Environmentally Sensitive Maintenance for Dirt, Gravel, and Low-Volume Roads

PennState
Center for Dirt and Gravel Road Studies

Pennsylvania SCC
PA State Conservation Commission

DCNR
PA Dept. of Conservation and Natural Resources
Forestry

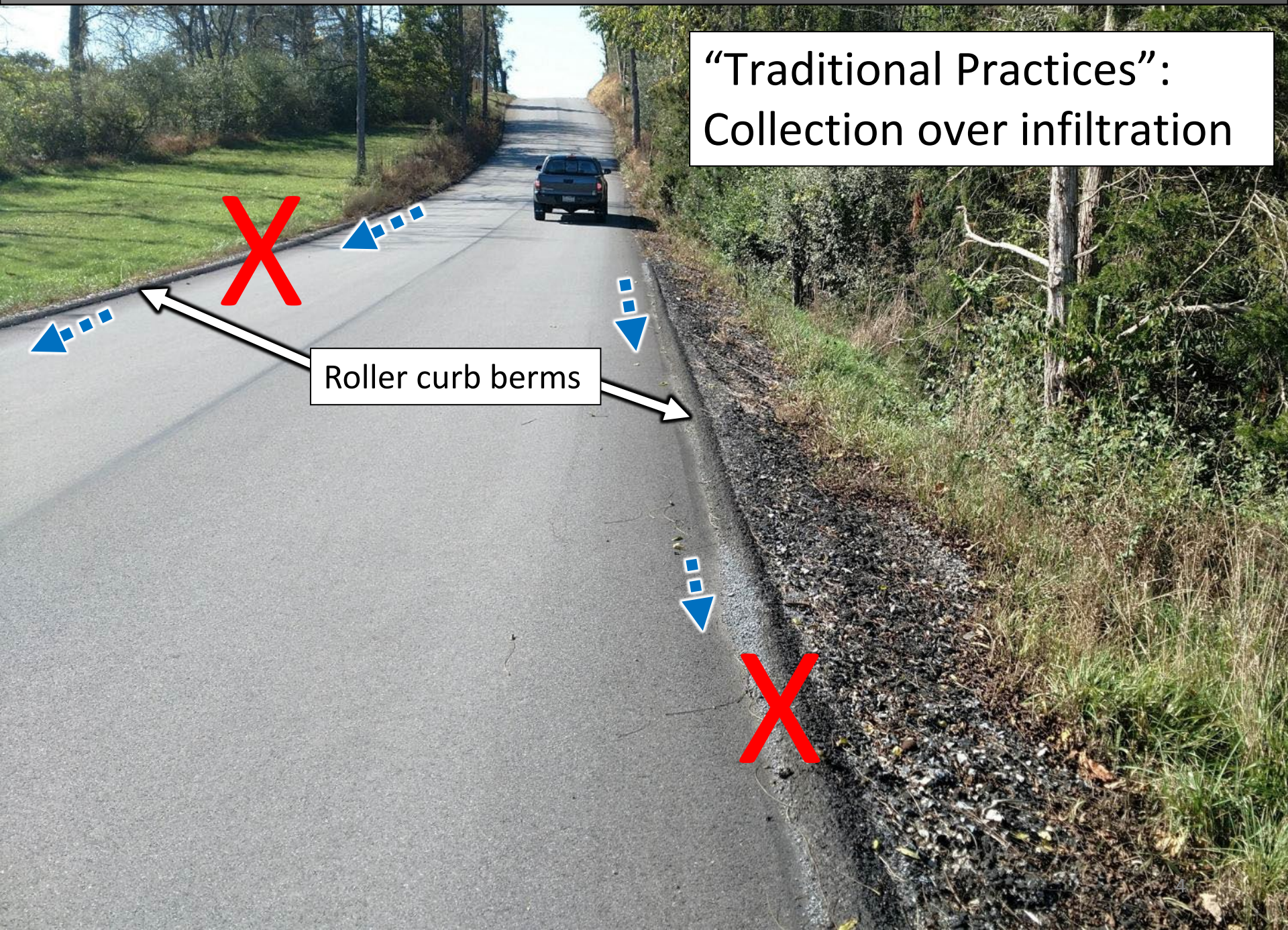
Structural Infiltration Practices

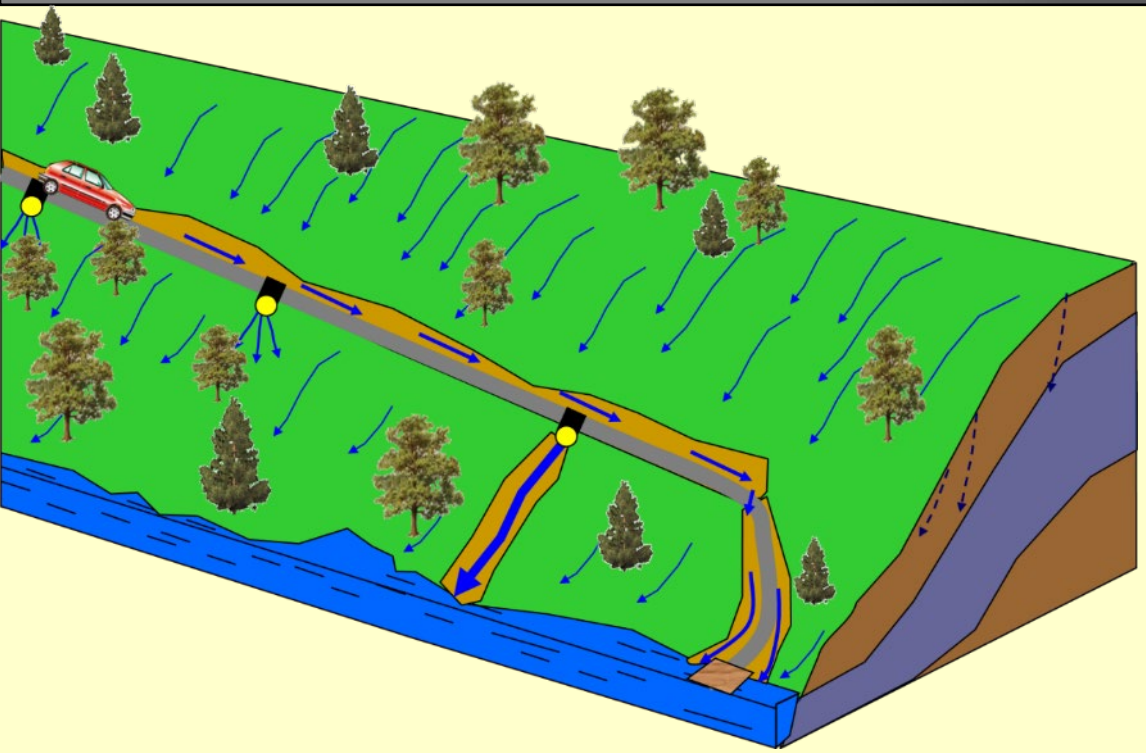
Structural Infiltration Practices

- **Introduction**
- Practices
- DGLVR Project Examples

What is “infiltration”:

Any practices that encourage water to soak into the ground instead of running off.


“Traditional Practices”:
Collection over infiltration
Roller curb berms



Remember our hillside?

- Infiltration over runoff is a Program Focus (road fill, pipes, underdrain, etc.).
- What happens in the real world….

Remember our hillside?

- Infiltration over runoff is a Program Focus (road fill, pipes, underdrain, etc.).
- What happens in the real world….
- **Sometimes the situation requires more “structural” infiltration practices**

Structural Infiltration practices:

- Structures that capture stormwater runoff and allow it to slowly seep into the soil.
- Applicable for urban, suburban, and rural roads.
- Often most beneficial in densely developed areas and agricultural landscapes.
- **Alleviate flooding and erosion, reduce surface water pollution, and promote groundwater recharge.**

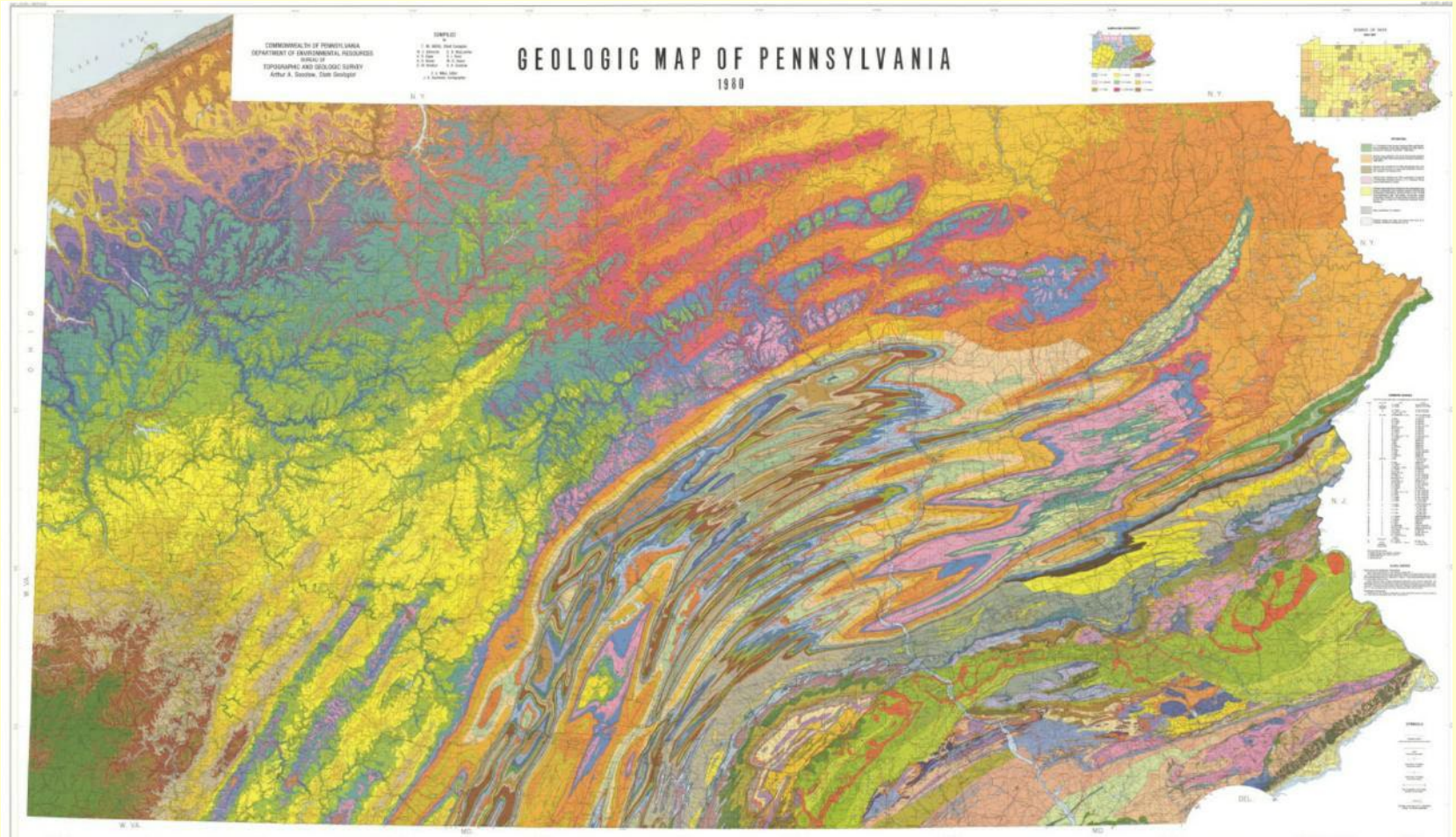
Structural Infiltration practices:

Any structure designed to capture stormwater runoff and allow it to slowly seep into the soil.

- Infiltration Basin
- Rain Garden
- Detention Basin
- Infiltration Trench
- Infiltration Swale
- Stilling Basin
- Bio-Swale
- Grassed Waterway
- Permeable Pavement
- Constructed Wetland

Examples: too many types and sizes to cover them all

- Geology, Soils, and Infiltration rates vary widely across PA.
- Analysis may be needed to determine infiltration rates.



Disclaimer #1

ENGINEERING / DESIGN (and permits) may be needed, depending on structure, location, and size.

Conservation District can help determine if an engineer or design is needed.

Disclaimer #2

- Practices are customizable and vary based on site conditions.
- This entire training could be on infiltration. These are examples only.
- Purpose is to show ideas of what might be possible through DGLVR!

Structural Infiltration Practices

- Introduction
- **Practices**
- DGLVR Project Examples

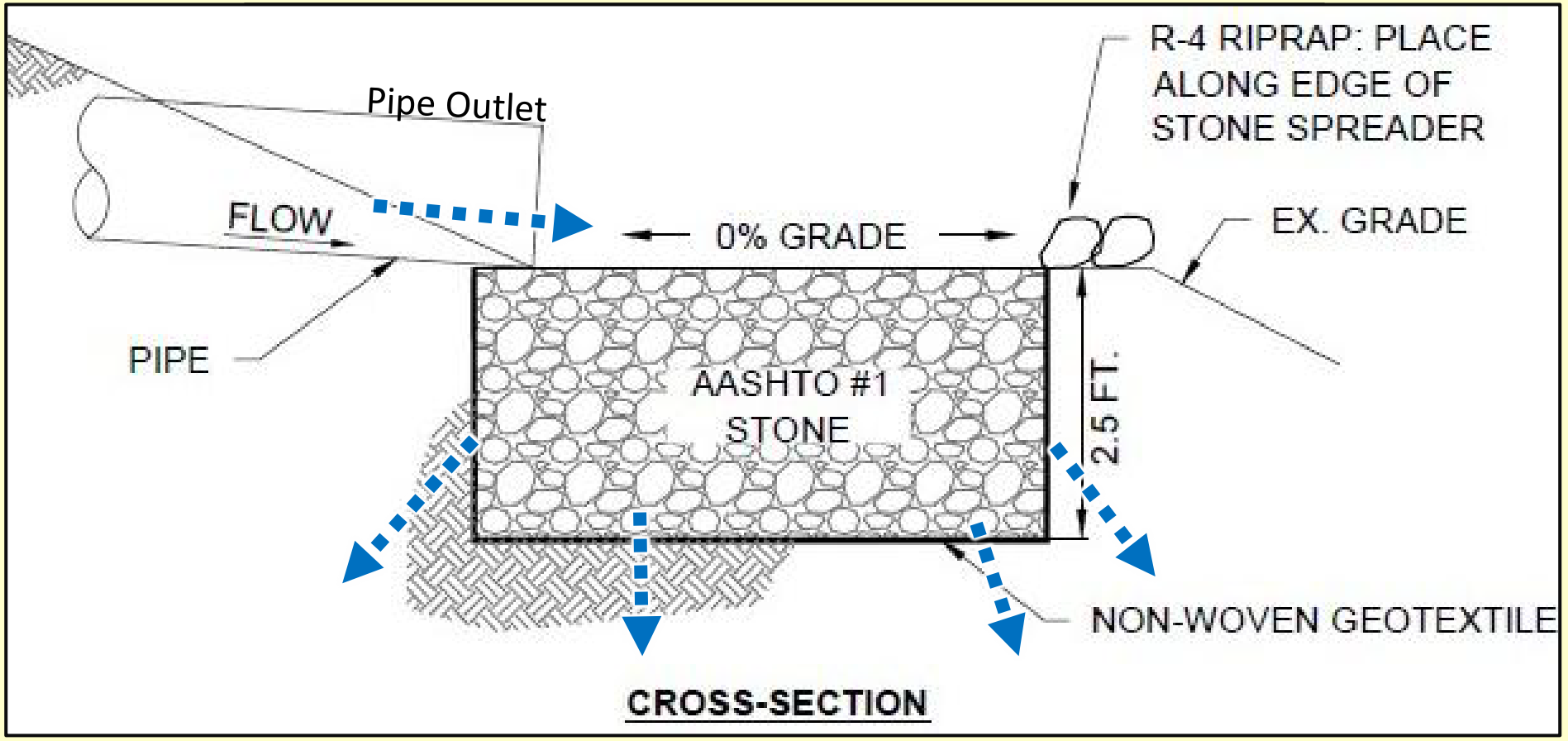
Structural Infiltration Practices

- **Infiltration Beds / Trenches**
- Infiltration Basins
- Vegetated Swales
- Rain Gardens
- Subsurface Structures

This is not all-inclusive

Infiltration Bed Detail

Typical from PA Stormwater BMP Manual



When sized appropriately, stone beds can be used at outlet of individual pipes and turnouts or at the terminal outlet of a storm sewer system.

Infiltration Beds / Trenches

Infiltration Bed used on rural storm sewer in agricultural area.
Bed located prior to discharge to headwater channel of valley stream.

Shaffer Hill Road,
Northumberland County

Infiltration Beds / Trenches

Infiltration Beds / Trenches

3’ Deep, filled w/ R4 and edged with pallet stone.

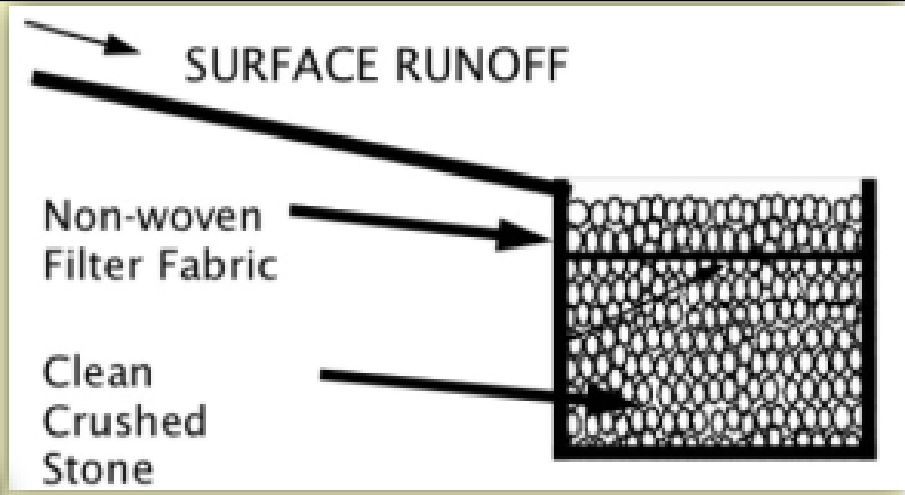
Infiltration Beds / Trenches

7 years later →

Over time Infiltration Bed blends in but continues to function as intended to reduce water and sediment leaving the road.

Infiltration Trench

Similar to infiltration bed, but longer and on contour (virtually flat)



Structural Infiltration Practices

- Infiltration Beds / Trenches
- **Infiltration Basins**
- Vegetated Swales
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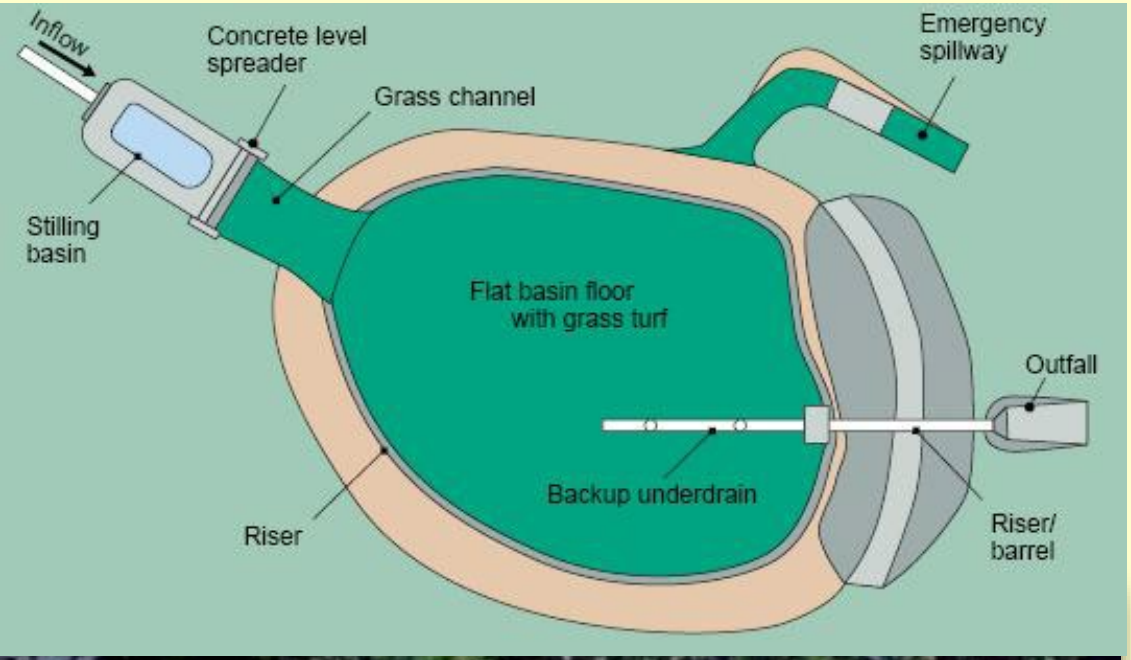
Infiltration basin: A depression that temporarily stores stormwater and allows it to seep into the soil.



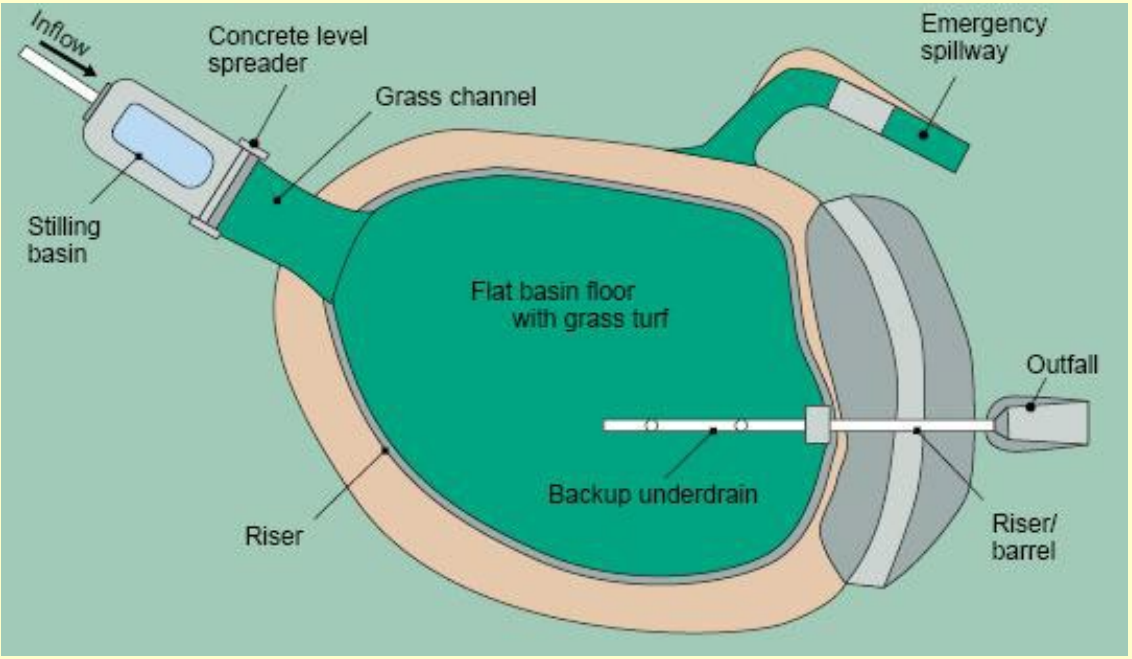
Typical features:

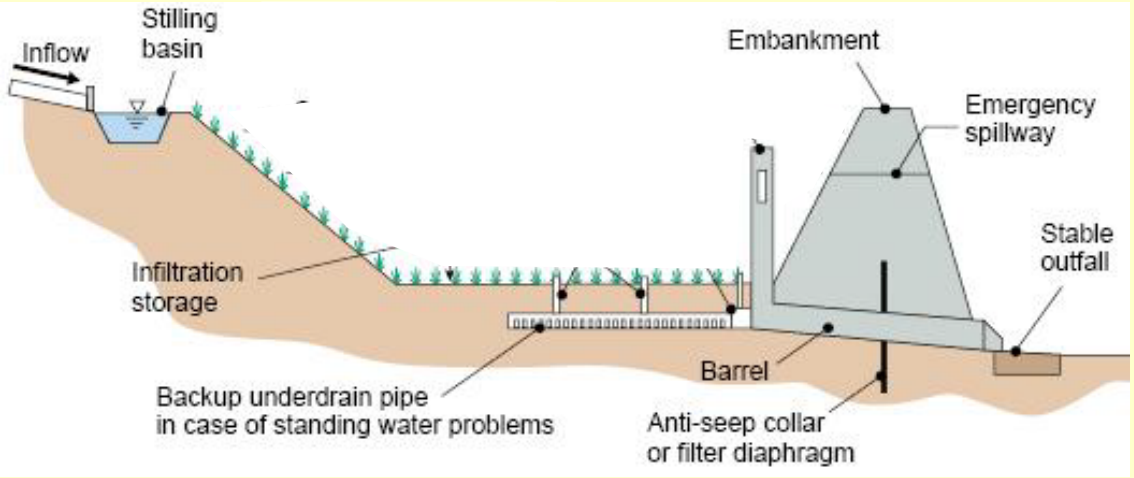
- Forebay or Stilling Basin
- Storage Pool
- Pool Level Riser
- High-water Spillway
- Incorporated Underdrain
- Easily Maintained

Not all infiltration basins have all the above features

https://stormwaterbook.safl.umn.edu/infiltration-practices

Infiltration basin: A depression that temporarily stores stormwater and allows it to seep into the soil.





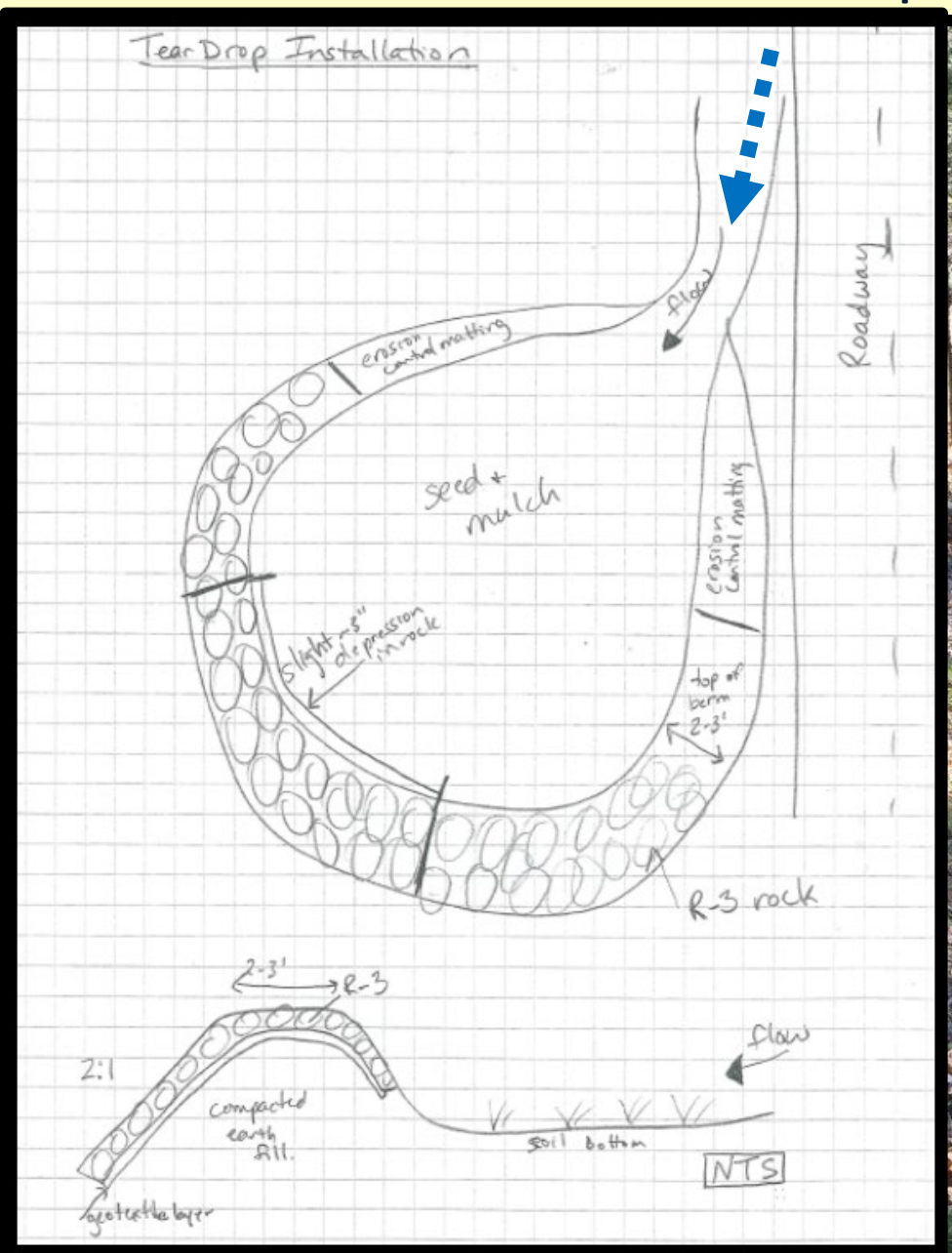
Practical Uses:

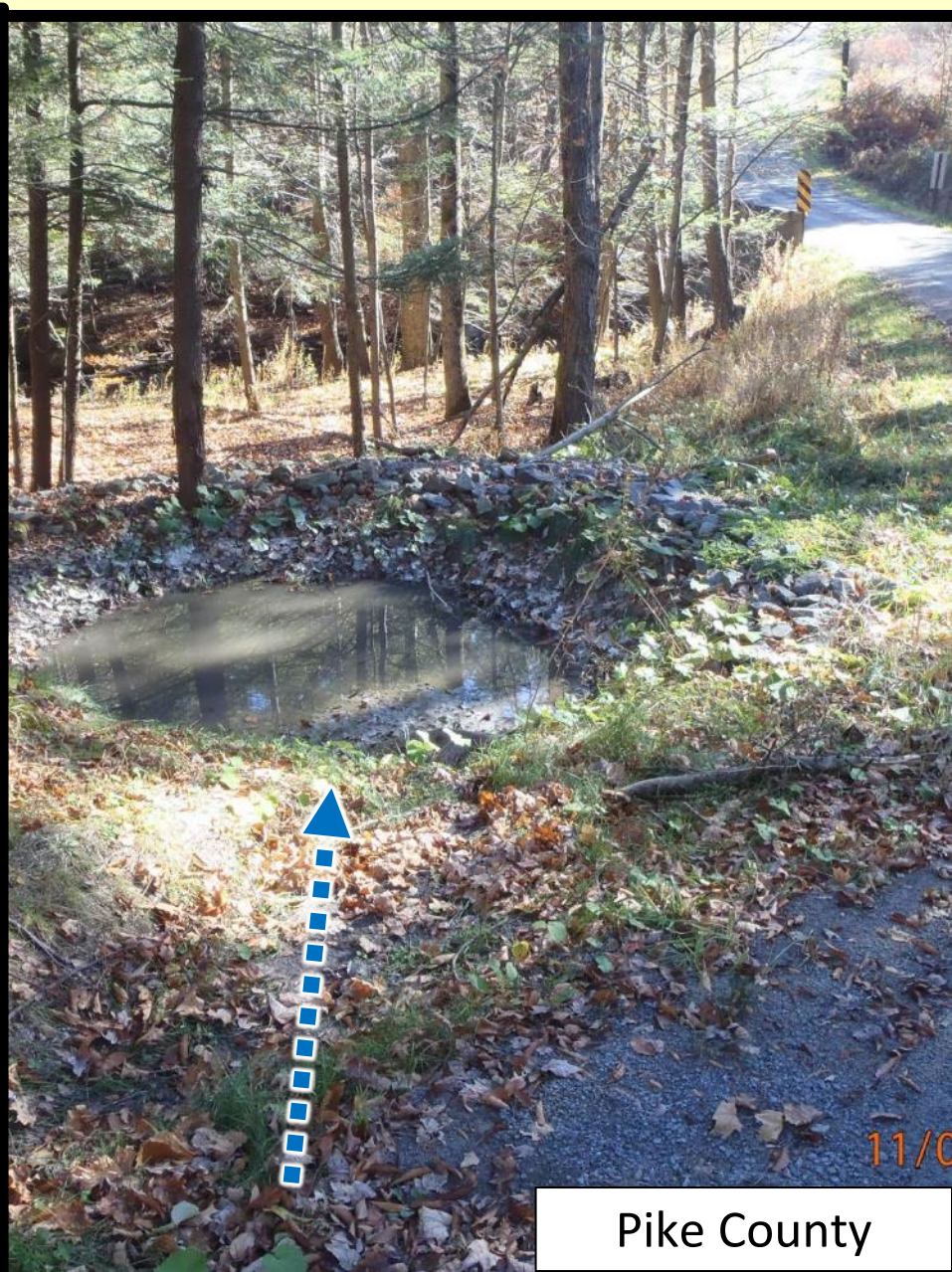
- Upslope of road to intercept water
- At ditch outlets
- At storm sewer discharge
- Before storm sewers to reduce flows

*situations often call for site specific innovation

https://stormwaterbook.safl.umn.edu/infiltration-practices

Infiltration Basins: “Teardrops” for individual pipe outlets



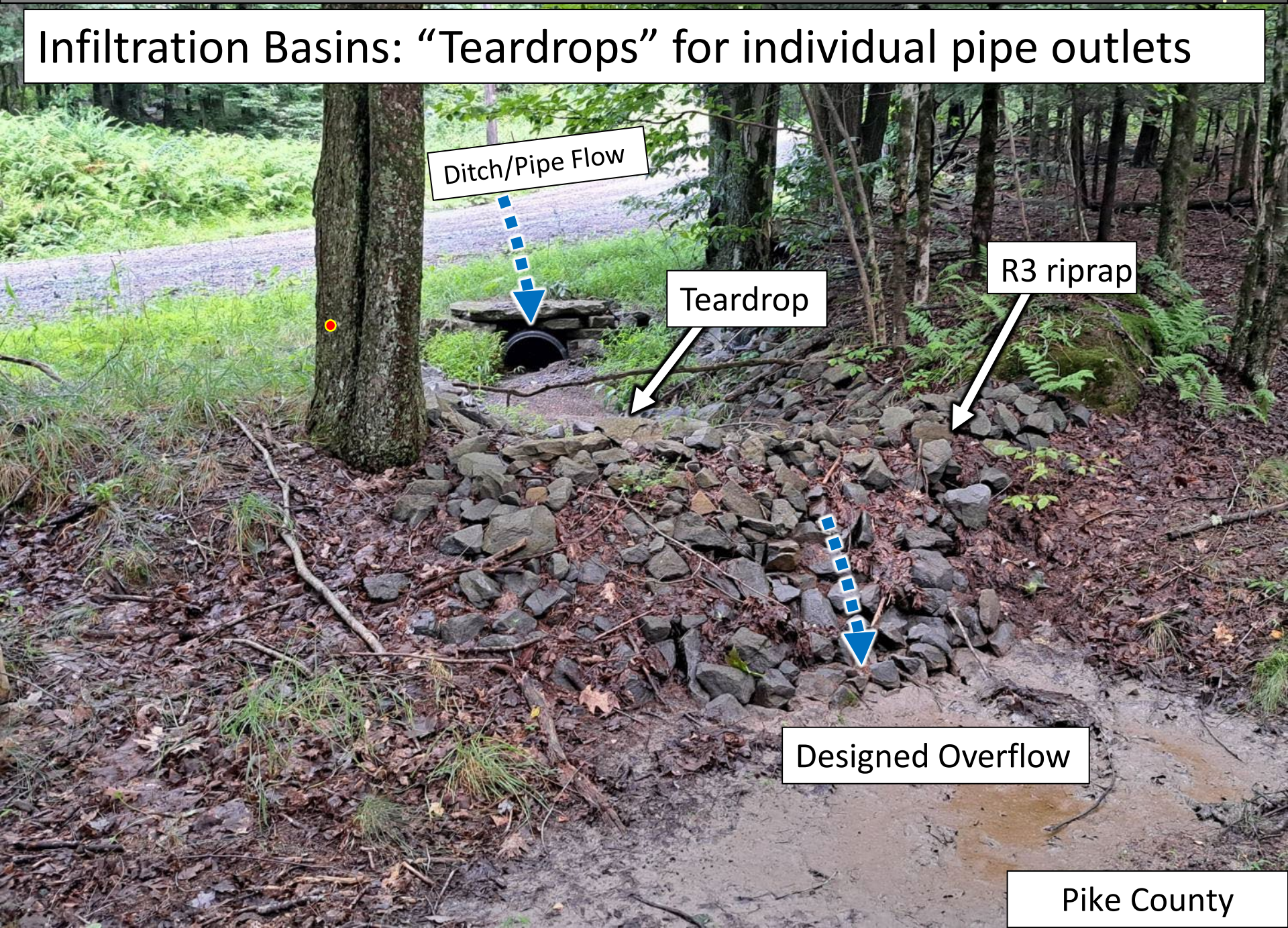


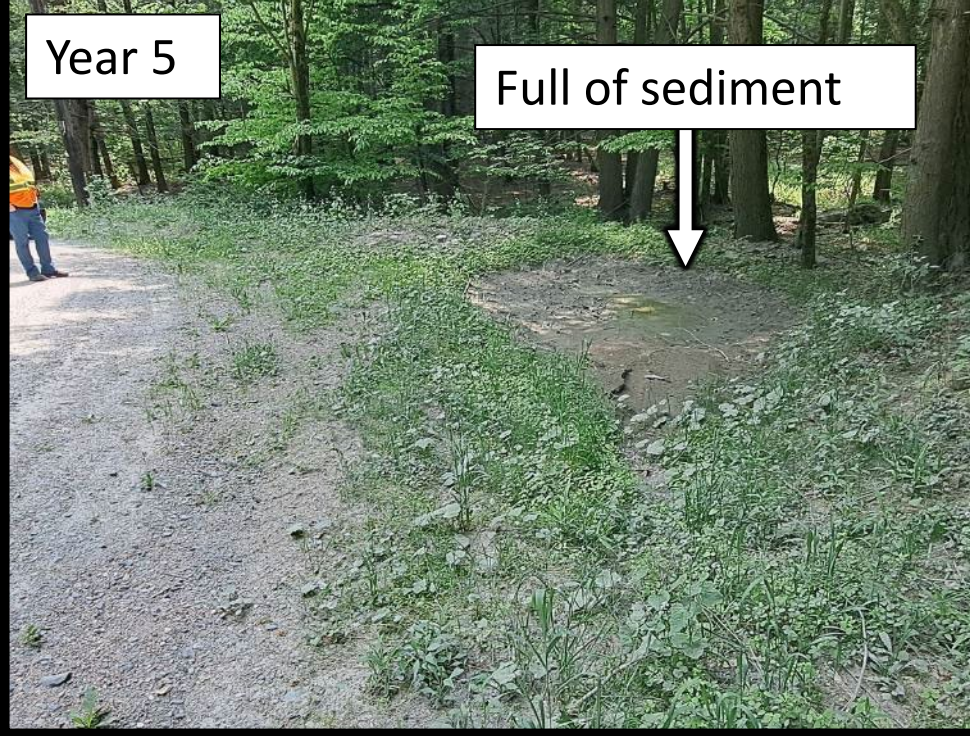
Pike County

Infiltration Basins: “Teardrops” for individual pipe outlets

Pike County

Infiltration Basins: “Teardrops” for individual pipe outlets



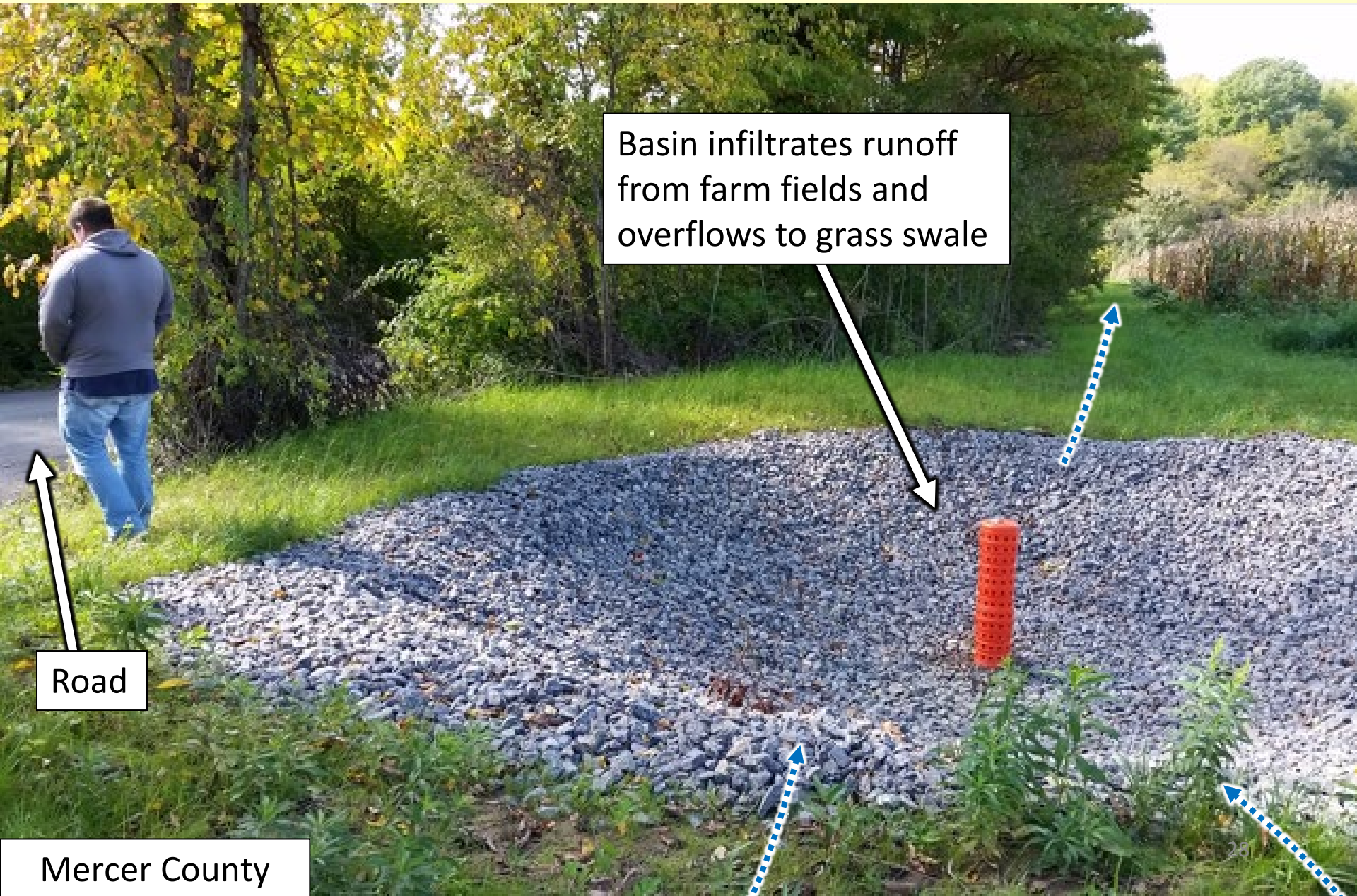


Must be maintained, especially on gravel roads.

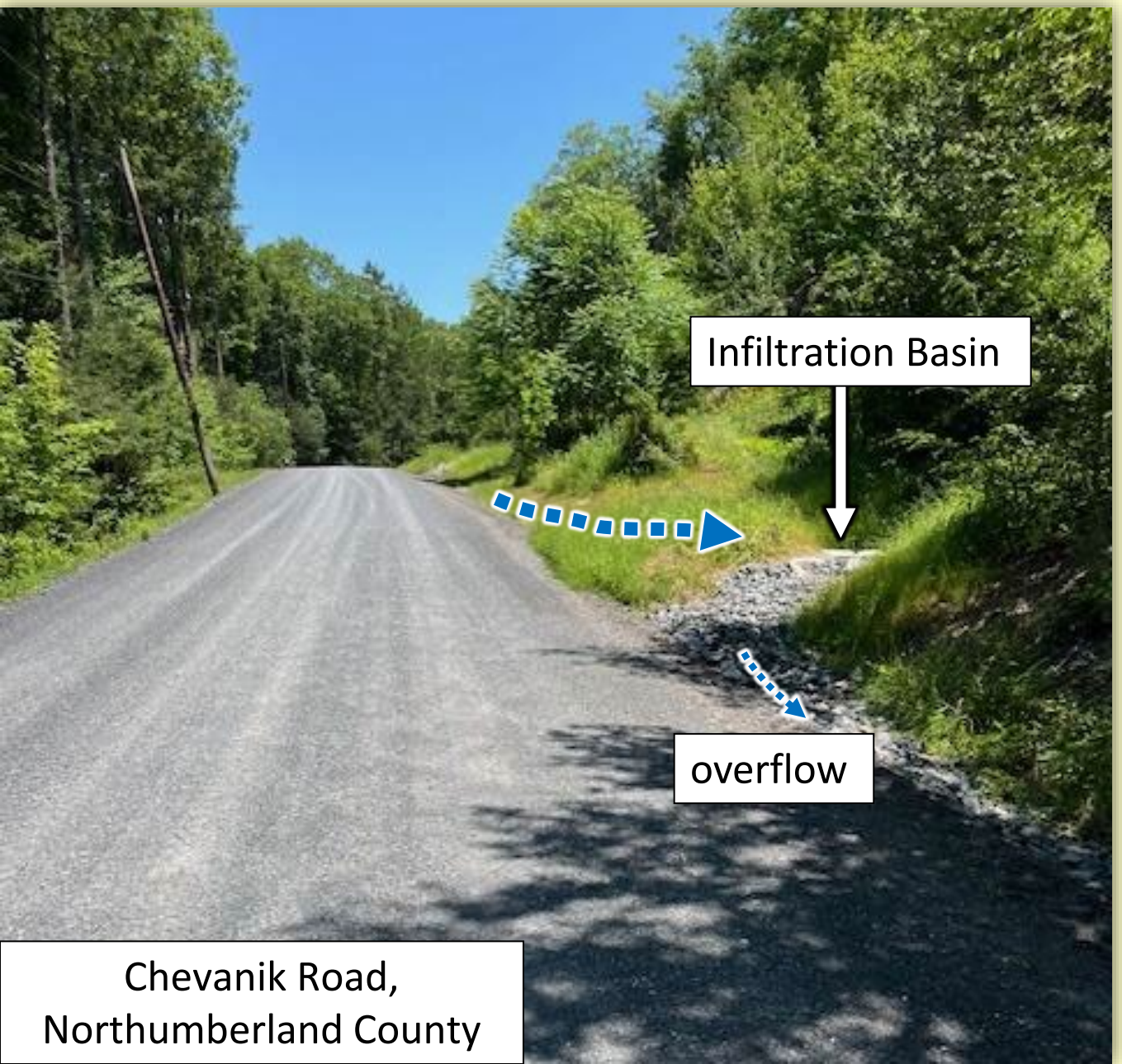
Infiltration Basins: for **Off-right-of-way** flow coming to road

Armstrong County

Infiltration Basins: Can go above road for **off-ROW** water



Infiltration Basins: Can go in ditch for road runoff



Chevanik Road, Northumberland County

Use when ditch outlets are not feasible, and space is available.

Basins can be in a series to:

- Slow ditch drainage
- Limit runoff
- Capture sediment

Design to be easily maintained from the road.

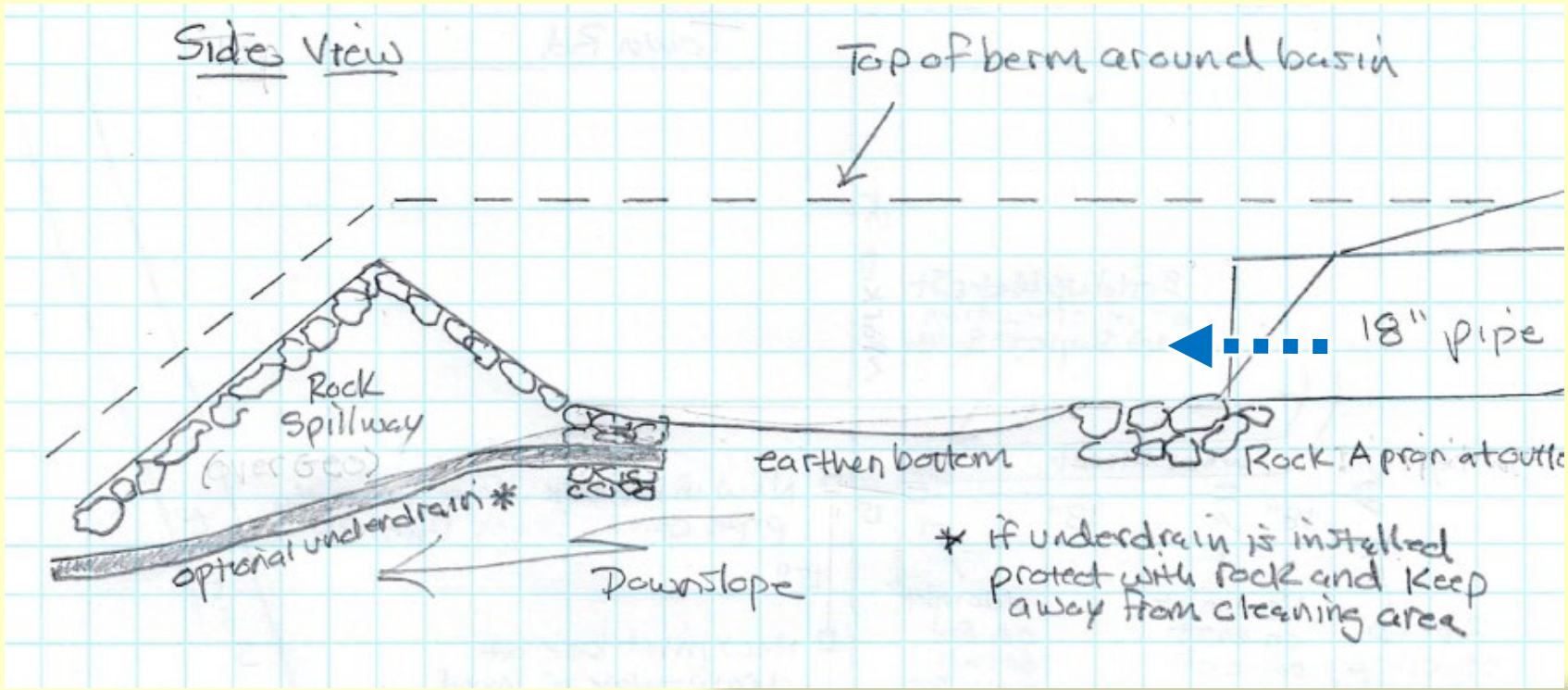
Infiltration Basins: Can go in ditch for road runoff

Chevanik Road,
Northumberland County

Infiltration Basins: Can go in ditch for road runoff

Chevanik Road,
Northumberland County

Infiltration Basins: Can go at pipe or storm sewer outlet



Infiltration Basins: Can go at pipe or storm sewer outlet

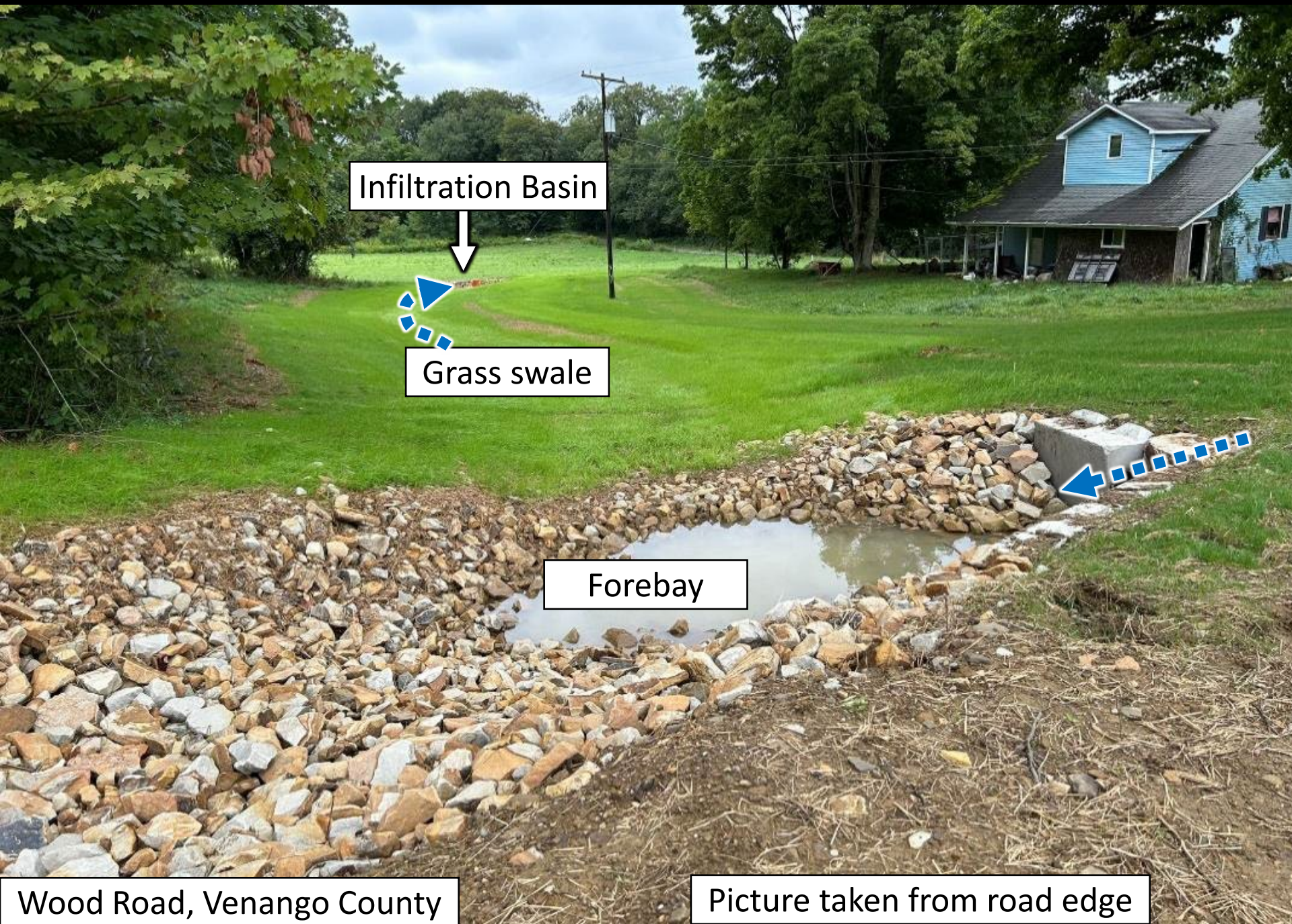
Westmoreland County

Infiltration Basin – Storm Sewer

Large basin collects water from two roads and parking lot

Outlet riser

Infiltration Basin



Wood Road, Venango County

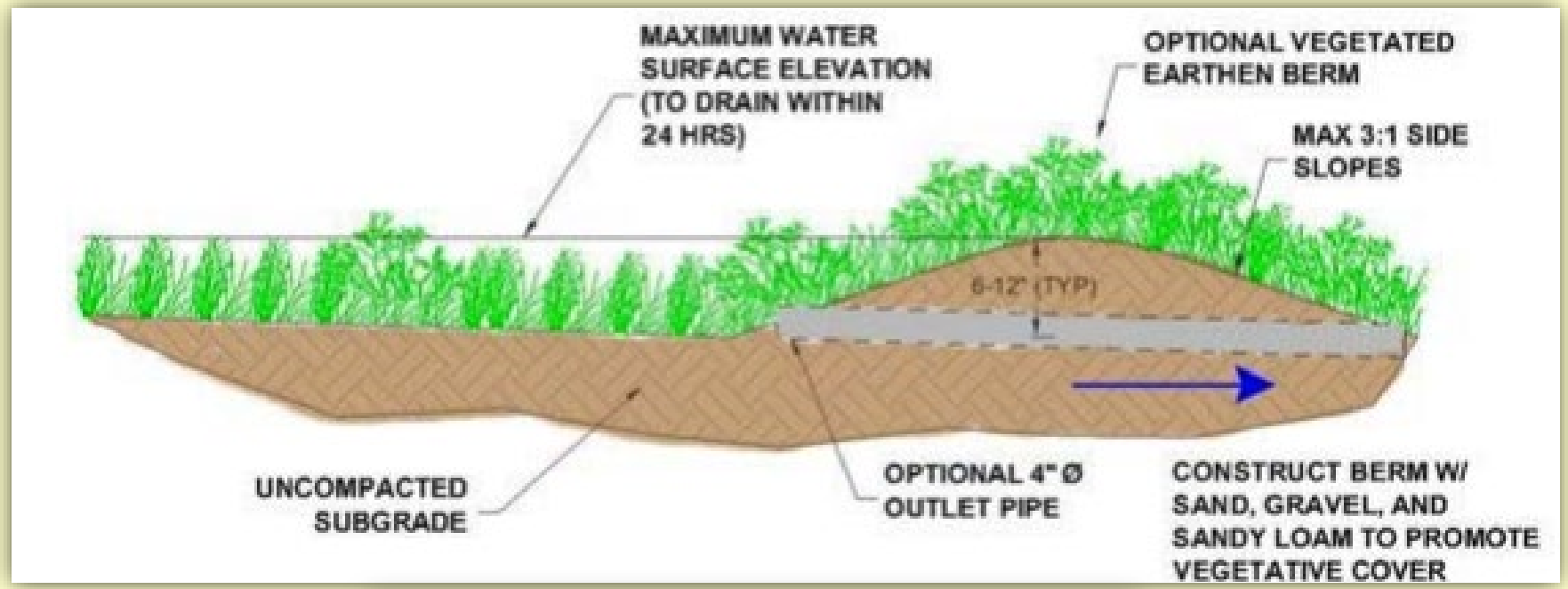
Picture taken from road edge

Structural Infiltration Practices

- Infiltration Beds / Trenches
- Infiltration Basins
- **Vegetated Swales**
- Rain Gardens
- Subsurface Structures

This is not all-inclusive

Vegetated Swales: Filter and slow runoff, promote infiltration



Vegetated Swales: Filter and slow runoff, promote infiltration

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Berks County

Structural Infiltration Practices

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Rain Gardens

- A depressed area in the landscape that collects stormwater from streets and roads to promote infiltration.
- Vary widely in size and shape.
- Typically planted with native vegetation
- Typically used in more urban settings

Infiltration Basin – Rain Garden

Rain Garden: A depressed area in the landscape that collects stormwater from streets and roads to promote infiltration.

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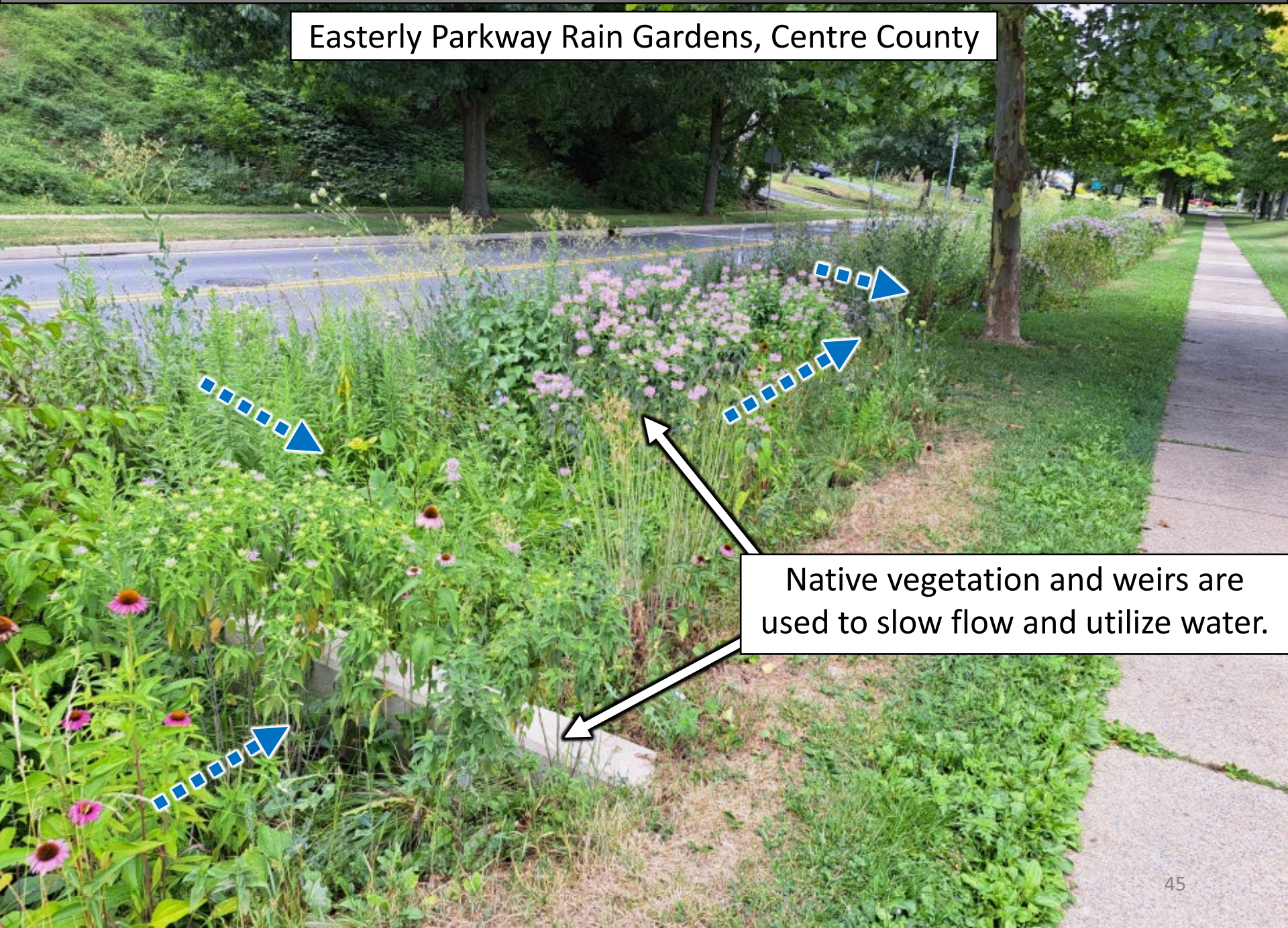
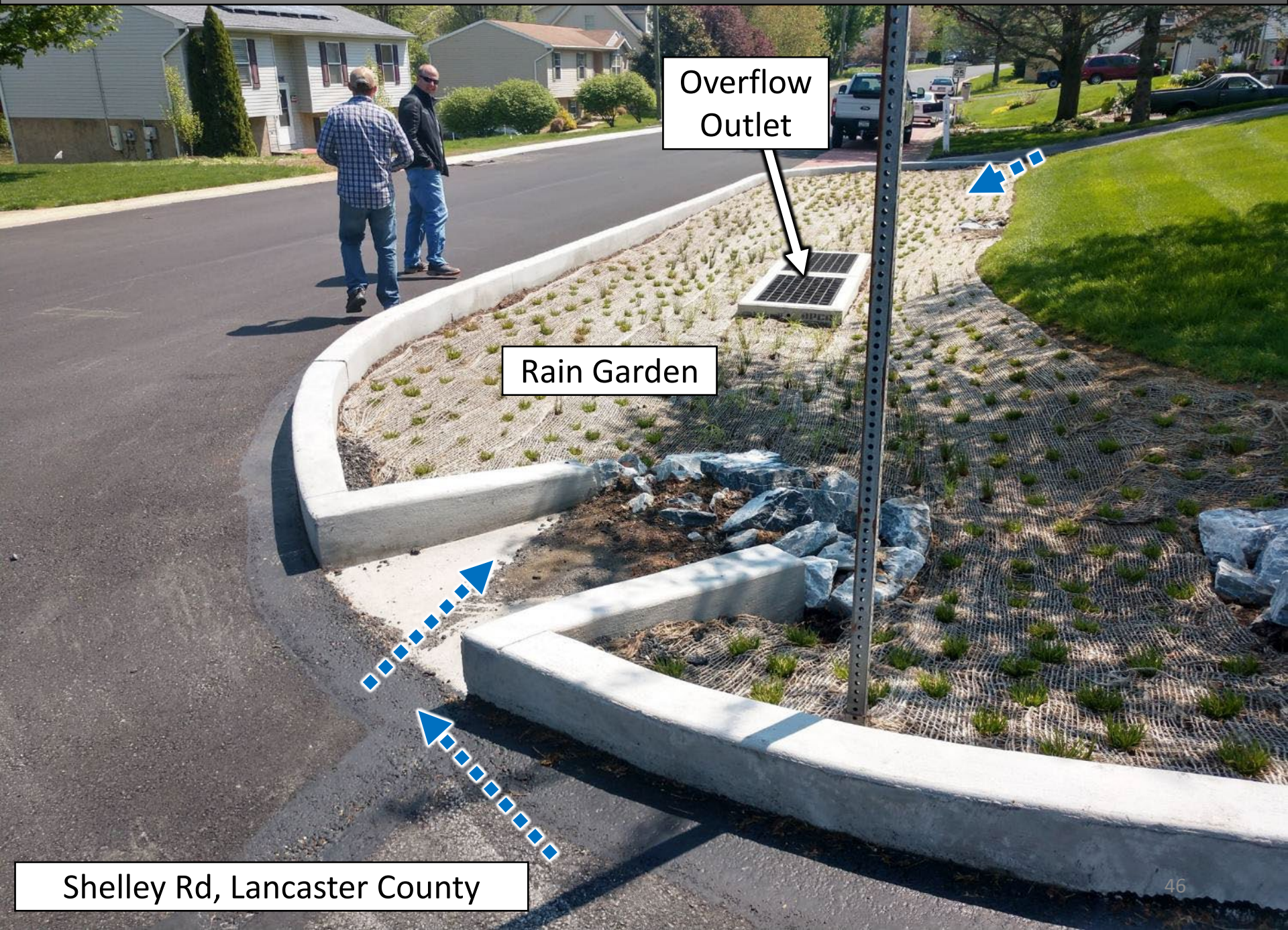
Easterly Parkway Rain Gardens, Centre County
Drainage from both sides of road is directed to a roadside rain garden. Overflow outlets to the storm sewer.


Easterly Parkway Rain Gardens, Centre County
Native vegetation and weirs are used to slow flow and utilize water.

Rain Garden




Yard Drain
Overflow Outlet
Rain Garden
Shelley Rd, Lancaster County

Structural Infiltration Practices

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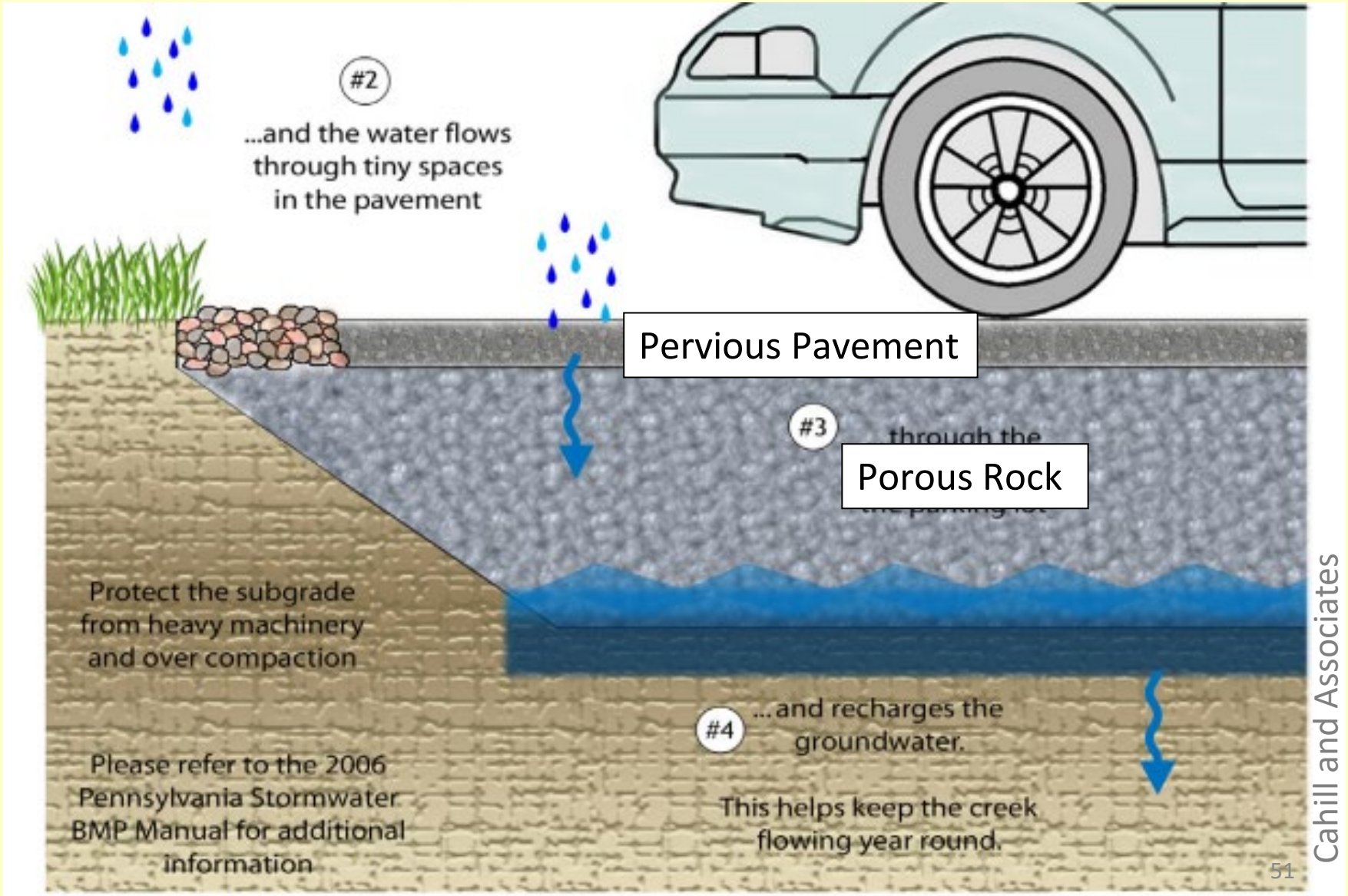
Infiltration bed under pavement
Reynolds Ave, Lancaster County

Reynolds Ave, Lancaster County

Pervious Pavement allows water to seep through the road surface to be absorbed by underlying soils.



Infiltration bed below road - Montgomery County

Hoopes Alley, Chester County

All pervious pavements require more specialized maintenance.

- Porous Surface will clog over time. How long depends on the amount of loose material: dirt, leaves, salt, cinders.

- Specialized vacuum trucks or street sweepers often needed.

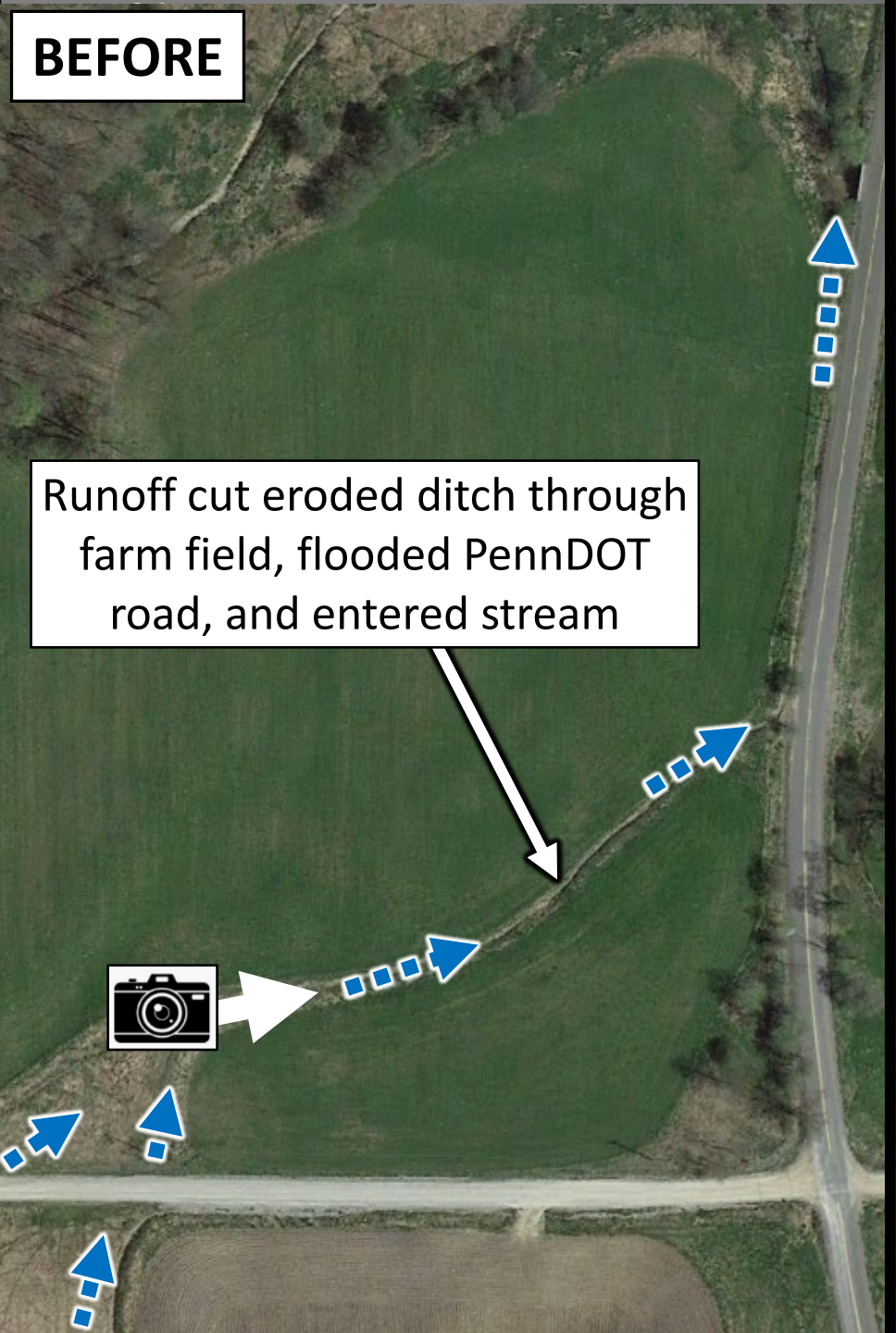
https://3rpsinc.com/porous-pavement-sweeping/

Structural Infiltration Practices

- Introduction
- Practices
- **DGLVR Project Examples**

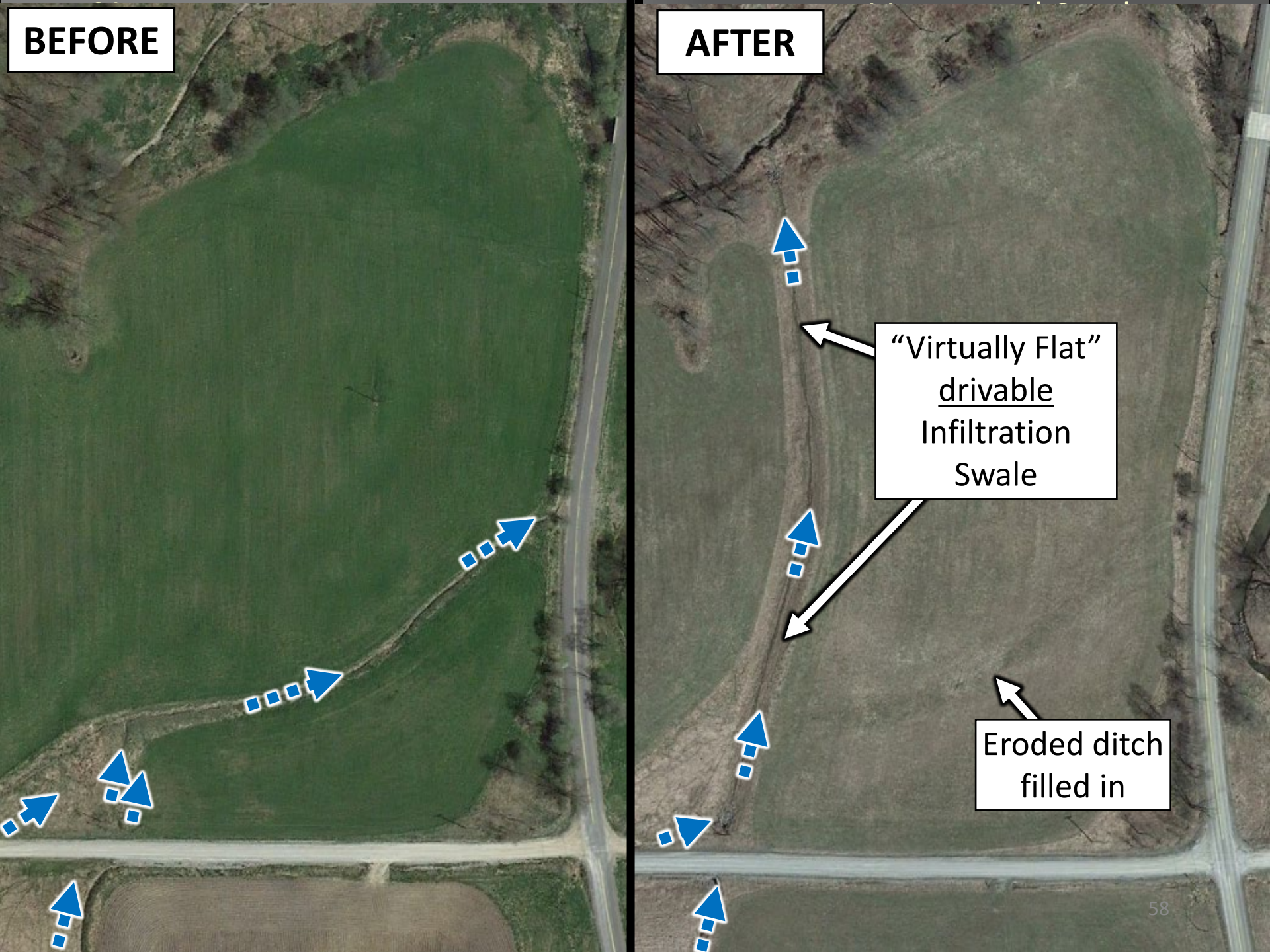
Project Walkthrough: Bradford County, Moore Hill Road

- **2016: $77K Grant, $26K in-kind**
- Road runoff eroding ditch to PennDOT road and stream
- Infiltration swale constructed through field



Bradford, Moore Hill 2/5

- Low-gradient infiltration swale through field for road runoff


BEFORE
AFTER
“Virtually Flat”
drivable
Infiltration
Swale
Eroded ditch
filled in

Bradford, Moore Hill 4/5

- Low-gradient infiltration swale through field for road runoff


9 YEARS
AFTER

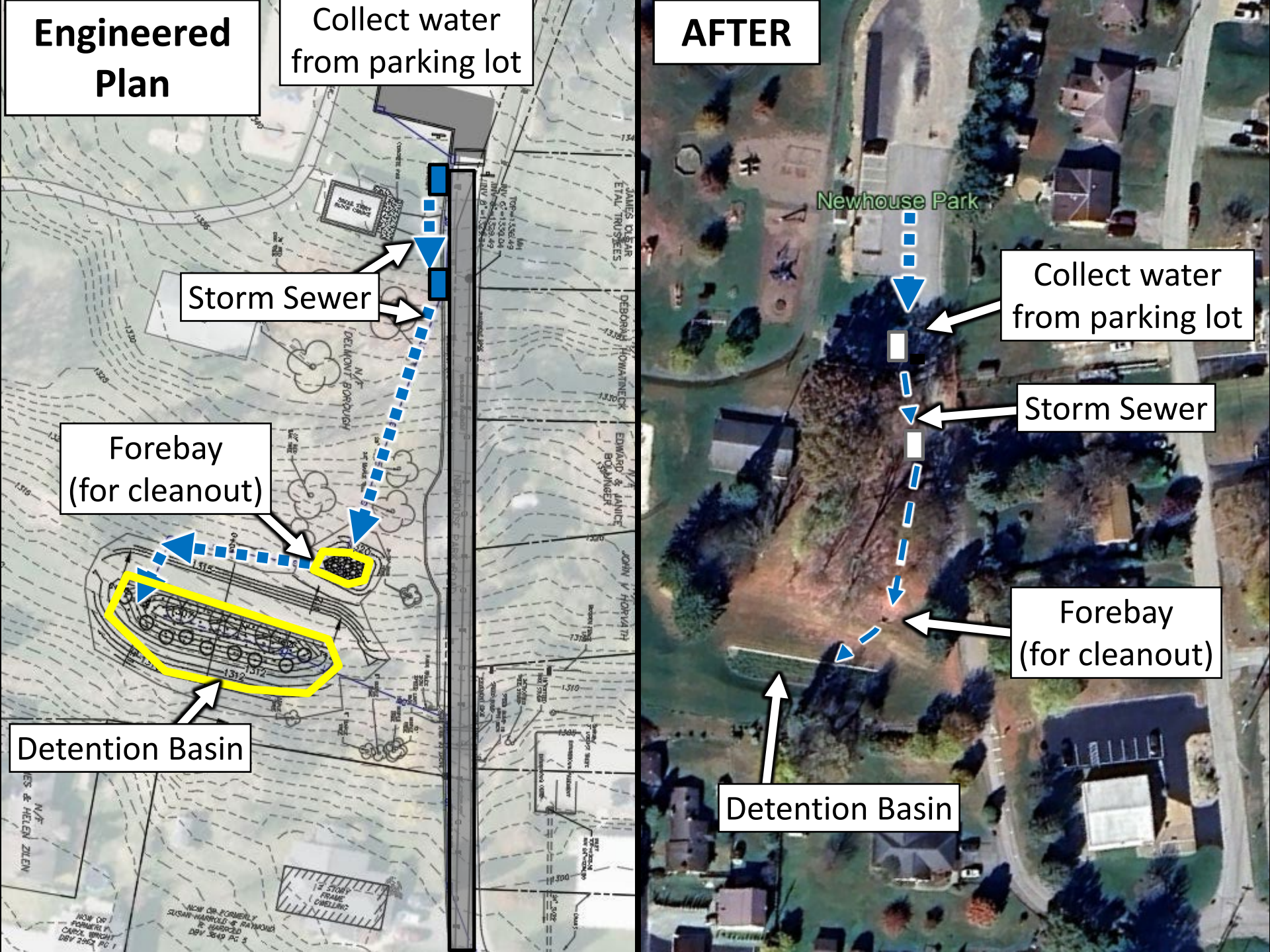
Project Walkthrough: Westmoreland County, Newhouse Park Rd

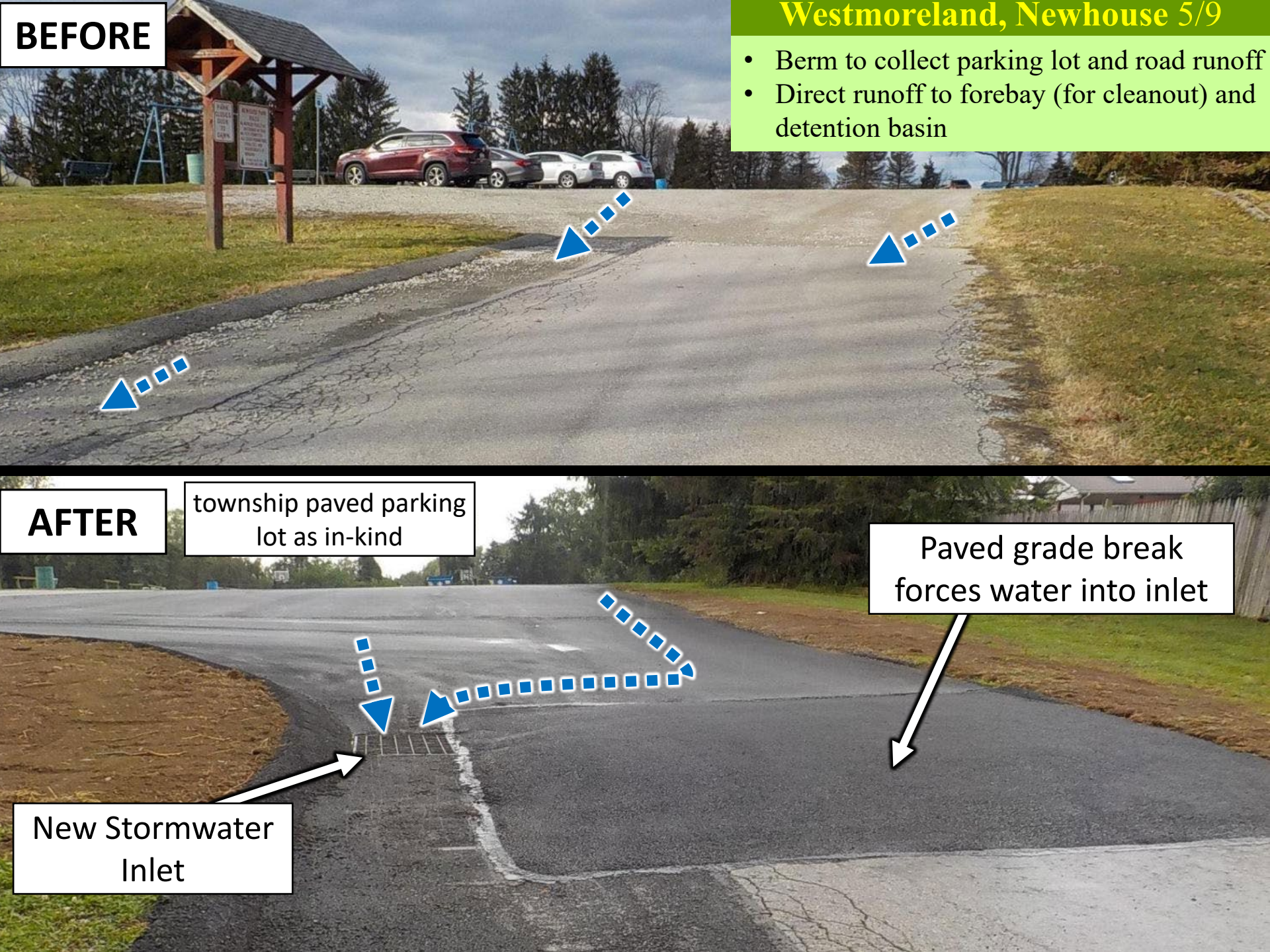
- **2022: $123K Grant, $22K in-kind**
- Parking lot runoff washing out road.
- Collected runoff in storm sewer.
- Directed runoff to forebay (for cleanout) and detention basin

Westmoreland, Newhouse 2/9

- Berm to collect parking lot and road runoff
- Direct runoff to forebay (for cleanout) and detention basin

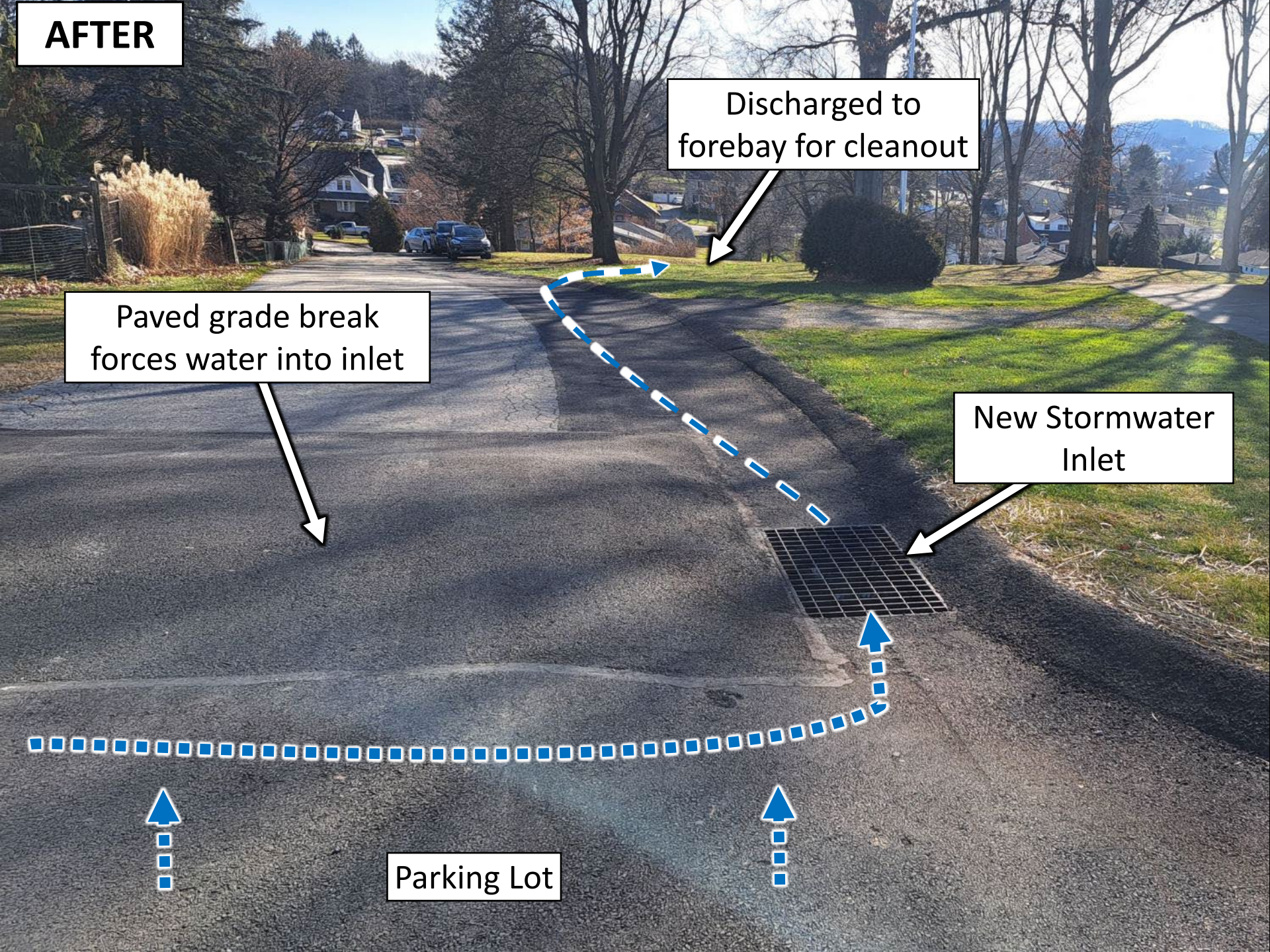

BEFORE
Newhouse Park
AFTER
Newhouse Park
Collect water from parking lot
Storm Sewer
Forebay (for cleanout)
Detention Basin

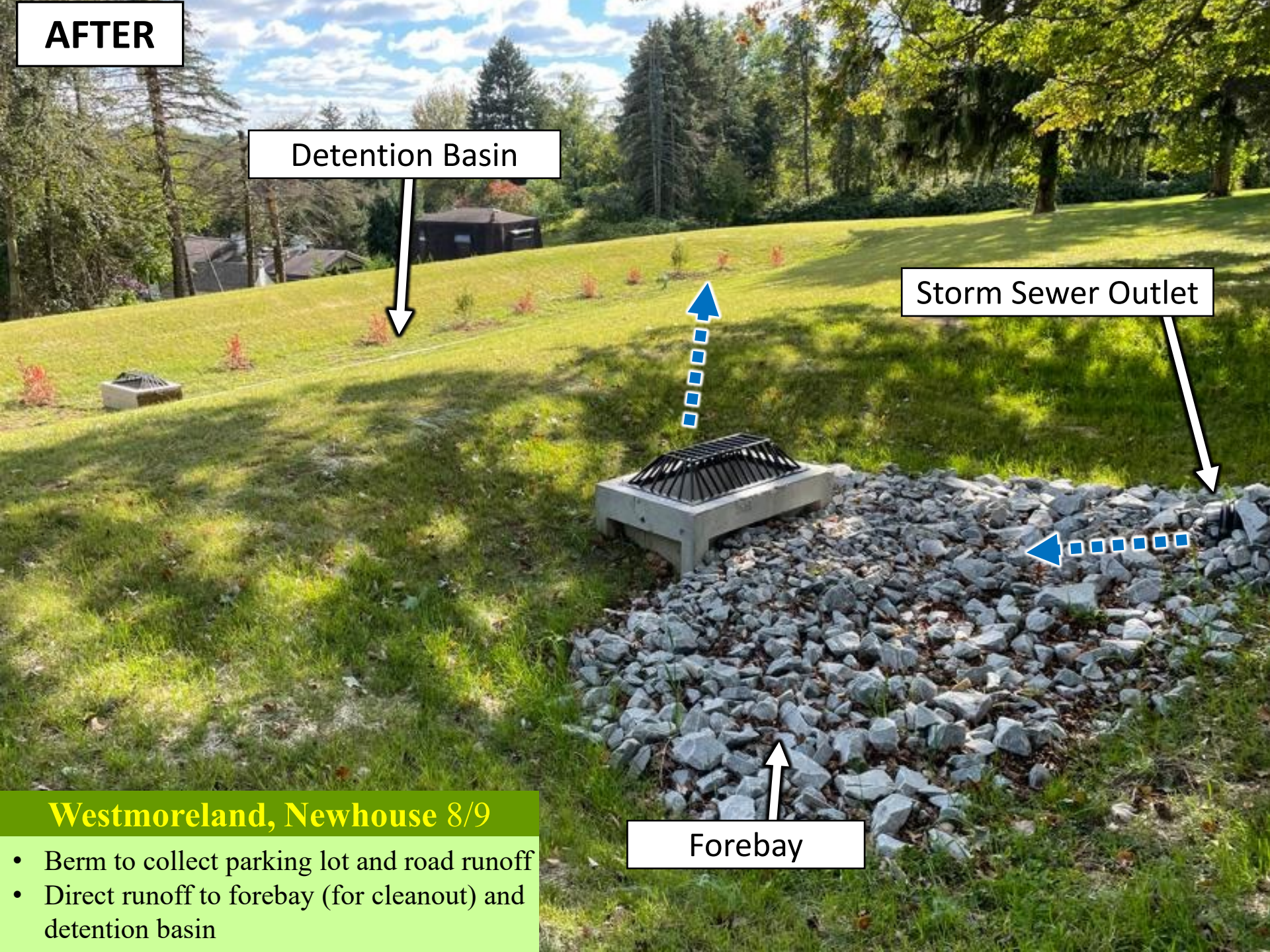

Engineered Plan
Collect water from parking lot
Storm Sewer
Forebay (for cleanout)
Detention Basin
AFTER
Newhouse Park
Collect water from parking lot
Storm Sewer
Forebay (for cleanout)
Detention Basin


BEFORE
Westmoreland, Newhouse 5/9
• Berm to collect parking lot and road runoff
• Direct runoff to forebay (for cleanout) and detention basin
AFTER
township paved parking lot as in-kind
Paved grade break forces water into inlet
New Stormwater Inlet

Westmoreland, Newhouse 6/9

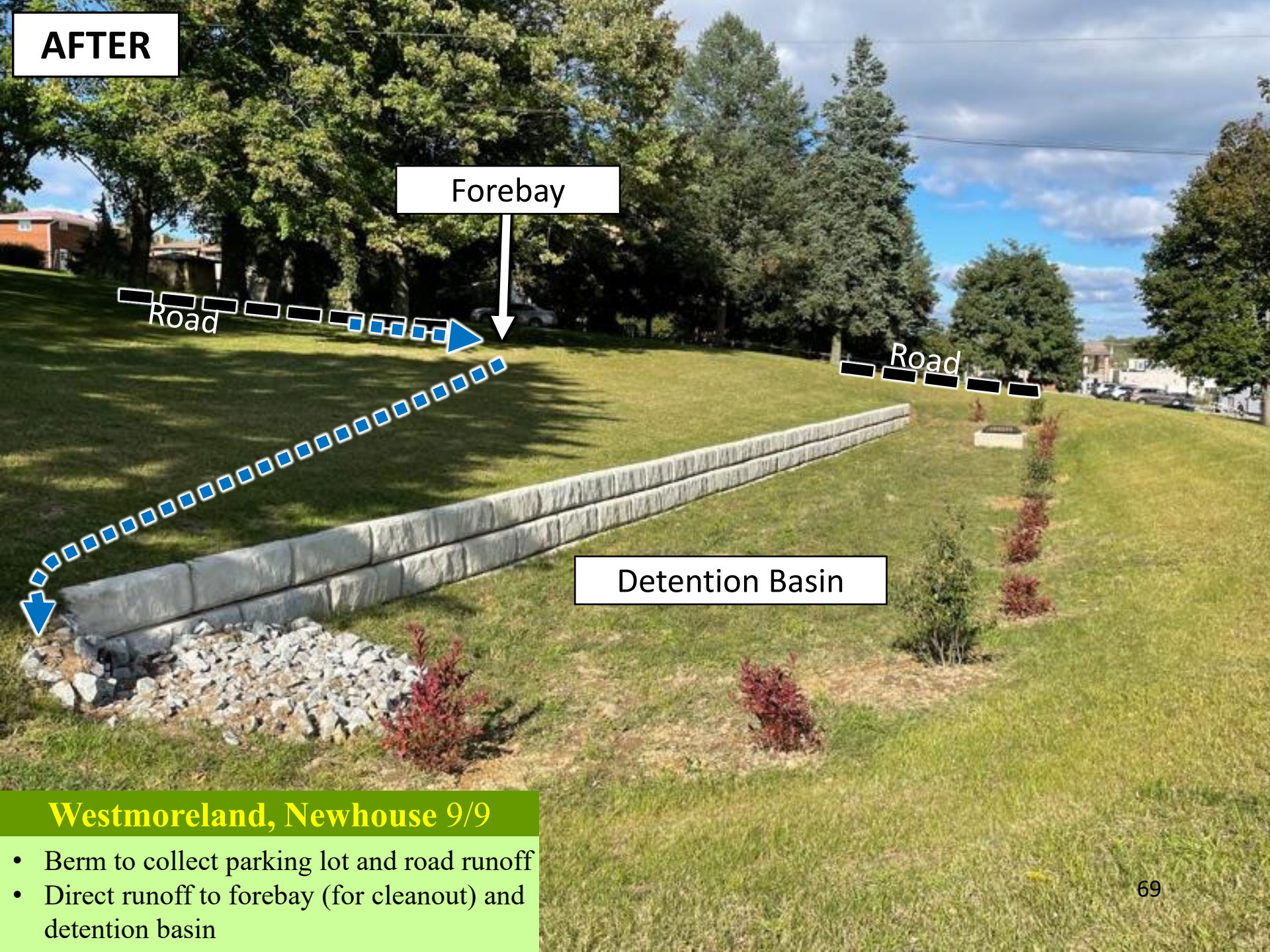
- Berm to collect parking lot and road runoff
- Direct runoff to forebay (for cleanout) and detention basin


AFTER
Discharged to forebay for cleanout
Paved grade break forces water into inlet
New Stormwater Inlet
Parking Lot



Westmoreland, Newhouse 8/9

- Berm to collect parking lot and road runoff
- Direct runoff to forebay (for cleanout) and detention basin

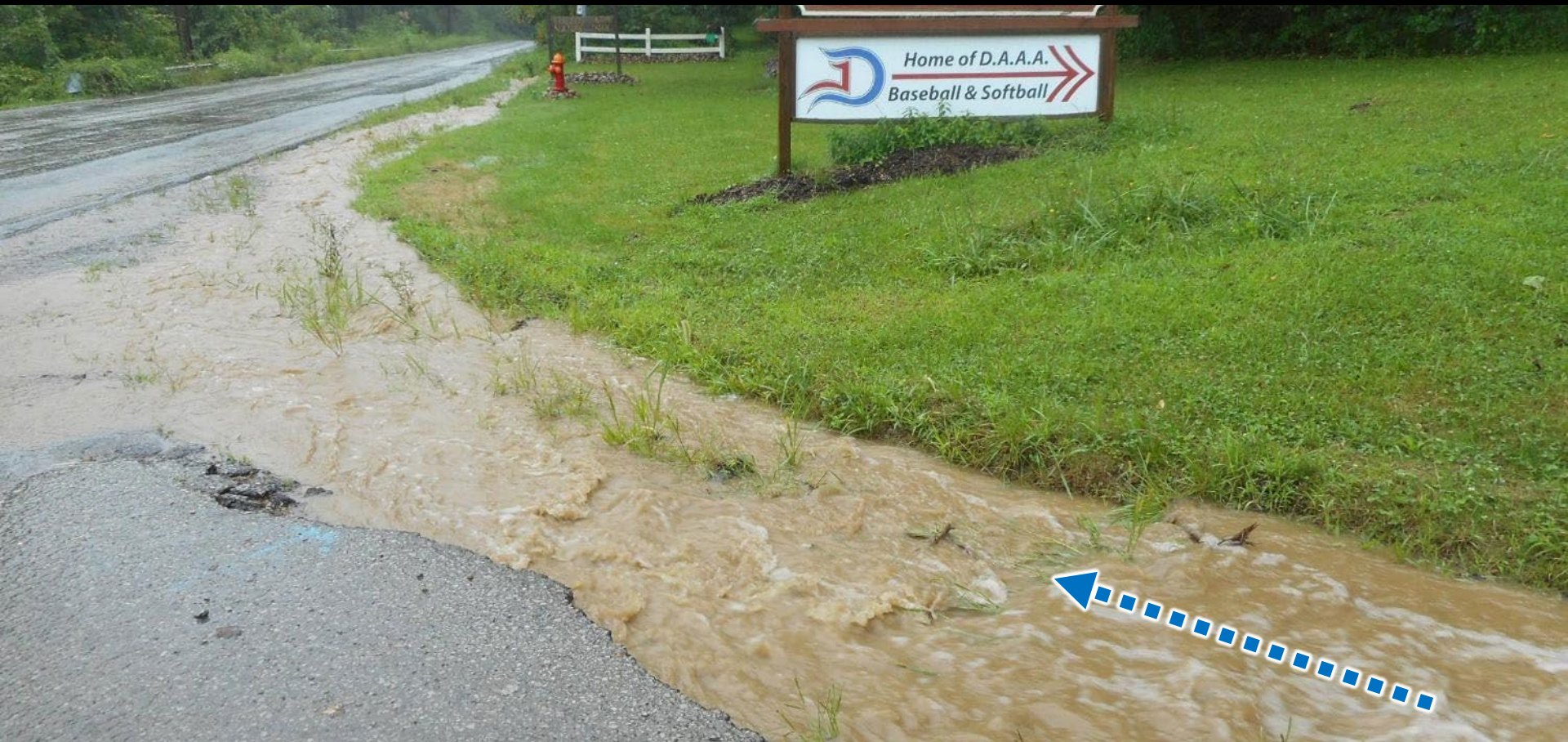


Westmoreland, Newhouse 9/9

- Berm to collect parking lot and road runoff
- Direct runoff to forebay (for cleanout) and detention basin

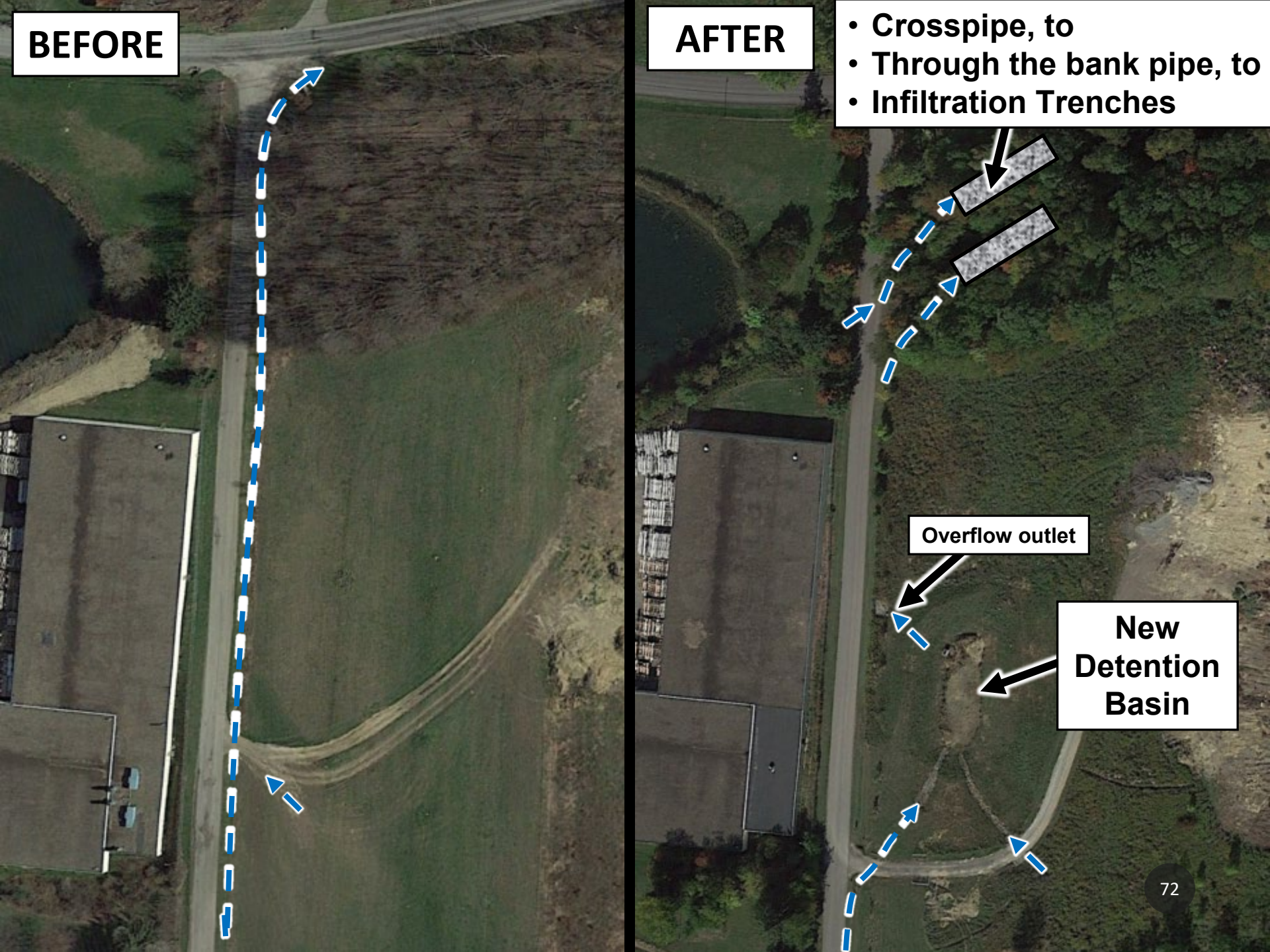
Project Walkthrough: Westmoreland County, Shields Farm Rd

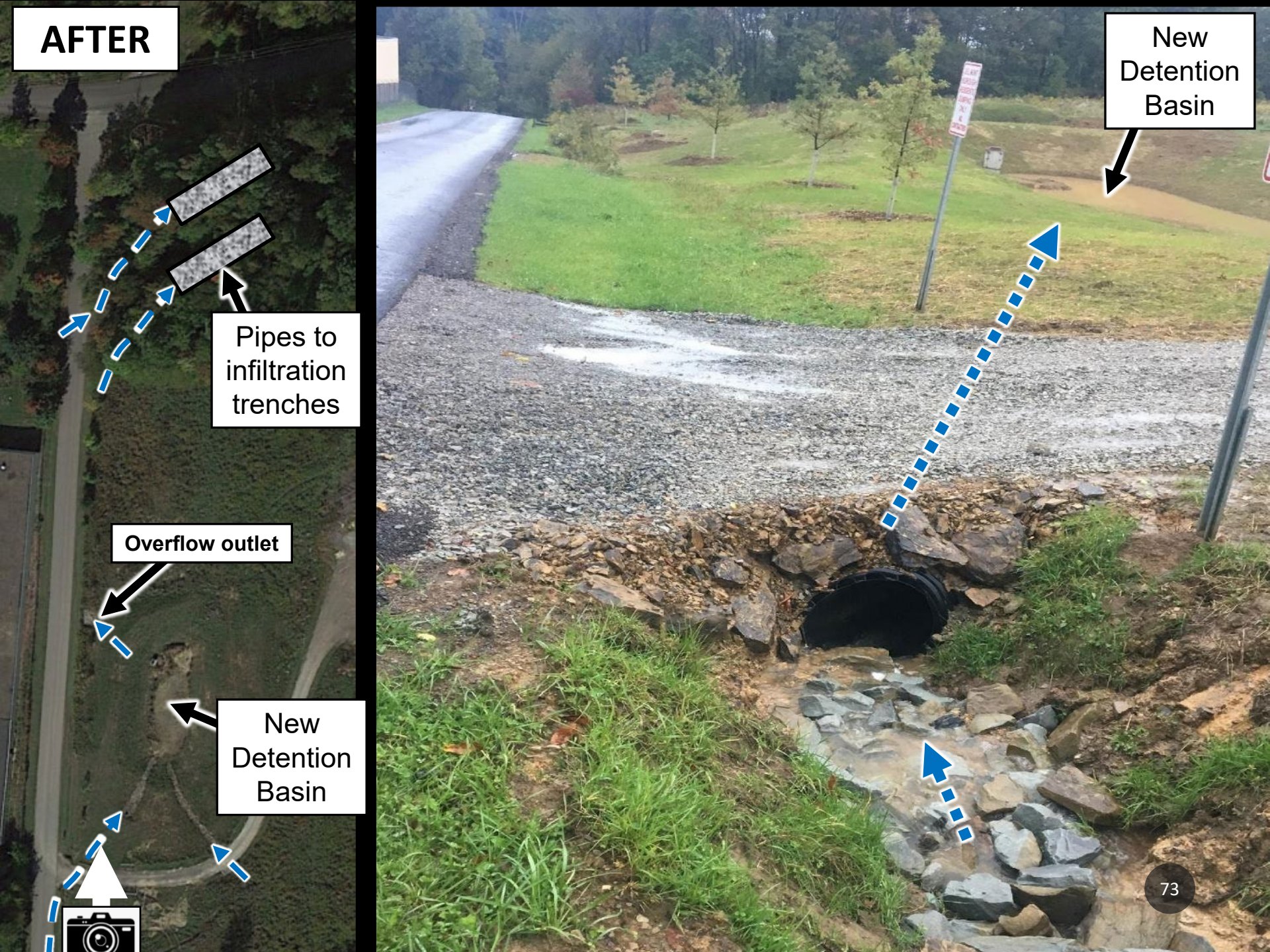
- **2018: $49K Grant, $11K in-kind**
- Road collected all runoff from long hill
- Installed detention basin
- Installed several crosspipes, through the bank pipes, and infiltration trenches

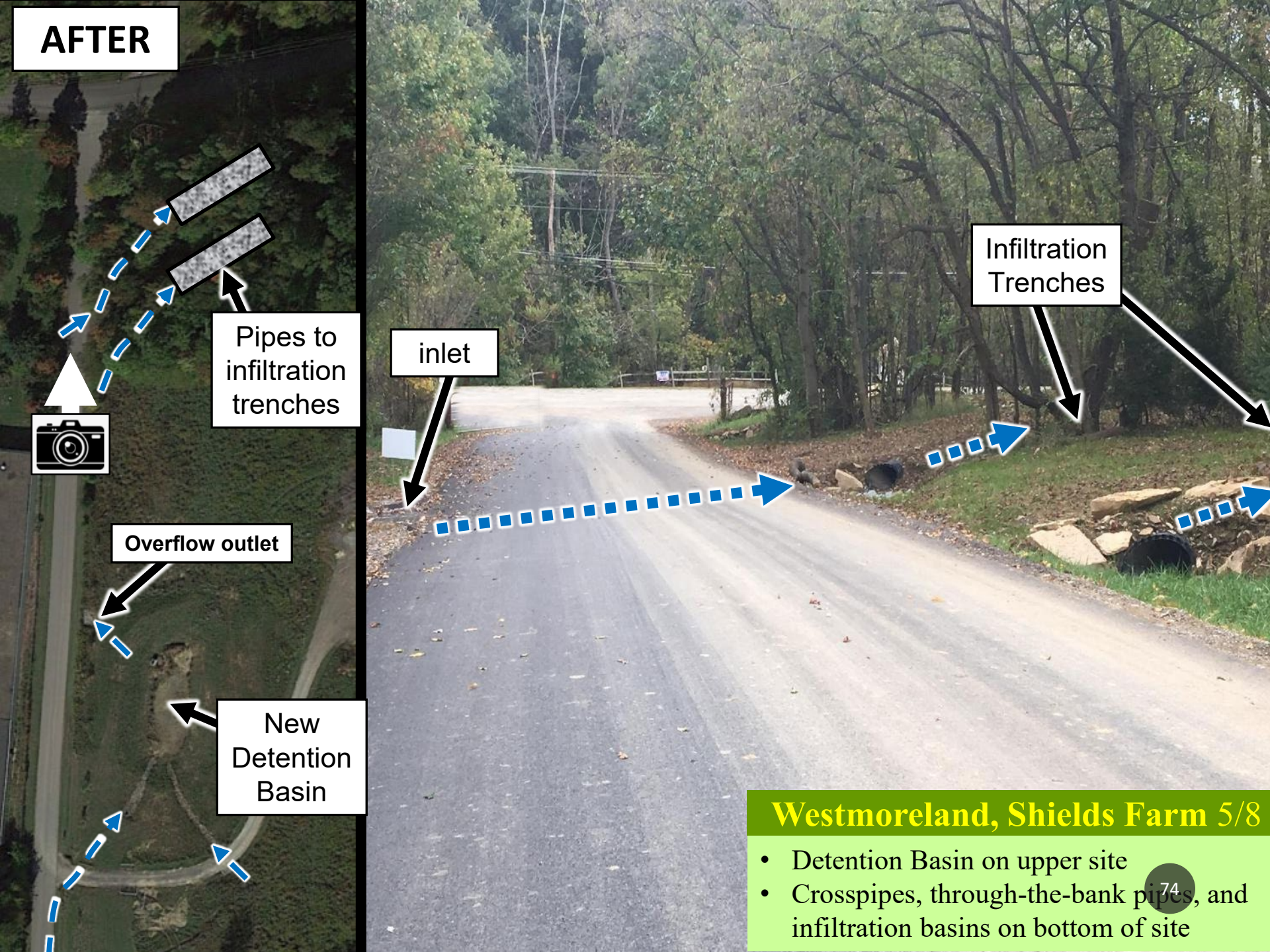


Westmoreland, Shields Farm 2/8

- Detention Basin on upper site
- Crosspipes, through-the-bank pipes, and infiltration basins on bottom of site


BEFORE
AFTER
• Crosspipe, to
• Through the bank pipe, to
• Infiltration Trenches
Overflow outlet
New Detention Basin


AFTER
Pipes to infiltration trenches
Overflow outlet
New Detention Basin
New Detention Basin

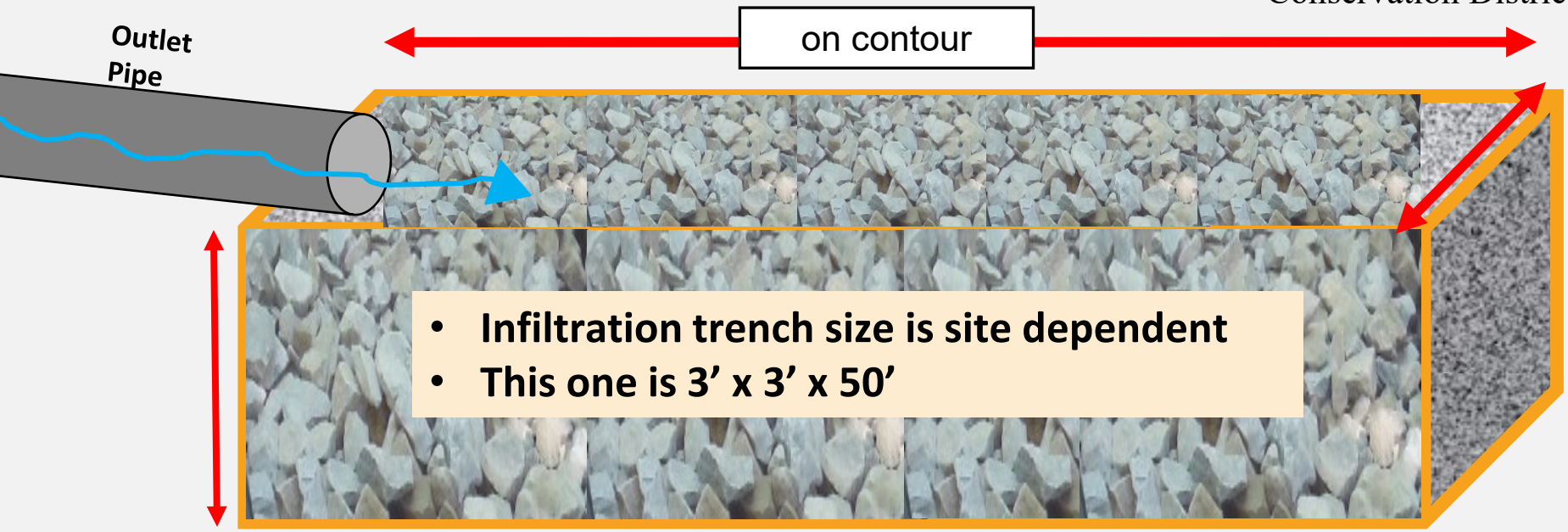


Westmoreland, Shields Farm 5/8

- Detention Basin on upper site
- Crosspipes, through-the-bank pipes, and infiltration basins on bottom of site

Infiltration Trench

Courtesy Westmoreland Conservation District

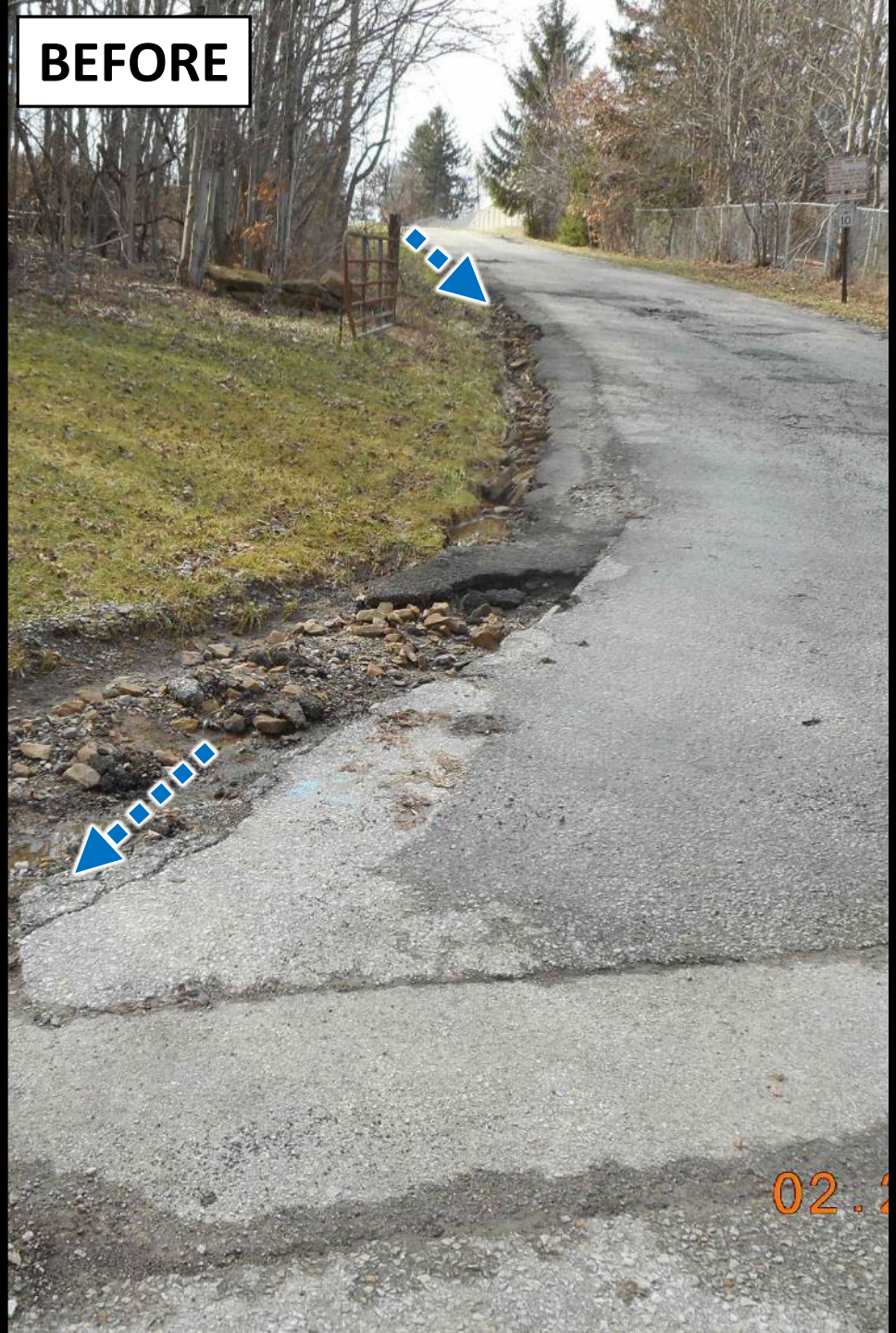


Westmoreland, Shields Farm 6/8

- Detention Basin on upper site
- Crosspipes, through-the-bank pipes, and infiltration basins on bottom of site

Westmoreland, Shields Farm 7/8

- Detention Basin on upper site
- Crosspipes, through-the-bank pipes, and infiltration basins on bottom of site

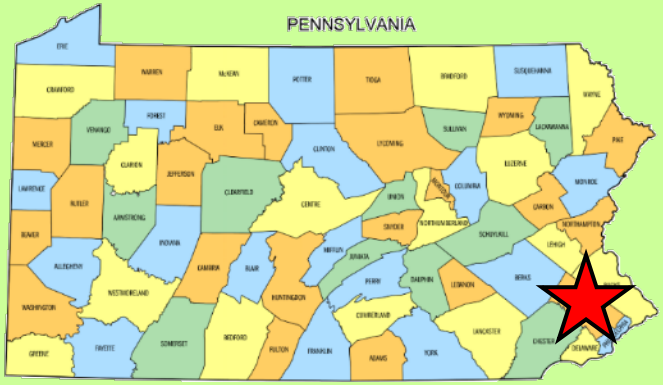


Westmoreland, Shields Farm 8/8

- Detention Basin on upper site
- Crosspipes, through-the-bank pipes, and infiltration basins on bottom of site

Project Walkthrough: Montgomery County, Webber Rd

- **2016: $24K Grant, $2K in-kind**
- Badly eroded ditch along suburban road.
- Installed storm sewer, but with grass sale over top to promote infiltration



Montgomery, Webber Rd 2/7

- Grass Swale constructed over newly installed storm sewer.

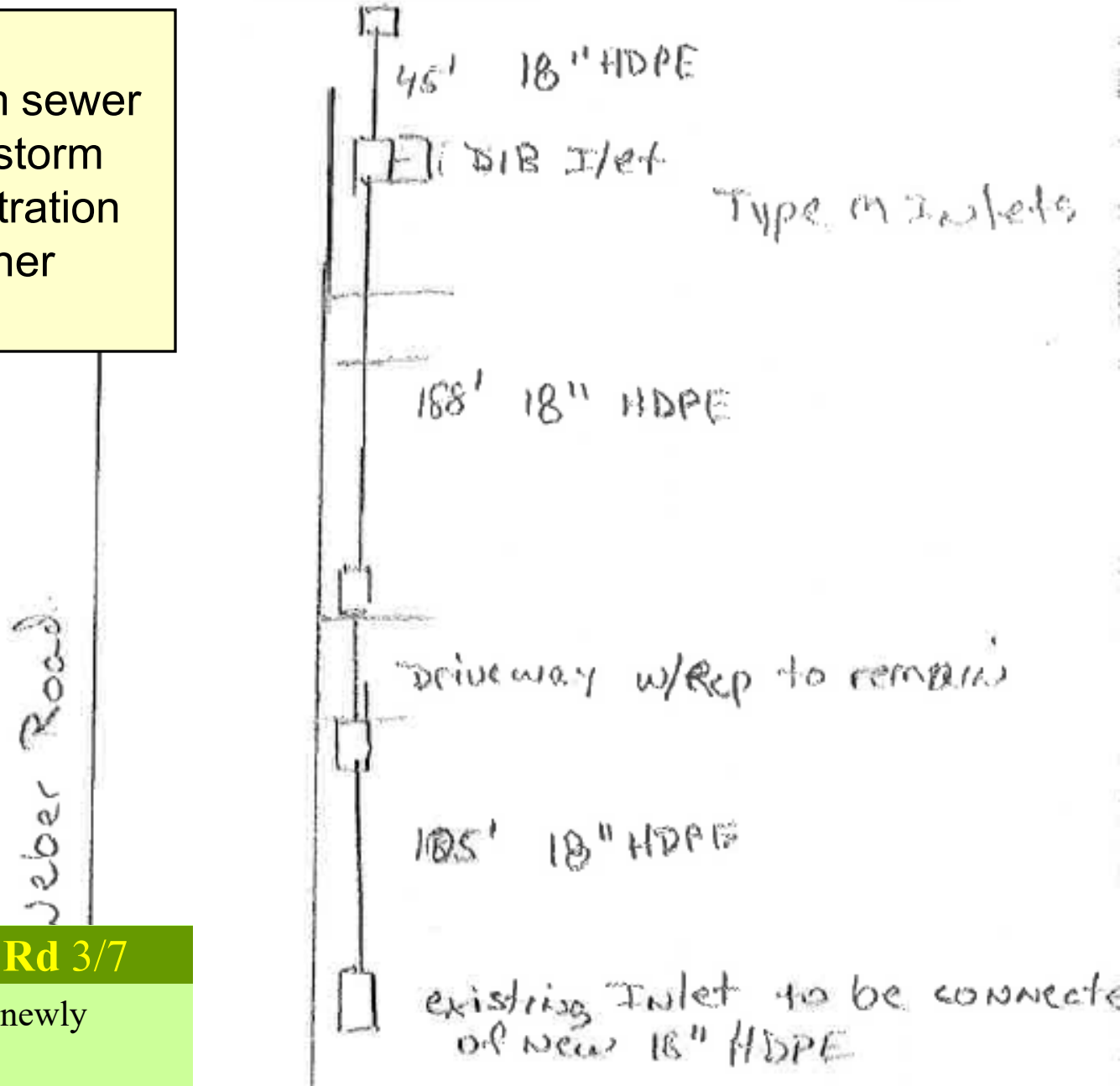
Salford Twp.
Applicant

Webber Rd. T-410
Road Name / ID Numb

3-15-16
Date

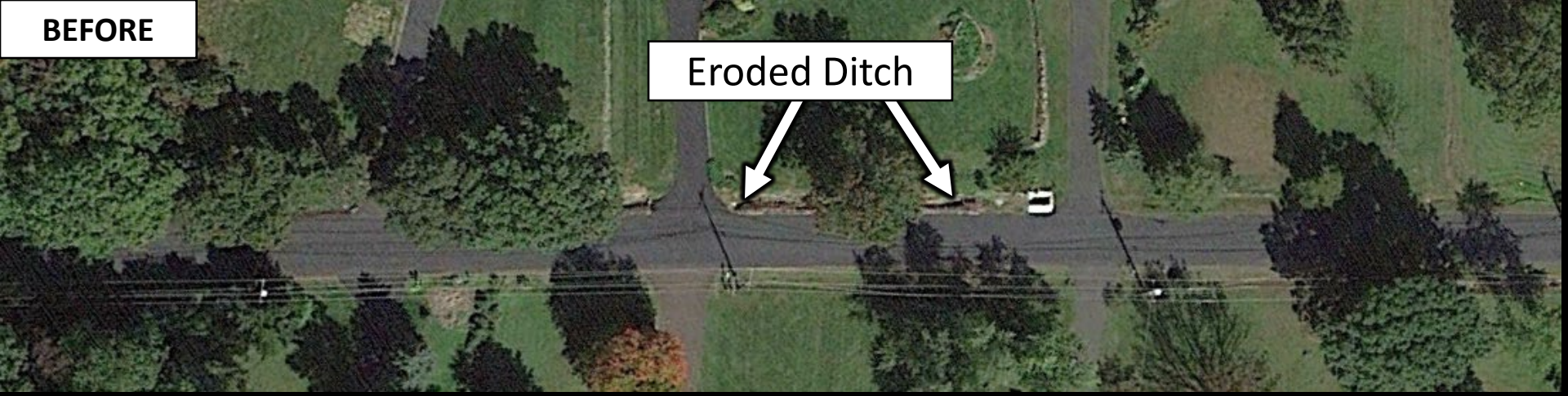
Site Plan:

- Drop inlets and storm sewer
- Grassed swale over storm pipes to promote infiltration and alleviate landowner concerns



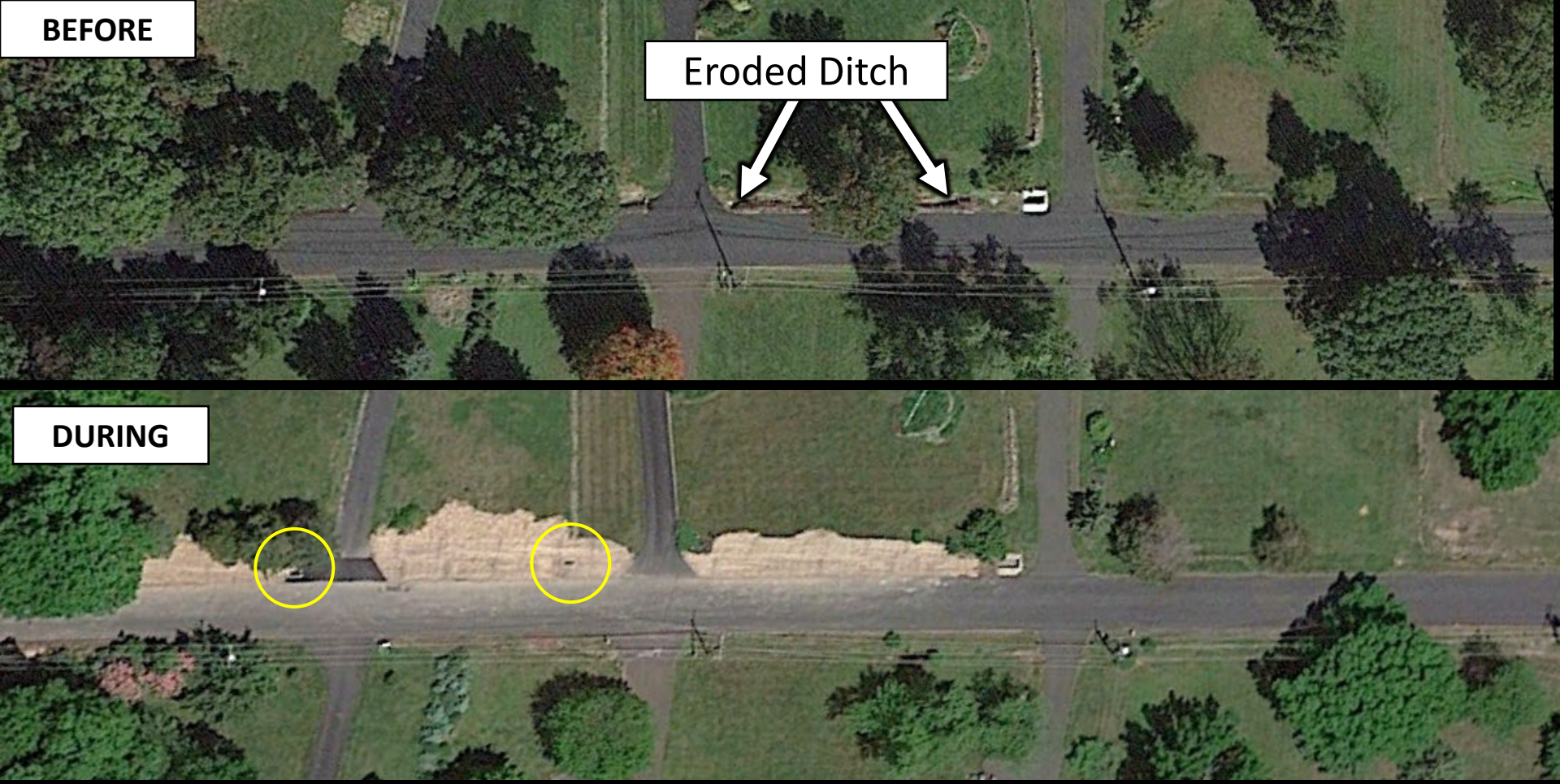
Montgomery, Webber Rd 3/7

- Grass Swale constructed over newly installed storm sewer.



Montgomery, Webber Rd 4/7

- Grass Swale constructed over newly installed storm sewer.



Montgomery, Webber Rd 4/7

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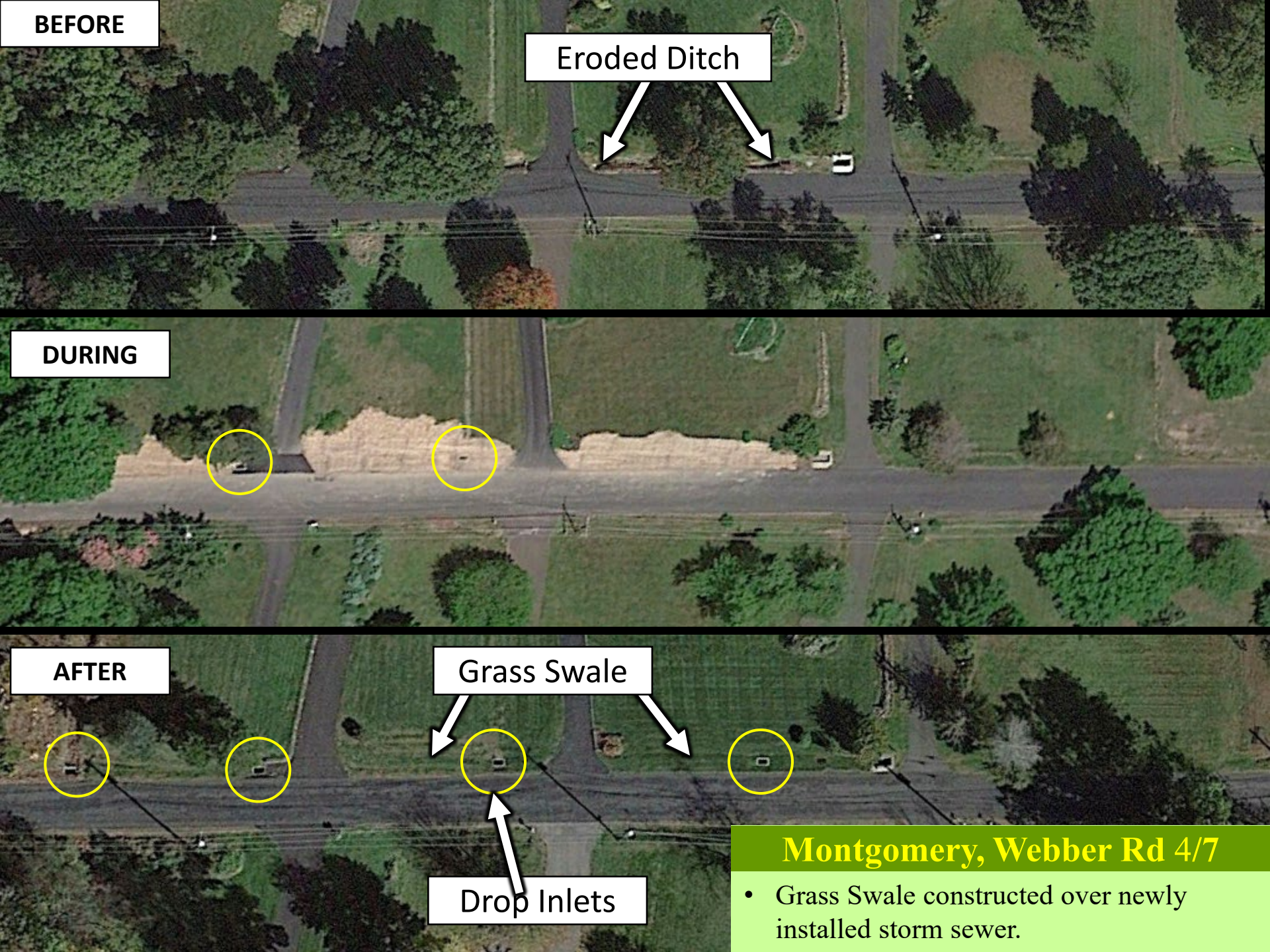
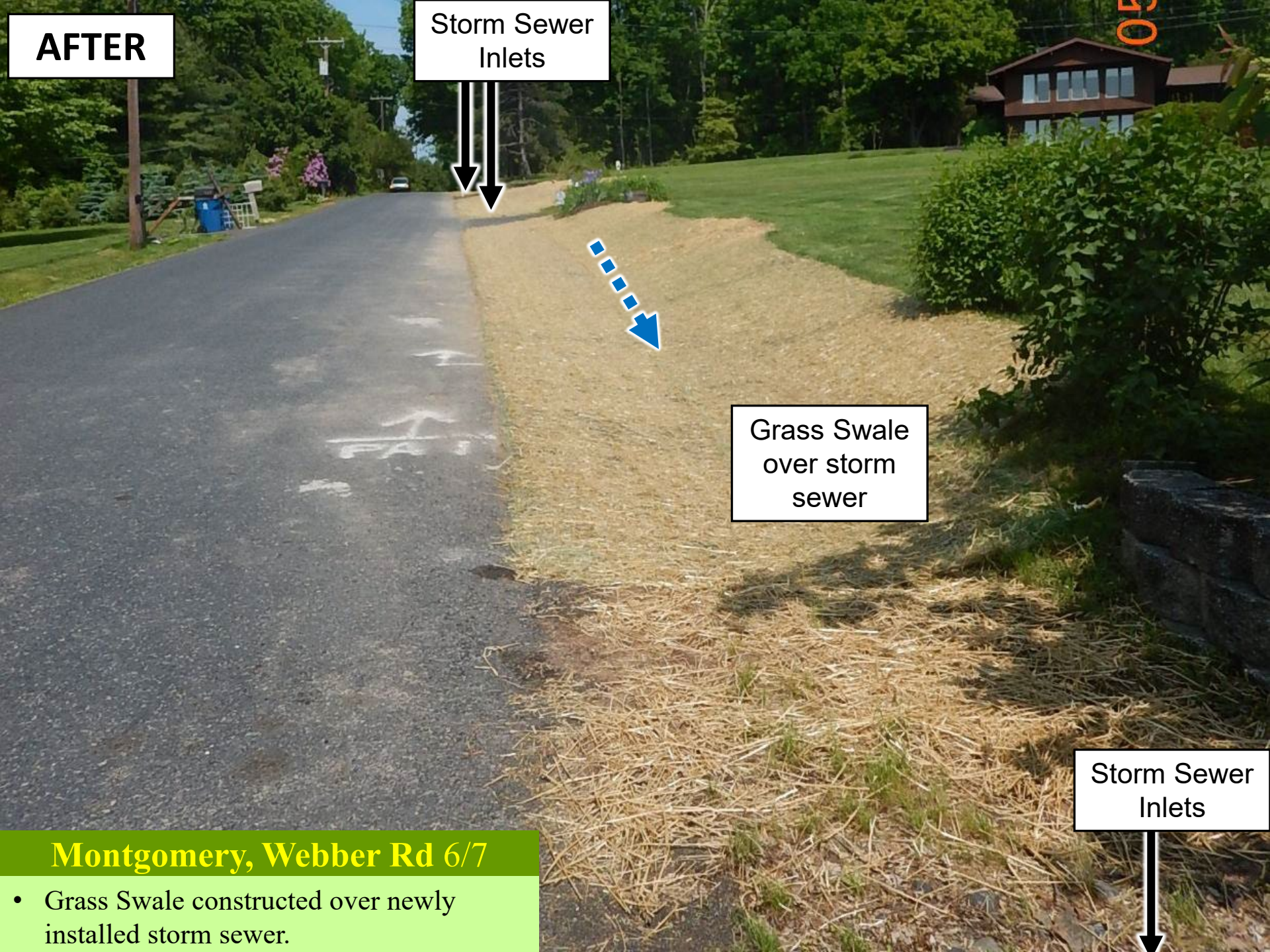


Montgomery, Webber Rd 4/7

- Grass Swale constructed over newly installed storm sewer.

Montgomery, Webber Rd 5/7

- Grass Swale constructed over newly installed storm sewer.



Montgomery, Webber Rd 6/7

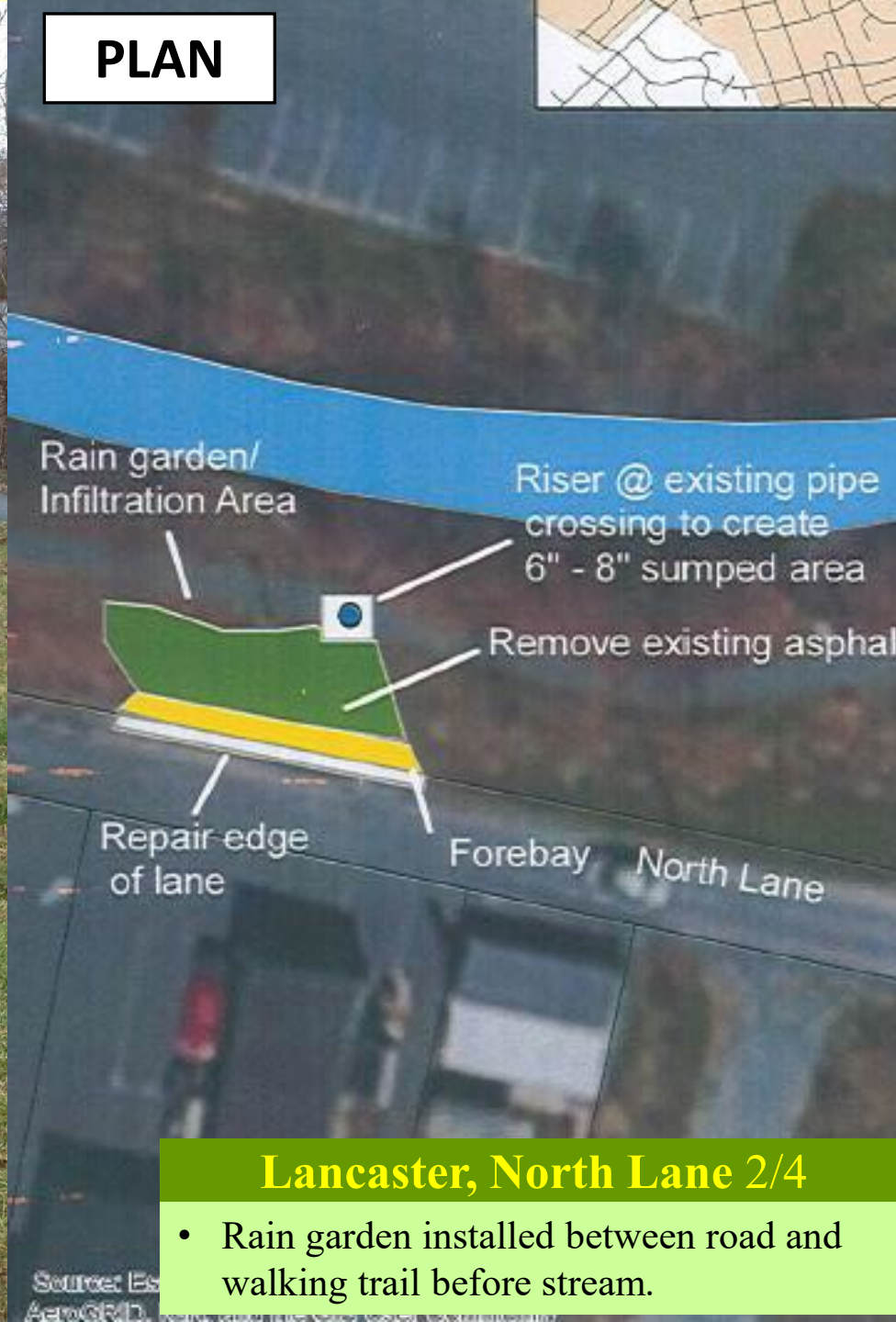
- Grass Swale constructed over newly installed storm sewer.

Montgomery, Webber Rd 7/7

- Grass Swale constructed over newly installed storm sewer.

Project Walkthrough: Lancaster County, North Lane

- **2019: $14K Grant, $3K in-kind**
- Stormwater in borough piped to stream
- Rain garden installed to filter sediment and infiltrate runoff



Lancaster, North Lane 2/4

- Rain garden installed between road and walking trail before stream.

Lancaster, North Lane 3/4

- Rain garden installed between road and walking trail before stream.

Lancaster, North Lane 4/4

- Rain garden installed between road and walking trail before stream.

Project Walkthrough: Dauphin County, 31st Street

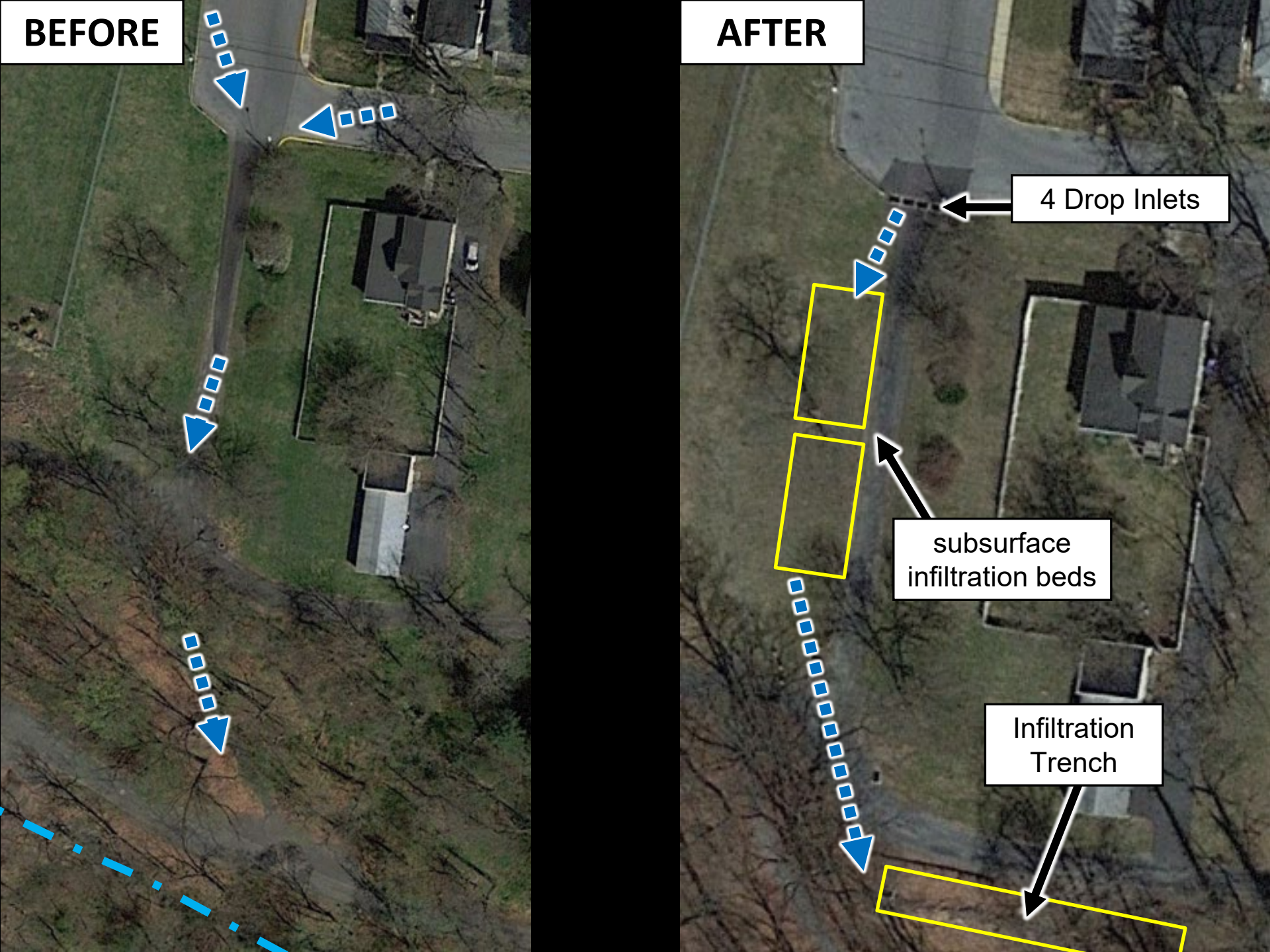
- **2019: $85K Grant, $0 in-kind**
- Road runoff washing out rail trail below into stream
- Installed drop inlets to “cascading” subsurface infiltration structures

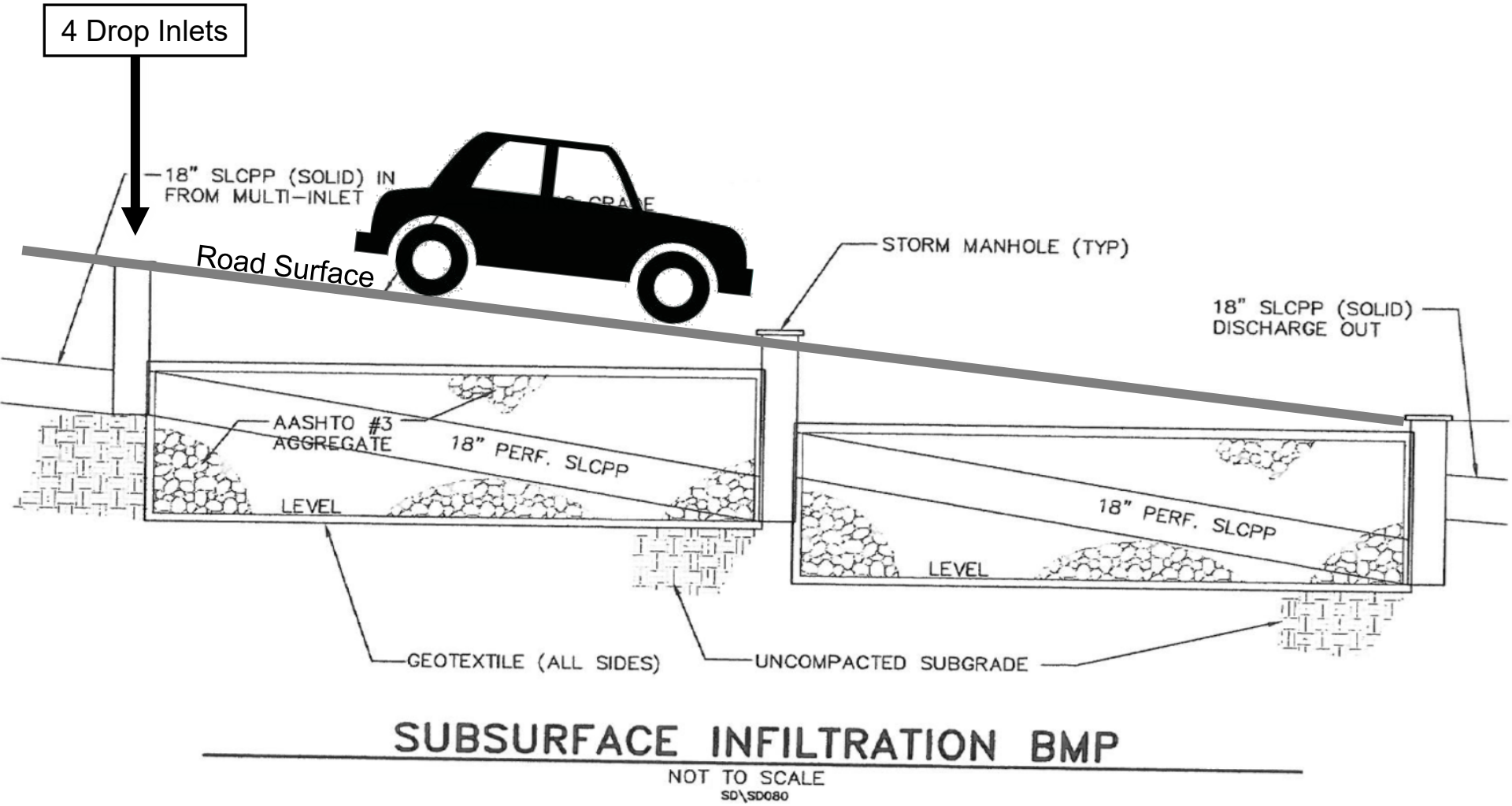
Water from two roads ran down road, washed out rail trail and into stream

02/23/2017

Dauphin, 31st St 2/8

- Installed drop inlets to “cascading” subsurface infiltration structures


BEFORE
AFTER
4 Drop Inlets
subsurface infiltration beds
Infiltration Trench



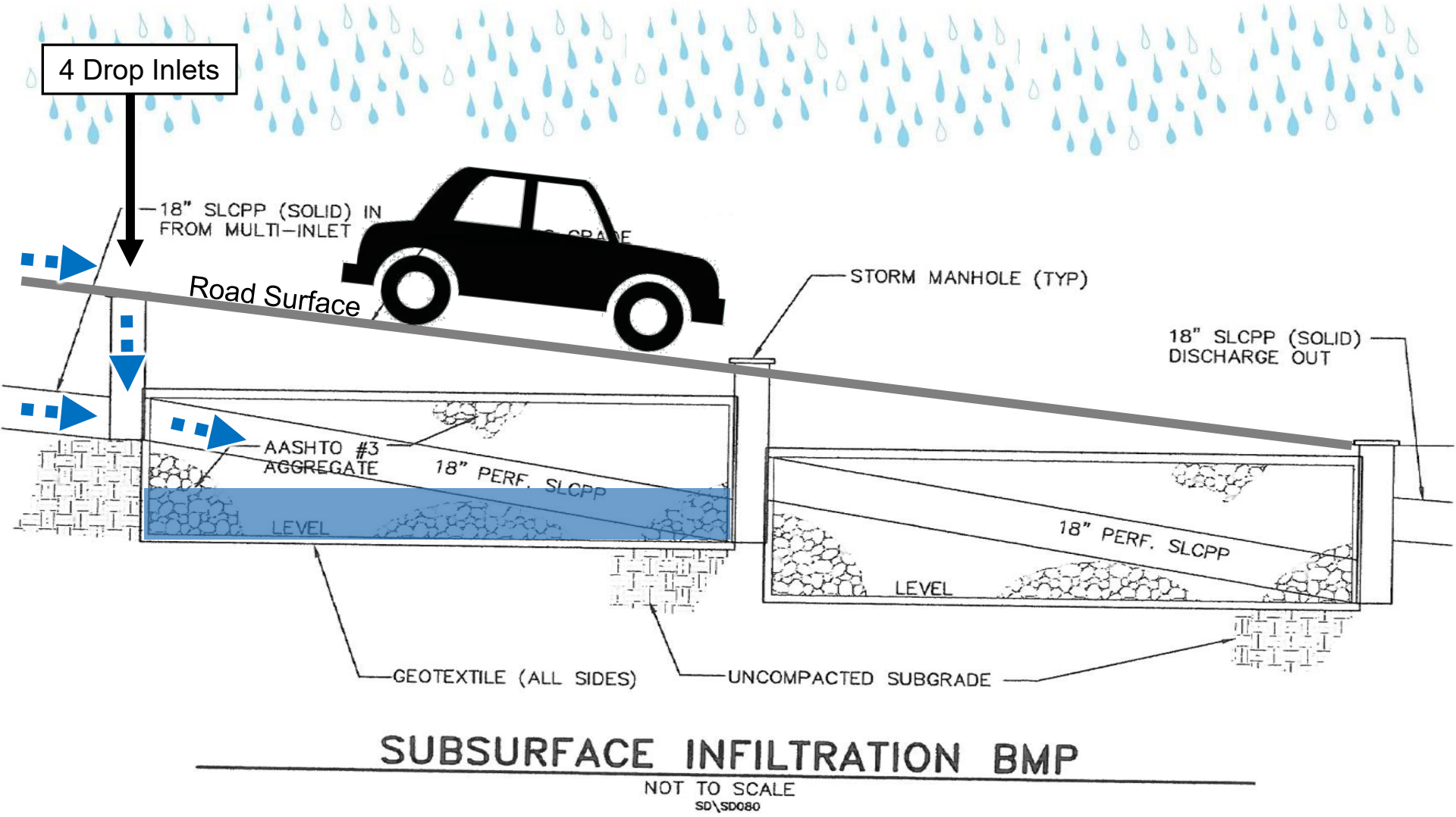
SUBSURFACE INFILTRATION BMP

NOT TO SCALE

SD\SD080

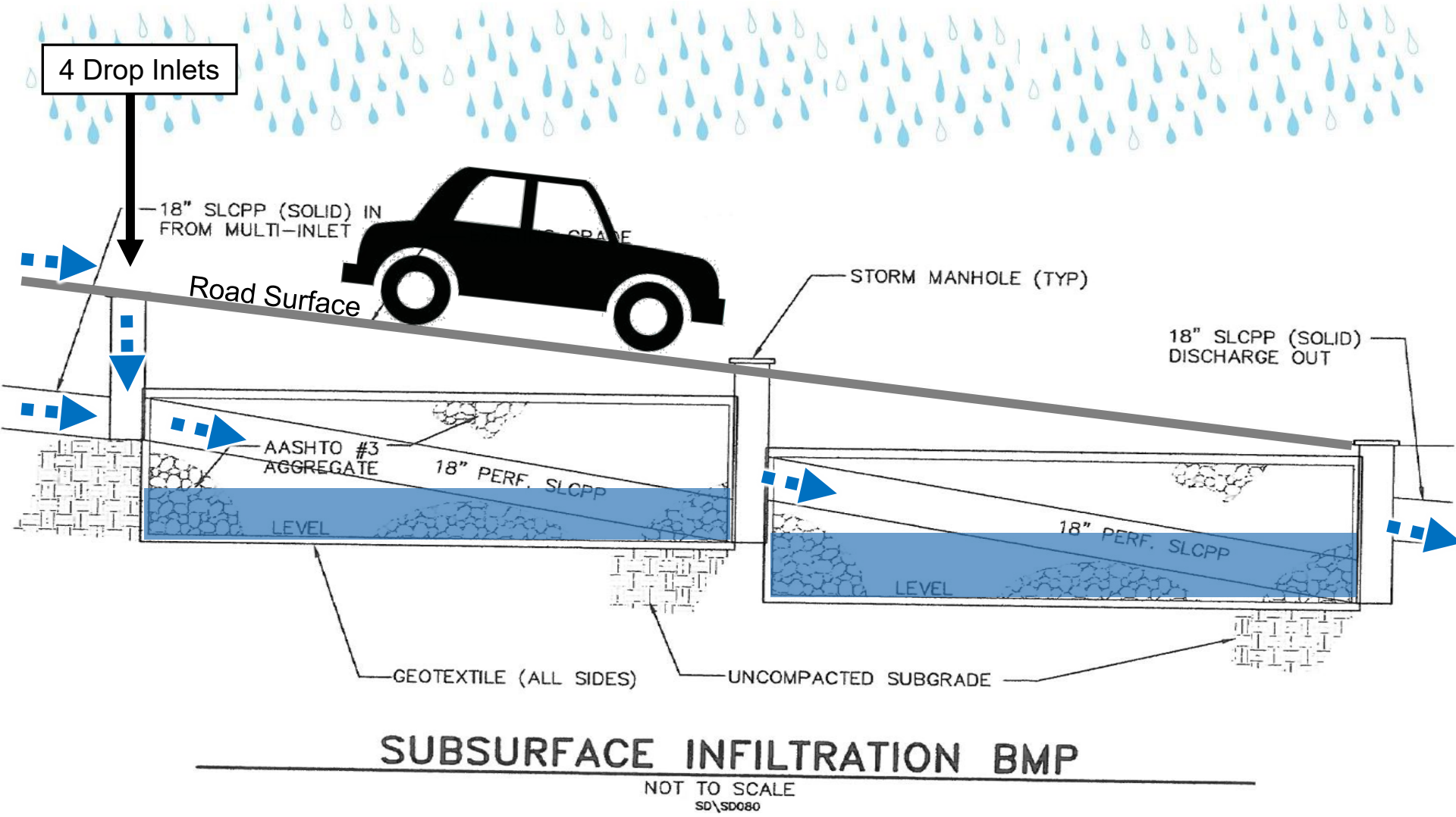
Dauphin, 31st St 4/8

- Installed drop inlets to "cascading" subsurface infiltration structures



Dauphin, 31st St 4/8

- Installed drop inlets to "cascading" subsurface infiltration structures



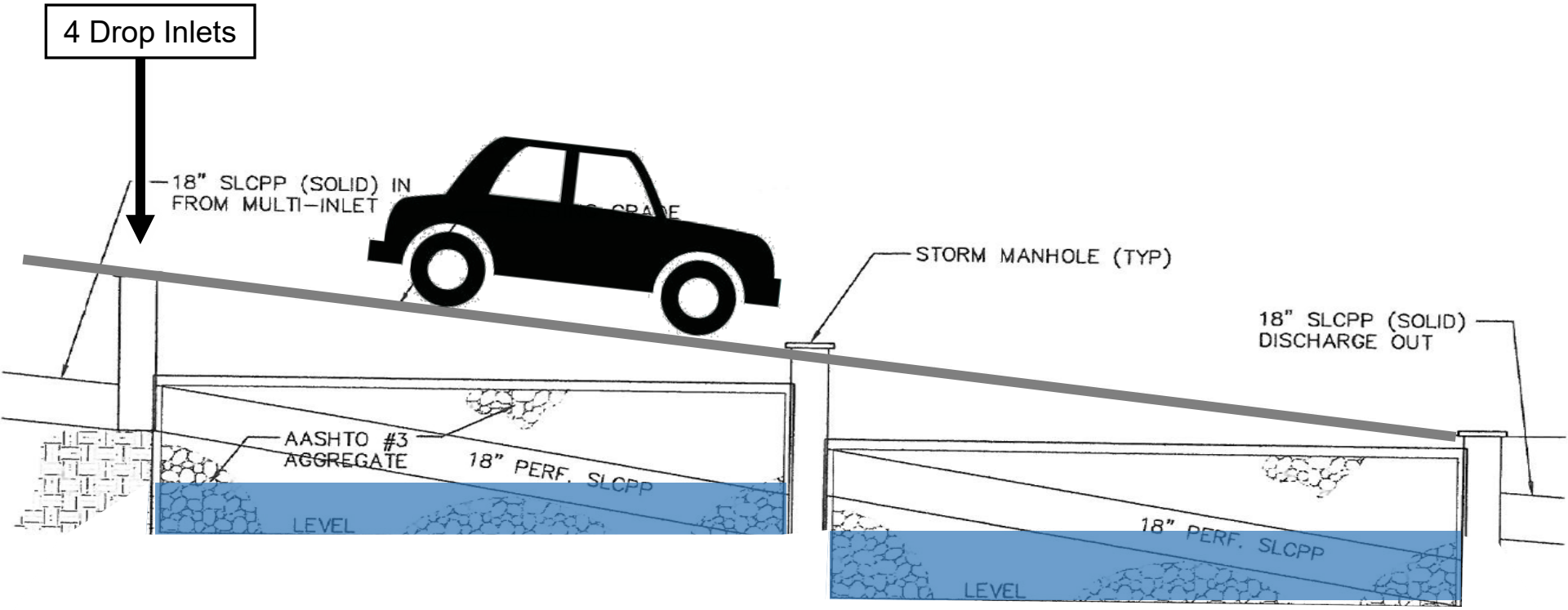
SUBSURFACE INFILTRATION BMP

NOT TO SCALE

SD\SD080

Dauphin, 31st St 4/8

- Installed drop inlets to "cascading" subsurface infiltration structures



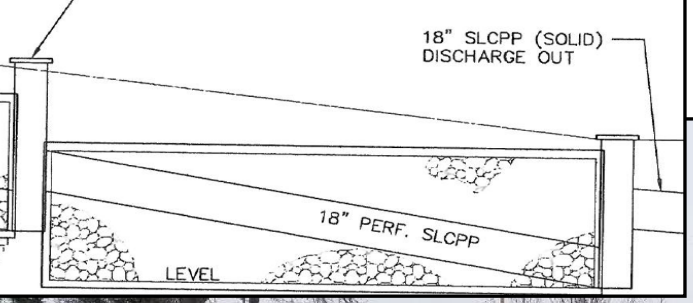
Dauphin, 31st St 4/8

- Installed drop inlets to "cascading" subsurface infiltration structures

Bank of drop inlets installed at top of project to capture all runoff

Dauphin, 31st St 5/8

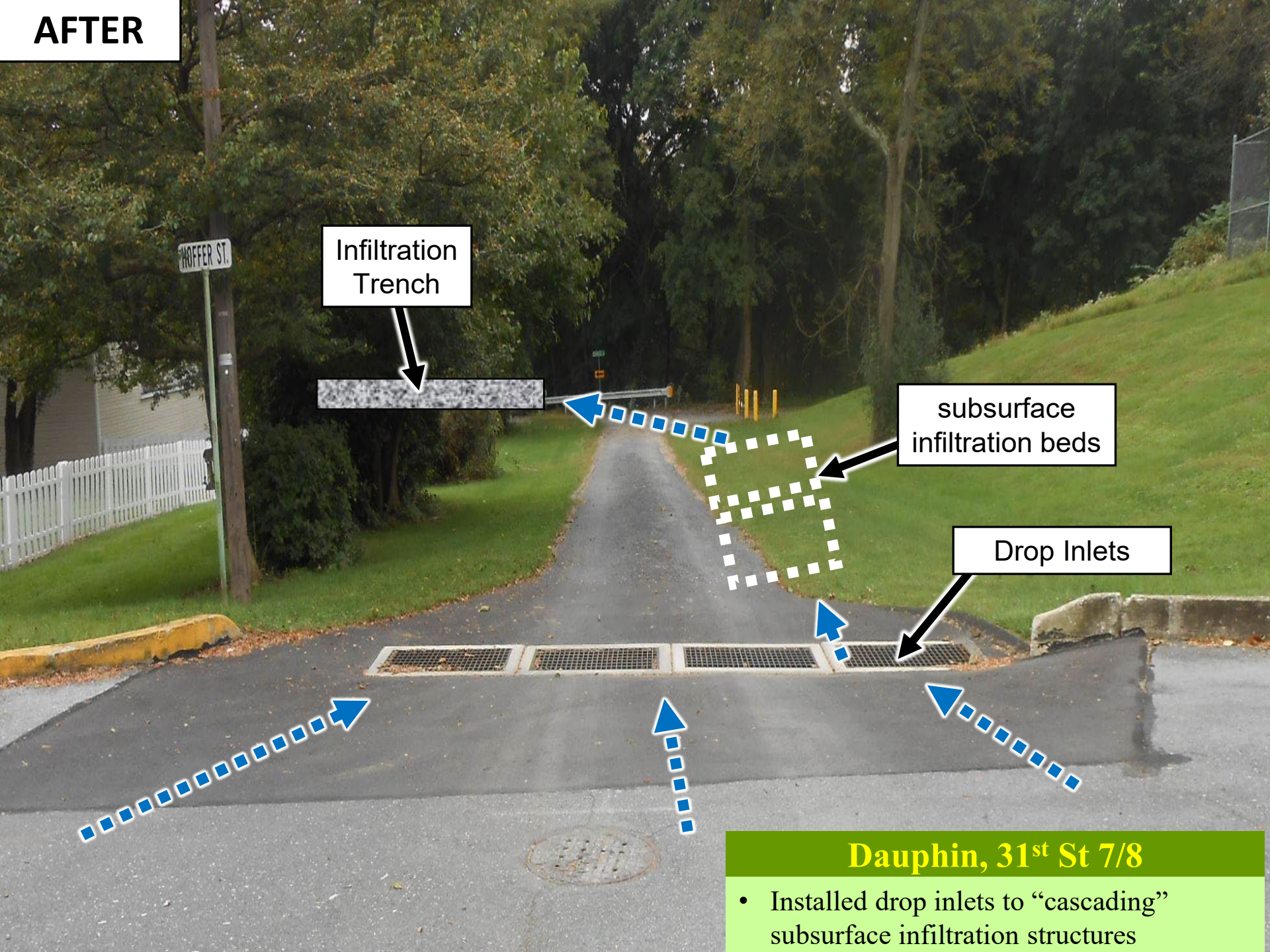
- Installed drop inlets to “cascading” subsurface infiltration structures



Excavation and filling of lower subsurface infiltration beds

Dauphin, 31st St 6/8

- Installed drop inlets to “cascading” subsurface infiltration structures



Dauphin, 31st St 7/8

- Installed drop inlets to “cascading” subsurface infiltration structures

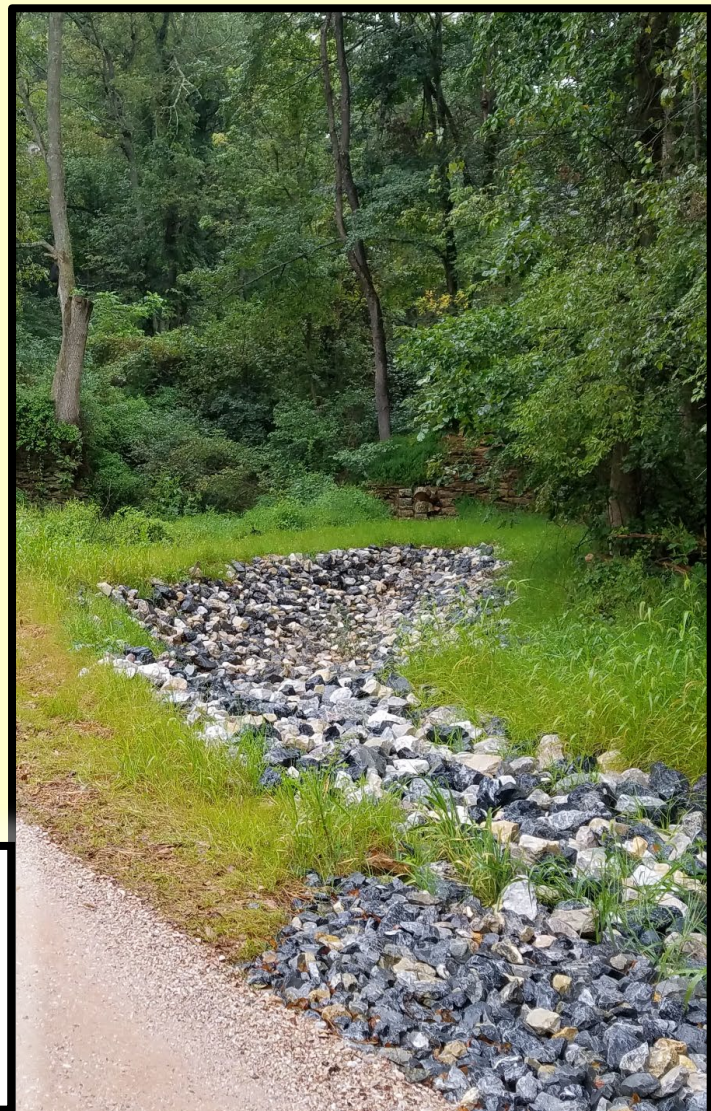
Dauphin, 31st St 8/8

- Installed drop inlets to “cascading” subsurface infiltration structures

Structural Infiltration Practices

ADDITIONAL RESOURCES:

- **Your Conservation District**
- **Your Municipal Engineer**
- **PA Stormwater Best Management Practices**: Specifically, chapter 6 on "Structural BMPs"
- **PA MS4**: DEP stormwater management resources. (Municipal Separate Storm Sewer System)



next chapter:

DSA