Jordan Lake Watershed Trading Project – Point Source Nutrient Loading Estimates and Potential Trading Scenarios for the Haw and Upper New Hope Watersheds

PREPARED FOR: Mid-Carolina Council of Governments
Cape Fear River Assembly

PREPARED BY: CH2M HILL

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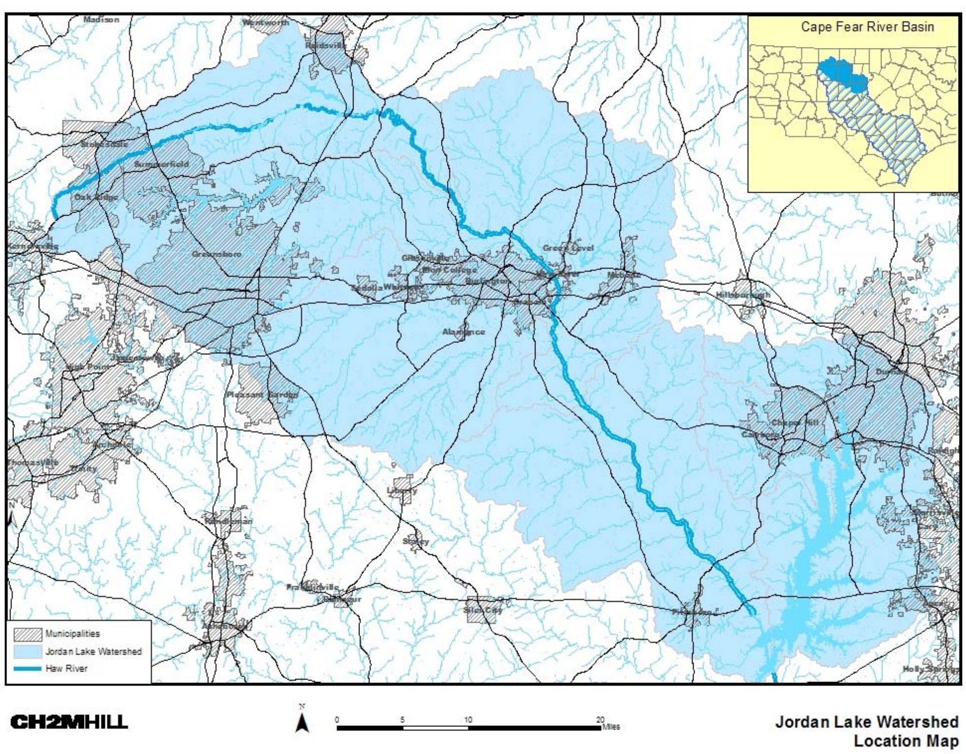
1.0 Introduction

Continued economic growth in the Cape Fear River Basin (the Basin) is essential for North Carolina's economy and quality of life. The Basin includes many of the state's largest urban areas —Greensboro, High Point, Burlington, Durham, Cary, Fayetteville, and Wilmington, as seen in Exhibit 1. As the largest watershed in the state, it represents 23 percent of the state's land area (CFRA, 2002). The Basin is currently home to 26 percent of the state's population and supports jobs in a variety of industries, including manufacturing, high-tech, and agriculture (CFRA, 2002). Growth rates currently exceed the state-wide average—water usage, one key growth indicator, is projected to increase nearly 95 percent by 2030 (NC DWR, 2002).

Jordan Lake is an important resource within the Cape Fear River Basin. Jordan Lake was created by the US Army Corps of Engineers (USACE) and provides the following services: downstream flood protection; downstream water quality protection; water supply; and recreation.

Two main tributaries form Jordan Lake: the Haw River, which accounts for the majority of the lake's drainage area, and New Hope Creek. The North Carolina Division of Water Quality (DWQ) considers Jordan Lake impaired due to chlorophyll *a* violations.

EXHIBIT 1
Cape Fear River Basin and Jordan Lake Watershed Detail



Water quality problems such as the chlorophyll *a* impairment in Jordan Lake can limit---and even stop—economic growth opportunities. In the early 1980s, North Carolina's Water Quality Assessment Report (305(b)) included many waters in the Cape Fear River Basin as impaired by specific toxic chemicals. Efforts over the last 20 years have been successful in improving water quality—see for example Exhibit 2. As a result, very few waters remain on the impaired waters list because of toxic pollutants.

EXHIBIT 2
Successful Cape Fear River Basin Partnerships

Partnerships formed in the Basin have resulted in water quality improvements. Examples of successful efforts include:

- Addressed toxic substances and color problems in the Haw and Deep Rivers through a combination of grassroots groups, state regulatory efforts, and pretreatment.
- Improved the water quality of Jordan Lake through policies developed by NC DWQ in concert with the watershed stakeholders that addressed nutrient loads from upstream communities. This effort began with a voluntary water supply watershed program in the mid-1980s, followed by mandatory rules in the early 1990s.
- USGS Monitored water supply watersheds on a regional scale to ensure long term data to evaluate quality and protect public health through local funding.
- Developed a nutrient response model for Jordan Lake through local funding.

Although these improvements benefit all in the Basin, there is still considerable work to accomplish. Twenty percent of the Basin's waters remain on the 303(d) list including Jordan Lake for nutrient enrichment. Nutrients are also a concern downstream in the Cape Fear River and may contribute to the low dissolved oxygen in the estuarine portion of the river, also a 303(d) listed water.

Accordingly, watershed management strategies must be formulated and implemented in a manner to balance the competing goals of growth and the environment. The Mid-Carolina Council of Governments (MCCOG) and the Cape Fear River Assembly (CFRA) are proposing to establish a framework for water quality credit trading as a potentially important component of a strategy that will build upon past successes and integrate powerful incentive-based options with existing regulatory and voluntary approaches.

The MCCOG and the CFRA were awarded a targeted watershed grant from EPA to evaluate water quality credit trading within the Jordan Lake Watershed. The goal of this grant project is to develop, demonstrate, and evaluate a water quality credit trading program for the Jordan Lake Watershed that will build on work conducted to date and provide an innovative, incentive-based framework to support implementation of the regulatory requirements based on the final TMDL embodied in the Jordan Water Supply Nutrient Strategy Rules (the "Rules" located in 15A NCAC 02B .0262-.0273) and support cost-effective water quality management strategies.

This study is organized into the following tasks:

1. Visioning and Project Chartering;
2. Designing the Trading Program;
3. Developing an Implementation Framework;
4. Evaluating the Monitoring Program;
5. Demonstrating the Trading, Implementation, and Monitoring Frameworks in a Pilot Subwatershed; and
6. Expanding Innovative Approaches throughout the Basin.

This Technical Memorandum (TM) is submitted in partial fulfillment of the deliverable requirements for Tasks 2 and 3. This TM builds on the previously submitted TM "Opportunities for Water Quality Credit Trading in the Jordan Lake Watershed" (CH2M HILL, 2007) and is a companion to the forthcoming TM "BMP Cost Estimates and Cost-Effectiveness" (CH2M HILL, 2008c). It also provides supporting detail for the point source-related aspects of the proposed trading framework described in the TM "Proposed Nutrient Credit Trading Framework for the Haw and Upper New Hope Watersheds" (CH2M HILL, November 2008b).

This TM addresses the following aspects of the major point sources in the Haw and Upper New Hope watersheds (subtasks are identified in parentheses): Assessment of Drivers and Opportunities (2.1); Identify Baselines for Trading (2.2); Identify/Establish Creditable BMPs/Other Actions (2.3); Cost-Effectiveness Analysis (2.4); Credit Trading Protocols—credit units and ratios (2.5); Evaluate Existing Frameworks (3.1); and Develop Watershed-Based Permitting Alternatives (3.2).

With respect to cost-effectiveness, the methodologies used by the point sources to estimate nutrient control costs vary. The cost methodologies are different enough that after careful evaluation of the data and consideration of the draft unit-cost results, it was determined inappropriate to publish unit cost estimates in this TM. Cost data submitted by the point sources are presented as provided and recommendations for developing comparable unit cost estimates in the future are offered.

This point-point trading feasibility analysis addresses two types of point source credits, nitrogen and phosphorus, under a three step process:

Step 1. Forecast nutrient loading estimates for each point source for the period 2008-2030 under two cases—(a) with and (b) without a technology upgrade specified by the POTW;

Step 2. Evaluate individual facility's future loads under the two cases compared to the individual wasteload allocation to identify potential credit and debit situations; and

Step 3. Based on the results of Step 2, develop scenarios that illustrate how a point source bubble, potentially implemented under a watershed or general permit, could support point-point trading for collective WLA compliance.

The remainder of this TM is organized under the following major headings:

Section 2. Methodology for Estimating Point Source Loading Projections;
Section 3. Projected Point Source Nutrient Loading;
Section 4. Illustrative Point-Point Source Trading Scenarios; and
Section 5. Summary and Next Steps.

2.0 Methodology for Estimating Point Source Loading Projections

In order to determine whether or not trading is a feasible option for point sources in the pilot watersheds—the middle Haw (approximately Alamance County area) and Upper New Hope — it is necessary to identify the following:

- Projected nutrient Wasteload Allocations (WLA) each point source will be required to meet;
- Design flows and nutrient concentrations from which the WLAs were derived; and
- Facilities' future expected loading rates under feasible treatment options.

As specified in the Rules, trading may only occur within a subwatershed, as delineated in Exhibit 3. Exhibit 4 lists the major point sources—wastewater treatment plants (WWTPs) that are all publicly owned treatment works (POTWs)—in each of the two pilot subwatersheds.

EXHIBIT 3
Potential Pilot Nutrient Trading Areas for Jordan Lake Watersheds
The potential pilot areas for this study include the middle portion of the Haw River watershed as delineated, and all of the Upper New Hope subwatershed. The Lower New Hope subwatershed is not included in the trading pilot, but is shown for completeness with respect to the area covered by the Rules applicable to the Jordan Lake watersheds.

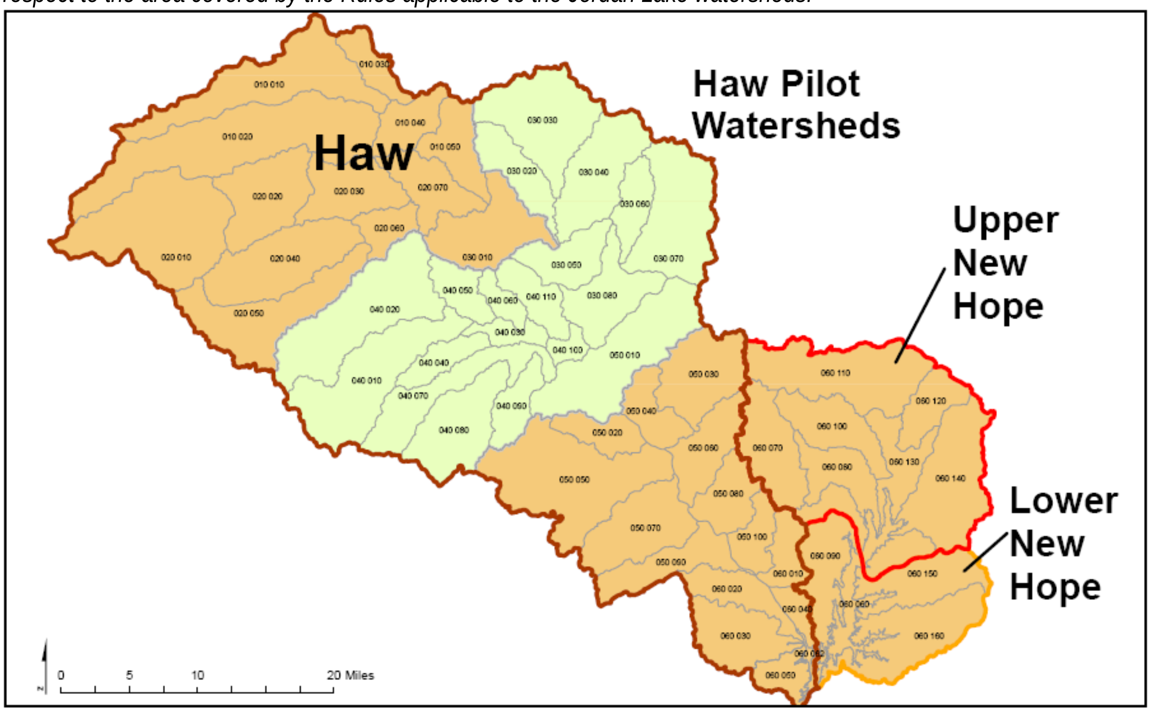


EXHIBIT 4
Major POTWs in the Two Pilot Subwatersheds

Haw	Upper New Hope
• City of Burlington, Eastside WWTP • City of Burlington, Southside WWTP • City of Graham, Graham WWTP • City of Mebane, Mebane WWTP	• City of Durham, South Durham Water Reclamation Facility (WRF) • Durham County, Triangle WWTP • Orange Water and Sewer Authority (OWASA), Mason Farm WWTP

WLAs for each POTW were calculated directly from the nitrogen and phosphorus concentration limits in the Jordan Lake TMDL, as identified in Exhibit 5. The TMDL specified that the WLA for each POTW would be calculated from these concentrations and each POTW's permitted discharge capacity as of December 31, 2001, with the exception of OWASA and Durham County, who were in the process of upgrading their POTWs and were assigned their upgraded discharge capacity. This calculation resulted in the WLA for each POTW in pounds per year for nitrogen and phosphorus as shown in Exhibit 6.

EXHIBIT 5
TN and TP Concentration Limits Used for WLA Calculation in the Two Pilot Subwatersheds

Watershed	TN (mg/L)	TP (mg/L)
Haw	5.30	0.67
Upper New Hope	3.04	0.23

The WLA (allowable annual mass load, in pounds) for each POTW can be approximated using the following formula:

Permitted Capacity in MGD X 8.3453 lbs./gal. X Concentration Limit in mg/l X 365 days

EXHIBIT 6
TN and TP WLAs for POTWs in the Two Pilot Subwatersheds

POTW	TN (lb/yr)	TP (lb/yr)
Haw		
City of Burlington, Eastside WWTP	193,078	24,270
City of Burlington, Southside WWTP	193,078	24,270
City of Graham, Graham WWTP	56,315	7,079
City of Mebane, Mebane WWTP	40,225	5,056
Upper New Hope		
City of Durham, South Durham Water Reclamation Facility (WRF)	185,345	14,053
Durham County, Triangle WWTP	111,207	8,432
OWASA, Mason Farm WWTP	134,375	10,188

Flow projections for the POTWs through 2030 were estimated from either the respective utility service provider's own projections or from population growth estimates and regional per capita water usage. Burlington, the City of Durham, Durham County and OWASA made available the projections they developed as a part of their capital improvement and planning programs and those have been used in this TM. In the absence of specific POTW-developed projections, as was the case for Graham and Mebane, the 2002 Local Water Supply Plan was used to determine the historical correlation between water demand and wastewater flow. Water demand projections from the 2002 Local Water Supply plan were then multiplied by the historical ratio of water flow to wastewater flow to estimate projected future wastewater flows.[1]

Using the flow projections and the average nutrient concentration discharged by each point source from 2005-2007 (if available), baseline nutrient load projections, on a pound per year basis, were developed. The nutrient concentration data for 2005-2007 were taken from the POTWs' Discharge Monitoring Reports (DMRs), submitted monthly to the DWQ in the Department of Environment and Natural Resources (DENR), and made available to the project team by the POTWs. These baseline projections represent estimated future nutrient loads assuming each POTW makes no changes or improvements to their current nutrient removal processes over the study period. The baseline projections also assume the plants would be able to achieve the same average nutrient concentrations as recorded during the 2005-2007 period even at higher flow rates; however, in practice this is not always possible.

All of the affected POTWs have phosphorus removal limits in place, some dating as far back to the 1980s. All have stringent ammonia-nitrogen limits in place as well. A number of the POTWs in the pilot area have either already started treatment upgrades to further remove nutrients or have plans to upgrade their facilities or treatment processes for additional nutrient removal. Based upon general planning-level information provided by the POTWs regarding the projected dates and treatment capabilities of their planned upgrades, an additional set of nutrient load projections was developed for each POTW to reflect a "with upgrade" case that can be compared to the baseline "without upgrade" case described above.

The future loading projections without and with the specified upgrade were presented to the POTWs and they concurred with the methodology used and the assumptions made, with the understanding that there remains a high degree of uncertainty in the assumptions and analyses. The resulting projections are presented in the next section.

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[1] The 2002 Local Water Supply plan was used to determine the historical correlation between water demand and wastewater flow for the cities of Graham and Mebane. The 2002 Local Water Supply plan provided water usage projections and water and wastewater usage for 2002. The average 2002 ratio of water usage/wastewater flow was found to be 0.78 for Mebane and 0.62 for Graham. Using the ratio of 0.62 resulted in an underestimation of flows seen in 2005 for the City of Graham, so, the ratio of .78 developed for Mebane was used to generate projected wastewater flows for the City of Graham as well.

3.0 Projected Point Source Nutrient Loading Without Trading

The results presented below show projected nutrient loads with and without planned upgrades. Most of the nitrogen control upgrades are shown as coming on line by 2014, as reported by the POTWs. As reported, all POTWs with one exception indicate they can meet their individual WLAs by 2014, if not before, through 2030 at projected flows, with a combination of capital improvements and/or operational improvements (such as chemical additions). For some, planned capital and operational upgrades will result in nutrient loadings substantially below WLAs; for others, the WLA is approached but not quite exceeded by 2030. Mebane provided no information about planned upgrades: it appears the POTW could meet its nitrogen WLA through 2030 at current concentrations, but that some improvement would be needed by about 2020 to decrease phosphorus concentrations to levels sufficient to meet the WLA.

A series of charts follow that present the POTWs' projected nutrient loading, with and without upgrades, compared to their WLAs. Descriptive narrative accompanies the charts. Exhibit 7 provides an explanation of the layout and interpretation of the charts shown in Exhibits 8 through 11. The "small multiple" charts are presented to allow evaluation of the compliance situations at a glance. The most important element of the charts is where the with and without upgrade bars top out relative to the red line: bars higher than the line are not compliant with the WLA; bars lower than the red line are compliant. It is important to note in all of the following exhibits that when calculating loads following planned upgrades it was assumed that the plants would be operated to their maximum nutrient removal capacity. This may not be the case in practice.

EXHIBIT 7
Guide to Loading Projection Charts, Exhibits 8 - 11

- The horizontal axis shows the years for which data are presented.
- The vertical axis marks the annual nutrient load in pounds.
- The red horizontal line indicates the facility's WLA.
- Hatched bars indicate load estimates based on reported data.
- Darker bars (blue for nitrogen and green for phosphorus) present annual load estimates without any additional upgrades.
- Lighter bars (blue for nitrogen and green for phosphorus) present annual load estimates with the planned upgrade(s) or treatment modification(s) specified by the POTW.
- Until the year of the upgrade or treatment modification, projected loads with and without the upgrade or modification (dark and light bars) are the same.

Example Chart

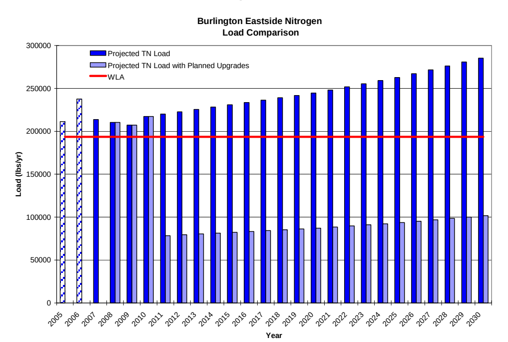
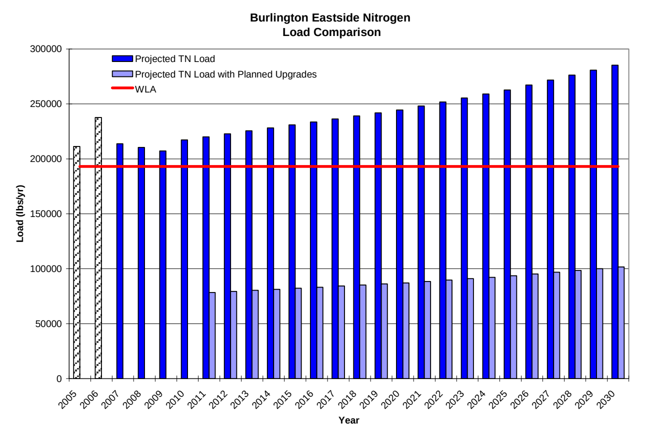
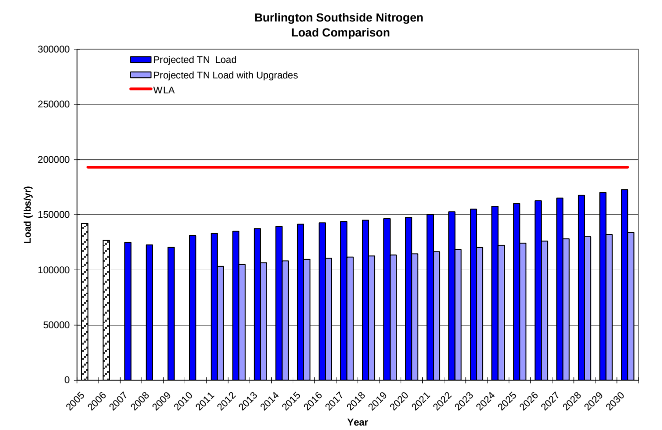


EXHIBIT 8

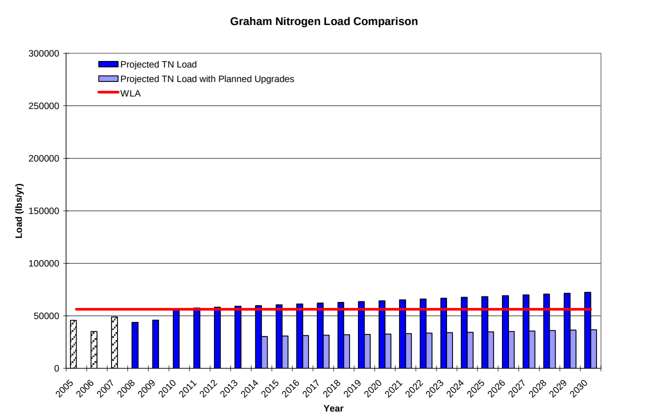
Haw TN Loading Comparisons

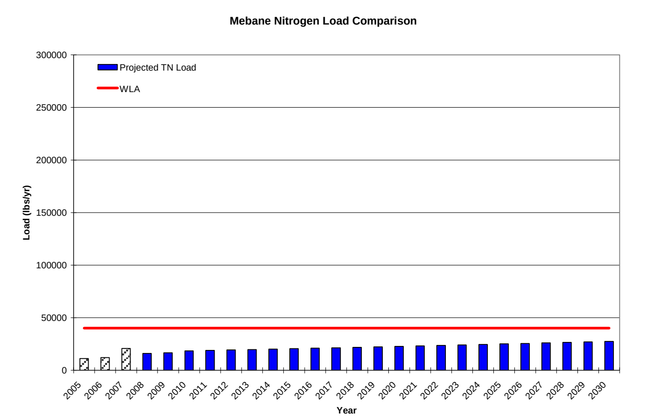
The Burlington Southside and Mebane facilities will be able to meet their TN WLAs at current concentrations through 2030. The Burlington Eastside and Graham facilities will be over their TN WLAs by 2014 at current concentrations. The City of Burlington already has an upgrade in progress for its Eastside facility and when complete will be able to meet the TN WLA. After both these upgrades, Burlington will have a significant amount of extra nitrogen reductions that may be creditable. The City of Graham assumes it would need an upgrade to comply with its WLA if trading were not a viable option. It appears that either or both Burlington plants could be a candidate to provide nitrogen credits to Graham since their upgrades put loadings well below their WLAs.





- Based on the City of Burlington's RFQ for Wastewater Treatment Plant Modifications, and confirmed in communication with the City, it was assumed that the first phase of construction for the upgrades for the Burlington Eastside and Southside plants would be complete in 2011 and that the nitrogen concentrations from the upgraded facility would meet the requirements of the Rules.





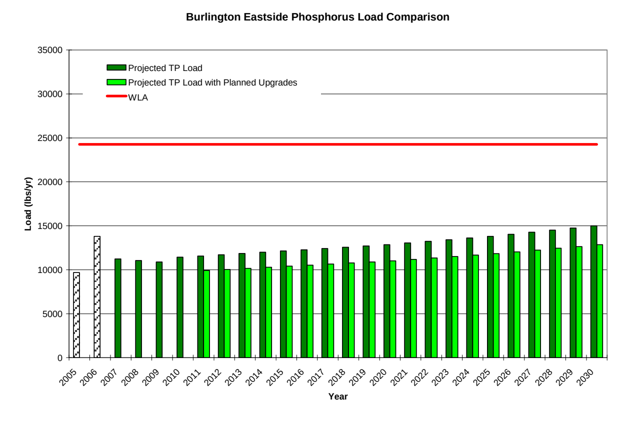
- The City of Graham assumed that it would need to have improvements in place by 2016 in order to meet the TN WLA.

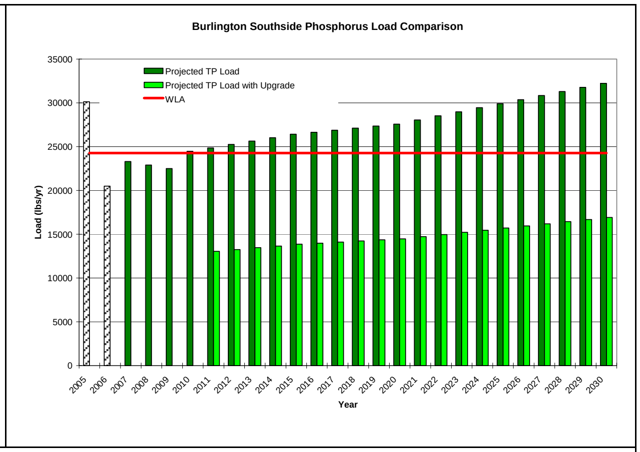
- Mebane provided no information about planned upgrades, but based upon projected loads it does not appear that the plant will need to upgrade in order to meet the TN WLA.

EXHIBIT 9

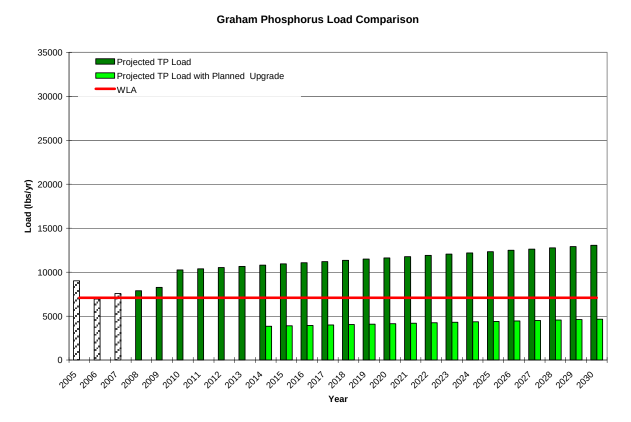
Haw TP Loading Comparisons

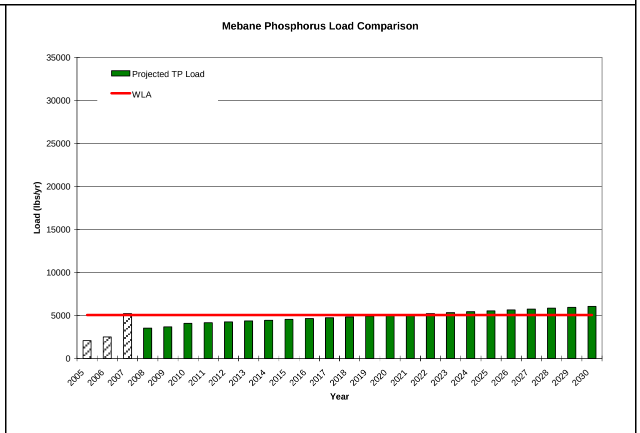
The Burlington Eastside facility will be able to meet its TP WLA through 2030 under existing operating conditions: however, Burlington already is planning upgrades for both of its POTWs. After both these upgrades, Burlington will have a significant amount of extra phosphorus reductions that may be creditable. The City of Graham assumes it would need an upgrade to comply with its WLA if trading were not a viable option. It appears that either or both Burlington plants could be a candidate to provide phosphorus credits to Graham since their upgrades put loadings well below their WLAs. Mebane will need to upgrade by 2020 or purchase credits to comply with its WLA.





- Based on the City of Burlington's RFQ for Wastewater Treatment Plant Modifications, and confirmed in communication with the City, it was assumed that the first phase of construction for the upgrades for the Burlington Eastside and Southside plants would be complete in 2011 and that the phosphorus concentrations from the upgraded facility would meet the requirements of the Rules.





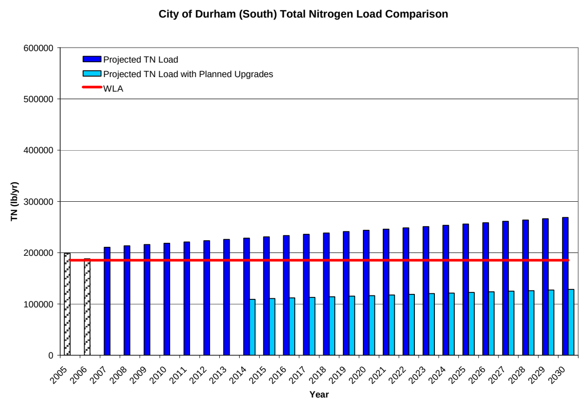
- The City of Graham cannot meet the proposed TP limits in the immediate future with existing TP removal processes.
- The City of Graham assumed that it would need to have improvements in place by 2014 in order to meet the TN WLA and it was assumed that improvements would also provide for TP reduction to the requirements of the Rule at that time.

- Mebane provided no information about planned upgrades and based upon projected loads it does not appear that the plant will need to upgrade in order to meet the phosphorus WLA.
- Based upon the average TP concentration of 2005-2007, the City of Mebane will be able to meet the phosphorus WLA until 2020.

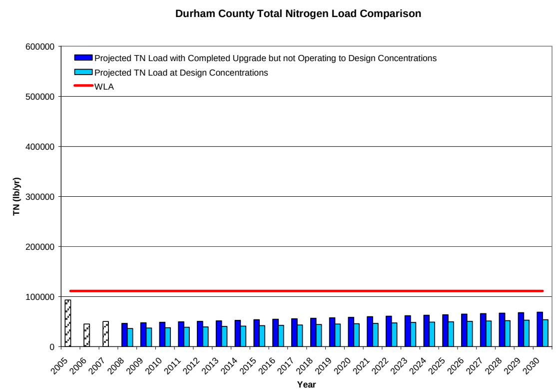
EXHIBIT 10

Upper New Hope TN Loading Comparisons

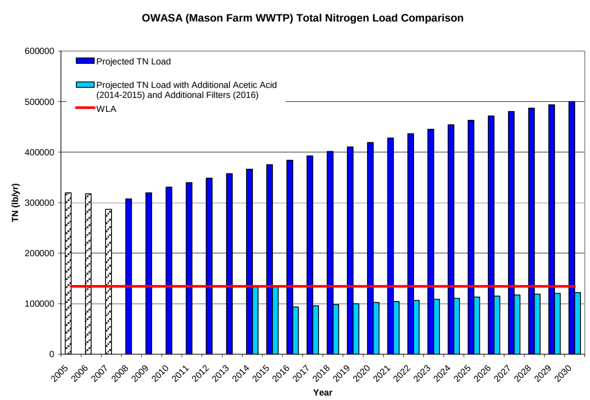
The City of Durham believes it can meet its WLA for nitrogen either through operational improvements or a capital upgrade. Durham County has already completed an upgrade with Enhanced Biological Nitrogen Removal (EBNR) and will be able to meet its TN WLA through 2030. OWASA is evaluating upgrade options, and timing thereof, that will bring loads below its WLA, as without upgrades loads already exceed the WLA level. Under any trading scenario, mathematically, OWASA would have to upgrade to some level, because the other two plants could not generate enough credits to cover OWASA under the assumptions outlined below.



- The City of Durham intends to complete upgrades to the South WRF in a phased manner. Phase 2 of the upgrade for TN is planned to be complete by 2014.
- One of the options for upgrades at the South Durham facility is the addition of supplemental carbon feed. This would allow the facility to meet the TN limit without a major capital expense. According to the POTW, additional facilities and capital expenditures would provide process reliability.



- Durham County recently completed an expansion and installation of an EBNR process that will allow it to meet the TN WLA through 2030 (although it appears it could have met the WLA without the upgrade).
- The above graph shows the projected load based off the average of the 2006 and 2007 concentrations following the upgrade as well as the projected load if the plant is operated to meet the design concentrations.

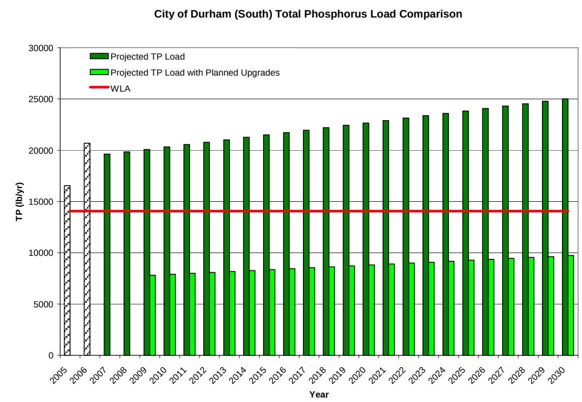


- Based on recent evaluations, OWASA expects it will need additional deep-bed denitrification filters to meet the TN mass load limit as of 2016, when average-day plant flows are expected to be 10 MGD. A further addition of TN and TP removal facilities will then be needed around 2019-2022 to maintain loads under the WLA.
- OWASA plans to undertake a facility optimization and re-rating study in FY 2010. That study will provide recommendations for the type, timing, and cost of improvements needed to meet the nitrogen WLA.

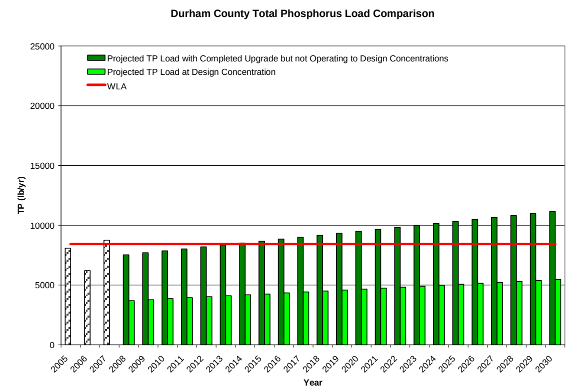
EXHIBIT 11

Upper New Hope TP Loading Comparisons

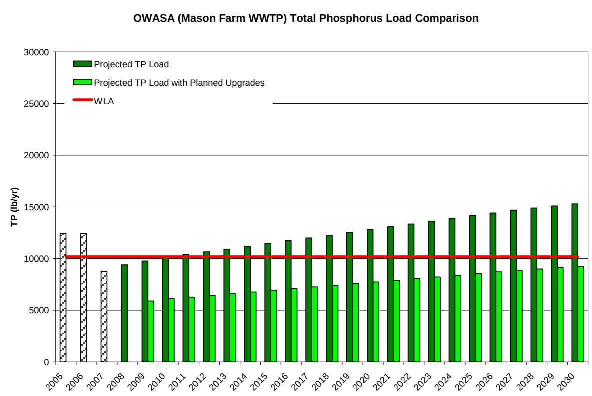
The City of Durham plans to meet TP removal requirements through increased chemical feed beginning in 2009. Durham County has already completed an upgrade with EBNR and will be able to meet its TP WLA at the upgraded design concentrations. OWASA completed an expansion and upgrade in 2007 that increased its TP removal capabilities and is planning for another upgrade in 2019-2022 that will further increase TP removal. Until the next upgrade, OWASA anticipates that it will be able to meet its TP WLA through additional chemical treatment. The projections indicate that both the City of Durham and OWASA will need to implement these plans in the near future, as there will not be enough TP credits among the three POTWs to support compliance through trading without some upgrades once the mass load limits are in effect.



- The City of Durham could complete some upgrades and meet the TP WLA by 2009 (as shown). The later upgrade for TN will include some minor piping changes to optimize chemical feed for TP removal.
- The City recently concluded it will be able to meet the TP WLA by increasing chemical feed, rather than completing the planned 2009 upgrade.



- Durham County recently completed an expansion and installation of an EBNR process. It intends to increase phosphorus polishing using sodium aluminate to improve the TP removal rate to meet the TP WLA.
- Durham County is adding an improved sludge holding and decanting system with potential decant phosphorus removal. This upgrade is to be completed in 2010.
- Durham County intends to upgrade the facility before it reaches its current capacity of 12 MGD, which is projected to be beyond the year 2030.



- OWASA's current plan is to initially meet TP requirements through an enhanced biological phosphorus removal process, with supplemental chemical removal with alum; however, OWASA anticipates that it will need additional TP removal facilities in place by 2019-2022.
- OWASA plans to undertake a facility optimization and re-rating study in FY 2010. That study will provide recommendations for the type, timing, and cost of improvements needed to ensure that OWASA can meet the nutrient limits.

4.0 Illustrative Point-Point Source Trading Scenarios

4.1 Scenario Development

The results presented in Section 3 showing each POTW's projected loads relative to its individual WLA under a case where no additional upgrades are made and under a case with an upgrade specified by the POTW indicate there may be mathematical potential for the POTWs in each subwatershed to use credit trading to meet their collective WLA rather than having to each upgrade to meet an individual WLA.

Ordinarily with such results, the next steps would involve: (1) refining the credit supply-demand analysis including location ratios that may be applicable (as may be derived from transport factors used by DWQ (Templeton, 2008)); and (2) evaluating the relative cost-effectiveness of the potential supply-demand scenarios inclusive of ratios. The first step is possible with available data, and the results are presented in this section. However, for the reasons discussed below, the second step cannot be completed with a sufficient level of precision to include the preliminary results in this TM.

The POTWs provided their best cost estimates for the specified upgrade and process improvement options that were available during the period the analysis for this TM was conducted. Despite concerted efforts to manipulate these data to produce comparable unit costs, differences in costing methodologies among the POTWs remained significant enough that direct comparisons of unit costs using available data are inappropriate. Summary cost data provided by the POTWs are presented in Appendix A to document the data collection effort. The POTWs are at different phases in planning their upgrades; some have hired design engineers and have preliminary engineering reports while others have less detailed information. Please note that these estimates, and the capital upgrades and operational improvements on which they are based are subject to change.

Without the unit cost comparisons, an assessment of trading opportunities focusing on potential credit demand-supply scenarios is still possible. In this section, for each subwatershed-pollutant combination, one mathematically feasible point-point trading scenario is presented in Exhibits 10 through 13. Each trading scenario was developed by assuming that one or more of the POTWs in the pilot watersheds would implement nutrient removal improvements that would result in loading below the applicable WLA(s). For purposes of scenario development, it was assumed that, upon completion of these improvements, the facilities would be operated for maximum possible nutrient removal. It is possible, that in light of economic and other considerations, a POTW may not operate to these low limits, but to some higher concentration that still allows it to meet its WLA. The difference between the WLA and the projected load would then be available to another POTW in the same subwatershed (see Exhibit 3) in the form of nutrient reduction credits that the other POTW(s) could use to offset loads above its individual WLA(s). In order to normalize the loads/load reduction of each of the POTWs relative to Jordan Lake, delivery ratios were applied to calculate a combined WLA at the lake as well as the number of pounds of nutrients delivered to the lake by each of the POTWs.

Section 4.2 presents the trading scenarios with graphics and narrative captions. Section 4.3 discusses how such trading scenarios could be implemented in the future.

4.2 Presentation of Potential Trading Scenarios

EXHIBIT 12

Haw Potential TN Trading Scenario

Under a collective loading cap, if Burlington Eastside upgrades as planned, other dischargers in the Haw could delay upgrades for TN past 2030. Because Burlington Eastside constitutes such a large amount of the combined load, its upgrade alone brings the combined load well below the collective WLA when the other POTWs remain at pre-upgrade concentrations at projected flows.

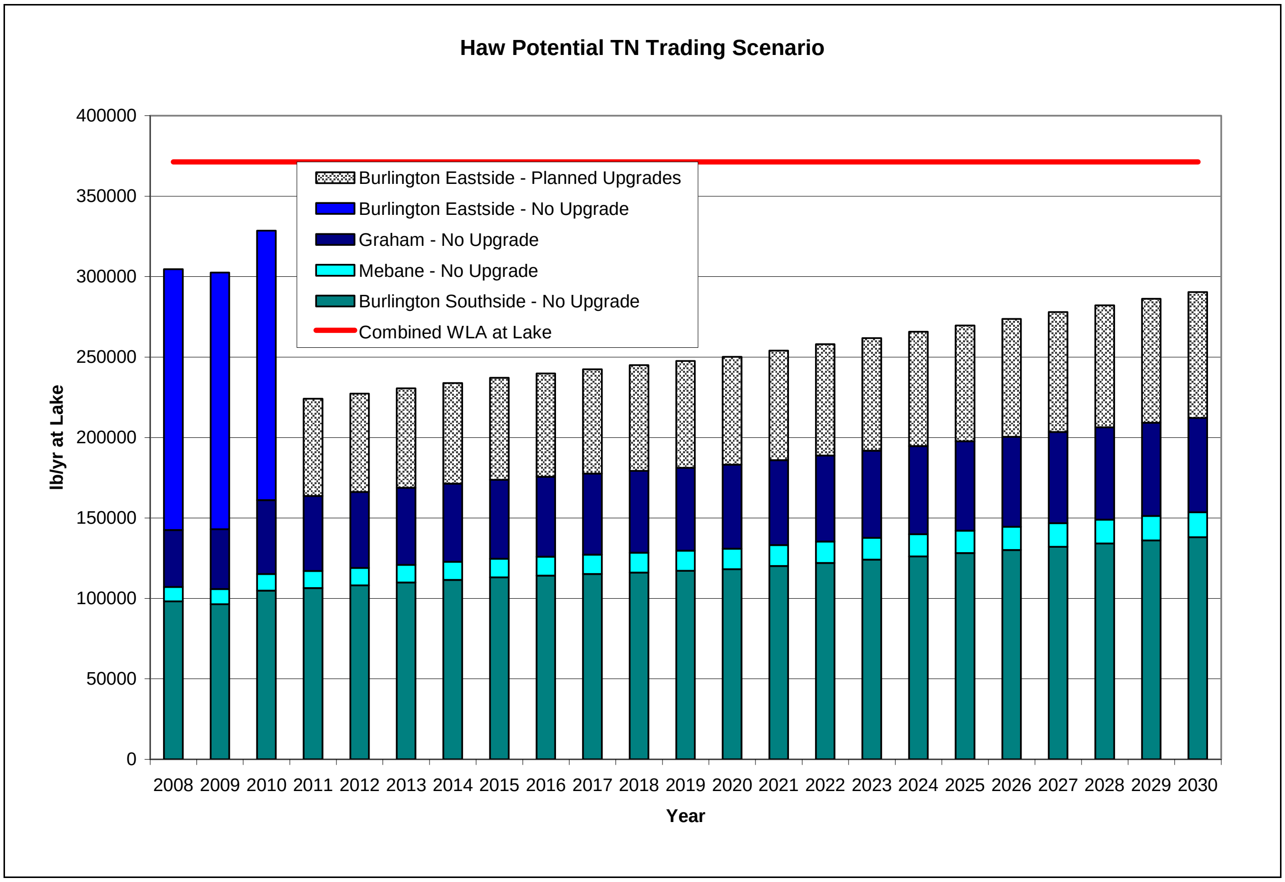


EXHIBIT 13

Haw Potential TP Trading Scenario

Under a collective loading cap, no POTWs in the Haw would need to upgrade for TP before 2024. As shown in Exhibit 9, Burlington Eastside has enough credits to cover the number of pounds of TP needed by Burlington Southside, Graham and Mebane to meet their WLAs until 2024. At that time, the next upgrade based on credits needed would be Burlington Southside, as shown below. Relative cost-considerations might change this preference.

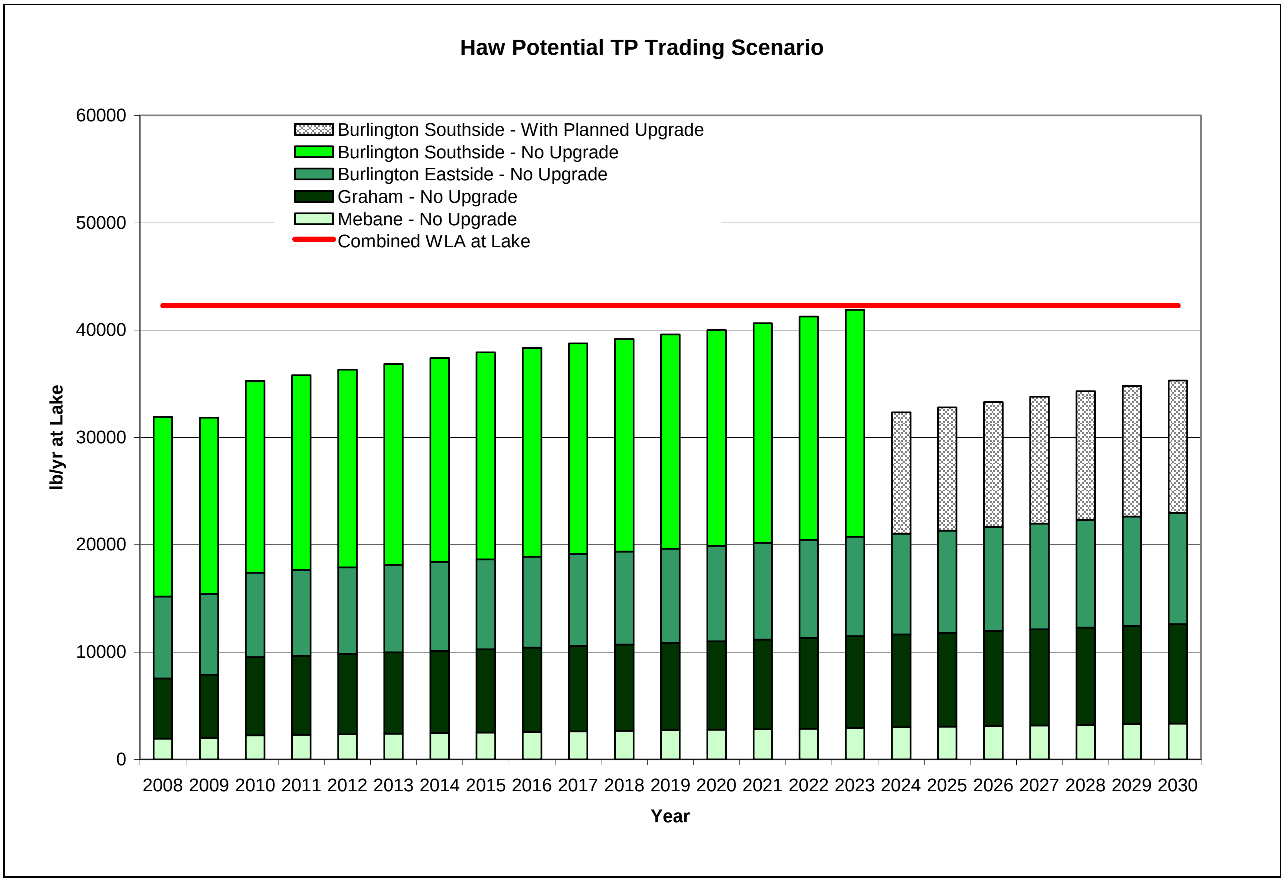


EXHIBIT 14

Upper New Hope Potential TN Trading Scenario

These loading projections show that with the already completed Durham County nutrient removal upgrades, it would be possible for the combined WLA of the three point sources to be met until 2030 if OWASA utilizes additional acetic acid from 2014-2016 and adds additional deep bed filters for TN removal in 2016 when its average daily flow (ADF) reaches 10 MGD. This would allow the City of Durham to delay planned upgrades from 2014 to 2030.

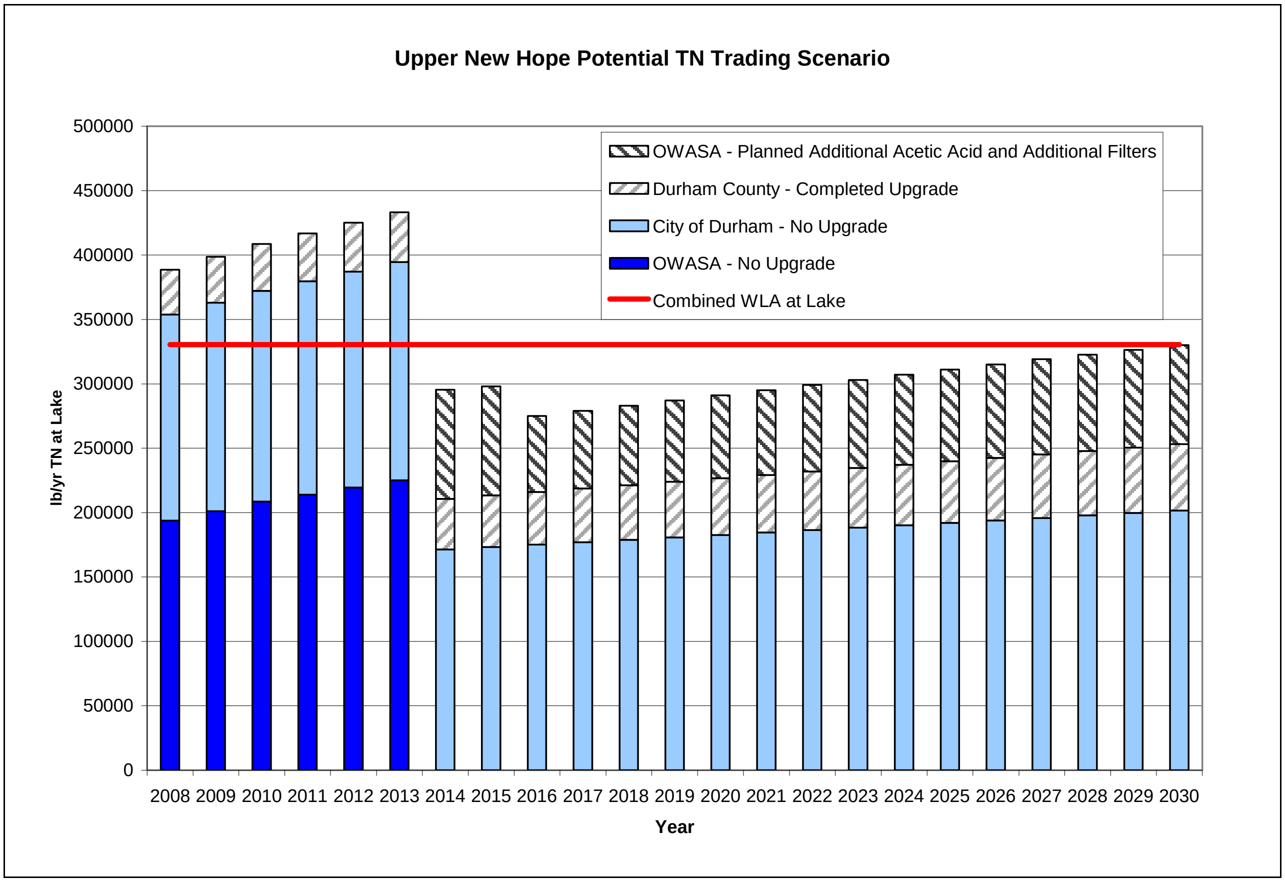
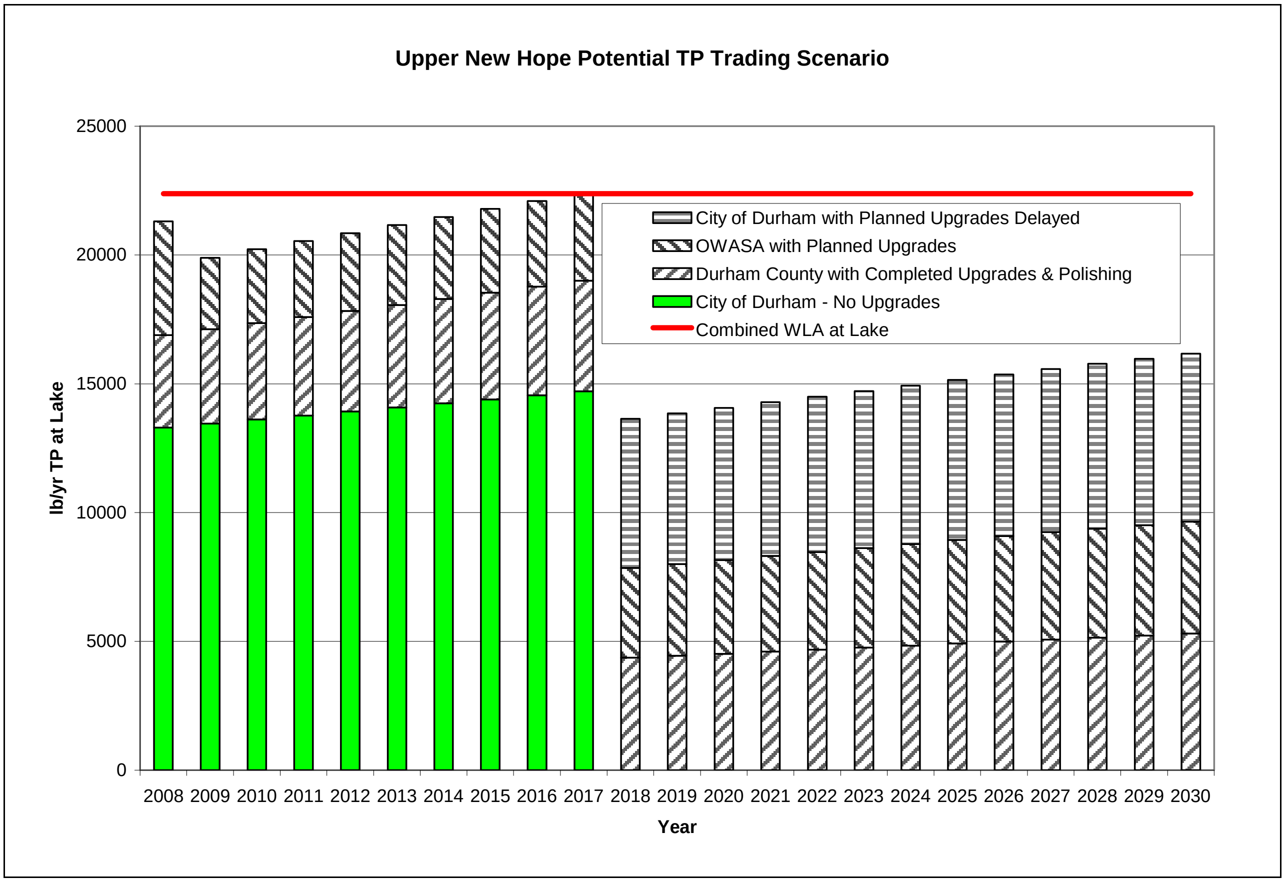


EXHIBIT 15

Upper New Hope Potential TP Trading Scenario

These loading projections show that with the completed Durham County upgrades, OWASA's planned operational adjustments and additional filters and Durham County's planned operational improvements, under a collective loading cap with trading, the City of Durham would be able to delay its planned introduction of additional chemical treatment until 2018.



4.3 Discussion of Point-Point Trading Implementation Options

Due to the apparent lack of demand for point-point phosphorus trading, and the roughly six year delay between now and when nitrogen WLAs will become effective, there is not an eminent need to develop point-point trading mechanisms as proposed for future consideration in *Proposed Nutrient Credit Trading Framework for the Haw and Upper New Hope Watersheds* (CH2M HILL, 2008b).

However, experience developing point-point trading frameworks has shown that it can take anywhere from two to five or more years to develop point-point trading programs from design to full operations; hence, consideration of point-point nitrogen credit trading opportunities is timely. This experience includes general or watershed permits, and/or nutrient credit exchange associations, as have been implemented for point sources in the Neuse and Tar-Pamlico river basins in North Carolina, in Connecticut for dischargers to Long Island Sound and its tributaries, and in Virginia for dischargers in Chesapeake Bay watersheds.

For example, the 111 of 127 eligible point sources now participating in the Virginia Nutrient Credit Exchange, which will begin formal trading for the 2011 compliance year, began developing their program in 2005 with the introduction of enabling legislation, and have spent the 2006-2008 period doing extensive modeling of trading scenarios and credit pricing schemes. Given that this was the first point-point nutrient trading program in Virginia and considering the significant lead time between upgrade design, contracting, construction, and coming on line, this pre-trading period has provided participants with an opportunity to fine-tune their plans consistent with their desired market position as a buyer, seller, or observer.

A smaller program involving fewer facilities, smaller geography, and state-precedent with the point-point trading programs in the Neuse and Tar-Pamlico river basins[2] should not need so long to develop a program. However, decisions about upgrades that would be needed for compliance in the absence of a trading program are being made now and any upgrades that are not already underway could take up to five or even seven years to bring on line, inclusive of design, construction, and pilot testing.

Under these circumstances, it is not too early to consider one or more of the point-point trading program implementation mechanisms summarized below (subject to the participants' preferences, negotiations with NPDES regulators, and stakeholder input).

- **General Permit**—Under this approach, the POTWs would be covered under a new NPDES permit for nitrogen (and possibly phosphorus). As defined in this TM, this model would involve documenting credit and debits against individual WLAs and implementing an accounting process which would transfer credits from sellers to buyers in an annual reconciliation process reported in a credit ledger. This is very similar to the Virginia program, and operationally similar to the Connecticut program (except that the state regulatory agency performs the reconciliation, rather than a discharger association).

[2] See for example: NCDWQ. 2002. NPDES Permit to the Neuse River Compliance Association and Its Co-Permittee Members. NPDES NCC000001.

- **Watershed Permit for Point Sources Only—**Under this approach, the POTWs would be covered under a new NPDES permit for nitrogen (and possibly phosphorus). As defined in this TM, collective loads would be tallied against the collective WLA. If the load were below the WLA, all would be deemed compliant and the credit/debit and reconciliation process described for the General Permit would not be necessary. If the group were not compliant, provisions would pre-determine how individual facilities or the group would handle the situation. This is operationally similar to the permit issued to the Neuse and Tar-Pamlico Point Source Compliance Associations.
- **Multi-Sector Watershed Permit—**Under this approach, a local jurisdiction with one or more POTWs as well as stormwater management responsibilities under Phase 1 or 2 program could combine their point and nonpoint source nutrient control programs under one regulatory mechanism. This could help facilitate situations where a jurisdiction wants to apply surplus point source nutrient reduction credits to its stormwater program, or apply stormwater BMP-generated nutrient credits to its POTW's WLA compliance.
- **Multi-Sector Credit Exchange—**This option represents the "Bank and Exchange" described in *Proposed Nutrient Credit Trading Framework for the Haw and Upper New Hope Watersheds,* 2008b), and may or may not involve one of the other options outlined above. With the regulators' approval, point sources could theoretically access nutrient credits generated by point and/or nonpoint sources through the set of credit trading facilitators that may ultimately provide such matchmaking, exchange, and reconciliation services without having a NPDES permit that collectively covers the point sources.

Based on the evolution of the Rules and desire to further explore point-point and point-nonpoint trading opportunities as a potential way to more cost-effectively comply with nutrient reduction requirements, POTWs could further explore these implementation mechanisms based on the results of a refined supply/demand and cost-effectiveness analysis to better determine point-point trading feasibility, as outlined in Section 5.

5.0 Summary and Possible Next Steps

Based on the analysis presented in this TM, the point-point trading potential for nitrogen and phosphorus differs as follows: there may be a potential opportunity for certain POTWs to meet a collective nitrogen WLA through one or more trading scenarios; whereas there appears to be little demand or opportunity for phosphorus credit trading given that many of the upgrades planned to meet the TP WLAs are either already completed or well underway. These findings merit further exploration to determine if trading could provide benefits to participants in the short- and/or medium-term: without further analysis, there is some skepticism among POTW owners as to whether the potential benefits could be significant enough to justify development and implementation of a point-point trading program in either or both watersheds.

Clearly, many factors will affect the feasibility of nutrient trading among the POTWs, including of course the willingness of those with extra credits to sell them and the willingness of those who might delay or avoid an upgrade to do so. Over the long term, mathematically trading would not be a permanent strategy to the extent that POTWs' eventually reach their design flows and loads approach their WLAs and to the extent that they have reached the limits of treatment technologies with respect to reducing nutrient concentrations. Under such circumstances, trading could help optimize scheduling and funding upgrades; whether it would reduce, increase, or represent no change in the total investment necessary for compliance with the WLAs without trading would depend on the relative levels of inflation, interest rates, labor and material costs, etc. in effect over the planning period.

Potential Point-Point Nitrogen Credit Trading Opportunities

It appears that when the TN WLAs become effective in 2014, there may be an opportunity for point-point trading in both watersheds to meet a collective TN WLA in both watersheds without needing nonpoint source credits.

In the Haw watershed, under a trading program, the four POTWs could meet a combined nitrogen WLA through 2030 with only the planned upgrades to the Burlington Eastside POTW. With this upgrade completed, the earliest projected demand for point-point nitrogen trading could come from Graham in 2014 seeking to purchase credits from Burlington when its nitrogen load exceeds its individual WLA after the Rules take effect (projected at 2014). It appears that any other nitrogen credits needs in the Haw watershed would be after 2030.

In the Upper New Hope watershed, the three POTWs could meet a combined nitrogen WLA through 2030 if OWASA completed its plan to increase acetic acid addition for TN removal from 2014-2015, the additional of additional deep bed filters for TN removal in 2016 when average daily flows are predicted to be over 10 MGD and other upgrades in 2019-2022. Under this trading scenario and the projected nitrogen loads and wastewater flows, the City of Durham could delay its planned upgrades until 2030 if it was able to purchase credits from both Durham County and OWASA beginning in 2014 when the Rules are expected to take effect.

Potential Point-Point Phosphorus Credit Trading Opportunities

From the analysis presented in Section 4, there appear to be limited opportunities for phosphorus trading among the POTWs in both watersheds.

In the Haw watershed, with a trading program it would be mathematically possible for the four POTWs to meet a combined phosphorus WLA without any upgrades to current treatment processes until 2024. However, the City of Burlington is already in the process of upgrading its Eastside and Southside POTWs for enhanced nutrient removal. With these upgrades completed, the earliest projected demand for point-point phosphorus trading could come from Graham seeking to purchase credits from Burlington when Graham's phosphorus load exceeds its individual WLA after the Rules take effect (projected at 2009). It also appears that after Mebane hits its loading cap (projected at 2020), it could seek to comply with its WLA through credit purchases from one of the Burlington plants.

For the Upper New Hope watershed, it is mathematically impossible for the three POTWs to meet a collective WLA without OWASA upgrading its treatment capabilities. Under a trading program, the City of Durham could delay additional chemical treatment that would be necessary to meet an individual WLA if OWASA and/or Durham County would sell a sufficient number of credits. However, by 2018, the group of three would exceed its collective cap without at least one of the POTWs creating additional credits for the group (as illustrated in Exhibit 15). This could conceivably be accomplished if the City implemented additional chemical treatment, or if one or both of the other two plants achieved lower concentrations and/or experienced lower than projected flows.

Potential Nonpoint-Point Trading Opportunities for Nitrogen

If the POTW(s) with potentially available nitrogen credits did not trade with other POTWs, or if point-point trading occurred but surplus nitrogen credits were still available after meeting a collective WLA, it might be possible to transfer or sell those credits to a local jurisdiction or individual with nonpoint source nutrient reduction compliance responsibilities.[3] For example, under another scenario discussed by stakeholders, a POTW might elect to transfer those credits to another department in its jurisdiction for use toward the local government's requirement to reduce loads from existing development. Whether this should or could involve a transfer of funds or not was debated, with the conclusion that each jurisdiction could handle the financial transaction—to the extent there was one—under its own accounting and budgeting protocols.

Under another scenario, a POTW could make its credits available for sale—either in a pre-arranged bi-lateral deal, or by offering the credits to the larger market through a broker or on any multi-facilitator exchange as may exist. Stakeholders generally felt more information about the amount of extra credits and exchange options would need to be available before such scenarios could be more seriously and specifically contemplated.

Compliance Considerations Under a Trading Program

In their input to this TM, several of the POTW stakeholders in the pilot watersheds have said they will be cautious about entering into trading agreements for several reasons. One consideration has to do with the predictability of credit generation. They will not want to be obligated to deliver more credits than they can reliably create. In the near term, they will be operating new facilities and processes and predictability would be expected to increase over time as the POTWs gain experience operating the new technology. Another consideration has to do with POTWs not wanting to permanently trade away credits they may later need as their own flows and loads increase and they begin to need more, if not all of their own allocation.

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[3] This option would theoretically also be possible for point sources' phosphorus credits. However as detailed in CH2M HILL, November 2008c, it is not anticipated that any urban nonpoint source sector parties (i.e., urban developers and local government responsible for existing development reductions) will have a significant demand for phosphorus credits due to the fact that most BMPs meeting sediment control requirements will also meet TP control requirements.

As with any trading program, participants will need to include mechanisms that provide an adequate level of conservatism and security with respect to the number of credits that might be "promised" by a seller to one or more buyers. Most trading programs adopt a policy that trading is voluntary up to the point that arrangements are made to exchange credits. This means that sellers typically completely control the decision as to how many credits—if any—they offer for sale. But once offers are made, potential sellers must conform to the applicable policies and rules.

If offers for sale are made after a compliance period, for example at the end of the year when the exact number of available credits would be known, there is little to no risk in over-promising. However, if offers for sale must be placed in advance, for example in the year prior to the compliance year, and/or if several compliance periods' worth of offered credits must be documented (e.g., five years' worth), then policies and procedures need to be in place to protect buyers and sellers in cases of a shortfall of credits compared to the number projected available.

There are a variety of approaches available to manage these situations, including for example: sellers pledging less than 100% of projected available credits; "no harm no foul" policies where if the group is compliant with its collective cap, individual shortfalls of pledged credits are not penalized; placing the responsibility on the seller to meet its pledge if needed; and "backstopping" the program with readily available credits of last resort (e.g., available for a fixed price from the state, or from a "reserve account" held by a point source association). The specific approaches that would be necessary and appropriate in either the Haw or the Upper New Hope would depend on the specific regulatory framework adopted and the preferences of the participants and regulators.

Possible Next Steps

If stakeholders and point sources wish to further explore how point-point trading could help implement sector and individual requirements under the Rules, and/or the possibility of transferring surplus point source credits to nonpoint sources, the following next steps are recommended in conjunction with the consideration of the *Proposed Nutrient Credit Trading Framework for the Haw and Upper New Hope Watersheds* presented in a separate TM (CH2M HILL, 2008b):

- Develop point source nutrient control cost estimates such that capital and O&M estimation methods are consistent or can be normalized (for example, include all relevant O&M, and exclude non-nutrient exclusive expenses);
- Further explore potentially compliant trading bubbles using the "Lake Credit" method, which converts each plant's end of pipe load (reduction) into a value at the Lake, and other possible methods that would use delivery factors for direct conversions between plants;
- More specifically identify and characterize planned but not yet initiated upgrades with respect to ability to accelerate or delay the planned project, and adjust the upgrade through capital design or O&M protocols to treat to slightly higher or lower nutrient concentrations; and
- With this improved data and information, develop refined trading scenarios that provide a higher level of rigor and precision with respect to feasible trading scenarios, potential cost-savings to participants, and credit pricing options.

These recommendations are offered assuming that under a scenario where one or more POTWs needed credits, it would be expected, based on the preliminary analyses conducted for this project and knowledge of relative cost-effectiveness analyses prepared for other watersheds, that POTWs will find the most available and cost-effective nitrogen credits from each other, rather than from the agricultural or urban sector. Under such assumptions, the POTWs could form a workgroup to build upon the economic analysis conducted for this study, as outlined above, to develop better estimates of relative nitrogen control costs and relative capacity for creditable reductions (i.e., the number of credits a given POTW could generate annually at a specified treatment level).

If the economic and credit capacity analysis showed that point-point trading could be a more cost-effective compliance strategy for the prospective participants, then the necessary intra-agency agreements and permit modifications (e.g., trading provisions in individual permits, and/or development of a general or watershed permit that would cover only the tradable parameter and establish a collective WLA for the trading bubble) could be developed and negotiated with DWQ. The timeframe for this analysis and decision-making process should be aligned with the date by which individual facilities would have to comply with their WLAs so that any trading program can be agreed to and put in place well ahead of the dates by which facilities will have to decide whether to upgrade or not, and if so, begin the design and construction process.

It also is possible that one or more POTWs could have extra credits beyond those that would be exchanged with another POTW as part of a compliance bubble, or they may have credits but elect to not participate in point-point trading. In either case, the POTWs' credits may be tradable to nonpoint sources, most likely the urban sector. Under one scenario discussed by stakeholders, a POTW might elect to transfer those credits to another department in its jurisdiction for use toward the local government's requirement to reduce loads from existing development. Whether this should or could involve a transfer of funds or not was debated, with the conclusion that each jurisdiction could handle the financial transaction—to the extent there was one—under its own accounting and budgeting protocols. Under another scenario, a POTW could make its credits available for sale—either in a pre-arranged bi-lateral deal, or by offering the credits to the larger market through a broker or on an exchange that may exist. Stakeholders generally felt more information about the amount of extra credits and exchange options would need to be available before such scenarios could be more specifically or seriously contemplated.

6.0 References

CFRA. 2002. *Population and Households within the Cape Fear River Basin, By County and Hydrologic Unit.* Cape Fear River Assembly.

CH2M HILL. 2007. Final Technical Memorandum: Opportunities for Water Quality Credit Trading in the Jordan Lake Watershed. October 2007.

___________. 2008a. Final Technical Memorandum: Trading Areas and Ratios. October 2008.

___________. 2008b. Final Technical Memorandum: Proposed Draft Nutrient Credit Trading Framework for the Haw and Upper New Hope Watersheds. November 2008.

___________. 2008c. Draft Technical Memorandum: BMP Cost Estimates and Cost-Effectiveness. November 2008.

Connecticut Department of Environmental Protection. 2007. 2006 Report of the Nitrogen Credit Advisory Board To The Joint Standing Environmental Committee Of The General Assembly.

NCDWQ. 2002. NPDES Permit Issued to the Neuse River Compliance Association and Its Co-Permittee Members. NPDES No. NCC000001.

NC DWR. 2002. *Cape Fear River Basin Water Supply Plan.* North Carolina Department of Environment and Natural Resources, Division of Water Resources.

Templeton, Mike. 2008. Email to Ruth Swanek dated April 30, 2008 confirming point source transport factors.

Virginia Nutrient Credit Exchange Association. 2008. Exchange Compliance Plan: 2008 Annual Update.

Appendix A. Preliminary Nutrient Control Estimates for Selected Point Sources

The seven POTWs in the two pilot watersheds were contacted to obtain cost estimates for capital upgrades and operational-maintenance (O&M) improvements described in the body of this TM. Future flow projections were either obtained from the facility owners, or estimated using population projections, as documented in the body of this TM. Nutrient effluent concentrations for each specified capital and/or O&M investment level also were obtained from the owners. Exhibit A-1 presents the cost and treatment data provided by four of the seven POTWs.

EXHIBIT A-1
POTW Cost-Effectiveness Calculation Inputs
Blank gray cells indicate values were not provided, while italicized values were imputed from data provided by the owners. Burlington provided a capital cost estimate range for their upgrades, without O&M estimates. The City of Durham provided capital cost estimates only. Durham County provided capital cost estimates for both nutrients, but O&M for TP only. OWASA provided capital and O&M cost estimates for both nutrients.

	Burlington Eastside	Burlington Southside	City of Durham	Durham County	OWASA
Projected Flow (MGD)					
2008	4.65	5.90	11.03	3.47	8.12
2030	6.30	8.30	13.90	5.66	13.19
Nutrient mg/L No Upgrade					
TN	14.88	6.83	6.35	7.00	13.55
TP	0.78	1.28	0.59	0.61	0.53
Nutrient mg/L With Upgrade*					
TN	5.30	5.30	3.04	2.75	3.04
TP	0.67	0.67	0.23	0.28	0.23
Capital Cost for Upgrade					
TN			$3,000,000	*$15,000,000*	$32,000,000
TP			$4,580,000	*$15,000,000*	$18,000,000
Both	$12 - $24 Million	$12 - $24 Million	*$7,580,000*	$30,000,000	
Operation & Maintenance					
TN					Acetic Acid Avg/Yr = $1.04 M
TP				$1,000,000/12 MGD/Year Avg/Yr = $389,755	Alum Avg/Yr = $11,800

* For all POTWs except Durham County, "Nutrient mg/L With Upgrade" values are the effluent limits from which the WLAs were derived. For Durham County, the "Nutrient mg/L With Upgrade" values are the design concentrations for their completed upgrade.