

Where the Water Goes

Hydrology for Inspectors

6 Contact Hours



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Your Instructors

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WebEx How To

How to Use the Handbook

Audio trouble?
Click the down arrow next to unmute and select different speakers

This is your participant panel
Click arrows next to each section to open.
* Chat is one way from DEQ to you.
* Questions is how you interact with us.
* Polling will appear after the first poll.

Click to open Q & A / Chat / Other
Access Q & A, Chat and --- (other features)

DEQ

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Continuing Education Courses
<https://www.deq.virginia.gov/our-programs/training-certification/continuing-education>

EVENT	DATE/TIME
Where the Water Goes (virtual)	01/22/2025 8:30 AM - 01/23/2025 12:00 PM
Refresher for Inspectors (Lynchburg)	03/18/2025 8:30 AM - 4:30 PM
Large Scale Construction Site Inspections (Fredericksburg)	04/07/2025 8:30 AM - 4:30 PM
Refresher for Inspectors (Fairfax)	05/28/2025 8:30 AM - 4:30 PM
Regulatory SWPPP Inspections (Fairfax)	05/29/2025 8:30 AM - 4:30 PM
Large Scale Construction Site Inspections (Wytheville)	06/18/2025 8:30 AM - 4:30 PM
Using the Virginia Stormwater Management Handbook (Hampton)	07/09/2025 8:30 AM - 4:30 PM

DEQ

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NEWS

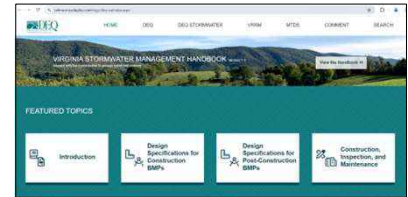
- Virginia Erosion Stormwater Management Act (VESMA)
- Effective July 1, 2024
- NEW! Virginia Stormwater Management Handbook – Online – July 1, 2024
- CGP update – July 1, 2024



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NEWS

New Virginia Stormwater Management Handbook Combined VESCH and SW BMP Clearinghouse – **Online**



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Agenda – Day 1

8:30 – 9:40	Module 1. Introduction/Hydrologic Cycle
10:00-10:15	Break
9:50 – 10:50	Module 2. Some Principles of Water
11:00 – 11:30	Module 3. Plan Reading Skills
11:30 – 12:00	Module 4. Hydrology and Land Disturbance

For 6 hours credit both days are required.



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Agenda – Day 2

8:30 – 9:00	Module 4. Continued
9:00 – 10:00	Module 5. Water and Slopes
10:00 – 10:15	Break
10:15 – 11:00	Module 6. Water and Our ESC and Stormwater BMPs
11:00 – 12:00	Module 7. Inspection issues



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QuickPolls - A bit about you



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The purpose of this class

1. The importance of hydrology
2. Basic theory/principles of hydrology
3. Inspector basics:
 - a. Compliance assistance
 - b. Enforcement
4. Have fun and learn something!

Six contact hours are given for completing this course. Hours earned may be applied to ESC and SWM recertification. No partial credit is given

Module I



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The purpose of this class

PLEASE NOTE – This course is not one of the required prerequisite classes for taking either ESC or SWM certification exams.



This isn't the class you're looking for.

Module I



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Module 1

Introduction and Hydrologic Cycle



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Module 1a

Introduction



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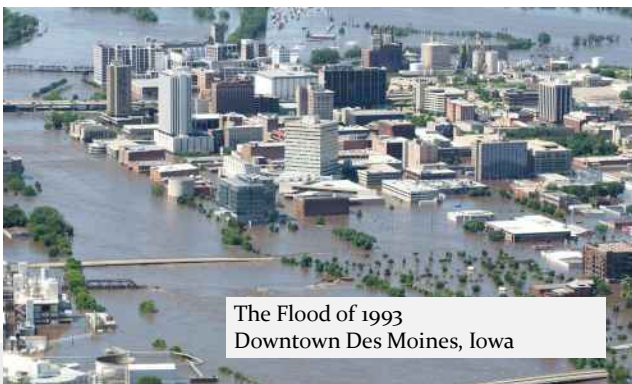
Famous Stormwater Quote

HELP! HELP!
I'M
DROWNING!
(ANONYMOUS)



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Flooding is a major issue in our country



The Flood of 1993
Downtown Des Moines, Iowa

25

Flooding is a major issue in our country




Hurricane Helene, Sept. 2024
Damascus, VA

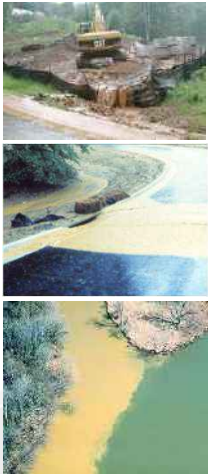
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Our Concern!

In the beginning




Land Disturbance & Construction

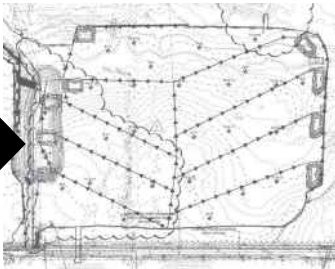


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Our Concern!



Land Disturbance & Construction



Altering the drainage patterns on a construction site



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Our Concern!




Post Construction Stormwater Management




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This Course:


WTWG - Hydrology for Inspectors

What is Hydrology?

The study of the distribution and movement of water both on and below the Earth's surface, as well as the impact of human activity on water availability and conditions.



National Geographic



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This Course:



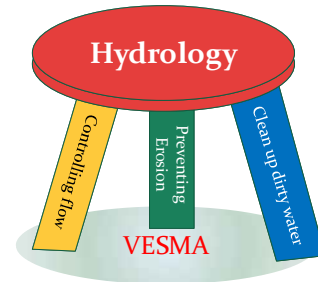
WTWG - Hydrology for Inspectors

In ESC and SWM
Movement of water in
relation to a
construction site and
construction activity



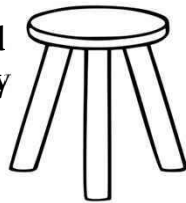
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Our Three- Legged Stool of Hydrology



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Our Three-Legged Stool of Hydrology



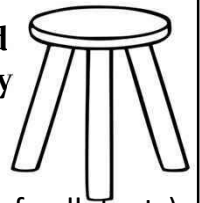
1. Controlling flow

- Various ESC measures (during construction - new nomenclature - C-BMPs)
- Various Stormwater BMPs (post construction – P-BMPs)



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Our Three-Legged Stool of Hydrology



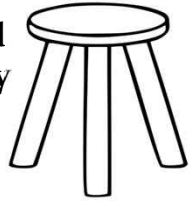
2. Preventing erosion (or pick up of pollutants)

- Ground cover
- Slowdown the water
- Slowdown discharge



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Our Three-Legged Stool of Hydrology



3. Cleanup dirty water

- Various Erosion C-BMPs (during construction)
- Various Stormwater P-BMPs (post construction)



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An Inspector's Job

The inspector's job is two-fold:

1. Ensure the plan is implemented as approved
 - a) All controls installed (ESC/C-BMP and SWM/P-BMP)
 - b) Per the details and specifications
2. Identify when the plan needs to be changed
 - a) Constructability issues
 - b) Plan is inadequate



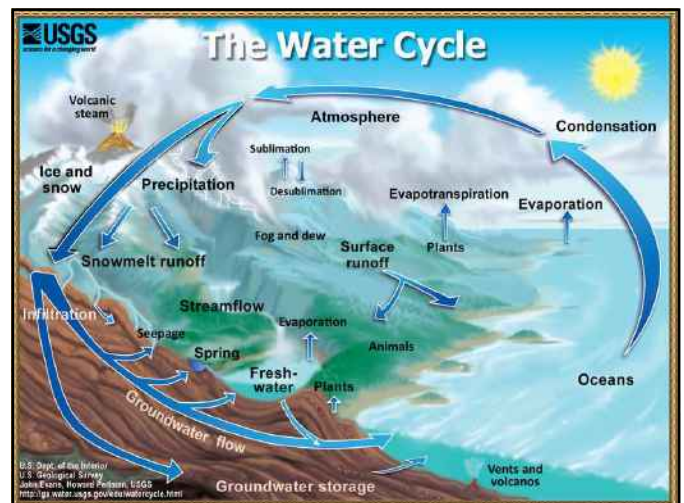
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Module 1b

The Hydrologic Cycle

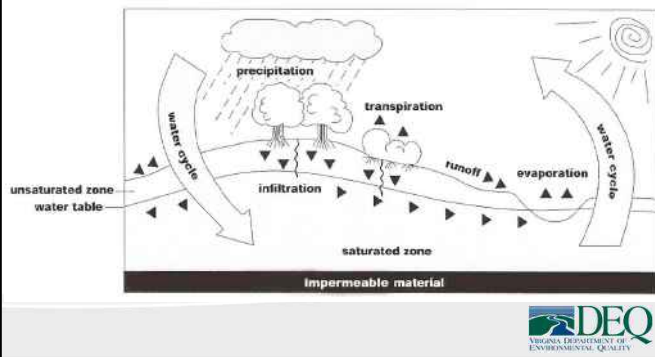


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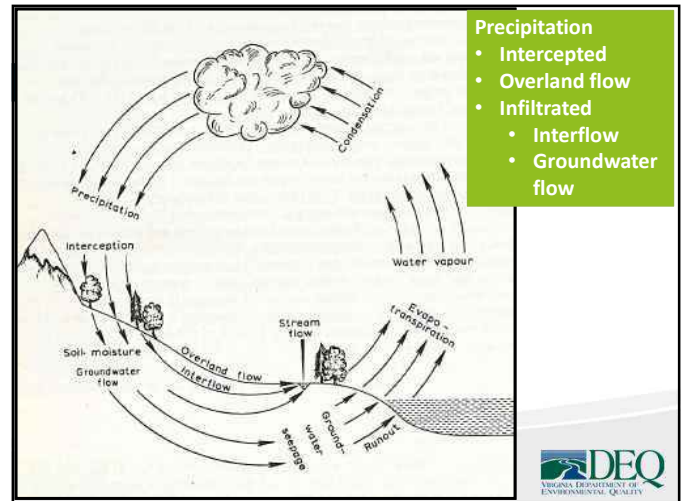


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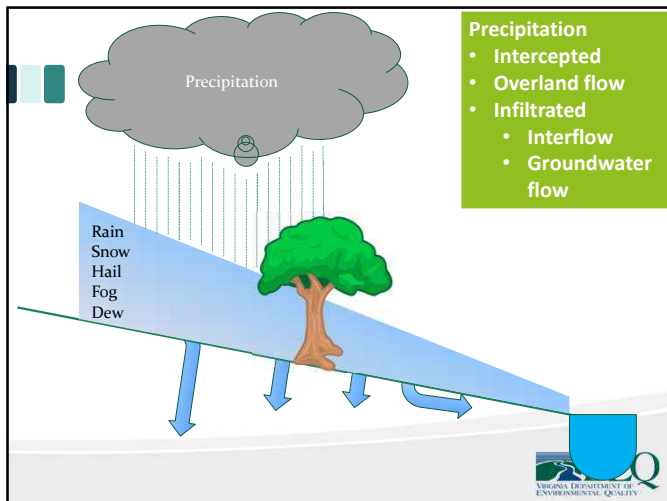
Hydrologic Cycle



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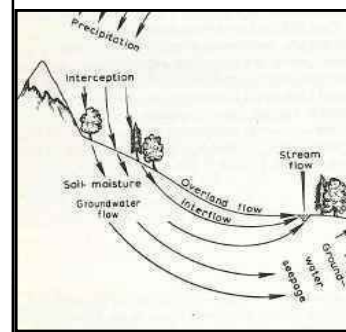


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Part 1 - Hydrology, ESC and SW



- **Precipitation:** Amount, duration, intensity
- **Interception:** Stabilization, Groundcover, MS-1, MS-3, MS-5
- **Overland flow:** Ground cover, imperviousness, ESC, SWM
- **Interflow:** Infiltration, SWM, stream base flow, springs
- **Groundwater flow:** Groundwater recharge

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Precipitation

Measurement

What?	Unit
Amount	Inches or mm
Duration	Hours
Intensity	Inches/hour

Note: CGP Part II, G.3a(1) and G.4a require that projects that are conducting SWPPP inspections record rainfall data!

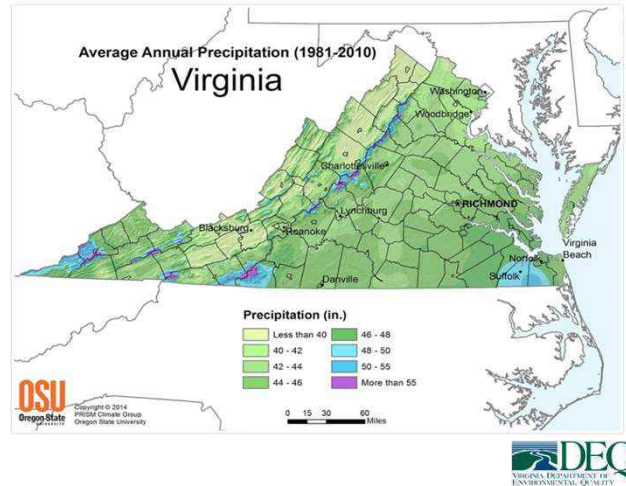
What is it?

Rain
Snow
Hail
Fog
Dew



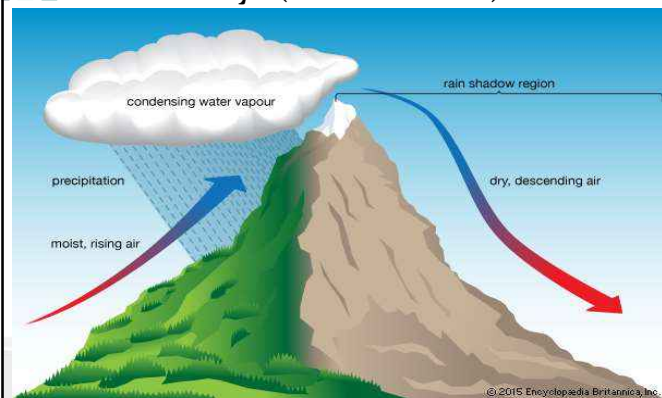
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Average Annual Precipitation (1981-2010) Virginia



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The "Valley" (Rain shadow)



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Precipitation

Measurement

What?	Unit
Amount	Inches or mm
Duration	Hours
Intensity	Inches/hour

What is it?

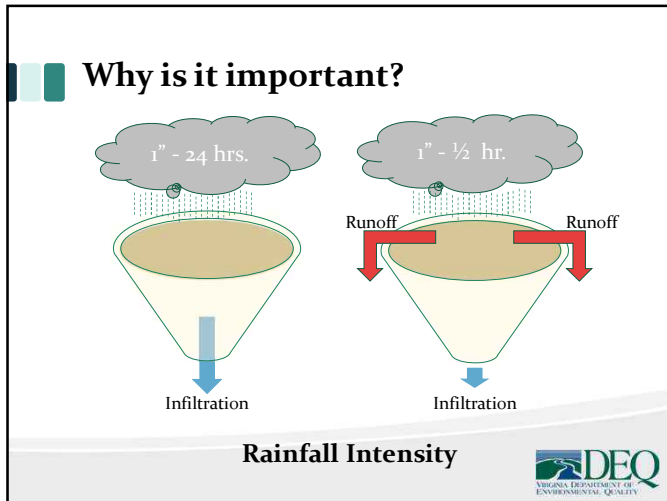
Duration	1	2	5	10	25	50	100
1 inch	0.008 (0.078 8.82)	0.009 (0.081 9.14)	0.009 (0.081 9.14)	0.009 (0.081 9.14)	0.009 (0.081 9.14)	0.009 (0.081 9.14)	0.009 (0.081 9.14)
10 inches	0.002 (0.016 0.40)	0.002 (0.016 0.40)	0.002 (0.016 0.40)	0.002 (0.016 0.40)	0.002 (0.016 0.40)	0.002 (0.016 0.40)	0.002 (0.016 0.40)
100 inches	0.001 (0.008 0.20)	0.001 (0.008 0.20)	0.001 (0.008 0.20)	0.001 (0.008 0.20)	0.001 (0.008 0.20)	0.001 (0.008 0.20)	0.001 (0.008 0.20)
1000 inches	0.000 (0.000 0.00)	0.000 (0.000 0.00)	0.000 (0.000 0.00)	0.000 (0.000 0.00)	0.000 (0.000 0.00)	0.000 (0.000 0.00)	0.000 (0.000 0.00)



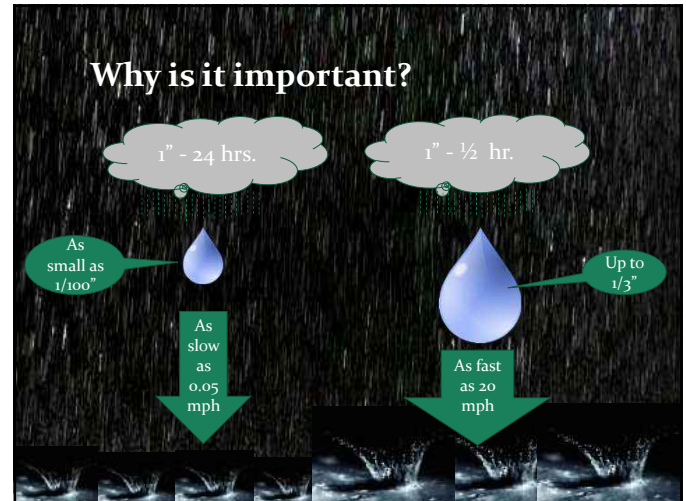
<http://hdsc.nws.noaa.gov/hdsc/pfds/>



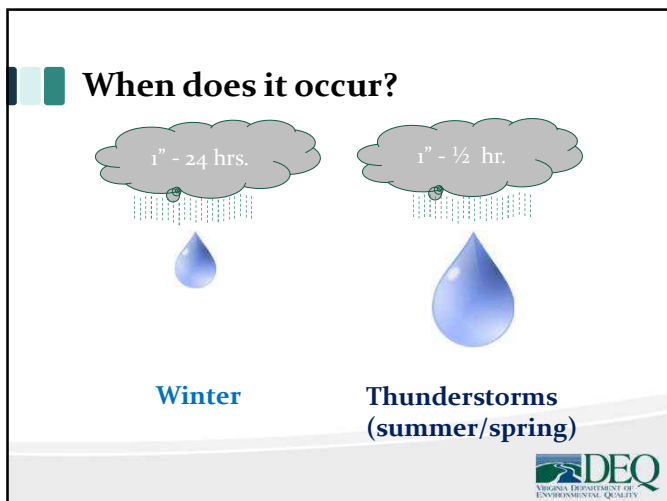
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24-hour storms in Virginia (DEQ offices)

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
Abingdon	2.10 (2.01-2.23)	2.56 (2.50-2.70)	3.03 (2.93-3.28)	3.44 (3.19-3.70)	3.95 (3.65-4.26)	4.57 (4.02-4.78)	5.19 (4.37-5.84)	5.73 (4.72-5.88)	6.23 (5.17-6.23)	6.73 (5.50-6.88)
Roanoke	2.61 (2.41-2.84)	3.17 (3.02-3.44)	3.69 (3.49-4.10)	4.19 (3.93-5.11)	4.75 (3.24-4.26)	5.62 (5.00-7.10)	6.58 (6.78-8.18)	7.58 (7.62-9.28)	8.58 (8.62-10.3)	9.58 (9.68-12.3)
H'burg	2.17 (2.05-2.27)	2.61 (2.48-2.88)	3.03 (3.19-3.80)	3.44 (3.14-4.21)	3.95 (4.23-5.11)	4.57 (4.84-5.80)	5.19 (5.48-6.87)	5.73 (6.10-7.51)	6.23 (7.08-8.02)	6.73 (7.79-9.88)
Woodbr.	2.34 (2.29-2.40)	2.61 (2.70-3.47)	3.03 (3.58-4.40)	3.44 (4.27-5.32)	3.95 (5.38-6.43)	4.57 (6.20-7.78)	5.19 (7.39-9.07)	5.73 (8.36-10.5)	6.23 (9.04-12.8)	6.73 (11.3-14.7)
Insbrook	2.73 (2.58-3.00)	3.31 (3.62-3.64)	3.83 (3.87-4.84)	4.33 (4.28-5.33)	4.83 (4.43-6.62)	5.33 (5.21-7.38)	5.83 (7.46-9.78)	6.33 (8.24-10.2)	6.83 (10.1-12.0)	7.33 (11.4-14.4)
CO	2.75 (2.60-3.05)	3.34 (3.04-3.71)	3.83 (3.84-4.74)	4.33 (4.39-5.81)	4.83 (5.02-6.91)	5.33 (5.40-6.95)	5.83 (7.43-9.22)	6.33 (8.40-10.1)	6.83 (8.54-12.3)	7.33 (10.2-14.3)
VAB	2.34 (2.25-2.25)	2.61 (3.64-3.93)	3.03 (4.31-5.08)	3.44 (5.11-5.84)	3.95 (5.26-7.47)	4.57 (6.73-8.78)	5.19 (8.33-10.1)	5.73 (9.46-11.8)	6.23 (11.1-13.8)	6.73 (12.5-15.8)
Crozet, VA	2.34 (2.25-2.25)	2.61 (3.64-3.93)	3.03 (4.31-5.08)	3.44 (5.11-5.84)	3.95 (5.26-7.47)	4.57 (6.73-8.78)	5.19 (8.33-10.1)	5.73 (9.46-11.8)	6.23 (11.1-13.8)	6.73 (12.5-15.8)

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

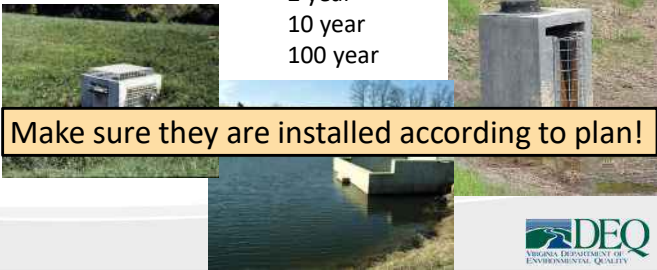
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What are design storms?

No!

All our stormwater structures (outlets) are designed to handle certain design storm:

2 year
10 year
100 year



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What are design storms?

In Stormwater:

- **Bioretention**
 - Overflow → associated with 2- and 10-year design storm
- **Constructed Wetland**
 - Overflow → safely pass the 10- and 100-year storm
- **Dry swale**
 - Convey flow at non-erosive velocity of a 2-year storm event and contain a 10-year storm event within its banks
- **Grass Channel**
 - Convey flow at non-erosive velocity of a 2-year storm event and contain a 10-year storm event within its banks



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Precipitation

Measurement

What?	Unit
Amount	Inches or mm
Duration	Hours
Intensity	Inches/hour

Why?

ESC:

- Inspect every two weeks or within 48 hours of a runoff producing rainfall event



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Precipitation

Measurement

What?	Unit
Amount	Inches or mm
Duration	Hours
Intensity	Inches/hour

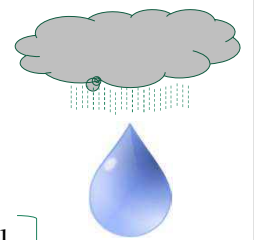
Why?

ESC:

- MS-1
- MS-2
- MS-3
- MS-5

Cover the soil!

Construction Sequence



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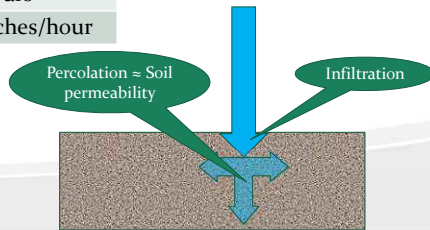
Precipitation

Measurement

What?	Unit
Amount	Inches or mm
Duration	Hours
Intensity	Inches/hour

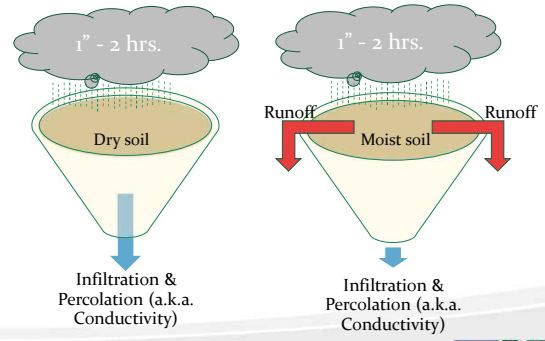
Why?

SWM: Runoff and Infiltration



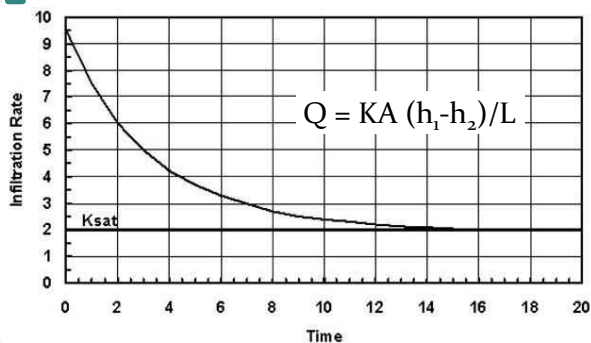
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Why is it important?



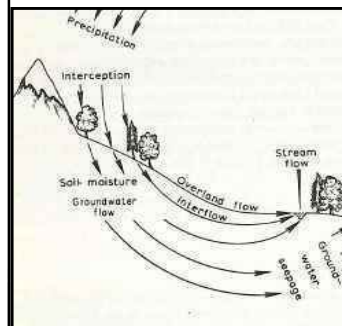
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Saturated Hydraulic Conductivity



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Part 2 - Hydrology, ESC and SW



- **Precipitation:** Amount, duration, intensity
- **Interception:** Stabilization, Groundcover, MS-1, MS-5,
- **Overland flow:** Ground cover, imperviousness, ESC, SWM
- **Interflow:** Infiltration, SWM, stream base flow, springs
- **Groundwater flow:** Groundwater recharge

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Interception



3 Types of Interception

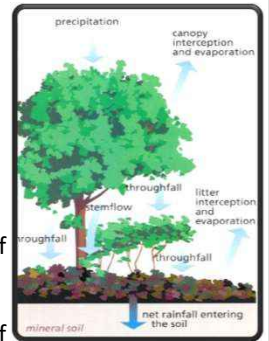
1. **Interception loss** → retained in the vegetation as surface storage and sometimes evaporated.
2. **Throughfall** → drips off leaves and other plant parts
3. **Stem flow** → Runs down leaves to branches to stems and trunks to the surface



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Interception

- In forested areas 35 to 40% of the rain may be intercepted
- In natural grass areas up to 60% of the rain may be intercepted
- In corn and soybeans up to 15% of the rain is intercepted
- Lawn ???



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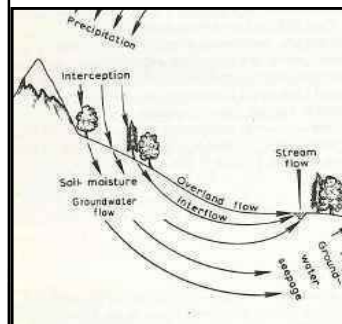
EFFECTIVENESS OF VARIOUS GROUND COVERS IN PREVENTING SOIL EROSION
(this table compares fully established stands of groundcover with bare soil)

Type of Ground Cover	Percent Reduction
Permanent grass	99
Perennial ryegrass	95
Annual ryegrass	90
Small grains	95
Millet	95
Field brome grass	97
Grass sod	99
Hay or straw (@2 tons/acre)	98



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Part 3 - Hydrology, ESC and SW



- **Precipitation:** Amount, duration, intensity
- **Interception:** Stabilization, Groundcover, MS-1, MS-5,
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- **Interflow:** Infiltration, SWM, stream base flow, springs
- **Groundwater flow:** Groundwater recharge

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Overland Flow

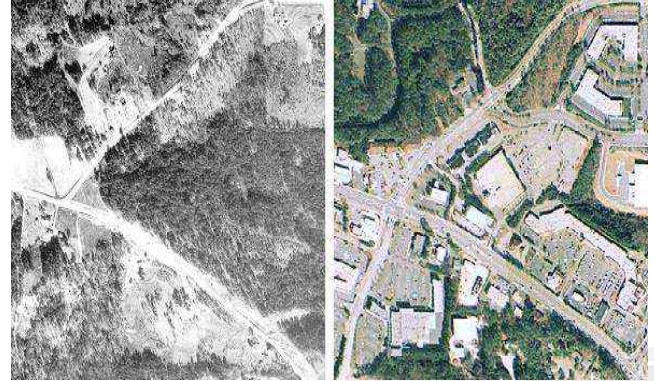


- Sheet flow
- Channelized flow
(Later sections)



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Pre- and Post-Development



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Urbanization

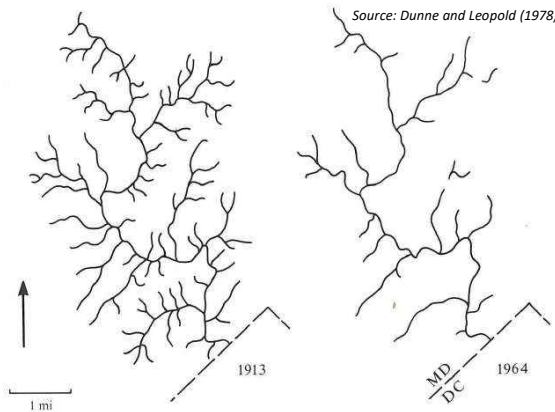


Figure 18-3 Drainage net of Rock Creek upstream of the District of Columbia-Maryland line in 1913, before modern urbanization and again in 1964. (From U.S. Geological Survey in Dept. Interior 1964.)

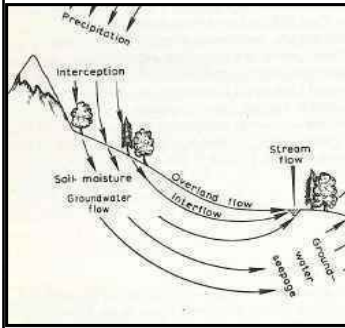
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Why is that important?



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Part 4 - Hydrology, ESC and SW



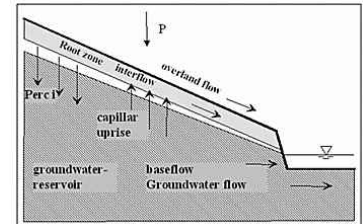
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Interflow

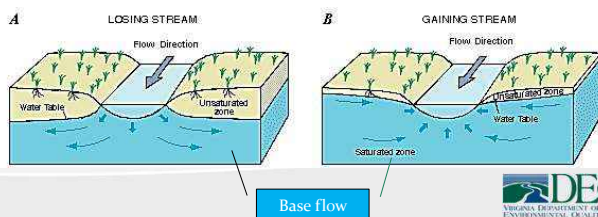
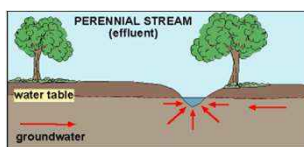
Important for:

- Groundwater needed to grow trees and other plants
- Springs
- Base flow or a steady water level in small streams
- Recharge of shallow groundwater wells



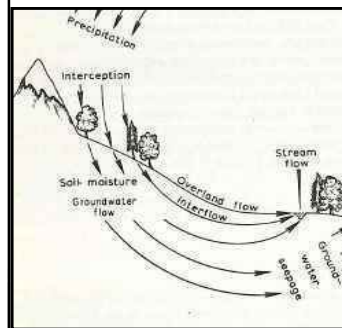
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Base flow of a stream



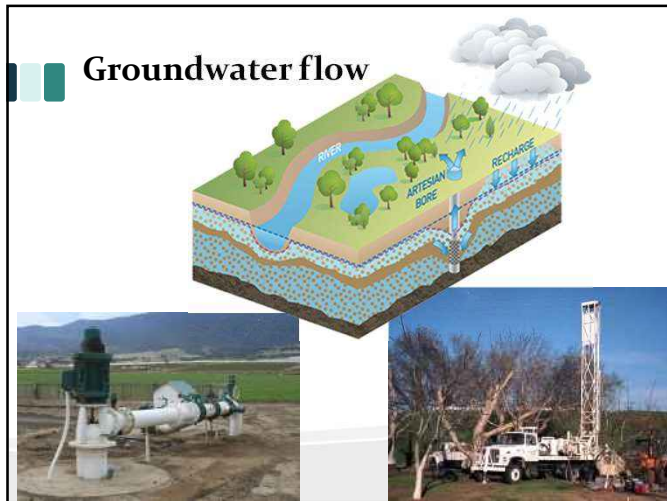
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Part 5 - Hydrology, ESC and SW

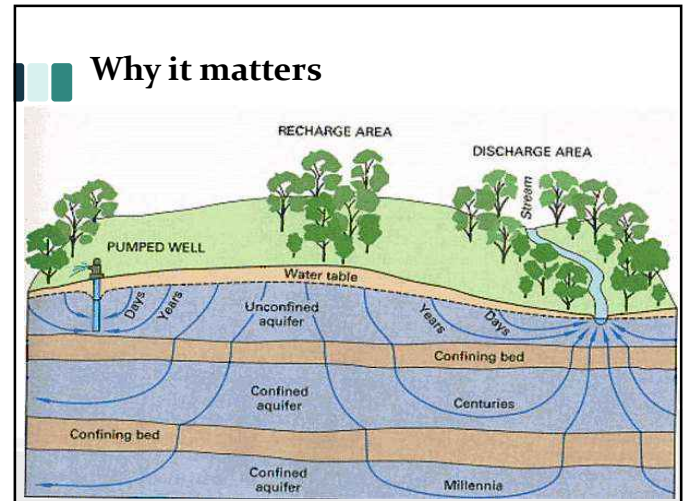


- **Precipitation:** Amount, duration, intensity
- **Interception:** Stabilization, Groundcover, MS-1, MS-5,
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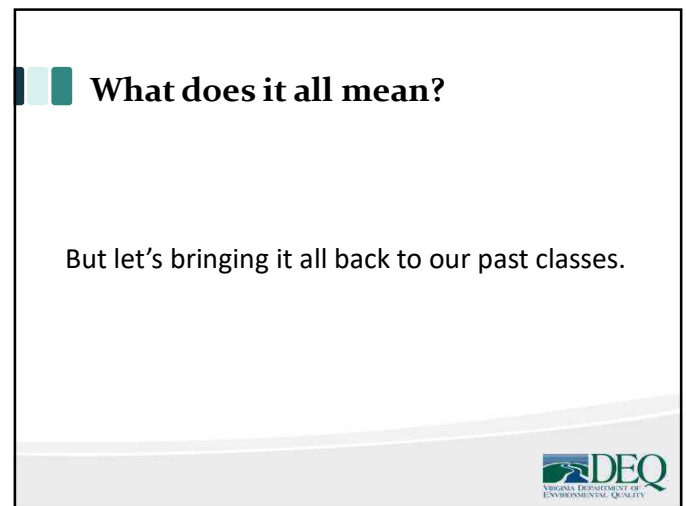
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Land Development

Construction



Road building



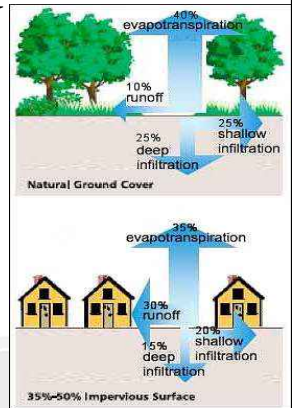
Other linear projects



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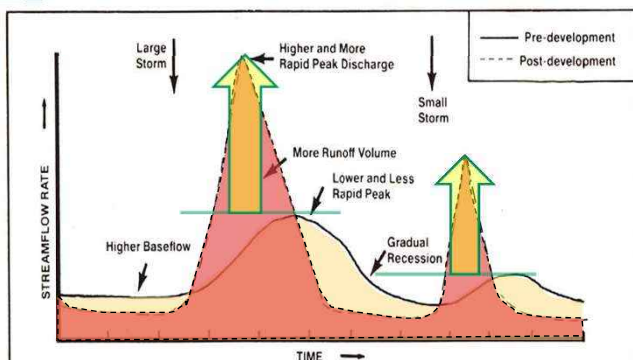
Land Development

- Changes rainfall runoff relationship

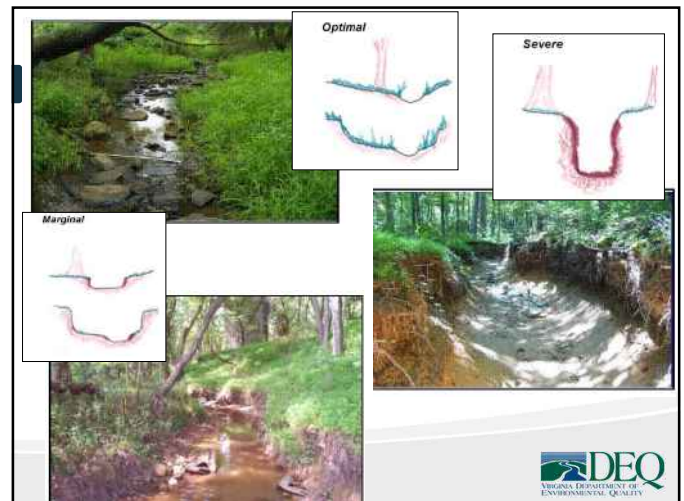


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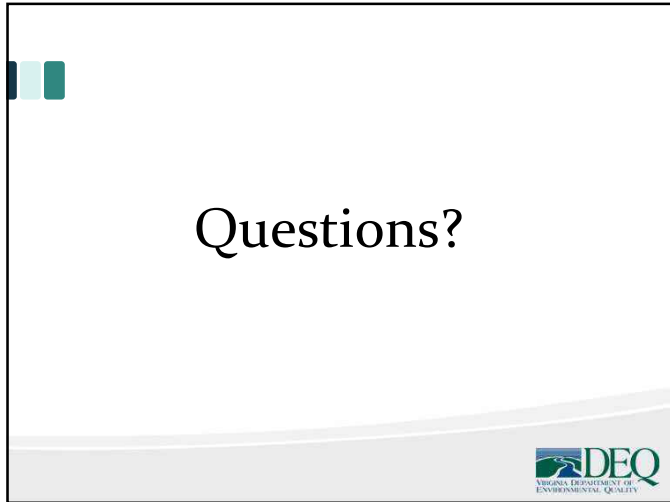
Stream Flow Changes as Potential Result of the Changes in Rainfall/Runoff Relationships



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