MARYLAND

Department of the Environment

Maryland's 2006 TMDL Implementation Guidance for Local Governments

Developed by

The Maryland Department of the Environment

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PREFACE

A TMDL, or "Total Maximum Daily Load," is the maximum amount of a certain pollutant that can be introduced to a waterbody and still meet water quality standards. TMDL implementation programs across the nation are still evolving, in part because federal regulations do not specify precise operating procedures for meeting this required element of the Clean Water Act. Until recently, Maryland has focused primarily on TMDL development, which establishes limits on pollutant loads. Now the State is moving into the implementation phase, and stakeholders involved in the transition can expect to experience "growing pains." This Guidance is being advanced to help ease the difficulties inherent in such a paradigm shift.

Implementation will be especially challenging in Maryland. Existing pollution control requirements are already stringent due to longstanding efforts to protect and restore the Chesapeake Bay. The State's population density is increasing rapidly, with high quality-of-life expectations and relatively affluent, resource-consumptive lifestyles. Despite diverging views on the subject, it is essential to anticipate and mitigate the potential impacts of continued land development. In areas where water quality standards are barely attained, or being violated, assessing the impacts of growth within the land use planning process is critical.

Much of the groundwork for TMDL implementation is being laid in Maryland via the Tributary Strategies to achieve the Chesapeake Bay Agreement nutrient goals. This TMDL Guidance complements that framework and begins to extend it to other types of water quality impairments. The product of State and local partnership, this document provides direction for gradually phasing in new technical, administrative and financial capacities needed to do the job. Such a phase-in period requires starting now, even with some operational details incomplete, and in this spirit the Guidance is being issued as an "interim" work in progress.

Its development was initiated in October 2004 following the "TMDL Implementation Workshop for Local Governments" hosted by MDE in September 2004. State and local government officials assisted as an advisory group, participating in a workshop to review the preliminary draft in June 2005, and providing valuable input. The advisory group will continue discussing operational procedures and Guidance revisions in the coming years.

DISCLAIMER

This document provides technical guidance for local governments on the implementation of Total Maximum Daily Loads (TMDLs) to meet water quality standards in Maryland. This document is not a substitute for the Clean Water Act and implementing regulations, which require that water quality standards be met. This specific guidance does not impose any additional legally binding requirements on the U.S. Environmental Protection Agency (EPA), the State of Maryland, local governments or the regulated community. Its application is entirely voluntary and can be used in complying with TMDLs. EPA, the State of Maryland, and local governments retain the discretion to adopt approaches that differ from this Guidance where appropriate. The State of Maryland may revise the Guidance in the future.

Address and E-Mail for Comments

The State of Maryland solicits comments on the "2006 TMDL Implementation Guidance for Local Governments." Send written comments to:

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EXECUTIVE SUMMARY

Maryland's 2006 TMDL Implementation Guidance for Local Governments is comprised of six parts: Background, General Guidance, Technical Guidance, Additional Guidance, a set of Appendices, and a sample "TMDL Implementation Framework" document. An Index is included to support its use as a reference document. The Guidance is also being provided in an electronic form allowing users to search for key terms.

The "Background" section, with detailed information on water quality standards, designated uses, monitoring, assessment, and TMDL development, will provide a foundation of shared knowledge. For example, people responsible for TMDL implementation should recognize that TMDLs could be developed at different geographic scales. The Guidance references two: highly localized impairments defined at the scale of small non-tidal streams, and downstream impairments to which many sources contribute from a larger watershed.

The State and federal government bear many of the formal responsibilities for TMDL implementation; however, local governments will want the capacity to make informed policy decisions and to manage relevant programs. Regardless of who is held legally responsible for ensuring consistency with TMDLs, the repercussions of falling short would be felt at the local level. Consequently, local governments have a strong incentive to acquire the capacity to develop and execute implementation policies and procedures.

The Guidance emphasizes the need to institutionalize TMDL implementation within the routine operations of existing programs, and initiates a joint State and local exploration of management methods that are cost-effective, minimally disruptive to economic development and administratively tractable. Section 3.1, "Guidance for Local Policymakers," urges local governments to begin building technical, financial and administrative capacity in anticipation of the challenges that lie ahead.

The "General Guidance" recommends two near-term steps for local governments to take: 1) identify a multi-agency TMDL implementation coordinating committee to help formulate policies and procedures, serve as liaison for dialogue with the State, and begin enhancing capacity; and 2) draft a "TMDL Implementation Framework" document that describes local agency roles, policies and procedures. This framework document is intended to provide a common point of reference for a complex multi-agency endeavor. A template of the framework document, in the form of a word-processing file, is being made available as a supplement to this Guidance.

The "Technical Guidance" is organized to address the two basic aspects of TMDL implementation: 1) reducing excess pollutant loads, and 2) offsetting new loads. Maryland's antidegradation policy, which protects high-quality waters from negative impacts, is also addressed. Although the Guidance is not a "How To" manual on developing TMDL implementation plans, it outlines the State's current thinking on the subject, and applicable implementation planning manuals and procedures for estimating nonpoint source reductions.

The Guidance recommends that local governments immediately work within the context of the Tributary Strategy process to address nutrient TMDLs. During 2006, the State-wide Tributary Strategy implementation plan will be refined to address the ten major basins in Maryland that drain to the Chesapeake Bay. In time, these plans will be refined further. The State is developing tools for general use, which will simplify and standardize nutrient load reduction analyses.

Offsetting future loads is already being done in Maryland, as the following tangible instances demonstrate: 1) stormwater retrofit requirements for redevelopment; 2) the State's nutrient cap management strategy for point sources; 3) the "10% Rule" for pollutant reductions under the State Critical Areas law; 4) State policy on offsetting increased loads from development expressed in guidance for implementing the 1992 Planning Act; and 5) no-net-loss wetlands mitigation programs.

The Maryland Department of the Environment (MDE) is actively pursuing a comprehensive nutrient offset policy. The State is presently managing point sources with the nutrient cap management strategy. A hypothetical example of a comprehensive offset analysis for a watershed is provided in Appendix F.

The "Additional Guidance" section discusses tracking, assessment, and land use planning issues. Tracking is central to accounting for the reduction and offsetting of new loads. Local governments are encouraged to continue tracking pollution control activities associated with current programs in order to document credit toward TMDL implementation. The Guidance also advises tracking changes in natural land cover, such as forest and wetlands, as well as impervious cover and new pollutant sources. Monitoring is critical to evaluating TMDL implementation, because progress is ultimately determined by assessing water quality. The State is responsible for identifying impaired waters and evaluating progress. Local governments or other regulated entities may conduct additional monitoring to document the effectiveness of innovative projects, or supplement State monitoring.

Land use planning (the continuum of comprehensive, functional, infrastructure, and site planning) will play a role in TMDL implementation. Innovative land use planning techniques that anticipate the effects of land use changes on pollutant loads are strongly encouraged. This will help optimize consumption of the limited nonpoint source load allocation, and minimize the administrative burden of offsetting new loads on a project-by-project basis.

It is important for local governments to interface with agricultural agencies. In many jurisdictions agriculture is central to the local economy and a critical component of pollution loads. Support for rural residential communities, and ensuring that water quality protection decisions are balanced with respect to sustaining the rural economy, are important considerations.

Case studies are provided to illustrate opportunities and offer technical insights. They also encourage contact and dialogue among professionals. One case involves land use planning in which the percentage of impervious cover is quantified and maintained within a range of 10%-15%. Although the example is not tied directly to a TMDL, the quantitative nature of the analysis exemplifies how land use planning should be conducted relative to TMDLs. A second case study describes a nutrient TMDL considered in the context of a county land use planning process. As the Guidance evolves, additional case studies will be collected and shared.

In summary, this Guidance provides background and interim direction to help local governments position themselves to address the paradigm shift associated with implementing TMDLs. It will serve as a guiding framework over the coming year as the State continues to engage local governments in evaluating and adopting a variety of new operational procedures. It will also serve as the repository for documenting refinements to these rapidly evolving procedures.

1.0 INTRODUCTION

The federal Clean Water Act (33 U.S.C. §§ 1251-1387) allows the U.S. Environmental Protection Agency (EPA) to delegate authority to states and Tribes to implement a systematic technical and administrative framework for managing water quality. Those delegated responsibilities include setting water quality standards, assessing water quality, identifying waters that do not meet standards, establishing limits on impairing substances, and issuing permits to ensure consistency with those pollutant limits.

For waters that do not meet water quality standards due to an excessive pollutant load, the State must conduct a scientific study to determine the maximum amount of the pollutant that can be introduced to a waterbody and still meet standards. That maximum amount of pollutant is called a Total Maximum Daily Load (TMDL), and the studies are called "TMDL Analyses," or simply TMDLs. The TMDL report is reviewed by the public, revised, and then submitted to the EPA to be considered for approval.

Although consistency with water quality standards is required under federal law, federal regulations and guidance do not prescribe all of the specific steps necessary to achieve and maintain standards. In particular, the federal government does not prescribe procedures for implementing TMDLs.

In Maryland, some legal responsibilities for water quality management, like sediment and erosion control and stormwater management associated with land development, are delegated to local governments. Other activities that have a strong bearing on water quality, such as land use planning and many aspects of land use development, also fall within their purview.

To maintain control over decisions that affect their communities, local jurisdictions have a stake in how the State's legal responsibilities for maintaining water quality standards are executed. In particular, local governments have an interest in the implementation of TMDLs. They are also best situated to address many aspects of implementation, due to their geographic proximity to the impaired waterbodies, and their direct role in decisions that affect local water quality.

Because specific federal procedures for implementing TMDLs are lacking, it is logical for State and local governments to work jointly in developing TMDL implementation procedures. Although this TMDL Implementation Guidance represents a joint State and local initiative, the Maryland Department of the Environment (MDE) assumes responsibility for its content. MDE invites local government representatives to continue engaging in refinements to the Guidance in the coming year.

2.0 BACKGROUND

The following background information provides a broad context for approaching the subject of TMDL implementation. It is intended to help local jurisdictions devise their own ways of approaching many TMDL implementation issues that cannot be anticipated by this guidance document. The background is also a prerequisite for understanding certain subjects addressed elsewhere in the document.

2.1 An Overview of the Clean Water Act Framework: Context for TMDL Implementation

The federal Clean Water Act (CWA) provides a systematic framework for managing water resources. The following outline summarizes the key elements in sequential order.

- Water Quality Standards
  - Designated Uses
  - Criteria for Meeting the Uses
  - Antidegradation Policy
- Water Quality Monitoring Strategy for State-wide Water Quality Assessment
- Data Management and Analysis
- Water Quality Reporting (Integrated 305b Report and 303d List of Impaired Waters)
- Intensive Monitoring and Information Collection to Support TMDL Development
- TMDL Development
- TMDL Implementation Planning and Execution
- Evaluation of implementation measures and the water quality response to those measures
- Continuous Planning Process (CPP)

Each element in the sequence supports the next element; for example, water quality standards indicate what to look for when conducting water quality monitoring. The public is provided an opportunity to review most steps in this sequence. This CWA framework is designed with the understanding that new insights gained at each step of the process can be used to continually improve the elements of the framework.

2.1.1 Water Quality Standards

Water quality standards address the federal requirement "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Clean Water Act §101). The broad term "water quality standards" encompasses the adoption of "designated uses" and specific "criteria" that indicate whether or not the uses are being achieved. For example, coldwater streams should support the "designated use" of naturally reproducing trout fisheries. In turn, naturally reproducing trout fisheries require that specific "criteria" be met for temperature, dissolved oxygen, physical habitat and other characteristics. This section provides basic background on water quality standards. Consult the Index for additional references to Water Quality Standards.

2.1.1.1 Designated Uses

Uses are identified by taking into consideration the use and value of the waterbody for public water supply; for protection of fish, shellfish, and wildlife; and for recreational, agricultural, industrial, and navigational purposes. Designated uses provide the foundation upon which waters of the State are managed under the Federal Clean Water Act. States and Tribes examine the suitability of a waterbody for the uses based on the physical, chemical, and biological characteristics of the waterbody, its geographical setting and scenic qualities, and economic considerations. Social preferences regarding the expectations for water quality, and trade-offs in conflicting goals, are determined through the public process of establishing designated uses. Designated uses may be goals for a waterbody, but must protect "existing uses"[1] and should be attainable. Once designated uses are established, water quality criteria are determined with sufficient coverage of parameters and of adequate stringency to ensure the protection of the designated uses. Water quality criteria are narrative or numeric expressions for pollutant thresholds not to be exceeded. Generally speaking, criteria are inviolate, meaning that, as a society, we have agreed not to violate standards regardless of implications *unless* we agree to change the underlying designated uses through an open public process, which then allows for the criteria to be changed in response (see Use Attainability Analysis below).

2.1.1.2 Antidegradation Policy

The water quality standards regulations require States to establish a three-tiered antidegradation policy. The specific steps to be followed depend upon which tier or tiers of antidegradation apply. Antidegradation implementation procedures identify the steps to take and questions that must be addressed when regulated activities are proposed that may affect water quality. Most relevant to Maryland presently are "Tier 2" waters, classified as "high quality," for which special protections are required beyond those that apply to all waters.

Tier 1 maintains and protects existing uses and water quality conditions necessary to support such uses. An existing use can be established by demonstrating that fishing, swimming, or other uses have actually occurred since November 28, 1975, or that the water quality is suitable to allow such uses to occur. Where an existing use is established, it must be protected even if it is not listed in the water quality standards as a designated use. Tier 1 requirements are applicable to all surface waters.

Tier 2 maintains and protects "high quality" waters -- waterbodies where existing conditions are better than necessary to support CWA § 101(a)(2) "fishable/swimmable" uses. Water quality may be lowered; however, State and Tribal Tier 2 programs must identify procedures to be followed and questions that must be answered before a reduction in water quality can be allowed (See COMAR 26.08.02.04 and .04-1). In no case may water quality be lowered to a level that would interfere with existing or designated uses.

Tier 3 maintains and protects water quality in outstanding national resource waters (ONRWs). Except for certain temporary changes, water quality cannot be lowered in such waters. ONRWs

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[1] The uses that were actually being met in November of 1975.

generally include the highest quality waters of the United States. However, the ONRW classification also offers special protection for waters of exceptional ecological or recreational significance, *i.e.*, those that are important, unique, or sensitive ecologically or aesthetically. Decisions regarding which waterbodies qualify to be ONRWs are made by States (COMAR 26.08.02.04-2) and authorized Indian Tribes.

2.1.1.3 Use Attainability Analyses

The process of changing designated uses involves conducting a use attainability analysis (UAA). A UAA is necessary when there is significant uncertainty as to the attainability of designated uses that were previously established (remember, designated uses may be waterbody "goals", and should be attainable when established). For example, setting a goal to have aquatic life representative of a forested watershed as the desired result in an urban stream, or the goal of water quality for swimming to be available in waters highly impacted by bacteria from wildlife sources that cannot be reduced since they are naturally occurring, may not be attainable.

A UAA is "a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in 40 CFR Sec. 131.10(g)." The six factors include natural and manmade effects that may irretrievably impact the potential use attainment in a waterbody, as well as the potential for widespread social and economic impacts required to attain the standards. A UAA supports a regulatory change to remove or lower a designated use, or to designate less restrictive criteria to protect a given set of uses, and to designate the "highest attainable use", based on the results of the UAA. Since a UAA is a scientific study, any group (state or local government, developer, industry, watershed organization, *etc*.) may perform the study.

The decision to change a water quality standard based on the information contained in the UAA is a public process that is regulatory in nature, and may only be performed by the Department of the Environment. The water quality standards for these waterbodies must be re-examined every three years (normally during a Triennial Review) to determine if new information has become available that would warrant a revision of the standard. If new information indicates that designated uses, which were previously determined unattainable through the UAA process, can now be attained, such uses must be designated.

Part of the requirements of a UAA is the determination of the "highest attainable use". This is a reflection that the existing conditions observed at the time of the UAA are not acceptable, even though the designated uses, as established, are not attainable. Determining the "highest attainable use" may be accomplished through modeling the effects of implementation of permits, comparison of reference sites or maximum feasible application of Best Management Practices (BMPs). Once determined, the highest attainable use is reflected in the new water quality standards. Although lower than the original standards, meeting the newly established standards may be a long-term process. It may be desirable to develop adaptive management plans that demonstrate commitment to, and implementation of, improvements to achieve the new designated uses and criteria. The State is required to review these areas every three years at a minimum, and to upgrade water quality standards if data indicate water quality standards meeting the requirements of the CWA can be attained.

2.1.2 Water Quality Monitoring Strategy for State Assessment

The Clean Water Act requires all waters of the State to be assessed on a periodic basis. The State maintains a water quality monitoring strategy, which among other things, describes how this requirement is addressed in Maryland (MDE, 2004).

Water quality monitoring for State-wide assessment is conducted in a way that ensures the resulting data will be sufficient to assess whether or not the standards are being met[2]. For example, when monitoring coldwater streams, a number of parameters must be measured, including dissolved oxygen, temperature, pH and the biological integrity of the stream.

Consider the dissolved oxygen criteria for the naturally reproducing trout designated use. For all non-tidal waters of Maryland, regardless of whether they are trout waters, dissolved oxygen (DO) concentrations must be above 5.0 mg/l at all times (some exceptions apply for deep waters in tidal areas and impoundments). However, because trout are particularly sensitive to oxygen needs, trout waters have the additional requirement of keeping the average DO above 6.0 mg/l. This implies that, for trout waters, monitoring data must be collected in a manner that allows both of these DO thresholds to be assessed.

In summary, water quality monitoring methods are designed to reflect the needs of assessing water quality standards. Monitoring provides a foundation for the following step, the analysis of water quality data to determine if standards are being achieved.

2.1.3 Data Management and Analysis

The monitoring of water quality often entails sending samples to laboratories where they are analyzed and the results are recorded. In addition to the water quality results, this process generates vast amounts of information that supports the assurance of the data's quality. The reliable transfer and management of such data is essential due to the vital importance of this information and the expense and staffing expertise involved in performing this function.

The Maryland Department of Environment (MDE) uses the US EPA's STORET data management system for storing and reporting this information. Further discussion of this process is beyond the scope of this guidance.

2.1.4 Integrated Water Quality Assessment (Identification of Impaired Waters)

The assessment of water quality monitoring data is done according to water quality standards, *i.e.*, determining if waters of the State are meeting their designated uses. Conceptually, this involves comparing the monitoring data to criteria, like 5.0 mg/l for dissolved oxygen in non-tidal waters. However, because data cannot be collected at all times in all places, they are an imperfect representation of the real world. The State is also required to consider all readily

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[2] In some cases initial screening monitoring is conducted with the intent to perform verification monitoring if a potential violation is indicated.

available data from the previous five years, some of which might have been collected for purposes other than assessing the attainment of water quality standards.

Consequently, systematic procedures for interpreting the data have been developed and documented to ensure a consistent, reproducible process for determining whether or not a water quality standard is violated. Procedures have been developed for all major categories of media (*e.g.*, water, sediment, fish tissue) that are monitored. These procedures are subject to public review and comment during the public process for the biennial release of the "Integrated List". See Chapter 8, "Listing Methodologies," of Maryland's Integrated Water Quality Assessment report.
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/final_2004_303dlist.asp

This integrated assessment report combines a comprehensive inventory of water quality, required by Section 305(b) of the CWA, with a list of impaired waters commonly called "the 303(d) list," required by Section 303(d) of the CWA. The integrated assessment is documented in the form of a 5-part list intended to represent all possible classifications of water quality status.

Category-5 of the integrated inventory constitutes the 303(d) list of impaired waters for which TMDLs are to be developed. This list identifies the pollutant causing the impairment, and identifies priorities and scheduling information for TMDL development[3].

In summary, waters of the State are assessed by comparison of water quality data to the established water quality standards, using documented methodologies. A list of waters not achieving standards, after all required management measures are in place, is reported to the US EPA and constitutes the waters for which TMDL analyses are required (the 303(d) list).

2.1.5 TMDL Development

As noted above, the 303(d) list identifies waters that fail to meet standards even after all of the required management measures are in place. The logic of the Clean Water Act is fairly straightforward. If the required pollution management measures are in place, but the remaining pollutants still cause the water quality standards to be violated, then it is necessary to conduct a scientific study of the waterbody to determine a "pollution budget" that will meet water quality standards. This study is commonly called a "TMDL analysis," because it determines the Total Maximum Daily Load (TMDL) of the impairing pollutant that may go into the affected waterbody without causing a water quality impairment[4].

[3] To be precise, the 303(d) list of impaired waters is actually a subset of impaired waters that fail to meet standards even after all of the minimum required management measures are in place. Waters that are impaired solely because minimum management requirements are not in place are not included in the 303(d) list. Instead, these waters are listed on Part 4b of the integrated list and other actions are taken to implement required management measures.
[4] It should be noted that some water quality standards violations are not conducive to TMDL analyses in the traditional sense of setting a loading limit expressed in terms of mass per unit time. Federal regulation 40CRF 130.2 requires TMDLs to be expressed in terms of mass per unit time, toxicity or other appropriate measure. TMDLs that are not expressed in terms of mass per unit time (loads) are referred to as "Non-traditional TMDLs," (See Section 2.3.3).

That is, the essence of a TMDL analysis is to quantify the maximum amount of the impairing substance or stressor that the waterbody can assimilate without violating standards. In doing so, the TMDL analysis defines a quantified framework for TMDL implementation, discussed briefly below.

Typically the TMDL is developed using some sort of waterbody simulation. EPA has developed several programs to help states do this, and there are other programs and models available as well. Typically there are two parts to the simulation process. The first part simulates the land part of the watershed, and, based on land use, estimates the loads of a pollutant that will be delivered to the waterbody. The second part simulates what happens when the pollutant gets into the waterbody and includes transport, transformations, and losses. Results include the prediction of water quality parameters, such as dissolved oxygen or chlorophyll concentrations. Using these models to run various "scenarios," State technical staff can estimate the maximum loads of the pollutant that would result in acceptable water quality (*i.e.*, within the criteria limit).

In some cases, the stressor may not be a substance that can be expressed in traditional terms of a load (mass per unit time). An example of this situation might be a trout stream impacted by increased water temperature due to clearing of riparian buffers. This would require a non-traditional approach that expresses the TMDL in quantified terms other than a load. Recently, one of the Midwestern states approached this problem, but not through a traditional engineering expression (*i.e.*, BTU reduction per unit area); rather, they expressed the TMDL in terms of percent effective shade, a concept amenable to public communication. Implementation of this type of TMDL would require a simple calculation of required canopy cover (% effective shade) in the riparian area, as well as the number of stream miles to be replanted with buffers.

Note that the 303(d) listings identify the combination of a waterbody and a substance or stressor that is causing a standard to be violated. Thus, it is possible for a single waterbody to have multiple 303(d) listings for a number of different impairing substances, implying the potential for more than one TMDL to be required for a single waterbody.

In summary, TMDL analyses are conducted for waters identified on Maryland's 303(d) list, which identifies specific pollutants causing a particular waterbody to violate a water quality standard. The resultant TMDL is a measure of the maximum allowable amount of the pollutant that can be assimilated by the waterbody. The TMDL provides a quantified management goal that guides TMDL implementation.

2.1.6 TMDL Implementation Planning and Execution

As emphasized above, water quality standards represent the basic benchmarks that guide how pollutants entering waters of the State are managed. TMDL analyses quantify the maximum allowable amount of a given pollutant, or stressor, from all sources that may enter a particular waterbody. Taking a broad view, every action and decision intended to restore or protect water quality standards can be viewed as being part of the TMDL implementation process. This is true even if a TMDL analysis has yet to be conducted, or the benefits of the activity or decision cannot be quantified. This implies that local governments may take credit for many ongoing activities. Local governments are encouraged to begin communicating this broad view of TMDL implementation to the public.

A more narrow perspective of TMDL implementation builds upon the essence of a TMDL analysis, which is to establish a quantified framework for managing pollutants. The concept is best understood as it applies to managing pollutants from traditional point sources, like waste water treatment plants, and those from nonpoint sources that wash off the land during rain events[5]. From this perspective, the effects of management actions, typically called "Best Management Practices" (BMPs), can often be estimated in quantified terms. This perspective suggests the potential to establish accounting frameworks for managing certain pollutants. Such a quantified framework has been established for managing nutrients under the Chesapeake Bay Agreement. This topic is elaborated in Section 2.3.2 "Traditional TMDLs" and in Section 4.0 "Technical Guidance."

As discussed below in Section 2.3.3, "Non-Traditional TMDLs," it is possible that some future TMDLs will address water quality impairments in a "non-traditional" manner. Although such TMDLs would be required to identify quantified management actions, these actions would not be expressed in terms of pollutant loads, that is, mass per unit time like "pounds per year." Instead, the elements of non-traditional TMDLs could be expressed in terms of quantified stream restoration actions to address impairments revealed by biological data. For example, a stream that is biologically impaired may require a stream restoration effort to reduce the stream's hydraulic energy flow and thereby reduce erosion and sedimentation, rather than a control process such as a sewage treatment plant. This subject is still somewhat uncertain, and the State awaits policy direction from the US EPA.

In summary, local governments are advised to characterize their ongoing water pollution management activities in terms of TMDL implementation and standards attainment (including antidegradation policy implementation), when applicable. In time, local governments and the State will need to enhance their technical and administrative capacities to manage pollutants in a quantified manner.

2.1.7 Evaluation of TMDL Implementation

The evaluation of TMDL implementation involves two assessments, for which the State is generally responsible. First, verify that the pollution control practices deemed necessary to achieve the TMDL load reductions have been implemented. Second, the evaluation process should include water quality monitoring to determine whether water quality standards have been achieved. Evaluation monitoring should be conducted at the appropriate restoration stage, and over enough years to account for potential lag-times before drawing conclusions (e.g., to account for riparian reforestation maturity, or groundwater flushing).

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[5] Note that regulated stormwater, subject to an NPDES stormwater permit, is formally classified as a point source as of November 2002 (EPA, November 2002). This implies an increased level of rigor in managing this classification of stormwater-related pollutants.

It is possible that the water quality standards will continue to be exceeded even after implementing all of the pollution control practices deemed necessary to achieve the TMDL. At least five possible scenarios might lead to this circumstance.

First, the current baseline NPS pollutant load was under-estimated during the implementation planning process. This implies that more BMP implementation is needed than originally predicted. Similarly, it is possible that unknown nonpoint sources were not accounted for when estimating the baseline load.

Second, it is possible that the assumed effectiveness of the BMPs was overly optimistic so that less pollutant reduction was achieved than expected.

Third, it is possible that all of the necessary BMPs have been implemented, but that it takes time for the BMPs to have the desired effect. For example, it could take several years for nitrates to be flushed from the groundwater, or for riparian forest buffer plantings to reach maturity. Bottom sediments might also need a period of time for natural recovery after pollution inputs have been reduced.

Fourth, it is possible that the TMDL analysis over-estimated the assimilative capacity of the waterbody. That is, the waterbody can safely absorb less pollution than predicted by the TMDL analysis. A review of the TMDL analysis might be warranted.

Finally, if all of the feasible control actions have been undertaken, and the TMDL analysis is technically sound, but the water quality standards still are not being achieved, then attention must be given to the water quality standards themselves. The State conducts a review of the standards on a three-year cycle.

As this discussion suggests, the Clean Water Act lays out a systematic framework for managing our water resources. The process is designed to be "self-correcting" in the sense that, at each step of the framework, new information is generated that can be used to refine other elements of the framework. These procedures are documented according to a procedure described in the following section.

2.1.8 The Continuing Planning Process

The Clean Water Act Section 303(e) requires each State to document their water quality management operating procedures in the form of a Continuing Planning Process (CPP) document. At a minimum, the CPP must address procedures for point source permitting, management of residual waste from treatment plants, TMDL development, intergovernmental cooperation, water quality standards enhancements, and revision of the CPP itself.

By exercising the Clean Water Act framework outlined above, new insights about water quality management are gained. As the State's operating procedures are modified to reflect these new insights, revisions are made to the CPP.

2.2 Key Elements of a TMDL Analysis and Implications for TMDL Implementation

This section provides an overview of the TMDL development process. Understanding how TMDLs are developed in Maryland will help lay a foundation for thinking about implementing TMDLs. Due to the variety of impairing substances (nutrients, sediments, toxic substances, bacteria, imbalanced pH, undetermined biological impairments), and types of waterbodies for which TMDLs are developed (shallow non-tidal streams, large non-tidal rivers, small and large reservoirs, small and large tidal estuaries, and ocean waters) the specific technical aspects of the TMDL analyses can vary widely. However, all TMDL analyses include key elements required for approval by the U.S. Environmental Protection Agency (US EPA, 1999). The following subsections address each of these key elements.

2.2.1 Identify the Impairment

Identifying the impairment being addressed by the TMDL implies the following:

a. Identify the waterbody and watershed draining to the waterbody. This information helps identify the geographic extent of the impairment and sources that contribute to the impairment (See Source Assessment below).
b. Identify the impairing substance and the water quality parameter(s) that respond to different amounts of that substance. For example, a nutrient like phosphorus is a common impairing substance, and chlorophyll *a* and dissolved oxygen are the parameters that respond to different levels of nutrients.
c. Provide the data that verifies and characterizes the impairment: Geographic location and extent; temporal aspects such as frequency, duration, seasonality; degree of criterion exceedance.

TMDL implementation should focus on the specific impairment described in the TMDL, which should be consistent with the original 303(d) listing. The characterization information could help target the implementation, both geographically and temporally.

2.2.2 Identify the Water Quality Endpoint

Identify the water quality endpoint that must be achieved by the TMDL analysis. TMDLs must be developed to achieve water quality standards. Thus, the water quality endpoint used in the TMDL analysis should be consistent with the water quality criterion that is exceeded and led to the waterbody's 303(d) listing.

Chapter 8 of Maryland's Integrated Water Quality Assessment provides written documentation of the "Listing Methodologies." These describe how the water quality monitoring data are interpreted to determine if the waters meet standards. Although these data analysis procedures do not always translate precisely to the water quality modeling tools used for TMDL development, they provide the best basis for ensuring consistency between the 303(d) listing process and the TMDL development process.
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/final_2004_303dlist.asp

For more information on water quality criteria see Section 5.2.2 "Resources."

The significance of the water quality endpoint for TMDL implementation is that it sets the threshold for evaluating success. Although this might seem fairly obvious, the subtleties of collecting and interpreting water quality data can be profound. For example, striving to achieve a water quality parameter threshold at all times or over a particular averaging period can produce vastly different results.

2.2.3 Source Assessment

A source assessment of pollutants, including natural and anthropogenic contributions, is required as part of the TMDL analysis. The maximum load must account for all sources, including atmospheric deposition and natural sources. This is because the TMDL represents the physical capacity of the waterbody to assimilate the pollutant of concern, regardless of where the pollutant originates.

The source assessment information will direct implementation to the areas contributing most to the problem. Source assessments typically must be refined during TMDL implementation planning and should be reviewed during the implementation evaluation process.

2.2.4 The TMDL

The TMDL must be clearly reported. The definition of a TMDL in Federal Regulation states that, "TMDLs can be expressed in terms of either mass per unit time [traditional load], toxicity, or other appropriate measure" (40CRF130.2). This definition is fairly flexible, including the traditional concept of pollutant loads, for example pounds of nitrogen per month. It also allows for the adoption of non-traditional TMDL methodologies, as long as such methods include sufficiently quantified "other appropriate measure(s)."

For some pollutants, different TMDL limits are set for different seasons, as discussed further below under "Critical Conditions and Seasonality." It is also noteworthy that the phrase "Daily Load" is not interpreted literally to mean mass per day. In some cases, it is more sensible to express the TMDL in terms of mass per month, or not even use mass per unit time. This understanding is clear from the broad regulatory definition cited above, and has been upheld by the courts.

The essence of a TMDL is to quantify an upper threshold on the pollutant or stressor. This establishes a rational framework for quantifying management controls to achieve the quantified TMDL. In some non-traditional TMDLs, discussed below, the quantified management actions are in-and-of-themselves the TMDL.

2.2.5 Waste Load Allocations and Load Allocations

Waste load allocations to point sources and load allocations to nonpoint sources must be identified by the TMDL analysis. That is, the TMDL, which includes natural and anthropogenic sources, must be divided among point sources and nonpoint sources as depicted in the following equation:

TMDL = Waste Load Allocations (WLA) + Load Allocations (LA) + Margin of Safety

The choice of allocations is solely the discretion of the State, provided that it is balanced in a reasonable way between source categories (See Reasonable Assurance below).

Maryland takes the view that the formal TMDL, which is approved by the US EPA, need only identify one broad aggregated WLA and one aggregated LA. That is, the TMDL need not identify separate allocations for each individual point source and nonpoint source in the study area. However, for general planning purposes, Maryland provides a "Technical Memorandum" with each TMDL report, which describes a more detailed partitioning of the TMDL among individual sources.

It is noteworthy that, as of 2002, EPA requires urban stormwater sources managed under an NPDES permit (municipal and industrial) be classified as waste load allocations (point sources) for the purpose of TMDL analyses (EPA, Nov. 2002).

NPDES permits, including those for regulated stormwater, must be consistent with TMDL allocations. Because allocations might change over time, administrative procedures for modifying allocations must be developed as part of the TMDL implementation framework. Reallocation procedures must include formal public participation.

2.2.6 Margin of Safety

A margin of safety (MOS) protective of the environment must be included in the TMDL. The MOS is intended to account for our limited knowledge of how the natural environment functions, the information available to estimate cause-and-effect relationships of pollutants in waterbodies, and other uncertainties.

The MOS may be expressed as an explicit amount of the maximum allowable pollutant load, which is set aside (not allocated to any source). Alternatively, the MOS may be expressed in terms of conservative assumptions incorporated into the analysis process.

In principle, as a greater understanding of the natural setting is gained over time, and can be factored into future refinements of TMDL analyses, the MOSs can be reduced. This would allow for more of the TMDL to be allocated to active sources.

2.2.7 Critical Conditions and Seasonality

Critical conditions and seasonality must be considered when establishing TMDLs and allocations. For example, algae growth, and the resultant bacterial decomposition that causes oxygen consumption, tends to be most pronounced during summer months. During this season there is more sunlight to promote photosynthesis and warmer water in which bacteria that consume dead algae are more active. It is also during this season that stream flows tend to be lower, resulting in less dilution of nutrient loads from waste water treatment plants. In recognition of these natural, seasonal phenomena, TMDL analyses often identify a number of thresholds that differ according to season.

For traditional point sources, the seasonality considerations of TMDL analyses often determine the maximum treatment technology, and plant operations requirements (including spray irrigation, oxygenation, etc.) that must be adopted by the plant. Because of inter-annual variability in precipitation, nonpoint source controls are usually accounted for on an average annual basis. In some natural settings, living resource life-cycles are particularly vulnerable during certain times, such as spawning seasons. TMDLs are intended to ensure that the timing of human activities, such as dredging and herbicide applications, does not conflict with these critical periods.

2.2.8 Reasonable Assurance of Implementation

The TMDL documentation includes a section that explains how the nonpoint source allocation will be attained. The intent is to ensure that the burden of pollution control not be shifted from the regulated point source sector to the unregulated nonpoint source sector as a means of easing the permitting process.

This section of the TMDL document provides an overview of the programs that will be used to implement the TMDL. It can be viewed as a cursory TMDL implementation plan, and should be consulted during the implementation planning process.

2.2.9 Public Participation

The TMDL development process must include a formal public review prior to submittal to the US EPA for approval.

Any significant future changes in the TMDL, for example, the significant redistribution of the allocations, necessitates a formal public review process. This ensures that stakeholders, who might have long-range plans that are dependent on expectations regarding the allocations, will be fully informed of any potential changes.

2.3 Diverse Types of TMDLs: Implications for Implementation

Understanding the TMDL is a basic prerequisite to its implementation. This section provides an overview of the variety of TMDLs developed in Maryland.

2.3.1 Diverse Types of Impairments

Recall that, for a given waterbody, a separate TMDL must be developed for each pollutant. For example, a reservoir might be impaired by both phosphorus and sedimentation. Consequently, two separate TMDLs would be needed for that reservoir. As indicated below in Figure 1, the State waters are impaired by a wide variety of pollutants in addition to the special case of impairments reflected by low indices of biological integrity (biological impairments).

In addition, a wide variety of different types of waterbodies are affected including: tidal rivers, tidal estuaries, non-tidal streams and rivers, various segments of the Chesapeake Bay, the coastal bays, and reservoirs of varying sizes. Furthermore, impairments can be expressed in the water itself, the physical habitat, the bottom sediments, or as bioaccumulated toxins in fish tissues.

In some cases, impairments exist long after the human activities that generated a particular pollutant have stopped. For example, bottom sediments and fish tissue can remain contaminated by toxic substances even when no new loads of that substance are entering the waterbody. This situation is commonly called a "legacy pollution" type of impairment.

Legacy pollution impairments pose a unique set of challenges. Because there are no active sources to "turn off," achieving pollutant reductions takes on a different meaning. Reductions can be achieved in two broad ways, either by allowing natural attenuation to reduce the pollutant over time or by conducting a cleanup process. The cleanup option is often complicated. In some cases, small amounts of toxic substances are spread over large areas, challenging the concept of a traditional cleanup. In other cases, there are concerns that stirring up bottom sediments during a cleanup process could create worse problems. Additionally, if large volumes of material are accumulated in a cleanup, that material must be treated or disposed of, which can present another host of environmental and social challenges. TMDL implementation for legacy impairments also implies that new sources of the pollutant cannot be offset easily.

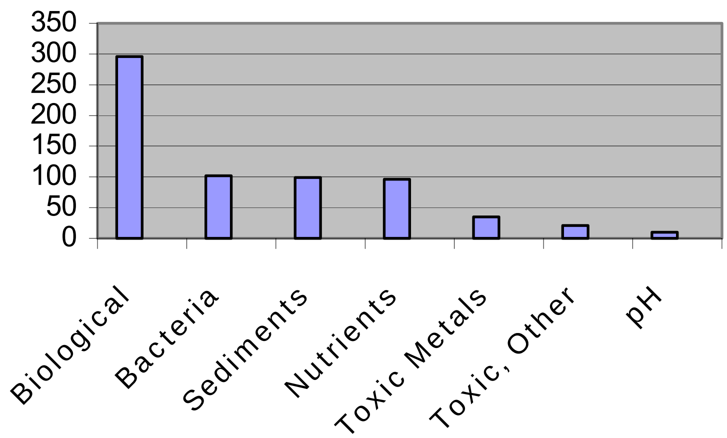

Figure 1 Types of Impairments Identified Maryland's 303(d) List as of 2004

The special case of legacy impairments suggests that different pollutant sources can affect the way in which a TMDL analysis and TMDL implementation is conducted. Mercury impairments in lakes, expressed by elevated concentrations of methylmercury in fish tissue, represent another example. Although a lake has one assimilative capacity for mercury (the TMDL for that lake) the method used to derive the TMDL would probably differ if atmospheric deposition was not the predominant source. Similarly, the means of implementing the TMDL would differ significantly depending on the kinds of sources that need to be controlled.

In summary, the approach to TMDL implementation can vary greatly depending on the type of pollutant or stressor, the waterbody type and the source of the pollutant. This is elaborated upon in the following subsections, which address traditional TMDLs and non-traditional TMDLs.

2.3.2 Traditional TMDLs

Recall from above, federal regulation states that, "TMDLs can be expressed in terms of either mass per unit time, toxicity, or other appropriate measure" (40CRF130.2). TMDLs expressed as a "mass per unit time," or "load" represent the traditional concept of a TMDL.

TMDLs for nutrients are expressed in the traditional manner, that is, in terms of loads. Because of Maryland's long involvement in efforts to restore the Chesapeake Bay, significant attention has been devoted to nutrient impairments in tidal waterbodies. Given the prominence of the issue and technical experience gained over the years, Maryland's initial TMDLs focused on nutrients. Consequently this guidance document focuses on nutrient impairments in tidal waters.

Some toxic substances can be addressed in traditional terms of loads, provided they do not bioaccumulate or accumulate in the bottom sediments. Mercury in reservoirs, for example, is expressed in loads, although the primary source is atmospheric deposition. Biochemical oxygen demand (BOD), which is a measure of organic matter, can also be addressed in terms of loads. TMDLs that address excessive reservoir sedimentation are expressed in terms of loads. The units might vary, with toxic substances often being expressed in small units of mass and short time periods, BOD being expressed in more intermediate terms, and sediments being expressed in large units of mass and longer time periods.

2.3.3 Non-Traditional TMDLs

TMDLs expressed in terms of "toxicity or other appropriate measure" can be called "non-traditional" TMDLs. Although Maryland has not developed many of these, the concept is worth noting, because as we begin to address biological degradation, non-traditional TMDLs will likely become increasingly important.

The potential types of non-traditional TMDLs are limited only by the creativity of TMDL development practitioners. The primary criterion for any TMDL is that the stressor must be expressed in a quantitative manner, and linked by cause-and-effect to the relevant water quality standard cited in the 303(d) listing.

In one case where chlordane, a banned termite pesticide was identified as the pollutant, the 303(d) impairment was expressed in terms of excessive fish tissue concentrations. Although some trace amounts might continue to come from the non-tidal streams, data indicated that the dominant source of chlordane was bottom sediments in the receiving waterbodies (reservoir and tidal estuary). Historic sampling seemed to indicate that chlordane concentrations in bottom sediments were decreasing, suggesting that this was a legacy pollution problem.

The working theory was that fish tissue concentrations were predicted to decrease as the waterbodies recovered naturally over time. Because the dominant source was the bottom sediments, a flux and load from the bottom could have been computed; however, the essential limit needed to prevent fish tissue accumulation was a threshold on the concentration in the water column. Although the load from the bottom is a function of bottom area, and could be computed, the water column concentration remains the same, regardless of whether the bottom area was one square meter or one square mile. In other words, the concentration, and not the load from the bottom sediment, was what determined the fish tissue concentration.

Based on this logic, and several other factors, an agreement was reached with EPA to express the TMDL in terms of "toxicity." That is, the TMDL is expressed as water column concentration predicted to be protective of the fish tissue bioaccumulation. The other factors included the recognition that the TMDL was addressing a substance no longer registered for use (legacy pollution), and that preliminary data indicated on-going natural recovery of bottom sediments (chlordane concentrations were decreasing). To institutionalize accountability, EPA's approval of the TMDL was conditioned upon the State committing to 1) conduct additional fish tissue monitoring to verify that natural recovery was occurring, and 2) to conduct source assessment monitoring if the fish tissue monitoring did not verify that chlordane concentrations in fish tissue were decreasing.

The previous example regarding chlordane is instructive. It demonstrates that a non-traditional TMDL can be developed and approved by EPA without complex modeling, provided that a commitment is made to an implementation-oriented adaptive approach. That is, highly detailed predictive modeling was exchanged for follow-up monitoring, and a commitment to iterative assessment and remediation steps. This is the essence of "adaptive management," which tends to be a hallmark of most non-traditional TMDLs.

Several other states have grappled with addressing biological impairments in non-tidal streams for which the stressor or impairing substance is not clear. Because the physical processes of a stream system are so complex, the prospect of successfully developing predictive models, or even statistical models based on empirical data, is remote. Such modeling is also very time-consuming and expensive. In such cases, some states have turned to adaptive management approaches in which the TMDL development process is tightly linked to the TMDL implementation process. That is, trial-and-error TMDL implementation is guided by a non-traditional TMDL expressed as a set of quantified target values for in-stream and upland "indicators." Relationships between these indicators represent the necessary linkage between the stress (source) and the water quality standard (receptor), which is a basic requirement of any TMDL analysis. With this in mind, consider the following simplified illustrative example regarding a biological impairment in non-tidal streams.

Consider a stream that fails to meet indices of biological integrity (IBI) for both benthic macroinvertebrates and fish. A field assessment suggests that the stressors are excessive hydrological energy due to land surface modification of the uplands; denuded riparian vegetation; sediment infill of pools that also submerges boulders, which previously dissipated stream energy; channel straightening; levy construction with resultant reduction in flood plain area; and erosive stream banks.

Table 2-1

Illustrative Example of Multiple-Indicator Non-Traditional TMDL

Non-Traditional TMDL Indicators	**Numeric Target**
Stream Energy Reduction: Combination of the following	35% Total Reduction[a]
Upland Controls	Maximum watershed-wide effective imperviousness of 25% Maximum sub-basin effective imperviousness of 35%
Channel Sinuosity	0% - 30% Increase
Flood Plain Reclamation	0 – 40 acres
Stream Debris	0% - 15% Increase in Bottom Roughness Coefficient
Pool Reestablishment in mainstem	mean depth > 2m at low flow
Bank Stability	No more than 10% erosive banks
Riparian Buffers	At least 75% of stream miles buffered

a. Expressed in terms of standard measures of mean and peak stream energies.

A non-traditional TMDL could be expressed in terms of quantified multiple-indicators representing remediation for each of the "stressors" noted above. Specific quantified targets for each stressor can be determined by a combination of engineering calculations, paired watershed analyses, and simple statistical relationships. These computations would provide a causal linkage between the stressor and the water quality endpoint of acceptable fish and benthic IBIs. The linkage need not be precise, provided that a commitment exists to take implementation steps, monitor the results, and refine those actions as needed. The non-traditional TMDL result might appear as in Table 1.

2.3.4 Near-field and Far-field Impairments

The final topic covered in this section is the distinction between near-field impairments, in which the source or cause is close to the impact, and far-field impairments, in which larger watersheds contribute to downstream impacts. The classic near-field impairment is physical habitat impairment of a non-tidal stream caused by excessive hydraulic energy associated with land cover modification. The classic far-field impairment is eutrophication expressed as algae blooms and low dissolved oxygen caused by nutrients draining to a tidal estuary from a large watershed. Near-field impairments are closer to the source or cause of the impairment, and tend to be more geographically localized. The opposite is true for far-field impairments. It is worth noting that some pollutants, for instance BOD, act at a somewhat intermediate range.

These distinctions are essential to an understanding of TMDL implementation and to avoid confusion. The phrase "TMDL implementation" can mean very different things depending on the type of impairment. Implementation planning for near-field impairments is likely to take the form of a localized stream restoration project, whereas planning for a far-field impairment is likely to take the form of identifying best management practices (BMPs) in a fairly large watershed.

Note, however, that BMPs in the far-field case can be targeted toward hot-spot sources, and eroding streams are one type of hot-spot source. An example would be a farmer who implements stream fencing and off-stream watering for livestock. The BMP implementation would reduce degradation from livestock in the stream, allow for riparian buffer re-establishment, and reduce the nutrients and bacteria flowing downstream that may impact waters many miles away. Clearly there is a relationship between the near-field and far-field impairments, which can be exploited to efficiently address two separate and distinct impairments; we can eliminate a near-field impairment while at the same time making progress on reducing loads that contribute to the downstream far-field impairment.

Another distinction is worth noting: Consider the far-field case when a new pollutant source is introduced. It is possible to offset that new load by making a reduction at a location in the watershed far away from the new source. In the near-field case, mitigation of a new source typically needs to take place close to it, which limits the options.

Given that TMDLs have not yet been developed for near-field cases, but have been for far-field cases (e.g., nutrients), this guidance document will focus on the latter. Nevertheless, as a general matter, local jurisdictions are advised to follow the Guidance for setting development standards under a sensitive areas element for the comprehensive plan (MDP 1993). That is, in areas that meet federal and State water quality standards, developers should strive to make post-development water quality as good as pre-development quality. For development where standards are not attained (impaired waters) post-development water quality should be improved over pre-development levels.

3.0 GENERAL GUIDANCE

The federal government does not mandate prescriptive requirements for TMDL implementation; nevertheless, states are expected to ensure that water quality standards are protected, and in cases of impairment, restored and maintained (EPA, July 1998). The lack of prescriptive guidance allows for flexibility, but this flexibility places a responsibility on states and local governments to craft a framework for implementing TMDLs.

This Guidance represents an evolving framework jointly developed by State and local government staff to assist in flexibly achieving water quality goals mandated by the Clean Water Act. The State invites local governments to engage in the process of enhancing the Guidance over the coming years, with a focus on self-education and building technical and administrative capacity.

Section 3.1 “Guidance for Local Policymakers” was written to ensure that the importance of this issue is communicated to people with decision-making authority. The crucial points regarding the current priorities for TMDL implementation are expressed therein.

Section 3.2 “Legal Landscape” identifies the federal law, regulation and guidance regarding TMDL implementation, which are limited. Several other guidance documents are also cited.

Section 3.3 “Objectives and Responsibilities” lays out the big picture on TMDL implementation, and begins to delineate responsibilities.

Section 3.4 “Adopting a Local TMDL Implementation Framework” recommends that local governments identify a committee to coordinate across local agencies. The coordinating committee is encouraged to begin establishing written policies and procedures on how to approach TMDL implementation. This coordinating body is invited to engage the State in a continuing dialogue on a variety of evolving implementation topics.

Section 3.5 “Public Involvement” provides a synopsis of stakeholders to include in the TMDL implementation process.

3.1 Guidance for Local Policymakers

This 2006 Guidance addresses the federal requirement “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters” (Clean Water Act §101). Although TMDL implementation focuses on the restoration and maintenance of waters that fail to meet standards (impaired waters), the Guidance also addresses the protection of waters that currently meet standards. This initiative is a State and local partnership; much of the Guidance also applies to State government, which is committed to leading by example.

Reducing excessive pollutants and preventing the future increase of pollutants according to quantified goals is the essence of TMDL implementation. It is in the interest of local governments to attain the technical and administrative capacity to participate in this process with appropriate State leadership and support. Enhancing capacity at the local level will help to ensure future flexibility, maintain local control, seize on opportunities, and maximize fiscal and administrative efficiency.

The importance of TMDL implementation was highlighted in a November 2003 letter from the Executive Committee of the Governor's Chesapeake Bay Cabinet to local elected officials. The Bay Cabinet includes the State secretaries of the departments of Environment, Planning, Agriculture and Natural Resources. They communicated the following:

> *[W]e are writing to inform you about recent developments in efforts to restore the Chesapeake Bay and implement the Clean Water Act. These changes may affect your thinking about where and how to target development based on its effect on pollution loads and water quality.*
>
> *We recommend that all counties examine their land use policies and programs to assess their ability to minimize future growth impacts on water quality. In particular, we encourage you to ensure that the principles and practices of watershed planning and resource protection are incorporated in your land use planning process.*

As it relates to future land use changes, TMDL implementation guidance can be stated very simply: In areas that meet water quality standards, new development should strive to ensure that post-development water quality is as good as pre-development quality. For development where standards are not attained, post-development water quality should be improved over pre-development levels. This latter statement holds true for impaired waters whether or not a TMDL has been developed, and applies to physical, chemical and biological aspects of water quality. Where this is not possible on-site, it might be necessary to consider off-site mitigation.

The brief guidance statements above are not new. Local jurisdictions have been advised to follow these general practices since at least 1993. These statements are included in State guidance for setting development standards under a sensitive areas element for comprehensive planning (MDP 1993). What is new is that they are now being tied to quantitative water quality targets, which implies the need to manage cause-and-effect relationships between activities on the land and their effect on water quality.

The guidance highlighted in the preceding box implies two tangible needs. First, technical and administrative procedures for offsetting future increases in pollutants need to be established. Procedures are currently being considered by MDE, which will be coordinated with local government.

Second, the enhanced technical and administrative procedures for ensuring consistency with TMDLs will place greater demands on State and local government. Anticipating these greater demands, local policies and procedures for financing water quality planning and implementation should be enhanced. The transition will be smoother if these financial enhancements are instituted proactively.

During the coming year, the State will be working with interested local parties to enhance this Guidance. Local policymakers are encouraged to help steer the evolving development of TMDL implementation policies and procedures. The following are some subject areas that will be priorities for the near-term:

- **Tracking Credit for Current Programs:** Many existing local programs and activities already deserve credit for contributing to the goals of TMDL implementation. Local governments are encouraged to think about integrating the tracking of these program activities in order to begin accounting for quantified credits toward TMDL implementation (See Section 5.1 on "Tracking and Assessing Progress").

- **Local Interagency Coordination:** Local governments are encouraged to identify a committee to coordinate TMDL implementation issues among agencies (e.g., Planning, Health, Permitting and Licensing and Public Works). The State plans to engage these coordinating committees over the coming year in a continuing dialogue on a variety of evolving TMDL implementation topics (See Section 3.4.1).

- **Local TMDL Implementation Framework:** It is important for local governments to demonstrate a good faith effort to begin implementing TMDLs. Success will be measured in terms of demonstrating consistent progress in the long-term effort to restore and maintain water quality. Local governments are encouraged to begin establishing written policies and procedures on how they plan to approach TMDL implementation. To assist, this Guidance is supplemented by a model framework document that can be tailored to evolving local needs (See Section 3.4.2).

- **Self-Education:** Key local government officials are encouraged to devote time to self-education regarding TMDL implementation over the coming years. This can begin with reading Maryland's 2006 TMDL Implementation Guidance, and the other guidance documents cited herein. State officials are being encouraged to make the same investment in order to support an informed dialogue with local officials over the coming year. (See the following section, "Legal Landscape", and Section 5.2 "Tools and Resources.")

- **Assess Enhanced Funding Options:** The challenges of TMDL implementation represent a paradigm shift in the sophistication of water quality management. The transition to this new paradigm will create additional workload for many local government agencies. Serious thought should be given to revenue enhancement options to support budget increases for key local agencies and to leverage resources from the private sector. Ideally, these enhanced financing mechanisms will create environmental incentives and will be integrated with a comprehensive framework for offsetting future loads. (See Section 4.3.1.9 on "Financial Planning").

Restoring water quality to meet standards is a long-range objective that will take many years to realize. However, enhancing existing technical tools and administrative procedures is a nearer term goal. A key intent of this Guidance is to alert local governments to this nearer term goal, which needs to be addressed expeditiously. We strongly encourage local government policy makers and local staff members work with the State on this initiative. Several specific examples of policies, tools and operational procedures that are under development are summarized in Table 3-1 below.

Table 3-1

Policies, Tools and Operational Procedures that are Under Development

Topic	Synopsis
Phase 5 Chesapeake Bay Watershed Model	This model is being refined, which will enable more geographically refined TMDL implementation plans that are consistent with Bay Agreement goals.
GISHydro NPS Tool	This tool is being developed to allow local watershed planning in a manner that is consistent with estimates from the complex Phase 5 watershed model. It is hoped that this tool will enable NPS offset computations to be computed more easily and consistently.
Nutrient offset policies and procedures	The State has adopted a policy of managing point sources under a cap established by the Chesapeake Bay Agreement. Routine technical and administrative procedures remain under development. NPS offset procedures are under consideration.
TMDL Implementation Planning Procedures	The State is committed to implementing TMDLs. Specific guidance for developing "TMDL implementation plans" remains to be developed in coordination with local governments.
Land Use Planning Policies and Procedures	Although this Guidance provides general direction on addressing TMDLs in the local land use planning process, specific technical guidance has not been included. Implementation of House Bill 1141 could provide a framework for doing this.

3.2 Legal Landscape

Section 303(d) of the 1972 Clean Water Act is the federal law that requires states to identify impaired waters and to develop TMDLs in a manner consistent with water quality standards (33 U.S.C. § 1313(d)). Part 40, Section 130.7 of the Code of Federal Regulations was issued in 1985 and amended in 1992 to implement Section 303(d). The law and regulation are available at www.epa.gov/owow/tmdl/policy.html

The basic logic of the legal landscape rests on assuring that decisions and actions are consistent with the maintenance of water quality standards. The primary nexus for this assurance is the National Pollutant Discharge Elimination System (NPDES) permitting framework. Although the federal regulations do not include prescriptive requirements for TMDL implementation, they do specify that NPDES permits be issued in a manner consistent with TMDLs and that TMDLs achieve water quality standards. In addition, NPDES permits must be issued in a manner consistent with water quality standards prior to the development and approval of TMDLs.

A common question regarding TMDL implementation is, "How is the State going to ensure that pollution from non-regulated activities is controlled, particularly nonpoint sources?" Because TMDLs create a holistic framework of accounting for pollutants, decisions regarding NPDES permits also consider the unregulated sectors. The consideration of unregulated nonpoint sources during the permitting process is essential to restoring water quality and offsetting future increases in loads. The nonpoint sources are considered through an overall accounting of pollutant loads. If a regulated activity is predicted to increase pollutants, then a means of offsetting that increase must be identified before the regulated activity may proceed. That offsetting reduction must typically be achieved by reducing loads in the unregulated sector. In this way, the regulated activities are linked to making reductions in the unregulated sector. The specific policies and operational procedures for doing this are beginning to take shape, and will be a significant focus of attention during the coming years.

The federal EPA provides some guidance on interpreting the TMDL regulations, which gives insights into TMDL implementation. Some of the key guidance documents are cited below.

"Guidance for Water-Quality-based Decisions: The TMDL Process", EPA-441-D-99-001, US EPA, 1999. www.epa.gov/OWOW/tmdl/decisions/ (1991 version)

"New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," Memorandum from Bob Perciasepe, August 8, 1997. www.epa.gov/OWOW/tmdl/ratepace.html

"Establishing Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," Memorandum from Robert H. Wayland, III and James A. Hanlon, November 22, 2002. http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

Several other documents that are not directly tied to TMDL regulations provide additional insights. The Clean Water Act Section 319 provides the framework for managing non-regulated nonpoint sources (NPS) of pollution. EPA places conditions on Section 319 grant funding by tying it to TMDL implementation.

In particular, the "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies key elements of watershed management planning (Part II.3.a-i). Elements "a through i" provide insight into what EPA considers to be the main logical elements of TMDL implementation planning for nonpoint sources. This is discussed further in Section 4.3.1 "Planning for Pollutant Reductions."

Another document that provides insight into TMDL development and implementation is the 1998 TMDL FACA report. Although this advice to EPA is somewhat dated, it provides a wide range of perspectives, which could help local governments assess the legal landscape. "EPA National Advisory Council for Environmental Policy and Technology", Report of the Federal

Advisory Committee on the Total Maximum Daily Load (TMDL) Program, EPA-100-R-98-006, July, 1998. www.epa.gov/OWOW/tmdl/advisory.html

The federal government has twice attempted to revise the TMDL regulations, with a focus on TMDL implementation. The initial attempt, during the Clinton Administration, was terminated by the U.S. Congress, which called for a review of the TMDL program by the National Academy of Sciences (NAS). That NAS review resulted in a report entitled, "Assessing the TMDL Approach to Water Quality Management," National Academy Press, 2001. Part 5 of the report, "Adaptive Implementation for Impaired Waters," is of particular relevance to TMDL implementation. http://books.nap.edu/html/tmdl/

In the absence of prescriptive federal requirements for TMDL implementation, the remainder of this Guidance provides a structure within which State and local government can work jointly toward establishing technical and administrative procedures. The following section describes the objectives of TMDL implementation. The presentation suggests near-term and longer-term priorities that anticipate an evolution of shared responsibilities in this State and local partnership.

3.3 Objectives and Responsibilities

State and local water quality management capacities are evolving. Investments toward the future enhancement of these capacities must occur at the same time current capacities are used to manage water quality. These parallel efforts strive for the ultimate objectives of restoring and maintaining water quality standards.

The responsibilities are distributed among federal, State and local governments, who in turn place some responsibilities on the private sector. Although the federal government has ultimate responsibility, the effects are experienced more directly at the State and local level. This naturally motivates the acceptance of responsibilities by State and local governments to ensure more local control of local outcomes.

3.3.1 Objectives

TMDL implementation involves environmental objectives and management objectives. These are outlined below.

Environmental Objectives: The ultimate environmental objective of TMDL implementation is to meet water quality standards. There are three key functional elements of this ultimate environmental objective:

1. Protection: Prevent the degradation of healthy waters.
2. Restoration: Develop and execute plans to reduce excessive pollutants.
3. Maintenance of Reductions: Institutionalize technical and administrative procedures to offset the introduction of new pollutants.

In addition to addressing impaired waters, this Guidance also promotes the State's antidegradation policy designed to protect existing high quality waters. Section 2.1.1 introduces the antidegradation policy in the context of State water quality standards. Section 4.2 provides more details on the policy.

Restoration of water quality is addressed in Section 4.3, and maintenance of water quality is addressed in Section 4.4. Appendix A provides two flow charts that give a conceptual overview for restoration and maintenance.

<u>Management Objectives</u>: TMDL implementation procedures are evolving. In view of this transition, State and local government should recognize two broad management objectives:

1. Current Operations: Conduct water quality operations with current capacities.
2. Capacity Enhancements: Enhance technical, administrative and financial capacities.

Meeting regulatory requirements with current operating capacities, while also investing in new capacities, is a challenge. Fortunately, many existing State and local programs and activities are already contributing to TMDL implementation. Local governments are encouraged to begin taking credit for existing programs with an understanding that TMDL implementation will build upon such programs. This is discussed further in Section 4.3.2.2 (restoration) and Section 4.4.2.2 (long-term protection).

Taking credit for existing programs can be done both qualitatively and quantitatively. Local governments are encouraged to begin developing a qualitative inventory of activities for which credit should be acknowledged. Section 5.1 "Tracking and Assessing Progress" addresses this subject.

This Guidance also stresses a recognition that the efficient protection of water quality begins with a well-conceived comprehensive land use plan. This is particularly important for local jurisdictions that are presently engaged in the process of updating their comprehensive plans. Section 5.3 "Land Use Planning" addresses this subject.

The establishment of appropriate incentives and removal of disincentives is vitally important. These can take the form of economic and regulatory considerations related to the land use planning process via zoning, subdivision and adequate public facilities ordinances, and site design requirements (e.g., requirements for more open section roads or requirements for increased pervious surfaces), or building permit requirements. The structure of incentives should be tied into considerations of financing the cost of environmental restoration and protection. Section 5.5 "Economic and Regulatory Incentives" addresses this subject.

The various capacity-building needs outlined above motivate enhanced inter-agency coordination and the integration of current operations and related information. As an initial step, this 2006 Guidance strongly encourages the explicit identification of a local government interagency coordination body. This is discussed in Section 3.4.1 below.

Many programs and procedures will be involved in TMDL implementation. Documenting appropriate policies and procedures is an important way to ensure coherence. It will also provide tangible evidence that local governments are making good faith efforts toward TMDL implementation. To this end, a specific objective of this 2006 Guidance is to encourage local governments to consider adopting a "TMDL Implementation Framework" document. This is discussed in Section 3.4.2 below.

In summary, protecting and maintaining water quality standards is the primary objective of TMDL implementation. Although current programs and tools are being used toward this end, another objective is to begin enhancing the capacity of these programs to address the quantitative nature of TMDL implementation. This can start with a simple inventory of current activities for which credit for TMDL implementation is warranted. Devoting thought to tracking such information will be important at this stage. Another near-term objective for some counties is to begin contemplating enhancing the comprehensive planning process with respect to water quality impacts. Overlapping this is the need to consider refining economic and regulatory incentive mechanisms, which should be integrated with the financing of restoration and protection needs. The 2006 TMDL Implementation Guidance encourages explicit coordination among local agencies. The 2006 Guidance also encourages the documentation of evolving local policies and practices in the form of a "TMDL Implementation Framework."

3.3.2 Responsibilities

Meeting water quality is the cooperative responsibility of all levels of governments. The foundational authority rests with the Clean Water Act, but each level of government is responsible for assuring that its actions are in, or will lead to, compliance with the Act's requirements. Local governments, responsible for land use decisions, must assure that those decisions are consistent with meeting water quality standards. The State issues permits that assure individual dischargers don't violate water quality standards and develops TMDLs to address multiple dischargers and nonpoint sources. The federal government provides guidance, standards, funding and backstops State decisions.

Although local governments do not have legal responsibility for implementing TMDLs *per se*, some local actions and decisions have a direct bearing on water quality standards. In addition, some existing mandatory programs, such as the State stormwater regulations, are an important subcomponent of TMDL implementation. Local governments are encouraged to communicate the linkages between existing programs and TMDL implementation to help the general public recognize the valuable contributions that are already being made.

In some cases, water quality management involves multiple jurisdictions, including jurisdictions outside of the State of Maryland. Ideally, governments can resolve issues cooperatively without the intervention of higher authorities. However, in some cases it might be necessary for the State or federal government to play a facilitating role. Section 5.8 "Multi-jurisdictional Coordination" addresses this subject.

See Section 3.5 "Stakeholder Involvement" for further discussion of roles and responsibilities, which include federal and private sector stakeholders.

3.3.2.1 Federal Responsibilities

The U.S. Environmental Protection Agency (EPA) is responsible for administering the federal Clean Water Act. Although they may delegate some functions to State and Tribal governments, oversight responsibility remains with the EPA.

Operationally, the EPA has approval authority over the State's development of water quality standards, the 303(d) list, TMDLs and NPDES permits. The EPA has a responsibility to seek concurrence from the U.S. Fish and Wildlife Service during their review of State 303(d) lists and TMDLs. If EPA disapproves a 303(d) list or TMDL, regulations require them to perform the duty for the state; however, EPA typically works with the state to overcome shortfalls.

The EPA also delegates enforcement authority to the State, but often becomes operationally involved in significant enforcement actions. Roles of other federal agencies are presented in Section 3.5 "Stakeholder Involvement."

3.3.2.2 State Responsibilities

This section provides an overview of State responsibilities organized by State agencies. Monitoring responsibilities are discussed separately in Section 5.1 "Tracking, Assessing and Reporting Implementation Progress."

The Maryland Department of the Environment is responsible for administering the elements of the federal Clean Water Act that have been delegated to the State of Maryland by the US Environmental Protection Agency (US EPA).

MDE's Water Management Administration (WMA) is responsible for NPDES permitting, State erosion and sediment control (which may be delegated to local governments), stormwater management related to State and federal facilities (local governments are responsible for implementing the State stormwater management program under State program review oversight), drinking water source assessment and protection, coal and surface mine permitting, abandoned mine remediation, wetlands and waterways permitting (401 Certification of federal discharges), federal Coastal Zone Management Act consistency review, and water and sewer plan approvals. WMA also manages a number of capital financing funding sources that play a role in TMDL implementation. The most recent addition to this is the Bay Restoration Fund.

MDE's Technical and Regulatory Services Administration (TARSA) is responsible for coordinating the elements of the Clean Water Act (CWA) outlined in Section 2.1 of this Guidance. In particular, TARSA administers the water quality standards, which are the basis for identifying impaired waters and serve as the water quality targets for TMDL analyses. This includes conducting three-year reviews of the standards (Triennial Reviews), and responsibility for Use Attainability Analyses (See Section 2.1.1 "Water Quality Standards." TARSA works closely with the Department of Natural Resources, which produces the CWA Section 305(b) water quality inventory for the State. A subset of the inventory comprises the list of impaired waters needing a TMDL required by CWA Section 303(d). This joint MDE/DNR assessment also supports the identification of watersheds used for other water resource management lists (e.g., for CWA Section 319 Nutrient Management Planning).

TARSA is responsible for developing TMDLs and has general responsibility for coordinating TMDL implementation, including nonpoint source controls through the CWA §319 grant program. This implementation responsibility includes informing governmental agencies and the general public about the existence of impaired waters and associated TMDLs. TARSA coordinates the State's general approach to TMDL implementation, of which development of guidance for local governments is a primary current focus. The general approach to TMDL implementation also recognizes the Tributary Strategies for nutrients under Chesapeake Bay Agreement 2000 (C2K) as a foundation. As necessary, geographic refinements will be made in coordination with other State agencies and local governments that mutually benefit the Bay nutrient goals and local nutrient TMDLs. TARSA is coordinating general approaches for TMDL implementation relative to other pollutants, and is responsible for coordinating the tracking of progress.

MDE's Waste Management Administration is responsible for residual sewage sludge permitting, hazardous waste site remediation, and the permitting of landfills.

MDE's Air and Radiation Management Administration is responsible for a number of programs that affect atmospheric deposition of nutrients, sulfur dioxide (acidic deposition), mercury and other substances.

Although federal regulations do not require "TMDL Implementation plans" the Maryland Department of Environment intends to adopt such plans. The exact nature and process for doing so will be determined in consultation with local governments and others. Section 4.3.1, "Planning for Pollutant Reductions," provides the current State thinking on TMDL implementation plans.

Certain responsibilities are shared, in varying degrees, with between MDE, other State agencies and local government. These are noted in the context of the remaining discussion of State and local responsibilities.

The following summary identifies several primary agencies; however, those not mentioned are responsible for being aware of TMDLs to ensure their decisions and actions are consistent with the key objectives of TMDLs. An example is good stewardship of State-owned property, of which the Department of General Services owns significant acreage or manages facilities on behalf of other units of government. The University of Maryland also has constructive roles to play in supporting TMDL implementation and plays an operational role in nutrient management planning through the Cooperative Extension Service, e.g., consolidating the most recent findings of agricultural research characterizing BMPs.

The Maryland Department of Natural Resources is responsible for many programs that interface with TMDL implementation, in addition to key monitoring responsibilities discussed in Section 5.1 "Tracking, Assessing and Reporting Implementation Progress." DNR is responsible for assessing all available water quality data relative to the standards and reporting the status of water quality to the US EPA as required by CWA Section 305(b). DNR works closely with MDE-TARSA, which is responsible for identifying impaired waters needing a TMDL. DNR coordinates the State's commitments to the Chesapeake Bay Agreement 2000 (C2K). In this role

DNR coordinates the State's assessment of new Chesapeake Bay criteria and the development of the Tributary Strategies for nutrient reductions, which represent a broad implementation plan for limiting nitrogen and phosphorus loading to restore the main Bay and its tributaries. DNR manages a wide array of programs that have a bearing on various aspects of TMDL implementation including forest harvesting and administration of the Forest Conservation Act, fisheries and wildlife management, the Critical Areas Program, Costal Zone Management, Watershed Management, a variety of resource planning and land conservation programs, and management of extensive park and natural resource lands.

The Maryland Department of Agriculture works closely with federal agencies, the Maryland Cooperative Extension Service, and local Soil Conservation Districts to deliver coherent technical and financial services to the farming and rural communities in support of natural resource protection. MDA is responsible for administering the Maryland Agricultural Land Preservation Program and regulations of the 1998 Water Quality Improvement Act that require nutrient management plans. MDA also works closely with landowners and farm operators to address various regulatory compliance issues, such as finding remedies for erosion "hot spots" and bacteria sources. MDA is also responsible for collecting and reporting information that supports the tracking of agricultural best management practices (BMPs), which are used to estimate progress toward achieving pollution reduction goals.

The Maryland Department of Planning has many responsibilities regarding land use planning, including the development of guidance for the Sensitive Areas Element of these plans, and assisting local governments in directing growth to appropriate areas with adequate infrastructure. MDP chairs the Governor's Smart Growth Subcabinet, which assists state agencies in directing funding for growth-related projects to Priority Funding Areas. It is responsible for coordinating the Governor's Priority Places Initiative, and it works with the Department of Natural Resources and the Maryland Department of Agriculture in land preservation efforts including agricultural land preservation and Rural Legacy Programs. The MDP also conducts detailed reviews of water and sewer plans to ensure consistency with comprehensive plans, and recommends actions to MDE. For some counties that do not have sufficient technical capacity, MDP provides staffing services during the comprehensive planning process, and subsequent land use implementation processes.

The Maryland Department of Transportation (MDOT) oversees the development and maintenance of many surface transportation corridors. The State Highway Administration (SHA), the Maryland Transportation Authority (MdTA) and the Maryland Transit Administration (MTA) must receive permits for many activities, and thus have TMDL implementation responsibilities that are similar in many ways to local governments in this regard. MDOT also conducts significant long-term system planning, which it coordinates annually with local governments via its Consolidated Transportation Program (CTP). Surface transportation plans are also coordinated with local land use plans through the Metropolitan Planning Organizations. Over time, the CTP should be integrated with local land use and water quality planning efforts (See Section 5.3 "Land Use Planning.")

3.3.2.3 Local Responsibilities

In addition to certain specific responsibilities noted below, local government's current responsibility is to work in partnership with the State to ensure the smooth transition to a more robust framework for restoring and protecting water quality standards. Although the federal government bears the legal responsibility for ensuring protection of water quality standards, many responsibilities are formally delegated to the State of Maryland. The State accepts these responsibilities because it is judged to be in the public's best interest. Similarly, local governments are likely to accept certain TMDL implementation responsibilities that are in their best interest and the interest of local stakeholders.

Local governments, with varying involvement of State and rural agencies (e.g., Soil Conservation Districts), manage numerous programs that have a role in TMDL implementation. This includes comprehensive planning, adoption and implementation of zoning and subdivision regulations, water and sewer planning, coastal zone programs, Critical Areas Law planning, Forest Conservation Act plan reviews, wetlands and floodplain management programs, management of capital programs necessary to support various regulatory programs, grading and building permits, soil and erosion control programs, stormwater management programs, bacteria monitoring and beach closure authority, among others. All play a role in TMDL implementation.

It is also in the interest of both county and municipal governments to work in partnership to address inter-jurisdictional matters, thereby minimizing the need for State intervention. A key principle is the legal responsibility to protect downstream waters. When different jurisdictions are upstream and downstream from one another, the upstream jurisdiction might have responsibilities regarding the protection and restoration of the downstream waters of the neighboring jurisdiction. This is discussed further in Section 5.8 "Multi-jurisdictional Coordination."

As part of the existing regulatory responsibilities under the programs outlined above, local governments can play a valuable role in tracking information that is essential to accounting for the status of pollutant loads relative to TMDLs. The traditional view of tracking is to maintain inventories of pollution control activities, that is, best management practices (BMPs). As discussed in Section 5.1; however, tracking also involves accounting for new pollutant sources, which can be deduced in part from changes in land cover. The concept of tracking can also be expanded to include water quality monitoring. This is also discussed further in Section 5.1.

have tracking responsibilities under existing regulatory programs and grant conditions, full implementation of these programmatic responsibilities will be sufficient for the current purposes of

The guidance statement highlighted above infers two areas of potential refinement of local tracking and monitoring responsibilities in the future. First, current resource constraints limit the ideal level of implementation of existing programs. Public scrutiny of TMDL implementation is likely to motivate more comprehensive implementation of existing programs, which will entail commensurate tracking activities. Second, State and local government understanding of TMDL implementation issues is evolving rapidly. It is possible that State and local partners will reach agreement on sharing new tracking and monitoring needs, which cannot currently be predicted.

Local responsibilities for implementing nutrient TMDLs are complementary to responsibilities under the Chesapeake Bay Agreement Tributary Strategies. Both strive to achieve and maintain quantitative loading goals on a watershed basis. In general, TMDL implementation will address smaller basins to correct local water quality impairments. Tributary Strategies address larger regions to correct the Chesapeake Bay impairments.

Local governments are encouraged to continue investing in and tracking remediation activities for which quantified load reductions have yet to be estimated. The Chesapeake Bay Program is striving to quantify the benefits of these practices, which could be credited to local jurisdictions in the future. Local governments that have expertise to share are encouraged to convey that information to the Bay Program. Past efforts of this kind by local governments have influenced the Bay Program to modify its estimates of urban nutrient loads, and adopt estimated nutrient reductions associated with stream restoration activities.

Managing land use is perhaps the most important responsibility of local governments that has a bearing on TMDL implementation. Local land use planning, implementing ordinances, regulations and decision processes all have a direct effect on offsetting future increases in pollutant loads and protecting the physical integrity of streams; and land use decisions are controlled by local government. This topic is explored in Section 5.3 "Land Use Planning" and Section 4.4 "A Framework for Offsetting Future Pollutants."

In summary, the present goal is to continue to integrate existing State and local programs to support quantified water quality management relative to water quality standards and TMDLs. Establishing the technical and administrative procedures to do this effectively and efficiently will be very challenging. The State will lead a joint initiative with local governments to build the capacity to meet this challenge. This TMDL Implementation Guidance document reflects the State's commitment to reaching that goal. The next section suggests tangible actions that local governments can take to establish a structured process that addresses TMDL implementation.

3.4 Adopting a Local TMDL Implementation Framework

TMDL implementation will build upon existing State and local programs. Ensuring a coherent and comprehensive approach will necessitate the integration of policies and procedures across multiple local government agencies. New policies and procedures will be sufficiently important to warrant documenting them in writing. This section recommends voluntary steps for local governments to consider in support of these needs.

3.4.1 Local Governmental Coordination Committee

Local governments are encouraged to identify an interagency coordinating committee on TMDL implementation. This would be an internal local governmental body constituted for the purpose of establishing local government policies and procedures.

This recommendation builds on the State's existing policy for coordinating with local governments on TMDL development. In 1999, the State solicited the appointment of a "Local TMDL Primary Contact" by the executive branch of each local government (See Appendix H "Local TMDL Primary Contacts"). The local TMDL Primary Contact serves as a liaison between the local government and the Maryland Department of the Environment (MDE) on TMDL development and implementation issues. A local coordinating committee is the logical next step beyond a single local TMDL Primary Contact.

In addition to identifying the roles of local government agencies in TMDL implementation, this committed would enhance the communications between the State and the local government. MDE plans to meet with these local committees periodically as TMDL implementation policies and procedures evolve over the coming year. In an attempt to help guide future dialogue within the coordinating committees, an initial list of issues is documented in Appendix B, entitled, "TMDL Implementation Issues for Consideration by Local Governments." In the near-term, the coordinating committees can also begin work on Tributary Strategy implementation plans for the ten-major basins in Maryland, which will ultimately support more refined implementation plans.

3.4.2 Documenting a Local TMDL Implementation Framework

Local governments are urged to adopt a written "2006 TMDL Implementation Framework." The framework is intended to serve as a reference point for the local government coordinating committee as it develops standard operating procedures (SOPs) for addressing TMDL implementation. Although adapting a written "framework" is voluntary, it is one way of demonstrating a good faith effort towards TMDL implementation. The framework is <u>not</u> intended to be an implementation plan for any specific TMDLs, but rather a means of documenting general policies and procedures.

MDE will provide an electronic template for the Local TMDL Implementation Framework document, which can be tailored to fit the particular interests of each local jurisdiction. An example is provided in Appendix B ("TMDL Implementation Issues for Consideration by Local Governments").

The template would include an outline of topics to be addressed, such as the composition of the committee, the workings of the committee, whether the committee has decision-making authority or is an advisory body, and so on.

It would also document new policies as the Coordinating Committee or other decision-making body adopts them. Examples might include how the land use planning process might be used to address consistency with TMDLs, new policies and procedures for offsetting new loads, and so on.

3.5 Stakeholder Involvement

Given the complexity of this subject and the limited federal guidance, many aspects of TMDL implementation remain undefined. Because of this, it is particularly important that many diverse voices be included in the TMDL implementation process to ensure its legitimacy.

Local governments are generally very adept at identifying and including key stakeholders in addressing local issues. Nevertheless, for completeness, this General Guidance section closes with a general synopsis of stakeholders to include in the TMDL implementation process.

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (*i.e.*, improving water quality and removing streams from the impaired waters list). This section identifies key stakeholders and their potential roles.

3.5.1 Federal Government

U.S. Environmental Protection Agency (EPA): EPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs are often delegated to the states. This is expanded on in Section 3.3.2.1.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS): NRCS is the federal agency that works hand-in-hand with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired waterbodies through the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentive Program (EQIP). For more information on NRCS, visit http://www.nrcs.usda.gov/.

US Department of Commerce, National Oceanic Atmospheric Administration (NOAA): In addition to collecting and making vast amounts of environmental information available, NOAA administers several programs to be coordinated with TMDL implementation. NOAA administers the federal Coastal Zone Management Act (CZMA), which created the National Estuarine Research Reserve system. CZMA supports state programs for managing coastal waters and provides grants that support local government elements of Maryland's CZM program administered by the Maryland Department of Natural Resources. For information on the federal program, visit www.coastalmanagement.noaa.gov For information on Maryland's program, visit www.dnr.state.ms.us/bay/czm

US Department of Interior, Geological Survey (USGS): The USGS conducts scientific studies and collects long-term data on stream flows and properties of surface and ground water. In Maryland, the USGS has played an active role in helping to develop watershed models used for TMDL development. For more information visit www.usgs.gov/tmdl/index.html

US Department of Interior, National Park Service (USNPS): In addition to managing parks, the National Park Service conducts studies on the effects of water quality on plants and wildlife. They also conduct watershed assessments and engage in stream restoration. As an example, research staff at the Assateague Island National Seashore are a source of local expertise on Maryland's Coastal Bays. For more information visit www.nps.gov/phos/maryland.htm

US Department of Interior, Fish and Wildlife Service (USFWS): Water quality standards must protect the terrestrial wildlife that depend on water. The US EPA is required to consult the USFWS during the process of approving state lists of impaired waters and TMDL studies. The USFWS comments can provide insights for the TMDL implementation process.

3.5.2 State Government

In Maryland, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Roles and responsibilities for the key State agencies are described above in Section 3.3.2.1.

3.5.3 Local Government

Local government groups are routinely invited to work closely with the State throughout the TMDL process; these groups possess insights about their community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Roles and responsibilities for local governments are described above in Section 3.3.2.2.

3.5.4 Soil Conservation Districts (SCDs)

The roles of SCDs vary among different local governments. The SCD's common role related to TMDL implementation is to increase voluntary conservation practices among farmers, ranchers and other land users. SCDs also assist in the development of soil conservation and water quality plans, which include best management practices (BMPs) for protecting wetlands, water quality, and preventing soil erosion. SCDs in many local jurisdictions also review soil and erosion control plans for urban development. District staff work closely with watershed residents and have valuable knowledge of local watershed practices. See the Maryland Association of Soil Conservation District web site: http://www.mascd.net/scds/MDSCD05.htm

3.5.5 Regional Councils of Government and Planning Commissions

"Regional councils of government are multipurpose, multi-jurisdictional, public organizations. Created by local governments to respond to federal and state programs, regional councils bring together participants at multiple levels of government to foster regional cooperation, planning and service delivery." – National Association of Regional Councils of Government.

A similar entity, created by State law, is the Maryland National Capital Parks and Planning Commission. This organization has separate but related organizations that provide services to Montgomery County and Prince George's County.

These organizations promote the efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. They focus much of their efforts on transportation planning, and water quality planning, which is complementary to the TMDL implementation process. Some of Maryland's TMDL development projects have been contracted or coordinated through councils of government.

For more information on the these organizations located in Maryland, please visit the following web sites:

Baltimore Metropolitan Council of Governments:
http://www.baltometro.org/index.asp

Maryland National Capital Parks and Planning:
www.mncppc.org

Metropolitan Washington Council of Governments:
http://www.mwcog.org/

Tri-County Council of Southern Maryland:
http://www.tccsmd.org/

Tri-County Council of Western Maryland:
http://www.tccwmd.org/

3.5.6 Businesses, Community Groups, and Citizens

Successful implementation depends on stakeholders taking responsibility for their role in the process. Local groups that are most affected include businesses, community watershed groups, and citizens.

Community Watershed Groups: Local watershed groups offer a forum to share ideas and coordinate preservation efforts. They also provide an avenue for citizen action. Watershed groups serve to institutionalize valuable knowledge of the local watershed and river habitat that is important to the implementation process.

Citizens: The primary role of citizens is to become informed and to voice their views in the TMDL implementation process. This may include participating in public meetings, becoming educated and in turn assisting with public outreach, sharing knowledge about the local watershed history, and serving as an example by implementing best management practices on their property.

Community Civic Groups: Community civic groups generally have a wide range of practical local knowledge that can be vital to getting things done on the ground, and avoiding unnecessary controversy. Once trust is built with community organizations, they can become allies in marshalling local support for taking on a wide range of environmental projects. Such groups include Rotary Clubs, Farm Clubs, Homeowner Associations and youth organizations such as 4-H and Future Farmers of America.

Animal Clubs/Associations: Clubs and associations for various animal groups (*e.g.*, beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other land owners, not only in rural areas, but in urban areas as well, where pet waste has been identified as a source of bacteria in waterbodies.

Businesses: There are a wide variety of businesses, both large and small, many of which have marginal interaction with environmental matters. Thus, businesses have varying roles and responsibilities. Businesses that are involved in land development are likely to play a key advisory role as this TMDL Implementation Guidance matures. Because they operate at the focal point where much of the implementation process occurs, their operations will be directly affected by requirements for consistency with TMDLs.

Informing these businesses about the ultimate goals of TMDLs, and seeking their suggestions for meeting those goals, will be a valuable process to incorporate into the evolving TMDL implementation framework. The development community is very conscious of the value placed on environmental protection, as indicated by the following statement in the Eastern Shore Builders Association *Code of Ethics*:

> *We will work toward establishing a balance between legitimate environmental concerns and the need to develop and construct new housing. This will include the conservation of land and energy through consideration of natural environment as an intrinsic element in housing design.*

In time, as the methodologies for restoring and protecting water quality mature, these businesses will continue to play a direct role.

Agricultural businesses will also have a direct role, not only the farmers, but the businesses that support farming operations. These include consultants that develop nutrient management plans, and businesses that provide inputs such as farm implements, fertilizers, pesticides and herbicides. Rural communities and non-farming businesses depend on the economic viability of the farming industry. Thus, what affects the success of agricultural businesses, indirectly affects other local businesses. Identifying environmental advocates in the rural business community can provide a vital communications bridge between the public sector and other members of the agricultural business sector.

The process of identifying businesses to include their insights on water quality issues can be painstaking. The following directory of Maryland's "Businesses for the Bay" participants might be of help.
http://www.mde.state.md.us/businessinfocenter/pollutionprevention/businesses_forthebay/directory.asp

Staff in MDE's Business Resource Center might also be able to provide information about businesses in a region of interest to you.
http://www.mde.state.md.us/BusinessInfoCenter/index.asp

Maryland Homebuilders Association:

http://www.homebuilders.org/

Maryland State Builders, provides links to regional associations:
http://www.mdstatebuilders.org/

(Acknowledgement is provided to the Virginia Department of Environmental Quality for sections of their TMDL Implementation Plan Guidance used in Section 3.5).

4.0 TECHNICAL GUIDANCE

The environmental objective of TMDL implementation is to meet water quality standards, which protect the physical, biological and chemical integrity of waterbodies. This Guidance goes beyond implementing TMDLs for impaired waters by also addressing the protection of healthy waters to avoid the need for TMDLs. This section is organized to address protection of water quality (Section 4.2), restoration of water quality (Section 4.3), and maintenance of water quality that has been restored (Section 4.4). Before addressing each of those sections, several preliminary matters are addressed in Section 4.1.

As noted elsewhere in the 2006 Guidance, State and local government representatives will continue to refine the document during the coming years. Much of that effort will focus on elements discussed in this technical section. In that light, the following sections may be viewed as a road map for steering future refinements to the implementation process.

4.1 Preliminaries

As discussed in the background Section 2.0, new types of TMDL analyses are still being developed. In particular, TMDL analysis methodologies for addressing biological impairments of non-tidal streams are still under development. TMDLs for this type of impairment could take a “non-traditional” form in which the TMDL is quantified as implementation actions needed to restore the water quality (See Section 2.3.3). Aside from encouraging current efforts to protect and restore the integrity of non-tidal streams, this subject remains beyond the scope of the current version of this Technical Guidance. The remainder of this Technical Guidance will focus on traditional TMDLs that are expressed in terms of the mass of pollutant per unit time (loads).

TMDLs are expressed in a way that is one step removed from directly measuring the achievement of water quality standards. Because TMDLs are set to meet standards, the implementation of control practices that meet the loading goal of a TMDL should also achieve the water quality standards. This allows routine management decisions to be made by accounting for pollutant loads. By providing a link between implementation practices and water quality standards, TMDL analyses serve as a planning guide for restoring impaired waters. Ultimately, however, the success of achieving pollutant loading goals must be verified by the direct measurement of water quality.

Before proceeding, the concept of “TMDL Implementation Plans” deserves introduction. This Guidance provides broad strategic direction, rather than a “how to” on developing TMDL implementation plans. Implementation plans traditionally focus on restoring impaired waters by identifying cost-effective actions to reduce pollution. Implementation planning from this traditional perspective is addressed in Section 4.3 on water quality restoration.

In addition to this traditional perspective, this Guidance considers a more comprehensive view that recognizes linkages between protecting healthy waters and restoring impaired waters. Careful accounting of pollutant loads associated with routine governmental decisions will help ensure that opportunities for pollution reduction are linked to requests for pollutant increases. This strategic view envisions institutionalizing technical and administrative procedures for managing pollutant loads within many units of government, not merely those that have traditionally been responsible for water quality management.

4.2 Defining and Protecting "Healthy" Water Quality

Water quality standards address the federal requirement "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Clean Water Act §101). Standards have been established to support beneficial uses such as fishing, aquatic life, contact recreation (swimming), boating, drinking (source water), and terrestrial wildlife that depend on water. The term "healthy" applies to those waters that can support or "attain" all of the beneficial uses designated for a given waterbody, allowing for natural limitations (e.g., blackwater swamps on the Eastern Shore of Maryland have naturally low dissolved oxygen levels).

The broad term "water quality standards" encompasses three elements, which include the adoption of designated uses, described above, and criteria that indicate whether or not the designated uses are being achieved. Criteria are expressed in narrative and numeric forms, which are promulgated in regulations. A narrative criterion is a descriptive statement expressing expectations, such as "supporting aquatic life and wildlife", or invoking professional judgment, e.g., the consideration of surveys conducted by professional sanitarian when interpreting bacteria criteria. As the name implies, numeric criterion are key environmental parameters that determine the threshold between healthy and unhealthy waters. Examples include, minimum acceptable concentrations of dissolved oxygen, maximum concentrations of toxic contaminants, and maximum cell counts of bacteria to protect human health associated with swimming beaches and shellfish harvesting.

The third element of water quality standards is a required antidegradation policy to protect waters at three tiers of quality ranging from 1) meeting existing minimum designated uses, to 2) maintaining high quality where it is better than the minimum requirements, and 3) maintaining outstanding waters with special or sensitive communities (e.g., highly diverse communities) that may not be impacted. The policy must also contain procedures for implementing the goals of the policy, that is, "how" each tier of water quality is to be protected. Maryland does not currently have any waters designated for this third category.

The first tier of water quality is the one with which most readers are familiar. For the first tier, impacts of human activities are managed under the Clean Water Act through permitting only discharges that will not prevent the attainment of designated uses. This includes TMDL development that helps inform the permit limits and implementation for impaired waters (waters that fail to meet the first tier of quality) to bring them back into attainment. Protection of the first tier is analogous to "maintaining" water quality, as described in Section 4.4 below. Potential impacts of human activities are closely reviewed and managed for the second tier of water quality under Maryland's Antidegradation Policy Implementation Procedures (COMAR 26.08.02.04) presented below.

4.2.1 Three Tiers of Water Quality

The three tiers of water quality adopted by Maryland are described in more detail below.

Tier 1 specifies the minimum standard that must be met, that is, the support of balanced indigenous populations of aquatic life and support of contact recreation, which is often referred to as "fishable-swimmable" (CWA § 101(a)(2)). This is the quality of water that protects all designated uses, which include "existing uses." An existing use can be determined by demonstrating that a particular use actually occurred as of November 28, 1975, or that the water quality is currently suitable to support such uses. Where an existing use is determined, it must be protected even if it is not codified in the water quality standards as a designated use. Tier 1 requirements are applicable to all surface waters.

Tier 2 specifies an existing high quality water that is better than the minimum needed to support "fishable-swimmable" uses. Water quality can be slightly impacted; however, the State antidegradation policy identifies procedures that must be followed before an impact to Tier 2 water quality can be allowed. In no case may water quality be lowered to a level that would interfere with existing or designated uses, unless a use attainability analysis is conducted to revise the designated use (See Section 2.1.1 "Water Quality Standards.").

Tier 3 specifies a particularly special level of water quality deserving to be classified as an Outstanding National Resource Water (ONRW). ONRWs generally include the highest quality waters of the United States. The ONRW classification also offers special protection for waters of exceptional ecological significance, i.e., those that are important, unique, or sensitive ecologically. Except for certain temporary changes, ONRW quality may not be impacted. Decisions regarding which waterbodies qualify to be ONRWs are made by the states. At present, Maryland has not identified any Tier 3 waters; however, this classification and procedures for establishing such waters do exist in State regulation.

4.2.2 Adopting Tier II Waters

Maryland's antidegradation policy follows the national model required by the US EPA, which includes three tiers of water quality described above. The antidegradation policies can be found in the Code of Maryland Regulations (COMAR) at 26.08.02.04, 04-1, and 04-2.

This section provides a brief introduction to Maryland's policies for identifying and adopting Tier II water quality protection for specific waterbodies.

In June 2004, the State adopted, through the normal regulatory process, about 85 non-tidal stream segments as Tier II waters based on observations of high quality biological communities as demonstrated by high Maryland Biological Stream Survey scores (> 4.0 on a 1 to 5 scale). Tier II water quality can also be documented based on water quality data using a statistical approach (90 percent confidence interval exclusion) and more waters will likely be identified on this basis in the future.

The Tier II designation applies only to the stream segment from which data is collected and analyzed. The stream segment is defined as the part of the stream that lies between the upstream and downstream confluences of major tributaries entering the stream. This approach to designating Tier II stream segments can result in very small stream segments to which the antidegradation implementation policy applies explicitly. However, the Clean Water Act also requires the protection of downstream water quality, creating an implicit protection of Tier II waters from upstream impacts. Consequently, activities proposed upstream of Tier II segments need to account for potential impacts on the downstream Tier II segment(s). The next section presents the review procedure for implementing the Tier II antidegradation policy in Maryland.

4.2.3 Maryland's Antidegradation Implementation Procedures for Tier II Waters

A summary of the key points of the Tier II antidegradation policy are listed below. Relevant sections of COMAR 26.08.02.04 – 1, which provides the most concise exposition of the implementation procedures, are presented in Appendix C; however, official copies of COMAR should be consulted for making regulatory decisions. The entire implementation policy can be found at Division of State Documents (DSD) website:
http://www.dsd.state.md.us/comar/26/26.08.02.04%2D1.htm

Before a new or expanded discharge can be permitted to a Tier II water, and before a change to a Water and Sewer Plan that would lead to such a discharge, the following three steps must be addressed:

1. Can the discharge be avoided or placed elsewhere? If so, that should be done.
2. If the discharge is necessary, has everything been done to minimize the water quality impact.
3. If the impact has been minimized to the greatest extent feasible, but an impact to water quality will still occur in the Tier II water, a social and economic justification for that impact must be prepared and approved by the Department, before the discharge can be permitted.

The Tier II implementation procedures are new, having been adopted in 2004. The State will provide assistance for questions relating to antidegradation review and compliance. The State will include this subject among the key topics for joint discussion with local government representatives during the coming year as the TMDL Implementation Guidance is refined.

4.3 Restoring Water Quality

A traditional view of water quality restoration involves the development and execution of implementation plans to meet water quality standards that are being violated. A technical overview, that addresses both pollutant loads and stream degradation, is provided in Appendix A. The remainder of this section focuses on managing the reduction of excessive pollutant loads[6].

Traditional implementation plans identify cost-effective measures needed to achieve the necessary pollutant reductions to achieve standards and are often cast in the context of watershed planning. This traditional view, which is discussed below, has two shortcomings. First, it generally does not address the establishment of financial and regulatory incentives that remove

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[6] In terms of tiered water quality discussed in Section 4.2, this section addresses the common Tier 1 waters.

barriers and engender positive patterns of behavior (See Section 5.5 Economic and Regulatory Incentives). Second, it generally focuses solely on reducing existing pollutants, thereby failing to address new sources of pollutants.

This Guidance intentionally links both restoration and maintenance. It explicitly recognizes the value in leveraging resources from new pollutant sources to offset both new sources and existing excess loads. Existing State guidance developed under the Planning Act of 1992 advises that, for new development where standards are not attained, post-development water quality should be improved over pre-development levels[7]. This State policy is affirmed by the similar requirements for redevelopment projects, and in Maryland's Critical Areas law by what is commonly called the "10% Rule" for pollutant reduction. This topic is expanded on in Section 4.4, "Maintaining Water Quality: A Framework for Offsetting Future Loads."

The remainder of this section addresses the more traditional approach of developing and executing pollutant reduction plans in support of TMDL implementation.

4.3.1 TMDL Implementation Planning for Pollutant Reductions

The State has not provided a "how to" manual on developing TMDL implementation plans at this time. Instead, this Guidance emphasizes the importance of incorporating that planning across existing programs from land use planning on down. It is envisioned that a variety of different planning activities and documents will constitute the over-all plan, which can eventually be consolidated into "TMDL implementation plans" directly or by reference.

This section focuses on TMDLs expressed in terms of pollutant loads (mass per unit of time), and on nutrients in particular. This focus is justified by the fact that most of the TMDLs developed to date are for nutrient impairments of tidal waters, a primary type of water quality impairment in Maryland.

TMDLs provide a quantitative foundation for effective planning. A key element in Maryland's broad TMDL implementation strategy is to conduct this planning within the context of existing State and local programs. This will entail greater interaction between different governmental agencies that will share a role in the process. Section 4.3.2, "Executing Pollutant Reduction Plans," identifies most of the programs that should be involved in the planning and decision-making process.

Another aspect of Maryland's current strategy for addressing nutrient TMDLs is to build upon the Tributary Strategies for restoring the Chesapeake Bay. Because the pollutant loads that impair Bay waters originate upstream, fixing the Bay will necessitate fixing the local tidal tributaries for which TMDLs have be developed, and vice versa.

Maryland's Tributary Strategies constitute broad implementation plans for achieving and maintaining nutrient allocations for ten major watersheds. These allocations were established through the year-2000 Chesapeake Bay Agreement process. Upon completion of the

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[7] Maryland Department of Planning, 1993.

Chesapeake Bay Program's new watershed model in 2006, procedures will be developed in coordination with local governments to integrate Tributary Strategy planning with nutrient reduction planning for local TMDLs[8]. In the 2006, on-going nutrient reduction implemented at a local level will help to advance the mutual goals of TMDLs and the Tributary Strategies for the Chesapeake Bay.

In addition to building upon the Tributary Strategies, a process for documenting specific TMDL implementation plans is under consideration. The State's current thinking on TMDL implementation plans is outlined below:

Maryland's Current Thinking on TMDL Implementation Plans

- During 2006 and 2007, local governments should actively support development of refined Tributary Strategy implementation basin plans as part of Maryland's nutrient TMDL implementation planning process.
- In coordination with Tributary Strategies, future TMDL implementation plans will address Maryland 8-digit watershed basins; however, some plans will be developed at a more refined geographic scale, e.g., reservoirs.
- Future TMDL implementation plans should address multiple pollutants for a given waterbody.
- The degree of detail in implementation plans may vary depending on the nature of the case. Some might take the form of very brief documents containing general language, and citing external documentation regarding local programs that address key issues integral to the implementation process (e.g., watershed assessments developed under NPDES MS4 permits). Others may be more detailed, fully self-contained documents that include significant technical analyses within the implementation plan, rather than citing external documents.
- Local governments will have an opportunity to play a lead role in developing plans if they so choose. The specifics will be worked out in consultation with individual local governments.
- In some cases, it might be logical to adopt existing reporting frameworks to document the TMDL implementation plans. Examples might include reservoir management plans, WRASs, Tributary Strategies, or Comprehensive Conservation Management Plans.
- The State will track implementation plans via the State "Water Quality Management Plan" (WQM Plan) framework per 40 CFR 130.7. WQM Plans, organized by 6-digit basin codes, will incorporate completed TMDLs, identify the document that constitutes the implementation plan, and identify other appropriate supporting information.
- Implementation plans should address permitted point sources and the nine (9) basic elements of a nonpoint source watershed plan summarized below in Section 4.3.1.1.

The State will work with local government advisors to establish a process for documenting specific TMDL implementation plans. Given that the process is under consideration, it is not the intent of this current Guidance to provide detailed procedures on how to develop implementation plans for achieving pollutant reductions.

[8] The new Phase 5 watershed model will be more geographically refined than the current Phase 4.3 model.

4.3.1.1 EPA Guidance on Nonpoint Source Implementation Plans

EPA's "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" (Part II.3.a-i), identifies nine (9) key nonpoint source elements to be addressed by TMDL implementation plans. The nine elements, which are summarized below, constitute good guidance for any watershed plan. The full text of the EPA watershed plan guidance is provided in Appendix C.

<u>EPA "A – I" Guidance on NPS Watershed Planning</u>

a. Identify the sources or groups of similar sources that will need to be controlled to achieve the load reductions necessary to achieve water quality goals;

b. Estimate the load reductions expected for the necessary management measures (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time);

c. Describe the NPS management measures necessary to achieve the load reductions estimates established under paragraph (b) above and identify the critical areas in which those measures will be needed to implement this plan;

d. Estimate the sources of technical and financial assistance needed, and/or authorities that will be relied upon, to implement this plan;

e. Develop an information/education component to enhance public understanding of the project and encourage their participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f. Schedule implementation of the NPS management measures identified in this plan that is reasonably expeditious;

g. Describe 2006, measurable milestones (e.g., amount of load reductions, or improvement in biological or habitat parameters) for determining whether NPS management measures or other control actions are being implemented;

h. Develop a set of criteria that can be used to determine whether loading reductions are being achieved and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

i. Implement a monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (g) immediately above.

4.3.1.2 Point Source Controls

Industrial and municipal treatment plants are addressed by ensuring consistency of NPDES permits with TMDLs. For nutrients, Maryland's nutrient cap management strategy provides the framework for point source planning. Decisions regarding point source permits should also consider the viability of achieving nonpoint source reductions. This subject is discussed further in Section 4.4 on offsetting future loads, and Section 5.1.2.2 on tracking loads.

Stormwater managed under federal NPDES permits is defined as a point source for purposes of establishing and managing pollutant allocations in TMDLs. This includes both municipal and industrial categories of stormwater permits. TMDL implementation planning for nonpoint sources should take this distinction into account, striving to separate and track the municipal and industrial stormwater sources separately from the remaining nonpoint sources. This subject is discussed further in regard to stormwater and urban land cover in Section 5.1 on tracking.

The remainder of Section 4.3.1 provides broad implementation planning guidance. Additional TMDL implementation resources are referenced immediately below:

4.3.1.3 Additional Implementation Planning Resources

TMDL implementation planning is a rapidly evolving issue nationally. New information is emerging as states like Maryland begin to document their policies and procedures. Readers are encouraged to search the internet for new information. Several leads are provided below.

Virginia's TMDL Implementation Plan Development Guidance:
http://www.deq.virginia.gov/tmdl/ipguide.html

Bacteria and Sediment TMDL Implementation Plans: Virginia has fairly extensive experience with TMDLs for bacteria. Although their TMDL development methodologies are different from those used in Maryland, the implementation actions identified in Section 6.0 of their bacteria implementation plans (IPs) have wide applicability. Their IPs also provide cost effectiveness information, which might prove useful http://www.deq.virginia.gov/tmdl/iprpts.html

Other potentially helpful resources regarding TMDL implementation planning are provided in Section 3.2 "Legal Landscape", and Section 5.2 "Tools and Resources."

4.3.1.4 Reviewing the TMDL and Supporting Materials

TMDL implementation planning should be founded on an understanding of the TMDL analysis. The essence of a TMDL analysis is to quantify the maximum amount of the impairing substance or stressor that the waterbody can assimilate without violating standards. Thus, the TMDL links a pollutant load to water quality standards. In doing so, the TMDL analysis defines a quantified framework for TMDL implementation.

In addition to reading the TMDL document, the following information should be reviewed prior to TMDL implementation planning.

- TMDL Technical Memoranda: Many TMDLs are accompanied by technical memoranda, which provide details on viable ways the total load can be divided among sources. These do not constitute formal allocations, but do provide potentially helpful implementation insights.
- 303(d) listing information, including documentation of the methodology used to make the listing determination: http://www.mde.state.md.us/assets/document/AppndxC2004-303d_Final.pdf
- All available water quality data, both in the receiving waterbody and in tributaries that discharge to the waterbody.
- Current inventory of pollutant sources including land use cover information, and an inventory of best management practices, which is maintained by MDE for nutrients.
- TMDL project technical materials. These include the detailed supporting computations and documentation archived in the TMDL administrative file after approval by EPA.

The required elements of a TMDL analysis are described briefly in Section 2.2 of this Guidance. These are described in more detail in Appendix J, and outlined below.

- Water Quality Target(s)
- Water Quality Impairment
- Source Assessment
- TMDL Allocations
- Technical Memorandum
- Reasonable Assurance of Implementation
- Other Key Assumptions and Insights

4.3.1.5 Estimating Nonpoint Source Loads

TMDL analysis reports for nutrients provide a simple estimate of the NPS load at the time the analysis was conducted. However, these estimates are likely to be outdated by the time a TMDL implementation planning effort is undertaken. Anticipating this, the TMDL documents refer to the NPS load as a “baseline” load rather than the “current” load.

There are a number of reasons for wanting to estimate NPS loads with regard to TMDLs. Some of these are listed below.

- Comprehensive Land Use Planning: Comparing the projected NPS load to the TMDL NPS allocation to assess consistency of the plan with the TMDL.
- Comparing the expected Tributary Strategy NPS loads to the TMDL NPS allocation. This serves as a simple test of the feasibility of achieving the TMDL, because the Tributary Strategy loads are considered to be very ambitious.
- Developing an NPS reduction plan to achieve the TMDL.
- Estimating NPS load increases due to land use changes associated with a development project.

- Estimating NPS load reductions due to NPS implementation activities.

One goal of this Guidance is to promote equity in decision-making across the State. In the context of estimating NPS loads, equity depends more on applying analysis methods consistently than on whether those methods produce precise estimates. This is one reason the Guidance advocates using simple, consistent methods of estimating NPS loads at the current time.

Another reason for using simple methods at this time is that NPS estimates are known to be highly uncertain. Measuring NPS loads is extremely difficult, and some question its technical feasibility[9].

Yet another reason to adopt simple procedures that can be used consistently is that operational procedures are needed presently. There is little time to debate issues of precision, particularly when the estimates are known to be highly uncertain.

A reasonable way to proceed at the present time is to use the existing framework of the US EPA Chesapeake Bay Program for estimating NPS loads. Information is available for estimating loads for current and projected land cover, with and without BMP implementation. Despite imperfections, this recommended approach provides an internally consistent framework for decision-making, which is peer reviewed, acceptable to the US EPA and consistent with the regional Chesapeake Bay Agreement Tributary Strategies.

Appendix E provides guidance on how to access information and conduct several NPS loading analyses using spreadsheets. Those seeking to perform more sophisticated analyses are urged to contact MDE for technical support. During the coming years, the State will develop and adopt tools to support routine operational NPS loading analyses.

4.3.1.6 Tracking and Assessing Progress

Although the subject of tracking and assessing progress is addressed at length in Section 5.1 it is critical to consider within the context of the planning process. The ideal is to effectively manage an accounting ledger of pollutants for each TMDL. This implies the need to track both reductions and new sources. Given that new sources are often associated with changes to the land cover, tracking land cover changes is critical. Assessment also includes monitoring to evaluate progress. This topic is also addressed in Section 5.1

This Guidance acknowledges that significant TMDL implementation is already being done by local jurisdictions under a wide variety of programs. Local governments are urged to invest in improving the tracking already required under existing programs. Meaningful tracking

[9] Attempting to measure the "current" annual NPS load poses a conundrum. Because precipitation changes from year to year, the NPS load is different each year. Consequently, the concept of an "annual load" typically refers to a multi-year average. For example, the "annual" load used to set goals in the Chesapeake Bay Agreement is actually a based on a specific set of years with precipitation ranging from dry years to wet years. In order to measure a "typical" year for comparison with the Bay Agreement goals, it would be necessary to collect data over a number of year to deduce a comparable "average." However, using multiple years of data conflicts with the notion of "current," wherein lies the conundrum.

information will be a valuable asset for managing offsets, which could eventually be needed to justify increased loads associated with new development.

The reader is directed to Appendix E for additional guidance on assessing changes in nutrient loads according to methods that are consistent with the Chesapeake Bay Agreement and Maryland's Tributary Strategies. Section 4.4 discusses assessments for the purpose of offsetting future loads to maintain water quality.

4.3.1.7 Guidance on Challenging Cases

The needs for TMDL implementation vary from place to place. Some situations will be more challenging than others, particularly in areas designated to absorb future development. In those cases, local governments might consider adopting land use planning policies and design standards that will prevent increased water quality impacts. Making these decisions in the broader context of land use planning will help avoid the additional cost and delay of making such decisions on a project-by-project basis.

The development of a systematic framework to do this could be daunting. Fortunately, Maryland's Chesapeake Bay Critical Areas framework includes a set of planning and design tools that might provide insights. The goals and objectives of the Critical Areas Program provide a menu of options to consider. These address three broad areas for establishing systematic management policies and techniques:

- Policies on the location, density and types of development.
- Policies on how land is developed in order to mitigate adverse environmental impacts.
- Policies to promote environmentally sound farming and timber harvesting practices.

The details of the Critical Areas Program management criteria can be found at http://www.dnr.state.md.us/criticalarea/

As noted in Section 4.3.1.3, "Bounding the Load Reduction Goal," sensitivity analyses for pollution reduction planning can reveal particularly intractable challenges. If an analysis suggests that the pollution reduction goal appears to be clearly infeasible, a meeting with MDE staff to review the situation is warranted.

4.3.1.8 Financial Planning

The need for building technical and administrative capacity is a consistent theme throughout this guidance document. Equally important is the need to improve fiscal capacity. Local jurisdictions that are proactive in developing and implementing comprehensive, sustainable financing strategies will find it easier to contend with the water quality management challenges ahead.

The federal government recognizes this need, and has acted by making billions of dollars available to the agricultural sector through the Farm Bill. The State of Maryland has responded as well, in part by enacting the Chesapeake Bay Restoration Fund to pay for upgrading wastewater treatment plants, septic systems and cover crops in the near term, and for other environmental needs in the future.

The keys to enable enhanced funding are 1) fiscal and administrative capacity to support the enhancements, 2) public recognition and support of the need to fund water quality management relative to other needs, 3) willingness of public elected officials, 4) a cadre of people to plan and execute new funding mechanisms.

There are numerous references to funding sources cited in Section 5.2 "Tools and Resources." This section focuses on financial planning in a more conceptual way.

New funding should take advantage of recent advances of knowledge in this subject. In particular, while maintaining simplicity, funding systems should also be integrated with multiple objectives. This concept is conveyed through the following example.

Example Integrated Fee-based Funding System with Incentives

This example focuses on a fee-based approach to funding government services associated with land use change. Fee-based systems are important because they internalize costs that are otherwise outside the market; they link the source of the problem to the funded solution; and they provide for the long term operations, administration, and maintenance of programs needed to protect water quality. Other funding approaches are briefly noted below following this example.

This example strives to organize financial planning by subject, while also integrating the subjects. It addresses the two management objectives of this Guidance (Section 3.1.1): 1) Investing in future capacity (e.g., new land use planning procedures that explicitly addresses TMDLs) and 2) Continuing to perform today's routine water quality protection activities (e.g., reviewing development plans and conducting site inspections). It also includes financial incentives as an explicit goal. In particular, one incentive is to influence new land development to locate in areas where it is desirable.

- Simple Concept: Outline the key elements of the financing system. In the present example the key elements would fund a new land use planning methodology and increase staff for reviewing development plans and conducting site inspections. The incentives derive from identifying areas for development where regulatory procedures would be streamlined and additional staff would be made available to expedite the process. (See "Funding Method").
- Lay the Groundwork for Support: Educate decision-makers about the needs, threats and opportunities. Explain how the funding system addresses each. Garner public support and consider documenting support via a simple public opinion survey.
- Start-up Funding: Secure a two-year budget to the cover start-up costs of researching, developing and implementing a new fee system. Consider an agreement to refund these start-up costs from proceeds
- Technical Elements: The funding system is likely to depend on some technical analyses. In this example, it would be necessary to develop a land use plan overlay that classifies land

areas according to the degree of desirability for development from the perspective of smart growth and water quality protection. Cover these expenses by the start-up funds.

- The Funding Method: Design a fee system that 1) fully funds the review and inspection process (fee-for-service), 2) funds a portion of the new land use planning operations, 3) takes advantage of offset opportunities (See Section 4.4), 4) considers justification for sharing the cost between developers and the current residents, 5) pays back the original two-year budget item to the general fund, 6) charges differential fees according to the project location relative to the land use overlays (See Section 5.5 regarding "Economic and Regulatory Incentives."). Ideally the accounting of these fees would use an enterprise fund, which is separate from the General Fund.
- Implementation: Enhance the land use planning, design review and inspection programs to 1) administer the new fee system, considering the establishment of an enterprise fund, 2) revise operational procedures, e.g., hire and train new staff, enhance the planning, review and inspection procedures, and 3) include a public education component to inform the permitted community about the new procedures.

Each element in the previous example would entail significant time and effort. This underlines the importance of starting this process soon.

Clearly, fee based programs are essential. However, they are just one tool available to local governments in their efforts to fund water quality programs. Effective financing strategies should consider a variety of approaches, including:

- Public and private funding assistance programs
- Effective laws and regulations
- Taxes and fees
- Effective use of debt, including subsidized programs such as the State Revolving Loan Fund
- Use of market-based programs
- Leveraging other community priorities, i.e. developing a comprehensive water resources protection strategy.

A number of government sources of funding are available to support TMDL implementation. Many of these are outlined in the "Maryland Water Quality Improvement Assistance Fact Sheet," which is available on the web at:
http://www.mde.state.md.us/assets/document/Water_Quality_Assistance_090804.pdf

One program in particular, the Clean Water Act Section 319 Nonpoint Source Program, provides over $1 million/year in grants in Maryland. This grant is oriented toward implementing TMDLs to the degree that EPA has established minimum eligibility criteria to that end. See Appendix D.

Capital funds from MDE are made available on a competitive basis. Project proposals are ranked according to the "Integrated Project Priority System." Thus, it is advantageous to plan projects with the priority system in mind. A web link to that ranking system is provided under the subsection "Financial Assistance," in Section 5.2.2.

Financial planning is a highly specialized subject, to which much thought has been devoted by a variety of organizations. The remainder of this section briefly outlines some concepts and resources that might be helpful.

Financing Strategy: Developing and implementing a financing strategy is a process. Communities must accurately identify the increased level of service (that is essentially what this entire document is about); calculate the associated cost; gauge its capacity cover the costs; and then develop a strategy for increasing capacity.

The fee-based example above primarily addresses the capacity issue. It is essential to note that increased funding is only one aspect of the strategy. Effective financing institutions are also important, such as the enterprise fund mentioned in the example above.

Budget Planning: Although budgeting is routinely performed by separate agencies, the multi-disciplinary aspect of TMDL implementation necessitates interagency coordination. Budgeting should consider all the diverse resources, both public and private, that ensure sufficient staff and resources to meet program operations goals and capital enhancement goals. This implies that a functional plan exists. Often the functional plan and budgeting plan must be developed in an iterative way relative to each other.

Environmental Financing Experience in Maryland: The long history of restoring and protecting the Chesapeake Bay has generated substantial thought on financing environmental management. Some of the experiences that have been institutionalized can serve as resources.

- Two Blue Ribbon Panels: In 1995, the State of Maryland organized a Blue Ribbon Panel to explore alternatives for funding the Tributary Strategies that were completed in 1995. The document produced as a result still serves as a helpful guide. (Univ. MD, 1995).

  In 2004 a Blue Ribbon Panel was convened to address the multi-billion dollar regional funding need on a more comprehensive scale. Because the approach was to "think big," considering only funding approaches that would generate at least $100 million per year, the outcome of this panel's deliberations does not provide guidance for adoption by local governments. However, local governments should be fully engaged in the follow-up process of advocating for the ideas that were advanced by the Blue Ribbon Panel. For more information see: http://www.efc.umd.edu/blueRibbon

- Environmental Finance Center
  4511 Knox Road, Suite 205, College Park, MD 20740
  phone: (301) 403-4610, ext 24, fax: (301) 403-4222, email: efc@umd.edu
  http://www.efc.umd.edu/

- Financing Alternatives for Water Quality: The EFC has developed matrices of financing alternatives for wastewater, the agricultural sector, developed lands, and forests.
  http://www.efc.umd.edu/our_work/matrices.cfm

- Maryland Water Quality Improvement Assistance Fact Sheet
  http://www.mde.state.md.us/assets/document/Wate_Quality_Assistance_090804.pdf

- Stormwater Utilities: During the 1990s, MDE conducted research into the revenue generation potential of stormwater utility fee systems in Maryland (George, 1991). MDE also conducted a number of feasibility studies for local governments and invested in an education initiative. One outcome of that was the establishment of a stormwater utility in Takoma Park, Maryland.

  Takoma Park, MD Stormwater Utility Ordinance
  http://www.stormwatercenter.net/Model%20Ordinances/misc__takoma.htm

  Takoma Park, MD Stormwater Budget Ordinance for 2005.
  http://207.176.67.2/clerk/ordinances/2004/or200413.pdf

4.3.1.9 Planning Documentation

In some cases, it might be logical to adopt existing reporting frameworks to document TMDL implementation plans. Examples include reservoir management plans, Tributary Strategies, the Environmental Element of a Comprehensive Land Use Plan, or Comprehensive Conservation Management Plans (e.g., the CCMP for the Maryland Coastal Bays). It is also possible to adopt a combination of plans, such as the Coastal Bay CCMP, which serves as an over-arching strategy that calls for more detailed, separate sub-basin plans.

The degree of detail in the initial implementation plans may vary depending on the case. Some plans might be very brief documents containing general language and citing external documentation regarding local programs that address key elements of the implementation process (e.g., citation of watershed assessments developed under NPDES MS4 permits). Others may be more sophisticated, fully self-contained documents that include significant technical data rather than citing external documents.

The State's current thinking on TMDL implementation plans is outlined in Section 3.3.2.1 "State Responsibilities," of the General Guidance section. As an initial step, it is likely that the State will work with local governments over the coming year or two to develop plans that include the minimum elements recommended by the US EPA (See Appendix D for a list of the minimum elements of a plan to qualify for federal nonpoint source grant funds).

4.3.2 Executing Pollutant Reduction Plans

TMDL implementation in Maryland will build upon existing programs rather than creating a new separate program. It is envisioned that local government coordinating committees, recommended in Section 3.4.1 of this Guidance, will steer the process of integrating existing local programs toward the common goal of executing TMDL implementation plans. However, local governments are free to adopt alternative approaches that might better suit their particular circumstances.

4.3.2.1 Overview

Building TMDL implementation upon existing programs such as the Tributary Strategies is a strategic approach that envisions institutionalizing TMDL implementation into routine technical and administrative procedures. This approach recognizes that preventing increases in future pollutant loads is linked to the function of reducing current excessive loads. As expanded on below, existing State guidance developed under the Planning Act of 1992 advises that, for new development where standards are not attained, post-development water quality should be improved over pre-development levels[10]. This State policy is affirmed by the similar requirements for redevelopment projects, and in Maryland's Critical Areas law.

Integrating existing programs toward the common goal of TMDL implementation will take time. It will be important to simultaneously consider both near-field issues, like the protection of small non-tidal streams, and far-field issues, like the generation of nutrients that affect downstream waters. It will also be important to identify which programs that will address key TMDL implementation, such as source assessments, tracking of new sources and reductions, and creating offsets. It is also important to identify decision points within administrative procedures so that TMDL considerations can be included in operating procedure checklists. The following section begins to look at this with the understanding that State and local governments will need to collaborate on further refinements.

4.3.2.2 Enhancing Existing Programs and Tools

Many existing programs are doing the work of TMDL implementation today. This Guidance recommends staying the course and continuing to use existing programs to make further advances in TMDL implementation. MDE considers continued incremental progress toward achieving TMDLs to be the 2006 measure of success.

To attain the ultimate goal of achieving and maintaining water quality standards, existing programs will need to be enhanced. Programs should be enhanced to obtain and analyze the information necessary to make decisions that account for TMDLs in a quantified manner.

The following brief outline identifies existing programs to be enhanced toward that goal, beginning with several general points. Appendix G elaborates on potential program enhancements and serves as road map, or checklist, for further consideration by State and local governments as this Guidance is refined.

- Targeting: Consider geographic targeting to benefit TMDL implementation in relation to the items below.

- Tracking and Reporting: Consider enhanced tracking of both new sources of pollution and pollution reduction actions. Reflect enhanced tracking in existing reporting frameworks.

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[10] Maryland Department of Planning, 1993.

Begin both technical and budget planning to upgrade information systems and databases to facilitate future tracking and reporting; offset planning should be central to this effort.

- Inter-Unit Coordination: Consider institutionalizing ways of ensuring coordination among governmental units to support consistent planning and decision making relative to TMDLs. For example, each key governmental unit could identify an individual to take the lead. These lead individuals could meet periodically to develop protocols for ensuring TMDL consistency. This group could select an over-all lead. Note: Each jurisdiction should already have a person who serves as the "TMDL Primary Contact" with MDE. Appendix H provides a list of the current local contacts.

Existing programs and functions (alphabetical order):

- Capital Programs
- Critical Areas Law
- Drinking Water Supply
- Erosion and Sediment Control
- Forest Conservation Law and Management in General
- Infrastructure Planning
- Land Use Planning and Implementing Ordinances
- Septic System Management
- Stormwater Management
- Soil Conservation District Functions
- Surface & Groundwater discharge permits:
- Waterways Permitting
- Wetlands Programs

Although this is a cursory outline it is intended to provide a needed road map for continued State and local dialogue about the means of executing pollution reduction plans (See Appendix G for elaboration). It should also be apparent that, in addition to reducing pollutants, many routine programs are witness to activities that result in the increase of pollutant loads. This demonstrates the logic of linking the management of pollution reduction to that of offsetting future loads.

4.3.2.3 Incorporating Feedback from Experience – Adaptive Management

Pollution reduction plans, whether for a broad area or specific site, tend to have an opportunistic component. That is, for reasons of practicality and efficiency, implementation plans adapt to the realities on the ground, such as the willingness of particular property owners to participate, the availability of particular funding, or physical constraints. The greater the investment in advance planning, the greater the certainty of the final result.

For complex situations, an adaptive management approach for implementation planning is often practical and helps to set reasonable expectations. This implies that post-implementation evaluation should be an explicit component of executing the implementation plan, and should be incorporated into the funding plan. This can often be done through various milestones for measuring progress. Adaptive management concepts are particularly applicable to non-traditional TMDLs, in which the TMDL is expressed in terms of quantified implementation actions (See Section 2.3.3, "Non-Traditional TMDLs").

When considering full-cost recovery fee systems, e.g., for offsetting future load increases, funding for post-evaluation and implementation refinements should be included; it is almost certain that follow-up steps will be needed to achieve full implementation.

4.4 Maintaining Water Quality: A Framework for Offsetting Future Loads

Although there are differing views on the inevitability of continued rapid growth, most jurisdictions will find it essential to plan for significant growth. In areas where water quality standards are barely attained, or where there are impairments, incorporating the impacts from growth into the planning process is critical. For example, if 100 acres of forested land are going to be replaced by residential development, nutrient loads are certain to increase. If a pending or existing TMDL implies the need to reduce nutrient loads, one might ask how it is that an increase is being allowed when the current loads are already too high. It is with that vexing question in mind that this guidance is being advanced.

This guidance proposes a simple two-part answer. First, develop an analysis showing that the excessive pollutants can be reduced to achieve the TMDL. Second, develop a technical and administrative framework for offsetting new loads. Much of the groundwork for the first step is being done in Maryland via the Tributary Strategies to implement the Chesapeake Bay Agreement nutrient goals. This was the topic of Section 4.3

The second step is the subject of this section. A technical overview, that addresses both pollutant loads and stream degradation, is provided in Appendix A. This section focuses on offsetting pollutant loads.

4.4.1 Developing Procedures for Offsetting Future Loads

In the simple case above, 100 acres of forested land with a unit nitrogen loading rate of 1.5 lbs/acre/yr is going to be converted to urban land with a loading rate of 7.5 lbs/acre/yr. According to figures provided by the Chesapeake Bay Program, the resultant nonpoint source nitrogen load is going to increase by about (7.5 – 1.5) lbs/acre/yr x 100 acres = 600 lbs/yr. In addition, if the development consists of 100 residential units, each generating about 250 gallons of municipal waste per day, another 304 lbs/yr will be generated for a total nitrogen increase of about 904 lbs/yr.

This guidance recommends adopting a reasonably simple 2006 computational framework to offset or compensate for these types of foreseeable load increases. The existing Chesapeake Bay Program loading rates, which reflect differences by region, provide a peer-reviewed framework that will enable consistent 2006 decision-making for those jurisdictions that choose to begin offsetting new pollutant loads.

It is possible to debate and refine numbers like these at great length; however, during that time the vexing question and the potential consequences posed above will remain unaddressed. In addition, adopting reasonable and fair computational procedures is only one aspect of an 2006 framework to be considered. Resources also need to be invested in identifying opportunities for offsets and in developing procedures for administering offsets.

4.4.2 Technical and Administrative Procedures to Support Pollutant Offsets

This section provides several examples of approaches for offsetting future increases in pollutants. The concept of offsetting future loads is implicit in federal law requiring TMDLs, which places a loading cap on impairing substances. It is also explicit in federal regulation prohibiting NPDES permits that would increase pollutant loads causing or contributing to an existing violation of water quality standards.

The concept is also well established in Maryland, both in broad policy and in operational form. In particular, Maryland is a signatory to the Chesapeake Bay Agreement, which calls for reducing and maintaining an upper bound on nutrient and sediment loads to the Bay and its tidal tributaries. In response, Maryland has established operational policies for point source discharges in the form of a "Nutrient Cap Maintenance Strategy." The Strategy sets limits on both major and minor municipal treatment plants, and includes evolving procedures for allowing increases that are offset by decreases elsewhere. This framework can interface with nonpoint sources as described in several examples below.

State guidance on protecting sensitive areas, developed under the Planning Act of 1992, also voices a policy of offsetting future loads, which considers two cases[11]:

1) In areas that meet federal and State water quality standards, developers should strive to make post-development water quality as good as pre-development quality.

2) For development where standards are not attained (impaired waters) post-development water quality should be improved over pre-development levels.

The State's perspective on pollutant offsets is also made operational for some nonpoint sources. Specifically, Maryland's stormwater management law requires that redevelopment of areas that predate the law reduce the effective imperviousness through the incorporation of stormwater management practices. Operational guidance can be found in Maryland's Stormwater Design Manual:
http://www.mde.state.md.us/programs/waterprograms/sedimentandstormwater/stormwater_design/index.asp

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[11] Maryland Department of Planning, 1993. The policy is actually broader than stated above, because it addresses all environmental matters.

This policy is also affirmed by what is commonly called the "10% Rule" for pollutant reduction required for development projects in the Intensely Developed Areas under Maryland's Critical Areas law. Operational guidance can be found in the Critical Area 10% Rule Guidance Manual: http://www.dnr.state.md.us/criticalarea/10percent_rule.html

State and federal wetlands programs also provide an example in which a finite resource is managed. In addition to avoiding wetlands loss, impacts must be offset through a formal mitigation process.

The previous examples demonstrate that a basis for developing a more comprehensive offset framework for protecting water quality currently exists. The following examples illustrate some specific ways in which offset decisions have been administered in Maryland. In addition, a hypothetical example on a watershed scale is introduced at the end of this section.

Point Source Offsets: Maryland's Nutrient Cap Maintenance Strategy has established loading limits for the existing major and minor point sources, and for any new point source. As with any offset policy, an allowable increase must be offset by an equal or greater decrease elsewhere that ensures water quality standards are attained and maintained.

In one particular case, a small treatment plant requested an increase beyond its currently permitted flow. One option would have been to upgrade the treatment; in principle, if the effluent concentration is reduced in half, the flow can be doubled. However, treatment upgrades for small plants can be less cost-effective than alternative options.

In this case, a shift in accounting was made with a large treatment plant that was many years away from using its full flow capacity. The accounting record for the large plant's flow cap was reduced a very small amount to offset an increase for the small plant. In time, after all of the major plants have been upgraded to Enhanced Nutrient Removal (ENR) technology, and funds from the Bay Restoration Fund are available to upgrade smaller plants, the small plant can be upgraded, and the temporary accounting transfer can be readjusted.

Septic System Connections: Maryland's Nutrient Cap Maintenance Strategy has motivated other innovative offset concepts. MDE is considering operational procedures that would allow an increase in a treatment plant cap to support new development. In exchange, the developer would fund the connection of septic systems to an advanced treatment plant. Although the pound loadings involved in septic connections are not particularly large, current estimates are that about one new residential unit could be justified for every two units that are connected (this ratio is subject to change).

Although this operational procedure is still under development, it might include a requirement that the nutrient reduction more than offset the estimated nutrient increase to account for uncertainties in load reduction estimations and, where applicable, begin to reduce existing impairments. This procedure demonstrates both the viability of reducing loads via the process of offsetting new loads, and financing it by leveraging private sector resources.

Land Application of Municipal Waste Water (Spray Irrigation): In certain cases, converting a municipal surface water discharge to land application can be used to offset increases in nutrient loads. Although cost is presently often a barrier, developers might find it financially preferable to support the capital cost of converting to spray irrigation relative to other offset options.

It is in the interest of local jurisdictions to consider the feasibility of setting aside land in advance to use for future spray irrigation[12]. In addition to creating future options for offsets, this would prevent pollutant loads associated with septic systems. It would also promote efficient growth principles, thereby preserving the rural character of the surrounding countryside and helping to ensure the economic viability of local agriculture.

A Comprehensive Offset Policy for Nutrients: To date, Maryland has dealt with nutrient removal offsets on a case-by-case basis; a comprehensive policy is under development. It is expected that the policy will build on the Nutrient Cap Maintenance Strategy for point sources and outline the basic requirements for adherence to water quality standards. These requirements are reflected operationally by both local nutrient TMDLs and the Chesapeake Bay nutrient limits.

Because a TMDL allocation falls under the rules and authority of the federal National Pollution Discharge Elimination System (NPDES), it cannot be viewed as a property right. A waste load allocation may be assigned to a specific facility only through issuance or modification of an NPDES discharge permit. Any assignment of TMDL allocations to point source facilities must follow existing NPDES permit rules, including those for waste load allocations, water quality permit limitations, best available technology requirements, public participation, etc., none of which convey any property or ownership rights.

Tracking and assessing pollutant sources and control practices will be a significant technical aspect of this policy. Section 5.1.2.2 discusses the tracking of point source allocations, including regulated stormwater.

A Watershed Planning Perspective:

Appendix F provides a hypothetical example that is intended to illustrate the kinds of issues that might be contemplated when considering nitrogen offsets from a watershed perspective. The example includes point sources and nonpoint sources (the concepts would be similar for phosphorus).

In summary, the watershed planning example in Appendix F demonstrates that a wide variety of options can be considered for offsetting new pollutant sources. Overall, the examples provided in this section are intended to highlight the importance of investing in developing the technical and administrative capacities to plan for and execute offsets. Planning in advance for future offsets will not only save time and money, it could maintain an option that might otherwise be irreversibly lost (e.g., foreclosing the option of spray irrigation by failing to set land aside).

[12] The land set aside for spray irrigation shall meet the site characteristics requirements such as groundwater table depth, depth to bedrock permeable soil and adequate buffer zone to neighbor's property and waterways etc.

Those jurisdictions that begin making these investments in offset planning are likely to have a competitive advantage for supporting development in the future.

5.0 ADDITIONAL GUIDANCE

5.1 Tracking and Assessing Progress

This section is about two functions that are necessary to ensure that society's actions are consistent with the restoration and protection of water quality. One function is the "tracking" of information. The second function is the "assessment" of that information. There are many intermediate tracking and assessment functions associated with routine activities like land development that typically focus on managing pollutant loads, which are linked by TMDL analyses to water quality impacts. Ultimately, water quality information must be tracked and assessed to determine progress in achieving regulatory standards.

Local jurisdictions implement a variety of activities that help to restore and protect water quality. Collectively, these activities represent TMDL implementation by different names. Perhaps it's called municipal stormwater management, or sensitive areas planning, or wetlands management, or forest conservation. Simply acknowledging and taking credit for this "TMDL implementation" by a different name is an essential first step toward tracking progress on achieving clean water.

The ability to document progress, particularly in regard to nonpoint source (NPS) pollution, has become a valuable technical asset. In addition to being able to account for progress on *reducing* excessive pollutant loads, similar assessment methods will be necessary to administer *offsets* of new sources of pollutants in the future. These same tracking and assessment capacities apply to *protecting* high-quality waters under Maryland's antidegradation policy.

Section 5.1.1 describes key tracking and assessment issues in general. It also highlights existing tracking and assessment frameworks and describes refinements that are anticipated in the near-term.

Section 5.1.2 goes into more depth. The material is organized by pollutant sources, in part because TMDLs must account for all pollutant sources, including natural sources.

Finally, Section 5.1.3 addresses water quality monitoring, which can be viewed as part of the assessment topic.

5.1.1 Overview of Key Tracking and Assessment Issues

Due to Maryland's long history of working to restore the Chesapeake Bay, many procedures have already been established to track the key restoration activities that address nutrients. These include agricultural best management practices, urban best management practices, a variety of natural resource management activities and point source discharges.

Current tracking and reporting requirements under existing regulatory programs for local governments are generally sufficient for addressing present nutrient TMDL implementation needs.

Stormwater management is of significant importance to local governments, and provides a relevant example. Routine procedures currently exist, in accordance with the Code of Maryland Regulations (COMAR) 26.17.02.09C, for each county or municipality to submit a notice of construction completion to MDE for each stormwater management practice.

Recently, a variety of natural resource practices associated with stream corridors have been recognized as having a quantifiable nutrient reduction value. These same practices will likely play a role in assessing progress with respect to TMDLs for biological impairments in non-tidal streams, which have yet to be developed. It is acknowledged in the "Stream Corridor" section below that tracking procedures for these activities need to be enhanced.

Taking a proactive view, although TMDLs for biological impairments have yet to be developed, we encourage local governments to continue investing in stream restoration initiatives as a priority.

Local governments covered by NPDES stormwater permits should track stream restoration projects as part of their routine NPDES reporting process.

Protection of healthy streams is also important.

The "Maryland Stormwater Design Manual" provides a systematic framework for managing the potential impacts to the physical habitat of non-tidal streams based on the quantified assessment of impervious cover.

Implementation activities related to other types of TMDLs are discussed in Section 5.1.2 In many cases, the tracking needs can build upon certain nonpoint source controls used to manage nutrients (e.g., sediment controls).

In addition, it is generally acknowledged that better information is desirable in the long run to reduce decision-making uncertainties. The subject of continued future refinements is discussed in Section 5.7 "Long-Range Capacity Building."

Although it should not affect local governments, certain State tracking procedures are undergoing enhancements. First, the Maryland Department of Environment is responsibile for consolidating the State's restoration tracking activities in support of the Chesapeake Bay Program nutrient management goals. This function, formerly performed by the Maryland Department of Natural Resources, will serve as the foundation for tracking progress on implementing nutrient TMDLs.

Second, Maryland is striving for consistent accounting procedures between localized nutrient TMDLs and the regional Chesapeake Bay Program nutrient goals. Because of the vastly different geographic scales at which these similar technical analyses have been conducted in the past, consistency gaps have been noted by local governments and acknowledged by the State (e.g., differences in estimates of urban loads). The adoption of a new Chesapeake Bay Program watershed model (Phase V) in about a year offers an opportunity to narrow that gap. Local governments with the technical capacity to participate in the development of that model are encouraged to do so over the coming years.

Third, Maryland is a regional partner in an initiative to begin using the National Environmental Information Exchange Network (NEIEN) as the means by which future BMP information will be transferred from the State to the EPA Chesapeake Bay Program. The enhanced automation of data transfer will motivate refinements that ensure Bay States use consistent BMP accounting protocols. The NEIEN initiative is not expected to affect the way local governments currently report information to the State.

Although this Guidance does not call for significant changes in local tracking and reporting of information to the State, local capacity to assess this existing information in support of enhanced water quality management decision-making will require attention. The specific policies, operational procedures and tools for such analyses are under development by the State. However, the Chesapeake Bay Program provides information to support 2006 analysis methods.

The Chesapeake Bay Program provides a common framework for nutrient load assessments, which accounts for regional differences. The State recommends that this framework be considered by local governments seeking to estimate nutrient loads. (See Appendix E "Nonpoint Source Nutrient Loading Assessments Using Chesapeake Bay Program Land Use Loading Coefficients").

This pollutant load assessment capacity will be helpful for conducting long-range land use planning. Also, MDE is in the process of exploring alternative technical and administrative procedures for offsetting the increase in nutrient loads from project-oriented land use changes. Maryland's Nutrient Cap Maintenance Strategy procedures for point sources will provide a key component of the framework. Local governments with an interest may play a role in the development of these procedures.

5.1.2 Tracking and Assessing Pollutant Sources and Control Practices

Local governments are not expected to have the expertise and capacity for maintaining an inventory of all pollutant sources. However, a basic understanding and evolving capacity in this regard will help local jurisdictions better determine their own destiny.

For example, a local jurisdiction that has the capacity to account for NPS pollutant loads might decide to set aside certain land in perpetuity to use for future spray irrigation of municipal wastewater. This would accommodate future growth that is consistent with TMDLs. By making use of public sewer systems it would avoid pollutant loads associated with septic systems. It would also promote efficient growth principles, thereby preserving the rural character of the surrounding countryside and help ensure the economic viability of local agriculture.

The remainder of this section provides an overview of key sources of pollutants. It identifies critical information to track, and relates that information to assessment needs for TMDL implementation.

5.1.2.1 Natural Sources

The assimilative capacity of a waterbody for a given pollutant is generally independent of the particular sources of that pollutant. Thus, TMDL analyses must account for all pollutant sources including natural sources and atmospheric deposition.

It is important to be aware of natural sources. Natural sources are likely to be accounted for within the context of tracking nonpoint sources, such as tracking existing and re-established forestlands and wetlands. This is discussed further in the Section 5.1.2.4 below.

In some cases, natural sources are the main reason why a waterbody is violating a water quality criterion. For instance, some geological formations release high amounts of certain heavy metals. In some cases these formations generate sufficient natural loads to cause the violation of a water quality criterion. However, State standards include a "natural conditions" provision, which could be invoked when interpreting whether the exceedance of a numeric water quality criterion should actually constitute a violation of the standard.

Local expertise in identifying a natural geological source of pollution can be essential in such a situation.

Simply being aware of existing natural sources of pollutants represents a basic, yet potentially vital, form of "tracking" by local governments. This concept of simply being aware of a pollutant source can apply to other source categories, and is an example of the kind of common sense that should be applied to this subject of "tracking."

Bacteria: In the case of fecal bacteria, wildlife sources can make up a significant portion of the total load. In some cases, ecosystem imbalances in predator/prey relationships or invasive species can cause a population imbalance, which might warrant human intervention. In other cases the wildlife sources are completely natural. The subject of how to address wildlife sources of bacteria is an active area of national debate. This subject is beyond the scope of this Guidance; however, it is acknowledged that local expertise could play a role.

Sediments: Some degree of sediment transport is natural to the healthy function of non-tidal streams. Although the exception, streams that have been "starved" of external sources of sediment have been observed to suffer more stream channel erosion as the stream seeks a natural hydrologic balance. The natural amount of sediment erosion varies by geographic region. Methodologies for sediment TMDLs are still under development in Maryland, and are taking this variability of natural sources into account.

Natural sources of pollutants must be accounted for when assessing progress on achieving TMDLs. It is in the interest of local governments to be involved in the on-going dialogue regarding natural sources of pollutants.

5.1.2.2 Point Sources

Traditionally, the term "point sources" was limited to describing concentrated discharges of wastewater, such as that from pipes (traditional point sources). On November 2002, the US EPA issued a refinement in their interpretation of the regulatory term "point source" to include any effluent that is managed under any type of NPDES permit (Wayland Memo, 11/22/02). This includes "regulated stormwater" managed under NPDES municipal separate storm sewer system (MS4) permits and permits for the eleven categories of industrial stormwater sources, which include construction activities.

Traditional Point Sources: The tracking and reporting of information for discharges from currently permitted traditional point sources are fairly well institutionalized within the NPDES permitting and compliance processes for most pollutants. Mechanisms for addressing special cases or operational details, such as aeration rates in the case of some BOD TMDLs, make use of the routine administrative and communications frameworks associated with the NPDES surface water discharge program. The standard operating procedures of the NPDES programs at MDE now include a consistency check for TMDLs.

A relatively small number of plants discharge upstream of reservoirs for which mercury TMDLs have been developed. Because the vast majority of mercury is known to be due to atmospheric sources, the TMDLs were developed using information from national surveys of mercury discharges from municipal point sources. This was justified because mercury concentrations are expected to be very low or zero in municipal point sources.

High values from the survey information were used to determine "future allocations," which may be assigned to point sources if the future characterization sampling detects mercury in any of the point source discharges. Measuring mercury at trace levels requires non-routine monitoring and lab analysis techniques. This effluent characterization monitoring will be conducted during the renewal of the permits within five years of the TMDL analyses.

The remainder of this section focuses on nutrients. The planning of future changes in major and minor point source discharges is tracked and assessed under Maryland's nutrient cap management strategy under the Chesapeake Bay Agreement 2000 (C2K). This tracking and assessment process is closely tied to enhancements being made to water and sewer planning procedures[13] and nutrient offset policies and procedures[14]. It is in the interest of local governments to understand these procedures as they relate to future sewer capacity planning and assuring consistency with TMDLs. (See Section 4.4 "A Framework for Offsetting Future Pollutants," and Section 5.3 "Land Use Planning").

[13] See MDE, Draft Guidance "Water Capacity Management Plans", 2005 www.mde.state.md.us/assets/document/water/wastewaterCapacityMgmtGuidance.pdf See MDE, Draft Guidance "Water Supply Capacity Management Plans", 2005, www.mde.state.md.us/assets/document/water/WaterSupplyCapacityMgmtGuidance.pdf

[14] These are key operational issues that will be reflected in future refinements of this Guidance.

In some cases, it will make sense to use spray irrigation rather than direct surface water discharges. These spray irrigation operations have mature tracking, reporting and assessment procedures15. For a spray irrigation site next to an impaired stream, the groundwater discharge permit will impose a pretreatment limit for nitrogen (total N<8 mg/l for 2"/wk spray irrigation rate) so that after crop uptake, there is zero nitrogen in the percolate. This nitrogen pretreatment limit, land cost and storage pond installation should be considered when considering whether spray irrigation is a cost effective alternative.

In some cases, nutrient TMDL limits for point sources in localized waters are <u>not</u> as stringent as the point source cap maintenance strategy under C2K. In these cases, the TMDLs for localized waters provide information that could be useful in the future to determine if a point source may increase its load to accommodate growth without causing a localized impact. Of course, such an increase would necessitate a decrease elsewhere in the Bay watershed to maintain the Bay nutrient limit.

MDE is tracking the information needed to support assessments similar to the previous conceptual example. It is important for local governments to understand these concepts, to make use of them as elements of future planning.

In most cases, TMDLs identify a broad waste load allocation (WLA, the allocation for point sources). As an initial TMDL implementation planning step, a "Technical Memorandum" is developed, which supplements the TMDL document. The Technical Memorandum suggests a viable way to partition the total WLA among individual point sources; however, it does not represent a formal decision of the Department. That decision is made during the NPDES permitting process.

In some nutrient TMDLs for tidal waters, small point sources that are far upstream of the receiving waterbody are not included in the TMDL waste load allocation[16]. Instead, because they are so small relative to the upstream nonpoint source load, they are incorporated with the upstream load as part of the TMDL nonpoint source allocation. These point sources are tracked by MDE, and any future consideration of expansion is managed under the following broad set of operating rules. First, load increases must be consistent with the Chesapeake Bay nutrient cap maintenance strategy. Second, the increase may not cause a violation of water quality standards

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[15] In most cases, spray irrigation is performed on agricultural land. In these cases, the portion of the effluent that is subject to spray irrigation is tracked as part of the cropland load under a nutrient management plan. The same holds true for wastewater sludge application to cropland. Any effluent that is discharged to the surface water, for instance during winter months, is tracked in the normal manner as a point source load. (Please consult MDE regarding the tracking and accounting of other cases of spray irrigation, e.g., to golf courses or forested land.)

[16] TMDLs analyses require that a cause-and-effect relationship be established. Because changes in the small point sources have no effect in the water quality at the scale of the TMDL analysis, the TMDL analysis could not be used as a basis for setting a limit on the point sources. These plants are still given various permit limits that protect the water quality in the immediate vicinity of the plant.

in local tidal waters. Finally, the expansion must be consistent with non-tidal water quality standards in the immediate vicinity of the WWTP[17].

In summary, the broad tracking and assessment of nutrients from traditional point sources is being done in accordance with Maryland's Chesapeake Bay nutrient cap maintenance strategy. Tracking the offsets for expansions will be managed in relation to the Bay limits, local tidal water quality constraints identified by TMDL analyses, and consideration of potential impacts in the immediate vicinity of the discharge.

Stormwater: Because the EPA's interpretation of stormwater as a point source is new, most of Maryland's TMDLs do not include explicit waste load allocations for stormwater. However, those TMDLs account for regulated stormwater in the load allocation (NPS) component of the TMDL. In many cases, it is technically possible to disaggregate stormwater allocations from the NPS allocation; however, doing so will require a public process and amendment of the existing TMDLs. This will entail the future coordination of TMDL allocation revisions and MS4 permits.

For the limited number of TMDLs in which stormwater waste load allocations (WLAs) are identified, separate allocations are identified for each political jurisdiction. Because of data limitations, these allocations are typically the aggregate of NPDES MS4 and industrial permits, including the transient loads from construction activities. The regulated stormwater WLAs are set at a value consistent with pollutant load reductions expected to be achieved under the existing permit. Thus, maintaining consistency with NPDES stormwater permits will ensure consistency with TMDL stormwater WLAs. Tracking, Assessment and reporting are addressed within current permit requirements.

Because EPA's regulatory interpretation of stormwater as a point source is fairly new (2002), and information is limited, future refinements are anticipated for allocations to regulated stormwater. First, as more detailed information about individual stormwater sources is developed, allocations to industrial sources may be disaggregated from the stormwater WLAs allocations. This is not likely to be done for several years.

Second, stormwater allocations are not static, because land uses change. The stormwater WLAs must be revised periodically to reflect these changes, and this must be done via a public process. This will likely take place within the 5-year cycle of NPDES stormwater permit renewals. TMDLs that were previously developed without explicit WLAs for regulated stormwater will be refined in the same manner.

[17] The reader will note that three geographic scales enter the discussion; the Chesapeake Bay scale, the intermediate scale of protecting tidal tributaries to the Bay, and the scale of non-tidal streams that feed the tidal tributaries.

Nonregulated stormwater will be tracked and assessed in the same context as other nonpoint sources. The section below on “Land Cover as a Pollutant Source Category” addresses this matter. Also, see Section 4.4 “A Framework for Offsetting Future Loads” and Section 5.3 “Land Use Planning” for further insights.

5.1.2.3 Atmospheric Sources

Some pollutants deposit from the atmosphere to the land surface and directly to the surface of waterbodies. It can be difficult to control atmospheric deposition, because some of the sources lie outside State or local jurisdictional boundaries. Most control efforts are regional, national or even international undertakings. Nevertheless, all sources, including atmospheric sources, must be accounted for in TMDL development and implementation. The following guidance addresses atmospheric sources of nutrients and mercury.

Nutrients: Atmospheric sources of nutrients deposit to the land surface and directly to surface waters. Those that deposit to the land are accounted for implicitly in estimates of nutrient loading rates from the various land use types. A significant component of nutrient loads from impervious surfaces, which readily wash off during storm events, originate from the atmosphere. This suggests that air pollution controls might eventually be a more cost-effective way of reducing urban nutrient loading; however, this subject is beyond the scope of this 2006 Guidance.

For TMDL analyses in which the surface area of the waterbody is fairly large relative to the watershed area, direct atmospheric deposition to the waterbody is accounted for explicitly. In these cases, the nonpoint source load allocation includes an atmospheric component that estimates the “current” average annual atmospheric load and the pollution reduction that is anticipated under existing federal law (e.g., the Clean Air Act).

> **For local planning purposes, it is sufficient to assume that where atmospheric deposition to water has been included explicitly in a TMDL, the anticipated load reductions will be achieved via compliance with the Clean Air Act.**

Mercury: Bioaccumulation of mercury in fish tissue has been documented in a significant number of reservoirs (impoundments) in Maryland. Atmospheric sources generally make up the vast majority of the load and, for broad planning purposes, can be viewed as the sole source unless there are other known sources. For this reason, local governments role in addressing mercury is limited.

5.1.2.4 Land Cover as a Pollutant Source Category

For many TMDL analyses, the different types of land cover have been aggregated into four broad groups: urban; agriculture; forest and other herbaceous; and surface water. Surface water was addressed in the section above on atmospheric sources. The remaining categories are addressed below.

Nonpoint source (NPS) pollution is difficult to estimate for many reasons. It is subject to highly variable patterns of precipitation. It is typically generated in small amounts per unit area, but given the large surface area of land, large amounts of NPS pollutants are produced. This makes direct measurement of NPS pollution costly and extremely difficult, if not impossible. Thus, NPS pollution is generally assessed by indirect estimation procedures and long term averages[18]. One simple approach for estimating NPS pollution is to assign different average annual rates of pollutant loading to different types of land cover, expressed as a certain number of pounds per acre per year (average annual unit area loading rate).

For example, if one assumes that forest land generates 1.5 lbs/acre of nitrogen per year, then one can estimate that a 1,000 acre undisturbed forested part of a larger watershed will contribute about 1,500 pounds of nitrogen on average over the period of a year (some years more, some years less, depending primarily on the rainfall). Applying this logic to all different types of land cover can help establish a reasonable estimate of the total average annual nitrogen load from a watershed. Because this type of calculation is one common aspect of assessing consistency with a TMDL on a broad scale, land cover data is critical information to track.. (SEE Appendix E, “Nonpoint Source Nutrient Loading Assessments Using Chesapeake Bay Program Land Use Loading Coefficients” for further discussion).

<u>Forested Land and Wetlands</u>: It is generally understood that undisturbed forestland and wetlands contribute the least amount of nutrients in the form of nonpoint source runoff than any other type of land, and can act as a sink for pollutants. Given this insight, the conversion of these land covers to other types usually results in an increase in pollutant loads to some degree. For this reason, from the perspective of addressing water quality associated with pollutant loadings, tracking forestland and wetlands is critical.

In addition, forestland acts like a sponge in the way it absorbs rainwater. When the forest’s absorptive capacity is lost, less rainwater soaks into the ground, and more of it runs off into streams. This additional surface runoff increases hydraulic energy, which increases erosive stress on the streams. Forestlands also serve as “reservoirs” that release water slowly thereby recharging streams with clean water during dry weather periods. When forestland is replaced with developed land, streams tend to have lower flows, or go dry, during dry weather periods. The increased erosive stress during wet weather periods, and decrease in stream flow during dry periods are reflected by low indices of biological integrity, which constitute a violation of water quality standards.

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18 T[illegible] esti[illegible] it should be recognized that these loads are composed of contributions from storm events and base flow (groundwater recharge of streams). One substance that has been addressed in TMDLs in relation to individual storm events is biochemical oxygen demand (BOD – organic matter). The rapid decomposition of BOD by bacteria (hours to days) can cause oxygen deficits and lead to fish kill events. TMDLs for BOD in non-tidal streams, usually associated with point source discharges, include an assessment of the effect of storm events as a critical condition analysis. If the analysis suggests potential impairment, the point source discharge is generally regulated more strictly to account for this.

Tracking the amount and location of forested land and wetlands that are restored and conserved during the land development process is critical. This also implies that greater attention be devoted to considering policies and procedures designed to ensure the protection and restoration of forested land and wetlands. This subject is discussed further in Section 4.4 "A Framework for Offsetting Future Loads."

Urban Land and Impervious Cover: Impervious land cover generally refers to surfaces on the land that prevent water from soaking into the ground. It is generally associated with land development (e.g., streets, buildings, sidewalks, parking lots), though natural rock surface and compacted soil also function as impervious cover. Impervious cover is the antithesis of forestland cover discussed above.

In general, impervious land cover contributes to many of the water quality impacts that forest cover and wetlands prevent. The most prevalent impact is the physical degradation of non-tidal streams and resultant degradation of biological integrity.

Since 1985, development activities, which create impervious cover, have been regulated by Maryland's stormwater management law and regulations (COMAR 26.17.02). These regulations were enhanced in 2000 with the adoption of a new "Maryland Stormwater Design Manual." The regulatory revisions focus on minimizing impervious cover through proper site design techniques and the use of nonstructural BMPs. The State stormwater law and regulation applies state-wide, including jurisdictions that are not subject to federal NPDES stormwater permits.

The primary benefit of the State stormwater law, and implementing regulations, is to ensure that the physical integrity of non-tidal streams is protected during new land development. All jurisdictions routinely track and report their urban best management practices (BMPs).

Development that occurred before Maryland's stormwater law went into effect has made a substantial impact on the physical integrity of non-tidal streams. The effects of this legacy development are being addressed in two ways, which warrant local attention to tracking. First, The State stormwater law, regulations and local ordinances require the effective removal of a percentage of impervious cover during redevelopment of land that was originally developed before the stormwater law went into effect in 1985. "Effective" removal means various practices that modify runoff characteristics to mimic removal of impervious surfaces are credited as if the impervious surface was removed. For example, a green roof on a building, or an underground stormwater holding tank below a parking lot would be credited. Local governments under NPDES stormwater permits track these practices.

The second way that legacy impervious surface is being redressed is through requirements in NPDES stormwater permits. These permits, which cover all the significantly large urbanized jurisdictions, require the treatment of 10% of the impervious surface area during each five-year permit cycle. This "urban BMP retrofitting" is undertaken as part of a watershed management process, which includes routine tracking and reporting under the NPDES MS4 permits.

In principle, it is possible to map exactly what type of surface is covering each parcel of land. The practicality of this would be challenging, although some jurisdictions that have stormwater utility fee systems perform this type of tracking to a fairly extensive degree using geographic information systems (GIS). They require large commercial and institutional property owners to pay a fee based on the area of impervious cover. This necessitates a fairly precise accounting of land cover. As remote sensing and GIS technologies evolve, this degree of tracking could become viable some day. (See Section 5.7 "Long-Rang Capacity Building").

More commonly, the tracking of impervious cover is done in a less direct manner. This generally entails accounting for different kinds of land use and assigning accepted estimates of the percentage of imperviousness associated with that type of land. For instance, high-density residential development tends to have a greater percentage of imperviousness than low-density residential development. Table 5.1 provides typical percentages of impervious areas associated with different classifications of land cover.

Table 5.1
Percentages of Average Impervious Area

Land Cover Type	**Percentage of Impervious Area**
Urban Districts	
Commercial	85
Industrial	72
Residential by Average Lot Size	
1/8 acre or less (town houses)	65
1/4 acre	38
1/3 acre	30
1/2 acre	25
1 acre	20
2 acres	12

Source: TR20 Manual

Although current TMDLs do not make explicit use of impervious cover, it is an important feature to track for several reasons, aside from the practical reasons associated with stormwater management noted above. First, watershed modeling, such as that conducted by the Chesapeake Bay Program to estimate pollutant contributions from different land use types, often partitions developed land into proportions that are pervious and impervious. More accurate locally-derived information could be provided on a voluntary basis to the Chesapeake Bay Program to increase consistency between regional and local information.

Second, future TMDLs for biological impairments of non-tidal streams might consider effective imperviousness of watersheds in some regard. Having the capacity to track and assess the impacts of that important landscape feature would smooth the transition to addressing such TMDLs. (See Section 5.6.1 Case Study).

Finally, as indicated by the Maryland Stormwater Design Manual, attention to impervious cover is a fundamental variable in development site design. This same logic translates to planning at the subdivision and small basin scales, and plays a vital role in protecting healthy waters.

The majority of this section on urban land has focused on impervious cover. The remainder addresses urban non-impervious cover (pervious cover).

The management of pervious cover for water quality benefits is a subject that is not as mature as others, like agricultural land management. In principle, encouraging and tracking reductions in lawn fertilizing and the conversion of fertilized lawns to shrubs, trees and ground cover, could be done. However, given the large number of separate residential landowners, doing so presents practical challenges. As future development faces the limits of TMDLs, new incentives will emerge that might motivate innovative ways of overcoming these challenges.

For example, it is conceivable that a program of incentives for replacing high-maintenance lawns with low-maintenance ground cover could be established to reduce surface runoff and pollutant loads. The costs associated with such a program, including tracking the benefits, could be funded by a combination of local tax incentives and development impact fees motivated by future development's need to offset increases in pollutant loads. Such a program would have an apparent tracking need associated with it.

Similar innovative ideas, like urban reforestation programs, are also worth considering. Again, because the subject of managing pervious urban areas is evolving, it is one for which tracking and accounting procedures are not well established. It is, however, a subject ripe with potential.

<u>Agricultural Land</u>: For property tax purposes, a significant amount of "agricultural land" is actually forested. Thus, it is important to make a distinction with between "cropland" and "agricultural land".

The subject of tracking and assessing pollutant contributions from cropland is fairly mature. This is due to the large acreages of cropland and high contributions of nutrients from this land use category on a per-acre basis relative to other categories.

Tracking and assessment of nutrients for agricultural cropland is performed by the Maryland Department of Agriculture. The information is reported to the Chesapeake Bay Program through a data consolidation process managed by the Maryland Department of Environment (until 2005, this process was managed by the Maryland Department of Natural Resources).

Although local governments do not have the task of tracking information associated with pollutant contributions from cropland, some familiarity with simple methods of assessing those loads can be of value in the context of comprehensive planning and assessing offset potentials.

5.1.2.5 Septic Systems

Septic systems are typically associated with nutrients and bacteria pollutants; however, anything that can go down a drain is a potential pollutant issue relative to septic systems. Local health departments are delegated authority through subdivision regulations to ensure the proper citing of septic systems relative to drinking water wells. In the case of failing septic systems that pose a bacteria contamination health risk, owners are compelled to repair their systems to be in compliance with local health regulations regardless of federal water quality standards and TMDLs. Maryland regulates septic systems for potential bacteria contamination of swimming beaches and shellfish harvesting areas. Given that these health-related programs guide local government policy and procedures for addressing bacteria from septic systems, the remainder of this subsection will focus on nutrients.

Identifying and tracking locations of all septic systems is no small matter. One way of estimating this is to assume that homes not on public sewer systems are on septic systems; however, some of these might use holding tanks and others might use small “package” treatment plants. Discussions in relation to the 2004 Bay Restoration Fund law have considered this subject; however, no decision has been made to create a GIS database of septic systems.

Assessing the nutrient contribution to waterbodies from septic systems is also not an easy task. Estimating nutrients going into the drain field is fairly well understood; however, estimating how much of that nutrient eventually reaches a waterbody is a challenge. Studies using monitoring wells have been conducted, but even these do not guarantee accurate estimates.

Given the many variables, complexities of different soils, distances of systems to the nearest waterbody, depth to the saturation zone and so forth, averaging techniques are used to estimate the nitrogen loads of large numbers of systems[19].

The following estimate, average household size in Maryland, follow assumptions used by the Chesapeake Bay Program to estimate the load from a residential septic system:

9.5 lbs/yr/person/household to the septic drain field
2.6 people/household (See: household size estimates by County www.mdp.state.md.us/msdc/dw_popproj.htm)
40% loss of nitrogen during transport from the septic field to the surface water.

These assumptions produce the following average annual septic system loading rate:

2.6 x 9.5 x 0.6 =14.8 lbs of Nitrogen per year per septic system delivered to surface water

[19] Phosphorus loads are generally assumed to be zero from septic systems, because it tends to bind to soils; however, some studies of lakes have indicated contributions of phosphorus from nearby septic systems.

Note this is an average, implying that some septic systems generate greater loads, and others generate lesser loads.

Another means of estimating the septic contribution on a broad geographic area is provided in Appendix E “Nonpoint Source Nutrient Loading Assessments Using Chesapeake Bay Program Land Use Loading Coefficients.”

Additional guidance on assessing septic system loads is provided in Section 4.4 “A Framework for Offsetting Pollutant Loads,” in which a credit accounting policy is described for connecting septic systems to a sanitary sewer system.

5.1.2.6 Stream Corridors

Many miles of non-tidal streams in Maryland are physically degraded, which is evidenced by signs of erosion and biological impairments identified on the 303(d) List. This erosion of the stream channels releases pollutants, which are transported to downstream waters (reservoirs and tidal tributaries of the Chesapeake Bay). Other streams, embedded with eroded sediments from the surrounding watershed, are also impaired and contribute pollutants to downstream waters.

Motivated by both of these upstream and downstream impairments, investments are being made to restore the streams. This includes physical stream channel restoration, restoration of riparian buffers, restoration of wetlands, stream protection with and without fencing, and recovery of flood plains. Upland stormwater management, to reduce stormwater runoff energy and control upland erosion, is often a necessary element of stream restoration that must be assessed. The tracking and reporting of the upland control practices is done through stormwater regulation.

The tracking of stream restoration activities is not as evolved as it is for some other activities. This is because much of the consolidated tracking in Maryland has been motivated by the Chesapeake Bay Program’s nutrient reduction efforts over the past decades. The nutrient benefits of stream restoration have not been well quantified. Consequently, there was a lack of motivation for tracking stream corridor activities (the same can be said today for tidal shoreline erosion management practices). Now, owever, based on data collected in part from a local government in Maryland, a quantified estimate of nutrient reductions associated with stream restoration has been developed (See: BMP reduction efficiency information referenced in Section 5.2 “Tools and Resources”).

Like other pollution reduction activities, stream restoration projects are usually tracked by the funding source; however, this information is not typically consolidated for functional use in planning and environmental management decision-making.

As noted in Section 5.1.1, DNR performs the consolidated tracking function for “natural resources” restoration activities, which ideally would include stream corridor activities. The present tracking includes riparian buffers and certain wetland restoration projects. The US Department of Agriculture’s Conservation Reserve Enhancement Program (CREP) funding covers about 95% of these projects, and the data is reported to DNR by field foresters and MDA. MDE reports wetland restoration projects to DNR.

A method for the consolidated tracking of stream restoration projects has not been established. Supported by federal grant funds, DNR extracted stream restoration project information from MDE's archived records.

Local governments covered by NPDES stormwater permits are encouraged to track stream restoration projects, and the funding sources, for inclusion as part of their routine NPDES reporting process. They are also encouraged to use common sense and share experiences with other jurisdictions, given the acknowledged lack of standardized tracking methods at this point in time.

It is possible that beneficial stream corridor activities are being documented locally as a routine matter in relation to other programs like implementation of the Forest Conservation Act and local flood plain management ordinances. In time, working jointly with the State, local governments might find it worthwhile to consider the consolidation of this information in order to document credit associated with TMDL implementation.

5.1.3 Water Quality Monitoring

The "tracking" of various activities provides information to be "assessed" as a means of judging progress on TMDL implementation. Although TMDL analyses explicitly link pollutant loads to water quality, tracking and assessing progress of TMDL implementation focuses on pollutant loads. Ultimately, however, water quality information must be assessed directly to evaluate progress. In addition to its evaluation function, monitoring information can also be used to target the location of implementation activities.

The State is responsible for water quality monitoring to identify impaired waters and evaluating water quality to determine if TMDLs are being achieved. Local governments or other groups may conduct additional monitoring to supplement the State monitoring. This may be done to document the effectiveness of innovative projects and programs, or to provide additional information about impaired waterbodies and pollutant sources.

From the perspective of TMDL implementation the purposes of monitoring can be categorized into two basic functions: 1) assessing pollutant or stressor sources, whether managed by BMPs or unmanaged, and 2) assessing the attainment of water quality standards. These are elaborated below.

1. Assessing pollutant or stressor sources is useful in planning (e.g., targeting) and evaluating implementation. Some examples follow:

- Monitoring pollutant loads delivered to reservoirs and tidal waterbodies by non-tidal streams:
  - Can serve as a diagnostic tool to target upstream sources for remediation.

- Can be used to demonstrate a trend in loads relative to implementation, e.g., point source controls, upland NPS BMPs or stream corridor restoration.
- Can serve the second basic function of assessing the attainment of standards in the non-tidal stream itself (this is an overlap with the second basic monitoring function outlined below).

▪ Monitoring baseflow concentrations in nontidal streams:
  - In the case of nutrients, this can help to target implementation to areas of high concentrations.
  - Can provide information for point source permitting decisions.
  - Can provide information to the biological stressor identification process and other diagnostic needs.
▪ Monitoring the function of a best management practice (BMP):
  - Can serve as research to improve knowledge about the pollutant removal efficiency of a BMP for extrapolation in estimating the reductions from similar BMPs.
  - Monitoring 2006 progress of implementation in the immediate vicinity of a set of BMPs:
  - Measuring the pollutant concentration in the base flow of small streams or in shallow monitoring wells to evaluate agricultural BMPs, spray irrigation practices, and septic systems.
▪ Monitoring discharges to waterbodies:
  - Treatment plant discharges.
  - Stormwater outfalls and other concentrated sources of stormwater runoff.
▪ Monitoring bottom sediments as a potential source of pollutants or stress:
  - Nutrient fluxes.
  - Oxygen demand.
  - Toxic contaminants.
▪ Monitoring atmospheric sources (at the source, as deposition at the receptor).
▪ A wide variety of monitoring is also required under various permits.

2. Assessing the attainment of water quality standards. This is generally the responsibility of the State; however, the State is required to consider all readily available data of sufficient quality when conducting mandatory water quality assessments under the Clean Water Act.

▪ Tidal and non-tidal long-term monitoring at fixed stations that can characterize time trends in water quality. Limited in geographic coverage. Generally a function of DNR.
▪ Intensive sampling studies of major waterbodies to characterize more detailed geographic aspects of water quality. Limited in temporal coverage. Generally a function of MDE.
▪ Random non-tidal biological monitoring that can measure statistical trends in the health of Maryland streams in general (Maryland Biological Stream Survey). This monitoring also has the explicit purpose of assessing the impacts of atmospheric acid deposition (e.g., acid rain). Generally a function of DNR.
▪ Continuous monitoring of shallow tidal waters to evaluate the shallow water criteria of the Chesapeake Bay. Generally a function of DNR.
▪ Assessment of fish tissue for toxic substances. Fish function as sentinels; fish tissue violations prompt the State to consider further source assessments, which may be performed

within the context of TMDL development and implementation. Generally a function of MDE.

- Shellfish monitoring for bacteria. A function of MDE.
- Beach monitoring for bacteria. A function delegated by MDE to local government health departments.
- A wide variety of in-stream monitoring is also required under various permits.

In summary, the State is responsible for assessing the waters of the State, both to identify impairments and to evaluate the progress of TMDL implementation.

The State must consider other sources of data when assessing the waters of the State. This includes data from local governments, private parties, academic institutions, and the general public. The consideration of data does not imply that the data must be used if not of sufficient quality. That said, data that do not meet certain quality criteria can still be of value in providing insights and clues to guide further investigation.

Finally, although the State is responsible for water quality monitoring, as described above, local governments and others are welcome to conduct monitoring. It is strongly recommended, however, that prior to investing in such monitoring, effort be made to coordinate with the MDE to ensure that proper methods are used.

5.2 Tools and Resources

This section provides a consolidated collection of tools and references to helpful resources. This information will be supplemented in the future as new information becomes available.

5.2.1 Tools

TMDL implementation tools should be viewed as spanning the same range as land use planning, from comprehensive plans to site plans (See Section 5.3.4). Many of the existing tools used to support decision-making across the full range of geographic scales can be adapted to serve as tools for TMDL implementation planning.

Load Estimations: Standardized procedures and tools for estimating NPS loads are being developed for use in local decision-making. In the 2006, Section 4.3.1.5 recommends the use of information and analytical tools that are consistent with the regional Chesapeake Bay Agreement Tributary Strategies (See Appendix E). Despite limitations, computations using the Bay program loading rates provide an internally consistent framework for decision-making, which is peer-reviewed, and accepted by the US EPA. Decisions based on analyses using this framework should be tested by common sense and professional judgment.

Until the State adopts standardized procedures, any technically justifiable load estimation tool may be used. For example, The Center for Watershed Protection (CWP) maintains spreadsheet-based tool called the Watershed Treatment Model (WTM) that can be used to evaluate nutrients, sediments, metals and bacteria. It addresses a wide range of pollutant sources and control options. It allows the user to adjust these loads to evaluate multiple alternatives for watershed treatment. See the appendix to "A User's Guide to Watershed Planning in Maryland:" http://dnr.maryland.gov/watersheds/pubs/userguide.html

Although Maryland's "Scenario Builder" is designed for the ten large Tributary Strategy basins, its results could be interpreted for nutrient reduction planning in smaller watersheds. This tool accounts for the non-additive effects of multiple BMPs on the same land parcel and provides cost estimates. www.dnr.state.md.us/bay/tribstrat/tsdw/scenario_builder.html

BMP Information: The EPA Chesapeake Bay Program maintains the latest information on best management practices (BMPs) for nutrients and sediments. Because sediment controls also control the pollutants that attach to sediment particles, it can be a reasonable surrogate for other pollutants, e.g., bacteria. This BMP information can be accessed via the web link: www.chesapeakebay.net/tribtools.htm

- Reduction Efficiencies: The "trib tools" web page cited above includes a section on "Best Management Practices" toward the bottom of the page. See "Nonpoint Source Best Management Practices" for information on BMP reduction efficiencies.

- BMP Unit Costs: A table of unit costs for BMPs is included in Appendix I.

5.2.2 Resources

The following resource references are not comprehensive, but provide a good starting point on many topics relevant to TMDL implementation. They are presented in alphabetical order.

303(d) List: See "Impaired Waters" under "Water Quality Standards."

Antidegradation Waters: See Tier II waters under "Water Quality Standards."

Bacteria TMDL Implementation:

Bacteria TMDL Implementation Plans: Virginia has fairly extensive experience with TMDLs for bacteria. Although their TMDL development methodologies are different from those used in Maryland, the implementation actions identified in Section 6.0 of their bacteria implementation plans (IPs) have wider applicability. Their IPs also provide cost effectiveness information, which might prove useful. http://www.deq.virginia.gov/tmdl/iprpts.html

Contacts:

Stakeholder Involvement: See Section 3.5 "Stakeholder Involvement" of this Guidance document.

Multi-jurisdictional Coordination: See Section 5.8.3 "Contacts" of this Guidance document.

Drinking Water Supply Management

Draft MDE Guidance "Water Supply Capacity Management Plans", 2005, www.mde.state.md.us/assets/document/water/WaterSupplyCapacityMgmtGuidance.pdf

See "Source Water Assessment" below.

Financial Assistance:

The following resources are in alphabetical order. The brochure, "Grants and other Financial Assistance…" provides fairly comprehensive information. Additional references are included to supplement that brochure.

Environmental Finance Center
4511 Knox Road, Suite 205, College Park, MD 20740
phone: (301) 403-4610, ext 24, fax: (301) 403-4222, email: efc@umd.edu
http://www.efc.umd.edu/

Financing Alternatives for Water Quality: The EFC has developed matrices of financing alternatives for wastewater, the agricultural sector, developed lands, and forests.
http://www.efc.umd.edu/our_work/matrices.cfm

Grants and other Financial Assistance Opportunities at MDE (Includes links to federal grants)
http://www.mde.state.md.us/aboutmde/grants/index.asp

Water Quality Improvement Assistance (brochure developed by MDE)
http://www.mde.state.md.us/assets/document/Water%20Quality%20Assistance_090804.pdf

MDE Barrowers Manual, Appendix L describes the system used to rank projects for a wide variety of capital funding sources, including grants and loans:
http://www.mde.state.md.us/assets/document/Water/app_100.pdf

Coastal Communities Initiative Grant (MD DNR):
http://www.dnr.state.md.us/bay/czm/index.html

Landowner Incentive Program (MD DNR):
http://www.dnr.state.md.us/wildlife/lip.asp

Forestry Management:

EPA recently published new National Management Measures to Control Nonpoint Source Pollution from Forestry, a technical guidance and reference document for use by State, Territory, and authorized Tribal managers as well as the public in the implementation of nonpoint source (NPS) pollution management programs in forest settings. The new guidance contains information on the best available, economically achievable means of reducing nonpoint source pollution that can result from forestry activities. http://www.epa.gov/owow/nps/forestrymgmt/.

Maryland Forest Service:
www.dnr.state.md.us/forests/

Geese: Managing Resident Geese: http://lakeaccess.org/urbangeese.html

Green Building:

Maryland Green Building Network (GBN) is an ad-hoc, informal group of architects, builders, contractors, developers, planners, landscape architects, related professionals, and citizens. Numbering over 1,000 individuals and affiliations, the Network focuses on promoting and encouraging the design and construction of buildings, and the development of sites, in a manner that encourages efficient use of natural resources and raw materials, protects the environment, and promotes sustainable communities.
http://www.dnr.state.md.us/ed/mdgbn/

US Green Building Council
The U.S. Green Building Council (USGBC) members work together to develop LEED products and resources that support the adoption of sustainable building. LEED, Leadership in Energy and Environmental Design, is a green building rating system designed to accelerate the development and implementation of green building practices. http://www.usgbc.org/

Impaired Waters List: See "Impaired Waters" under "Water Quality Standards."

Land Conservation:

Maryland Environmental Trust Land Trust Assistance Program:
A land trust is a non-profit organization devoted to land preservation. It can be a private non-profit or public, like the Maryland Environmental Trust. This website has contact information for many local land trust organizations.
http://www.dnr.state.md.us/met/landtrusts.html

Land Use Planning and Water Quality:

"Protecting Water Resources with Smart Growth"
http://www.epa.gov/smartgrowth/water_resource.htm

EPA Brochure: "Growth & Water Resources: The link between land use and water resources" Includes links to other documents and resource links.
http://www.epa.gov/water/yearofcleanwater/docs/growthwater.pdf

Land Use Planning Models and Guidelines. Maryland Department of Planning publications. Order forms may need to be FAXed to purchase some of the documents.
http://www.mdp.state.md.us/order_publications.htm

"Eight Tools of Watershed Protection in Developing Areas" EPA training module.
http://www.epa.gov/watertrain/protection

Maryland Department of Environment Water Publications:
http://www.mde.state.md.us/researchcenter/publications/water/index.asp

Maryland Department of Environment Permit Guide:
http://www.mde.state.md.us/Permits/busGuide.asp

Maryland Stormwater Design Manual:
http://www.mde.state.md.us/programs/waterprograms/sedimentandstormwater/stormwater_design/index.asp

Pesticides and TMDL Implementation:

California: TMDL implementation plans are required as part of the TMDL development process. This link is to a specific case for pesticides in the San Joaquin River (California's Highly Agricultural Central Valley).
http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/sjrop/OPImpWrkShp_091002.pdf

Sediment TMDL Implementation:

Sediment TMDL Implementation Plans: Virginia has some experience with TMDLs for sediment.
http://www.deq.virginia.gov/tmdl/iprpts.html

Soil Conservation District, Maryland Association of web site:
http://www.mascd.net/scds/MDSCD05.htm

Source Water Assessment:

EPA Web Page: http://www.epa.gov/ost/biocriteria/stressors/stressorid.pdf

MDE Source Water Assessment Fact Sheet and Guidance:
www.mde.state.md.us/programs/waterprograms/water_supply/sourcewaterassessment/index.asp

Stormwater: See Maryland Stormwater Design Manual

TMDL Implementation

Maryland TMDL Implementation Web Page:
http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/implementation.asp

National Examples: *The inclusion of these examples is not intended to constitute an endorsement.*

- California: TMDL implementation plans are required as part of the TMDL development process. Specific Case of Pesticides in the San Joaquin River (California's Highly Agricultural Central Valley).
  http://www.swrcb.ca.gov/rwqcb5/programs/tmdl/sjrop/OPImpWrkShp_091002.pdf
- Georgia:
  http://www.northgeorgiawater.com/pdfs/CH2M-SW/TM8(11-22-02).pdf
- Minnesota: Implementation Cost Estimate Method for Stormwater, PowerPoint
  http://www.stormwater-resources.com/Library/154TTMDLImplementation.pdf
- South Carolina: Implementation Plan for Achieving Total Maximum Daily Load Reductions From Nonpoint Sources. Submitted to EPA September 1998
  http://www.scdhec.net/eqc/water/html/npsplan.html
- Implementing TMDLs in Texas: A Status Report, July 2004
  http://www.tnrcc.state.tx.us/water/quality/tmdl/TMDLStatus03.pdf

- Texas TMDLs and Associated Implementation Plans
  http://www.tnrcc.state.tx.us/water/quality/tmdl/tmdl_projects.html
- Virginia: Guidance Document, Draft and Final Implementation Plans for Bacteria TMDLs, and Implementation plan development schedule.
  http://www.deq.virginia.gov/tmdl/implement.html

See Section 3.2 "Legal Landscape" for additional references to guidance on TMDL development and implementation.

Wastewater Planning:

Draft MDE Guidance "Wastewater Capacity Management Plans", 2005
www.mde.state.md.us/assets/document/water/wastewaterCapacityMgmtGuidance.pdf

Water Quality Standards:

Designated Uses COMAR 26.08.02.02
www.dsd.state.md.us/comar/26/26.08.02.02.htm
www.dsd.state.md.us/comar/26/26.08.02.02%2D1.htm

Water Quality Criteria COMAR 26.08.02.03, .03-1, .03-2, .03-3, and .03-4
General: www.dsd.state.md.us/comar/26/26.08.02.03.htm
Toxic Substances: www.dsd.state.md.us/comar/26/26.08.02.03%2D1.htm
and www.dsd.state.md.us/comar/26/26.08.02.03%2D2.htm
Criteria Specific to Designated Uses: www.dsd.state.md.us/comar/26/26.08.02.03%2D3.htm
Biological Criteria: www.dsd.state.md.us/comar/26/26.08.02.03%2D4.htm

Tier II waters for which the antidegradation policy applies:

- Maps, organized by county, are available from MDE that identify the locations of the Tier II streams. Contact Jim George jgeorge@mde.state.md.us
- Antidegradation Policy www.dsd.state.md.us/comar/26/26.08.02.04.htm
- Anitdegradation Implementation Procedures and coordinates of Tier II Streams: www.dsd.state.md.us/comar/26/26.08.02.04%2D1.htm

Impaired Waters: Maryland's 303(d) List identifies impaired waterbodies. Below is a link to a searchable database of the 303(d) list:
www.mde.state.md.us/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/303d_search/index.asp

Watershed Planning:

EPA watershed planning handbook:
http://www.epa.gov/owow/nps/watershed_handbook

A User's Guide to Watershed Planning in Maryland:
http://dnr.maryland.gov/watersheds/pubs/userguide.html

Wetlands:

Maryland’s Wetlands and Waterways webpage:
http://www.mde.state.md.us/Programs/WaterPrograms/Wetlands_Waterways/index.asp

5.3 Land Use Planning

"The health of our waters is the principal measure of how we live on the land"
Luna B. Leopold

The statement above by the renowned conservationist Luna Leopold provides a context for understanding the relationship of Total Maximum Daily Load (TMDL) implementation to land use. Poor water quality ("impaired waters") exists primarily because land use activities have resulted in the excessive discharge of pollutants into waterways. Although pollutants such as nutrients and sediment are rather ubiquitous, water quality and biological monitoring programs suggest that the number of impairments (and therefore TMDLs) for other pollutants, as well as the physical degradation of streams, is generally greater for urbanized watersheds.

Land use planning, particularly as influenced by the local comprehensive plan, is an essential tool for addressing existing TMDLs and the prevention of future water quality impairments. The purpose of this section of the Guidance is to provide some first thoughts about the evolution in local comprehensive land use planning and implementation needed to better address TMDLs (and potentially other environmental management challenges).

This section does not presently describe how to conduct analyses toward this end. Rather, it serves as a road map that begins to layout key concepts and to identify complicating factors such as potential unintended consequences of TMDLs in relation to principles of Smart Growth.

5.3 1 Traditional Comprehensive Planning and the Environment

It is useful to first define planning and the purpose of the comprehensive plan. As a process, the objective of planning is the effective management of changes to the use of land. The comprehensive plan provides the vision and goals for how the public wants their communities to appear and function. The comprehensive or "master" plan also provides recommended policies and actions to achieve these desired outcomes. Comprehensive planning is an appropriate tool for addressing TMDL implementation; however, to accomplish this, the range of issues considered and analyses conducted during the comprehensive planning process needs to be expanded beyond the traditional focus.

The traditional treatment, if any, of environmental protection in comprehensive planning often consists of developing an inventory of "sensitive" resource areas with policies to protect them from loss due to development. Maryland's Economic Growth, Resource Protection and Planning Act of 1992 (Planning Act of 1992) requires local jurisdictions to adopt a sensitive areas element that protects streams and their buffers, 100-year floodplains, habitats and endangered species and steep slopes from adverse effects of development (Codified at § 3.05(a)(1)(viii), Article 66B, Annotated Code of Maryland). Generally, this has resulted in the treatment of sensitive areas as a constraint to development.

Furthermore, environmental considerations are typically relegated to the role of site design, a stage in the overall land use planning process that is often arguably too late. Without effective land use planning, site design planning typically cannot provide effective tools for resolving the inevitable conflicts between providing for livable communities and a sustainable environment. In many of Maryland's jurisdictions, environmental standards have not been sufficiently incorporated into early stages of land use planning and into implementation processes.

Maryland's Planning Act of 1992 provides guiding principles to address development's impact on natural resources early in the planning process through the Act's eight visions. See the section "Full Range of Land Use Planning" below. Subsequent to the Planning Act of 1992, Maryland passed its Smart Growth Initiatives intended to implement the visions of the 1992 Planning Act. These initiatives, particularly relevant to environmental concerns, include Priority Funding Areas (PFAs) and the Rural Legacy Areas (RLA). For more information on PFAs and RLAs, go to www.mdp.state.md.us.

Significant to note are efforts of some of Maryland's more urbanized local jurisdictions to address development's impacts on natural resources in comprehensive planning efforts prior to Maryland's passing of the 1992 Planning Act. Notable experiences can be found in Baltimore County's establishment of an urban growth boundary and its resource conservation zoning and Montgomery County's Transfer of Development Rights Program and development of Special Protection Areas. These measures attempt to address water pollution from septic systems, development threats to drinking water reservoirs, and encroachment of development into productive agricultural areas.

To address environmental considerations earlier in the planning process, the question that must now be asked is what are appropriate land use planning standards for achieving environmental quality goals? What should community standards be for the control of pollutant load generation? Water quality standards and TMDL analyses provide targets for answering these questions. The challenge is to integrate the disciplines of land use planning and watershed planning in a balanced manner to achieve the desired environmental goals while also meeting other necessary social goals, such as affordable housing, appropriate location of development, and sustainable businesses including agriculture.

5.3.2 New Challenges

The need today to assure environmental protection through land use planning presents significant practical challenges for planning at both the comprehensive and community levels. Expanding the objectives and process of comprehensive planning is critical to success. However, investing in the capacity to conduct this kind of proactive planning has practical administrative benefits.

Addressing water quality in a quantitative manner at the early stage of comprehensive land use planning and implementing the appropriate land use and growth management tools will help to ensure greater certainty and efficiency for future development, a benefit to developers for whom time is money. It will also reduce local government costs in two ways. First, the greater certainty and efficiency during the development process, afforded by advanced planning, will reduce delays associated with uncertain legal liabilities as well as the time invested by local staff and officials to review plans and make decisions. Second, conducting advanced planning to ensure that water quality is improved or maintained will reduce the costs of fixing problems created by development after they occur.

In terms of land cover, the main cause of impairments is the altering of the landscape's natural hydrology, loss of natural resource lands most effective in filtering pollutants (e.g., wetlands and forest cover), and increased impervious surfaces, particularly in relation to dispersed development patterns and the increased need for stormwater management and transportation infrastructure. Roads and parking lots generate high pollutant loads particularly when connected directly to storm drain systems. Runoff constituents from these surfaces such as metals and petroleum by-products, typically poorly controlled by stormwater management systems, a condition that is often not well understood by the public and many planners. Despite toxicological research, the effects of these substances in the natural environment, particularly in combination, are also not fully understood. Thus, the temptation to focus attention narrowly on better understood substances, like nutrients, runs the risk of failing to address these pollutants until it is too late. The issue of impervious cover is one where both advanced land use planning, and implementation standards and guidelines need to be enhanced to meet the goals of restoring and protecting water quality.

With regard to land use planning, some local governments are beginning to incorporate limits on impervious cover as part of their sector planning process. Although caution is advised on simply placing a fixed limit on the percentage of impervious cover, practical experience is being acquired with area planning methods that explicitly address impervious cover. The information technology and computing tools are close at hand to conduct these analyses. (See Section 5.6 for a case study).

While some have advocated approaches involving "low impact development" and "environmentally-sensitive site design," many planning codes are outmoded, resulting in regulatory, bureaucratic and financial barriers to innovative development techniques. That is, current codes are often an impediment to meeting water quality standards. For example, local codes generally have minimum requirements regarding the provision of parking, but few codes place a maximum limit on the creation of parking. This promotes over-design of parking lots and thus excessive impervious cover. As planners and policy leaders begin to understand that stormwater management and other site design regulations for new development are not fully adequate to control these water quality impacts, comprehensive planning and its implementation will become more effective.

5.3.3 TMDL Guidance as a Road Map to Enhanced Land Use Planning

The list of measures below is intended to stimulate dialogue about the role of comprehensive planning and implementation to address TMDLs. This list presents general concepts with the understanding that there needs to be consistency and follow-through between the comprehensive plan and its implementation tools; as such, it does not repeat the same ideas for the comprehensive plan, zoning, subdivision regulations, and site design requirements. Consistent with the overall intent of the MDE Guidance, this list suggests steps that the State and local governments should consider jointly to improve the financial, technical and administrative capacity to manage land use in a quantitative manner to protect and restore water quality. (See Appendix B for a list of other issues to be considered when refining this Guidance).

1. **Basic Context of Land Use and Environment** - Local comprehensive plans need to include a vision and a consistent set of goals, policies, and action recommendations to address the impact of land use on protecting and restoring water quality standards. Plans should note that the protection and provision of clean air, water, and land resources is not only a matter of legal consistency, but a necessary part of the local quality of life. Addressing pollution closest to the source is preferable to management of pollutants "downstream". In instances where addressing pollutants closest to the source prohibits development and/or redevelopment in growth areas, a watershed approach should be used to address far field impairments and provide a means for adequate offsets.

2. **Areal Relationships** - Local comprehensive plans and their implementation should relate areal land use planning units (community or sector boundaries, management areas, etc.) to functional environmental units (watersheds in the context of TMDLs). Because local jurisdictional boundaries often split watersheds, municipalities, counties and state agencies also need to work together to address inter-jurisdictional issues. For some jurisdictions, this is also an inter-state issue. (See Section 5.8 Multi-jurisdictional Coordination).

3. **Local Governments** – Comprehensive plans should acknowledge the special issues of land use and water quality in relation to municipalities. Issues that should be addressed include land use authority, annexation, and coordination of infrastructure planning. Municipalities, counties, and state and federal agencies need to work together regarding which units of local government will be responsible for TMDL implementation and how conflicting roles of counties and municipalities can be addressed. The recommendation to identify local government coordinating committees, advanced in Section 3.4.1 "Intra-governmental Coordination," is intended to address this and similar issues. The identification of a local group with multi-disciplinary knowledge will provide a key point of contact for the State to communicate with municipal and county governments on these kinds of topics.

4. **Performance Standards -** Planning needs to develop performance standards and guidelines for the environment. For older development without stormwater management, planning should strive to restore natural resource lands and habitat, and improve water quality. Care should be taken to avoid the unintended consequence of driving development outside of growth areas. In growing rural and suburban designated growth areas, advance planning can be used to minimize the cost and administrative burden of maintaining consistency with TMDLs and the antidegradation policy (See Section 4.2.3 on implementing the antidegradation policy). The State is committed to working with county and municipal governments toward the adoption of indicators that reflect these goals. Section 4.1 of the Guidance describes how TMDLs and water quality standards are intended to serve as these indicators. The next section discusses the need for analytical methods that link land use planning elements to environmental outcomes.

5. **Environmental Analyses -** For growing suburban and rural watersheds, local comprehensive plans should include analyses relevant to the relationship of land use and

functional environmental outcomes, such as: analyses of pollutant loads associated with existing and projected land use and of impacts due to impervious surfaces, considering percentage and per capita imperviousness for planning areas, in relation to sub-watersheds. Where possible, analyses should include traditional chemical water quality, biological impairment, and stream channel stability. Evaluation of the distribution of protective forest cover, including total watershed forest coverage and forest coverage within stream buffers and on steep and erodible slopes, should also be considered.

Appendix E "Nonpoint Source Nutrient Loading Assessments Using Chesapeake Bay Program Land Use Loading Coefficients" provides 2006 guidance on addressing nutrients. Section 4.4 "Maintaining Water Quality: A Framework for Offsetting Future Loads," discusses a means of evaluating forest cover from the perspective of managing nutrient loading. The Maryland Stormwater Design Manual provides a wide array of detailed technical analysis methods that can be adaptated to larger area planning for impacts of impervious land cover.

As this Guidance is refined, the previous list of issues can be expanded. The analyses that address these issues can be refined and tailored for differing land cover, various waterbodies and associated water quality standards, different types of TMDL analyses, and specific cases like options for very challenging circumstances.

6. **TMDLs, Tradeoffs, and Smart Growth -** Comprehensive plans should consider the jurisdiction-wide tradeoff of development patterns regarding water quality impairments and sound land use concepts, e.g., targeting growth to Priority Funding Areas (PFAs). A special issue is that older urban development predating water quality standards probably fails to meet today's water quality standards. Although improvements in water quality are possible in such areas, it will be infeasible to raise physical, chemical and biological water quality to levels achievable in a rural setting. This is an active area of public policy discussion and another key subject for dialogue during refinement of this Guidance.

   Land use planning should continue to promote principles of targeted growth, but strive to improve water quality in the process. Preserving the rural character of a local jurisdiction, and open space in general, is an environmental goal that could necessitate the balancing of water quality goals. When considering the following itemized guidance points, planning should strive to avoid the potential unintended consequence of driving development from concentrated areas of development into the countryside.

   First, it is desirable to create incentives that promote the redevelopment of older urban areas that predate State stormwater regulations. This requires flexibility when addressing stormwater from redevelopment projects. Flexibility is afforded by allowing offsets elsewhere in a watershed when site constraints prohibit stormwater management on site. State law requires the reduction of impervious surfaces during redevelopment projects, which provides an incremental improvement in water quality in areas that would otherwise go unimproved due to lack of resources. (Editorial NOTE: the first and second sentences refer to incentives and the third sentence refers to requirements. It is acknowledged that the requirement can act as a disincentive for redevelopment.)

Second, new development that will displace agricultural land should be leveraged to include stream restoration to help restore biologically impaired streams. This is consistent with the standards expressed in State guidance entitled, "Preparing a Sensitive Areas Element for the Comprehensive Plan" (Maryland Department of Planning, May 1993, p.10), and with the federal Clean Water Act.

Third, new development should be targeted to avoid deforestation. This is motivated both as a means of protecting healthy stream channel integrity and as a means of avoiding the need to offset increases in pollutant loads that accompany deforestation (See the hypothetical watershed example in Section 4.4.2 "Technical and Administrative Procedures to Support Pollutant Offsets ").

Fourth, it is desirable to identify potential areas for reforestation in an amount of acreage estimated to reduce any excess pollutants and offset pollutant loads from proposed development areas. Section 4.4 provides guidance on how to perform planning level calculations to do this. It should be recognized that the general subject of pollutant offsets is evolving both as a technical and public policy issue.

Fifth, plans should demonstrate that dense development within designated growth areas is offset by the protection of natural resources and rural areas. This can be demonstrated by development area capacity analyses and evaluation of rural-to-urban area ratios. As in the case of Baltimore County, where the rural to urban land area ratio is 2:1, such ratios should be significant.

In summary, healthy water quality must be protected and impairments must be addressed and improved even where it is infeasible to achieve water quality standards at present. TMDL implementation in the context of land use planning should be balanced with the broader set of environmental issues (e.g., targeted growth and other TMDLs[20]) and social mandates (e.g., public safety and affordable housing). It is important that comprehensive plans recognize that TMDL implementation should not result in the abandonment of growth management commitments or targeted development at reasonable densities.

7. **Strategies for Existing Development** – When conducting planning for sub-watershed areas with existing and older development without stormwater management, comprehensive plans should commit to reducing future cumulative pollutant and hydrologic loads. Strategies for this include: improving water quality through reduction of impervious surfaces during re-development; including green roofs; removing "unused" impervious surfaces (on public lands and excess parking); retrofitting older development with stormwater management

[20] An example of conflicting goals arises between nutrient TMDLs and the management of municipal wastewater discharges to protect shellfish harvesting areas from bacteria. Wastewater discharge outfalls have intentionally been located as far upstream away from shellfish waters as possible. This is done as a preventive measure to protect shellfish harvesting areas from contamination due to a potential treatment plant malfunction. The environmental tradeoff is that locating treatment plant outfalls upstream results in discharges of nutrients to poorly flushed tidal headwaters of limited volume (limited assimilative capacity), which increas the occurrence of algal blooms that would not occur if the discharge outfall was located in the larger part of the tidal river.

systems; and implementing impervious surface maintenance practices such as vacuuming. The amount of additional low-density land use within urban areas should be minimized.

8. **Density** – For both existing and future development areas, the most effective long-term strategy is increased density of urban development combined with permanent protection of open space. Floor area ratio (FAR) and population density can be used as indicators for assessing this strategy, and specific goals can be set to increase FAR and density. To implement this strategy, local governments should consider the physical, economic, and legal issues for achieving increased density. For example, local governments need to consider infrastructure issues such as adequate water pressure for high FAR development and fire insurance, economic issues such as financing for higher-density mixed-use development and structured parking, and legal issues such as form-based codes to encourage alternative "new urbanism" development. Local governments should work with state and federal agencies to address barriers to implementation of water-quality performance development. Other familiar urban land use alternatives such as transit-oriented development (TOD) should be encouraged to help meet existing TMDLs and to protect healthy water quality. As a further strategy, high-functioning resources such as forested areas within urban growth boundaries should not be zoned for development. That is, net density concepts, in which the same number of development units is maintained by increasing density in some places and preserving other places, should be applied.

9. **Rural Land Use Strategies** – Healthy rural "working lands" economies help preclude water quality impairments associated with urbanization, as they provide high-value economic return for the use of land. Economically viable agriculture helps prevent land conversion pressures, thus preserving open space and Maryland's rural heritage. Comprehensive planning should emphasize and support the ecosystem services of rural land (particularly forests), including regulation of watershed hydrology, protection of drinking water sources, maintenance of stable stream morphology, and even non-TMDL benefits such as maintenance of air quality[21].

   Rural development potential and environmental impact on water quality can be reduced through use of Purchase/Transfer of Development Rights (PDR and TDR), down-zoning, and clustering. These measures alone will not protect rural lands. They are much more effective when used in conjunction with incentives to concentrate growth to designated growth areas. The comprehensive plan and its implementation should encourage cooperation among existing rural "service" agencies (counties, Soil Conservation Districts, USDA Natural Resource Conservation Service, Forestry Boards, Maryland Department of Agriculture, MD Department of Natural Resources, etc.) and citizen-based watershed organizations for education of citizens about overall stewardship and provision of technical and financial assistance for specific water quality practices.

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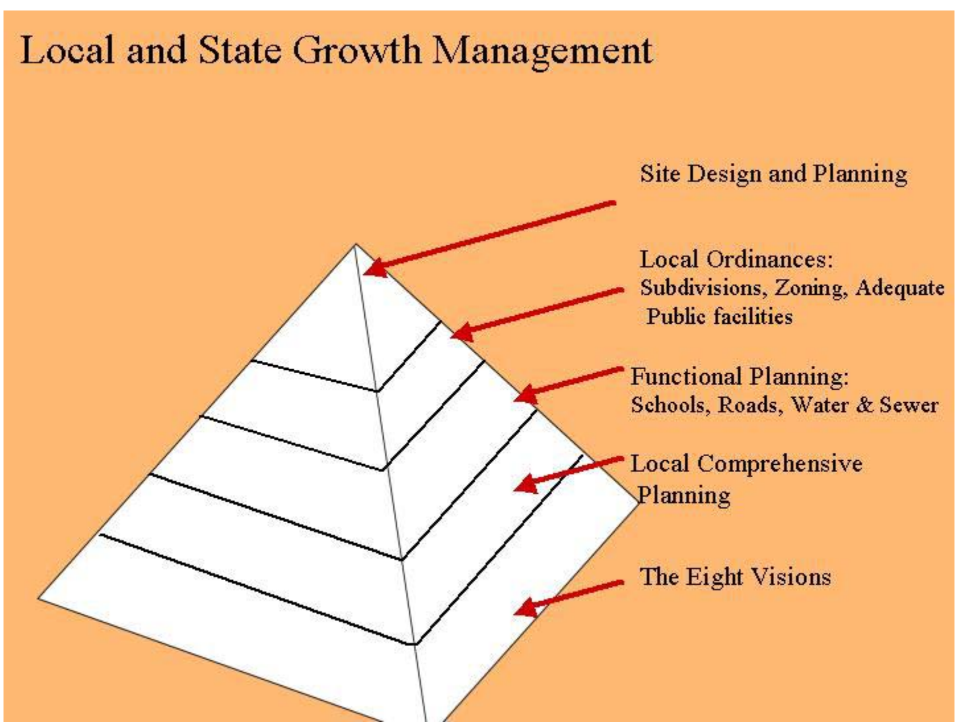
[21] The Code of Maryland Regulations, 26.08.02.01(A)(2)(c) specify that, among other things, "Water quality standards shall provide water quality for the designated uses of… Propagation of fish, other aquatic life, and wildlife," emphasis added. Although TMDLs do not set explicit goals for terrestrial wildlife, this regulation can be interpreted to include protection of balanced wildlife populations and biodiversity.

5.3.4 The Full Range of Land Use Planning

Meeting the challenges of TMDL implementation will necessitate use of the full range of land use planning elements portrayed graphically below. In Maryland, the full range of land use planning elements builds conceptually upon the following Eight Visions:

(1) Development is concentrated in suitable areas;
(2) Sensitive areas are protected;
(3) In rural areas, growth is directed to existing population centers, and resource areas are protected;
(4) Stewardship of the Chesapeake Bay and the land is a universal ethic;
(5) Conservation of resources, including a reduction in resource consumption, is practiced;
(6) Economic growth is encouraged and regulatory mechanisms are streamlined;
(7) Adequate public facilities and infrastructure under the control of the county or municipal corporation are available or planned in areas where growth is to occur; and
(8) Funding mechanisms are addressed to achieve these visions.

How local governments choose to use the full array of land use planning elements to meet the challenges of restoring and protecting water quality is a local decision. Although consistent practices among local governments are desirable, some aspects will vary depending on the policies adopted by different local governments. The subject of land use planning and implementation measures will be a key part of ongoing dialogue as the State and local governments refine this TMDL Implementation Guidance during the coming years.



5.4 Rural and Agricultural Settings

This section recognizes the need for local governments to interface with agricultural agencies. There is a potential gap in support for rural residential communities. There is also a need to ensure that water quality protection is balanced with maintaining the rural economy.

The Maryland Department of Agriculture works closely with federal agencies, the Maryland Cooperative Extension Service, and local Soil Conservation Districts (SCDs) to deliver coherent technical and financial services to farming and rural communities in support of natural resource protection. MDA is responsible for administering Maryland Agricultural Land Preservation Program and regulations of the 1998 Water Quality Improvement Act that require nutrient management plans. MDA also works closely with landowners and farm operators to address various regulatory compliance issues, such as finding remedies for erosion “hot spots” and bacteria sources. MDA is also responsible for collecting and reporting information that supports the tracking of agricultural best management practices (BMPs). This information is used to estimate progress toward achieving pollution reduction goals and the Chesapeake Bay Agreement Tributary Strategies for nutrient reduction.

The roles of SCDs vary among different local governments. The SCDs common role related to TMDL implementation is to increase voluntary conservation practices among farmers, ranchers and other land users. SCDs also assist in the development of soil conservation and water quality plans, which include best management practices (BMPs) for protecting wetlands, water quality, and preventing soil erosion. SCDs in many local jurisdictions also review soil and erosion control plans for urban development. District staff work closely with watershed residents and have valuable knowledge of local watershed practices. See the Maryland Association of Soil Conservation District web site: http://www.mascd.net/scds/MDSCD05.htm

Agricultural businesses will also have a role in TMDL implementation, not only farmers, but businesses that support farming operations. These include consultants that develop nutrient management plans, and businesses that provide inputs such as farm implements, fertilizers, pesticides and herbicides. Rural communities and non-farming businesses depend on the economic viability of the farming industry. This should be considered as part of the development of policies and procedures for protecting water quality.

5.5 Economic and Regulatory Incentives

Economic and regulatory incentives offer a balanced approach to environmental protection. Incentives influence the way regions, counties, municipalities, and neighborhoods grow by incentivizing certain types of practices and land use decisions. When benefits embodied in well-conceived incentives are widely known, private sector actions tend toward desired environmental outcomes. New commercial and residential buildings are proposed, planned, and built in a more environmentally sensitive way with less government intervention at each step of the way. This increases public and private sector productivity by saving time and human resources. Private profits are enhanced and the public receives more for their tax investments.

The multi-media environmental impacts of land use and transportation decisions are incremental, cumulative, and large. Growth and development can have profound effects on both water quality and quantity. Protecting our water resources becomes increasingly difficult as more woodlands, meadowlands, and wetlands disappear under impermeable cover. People are concerned about preserving the environmental quality of local rivers, lakes, and streams while continuing to develop. Local governments, working with planners, citizen groups, and developers, are thinking about where and how this new development can enhance existing neighborhoods and also protect the community's natural environment. They are identifying the characteristics of development that provide vibrant neighborhoods rich in natural and historic assets, with jobs nearby, a range of residential options, secure drinking water, functional schools and more transportation choices.

To achieve these goals, local governments are looking for, and using, policies and tools that enhance these desired characteristics. Many are attempting to direct growth to places that maintain and improve the historic appearance and infrastructure for which investments have already been made.

There is a growing consensus that traditional environmental protection systems need to be enhanced to handle an increasingly complex set of environmental challenges. The challenge posed by maintaining consistency with TMDLs to protect water quality and reverse the loss of habitat and biodiversity requires a broader set of tools than those relied upon in the past.

Public programs that educate businesses about pollution prevention (P2) are one example of an enhanced environmental program. Combined with traditional regulatory programs, drawing attention to P2 can reveal near-term and long-term financial savings inherent in changing processes (lower input cost, increased process efficiency, lower environmental management costs, and decreased legal liability).

New protection systems internalize environmental and health costs *and* benefits within the business decision framework. These can take the form of market-based programs, or requiring that activities bear the full cost of preventing any potential environmental degradation. The latter is represented by the principle of requiring new pollutant loads be offset. This can be administered by requiring actions be taken to offset new loads, or by a fee-in-lieu system that covers the full cost for the public sector to take actions that offset the new loads.

A variant on internalizing the cost of environmental protection is differential development-related fees. Although not necessarily designed to internalize the cost of environmental protection, fees can be structured to influence how or where development is conducted. For example, larger fees can be set for sewer hook-ups and plat approvals with septic systems in suburban fringe locations than for sewer hook-ups in areas of existing development. See, “Funding and Fee Structures” in “Protecting Water Resources with Smart Growth” (EPA, 2004). http://www.epa.gov/smartgrowth/pdf/waterresources_with_sg.pdf

Greater attention is also being given to cross-media efforts that leverage individual actions for multiple environmental benefits. The principle of directing land development to specific growth areas is desirable for this reason: the countryside is preserved (land); fewer miles of roadway must be paved per unit of development, resulting in less stormwater runoff (water); and average travel distances are reduced thereby reducing auto emissions (air & water - nitrogen & land when greenhouse gases are considered).

This new generation of environmental challenges is well represented by the impacts of land development and water quality protection. The many individuals and groups who exert influence on how and where communities grow are fragmented. Development outcomes are determined by a complex set of market, regulatory, institutional, and social factors. The resources needed for typical command and control approaches to environmental management are easily overwhelmed. Incentive systems are ideal for this situation.

Local land use plans help direct development to specific areas within their communities. In addition, they help plan how that development occurs. A number of tools are available to communities to encourage development practices that serve smart growth and water quality goals. In addition to regulations mandating certain types of development, incentives can help shape development practices through voluntary changes. Incentives such as density bonuses, streamlined permitting in areas where development is desired, differential fee structures, and the identification of development areas that have no pollutant offset requirements are all ways to provide development incentives. The creation of these kinds of incentives can incorporate features that balance water quality and smart growth goals.

For example, a density bonus allows a developer to construct a building at a size and scale beyond that allowed by conventional zoning, thereby offering more opportunity for profit on the same amount of land. It is typically provided to developers as a reward or incentive when they provide a public amenity, such as parks, plazas, or affordable housing.

Enhanced water quality benefits could also be included in the list of eligible public amenities. Municipalities can offer decreased development fees for developments that include features to reduce impervious cover beyond minimum requirements. Such features could include the use of living (green) roofs or landscaping that reduce runoff and treat water onsite. Bonuses or reduced fees can also be provided to developers who agree to replace older water and sewer infrastructure serving the project. This type of approach yields multiple benefits. More projects are likely to incorporate features that mitigate runoff, and increased density allows more development to occur on less land, leading to more efficient use of existing roads, sidewalks, and water/sewer systems.

As one example, the city of Portland, Oregon, was the first in the nation to offer significant private sector incentives in the form of density bonuses for developments that incorporate green roofs to reduce runoff. In 2001, with a large concentration of new development along the Willamette River, the city approved the Floor Area Ratio bonus option for developments that include the use of landscaped rooftops to retain and filter rainwater. The program offers a sliding scale of density bonuses based on the size and relative scale of the green roof; developers can earn as much as three square feet of additional floor area for each square foot of green roof area.[22]

A similar incentive framework can be created to address existing development, which could be administered through a stormwater management impact fee system. Stormwater management systems assess property owners an annual impact fee based on their contribution of stormwater. Such fees typically fund the maintenance of existing stormwater devices, and can be used to fund the restoration of streams that have been impacted by stormwater runoff. Fee structures can be designed to offer reductions to property owners for retrofitting their properties with stormwater management.

It is important, however, that the fees in question be meaningful relative to the commercial costs, otherwise a fee reduction incentive has no relevance to the business decision-making process, and merely takes on a public relations appearance. Because TMDLs create a quantified accounting framework for assessing results, inadequate fee structures are likely to be exposed in the future. In light of recent changes in Maryland real estate values, and the impending need for enhanced environmental management capacity, local reviews of existing fee structures would be advisable.

This same approach of incentivizing environmental protection can also be applied to TMDLs. Maryland intends to develop TMDL implementation plans in coordination with local governments and stakeholders. Because many elements of an implementation plan are most effectively administered at the local level, the State could offer incentives to encourage local government involvement. For example, financial incentives could be provided to communities that accelerate the adoption of necessary technical and administrative capacities to create a nutrient offset management framework. Other incentives could be provided for institutionalizing policy in formal frameworks, such as comprehensive plans, zoning plans and local subdivision regulations.

In summary, planning and regulatory requirements will continue to play a significant role in the protection of water quality. However, these traditional tools can be modernized to incorporate concepts of regulatory incentives. In addition, separate economic incentives also provide very powerful influences on positive choices by the private sector. Establishing and continually refining these kinds of incentives can dramatically improve the way traditional planning-based environmental management frameworks function. In addition, if the incentives are well-

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[22] Portland Provides Incentives for Green Roof Implementation. 2001. *The Green Roof Infrastructure Monitor*. Vol 3., No. 1. www.greenroofs.ca/grhcc/GRIM-Spring2001.pdf.

designed and financially meaningful, far less government intervention will be needed to achieve the environmental outcomes that the general public desires.

5.5.1 Incentives References

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www.yosemite.epa.gov/ee/epa/eed.nsf/Webpages/USExperienceWithEconomicIncentives.html

US EPA "Protecting Water Resources with Smart Growth," 2004, provides 75 policy proposals, which include many incentive concepts.
www.epa.gov/smartgrowth/pdf/waterresources_with_sg.pdf

5.6 Case Studies

Case studies provide tangible examples of how local governments are incorporating water quality protection and restoration into their routine planning and decision-making. These examples demonstrate that "TMDL implementation" need not be defined solely in terms of "TMDL Implementation Plans," but instead can be instituted through policy and procedure enhancements to existing programs.

5.6.1 Montgomery County Case Study: Using Imperviousness Studies to Guide Area Master Planning

For more than a decade, the Montgomery County Department of Parks and Planning has been using the projection of imperviousness by subwatersheds to aid in the density, parkland designations and facility decisions made in local area master plans. Using the research compiled by the Center for Watershed Protection and our own statistical analyses, planning for good quality Use III and IV streams strives for ultimate imperviousness near or below 10%.

These projections are developed using the baseline imperviousness derived from planimetric information (from aerial photography at 1"=200'). Prior to undertaking a master plan, a study of recently approved subdivisions is conducted to determine how much typical imperviousness (on a per acre basis) is associated with different zoning categories that might be used in the master plan. Then the planning team identifies properties that are vacant and redevelopable, and the imperviousness factors are substituted for the existing imperviousness on those parcels. The results are then totaled by subwatershed and accumulated for downstream subwatersheds. This is repeated for as many different scenarios as the process requires. Initially, these calculations are used to identify a range of environmentally acceptable alternatives that meet as many of the other desired goals for the area as possible. If other goals, such as development in priority funding areas, are determined to take precedence, then the calculations are used to determine the potential impacts of various alternatives.

The projected imperviousness findings are compared to the existing imperviousness and stream conditions found in each subwatershed and a finding made as to whether stream conditions appropriate to the Use designation will be maintained. This is done using a water quality regression model utilizing imperviousness to estimate future impacts on the benthic macroinvertebrate and fish communities. The health of the existing benthic and fish communities is measured using monitoring data that are combined into a composite score. Using the modeling results for various buildout scenarios, zoning and density adjustments to existing zoning are recommended, where feasible, to help maintain high quality waters, particularly Use III and IV streams.

Most of the master plan areas studied in the last decade had a substantial amount of existing development with many subwatersheds already at 8-11% imperviousness. In the Use III and IV streams, the primary means of protection has been the use of a low-density tight cluster zone that results in less than 8% imperviousness for new development. Depending on the amount of existing development, the resulting projected ultimate subwatershed imperviousness has ranged from 10-13% imperviousness. This then allows some additional "cushion" for the normal expansion of existing development, public facilities, institutions and other uses that may need to be accommodated over the 15-20 year lifespan of the master plan.

5.6.2 Worcester County Case Study: Using Nutrient TMDLs to Guide Comprehensive Land Use Planning

Worcester County is home to Maryland's Coastal Bays, which are very shallow sensitive embayments created by narrow barrier islands that separate the bays from the Atlantic Ocean. It is also one of the first jurisdictions in Maryland to make a conscious link between nutrient TMDLs and Comprehensive Landuse Planning.

The Worcester County Commissioners were briefed on the draft Comprehensive Land Use Plan during their September 20, 2005 meeting. According to records of the meeting, the County Planning Director stated that, "the overall objective of the Comprehensive Plan is to preserve the rural/coastal character of Worcester County." This objective reflects the need to balance the growth pressures with protection of the desirable characteristics that attract people to the coastal area of Worcester County.

At that meeting, the Planning Commission Chair, Carolyn Cummins, stated that, "the County's population is projected to grow by roughly 18,000 year-round residents over the next 15 to 20 years, and the plan proposes providing about 3,700 acres of new growth to accommodate that population." She also noted that one of the four "primary concerns" of area residents who participated in the process of creating the plan was that "growth areas needed to proactively address Total Maximum Daily Load implementation to protect our waterways."

The County Director of Environmental Programs, which serves the function of the Health Department in many other counties, also cited the TMDL in his remarks. He indicated that the Comprehensive Plan recommends an existing development, currently served by septic systems, should be connected to a sewer system. He explained that doing so would reduce nutrient loads. He also cited nutrient TMDLs when recommending sewer connections, rather than septic systems, for several future developments.

The proximity of the County to this special waterbody, and its dependence on tourism, explains in part why the TMDL is playing a role in the comprehensive planning process. Maryland's Coastal Bays Program, which guides the restoration and protection of this resource, also played a role by raising public awareness about TMDLs in a "Special Comp Plan Edition" of their "Solutions" newsletter mailed to every resident in the watershed. In a more general way, The Coastal Bay Program set the foundation by leading development of the Comprehensive Conservation Management Plan (CCMP), which calls for the development of subwatershed plans.

Within the context of developing subwatershed plans, the County invested time and staff resources into quantified TMDL implementation analysis for the Coastal Bay nutrient TMDLs. As a result, Worcester County is one of the first counties in Maryland to begin incorporating quantified TMDL implementation analyses into their planning process.

The process began in 2004, as Worcester County worked with State agency staff to conduct a preliminary nonpoint source reduction analysis for Newport Bay. The goals of the project were limited to conducting a sensitivity analysis designed to assess the upper and lower bounds on what could be achieved through nonpoint source reductions. The sensitivity analysis considered two types of uncertainty: 1) uncertainty in the areas where BMPs could be implemented, for example, how many miles of forested buffers could be planted, and 2) uncertainty in the reductions that could be achieved by various types of BMPs, for example, assuming that the percentage reduction of a particular BMP might range from 25% to 40%. The quantitative result of the analysis was expressed as a range of potential nonpoint source load reduction. The practical result was the revelation that achieving the nonpoint source reductions would be very challenging. This insight prompted local officials to ponder the value of various programmatic tools, such as transfer of development rights and the County forest-banking ordinance, which is on the books but was inactive.

The insights from the analysis also informed the planning staff in a general way as they developed the Comprehensive Land Use Plan. In early 2006, Worcester County will refine the nonpoint source analyses to guide several specific planning questions. One question relates to the need to reallocate nutrients that were originally provided to two industrial point sources that have ceased operations. Another questions is whether or not some of the point source allocation should be reallocated to offset a potential shortfall in achieving the nonpoint source goals. An alternative to this would be to redirect some of the current point source effluent to spray irrigation. Consideration of this option would influence land use decisions regarding the preservation of land for this purpose.

The value of incorporating the nutrient TMDLs into local land use planning is evident from the experiences of Worcester County. The judicious consideration of alternatives from the broad perspective of land use planning will help optimize the consumption of the limited nutrient allocations. This will help preserve future development potential while simultaneously achieving required water quality goals.

5.7 Capacity Building

The procedures for TMDL implementation are evolving rapidly. New technical and administrative capacity will be needed to manage water quality in a more sophisticated way. The needs will include the collection and management of new information, the analysis of that information for making new decisions, and the administration of these new activities.

Specifically, these enhanced capacities include the ability to conduct land use planning in a way that minimizes the consumption of limited pollutant load allocations. To do this, it will be necessary to evaluate changes in pollutant loads due to land use changes and pollution control actions. It will also be necessary to ensure that any future load increases are evaluated and offset by pollution reductions, while also striving to gradually reduce existing excessive pollutant loads.

These enhanced technical capacities will in turn require enhanced financial capacities. Local governments are urged to consider new or enhanced financing systems and revenue sources. Ideally, these will be conceived in a way that creates incentives for the private sector to protect water resources (See Section 5.5 "Economic and Regulatory Incentives").

Failure of State and local government to build these capacities could leave future development projects vulnerable to third party legal challenges on the grounds that they are inconsistent with TMDLs and related provisions of federal law. Having enhanced capacity at the local level will help to ensure future flexibility, maintain local control, seize on opportunities, and maximize fiscal and administrative efficiency. This will enable a smooth transition and will benefit those who depend on government services by avoiding confusion and delays. Recognizing how much is at stake, the State will lead a joint initiative with local governments to build the capacity needed to meet this challenge.

5.8 Multi-Jurisdictional Coordination

One of the more challenging TMDL implementation issues is the future management of pollutant allocations. That is, how can allocations be re-distributed over time in a transparent and equitable way? This subject is further complicated when multiple jurisdictions are involved. This section begins to shed light on this and other topics.

5.8.1 Basic Principles

Maintaining Local Control: The desire to maintain local control over decisions is a basic principle whether that local control is of a State relative to the federal government, or local jurisdictions relative to the State. When complex decisions regarding water quality arise among states, it is ideal for the affected states to resolve the issue without forfeiture of control to federal authorities. The same can be assumed among local jurisdictions.

The State urges local governments to take proactive steps to maximize local control over future water quality decision-making. First, heed the recommendation to identify a TMDL coordinating committee described in Section 3.4.1 of this Guidance. Begin familiarizing yourself with the many emerging TMDL implementation issues.

Second, identify inter-jurisdictional challenges. Begin engaging neighboring jurisdictions on these issues through your TMDL coordinating committee framework.

Finally, solicit early State facilitation of inter-jurisdictional dialogue on complex TMDL implementation issues. Failure to bring the State in early could result in time-sensitive decisions being made in a crisis mode, which is likely to result in less than ideal outcomes.

Golden Rule of Upstream and Downstream Cooperation: Most jurisdictions are both upstream and downstream of other jurisdictions. The principle of "do unto others as you would have others do unto you" takes on relevance in the context of upstream and downstream water quality relationships. This recognition promotes goodwill when considering actions, or inaction, that might affect downstream neighbors.

Legal Considerations: Ideally, the "Golden Rule" of upstream and downstream cooperation will suffice to ensure that upstream jurisdictions respect their downstream neighbors. However, failing that, upstream jurisdictions can be held responsible for protecting downstream water quality (40CFR Part 131.10(b)). TMDLs can play a role in clarifying these matters.

5.8.2 Issues to Consider

Formal and Informal Public Involvement: The federal Clean Water Act includes legal requirements for public involvement at various stages of the water quality management process. These stages include the establishment and revision of water quality standards, the identification of impaired waters on the State 303(d) list, the adoption of a TMDL, the issuance of permits in conformity with TMDLs, and the redistribution of pollutant allocations between point source and nonpoint source categories, and between political jurisdictions.

In multi-jurisdictional situations, the formal public involvement process must include proper notification of all jurisdictions. This implies the potential need to include public notices in multiple news sources, particularly in multi-state circumstances.

Land use planning: Ideally, TMDL implementation planning should be incorporated into the land use planning process so that competing needs may be weighed as part of a unified process. Including water quality planning at an early stage also helps to avoid missed opportunities. It also helps avoid the more difficult and costly regulatory decision-making processes that result from addressing the issues too late in the planning sequence. Given that water quality planning often necessitates a multi-jurisdictional approach, it stands to reason that land use planning should also be conducted as a multi-jurisdictional undertaking.

Allocations and Upstream and Downstream Considerations: TMDL analyses include technical information that clarifies the responsibilities among jurisdictions. This can take several forms. For low flow conditions, some TMDLs place an upper threshold on the upstream concentration of pollutants, which is reflected in technical support information (e.g., in model input files for TMDL scenarios). This pollutant concentration information, in combination with flow information, can be interpreted to imply a low-flow loading limit or geographical allocation. However, because nonpoint source management is generally assessed on an average annual basis, allocations of annual loads among jurisdictions are typically more useful.

Logic similar to that applied to the low-flow condition could be used to estimate an inter-jurisdictional allocation for the case of average annual loads. That is, average annual upstream concentrations and flows used in the TMDL modeling scenario can be used to deduce load allocations among jurisdictions. However, the use of land use information combined with typical unit area loading rates might be an easier approach.

For instance, pollutant loads associated with land cover that was present at the time the TMDL was developed could serve as a guide for partitioning loads among local jurisdictions. The load reductions needed to meet the TMDL could be estimated under the assumption of uniform implementation of BMPs that are commonly used on each type of land use. This would result in projected pollutant reductions that are proportional to the land use in each jurisdiction (areas with a large proportion of forest would be expected to reduce less than areas with greater areas of agriculture and urban land). The resultant loads, after the reduction calculations, would constitute an allocation among various jurisdictions. This type of approach could serve as an equitable means of allocating the TMDL among the jurisdictions in cases where the TMDL analysis does not do so. Variants of this general concept could also be used to arrive at fair allocations.

Some TMDL analyses partition the TMDL among subwatersheds. This allocation might be reflected in the technical memoranda or deduced from the technical support materials (e.g., TMDL modeling input files). To the degree that the subwatersheds are divided among separate jurisdictions, this information can be used as a guide for partitioning loads.

TMDLs that include regulated stormwater waste load allocations for compliance under NPDES stormwater permits specify a partitioning of the loads in a technical memorandum to the TMDL document. Note that, although these allocations are identified in tables under MS4 permit numbers, they include municipal, State Highway and industrial loads within the given jurisdictions, including a factor for loads associated with construction activities. These allocations are aggregated because currently there is insufficient information upon which to base disaggregated allocations.

5.8.3 Contacts

Multi-jurisdictional depends on routine communications among key stakeholders. The following contacts will help in that regard.

Baltimore Metropolitan Council of Governments (BMC)
2700 Lighthouse Point East
Suite 310
Baltimore, MD 21224-4774
(410) 732-0500 (contact: Gould Charshee)
http://www.baltometro.org/index.asp

EPA Chesapeake Bay Program Office
410 Severn Avenue - Suite 109
Annapolis City Marina
Annapolis, MD 21403
1-800-YOURBAY
http://www.epa.gov/region03/chesapeake/index.htm

EPA Region III
1650 Arch Street
Philadelphia, PA 19103
1-800-438-2474
http://www.epa.gov/region03/index.htm

Interstate Commission on the Potomac River Basin (ICPRB)
51 Monroe Street, Suite PE-08
Rockville, MD 20850
(301) 984-1908
info@icprb.org
http://www.potomacriver.org/

Maryland Association of Counties (MACO)
169 Conduit Street
Annapolis, MD 21401
(410) 269-0043 (contact: Leslie Knapp)
http://www.mdcounties.org/

Maryland Coastal Bays Program
9609 Stephen Decatur Highway
Berlin, MD 21811
(410) 213-2297 (contact: Carol Cain)
http://www.mdcoastalbays.org/

Maryland Department of Agriculture
50 Harry S. Truman Parkway
Annapolis, MD 21401
(410) 841-5896 (contact John Rhoderick)
rhoderjc@mda.state.md.us

Maryland Department of Environment
1800 Washington Blvd., Suite 540
Baltimore, MD 21230-1718
(410) 537-3902 (contact Jim George)
jgeorge@mde.state.md.us

Maryland Department of Natural Resources
Tawes State Office Building, D2
Annapolis, MD 21401
(260) 260-8630 (contact Sherm Garrison)
sgarrison@dnr.state.md.us

Maryland Department of Planning
301 W. Preston St.
Baltimore, MD 21201-2365
(410) 767-4560 (contact Rich Hall)
rhall@mdp.state.md.us

Maryland Municipal League (MML)
1212 West St.
Annapolis, MD 21401
(410) 268-5514 (contact: James Peck)
http://www.mdmunicipal.org/

Metropolitan Washington Council of Governments (MWCOG), Suite 300
777 North Capitol Street, NE
Washington, DC 20002
(202) 962-3200 (contact: Ted Graham)
http://www.mwcog.org/

Susquehanna River Basin Commission (SRBC)
1721 N. Front Street
Harrisburg, PA 17102
(717) 238-0423
srbc@srbc.net
http://www.srbc.net/

Tri-County Council of Southern Maryland
PO Box 745
15045 Burnt Store Road
(301) 274 – 1922
www.tccsmd.org/
http://www.tccsmd.org/web/t/indext.html

Tri-County Council of Western Maryland
113 Baltimore Street, Suite 300
Cumberland, MD 21502
(301) 777-2158 (contact: Leanne Mazer)
http://www.tccwmd.org/

Other States

Delaware DNREC
Division of Water Resources
Watershed Assessment Section
820 Silver Lake Boulevard, Suite 220
Dover, DE 19904-2464
302-739-4590 (contact: John Schneider)
john.schneider@state.de.us
http://delaware.gov/

Pennsylvania DEP
Rachel Carson State Office Building
400 Market Street
Harrisburg, Pennsylvania 17105
(717) 787-2814 (contact: Glen Rider)
grider@state.pa.us
http://www.dep.state.pa.us/

Virginia DEQ
629 East Main Street
Richmond, Va. 23219
(804) 698-4000 (contact: Charles Martin)
http://www.deq.state.va.us/

West Virginia DEP
601 57th St. S.E.
Charleston, WV 25304
(304) 926-0495 (contact: Jennifer Pauer)
http://www.dep.state.wv.us/

Other Local Governments

See Appendix H "Maryland Local Government TMDL Primary Contacts"

Federal Agencies

See Section 3.5.1

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US EPA, "Stressor Identification Guidance Document," Office of Water, Office of Research and Development, 822-B-00-25, December 2000. http://www.epa.gov/ost/biocriteria/stressors/stressorid.pdf

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http://yosemite.epa.gov/ee/epa/eed.nsf/Webpages/USExperienceWithEconomicIncentives.html

US EPA, "Establishing Total Maximum Daily Load (TMDL) Waste load Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs," Memorandum from Robert H. Wayland, III and James A. Hanlon, November 22, 2002.
<http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf>

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http://www.epa.gov/smartgrowth/pdf/waterresources_with_sg.pdf

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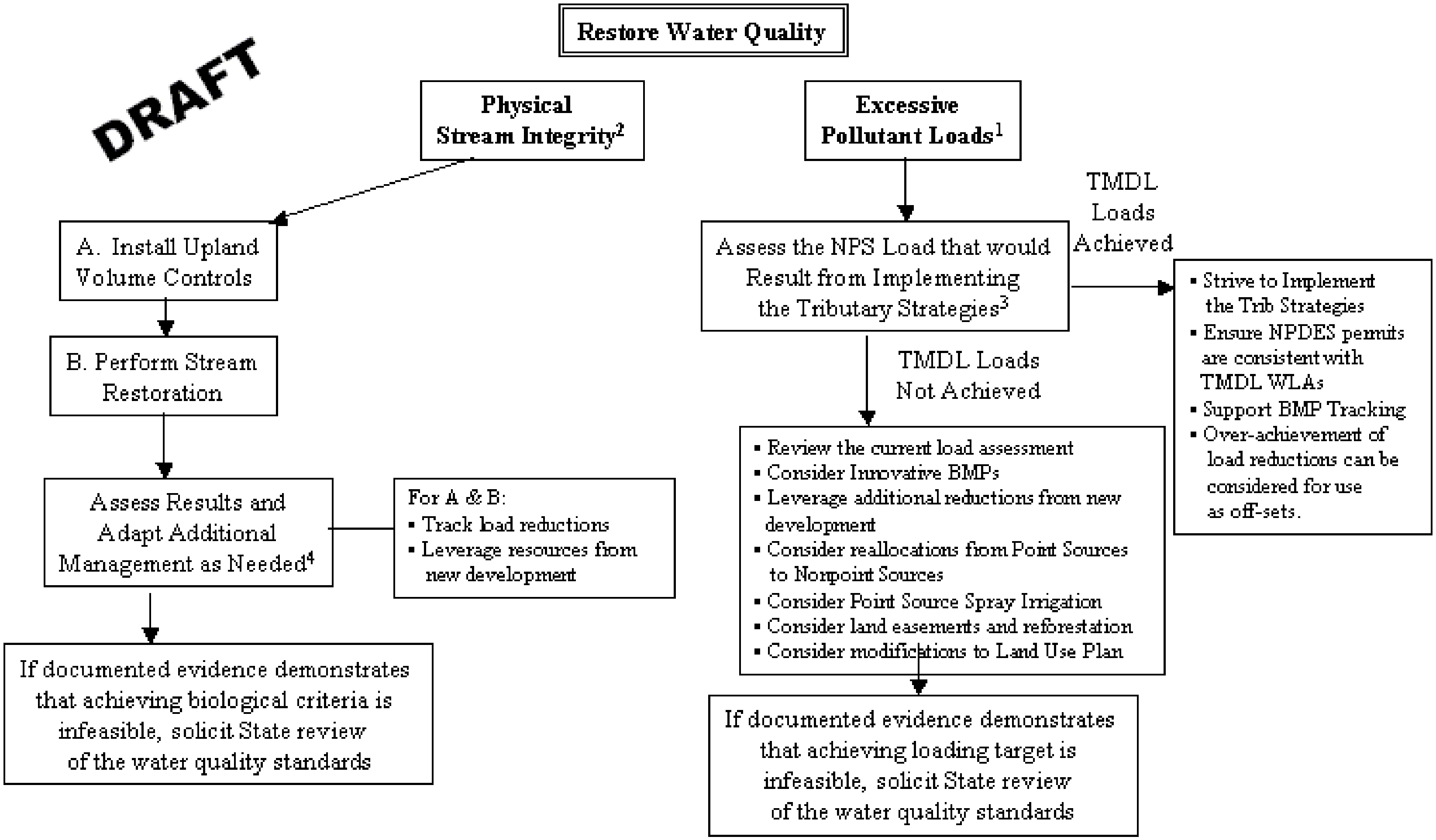
APPENDICES

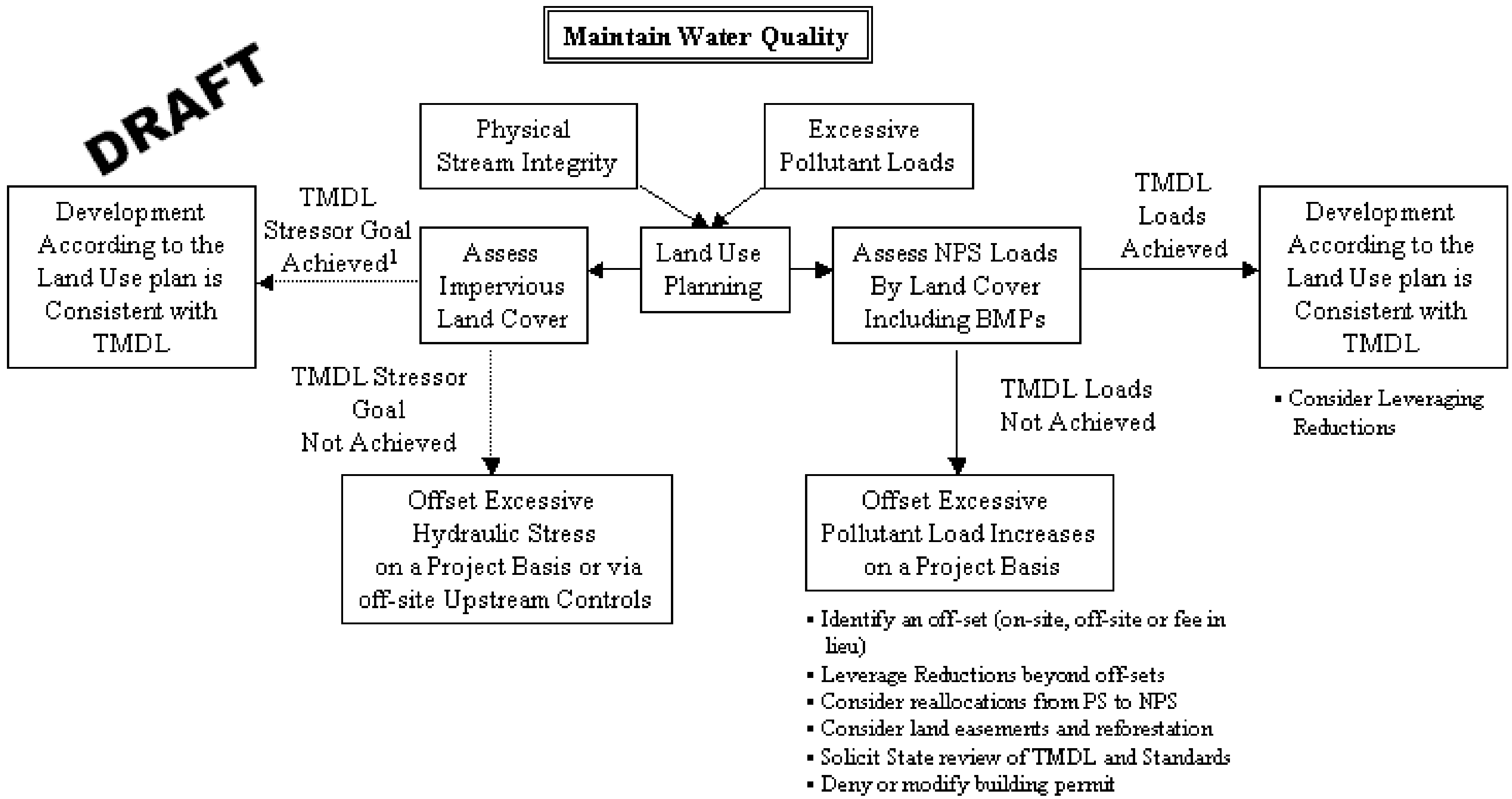
A Appendix A: Flow Charts - Key TMDL Implementation Elements

Key TMDL Implementation Elements: Restore Water Quality



Notes:
1. This example is for nutrients.
2. TMDLs for stream integrity have not yet been developed. EPA requirements remain an outstanding policy issue.
3. Part of the analysis should consider projected future land cover.
4. Assess the results relative to biological criteria used to identify waters on the 303(d) List

Ideal TMDL Implementation Approach: Maintain Water Quality



Note:
1. No TMDLs have yet been established for this purpose. See Montgomery County Case Study in Section 5.6 for one proposed approach for addressing impervious cover.

B Appendix B: TMDL Implementation Issues for Consideration by Local Governments

Create an interagency coordinating committee to establish local government policies and procedures on issues relating to TMDL implementation. The following is a list of issues and activities for the coordinating committee to contemplate.

Review and discuss the State Guidance document. Record any questions, comments or suggestions identified during this process. Consider inviting State representatives to address the issues at a meeting of the committee. (MDE Contact: Jim George: jgeorge@mde.state.md.us)

Adopt a written framework for TMDL Implementation. The State is providing an electronic template, adaptable to the needs of each jurisdiction.

Comprehensive Planning and Implementing Procedures. The following questions identify issues for developing explicit policies to be documented in the written framework.

1. Does your jurisdiction's land use planning agency address the condition of local and downstream waterbodies in its comprehensive or area-wide master plans? Is the protection of water quality standards a stated priority of your planning process? Does the process include a review of the latest 303(d) list and Tier II waters (high quality waters)?

1a. If so, how is this information used in developing plans, policies, regulatory provisions and possible mitigation activities, such as designating preservation areas and adopting policies to reduce imperviousness?

1b. If not, is additional training or self-education needed? Do decision-makers have the appropriate background necessary to give land use planning practitioners informed direction? Do resource constraints create barriers to conducting the functional analyses necessary to protect water quality standards? Do technical, informational, conceptual, legal or feasibility barriers impede such analyses?

2. How does your jurisdiction coordinate between those involved in water quality planning and those involved in land use planning? Does the coordinating committee bring these groups of people together? Is a special working group warranted?

3. If a TMDL indicates the need to reduce pollutants to meet WQ standards, how should that be addressed in the comprehensive planning process and implementation aspects of local land use management (e.g., zoning, subdivision regulation)?

4. Summarize inter-jurisdictional relationships in terms of upstream and downstream water flow. Use the 303(d) List to identify water quality impairments that might necessitate inter-jurisdictional coordination of functional land use planning. Consider holding a joint meeting with neighboring TMDL Coordinating Committees to compare information.

5. Could the establishment and communication of social and economic justification policies help avoid conflicts in the future? Could establishment of such policies cause any unintended consequences that should be anticipated and prevented?

6. Has your jurisdiction explored the use of innovative zoning techniques for water quality protection? Has your jurisdiction conducted the assessment of alternative land use configurations, tied to alternative zoning options and simple pollutant loading estimation tools, for assessing the range of pollutant loads from a watershed?

7. Subdivision regulations set minimum standards for public welfare, and reduce public expenditures by making developers responsible for the installation of basic public facilities before the recording and sale of lots. Should this include local and downstream protection of water quality? Do current subdivision regulations include the assessment of cumulative impacts to water quality relative to the larger watershed? Are the activities managed by subdivision regulations the appropriate point to consider the process of offsetting increased loads? Would it be preferable to assess cumulative impacts and pollutant offsets *before* the subdivision step in the planning process? If so, how could decisions made under the subdivision regulations be linked to previous planning results?

8. Minimum standards can reduce the flexibility necessary to allow innovative designs more protective of water quality. Have the standards been assessed recently with regard to this issue? Can steps be identified to make progress in this regard?

Capacity Building. Enhanced water quality management requires increased technical and administrative capacities at State and local levels of government. Identify and prioritize the primary capacity-building needs for local government (near-term and long-term). What specific needs can you recommend to State government to support local progress on TMDL implementation? (See "Assigning Costs, Generating Revenue, and Budgeting")

Assigning Costs, Generating Revenue, and Budgeting.

<u>Assigning Costs</u>: The question of "who pays" for the cost of environmental protection and restoration is central to developing revenue sources. Reasoning suggests that almost everyone should share in paying for the restoration and protection of water quality. The cost of protection is appropriately borne by those who generate new pollutant loads and stresses on the environment (*e.g.*, developers, new owners of commercial and residential structures, new agricultural and industrial operations). The cost of restoration ideally should be borne by those who caused or benefited from impacts in the past. In some cases, assigning costs to responsible parties of the past is impossible because they no longer exist. In such cases it might be reasonable for these restoration costs to be shared widely by society at large.

Assigning costs in a *fair* way is far more likely to gain public acceptance. However, the fairest approach isn't always the most cost-effective. For instance, if each sector of society is asked to do its fair share, then some less efficient restoration activities will be funded. The government can collect funds and direct them toward more cost-effective activities, but the administrative process of redistributing resources can be inefficient. Expert advice on cost allocations can be helpful when assessing funding options for the protection and restoration of water quality.

Generating Revenue: Costs for enhanced water quality management borne directly by the private sector would not be counted as "revenue." What existing fees support water quality restoration and protection? Do they cover the full cost? Are fees structured to create incentives to protect water quality? Do any fee structures vary with geographic location to create incentives on where to site land disturbances or to help cover the full cost of addressing water quality impacts? Would new fees be justified to cover the cost of enhanced government or contracted services? Would new fees be justified to offset environmental impacts? Can governance procedures ensure that fees intended to pay for water quality restoration and protection would not be diverted to other uses? Does the full-cost accounting of fee rates analysis include follow-up evaluations and maintenance costs?

Start-up Costs: "It takes money to make money." What existing revenue sources could be diverted temporarily to support the assessment and establishment of new revenue sources? (Examples: Parking meter revenues have been used to fund the research and development of storm water management fees. A one-time flat fee, assessed using an existing billing system, could be used to cover start-up costs.)

Covering Risks: Do bonding systems exist to cover the potential failure of expected water quality enhancements to be addressed by the private sector? Are they appropriately rated to cover the costs? Could a non-recoverable "insurance" system be instituted that would cover the risks and costs of protecting water quality in the future?

Budgeting: Public expectation for progress in TMDL implementation is increasing. The creation of new local government funding sources is justified by the need to provide more sophisticated technical and administrative services to commercial and non-commercial stakeholders. Budgeting to meet increased needs is more reliable if dedicated funding sources are established for that purpose, rather than relying on general revenues.

In terms of budgeting, what are the high-priority technical and administrative needs? What needs are easiest to justify in the political arena? Are they the same as the high-priority needs? Can you assign rough costs to these needs? What existing dedicated funding vehicles could be enhanced? What government water quality protection services are being provided, or should be provided, for which costs are not being recovered? Do any of these priorities and funding vehicles coincide? What concepts could be proposed to increase dedicated funding?

Tracking. What are the key pollutant sources that are, or should be, tracked by local governments? What are the key pollutant reduction activities that are, or should be, tracked by local governments?

Information Management. The information needed to assess TMDL consistency is probably spread among several local agencies, or outside of local government (*e.g.*, agricultural information). What local agencies need this information? Should the information be managed in a central way or distributed manner? What local agency is best suited to coordinate the sharing and exchange of this information to support planning and management decisions?

Assessment Tools. Does the local jurisdiction want to have the technical capacity to conduct pollutant loading analyses in-house, to have that work contracted, or to solicit assistance from the State? If you have the capacity in-house, what tools/methods are currently used to assess pollutant loading for broad scale land use planning as it relates to nutrient management? At what geographic scale are these tools applied?

Economic and Regulatory Incentives. Do current zoning regulations, fee systems, and minimum subdivision regulations create incentives/disincentives to protect water quality?

Agricultural and Rural Areas. Does the Maryland Agricultural Land Preservation Program, or other land preservation programs, play a role in local water quality management decisions? Has there been consideration of the potential relationship between land preservation programs and the potential for using spray irrigation as a wastewater discharge option (perhaps for future expansion)? Are any steps needed to enhance local government and rural agency coordination relative to water quality management?

C Appendix C: Maryland's Tier II Antidegradation Implementation Procedures

Maryland's antidegradation policy follows the national model required by the US EPA. The antidegradation policies can be found in the Code of Maryland Regulations (COMAR) at 26.08.02.04, 04-1, and 04-2. The key sections are presented below. The entire implementation policy can be found at Division of State Documents (DSD) website: http://www.dsd.state.md.us/comar/26/26.08.02.04%2D1.htm

E. Designation for Specific Water Quality Measures:

Where a waterbody is designated a Tier II water based on a specific water quality measure, potential impacts to only that specific characteristic shall be subject to Tier II review. For example, where a waterbody is designated Tier II because of high dissolved oxygen, only potential impacts to dissolved oxygen are subject to Tier II review[23].

F. Need for Tier II Antidegradation Review:

(1) Permits. Before submitting an application for a new discharge permit or major modification of an existing discharge permit (for example, expansion), the discharger or applicant shall determine whether the receiving waterbody is Tier II or, if a Tier II determination is pending, by consulting the list of Tier II waters.

(2) Water and Sewer Plans (County Plans). As part of its continuing planning process, the Department shall review proposed amendments to county plans for any new or major modifications to discharges to Tier II bodies of water. If a proposed amendment to a County Plan results in a new discharge or a major modification of an existing discharge to a Tier II water, the applicant shall perform a Tier II antidegradation review.

(3) Exemptions. The requirement to perform a Tier II antidegradation review does not apply to individual discharges of treated sanitary wastewater of less than 5,000 gallons per day, if all of the existing and current uses continue to be met.

G. Tier II Antidegradation Review:

(1) If a Tier II antidegradation review is required, the applicant shall provide an analysis of reasonable alternatives that do not require direct discharge to a Tier II waterbody (no-discharge alternative). The analysis shall include cost data and estimates to determine the cost effectiveness of the alternatives.

(2) If a cost effective alternative to direct discharge is reasonable, the alternative is required as a condition of the discharge permit or amendment to the county plan.

[23] Because all of Maryland's current Tier II waters were designated on the basis of biological indices of integrity, all potentially impacting substances and stressors are subject to the Tier II Review.

(3) If the Department determines that the alternatives that do not require direct discharge to a Tier II waterbody are not cost effective, the applicant shall:

(a) Provide the Department with plans to configure or structure the discharge to minimize the use of the assimilative capacity of the waterbody, which is the difference between the water quality at the time the waterbody was designated as Tier II (baseline) and the water quality criterion[24]; and
(b) If an impact cannot be avoided, or no assimilative capacity remains as described in §G(3)(a) of this regulation, provide the Department with a social and economic justification for permitting limited degradation of the water quality.

(4) An applicant shall update an antidegradation review when applying for a new permit or major modification to an existing permit.

H. Potential Determinations Resulting from Antidegradation Reviews.

(1) If there is a cost-effective alternative to direct discharge, the applicant shall implement the no discharge alternative and it shall be a condition of the discharge permit.

(2) If there is no cost-effective alternative to direct discharge, but there is potential for further minimization of the use of assimilative capacity, the applicant shall revise the initial application to further minimize the use of assimilative capacity.

(3) If there is no cost-effective, no-discharge alternative, and minimization of the use of assimilative capacity is adequate, but the social and economic justification (SEJ) is not adequately performed, the applicant shall revise the SEJ.

(4) If there is no cost-effective alternative to direct discharge, minimization of the use of assimilative capacity is adequate, the SEJ is adequately performed but does not justify the water quality impact, the proposed amendment to the county plan or discharge permit application shall be denied.

(5) If there is no cost-effective alternative to direct discharge, all reasonable efforts have been made to minimize the use of assimilative capacity, and the SEJ is adequate and justifies the discharge, the proposed amendment to the county plan or discharge permit shall be granted subject to other applicable requirements.

I. Wetlands Permits and Water Quality Certifications.

Maryland's wetlands and waterways regulatory process, governed by the Tidal Wetlands (COMAR 26.24.01—26.24.05), Nontidal Wetlands (COMAR 26.23.01—26.23.06), and

[24] For example, if dissolved oxygen is presumed necessary to meet the biological threshold, and the water quality criteria for DO is 5.0 mg/L and the Tier II baseline is 7.0 mg/L, the threshold for using the assimilative capacity would be 6.5 mg/L.

Waterway Construction (COMAR 26.17.04) regulations, satisfies the requirements of this regulation.
J. Social and Economic Justification (SEJ).

(1) An SEJ shall be submitted if:

(a) No cost effective alternative to the discharge is available; or
(b) The cumulative degradation resulting from nonpoint source pollution and any other permitted discharges would diminish water quality.

(2) To allow for natural variability, water quality shall be considered diminished only if the assimilative capacity as defined in §G(3)(a) of this regulation is cumulatively reduced by more than 25 percent from the baseline water quality determined when the waterbody was listed as Tier II.

K. Demonstrating Social and Economic Justification for an Impact to Tier II Waters.

(1) In order to promote compact development, maintain habitat and open lands, and minimize water impacts in undeveloped areas, the requirement for social and economic justification is met if the following demonstrations are made:

(a) The watershed affecting the Tier II water is located in a priority funding area as defined in State Finance and Procurement Article, §5-7B-02, Annotated Code of Maryland;
(b) The Department determines, in consultation with the Maryland Department of Planning, that the local jurisdiction in which the watershed affecting Tier II waters are located, is using to the extent reasonably practical, innovative development approaches to minimize impacts to water quality from development;
(c) Physical development after the date of the Tier II listing is necessary to accommodate the projected growth within the watershed, and use of innovative development approaches are maximized to the extent reasonably practicable to encourage redevelopment, reuse and infill development; and
(d) If the Department of Planning's growth projections for the watershed affecting the Tier II waters demonstrate that additional physical development of undeveloped land is required to accommodate the projected growth and that development is consistent with the applicable county master plan.

(2) The approaches described in §K(1)(b) of this regulation include, but are not limited to, innovative stormwater management and sediment and erosion control design practices, green building design techniques, nutrient removal technology for septic systems, innovative technologies designed to reduce point source discharges of pollutants, uniform building codes designed to remove impediments to rehabilitation projects, model infill development guidelines designed by the Maryland Department of Planning, and transit-oriented development.

L. Components of the Social and Economic Justification.

(1) Components of the SEJ may vary depending on factors including, but not limited to, the extent and duration of the impact from the proposed discharge and the existing uses of the waterbody.

(2) The economic analyses shall include impacts that result from treatment beyond the costs to meet technology-based or water quality-based requirements.

(3) The economic analysis shall address the cost of maintaining high water quality in Tier II waters and the economic benefit of maintaining Tier II waters.

(4) The economic analysis shall determine whether the costs of the pollution controls needed to maintain the Tier II water would limit growth or development in the watershed including the Tier II water.

M. Department [of Environment] Responsibilities.

(1) The Department shall determine whether the SEJ demonstrates that the costs of water pollution controls are reasonable and would not limit development or growth and, if not, shall determine whether lowering of the water quality is necessary for development or growth to take place in the watershed.

(2) The Department shall determine whether the SEJ demonstrates that the impact to water quality is necessary for development or growth to take place in the watershed. Evaluation of the SEJ shall consider the relative magnitude of costs and benefits of development, recognizing the difficulty in quantifying benefits, and the extent to which denial of the amendment or permit would substantially impact future development within the watershed.

(3) The Department shall propose a tentative determination to either issue or deny the permit application. If the tentative determination is made to issue a permit, the notice of tentative determination shall state that these waters are designated as Tier II and, if applicable, that a social and economic justification is available for review.

(4) Existing in-stream water uses and the level of water quality necessary to protect existing uses shall be maintained and protected.

(5) All required point and nonpoint source controls under State statutes and regulations shall be achieved.

N. Public Participation.

(1) Public participation for a permit to discharge to a Tier II water is the same as that required for any permit subject to the Administrative Procedure Act or the requirements of Environment Article, Title 1, Subtitle 6, Annotated Code of Maryland.

(2) If an SEJ is not required, the public notice shall reflect the Tier II status of the waterbody and note that an SEJ is not required and note the justification.

D Appendix D: EPA "A – I" Guidance on NPS Watershed Planning

a. An identification of the sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated established in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).

b. An estimate of the load reductions expected for these management measures (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level of as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks);

c. A description of the NPS management measures that will need to be implemented to achieve the load reductions estimated established under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan) an estimate of the load reductions expected for these management measures (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time), and an identification of the critical areas in which those measures will be needed to implement this plan;

d. An estimate of the sources of technical and financial assistance needed, and/or authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their 319 programs, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan;

e. An information/education component that will be used to enhance public understanding of the project and encourage their participation in selecting, designing, and implementing the NPS management measures that will be implemented.

f. A schedule for implementing the NPS management measures identified in this plan that is reasonably expeditious;

g. A description of 2006, measurable milestones (e.g., amount of load reductions, or improvement in biological or habitat parameters) for determining whether NPS management measures or other control actions are being implemented;

h. A set of criteria that can be used to determine whether loading reductions are being achieved and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.

i. A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (g) immediately above.

E Appendix E: Nonpoint Source Nutrient Loading Assessments

For watershed planning purposes it is reasonable to estimate average annual nutrient nonpoint source (NPS) loads using the EPA Chesapeake Bay Program (CBP) loading coefficients. The CBP peer review process ensures that these values receive regular technical scrutiny. Although it is acknowledged that these average values are not site-specific, they provide reasonable, defensible loading rates for which refinements may be proposed in the future. In addition, the use of CBP loading coefficients promotes consistency with the Tributary Strategies under the Chesapeake Bay Agreement 2000 (C2K).

The following technical guidance describes how to obtain CBP NPS loading information and several ways the information can be used to conduct NPS loading assessments. Examples of regionally specific nonpoint source loading information available from the Bay Program web site include the following (all are long-term average annual loads):

A) Most-current NPS nutrient loading rates by land use category.
B) Future NPS nutrient loading rates by landuse category that account for full Tributary Strategy implementation.
C) 1985 period when few BMPs had been implemented.
D) 100% forested landscape.
E) No BMP implementation.
F) Implementation of every BMP, implemented by everyone, everywhere (E3).

The information above can be used to conduct the following NPS loading analyses, several of which are explained in more detail later in this appendix:

- <u>Current Load</u>: What is the current average annual nutrient load from a particular watershed? Use the estimated loading rates from (A) and the land use in the particular watershed to estimate the current loads.

- <u>Future Land Use Load</u>: What is the expected future average annual nutrient load from a particular watershed accounting for projected land use change? Use the estimated loading rates from (A) and future land use in the particular watershed to estimate the future loads.

- <u>Load Reduction Needed</u>: What NPS nutrient load reduction is needed to reach the TMDL NPS allocation in a particular watershed? The analysis can account for current land use (i) or future land use (ii). Use most current estimated load from (A), and the TMDL NPS allocation as follows:

  (i) TMDL NPS Allocation – Current Load = NPS Reduction Needed
  (ii) TMDL NPS Allocation – Future Land Use Load = NPS Reduction Needed

- <u>Lowest Practicable NPS Load</u>: What is the lowest NPS load that can be reasonably expected from the current land cover? Use either the E3 loading in (F) or the Tributary Strategy loading in (B) and land cover data for the particular watershed to estimate the lowest viable

NPS load using conventional BMPs. The analysis can account for current land use or future land use.

- Greatest Practicable NPS Reduction: What is the maximum possible NPS load reduction that could be achieved relative to the current loading using conventional BMPs on the current landscape? The analysis can account for current land use or future land use. Subtract the Tributary Strategy NPS load for the current land cover computed using (B) from the current load using (A).

  Current Load – Tributary Strategy Load = Greatest Practicable NPS Reduction

  Greater reductions could be achieved if land cover is changed by reforestation and wetland restoration initiatives, phosphorus-free fertilizers are adopted, or other social changes are accepted.

- What is the change in NPS loading due to replacing 100 acres of forestland with developed land that accounts for required stormwater management? What's the change in NPS loading due to replacing 75 acres of cropland and 25 acres of forestland with developed land? These analyses can account for development on sewer or septic systems.

Note that none of the analyses above require an inventory of best management practices (BMPs), although these Bay Model loading rates account for BMPs that have been implemented. Note also that some of the annual per-acre loading rates represent spatial averages. For example, the current urban loading rate represents the average of areas with stormwater BMPs and areas without stormwater BMPs, similarly for agricultural loading rates.

CASE 1: Estimating Current NPS Nutrient Loads

Each year the Chesapeake Bay Program (CBP) updates the estimated average annual loads by region by accounting for new pollutant sources and the implementation of nutrient controls (BMPs)[25]. Estimating the current load entails the following steps for total nitrogen and total phosphorus:

- Download a spreadsheet file with the most current Bay Program loads for the region of interest (a Bay model watershed segment. See detailed instructions below).
- Open the spreadsheet and calculate the loading rates for each land use by dividing the load by the acres.
- Obtain the most current land use in the watershed of interest. It might be necessary to aggregate detailed land use types into a fewer number shown in Table 1 below.

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[25] The most recent estimation is usually about one-year old, because it takes time to inventory BMP implementation progress and then run the Bay Watershed Model to estimate the loading rates. It should also be understood that the "current" NPS load estimate represents a ten-year rainfall period on land that mimics the land cover and BMP implementation for the year of interest. Thus, it is a long-term average intended to average over wet and dry years. This enables comparisons of loads between years due to changes in BMPs and not due to differences in rainfall

- Create a spreadsheet with columns for A) land use type and open water for cases in which there are large waterbodies, B) acres, C) loading rates (lbs/yr/ac), and D) the load for each land use, which is the product of each land use acreage (B) and loading rate (C).
- Sum the entries in column D to obtain the total current NPS load.

CASE 3, below, provides more discussion of the current load, and Table 3 provides an example of the spreadsheet mentioned above. The section entitled "Data Download Process," explains how to obtain the data from the Bay Program web site, and includes procedure for separating the septic contribution from the urban stormwater contribution.

Table 1 shows the 2003 estimated loading rates for two watersheds. This provides an example of relatively "current" loads, showing that the loading rates differ slightly by region. Note that the urban loading rate includes septic systems.

Table 1

2003 Estimated Average Annual Loading Rates of Total Nitrogen

Major Land Use	Potomac River Segment 210	Lower Eastern Shore Segment 430
	lbs/acre/year	lbs/acre/year
AGRICULTURE	16.2	16.0
ATDEP WATER	10.4	9.6
FOREST	2.0	1.2
MIXED OPEN	6.3	4.4
URBAN*	18.9	15.1
* Includes Septic Contributions		

CASE2: Estimating the Lowest NPS Load that can be Achieved with Conventional BMPs on the Current Land Cover: The "E3" or Tributary Strategy Loads.

In 2002, the Chesapeake Bay Program estimated a credible minimum technically feasible load by simulating what would occur if "everyone, does everything, everywhere" to reduce nutrients. Unit area loading coefficients for this scenario, called "E3" for short, are available in a spreadsheet from the Chesapeake Bay Program website. See Excel file "detailed loads and landuse acreage" under Section "Chesapeake Bay Program Watershed Model Output Data." http://www.chesapeakebay.net/tribtools.htm

It is universally accepted that the implementation of every conceivable BMP assumed in the E3 scenario is not practical. As a more practical estimate of the lowest NPS load, Maryland's Tributary Strategy could be used. These loads are also considered extremely ambitious.

These estimates can be enhanced in several simple ways. First, the land cover can be modified, for example, to simulate a reforestation initiative. Second, loading rates can be mixed from two or more sets of coefficients. For example, if the septic load reductions in the Tributary Strategies seem too ambitious, the septic loads from the "current" scenario can be used in combination with the remaining coefficients from the "Trib Strategy" scenario.

CASE 3: Estimating the Maximum Feasible NPS Nutrient Reduction Potential with Conventional BMPs on the Current Land Cover: Current Load – Tributary Strategy Load

Note: The analyses described below could be performed using the E3 loading rates discussed in CASE 2.

The "NPS nutrient reduction potential" for a watershed is the estimated amount of NPS load that could be reduced relative to the current load. This can be computed as the difference between the current NPS load, and the NPS load that would result if Maryland's Tributary Strategy is fully implemented.

Table 2 provides a sample computation of the NPS nutrient reduction potential for a watershed with hypothetical acreages using the loading rates associated with the Lower Eastern Shore region (CBP watershed segment 430).

As of April 2005, the CBP's most recent estimate of the "current" NPS load was for 2003. The total watershed NPS load is computed as the sum of the loading contributions from each land use. For example, the agricultural load is computed as Column B multiplied by Column C (7,345 x 16 = 117,520). Summing all of the cells in Column D yields the total 2003 NPS load of 139,874 lbs/year.

Again, be aware that this is not an estimate of the NPS load generated in 2003. Rather, it is an estimate of the *long-term average annual load*, accounting for variations in annual rainfall over ten years, and conditions on the ground in 2003. This procedure allows comparisons between years due solely to changes in BMPs and not due to differences in rainfall for a given year.

The Tributary Strategy load is computed in a way similar to that for the 2003 load, using revised loading rates in Column E, rather than the rates in Column C. For example, the reduced agricultural load is estimated to be 9 x 7,345 = 66,105 lbs/year. The total long-term average annual load predicted when the Tributary Strategy is fully implemented is about 82,164 lbs/year.

Thus, the maximum NPS reduction potential for this hypothetical watershed, assuming no land use changes occur, is 139,874 lbs/year – 82,164 lbs/year = 57,710 lbs/year. This implies a 41% NPS reduction potential is possible. If an analysis indicates that greater reductions than this are needed, then more detailed analyses and discussions with MDE staff are warranted.

Refined Land Use Categories

If sufficient data is available, the CBP's refined land cover categories may be used to estimate nutrient loads in a manner analogous to those examples described above, only with more detailed land use categories. It is also possible to use subsets of the following land categories, for example, using more refined urban information, and less refined categories for the other land uses. Table 3 shows refined land use categories (left column) and their corresponding major land use categories (right column), as defined by the CBP.

Table 2

A	B	C	D	E	F
Major Land Use	**Land Area**	**"Current" 2003 Loading Rates**	**"Current" 2003 Annual Loads**	**Trib Strategy Loading Rates**	**Trib Strategy Annual Loads**
	acres	**lbs/acre/year**	**lbs/year**	**lbs/acre/year**	**lbs/year**
AGRICULTURE	7,345	16.0	117,520	9.0	66,105
ATDEP WATER	35	9.6	366	7.9	278
FOREST	4,544	1.2	5,453	1.2	5,300
MIXED OPEN	320	4.4	1,408	3.3	1,062
URBAN*	1,002	15.1	15,130	9.4	9,419
TOTAL	11,246		139,847		82,164
* Includes Septic Contributions					

Table 3

Chesapeake Bay Program Watershed Model Land Uses and Major Land Use Categories

LAND_USE	MAJOR_LAND_USE
Forest	FOREST
High Till (Crop)	AGRICULTURE
Low Till (Crop)	AGRICULTURE
Pasture	AGRICULTURE
Perv Urban	URBAN
Hay	AGRICULTURE
Mixed Open	MIXED OPEN
Imp Urban	URBAN
Manure	AGRICULTURE
AtDep Water	ATDEP WATER
Septic	URBAN

See land use descriptions on page 6 below

Loading rates, like those examples in Table 1, are also available for the more detailed land use categories shown in the left column of Table 3. These can be obtained from the CBP web site by selecting “All Land Uses” in Step 2 D of the data download process described below.

The Chesapeake Bay Program land uses are described below.

Atmospheric Deposition to Water (AtDep Water) simulates atmospheric deposition loads directly to the rivers, lakes, reservoirs, and streams of the watershed.

Forest contains both forested and wetland land covers.

Hay, **Pasture**, **High Tillage** (High Till), and **Low Tillage** (Low Till) are defined as cropland with varying applications of nutrient input and management practices.

Manure land use represents concentrated manure piles on agricultural land. [It is advised that this be used in consultation with the Bay Program staff].

Point source and **septic** land uses load directly to the tributary waters.

Pervious urban (perv urban) and **impervious urban** (imp urban) represent non-point source urban loads.

Mixed Open represents land that is not specifically urban or agricultural and may include parks, golf courses, large residential lots, and school yards.

The application of the CBP’s more detailed land use loading coefficients necessitates an estimate of pervious and impervious urban land use. Table 4, from the TR-55 Manual for modeling urban hydrology for small watersheds, may be used to develop estimates. It should be noted that these estimates do not account for reductions in “effective imperviousness” associated with implementation of Maryland’s stormwater management law on development after 1985, and the retrofitting of older development.

Table 4
Percentages of Average Impervious Area

Land Cover Type	**Percentage of Impervious Area**
Urban Districts	
Commercial	85
Industrial	72
Residential Districts by Ave Lot Size	
1/8 acre or less (town houses)	65
1/4 acre	38
1/3 acre	30
1/2 acre	25

1 acre	20
2 acres	12

Data Download Process

Option 1: A large spreadsheet of all loading rates for all scenarios and watershed segments is available from the Bay Program. See Excell file "detailed loads and landuse acreage" under Section "Chesapeake Bay Program Watershed Model Output Data." These loading rates are for land use categories shown in the left column of Table 3.

http://www.chesapeakebay.net/tribtools.htm

Option 2: Subsets of the large spreadsheet in Option 1 can be downloaded individually. This option provides loading rates by both land use categories in Table 3 (left column or right column). Unfortunately, this option does not include all scenarios, e.g., does not include the E3 scenario.

The following process describes how to obtain similar loading rates by geographic region.

Step 1: Determine the Applicable Watershed Segment: To obtain loading information for a particular region, begin by determining which watershed CBP model segment corresponds you your particular case. A watershed segment map is available via the internet at: http://www.chesapeakebay.net/pubs/maps/2002-134.pdf

For the far western part of Maryland use Segment 160. For the Coastal Bays region, use Segment 430. If it is difficult to determine which segment corresponds to your region, use your best judgment, because regional differences are not that drastic, or contact the CBP Office for assistance at 800-YOUR-BAY ext. 844.

Step 2: Download Nutrient Loading Data: The following information should support a reasonable estimate of the baseline load (or range of loads), assuming few or no BMPs. This can be done as follows:

A. Access the "CBP Data Hub" via the internet: http://www.chesapeakebay.net/datahub.htm

B. "Click to Get Data" on the oval in the center of the web page.

C. Click "Query Data"

The first time you do this, you'll need to register as a new user.

D. On the next web page, Select "Summary Data," Select "Major Land Uses" and Select "Watershed Segment."

E. On the next web page, scroll down to select the desired watershed segment number, which you should have determined in Step 1 above.

- Then, scroll down to find the desired scenario. If you have questions about the different scenarios, contact the CBP Office for assistance at 800-YOUR-BAY ext. 846.

- Then, select all of the major land uses by placing your cursor on the top land use (agriculture), holding your shift key down, and selecting the remaining land uses so that they are all shaded.
- Finally, select the "edge of stream" load type (the "delivered load" accounts for transport losses of nutrients as they are conveyed to the Bay).

F. Click on "Run Query" then Click on "Download Data." A dialogue box will appear. Select "Save," which will allow you to select the directory on your computer and file name you wish to give the data file. This text file can be read by Excel spreadsheet software, and saved in a spreadsheet format.

G. Septic Loads can be disaggregated from the urban load:
- First, run another query as in Step 2 D above, but selecting "All Land Uses" this time. You will need only one number from this spreadsheet, the total nitrogen value for septic systems. (See Step 3 "Spreadsheet Computations" below for how to use this value in obtaining the urban load without septic component).

Step 3: Spreadsheet Computations

To calculate the unit loading rate (lbs/acre/year) from each type of land use type, using the "Major Land Uses" spreadsheet, insert new columns to the right of "TN" and "TP" columns (Total Nitrogen & Total Phosphorus). Then, for each land use, divide the total load by the acres.

For example, for nitrogen on the Lower Eastern Shore (Seg 430), you would insert the column labeled (4) and divide the contents of column 3 (210,837 lbs/yr) by column 2 (13,934 acres) to arrive at 15.1 lbs/acre/yr.

Table 5

1	2	3	4
MAJOR_LAND_USE	ACRES	TN (LBS/YR)	TN lbs/ac/yr
URBAN*	13,934	210,837	15.1

* Includes the septic load component.

To determine the urban load *without* the septic load component, first obtain the septic load as described above in Step 2 G. In this particular case, the septic load is 107,004 lbs/yr. The urban load without septic component is computed as follows:

(urban load with septic – septic load)/(acres of urban land) =

(210,837 – 107,004)/13,934 = 7.45 lbs/acre/year (Urban load without septic part)

BMP-Based Accounting of NPS Loads

A more advanced way of estimating NPS loads, and developing NPS reduction strategies, is to track the available opportunities for BMP implementation and an inventory of BMPs that have been implemented. This is being done on a coarse geographic scale for the Chesapeake Bay

Agreement, which supports TMDL implementation in a general way. Doing this on a more refined scale is the eventual goal of TMDL implementation. The specific policies and procedures for doing this in a routine way are presently under consideration. Although this approach is beyond the scope of this Guidance, the concepts are outlined below.

First, compute the baseline NPS load with no BMPs. Loading rates from the 1985 CBP scenario could be used for this. Then apply reduction efficiencies associated with the desired level of BMP implementation. This can be combined with BMP cost information to assess cost-effectiveness (See Appendix I “BMP Efficiencies and Costs”). Note that when multiple BMPs are applied to the same pieced of land, the efficiencies cannot simply be added (e.g., a 55% reduction on top of a 55% reduction doesn’t result in a 110% reduction).

Various database and spreadsheet tools have been developed to assist in this type of analysis (See Load Estimations under Section 5.2.1). Several State agencies are presently working with on the development of a GIS-based tool that will be considered for use in TMDL implementation planning and decision-making.

F Appendix F: A Hypothetical Watershed Perspective on Offsetting Nutrient Load Increases

This example is for illustrative purposes to support informed dialogue on the subject of offsetting pollutant load increases. Neither the general approach nor the specifics represent State policy.

The setting is a watershed of about 25,500 acres with land uses shown in Table 1 below. A TMDL has been established, which is summarized as part of the "Summary of Initial Considerations" below. This case has been intentionally created to be challenging. There are two municipal point sources, and two permitted industrial point sources; however, the larger industrial source has announced that it will be ceasing operations within the year. Several subdivision development projects are pending, and additional land has been zoned for future development.

Table 1
Baseline Nonpoint Source Conditions for Hypothetical Watershed

Land Use	Land Use Acres	TN Loading Rate lbs/ac/yr	TN Load lbs/yr
Mixed Agriculture	12,892	15.3	196,937
Atm Dep to water	1,736	9.6	16,663
Forest	9,078	1.2	10,893
Open Urban	255	4.5	1,138
Urban on Septic	2,537	14.7	37,344
Urban on sewer	779	7.5	5,846
	25,541		268,821

Summary of Initial Considerations

- Small Municipal WWTP
  (Design flow capacity of 88,000 gallons per day, 18 mg/l, Allocation of 4,822 lbs/yr)
- Large Municipal WWTP
  (design flow capacity of 3.0 million gallons per day, 8 mg/l, Allocation of 73,060 lbs/yr)
- Small Industrial WWTP
  (flow of 8,000 gallons per day, 18 mg/l, Allocation of 438 TN lbs/yr)
- Large Industrial WWTP
  (flow of 0.247 million gallons per day, 18 mg/l, Allocation of 13,530 TN lbs/yr, ceasing operations within the year)
- Zoning and pending subdivisions, consisting of 800 acres of forest, and 200 acres of crop land, are planned for development over a future time horizon.
  - About 70% will be on public sewer for which there is sufficient capacity at the large WWTP. The land has potential for about 1,300 equivalent dwelling units (EDUs).
  - About 10% is currently planned to use onsite sewage disposal systems.

- About 20%, located near the small WWTP, has a 450 (EDU) potential; however, the small plant flow capacity would need to be doubled (or more if current inflow and infiltration (I&I) problems are not resolved).

- **TMDL* (TN) = Point Source Allocations + Nonpoint Source Allocations**
  212,819 lbs/yr= 91,850 + 120,969

  * To simplify this example, this number is actually the TMDL minus the margin of safety.
- Current NPS baseline load: 268,821 lbs/yr (TN) implies that a 55% Reduction needed.
- Point sources are currently within their allocations; however, it will be shown that part of the point source load will need to be reallocated to meet the nonpoint source load, and offsets will be needed to support the addition growth reflected by zoning and pending subdivisions.

A watershed-wide planning level analysis suggests possible steps for reducing nitrogen to achieve the TMDL, and offsetting proposed increases in nitrogen to ensure that the proposed development is consistent with maintaining the TMDL. To simplify the presentation, the analysis is divided into two parts. For the first part, recall the current point source loads are consistent with the waste load allocations for point sources in the TMDL. Hence, the first part focuses on taking steps to achieve consistency of the nonpoint sources with the TMDL. This will be done in part by reallocating some of the point source WLA to the nonpoint source LA.

The second part of the analysis focuses on meeting the needs of the proposed development near the small WWTP, which will need to expand to accommodate the new development. A range of options is proposed that would enable consistency with the TMDL. The ultimate choice would depend on cost estimates and other practical factors that are beyond the scope of this hypothetical case. One of these factors is the potential that elements of the first part of the analysis might provide other options to consider in the second part.

First Part of Analysis: Nonpoint Source Consistency with TMDL

Below is a listing of the steps in the first part of the analysis. It makes use of NPS reductions and reallocations from point sources to nonpoint sources, resulting in a broad plan that is consistent with the TMDL.

A. Update the land cover to reflect the conversion of forestland and cropland to developed land accounting for 10% of that land being on septic systems. Compute the nonpoint source loads by using the Chesapeake Bay Program loading rates under the assumption that the Tributary Strategies have been fully implemented in this watershed. The results are summarized in Table 2.

   RESULT: The NPS load is reduced 25% from 268,821 lbs/yr to 172,307 lbs/yr. A 30% reduction remains necessary to achieve the NPS LA of 120,969 lbs/yr.

Table 2
Nonpoint Source Conditions for a Hypothetical Watershed Including Tributary Strategy Implementation and Changes in Land Use to Reflect Proposed Development

Land Use	Projected Land Use Acres	TN Loading Rate[a] lbs/ac/yr	TN Load lbs/yr
Mixed Agriculture	12,693	9.0	113,800
Atm Dep to water	1,736	7.9	13,787
Forest	8,277	1.2	9,655
Open Urban	255	3.3	847
Urban on Septic	2,636	9.4	24,778
Urban on Sewer	1,680	5.6	9,439
	25,541		172,307

a. Loading Rates assuming the Tributary Strategy is fully implemented.

It appears infeasible to achieve the NPS reduction given that the Tributary Strategy is considered to be very ambitious. Attention is turned to options for redistributing some of the excess point source waste load allocation to the NPS allocation category.

B. The TMDL analysis assumed an 8 mg/l nitrogen concentration at the large WWTP, which has a design flow of 3.0 million gallons per day (MGD). The Tributary Strategy includes a policy to upgrade major plants to ENR, which are predicted to operate at 4 mg/l. The difference in point source load associated with this upgrade (36,530 lbs/yr) can be reallocated from the point source WLA to the nonpoint source LA in the TMDL. The calculation is shown below:

Current WLA: 3.0 MGD x **8 mg/l** x 8.34 (conversion) x 365 days/yr = 73,060 lbs/yr
ENR WLA: 3.0 MGD x **4 mg/l** x 8.34 (conversion) x 365 days/yr = 36,530 lbs/yr
Difference: 73,060 lbs/y – 36,530 lbs/yr = 36,530 lbs/yr

RESULT: The TMDL equation changes as the NPS and PS allocations are shifted:
TMDL* (TN) = Point Source Allocations + Nonpoint Source Allocations
Original: 212,819 lbs/yr =91,850 + 120,969
Revised: 212,819 lbs/yr =55,320 + 157,499

Based on NPS reductions in Step A, the projected nonpoint source load shown in Table 4.1 remains at 172,307 lbs/yr, which is still in excess of the new more generous NPS allocation of 157,498 lbs/yr shown in the revised TMDL immediately above.

C. Knowing that the large industrial firm is planning to cease operation, the allocation from that source of 13,530 lbs/yr will become available for redistribution to the NPS allocation category.

RESULT: The TMDL equation changes as the NPS and PS allocations are shifted:

TMDL* (TN)	**= Point Source Allocations**		**+ Nonpoint Source Allocations**
Previous: 212,819 lbs/yr =	**55,320**	**+**	**157,499**
Revised: 212,819 lbs/yr =	**41,790**	**+**	**171,029**

The revised allocation of 171,129 lbs/yr is nearly sufficient to cover the projected NPS load of 172,307 lbs/yr. At this point, alternative NPS reductions are considered for closing the remaining gap by reducing the projected 172,307 lbs/yr down to 171,129 lbs/yr.

D (Option 1) Reforestation or wetlands creation of about 165 acres of cropland is estimated to achieve the necessary reduction. The 165 acres represents slightly more than 1% of the remaining 12,693 acres of cropland after cropland acreage reductions associated with development projections have been accounted for. It would be appropriate for the costs of reclaiming the 165 acres to be borne by developers who benefit from the associated offset. Administering such offsets could be affected by transfer of development rights, by transactions with land trust organizations, or by local government administered forest/wetlands banks.

Optionally, part or all of the projected 165 acres could be accommodated in advance through a combination of options for refining the land use plan in this watershed (a little down zoning, special forest conservation requirements in some areas (e.g., clustering, forest preservation ratios, etc.), shifting the proportion of forest and crop lands that are identified for intense development. Advanced planning would have the benefits associated with addressing the TMDL issues up front, rather than as part of an offset requirement for developers. These benefits include more certainty in the outcome, less time expended by government and developer staff to negotiate offsets, less administrative burden (time and cost) associated with identifying and executing the offset (this has a long-term compliance element to consider), less cost to the developer who would likely have to fund the offset, which might include financial commitments associated with bonding the forest/wetlands mitigation process.

(Option 2) The connection of septic systems to public sewer could also be considered to close this gap, in part or in whole; however, the accounting would have to consider that a septic system reduction has already been credited as part of the assumed implementation of the Tributary Strategies in Step A.

RESULT: The TMDL is projected to be achieved. A reallocation, subject to public review, would produce a result as shown in the revised TMDL under Step C, above.

The four previous scenarios are summarized in Table 3 below.

Table 3
Summary of a Hypothetical Watershed Analysis to Outline a Plan for Nonpoint Source Consistency with the Nitrogen TMDL

Loading Scenario	NPS Load lbs/year	NPS Allocation lbs/year	PS Allocation lbs/year	TMDL* Allocation lbs/year	Percentage of NPS Reduction Needed
Current NPS Baseline	**268,821**	**120,969**	**91,850**	**212,819**	**55.0**
A. Tributary Strategy NPS Loads & Land Use Changes	172,307	120,969	91,850	212,819	29.8
B. Trib Strategy NPS & 4mg/l at Large WWTP	172,307	157,499	55,320	212,819	8.6
C. Trib Strategy NPS & 4 mg/l & transfer of industrial load to NPS	172,307	171,029	41,790	212,819	0.7
D. Trib Strategy NPS & 4 mg/l & transfer of industrial load to NPS & Reforestation	171,020	171,029	41,790	212,819	0.0

* Note the margin of safety has been subtracted from the TMDL.

<u>Second Part of Analysis: Offsetting Point Source Load Increases at the Small WWTP</u>

Due to projected growth in the village serviced by the small WWTP, the need for waste treatment is projected to about double. The current WWTP has effectively reached capacity, in part due to an aged sewer collection system that experiences significant inflow and infiltration (I&I) during wet weather conditions.

Table 4 summarizes some supporting information for the analysis. Supporting Element 1 is the current design capacity of the small WWTP. The design flow is 88,000 gpd, which on average should service 350 equivalent dwelling units (EDU) at 250 gpd per EDU. The point source allocation in the TMDL is sufficiently large to accommodate the projected load of 4,822 lbs/yr; however, due to the I&I, the plant flow reaches capacity during wet weather conditions. The load estimate assumes an effluent concentration of 18 mg/l, which is the norm for small plants that do not use biological nutrient reduction (BNR) technology[26].

Table 4
Supporting Information for Analysis to Offset Nitrogen Load Increases for Development Near the Small WWTP

Supporting Information Elements	Waste Flow (gallons/day)	Effective Dwelling Units[a]	TN Load (lbs/year)
1. WWTP Design Capacity	88,000	350	4,822
2. Current WWTP Status	87,500	250[b]	4,794
3. Proposed Incremental Increase	112,500	450	6,164
D. Proposed Totals	200,500	650 –750[c]	10,984[d]

a. Each EDU is estimated to generate an average of 250 gallons of waste flow per day.
b. I&I results in an effective flow per EDU of about 350 gallons per day (29% over the norm of 250 gpd). This results in a lost plant capacity of 25,000 gpd, or about 100 EDUs in development potential.
c. Only 650 EDUs would be available under the current proposal if the I&I problem is not mitigated.
d. Given that the current load (4,794 lbs/yr) nearly reaches the waste load allocation (4,822 lbs/yr), nearly all of the proposed increase in load (6,164 lbs/yr) would need to be offset.

Element 2 shows the current status of the small WWTP. Due to I&I, the plant capacity is not being used efficiently. Flow to the plant during wet weather (87,500 gpd) nearly reaches capacity (88,000 gpd). As a result, only 250 EDUs, of the 350 EDU design potential, can currently be serviced by the plant. This results in a lost development potential of about 100 EDUs. The current annual nitrogen load of 4,794 lbs/yr nearly reaches the waste load allocation cap of 4,822 lbs/yr.

Element 3 shows the incremental increases associated with development potential reflected in the local land use plans. Waste flow is projected to increase by 112,500 gpd in order to support about 450 planned EDUs. If treated at a larger WWTP of similar treatment technology (effluent concentration of 18 mg/l) this projected development would generate 6,164 lbs/yr beyond the allocation of 4,822 lbs/yr reflected in the current NPDES permit.

Below is a list of offset considerations. They are presented independently; however, the ultimate outcome would most likely consist of a combination of these considerations, and possibly others. The final outcome might also involve reconsideration of the First Part of the analysis, presented above.

A. I&I Mitigation[27] could reclaim WWTP flow capacity to accommodate as much as 100 EDUs of the 450 proposed by land use planning (partial mitigation is also an option). In addition to

[26] BNR technology, adopted in the 1995 Tributary Strategies, achieves an effluent concentration of about 8 mg/l. ENR technology (Enhanced Nitrogen Removal) treats to about 4 mg/l, and is being adopted in the current Tributary Strategies.

[27] Inflow and infiltration (I&I) of subsurface water into cracks in the sewage collection system can significantly increase the volume of water received by the plant during wet weather conditions. This uses up the available tank

accommodating new development, this would help to offset about 1,540 lbs of the 6,164 lbs/yr projected increase in nitrogen. Due to the cost and disruption of I&I repairs, the jurisdiction is considering the establishment of an impact fee on all future development in this sewer district to create an investment fund envisioned to support longer-term development potential beyond the 450 EDUs presently envisioned in the land use plan.

B. Spray Irrigation could be considered for all or part of the effluent. It would be necessary to expand the WWTP flow capacity. If sufficient spray field acreage can be located to receive the additional 112,500 gpd, it might be possible to offset the increased nitrogen without investing in additional treatment technology. Funding from developers to cover the WWTP flow expansion and spray irrigation capital costs could be justified to cover the cost of offsetting increased nutrient loads necessary to accommodate the new development.

   Even if alternative options to spray irrigation are chosen at this time, the local jurisdiction might consider establishing an impact fee on new development for the purchase or creation of easements to maintain the option of future spray irrigation. This fee would be justified on the basis of ensuring long-term development potential, beyond the envisioned 450 EDUs, which is in the interest of the development community.

C. Upgrading the WWTP to BNR might prove to be a more cost-effective alternative than the use of spray irrigation at the present time. Treating the total projected flow of 200,500 gpd (88,000 + 112,500) to 8 mg/l would result in an annual load of 4,883 lbs/yr, which happens to compare favorably with the current allocation of 4,822 lbs/yr.

D. A short-term transfer of load allocation from the WLA for the large WWTP to the small WWTP is another option to consider. In other words, because the large WWTP is not currently discharging its total allowable waste load allocation, part of the unused portion could be transferred to the small WWTP as a temporary accounting of loads. This could enable cost savings in the near term (e.g., delaying the cost of investing in spray irrigation or a treatment upgrade at the small WWTP). NOTE: If the two plants are operated by separate entities, an additional administrative process would be necessary.

   In order for a short-term transfer of the accounting to be acceptable, a solid plan would likely be necessary to show that offsets at the small WWTP were certain to be executed at a future date when the large WWTP needs to reclaim the transferred allocations. If future offsets at the small WWTP did not come to fruition, it would prevent a reallocation of loading credits back to the large WWTP from the small WWTP. This might result in an effective cap on using the full flow capacity of the large WWTP. This could have serious implications if the financing for the capital costs of building the large plant depends on a funding stream from utility fees from future development, which in turn depends on using the full design capacity of the plant.

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volume at the treatment plant, reducing the amount of sewage the plant can accept. This translates into a reduction in the number of development units that can be serviced by the plant. Mitigation involves fixing the cracks or replacing pipes.

G Appendix G: Existing Programs for Potential Enhancement to Achieve TMDL Implementation Goals

Capital Programs

- Set long-term capital program goals.
- Assess land purchase opportunities for forest protection, reforestation opportunities, and long-term opportunities for the spray irrigation disposal of wastewater effluent.
- Select priorities for capital program projects.

Critical Areas Law

- Assess adequacy of local Critical Areas ordinances and regulations.
- Conduct Critical Areas plan review decisions in light of TMDL goals.
- When appropriate, use Critical Areas management techniques to support TMDL implementation outside of the Critical Areas.

Drinking Water Supply

- Coordinate source water assessment and protection planning with TMDL goals.
- Prioritize initial TMDL implementation projects to coincide with drinking water supplies.
- Conduct water and sewer planning holistically to address both point sources and nonpoint sources, which is the hallmark of TMDL implementation.

Erosion and Sediment Control

- Identify key resource needs and programmatic enhancements that could benefit from additional resources.
- Identify efficient and effective measures beyond permit requirements that could be included in a program of pollutant offsets, including ways to track them.
- Determine whether any decisions within the erosion and sediment plan review process should serve as a TMDL consistency checkpoint.
- Assess existing variances to determine if any need to be reconsidered.

Forest Conservation Law and Management in General

- Assess adequacy of local forest conservation ordinances and regulations (e.g., formula for percentages of forest retained during construction).
- Account for TMDL goals in forest conservation planning, reviews and permitting decisions.
- Assess existing variances to determine if any need to be reconsidered.
- Assess whether forest restoration projects could provide information to support pollutant offset needs elsewhere.
- Track forest losses and share that information with other units of government that track landuse changes.
- Institute a full-cost recovery fee system to cover administrative costs.
- See Land Use Planning and Soil Conservation District functions.

Infrastructure Planning

- Plan water and sewer capacity for meeting TMDL goals.
- Check for Tier II waters when considering future surface water discharges to ensure consistency with antidegradation policies of the water quality standards.

http://www.mde.state.md.us/researchcenter/data/waterqualitystandards/index.asp

Land Use Planning and Implementation

- "Stream buffer and 100-year floodplain" Sensitive Areas land use plan elements relative to existing 303(d) listings based on biological data.
- "Steep slopes" Sensitive Areas land use plan elements relative to existing 303(d) listings for sediment and biological impairments.
- Include wetlands in the Sensitive Areas element of plans, since wetlands are often linked ecologically to stream buffers and the 100-year floodplain. Greater protection at planning stage will reduce the administrative burden associated with time-consuming and costly mitigation process.
- Consider Tier II antidegradation waters in the Sensitive Areas element to reduce the costs and administrative burdens associated with Tier II reviews.

http://www.mde.state.md.us/researchcenter/data/waterqualitystandards/index.asp

- Consider brook trout streams in the Sensitive Areas element to reduce the costs and administrative burdens associated with potential future Tier II reviews
- TMDL consistency in zoning and subdivision regulations

– Assess zoning as a planning tool to manage impervious cover and forest conservation.
– Determine whether plat reviews could serve as a potential decision point for TMDL consistency review (e.g., impacts of on-site sewage disposal systems).
– Refine loading assessments during the zoning process prior to platting decisions. Determine whether any new certificates or additional information is warranted during re-zoning and platting processes.
– Assess existing variances to determine if any need to be reconsidered.
– Assess existing fee structures to help support full-cost recovery for local government services and to set appropriate incentives for the location of future development (e.g., graduated fees).

Septic System Management

- Maximize use of the Bay Restoration Funding program:
  - Homeowners and local governments can submit pre-applications for grant funds; local governments can submit proposals for block grants for use in targeted areas with problems and/or interested homeowners.
  - Priorities: MDE hopes to include some targeting of installation of the new systems to maximize impact in the upgrade program. Once all proposals for failing systems in the Critical Area are addressed, all other proposals will then be considered.
  - Grants will fund proven technologies as well as technologies already verified by 3rd parties, providing some flexibility in design/installation of systems.

- A maintenance contract will be required on the new systems. Revised regulations are being developed that will address this requirement for all BAT systems regulations.
- Contact John Boris, at MDE: jboris@mde.state.md.us

Stormwater Management

- Implement State and federal stormwater management regulations that apply.
- Implement and track retrofit activities for Maryland's Tributary Strategies.
- Consider the issues outlined for Erosion and Sediment Control, which might apply to stormwater management.
- For long-term planning, consider local roles in promoting air pollution controls as a preventive measure for reducing urban pollutants.

Soil Conservation District Functions

- See Erosion and Sediment Control above for Districts where this applies.
- Support for rural residential needs, e.g., horse pasture management.
- Assess potential enhancements to review and approval of agricultural and forestry wetlands determinations. Track changes in loads that result from determinations and the need for offsetting increased loads.
- Use full-cost recovery fee systems to fund additional workload associated with TMDL implementation.

Surface & Groundwater discharge permits

- Operate discharges in a manner consistent with NPDES permits.
- Manage land application of wastewater in a manner consistent with NPDES permits.
- Assess opportunities for future land application of wastewater to support development growth. Integrate this into land use planning and implementation processes.
- Assess opportunities for utilizing land preservation programs, and consider funding within the capital planning process.

Wetlands Programs

- Assess adequacy of local wetlands ordinances and regulations with emphasis on avoiding impacts to wetlands and buffers.
- Wetlands permit planning and permitting decisions should consider TMDLs.
- Assess wetlands restoration projects in light of TMDL pollutant offset goals.
- See Land Use Planning and Soil Conservation District functions.

H Appendix H: Local TMDL Primary Contacts

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Allegany County Midland	Mayor Craig W. Alexander		P. O. Box 306	19428 Big Lane		Midland MD 21542 - 0306	301-463-5290	
Allegany County Barton	Mayor John F. Bean, Sr.		P. O. Box 153	19018 Legislative Road, SW		Barton MD 21521 – 0153	301-463-6347	town_of_barton@allconet.org
Allegany County Frostburg	Mr. Christopher L. Hovatter, P.E.	Public Works Department	P. O. Box 440	City Hall	59 E. Main Street	Frostburg MD 21532 - 0440	301-689-6000, ext 23	
Allegany County Luke	Mr. Thomas D. Clayton	Commissioner of Streets & Water	P. O. Box 9	City Building	510 Grant Street	Luke MD 21540 - 0009	301-359-3074	Lukemd@verizon.net
Allegany County	Mr. W. Stephen Young	Director of Public Works	County Office Complex		701 Kelly Road, Suite 300	Cumberland MD 21502-3401	301-777-5933	syoung@allconet.org
Allegany County Lonaconing	Mr. Warren E. Foote	Commissioner of the Water Department	7 Jackson Street			Lonaconing MD 21539 – 0239	301-463-6233	
Allegany County Cumberland	Ms. Racquel Ketterman	Environmental Specialist	City of Cumberland	P. O. Box 1702		Cumberland MD 21501 – 1702	301-759-6600; 301-759-6604	rketterman@allconet.org
Allegany County Westernport	Ms.Katherine Mitchell	Water Commissioner	Water Department	P. O. Box 266	107 Washington Street	Westernport MD 21562 - 0266	301-359-9281	townofwesternport@allconet.org
Anne Arundel County	Mr. Michael P. Bonk	Deputy Director of Utility Operations	Anne Arundel County –	Department of Public Works	2662 Riva Road, MS 7201	Annapolis MD 21401	410-222-7521	pwbonk37@mail.aacounty.org
Anne Arundel County Annapolis	Ms. Sheila M. Tolliver	Environmental Matters Committee Chair	City Hall	160 Duke of Gloucester Street.		Annapolis MD 21401	410-974-8070	Tollivers@mindspring.com

Local Government TMDL Primary Contacts

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Anne Arundel County Highland Beach	Ms. Sterling P. Seay	Commissioner of Public Works	P. O. Box 4206	3243 Walnut Drive		Annapolis MD 21403 – 4206	410-268-2956	perseay@comcast.net
Baltimore City	Mr. William Stack	Chief, Water Quality Management Section	Department of Public Works	301 Druid Park Drive		Baltimore MD 21215	410-396-0732	Bill.Stack@baltimorecity.gov
Baltimore County	Mr. Steve Stewart	Baltimore County	Department of Environmental	County Courts Building, Room	401 Bosley Avenue	Towson MD 21204-4420	410-887-4488 x240	sstewart@co.ba.md.us
Calvert County	Mr. Barry King	Bureau Chief	Calvert County Bureau of Utilities	175 Main Street		Prince Frederick MD 20678	410-535-1600 x2328	kingbk@co.cal.md.us
Calvert County North Beach	Mr. Brian McNeil	Supervisorof the Public Works Department	P. O. Box 99	8916 Chesapeake		North Beach MD 20714 - 0099	410- 257-6335	
Calvert County Chesapeake Beac	Mr. Russell King	Director of Public Works Department	P. O. Box 400	8200 Bayside Road		Chesapeake Beach MD	410-257-2230, 301-855-8398	Mjenkins@chesapeake-beach.md.us
Caroline County Templeville	Mayor Helen M. Knotts		P. O. Box 25			Templeville MD 21670 – 0025	410-482-8680	
Caroline County Henderson	Mayor Sandra M. Cook		P. O. Box 10			Henderson MD 21640 – 0010	410-482-2193, 410- 482-8979	hendsandy@comcast.net
Caroline County	Mr. Charles E. Emerson	Director	Department of Public Works	520 Wilmuth Street		Denton MD 21629-0386	410-479-0520	cemerson@pubworks.caroline.md.us
Caroline County Goldsboro	Mr. Dale R. Mumford	Town Manager	P. O. Box 132			Goldsboro MD 21636 - 0132	410-482-8805	Mumford@dmv.com

Local Government TMDL Primary Contacts

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Caroline County Ridgely	Mr. David Crist	Superintendent - Water/Wastewater	P. O. Box 710	2 Central Avenue		Ridgely MD 21660 – 0710	410-634-2177	
Caroline County Greensboro	Mr. David L. Kibler	Town Manager	P. O. Box 340	111 S. Main Street		Greensboro MD 21639 – 0340	410-482-6222	greensboro@greensboromd.com
Caroline County Hillsboro	Mr. Ronald A. Stafford	President	P. O. Box 128	22043 Church Street		Hillsboro MD 21641 - 0128	410-820-2967	
Caroline County Denton	Mr. Scott Getchell	Superintendent of Public Works, Town of Denton	Department of Public Works	650 Legion Road		Denton MD 21629	410-479-5446	sgetchell@dentonmaryland.com
Caroline County Federalsburg	Mr. Steve Dyott	Director of the Public Works Department	P. O. Box 471	118 North Main Street		Federalsburg MD 21632 – 0471	410-754-8173	hsdyott@hotmail.com
Caroline County Preston	Ms. Ann G. Willis	Town Manager	P. O. Box 91	172 Main Street		Preston MD 21655 – 0091	410-673-7929	Tpreston@shore.intercom.net
Carroll County Union Bridge	Mayor Bret D. Grossnickle		104 West Locust Street			Union Bridge MD 21791	410-775-2711	Unionbr@ccpl.carr.org
Carroll County Mount Airy	Mayor James S. Holt		P. O. Box 50	110 South Main Street		Mount Airy MD 21771 - 0050	301-831-5768, 301- 829-	
Carroll County New Windsor	Mayor Samuel M. Pierce		P. O. Box 609	211 High Street		New Windsor MD 21776 – 0609	410-635-6575	

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Carroll County Manchester	Mr. Douglas Myers	Waste Water Supervisor	P. O. Box 830	3208 York Street		Manchester MD 21102 - 0830	410-239-7900	
Carroll County Taneytown	Mr. James L. Schumacher	City Manager	17 East Baltimore Street			Taneytown MD 21787	410-751-1100	jlschumacher@taneytown.org
Carroll County	Mr. Jim Slater	Environmental Compliance Officer	Department of Planning - Office	County Office Building, Room	225 North Center Street	Westminster MD 21157	410-386-2756	jslater@ccg.carr.org
Carroll County Hampstead	Mr. Kenneth C. Decker	Town Manager	1034 South Carroll Street			Hampstead MD 21074	410-374-2761; 410-239-7408	Hampstead@carr.org
Carroll County Sykesville	Mr. Matthew H. Candland	Town Manager	7547 Main Street			Sykesville MD 21784	410-795-8959, 410- 795-6390	mcandland@sykesville.net
Carroll County Westminster	Mr. Thomas B. Beyard	Director	Department Of Planning & Public	P. O. Box 710	1838 Emerald Hill Lane	Westminster MD 21157 - 0710	410-848-9002	tbeyard@westgov.com
Cecil County Port Deposit	Mayor Charles Robert Flayhart		64 South Main Street			Port Deposit MD 21904	410-378-2121/2	
Cecil County Cecilton	Mayor John J. Bunnell		P. O. Box 317	117 West Main Street		Cecilton MD 21913 – 0317	410-275-2692	ceciltonmd@aol.net
Cecil County Chesapeake City	Mayor Robert E. Bernstine		P. O. Box 205	108 Bohemia Avenue		Chesapeake City MD 21915 - 0205	410-885-5298	Chesapeakecity@dol.net
Cecil County	Mr. David Hollenbaugh	Deputy Director of Public Works	Department of Public Works	County Office Building, Room	129 East Main Street	Elkton MD 21921	410-996-1100	dhollenbaugh@ccgov.org

Local Government TMDL Primary Contacts

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Cecil County Rising Sun	Mr. Jeffery Williams	Town Administrator	Town of Rising Sun	1 East Main Street	P.O. Box 456	Rising Sun MD 21911	410-658-5353	rsadmin@zoominternet.net
Cecil County Elkton	Mr. Lewis H. George, Jr.	Town Administrator	Town of Elkton	Administration Office	P. O. Box 157	Elkton MD 21922 – 0157	410-398-0970, ext 142	Elkadsec@iximdcom
Cecil County North East	Mr. Ronald Carter	Supervisor of the Water Department	39 N. Leslie Road			North East MD 21901	410-287-9181, 410-287-8102	Severntrent_northeast@verizon.net
Cecil County Charlestown	Mr. Steven W. Vanderwort	President of the Town Commission	P. O. Box 154	241 Market Street		Charlestown MD 21914 - 0154	410-287-6173	charlestown_admin@comcast.net
Cecil County Perryville	Ms. Sharon Weygand	Town Administrator	P. O. Box 773	515 Broad Street		Perryville MD 21903 - 0773	410-642-6066	Swaygand@iximd.com
Charles County Port Tobacco	Mr. Calvin L. Compton, Jr.	President of the Village Commision	P. O. Box 386	Courthouse	Commerce Street	Port Tobacco MD 20677– 0386	301-932-1715	
Charles County La Plata	Mr. Stephen Murphey	Director of the Public Works Department	P. O. Box 1038	5 Garrett Avenue		La Plata MD 20646 - 1038	301-870-3377	
Charles County Indian Head	Mr. Steve Sager	Town Manager	4195 Indian Head Highway			Indian Head MD 20640	301-743-5511	stevesager1@verizon.net
Charles County	Ms. Karen Wiggen		Charles County Planning Division	P.O. Box 2150		La Plata MD 20646	301-645-0598	WiggenK@charlescounty.org
Dorchester County East New Market	Mayor Caroline S. Cline		P. O. Box 24	Academy Street		East New Market MD 21631 – 0024	(410) 943-8112;410-228-	enmtownhall@bcctv.com

Local Government TMDL Primary Contacts

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Dorchester County Brookview	Mayor Richard E. Sullivan		5649 Indian Town Road			Rhodesdale MD 21659	410-943-1625	
Dorchester County Church Creek	Mayor Robert L. Herbert		P. O. Box 52			Church Creek MD 21622 – 0052	410-228-7030	
Dorchester County Vienna	Mayor Russell B. Brinsfield		P. O. Box 86			Vienna MD 21869 - 0086	410-376-3442	
Dorchester County Galestown	Mr. D. James Cole	President of the Town Commission	P. O. Box 190			Sharptown MD 21861 - 0190	410-883-3156	
Dorchester County Cambridge	Mr. David F. Pritchett	Director of the Department of Public Works	P.O. Box 255			Cambridge MD 21613 – 0255	410-228-1955	
Dorchester County Secretary	Mr. Eric Barnhart	Operator	Water & Wastewater	P. O. Box 248		Secretary MD 21664 – 0248	410-943-3113	
Dorchester County Hurlock	Mr. Frank E. Wright	Superintendent of the Public Works Department	P. O. Box 327			Hurlock MD 21643 – 0327	410-943-4181	
Dorchester County	Mr. Robert M. Tenanty, P.E.	County Engineer	5435 Handley Road			Cambridge MD 21613	410-228-2920	btenanty@docogonet.com
Frederick County Rosemont	Burgess Jacquelyn M. Ebersole	Village Commission	1219 Rosemont Drive			Rosemont MD 21758	301-834-7444	cebersoles@aol.com

Local Government TMDL Primary Contacts

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Frederick County Middletown	Mr. Andrew J. Bowen	Town Administrator	31 West Main Street			Middletown MD 21769	301-371-6171	abowen@ci.middletown.md.us
Frederick County Walkersville	Mr. Bob DePaola	Public Works Director/Water Superintendent	Town of Walkersville	21 West Frederick Street	P.O. Box 249	Walkersville MD 21793	301-845-4500	
Frederick County Burkittsville	Mr. Daniel P. Meyer	Chair of the Planning & Zoning Commission	P. O. Box 485			Burkittsville MD 21718 – 0485	301-834-6780	smartgrowth@hotmail.com
Frederick County Emmitsburg	Mr. David Haller	Town Manager	300 A-1 South Seton Avenue			Emmitsburg MD 21727 - 0380	240-629-6300	dhaller@emmitsburgmd.gov
Frederick County Frederick	Mr. Fred L. Eisenhart, Jr.	Director of the Public Works Department	111 Airport Drive East			Frederick MD 21701	301-694-1159	Fred@cityoffrederick.com
Frederick County Thurmont	Mr. Gary W. Dingle	Director of the Water Department	P. O. Box 17	10 Frederick Road		Thurmont MD 21788 – 0017	301-271-7313	
Frederick County Myersville	Mr. Michael Collins	Chair of the Planning Commission	P. O. Box 295			Myersville MD 21773 - 0295	301-293-4281	
Frederick County	Mr. Michael Marschner	Director	Division of Utilities and Solid	Department of Public Works	118 North Market Street	Frederick MD 21701	301-694-2568	landfill@fredco-md.net

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Frederick County Brunswick	Mr. Mike Campbell	Superintendent, Waste Water Plant	City Hall	1 West Potomac Street		Brunswick MD 21716	301-834-7737	
Frederick County Woodsboro	Mr. Richard Priddey	Superintendent	P. O. Box 88			Woodsboro MD 21798 - 0088	301-845-4288	Townwoodsboro@aol.com
Garrett County Mountain Lake Par	Mayor Britten L. Martin, Jr.		P. O. Box 2182	1007 Allegheny Drive		Mountain Lake Park MD 21550 -	301-334-2250	mtnlakepark@cebridge.net
Garrett County Deer Park	Mayor Donald E. Dawson		100 Church St.			Deer Park MD 21550	301-334-4531	
Garrett County Kitzmiller	Mayor James A. Browning, Jr.		P. O. Box 607	104 West Centre Street		Kitzmiller MD 21538 - 0607	301-453-3449	
Garrett County Loch Lynn Heights	Mayor Larry F. Friend		211 Bonnie Boulevard			Loch Lynn Heights MD 21550	301-334-8339	Townoflochlynn@cebridge.net
Garrett County Oakland	Mayor Margaret J. (Peggy) Jamison	Town of Oakland	15 South Third Street			Oakland MD 21550	301-334-2691	
Garrett County Accident	Mayor Richard W. Carlson		P. O. Box 190	Municipal Building	104 South North Street	Accident MD 21520 – 0190	301-746-6346	Accidenttownhall@iceweb.net
Garrett County Friendsville	Mr. C. Allen Festerman	Operations Supervisor	Garrett County Department of	2008 Maryland Highway, Suite 2	Public Service Center	Mountain Lake Park MD 21550	301-334-6983	cafesterman@gcnet.net
Garrett County	Mr. John E. Nelson	Director	Court House	203 South Fourth Street		Oakland MD 21550	301-334-1920	john@garrettcounty.org

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Garrett County Grantsville	Mr. William Hetrick	Operator	Water Department	P. O. Box 296	171 Hill Street	Grantsville MD 21536 - 0296	301-895-3144	
Harford County Aberdeen	Mr. Donald E. Brand	Acting Director	Department of Public Works	60 N. Parke Street		Aberdeen MD 21001	410-272-1600; 410-575-6569	dbrand@aberdeen-md.org
Harford County Bel Air	Mr. Randolph C. Robertson	Director of Public Works	705 Churchville Road			Bel Air MD 21014	410-638-4536; 410-879-9507	rrobertson@belair.org
Harford County Havre de Grace	Ms. Donna A. Costango	Deputy Director of Public Works	711 Pennington Avenue			Havre de Grace MD 21078	410-939-1800	Donnac@havredegracemd.com
Harford County	Ms. Elizabeth Weisengoff		Water Resources Engineering	212 S. Bond Street, 3rd Floor		Bel Air MD 21014	410-638-3545	baweisengoff@harfordcountymd.gov
Howard County	Mr. Howard Saltzman	Chief	Storm Water Management	Bureau of Environmental	Howard County - Department of	Columbia MD 21046	410-313-6416	hsaltzman@co.ho.md.us
Kent County Betterton	Mayor and Council for Town of Betterton		3 Third Avenue	P. O. Box 339		Betterton MD 21610 - 0339	410-348-5522	
Kent County Rock Hall	Mr. Ronald H. Fithian	Town Administrator	P. O. Box 367			Rock Hall MD 21661 - 0367	410-639-2293	
Kent County Galena	Mr. Thomas R. Bass	Town Administrator	P. O. Box 279	101 South Main Street		Galena MD 21635 - 0279	410-648-5151	
Kent County	Mr. Wayne Morris	Director	Department of Water and	709 Morgnec Road, Suite 201		Chestertown MD 21620	410-778-3287	wmorris@kentgov.org

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Kent County Chestertown	Mr. William S. Ingersoll	Town Manager	118 North Cross Street			Chestertown MD 21620	410-778-0500	office@chestertown.com
Kent County Millington	Ms. Janice Hassell	Town Administrator	P.O. Box 330			Millington MD 21651 -0330	410-928-3880	
Montgomery County Poolesville	D. Wade Yost	Town Manager	P.O. Box 158	19710-C Fisher Avenue		Poolesville MD 20837 - 0158	301-428-8927	townhall@lan2wan.com
Montgomery County Laytonsville	Mayor Charles W. Oland		P. O. Box 5158			Laytonsville MD 20882 - 5158	301-869-0042	clerk@laytonsville.md.us
Montgomery County Glen Echo	Mayor Deborah M. Beers		P. O. Box 598	6106 Harvard Avenue		Glen Echo MD 20812 - 0598	301-320-4041	townhall@glenecho.org
Montgomery County Washington Grove	Mayor John G. Compton		P. O. Box 216	300 Grove Avenue		Washington Grove MD	301-926-2256	
Montgomery County Somerset	Mayor Walter J. Behr		4510 Cumberland Avenue			Chevy Chase MD 20815	301-657-3211	mayor@townofsomerset.com
Montgomery County Takoma Park	Mr. Ali Khalilian	City Engineer	Public Works Department	31 Oswego Avenue		Silver Spring MD 20910	301-891-7633	DarylB@takomagov.org
Montgomery County Rockville	Mr. Craig L. Simoneau	Director	Public Works Department	111 Maryland Avenue		Rockville MD 20850	240-314-8500	csimoneau@rockvillemd.gov
Montgomery County Kensington	Mr. David Furman	Director	Public Works Department	3710 Mitchell Street		Kensington MD 20895	301-949-2424, ext. 14	Mayor.counil@tok.org

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Montgomery County Garrett Park	Mr. Edwin Pratt, Jr.	Town Administraor	P. O. Box 84	4600 Waverly Avenue		Garrett Park MD 20896 - 0084	301-933-7488	garrett-park@comcast.net
Montgomery County Chevy Chase Villa	Mr. Geoffrey Biddle	Village Manager	5906 Connecticut Avenue			Chevy Chase MD 20815	301-654-7300	geoff.biddle@montgomerycountymd.gov
Montgomery County Barnesville	Mr. Peter T. Menke	Town Commission President	P. O. Box 95			Barnesville MD 20838 - 0095	301-972-8411	TownBarnesville@aol.com
Montgomery County Brookville	Mr. Richard S. Allan	President	Town Commission	P. O. Box 67		Brookeville MD 20833 - 0067	301-570-4465	townofbrookeville@starpower.net
Montgomery County North Chevy Chase	Mr. Robert J. Weesner	Village Manager	P. O. Box 15887			Chevy Chase MD 20825-5887	301-654-7084	nccvm@comcast.net
Montgomery County The Town of Chevy	Mr. Todd Hoffman	Town Manager	4301 Willow Lane			Chevy Chase MD 20815	301-654-7144	townoffice@townofchevychase.org
Montgomery County Village of Chevy C	Ms. Andy Leon Harney	Village Manager	P.O. Box 15070			Chevy Chase MD 20815	301-656-9117	VillageManager@ChevyChaseSection3.com
Montgomery County Gaithersburg	Ms. Erica Shingara	Environmental Specialist	31 S. Summit Avenue			Gaithersburg MD 20877	301-258-6313, ext. 171	eshingara@gaithersburgmd.gov
Montgomery County Village of Chevy C	Ms. Francies L. Higgins	Village Manager	P. O. Box 15140			Chevy Chase MD 20815	301-986-5481	
Montgomery County Chevy Chase View	Ms. Jana S. Coe	Town Administrator	P. O. Box 136			Kensington MD 20895 - 0136	301-949-9274	

Local Government TMDL Primary Contacts

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Montgomery County Martin's Additions	Ms. Maura Gordy	Village Manager	P. O. Box 15267			Chevy Chase MD 20825	301-656-4112	mgordy@aol.com
Montgomery County	Ms. Meosotis Curtis	Montgomery County DEP-WMD	255 Rockville Pike, Suite 120			Rockville MD 20850	240-777-7711	meosotis.curtis@montgomerycountymd.gov
Prince George's County Edmonston	Mayor Adam Ortiz		5005 52nd Avenue			Edmonston MD 20781	301 699-8806	townofedmonston@msn.com
Prince George's County Seat Pleasant	Mayor Eugene W. Grant		6301 Addison Road			Seat Pleasant MD 20743	301-336-2600	eugene.grant@seatpleasantmd.gov
Prince George's County University Park	Mayor John L. Brunner		6724 Baltimore Avenue			University Park MD 20782	301-927-2997, 301- 927-4262	Townhall@upmd.org
Prince George's County Forest Heights	Mayor Joyce A. Beck	Municipal Building	5508 Arapahoe Drive			Forest Heights MD 20745	301-839-1030	mayor.fh@verizon.net
Prince George's County North Brentwood	Mayor Lillian K. Beverly		4009 Wallace Road			North Brentwood MD 20722 – 0196	301-699-9699	northbrentwood@earthlink.net
Prince George's County College Park	Mayor Stephen A. Brayman	City of College Park	4500 Knox Road			College Park MD 20740	301-864-8666	Sbrayman@ci.college-park.md.us
Prince George's County Capitol Heights	Mr. Antonio Rouse	Director	Public Works Department	One Capitol Heights Boulevard		Capitol Heights MD 20743	301-336-0626	
Prince George's County District Heights	Mr. Brian Edwards	Supervisor	Public Works Department	2000 Marbury Drive		District Heights, MD 20747 – 2399	301-336-7417	Edwardsb@districtheights.org

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Prince George's County Fairmount Heights	Mr. Carlton Whittingham	Supervisor	Public Works Department	6100 Jost Street		Fairmount Heights MD 20743	301-925-8585	
Prince George's County	Mr. Chris Akinbobola	Associate Director, Environmental Services Division	Prince George's County -	Inglewood Center Three	9400 Peppercorn Place, Suite 610	Largo MD 20774	301-883-5834	caakinbobola@co.pg.md.us
Prince George's County Bowie	Mr. Chris Bolander	Superintendent	Bowie Wastewater	2614 Kenhill Drive		Bowie MD 20715	301-809-2392	cbolander@cityofbowie.org
Prince George's County Colmar Manor	Mr. Daniel R. Baden	Clerk-Treasurer	3701 Lawrence Street			Colmar Manor MD 20722	301-277-4920	jmyerscm@aol.com
Prince George's County Mount Rainier	Mr. Edmund Gabay	Public Works Director	One Municipal Place			Mount Rainier MD 20712	301-985-6583	Mrpwdirector@capu.net
Prince George's County Glenarden	Mr. Herbert Jackson, Sr.	City Manager	8600 Glenarden Parkway			Glenarden MD 20706	301-773-2100	
Prince George's County New Carrollton	Mr. J. Michael Downes	City Administrator	6016 Princess Garden Pkwy			New Carrollton MD 20784 – 2898	301-459-6100	
Prince George's County Riverdale Park	Mr. James F. Houser	Director	Public Works Department	5012 Queensbury Road		Riverdale Park MD 20737	301-864-1803	
Prince George's County Bladensburg	Mr. Joe Carmena	Public Works Foreman	Bladensburg Public Works	4901 Upshur Street		Bladensburg MD 20710	301-927-1452	
Prince George's County Berwyn Heights	Mr. Joseph A. Coleman	Director	Public Works Department	5700 Berwyn Road		Berwyn Heights MD 20740	301-474-6897	

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Prince George's County Cheverly	Mr. Juan L. Torres	Director	Public Works Department	6401 Forest Road		Cheverly MD 20785	301-773-2666	cheverlyPW@netscape.net
Prince George's County Laurel	Mr. Karl Brendle	Director	Community Planning &	Laurel Municipal Center	8103 Sandy Spring Road	Laurel MD 20707	301-725-5300 ext.301	kbrendle@laurel.md.us
Prince George's County Greenbelt	Mr. Kenneth Hall	Director	Public Works Department	555 Crescent Road		Greenbelt MD 20770	301-474-8004	Khall@greenbelt.md.gov
Prince George's County Brentwood	Mr. Lanny E. Mummert	Town Administrator	4300 39th Place			Brentwood MD 20722	301-927-7395	town_bwood@hotmail.com
Prince George's County Hyattsville	Mr. Lee E. Henry	Director	Public Works Department	City of Hyattsville	4633 Arundel Place	Hyattsville MD 20782	301-985-5045	lhenry@hyattsville.org
Prince George's County Cottage City	Mrs. Anna Marie Angolia	Chair	Town Commission	3820 40th Avenue		Cottage City MD 20722	301-779-2161	Amangolia@aol.com
Prince George's County Eagle Harbor	Ms. Bertha A. Guerra	Clerk Treasurer	Town of Eagle Harbor, Inc.	P.O. Box 28		Aquasco MD 20608	202-671-2011wk;202-723-	Bguerra@dpw.dcgov.org;bertha.guerra@dc.gov
Prince George's County Morningside	Ms. Elizabeth Long	Clerk	6901 Ames Street			Morningside MD 20746	301-736-2300 ext.6	clerkmorningside@aol.com
Prince George's County Landover Hills	Ms. Kathleen A. Tavel	Town Manager	6904 Taylor Street			Landover Hills MD 20784	301-773-6401	Townkat528@aol.com
Prince George's County Upper Marlboro	President Helen H. Ford		P.O.Box 280	14211 School Lane		Upper Marlboro MD 20773	301-627-6905	

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Queen Anne's County Templeville	Mayor Helen M. Knotts		P. O. Box 25			Templeville MD 21670 - 0025	410-482-8680	Bhe@dmu.com
Queen Anne's County	Mr. Alan Quimby	Chief Sanitary Engineer	Queen Anne's County	310 Bateau Drive		Stevensville MD 21666-0010	410-643-3535	AQuimby@QAC.ORG
Queen Anne's County Millington	Mr. Dave Teel	Town Administrator	P.O. Box 330			Millington MD 21651 -0330	410-928-3880	millington@atlanticbbn.net
Queen Anne's County Sudlersville	Mr. David Teel	Town Manager	P.O. Box 116	200 South Church Street		Sudlersville MD 21668-0116	410-438-3465	
Queen Anne's County Queenstown	Mr. John W. S. Foster III	Town Commissioner	P.O. Box 4			Queenstown MD 21658	410-827-7646	
Queen Anne's County Centreville	Mr. Royden N. Powell III	Town Manager	Centreville Town Hall	101 Lawyers Row		Centreville MD 21617	410-758-1224	
Queen Anne's County Queen Anne	Mrs. Juanita Kohn	Town Clerk/Treasurer	P. O. Box 365			Queen Anne MD 21657 - 0365	410-364-9229	townofqa@comcast.net
Queen Anne's County Barclay	Ms. Lenora Swain	Clerk	P. O. Box 39			Barclay MD 21607	410-438-3457; 410-438-3430	lswain@dmv.com
Queen Anne's County Church Hill	Ms. Marie L. Rameika	Town Administrator/Clerk	P. O. Box 85	324 Main Street		Church Hill MD 21623 - 0085	410-758-3740	mrameika@intercom.net
Somerset County Princess Anne	Mr. Bruce W. Riggin, Sr.	Superintendent	Public Works Department	Town of Princess Anne	11786 Beckford Avenue	Princess Anne MD 21853	410-651-3001	

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County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Somerset County Crisfield	Mr. Calvin R. Dize, Jr.	City Manager	City of Crisfield	City Hall	P. O. Box 270, 319 West Main	Crisfield MD 21817 – 0270	410-968-1333	crisfield@ccisp.net
Somerset County	Mr. Earl Ludy	Plant Supervisor	Somerset County Sanitary District	Somerset Office Complex	11916 Somerset Avenue, P.O. Box	Princess Anne MD 21853	410-651-0268	Ecludy@ezy.net
St. Mary's County	Mr. George A. Erichsen	Director	Department of Public Works and	P.O. Box 508	44825 St. Andrew's Church	California MD 20619-0508	301-863-8400	george_erichsen@co.saint-marys.md.us
St.Mary's County Leonardtown	Mr. John Johnson	Utilities Superintendent	Water & Wastewater	22620 Van Wert Lane	P.O. Box 1	Leonardtown MD 20650 – 0001	301-475-3511	Ltownwwtp@erols.com
Talbot County Queen Anne	Mayor Randolph Esty		P. O. Box 365			Queen Anne MD 21657 - 0365	410-364-9229	R-Esty@comcast.net
Talbot County Easton	Mr. Michael J. Dickerson	Superintendent	Public Works Department	P. O. Box 520	14 South Harrison Street	Easton MD 21601 - 0520	410-822-0513;410-822-	mdickerson@town-eastonmd.com
Talbot County	Mr. Ray Clarke	County Engineer	Department of Public Works	Talbot County Government	11 North Washington Street	Easton MD 21601	410- 770-8170	rclarketalbgov.org
Talbot County Oxford	Mr. Richard Copper	Superintendent	Public Works Department	P. O. Box 339	100 North Morris Street	Oxford MD 21654 – 0339	410-226-5740	
Talbot County St. Michaels	Ms. Cheril S. Thomas	Town Manager	P. O. Box 206	300 Mill Street		St. Michaels MD 21663 - 0206	410-745-9535	Stmichaelsthomas@aol.com
Talbot County Trappe	Ms. Cheryl Lewis	President of the Town Council	P. O. Box 162	4011 Powell Avenue		Trappe MD 21673 - 0162	410-476-3170	

Local Government TMDL Primary Contacts

County/ Municipality:	Name	Title	Address1	Address2	Address3	City State Zip	Telephone	E-mail
Washington County Sharpsburg	Mayor Hal R. Spielman		P. O. Box 368			Sharpsburg MD 21782 - 0368	301-432-4428	
Washington County Williamsport	Mayor John W. Slayman		Town Hall	Conococheague & Salisbury		Williamsport MD 21795	301-223-7711	
Washington County Keedysville	Mayor Kenneth Lee-Brandenburg II		P. O. Box 359			Keedysville MD 21756 - 0359	301-432-5795	
Washington County Clear Spring	Mayor Paul D. Hose, Jr.		P. O. Box 104	146 Cumberland Street		Clear Spring MD 21722 - 0104	301-842-2252	Townofclearspring@starpower.net
Washington County Funkstown	Mayor Robert L. Kline		P. O. Box 235	30 East Baltimore Street		Funkstown MD 21734 - 0235	301-791-0948	
Washington County Hagerstown	Mr. Christopher L. Bordlemay	Acting Manager	City of Hagerstown	Water and Sewer Department	1 Clean Water Circle	Hagerstown MD 21740-4817	301-791-4528	cbordlemay@hagerstown.org
Washington County Boonsboro	Mr. John L. Kendall	Town Manager	21 North Main Street			Boonsboro MD 21713	301-432-5141	
Washington County	Mr. Mark Stransky	Utility and Stormwater Management	Washington County	100 West Washington Street		Hagerstown MD 21740	240-313-2415	mstransky@washco-md.net
Washington County Hancock	Mr. Ricky Faith, Sr.	Superintendent	Public Works Department	126 West High Street		Hancock MD 21750	301-331-7093	
Washington County Smithsburg	Mr. William Loughridge	Supervisor	Public Works	P. O. Box 237		Smithsburg MD 21783	301-824-7234	Leopards@erols.com

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Wicomico County Willards	Mark Joines	Superintendent		P. O. Box 98	7360 Main Street	Willards MD 21874 - 0098	410-835-8192	TownofWillard@Wicomico.org
Wicomico County Mardela Springs	Mr. David Insley	President	Town Commission	Town Hall	P. O. Box 81, 201 Station Street	Mardela Springs MD 21837 - 0081	410-742-9190	
Wicomico County Delmar	Mr. Jerome Reid	Superintendent	100 South Pennsylvania			Delmar MD 21875	410-896-3233	Wwtp@town.delmar.md.us
Wicomico County Salisbury	Mr. John F. Jacobs III	Director	Public Works Department	125 North Division Street	Room 202	Salisbury MD 21801 - 4940	410-548-3170	jjacobs@ci.salisbury.md.us
Wicomico County Pittsville	Mr. Kenneth Federighi	Superintendent	Water Treatment Plant	P. O. Drawer A		Pittsville MD 21850	410-835-2386	
Wicomico County Fruitland	Mr. P. Cooper Townsend	Director	Public Works Department	P. O. Box F	401 East Main Street	Fruitland MD 21826 - 0120	410-548-2807	
Wicomico County	Mr. P. Rai Sharma	Director	Department of Public Works	P.O. Box 968	Government Office Building,	Salisbury MD 21803-0870	410-548-4810	Psharma@wicomicocounty.org
Wicomico County Sharptown	Mr. William R. White	Supervisor	Public Works Department	P. O. Box 338	401 Main Street	Sharptown MD 21861 - 0338	410-883-3767	Sharptow@ezy.net
Wicomico County Hebron	Mrs. Mary Purner	Town Manager	P. O. Box 299			Hebron MD 21830 - 0299	410-742-5555	townofhebron-mdmap@comcast.net
Worcester County	Mr. Sandy Coyman	Director	Department of Comprehensive	Government Office Center,	One West Market Street	Snow Hill MD 21863	410-632-5651	scoyman@co.worcester.md.us

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Worcester County Pocomoke City	Mr. William R. White	Supervisor	Public Works Department	P. O. Box 29		Pocomoke City MD 21851 - 0029	410-957-0107	
Worcester County Berlin	Ms. Jane Kreiter	Superintendent of Wastewater	Town of Berlin	10 Williams Street		Berlin MD 21811	410-641-3845	berlinww@intercom.net
Worcester County Snow Hill	Ms. Kelly Brewington	Town Manager	P.O. Box 348	103 Bank Street		Snow Hill MD 21863	410-632-2080	brewington@snowhillmd.com

I Appendix I: BMP Efficiencies and Costs

Efficiencies: BMP definitions and reduction efficiency information is available in the "Best Management Practices" section of the Bay Program web site: www.chesapeakebay.net/tribtools.htm

Costs: The following are typical BMP unit costs in Maryland as of 2005.

BMP Category	Unit	Unit Costs			
		Capital	Rate	Term	O&M
AGRICULTURAL BMPs					
Conservation Plans	acres	$280	5%	10	$0
Conservation Tillage	acres	$8/$17	0%	1	$0
Cover Crops	acres	$0	0%	1	$40
Small Grain Commodity	acres	$0	0%	1	$20
Alternative Crops	acres	$0	0%	1	$25
AWMS, SP	systems				
AWMS - Livestock	systems	$63,533	5%	15	$2,541
AWMS - Poultry	systems	$26,627	5%	15	$1,065
Runoff Control	systems	$7,058	5%	15	$282
Stream Protection w/Fencing	systems	$1,000	5%	10	$40
Stream Protection w/o Fencing	systems	$670	5%	10	$27
Nutrient Management	acres	$30	0%	10	$0
Retirement BMPs	acres				
Retirement HEL	acres	$120	5%	10	$5
Buffers Forested	acres	$1,000	5%	25	$40
Buffers Grassed	acres	$140	5%	10	$6
Wetlands	acres	$3,500	5%	30	$140
Tree Planting (Ag)	acres	$615	5%	25	$25
Precision Agriculture	acres	$28	0%	8	$0
Horse Pasture Management	systems	$4,317	5%	15	$173
Alternative Manure Mgt	tons exported	$0	0%	1	$20
Phytase Feed Additive	% reduced	$0	0%	1	$1,000,000
Ammonia Emission Reduction	operation	$13,000	0%	8	$0
Oyster Aquaculture	trays	$125	0%	1	$24
URBAN BMPs					

SWM (New)	acres	$3,500	5%	20	$175
SWM Retrofits (Old)	acres	$3,500	5%	20	$175
SWM Retrofits (Recent)	acres	$3,500	5%	20	$175
Erosion and Sediment Control	acres	$0	5%	20	$5,800
Urban Nutrient Management	acres	$6	5%	3	
Buffers Forested, Urban	acres	$1,200	5%	25	
Urban Tree Planting	acres	$4,356	5%	25	
Stream Restoration, Urban	feet	$224	5%	25	
SEPTICS					
Sprawl Reduction	acres	$0			$0
Enhanced Septic Denitrification	systems	$7,500	7%	20	$300
Septic Connections	systems	$17,500	7%	20	

J Appendix J: TMDL Elements to Review Prior to Implementation Planning

Water Quality Target(s): TMDL loading limits are set to meet a specific water quality parameter threshold. The threshold used in the TMDL analysis is consistent with the threshold used in the 303(d) listing, which motivated the need for a TMDL analysis. When a numeric water quality criterion is the basis of a 303(d) listing, the water quality target used in the TMDL is likely to be the numeric criterion[28].

When a narrative criterion is the basis of a 303(d) listing, a systematic methodology must be used to quantify the water quality target. Derivation of water quality targets can often be complex if EPA has not provided specific standards or if site-specific conditions are critical to the determination. For example, water quality targets for high fish tissue concentrations of pollutants depend on risk calculations and site-specific rates of biological accumulation through the food chain.

Similarly, because EPA has not provided substance-specific sediment criteria, target values for bottom sediment concentrations of pollutants can be difficult to determine. This is further complicated when multiple pollutants are present.

Multiple water quality targets can also be associated with a single impairing substance. For example, the nutrient phosphorus can cause both excessive algae growth and depressed concentrations of dissolved oxygen. Water quality targets for both of these parameters must be achieved when setting the maximum loading threshold for phosphorus. In turn, implementation must ensure that both parameters are met.

It is also important to understand how the water quality target is measured. Is the measurement an "average" or "instantaneous"? If it is an average, is it an arithmetic or geometric mean? What is the averaging period (30-days, an average of the most recent five samples, annual, multi-year annual average)? Is it necessary to assess the dissolved parameter of interest, or the total parameter or both? Is it necessary to collect any supplemental information in addition to the parameter of interest, e.g., temperature or water hardness?

The water quality target is the threshold that is used in the TMDL analysis to define a violation. Clearly understanding how this threshold is defined will help ensure that implementation plans are properly focused. This is closely related to the next topic on the water quality impairment, which also addresses the issue of where and when the threshold is violated.

Water Quality Impairment: In addition to understanding the water quality target discussed above, impairments have other characteristics. For instance, the specific location of the impairment is important. Maryland's 303(d) listings for nutrients identify the Maryland 8-digit watershed, and indicate whether the impairment is in tidal water, non-tidal water, or both. It is also important to know precisely where within the given waterbody the standards are violated.

[28] This is not always the case. If elevated fish tissue concentrations of a toxic substance triggered the 303(d) listing, then the TMDL analysis must address the fish tissue concentration as the water quality target.

For example, a tidal waterbody can be rather large. Nutrient impairments are often isolated in a fairly confined area at the head of tide where the main non-tidal tributary meets the tidal river. This is the location where the nutrient-laden load is discharged to the warmer, slack tidal water and effectively comes to a stop. The most pronounced algae blooms tend to appear in these areas. If the impairment is geographically concentrated, then implementation should be targeted to affect a response in that location.

Temporal aspects of the impairment can be important too. In some cases, tidal nutrient impairments are most acute during the warm season when low stream flows lead to poorly flushed conditions and there is ample sunlight to grow algae. Some TMDL analyses set different limits for different seasons. It might be discovered that the effect of the point source load is the dominant issue in the summer season. This recognition, in the face of development growth pressure, could motivate a decision to redirect the location of the municipal treatment plant discharge. It could also motivate future planning to redirect part or all of the discharge from surface water to spray irrigation.

The frequency and magnitude by which the water quality threshold is exceeded can also provide insights regarding alternative courses of implementation. Given limited resources, some local jurisdictions might want to focus their resources on a waterbody that is not too severely impaired in order to meet a policy objective protecting relatively healthy water before turning attention to more severely impaired waters. Other jurisdictions might choose the reverse priority.

Another aspect of understanding the impairment is to know what key factors control the impairment. Part of that has to do with the source assessment, discussed below. But there are other things to consider. For example, a suspended sediment impairment in a tidal waterbody might primarily be due to the resuspension of bottom sediments. In this case, upstream sources of sediment might not be a significant cause. Thus, it might be better to focus implementation actions on the reestablishment of submerged aquatic vegetation, the baffling effect of which would help dampen the resuspension of bottom sediments.

In another case, poor flushing of a tidal system might be the primary factor causing persistent algal blooms. An assessment might reveal that a sediment bar created by a hurricane many years in the past, if dredged, could improve natural flushing and lead to dramatic water quality improvements.

In some cases, this kind of information will have been noted in the TMDL document or supporting materials. However, in other cases, such information will only come to light during the implementation process. It is not uncommon for citizens from the watershed to provide vital insights, which emphasizes the importance of involving the public in the TMDL implementation process.

In summary, understanding the characteristics of the impairment, particularly the specific location, is central to developing an efficient TMDL implementation plan.

Source Assessment: By definition, TMDLs must account for the sum of all sources, including natural sources. However, from a practical and legal standpoint, a TMDL analysis merely needs to establish the receiving waterbody's capacity to assimilate those aggregate pollutants regardless of the details of the specific sources. Consequently, although TMDLs initiate the source assessment process, they do not necessarily provide a detailed accounting of sources; sources are constantly changing over time, and it is not the role of the TMDL developer to account for and track this progression. This function is part of the implementation planning and execution process.

Traditional source assessments involve an accounting of sources associated with land use cover, and visual surveys, including stream corridor assessments, designed to identify discrete atypical pollutant sources. Loads from these sources are estimated, with an accounting for reductions due to best management practices that are also part of the source assessment accounting. This process is discussed further in Section 5.1 "Tracking and Assessing Progress," and Appendix E, "Nonpoint Source Nutrient Loading Assessments Using Chesapeake Bay Program Land Use Loading Coefficients." Also See: Maryland DNR Stream Corridor Assessment Survey Protocols:
http://www.dnr.state.md.us/streams/pubs/SurveyProtocols2.pdf

The stressor identification process, a systematic process of identifying the causes of biological impairment in aquatic systems, is closely related to source assessment and stream corridor assessment, and is necessary to determine for which pollutant(s) the TMDL must be written. The process includes steps that often reveal pollutant sources. See: EPA Stressor Identification Process: http://www.epa.gov/ost/biocriteria/stressors/stressorid.pdf

The Maryland Department of Environment is also developing a stressor identification process. This will be closely integrated with Maryland's TMDL methodologies under development for biological impairments.

Another resource for pollutant source information is Maryland's Source Water Assessment Program. See: MDE Source Water Assessment Fact Sheet and Guidance:
http://www.mde.state.md.us/programs/waterprograms/water_supply/sourcewaterassessment/index.asp

See also the EPA Source Water Assessment web page:
http://www.epa.gov/safewater/protect/swpbibliography/source-water-assessment.html

The source assessment process can also make use of monitoring to help target implementation. For example, synoptic surveys of non-tidal streams, conducted as part of the Watershed Restoration Action Strategy (WRAS) development process, reveal the subwatersheds with high nitrate loadings. Similar comparison of data from the tributaries discharging to tidal rivers can help to reveal which tributaries are contributing the most pollutants.

Bacteria pose a special case. Septic systems are typically associated with nutrients and bacteria. Local health departments are delegated authority through subdivision regulations to ensure the proper location of septic systems relative to drinking water wells. They also regulate potential bacteria contamination of swimming beaches under delegated State authority and conduct source assessments to diagnose beach closure incidents. MDE assesses septic systems for potential bacteria contamination of shellfish harvesting areas via sanitary shoreline surveys, the results of which can provide helpful source assessment information. MDE has also been conducting bacteria source tracking (BST) studies from 2003 to the present in support of developing TMDLs for bacteria. These BST studies will provide supporting information for bacteria TMDL implementation.

Natural sources are discussed in Section 5.1 "Tracking and Assessing Progress." Of particular interest is the topic of wildlife sources of bacteria.

A full understanding of pollutant sources should include an assessment of bottom sediments. Nutrient TMDLs account for these sources, both in terms of nutrient fluxes generated by the sediments, and dissolved oxygen consumed by the bottom sediments. Bottom sediments are also a common second-generation source of legacy toxic pollutants. That is, many toxic substances, which originate elsewhere, tend to accumulate in the bottom sediments. In addition to violating standards by directly impacting benthic organisms, the contaminated bottom sediments are a potential long-term source for exchange with the water column and biological accumulation in other aquatic life that do not live in the benthos.

A full accounting of pollutant sources should also consider atmospheric deposition. For waterbodies with large surface areas, relative to the watershed area, direct deposition of pollutants from the atmosphere can be significant. For mercury TMDLs, combustion leading to atmospheric deposition is the primary source. This subject is discussed further in Section 5.1 "Tracking and Assessing Progress."

In summary, a source assessment is an important aspect of TMDL implementation planning. If done in coordination with information on the specific location of the impairment, the source assessment can be geographically targeted to make more efficient use of limited resources.

<u>TMDL Allocations</u>: In addition to the maximum load itself, TMDL analyses must also identify an allocation of the total load to both point sources and nonpoint sources. Typically, a portion of the TMDL is also set aside as a margin of safety.

The TMDL and the allocations can be viewed as initial steps in an implementation plan. That is, the waterbody is impaired by too much pollution and the TMDL indicates how much is too much, thereby providing a quantified target for implementation. The allocations between point and nonpoint sources refine this quantified implementation target into broad source categories.

Allocations are not fixed permanently and may be reallocated; however, the reallocation of loads requires a public review process. This is because the public needs to have advance notice of proposed changes that might affect them.

The subject of managing allocations is addressed in more detail elsewhere in this document. Section 5.1.2.2 includes a discussion of regulated stormwater, which requires separate point source allocations. Section 5.8 on "Multi-Jurisdictional Coordination" considers the issue of allocations among different political jurisdictions. The following discussion of TMDL technical memoranda also expands on the subject of allocations.

Technical Memorandum: Nutrient TMDL documents submitted by MDE to EPA often include a Technical Memorandum. The Technical Memo is considered supporting information rather than a formal part of the TMDL analysis. The Technical Memo describes a viable partitioning of the loads among more detailed source categories. Although the Technical Memo does not identify formal allocations, it can be viewed as another initial implementation planning element of the TMDL development process.

For point source allocations, the Technical Memo typically identifies any source requiring an NPDES permit. Source categories for which there is insufficient information may be grouped together, as shown in the grouping of stormwater allocations below.

Stormwater allocations are a new TMDL requirement and have only been explicitly identified in a few of the approximately 100 TMDLs developed thus far. For these limited cases, separate stormwater allocations are identified for individual jurisdictions; however, allocations for industrial sources are grouped into the municipal allocations. For TMDLs developed prior to EPA's new requirement to identify stormwater allocations, the allocations are included implicitly as part of the nonpoint source allocation. See Section 5.1.2.2, under "Tracking and Assessing Progress," for further discussion.

Typical Point Sources Addressed in Technical Memoranda

- Municipal WWTPs
- Industrial Plants
- CAFOs
- MS4s
- Construction Stormwater
- Other Industrial Stormwater
- In general, anything requiring an NPDES Permit

Grouping { MS4s, Construction Stormwater, Other Industrial Stormwater }

For nonpoint sources, the Technical Memo does not provide as much useful information for TMDL implementation planning. Although the Technical Memo typically indicates a partitioning of the load to land use categories or subwatersheds, per EPA's request, this information should not be interpreted as allocations. That remains to be done as part of the TMDL implementation process, specifically through the issuance of permits.

Reasonable Assurance of Implementation: TMDL documents include a section entitled, "Assurance of Implementation," which provides basic TMDL implementation planning information. This required element of a TMDL is motivated by the need to ensure that the allocations between nonpoint source and point source categories are reasonably balanced. Although the determination of allocations is a State prerogative, the federal government provides some degree of oversight.

During the TMDL implementation planning process, local governments may revisit the balance between wasteload allocations and load allocations to seek more efficient, effective, or practical reductions to achieve the same goal. In addition, because sources are continually changing, load allocation goals set at the time the TMDL was developed may no longer be accurate. A simple technique for conducting a preliminary analysis of this type is described in Appendix D.

Other Key Assumptions and Insights: TMDLs analyses address many technical details that affect whether or not water quality standards will be achieved. Awareness of technical assumptions and qualifying conditions can be vital to implementation planning and evaluation. For example, it is recognized that pH levels affect the release of phosphorus fluxes from bottom sediments. This understanding might motivate implementation actions that relate to pH, and steer monitoring plans to evaluate TMDL implementation.

As another example, nutrient and BOD TMDLs with significant point sources typically assume a minimum dissolved oxygen concentration in the treatment plant effluent, particularly during the dry season. Success in achieving standards depends on ensuring that aeration of the permitted discharge maintains a minimum level of oxygen. Similarly, effluent temperature, and water temperature in general, can have a very significant effect on the outcome of achieving dissolved oxygen goals. It is conceivable that the shading and temperature effect of strategically placed riparian forested buffers could be more significant in achieving dissolved oxygen goals than the buffer's role in reducing nutrient loads.

Model boundary conditions used in a TMDL analysis represent necessary conditions for achieving the TMDL goals and thus provide a potential diagnostic tool. For instance, consider the dissolved oxygen, chlorophyll, and nutrient concentrations used in a nutrient TMDL modeling scenario at the mouth of the tidal river and at the main non-tidal tributaries to the river (the model boundaries). These are the concentrations deemed to be necessary for achieving water quality standards in the tidal river. Monitoring data collected at these boundary points can be compared to the boundary concentrations used in the TMDL modeling scenario. This information can be used to target implementation and serves as an intermediate indication of TMDL implementation progress.