

Green Infrastructure

SANDRA BLICK

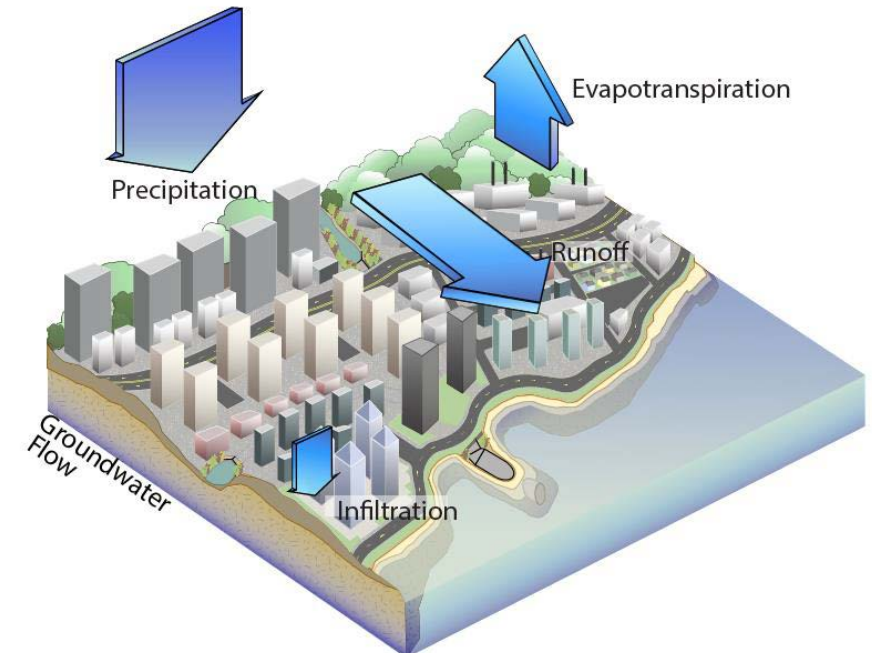
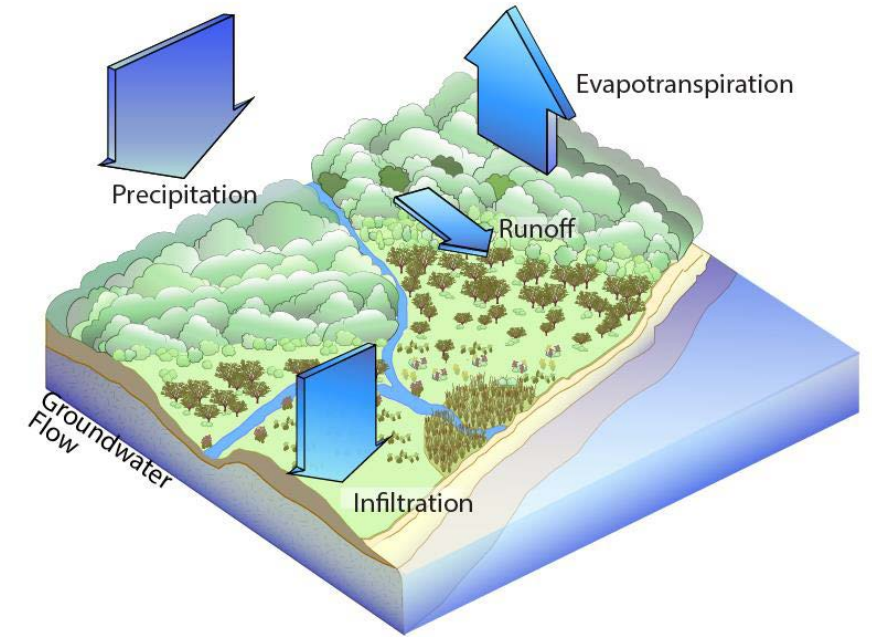
NJDOT HYDROLOGY & HYDRAULICS

JUNE 5, 2019



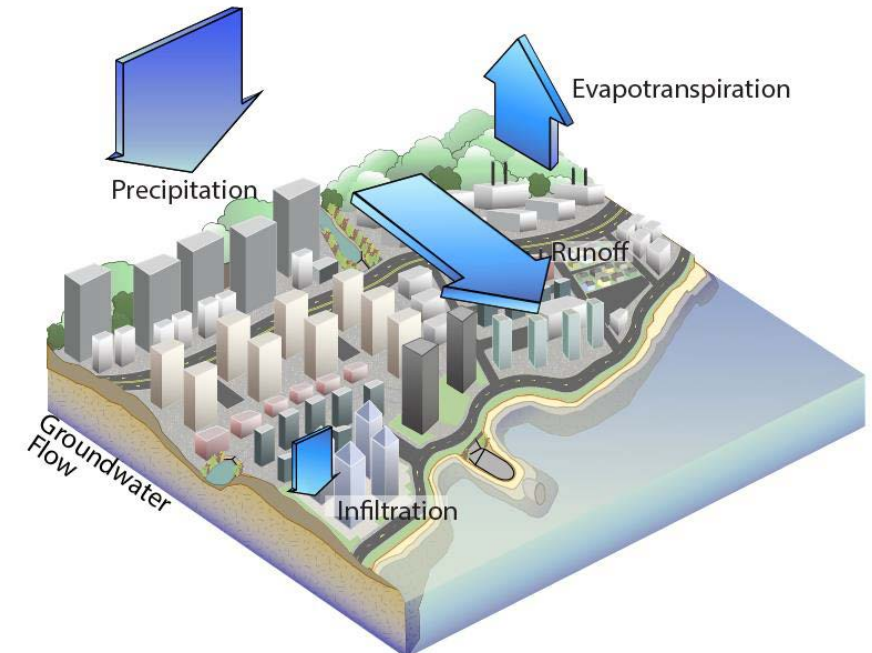
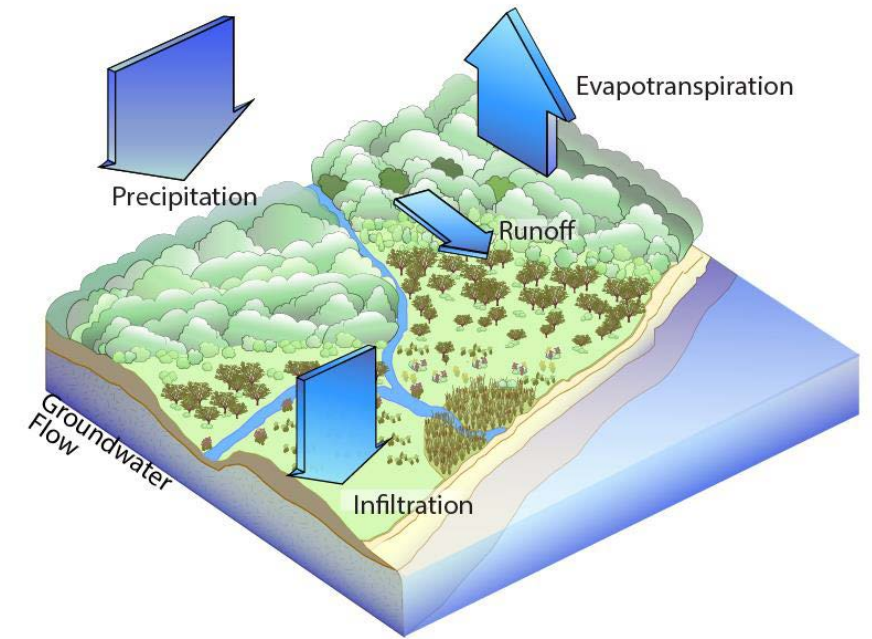
Stormwater Management Goals

- Prevent/Alleviate flooding, drainage & soil erosion issues
- Clean stormwater runoff before entering sensitive areas – streams, wetlands
- Maintain baseflow – streams, wetlands



Nature Based Stormwater Management

- Environmentally-sensitive site design
- Low Impact Development
- Nonstructural Strategies
- Designing with Nature
- Green Infrastructure



Source: NJ Stormwater Management Best Management Practices Manual



Brief History of Green Infrastructure in NJ

- **SWM mostly met using detention basins and wet ponds**
 - Pinelands Commission – required the infiltration for projects
- **2004 – NJDEP adopted 100% groundwater recharge standard and 80/95% TSS removal criteria**
 - Detention basins and wet ponds no longer sufficient to meet the criteria
 - Significant changes in BMP design in NJ. Green Infrastructure BMPs became more common
 - Pinelands evaluated success of Infiltration Basins, found significant failure
- **2009 - Pinelands Commission & NJDEP develop more stringent soil testing criteria**
- **2019 - NJDEP Proposing Rules to Modify Uses of Green Infrastructure**
- **2019 - Existing Design Criteria is being updated to improve GI functionality**



What is Green Infrastructure?

EPA – “cost-effective, resilient approach to managing wet weather impacts that provides many community benefits... uses vegetation, soils and elements... patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water... mimic nature soak up and store water. “

NJDEP CSO Permit -"Green Infrastructure" means methods of stormwater management that reduce wet weather/stormwater volume, flow, or changes the characteristics of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing the stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse.”

NJDEP – “GI is a broad term that generally refers to engineered systems that manage runoff close to where it is generated by incorporating natural features into the design of the system. “

Use vegetation, soils or water reuse for stormwater management and flood protection



Detention Basin



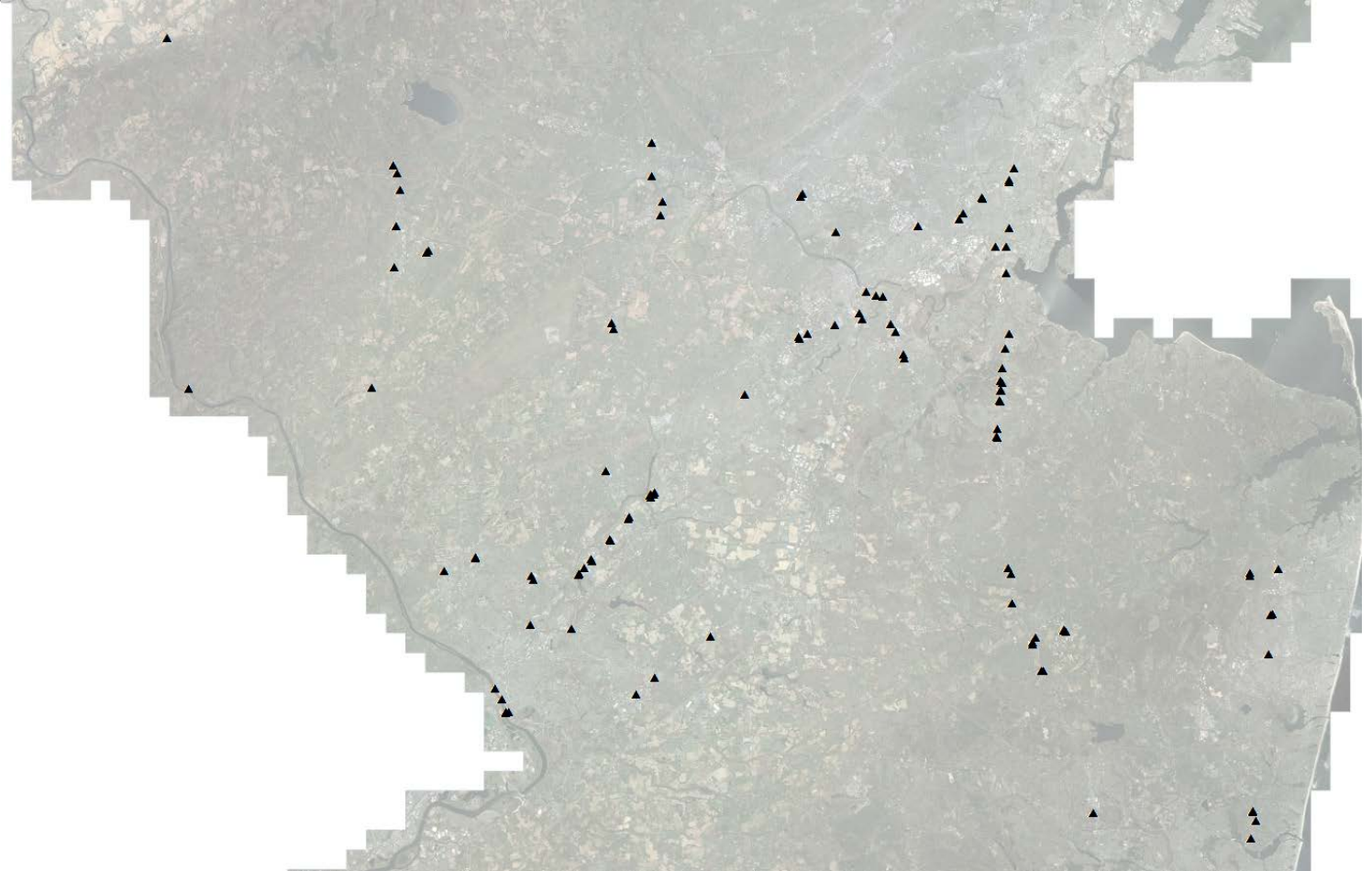
- The Bathtub Model
 - Dirty Water Enters Quickly
 - Goes Out a Small Hole Slowly
 - Some Dirt Remains At the Bottom
- Maintenance
 - Mow
 - Clean debris and sediment
 - Fix broken areas

Wet Pond

- Water remains between storm events to settle solids
- Maintenance – Clean debris, remove sediment when too full



Detention Basin and Wet Ponds



What is Green Infrastructure?

EPA – “cost-effective, resilient approach to managing wet weather impacts that provides many community benefits... uses vegetation, soils and elements...

Take Home: Green Infrastructure Only

Works if the Treatment Processes Continue to Function

NJDEP CSO Permit: “Green Infrastructure” means methods of stormwater management that use vegetative treatment, infiltration, storage, or other natural processes of the flow into combined or separate sanitary or storm sewers, or surface waters, by allowing stormwater to infiltrate, to be treated by vegetation or by soils; or to be stored for reuse.”

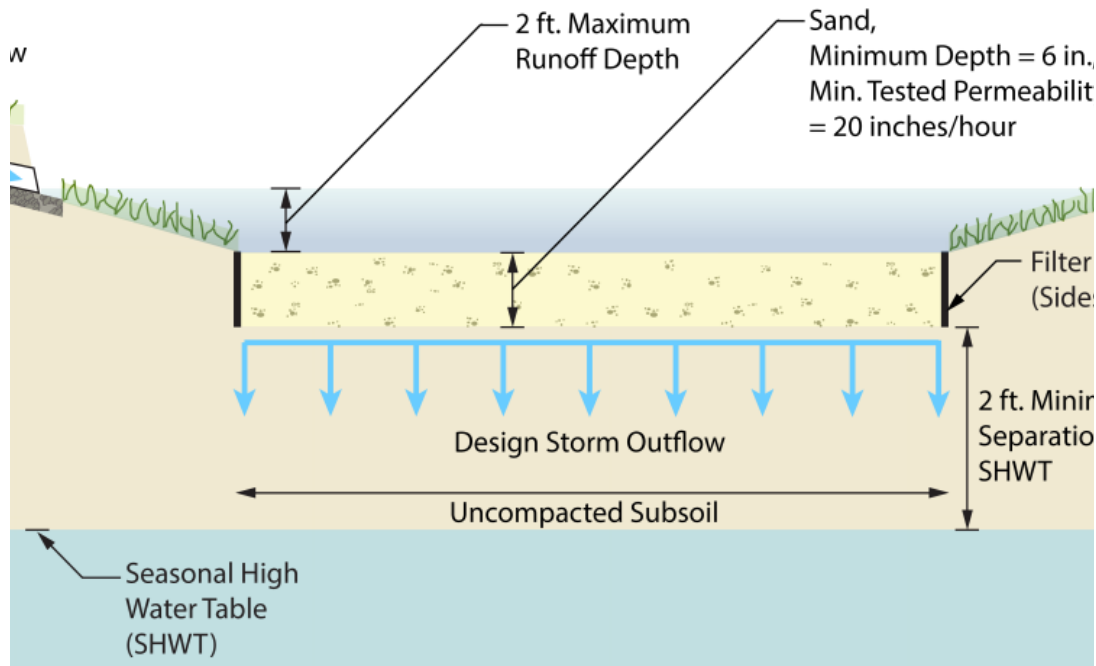
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Treatment With Soil

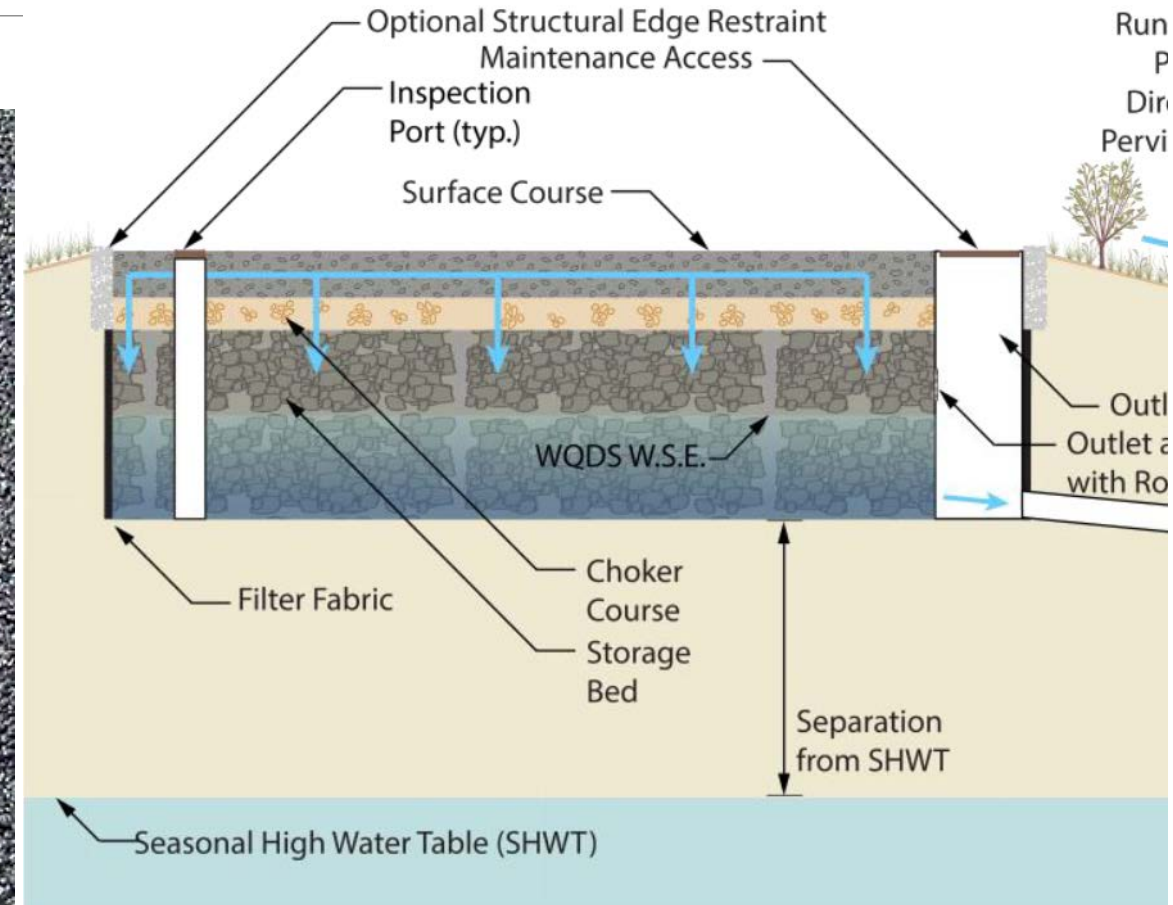
- Infiltration Basins
- Pervious Paving with Infiltration



Source: NJ Stormwater Management Best Management Practices Manual



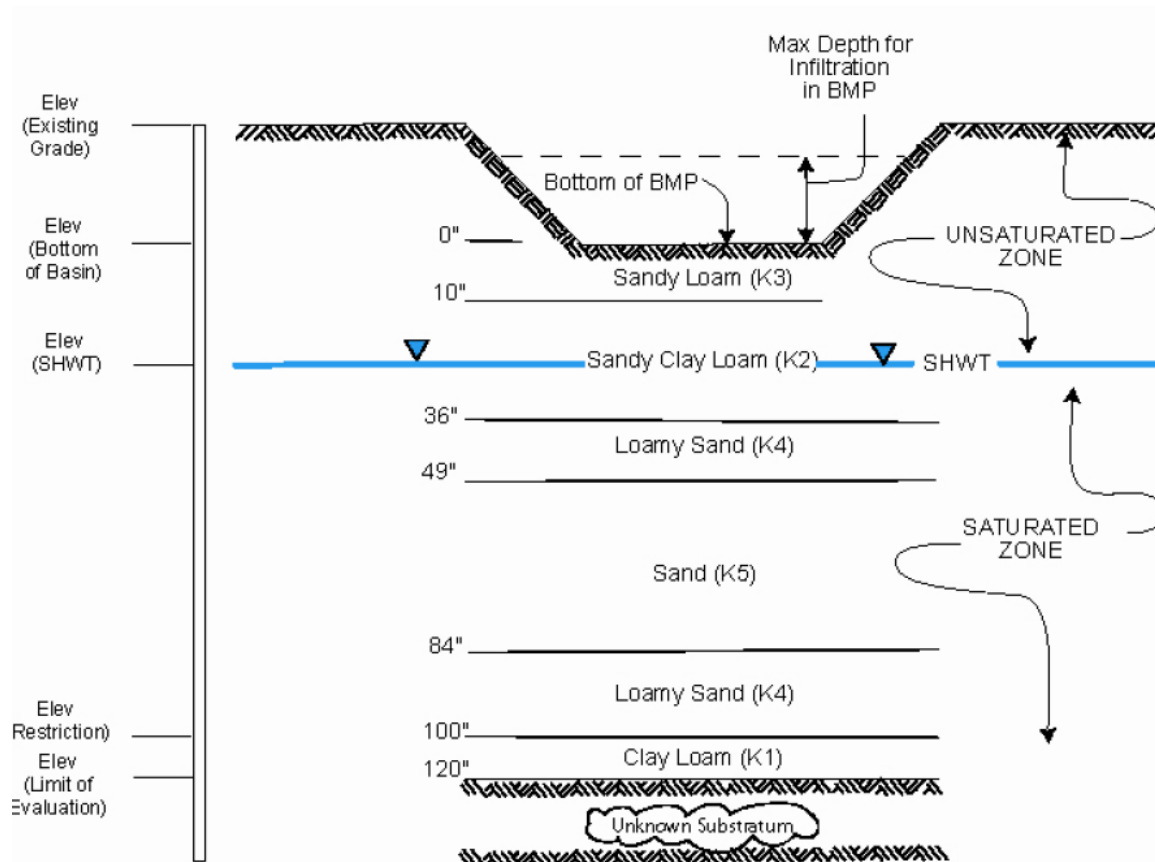
Treatment With Soil – No Underdrain



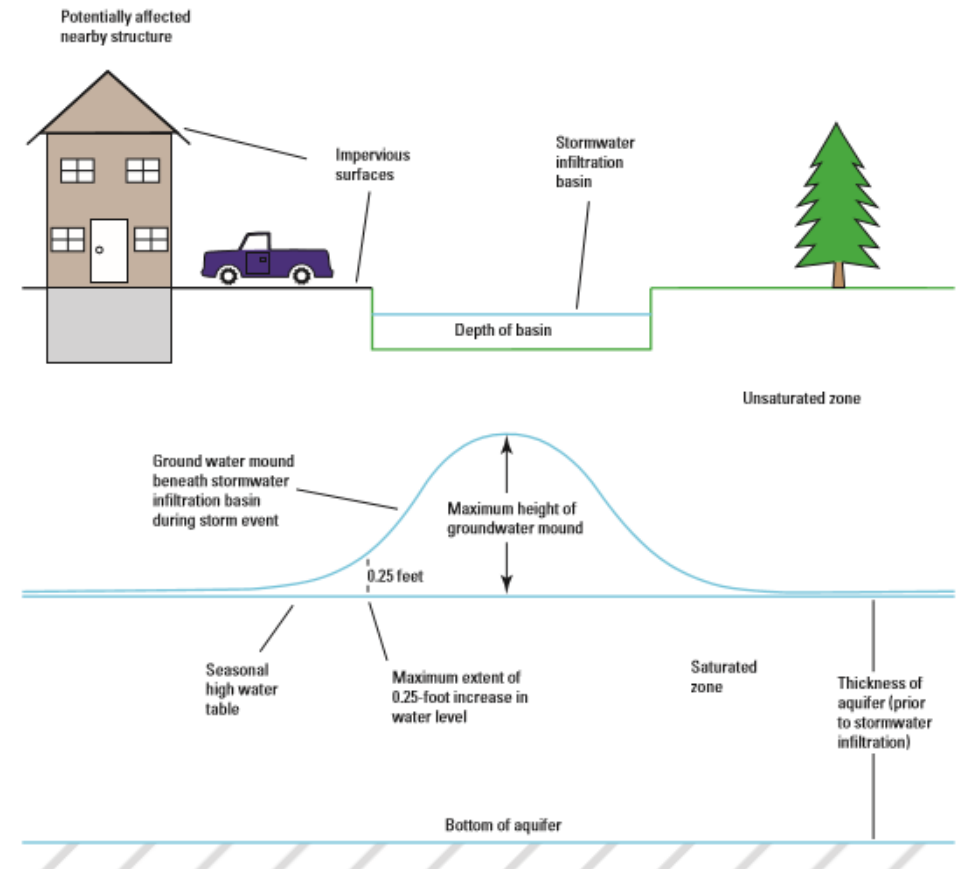
Source: NJ Stormwater Management Best Management Practices Manual



Soil Considerations



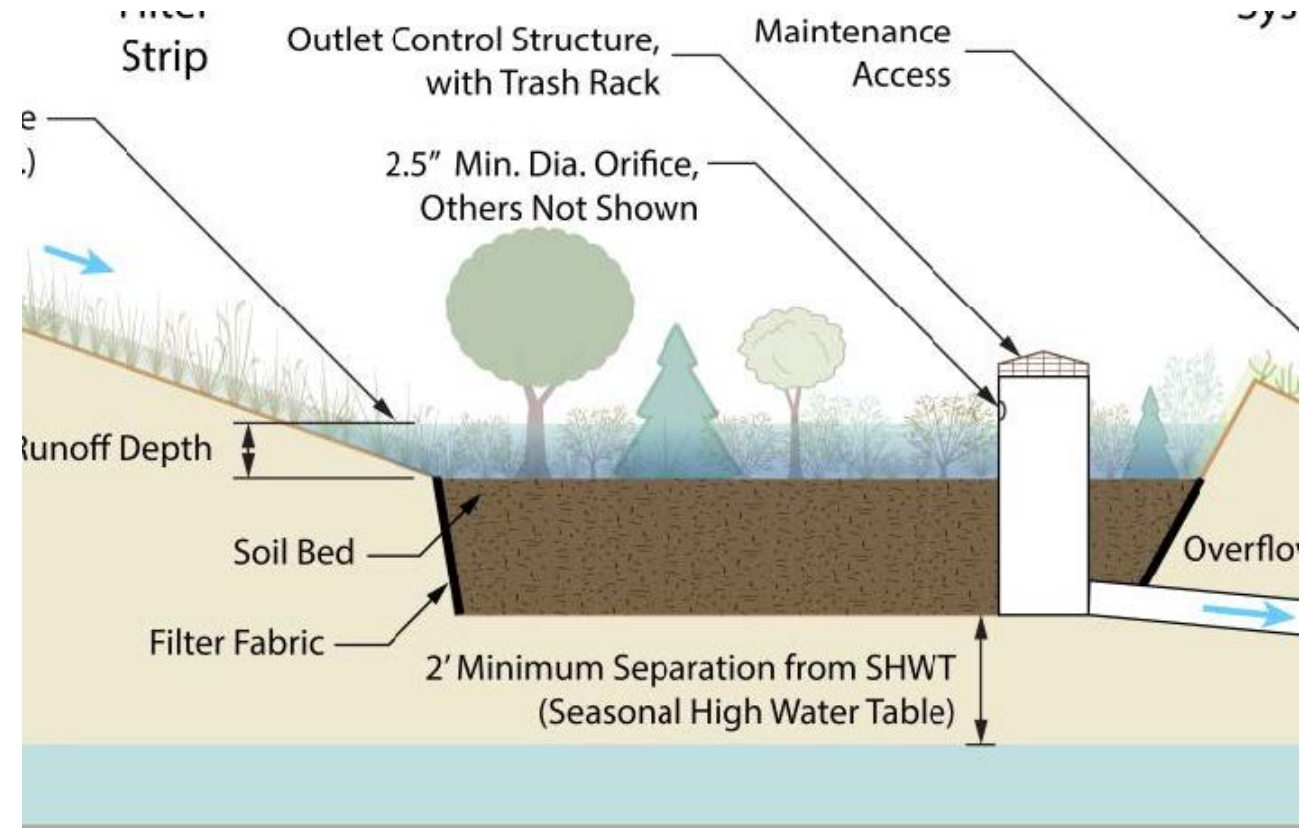
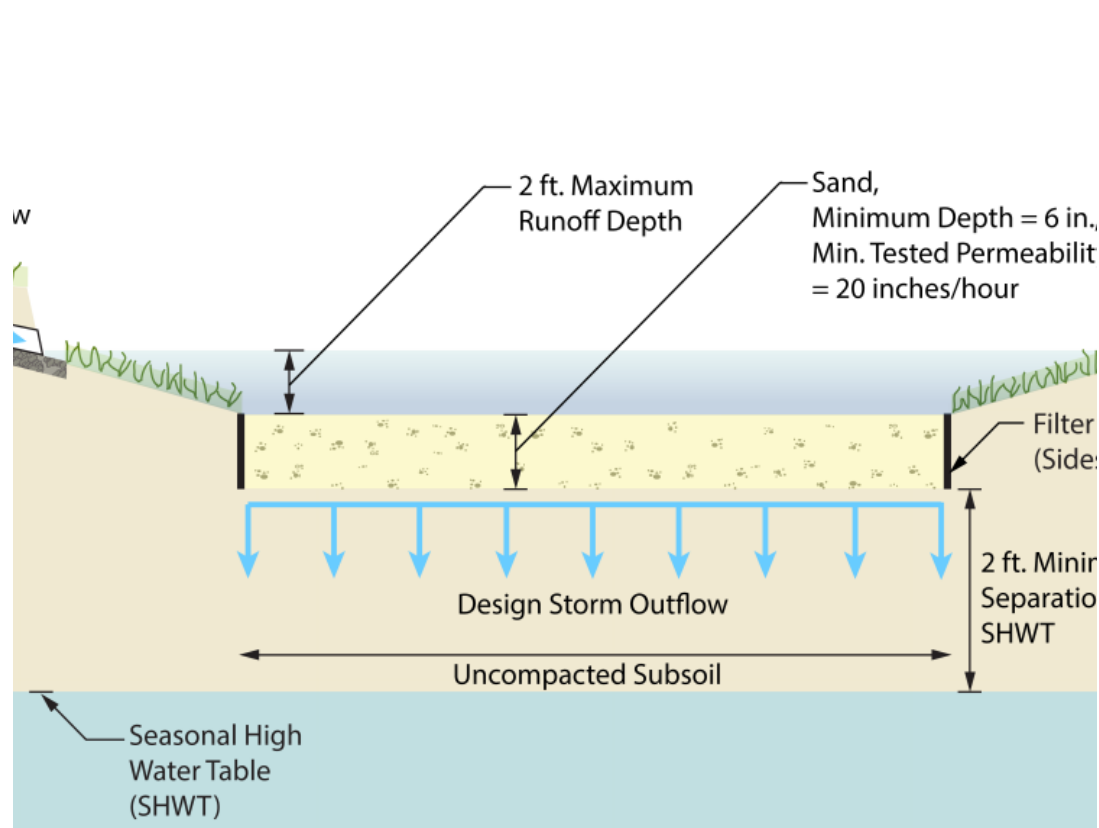
Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins



Scientific Investigations Report 2010-5102



Treatment With Soil

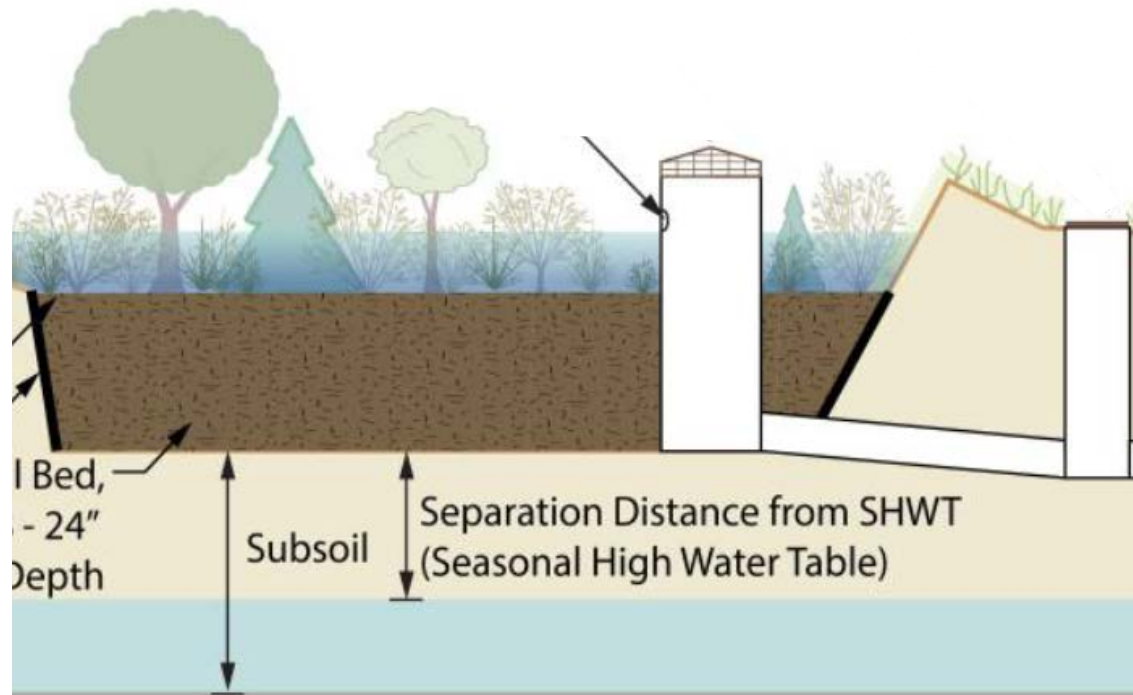


Source: NJ Stormwater Management Best Management Practices Manual



Treatment with Soil & Vegetation

- Bioretention Basin/ Swale
- Rain Garden



SOURCE: NJ Stormwater Management Best Management Practices Manual



Source: Ocean County Soil Conservation District



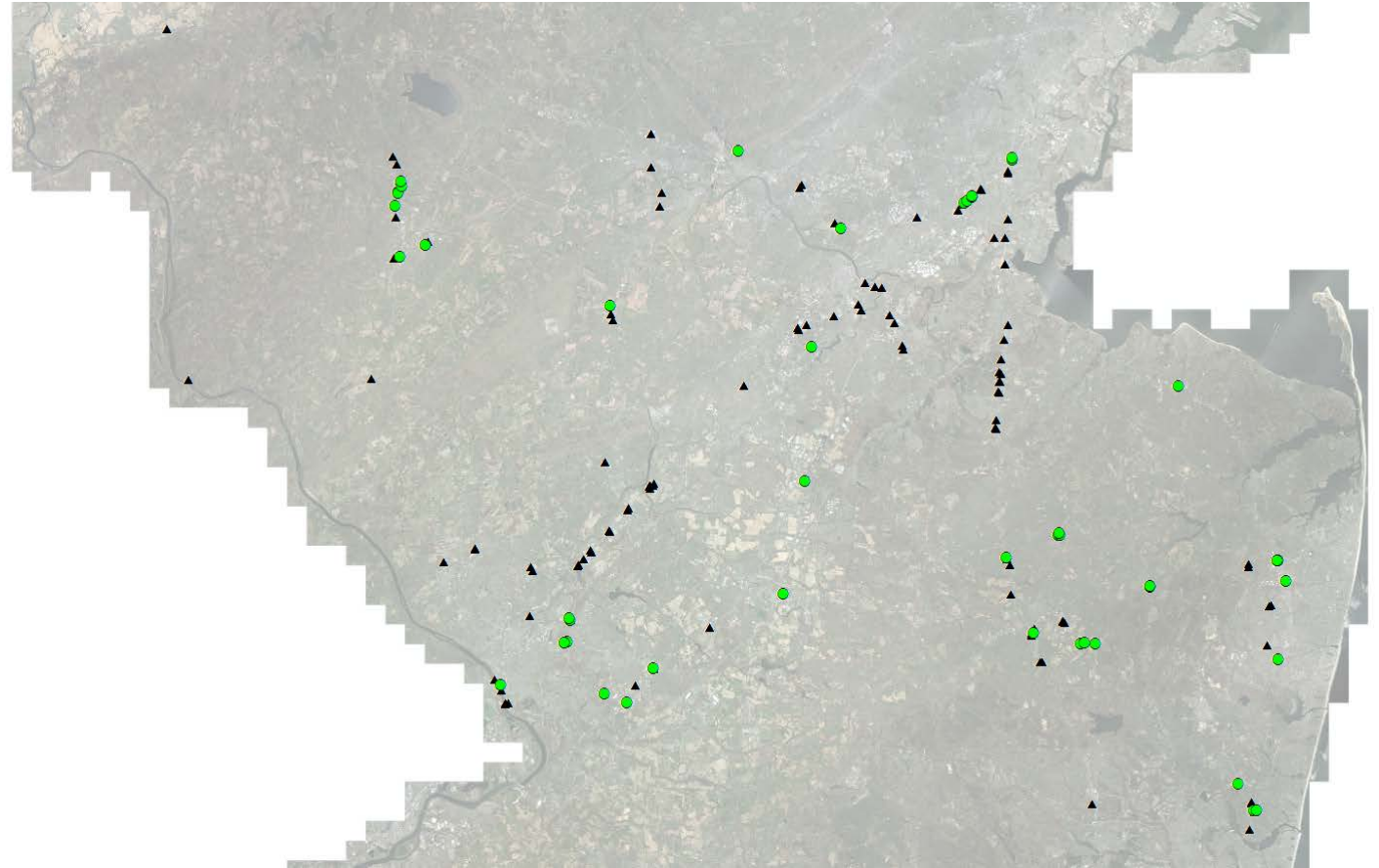
What About NJDOT

- Groundwater recharge required BMPs that infiltrate
- TSS removal rates required to use of BMPs that utilize soil and vegetation to achieve the removal rates



NJDOT Green Infrastructure BMPs

- Bioretention Basin
- Bioretention Swale
- Constructed Wetland
- Grass Swale
- Gravel Wetlands
- Infiltration Basins
- Porous Sidewalks



Grassed Swale



Source: Google Maps



Pervious Concrete Sidewalk



Source: Google Maps

Constructed Wetlands

DEEP MARSH PLANT MATERIAL



PELTANDRIA VIRGINICA
(ARROW ARUM)



PONTEDERIA CORDATA
(PICKERELWEED)



SAGITTARIA LATIFOLIA
(ARROWHEAD / DUCK POTATO)

SHALLOW MARSH PLANT MATERIAL



SCIRPUS VALIDUS
(SOFTSTEM BULRUSH)



SCIRPUS CYPERINUS
(WOOL GRASS)



IRIS VERSICOLOR
(BLUE FLAG IRIS)



SYMBOL	AREA	SYMBOL	AREA
	RIPRAP FOREBAY (>18" DEEP)		DEEP MARSH AREAS (6" TO 18" DEEP) ARROW ARUM (PELTANDRIA VIRGINICA) 4' O.C. (227 pu) PICKERELWEED (PONTEDERIA CORDATA) 4' O.C. (227 pu) ARROWHEAD/DUCK POTATO (SAGITTARIA LATIFOLIA) 4' O.C. (227 pu)
	MICROPOND AREAS (>18" DEEP)		SHALLOW MARSH AREA (0" TO 6" DEEP) BLUE FLAG IRIS (IRIS VERSICOLOR) 4' O.C. (350 pu) WOOL GRASS (SCIRPUS CYPERINUS) 4' O.C. (350 pu) SOFTSTEM BULRUSH (SCIRPUS VALIDUS) 4' O.C. (350 pu)
	1,517 SF		10,893 SF
	3,205 SF		16,787 SF

Green Infrastructure for Roadways

PROS

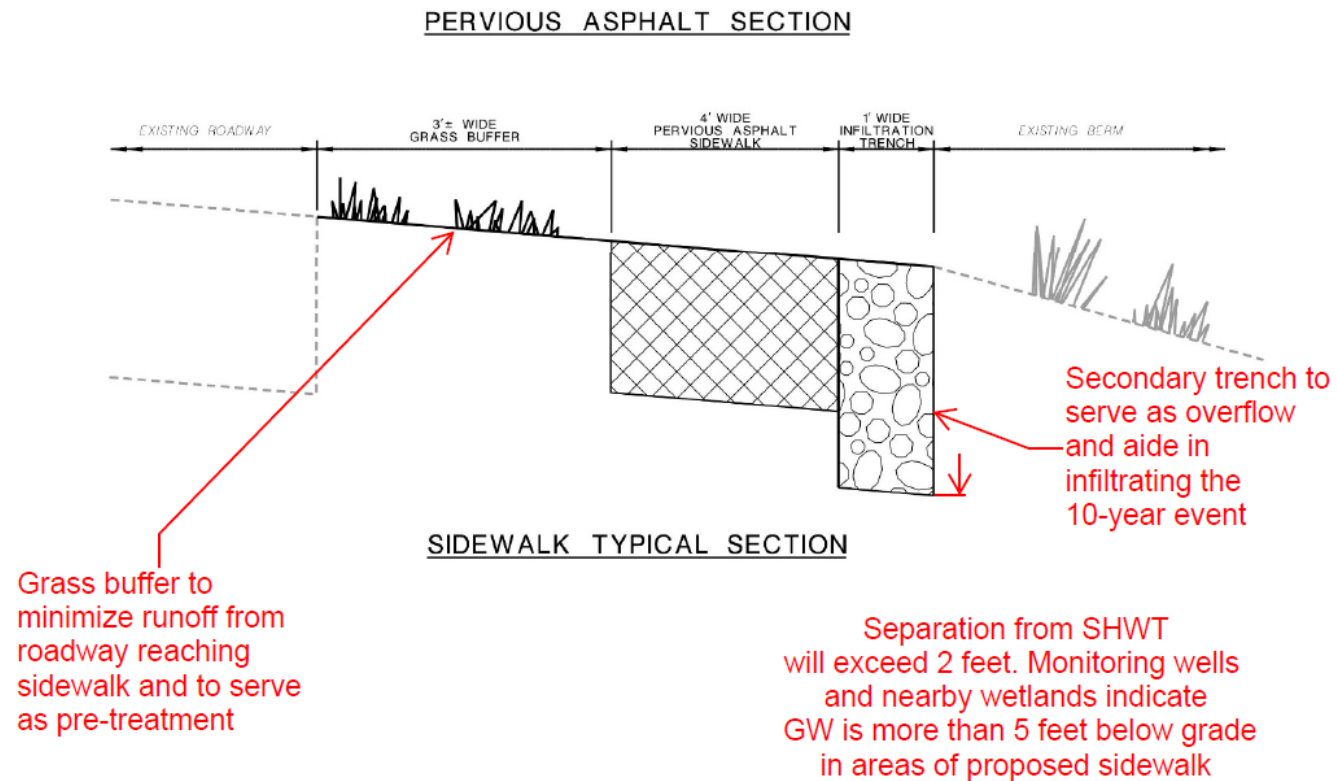
- More effective at cleaning runoff
- Baseflow
- Reduces Heat Island Effect
- Improves Air Quality
- Better Visual Impact

CONS

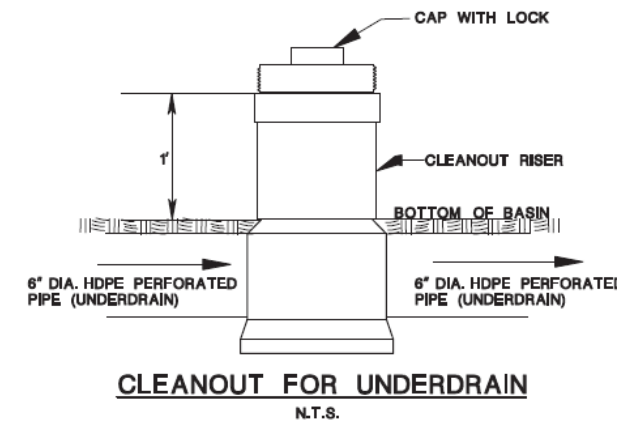
- Complex Design & Construction
 - Soil
 - Vegetation
- Difficult to repair if problems
- More Maintenance Intensive



Pervious Asphalt Sidewalk



Bioretention (Rain Garden)

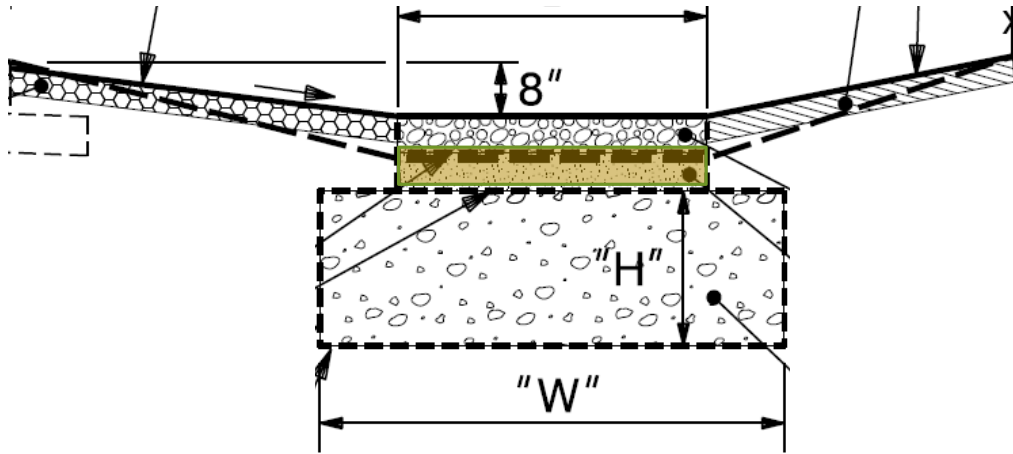


Infiltration Swale

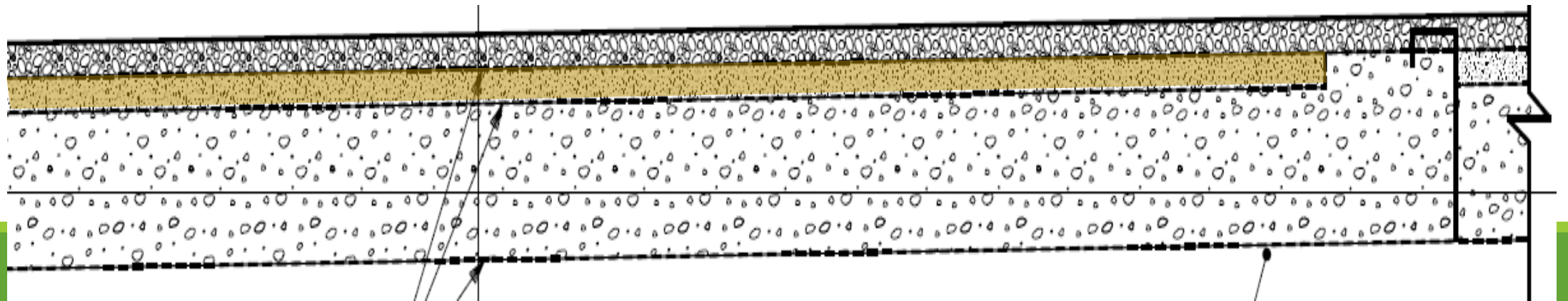


Source: Google Maps

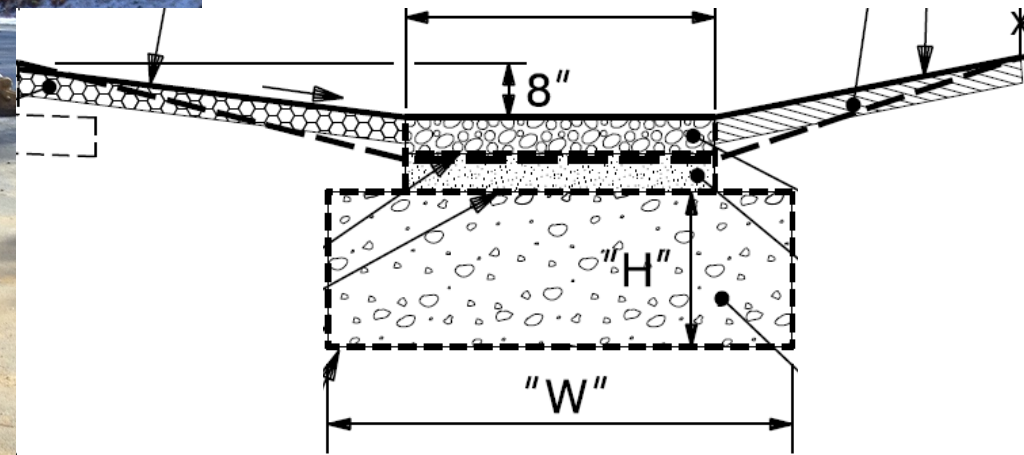
Infiltration Swale



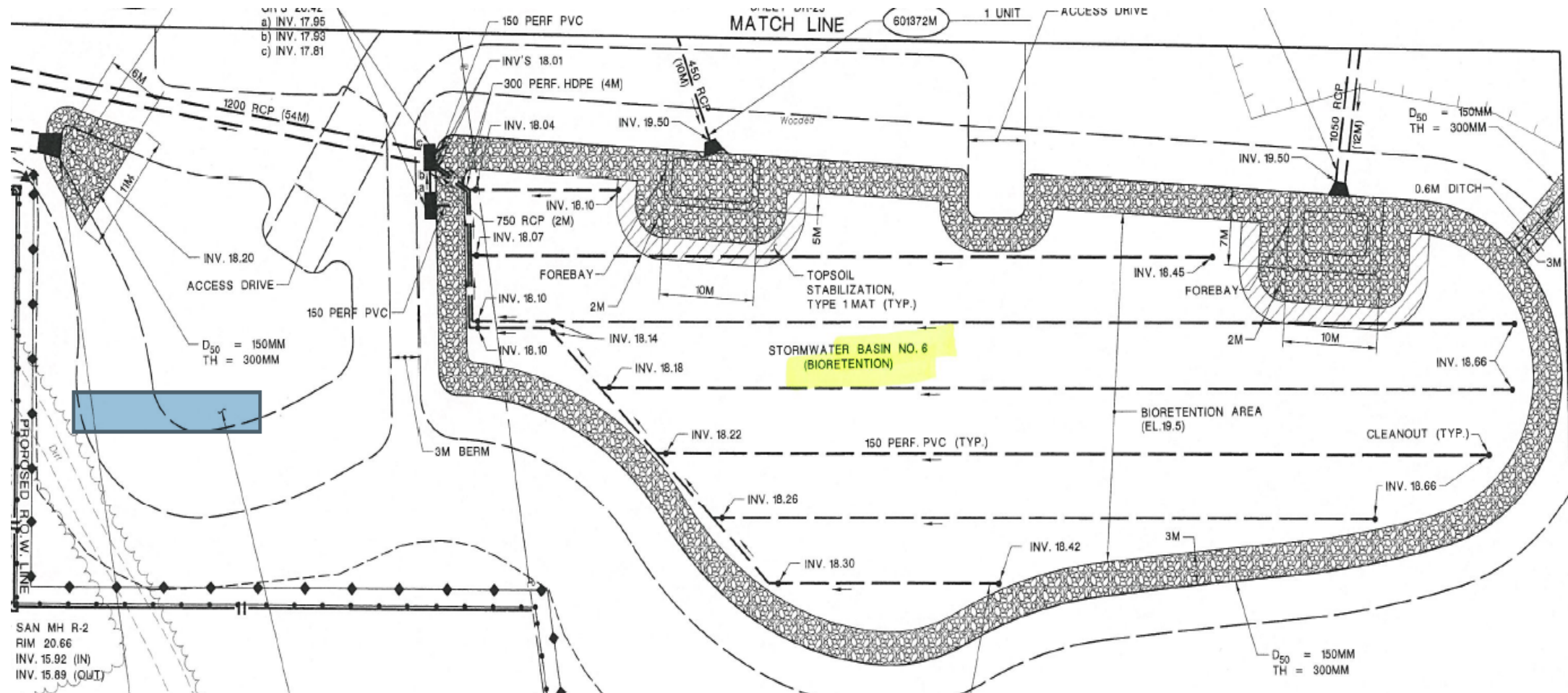
- 3' to 4' Wide Swale
- 6" Sand with 6" River rock for Erosion Control
- Stone pocket – variable depth & width
- 2' Separation from SHWT

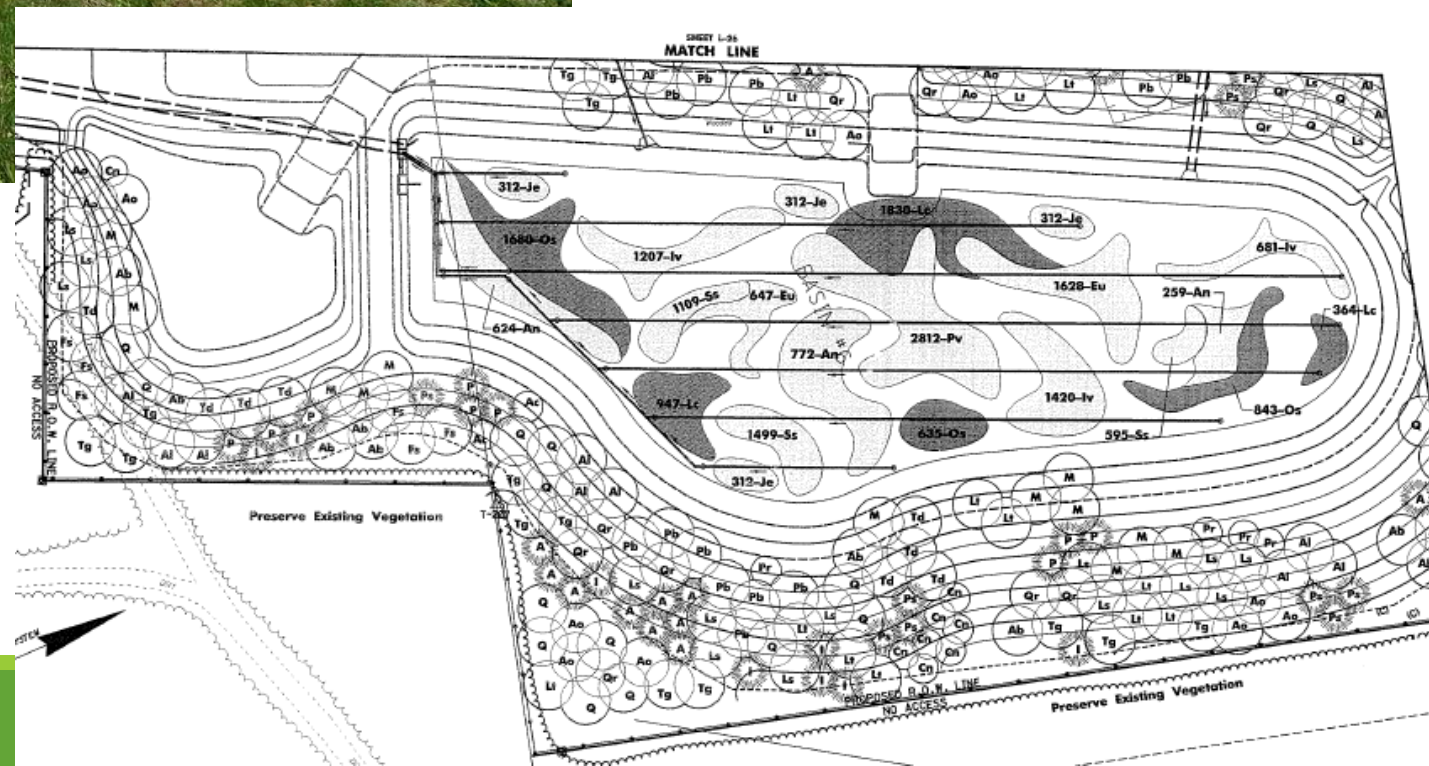


Infiltration Swale



Bioretention Basin with Underdrain

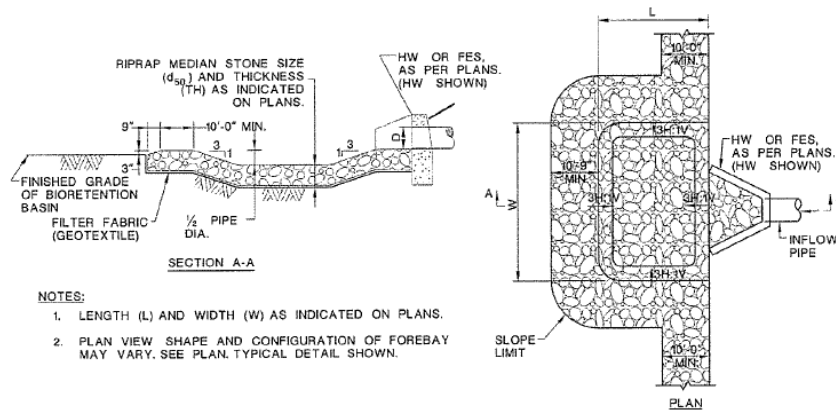




Bioretention - Maintenance

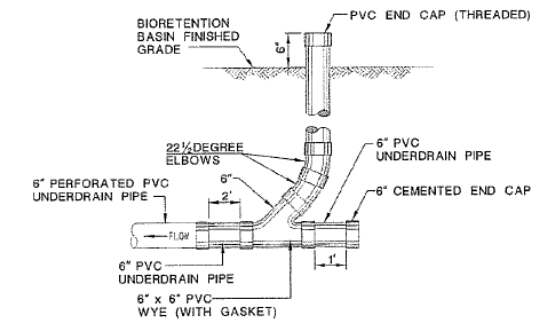
BIORETENTION BASIN - TYPICAL SECTION

N.T.S.

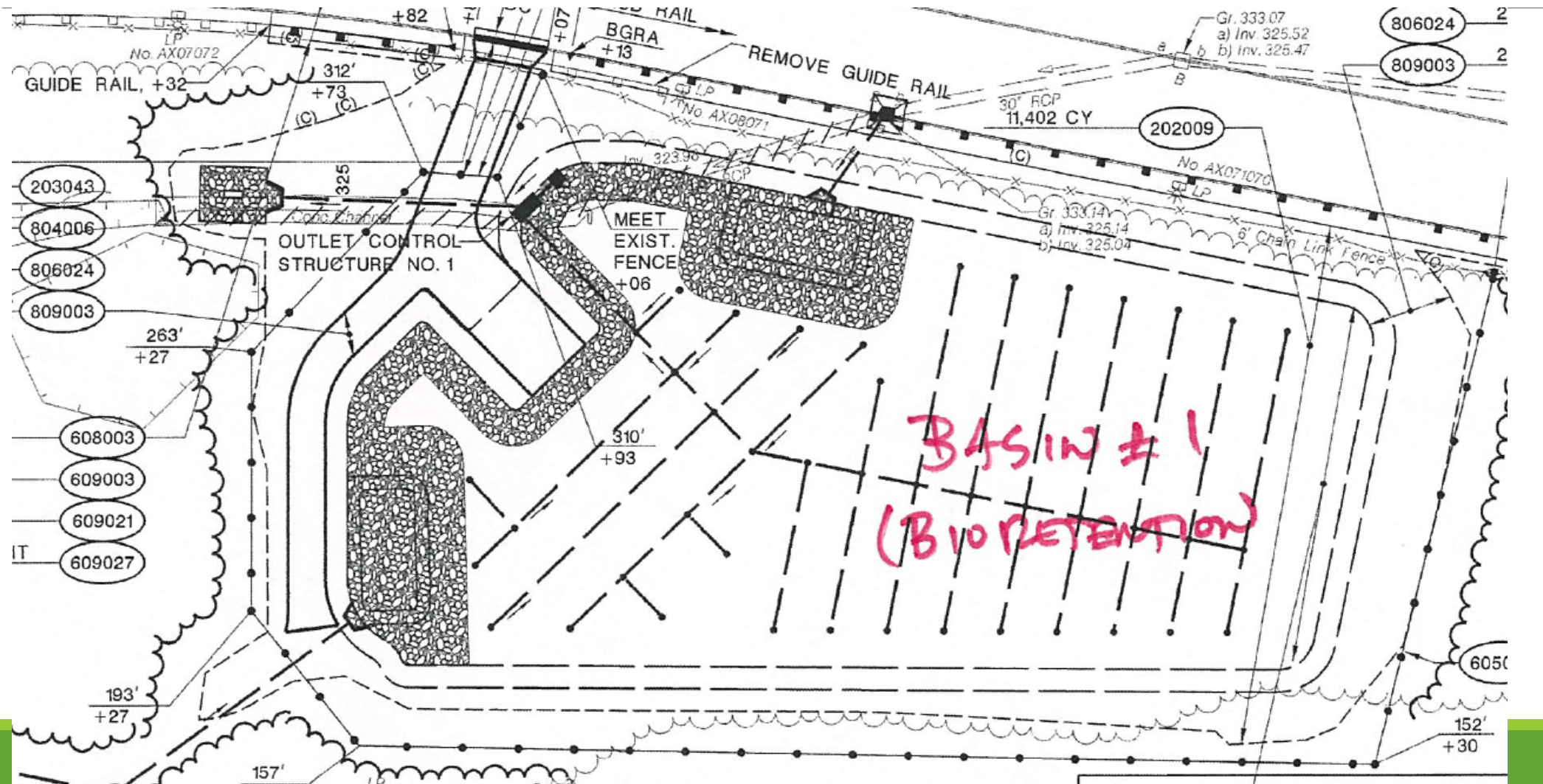


STORMWATER BASIN NOS. 1 & 2 FOREBAY DETAIL

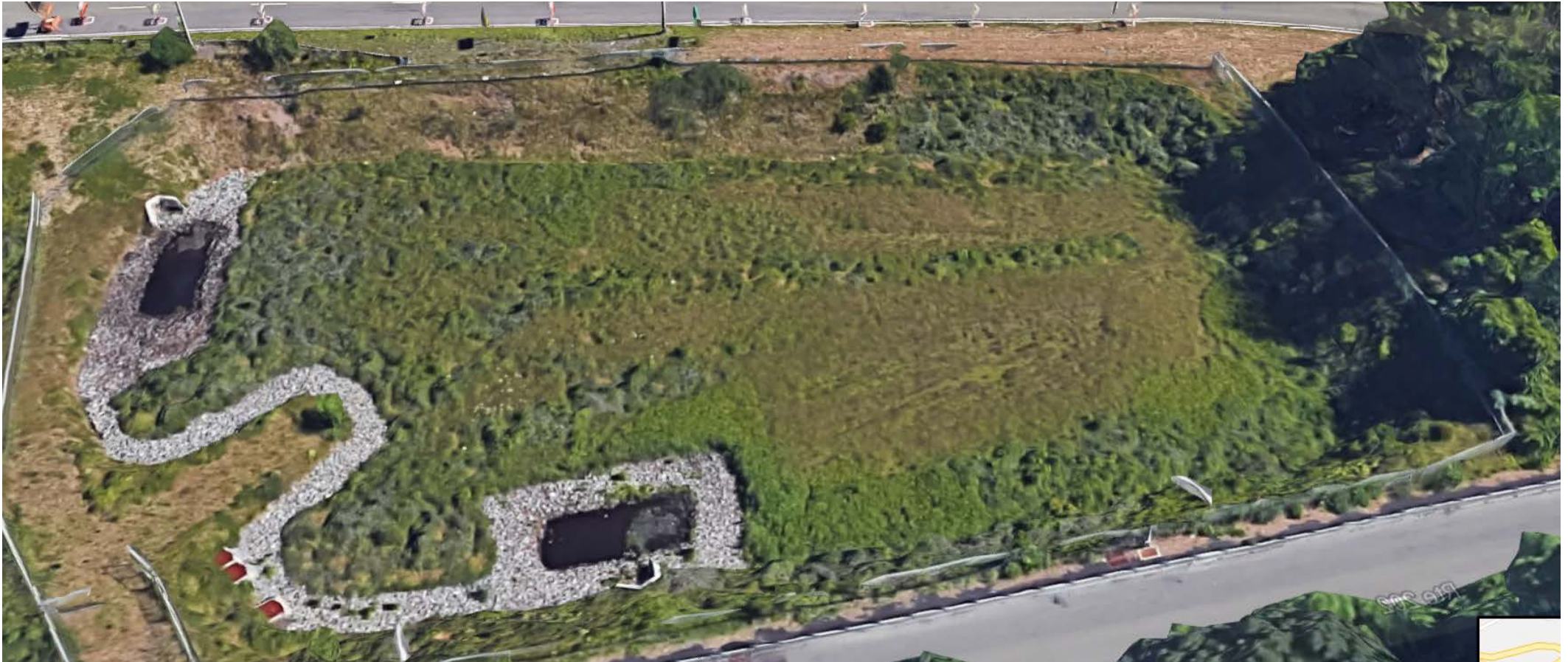
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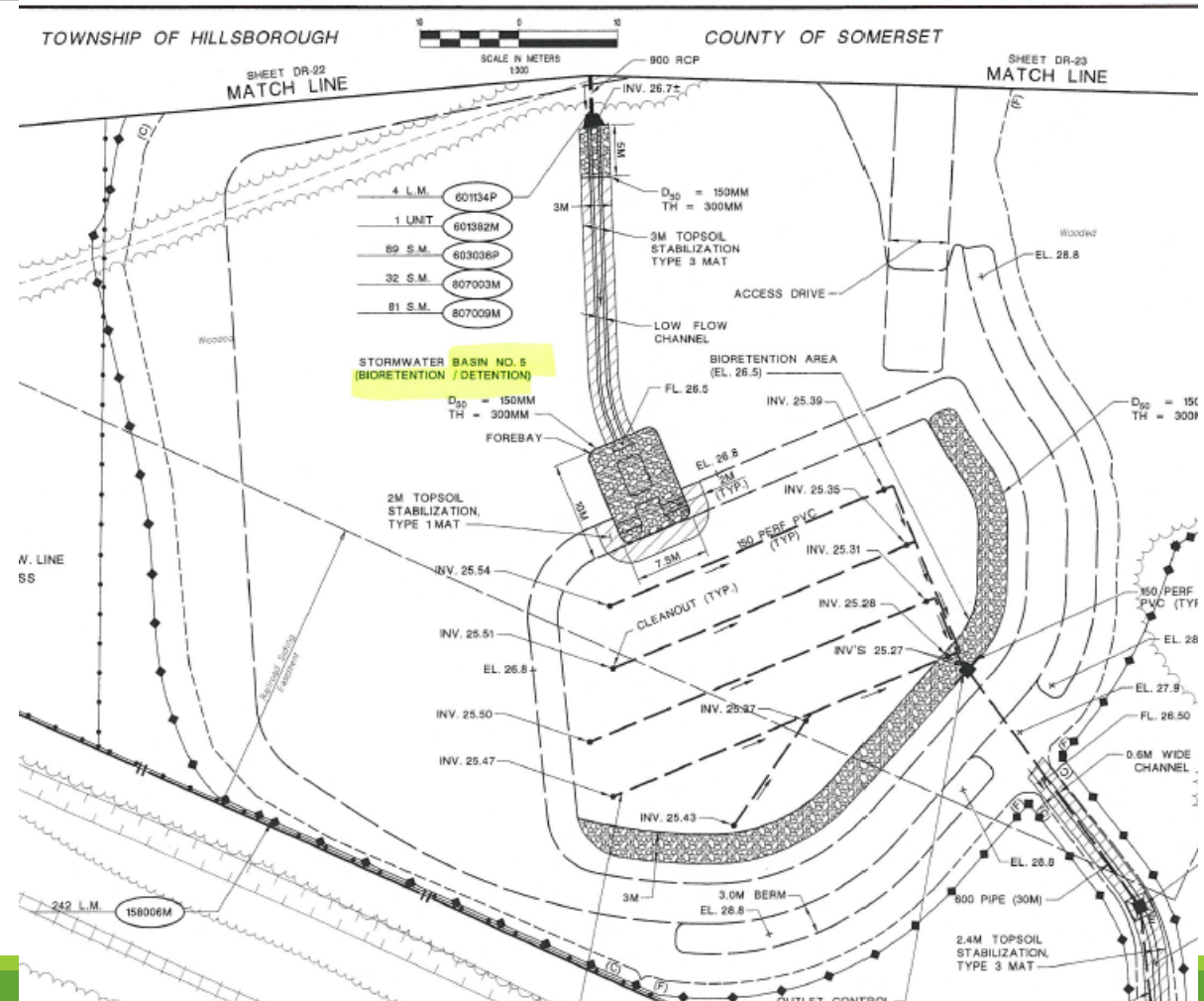


Bioretention Basin



Bioretention with Sediment Forebay





A photograph of a field with dense, dry, brown vegetation and bare trees in the background under a clear sky. The foreground is filled with tall, thin, brown stalks, possibly dried grass or reeds. The middle ground shows a dense thicket of brown shrubs and bushes. In the background, a line of bare trees stands against a clear blue sky. The overall scene suggests a late autumn or winter landscape.



Detention Basin Maintenance

- Clean Low Flow Channel
- Mow
- Fix anything Broken



Source: Google Maps



Infiltration Basin – Water Quality



Pervious Concrete Sidewalk



Source: Google Maps

Infiltration Basin

- Filter fabric prevented basin infiltration
- Fabric removed



Infiltration Basin

- Basin did not drain
- Converted to extended detention basin

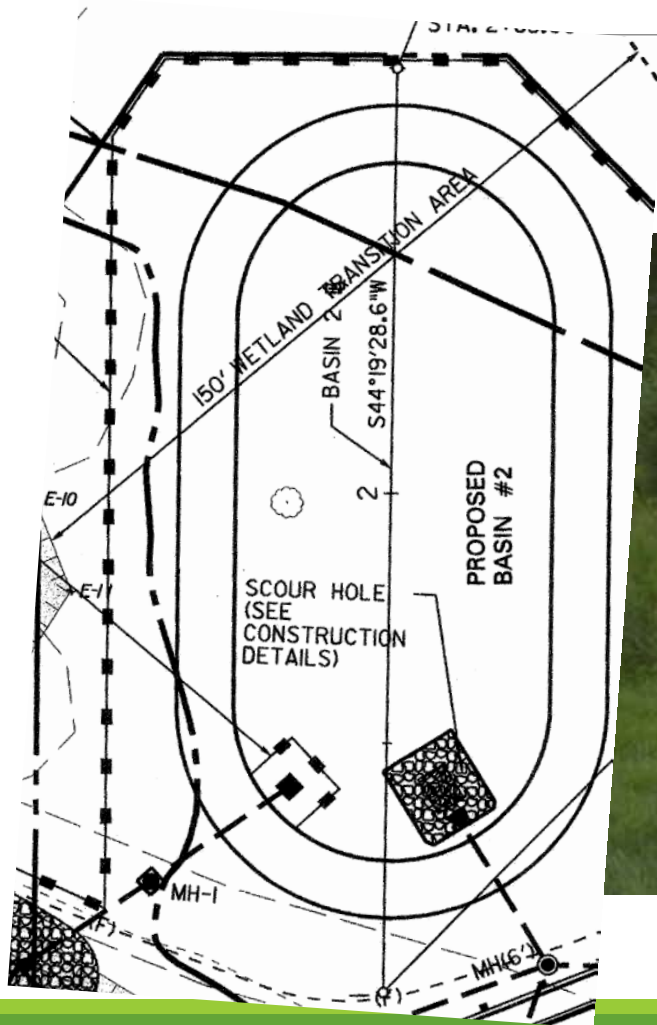


Basin

- Infiltration/Detention
- If Infiltration, Preserving the permeability of the soil



Infiltration Basin?



Source: Google Maps

Subsurface Gravel Wetlands Basin



Green Infrastructure for Roadways

PROS

- More effective at cleaning runoff
- Baseflow
- Reduces Heat Island Effect
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- Better Visual Impact

CONS

- Complex Design & Construction
 - Soil
 - Vegetation
- Difficult to repair if problems
- More Maintenance Intensive



Green Infrastructure

- Complex system, requires careful design
- More training needed
 - Construction staff
 - Maintenance personnel
 - Resident engineers
- More GI BMPs will be placed in the future

Green Infrastructure Only Works if the Treatment Processes Continue to Function

