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The Economic Analysis of the FDEP Proposed Numeric Nutrient Criteria in Florida

DEP Contract No: SP699

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Executive Summary

This report represents the research conducted by the Center for Economic Forecasting and Analysis at the Florida State University on the economic analysis of Numeric Nutrient Criteria in Florida adopted by the Environmental Regulation Commission on December 8, 2011. The FSU CEFA analysis examined and integrated some of the assumptions used in previous studies and developed some other assumptions based on more current cost data, and incorporated current changes in regulation rules. For example, the definition of "stream" in the amended rule 62-302.200(36), does not include ditches, canals and other conveyances, or segments of conveyances, which are man-made, or predominantly channelized or physically altered. Therefore, the previous December 6, 2011 draft FSU CEFA cost estimate was revised and re-calculated reflecting this amendment. The highlights of the FSU CEFA research analysis included the NNC cost estimation and economic analysis results.

The research data for this study were provided by the Florida Department of Environmental Protection (FDEP). FDEP classified waterbodies into six categories. The Numeric Nutrient Criteria in Florida was applied to all six classified categories, however, the costs were primarily assigned to Category Three (Cat 3), those waterbodies that would be deemed impaired under FDEP's Numeric Nutrient Criteria rule. As FDEP defined Category Five as "those waterbody WBIDs with insufficient information to determine if they fit in Category Three or Four," this study included a proportion of Category Five (Cat 5), or those waterbodies with classification "Cat 5" with a high likelihood of being reclassified as Cat 3's[1].

The economic analysis consisted of five sectors; Domestic Wastewater (DW) Sector, Industrial Wastewater (IW) Sector, Urban Stormwater Controls (SW) Sector, Septic System Sector, and the Agriculture Sector. These five sectors corresponded to sector groupings consistent with the previous studies; namely, the EPA study and Cardno Entrix studies. Each sector calculation is described in the following orders: methodology, data and result for Cat 3, and data and result for Cat 5 to Cat 3.

Although each sectors' methodology varied, the domestic and industrial (DW and IW) sectors cost calculations were based on the affected facilities' water capacity multiplied by capital and maintenance cost(s). The Urban Stormwater (SW) and Agriculture sector's cost calculations were based on the proposed NNC rule number of "impacted acres" multiplied by the assumed capital and maintenance costs. The

[1] For the cost analysis conducted for this study, the probability to be reclassified from a CAT 5 to a CAT 3 is estimated to be 17.54% based on the assessment data by WBID, provided by FDEP. Of the WBIDs for which there was sufficient data to assess them, 429 WBIDs were impaired out of a total of 2,446 WBID's (an 17.54% impairment rate).

Septic system cost calculations were based on the number of proposed NNC rule estimated septic systems multiplied by the corresponding upgrade and/or replacement capital and maintenance costs.

Table 1 provides a summary of the results of this study. The annual cost estimates were presented by sector, and included low, median and high projections. With regard to cost estimates pertaining only to the Cat 3 area, about $8.9 million would be the estimated annual median cost. With the inclusion of additional waterbodies to be reclassified from Cat 5 to Cat 3, the median costs were estimated to be a grand total of about $65.8 million. The research team estimated that that the minimum and maximum costs for implementation of the NNC rule would range from $50.5 million to $149.8 million per year.

Table 1 Summary of the Low, High and Median Costs for the NNC Rule in Florida

Cat3	Low	High	Median Cost
DW	$0	$0	$0
IW	$0	$0	$0
SW	$2,026,816	$7,972,144	$3,910,404
Septic	$733,203	$2,133,694	$892,628
Agriculture	$4,194,034	$4,194,034	$4,194,034
Total	$6,954,053	$14,299,871	$8,997,066
Cat 5 to Cat 3			
DW	$1,838,810	$4,495,552	$2,394,744
IW	$3,355,215	$34,566,580	$9,886,313
SW	$14,365,292	$56,503,482	$27,715,437
Septic	$8,370,000	$24,357,528	$10,189,944
Agriculture	$15,624,333	$15,624,333	$15,624,333
Total	$43,553,651	$135,547,476	$65,810,772
Grand Total			
DW	$1,838,810	$4,495,552	$2,394,744
IW	$3,355,215	$34,566,580	$9,886,313
SW	$16,392,108	$64,475,626	$31,625,841
Septic	$9,103,203	$26,491,222	$11,082,573
Agriculture	$19,818,367	$19,818,367	$19,818,367
Grand Total	$50,507,704	$149,847,347	$74,807,838

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Introduction

Since the inception of their water quality standards in the 1970s, Florida has used a narrative nutrient standard to guide the management and protection of its waters. Chapter 62-302.530, Florida Administrative Code (FAC), states that "in no case shall nutrient concentrations of body of water be altered so as to cause an imbalance in natural populations of flora or fauna." The narrative criteria also states that (for all waters of the state) "the discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Chapter 62-302, FAC]. Man-induced nutrient enrichment (total nitrogen or total phosphorus) shall be considered degradation in relation to the provisions of Sections 62-302.300, 62-302.700, and 62-4.242, F.A.C."

FDEP has relied on this narrative for many years because nutrients are unlike any other "pollutant" regulated by the federal Clean Water Act (CWA). Most water quality criteria are based on a toxicity threshold, evidenced by a dose-response relationship, where higher concentrations can be demonstrated to be harmful, and acceptable concentrations can be established at a level below which adverse responses are elicited (usually in laboratory toxicity tests). In contrast, nutrients are not only present naturally in aquatic systems, they are absolutely necessary for the proper functioning of biological communities, and are sometimes moderated in their expression by many natural factors.

The FDEP has been actively working with EPA on the development of numeric nutrient criteria for several years. FDEP submitted its initial DRAFT Numeric Nutrient Criteria Development Plan to EPA Region IV in May 2002, and received mutual agreement on the Numeric Nutrient Criteria Development Plan from EPA on July 7, 2004. The FDEP revised its plan in September 2007 to more accurately reflect its evolved strategy and technical approach, and FDEP received mutual agreement on the 2007 revisions from EPA on September 28, 2007. Florida has been guided in their development of numeric nutrient criteria by recommendations from a Technical Advisory Committee (TAC) composed of technical experts from throughout the state. The TAC reviewed all available technical information to ensure that the resulting criteria reflect the characteristics and aquatic life use of Florida's diverse waterbodies.

In 2008, Earth Justice filed a lawsuit against the EPA on behalf of five environmental groups[2]. The suit alleged that: 1) the EPA had previously determined that NNC is necessary as described in the Federal Clean Water Act; and that: 2) the EPA was obligated to promulgate numeric nutrient criteria for Florida. In January 2009, EPA formally determined that numeric nutrient criteria were necessary for Florida's waters and subsequently entered into a consent decree with the environmental groups in August 2009. EPA finalized its rules for inland lakes and flowing waters on Nov 14, 2010. That rule faces at least eight legal and/or scientific challenges,

[2] Namely, the Florida Wildlife Federation, the Conservancy of Southwest Florida, the Environmental Confederation of Southwest Florida, St. John's Riverkeeper, and the Sierra Club

including those from the State Attorney General, State Commissioner of Agriculture, and a lawsuit filed by the Florida League of Cities and the Florida Stormwater Association.

In the meantime, FDEP formally initiated rulemaking on numeric nutrient criteria in January, 2009, following receipt of EPA's determination letter. Since then, FDEP has held four publically noticed TAC meetings and three additional public rulemaking workshops. Issues and concerns rose by stakeholders, both verbally and in writing, were carefully considered, and modifications in the rules reflect the input.
EPA Numeric. On Nov 3, 2011, the EPA gave a tentative approval for a state alternative to its NNC rule, the FDEP NNC proposal that was adopted by the state Environmental Regulation Commission on December 8, 2011. The rule has subsequently been submitted to the Florida legislature for ratification.

Florida modified the rule in order to be tailored and as specific to, Florida, and for the purpose of clarification or simplification of the rule language. For example, FCG EC and FWEA Utility Council introduced an amendment to the FDEP proposed Section 62-302.200, F.A.C. to specifically[3] exclude ditches, canals and other conveyances, or segments of conveyances, which are man-made, or predominantly channelized or

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3 From:
(36) "Stream" shall mean, for purposes of interpreting the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., a predominantly fresh surface waterbody with perennial flow in a defined channel with banks during typical climatic and hydrologic conditions for its region within the state. During periods of drought, portions of a stream channel may exhibit a dry bed, but wetted pools are typically still present during these conditions. Streams do not include non-perennial water segments, wetlands, or portions of streams that exhibit lake characteristics (e.g., long water residence time, increased width, or predominance of biological taxa typically found in non-flowing conditions).

To:
(36) "Stream" shall mean, for purposes of interpreting the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., under paragraph 62-302.531(2)(c), F.A.C., a predominantly fresh surface waterbody with perennial flow in a defined channel with banks during typical climatic and hydrologic conditions for its region within the state. During periods of drought, portions of a stream channel may exhibit a dry bed, but wetted pools are typically still present during these conditions. Streams do not include:
(a) non-perennial water segments where fluctuating hydrologic conditions, including periods of desiccation, typically result in the dominance of wetland and/or terrestrial taxa (and corresponding reduction in obligate fluvial or lotic taxa), wetlands, portions of streams that exhibit lake characteristics (e.g., long water residence time, increased width, or predominance of biological taxa typically found in non-flowing conditions) or tidally influenced segments that fluctuate between predominantly marine and predominantly fresh waters during typical climatic and hydrologic conditions; or
(b) ditches, canals and other conveyances, or segments of conveyances, that are man-made, or predominantly channelized or physically altered and;
1. are primarily used for water management purposes, such as flood protection, stormwater management, irrigation, or water supply; and
2. have marginal or poor stream habitat or habitat components, such as a lack of habitat or substrate that is biologically limited, because the conveyance has cross sections that are predominantly trapezoidal, has armored banks, or is maintained primarily for water conveyance.

physically altered from the definition for streams. Therefore, the previous December 6, 2011 FSU CEFA cost estimate was revised and re-calculated reflecting this new amendment.

While many states have adopted some version of numeric nutrient criteria to parts of their water bodies[4], Florida NNC rule would be the first one that is applied on a state wide basis. Noticeably, this new numeric nutrient criteria would likely result in greater regulatory costs in terms of its design, implementation, and monitoring. The Florida Department of Environmental Protection (FDEP) acknowledges that "the derivation of specific numeric nutrient criteria to complement the narrative is very complex", since each waterbody can have very different and unique nutrient requirements"[5]. In October, 2011, FDEP contracted with the Florida State University Center for Economic Forecasting Analysis (FSU CEFA) to conduct the cost and economic analysis associated with implementation of FDEP's proposed NNC rule.

Waterbodies were assessed in segments (termed Waterbody IDs or WBIDs) for the purpose of developing cost estimates for the implementation of the Department's Numeric Nutrient Criteria Rule. WBIDs were apportioned into the following six categories for cost assessment purposes:

Category One – WBIDs that are impaired for nutrients or dissolved oxygen with nutrients as the causative parameter on Florida's 303(d) list under categories 4a, 4b, 4e, or 5 and for which a TMDL has been established for either nitrogen or phosphorus or both. For this category, the load reductions being required under these TMDLs will be compiled and the distribution of the data will be used to derive cost estimates.

Category Two - WBIDs that are impaired for nutrients or dissolved oxygen with nutrients as the causative parameter on Florida's 303(d) list under categories 4a, 4b, 4e, or 5 and for which a TMDL has not yet been established for either nitrogen or phosphorus are included. There are 720 such WBIDs based on our current assessment. Therefore, it will be assumed that the expected load reductions for these WBIDs will be similar to those in category one and the costs can be estimated using the distribution of those load reductions.

Category Three – WBIDs that would be deemed impaired under the Department's Numeric Nutrient Criteria rule. This category will include lakes, streams, and estuaries which will be calculated as follows:

Lakes – Lake WBIDs will be deemed impaired if they exceed either the applicable annual chlorophyll a criterion, the applicable maximum annual total nitrogen, or total phosphorus value in the Department's rule.

Streams – stream WBIDs will be deemed impaired if they exceed the applicable stream thresholds and the biology is deemed impaired under the Department's rule.

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[4] http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/ .

[5] http://www.dep.state.fl.us/water/wqssp/nutrients/faq.htm

Estuaries – estuarine WBIDs will be deemed impaired if they exceed the applicable criteria established for that estuary under the Department's rule

Category Four – WBIDs that would be deemed unimpaired under the Department's Numeric Nutrient Criteria rule. This category will also include lakes, streams, and estuaries which will be calculated as follows:

Lakes – Lake WBIDs will be deemed impaired if they achieve the applicable annual chlorophyll a criterion

Streams – stream WBIDs will be deemed unimpaired if the achieve either the applicable stream threshold or the biology is deemed unimpaired under the Department's rule

Estuaries – estuarine WBIDs will be deemed unimpaired if the achieve the applicable criteria established for that estuary under the Department's rule.

Category Five – WBIDs for which there is insufficient information to determine if they fit in category three or four.

Category Six – WBIDs for which there is insufficient information are placed on the study list.

Background

The Florida Department of Environmental Protection (FDEP), recognizing the role of site-specific factors that affect numeric responses, proposes to base new standards on establishing ***a systematic numeric interpretation of the existing narrative criteria***. As was also the case for the Environmental Protection Agency's rule at 40 CFR 131.43(e) [Federal Register, Volume 75, Number 233, Page 75762], this concept is intended to implement Rule 62-302.530 (47) (b), FAC, which states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna."

1. **What is the standard for impaired water?**

In a nutshell, an impaired waterbody is one that does not meet water quality standards. These standards can be either numeric or narrative. The most current version of FDEP's numeric interpretation of the above mentioned narrative standard states:

For lakes, the applicable numeric interpretations of the narrative nutrient criterion in paragraph 62-302.530(47) (b), F.A.C., for chlorophyll *a* are shown in the table below. The applicable interpretations for TN and TP will vary on an annual basis, depending on the availability of chlorophyll *a* data and the concentrations of nutrients and chlorophyll *a* in the lake as described below. The applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three year period.

a. If there is sufficient data to calculate the annual geometric mean chlorophyll *a* and the mean does not exceed the chlorophyll *a* value for the lake type in the table below, then the TN and TP numeric interpretations for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in the table below. However, for lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region; or

b. If there are insufficient data to calculate the annual geometric mean chlorophyll a for a given year or the annual geometric mean chlorophyll a exceeds the values in the table below for the lake type, then the applicable numeric interpretations for TN and TP shall be the minimum values in the table below.

Table 2 Standard for Impaired Lakes

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L[1]	2.23 mg/L
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L[1]	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L[1]	0.93 mg/L

[1] For lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region.

For streams, if a site specific interpretation pursuant to paragraph 62-302.531(2) (a) or (2) (b), F.A.C., has not been established, biological information shall be used to interpret the narrative nutrient criterion in combination with nutrient thresholds. The narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., shall be interpreted as being achieved in a stream segment where information on chlorophyll *a* levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition indicates there are no imbalances in flora or fauna, and either:

1. The average score of at least two temporally independent SCIs performed at representative locations and times is 40 or higher, with neither of the two most recent SCI scores less than 35, or
2. The nutrient thresholds set forth in the table below are achieved.

Table 3 Standard for Impaired Streams

Nutrient Watershed Region	Total Phosphorus Nutrient Threshold1	Total Nitrogen Nutrient Threshold1
Panhandle West	0.06 mg/L	0.67 mg/L
Panhandle East	0.18 mg/L	1.03 mg/L
North Central	0.30 mg/L	1.87 mg/L
Peninsular	0.12 mg/L	1.54 mg/L
West Central	0.49 mg/L	1.65 mg/L
South Florida	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47) (b), F.A.C., applies.	No numeric nutrient threshold. The narrative criterion in paragraph 62-302.530(47) (b), F.A.C., applies.

For spring vents, the applicable numeric interpretation of the narrative nutrient criterion is 0.35 mg/L of nitrate-nitrite ($NO_3 + NO_2$) as an annual geometric mean, not to be exceeded more than once in any three calendar year period.

For Estuary, (1) Estuary-specific numeric interpretations of the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., are in the table in *Page 9- 11, NPR 62-302 11-1-11 FINAL.* The concentration-based estuary interpretations are open water, area-wide averages. The interpretations expressed as load per million cubic meters of freshwater inflow are the total load of that nutrient to the estuary divided by the total volume of freshwater inflow to that estuary.

(2) Estuarine and marine areas are delineated in the map of the Florida Marine Nutrient Regions that may be obtained from the Department's internet site at http://www.dep.state.fl.us/water/wqssp/swq-docs or by writing to the Florida Department of Environmental Protection, Standards and Assessment Section, 2600 Blair Stone Road, MS 6511, Tallahassee, FL 32399-2400.

(3) The Department shall establish by rule or final order an estuary specific numeric interpretation of the narrative nutrient criteria for TN and TP for Perdido Bay, Pensacola Bay (including Escambia Bay), St. Andrews Bay, Choctawhatchee Bay, and Apalachicola Bay by June 30, 2013, subject to the provisions of Chapter 120, F.S. The Department shall establish by rule or final order the estuary specific numeric interpretation of the narrative nutrient criteria for TN and TP for the remaining estuaries by June 30, 2015, subject to the provisions of Chapter 120, F.S. This subsection shall not be implemented until Rule 62-302.531, F.A.C., is approved in its entirety pursuant to 40 C.F.R. § 131.21 and 33 U.S.C. § 1313(c). If any provision of Rule 62-302.531, F.A.C., is later determined invalid, then this subsection shall not be implemented.

2. Current status in Florida

Table 3 provides a summary of recent state of Florida area and population by counties in 2010. Florida consists of 67 counties which contains 31 small counties[6].

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6 According to 210.52(19), FS, small county is defined as population of county is below 75,000. Folloiwng counties in Florida are small counties; Baker, Bradford, Calhoun, Columbia, Desoto, Dixie, Franklin, Gadsden, Gilchrist, Glades, Gulf, Hamilton, Hardee, Hendry, Holmes, Jackson, Jefferson, Lafayette, Levy, Liberty, Madison, Monroe, Nassau, Okeechobee, Putnam, Suwannee, Taylor, Union, Wakulla, Walton, Washington

Table 4 The State of Florida Area and Population by Counties

County	Area	Population (2010)	County	Area	Population,(2010)
Alachua	969.2	217,955	Lake	1,156.5	210,528
Baker	589	22,259	Lee	1,212	440,888
Bay	1,033.3	148,217	Leon	701.8	239,452
Bradford	300.1	26,088	Levy	1,412.4	34,450
Brevard	1,557.3	476,230	Liberty	843.2	7,021
Broward	1,319.8	1,623,018	Madison	715.9	18,733
Calhoun	574.4	13,017	Manatee	892.8	264,002
Charlotte	859.3	141,627	Marion	1,663.1	258,916
Citrus	773.5	118,085	Martin	752.9	126,731
Clay	643.7	140,814	Miami-Dade	2,429.6	2,253,362
Collier	2,305.1	251,377	Monroe	3,737.5	79,589
Columbia	801.2	56,513	Nassau	725.9	57,663
DeSoto	639.5	32,209	Okaloosa	1,082.1	170,498
Dixie	863.8	13,827	Okeechobee	892	35,910
Duval	918.3	778,879	Orange	1,004.3	896,344
Escambia	893.9	294,410	Osceola	1,506.5	172,493
Flagler	570.8	49,832	Palm Beach	2,386.5	1,131,184
Franklin	1,026.5	11,057	Pasco	868	344,765
Gadsden	528.6	45,087	Pinellas	535.8	921,482
Gilchrist	355.5	14,437	Polk	2,010.2	483,924
Glades	986.2	10,576	Putnam	827.3	70,423
Gulf	755.8	13,332	Santa Rosa	1,155.3	123,135
Hamilton	519.4	13,327	Sarasota	725.3	192,695
Hardee	638.4	26,938	Seminole	344.9	117,743
Hendry	1,189.9	36,210	St. Johns	821.4	325,957
Hernando	589.1	130,802	St. Lucie	688.1	365,196
Highlands	1,106.4	87,366	Sumter	580.4	53,345
Hillsborough	1,266.3	998,948	Suwannee	692	34,844
Holmes	488.8	18,564	Taylor	1,232.1	19,256
Indian River	617	112,947	Union	249.7	13,442
Jackson	954.7	46,755	Volusia	1,432.5	443,343
Jefferson	636.7	12,902	Wakulla	735.8	22,863
Lafayette	547.9	7,022	Walton	1,238.2	40,601
			Washington	615.9	20,973

Source: US Census Bureau 2010, and State Library of Florida

Development of the Scope of Work

In order to fully assess the scope of work involved with the FDEP draft rule and economic and cost analyses, four documents were provided as background informational materials. The documents included "FDEP Review of the EPA's Preliminary Estimate of Potential Compliance Costs and Benefits Associated with EPA's Proposed Numeric Nutrient Criteria for Florida", draft Chapter(s) 62-302 and 62-303, "EPA's Economic Analysis of Final Water Quality Standards for Nutrients for Lakes and Flowing Waters in Florida", and "Economic Analysis of the Proposed Federal Numeric Nutrient Criteria for Florida" by Cardno ENTRIX.

The documents provided two cost estimates for the proposed rule from the EPA and Cardno ENTRIX. In summary, the cost estimates of the Cardno ENTRIX study are far greater than the EPA estimates. Depending on the level of enforcement by the EPA, the Cardno ENTRIX cost estimates range from $3.4 to $4.7 billion for the "end of pipe" criteria, and for the less strict "Best Management Practices" (BMP's) and "Limit of Technology" (LOT), the costs could range from $298 - $533 million. These ranges were within a 95% confidence interval that represented operating, maintenance, and capital costs annualized over a 20-year period.

Tasks

The tasks associated with the following project are outlined below.

FDEP Rule Analysis

- Literature Review
- Data collection
    - CEFA will base the initial cost estimates on the Cardno ENTRIX most recent/updated cost analyses (by county). If it's determined additional cost data is needed to perform the FDEP draft rule analysis (per county), CEFA proposes to work with FDEP staff, and other data sources in order to obtain pertinent cost data.
    - Data validation/cleaning if needed.
    - Conduct data and statistical analyses.
- Draft Chapter/Report on FDEP Rule Analysis Cost Estimation
- Draft report of Economic analyses
- Final report

FSU CEFA will provide the final report to the FDEP no later than 5:00 p.m. on March 15, 2012, and supply any needed clarifications or revisions by March 31, 2012.

II. Description of the Rule

Proposed Rule Structure

The narrative nutrient criteria would continue to apply to all bodies of water, and numeric interpretations would be applied based on the scientific information available. The narrative would be implemented using a systematic structure that numerically interprets the narrative nutrient criteria for each body of water in the following hierarchical manner:

1. Established site specific numeric interpretations of the narrative criteria (including TMDLs, SSACs, and other interpretations embodied in an official Department action) would be the primary interpretation of the narrative nutrient criteria.
2. If “1” (above) is not available for a body of water, the interpretation of the narrative criteria for a specific one would be based on established, quantifiable nutrient cause and effect relationships where the nutrient concentrations responsible for causing an imbalance of natural populations of aquatic flora or fauna is understood (currently, this is limited to fresh water springs and lakes).
3. If “1” and “2” (above) are not available, a combination of reference-based nutrient thresholds and biological information will be used (currently, this is limited to fresh flowing bodies of water excluding largely intermittent streams):

   a. Waters achieving the nutrient thresholds that are also biological healthy (*e.g.,* using SCI and measures of floral health) are deemed to meet the narrative criteria.

   b. Waters that exceed the nutrient thresholds but also reflect balanced flora and fauna (*e.g.,* using SCI and measures of floral health) are deemed to meet the narrative nutrient criteria.

   c. Waters that meet the nutrient thresholds, but are not biologically healthy are deemed to not attain Aquatic Life Use Support goals. FDEP would target these waters for a stressor identification study to determine the causative factor(s).

   These waters are initially deemed to attain the narrative nutrient criteria unless the stressor identification study links the adverse biological effects to nutrients.

   d. Waters that exceed the nutrient thresholds that are not biologically healthy would be deemed to not attain the narrative nutrient criteria unless a stressor identification study determines that nutrients are not the causative pollutant.

For “c” and “d”, if nutrients are identified as a causative pollutant, the Department will develop a TMDL or SSAC, at which point the numeric interpretation would default to the provisions of “1” after Department action. During these studies, confounding factors (those other than nutrient effects) will be considered.

General Discussion on Proposed Rule Structure

• Attainment of the narrative criterion is assessed as a spatial average for the body of water. If interpreted based on a TMDL or SSAC, the spatial component is as defined in the TMDL or SSAC document. If based on a generally applicable dose-response relationship, it will be as stated in a manner consistent with the derivation of the criterion. For reference-based thresholds, the spatial extent will be determined by site-specific considerations, such as relative system homogeneity, system classification, biological expectations, or empirically measured responses. Waterbody segments or aggregations of segments from a waterbody may be appropriate in many, but not all cases.
• If there are both a TMDL and a SSAC for a given waterbody, the most recently adopted TMDL or SSAC would take precedence.
• Protection of downstream waters will be provided using a narrative, rather than "downstream protection values". In no case shall the loading of nitrogen or phosphorus from a Class I or III fresh water stream or lake cause or contribute to an exceedance of water quality standards in a downstream waterbody. Upstream actions taken by the Department would consider downstream standards pursuant to this narrative.

Additional Description of Hierarchical Approach

Discussion on TMDLs as NNC

• Only State adopted nutrient related TMDLs would be eligible as site-specific interpretations of the narrative nutrient criteria.
• To be eligible, the nutrient TMDLs should be based upon prevention of imbalances of flora or fauna [Rule 62-302.530 (47) (b), FAC], but TMDLs for dissolved oxygen (DO) (Rule 62-302.530 (47) (a), FAC) would also be eligible if nutrients were identified as a causative pollutant and the TMDL demonstrated that it would also prevent an imbalance of natural populations of flora and fauna. As an example, surplus anthropogenic nutrients could be shown to generate excess plant biomass (periphyton, phytoplankton, or vascular plants), which could by themselves constitute an imbalance in flora or result in habitat smothering (e.g., excess periphyton accumulation), food web alteration (*e.g.*, dominance of taxa that thrive in nutrient enriched conditions), or low DO (from decomposition or respiration of excess plant biomass), etc., that results in imbalances in fauna, as reflected by failing SCI scores or other meaningful biological endpoint (*e.g.*, sea grass and transparency, etc.). If the TMDL is written to prevent this cycle and then achieve DO, it could be eligible as the numeric interpretation of Rule 62-302.530 (47) (b), FAC.
• Many TMDLs are expressed as loads instead of concentrations, but the loads do not have to be translated into concentrations to be deemed the numeric interpretation of the narrative nutrient criteria.

• TMDLs may be modified based on new data, new science, or different targeted endpoints (such as DO). When TMDLs are modified and readopted, they become the new interpretation of the narrative.
• Future TMDL rules may include a response target (chlorophyll a, for example) designed to implement the narrative nutrient criterion. Scientific information relating to the response target and the bases for existing TMDLs is presented in the TMDL reports, and this information can be used to establish a site-specific listing threshold for nutrient impairment pursuant to Rule 62-303.450, F.A.C.
• TMDLs may be written to achieve numeric nutrient values established in Chapter 62-303 (lakes or springs), or alternatively, be written to achieve conditions necessary to protect specific thresholds used for the TMDL would become the numeric interpretation of the narrative pursuant to “1” of the hierarchy.

Discussion on Site Specific Alternative Criteria as NNC

• The current restriction on establishing a SSAC for nutrients pursuant to Rule 62-303.800(2), F.A.C., would be eliminated.
• A structure to allow a predictable approach to developing nutrient SSACs (such as the previously proposed Type III SSAC) would be included as part of the rulemaking. The rule language will provide clear expectations on the water quality and biological data needed to characterize existing nutrient concentrations and aquatic health, but the specific number of stations required for assessment will be determined on a site specific basis.
• Since numeric nutrient criteria are intended to protect healthy, well-balanced natural populations of flora and fauna, and if the biology is found to be healthy, then the existing nutrient concentrations are deemed protective. The nutrient SSAC will need to address the natural variability in nutrient concentrations. Any SSAC must demonstrate that the designated use is being protected.
• As part of Type III SSAC development, aquatic life use support must be demonstrated. Waterbodies where the average of two temporally independent Stream Condition Index (SCI) results is greater than 40 and that do not exhibit excess algal growth or nuisance aquatic plants are biologically healthy.
• FDEP will consider phytoplankton, periphyton, and vascular plant community responses as additional evidence to demonstrate systems are meeting their designated use. Impaired Waters Rule- chlorophyll a metrics may also be used for this demonstration.

Criteria Based on Cause-Effect Relationships

Scope of Approach

For springs and lakes, quantifiable nutrient cause and effect relationships provide the basis for the numeric interpretation of the narrative nutrient criteria:
Springs: Nitrate criterion of 0.35 mg/L as an annual average.
Lakes: Use the existing chlorophyll/nutrient regression equations, acknowledging the uncertainty in the equations by allowing for "modified" criteria when chlorophyll targets are achieved.

Discussion of Numeric Interpretations Based on Cause and Effect

• The scientific bases for the spring and lake criteria have been previously presented in FDEP 2009 document, "Development of Numeric Nutrient Criteria for Florida Lakes and Streams". In highly colored lakes (long term average >140 PCU) where there is no longer a cause and effect relationship, the narrative nutrient criteria should continue to apply.
• FDEP is re-examining regionalization and morphoedapthic factors (color, alkalinity) to establish more appropriate lake criteria for some situations.
• Paleoliminological evidence may provide the basis for alternate natural chlorophyll targets in many Florida lakes, which could allow adjustment in the acceptable TP and TN using the regression equations.

Flowing Waters (Streams)

The FCG EC and FWEA Utility Council suggested a more specific and clear definition of the rule amendment regarding streams.
According to the amended Rule 62-302.200, F.A.C. (36), "Stream" shall mean, for purposes of interpreting the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., under paragraph 62-302.531(2)(c), F.A.C., a predominantly fresh surface waterbody with perennial flow in a defined channel with banks during typical climatic and hydrologic conditions for its region within the state. During periods of drought, portions of a stream channel may exhibit a dry bed, but wetted pools are typically still present during these conditions. Streams do not include:
(a) non-perennial water segments where fluctuating hydrologic conditions, including periods of desiccation, typically result in the dominance of wetland and/or terrestrial taxa (and corresponding reduction in obligate fluvial or lotic taxa), wetlands, portions of streams that exhibit lake characteristics (e.g., long water residence time, increased width, or predominance of biological taxa typically found in non-flowing conditions) or tidally influenced segments that fluctuate between predominantly marine and predominantly fresh waters during typical climatic and hydrologic conditions; or
(b) ditches, canals and other conveyances, or segments of conveyances, that are man-made, or predominantly channelized or physically altered and;
1. are primarily used for water management purposes, such as flood protection, stormwater management, irrigation, or water supply; and

2. have marginal or poor stream habitat or habitat components, such as a lack of habitat or substrate that is biologically limited, because the conveyance has cross sections that are predominantly trapezoidal, has armored banks, or is maintained primarily for water conveyance.

Discussion of NNC Process for Streams

- FDEP plans to use referenced-based stream nutrient values, such as the EPA's promulgated criteria, as thresholds during the process for numerically interpreting the narrative criteria described in this document.
- Note that the reference-based nutrient values were derived as waterbody geometric means. Spatial application of these values to streams is determined by site-specific considerations, such as relative system homogeneity, system classification, biological expectations, or empirically measured responses. WBIDs or aggregations of WBIDs may be appropriate in many, but not all cases.
- Reference based nutrient values were derived in perennial streams, generally. Application of these values to intermittent streams is not appropriate given their derivation and expression.
- Following amended rule 62-302.200, F.A.C., streams do not include ditches, canals and other conveyances, or segments of conveyances, which are man-made, or predominantly channelized or physically altered.

Waterbody Types and Cases with Insufficient Information

In aquatic systems where insufficient information currently exists to accurately interpret the narrative nutrient criteria, such as Class III wetlands, Class III flowing waters in South Florida, and Class III intermittent streams, the narrative will continue to apply, and the Department will numerically interpret the narrative criteria as the information is developed.

Implementation Considerations

Permitting

• Nutrient effluent limits for facilities discharging to surface waters will be developed through the Water Quality-Based Effluent Limitations (WQBEL) process pursuant to Chapter 62-650, F.A.C. Nutrient WQBELs developed to date were developed to attain the narrative nutrient criteria, and these WQBELs will remain in effect unless a more recent waste load allocation (WLA) is developed for the facility, the WQBEL is revised pursuant to the WQBEL rule, or the WQBEL is superseded by an agency action. For new or revised WQBELs, the WQBEL process will determine the approach that best interprets the narrative nutrient criteria as outlined in the hierarchical structure. The site specific analysis performed as part of the WQBEL process can be written to achieve "1", "2" or "3" of the structure, depending on the available information or result in a new interpretation of the narrative that could be considered a Department action relevant to "1".

Assessment

• FDEP will revise the IWR to be consistent with the revisions to Chapter 62-302, F.A.C., including provisions to directly implement the NNC for lakes and springs and to directly assess TMDLs.

• For waters with nutrient TMDLs expressed as a load, attainment of the allowable loads will be evaluated as part of the BMAP reporting process, and nonattainment will be assumed until information is provided to prove attainment (a combination of model estimated loads of nonpoint sources and measured loads from point sources). Waters should only be deemed to be in attainment if they meet the loads (or concentrations) and targets (*e.g.,* chlorophyll) and a demonstration that nutrients are no longer causing biological imbalances. If the waterbody attains the allowable loading but there is site-specific information indicating an imbalance in flora or fauna, the TMDL would be revisited and revised as needed.

• As part of these revisions, the Department is contemplating the creation of the study list (in addition to the planning list and verified list) for waters that do not attain water quality standards based on the evidence, but appropriate actions have yet to be identified to rectify the situation. This is common for dissolved oxygen nonattainment, biological nonattainment, and is anticipated for nutrient criteria nonattainment. For example, waters that exceed reference-based nutrient thresholds will be placed on a "study list" unless there are bio-assessment data indicating the stream is healthy. Waters on the study list will receive a site-specific physical, chemical, and biological investigation to determine if aquatic life use support goals are attained (if there were no bio-assessment data available), and if aquatic life use support is not attained, to then determine the causative pollutant(s). This process constitutes a "stressor identification" study. If the stream is determined to be impaired due to nutrients (at least in part), the water will be listed on the verified list for TMDL development, which will determine the reductions needed. This approach places waters on the study list if there is a nonattainment condition based on the current numeric interpretation of the narrative criteria outlined above, and also places waters on the IWR verified list for nutrients if they need a reduction in nutrient loading to attain the narrative nutrient criteria or otherwise restore the waterbody's designated use.

General Assumptions for Calculation: Amortizations

1. Amortization

Previous studies use various amortization methodologies. FSU CEFA included two separate amortization methodologies, with regard to private and public sectors as because the timeframe and the rate of time preference are different between private and public sectors. Basically, for the Industrial Wastewater, Septic System, and Agriculture Sector FSU CEFA used private sector amortization. For the Domestic Wastewater and Stormwater sectors, FSU CEFA used public sector amortization.

1) Private sectors

CEFA calculated the amortization year and rate for private sectors based on the board of governors of Federal Reserve System data[7]. For example, CEFA will use 20 years and 6.40 %.

Table 5 Amortization Standard (for Private Sector)

Period	10 year	15 year	20 year	25 year	30 year
Interest rate	6.10%	6.25%	6.40%	6.55%	6.70%

Source: HSHAssociates.com, adjusted by CEFA staff.

7 Sources

- Date, 15-Year FRM, 30-Year FRM, 1-Year ARM retrieved from http://www.federalreserve.gov/releases/h15/data/Annual/H15_TCMNOM_Y10.txt
- Instrument,"U.S. government securities/Treasury constant maturities/Nominal"
- Maturity,"10-year"
- Frequency,"Annual"
- Description,"Market yield on U.S. Treasury securities at 10-year constant maturity, quoted on investment basis"
- Note,"Yields on actively traded non-inflation-indexed issues adjusted to constant maturities. The 30-year Treasury constant maturity series was discontinued on February 18, 2002, and reintroduced on February 9, 2006. From February 18, 2002, to February 9, 2006, the U.S. Treasury published a factor for adjusting the daily nominal 20-year constant maturity in order to estimate a 30-year nominal rate. The historical adjustment factor can be found at www.treasury.gov/resource-center/data-chart-center/interest-rates/. Source: U.S. Treasury."

2) Public sectors

FSU CEFA calculated the amortization methodology for public sectors based on: the Florida municipal bond rates (on water, sewerage and power sector).[8] FSU CEFA staff used 10 years and 15 year moving averages of the bond rates projected 20 and 30 years from Year 2011. For example, for 20 years, FSU CEFA used 4.90%.

Table 6 Amortization Standard (for Public Sector)

Period	20 year	30 year
Interest rate	4.90%	4.70%

Source: Florida municipal bond rates, adjusted by FSU CEFA staff.

2. Classification Categories for Analysis

As previously mentioned, FDEP classified Florida's waterbodies into six categories. Within the six categories, the primary category of NNC Rule costs was Category Three; Cat 3. In addition, Category Five was: "WBIDs for which there is insufficient information to determine if they fit in Category three or four"; the economic analysis also focused on the costs associated with the probability, or likelihood, of the Cat 5's being reclassified in the near future, to Cat 3's. Similar to previous studies, the economic analysis consisted of five sectors: the Domestic Wastewater (DW), Industrial Wastewater (IW), Urban Stormwater (SW), Septic System, and Agriculture Sectors. The following report framework was applied to the description of each sector: the Cat 3 and (Cat 5 to Cat 3) economic analysis data and methodology, and associated results.

8 Sources from http://florida.municipalbonds.com/bonds/search/wtr%20swr%20pwr/s_type:desc/category:1/

III. Costs to Domestic Wastewater (DW) Treatment Plants

1. Methodology and Assumptions

(1) Domestic wastewater facilities with NPDES permits discharging to surface waters were included in the estimate. The list of domestic wastewater facilities for which costs were estimated was provided by FDEP staff.

(2) Costs for facilities discharging to a WBID, which is currently impaired and for which there currently exists (Cat 1) or will in the future (Cat 2) be a TMDL, were attributable to the current rule. Costs for facilities discharging to a WBID, which will become impaired (Cat 3) under the FDEP Numeric Nutrient Criteria, were attributed to the new rule.

(3) No costs were calculated for facilities discharging to a wetland or to a stream in the South Nutrient Watershed Region. No costs were calculated for facilities discharging to an estuary for which criteria are not proposed in the Department's rule. In addition, no costs were calculated for facilities discharging to an estuary for which criteria are proposed since those criteria are being established to maintain existing nutrient conditions in those estuaries; therefore, it is not believed that further nutrient reductions are required.

(4) For intermittent discharges for Mechanical Integrity Testing[9], discharges under Florida's Apricot Act[10] (Section Section 403.086(7), Florida Statutes (F.S.), intermittent discharges from golf course ponds[11], and for intermittent wet weather discharges from reuse facilities under certain conditions[12], it was

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[9] Mechanical Integrity Testing discharges are for facilities using deep well injection. Such facilities require a Mechanical Integrity Test once every five years. Since the testing is for a very brief duration once every five years and is required to be conducted under circumstances where the nutrients won't harm the receiving water, it was not deemed practical or necessary to require additional treatment.

[10] The Florida Apricot Act of 1994 states that backup discharges for reuse facilities that are at AWT and provide high-level disinfection may discharge up to less than 30% of their permitted capacity annually. Since these discharges are statutorily authorized, it was not deemed necessary to require additional treatment.

[11] Reclaimed water is often stored in golf course ponds (or other lakes ponds or lakes) which are not waters of the State. Reclaimed water is only discharged to such ponds when the lake level is below the level needed to ensure adequate stormwater storage and treatment volume requirements. As a result, discharges from such ponds to water of the State are intermittent and consist primarily of stormwater in response to storm events. Since such discharges are intermittent and only occur during times when there is significant dilution available in the ponds and receiving waters it was not deemed necessary to require additional treatment for such discharges.

[12] Review of data for intermittent wet weather discharges from reuse facilities indicates that many of those facilities generally discharge less than 15% of their total volumes. Since such discharges occur only intermittently, involve relatively small volumes of effluent, and occur when there is significant dilution available in the receiving waters, it was not deemed necessary to require additional treatment for such discharges.

assumed that no further improvements would be necessary in their level of treatment unless an increase in their discharge was being requested. Therefore, no cost was assumed for such discharges.

(5) For facilities with multiple discharge locations, costs were calculated based on the permitted facility flow and the primary discharge location.

(6) For facilities already at or better than advanced wastewater treatment (AWT), no further treatment was assumed to be necessary to provide reasonable assurance for permitting discharge to surface waters. AWT is defined by Section 403.086, Florida Statutes, as containing not more, on a permitted annual average basis, than CBOD5 of 5mg/L, suspended solids of 5mg/L, total nitrogen of 3 mg/L, total phosphorus of 1 mg/L and has received high level disinfection. Therefore, no cost was assumed for such discharges.

(7) Unit capital costs to upgrade were based on "AWT-upgrades cost data" from FDEP: The data was made more consistent since some had lacked an "engineering cost" component. The relative engineering cost part was assumed to be 25%. The unit capital costs were calculated relative to the MGD capacities of the various facilities. The range of the unit capital cost data (n=19) was subjected to a distribution analyses using @RISK software, and a fit was established with a Lognormal distribution. Given the distribution, a lower tail at 10% was established at $0.90, the medium at $3.30, and the upper 90% tail at $12.36.

(8) The unit Operation & Maintenance costs were estimated to be $0.56 per gallon per year based on Cardno ENTRIX cost data.

(9) The amortization was for 20 years at a 4.9% interest rate, as described in the general assumptions.

2. Data and Calculations for Cat 3

1) Affected Facilities and Capacities

Costs for facilities discharging to a WBID that will become impaired (Cat 3 and a proportion of Cat 5) under the FDEP Numeric Nutrient Criteria were attributed to the new rule. FDEP provided a domestic wastewater dataset which contained information concerning a total of 341 outfalls on 203 facilities in Florida. After assigning the 341 outfalls to the six categories and eliminating facilities for which no costs would be anticipated as described in the Methods and Assumptions section, there were zero facilities associated with only category 3 costs.

Table 7 DW Facilities with Multi-Category Entries Eliminated

Total Outfalls in Facilities	Outfalls with Categorized	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6	MGD in Cat 3
341	58	16	14	0	19	8	1	0

3. Data and Calculations for Estimating the Likelihood of Being Reclassified from a Cat 5 to Cat 3 (Impaired)

Baseline Assumptions

1. Using a data assessment performed by FDEP, facilities in Cat 5 will be reclassified by FDEP as a Cat 3 or Cat 4
2. The probability to be reclassified from a Cat 5 to a Cat 3 is estimated to be 17.54% based on the assessment data by WBID, provided by FDEP. Of the WBIDs for which there was sufficient data to assess them 429 WBIDs were impaired out of a total of 2446 WBID (17.54% impairment rate).
3. FSU CEFA applied the probability of 17.54% to the costs for each Cat 5 sector based on the individual sector cost methodologies.

DW Cat 5 to Cat 3 Cost Calculations

1. Cat 5 Data

   After removing facilities for which no costs would be incurred (consistent with the Methods and Assumptions), there are five facilities which would incur costs in Cat 5.
   The facility capacity total for the 5 facilities is 16.605 MGD.
   By applying the probabilities of 17.54% to the facility's total capacity, a facility capacity of 2.91 will be obtained.

2. DW Cost Data

Table 8 DW Costs for Calculation

Capital Cost	O&M Cost
Minimum : $0.90/ gallon Median: $3.30 /gallon Maximum: $12.36 /gallon	$ 0.56/ gallon/year

3. The Capital Cost and O&M cost are multiplied by the (facility capacity * MGD). Amortization is 4.9% for 20 years.

4. Cost Results

Table 9 Cost Result for DW Sector (Cat 5 to Cat 3)

	Capital Cost	Annual Cost	O&M Cost	Total Annual Cost
Median	$ 9,599,036.50	$763,734.07	$1,631,009.52	$2,394,743.59
Low	$ 2,611,756.02	$207,800.76	$1,631,009.52	$1,838,810.28
High	$ 36,003,166.60	$2,864,542.18	$1,631,009.52	$4,495,551.70

5. Cost Results for Cat 5 to Cat 3 by Counties

Table 10 Cost Result for DW Sector by Counties (Cat 5 to Cat 3)

County	Minimum Annual cost	Maximum Annual cost	Median Annual cost
Clay	$99,665	$243,661	$129,796
Duval	$1,705,371	$4,169,316	$2,220,961
Flagler	$33,222	$81,220	$43,265
Nassau	$554	$1,354	$721
Total	$1,838,810	$4,495,552	$2,394,744

IV. Costs to Industrial Wastewater (IW) Treatment Plants

1. Methodology and Assumptions

(1) Industrial wastewater facilities with NPDES permits discharging to surface waters were included in the estimate. The list of industrial wastewater facilities for which costs were estimated were provided by FDEP staff.

(2) The list of facilities was restricted to:

a. Facilities that have numeric discharge limitations for any form of nitrogen and/or phosphorus in their NPDES IW permits,

b. Facilities that are required to report the concentration of any form of nitrogen and/or phosphorus in their NPDES IW permits, and

c. Other NPDES permitted IW facilities that are not currently required to monitor nutrients, but are in the SIC categories for a and b, above.

(3) The following were specifically excluded from the cost analysis:

a. Stormwater Treatment Areas (STAs) (SIC 3822) developed for Everglades restoration efforts within the Everglades Protection Area have separate criteria and are not included.

b. Facilities discharging to a wetland or to a stream in the South Nutrient Watershed Region.

c. Facilities discharging to a WBID which is currently impaired and for which there currently exists or will in the future be a TMDL and therefore have costs attributable to FDEP's current rule.

d. NPDES permitted facilities in various SIC categories that meet the criteria in items 1 and 2, above, but which discharged during 10% or fewer months within the past five years, based on U.S. Environmental Protection Agency's (EPA) Permit Compliance System (PCS) database, were not included in cost calculations. It was assumed that no further improvements would be necessary in their level of treatment due to the infrequent nature of their discharge.

(4) Costs for facilities discharging to a WBID, which is currently impaired and for which there currently exists (Cat 1) or will in the future (Cat 2) be a TMDL, were attributable to the current rule. Costs for facilities discharging to a WBID which will become impaired (Cat 3) under the FDEP Numeric Nutrient Criteria were attributed to the new rule.

(5) Discharge estimation assumptions are as follows:

a. The discharge flows were based on data obtained from the FDEP Permit Compliance System, as reported on Discharge Monitoring Reports from permitted facilities for the five year period from January 1, 2005 through December 31, 2009.

b. For facilities with multiple discharge points (outfalls), flows from all outfalls that potentially may discharge nutrients were used.

c. Estimated annual discharges were assumed for 340 days/year of discharge, except for facilities that are known to have intermittent discharges, in which case the number of months per year during which discharge occurred were identified from PCS[13].

d. Monthly average flows were used as the flow basis in estimating annual operation and maintenance (O&M) costs.

e. Daily maximum flow data were used as an approximation of maximum design capacity for estimating capital costs.

(6) Estimated discharges for phosphogypsum processing facilities with associated gypsum stacks (SIC 2874) were obtained from the Bureau of Mine Reclamation. Gypsum stacks discharge treated industrial wastewater during a five year closure period, followed by post-closure treatment and discharge over periods up to 50 years.

(7) Capital and operating costs for phosphogypsum processing facilities with associated gypsum stacks (SIC 2874) were also obtained from the Bureau of Mine Reclamation.

(8) Unit capital costs to upgrade were based on "AWT-upgrades cost data" from FDEP: The data was made more consistent since some lacked an "engineering cost" component. The relative engineering cost part was assumed to be 25%. Unit Capital Costs were calculated as to the MGD capacities of the various facilities. The range of unit capital cost data (n=19) was subjected to a distribution analyses with the @RISK software package, and a fit was established with a Risk Lognormal distribution. Given the distribution, a lower tail at 10% was established at $0.90, the medium at $3.30, and the upper 90% tail at $12.36.

(9) Total capital cost is calculated by Affected Daily Maximum Flow * Capital Cost in assumption (8).

(10) Unit Operation & Maintenance costs were $0.56 per gallon per year based on Cardno ENTRIX cost data.

(11) Total O&M cost per year is calculated by Affected Monthly Average Flow * O&M Cost in assumption (10).

[13] The estimate of 340days/year of discharge for continuously discharging IW facilities is conservatively high to avoid under estimating costs. This approach seems appropriate because it provides an estimate of the potential cost and operational burden for facilities operating at full capacity Personal Communication, Allen Hubbard, Industrial Waste, FDEP.

(12) As mentioned earlier in the general assumptions, FSU CEFA will assume a rate of 6.7% amortized over 30 years for the private sector and 4.7% amortized over 30 years for the public sector.

2. Data and Calculations for Cat 3

1) Affected Facilities and Capacities

The FDEP NPDES IW database was used which contained 158 data points with variable outfalls. 118 outfalls in 87 IW facilities were classified into 6 categories by FDEP staff. Excluding facilities which fell under either category 1 or 2, only 3 outfalls in 3 facilities are classified in category 3. However, one facility was "intermittent" and based on the current IW assumptions, FSU CEFA didn't include this facility in the cost analysis. The other two facilities are categories that were removed because these facilities discharge to wetlands and FDEP have not established criteria for wetlands in NNC rule. Therefore, there is no affected facility by NNC rule.

Table 11 IW Facilities with Multi-Category Entries Eliminated

Total outfalls	Categorized Outfalls	Cat1	Cat2	Cat3	Cat4	Cat5	Cat6	MGD in Cat3
203	118	19	40	0 (3=> 2 go for wetland and 1 is intermittent)	21	26	9	22.659(aver.) /62.83(max.)

3. IW Data and Calculations for Cat 5 to Cat 3

Baseline Assumptions

1. Using a data assessment performed by FDEP, facilities in Cat 5 will be reclassified by FDEP as a Cat 3 or Cat 4.
2. The probability to be reclassified from a Cat 5 to a Cat 3 is estimated to be 17.54% based on the assessment data by WBID, provided by FDEP. Of the WBIDs for which there was sufficient data to assess them, 429 WBIDs were impaired, out of a total of 2,446 WBID (17.54% impairment rate).
3. FSU CEFA applied the probability of 17.54% to the costs for each Cat 5 sector based on the individual sector cost methodologies.

IW Cat 5 to Cat 3 Cost Calculations

1. Cat 5 Data

   After removing facilities for which no costs would be incurred (consistent with the Methods and Assumptions), there are five outfalls which would incur costs in Cat 5.
   Average flows total 9.305 MGD and maximum flows total 198.55 MGD for those 5 outfalls.
   By applying the probabilities of 17.54%, the average flow and maximum flow of 1.632 MGD, and 34.83 MGD will be obtained.

2. IW Cost Data

Table 12 IW Costs for Calculation

Capital Cost	**O&M Cost**
Minimum : $0.90/ gallon Medium: $3.30 /gallon Maximum: $12.36 /gallon	$ 0.56/ gallon/year

3. Capital cost is multiplied by (maximum flow * MGD), and O&M cost is multiplied by (average flow * MGD). Amortization is 6.7% for 30 years.

4. IW Cost Results

Table 13 Cost Result for DW Sector (Cat 5 to Cat 3)

	Capital Cost	Annual Cost	O&M Cost	Total Annual Cost
Median	$ 114,777,422	$ 8,972,338	$ 913,974	$ 9,886,313
Low	$ 31,229,241	$ 2,441,241	$ 913,974	$ 3,355,215
High	$ 430,496,400	$ 33,652,606	$ 913,974	$ 34,566,580

5. Cost Results for Cat 5 to Cat 3 by counties

Table 14 Cost Result for DW Sector by Counties (Cat 5 to Cat 3)

County	Minimum Annual cost	Maximum Annual Cost	Median Annual Cost
Santa Rosa	$7,957	$19,276	$10,326
Polk	$3,347,258	$34,547,305	$9,875,987
Total	$3,355,215	$34,566,580	$9,886,313

V. Costs for Urban Stormwater (SW) Controls

1. Methodology and Assumptions

(1) Florida was the first state in the nation to implement comprehensive stormwater treatment programs in 1981 for all new urban development and re-development. This program specifies the BMPs to be used to treat stormwater to specific performance standards (minimum level of treatment) for all stormwater discharges during and after construction. Therefore, for the purpose of this estimate, it was assumed that implementation of urban stormwater measures subsequent to the 1981 stormwater program would achieve the proposed criteria, but that pre-1982 urban areas without such measures would not.

(2) For calculating the costs associated with the NNC, FDEP staff performed GIS analysis to find the urban area-specific included within the target waterbody IDs WBIDs for years 1990 and 2005. In 1990, the urban area that was included in the target WBIDs was 2,575,895 acres, and the urban area was 3,562,468 acres, in 2005. FDEP staff classified the urban areas in 1990 and 2005 by six categories.

(3) FDEP has undertaken numerous retrofit projects to address pollutant loading from municipal stormwater runoff, many of which required monitoring in order to show the effectiveness of the retrofit. The data from these projects have been compiled into a database by FDEP, which include information on the acreage of the area which was retrofitted. This information was used to derive a cost per unit acre to retrofit urban areas for nutrient removal. Utilizing the bootstrap analysis performed by Cardno-ENTRIX on FDEP's data, the mean cost per acre for such retrofit projects was $2,800 per acre, with a range around that mean of $1,500 per acre to $5,900 per acre, ranging from the 10th to the 90th percentile.

(4) The operation and maintenance costs were estimated based on existing literature[14]. Although actual costs can often exceed this rate, a conservative estimate of 5% of the capital outlay was chosen for this estimate.

(5) A 30-year annualized cost was calculated using an amortization rate of 4.7%.

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[14] *The Use of Best Management Practices (BMPs) in Urban Watersheds* – U.S. EPA, 2004; Stormwater: The Journal for Surface Water Quality Professionals, Nov.-Dec., 2008.

2. Data and Calculations for Cat 3

1) Affected Urban Stormwater Acres

Concerning the NNC cost calculations, the category 3's were the primary focus. About 51,717 acres were classified as category 3's according to year 2005 data, and about 67,667 acres were classified based on the year 1990 data. Ruling out multiple category acres, the remaining representative acres (designated as category 3) were 20,141 and 27,734, for years 1990 and 2005, respectively. The category 3 acres decreased about 27.4% from years 2005 to 1990. Annually, there have been decreases of about 2.11%. Extrapolated to year 1982, the category 3's acreage would be 16,982 acres, representing a 38.8% decrease from 2005. According to the assumption (1), it is estimated that about 16,982 acres would be affected by implementation of the NNC rule.

Table 15 Years 1990 and 2005 Classification of Urban Stormwater WBID Acreage

	#_WBID	Acres*	Cat 1 Acres	Cat 2 Acres	Cat 3 Acres**	Cat 4 Acres	Cat 5 Acres	Cat 6 Acres
1990	5,231	2,575,895	111,524	422,313	20,141	626,401	839,491	123,558
2005	5,833	3,562,468	195,794	524,781	27,734	914,350	1,225,045	155,812

Source: FDEP staff
*Acreage based on the WBIDs – some WBIDs fell in multiple categories
**Excluding WBIDs which also fell in Categories 1 or 2

Table 16 Years 1990 and 2005 Classification of Urban Stormwater WBID Acreage

	# WBID	Acres	**Cat 3 Only Acreage**	**Cat 5 to Cat 3 Acreage***
1990	5,231	2,575,895	20,141	147,247
2005	5,833	3,562,468	27,734	214,873

Source: FDEP staff
*Costs for Cat 5 to Cat 3 Acreage were based on 17.54% assumption of total Cat 5 acreage.

2) Capital Costs Per Acre

Table 17 Capital Costs Per Acre

Min	Max	Most likely
$ 1,500	$5,900	$ 2,894

Source: Cardno ENTRIX (2011)

3) Total Costs

We assumed an interest rate of 4.9% over 30 years[15]. The total capital cost was calculated by 1) Affected urban acres * 2) Capital costs per Acre. The total O&M cost per year was calculated by deriving 5% of the total cost.

Table 18 Total Urban SW Costs (Cat 3)

	Treatment Acres	Cost per Acre	O&M Cost (5%)	Annual Cost
Min	16,982.14	$1,500	$75	$2,026,816
Max	16,982.14	$5,900	$295	$7,972,144
Most likely	16,982.14	$2,894	$145	$3,910,404

[15] Based on FDEP methodology (2010).

3. Cost Results by Counties for Cat 3

The following Table depicts the cost results by counties.

Table 19 Urban SW Costs by Counties (Cat 3)

County	1990 Cat 3 Acreage	Ratio	Minimum Cost	Maximum Cost
Alachua	2.84	0%	$286	$1,126
Calhoun	145.73	1%	$14,665	$57,683
Citrus	3.62	0%	$364	$1,433
Desoto	1394.99	7%	$140,379	$552,156
Dixie	.22	0%	$22	$86
Escambia	4484.11	22%	$451,238	$1,774,869
Franklin	76.87	0%	$7,735	$30,425
Glades	4.57	0%	$460	$1,808
Hardee	92.73	0%	$9,332	$36,706
Hendry	.84	0%	$85	$333
Hernando	4044.63	20%	$407,013	$1,600,917
Highlands	2.53	0%	$254	$1,001
Hillsborough	8.51	0%	$856	$3,369
Indian River	1528.05	8%	$153,769	$604,823
Lake	1.60	0%	$161	$632
Lee	1291.72	6%	$129,986	$511,279
Leon	76.28	0%	$7,676	$30,192
Manatee	1.02	0%	$103	$405
Okeechobee	432.71	2%	$43,544	$171,273
Orange	31.01	0%	$3,120	$12,273
Pasco	3055.87	15%	$307,513	$1,209,553
Pinellas	3035.87	15%	$305,501	$1,201,638
Polk	181.53	1%	$18,268	$71,852
Seminole	23.77	0%	$2,392	$9,410
Taylor	208.38	1%	$20,970	$82,482
Volusia	11.17	0%	$1,124	$4,421
Total	20141.17	100%	$2,026,816	$7,972,144

4. Data and Calculations for Cat 5 to Cat 3

1. Cat 5 data
   In 2005, the Cat 5-only acres totaled 1,225,045. Based on our SW assumption whereby there will be an annual 2.49% decrease for 23 years, the base 1982 Cat 5 acres were extrapolated to total 686,241.
   By assuming an estimated likelihood of 17.54%, the affected area is 120,366.72 acres.

2. Stormwater Cost Data

Table 20 SW Costs for Calculation

Capital Cost	O&M Cost (5% per year)
Most likely: $2,894 Minimum: $1,500 Maximum: $5,900	Most likely: $144.7 Minimum: $75 Maximum: $295

3. The Capital cost is multiplied by 17.54% of the Cat 5 acres, and the O&M cost is estimated at 5% of annual capital costs. The amortization is 4.9% for 20 years.

4. SW Cost Results

Table 21 Cost Result for SW Sector (Cat 5 to Cat 3)

	Treatment Acres	Cost per Acre	O&M Cost (5%)	Annual Cost
Most Likely	120,366.72	$2,894.00	$144.70	$27,715,436.87
Min	120,366.72	$1,500.00	$75.00	$14,365,292.09
Max	120,366.72	$5,900.00	$295.00	$56,503,482.22

5. Cost Results for Cat 5 to Cat 3 by Counties

Table 22 Cost Result for SW Sector by Counties (Cat 5 to Cat 3)

County	1990 Cat 5 to Cat 3	Ratio	Minimum Annual Cost	Maximum Annual Cost
Alachua	4766.57	3%	$465,023	$1,829,092
Baker	1355.21	1%	$132,213	$520,039
Bay	2231.23	2%	$217,677	$856,198
Bradford	344.94	0%	$33,652	$132,365
Brevard	3516.16	2%	$343,034	$1,349,269
Broward	5.20	0%	$508	$1,997
Calhoun	358.07	0%	$34,934	$137,405
Charlotte	244.04	0%	$23,809	$93,647
Citrus	866.95	1%	$84,579	$332,677
Clay	4038.97	3%	$394,040	$1,549,890
Columbia	1538.51	1%	$150,096	$590,379
Dade	1.46	0%	$143	$561
Desoto	453.61	0%	$44,254	$174,064
Dixie	359.95	0%	$35,117	$138,126
Duval	3518.49	2%	$343,262	$1,350,164
Escambia	1764.96	1%	$172,189	$677,275
Flagler	775.96	1%	$75,702	$297,761
Franklin	43.97	0%	$4,290	$16,872
Gadsden	2391.01	2%	$233,265	$917,509
Gilchrist	22.36	0%	$2,182	$8,581
Glades	5.74	0%	$560	$2,202
Gulf	469.97	0%	$45,850	$180,344
Hamilton	228.37	0%	$22,280	$87,635
Hardee	282.54	0%	$27,565	$108,421
Hernando	4629.85	3%	$451,685	$1,776,628
Highlands	2725.98	2%	$265,945	$1,046,052
Hillsborough	2738.91	2%	$267,207	$1,051,013
Holmes	929.03	1%	$90,636	$356,500
Indian River	1016.89	1%	$99,207	$390,214
Jackson	2459.83	2%	$239,979	$943,919
Jefferson	218.09	0%	$21,277	$83,688
Lake	6390.62	4%	$623,465	$2,452,295
Lee	440.76	0%	$43,000	$169,135
Leon	2432.75	2%	$237,337	$933,526
Levy	2316.26	2%	$225,973	$888,825
Liberty	430.17	0%	$41,967	$165,071

Madison	224.46	0%	$21,898	$86,133
Manatee	926.29	1%	$90,368	$355,449
Marion	16699.88	11%	$1,629,229	$6,408,301
Martin	423.38	0%	$41,304	$162,464
Nassau	1944.47	1%	$189,701	$746,158
Okaloosa	5462.08	4%	$532,877	$2,095,982
Okeechobee	91.90	0%	$8,966	$35,265
Orange	12396.18	8%	$1,209,363	$4,756,829
Osceola	2468.86	2%	$240,860	$947,384
Pasco	9076.18	6%	$885,466	$3,482,833
Pinellas	2487.44	2%	$242,673	$954,515
Polk	9378.36	6%	$914,947	$3,598,790
Putnam	4196.46	3%	$409,404	$1,610,321
Santa Rosa	2888.82	2%	$281,832	$1,108,539
Sarasota	1887.48	1%	$184,141	$724,290
Seminole	1626.54	1%	$158,684	$624,157
St. Johns	1145.12	1%	$111,717	$439,421
St. Lucie	200.28	0%	$19,539	$76,854
Sumter	2292.68	2%	$223,672	$879,777
Suwannee	809.65	1%	$78,988	$310,688
Taylor	108.29	0%	$10,565	$41,554
Union	228.48	0%	$22,291	$87,677
Volusia	8136.13	6%	$793,756	$3,122,107
Wakulla	308.32	0%	$30,079	$118,311
Walton	4445.18	3%	$433,669	$1,705,764
Washington	1080.39	1%	$105,402	$414,582
Total	147,246.70	100%	$14,365,292	$56,503,482

VI. Costs for Septic Systems

1. Method and Assumptions

(1) FDEP staff provided the number of septic tanks , derived from the FDEP GIS analysis results. The locations of the septic tanks were provided by the Florida Department of Health. Only those tanks with STATUS = ACTIVE were part of the cost analysis. Using the 100K National Hydrography Dataset (NHD), a GIS layer representing streams, and lakes larger than two acres, was created. This layer was then buffered by 500 feet (153 meters). FDEP staff calculated the number of septic tanks that fell inside the buffer.

(2) Estimated construction costs were taken from an interim report prepared for the FDEP entitled "Onsite Sewage Treatment and Disposal Systems Evaluation for Nutrient Removal", January 7, 2010, Stormwater Management Academy, University of Central Florida. It compared different advanced septic systems with conventional systems.[16] The septic systems costs with higher levels of nutrient removal (e.g., advanced or performance based systems) ranged from $9,320 to $18,200 per unit. The operation and maintenance costs were also estimated from this report, which indicated values ranging from $200 - $1,800 per year.

(3) Regarding financing a septic system, FSU CEFA staff assumed a shorter financing stream; as 20 years was viewed as not realistic, given 20 years is the average life span of a septic system. FSU CEFA decided that anywhere from 5-10 years would be representative of a higher level septic system, e.g., advanced or performance based system. FSU CEFA staff assumed an interest rate of 6.1% (see aforementioned assumption related to financing public and private projects) over ten years. The O & M costs were not tied to inflation.

2. Data and Calculation for Cat 3

1) The Number of Septic Tanks

The total number of septic tanks which would potentially be affected by implementation of the NNC rule was 76,994. The number of septic tanks in category 3 is 1,201 (this total includes septic tanks in category 3 which also are listed in category 1 or 2). The number of septic tanks with costs that could be incurred under the NNC rule is 498 (septic tanks which are listed in category 3 only).

[16] Stormwater Management Academy (2010). UCF. Onsite Sewage Treatment and Disposal Systems Evaluation for Nutrient Removal, p.3

Table 23 Number of Septic Tanks

Total	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
76,994	3,266	9,451	498	19,372	32,413	3,909

2) Costs to Upgrade Per Tank

Table 24 The Capital Costs and O&M Costs to Upgrade (Per Tank)

	Low	**High**
Capital Costs To Upgrade Per Tank	$9,320	$18,200
O & M per Septic System	$200	$1,800

3) Total Costs

We assumed an interest rate of 6.1% over ten years (based on aforementioned assumptions). The total cost of replacement was calculated by 1) Number of septic tanks * 2) Capital costs to upgrade per tank. The total O&M cost per year was calculated by 1) Number of septic tanks * 2) O & M cost per septic system.

Table 25 Total Costs of Affected Septic Systems (Cat 3)

	Low	**High**
Replacement Total Cost	$4,641,360	$9,063,600
Total O & M cost per year	$99,600	$896,400
Capital Investment Amortization	6.1% over 10 years	
Replacement Annual Costs	$733,203	$2,133,694

3. Total Costs Results by Counties for Cat 3

The following Table reports the cost results by counties.

Table 26 Total Costs of Septic Systems, by Counties (Cat 3)

County	#of Septic Systems Cat 3 Only	Low	High
Calhoun	1	$1,472	$4,285
Desoto	42	$61,836	$179,950
Dixie	1	$1,472	$4,285
Escambia	170	$250,290	$728,369
Franklin	4	$5,889	$17,138
Hardee	4	$5,889	$17,138
Hernando	101	$148,702	$432,737
Hillsborough	3	$4,417	$12,854
Indian River	36	$53,003	$154,243
Lee	2	$2,945	$8,569
Okeechobee	37	$54,475	$158,527
Pasco	24	$35,335	$102,829
Pinellas	48	$70,670	$205,657
Polk	2	$2,945	$8,569
Taylor	23	$33,863	$98,544
Total	498	$733,203	$2,133,694

4. Data and Calculations for Cat 5 to Cat 3

1. Cat 5 Data
   There are a total of 32,413 septic systems listed in Cat 5.
   Similar to the previous methodology regarding a probability of 17.54% in being reclassified from a Cat 5 to a Cat 3, it was estimated that there were 5,685 septic systems which might be reclassified to a Cat 3.

2. Cost Data

Table 27 Costs for Calculation

Capital Cost	**O&M Cost**
Low: $9,320 High: $18,200 Median: $10,200	Low: $200 High: $1,800 Median: $400

3. The capital cost and O&M costs were multiplied by the number of septic systems likely to be reclassified from a Cat 5 to a Cat 3. Amortization is 6.1% for ten years.

4. Septic System Cost Results

Table 28. Cost Results for Septic System Sector (Cat 5 to Cat 3)

Total Number of Septic Systems to be Upgraded	5,685		
	Low	High	Median
Capital Costs To Upgrade Per Tank	$9,320	$18,200	$10,200
O & M per Septic System	$200	$1,800	$400
Total Annualized Cost	$1,472.30	$4,284.53	$1,792.43
Instant Replacement Total Cost	$52,984,200	$103,467,000	$57,987,000
Total O & M Cost per Year	$1,137,000	$10,233,000	$2,274,000
Capital Investment Amortization	6.1% over 10 years		
Instant Replacement Annual Costs	$8,370,000	$24,357,528	$10,189,944

5. Cost Results for Cat 5 to Cat 3 by Counties

Table 29 Cost Result for Septic System Sector by Counties (Cat 5 to Cat 3)

County	Cat 5 to Cat 3	Ratio	Low Annual Cost	High Annual Cost
Alachua	56	1%	$82,892	$241,223
Baker	19	0%	$28,663	$83,414
Bay	68	1%	$99,935	$290,820
Bradford	15	0%	$21,691	$63,124
Brevard	20	0%	$29,696	$86,420
Calhoun	12	0%	$17,818	$51,852
Charlotte	10	0%	$14,203	$41,331
Citrus	32	1%	$47,514	$138,271
Clay	317	6%	$466,363	$1,357,162
Columbia	38	1%	$55,261	$160,815
Desoto	27	0%	$39,767	$115,727
Dixie	13	0%	$19,625	$57,112
Duval	120	2%	$176,629	$514,008
Escambia	63	1%	$92,704	$269,779
Flagler	3	0%	$3,873	$11,272
Franklin	1	0%	$1,291	$3,757
Gadsden	109	2%	$160,361	$466,665
Gilchrist	1	0%	$1,549	$4,509
Gulf	14	0%	$20,917	$60,869
Hamilton	14	0%	$19,884	$57,864
Hardee	15	0%	$22,724	$66,130
Hernando	121	2%	$178,695	$520,020
Highlands	206	4%	$303,936	$884,485
Hillsborough	142	2%	$209,166	$608,694
Holmes	52	1%	$75,920	$220,933
Indian River	180	3%	$264,685	$770,261
Jackson	122	2%	$179,986	$523,777
Jefferson	20	0%	$29,955	$87,171
Lafayette	1	0%	$775	$2,254
Lake	473	8%	$696,187	$2,025,974
Leon	104	2%	$152,614	$444,121
Levy	14	0%	$20,142	$58,615
Liberty	9	0%	$13,428	$39,077
Madison	4	0%	$5,165	$15,029
Manatee	60	1%	$88,573	$257,756
Marion	43	1%	$63,525	$184,863
Martin	19	0%	$27,631	$80,408

Nassau	50	1%	$74,112	$215,673
Okaloosa	163	3%	$239,379	$696,616
Okeechobee	18	0%	$25,823	$75,147
Orange	793	14%	$1,167,973	$3,398,917
Osceola	115	2%	$169,140	$492,215
Pasco	341	6%	$501,482	$1,459,363
Pinellas	27	0%	$39,767	$115,727
Polk	457	8%	$672,172	$1,956,087
Putnam	153	3%	$225,176	$655,285
Santa Rosa	142	3%	$209,424	$609,445
Sarasota	36	1%	$52,421	$152,549
Seminole	123	2%	$181,277	$527,535
St. Johns	116	2%	$171,465	$498,979
St. Lucie	6	0%	$8,522	$24,799
Sumter	61	1%	$89,606	$260,761
Suwannee	13	0%	$19,109	$55,609
Taylor	18	0%	$26,081	$75,899
Union	10	0%	$14,719	$42,834
Volusia	302	5%	$445,188	$1,295,541
Wakulla	2	0%	$2,582	$7,515
Walton	148	3%	$218,204	$634,996
Washington	56	1%	$82,634	$240,472
Total	5685	100%	$8,370,000	$24,357,528

VII. Agriculture Costs

1. Methodology and Assumptions

FSU CEFA adhered to the majority of assumptions developed by an earlier study conducted by FDACS, UF & SWET (2010).

(1) FDEP staff provided FSU CEFA with WBID acreages relating to agriculture.

(2) The estimated per-acre costs for agricultural producers to implement BMPs were taken from a report prepared for the South Florida Water Management District[17]. The BMPs included the full range of typical owner-implemented practices, such as fertilizer management, grazing management, and livestock exclusion from waterways.

(3) The initial capital cost estimates included materials, labor and engineering.

(4) The total annual costs included O&M (estimated at 20% of the capital costs) and amortization of the capital investment at 6.4% interest over 20 years.[18]

2. Data and Calculations for Cat 3

1) Affected Acreages

The following Table portrays the agricultural WBID acreages (by six categories) totaling 5,092,884. Using 5.09 million acres as a baseline, implementation of the NNC rule will affect approximately 187,659 (category 3) acres. Therefore, FSU CEFA examined about 188,000 acres relating to costs.

Table 30. Affected Agricultural Acres

Total	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
5,092,884	276,259	847,423	97,056	1,231,307	2,277,952	300,282

Ruling out the acres with costs associated across agricultural WBIDs which are also listed under category 1 or 2, FSU CEFA estimated that about 97,056 acres would be

[17] Soil & Water Engineering Technologies, Inc. (SWET), 2008. *Nutrient Loading Rates, Reduction Factors and Implementation Costs Associated with BMPs and Technologies*, Appendix A.
[18] Based on FSU CEFA methodology.

affected by implementation of the NNC rule (category 3 only). The affected areas were divided by 25 counties and 9 agricultural classes (FDACS). The following Tables depict affected acres by agricultural class.

Table 31 Affected Agricultural Acres by Classes (Cat 3)

FDACS Classification	Acre(s)
Aquaculture	1
Beef Cattle Ranching & Farming	44,845
Citrus	1,194
Dairy Cattle & Milk Production	870
Hay Farming	4,558
Horse & Other Equine Production	628
Non-citrus Fruit & Berry Farming	6,093
Ornamentals	600
Row Crops	38,268
Total	97,056

Source: GIS estimation performed by FDEP staff.

2) Capital Costs

Table 32 Capital Costs of Agriculture (Cat 3)

FDACS	Per Acre Cost	Acre	Capital Cost
Aquaculture	$58	1	$76.56
Beef Cattle Ranching & Farming	$25	44,845	$1,134,571.71
Citrus	$490	1,194	$584,876.21
Dairy Cattle & Milk Production	$1,045	870	$908,974.02
Hay Farming	$58	4,558	$264,352.46
Horse & Other Equine Production	$50	628	$31,074.90
Non-Citrus Fruit & Berry Farming	$490	6,093	$2,985,411.23
Ornamentals	$220	600	$132,088.81
Row Crops	$220	38,268	$8,418,925.50
Total		97,056	$14,460,351.41

Source: FDACS, UF & SWET (2010)

3) Total Costs of Agriculture

FDACS, UF & SWET (2010) used an amortization rate of 10% over 20 years. According to the aforementioned methodology, FSU CEFA assumed 6.4% over 20 years. The O & M cost was estimated based on 20 percent of the capital costs.

Table 33 Agricultural Total Costs Results (Cat 3)

FDACS	Capital Cost	Annual Cost	Total Annual Cost
Aquaculture	$76.56	$6.89	$22.21
Beef Cattle Ranching & Farming	$1,134,571.71	$102,153.20	$329,067.54
Citrus	$584,876.21	$52,660.38	$169,635.62
Dairy Cattle & Milk Production	$908,974.02	$81,841.10	$263,635.91
Hay Farming	$264,352.46	$23,801.45	$76,671.94
Horse & Other Equine Production	$31,074.90	$2,797.88	$9,012.86
Non-Citrus Fruit & Berry Farming	$2,985,411.23	$268,796.84	$865,879.09
Ornamentals	$132,088.81	$11,892.85	$38,310.62
Row Crops	$8,418,925.50	$758,013.03	$2,441,798.13
Total	$14,460,351.41	$1,301,963.63	$4,194,033.91

3. Costs Results by Counties for Cat 3

The following Table shows the total costs results by counties.

Table 34 Agricultural Total Costs by Counties (Cat 3)

County	Acres	Capital Cost	Annual Cost (incl. 20% O&M)
Alachua	.0	$0	$0
Calhoun	844.6	$125,834	$36,497
Citrus	.0	$3	$1
Desoto	10,627.5	$1,583,392	$459,242
Dixie	215.1	$32,050	$9,296
Escambia	1,473.5	$219,538	$63,674
Glades	3,139.4	$467,746	$135,663
Hardee	10,599.6	$1,579,232	$458,035
Hendry	128.0	$19,069	$5,531
Hernando	11,046.8	$1,645,864	$477,361
Highlands	260.3	$38,784	$11,249
Hillsborough	2,319.7	$345,615	$100,241
Indian River	1,745.7	$260,090	$75,436
Lake	.2	$37	$11
Lee	1,473.0	$219,467	$63,654
Leon	24.7	$3,682	$1,068
Okeechobee	41,044.1	$6,115,148	$1,773,618
Orange	9.2	$1,374	$398
Pasco	11,464.5	$1,708,088	$495,408
Pinellas	9.6	$1,426	$414
Polk	493.6	$73,538	$21,329
Seminole	3.8	$570	$165
Sumter	120.0	$17,873	$5,184
Taylor	6.5	$973	$282
Volusia	6.4	$957	$278
Total	97,056.0	$14,460,351	$4,194,034

4. Data and Calculations for Cat 5 to Cat 3

1. Cat 5 Data
   There are a total of 2,277,952 Cat 5 acres in agriculture.
   FSU CEFA calculated the "Cat5 to Cat 3" cost by assuming a probability of 17.54% of Cat 5 acres.

2. Cost Data

Table 35 Costs for Calculation

DACS	Cost
Aquaculture	$ 58.00
Beef Cattle Ranching	$ 25.30
Citrus	$ 490.00
Dairy Cattle and Milk Production	$ 1,045.00
Hay	$ 58.00
Horse and Equine Production	$ 49.50
Non Citrus fruit and berry farming	$ 490.00
Ornamentals	$ 220.00
Poultry and Egg Production	$ 58.00
Row Crops	$ 220.00
Silviculture and Tree Plantation	$ 22.00
Sod Production	$ 110.00
Sugarcane	$ 110.80

3. The capital cost is multiplied by the Cat 5 acres and the O&M cost is assumed to be approximately 20% of the capital cost. Amortization is 6.4% for 20 years.

4. Agriculture Cost Results

Table 36 Cost Result for Agriculture Sector (Cat 5 to Cat 3)

DACS	Cat 5	Cost	Capital Cost	Total Annual Cost
Aquaculture	1,843	$58.0	$106,903.13	$31,005.84
Beef Cattle Ranching & Farming	938,234	$25.3	$23,737,315.21	$6,884,694.71
Citrus	61,972	$490.0	$30,366,313.35	$8,807,348.06
Dairy Cattle & Milk Production	1,589	$1,045.0	$1,660,196.89	$481,518.18
Hay Farming	329,765	$58.0	$19,126,376.28	$5,547,352.79
Horse & Other Equine Production	86,187	$49.5	$4,266,243.15	$1,237,367.47
Non-citrus Fruit & Berry Farming	150,009	$490.0	$73,504,187.79	$21,318,918.70
Ornamentals	27,329	$220.0	$6,012,466.52	$1,743,836.49
Poultry & Egg Production	2,241	$58.0	$129,982.00	$37,699.56
Row Crops	668,649	$220.0	$147,102,818.91	$42,665,229.44
Sod Production	10,134	$110.0	$1,114,776.73	$323,326.27
Total	2,277,952		$307,127,579.98	$89,078,297.51
Probability of Cat 5 to Cat 3 Cost*	399,553		$53,870,177.53	$15,624,333.38

*FSU CEFA calculated the costs based on the probability of 17.54% to be reclassified from a "Cat 5 to a Cat 3".

5. Agriculture Costs by Counties (For Cat 5 to Cat 3)

Table 37 Cost Result for Agriculture Sector by Counties (Cat 5 to Cat 3)

County	Cat 5 to Cat 3	Ratio	Capital Cost	Total Annual Cost
Alachua	14,225	4%	$1,917,919	$556,267
Baker	2,121	1%	$285,942	$82,934
Bay	951	0%	$128,198	$37,182
Bradford	2,588	1%	$348,973	$101,215
Brevard	4,563	1%	$615,257	$178,447
Calhoun	3,281	1%	$442,326	$128,291
Charlotte	1,507	0%	$203,246	$58,949
Citrus	876	0%	$118,163	$34,272
Clay	1,304	0%	$175,767	$50,979
Columbia	6,083	2%	$820,107	$237,861
Desoto	9,725	2%	$1,311,213	$380,300
Dixie	1,498	0%	$202,036	$58,598
Duval	1,148	0%	$154,840	$44,909
Escambia	4,109	1%	$553,991	$160,678
Flagler	2,749	1%	$370,659	$107,505
Franklin	14	0%	$1,925	$558
Gadsden	4,440	1%	$598,569	$173,607
Gilchrist	2,557	1%	$344,791	$100,002
Glades	3,602	1%	$485,698	$140,870
Gulf	364	0%	$49,130	$14,249
Hamilton	2,986	1%	$402,623	$116,776
Hardee	16,640	4%	$2,243,567	$650,717
Hernando	2,589	1%	$349,098	$101,251
Highlands	6,527	2%	$880,013	$255,236
Hillsborough	2,905	1%	$391,606	$113,580
Holmes	8,149	2%	$1,098,654	$318,650
Indian River	6,949	2%	$936,872	$271,727
Jackson	22,331	6%	$3,010,867	$873,262
Jefferson	5,414	1%	$729,959	$211,715
Lafayette	2,232	1%	$300,880	$87,266
Lake	17,232	4%	$2,323,331	$673,851
Lee	25	0%	$3,425	$993
Leon	1,740	0%	$234,589	$68,040
Levy	14,985	4%	$2,020,346	$585,975
Liberty	406	0%	$54,793	$15,892
Madison	6,971	2%	$939,852	$272,592

Manatee	11,866	3%	$1,599,901	$464,030
Marion	34,879	9%	$4,702,661	$1,363,945
Martin	193	0%	$25,998	$7,540
Nassau	2,305	1%	$310,737	$90,125
Okaloosa	4,997	1%	$673,711	$195,401
Okeechobee	6,743	2%	$909,121	$263,679
Orange	9,370	2%	$1,263,328	$366,412
Osceola	44,121	11%	$5,948,636	$1,725,323
Pasco	10,304	3%	$1,389,304	$402,949
Pinellas	53	0%	$7,188	$2,085
Polk	31,698	8%	$4,273,761	$1,239,548
Putnam	2,739	1%	$369,351	$107,125
Santa Rosa	6,175	2%	$832,522	$241,462
Sarasota	3,477	1%	$468,791	$135,967
Seminole	746	0%	$100,545	$29,162
St. Johns	624	0%	$84,120	$24,398
St. Lucie	65	0%	$8,746	$2,537
Sumter	16,734	4%	$2,256,133	$654,362
Suwannee	7,856	2%	$1,059,138	$307,189
Taylor	735	0%	$99,111	$28,746
Union	1,665	0%	$224,552	$65,128
Volusia	5,280	1%	$711,886	$206,473
Wakulla	123	0%	$16,581	$4,809
Walton	7,165	2%	$966,069	$280,196
Washington	3,850	1%	$519,062	$150,547
Total	399,553	100%	$53,870,178	$15,624,333

VII. Conclusions

Florida has adopted quantitative nutrient water quality standards to facilitate the assessment of attainment of water quality standards and to protect state waters from the adverse effects of nutrient over enrichment. The addition of excess nutrients not only have a negative effect on Florida's environment and public health, but can also negatively affect Florida's economy as explained more fully below. The FDEP Numeric Nutrient Criteria rule (NNC rule) in Florida is an important component of Florida's efforts in decreasing these negative impacts.

This report represents the research conducted by FSU CEFA concerning the economic analysis of the FDEP Numeric Nutrient Criteria adopted for Florida. The FSU CEFA analysis examined and integrated some of the assumptions used in previous studies and developed some other assumptions based on more current cost data, and incorporated current changes in regulation rules. The highlights of the FSU CEFA research analysis included the NNC cost estimation and economic analysis results.

The research data for this study were provided by the Florida Department of Environmental Protection (FDEP). FDEP classified waterbodies into six categories. The Numeric Nutrient Criteria in Florida was applied to all six classified categories, however, the costs were primarily assigned to Category Three (Cat 3), those waterbodies that would be deemed impaired under FDEP's Numeric Nutrient Criteria rule. As FDEP defined Category Five as "those waterbody WBIDs with insufficient information to determine if they fit in Category Three or Four," this study included a proportion of Category Five (Cat 5), or those waterbodies with classification "Cat 5" with a high likelihood of being reclassified as Cat 3's[19].

The economic analysis consisted of five sectors; Domestic Wastewater (DW) Sector, Industrial Wastewater (IW) Sector, Urban Stormwater Controls (SW) Sector, Septic System Sector, and the Agriculture Sector. These five sectors corresponded to sector groupings consistent with the previous studies; namely, the EPA study and Cardno Entrix studies. Each sector calculation described following orders; methodology, data and result for Cat 3, and data and result for Cat 5 to Cat 3.

Although each sectors' methodology varied, the domestic and industrial (DW and IW) sectors cost calculations were based on the affected facilities' water capacity multiplied by capital and maintenance cost(s). The Urban Stormwater (SW) and

[19] For the cost analysis conducted for this study, the probability to be reclassified from a CAT 5 to a CAT 3 is estimated to be 17.54% based on the assessment data by WBID, provided by FDEP. Of the WBIDs for which there was sufficient data to assess them, 429 WBIDs were impaired out of a total of 2,446 WBID's (an 17.54% impairment rate).

Agriculture sector's cost calculations were based on the proposed NNC rule number of "impacted acres" multiplied by the assumed capital and maintenance costs. The Septic system cost calculations were based on the number of proposed NNC rule estimated septic systems multiplied by the corresponding upgrade and/or replacement capital and maintenance costs.

The following Table provides a summary of the results of this study. The annual cost estimates were presented by sector, and included low, median and high projections. With regard to cost estimates pertaining only to the Cat 3 area, about $8.9 million would be the estimated annual median cost. With the inclusion of additional waterbodies to be reclassified from Cat 5 to Cat 3, the median costs were estimated to be a grand total of about $65.8 million. The research team estimated that that the minimum and maximum costs for implementation of the NNC rule would range from $50.5 million to $149.8 million per year.

Table 38 Summary of the Low, High and Median Costs for the NNC Rule in Florida

Cat3	Low	High	Median Cost
DW	$0	$0	$0
IW	$0	$0	$0
SW	$2,026,816	$7,972,144	$3,910,404
Septic	$733,203	$2,133,694	$892,628
Agriculture	$4,194,034	$4,194,034	$4,194,034
Total	$6,954,053	$14,299,871	$8,997,066
Cat 5 to Cat 3			
DW	$1,838,810	$4,495,552	$2,394,744
IW	$3,355,215	$34,566,580	$9,886,313
SW	$14,365,292	$56,503,482	$27,715,437
Septic	$8,370,000	$24,357,528	$10,189,944
Agriculture	$15,624,333	$15,624,333	$15,624,333
Total	$43,553,651	$135,547,476	$65,810,772
Grand Total			
DW	$1,838,810	$4,495,552	$2,394,744
IW	$3,355,215	$34,566,580	$9,886,313
SW	$16,392,108	$64,475,626	$31,625,841
Septic	$9,103,203	$26,491,222	$11,082,573
Agriculture	$19,818,367	$19,818,367	$19,818,367
Grand Total	$50,507,704	$149,847,347	$74,807,838

Table 39 Comparison Cost Results among FSU CEFA, EPA and Cardno ENTRIX (in Million Dollars per Year)

Sector	Low	High	Median Cost
CEFA(2012)			
DW	$2	$4	$2
IW	$3	$35	$10
SW	$16	$64	$32
Septic	$9	$26	$11
Agriculture	$20	$20	$20
Total	**$50**	**$150**	**$75**
EPA(2010)			
DW	$22	$38	
IW	$25	$25	
SW	$61	$108	
Septic	$7	$11	
Agriculture	$20	$23	
Total	**$135**	**$206**	
Cardno ENTRIX(2011)			
DW	$17	$66	$41
IW	$164	$372	$270
SW	$25	$115	$61
Septic	$2	$18	$8
Agriculture	$24	$42	$33
Total	**$298**	**$533**	**$415**

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Appendix A –Acronyms and Abbreviations

ANMP Agricultural nutrient management plan
BMAP Basin Management Action Plan
BMP Best management practice
BNR Biological nutrient removal
BOD Biochemical oxygen demand
C&D Construction and development
CAFO Confined animal feeding operation
cfs Cubic feet per second
CH Chlorophyll a
COI Cost of illness
CREP Conservation Reserve Enhancement Program
CRP Conservation Reserve Program
CSP Conservation Stewardship Program
CTA Conservation Technical Assistance
CWA Clean Water Act
DACS Department of Agriculture and Consumer Services
DOH Department of Health
DPV Downstream protection value
DO Dissolved Oxygen
DOF Department of Forestry
EAA Everglades Agriculture Area
EPA U.S. Environmental Protection Agency
EQIP Environmental Quality Incentive Program
F.A.C. Florida Administrative Code
FC Fecal coliform
FDACS Florida Department of Agriculture and Consumer Services
FDEP Florida Department of Environmental Protection
FDOF Florida Division of Forestry
FDOH Florida Department of Health
F.S. Florida Statutes
FWRA Florida Watershed Restoration Act
GAC Granulated activated carbon
GIS Geographic information systems
GLCI Grazing Land Conservation Initiative
HABs Harmful algal blooms
HUC Hydrologic unit code
IPM Integrated pest management
IWR Impaired Waters Rule
LSJR Lower St. Johns River
MEP Maximum extent practicable
MIB 2-methylisborneol
MLE Modified Ludzack-Ettinger
MS4 Municipal separate storm sewer system
NO2 Nitrate
NO3 Nitrite

NOI Notice of intent
NRCS Natural Resource Conservation Service
NPDES National Pollutant Discharge Elimination System
NWIS National Water Information System
O&M Operation and maintenance
OCBWG Orange Creek Basin Working Group
OIG Office of Inspector General
OSTDS Onsite sewage treatment and disposal system
PAC Powered activated carbon
PCS Permit compliance system
Pt-Co Platinum cobalt units
RA Reasonable assurance
RBC Rotating biological contactor
SBR Sequencing batch reactor
SCR Selective catalytic reduction
SDT Secchi disk transparency
SDM Secchi disk measurement
SFWMD South Florida Water Management District
SIC Standard industrial classification
SJWMD St. Johns Water Management District
SMP Strategic monitoring plans
SMZ Special Management Zone
SSAC Site specific alternative criteria
SWET Soil and Water Engineering Technology, Inc.
SWIM Surface Water Improvement and Management
SWMP Stormwater management program
TMDL Total maximum daily load
TN Total nitrogen
TP Total phosphorus
TSD Technical Support Document for Water Quality-Based Toxics Control
TSI Trophic state index
TSS Total suspended solids
UCT University of Cape Town
USDA United States Department of Agriculture
USGS United States Geological Survey
WAFR Wastewater facility regulation
WBID Waterbody identification
WLA Wasteload allocation
WOD Works of the District
WQBEL Water quality-based effluent limit
WQI Water quality index
WQL Water quality ladder
WQS Water quality standards
WRF Water reclamation facility
WTP Willingness to pay
WWTP Wastewater treatment plant

Appendix B – Fact Sheet

Economic Analysis for FDEP Numeric Nutrient Criteria

The FSU Center for Economic Forecasting and Analysis (CEFA) performed an initial economic analysis of FDEP's Numeric Nutrient Standards approved by the Environmental Regulation Commission on December 8, 2011. Estimates of the costs potentially associated with the FDEP proposed rule were provided to FSU CEFA by FDEP, and cost analysis was performed by FSU CEFA for five industry sectors that may incur costs to reduce nutrients sufficiently for Florida's waters to be in compliance with the proposed rule. It was assumed that such costs would potentially be incurred by entities in waterbodies which do not appear to achieve the standards, based on an assessment by FDEP. Costs for domestic and industrial wastewater facilities were estimated based on the cost associated with upgrading those facilities to advanced wastewater treatment. Costs for agricultural and urban stormwater were based on the acreage and cost associated with BMP implementation for those waterbodies[20]. Costs for septic tanks were based on the number of affected systems and costs associated with their upgrade. The initial estimate[21] was revised to reflect the rule adopted on December 8th, 2011. The revised estimate is:

Sector	Low Cost	High Cost	Median Cost
Industrial Wastewater	$3,355,215	$34,566,580	$9,886,313
Domestic Wastewater	$1,838,810	$4,495,552	$2,394,744
Urban Stormwater	$16,392,108	$64,475,626	$31,625,841
Agricultural Stormwater	$19,818,367	$19,818,367	$19,818,367
Septic Tanks	$9,103,203	$26,491,222	$11,082,573
Total	$50,507,704	$149,847,347	$74,807,838

The Department's rule represents a significant cost saving in comparison to the recently-adopted U.S. EPA rule. Estimates of those costs were performed by Cardno ENTRIX[22] with assumptions similar to those assumed for the Department's rule. The Cardno ENTRIX estimated costs were:

	Estimated Annual Costs (Million $)		
Sector	Low Cost	High Cost	Median Cost
Industrial Wastewater	$164	$372	$270
Domestic Wastewater	$17	$66	$41
Urban Stormwater	$25	$115	$61
Agricultural Stormwater	$24	$42	$33
Septic Tanks	$2	$18	$8
Total	$298	$533	$415

20 Based on FDEP definition of Waterbody Identification (WBID)

21 Based on removal of the costs of associated canals from the total cost analyses.

22 *Addendum to the Economic Analysis of the Federal Numeric Nutrient Criteria for Florida*. Prepared for the Florida Water Quality Coalition by Cardno ENTRIX. July 2011