FWEA Utility Council

Protecting Florida's Clean Water Environment

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December 3, 2009

Governor Charlie Crist
Office of the Governor
PL-05 The Capitol
Tallahassee, FL 32399-0001

Re: Numeric Nutrient Criteria Cost Implications for Florida POTWs

Dear Governor Crist,

The Florida Water Environment Association Utility Council (FWEA Utility Council) respectfully submits this letter to alert you to an issue of critical importance to Florida's municipal wastewater treatment community: the U.S. Environmental Protection Agency's (EPA's) decision to promulgate federal numeric nutrient standards for Florida surface waters. EPA plans to propose stringent numeric nutrient water quality standards for Florida by January 2010 for streams, canals, and lakes and by January 2011 for coastal waters. EPA determined that Florida -- and only Florida -- needs federal standards in this short timeframe, even though Florida has one of the most sophisticated water quality standards programs in the nation.

As the state's preeminent association of local government and private utilities in Florida that own and operate domestic wastewater treatment, disposal, reuse, and recycling facilities, the FWEA Utility Council has taken a leadership role in opposing EPA's decision to develop federal nutrient standards for Florida waters. Utility Council members treat the wastewater produced by over 7 million Florida residents, and these residents pay for our capital projects and operating costs through their utility bills. FWEA Utility Council members thus have an obligation to ensure that our ratepayers' money is efficiently spent on projects that benefit the environment. It is because of this obligation to our ratepayers that we have such significant concern regarding EPA's decision to impose federal numeric nutrient criteria on Floridians. EPA's approach to developing numeric nutrient standards has serious scientific flaws that will lead to arbitrary standards creating drastic economic consequences for Floridians.

According to technical and economic analysis performed by Carollo Engineers in the enclosed whitepaper, federal numeric nutrient criteria for Florida surface waters will cause wastewater utility rates to double on average across the state. Florida municipal wastewater treatment utilities will spend an estimated \$24.4 to \$50.7 billion in capital costs for additional treatment facilities and incur an estimated \$0.4 to \$1.3 billion dollars per year in additional operating costs.[1]

[1] These cost estimates were calculated using draft numeric nutrient criteria released by the Florida Department of Environmental Protection in July 2009. The Department developed its draft criteria using a variation of EPA's statistical approach to deriving nutrient criteria, yet in an open letter dated September 16, 2009, EPA criticized the Department's criteria as not being adequately protective of downstream waters.

EPA publicly justifies its intervention into Florida's water quality standards program based on the occurrence of algal blooms and other periodic nutrient problems in some Florida waters. However, statewide federal numeric nutrient criteria are not the solution to this problem. Algal blooms violate Florida's existing nutrient standards, and Florida's Total Maximum Daily Load (TMDL) program is designed specifically to bring these waters back into compliance with Florida law. EPA's decision to promulgate federal standards for Florida waters is in direct contradiction to the state primacy envisioned by the Clean Water Act.

We ask that you join the FWEA Utility Council in opposing this unneeded federal intervention into state water policy. Floridians deserve to maintain their own science-based nutrient water quality standards program, which protects state water ecosystems and protects utility ratepayers from the economic burdens of unsound federal regulatory policy.

If you have any questions or concerns regarding this letter or the attached report, please contact Paul Steinbrecher, the FWEA Utility Council Vice President and Numeric Nutrient Criteria Issue Chair, at (904) 665-6827.

Sincerely,

Jim Oskowis

Jim Oskowis, P.E.
FWEA Utility Council President

Encl: *Technologies to Meet Numeric Nutrient Criteria at Florida's Domestic Water Reclamation Facilities*

CC: Charles Bronson, Commissioner, Florida Department of Agriculture and Consumer Services
Bill McCollum, Florida Attorney General
Alex Sink, Chief Financial Officer, Florida Department of Financial Services
Jeff Atwater, President, Florida Senate
Larry Cretul, Speaker, Florida House of Representatives
Michael Sole, Secretary, Florida Department of Environmental Protection
Representative Trudi Williams, Chair, Agriculture & Natural Resources Policy Committee
Gary Williams, Executive Director, Florida Rural Water Association
Dominic Calabro, President, Florida TaxWatch
David Childs, Hopping Green & Sams

TECHNOLOGIES TO MEET NUMERIC NUTRIENT CRITERIA AT FLORIDA'S DOMESTIC WATER RECLAMTION FACILITIES

November 18, 2009

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TECHNOLOGIES TO MEET NUMERIC NUTRIENT CRITERIA AT FLORIDA'S DOMESTIC WATER RECLAMTION FACILITIES

EXECUTIVE SUMMARY

The consent decree between the US Environmental Protection Agency (EPA) and a coalition of environmental groups over the need to set numeric nutrient criteria (NNC) for surface waters in the State of Florida will have severe consequences for Florida's wastewater utilities and the customers they serve. If the expected NNC to be proposed by EPA are implemented in the state's water quality regulations, all Florida wastewater facilities that discharge reclaimed water to rivers, streams, lakes and estuaries will likely be required to meet new, very low limits on the discharge of total nitrogen (TN) and total phosphorus (TP). These new limits are anticipated to require a reduction in the current discharge of TN by 40 to 80% and TP by 90 to 95%.

Should the proposed numeric nutrient criteria become incorporated in the discharge permits for these treatment plants, Florida utilities will spend an estimated $24.4 to $50.7 billion in capital costs for additional treatment facilities, and will incur an estimated $0.4 to $1.3 billion dollars per year more in increased operating costs. This corresponds to tens of billions of dollars in costs passed down to approximately three quarters of the individual citizens and businesses in the State of Florida. In addition, the treatment technologies needed to achieve these limits will potentially use almost 5 percent of the total electric power generating capacity in the State of Florida and contribute over 17.4 million tons of carbon dioxide (CO_2) emissions per year.

According to the Florida Department of Environmental Protection (FDEP), there are approximately 2,100 permitted domestic wastewater facilities in the State with a total treatment capacity of about 2.4 billion gallons per day, approximately half of which discharge effluent to surface waters. FDEP reported in 2005 that approximately 64% of Florida's population is served by central sewer systems that feed these treatment facilities. Florida's total population is in excess of 18 million residents according to the US Census Bureau. Based on these figures, approximately 12 million citizens of Florida are served by permitted wastewater treatment facilities that will be impacted by the proposed NNC.

Required facility upgrades to treat the 2.4 billion gallons of wastewater per day to the new standards would result in a cost of approximately $1.6 to $3.3 billion dollars per year over the next 30 years in addition to current treatment costs. Considering the interest paid on bonds required to fund these improvements, the State's wastewater utilities are facing a $47.6 to $98.7 billion dollar price tag to meet the proposed nutrient criteria over the next 30 years. These figures do not account for the corresponding increase in operating costs. We estimate that annual user fees for customers served by the impacted facilities will increase by an average of $673 to $726

per year in total. Table 1 summarizes the potential cost to Florida and the average individual household.

This paper addresses the anticipated costs for Florida utilities to be in compliance with EPA-promulgated numeric nutrient criteria; the treatment technologies available to achieve the proposed criteria; and lastly, the additional $673 to $726 in yearly costs to customers should these regulations be adopted.

Table 1 Summary of Estimated Project Costs and the Estimated Average Increase in Annual Sewer Rates for the State of Florida to Implement Numeric Nutrient Criteria.

	Project Cost[1]	Annual Debt Service[2]	Increase in Annual Operating Costs[3]	Yearly Sewer Rate Increase per Customer[4]
Florida Facilities with NPDES Permits[5]	$24,400,000,000	$1,600,000,000	$433,000,000	$673
All Florida Facilities[5]	$50,700,000,000	$3,300,000,000	$1,330,000,000	$726

Notes:

1. Project costs include estimated construction costs plus contingencies, administrative, legal, engineering and financing costs. Estimates also assume all private facilities must be upgraded to provide advanced wastewater treatment, microfiltration, and reverse osmosis with concentrate drying with landfill disposal. Assumes public facilities with deep wells will construct new deep wells for concentrate disposal. All other public facilities assumed to construct facilities for concentrate drying.
2. Annual debt service based on 30-year amortization schedule and 5% interest.
3. Assumes current flow is 50% of design flow, and that this is representative of "actual" usage of the plant. Capital upgrades will be required for the entire design flow, while operating costs are based on actual usage.
4. Average cost for public and private systems. Customer size estimated at 2.1 persons per household based on US Census information.
5. The range of project costs was based on two scenarios. The lower project cost assumes that only surface water dischargers (e.g. assumed to be plants with NPDES permits) would be required to comply with the proposed nutrient criteria. The higher project cost assumes that all Florida plants will be required to comply with the proposed nutrient criteria.

EXISTING AND PROPOSED NUTRIENT STANDARDS

Florida's water reclamation plants already operate within a complex system of water quality regulations that are among the most stringent in the world. Currently, the highest level of treatment provided by Florida wastewater treatment plants is Advanced Wastewater Treatment (AWT). In Florida, the term "AWT" is often used to refer to wastewater treatment that produces a reclaimed water achieving standards set out in section 403.086(4), Florida Statutes, i.e. reclaimed water containing no more than 5 mg/ L of carbonaceous five-day biochemical oxygen demand ($cBOD_5$), 5 mg/L total suspended solids (TSS), 3 mg/L TN, and 1 mg/L TP.

According to the proposed consent decree between EPA and a coalition of environmental groups, EPA is to propose NNC for fresh waters in Florida in January 2010 and marine waters by January 2011. NNC proposed by FDEP in June 2008 would drop the TN limit from 3.0 mg/L to 0.82 – 1.73 mg/L and TP limits from 1.0 mg/L down to 0.069 – 0.415 mg/L. Based on review comments from EPA on the FDEP NNC, the actual values for EPA's NNC are expected to be lower than the NNC proposed by the FDEP. While these proposed changes might seem small, the new NNC are at (for TP) or below (for TN) the concentrations achievable with proven nutrient removal technologies now in full-scale use at municipal wastewater plants. Table 2 allows a comparison of the current standards for secondary and AWT standards with the proposed NNC standards.

The very low concentration criteria on TN and TP being proposed can be met, although at significant cost, by adding additional treatment processes at the end of a Florida advanced wastewater treatment (AWT) plant. AWT as currently practiced will not provide consistent compliance with the proposed NNC, and additional technologies must be employed.

Table 2 Comparison of Maximum Pollutant Concentrations Allowed by Water Reclamation Standards

Pollutant	Secondary Limits[1]	AWT Limits[2]	Proposed Numeric Nutrient Limits[3]
$cBOD_5$, mg/L	20-30	5	-
TSS, mg/L	20-30	5	-
TN, mg/L	No limit	3	0.82 – 1.73
TP, mg/L	No limit	1	0.069 – 0.415

Notes:
1. Nationwide technology based standards required by the Clean Water Act for all wastewater treatment plants.
2. Florida standards required by state law for discharge to specific nutrient sensitive water bodies.
3. Proposed in-stream water quality standards that would become end-of-pipe limits unless a facility obtains a mixing zone or site-specific alternative criteria.

CURRENT NUTRIENT REMOVAL TECHNOLOGY

Today more than 65 Florida plants with a total treatment capacity of over 500 million gallons per day (mgd) use various AWT technologies to produce high quality reclaimed water. However, these plants represent only a relatively small fraction of the plants in Florida. In order to achieve current AWT water quality limits, a plant generally must remove about 96% to 98% of TN and 85 to 88% of TP from raw sewage. At nearly all AWT plants in Florida, reclaimed water meeting AWT limits is achieved using a combination of a biological nutrient removal (BNR) treatment technology plus some form of filtration. BNR processes grow naturally occurring bacteria to remove the oxygen demanding organic pollutants, nitrogen, and phosphorus from raw sewage. Most of the nitrogen is released to the atmosphere as nitrogen gas while the phosphorus is removed with biosolids wasted from the plant.

The TN in reclaimed water consists of inorganic nitrogen (ammonia and nitrates) and organic nitrogen. The ammonia and nitrates can be removed down to low levels by conventional BNR processes – nitrification and denitrification with supplemental carbon (e.g. methanol) if necessary. The presence in reclaimed water of soluble nitrogen and phosphorus compounds that are not biodegradable (also known as refractory compounds) ultimately sets the lowest concentrations possible at treatment plants that rely on biological treatment methods. Researchers call the refractory dissolved organic nitrogen (RDON). RDON is present in many raw water supplies and thus is present in the influent to water reclamation facilities. RDON is also a byproduct of biological treatment and will be found in reclaimed water even if not found in raw sewage.

The effluent TN and TP concentrations reported by Florida AWT plants are generally consistent with the lowest effluent concentrations of TN and TP typically reported by researchers as achievable with current BNR technologies. In other words, Florida AWT plants are already removing nutrients as well or better than most BNR plants.

ADDITIONAL TECHNOLOGIES TO MEET PROPOSED NUMERIC NUTRIENT CRITERIA

Water treatment technologies do exist to produce reclaimed water with any desired water quality such as the ultra pure water required for electronics manufacturing and high-pressure boiler feed water. Since most technologies that can achieve these limits are typically used for applications other than removing nutrients from reclaimed water, little data exists on their performance in removing nitrogen and phosphorus to meet NNC.

The additional treatment technologies that might be used to meet numeric nutrient criteria include high-pressure membranes (reverse osmosis and nanofiltration), adsorption (activated

carbon and reactive filtration), oxidation (ozone, UV, peroxide), chemical coagulation and precipitation, and ion exchange.

Of the aforementioned additional treatment technologies, reverse osmosis (RO) is a leading candidate technology when considering very low nutrient limits because of its ability remove nearly all constituents in the water to very low concentrations. In simple terms, RO is a selectively permeable barrier that rejects nearly all contaminants larger than a specific size, while letting water molecules through. A number of large water reclamation plants currently use RO to produce very high quality reclaimed water. These include the West Basin plant in El Segundo, California (22.5 mgd), the Scottsdale, Arizona Water Campus (14 mgd), the GWRS (70 mgd) plant in Orange County California, and four NEWater plants in Singapore (Bedok, 8.4 mgd; Kranji, 10.6 mgd; Seletar, 5.0 mgd; and Ulu Pandan, 39.1 mgd) among others. All of these facilities have successfully used membrane technologies to produce exceptionally high quality water for other purposes than to remove nutrients. Specifically, the West Basin plant in El Segundo and the GWRS plant use MF/RO treated reclaimed water to create saltwater intrusion barriers and for indirect potable reuse. The Scottsdale plant treats to drinking water standards and then injects MF/RO treated water into an aquifer to supplement drinking water supplies, and the four NEWater plants in Singapore use MF/RO or UF/RO to create high quality industrial water supplies for electronics manufacturing and to provide supplemental water to a reservoir used as a drinking water supply.

Figure 1 provides a schematic representation of the sequence of treatment zones in the typical Florida water reclamation plant designed to meet AWT limits using BNR along with the selected additional technology of reverse osmosis membranes and associated concentrate disposal.

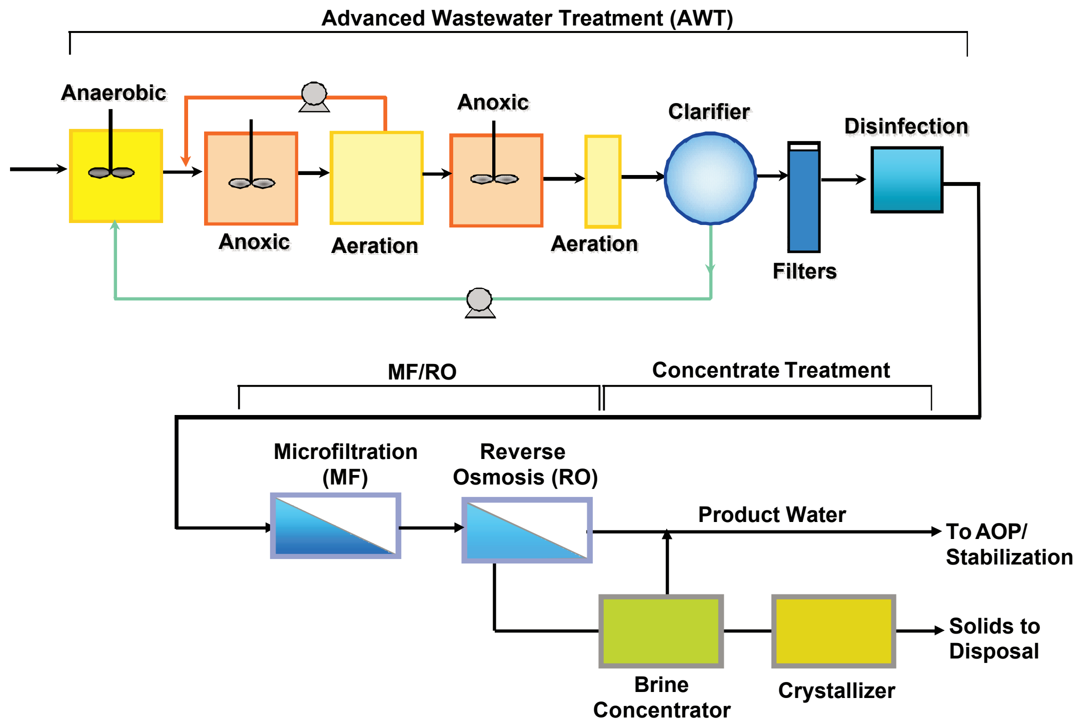

Figure 1. Schematic illustration of the type of processes likely required for Florida wastewater plants to comply with the proposed numeric nutrient criteria.

CHALLENGES ASSOCIATED WITH REVERSE OSMOSIS SYSTEMS

RO systems create several significant challenges. First, since membranes simply separate various constituents from water, RO creates a "concentrate" stream, typically 15 to 20% of the feed water, that contains concentrated levels of the rejected constituents. For example, if the mineral calcium was in the untreated water at 100 mg/L, it would be treated to nearly 0 mg/L in the treated stream with a concentration of about 500 mg/L in the concentrate stream that then needs to be disposed of. Finding economical methods that will comply with regulatory and public perception requirements for reuse or dispose of concentrate can be a challenge. In areas with suitable geology, deep well disposal is an option. Concentrate cannot be recycled upstream of an RO system as the salt concentration very quickly builds to intolerable levels. Concentrate can also be evaporated, dried, and landfilled; however, both the capital and operating costs of drying concentrate are on the order of $3.00 per 1000 gallons treated more expensive than other disposal methods.

Another significant drawback to RO treatment is the high power cost required to operate an RO system. Adding RO to the typical water reclamation plant will increase power consumption for an already energy-intensive system by at least 90%. Power requirements for RO systems treating reclaimed water range from about 1,400 to 2,400 kWh per mgal treated, compared with the

average power consumption for existing water reclamation facilities of about 1,500 kWh/mgal. RO membranes also tend to foul quickly in reclaimed water applications, requiring pretreatment of feed water and regular chemical cleaning of the membranes, both of which increase the cost and complexity of building and operating an RO system. At present most reclaimed water RO systems use microfiltration (MF) for pretreatment.

Finally, RO treatment still needs to be preceded by a BNR process. RO alone will not remove ammonia and nitrate to the degree required due to their similar size and molecular characteristics to water. A typical RO membrane will reject about 90% of the nitrate and 95% of the ammonia in the feedwater. While phosphates are better removed by RO membranes (rejection ≥ 99.8%), too much phosphorus going to an RO system will also foul membranes as a result of the precipitation of insoluble phosphate compounds.

COSTS TO MEET THE NUMERIC NUTRIENT CRITERIA

A Specific Case Study

To illustrate the costs to implement additional treatment to meet the proposed numerical nutrient criteria, consider an existing 10 mgd Florida water reclamation plant that meets advanced secondary water quality standards for public access reuse. To meet the numeric nutrient criteria, the biological portion of this plant must be upgraded to meet AWT limits, and then additional tertiary physical-chemical treatment processes must be added. For this example, assume that conventional BNR and MF/RO processes will be used.

Based on a study of 50 BNR upgrade projects, the expected cost to upgrade a 10 mgd plant from secondary to AWT standards is on average about $82 million. Based on bid-data available from eleven wastewater treatment plants using MF-RO, adding MF-RO treatment to an existing water reclamation plant is estimated to cost between $54 million to $81 million depending on the concentrate disposal method. These costs could be significantly higher at existing sites because of site constraints. The total capital cost to upgrade a 10-mgd water reclamation facility not already meeting AWT limits could be in the range of $140 – $160 million, and operating costs would increase by at least $1.00 per thousand gallons treated (about $3.6 million per year), not including concentrate disposal costs which can range from an additional $1.10 per thousand gallons for a deep well up to $3.00 per thousand gallons for a brine concentrator system (these numbers have been normalized to reflect design flow and not concentrate flow). These additional operating costs are in addition to the estimated $1.00 to $1.50 per thousand gallons being treated already being spent for typical Florida treatment facilities producing water for reuse. Table 3 summarizes the incremental capital costs required to meet the proposed NNC.

Further, meeting low yearly average nutrient limits requires highly consistent performance by the treatment process, which will likely result in significant conservatism in the sizing of treatment facilities, provision of redundant systems, and other provisions to increase reliability that ultimately add additional costs. These additional costs are not accounted for in the estimates provided here.

Table 3 Summary of Incremental Capital Costs ($M) for BNR and MF/RO Treatment to Upgrade a 10-mgd Water Reclamation Facility for Three Different Concentrate Disposal Options.

	Deep Well (10,000 ft)[3]	Deep Well (2,500 ft)[3]	Zero Liquid Discharge[4]
BNR Upgrade	80	80	80
MF-RO Systems[1]	50	50	50
Concentrate Disposal[2]	11	4	31
Total	141	134	161

Notes:
1. Assumed recoveries: MF = 95%; RO = 85%.
2. Concentrate disposal costs are estimated from a combination of bid-data, vendor quotes, and a report published by the AWWA Membrane Residuals Management Subcommittee.
3. Excluding any pretreatment and standby disposal system.
4. With a brine concentrator and brine crystallizer; excluding cost for solids disposal; brine concentrator recovery assumed = 95%.

The Big Picture

In order to further quantify the effect of the proposed NNC on the State, the case study variables described above were applied to all publicly owned wastewater treatment plants documented by FDEP. The plants were broken down into plants that already have AWT and ones that do not. AWT technology upgrades were assumed and projected to cost $8.20 per design gallon to upgrade. Subsequently, all plants would be required to be upgraded by the addition of an advanced tertiary technology following AWT. Reverse osmosis was assumed at an average cost of $5.00 per gallon per day of design treatment capacity. An additional cost of $1.10 per gallon of design treatment capacity was applied for concentrate disposal for facilities that have an existing deep injection well, as they were assumed to be able to construct an additional deep injection well for RO concentrate disposal. All other facilities included a $3.10 per gallon capital cost for a brine concentrator, as these facilities were assumed to not have access to a deep injection well. Lastly, the estimated increase in annual operating costs was calculated as follows: $1.00 per 1,000-gallons treated for AWT and MF/RO treatment, and $3.00 per 1,000 gallons for facilities that must treat RO concentrate with a brine concentrator. Applying the “dollar” per gallon unit capital costs to the FDEP database provided a lump sum capital expenditure for the state of $24.4 to $50.7 billion dollars. This cost was converted to an annual debt payment over an

assumed 30 years with 5% interest, which amounts $1.6 to $3.3 billion dollars plus an additional $0.4 to $1.3 billion dollars per year in increased operating costs.

Much of the increase in operating costs can be attributed to power consumption. We anticipate that the addition of these facilities will increase overall power demand by almost 26 million megawatt-hours/year. The estimated increase in connected electrical load requires about 5 percent of the total power generation capacity in Florida. Moreover, based on data published by the Department of Energy on CO_2 emissions by power plants, the additional power consumption will increase CO_2 emissions in Florida by over 17.4 million tons per year.

These costs would be passed along to customers through increased wastewater rates. To estimate the increase in rates, facility upgrade costs and population information were used to calculate the average monthly cost per household. On average, rates would increase by an average of $673 to $726 per year per household.

Sample of Utilities

A sampling of utilities was conducted to support the general effort of analyzing the cost impacts to all of the Florida utilities described in the "Big Picture" approach. These utilities have based their estimated capital costs on various technical alternatives to meet the NNC rule that range from the addition of RO, to implementing 100% reuse via infrastructure improvements, to deep well injection of effluent for aquifer recharge. The utilities sampled have wastewater treatment facilities that range in size from 6 to 42 mgd, and are located in various areas of the state. Each utility reported their present average monthly residential customer wastewater charge and a preliminary estimate of the anticipated increase in rates to meet the proposed NNC. These percentages were translated to approximate rate increases. Table 4 summarizes the results of this analysis. The average rate increase reported across these 8 utilities ($618/yr) compares well with the independent conceptual statewide estimate prepared by the independent engineer ($673/month to $726/month).

Table 4 Summary of Estimated Capital Costs and Increases in Sewer Rates for Eight Florida Utilities to Construct Facilities to Meet Proposed Numeric Nutrient Criteria.		
	Capital Cost	**Yearly Sewer Rate Increase per Household**
STATE OF FLORIDA[1]	*$24,400,000,000-$50,700,000,000*[2]	*$673-$726*
Bay County	$42,000,000	$684.44
Broward County	$425,000,000	$793.32
Destin Water	$34,000,000	$581.16
Escambia County	$275,000,000	$590.88
Hollywood	$370,000,000	$995.88
Jacksonville	$2,000,000,000	$815.04
Cross City[3]	$5,800,000	$336.48
South Walton[3]	$16,000,000	$147.00

Notes:
1. Estimated average costs for the State of Florida including annual O&M expenses and are shown for comparative purposes.
2. The low end of the range provides the probable opinion of cost assuming only plants with surface water discharges will be required to meet numeric nutrient criteria while the high end of the range assume that all plants will need to meet numeric nutrient criteria.
3. Assumes 2.5 persons per connection and 150 gpcd.

CONCLUSIONS

Implementation of the proposed numeric nutrient criteria will initiate widespread and dramatic changes in the way Florida wastewater utilities treat and reuse reclaimed water. The necessary changes will likely require decades to fully implement. The major impacts expected for Florida consumers include the following:

1. Wastewater utility rates can be expected to at least double for those utilities required to meet the proposed NNC criteria.
2. The total municipal wastewater treatment cost to the people of the State of Florida will range from $47.6 to $98.7 billion dollars over the next 30 years. The actual cost within this anticipated range will depend upon how many utilities would be required -- besides those discharging *directly* to surface water streams -- to meet these criteria.
3. Energy requirements for treatment could increase by almost 26 million megawatt-hours/year.
4. Emission of CO_2 and other greenhouse gases could increase by over 17.4 million tons per year of CO_2.