MONTGOMERY COUNTY PLANNING DEPARTMENT
THE MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION

MCPB
Item #
11/20/08

MEMORANDUM

TO: Montgomery County Planning Board

VIA: Jorge A. Valladares, P.E., Chief
Environmental Planning Division
Mary Dolan, Planner Supervisor
Environmental Planning Division

FROM: Mark Symborski, Planner Coordinator, (301) 495-4636
Environmental Planning Division

SUBJECT: Current County Practices in Evaluating Impervious and Pervious Surfaces

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RECOMMENDATION: Information and Discussion

Executive Summary

Reason for the Memo

- Requests to consider assigning perviousness credits for certain BMPs towards imperviousness limits have been raised, as well as questions regarding differences between DPS stormwater and M-NCPPC imperviousness-related methodologies.

Imperviousness as an Indicator and a Planning Tool

- Impervious surfaces are generally defined as those land cover types that prevent or significantly impede infiltration into the underlying soil. Impervious surfaces also completely or significantly disrupt natural pollutant treatment through removal of vegetation and altered soil ecological processes due to soil removal and compaction. Impervious land cover includes such areas as roofs, roads, and parking lots.
- Imperviousness has been well-documented as an indicator of general watershed health.

- Because it is correlated with stream health and is easy to measure, imperviousness has become one of the most important and widely used indicators of general watershed health.
- Limits on a site's imperviousness are intended to work in conjunction with engineered stormwater management Best Management Practices (BMPs) to help limit development impacts to aquatic ecosystems in sensitive areas. Reliance on engineered BMPs alone is not sufficient to adequately protect sensitive watersheds.

<u>Permeable Pavements and Green Roofs</u>

- Permeable pavements and green roofs are special case BMPs that are both BMPs and land cover types.
- Various permeable pavement and green roof systems have already been successfully used in many parts of the country, including Montgomery County, but their performance and reliability over time will vary depending on specific site conditions and how well they are designed, installed, and maintained over time. As with all BMPs, even with proper maintenance, there will be performance degradation with time.

<u>M-NCPPC Imperviousness Calculations</u>

- For the purposes of calculating total impervious surface for an area, M-NCPPC employs standard planning-level practice in classifying land cover types as either pervious or impervious. This method is a simplification, but results in a metric that is readily understandable and applicable, especially on a watershed scale.
- M-NCPPC, like most jurisdictions, currently classifies permeable pavement and green roofs, with other engineered hard surfaces, as impervious. This approach is consistent with most other state and local jurisdictions which have regulatory impervious surface limitations. These systems are characterized by a number of factors including the soil removal, grading, and compaction involved that significantly affects natural hydrologic processes, as well as the lack of many natural processes and functions compared with natural forest conditions. In addition, the general decline in BMP performance seen over time, even with proper maintenance, which is often difficult to ensure. DEP and DPS continue to support the Planning Department in this approach.
- The purpose of M-NCPPC reviews for impervious surface limits is to minimize the amount of engineered, artificial land surfaces in sensitive watersheds, and maximize the preservation of natural soils and vegetation, and their functions in providing habitat and fostering other ecological processes. These processes include, but are not limited to infiltration and other water quality functions.

<u>DPS Stormwater Management Calculations</u>

- DPS reviews land development projects to ensure adequate control of stormwater runoff to prevent or minimize adverse effects to water resources. In contrast, the purpose of regulatory imperviousness limits is not only to minimize impacts of stormwater runoff, but to protect the overall ecological health of the watershed.
- The stormwater management review by DPS requires the use of a more detailed differential runoff-based method to compute runoff volumes from all surface

types and determine if a proposed development and BMPs will provide adequate stormwater and water quality management.

- DPS recognizes permeable pavement and green roofs as BMPs and assigns a fixed runoff factor to them in calculating runoff volumes that are required to be managed.

Issues in Considering Differential Infiltration and Runoff in Looking at Imperviousness

- All of the benefits provided by the preservation of natural surfaces cannot be replicated by permeable pavement, and the secondary impacts of permeable pavements cannot be offset by additional BMPs. Watersheds where impervious surface limitations are in place are generally considered to be sensitive, and the required limits are an attempt to aid in preserving general ecological functions and values.
- M-NCPPC's imperviousness calculations do not factor in the increased permeability and decreased runoff of permeable pavement compared with solid pavement, but neither does it factor in the decreased permeability and increased runoff from many pervious cover types, such as grassed areas, compared with natural forested areas.
- Some of these pervious areas can actually contribute significant amounts of runoff. So the argument of considering differential infiltration and runoff characteristics in dealing with imperviousness applies to all land cover types, not just permeable pavement. Moving to a runoff-based assessment of all land cover types in determining imperviousness would require devising an entirely new definition of imperviousness and computational method. Such a method would very likely increase the current imperviousness estimates for the entire County, as well as its watersheds, SPAs, and parcels.
- The existing overlay zones and imperviousness policies were established using the current methods. It is not clear how using a method that defines and estimates imperviousness in a different way than before would relate to established caps. Moving to a runoff-based method of computing imperviousness might require revising the environmental overlay zones that established the existing imperviousness cap concept and implementation process.
- Because of product, installation, and site condition variability, assumed standard runoff factor values for permeable pavement would be difficult to determine and defend, and would be subject to contest by product manufacturers and applicants.
- In the past, the Planning Board has been consistent in not allowing higher imperviousness than is appropriate or permitted in exchange for the use of additional BMPs. The reason for this policy is that BMPs cannot restore or substitute for the environmental functions provided by natural forested land. As a result, advances in stormwater management should not be considered as offsets for developing more land than planned and ever increasing levels of imperviousness.

Staff Position

- Stormwater management is one important environmental protection measure. The role of stormwater management is to reduce the impacts of development; it cannot remove them. All development, regardless of what BMPs are used, will have some detrimental impacts. The mitigation of environmental impacts of development cannot be addressed solely through stormwater management. There are no simple or easy solutions to these problems.

- Limiting imperviousness in sensitive watersheds is another important environmental protection measure. Limiting imperviousness not only reduces impacts due to stormwater runoff, but preserves and protects the watershed's habitats and biodiversity.
- Staff recommends continuing the current method used in defining imperviousness and in administering impervious surface limitations. Permeable pavements and green roofs are useful BMPs for stormwater management, and should continue to be used where appropriate, as permitted and regulated by DPS and DEP. By continuing this approach in sensitive areas, permeable pavements and green roofs can provide environmental benefits in addition to those afforded by any imperviousness caps.
- The current impervious cover policy is consistent with legislation recently passed by the State (HB 1253) that has defined imperviousness as "lot coverage", including permeable pavements and green roofs.
- Permeable pavements and green roofs can be used in new development and redevelopment. They can also be used in sensitive areas, as long as they are not used in exchange for extra imperviousness than would otherwise be appropriate or allowed in those areas (except through a waiver). In urban areas and potential areas for redevelopment, permeable pavements and green roofs are especially viable BMP options for reducing urban impacts. Areas targeted for redevelopment and infill are generally not subject to imperviousness caps, so a caps issue should not arise in the County's urban areas.
- Looking ahead beyond the issues of limiting imperviousness, however, it is also important to point out the larger context and broader issues and needs that the County is facing. Currently, we are working to bridge the gap between current methods of addressing environmental protection, and the need for additional, new, and more comprehensive approaches that will address sustainability of both growth and the environment. For example, we are looking at other techniques for achieving multiple objectives in implementing our master plans by allowing increased density in appropriate areas in exchange for increased environmental benefits. This will help the County to accommodate additional expected growth where it makes sense, and at the same time make progress in enhancing the functions and values of our environment. We will be continuing to explore ways to accomplish this in current and upcoming master plan updates, the Water Resources Functional Master Plan, the Green Infrastructure Functional Master Plan, and the Zoning Code rewrite.

Introduction

As developable land decreases and stormwater management technology improves, there have been increasing requests from the development community to assign perviousness credits toward meeting imperviousness limits for the use of certain engineered hard surfaces, such as permeable pavements, that are designed to allow partial infiltration of water into the subsoil. Others have asked why the Department of Permitting Services (DPS) uses a different methodology for their stormwater management reviews than M-NCPPC uses for its impervious limit reviews.

Limits on imperviousness have been used as a tool to control development-related environmental impacts in certain areas in Montgomery County. There are two overlay zones in the County Zoning Ordinance which require land development projects to meet impervious surface limits: the Environmental Overlay Zones of the Upper Paint Branch Special Protection Area and of the Upper Rock Creek Special Protection Area. Some master plans, such as Clarksburg and Germantown, include imperviousness limits for specific properties in environmentally sensitive areas. The Planning Board has raised questions in the review of projects that are subject to regulatory impervious surface limits or master plan recommendations, about using certain engineered structures, such as porous pavement, grasscrete, green roofs, etc., to meet the imperviousness limits. There are many aspects and issues that need to be seen in context and clarified, in order to properly evaluate these questions. This paper provides information for discussion and dialogue on these topics.

Environmental Impacts of Development

Watershed ecological health, including habitat quality and diversity, biological integrity, and air and water quality is highly dependent on the land cover types and distribution, and the associated land uses of the contributing watershed. Land cover types exhibit a wide range of water treatment, permeability, and runoff characteristics. These range from well established forest, with the highest pollutant treatment capability, the greatest permeability capacity, and lowest runoff values--to solid pavement, with virtually no pollutant treatment capability, negligible permeability, and the highest runoff values.

Natural systems are complex, and the various ways that development affects them are difficult to model. This has made it difficult to predict the environmental impacts of development on natural systems. Highly technical and detailed physically-based models have been developed for this purpose, but even on small area applications, they are highly data and labor intensive to use, and still have predictive limitations. On a large scale, they are usually not practical without significant commitments of staff and financial resources. As a result, planning-level analyses have usually tended to employ much simpler metrics or indicators related to development impacts on aquatic ecosystems. The most common indicator that has been used for this purpose is total impervious cover in a watershed.

<u>Imperviousness as an Indicator of General Watershed Health</u>

Impervious surfaces are generally defined as those land cover types that prevent or significantly impede infiltration, and natural pollutant treatment through vegetation and soil ecological processes. Impervious cover types tend to contribute large portions of untreated or poorly treated stormwater runoff compared with natural forested conditions, and therefore contribute the most to the negative impacts from development on aquatic ecosystems. Impervious land cover includes engineered surfaces and areas such as roofs, roads, and parking lots.

In contrast, pervious cover types provide a significant measure of infiltration and stormwater pollution treatment compared with impervious land cover conditions. Pervious land cover includes areas such as forests, meadows, and grasslands. These land covers are characterized by vegetation, natural soil ecological processes, and direct access to the underlying ground water.

For the purposes of calculating total impervious surface for an area, M-NCPPC employs standard planning-level practice in classifying all surfaces as either pervious or impervious. This methodology is a simplification, but results in a metric that is readily understandable and applicable, especially on a watershed scale. It is important to note, however, that because imperviousness is only one of many development-related factors that impact aquatic ecosystems, and because of the variability of the data, it is appropriate to use as an indicator of general watershed health, not as a predictor of specific water quality and stream conditions. Nevertheless, because it is correlated with stream health and is easy to measure, it has become one of the most important and widely used indicators of general watershed health. Impervious cover is a major contributor of stormwater, so controlling it is also one of the chief strategies in limiting stormwater impacts.

Because of the general correlation between imperviousness and declining stream health, imperviousness caps have in the past been recommended in certain master plans, or required in specific Special Protection Areas (SPAs) through environmental overlay zones. To the extent that these caps have limited impervious surfaces that would otherwise have been created, this approach has had benefits in curbing impacts in capped areas. These caps, and how they have been administered, are based on the generally accepted definition of impervious cover. Because of this, a move to determining imperviousness on the basis of differential infiltration and runoff characteristics would entail a major change in the definitions and methods currently used in establishing and administering the capped areas. Such a method would be similar to the one that is currently used in Montgomery County by the Department of Permitting Services (DPS), in their regulatory role of reviewing stormwater management plans for land development projects.

Stormwater Management in Montgomery County

DPS reviews and approves stormwater management plans for land development projects in Montgomery County. DPS requires the applicant to use a standard site engineering methodology for the computation of different stormwater runoff volumes for management. This method is not based on differentiating between pervious versus impervious surfaces, but instead involves the consideration of differential permeability and its relationship to runoff for all land cover types, which provides a better assessment of stormwater runoff. As a result, the proposed development's ultimate land cover types, such as forest, grass, and impervious surfaces are all considered in terms of their relative infiltration/runoff characteristics. These runoff characteristics are also influenced by other factors such as loss of natural vegetation, site grading, and soil types. Each land cover type is assigned a runoff factor called a Runoff Curve Number (RCN) that takes average differential permeability and runoff characteristics on different soil types into account. Runoff Curve Numbers range from 30 for forest in good condition on the most permeable soils, to 98 for paved surfaces (Figure 1). DPS requires this greater level of detail as part of a stormwater management plan for a specific land development project in order to evaluate and determine if the proposed development and Best Management Practices (BMPs) will provide adequate stormwater and water quality management as required by regulation. Forest in good condition represents the natural state for the County with respect to environmental services such as infiltration, runoff, and pollution removal capacity, and is thus the standard for assessing mitigation of the environmental impacts of development (Figure 2).

Permeable Pavements

In recent years, newer stormwater management control technologies have been developed that increase options for partial treatment and infiltration of precipitation. Permeable pavement technology has been refined over time and can allow a certain amount of rainfall to infiltrate back into the ground, thus reducing stormwater runoff. Many permeable pavement types have been developed, including porous asphalt, porous concrete, grass pavers, and various other types of grid pavers. These are generally installed over a sub-base of angular rock fragments that provides a certain amount of water storage, which can then percolate into the partially compacted subsoil underneath the installed pavement and excavated sub-base.

Basic Issues

For permeable pavement to function properly there are three critical aspects that must be fulfilled: proper design, proper installation, and proper inspection and maintenance. As with any BMP, a deficiency or failure in one or more of these aspects can result in serious degradation or failure of the permeable pavement system. Although proper design and installation are comparatively easier to ensure, adequate maintenance remains a long-term critical issue for continued functionality. Any significant use of permeable pavement will require adequate inspection and maintenance to ensure its designed benefits are maintained over the long-term. Permeable pavement is a special type of BMP because it is both a BMP and a land cover type, and thus has the potential to cover large surface areas. If large areas are paved with permeable pavement, then the BMP function is distributed over a much larger area than conventional BMPs, such as stormwater dry ponds and infiltration trenches. This decreased centralization of stormwater management adds significantly to the challenge of providing proper inspection and maintenance. In addition, BMP performance degradation of large areas covered by permeable pavement could result in unintended increases in imperviousness, and associated negative impacts.

Benefits to Using Permeable Pavement Systems

- If properly designed, installed, and maintained it can help reduce impacts associated with impervious surfaces
  - Infiltrates a portion of precipitation
  - Provides limited treatment of the infiltrated water in the subsoil
  - Provides a reduction in runoff volumes
- Increases the stormwater management options
- Allows for more flexibility in site design
- Provides additional options for infiltration in dense urban areas

Limitations and Concerns in Using Permeable Pavement Systems

- Actual performance is variable dependent on specific site conditions, type of system, design, installation, and long-term maintenance. The maintenance issue is especially important. Without adequate inspection and maintenance, potentially large areas could end up becoming essentially impervious.
- Environmental functions from native vegetation and soil processes are not fully replicated by the permeable pavement system that replaces them.
- Will allow the transmission of applied salt and/or other dissolved contaminants into groundwater, causing potential long-term problems to nearby streams and water supply aquifers.
- Sand and grit should not be used for snow and icing to minimized pavement clogging. Even one application can significantly reduce system effectiveness.
- Snow plow blade height must be higher than normal to avoid damage to the pavement
- Because they are prone to clogging they require strict long-term inspection and maintenance for continued effectiveness.
- Requires maintenance inspection on a regular basis and vacuuming as needed to mitigate clogging.
- Pavement can easily clog if particulates and debris such as sediment, mulch, grass clippings, and leaves accumulate on the pavement.

Permeable pavement systems are well-tested in many areas of the United States, including the mid-Atlantic region. The above advantages and disadvantages have been found to be fairly typical. Well-controlled empirical studies in terms of design, construction, and maintenance have demonstrated that these systems can provide long-term benefits compared with conventional pavement. However, the extent to which the highly controlled conditions and maintenance provided in these studies can be duplicated in real world applications is less clear. Various permeable pavement systems have already been used in many parts of the Piedmont province, including Montgomery County. DPS and DEP are responsible for the proper design, installation, inspection, and maintenance of permeable pavement systems. Permeable pavement can continue to be used in the County as a stormwater BMP, but as indicated above, its performance and reliability over time will vary depending on a variety of factors.

DPS, DEP, and Permeable Pavement

DPS recognizes permeable pavement as a BMP and using the methodology described above, assigns stormwater and water quality management credits for its use by factoring an assumption of increased permeability into the calculation of stormwater volumes. DPS uses a single runoff curve number for the use of all permeable pavement types to calculate credit for runoff reduction. For commercial and industrial properties, DPS requires that permeable pavement be placed in a stormwater management easement. Under the terms of these easements, the permeable pavement system must be maintained by the property owner. For commercial and industrial sites, the Department of Environmental Protection (DEP) inspects the permeable pavement regularly, and requires the owner to repair or replace any degradation or failures to the system. If the owner does not comply, DEP carries out the repairs and charges the property owner. For residential development projects, DPS has allowed the use of permeable pavement, but neither DPS nor DEP require maintenance, nor do they inspect such applications. This raises the issue of long-term effectiveness of these BMPs in residential areas, especially if the use of permeable pavement were to increase over its current low levels in residential areas.

Green Roofs

Green roofs are another example of a land cover type that is also a BMP. In contrast to permeable pavement systems, green roofs serve to reduce some of the impacts of an impervious surface by placing a thin layer of vegetated soil directly on top of it. Although they provide real benefits, they also have limitations, including hydrologic disconnection from underlying soils and groundwater recharge. Like permeable pavement, green roofs are not a substitute for a natural ecosystem on the ground. Because of these considerations, green roofs are also identified as impervious surfaces for the calculation of total imperviousness.

<u>Benefits to Using Green Roof Systems</u>

- If properly designed, installed, and maintained, they can help to reduce impacts associated with building roofs by:
  - Absorbing a portion of precipitation
  - Providing a reduction in runoff volumes
  - Providing some treatment of the absorbed water in the soil layer and vegetation
- Increases stormwater volume and quality management options, especially in urban areas
- Provides additional non-stormwater benefits:
  - Lower energy costs
  - Lowers heat island effect
  - Green amenity benefits
  - Increases working life of roofs

Limitations of Green Roof Systems

- Pollution removal capacity is limited due to the thinness of the system
- Rainfall absorption capacity is limited due to the thinness of the system
- System does not allow any infiltration of water to the underlying soils and does not recharge the natural groundwater system that supports stream baseflow
- Excess stormwater runoff flows off of the roof
- Actual stormwater volume and quality performance is variable depending on design, installation, and long-term maintenance.

Green roof systems are well-tested in many areas of the United States, including the mid-Atlantic region. The above advantages and disadvantages have been found to be fairly typical. Various green roof systems have already been successfully used in many parts of the country, including Montgomery County, but as indicated above, their performance and reliability over time will vary depending on specific site conditions and how well they are designed, installed, and maintained over time.

DPS, DEP and Green Roofs

DPS recognizes green roofs as a BMP, and using the methodology described above, assigns stormwater and water quality management credits for its use by factoring their rainfall absorption and treatment capacity into the calculation of stormwater volumes. As with permeable pavement, DPS uses a single runoff curve number for the use of green roofs to calculate credit for runoff reduction. DPS has allowed the use of green roofs in a variety of settings, but does not require maintenance; and neither DPS nor DEP inspect them after the sediment control permit is released.

Permeable Pavement and Green Roofs in Stormwater Management and Imperviousness Calculations

Current Status in Montgomery County

As described above, DPS currently grants stormwater and water quality volume credits for the use of permeable pavement and green roofs, based on assumed permeability and runoff characteristics of these practices. For the purposes of calculating total impervious surface for an area, M-NCPPC employs standard planning-level practice and groups all surfaces into two categories: pervious and impervious. M-NCPPC currently classifies permeable pavement and green roofs, with other engineered hard surfaces, as impervious. This is based on the lack of many natural processes and functions in these systems compared with natural forest conditions, and the general decline in BMP performance seen over time, even with proper maintenance. It should be pointed out that although this method does not consider the fact that permeable pavement can allow some infiltration and lower runoff volumes, it also does not take into account that pervious land cover types actually have widely varying permeability and runoff characteristics. Some pervious land covers can have very low permeability and high amounts of runoff.

The Maryland Chesapeake Critical Area Law Experience and Current Status

The Chesapeake Bay Critical Area Act of 1984 was designed to help protect the Chesapeake Bay and its tributaries from resource degradation resulting from development activity. The Critical Area law that followed stipulated an imperviousness definition and cap, which are also cited in the State Stormwater Design Manual. Although the original definition of imperviousness in the Law allowed the granting of perviousness credits for permeable pavements, in practice the experience with this definition has been negative. Over time, it became evident that the overall imperviousness that resulted from applying this definition and the granting of credits was escalating over the desired cap, and was negatively impacting the receiving aquatic ecosystems. As a result, in 2008, State House Bill 1253 was passed that redefined imperviousness as "lot coverage". This new definition includes permeable pavements and green roofs under lot coverage. The new State Stormwatrer Manual will also be modified to reflect the new law. The current impervious cover policy in the County is consistent with this new legislation. It seems reasonable to follow the State's lead on this matter, especially as it so closely resembles the SPA intent and process that was created in Montgomery County.

Discussion

All of the benefits provided by the preservation of natural surfaces cannot be replicated by permeable pavement, and the secondary impacts of permeable pavements cannot be offset by additional BMPs. Watersheds where impervious surface limitations are in place are generally considered to be sensitive, and the required limits are an attempt to aid in preserving general ecological functions and values.

In addition, using a runoff-based approach that takes variable permeability and runoff into consideration in formulating a new definition and method of calculating imperviousness would have some significant implications. Some pervious land covers, such as grassed areas, frequently contribute a great deal of stormwater runoff. This is especially true if these areas are graded and compacted, as is typically the case in developed areas. In fact, some grassed areas have soils that are so altered and compacted that they are similar in their runoff characteristics to asphalt and concrete surfaces. The environmental impacts of the extra runoff and pollutants from grassed areas, and other surfaces that are currently lumped together as pervious, are not factored into the standard calculation of imperviousness. So the argument of considering differential infiltration and runoff characteristics in dealing with imperviousness applies to all land cover types, not just permeable pavement.

Because of this, redefining and calculating imperviousness to include the concept of differential permeability and runoff from all surface types, could, in many cases, (especially those with significant amounts of grassed cover), result in higher imperviousness assessments, rather than lower. On the other hand, on sites with high levels of imperviousness, such as urban areas, conversion of existing paved areas to permeable pavement could result in a net decrease in imperviousness, if it is assessed by considering runoff factors. Dense urban areas, however, are generally not subject to imperviousness caps, so caps should not be an issue in such areas.

The question has been raised that if DPS grants stormwater and water quality volume credits for permeable pavement and green roofs, then why can't perviousness credits be assigned for their use for the purpose of calculating total imperviousness? The purpose of DPS' review is to determine the appropriate methods for controlling stormwater runoff from a proposed development project. This review typically includes determining the type, size, and location of stormwater BMPs. DPS considers all surfaces on a given site with respect to their different permeability and runoff characteristics. Site and watershed imperviousness could potentially be assessed with such a method, but it would require devising an entirely new definition of imperviousness and an entirely new computational method.

DPS' regulatory program covers issues related to stormwater management including runoff, infiltration, and groundwater recharge. M-NCPPC's review of impervious surface land cover focuses on limiting the loss of natural land surfaces and the ecological functions and values they provide. Our review complements DPS' review, but also has a focus on general ecological function and health. In addition, a runoff-based approach to imperviousness would be more data intensive and time consuming, especially if applied on a watershed scale. It is also not clear how using a method that defines and estimates imperviousness in a different way than before would relate to established caps that were based on another, simpler definition and method of calculation. Moving to a different way of computing imperviousness might require revising the environmental overlay zones that established the existing imperviousness cap concept and implementation process. In addition, a new way of defining and calculating imperviousness would pose the need to recalculate imperviousness estimates. Using a runoff-based method would very likely increase imperviousness estimates for the entire County, as well as its watersheds. SPAs, and parcels. It is also unlikely that any of the areas under imperviousness caps would meet their caps under existing conditions.

There is no existing methodology to calculate imperviousness on the basis of differential runoff properties. It is clear, however, that using a method that considers differential runoff in assessing imperviousness, surfaces would not be classified as either pervious or impervious, but rather, the degree of imperviousness of each land cover type would be evaluated in terms of its permeability and runoff producing characteristics. Thus, there would be a range of imperviousness factors corresponding to a full range of land cover types, cover conditions, and soil types, including grass and forests. In calculating stormwater runoff volumes, DPS currently assigns a standard RCN for the use of permeable pavements. Following the DPS approach, permeable pavements, and green roofs could be assigned a standard imperviousness factor.

In actuality, however, runoff characteristics of permeable pavement systems are highly variable depending on the pavement type, design, installation, and specific site conditions. But even if different runoff factors are assigned to different types of permeable pavement, official determinations would need to be made as to how impervious each product would be considered to be, since not all products, installations, and site conditions are the same. These determinations would almost certainly be contested by product manufacturers and applicants, and would be quite difficult both to fix and defend. So far, DPS has not been challenged on its use of a single standard runoff factor for permeable pavements and green roofs. But with potentially much more at stake in capped areas, it is not difficult to foresee challenges to any assumed runoff factors by applicants who believe their particular permeable pavement product and installation merits a lower runoff factor.

Performance of these systems is also highly dependent on adequate inspection and maintenance over the lifetime of the pavement. The inevitable variations in maintenance could compromise the integrity of the pavement system. In addition, BMPs typically degrade over time, even with proper maintenance. While this is true for all BMPs, it becomes especially problematical in sensitive areas. As a result, degradation of significant areas covered by permeable pavement could result in unintended increases in imperviousness, and associated negative environmental consequences, particularly for the sensitive areas that can least afford them.

Moreover, if permeable pavement and green roofs are assigned perviousness credit toward imperviousness caps, then the same argument could be made for granting perviousness credits for standard pavement and roofs, depending on how much runoff is infiltrated in receiving BMPs. At that point, the issue becomes basically a special case of a more general question that has come before the Planning Board before: whether to permit higher imperviousness than is appropriate or allowed in exchange for the use of more BMPs. Such a position is generally not supported by watershed protection experts, nor has it ever been supported by staff or the Board in the past.

The reason for this general policy is that BMPs cannot restore or substitute for the many environmental functions provided by natural forested land, and therefore cannot completely mitigate the impacts of development. As a result, advances in stormwater management should not be considered as offsets for developing more land than planned and ever increasing levels of imperviousness. The role of stormwater management, including minimizing imperviousness, is to reduce the impacts development places on the environment; it cannot eliminate them. All development, regardless of what stormwater management approaches or BMPs are used, will have some detrimental environmental impacts. Development will always be accompanied by increases in imperviousness, and the removal and alteration of soils, soil compaction, soil biology, pollutant treatment capacity, infiltration, runoff, pollutant loads, vegetation loss and changes, temperature increases, and so on. The mitigation of environmental impacts of development cannot be addressed solely through stormwater management. There are no simple or easy solutions to these problems.

Staff Position

Staff recommends continuing the current method used in defining imperviousness and in administering imperviousness caps. This does not preclude the expanded use of permeable pavement as a stormwater management BMP. By continuing this approach in sensitive areas, permeable pavements and green roofs can provide environmental benefits in addition to those afforded by the cap itself. This policy is consistent with legislation recently passed by the State for the Chesapeake Bay Critical Area Program.

In sensitive watersheds there are many tools that are used to protect environmental resources. Limiting impervious surface coverage is one of these tools. This particular tool addresses more than just the stormwater impacts from development. It also promotes the preservation of habitat and reduces pollution generating activities. The combination of all these measures is needed to maintain the overall health of the high quality environmental resources of these watersheds.

The Planning Department has not, and will not discourage the use of permeable pavement systems or green roofs as methods to meet the stormwater management requirements of a project. In reviewing plans that are subject to some form of impervious cap, staff has always maintained that limiting imperviousness is a type of BMP that complements SWM controls required by DPS. DPS and DEP continue to support the Planning Department in this approach. Imperviousness limits do not replace engineered SWM controls, or vice versa. Both imperviousness limits on a site and engineered SWM controls (in combination with other land use measures such as wide environmental buffers, maximizing forest cover, etc.) are necessary to reduce impacts of development on sensitive stream systems.

Wherever they can be properly designed, installed, inspected, and maintained, permeable pavement and green roofs are useful BMPs for stormwater management. They can be used in new development and redevelopment. They can also be used in sensitive areas, as long as they are not used in exchange for more imperviousness than would otherwise be appropriate or allowed in those areas (except through a waiver). In urban areas and potential areas for redevelopment, permeable pavements and green roofs are especially viable BMP options for reducing urban impacts. In fact, the soon to be finalized revisions to the State Stormwater Management Manual will require the use of Environmental Site Design (ESD) (which includes such BMPs as permeable pavement and green roofs) to the maximum extent practicable. So these systems will, in many cases, be an important part of the urban stormwater retrofit toolkit, especially where other potential BMP options are limited. Areas targeted for redevelopment and infill are generally not subject to imperviousness caps, so the caps issue should not arise in the County's urban areas. Nevertheless, long-term maintenance and other issues such as salt infiltration to ground water will still need to be addressed.

Looking ahead beyond the issues of limiting imperviousness, however, it is also important to point out the larger context and broader issues and needs that the County is facing. Currently, we are working to bridge the gap between current methods of addressing environmental protection, and the need for additional, new, and more comprehensive approaches that will address sustainability of both growth and the environment. For example, we are looking at other techniques for achieving multiple objectives in implementing our master plans by allowing increased density in appropriate areas in exchange for increased environmental benefits. This will help the County to accommodate additional expected growth where it makes sense, and at the same time make progress in enhancing the functions and values of our environment. We will be continuing to explore ways to accomplish this in current and upcoming master plan updates, the Water Resources Functional Master Plan, the Green Infrastructure Functional Master Plan, and the Zoning Code rewrite.

Figure 1. Table of Runoff Curve Numbers (SCS, 1986)

Description of Land Use	**Hydrologic Soil Group**			
	A	**B**	**C**	**D**
Paved parking lots, roofs, driveways	98	98	98	98
Streets and Roads:				
Paved with curbs and storm sewers	98	98	98	98
Gravel	76	85	89	91
Dirt	72	82	87	89
Cultivated (Agricultural Crop) Land*:				
Without conservation treatment (no terraces)	72	81	88	91
With conservation treatment (terraces, contours)	62	71	78	81
Pasture or Range Land:				
Poor (<50% ground cover or heavily grazed)	68	79	86	89
Good (50-75% ground cover; not heavily grazed)	39	61	74	80
Meadow (grass, no grazing, mowed for hay)	30	58	71	78
Brush (good, >75% ground cover)	30	48	65	73
Woods and Forests:				
Poor (small trees/brush destroyed by over-grazing or burning)	45	66	77	83
Fair (grazing but not burned; some brush)	36	60	73	79
Good (no grazing; brush covers ground)	30	55	70	77
Open Spaces (lawns, parks, golf courses, cemeteries, etc.):				
Fair (grass covers 50-75% of area)	49	69	79	84
Good (grass covers >75% of area)	39	61	74	80
Commercial and Business Districts (85% impervious)	89	92	94	95
Industrial Districts (72% impervious)	81	88	91	93
Residential Areas:				
1/8 Acre lots, about 65% impervious	77	85	90	92
1/4 Acre lots, about 38% impervious	61	75	83	87
1/2 Acre lots, about 25% impervious	54	70	80	85
1 Acre lots, about 20% impervious	51	68	79	84

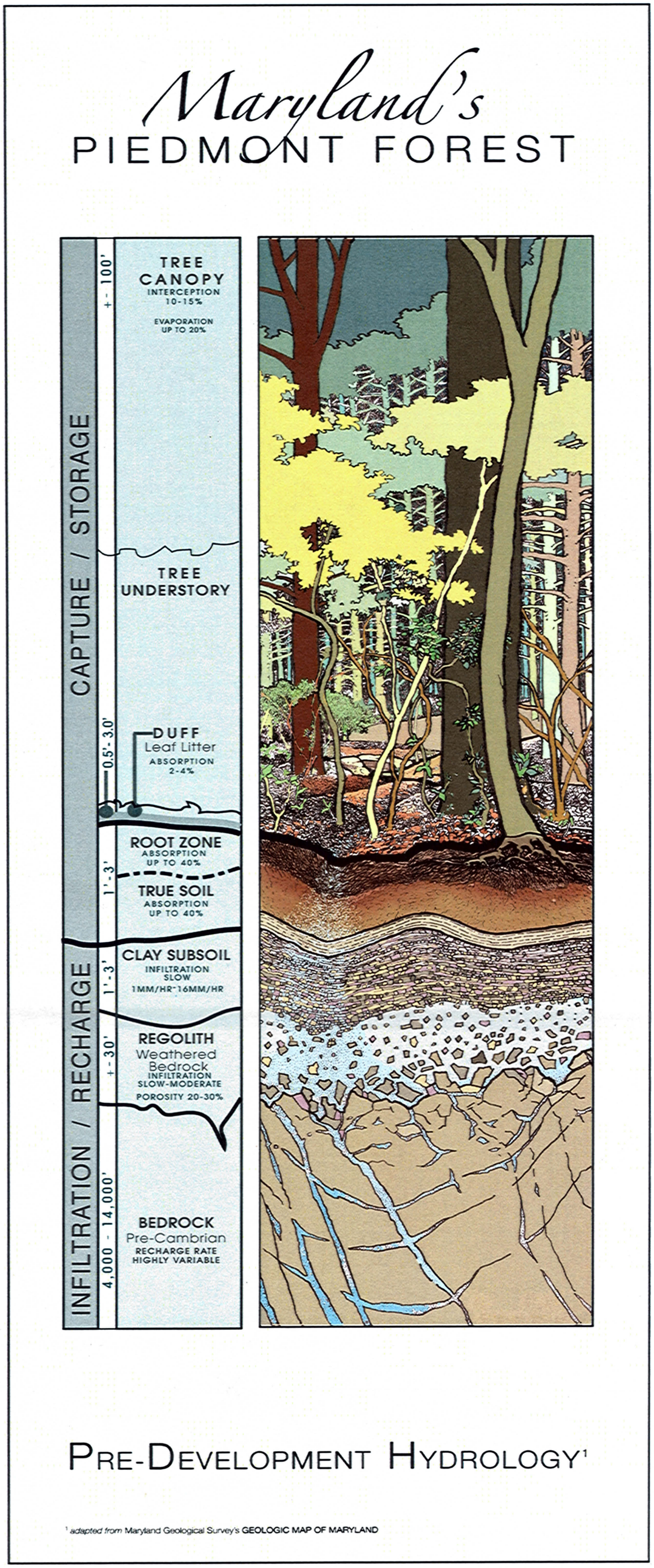

Figure 2. Maryland's Piedmont Forest (Draft)*

*Note: This figure is a draft poster under development by Judy Hanks-Henn of the Audubon Naturalist Society