Elimination of Discovered Nutrient Discharges From Grey Infrastructure

Findings: Expert Panel Final Report

Urban Stormwater Workgroup Meeting

June 17, 2014

Could have been the first expert panel report to be issued with a brown wrapper and a warning label

REPORT WARNING: Must be 18 years or older to read it as it contains :

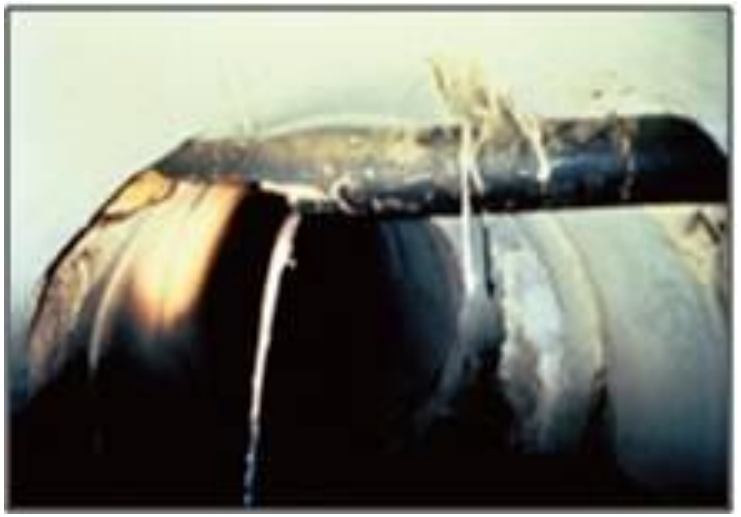
- offensive language on illicit relationships, commingling, inappropriate discharges, and non-sanitary flows,
- high levels of trans-fats, oil and grease, and
- mind-numbing complexity and jargon.

Thankfully, the Panel agreed on a less “inappropriate” approach at its last meeting in May

Outline of Today's Presentation

1. Charge and Membership of Panel
2. Basics About Nutrient Discharges
3. Key Definitions
4. Review of the Available Science
5. Nutrient Discharges that are Credited
6. Non-eligible Nutrient Discharges
7. The Programmatic Credit
8. Verification
9. Next Steps

Charge and Membership of Panel



Expert Panel Roster

EXPERT BMP REVIEW PANEL Grey Infrastructure Upgrades	
Panelist	***Affiliation***
Marianne Walch	Delaware Department of Transportation
Megan Brosh	Baltimore County Department of Environmental Protection and Sustainability
Lori Lilly	Independent Consultant
Jenny Tribo	Hampton Roads Planning District Commission
June Whitehurst	City of Norfolk, VA
Barbara Brumbaugh	City of Chesapeake, VA
Diana Handy	Arlington County Department of Environmental Services
Mark Hoskins	Dewberry, VA
Kevin Utt	City of Fredericksburg, VA
Bob Pitt	University of Alabama
Tanya Spano	Metropolitan Washington Council of Governments
Whitney Katchmark	Hampton Roads Planning District Commission

Panel met 8 times over two years to come to consensus

Charge of the Panel

- 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.

Charge of the Panel

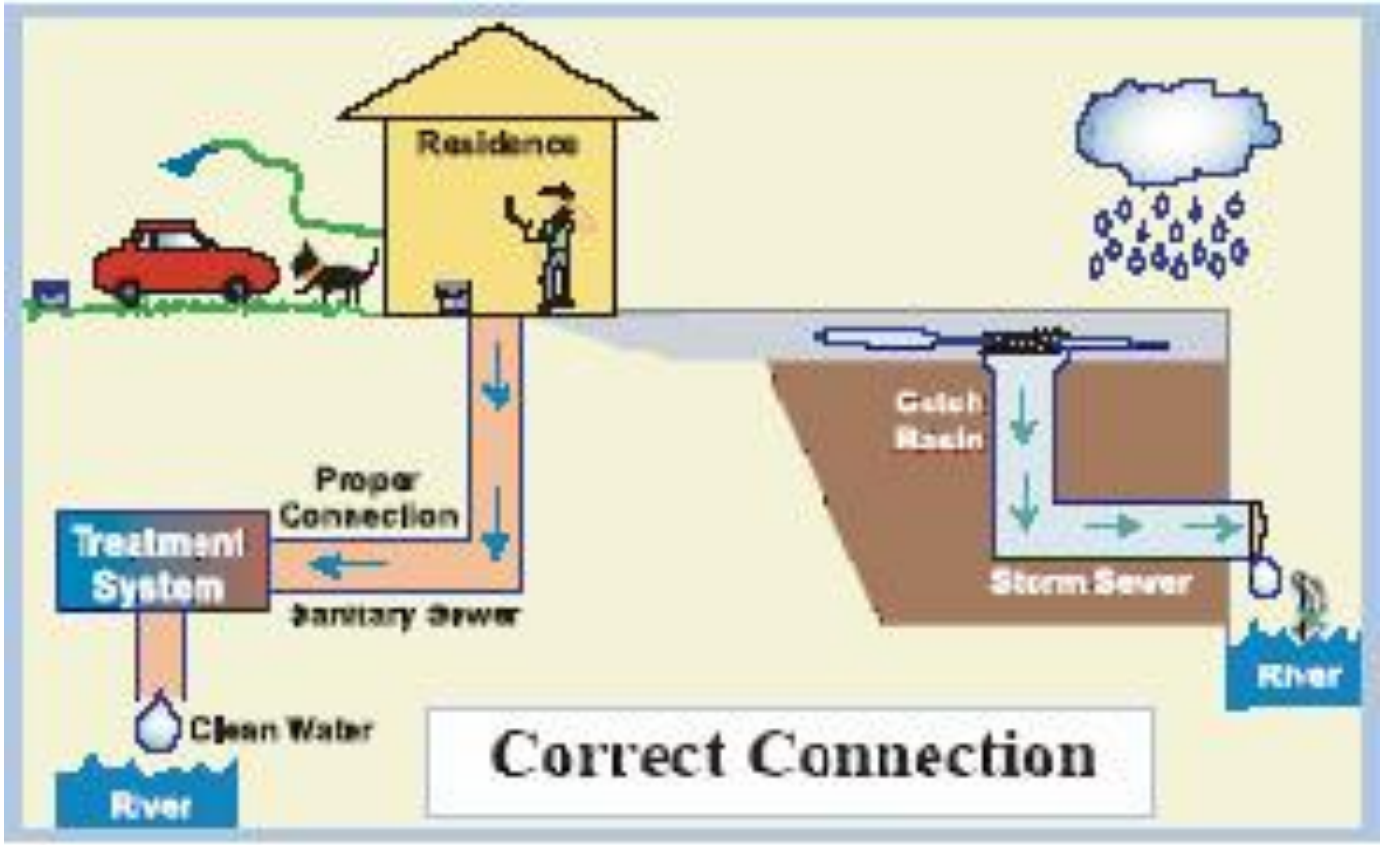
- Provide guidance to MS4 communities on improved stormwater outfall screening protocols to detect nutrient-laden discharges.

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

- 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.

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

2. Our Leaky Grey Infrastructure



How??

- There are many different ways non-stormwater gets into the storm drains and/or streams…
  - Illicit discharges
  - Incorrectly connected pipes
  - Leaky sewers, water mains etc.
  - Overflow events: either intentional or accidental

Incorrect Connection

Residential sanitary pipe incorrectly connected to the storm drain system

Photo credit: Kent Count, Michigan

Inflow and Infiltration

Known as I/I, when excess flow from groundwater or other sources (runoff from storm events) enters the sanitary sewer system through cracks and joints in the pipes, thereby overwhelming the system's capacity to handle sewage flows and resulting in more overflow events

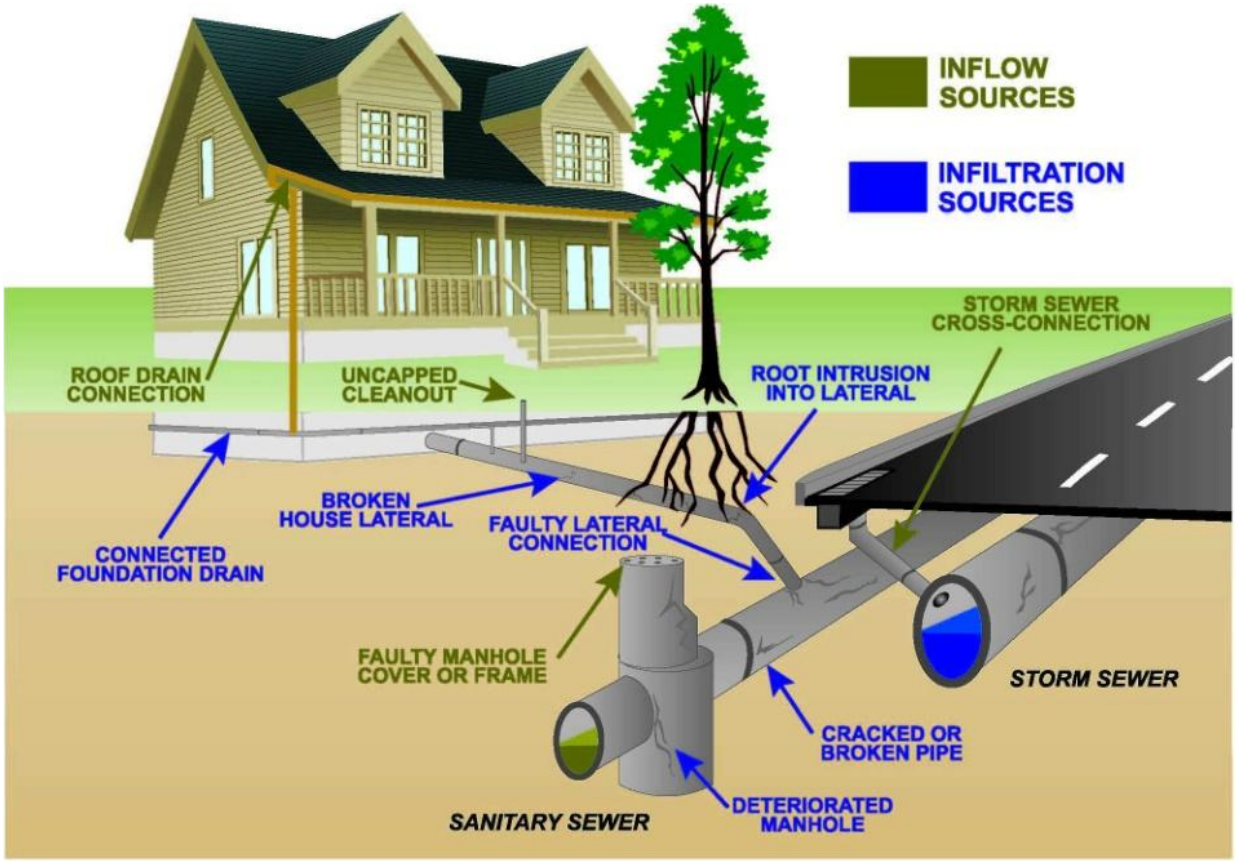


Photo credit:
City of Bryan, Texas

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

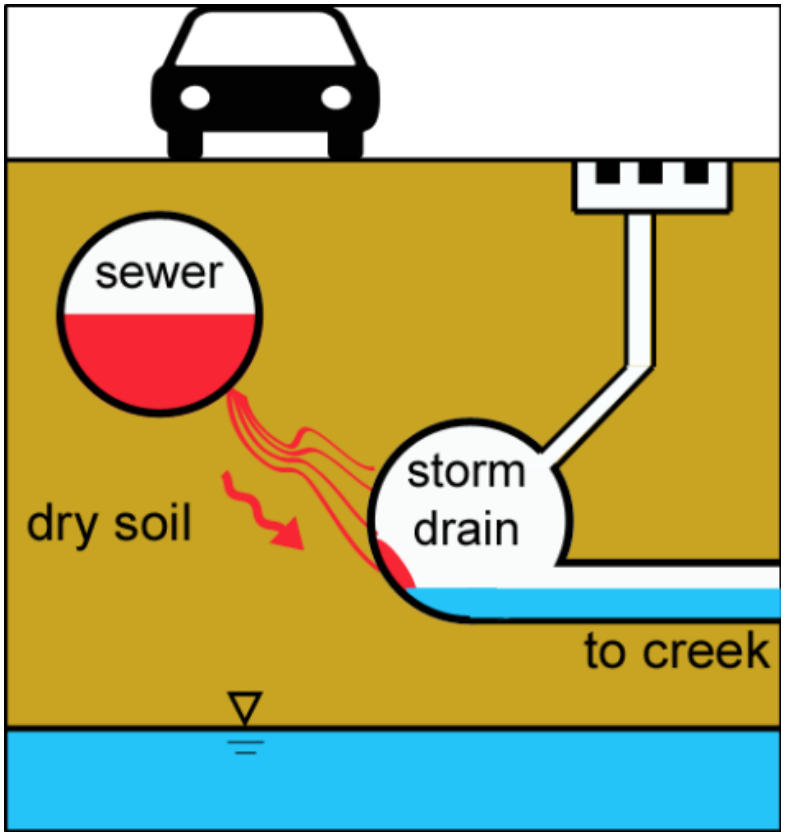


Photo credit: Sercu, 2011

Also, how drinking water can end up in the storm drain. Referred to as "Transmission Loss"

3. Key Definitions

- Panel devoted a lot of time to define and classify various nutrient discharges from storm, sewer and water pipes
- Lots of arcane, confusing and sometimes conflicting engineering terminology
- Panel devoted 3 pages to have more precise and operable definitions

Nutrient Discharges

- Refers to the complex range of non-stormwater flows that deliver nutrients into urban receiving waters during dry and/or wet weather caused by 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.

Discovered versus Reported NDs

- **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.

- **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.

4. Review of the Available Sciences

- Panel reviewed more than 60 papers and reports to come to its conclusions

Significance of Nutrient Discharges

- Conclusive evidence that they increase N and P levels in dry weather urban stream flow
- Dry weather NDs collectively account for as much as 20 to 40% of the annual nutrient load in urban watersheds, depending on the age and condition of its grey infrastructure.
- NDs comprise 1 to 2% of the total urban wet weather load, particularly during intense or extreme storms.

9 Creditable Nutrient Discharges

No.	Discharge Type	Protocol Used
N-1	Laundry Wash Water	1
N-2	Commercial Car Wash	1
N-3	Floor Drains	1
N-4	Misc. High Nutrient Discharges	1
N-5	Sanitary Direct Connection	1
N-6	Sewer Pipe Exfiltration	2
N-7	Drinking Water Transmission Loss	2
N-8	Dry Weather Sanitary Sewer Overflows	3
N-9	Chronic Wet Weather Sanitary Sewer Overflows	3

The Crediting Approach

The guiding principle is that elimination of a discovered nutrient discharge could only be considered as a urban BMP, if they:

- Are detected and physically eliminated
- 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

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.

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Intermittent
- Multiple Methods of Discovery
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement or estimation of flow rate
- Verification involves inspection confirming the reconnection

N-2: Commercial Car Wash

Definition: Washing of vehicles that results in the discharge of washwater into the storm drains system. It may involve a commercial car wash operation (fixed or mobile).

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Intermittent
- Multiple Methods of Discovery
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of nutrient concentration and estimation of flow rate and duration
- Verification includes:
  - Confirmation inspection after reconnection
  - Confirmation screening during business hours

N-3: Floor Drains

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

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Intermittent
- Multiple Methods of Detection
- Regulated by MS4 Permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of pollutant concentration and estimation of flow rate and duration
- Verification includes inspection confirming reconnection

N-4: Misc. High Nutrient Discharges

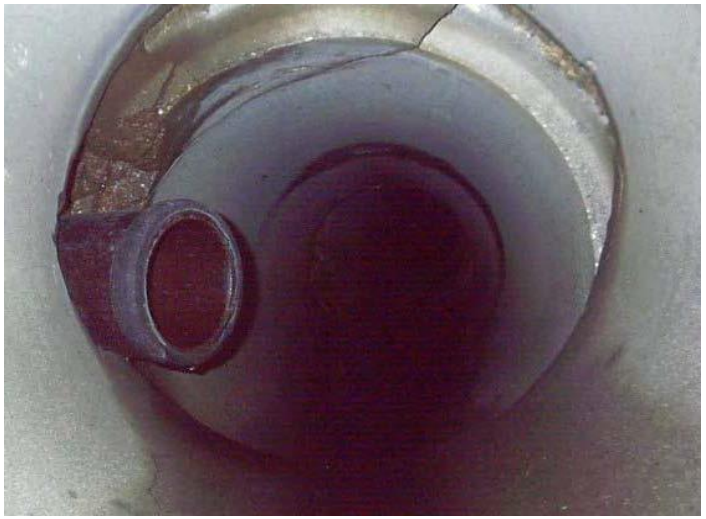
Definition: This discharge category applies to other non-sanitary, high-nutrient discharges that are discovered during nutrient-based outfall screening. The most common so far has been nutrient-associated cleaning agents used to keep outdoor HVAC systems healthy. If other such discharges are discovered, then direct monitoring is required to establish the credit.

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Intermittent
- Indirect Entry through an inlet
- Methods of Discovery:
  - Nutrient source sampling
  - Rooftop inspection
- Pollution Prevention to eliminate discharge
- Protocol 1 used to calculate credit
- Requires nutrient concentration measurement and estimation of flow rate
- Verification methods are discharge dependent:

N-5: Sanitary Direct

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.

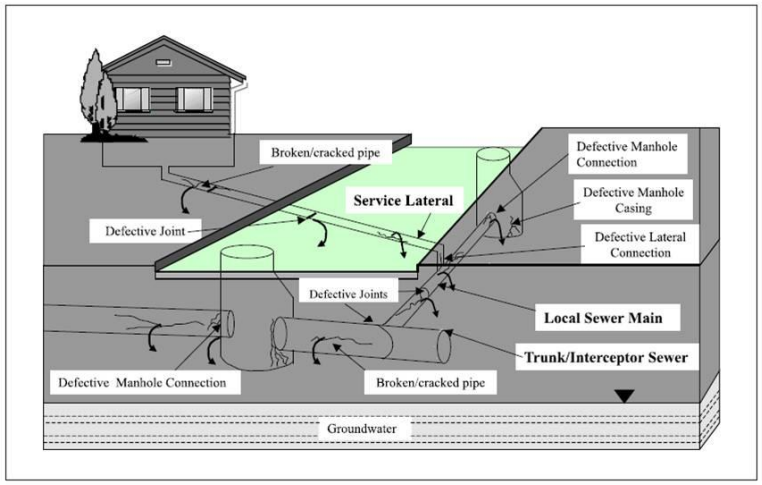


DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Continuous
- Direct Entry to storm sewer or stream
- Multiple Methods of Detection
- Regulated by MS4 Permit and/or WW permit
- Pipe reconnection to eliminate discharge
- Protocol 1 used to calculate credit
- Requires measurement of nutrient concentration
- Verification includes:
  - Confirmation inspection after reconnection
  - Outfall screening once a year for at least 3 years

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.



DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Continuous or Intermittent
- Multiple Methods of Detection
- Regulated by NPDES WW permit
- Multiple Elimination Methods:
  - Slip-lining of Pipes
  - Pipe Replacement
  - Manhole Sealing
- Protocol 2 used to calculate credit
- Requires 6 mos of before and after sewer metering to measure flow and estimate conc.

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.

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Continuous
- Regulated differently by each state
- Multiple Elimination Methods:
  - Slip-lining of Pipes
  - Pipe Replacement
  - Pipe upgrades
- Protocol 2 used to calculate credit
- Requires 6 mos of before and after sewer metering to measure flow
- Nutrient concentrations derived from CCRs
- Verification includes:
  - Flow monitoring at the site of repair and above and below the problem water line for one year

N-8: Dry Weather SSOs

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

DISCHARGE CHARACTERISTICS

- Dry Weather Discharge
- Transitory
- Regulated by NPDES WW permit
- Multiple Elimination Methods:
  - FOG Reduction Programs
  - Pretreatment Requirements
  - Sewer Realignment
  - Pipe Replacement
  - Manhole Casing
- Protocol 3 used to calculate credit
- 2 years of before and after tracking of the number and flow volume of overflows within the sewershed
- Verification includes:
  - See confirmation monitoring above

N-9: Chronic Wet Weather SSOs

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).

DISCHARGE CHARACTERISTICS

- Wet Weather Discharge
- Intermittent
- Regulated by NPDES WW permit

- Improvements to storage, pumping and/or sewer transmission capacity within a sewer-sewershed to upgrade infrastructure
- Protocol 3 used to calculate credit
- The frequency and overflow volumes must be tracked for 2 years prior to improvement and two years after
- Verification includes:
  - Continued tracking of overflows for 3 years after the credit is taken

Summary of the 3 Protocols to Estimate Nutrient Reduction Credits

Empirical Approach to Crediting

LOAD = Flow * Flow Duration * Concentration

Protocol	Requirements
Protocol 1: The Prevented Load Calculation	Requires direct sampling of flow and concentration 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 tracking dry and/or wet weather overflow events in a sewershed before and after FOG pretreatment or infrastructure upgrades

Data Requirements to Compute the Credits

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					

Discharge Discovery

But how do we discover these nutrient discharges??

- 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

Discharge Elimination

- 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

6. Non-Eligible Nutrient Discharges

- 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.
- Residential car washing
- Transitory illicit discharges associated with power-washing, dumpster juice, transport accidents, and illegal sewage disposal by boats and RVs.
- Catastrophic wet weather sanitary sewer overflows that exceed the sewer design capacity
- Combined Sewer Overflows *
- Septic field discharges caused by system failure *

7. The Temporary Program Credit

- An temporay credit to provide incentives to communities to re-focus their existing IDDE and SSO abatement programs toward greater *nutrient reduction* without initially having to compute reductions for individual events.

- Only available to localities that go above and beyond the minimum requirements set forth under their MS4 permit and SSO consent decree

Programmatic Credit

- Equivalent to a MAXIMUM of 2% of the dry weather nutrient load within the jurisdiction
  - Defined as 20% of the total annual N and P load discharged from urban pervious land in which the programs are targeted.
  - Lapses at end of 2017

IDDE Program Credit

- Maximum 1%
- Must operate at an advanced level which includes documenting:
  - 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

IDDE Program Credit

- AND do two of the following:
  - 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

- Maximum 1%
- Entails:
  - 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.

Programmatic Credit Design Example

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 the report. The interim nutrient reduction credit for modifying their program is computed as follows.

Photo Credit:
Coastal Waccamaw
Stormwater Education
Consortium

Programmatic Credit Design Example

***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:**

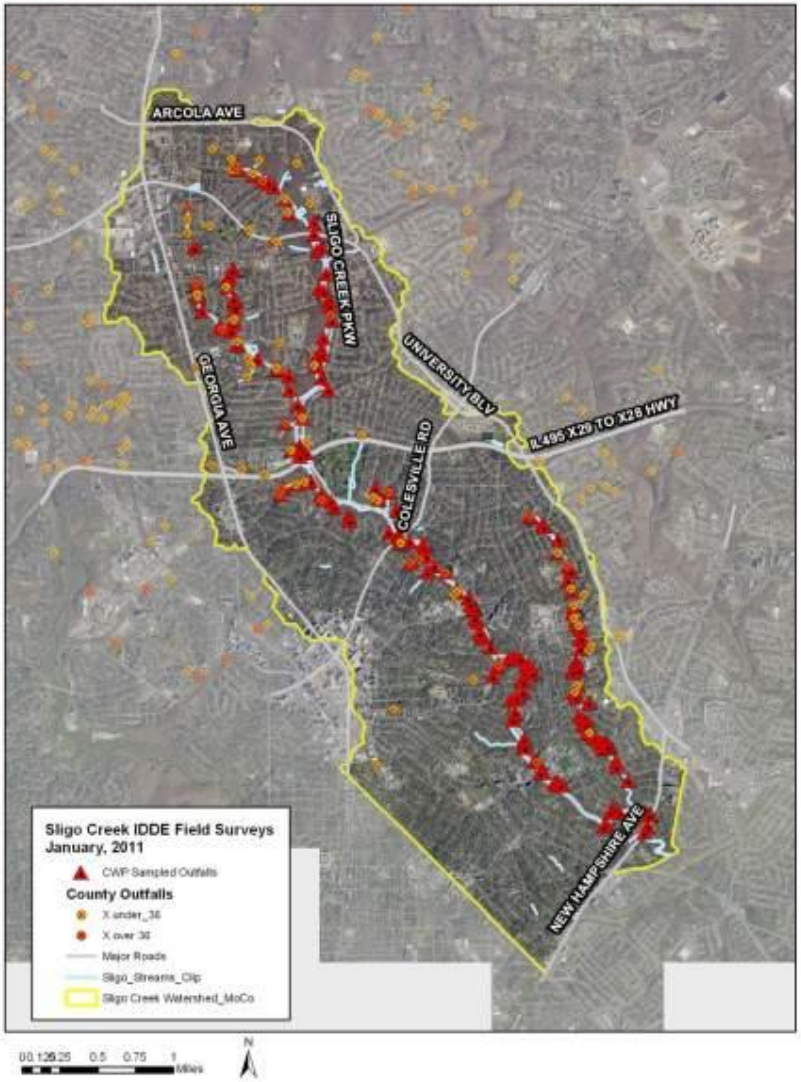
4815 lbs/yr of TN and 198.1 lbs/yr of TP

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

Discharge Detectives



DND Reporting

- 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

MS4 Recordkeeping

- 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 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).
- Confirmation that the DND was eliminated

Verification

- Method Depends on the type and size of the nutrient discharge
- Can be as simple as a confirmation inspection that the discharge was physically eliminated
- Mo

ND Management Significance

- More than a thousand Bay communities are required to have an IDDE program (although very few have nutrient-based outfall screening)

- Most large Bay cities are under consent decrees to reduce sewage overflows, and are spending hundreds of millions on these upgrades (but getting no credit for it)

- Potential new partners in reducing nutrients from the urban sector

Next Steps

- Coordinate with Wastewater Technical Workgroup on 6/24
- Accept Comments until 7/8
- Seek Approval from Urban Stormwater Group (7/15)
- Seek Final Approval from Watershed Technical Work Group and Water Quality Goal Implementation Team (Aug to Sept)
- Stress Monitoring Recommendation

Questions