Maryland Department of the Environment (MDE)
The Stormwater Management Act of 2007 (Act)
Response to: "Core Environmental Site Design Principles," dated January 2008
July 25, 2008

Principle No. 1: Increase Onsite Runoff Reduction Volumes. This Principle recommends that the stormwater management regulations define an operational runoff reduction volume to ensure that designs mimic predevelopment hydrology. It is also recommended that the Unified Sizing Criteria (USC) be modified to require reduction equivalent to the difference in runoff from the one-year, 24-hour design storm. Methods for computing runoff reduction volumes and for assessing compliance with this goal are presented in Notes 17 and 18.

Maryland's Runoff Reduction Policy

MDE concurs with the goal that there is a need for increased runoff reduction if site designs are to mimic more closely pre-development hydrology. The equation proposed in Note 17 is a variant of that currently used to calculate the recharge and water quality volumes (Re_v and WQ_v, respectively) in the 2000 Maryland Stormwater Design Manual (Design Manual). The major differences in Note 17 are that this equation is to be used to determine both pre and post-development runoff volumes using one-year rainfall depths and disturbed soils are to be factored into post-development conditions. Under MDE's current proposal, pre-development conditions would be based solely on forest cover with runoff volumes ranging from 2% to 5% of the one-year design storm. The resulting runoff reduction volume (RR_v) is roughly equal to the post-development runoff volume in all but the least developed conditions (e.g., impervious cover ≤ 20% in poor soils).

Maryland's original stormwater management program mandated comparisons of pre and post-development runoff conditions for determining storage requirements. Designers were encouraged to "downgrade" disturbed soils in post-development calculations by using a runoff curve number (RCN) based on less permeable hydrologic soil groups (HSGs). Experience gathered over years of implementation confirmed that these requirements provided too many opportunities to misrepresent site conditions and reduce stormwater management requirements. In 2000, MDE addressed this problem by eliminating pre and post comparisons for Re_v, WQ_v, and channel protection volume (Cp_v), and basing Re_v and WQ_v solely on percent imperviousness. Given the minimal effect of pre-developed conditions on RR_v and past problems with modeling disturbed soils, MDE believes that the method proposed in Note 17 is not the most effective for achieving runoff reduction goals.

While Note 17 outlines a method for calculating runoff volumes, Note 18 provides a working definition for assessing compliance with runoff reduction goals and establishes reduction efficiencies for a few select ESD practices based on limited research. Although the reported median reduction efficiency for these practices is around 75%, more current research used to develop Virginia's nascent stormwater management program indicates that most ESD practices have recommended reduction efficiencies closer to 40% when used individually. These newer

values are based on very limited research, reflect a best estimate of individual performance, and do not consider cumulative runoff reduction when used in series.

In the latter 1990's, MDE confronted a situation similar to that described above. BMP pollutant removal efficiency research for the practices listed in Chapter 3 of the Design Manual were similarly disparate. To equate BMP performance, the Center for Watershed Protection (CWP) evaluated available research to determine design shortcomings. Corrections for these were then incorporated into the design standards for each practice to improve overall performance.

The response to Principle 3 below discusses in more depth current pollutant and nutrient removal issues. However, assessing runoff reduction efficiencies now is similar to the dilemma MDE faced then while developing standards for new development water quality control. Rather than establishing individual removal rates based on limited data and requiring developers to assess compliance on a site-by-site basis, it is more critical to develop design standards to ensure actual practice performance. Experience in implementing the current program supports that decision. Similarly, developing design standards to ensure runoff reduction performance for ESD practices, may be more productive.

As stated above, MDE agrees that there is a need for increased runoff reduction and that State regulations, including the Design Manual, should do more to address this need. However, methods to accomplish this should provide options for addressing Re_v, WQ_v, and Cp_v requirements. MDE has developed a method to address runoff reduction using the WQ_v equation, incremental increases in rainfall, and the "Change in Runoff Curve Number Method" developed by Dr. Richard McCuen (Modeling Infiltration Practices Using TR-20, MDE, 1983). The latter was also used to model the effect of low impact development (LID) and ESD on watershed hydrology in the Queen Anne's County Environmental Site Design Manual (Clar, M., Queen Anne's County Department of Public Works, 2007) and "Five Methods of Accounting for the Effect of Distributed Retention on the Runoff Hydrograph" (Koch, P., Appendix L, Surface Water & Storm Water Rules Guidance Manual, Milwaukee Metropolitan Sewerage District, 2005).

The core of this method is that a reduced RCN may be calculated by subtracting the runoff volume captured in ESD practices, or ESD_v, from the total runoff from the one-year design storm. A revised RCN is then used to address Cp_v, Qp_2, Qp_{10}, and Q_f requirements. If ESD_v is sufficient to reduce the RCN to reflect woods in good condition, then Cp_v would be addressed. For example, an ESD_v of 1.5 inches per acre for a townhouse development (approx. 65% imperviousness) in B (e.g., loamy) soils would reduce the RCN from 85 to 61, or "open space in good condition". In this example, an ESD_v of 1.75 inches per acre would reduce the RCN to 55 or "woods in good condition", addressing Cp_v.

ESD_v ranges up to the runoff from the one-year design storm. However, designers must treat at least the WQ_v using ESD practices, either singly or in series, to apply curve number reductions. This establishes a minimum level of compliance and encourages designers to take full advantage of pervious areas to capture and store runoff in interconnected practices. MDE has revisited the design standards in draft Chapter 5 to allow the configuration of individual practices to vary with respect to ESD_v requirements.

Principle 2: Require a Unified Early ESD Map. This Principle recommends that MDE require a unified ESD map and plan at the time of early development concept design to ensure ESD practices are incorporated into initial site layout. The goal is to ensure that every site planning, resource protection, and ESD opportunity is fully considered from the beginning. The minimum features recommended for concept plan approval are specified in the Core Principles. Several of these items are incorporated into MDE's redrafted Chapter 5 and include: mapping of existing topography, drainage features, and streams; site footprint that includes existing and proposed land uses; identification of soil types and erodible soils; and the location of all natural resources such as wetlands, streams, forested areas, etc. In addition to the mapping and natural resource protection efforts described above, guidelines for better site design techniques that will reduce impervious cover within the development project are also provided. In addition, a concept plan approval process will be required and will allow for coordination among other regulatory programs in the early phase of plan development. These efforts can integrate the nonstructural approaches discussed in Principle 5 into the development plan and promote collaboration among various approving agencies. Individual site development can also be evaluated in the context of larger special protection or restoration efforts at the local level. These requirements will be established as part of modifications to COMAR.

MDE agrees with and shares the same goal outlined in this Principle. MDE received a number of comments on the Planning Techniques section in Chapter 5 from local programs as well as design engineers. Some of these comments suggested outlining the planning process in a step by step graphic for clarification. MDE has considered all comments while preparing the second draft of Chapter 5. The objective is to clarify the development review process in order to ensure that thorough planning efforts will integrate resource protection with all available opportunities for ESD implementation.

Principle 3: Establish Nutrient-Based Stormwater Loading Criteria. This Principle recommends that MDE develop specific numeric performance criteria in order to establish post development nutrient discharge limitations. The methodology currently proposed in Virginia was provided as an example for MDE to implement with minor modifications. Virginia's draft stormwater management regulations (September 19, 2007), the Virginia Stormwater Management: Nutrient Design System (Center for Watershed Protection, 2007), and other documentation were reviewed in order to determine the applicability of implementing this type of system in Maryland.

Virginia's draft regulations will require nutrient discharge limits of 0.28 lbs/acre/year for total phosphorus for any development less than 40% impervious and 2.68 lbs/acre/year for total nitrogen for development greater than 40% impervious. A "BMP Lookup Table" is used to determine the nutrient removal requirements for a given development density. Depending on the amount of site imperviousness, the "BMP Lookup Table" suggests two levels of treatment criteria based on separate rainfall depths. For example, treatment for the first one-inch of rainfall will be required for lower density developments, while higher density development may require treatment for 1.25 inches of rainfall or more. The practices recommended for treatment include typical, structural BMPs such as extended detention, bioretention, infiltration, wet ponds, and

wetlands. It is recognized that design guidance has not been finalized and a web-based clearinghouse hosted by Virginia Tech will ultimately provide more information.

The Virginia Stormwater Management: Nutrient Design System (CWP, 2007) outlines the process of calculating nutrient removal on-site. This includes the following steps:

1. Site percent impervious area is assessed.
2. Application of LID implementation is evaluated. Depending on the practice proposed, a "credit" is applied in order to calculate an "adjusted impervious area."
3. The simple method is used to calculate post-development loading rates for total nitrogen and total phosphorus. The calculation is based on site impervious area or "adjusted impervious area" when LID is used and will determine the pollutant removal requirement for the site.
4. Pollutant removal is achieved by selecting the appropriate choice from the "BMP Look-Up Table." Pollutant removal efficiencies for the BMPs are based on the National Pollutant Removal Performance Database (CWP, September 2007).

Virginia's Stormwater Management Program

Chapter 372 of the 2004 Virginia Acts of Assembly (HB1177) (Virginia Regulatory Town Hall, 2007) created the Virginia Stormwater Management Program. This act authorized the Virginia Soil and Water Conservation Board to, among other things, adopt regulations pertaining to the control of stormwater runoff in the Commonwealth. This began a process that involved receiving input from stormwater stakeholders, the public, and consultants to change water quality and quantity requirements for stormwater management. According to Virginia Department of Conservation and Recreation, the process that began 2 years ago resulted in several iterations of proposals that include the "BMP Lookup Table" procedure described above. At the current time, the approach is being modified and further details will be provided for public comment in the coming months. In the meantime, technical guidelines and supporting documentation is being adjusted as new data become available. While Virginia is currently modifying the regulations proposed in September 2007 and technical details are not final, it is clear that the intended direction will produce a policy goal of a nutrient discharge limit of 0.28 lbs/acre/year of phosphorus for new development projects. The feasibility of implementing this policy within the current direction of Maryland's stormwater management program will be discussed below. Additionally, there are fundamental differences between the mandates under the enabling legislation for the stormwater programs in both states that will affect implementation of the Virginia procedures in Maryland.

Stormwater Calculations and the Nutrient Design System

The use of ESD is not required in Virginia, however, it is encouraged by using "adjusted impervious area" calculations to show how storage volumes will be decreased. ESD practices are used for the purpose of runoff reduction. The Nutrient Design System and other recent documentation state that there are not enough data on pollutant removal efficiencies for these practices to accurately account for water quality benefits. Therefore, structural BMPs are proposed to meet the nutrient reduction requirements.

Because ESD is now required in Maryland, no advantage is gained by requiring a procedure to calculate nutrient loading per site when the process does not account for pollutant removal of the ESD practices that are to be implemented. In addition, ESD will provide management at the source for small impervious areas such as a half acre or less. When MDE's policies are applied and impervious areas are disconnected, the goal is to eliminate the need for large structural BMPs, which are the very practices that are proposed in the Nutrient Design System to meet the nutrient reduction requirements.

The WQ_v calculation in the Design Manual is based on the simple method. Therefore, it is not necessary for MDE to require a second calculation to verify removal rates because the water quality sizing criteria already accounts for site drainage area, percent imperviousness, and pollutant loading. All of these factors apply to the equation in the Nutrient Design System and therefore, MDE believes this process does not add a benefit.

BMP Database and Pollutant Removal Efficiencies

The accuracy of the nutrient removal calculation is dependent on the pollutant removal performance documented in the National Pollutant Removal Performance Database (CWP, 2007). Review of this database shows that negative removal rates and extremely high ranges in performance values were recorded for most BMPs. For example, the total phosphorus removal efficiency for bioretention 1 is listed as 45%. However the data show a range of –100 to 65% while the median rate is only 5%. MDE finds these data so variable that it is unclear how the final pollutant removal efficiency (45%) was chosen with confidence.

As discussed, the assumptions behind the nutrient removal calculations are based on highly variable performance data. However, the targeted discharge limits have an accuracy level to the hundredths of a decimal place (0.28 lbs/acre/year of phosphorus). Due to the wide range of assumptions and the variability associated with this process, MDE questions the accuracy claimed with this method.

MDE believes that the actual performance of the practice is more important than the attempt to quantify theoretical nutrient discharge rates. When stormwater BMPs perform effectively, the nutrient removal targets will be achieved. However, if the practices are not designed, constructed, or maintained properly, then the nutrient removal rates in the calculations will have no true meaning. The highly variable pollutant removal efficiencies recorded in the database suggests that performance is affected by a number of factors. At this time, MDE is focused on addressing these factors by updating design, construction, and maintenance guidelines and working with local programs to overcome the many obstacles that affect long-term performance. These efforts will provide larger returns for the most effective in-the-ground practice, as opposed to a nutrient reduction calculation whose result is based on a wide range of assumptions, which are in-turn based on a highly variable dataset.

Maryland's Stormwater Management Program

Maryland intends to require ESD practices to provide water quality treatment for the first one-inch of rainfall. This is equivalent to 90% of the average annual rain events in the State. The great majority of studies referenced in Note 18 of the Core Principles also used this criterion for storage in the practices that were monitored. For the case of medium to high-density development, MDE has evaluated hydrologic models to determine the necessary storage requirements for protecting receiving stream channels. In the end, enhanced storage and runoff reduction requirements based on site imperviousness will meet the underlying goals and intent of the Nutrient Design System. Therefore, as noted above, the intent of the two tiered design criteria is to provide a higher level of treatment for higher density developments. The new MDE guidelines will have the same effect.

Principle 4: Environmental Site Design Applies to Redevelopment. This Principle recommends that MDE apply the requirements for new development for runoff reduction and ESD site assessment methods to redevelopment projects. Additional recommendations include providing technical guidelines, design examples, grant options, incentives, flexibility and fee-in-lieu requirements for the redevelopment criteria.

Public Comments and Recommendations for Redevelopment Policy in Maryland

There was significant discussion concerning redevelopment at the stormwater focus group meetings held by MDE in January and February 2008. Comments from environmental groups, local governments, and regulated communities were wide ranging in scope and often conflicting in nature. Most notable is the local need for redevelopment criteria to make smart growth more feasible and desirable, versus recommendations to regulate redevelopment to the same standards as new development. The varied nature of these comments and concerns reflects the need for MDE to adopt a redevelopment approach that is flexible, while recognizing the importance of addressing current water quality concerns.

Maryland's Redevelopment Guidelines and Policy

MDE agrees that redevelopment projects provide important opportunities to treat existing impervious areas. However, these requirements must consider local priorities and provide incentives to promote development in existing urbanized areas. Therefore, MDE asked an informal advisory group to offer local perspective on redevelopment in urban areas. Several issues needed detailed evaluation prior to finalizing a redevelopment policy. Some of these issues included: whether the current 20% criteria needs to be greater, and how much greater; developing guidelines for and review of successful applications, design examples, and case studies; an evaluation of how the planning process will apply to redevelopment; and identifying other factors that affect successful implementation.

The redevelopment technical guidelines and policies have been developed with careful consideration from local governments, design engineers, developers, and the environmental community. These coordinated efforts have allowed for better guidelines and ESD strategies to foster healthy and viable urban core areas throughout the State.

Principle 5: Integrate Erosion and Sediment Control (ESC) and ESD Together at Construction Sites. This Principle deals with the integration of erosion and sediment control and ESD for construction sites. There is a call to include requirements for the use of nonstructural erosion and sediment control practices during the land disturbance process. These nonstructural practices include the maximum use of phasing, avoidance of work on steep slopes, clearing and grading restrictions, preservation of soils, retaining natural vegetative cover and trees, and rapidly stabilizing soils during construction.

MDE agrees that the technical recommendations made in this Principle will improve the control of construction site runoff. Many of the specific items suggested are available currently to erosion and sediment control plan review authorities. The "1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control" (Standards and Specifications) identifies protecting natural resources, limiting the extent and timing of exposed soils, and using erosion control over sediment control whenever possible. While the Standards and Specifications represent the minimum that must be included to control construction site runoff, implementation can be made "…simple and less costly by incorporating environmental planning methodologies into the start of the site development process." The appropriate tools and more than adequate authority exist presently to effectively control erosion and sediment deposition. The main difficulty lies in ensuring that appropriate practices are implemented correctly and maintained regularly throughout the life of a construction project. This requires field vigilance and will be discussed in response to Principle 11 in the context of turbidity standards. Regardless of what is required on plans now or will be demanded in the future, effectiveness will depend on proper inspection and enforcement.

As mentioned, many of the practices recommended by this Principle are already included in the Standards and Specifications. For example, it is suggested that there be an upper drainage area limit for sediment traps and basins. Maximum drainage area limits are established now. Pipe outlet and stone outlet sediment traps have a maximum drainage area of five acres. Rip-rap and stone/rip-rap outlet traps can drain up to ten acres. Storage provided in temporary sediment basins is based on a one-inch rain event over the drainage area up to 100 acres.

Limiting exposed soil conditions is not only an existing option but also a regulatory requirement. COMAR requires timeframes for all areas of earth disturbance. Temporary and permanent stabilization is required on all perimeter controls, perimeter slopes, and slopes steeper than 3 horizontal to 1 vertical (3:1) within seven days of initial disturbance. All other areas not actively being graded are required to be stabilized in 14 days. There similarly is no limit to the ways available to ensure properly stabilized soil. Some of the practices mentioned in this Principle are in current use statewide to address limiting exposure. These include the widespread use of hydro-seeding, erosion control matting, topsoiling and seed and mulch. Proper use is key.

Restricting heavy equipment in certain site areas, construction phasing, and setting clearing limits to accommodate building and traffic footprints can be implemented now through requirements placed on approved erosion and sediment control plans. These nonstructural approaches are mentioned in the Standards and Specifications but are difficult to define outside the site-by-site plan review and approval process that has been in Maryland for decades.

Historically, there have been two related but distinct programs for erosion and sediment control and stormwater management. Because there are separate plan approval authorities for each, integrated review is not typical and a disconnection between the disciplines can result. The first re-draft of Chapter 5 included both construction restrictions for individual ESD practices and a concept plan approval stage initially to require site planning. The mapping component of the latter includes the identification of site drainage features, buffers, wetlands, etc. The planning section of Chapter 5 will be expanded to include some of the nonstructural approaches suggested in this Principle. MDE believes this can create a bridge between erosion and sediment control and stormwater management plan review provide the basis for integration.

Integrating other statewide regulatory programs into the Design Manual has been suggested. During focus group meetings held in early 2008, several discussions took place regarding forest conservation, wetland protection, and the Chesapeake Bay Critical Area Act. Some aspects of these will be included in the planning section of Chapter 5. For example, all three of the State statutes governing these programs demand minimum buffer widths. Within the "Critical Area," there is a mandatory 100 foot buffer required for tidal waters, tidal wetlands, and tributary streams. Similarly, the Nontidal Wetlands Act contains a 25-foot nontidal wetlands buffer and the Forest Conservation Act establishes a 50-foot stream buffer. These will all be included in Chapter 5 with references to the appropriate laws and COMAR sections. Information about the Economic Growth, Resource Protection, and Planning Act of 1992 will be added as well to summarize local comprehensive planning processes as they relate to sensitive area and steep slope protection.

The existing structural and nonstructural practices now available, expanding the planning section of Chapter 5, and requiring a concept plan approval stage should better integrate erosion and sediment control and stormwater management plans review. However, it cannot be overemphasized that no matter what is required in the Standards and Specifications, the Design Manual, and on plans, effectiveness will lag without appropriate inspection and enforcement.

Principle 6: Provide Adequate Financing to Implement the Act and Technical Assistance and Incentives for early Adopters. This Principle encourages the State to review the current fee system according to the Act to ensure that proper resources are provided for stormwater research, implementation, and staffing. Incentives for early adoption are also suggested in order to begin using ESD as soon as possible.

This Principle states, "[t]he transition to ESD will require considerable financial and staff resources at the local and State level." MDE could not agree more however, the resources needed are not currently available. All State stormwater management program efforts over the last two years have been dedicated singularly to addressing the requirements of the Act.

Aside from research review, technical guidance development, regulation drafting, and ordinance composition, MDE evaluated funding opportunities available to the State in a report submitted to Maryland's House of Representatives' Environmental Matters Committee and the Senate's Education, Health, and Environmental Affairs Committee. This report, "Report on Stormwater Management Act of 2007," pointed out the lack of direct State staffing and the fact that only a few jurisdictions in Maryland have developed a system of charges to properly support local

stormwater management programs. It is essential that both State staffing be increased appropriately and more local stormwater utility fee systems be implemented in order to provide proper resources. While neither is anticipated in the near future, this situation may change due to the passage by the Maryland General Assembly of the Chesapeake Bay Restoration 2010 Trust Fund earlier this year. The Bay Trust Fund will initially inject funding for local capital projects for stormwater management.

The effectiveness of the State's channel protection criteria was vigorously questioned in the late 1990s due to a lack of monitoring support. MDE did implement an "organized monitoring system" to address channel protection efficacy. This is being done currently through MDE's NPDES municipal storm drain system permit program using long-term physical stream assessments in ten local watersheds undergoing development using the Design Manual for stormwater management. These assessments were first required when Phase I NPDES stormwater permits were reissued for the first time in 1998 and useful data are just now being compiled to judge how current standards are working.

The Act mandates the use of ESD. Significant effort is being invested to produce design guidance and implementation regulations to meet this mandate and all stormwater communities will be required to modify how their business is conducted accordingly. MDE would support any incentives used by local stormwater management programs to affect ESD use quicker. Certainly monitoring of ESD will be critical. How it will be conducted is not known presently but it will develop as the requirements of the Act are implemented.

Principle 7: Develop an ESD Ordinance that Truly Changes Local Codes and Culture.
This Principle recommends that MDE develop an ESD ordinance that will be used as a model to change local codes and to define and ensure the implementation of ESD. In addition it recommends that MDE require local governments to specify those ESD practices that can be offered currently for use in new and redevelopment situations and identify those that cannot. Local codes should then be altered to remove impediments to ESD implementation.

This Principle references several efforts throughout Maryland that sought to establish consensus on new development codes to permit the use of ESD. Site planning roundtables composed of local agency representatives, the CWP, the Alliance for the Chesapeake Bay, and the Home Builders Association of Maryland were conducted in Baltimore, Cecil, Frederick, Harford, and Worcester Counties. These roundtables all produced recommendations for local code and regulation changes. These include narrower streets and rights-of-way; smaller and where possible, landscaped cul-de-sacs; reduced parking ratios; structural and shared parking; alternate construction materials; maximizing transportation choices; more community open space; flexible sidewalk requirements; reduced setbacks; increased vegetative buffers; enhanced native vegetation; and limited clearing and grading. As stated in this Principle, despite consensus, progress toward local code changes has been slow.

For example Frederick County’s efforts to adopt roundtable recommendations by changing its codes were not successful mainly because the County had included them in their comprehensive rezoning ordinance that faced resistance from the community. Currently, the County, through its Planning Department has setup guidelines that incorporate the recommendations into the new

development plan review process that is used throughout the County. It is not clear whether comprehensive rezoning is going to be revisited.

In Baltimore County, roundtable discussions generated recommendations for either code or regulatory changes involving numerous agencies. It was found that the Department of Environmental Protection and Resource Management (DEPRM), Department of Public Works (DPW), Office of Planning (OP), Permits and Development Management (PDM), and Recreation and Parks would all provide input and interagency coordination was critical. Currently, Baltimore County implements ESD by reference to the credits provided in Chapter 5 of the Design Manual. Similarly, code changes have not been made nor recommendations implemented as a result of roundtables in both Harford and Worcester Counties primarily due to public opposition. Each of these jurisdictions uses the current credits in Chapter 5 of the Design Manual to get nonstructural stormwater management practices used more consistently.

Prince George's County is one of the first localities in the country to embrace LID runoff control policies. While strides have been made, regulators and inspectors have faced community complaints and requests to remove systems already installed. Rain gardens, for example, have been filled or removed by homeowners and common complaints include standing water and safety issues. All the efforts of these jurisdictions have met obstacles that will need to be overcome to meet the requirements of current State law.

The Act requires the review of local planning and zoning and public works ordinances in the context of ESD implementation. During focus group meetings held in early 2008, inflexible requirements for street widths and minimum cul-de-sac radii, parking ratios and lot design, and curb and gutter were often cited as examples of local regulations that prevent the use of innovative ESD practices. The Act compels the modification of these local regulations to remove the hindrances that are encountered statewide.

MDE believes counties and municipalities are in the best position to evaluate their existing codes regarding ESD impediments. The codes vary tremendously from jurisdiction to jurisdiction and each locality is closer to, and more knowledgeable of its own ordinances and regulations than any other entity. Moreover, there is more familiarity with the relevant communities that must be engaged to reach consensus on the changes needed to allow ESD to be used more easily. The roundtables presented in this Principle and discussed above can serve as a starting point but the results of discussions involved must be acted on vigorously to affect the changes demanded by the Act.

MDE agrees that an updated model ordinance is needed to ensure that ESD is used to the maximum extent practicable (MEP). The Act provides MDE the authority to enforce the provisions related to modifying local planning, zoning, or public works ordinances to remove impediments to ESD implementation. To that end, MDE intends to use the model ordinance that has been updated significantly and its authority under the Act to better implement ESD.

Principle No. 8: Strengthen Design Standards for ESD and Stormwater Practices. This Principle recommends that the Design Manual contain stringent performance criteria for the design, installation, and maintenance of all stormwater practices. Additionally, it is

recommended that the Design Manual be revised every three years, an independent technical committee review all such revisions, and that it be completely reorganized to present ESD practices first.

Maryland's Design Manual Policy

This Principle recommends that the Design Manual be updated to incorporate new standards for ESD based on emerging research. To underscore this, Note 29 cites five articles highlighting recent advances in innovative practice design, one (Davis 2005) providing a general overview of LID, and one describing a method for analyzing BMP pollutant load reductions (Appendix B, Schueler et al, 2007). Of those specific to practice design, two (University of New Hampshire 2005 & Traver 2006) present monitoring results of both ESD and conventional practices, two (Cappiella et al, 2006 and Underwood et al, 2005) discuss new techniques for integrating trees into stormwater management practices design, and one (Hunt and Lord, 2006) revisits bioretention design and maintenance standards to enhance removal of specific pollutants.

MDE agrees that standards for new ESD practices should be based on the latest information available. To that end, a comprehensive review of the latest research on ESD techniques and practices, including the studies mentioned in Note 29, is in progress. Of those studies cited here, the two on integrating trees into stormwater practices and the one on removing targeted pollutants with bioretention are particularly useful in the development of ESD standards. Likewise, the two monitoring reports help establish performance thresholds for the practices (e.g., bioretention, wet ponds, sand filters) discussed, and the general overview of LID (Davis 2005) provides some good background information. The remaining article (Schueler et al, 2007) describes a method for analyzing pollutant load reductions similar to that discussed in Principle 3 above and is not relevant to the development of ESD practice standards. MDE will incorporate the information gleaned from these and numerous other studies into the proposed Design Manual revisions.

It is also recommended that the Design Manual be revised every three years and that the most current edition be cited as the authoritative version. MDE currently has the ability to update the Design Manual whenever warranted. COMAR 26.17.01-01 incorporates by reference the Design Manual, establishing it as the authoritative version and conferring regulatory status to any mandatory requirements within it. Incorporation by reference also allows the Design Manual to be supplemented in part or in its entirety at any time using established procedures for revising regulations. This process is relatively simple and includes public notice and input provisions. MDE has found this technique to be effective and will continue to use it as ESD is integrated into the State's stormwater management program.

It has been suggested that MDE establish an independent technical committee to review all future changes to the Design Manual. While any future supplements must follow procedures that include public notice, MDE has long recognized that independent assistance is useful. In the mid-1990's, MDE formed a stormwater management regulations committee with representatives from all interested parties including the engineering and environmental communities to assist in the development of both the Design Manual and regulations. MDE again has engaged these

independent communities to help craft changes to address the Act. This process will be sustained.

Finally, this Principle recommends that MDE completely revisit the existing structure of the Manual to place ESD practices in front of other, more traditional structures. MDE recognizes that the breadth of changes currently under consideration may require some reorganization of the Design Manual. However, sweeping reforms of the Design Manual at the scale suggested will delay the adoption of the more immediate changes needed to implement ESD. MDE will consider carefully all proposed changes to the Design Manual and will revisit the suggestion of complete reorganization subsequent to completing current tasks.

Core Principle 9: Ensure that all ESD practices can be maintained. This Principle suggests that traditional stormwater maintenance procedures should be followed for ESD practices. These typically include performance bonds to ensure that facilities are built properly; establishing some sort of legal agreement stipulating responsibilities and access to the site; and inspections to ensure that facilities are working and needed repairs are made. Additionally, this Principle states that, "it is recognized that the progression to ESD practices will require localities to shift toward a hybrid public-private maintenance system, and change the manner by which post-construction inspections are conducted."

When ESD is successfully implemented in a comprehensive fashion, the need for maintenance should be greatly reduced. Most planning techniques, the backbone of ESD, need no maintenance. Examples include preserving forests, riparian buffers, and wetlands; site foot printing; clustering; reducing impervious cover; disconnecting impervious areas; minimizing soil compaction; reducing concrete infrastructure; using open-section road drainage; and strategic grading. The goal will clearly be to utilize these techniques to the MEP, establishing over time a verdant stormwater system that is virtually self-sustaining. Preserved buffers and natural resource areas should be covered by conservation easements to ensure perpetual protection.

Even the best planned subdivision, though, will most likely incorporate some small-scale structural ESD practices that will require maintenance. Maryland law allows for the same maintenance procedures available for traditional BMPs to be used for ESD. Some jurisdictions that have already begun to approve ESD for stormwater are relying on such procedures, especially collecting bonds before construction and recording permanent maintenance agreements with property owners. Others limit these procedures to larger residential and commercial facilities. Most local jurisdictions have expressed difficulty inspecting the increasing number of structures required by ESD and trying to enforce maintenance of small-scale practices on individual lots.

At focus group meetings held across the State in early 2008, MDE heard from numerous localities that were receiving complaints from homeowners regarding narrow driveways, rooftop disconnections, dry-wells, and rain gardens. These practices were often manipulated by the owners after installation or removed altogether. In *Stormwater*, Mary Catherine Hager says, "If we design and implement something that might be extraordinarily effective from the standpoint of stormwater management or the standpoint of ecology, but people don't get it or don't particularly like it in their neighborhood or their yard, it's just not going to be there in five or 10

years." Some suggested that traditional maintenance procedures are much more easily employed in larger residential developments where ESD practices can be grouped for several residences into a local right-of-way. This is certainly an option that locals can choose to pursue.

Other focus group participants representing garden clubs and watershed associations expressed an interest in providing outreach to homeowners in order to ensure the longevity of ESD practices. One local jurisdiction provided an example of how it conducted a drive-thru in a new residential neighborhood where downspout disconnects were extensively used, but, many had been reconnected to driveways and away from grass swales. Staff knocked on doors and explained to homeowners the importance of these practices for protecting water resources. Many were not familiar with ESD, yet upon explanation were willing to convert the downspouts back to their original design. Localities may find that resources put into education or working with local garden clubs to provide outreach will prove more efficient in maintaining ESD practices than trying to enforce legal covenants.

Building upon these experiences of traditional maintenance procedures and homeowner involvement, a new quasi public-private approach may be the best approach for ensuring the long-term maintenance of ESD. First, it will be necessary to pursue site designs that will maximize riparian buffers and conservation areas and that rely far less upon structural controls. Second, when structural controls are employed, there should be a rigorous design and plan approval process to make them as maintenance free as possible. This requires showing ESD practices prominently on plans, protecting structure locations during construction, and complying with bonding and as-built requirements. Third, it will be important to create designs that appeal to homeowners and are viewed as adding property value. Allowing homeowners an opportunity to select from numerous rain garden options from the homebuilder, similar to selecting kitchen appliances for a new house, can help to develop buy-in and ownership. And finally, by providing education on the importance of these practices for protecting the environment and instruction on proper maintenance, the hope is for homeowners to keep these facilities operational. The goal will be for maintenance of ESD in one's yard to become a routine task like cleaning out leaf filled rain gutters or cutting the lawn.

Principle No. 10: Devise an Enforceable Design Process to Require ESD. This Principle recommends that both the regulations and Design Manual use a decision tree to ensure that ESD practices are thoroughly evaluated and maximized at all sites. This decision tree should promote the use of a treatment train and discourage large diameter storm drainpipes, curb and gutter, and standard BMPs. This Principle also suggests that MDE adopt an enforceable mechanism to ensure that ESD is implemented to the MEP and recommends a decision tree approach to demonstrate compliance and require applicants to provide reasons for rejecting specific ESD practices.

Maryland's ESD Design Process

This Principle recommends that MDE's regulations and the Design Manual use a decision tree mechanism to ensure that ESD is used first during the design process. To accentuate this approach, a flowchart for assessing runoff reduction opportunities at a development site was submitted under separate cover. This chart outlines five basic steps: (1) Conserving Natural

Resources, (2) Applying ESD Reduction Practices, (3) Applying Engineered Reduction Practices, (4) Applying Standard (or Structural) Treatment Practices, and (5) Payment of Mitigation Fees. Under each of the first four steps there is a list of techniques or practices that may be employed. Techniques listed for accomplishing Step 1 are using soil amendments, conserving forests, minimizing impervious area, and reducing soil disturbance. Step 2 techniques include disconnecting rooftops, promoting sheetflow to buffers, providing reforestation, and using soil amendments and permeable pavers. Practices listed under Step 3 include bioretention, dry swales, green roofs, infiltration, and other traditional standard treatment practices (e.g., wet ponds, constructed wetlands, filters). Step 4 requires adjusting site phosphorus loads for treatment. Lastly, Step 5 requires payment of fees to mitigate for the balance of unmet requirements. This flowchart documents in simple steps the process for implementing ESD promoted in the Core Principles.

MDE believes that the Act itself is the enforceable mechanism for ensuring compliance with the Design Manual and ESD implementation. The Act requires that the current enforcement tools: COMAR, the Design Manual, and local stormwater ordinances, be modified to include ESD. MDE believes that this process and these tools will ensure that ESD is implemented to the MEP at all sites.

MDE thinks that the idea of using a flowchart for guidance during the design process is a good one. Using the Core Principles flowchart as a model and the runoff reduction approach described in Principle 1 above, MDE will developed a flowchart and a checklist to assist local jurisdictions and developers through the stormwater plan design, review, and approval process. Coupled with the unified planning process described in Principle 2 above and the concept plan requirements formalized in COMAR, all of these tools will provide a more than adequate enforceable mechanism for ESD.

Principle 11: Establish Turbidity Standards for Construction Sites. This Principal suggests that numeric turbidity standards be included into State regulations, the revised Design Manual, and the model ordinance. Proposed are a 150 Nephelometric Turbidity Unit (NTU) instantaneous limit and a maximum monthly average of 50 NTUs for discharges. A three-day complaint response time is similarly proposed.

MDE agrees that Maryland's streams "…need more effective protection…" from construction site runoff and that erosion and sediment control continue to be variable across the State. Addressing both is being discussed in the process for reissuing the general permit for construction activity. Discussing turbidity standards is also part of that process, which is more appropriate because the general permit regulates construction activity. MDE has initially looked into the research on this suggestion and found the following.

In a report entitled "The Feasibility of Numeric Effluent Limits Applicable to Discharges of Storm Water Associated with Municipal, Industrial and Construction Activities," (California State Water Resources Control Board, June 2006), a panel of experts raised several reservations regarding the use of numeric limits and requiring widespread sampling at construction sites. For example, it was observed that, while the use of numeric limits and action levels "are technically feasible," concerns such as establishing natural turbidity background levels, site size, seasonality,

and the available use of "active treatment systems" all need to be considered. The report states that the "[a]ttainment of Numeric Limits is not likely without the use of chemical flocculants prior to discharge." The toxicity resulting from chemical coagulants like the polyacrylimides suggested by this Principle "have not been fully explored" and "long-term effects are not known."

From an operational standpoint, MDE investigated the use of numeric turbidity standards in several states across the country and found marked differences in how construction site runoff control is administered. The disparate approaches discovered revolve around two main issues. These are the determination that noncompliance exists and what is done about it. Most states regulate construction site runoff by using general permits issued under the NPDES stormwater program. Monitoring requirements and BMP implementation schemes vary greatly among these permits.

For example, California, Georgia, Oregon, and Washington all require construction site discharge sampling, but differ in specific permit monitoring conditions and numeric standards. Sample collection frequency ranges from twice over the life of the project, to every week, to whenever there is a rain event over a given magnitude. Discharge limits include a specific action level such as 250 NTUs or a percentage over the upstream turbidity level. North Carolina and Delaware allow simple visual inspections to determine compliance with subsequent field judgments made for what BMP improvements are needed. Delaware's general permit states that "[c]ompliance with Best Available Technology (BAT)…" constitutes compliance with effluent limitations for stormwater discharges associated with construction activity.

Aside from requiring additional or better-designed BMPs when visual monitoring finds existing controls not performing adequately, most states use general permitting to manage construction sites similar to other self-monitoring NPDES programs. The permittee develops a stormwater pollution prevention plan (SWPPP), conducts the required inspections, performs sampling, and makes necessary revisions to the SWPPP. All records are kept on-site and most states do not require the submittal of the SWPPP for review and approval to any regulatory authority.

Maryland's erosion and sediment control program is significantly different than the states mentioned above. Where few states require an initial, proactive review of SWPPP, locally issued grading and building permits in Maryland are contingent upon erosion and sediment control plan approval for earth disturbances greater than 5,000 square feet. This far exceeds the NPDES Phase I threshold of 5 acres and is still greater than the one-acre used currently for Phase II general permits. The State's program also uses BMP standards applicable for all sediment control plan design, requires on-site responsible personnel training, and has in regulations currently the 72-hour complaint response time recommended by this Principle. All of these program components however, with or without numeric turbidity standards, are of limited value without the appropriate level of inspection and enforcement.

The response to Principle 5 above explains how MDE proposes to better integrate stormwater management and erosion and sediment control plans review. Further changes may be forthcoming subsequent to the renewed general permit.

Principle No. 12: Craft Special Stormwater Criteria for Sensitive and Impaired Waters. This Principle recommends that stormwater regulations, including the Design Manual, define more stringent criteria to protect and maintain sensitive waters, including Maryland's trout streams, tidal and nontidal wetlands, shellfish harvesting areas, and drinking water reservoirs. In addition, it is suggested that more stringent pollutant load reduction criteria be implemented in 303(d) listed impaired waters.

Maryland's Special Stormwater Criteria for Sensitive Waters

This Principle references Note 31 for examples of state stormwater manuals and other publications that promote special design criteria for sensitive waters. One of the manuals cited that contains special stormwater design criteria for trout streams, sensitive waters, and wetlands is the Minnesota Stormwater Manual (Minnesota Stormwater Steering Committee, 2005). In Minnesota, stormwater management must be addressed as part of the Construction General Permit (CGP) for NPDES-regulated construction activities. Typically, stormwater management is required on any project with one acre or more of land disturbance.

Chapter 10 of the Minnesota manual outlines the state's unified sizing criteria and offers recommendations for adapting these for sensitive waters. Minnesota's unified sizing criteria include a recharge volume (V_{re}) based on annual soil recharge rates, a water quality volume (V_{wq}) based on either ½" or 1" of rainfall over impervious cover, and a channel protection volume (V_{cp}) based on providing either 12 or 24 hour extended detention of the one-year 24 hour design storm. While V_{re} and V_{cp} are recommended, only V_{wq} (½") must be addressed in waters not classified as "sensitive" or "special".

In sensitive waters (e.g., lakes, wetlands, reservoirs), both V_{wq} (1") and V_{cp} (24 hour) are required and V_{re} is recommended. In special waters (e.g., trout streams, wilderness areas), V_{wq} (1"), V_{re}, and V_{cp} (12 hour) are required. The Minnesota manual also offers guidance discouraging the use of ponds and wetlands, maintaining and expanding riparian-forested buffers, and minimizing impervious areas in sensitive and special waters.

Also referenced in Note 31, Adapting Watershed Tools to Protect Wetlands (Cappiella et al., 2005) provides guidance for protecting wetlands when applying stormwater management techniques in or near wetlands and within their contributing drainage areas. Noteworthy recommendations for stormwater management in or adjacent to wetlands include prohibiting the use of natural wetlands and their buffers for stormwater treatment, discouraging constrictions at outfalls, restricting discharges of untreated stormwater, and encouraging wetlands features within stormwater practices. Likewise, the primary recommendation for stormwater treatment within contributing drainage areas is to maximize infiltration and filtration using better site design techniques like disconnecting rooftop runoff, using bioretention and rain gardens, and conserving natural areas.

In Note 32 this Principle reiterates the need to better protect Use III and IV waters. Note 32 states that the lethal temperatures for brook, and brown and rainbow trout are 72º and 82º Fahrenheit respectively, and that Maryland's current 12-hour extended detention requirement may result in runoff temperatures that exceed these limits. It is further recommended that

infiltration of the first full inch of runoff is needed and that MDE implement additional techniques (e.g., shading impervious surfaces) to mitigate thermal impacts associated with development.

Nearly all of the design criteria in the Minnesota manual are identical to that contained in the Design Manual except for one significant difference, Maryland's Unified Sizing Criteria are required and not recommended. Recharge based on annual soil recharge rates, water quality treatment of a one-inch rainfall event, and channel protection control of either the one or two-year storms are all mandated to be addressed for new development projects disturbing more than 5,000 square feet. The only options available to control the resulting volumes of the State's Unified Sizing Criteria are the structural BMPs in Chapter 3 and the current credits in Chapter 5, some of which are cited in Cappiella et al., 2005 (e.g., rooftop disconnections, natural area conservation).

Receiving water temperature increases caused by urbanization has been a concern in Maryland for some time. In a study prepared for MDE in 1990 by the Metropolitan Washington Council of Governments, it was determined that "[i]mperviousness together with local meteorological conditions had the largest influence on urban stream temperatures" (Thermal Impacts Associated with Urbanization and Stormwater Best Management Practices, John Galli 1990). Galli found that, while many stormwater facilities with wet pool conditions exacerbated elevated temperature discharges to some extent, as watershed impervious area increased, progressively smaller rainfall depths were needed to produce large stream temperature fluctuations.

In the study that Note 32 of this Principle is possibly referring to, three stormwater management basins each designed for different extended detention times (6, 12, & 24 hours) were found to discharge all incoming storms studied above Use III temperature standards (A Temperature Study of Discharges from Three Extended Detention/Wetland Stormwater Management Basins in Maryland, Ray Bahr, 1996). Each basin's release rate caused temperature spikes. For example, results showed that "…six hours of extended detention allowed stormwater from afternoon thunderstorms to be discharged before cooler overnight temperatures were reached." The 24-hour rate "…often continued to discharge the following day when temperatures were once again elevated."

MDE recognizes that temperature increases caused by development are a primary impact to the quality of coldwater streams and that some conventional BMPs contribute to the problem. Implementing ESD practices to the MEP, including using infiltration where appropriate, will help mitigate many of the thermal impacts associated with development. However, additional techniques like using open-grid or permeable pavements and green roofs, shading impervious areas, and using high-reflectance materials for roofing and pavement (e.g., lighter-colored concrete) may be needed to limit these impacts at the source.

Likewise, MDE recognizes that enhanced environmental restrictions are needed to fully protect other aquatic resources. Section 5.5 of the Design Manual is being developed to identify several areas of concern including coldwater streams (Use III and IV) sensitive streams (e.g., streams with watershed imperviousness ≤ 15%), wellhead and reservoir protection areas (Use I-P, II-P, II-P, and IV-P), shellfish harvesting or beaches (Use II), and others (e.g., local watershed

protection zones). This section will identify other State regulatory programs (e.g., Critical Areas, Wetlands and Waterways, Forest Conservation) and how their requirements (e.g., reforestation, buffers) may be addressed using ESD.

Principle 13: Develop a Statewide ESD Training and Certification Program. This Principle advocates the development of a professional training program to assist design engineers and plans reviewers to better understand and apply the new practices required by the Act.

Suggested is a certification process where designers and reviewers would be required to acquire a minimum number of hours training in stormwater management and ESD. A third party could be used to administer this training and permit application fees could support it. Examples given include expanding Maryland's erosion and sediment control "Green Card" certification program and Delaware's "Certified Construction Reviewer" where the development community hires state certified third party inspectors.

MDE cannot agree more that education and training are essential for the successful implementation of Maryland's stormwater management program. This Principle states "(a) new stormwater system cannot be implemented until local plan reviewers and design consultants fully understand it and are confident on how to apply it to real world sites." MDE believes that this statement has been true since the inception of the State's original stormwater management program. Education was needed initially when Maryland's statue was first passed in the 1980s, was essential when the Design Manual overhauled the program in the late 1990s, and is just as critical as ever now that ESD is to be implemented under the Act. For MDE's part, this issue comes down to resources.

The ability to provide proper, statewide stormwater management education and outreach has been significantly limited for quite some time. Hampered by budget and staff shortages, MDE's role has been limited to providing guidance through public presentations and spending inordinate amounts of time interpreting stormwater policy and Design Manual criteria through email and telephone conversations. Clearly this is not sufficient. There are several things that could be done to provide guidance to Maryland's stormwater community, however, without sufficient increases in resources, MDE's ability to provide consistent education will continue to lag.

Recently, priorities have dictated that ESD design standards be developed, new regulations drafted, and a model ordinance be composed to implement the requirements of the Act. Additionally, redevelopment policy was vetted, numerous agencies were canvassed to determine how best to integrate erosion and sediment control and stormwater plans review. Localities are now engaged and seeking ways to alter building and planning and zoning codes to help implement ESD. All this effort is essential prior to MDE devoting attention to training. For now, any formal training program will need to be generated in the stormwater management community through professional organizations, universities, and non-profit institutions. MDE is more than willing to discuss any ideas proffered that will move this essential component forward.