

Appendix 1-3: Comments on the Draft 2009 South Florida Environmental Report – Volume I from Outside Persons and Organizations

In September 2008, these comments were provided to the public on the District's WebBoard (<http://www.sfwmd.gov/sfer>). With the exception of reformatting some information for better readability, this appendix was not edited or spellchecked by the SFER production staff and appears verbatim as posted on the District's WebBoard.

COMMENTS ON THE DRAFT 2009 SFER – VOLUME I, CHAPTER 3B AND RELATED APPENDICES¹

Reviewer: posted by Tom DeBusk

Subject: Chapter 3B Comments

Posted: 23 Sep 2008 01:05 PM

Comments on SFER Chapter 3B: Mercury and Sulfur Monitoring, Research and Environmental Assessment in South Florida

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Based on several years of monitoring data, it is clear that surface water sulfate concentrations are elevated in certain regions of the northern Everglades Protection Area due to historical discharges of runoff and lake waters. Additionally, as noted on page 3B-19, areas in the northwest portion of WCA-2A that recently have received STA-2 discharges for hydropattern restoration are exhibiting increases in sulfate levels. Areas of WCA-2A that previously exhibited water column sulfate concentrations of 4 – 12 mg/L now display concentrations of 52 – 78 mg/L.

What is not well understood is the impact, if any, of these elevated sulfate concentrations on MeHg production, wetland P retention, and health of aquatic biota. The implication from page 3B-18 is that extremely low surface water sulfate levels are required to minimize potential adverse effects of sulfate. The Chapter 3B authors state: “At the CERP goal of 1 mg/L sulfate in Everglades surface water, data indicate that microbial sulfate reduction and MeHg production rates would be low due to sulfate limitation, and sediment porewater sulfide levels would only be in the tens of µg/L, minimizing both sulfide toxicity to aquatic plants and animals and internal eutrophication – phosphate and ammonia release from sediments (Gilmour et al., 2007 a, b).”

While numerous scientific studies have shown that the presence of sulfate in freshwater marsh waters *can* stimulate MeHg formation, sediment release of ammonium and P, as well as cause toxic effects to biota (all a consequence of sulfide formation), the minimum sulfate concentration (or range of concentrations) that will cause these adverse effects in the Everglades marshes remains unknown.

For example, in their development of the P criterion in the early 2000s, FDEP classified site U3 in the interior of WCA-2A as a “reference” site, since it provides both a desirable assemblage of “balanced” biota (plant communities extremely sensitive to P enrichment, such as calcareous periphyton and bladderworts), and low water column TP concentrations (10 µg/L). It should be noted that site U3 has received water inputs with sulfate levels of 40 – 50 mg/L for decades, but still exhibits the desirable biological and chemical characteristics of a balanced and pristine south Florida freshwater marsh. Therefore, if sulfate indeed causes adverse effects on P cycling and plant toxicity in south Florida marshes, the effects undoubtedly occur at concentrations substantially higher (by more than 50X) than the 1 mg/L concentration suggested on page 3B-18.

¹ For the draft *2009 South Florida Environmental Report – Volume I*, no other outside persons and organizations posted responses to the other chapters of this volume on the WebBoard during the review period.

Similarly, the chapter authors note the increased sulfate levels in the hydropattern restoration area in the NW of WCA-2A, but provide no additional information related to resulting biological or chemical impacts. The SFWMD is conducting monitoring to evaluate effects of STA-2 discharges on water and soil chemistry and biota in this area. Their most recent report (Garrett and Ivanoff 2008) states: “ In summary, these results indicate that there have been improvements at several previously nutrient impacted sites, i.e., areas with soil TP > 500 mg/kg, and there was generally no negative impact at previously unimpacted sites in WCA-2A resulting from STA-2 discharge. The benefits include increased hydroperiod and improved water quality, as evidenced by decreased surface water TP, steady soil TP concentrations, increased relative abundances of low nutrient periphyton indicator species, decreased relative abundances of high nutrient periphyton indicator species, and decreased nutrient content in periphyton tissues.”

The existing data from WCA-2A northwestern and central interior sites therefore demonstrate that sulfate in the water column at concentrations exceeding 50 mg/L can result in elevated porewater sulfide levels, but adverse impacts to wetland P cycling or to biota have not been demonstrated.

In 2008, the SFWMD initiated a three-year research program to address these discrepancies between “theoretical” impacts of sulfate and actual impacts to P cycling and plant toxicity in Stormwater Treatment Areas and Everglades marshes, and a description of this effort (Projects #1 – 3) is provided on pages 3B–25 and 3B-26. Additional data on sulfate effects are likely available from the USGS and Smithsonian scientists that comprise the Aquatic Cycling of Mercury in the Everglades (ACME) project team. These scientists have studied mercury cycling in the Everglades since 1995. In a description of their prior efforts (page 3B-27) it is noted: “.....the second component of the study is a series of field mesocosm experiments designed to test cause and effects hypotheses. Additions to mesocosms have included mercury, sulfate, DOC and phosphate. Mesocosm experiments have been run in WCA-1, WCA-2 and WCA-3, the most detailed sulfate and DOC addition studies were carried out at site 3A-15, WCA-3A.”

We are very interested in the ACME team’s findings from the mesocosms at site 3A-15, but have found the reported results inconclusive. We have submitted repeated requests for the raw data so that we could study the experimental design and findings in more detail. To date, the ACME group has released only a small subset of data, which represents only partial results from selected experiments. Our analysis of these raw data packages has not provided needed answers, but rather has raised several concerns about the experimental design and laboratory procedures used by the ACME (USGS/Smithsonian) research team.

The first package of data contained copies of two contracts (between SFWMD and the Smithsonian, and FDEP and the Smithsonian), a brief report from the USGS (Chemical Results of Laboratory Dry/Rewet Experiments Conducted on Wetland Soils from Two Sites in the Everglades, Florida), and raw laboratory bench sheets and instrument printouts that appear to be from the Dry/Rewet Experiments. We have developed a list of analytes and sample locations from the bench/instrument sheets that were included in the package (Table 1).

Table 1. Analytes, sample locations, and dates of analyses pertaining to the Smithsonian/USGS Dry/Rewet Experiments.

Analyte(s)	Sample Location	Date of Analyses
Ammonium & Phosphate	STA-2	Feb-April 2002
Anions (Sulfate)	STA-2; WCA3A15	April-July 2002
Ammonium & Phosphate	STA-2; WCA3A15	June 2002
Phosphate	STA-2; WCA3A15	Feb 2003
Anions (Sulfate)	STA-1W; STA-2; STA ¾; STA-6	May 2006
Ammonium & Phosphate	STA-1W; STA-2; STA ¾; STA-6	May-June 2006
Anions (Sulfate)	STA-2; WCA3A15	April-Sept 2006
Ammonium & Phosphate	STA-1W; STA-2; STA ¾; STA-6	Aug-Sept 2006

Our review of the laboratory bench sheets and instrument printouts suggest that the USGS laboratory(s) failed to adhere to a number of critical QA/QC requirements. One possibility is that USGS excluded QA/QC information from the information request. However, many of the QA/QC protocols (i.e., spikes, duplicates, continuing check standards) typically are embedded in the analytical runs, and therefore should show up in the types of printouts that were provided in the data package. A summary of key QA/QC procedures that USGS apparently did not perform (i.e., not included in the package) is provided below.

The following National Environmental Laboratory Accreditation Program (NELAP) - or FDEP-approved QA/QC Components were not included in the data package:

1. Chain-of-custody (COC) was not provided. This is a very significant component of NELAP-approved QA/QC. The COC sheet tracks the route taken by a set of samples from the time of collection to their final destination at the lab. It also lists the persons responsible for each leg of the journey and provides evidence as to the preserved state of the samples when they arrived at the lab (e.g., sample temperature if ice melted; acid preservative added by taking pH of sample). Given the distances from south Florida and the number of labs that the samples were shipped to, proof of timely arrival and proper sample preservation, with no accidental or purposeful tampering during the shipment, is essential.
2. No secondary check standard was performed in any of the analyses. The secondary standard is from a source other than the one that is used for the standard curve. The secondary standard provides a check on the accuracy of the primary standard.
3. No addition of a known analyte to a sample matrix (i.e., spike recovery) was performed on any of the analyses. A spiked sample with a known amount of the analyte indicates whether there are positive or negative chemical interferences present in the sample matrix.
4. No continuing check standards (CCS) were performed on any of the analytical runs with the exception of the sulfate analysis from April-Sept. 2006. The appropriate frequency is a minimum of 5% (1 for every 20 samples) or at least once if sample number is less than 20. The CCS provides assurance that the instrument and chemistry during the complete analytical run have not been compromised.
5. Laboratory blanks (distilled or de-ionized water) were not always run at a minimum frequency of 5% (1 for every 20 samples) or at least once if sample number is less than 20. This ensures that there has not been contamination introduced by the lab water, reagents, or glassware.

Due to the profound management implications of the sulfur and mercury research performed by the ACME group, we recommend that they make raw data available to interested parties, and also facilitate a documentation review by FDEP and SFWMD QA/QC personnel to ensure appropriate quality assurance protocols were followed during their monitoring and experimental efforts in south Florida marshes.

A second information release from USGS raised concerns about the mesocosm design and operational procedures used at site 3A-15. The investigators used a series of mesocosms to spike constituents such as sulfate into the water over a range of concentrations, and chemical and biological constituents in the water column and sediments subsequently were monitored over time to characterize the responses, such as MeHg and sulfide formation.

Based on the information release, each of the mesocosms apparently was totally isolated from the surrounding environment (i.e., there were no planned water exchanges with the outside environment at pre-determined intervals). During prolonged periods of constant water stages in WCA-3A, the mesocosms therefore would remain stagnant, with no exchange of water with the surrounding wetland. During periods of stage increases in WCA-3A (onset of the wet season), however, the elevated water levels outside the mesocosms would cause water to be pushed upward through the sediments into the mesocosm. Similarly, when water stages in WCA-3A were dropped, water would flow out the bottom of the mesocosms through the sediments, so that internal water levels could equilibrate with the surroundings.

For mesocosms to be effective in addressing “cause and effect” hypotheses, considerable care is needed with respect to design and operations to ensure that the small-scale systems accurately mimic conditions in the natural wetland. Because many of the processes of interest (e.g., sulfide formation) occur in the sediments and at the sediment-water interface, the operational approach utilized for the 3A-15 mesocosms appears questionable. A more thorough analysis of these findings, with respect to chemistry changes during prolonged stagnant periods, and during periods of rapid stage changes (and consequently, rapid bulk flow through the sediments), would help clarify the validity and representativeness of their findings.

References

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Reviewer: posted by Victor Bierman

Subject: LimnoTech Comments on Chapter 3B

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Comments on

2009 Draft South Florida Environmental Report

Chapter 3B: Mercury and Sulfur Monitoring, Research and Environmental

Assessment in South Florida

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CHAPTER 3B SUMMARY

The summary begins by introducing sulfur as the element of concern in the Everglades. Although sulfur plays a rather complex role in influencing mercury (Hg) dynamics in the Everglades, a clear discussion was not provided in the chapter body of how sulfate and sulfide influence methylation of Hg in the Everglades. It is understood that the 2009 Draft SFER builds upon previous SFER reports, but it would be helpful to the reader to cite relevant portions of these earlier documents in order to provide more complete background information.

It was stated that fish Hg concentrations in the Water Conservation Areas (WCAs) have declined markedly from the late 1980s to the early 1990s. An important question is whether there had been a substantial decrease in the atmospheric Hg loading during the same time period. It is interesting to note that the Everglades National Park (ENP), despite containing sulfate concentrations several-fold lower than the WCAs, has promoted higher Hg bioaccumulation in fish. Further investigation of the various controlling factors for Hg bioaccumulation in the ENP, Shark River Slough in particular, should be conducted.

It is suggested that higher sulfate levels would enhance and lower sulfate levels would reduce, respectively, Hg bioaccumulation in the Everglades. This statement lacks scientific credibility and is often not the case. Although sulfate is an important substrate, a number of other factors are important in controlling Hg methylation. Given the complex nature of the Everglades ecosystem, a detailed investigation that includes sulfate, sulfide, iron, nitrogen, DOC and pH of the system is required for a comprehensive understanding of Hg dynamics, including bioaccumulation in fish.

There are also food web structure, function and bioenergetics differences among the various spatial locations in the Everglades. These can be important and can confound the use of Hg concentrations in fish to draw inferences on methylation rates.

NEW FINDINGS

This section provides a summary of the recent findings on Hg in fish in the Everglades

Protection Area (EPA) including the WCAs. In the WCAs, it was encouraging to note that the system-wide median Hg concentrations in largemouth bass (LMB) have declined 70% since 1988. However, annual median values indicate that the human health fish consumption criterion of 0.3 ng/g (Environmental Protection Agency) remains to be met for 61% of all the LMB collected between 2001 and 2007. During this time period the median Hg concentrations in LMB have varied minimally and it remains to be seen if further declines are likely to occur in the future. The sample size has increased substantially from 1988 (n = 12) to 2007 (n = 263). It would be useful to provide the sample size in parentheses with the various years to better interpret Figure 3B-2.

In Shark River Slough, higher levels of Hg were found in fish, including mosquitofish, sunfish, and LMB, compared to other locations in the EPA. This raises an important question as discussed earlier: Why is the rate of Hg bioaccumulation in Shark River Slough higher than elsewhere in the EPA?

MERCURY IN EVERGLADES FISH AND WILDLIFE HISTORICAL MONITORING OF MERCURY IN BIOTA

In the opening paragraph of this section, fish concentrations of Hg are reported in mg/L. This should be changed to either $\mu\text{g/g}$ or mg/kg to be consistent with the rest of the document.

MERCURY IN FISH – CURRENT YEAR SAMPLING

Fish Collection, Analysis and Mercury Concentration Normalization

It was stated that fish samples were analyzed for Hg by two separate USEPA methods: (1) method 245.6 (Hg in Tissue by CVAAS); and (2) method 7473 (Hg in solids and tissues by thermal decomposition, amalgamation and AA). Attempts should be made to clarify if both methods yielded consistent results.

It was asserted that LMB are excellent biotic indicators and generally reflect “ambient” MeHg concentrations. If this is true, then it implies that food chain bioaccumulation processes in LMB are the same throughout the EPA. This is an important unstated assumption that requires clarification in the report and further investigation to determine its validity.

Mercury levels in LMB were standardized to expected age-3 Hg concentrations (EHg3) to interpret results. While it is a common practice to normalize Hg concentrations for evaluations of spatial and temporal patterns, the underlying assumptions regarding EHg3 standardization in this study need to be clarified. For example, spatial variability in growth rates and food sources of LMB across EPA can confound interpretation of EHg3 normalized results. Furthermore, three year-old fish can exhibit a range of sizes and lipid content.

The term “mercury hotspot” should be stated with more specificity. In the current state of the science for Hg, there are “depositional hotspots” representing landscape areas with high Hg

loadings from the atmosphere and “biological hotspots” representing landscapes characterized by elevated Hg levels in biota that exceed established human health and wildlife criteria.

Results: Regional Trends

The important aspect of regional trend is the finding that Hg bioaccumulation in LMB and snook in Shark River Slough is higher than in other locations in the EPA. It is also notable that sites located outside of the influence of Shark River Slough but within the ENP, Taylor Slough, and ENP/LOST, had relatively low levels of Hg in LMB and snook.

Understanding the controls on Hg transport and bioaccumulation in Shark River Slough is critical for understanding the patterns of Hg bioaccumulation across the EPA. There are several reasons that may help explain the mechanisms behind higher Hg accumulation in Shark River Slough. The growth rates of LMB and snook in the Shark River Slough may be slower and thus they may accumulate more Hg per unit body mass over time compared to other locations. Also, LMBs are opportunistic feeders and their diet includes worms, macroinvertebrates, fish, salamanders, and frogs, consequently, LMB may be consuming prey through food chains with different trophic structures in the ENP versus the WCAs.

Another factor is that the bioavailability of MeHg is thought to be regulated by the extent to which Hg binds with organic carbon. The concentrations of dissolved organic carbon in the Shark River slough may be at low levels compared to other parts of the EPA and consequently more Hg may be bioavailable at this site. Alternatively, groundwater (salt water intrusion) may supply sufficient nutrient inputs to sustain high rates of Hg methylation and bioaccumulation within Shark River Slough.

These factors pertaining to LMB growth rates and food chain structure, and to sources and sinks of organic carbon and nutrients, all need further investigation.

Results: Site Specific Trends

The site specific results indicate that for all WCA sites except L35B (WCA2), minimum concentrations of EHg₃ in LMB occurred between 2001 and 2008 and maximum concentrations for all WCAs generally occurred during the early 1990s (period of record: early 1990s to 2008).

For the HOLEY site, an upward trend was observed for concentrations of EHg₃ in LMB from 1999 to present. It is evident from the long-term observations that large percentages of LMB sampled from individual sites in the EPA still contain Hg at levels above established criteria for wildlife protection and human health.

For ENP sites (Shark River Slough and ENP/LOST) annual concentrations of EHg₃ in LMB were above the established criteria for wildlife protection and human health. As stated earlier, it is essential to understand the controls on higher rates of Hg bioaccumulation within the ENP landscape.

References were made to (Table 3B-10), which does not exist, when pointing to LMB results of age cohorts one and two. The intended reference here must be (Figure 3B-10).

On page 3B-8, it was asserted that within the EPA, Hg concentrations in mosquitofish and sunfish increased during monitoring year 2007 as compared to 2006, and that these findings were significant because sunfish and mosquitofish represent the preferred prey item of many fish-eating species in the Everglades. Relative increases in Hg concentrations for the year 2007 were also observed for LMB sampled in sites WCA1 and WCA2 (Figure 3B-4; 3B-5). In the later section “SULFUR IN THE EVERGLADES” it was also observed that during WY2008 (May 1 – April 30, during which fish were sampled for year 2007) sulfate concentrations measured in WCA-1 and WCA-2 sites were relatively low compared to previous water years. If the changes observed in fish Hg were significant, as asserted, then these changes occurred when concentrations of

sulfate in the surface water declined. There should be a more complete investigation of these reported increases in Hg concentrations in fish, and the potential causes of these increases despite declines in concomitant sulfate concentrations.

One possibility is that a transient increase in atmospheric Hg loading in the EPA during 2007 may have resulted in the observed increase in fish Hg. Such a cause-effect relationship should be evaluated for the year 2007. It was asserted in Appendix 3B-1 that the total annual wet Hg deposition in the Everglades National Park (ENP) was 15% higher in 2007 compared to 2006. However, the authors mention that robustness of the 2007 Hg deposition data was compromised due to technical difficulties.

SULFUR IN THE EVERGLADES

As pointed out earlier in our assessment, it was stated in a more qualitative way that increased sulfate levels would enhance and decreased sulfate concentrations would reduce, respectively, net MeHg accumulation in soils and aquatic biota. Managing sulfate inputs was also stated as a potential option for reducing MeHg bioaccumulation and internal phosphorus loads from sediments in the EPA. Sulfate inputs are important but are not the only factor in influencing the methylation of mercury. Within the EPA, along with other factors, sulfide-Hg interactions may play a key role in controlling bioavailability of Hg for methylating bacteria. Previous studies have identified elevated porewater concentrations of sulfide (e.g., SFER 2007, Appendix 3B-3).

The availability of Hg for methylation in surficial sediments is dependent upon the formation of neutral Hg-sulfide complexes. Recent studies have shown that under high sulfide conditions, the formation of cinnabar and charged Hg-polysulfide complexes decreases bioavailability of Hg for methylating bacteria (Jay et al., 2002; Benoit et al., 1999).

The influence of nitrogen inputs on Hg cycling in the EPA remains unclear. Sulfate reduction proceeds after nitrate and iron have been utilized as electron acceptors by bacteria. Nitrate is also an energetically more favorable electron acceptor than sulfate. Therefore it is possible that higher nitrate concentrations, particularly in the northern parts of EPA influenced by runoff from the EAA, may result in lower rates of sulfate reduction, and hence lower rates of Hg methylation. It should be noted that an ongoing Hg remediation study in Onondaga Lake, New York, is considering enhancing nitrate inputs to counter the high mercury methylation rates within the lake. Abstracts by Todorova et al. and Auer et al. describing this ongoing work can be found at http://www.upstatefreshwater.org/html/olsf-eight_presentations.html. There is also increasing evidence in the recent literature about the ability of iron reducing bacteria to convert ionic Hg to

MeHg (Fleming et al., 2006; Warner et al., 2003). It was asserted that reducing sulfate inputs would result in reduced sulfide toxicity to aquatic plants and animals, and reduced sediment release of phosphorus. It is unclear if this statement is hypothetical or based on previous process experimentation/observation with the EPA. The authors do not provide evidence or refer to scientific studies that have demonstrated high sulfide levels leading to plant toxicity and P release from sediments in the Everglades. Comparison of *in situ* sediment P efflux from low sulfate sites such as ENP and sites that exhibit high sulfate concentrations (e.g., WCA2) would be a good test of the extent of sulfide-mediated P release from sediment in the ENP.

Many scientific studies have suggested that internal eutrophication may occur when high sulfate inputs result in mobilization of iron-bound P in the sediment through sulfide-induced reduced-Fe binding (e.g., Beltman et al., 2000; Caraco et al., 1989; Lamers et al., 1998). This phenomenon is likely to occur in iron rich sediments that tend to form iron-phosphate complexes. However, if nitrate is present in high concentration then sulfate reduction may not be favored, by the mechanism mentioned above, and the mobilization of phosphate from iron-phosphate complexes may actually be prevented (Lucassen et al., 2004).

Closure of the S-10 E structure resulted in pre- and post-hydropattern restoration periods and provides some interesting observations with regard to sulfate concentrations in WCA2. Sulfate concentrations were approximately an order of magnitude higher during the post-hydropattern period (2001 - 2006) compared to the pre-hydropattern period (1998 - 2001) (Figure 3B-12). If sulfate inputs are the primary factor controlling MeHg production, then the post-hydropattern should have resulted in substantially elevated Hg bioaccumulation in the WCA2. However, fish samples collected from the WCA2 site did not show any appreciable increase in Hg concentration. We recommend that efforts be made to evaluate changes in Hg concentrations in biota in response to pre- and post hydropattern periods.

It is clear that based on the data provided in Chapter 3A, that sulfate concentrations in the EPA generally exhibit a north to south gradient with the exception of interiors of WCA1 (Loxahatchee National Refuge) which remains relatively uninfluenced by the sulfate-rich inflow water. On Page 3B-18 it was stated that “For WY2008, the interior sites in WCA-2 exhibited a median sulfate concentration of 15 mg/L compared to a minimum median concentration of 0.7 mg/L observed in the ENP (Chapter-3A)”. Data provided in Chapter 3A indicate that during WY2008, interiors of the Wildlife Refuge exhibited a median sulfate concentration of 0.8 mg/L. It would be more correct to state that low median sulfate concentrations were observed at ENP as well as the interiors of the Wildlife Refuge during WY2008.

DISCUSSION

In the opening paragraph, it is stated that “Everglades sulfate levels also appear problematic from the standpoint of stimulating mercury methylation, and potentially with regard to sulfide toxicity to plants and animals, and to sulfate-induced liberation of phosphate and ammonium from Everglades soils”. The report does not indicate that these factors have been adequately studied.

It is also suggested that declines in atmospheric Hg deposition and sulfate concentrations are the mechanisms that account for declines in Hg concentrations in fish. The long-term monitoring data presented in Chapter 3B do not establish or show a clear link between reduction in sulfate levels and a resultant reduction in Hg concentrations in fish. In contrast, the Hg bioaccumulation appears to be higher in Shark River Slough, where the sulfate levels are among the lowest in the EPA.

RESEARCH PROGRESS

We agree with all of the ideas for research progress and also stress the need for more monitoring, field studies and improved representation of biogeochemical process in the Everglades Mercury Cycling Model (E-MCM). A complete understanding of the biogeochemistry of sulfate, DOC, nitrate and iron, and their complex interactions with Hg dynamics, is essential for developing scientifically credible and well-founded restoration and management plans for the EPA. For example, the CERP goal of 1 mg/L surface water sulfate concentrations has enormous management implications because it would require very large reductions in current sulfate levels in the EPA, particularly within the WCAs. Restoration and management plans to implement this goal need to be founded on good data and good science.

It should also be noted that numerous acidification studies have suggested that under the scenario of declining sulfate in surface water, the release of legacy sulfur in soil and sediment over the long term would sustain high levels of sulfate in the surface water (e.g., Driscoll et al., 2001; 1998). Further research is warranted regarding the release mechanism of sulfate in the

Everglades soils and its long-term implications on potential sulfate management options for the EPA.

The report states that efforts are under way by the FDEP to compile and synthesize ACME data and provide open public access to these data. We strongly support the effort by FDEP in bringing these data into the public domain. This will allow external review and evaluations of ACME experimental design and data, and facilitate better-informed inputs to the process of developing restoration and management options for the EPA.

FUTURE ACTIVITIES OF THE MERCURY PROGRAM

State-wide Mercury and Total Maximum Daily Load Program

This section outlines plans for developing a statewide mercury Total Maximum Daily Load (TMDL). We agree with the need for development of statewide TMDL for the recovery of Hg impaired waters.

It is stated that one wet only deposition site will be located in the Everglades National Park Research Station. We assume that the three-site mercury deposition network currently located within the EPA will continue to monitor wet Hg deposition and these data will be used in the TMDL development. It is not clear whether dry Hg deposition will be monitored for the EPA sites. Dry Hg deposition forms a significant portion of total Hg deposition. Alternatively, dry Hg deposition can be estimated by applying atmospheric models. In any case, the overall plan for monitoring direct total Hg loading from the atmosphere should be clarified.

Elements of the TMDL should also include efforts to evaluate the release of Hg from soil through mineralization and also volatilization of Hg to the atmosphere. A more detailed description of the “empirical probabilistic based aquatic cycling model” is required, along with how it will be applied to the EPA at relevant spatial and temporal scales. We also suggest that further information be provided by the FDEP regarding whether this model will be different for the EPA than for other areas in the state.

Regional Sulfur Mass Balance Study

The report outlines the objectives of the sulfur mass balance study being conducted by the South Florida Water Management District (SFWMD). There should be some discussion of how the field observations from this study will be synthesized to determine the mass exchanges of sulfur among the four major land use areas of South Florida. For example, will results from the SFWMD Regional Simulation Model (RSM) be used to quantify the hydrologic exchanges among these major land use areas?

Evaluation of Sulfate Effects in South Florida Wetlands

Three separate projects are being funded by SFWMD to investigate potential adverse ecological effects of sulfate in South Florida wetlands, particularly on the role of sulfur in promoting sediment P release and on sulfide toxicity. We recommend that all three projects also examine the role of nitrogen and iron with regard to microbial respiration and phosphorous release. The influence of these nutrients in affecting P release from sediments was discussed above.

It is not clear whether all three projects would be conducted by the SFWMD itself or contracted to other agencies and/or organizations. The spatial diversity of the South Florida wetlands should also be addressed in these projects. Within the EPA the biogeochemical interaction of sulfur should be examined individually in all three WCAs and other sites in the ENP that are under long-term monitoring for Hg concentrations in fish.

The mesocosm studies in Project #3 are particularly important. In addition to the proposed objectives in Project #3 we also recommend that phosphorus fluxes from the sediment at individual locations within the EPA also be determined.

OTHER ISSUES FROM APPENDIX 3B-1

- On Page App. 3B-1-4, it was stated that the pre-ECP mercury baseline conditions were defined based on mercury studies conducted during the construction of, but prior to, the operation of the first STA. Baseline should be established prior to the construction of any STA because any disturbance during the construction of STA may result in a shift in the baseline conditions.
- In Page App. 3B-1-6, it was stated that that surface water will be sampled at quarterly intervals for non-ECP structures under the HGLE program and analyzed for Hg and MeHg. Does the HGLE program also entail analyzing other relevant ancillary parameters in surface waters (DOC, sulfate, pH, Fe, nitrate etc.)?
- It is a common practice in mercury analysis to include continuous calibration verification (CCV), continuous calibration blanks (CCB), Matrix Spike (MS) and Matrix Spike Duplicates (MSD) as part of QA/QC measures. These control samples were not found in the QA/QC measures outlined in this report.

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