and consistently applied.	We hope the answer for #5 will clear up some of the confusion, and the report will also be edited.
8. This is a large and relatively complex report; the table of contents should be much more extensive.	Changed.
9. My preference is to use "data" as a plural ("datum" is the singular). No problem with your use as singular if that is standard District policy.	Changed.
10. Page 1 cites Rule 62-40.473, F.A.C. regarding how minimum flows and levels should be expressed. Does this report comply – it is not a specified flow or level.	Setting multiple flows as described by Rule 62-40.473, F.A.C., for this waterbody was not deemed practical or necessary. In the final rule regarding Silver Glen MFLs, the minimum flow will be expressed as a mean flow (99.6 cfs), which is the mean flow based on the period of record from 1984 - 2015 with an allowable reduction of 2.6 cfs from the no-pumping condition. SJRWMD usually assesses compliance for MFL waterbodies by looking at the model-estimated reduction in flow (or water levels, etc.) due to water use, rather than whether observed flows or levels are meeting the specified flows or levels.
11. P. 2. I don't recall seeing the NRC principles in prior reports; it's a good addition.	The SWFWMD's MFL report for Gum Slough Spring Run also included this set principles, which is where we read them initially. These principles have been repeated and expanded upon by various sources. They can serve as a useful guide for Florida MFLs.
12. P. 3. Is it possible to show the shell mounds on a map or photo? Not essential.	We have not included one, but more information can be found in the references provided at the end of the report.
13. Figure 2, suggest you use put a box around the area shown in Figure 3.	Changed.

14. I recommend you provide a map and discussion of the springshed before introducing other maps. This would provide valuable context to other maps, e.g. Figure 5 which extends far beyond where land use matters to the spring. Given the uncertainty in the springshed boundaries set out in Appendix C, the map might show the "high probability" and "possible" limits.	The discussion of the springshed is only in Appendix B, but the outline of the area used has been added to Figure 5. The springshed is the estimated area that contributes groundwater to the spring, but water use outside the springshed can alter the size and shape of the area contributing groundwater over time.
15. The first sentence on p. 7 suggests that there were significant land use changes within Ocala NF in or before the 70s. Is that the case, I recommend you add a bit of explanation.	The purpose of this paragraph is to emphasize that land use and groundwater use outside of Ocala National Forest, especially to the west and southwest, have changed a lot over the past several decades. By comparison, land use within Ocala National Forest has not changed much.
16. Figure 5. The text sets out information based on counties. Figure 5 (or Figure 1) should show county lines.	Changed.
17. Figure 6 provides use data for an area of 240 square miles. Is this intended to be the springshed? If yes, which springshed – the one in Figure 5 of Appendix B or Figure 2-3 of Appendix C?	Yes, this is the springshed used and it is the same as the one in Appendix B. The discussion of the springshed is only in Appendix B, but the outline of the area used has been added to Figure 5.
18. In Figure 6, why is the large use from north of the spring excluded? I found no explanation related to the change in the self-supply methodology. As it stands, this graphic generates more questions than insights.	Water use north of the spring was not excluded from the determination of the MFL. Please see our response to comment #5. The method used to estimate domestic self-supply was updated around 2000. Older estimates were not changed, and they continue to reflect the method used to estimate domestic self-supply at the time.
19. The discussion of manatee habitat on p. 10 could benefit by discussing the maximum number of animals observed using this run.	The first part of the Technical Approach section, "Observations of manatees at Silver Glen Springs", discusses the number of manatees observed in the 2009 - 2010 study. Manatee observations also exist for subsequent years, and were similar. Although the number of manatees observed using Silver Glen

	Springs is relatively low, the site has the potential to become a primary warm-water refuge for manatees in the future if warm-water habitat remains protected, according to the FWS.
20. P. 11. Suggest saying more about the cave crayfish. If "endemic" means not found anywhere else then whether it is listed or not that makes it a big deal in limiting reductions to springflow.	Only very limited information is available about the Silver Glen Springs cave crayfish (*Procambarus attiguus*). We added the following information to the report: Hobbs and Franz (1992) described the crayfish as being found at a depth of 49 m, 213 m from the main entrance of Silver Glen Springs cave, with individuals observed in cave crevices or on the cave substrate. Hobbs and Franz (1992) also suggested that the crayfish may feed on bacterial growth as well as scavenging dead material. Information available through IUCN states, "The life history of this species is unknown, but due to the low levels of nutrients reaching the cave chamber due to the strong outflow current, it can be assumed that this species has a late reproductive maturity and a long life-history making it susceptible to loss of individuals" (Cordeiro et al. 2010).
21. P. 12. Somewhere need to explain why all the analysis in Appendix C is on winter conditions, when summer conditions in this particular spring run are of importance to striped bass.	When the temperature model was developed, we were not aware of the importance of the spring for striped bass in summer. We expect that maintaining flows adequate for manatee warm-water habitat in winter will also protect flows adequate for striped bass cold-water habitat in summer. Striped bass already tend to congregate near the spring vents, which are much less sensitive to changes in spring flow than the areas near the mouth of the spring run used by manatees.
22. P. 15-16. Readers may wonder why Figure X is unique in using a roman numeral. It would take some work, but ideally you would make it Figure 10 and renumber all that follows.	Changed.
23. P. 17. While I appreciate the effort made to develop a temperature model, the resulting bias to high	More information about the reliability of the model for estimating effects from changes in flow is available in the updated model report. The model is

values needs further discussion as to how that plays into setting the MFL, i.e. defend the concept that the model is still reliable for evaluating effects from changes in flow, even if the absolute values will not be precisely predicted.	reliable for estimating changes in temperature, and may be less reliable for estimating absolute temperatures. Please note that the maps showing the estimated changes in temperature (of at least 0.14°C) from changes in flow have been moved to Appendix C.
24. Figures 14-17. Should the caption and discussion of these figures reflect the bias in the model results?	The mention of this issue has been removed from the caption.
25. P.27. Suggest adding a bit of discussion of the rating curves here. Note also there is no page number.	Some discussion has been added to Appendix B.
26. Andrew is well aware of my concerns regarding stationarity. The numbers in Table 2 jump off the page (at least to me) as requiring some discussion of what is going on. Figures 18-20 are arguably even more dramatic. If there is some type of long-term shift in hydrology there should be zero change allowed.	Some of these concerns are addressed in Appendix F.
27. Figures 21-23. Why is Silver Glen Q going down when water levels are not trending and SJR flows are steady?	Some discussion has been added to Appendixes B and E.
28. First line on p. 32 has what seem to be random question marks.	Changed.
29. Table 3 is very interesting and worthy of assessment and discussion, if not here there in a standalone document.	We have noted this comment.
30. In Table 4 should mention striped bass and the endemics. Not sure what is meant by the "?" for freshwater supply and aesthetics; surely both are protected.	Changed.

31. Appendix A, p. 1. Why is it a problem that more particles settle out – i.e. on what basis is less turbid water better than increased bottom sediment.	More detritus may settle onto the bed of the spring run, increasing sediment oxygen demand.
32. I enjoyed the cave diagram on page A-10, but was disappointed to see no discussion of fauna.	We have only been able to find very limited descriptions of the cave fauna at Silver Glen Springs. According to a team of cave divers and biologists that has explored Silver Glen Springs cave over several decades, "Silver Glen is home to its own species of cave-dwelling crayfish. Discovered during our original project in the early 90s, this was the last new species of cave crayfish to be found in Florida. The entrance area was abundant with fresh water eels and macrobrachium (a very large freshwater shrimp)" (http://www.silverglenspringscavedivingteam.com/, accessed April 6, 2017).
33. P. A-11. I found the water clarity discussion hard to follow given so many different numbers.	This comment has been noted.
34. P. A-16. Does the MFL help protect these cultural resources? If so that is a prime consideration that deserves emphasis.	The MFL does not increase the potential of harm to cultural resources along the main spring run, but more information is needed about the area near the sand boil springs.
35. P. A-19. Figure 14 has lots of information, but no discussion at all. The V-shape in some of the patterns is unusual. The TKN relationship to flow is one that would benefit from sharing your understanding.	A comment has been added to the caption to indicate that the trendlines to not indicate significance, as significance tests have not been conducted and time is a confounding factor here. The lack of overlap in the range of flows before vs. after 2010 makes it difficult to determine whether changes in these water quality parameters are due to the change in flow, the different time period, or a combination of both.
36. P. B-2. Recommend adding the 2012-2016 value to Table 2. See comments made on these same graphs in the main report.	The 2011 – 2016 value is in the main report, but not in Appendix B.
37. Many comments on the main report apply to Appendix B.	These have been noted.

38. Figure 5 does not have a scale. Figure 5 is in substantial disagreement with Figure 2-3 in Appendix C. The concept that this is the springshed plus a one mile buffer suggests the springshed is drawn rather precisely; Section 10.4 in Appendix C suggests otherwise.	A scale has been added to the figure.
39. The mgd values in Figure B-7 don't seem to quite match with the mgd and cfs values elsewhere.	The values here are based on the Northern District groundwater model.
40. In Figure B-8, why the bump in flow reduction 1995-1999? Is this the high pumping shown in Figure 6, and if so what was going on?	Ultimately the high DSS historic water use in the 90s was the result of district DSS calculations. Prior to 2000, we were overestimating the population in the SJRWMD-portion of Marion County. When apportioning county-wide population data to our District, we were using a percent that was too high. This was corrected in 2000. In addition, prior to 2000 we were using county-wide utility gross per capita data to estimate DSS use. Gross per capita includes all uses provided water by utility which, in addition to residential use, includes uses such as commercial, industrial, institutional, non-residential irrigation, etc. The refined methodology used from 2000 to present uses county-wide residential per capita to estimated DSS use. With the revised Marion County population distribution between the districts and the updated DSS use methodology, staff believe that estimates of DSS in SJRWMD-Marion County are more accurate post-1999.
41. Overall Appendix C is a good technical document, but left me wondering why so much effort was put into so simple an MFL. Suggest some explanation be added.	When the draft model report was sent to you, Joe Stewart was already working on updating the model report in response to a separate peer reviewer. Some of those updates address your questions as well. Some comments unfortunately cannot be addressed with current time constraints and are hopefully not essential to the understanding of this MFL.
42. Title page of Appendix C should identify it as the beginning of Appendix C. Changing the pagination to indicate "C" is not a bad idea.	Noted for future reports.

43. The Appendix uses metric and English units inconsistently.	Noted for future reports.
44. Is there a useful topo map that could be added to Appendix C?	Please see our response to #41.
45. The assumption about runoff temperature (P. C-3) made no sense to me, and the rest of the paragraph was a bit obtuse as well.	Please see our response to #41.
46. Appendix C is already interesting but would be more so if it provided a map to illustrate the anthropological influences. More photos too.	Please see our response to #41.
47. Section 2.3 would benefit from an opening paragraph on the overall thermal regime of the spring compared to the lake that covers both winter and summer conditions and that also includes some insights on how lake elevations change and what that means to the spring.	Please see our response to #41.
48. Figure 2-3. This is a much smaller springshed than in Figure 5 of Appendix B, or Section 10.4 in Appendix C. The scale is metric only; in general need to have English units everywhere, even if in parentheses after metric. If the decision is made that all quantification will be metric only, then I recommend adding a conversion table to the beginning of the appendix.	Updates have been made to clarify the springshed figure. The issue with units is noted for future reports.
49. I didn't come away with a clear understanding of Figure 3-1.	Please see our response to #41.
50. Bottom of p. C-8, what is the "Cardo, Inc. survey"? Also in Figure	Please see our response to #41.

3-3, is there any explanation for the channel extending into the lake?	
51. P 11 says “velocity and thus discharge”. Discharge is also a function of cross-section area, so it does not automatically follow that discharge is “thus” the result of only velocity.	Please see our response to #41.
52. P. 15. Suggest you note the typical tidal range. Also should explain the significance of determining water age in general (though I’m not sure it is very meaningful in this instance).	Please see our response to #41.
53. Figure 4-1 is not map of “grid” as I normally use that term.	Please see our response to #41.
54. Figure 4-2. Data locations are hard to see.	Please see our response to #41.
55. P. 19. I found no text citing Figure 5-1.	Please see our response to #41.
56. Table 5-2. Why would Sandboil be included in discharge at the 80-ft station?	Please see our response to #41.
57. P. 21, end of full paragraph. I’m not sure where you ever laid out the “issues with model performance”.	Please see our response to #41.
58. Table 5-6. Suggest you explain why rainfall heat transfer did not need to be considered.	Please see our response to #41.
59. Figure 6-1. Putting statistics on graph is a good protocol – suggest this be done on all.	Please see our response to #41.
60. P. 27 line 4. Deployments of what?	Please see our response to #41.

61. P. 31. The validation statistics were not particularly impressive; suggest some discussion in text.	Please see our response to #41.
62. p. 32. An r-sq of 0.7 is better said to be “reasonable” than “accurate”, and the consistent bias of over-prediction of temperature is a definite concern given that this overstates suitability for manatees.	Please see our response to #41.
63. Figure 7-2. Perhaps I missed it, but exactly where do the “observed” data come from.	Please see our response to #41.
64. p. 35. Why was a 20% flow reduction evaluated?	The 20% flow reduction was evaluated to illustrate temperature sensitivity to a reduction in discharge. Any percent reduction could have been evaluated.
65. p.38. Can you explain why you picked 0.9 to adjust solar radiation for shade?	Please see our response to #41.
66. Figure 10.4 does not agree with Figure 2-3 and suggests a lot of uncertainty, in contrast to Figure 5 in Appendix B.	The report has been updated and no longer shows this figure. The figure showed the areas contributing recharge to Silver Glen Springs based on travel times up to 100 years as simulated by three different groundwater models for the average hydrologic conditions of the calibration period.
67. 10.6 does not indicate a particularly good match for the salinity model.	Please see our response to #41.
68. 10.9 should point the reader to where the results of the statistical tests are reported.	Please see our response to #41.
69. 10.10 has no legend.	The lines originating from each dot show the direction and relative magnitude of water velocities throughout the spring run.

LEE WILSON AND ASSOCIATES
HYDROLOGY • ENVIRONMENT • RESOURCES

Mail: Box 931, Santa Fe NM, 87504 Courier: 105 Cienega, Santa Fe NM, 87501

Telephone: 505-988-9811/fax 505-986-0092 e-mail: lwa@lwasf.com

To: Andrew Sutherland, Ph.D.

From: Lee Wilson, Ph.D.

Date: 28 March 2017

Re: Minimum Flows Determination for Silver Glen Springs, Marion and Lake Counties, Florida

This memorandum reflects my ongoing assignment from SJRWMD to review reports related to MFLs development for water bodies within the District. The subject report, for Silver Glen Springs, was authored by Casey Harris, Nathaniel Mouzon and Andrew Sutherland and is dated "2017".

I continue to hold the opinion that the SJRWMD MFL program is scientifically sound and at the forefront of the application of ecological principles to protection of instream flows, spring flows and lake water levels. The fact that certain of my comments are critical of certain aspects of this report is a reflection of my assignment to identify issues and find possible problems, and should be read in that spirit.

Primary comments

1. Overall this is a very good report, but one that raises a lot of questions.
2. I agree with the concept that the MFL regime for Silver Glen should allow no significant decrease in warm-water habitat (for manatees) due to water withdrawals. Given the changes in flow that have already occurred, I suggest a zero change MFL.
3. I did not understand how exactly SJRWMD determined that a 2.5% flow reduction from baseline due to depletions *would not* cause significant harm, whereas harm *would* result from a 5% reduction. The discussion on p. 17 didn't help, so I'm guessing you may be relying on Appendix D, though that document didn't offer any substance.

4. Annual flow in the last six years (73 cfs) is barely 70% of the long-term flow (102.1 cfs). The report needs to be very clear in explaining how it makes sense to allow a small increase in consumptive use is protective when flows are already so diminished. On the other hand, if there is no stress from such low flows, the MFL can be argued as overly protective. I suggest you consider how best to address this paradox, and in so doing include some discussion of stationarity.
5. As I understand it the consideration of groundwater use focused on the <2 mgd that occurs in an area that may or may not be the springshed, but ignored "several million gallons per day" (p 7) just to the north of the springs This seems like a major concern in any quantification of future flows, especially given that the allowable increase in groundwater use impacts is only 0.5 cfs (0.3 mgd). If you think this doesn't really matter, then I recommend you explain your logic in some detail.
6. The air photos in 10-2 and 10-3 of Appendix C show large islands in the spring run that no longer exist. The upper one is still seen (smaller) on a 1999 Google Earth photo. Loss of the islands would seem to indicate significant geomorphic processes that I don't believe are discussed anywhere in the report, but which may be important to understanding the dynamics of this system.
7. As the specific comments indicate, the report presents confusing information about the springshed area. The District's concept on this subject needs to be clearly stated and consistently applied.

<u>Specific comments</u>

8. This is a large and relatively complex report; the table of contents should be much more extensive.
9. My preference is to use "data" as a plural ("datum" is the singular). No problem with your use as singular if that is standard District policy.
10. Page 1 cites Rule 62-40.473, F.A.C. regarding how minimum flows and levels should be expressed. Does this report comply – it is not a specified flow or level.
11. P. 2. I don't recall seeing the NRC principles in prior reports; it's a good addition.
12. P. 3. Is it possible to show the shell mounds on a map or photo? Not essential.
13. Figure 2, suggest you use put a box around the area shown in Figure 3.
14. I recommend you provide a map and discussion of the springshed before introducing other maps. This would provide valuable context to other maps, e.g. Figure 5 which extends far beyond where land use matters to the spring. Given the uncertainty in the springshed boundaries set out in Appendix C, the map might show the "high probability" and "possible" limits.
15. The first sentence on p. 7 suggests that there were significant land use changes within Ocala NF in or before the 70s. Is that the case, I recommend you add a bit of explanation.
16. Figure 5. The text sets out information based on counties. Figure 5 (or Figure 1) should show county lines.
17. Figure 6 provides use data for an area of 240 square miles. Is this intended to be the springshed? If yes, which springshed – the one in Figure 5 of Appendix B or Figure 2-3 of Appendix C?

18. In Figure 6, why is the large use from north of the spring excluded? I found no explanation related to the change in the self-supply methodology. As it stands, this graphic generates more questions than insights.
19. The discussion of manatee habitat on p. 10 could benefit by discussing the maximum number of animals observed using this run.
20. P. 11. Suggest saying more about the cave crayfish. If "endemic" means not found anywhere else then whether it is listed or not that makes it a big deal in limiting reductions to springflow.
21. P. 12. Somewhere need to explain why all the analysis in Appendix C is on winter conditions, when summer conditions in this particular spring run are of importance to striped bass.
22. P. 15-16. Readers may wonder why Figure X is unique in using a roman numeral. It would take some work, but ideally you would make it Figure 10 and renumber all that follows.
23. P. 17. While I appreciate the effort made to develop a temperature model, the resulting bias to high values needs further discussion as to how that plays into setting the MFL, i.e. defend the concept that the model is still reliable for evaluating effects from changes in flow, even if the absolute values will not be precisely predicted.
24. Figures 14-17. Should the caption and discussion of these figures reflect the bias in the model results?
25. P.27. Suggest adding a bit of discussion of the rating curves here. Note also there is no page number.
26. Andrew is well aware of my concerns regarding stationarity. The numbers in Table 2 jump off the page (at least to me) as requiring some discussion of what is going on. Figures 18-20 are arguably even more dramatic. If there is some type of long-term shift in hydrology there should be zero change allowed.
27. Figures 21-23. Why is Silver Glen Q going down when water levels are not trending and SJR flows are steady?
28. First line on p. 32 has what seem to be random question marks.
29. Table 3 is very interesting and worthy of assessment and discussion, if not here there in a standalone document.
30. In Table 4 should mention striped bass and the endemics. Not sure what is meant by the "?" for freshwater supply and aesthetics; surely both are protected.
31. Appendix A, p. 1. Why is it a problem that more particles settle out – i.e. on what basis is less turbid water better than increased bottom sediment.
32. I enjoyed the cave diagram on page A-10, but was disappointed to see no discussion of fauna.
33. P. A-11. I found the water clarity discussion hard to follow given so many different numbers.
34. P. A-16. Does the MFL help protect these cultural resources? If so that is a prime consideration that deserves emphasis.

35. P. A-19. Figure 14 has lots of information, but no discussion at all. The V-shape in some of the patterns is unusual. The TKN relationship to flow is one that would benefit from sharing your understanding.
36. P. B-2. Recommend adding the 2012-2016 value to Table 2. See comments made on these same graphs in the main report.
37. Many comments on the main report apply to Appendix B.
38. Figure 5 does not have a scale. Figure 5 is in substantial disagreement with Figure 2-3 in Appendix C. The concept that this is the springshed plus a one mile buffer suggests the springshed is drawn rather precisely; Section 10.4 in Appendix C suggests otherwise.
39. The mgd values in Figure B-7 don't seem to quite match with the mgd and cfs values elsewhere.
40. In Figure B-8, why the bump in flow reduction 1995-1999?. Is this the high pumping shown in Figure 6, and if so what was going on?
41. Overall Appendix C is a good technical document, but left me wondering why so much effort was put into so simple an MFL. Suggest some explanation be added.
42. Title page of Appendix C should identify it as the beginning of Appendix C. Changing the pagination to indicate "C" is not a bad idea.
43. The Appendix uses metric and English units inconsistently.
44. Is there a useful topo map that could be added to Appendix C?
45. The assumption about runoff temperature (P. C-3) made no sense to me, and the rest of the paragraph was a bit obtuse as well.
46. Appendix C is already interesting but would be more so if it provided a map to illustrate the anthropological influences. More photos too.
47. Section 2.3 would benefit from an opening paragraph on the overall thermal regime of the spring compared to the lake that covers both winter and summer conditions and that also includes some insights on how lake elevations change and what that means to the spring.
48. Figure 2-3. This is a much smaller springshed than in Figure 5 of Appendix B, or Section 10.4 in Appendix C. The scale is metric only; in general need to have English units everywhere, even if in parentheses after metric. If the decision is made that all quantification will be metric only, then I recommend adding a conversion table to the beginning of the appendix.
49. I didn't come away with a clear understanding of Figure 3-1.
50. Bottom of p. C-8, what is the "Cardo, Inc. survey"? Also in Figure 3-3, is there any explanation for the channel extending into the lake?
51. P 11 says "velocity and thus discharge". Discharge is also a function of cross-section area, so it does not automatically follow that discharge is "thus" the result of only velocity.
52. P. 15. Suggest you note the typical tidal range. Also should explain the significance of determining water age in general (though I'm not sure it is very meaningful in this instance).
53. Figure 4-1 is not map of "grid" as I normally use that term.

54. Figure 4-2. Data locations are hard to see.
55. P. 19. I found no text citing Figure 5-1.
56. Table 5-2. Why would Sandboil be included in discharge at the 80-ft station?
57. P. 21, end of full paragraph. I'm not sure where you ever laid out the "issues with model performance".
58. Table 5-6. Suggest you explain why rainfall heat transfer did not need to be considered.
59. Figure 6-1. Putting statistics on graph is a good protocol – suggest this be done on all.
60. P. 27 line 4. Deployments of what?
61. P. 31. The validation statistics were not particularly impressive; suggest some discussion in text.
62. P. 32. An r-sq of 0.7 is better said to be "reasonable" than "accurate", and the consistent bias of over-prediction of temperature is a definite concern given that this overstates suitability for manatees.
63. Figure 7-2. Perhaps I missed it, but exactly where do the "observed" data come from.
64. P. 35. Why was a 20% flow reduction evaluated?
65. P.38. Can you explain why you picked 0.9 to adjust solar radiation for shade?
66. Figure 10.4 does not agree with Figure 2-3 and suggests a lot of uncertainty, in contrast to Figure 5 in Appendix B.
67. 10.6 does not indicate a particularly good match for the salinity model.
68. 10.9 should point the reader to where the results of the statistical tests are reported.
69. 10.10 has no legend.

<u>Items in scope of work</u>

I have reviewed the MFLs report with consideration given to four specific review items specified in the Scope of Work. Most of the comments below relate to one of the four overall concerns expressed at the beginning of this memo.

- The report does not explain why a total 2.5 cfs flow reduction is acceptable but 5 cfs is not.
- The report does not explain how the current very large flow reduction has come about, or account for how it should impact the MFL.
- The report does not explain why a very large proximate groundwater use is ignored, or account for how it could impact the MFL.
- The report does not discuss the major geomorphic changes in the channel that have occurred in recent years.

1. Assess adequacy of environmental data in terms of appropriateness, quality and length of record.

a. Are there any deficiencies and/or errors regarding data availability? *Data on groundwater use appear to be incomplete.*

b. Were appropriate analytical methods and field procedures used for data collection? *There is no assessment of the flow decease or geomorphic change.*

c. Were reasonable quality assurance assessments performed on the data? *Yes, the data actually provided seem fine.*

d. Was relevant data available but discarded without appropriate justification? Would use of discarded information significantly affect the development of the MFLs? *Not clear if groundwater data for area north of springs were discarded, or simply not available. Geomorphic changes are ignored.*

e. Was "best information available" utilized in developing the MFLs? *Not sure. MFL is not based on flow or water levels, so it really doesn't compare to the norm or even depend very much on information. From the information that is available, a "zero change" MFL might make more sense.*

2. Assess methods and procedures for data analysis, including, where appropriate, performing appropriate statistical analyses of data to ensure that each is statistically valid and is used appropriatel

a. Are there any deficiencies and/or errors in analytical methods and procedures? *Don't know effec of ignoring a large quantity of groundwater use or lack of evaluation of the substantial decrease in flow over the past several years.*

b. Were appropriate analytical methods and procedures used for data analysis? *Yes, subject to othe statements made here.*

c. Were the analytical methods and procedures appropriate given the "best information available"? *Don't know effect of ignoring a large quantity of groundwater use or providing no insights on the substantial decrease in flow over the past several years. No analysis of substantial geomorphic change.*

d. Do the analyses include all necessary factors? *See comments above.*

e. Were the analyses correctly applied? *Those that were done were done well.*

f. Were any limitations and imprecisions in the information handled appropriately? *Not clear why complete groundwater data set was not used.*

g. Are the analyses repeatable? *Yes.*

3. Evaluate the validity and appropriateness of all assumptions used and conclusions made in the development of the MFLs analysis.

a. Are the assumptions reasonable and consistent given the "best information available"? *Not sure about the effect of incomplete groundwater analysis or recent substantial decrease in flow. Do not understand basis for determining a 2.5% change is ok but a 5% change is not.*

b. Is there information available that could have been used to eliminate any of the assumptions? Would the use of this additional information substantially change the development of the MFLs? *Don't know.*

c. Are the assumptions stated clearly? *Yes.*

d. What, if any, assumptions are implied or inherent in the methodologies? *None of significance.*

e. Are other analytical methods or procedures available that would require fewer assumptions but could provide comparable or better results? Are adequate data available to support using these alternative methods or procedures? *A simpler hydrodynamic analysis may have been sufficient.*

f. Are there deficiencies and/or errors in the MFLs or application of findings and conclusions? *See comments above: I have concerns about the basic finding of 2.5%= ok, 5% not; partial consideration of groundwater use; lack of analysis of major decline in flow; no assessment of major geomorphic changes.*

g. Identify all sources of uncertainty and assess their impact on developing MFLs that will prevent significant harm to the ecological structure and/or function of the water resource. *See comments above for several of my concerns.*

4. Determine if the data, analyses, and interpretation of results support the recommended MFLs. *Not yet.*