Date: June 27, 2013

To: Urban Stormwater Workgroup

From: Norm Goulet, Chairman
Tom Schueler, Workgroup Coordinator

Re: Final Recommended Principles and Protocols
For Urban Stormwater BMP Verification.

This memo describes how the Workgroup developed principles and protocols to verify the performance of urban BMPs in the Bay watershed, and is organized into 7 parts.

A. The Need for BMP Verification and the CBP Process to Define it.
B. Key Verification Definitions
C. Background on Urban BMP Verification
D. Verification Principles for BMPs Located in MS4 areas
E. Verification Principles for BMPs Located in non-MS4 areas
F. Verification Principles for Legacy BMPs
G. Process for Developing Urban BMP Verification Protocols

Part A: The Need for Verification and the CBP Process to Define it

Given the ever increasing importance that accounting for implemented practices is taking on within the partnership—Bay TMDL reasonable assurance, two-year milestones, offsets, tradable credits—the Partnership must agree to a framework whereby we can have both expanded tracking and reporting of practices AND verifiable confidence in the outcome of those implemented practices.

The implementation, tracking, and reporting of BMPs has been at the center of the Partnership's Bay restoration efforts for close to three decades. Within the past two years, there have been numerous requests and commitments to improve the accountability of actions taken to install BMPs which prevent or reduce the loads of nutrients and sediment to Chesapeake Bay.

- The Citizens Advisory Committee has repeatedly called on the Partnership to provide for transparent and open verification of cost shared as well as non-cost shared best management practices tracked and reported by the watershed's seven jurisdictions.

- The President's Chesapeake Bay Executive Order Strategy committed the U.S. Department of Agricultural (USDA) and the U.S. Environmental Protection Agency (EPA) to develop and implement "mechanisms for tracking and reporting of voluntary conservation practices and other best management practices installed on agricultural lands" by July 2012.

- Within its Chesapeake Bay Independent Evaluation Report, the National Research Council's (NRC) panel put forth a series of five specific science-based conclusions all focused on their key finding that "accurate tracking of BMPs is of paramount importance because the CBP relies upon the resulting data to estimate current and future nutrient and sediment loads to the Bay."

- The 2010 Chesapeake Bay TMDL's Appendix S outlines the common elements from which EPA expects the watershed jurisdictions to develop and implement offset programs.

At the request of the Water Quality Goal Implementation, the Urban Stormwater Workgroup (USWG) devoted much of 2012 to developing principles and protocols for urban BMP verification. The topic was discussed at the February, March, April, May and October USWG meetings, and six drafts of this memo were made in response to verbal and written comments by local and state partners. In addition, recommendations for BMP reporting, tracking and verification were an integral element of the deliberations of four urban BMP expert panels:

- Stormwater Retrofits
- New State Stormwater Performance Standards
- Urban Nutrient Management
- Stream Restoration

This memo represents a synthesis of the consensus reached by the Workgroup on urban sector verification issues.

Part B: Key Definitions for Urban BMP Verification:

The following terms are defined to clarify the issues related to urban BMP verification.

Urban BMPs: In this context, they are defined as stormwater practices for which definitions and removal rates have been developed and approved through the CBP BMP review protocol. These urban BMPs fall into four broad categories:

1. *Traditional stormwater BMPs* that were historically installed through a local stormwater plan review process in response to state stormwater requirements (e.g., wet ponds, dry ED ponds, bioretention, infiltration, filtering practices, bioswales, grass channels, permeable pavement).

2. *New runoff reduction BMPs* that will be implemented in the future to meet new state stormwater performance standards that typically go through a local stormwater review process (e.g., impervious surface disconnection, green roofs).

3. *Non-structural or operational BMPs* that are typically applied by a municipal agency (e.g., street sweeping, urban nutrient management, illicit discharge elimination).

4. *Restoration BMPs* installed by localities to treat existing impervious cover (e.g., stormwater retrofits and stream restoration).

Regulated BMPs: Refers to any BMP that is installed in a jurisdiction that has a Phase 1 or 2 Municipal Separate Storm Sewer System (MS4) permit. These permits establish a requirement that a locality have a BMP maintenance program and the capacity to inspect all of their BMPs within a portion or all of each permit cycle (typically 5 year cycle). As can be seen in Figure 1, only a portion of the developed/developing land in the Bay watershed occurs within communities that are regulated under MS4 permits.

Semi-Regulated BMPs: Refers to any BMP that is installed locally under a state construction general permit (CGP) outside of a MS4 community. While the permit applicant must sign an agreement that they will maintain the BMP, the locality is not required to have an inspection program to enforce maintenance, and the state may not have sufficient staff resources to do so on their behalf.

Non-regulated BMPs: Refers to any BMP that is voluntarily installed in a community that was not triggered by an explicit MS4 requirement or stormwater regulation. Examples might include rain gardens built by homeowners or demonstration BMPs constructed through grants.

Legacy BMPs: Refers to the population of urban BMPs in a community that the state has reported to EPA for inclusion into any past version of the CBWM for sediment or nutrient reduction credit. Legacy BMPs fall into three categories:

- *Actual BMPs with a geographic address*
- *Actual BMPs that lack a specific geographic address*
- *Estimated BMPs* that were projected based on some assumed level of development activity and compliance with state stormwater regulations.

Discovered BMPs: Refers to any BMP that was installed in the past but was never reported to the state or CBP, and has not received any prior nutrient removal credit. Examples include older BMPs installed prior to the establishment of state BMP reporting systems, and voluntary BMPs.

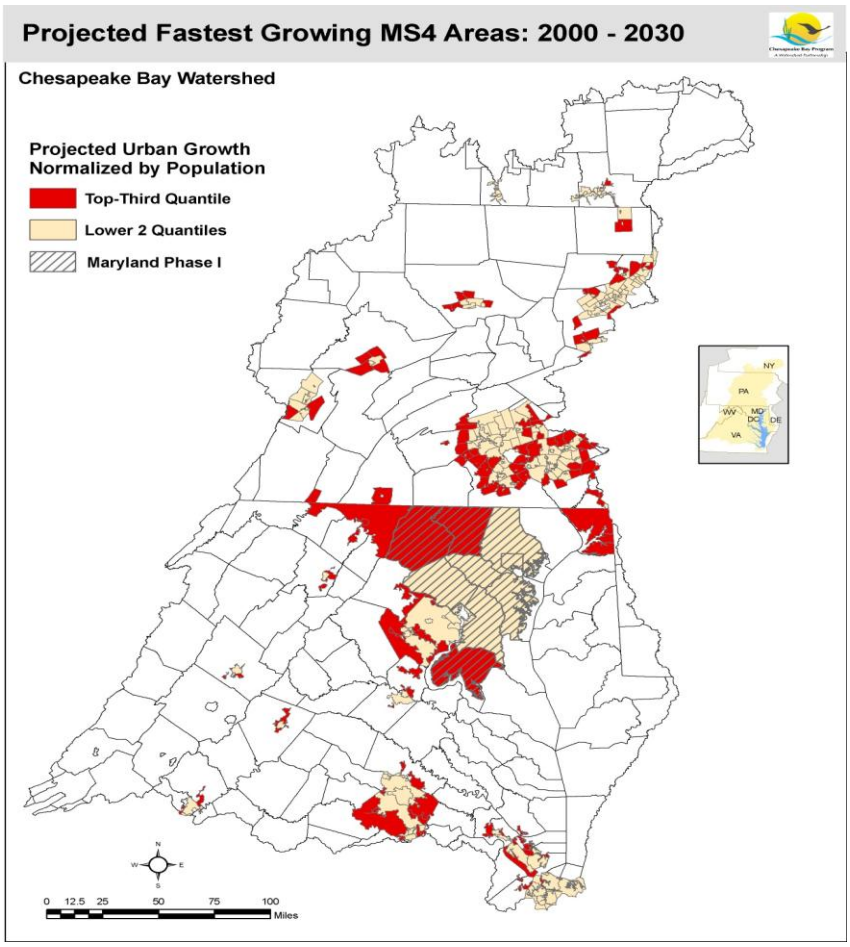

Figure: Distribution of MS4 Communities in the Bay Watershed
Source: Claggett, 2010

Part C: Background on Verification of Urban Stormwater BMPs

As part of the development review process, localities in the Chesapeake Bay typically conduct a post-construction inspection of stormwater BMPs to ensure that they are functional, maintain project engineering files and inspect them periodically to ensure they are still performing.

Phase 1 and Phase 2 communities have NPDES MS4 permit conditions which require them to have programs and staff in place to ensure that maintenance inspections are done according to a prescribed cycle. The frequency of maintenance inspections ranges from 3 to 5 years, depending on the permit status of the jurisdiction.

In addition, most MS4 communities have an annual reporting requirement, and often provide aggregate information to the state on the number and type of BMPs that are installed during the reporting period.

Consequently, an inspection framework currently exists in much of the watershed which can be adapted to provide the foundation for a reliable BMP reporting, tracking and verification system. However, several problems need to be overcome to develop an effective system:

- Larger MS4 communities have an existing urban BMP inventory that numbers in the thousands, with hundreds more being added each year.

- Some Ms4s do not currently report all of the individual BMP information needed by the state to prepare the input deck for the Chesapeake Bay Watershed Model (CBWM), such as Chesapeake Bay Program (CBP) BMP classification, drainage area served, geographic location and year of installation.

- Very few localities have digitized their individual BMP files and integrated them within a spreadsheet and/or GIS system.

- In the absence of good geo-spatial data, the prospect for double counting of BMPs is significant, particularly when multiple BMPs of different ages are located within same drainage area. In other cases, BMPs that have failed or don't really meet the CBP BMP definition are counted when they should not be.

- Most non-MS4 localities have little experience in reporting BMP implementation data for new or existing development (e.g., retrofits). These communities are classified as being semi-regulated, in that they have limited authority to inspect or enforce maintenance on private land.

- Several urban BMPs are implemented outside the MS4 permit or local/state stormwater review process, and therefore may not be properly counted or reported (e.g., street sweeping, reforestation, urban nutrient management, tree planting and stream restoration). Localities may need to internally coordinate with multiple agencies and/or departments to accurately report this BMP data.

- Most localities do not currently report on voluntary BMPs that are installed by homeowners or watershed groups, even if they provide them financial or other incentives to do so.

- Most Bay states are just now developing BMP reporting systems to track the BMPs installed within individual localities, and several have not been able to keep up with BMP information submitted by 70 to 400 MS4s in their jurisdiction.

- Up to now, few states have allocated sufficient staff resources to fully enforce MS4 permit maintenance conditions, verify that local BMP information is accurate, and cull out BMPs from the CBWM input deck that are no longer achieving their intended nutrient or sediment removal rate.

- Some urban BMPs are installed in non-regulated areas in the watershed (i.e., not covered by MS4 permits). Consequently some of these communities may not have all of the legally required BMP inspection and maintenance provisions found in MS4 communities. As a consequence, BMP reporting and verification may be challenging in non-MS4 communities, particularly in smaller communities with limited staff resources.

- Perhaps the greatest weakness of the current system is that current post construction and maintenance inspection efforts are not oriented toward verifying the actual pollutant removal performance of the BMP in the field. Instead, local inspections primarily focus on whether a BMP was installed per design, and that its future condition will not cause harm to public safety and/or cause nuisance problems in the community. Consequently, it will be necessary to develop improved inspection guidelines that utilize visual indicators to verify that the hydrologic performance of the BMP is adequate to still achieve the intended nutrient and sediment removal rate.

- The past assumption is that nearly all structural urban BMPs are permanent in nature. This means that a twenty year old wet pond keeps on performing in perpetuity, with no discount for their age, diminished capacity and lack of maintenance.

Part D: Principles for Verifying Regulated BMPs (e.g., MS4s)

The following principles should guide the urban BMP verification process for MS4s in each of the Bay States:

1. *Verification methods will differ depending on the class of urban BMPs (traditional, runoff reduction, operational, and restoration*. The CBP has approved nearly 20 different BMPs in the urban sector, and expert panels are adding more every year. Consequently, specific verification protocols need to be crafted to address each class of BMPs.

2. *Key Role of Maintenance in Performance*. Regular inspections and maintenance of BMPs are critical to ensure their pollutant removal performance is maintained and extended over time, as well as maintain other local design objectives (e.g., flood control, public safety, stream protection and landscape amenity). Therefore, a core verification principle is to ensure that BMPs are installed and maintained properly over their design life to qualify for their pollutant removal rates. To ensure this, verification protocols are needed to define (1) the cycle for field verification of BMPs and (2) the process for BMP downgrades if maintenance is not performed.

3. *Utilize Existing MS4 Framework*. The existing MS4 inspection and maintenance framework for hundreds of communities in the Bay watershed should be the foundation of any BMP verification system for the Bay TMDL. Ongoing BMP reporting and maintenance inspections requirements in MS4 permits may need to be adjusted slightly to verify BMP performance, but the modifications should be limited to reduce the administrative burden for local and state agencies.

4. *Removal Rate Tied to Visual Inspections*. The basic concept is that urban BMPs will have a defined time-frame in which the pollutant removal rate applies, which can be renewed or extended based on a visual inspection that confirms that the BMP still exists, is adequately maintained and is operating as designed. An example of how BMP verification can be integrated with ongoing MS4 BMP inspections is shown Figure 2.

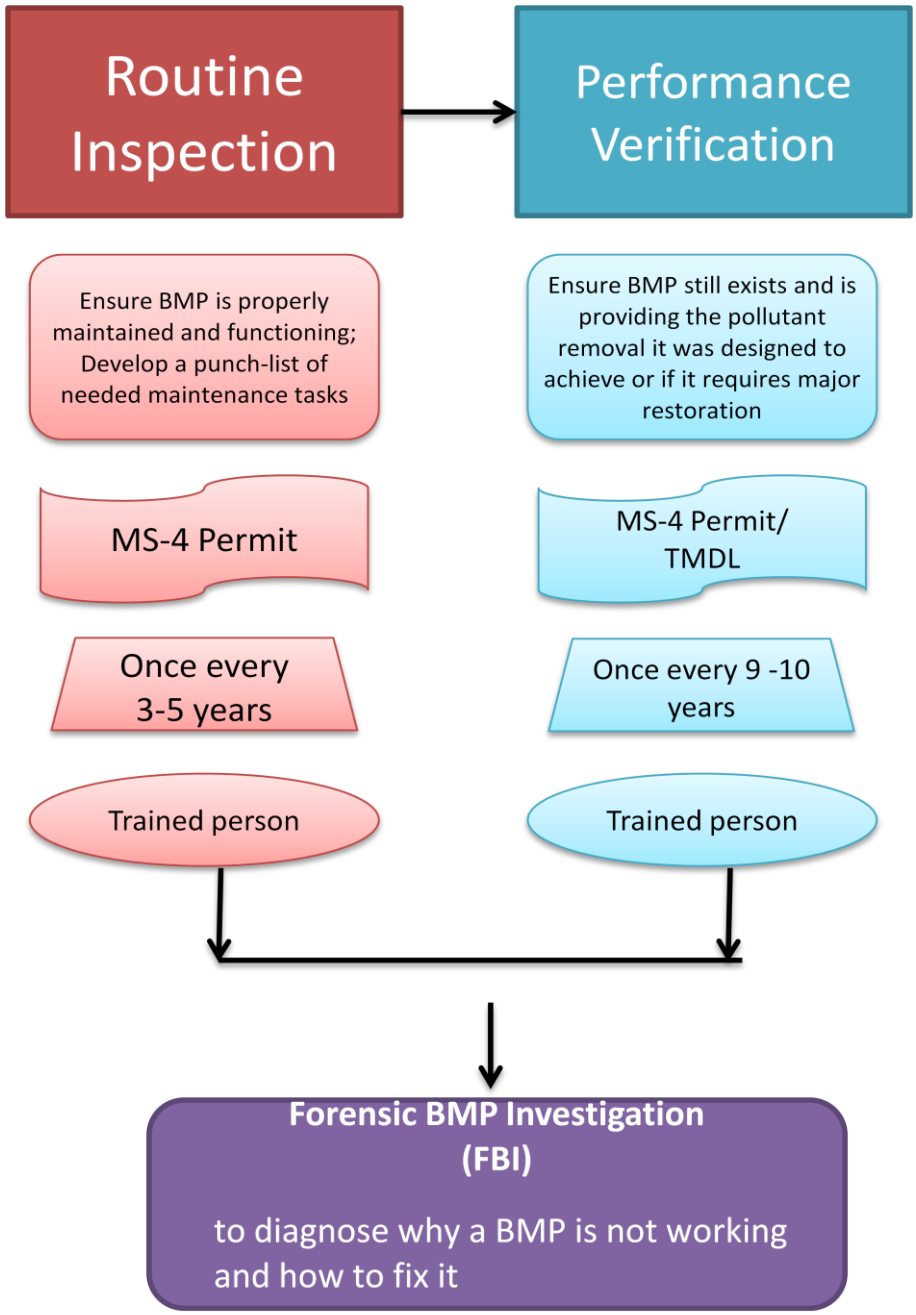

Figure 2: Relationship of Routine MS4 BMP Inspections to Verification Inspections

A rapid inspection is conducted to quickly assess urban BMP performance in the field using simple visual indicators. This approach was refined and tested through an extensive analysis of BMPs located in the James River Basin of the Chesapeake Bay watershed. More detail on the methods and results can be found in Hirschman et al (Hirschman, D., L. Woodworth and S. Drescher. 2009. *Technical Report: Stormwater BMPs in Virginia's James River Basin – An Assessment of Field Conditions and Programs*. Center for Watershed Protection. Ellicott City, MD). The basic form can be modified or adapted to meet the unique BMP terminology and design criteria employed

in each Bay jurisdiction. CSN is also developing a broader visual indicator method to assess BMP performance which it plans to release in 2013 (Bioretention Illustrated:A Visual Guide for Constructing, Inspecting, Maintaining and Verifying the Practice, http://chesapeakestormwater.net/wp-content/uploads/downloads/2013/04/REVIEW-DRAFT-OF-BIORETENTION-ILLUSTRATED-040113.pdf).

5. *BMP Verification as Adaptive Management*. The purpose of verification is to maintain or expand the pollutant removal performance of existing and future local stormwater infrastructure assets. Field assessments are used to identify which BMPs are working well and which ones require preventative or corrective maintenance to maintain their function. In addition, field verification enables local governments to analyze their historical inventory of private and public stormwater BMPs to identify which individual projects present the best opportunities for additional nutrient reduction through retrofits or restoration of existing BMPs.

   The real world data collected on actual BMP performance also enables local and state agencies to improve the next generation of BMPs in an adaptive management process. This process can isolate the specific site conditions, design features and maintenance tasks that influence BMP longevity and performance, and incorporate these into improved design specifications, review and inspection procedures and maintenance requirements. Future BMP expert panels would review such data to determine if these improved BMPs would qualify for a higher removal rate.

6. *BMP Reporting Must Be Consistent with CBP Standards*. Each state has a unique system to report BMPs as part of their MS4 permit. In some cases, states are still developing and refining their BMP reporting systems. Consequently, it may not be possible or even desirable to implement a Bay-wide BMP reporting format. However, to get credit in the context of CBWM progress runs, states will need to report BMP implementation data using CBP-approved rates or methods, reporting units and geographic location (consistent with NEIEN standards), and periodically update data based on the local verification of BMPs in the field.

7. *Initial Verification of BMP Installation*. MS4s will need to verify that urban BMPs are installed properly, meets or exceeds the design standards for its CBP BMP classification, and is functioning hydrologically as designed prior to submitting the BMP for credit in the state tracking database. This initial verification is provided either by the BMP designer or the local inspector as a condition of project acceptance, as part of the normal local stormwater BMP plan review process. From a reporting standpoint, the MS4 community should outline the BMP review and inspection procedures it has in place and indicate if adequate staff is available to implement them.

8. *Recommended Cycle for Field Verification of Urban BMPs*. Local inspectors should perform field performance verification for all of their BMPs at least once every other MS4 permit cycle (typically a permit cycle is 5 years). It is recommended that these rapid investigations of visual indicators be integrated into the routine stormwater BMP inspections already required under MS4 permits.

9. *Suggested Process for BMP Downgrades*. If a field inspection indicates that a BMP is not performing to its original design, the localities would have a defined time frame (e.g., one year) to take corrective maintenance or rehabilitation actions to bring it back into compliance. If a facility is not fixed during the defined timeframe, the pollutant reduction rate for the BMP would be eliminated, and the locality would report this to the state in its annual MS4 report. If corrective maintenance actions were verified for the BMP at a later date, the MS4 could take credit for it then.

10. *Special Procedures for Urban BMPs Used for Offsets, Mitigation and Trading*. Some urban BMPs are built to offset, compensate or otherwise mitigate for impacts caused by development elsewhere in the watershed. Examples include stream restoration mitigation and stormwater retrofit offsets when full compliance with stormwater performance standards is not possible at a new development site.

    In other cases, urban BMPs may be built for purposes of trading nutrient credits within a community or a state. Special procedures need to be developed in both cases to prevent double counting of BMPs. In addition, states and localities may elect to require more frequent BMP field inspection for these types of projects to assure they are meeting their intended nutrient reduction objectives.

11. *State Oversight of Local BMP Reporting*. To provide accountability, Bay states should audit a subset of local BMP project files, analyze local maintenance inspection records, or conduct joint field BMP inspections to verify performance under their existing MS4 regulatory authority. The state oversight process needs to be transparent and publicly accessible so that NGOs, watershed groups and other stakeholders can be confident that BMP implementation is real.

12. *EPA Review of State Verification Oversight*. EPA Region 3, under its existing NPDES MS4 permit oversight role, should periodically review the implementation of state BMP verification protocols to ensure they are being effectively implemented.

13. *Review and Verification of CBP BMP Accounting*: The accounting methods and verification procedures used by the Bay Program must be clear and transparent so that local governments and the states can readily understand how the urban BMPs they report are being used to calculate pollutant reductions in the Bay Model. Better communication among the Bay Program and its state and local government partners will help to improve BMP reporting and ensure a fair representation of State and local program implementation.

Part E: Principles for Verification for Semi-Regulated BMPs

The Workgroup created several options to address verification for semi-regulated BMPs (see Part B). These BMP are typically installed locally under a state construction general permit (CGP) outside of a MS4 community. Some of these non-regulated communities are not required to have an inspection program to enforce maintenance, or rely on the state to do it on their behalf (who in turn, may currently lack inspection/enforcement resources). The following options are recommended:

Option 1: Local or state agency follows the verification inspection process outlined in Part D and gets the same credit as a MS4 community.

Option 2: Local or third party performs verification inspections on a sub-sample of their BMP inventory. Non-MS4 communities may elect to reduce the scope of their visual inspections by sub-sampling a representative fraction of their local BMPs and applying the results to their entire population of BMPs that are credited in the CBWM. The sub-sampling method must be designed to have at least and 80% confidence level that the BMPs are reported accurately. There are several well accepted approaches to determining the sample size. These include using a census for a small population of BMPs, imitating a sample size of similar studies, using published tables, and/or applying formulas to calculate a sample size.

Option 3: State or third party conducts a sub-sample of BMP verification in a representative non-MS4 community, and applies the results to other comparable non-Ms4s in their portion of the watershed.

Option 4: Local government does not perform verification inspections and accepts gradual downgrades in BMP performance. Full performance credit is given for the first five years, and then is downgraded by 20% each year over the next five years, such that all BMP credits expire in ten years. This option is not intended to promote non-inspection, but rather, to give smaller communities more time to develop local inspection and verification programs.

Given the importance of BMP verification, states may wish to allocate some of their CBRAP grants to support BMP targeting and verification efforts in targeted non-MS4 communities.

Part F: Principles for Verifying Legacy BMPs

The Workgroup discussed the process by which states and MS4 communities would account for both legacy and discovered BMPs.

Legacy BMPs are those that have been reported to EPA CBP for inclusion into any past version of the CBWM for reduction credit over the past two decades. The goal over time is to clean up local and/or state BMP databases so that all entries are actual BMPs with a geographic address that can be subject to inspection verification. This implies that desktop and/or field inspections will be needed to confirm the geographic address of the BMP and determine whether estimated BMPs actually exist. Assembling an actual BMP inventory from historical data is a major task, and may take several years in some communities.

Localities may benefit when the clean up their BMP inventory since it is likely they will discover BMPs that were installed in the past but was never reported to the state for credit in the CBWM. They may also find cost-effective retrofit opportunities involving BMP conversion, enhancement or restoration (Retrofit Panel Expert Panel Report, http://www.chesapeakebay.net/documents/Final_CBP_Approved_Expert_Panel_Report_on_Stormwater_Retrofits--_long.pdf). CSN will be providing some methods for analyzing the local BMP inventory in a forthcoming Technical Bulletin to be released in 2013.

The Workgroup noted that the MS4 communities should seek to assess their entire BMP population with two MS4 permit cycles using the methods outline in the recently approved Stormwater Performance Standards Expert Panel. The Workgroup also noted that the burden of assessing legacy BMPs could be sharply reduced if the most problematic older BMPs were targeted first. For example:

- Assess all pre-2000 BMPs in first permit cycle, and focus on pre-1990 BMPs in the first two years of that cycle.
- Initially sub-sample their population of BMPs by type and year installed to look for problematic BMP types and design eras, and then focus inspection efforts on the problem BMPs in future years.
- Focus initial efforts to confirm whether estimated BMPs actually exist, and what their current condition is.

Part G: Process for Developing More Specific BMP Verification Protocols

The Workgroup is in the process of developing specific urban BMP protocols based on the work of numerous expert panels, as shown in Table 1. Additional verification protocols for other urban BMPs will be developed as new expert panels are formed.

Table 1: Status of Verification Protocol Development for Urban BMPs

BMP Class	BMP Types	Developed By	Status
Traditional Stormwater BMPs (CBP-approved)	Wet ponds, Dry ED Ponds, Constructed Wetlands, Bioretention, Infiltration, Filtering Practices, Grass Channels, Bioswales, Permeable Pavement	Use Verification Protocol Developed by Stormwater Performance Standards Panel	Agreed to at 10/16/2012 USWG meeting
Runoff Reduction Practices	ESD and LID practices installed in response to new state SWM regulations	Stormwater Performance Standards Panel	Approved by WQGIT
Operational BMPs	Urban Nutrient Management	Expert Panel	Approved by WQGIT
	Street Sweeping	Expert Panel	Projected early 2014
	Illicit Discharge Elimination	Expert Panel	Projected late 2013
	Erosion and Sediment Control	Expert Panel	Projected late 2013
Restoration BMPs	Stormwater Retrofits	Expert Panel	Approved by WQGIT
	Stream Restoration	Expert Panel	Approved by WQGIT
	Reforestation/Tree Planting	Expert Panel	Projected late 2013
	Shoreline Erosion Control	Expert Panel	Projected late 2013