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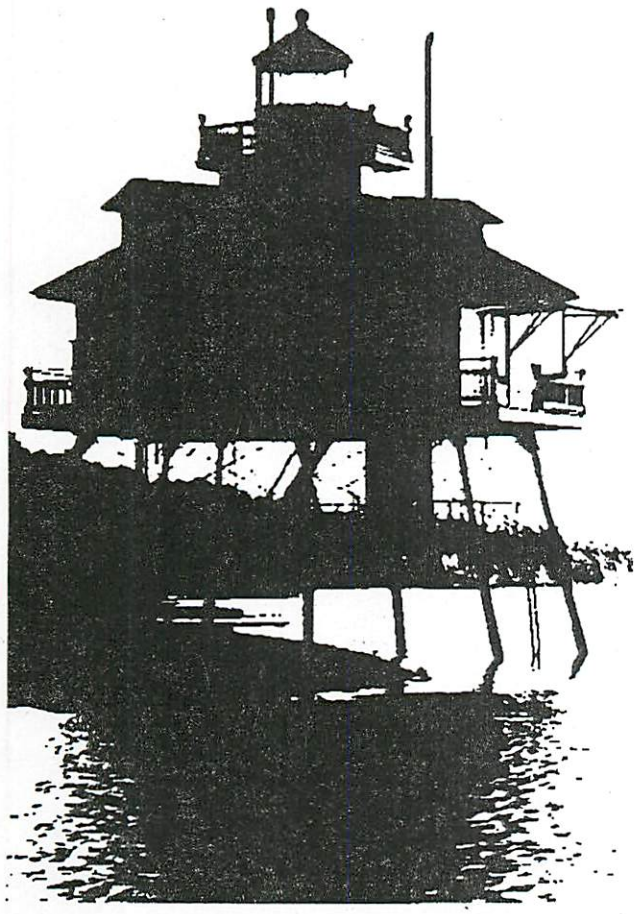

SEDIMENT AND EROSION CONTROL IN THE CHESAPEAKE BAY DRAINAGE BASIN

Contents

What is a Solomons Forum?

A Solomons Forum is a mediated policy dialogue on an environmental issue, organized by the University of Maryland's Coastal and Environmental Policy Program (CEPP). The goal of these meetings is to bring together people with diverse viewpoints and a common concern for improving the environmental quality of the Chesapeake Bay region.

This document is a summary of the discussions and conclusions from the Solomons Forum on sediment and erosion control in the Chesapeake Bay drainage basin, held on November 3rd and 4th, 1988, and April 13 and 14, 1989 at Solomons Island, Maryland and May 8, 1989 at Annapolis, MD. At the meetings we discussed the impacts and control of sediment in the Chesapeake Bay and its drainage basin, with special emphasis on southern Maryland. Robert Costanza chaired the meetings and Joy Bartholomew was the facilatator.

There was approximately equal representation at the Forum from the environmental community, the government community, the scientific community, and the developer community. Participation in the Forum was by invitation only. This was done to keep the group relatively small (29 total participants) and with a representative mixture of viewpoints in order to take full advantage of each participant's knowledge of the issues in a mediated workshop setting. Several of the participants attended all three meetings. Others attended as many of the meetings as they were able to.

Ground Rules

The goal of the Forum was to provide fruitful, meaningful exchange of views on this important environmental policy issue. The format of the meeting was very important. We aimed to create a meeting environment that was conducive to the expression of the participants' true thoughts and feelings, and to the creative formulation of new approaches to the problem. To create and maintain this intellectually productive environment several ground rules were agreed upon by the participants.

1. **Common goals, common ground**
   While participants had different points of view, it was most productive to identify common goals and shared beliefs first, and to keep these common goals firmly in mind when evaluating the areas of conflict. In our case the common goal was to preserve and protect the environmental quality of the Chesapeake Bay and its watershed.
2. **Not for attribution**
   Discussions held at the meeting were not to be subsequently attributed to a specific individual or group. This allowed free expression of ideas.
3. **Individuals participate, not organizations**
   At this Forum, individuals were primary and the organizations they represent were secondary. Participants views represent their own professional judgment and experience, not the positions of their organizations.
4. **Equal time for all views**
   All participants were encouraged to voice their views. Ensuring the expression of all members views was the responsibility of the meeting's facilitator. The goal was to provide an intellectually safe environment for all viewpoints, not just those of the most talkative persons.
5. **Consensus building and the written record**
   All written conclusions of the group were arrived at through consensus, not voting. All written records of the Forum's outcome are attributed to the "consensus of the group." This protects minority views and concentrates effort on finding "win-win" solutions to provide better environmental policies.

Context: The Chesapeake Bay Agreement and the Findings of the 2020 Panel

Effectively handling growth and development while continuing to improve Bay water quality and creating a better life for all people is a significant challenge. The 1987 Chesapeake Bay Agreement challenged the region's leaders to create a future that is better than what today's growth and development trends would otherwise bring.

In the 1987 Agreement, a Panel of concerned people was established to study the consequences of population growth and development for the Chesapeake Bay watershed to the year 2020. The 2020 Panel, as it came to be known, examined a broad range of options for preventing or ameliorating adverse environmental impacts that come from growth. The Panel found that means are available to change the current trends if prompt and forceful action is taken.

Even the most casual review of the state of the Chesapeake Bay region reveals disturbing trends of growth and development that will gradually overtake the gains being made in improving environmental quality. While providing immediate economic prosperity, unmanaged growth in the region creates pollution and congestion and degrades the region's quality of life. This may ultimately lead to long term environmental and economic problems[1].

It was in this context of trying to find ways to effectively manage the environmental problems that often come with rapid growth that we met to discuss sediment and erosion control issues. What follows represents the consensus of the group of participants on this difficult issue. By consensus we mean that the participants were able to "live with" the wording we arrived at. This allows a convenient summary of the salient issues but obviously misses the richness of the discussions and the range of views of the problem represented at the meetings. This document should not, therefore, be interpreted to mean that the range of opinions at the meeting was small, or that there are not significant remaining differences of opinion. But the consensus defines the activities about which we could generally agree and that can therefore form the basis for immediate action.

We also identified areas about which we could not agree and that deserve further attention. These included: different philosophies about the implementation of government management (should we have overlapping authority to provide checks and balances or central authority for efficiency); the overall role of agriculture in sediment and erosion problems; and the adequacy of staffing to implement and enforce currently existing regulations.

Summary

The magnitude and type of sediment impacts in the Chesapeake Bay basin vary according to location and timing. Therefore we need to emphasize the watershed approach[2] to sediment pollution control criteria that can accommodate these differences. While this may be administratively difficult, it is already beginning to happen.[3] We should encourage and accelerate this evolution. This suggests a need to fine-tune the existing sediment and erosion control strategies towards specific problems to be addressed at specific locations.

There is a need for interjuristictional agreements to set goals and objectives by watershed, with enactment and enforcement carried out at the local level. Furthermore, flexible regulations to take into account local conditions are needed, as well as rigid enforcement of the resulting plans to ensure compliance.

Sediment budgets should be the starting point for establishing decisions on acceptable sediment loads. Site-specific calculation of sediment loads was generally thought to be the best overall way to provide environmental protection. Sediment loading

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[1] Population Growth and Development in the Chesapeake Bay Watershed to the Year 2020. The Report of the Year 2020 Panel to the Chesapeake Executive Council, December 1988.

[2] See Figure 1 and discussion in the text

[3] ie. the Chesapeake Bay Agreement, the Puget Sound Program, Florida's Water Management Districts.

determinations should be based on effects on local water quality and other environmental criteria.

The research community needs to develop and test a hierarchy of sediment and erosion dynamics models. Suitable modeling capabilities linked to the permitting process would allow local site conditions to be more effectively taken into consideration.

General Recommendations[1]:

1. Develop water quality standards and criteria for sediments.
2. Implement the watershed approach for sediment control.
3. Develop detailed sediment budgets by drainage basin, watershed, and subwatershed as an information tool to clarify the relative contributions of various land use activities.
4. Enhance educational programs to increase awareness of sediment and erosion control problems, programs, and practices.
5. Encourage predesign site visits in order to make the plans work with nature.

Sediment Impacts

Even though sediments and erosion occur naturally, they can be a problem *Accelerated* erosion that results in excessive sedimentation can stress the bodies of water that receive it, and leave the land from which it eroded less biologically productive[2]. In addition to the physical properties of blocking sunlight and water flow, sediments carry nutrients and toxins that can cause a range of problems in ecosystems not adapted to them.

Different kinds of land uses produce different kinds of sediment - with different environmental impacts. Impacts of sediments vary depending on where and when they occur in ecosystems. For example, watersheds with much new construction activity can contribute large amounts of sediments over relatively short periods. These sediments are not generally toxic or nutrient rich, since they are mainly from the subsoils. Agricultural lands usually contribute sediments at a slower rate, over longer periods (although high rates for short periods are also possible). These sediments can have nutrients from agricultural fertilizers and toxins from herbicides and pesticides attached to them. Natural areas also contribute sediments, but at a much slower rate and with low amounts of nutrients and essentially no toxins. Existing urban and built up areas contribute sediments in pulses at the beginning of storm events as impervious surfaces washed by the rainfall drain into streams and rivers. The sediment carried in this urban runoff can have a wide range of nutrients and toxins attached to it.

Negative impacts of sediments can be classified as (1) those impacts adversely affecting ecosystems and (2) those impacts adversely affecting users. Some of the currently recognized negative impacts on ecosystems include:

- shoaling
- water quality changes (increased nutrients and toxics)
- loss of habitat (i.e., sea grasses)
- smothering of tidal and nontidal ecosystems
- turbidity (which affects the water column and submerged aquatic vegetation productivity)

Some of the currently recognized negative impacts on users and public works include:

- loss of topsoil (which decreases agricultural productivity)
- increased silt in reservoirs
- changes in freshwater streams
- increased drinking water treatment plant costs
- clogging of storm drains
- a degraded image of the Bay which affects economic attractiveness and our quality of life.

Next Steps

Since soils' erosion characteristics and local ecosystem characteristics vary considerably in different watersheds, it seems most logical to seek to tailor sediment control programs to specific conditions in specific watersheds. A first step in this is to determine "sediment budgets" for specific watersheds and for the Bay as a whole. These budgets should account for the major sources and sites of deposition (sinks) of sediments. Budgets for nutrients and toxins are also important since they are often linked to sediment budgets.

Sediment Budgets

To determine the relative contributions of new construction, existing urban areas, agriculture, and natural systems to the total sediment loads of water bodies in the Bay drainage system, quantitative budgets of sediment sources and sinks are needed. This knowledge of sediment sources and deposition is needed to effectively manage sediment loading.

While much scientific work has been done on some aspects of sediment, no comprehensive, detailed

[1] See further on for specific recommendations.

[2] While many of the natural systems in the Bay are negatively impacted by increased sediment loads, there are some areas that are actually receiving too little sediment, and where increased sediments would probably have positive impacts. For example, the coastal marshes on the lower Eastern Shore are eroding. This erosion is thought to be due to the marsh's inability to accumulate new sediments fast enough to keep up with sea level rise. Historic rates of sedimentation have increased in the past few decades in many parts of the Bay, but not in the Eastern Shore wetland areas, while the level of the water in Chesapeake Bay has risen 4 inches in the last 20 years.

sediment budgets[1] have been done for the Bay or its subwatersheds. Figure 1 shows the major watersheds of the Bay, along with a typical subwatershed breakdown for the Patuxent watershed. The watersheds and subwatersheds vary tremendously in topography, land use, geology, and socioeconomic characteristics.

A set of nutrient (nitrogen and phosphorus) budgets for several watersheds within the Bay drainage basin has recently been completed by Boynton et al.,(1988). The detail and comprehensive coverage that we now have on nutrient budgets for some basins is also needed for sediments. Figure 2. shows the level of detail in the Boynton, et al. nutrient budgets, and the kind of information we need for sediment budgets.

In some ways, sediment budgets will be easier to compile than nutrient budgets because there are fewer complex, biologically or chemically mediated processes to evaluate. However, the task is still difficult and the following issues should be carefully considered prior to initiating work on sediment budgets.

The major sources and sinks of erosion and sediment need to be evaluated. Riverine sources dominate in some areas while shoreline erosion or the tidal transport of sediments dominate in other areas. Furthermore, the spatial extent of each budget needs careful consideration. If the boundaries are not chosen correctly, it is possible to overlook locally important sources and sinks of sediments because these terms become overwhelmed by generally larger regional terms. Finally, the time period considered can substantially influence the utility of sediment budgets. For some purposes, decade-long periods (or even longer periods) are appropriate while for others, seasonal or storm-event time scales are necessary.

Sediment budgets should be the starting point for establishing decisions on acceptable sediment loads.

Current Sediment and Erosion Controls

Land use controls

While land use decisions are seldom made for erosion and sediment control reasons alone, land use decisions affect sediment budgets and sediment loading in water bodies. Conflicts about changing land uses are becoming more strident and pressure for development is becoming more intense. As more and more people live and work in the Chesapeake Bay region, there is less natural land to buffer their pollution[2]. As detection technology and scientific understanding advance, the cumulative impacts of development are more clearly understood .

The practice of land use zoning has been recognized as constitutional for decades. Therefore, the argument that zoning and other land use controls represent a "taking" of private property rights is not a defense against planning and managing growth. In order to be more productive, all parties involved should recognize that environmental protection is a necessary component of land use planning. It is also important for sediment control programs to be rationally designed, fairly administered, and even handed in their application.

Current sediment and erosion control programs

The history of environmental regulation is a history of evolution. Maryland's program that regulates sediment began 18 years ago. This program has significantly reduced sediment pollution during that time. The program has continued to evolve to reflect changing conditions and the availability of new information. This Forum is an attempt to continue the ongoing process of constructive change.

It is useful to divide current controls based on the regulated activity. At this Forum we concentrated on new construction, while recognizing that agriculture also plays an important role in sediment and erosion control issues.

New Construction:

The goal of the current program in Maryland is to retain all the sediment on site during construction. In practice, this goal is noble but rarely achieved for a variety of reasons, such as:

- available technology is limited in its ability to contain all sediments;
- soil conditions are changed by the construction process;
- controls are currently designed to retain the first 1/2 inch of runoff[3] and are progressively less effective for higher runoff events.

As a long range goal, sediment control measures should be implemented in a manner consistent with water quality goals based on watershed sediment budgets and other relevant factors. Our ability to design and implement water quality based sediment control programs is limited at present for a wide range of reasons including:

- there are currently no applicable water quality criteria for sediment
- sediment budgets are not generally available
- water quality and runoff models are currently too expensive to implement on a site by site basis.

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[1]Sediment budgets are routinely performed for a variety of federal and state projects by the Corps of Engineers, USGS and the SCS, and by academic research scientists. Examples of specific recent sediment budgeting studies in the Chesapeake region include Stevenson et al (1988) , Yarbro et al (1983), Smullen et al (1982), Schubel and Hirschberg (1977), Hirschberg and Schubel (1979), Biggs (1967), and Biggs (1970).

[2]Population Growth and Development in the Chesapeake Bay Watershed to the Year 2020. The Report of the Year 2020 Panel to the Chesapeake Executive Council, December 1988.

[3]By the time of publication, this standard will probably be revised to 1 inch in Maryland.

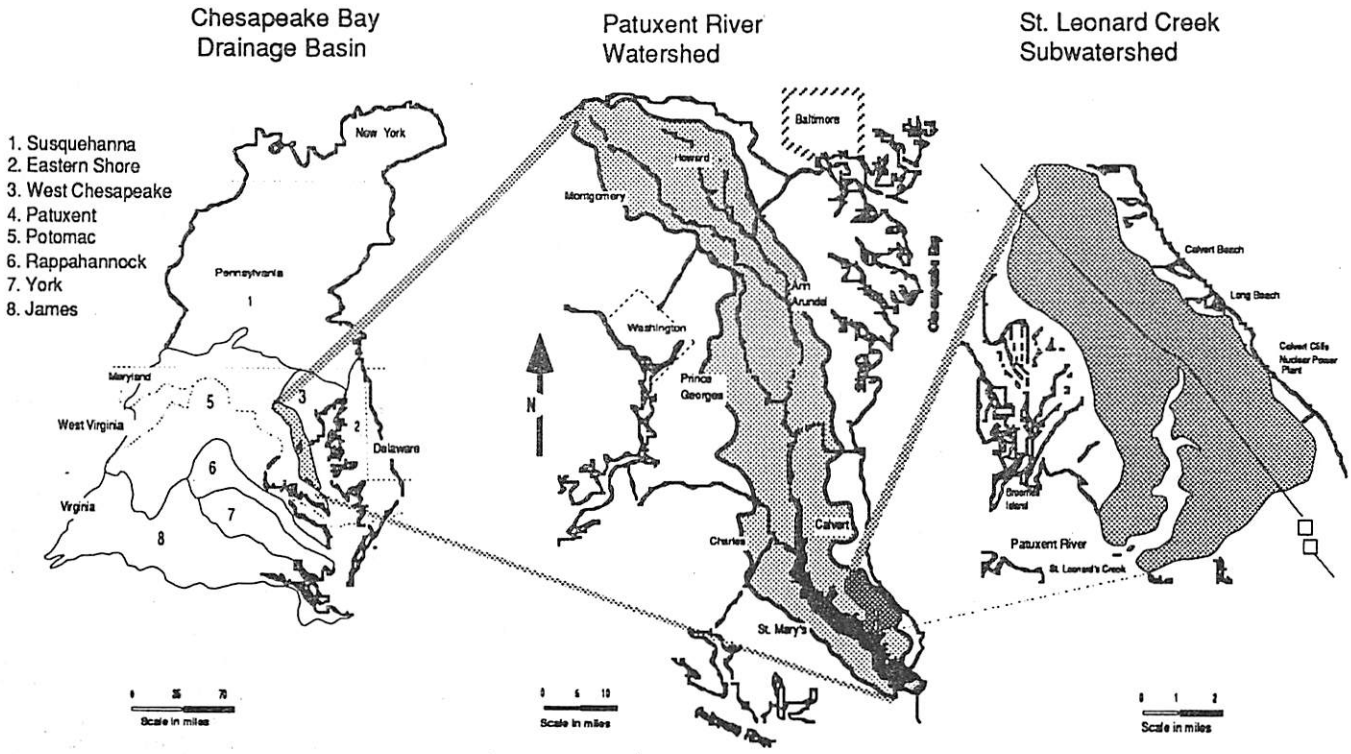

Fig. 1. Hierarchy of watersheds in the Chesapeake Bay Drainage Basin.

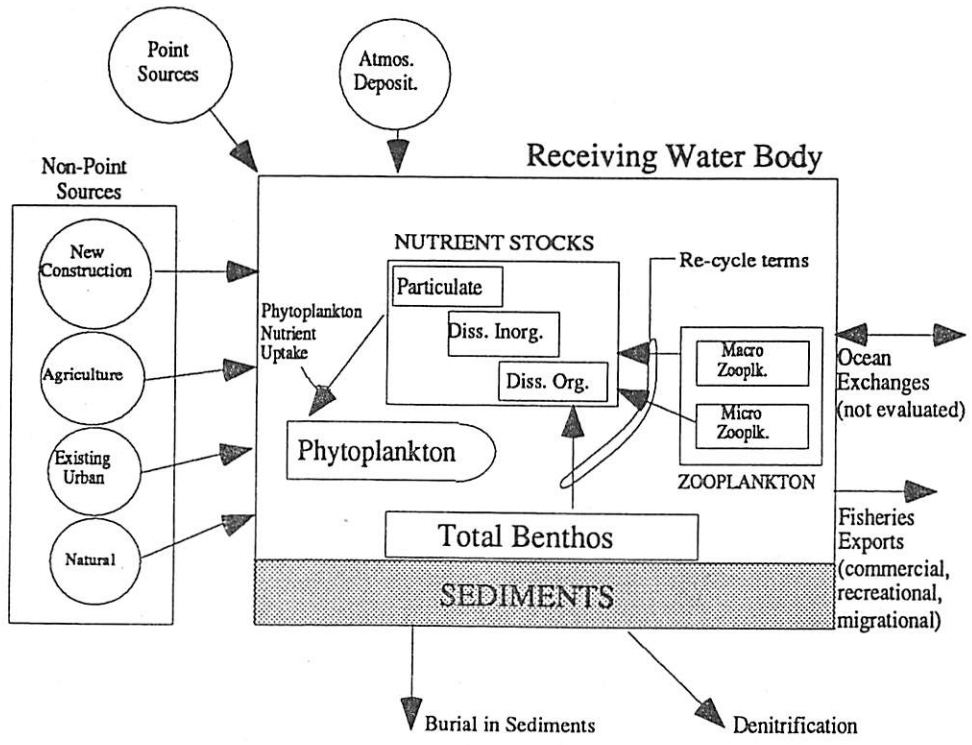

Fig. 2. Schematic diagram of the conceptual model used in developing nutrient budgets for regions of the Maryland portion of Chesapeake Bay.

As an interim measure, the design and implementation of sediment control plans should be improved to better reflect site conditions in order to move closer to achieving the goal of retaining all sediments on site.

Current regulations require that minimum standards be met for each specific site. Beyond this basic premise, site design can be site specific. While in theory the regulations are flexible, this flexibility is hard to implement. Each set of plans must reflect local conditions and requires only those practices necessary to contain sediment pollution. Often plans are overdesigned in an attempt to insure speedy approval. This not only wastes resources but can cause additional environmental degradation.

Different degrees of control could be required, (based on soil types and erosion models) but in current practice all areas are treated alike, and the worst case conditions are assumed. Therefore, the sediment and erosion control measures that are needed on the most highly erodible sites are uniformly required in other areas as well. This wastes resources, particularly if more flexible regulations that take account of local conditions can be cost-effectively applied.

Agriculture

In the 1930's, agriculture recognized the need to control erosion because of dust storms in the West and the Soil Conservation Service (SCS) was organized. From then until the sixties the SCS was involved with supporting the voluntary requests from agriculture to assist in planning and the application of "best management practices" to minimize soil erosion on cropland and the loss of top soil. In 1970 Maryland passed the Sediment Control Law and agriculture was included with authority to the DNR to cite any person, including farmers, who has a point or nonpoint source discharge.

Farmers are currently required to comply with the existing rules and regulations. Those rules and regulations apply to sediment and erosion control in a broad context (which includes construction) and are not specific to agricultural problems. Maryland farmers are not required to have a management plan implemented until 1995, at which time the law requires a plan on every farm.

In Maryland, enforcement methods currently include citations and court actions; however these enforcement methods can only respond to problems that have been brought to the attention of enforcement agencies. There is no formal, structured, inspection process for agriculture as there is for new construction.

The federal government has become more involved in sediment control. The 1985 Farm Bill makes it compulsory for agricultural producers who participate in USDA programs to have conservation plans by 1990 for their highly erodible fields. Failure to comply could cause the producer to forfeit certain USDA program benefits. Also, USDA is increasing their attention to water quality concerns. USDA agencies are working with agricultural producers and state and federal agencies to identify and treat water quality problems on the farm and within watersheds.

In that farmers have to absorb the costs of implementing management plans, and cannot readily pass those costs on by increasing prices, substantial implementation of these plans will most likely need financial support.

Specific Recommendations

While recognizing that the current sediment and erosion control system in Maryland is one of the most effective in the nation, several recommendations for further improving the process were developed. These include some general recommendations (listed earlier) and some more specific recommendations listed below:

1. Administrative Changes

For governments

- Inducing compliance through appropriate positive incentives is usually less expensive and more effective than negative fines and regulations. Governments should therefore develop and implement positive incentives for performing well for all involved, including inspectors, developers, builders, contractors, engineers, and farmers.
- Plan design, review, and enforcement should be on a watershed and/or subwatershed basis.
- Governments must provide adequate funding for carrying out the programs.

For the permitting process

- Streamline and clarify the review process without eliminating the benefits of checks and balances.
- Design with the site and with nature. For example, natural buffers provide backup to control measures. Encourage designs that maximize infiltration and ground water recharge.
- Allow reasonable flexibility in design review so that innovative plans to control sediment can be encouraged, but enforce approved designs rigidly.
- Encourage phasing (sequencing of operations) and stabilization. Examine current regulations, identify conflicts, and eliminate disincentives to phasing.

For the development and construction industry

- Recognition for good projects.
- Expand and improve the contractor certification.(green card) program.
- Encourage continuing education for builders/contractors regarding sediment control
- Encourage better internal quality control on job sites.
- Explore financial mechanisms to finance mid-course construction changes in order to improve sediment and erosion control.

2. Land Uses

- Land use planning/comprehensive zoning has been used as a method to protect highly erodible lands or other sensitive areas and can be considered as a viable erosion control technique. There is a need to define areas that can support new development, areas where appropriate development would improve environmental conditions , and sensitive

areas where no further development should occur. Once these areas are defined, incentives should be developed to guide growth as well as to provide restrictions. Maryland's Critical Areas legislation is one attempt to control land use in order to achieve environmental goals for a small section of the state. We recommend that we make better use of land planning and zoning for erosion control statewide.

3. Voluntary and Experimental Recommendations

- Before preparation of construction documents, engineers and regulators should go to the site together and discuss various sediment control strategies that would be appropriate for the job. An experiment with this in several counties with different developers and sites would be useful.

4. Water Quality Criteria for Sediment

- Water quality criteria for sediment, on a concentration basis, is needed in order to fine tune sediment control. A "worst case" approach now governs regulations regarding sediment basin size and this provides no incentives for improvement while sometimes wasting resources on oversized basins.[1]
- Monitoring construction site outfalls for sediment pollution is a possible strategy to better understand the specific sources of sediments and the effectiveness of innovative plans.

5. Applied Research, Modeling and Data Synthesis

- A key to making the regulatory process more flexible is increasing the use of computer models for analyzing the impacts of specific plans. We recommend additional effort to improve the predictive capability of sediment and erosion models.[2] Better models would allow trade offs between structural features and non-structural features to be evaluated.
- Research is needed on the effectiveness of the current regulatory system relative to other possible alternatives aimed at achieving the same environmental protection goals.

Definitions

Erosion control - technologies that are designed to prevent soil from eroding, such as straw, mulch and seed, netting, etc. Erosion control can also be accomplished through administrative land use decisions that restrict or prohibit disturbance of highly erodible soils

Sediment - soil that has been eroded and carried by natural forces of wind and water.

Sediment budget - a quantatative determination of the relative contributions of sediment from all possible sources to a particular water body for a specific time interval.

Sediment control - technology that is applied in order to trap eroded soil (sediment) and prevent it from migrating to a nearby waterway. Examples include dikes, silt fences, basins, etc.

Sink - a location where material is deposited.

Watershed - an area of land from which all of the precipitation drains into a common water body.

[1] Water quality criteria for sediment *concentrations* can be a useful tool but the application of those standards can be abused. Daily, seasonal, and total *loadings* of sediment are often much more critical to the health of a stream system. The types of sediments and other particulate runoff must be defined and measured carefully. The goal of all the standards should be to avoid degradation of the existing near-field environment. The main stem of the Bay is not the only place that has been damaged by previous development techniques.

[2] Because most current models lack adequate scientific calibration, and fall far short in reflecting natural systems, better scientific research and better and more convenient models are needed at several scales of the process, from the entire basin to the watershed to the project site.

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