Tampa Bay Estuary Program
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A Compilation of Selected Analyses Supporting the Tampa Bay National Estuary Program's Nitrogen Allocation Workshops

1993-1996

Prepared by
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Preface

This document presents selected analyses and presentations prepared by Apogee Research, Inc. for the Tampa Bay National Estuary Program (TBNEP) between June 1993 and May 1996. This work was conducted under TBNEP Contracts T-93-05 and T-94-07. This compilation does not include cost estimates Apogee developed for selected TBNEP CCMP actions (1995). It also does not include work plans, scopes of work, or selected planning and strategy papers Apogee prepared under the above referenced contract at TBNEP's request.

Materials in Sections 1, 2, and 3 were developed specifically for a Management Conference workshop held in June 1993. The purpose of these materials, consisting of two sets of overheads and a background paper, was to present basic pollutant load reduction allocation concepts.

Materials in Sections 4 through 8 were developed specifically for a Management Conference workshop held in October 1995. Apogee performed several related tasks in conjunction with this workshop:

- Developed a spreadsheet model for Tampa Bay that includes data on current loadings and estimated future loadings by source by segment, where assumptions about future growth in loadings and effectiveness of loading reductions are variables, as are reduction responsibilities and unit load reduction costs;
- Projected nitrogen load reductions for bay segments under base case assumptions;
- Developed unit load reduction cost estimates for nitrogen;
- Developed a trading scenario for each bay segment;
- Calculated potential cost savings under trading assumptions;
- Prepared four cost-effectiveness case studies for CCMP actions; and
- Identified issues associated with implementing nitrogen load reduction allocations with and without a trading option.

The purpose of this compilation is to locate the bulk of Apogee's work for TBNEP in a single document. It is not intended to provide additional analysis beyond that presented in each section. If you have questions about any of the materials presented herein, please call the Tampa Bay National Estuary Program office at 813-893-2765 or Apogee Research, Inc. at 301-652-8444.

WORKSHOP STRUCTURE

OBJECTIVE: Minimize total cost of reducing pollutant loads

CONSTRAINTS: Effectiveness

Equity

Technological Feasibility

Affordability

Support For Other Water Goals

EFFECTIVENESS

Assurance that the final set of pollutant load reductions will, indeed, attain ambient water quality goals. Interesting issues include:

- Whether and how the seven areas affect each other
- How to measure and incorporate background loadings
- How much reserve is needed to account for growth

EQUITY

Assurance that members of the regulated community are being treated fairly in the reductions they must bear. Key issues include:

- Discussion and agreement on what equity means
- How to measure equity for purposes of this process
- Intergenerational and spatial equity

TECHNOLOGICAL FEASIBILITY

Assurance that readily available technologies and BMPs are capable of performing at the levels of removal contemplated. Key issues include:

- Practical versus capital limits
- Robustness and reliability of technologies and BMPs
- Role of O & M

AFFORDABILITY

Assurance that all members of the regulated community are able to pay for the level of reduction contemplated. Defining affordability is harder than it sounds:

- Total cost
- Cost per capita
- Fixed or expandable budgets

WORKSHOP 1: INTRODUCTION

- Introduce Pollutant Load Reduction Allocation Process
- Introduce Current Regulatory Approach
- Introduce Alternative Approaches
- Planning The Workshop Series
- Introduce Organizing Principles
- Seek Leadership on Issues

WORKSHOP 2: EFFICIENCY & EFFECTIVENESS

- Present Refined PLRGs by Bay Segment
- Agreement on Product
- The Objective Function -- Minimize Total Cost
- The Effectiveness Constraint -- How to Define & Quantify It
- Accounting for Reserve Loading & Baseline Loading

WORKSHOP 3: EQUITY & AFFORDABILITY

- The Equity Constraint -- How Do We Define & Measure Equity?

- The Affordability Constraint -- What Does Affordability Mean & How Do We Measure It?

WORKSHOP 4: TECHNOLOGICAL FEASIBILITY

- Technological Feasibility -- What Does It Mean & How Do We Measure It?
- Perhaps Treat this Subject in Sub-Groups by Type of Source?
- Discuss Possible Evaluation of the Dual Problem -- i.e., Switch Constraints with Objective Function
- Potential to Attain Other Water Management Goals -- Water Use Efficiency, Flood Control, etc.

WORKSHOP 5: UNDERSTANDING AND PRESENTING RESULTS

- Present Results of Optimizations -- Alternative Allocations

- Discuss Nature and Form of Presentation of Allocations to Regulatory Agencies

Tampa Bay Watershed Management Workshops

Background Paper: Alternative Wasteload Allocation Bases

1. INTRODUCTION

This paper provides background information on the alternative methods for making wasteload allocations that have been used in practice and proposed in theory. The following material is presented in this paper:

- A summary of the goals of wasteload allocations;
- A series of lessons learned from other states' experiences that provide recommendations for Tampa Bay to consider;
- A summary list of the primary methods that states have used to make wasteload allocations;
- For each method, a list of advantages, disadvantages, and indications from field use; and
- A short list of references for additional information.

The information provided in this background paper is drawn from Apogee's experience with total maximum daily load processes and policy, including wasteload and load allocations. The presentation of the information herein is also based on Mr. William R. McLoud's survey of wasteload allocations for multiple dischargers conducted in 1989 and 1990. This document and other reference documents are cited in Section 5 of this paper.

2. GOALS OF WASTELOAD ALLOCATIONS

Wasteload allocations (WLAs) attempt to find the receiving water body's loading capacity allocation that is equitable to all dischargers while achieving water quality goals. Equity can be subjective and does not have a precise definition. Multiple discharger WLAs require the difficult balancing of various competing interests by ascribing values to those interests and attempting to reconcile them both equitably and efficiently. The greater the number of criteria at work, the more theoretically equitable the outcome but the process can become more time-consuming and cumbersome.

In determining WLA's, an equitable solution might attempt to include as many of the following considerations as practicable:

- Must meet water quality standards at all times;

- Requires the minimum cost individually and collectively;
- Does not impose an undue financial burden on any individual discharger;
- Utilizes the full assimilative capacity of the receiving water body;
- Accounts for and handles equitably the occurrence of new or expanded discharges;
- Includes an appropriate factor of safety;
- Allows the process to be dynamic and inclusive of all parties;
- Equalizes the environmental impact of each source;
- Is understandable to wide segments of interested parties; and
- Has a broad based consensus of approval from the regulated dischargers.

The competing forces in the criteria above illustrate the difficulty in achieving an equitable and effective result. An ideal wasteload allocation method would satisfy all of these criteria. Although this may not be attainable in the real world situations confronted by decision makers in the allocation process, the search for such a method may result in feasible and appropriate solutions to the practical problem they must address.

3. LESSONS FROM WLA EXPERIENCES

Experience throughout the states and at the regional level over the years provide several recommendations for future WLAs to facilitate the process and produce effective allocations. These lessons are presented below.

- Use of a "facilitator" in all WLA negotiations. This carefully chosen individual needs to have no advantage from any eventual solution, to be particularly skilled at communications and diplomacy, and to command the respect through his technical credentials with all parties.
- Solutions that include a comprehensive, integrated management plan, not just single numeric allocations. The management plan might include such factors as controls for both point and nonpoint sources of pollution, structural and non-structural solutions, allowances for periodic review, monitoring provisions, organizational setup for future decision making, financing mechanisms, and deadlines for future actions.
- An early identification of the responsible parties (often the dischargers) for providing data to be used in the process. Additionally, when cost analyses are

performed, require the dischargers to put together the financial information, and to provide the analysis.

- An allowance for seasonal allocations.

- Organize the WLA negotiations by establishing a local "advisory group", that is, a group where all key interests are represented.

- Require all point source and nonpoint source agencies to submit program plans as an initial step in the process.

- Recognize that WLA determinations are an iterative process. Condition the participants that initial iterations "test the water", and that one should not overreact to preliminary conclusions.

- WLA negotiations should include local jurisdictions.

- Require a plan of study early in the process that is approved by all parties.

- Possibly incorporate the availability of grants or loans as part of the decision making process.

- When modeling, insure that 1) regulators approve of the model; and 2) the model produces results that can be directly converted to effluent limitations.

- Allow for solutions that include sequencing of actions.

- Clarify with participants that if a negotiated settlement cannot be reached, the regulatory agency will make the decision.

- Possible use of different methodologies for municipalities and industries.

- Use of different methodologies for oxygen demanding substances versus toxics or others.

4. ALTERNATIVE WLA METHODOLOGIES

Approximately eight to ten major approaches to WLA in exist in practice and theory; some of these have several variations. These approaches and some variations are listed below. The most commonly used methods are described in the tables that follow.

- Equal Effluent Concentration
- Equal Percent Removal
- Maximum Assimilative Capacity
- Equal Total Mass Discharger per Day
- Cost Based Methods
- Proportional Approach Methods
- Production Based Methods
- Tradeable Discharge Permits
- Negotiated Load Allocations and Trading Bubbles
- Hybrid - Varying Criteria Per Source
- Inclusion of Maximum and Minimum WLAs In Modeling
- Controlled Release Strategies: At Low Flows, Store Discharge
- Relating Effluent Limitations To Flow In The Receiving Stream
- River Flow Augmentation From Upstream Reservoir Releases
- Seasonal WLAs

EQUAL EFFLUENT CONCENTRATION

DESCRIPTION

- Each discharger is assigned the same effluent limitation by concentration (e.g., mg/l). Loading differs according to flow.

USE

- 18 states, including Florida, have used this method. It is the most widely used, according to a survey of the states.

ADVANTAGES

- Concentration limits are easily understood by dischargers.
- Identical limits for all dischargers appears equitable.
- Concentration-based limit allows for variations and increases in flow.
- Can be easily incorporated into discharge permits.

DISADVANTAGES

- Limit on concentration does not prevent increased pollutant loading as flows increase.
- Concentration-based limits are generally not directly related to control costs.
- Concentration limits can be unfavorable to small dischargers who must install additional treatment capabilities although their relative contribution to total pollutant loading is smaller.

FIELD INDICATIONS

- Adaptable to both municipalities and industries.

EQUAL PERCENT REMOVAL

DESCRIPTION

- Each discharger is assigned the same effluent limitation by percent removal of parameters (e.g., 85%). Loading differs according to flow. Variations include a method where total assimilative capacity is divided among dischargers to require a "equal effort" from all dischargers.

USE

- 6 states have used this method.

ADVANTAGES

- Method is readily understandable by dischargers and regulators.

- Equal percent removal requirement appears equitable.

- Changing water quality variables do not alter allocations.

DISADVANTAGES

- Pollutant loading may increase as flows increase.

- Method does not directly relate effluent limits to receiving water assimilative capacity.

- Treatment costs resulting from this method may not be proportional to pollution contribution (potentially inefficient).

- Equal percent removal requirements may not be readily adaptable to discharge permit requirements.

FIELD INDICATIONS

- More favorable to larger dischargers, less favorable to smaller dischargers, where smaller dischargers incur relatively higher treatment costs.

MAXIMUM ASSIMILATIVE CAPACITY

DESCRIPTION

- Effluent concentration for each discharger is a function of water quality standards, assimilative of the receiving water at the point of discharge, background concentration, and effluent design flow. Loading differs according to assimilative capacity at discharge location and according to flow. Variation: apportion 90 percent of receiving water assimilative capacity to dischargers to build in a safety factor and/or reserve capacity.

USE

- 10 states have used this method.

ADVANTAGES

- Method established clear link between standard and water quality science, taking advantage of the waterbody's assimilative capacity.
- Gives dischargers most flexible limitations local water quality conditions allow.
- Dischargers generally feel they are getting a fair deal, even though allocations may be unequal.

DISADVANTAGES

- Upstream dischargers may receive larger relative allocations than downstream dischargers, creating appearances of unequal treatment.
- This method may not be flexible enough to address changing conditions in the receiving water if permits cannot be reopened easily.

FIELD INDICATIONS

- Discharger location and background water quality conditions are major factors; upstream dischargers receive a greater benefit from receiving waters' assimilative capacity.

EQUAL TOTAL MASS DISCHARGE PER DAY

DESCRIPTION

- Each discharger is assigned the same load allowance per unit of time (e.g., 15 kg/day). Loading does not differ according to flow.

USE

- Two states have used this method.

ADVANTAGES

- Method is clear and easily understood.
- Allocation appears equitable as each discharger allowed equal pollutant loads.
- Load allocations are easily incorporated into discharge permits.
- Limits based on mass give flexibility to dischargers to determine whether to meet limits by varying flow, concentration, or treatment method (potential for efficiency good)

DISADVANTAGES

- Mass-based allocation may impose unequal treatment costs and larger flows may require higher expenditures.
- As growth leads to flow increases flows, treatment levels must also increase to meet mass-based limits.

FIELD INDICATIONS

- Method is generally more favorable to smaller dischargers, and less favorable to larger dischargers, because larger flows require lower concentrations to meet limit. As a result, larger discharger must treat to higher levels.
- Adaptable to both municipalities and industries.
- Pollution reduction requirements are proportional to discharger's relative pollutant contribution -- increasing equity of allocation.

COST BASED METHODS

DESCRIPTION

- Each discharger is assigned the effluent limitation according to some cost-based criteria. Variations include: minimum total cost; percent removal proportional to community income measure (ability to pay); equal total cost per pound of pollutant removed; equal incremental cost per pound of pollutant removed; equal cost per discharger per unit of flow; and equal marginal cost.

USE

- 6 states have used these methods.

ADVANTAGES

- Methods attempts to minimize adverse financial impacts by equalizing financial burden per production unit across dischargers.

- Method can be used to maximize efficiency by basing control requirements on least cost criteria.

- Where cost and financial WLA criteria are important, this method is useful because, unlike many of the other methods, it directly addresses financial issues.

DISADVANTAGES

- Allocating wasteloads on the basis of cost, or some proxy thereof, can be controversial, among dischargers and among the environmental community.

- Necessary cost information may not be available over the continuum of pollution removal by mass or concentration, for both public and private dischargers.

- Industry cost information is generally considered proprietary and may be difficult to obtain.

FIELD INDICATIONS

- Cost-based allocations focus directly on equity and fairness by equalizing impact according to some financial measure.

- Cost information has been most accepted when it comes from a neutral source, e.g., EPA.

- When this method leads to allocations that minimize financial impacts, dischargers acceptance of the allocation is greatly enhanced.

PROPORTIONAL APPROACH METHODS

DESCRIPTION

- Each discharger is assigned (1) a percent removal requirement that is proportional to some input (or raw) load of pollutant(s); or (2) an effluent concentration that is inversely proportional to raw loading.

USE

- 3 states have used these methods.

ADVANTAGES

- Approach is widely applicable and equitably applies to different types of dischargers.
- Basing treatment requirements on use of polluting inputs is consistent with the principal that larger contributors should be required to make larger reductions.
- Approaches are easily understandable by regulated and regulator.

DISADVANTAGES

- Relating WLAs to percent input removals may not be easily adaptable to discharge permits.
- It is not clear how this approach relates to the TMDL calculation.
- It is not clear if this approach distributes the treatment cost burden in an equitable manner.
- Effluent limits resulting from this approach may vary across dischargers and therefor appear inequitable.

FIELD INDICATIONS

- Proportional allocation approaches may generally be perceived as fair: the method is based on the logic that treatment levels and discharge requirements should be proportional to the relative environmental impact of the amount of polluting inputs used -- those using more polluting inputs should face a higher burden to clean up.

PRODUCTION BASED METHODS

DESCRIPTION

- Each discharger is assigned pollutant limits based on some unit of production or proxy; variations include: equal treatment cost per unit of production; equal mass discharged per unit of raw material; and equal mass discharged per unit of production.

USE

- 1 state has used these methods.

ADVANTAGES

- Relates pollution control to productivity so that small and new industries have a lower cost burden.
- All industries are treated the same.

DISADVANTAGES

- It may be difficult to determine equivalent units of production for varying industries.
- Limits based on production units or proxies creates a disincentive to increasing production.
- Calculations to arrive at effluent limits are independent of assimilative capacity.
- This method has not been widely applied, and as a result little practical experience with the approach exists.

FIELD INDICATIONS

- Production-based methods are applicable only to industries.
- As usage of raw materials increase and/or production increases, treatment levels must also increase.

TRADEABLE DISCHARGE PERMITS

DESCRIPTION

- Under a tradeable permit system, TMDLs are established and the regulatory agency issues a fixed number of permits. These permits may be auctioned to the highest bidder, or sell for a fixed price. Under this system, dischargers may buy and sell permits, sometimes on an open market, and sometimes at set times.

USE

- The Fox River in Wisconsin is perhaps the only place where this type of system was attempted. Only one trade has occurred since the inception of the program in 1981. Most attribute this low success rate to regulations that create disincentives for trading.

ADVANTAGES

- Tradeable permits, in theory, maximize efficiency and promote cost effectiveness.
- A system in which permits may be traded involves dischargers in control efforts.
- Once the trading system is established, regulatory agency administrative costs are expected to be less than for traditional command-control systems.

DISADVANTAGES

- A true system of tradeable effluent permits is unproven in field.
- The system creates an appearance of "selling" a "right" to pollute that is very uncomfortable for some regulators and the majority of the environmental community.
- Permits will go to those that can afford them -- as a result, economically depressed communities may be at a significant financial disadvantage to participate in trading.
- Tradeable permit systems can require detailed and complex accounting, increasing transaction and administrative costs to regulators and participants.

FIELD INDICATIONS

- In theory, dischargers with highest abatement costs will purchase the majority of permits, supporting the goal of meeting water quality standards at least cost.
- Similar permit trading systems have a successful track record in air quality control programs.

NEGOTIATED LOAD ALLOCATIONS AND TRADING BUBBLES

DESCRIPTION

- Under a bubble system, the regulatory agency establishes the TMDL for the waterbody. Dischargers then decide among themselves, sometimes with assistance and/or oversite by the regulatory agency, how to apportion the total allowable load. If the group of dischargers, or one discharger is unable to meet their allocation, they may "trade" for nonpoint source reductions buy funding urban or agricultural best management practices.

USE

- This approach is currently in use at the Dillon Reservoir in Colorado and Tar Pamlico River in North Carolina. This approach is also being considered for a number of other waterbodies, including: Cherry Creek Reservoir and Chatfield Basin in Colorado; and the Chehalis River Basin in Washington state.

ADVANTAGES

- This method is an interactive process that provides meaningful opportunity for cooperation between regulators and dischargers, and among dischargers.

- This method provides dischargers with a process to come up with allocations themselves and gives dischargers significant flexibility in allocating loads.

- Allocation by negotiation offers a path to least cost solutions without divulging cost information.

- When trading occurs, the arrangement increases nonpoint source controls over level without trading.

DISADVANTAGES

- Practical experience with this approach is limited and many results from existing programs may be state- or waterbody-specific.

- Point/nonpoint source trading may result in local water quality problems.

- Regulatory authority often split between point and nonpoint sources, making it difficult to establish clear and simple regulatory authority over trading program.

- Uncertainty about nonpoint source control effectiveness makes it difficult to establish trading ratios (number of pounds of nonpoint source pollutant that must be controlled to receive credit for one pound of point source control).

FIELD INDICATIONS

- Programs at Dillon Reservoir and Tar Pamlico River are generally considered successful.
- Accessing funding to do nonpoint source control studies has been difficult.
- EPA verbally supports pilot projects, funding support has been limited.

5. REFERENCES

Apogee Research, Inc. *Incentive Analysis for Clean Water Act Reauthorization: Point Source/Nonpoint Source Trading for Nutrient Discharge Reduction.* Prepared for EPA's Office of Water. April 1992.

Brandes, R., et al., "Technical Support Document for Water Quality-based Toxics Control." EPA 440/4-85-032, U.S. EPA, Washington, D.C. (1985).

Chadderton, R.A., *et al.*, "Analysis of Waste Load Allocation Procedures." *Water Resour. Bull.*, **17**, 760 (1981).

Chadderton, R.A., and Kropp, I.S., "An Evaluation of Eight Wasteload Allocation Methods." *Water Resour. Bull.*, **21**, 833 (1985).

Driscoll, E.D., *et al.*, "Technical Guidance Manual for Performing Waste Load Allocations." Book II, Chapt. 1, EPA 440/4-84-020, U.S. EPA, Washington, D.C. (1983).

EPA. 1985 "Guidance for State Water Monitoring and Wasteload Allocation Programs." EPA 440/4-85-031, U.S. EPA, Washington, D.C.

EPA. 1986. "Guidance on EPA's Review and Approval Procedure for State Submitted TMDLs/WLAs. Washington, D.C.

EPA. 1987 "Permit Writer's Guide to Water Quality-Based Permitting for Toxic Pollutants." EPA 440/4-85-031, U.S. EPA, Washington, D.C.

EPA. 1987 "National Water Quality Inventory: 1986 Report to Congress." EPA 440/4-87-008, U.S. EPA, Washington, D.C.

EPA. 1991. "Guidance for Water Quality-Based Decisions: The TMDL Process. EPA Report 440/4-91-001. Washington, D.C.

GKY and Associates, Inc. 1984. "Technical Guidance Manual for Performing Wasteload Allocations, Book IX - Innovative Wasteload Allocations. EPA Draft Report. Washington, D.C.

McLoud, William R. *Wasteload Allocation Methodologies for Multiple Dischargers*. A Masters Degree Report submitted to the University of Colorado, at Denver. 1990.

WHAT ARE POLLUTANT LOAD REDUCTION ALLOCATIONS?

A pollutant load reduction (PLR) allocation is that portion of the total pollutant load reduction goal that a source must meet. Reduction allocations may be expressed as:

- Allowances -- e.g., lbs/day, mg/l
- Loading Reduction Requirements -- e.g., percent removal rates, lbs/day, mg/l
- Required Type or Level of Treatment
- Required Type or Scope of BMPs

PLR ALLOCATION GOALS

- Meet Water Quality Standards
- Minimize Costs
- Avoid Unmanageable Financial Burdens
- Consume Assimilative Capacity
- Equitably Account for New/Expanded Sources
- Include Appropriate Safety Factor(s)
- Make Allocation Process Dynamic
- Include All Stakeholders in Process
- Equalize Environmental Impacts Across Sources
- Clarify Process and Allocations
- Enable Sources to Approve Process and Allocations

ALTERNATIVE ALLOCATION BASES

- Equal Effluent Concentration ✓
- Equal Percent Removal ✓
- Maximum Assimilative Capacity ✓
- Equal Total Mass Loaded per Day ✓
- Proportional Approach Methods ✓
- Negotiated Allocations/Trading Bubbles ✓
- Seasonal PLAs
- Cost Based Methods
- Hybrids - Varying Criteria by Source

EQUAL EFFLUENT CONCENTRATION

- *Sources assigned same effluent limit by concentration (e.g., mg/l) -- loading differs by flow*
- *Most widely used method (18 states, including Florida)*

⊕ Limits are easy to understand

⊕ Identical limits for all appears equitable

⊕ Allows for variations and increases in flow

⊕ Easily incorporated into permits

⊖ Increased flows lead to increased loadings

⊖ Not directly related to control costs

⊖ Can be unfavorable to small dischargers

EQUAL EFFLUENT CONCENTRATION: JORDAN RIVER, UTAH

- River flows from Utah Lake to Great Salt Lake through urban and agricultural areas
- BOD and ammonia problems resulted in advanced treatment requirements
- Point sources include 2 regional WWTPs and numerous industrial dischargers
- Municipalities, industries, and rural constituencies participated in regional studies of water quality problems
- Compromise solution: all meet same discharge requirements, regardless of cost
- Regional plants and industrial dischargers subjected to same effluent limits for BOD, SS, NH_3-N, DO, and fecal coliforms

EQUAL PERCENT REMOVAL

- *Sources assigned same effluent limit by percent removal of parameters (e.g., 85%)*
- *Variation: total assimilative capacity divided among sources to require "equal effort" from all*

⊕ Appears equitable

⊕ Changing water quality variables don't alter allocations

⊖ Loading may increase as flows increase

⊖ Does not directly relate effluent limits to receiving water assimilative capacity

⊖ Treatment costs may not be proportional to pollution contribution (potentially inefficient)

⊖ May not be readily adaptable in permits

EQUAL PERCENT REMOVAL: SPOKANE RIVER & LONG LAKE

- Water quality problem: Phosphorus
- Phosphorus TMDL: 259 kgs (571 lbs) /day
- Point sources: six municipalities, and three industries
- Dischargers allowed to allocate TMDL
- Group proposed and regulators accepted:
  - 85% removal requirement (phased in)
  - Dischargers taking immediate action recover some of their costs from others
  - $$$ capital outlays avoided until necessary
  - Source with greatest load must treat first
  - Sources already at 85% receive credits
  - Industries treated as one discharger
  - No new point source dischargers

MAXIMUM ASSIMILATIVE CAPACITY

- *Limits a function of water quality standards, assimilative capacity at point of loading, background concentration, and design flow*
- *Variation: 90% capacity assigned, 10% reserved*

⊕ Clear link between allocations and water quality science

⊕ Takes advantage of assimilative capacity

⊕ Results in most flexible limitations local water quality conditions allow

⊕ Sources often see limits as fair, even if different

⊖ Sources upstream may receive larger relative allocations than those downstream -- creating appearances of unequal treatment even though basis for allocation the same

⊖ May not be flexible enough to address changing receiving water conditions if permits can't be reopened easily

MAXIMUM ASSIMILATIVE CAPACITY: TUALATIN RIVER, OREGON

- River slow moving, problems included low DO, caused by ammonia and phosphorus-induced algal blooms
- Two TMDLs: phosphorus and ammonia
- Sources include 6 regional WWTPs -- they exceeded secondary treatment standards
- Objective of TMDL: maximize assimilative capacity throughout river basin
- Oregon DEQ established TMDLs that relate allowable loads (pounds/day) for each plant to flow
- DEQ assigned loads according to segment or river mile
- Control regulation includes compliance schedule
- DEQ solicited input from dischargers at public forums held throughout process

NEGOTIATED ALLOCATIONS & TRADING

- *Sources decide how to apportion the total load*
- *Sources may "trade" for reductions by funding point source improvements or BMPs*

⊕ Process interactive, flexible, and provides opportunities for cooperation

⊕ Offers a path to least cost solutions without divulging sensitive cost information

⊕ Trading provides funding for nonpoint source controls over level without trading

⊖ Practical experience limited, results may be case-specific

⊖ Local water quality problems may develop

⊖ Regulatory authority over trades may be unclear

⊖ Funding for nonpoint source control studies limited in past

⊖ EPA verbally supports pilot projects, funding support has been limited

EXAMPLES OF TRADING PROGRAMS

DILLON RESERVOIR, COLORADO

- Phosphorus sources: 4 WWTPs and urban development
- Each WWTP assigned allocation based on 1984 loads
- WWTPs contract directly for BMPs
- Program developed in cooperative process
- Program now focuses on *new* NPS funding BMPs for existing NPS

TAR PAMLICO RIVER, NORTH CAROLINA

- Phosphorus sources: 16 WWTPs and agriculture
- 200,000 kgs/yr reduction goal over 5 yrs
- PS contribute $ to a fund for NPS BMPs
- Arrangement proposed by point sources and EDF
- PS allocated reduction goal among themselves
- Reduction goal related to water quality standards

CHEHALIS RIVER, WASHINGTON (planned)

- TMDL for DO
- Sources: 6 WWTPs, stormwater and industrial discharges, land applications, dairy, other ag
- PS may fund BMPs for credit *and/or* some NPS may fund BMPs for other NPS for credit (too soon to tell which)
- NPS allocations made to tributaries

EQUAL TOTAL MASS PER DAY

- *Sources assigned the same load allowance per unit of time (e.g., 15 kg/day)*
- *Loading does not differ according to flow*
- *May be more favorable to smaller dischargers*

⊕ Resulting allocations appear equitable as each discharger allowed equal pollutant loads

⊕ Load allocations easily incorporated into permits

⊕ Gives dischargers flexibility to determine whether to meet limits by varying flow, concentration, or treatment method/BMP (good potential for efficiency)

⊕ Reduction requirements proportional to relative pollutant contribution -- allocations equitable

⊖ May impose unequal treatment/control costs -- larger flows, higher expenditures

⊖ With growth, treatment levels/scope of controls must increase to meet mass-based limits

PROPORTIONAL APPROACHES

- *Sources assigned:*

  (a) *A percent removal requirement that is proportional to some input (or raw) load of pollutant(s); or*

  (b) *A pollutant concentration limit that is inversely proportional to raw loading.*

⊕ Similarly applicable to a variety of sources

⊕ Consistent with principal that larger contributors should be required to make larger reductions

⊖ Relating allocations to percent input removals may not be easily adaptable in permits

⊖ Relation to TMDL calculation unclear

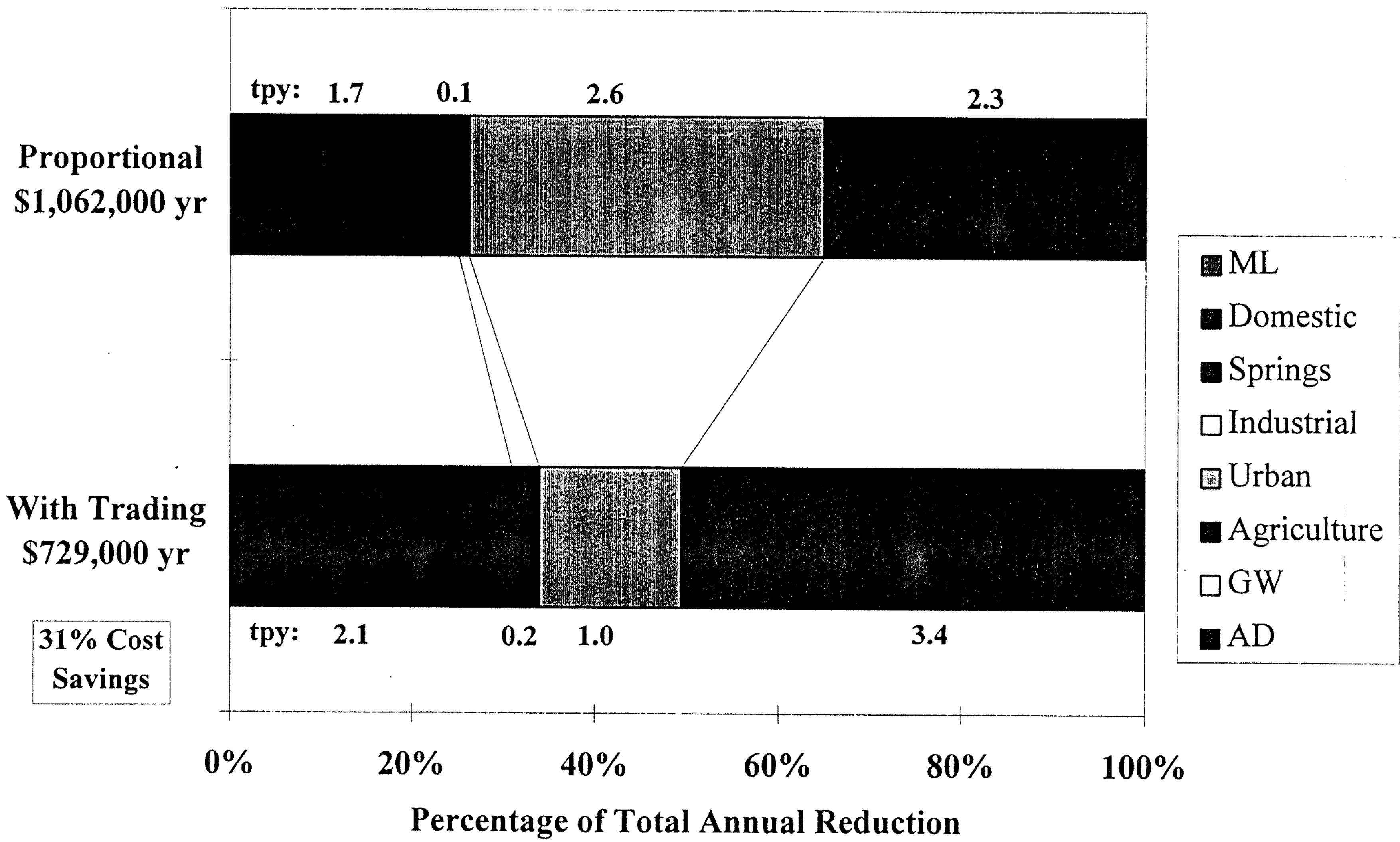
⊖ Equity of distribution of treatment/BMP costs unclear

⊖ Limits may vary across sources and appear inequitable

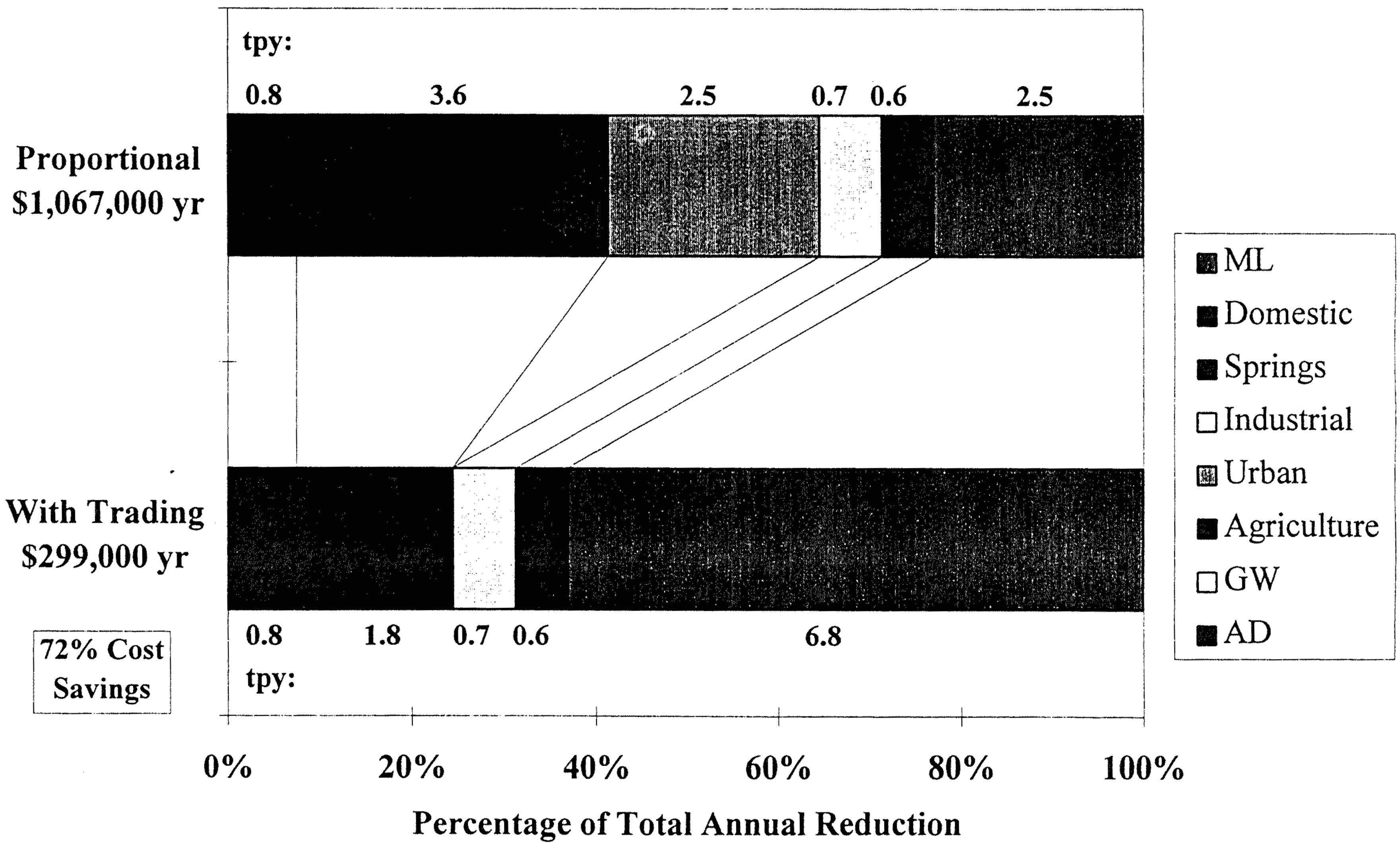
LESSONS FROM PAST EXPERIENCES

- Use a Facilitator
- Establish an Advisory Group
- DER Will Make Allocations if Group Can't
- Point & Nonpoint Program Plans Submitted
- Identify Parties With Cost and Loading Data
- Group Develops and Approves Plan of Study
- Iterative Process, Early Results May Change
- Allocations Part of Broader Management Plan
- Geographically Target BMPs
- Allow Seasonal Allocations When Appropriate
- Sequence Actions in Solutions
- Models Approved by Regulators, Results Directly Convert To Loading Limits (except for BMPs)

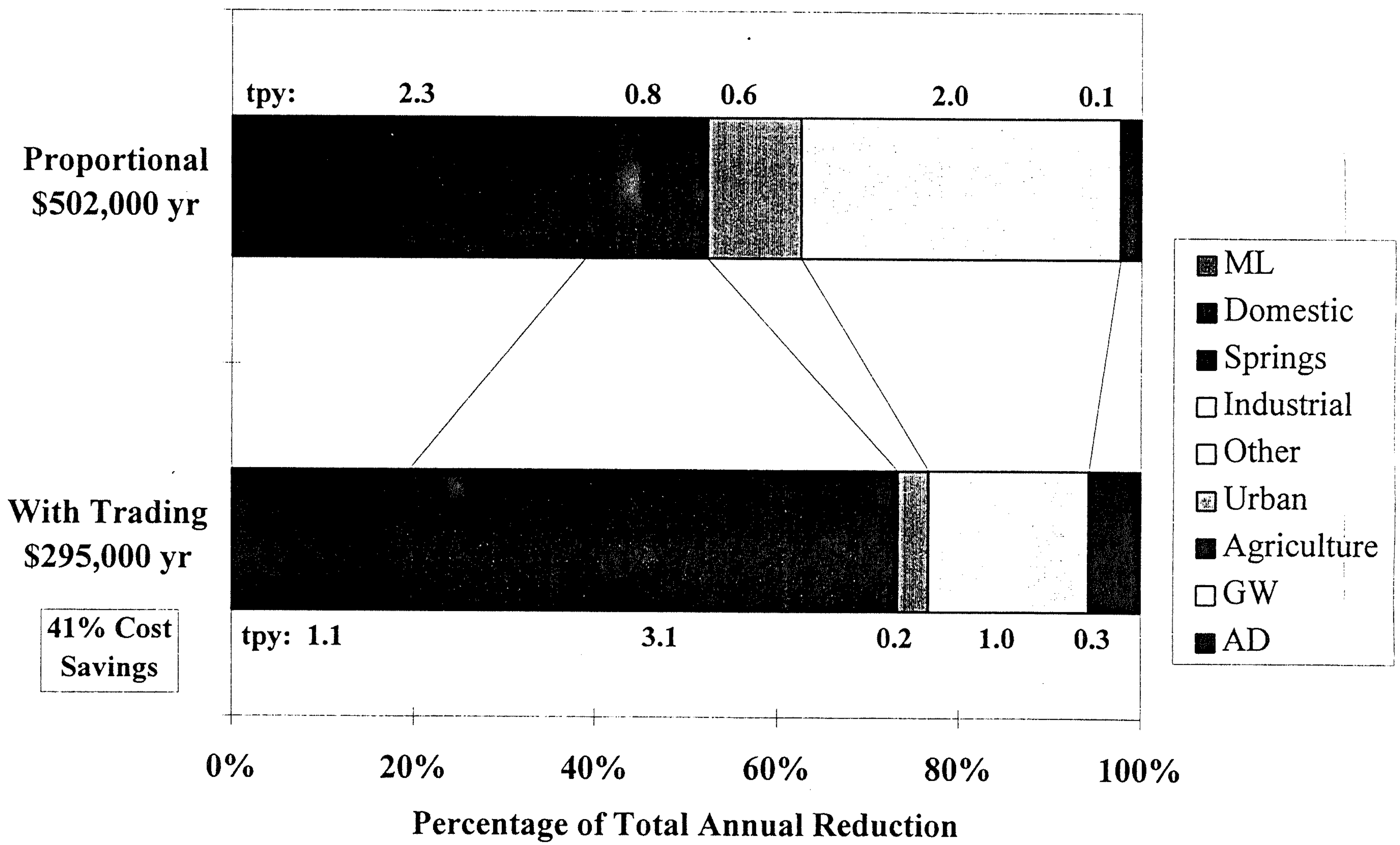
Comparative Scenarios for Old Tampa Bay (Segment 1)



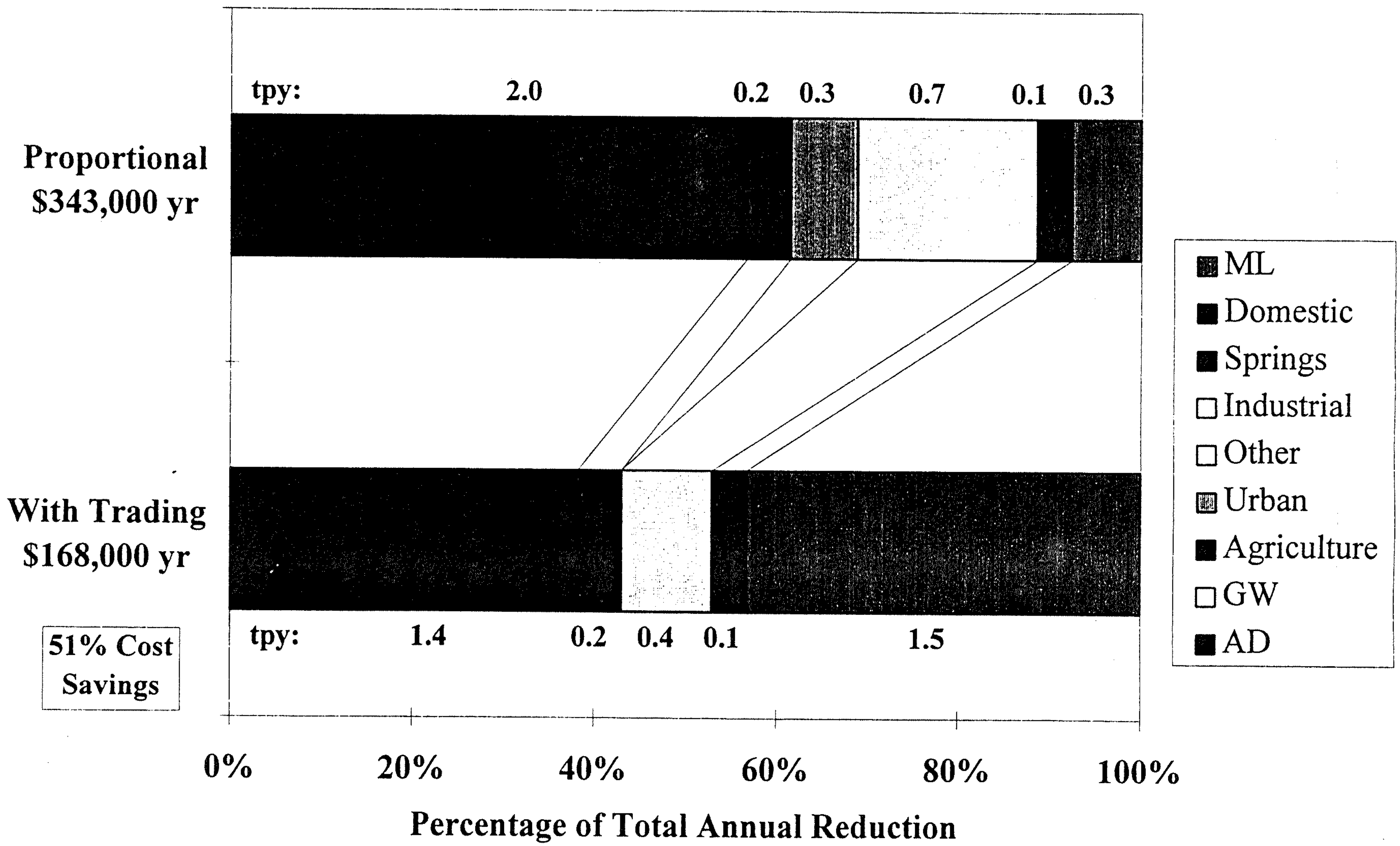
Comparative Scenarios for Hillsborough Bay (Segment 2)



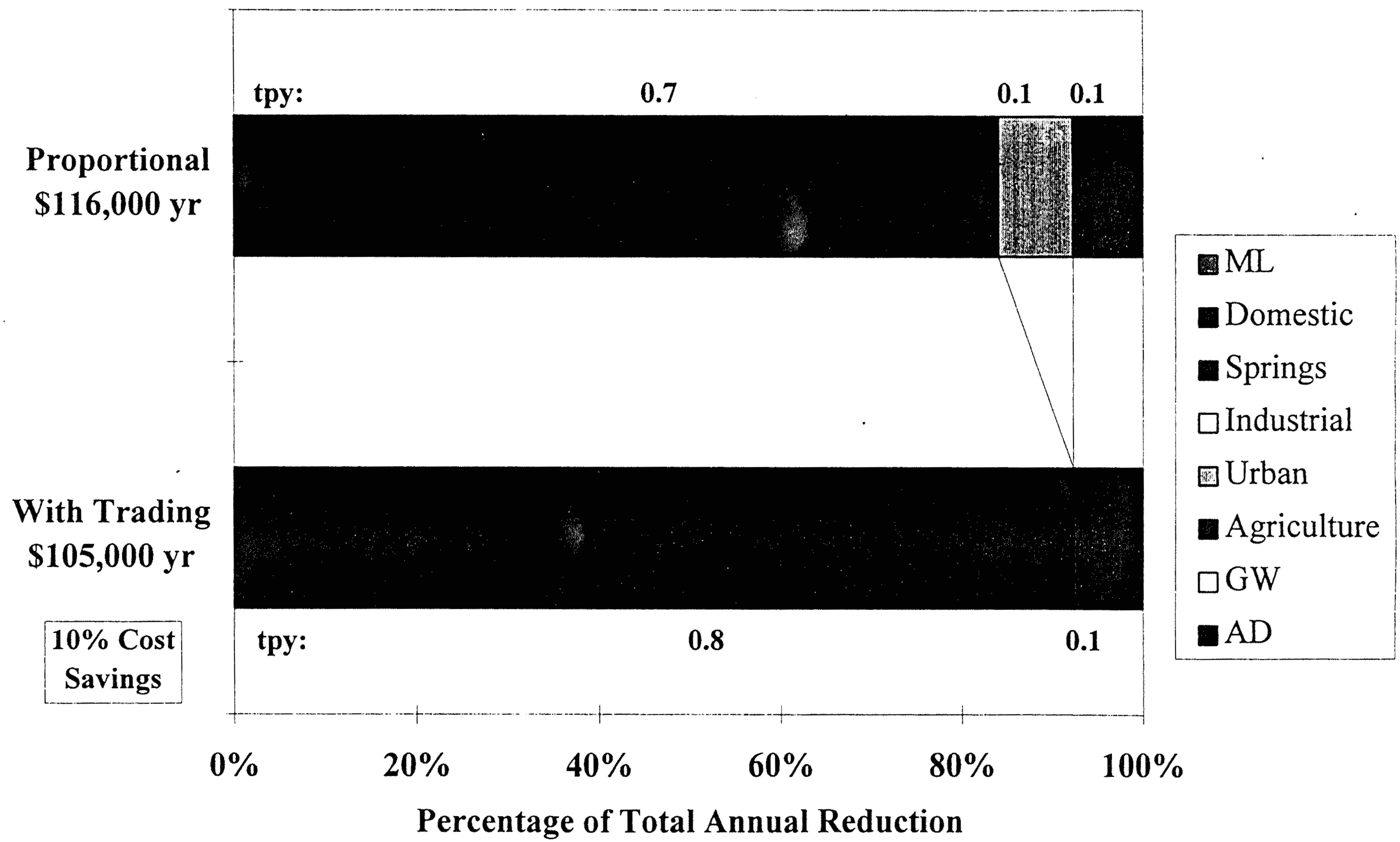
Comparative Scenarios for Middle Tampa Bay (Segment 3)

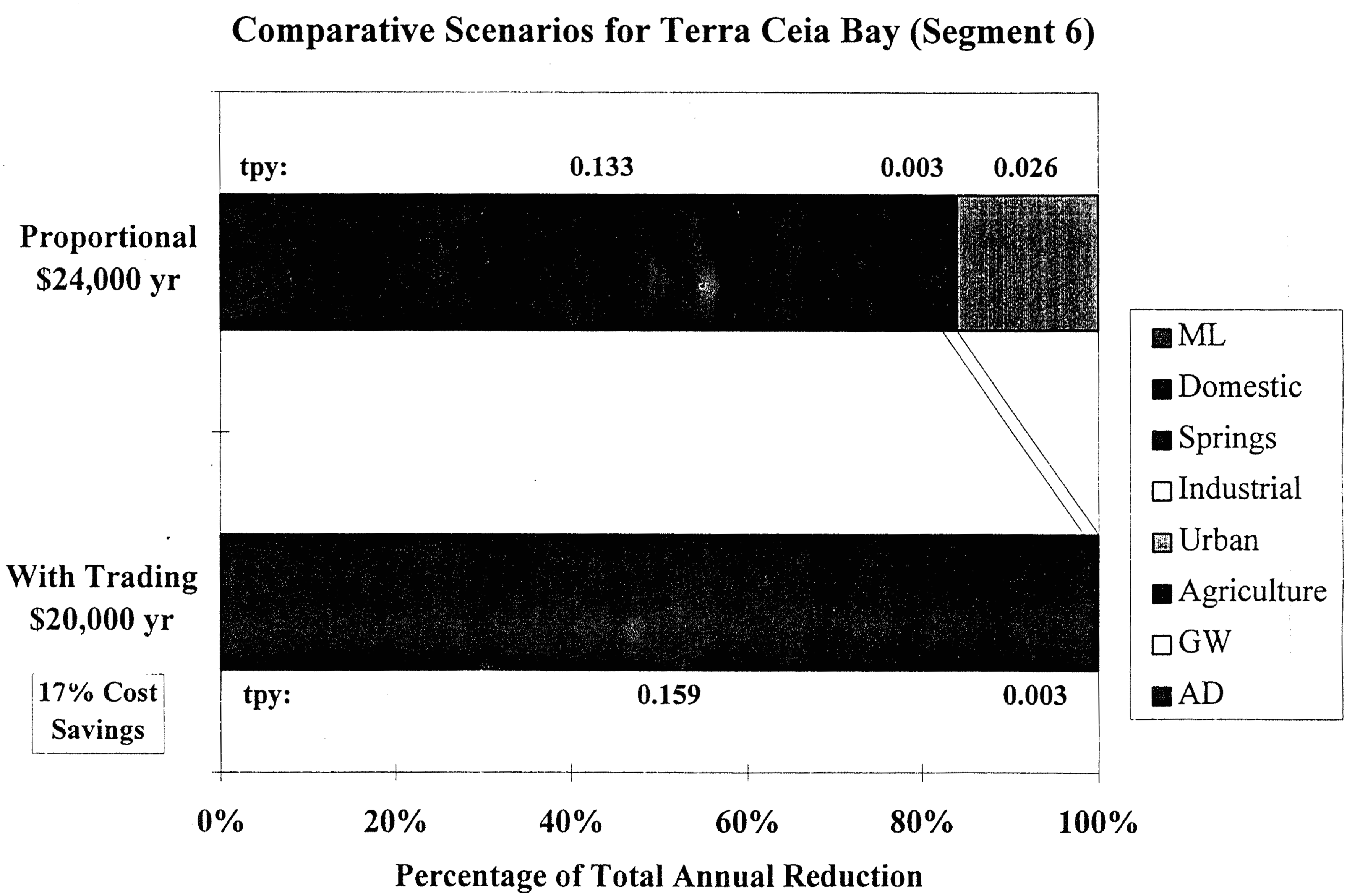


Comparative Scenarios for Lower Tampa Bay (Segment 4)

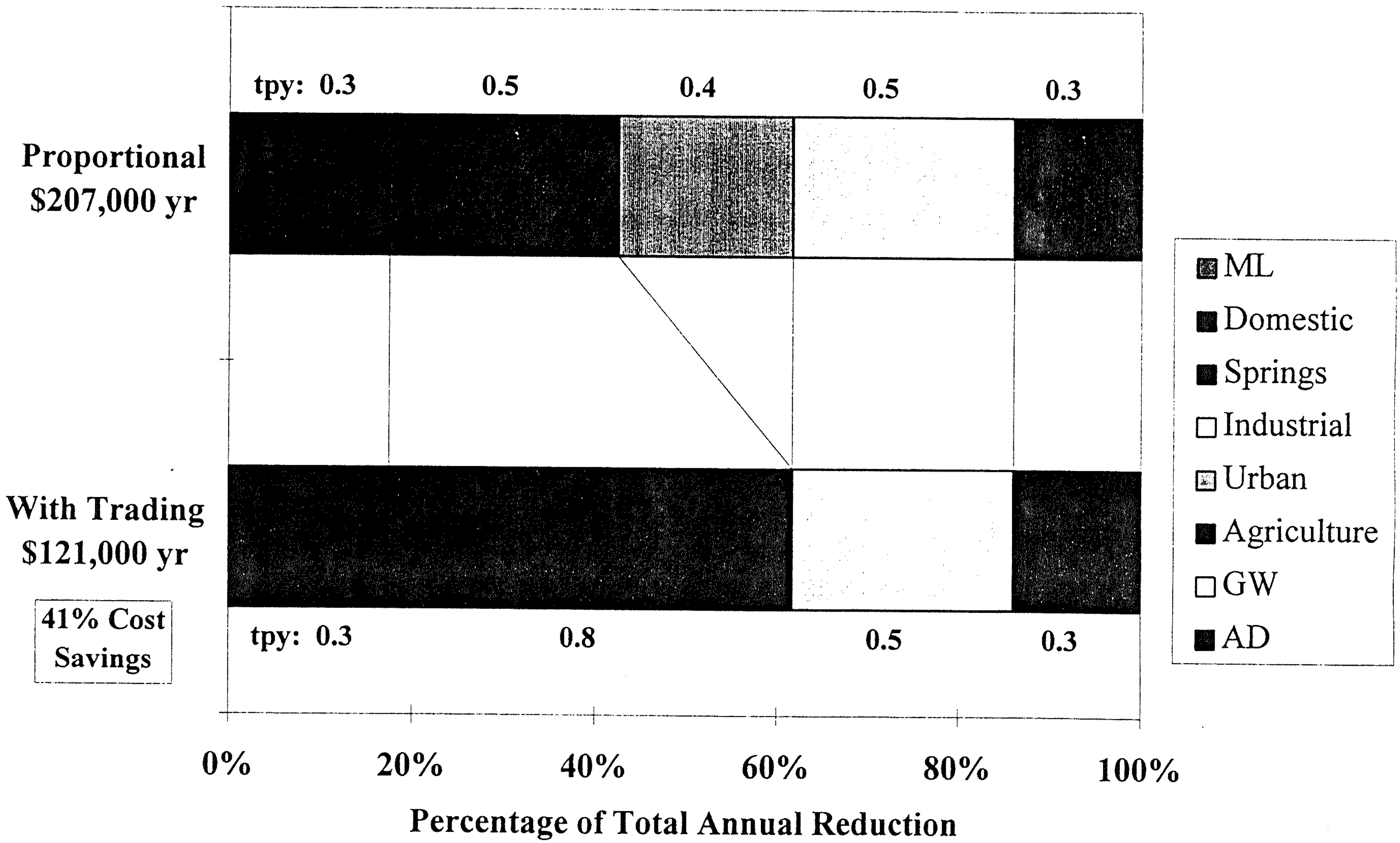


Comparative Scenarios for Boca Ciega Bay (Segment 5)

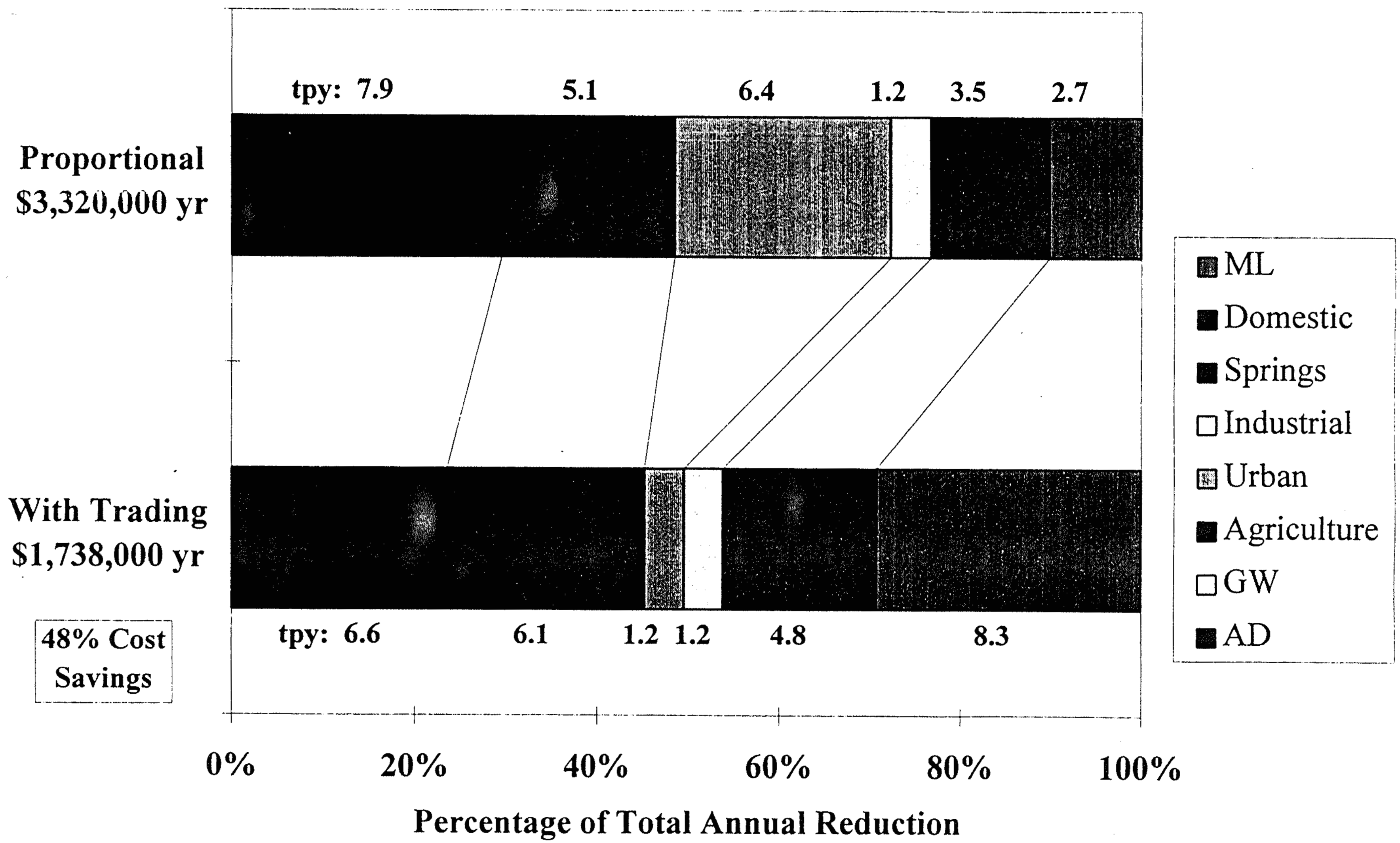



Comparative Scenarios for Terra Ceia Bay (Segment 6)
Proportional
$24,000 yr
tpy:
0.133
0.003
0.026
With Trading
$20,000 yr
17% Cost Savings
tpy:
0.159
0.003
ML
Domestic
Springs
Industrial
Urban
Agriculture
GW
AD
0%
20%
40%
60%
80%
100%
Percentage of Total Annual Reduction

Comparative Scenarios for Manatee River (Segment 7)



Comparative Scenarios, Totaled across All Segments



Cost Estimate Assumptions

Atmospheric Deposition: $126,000/N tpy *(Average of industry range for Selective Non-Catalytic and Catalytic Reduction and 0.01 air-open water transfer)*

Agriculture: $50,000/N tpy *(Chesapeake Bay Program, May 1995, average of selected agricultural BMPs)*

Urban: $284,000/N tpy *(Chesapeake Bay Program, May 1995)*

Industrial: $50,000/N tpy *(Ballpark placeholder, Apogee)*

Springs: $120,000/N tpy *(Case study to sewer portion of Allens Creek Area, Apogee, October 1995)*

Domestic: $50,000/N tpy *(Average based on 12 reuse projects, TBNEP)*

Material Loss: $6,000/N tpy *(Based on Port Sutton Terminal experience reducing spillage and stormwater nutrient loads, Apogee, October 1995)*

Trading Assumptions

Scenarios developed for each segment based on comparative economics and reduction capacity using several rules of thumb:

- Urban sources buy nitrogen reductions from material losses, agriculture, domestic sources, and sometimes atmospheric deposition (in that order where possible)
- Trading does not reduce loading by more than half for any "selling" source category (cumulative, 1995 to 2010)
- Special trading ratios for atmospheric deposition
- Industrial, springs, and groundwater sources not involved

Trading Scenarios Summary

1. Old Tampa Bay: *Urban ⇦ Ag, Air, Domestic*
2. Hillsborough Bay: *Urban ⇦ Material Loss*
   Air ⇦ Material Loss
3. Middle Tampa Bay: *Urban ⇦ Ag, Domestic*
   Air ⇦ Ag
4. Lower Tampa Bay: *Urban ⇦ Ag, Domestic*
   Air ⇦ Material Loss
5. Boca Ciega Bay: *Urban ⇦ Air*
6. Terra Ceia Bay: *Urban ⇦ Air*
7. Manatee River: *Urban ⇦ Ag*

SEGMENT: OLD TAMPA BAY (1)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	499
Loading Target in 2010	499

Growth in Discharges	
Overall Growth	20%
Light % Red.	0%
Total Offset	20%

BASE CASE

Source Category	AD	GW	NONPOINT SOURCES		POINT SOURCES			ML	
Source	AD	GW	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Projected Loading (tpy) in 2010	275.0	0.0	2.8	188.3	0.0	0.0	42.0	0.0	598
Current Loading (tpy)	250.0	0.0	1.7	149.6	0.0	0.0	77.0	0.0	499
Percent of Total Loading	50%	0%	0%	30%	0%	0%	15%	0%	100%
Percent of Loading by Category	100%	100%	1%	87%	0%	0%	100%	100%	
Total Required Reduction in 2010 (ton	25	0	1.09	38.63	0	0	35	0	99
Average Annual Reduction (tons)	1.7	0.0	0.1	2.6	0.0	0.0	2.3	0.0	11.3
Growth (1995-2010)/Required Offset	10%	0%	63%	26%	0%	0%	55%	0%	20%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
AD	% to reduce	100%	0%	0%	15%	0%	0%	0%	0%	115%
	tpy reduced	1.7	0.0	0.0	0.4	0.0	0.0	0.0	0.0	2.1
GW	% to reduce	0%	100%							100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce	0%		100%	5%					105%
	tpy reduced	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2
Urban	% to reduce	0%			40%					40%
	tpy reduced	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0
Other	% to reduce	0%								100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6
Industrial	% to reduce	0%				100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs	% to reduce	0%					100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce	0%			40%			100%		140%
	tpy reduced	0.0	0.0	0.0	1.0	0.0	0.0	2.3	0.0	3.4
ML	% to reduce	0%							100%	100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COMPARISON OF RESULTS

	AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
Proportional Case									
Annual Reduction (tpy)	1.7	0.0	0.1	2.6	0.0	0.0	2.3	0.0	11.3
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target	$210,000	$0	$3,633	$731,395	$0	$0	$116,667	$0	$1,061,695
Total Cost to Target	$3,150,000	$0	$54,500	$10,970,920	$0	$0	$1,750,000	$0	$15,925,420
Trading Case									
With Trading Total Reduction from S $729,000 yr	2.1	0.0	0.2	1.0	0.0	0.0	3.4	0.0	11.3
Proportional Annual Reduction Res $1,062,000 yr	1.7	0.0	0.1	2.6	0.0	0.0	2.3	0.0	11.3
Cost per Ton Reduced	$126,000	$0	$50,000	$155,000	$50,000	$120,000	$50,000	$6,000	31%
Ann. Cost to Target	$210,000	$0	$3,633	$399,177	$0	$0	$116,667	$0	$729,477
Total Cost to Target	$3,150,000	$0	$54,500	$5,987,650	$0	$0	$1,750,000	$0	$10,942,150

SEGMENT: HILLSBOROUGH BAY (2)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	1855
Loading Target in 2010	1855

Growth in Discharges	
Overall Growth	16%
Light % Red.	0%
Total Offset	16%

BASE CASE

Source Category	*AD*	*GW*	*NONPOINT SOURCES*		*POINT SOURCES*			*ML*	
Source	*AD*	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Projected Loading (tpy) in 2010	133.0	1.0	161.7	335.9	77.0	194.0	224.0	273.0	2146
Current Loading (tpy)	121.0	1.0	216.0	373.2	88.0	194.0	233.0	236.0	1855
Percent of Total Loading	7%	0%	12%	20%	5%	10%	13%	13%	100%
Percent of Loading by Category	100%	100%	22%	38%	17%	38%	45%	100%	
Total Required Reduction in 2010 (ton	12	0	54.32	37.28	11	0	9	37	291
Average Annual Reduction (tons)	0.8	0.0	3.6	2.5	0.7	0.0	0.6	2.5	34.3
Growth (1995-2010)/Required Offset	10%	0%	75%	90%	88%	0%	96%	16%	16%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
AD	% to reduce	100%	0%	0%	0%	0%	0%	0%	0%	100%
	tpy reduced	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
GW	% to reduce		100%							100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce	0%		50%						50%
	tpy reduced	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	1.8
Urban	% to reduce				0%					0%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	% to reduce									100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.6
Industrial	% to reduce					100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7
Springs	% to reduce						100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce							100%		100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.6
ML	% to reduce			50%	100%				100%	250%
	tpy reduced	0.0	0.0	1.8	2.5	0.0	0.0	0.0	2.5	6.8

COMPARISON OF RESULTS

	AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Proportional Case									
Annual Reduction (tpy)	0.8	0.0	3.6	2.5	0.7	0.0	0.6	2.5	34.3
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target	$100,800	$0	$181,067	$705,835	$36,667	$0	$30,000	$12,333	$1,066,701
Total Cost to Target	$1,512,000	$0	$2,716,000	$10,587,520	$550,000	$0	$450,000	$185,000	$16,000,520
Trading Case									
With Trading Total Reduction from S $299,000 yr	0.8	0.0	1.8	0.0	0.7	0.0	0.6	6.8	34.3
Proportional Annual Reduction Res $1,067,000 yr	0.8	0.0	3.6	2.5	0.7	0.0	0.6	2.5	34.3
Cost per Ton Reduced	$126,000	$0	$28,000	$6,000	$50,000	$120,000	$50,000	$6,000	72%
Ann. Cost to Target	$100,800	$0	$101,397	$14,912	$36,667	$0	$30,000	$14,800	$298,576
Total Cost to Target	$1,512,000	$0	$1,520,960	$223,680	$550,000	$0	$450,000	$222,000	$4,478,640

SEGMENT: MIDDLE TAMPA BAY (3)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	705
Loading Target in 2010	705

Growth in Discharges	
Overall Growth	9%
Light % Red.	0%
Total Offset	9%

BASE CASE

Source Category	AD	GW	NONPOINT SOURCES			POINT SOURCES			ML	
Source	AD	GW	Agriculture	Urban	Other	Industrial	Springs	Domestic	ML	Total
Projected Loading (tpy) in 2010	373.0	0.0	69.9	73.6	224.5	7.0	0.0	21.0	0.0	769
Current Loading (tpy)	339.0	0.0	81.6	64.6	193.8	7.0	0.0	19.0	0.0	705
Percent of Total Loading	48%	0%	12%	9%	27%	1%	0%	3%	0%	100%
Percent of Loading by Category	100%	100%	24%	19%	57%	27%	0%	73%	100%	
Total Required Reduction in 2010 (ton	34	0	11.68	9	30.68	0	0	2	0	64
Average Annual Reduction (tons)	2.27	0.0	0.8	0.6	2.0	0.0	0.0	0.1	0.0	5.8
Growth (1995-2010)/Required Offset	10%	0%	86%	14%	16%	0%	0%	11%	0%	9%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$0	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	GW	Agriculture	Urban	Other	Industrial	Springs	Domestic	ML	Total
AD	% to reduce	50%	0%	0%	0%	0%	0%	0%	0%	0%	50%
	tpy reduced	1.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
GW	% to reduce		100%								100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce	95%		100%	33%		0%				228%
	tpy reduced	2.14	0.0	0.8	0.2	0.0	0.0	0.0	0.0	0.0	3.1
Urban	% to reduce				33%						33%
	tpy reduced	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
Other	% to reduce					50%					50%
	tpy reduced	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0
Industrial	% to reduce						100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs	% to reduce							100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce	0%			33%				100%		133%
	tpy reduced	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.3
ML	% to reduce									100%	100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COMPARISON OF RESULTS

	AD	GW	Agriculture	Urban	Other	Industrial	Springs	Domestic	ML	Total
Proportional Case										
Annual Reduction (tpy)	2.3	0.0	0.8	0.6	2.0	0.0	0.0	0.1	0.0	5.8
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$0	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target	$285,600	$0	$38,933	$170,400	$0	$0	$0	$6,667	$0	$501,600
Total Cost to Target	$4,284,000	$0	$584,000	$2,556,000	$0	$0	$0	$100,000	$0	$7,524,000
Trading Case										
Total Reduction from S — With Trading $295,000 yr	1.1	0.0	3.1	0.2	1.0	0.0	0.0	0.3	0.0	5.8
Annual Reduction Res — Proportional $502,000 yr	2.3	0.0	0.8	0.6	2.0	0.0	0.0	0.1	0.0	5.8
Cost per Ton Reduced	$76,298	$0	$50,000	$128,000	$0	$50,000	$120,000	$50,000	$6,000	41%
Ann. Cost to Target	$172,941	$0	$38,933	$76,800	$0	$0	$0	$6,667	$0	$295,341
Total Cost to Target	$2,594,118	$0	$584,000	$1,152,000	$0	$0	$0	$100,000	$0	$4,430,118

SEGMENT: LOWER TAMPA BAY (4)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	365
Loading Target in 2010	365

Growth in Discharges	
Overall Growth	11%
Light % Red.	0%
Total Offset	11%

BASE CASE

Source Category	*AD*	*GW*	*NONPOINT SOURCES*			*POINT SOURCES*			*ML*	
Source	*AD*	*GW*	*Agriculture*	*Urban*	*Other*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Projected Loading (tpy) in 2010	332.0	0.0	7.2	11.2	21.6	0.0	0.0	3.0	30.0	405
Current Loading (tpy)	302.0	0.0	9.7	15.1	11.2	0.0	0.0	1.0	26.0	365
Percent of Total Loading	83%	0%	3%	4%	3%	0%	0%	0%	7%	100%
Percent of Loading by Category	100%	100%	27%	42%	31%	0%	0%	100%	100%	
Total Required Reduction in 2010 (ton	30	0	2.52	3.92	10.44	0	0	2	4	40
Average Annual Reduction (tons)	2.0	0.0	0.2	0.3	0.70	0.0	0.0	0.1	0.3	3.5
Growth (1995-2010)/Required Offset	10%	0%	74%	74%	94%	0%	0%	200%	15%	11%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$0	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	*GW*	*Agriculture*	*Urban*	*Other*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
AD	% to reduce	68%	0%	0%	0%	0%	0%	0%	0%	0%	68%
	tpy reduced	1.35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
GW	% to reduce		100%								100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce			100%							100%
	tpy reduced	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Urban	% to reduce				0%						0%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	% to reduce					50%					50%
	tpy reduced	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3
Industrial	% to reduce						100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs	% to reduce							100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce								100%		100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
ML	% to reduce	50%			100%					100%	250%
	tpy reduced	1.0	0.0	0.0	0.26	0.0	0.0	0.0	0.0	0.3	1.5

COMPARISON OF RESULTS

		AD	*GW*	*Agriculture*	*Urban*	*Other*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Proportional Case											
Annual Reduction (tpy)		2.0	0.0	0.2	0.3	0.7	0.0	0.0	0.1	0.3	3.5
Cost per Ton Reduced		$126,000	$0	$50,000	$284,000	$0	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target		$252,000	$0	$8,400	$74,219	$0	$0	$0	$6,667	$1,333	$342,619
Total Cost to Target		$3,780,000	$0	$126,000	$1,113,280	$0	$0	$0	$100,000	$20,000	$5,139,280
Trading Case											
Annual Red from Sour	With Trading $168,000 yr	1.4	0.0	0.2	0.0	0.4	0.0	0.0	0.1	1.5	3.5
Annual Red from Sour	Proportional $343,000 yr	2.0	0.0	0.2	0.3	0.7	0.0	0.0	0.1	0.3	3.5
Cost per Ton Reduced		$74,936	$0	$50,000	$6,000	$0	$50,000	$120,000	$50,000	$6,000	51%
Ann. Cost to Target		$149,872	$0	$8,400	$1,568	$0	$0	$0	$6,667	$1,600	$168,107
Total Cost to Target		$2,248,085	$0	$126,000	$23,520	$0	$0	$0	$100,000	$24,000	$2,521,605

SEGMENT: BOCA CIEGA BAY (5)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	192
Loading Target in 2010	192

Growth in Discharges	
Overall Growth	7%
Light % Red.	0%
Total Offset	7%

BASE CASE

Source Category	AD	GW	NONPOINT SOURCES		POINT SOURCES			ML	
Source	AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
Projected Loading (tpy) in 2010	117.0	0.0	0.0	81.6	0.0	0.0	4.0	0.0	206
Current Loading (tpy)	106.0	0.0	0.0	80.5	0.0	0.0	3.0	0.0	192
Percent of Total Loading	55%	0%	0%	42%	0%	0%	2%	0%	100%
Percent of Loading by Category	100%	100%	0%	97%	0%	0%	100%	100%	
Total Required Reduction in 2010 (ton	11	0	0	1.09	0	0	1	0	14
Average Annual Reduction (tons)	0.7	0.0	0.0	0.0727	0.0	0.0	0.1	0.0	0.9
Growth (1995-2010)/Required Offset	10%	0%	0%	1%	0%	0%	33%	0%	7%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
AD	% to reduce	100%	0%	0%	100%	0%	0%	0%	0%	200%
	tpy reduced	0.7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.8
GW	% to reduce		100%							100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce			100%						100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban	% to reduce				0%					0%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	% to reduce									100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Industrial	% to reduce					100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs	% to reduce						100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce				0%			100%		100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
ML	% to reduce								100%	100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COMPARISON OF RESULTS

	AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
Proportional Case									
Annual Reduction (tpy)	0.7	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.9
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target	$92,400	$0	$0	$20,637	$0	$0	$3,333	$0	$116,371
Total Cost to Target	$1,386,000	$0	$0	$309,560	$0	$0	$50,000	$0	$1,745,560
Trading Case									
Total Reduction from S With Trading $105,000 yr	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.9
Annual Reduction Res Proportional $116,000 yr	0.7	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.9
Cost per Ton Reduced	$126,000	$0	$50,000	$126,000	$50,000	$120,000	$50,000	$6,000	10%
Ann. Cost to Target	$92,400	$0	$0	$9,156	$0	$0	$3,333	$0	$104,889
Total Cost to Target	$1,386,000	$0	$0	$137,340	$0	$0	$50,000	$0	$1,573,340

SEGMENT: TERRA CEIA BAY (6)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	34
Loading Target in 2010	34

Growth in Discharges	
Overall Growth	9%
Light % Red.	0%
Total Offset	9%

BASE CASE

Source Category	*AD*	*GW*	*NONPOINT SOURCES*		*POINT SOURCES*			*ML*	
Source	***AD***	***GW***	***Agriculture***	***Urban***	***Industrial***	***Springs***	***Domestic***	***ML***	***Total***
Projected Loading (tpy) in 2010	22.0	0.0	0.4	6.7	0.0	0.0	4.0	0.0	37
Current Loading (tpy)	20.0	0.0	0.4	7.1	0.0	0.0	4.0	0.0	34
Percent of Total Loading	59%	0%	1%	21%	0%	0%	12%	0%	100%
Percent of Loading by Category	100%	100%	4%	71%	0%	0%	100%	100%	
Total Required Reduction in 2010 (ton	2	0	0.04	0.39	0	0	0	0	3
Average Annual Reduction (tons)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Growth (1995-2010)/Required Offset	10%	0%	10%	95%	0%	0%	0%	0%	9%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
AD	% to reduce	100%	0%	0%	100%	0%	0%	0%	0%	200%
	tpy reduced	0.1	0.0	0.0	0.03	0.0	0.0	0.0	0.0	0.2
GW	% to reduce		100%							100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce			100%						100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Urban	% to reduce				0%					0%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	% to reduce									100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Industrial	% to reduce					100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs	% to reduce						100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce							100%		100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ML	% to reduce								100%	100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COMPARISON OF RESULTS

	AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Proportional Case									
Annual Reduction (tpy)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$5,000	
Ann. Cost to Target	$16,800	$0	$133	$7,384	$0	$0	$0	$0	$24,317
Total Cost to Target	$252,000	$0	$2,000	$110,760	$0	$0	$0	$0	$364,760
Trading Case									
With Trading Total Reduction from S $20,000 yr	0.159	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.3
Proportional Annual Reduction Res $24,000 yr	0.133	0.000	0.003	0.026	0.000	0.000	0.000	0.000	0.3
Cost per Ton Reduced	$126,000	$0	$50,000	$126,000	$50,000	$120,000	$50,000	$6,000	17%
Ann. Cost to Target	$16,800	$0	$133	$3,276	$0	$0	$0	$0	$20,209
Total Cost to Target	$252,000	$0	$2,000	$49,140	$0	$0	$0	$0	$303,140

SEGMENT: MANATEE RIVER (7)
At Current Light %

SUMMARY TABLES

Loading Summary	
Current TPY (1992-94)	607
Loading Target in 2010	607

Growth in Discharges	
Overall Growth	7%
Light % Red.	0%
Total Offset	7%

BASE CASE

Source Category	AD	GW	NONPOINT SOURCES		POINT SOURCES			ML	
Source	*AD*	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Projected Loading (tpy) in 2010	58.0	0.0	81.1	59.8	145.0	0.0	22.0	0.0	652
Current Loading (tpy)	53.0	0.0	88.3	65.3	152.0	0.0	18.0	0.0	607
Percent of Total Loading	9%	0%	15%	11%	25%	0%	3%	0%	100%
Percent of Loading by Category	100%	100%	23%	17%	89%	0%	11%	100%	
Total Required Reduction in 2010 (ton	5	0	7.19	5.5	7	0	4	0	45
Average Annual Reduction (tons)	0.33	0.0	0.5	0.4	0.5	0.0	0.3	0.0	5.6
Growth (1995-2010)/Required Offset	9%	0%	92%	92%	95%	0%	22%	0%	7%
Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$6,000	

TRADING CASE

		AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
AD	% to reduce	100%	0%	0%	0%	0%	0%	0%	0%	100%
	tpy reduced	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
GW	% to reduce		100%							100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Agriculture	% to reduce	0%		100%	100%					200%
	tpy reduced	0.0	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.8
Urban	% to reduce	0%			0%					0%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	% to reduce									100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7
Industrial	% to reduce					100%				100%
	tpy reduced	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.5
Springs	% to reduce						100%			100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Domestic	% to reduce							100%		100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.3
ML	% to reduce								100%	100%
	tpy reduced	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COMPARISON OF RESULTS

		AD	*GW*	*Agriculture*	*Urban*	*Industrial*	*Springs*	*Domestic*	*ML*	*Total*
Proportional Case										
	Annual Reduction (tpy)	0.3	0.0	0.5	0.4	0.5	0.0	0.3	0.0	5.6
	Cost per Ton Reduced	$126,000	$0	$50,000	$284,000	$50,000	$120,000	$50,000	$5,000	
	Ann. Cost to Target	$42,000	$0	$23,967	$104,133	$23,333	$0	$13,333	$0	$206,767
	Total Cost to Target	$630,000	$0	$359,500	$1,562,000	$350,000	$0	$200,000	$0	$3,101,500
Trading Case										
Total Reduction from S	With Trading $121,000 yr	0.3	0.0	0.8	0.0	0.5	0.0	0.3	0.0	5.6
Annual Reduction Res	Proportional $207,000 yr	0.3	0.0	0.5	0.4	0.5	0.0	0.3	0.0	5.6
	Cost per Ton Reduced	$126,000	$0	$50,000	$50,000	$50,000	$120,000	$50,000	$6,000	41%
	Ann. Cost to Target	$42,000	$0	$23,967	$18,333	$23,333	$0	$13,333	$0	$120,967
	Total Cost to Target	$630,000	$0	$359,500	$275,000	$350,000	$0	$200,000	$0	$1,814,500

		AD	GW	Agriculture	Urban	Industrial	Springs	Domestic	ML	Total
Segment 1	With Trading	2.1	0.0	0.2	1.0	0.0	0.0	3.4	0.0	11.3
(tpy)	Proportional	1.7	0.0	0.1	2.6	0.0	0.0	2.3	0.0	11.3
Segment 2	With Trading	0.8	0.0	1.8	0.0	0.7	0.0	0.6	6.8	34.3
(tpy)	Proportional	0.8	0.0	3.6	2.5	0.7	0.0	0.6	2.5	34.3
Segment 3	With Trading	1.1	0.0	3.1	0.2	0.0	0.0	0.3	0.0	5.8
(tpy)	Proportional	2.3	0.0	0.8	0.6	0.0	0.0	0.1	0.0	5.8
Segment 4	With Trading	1.4	0.0	0.2	0.0	0.0	0.0	0.1	1.5	3.5
(tpy)	Proportional	2.0	0.0	0.2	0.3	0.0	0.0	0.1	0.3	3.5
Segment 5	With Trading	0.8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.9
(tpy)	Proportional	0.7	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.9
Segment 6	With Trading	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
(tpy)	Proportional	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Segment 7	With Trading	0.3	0.0	0.8	0.0	0.5	0.0	0.3	0.0	5.6
(tpy)	Proportional	0.3	0.0	0.5	0.4	0.5	0.0	0.3	0.0	5.6
Total	With Trading $1,738,000 yr	6.6	0.0	6.1	1.2	1.2	0.0	4.8	8.3	61.7
(tpy)	Proportional $3,320,000 yr	7.9	0.0	5.1	6.4	1.2	0.0	3.5	2.7	61.7

Annual Cost, totalled for all segments -- Proportional
$3,320,069

Annual Cost, totalled for all segments -- With Trading
$1,737,566

COST-EFFECTIVENESS CASE STUDY 1
WW1 -- Expand the Use of Reclaimed Water Where Reuse Benefits the Bay

As population growth continues in the Tampa region, and demand for fresh water for residential, commercial, and industrial use continues to expand, the cost-effectiveness of reclaimed water is becoming more and more important.

What is the Action?

Generally, this action involves redirecting water that has been highly treated at a wastewater treatment plant back into a municipal reservoir, irrigation system, or ecosystem. The specific case illustrating the cost-effectiveness of this action is a proposal to reuse water from the Hookers Point Advanced Wastewater Treatment Facility. The proposal involves supplementary treatment of approximately 50 percent of the effluent from Hookers Point and use of this water to supplement the supply in Hillsborough Drinking Water Reservoir. The additional water would help satisfy future water demands of both the City of Tampa and the West Coast Regional Water Supply Authority (WCRWSA).[1]

What are the Benefits of Reusing Water?

The general potential benefits of reusing effluent from a wastewater treatment plant are:

- Increased water supply for residential, commercial, industrial, and/or ecological use;
- Decreased loading of nutrients and total suspended solids (TSS) to the receiving waters of the wastewater treatment plant; and
- Decreased draw-down of ground water aquifers (and resulting protection against saltwater intrusion).

For the Hookers Point project, these benefits translate into the following:

- Increase of approximately 30 million gallons per day (mgd) of water in the Hillsborough Drinking Water Reservoir. According to estimates in the Southwest Florida Water Management District's (SWFWMD) *Water Supply Needs and Sources Report* (January 1992), this supplemental water supply is enough to cover expected dry season supply deficits for the City of Tampa through the year 2020. This extra water supply could also allow continued growth in population, business and industry, and other economic factors.
- Approximate 95.7 tons per year (tpy)[2] decrease in nitrogen loading to Hillsborough and Tampa Bays.
- Approximate 67.3 tpy[3] decrease in TSS loading to Hillsborough and Tampa Bays.
- Augmentation of ground water supplies which cannot sustain increased withdrawals.

What are the Potential Harms of Reusing Water at Hookers Point?

- Potential 95.7 tpy increase in nitrogen loading and 67.3 tpy increase in TSS loading to the Hillsborough Drinking Water Reservoir.
- Decrease of 30 mgd of freshwater inflow into Hillsborough Bay.

Who Stands to Benefit from the Hookers Point Reuse Project?

- *Water users:* Residents, and commercial and industrial operations would benefit from having a reliable water supply for an extended period of time.
- *Hillsborough and Tampa Bays:* The bay system would receive lower nitrogen and TSS loads, and accrue the ecological benefits from such decreases. However, the salinity effects of lost freshwater inflows could play a counterproductive role, although these effects are expected to be relatively negligible.[4]
- *Regional economy:* The reliability of water supplies and the additional water capacity necessary to support population and business growth allow for regional economic gains.

Who Would Pay the Costs?

- The City of Tampa
- WCRWSA

What are the Estimated Costs of Implementing the Hookers Point Reuse Project?

Project costs have been estimated for various scenarios of construction and water treatment capacities. Under a scenario in which additional facilities are built to augment water supplies for both the City of Tampa and WCRWSA, the capital cost is estimated to be $97,839,000 in 1992 dollars. The annual operations and maintenance cost is $7,437,000 for a 1992 present value of $176,627,000.[5] These costs incorporate the following assumptions: 50 mgd recovered water production capacity; 90 day per year operation of the supplemental treatment facility; and year-round operation of a linear well field and regional wastewater treatment plant.[6] Assuming a project life of 30 years and a real discount rate of 7 percent, the annualized real cost of implementing the Hookers Point proposal is estimated to be $14,094,288 in 1992 dollars. This total annual cost translates into a cost of approximately $74 per pound of nitrogen removed from the bay, and $105 per pound of TSS removed from the bay. Further treatment of reclaimed water before discharge to the Hillsborough Drinking Water Reservoir could possibly increase costs.

What are the Potential Consequences of Postponing or Forgoing the Hookers Point Project?

According to the SWFWMD 1992 *Water Supply Needs and Sources Report* (January 1992), based on a per capita water use of 150 gallons per day, the City of Tampa would experience dry season water deficits as follows:

Year	Deficit
1995	3.5 mgd
2000	7.7 mgd
2010	17.1 mgd
2020	30.6 mgd

If per capita water use were regulated and decreased over time, these deficits would be lower. However, deficits are still expected under such regulations. Without the reuse project, the region can either accept the deficits or attempt to use traditional water supply methods or another unconventional method. Accepting deficits could cost the region immense amounts from loss of economic growth.

Conventional water supply methods available to the City of Tampa are collection and storage of surface water and withdrawal of ground water from well fields. Expanding surface collection is impracticable, due to the lack of reservoir sites available to the city. Although groundwater withdrawal is an ongoing and relatively low-cost option, the practice is encumbered by many regulatory constraints, involving protection of wetlands and prevention of saltwater intrusion. In addition, there are few, if any remaining ground water sources that have not been tapped.

One unconventional water supply project being considered is an aquifer storage and recovery methodology. This option is in the initial stages of research and may not provide enough supplemental water to satisfy the region's needs.

What Are the Cost-Effectiveness Implications of the Hookers Point Project

While the cost of the reuse project is greater than conventional water supply projects, the regulatory environment favors it because of the potential high future costs (ecological and economic) of more conventional options. In addition, the costs of removing pollutants from the bay (as measured on a per pound basis) may be relatively high, but such pollution removal is a secondary effect of the water supply project. Thus, the cost of this removal is not a primary criterion for determining cost-effectiveness of the action. Overall, the reasonable costs of implementing the project, along with the pollution reduction benefits and the avoidance of water supply shortages, tend to make the project cost-effective.

COST-EFFECTIVENESS CASE STUDY 2
WW2 -- Establish Limits on the Amount of Nitrogen Discharged to the Bay in Industrial Wastewater

Analyzing the cost-effectiveness of limiting the amount of nitrogen discharged to the bay by industrial sources is somewhat precarious. From the perspective of nitrogen reduced per regulatory dollar spent, this action may seem like a bargain. However, the effects on existing or potential industrial sources can be large, and are the major component requiring evaluation for a cost-effectiveness calculation.

What is the Action?

Generally, this action involves setting stricter limits on overall nitrogen discharges from industrial sources to allow for a healthy bay ecosystem, including a revival of seagrass habitats. The limit of nitrogen loading that allows healthy seagrasses is the basis for setting limits on the amount of nitrogen discharged from industrial facilities. Limits would be incorporated into NPDES permits, both newly issued and those that are being renewed.

Industrial point sources could meet their permit requirements by one or more of the following ways:

- Decreasing on-site discharge;
- Arranging to eliminate an amount of discharge from another point source(s);
- Arranging to eliminate an amount of discharge from a nonpoint source(s); and
- Contributing money to a government fund that supports control of nonpoint discharges.

The specific case to illustrate the cost-effectiveness of this action is a hypothetical expansion of a citrus processing facility (SuperJuicy), coupled with a legal rule that (1) freezes total industrial nitrogen discharges to the bay at the current level of 160 tons per year until January of next year and (2) requires net industrial discharges of nitrogen to decrease to 120 tons per year (the amount ecologists believe will allow a healthy return of seagrasses) as of January of next year. The SuperJuicy orange juice plant is the largest industrial discharger of nitrogen to Tampa Bay. It presently is discharging 50 tons of nitrogen per year. SuperJuicy is considering building a lemonade processing facility near its current plant that would discharge an estimated 20 tons of nitrogen per year. The lemonade plant would require an NPDES permit that is consistent with the new 120 tons per year requirement. One year from now, the orange juice plant will need to renew its permit, and also will be subject to the new requirement.

What are the Benefits of Limiting Industrial Nitrogen Discharges?

The benefits of imposing limits on the amount of nitrogen that industrial point sources can discharge are:

- Decreased nitrogen loads to Tampa Bay with the resultant positive health effects on seagrasses and the rest of the ecosystem; and

- Freedom of industrial sources to choose the lowest cost method of complying with the total nitrogen limit.

What are the Potential Harms of Limiting Industrial Nitrogen Discharges?

- Existing industrial sources that will incur high costs to comply with limits may choose to relocate or cut back production;
- New businesses that would incur high costs to comply with limits may locate elsewhere;
- New businesses also may perceive risks associated with the uncertainty of trading/offset opportunities, and may choose not to locate in the area; and
- If compliance costs are too high for industrial sources, the regional economy could suffer in the form of decreased business activity and lower rates of employment.

Who Stands to Benefit from Nitrogen Limits?

Water users: All users of clean water, including area residents, recreationists, commercial and industrial operations, and marine life would benefit from having cleaner bay water.

Who Would Pay the Costs?

Industrial dischargers: Industrial dischargers would almost solely bear the costs of limiting their nitrogen input into the bay. The discharges can swallow these costs, search for opportunities to reduce other costs, or pass the costs to their consumers. Government agencies might incur some administrative costs for implementing regulations or arranging an offset bank, but these costs are negligible compared to industrial costs.

What are SuperJuicy's Estimated Costs of Complying with Nitrogen Limits?

SuperJuicy, sensing that the market for lemonade is ripe, has set a construction plan for the lemonade plant that calls for completion and a grand opening in six months (July of *Year 1*). Since the plant will be operating for only half of *Year 1,* it will be contributing a total of 10 tons of nitrogen to the bay. With the freeze at 160 tpy, SuperJuicy must find a way to eliminate 10 tons of nitrogen from the bay, if it is to begin operations on time. Corporate executives examined the costs of all of their options, and developed the following chart:

Options	Costs
Option 1. Upgrade treatment capabilities at the orange juice plant.	$xx/ton for the first 10 tons removed and $xx+/ton for each additional ton.
Option 2. Cut back production at either of the plants.	Lost profits from scaling back output. This cost is highly variable, but estimated to be $xx in *Year 1* and $xx in *Year 2.*
Option 3. Install urban BMPs to control nonpoint source discharges to the bay.	Average of $xx/ton.

Options	Costs
Option 4. Contribute to the government's NPS/BMP Fund.	The government has decided to charge $xx/ton, so that it can implement BMPs and pay administrative costs.
Option 5. Contract with other companies to reduce their discharges.	Due to perceptions of risk and uncertainty, area companies are willing to accept a minimum of $xx/ton to reduce nitrogen loads.
Option 6: Locate the lemonade plant at a different, inland site.	This option would decrease SuperJuicy's compliance costs by $xx, but increase administrative and transportation costs by $xx.

[Write about the least cost option for Year 1 – Expecting additional information as of 10/4/95]

The 120 tpy limit for *Year 2* is being implemented such that all dischargers in *Year 1* must cut net discharges by 25 percent in *Year 2* and beyond. Since SuperJuicy contributed a net nitrogen load of 50 tons in *Year 1,* it must decrease its net nitrogen load to 37.5 tons in *Year 2.* The costs in the chart above are valid for *Year 2.* *[Write about the least cost option for Year 2 – Expecting additional information as of 10/4/95]*

What are the Potential Consequences of Postponing or Forgoing the Nitrogen Limits?

Postponing or forgoing the nitrogen limits would allow continued discharges to the bay, affecting the ecological health of the bay system. In addition, a moratorium on limits would allow more industrial sources discharge to the bay, generating two potential negative effects: (1) If industrial growth occurs, many sources, all of whom are within nitrogen concentration limits in their permits, could discharge high levels of nitrogen to the bay; and (2) Imposing overall limits in the future could be more difficult (politically and administratively) and costlier.

What Are the Cost-Effectiveness Implications of the Nitrogen Limits for SuperJuicy?

[Write about SuperJuicy's total costs, the connection to market forces, the outcome that occurred under this scenario, and the potential for other outcomes – Expecting additional information as of 10/4/95]

COST-EFFECTIVENESS CASE STUDY 3
WW3 -- Extend Central Sewer Service to Priority Areas Now Served by Septic Tanks

One way to prevent pollution from faulty septic tanks is to extend central sewer service to unsewered areas. Given the potential seriousness of septic system problems at the local level, it is important to determine the cost-effectiveness of sewer hook-up projects.

What is the Action?

Generally, this action involves upgrading community infrastructure to include sewer lines that direct wastewater to a wastewater treatment plant. Sewer services would replace septic tanks in high density areas along the bay and its tributaries, especially where pollution from septic tanks has been detected. The specific case to illustrate the cost-effectiveness of this action is a proposal to extend sewer service from the city of Largo to a portion of the Allen's Creek watershed in Pinellas County. One hundred twenty four residential lots, two large churches, and one school in the area are using septic tanks,[7] and pollution problems from the tanks are considered to be substantial. In fact, based on a linear relationship between septic tanks and nutrient pollution in the area, the estimated loading from the septic tanks on these lots is 0.28 tons per year (tpy) of nitrogen and 0.30 tpy of phosphorus.[8] In addition, the city of Largo's wastewater treatment plant uses advanced treatment procedures that allow wastewater to be reused. Thus, the treatment plant does not discharge to the bay or its tributaries, but recycles wastewater into irrigation projects in the city, resulting in no effluent loading to the bay.

What are the Benefits of Extending Central Sewer Service?

The general potential benefits of providing sewer service to more lots are:

- Decreased loading of nutrients and pathogens to surface waters that receive leachate from septic tanks;
- Restoration of recreational and habitat uses of surface waters; and
- Increased potential for economic growth and higher property values in the area receiving sewer service.

For the Allen's Creek proposal, these benefits translate into the following:

- Removal of approximately 0.28 tons of nitrogen per year, 0.30 tons of phosphorus per year, and some of the pathogen loads to the creek;
- Restoration of fishable and swimmable uses in Allen's Creek, where pathogen levels are currently too high to permit these activities; and
- Potential annexation of the Allen's Creek residents into the city of Largo, with a resultant increase in tax revenues to the city.

What are the Potential Harms of Extending Central Sewer Service?

- Someone must pay the sizable costs of extending sewer lines and connecting households to the lines; and

- Septic tank service providers may be displaced.

Who Stands to Benefit from Extension of Central Sewer Service?

- *Water users:* All users of clean water, including area residents, recreationists, commercial and industrial operations, and marine life would benefit from having cleaner water in Allen's Creek and Tampa Bay.
- *Regional economy:* Residents in the geographic area receiving sewer lines may benefit from increased potential for economic growth and higher property values.
- *Sewer utility:* The sewer utility may increase revenues due to an increase in the customer base and a larger supply of clean wastewater for irrigation projects.

Who Would Pay the Costs?

Several different groups, or a combination of them, could conceivably pay for the extension of sewer lines from the city of Largo to the Allen's Creek area. Currently, efforts are being financed by a low-interest loan to the city of Largo from Florida's revolving loan program. However, this loan must be repaid by one or more of the following groups:

- Residents of the City of Largo;
- Residents in the Allen's Creek area; and
- Other Florida residents.

One of two payment plans is most likely to be selected. For the first, the city of Largo will annex the geographic area that will receive the new sewer lines. The annexed residents would then pay the standard hookup fee for Largo sewer service (approximately $1,100 per residential lot), and the city would finance the rest of the costs of the extension. For the second payment plan, the city will not annex the geographic area, and the residents who benefit from the extension will pay the full costs of connecting to the sewer system ($7,000 to $8,000 per residential lot).[9] In one other scenario, Florida general funds could finance some of the costs, since the state would benefit from increased water quality. However, the state is already providing low-interest loans, effectively subsidizing the capital costs of extending the sewer system.

What are the Estimated Costs of Implementing the Sewer Expansion Project?

The city of Largo estimates that expanding the sewer system to include the 127 lots in the Allen's Creek area will cost a total of $1 million.[10] This represents a cost of $7,874 per lot. Assuming that the capital for the sewer expansion lasts for thirty years and operating costs for the wastewater treatment remain at current levels, this cost yields approximately $60 per pound of nitrogen removed from the bay and $56 per pound of phosphorus (based on 0.28 tpy of nitrogen removed and 0.30 tpy of phosphorus removed).

What are the Potential Consequences of Postponing or Forgoing the Project?

If the sewer extension project is delayed or halted, the pollution from the septic tanks will continue, and possibly increase as tanks age. While no study has documented the level of compliance of the tanks with Florida public health and water quality standards, it is suspected that many tanks are not in compliance. This is due to fairly stringent requirements in Florida, and lot and soil characteristics that are unfavorable for septic tanks. Connection to a central sewer system seems to be the only method available to stop pollution from the septic tanks. According to a study conducted in the Sarasota Bay area, the cost of installing a perfectly operating septic tank that complies with all standards is $5,000, but many lots in the area are too small to accommodate such a tank.[11]

What Are the Cost-Effectiveness Implications of the Sewer Extension Project

Extending sewer services to the Allen's Creek area is the most cost-effective way to solve the pollution problem, given the current situation. Since septic tanks in the area probably are not meeting public health and water quality standards, they must either be upgraded, replaced, or bypassed through connection to a sewer system. Since upgrading or replacement probably will not work for all properties, connection to the sewer system is the best option. In addition, beyond elimination of nutrient discharges, connection to a central sewer would eliminate pathogen discharges from the septic tanks, bolstering the cost-effectiveness of the action.

COST-EFFECTIVENESS CASE STUDY 4
SW7 -- Improve Compliance with and Enforcement of Stormwater Permits

Stormwater facilities that are not in compliance with standards for design and operation contribute considerable pollutant loads to the Tampa Bay system. Improving compliance and enforcement efforts with respect to stormwater permits may be a cost-effective approach to correct some of the problems with stormwater facilities.

What is the Action?

Generally, this action involves increasing administrative capabilities to ensure that stormwater facilities are built and operated in accordance with specifications in stormwater permits. More specifically, the Southwest Florida Water Management District (SWFWMD) is proposing to reorganize and expand its stormwater permitting, compliance, and enforcement program. Previously, programmatic and personnel constraints prevented staff from regularly overseeing many of the stormwater facilities in the Tampa Bay watershed. Only when facilities required permit renewals did the District check their compliance with standards.

The strategy to improve compliance monitoring and enforcement of stormwater permits includes:

- Development of targets for inspecting facilities, enforcing compliance, and providing services; and
- Increasing staff to meet targets and undertake new compliance and enforcement efforts.

What are the Benefits of Improving Compliance and Enforcement for Stormwater Permitting?

The general potential benefits of improving compliance and enforcement are:

- Wider compliance with stormwater standards, with an accompanying decrease in loading of pollutants to the Tampa Bay system;
- Greater public awareness of stormwater requirements;
- Enhanced credibility of the standards found in stormwater permits;[12] and
- Fairness for facilities that voluntarily comply with permits.[13]

For SWFWMD, these benefits translate into the following:

- *Increased rate of compliance with stormwater rules.* It is estimated that one additional enforcement officer can conduct approximately 450 inspections per year.[14] Given an estimated compliance rate of 10 percent for stormwater facilities,[15] an enforcement officer will find 405 noncompliant facilities per year (the number of noncompliant facilities found should decrease in future years, as the enforcement program matures).
- *Decreased pollution.* Assuming that a noncompliant stormwater facility is equivalent to a lack of any facility, the estimated total nitrogen reduction from an inspection that finds and induces rehabilitation of a noncompliant facility is 52 percent (compare 3.67 mg

nitrogen/L in untreated stormwater to 1.78 mg nitrogen/L in treated stormwater).[16] In addition, other pollutants such as metals, phosphorus, and suspended solids would be reduced. These decreases in pollutant levels would provide ecological and health benefits.

Who Stands to Benefit?

- *SWFWMD:* The District would receive additional staff and funding, and would be able to execute its functions more effectively.
- *Tampa Bay system:* The bay system would receive lower pollutant loads, and accrue the ecological benefits from such decreases.

Who Would Pay the Costs?

- *Taxpayers:* Taxpayers who live in SWFWMD's jurisdiction would pay most of the cost, although taxpayers throughout the state also could pay.
- *Operators of stormwater systems:* Operators of noncompliant stormwater systems, including public and private entities, would have to pay the costs of upgrading their systems to meet standards. All stormwater facility operators could also be responsible for paying inspection fees.

What are the Estimated Costs of Improving Compliance and Enforcement?

The estimated annual cost to develop targets for inspecting facilities, enforcing compliance, and providing services is $6,000, based on a two-month mid-level managerial effort.[17] The annual cost of hiring one additional enforcement officer is estimated to be $24,000 for personnel-related expenses. Additional up-front capital costs per new field staff are estimated to be $5,700.[18]

The cost required to upgrade a noncompliant stormwater facility is highly variable, depending on the type and size of facility, the state of disrepair, natural features, and many other factors. Given the variability of such costs, they are not estimated. If 405 noncompliant facilities (the estimated number that one inspector can detect) are required to upgrade, however, the total cost for all facilities could be very high, and even higher if multiple inspectors are hired.

What are the Potential Consequences of Postponing or Forgoing the Improvement?

If enforcement of stormwater permits is delayed or neglected, pollution from noncompliant stormwater facilities will continue, and possibly increase as more facilities slip into noncompliance. Functional stormwater facilities can remove 90 percent or more of some pollutants from stormwater discharges (e.g., lead, ammonia, and nitrate + nitrite).[19] Stormwater facilities operating at sub-optimal levels contribute substantial, unnecessary pollution to the Tampa Bay system. Permits are in place to prevent this pollution, but they are largely ineffective without strong enforcement.

What Are the Cost-Effectiveness Implications of the SWFWMD Project?

One stormwater official stated that the process of local governments issuing permits and enforcing them with inspections is the most cost-effective way to reduce pollution from stormwater -- certainly when compared to buying land and constructing a regional facility.[20] The annual cost to SWFWMD of hiring an additional enforcement officer is approximately $29,700, and each officer can inspect a considerable number of facilities. If the current stormwater facility compliance rate is as low as estimated, then this action could be an extremely cost-effective way of handling stormwater pollution from the regulator's perspective. Note that a higher compliance rate translates into a lower cost-effectiveness. Cost-effectiveness may be less straight forward for the regulated community. If compliance costs are prohibitively high, then other, less costly options for controlling stormwater pollution may be possible. Forcing noncompliant stormwater facilities to meet legal standards, however, is a justifiable maneuver, regardless of costs faced by facility owners.

Other factors can affect the cost-effectiveness of increasing enforcement efforts. For example, the assumption that a noncompliant stormwater facility is equivalent to a lack of any facility influences cost-effectiveness. This assumption may cause the action to seem more cost-effective than it actually is. If noncompliant stormwater facilities are providing some level of loading reductions, then upgrading those facilities will not produce as high a pollution reduction as calculated above, and enforcement will be less cost-effective than it appears under the current assumption.

In order to compare the cost-effectiveness of this proposed pollution reduction action to other programmatic actions, an analyst could:

- Calculate the annual flow through an average stormwater facility;
- Calculate the mass of nitrogen and other pollutant loading prevented (multiply annual flow by pollutant reductions achieved by stormwater facilities[21]);
- Calculate SWFWMD's costs [$6,000 + ($29,700 x number of additional personnel)];
- Find the cost to bring the average noncompliant stormwater facility into compliance;

Divide the sum of SWFWMD's costs and compliance costs by the mass of nitrogen or other pollutant loading prevented. This calculation provides a figure that describes the cost per unit of pollution prevention

Memorandum

DATE: February 14, 1996

TO: Holly Greening

FROM: Rob Dietz

RE: Cost Effectiveness Case Study -- SW7

This is the final cost-effectiveness case study on improving compliance with stormwater permits. As we discussed previously, there was a general lack of background data. After compiling the available data, I advanced the case study as far as possible. I used reasonable estimates for some of the data gaps (e.g., I took the rate of compliance for stormwater facilities from the SJRWMD instead of the SWFWMD). Other similar estimates are noted in the case study. Additional data that would be useful to advance this case study include:

1. The actual SWFWMD compliance rate;
2. The difference in performance between an average noncompliant stormwater facility and an average compliant one (the case study uses the difference between a compliant facility and no facility);
3. The flow for an average stormwater facility; and
4. The cost to upgrade and maintain the average noncompliant facility.

In response to gaps in the data, the case study's final cost-effectiveness discussion is more qualitative than discussions in previous case studies. It does, however, provide a description of how to use data when they become available to calculate a final cost-effectiveness figure. In subsequent work with TBNEP, Apogee would be happy to try to obtain these data and calculate cost-effectiveness figure.

If you have any questions, please do not hesitate to call me or Elise at (301) 652-8444. Thank you.

Memorandum

DATE: March 4, 1996

TO: Holly Greening, TBNEP

FROM: Rob Dietz and Elise Bacon

RE: Updates to Case Study 4, SW7 and distribution of case studies

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After submission of the final case study, we received some additional data from Karen Gruenhagen of the SWFWMD. We are including a copy of her letter with this memo.

Apogee would be happy to update the case study with the new data as part of one of our other work assignments with TBNEP. This task requires minimal effort, since the case study already explains how to incorporate the data. There would probably be some follow-up with Karen, though, to clarify some responses in her letter.

During our data collection efforts for all of the case studies, we received several requests to see the results. We wanted to check with you before taking any actions to handle those requests. We can distribute drafts of the case studies, or we can make other arrangements, depending on what you want to do.

If you have any questions, please do not hesitate to call either of us at (301) 652-8444. We look forward to hearing from you. Thanks.

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Assistant Executive Director
Edward B. Helvenston
General Counsel

February 16, 1996

MEMORANDUM

TO: Rob Dietz, Apogee Research, Inc.

FROM: KG Karen Gruenhagen, Environmental Scientist, Technical Services

SUBJECT: Requested Information

At last I'm able to put some numbers together to answer your questions.

Q: What is the total number of stormwater facilities that received permits from the SWFWMD?

A: In 12 years, the District has issued a total of 25,796 permits that authorize the construction of a stormwater facility. I'm defining a stormwater facility as a stormwater pond or a series of ponds that are designed to treat runoff from a project site. This count is an overestimate since I could not exclude permits that either modify a stormwater facility already permitted or authorize project modifications that are not related to the stormwater facility.

Q: What is the approximate rate of compliance among stormwater facilities (how many are believed to be operating correctly and how many are operating improperly)?

A: There is no information available to directly answer this question. However, the District's as-built inspection program verifies that each stormwater management facility is constructed according to permitted plans. Therefore, presumably 100% of the permitted stormwater facilities are operating properly at the time the operation phase of a construction permit is issued. However, even though the permittee is required to submit follow-up operation reports, the District does not routinely reinspect these sites unless a complaint is received. Furthermore, it is now the District's practice to reduce follow-up requirements for facilities where no problems are apparent.

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Q: In the most recent full year for which data is available, how may noncompliant stormwater facilities were brought into compliance?

A: In 1995, 186 compliance cases involving as-built deviations were closed. This is a count of projects that were not built according to the permitted plans. However, I can not separate incorrect stormwater facility construction from other aspects of the project such as wetland impact and mitigation.

Q: What is the total number of compliance and enforcement staff who work full time on stormwater facilities?

A: There are about 17 staff that have responsibilities for surface water enforcement and compliance. Job responsibilities cover both stormwater and water quantity (flooding) concerns.

I hope this information isn't to late to be included into your analysis. Please call if you have any questions regarding these answers to your questions.

[1] CH_2M Hill, *Tampa Water Resource Recovery Project: Summary Report,* p. 1.

[2] Fifty percent of the total tpy figure in Appendix 12 of the Tampa Bay National Estuary Program's *Estimates of Total Nitrogen, Total Phosphorus, and Total Suspended Solids Loadings to Tampa Bay, Florida,* (May 1994).

[3] Fifty percent of the total tpy figure in Appendix 12 of the Tampa Bay National Estuary Program's *Estimates of Total Nitrogen, Total Phosphorus, and Total Suspended Solids Loadings to Tampa Bay, Florida* (May 1994).

[4] Personal communication with Mark Hammond, Southwest Florida Water Management District

[5] CH_2M Hill, *Tampa Water Resource Recovery Project: Summary Report,* p. 15.

[6] CH_2M Hill, *Tampa Water Resource Recovery Project: Summary Report,* p. 15.

[7] Personal communication, Chris Kubala, Director of Public Works, City of Largo, October 11, 1995.

[8] These figures are based on estimates that 1,650 septic tanks in the whole Allen's Creek watershed discharge 3.7 tons of nitrogen and 3.9 tons of phosphorus per year. Personal communication, Scott Stevens, Southwest Florida Water Management District, October 9, 1995.

[9] Personal communication, Chris Kubala, Director of Public Works, City of Largo, October 11, 1995.

[10] Personal communication, Chris Kubala, Director of Public Works, City of Largo, October 11, 1995.

[11] *Final Report of the Finance Subcommittee of the Wastewater Advisory Task Force,* May 30, 1995, and Personal communication, Mark Alderson, Sarasota Bay National Estuary Program, September 12, 1995.

[12] Cheryl E. Wasserman, *Principles of Environmental Enforcement,* Office of Enforcement, U.S. Environmental Protection Agency, 1992, page 1-3.

[13] Cheryl E. Wasserman, *Principles of Environmental Enforcement,* Office of Enforcement, U.S. Environmental Protection Agency, 1992, page 1-3.

[14] Based on personal correspondence with Don Rome, Southwest Florida Water Management District, 12/7/95 and personal communication with Bill Campbell, Montgomery County Department of Environmental Protection, 2/14/96. Calculated as 1,807 hours available for an inspector to conduct inspections divided by 4 hours to complete one inspection.

[15] Taken from the estimated compliance rate for the St. Johns River Water Management District, personal communication, Eric Livingston, Florida Department of Environmental Protection, 11/14/95.

[16] Calculated from Table 4 in Betty Rushton et al., *Results Documented from Wet-Detention Stormwater Studies,* Southwest Florida Water Management District, November 1993, p. 6.

[17] Tampa Bay National Estuary Program Draft Action Plans, p. 23.

[18] Personal correspondence with Don Rome, Southwest Florida Water Management District, 12/7/95.

[19] Table 4 in Betty Rushton et al., *Results Documented from Wet-Detention Stormwater Studies,* Southwest Florida Water Management District, November 1993, p. 6.

[20] Personal communication with Eric Livingston, Florida Department of Environmental Protection, 11/14/95.

[21] These pollutant reductions appear in Table 4 in Betty Rushton et al., *Results Documented from Wet-Detention Stormwater Studies,* Southwest Florida Water Management District, November 1993, p. 6.

NOx Reduction Cost Estimates

Source:	TECO Apr-95	STAPPA-ALAPCO Jul-94 wall fired	STAPPA-ALAPCO Jul-94 tangentially	Acurex May-95
SNCR				
$/tpy	$2,000	$520 - $670	$540 - $710	$800 - $1,140
efficiency	30%	30 - 60%	30 - 60%	
SCR				
$/tpy	$4,500	$640 - $870	$780 - $1,070	$1,200 - $1,700
efficiency	75%	75 - 90%	·75 - 90%	

SNCR = Selective Non-Catalytic Reduction
SCR = Selective Catalytic Reduction

Major Components of a Trading Program

- A Trading Policy -- the "rules of the game" -- such as:

  ✓ Trading ratios?
  ✓ Trading within or across segments?
  ✓ Temporal considerations -- tons reduced /yr the right unit?
  ✓ Trading only N or other pollutant load reductions?
  ✓ Can non-sources effect a trade with cash?
  ✓ Is banking allowed?
  ✓ Who bears ultimate regulatory responsibility -- buyer or seller or both?
  ✓ What kind of "binding agreement" is needed to effect a trade?
  ✓ Consistent with other statutes and regulations?

- A Trading "Broker"

  ✓ To facilitate trades by identifying reduction options by location and makes costs, contacts, other relevant information known to all buyers
  ✓ Minimizes "transaction costs"
  ✓ Public, private, or non-profit
  ✓ Individual or institution

- Institutional Monitoring System

  ✓ Perhaps a database of transactions
  ✓ Buyer, seller, price, amount, date effective, etc.

- Performance Measurement System

  ✓ Answers question: "How's it working?"
  ✓ Physical actions taken?
  ✓ Investments made as promised?
  ✓ Water quality results as predicted?

- Financial Support System

  ✓ Who will pay the broker?
  ✓ Who will pay to maintain the monitoring systems?
  ✓ Who will pay to measure performance?

NEXT STEPS IN NITROGEN LOAD ALLOCATION

(not necessarily in this order)

- TAC and selected experts outside of the NEP review future loading and revised water quality models (both empirical and mechanistic models) and recommend seagrass restoration targets to the Management Committee.
- Management Committee finalizes seagrass restoration and nitrogen loading targets for incorporation into final CCMP.
- Decide which types of loads will be considered "controllable" and which "uncontrollable."
- Allocate nitrogen reduction targets among controllable sources in proportion to an agreed upon loading base. Decide if allocation should be based on existing loads for projected increases in loads between now and 2000.
- Decide how the benefits accruing to downstream users of the bay from upstream improvement should be accounted for in allocating loading targets.
- Determine how allocated reductions will be implemented -- first, determine how far planned actions will go toward reaching targets (get commitment from local governments to provide that information to NEP).
- Decide upon and establish the structure for negotiated trading. What legislative and/or administrative actions would be necessary to establish trading bubbles and the process for trading?
- Decide on trading ratios, e.g., how much would atmospheric deposition have to be reduced in relationship to a ton of N reduction from urban stormwater sources?
- Decide how to monitor performance of the players (Are they doing what they agreed to?) and the results.
- Determine what happens if some players drop out (either as sellers or as buyers).
- Get better information on cost versus benefits, i.e., $/ton of N reduction which will determine which sources are buyers and which are sellers of nitrogen reduction. It will be especially important to determine where electric utilities fall out.
- Examine the question of spatial scale at which allocations should be applied, i.e., the size of the "bubble." Determine if the allocations should be bay-wide, bay segment, river basin, or smaller tributary. Determine how the TMDL process should be integrated with the bubble trading concept.

EXECUTING TRADING IN TAMPA BAY: DISCUSSION POINTS

Geography

- Within segments only, across certain segments, across any segment (w/criteria)?

Regulatory Issues

- Point sources who are in compliance with technology-based effluent standards can trade to meet additional pollution reductions needed to meet water quality criteria.

- All NPDES provisions remain in effect, including mass- and concentration-based pollutant limits, monitoring, and reporting requirements. To accommodate trading, permits include new pollutant loading limits that are effective if point sources achieve a specified level of pollutant reductions at nonpoint sources. If necessary, monitoring, reporting, and/or other permit conditions can be modified to reflect different conditions when point sources trade.

- WLAs are developed for specific point sources and incorporated into NPDES permits.

- CWA provisions establish performance objectives for trading -- trading results should meet or exceed applicable water quality standards in the trading area and throughout waterbodies where trading occurs.

- TMDLs, PLRGs, ambient water quality standards, mixing zone standards, and designated uses all provide targets for trading.

- A key concern in point/nonpoint source trading is the attainment of water quality standards at point source sites. Point/nonpoint source trading shifts the location of additional reductions in pollutant loading from the point source mixing zone to one or more zones adjacent to nonpoint sources. Where more than one point source is involved in trading, this effect is multiplied.

- Ideally, point sources will arrange trades with nearby nonpoint sources to ensure water quality objectives are met everywhere in the trading area.

- Where point and nonpoint sources are far apart, even though standards are met adjacent to nonpoint sources, water quality in the point source mixing zone could fall short of water quality standards.

- Are any potential nonpoint source trading partners covered by regulations? Where they exist, nonpoint sources may be expected to fulfill applicable regulatory responsibilities before selling additional reductions to point sources. States and localities have some flexibility in determining which nonpoint sources can participate in trades with point sources.

- TMDLs raise regulatory issues for nonpoint sources involved in trading only to the extent they are subject to regulatory requirements. LAs can be developed for individual sources, but are more commonly developed for several or all nonpoint sources within a TMDL's geographic area. LAs are implemented through state and local nonpoint source control programs which vary in their reliance on regulatory requirements and voluntary measures to achieve LAs.

Technical/Scientific Issues

- Spatial, temporal, and chemical differences between point and nonpoint source pollutant loadings pose challenges to understanding and predicting effects of point/nonpoint trading on water quality. Accommodating these differences in the conditions of a trade can help attain environmental objectives.

- *Spatial Considerations* --Point sources discharge a relatively concentrated load continuously at specifically identifiable points. In contrast, concentrations of pollutants in nonpoint source discharges vary considerably and are released intermittently over the length of the water-land boundary.

- *Temporal Considerations* -- Point source loadings are relatively predictable and vary little over time, as allowed by daily and monthly average limits in their NPDES permits. Nonpoint source loads are more random, and will vary with seasons, weather, topography, and soil conditions.

  Nonpoint source loadings generally increase during rainy seasons and decrease during dry seasons (one exception is nonpoint source pollution conveyed by irrigation return flows). Since rain also dilutes nonpoint source runoff with higher waterbody flows, the effects of nonpoint sources are mitigated to some extent.

  Point source loadings are relatively constant across seasons; exceptions include CSO or sanitary sewers with high inflow.

  During dry seasons, point source loadings are higher relative to a waterbody's assimilative capacity: although loadings remain constant on average, waterbody flows are reduced. For this reason, estimating loads coming from a point source during low flow periods after a trade is critical to protecting water quality year-round.

- *Chemical Considerations* -- Chemical differences can exist between the same pollutant coming from a point source compared to a nonpoint source. Pollutants from point sources typically reach waterbodies in a dissolved form, making them readily available to plants and animals. In contrast, pollutants from nonpoint sources can be attached or adsorbed to sediment when they reach water. In this form, pollutants are unavailable to create water quality problems until pollutant molecules separate from their inert companions.

- *Accommodating Differences* -- Several approaches are available to account for differences between point and nonpoint source loadings and address uncertainty about how to exchange point source for nonpoint source loading reductions in such a way that water quality standards are maintained throughout watersheds.

  For example, point and nonpoint source loadings could be compared using average loadings for each over time periods where variance is acceptable.

  TMDL margins of safety offer a way to protect water quality by setting aside a portion of pollutant allocations that reflect uncertainty about the relative effectiveness of point source and nonpoint source controls where trading is an option.

  Establishing exchange rates between point and nonpoint sources that reflect known and unknown differences in effect also are an option. Exchange rates, or trading ratios define the number of units of nonpoint source pollutant loading reduction that are equivalent to one unit of point source loading reduction. Where nonpoint source loading reductions are less certain than point source reductions (or result in less water quality improvement), point sources will pay for more than one unit of loading reduction for every unit of credit received. This "extra" reduction represents a margin of safety to help ensure that expected water quality improvements actually occur.

Institutional Issues

- Support from institutions and organizations that have relationships with point and nonpoint sources is critical to successful trading.

- Key support needs of any trading project include:

  Regulatory oversight;
  Providing information;
  Brokering and facilitation;
  Tracking and documentation; and
  Technical assistance.

- Generally, entities that already provide support to trading partners are the best candidates to perform these functions for a trading program. By matching roles and responsibilities in a trading project to current ones, point/nonpoint source trading is easily integrated into the existing water quality management framework of a given area.

Administrative Issues

- Administrative issues relate to the nuts and bolts of trading between point and nonpoint sources. Generally, they include the following activities:

Guidelines for trading (e.g., eligibility, trading ratios)
Information management and dissemination;
Facilitation and brokering;
Tracking and documentation; and
Technical assistance.

- Experience to date with point/nonpoint source trading, other types of effluent trading, and trading in other media has shown that the most successful trading projects are those that minimize administrative requirements for trading parties and their governmental partners.

- *Matching Administrative Arrangements to Trading Arrangements* -- The type of trading arrangements between point and nonpoint sources, as well as the number of trades and traders will influence how much and what kind of administrative support is needed and whether point and nonpoint sources would benefit from administrative assistance from other stakeholders.

- Examples of trading arrangements:

  ⇒ Point sources contract directly with nonpoint sources to implement BMPs or otherwise change land use practices to achieve a specified level of pollutant loading reduction.

  ⇒ Point sources buy pollutant loading reduction credits with contributions to a fund (existing or trading-specific) that pays for nonpoint source controls, BMPs, or otherwise supports quantifiable loading reductions (e.g., technical assistance, BMP maintenance, stream restoration, wetlands restoration).

  ⇒ Point sources contract with third parties, including public agencies, non-profit environmental groups, and for profit firms, to implement nonpoint source BMPs or conduct restoration activities for the specific purpose of providing quantifiable level of water quality improvement or pollutant loading reduction point sources apply to their loading reduction targets.

  ⇒ Point sources "piggy-back" trades on nonpoint source BMP or restoration projects, contributing funds to increase the size and/or scope of projects to generate a specified level of pollutant reduction or water quality improvement.

  ⇒ A governmental or private entity establishes a bank and serves as a clearinghouse for both buyers (point sources) and sellers (nonpoint sources).

  ⇒ Two or more point sources are treated as a single source -- as if under a bubble -- and trade to reach or maintain a joint loading target in any of the above scenarios.

- *Information Management and Dissemination* -- To facilitate trading, potential point and nonpoint source partners need to be able to identify each other.

    This can be accomplished by the sources independently, or
    Through a centralized service.

    Regulatory agencies, resource management departments, watershed groups, trade associations, and nonpoint source organizations are examples of candidates that can provide information about point and/or nonpoint sources to interested parties.

    Selected print and electronic media can provide forums for communication about many aspects of trading? For example, local newspapers, existing environmental and association publications, trading-specific newsletters, and electronic bulletin boards offer avenues for disseminating information about trading projects and publicizing opportunities.

Facilitation and Brokering -- In some cases, point and nonpoint source trading partners can benefit from facilitation or brokering assistance to identify, evaluate, and/or transact trades. Traders will likely look for two things in a facilitator or broker: a familiarity with participants and issues; and independence. Watershed associations, non-profit groups, private firms, and some government agencies meet these criteria.

- *Tracking and Documentation* -- At a minimum, tracking and documentation of trades provides feedback to regulatory agencies and natural resource managers to ensure that trading is consistent with water quality objectives. Additionally, following implementation of BMPs and restoration projects enables lists of candidate nonpoint source projects to be kept up to date. For larger trading projects, regular (e.g., annual, quarterly) summaries of trading activities can be an important administrative tool. Information point and nonpoint traders and other stakeholders might be interested in includes:

    Parties to a trade;
    Number loading reduction credits purchase;
    Terms of trade (e.g., type of arrangement, price, trading ratio, monitoring/maintenance conditions, etc.); and
    Location of point and nonpoint source(s).

Technical Assistance -- Because many potential nonpoint source trading partners may have had limited experience with BMPs and other pollution prevention measures, appropriate technical assistance can increase chances for successful trading. Identifying any necessary assistance is particularly important when nonpoint source owners or managers, rather than third parties, are responsible for operating and maintaining BMPs that provide loading reduction credits to point sources.

Accountability and Enforcement

- Point/nonpoint source trading poses interesting questions with respect to accountability and enforcement because a majority of potential sellers, i.e., nonpoint sources, generally operate outside of any formal system of water quality responsibilities -- pollution prevention is often voluntary. In contrast, point sources operate under a highly structured system that specifies detailed responsibilities for water quality protection.

- The resulting situation presents two types of accountability issues for point/nonpoint source trading to address:

    1. Who is responsible for ensuring that nonpoint source pollutant loading reductions occur as expected?
    2. Who is responsible for the attainment of water quality objectives?

- *Accountability for BMPs and Restoration Efforts* --

    Generally, it will be most effective for nonpoint sources or third parties to accept responsibility for properly implementing and maintaining nonpoint source pollution prevention measures.

    Nonpoint source managers, owners, and organizations that traditionally provide assistance services are most familiar with site characteristics and will have significant, direct contact with the area providing pollutant loading reduction credits to point sources. In some cases, third parties, such as contracted management firms, public resource managers, and non-profit environmental organizations also can be in a good position to be responsible for BMPs and other projects producing water quality improvements.

    All stakeholders, especially point sources, will be interested in clearly specifying responsibilities in an enforceable manner. Options include contracts between point sources and nonpoint sources or third-parties and other legally binding agreements, such as letters of agreement and memoranda of understanding

- *Accountability for Overall Water Quality* -- The Clean Water Act currently focuses pollution prevention responsibilities on point sources making them accountable for achieving water quality objectives under a trading program. Exceptions exist where TMDL load allocations, state, or local governments have identified non-voluntary water quality protection responsibilities for nonpoint sources. If preferable, Memoranda of Agreement or Understanding can be used to assign specific responsibilities to nonpoint sources beyond BMP/restoration project implementation that address effectiveness issues.

Minimizing Transaction Costs

- Transaction costs are expenses that point and nonpoint sources incur to complete a trade; third parties such as state agencies and local organizations also may face transaction costs, depending on how trading projects are designed.

- Examples include: searching for and identifying trading partners; evaluating and selecting nonpoint source reduction projects; arranging for trades and executing any legal agreements; and monitoring reductions.

- Stakeholders help reduce transaction costs by supplying both point and nonpoint sources with information on potential trading partners; contacts local governments and state agencies involved in nonpoint source pollution management, nonprofit environmental organizations, as well as watershed management, growth management, and local comprehensive plans.

- "Piggybacking": Stakeholders reduce transaction costs by sharing information about existing or planned projects where point sources could contribute additional funding to expand a project's scope and increase resulting loading reductions above those expected without point source contributions.

Reducing Uncertainty and Risk

- Reasons for risk include:

  Point sources could be concerned about how regulatory authorities might react in the event a trade produced lower loading reductions than expected.

  Point sources also could question the longevity of a trading option, resulting in an unwillingness to make capital investment choices that rely on trading.

  Nonpoint sources may be uncertain about or unwilling to accept additional pollution control responsibilities.

  Nonpoint sources also may be reluctant to discuss trading if they believe it will draw attention to previously unnoticed or unregulated sources, possibly removing a trading option and introducing new obligations.

- Clearly specifying point source and nonpoint source roles and responsibilities in permits, memoranda of agreement, contracts, and other trading documents help reduce risk and uncertainty.

- Other tools such as performance bonds can supplement trading documents and further reduce risk and uncertainty.