Recommendations of the Expert Panel to Define Removal Rates for the Elimination of Discovered Nutrient Discharges from Grey Infrastructure

FINAL PANEL REPORT

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List of common acronyms used throughout the text:

BMP	Best Management Practices
CAST	Chesapeake Assessment Option Tool
CBP	Chesapeake Bay Program
CBWM	Chesapeake Bay Watershed Model
CMOM	Capacity, Management, Operation and Maintenance Programs
CSO	Combined Sewer Overflow
DIN	Dissolved Inorganic Nitrogen
GIS	Geographic Information Systems
HUC	Hydrologic Unit Code
HVAC	Heating Ventilation and Air Conditioning
IDDE	Illicit Discharge Detection and Elimination
I/I	Inflow and Infiltration
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
RR	Runoff Reduction
RT VM	Reporting, Tracking, Verification and Monitoring
SSO	Sanitary Sewer Overflow
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WIP	Watershed Implementation Plan
WQGIT	Water Quality Group Implementation Team
WTM	Watershed Treatment Model

Summary of Panel Recommendations

At the outset, the Panel coined the term "Nutrient Discharges" to refer to the complex range of non-stormwater flows that export nutrients and other pollutants into urban receiving waters during dry and/or wet weather conditions due to spills, leaks, and overflows from grey infrastructure. These discharges are created by the interaction of pollutant generating activities/sources with aging grey infrastructure (sanitary sewers, drinking water pipes and storm sewers) via stormwater runoff and groundwater migration.

Many nutrient discharges from grey infrastructure are regulated under MS4 permit requirements for illicit discharge detection and elimination (IDDE) and NPDES wastewater permit requirements to abate sanitary sewer overflows (SSO). More than 1,000 communities across the Bay watershed are now subject to one or both permits, but to date, most have not utilized their programs to specifically focus on potential nutrient reductions.

Nutrient discharges from grey infrastructure are not explicitly simulated in the current version of the Chesapeake Bay Watershed Model (CBWM), and no pollutant reduction credits are currently available to states and localities that invest in finding and eliminating them.

The Panel reviewed 15 different types of nutrient discharges from grey urban infrastructure, and concluded that they collectively can contribute a significant portion of the dry and/or wet weather nutrient loads in urban watersheds, although their share of the total load is extremely variable in both space and time. The Panel reasoned that nutrient reduction credits could be assigned when certain types of individual discharges are permanently eliminated, as confirmed by actual monitoring data.

The Panel evaluated the 15 different infrastructure-related nutrient discharges against five technical criteria to determine whether they were eligible for potential nutrient reduction credit should they be permanently eliminated. The following nine discharge types were recommended for an annual nutrient reduction credit, based on empirical measurement or calculations of the unique nutrient concentration, flow rate and discharge duration over the year.

1. Laundry Washwater
2. Commercial Car Washing
3. Floor Drains
4. Miscellaneous High Nutrient Non-Sanitary Discharges
5. Sanitary Direct Connections
6. Sewage Pipe Exfiltration
7. Drinking Water Transmission Loss
8. Dry Weather Sanitary Sewer Overflows
9. Chronic Wet Weather Sanitary Sewer Overflows

Six other types of nutrient discharges either could not meet the five technical eligibility criteria, or were already been addressed by the Wastewater Work Group or will be addressed by a future expert panel. Consequently, the Panel concluded that the following discharges are not eligible for nutrient reduction credit, as defined in this report:

1. Unexpected nutrient discharges from pipe breaks, spills, leaks and overflows that are reported to the local authority by the public or first responders and require immediate emergency repairs to stop the discharge.
2. Residential car washing
3. Selected transitory illicit discharges associated with power-washing, dumpster juice, transport accidents, and illegal sewage disposal by boats, recreational vehicles and transients.
4. Catastrophic wet weather sanitary sewer overflows that exceed the sewer design capacity
5. Combined Sewer Overflows (other procedures for estimating nutrient reductions associated with CSO abatement already exist)
6. Septic field discharges caused by system failure (subject of existing WWG expert panel)

After reviewing the available science, the Panel concluded that nutrient discharges from grey infrastructure could collectively account for as much as 20 to 40% of the dry weather nutrient load in urban watersheds, depending on the age and condition of its grey infrastructure. Given the site-specific nature of these discharges, however, the Panel could not estimate the relative contribution of the many different individual nutrient discharges that produce the loads.

The Panel concluded that nutrient discharges from grey infrastructure could also be a significant source of loads in urban watersheds during wet weather, although their presence is masked and diluted by the billions of gallons of stormwater runoff during these conditions. The Panel concluded that grey infrastructure discharges could account for 1 to 2% of the total urban wet weather load, particularly during intense or extreme storms.

The Panel further concluded that any nutrient reduction credit must be based on an empirical monitoring approach for each eligible individual discharge. The guiding principle was that elimination of a discovered nutrient discharge could only be considered an urban BMP, if they:

- Are detected and physically eliminated from 2009 or later.
- On-site sampling of the discharge that has been eliminated to define one or more of the following parameters -- nutrient concentration, flow rate and duration.
- Subsequent inspections and/or monitoring verify or otherwise confirm that discharge no longer exists

Toward this end, the Panel created three conservative computational protocols which can be used to estimate the annual nutrient reduction associated with the confirmed elimination of an eligible nutrient discharge. The protocols are summarized below, and design examples are provided in Section 5 to show users how they are applied.

Summary of the 3 Protocols to Estimate Nutrient Reduction Credits	
Protocol	**Requirements**
Protocol 1: The Prevented Load Calculation	Requires measurement or sampling of flow and concentration and/or the use of default values
Protocol 2: The Before and After Load Approach	Requires metering or tracing of changes in sewer or drinking water flow before and after infrastructure upgrades
Protocol 3: The Overflow Reduction Tracking Method	Requires before and after tracking of dry and/or wet weather overflow events in a sewershed before and after FOG pretreatment or infrastructure upgrades

In general, the specific protocol that is applied depends on the type of nutrient discharge that is eliminated and where in the storm drain or stream network in which it will be measured. The Panel also prepared a short profile sheet that describes each type of eligible nutrient discharge, the unique crediting approach for when the discharge is prevented or eliminated, as well as a design example to demonstrate how the credit is calculated.

In addition, the Panel also recommends that an interim programmatic credit be granted to localities that shift to a more nutrient-targeted approach to upgrading their grey infrastructure. This involves improvements to local IDDE programs that can demonstrate that they have shifted from a traditional visual outfall screening program to one that focuses on targeted nutrient screening, and meet several numeric metrics for program performance. The credit also applies to localities that can demonstrate their ongoing sewer upgrades are improving water quality by making progress on their SSO consent decrees.

This interim program credit is available to localities that are not yet sophisticated to use the protocols, but are implementing an advanced program that is working to eliminate nutrient discharges in their urban watersheds.

Communities that meet or exceed the metrics for their IDDE and SSO programs can qualify for a 2% reduction in their dry weather nutrient load as defined in Section 6. The programmatic credit expires in 3 years (end of 2017), at which time the community will need to report load reduction due to removal of individual nutrient discharges, using the protocols outlined in Section 5 of this report.

The basis for verifying the removal of nutrient discharges from grey infrastructure is different than other urban BMPs in that a discharge is being prevented rather than treated. Therefore, the Panel elected to require post-removal inspections, outfall and/or dry weather sampling to confirm that the individual discharge does not re-occur again. The Panel also outlined what localities need to submit to the state to get credit for nutrient reduction, and the records they must maintain to keep the credit.

The Panel did not propose any refinements to the next phase of the CBWM, given how difficult it is to simulate the processes that create nutrient discharges, but did agree that the collective nutrient load created by the range of nutrient discharges is probably a substantial part of the load from pervious and impervious land, and might be best simulated as a load produced in the urban stream corridor, rather than upland impervious or pervious urban land.

The Panel recommends that the Bay Program establish a nutrient discharge fingerprinting database. The database would consist of the nutrient concentrations, flow rates, and flow durations for each nutrient discharge type in the watershed, as they are submitted for credit. Analysis of this database should provide valuable information to IDDE and SSO managers, better predictive tools in the future and inform future default values for crediting.

The Panel acknowledges that the shift to a more nutrient-based approach for implementing IDDE and SSO programs will require more intensive training and outreach and more refined outfall monitoring protocols. Both programs also should continue to prevent leaks and spills of bacteria and other pollutants to the streams and rivers of the Chesapeake Bay, which would provide an additional public health benefit.

Section 1
Charge and Membership of the Panel

EXPERT BMP REVIEW PANEL Grey Infrastructure Upgrades	
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The initial charge of the Panel was to review all of the available science on the load generated by nutrient discharges from grey infrastructure (water, sewer and storm drain systems).

The Panel was specifically requested to:

- Make recommendations on how to better incorporate nutrient loadings from illicit discharges and sanitary sewer overflows into the urban land component of the Chesapeake Bay Watershed Model.

- Review available literature on the nutrient loading rates associated with grey infrastructure and the effect of measures to physically eliminate them.

- Provide a specific definition of what constitutes an illicit discharge and outline the qualifying conditions under which a locality can receive a nutrient reduction credit for eliminating it. The Panel may wish to define a nutrient monitoring protocol to determine the magnitude of the discharge and confirm that it has been actually eliminated.

- Define the proper units that local governments will use to report eliminated discharges to the state for inclusion into future CBWM progress runs, as well as verification procedures.

- Provide guidance to MS4 communities on improved stormwater outfall screening protocols to detect nutrient-laden discharges.

- Critically analyze any unintended consequences associated with the nutrient credit and any potential for double or over-counting of the credit

- Although bacteria is not specifically managed in the context of the Bay TMDL, the Panel was requested to determine if a protocol for bacteria reductions associated with Illicit Discharge Detection and Elimination programs (IDDE) is feasible in order to meet local bacteria TMDLs

- The Panel may also look at other sources of nutrients that enter the storm drain system during dry and wet weather and make appropriate recommendations, as warranted by the available research.

Beyond this specific charge, the Panel was asked to:

- Recommend procedures to report, track and verify that infrastructure discharges are actually being prevented or eliminated.

- Critically analyze any unintended consequences associated with the nutrient discharge credit and any potential for double or over-counting of the credit

While conducting its review, the Panel followed the procedures and process outlined in the WQGIT BMP review protocol (WQGIT, 2010). The process begins with BMP expert panels that evaluate existing research and make initial recommendations on removal rates. These, in turn, are reviewed by the Urban Stormwater Workgroup, and other Chesapeake Bay Program (CBP) management committees, to ensure they are accurate and consistent with the Chesapeake Bay Watershed Model (CBWM) framework.

Appendix A documents the process by which the expert Panel reached consensus, in the form of a series meeting minutes that summarize their deliberations. Appendix B shows how the panel conformed to the requirements of the urban BMP review protocol.

Section 2
Definitions Used in the Report

The analysis of grey infrastructure draws from a lot of complex terminology drawn from stormwater and wastewater engineering fields, as well as many water quality and public health regulations. To aid the reader, the Panel agreed on the following definitions that are used in this report.

Capacity, Management, Operation and Maintenance Programs (CMOM): A management system whereby wastewater utilities plan and manage how they can improve the performance and longevity of their sewage collection and pipe network assets.

Catchment: The land area (in acres) served by a storm drain system prior to its outfall.

Confirmation Inspection (CI): a field inspection that confirms whether a nutrient discharge has been effectively fixed or eliminated.

Confirmation Screening: Periodic outfall or stream sampling/screening for several years after a discharge has been eliminated to verify the discharge does not reoccur. The type and frequency of screening depends on the individual discharge type.

Consent Decree: A comprehensive multi-year construction plan by a community to invest in upgrades to its sewer collection infrastructure to reduce the volume and frequency of overflows, with a current emphasis on wet weather flows. EPA and/or the state wastewater regulatory agency establish the specific requirements of each consent decree.

Cross-Connection: A sewer pipe that is improperly connected to the storm drain system produces a continuous or intermittent discharge of raw sewage to the pipe.

Direct Connection: A sewer pipe or septic drain pipe that is directly connected to an open channel or stream corridor, usually involving small pipe diameters with continuous or intermittent flow.

Discharge Discovery Method: A series of field methods that are used to find, isolate and measure nutrient discharges from grey infrastructure. Several unique detection methods apply to each discharge type which are described in Section 5.

Discharge Elimination Practice: Refers to the specific practices that are implemented to prevent or eliminate a nutrient discharge from urban pipe infrastructure.

Discharge Type: One of nine nutrient discharges that are eligible for nutrient removal credit when they are effectively prevented or eliminated.

Discovered Nutrient Discharge: An existing nutrient discharge that is found through systematic assessment of a catchment, sewershed or stream corridor by the designated MS4 permit agency or local sewer utility, using the screening, tracing and analysis methods described in this report. Nutrient discharges that are discovered using these methods may be eligible for a credit if they lead to the prevention or elimination of the discharge.

Drinking Water Transmission Loss: The loss of water through the drinking water pipe network as it moves from the producer to the user.

Dry Weather Nutrient Loads: The proportion of the annual nutrient load from urban watersheds that is delivered when it is not raining.

Dry Weather Sanitary Sewer Overflows (SSOs): Sewage overflows that occur when sewer pipes become blocked or obstructed by roots, solids or fats, oil and grease. Sewer lines are often designed to surcharge through the manhole during these events so as to prevent the sewage from backing up into residential basements.

Dry Weather Stream Monitoring: Sampling of nutrient and bacteria in urban streams to isolate catchments with a high risk of nutrient discharge. Also, may be used in some catchments and sewersheds to confirm and verify that the discharges have been effectively eliminated.

Pipe or Infrastructure Failure: Complete cessation of pipe or infrastructure design function that causes non-stormwater flows to be discharged into the storm drain system or directly into the stream. Examples include sewer or water pipe breaks associated with extreme weather, intense storms or aging infrastructure.

Fats, Oil and Grease (FOG) Reduction Program: A pre-treatment program to prevent businesses from discharging these materials into the sewage collection system, which are known to cause pipe blockages and dry weather sanitary sewer overflows.

Illicit Discharge: Any non-stormwater discharge of pollutants to a municipal separate storm sewer system (MS4), except for discharges resulting from fire-fighting activities and other authorized non-stormwater discharges specified in the NPDES permits.

Illicit Discharge Detection and Elimination (IDDE): A local program to detect and eliminate illicit discharges from the storm drain system. IDDE programs are mandated as one of the six minimum stormwater management measures that must be addressed by communities regulated under Phase 1 or Phase 2 MS4 NPDES stormwater permits.

Inflow and Infiltration (I/I): Inflow refers to the entry of runoff to the sewage collection system during storm events, whereas infiltration refers the movement of groundwater into the sewer pipe system through cracks and joints. Together, these two processes dilute the sewage concentrations in the affected pipe, and may also cause wet weather SSOs to occur.

MS4 Permit Agency: The local agency responsible for complying with their municipal separate storm sewer system (MS4) NPDES permit.

Outfall Screening Method: A method that uses water quality indicators to determine the source and severity of contamination of dry weather flows in storm drain system. The best known is the Flow Chart Method (p. 130-133 in Brown et al, 2004), which uses the relative concentrations of ammonia, boron, potassium and fluoride in an outfall water sample to establish the likely source of contamination.

Overflow Tracking: Method for estimating the frequency, volume and duration of sewage overflows within a defined sewershed.

Pipe Defects: Deficiencies in pipes that create structural defects such as cracks, fractures, breaks, deformations, faulty alignment, open joints, that can lead to underground nutrient discharges.

Reported Nutrient Discharge: Unexpected discharges from pipe breaks, spills, leaks and overflows that are reported to the local authority by the public or first responders and require immediate emergency repairs to stop the discharge. Most of these involve sudden pipe and/or infrastructure failure that is easily observed. Reported nutrient discharges are generally NOT eligible for nutrient reduction credits.

Sewer Exfiltration: The process that occurs when pipes are located above the water table and sewage leaks through pipe joints and cracks and migrates into adjacent storm drain pipes or into shallow groundwater.

Sewershed: The land area (in acres) effectively served by the sanitary sewer network to a defined study point. In some cases, the sewershed and catchment are the same since both pipes rely on gravity. In other cases, the sewershed relies on pumping stations to effectively move sewage through the network.

Wet Weather Nutrient Loads: The fraction of the annual nutrient load from an urban watershed that is delivered when it rains, primarily from stormwater runoff but also including any wet weather sewage overflows.

Wet Weather Sanitary Sewer Overflows: When groundwater infiltration and stormwater inflow enter sewer pipes and the excess water overwhelms the sewer's capacity to handle sewage, causing overflows at manholes and other points in the sewer system.

Section 3
Background on Nutrient Discharges from Grey Infrastructure

3.1 Our Leaky Grey Infrastructure

In the context of this report, "grey infrastructure" is defined as the underground network of sewer, water and storm drain pipes that serve a community. Most cities and counties in the Bay watershed maintain thousands of miles of pipes to move drinking water, sewage and stormwater runoff to where it needs to go. Many segments of this urban infrastructure are aging and are prone to leakage and overflows. Therefore, what goes into the pipe network doesn't always come out the other end. Multiple lines of evidence show that all three kinds of grey infrastructure are quite leaky, and their flows often commingle together and migrate to urban streams.

There are many complex interactions among the three kinds of infrastructure, as they are heavily influenced by local groundwater and storm runoff. Under certain conditions, they can interact together to produce high nutrient discharges to local streams, and are believed to be responsible for the high nitrogen loads observed during dry weather in urban watersheds. Communities that invest in strategic upgrades to reduce or eliminate nutrient discharges from their infrastructure are eligible for nutrient reduction credits in the Chesapeake Bay Watershed Model. This section describes the complex technical and regulatory background on how nutrient discharges from grey infrastructure are managed in the Bay states, as well as how they are represented in the context of the CBWM.

3.2 Illicit Discharges to the Storm Drain System

Illicit discharges occur when non-stormwater flows end up in the storm drain system. Discharges can enter the storm sewer through *direct entry* in the case of sewer pipes and other pipes that are illegally connected to a storm sewer, or *indirect entry* where flow enters the storm drain system through inlets or leaks/cracks within storm drain pipes (Brown et al, 2004). Illicit discharges that flow *directly* into the storm drain system via a straight pipe have measurable concentration and flow associated with them. Examples of these kinds of discharges include floor drains, direct connections from residential or commercial laundry facilities and other straight pipe discharges (See Figure 1).

Illicit discharges comprise a wide range of flow types with variable nutrient concentrations, flow and modes of entry into the storm drain system. Not all dry weather flows in the storm drain system contain pollutants. Many are caused by groundwater seepage into the storm drain pipes. Various outfall screening methods are available to isolate the storm drain flows that contain sewage and other pollutants, and trace them back to their source (Brown et al, 2004). As one example, over three hundred stormwater outfalls were tested in two urban watersheds in Maryland, and non-stormwater flows were detected during dry weather in more than a third of all outfalls (Lilly et al, 2012). They also observed indicators of the presence of sewage in half of the outfalls with non-stormwater flows.

Figure 1. Residential sanitary pipe incorrectly connected to the storm drain system (Photo credit: Kent Count, Michigan, http://www.accesskent.com/Departments/DrainCommissioner/stormwater.htm)

3.3 Regulatory Background on Illicit Discharges

Non-stormwater discharges to the storm drain system are regulated under the minimum management measures prescribed for illicit discharge elimination by the state stormwater agency. MS4 NPDES stormwater permits prescribe that communities must develop and maintain a program to control these discharges by implementing the following minimum management measures for illicit discharge detection and elimination (IDDE):

- Adopt and enforce a local ordinance to prohibit illicit discharges to the MS4 storm drain system.
- Create a map and inventory of their storm drain system, including all outfalls greater than 36 inches in diameter.
- Screen outfalls in the field to isolate illicit discharges in every MS4 permit cycle.
- Educate public employees, businesses and the general public about the hazards of illicit discharges.
- Establish a hotline or other method so residents can report illicit discharges.
- Implement the most effective detection and elimination practices to find, fix and control illicit discharges, and set measurable goals during each permit cycle.

More information on components of an effective local IDDE program can be found in Brown et al (2004). Over a thousand communities in the Bay watershed are required to administer an IDDE program under their MS4 permit, although the quality and effectiveness varies widely from community to community.

Most MS4 communities in the Bay watershed use visual indicators to screen their stormwater outfalls to detect illicit discharges, although several states are now requiring Phase 1 permittees to conduct water quality monitoring at suspect outfalls. MS4 communities currently do not get any nutrient reduction credit if they actually eliminate a real illicit discharge in their watershed.

3.4 Sewer Exfiltration and Overflows

Sewer pipes are not designed to be water tight. Sewer design sets a standard for allowable leakage during construction, which averages 125 gallons per 400 feet of pipe, which is the standard distance between sewer manholes (ASTM, 2009), or about 1,650 gallons per mile of standard sewer pipe. Sewer pipes become leakier over time as cracks occur and pipe joints expand.

Most of the measurements of sewer exfiltration rates have been conducted in Europe, Australia and the West Coast. The rates are quite variable and span three orders of magnitude. Ellis et al (2008) summarized typical exfiltration rates ranging from about 350 to 7,250 gallons of sewage per day per mile of sewer pipe (assuming the standard 6 to 8 inch diameter pipe). The variability in exfiltration is strongly influenced by the dynamic evolution and decay of a biofilm layer on the outside of the sewer pipe.

Even sewers that do not exfiltrate are influenced by groundwater infiltration and stormwater inflow into the sewer pipe system (known as infiltration and inflow). The excess water can overwhelm the sewer's capacity to handle sewage, leading to overflows at manholes and other points in the sewer system. These are known as wet weather sanitary sewer overflows (SSOs). According to a recent study by Vallabhaneni and Miles (2008), about 4% of the rainfall in an average storm over a typical urban sewershed flows into its sewer pipes, rising to nearly 30% during extreme storm events.

This excess flow, referred to as inflow and infiltration (I/I), causes capacity issues within the conveyance system and often leads to unanticipated overflows of sewage (Figure 2). Aging pipe infrastructure in many communities causes chronic I/I problems during storm events.

During large storm events, sanitary sewers are typically designed to discharge excess flow into waterways through “structural overflows” or surcharged manholes to prevent sewage from backing up into basements through business or household lateral connections. Wastewater flows fluctuate on diurnal, weekend/weekday, and seasonal cycles. Further, I/I problems increase in sewer systems as a result of large storms or extended wet weather periods which elevate the groundwater table. The large volume of

I/I diminishes the nutrient concentrations during wet weather SSOs by as much as 75% (EPA, 2004).

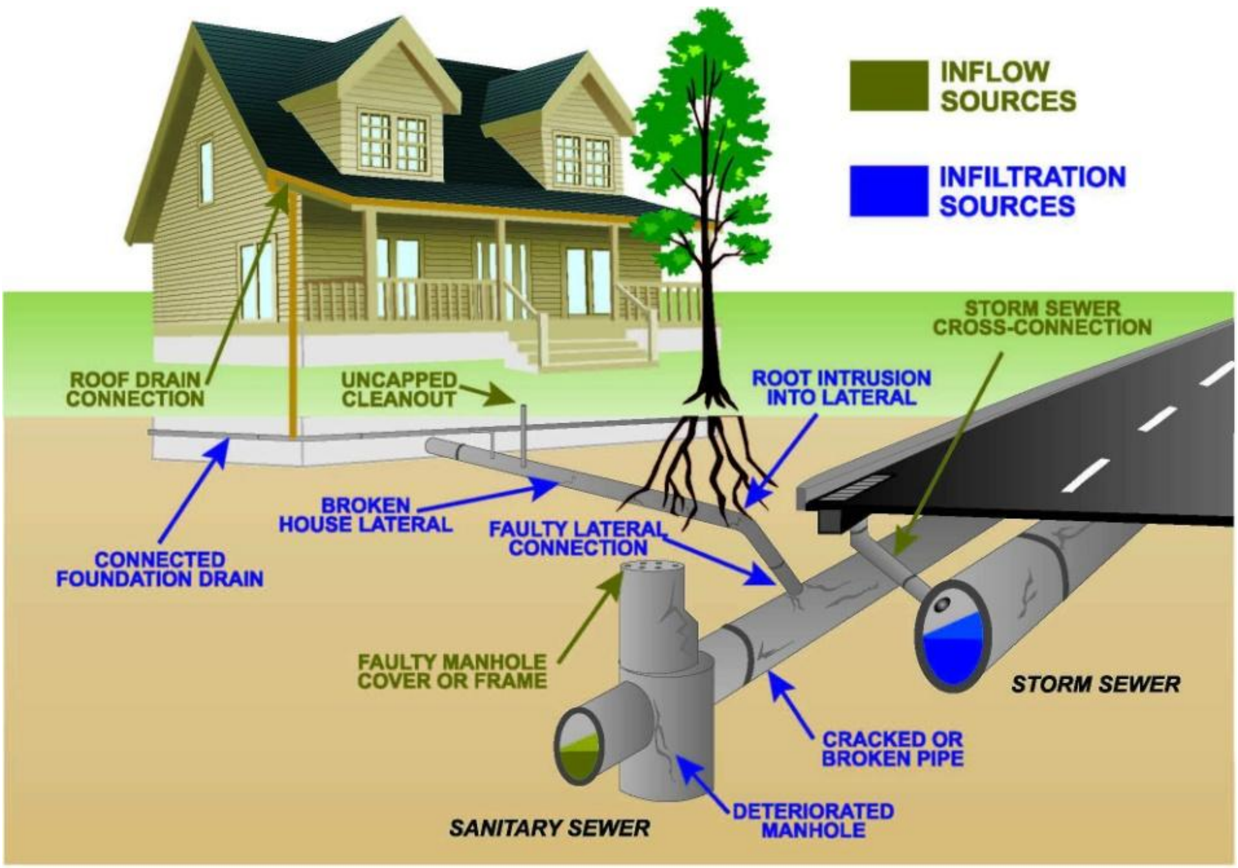

Figure 2. Example of inflow and infiltration pathways. (Photo credit: City of Bryan, Texas)

Dry weather sanitary sewer overflows (SSOs) occur when sewer pipes become blocked or obstructed by roots, solids or fats, oil and grease. Sewer lines are intentionally designed to surcharge through the manhole when these back-ups occur to prevent the sewage from backing up into residential basements. Since sewer lines generally rely on gravity flow, they are often located in the urban stream corridor.

When these dry weather sanitary sewer overflows occur, they can quickly deliver un-diluted sewage into the stream. Because dry weather SSOs are less influenced by I/I, the nutrient and bacteria concentration from these discharges are comparable to the influent concentrations at wastewater treatment plants (EPA, 2004).

3.5 Regulatory Background on Sanitary Sewer Overflows

Wastewater utilities are subject to NPDES permits that essentially prohibit the discharge of raw sewage from their collection and treatment system. While Bay states are all sharply increasing the nutrient reduction achieved at their wastewater treatment plants, there has been less emphasis in reducing nutrient losses from the sewage collection system.

Wastewater utilities must report any sewage spills and overflows that occur in their collection system to their state NPDES agency, including an estimate of the flow volume, the duration of the event and evidence that the problem has been corrected (EPA, 2004). Based on these reports, the State NPDES agency will frequently impose a fine. If a community experiences frequent system-wide overflow problems, they are often required to upgrade their sewage infrastructure in what is known as a consent decree.

Nearly all of the larger communities in the Bay watershed are now subject to consent decrees which require major long-range investments in sewer repair, replacement and rehabilitation to reduce the frequency and volume of sewage overflows. Examples include Baltimore, District of Columbia, the Maryland and Virginia suburbs, Richmond, Harrisburg, and the Virginia tidewater. The emphasis of most consent decrees is on the reduction of wet weather sanitary sewer overflows, with some attention to dry weather overflows.

3.6 Drinking Water Transmission Loss

Substantial losses are also experienced as drinking water goes from the treatment plant to the tap. In the drinking water world, this is known as unaccounted for water (UFW). According to the International Water Supply Association, the typical amount of transmission loss ranges from 20 to 30% of water production (Cheong, 1991). Transmission losses can approach 50% in communities with aging water infrastructure (AWWA, 1987) and averages about 15% in communities with newer water lines (Burn et al, 1999). While the nutrient concentrations in drinking water are quite low, the large volume of transmission losses can introduce a significant nutrient load into urban groundwater (Lerner et al, 1999).

While the <u>quality</u> of drinking water is tightly regulated under numerous state and federal safe drinking water regulations, the <u>quantity</u> of treated drinking water that is lost in transit from the plant to the tap is not. Most water utilities have an economic interest in minimizing the loss of potable water in transit however, despite that they often have hundreds or even thousand miles of underground pipes assets to oversee and manage.

3.7 How Nutrient Discharges from Grey Infrastructure are Simulated in the Chesapeake Bay Watershed Model

Nutrient discharges from grey infrastructure are not explicitly simulated in the current version of the Chesapeake Bay Watershed Model (CBWM), mainly because their variability and complexity make it difficult to forecast flows, concentrations or loads over the long term. Instead, the nutrient discharges are implicitly assumed to be part of the nutrient load from both pervious (dry weather) and impervious land (wet weather). The total urban loads are calibrated to a target nutrient load based on observed monitoring data from the literature, river and stream monitoring stations and statistical models (Shenk, 2012).

Section 4
Review of the Available Science on Nutrient Discharges from Grey Infrastructure

The Panel reviewed more than 60 papers and reports on nutrient discharges from grey infrastructure. This section describes the key findings based on the literature review.

4.1 Evaluation of Urban Nutrient Discharges

The panel developed technical criteria to determine if the elimination of a nutrient discharge type could be eligible for a reduction credit. The Panel decided a discharge type must meet all five of the following criteria to be eligible:

1. The unique nutrient discharge must be discovered by the local authority through a systematic assessment of the catchment, sewershed or stream corridor.

2. The discharge type must have a <u>definable nutrient concentration</u>. The local authority must be able to measure the concentration through direct sampling, or there must be enough robust data in the literature to confidently assign a default value (Table 1). The intensity of sampling requirements is in direct proportion to the flow volume associated with the discharge type.

3. Each individual discharge type must have a <u>measurable flow volume and duration</u> so that a total nutrient load can be computed for each discharge event. The local authority must be able to estimate both the flow volume and duration through direct metering, visual observations or engineering analysis. For smaller discharge events, the flow data can be estimated using accepted default values from the scientific and engineering literature (Table 2).

4. The <u>specific corrective actions taken to eliminate the discharge must be clearly documented</u> (e.g., slip-lining a leaky sanitary pipe or removing an illicit connection and reconnecting it to a sanitary sewer pipe).

5. Additional screening, sampling or monitoring must be conducted to confirm and verify that nutrient discharge has been permanently removed. The length and intensity of sampling needed for verification is related to the estimated nutrient load that is eliminated (Section 5).

Based on these technical criteria, the Panel decided that nine discharges types could be eligible for a credit.

1. *Laundry Washwater*: Washwater flows that result in the discharge of washwater into the storm drain system. It may involve a residential situation or a commercial laundry operation.

2. *Commercial and Mobile Vehicle Washing:* Washing of vehicles that results in the discharge of washwater into the storm drain system.

3. *Floor Drains*: Floor or foundation drains illegally connected to the storm drain system.

4. *Miscellaneous High Nutrient Illicit Discharges*: Nutrient-based outfall screening programs may detect other illicit discharges that can contribute high nutrient loads to local waterways. For example, Lilly et al (2014) recently reported that discharges from rooftop HVAC system can contribute high nitrogen loads to the storm drain system.

5. *Sanitary Direct Connection:* A sewer pipe that is improperly connected to the storm drain system either through a cross-connection or from a straight pipe. This discharge category produces a continuous discharge of raw sewage into the storm sewer system or directly to a stream.

6. *Sewer Pipe Exfiltration:* Loss of sewage from sanitary sewer pipes during dry weather through the groundwater matrix to the storm drain system as a result of cracks or leaks in sewer pipes.

7. *Drinking Water Transmission Loss:* The loss of drinking water as it is delivered in pipes to the consumer that reaches the stream through storm drain pipes and/or groundwater migration.

8. *Dry Weather Sanitary Sewer Overflows:* A sanitary sewer overflow that occurs during dry weather periods as a function of either a blockage or failure of the sanitary sewer system.

9. *Chronic Wet Weather Sanitary Sewer Overflows*: Overflows that occur during rain events less than or equal to the design capacity of the system. These overflows are a function of an inadequately sized system or aging infrastructure (excess inflow and infiltration).

The Panel also agreed that six discharge types could not meet the technical criteria were therefore not eligible to receive a credit, as defined in this report:

1. Unexpected nutrient discharges from pipe breaks, spills, leaks and overflows that are reported to the local authority by the public or first responders and require immediate emergency repairs to stop the discharge.
2. Residential car washing
3. Selected transitory illicit discharges associated with power-washing, dumpster juice, transport accidents, and illegal sewage disposal by boats, recreational vehicles and transients.
4. Catastrophic wet weather sanitary sewer overflows that exceed the sewer design capacity
5. Combined Sewer Overflows (other procedures for estimating nutrient reductions associated with CSO abatement already exist)
6. Septic field discharges caused by system failure (subject of existing WWG expert panel)

4.2 Nutrient Discharge Characterization

The Panel evaluated the scientific and engineering literature to define the general nutrient concentration, flow volumes and durations associated with the nine discharge types, which are shown in Tables 1 and 2.

Table 1
Default Nutrient Concentrations Associated Different Discharge Types

ID	Name	TN	TP	Notes/Sources
N-1	Laundry	3.2	0*	Brown, 2004, Appendix E
N-2	Car Wash	0.9	0.1	Brown, 2004, Appendix E
N-3	Floor Drain	4.9	--	Requires sampling
N-4	Misc. Discharge	N/A	N/A	Requires sampling
N-5	Sanitary Direct	33.0	6.0	EPA, 2004
N-6	Sewage Exfiltration	33	6.0	Subject to Discount
N-7	DW transmission	1.7	0.3	Or From DW CCR's
N-8	Dry Weather SSO	33	6.0	EPA, 2004
N-9	Wet Weather SSO	9	1.5	Dilution by inflow

* assumed to be zero as to reflect P ban in laundry detergent (Litke, 1999).

The product of these three variables provides a general indication as to the potential nutrient load associated with each discharge event.

Table 2 Comparative Magnitude of Discharge Flow Volumes and Durations			
ID	**Name**	**Discharge Volume**	**Duration**
N-1	Laundry	10 to 100 gpd	I, a few hours per week
N-2	Car Wash	100 to 10,000 gpd	I, during business operations
N-3	Floor Drain	10 to 100 gpd	I , a few hours per week
N-4	Misc Discharge	1 to 10 gpd	I/C
N-5	Sanitary Direct	1 to 100 gpd	I/C,
N-6	Sewage Exfiltration	100 to 5000 gpd/spm	I/C
N-7	DW transmission	100 to 5000 gpd/spm	C
N-8	Dry Weather SSO	500 to 10,000 gpd	I, episodic
N-9	Wet Weather SSO	25,000 to 250,000 gpd	I, during large storms
KEY: gpd = gallons per day, spm = standard pipe mile, I= intermittent discharge, C= continuous discharge. * Flow estimates are general and are based on literature and state SSO databases. NOTE: Values shown only for informational purposes, and SHOULD NOT BE used as defaults in the calculation of removal credits			

4.3 Review of Major Discharge Types

A. Illicit Discharges to the Storm Drain System

In general, there has not been a lot of research to define the nutrient concentrations in illicit discharges. The best assessment is presented in Appendix E of the IDDE report (Brown et al, 2004).

B. Exfiltration from Sanitary Sewers

Exfiltration from sanitary sewers can contribute to nutrient loads. Amick and Burgess (2000) conducted a national assessment of sewer exfiltration, and concluded while many factors cause exfiltration the most important is when the water table is lower than the invert of the sewer pipe. Consequently, exfiltration is likely to be greater for shallow sewer line and service laterals that are often located above the water table.

Ellis et al (2004) report that frequent sources of exfiltration are house connections especially at their junction with the main sewer line, as these pipes are often above the water table. Ellis et al (2008) summarized typical exfiltration rates ranging from about 350 to 7,250 gallons of sewage per day per mile of sewer pipe (assuming the standard 6 to 8 inch diameter pipe). The variability in exfiltration is strongly influenced by the dynamic evolution and decay of a biofilm layer on the outside of the sewer pipe.

Most of the research measurements of sewer exfiltration rates have been conducted in Europe, Australia and the West Coast (Ellis et al, 2008, Ellis, 2011, OCSD, 2008, Sercu et al 2011). The rates are variable in both space and time, and can span three orders of magnitude. Ellis et al (2008) conducted a research review that indicated exfiltration losses are greatest in pre-1960 sewer pipes, but can occur in younger sewer networks, as well.

Prigiobbe and Giulianelli (2011) used continuous tracers and reported a sewer exfiltration rate of 12% in Italy. Fenz et al (2005) used an anti-epileptic drug as a tracer in a German sewer system and reported a 1% exfiltration loss system-wide, but a 5% loss in problem segments of the sewer network. A follow up study by Ruzicka et al (2011) documented that exfiltration losses were reduced by half after reconstruction of the problem sewer segments. Rieckerman (2009) notes that detection limits in most sewer tracer methods can only accurately measure flows to within +/- 10%, so that it is difficult to precisely measure exfiltration losses.

Most of the exfiltration occurs in small pipe defects that are hard to find (cracks, joint leaks, and at manhole connections. OCSD (2008) reported that 3.7 to 32 gallons of sewage per day exfiltrated at each pipe defect, although several defects experienced no exfiltration. This reflects the dynamic nature of exfiltration over the year, as to some extent, these defects are self-sealing. Over time, the organic matter and sewer solids form a colmation layer (congestion that leads to a seal) at the point of leakage, which may also be covered by a biofilm layer. At low sewer pipe flows, these layers slow or reduce sewage exfiltration, but the layers are disrupted during daily pulses of higher sewer flows. The exfiltrated sewage can either migrate into storm drains, as shown in Figure 3, or reach the water table where it may also migrate to an urban stream.

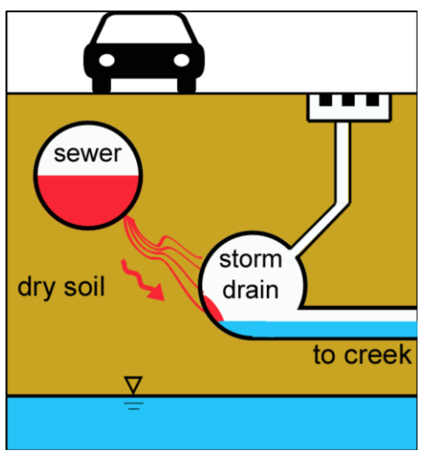

Figure 3. Exfiltration pathway from sanitary sewer line to storm drain system. (**Photo credit: Sercu, 2011).**

The research indicates that four factors promote greater sewer exfiltration:

- Older sewer pipes, with outdated pipe material specifications
- Sanitary sewer pipes that are located above storm drain pipes
- Sanitary sewer and storm drain pipes that cross each other or are in close proximity to another
- Both pipes are located above the water table

C. Estimates of Dry and Wet Weather SSOs in the Bay Watershed

The Panel could find very few estimates of the contribution of SSOs to urban nutrient loads. A national assessment by EPA (2004) estimated that SSOs discharge between 3 and 10 billion gallons of "comingled" sewage and stormwater into the nation's waterways every year. EPA (2004) also estimated that 48% of all SSO events were caused by complete or partial sewer blockage and 26% were caused by wet weather and I/I. EPA also noted that wet weather SSOs had a greater total overflow volume than dry weather SSOs.

The Panel reviewed Bay state databases in an effort to document the number and volume of dry weather SSOs that are reported each year by wastewater utilities. The review indicated that hundreds of dry weather SSO events occur each year in each major wastewater service area; thousands are reported on a state-wide basis every year. In general though, the overflow volume associated with wet weather SSOs appeared to be greater than those produced by dry weather SSOs.

Due to incompatible formats and data quality issues, however, state data could not be compared, and a Bay-wide estimate of an annual SSO volume could not be derived. Some of the key data quality issues involved visual estimates of the sewage volume discharged during each SSO event, and the difficultly in establishing when the SSO event actually began (as opposed to when it was first reported).

Notwithstanding the data quality issues, the Panel concluded that dry and wet weather related SSOs were a potential source of controllable nutrient loadings in many parts of the Bay watershed.

4.3 Overall Contribution to Dry Weather Nutrient Loads

A. Significance of Dry Weather Nutrient Loads in Urban Streams

The conventional thinking is that stormwater runoff delivers the vast majority of the nutrient load from urban watersheds, but the Panel discovered multiple lines of evidence that this may not be true, especially for nitrogen. The first line of evidence comes from the calibration of the Chesapeake Bay Watershed Model itself. In urban river basin segments, as much as 25 to 40% of the simulated annual nitrogen load is delivered during dry weather periods (Shenk, personal communication), with a somewhat lower phosphorus load.

Recent stream research in six urban watersheds in Minnesota determined that dry weather baseflow accounted for approximately 50% of the total water yield during the growing season (Finlay and Hobbie, 2013). The authors also reported that dry weather baseflow was responsible for about 20% of annual TP load and 30 to 70% of the annual TN loads in the test watersheds. Most of the nitrogen load during dry weather was in the form of dissolved inorganic nitrogen (DIN).

Stewart et al (2005) also looked at the ratio of dry weather nutrient loads to the annual nutrient loads in six urban streams in Baltimore County, MD, which were located in watersheds with 25 to 50% impervious cover. They reported that dry weather phosphorus loads ranged from 2 to 25% of the annual load, and dry weather nitrogen loads were 7 to 65% of the annual load. The authors concluded that dry weather sewage discharges were the source of the highest dry weather stream loads.

Two California studies reported a major influence of dry weather flows on total annual nutrient loads. In Los Angeles, Stein and Ackerman (2007) reported that dry weather nutrient loads accounted for 20 to 60% of the annual nutrient load. Similarly, McPherson et al (2005) sampled another Los Angeles watershed, and reported that dry weather flows contributed more than 40% of the annual nitrogen and phosphorus loads. The Panel felt that these studies may not be fully transferable to the Chesapeake Bay watershed because they were done in a more arid climate and a significant fraction of the dry weather flows were produced by irrigation return flows and discharges from water reclamation plants.

B. The Significance of Sewage as a Nutrient Source in Dry Weather Flows

These findings are reinforced by recent research on urban streams in Pittsburgh, PA by Divers et al (2013). They reported that sewer leakage to the stream could account for up to 12% of the nitrogen load carried by the sewer, and that most of the loss occurred during dry weather periods, when high DIN concentrations were consistently measured. Based on their analysis, Divers et al (2013) estimated that sewage contributions could account for 5.4 to 12.5 lbs DIN/acre/year, which was a significant fraction of the annual nitrogen budget in their urban watersheds.

Similar results were reported by Lilly et al (2012) who sampled dry weather flows at more than 300 storm drain outfalls in two urban watersheds in Maryland. They reported that 16% of the outfalls tested positive for indicators of sewage contamination, and the cumulative nutrient load generated from the suspect outfalls could account for 20 to 100% of the observed dry weather nitrogen load in the two urban streams.

Further evidence for the sewage origin of dry weather DIN was provided by the stable isotope analysis conducted in six Baltimore streams by Kaushal et al (2011). He concluded that sewage was the predominant source of nitrogen load during dry weather flow. Hyer (2007) used multiple continuous tracers in Accotink Creek in Northern Virginia and found direct evidence of sewage contamination during dry weather flows, isolating three major sewage breaks and a dozen minor ones (although the actual nutrient load contribution was not calculated).

Sauer et al (2011) provided further evidence of dry weather sewage contamination in a study of stormwater outfalls at four urban watersheds in Milwaukee, Wisconsin. They concluded that storm drain outfalls were an effective conduit for sewage leaks to move away from the sanitary sewer. The research team intensively sampled 45 stormwater outfalls over a four-year period using traditional and alternative indicators of fecal pollution. All outfalls were found to have a human *Bacteroides* genetic marker detected in at least one sample, "suggesting sewage contamination is nearly ubiquitous in the urban environment."

Most outfalls were intermittently positive, with fecal indicators detected from 11% to 100% of the time. The major source of fecal pollution appeared to be from sewage sources rather than non-human sources based on the ratios of human *Bacteroides* to total *Bacteroides spp*. Sauer et al also found that high I/I levels in sewers were linked to elevated human *Bacteroides levels* in adjacent stormwater outfalls.

A definitive link between sewage exfiltration and bacterial contamination in storm drains was made by Sercu et al (2011) in urban watersheds in Santa Barbara, CA. The research team utilized tracers in urban storm drain systems during dry-weather flow and found direct evidence that leaking sanitary sewers directly contaminate nearby storm drains. Although they did not measure nutrients, they also concluded that chronic sanitary sewer leakage was a major contributor to downstream beach contamination.

Two other studies showed little or no improvement in dry weather nutrient or bacterial loads in Baltimore streams, despite long term sewer system upgrades to reduce wet weather SSOs (CWP and Biohabitats, 2011). In response to a consent decree, the City spent millions of dollars to control wet weather SSOs, but the CWP studies demonstrated that the upgrades had little impact on dry weather nutrient loads in the ten streams that were sampled.

C. Overall Panel Finding

After reviewing the available science the Panel concluded that sewage exfiltration was a major source of DIN to urban streams during dry weather, but determined that specific loads in individual watersheds could not be reliably predicted at the present time. In the best professional judgment of the Panel, nutrient discharges from grey infrastructure could collectively account for as much as 20 to 40% of the dry weather nutrient load in urban watersheds, depending on the age and condition of its grey infrastructure. Given the site-specific nature of these discharges, however, the Panel could not estimate the relative contribution of the many different individual nutrient discharges that produce these loads.

There is some question as to the actual delivery of these loads to streams and potential losses due to denitrification. The panel took a conservative approach and discounted the loads based on proximity to the stream corridor.

4.4 Overall Contribution to Wet Weather Nutrient Loads

As noted earlier, the Panel could not derive an accurate estimate of the nutrient load that could be attributed to wet weather SSOs in the Bay watershed (see Section 4.3). Part of the reason is that wet weather SSOs are frequently masked by the enormous stormwater runoff volumes that are generated during rain fall events. For example, a one inch rain event that falls over a one square mile urban watershed (at 50% impervious) produces nearly nine million gallons of stormwater runoff, which dwarfs the impact of any individual wet weather SSO event.

According to EPA (2004), SSOs account for about 1 to 2% of the municipal discharges of sewage loads on an annual basis, but this is only a general estimate. An unpublished analysis by MDE of its SSO database indicated that they represented about 1% of the total nutrient load from its urban sector in its Phase 1 Watershed Implementation Plan.

The Panel concluded that nutrient discharges from SSOs were a small but potentially controllable load source in urban watersheds during wet weather, although their presence is masked and diluted by the billions of gallons of stormwater runoff during these conditions. The Panel concluded that grey infrastructure discharges could account for 1 to 2% of the total urban wet weather load, particularly during intense or extreme storms.

4.5 Ability to Discover and Eliminate Nutrient Discharges from Grey Infrastructure

The next key issue the Panel considered was whether we have the technology to discover nutrient discharges from grey infrastructure and eliminate them.

Many new methods have been tested in the last decade to discover nutrient discharges from the storm drain and sewer network (Brown et al, 2004, Burn et al, 1999, Holden et al, 2011, Hyer et al, 2007, Irvine et al 2011, Murray et al, 2011, and Sercu et al, 2011). A summary of the discovery methods is provided in Table 3.

The Panel agreed that the high nutrient levels detected in dry weather warrants more widespread use of nutrient-based indicators for outfall screening. Such screening could be a potentially cost-effective strategy for local governments to achieve greater nutrient reductions (Lilly et al, 2012). The only limitation of these methods is that while they are effective at finding suspect outfalls and sewer pipe segments, they often require considerable sleuthing to find the specific source or location of the nutrient discharge.

Once found, the methods to prevent or eliminate the nutrient discharge are fairly straightforward, as shown in Table 4.

Table 3
Summary of Methods to Discover Nutrient Discharges from Grey Infrastructure

• Visual Inspection and Outfall Screening • Flow Chart Method to Sample Suspect Outfalls • Source Tracking • Smoke Testing • Dye Testing • Optical Brightener Testing • Closed Circuit Television • HVAC testing	• Trained Sewage Sniffing Dogs • Stream Walks to Look for Small Diameter Pipes • GIS Analysis of Storm and Sewer Pipe Interactions • Sewer pipe flow metering • Continuous tracers in sewers • Nitrate Isotopes • Human Markers (caffeine, Bifidobacterium) • Overflow reporting • CMOM and other sewer asset programs

Table 4
Common Methods to Prevent or Eliminate Nutrient Discharges

• Reconnecting Pipe to Sewer Network • Change in HVAC Management Practices • Slip-lining Sewer or Water Pipes • Reducing I/I into Sewer System	• Sewer or Water Pipe Replacement • Sewer or Water Pipe Re-Alignment • Implementing FOG Pretreatment • Upgrades to Sewer Capacity, Storage and Pumping in Individual Sewersheds

The Panel could find no research studies in which the actual nutrient reduction associated with the elimination of nutrient discharge has actually been calculated. However, numerous engineering models and empirical data exist to measure or calculate the nutrient reduction associated with their elimination, and the Panel reasoned that these were acceptable for its purposes, as long as there were rigorous quality controls on their use.

The Panel agreed that eliminating "discovered" nutrient discharges can be considered as a urban BMP capable of producing a real change in urban nutrient loads, if they:

- Are detected and physically eliminated.
- On-site sampling of the discharge is conducted to define one or more of the following parameters -- the concentration, flow rate and/or flow duration.
- Subsequent inspections and/or sampling to verify that discharge no longer exists.

The Panel concluded that there was considerable scientific support that nutrient discharges from grey infrastructure could collectively contribute a significant portion of the dry and/or wet weather nutrient loads in urban watersheds, although their share of the total load is extremely variable in both space and time. Given this uncertainty, it is not possible to assign a unit flow rate or nutrient reduction efficiency to each type of nutrient discharge.

Consequently, the Panel concluded that any nutrient reduction credit must be empirically based for each individual discharge that is removed, using a calculation of its unique nutrient concentration, flow rate and discharge duration over the year. Three protocols for calculating the credit are presented Section 5 that rely on empirical data.

The Panel also noted that IDDE and SSO programs can reduce the input of partially diluted sewage and other pollutants into the storm drain system or the urban stream network, and as such are a strong tool to keep nutrients, bacteria, and toxic pollutants from entering the watershed. The Panel defined three protocols to determine conservative and verifiable nutrient reduction. In this context the term "protocol" refers to the method used to define and verify the load reduction credit associated with finding and fixing an individual nutrient discharge, as follows:

- Protocol 1: The Prevented Load Calculation
- Protocol 2: The Before and After Load Approach
- Protocol 3: The Overflow Reduction Tracking Method

Table 5 also shows the data requirements needed to apply the protocols for each specific discharge type.

Table 5
Data Requirements to Compute Reduction Credits

No.	Discharge Type	Method	Nutrients	Flow Volume	Flow Duration
N-1	Laundry Wash Water	1	S or D	E or M	E
N-2	Commercial Car Wash	1	S	E or M	E
N-3	Floor Drains	1	S	E or M	E
N-4	Misc. High Nutrient Discharges	1	S	E or M	E
N-5	Sanitary Direct Connection	1	S or D	E or M	E
N-6	Sewer Pipe Exfiltration	2	S or D	M	E
N-7	Drinking Water Transmission Loss	2	S or D	M	E
N-8	Dry Weather SSOs	3	D	E	M
N-9	Chronic Wet Weather SSOs	3	D	E	M
KEY: S= SAMPLE, D=Use DEFAULT VALUE, E=ESTIMATE, M= MEASURE					

Section 5

Profile Sheets for Crediting Nutrient Reductions from Grey Infrastructure

This section provides a series of profile sheets outlining each of the discharges that are eligible for a credit. Each profile sheet describes the discharge, its characteristics and the crediting approach used when it is fixed and/or prevented. A design example to show how the credit is calculated is also provided.

The following nine discharges are eligible for a credit.

- N-1. Laundry Washwater
- N-2. Commercial Car Washing
- N-3. Floor Drains
- N-4. Miscellaneous High Nutrient Non-Sanitary Discharges
- N-5. Sanitary Direct Connections
- N-6. Sewage Pipe Exfiltration
- N-7. Drinking Water Transmission Loss
- N-8. Dry Weather Sanitary Sewer Overflows
- N-9. Chronic Wet Weather Sanitary Sewer Overflows

Discharge Characteristics Definitions

The following terms are used to describe the characteristics of the discharges.

Dry vs. Wet Weather Discharge: This term applies to when the discharge is most likely to occur and be detected.

- **Dry**: discharges that may occur during either wet or dry periods but are only detectable during dry periods.
- **Wet**: discharges that occur during wet weather periods as a result of inadequate pipe capacity.

Discharge Frequency: This describes how often a discharge is likely to occur. The options are as follows:

- **Continuous**: discharges that occur most or all of the time and as a result are usually easier to detect.
- **Intermittent**: discharges that occur over a shorter period of time (e.g., a few hours per day, or a few days per year). Due to their infrequent nature, these discharges are hard to detect but can still create a serious water quality problem.
- **Transitory**: discharges that occur rarely, often in response to a singular event such as an industrial spill or emergency break in a sewage line.

Mode of Entry: This describes how the discharge enters the stream or storm drain system.

- **Direct Entry**: the discharge enters the stream or storm drain through a straight pipe.
- **Indirect Entry**: the discharge is generated outside of the stream or storm drain system and enters through runoff to a storm drain inlet or migration through groundwater.

Flow Duration: This indicates how long the discharge typically lasts. **Maximum flow duration for any discharge is one year** however most discharges only occur during a portion of the year. Flow duration is discharge specific.

Elimination Method: A series of field methods that are used to find, isolate and measure nutrient discharges from grey infrastructure. Several unique detection methods apply to each discharge type, they are as follows:

- BMPs to protect stormwater system from discharge
- Direct discharges to sanitary sewer
- Disallowing mobile operations
- FOG Reduction Programs
- Manhole Sealing
- Pipe Reconnection to the appropriate pipe network
- Pipe Realignment of Sewer or Water Pipes
- Pipe Replacement of Sewer or Water Pipes
- Pollution Prevention Programs
- Pretreatment Requirements
- Slip-lining of Sewer or Water Pipes
- Reducing I/I into Sewer System
- Upgrades to Sewer Capacity, Storage and Pumping in Individual Sewersheds

Method of Discovery: The methods that can be used to discover the source(s) of the discharge, depends on the nature of the nutrient discharge. They are as follows:

- **CMOM**: A management system whereby wastewater utilities plan and manage how they can improve the performance and longevity of their sewage collection and pipe network assets (see Section 2).
- **Dye Testing**: Fluorescent dye is introduced into the sewer network and suspected manholes are then inspected to trace the path of flow through the network to locate the source of the discharge.
- **Flow Metering**: upstream and downstream flow metering in the pipe to determine the loss in materials through the pipe.
- **GIS Risk Analysis**: Mapping locations where sanitary and storm sewer lines cross to target areas where discharges could occur.
- **Hotline Complaints**: Citizen pollution hotlines are used as a strategy to engage the public in illicit discharge surveillance are a highly effective way to pick up intermittent and transitory discharges that escape routine outfall screening.

- **Nutrient-based Outfall Screening**: Water quality monitoring of outfalls that includes nutrient sampling techniques, specifically for Nitrogen and Phosphorus.
- **Nutrient Source Sampling**: Nutrient sampling done at the source of the discharge done to calculate the pollutant load reduction.
- **Optical Brightener Monitoring**: The use of optical brightener traps to capture dry weather flows, which are then later analyzed for the presence of optical brighteners which would indicate the presence of an intermittent discharge.
- **Overflow Reporting**: Tracking overflow events along with rainfall analysis to demonstrate a causal relationship between them. This is used as a predictive method for identifying areas prone to overflows as a result of a certain sized rainfall event.
- **Risk Assessment**: Analysis of businesses in the sewershed and pretreatment activity
- **Rooftop Inspection**: Analysis of downspouts and rooftops from commercial parcels in the sewershed to identify potential sources of high nutrient discharges.
- **Sewage Sniffing Dogs**: Specially trained dogs that can detect and source track human sewage in stormwater.
- **Smoke Testing**: Introducing smoke into the sewer system and observing where the smoke surfaces to locate the source of the discharge.
- **Stream Walk**: Walk streams in the watershed to inventory all outfalls in the MS4, visually asses and collect samples to identify possible high nutrient discharges.
- **System Maintenance Records**: Records held by a locality that indicate specific areas of the sanitary sewer system where repeated overflows or line blockages tend to occur.
- **Televising**: A remote camera with a video recorder is used to assess the condition of a storm or sewer line and look for discharges.
- **Visual Inspection**: Visual observations are used to observe conditions at the manhole or outfall and look for any signs of discharges or dry weather flow. Includes inspecting for the presence of flow, color, odor, foam, oils, floatable materials, deposits or stains.

Regulated Discharge: This includes under which permit the discharge is regulated (i.e., who is accountable for fixing the discharge).

- **NPDES MS4 Permittees**: the discharge is regulated under/prohibited by the National Pollutant Discharge Elimination System as a Municipal Separate Storm Sewer System (MS4) permit.
- **NPDES Wastewater Discharge Permittee**: the discharge is regulated under/prohibited by the National Pollutant Discharge Elimination System as a wastewater permit.
- **Non-regulated**: at this time, this discharge is not regulated by a permit.

Crediting Protocol: The protocol that is used to determine the credit for the eliminated discharge.

- **Protocol 1**: The Prevented Load Calculation
- **Protocol 2**: The Before and After Load Approach
- **Protocol 3**: The Overflow Reduction Tracking Method

Sampling Requirement: The sampling that is required to be done by the locality in order to claim the credit.

Verification Requirements: The verification requirement in order for the locality to claim and maintain the pollutant reduction credit.

- Confirmation inspection after reconnection
- Confirmation screening

N-1: Laundry Washwater

Definition: Washwater flows that result in the discharge of washwater into the storm drain system. It may involve a residential situation or a commercial laundry operation.

Photo credit: Arlington County DES

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Intermittent (I)**

Mode of Entry
- **Direct** – through a straight pipe

Method(s) of Discovery
- Dye Testing
- Hotline Complaints
- Nutrient Source Sampling
- Optical Brighteners
- Smoke Testing
- Stream Walk
- Visual Inspection

Regulated Discharge
- **MS4 permit (IDDE)**

Elimination Methods
- Enforcement and,
- Pipe reconnection to the sewer system

Crediting Protocol
- **Protocol 1**

Sampling Requirement
- Flow rate for individual discharge must be estimated or measured

Verification Requirements
- Confirmation inspection after reconnection
- Optional screening at outfall or stream once in the year after elimination if multiple discharges are suspected

DISCHARGE CREDITING

Laundry discharges are credited under Protocol 1 which requires:

1. Direct monitoring of the discharge characteristics or,
2. Use default values for concentration and flow

The following example shows how a locality would calculate the load reduction under both scenarios. While direct monitoring will result in more accurate and higher loads associated with the discharge, it requires much more resources from the locality.

DESIGN EXAMPLE

A citizen complaint is made to Green City Public Works Department regarding a large amount of suds being discharged from an outfall. It was determined by working back up the pipe that the suds were originating from a laundry room in a 50-unit apartment building 1/8 mile away. The plumbing from the laundry room was inadvertently tied into the storm drain system. Once the source was identified, City staff obtained a water sample, duplicate and flow measurements from a storm drain manhole outside of the building to determine the credit (Table 1). An interview with the building manager determined that based on the number of people living in the building, typical washing habits per resident and gallons of water used per wash, that the flow occurs 25% of the year. The discharge duration is therefore 25% of the estimated annual load (365/4 = 91.25). An outfall screening the following year confirmed that the discharge did not recur and so the credit was maintained.

Laundry Discharge Monitoring Measurements		
	TN (mg/l)	TP (mg/l)
Sample 1	2.1	0.4
Duplicate	2	0.39
Average	**2.05**	**0.395**
	Flow (cfs)	
Replicate 1	0.005	
Replicate 2	0.007	
Replicate 3	0.006	
Average	**0.006**	

$$Annual\ Load = Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

$$TN\ Load = 2.05\ \frac{mg}{L} \times 3{,}878\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 91.25 \frac{days}{year} = \mathbf{6.05}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

$$TP\ Load = 0.395\ \frac{mg}{L} \times 3{,}878\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 91.25 \frac{days}{year} = \mathbf{1.17}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

The annual load contributed as from the laundry discharges is calculated to be 6.05 lbs/year for Nitrogen and 1.17 lbs/year for Phosphorus.

Alternatively, the City could have used default values to determine the credited load. The default concentrations, flows and durations for different laundry discharges are taken from Table 5 of the memo. Assuming laundry in both single family and multifamily households occurs only twice a week gives us a default value for the duration of 104 days per year.

$$TN\ Load = 3.2\ \frac{mg}{L} \times 1{,}500\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 104 \frac{days}{year} = \mathbf{4.17} \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

N-2: Commercial Car Washing

Definition: Washing of vehicles that results in the discharge of washwater into the storm drains system. It may involve a commercial car wash operation or a car washing business operating in a residential area (such as a mobile car wash).

Photo credit: Dr. Bob Pitt, University of Alabama

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Intermittent (I)**

Mode of Entry
- **Direct** – through a straight pipe
- **Indirect –** runoff from washing area enters through a storm drain inlet

Discovery Methods
- Dye Testing
- Nutrient Source Sampling
- Optical Brighteners
- Smoke Testing
- Visual Inspection

Regulated Discharge
- **MS4 permit**

Elimination Methods
- Pipe reconnection to the sanitary sewer system
- Disallowing mobile operations
- BMPs to protect stormwater system from discharge

Crediting Protocol
- **Protocol 1**

Sampling Requirement
- Must estimate flow rate and duration and measure nutrient concentration

Verification Requirements
- Confirmation inspection after reconnection
- Confirmation screening during business hours, once a year.

DESIGN EXAMPLE

IDDE Staff discover that Joe's Wash & Wax illegally discharges to the storm drain system rather than the sanitary sewer system. Based on water meter records, the average daily flow is measured to be 2,500 gallons per day. Two replicate samples of the discharge indicate a TN and TP concentration of 2.5 mg/L and 0.5 mg/L respectively. The duration of the flow is considered to be one year. The annual load is calculated by using the following equation:

$$Annual\ Load = \ Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

$$TN\ Load = \ 2.5\frac{mg}{L} \times 2{,}500\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 365\frac{days}{year} = \mathbf{19.04}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

$$TP\ Load = \ 0.5\frac{mg}{L} \times 2{,}500\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 365\frac{days}{year} = \mathbf{3.81}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

The annual load contributed as a result of Joe's Wash and Wax discharges is calculated to be 19.04 lbs/year for Nitrogen and 3.81 lbs/year for Phosphorus.

<u>Alternate Method</u>

As it turns out, water billing records are not useful due to other water uses at the facility. So IDDE staff estimate flow in gallons per wash multiplied by the number of washes per business day to get the average daily flow. They then adjust the estimate to account for non-operating hours e.g., 48 hours of operation per week is 48/168 = 0.286.

This can then be used to calculate the flow duration as follows: 0.286*365 = 104.29

N-3: Floor Drains

Definition: Floor or foundation drains illegally connected to the storm drain system.

Photo credit: Regional Water Quality Control Board

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Intermittent (I)**

Mode of Entry
- **Direct** – through a straight pipe

Method(s) of Detection
- Dye Testing
- Nutrient Source Sampling
- Smoke Testing
- Televising
- Visual Inspection

Regulated Discharge
- **MS4 permit (IDDE)**

Elimination Methods
- Pipe reconnection to the sanitary sewer system

Crediting Protocol
- **Protocol 1**

Sampling Requirement
- Two replicate samples of nutrient concentration prior to reconnection, and a reliable estimate of flow and duration associated with discharge

Verification Requirements
- Inspection to confirm reconnection
- Optional confirmation screening at the site once a year for two years

DISCHARGE CREDITING

Floor drain discharges are credited under Protocol 1. Flow rates and pollutant concentrations will vary based on the nature of the discharge. As a result, these discharges require direct monitoring to establish the credit and there are no default values available. The annual load contribution from the discharge is calculated by using the following equation:

$$Annual\ Load = \ Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

Average Daily Flow is estimated by determining the amount of gallons used in a typical cleaning and the number of times a day the shop floor is hosed down.

$$Average\ Daily\ Flow = \frac{gallons}{event} \times \frac{events}{day}$$

Flow Duration is calculated by determining the number of days per week the business or institution is in operation and adjusting it for the number of weeks per year it is open.

$$Annual\ Flow\ Duration = \frac{days}{wk} \times \frac{weeks}{year} = \ days/yr$$

If through interviews with the shop owners, business managers or previous knowledge of the business, the locality can demonstrate different values for any of the above variables; those should be used as replacements in the above equation to determine the daily flow volume and the annual duration. The following example shows how a locality would calculate the load reduction under Protocol 1.

DESIGN EXAMPLE

A local house painting business hoses down the shop floor once each day at the end of the day. The business is in operation 5 days a week, 52 weeks a year. County staff were able to obtain replicate samples that measured the pollutant concentration of the discharge to be 2.90 mg/L of TN. Using these assumptions and estimating that the gallons used in the 1 wash event each day is 7.5 gpd we can complete the following equation to determine the annual flow duration and annual pollutant load as follows:

$$Annual\ Flow\ Duration = 5\frac{days}{wk} \times 52\frac{weeks}{year} = 260\frac{days}{yr}$$

$$TN\ Annual\ Load = 2.90\ \frac{mg}{L} \times 7.5\frac{gal}{day} \times \frac{8.345 \times 10^{-6} lbs/gal}{mg/L} \times 260\frac{days}{year}\ = \mathbf{0.05}\frac{\boldsymbol{lbs}}{\boldsymbol{year}}$$

The annual load contributed from the local house painting business is calculated to be 0.05 lbs/year of Nitrogen.

N-4: Miscellaneous High Nutrient Discharges

Definition: This discharge category applies to other non-sanitary, high-nutrient discharges that are discovered during nutrient-based outfall screening. The most common so far has been nutrient-associated cleaning agents used to keep outdoor HVAC systems functioning. Some other high nutrient discharges may include routine fire engine washing, restaurant cleaning operations, metal plating operations and radiator fluid discharges; however, direct monitoring of flows and concentration are required to establish the credit.

Photo credit: Center for Watershed Protection

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Intermittent (I)**

Mode of Entry
- **Direct** – can be directly tied into the storm drain system
- **Indirect –** generated outside the storm drain system and enters through the storm drain inlet

Discovery Methods
- Dye Testing
- Nutrient Source Sampling
- Rooftop Inspection

Regulated Discharge
- **Regulated,** under an IDDE program and MS4 permit

Elimination Methods
- Pipe reconnection to the sanitary sewer system
- Pollution prevention: change in cleaning agents

Crediting Protocol
- **Protocol 1**

Sampling Requirement
- Nutrient sampling is required, and flows can be estimated

Verification Requirements:
Confirmation inspections

DISCHARGE CREDITING

Miscellaneous high nutrient discharges are credited under Protocol 1. Flow rates and pollutant concentrations will vary based on the nature of the discharge. As a result, these discharges require direct monitoring to establish the credit and there are no default values available.

The annual load contribution from the discharge is calculated by using the following equation:

$$Annual\ Load = Concentration \times Flow \times Conversion\ Factor \times Duration$$

The following example shows how a locality would calculate the load reduction under Protocol 1.

DESIGN EXAMPLE

During a routine outfall investigation Bay County discovered a miscellaneous high nutrient discharge. Upon further investigation, the County was able to trace it back to a downspout from an industrial building. Upon receiving access to the building's rooftop, county employees discovered an HVAC discharge system, the condensate from which was draining to a roof drain that fed the building's downspout. Upon further investigation County staff determined that the cooling system was being treated with an antimicrobial solution high in nitrogen. Education and outreach efforts to the building maintenance staff resulted in a switch to a nitrogen-free antimicrobial solution. The rooftop drain was inspected annually, for 2 years, to ensure that the AC condensate was nutrient free. A high nutrient discharge did not recur and so the credit was maintained.

$$Annual\ Load = Concentration \times Flow \times Conversion\ Factor \times Duration$$

$$TN\ Load = 4.6\ \frac{mg}{L} \times 297\ gpd \times \left(8.345\ \times\ 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 150\frac{days}{year} = \mathbf{1.71}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

N-5: Sanitary Direct Connection

Definition: A sewer pipe that is improperly connected to the storm drain system either through a cross-connection or from a straight pipe. This discharge category produces a continuous discharge of raw sewage into the storm sewer system or directly to a stream.

Sewer Lateral Connected to the Storm Drain System (Walch, DelDOT)

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Continuous (C)**

Mode of Entry
- **Direct** – through a straight pipe or a cross-connection

Discovery Method(s)
- Dye Testing
- GIS Risk Analysis
- Nutrient-based Outfall Screening
- Optical Brighteners
- Sewage Sniffing Dogs
- Smoke Testing
- Televising

Regulated Discharge
- **MS4 permit** and/or
- **WW permit**

Elimination Methods
- Pipe reconnection to the sanitary sewer system

Crediting Protocol
- **Protocol 1**

Sampling Requirement
- Must measure nutrient concentration at the source or

Verification Requirements
- Confirmation inspection after reconnection
- Annual outfall screening for at least two years (optional, when multiple discharges are suspected in storm drain)

DESIGN EXAMPLE

Sanitary direct connections are credited under Protocol 1.

There are two ways to take credit for eliminating sanitary direction connections under Protocol 1:

1. Direct monitoring of the discharge characteristics or,
2. Use default values for concentration along with **field collection of flow values** for the discharge

Takoma Park is a Phase II community. The 550 acre Maple Ave outfall drainage, which drains to Sligo Creek, is suspect for multiple illegal discharges. In the summer, 2012, one of these inappropriate discharges was tracked down about ¼ mile upstream of the outfall. Dry weather monitoring was conducted at the outfall and the City recorded the following measurements:

Takoma Park Illegal Discharge Measurements		
Flow (cfs)	TN (mg/L)	TP (mg/L)
0.005	4.28	0.19

The annual load was determined using the following calculation and was determined to be 42.13 lb/yr for total nitrogen and 1.87 lb/yr for total phosphorus as shown below.

$$Annual\ Load = Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

$$TN\ Load = 4.28\ \frac{mg}{L} \times 3{,}213\ gpd \times \left(8.345 \times 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 365 \frac{days}{year} = \mathbf{42.13}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

$$TP\ Load = 0.19\ \frac{mg}{L} \times 3{,}213\ gpd \times \left(8.345 \times 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 365 \frac{days}{year} = \mathbf{1.87}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

The City was able to correct the sewage break by lining the pipe. Monitoring data in downstream storm drain annually for three years after the repair showed no flow after and credit was maintained. Alternatively, default values could be taken from Table 5 of the memo. The following summary table demonstrates the load reductions for each method.

Summary of Sanitary Discharge Credits Using Protocol 1						
Method	**Pollutant Conc.** (mg/L)		**Avg. Daily Flow** (gpd)	**Conversion Factor**	**Duration** (days/yr)	**Annual Load** (lbs/yr)
User Defined	TN	4.28	3,213	8.345×10^{-6}	365	42.13
	TP	0.19	3,213	8.345×10^{-6}	365	1.87
Default Values[1]	TN	33.0	3,213	8.345×10^{-6}	365	324.8
	TP	6.0	3,213	8.345×10^{-6}	365	59.05
[1]Taken from Table 5; Grey shaded areas indicate the input values required by the locality						

N-6: Sewer Pipe Exfiltration

Definition: Loss of sewage from sanitary sewer pipes during dry weather through the groundwater matrix to the storm drain system as a result of cracks or leaks in sewer pipes.

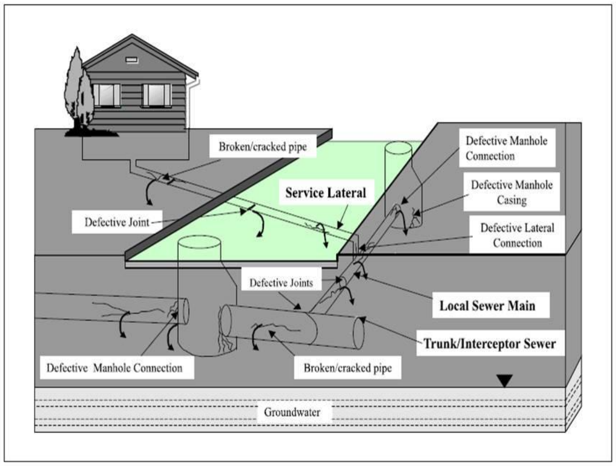

Photo credit: Amick and Burgess (2000)

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Continuous (C)** or
- **Intermittent (I)**

Mode of Entry
- **Indirect –** the discharge is generated outside the storm drain system and enters through the groundwater matrix

Discovery Method
- Dye Testing
- Flow Metering
- GIS Risk Analysis
- Sewage Sniffing Dogs
- Televising
- Visual Inspection

Regulated Discharge
- **NPDES WW permit**

Elimination Methods
- Slip-lining of pipes
- Pipe replacement
- Manhole Sealing

Crediting Protocol
- **Protocol 2**

Sampling Requirement
- Six month before and after sewer metering to measure flow and nutrient concentrations

Verification Requirements
- Confirmation monitoring

DISCHARGE CREDITING

Sewer Pipe Exfiltration discharges can be credited under Protocol 2. It requires before and after flow metering in the pipe to determine the change in sewage exfiltration as a direct function of the sewer repair, based on the decline in flow rate associated with the capital project. While it is allowable to use the sewage concentration default values, the credit may also be subject to a discount factor.

Discount factors

- 50% if project is within 150' of stream or within 10 feet of a lower elevation storm drain pipe,
- 10% if project is greater than 150' away from the stream or greater than 10' feet from a lower elevation storm drain pipe to account for losses during groundwater migration

DESIGN EXAMPLE

The City of Salisbury has discovered a suspect aging 6 inch sewer main. Based on flow metering, the 4,000 foot network of sewer pipe experiences a 20% loss over this distance (from 7,500 gpd to 6,000 gpd).

After a program of slip-lining, the loss dropped to 375 gpd. The City used the default values listed in the table below to calculate the load associated with the discharge. Since the project is located within 50 feet of an urban stream corridor, a discount factor of 50% is applied.

Default Nutrient Concentrations for Dry Weather SSO's	
TN (mg/l)	TP (mg/l)
33.0	6.0
U.S. EPA, 2004	

$$Annual\ Load = Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

Reduction in Nutrient Loading from Sewage Pipe Exfiltration due to Infrastructure Improvements		
	TN (lbs/yr)	TP (lbs/yr)
Before Slip-lining	150.77	27.41
After Slip-lining	37.69	6.85
Reduction	113.10	20.56
50% Discount Factor	**56.54**	**10.28**

The City continues to monitor flow and concentration for six months after the improvements and since there is no increase in the flow or nutrient concentration of the remaining flow the credit is maintained.

N-7: Drinking Water Transmission Loss

Definition: The loss of drinking water as it is delivered in pipes to the consumer that reaches the stream through storm drain pipes and/or groundwater migration.

Photo credit: Baltimore City DPW

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Continuous (C)**

Mode of Entry
- **Indirect** – the discharge is generated from pipes in the drinking water transmission lines and leaks from the pipes into the soils where it migrates to into the groundwater matrix.

Discovery Method(s)
- Flow Metering
- Televising
- Visual Inspection

Regulated Discharge
- **Non-regulated**

Elimination Methods
- Slip-lining of pipes
- Pipe replacement
- Pipe upgrades

Crediting Protocol
- **Protocol 2**

Sampling Requirement
- Six months of before and after pipe metering to measure change in flow
- Nutrient concentrations can be derived from consumer confidence reports (CCR) produced by the drinking water utility

Verification Requirements
- Flow monitoring at the site of repair and above and below the problem water line for one year

DISCHARGE CREDITING

Protocol 2 is used to obtain credit for eliminating discharges as a result of drinking water transmission loss. It requires before and after flow metering in the pipe to determine the transmission los above and below the problem pipe section.

The nutrient concentration associated with drinking water is directly derived from the water quality monitoring data that is summarized in the most recent consumer confidence reports prepared annually by the local drinking water utility. The final credited load is discounted to reflect that not all transmission loss reaches the stream, as follows:

- By 50% if project is within 150' of stream or within 10 feet of a lower elevation storm drain pipe,
- By 10% if project is further away to account for the lack of full understanding of groundwater migration

The following example shows how a locality would calculate the load reduction under Protocol 2 using typical values from Table 5 of this memo. However the default values used here are for example purposes only, localities are required to collect their own concentration data from consumer confidence reports from their local drinking water plants.

DESIGN EXAMPLE

A Bay City has discovered that one of the water mains from its drinking water plants is delivering significantly less water than is being transmitted. Based on flow metering, the 4,000 foot network of water pipe experiences a 20% loss over this distance (from 7,500 gpd to 6,000 gpd). After a program of slip-lining, the loss dropped to 375 gpd. The City knew the nitrogen content of the water from the testing done at the plant and used that number to calculate the load associated with the discharge. Since the project is located within 50 feet of an urban stream corridor, a discount factor of 50% is applied.

$$Annual\ Load = Concentration \times Average\ Daily\ Flow \times Conversion\ Factor \times Duration$$

Reduction in Nutrient Loading from Drinking Water Pipe Exfiltration due to Infrastructure Improvements		
	TN (lbs/yr)	**TP (lbs/yr)**
Before Slip-lining	7.77	1.37
After Slip-lining	1.94	0.34
Reduction	5.80	1.03
50% Discount Factor	**2.91**	**0.51**

The City continues to monitor flow for six months after the infrastructure improvements to confirm that the flow reductions in the pipe segment are maintained over time in order to verify the credit.

N-8: Dry Weather Sanitary Sewer Overflows

Definition: A sanitary sewer overflow that occurs during dry weather periods as a function of either a blockage or defect in the sanitary sewer system.

Photo credit: Bill Stack, CWP

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Dry (D)**

Discharge Frequency
- **Transitory (T)**

Mode of Entry
- **Indirect** – the overflow may either enter through the storm drain system or directly discharge to the stream.

Discovery Method(s)
- Hotline Complaints
- Overflow Reporting
- Risk Assessment: analysis of the businesses in the sewershed and pre-treatment activity
- System Maintenance Records
- Visual Inspection
- CNOM

Regulated Discharge
- **NPDES WW permit**

Elimination Methods
- FOG Reduction Programs
- Pretreatment Requirements
- Sewer Realignment
- Pipe Replacement
- Manhole Casing

Crediting Protocol
- **Protocol 3**

Monitoring Requirement
- Two years of before and after tracking of the number and flow volume of sanitary sewer overflows within the sewershed

Verification Requirements
- See monitoring requirement above

DISCHARGE CREDITING

Protocol 3 is used to obtain credit for a systematic reduction and elimination of dry weather sanitary sewer overflows in a sewershed. It requires before and after monitoring of the volume and frequency of the sanitary sewer overflows within a sewershed for a period of at least 4 years.

The following example shows how a locality would calculate the load reduction under Protocol 3.

DESIGN EXAMPLE

The City of Norfolk, VA has instituted a FOG reduction program in a 1,200 acre sewershed in its Central Business District. Based on historical data, 123 dry weather sanitary sewer overflows were reported on average per year, with a cumulative overflow volume of 125,000 gallons per year. After the implementation of a FOG program, the average frequency of dry weather sanitary sewer overflows decreased to 25 and the cumulative overflow volume dropped to 25,000 gallons per year.

Using the default values for Nitrogen and Phosphorus associated with dry weather sanitary sewer overflows (EPA, 2004) the City determines the nutrient loading before and after the implementation of their FOG program.

Default Nutrient Concentrations for Dry Weather SSO's	
TN (mg/l)	TP (mg/l)
33.0	6.0
U.S. EPA, 2004	

$$Annual\ Load\ \left(\frac{lbs}{yr}\right) = Concentration\ \left(\frac{mg}{L}\right) \times Annual\ Flow\ \left(\frac{gal}{yr}\right) \times Conversion\ Factor\ \left(\frac{\frac{\mathrm{lbs}}{\mathrm{gal}}}{\frac{\mathrm{mg}}{\mathrm{L}}}\right)$$

Reduction in Nutrient Loading from Overflows due to FOG Program		
	TN (lbs/yr)	TP (lbs/yr)
Before FOG Program	34.42	6.26
After FOG Program	6.88	1.25
Reduction	**27.5**	**5.01**

No discount in the credit is taken.

N-9: Chronic Wet Weather Sanitary Sewer Overflows

Definition: Overflows that occur during rain events less than or equal to the design capacity of the sewershed. These overflows are a function of an inadequately sized system or aging infrastructure (excess inflow and infiltration).

Photo credit: Christopher Zurcher, CT Environmental Headlines

DISCHARGE CHARACTERISTICS

Dry vs. Wet Weather Discharge
- **Wet (W)**

Discharge Frequency
- **Intermittent (I)**

Mode of Entry
- **Direct** – the discharge is generated inside the stream corridor
- **Indirect** – the discharge is generated outside the stream or storm drain system and enters through inflow to the storm drain system or stream

Discovery Method(s)
- CMOM Programs
- GIS Risk Analysis
- Hotline Complaints
- Overflow Reporting
- Televising
- Visual Inspection

Regulated Discharge
- **NPDES WW permit**

Elimination Methods
- Improvements to storage, pumping and/or sewer transmission capacity within a sewer-sewershed to upgrade infrastructure

Crediting Protocol
- **Protocol 3**

Sampling Requirement
- The frequency and overflow volumes must be tracked for 2 years prior to improvement and 2 years after improvement

Verification Requirements
- Continued tracking of overflows for 3 years after the credit is taken

DISCHARGE CREDITING

Protocol 3 is used to calculate the annual credit for eliminating chronic wet weather sanitary sewer overflows that occur during rain events that exceed the current design capacity of the sewershed. In order to calculate the annual credit, the jurisdiction must:

1. Establish a 2 year baseline of overflows in gallons/year. The baseline and credit will be determined by overflows aggregated for the sewershed.
2. Calculate post-improvements on a 2-year average of overflow aggregated for the sewershed.
3. Obtain nutrient concentrations either through direct monitoring of overflows or by using default values from Table N.9-1.
4. Monitor overflow events for three additional years in the sewershed to verify the improvements have resulted in a reduction of overflow volumes.

Table N.9-1 Default Nutrient Concentrations for Wet Weather SSO's	
TN (mg/l)	TP (mg/l)
9.0	1.5
U.S. EPA, 2004	

The following example shows how Protocol 3 is applied to calculate the annual credit for eliminating or reducing chronic wet weather sanitary sewer overflows.

DESIGN EXAMPLE

The City of Goose Neck, VA reported sanitary sewer overflow volumes for 2006 – 2012 as shown in the following table.

Sanitary Sewer Overflows in Goose Neck, VA (gal/year)							
Year	2006	2007	2008	2009	2010	2011	2012
Volume	24,000	25,900	20,100	19,300	19,400	17,420	17,000
Average	**24,950**		**19,700**				

In 2008 the City began repairs to the sanitary system that would reduce inflow and infiltration to the system. To determine the credit for the reduced overflow events the City first establishes the baseline overflow volume. This is the average volume of overflows in gallons per year over the 2 year period immediately prior to the repairs being made. Using the overflow volumes from 2006 – 2007, the City's baseline volume is calculated to be 24,950 gal/yr.

Once the improvements have begun, the City calculates an average of overflow volumes for a successive 2-year time period which in this example is 19,700 gal/yr.

The City then calculates the *credited volume* by subtracting the post-improvement average from the baseline volume. So the credited volume is:

$$= 24{,}950 - 19{,}700 = 5{,}250 \text{ gal/yr.}$$

The City used the default pollutant concentrations to calculate the annual credited load as shown below:

$$Annual\ Load = Concentration \times Annual\ Flow \times Conversion\ Factor$$

$$TN\ Load = 9.0\ \frac{mg}{L} \times 5{,}250\ gpy \times \left(8.345 \times 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) = \mathbf{0.39}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

$$TP\ Load = 0.19\ \frac{mg}{L} \times 3{,}213\ \ gpd \times \left(8.345 \times 10^{-6}\ \frac{\text{lbs/gal}}{\text{mg/L}}\right) \times 365 \frac{days}{year} = \mathbf{0.07}\ \frac{\boldsymbol{lbs}}{\boldsymbol{yr}}$$

Section 6
Program Credit for Nutrient-Targeted Grey Infrastructure Upgrades

The Panel recommends a nutrient removal credit for communities that meet numeric program metrics for finding and reducing nutrient discharges from their grey infrastructure. The interim credit is offered to provide an incentive for communities to re-focus their existing IDDE and SSO abatement programs toward greater nutrient reduction, without (initially) having to compute reductions for individual discharge events.

The programmatic credit is only available to localities that go above and beyond the minimum requirements set forth under their MS4 permit and SSO consent decree, and is contingent on documentation that their program elements are targeted to screen, detect and correct the nutrient discharges with the highest nutrient loading risk. The eligibility criteria for the credit are shown in Table 6.

Table 6 **Criteria for Program Credit**
The annual credit is equivalent to a maximum of 2% of the dry weather nutrient load within the jurisdiction, which is defined as 20% of the total annual N and P load discharged from urban pervious land in which the programs are targeted.
IDDE PROGRAM CREDIT CRITERIA (max 1%)
The locality will provide justification including numeric program metrics that indicate that they are operating at an advanced level. At a minimum, they will document the: • Number of outfalls subject each year to nutrient testing • Dry weather stream monitoring data or mapping analysis used to prioritize the catchments with the highest risk for nutrient and bacteria discharge that warrant targeted investigation. • Capability to track a suspect illicit discharge to its source in the storm drain networks • Enforcement authority to correct illicit discharge when they are located, and • Annual statistics as to the number of illicit discharges that were actually eliminated In addition, localities need to provide evidence that they are conducting at least two of the following IDDE program elements to reduce illicit discharges: • GIS desktop assessments for outfall screening prioritization • In stream nutrient monitoring to locate nutrient hotspots • Use of CCTV inspections and or dye testing in storm drains to look for sewer leaks • Targeted inspections of commercial and industrial facilities subject to high risk

for illicit discharges (e.g. restaurants, car rental agencies, etc.) • Special IDDE research projects to improve detection and repair of illicit discharge • Number of businesses participating in pollution prevention incentive programs • Number of citizen volunteers conducting water quality testing and documentation of follow-up activities undertaken when illicit discharges are detected
SSO ABATEMENT PROGRAM CREDIT CRITERIA (max 1%)
• Currently make progress in meeting implementation milestones in their SSO consent decree • Dry weather stream monitoring is used to prioritize the stream segments with the highest nutrient and bacteria levels that warrant further investigation • Conducts detailed field assessments of its pipe network to identify problem sewersheds with greatest risk of nutrient discharge from exfiltration and overflows. • Uses sewer modeling and metering tools to measure reductions in sewer pipe losses during dry and wet weather conditions.

Example of Computing Nutrient Load Reductions for the Program Credit

Bay Village elects to transition to a nutrient based outfall screening program in two priority catchments within its jurisdiction -- Icky Creek and Filthy Run. Together, the two catchments are 3,600 acres in size, and average 64% urban pervious land. Bay Village documents in its annual MS4 report that it has met or exceeded the program metrics outlined in Table 6 of this report. The interim nutrient reduction credit for modifying their program is computed as follows.

Step 1: Determine the unit area nutrient load for pervious land from CAST or state equivalent, and multiply by 0.20.

> Staff determine unit area TN and TP loads are 10.43 and 0.43 lbs/acre/year, respectively, within their jurisdiction. These are multiplied by the dry weather baseline multiplier of 0.2, which yields 2.09 lbs TN/ac/yr and 0.086 lbs TP/ac/yr.

Step 2: Multiply these unit loads by the qualifying acres of pervious land in Icky Creek and Filthy Run (3,600 acres*64% = 2,304 ac), which yields:

> 4815 lbs/yr of TN and 198.1 lbs/yr of TP

Step 3: Multiply these loads by the 0.01 to determine final nutrient reduction credit for the program change.

> 48.2 lbs/yr of TN and 1.98 lbs/yr of TP

Bay Village would report these for credits until the end of 2017 at which time they would need to compute load reductions for individual nutrient discharges using the protocols in this report

Section 7
Accountability Mechanisms

The Panel concurs with the conclusion of the National Research Council (NRC, 2011) that verification of BMP installation and subsequent performance is a critical element to ensure that pollutant reductions are actually achieved and sustained across the watershed. The Panel also concurred with the broad principles for urban BMP reporting, tracking and verification contained in the technical memo approved by the Urban Stormwater Workgroup (USWG, 2014).

7.1 Reporting Requirements for Nutrient Discharge Reduction Credits

The reporting requirements for nutrient discharge reduction credits are generally the same, regardless of which protocol is used. The key information to be reported to the state is as follows:

- Type of discharge eliminated (e.g. N-1, N-2, etc)
- Total N and P load removed (lbs)
- Protocol used (1, 2 or 3)
- Nutrient concentration, pre and post elimination (mg/l)
- Discharge flow volume prior to elimination (gallons)
- Estimated flow duration (up to maximum of one year)
- River basin segment where the discharge was corrected
- Year that discharge was eliminated

Reporting the Program Credit for Nutrient Targeted Grey Infrastructure Upgrades

Consult with your state NPDES permit authority on what to report to obtain the credit. Normally, this will be done as part of the annual MS4 report submission or consent decree. At a minimum, this will normally include:

- Acreage of pervious land in the jurisdiction that is effectively targeted by the IDDE and SSO programs (note: this will always be less than the total acreage of pervious land in the jurisdiction)
- Calculation of the dry weather nutrient load for the urban pervious land covered by the program using the CAST tool or state variant
- Justification that the IDDE or SSO program meets the criteria in Table 6
- Year on which the nutrient credit is earned (i.e., cannot go beyond 2017)

7.2 Individual Nutrient Discharge Credit Recordkeeping Requirements

Local governments must also maintain a more extensive file on each nutrient discharge they take credit for which fully documents the monitoring data and technical assumptions that were used with each protocol. States and/or EPA, reserve the right to inspect and review these files, particularly when a large nutrient reduction credit is being claimed, the Panel recommends an initial numeric trigger for this review for individual discharge reduction credits that exceeds 100 lbs per year.

The local documentation file should contain all the supporting information required for the specific protocol which is being used, as described below:

- Whether direct monitoring or default values were used for calculating the load reduction. If default values, report the values used in the calculations.
- The date that the nutrient discharge was detected and the date that it was eliminated.
- All monitoring data used to establish the concentration, including duplicate sample, analytical methods and QA/QC procedures.
- The method used to measure the flow rate, and at least three flow measurements collected with average reported before and after the discharge is eliminated.
- Defining the flow as either continuous or intermittent and if, intermittent, the technical assumptions used to determine the percentage of the year the flow occurred.
- The final load reduction calculations that were performed in pounds per year (lb/yr).
- An outfall screening plan and schedule to verify that the discharge has been eliminated.

Protocol 3: The Overflow Reduction Tracking Method

- The overflows, aggregated at the 12-digit HUC scale, over a 3-year period is established and reported in gallons/year.
- Rainfall rates associated with each overflow event.
- Whether the nutrient concentrations were derived from direct monitoring or by using default concentrations (mg/l), maintaining consistency between pre-and post-elimination values (monitored vs. default).
- Depth in inches of any catastrophic rainfall events, as defined by the Panel, that occurred during the baseline period.
- Documentation of what specific corrective actions were implemented to reduce overflows.
- 2-year running averages of overflows (gallons/year)

7.3 Field Verification of Discharge Removal

The basis for verifying discharge removal is somewhat different than other urban BMPs in that a discharge is being eliminated/prevented rather than treated. Therefore, the Panel elected to require post-removal inspection, screening and/or monitoring to confirm that the individual discharge does not re-occur again. These follow-up inspections are conducted at the point of repair, and where possible, may involve further downstream outfall screening or sampling. The nature of the verification method depends on which protocol is used to estimate the nutrient reduction credit, so consult the appropriate profile sheet.

Section 8
Future Research and Management Needs

8.1 Justification of the Recommendations

One of the key requirements of the CBPO protocol is for the expert Panel to justify the selected effectiveness in the removal rates that they ultimately recommend (WQGIT, 2010). The Panel acknowledges that major scientific gaps still exist to our understanding of the following:

- Magnitude and extent of illicit discharges, sewage exfiltration and overflows across the Chesapeake Bay
- The best detection methods, especially for tidewater communities
- Nutrient concentrations associated with specific nutrient discharge types
- Effect of groundwater migration and denitrification on nutrient discharges from grey infrastructure
- More precise methods for estimating the flow volume and duration associated with all nutrient discharge types

Given these significant gaps, the Panel agreed that the recommended rates should be reevaluated by a new Panel to be reconvened by 2018 when more research data, implementation experience and an improved CBWM model all become available.

8.2 Proposed Refinements in the Next Phase of the Watershed Model

The Panel is confident that the nutrient load generated by the types of nutrient discharges reviewed in this report does represent a significant portion of the load that is currently being generated from pervious land uses in the CBWM.

The Panel does not recommend any specific CBWM refinements to simulate nutrient discharges from grey infrastructure as part of the midpoint assessment in 2017. In theory, it would be useful to partition grey infrastructure loads as a specific component of the total load generated from urban pervious lands. However, at the present time, we do not have enough data on the specific processes that generate these nutrient discharges to accurately simulate or forecast them.

8.3 High Priority Research and Implementation Recommendations

The Panel identified the following priorities to improve our understanding of nutrient discharges from grey infrastructure, and improve local capability to reduce their contribution to nutrient loading in the Bay watershed:

- The Panel recommends that the Bay Program establish a nutrient discharge fingerprinting database for grey infrastructure. The database would consist of the nutrient concentrations, flow rates, and flow durations for each of the discharge types in the watershed, as they are submitted for credit. It would also be desirable to track the fingerprints of other pollutants, such as bacteria, trace metals, and hydrocarbons. As the database grows over time, it will provide valuable information to IDDE and SSO managers, reduce our data gaps, and allow development of better predictive tools in the future.

- Improvement in overflow estimation methods, particularly for dry and wet weather SSOs

- The Panel acknowledges that the shift to a more nutrient-based approach for implementing IDDE and SSO programs will require more intensive training and outreach and more refined outfall monitoring protocols. Both programs also should continue to prevent leaks and spills of other pollutants to the streams and rivers of the Chesapeake Bay.

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Appendix A:
Consolidated Expert Panel Meeting Minutes

Illicit Discharge Elimination Expert Panel
First Teleconference Meeting Minutes
Monday, July 16, 2012

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	Yes
Megan Brosh	Baltimore County	Yes
Lori Lilly	CWP	Yes
Barry Newman	PA DEP	No
June Whitehurst	City of Norfolk	Yes
Barbara Brumbaugh	City of Chesapeake	Yes
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	Yes
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	Yes
Tanya Spano	MWCOG	Yes
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes
Non-panelists: Chris Mellors – Tetratech; USWG; Jeremy Hanson – CRC, Gary Shenk – EPA, CBPO		

1. **Call to Order and Panelist Introductions** *10 min* Tom Schueler, CSN

Tom Schueler called the meeting to order and thanked the panelists for their service on the on the panel. He gave a brief background on the purpose and evolution of the panel and then asked each panelist to briefly introduce themselves. **Tom** also covered the ground rules of the panel process and highlighted other concurrent panels.

2. **Review of the Charge for the Panel, the BMP Panel Review Process and Panelist Responsibilities** (*Attachments A and B) 30 min* Cecilia Lane, CSN

Cecilia Lane went over the CBP Protocol and the Expert Panel process. She went through the proposed charge for the panel and asked for panelist's feedback. **Tom** noted that SSOs will not be covered under the purview of the panel nor will CSOs. **Lori Lilly** noted that she would like the charge to be expanded to include high nutrient non-sewage nutrient illicit discharges. **Tanya Spano** noted that it should be left up to local governments to decide if they will use illicit discharge elimination to reduce their nutrient loads. Tom concurred that this panel will not require localities to implement this, or any other, practice. **Tom** asked the panel to approve the proposed charge with the noted amendments. The panel approved the proposed charge.

ACTION: CSN to update the charge per the panel's comments and send around to the panel.

3. **Background: How illicit discharges are estimated/simulated in the Watershed Model** *20 min* Gary Shenk EPA, CBPO

Gary Shenk explained to the panel how the CBWM does not currently simulate illicit discharges and where and how they would be simulated in the model. **Gary** remarked that IDDE can be included in the model if it is known when, where, and how much the discharges contribute. He also commented that, ideally, the model would include historical estimates of illicit discharges through time for explicit incorporation in possible future models. **Gary** noted that he thought that the illicit discharges were inherently part of the urban load whereas **Bob Pitt** commented that this may not be the case. **Tom Schueler** reminded the panel that part of the charge is to make recommendations for model improvement.

4. **Review of Recent Literature on Illicit Discharge Elimination** *20 min* Christina Mellors, Tetra Tech

Chris Mellors instructed the panelists how to access the share point site. She asked the panel to review the surveyed literature and notify her of any errors and/or recommend any additional literature that should be included. She noted that the proper process for doing so would be to email her directly and she would add the literature directly to the share site and update the literature summary spreadsheet. **Tom requested that panelists review the literature summary and read through 1-2 documents of the most recent CWP literature that document nutrient loadings associated with illicit discharges by 8/1/12.**

All panelists to read through the literature review to ensure there are no studies missing. If there is, please send the study or citation to Chris Mellors: Christina.Mellors@tetratech.com no later than 8/15/12

5. **Scoping of Technical Issues to Address.** *30 min.* Tom Schueler, CSN

Tom requested each panelist to describe some key technical issues that need to be solved to reach a set of recommendations. The overall comments were as follows:

- **Lori Lilly** noted that estimating flow rates is a problem; tracking and confirming the sources of the illicit discharges proves challenging; smaller outfalls are a significant contributor to dry weather loads, at least in the City of Baltimore
- **Marianne Walch** noted that intermittent discharges are very difficult to estimate and manage
- **Megan Brosh** commented that there is a need for better parameters to measure in the field
- **Diana Handy** noted that transient discharges are difficult to manage and quantify
- **Barbara Brumbaugh** reiterated that there is a need for good field methods for screening; also noted that distinguishing between permitted

and illicit discharges can be difficult in some communities; and that tidally influenced outfalls prove to be a problem.

- **Kevin Utt** questioned what the process would be for crediting illicit discharge eliminations
- **Mark Hoskins** noted that differences in flow patterns could complicate the issue

Tom explained how the other expert panels have come up with a protocol to address these issues, calculate a load reduction, include in annual MS-4 report. **Tom** also recommended that the panel review bacteria studies as well since the protocol may be useful to localities that have bacteria TMDLs.

6. **Set Next Meeting Date and Adjourn.** *10 min.* Cecilia Lane, CSN

Tom thanked the Panel for their participation in the first phone call and the overall panel process. The next meeting date was set for a face-to-face "Research Workshop" in Ellicott City, MD where many panelists will be asked to present on the current research and or illicit discharge elimination protocol.

CSN will send out an agenda for the research workshop and invite Bob Pitt, Lori Lilly and Bill Stack to present their research. If other panelists wish to present their research, please let Cecilia Lane watershedgal@hotmail.com know by 8/1/12. We are looking for municipal panelists and DelDOT to do some short presentations on how they implement their IDDE programs.

Next meeting set for Thursday, August 16th, 2012 from 10 AM – 3 PM at:

Center for Watershed Protection
8390 Main Street, Second Floor
Ellicott City, MD 21043

Illicit Discharge Elimination Expert Panel
Research Workshop Meeting Minutes
Thursday, August 16, 2012

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	Yes
Megan Brosh	Baltimore County	Yes
Lori Lilly	CWP	Yes
Barry Newman	PA DEP	No
June Whitehurst	City of Norfolk	No
Barbara Brumbaugh	City of Chesapeake	Yes
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	No
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	Yes
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes
Non-panelists: Chris Mellors – Tetratech; USWG; Jeremy Hanson – CRC, Norm Goulet, NoVa, Bill Stack, CWP, Jenny Tribo HRPDC, Sujay Kaushal, UMD		

Workshop Introduction **Tom Schueler, CSN**
Tom Schueler called the meeting to order and thanked the panelists for their service on the on the panel.

Literature Update **Chris Mellors, Tetra Tech**
Chris Mellors informed the panel that there are a total of 7 new documents added to the literature review/sharepoint site since the last meeting. **Tom** asked if the panel felt that we have sufficient literature for the panel process. **Bob Pitt** commented that the lit survey should remain open for the entirety of the panel process.

Discussion of SSOs **Tom Schueler, CSN**
Tom informed the panel of EPA's decision that SSOs are approved to be covered as part of the charge of the panel. **Gary Shenk** had expressed interest in quantifying the urban TN load from SSOs and incorporating it into the CBWM. CSO communities do get a reduction for their long term control plan in the model. Tom asked the panel if they agree with the idea of giving communities credits for SSO abatement as part of a LTCP. **Jenny Tribo** commented that the Hampton Roads Planning District Commission did a rough calculation for their WIP and can provide more data on how estimate loadings and prediction of frequency reductions and what is strength of SSO in terms of sewage. **Bill Stack** commented that the flows may be diluted for SSOs. **Bob Pitt** commented that there are two types of SSOs: wet weather flows and blockages. From a volume standpoint wet weather conditions are the most significant but less concentrated.

Blockages should be improved as a result of education and outreach efforts. **Schueler** asked about SSOs reported? **Pitt** commented that communities are required to report SSOs to state agencies. **Lori Lilly** noted that they are reporting volumes.

ACTION: Jenny to share HRPDC data with the group; will be added to an SSO folder on the sharepoint site.

ACTION: CSN web search re: database for frequency for Bay states: MD, VA, DC, PA

Research Presentations

All presentations are available on the IDDE Panel's Share Point. This summary only provides a brief snapshot of the day's presentations, and focuses on the key points and discussion rather than the information presented on the slides. Please consult the presentations for details.

Tom notified the group that we are looking for the panel to find areas of concurrence, common threads and also identify areas of missing information.
Bob Pitt, Bill Stack, Lori Lilly, Sujay Kaushal and Tom Schueler all gave research presentations on various aspects of illicit discharges.

Bob Pitt gave a presentation on the Basics of IDDE. His main conclusions can be found in his presentation. The following are some of the discussion highlights:

- Schueler: appears to be the pipes <36" are more numerous and produce more illicit discharges.
- Major bulk of bacteria in streams is from "natural sources". 10,000+ colonies indicated sewage.
- Localities concerned about their own vaults could be opportunity for coordination.
- Seeing about 10% sewage contamination of samples in southeast.
- **Bob to send papers on P content of street tree litter to CSN**.
- Don't see first flush impacts with bacteria; bacteria increases over time.

Bill Stack with the Center for Watershed Protection gave a presentation on water mains, nutrient loadings and the work he did for Baltimore City managing the stormwater permit program and the work he has done at CWP on illicit discharges. His main conclusions can be found in his presentation. The following are some of the discussion highlights:

- In areas with high water table areas, water infiltrates into the sewers.
- He has found that there are two types of dry weather connections: connections from the MS4 system and direct discharges (individual homes connected)

Lori Lilly gave an overview of CWP's research on illicit discharge detection and elimination. Major findings include:

- Dry weather flow in 40% of outfalls in six different watersheds

- Hits for ammonia, a primary wastewater indicator, in 80% of outfalls with dry weather flow
- Significant nutrient loading in Baltimore from small diameter pipes with potential illicit discharges
- Nutrient loading from potential and confirmed illicit discharges in Western Run (Baltimore) and Sligo Creek (Montgomery County) make up a significant portion of in-stream loading
- Illicit discharge elimination can make significant strides towards meeting Bay TMDL targets based on these initial studies.

Sujay Kaushal from University of Maryland presented his research on Isotopic Tracing of Nitrogen in Baltimore Streams. His main conclusions can be found in his presentation. The following are some of the discussion highlights:

- **Tom** asked about EMC for TKN in the field, Sujay noted that the majority of the work focused on Nitrate, not TKN however they did look at particulate Nitrogen (transported during high flows).
- **Bob Pitt** commented that it would be good to compare sheetflow data from different land uses.
- Nitrogen from wastewater during baseflow conditions; nitrogen from atmospheric deposition during storm flow conditions.

Tom Schueler gave a brief overview of Jill Murray's presentation on Santa Barbara's IDDE program from the CSN stormwater retreat.

Discussion on Research Presentations

Tom noted that a lot of the information is from older urban, suburban communities and ask the panel if they are seeing the same trends universally in communities around the Bay Watershed or are there areas that can be identified as hotspots? **Brosh** and **Handy** find more problems in the older portions of the communities; also more difficult to track problems in the older areas. **Pitt** did find problems in 'brand-new' areas, potentially surface contamination. **Walch** not as many urban areas in the Chesapeake Bay watershed portion of Delaware, more greywater (sump pumps, laundry) and septic connections; usually occurs in the older communities and mostly people aren't aware of it; tends to occur in lower income communities probably as a result of lack of maintenance. **Brosh** added that they find more chlorine and water main breaks instead of sewage in Baltimore County.

Local Representative Presentations

Local representatives presented on their IDDE programs. The information can be found in each presentation but an overview of the highlights follows:

- Delaware DOT Phase 1 permit expired 6 years ago but administratively continued. DelDOT responsible for 90% of all roads in Delaware, so most of the drainage from roads is theirs. Found the door hangars to be very helpful for education/outreach component. Good public outreach campaign. Difficulty

enforcing problems. Proposing a subsampling technique. **Schueler** question for the panel: How to credit more rural illicit connections?
- **Megan Brosh** discussed Baltimore County's IDDE program. Use of a subsampling technique – with prioritization. Take flow measurements as well. County doesn't operate a 24-hr hotline.
- **Diana Handy** gave an overview of Arlington County's IDDE program. Lots of hands-on outreach and collaboration among agencies. Aiming their outreach to the business sector – where most of the illicit discharges come from. Prioritization scheme for outfalls. Majority of bacteria from wildlife. Ticketing system. Tracking system with information compiled in an access database.
- **Kevin Utt** gave an overview of the City of Fredericksburg's IDDE program, a Phase II community. He has just recently taken over the program and is in the process of getting it up to speed. Do have significant enforcement procedures.

ACTION: local reps please send out documents referenced in your presentations to the panel/add to the meeting folder on the sharepoint.

Discussion

Tom asked the panel to summarize what they learned during the research workshop, to identify what they think areas of importance, what the priority issues are that need to be resolved in order to develop a crediting system.

- **Handy:** the number of types and nature of illicit discharges is going to be challenging to come up with credit system. How to eliminate them? Specifically with the transient discharges. How to track and quantify.
- **Pitt** warns the panel on the level of detail for this panel; can establish broad categories.
- **Schueler** commented that we can characterize the quality of the various flow (on bay-wide basis) the flow part of the parameter may become a best professional judgment; water main breaks, SSOs, sewer exfiltrations, illicit discharges.
- **Walch** impressed by potential contribution of illicit discharges; seen so much variability in what is found, looked for. Some of the more intermittent discharges may not be feasible to monitor for.
- **Schueler** conveyed that where the science is strong it will be easier to come up with a reporting, tracking and verification system. Informed how other panels are dealing with the RTV and the unit credit approach – and a program would have to meet a checklist of prescribed best practice.
- **Pitt** says there may be a way to statistically estimate the intermittent discharges.
- **Lilly** how to credit the transitory discharges? Would be good to incentivize communities to get problems fixed as quickly as possible.
- **Schueler** will need to avoid "gamers" of the system. Verification of the credit – maybe on a 5-year cycle (permit?); requires visual confirmation. Two categories: constant bad actors and intermittent bad actors.
- **Lilly** said it would be good if a community could evaluate which illicit discharges are the most pressing. Tidal areas will be problematic.

- **Pitt** commented that should require communities to have nutrient data in order to take the credit.
- **Handy** flow is not a good indicator in Arlington County b/c there is constant baseflow in most of the outfalls.
- **Schueler** the hardest thing will be to estimate the car washing. Suggested tiers of program efficacy. As sophistication of program increases – get more credit. Won't be overwhelming to localities in administrative burden. For example:
    - Continuous: Measure Q, N, P
    - Physical Indicators: no credit
    - Hotline, logging complaints, follow-up: some credit
- **Schueler** what percentage of the annual urban load would the credit be applied to?
- **Lilly**: communities would need to establish a baseline for a particular problem.
- **Brosh**: Baltimore County doesn't even bother with transitory discharges, too many chronic problems to focus on first
- **Pitt**: leave that option to the communities
- **Schueler**: there may be a pollution prevention panel in the future. Episodic, transitory discharges are more related to pollution prevention programs than IDDE programs

ACTION: CSN will put together a strawman on the tier approach as well as the framework for measuring flow and concentration for next meeting.

ACTION: Tom to talk to the modelers regarding IDDE modeling.

Next meeting was scheduled for Wednesday, October 3, 2012 from 1 PM – 3 PM (conference call).

Illicit Discharge Elimination Expert Panel
Teleconference Call
Meeting Minutes
Wednesday, October 3, 2012

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	Yes
Megan Brosh	Baltimore County	No
Lori Lilly	CWP	Yes
Jenny Tribo	HRPDC	Yes
June Whitehurst	City of Norfolk	No
Barbara Brumbaugh	City of Chesapeake	Yes
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	No
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	Yes
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes
Non-panelists: Kamran Zendehdel – Tetratech, Norm Goulet – NVRC, Jenny Tribo – HRPDC, Jeremy Hanson – CRC		

Call to Order, Review of Actions Items and Meeting Minutes from August Workshop: Tom Schueler (CSN) thanked the Panel for their participation in the Expert Panel and asked them to approve the minutes from the August Research Workshop meeting.

Decision: The Panel approved the minutes from the August Research Workshop meeting.

State SSO Research Update: Cecilia Lane (CSN) gave an update on the research of the state SSO data availability that had been requested at the last meeting. The research can be found in Attachment B. **Tom** noted that due to the obvious variability in the data we cannot be sure of the reliability of the information. **Bob Pitt** noted that states should only be able to receive credit for eliminating/reducing SSOs if they can document that they have complete and accurate data. **Tom** noted that the D.C. numbers are most likely low due to the fact the most of the area is covered by a combined sewer system. Tom then turned the meeting over to **Jenny Tribo** (HRPDC) to discuss how HRPDC collects, manages and reports their SSO data. The information can be found in Attachments C and D. **Jenny** noted that the HRPDC data is *not* included in the VA DEQ data that Cecilia had presented earlier and **Tom** noted that due to the variability between the HRPDC and the DEQ data it is most likely that the DEQ data is not comprehensive. Jenny offered to look into if other regions maintain individual databases. She noted that within the timeframe of September 2011 – August 2012, approximately 10% of the SSOs were considered “unknown volumes”. Jenny noted that maintains their own database in order to meet the consent decree with EPA and DEQ. **Jenny** discussed HRPDC’s estimating of nutrient reductions associated with control of SSOs (Attachment C). **Tom** asked **Jenny** to clarify the 10% assumption and the nutrient concentration assumptions (last 2 bullets on page 1 of Attachment C). **Jenny** noted that these assumptions come from an individual in the wastewater field and that she would follow-up with him for a more detailed explanation. **Jenny** defined the acronym FOG to stand for: fats, oils and grease, and indicated that the “FOG program” came out of the consent order and that it consists of outreach campaigns and hotspot targeting (Attachment D). She clarified that the oil and grease blockages were considered dry weather SSOs and the “hotspot cleaning footage” consisted of video footage of lines, cleaning of blockages, and targeted campaigns in historic problem areas. **Diana Handy** asked if the FOG information is being tracked in GIS and while Jenny couldn’t speak directly to that **Barbara Brumbaugh** noted that her community was using GIS to track this information. **Tom** noted that the purpose of this information is for the panel to decide if certain management practices can be related to the reduction or elimination of SSOs and if it would be possible to issue a credit for such practices. **Lori Lilly** commented that she is concerned that discharge volumes tend to be underreported and if a credit is offered it could potentially lead to a scenario of over crediting. **Tom** commented that the panel could develop a method that uses the existing flow volumes (which tend to be conservative) and apply them to reduction of dry weather SSOs and this would avoid over crediting. **Lori** asked if someone could clarify how discharge estimates are made in the field. **Diana** noted that Arlington County estimates the discharge by using the typical flow volume of the pipe, the diameter of the pipe and the duration of the discharge from discovery. **Jenny Tribo** offered to follow-up with more information on how flows are estimated. **Tom** noted that it would be good to determine if there is a consistent/superior method for estimating SSO discharge flows in the field and requested the local government panelists to submit information if they have it. **Bob Pitt** noted that SSOs can be caused by multiple causes which may influence what technique should be used to estimate the flow. **Tom** asked **Jenny** about the year to year variability of the wet weather SSO data in Attachment C and if this was a result of wet weather events. **Jenny** noted that it is possible to query the database by dry and wet weather overflows. **CSN** to follow-up with **Jenny** to perform such a query.

ACTION: Jenny Tribo to check if other regions maintain own databases

ACTION: Jenny Tribo to follow-up with Ted regarding the assumptions in Attachment C (last two bullets of p.1)

ACTION: Jenny Tribo to follow-up with more information on how flows are estimated in the field.

ACTION: Local government panelists to submit information on how to estimate SSO discharge flows in the field.

ACTION: CSN and Jenny to follow-up on querying the HRPDC database by certain classes of SSOs

Panel Discussion on Illicit Discharge Strawman: Tom and **Cecilia** led the panel in a review and discussion of the proposed strawman that CSN developed to outline a tiered approach to discharge categorization (Attachment F). A lively discussion ensued; the main points were as follows:

- Add indicator bacteria to discharge categorization framework
- Add "other" category of inappropriate discharges to include (but not be limited to): restaurants, metal plate washing, HVAC rooftop discharges, commercial car washing, commercial laundry, power washing, dumpster juice
- If we add numbers to the framework, a range will need to be specified or they will need to be within the 95% confidence interval
- The addition of graphics to the technical memo would be helpful for the definitions section
- CSN needs to discuss septic and sanitary discharges with the wastewater treatment workgroup to ensure no double counting
- Clarified that the "septic" category refers to surface flow; subsurface flow falls under the purview of the wastewater treatment workgroup
- CSN to talk to Tanya Spano to ensure that other groups are not taking credit for eliminating dry weather SSOs

Based on the Panel's feedback, CSN will revise the framework and send out updated versions prior to the next panel meeting. Panelists who were not present on the call are requested to provide written feedback by November 1, 2012.

ACTION: Jenny Tribo to break out categories of wet weather SSOs for "wet vs. really wet"

ACTION: Panelists who were not present on the call are requested to provide written feedback on both strawman by October 19, 2012.

ACTION: Panelists to look at local drinking water reports to obtain N and P concentrations and send to CSN

ACTION: Panelists please send concentration data to CSN for inclusion in the framework. Please include source citations.

ACTION: CSN to talk to Bill Stack at CWP regarding transmission loss of drinking water data

ACTION: CSN to revise strawmen based on the Panel's feedback and share with Ning Zhou, the coordinator of the wastewater treatment workgroup.

Panel Discussion on Illicit Discharge Programmatic Strawman: Tom and **Cecilia** led the panel in a review and discussion of the proposed strawman that CSN developed to outline a percent credit based on programmatic categorization (Attachment E). A lively discussion ensued; the main points were as follows:

- This approach is to address certain discharges that are not quantifiable otherwise
- The credit based on loading from pervious land from the community
- **Pitt** likes the idea of offering credit for an "intermediate" program, will allow communities to receive some credit while they get their more advanced programs off the ground
- **Norm** commented that the new Phase ½ MS4 permits have different requirements and should be reviewed and incorporated into the framework
- (Diana Handy had to leave the meeting to address and illicit discharge)
- **Lori** noted that it should contain a way for non-regulated communities to receive credit

CSN to review phase 1/2 draft permits for MD, VA, PA, DC and incorporate the changes into the programmatic strawman.

Reading Group Reports: All panelists were requested to review 3-4 articles from the literature survey and summarize the key findings pertinent to the charge and provided a general outline of suitability of these materials they reviewed for use by the panel. **Lori Lilly** and **Marianne Walch** presented brief reports on the literature they reviewed. Their presentations can be accessed on the sharepoint site. All other panelists are requested to complete their reading assignments for the next panel call. Due to some technical difficulties with the sharepoint site, CSN will be assigning and distributing specific articles to each panelist. The panel requested that CSN create and distribute a template for the research reviews.

ACTION: CSN to create and distribute a template for the research reports and assign and distribute papers to remaining panelists.

ACTION: All remaining panelists to complete a brief review of 3-4 articles within the literature survey and put together 3-4 slides summarizing what are the key findings pertinent to the panel's charge.

Review Consensus, Agree on Action Items and Set Next Meeting Date
Tom decided to postpone the *Technical Discussion on Techniques for Measuring Discharge Flows and Nutrient Concentration* until the next call and adjourn the meeting.

Next meeting was scheduled for Monday, November 19, 10 – 12 PM (conference call).

Illicit Discharge Elimination Expert Panel
Teleconference Call
Meeting Minutes
Monday, November 19, 2012

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	Yes
Megan Brosh	Baltimore County	Yes
Lori Lilly	CWP	Yes
Jenny Tribo	HRPDC	No
June Whitehurst	City of Norfolk	Yes
Barbara Brumbaugh	City of Chesapeake	Yes
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	Yes
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	No
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes
Non-panelists: Chris Mellors – Tetratech, Whitney Katchmark – HRPDC		

Call to Order, Review of Actions Items and Meeting Minutes from October Meeting: Tom Schueler (CSN) thanked the Panel for their participation in the Expert Panel and asked them to approve the minutes from the October meeting. **Tom** and **Cecilia** updated the Panel on the information they received from their meeting with representatives from the Wastewater Workgroup and the Septic Expert Panel indicating that the Septic Panel is not looking at failed septic systems. In addition, members from the Septic Panel noted that in their experience, failed septic systems tend to be localized and do not result in a "surface flow" that would reach the storm sewer system (per the Panel's discharge categorization strawman) and considered a public health concern and in general are remediated immediately (thereby providing even less of an opportunity for pollutants to reach the storm sewer system). **Tom** notified the Panel of CSN's intentions to coordinate with the Septic Expert Panel in the first quarter of 2013 and to share an interim draft of our recommendations to ensure consistency.

DECISION: The Panel approved the minutes from the October meeting.

Update on SSO Research: Cecilia Lane and **Tom Schueler** went over the research **Jenny Tribo** collected on SSO tracking as follow-up from the last meeting. Panelists were asked to report any information they obtained regarding estimating SSO flow data in the field. **Diana Handy** said that Arlington County estimates SSOs by using: historical flow data, discharge time, pipe diameter, time of day, area upstream and sewer volume whereas estimates made at pumping stations are done differently and tend to be more accurate. **Barbara Brumbaugh** indicated that her community uses a "cheat sheet" to estimate flow in the field and she will send this to CSN. The Panel decided that estimating flow is unique to each type of SSO discharge and so there is no standard way for it to be done but directed CSN to put together a general method to be used as guidance.

ACTION: Barbara to send flow estimate "cheat sheet" to CSN.

ACTION: CSN to put together a general method for estimating SSO flows in the field.

Review of the Updated Strawman: Cecilia Lane and **Tom Schueler** gave an overview of the revised discharge categorization strawman as a result of the panel's feedback at the October meeting and reminded the panel that the nutrient and bacteria values should be updated with data from the literature. Panelists discussed the revised strawman and discussed the following:

- Mobile car washing should be added to the commercial car washing category and that there are numbers in the literature to support higher nutrient concentrations for this practice.
- How to differentiate between *chronic* and *catastrophic* wet weather SSOs. **Tom** offered that *chronic* refers to a system that is producing illicit discharges during smaller storms and recommended 1" to be the threshold. *Catastrophic* would apply to storms greater than 1". **Megan Brosh** noted that rainfall intensity may be necessary for defining the difference between the two categories.
- The Panel then had a discussion on dry weather SSOs and agrees that they could be addressed on a system-wide basis by implementing a FOG program (per Jenny Tribo's research). The Panel decided that episodic or occasional dry weather SSO discharges are not easily measured and would be addressed through programmatic controls.

ACTION: Megan Brosh, Whitney Katchmark and Marianne Walch to follow-up with their public works and wastewater departments to see how they estimate intensity.

ACTION: CSN to ask the wastewater workgroup if they have any methods for estimating SSOs based on rainfall intensity.

ACTION: CSN requested the panelists to forward the most recent permits for incorporation into the programmatic framework.

Reading Group Reports: Panelists presented their brief reports on the literature they reviewed. They highlighted the most pertinent research and provided a general outline of suitability of these materials reviewed for use by the panel. Their main conclusions can be found in their presentations accessible on the sharepoint site.

ACTION: All remaining panelists to complete a brief review of 3-4 articles within the literature survey and put together 3-4 slides summarizing what are the key findings pertinent to the panel's charge for the next panel meeting.

Technical Discussion on Techniques for Measuring Discharge Flows and Nutrient Concentration: Lori Lilly (CWP) discussed the framework she put together on techniques for measuring discharge flows and nutrient concentration in the field. **Lori** explained that the goal is to establish a method or procedure to estimate the delivery of discharges for each category that can be credited.

ACTION: Lori Lilly to meet with CSN prior to the next Panel meeting about the Techniques for Measuring Discharge Flows and Nutrient Concentration table.

Review Consensus, Agree on Action Items and Set Next Meeting Date: The Panel directed CSN to edit the tables and write-up a first draft of the report outline and circulate it to the panel for review. The next meeting date will be set for February once these materials have been drafted.

ACTION (*ongoing*): Panelists to look at local drinking water reports to obtain N and P concentrations and send to CSN

ACTION (*ongoing*): Panelists please send concentration data to CSN for inclusion in the framework. Please include source citations.

Illicit Discharge Elimination Expert Panel
Teleconference Call
Meeting Minutes
Thursday, June 27, 2013

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	Yes
Megan Brosh	Baltimore County	Yes
Lori Lilly	CWP	Yes
Jenny Tribo	HRPDC	No
June Whitehurst	City of Norfolk	Yes
Barbara Brumbaugh	City of Chesapeake	No
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	Yes
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	Yes
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	No Yes
Bill Stack	CWP (facilitator)	Yes
Non-panelists: Whitney Katchmark – HRPDC		

Call to Order, Review of Actions Items and Meeting Minutes from November Meeting: Bill Stack (CWP) introduced himself and informed the panel that he is standing in as facilitator of the panel for Tom Schueler while he is away on vacation.

Reconnect since Last Meeting: **Cecilia Lane (CSN)** thanked the Panel for their participation in the Expert Panel and gave a brief update on where the panel stands: giving an overview of the items of consensus since the beginning of the panel. **Lane** reviewed the meeting minutes and action items from the November meeting and requested the Panel approve them.

DECISION: The Panel approved the minutes from the November meeting.

Presentation on Discharge Classification and Crediting Approach: Lori Lilly (CWP) presented the illicit discharge classification scheme and crediting approach. The overall approach can be found in the presentation but the following is a summary of the discussion that ensued.

- **Bill Stack** clarified that CMOM stands for Capacity, Management, Operation and Maintenance Programs (under Category 2 discharges).

- **Diana Handy** asked about drinking water transmission loss as an illicit discharge (Category 2), noting that in Virginia it is an "allowable discharge" under their permit. **Stack** noted that it may vary by state and indicated he would change the language to reflect differences in what constitutes an illicit discharge in the various Bay watershed states.
- **Kevin Utt** recommended that leaking marina pump-out stations is a better example of a Category 1 sewage discharge than boats or RV's.
- **Handy**, **Utt** and **Megan Brosh** clarified that HVAC discharges (Category 1) would include air conditioning condensation which is allowable in VA, MD.
- The Panel noted that commercial car washing is a permitted activity in VA
- **Stack** asked the Panel to comment on which discharges are missing from the classification scheme.
    - o **Handy** is concerned that a number of the discharges that are found in the field and that impair water quality are not listed in the classification scheme
    - o **Utt** noted that technically a community shouldn't have dumpster leaks or and spills to begin with.
- **Handy** asked for clarification of "emergency repair" under "non-eligible discharges"
    - o **Stack** clarified that many overflows that occur happen after 2009 (the baseline year for the Bay TMDL). An emergency break behaves more like an addition to the baseline load whereas a chronic break most likely occurs on a more regular basis and is already part of the baseline load therefore in order to avoid double-counting emergency repairs would not be considered eligible for a credit.
- **Whitney Katchmark** asked for clarification regarding the "tangible BMP" requirement under the eligibility criteria. **Stack** clarified that it is that "something that is done to fix a discharge" and BMP is just the word commonly used at the Bay program but would be open to using a different term.

Lori Lilly then went through the crediting approach for illicit discharges (3 protocols). The overall approach can be found in the presentation but the following is a summary of the discussion that ensued.

Protocol 1

- **Handy** commented that it is not always possible to sample at the source (Protocol 1).
- **Marianne Walch** noted that the same monitoring for protocol 2 (at the point of repair and the outfall) could be used for protocol 1 asked for clarification regarding where the monitoring occurs (at the outfall or discharge location).
- **Mark Hoskins** remarked that it is very difficult to separate from baseflow and detect low contributions
- **Handy** asked how to collect flow measurements for polluted runoff coming off a parking lot?

- **Pitt** noted that flow collection recommendations were put together by CWP as an appendix to the IDDE manual.

Protocol 2

- **Stack** clarified that 12-digit HUC code would be used to deal with the difficulty of detecting low contributions.
- **Handy** commented on the 5 year verification requirement and noted that VA permits are 5 years in duration
- **Stack** – clarified that perhaps the panel could consider a 3 year verification period if a community has a long-term monitoring program already in place that the panel
- **Bob Pitt** asked how uncertainty is being dealt with in regards to using an indirect baseline condition; **Lilly** indicated that the 3-5 year verification period would provide the opportunity to verify the baseline load. **Stack** commented 3-5 year verification period would give a more accurate load estimation that would trump the original baseline load estimation but noted that if a community is using the Bay model load estimation it will be important to limit the reducible load (i.e., by adding a cap).
- **Marianne Walch** asked for clarification regarding where the monitoring occurs (at the outfall or discharge location). **Lilly** clarified that under Protocol 2 measurements made at point of repair and at the outfall. **Walch** noted that same method could be used in Protocol 1 as well.

Protocol 3

- **Lilly** requested standard nutrient concentration data for wet weather SSOs.
- **Utt** asked for clarification on the difference between "making a repair" and "applying a sanitary BMP". **Stack** noted that we will either more clearly define the term "BMP" or are open to using a better term.
- **Handy** asked how we can measure the flow for wet weather SSOs. **Stack** remarked that EPA has some guidance on estimating the volumes and that most wastewater agencies follow these guidelines when reporting SSOs. **Handy** recommended that *volume data* was used in lieu of flow.
- **Hoskins** questioned whether this category really is an illicit discharge noting that these systems are designed to overflow. He offered to follow up with colleagues in Aurora regarding nutrient and volume data.
- **Katchmark** asked if a FOG program would be eligible for credit under Protocol 3. **Stack** clarified that that a FOG Program could potentially contribute to credits if we adopted the "Programmatic Credit".

ACTION: ALL to send nutrient concentration data for wet weather SSOs to Cecilia Lane and Lori Lilly.

ACTION: Panel to consider possibility of 3-year verification with long-term monitoring program at next meeting

ACTION: Mark Hoskins to follow-up with colleagues in Aurora regarding wet weather SSO data.

Lori Lilly and **Bill Stack** led the Panel in a discussion on the issue of including TSS and bacteria in the crediting approach. **Lilly** noted that there is very little scientific data to support a TSS credit for eliminating discharges. **Utt** and **Handy** indicated that they often see sediment inputs in the field as a result of ESC dewatering activities. **Stack** noted that this will most likely fall under the purview of the ESC panel that is currently being held. **Hoskins** noted that TSS is difficult to credit due to its nature of settling in the storm drain and being flushed out during an unrelated discharge. He also commented that communities should receive bacteria credit for wildlife eradication programs. **Pitt** noted that there is a lot of variability but a very real benefit to offering a credit for both TSS and bacteria and noted that a partial credit would be a way to address the variability. Several panelists noted that sediment reductions should be credited if a reduction is monitored in the field. The Panel agreed that there is not enough scientific data to support a default value for TSS or bacteria but decided that a credit should be available if reductions can be shown through monitoring

DECISION: The Panel agreed that there is not enough scientific data to support a default value for TSS and bacteria reductions associated with illicit discharge elimination however decided that credit should be given if field monitoring can demonstrate a reduction.

Technical Discussion on the Proposed Crediting Approach: Bill Stack (CWP) led the Panel in a discussion on the proposed classification scheme and crediting approach for illicit discharges. He asked the panelists to comment on the overall approach and list off any concerns they have moving forward.

- **Walch** commented that she is okay with the basic strategy
- **Brosh** commented that she concerned about not allowing the "oddball discharges" in the matrix. She noted that she comes across many strange things in the field and they should be creditable if one can produce monitoring data. It would be good to add a miscellaneous category; **Stack** agreed and noted that this would address the discharges that are illicit in only some Bay states and not others and would give states the flexibility to take credit for discharges as they see fit.
- **Katchmark** noted two concerns:
    - Not sure about using a 1" rainfall threshold for distinguishing chronic and catastrophic overflows; possibly "level of service" (LOS) would be a better way to distinguish between the two discharge types
        - **Katchmark** explained that a sewer system is supposed to perform at a certain "level of service" LOS (5 or 10 year storm) which means any storm event that exceeds the LOS would be considered catastrophic and they would not receive credit. Anything below that could fall into the *chronic* category. **Lane** questioned if all

communities have this information readily available. **Stack** noted that it will be necessary to follow-up with people at the Bay Program to see if this differentiation would be possible in the model.

  - Even though some discharges are “allowable discharges,” they still have a pollutant load associated with them that can be removed –whether they are illicit or allowed is not relevant.
- **Whitehurst** noted that she is concerned about implementation for localities. Currently the focus is on identifying the source of the discharge and stopping it, collecting flow and concentration data will be difficult with existing resources and wondered how practical it would be in the field. Also concerned about the non-eligible discharges: if it can be monitored it should be eligible for a credit. **Lilly** noted that it would be good to include guidance protocols for monitoring in the recommendations.
- **Handy** also concerned about the resource intensity of implementation and would like to see a partial credit at least for pollution prevention activities.
  - **Stack** asked the Panel if we went with a programmatic credit – and had 3 year verification: would you have the capacity to do a monitoring program at a larger scale?
- **Hoskins**: overall good, logical approach; monitoring program is difficult; linking into a storm size (1 yr, 5 etc) to calibrate back for the baseline. Could there be a lbs/yr reduction associated with the discharge category? (i.e., car washing program); TSS issue is going to be difficult but should be able to receive the credit if monitoring; SSO overflows are not ‘illicit’ (designed to overflow for a certain rare event)
- **Utt**: making good progress; need a simple way for communities to utilize it (less complex); asked if there could be a “curve approach” for crediting SSOs and exfiltration based on the age of the system.
- **Pitt**: prefers the term “inappropriate discharges” vs. illicit for nomenclature; notes that a number of the discharges are continuous; recommends monitoring during dry weather to eliminate many of the issues with dilution and sediment transport

ACTION: Bill Stack to follow-up with Jeff Sweeney at CBPO regarding the differentiation of chronic and catastrophic wet weather overflows.

Discussion on Offering a Programmatic Credit: Stack and **Lane** explained that other panels have not had much luck getting the programmatic credit approved and asked the panel if they thought it would be worthwhile to continue to pursue the credit. **Stack** noted that the credit would need to be quantifiable and specifically defined. The Panel unanimously voted to continue to pursue the programmatic credit.

DECISION: The Panel directed Stack, Lilly and Lane to continue to pursue the programmatic credit.

Technical Memo and Profile Sheet Discussion: Cecilia Lane (CSN) led the Panel in a discussion on the proposed outline for the technical memo, a discussion of the discharge profile sheet (Attachment D) and outlined the plan for next steps for the panel.

- **Utt** questioned if it would be possible to make the profile sheets a working document: create a tool that would automatically calculate values for the user. **Lane** noted that under the current budget we didn't have the capacity to create such a tool but that many outside organizations are pursuing funding to create tools based on the expert panel recommendations.
- **Pitt**: for Section 8 – recommendation to create a nutrient library associated with sources of discharges to develop a regional monitoring program for discharges

Review Consensus, Agree on Action Items and Set Next Meeting Date: The Panel directed CWP and CSN to make the recommended changes and move forward with a first draft of the recommendations. CSN/CWP committed to having a first draft to the Panel by August 15, 2013. The Panel would then have 1 month (until September 15, 2013) to review the draft and provide comments. The next meeting date will be set for the end of September 2013.

Bill Stack thanked the Panel for their service and adjourned the meeting.

Illicit Discharge Elimination Expert Panel
Teleconference Call
Meeting Minutes
Wednesday, October 2, 2013

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	No
Megan Brosh	Baltimore County	Yes
Lori Lilly	CWP	Yes
Jenny Tribo	HRPDC	Yes
Whitney Katchmark	HRPDC	Yes
June Whitehurst	City of Norfolk	Yes
Barbara Brumbaugh	City of Chesapeake	No
Diana Handy	Arlington, VA	No
Mark Hoskins	Dewberry	No
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	No
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes Yes

Call to Order, Review of Actions Items and Meeting Minutes from June Meeting. Tom Schueler (CSN) called the meeting to order and thanked the panelists for their service on the panel. **Tom** thanked **Bill Stack** and **Lori Lilly** (CWP) for their work on the panel over the summer. Tom reviewed the meeting minutes from the June meeting and the panel accepted them.

DECISION: The Panel approved the minutes from the June meeting.

Summary of Report. **Tom Schueler (CSN)** thanked **Megan**, **Jenny** and **Whitney** for providing written comments on the first draft of the report. **Tom** briefly went over the first draft of the Illicit Discharge Panel recommendations and discussed some of the changes that have been identified since the panel received the report. More information can be found in the presentation on the sharepoint site (Attachment C) but the following is a highlight of the discussion:

- **Tom** discussed the revised summary table and noted the revisions of the “Protocol Used” column and the addition of an “Elimination Method” column. **Tom** explained that the intent is to link each discharge type to a specific elimination method as this demonstrates that there is an actual environmental benefit by eliminating the discharge and also it helps to inform which protocol is appropriate to use when crediting the discharge. **Tom** asked the panelists to review the elimination methods for each discharge and contribute terms and definitions as needed.

- **Tom** explained to the panel that while working on some of the remaining tasks of the report (discharge profile sheets) several necessary revisions were identified. **Tom** asked **Cecilia Lane** (CSN) to discuss them with the panel. **Cecilia** explained to the panel how transitory discharges and miscellaneous high nutrient discharges are very similar in nature and indicated that it might make sense to combine the two discharges. The Panel agreed and directed CSN to combine the two categories. **Cecilia** also indicated that it might be possible to credit dry weather SSOs by tracking a reduction in overflow events as is the case with wet weather SSOs under Protocol 3 and noted that the panel may elect to add an additional crediting option for this category of discharges.
- **Tom** outlined the major issues for the panel to go over in this meeting based on initial feedback of the report.
    - Verification requirements may be too time demanding/difficult for local governments to meet
    - Protocol 2 is too complex and most localities would opt for credit under Protocol 1; need to identify which discharges could be addressed by Protocol 1
    - Protocol 3, could be possible to credit dry weather SSOs by tracking a reduction in overflow events as is the case with Protocol 3
    - The programmatic credit needs to be made more prominent in the report as an option for crediting discharges
    - The ultimate document should be a simple guide for users

ACTION: Panelists to review the elimination methods for each discharge and contribute terms and definitions as needed.

DECISION: CSN to combine the transitory and miscellaneous high nutrient discharges into one category.

ACTION: CSN to make programmatic credit more prominent in report

ACTION: CSN to explore overflow reduction method for dry weather SSOs

Rapid Feedback on First Draft of the Final Technical Memo. Each panelist was asked to provide a brief summary of their overall comments on the first draft of the report. Specifically on what they liked (and didn't like) about the first draft and what areas need more work.

- **Megan Brosh**, asked if it would it be possible to have different categories for verification requirements based on the type of discharge and noted that some discharges require more stringent verification requirements to ensure that the discharge has been eliminated. Not sure why certain transitory discharges (i.e., dumpster juice) are ineligible for a credit and reiterated thoughts from previous panel meeting that if a locality can demonstrate monitoring and flow data then should be able to get credit. **Megan** provided an example from Baltimore County

of a high nutrient discharge that was traced back to an industrial size compactor; Protocol 2 is very overwhelming, would prefer to default to Protocol 1 as much as possible.
  - **Tom** reminded the panel that credits do not apply to emergency repairs of discharges.
  - **Tom** said that CSN would add verification requirement to discharge summary table.
  - **Tom** agreed with the idea of receiving credit if can demonstrate monitoring and flow data and committed to making this change in the next version of the report.
- **Jenny Tribo**, noted that FOG programs could lead to a reduction in wet weather SSOs as well; should split out programmatic credit so that a community could use the programmatic credit for dry weather discharges while using another protocol (e.g., Protocol 3) for the wet weather discharges; need greater distinction in the report on calculating reductions for planning purposes versus for reporting after implementation. MS4s need to be able to estimate load reductions associated with illicit discharge elimination for WIP planning.
- **Whitney Katchmark**, noted that catastrophic design capacity is not directly tied to rainfall events and so setting a 2-year rainfall wouldn't be best way to determine the threshold between chronic and catastrophic events and it would be better to look at peak flow/capacity of the system. **Whitney** to write up an explanation of using peak flow to determine the catastrophic threshold for eligible wet weather SSOs and share with the panel by **Friday, October 11**.
- **Kevin Utt**, supported the idea of receiving partial credit for discharge elimination at the time when it is fixed and getting the rest of the credit once the verification requirements have been met as discussed at the June meeting; Defining monitoring for nutrient credit needs to be done in the report; comprehensive classification of each discharge/category; rainfall depth that triggers an overflow will be different across the sewer systems based on capacity; asked if there is any additional information to add to Section 4.5 on the contribution of illicit discharges to the dry and wet weather nutrient loads in urban watersheds.
- **Lori Lilly**, noted that it is important to define an upper limit to credits using Protocol 1 specifically for direct sanitary connections. **Tom** agreed that we can be sure to add an upper limit to prevent double-counting or over crediting.
- **Bob Pitt,** noted that the IDDE manual (CWP) would be a good place to start for creating guidance on a nutrient-based outfall screening program however it should be updated to reflect some of the newer methods out there; reiterated the view that localities should be required to sample for/collect nutrient concentration information in order to classify the nutrient concentrations for particular discharges and create a regional illicit discharge "database"; could pursue different levels of credit and verification requirements as increase the level of confidence to address the local government resource issue. **Tom** agreed and said that we would pursue this for the next version of the memo.

- **Diana Handy**, reiterated the concern that Protocol 2 requirements may exceed the resource capacity of local governments; verification requirements may be too intensive and should be revisited; concerned about unintended consequences as a result of requiring localities to collect monitoring data for discharges that they are required to eliminate immediately; emphasized the need to align credits with permit cycles and indicated support for the idea of a partial credit system.
- **Mark Hoskins**, noted that sump pump discharges could be added to the miscellaneous high nutrient discharges category; offered to help draft the catastrophic storm event definition.
- **Barbara Brumbaugh**, concerned about the long-term monitoring requirement and verification requirements, specifically the expense of the sampling to local governments and the ability to have it done properly. Noted that many discharge investigations are complaint driven and once repaired are not revisited by the locality (e.g., a dishwasher improperly tied into storm drain); Noted that many localities use visual inspections for dry weather outfall screening

Numeric Cap Discussion. Tom asked the panel about setting a numeric trigger for state/federal review and what additional information the locality would be required to submit. He explained that the purpose of the trigger (per discharge) is to provide review/quality control only, not an upper limit for the amount of credit you can claim.

- **Kevin Utt** noted that he doesn't feel comfortable setting a trigger.
- **Lori Lilly** to look at ranges when putting together the nutrient default table, use upper end of range to set trigger (for N only).

Design Examples Discussion. Tom asked the panel for feedback on the design examples and whether there were too many in the document and should be moved to an appendix.

- **Utt** doesn't think there are too many, the more the better.
- **Brosh** requested to go into more detail and show equations for 1 example in the main body of the document but not for all of them.

ACTION: CSN to add verification requirement to discharge summary table

ACTION: CSN to split out programmatic credit for wet/dry weather events.

ACTION: CSN to add language on calculating reductions for planning purposes to the report

ACTION: Whitney to write-up explanation of using peak flow to determine the catastrophic threshold for eligible wet weather SSOs and share CSN by Friday, October 11.

ACTION: Mark Hoskins to work with Whitney Katchmark and Jenny Tribo on the catastrophic storm event definition.

ACTION: Lilly to look at ranges when putting together the nutrient default table, use upper end of range to set trigger (for N only).

ACTION: CSN to include equations in the design example portion of the main document.

Review Consensus, Agree on Action Items and Next Steps in the Panel Review Process. Tom informed the panel that **CSN** will make the identified changes and put together a second draft of the report complete with profile sheets and have to the panel by Thanksgiving, with the next panel meeting to occur in early December. noted that going forward, panelists should expect more frequent communication from **CSN** as individual sections of the report are revised and panelists are asked to provide "rapid feedback".

ACTION: CSN to send out individual sections of the report to panelists as they are revised.

ACTION: CSN to have second draft of the report to panel by Thanksgiving.

ACTION: Next panel meeting to occur in early December.

ACTION: Cecilia to schedule the next panel meeting immediately.

Tom Schueler thanked the Panel for their service and adjourned the meeting.

Illicit Discharge Elimination Expert Panel
Teleconference Call
Meeting Minutes
Monday, May 5, 2014

EXPERT BMP REVIEW PANEL Illicit Discharge Elimination		
Panelist	***Affiliation***	**Present?**
Marianne Walch	DelDOT	No
Megan Brosh	Baltimore County	Yes
Lori Lilly	Independent Consultant	No
Jenny Tribo	HRPDC	Yes
Whitney Katchmark	HRPDC	No
June Whitehurst	City of Norfolk	No
Barbara Brumbaugh	City of Chesapeake	No
Diana Handy	Arlington, VA	Yes
Mark Hoskins	Dewberry	No
Kevin Utt	City of Fredericksburg	Yes
Bob Pitt	University of Alabama	Yes
Tanya Spano	MWCOG	No
Tom Schueler Cecilia Lane	CSN (facilitator)	Yes Yes

Call to Order, Review of Actions Items and Meeting Minutes from October Meeting. Tom Schueler (CSN) called the meeting to order and thanked the panelists for their service on the panel. **Tom** thanked the Panel for their service to the Illicit Discharge Expert Panel. Tom reviewed the meeting minutes from the October meeting and the panel accepted them.

DECISION: The Panel approved the minutes from the October 2013 meeting.

Summary of and Panel Comments on Second Draft. **Tom Schueler (CSN)** went over some of the key changes in the second version of the expert panel report with a focus on the simplified protocols and profile sheets. Tom then asked each panelist to provide verbal comments on the report, and their ideas on what is needed to finalize it. The following is a summary of the comments based on the section of the report/discharge type.

General Comments:

- **Pitt**: current title doesn't distinguish between normal role of grey infrastructure vs upset (i.e., illicit) conditions. Tom agreed, we should hash out the definition to identify what these discharges are and are not.
- **Tribo**: agreed there needs to be a qualifier since it does not apply to all discharges

- **Pitt**: please define “dry weather flows”
- **Pitt**: if you took credit at the outfall for the flow there may be multiple sources. Credit can only be applied to the portion that is being repaired.
- **Tribo**: add if locality has established process for confirming these with plans, plumbing inspector, photos etc. then wouldn’t need to do another site visit i.e., confirmation is an *inspection*.

Car Washing:

- **Handy**: remove “residential” from definition, more of an indirect runoff. Hotline complaints are a way to locate the discharge; Requiring a permit to allow this type of washing is an elimination method; verification frequency should be reviewed. Under a state permit, annual discharge monitoring is reported to the state.
- **Stack**: These mobile sources are in addition to the baseline load – should they receive credit? The only sources to get credit should be the ones that were in existence when the baseline load was set.
    - **Tom** agreed; but most likely this source has been a chronic source for many years (i.e., was most likely here when the baseline load was set)
    - **Pitt**: fire stations are a good example, required to wash every time they return, don’t always have a cleaning bay.
        - Also have outdoor washing of buildings as a source – where does that live? Restaurant grease trap washing etc.

Miscellaneous Discharges:

- **All**: Might be worth combining restaurant discharges, outdoor building power washing, floor drains etc. into the high nutrient misc. discharges category
- This discharge category requires the measurement of nutrient concentration and estimation of flow and duration
- **Handy**: in VA cooling towers may require a permit from the state if they are a significant source therefore permitting is an elimination method
- **Brosh**: elimination method would be dependent on the type of discharge (i.e., restaurant dumping would be discharge to sanitary etc.)
- Question for all: How to verify that a different employee doesn’t dump substances into the storm drain?
- **Pitt**: restaurant discharges were more continuous (not intermittent) and hold the *restaurant* accountable (not necessarily the staff)

Sanitary Direct Connection:

- **Tribo**: need to clarify that it is an intentional discharge
- **Schueler**: emergency pipe ruptures of a sewer line do not receive credit; this discharge category applies to incorrectly connected (intentionally or accidentally) pipes.

- **Pitt**: these discharges that are a continuous, long-term problem are highly significant over a large area.
- **Handy**: asked why the verification period for this discharge was longer than the other Protocol 1 discharges.

- **Schueler**: CSN will modify the profile sheet to include cross-connections, straight pipe connections and underground leakages
- **Tribo**: Recommend splitting the two categories: cross-connections and straight pipes to better reflect to nature of the discharge (defect vs. failure). **Schueler** agreed: A defect, fully exploited, becomes a failure.
- **Stack**: noted that in the case of sewage spills, legacy failures do apply for a credit (before the baseline), and asked if that would require a new profile sheet?
- **Schueler**: noted that verification requirements would need to change to reflect the two different discharge types: verification for the individual sanitary discharge would change to be the same as the rest in Protocol 1, but the other discharge would require a system-wide approach, so the longer verification period would be necessary. Also, screening isn't completely related to the credit i.e., the locality wouldn't have to wait 3 years to get the credit but must commit to doing the screening over that time.

Sewer Pipe Exfiltration

- **Stack**: add sewage spills, pipe failure to this category but in order to verify that it is fixed, would be similar to legacy or long-term breaks/leaks

Drinking Water

- Nutrient concentrations given by Consumer Confidence Reports
- **Stack**: this is regulated in MD by chlorination above a certain level. Add to text of memo explaining this; **Stack** to see if he can find the flow threshold.
- ALL: Add state-specific language for whether this discharge is regulated or not.
- **Brosh**: discharges are not allowable as a result from line breakage (catastrophic) not creditable. But can get credit for legacy problems. What about using a concentration of Chlorine as a threshold? Currently used a number to trigger the investigation.

Dry weather SSOs

- **Stack**: important to credit only loadings that have occurred after the TMDL. A longer period of tracking is required to assess the baseline
- **Handy**: how is this different from sewage pipe breaks/failure?

- **Pitt**: not associated with blockages per se, distinct, engineered overflow relief points that were built into systems that would overflow due to I/I – applies to chronically undersized systems.

Default Concentrations

- **Tribo**: floor drain and misc. concentrations – too similar; there shouldn't be a default value for a category that includes so many different discharge types.
- **Pitt**: add language about the variability of the default concentrations; coefficient of variation, range of variability (low, medium and high). If there is a high degree of variation than the concentration needs to be measured rather than using the default (or discount).

ACTION: CSN to add definition for dry weather monitoring

ACTION: CSN will modify the profile sheet to include cross-connections, straight pipe connections and underground leakages

ACTION: Split the sanitary direct connection into two different discharge categories.

ACTION: Bill Stack to see if he can find the flow threshold associated with drinking water transmission loss.

Review Consensus, Agree on Action Items and Next Steps in the Panel Review Process. Tom informed the panel that **CSN** will make the identified changes and put together a consensus draft of the report which includes the changes noted today. Once done, it will be circulated to the panel for any final comments.

Tom Schueler thanked the Panel for their service and adjourned the meeting.