Stormwater Management in the New Jersey Pinelands

Review of Recent Amendments to the Pinelands Comprehensive Management Plan

Presented By Ed Wengrowski, Environmental Technologies Coordinator,
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NJ Pinelands Commission - February 10th, 2022

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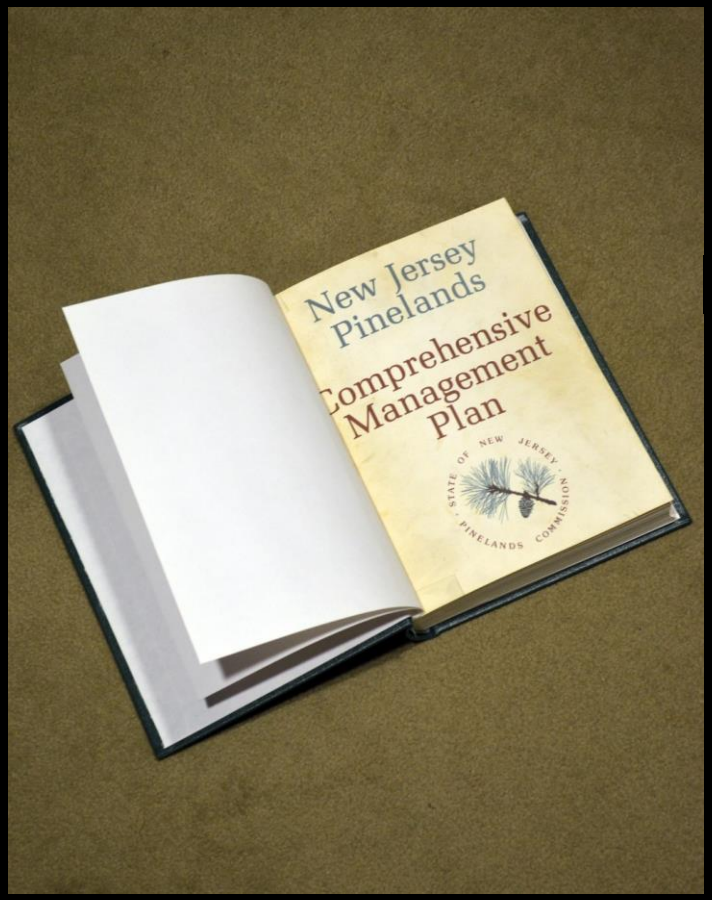
A Comprehensive Review of Stormwater Management in the New Jersey Pinelands

Pinelands Facts

- The Pinelands Area gained Federal & State designation and protection in 1978 & 1979
- Approx. one million acres – spanning 7 counties and 53 municipalities - roughly 20% of NJ's land area
- Governed by the 15 member Pinelands Commission. 7 members appointed by the Governor, 7 members appointed by each of the 7 Pinelands counties, & 1 member appointed by the Federal Secretary of the Interior
- The Pinelands are protected thru land use controls & environmental programs embodied in the CMP
- A globally rare ecosystem characterized by low pH, low nutrient streams fed by shallow groundwater
- Habitat for 43 T&E animal species and 92 T&E plant species
- Famous for the 17.7 trillion-gallon Kirkwood-Cohansey aquifer system –drinking water to approx. one million people, water for agriculture and base-flow to wetlands, streams and rivers
- Headwaters to Atlantic and Delaware River Basin Watersheds

- Surface waters classified as "Outstanding National Resource Waters"
- Groundwater classified as "Groundwater of Special Ecological Significance"

1980 – Initial steps toward stormwater management in the Pinelands



Original CMP Adopted
Nov. 21, 1980

- Identifies stormwater as a natural resource
- Emphasizes the importance of recharging stormwater to the K/C Aquifer
- Cautions that waterborne pollutants can impair groundwater quality where soils are excessively sandy.
- Eliminates direct discharges of stormwater to surface waters and wetlands
- Recommends clean stormwater from rooftops be directed to drywells for recharge
- Requests that NJDEP develop a BMP Manual for stormwater runoff control and management
- CMP remains a living document incorporating periodic amendments to the Commission's land use and environmental standards – see N.J.A.C. 7:50-6.84(a)6 for the most recent stormwater management standards

We manage stormwater runoff to reduce waterborne pollution …

Trash

Nitrogen

Phosphorus

Bacterial & viral pathogens

Heavy metals

Oil

Gasoline

Sediment (TSS)

Motor vehicle surfaces are particularly problematic…

https://pressofatlanticcity.com/news/breaking/proposed-improvements-at-garden-state-parkway-exits-36-37-38-in-egg-harbor-township-may/article_ed711290-3e72-11e2-ad57-0019bb2963f4.html

A ubiquitous tire rubber–derived chemical* induces acute mortality in coho salmon (Oncorhynchus kisutch) Zhenyu Tian, Haoqi Zhao et al.

* The highly toxic quinone transformation product of N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine) (6PPD), a globally ubiquitous tire rubber antioxidant. https://science.sciencemag.org/content/early/2020/12/02/science.abd6951

Motor fuels

Lubricants

Antifreeze

Brake residue

Deicing salt crystals, brine and sand

Other emerging pollutants*

Fish kills linked to runoff from road surfaces (NY Times 12.6.2020)

Dr. McIntyre, left, examined a coho salmon that died from exposure to highway runoff in 2014.Credit...Ted S. Warren/Associated Press

Chemically treated lawns, recreation fields and agricultural lands are also significant contributors of nonpoint source pollution …

- Nitrogen fertilizers applied in excess can cause eutrophication in surface waters.
- Harmful Algal Blooms (HABs) caused by Cyanobacteria (Blue-Green Algae)
- Cyanobacteria have a particular affinity for fertilizers containing Urea.
- Slow release (organic) N is better than synthetics. Apply seasonally according to NJ law.
- Herbicides, fungicides and insecticides can be leached to groundwater and transported to surface water in stormwater runoff.

Pancoast Mill Pond
Buena Vista Township Sept. 2014

Eutrophic (non-HAB) conditions likely resulting from excessive fertilizer laden stormwater runoff from managed turf.

And we manage stormwater to minimize local flooding

www.burlingtoncountytimes.com

www.burlingtoncountytimes.com

July 12, 2004 Estimated 100+year storm event

13" rain over 15 hour- Failure of 17 dams, 28 others damaged

July 12, 2021 Estimated 100+ year storm event

7.63" rain in Florence Township, Burlington County

whyy.org/articles/burlington-county-residents-businesses-now-eligible-for-july-12-storm-aid/ty-flooding/

Addressing these issue through long-standing Pinelands stormwater regulations

Stormwater management is required for all "Major Development" (disturbance of >5,000 SF)

Volume Control

Retain and infiltrate rainfall from new impervious surfaces from the 10-year storm of 24-hour duration:

~ 5"+ rainfall.

Ensures most stormwater is recharged to the Kirkwood Cohansey aquifer.

Runoff Rate Control

No increase in the rate of runoff from the parcel from the 2-yr, 10-yr and 100-yr storm of 24-hour duration – from pre to post development

Aims to minimize local flooding.

Long-standing Pinelands stormwater regulations

- Prohibit the direct discharge of stormwater runoff to wetlands and surface waters.
  - For pollution control and maintenance of wetland hydrology

- Retain and infiltrate the volume of runoff from the 10-year, 24-hour storm from all new impervious surfaces. Rainfall totals (inches) and average recurrence intervals (years) are based on NOAA Atlas 14 data (being updated).
  - For groundwater recharge and flood control

- Minimum 2-feet separation between a stormwater infiltration basin and the seasonal high-water table and avoid excessively drained soils.
  - For water quality renovation

- Rates of runoff from the parcel from the 2-year, 10-year and 100-year storms shall not increase as a result of development.
  - For flood control

Storm totals based on NOAA ATLAS 14 - Point Precipitation Frequency Estimates

Location information: Toms River, New Jersey, USA*
Latitude: 39.9163°
Longitude: -74.2182°
Elevation: 39.11 ft **

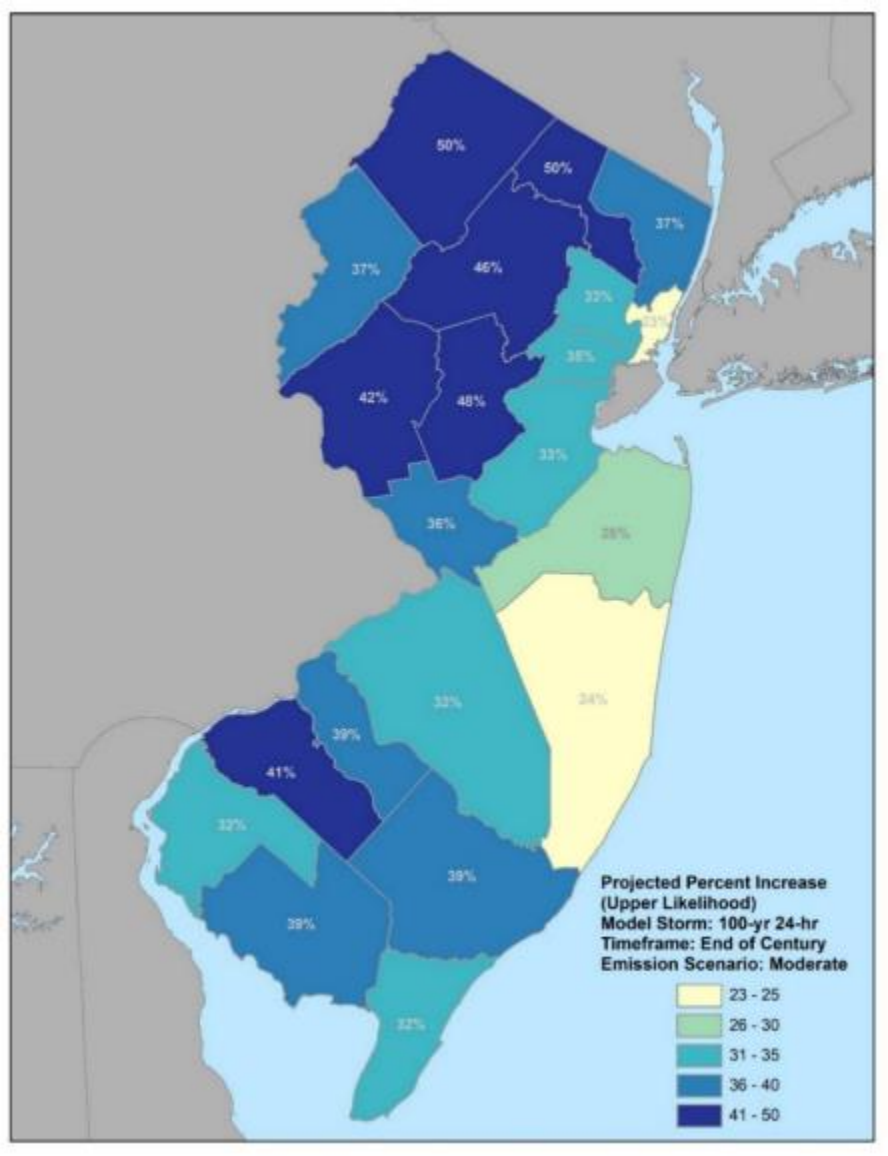
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.351** (0.317-0.388)	**0.420** (0.380-0.464)	**0.498** (0.450-0.551)	**0.555** (0.501-0.615)	**0.627** (0.563-0.694)	**0.679** (0.607-0.752)	**0.733** (0.651-0.813)	**0.782** (0.691-0.871)	**0.846** (0.739-0.948)	**0.896** (0.775-1.01)
10-min	**0.561** (0.506-0.620)	**0.671** (0.608-0.743)	**0.798** (0.721-0.883)	**0.888** (0.802-0.984)	**0.999** (0.898-1.11)	**1.08** (0.967-1.20)	**1.16** (1.03-1.29)	**1.24** (1.10-1.38)	**1.34** (1.17-1.50)	**1.41** (1.22-1.59)
15-min	**0.701** (0.633-0.775)	**0.844** (0.764-0.934)	**1.01** (0.912-1.12)	**1.12** (1.01-1.24)	**1.27** (1.14-1.40)	**1.37** (1.22-1.52)	**1.47** (1.31-1.63)	**1.57** (1.38-1.74)	**1.68** (1.47-1.89)	**1.77** (1.53-2.00)
30-min	**0.962** (0.868-1.06)	**1.17** (1.06-1.29)	**1.43** (1.30-1.59)	**1.63** (1.47-1.80)	**1.88** (1.69-2.08)	**2.06** (1.84-2.29)	**2.25** (2.00-2.50)	**2.44** (2.15-2.71)	**2.68** (2.34-3.00)	**2.87** (2.48-3.23)
60-min	**1.20** (1.08-1.33)	**1.46** (1.32-1.62)	**1.84** (1.66-2.03)	**2.12** (1.91-2.35)	**2.50** (2.24-2.77)	**2.80** (2.50-3.10)	**3.10** (2.76-3.44)	**3.42** (3.02-3.80)	**3.85** (3.36-4.31)	**4.19** (3.62-4.72)
2-hr	**1.47** (1.33-1.64)	**1.80** (1.62-2.00)	**2.28** (2.06-2.54)	**2.65** (2.38-2.95)	**3.16** (2.82-3.51)	**3.58** (3.18-3.97)	**4.01** (3.53-4.47)	**4.46** (3.90-4.98)	**5.09** (4.39-5.73)	**5.60** (4.79-6.34)
3-hr	**1.62** (1.46-1.81)	**1.98** (1.78-2.21)	**2.52** (2.26-2.81)	**2.93** (2.63-3.27)	**3.52** (3.13-3.93)	**4.00** (3.53-4.47)	**4.51** (3.95-5.04)	**5.04** (4.37-5.65)	**5.79** (4.95-6.54)	**6.41** (5.41-7.28)
6-hr	**2.04** (1.83-2.29)	**2.48** (2.22-2.79)	**3.14** (2.81-3.52)	**3.68** (3.27-4.12)	**4.46** (3.93-4.99)	**5.11** (4.47-5.72)	**5.81** (5.04-6.51)	**6.57** (5.64-7.38)	**7.67** (6.47-8.68)	**8.60** (7.15-9.78)
12-hr	**2.47** (2.22-2.79)	**3.00** (2.69-3.38)	**3.82** (3.41-4.29)	**4.52** (4.02-5.07)	**5.56** (4.90-6.23)	**6.47** (5.65-7.25)	**7.46** (6.43-8.38)	**8.57** (7.28-9.66)	**10.2** (8.51-11.6)	**11.7** (9.53-13.3)
24-hr	**2.87** (2.64-3.13)	**3.49** (3.22-3.82)	**4.54** (4.17-4.95)	**5.44** (4.98-5.93)	**6.82** (6.19-7.39)	**8.02** (7.24-8.68)	**9.39** (8.40-10.1)	**10.9** (9.68-11.8)	**13.3** (11.6-14.3)	**15.3** (13.2-16.5)

Current NOAA Atlas 14 precipitation quantity estimates are not up to date, nor do they reflect likely changes due to climate change. These estimates are being updated by the DEP based on the latest science.

For quality control DEP uses the "Water Quality Design Storm" is a 1.25" rainfall event falling over a 2-hour period.

Managing stormwater runoff with an eye toward climate change.



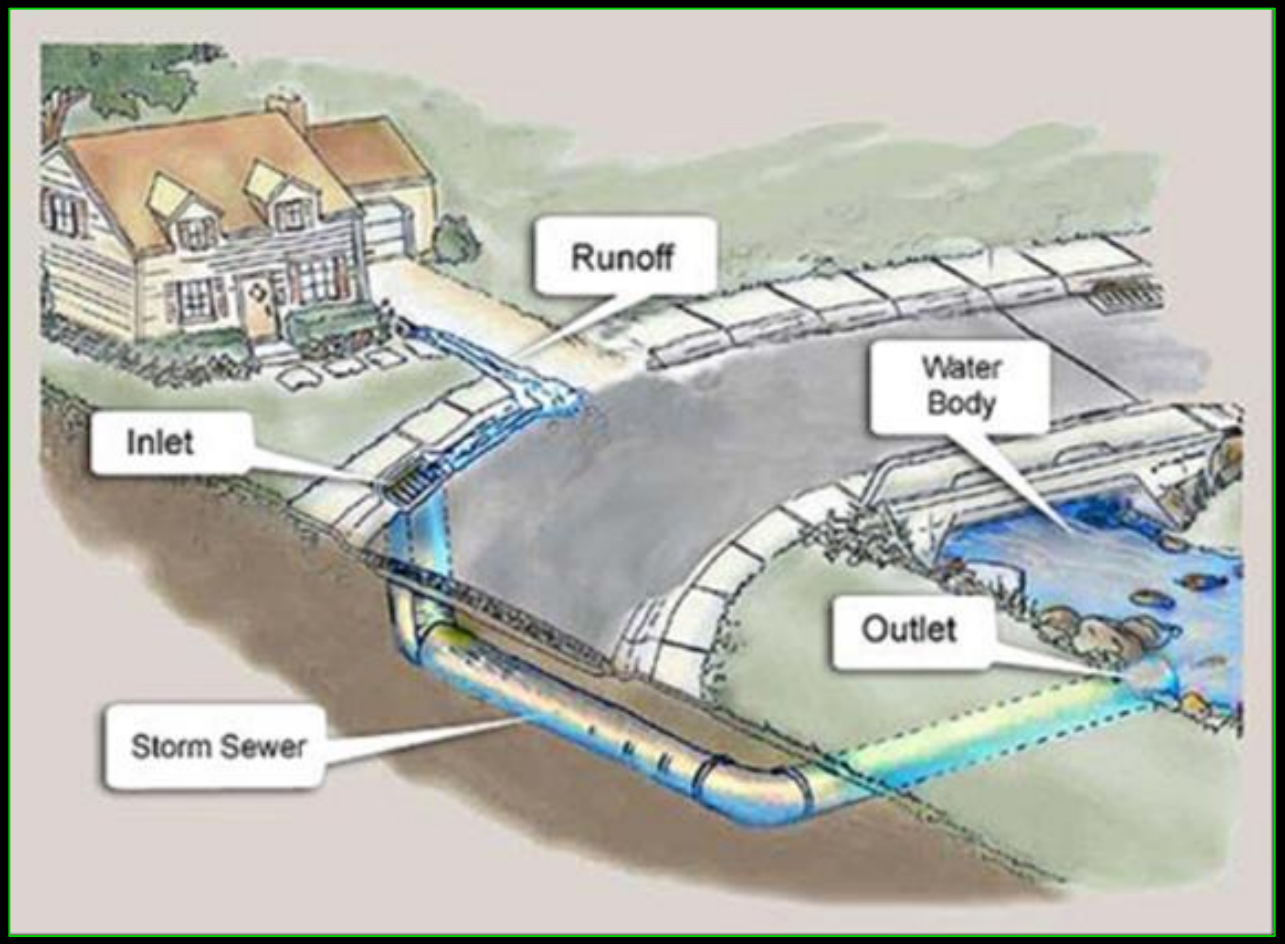
Changes in Hourly and Daily Extreme Rainfall Amounts in NJ since the Publication of NOAA Atlas 14 Volume

Art DeGaetano and Harrison Tran
Northeast Regional Climate Center
Department of Earth and Atmospheric Science
Cornell University, Ithaca NY

https://www.nj.gov/dep/dsr/publications/nj-atlas-14.pdf

By referencing NJDEP's N.J.A.C 7:8 in the CMP, the Commission aims to incorporate the updated storm totals coincident with NJDEP's rule change

Stormwater Management using Grey Infrastructure



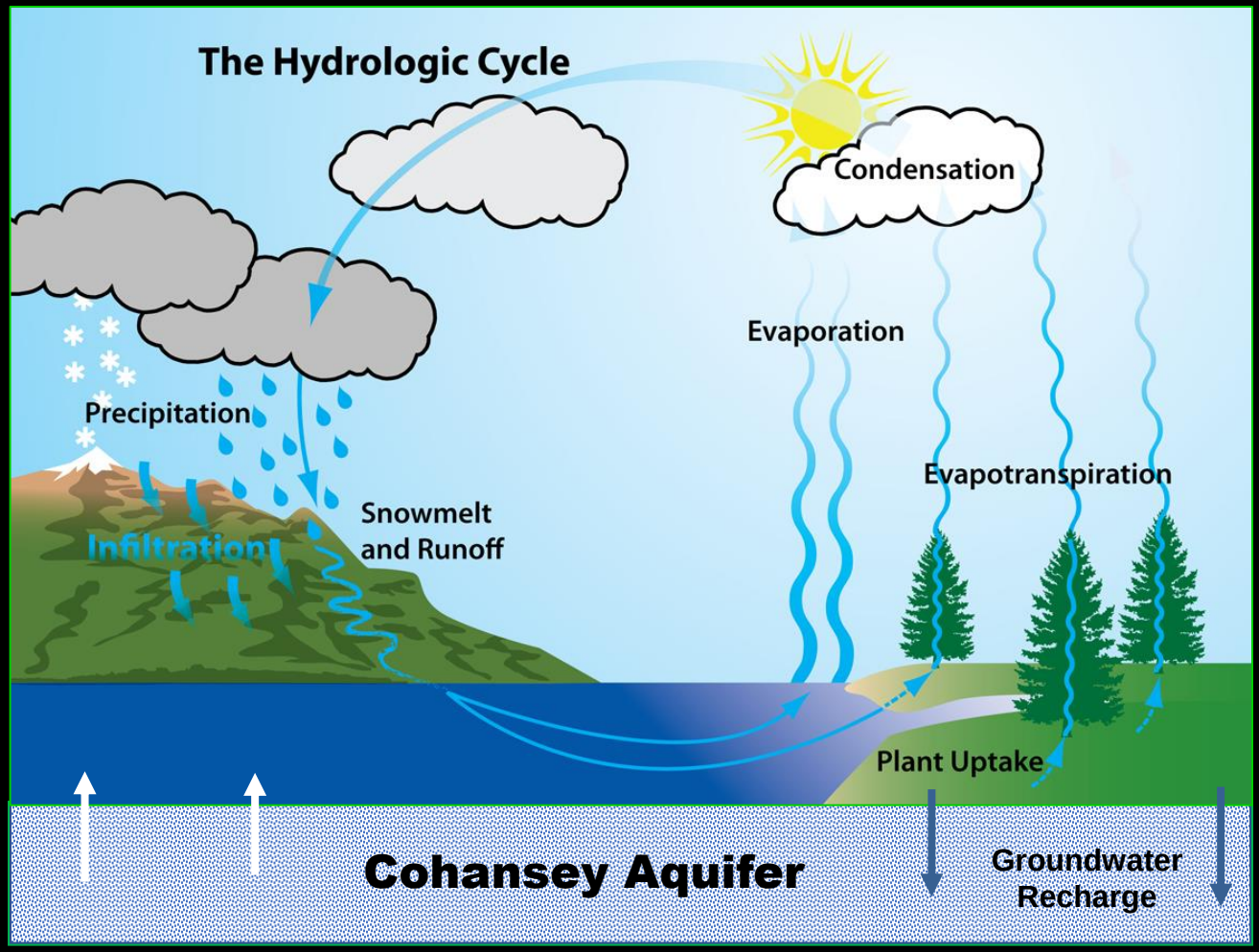
Hard surfaces do little to remove waterborne pollutants or slow the movement of runoff onto adjoining lands and water bodies.

Goal of the New Stormwater Management Rules

Use of Green infrastructure

To create hydrologically functional landscapes to maintain or reproduce the natural hydrologic cycle for the developed area

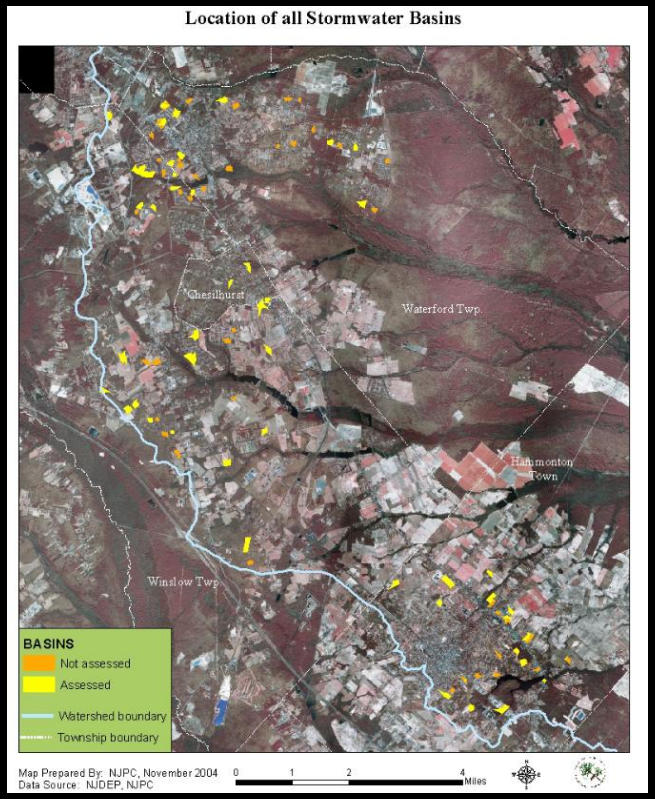
Soil and plants are used to their full advantage in absorbing runoff and incorporating nutrients into plant tissue



Adapted from USGS graphic

Learning from Experience

Groundwater recharge is often difficult !



2003 – "Pinelands Assessment of Existing Infiltration Basins in the Mullica River Watershed" – a NJDEP Grant Funded Project.

- Pinelands staff evaluated basins designed to infiltrate at least the 10-year storm volume to see if they were infiltrating as designed.

- All reportedly provided two-feet separation to the SHWT (Hand auger method)

- In many cases, there was no record of soil testing (permeability/perc tests, identification
- of restrictive soil layers, etc.) at the site of the basin other than a single hand auger soil boring log for SHWT.

- In other cases, the soil layer in which a permeability/perc test was performed was excavated during basin construction and the basin bottom was placed in untested soil.

Learning from Experience

- Ninety-three basins were identified , forty-seven randomly selected for visual assessment
- All basin field assessments conducted at least 72 hours after a rainfall event.
- 70% of basins were not infiltrating, nearly half with >75% basin bottom under water
- More than half appeared to be "maintained" as evidence by mowing.
- No correlation between basin failure and USDA soil mapping, HSG, age of basin, or type of development served
- This study identified the need to revise the CMP's stormwater management standards – with a particular emphasis on rigorous soil testing both before and after basin construction.

Lessons learned were incorporated into the 2006 CMP amendments

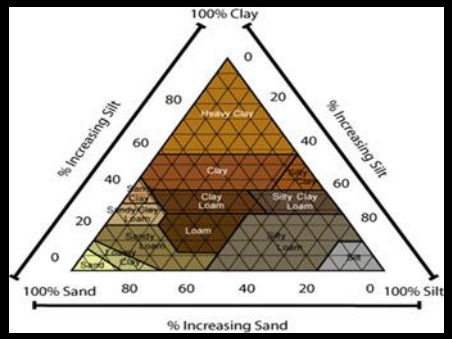
Required rigorous soil and site evaluations during basin location selection

- backhoe-excavated soil test pits
- detailed (USDA) soil profile descriptions
- permeability testing

Required post construction permeability testing

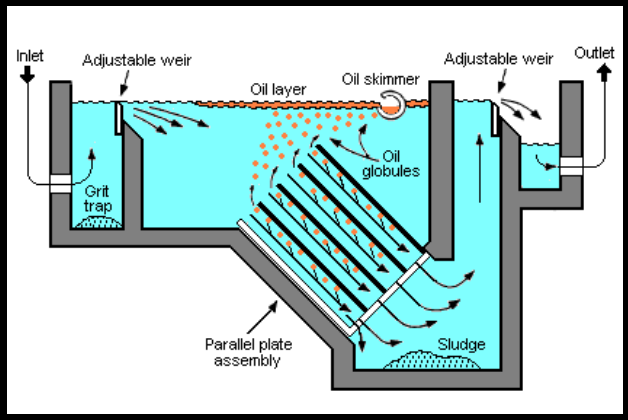
Required post construction as-built plans and certifications to confirm basin geometry

Required enhanced basin maintenance (in perpetuity) and annual reporting of maintenance activities

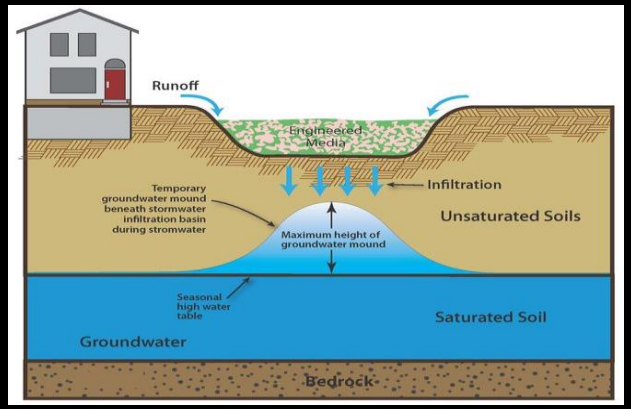


Other important stormwater requirements incorporated in the 2006 CMP stormwater amendments

Required pretreatment of stormwater runoff from High Pollutant Load Areas (HPLA) including 90% TSS removal and oil/water separators where petroleum products are present



https://en.wikipedia.org/wiki/API_oil%E2%80%93water_separator



https://stormwater.pca.state.mn.us/index.php?title=File:Mounding_schematic.jpg

Required groundwater mounding analysis to ensure a mounded water table would not interfere with basin hydraulics and to protect nearby basements and septic systems

Prohibited heavy equipment from operating on the stormwater basin infiltrative surface.

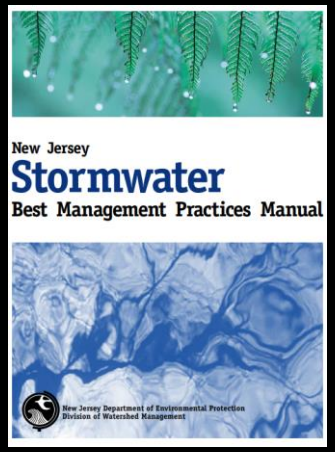
Still more important rule amendments incorporated in 2006

Required the use of smaller distributed BMP's

Conventional site design

Low Impact Development Site Design

https://www.wbdg.org/resources/low-impact-development-technologies



Harmonize Pinelands rules with NJDEP's rules

Limited site disturbance – save the trees

https://www.realtor.com/realestateandhomes-search/Sicklerville_NJ/with_woodedland

Effective March 2021, NJDEP requires Green Infrastructure to manage stormwater

The recently adopted Pinelands stormwater rule amendments follow suit

Manage the stormwater close to the source

Store stormwater runoff for reuse

Treat stormwater through infiltration into the subsoil

Treat stormwater through filtration by vegetation or soil

Recent (Jan. 18, 2022) Stormwater management amendments to the CMP

Stormwater management is now required for <u>minor residential development</u>

- Groundwater recharge of clean runoff from roofs to pervious pavement, rain gardens and/or drywells. Drywells shall be designed to prohibit reptile and amphibian entrapment.

Stormwater management is also now required for <u>minor non-residential development</u>

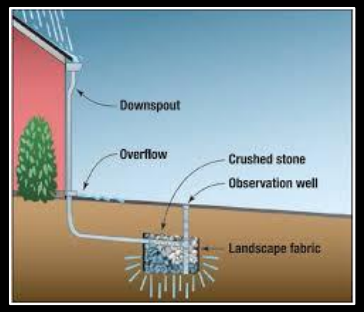
- Pretreat stormwater to remove 80% TSS and recharge runoff when an increase of more than 1000 square feet of regulated motor vehicle surface is proposed.

Major development must remove at least 65% nitrogen from stormwater by routing runoff through multiple green infrastructure BMP's for the water quality design storm

Minor* residential development

- New Pinelands requirement to retain and infiltrate clean stormwater generated by the 10-year storm (~5”) from the roof of a house through use of green infrastructure measures, including:

- Dry wells



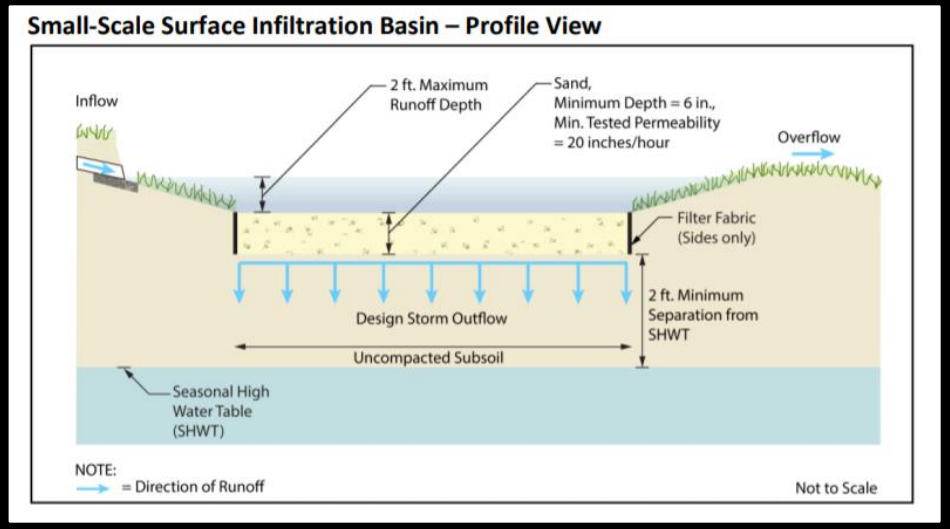
* Minor residential development includes the construction of four or fewer dwelling units.

- Pervious paving systems

- Small scale bioretention (incl. rain gardens)

Minor Non-residential Development

- Requires on-site treatment and infiltration of stormwater generated from motor vehicle surfaces by the water quality storm (1.25"/2 hrs.) from non-residential development with an increase of more than 1,000 square feet of regulated motor vehicle surface.



Stricter treatment standard for nitrogen removal in the Pinelands Area

- For new major development, requires reduction of total nitrogen load in stormwater runoff from the water quality storm by a minimum of 65% including permanent lawn and turf areas intended for active human use*.

- This protects surface water from algal blooms, low DO, and invasive species resulting from nutrient inputs

* Does not apply to road projects with vegetated shoulders or medians that are not fertilized and are not intended for active human use.

How to attain and demonstrate 65% removal of Nitrogen from stormwater runoff

Table 4.2 – Typical Phosphorous and Nitrogen Removal Rates for BMPs

Best Management Practice (BMP)	Total Phosphorous Removal Rate (%)	Total Nitrogen Removal Rate (%)
Bioretention Basin	60	30
Constructed Stormwater Wetland	50	30
Extended Detention Basin	20	20
Infiltration Basin	60	50
Manufactured Treatment Devices	See N.J.A.C. 7:8-5.7(d)	See N.J.A.C. 7:8-5.7(d)
Pervious Paving[2]	60	50
Sand Filter	50	35
Vegetative Filter	30	30
Wet Pond	50	30

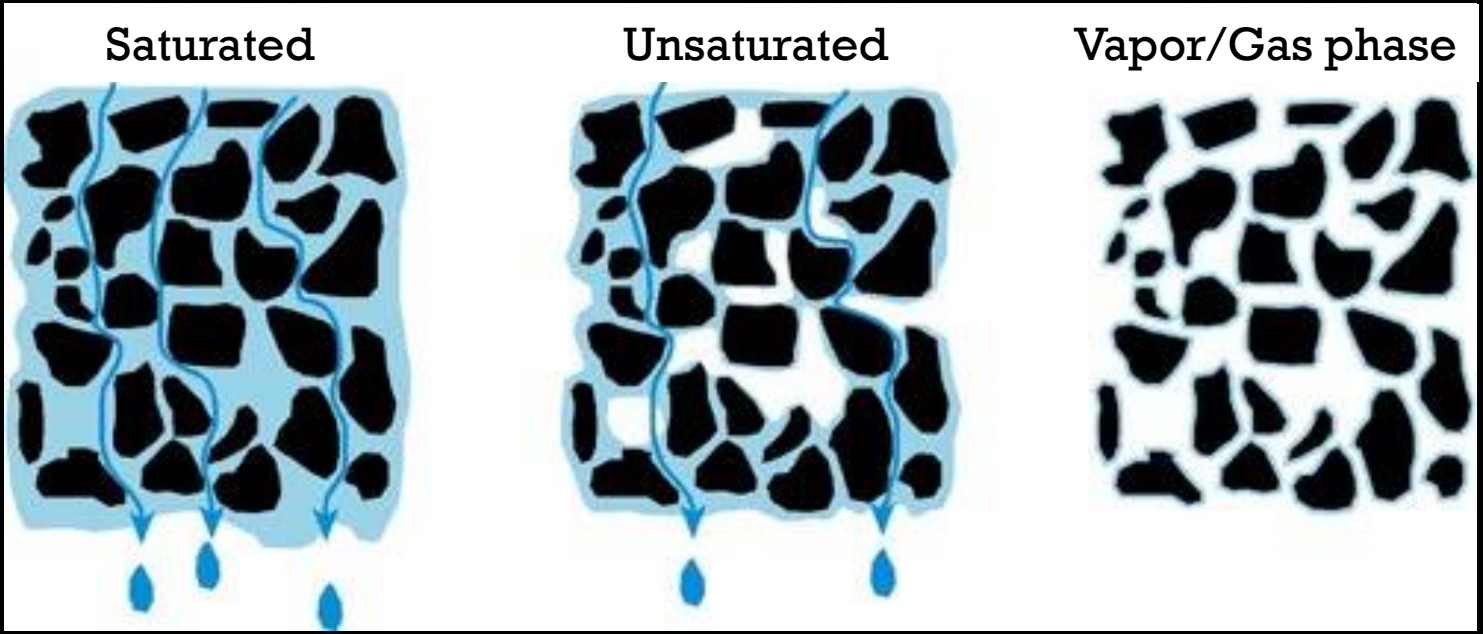
$$E = A + B - \left[\frac{(AxB)}{100}\right]$$

Where:
E = Total pollutant removal efficiency (%)
A = Efficiency of the First or Upstream BMP
B = Efficiency of the Second or Downstream BMP

BMP	% Removal
Bioretention	30
Vegetated filter	30
Infiltration basin	50

BMPs in series	A+B	AxB	AxB/100	Total TN	% removal
Bioretention + Infiltration basin	80	1500	15		**65**
Vegetated filter + infiltration basin	80	1500	15		**65**

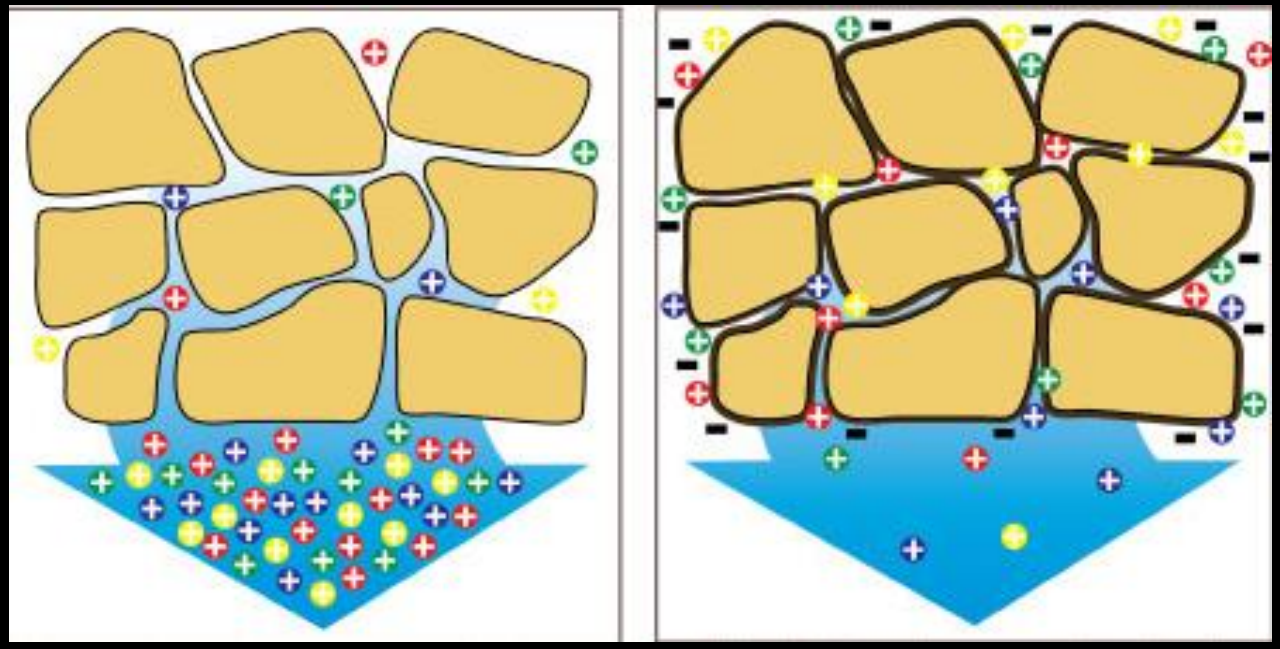
Using soil as a treatment medium



- Unsaturated flow increases travel time and maximizes contact with soil particle surfaces (via surface tension)
- Soil pores contain both air and water enabling aerobic microbes to treat the wastewater.
- Permeability rate and rain size distribution matters – A wide range of soil particle sizes is better that uniform soils and permeability rates between 1 and 20 in/hr. are required

Soil as a treatment medium –removal of positively charged pollutants

Cation Exchange – attraction and retention due to electric charge



Sandy soils often lack the negative charge on clay & organics & don't retain positively charged (cation) pollutants.

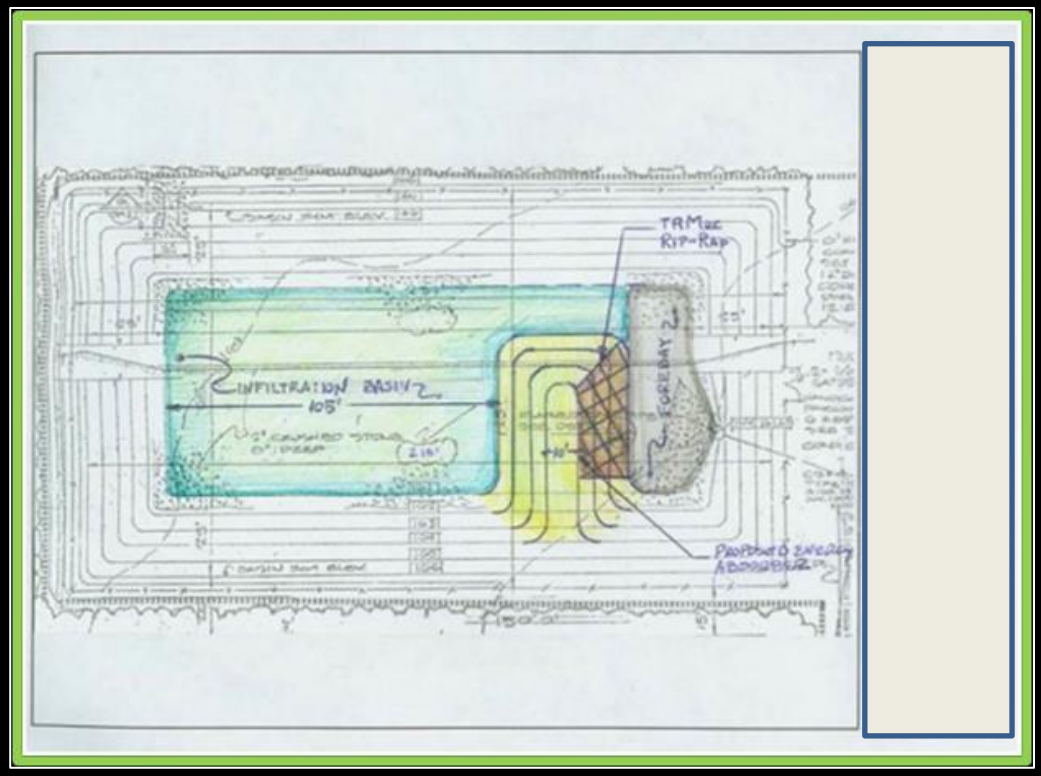
Loamy soils containing clay and organics attract and retain positively charged cations (Virus particles, heavy metals, sodium, calcium, potassium, ammonium, etc.)

Neither sandy soils nor loamy (silty/clayey) soils are effective at removing NO_3^- . This is where plants play a major role via nutrient uptake.

Exceptions and Mitigation

If stormwater management requirements cannot be met on-site, based on NJDEP standards, applicants may request:

- A municipal variance (for private development)
- An exception from the Pinelands Commission (for public development)



Exceptions and Mitigation

- Variances and exceptions may only be granted from the on-site design and performance standards for green infrastructure, groundwater recharge, runoff quality, and runoff quantity.

- No decrease in the total volume of stormwater required to be infiltrated will be permitted.

- No variance or exception may be granted from the CMP's prohibition on direct discharge of runoff of wetlands, wetlands transition areas or surface water bodies.

Off-site Mitigation Requirements

- If a variance or exception is approved, an off-site mitigation project must also be identified and approved.
- Variance or exception can only be granted for the portion of the standards that can't be met onsite. That is, if only half of the required volume can be retained and infiltrated onsite, it must be achieved onsite, and the remaining volume obligation may then be retained and infiltrated off-site.
- All mitigation projects must be in the same HUC-14 drainage area as the proposed development. Sites in the larger HUC-11 drainage area may be approved if necessary.
- All mitigation projects must be in the Pinelands Area.
- The same requirements will be applied to all public and private development.

Summary of Pinelands Stormwater Rules

Retained CMP standards:

- Greater volume recharge than is required by DEP
- Prohibition on discharging stormwater to wetlands/streams
- Special treatment of runoff from HPLA (90% TSS removal)
- Emphasis on soil testing and as-built certifications
- No outright exemptions to any of the stormwater standards.

New CMP amendments:

- Stormwater management required for more development:
- all minor residential development and minor non-residential development proposing a significant increase in regulated motor vehicle surface
- More stringent conditions for off-site recharge of stormwater
- New stringent nitrogen removal standard

Next Steps

Pinelands staff will develop and distribute an updated Model Stormwater Control Ordinance for Pinelands Area municipalities.

Target for completion and distribution of the updated Model Pinelands Stormwater Control Ordinance is April 1, 2022.

The January 18, 2022 Stormwater CMP amendments will need to be met for both public and private development in the Pinelands Area.

Of special note:

All Pinelands Area municipalities must adopt a local stormwater control ordinance within one year of the January 18, 2022 adoption of the CMP's stormwater rule amendments.

Compliance with the updated rules must be achieved on or before January 18, 2023.

Questions?

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