UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF FLORIDA
CASE NO. 88-1886-CIV-MORENO

UNITED STATES OF AMERICA,	)
	)
Plaintiff,	)
	)
v.	)
	)
SOUTH FLORIDA WATER MANAGEMENT DISTRICT, et al.,	)
	)
Defendants.	)

REBUTTAL REPORT OF WILLIAM W. WALKER, PH.D.

I, William Walker, have submitted direct testimony and do hereby submit rebuttal testimony in response to the initial reports filed by State witnesses Garth Redfield (State Exh. 2002), Wossenu Abtew (State Exh. 2003), Tracey Piccone (State Exh. 2000), and Jeff Kivett (State Exh. 2001). While I have similar concerns with their rebuttal testimony, I do not specifically address them because of time constraints.

Introduction

1. Appendix B violations have occurred and require sustainable remedies that would not undermine other provisions of the Consent Decree (even setting aside the Class III requirement for the moment). I use the word "sustainable" to mean the remedies will achieve the Appendix B levels in the long-term without having adverse impacts on the Refuge hydrology (critical to supporting a healthy balance of flora and fauna) or on water quality, flora, and fauna in the other Water Conservation Areas (WCAs). After again reviewing the recent monitoring data and testimony by witnesses for the South Florida Water Management District (SFWMD) relative to above requirements, I do not believe

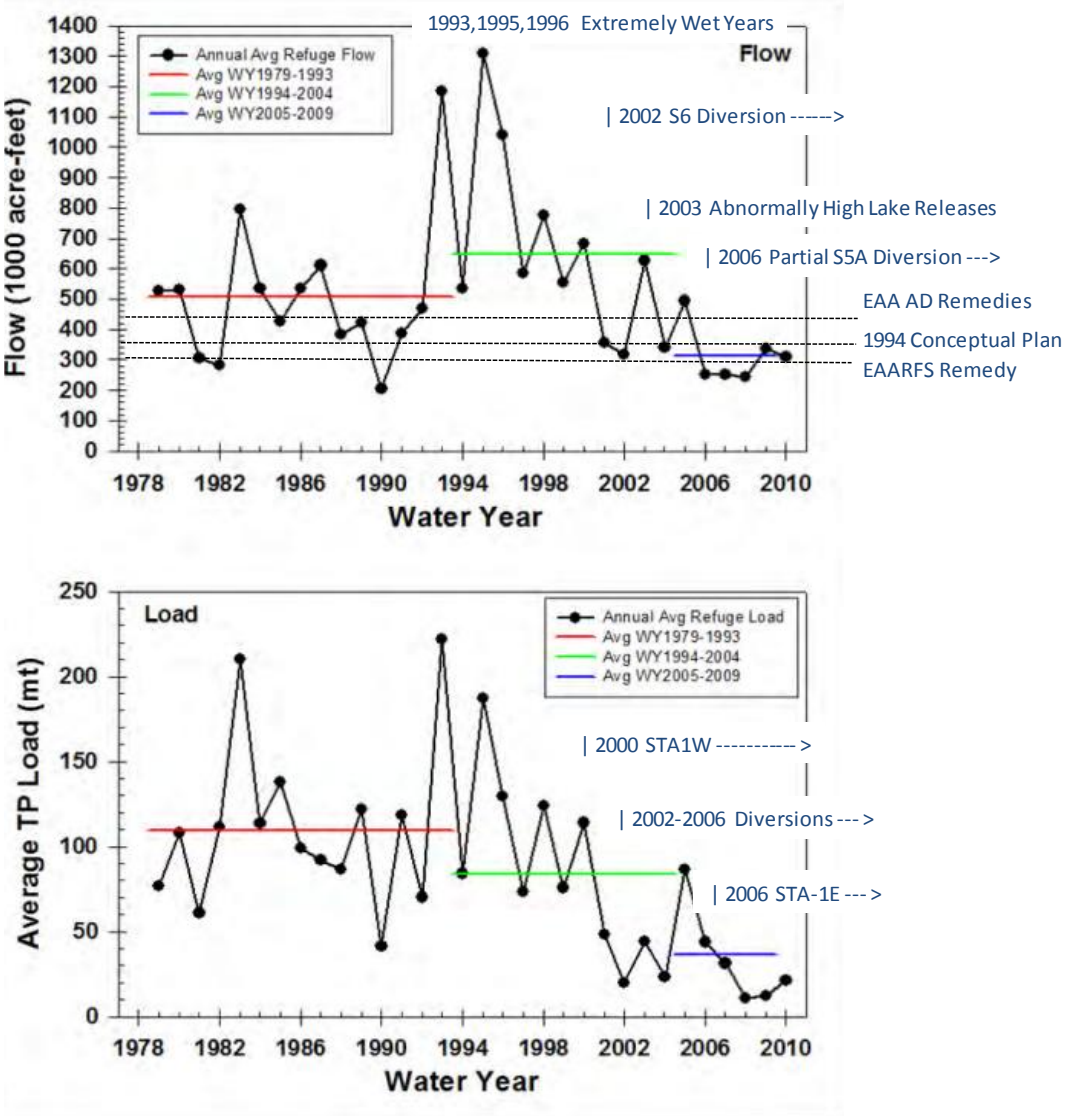
that the remedies proposed by the SFWMD are sustainable as defined above and, even if they were sustainable, would not adequately address the major problems currently impeding STA performance and restoration of the Refuge caused by insufficient treatment capacity and basin water management inconsistent with the 1994 Conceptual Plan.

2. The SFWMD witnesses rely primarily on overly optimistic interpretations of the recent marsh data, unscientific extrapolation of historical trends into the future, and what they characterize as "uncertainty" as bases for declining to propose more realistic and substantial measures to reduce P loads entering the Refuge. Even if the remedies sketched out by the SFWMD witnesses could actually achieve Appendix B compliance in a sustainable fashion, the witnesses have offered no testimony supporting the sustainability component, much less providing any degree of assurance that all of the Consent Decree (CD) requirements would be met. If we also factor into the mix the need for further measures for Refuge inflows to achieve Class III compliance throughout the entire Refuge, as described in the January 26, 2011 initial federal witnesses' remedies reports, the SFWMD's proposed remedies for the admitted Appendix B violations (November 2008-June 2009 exceedance) fall even further short.

3. Significant long-term decreases in phosphorus load to the Refuge have been accomplished since 1979 [Figure 1, US Exh. 2303]. Those reductions were accomplished largely by measures prescribed in the Consent Decree (BMPs and STAs) designed to achieve 50 ppb in the Refuge STA discharges. Unfortunately, the load reductions have also been accompanied by decreases in inflow volume, which raise

concerns about the water quantity provisions of the Consent Decree (¶¶ 3, 9). The flow diversions also make it difficult to determine the extent to which apparent improvements in the marsh since the June 2009 exceedance are due to temporary flow diversions to help the wounded STAs and avoid untreated bypass, atypical rainfall, and atypical stage, as compared with responses to historical load reductions and to the vaguely-defined and inadequate remedies proposed by the District. In short, the marsh data collected after the June 2009 exceedance cannot be used as a basis to justify the inadequate remedies.

Figure 1: Refuge Inflow Volume & TP Load, WY 1979-2010 (SFER, 2011)



ure 3A-16. Annual flow (upper graph) and average TP load (lower graph) to the Refuge from WY1979–WY2010. The horizontal lines indicate the average annual flows and loads for the WY1979–WY1993, WY1994–WY2004, and WY2005–WY2009, and 2010 periods, respectively.

Decreases in TP Load (bottom) reflect implementation of P controls and diversion of flow away from the Refuge (S6 runoff in WY 2002, southwestern S5A runoff in WY 2006). Most of the historical load reduction occurred with the S6 diversion in WY 2002. The average flow in WYs 2006-2010 was below that provided in the 1994 CP, the EPA AD Alternatives, and the 1978-1988 baseline period (dotted lines, top). The District's most recent remedy for STA overloading is to divert additional S5A runoff away from the Refuge (2005 EAA Regional Feasibility Study, Alt. 1).

4. SFWMD witness Dr. Redfield (State Exh. 2002, p. 16) recommends undefined changes in water level management as part of the remedy. Changes in Refuge water level

management and reductions in inflow, however, are not included in the suite of long-term remedies for Appendix B violations that are explicitly required by Appendix C (Page C-4):

> *[N]otwithstanding implementation of these control programs, if the Park or Refuge phosphorus limits or concentration levels are violated, then additional remedies will be taken, such as expansion of STAs, more intensive management of STAs, a more stringent EAA Regulatory Program, or a combination of the above. The State Parties shall not implement more intensive management of the STAs as the sole additional remedy.*

5. The Consent Decree also has specific provisions with respect to water quantity and associated wildlife habitat. These include:

> *Quantity, distribution and timing of water flow to the Park and Refuge must be sufficient for maintaining and restoring the full abundance and diversity of the native floral and faunal communities throughout the Park and Refuge. The Parties shall take all actions within their authority necessary to provide adequate flows to meet the water quantity, distribution, and timing needs of the Park and the Refuge. The District shall implement mitigation measures to offset flow reductions to the EPA resulting from efforts to improve the water quality in the EPA.*

CD at ¶ 9. As discussed at Technical Oversight Committee (TOC) meetings, diversions and changes in water management over the past few years have been justified as stopgap measures to reduce loads to the Refuge within the constraints of the existing STA capacities resulting from excessive inflow volumes and loads, construction, and repair. The SFWMD has provided no evidence, much less assurance, that these types of flow restrictions and stage management measures are adequate as sustainable long-term remedies without compromising the above water quantity protections of the Consent Decree.

6. Aside from stressing the need to repair STA-1E (a non-controversial topic, and a matter which is already in progress), and apart from describing in very general terms an option of utilizing land recently purchased from U.S. Sugar Corporation, SFWMD witnesses offer no plan for remedies that will decrease P loads to the Refuge using the remedial tools that are clearly specified in the Consent Decree, such as STA expansion or additional source controls. [CD, Appx. C at C-4.]

7. Dr. Redfield [State Exh. 2002, p. 8] resurrects unsuccessful challenges to the statistical validity of the Consent Decree Appendix B equations by making faulty, irrelevant arguments about Type I error and regression slopes, as I explained in previous testimony [ref. March 2006 Special Master Hearing]. Challenges to the equations have already been addressed and resolved by the Court and the Special Master in prior orders. [June 1, 2005 Judge Moreno Order, DE 1935; 2006 Special Master Report, DE 1976; and March 31, 2010 Judge Moreno Order, DE 2134.] Dr. Redfield's report provides no cogent justification for revisiting that topic in 2011.

8. In referring to a "low" excursion frequency (Redfield, State Exh. 2002, p.8) and "small concentration increases" above the 90th percentile limits [Abtew, State Exh. 2003, p. 4], SFWMD witnesses downplay the seriousness of exceedances, which are already set above the 90th percentile limit of the phosphorus values that should be achieved at the 14 stations. Despite the declining trends in the marsh TP data relative to the 50th percentile value predicted by the Appendix B equation (Redfield, Figure 1), the data were above the 50th percentile in 14 out of 18 months subsequent to the June 2009 exceedance.

9. The SFWMD witnesses rewrite the remedial provisions of the Consent Decree (at C-4) by claiming that the State's obligation to implement effective long-term load-reduction remedies after an exceedance is contingent upon proof by the United States that there is a correlation, or one-to-one causal connection between excessive P in STA discharges and interior marsh P concentrations. They also suggest that any such load-reduction measures would be justified only if there is an exact model to predict the marsh response. As described in my previous testimony: "Dr. Redfield attempts to reset the clock back to 1988" [W. Walker Surrebuttal Report; 2006 U.S. Exh. 98 at 4]. The causal connection, the need to reduce loads, and the uncertainties were the subject of joint state-federal understandings spelled out in Paragraph 3 of the Consent Decree. There is no substantial evidence that those fundamental assumptions are wrong; in fact, there continues to be substantial evidence that they are correct. Moreover, there remains no reason not to proceed down the path prescribed under the Decree to accomplish further load reductions.

10. The SFWMD's witnesses undermine the State's commitments in Paragraphs 3, 4, and 5, and Appendix C at C-4, to restore water quality in the Refuge by:

- Speculating that "determining an increase in STA acreage of BMPs is premature and would likely result in too protective a remedy (and accompanied by the added expense)." [Abtew, State Exh. 2003, p.4]

- Declining to include further load-reduction measures as a cornerstone of the remedy because of uncertainty in the STA performance forecasts and interior marsh responses.

- Proposing undefined stage-regulation options to reduce intrusion from the rim canal as remedies without demonstrating that they will not have adverse water quality impacts on flora and fauna in the other WCAs, and potentially in Everglades National Park, by simply re-directing the excessive P loads around the Refuge rim canal instead of reducing them.

- Proposing remedies that will decrease the average inflow to the Refuge relative to the historical values (1979-1988), 1994 Conceptual Plan, and U.S. Environmental Protection Agency Amended Determination (USEPA-AD) alternatives [Figure 1 US Exh. 2303]

- Proposing remedies that will constrain operation of Refuge water levels without also providing assurance that it can be done without adversely impacting its flora, fauna, and/or functions to provide flood control and water supply.

- Proposing remedies that will not achieve the Class III requirements and allow the exterior marsh to continue functioning as an STA in order to protect the interior marsh [U.S. Exh. 2248, W. Walker 1-26-2011 Testimony]

The bases for my opinion that building a remedy for the Appendix B violations on the vaguely defined and inadequate remedies proposed by the District would not be consistent with the Consent Decree, leaving aside the Class III requirements for the moment, are further explained below.

Interpretation of Apparent Trends in Marsh TP Concentrations

11. Donning rose-colored glasses, SFWMD witnesses look back at the apparent trends in the historical data and refer to them in the present tense (e.g. "TP levels are continuing to decrease" (Redfield State Exh. 2002, p.2.); "TP concentrations are going down" (Redfield, id., p.3), and "continue to decline" (Piccone, State Exh. 2000, p.2). Those apparent trends were historical in nature and the witnesses' optimistic interpretations would require data from the future in order to substantiate.[1] While I agree that the marsh did improve as a consequence of historical reductions in P loads over the

[1] By "apparent" trends, I mean patterns in historical data from a specific period which indicate a "statistically significant" upward or downward slope, as opposed to random variations. Concluding that "apparent trends" are "real" in the sense that they reflect a true change in the long-term mean that is of management significance is a giant step beyond assessing an historical trend, especially when the period of record is as short as 5 years.

long period of record, there is no assurance that the historical trends were still continuing when they submitted their initial reports on January 26, 2011, especially given the unusually high stages that occurred in the dry season of 2010 [Redfield, State Exh. 2002, Figure 7] and the fact that most of the historical decreases in phosphorus load occurred prior to 2002 [Figure 1, US Exh. 2303]. Dr. Redfield then goes even farther out on the limb to extrapolate the historical trends in excursion frequency through 2013 (Redfield, State Exh. 2002 Appendix, Figure 1).

12. Historical signals in the marsh geometric means [Figure 2, US Exh. 2304; Redfield, Figure 4] and excursion frequencies [Redfield, State Exh. 2002 Appendix Figure 1] are highly variable and exhibit apparent trends in one direction or another within various 5-year intervals, one of the time frames used by Dr. Redfield to assess trends at the interior and exterior sites (60 months, p. 2). If the TOC had met regularly over the 1979-2010 period and taken that approach to interpret the data (looking back at the last 5 years and forecasting marsh TP concentration and compliance for the next 3 years (Redfield, State Exh. 2002, Appendix Fig. 1), they would have sent confusing signals to the Consent Decree signatories as to whether or not there was a problem with Appendix B compliance and further remedies were needed. Meanwhile, excess phosphorus would continue to accumulate in the Refuge marsh with significant long-term consequences to the ecosystem.

13. TP concentrations at the 14-stations between 1978 and 2010 were never in a range indicating that Consent Decree Appendix B objective had been consistently achieved, as measured by either the exceedances of the 90^{th} percentile levels [Redfield, State Exh.

2002, Figure 4], or by the differences between the observed P concentrations and the 50th percentile of those measured in 1978-1979 at the 3 least-impacted sites [Redfield, Figure 5]. Analyzing the historical data in various ways, it is unlikely that the hypothetical panel of scientists mentioned by Dr. Redfield (State Exh. 2002, p. 8) would conclude that the Consent Decree objective to restore the 14-station interior marsh TP concentrations to levels measured at the 3 least-impacted sites in 1978-1979 had been achieved. The panel would be convinced that this Consent Decree water quality objective had not been achieved if they considered that the inherent variability in the marsh data decreased over time as a consequence of improvements in the marsh sampling technique, which had the effect of artificially decreasing the frequency of excursions even though the long-term geometric mean remained above the 1978-1979 value [W. Walker 2006 testimony, 2006 U.S. Exh. 57 at 23-25].

Figure 2 Refuge Inflow and Interior Marsh Geometric Means, 1979-2010 (SFER, 2011)

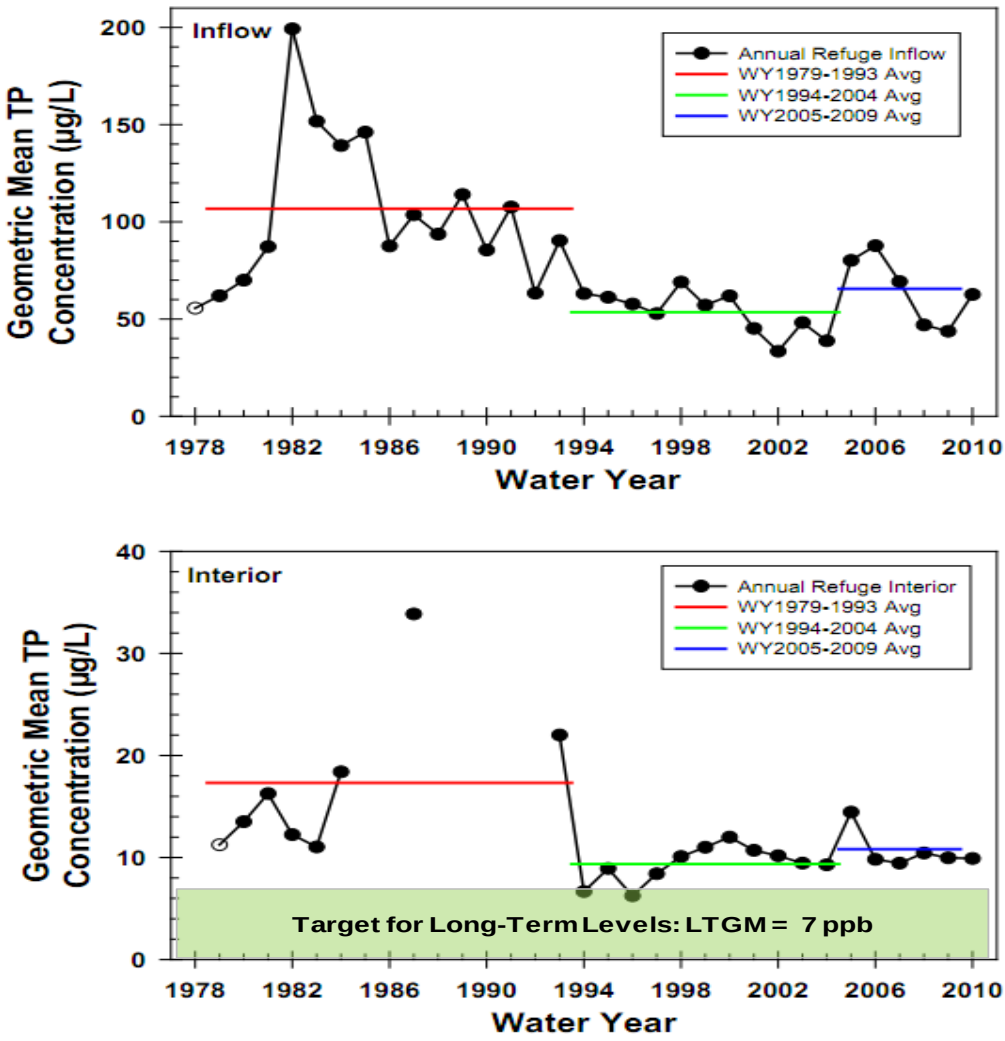


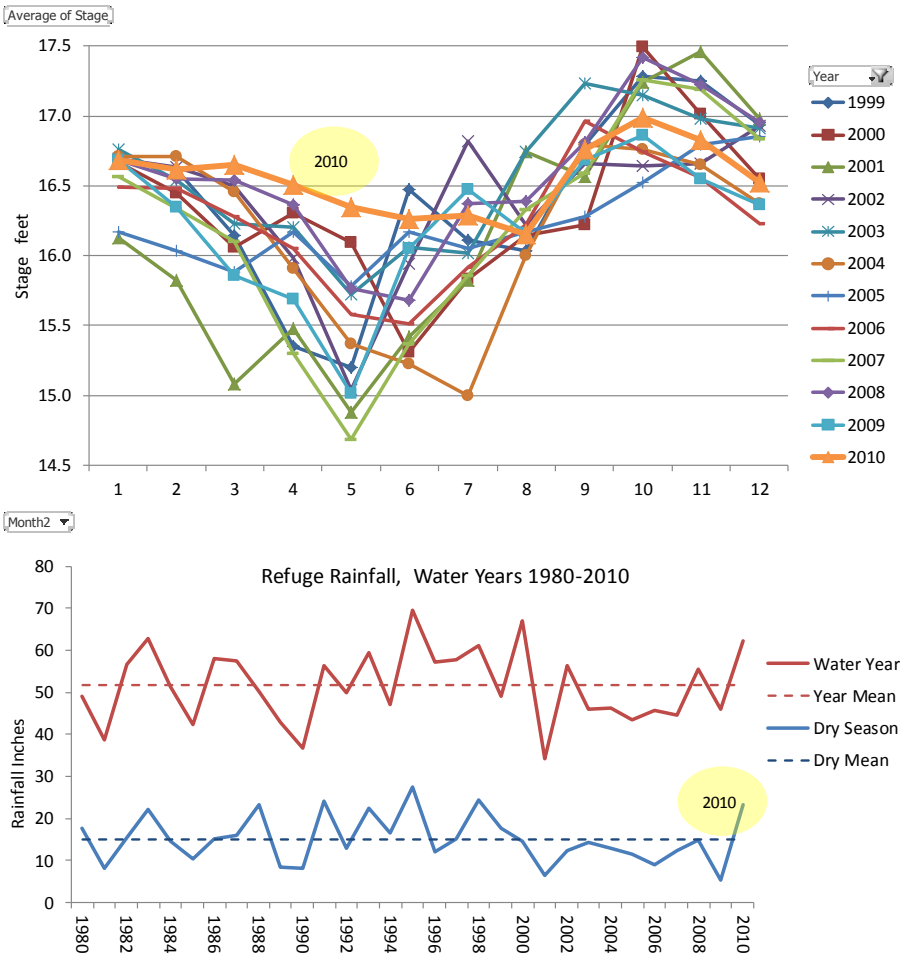
Figure 3A-10. Annual geometric mean TP concentrations [microgram per gram µg/L)] for inflow (upper graph) and interior (lower graph) areas of the Refuge from WY1978–WY2010. The horizontal lines indicate the average annual geometric mean TP concentrations for the WY1979–WY1993, WY1994–WY2004, WY2005–WY2009, and WY2010 periods.

Comparing the top and bottom panels shows that the inflow and marsh GM concentrations are correlated when averaged over 6-10 year periods.

14. Interpretation of the relatively low TP values measured since the June 2009 must consider the unusually high rainfall and water levels in the dry season of 2010 [Figure 3, US Exh. 2305]. I agree with Dr. Redfield in the sense that reducing variability in water

levels may help to reduce intrusion and exceedances [State Exh. 2002, p. 16]. When the water levels are high at the end of the dry season, less inflow from the rim canal and/or rainfall is needed to increase the Refuge stage and follow the regulation schedule later in the summer and fall. Depending on the amount of wet-season rainfall, higher water levels in the spring could lead to less intrusion in the summer and a subsequent decrease in the marsh TP concentrations. Such a decrease would represent a "variation" triggered by unusual hydrologic conditions, not a "trend" reflecting a long-term decrease in loads and assurance that the Appendix B levels will be met in the future. Furthermore, if Dr. Redfield's remedy to provide "stage stability" [pg. 16] were to involve operating the rim canal stage in such a way as to provide water levels similar to those observed in 2010, he would have to demonstrate conclusively that operation would not have adverse impacts on the Refuge vegetation community, which requires occasional dry-out to sustain its diversity.

Figure 3 Historical Variations in Refuge Stage and Rainfall



DBHYDRO Data. Average Stage ([1-7, 1-9, 1-8C]. Average Rainfall [S5A, S6, S39, WCA1ME, LOXWS]. Stage was abnormally high in the dry season of 2010 (top) due in part to the abnormally high rainfall relative to that experienced in the last 10 years (bottom). As a consequence, less intrusion into the marsh from the rim canal would have been needed to bring the water levels up during the summer of 2010 according to the regulation schedule. These data suggest that the lower marsh TP concentrations observed after the June 2009 may have been abnormally low because of the unusual hydrologic conditions.

15. The apparent trends at most of the exterior sites described by Dr. Redfield [State Exh. 2002, Figure 3] were based upon only 4-6 years of data and would have been influenced by the unusually high stage in 2010. Especially given the short period of

record, there is no evidence that the apparent trends at those sites during that short period of record were anything but random variations, although it is likely that concentrations have decreased over the long-term because of the reductions in load.

Causal Connection between External Loads and Interior Marsh

16. Correlations between interior marsh GMs and external loads or inflow concentrations have been explored by state and federal witnesses using data averaged over various time scales, including monthly [Abtew, State Exh. 2003, Figure 1], yearly [Walker, 2009], 6-10 year intervals [Figure 2, US Exh. 2304]. A simple direct one-to-one correlation between load and marsh concentration is not expected to be strong because of the large numbers of factors involved and sampling variations.

17. Dr. Abtew [SFWMD Exh. 2003, Figure 1] shows a simple correlation between monthly inflow P concentration and interior marsh geometric mean. There is a great deal of scatter, as expected because the short time-scale and large numbers of interacting factors, but the slope of the line is positive and significantly different from zero ($p < 0.01$[2]). That p value is a much more relevant statistic than the R^2 (0.07); we expect that to be low because of the overly simplistic model, short time scale, and the expected high variability in the marsh and inflow data.

18. Dr. Abtew strays from the established scientific approach to data analysis. Normally, we would start with a formal hypothesis based upon other evidence or an initial premise. The initial premise of the Consent Decree is that there is a causal

[2] While the P value was not reported by Dr. Abtew, I calculated it using the data provided by the State.

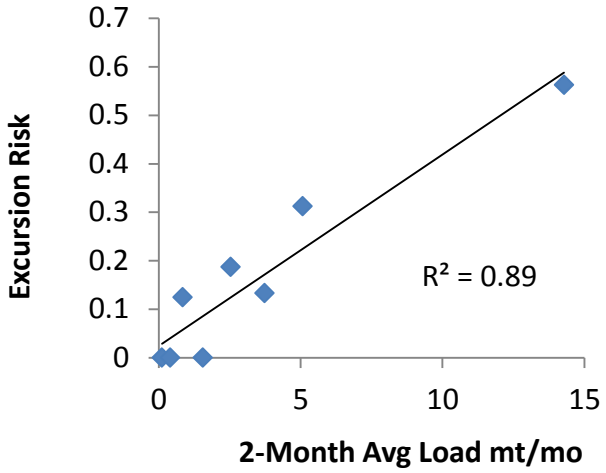
connection between external inflow P concentrations and the interior marsh TP concentrations. We state the null hypothesis that the pattern in the data is random; i.e. the slope of the line is not greater than zero), even though that appears to be the case in the scatter plot generated by Dr. Abtew (Figure 1). We would then apply the best statistical model applicable to the data (i.e., the most powerful, or the one with the lowest Type II error) to test the likelihood that the pattern seen in the data is random. The purpose of the model is to account for as much of the variation in the data due to other factors, in order to allow the underlying signal to come through, both visually and in the context of the statistical tests.

19. Even though Dr. Abtew uses a weak statistical model, the results indicate that there is less than a 1% chance that the slope of the line is equal to zero ($p < 0.01$).[3] Therefore, we reject the null hypothesis that the pattern in the data is random. In other the words, we cannot reject the Consent Decree's cornerstone premise that the inflow and interior marsh TP concentrations are correlated and causally connected. While these results alone do not establish causality, there is abundant independent evidence to support that conclusion (conductivity plumes, hydraulic gradients, patterns seen in the time series data, as explained in federal testimonies and exhibits (Harwell October 2010 testimony; Walker 2006 Testimony; Walker 2009 TOC presentation). In my opinion, there is already more than enough information to conclude causation without Dr. Abtew's analysis.

[3] While the P value was not reported by Dr. Abtew, I calculated it using the data provided by the State.

20. In Figure 4 (US Exh. 2312), I apply a more powerful statistical method to test a null hypothesis that monthly excursion frequencies at the interior 14 stations are random events independent of external phosphorus loads. I divided the data from February 1999 through October 2010 into eight groups of approximately equal size (15-16 months) sorted based upon increasing P load and computed the excursion frequency, or percent of the sampling events with excursions within each load interval. Data for months that were not tested for compliance because of low stage were excluded from the analysis.

Figure 4 – Appendix B 14-Station Excursion Frequency vs. Monthly P Load, 1999-2010 Data



21. My analysis is analogous to that used by Dr. Redfield (Appendix Figure 1), except that the predictor variable (x-axis) is external P load instead of Water Year. I used the rolling 2-month average P load as the predictor variable, although my basic conclusions are independent of the averaging period for the load (current month, previous month, 2 months, 3 months). To explain Figure 4, the highest data point represents an average load of 14 mt/month and has an excursion frequency of 56%. The lowest

interval represents an average load of 0.1 mt/month and has an excursion frequency of 0%. The correlation is very strong ($R^2 = 0.89$) and statistically significant ($p < 0.001$).

22. We therefore reject the null hypothesis that excursions are random events (i.e. that the slope of the line in Figure 4 would actually be equal to zero if we were to apply that same procedure to an infinitely large dataset). Compared with the simple scatter plots of the types used by Dr. Abtew, the frequency analysis is a more powerful statistical model for testing the underlying correlation because it filters out random variations in the data. Based upon this and the other corroborating evidence derived from the Refuge data, there are strong signals linking the exterior loads and the excursion risk, as assumed in the Consent Decree. In my opinion, this justifies implementing further load reduction measures to achieve the Appendix B levels, even if we totally ignore the Class III requirements.

23. As compared with Dr. Abtew's scatter plots, the correlation between inflow and marsh geometric means becomes more evident when we apply more powerful statistical models (frequency analysis or longer averaging intervals), because the random variations are averaged out and the underlying signal emerges. Dr. Redfield (State Exh. 2002) refers to the concurrent long-term decreases in external P load and marsh TP concentration as a "weak association". Even though the decreasing trend slopes may be appear to be low, they are not zero (or positive) and are of major significance to the Consent Decree because they demonstrate improvement and support the long-standing underlying premise that marsh TP concentrations are causally connected to the external P loads.

24. The District witnesses go to great ends to understate the obvious conclusion that the long-term decreases in marsh TP concentrations are causally related to the long-term decreases in external P loads:

This finding should not be interpreted to say that over time changing external inputs cannot gradually promote some decrease in marsh TP levels, but it should be interpreted to say that no definable, one-to-one quantitative relationship exists upon which remedies can by designed and justified for improved compliance with Appendix B

Redfield, State Exh. 2002, at p.9.

While emphasizing the importance of internal factors for individual excursions, State parties never asserted that long-term, gradual decreases in marsh TP can could not associated with declining external TP control.

Redfield, State Exh. 2002, at p.9.

Phosphorous concentrations at the 14 station Refuge monitoring network have declined steadily since implementation of the existing phosphorus control program and this declining trend is continuing.

Piccone, State Exh. 2000, at p.2.

25. Despite the downplay by the State witnesses of the causal relationship in the above-quoted statements, it appears to me that there is a consensus among TOC state and federal witnesses that there is a causal connection between the exterior load and interior marsh concentrations when viewed over long time frames. The understatements about causal relationship do not warrant abandoning the cornerstone consensus of the Consent Decree signatories that the additional remedies specified in the Decree at C-4 are necessary whenever there is an exceedance that is a violation of the Decree, such as the 2008-2009 exceedance violation admitted by the State.

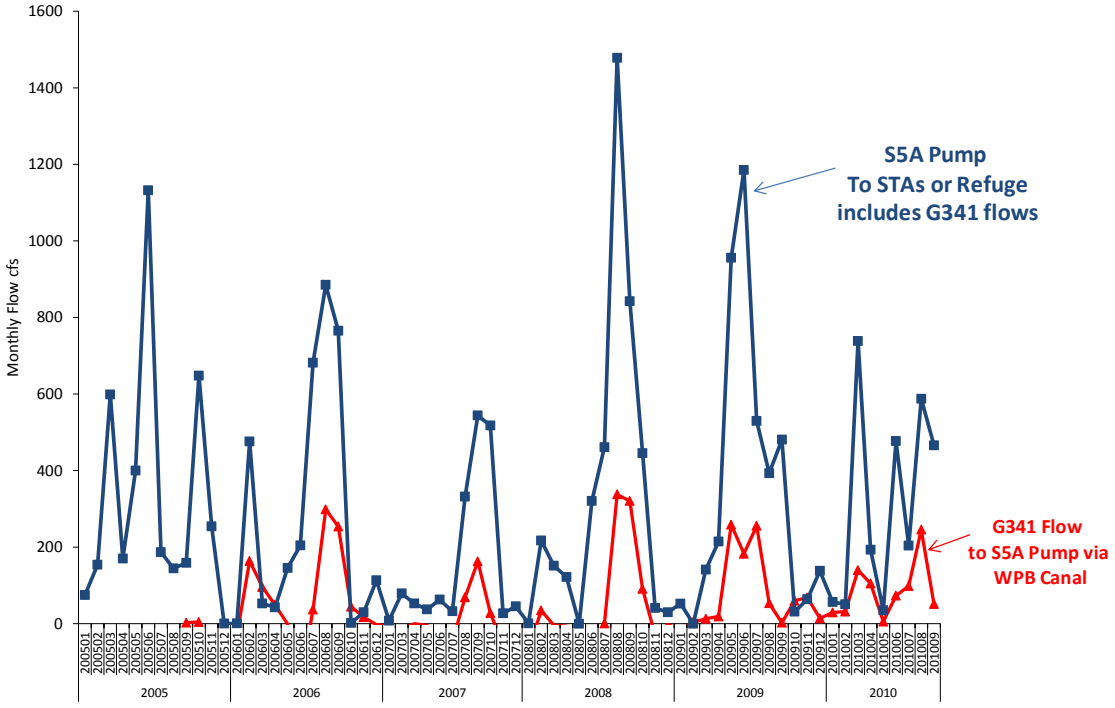
No Remedy for Overloading of the STAs Resulting from Water Management Inconsistent with the STA Design Basis

26. None of SFWMD witnesses mention that a significant portion of the excess phosphorus loads entering STA-1W and STA-1E comes from sources that were supposed to have been diverted to other basins under the 1994 Conceptual Plan. Nor do the SFWMD witnesses propose any remedies for those problems. The L8 diversion has been discussed extensively and remains a significant problem, particularly during high flow periods such as the 2004 hurricanes [Walker 2006 Testimony, 2006 U.S. Exh.74 (Fig. 16); see also 2006 U.S. Exh. 75 at p. 32-33]. Potential remedies for that, such as increasing the capacity of the S155A structure to allow diversion of peak flows away from STA-1E, are not offered by the state witnesses.

27. On top of that, runoff from southwestern portion of the S5A basin adjacent to the Ocean Canal (approximately 20% of the S5A watershed) was supposed to have been diverted to STA-2 under the 1994 Conceptual Plan, but is still a major component of the runoff reaching the S5A pump station during wet period periods [Figure 5, US Exh. 2306]. That diversion was originally designed to include a divide structure (G341) at the eastern end of the Ocean Canal and sufficient increase in the canal's conveyance capacity (pump and/or widening) to transport runoff west to the Hillsboro Canal and STA-2. The divide structure has been in place since 2006, but the Ocean Canal conveyance improvements were apparently not made for some unknown reason. As a consequence, significant flows are still discharged during high runoff periods east through G341 into the West Palm Beach Canal and subsequently into STA-1W and STA-1E via the S5A pump station [Figure 5, below]. The TP concentration in flows through the G341 station

averaged 213 ppb in WY 2005-2009, as compared with 182 ppb in runoff from the rest of the S5A basin [USEPA-AD Att. H at 5, U.S. Exh. 2218]. The G341 flows now account for significant percentage total flow entering the S5A pump station in wet periods, when the STAs are most stressed. The remaining G341 flows further compound problems caused by the L8 runoff during those same periods.

Figure 5 - Monthly Flows from G341 to S5A Pump Station



Flows discharged east through G341 into the West Palm Beach Canal are an important component of the flow reaching the S5A pump station and STAs during high-flow periods. These flows were supposed to have been diverted west to STA-2 under the 1994 Conceptual Plan.

28. The problem with G341 flows was discussed with the State technical representatives during our collaboration in 2010 [U.S. Exh. 2308], yet the State witnesses do not mention the problem or propose a solution. All of the remedy scenarios evaluated jointly with the State in 2010, as well as in the USEPA-AD, assumed that diversion will

be completed with improvements in operation and/or infrastructure. . Under the baseline scenario without STA expansion (EPA-AD Att. H-Scenario 2, US Exh. 2255), the average inflow concentration to the Refuge is forecasted at 34 ppb and would be significantly higher if the G341 and L8 flows are not reduced relative to the 2005-2009 values in order to be consistent with the 1994 Conceptual Plan and the 2x2 flow simulations.

29. Like the overloading of STA-1W with excessive lake releases in 2002-2004 (Walker & Kadlec, 2003; Walker Testimony 2006), the G341 problem is one that I do not believe can be ascribed to the Corps of Engineers. I am unaware of any reason not to proceed immediately developing a remedy for the G341 flows, which may be a simple as changing the G341 structure operational rules, although a pump station and/or increase canal conveyance capacity may also be needed **.**

Repair of STA-1E

30. Ms. Piccone describes important considerations for restoring the treatment capacity of STA-1E; however, continuing to point fingers at the Corps of Engineers is not constructive and, worse, is misleading, given the fact that overloading problems partially reflect the District's inability to manage the basin source flows and loads in manner that is consistent with the 1994 design, as discussed above [Figure]. The need to restore STA-1E is not controversial; it is already in progress and a study is underway that could deal with all that is necessary to rehabilitate that STA so that it achieves design outflow concentrations of 50 ppb. There is sufficient information now to support additional STA expansion. Waiting to measure the marsh response after STA-1E is fully functional

would involve perhaps another decade of inaction and degradation of the Refuge marsh, before deciding on further remedies.

31. Repairs to STA-1E should be integrated with a long-term solution similar to the USEPA-AD alternatives. If such remedies were implemented, the dispute over whether L40 dredging is needed and/or possible would likely become moot and academic, since the peak outflow from STA-1E would decrease substantially (~75%) as the inflows are diverted to the expanded STA-1W and/or C51 Rockpit. It is unlikely that there would be any good reason to construct the L-40 berm or dredge the canal, much less hold up all of the remedies until the Corps implements those projects, as recommended by Dr. Abtew [p. 6].

Options for Utilizing the U.S. Sugar Purchase

32. Mr. Kivett (State Exh. 2001) presents testimony regarding the general scope of the U.S. Sugar purchase and general ideas that have been considered to utilize that land for storage and/or treatment. This is useful information and property, but his testimony does not go far enough to describe specific configurations that would work for the Refuge as a remedy for the overloading of STA-1W or STA-1E. He briefly mentions the C51 Rockpit as a useful feature that could be integrated with the new storage/treatment facilities, yet cites "infancy" and "complicated issues relating to permitting, engineering, operations, funding, and government agency oversight and regulation." These excuses are weak, given that the conceptual design for the facility has already been developed (US Exh. 2251) and the project has already been extensively discussed with the various stakeholders. The SFWMD should have a defined plan for utilizing the 8,900 acre parcel from U.S. Sugar given that the purchase had been under consideration for a few years and

that the District was supposed to have rolled up its sleeves and develop a remedy jointly with the federal parties in 2010.

33. As described in my direct testimony, I am confident that the land acquired from U.S. Sugar could be put to good use as part of a sustainable remedy for the Refuge, either in place or swapped for land adjacent to STA-1W, as well as the C51 Rockpit. I am less enthusiastic, however, when I learn that the property might be used to store/treat additional outflow from Lake Okeechobee and L8 runoff and direct it to the Refuge STAs [Kivett, p 3]. Those sources are minimal under the USEPA-AD-H alternatives. The additional treatment capacity would not be helpful as a remedy for overloading of the Refuge STAs if additional flow is brought into the basin, especially given the relatively high TP concentrations in the lake releases into this basin.

Remedy Design and Uncertainties

34. The SFWMD's engineering witnesses offer the following recommendations with respect to remedies to the Appendix B violations:

Abtew [p 4]:

> *Until interior phosphorus levels stabilize, determining an increase in STA acreage or BMPs is premature and would likely result in too protective a remedy (and accompanied by the added expense).*

Piccone [p 8]:

> *While it is not currently known how much further phosphorus concentrations will decline under the current phosphorus control program, until the phosphorus concentrations at the monitoring network stabilize, it would be premature to implement additional remedies.*

Kivett [p 5]:

> *At this time, no one has quantified the relationship between the level of phosphorus in the discharges from the stormwater treatment areas and resulting changes at the Refuge's 14-station monitoring network. That said, while no one knows if projects built on the S-5A property will prevent violations, it is safe say that they will create additional hydraulic control of the run-off of the local basin and provide significant additional treatment of phosphorus that could enter it.*

35. My perspective is that the SFWMD witnesses are relying on overly optimistic interpretations of the marsh monitoring data and balking at the uncertainties in order to justify standing-pat on the existing remedies and not proposing any specific plan for utilizing the new S-5A basin property, the C51 Rockpit, and other measures to achieve further load reductions. They do not mention the adverse consequences of allowing excess P to accumulate in the exterior marsh as they wait indefinitely for the interior marsh to "stabilize" and for STA-1E to be repaired. They offer no testimony that addresses or even acknowledges the constraints on the remedy imposed by the Consent Decree related to Appendix B measures and water quantity, as described in my introduction.

36. Ms. Piccone concludes with the following opinion regarding design of the STAs to achieve "revised" discharge limits [p 8]:

> *Once the revised discharge limits are known, tools currently exist that can be used to assist with the sizing and design of the STAs within the range of the calibration datasets.*

As explained in my direct testimony, it is unnecessary to wait until discharge limits are known in order to proceed with designing a Class III remedy building on the assumptions developed jointly by the District, the Department of Interior, and USEPA in 2010. That effort also reached a consensus that the Dynamic Model for Stormwater Treatment Areas (DMSTA, Walker and Kadlec, 2005) was the best available tool for designing the STAs.

The SFWMD and other agencies have relied on DMSTA to develop several basin plans over the past decade [Walker & Kadlec, 2010, U.S. Exhibit 2254 at p. 10]. Ms. Piccone's reference to "tools" suggests that there may be alternative STA design models, but none were mentioned in the 2010 meetings. Model limitations and uncertainties were discussed and factored into the assumptions. There was agreement that the remedies would be designed to achieve a LTGM or 10 ppb in the STA discharges using DMSTA and not constrained by the "range of the calibration datasets."

37. The STAs were originally designed to mimic phosphorus removal dynamics in the natural marsh, which has demonstrated its ability to treat the inflows down to background levels of 6 ppb or less (US Exh. 2309, US Exh. 2313]. To support design of the enhanced STAs, DMSTA integrates data collected primarily by the SFWMD and its researchers from more than 70 treatment cells and marsh transects with a wide range of sizes, vegetation communities, soil substrates, water depths, etc. that overall span a range of 6 ppb to more than 1000 ppb. [U.S Exh. 2309]. The amount of data from full-scale cells operating in the low TP concentration ranges is acknowledged to be limited by the fact that the existing STAs have not been designed or operated to achieve those levels (well after December 2006). The district technical representatives have invoked circular reasoning to justify not expanding the STAs sufficiently to meet the criterion in the discharge. They have claimed that the STAs can't be designed to meet low P levels because there are limited model calibration data in that range from the operating STAs. If we accept that faulty logic, the STAs could never be expanded and the Consent Decree requirements could never be achieved.

38. Limitations of the existing DMSTA model were discussed extensively in the 2010 meetings with the State and others. At that time, it was agreed to use the existing model as a

basis for conceptualizing the alternatives. Further work on DMSTA (e.g., extending the period of record) was deferred until that first phase was completed. I have already initiated efforts to extend the period of record, but those results are very preliminary and do not provide a sufficient basis for testing the existing model. Extending the period of record and interpreting results are complicated by the fact that many of the cells have been in partial operation and/or startup mode. It can take as many as three or more years for STA performance to stabilize after construction or optimization as the water column, vegetation, and soils to come to a dynamic equilibrium with the inflowing phosphorus and water that is simulated by DMSTA (US Exh. 2313). On top of that, data required for calibration (ground elevations, flow, water levels) are frequently revised as the monitoring network is improved after startup.

39. Model uncertainty is only one of a number of factors that can influence the project performance, including such factors as variations in operation relative to design assumptions, hydrologic variability, 2x2 model error, variations in source P concentrations, and differences between actual vs. assumed vegetation growing in each cell (SAV vs. Emergent). Consistent with the consensus of the state/federal workgroup, the existing DMSTA calibrations are sufficient for purposes of developing the EPA-AD alternatives. It would risk further significant damage to the resource if we wait indefinitely for the perfect model to conceptualize the remedy that is already more than four years late.

40. In the early 1990s, the parties to the Settlement Agreement and their technical representatives likewise faced considerable uncertainties in designing the initial remedies and in ultimately signing the original Consent Decree. Unlike the SFWMD witnesses, other witnesses who have testified or provided technical support for this and for previous hearings (Mr. Nearhoof, Mr. Scheidt, Dr. Jones, Dr. Kadlec, and myself) were personally involved in

the settlement negotiations and have first-hand appreciation for the uncertainties that existed in 1991 and how they were addressed in developing a technical plan, as well as the compliance tests.

41. Very little would have been accomplished had we been as hesitant as the SFWMD's engineers appear now to be, and had we balked at making assumptions that were necessary in order to design the remedies that were needed because of technical uncertainties. Despite those uncertainties, the design assumptions that we agreed upon turned out to be conservative and the performance of the BMPs and STAs has been better expected when operated in design ranges. As a result, a great deal of progress has been accomplished in terms of measured load reduction from BMPs and STAs. There is no reason not to expect a similar outcome if the remedies are designed and implemented to achieve Class III as well as Appendix B levels, especially if the opportunities are taken to improve technology and performance with further source controls, research, and monitoring as the expanded STAs are constructed and operated according to design.

42. Questions of whether remedies necessary to achieve Appendix B level compliance and Class III level water quality are "too costly" given the level of protectiveness they secure are non-technical decisions to be made by the principals of the Consent Decree, not by scientists or engineers. In my opinion, there is little risk that the USEPA AD Att. H remedies are overly protective. If, on the other hand, the remedy were under-designed, the major consequence would be that the Consent Decree requirements would not be achieved or at least be further delayed allowing further degradation of the marsh. The Appendix B violations would continue unabated, and Class III violations will be perpetuated as discharges to the Refuge and other parts of the Everglades will continue to exceed the 10 ppb criterion.

Conclusion

43. Despite the acknowledged violation of Appendix B, and after more than a year of joint efforts to develop a remedy, the State Parties do not offer a specific remedy to the Court that is consistent with the Consent Decree at C-4 or that will provide any degree of assurance, let alone a high degree of assurance, that the Appendix B levels will be achieved without adversely impacting the hydrology, flora, or fauna of the Refuge, other WCAs, or Everglades National Park. The State did not take advantage of a significant opportunity to build upon the successful collaboration of state, federal, and other stakeholders in 2010 that led to progress concerning on modeling assumptions and screening alternatives. Instead, the State elects to stand pat on its optimistic interpretations of the marsh data and offers no specific remedy for the Appendix B and/or the Class III violations. I am discouraged that the State did not take advantage of USEPA's invitation in September 2010 to use the AD alternatives and assumptions as starting points for developing its own remedy. For the reasons discussed above, the State's January 26 reports provide no justification for deferring load-reduction remedies that will prevent future exceedances of Appendix B levels. Deferring load-reduction remedies will delay the attainment of Class III water quality throughout the Refuge, and only serve to perpetuate the ongoing degradation to the Refuge's marsh as well as the downstream WCAs.

Pursuant to 28 U.S.C. § 1746, I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge, information, and belief.

Executed this 11th day of February 2011

William W. Walker, Jr., Ph.D.

References

Walker, W.W. & R.H. Kadlec, 2005. Dynamic Model for Stormwater Treatment Areas, prepared for U.S. Department of the Interior and U.S. Army Corps of Engineers. http://www.wwwalker.net/dmsta

Walker, W.W. and R.H. Kadlec, 2010. Modeling Phosphorus Dynamics in Everglades Wetlands and Stormwater Treatment Areas. Critical Reviews in Environmental Science and Technology, 41(S1):1–17, 2010. [Oct 2010 hearing exhibit]

Walker, W., TOC Workgroup Presentation, August 18, 2009. [Page 17 from FDEP Knecht Testimony Jan 2011 Exhibit C , Also Attached as US Exh. 2307]