



Hello! Thanks for having us today!



Today's Topics

- Stormwater
- MS4 Permit
 - Context
 - Purpose
 - Components
- Roles and Responsibilities
- Middlesex Achievements
- Next Steps
- Q&A

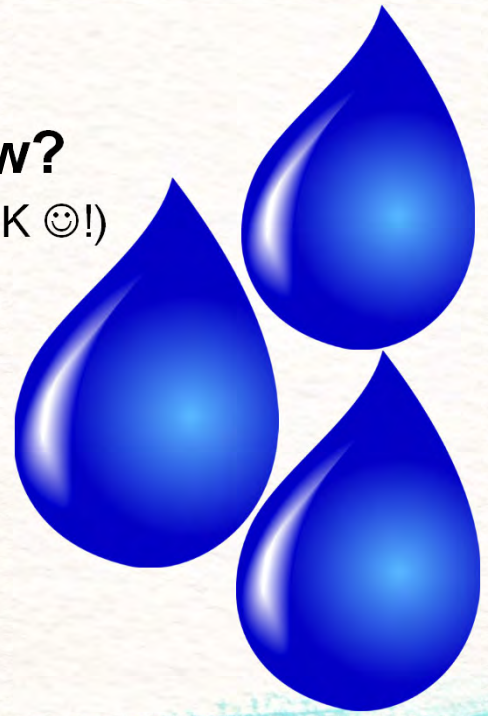


This is the introduction to the Middlesex Township Stormwater Management Program that responds to the Township's MS4 Permit. We will be covering the listed topics. Some are basic and you are already familiar with the topic. Others might be head scratchers. So, feel free to ask questions as they arise.

Before we get started... What do you know?

("I don't know" is OK 😊!)

- What is Stormwater?
- What is stormwater runoff?
- Where does runoff go?
- What does the acronym MS4 represent?
- What is the MS4 Permit...Why is it needed?
- How does the permit involve you?



Let's check the basics. What does this audience already know?

Have Eileen count hands for each question

Sequence:

Request a hand raise

How many don't know?

Who does know?

How many agree?

Stormwater



What is Stormwater?



Rain & Snow melt



(Wait and then click) No trick questions here...rain and snow melt.

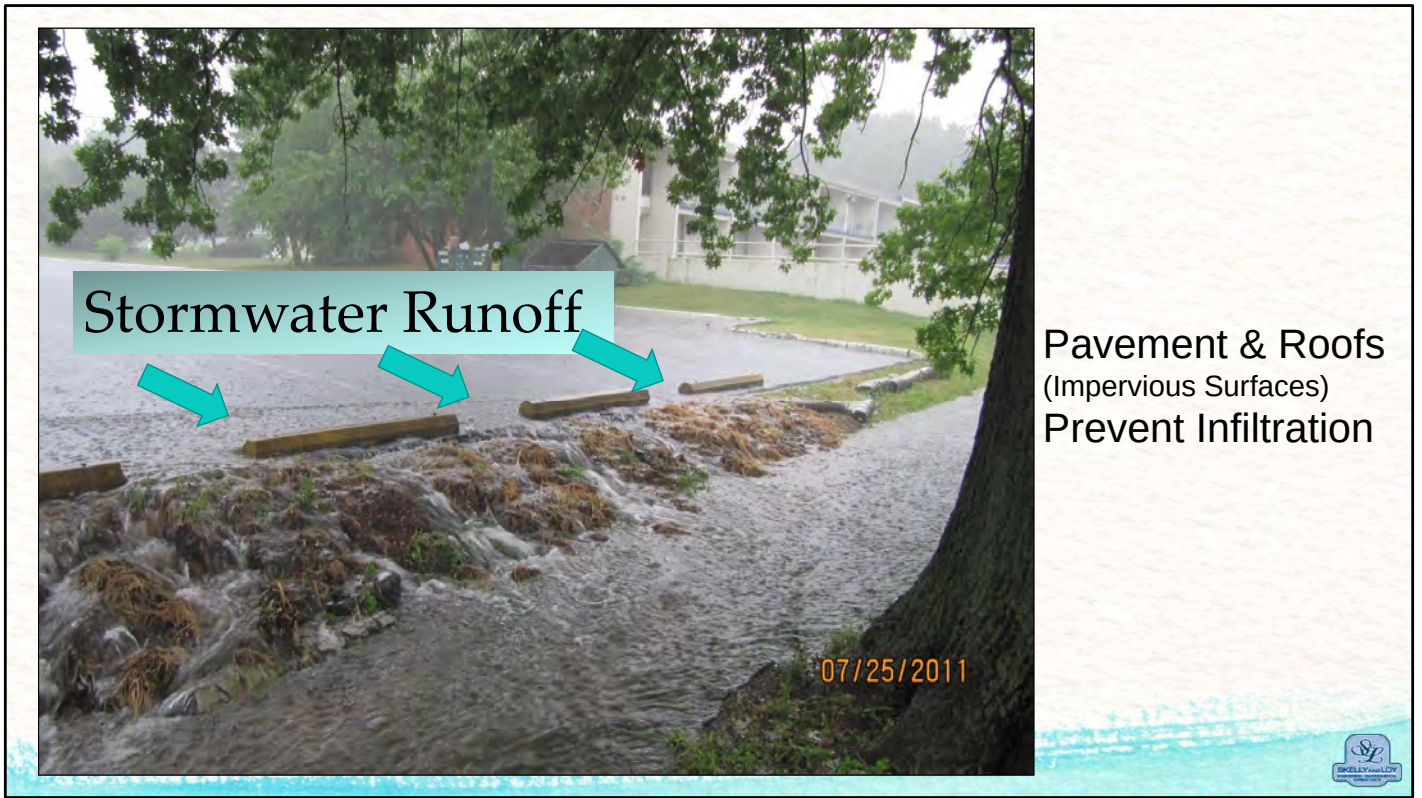
So...What is Stormwater **Runoff**?



Deep soils, complex Micro-topography, thick forest floor
= max depression storage
= maximum infiltration



Surface runoff is minimal in undisturbed forests. Look at all the depressions and water-holding features caused by boulders, fallen trees, and depressions caused by fallen trees. In addition, the decaying leaves and soft ground soak up water, even on hillsides.



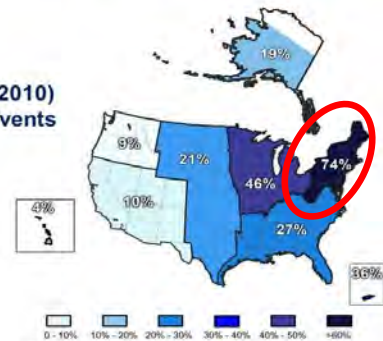
Pavement prevents stormwater from soaking in...it RUNS OFF

**Heavier downpours = more flooding,
channel erosion, and pollution**



**Regardless of Shifts in Total Annual Rain
More of It Is Coming in Heavy Downpours**

**Percent Increase (1958-2010)
in Heavy Precipitation Events
(>2inch/48 hr)**



NOAA, provided by A. DeGaetano, NERCC, Cornell

**The volatile urban
runoff regime**



A study by NOAA suggests that storm events are intensifying. While the region might still receive an average of 40 inches per year, more rain is occurring in heavy down pours. Stormwater cannot soak into the ground when it arrives too fast. Think of a bathtub drain. If the same volume of water is delivered to it in buckets instead of a trickle, the water cannot get into the drain. So, in areas where there is no or limited stormwater storage...stormwater basins, wetlands, floodplains and similar... these intensified storms increase the amount of rainwater that runs off.

What Else?

Built Environments

- Increase runoff rates
- Increase runoff quantities
- Increase pollutant discharges
- Increases water temperature

Results In

- Flooding
- Erosion
- Stream instability



As shown on the slide water running over pavement moves faster than when it drains across grass or other vegetation. It picks up more dirt, debris and other pollutants; gets hotter; and doesn't soak into the ground. That's why the MS4 permit focuses on intensely developed areas.

When stormwater arrives at the stream, the water velocity or speed of runoff is faster than if it oozes out of the ground. The fast and concentrated water hits the stream banks like water from a firehose and causes the banks to erode and collapse. The end result is more sediment.

Some sediment is necessary and healthy. Too much of the fine sediment can coat and destroy aquatic habitat; Heavy coating of fine sediment kills the macroinvertebrates (or bugs, crustaceans and worms) which is the food supply for aquatic wildlife and so on, ultimately making the stream unhealthy.



Where does Stormwater Runoff Go?

- Stormwater runoff travels over the ground, and pavement
- And through stormwater systems – pipes, gutters, swales, and ditches
- Transporting pollution

**DISCHARGES TO:
STREAMS RIVERS AND LAKES**



Where does stormwater go when it is captured in a stormwater inlet? The water and all the pollution are conveyed to area waterways ...usually untreated.

Runoff Transports Pollution



These pollutants are suspended and conveyed with the stormwater.



Sediment, pollutants and trash are discharged from impervious surfaces



Here is another example of water pollution.

MS4 Permit





It stands for the
One M and
Four S's
At the beginning of each word.

MS4 is all about

CLEAN WATER

STORM WATER

URBAN WATER



<https://innovative-results.com/millions-in-u-s-drink-dirty-water/>

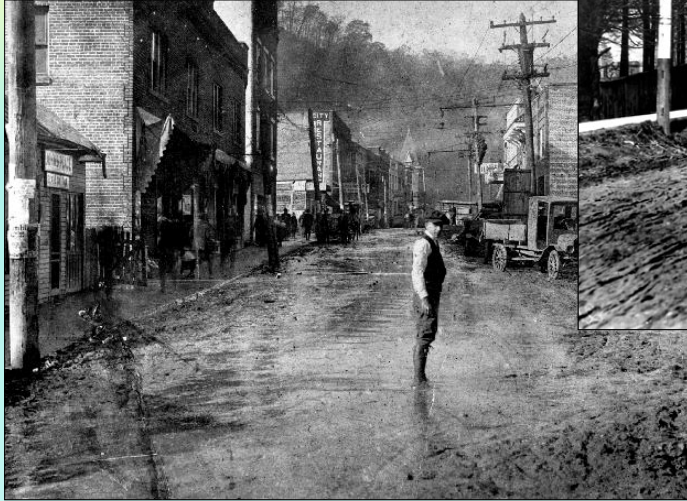


(Read slide)

MS4 is a Federal permit emanating from the Clean Water Act of 1972 and amended in 1987. Its focus is water QUALITY, not flooding.

While most of us rail against too much regulation, it appears that when regulation is about managing pollution, we need some guidance.

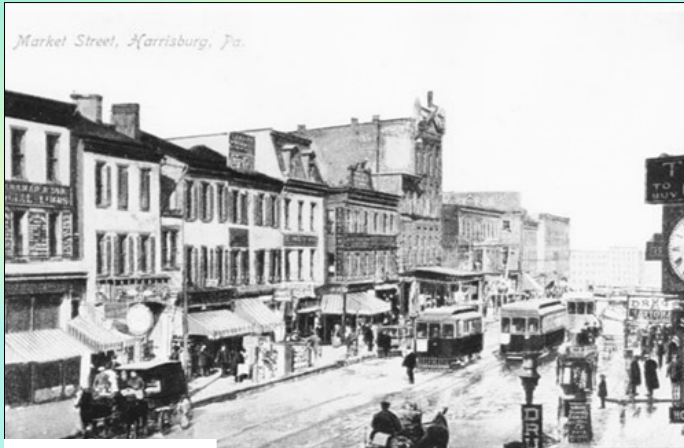
**A bit of stormwater
management history...**



**Streets were quagmires before
stormwater management (SWM)**



Let's look at a bit of history to give context to how and what led to current stormwater management regulations. As you can see in the pictures...getting around town could be a challenge when rain and snow melt turned streets into muddy, mucky messes.



**Market Street
Circa 1865**

<http://www.cattransit.com/wp-content/gallery/cat-history/history2.jpg>

Harrisburg, PA

**Street paving improves access
to business centers...but
generates increased runoff**



**Market Street
Circa 1910**

<https://s-media-cache-ak0.pinimg.com/736x/b7/65/9f/b7659f5d9773dbb6becf0598949f4ed5.jpg>



Paving the streets made getting around town easier, but as we noted earlier...it also increased runoff.



Ascent of Regulation

- **Federal incentives** following WWI for private housing construction
- **New Deal** – 1934 –FHA created by the National Housing Act- regulate interest rates and mortgage terms
- **Large-scale residential development** initiated 1941 to 1944 – developers adopted standardization acceptable to qualify for FHA mortgages

Financial incentive influences design



How many people have heard of a game “Six degrees of Kevin Bacon?” Its premise is that any person is related to every other person in as few as six relationships...even if at first impression they are totally unrelated. This is how it is with regulation as well.

You will see that regulation in general is cyclical. First government incentivizes to encourage some behavior then it regulates to dampen unintended consequences of success. So let's see how the desire to ensure a basic need like housing is related to stormwater management.

Following WWI, the federal government created a number of incentives to expand the inventory of housing especially to accommodate returning soldiers and their families.

(Click) Roosevelt's New Deal included creation of the National Housing Act to regulate interest rates and make sure mortgages were affordable.

(Click) The FHA mortgage requirements made it most profitable for housing builders to standardize housing construction so their customers would qualify for loans. (Click)



The image shows a black and white aerial photograph of a large, uniform suburban housing development, Levittown. Overlaid on the bottom left is a newspaper clipping from the 'Times' dated Thursday, April 16, 1953. The main headline reads 'Levitt Plans Low-priced Homes Suitable for Any Wage Earner'. Other headlines include 'Local Churchmen Disclose Future Construction Plans' and 'I Know Nothing Says Wm. Levitt About Authority'. A small photo of a family is also visible on the clipping.

Ascent of Regulation

- **1947- Levittown** - standardized rental housing for returning veterans
- **1948 amendments to National Housing Act** incentivized large-scale corporate builders

Financial incentive influences intensity and scale
(not mandates) Comprehensive Plans, Zoning, Subdivision and Land Development (major amendments 1988 and 2000)

Regulatory reaction to accelerated growth



(Click) (Click) Standardization spawned housing developments like Levittown (the epitome of cookie-cutter one-size-fits-all development).

(Click) The next set of amendments to the National Housing Act ushered in housing construction as big business. More and larger developments were created.

(Click) The impacts of fast growth was felt. Land use regulations were born. (Click)

Shopping Malls Serve Suburbia

Where is the stormwater management?

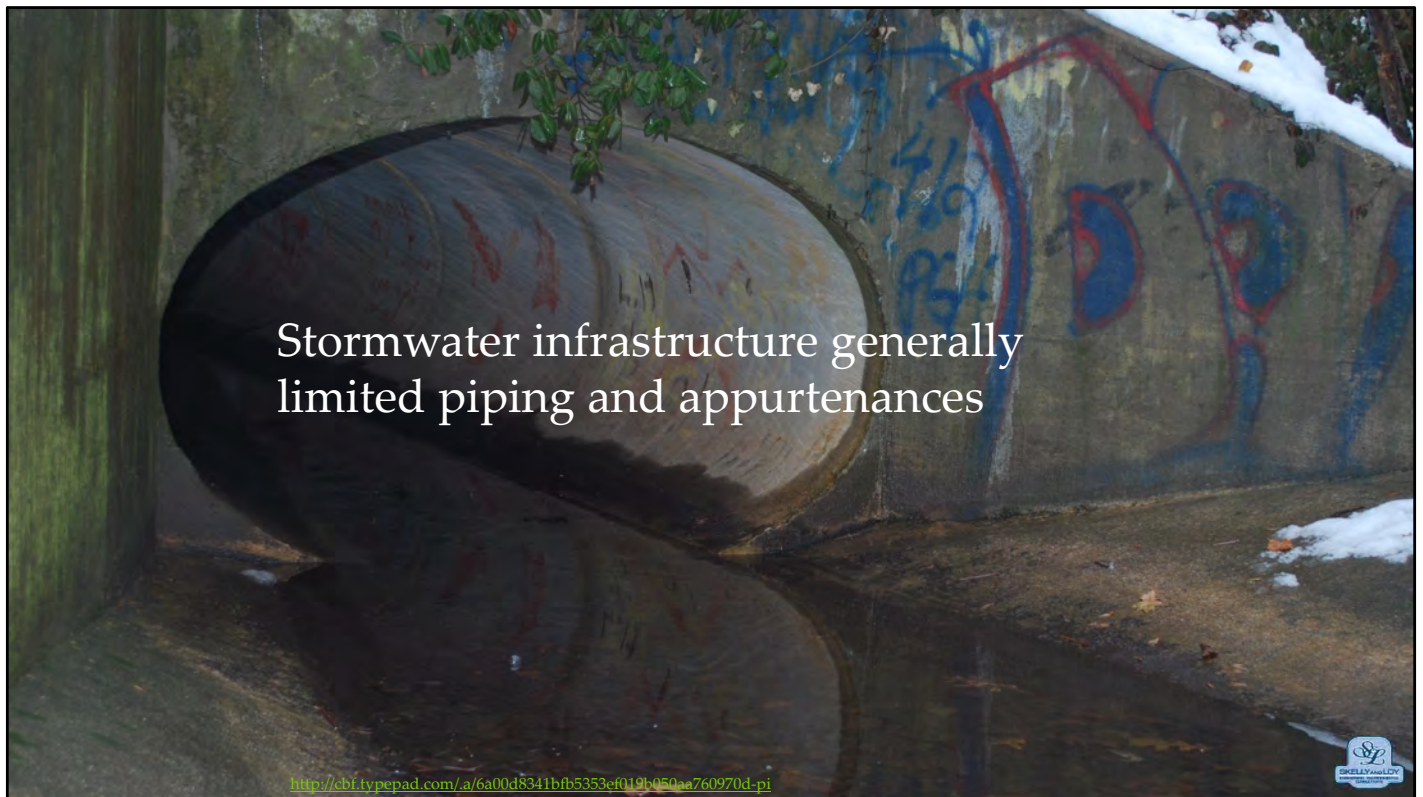


All the people that moved to the suburbs needed places to shop.

The picture on the screen shows a rendering of Park City shopping mall. In 1971 when it opened, it was one of the largest, if not THE largest shopping mall.

Do you see the correlation....more and more impervious surfaces.

(click) So....where is the stormwater management?



Early stormwater management consisted of directing stormwater to pipes and conveying it to waterways directly. There was no treatment or attention to possible repercussions.

Late 1960's and early 1970's –
**Momentum for controlling
pollution swells nationally**



Cuyahoga River 1969



This picture shows what was also happening at the time. Rivers aren't supposed to burn...but that is exactly what happened. The picture is the Cuyahoga River that flows through downtown Cleveland. The Time Magazine photographer who snapped the picture just happened to be in town to cover a nasty political campaign.

Fires on the Cuyahoga were commonplace and there are other pictures dating back into the 1950's...this one is just famous as being the catalyst to environmental regulation.

Cuyahoga River 1969



This is another picture of just how polluted the river was. Listen to the description we found online.

Excerpts from a blog article:

http://www.cleveland.com/news/index.ssf/2009/06/cuyahoga_river_fire_40_years_a.html

Cuyahoga River fire 40 years ago ignited an ongoing cleanup campaign

by **Michael Scott/Plain Dealer Reporter**

The fire -- a brief Sunday afternoon flare-up of oil-soaked debris likely ignited by either molten steel or a spark from a passing rail car -- was doused by local firefighting tugboat crews. The story barely made the newspapers the next day. But the effect of that two-hour flare-up has lasted for decades.

Today, the river fire stands as an enduring image of progress gone wrong. But after so many years, it becomes difficult to really understand and *feel* the rampant water (and air) pollution of the industrial era that led to the Cuyahoga fire. Unless you were there.

Richard Ellers was there.

And Ellers *felt* the Cuyahoga River pollution -- literally.

"Back in the '60s ... I went on a news excursion on the river downtown to show how bad the pollution was," Ellers recalled recently. "I remember we could see a layer of crud on the water but didn't appreciate its thickness until the photog on the trip, Marv Greene, said, 'Richard, dip your hand in there and pull it out.' "

The image of a black, gooey hand coming out of the Cuyahoga like a B-movie swamp monster defined the plight of the Cuyahoga. By association, it indicted all industrial American cities -- and a culture that for a century had generally viewed natural waterways as a means to an end.

"The Cuyahoga River -- the thick pollution on the water and the fire -- became a convenient example of what 'bad' really is,"

1972

- PA requirements for **erosion control for construction sites** and **agriculture** (25 PA Code Chapter 102)
- Federal **Clean Water Act** (40 CFR 122)
 - National Pollutant Discharge Elimination System (NPDES)
 - Primary focus on industrial and public wastewater treatment plant discharges to “waters of the US”



1972

Here in Pennsylvania, first efforts to clean up storm water focused on **erosion control for construction sites** and **agriculture** (25 PA Code Chapter 102)

The Federal **Clean Water Act** concentrated on industrial and public wastewater treatment plant discharges to “waters of the US”.

Floods!



1972 Harrisburg
Hurricane Agnes

<http://www.weather.gov/images/bgm/flood/june1972/wilkesbarre001.jpg>



10 inches in 12 hours!
6 dam failures
84 deaths

1977 Johnstown

<http://www.weather.gov/images/bgm/flood/june1972/wilkesbarre001.jpg>



Next came the decade of big floods. 1972 was Hurricane Agnes. Five years later an intense rainstorm dumped 10 inches in 12 hours near Johnstown.

Regulatory Reaction

1978

- **PA Storm Water Management Act** (Act 167)

- Mandates management of stormwater runoff rates from new and redevelopment on county-wide or watershed basis to prevent additional rise in the flood elevation



Pennsylvania passed legislation requiring that county-wide plans be developed to prevent additional rise in flood elevations associated with development and re-development activities.

Abundance of Stormwater Detention Basins!



Stormwater detention basins appeared at all newly constructed projects.

Increased Regulation = Increased Cost of Stormwater Management

- Cost of design
- Cost of permitting
- Cost of piping and appurtenances
- Cost of excavation
- Cost of maintenance
- Loss of revenue producing property

...to manage **flooding**



The new requirements drove costs up as shown on the slide. All of this to address flooding.

Stormwater/Pollutant Transmission Link

1987

- Amendments to the **Clean Water Act** (federal)
- **National Pollution Discharge Elimination System Permits**
 - Earth disturbance
 - Municipal Stormwater

MS4!



1987

Remember the Clean Water Act focused on industrial wastewater and sanitary wastewater clean-up. Amendments to the Clean Water Act (federal) were a response to an environmental suit that required stormwater to be clean, too. (Click)

There was a phased implementation of the **National Pollution Discharge Elimination System Permits abbreviated NPDES**

NPDES required for earth disturbance

Phase 1 > 5 acres

Phase 2 > 1 acre

Beginning of MS4 (the municipal version)

Phase 1 >100,000

Phase 2 <100,000



So... back to the MS4 Permit. It is a Federal Permit. DEP is delegated with enforcement authority.

MS4 Short Definition

- Network that conveys exclusively stormwater and is owned or operated by a municipality or similar regulated entity that discharges to a “waters of the United States”



The basic definition is:

A network that conveys exclusively stormwater and is owned or operated by a municipality or similar regulated entity that discharges to a “waters of the United States”.

Combined vs. Separate



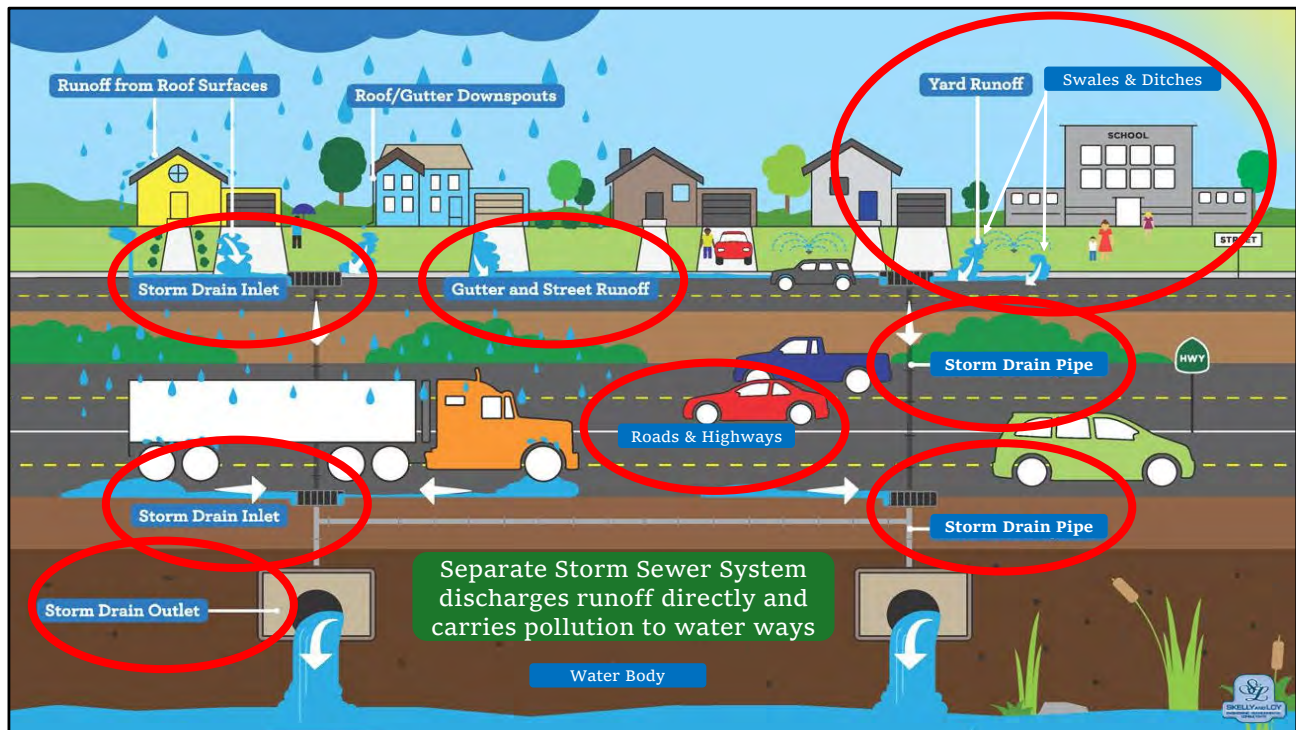
There are two types of storm sewer systems. The picture on the left shows a Combined System. Stormwater and sanitary wastewater flow through the same pipes. Many older towns have this type of system. As you saw on the pictures of the Cuyahoga, rivers and streams were the early sewers. Waste was dumped into them. The streams were simply enclosed and both types of water were conveyed to the next larger watercourse. Wastewater treatment plants then started to treat the water.

You can see the problem...more development increases runoff and when it rains, there is simply not enough capacity at the treatment plant. When that happens, untreated sewage is diverted away from the plant and discharge directly to receiving streams and rivers. The discharge is called a Combined Sewer Overflow or CSO.

(Click) Harrisburg is a local example.

The other kind is a separate storm sewer system. This is where sanitary and stormwater are piped separately. Historically, there has been no treatment to remove pollution associated with storm-water-only systems.

(Click) Middlesex Township is an example.



The Separate Storm Sewer System is the collection of all structures that gather stormwater and discharge it into local waterways. The MS4 system includes [\(click\)](#) Inlets, [\(click\)](#) Curbs and Gutters, [\(click\)](#) Ditches and Swales, [\(click\)](#) Storm Pipes, [\(click\)](#) Storm Outlets and [\(click\)](#) Roads.

MS4 is all about

CLEAN WATER

STORM WATER

URBAN WATER



(Read slide)

MS4 focus is water QUALITY not flooding, although flooding might be reduced as a result of water quality enhancement

MS4 Permit Components

Minimum Control Measures (MCMs) & Pollution Reduction Plan (PRP)



Middlesex's Stormwater Management Program is a response to the MS4 permit.

Stormwater Management Program elements #1 through #6 are often referred to as Minimum Control Measures – MCMs. Item #7 is a more recent addition to the permit program and has not been designated as an MCM.

(Click) The first two MCMs are almost like a marketing plan...they are meant to educate, inform and inspire action to prevent or reduce pollution.

(Click) The other 4 MCMs are actions for prevention and the Pollution Reduction Plan is what its name says...a plan for installing treatment systems to reduce pollution.

MS4 Permit Components

Minimum Control Measures (MCMs) & Pollution Reduction Plan (PRP)

MCM#1 – Public Education and Outreach	• Understand
MCM#2 – Public Involvement and Participation	• Join/Support
MCM#3 – Illicit Discharge Detection and Elimination	• Pollution
MCM#4 – Construction Site Runoff Control	• Escaping Mud
MCM#5 – Post-Construction Stormwater Management	• Functionality
MCM#6 – Pollution Prevention and Good Housekeeping	• Maintenance
Pollutant Reduction Plan	• Mitigation



Each MCM has a particular focus:

(Click) #1 – Provides understanding of the negative effects of pollution in stormwater

(Click) #2 – Encourages joining the effort to reduce pollution

(Click) #3 – Identifies pollution sources so it can be removed

(Click) #4 – Focus on stopping migration of dirt from construction sites

(Click) #5 – Promotes long-term maintenance to ensure facilities continue to remove pollution

(Click) #6 – Advocates keeping Middlesex-owned and operated properties clean and tidy so they are not pollution sources

(Click) #7 – Provides a strategy to mitigate unavoidable pollution

Pollutants Tracked by the MS4 Permit

A. Acidity: pH and Metals *(typical from mine drainage)*

B. Bacteria: Pathogens *(Usually associated with manure & sanitary waste)*

C. Compounds: Priority Organic Compounds *(like Chlordane, PCBs, & Benzene)*

D. Sediment

E. Nutrients: Phosphorus and Nitrogen

**Focus of Pollution
Reduction Requirements**

These pollutants are tracked by the MS4 Permit.

(click) Sediment and Nutrients are the focus of pollution reduction. This is because these two categories of pollution can be reduced through stormwater management. The others require additional mitigation strategies.



How Does Polluted Stormwater Happen?

- As stormwater travels it picks up pollutants from...
 - Lawns
 - Parking lots
 - Any other surface it crosses
- Examples of pollutants
 - Motor vehicle fluid
 - Bacteria from pet waste
 - Road salt
- Pollution is transported directly into streams, rivers and lakes



<https://fnfsr.org/harrisonburg-stormwater-utility-fee/>



As stormwater flows across surfaces, it lifts and suspends pollutants. Some examples are listed on the slide. The stormwater also picks up other materials like sediment, fertilizers, pesticides, detergents and trash.

Why Should I Care?

- Health Threat

- Polluted water is harmful to
 - People
 - Aquatic life
 - Wildlife
 - Plants
- It can kill or sicken fish, wildlife, and vegetation
- Contaminate our drinking water
- Cause people to get sick from eating fish or drinking water



<https://www.clipart.email/clipart/how-to-prevent-water-pollution-clipart-4891.html>



These non-water ingredients don't sound appetizing and they're not. In fact, they can be outright harmful to people and animals. They can also cause degradation to the environment and habitat.

Why Should I Care?

- Expense
 - Preventing pollution is cheaper than removing the contaminants
- Economic benefits
 - Higher residential property values
 - Protection of natural tourism and recreation industries



There are other reasons to care about the quality of our waterways. It is less expensive to prevent pollution from entering waterways than to remove it after it has spread. For example, consider an oil tanker spill in the ocean. It is cheaper to make sure the tanker doesn't leak than to clean up afterward.

There are also economic benefits. In the Carlisle region, the Letort Spring Run, a nationally known Class A Trout stream, generates auxiliary businesses...tourism, fishing gear sales, and eateries serve the angler community. Likewise the adjacent trails attract hikers and bikers. And water is a people magnet. The natural beauty of the Condoquinet and its tributaries like the Letort, attract residents to pay a premium to be within line of sight to the streams.

So protection of the waterways are economically and environmentally important.



What does it mean for you?



DOCUMENTATION



You all already do much of the work required by this permit. However, like all permits, activity must be documented. For the Township to prove compliance, the biggest change most of you will encounter is new documentation production, filing and retrieval.

Roles and Responsibilities



Middlesex MS4

- Middlesex is responsible for maintaining stormwater systems
 - Comprehensive Stormwater Management Program (SWMP)
 - Prevention and reduction of pollution in stormwater is essential to the SWMP

Middlesex Employees are
critical to Success



Middlesex is responsible for maintaining stormwater systems.

Challenges

- Roads can convey polluted runoff
- Stormwater systems convey pollutants

Solution

- Management of the stormwater systems
- Develop/Implement comprehensive stormwater program to reduce pollution during run-off events

Middlesex staff will play a critical role in educating the public, identifying pollution, preventing pollution and/or reducing pollution.

The next slides will explain how you can help the Township comply with minimum control measures 3, 4, 5 and 6.

MCM#3

What is an Illicit Discharge?

Not Pure
Stormwater

In addition to pipes, swales and basins, Stormwater System includes the **Roadway** itself & **Eroded Ditches!!!**



An illicit discharge is any discharge to the Middlesex's stormwater system that is not composed entirely of stormwater ([click](#)), except those discharges already authorized under the specific permits, which we will discuss later.



MCM3- Illicit Discharge Detection & Elimination (IDD&E) Overview

- Develop, implement and enforce a program to detect and eliminate illicit discharges
- Includes MS4 permitting area only
- Middlesex Township program:
 - outfall inspections
 - illicit discharge reporting
 - illicit discharge elimination
 - documentation



MS4 permit requirements include the development of an Illicit Discharge Detection and Elimination Program, often abbreviated as IDD&E. An outfall inspection is when an inspector goes to an outfall (location where the stormwater system enters a waterway, such as a stream) to determine the presence of an illicit discharge. Outfall inspections will be conducted twice during the five-year permit term. If you observe a potential illicit discharge, report it to your supervisor.

Discharges that **ARE** Potential Illicit Discharges

- Nonresidential Vehicle Wash Water
- Accidental Spills (Hazardous and non-hazardous materials)
- Direct Discharge of Agricultural Wastes
- Cooking Oil and Grease
- Sanitary wastewater from showers, sinks, etc.
- Unauthorized Connections
- Concrete Washout Water
- Solid Waste Dumping
- Sewer Discharges
- Fertilizer, Pesticides and Herbicides – Misapplied or Over applied
- Septic/Sanitary Sewer Discharges
- Improper disposal of fluids (oil, gas, solvents, etc.)



(*Read Slide*) These discharges are NOT acceptable and should be reported to your supervisor.

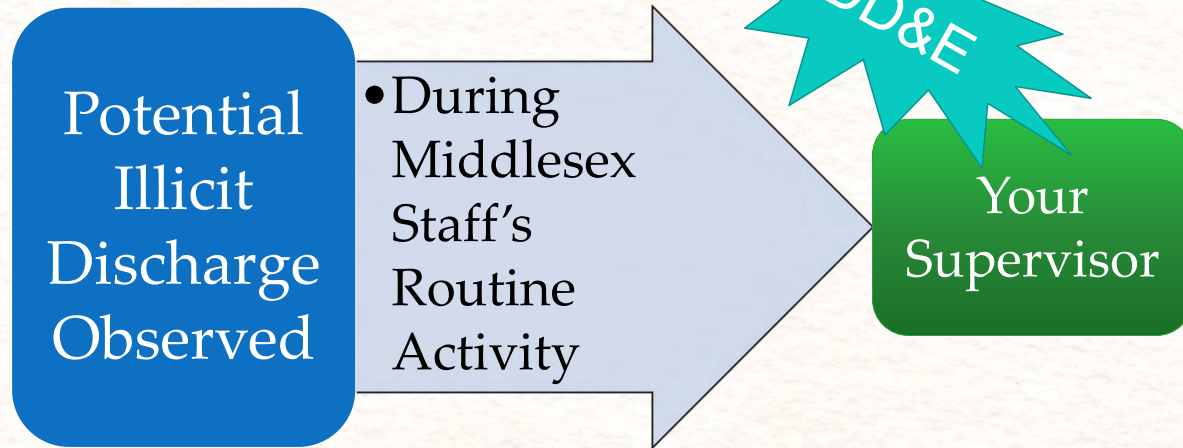
Discharges that are **NOT** Potential Illicit Discharges

- Fire-fighting activity
- Accident Clean up
- Potable water sources
- Irrigation drainage
- Lawn watering
- Individual car washing
- Building wash down (water only) Pavement washing (water only)
- Air conditioner condensate
- Riparian habitat/wetlands
- Uncontaminated groundwater (springs, crawl space pumps, foundation/footing drains)
- Waterline flushing



These discharges are OK.

Report Observed Potential Illicit Discharge to your supervisor



Illicit Discharge Detection and Elimination Program



(Click) The MS4 permit requires development of an IDD&E program.

(Click) An outfall is where we first look for evidence that material other than water is being discharged to the stream. Remember, an outfall is where the stormwater system, usually a pipe or swale, joins the waterway.

Skelly and Loy will begin inspecting outfalls very soon, but you are out and about the Township routinely and might encounter suspicious situations. We want you to be informed so you can report your findings to your supervisor.

Identification of Potential Illicit Discharge

Potential Illicit Discharge Characteristics:

1. Flow
2. Odor
3. Clarity/Turbidity
4. Color
5. Solids/Floatables
6. Vegetation
7. Deposits or Staining



7 potential illicit discharge indicators are listed on the slide. These characteristics can be observed using our senses. No special equipment is needed, and no special testing is required. The seven indicators can predict an illicit discharge but need to be reported and investigated further.

While Skelly and Loy will be performing the 1st-year outfall screening, if any of you observe discharge with these characteristics, report it to your supervisor. We are developing ...you go it!...more forms and procedures for documentation. And that will be provided in upcoming sessions. For now, Eileen Gault, Barry Sherman and Rory Morrison will be gatekeepers. They know what to do and will either follow up personally or contact Skelly and Loy.

Let's now discuss each of these indicators.

Identification of Potential Illicit Discharge

- **Flow** – fluid discharge during dry weather.

Normal stormwater vs illicit discharge

- Has it rained in the past 3 days
 - Yes → stormwater
 - No → might be an illicit discharge
- Report to your immediate supervisor



Discharge from a stormwater pipe during extended periods of dry weather (greater than 72 hours, 3 full days) should raise some alarm that it may not be stormwater. This may be an indication of a Potential Illicit Discharge and should be reported to your supervisor.

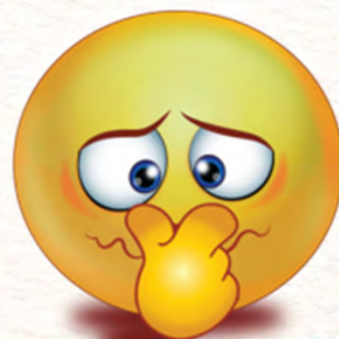
Identification of Potential Illicit Discharge

• **Odor** - Musty, Sulfur, Rancid/Sour Milk, Sewage, Gas/ Petroleum, Cooking Oil.

– Is the discharge the **SOURCE** of the odor?



Under **NO** circumstance should Middlesex personnel intentionally smell an open source.



FROM WEB:
http://www.12symbol.com/pictures/emojis/1/b/c/8/1bc851fb837a9caa815462a80c714a8e_256.png



Establish what type of odor is being smelled. Is it musty, a sulfurous or sewage smell, or is it similar to gas or petroleum? Try to determine the source of the odor to make sure the odor is coming from the potential illicit discharge. In some situations the source of the odor can be misleading; it may actually be shrubs, trash, carrion or animal waste. Never get too close to a strange discharge - they can be dangerous! Never inhale the air directly off an open source as many potential contaminants are harmful to nasal membranes and lung tissue.

Identification of Potential Illicit Discharge

•Clarity/Turbidity

- Clear,
- Cloudy,
- Opaque,
- Grayness
- If obvious, note Source:
 - Spill, Accident, Dumping?
 - Unauthorized connection?
 - Eroding Streambanks?



Continuing, Clarity/Turbidity is the next characteristic.

Turbidity is a measurement of the cloudiness of water, and it is caused by particles that are suspended in the water.

Clarity gives us an idea how far light can penetrate into the water.

Characteristics of these two include:
Clear, Cloudy, Opaque, and Grayness.

Is the water murky? If so, a Potential Illicit Discharge may be present. If obvious, note the source.

Identification of Potential Illicit Discharge

•Color —

- Clear,
- Slightly Tinted,
- Visible Colorations (e.g. Red, Green, Blue, other).

- Note: Water depth, substrate composition, aquatic plants, and sky conditions can all influence your perception of the color of water.



Unnatural color of water can also indicate an illicit discharge. Do not try to assess the color of water by looking directly into the waterway. Water depth, substrate composition, aquatic plants, and sky conditions can all influence your perception of color.

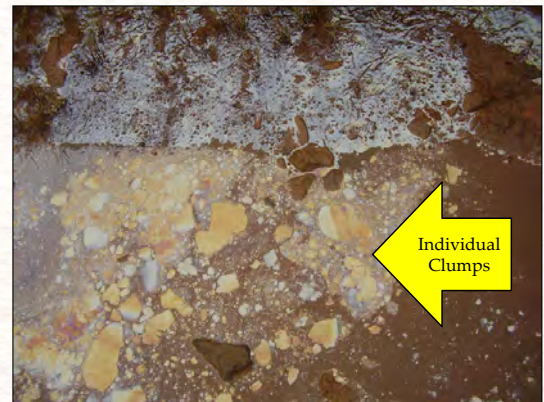
But certainly the obvious, such as that shown in the pictures on the right, can be easily identified.

Identification of Potential Illicit Discharge

•Solids/Floatables Garbage, Sewage, Oily Sheens, or Suds



Petroleum Sheen – swirls and re-adheres if mixed



Nonpetroleum Sheen – breaks apart into clumps with jagged edges



Solids and floatables in a water stream or body is also a sign of a Potential Illicit Discharge. A visual observation can usually be seen from a distance making it more noticeable than other indicators. This may include Garbage, Sewage, Oily Sheens, or Suds.

Both pictures show examples of an oily sheen. Such a condition can be natural and not indicative of petroleum. You can use a stick to stir the water to determine whether it's a naturally occurring sheen or petroleum-based sheen. Petroleum sheens will swirl and re-adhere quickly while naturally occurring sheens will separate into clumps with jagged edges.

Identification of Potential Illicit Discharge

•Solids/Floatables

Natural Foam/Suds may appear white at first but will generally turn brown over time



Manmade foam/suds is usually white in color and sometimes has a sweet or scented odor.



Foam or suds can also be either natural or manmade. Naturally occurring suds will break up quickly and are generally clear or white but will turn brown over time. Manmade foam or suds are white and can have a sweet or scented odor. Naturally occurring floatables should NOT be reported as potentially illicit.

Identification of Potential Illicit Discharge

•Vegetation -

- Excessive growth
- Algae plumes
- Stressed
- Damaged
- Dead



Vegetation can also indicate an illicit discharge. Some pollutants may kill vegetation while others may promote excessive growth of algae or other vegetation.

Identification of Potential Illicit Discharge



Staining- Color, Sheen, Material Fragments



Illicit discharge may cause staining. Sewage may be present if there is black staining inside the drainage pipe; visible evidence of sanitary waste, such as toilet paper or opaque or gray water. Certainly, there also may be an odor.

Do not report a rusty pipe as a Potential Illicit discharge! Do report it if there is an indication that something else caused premature rust or that the rust originated from upstream.

Identification of Potential Illicit Discharge

•Deposits

- Minerals,
- Sediments,
- Oils,
- or Grease.

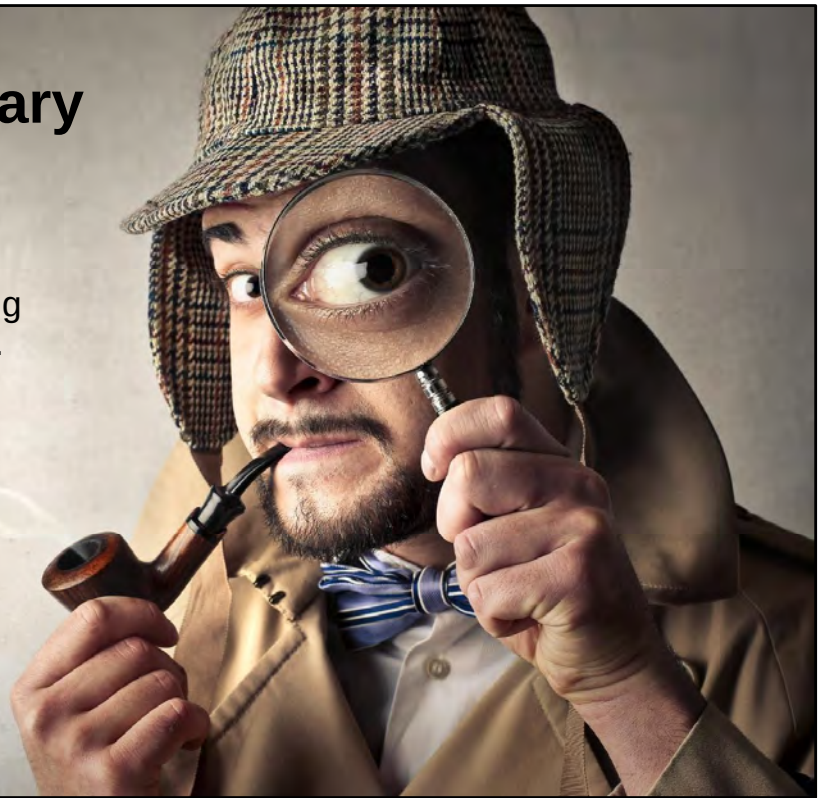


Deposits are sometimes indicators too. For example, gray-white deposits can be from illegal dumping of concrete truck washouts and crystalline powder can indicate the discharge of fertilizer wastes.



MCM#3 Summary

- You are our eyes.
- Report suspicious looking water to your supervisor.



MCM #4: Construction Site Runoff

- Goal: Prevent pollutants from reaching waterways during earth disturbance activity.
- Priority is erosion and sedimentation (E&S) control
 - Coordinate with Cumberland County Conservation District
 - Inspections
 - Enforcement
 - Training



<http://www.brownsriverballinacorney.com/waterkeeper/programs/stopwaterpollution/>



Middlesex largely relies on the County Conservation District and the Township Engineer, Bud Grove (Skelly and Loy) to monitor discharges from construction sites.

MCM#5

Post Construction Stormwater Management (PCSM)

Sediment clogging:
This media will have to be dug out, disposed of, and replaced



- Goal: Ensure stormwater management facilities are functioning and maintained
 - Stormwater Management Ordinance
 - Standard Operating Procedures (SOPs)
 - Inspections
 - Deficiency correction

The Township will be intensifying monitoring the functionality of Stormwater Management facilities.

Maintenance is required to make sure facilities perform as designed.

(Click) The Township, homeowners' associations, or private landowners are responsible to operate and maintain stormwater facilities. It depends on who constructed the facilities and who accepted ongoing maintenance responsibility.

Currently, the Township relies on the County Conservation District, the Township Engineer, and Mark Carpenter for enforcement. But all of you are front-line scouts. Report stormwater facilities that don't look right to your supervisor.





These are examples of functional stormwater facilities.



Here is a facility that needs repair.

MCM#6: Good Housekeeping and Pollution Prevention

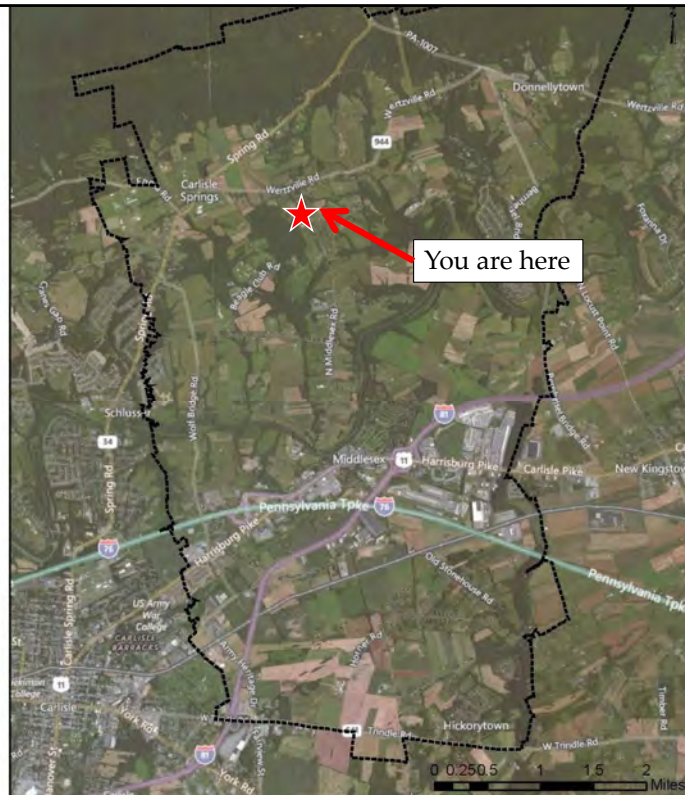
Anderson Park Standard Operating Procedure

	Description	Responsible
Trash & Refuse Management	1. Grounds inspected and litter deposited in refuse containers 2. Refuse containers emptied	1. Roadway Supervisor 2. Certified Harbinger
Pet Waste Management	1. Grounds inspected and waste deposited in refuse containers. 2. Refuse containers emptied	1. Roadway Supervisor 2. Certified Harbinger
Vegetation Management	1. Mow Grass 2. Collect Leaves 3. Trim trees & shrubs	



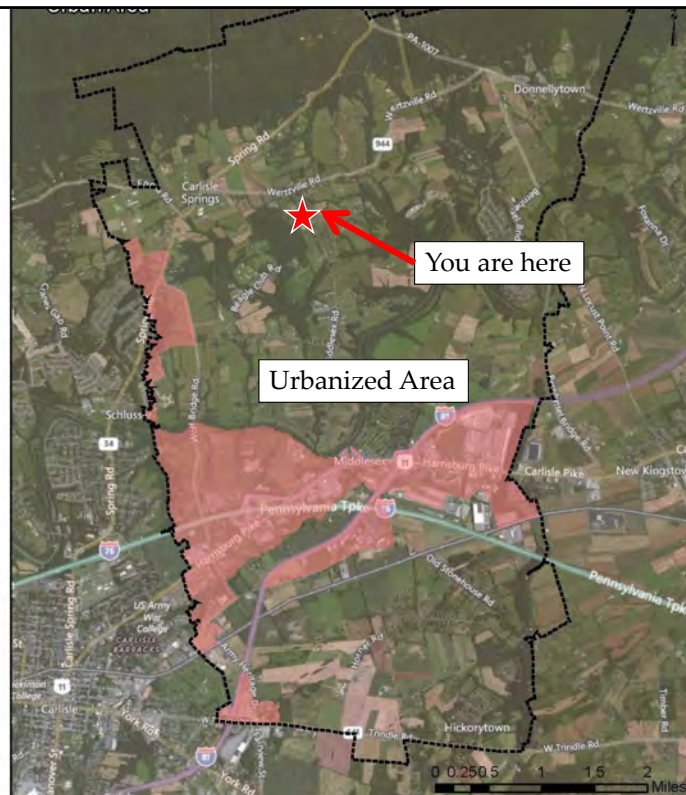
MCM#6 focuses on the Township's operations and procedures to prevent and reduce pollution emanating from Township-owned property exclusive of streets and roads.

Middlesex Township Urbanized Area



Remember at the beginning we said MS4 is all about Clean Water, Stormwater, Urban Water? The Urbanized areas regulated by the MS4 permit are delineated by the US Census Bureau in the latest 10-year Census. The designation is largely based on population density, but the US Census Bureau has incorporated a couple other criteria related to impervious surface.

Middlesex Township Urbanized Area



In Middlesex, the Urbanized Area (highlighted in pink on the slide) surrounds the Miracle Mile where the trucking operations and warehousing are generally located.

Middlesex Township MS4 Area

Urbanized Area
+ Contributory Drainage

Regulated MS4



The regulated area also includes adjacent land that flows into the urban area before reaching a stream, shown in yellow. Anderson Park is the only Township-owned property that is in the regulated MS4.



Good Housekeeping Activities

- Manage litter
- Collect pet waste
- Close refuse and recycling container lids
- Manage Vegetation;
 - Mowing
 - Leaf and Debris Clean up



Anderson Park is the only site that is REGULATED. However, the Township wants all Township-owned properties to be kept ship-shape and clean, including the Township building with its maintenance and police operations.

So what does the SOP, say to Middlesex Maintenance Crew?

1. Barry, as the Roadway Supervisor, has the responsibility to make sure you do the jobs listed on the slide.
2. The SOP lists the MINIMUM frequency for completion of jobs.
3. Examples:
 - A. Collect and deposit trash and pet waste in trash bins 1x month...year round
 - B. Mowing 1x week...during the growing season
 - C. Leaf collection 2x in November
 - D. Trimming Trees and pick up debris, as needed
4. It provides other direction. For example, when you mow, you will direct clippings away from stormwater conveyance. So that means don't put clippings in gutters or inlets. If you do...you will need to sweep up, collect and dispose of the clippings because clippings are not pure water, so they are considered a pollutant. And of course they can cause other problems too, like blocking inlets and causing ponding water on roadways.
5. The SOP states that trash will be emptied and disposed by a certified hauler.

Middlesex Achievements



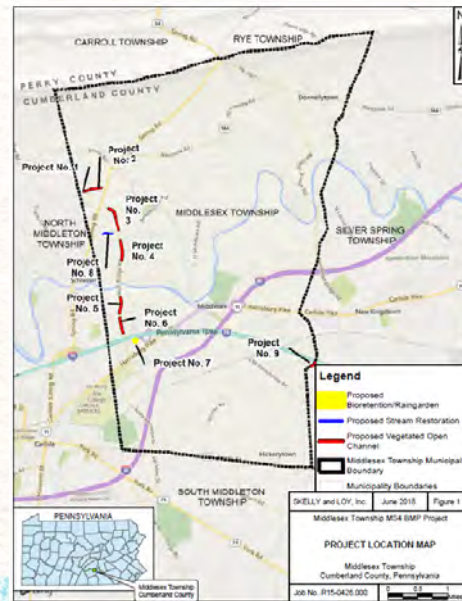
2018 to 2019 Achievements

Approved MS4 Permit

Began development of the Township Stormwater Management Program (SWMP)

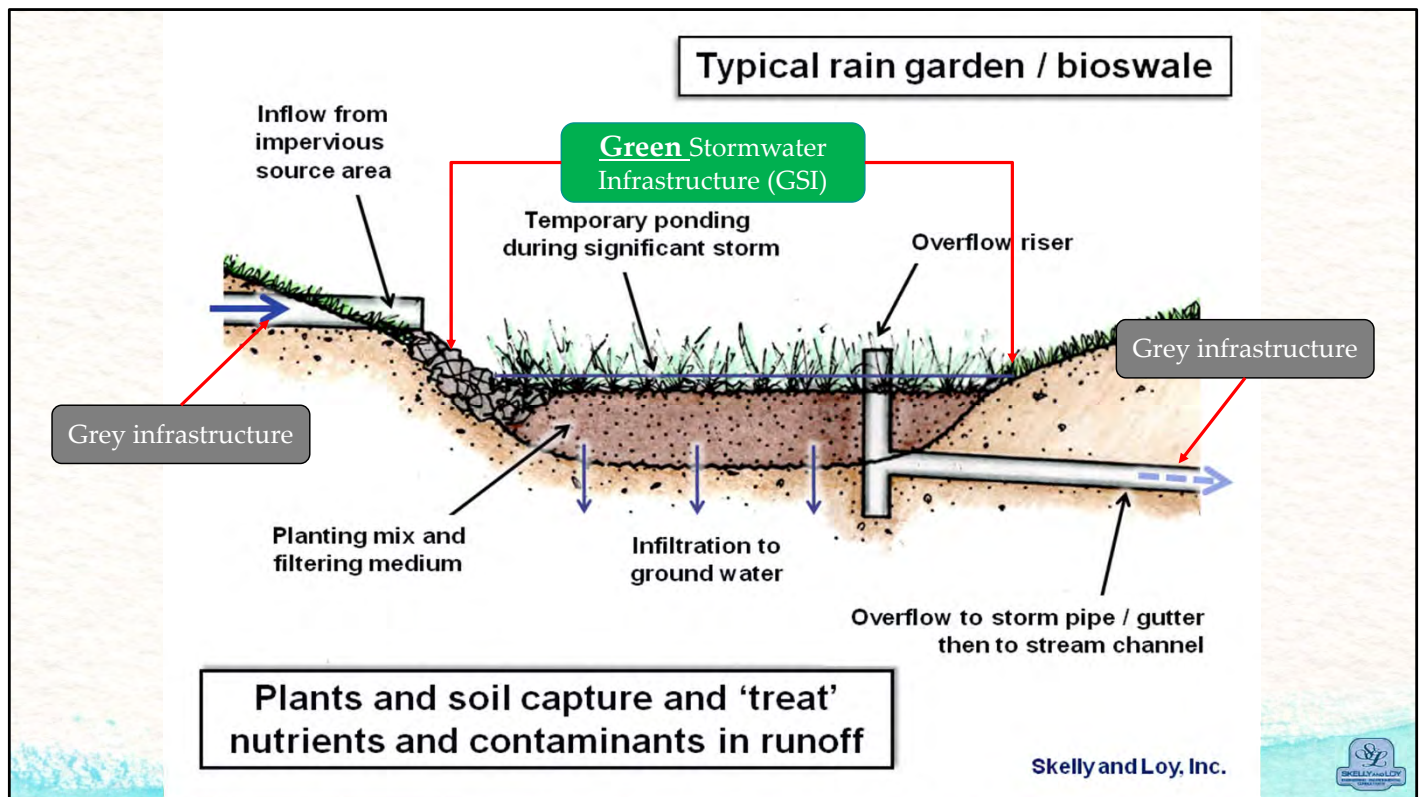
Mariner Grant- \$631,600

- Funded projects include:
 - Open Vegetated Roadside Channels (8,900 LF at 7 sites)
 - Rain Garden at Andersen Park
 - Stream Restoration for Unnamed Tributary to Wertz Run (1,100 LF)



The Township is required to perform activities to prevent/reduce pollutants including more vigorous attention to maintenance, replacement of degrading infrastructure, plus new pollutant reducing projects. All of this is very expensive.

The Township was successful in a grant award to fund the Pollutant Reduction Plan Projects or PRPs.



Before we walk through the Township's PRP projects, let's understand just a little bit how they work.

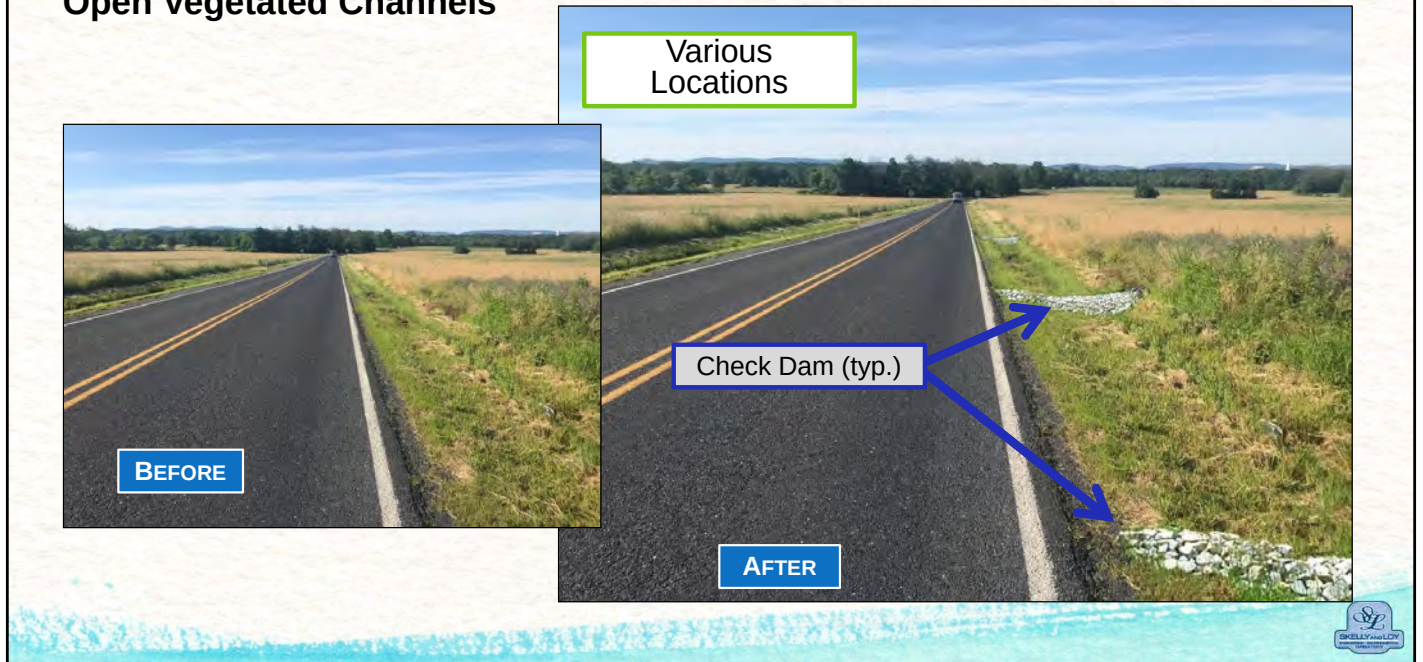
Many PRP Projects rely on reducing pollutants by promoting infiltration into the soil. The soil acts like a filter by capturing pollutants. Infiltration also slows the velocity and amount of stormwater runoff and reduces erosion.

(Click) Infiltrative stormwater management solutions are collectively called "Green" or Green Stormwater Infrastructure, abbreviated GSI.

(Click) Traditional inlets and pipes are called grey infrastructure.

Proposed PRP Projects

Open Vegetated Channels



First up... Open Vegetated channels.

There are 7 proposed vegetated roadside channel projects. Open vegetated channels can be effective pollutant reducers simply by maintaining road shoulder stability. In other words, conveying storm water without causing erosion. The channel projects are under evaluation to determine the appropriate solution at each site. Some solutions might mix green and grey infrastructure.

Proposed PRP Projects

Treatment Train

Open Vegetated Channel
+ Plunge Pool

Greater Reduction



Appalachian Drive has some site constraints, but the Township is going to maximize pollutant reduction using a treatment train, which means the construction of two or more pollutant reducing management solutions that are interconnected. More pollutants are removed as the water moves along the system than would happen if there were only a single treatment.

Proposed PRP Projects

Rain Garden



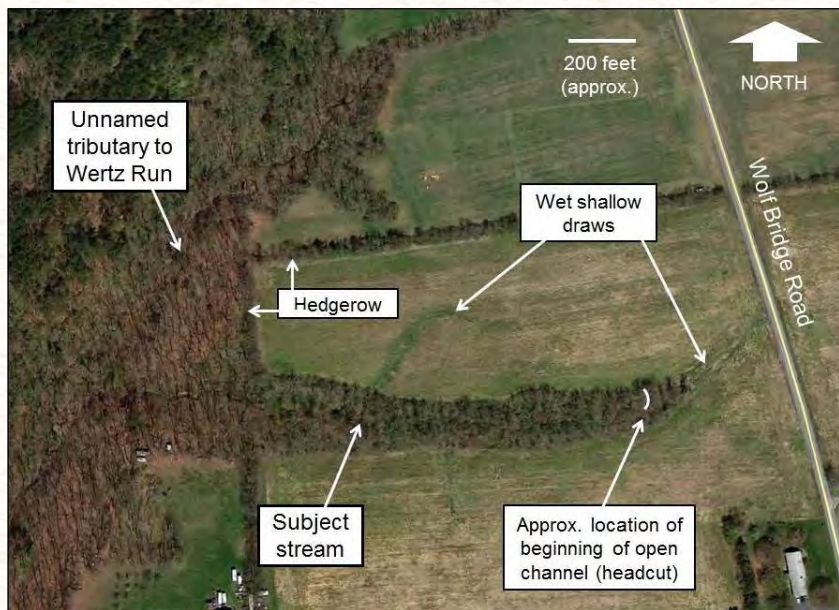
We spoke of Anderson Park in MCM#6 and the Township proposes a raingarden at this location.

The rain garden will add visual interest to the park and will act as a sponge to reduce runoff onto the road. In addition, the plants will utilize the nutrients, which are considered to be pollutants, for growth. The project is valuable due to its high visibility and prominent position in the park that will make it attractive for promotion of the MS4 program and a natural education site.

Proposed PRP Projects

Stream Restoration/ Stabilization Project

Northwest of Wolf's Bridge
and
West Middlesex Roads



The Township will be undertaking a Stream restoration/ stabilization project on the Frey Phillips Property located Northwest of Wolf's Bridge and West Middlesex Roads.

We talked about the negative impacts to stream health caused by erosion previously in the presentation. What we didn't discuss yet is that stream bank erosion is THE largest contributor of sediment to our waterways so stabilizing banks and providing area for floodwater to spread out and slow down is THE MOST EFFICIENT PRP for sediment reduction.

Proposed PRP Projects

Stream Restoration/ Stabilization Project

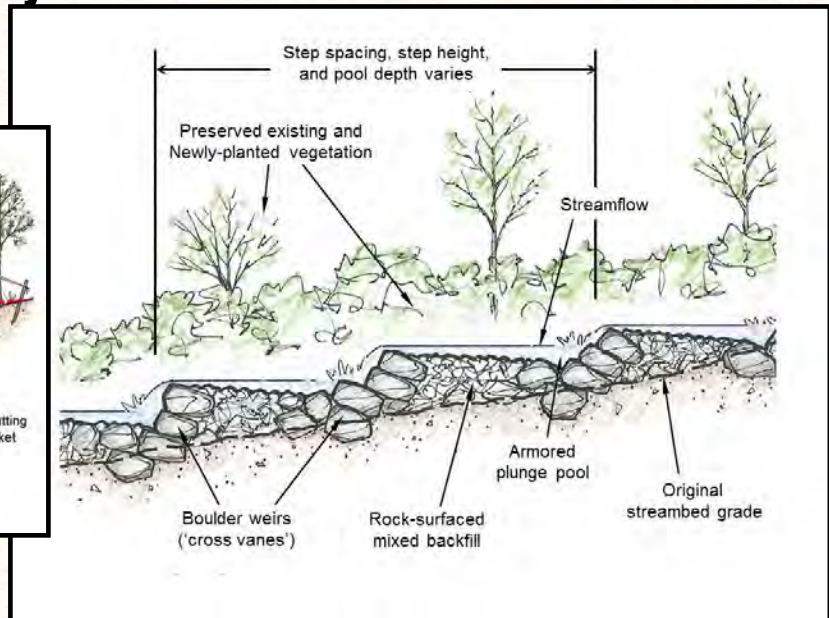
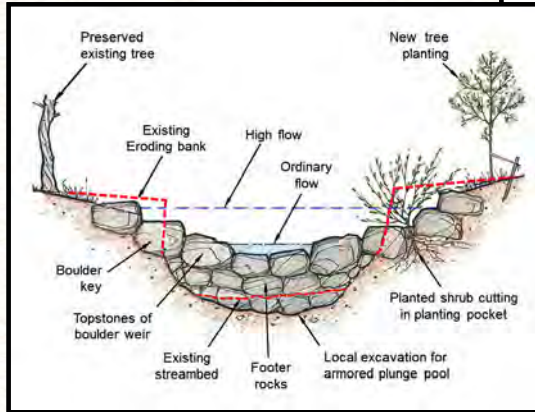


The pictures show what the stream looks like right now. The stream banks are 4 to more than 8-feet deep and highly eroded.



Proposed PRP Projects

Stream Restoration/ Stabilization Project



The plan is to construct a step-pool channel and use rock to dissipate the stream's erosive energy and stabilize it.

Left: concept channel cross section view of a boulder weir

Right: Concept profile view of a constructed step-pool stream channel

Proposed PRP Projects

Stream Restoration/ Stabilization Project



This is a series of pictures to help you visualize what it will look like in the future.

Photo 1: Similar sized project in Philadelphia ([click](#))

Photo 2: After Construction ([click](#))

Photo 3: A stream in northwestern PA shortly after the project completion...Larger than the tributary that will be restored...flow in the Middlesex channel will likely be visible in only in wet years and during significant rain events

Middlesex MS4 Summary

Acronyms

E&S: Erosion and Sedimentation	GSI: Green Stormwater Infrastructure	IDD&E: Illicit Discharge Detection and Elimination	MCM: Minimum Control Measure
MS4: Municipal Separate Storm Sewer System	PCSM: Post Construction Stormwater Management	PRP: Pollutant Reduction Plan	SWMP: Stormwater Management Program

Here is a list of the acronyms we used in the presentation.

(Click) The one you need to remember is MS4.

The others were provided so you become familiar with them... Eventually you too will want to abbreviate some of these long descriptions.

Alphabetical Acronym List

E&S	Erosion and Sedimentation
GSI	Green Stormwater Infrastructure
IDD&E	Illicit Discharge Detection and Elimination
MCM	Minimum Control Measure
MS4	Municipal Separate Storm Sewer System
PCSM	Post Construction Stormwater Management
PRP	Pollutant Reduction Plan
SWMP	Stormwater Management Program

Middlesex MS4 Summary

Pollution Prevention

- No Illicit Discharges
- Control Construction E&S
- Functional Stormwater Management Systems
- Keep Township Properties Clean
- Prevent/Clean-up spills and leaks

Pollution Reduction

- Construct Projects



In summary, pollution prevention includes:

- Eliminating intentional or accidental releases of non-stormwater materials into the stormwater system that feeds the streams
- Preventing loose soil from leaving construction sites
- Ensuring stormwater management facilities designed to slow run-off or remove water pollution are functioning well

- Keeping Township properties clean
- Preventing pollution releases during Township's operation and maintenance activities

Pollution Reduction includes:

- Constructing projects to reduce pollution

Next Steps



- **Dry-weather screenings of outfalls** (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)



The screenings will be conducted soon.

- Dry-weather screenings of outfalls (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)
- **Updated to portable data collectors**



The data collectors have been updated and are ready to go!

- Dry-weather screenings of outfalls (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)
- Updated to portable data collectors
- **Enhancement of Mapping**

Mapping is being updated now. Revisions to locations of pipes and swales and new information is regularly being incorporated.

- Dry-weather screenings of outfalls (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)
- Updated to portable data collectors
- Enhancement of Mapping
- **Creation of chain of command and reporting processes**

We will be creating better reporting of suspicious discharge and other stormwater related issues and a chain-of-command so staff knows who to report to for resolving problems.

- Dry-weather screenings of outfalls (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)
- Updated to portable data collectors
- Enhancement of Mapping
- Creation of chain of command and reporting processes
- **Creation and initiation of forms and instructions for many forms of documentation**
 - **Tracking complaints**
 - **Tracking potential illicit discharges**
 - **Documenting erosion control during construction**
 - **Documenting long-term operations and maintenance of stormwater management controls**



You will be seeing more types of forms for documentation
(Click 4 times and read)

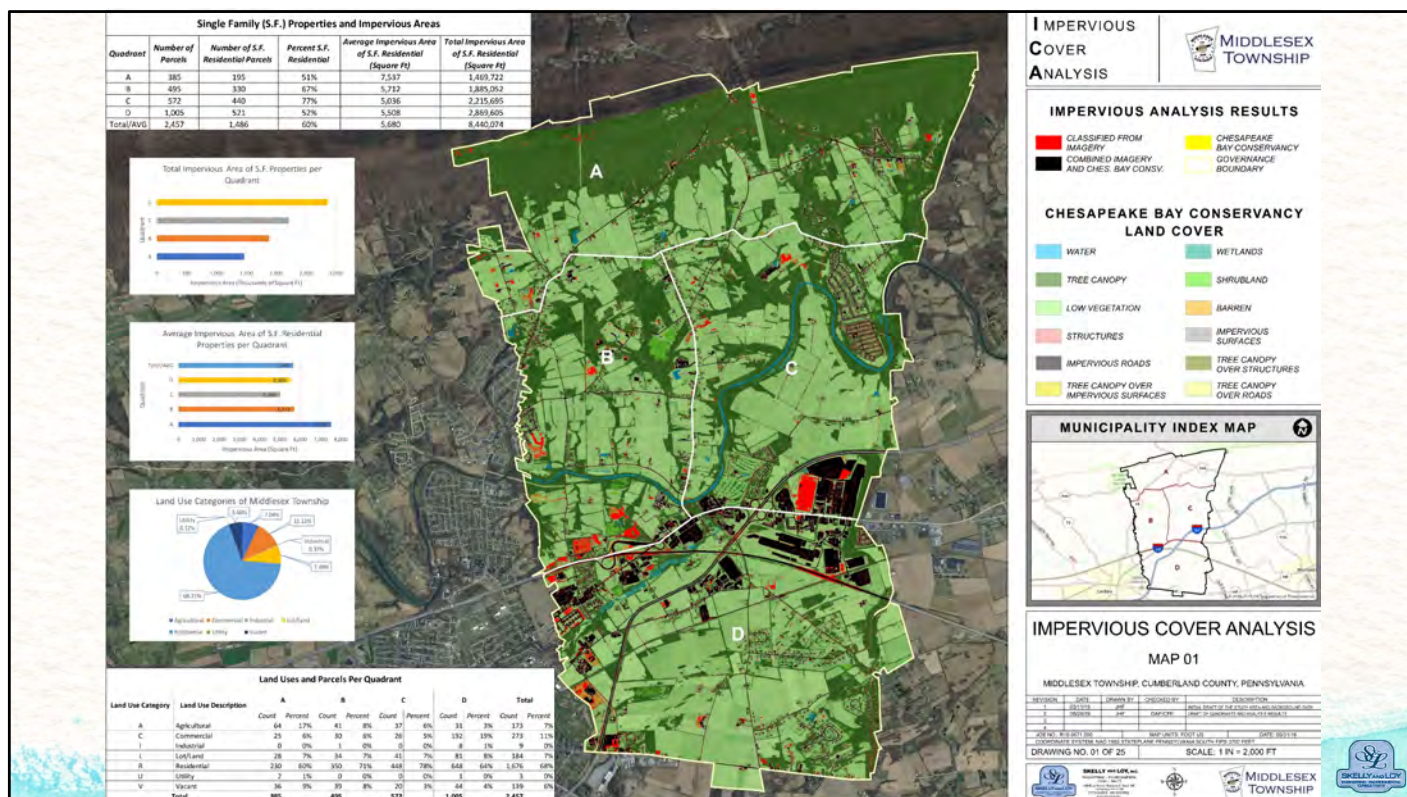
- Dry-weather screenings of outfalls (*1st cycle: Consultant / 2nd cycle: Middlesex Staff*)
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- Creation of chain of command and reporting processes
- Creation and initiation of forms and instructions for many forms of documentation
 - Tracking complaints
 - Tracking potential illicit discharges
 - Documenting erosion control during construction
 - Documenting long-term operations and maintenance of stormwater management controls
- **Many More...**



Preparing for Stormwater Fees: GIS Impervious Analysis



Your management team also wants you to know that stormwater fees are in the Township's future. They want you to be knowledgeable enough to answer basic questions.



Imperviousness is the most significant predictor of pollution. As previously stated, it also directly contributes to flood elevation increases. Skelly and Loy performed an analysis of the location and extent of impervious surfaces in the Township. The results of the analysis are shown on the map.

Previous slides showed the impact of stormwater runoff. Hard surfaces like paving and roofs prevent stormwater from soaking into the ground. Remember from the beginning of the presentation?...What doesn't soak in runs off...Stormwater runoff.

...And water quality is degraded.



This is the Key for the map. It shows the various land surface covers. The Top part shows impervious surface and the source of the data.

There was a data base created by the Chesapeake Bay Conservancy (Based on 2003-2008 imagery) that is very detailed but did not capture recent changes in Middlesex.

The Skelly and Loy GIS team analyzed 2018 PEMA (Pennsylvania Emergency Management Agency) imagery and classified the “red” areas. Where the two coincide, the map is black. The exercise produced the areas of imperviousness with a very high degree of confidence that the analysis reflects actual land cover.



This image shows a high degree of imperviousness...The equivalent to hundreds of single-family residences.



This image shows various intensities of residential development.

Single Family Residential Property supports 5.680 SF Impervious

Single Family (S.F.) Properties and Impervious Areas					
<i>Quadrant</i>	<i>Number of Parcels</i>	<i>Number of S.F. Residential Parcels</i>	<i>Percent S.F. Residential</i>	<i>Average Impervious Area of S.F. Residential (Square Ft)</i>	<i>Total Impervious Area of S.F. Residential (Square Ft)</i>
A	385	195	51%	7,537	1,469,722
B	495	330	67%	5,712	1,885,052
C	572	440	77%	5,036	2,215,695
D	1,005	521	52%	5,508	2,869,605
Total/AVG	2,457	1,486	60%	5,680	8,440,074



Results. The analysis concentrates on single-family residences to establish an “apples to apples” comparison regarding the extent of imperviousness regardless of land use. The average single-family property in Middlesex has 5,680 square feet of impervious surface. These results will be used to establish the stormwater fee structure.

Middlesex Current Stormwater Program Funding

- Grants
- General Fund



To date, Middlesex has relied on grants and use of the general fund. The next several slides will explain how reliance on those funding sources is insufficient.

Stormwater Program Benefits



- Property Value Protection
- Fishing-based Tourism Support
- Reduced Flooding and Damage
- Groundwater Recharge (supply)
- Recreational Opportunity
- Improved Stream Health
- Improved Wildlife Habitat



We visited some of the benefits of clean stormwater and why we should care. This is achievable through implementation of a Comprehensive Stormwater Management Program.

Stormwater Program Goals

- Assess drainage, flooding and stormwater problems
- Maintain aging Infrastructure
- Implement System Improvements
- Comply with state and federal regulations, particularly NPDES MS4 permit



The goals of Middlesex Township's Stormwater Management Program are:

(Click) Assess drainage, flooding and stormwater problems

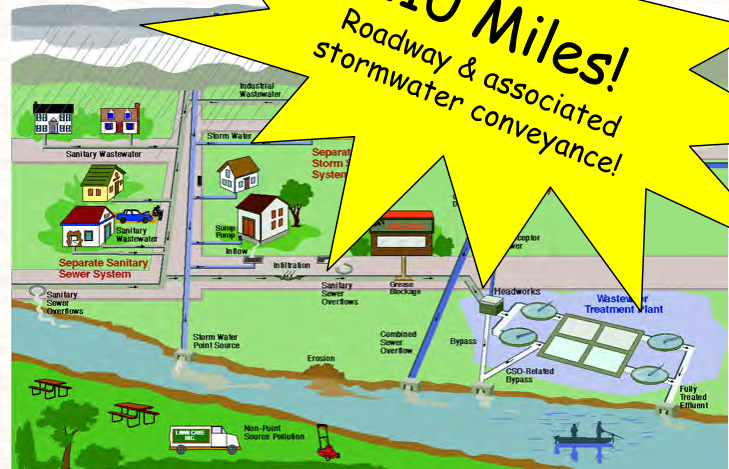
(Click) Maintain aging Infrastructure

(Click) Implement System Improvements

(Click) Comply with state and federal regulations, particularly NPDES MS4 permit

Stormwater infrastructure Utility

- Maintenance (repair and replacement)
- Capital Improvements and Expansion
- Personnel Management
- Administrative Duties



Maintenance:

Stormwater Infrastructure is a utility. It wears out just like other systems. Storm water pipes and swales serve urban, suburban and rural parts of the Township.

Remember earlier we listed all the different parts of the

stormwater system.

Storm conveyance (pipes, channels and swales)

Catch basins

Detention/retention ponds

Raingardens and bioswales

They all require inspection, repair and replacement.

And often the infrastructure is part of the roadway.
Did you know that Middlesex Township has 110 miles of roadway?

(Click)

All these maintenance activities will be increasing.

Capital Improvements and Expansion:

- We need more stormwater infrastructure to perform stormwater cleaning in addition to the previous conveyance

requirements.

- The maintenance staff constructed Wagner Road Open Channel and other improvements. These improvements will be expanded.
- The Maintenance Crew needs to continue to respond to non-routine maintenance and repairs like
 - Storm damage
 - Spills
 - Accidents

...And now will need to produce better documentation

- We reviewed the projects required for MS4 permit compliance. New and retrofit MS4 BMPs to improve/protect local water quality and the Chesapeake Bay will cost approximately \$1 million
- The Township is investing in computer hardware/software to manage the compliance documentation

Regulatory compliance, staff education and so on increases required management and administration services.

Personnel Management & Administrative Duties

Record keeping

Payroll and contracts

Complaint resolution

Funding procurement and management (grants and

loans)

You all are part of providing these services.

Bottom Line...

Current Costs

- Routine Road/Stormwater Maintenance
- Emergency Repair Response

NEW COSTS!

- BMP Construction
- Additional Personnel
- Inspections
- Administration
- Documentation

= STORMWATER MANAGEMENT FEES



The Township can no longer afford to continue business as usual. Financing aging stormwater infrastructure was a cost on the horizon regardless of the MS4 permit...the permit only accentuated the need to revisit funding.

(Click)

The financial burden for supporting a stormwater Management Program is most fair and defensible by establishing a Township-wide fee based on impervious surface.

The reason that your management team wanted you to be aware of the effort is, as employees of the Township, you are likely to be fielding questions and comments relative to many aspects of stormwater, including..."why are stormwater fees required?"

Hopefully, you will feel better equipped when these opportunities arise.

Questions



Thank you for allowing us to be with you today. Now its time for Questions and Answers...
Me first!

Me first...

What do you know?

- What is Stormwater?
- What is stormwater runoff?
- Where does runoff go?
- What does the acronym MS4 represent?
- What is the MS4 Permit...Why is it needed?
- How does the permit involve you?



Let's check what you know now?

Have Eileen count hands for each question

Sequence:

Request a hand raise

How many don't know?

Who does know?

How many agree?

Your turn...
Questions???

