Comments of the South Florida Water Management District

(April 28, 2010)

concerning

Proposed 40 CFR Part 131 – Water Quality Standards for the State of Florida's Lakes and Flowing Waters

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A. Nutrient-Chlorophyll *a* Relationships Do Not Show Direct Cause and Effect

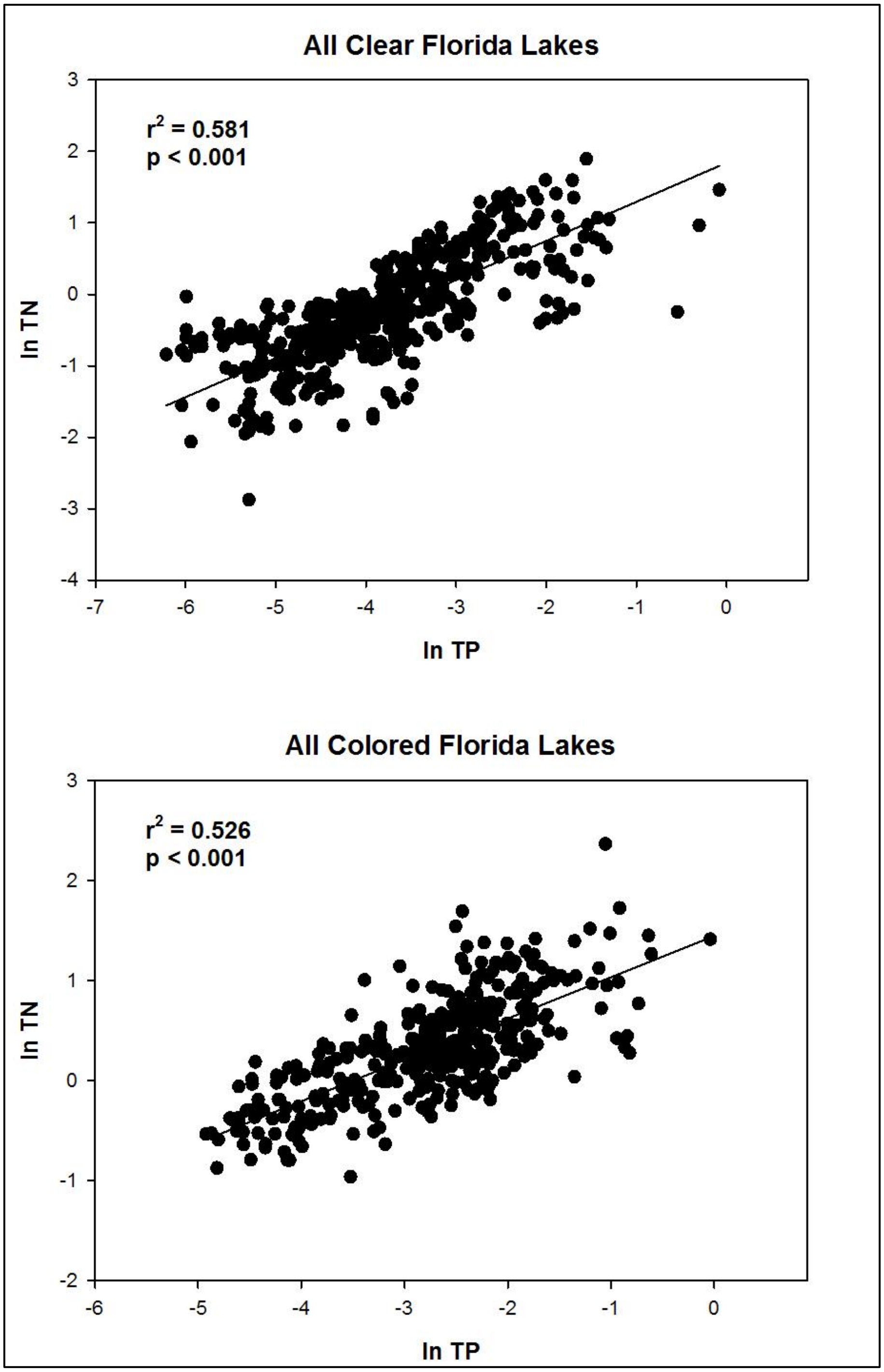
The assumptions underlying the use of regression relationships between individual nutrients and chlorophyll *a* to derive numeric criteria need to be clearly stated. The chlorophyll *a* -nutrient regressions do not reflect simple cause-effect relationships. In reality, the presumed stressor (nutrients) and response (chlorophyll *a*) values are intertwined such that lakes with high phytoplankton biomass will necessarily have high concentrations of both water-column total nitrogen (TN) and total phosphorus (TP) since these nutrients are a component of the algal biomass. Therefore, the mere presence of such relationships does not show that both TN and TP are responsible for increased chlorophyll *a* in lakes throughout the state. Concentrations of TN and TP are themselves correlated in Florida lakes (Figure 1), making it impossible to tease out cause-effect relationships between individual nutrients and chlorophyll *a* based on a simple regression analysis. Additional analyses should be performed to identify the limiting nutrient for reference lakes in different regions of the state and to focus regulatory efforts towards controlling inputs of that nutrient to impaired lakes in the same region. In summary, the proposal to target both TN and TP in all Florida lakes is not supported by the simple fact that these nutrients are associated with chlorophyll *a*.

B. **Limitations to the Use of Statewide Empirical Relationships for Establishing Nutrient Criteria Need to be More Fully Evaluated**

While simple empirical relationships are widely used as screening tools for examining effects of increased nutrients on lake productivity, their power to predict nutrient thresholds for individual lakes or sets of lakes is often quite low (Welch and Jacoby 2004). The United States Environmental Protection Agency (EPA) (2000) provided guidance to the States and Tribes for the development of numeric nutrient criteria for lakes. The limitation to the use of nutrient-chlorophyll *a* relationships for establishing these criteria is noted in this guidance document:

"In summary, although they have some utility, empirical models (and particularly those based on global data) do not usually have the required precision upon which high-cost decisions can be made. As such, empirical models should be relegated to broad screening applications and for identifying atypical lakes. However, they may have sufficient precision if developed and applied for regional populations of lakes and reservoirs."

Figure 1: Total Phosphorus (TP) – Total Nitrogen (TN) relationships for clear and colored lakes from same log (ln) transformed data set used by USEPA in criteria development.



Statewide nutrient-chlorophyll *a* relationships are being used to set numeric criterion for individual lakes across the state. Few analyses are presented to test the key assumption that these statewide relationships are equally applicable to lakes in different regions of the state. A set of graphs (figures 1-1, 1-2, 1-9, 1-10) is presented as evidence that lakes within 5 stream ecoregions (as opposed to the 47 distinct lake regions identified by Griffith et al. 1997) exhibit similar chlorophyll *a* responses to TP and TN. However, visual examination of the linear regression lines in these graphs suggests that lakes in some regions show very different responses, and no statistics are provided to show that regression lines for different regions are coincident or that regression lines for individual regions do not provide greater explanatory value than a single statewide regression relationship. Examples of regional differences based on visual examination of regression lines:

- For clear lakes, the TP value corresponding to a chlorophyll *a* concentration of 20 micrograms per liter (µg/L) ranges from approximately 40 µg/L (Bone Valley) to approximately 200 µg/L (North Central);
- For clear lakes, the TN value corresponding to a chlorophyll *a* concentration of 20 µg/L ranges from approximately 1 milligrams per liter (mg/L) (Bone Valley) to approximately 1.6 mg/L (North Central);
- For moderately colored lakes, the TP value corresponding to a chlorophyll *a* concentration of 20 µg/L ranges from approximately 65 µg/L (Peninsula) to approximately 330 µg/L (Panhandle);
- For moderately colored lakes, the TN value corresponding to a chlorophyll *a* concentration of 20 µg/L ranges from approximately 1 mg/L (Northeast) to approximately 1.6 mg/L (Peninsula);
- All (or nearly all) moderately colored lakes in the Bone Valley have chlorophyll *a* values >20 µg/L regardless of nutrient concentrations.

C. Log-Log Transformations need to be Augmented with Further Scientific Data

The reliance on log-log relationships based on large datasets for identifying nutrient concentrations that cause impairment masks considerable variation in the response of individual lakes and lake regions to nutrient enrichment (Lewis and Wurtsbaugh 2008). And, even after log transformation, the resulting relationships between nutrients and chlorophyll *a* for Florida lakes still include considerable unexplained variation and, in the case of moderately colored lakes, have poor predictive power (see Prairie 1996 for a discussion of the use and misuse of empirical relationships in the aquatic sciences). The USEPA approach apparently presumed that observed inter-lake variation in the empirical relationships is random error; however, it is not apparent that much effort was devoted to attempting to extract information from this variation in order to derive more robust and defensible relationships. USEPA should perform a more rigorous and thoughtful analysis of the data to identify the causes of observed variation rather than simply applying a transformation in order to force a linear regression through the data swarm.

D. The Classification Method for Colored Lakes is Overly Simplistic and Nutrient Criteria for Highly Colored Lakes is Indefensible

Classification of lakes into two color categories (<40 PCU vs. >40 PCU) facilitates analysis but ignores the reality that the effects of color on nutrient-chlorophyll *a* relationships represent a continuum. The more colored a lake's waters, the less closely its productivity (chlorophyll *a* concentration) is tied to ambient nutrient levels. The references used to support the two-tier classification used by USEPA are Shannon and Brezonik (1972) and Gerritsen et al. (2000). Neither of these investigations supports a "natural" separation of lakes into just two color categories.

Shannon and Brezonik (1972) relied on cluster analysis to separate 55 Florida lakes into categories based on measured water chemistry parameters. While they determined that color was an important factor distinguishing different lake types, they also concluded that lakes within their "colored" category were highly heterogeneous. In particular, they concluded that, with respect to nutrients and chlorophyll *a*, "a simple harmonious oligo- to eutrophic gradation may not occur in highly colored lakes." They go on to state that their colored lakes could be subdivided into "anywhere from two to six or more [trophic] groups, none of them satisfactorily interpretable."

Gerritsen et al. (2000) use ordination (principal components analysis) to separate 570 Florida lakes into categories based on 8 water chemistry variables. Again, these investigators identified color as an important lake classification factor. However, their results also show considerable variability within their colored lakes categories and do not support the proposition that these lakes can be considered as a single homogeneous group. The authors state that their results "confirm" the classification of Shannon and Brezonik, which, as already noted, was inconclusive with respect to colored lakes.

The USEPA analyses of colored lakes revealed these classification problems. It was concluded that nutrient-chlorophyll *a* relationships for this category were weak and lacked predictive power and that "color in excess of approximately 150 PCU depresses the nutrient response." On the basis of additional statistical analyses, it was possible to identify two subcategories for colored lakes: (a) moderately colored lakes (40-140 PCU) that could be used to derive improved (but still weak) nutrient-chlorophyll *a* relationships (fig 1-11); (b) a second subset of highly colored lakes (>140 PCU) where chlorophyll *a* concentrations could not be predicted from nutrient levels (fig 1-12). Clearly, other environmental factors strongly influence primary productivity in colored lakes and additional information is required before scientifically or statistically defensible nutrient criteria can be developed for highly colored lakes.

The USEPA established separate nutrient criteria for colored and highly colored lakes as follows: (a) determined that the empirical relationship between nutrients and chlorophyll *a* was poor when applied to all colored lakes (>40 PCU); (b) determined that an improved relationship could be obtained if analysis was limited to lakes with a color range of 40-140 PCU; (c) used this improved relationship to establish numeric nutrient criteria for this subset of colored lakes; (d) then applied these criteria to the highly colored (>140 PCU) lakes that had been removed from the analysis in order to generate the improved relationship. There is no scientific basis for extrapolating the results of the analysis on one subset of lakes to a second subset of lakes that had been intentionally removed from the analysis in order to generate a satisfactory statistical relationship.

There are scientific explanations for why chlorophyll *a* concentrations are poorly correlated with nutrient levels in highly colored lakes. For example, as discussed in USEPA's Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs (USEPA 2000):

"Highly colored lakes have been termed dystrophic because they often are observed to have low productivity in spite of moderate to high nutrient concentrations (Wetzel, 1975). Colored water not only reduces light penetration, but the dissolved organic matter also can chelate nutrients, making them unavailable for algal uptake. Therefore, water color is an important classification variable (or covariate; see below) for lake nutrient criteria."

In other words, the simple presence of high nutrients (particularly TN) in highly colored lakes is not a good indicator of either nutrient availability or impacts. It is unclear why established science was ignored and arbitrary criteria set for this lake type.

E. Minimally Impacted (Reference) Lakes May Be Classified As Impaired for Nitrogen

Lakes within the South Florida Water Management District (the District) fall into the colored and highly colored categories defined by FDEP and USEPA. Minimally impacted (i.e., reference) lakes within this region have not been routinely monitored for water quality. However, water quality in three of these lakes (Lakes Preston, Joel, and Myrtle) was surveyed by the District in February 2009 and the findings from this preliminary assessment were that these lakes:

- Are highly colored (>250 PCU);
- Have low TP concentrations (17-20 µg/L);
- Have high TN concentrations (1.94-2.31 mg/L);
- Appear to be strongly P limited (based on TN:TP ratios >100:1) and, therefore, unresponsive to N levels;
- Are highly unproductive (Chl*a* values in the 1-3 µg/L range).

These findings are consistent with the broader scientific literature on highly colored lakes (noted above) and with USEPA analyses showing that productivity (chlorophyll *a*) in highly colored lakes is poorly correlated with nutrient levels. Yet, these minimally impacted lakes have TN concentrations that approach or even exceed the upper allowable limit proposed by USEPA.

High background N levels in these lakes are likely a consequence of high inputs of dissolved organic nitrogen (DON) from the surrounding, largely undeveloped watershed. The south

Florida watershed contains large areas of wetland and riparian habitat, which has been found to be a significant natural source of DON to downstream waters in other watersheds (Daley and McDowell 2002, Pellerin et al. 2004). Much of this DON is refractory in nature and, therefore, not capable of promoting phytoplankton productivity in either the lake where it is measured or in downstream waters (streams, estuaries). Therefore, TN may not be a reliable predictor of either N availability or anthropogenic N enrichment in south Florida lakes.

F. How Are Lake Criteria Influenced by Downstream Criteria?

Most Florida lakes discharge into streams or man-made canals. In these situations, USEPA has not explained whether lake numeric nutrient criteria are to be determined based on the proposed lake criteria or on the criteria for the downstream waterbody. For example, within the District, all of the Lake Management Areas of the Kissimmee-Chain-of-Lakes discharge into canal segments, which are classified as streams in that region. The lakes are the sole or primary source of water for these canals. Does this mean that TN and TP concentrations in lake discharges cannot exceed stream nutrient criteria (annual geometric mean concentrations) of 0.107 mg/L for TP and 1.203 mg/L for TN? Given that background TN levels in at least some of these lakes may be above 1.2 mg/L (see comment E above), this could require treatment to remove naturally occurring N.

G. Period of Record Requirements Need to be Defined

Within the District boundaries (and probably elsewhere), some lakes have water quality (nutrient, chlorophyll *a*) data stretching as far back as the early 1980s. This period of record encompasses the period when secondary treatment infrastructure was installed in wastewater treatment plants to reduce nutrient discharges from these point sources. Several District lakes exhibited marked improvements in water quality during the 1980s and early 1990s following these treatment upgrades (James et al. in press). Poor water-quality conditions prior to the implementation of these effective nutrient reduction measures should therefore not be included in current determinations of nutrient impairment. USEPA should adjust its period of record requirements for determining compliance to account for past improvements in water quality.

H. Text Specific Comments

Comment #	Page	Comment
1	2	"Nutrient concentrations, chlorophyll concentration, specific conductance, and alkalinity were log-transformed (natural log) for statistical analyses." Please clarify that the transformations were for raw data. Why was natural log used? Were other transformations considered? How was it determined that transformations were needed?

Comment #	Page	Comment
2	2	"FDEP categorized lakes into clear and colored lakes on the basis of the geometric mean color for the period of record." This is not consistent with the footnote statement on Table 1-4 "Platinum Cobalt Units (PCU) assessed as true color free from turbidity. Long-term average color based on a rolling average of up to seven years using all available lake color data."
3	2	How were shifts between colored and clear classification of some lakes (including Lake Okeechobee) handled?
4	2	"Lakes showed similar chl. *a* responses regardless of location, with some differences in the range of nutrient concentrations (Figures 1-1 and 1-2)." Please show analysis of covariance to justify the statement. It appears that some of the lake sets have different slopes or are significantly separated to justify sub-setting based on location.
4	4	Salas and Martino (1991) do not discuss Trophic State Indices (TSIs). The citation is inappropriate here. The District suggests the following Kratzer & Brezonik (1981), Brezonik (1984), Dierberg *et al.* (1988).
5	5	Salas & Martino (1991) did not consider trophic state indices. They considered trophic states based on total phosphorus concentrations.
6	5	Havens (2000) did not suggest averaging the TSIs, rather he suggested looking at differences to define the general mechanism that is maintaining the TSI at the given level. A better citation for this procedure is Carlson & Havens (2005).
7	5	"Salas and Martino considered that same range of TSI values to be mesotrophic in warm-water lakes." Salas and Martino (1991) did not consider TSI values, but rather TP concentrations.
8	12	For designated uses, USEPA should consider Bachmann *et al.* (1996).
9	13	"The USEPA proposes the TAC suggested nutrient thresholds in clear, high-specific conductance lakes be based on preventing the annual average chl. *a* from exceeding 20 µg/L." Please clarify: Is this proposal for high (> 100 uS/cm) conductivity, or are you including these in high alkalinity lakes (> 50 mg CaCO3/L or conductivity > 250 uS/cm). How are lakes with conductivity between 100 and 250 uS/cm and alkalinity < 50 mg CaCO3/L considered?
10	14	There are also strong relationships among TP, TN, and color. Thus, light is limited because of higher color, TN and TP, making chlorophyll values lower.
11	14	"Regional differences among the moderately colored lakes (color between 40 and 140 PCU) were evaluated, but USEPA found that those colored lakes show similar chl. *a* responses regardless of location, although there were differences in the range of nutrient concentrations (Figures 1-9 and 1-10)." USEPA should demonstrate this statistically using analysis of covariance (it appears that the slopes and positions of the curve are quite different).

Comment #	Page	Comment
12	14	"Without a strong and robust nutrient-chl. *a* relationship in the highly colored (> 140 PCU) lakes, fully protective criteria for these systems can be developed on the basis of the response relationships from the moderately colored lakes (40–140 PCU), although the criteria will be somewhat overprotective, given that high color will reduce algal response and biomass." If TP and TN are not related to chlorophyll *a* in highly colored lakes, then using a surrogate to impose a standard is not logical because based on the chlorophyll *a* standard only five or six of these highly colored lake samples exceed the standard. Most meet the standard throughout the range of TN and TP values. Setting TN and TP values would misclassify most of these lakes as impaired when they are not.
13	14	Given this approach and using annual average chl. *a* values of 20 µg/L for colored lakes and higher-specific conductance clear lakes, and 6 µg/L for clear, low-specific conductance Florida lakes, respectively, criteria ranges associated with protection of designated uses can be defined on the basis of the 50% prediction intervals depicted in Figures 1-11 and 1-13." The axes should be reversed. Since you are trying to define TP and TN values based on chlorophyll *a* of 20, then the independent variable is chlorophyll *a* and TN and TP are the dependant variables
14	14	"Results indicate that a 5-year rolling average was generally sufficient to ensure minimization of the variance (for an example data set, see Figure 1-14). Yet a 7-year average is the basis to determine color in the rule.
15	17	"The 50% prediction interval is the range within which one-half of chl. *a* observations are expected to fall for a given nutrient concentration (TN or TP), centered on the mean expectation at the regression line. In other words, the lower and upper bounds approximate the 25th and 75th percentiles of expected chl. *a* response for the given TN or TP, as predicted by the regression equations (Figures 1-11, 1-13)." See comment 13 above.
16	19	"…the cool season (October to April) and the warm season (May to September)." For the southern part of the state these are considered dry (October to April) and wet (May to September) seasons.
17	19	TP, TN, chlorophyll, and specific conductance are all correlated with alkalinity in the described data set (Figure 1-16)." The data are compressed by the natural log. USEPA should provide figures showing results if the data are un-transformed.
18	19	"The acidic and alkaline lakes appeared to lie on the same regression relationship, although alkaline lakes had higher mean nutrient and chlorophyll concentrations." USEPA should use analysis of covariance to demonstrate this.
19	22	Table 1-1. Only the TP values are from Salas and Martino (1991)

I. An Alternative Approach for Establishing Lake Numeric Nutrient Criteria

The following alternative approach is provided by the District for developing Lakes Numeric Nutrient Criteria. The purpose of this alternative approach is to offer another tool for USEPA in the development of lake criteria. The previous concerns listed in Sections A through H still apply, especially in terms of nitrogen criteria. A major benefit of this approach is its independence of relying on any specific nutrient and chlorophyll *a* relationship (e.g., does not assume a linear response). It does not assume any statistical distribution, skewness or kurtosis for the parameters TN, TP, and chlorophyll *a* as presented in detail below.

Given that both total nitrogen and total phosphorus (TN and TP) are associated with each other, with chlorophyll *a*, as well as other water quality parameters (such as color, dissolved organic carbon, etc.) using regression techniques to define criteria of nutrients for Lakes is not ideal.

The method considers each individual point (chlorophyll *a*, TN, TP) in the data set and classifies them as either meeting the chlorophyll *a* criterion (chlorophyll $a \leq 20$ µg/L) or not (chlorophyll $a > 20$ µg/l). This analysis is presented for TP and TN in clear and moderately colored lakes.

Frequency diagrams of nutrients (TP or TN) for each set can be compared, and nutrient criteria can be suggested as corresponding to the majority of non-impaired samples meeting the chlorophyll *a* criterion and a majority of the impaired samples having chlorophyll *a* above this threshold (see Attachment A). The procedure becomes more powerful, more precise, and more robust as more samples are added. Tradeoffs between categories of percent correctly identified, percent false positives (categorizing samples as impaired when they are not), and percent false negatives (categorizing samples as not impaired when they are) based on chlorophyll *a* criterion can be compared and optimal nutrient criteria values (or ranges) can be chosen.

The FDEP's data set of averaged annual lake observations is used to illustrate an alternative method for establishing TP and TN thresholds. Using some basic statistical concepts of error rate (i.e. type I or false positive, and type II or false negative), the available data can be used to set nutrient criteria. These criteria can be set by choosing nutrient values associated with the desired outcome of type I /type II errors being low. While the ideal values (e.g. 5% false positive, and 10% false negative) are not always attainable, reasonable accommodation may be attained through understanding of the information.

Annual averaged data for Florida lakes were obtained from: publicfiles.dep.state.fl.us - /DEAR/Weaver/Inland TSD Data/02) Lakes/All Lakes Ann Av N4.xls

From the 924 annual-lake averaged observations, data sets were created for moderately colored lakes (apparent color values between 40 and 140 PCU and predefined as "col", 308 observations) and clear lakes (apparent color values below or equal to 40 PCU and predefined as "clr", 509 observations).

The analysis was done separately for each nutrient (TP and TN) and for clear lakes and moderately colored lakes. Each lake type data set provided by USEPA contains chlorophyll *a*, TP and TN natural log transform values that were averaged for each lake-year. Prior to performing the current analysis, chlorophyll *a*, TP and TN data were back transformed.

Individual data records (containing chlorophyll *a*, TP and TN values) were classified as either meeting the chlorophyll *a* criterion (chlorophyll *a* ≤ 20 µg/L) or not (chlorophyll *a* > 20 µg/l). Histograms of TP and TN from these data sets were produced for each lake type in Microsoft Excel. The cumulative percentage of all samples correctly identified at a given nutrient value as exceeding or meeting the criterion (20 µg/L) was plotted for all values of TN and TP. In addition the cumulative percentage of samples that exceeded the nutrient value but met the chlorophyll *a* criterion (false positive) was also plotted, as was the cumulative percentage of samples that did not exceed the nutrient value but did exceed the chlorophyll *a* criterion (false negative).

These plots can be evaluated to determine the nutrient value that:

- Correctly identifies a large percentage of samples that meet or exceed the chlorophyll *a* criteria;
- Maintains a low percent of false positives;
- Maintains a low percent of false negatives.

For colored lakes there were 178 observations that did not exceed the criteria and 131 that did (Figure 1). Nutrient values for the samples that did not exceed the chlorophyll *a* criterion ranged from 0.004 to 0.55 mg/l for TP (Figure 1A) and 0.22 to 2.6 mg/l for TN (Figure 2A). Conversely, nutrient values for samples that did exceed the chlorophyll *a* criterion ranged from 0.04 to 0.96 mg/l for TP and 1.14 to 10.6 mg/l for TN (Figures 1B, 2B). The maximum percent of lakes correctly identified as meeting or exceeding the chlorophyll *a* criterion were 0.059 mg/l (77%) of TP and 1.4 mg/l (82%) for TN (Figures 1C, 2C). No matter what nutrient criterion value is selected, there will also be some false positives and negatives. The curves (Figures 1C, 2C) can be used to identify the tradeoffs for each criteria value. For example at the TP value of 0.059 mg/l, 19% of the lakes exceed this value but meet the chlorophyll *a* criterion (i.e. a false positive). As a tradeoff, using higher values of TP for the nutrient criteria will result in fewer lakes correctly identified, but will also result in fewer false positives. Most statisticians use a false positive (Type I) error rate of 5% although 10% is sometimes used.

Three values from each lake type and nutrient (TP and TN) are presented that are closest to the type I error rate of 5%. (Table 1). Using a 5% type I error rate for colored lakes gives nutrient criteria of 0.136 mg/L for TP and 1.71 mg/l for TN, resulting in 67.7% and 80.5%, respectively, of the lakes being correctly identified as meeting or exceeding the chlorophyll *a* criterion. However this is offset with a 27.5% and 15.3% false negatives (or Type II error rate), respectively. In this case 27.5% and 15.3% of the samples are classified as meeting the given nutrient criteria but actually exceed the chlorophyll *a* criterion.

For alkaline lakes, there were 325 observations that did not exceed the chlorophyll *a* criterion and 185 that did (Figure 3). Nutrient values for samples that did not exceed the chlorophyll *a* criterion ranged from 0.002 to 0.25 mg/l for TP (Figure 3A) and 0.06 to 1.89 for TN (Figure 4A). Conversely, nutrient values that did exceed the chlorophyll *a* criterion ranged from 0.019 to 0.921 mg/l for TP (Figure 3B) and 0.89 to 6.6 mg/l for TN (Figure 4B). The maximum percent of samples correctly identified as meeting or exceeding the chlorophyll *a* criterion occurred at 0.026 mg/l for TP (85%) and 1.15 for TN (93%) (Figures 3C, 4C). Using these values to set nutrient criteria would result in type I errors of 12.9% and 2.7%, respectively. Using the values that are closest to the 5% error rate (0.050 mg/l and 1.14 mg/l for TP and TN, respectively) produce Type II error rates of 15.4% and 4.3%, respectively.

For comparison the baseline values for clear alkaline lakes proposed by USEPA (Table 2) would result in 12.9% and 5.6% false positives for TP and TN, respectively. The baseline values for colored lakes proposed by USEPA would result in approximately 18.9 and 16.3% false positives for TP and TN respectively.

Table 1: Potential criteria for TN and TP by lake type and the associated percentage of samples correctly identified (as meeting or exceeding the chlorophyll *a* criterion) as well as percentage of type I and type II errors.

Lake Type	Nutrient	Standard value	Number of False positive (type I error)	Number of False negative (type II error)	Number of correctly identified lakes	Percent false positive	Percent false negative	Percent correctly identified
Colored	TP	0.103	21	61	209	7.22%	20.96%	71.82%
		0.136	14	80	197	4.81%	27.49%	67.70%
		0.180	5	104	182	1.72%	35.74%	62.54%
	TN	1.396	30	30	248	9.74%	9.74%	80.52%
		1.711	13	47	248	4.22%	15.26%	80.52%
		2.097	2	67	239	0.65%	21.75%	77.60%
Clear Alkaline	TP	0.037	34	43	427	6.75%	8.53%	84.72%
		0.050	20	78	406	3.97%	15.48%	80.56%
		0.070	12	108	384	2.38%	21.43%	76.19%
	TN	0.892	39	10	459	7.68%	1.97%	90.35%
		1.147	14	22	472	2.76%	4.33%	92.91%
		1.474	5	61	442	0.98%	12.01%	87.01%

Table 2: USEPA Proposed Nutrient Criteria for colored and alkaline lakes (From 40 CFR Part 131 EPA-HQ-OW-2009-0596; Water Quality Standards for the State of Florida's Lakes and Flowing Waters, 2010)

Long Term Average Lake Color and Alkalinity	Chl*a* (µg/L)	Baseline Criteria		Modified Criteria (within these bounds)	
		TP (mg/L)	TN (mg/L)	TP (mg/L)	TN (mg/L)
Colored Lakes > 40 PCU	20	0.050	1.23	0.050-0.157	1.23-2.25
Clear Lakes, Alkaline ≤ 40 PCU and > 50 mg/L $CaCO_3$	20	0.030	1.00	0.030-0.087	1.00-1.81

Figure 2: Histogram and percent cumulative distribution of TP values in moderately colored lakes: (A) shows plot for samples with chlorophyll *a* ≤ 20 µg/l; (B) shows plot for samples with chlorophyll *a* > 20 µg/l; and (C) plot shows cumulative percent of samples that are correctly identified (as meeting or exceeding the chlorophyll *a* criterion) for a given TP concentration, cumulative percent of all samples incorrectly identified as exceeding the standard when they do not (false positive), and cumulative percent of samples incorrectly identified as meeting the standard at or below a given TP when they do not (false negative).

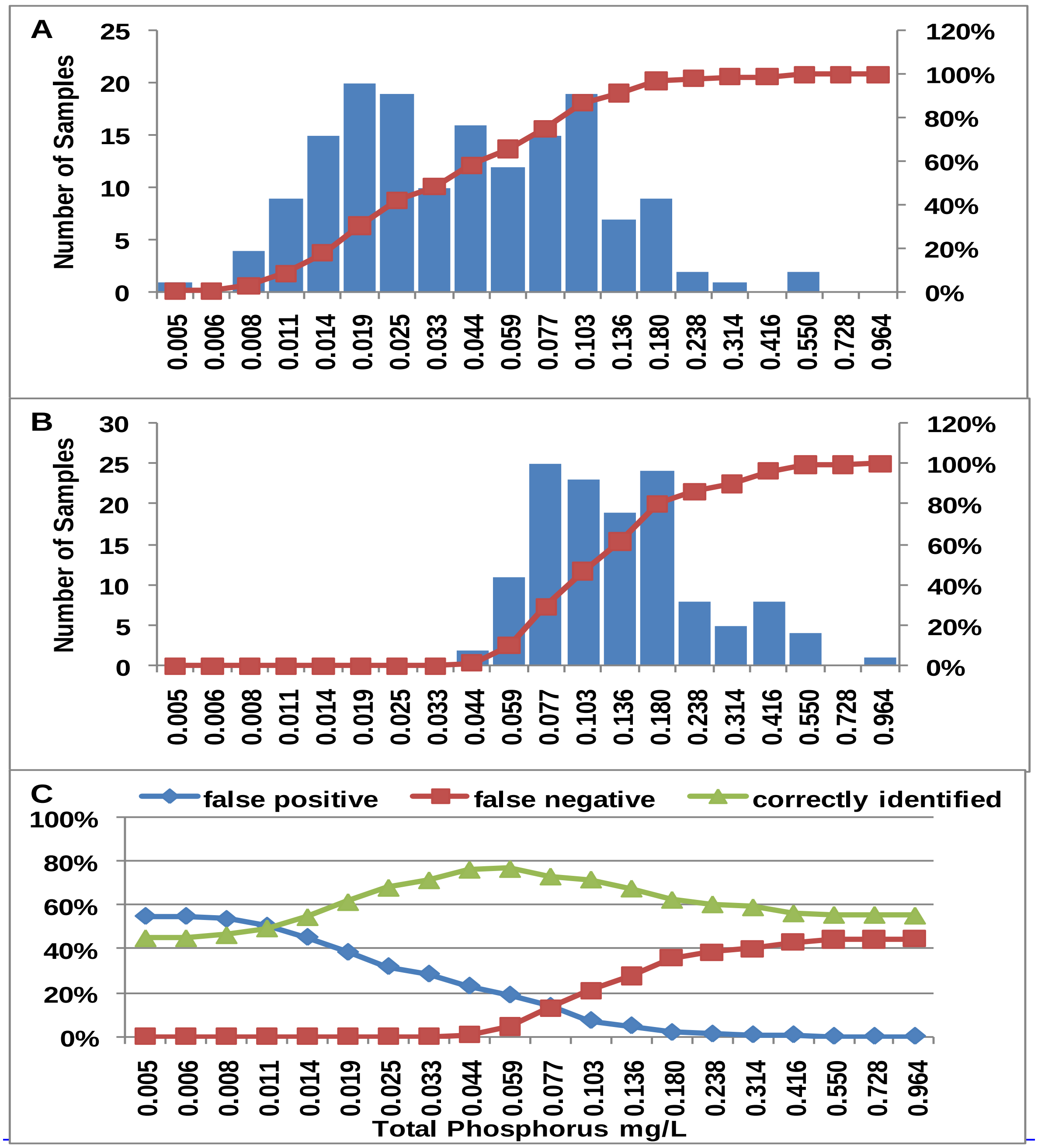


Figure 3: Histogram and percent cumulative distribution of TN values in moderately colored lakes: (A) shows plot for samples with chlorophyll *a* ≤ 20 µg/l; (B) shows plot for samples with chlorophyll *a* > 20 µg/l; and (C) plot shows cumulative percent of samples that are correctly identified (as meeting or exceeding the chlorophyll *a* criterion) for a given TN concentration, cumulative percent of all samples incorrectly identified as exceeding the standard when they do not (false positive), and cumulative percent of samples incorrectly identified as meeting the standard at or below a given TN when they do not (false negative).

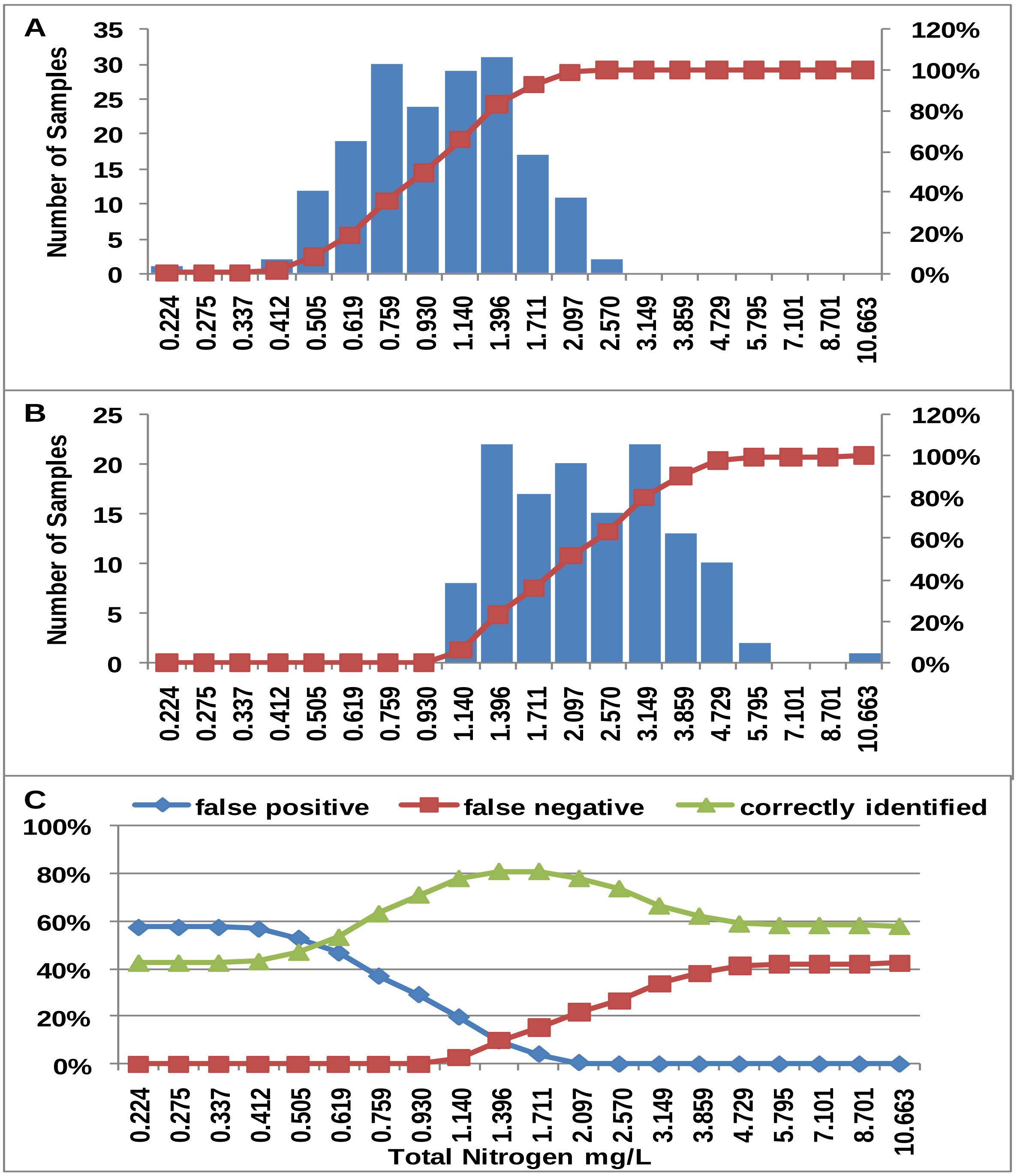


Figure 4: Histogram of TP in clear alkaline lakes and cumulative percent of lakes: A) with chlorophyll *a* < 20 µg/l; B) with chlorophyll *a* > 20 µg/l; C) Percent of lakes that are correctly identified as meeting or exceeding the chlorophyll *a* criterion at a given TP value, cumulative percent of all lakes incorrectly identified as exceeding the standard when they do not (false positive), and incorrectly identified as meeting the standard at or below a given TP when they do not (false negative).

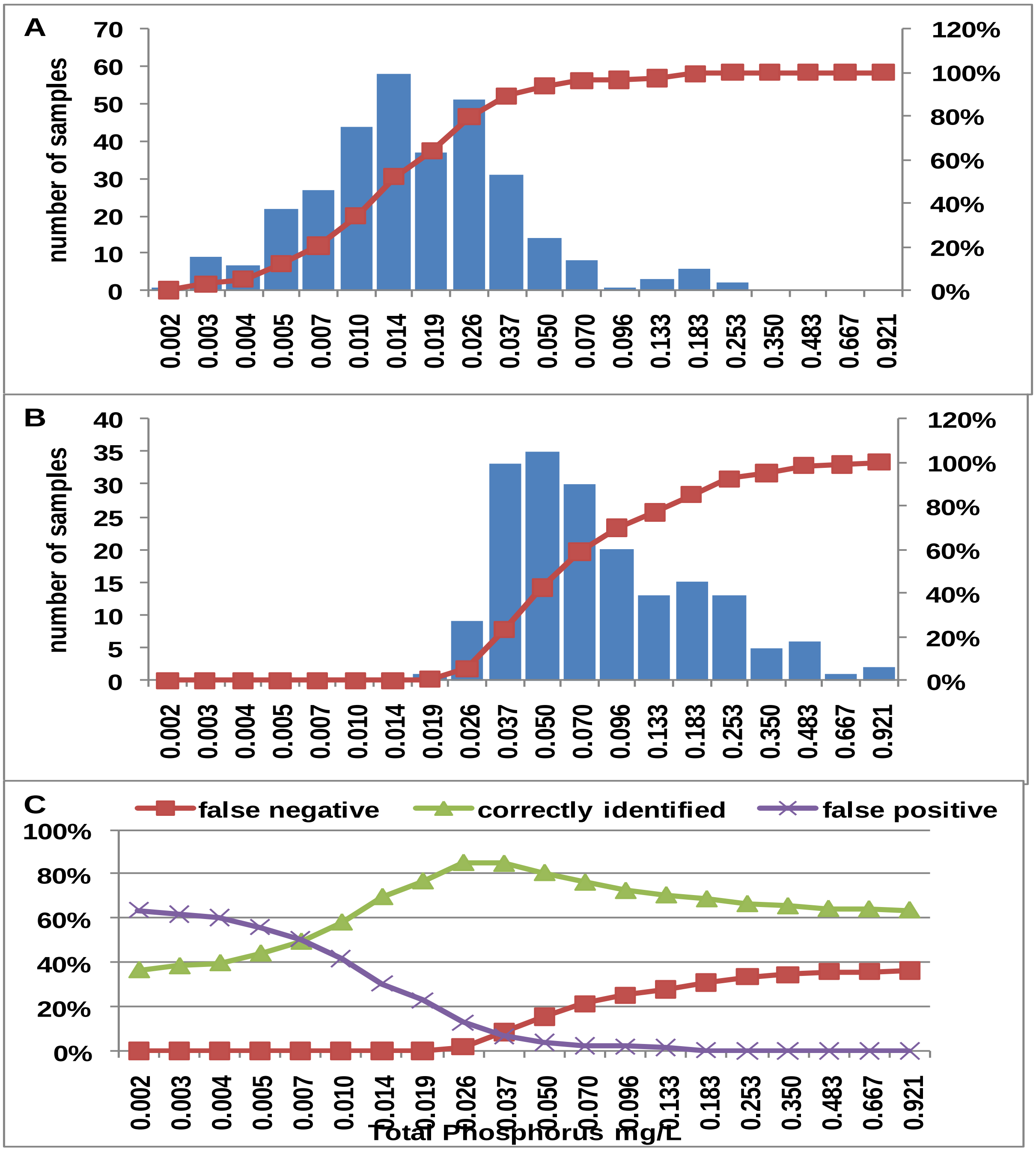
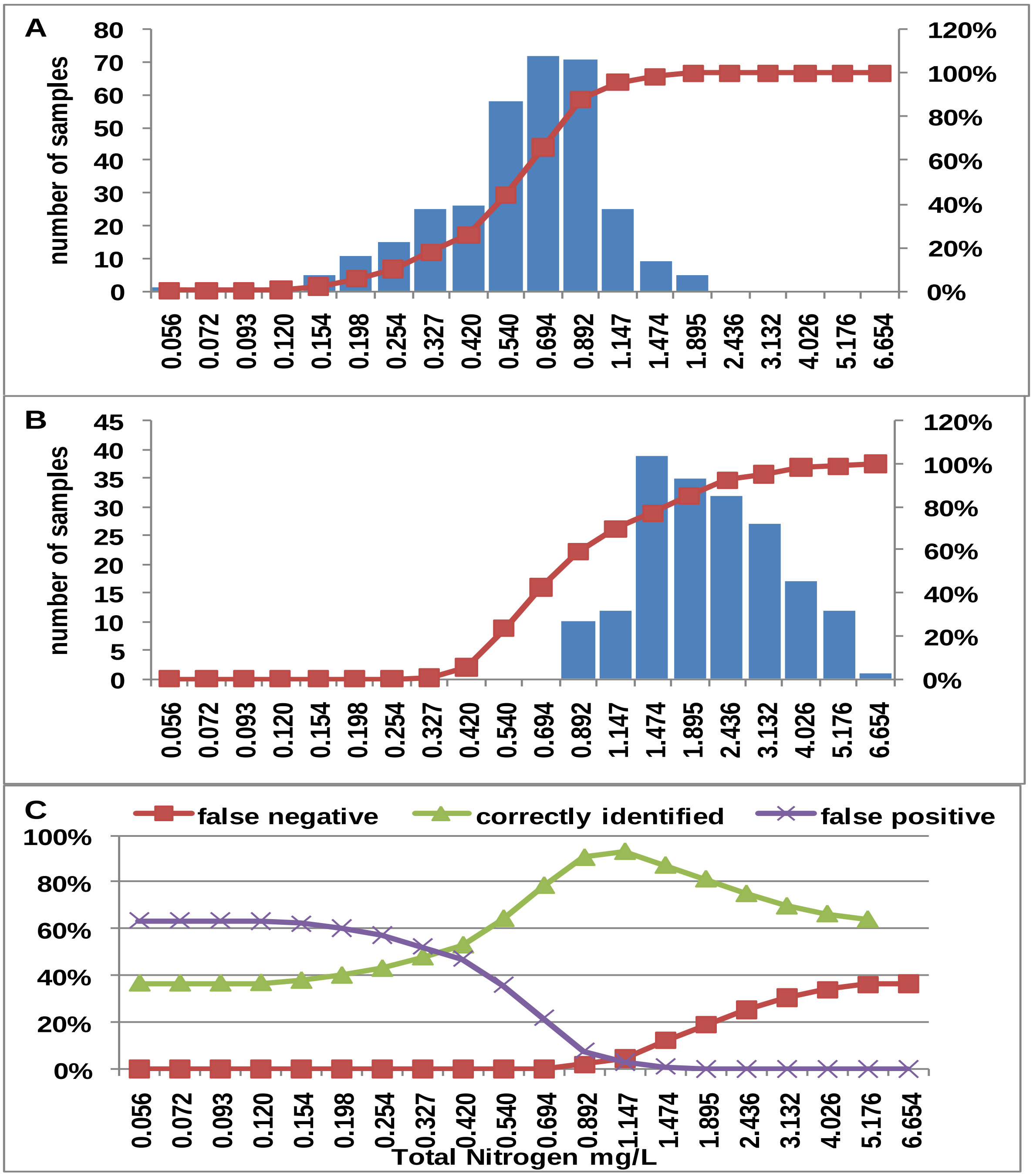


Figure 5: Histogram of TN in alkaline clear lakes and cumulative percent of lakes: A) with chlorophyll *a* < 20 µg/l; B) with chlorophyll *a* > 20 µg/l; C) Percent of lakes that are correctly identified as meeting or exceeding the chlorophyll *a* criteria at a given TN value, cumulative percent of all lakes incorrectly identified as exceeding the standard when they do not (false positive), and incorrectly identified as meeting the standard at or below a given TN when they do not (false negative).



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II. South Florida Water Management District Response to USEPA Proposed Numeric Nutrient Criteria: River and Streams

Numerous papers have been published on using landscape classification (e.g., ecoregions, bioregions) to define reference conditions for environmental management. A recent review of published papers over the last 25 years (Hawkins et al. 2010) made the following conclusions with regard to the use of reference sites to set numeric water quality criteria that are applicable to USEPA's proposed numeric criteria for nutrients.[1]

A. USEPA Has Not Adequately Assessed Several Critical Assumptions Necessary to Set Defensible Water Quality Criteria Using a Reference Approach

The proposed Nutrient Watershed Regions produced coarse estimates of reference conditions leading to numeric criteria that may not be ecological meaningful. The lack of predictive modeling that links nutrients to a biological response is a major shortcoming (see comment B below). USEPA has not provided evidence to demonstrate that it adequately assessed the natural variability in the data to minimize predictive bias. No analysis has been provided supporting the assertion that the reference data, and the 75th percentile, are an accurate statistic for defining the distribution and natural variability in the data at reference and other sites. The application of this statistic to all sites in the region cannot be assessed with any degree of confidence without this assessment of data variability. Variations in time and space at any particular site may be greater than the variation within the region. Hydrologic variability, day-to-day, season-to-season, and year-to-year, make the interpretations of criteria exceedances difficult to assess without a large number of measurements taken over a long period of time (see comment E below).

B. USEPA Has Failed to Demonstrate a Link Between Its Proposed Nutrient Criteria and a Biological Response

Dodds and Welch (2000) outlined the many difficulties in setting nutrient criteria in streams, including the multiple management reasons for setting the criteria, the uncertainties associated with biological responses, and the high variability associated with nutrient data collected in streams. Although this white paper is 10 years old, these conclusions are relevant to the criteria proposed by USEPA today.

It is necessary that the proposed thresholds (i.e., criteria) have a quantified link to a biological response. Without such a link, there is no basis that reducing nutrients will have a measureable effect on the biota, and could lead to costly and unnecessary controls. Existing water quality criteria (e.g., temperature, dissolved oxygen, pH, metals) use laboratory bioassays to link stressors to biology. Studies of natural systems use modeling to relate stressors to biology as has

[1] FDEPs comments can be found at: http://www.dep.state.fl.us/water/wqssp/nutrients/docs/federal/fdep_comments_streams_criteria.pdf . Cross-references to FDEP draft comments dated March 12, 2010, are provided where applicable.)

been done for nutrients and chlorophyll biomass in New Zealand rivers. (Snelder et al., 2004). Such evidence has not been provided for Florida streams. This conclusion was made by FDEP (see FDEP comments D, F, and J) and acknowledged by USEPA in the proposed rule.

The natural environment is an uncontrolled experiment with biological conditions affected regionally by geology, climate, and land use. FDEP should be commended for assessing many of these regional patterns by developing specific bioregions for the Stream Condition Index (SCI), Nutrient Watershed Regions (NWR), and the Landscape Development Intensity (LDI) index. However, these tools do not fully explain the high spatial and temporal variability of nutrients in Florida streams. Highly variable flow conditions in streams, compared to lakes, and seasonal changes in macrophyte and periphyton growth make correlations between nutrients and biology (e.g., SCI and component metrics) statistically weak. They may need to be assessed on a site-by-site basis rather than a broad regional basis (see FDEP comment E and Appendices A-C). Both USEPA and FDEP have recognized this limitation and have additionally identified the importance of shade in regulating stream primary production.

C. USEPA Should Document Why They Did Not Adopt the FDEP's Benchmark Approach

The District supports the comments provided by FDEP (see FDEP comment C1-C4) and sees no defensible reasons why USEPA did not adopt the FDEP benchmark approach. USEPA failed to provide the significant lines of evidence needed to support its approach. If the reference approach, with its inherent shortcomings, is the tool used to develop numeric nutrient criteria, it is appropriate to utilize the technical methodologies from the state agency that developed the tool for the state in question.

Furthermore, the state agency in this instance has invested significant time and resources in the development of their benchmark approach to ensure validity of its approach. Specifically, the FDEP has spent over a decade and over three million dollars refining their SCI based benchmark approach (FDEP Numeric Nutrient Criteria Development Plan, March 2009).[2] They also went to extra quality control measures in the selection of their benchmark sites, a process not followed by USEPA in its approach.

Where the data sets have been rigorously developed, the selection of the 90th percentile for the criterion development should be used in favor of the 75th percentile due to the documented rigor associated with FDEP's methodology. More importantly, FDEP has evidenced the importance of a biological validation as part of a rule developed with the reference approach. The District strongly supports the use of the biological confirmation as a mechanism to handle the uncertainty associated with criteria developed without known dose-response relationships.

[2] FDEP's NNC Development Plan is available at http://www.dep.state.fl.us/water/wqssp/nutrients/docs/fl-nutrient-plan-v030309.pdf.

D. The Precision Associated with the Percentiles Used to Define Nutrient Thresholds Have Not Been Adequately Assessed

The reference condition approach ignores the lack of evidence on nutrient stressors in streams, leading to the high potential for over-protection or possibly under-protection. There is no technical basis supporting the assertion that levels of nutrients at a few reference sites accurately define what is achievable at other sites to meet some prescribed level of biological condition or use. Selecting a threshold based on a probability value (e.g., 75th percentile) assumes that all the sites in the population of that region function similarly, and ignores the spatial and temporal (seasonal) variability inherent in the data. The precision of the proposed criteria is determined by an analysis of the variability in the data at both reference sites and sites where the proposed criteria will be applied to determine use attainment. Such analyses have not been completed.

The District substantially agrees with comments made by FDEP in its Streams Document (See FDEP comment D) and supports FDEP's 90th percentile approach with accompanying biological validation given the uncertainties inherent in a reference basal approach.

E. Analyses to Support Duration and Frequency Criteria are Incomplete

Water quality criteria include magnitude (concentration that exerts an adverse effect), duration (exposure period, or averaging period) and frequency (how long it takes the system to recover) criteria. Frequency criteria are generally less definitive than threshold and duration criteria because the magnitude and duration of an adverse event are measured directly by dose-response studies while the frequency requires judgment to determine how often an adverse event can be allowed to occur without causing unacceptable harm. The lack of dose-response information for Florida streams makes selection of both the magnitude and duration criteria subjective and arbitrary.

USEPA provided no analysis as part of its proposed rule that defines the proposed annual geometric mean as the averaging period that best defines ecological effects, and specifically requested comments on this component. It is not possible to assess this and any other alternative without a good understanding of the dose-response relationships. The lack of technical support for the duration criterion further illustrates the difficulties setting numeric criteria without an understanding of dose-response. Without this understanding, numeric criteria define only where there are values that exceed 75% of those measurements at reference sites.

The District substantially agrees with FDEP comments D2, G, and I and requests that USEPA provide support and analysis as to why the proposed F and D were chosen. Additionally, based on existing evidence, USEPA should undertake additional peer review and research to properly produce and confirm a defensible D and F.

F. The Different Criteria for Canals and Streams Produces Inconsistencies in Their Applications Throughout The District (Also See District Comments On Canals)

Fla. Admin. Code R. 62-302.400 articulates the designated uses for Florida's waters. Class III waters are designated for recreation and the propagation and maintenance of a healthy, well balanced population of fish and wildlife (i.e. "fishable and swimmable"). While both streams and canals are designated as Class III waters, as noted in the attached Canal Science Inventory, the physical and biological nature of canals is significantly different than that of a natural stream. In other words, what is protective of recreation and a healthy, well balanced population of fish and wildlife in a natural stream is entirely different than that in a canal. Both waterbodies can be classified as Class III waterbodies, but USEPA must still examine how the use specifically applies to the physical and biological attributes of a given waterbody instead of subjectively promulgating criteria that does not reflect the nature of the designated use on an eco-region basis. It is therefore arbitrary and capricious to treat canals outside of the South Florida Region as streams under the proposed rule since they are operated and managed the same as canals in the South Florida Region.

USEPA has provided no support for approaching canals north of the South Florida Region in this manner. Additionally, USEPA has not proposed any solutions regarding how to address systems that are heavily managed in certain sections but qualify as natural streams in others.

G. Promulgating Numeric Criteria for Streams in Advance of Setting Criteria for Downstream Waterbodies Such As Estuaries May Cause Confusion With the TMDL Process

Nutrients effects occur over long time frames and are most severe in downstream waterbodies (e.g., lakes and estuaries) that accumulate nutrients over time in sediments and in the water column. Establishing numeric criteria for streams in advance of estuaries may require revising the criteria for streams after the criteria for estuaries have been adopted. It seems most effective to adopt numeric criteria for downstream waterbodies first because (1) nutrient effects are cumulative over time, and (2) focuses management attention on the most severe nutrient problems in Florida, (3) the knowledge base for nutrient problems is the most well understood for downstream waterbodies (e.g., lakes and estuaries) compared to flowing water systems such as streams and canals.

In addition, criteria designed to protect downstream waters may cause confusion between water quality standards and the TMDL process. Water quality standards for a particular waterbody are designed to protect the designated uses of that waterbody. Setting criteria to protect downstream uses will likely be based on tools and modeling currently used to set TMDLs, and may blur the distinctions between these regulatory tools. This creates difficulties for both unimpaired and impaired streams (and canals). Unimpaired streams discharging to a heavily impaired lake or estuary could have higher criteria, and allow higher nutrient loadings, compared to streams discharging to higher quality downstream waterbody. Conversely, heavily impaired streams discharging to high quality lake or estuary could have lower criteria, and require lower nutrient loadings, compared to other streams discharging to a lower quality downstream waterbody.

There is substantial agreement between FDEP and the District (see FDEP comment E), and FDEP Appendices A-C provide a process for setting numeric criteria on a watershed basis.

H. Site Specific Alternative Criteria (SSAC) Were Designed to Address Unique or Unusual Situations, and Should Not Be Used to Overcome Weakly Supported Regional Criteria

EPA proposes the option of developing SSACs as a way to address the technical uncertainties of the proposed regional criteria are somewhat addressed by the. However, the implication of such an approach is difficult to assess without a detailed estimate of the number of SSACs that would likely be required. If the number is very large, which is likely given the lack of dose-response relationship and the proportion of reference sites that do not meet the criteria (see FDEP comment J, Tables 2 and 3), then it may be more efficient to adopt site-specific criteria from the start. For instance, the District supports the adoption of TMDLs previously set and approved by USEPA and FDEP as protective of a given water body as automatic SSACs requiring no further submissions under the rule. SSACs should not be used to support regional or statewide numbers without a detailed estimate of the expected numbers of SSACs.

SSACs are costly and time consuming, and can be contentious in the context of stringent criteria. They are intended to apply to unique and unusual cases, and should not be used to supplement weakly supported regional or statewide criteria.

I. Potential Additional Research Pathways

Additional research for streams (and canals) might include two basic types; (1) studies of natural systems and (2) controlled experimental designs that include bioassay and mesocosm studies. Empirical studies of natural systems include assessments of water quality and biological communities at reference sites compared to sites with similar physiographic characteristics and high nutrient concentrations.

Hydrology and water quality are more variable in streams than lakes and wetlands, making it more difficult to define relationships between nutrients and biology in the natural environment. Controlled testing will likely be required. Such studies would identify the “potential” for streams to exhibit nutrient related problems, and identify those factors (geology, habitat, land use) that define the degree of impact in specific streams or watersheds. The types of research conducted on phosphorus limitations for the Everglades over the last two decades can provide a template for such research in streams. It will be important to define the expectation for such research: it will take several years of targeted research of both types to establish numeric criteria for streams.

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III. South Florida Water Management District Response to USEPA Proposed Numeric Nutrient Criteria: Canals

A. Sound Scientific and Regulatory Foundations Are Not Provided for Protective Numeric Nutrient Criteria (NNC) in South Florida Canals by USEPA

In the USEPA proposed rule, there is no quantified linkage between nutrients and impaired biology in south Florida canals, and no evidence is provided that canal ecosystems are even sensitive to total nitrogen (TN) or total phosphorus (TP). As a result of these scientific weaknesses, the District cannot support any conclusion that these nutrients will adversely affect the designated uses of canals in south Florida. The USEPA does not provide a valid regulatory connection between the NNC values and achievement of the designated use of the waterbody, the heart of the Clean Water Act. Without a proper foundation, it is entirely possible that the State of Florida could spend millions of dollars and many years of effort on nutrient controls that would have little or no measureable benefit to the designated uses of canals. Simply stated, USEPA can provide no evidence to demonstrate what recreation or a healthy population of fish and wildlife are for canals and thereby cannot develop criteria to support them, particularly given the uncertainties inherent in their highly managed states and design.

Similarly, no data are provided that link chlorophyll *a* (Chl*a*) concentrations to designated uses in south Florida canals, and even if USEPA could furnish some such evidence, they would need to separate Chl*a* generated from within the canal from that imported during periods of discharges from upstream systems, particularly lakes. Additionally, USEPA notes that TP and Chl*a* are correlated, but then fails to account for their mutual chemistry. Much of the TP measured in water samples with significant concentrations of algae is derived from the chlorophyll-containing algae, so naturally the two parameters will be correlated. However, due to the complexity of canal flow patterns, the regression of TP and Chl*a* is weak and cannot be used for any regulatory purposes unless it is corrected for this lack of independence, seasonal flow patterns and for the proportion imported into the canal.

B. The Volume of Scientific Studies (Especially in Ecology) Available for Canals is Much Lower Than Those Found for Other South Florida Ecosystems (e.g., the Everglades Marsh Systems)

Determining the appropriate protective numeric nutrient criteria is premature if it is not clear what comprises the ecological community which is being protected. The District's recent 'Canal Science Inventory' (see District Attachment 1) has clearly shown the lack of canal ecological studies as compared to other systems in Florida (e.g., the Everglades, see '2010 South Florida Environmental Report; see District Attachment 2). FDEP's own Technical Advisory Committee (TAC) consistently struggled with the lack of available information on the ecological components of canals and how nutrients may or may not have an impact. In fact many of the

TAC's conversations often would focus on what is the appropriate designated use of these conveyance systems and what a canal biological community should look like.

C. Imbalances in Flora and Fauna Cannot be Used as a Basis for Determining Impairment in Canals Maintained for Conveyance Purposes

In order to function as conveyance systems, canals must be maintained by removing or limiting vegetation, creating immediate imbalances in canal flora and potentially fauna. The congressional authority for the Central and Southern Florida Project, which upgraded and expanded South Florida canals, specifies their primary uses as flood control and water supply, including environmental supply for the Water Conservation Areas and other natural systems. The designated uses derived under the Clean Water Act for maintenance of healthy, well balanced flora and fauna were not considered in this legislated intent. To keep their conveyance capacity and protect public safely, canals and their banks must be maintained open and free of obstructive vegetation, natural habitat, through mechanical harvesting or the use of herbicides. The FDEP TAC has discussed the extreme challenge of determining biological 'normalcy' under such circumstances and therefore, has noted on several occasions that it is extremely problematic to determine a rational basis upon which to develop numeric nutrient criteria in these systems.

D. Establishing Numeric Nutrient Criteria for Canals Requires the Analysis of Different Parameters and Derivation Techniques Than Those Used for Streams, Springs or Lakes

USEPA recognizes that canals are modified systems that behave in unnatural patterns, sometimes acting like reservoirs, other times flowing more like streams, and other times flowing more like slow moving rivers. Simple compilations of data cannot describe such complexity. As a result of these complex interactions, canals cannot be subject to the same parameters and derivation approaches applied to streams or lakes. Consider:

- **Using annual geometric means is not representative for canals.**

Canals behave like streams when the water is flowing for flood control or water supply, and then behave like lakes/reservoirs when water is not flowing, sometimes for months at a time. A single annual geometric mean (for Chl*a*, TP and TN) used by USEPA to establish nutrient criteria may not be representative of the actual conditions for a conveyance waterbody in light of their rainfall driven and seasonal complexity. Analysis of a certain year and across years should be done separately for flowing and not flowing regimes. Flow weighted means rather than annual geometric mean Chl*a*/TN/TP concentrations might be more appropriate for analysis.

- **Averaging over an entire waterbody is not representative for the canals crossing multiple ecoregions or other landscape types.**

Some primary canals in South Florida can cut across different geologic or ecological regions. Applying an annual geometric mean over the entire waterbody (canal WBID) might mask regional differences and provides statistics reflecting none of the actual environments being considered. The District's statistical comment section (see Section IV) provides a quantitative example of this problem.

- **There is no means provided by USEPA to deal with any sporadic stratification in canals.**

There is little doubt that deeper primary canals have the potential to stratify thermally during periods with no flow. However, all samples are taken at 0.5 m near the surface. During stratification, surface values can be reduced temporarily and during subsequent mixing with flow, surface values will be elevated. This process could add greatly to data variance and could contribute to future exceedances in some canals whether the reference canals representative of stratification patterns of canals as a whole! USEPA does not indicate one way or the other.

E. Setting Regional Criteria Based on Statistical Analyses of Diverse Environments is Invalid

Nutrient levels are highly variable (site specific), and USEPA provides no basis for the establishment of reference sites upon which to examine designated uses and potential impairment. The reference condition approach used for canals and the regional/ecoregional scheme for streams also ignores the lack of evidence that nutrients are key stressors in canals or streams (see above), leading to the high potential for unnecessary protection with little or no net benefit to the environment. As stressed by USEPA reviewers, both their Scientific Advisory Board and reviewers of the proposed rule (Attachments 3 and 4), there must be more information on stressor-response and impairment before any criterion can be justified for canals. An alternative approach would establish numeric nutrient criteria on a more rational watershed basis using available site specific information, such as setting criteria for a downstream body and then determining the proper way to operate the system and build projects to achieve this objective (i.e., the TMDL process). USEPA must identify specific canals that are nutrient sensitive, identify those impaired and the associated water quality levels, and then put into place numeric nutrient criteria to protect uses of these systems. The 303d list used by USEPA does not do this, even partially. No evidence was provided supporting the unimpaired status of selected canals as a basis for finding a threshold concentration of TN, TP or Chl*a* applicable to all canals.

F. Using Water Quality Monitoring Sites Not Included in Florida's Clean Water Act Section 303(d) List ("303(d) List) as 'Reference Sites' is Highly Biased, Provides No Evidence Concerning Ecological Balance, and is an Inappropriate Interpretation of the Listing Process

The 303(d) list was developed to identify areas appearing not to meet water quality standards and therefore requiring prioritization for TMDL development. Using the list to select unimpaired canals is scientifically unsound and may be contrary to Section 403.067, Fla. Stat., which states that the 303(d) list is not to be used for any regulatory purpose, at least under Florida law.

Any canal reference site should reflect direct evidence of conditions fully meeting the designated use and should be selected based on known thresholds that define imbalances in flora and fauna (e.g., land use, riparian habitat, pollution sources, etc.) and encompass physiographic differences (e.g., ecoregions). As noted above (#2), USEPA would have to demonstrate for the south Florida water management system canals, how imbalance would be defined for devices maintained for water conveyance purposes.

Due to the fact that canals are conveyance devices and flow dynamics can vary greatly based on location, USEPA must also match any potential reference sites with representative flow regimes. It would not be defensible to use canals draining small undeveloped areas as reference sites for those draining large, developed areas. The selection process for reference sites should not be based upon the target parameters (TN & TP) to avoid obvious circularity and lack of independence.

By USEPA's logic, a site is a reference site for contaminant A because the levels of contaminant A are low without any consideration of biological functions. In addition, sites used must be independent of each other to avoid spurious correlation and unintended data bias (multiple sites in one canal are NOT independent). Bias is self-evident in the fact that the draft criteria for TP (42 ppb) and Chl*a* (4 ppb) in South Florida canals are substantially lower than those for natural streams (TP, 107 ppb) and lakes (Chl*a*, 20 ppb), respectively; an absurd result. There is no justification for this inconsistency and none is apparent from general principles of ecological science.

Additionally, USEPA supplied no justification for using the 75th percentile of the reference site data. If USEPA's selection process is sound, then the 90th or even 95th percentile could be used to provide a reasonable margin of safety. Using the 75th percentile, forces up to 25% of canals in the reference set to become impaired when split off at the 75th percentile and to require unnecessary regulation. In addition, the use of an alternative percentile analyses (e.g. 25th) using an "all canals" approach is not justified for developing criteria for canals. The problems with this methodology have been well documented by FDEP and its TAC.

G. Proper Justification Is Not Provided for Separate NNC for South Florida Canals, While Canals in More Northern locations Are Classified as 'Streams'

There is no technical basis for setting different NNC for canals in the Everglades Nutrient Watershed (South Florida canals) and canals in the Peninsula Nutrient Watershed that use the NNC for "streams" (i.e., canals in all nutrient watersheds should be classified as canals). In fact, USEPA excluded data from Peninsula canals in the development of the NNC for the nutrient watershed (Chapter 2: Methodology for Deriving USEPA's Proposed Criteria for Streams, page 2-34). This would appear to mean USEPA appreciates the many different characteristics that exist between canals and natural streams.

For example, there are 11 significant canals in the Lower Kissimmee and Lake Istokpoga watershed (e.g., C38, C40 and C41) and 4 major canals along the Upper East Coast (C44, C23, 24, &25). In fact, these canals in the Peninsula Bioregion are typical, large artificial conveyances. Some canals in the Lake Okeechobee watershed have segments that are somewhat natural and others that are fully engineered. Many canals in South Florida were built in part along gradients provided by natural steams and some drain into former streams. Under such conditions, how does USEPA propose differentiation between a canal and stream, and what guidance will be provided on deciding between which instream criterion applies along a single canal? What is a stream and what is a canal, and how do canals in the north differ from canals farther south? Some rationale should be provided by USEPA for deciding which designation applies within and between regions.

This disparity between streams and canals has significant impacts. Canals in the Peninsula Region have no Chl*a* criterion at all, according to USEPA, but they do have a TP NNC more than 2.5 times the 42 ppb requirement farther south. Based on land use, location and design, canals are clearly more prone to higher baseline nutrient levels, and if anything, their NNCs should be less stringent than those of more natural streams. Some canals north of the EAA and some canals south of the EAA discharge directly to tide. What justification does USEPA have for the large difference in the NNC north versus south, both discharging into nitrogen limited marine systems?

H. The Use of the Everglades Protection Area TP Rule Criterion of 10 ppb as an Instream Criterion is Unsound

The TP Rule for the Everglades Protection Area was developed after extensive research on biotic community responses to TP in P-limited marshes. The Rule was based on evidence from many different experimental and observational data sets, but did not include any use of or reliance upon a TP to Chl*a* relationship in marshes or in canals. In fact, the TP rule included no data whatsoever on canal nutrient effects. This fact and the nearly complete lack of ecological similarity between canals and marsh sloughs, precludes the use of a criterion developed for marshes as an instream NNC for South Florida Canals in the Everglades Protection Area without qualification.

If USEPA is going to justify the scientifically inappropriate application of the TP criterion to canals, then it must clearly specify that it is not an instream protection number, but is being asserted based upon downstream or in this case, lateral marsh interactions. Justification must be provided by USEPA for protecting some canals to 10 ppb, while neighboring canals on the other side of a levee are held to 42 ppb with Chl*a* at 4 ppb and those 20 miles north are at 107 ppb TP and no Chl*a*. This unjustified segmentation of criteria is not defensible.

I. USEPA Has No Documented Peer Review of the South Florida Canal Numeric Nutrient Criteria

In the District's review of the USEPA's rule and supporting documentation (on USEPA website: Docket Folder containing Supporting Technical Documents), we have not found any reference on scientific peer review of the South Florida Canal nutrient watershed criteria or methodology used to create those criteria. In addition, we have not observed scientific peer review for the alternatives reviewed by USEPA for the South Florida Canal nutrient watershed. The District requests any information that USEPA may have gathered as a scientific peer review for the South Florida Canal nutrient watershed. If no such peer review has been undertaken, the District strongly suggests such a review by USEPA's own SAB, the NAS, NRC, or other recognized body of experts.

IV. South Florida Water Management District Response to USEPA Proposed Numeric Nutrient Criteria: Comments on Statistical Methods and Assumptions

A. Statistical Flaws in the Derivation Process: Global Issues

Universally, USEPA has not documented that their data assumptions are validated or satisfied based on the distribution of the data. Use of transformations, parametric tests and other more complex statistical measures need direct evidence of meeting all assumptions. For example, USEPA never appears to test for the log-normality of the water quality data; this untested assumption is important in setting criteria.

The calculation of percentiles as presented by USEPA from means and standard deviations of log-transformed data distributions is unnecessary and potentially incorrect. If USEPA elects to use percentiles of the data approach to criteria setting, then they should derive percentiles from the available data directly, without log-transforming. Using data from different regions for TP, TN and Chl*a* can bias the results and render them inappropriate for application across the region, as proposed by USEPA. For example, canals may cross different landscape types, as noted above, and data being summarized for a single threshold number using an assumption of a single statistical distribution can be invalid because multiple distributions may be present in the underlying data.

For the linear regression analyses used by USEPA, the assumptions of log-normality and constant variance of residuals could lead to large discrepancies. Measurement error associated with using average values has not been unaccounted for. Beyond these global concerns, the following text focuses on specific statistical concerns within the lakes and South Florida canals section of the proposed rule.

B. Statistical Flaws in the Derivation Process: Lakes

The statistical results used to derive numeric nutrient criteria are only valid if various assumptions about the distribution of the data are met. The document provides no evidence that any of these assumptions were considered or tested. Consequently, the resulting prediction intervals (criteria) generated by USEPA may be inaccurate. The following statistical assumptions and considerations should be tested and/or considered.

(1) Distributional Assumptions

Log-normal distribution of data: USEPA assumes that all the water quality data used in their assessments are log-normally distributed. The document does not provide any evidence that this assumption is correct. In other words, there are no formalized tests (outside of an occasional plot) to support/validate this assumption. While normal probability and cumulative distribution plots are helpful in identifying severe skewness and kurtosis, more formal tests should be used to account for cases where the departure from normality is not obvious. This is especially true when setting strict compliance criteria.

(2) Linear Regression Assumptions

Log-normal distribution of residuals: USEPA used the (log transformed) chlorophyll *a* to nutrient relationship to set the nutrient criteria for lakes. These criteria are based on a statistical model (linear regression) between the two parameters. It does not appear that the normality of the residuals from this model was tested or discussed in the document. If the residuals statistically deviate from normality, then the prediction intervals are erroneous. However, the District did test the residuals of chlorophyll *a* vs TP for colored and clear lakes and found the residuals deviating from normality at the 0.05 level. Distribution assumptions should be tested using formalized tests rather than visual examinations (see Item 1).

(a) Constant variance of residuals (heteroskedasticity or homoskedasticity)

It appears the USEPA assumed (and did not test) that the residuals had constant variance. This assumption can be tested by doing a plot of residuals versus predicted values. High concentration of residuals above zero or below zero indicates the variance is not constant (systematic error exists). In addition, performing a plot(s) of the residuals versus the X value(s) can be done. A Fanning effect in the residuals indicates the variance is not constant. Formal tests such as White's and Breusch-Pagan's can also be performed.

A violation of constant variance assumption will cause the ordinary least squares (OLS) standard errors to be biased, so the usual confidence intervals and test statistics will be incorrect, and may lead to incorrect conclusions such as described below:

- If errors increase as X increases (fanning out as X increases) OLS underestimates true variance/standard errors and overestimates test statistics yielding p-values that are too small for tests of hypotheses and confidence/prediction intervals that are too narrow (Type I error inflation);

- If errors decrease as X increases (funneling inward as X increases) OLS underestimates true variance/standard errors and overestimates test statistics yielding p-values that are too small for tests of hypotheses and confidence/prediction intervals that are too narrow (Type I error inflation);

- If errors increases (up to a point) and then decreases as X increases (fanning out and then funneling inward as X increases) OLS overestimates true variance/standard errors and underestimates test statistics, yielding p-values that are too large for test of hypotheses and confidence/prediction intervals that are too wide (Type II error inflation).

(b) Measurement Error

A basic assumption of linear regression is that the data points are measured without error. The data points used in the regressions are annual means. Any mean has an error associated with it. How are these errors being accounted for in the determination of nutrient limits from the regression analyses? Based on the USEPA document, it is not apparent that this error was accounted for.

(c) Independence of Error Terms - successive residuals are not correlated

This assumption can be tested as follows by a plot of residual versus predicted value. Patterns in residuals such as successive positive residuals followed by successive negative residuals (positively correlated errors) or alternating positive and negative residuals (negatively correlated errors).

In addition, the Durbin-Watson test can be performed. Violation of the Independence assumption causes the ordinary least squares (OLS) standard errors to be biased, so the usual confidence intervals and test statistics are incorrect, and may lead to incorrect conclusions.

Positively correlated errors have the following effects on statistics. OLS underestimates standard errors and overestimates test statistics, yielding p-values that are too small for tests of hypotheses and confidence/prediction intervals that are too narrow (Type I error inflation). R^2 will be higher than it should be;

Negatively correlated errors has the following effects on statistics. OLS overestimates standard errors and underestimates test statistics, yielding p-values that are too large for tests of hypotheses and confidence/prediction intervals that are too wide (Type II error inflation). R^2 will be lower than it should be.

(d) Predictive Ability

The coefficient of determination (R^2) expresses the amount of variability in the Y-variable that is explained by the X-variable. It also determines how well the regression predicts the dependent value (Y-variable). Models with $R^2 \leq 0.65$ have low predictive power (Prairie 1996).

(3) Linear Regression Approach: Predictor/Predicted Values

Based on the regression plots as presented in the document, the nutrients (TP and TN) are the predictor variables (X-axis) and chlorophyll *a* is the predicted variable (Y-axis). USEPA establishes the chlorophyll *a* limit of 20 µg/L (based on a TSI=60) to set the nutrient criteria. Rather than regressing chlorophyll *a* as the predicted variable, USEPA should use it as the predictor because the interest is in establishing a nutrient limit for a given/required/fixed chlorophyll *a* concentration.

(4) Seasonal Differences: Comparison of Data

USEPA used a simple box plot of wet and dry season chlorophyll *a* data for clean and colored lakes (their Figure 1-3) to show that there is not a statistically significant difference between seasons. A notched box and whisker plot would have provided more information. However, a formal (two-sample) statistical test (e.g., t-test, Wilcoxon rank sum) should have been done and would provide more conclusive results.

(5) Handling varying method detection limits (MDLs) within the dataset

USEPA did not provide any information on how differing MDLs for a particular parameter (chlorophyll *a*, TN, TP) were handled. For instance, chlorophyll *a* MDL could range from 0.1 µg/L to 10 µg/L (based on STORET). It is not clear how USEPA applied these varying limits with regards to using significant figures for the overall data analyses. The spread in MDL values could be highly influential for lakes with low chlorophyll *a* criterion (e.g. clear acidic lakes have a proposed limit of 6 µg/L).

C. Statistical Flaws in the Derivation Process: Canals

As stated in Section III of this document the District does not believe the inference model used by USEPA is appropriate for setting numeric nutrient criteria for South Florida Canals. Beyond the global concern of the methodology not being appropriate, the following comments on focused solely on concerns we have the statistical methodologies of the Canal section.

(1) Distributional Assumptions:

(a) Log-normal distribution of data

USEPA assumes that all the water quality data used in their assessments are log-normally distributed. The document does not provide any evidence that this assumption is correct. In other words, there are no formalized tests (outside of an occasional plot) to support/validate this assumption. Normal probability and cumulative distribution plots are helpful in identifying severe skewness and kurtosis. However, more formal tests should be used to account for cases where the departure from normality is not obvious. This is especially true when setting strict compliance criteria.

(b) Annual geometric mean is not representative for canals

Canals behave as streams when the water is flowing (mostly during the wet season) and as lakes/reservoirs when water is not flowing (mostly during the dry season). Therefore the annual geometric mean (for Chl*a*, TP and TN) used by USEPA to establish nutrient criteria may not be representative of the actual conditions for the waterbody since canals may not behave as either category (stream or lake) on an equal basis. Analysis of a certain year and across years should be done separately for flowing and not flowing regimes in canals. Flow weighted means rather than annual geometric mean Chl*a*/TN/TP concentrations might be more appropriate for analysis.

(c) Averaging over an entire waterbody is not representative for the canals crossing multiple regions.

Some canals cross 2-3 landscape regions and annual geometric mean over entire waterbody (canal WBID) might mask natural differences between different ecoregions. The table and the graph below present the TN annual geometric mean for the waterbody "3245" for the interval 1996 through 2009. This canal crosses two ecoregions: HESEA and SEA. TN annual geometric mean averaged over the stations along for the entire waterbody is compared to TN annual geometric mean averaged over the stations placed in ecoregions HESEA and SEA separately. Note in the graph that each ecoregions appear to differ from the average over the entire canal. In addition when the annual geomeans for the entire canal and the ecoregions are compared, they were all found to be significantly different statistically.

(d) Improper use of a single distribution to determine a percentile

Using a single distribution (of Chl*a*, TN or TP respectively) to determine a percentile as the threshold for chlorophyll *a* and nutrients may be incorrect because different distributions may exist between different ecoregions. We used the canal data set provided by USEPA and arithmetic averages of the annual geometric means were calculated by ecoregion for Chl*a*, TN and TP. These averages are provided below and clearly show that differences exist between these means across ecoregions. The tables suggest that the data may not come from a single distribution and such differences need to be investigated. Also the disparity in the number of records and the period of records between the nutrient and Chl*a* datasets might produce a bias in the analysis.

Table 3: Arithmetic averages of the annual geometric means calculated by ecoregion.

Ecoregion	Period of Records	# data points	TN (mg/L)
HESEAA	1973 - 2009	399	2.80
HESEPA	1976 - 2009	771	1.81
SAS	1973 - 2009	490	1.08
SEA	1974 - 2009	1305	1.41

Ecoregion	Period of Records	# data points	TP (mg/L)
HESEAA	1973 - 2009	471	0.078
HESEPA	1976 - 2009	1023	0.027
SAS	1973 - 2009	582	0.048
SEA	1974 - 2009	1705	0.071

Ecoregion	Period of Records	# data points	CHLA (µg/L)
HESEAA	1994 - 2007	19	7.75
HESEPA	1994 - 2007	79	3.06
SAS	1996 - 2008	227	3.27
SEA	1996 - 2008	271	4.32

(2) Percentiles

(a) Percentile calculations

The use of percentiles generated from lognormal distributions to derive chlorophyll *a* and nutrient criteria is unsubstantiated because documentation has not been provided showing that the data follow a lognormal distribution (i.e., no formalized test to prove that log transformation normalized data). It would be more appropriate to simply calculate the percentiles from the available data, instead of generating them based on summary statistics (mean and standard deviation) of an assumed distribution of the data. In other words, use the available data and determine desired percentiles.

(b) Regional limits for chlorophyll *a* and nutrients

It appears that different regions were used to calculate the 75th percentiles for chlorophyll *a*, Total P and Total N. It is not clear from the document whether the preponderance of the data comes from one particular region or if the data are approximately evenly distributed across the regions. This could result in a region being under/over represented in the data. It appears from the map (Figure 4-3), that certain canals may be over represented (due to the close proximity of sampling sites along the same canal) while other canals are underrepresented.

(3) Setting Criteria

(a) Unimpaired canals

It is not clear why the 75th percentile is being used to set a nutrient criterion from unimpaired canal data. This means that 25% of the "clean" canals do not meet criteria. The nutrient criteria should be set to maximum nutrient level using "unimpaired" canal data sets.

(b) Chlorophyll *a* criterion

The Chl*a* data set contains approximately 5-fold fewer stations than the nutrient data sets. Based on the geometric mean and 75th percentile, it would be a safe assumption to say that some stations (~25%?) in the EVPA would not meet the criterion. The chlorophyll *a* criterion based on the 75th percentile is at (or within) the PQL range. The District's freshwater Chl*a* MDL is 1.0 µg/L. Collier County has an MDL level for Chl*a* at 3.0 µg/L.

It appears that the statistical analyses performed for chlorophyll *a* may be highly skewed by data with concentrations between the MDL and PQL. Is it the contention of USEPA that Chl*a* criterion should be set at practically the method detection limit? USEPA has categorized several District canals (e.g., C-44, C-43) as streams rather than canals. Both of these canals carry Lake Okeechobee water to tide. Since these canals have been classified as streams, there is no proposed Chl*a* criterion. What makes these canals different from other canals (such as C-51) that discharge to tide and not to the EVPA?

In canals, the relationship Chl*a* vs nutrients is hard to define and quantify. Chlorophyll *a* can be produced within the canal when discharges are less frequent and of smaller volume. During periods of flow, chlorophyll *a* will be transported from other regions and therefore no correlation with the nutrient concentrations would be expected, just as it was not found in streams. Based on the USEPA's analyses, they realized that the correlation between waterbody annual geometric mean chlorophyll *a* vs nutrients (TN/TP) was weak and was not used in the determination of nutrient criteria.

(4) Linear Regression Assumptions

The District has the same concerns with the USEPA’s linear regression assumptions for South Florida Canals as stated in this section for Lakes.

V. South Florida Water Management District Response to USEPA Proposed Numeric Nutrient Criteria: Criteria Implementation Issues

A. Restoration Programs and Projects

The implementation of the numeric nutrient criteria from USEPA will have significant affects on current environmental restoration efforts being conducted by the South Florida Water Management District, including the Comprehensive Everglades Restoration Plan (CERP). CERP was approved by Congress as the framework for Everglades Restoration in the Water Resources Development Act of 2000 (WRDA-2000). CERP components include Stormwater Treatment Areas (STA's), surface water storage reservoirs, aquifer storage and recovery, seepage management, operational changes, and other components to be implemented over 35 years. To date, the state of Florida has invested over 1.8 billion dollars towards CERP.

The Florida Legislature in 2007 adopted the Northern Everglades and Estuaries Protection Act (NEEPA) to strengthen protection for the Northern Everglades. NEEPA recognizes Lake Okeechobee, Caloosahatchee and St. Lucie watersheds are critical water resources of the State and consolidates numerous restoration activities into a comprehensive approach.

All restoration projects, including CERP and Northern Everglades, are regulated under Chapter 373, Florida Statutes (F.S) to ensure protection of the State's water resources and specifically need to meet the State's water quality criteria. There are a variety of specific regulations for restoration projects with varying water quality requirements. For example for CERP projects, state water quality standards, including water quality criteria will be met. Under no circumstances shall the project component cause or contribute to violations of state water quality standards. However, for Lake Okeechobee restoration projects, discharges must be "of equal or better quality than inflows" and "not pose a serious danger to public health, safety, or welfare" for water quality parameters other than phosphorus. Fla. Stat. § 373.4595(7)(d).

Implementation of the nutrient criteria may have a significant impact on restoration projects in Florida, depending on how the criteria are applied. Strict application of the criteria could result in project redesigns, the need for additional land acquisition, project delays, increased costs, and ultimately could result in the inability to move forward with restoration projects. The criteria will also likely result in reduced flexibility of operations, and operational constraints that may reduce or negate the effectiveness of restoration projects.

For example, the initial WRDA of 1996 authorized the United States Army Corps of Engineers (Corps) to cost share with the state of Florida (50-50) on CERP water quality features the Secretary of Army deemed to be essential to Everglades Restoration. In addition, the April 1999 Feasibility Report ("the Yellow Book") determined 22 project components with water quality features to be essential to Everglades Restoration and recommended 50-50-costs share on these. However, the Corps has subsequently interpreted the "essential to Everglades Restoration" cost share requirement to apply only to those projects or components that provide WQ improvement beyond the State WQS that would need to be achieved prior to inflow to the project. For example, through the Lake Okeechobee Watershed Project process the Corps has indicated that they are unsure if there will be federal cost sharing water quality elements of this project as a result of the establishment of a TMDL for Lake Okeechobee, even though the TMDL is a restoration standard. For example, the Corps has indicated reluctance regarding possible federal cost sharing on water quality elements of the Lake Okeechobee Watershed Project as result of the establishment of a TMDL for Lake Okeechobee, even though the TMDL is a restoration standard.

The District is unsure how the Corps will work within the context of numeric nutrient criteria as we continue our discussions with them on this complex issue. However, the development of numeric nutrient criteria without sound science will lead to even more challenges for our Federal Partners in Everglades restoration The proposed rule will result in inherent conflicts between CERP's overall South Florida restoration goals (i.e., "getting the water right," Quality, Quantity, Timing and Distribution of water) and new federally imposed water quality standards that have poor scientific linkages to protecting the environment and no linkages to the region's current comprehensive restoration plan.

In order to avoid these affects on environmental restoration projects, USEPA needs to include restoration specific provisions within the new regulations, which recognize the unique nature of restoration projects. Typically, restoration projects are not a source of pollutants, rather they result in a net improvement to water quality and/or quantity. A restoration project should not be held responsible for fully resolving water quality problems caused by other point and non-point sources, therefore restoration specific provisions such as net improvement provisions, exemptions, variances and/or compliance schedules for large scale restoration projects and STA's should be included within the new regulations.

With regard to water quality restoration projects, most of the emphasis in Everglades Restoration has been on nutrient reduction. To date, the focus has primarily been on the use of natural treatment systems (e.g., Stormwater Treatment Areas) for phosphorus reduction. Significant data collection and management practices have been in place to ensure maximum performance for phosphorus removal. STA's have not been focused on or designed to reduce other nutrients that are included in the proposed nutrient criteria rule (e.g. nitrogen or chlorophyll *a*). It is not currently clear, the extent to which these natural treatment systems can be optimized to reduce nitrogen or chlorophyll *a* to levels consistent with the proposed criteria.

In addition, several restoration projects are planned and designed to address water quantity rather than quality (e.g., storage reservoirs, hydropattern restoration, Aquifer Storage and Recovery). If the proposed criteria are applied in a strict manner, a restoration project designed to improve water quantity issues could also be held responsible for resolving water quality issues and ensuring discharges could comply with proposed criteria. Currently as a part of the

Comprehensive Everglades Restoration Plan, the District and U.S. Army Corps of Engineers have NPDES permits for their ASR pilot projects that allow them to return water back to its regional source (e.g., canal). The proposed criteria have the potential to adversely impact those permits.

It has always been recognized that Everglades Restoration will take a comprehensive approach involving a large number of projects that work together to achieve restoration. Applying water quality criteria in a way that forces each project to fully achieve/address water quality issues will significantly impact the current approach to restoration. Therefore, consideration of alternatives specific for restoration projects is imperative in order for restoration to continue.

B. Effects on State of Florida's Current Total Maximum Daily Load Program

The District is concerned that the numeric nutrient criteria proposed by USEPA does not consider fully the current total maximum daily load program (TMDLs) and Basin Management Action Plan (BMAP) processes already in place. Through programs such as the Northern Everglades (see section IV.A.), the District has been participating and investing significant time and resources with both the TMDL and BMAP processes.

As noted by USEPA in its preamble of the numeric nutrient criteria rule, the state of Florida is a leader across the nation in terms of its (TMDLs). From the rule:

"Moreover, Florida is one of the few states that has in place a comprehensive framework of accountability that applies to both point and nonpoint sources and provides the enforceable authority to address nutrient reductions in impaired waters based upon the establishment of site specific total maximum daily loads (TMDLs)."

Through the Florida Watershed Restoration Act (Fla. Stat. § 403.067), the Florida Department of Environmental Protection has developed a prototype five-step program to manage the listing of impaired waters, the development and implementation of TMDLs across the state. These are the same TMDLs that have been approved by the USEPA. Yet, in the rule, USEPA states

"TMDL targets submitted to USEPA by the State for consideration as new or revised WQS could be reviewed under this SSAC process."

The District is uncertain how this affects current TMDLs. The District cannot support the requirement that TMDLs be resubmitted under the Site Specific Alternative Criteria process. This would slow down water quality restoration efforts across the state and run in conflict with USEPA's stated goal of speeding up the process with numeric nutrient criteria. For example, it would seem stakeholders in a BMAP planning process would be hesitant to start planning for load allocations if the TMDL has a significant chance of being delayed and/or changing.

In addition, the District has concerns with the Proposed Restoration Water Quality Standards (WQS) Provision and its comparability with the BMAP program. Initially some portions of the

Restoration WQS provision reads similar to BMAP language. In fact, USEPA acknowledges the Florida BMAP program covers many of the provisions in the Restoration WQS process. However, USEPA goes on to state:

"To the extent necessary, FDEP could potentially use aspects of the BMAP process and plans such as these to help form the basis for Restoration WQS."

The District is uncertain how this affects current BMAPs. Will current BMAPs for nutrients need to be resubmitted under the Restoration WQS process? If so, this would seem to slow down water quality restoration efforts significantly across the state and run in conflict with USEPA's stated goal of speeding up the process with numeric nutrient criteria. For example, it would seem stakeholders in a BMAP planning process would be hesitant to start planning and allocating funding for restoration projects if a BMAP has a significant chance of being delayed and/or changing.

If BMAP components would need to be integrated with the USEPA's Restoration WQS process then it would appear from the rule that Use Attainability Analyses would need to be retroactively performed for all current nutrient TMDLS and BMAP processes. The District requests USEPA to determine the number of UAAs developed nationwide over the last 5 years and the approximate length of time and resources it has taken to develop them. This information will assist us in understanding how the Restoration WQS process will be implemented.

Overall, the District supports the FDEP's approach for the TMDL and BMAP process as the proper alternatives. As stated in the draft numeric nutrient criteria (draft revisions Florida Administrative Code [F.A.C.] July 2009) presented at a public workshop (Marco Island Florida July 22, 2009) the FDEP would, in effect, take all current TMDLs as SSACs immediately within their rule without further administrative review. In addition, the District requests the USEPA to utilize the FDEP's current BMAP process over the Restoration WQS.

C. Effects on Water Supply Reuse Programs and Projects

Although the District does not directly operate or regulate water reuse, it has actively promoted, encouraged, and funded water reuse programs. The District is concerned that the proposed criteria may impact the ability of local wastewater utilities to provide reclaimed water – and it may have a ripple effect throughout the water management activities in the District. Reclaimed water has been a valuable resource in meeting existing water needs and is critical to meet future water needs. Currently, almost 240 million gallons per day of previously wasted water is being reused in the District.

In response to the state objectives in Sections 373.250 and 403.064, Florida Statutes, of "encouraging and promoting reuse," the State of Florida has developed a comprehensive reuse program. The Florida Department of Environmental Protection (FDEP) has created extensive rules dealing with water reuse which are contained in Chapter 62-610, F.A.C.

Water reuse involves taking domestic wastewater, giving it a high degree of treatment, and using the resulting high-quality reclaimed water for a new, beneficial purpose. Extensive treatment and disinfection ensure that public health and environmental quality are protected.

Florida Statutes state, "A water management district may require the use of reclaimed water in lieu of surface water or groundwater when the use of uncommitted reclaimed water is environmentally, economically, and technically feasible and of such quality and reliability as is necessary to the user." Fla. Stat. § 373.250. Additionally, "The South Florida Water Management District shall require the use of reclaimed water made available by the elimination of wastewater ocean outfall discharges … in lieu of surface water or groundwater when the use of uncommitted reclaimed water is environmentally, economically, and technically feasible and of such quality and reliability as is necessary to the user. This legislation directed that each domestic wastewater facility that discharges through an ocean outfall shall install a functioning reuse system no later than December 31, 2025." Fla. Stat. § 403.086.

The District is concerned that the proposed criteria will trigger violations related to water reuse, causing local wastewater utilities to abandon or reduce the practice – thus eliminating or reducing the reuse of a beneficial, fresh-water resource. As an example, consider a south Florida wastewater utility that has invested to upgrade its facilities so it can produce reclaimed water. As in many cases in south Florida, the utility delivers its reclaimed water to a storm-water pond at a local golf course. The golf course, in turn, uses the combination storm-water/reclaimed water pond for irrigation of the golf course and, in some cases, residences. The pond is connected for flood protection purposes to the regional drainage canal. As a result of the proposed criteria for canals, the utility might be in violation of its NPDES municipal separate storm sewer system (MS4) permit. If so, the utility either pays for costly upgrades to its treatment facility to meet the criteria, or it chooses to dispose of the reclaimed water in a deep injection well previously used as a backup.

Other main concerns with the numeric nutrient criteria on reuse programs include:

- Reclaimed water is a valuable, fresh-water resource (i.e., water management tool) for the District. As a water management agency, the use of reclaimed water is essential to reducing the dependence on limited fresh-water sources, such as groundwater and surface water. If water reuse declines as a result of the proposed criteria, stress on these limited resources would increase.
- Any reduction in existing or projected water reuse would result in unmet water needs, and increased additional investment in costly alternative water supplies would be required, if available.

- Effluent disposal, in lieu of reuse, would increase (e.g., deep-well injection)
- For those utilities that decide to continue a water reuse program, wastewater treatment costs will dramatically increase. Such cost increases, ultimately to be borne by the rate payer, may not be economically or politically feasible and reduce water reuse in the future.
- Those utilities that are required by State legislation to reuse a minimum 60% of their ocean discharge (Ocean Outfall Legislation, Chapter 2008-232) might be severely handicapped in their ability to meet those requirements.
- The proposed criteria could affect the availability and timing of water in environmentally-sensitive areas. The loss of reclaimed water might adversely affect water reservations that the District is developing to secure the long-term availability of water for thousands of fish and wildlife species throughout the region. The effect may come directly from disposal instead of reuse (e.g., deep-injection wells) or indirectly by increasing groundwater and surface water withdrawals to substitute for the loss of reclaimed water. Those additional groundwater and surface water allocations may be in direct competition with the environmental needs.
- The proposed criteria could limit or eliminate the use of Aquifer Storage and Recovery (ASR) technology as a component in the federally-partnered Comprehensive Everglades Restoration Plan (CERP). Currently, the District and U.S. Corps of Engineers have NPDES permits for their ASR pilot projects that allow them to return water back to its regional source (e.g., canal). The proposed criteria have the potential to adversely impact those permits and therefore ASR technology, which is a vital component to restoring America's Everglades.

D. District Regulatory Programs

The proposed NNC rule may require existing regulatory programs (Rules 40E-61 and 63, F.A.C. for the District) that currently focus on total phosphorus source control Best Management Practices (BMPs), the limiting nutrient for the waterbodies of concern, to be amended to include nitrogen source control BMPs. These programs have reduced phosphorus loads up to 50% compared to historic levels. Amending and implementing these rules to add BMPs for nitrogen will require additional resources from the District to conduct research, monitoring, rulemaking, implementation and compliance with no real ecological benefit since nitrogen is not the limiting nutrient.

The proposed NNC rule has the potential to erroneously increase the number of impaired waterbodies, thus, increasing the complexity of Environmental Resource Permit (ERP) applications and the resources necessary for the agencies implementing the program and the entities applying for the permits. The District issues an average 1,800 permits per year. The District and the other 4 water management districts, along with FDEP, issue these permits throughout the State.

The State ERP program, in existence since the mid 1980s, and a proposed comprehensive statewide revision to the water quality treatment aspects of the ERP program (focusing on nutrient reduction) are predicated on a rebuttable presumption that an applicant will not cause or contribute to violations of surface water standards if the applicant is in compliance with the design criteria within the rules. In addition, the ERP program provides state water quality certification. The proposed NNC rule could require a change in the water quality analysis methodology and compliance requirements to be similar to NPDES permits, which the state agencies do not have the authority to implement. This could result in the State no longer being able to issue water quality certification.

Currently, the State has a net improvement provision for retrofit or restoration projects submitted for ERP applications. The proposed NNC rule does not have these provisions, which could severely limit the number of retrofit or restoration projects being submitted. Without net improvement provisions local governments and other entities would not be able to get ERP permits for projects designed to improve waterbodies that are impaired.

E. Additional Peer Review and Comment

EPA's own Scientific Advisory Board ("SAB") found substantial shortcomings in the technical guidance documents published by EPA in order to assist states in developing their own numeric standards, yet EPA did not return to the SAB for a peer review of the scientific methodologies and approaches underlying the current proposed rule. In fact, no review of the methodology and approaches utilized to develop the canal criteria was ever undertaken or included in the proposed rule. The District strongly recommends that EPA delay promulgating criteria, particularly for streams and canals in the state, until such time as a more thorough peer review is undertaken by the SAB, National Academy of Sciences, or other nationally recognized scientific panel to determine the validity of the technical and scientific underpinnings of the proposed criteria.

Although EPA requested that stakeholders comment on the alternatives considered as part of the rulemaking process, it failed to include adequate methodological explanations or explanations of scientific assumptions underlying these alternatives, instead addressing the alternatives in "general terms." *See Amer. Med. Ass'n. v. U.S.,* 887 F.2d 760 (7^{th} Cir. 1989) (holding that notice was inadequate when an issue was only addressed in general terms in the initial proposal). The District was therefore unable to thoroughly address the validity of the science and methodologies supporting the considered alternatives. The District has also had no opportunity to address any alternatives proposed by other commenting stakeholders. The District respectfully requests that should the EPA change its approach and methodology to adopt a different rule than that proposed based on either those alternatives considered in the proposed rule or any alternative proposed by a commenting stakeholder, it republish the proposed rule to allow additional time for review and comment on the newly adopted alternatives. A substantially changed final rule based on alternatives utilizing different methodologies and scientific assumptions that currently lack an adequate explanation of scientific assumptions and methodologies would not qualify as a logical outgrowth of the rulemaking process and EPA should not promulgate a final rule based on these alternatives until a new round of comments was held so that stakeholders would be provided "their first occasion to offer new and different criticisms that the agency might find convincing," regarding the newly adopted alternatives. *See Assoc. of Battery Recyclers Inc. v. U.S. EPA*, 208 F.3d 1047 at 1059 (C.A.D.C. 2000).