

## DEP Responses to EPA's 9/16 Comment Letter

10-9-09

Overall, FDEP found EPA's comments very comprehensive and detailed. However, it was not always clear whether the comment was offered as a suggestion/observation, or whether the comment was an alert to the State that, if adopted, a disapproval action would be forthcoming. As the State has already invested a significant amount of public resources in the current draft, including a briefing of the Environmental Regulatory Commission (ERC), it would be helpful for EPA to identify those comments that alert the State to an impending disapproval and provide the rationale so that we can fully address the issue and brief FDEP leadership.

### Definitions

- 1) EPA suggested edits to the definition of lakes to help differentiate from wetlands (use depth, vegetation or water residence time to distinguish), and noted that they do not want to exclude lakes based on size.

**Response:** The primary intent of the definition is to differentiate lakes from wetlands, and was developed based on input from our wetlands permitting staff (Environmental Resource Permitting Program). While the definition reflects their input (and is described below), we would like to emphasize that any waters that are defined as wetlands, rather than a lake, based on size will still be protected from nutrient impairment under the current narrative criteria and under a numeric nutrient criteria, once numeric criteria are available for wetlands.

As part of Florida's adopted methods for delineating wetlands and determining the extent of State waters established under Section 373.4211, Florida Statutes, DEP's Environmental Resource Permitting Program has established a threshold of two acres of open water to distinguish lakes from wetlands. Florida, with over 7,800 lakes of two acres or greater, has more lakes than any other state. Florida has extremely rich wetland resources as well, with over 10% of the land surface classified as wetlands. It is DEP's stated mission to protect both resources, however, for practical purposes, it is necessary to classify systems appropriately to ensure the correct assessment tools (Lake Vegetation Index versus Wetland Condition Index) are applied to the proper waterbody type. In Florida, lakes with 2 acres or less of open water are generally associated with water depths of < 2 feet (conditions closely associated with wetlands). A literature search indicated that most entities consider a "pond" to be defined by an open water area of 5 acres or more, making DEP's lake definition more inclusive than other lake definitions. For the purposes of lakes nutrient and biological criteria, the "two acres of open water" definition has a long, legally accepted history of use, and is an appropriate way to distinguish lakes from wetlands.

- 2) EPA asked about the term "free-flowing" in the definition for streams.

**Response:** The definition is based on a statutory (Chapter 373, F.S.) definition for streams, but DEP will propose to delete "free".

- 3) EPA suggested we edit the definition of “water quality standards” to include “policies” or “procedures” in front of mixing zones so that we would not have to submit individual mixing zones, and asked for clarification on what “exemptions” the rule referred to.

**Response:** We agree to propose the addition of “procedures” and deletion of “exemptions.”

#### 62-302.531 Numeric Nutrient Criteria: General

- 1) EPA suggested some wordsmithing to the paragraph that mentions SSACs established based on adopted TMDLs, noted that the SSAC should only be based on the nutrient addressed in the TMDL, and recommended a separate paragraph addressing the process for adopted TMDLs as SSACs.

**Response:** DEP will review at a later date.

- 2) EPA suggested some wordsmithing about the applicability of the narrative criteria, which would make paragraph (a) of the narrative criterion apply to all waters.

**Response:** DEP recognizes the benefit of continuing to apply the narrative. However, it was our impression that EPA is no longer considering narratives as acceptable nutrient criteria in the State of Florida (next comment). FDEP will consider continuing to apply the narrative criterion if that is still acceptable.

- 3) EPA noted several “indications” that the draft criteria are not protective of downstream waters, and asked for clarification of “best available scientific information”.

**Response:** There are equivalent lines of evidence that the draft criteria are inherently protective of downstream waters including, Gulf Breeze’s analysis in the Apalachicola River Basin, overlap in distribution of “all streams” and benchmark when using a truly probabilistic design, evidence that low DO streams exhibit those concentrations in the natural and minimally disturbed conditions, and natural condition modeling in Fisheating Creek revealed similar TP values that those represented by the draft criteria. However, there will be circumstances when the draft criteria may not provide the full level of attention. In those cases, FDEP has proposed narrative criteria for protection of downstream waters to account for site specific circumstances. FDEP would like to note that where exact science is limited, narrative criteria are fully approvable under current federal regulations [40 CFR 131.3(b)].

#### 62-302.533 Numeric Nutrient Criteria: NO<sub>2</sub>/3 in Clear Streams

- 1) EPA requested supporting documentation for:

- Time scale for color?

**Response:** The instantaneous color of each sample will be used to establish clear versus colored conditions, and then any samples that qualify as clear will be assessed against the criterion. This approach results in a very conservative criterion, since it takes weeks for biological responses to nutrients be realized after color is no longer an issue.

- How are streams with color > 40 protected?

**Response:** Due to light limitation, DEP and Tetra Tech could find no cause-effect relationships between nitrate and biological response in streams with color >40 PCU, therefore, they are inherently protected through the proposed criterion.

- How do 10% exceedances and binomial relate, and what is basis for the 10% exceedance rate?

**Response:**

As explained in DEP's TSD, the clear streams nitrate criterion was derived based on multiple lines of evidence, with the primary lines of evidence being mesocosm dosing experiments and field studies. These two main studies were conducted over very different time frames. Stevenson's mesocosm studies were conducted for periods just under one month (i.e., 21 to 28 days), while the algal biomass field study from the Suwannee drainage basin was conducted over an eighteen year period and was analyzed using four to five year averaging periods. While lab studies indicate that algal communities can respond to excess nitrate over a short period of time, the mesocosm and other dosing studies indicate that this response occurs on the order of a month, which led DEP to propose a monthly expression of the criterion. Further, there is no evidence to suggest that the short-term responses observed under controlled lab settings equates to impairment of the designated use in conditions experienced in State waters. In fact, the more realistic field surveys demonstrated that excess biomass does not become persistent in clear streams until average nitrate exceeds 0.441 mg/L. The 0.441 mg/L threshold was adjusted to 0.35 mg/L to provide a fully protective criterion with a low likelihood of excess algal growth.

The 10% exceedance frequency was established in recognition that in most cases the monthly "median" will actually be based on a single sample. DEP considered the option of setting a minimum sample size to calculate the monthly median, but given the potential data limitations (most streams are only sampled monthly at the most), decided it was best to not set a minimum sample size and instead allow a 10% exceedances frequency. However, it should be emphasized that application of a 10% exceedance frequency of the monthly criterion is still highly conservative and will necessitate maintenance of a long-term average nitrate conditions well below the established response threshold. For example, given the typical variance in the data, a stream with a long-term annual average nitrate concentration at 0.35 mg/L would be expected to exceed the criterion during approximately 50% of the months, well in excess of the frequency allowed. Review of the month to month nitrate variability at stream benchmark sites and sites within the Suwannee drainage basin suggests that average concentration within a stream would need to be below 0.10 mg/L in order to consistently meet the <10% exceedance requirement.

As for the question about the binomial, DEP concluded that the binomial is well-suited to assess compliance with a criteria expressed as not to be exceeded more than 10 percent of the time. DEP currently uses this approach (and EPA has approved it) for evaluation of the fecal coliform criteria (the component expressed as not to be exceeded in more than 10% of the samples).

- 2) EPA asked what evidence supports the conclusion that keeping NO<sub>2</sub>/3 concentrations below which lyngbya growth/biomass is low support healthy native plant communities, and whether 0.23 mg/l would be more appropriate?

**Response:** DEP assessed all available scientific information in an effort to develop protective nutrient criteria for clear streams. The evidence (as shown in the TSD) indicated that excess algal growth was the fundamental issue to address in these systems. DEP has determined that plant community shifts, in relation to nutrient enrichment in clear streams, occur only after algal smothering is sufficient to interfere with growth and development of the macrophytes. Therefore, prevention of the nuisance algal smothering, where unambiguous cause-effect relationships exist, would result in inherent protection of the aquatic plant communities. Note that no cause-effect relationship has been established between nutrient enrichment and plant communities in clear streams (because most aquatic plants receive their nutrients from sediment sources).

As stated in the TSD, both laboratory and field responses were evaluated to develop a protective nitrate criterion. The strength of laboratory experiments includes the ability to determine cause effect relationships under controlled conditions (which was how the 0.23 mg/L threshold was derived). However, because actual ecological responses to nutrients are influenced by many other variables (light penetration, flow, grazing, physical disturbance, etc.), lab studies alone do not conclusively demonstrate levels where “real world” adverse responses would be detected. If laboratory studies alone were the definitive answer to numeric nutrient criteria, EPA could establish nationwide criteria based upon the very lowest level of algal growth that could be detected during a nutrient addition experiment. Because nutrients are not toxic, and require an ecosystem response to exert actual adverse effects, it is the consensus of the scientific community that a “lab only approach” would be an unreasonable, overly restrictive way to derive nutrient criteria. In fact, EPA guidance does not recommend lab studies as a stand-alone approach.

DEP’s method was to use lab studies to demonstrate that nitrate caused nuisance algal growth, and then field studies to determine the levels where problems occurred under actual environmental conditions. DEP then applied a protective margin of safety to gain 95% confidence that adverse responses would not occur if nitrate was maintained below 0.35 mg/L. During extensive public input, this approach was widely recognized as a defensible method.

#### 62-302.354 Numeric Nutrient Criteria: Lakes

- 1) EPA requested more documentation about use of alkalinity (and specific conductance) as basis for distinguishing clear lakes.

**Response:** Investigations of inherent fish diversity and abundance, and hence productivity, in Canadian lakes (Rawson, 1951; Rawson, 1952) documented the relationship between lake basin parent material, alkalinity and baseline phosphorus supply, and lake depth. Vighi and Chiaudani (1985) applied the concepts of Rawson and Ryder *et al.* (1974), and proposed the use of a morphoedaphic index (MEI) as a way to quantify the departure from inherent productivity due to accelerated eutrophication. The underlying premise of its use in this context is that, while phosphorus tends to increase with watershed development, the sources of alkalinity are relatively invariant. Hence, present day alkalinity can be used as a proxy for natural background phosphorus and inherent productivity.

An MEI has promise for Florida lakes, as the predominant natural background source of phosphorus, dissolution of limestone bedrock, leeching of calcareous soils in the contributing basin, and artesian inflow, also impart alkalinity. It also represents a way to distinguish between lakes with different inherent productivity that would otherwise be grouped together in an ecoregional classification approach. In northeast Florida, the most productive lakes are those of the central lake district that are in contact with the Eocene-Miocene limestone, at roughly at 20 meters above sea level. In the same lake region where these lakes reside, there are also many higher elevation sand ridge-perched lakes, with contributing basins in deep sands, that are not in contact with limestone, and exhibit very low phosphorus and productivity. The former typically exhibit calcium and magnesium concentrations above 30 mg/L and 10 mg/L, respectively, while the latter typically exhibit concentrations about one tenth of these.

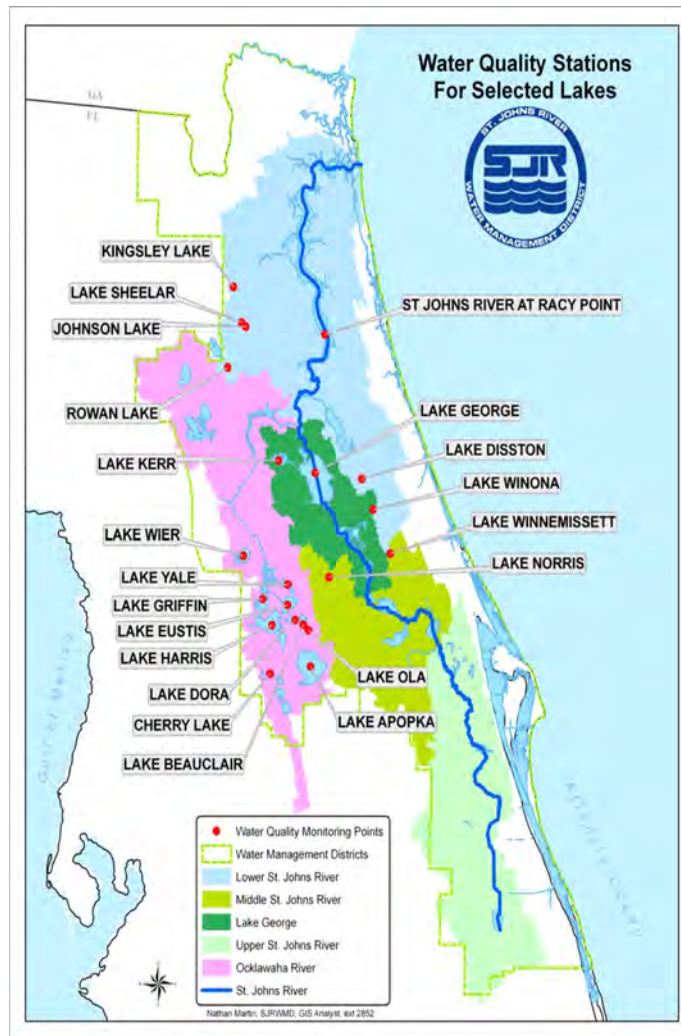
In the absence of a fully calibrated MEI for Florida, the TAC suggested on August 5, 2009 that different nutrient and chlorophyll *a* expectations should be established for high alkalinity (>50 mg/L) clear lakes because of the naturally higher, aquifer-derived phosphorus levels this subset of clear lakes. The TAC suggested that nutrient thresholds in clear, high alkalinity lakes should be based on preventing the annual average chlorophyll *a* from exceeding 20 µg/L. Subsequent work on a Florida lakes MEI provides support for these thresholds.

Although the index will require further development prior to direct criteria application, Lowe *et al.* (2009) developed an initial MEI for Florida lakes that is sufficiently calibrated to help inform protective chlorophyll thresholds related to natural background nutrient expectations. Lowe *et al.* (2009) compiled a dataset for northeast Florida lakes with approximately equal representation of the four lake types in the proposed FDEP lake numeric criteria: acid colored, acid clear, alkaline colored, and alkaline clear [we only have 3 types?]. The lakes are listed in Table 1, and locations of these lakes are shown in the map below. Data sources included the Environmental Data Base of the SJRWMD, the Lake Watch data base (for mean depth), and several published reports. One river system, the Fresh Tidal St. Johns (represented by the center station at Racy Point), was included in the data set, as this broad, slow-moving reach exhibits residence time and autochthonous productivity similar to lentic systems, and has traditionally been assessed in the 305(b) and 303(d) assessments with lake criteria. Individual lake medians were calculated for total phosphorus, chlorophyll *a*, color and alkalinity concentrations indicative of the natural background, or reference, condition. Color was included in the data set due to its inclusion in the draft criteria as a way to distinguish lake types.

Because several of the lake classes, most notably colored and clear high alkalinity lakes, represent highly valued aesthetic, recreational and productive systems, there are few remaining examples in undeveloped settings and, unfortunately, in an undegraded condition. For these lake types, it was necessary to rely upon either historic data, or reconstructed natural background conditions. Since most of these alkaline lakes in NE Florida are in the well-studied and intensively-managed St. Johns and Ocklawaha chains of lakes, they have been the subject of restoration studies under the TMDL or PLRG process, during which reconstructed natural background concentrations have been developed.

Several of these lakes have also been the subject of studies to reconstruct their pre-development condition (Whitmore and Brenner, 2002). For the St. Johns and Ocklawaha River TMDL and PLRG natural background condition reconstructions, a combination of contributing watershed modeling to estimate external phosphorus load for the hypothetical pre-development land cover, and receiving water body models to estimate in lake chlorophyll *a* and total phosphorus concentrations, were used (Fulton et al, 2004; Hendrickson et al, 2002). These reconstructions were corroborated with historic data where available.

Because sufficient examples of un-impacted low alkalinity clear and colored lakes still remain, existing condition data were used for a representative set of lakes that lacked development in the contributing watershed. These lakes have hereafter been referred to as “reference” lakes.



Locations of Lakes Used to Develop the Florida Morphoedaphic Index.

Lakes used in the Morphoedaphic Index Model

Lake	DEP Type	Ex/Re*	Area, ha.	Mean Depth (m)	Median Alkalinit, mg/L as CaCO <sub>3</sub>	Median Color, Pt-Co Units	MEI
Lake Sheelar	ACID CLEAR	E	7	9.9	0.9	10	0.002
Lake Winona	ACID CLEAR	E	30	4.9	3.7	10	0.015
Lake Kerr	ACID CLEAR	E	1,146	2.2	1.9	10	0.017
Kingsley Lake	ACID CLEAR	E	669	7.8	12.0	10	0.031
Lake Winnemissett	ACID CLEAR	E	66	4.0	9.4	10	0.047
Lake Ola	ACID CLEAR	E	179	3.5	30.8	10	0.178
Lake Wier	ACID CLEAR	R	2,332	5.4	14.0	10	0.052
Lake Annie (Highlands Co.)	ACID CLEAR	E		8.0	3.0	10	0.008
Cherry Lake	ACID COLORED	E	160	3.3	2.0	75	0.012
Lake Disston	ACID COLORED	E	774	2.6	3.2	400	0.025
Lake Norris	ACID COLORED	E	458	2.8	26.0	440	0.189
Lake Rowan (Ordway)	ACID COLORED	E	106	2.5	3.0	200	0.024
Crescent Lake	ACID COLORED	R	6,879	2.5	34.6	300	0.277
Lake Lochloosa	ACID COLORED	R	2,310	1.8	28.0	108	0.304
Orange Lake	ACID COLORED	R	3,478	2.8	23.0	71	0.164
Newnans Lake	ACID COLORED	R	2,400	1.9	12.0	135	0.128
Lake Eustis	ALKALINE CLEAR	R	3,161	2.5	100.8	20	0.806
Lake Griffin	ALKALINE CLEAR	R	2,164	2.0	110.9	30	1.119
Lake Dora	ALKALINE CLEAR	R	1,788	2.3	122.7	30	1.062
Lake Harris	ALKALINE CLEAR	R	5,582	3.2	93.1	20	0.581
Lake Yale	ALKALINE CLEAR	R	1,632	2.8	112.0	20	0.800
Lake Apopka	ALKALINE CLEAR	R	12,417	1.7	113.5	25	1.344
Lake Beauclair	ALK. COLORED	R	440	1.7	120.0	60	1.455
Fresh Tidal St. Johns River	ALK. COLORED	R	17,814	2.9	69.5	161	0.479
Lake George	ALK. COLORED	R	18,623	3.0	68.5	80	0.457
Lake Jesup	ALK. COLORED	R					

\*Unimpacted Existing Condition (E) or Reconstructed Natural Background (R).

Empirical models were developed from this set of reference (for currently unimpacted lakes) or reconstructed (altered, degraded systems) data, with the MEI and color as independent variables, predicting the natural background total phosphorus and chlorophyll *a*. Two versions of natural background models were evaluated: one that used reference condition and TMDL/PLRG reconstructed annual mean TP and chlorophyll *a* as dependent variables, and another that replaced the TMDL/PLRG estimated values of TP with the inferred limnetic P values where available.

**MEI Model**

The MEI model proposed by Vighi and Chiaudani (1985) related the  $\log_{10}$  of mean total phosphorus to the  $\log_{10}$  of the MEI, with the MEI calculated as mean alkalinity (milliequivalents/L) divided by mean depth (m). The median, rather than the mean, was used in this test as a measure of central tendency, as it is less prone to bias from outliers, and it eliminated the need to develop log-normalized means for variables that exhibit skewed distributions. The median alkalinity, color and the calculated MEI for the NE Florida test lakes are listed in the first table below. Calculated MEIs range from 0.002 to 1.45. For the lake data set developed by Vighi and Chiaudani, values ranged lower, from 0.001 to 0.32, and this appears to be due to the lack of shallow, high alkalinity lakes in their analysis, in comparison to the Florida lake data set used by Lowe et al. The existing reference lake or reconstructed natural background concentrations for TP and chlorophyll are also provided in the table below.

A set of simple two-factor multiple regression models were developed that used the MEI and color to predict either the natural background or chlorophyll *a*. Model versions were tested with MEI and color annual medians untransformed, or were based on the  $\log_{10}$  transformed values (as was the case for the original Vighi and Chiaudani model). This set of regression models are listed in the second table below.

All of the models developed with this test data set were highly significant. With the exception of color in the model to predict natural background chlorophyll *a*, both MEI and color individually were highly significant factors in determining both background chlorophyll *a* and TP. All models also produced slopes between predicted and observed very close to 1, with intercepts close to zero, suggesting very little bias with this data set of wide-ranging lake types. The F-statistic for a color =  $f(\text{MEI})$  model was not significant, indicating that these two variables are independent of one another and hence account for contrasting environmental gradients in the continuum of inherent lake productivity.

The natural background chlorophyll *a* model also had the poorest fit between predicted and observed annual medians (Adjusted  $R^2 = 0.58$ ). This is in contrast to the relatively high fit correlations seen for natural background models for TP. The version of the natural background TP model that relied on a combination of reference lake existing condition, TMDL reconstruction for the St. Johns, and inferred limnetic P (Whitmore and Brenner, 2002), produced the highest adjusted  $R^2$  of 0.88. The relatively poor fit and lack of significance of color in the natural background chlorophyll model may be due to the somewhat hypothetical nature and degree of extrapolation inherent in trying to estimate pre-development chlorophyll concentrations. Use of paleolimnologic techniques to directly estimate historic chlorophyll concentration, rather than relying upon phosphorus to chlorophyll relationships employing phosphorus concentrations determined by historic reconstruction, could improve the natural background chlorophyll model.

Existing Condition and Reconstructed Natural Background Phosphorus and Chlorophyll Concentrations  
for the MEI Example Lake Data Set.

Lake	DEP Type	Method*	Current Median TP, µg/L	TMDL/PLRG Natural Background TP, µg/L	Whitmore Inferred Limnetic P, µg/L	Current Median Chl. a, µg/L	Est. Natural Background Chl. a, µg/L
Lake Sheelar	ACID CLEAR	E	5.4	5.4		2.2	2.2
Lake Winona	ACID CLEAR	E	9.0	9.0		1.8	1.8
Lake Kerr	ACID CLEAR	E	11.7	11.7		1.4	1.4
Kingsley Lake	ACID CLEAR	E	7.0	7.0		2.1	2.1
Lake Winnemissett	ACID CLEAR	E	9.0	9.0		1.5	1.5
Lake Ola	ACID CLEAR	E	16.5	16.5		2.7	2.7
Lake Wier	ACID CLEAR	P	13.7	13.0	18.5	9.8	7.0
Lake Annie	ACID CLEAR	E	2.4	2.4		5.0	5.0
Cherry Lake	ACID COLORED	E	21.6	21.6		5.2	5.2
Lake Disston	ACID COLORED	E	34.1	34.1		3.0	3.0
Lake Norris	ACID COLORED	E	63.0	63.0		1.3	1.3
Lake Rowan (Ordway)	ACID COLORED	E	40.5	40.5		13.4	2.9
Crescent Lake	ACID COLORED	R	52.1	52.1		19.0	11.1
Lake Lochloosa	ACID COLORED	R	61.0	50.0		41.5	23.0
Orange Lake	ACID COLORED	R	59.0	28.0	51.0	29.4	22.0
Newnans Lake	ACID COLORED	R	192.9	60.0	54.0	166.1	20.0
Lake Eustis	ALK. CLEAR	R	42.0	24.0	29.5	53.9	20.0
Lake Griffin	ALK. CLEAR	R	62.0	28.0	28.8	82.8	24.0
Lake Dora	ALK. CLEAR	R	65.0	28.0	28.2	125.2	24.0
Lake Harris	ALK. CLEAR	R	42.0	23.0	39.6	51.4	18.0
Lake Yale	ALK. CLEAR	R	26.0	18.0	34.8	20.9	12.0
Lake Apopka	ALK. CLEAR	R	43.0	43.0		74.6	21.0
Lake Beauclair	ALK. COLORED	R	200.0	28.0	54.0	169.4	25.0
Fresh Tidal St. Johns	ALK. COLORED	R	89.0	45.0		27.0	12.3
Lake George	ALK. COLORED	R	68.0	44.0		25.9	15.0
Lake Jesup	ALK. COLORED	R		94.0			

\*Methods for Background TP and Chlorophyll Estimates: E = Existing condition; deemed unimpacted and representative of natural background. For these lakes, the natural background concentration = the current condition. P = For the Ocklawaha Lakes PLRGs, phosphorus loading was determined from watershed models simulating no basin development, and from P concentrations in reference lakes in the same region (Fulton et. al, 2004). R = Reconstructed from linked watershed modeling of loads simulating no basin development, and receiving water body assimilation and phytoplankton growth.

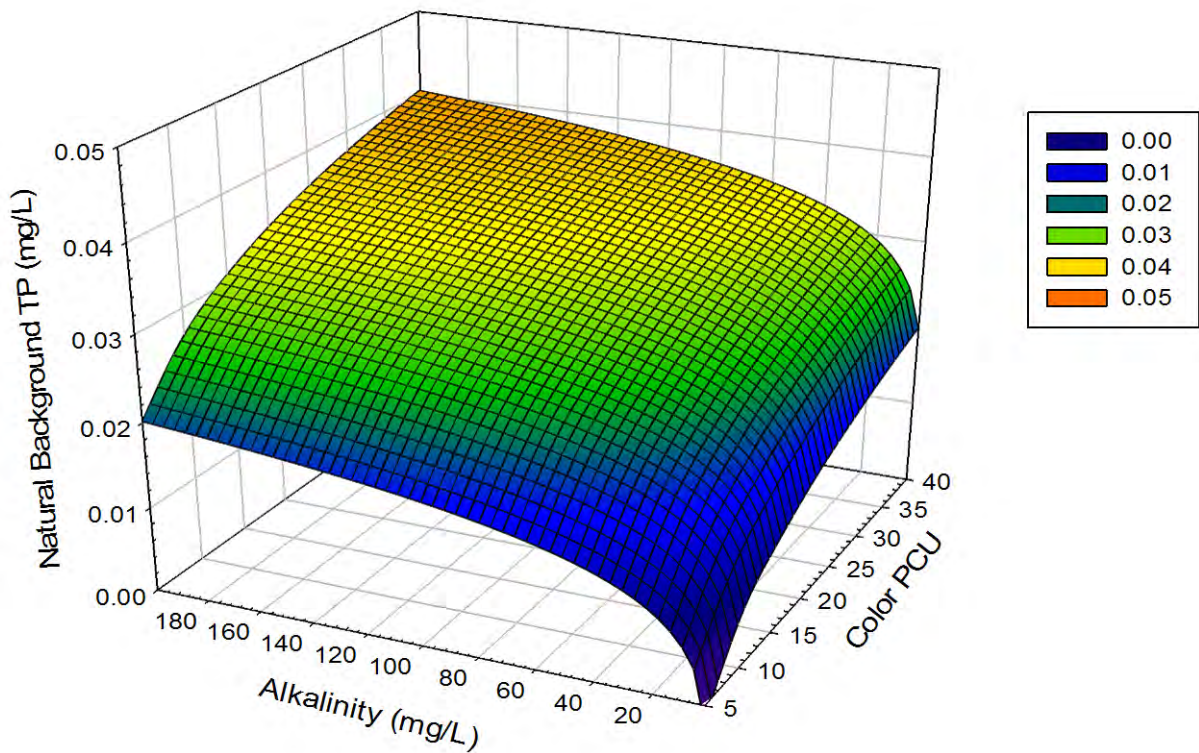
Multiple Regression Models Relating Natural Background and Designated Use Failure Threshold Annual Median Total Phosphorus and Chlorophyll *a* For 26 NE Florida Lakes With a Range of Color and Alkalinity.

Dependent Variable	Model	Variables Significance			Comparison Predicted vs. Observed			
		Regression F Statistic	P-value MEI	P-value Color	Slope	Intercept	R <sup>2</sup>	Adjusted R <sup>2</sup>
Natural Background TP Based on Reference Lakes or PLRG & TMDL Estimates	$\text{Log}_{10}(\text{TP}) = 0.822 + 0.210 * (\text{log}_{10}\text{MEI}) + 0.442 * (\text{log}_{10}\text{Color})$	71.6	3.85E-06	1.16E-08	0.90	0.82	0.86	0.85
Natural Background TP, Based on Reference Lakes and Inferred Limnetic P where available	$\text{TP} = 5.25 + 11.00 * (\text{log}_{10}\text{MEI}) + 22.48 * (\text{log}_{10}\text{Color})$	92.6	4.41E-07	1.53E-09	1.00	0.00	0.89	0.88
Natural Background Chlorophyll <i>a</i> : Existing for Unimpacted, or TMDL/PLRG Reconstructed	$\text{CHLA} = 5.89 + 14.92 * (\text{MEI}) - 0.002 * (\text{Color})$	17.4	9.10E-06	8.49E-01	1.00	0.00	0.61	0.58

The models developed by Lowe, *et al.* could ultimately be used to develop nutrient and chlorophyll criteria expressed as a continuous function of color and alkalinity as opposed to discrete breakpoints in these parameters. The current Federal promulgation schedule does not provide sufficient time to further develop and calibrate such a model. However, the model can be used to inform regulatory decisions related to natural background expectations, particularly for TP where the empirical regression for natural TP is statistically very significant. The MEI-color model was used to evaluate the relationship between alkalinity and natural TP and chlorophyll *a* expectations.

The natural background TP model [ $TP = 5.25 + 11.00 * (\log_{10}MEI) + 22.48 * (\log_{10}Color)$ ] was used to predict levels of background TP expected within clear lakes for a range of alkalinity conditions (see below). The depth valued used to calculate the MEI portion of the MEI was held at 3.0 meters, which represents a typically average Florida lake depth. Average depths for Florida lakes typically range from 2.0 to 4.0 meters, and 3.0 meters represents a centroid of that range.

3D Graph 1



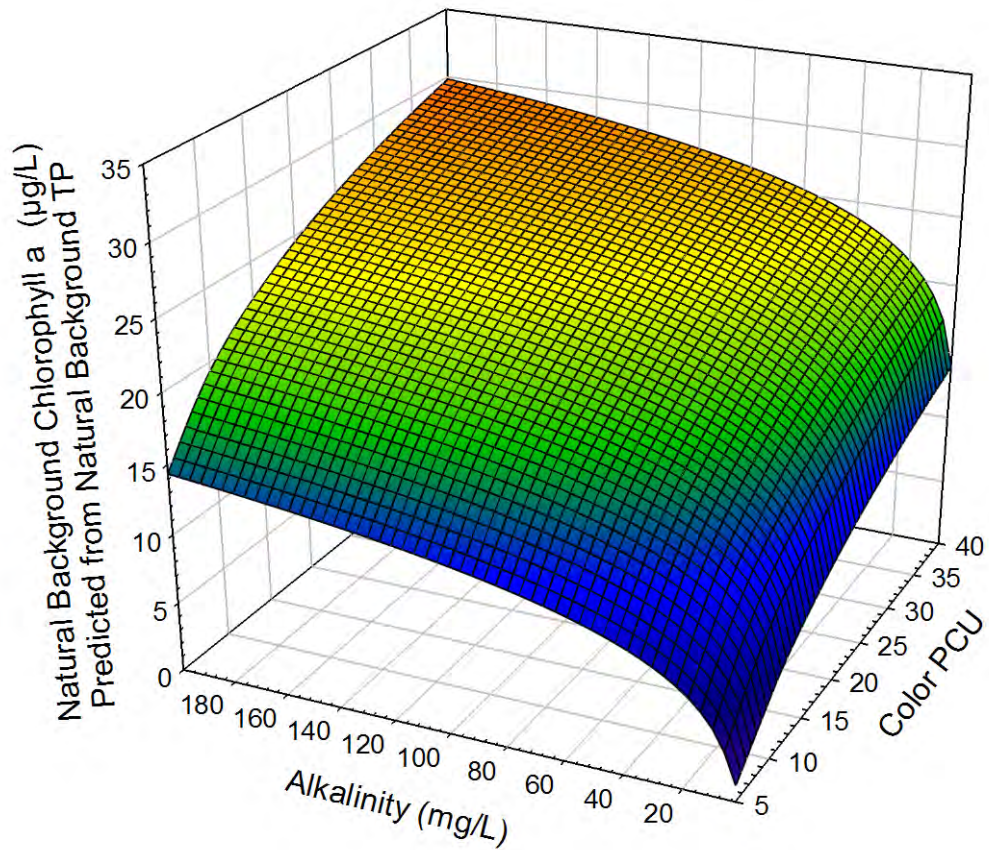
Plot of the Morphoedaphic Index predicted natural background lake TP for clear Florida lakes ( $\leq 40$  PCU). A constant depth of 3.0 meters was applied to the MEI calculation to investigate the influence of alkalinity on TP.

Background chlorophyll *a* expectation can either be estimated from the MEI-color equation or using the regression models developed by DEP and described in Section 10.3 of the TSD. The DEP regression

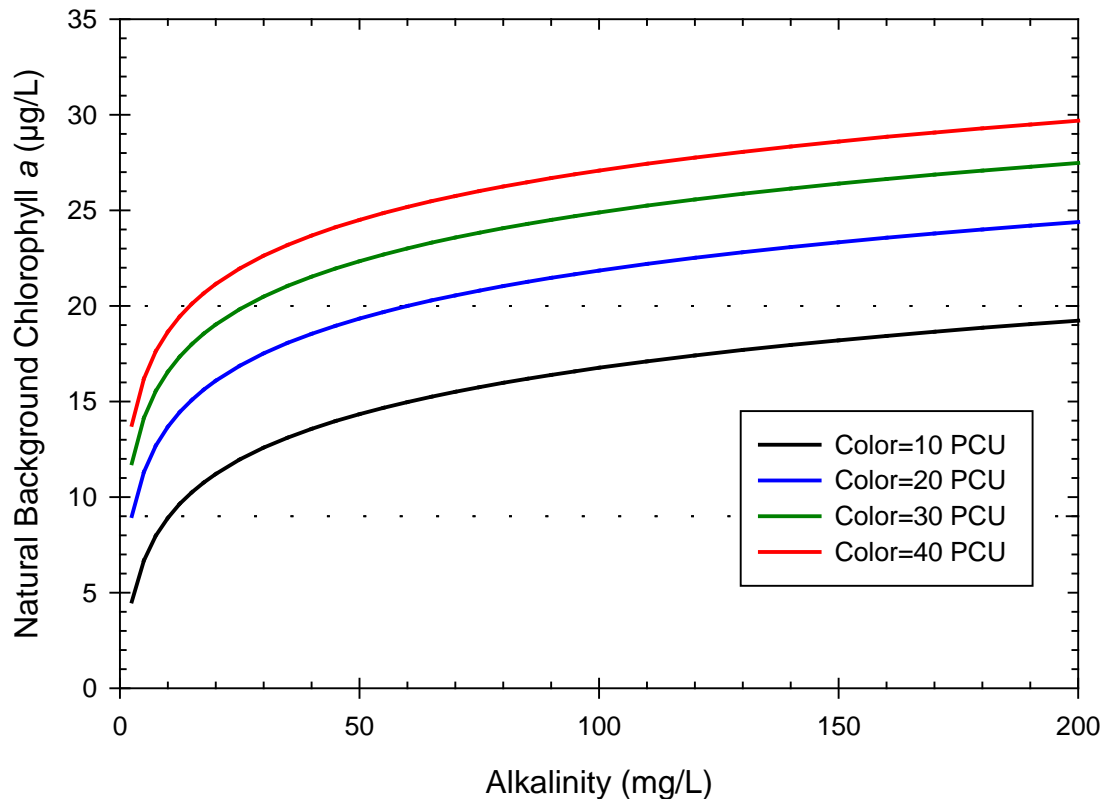
model for clear lakes had a higher adjusted  $R^2$  (0.68) than the MEI-color model. Additionally, the relationship between MEI and chlorophyll is indirect and most likely related to the relationship between alkalinity (parent material) and background nutrient conditions. Therefore, the best estimate of natural background chlorophyll  $a$  would be based on the DEP's regression equation for clear lakes. The DEP derived regression equation represents the average relationship between TP and chlorophyll; however, the current application is more concerned with extrapolating a reference or pristine condition. A more appropriate analysis in this case would involve an extrapolation of an upper percentile background condition to better control for type I statistical error. DEP regression equations already incorporate a 50% prediction interval. The upper limit of this prediction interval would be analogous to the use of an upper 75<sup>th</sup> percentile; that is, 75 percent of the observations are expected to be below the upper limit.

Natural background chlorophyll  $a$  was calculated from the MEI-color predicted natural background TP concentrations, within clear lakes for a range of alkalinity conditions, using the equation for the upper 50% prediction limit [ $\text{Ln}(\text{Chl-}a) = 1.137 \text{ Ln}(\text{TP}) + 6.978$ ]. The results of this analysis clearly demonstrate that natural background chlorophyll  $a$  would be expected to exceed 9  $\mu\text{g/L}$  with natural alkalinity greater than 50 mg/L (see Figure xx); that is, in lakes with contact to limestone naturally high in phosphorus.

Use of a 50 mg/L discrete alkalinity threshold to differentiate between natural oligotrophic and mesotrophic lakes appears to be a very conservative threshold. Lakes across the clear lake color range would be expected to exceed 9  $\mu\text{g/L}$  at an alkalinity of 50 mg/L (see below). A threshold of 20  $\mu\text{g/L}$  would appear to be protective of all but the lowest color lakes.



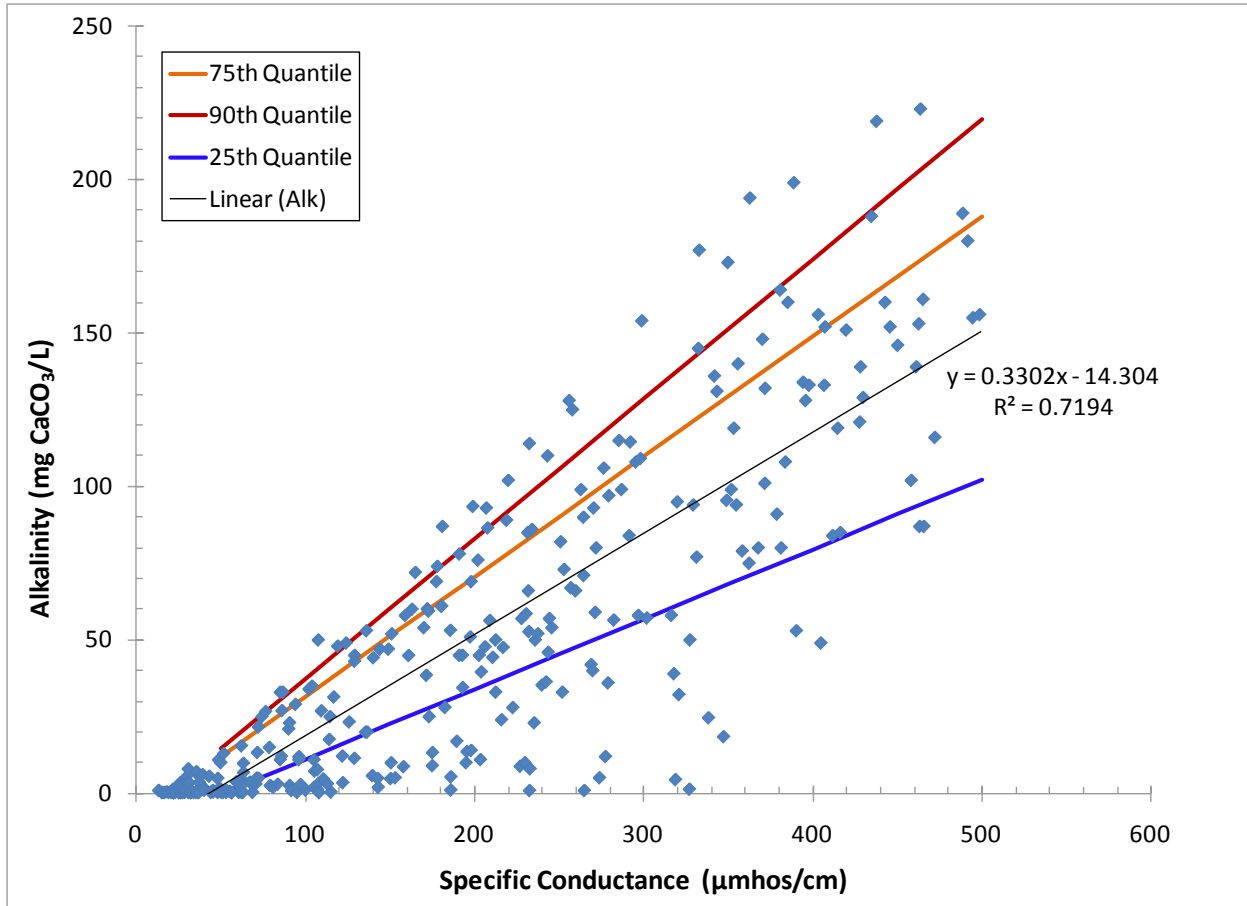
Plot of predicted natural background chlorophyll *a* in clear Florida lakes ( $\leq 40$  PCU). Chlorophyll *a* was calculated based on the MEI predicted natural background TP condition. A constant depth of 3.0 meters was applied to the MEI calculation to investigate the influence of alkalinity on TP.



Plot of predicted natural background chlorophyll *a* in clear Florida lakes ( $\leq 40$  PCU) at four levels of color represent transects through Figure 3 for better visualization. Chlorophyll *a* was calculated based on the MEI predicted natural background TP condition. A constant depth of 3.0 meters was applied to the MEI calculation to investigate the influence of alkalinity on TP.

### Specific Conductance Surrogate

Alkalinity measurements are not currently available for many clear Florida lakes. However, specific conductance, which can be used as a surrogate measure for alkalinity, is typically available. To evaluate the relationship between alkalinity and specific conductance, a data set of 347 paired lake average specific conductance and alkalinity values was assembled. The relationship between the two parameters was investigated using both least squares and quantile regression (see Figure below). Quantile regression is the preferred statistical approach to investigate the outer edges of the relationship because specific conductance is influenced not just by alkalinity but also all dissolved ions. The analysis suggests that a specific conductance of 250  $\mu\text{mhos/cm}$  would provide a high level of certainty that the majority of low alkalinity lakes (naturally oligotrophic) would be characterized as having low alkalinity and thus be ascribed the more protective 9  $\mu\text{g/L}$  threshold. Use of the 250  $\mu\text{mhos/cm}$  surrogate threshold represents a step that would result in only an approximate 25% chance of misclassifying a low alkalinity lake as high alkalinity. However, it may result in a misclassification of a number of high alkalinity sites and thus be overprotective for a portion of Florida's clear lakes.



Relationship between specific conductance and alkalinity in clear Florida lakes.

Literature cited:

Fulton III, R.S. et al. 2004. Pollutant Load Reduction Goals for Seven Major Lakes in the Upper Ocklawaha River Basin. SJRWMD Technical Publication SJ2004-5.

Hendrickson, J.C., Trahan, N., E. Stecker and Y. Ouyang. 2002. TMDL and PLRG Modeling of the Lower St. Johns River: Calculation of the External Load. SJRWMD Draft Report.

Lowe, E., L. Battoe, J.C. Hendrickson, M. Coveney, R. Fulton, E. Marzolf, S. Winkler and J. Di. 2009. A Morphoedaphic Index to Predict Natural Background and Designated Use Failure Threshold Phosphorus and Chlorophyll Concentrations in Florida Lakes. SJRWMD Draft Report.

Rawson D. S. (1951) The total mineral content of lake waters. *Ecology* 32, 669-672.

Rawson D. S. (1952) Mean depth and the fish production of large lakes. *Ecology* 33, 513-521.

Ryder, R. A., S.R. Kerr, K.H. Loftus and H.A. Reiger. 1974. The morphoedaphic index as a fish yield estimator: Review and evaluation. *J. Fish. Res. Bd. Can.* 31: 66-688.

Vighi, M. and G. Chaudani. 1985. A simple method to estimate lake phosphorus concentrations resulting from natural background loadings. *Water Res* 19(8): 987-991.

Whitmore, T.J. and M. Brenner. 2002. Paleolimnological Characterization of Pre-disturbance Water Quality Conditions in EPA-Defined Florida Lake Regions. Final Report to the Department of Environmental Protection.

2) EPA suggested we add “consecutive” in references to 3-year increments.

**Response:** DEP believes this is not necessary, but will consider the request.

3) EPA requested additional documentation regarding the selection of chlorophyll *a* criteria, particularly for clear, low conductivity lakes (the comment said data “seem to show greater support for a criterion of 5 ug/L” and included specific questions:

- How are TSI/chl *a* thresholds related to aquatic life use protection, and how are TN and TP from TSI related to ALUS?

**Response:** The analyses conducted by DEP relating chlorophyll *a* to aquatic life use was independent of the TSI. DEP’s analysis resulted in TN and TP to chlorophyll relationships that were significantly stronger than those used for the original TSI. Multiple lines of evidence were used to evaluate the rigor of protection inherent in the proposed 20 ug/L chlorophyll for colored and clear, high alkalinity lakes and 9 ug/L for clear lakes (see Table below)

**Lines of evidence used in determining support of the chlorophyll *a* targets.**

Line of Evidence	Chlorophyll <i>a</i> target	State
Paleolimnological studies	14 to 20 µg/L (higher for some lakes)	Florida
Expert opinion	20-33 µg/L	Virginia, Iowa, West Virginia, Maryland
Fisheries responses (warmwater) Fisheries responses (coldwater trout and coolwater)	35-60 µg/L 3-5 µg/L and 25 µg/L, respectively	Virginia Minnesota, Colorado
Lake user perceptions	20-25, up to 30 µg/L in colored lakes; as low as 3 µg/L in Florida Trail Ridge clear lakes	Texas and Florida
Existing levels approach	5-27 µg/L	Alabama
Reference lake approach	2-8 µg/L in clear lakes, 9-18 µg/L in colored lakes	Florida, using 75 <sup>th</sup> percentile

As seen in the table, several lines of evidence, including paleolimnology, fisheries success, and user perception, converge to support the conclusion that 20 µg/L of chlorophyll *a* in colored and clear, high alkalinity lakes is protective of designated uses. It has been hypothesized that phytoplankton populations may switch to communities dominated by cyanobacteria at chlorophyll *a* levels above 20 µg/L, however, this pattern was not observed in an analysis of 1,364 Florida lakes. Cyanobacteria are usually an unfavorable food source to zooplankton and many other aquatic animals, and some may even produce toxins, which could be harmful to fish and other animals. For this reason, the World Health Organization considers it to be a high risk for swimming when waters are dominated by cyanobacteria and accompanied by an instantaneous chlorophyll *a* of 50 µg/L (symptoms such as skin irritation and conjunctivitis may be more prevalent). Based upon the above multiple lines of evidence, DEP proposes that an annual average chlorophyll *a* of 20 µg/L in colored lakes is protective of designated uses. See below for additional information supporting the 9 µg/L threshold in clear lakes.

- Is 9 protective of all clear lakes, or is sub-classification needed to protect Sand-Hill lakes?

**Response:** Coldwater trout fisheries (which do not exist in Florida) require chlorophyll *a* in the 3-5 µg/L range. A reference lake approach proposed by Tetra Tech suggests that chlorophyll *a* values of up to 8 µg/L in clear lakes represent the 75<sup>th</sup> percentile of reference lakes. Moreover, the TSI categorization of Salas and Martino (1991), based on warm water lakes, would consider a chlorophyll *a* of 10 µg/L (TSI of 50) to be mesotrophic. Thus, a multiple lines of evidence approach suggests that a chlorophyll *a* concentration <10 µg/L would be a protective threshold for Florida's clear lakes. DEP solicited input from the Nutrient TAC in June, 2009, and the Nutrient TAC also suggested that maintaining chlorophyll *a* below 10 µg/L in low alkalinity (<50 mg/L) clear lakes would be protective of the designated use, since a value of <10 µg/L would still be categorized as oligotrophic.

As another line of evidence, FDEP regressed the macroinvertebrate Lake Condition Index values against chlorophyll *a* in clear, low alkalinity lakes to determine if there was a chlorophyll *a* threshold, below 10 µg/L, which could be used for criteria development (see below). The Lake Condition Index is a measure of lake health based upon a composite of five benthic macroinvertebrate metrics, including taxa richness, the number and percent of the Ephemeroptera/Trichoptera/Odonata, Shannon diversity, the Hulbert (sensitive) Index, and the percent Diptera (DEP SOP LT 7300, found at: <ftp://ftp.dep.state.fl.us/pub/labs/assessment/sopdoc/2008sops/lt7000.pdf> ).

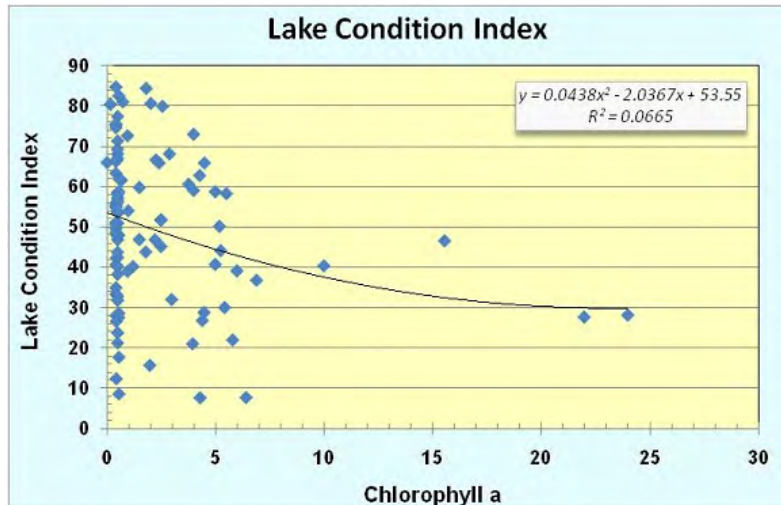


Figure 9-2. The relationship between chlorophyll *a* concentrations and invertebrate Lake Condition Index.

The results of this regression showed that there was no significant relationship between biological health (LCI) and chlorophyll *a* when chlorophyll *a* was below 10 µg/L ( $r^2 < 0.067$ ). Therefore, DEP has established the low alkalinity, clear lake chlorophyll *a* at a protective threshold of 9 µg/L.

4) EPA suggested we check numbering and rule references.

**Response:** DEP will check.

5) EPA had several questions related to the implementation of the lakes criterion.

- How will criteria be documented and available to the public?
- How often can they be modified?
- Suggested we change column heading of second table, which currently reads “Calculated criteria may not be lower than.”
- Could a waterbody be listed for exceedances of chl *a* , TP, or TN, and would it be on planning or verified list?

**Response:** See below.

6) EPA’s suggested edits to the text that follows the second lakes table indicate that we need to provide additional background information about implementation of the rule language.

**Response:** The draft FDEP lakes criteria contain a performance based element to the criteria to account for the differences between lakes and how they respond to ambient nutrient concentrations. The overall criteria are expressed as annual averages that cannot be exceeded more than once in a three year period. The criteria are exceeded when there are two excursions of the magnitude and duration component of the criteria within a three year period. Since an excursion is applied on an annual timeframe and an exceedance is applied on a three year timeframe, the following describes how the criteria operate during such timeframes.

The underlying criteria are those contained in proposed Rule 62-302.534(1) which, in the absence of sufficient chlorophyll *a* data, are in effect for a given lake. However if there is sufficient Chlorophyll *a*, Total Nitrogen (TN), and Total Phosphorus (TP) data to calculate an annual geometric mean and the magnitude of the Chlorophyll *a* criterion is attained for that year, the applicable magnitude of the TN/TP criteria is automatically adjusted based on existing in-lake conditions for that given year, and that given year alone, subject to upper and lower boundaries. The duration and the frequency of the TN/TP criteria remain the same and the magnitude, duration, and frequency of the criteria for Chlorophyll *a* is not adjusted. If the requisite Chlorophyll *a* magnitude is not attained for a given year, the TN/TP values in Rule 62-302.534(1) are the applicable criteria.

Under this analysis, an excursion of the numeric nutrient criteria can be analyzed for any given year for many different purposes including assessment and permitting. For assessment purposes, the historical record of water quality data is analyzed to determine the number of excursions and the frequency of which those excursions occur. If more than one excursion has occurred in a three year period, then an exceedance of the criteria has occurred. If that exceedance is recent, or is not recent and not been followed by multiple years where no excursions have occurred, then the assessment would conclude that the waterbody should be placed on the 303(d) list for nutrients.

For permitting purposes, permit limits will be developed to protect against exceedances during critical conditions. This can be done in two ways when sufficient water quality data exists.

1. **Data Assessment:** Using multiple years of data, water quality based effluent limits (WQBEL) are established using the TP/TN criteria applicable during the most critical condition year. Critical condition year is generally defined by the highest Chlorophyll *a* year, but can also be evaluated using other metrics. If the historical record indicates that the Chlorophyll *a* criterion will **not** be met under critical conditions, then the WQBEL will be set at the TN/TP values in Rule 62-302.534(1). However, if the historical record provides reasonable assurance that the worst case year meets the Chlorophyll *a* criterion, then the WQBELs will be established at the TN and TP levels that have been demonstrated to result in attainment of the criteria. Using data assessment alone, this approach provides a margin of safety of preventing the WQBEL from causing excursions in any year even though one is allowed in a three year period.
2. **Modeling:** Using modeling (either a calibrated and validated water quality model, or an empirical regression model), the most critical three year period can be targeted to ensure that WQBELs for TN and TP result in attainment of the Chlorophyll *a* and TN/TP criteria (one or fewer excursions during that time period). The models will provide a more site-specific relationship between nutrients and chlorophyll *a* and the resultant WQBELs will be compared to both the annual Chlorophyll *a* and TN/TP criteria applicable during each year to ensure attainment.

The following examples help illustrate its operability. It should be noted that, to simplify the discussion, the examples only address data and analysis for Chlorophyll *a* and TP. During actual assessment of lakes and development of WQBELs, TN data would, of course, also be evaluated.

In the first example, which is a clear lake with alkalinity greater than 50, the lake condition is above the applicable chlorophyll a criterion of 20 in years 5 and 6 resulting in two excursions during a three year period. As this is more than once in a 3-year period, these chlorophyll a values alone would result in the lake being listed as impaired for nutrients due to a recent exceedance of the criteria. In this case, there was also an exceedance of the TP criterion because of the excursions in Years 1, 3, 5 and 6 (which results in multiple 3-year periods with more than one excursion). Because the historical records indicate excursions of the chlorophyll a criterion, WQBELs for discharges to this lake would be set to achieve 0.030 mg/L and 1.00 mg/L, for TP and TN, respectively.

In the second example, which is another clear lake with alkalinity greater than 50, there is only one excursion of the chlorophyll a criterion (Year 4), but there are two excursions of the TP criterion within three years (Years 4 and 5), and as a result, the lake would be listed as impaired for nutrients (TP) due to a recent exceedance of the criteria. In this case, there was only one year that was above the magnitude of the chlorophyll a criterion, and staff would need to check to see if this year was an extreme condition or a potential data error. If the year is representative of worst case conditions, the WQBEL for TP would again be 0.030 mg/L. However, if this was determined to be an extreme condition or a potential data error, then modeling would be conducted to determine the levels of TN and TP that would not result in an exceedance of any of the criteria during critical conditions.

For the third example, which is a colored lake, the lake would qualify for listing based on the excursions of the TP criterion in Years 2 and 3, but the lake would not be listed as impaired because the more recent data from Years 4-7 indicate that the lake is now meeting the criterion [Rule 62-303.720(2)(j), F.A.C., states that waters listed for exceedances of annual average criteria will be delisted if they meet the criteria for three consecutive years]. However, the WQBEL would either be set to achieve the TP criterion of 0.03 mg/L (based on the high chlorophyll a in Year 3), or be based on model results that determined the nutrient concentration that would attain the Chlorophyll *a* and TP criterion under worst case conditions.

In the fourth example, which is another colored lake, there are no excursions of the Chlorophyll *a* criterion and only one year (Year 2) with an excursion of the TP criterion. As such, the lake would not be listed as impaired for nutrients because the criteria are attained throughout the period of record. While there were no excursions of the chlorophyll a criterion, DEP staff would still need to carefully review the historical data to determine worst case conditions, and then establish the WQBEL for TP based on model results that determined the nutrient concentration that would meet the Chlorophyll *a* and TP criterion under worst case conditions.

Example Data Sets and Assessment Results<sup>i</sup>

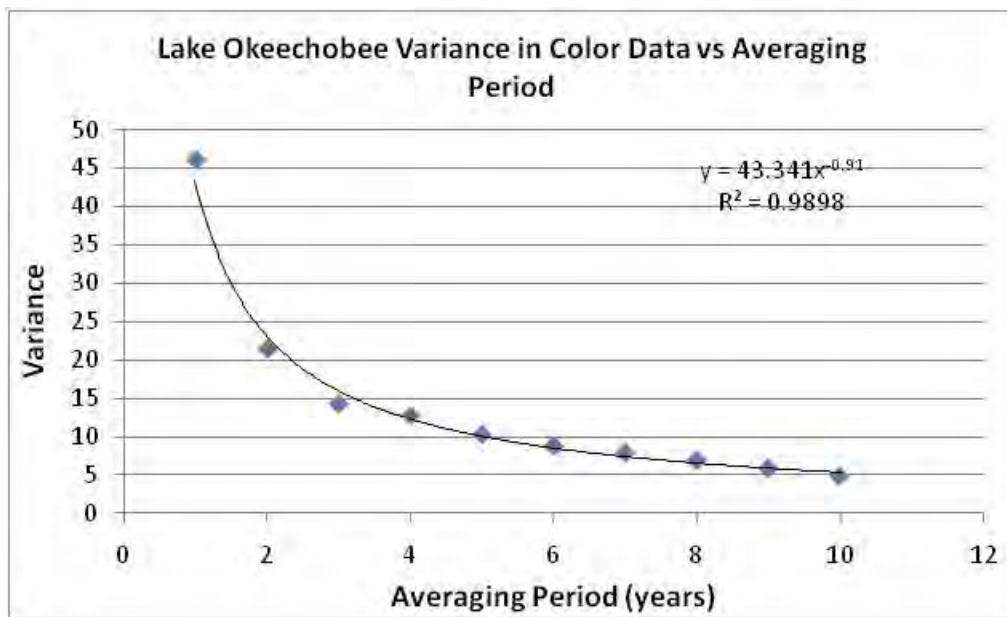
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Example 1  Lake Color <40  Alkalinity >50	Chl <i>a</i> Annual Geomean		22	18	15	10	27	25
	TP Annual Geomean		0.080	0.040	0.170	0.020	0.180	0.050
	Conclusion	TP Standard	0.030	0.040	0.087	0.030	0.030	0.030
Annual Assessment		Excursion of Chl <i>a</i> and TP	Meets	Excursion of TP	Meets	Excursion of Chl <i>a</i> and TP	Excursion of Chl <i>a</i> and TP	
Example 2  Lake Color <40  Alkalinity >50	Chl <i>a</i> Annual Geomean		18	10	8	26	9	5
	TP Annual Geomean		0.040	0.070	0.080	0.070	0.110	0.027
	Conclusion	TP Standard	0.040	0.070	0.080	0.030	0.087	0.030
Annual Assessment		Meets	Meets	Meets	Excursion of Chl <i>a</i> and TP	Excursion of TP	Meets	
Example 3  Lake Color >40  Alkalinity	Chl <i>a</i> Annual Geomean		18	16	21	12	15	8
	TP Annual Geomean		0.060	0.180	0.090	0.060	0.070	0.080
	Conclusion	TP Standard	0.060	0.087	0.030	0.060	0.070	0.080

>50		Annual Assessment	Meets	Excursion of T{	Excursion of chl a and TP	Meets	Meets	Meets
Lake Color >40	Chl a Annual Geomean		18	16	18	12	15	8
Alkalinity >50	TP Annual Geomean		0.060	0.180	0.080	0.060	0.070	0.080
	Conclusion	TP Standard	0.060	0.087	0.080	0.060	0.070	0.080
		Annual Assessment	Meets	Excursion	Meets	Meets	Meets	Meets

<sup>1</sup> Excursions are highlighted in yellow.

- 7) EPA requested more documentation for the 7 year averaging period for color, and use of specific conductance where there is insufficient alkalinity data.

**Response:** Analysis of the variance in the available historical data indicate that averaging over a 7 year period, which is consistent with the IWR assessment period, provides a reliable indicator of color, with < 10% variance (see graph below).



- 1) EPA asked if Type I and II SSAC are available for nutrients, and suggested some guidance on the issue in implementation guidance.

**Response:** Yes, Type I and Type II SSACs will also be available for nutrients. DEP is in the process of developing guidance for the appropriate application of each SSAC provision for nutrients.

- 2) EPA requested revisions to (2)(d)7., which states “Substances, other than nutrients, in concentrations that result in the dominance of nuisance species...”, so that it does not imply that nuisance species due to nutrients are allowed for Type II SSACs.

**Response:** We plan to delete the phrase “other than nutrients” as we agree that nuisance species should not be allowed by Type II SSACs.

- 3) EPA asked whether the Type III SSAC text means that a water can get a SSAC only if it meets all of the criteria for ALUS or is the use of biological health assessments used to demonstrate the criteria are fully protective?

**Response:** Biological health assessments will be used to demonstrate the criteria are fully protective of aquatic life use.

- 4) EPA suggested new text requiring protection of downstream uses/standards, and asked two questions about the spatial aspect:

- Do both spatially independent stations have to be in the affected portion of the water?
- How will SSAC address spatial variation in how nutrients express themselves downstream?

**Response:** Yes, both stations have to be in the affected portion of the waterbody. The SSAC will address downstream protection primarily by evaluation of whether downstream waters are currently attaining water quality standards related to nutrients, or alternatively, the nutrients delivered by the waterbody meet the allocations of a TMDL for a downstream water.

- 5) In the paragraph (4) about use of BHAs, EPA suggested we change “indicator of designated use of support of propagation and maintenance...” to “indicator of biological integrity consistent with designate use of ...”, and asked if Class II waters are intended to be included.

**Response:** We would like to discuss this suggestion with EPA. The proposed language could cause confusion given our current criterion for biological integrity. As for the reference to Class II waters, we will propose deletion of this reference to Class II waters since the current BHA’s do not apply to marine waters.

- 6) EPA had several comments about the SCI thresholds, including:

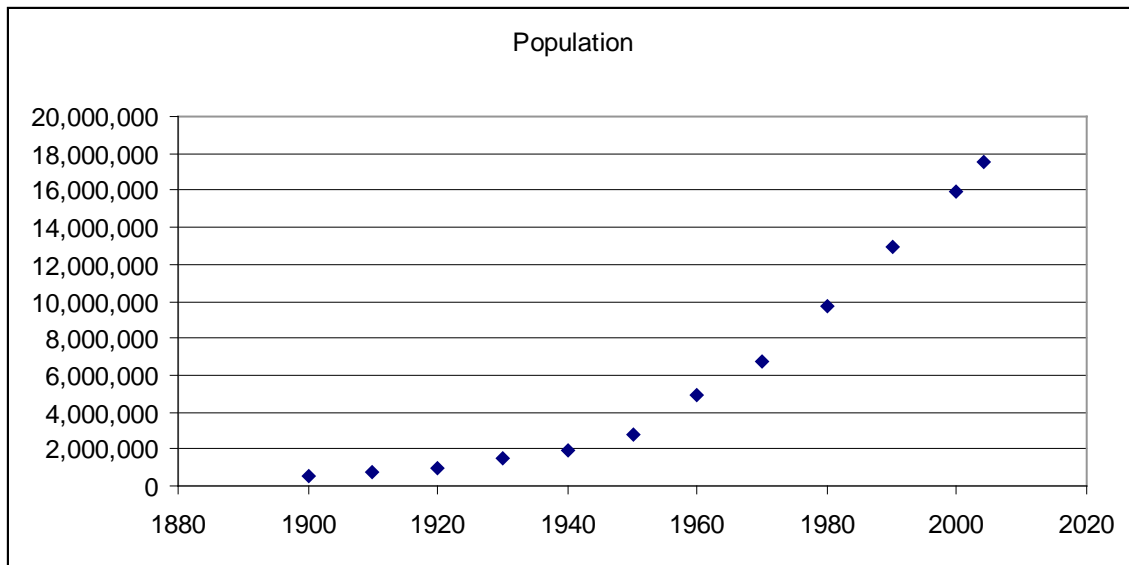
- Said significant uncertainty remains whether reference sites truly represent minimally disturbed conditions, and asked for more documentation on historical human disturbance and past/present use of pesticides and fertilizers, and historical land use.

**Response:** A DEP literature search and information from EPA’s contractor (Tetra Tech) conclusively indicate that Florida has used objective, defensible criteria and has produced more documentation

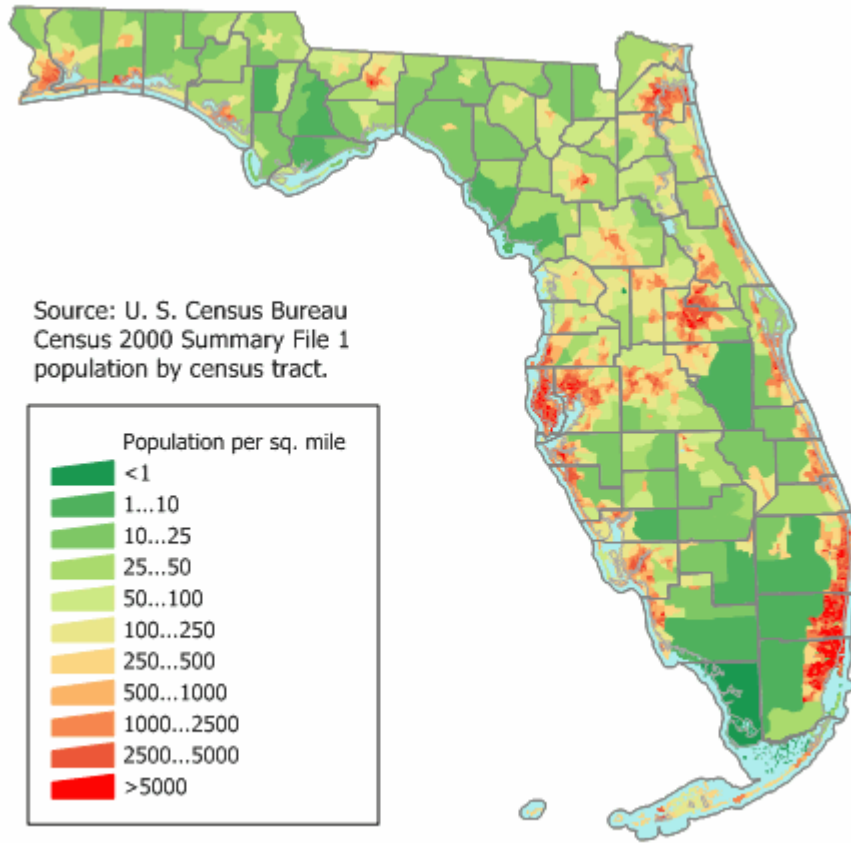
supporting reference site conditions than has any other state. **EPA’s own peer review panel commented that DEP’s reference selection approach was reasonable and scientifically defensible.** However, DEP will continue to provide information about historical impacts in an effort to alleviate EPA’s concerns.

Historical Land Use Impacts

- Prior to the construction of Flagler’s Railroad and the development of air conditioning (1940s), Florida had a relatively low human population, and the interior landscape was largely unimpacted (see Figures below from US Census). Logging in the pinewoods, cattle grazing in native prairies, and citrus production on high sandy ridges were the most intense land uses. Beginning in the 1940s, excessive colonization of the state, resulting in much more intense land uses, became common. As seen in the population trend graph, the current conditions in the state reflect the most intense potential environmental impacts from humans throughout the state’s history. Therefore, other than isolated, small-scale cases (areas surrounding “cattle dip vats” for example), DEP has a high degree of confidence that the site has never experienced past adverse human effects if a current site is demonstrated to be minimally disturbed.



Note the exponential increase in population which began during the 1940s. If a modern day site is minimally disturbed, there is high confidence that the site has not been adversely affected in the past.



Note that despite being the fourth most populous state, the majority of human disturbance is located on the coastal areas and the I-4 corridor. There are still stream and lake watersheds with minimal disturbance for setting reference site expectations.

#### Pesticide Issue

To examine the potential for pesticide impacts at reference waters, DEP evaluated available pesticide data from the Impaired Waters Rule database. The dataset included 26,732 observations for 43 pesticides covering 134 WBIDs. Of the 26,732 total observations, only 145 results (0.54% of the observations) indicated concentrations that were above the Method Detection Limit (MDL). Applicable MDLs may be found in Chapters 62-4 and 62-777 FAC:

<http://www.dep.state.fl.us/labs/library/index.htm>

Detectable concentrations were observed for 11 pesticides (Methoxychlor, Aldrin, Tetrachloroethylene, Pentachlorophenol, Dieldrin, Cyanide, Chloroform, Malathion, 24D, Phenol, and Endosulfan). Of the 145 detected concentrations, **only 13 observations (0.05%) statewide exceeded the applicable criteria** for Class III freshwaters. The observed exceedances occurred for 4 pesticides (Endosulfan, Cyanide, Dieldrin, and Malathion).

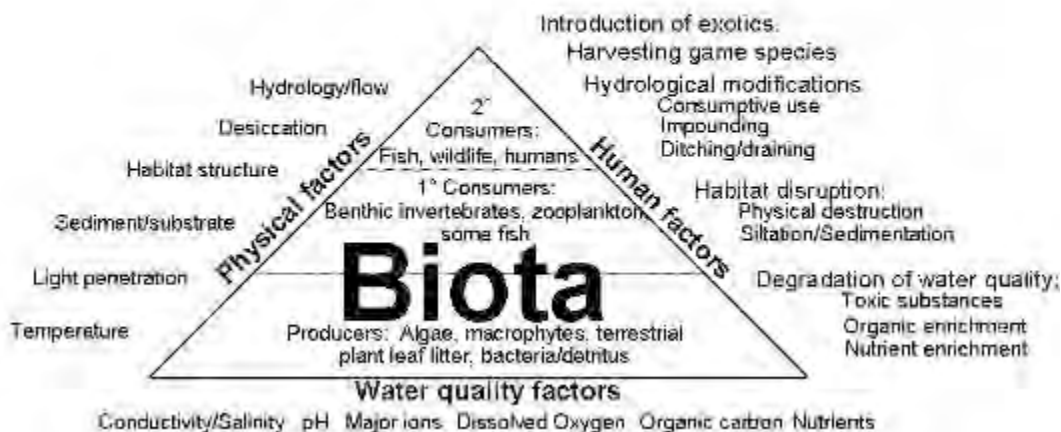
Of the 13 exceedances of criteria, all but 2 occurred in south Florida, where there are no natural streams. The 2 exceedances not occurring in South Florida occurred in the Middle St. Johns basin during March and April 2004 for cyanide. In addition, **none of the exceedances or pesticide detections occurred in any of the WBIDs used for derivation of the thresholds for the biological indices.** DEP has high confidence that the referenced sites represent minimally disturbed conditions, and this pesticide data supports that contention.

### Fertilizer and Silviculture

While native plant communities were the most common land cover in the reference site watersheds, forestry operations did occur in many of the watersheds. DEP provided EPA with a comprehensive analysis showing the relative lack of forestry fertilization and the lack of increases in nutrients at sites associated with silviculture sites on 10-2-09.

- Asked for our view on comments from peer review that:
  - Are SCI and LVI appropriate indicators of nutrient enrichment given that they also respond across a gradient of natural factors?

**Response:** Bioassessment methods are developed with the knowledge that that biological communities respond to all environmental stressors, both natural and anthropogenic (see Figure below).

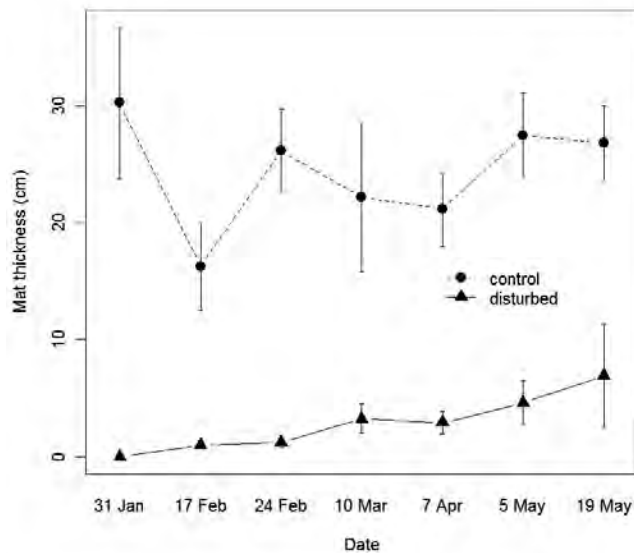


Because biological communities integrate effects of stressors over time (both acute and chronic factors) and provide a direct measure of ecosystem health, they are ideal for assessing biological integrity. However, there are natural gradients of nutrients throughout Florida, and characteristic biological communities have evolved over time to reflect natural physical and chemical dynamics. Therefore, to determine the relative influence of human disturbance, considering the “backdrop” of natural factors, DEP utilized the Human Disturbance Gradient approach (HDG). The HDG included measures for land use intensity, habitat, hydrologic modification, and water quality. Only biological

attributes that responded predictably to objective measures of human disturbance (the HDG) were selected for inclusion as metrics in our multi-metric indices. DEP then calibrated the indices using a combination of the reference site approach and the Biological Condition Gradient (BCG) model. Type I and Type II errors were statistically balanced during the impairment threshold selection process and the threshold was “anchored” to the clearly defined endpoints of the BCG. DEP is confident that sites that fail the SCI or LVI are indeed impaired by human activities. DEP is also confident that sites which pass the SCI or LVI fully meet the designated use of a healthy, well balanced aquatic community. However, because TP and TN dose-response relationships were not seen in streams, DEP used the reference site distributional approach to derive criteria for streams. The LVI and chlorophyll did respond to both TN and TP in lakes, and DEP linked the nutrients to aquatic life use endpoints. DEP also provides for Site Specific Alternative Criteria, to address instances when statewide criteria are not as appropriate as site specific values.

- SCI might not detect impacts due to acute nutrient loading due to rain

**Response:** The literature overwhelmingly indicates that there are no “acute” nutrient effects (other than toxicity due to un-ionized ammonia, which is addressed by a separate criterion). Experimental data show that a minimum of a week of exposure to a given nutrient concentration is required to elicit a response in algal growth (different from a control), and that longer time periods would be needed to affect aquatic plants.



From Stevenson et al. (2007). Lyngbya growth rate in a high nitrate stream (Blue Hole, with over 0.7 mg/L nitrate) after disturbance. Note that after 6 months, Lyngbya thickness had not matched that of the control (undisturbed) population.

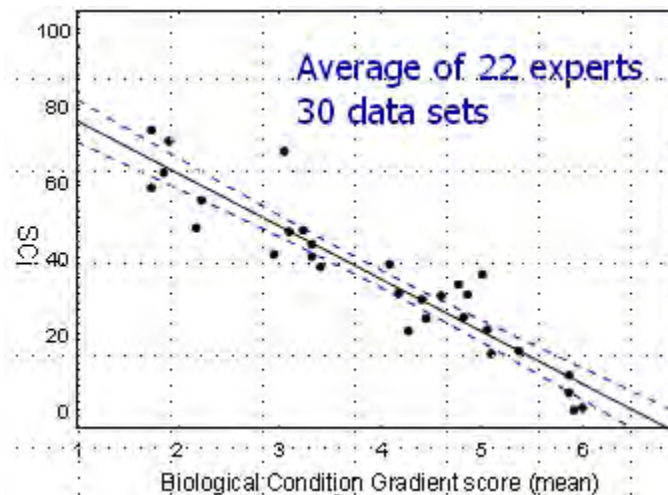
- EPA noted that given that the SCI threshold is at the low edge of the reference site distribution, they “remain concerned” about the risk of missing impaired waters, and requested we take a closer look at the variability near the threshold. EPA also asked how we will quantify and

address the risk, if any, of missing impairment. EPA asked us to fully explain how the threshold protects the designated use of ALUS, and “articulate how any difference in information have been reconciled”.

**Response:** In 2006, the EPA Biological Condition Gradient model was published, offering what DEP considers to be an objective, nationally consistent method to calibrate biological indices. DEP believes that the BCG approach is a rigorous, scientifically defensible method to calibrate indices because it is:

- Based on recognized ecological principles;
- Contains clear definitions to link community structure and function to numeric endpoints;
- Provides a method to ensure that consistent aquatic life use thresholds are established nationally; and
- Overcomes the potential criticisms associated with the reference site approach .

In 2007, DEP calibrated the SCI using primarily the Biological Condition Gradient approach (secondarily on the reference site approach), resulting in an impairment threshold of 34 and exceptional threshold of 67. During the development of the BCG model at National BCG Workshops, each of the break-out groups independently reported that the ecological characteristics conceptually described by tiers 1–4 corresponded to how they interpret attainment of the CWA’s interim goal for protection and propagation of aquatic life (Davies and Jackson 2006). Two panels of Florida experts (one for the SCI, and one for the Lake Vegetation Index) independently arrived at the same conclusions as did the national expert groups (BCG category 4 and above supported CWA aquatic life use goals). Additionally, the State of Maine has adopted a policy that aquatic communities conceptually aligned with BCG Category 4 meets the CWA’s interim goal for protection and propagation of aquatic life, and this was subsequently approved by EPA.



Category 4 on the BCG is equivalent to an SCI score of 34.

Despite the clear, objective advantages of using the BCG, EPA requested DEP to revise the SCI impairment threshold to be based on the reference site approach as the primary line of evidence. DEP believes the reference site approach to be less defensible, as EPA now criticizes the reference site selection process and the percentage of reference sites that must “fail, by definition” when establishing the SCI threshold based on a lower percentile distribution.

However, in response to EPA’s request to pursue the reference approach, DEP conducted statistical interval and equivalence tests with SCI data from 55 reference streams (predominantly consisting of the recently verified nutrient benchmark sites, with additional data from the Fore *et al.* (2007a) analysis). DEP provided site information and taxa lists for the majority of the benchmark streams used in this analysis, as well as maps, photos, and a summary of data for each of the verified benchmark streams. The analysis of reference streams was performed to determine the lower bounds of the reference site distribution of SCI scores, while balancing type I errors (falsely calling a reference site impaired) and type II errors (failing to detect that a site is truly impaired). The examination of the two most recent visits at 55 reference streams showed that the 2.5<sup>th</sup> percentile of reference data was in the range of 35-44 points (see Table). The middle of this range was 40 points, which represents an impairment threshold that balances Type I and Type II errors.

Results of interval and equivalence tests conducted on reference sites with 2 SCI results. Shown are site mean, impairment threshold, and range for threshold values defined at the 2.5<sup>th</sup> and 5<sup>th</sup> percentile of reference sites ( $p < 0.05$ ;  $N = 55$  reference sites with two SCI values for each site). Reference site values from Fore *et al.* (2007a) and comprehensively verified nutrient benchmark sites.

Impairment threshold (description)	Ref site mean	Impairment threshold (numeric)	Impaired	Undetermined	Reference
2.5 <sup>th</sup> percentile of reference	65	40	<35	35–44	>44
5 <sup>th</sup> percentile of reference	65	44	<39	39–47	>47

When calibrating an impairment threshold for an index, the amount of human disturbance inherent at the reference sites is a major issue. Some states select reference sites based on the “best available condition” (may have substantial disturbance), using a Best Professional Judgment approach. **This introduces extreme uncertainty as to what level of protection is actually afforded by any given reference site population.** Florida has employed a rigorous reference site selection approach, which objectively demonstrates the “minimally disturbed” (limited human influence) nature of Florida’s reference sites. When establishing an impairment threshold using a lower distribution of reference sites, a rigorous reference site selection process provides greatly increased confidence that the reference site population is minimally disturbed, thereby significantly reducing Type II errors (*i.e.*, classifying impaired sites as healthy). This increased confidence also allows for

establishing the impairment threshold at a low level of the reference site distribution to minimize Type I errors (classifying healthy sites as impaired).

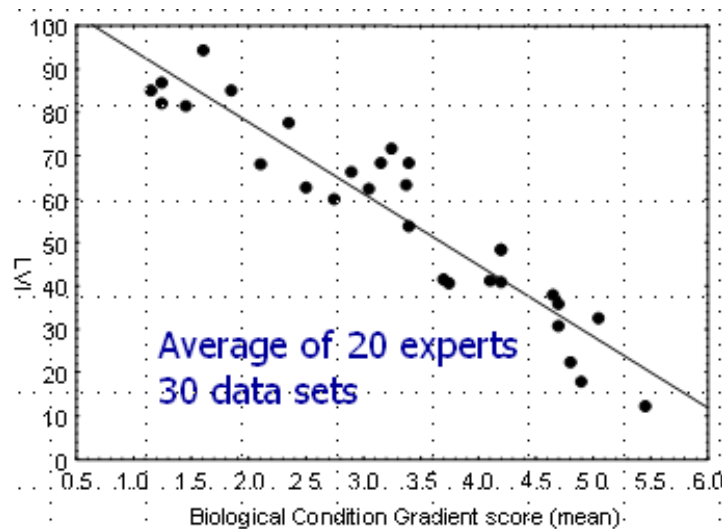
In the proposed threshold for the SCI, impairment will be determined by the average of two site visits, so the threshold determined from the interval and equivalence tests (40, based on an average of two site visits) is closely aligned with the assessment methods. An impairment threshold of 40 would result in approximately 2.5 % of reference sites (known to be minimally disturbed) to be deemed impaired. An SCI score of 40 is approximately 3.4 on the BCG scale. DEP believes that this threshold is more protective than required by the CWA aquatic life use support goal (BCG of 4). DEP requests EPA to recognize that BCG Category 4 is an acceptable national endpoint for index calibration. As stated earlier, the reference site approach is subject to subjective application and uncertainty, since a lower percentage of any given reference site population is not clearly linked to objective, numeric aquatic life use endpoints. See table below to show the level of protection afforded by the 40 impairment threshold compared to exceptional sites. Note that the individual metrics are not too dissimilar from that of the exceptional expectation.

<b>SCI Metric</b>	<b>Metric Average at BCG 2 (Exceptional)</b>	<b>Metric Average Near Impairment Threshold</b>
Number of Total Taxa	32.0	28.7
Number of Clinger Taxa	5.6	3.3
Number of Long Lived Taxa	1.5	1.1
Percent Suspension Feeders and Filterers	22.0	15.8
Number of Sensitive Taxa	5.4	2.7
Percent Tanytarsini	13.3	9.5
Percent Very Tolerant	6.5	14.3
Number of Ephemeroptera Taxa	3.5	2.3
Number of Trichoptera Taxa	4.5	2.6
Percent Dominant	22.6	26.2
Number of Sites in Average	134	64

7) EPA had several comments about the LVI thresholds, including:

- Said there is an even higher probability of missing an impaired water

**Response:** DEP believes the BCG approach to be the most defensible and objective method for biological index calibration. A BCG score of 4 is equivalent to an LVI score of 45 (see graph below). However, following EPA’s instructions, DEP evaluated data from existing sites to identify benchmark lakes that could be used to determine the appropriate threshold for the LVI. To be considered benchmark, the watershed-scale landscape development intensity (LDI) index score had to be less than 3, and the LDI of the 100-m buffer zone around the lake had to be less than 2. DEP biologists also examined aerial photos and conducted an onsite watershed survey to ensure that there were no adverse human influences not detected by the LDI, and performed a whole-lake habitat assessment. Candidate benchmark lakes were excluded if they had a history of adverse human activity (*e.g.*, aquatic plant control, artificial fertilization) or current human activity (*e.g.*, adjacent citrus groves). DEP provided site information and taxa lists for the 30 benchmark lakes used in this analysis, as well as maps, photos, and a summary of data for each of the verified benchmark lakes.



A BCG Category 4 is equivalent to an LVI score of 45.

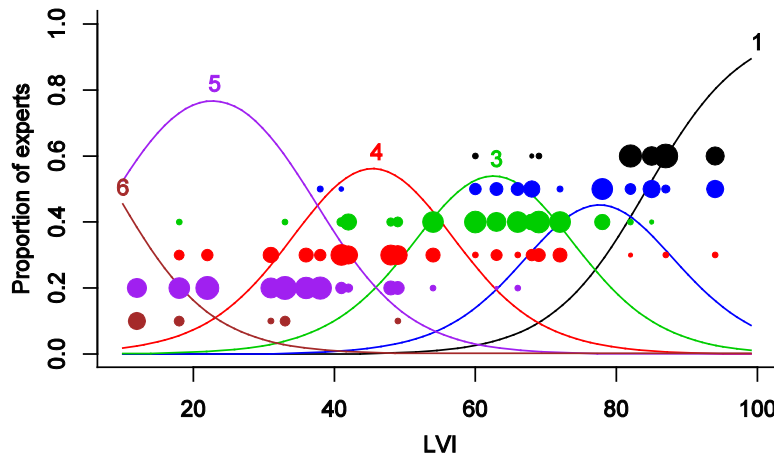
DEP conducted statistical interval and equivalence tests with LVI data from these 30 reference lakes to determine the lower bounds of the reference site distribution. As was described for the SCI, the intent was to identify a threshold for the LVI that balanced type I (falsely calling a reference site impaired) and type II (failing to detect that a site is truly impaired) errors. The analysis of the most recent LVIs at all 30 sites showed that the 2.5<sup>th</sup> percentile of reference data was in the range of 33-48 points, while the analysis of the two most recent visits at 15 lakes showed that the 2.5<sup>th</sup> percentile of reference data was in the range of 31-53 points (see below). The middle of this range was 46 points, representing an impairment threshold that balances Type I and Type II errors. In the proposed water quality threshold for the LVI, impairment will be determined by two site visits, so the threshold of 46 is closely aligned with the assessment methods. An impairment threshold of 46

would limit the percentage of reference sites that will be deemed impaired to 2.5%. Note that a BCG Category 4 LVI score is 45, which means using an LVI threshold of 46 to be protective.

Results of interval and equivalence tests conducted on reference sites with 2 SCI results. Shown are site mean, impairment threshold, and range for threshold values defined at the 2.5th and 5th percentile of reference sites ( $p < 0.05$ ;  $N = 15$  reference sites with two LVI values for each site).

Impairment threshold (description)	Impairment threshold (numeric)	Impaired	Undetermined	Reference
2.5 <sup>th</sup> percentile of reference	46	<31	31–53	>53
5 <sup>th</sup> percentile of reference	50	<37	37–57	>57

EPA’s issue with the LVI calibration appears to be due to the proportional odds logistic regression model of the LVI BCG workshop results (see figure below). DEP notes the affect of outliers on the both the Category 5 and Category 2 scores , causing additional overlap in the proportional odds distribution (resulting in scores of approximately 50-58 to correspond with both a low probability of assignment to Tier 5 (*i.e.*, impaired) and a low probability of assignment to Tier 2 (*i.e.*, reference conditions)).



BCG tier assignments based on the Lake Vegetation Index.

DEP has more confidence in using the central tendency approach (calculation of mean values) for establishing a robust impairment threshold, since outliers have less effect on the results. As stated earlier, a mean BCG Category 4 corresponds to an LVI score of 45, meaning a score of 46 is protective. Note that the individual metrics are not too dissimilar from that of the “exceptional” expectation.

LVI Metric	Metric Average at BCG 2 (Exceptional)	Metric Average Near Impairment Threshold
Dominant C of C	5.3	3.7
Percent Sensitive Taxa	21.0	7.4
Percent Invasive Taxa	3.9	14.5
Percent Native Taxa	92.4	78.6
Total Taxa	15.5	19.9
Number of Lakes for Average	27	39

- Noted that peer reviewers commented that:
  - Presence/absence of individual plant species has little impact on the whole lake species composition of other fauna.

**Response:** DEP believes that native aquatic plant communities are inherently valuable, and that they deserve protection under the CWA in their own right. While DEP agrees that invertebrates, fish, and other wildlife also deserve protection, DEP does not believe that these other communities must be shown to be adversely affected before protecting the aquatic plant biota.

- Invasive aquatic macrophytes can proliferate in low nutrient waters.

**Response:** While this statement is true, this observation indicates that the LVI is a conservative measure of nutrient enrichment. In situations where the LVI is impaired due to reasons other than nutrients, DEP still believes that management action or restoration are required under the CWA.

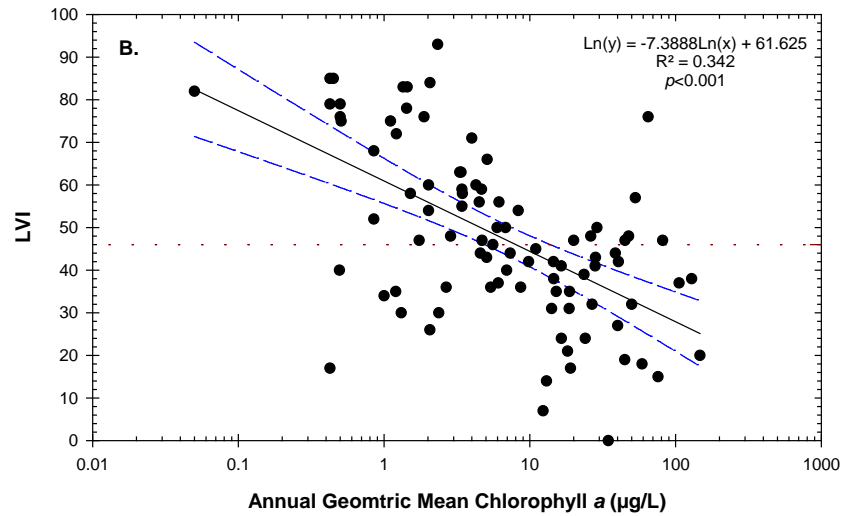
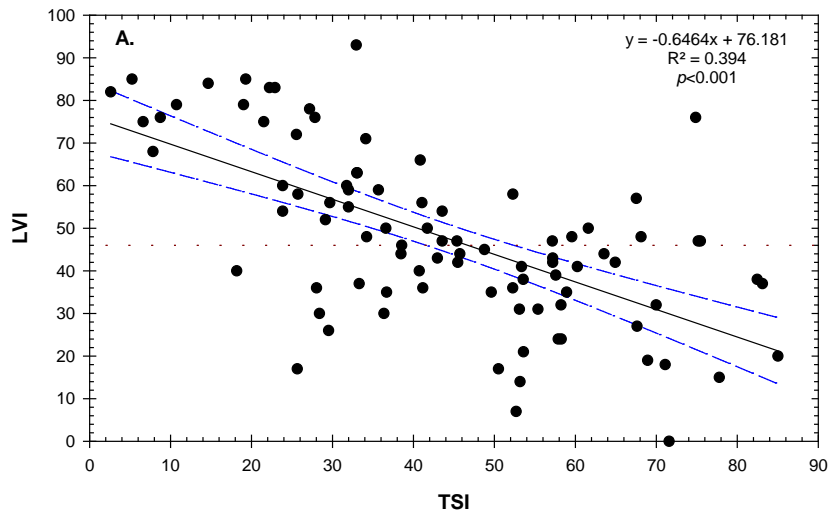
- Suggested we regress LVI against TSI, chl a, TN, and TP to show stronger relationship between the LVI and nutrients.

**Response:** Lake Vegetation Index samples from 91 clear and 53 colored lakes were paired with nutrient data from STORET, DEP’s Ambient Program’s database (GWIS), and Florida’s biological database (SBIO). Nutrient data collected during the one year period prior to LVI sample collection were averaged using a geometric mean concentration. Only lakes with a minimum of three water chemistry samples during the period were analyzed further. Statistically significant relationships were found between LVI and TSI and annual geometric mean chlorophyll *a* concentrations in both colored and clear lakes (see Figures below). However, the relationships

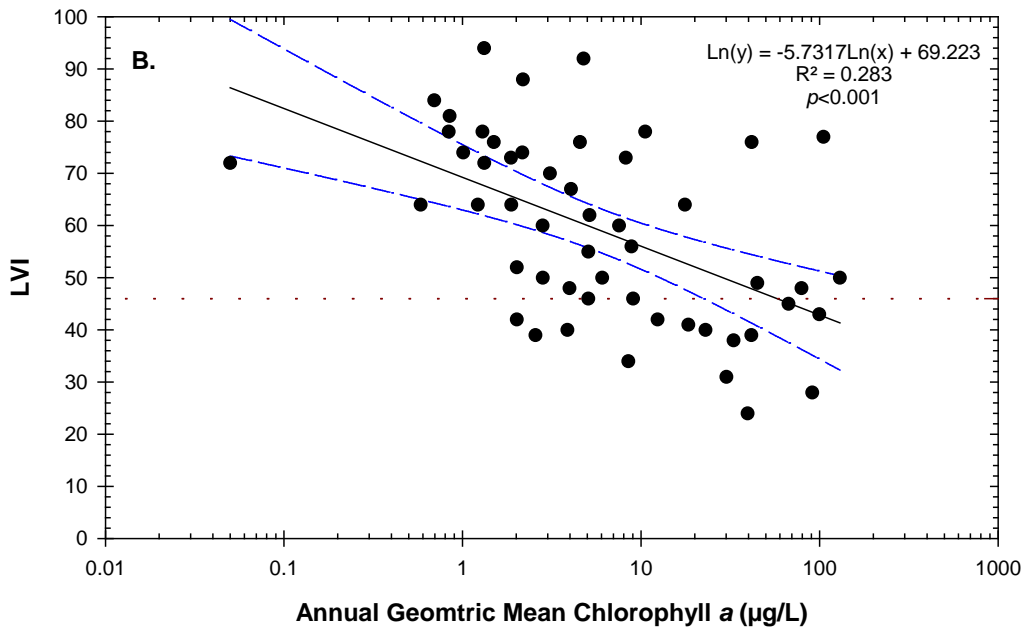
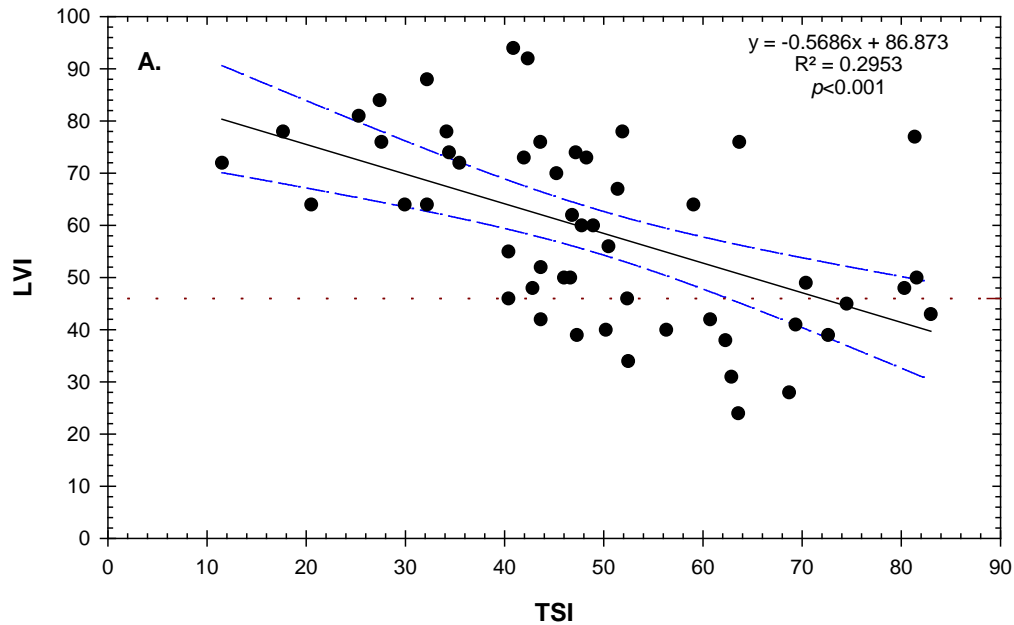
are weak, especially compared to the relationship between individual nutrients and chlorophyll *a*.

The additional analyses also show that the selected 9 ug/L and 20 ug/L chlorophyll *a* thresholds for clear and colored lakes, respectively, are protective of the plant communities within these lakes. Lakes with chlorophyll *a* at or below these thresholds typically achieve an LVI of 46 or greater.

It is important to note that LVI responds to many stressors and the observed response to chlorophyll may only partially be related to shading effects. It is additionally likely that there is a level of inherent non-casual relationship between the two parameters due to the fact that both will respond to increased human disturbance, albeit in opposite directions. Increased human disturbance tends to increase nutrient loading to lakes, which results in increased chlorophyll concentrations and TSI. Conversely, increased human disturbance causes reduction of the LVI due to physical habit disruption and the introduction of non-desirable plants including exotic species. It is therefore not advisable to use the relationships with LVI to directly derive chlorophyll *a* thresholds. However, it can be concluded that selected thresholds are protective of plant communities.



Relationship between (A) TSI and (B) annual geometric mean chlorophyll a concentrations and LVI values in clear Florida lakes.



Relationship between (A) TSS and (B) annual geometric mean chlorophyll a concentrations and LVI values in colored Florida lakes.

8) EPA asked whether 302.800(6), which mentions that “additional relief from criteria... may be provided through exemption... or variances” is applicable to nutrients following SSACs or TMDLs.

**Response:** This subsection does apply to nutrients, but we would not expect to use it in conjunction with a SSAC or TMDL. We appreciate EPA pointing out this rule provision, and it is one of the reasons why we plan to delete the reference to exemptions in the definition of water quality standards.

9) EPA requested that we include a column for concentration in the table of TMDLs, and then noted several questions that need to be answered about each TMDL:

- Does target nutrient provide full protection of ALUS in the subject water?
- Is there adequate supporting documentation to demonstrate full protection of ALUS?
- Does it ensure adequate protection of downstream uses?
- Was public participation provided?
- **Response:** We do not believe a separate column is needed for concentration, but will consider the request. All of the TMDLs included a site-specific evaluation to determine which nutrients needed to be addressed to prevent an imbalance in flora or fauna, and we will provide the available supporting documentation with the submittal package to EPA. The TMDL analysis also examines protection of downstream waters, and supporting documentation will be provided to EPA. All TMDLs are adopted by rule, which provides opportunities for public participation consistent with federal requirements, however, the TMDLs will need to be re-adopted as SSAC as part of the numeric nutrient criteria rulemaking so that the public is notified that they are being proposed as SSAC.

EPA provided some details about the above, and requested

- We delete the text that addresses case where TMDL only addresses one parameter.

**Response:** While we believe this is an appropriate solution to EPA’s request for criteria addressing both TN and TP, we are considering the option of deleting this language and instead calculating the appropriate SSAC number for each water prior to rule adoption so that the SSAC values can be added to the table. This will make them available to the public and EPA.

- Provide additional documentation, “such as data summaries and site specific reports, beyond the approved TMDL, that contain sufficient detail for EPA to review and make a decision regarding the appropriateness of the SSAC.”

**Response:** We would like clarification on this because it seems like a wildcard that makes the previous guidance of limited values.

### Impaired Waters Rule

#### General

1) EPA had a general comment about rule construction, noting that it would be helpful to clarify when there are multiple, independent ways to list a water.

**Response:** We will review the rule language.

- 2) EPA noted that 62-303.310 (Evaluation of Aquatic Life Use Support) notes that waters will be listed on the planning list if it “exceeds applicable aquatic life-based thresholds”, and asked if they are intended to include numeric nutrient criteria.

**Response:** We did not intend to include numeric nutrient criteria, and will propose revisions to the language to exclude the NNC.

#### Biological Assessment

- 1) EPA asked if we should add BioRecon to 302 too to be consistent with the IWR.

**Response:** We do not believe the BioRecon is sufficient as a basis for a SSAC , but plan to use it as an additional listing method.

- 2) EPA asked for clarification on how the BHA thresholds are different for the planning list (PL) and verified list (VL), specifically on the use of the averaging. The comment also seemed to suggest an additional threshold to list on the VL based on a single failing score.

**Response:** The thresholds are different for the PL and VL. Given the documented variability in scores (which is small relative to analyses of water chemistry, but still significant) and the potential for low scores due to hydrology, DEP concluded that the threshold for the VL should be the average of two scores. However, consistent with our overall approach to the PL, we lowered the listing threshold for the PL such that waters could be listed on the PL based on only one failed score. This allows DEP to prioritize these waters for further study to verify whether they are, in fact, impaired. We do not believe an additional single-sample threshold is needed given that there will typically be very few BHA scores available for a given waterbody.

#### 62-303.350 Evaluation of Nutrient Criteria

- 1) EPA asked if the reference to “annual mean chlorophyll a values” applied to all waterbody types, including estuaries.

**Response:** Yes.

#### 62-303.351 and .352 Nutrients in Freshwater Streams and Lakes

- 1) EPA asked how long the planning period is, and asked us to ensure the IWR is consistent with the language in Chapter 62-302 for both streams and lakes.

**Response:** The planning list assessment is 10 years, and the listing threshold is more conservative than the criteria in Chapter 62-302, F.A.C., in that exceedances are defined as more than one exceedances in three years, rather than 10. However, we intentionally make the thresholds for the PL more conservative as way to prioritize our monitoring resources on waters that are potentially impaired.

#### 62-303.420 Aquatic Life-Based Water Quality Criteria Assessment

- 1) EPA asked if we meant for the NNC to be included in the ALUS assessment?  
**Response:** No, as noted in the response to a previous comment for the planning list assessment, we need to revise the rule language to clarify that nutrients are assessed separately.
  
- 2) EPA had several comments about the text in (1)(b), which allows us not to list waters for DO if the water passes BHAs and meets numeric nutrient criteria and BOD. Comments include:
  - They say benchmark numbers do not represent natural conditions, and say we would need to demonstrate that they approximate natural background.  
**Response:** While we have focused much of the discussion about the benchmark sites on the fact that they are “minimally disturbed”, we are also confident that the sites are representative of natural background conditions. Further, given the extensive requests for additional information about the benchmark sites, we would like clarification from EPA on what information would be needed to demonstrate a site is “minimally disturbed” versus the information needed to demonstrate that a site represents “natural background.”
  
  - Note that EPA may need to review this provision as a revision to the DO standard.  
**Response:** It is our understanding that EPA already reviewed this provision as a change to Florida Water Quality Standards (FWQS), and we do not see how the proposed changes substantively change the approvability of the provision. EPA was aware that we previously compared nutrient concentrations to the 75<sup>th</sup> percentile of State waters, and now the text references the benchmark-based numeric nutrient criteria, which certainly better approximate natural background conditions. That being said, we certainly anticipate that EPA will review all of the proposed changes to the IWR as potential changes to FWQS.

#### 62-303.430 Biological Impairment

- 1) EPA suggested a minor wordsmithing and then asked why we deleted “Failure of this additional bioassessment shall constitute verification that the water is biologically impaired.”  
**Response:** The proposed edits are fine. The sentence was deleted because the VL threshold is the average of two BHAs.
  
- 2) EPA asked for examples of “Other scientifically credible methods or procedures” that we might use to assess estuaries.  
**Response:** We added this in acknowledgment that we do not currently have a BHA for estuaries, and this would allow us to use other methods if they are developed/proposed.

#### 62-303.450 Evaluation of Nutrient Criteria

- 1) EPA asked several questions about how the section is intended to be used:
  - Asked what is meant by “sufficient data” and whether it relates to historical data.  
**Response:** This rule provision relies on the same data sufficiency requirements of the PL, but the required data must be available in the verified period (7 ½ years), rather than the slightly

longer planning period (10 years). However, the date limitation does not apply to data used to determine historical levels of chlorophyll a.

- EPA asked what is the difference between the listing thresholds for the PL and VL for estuaries?

**Response:** There are no differences between the listing thresholds for the PL and VL for estuaries, other than the length of the planning and verified periods.

- EPA suggested we limit this provision to waters where only narrative applies and place reference to the stream NO<sub>2</sub>/3 criterion in separate section.

**Response:** We are considering whether to more clearly differentiate between nutrient thresholds and nutrient criteria, which would help to clarify that this subsection (1) only applies to impairment thresholds.

- 2) EPA suggested we delete (or limit to estuaries) sentence stating that “the thresholds for impairment due to nutrients used under this section are not required to be used during development of WLAs or TMDLs.”

**Response:** We intended this to apply to all “thresholds” as opposed to NNC, and it would apply to both the estuaries and stream chlorophyll a thresholds. We will consider whether we need to clarify the distinction between a threshold and a criterion.

- 3) EPA again asked about application of the NO<sub>2</sub>/3 criterion using the binomial, and asked if the annual geometric mean would be a better expression for nutrients given the time needed to cause algal growth and eutrophication problems.

**Response:** As noted in our previous response regarding the NO<sub>2</sub>/3 criterion, the studies that were the basis for the criterion approximate a monthly time scale, and we believe it is more appropriate to select the more conservative monthly median value than an annual mean.

- 4) EPA noted that rule does not list waters on VL based on benchmark numbers and asked that we revise the rule to do so, noting CWA requires listing waters as impaired based on “**any** water quality standard applicable to such waters.” EPA also noted that the chl a threshold for streams is considered “one-sided”, and therefore may not be fully protective. EPA also noted there may be a temporal disconnect between stressor and response measurements.

**Response:** We believe that biological confirmation is needed to list waters on the VL because there is insufficient linkage between the benchmark based criteria and impairment. While we are aware that EPA considers the chlorophyll a threshold for streams (20 ug/L) as “one-sided”, we would like to remind EPA that there are other listing thresholds (50% above historical levels) that are very conservative and protective of nutrient impairment in streams. Regardless, we believe it is better to retain this additional listing threshold rather than to delete it. We have provided a separate submittal regarding the potential temporal disconnect between stressor and response measurements.

---