Technical Support Document for the STA-1E TBEL
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1. INTRODUCTION

The Everglades Forever Act (EFA), Section 373.4592, Florida Statutes (F.S.), and the Everglades Lawsuit Settlement Agreement (Case No. 88-1886-CIV-MORENO) require the construction and operation of Stormwater Treatment Areas (STAs) to achieve compliance with State water quality standards. The initial design goal was a long-term flow-weighted mean total phosphorus concentration of 50 parts per billion (ppb) or less at points of discharge from the STAs to the Everglades Protection Area. This was a technology-based effluent limitation (TBEL) in accordance with the EFA. It was assumed that the initial 50 ppb TBEL would be revised, consistent with the iterative adaptive implementation of Best Available Phosphorus Reduction Technology being implemented through the State's Long-Term Plan under the EFA (Burns & McDonnell 2003, SFWMD 2004). Through this process, the TBEL will be revised as appropriate until such time as discharges achieve compliance with the 10 ppb phosphorus criterion within the Everglades Protection Area in accordance with Rule 62-302.540 F.A.C.

A methodology for determining achievement of the initial 50 ppb TBEL was first derived by Walker (1996). This 1996 methodology estimated the year-to-year variability in performance of the STAs above and below the 50 ppb TBEL, based on the variability of phosphorus concentrations at inflows to the Everglades Protection Area at that time. Phosphorus outflow data from STAs 1W, 2, 5 and 6 were used to update and refine the estimated year-to-year variability in performance above and below the initial 50 ppb TBEL (Nearhoof et al. 2005).

This document continues the refinement of the TBEL for STA-1E. Specifically, it provides estimates of anticipated performance of the STA as it will exist at the time of issuance of the permits in 2007. In addition, it provides a methodology for determining achievement of performance estimates. All data and calculations used in the derivation of this methodology are in MS Excel spreadsheets and are available upon request.

2. BACKGROUND

In accordance with the EFA and the Settlement Agreement, the South Florida Water Management District (District) is optimizing the phosphorus removal performance of the STAs. As such, all of the STAs will be affected by structural enhancements, conversion of treatment vegetation or treatment area expansion over the life of the permits, and it is critical that the permits recognize the associated interim period until the full treatment areas achieve optimal performance. In general, one or more flow-ways will be taken off-line to perform these enhancement activities, which will temporarily increase loading to the remaining flow-ways and have an associated reduction in STA performance. As flow-ways are constructed and managed to optimize performance, they will undergo three operational phases, each with different levels of performance:

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1. **Start-up Phase** - No discharge from a new flow-way is authorized until net improvement is demonstrated[4]. Once net improvement is demonstrated, the STA will enter the Stabilization Phase.

2. **Stabilization Phase** - An STA enters the Stabilization Phase after each of three antecedent conditions: (1) once flow-through operations begin following the initial start-up of a new treatment cell; (2) when a treatment cell is taken off-line for implementation of Long-Term Plan enhancements that may have adverse impacts on STA performance, or (3) when a treatment cell is taken off-line for recovery activities associated with a major event that compromises the structural integrity or performance of the STA. During the Stabilization Phase the treatment vegetation will be maturing and the STA performance will generally be improving toward achieving the TBEL. However, the overall performance of the STA is extremely difficult predict due to inherent variability of individual cells/flow-ways coming on and off-line. It is anticipated that the treatment vegetation will require one to three years after flow-through operations begin for the affected cells to achieve optimal performance. During the stabilization phase the Department has determined that the TBEL shall apply.

3. **Routine Operations Phase** - During the Routine Operations Phase, discharges from the STA shall meet the TBEL.

Other General Considerations. Compliance with the TBEL will be tested using data from monitored representative outfalls for each STA's treatment area. If an STA has more than one outfall, then a flow-weighted mean calculated from the monitored representative outfalls[5] will be used. While TBELs for all STAs were derived using consistent methods, each STA has a unique TBEL dependent on site-specific characteristics, e.g., inflow volumes and phosphorus loads, treatment vegetation, effective treatment area, status of performance optimization, etc. The method used for developing the TBELs for the STAs utilized the forecasting capabilities of the Dynamic Model for Stormwater Treatment Areas - Version 2 (DMSTA2) model (Walker and Kadlec 2005). Any method for predicting TBELs contains inherent error, including model error, data measurement error and related error; these errors were taken into account in deriving the TBEL. Annual environmental variability – i.e., hydrologic and phosphorus loading variability as well as treatment variability – was also taken into account in the development of the TBEL.

[4] Specific performance tests are described in the STA permits.

[5] To avoid unnecessary monitoring, effluent is not monitored at each outflow or discharge point. For instance, STA-3/4 has 17 "outfalls" listed in the NPDES permit. These are the structures that take water out of the individual flow paths into the L-5 borrow canal on the North end of WCA-3A. The Department has determined that monitoring at a specific subset of the total number of outfalls will provide representative information. Hence, the use of the term "monitored representative outfall" means monitored outfalls that have been determined to be representative of the total discharge.

3. STA OPERATION AND PERFORMANCE PERIODS

As part of the phased implementation of the Everglades restoration program, numerous regional water management projects are underway that will influence the flows and phosphorus loads entering, and therefore the performance of, the STAs over the next decade. To account for this evolving situation, the inflow data sets for the STAs were updated during the recent EAA Regional Feasibility Study (RFS) to incorporate the daily simulated flows of the re-calibrated South Florida Water Management Model (SFWMM) and the most recent phosphorus data for the tributary basins (ADA/Burns & McDonnell 2005). Inflow data sets were developed for two time periods: Water Years (WY) 2006-2009 and WY2010-2014, and each data set incorporated specific operational assumptions. A May-April water year was used in the EAA RFS and is also used in this analysis. The STA configuration, operation and performance will vary considerably during the life of the permits due to on-going performance enhancements and future water resource projects in and around the EAA and other tributary basins. These are briefly described below; more details can be found in the Long-Term Plan (Burns & McDonnell 2003, SFWMD 2004, as amended).

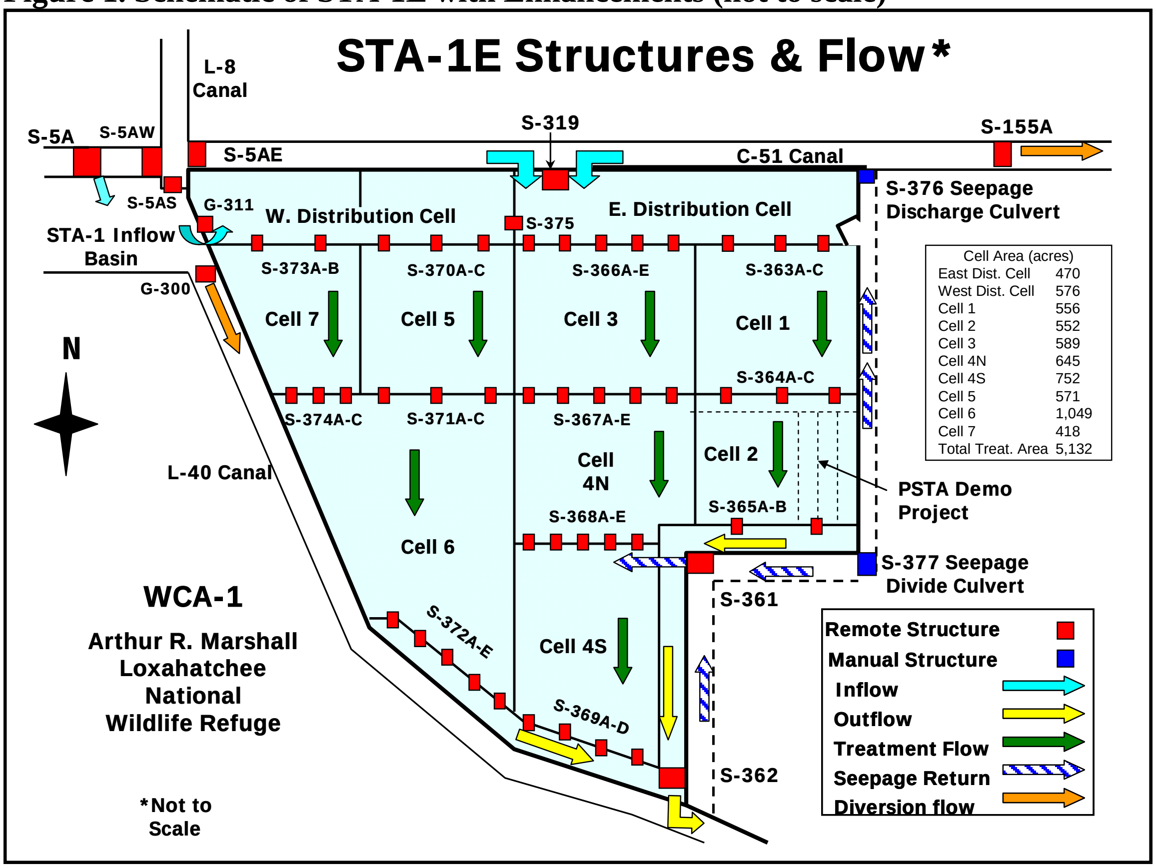
3.1 Enhancements and Start-up Phase. A schematic of STA-1E is presented in **Figure 1**. Enhancement and Start-up will be managed individually in the three flow-ways.

1. The **Eastern Flow-way**, representing about 20% of the treatment area, is currently off-line and remains under the control of the U. S. Corps of Engineers (USACE) for a Periphyton-based STA (PSTA) Demonstration project. The demonstration project is currently beginning startup after approximately 6 months delay due to drought conditions, and is anticipated to be operated over a 24-month period by the USACE. After completion of the demonstration project in approximately June 2009, test cell levees and structures shall be removed to return the Eastern flow-way to full flow capability by the USACE. The USACE has provided no schedule indicating when the Eastern Flow-way will achieve net improvement following the completion of the PSTA Demonstration project. For the purpose of forecasting a performance schedule, it is assumed that flow-through in the Eastern flow-way will occur by June 30, 2010; however, the actual time frame is subject to vegetation establishment**.** The Stabilization Phase is assumed to last approximately 36 months until June 30, 2013. It is recognized that additional time will be needed in order for STA-1E to achieve full flow-through operations.

2. **Central and Western flow-ways.** Following limited emergency operations associated with the 2004 hurricanes, the Central and Western flow-ways of STA-1E began flow-through operations in September 2005. Vegetation enhancements designed to improve the phosphorus removal performance are underway in the Central and Western flow-ways. Although the downstream cells (4N, 4S and 6) of these flow-ways were originally designed for emergent vegetation, vegetation management activities have been enacted to develop submerged aquatic vegetation (SAV). Presently (July 2007), the SAV in the Central flow-way is filling in nicely, while the SAV in Cell 6 of the Western flow-way has been slower to grow in. Full conversion to SAV is anticipated to take two to three years and should be complete by September 2008, subject to factors

outside the control of the permittee. In addition to the vegetation enhancement in these flow-ways, Corps of Engineers survey data indicate that the Cell 7 average ground elevation is lower than the design specifications (Survey No 02-200 (Sea Systems)). To the extent that remediation is necessary to achieve optimal performance, the time frame for enhancement and start-up may need to be extended. In addition, until the Eastern Flow-way has been converted to full flow-through operations (see above), the Central and Western Flow-ways may receive flows and phosphorus loads in excess of their design, and as a result may remain in the Stabilization Phase beyond September 2008.

Figure 1. Schematic of STA-1E with Enhancements (not to scale)



3.2 Stabilization Phase. Once net improvement is demonstrated and flow-through begins, the enhanced flow-way enters the Stabilization Phase. The Central and Western flow-ways entered the Stabilization Phase in September 2005. During the Non-Routine Stabilization Phase, performance is improving toward achieving the STA's TBEL, however, the overall performance of the STA is extremely difficult to evaluate and predict. In light of highly variable inflow magnitude, duration, and frequency of discharges into the STAs in combination with the inability to predict overall performance of the STAs during the stabilization phase, calculation of a numeric limitation for this phase is infeasible. The Non-Routine Stabilization Phase ends when the STA is achieving the TBEL or after three years of full flow-through operation, whichever occurs first. The treatment cells being converted to SAV may require 2-3 years after conversion for the STA performance to achieve the TBEL. The Eastern Flow-way will enter the Stabilization Phase after demonstration of net improvement following deconstruction of the PSTA Demonstration Project by the USACE.

3.3 Routine Operations - Interim Performance Period. As part of the phased implementation of the Everglades restoration program, numerous regional water management projects are underway that will influence the flows and phosphorus loads entering STA-1E, and therefore its performance, over the life of the 5-year permits and beyond. During this **Routine Operations - Interim Performance Period**, flows to STA-1E may be higher than anticipated in the EAA Regional Feasibility Study for the WY2006-2009 period, resulting in less than optimal STA performance. The Interim Performance Period will begin when the three flow-ways have completed their stabilization phases. The Interim Performance Period will end when the regional projects described below are completed.

STA-1E performance will be most significantly affected by the implementation of the following projects:

1. **CERP L-8 Basin Diversion Project.** As part of the Comprehensive Everglades Restoration Plan (CERP), the Corps of Engineers and the District are underway with the land acquisition and planning of capital works that will eventually divert upwards of 75,000-100,000 AF/yr away from the STA-1E/STA-1W inflow works. The L-8 Diversion Project features are scheduled to be completed in accordance with the Master Implementation Schedule, subject to factors outside the control of the District. For example, the construction of this project has not yet received Congressional authorization or funding appropriation and without this necessary Congressional action, the Corps of Engineers will not be able to construct these facilities. Until the L-8 Diversion Project is completed, a portion of L-8 Basin runoff will continue to be captured and treated by STA-1W and STA-1E, contributing to flows and phosphorus loads greater than their design values.

2. **EAA Regional Treatment.** To the extent that STA-1E inflow volumes and loads include runoff from the S-5A Basin, STA-1E operations and performance will be influenced by the completion of the Compartment B treatment area and associated EAA canal conveyance improvements. The project is expected to be flow-capable in accordance with the schedules in the Long-Term Plan. Due to vegetation grow-in and other factors, flow-through operations for the additional treatment area will likely not occur within the 5-year term of this permit.

During this **Routine Operations - Interim Performance Period**, flows and TP loads to STA-1E may be higher than anticipated in the EAA Regional Feasibility Study (RFS) for the WY 2006-2009 period, however, the District will attempt to operate the STA at or below the WY 2006-2009 values. An estimate of performance was developed for this interim period by utilizing the same STA configuration parameters as were used in the EAA RFS (ADA/Burns & McDonnell 2005), including the assumption of seepage into Cells 3-4 from the western cells. The DMSTA2 input parameters were modified slightly from the EAA RFS to balance the phosphorus loading rate from the STA-1 Inflow Basin (downstream of the S-5A pump station) between STA-1W and STA-1E. Where the EAA RFS utilized a 70 percent/30 percent distribution between STA-1W and STA-1E, this analysis balanced the phosphorus loading rate for each STA with a 82.8 percent/17.2 percent distribution. In addition, only minimal TP removal was simulated in the East and West Distribution Cells, as these are outside of the STA-1E treatment area and exhibit regular dryout and deep inundation due to a relatively extreme range of ground elevations[6].

3.4 Routine Operations - Long-term Performance Period. The Long-term Performance Period will begin when the regional projects described in section 3.3 above are completed. Assuming the L-8 Diversion Project is completed by the Corps of Engineers by 2014, the Long-term Performance Period could begin by 2014; **actual time frames are subject to vegetation grow-in, storm events and other factors outside the control of the District.** The inflow volumes and TP loads for STA-1E during this period are forecast to be significantly reduced compared to the interim period (ADA/Burns & McDonnell 2005). It is anticipated that inflow volumes will be maintained at a long-term average of approximately 165,000 AF/yr. A TBEL for STA-1E for the **Routine Operations - Long-term Performance Period** will be derived after completion of the final design of the L-8 Diversion Project.

3.5 Diversion. Under limited conditions, e.g., during extreme storm events and periods of water supply deliveries, to avoid damage to treatment vegetation and to avoid overloading the STA, untreated water could be diverted directly from basins upstream of STA-1E to the Everglades Protection Area through the G-300 and G-301 diversion structures.

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[6] The effective settling rate, K, was set to 0.01 m/yr, as DMSTA2 does not allow K=0 m/yr.

4. DERIVING THE STA TBELs

The method used for developing the TBELs for the STAs utilized the forecasting capabilities of the DMSTA2 model. The following assumptions were made during the TBEL derivation:

- DMSTA2 was used to predict annual and long-term average flow-weighted mean concentrations for the May 1965 – April 2000 (i.e., WY1966 – WY2000) simulation period, with a 365-day averaging period. These projections are subject to the standard assumptions, constraints and limitations of DMSTA2 modeling and STA operations, including the following.
    1. DMSTA2 calibrations are based upon data from fully functional treatment cells with viable vegetation communities that have near optimal performance. The use of the DMSTA2 calibration vegetation types, e.g., SAV, assumes that the vegetation will be maintained in the long-term.
    2. STA performance projections are subject to the complete set of DMSTA2 assumptions, which can be found at http://www.wwwalker.net/DMSTA2/index.htm.
    3. Additional uncertainty exists in flow estimates and regional water management.

- Forecast error is inherent when using any simulation model. These errors result from limitations of the calibration datasets (measurement error, short duration, etc.) and other sources that are difficult to quantify. Based on information from the DMSTA2 website (http://www.wwwalker.net/DMSTA2/index.htm) and Walker (personal communication), the DMSTA2 forecast error for flow-weighted mean concentrations is approximately +/-23% of the expected value.

- The STA configuration, effective treatment area, treatment vegetation types and calibration sets utilized during the RFS were incorporated in this TBEL analysis (ADA/Burns & McDonnell 2005), with the modifications noted in Section 3.3 above.

- Phosphorus loading rates from upstream basins to the STA do not exceed those utilized during the RFS. This will be achieved through ensuring that upstream discharges comply with all applicable Federal, State, and District rules, laws, regulations and permits.

A summary of DMSTA2 results for the interim period is presented in **Table 1** and the time series of projected annual flow-weighted mean outflow concentrations is shown in **Figure 2**. Annual summaries of the inflow volumes and phosphorus loads used in developing the TBEL are presented in Appendix 1. The DMSTA2 model output is provided in Appendix 2.

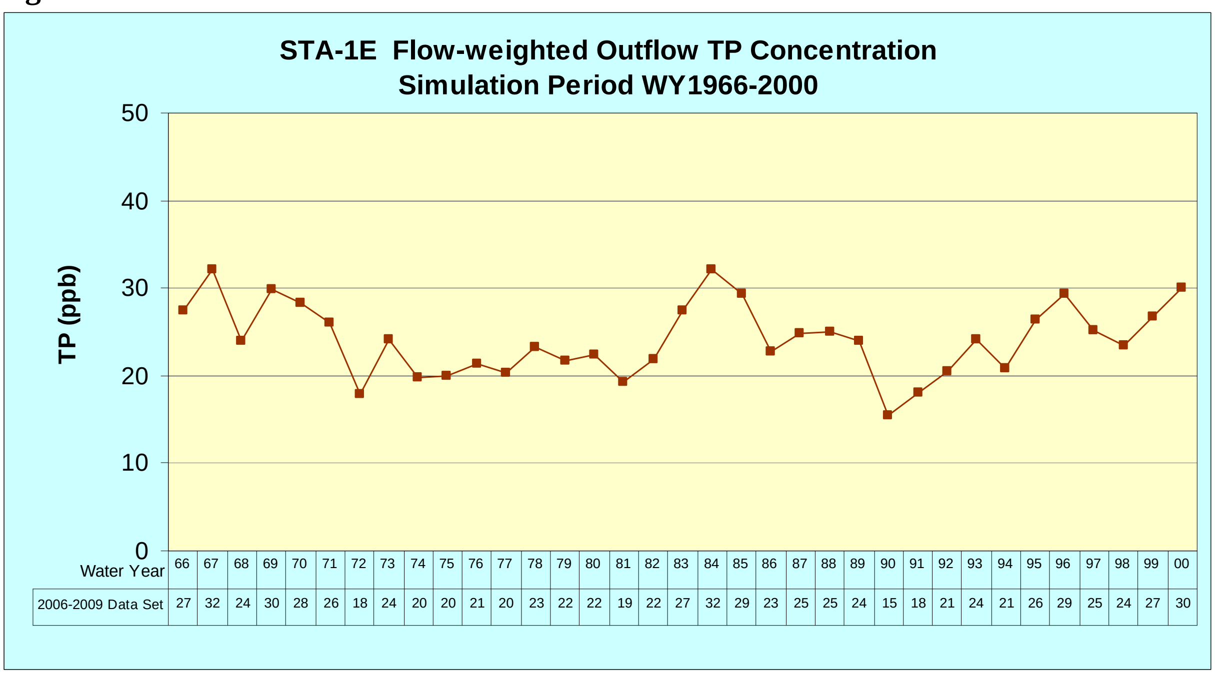
DMSTA2 generates various warning and error messages based on the simulation results compared to the calibration data sets; these are displayed in the DMSTA2 results in Appendix 2. For Cells 2 and 6, the flow/width was 21% and 52% below the range in the calibration data sets. For Cell 3, the flow/width was 18% above the range in the calibration data sets.

Table 1. DMSTA2 Simulation Results – Interim Period

Parameter	Interim
Treatment Area (acres)	5,132
Annual Inflow Volume (AF/yr)	210,670
Annual Inflow TP Load (kg/yr)	34,253
Flow-weighted Mean TP Concentration (ppb)	132
Number of flow-ways	3
Rainfall Period of Record	1966-2000
Minimum Annual Rainfall (inches)	39.8
Average Annual Rainfall (inches)	56.3
Maximum Annual Rainfall (inches)	77.5
Annual Outflow Volume (AF/yr)	209,287
Annual Outflow TP Load (kg/yr)	6,396
Flow-weighted Mean Outflow TP Concentration Using Median Estimate of Settling Rate (ppb)	25

Inflow includes 4% seepage from western cells into Cells 3-4; net average inflow = 204,213 AF/yr.

Figure 2. DMSTA2 Simulation Results – Interim Period



5. CALCULATION OF THE ANNUAL TBEL

1. The annual TBEL was derived by initially developing a linear regression equation of simulated outflow TP concentration as a function of inflow phosphorus loading rate (PLR) to account for hydrologic and phosphorus variability. The PLR was calculated by dividing the annual inflow phosphorus load by the effective treatment area of the STA, and is commonly expressed in grams per square meter per year. Historically, the average annual PLR of the STAs ranged from 0.5 – 4.0 g/m^2/yr. For the STA simulations, the resulting regression equation is

$$TP_{i,\,pred} = a + bX_i \qquad (1)$$

where, $TP_{i,pred}$ is the i^{th} predicted annual TP outflow concentration,
a is the intercept of the regression line,
b is the slope of the regression line, and
X_i is the simulated annual PLR value.

The slope and intercept of the regression equation were derived using the ordinary least squares method. The coefficient of determination (r^2) for the resulting equation was 0.41. While this indicates that factors in addition to the PLR are contributing to the variations in outflow concentrations, the slopes of the regression line were all significantly different from zero at the 95% confidence level, indicating that Equation (1) is a better predictor of outflow TP than using just the long-term mean outflow TP concentration. Other regression equations were investigated, including log-transforming the outflow TP concentrations, and multiple linear and polynomial regressions (e.g., TP inflow concentration and hydraulic loading rate), but the linear PLR regression equation generally had the best fit. For instance, using the log transform of the TP concentration is a common approach because TP concentrations often exhibit a lognormal distribution; however, the back-transformed standard error of the prediction was generally higher for the resulting exponential equation than for the linear PLR regression in Equation (1).

2. The TBEL was derived as the 90% confidence limit above the predictions from Equation (1). The upper 80% prediction interval is equivalent to a confidence level of 90% when used as an exceedance criterion, with an associated maximum Type I error (i.e., false positive) of 10% if the future long-term flow-weighted STA outflow concentration is exactly equal to the forecasted value. While this confidence level results in exceedance criteria that are more protective than generally considered in USEPA guidance methodology, the District, FDEP and USEPA have established this precedence in permits issued for the STAs and other discharges in the Everglades region (USEPA 2002). In deriving the 90% confidence limit on the individual predicted value of the TP concentration, the product of the appropriate t-statistic and an expression of the algorithm's standard error (SE) is added to the predicted value

$$TP_{i,90\%\,\mathrm{CL}} = \mathrm{a} + \mathrm{bX_i} + \left(t_{\alpha,n-2}\right)\mathrm{SE} \tag{2}$$

where TP $_{i,90\%CL}$ is the TP concentration corresponding to the 90% confidence limit,
$t_{\alpha,n-2}$ is the value of the one-tailed t statistic at significance level α, with n-2 degrees of freedom (for 90% confidence level, α = 0.10), and
n is the number of simulated annual TP concentrations.

The standard error for the algorithm in this case is a composite of the standard error of the regression (SE_r) and the standard error of the underlying prediction model (SE_m). The composite standard error is expressed as

$$SE = (SE_r^2 + SE_m^2)^{1/2} \tag{3}$$

The expression for the standard error of the residuals, SE_r, is comprised of the standard deviation of the residuals and the standard error of the predicted mean value, expressed as (Haan 1977)

$$SE_r = s\sqrt{1 + \frac{1}{\mathrm{n}} + \frac{\left(X_i - \overline{X}\right)^2}{\sum\left(X_i - \overline{X}\right)^2}} \tag{4}$$

where s is the unbiased estimate of the standard error of the prediction residuals,

$$s^2 = \frac{\sum_{i=1}^{n}\left(TP_{i,\mathrm{sim}} - TP_{i,\mathrm{pred}}\right)^2}{(n-2)} \tag{5}$$

where TP $_{i,sim}$ is the i^{th} simulated annual TP concentration,
X_i is the annual simulated PLR, and
$\overline{X}$ is the mean of the simulated annual PLR values.

An assumption inherent in the use of Equation (2) is that the residuals of the regression Equation (1) are uniformly distributed over the observed range of PLR, and their resulting variance is constant (i.e., homoscedastic). If the variance is not constant (i.e., heteroscedastic), the regression estimates are unbiased but the covariance matrix is inconsistent (SAS 1999, p. 2891), i.e., the regression equation is still valid, but weakened if left uncorrected. Several methods are available to quantify the presence of homoscedasticity and correct for heteroscedasticity (Long and Ervin 1998). The regression residuals from Equation (1) are presented in **Figure 3**. White's test for homoscedasticity was performed on the STA-1E data and the results indicated that the variability in the residuals distribution is not sufficient to reject the null hypothesis of homoscedasticity at the 95% confidence level (see **Table 2**).

Figure 3. STA-1E Regression Residuals.

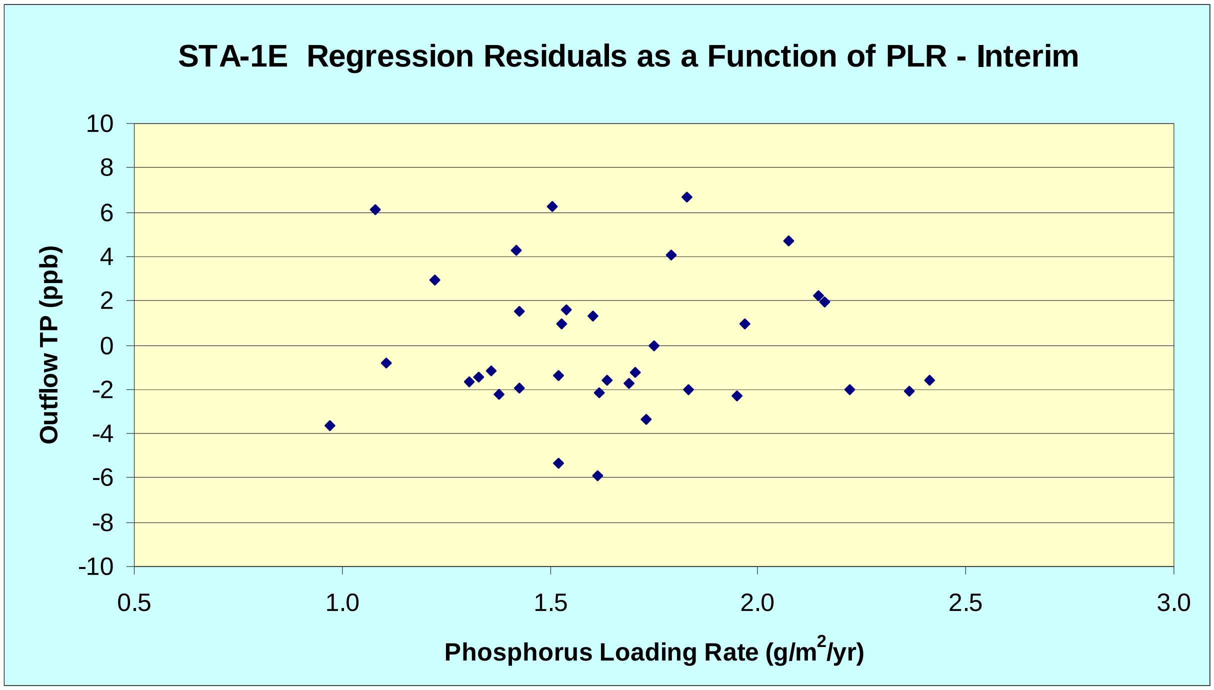


Table 2. Results of Heteroscedasticity Test

Test	Statistic	DF	Pr>Stat	Conclusion
White's Test	0.6333	2	0.7286	Cannot reject hypothesis of homoscedasticity at 95% confidence level

The standard error of the prediction model documented at the DMSTA2 website was ±23%. However, this value was based on single-flow-way and cell calibration data sets, and the prediction error is expected to decrease when applied to STAs containing multiple flow-ways. An estimate of the adjusted prediction error is derived by assuming a constant standard error for each flow-way to obtain (Reckhow and Chapra 1983):

$$SE_m = 0.23\overline{TP} / \sqrt{Paths} \qquad (6)$$

where $\overline{\text{TP}}$ is the simulated long-term flow-weighted mean outflow concentration, and *Paths* is the number of flow-ways within the STA.

Collecting terms yields the following equation for the upper 90% confidence limit around the individual prediction of outflow TP concentration

$$TP_{i,90\%\text{CL}} = \text{a} + \text{bX}_\text{i} + \left(t_{\alpha,n-2}\right)\sqrt{s^2\left[\ 1 + \frac{1}{n} + \frac{\left(X_i - \overline{X}\right)^2}{PLR_{ss}}\ \right] + \left[\ 0.23(\overline{TP}) / \sqrt{Paths}\ \right]^2} \qquad (7)$$

where $PLR_{ss} = \sum\ (X - \overline{X})^2$, which is a constant for each STA.

Table 3 and **Figure 4** present summaries of the regression equation and discharge limit as a function of the phosphorus loading rate. Note in **Figure 4** that some predicted outflow concentrations lie above the computed discharge limit; this is expected in 10% of the years in this derivation or if the future long-term flow-weighted-mean outflow concentration is exactly equal to the forecasted value. This risk is inherent in the adoption of the 90% confidence level as a basis for setting discharge limits in the Everglades by the District, FDEP and USEPA (USEPA 2002).

The estimated TBELs as a function of the annual PLRs are summarized in **Table 4**. **Table 4** or Equation (7) can be used each compliance year to calculate the annual limit as a function of the inflow PLR to the STA that occurred during the compliance year by substituting the observed PLR for X_i. For example, if the phosphorus load to 5,132-acre STA-1E for the compliance year was 34,253 kg, the PLR would be

PLR = (34253 kg/yr / 5132 ac / 4.047 conversion factor) = 1.649 $g/m^2/yr$

Entering 1.649 $g/m^2/yr$ and the other values for STA-1E from **Table 3** into Equation (7) yields

$$\text{Annual limit} = 11.790 + 7.492 * 1.649 + 1.308\sqrt{10.344\left[\ 1 + \frac{1}{35} + \frac{(1.649 - 1.649)^2}{4.283}\ \right] + \left[\ 0.23(25)/\sqrt{3}\ \right]^2}$$

Annual limit = 30 ppb

An advantage of this derivation of the annual limit compared to earlier versions is that the annual limit is adjusted for annual variability of the inflow loads and effective treatment area – during years of low inflow loads, the annual limit will be lower than in years of higher loading.

The spreadsheets that contain the data and algorithms used in the derivation of the TBELs are available upon request. Appendix 3 contains the operational envelope of flows and loads to the STA based on the inflow data used in developing the TBEL.

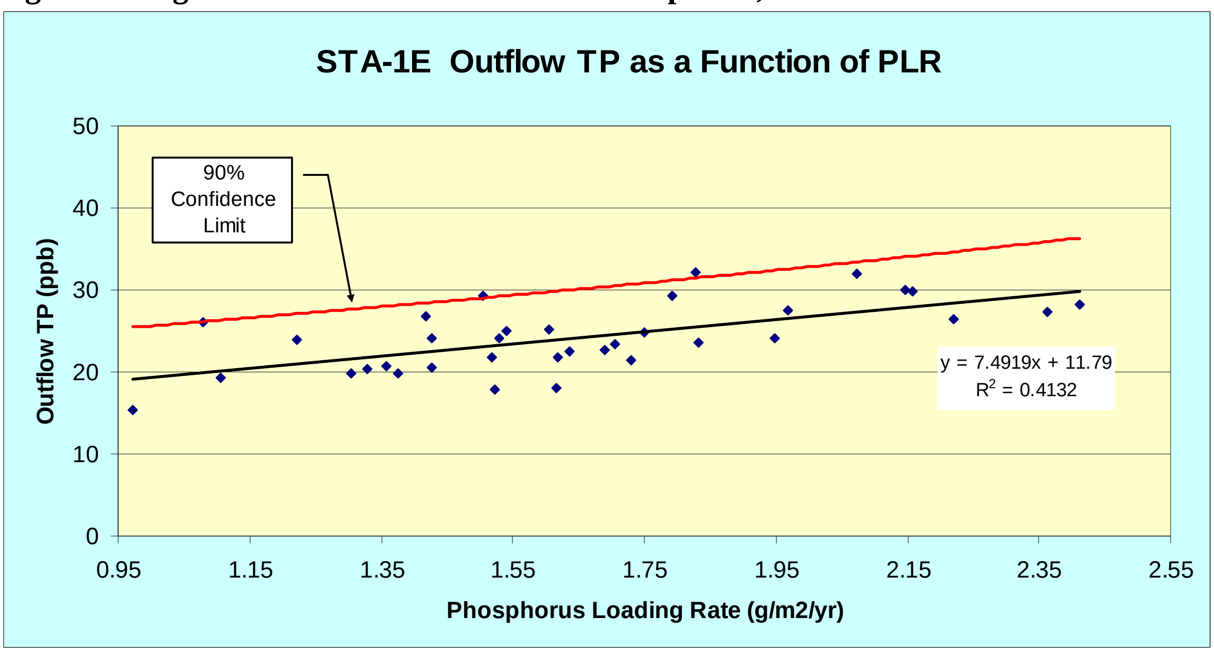
Table 3. Summary of Annual STA-1E TBEL Parameters for the Interim Period.

Parameter	Interim
Long-term Flow-weighted Mean Outflow TP	25
Number of flow-ways	3
Number of years simulated	35
PLR regression intercept	11.790
PLR regression slope	7.492
PLR regression variance, s^2	10.344
PLR r^2	0.413
Mean simulated PLR	1.649
Minimum simulated PLR	0.972
Maximum simulated PLR	2.412
PLR_{ss}	4.283
Value of $t_{0.1,n-2}$	1.308

Table 4. Interim TBELs for STA-1E As A Function of PLR

Phosphorus Loading Rate g/m^2/yr	Annual Phosphorus Limit ppb	Phosphorus Loading Rate g/m^2/yr	Annual Phosphorus Limit ppb	Phosphorus Loading Rate g/m^2/yr	Annual Phosphorus Limit ppb
0.972	25	1.500	29	2.050	33
1.000	25	1.550	29	2.100	34
1.050	26	1.600	30	2.150	34
1.100	26	1.650	30	2.200	34
1.150	27	1.700	31	2.250	35
1.200	27	1.750	31	2.300	35
1.250	27	1.800	31	2.350	36
1.300	28	1.850	32	2.400	36
1.350	28	1.900	32	2.412	36
1.400	28	1.950	32		
1.450	29	2.000	33		

Figure 4. Regression results for STA-1E interim period, with 90% confidence limits.



6. APPLICATION OF THE TBEL

The TBEL derived above[7] will be applied as follows:

1. STA discharge concentrations will be compared to the TBEL each water year (May – April) using data from monitored representative inflow and discharge structures, except as noted below.

    a. The calculation of STA discharge concentrations will exclude flows made for low flow water supply deliveries. Low flow water supply deliveries are deliveries that pass through the Everglades Protection Area to Dade, Broward or Palm Beach County, and the Big Cypress Seminole Indian Reservation for water supply (wellfield recharge and salt water intrusion prevention) purposes, and as such, constitute traditional state water management activities and should not be part of the calculations. In addition, low flow water supply deliveries are made at times when water levels in the Water Conservation Areas (WCAs) are below certain minimum elevations. For the purpose of this method, those minimum elevations shall be when the WCAs and the gauges at which they are applied are as follows:

        • WCA-1 – 14.5 ft. NGVD measured at the 1-8C gauge
        • WCA-2 – 10.5 ft. NGVD measured at the headwater (HW) of the S-11B structure
        • WCA-3A – 7.5 ft. NGVD measured at HW of S-333 or 11.0 ft at HW of G-409

    These stage thresholds will be reviewed as part of any future analyses associated with revisions to the current regulation schedules (WCA-1: May 1995; WCA-2: June 1989; WCA-3A: November 2000).

2. STA discharge concentrations will not be compared to the TBEL in water years when rainfall in the source basins tributary to the STA exceeds the maximum annual basin rainfall that occurred during the period of record used for deriving the TBEL (see Table 1). STA discharge concentrations will also not be compared to the TBEL in water years when rainfall in the basin tributary to that STA is less than the minimum rainfall that occurred during the period of record used for deriving the TBEL for that STA if supplemental flows are not available to maintain wet conditions in that STA. If a year is excluded based upon these criteria, results from adjacent years will be treated as consecutive in assessing STA discharge concentrations.

3. Factors that may be considered by the Department when exercising their enforcement discretion if the STA discharge concentration is higher than the TBEL include, but are not limited to, the following:
    a. The District's operating intent is to avoid untreated diversions if possible; hence, diversion may not occur despite extreme meteorological events or

[7] Compliance with the TBEL is described in the STA's permit.

potential meteorological events. While this intent minimizes phosphorus loads to the Everglades, STA performance could suffer due to short-term overloading. To account for this, an additional calculation will be made if such operation causes or contributes to discharge concentrations that are higher than the TBEL. If the inflow volume or rainfall depth is greater than the corresponding baseline period for the 7-day, or 30-day durations, the District will determine the cumulative effect on the STA performance of this extreme meteorological event.

b. Performance impacts of extreme meteorological events occurring in the previous water years, if relevant, in addition to those extreme meteorological events occurring in the current water year.

c. The inflow to STA-1E consists almost entirely of stormwater runoff, and as such, varies considerably on a daily, monthly, seasonal and annual basis. The STA may be subject to an increase in inflow source loads beyond what was anticipated in development of the TBEL or due to violations of federal, state or District rules, laws, regulations or permits by persons other than the District.

d. Performance enhancement activities resulting from the District's adaptive implementation of STA optimization.

e. In recognition of the 10% Type I error associated with the derivation of the TBEL, the District will evaluate the potential for statistical, data measurement or other error.

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APPENDIX 1. INFLOW VOLUMES AND PHOSPHORUS LOADS TO THE STA USED IN DEVELOPING THE TBELs

STA-1E Inflow Sources - Interim Period

Cells 1-4

Water Year	C-51 W All			L8 to C-51W			Acme Basin B			L-8 To Tide			Total Inflow		
	Flow AF/yr	TP Load kg/yr	TP Conc ppb	Flow AF/yr	TP Load kg/yr	TP Conc ppb	Flow AF/yr	TP Load kg/yr	TP Conc ppb	Flow AF/yr	TP Load kg/yr	TP Conc ppb	Flow AF/yr	TP Load kg/yr	TP Conc ppb
1966	143,258	25,032	142	42,562	4,109	78	38,045	5,889	125	42,562	6,421	122	181,303	28,610	128
1967	142,199	24,790	141	106,887	9,799	74	38,531	5,347	112	106,887	13,757	104	180,730	26,179	117
1968	104,897	17,789	137	754	75	81	29,030	4,186	117	754	142	152	133,927	21,909	133
1969	160,817	29,907	151	168,235	15,115	73	39,498	5,429	111	168,235	21,530	104	200,314	28,922	117
1970	183,542	32,014	141	138,522	14,338	84	42,740	5,941	113	138,522	18,604	109	226,282	33,689	121
1971	78,821	14,488	149	66,582	5,648	69	20,319	2,898	116	66,582	8,326	101	99,140	14,708	120
1972	103,948	18,676	146	18,830	1,810	78	29,288	4,087	113	18,830	3,255	140	133,236	21,318	130
1973	119,101	21,271	145	3,939	318	66	32,506	3,994	100	3,939	771	159	151,607	24,811	133
1974	107,071	17,144	130	0	0	0	32,432	4,416	110	0	0	0	139,503	21,560	125
1975	93,173	15,794	137	51,933	5,662	88	26,847	3,961	120	51,933	7,020	110	120,020	18,397	124
1976	117,530	21,036	145	4,876	510	85	33,117	4,923	121	4,876	830	138	150,647	25,639	138
1977	96,407	16,416	138	0	0	0	25,761	3,230	102	0	0	0	122,168	19,645	130
1978	130,209	20,570	128	0	0	0	34,141	4,457	106	0	0	0	164,350	25,027	123
1979	129,365	22,072	138	185,501	16,806	73	33,113	4,724	116	185,501	22,584	99	162,478	21,018	105
1980	129,655	20,963	131	41,865	4,152	80	36,261	5,210	116	41,865	6,296	122	165,916	24,029	117
1981	84,607	13,986	134	13,087	1,294	80	23,873	3,236	110	13,087	1,738	108	108,480	16,779	125
1982	116,450	19,518	136	0	0	0	32,048	4,229	107	0	0	0	148,498	23,747	130
1983	193,495	33,359	140	178,434	18,780	85	44,329	6,269	115	178,434	23,575	107	237,824	34,833	119
1984	171,519	30,897	146	129,397	11,958	75	39,003	5,698	118	129,397	17,697	111	210,523	30,856	119
1985	120,583	21,990	148	88,664	8,295	76	28,128	4,014	116	88,664	11,996	110	148,710	22,303	122
1986	126,892	21,103	135	8,249	815	80	35,532	4,996	114	8,249	1,384	136	162,424	25,530	127
1987	128,221	21,586	136	8,633	547	51	34,304	4,606	109	8,633	870	82	162,524	25,869	129
1988	117,225	20,914	145	34,981	3,294	76	30,494	4,428	118	34,981	5,747	133	147,719	22,889	126
1989	95,973	15,914	134	46,417	4,838	84	24,937	3,127	102	46,417	5,994	105	120,910	17,884	120
1990	67,213	10,807	130	0	0	0	20,411	2,760	110	0	0	0	87,624	13,567	126
1991	131,295	20,169	125	223	14	49	33,819	4,461	107	223	25	93	165,114	24,617	121
1992	116,175	19,700	137	51,524	5,248	83	27,965	3,809	110	51,524	6,958	109	144,141	21,800	123
1993	162,525	26,237	131	254,040	24,188	77	37,498	5,178	112	254,040	30,279	97	200,024	25,324	103
1994	95,246	15,572	133	71,671	7,359	83	28,963	4,184	117	71,671	9,323	105	124,209	17,792	116
1995	187,012	32,428	141	265,068	24,794	76	40,555	5,878	118	265,068	32,993	101	227,567	30,107	107
1996	154,079	26,550	140	165,111	16,976	83	35,884	5,360	121	165,111	22,403	110	189,963	26,484	113
1997	143,487	24,902	141	70,181	5,690	66	35,220	4,774	110	70,181	9,652	111	178,707	25,714	117
1998	151,589	23,771	127	119,826	13,005	88	40,947	5,216	103	119,826	15,068	102	192,536	26,924	113
1999	111,393	18,855	137	88,691	8,232	75	32,907	4,691	116	88,691	12,045	110	144,300	19,733	111
2000	165,488	30,725	151	78,808	7,923	82	43,425	6,535	122	78,808	11,936	123	208,913	33,247	129
Minimum	67,213	10,807	125	0	0		20,319	2,760	100	0	0		87,624	13,567	103
Average	128,013	21,913	138	71,528	6,903	66	33,196	4,633	113	50,508	6,407	97	161,209	24,042	122
Maximum	193,495	33,359	151	265,068	24,794	88	44,329	6,535	125	254,040	30,279	159	237,824	34,833	138

Cells 5-7

WY	S-5A Basin Flow AF/yr	S-5A Basin TP Load kg/yr	S-5A Basin TP Conc ppb	EBWCD Flow AF/yr	EBWCD TP Load kg/yr	EBWCD TP Conc ppb	Total to Cells 5-7 Flow AF/yr	Total to Cells 5-7 TP Load kg/yr	Total to Cells 5-7 TP Conc ppb	Total to STA-1E Flow AF/yr	Total to STA-1E TP Load kg/yr	Total to STA-1E TP Conc ppb
1966	49,110	9,061	150	3,284	2,051	506	52,394	11,112	172	233,697	39,722	138
1967	47,527	8,812	150	3,141	1,918	495	50,668	10,730	172	231,398	36,910	129
1968	30,112	5,551	149	2,024	1,298	520	32,136	6,849	173	166,063	28,757	140
1969	64,037	12,207	155	4,271	2,524	479	68,308	14,731	175	268,622	43,653	132
1970	64,129	12,544	159	4,250	2,469	471	68,379	15,013	178	294,661	48,702	134
1971	31,514	5,852	151	2,116	1,220	468	33,630	7,073	170	132,770	21,781	133
1972	42,658	8,108	154	2,866	1,869	529	45,524	9,977	178	178,760	31,295	142
1973	23,150	4,513	158	1,556	855	445	24,706	5,368	176	176,314	30,179	139
1974	27,519	5,033	148	1,836	1,094	483	29,355	6,128	169	168,858	27,687	133
1975	35,076	6,487	150	2,349	1,454	502	37,425	7,941	172	157,444	26,337	136
1976	40,893	7,580	150	2,728	1,676	498	43,622	9,256	172	194,269	34,895	146
1977	31,868	6,069	154	2,142	1,057	400	34,010	7,125	170	156,178	26,770	139
1978	40,585	7,881	157	2,702	1,475	443	43,287	9,356	175	207,637	34,383	134
1979	52,665	10,009	154	3,530	1,944	446	56,195	11,953	172	218,673	32,971	122
1980	38,667	7,257	152	2,579	1,512	475	41,246	8,769	172	207,162	32,798	128
1981	24,872	4,510	147	1,662	941	459	26,534	5,451	167	135,015	22,230	133
1982	30,384	5,854	156	2,009	1,176	475	32,392	7,030	176	180,891	30,777	138
1983	56,111	10,645	154	3,749	2,055	444	59,861	12,700	172	297,684	47,533	129
1984	46,500	9,080	158	3,096	1,924	504	49,596	11,004	180	260,119	41,860	130
1985	35,557	6,892	157	2,338	1,312	455	37,895	8,204	176	186,605	30,507	133
1986	36,417	6,750	150	2,436	1,444	481	38,853	8,194	171	201,277	33,724	136
1987	40,275	7,864	158	2,699	1,550	466	42,974	9,414	178	205,498	35,283	139
1988	34,349	6,554	155	2,246	1,593	575	36,595	8,147	180	184,314	31,037	137
1989	31,126	5,794	151	2,082	1,236	481	33,207	7,029	172	154,118	24,914	131
1990	25,865	4,762	149	1,739	1,079	503	27,604	5,842	172	115,227	19,408	137
1991	37,780	7,301	157	2,495	1,391	452	40,276	8,692	175	205,389	33,309	131
1992	27,590	5,131	151	1,854	1,110	485	29,444	6,240	172	173,585	28,041	131
1993	62,407	11,733	152	4,102	2,383	471	66,509	14,116	172	266,533	39,439	120
1994	44,817	8,376	152	2,968	1,794	490	47,785	10,170	173	171,994	27,962	132
1995	65,325	12,826	159	2,211	1,363	500	67,536	14,189	170	295,103	44,296	122
1996	44,732	8,356	151	1,938	1,368	572	46,670	9,724	169	236,634	36,208	124
1997	34,638	6,663	156	611	384	509	35,248	7,047	162	213,955	32,761	124
1998	43,645	8,718	162	1,727	859	403	45,372	9,576	171	237,908	36,501	124
1999	33,495	6,260	152	3,199	2,491	631	36,693	8,751	193	180,994	28,484	128
2000	38,155	7,345	156	5,037	3,367	542	43,192	10,712	201	252,105	43,959	141
Minimum	23,150	4,510	147	611	384	400	24,706	5,368	162	115,227	19,408	120
Average	40,387	7,668	154	2,616	1,578	487	43,004	9,246	174	204,213	33,288	133
Maximum	65,325	12,826	162	5,037	3,367	631	68,379	15,013	201	297,684	48,702	146

APPENDIX 2. DMSTA2 MODEL RESULTS

DMSTA2- Inputs & Outputs | **Project:** STA 1E TBEL | Model Release: 07/05/07 | Current Date: 10/11/2007

Input Variable	Units	Value	Case Description:
Design Case Name	-	_4 2006Mod re	Cells 1-4S of STA-1E with East Distribution Cell
Input Series Name		TS_1_42006Al	Only difference from EAA RFS is EDC K=0.01 instead of EMG_3
Starting Date for Simulation	-	05/01/65	Cell-to-cell seepage not considered in analysis; inflows increased by 4% (approx. 6,400 ac-ft/yr) for seepage recycle from west flow path
Ending Date for Simulation	-	04/30/00	East Distribution Cell modeled as two cells in parallel; K=0.01 m/yr
Starting Date for Output	-	05/01/65	Used in STA-1E Interim TBEL
Integration Steps Per Day	-	4	Simulation Type: Base
Number of Iterations	-	0	
Output Averaging Interval	days	365	
Inflow Conc Scale Factor	-	1	
Rainfall P Conc	ppb	10	
Atmospheric P Load (Dry)	mg/m2-yr	20	

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	26.5	#N/A	#N/A
GM Outflow C (ppb)	25.4	#N/A	#N/A
Load Reduction %	78%	#N/A	#N/A
Bypass Load (%)	0.0%		

Diagnostics		
H20 Balance Error Mean & Max	0.0%	0.0%
Mass Balance Error Mean & Max	0.0%	0.0%
Iterations & Convergence	3	0.0%
Warning/Error Messages	2	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	EDCE	1	2	EDCW	3	4N	4S					
Vegetation Type	-->	none	EMG_3	SAV_3	none	EMG_3	SAV_3	SAV_3					
Inflow Fraction	-	0.333			0.707								
Downstream Cell Number	-	2	3		5	6	7						
Surface Area	km2	0.95	2.25	2.23	0.95	2.38	2.61	3.04					
Mean Width of Flow Path	km	0.66	1.55	1.55	0.66	1.55	1.55	1.55					
Number of Tanks in Series	-	0.5	3.0	3.0	0.5	3.0	3.0	3.0					
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	40	40	60	90	40	60	60					
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-	4	4	4	4	4	4	4					
Outflow Coefficient - Intercept	-	1	1	1	1	1	1	1					
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm												
Inflow Seepage Control Elev	cm												
Inflow Seepage Conc	ppb												
Outflow Seepage Rate	(cm/d) / cm	0.0095	0.0042	0.0042	0.0095			0.0054					
Outflow Seepage Control Elev	cm	-137	-137	-99	-87			-38					
Max Outflow Seepage Conc	ppb	20	20	20	20			20					
Seepage Recycle to Cell Number	-	1	1	1	4			7					
Seepage Recycle Fraction	-	1	1	1	1			1					
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	30	30	30	30	30	30	30					
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500	500	500					
Initial Water Column Depth	cm	50	50	50	50	50	50	50					
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3	3	3					
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22	22	22					
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300	300	300					
K = Net Settling Rate at Steady State	m/yr	0.0	16.8	52.5	0.0	16.8	52.5	52.5					
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40	40	40					
Z2 = Lower Penalty Depth	cm	100	100	100	100	100	100	100					
Z3 = Upper Penalty Depth	cm	200	200	200	200	200	200	200					

Output Variables	Units	1	2	3	4	5	6	7	8	9	10	11	12	Overall
Execution Time	sec/yr	8.66	9.31	9.97	10.34	11.00	11.66	12.31						12.31
Run Date	-	10/11/07	10/11/07	10/11/07	10/11/07	10/11/07	10/11/07	10/11/07						10/11/07
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65						05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65						05/01/65
Ending Date	-	04/30/00	04/30/00	04/30/00	04/30/00	04/30/00	04/30/00	04/30/00						04/30/00
Output Duration	days	12784	12784	12784	12784	12784	12784	12784						12784
Cell Label		EDCE	1	2	EDCW	3	4N	4S						Total
Downstream Cell Label		1	2	Outflow	3	4N	4S	Outflow						-
Network Simulation Name	-	none	none	none	none	none	none	none						none
Simulation Type	-	Base	Base	Base	Base	Base	Base	Base						Base
Surface Area	km2	0.95	2.25	2.23	0.95	2.38	2.61	3.04						14.41
Mean Rainfall	cm/yr	142.94	142.94	142.94	142.94	142.94	142.94	142.94						142.9
Mean ET	cm/yr	129.66	129.66	129.66	129.66	129.66	129.66	129.66						129.7
Cell Inflow Volume	hm3/yr	66.3	78.6	72.2	140.7	140.8	141.1	141.5						207.0
Cell Inflow Load	kg/yr	8011.8	7813.5	5212.1	17009.9	16487.1	13733.0	7431.3						25022
Cell Inflow Conc	ppb	121	99	72	121	117	97	53						120.9
Treated Outflow Volume	hm3/yr	78.6	72.2	67.0	140.8	141.1	141.5	141.9						208.9
Treated Outflow Load	kg/yr	7813.5	5212.1	1815.2	16487.1	13733.0	7431.3	3710.6						5526
Treated FWM Outflow Conc	ppb	99	72	27	117	97	53	26						26.5
Upper Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Lower Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Total Outflow Volume + Bypass	hm3/yr	78.6	72.2	67.0	140.8	141.1	141.5	141.9						208.9
Total Outflow Load + Bypass	kg/yr	7813.5	5212.1	1815.2	16487.1	13733.0	7431.3	3710.6						5525.8
Total FWM Outflow Conc	ppb	99.4	72.2	27.1	117.1	97.3	52.5	26.2						26.5
Bypass Load	kg/yr	0	0	0	0	0	0	0						0.0
Bypass Load	%	0%	0%	0%	0%	0%	0%	0%						0.0
Maximum Inflow	hm3/d	0.27	0.30	0.29	0.57	0.57	0.58	0.58						0.84
Maximum Outflow	hm3/d	0.30	0.29	0.28	0.57	0.58	0.58	0.59						0.87
Surface Load Reduction	kg/yr	579	2601	3397	643	2754	6302	3847						19496
Load Trapped in Sediments	kg/yr	0	2168	3278	0	2835	6390	3758						18431
Overall Load Reduction	%	2%	33%	65%	3%	17%	46%	50%						78%
Lower Confidence Limit	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Upper Confidence Limit	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Daily Geometric Mean	ppb	83.3	68.1	23.1	108.0	92.2	46.9	22.0						#N/A
Outflow Geo Mean - Composites	ppb	99.2	71.4	26.1	117.4	96.6	51.0	25.1						25.4
Upper Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Lower Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	100%	100%	100%						100%
Frequency Outflow Conc > 20 ppb	%	100%	100%	94%	100%	100%	100%	89%						100%
Frequency Outflow Conc > 50 ppb	%	100%	100%	0%	100%	100%	58%	0%						92%
Freq Outflow Volume > 10 ppb	%	100%	100%	100%	100%	100%	100%	100%						100%
95th Percentile Outflow Conc	ppb	108.68	79.15	33.60	128.06	105.60	62.23	33.05						33
Mean Biomass P Storage	mg/m2	687	3027	1476	1088	3738	2455	1244						2142
Storage Increase / Net Removal	%	1681%	0%	0%	1949%	0%	0%	0%						0%
Net Storage Turnover Rate	1/yr	0.0	11.1	34.9	0.0	11.2	34.9	34.8						20.9
Unit Area P Load	mg/m2-yr	8425	3473	2337	17886	6927	5262	2445						1736
Unit Area P Removal	mg/m2-yr	0	964	1470	0	1191	2448	1236						1279
Mean Water Load	cm/d	19.1	9.6	8.9	40.5	16.2	14.8	12.7						3.9
Max Water Load	cm/d	28.3	13.5	12.9	60.0	24.0	22.0	19.0						5.8
Mean Depth	cm	72	57	63	95	66	70	70						68
Minimum Depth	cm	64.2	49.8	59.4	92.5	56.5	64.0	64.1						62
Maximum Depth	cm	80.2	64.7	66.2	99.1	76.1	77.3	78.4						75
Frequency Depth < 10 cm	%	0%	0%	0%	0%	0%	0%	0%						0.0%
Flow/Width	m2/day	275	139	128	584	249	249	250						237.0
HRT Days	days	3.8	5.9	7.1	2.4	4.1	4.7	5.5						17.3
Mean Velocity	cm/sec	0.44	0.28	0.23	0.71	0.44	0.41	0.41						0.39
Seepage Outflow / Total Outflow	%	0%	0%	0%	0%	0%	0%	0%						0%
Release 1 Outflow Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.0
Release 2 Outflow Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.0
95th Percentile Outflow Volume	hm3/d	0.3	0.3	0.3	0.5	0.5	0.6	0.6						0.8
95th Percentile Outflow Load	kg/d	29.2	20.5	8.2	62.1	52.5	31.8	16.9						25.1
Simulated / Specified Mean Depth	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Release 1 Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Release 2 Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Outflow Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A						#N/A
Range Check - Mean Depth	-													0
Range Check - Freq Depth < 10 cm	-													0
Range Check - Flow/Width	-			0.79		1.18								2
Range Check - Inflow Conc	-													0
Range Check - Outflow Conc	-													0
Water Balance Error	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%						0.01%
Mass Balance Error	%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%						0.01%
Warning or Error Messages		Cell# 3 Flow/Width out of calib. range for SAV_3: 128 vs. 162 - 374 m2/day Cell# 5 Flow/Width out of calib. range for EMG_3: 249 vs. 26 - 210 m2/day												2

DMSTA2- Inputs & Outputs — **Project: STA 1E TBEL**

Model Release: 07/05/07
Current Date: 10/11/2007

Input Variable	Units	Value	Case Description:
Design Case Name	-	7 2006Mod2 r	Cells 5-7 of STA-1E with West Distribution Cell
Input Series Name		TS_ST1IDAll	Inflows limited to discharges from G-311, set at 23.9% of total inflows to STA-1 I&D Works (S-5A Basin and EBWCD Runoff)
Starting Date for Simulation	-	05/01/65	Cell-to-cell seepage not considered in analysis
Ending Date for Simulation	-	04/30/00	West Distribution Cell modeled as two cells in parallel; K=0.01 m/yr
Starting Date for Output	-	05/01/65	Used in STA-1E TBEL; only difference from EAA RFS is 23.9% split instead of 30% and WDC K=0.01 m/yr instead of EMG_3
Integration Steps Per Day	-	4	Simulation Type: Base
Number of Iterations	-	0	
Output Averaging Interval	days	365	
Inflow Conc Scale Factor	-	1	
Rainfall P Conc	ppb	10	
Atmospheric P Load (Dry)	mg/m2-yr	20	

Output Variable	Mean	Lower CL	Upper CL
FWM Outflow C (ppb)	17.7	#N/A	#N/A
GM Outflow C (ppb)	16.6	#N/A	#N/A
Load Reduction %	91%	#N/A	#N/A
Bypass Load (%)	0.0%		

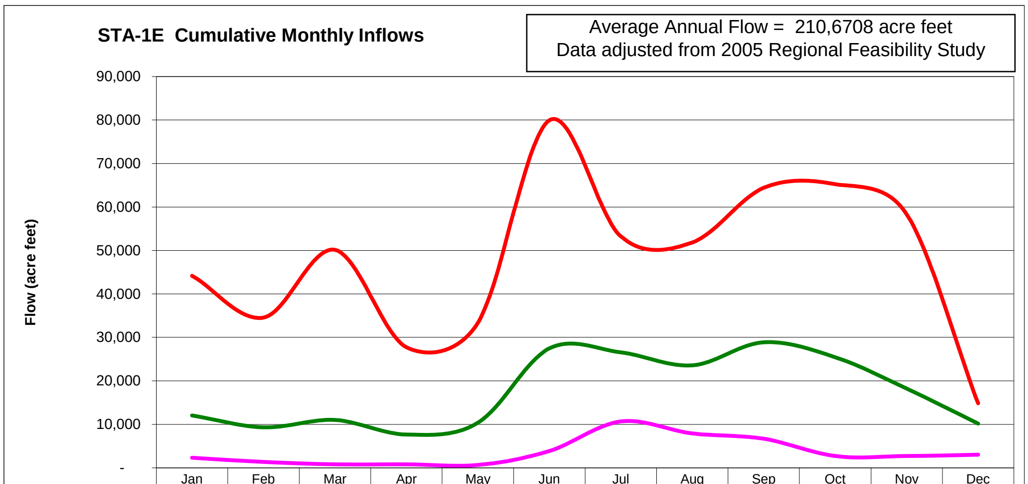
Diagnostics		
H20 Balance Error Mean & Max	0.0%	0.0%
Mass Balance Error Mean & Max	0.0%	0.0%
Iterations & Convergence	3	0.0%
Warning/Error Messages	2	

Cell Number -->		1	2	3	4	5	6	7	8	9	10	11	12
Cell Label	-	WDCW	7	WDCE	5	6							
Vegetation Type	-->	none	EMG_3	none	EMG_3	SAV_3							
Inflow Fraction	-	0.072701474		0.099298526									
Downstream Cell Number	-	2	5	4	5								
Surface Area	km2	1.17	1.69	1.17	2.31	4.25							
Mean Width of Flow Path	km	0.75	1.18	0.75	1.61	1.61							
Number of Tanks in Series	-	0.5	3.0	0.5	3.0	3.0							
Minimum Depth for Releases	cm												
Release 1 Series Name													
Release 2 Series Name													
Outflow Series Name													
Depth Series Name													
Outflow Control Depth	cm	100	40	40	40	60							
Outflow Weir Depth	cm												
Outflow Coefficient - Exponent	-	4	4	4	4	4							
Outflow Coefficient - Intercept	-	1	1	1	1	1							
Bypass Depth	cm												
Maximum Inflow	hm3/day												
Maximum Outflow	hm3/day												
Inflow Seepage Rate	(cm/d) / cm		0.0054			0.0057							
Inflow Seepage Control Elev	cm		69			94							
Inflow Seepage Conc	ppb		20			20							
Outflow Seepage Rate	(cm/d) / cm	0.01		0.01									
Outflow Seepage Control Elev	cm	-15		-76									
Max Outflow Seepage Conc	ppb	20		20									
Seepage Recycle to Cell Number	-												
Seepage Recycle Fraction	-												
Seepage Discharge Fraction	-												
Initial Water Column Conc	ppb	30	30	30	30	30							
Initial P Storage Per Unit Area	mg/m2	500	500	500	500	500							
Initial Water Column Depth	cm	200	200	200	200	200							
C0 = Conc at 0 g/m2 P Storage	ppb	3	3	3	3	3							
C1 = Conc at 1 g/m2 P storage	ppb	22	22	22	22	22							
C2 = Conc at Half-Max Uptake	ppb	300	300	300	300	300							
K = Net Settling Rate at Steady State	m/yr	0.0	16.8	0.0	16.8	52.5							
Z1 = Saturated Uptake Depth	cm	40	40	40	40	40							
Z2 = Lower Penalty Depth	cm	100	100	100	100	100							
Z3 = Upper Penalty Depth	cm	200	200	200	200	200							

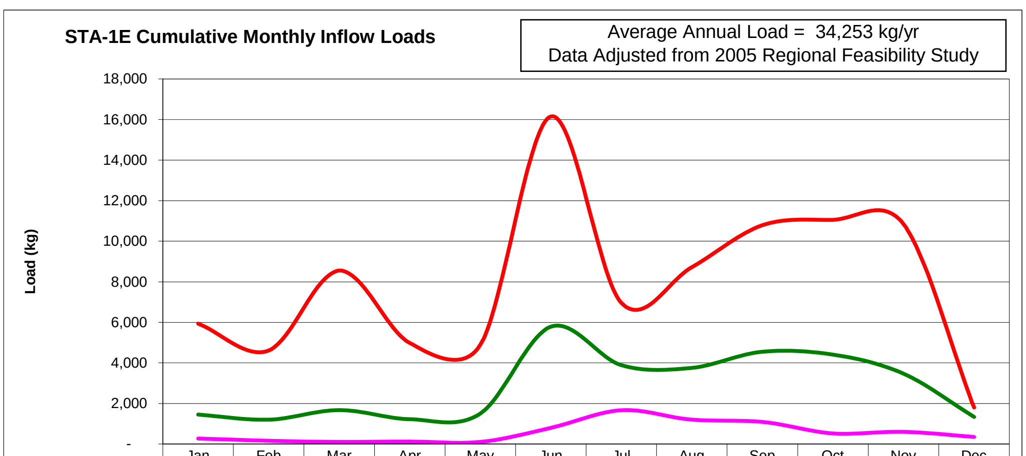
Output Variables	Units	1	2	3	4	5	6	7	8	9	10	11	12	Overall
Execution Time	sec/yr	5.97	6.63	6.97	7.63	8.29								8.29
Run Date	-	10/11/07	10/11/07	10/11/07	10/11/07	10/11/07								10/11/07
Starting Date for Simulation	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65								05/01/65
Starting Date for Output	-	05/01/65	05/01/65	05/01/65	05/01/65	05/01/65								05/01/65
Ending Date	-	04/30/00	04/30/00	04/30/00	04/30/00	04/30/00								04/30/00
Output Duration	days	12784	12784	12784	12784	12784								12784
Cell Label		WDCW	7	WDCE	5	6								Total
Downstream Cell Label		7	6	5	6	Outflow								-
Network Simulation Name	-	none	none	none	none	none								none
Simulation Type	-	Base	Base	Base	Base	Base								Base
Surface Area	km2	1.17	1.69	1.17	2.31	4.25								10.58
Mean Rainfall	cm/yr	142.94	142.94	142.94	142.94	142.94								142.9
Mean ET	cm/yr	129.66	129.66	119.14	129.66	129.66								128.5
Cell Inflow Volume	hm3/yr	22.4	18.4	30.6	26.3	46.1								53.1
Cell Inflow Load	kg/yr	3911.0	3165.8	5341.9	4513.6	3602.4								9253
Cell Inflow Conc	ppb	174	172	174	171	78								174.3
Treated Outflow Volume	hm3/yr	18.4	19.5	26.3	26.7	49.5								49.5
Treated Outflow Load	kg/yr	3165.8	1494.8	4513.6	2107.6	876.9								877
Treated FWM Outflow Conc	ppb	172	77	171	79	18								17.7
Upper Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Lower Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Total Outflow Volume + Bypass	hm3/yr	18.4	19.5	26.3	26.7	49.5								49.5
Total Outflow Load + Bypass	kg/yr	3165.8	1494.8	4513.6	2107.6	876.9								876.9
Total FWM Outflow Conc	ppb	171.7	76.7	171.3	79.1	17.7								17.7
Bypass Load	kg/yr	0	0	0	0	0								0.0
Bypass Load	%	0%	0%	0%	0%	0%								0.0
Maximum Inflow	hm3/d	0.10	0.09	0.13	0.12	0.22								0.23
Maximum Outflow	hm3/d	0.09	0.09	0.12	0.13	0.24								0.24
Surface Load Reduction	kg/yr	745	1671	828	2406	2725								8376
Load Trapped in Sediments	kg/yr	0	1745	0	2485	2927								7157
Overall Load Reduction	%	19%	53%	16%	53%	76%								91%
Lower Confidence Limit	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Upper Confidence Limit	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Daily Geometric Mean	ppb	191.4	61.6	188.0	73.6	7.9								#N/A
Outflow Geo Mean - Composites	ppb	171.6	74.3	172.2	76.9	16.6								16.6
Upper Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Lower Confidence Limit	ppb	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Frequency Outflow Conc > 10 ppb	%	100%	100%	100%	100%	97%								97%
Frequency Outflow Conc > 20 ppb	%	100%	100%	100%	100%	28%								64%
Frequency Outflow Conc > 50 ppb	%	100%	100%	100%	100%	0%								28%
Freq Outflow Volume > 10 ppb	%	100%	100%	100%	100%	79%								79%
95th Percentile Outflow Conc	ppb	182.07	89.73	191.81	93.53	23.41								23
Mean Biomass P Storage	mg/m2	915	3239	730	3376	690								1714
Storage Increase / Net Removal	%	3107%	0%	2184%	0%	0%								0%
Net Storage Turnover Rate	1/yr	0.0	11.1	0.0	11.1	35.0								13.8
Unit Area P Load	mg/m2-yr	3357	1871	4585	1953	849								875
Unit Area P Removal	mg/m2-yr	0	1031	0	1075	689								677
Mean Water Load	cm/d	5.3	3.0	7.2	3.1	3.0								1.4
Max Water Load	cm/d	8.4	5.2	11.5	5.3	5.2								2.2
Mean Depth	cm	83	44	39	42	62								55
Minimum Depth	cm	60.6	41.0	25.3	32.8	60.1								47
Maximum Depth	cm	95.0	49.4	52.6	49.2	65.0								61
Frequency Depth < 10 cm	%	0%	0%	0%	0%	0%								0.0%
Flow/Width	m2/day	82	43	112	45	78								69.5
HRT Days	days	15.7	14.8	5.4	13.4	20.8								39.7
Mean Velocity	cm/sec	0.11	0.11	0.33	0.12	0.15								0.15
Seepage Outflow / Total Outflow	%	18%	0%	15%	0%	0%								15%
Release 1 Outflow Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00								0.0
Release 2 Outflow Volume	hm3/yr	0.00	0.00	0.00	0.00	0.00								0.0
95th Percentile Outflow Volume	hm3/d	0.1	0.1	0.1	0.1	0.2								0.2
95th Percentile Outflow Load	kg/d	14.8	7.6	20.6	10.7	4.7								4.7
Simulated / Specified Mean Depth	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Release 1 Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Release 2 Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Outflow Demand Met	%	#N/A	#N/A	#N/A	#N/A	#N/A								#N/A
Range Check - Mean Depth	-					1.00								1
Range Check - Freq Depth < 10 cm	-													0
Range Check - Flow/Width	-					0.48								1
Range Check - Inflow Conc	-													0
Range Check - Outflow Conc	-													0
Water Balance Error	%	0.00%	0.00%	0.00%	0.00%	0.00%								0.00%
Mass Balance Error	%	0.00%	0.03%	0.00%	0.01%	0.02%								0.02%
Warning or Error Messages		Cell# 5 Depth out of calib. range for SAV_3: 62 vs. 62 - 87 cm Cell# 5 Flow/Width out of calib. range for SAV_3: 78 vs. 162 - 374 m2/day												2

APPENDIX 3. OPERATIONAL ENVELOPES FOR STA-1E

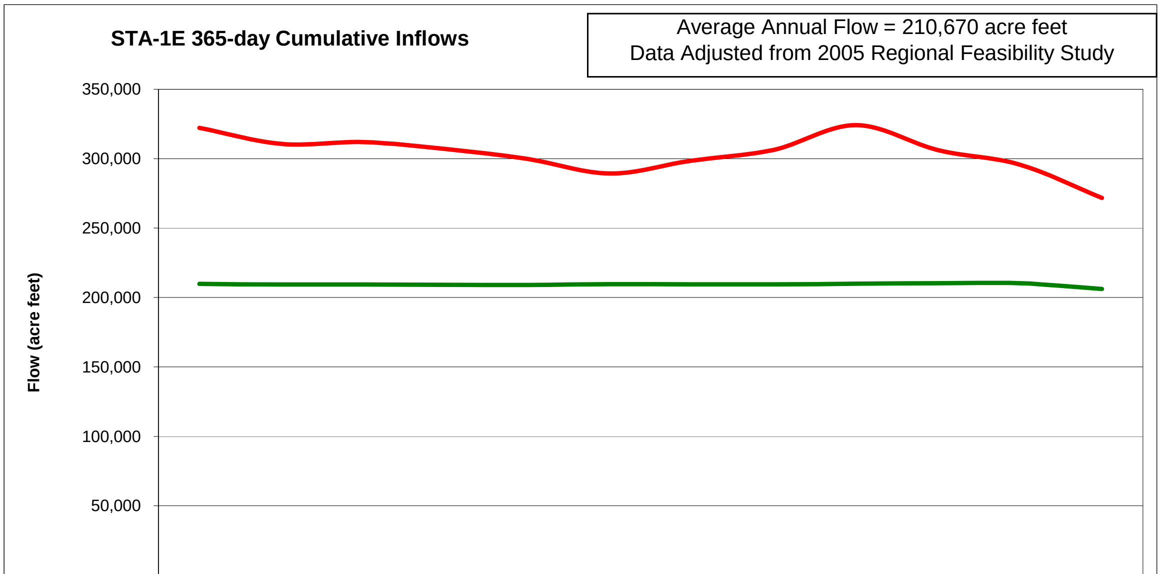
The STA's operational envelope refers to the range of inflow volumes and phosphorus loads into the STA based on rainfall data from the 1966-2000 period of record that was used in the development of the technology-based effluent limitation. The upper chart presents the monthly average and range of STA inflow volumes simulated by the South Florida Water Management Model (SFWMM) using the 1966-2000 period of record rainfall data. The lower chart presents the monthly average and range of STA inflow phosphorus loads developed by assigning appropriate source concentrations to the daily SFWMM output. These values were subsequently used in the DMSTA2 simulation model to forecast STA performance during the development of the TBELs. The following page presents the 365-day average and maximum STA inflow volumes and phosphorus loads.



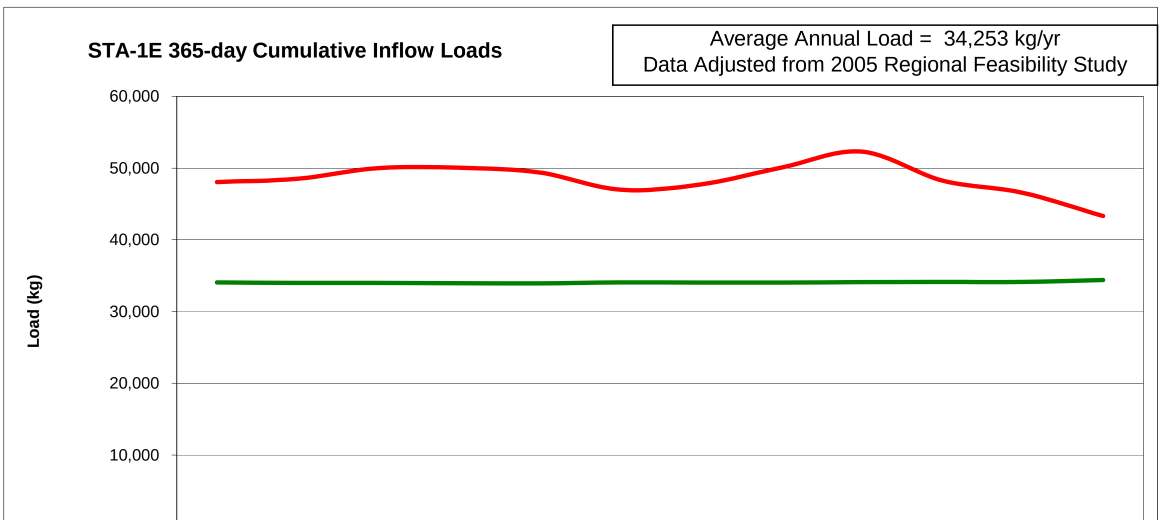
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly min	2,325	1,386	832	823	653	3,866	10,678	7,906	6,678	2,713	2,706	3,029
Monthly ave	12,036	9,345	11,006	7,664	10,384	27,481	26,538	23,562	28,889	25,439	18,211	10,173
Monthly max	44,186	34,545	50,131	27,759	33,351	79,913	53,271	51,849	64,401	65,247	58,326	14,853



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly min	270	157	103	117	104	794	1,662	1,205	1,090	525	602	350
Monthly ave	1,456	1,202	1,669	1,222	1,508	5,782	3,893	3,758	4,555	4,406	3,467	1,339
Monthly max	5,938	4,613	8,558	4,979	4,891	16,157	6,966	8,721	10,791	11,050	10,849	1,800



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day ave	209,876	209,450	209,444	209,153	209,091	209,711	209,500	209,580	209,889	210,299	210,321	206,157
365-day max	322,366	310,738	312,039	306,967	299,798	289,419	298,596	306,313	324,319	306,193	295,808	271,776



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day ave	34,052	33,994	33,993	33,920	33,899	34,065	34,029	34,037	34,073	34,120	34,112	34,396
365-day max	48,049	48,499	49,986	50,043	49,371	46,976	47,717	50,045	52,296	48,266	46,542	43,313