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Erosion and Sediment Control Basic Course

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Module 5c

MS-19: Stormwater Management in relation to Erosion and Sediment Control

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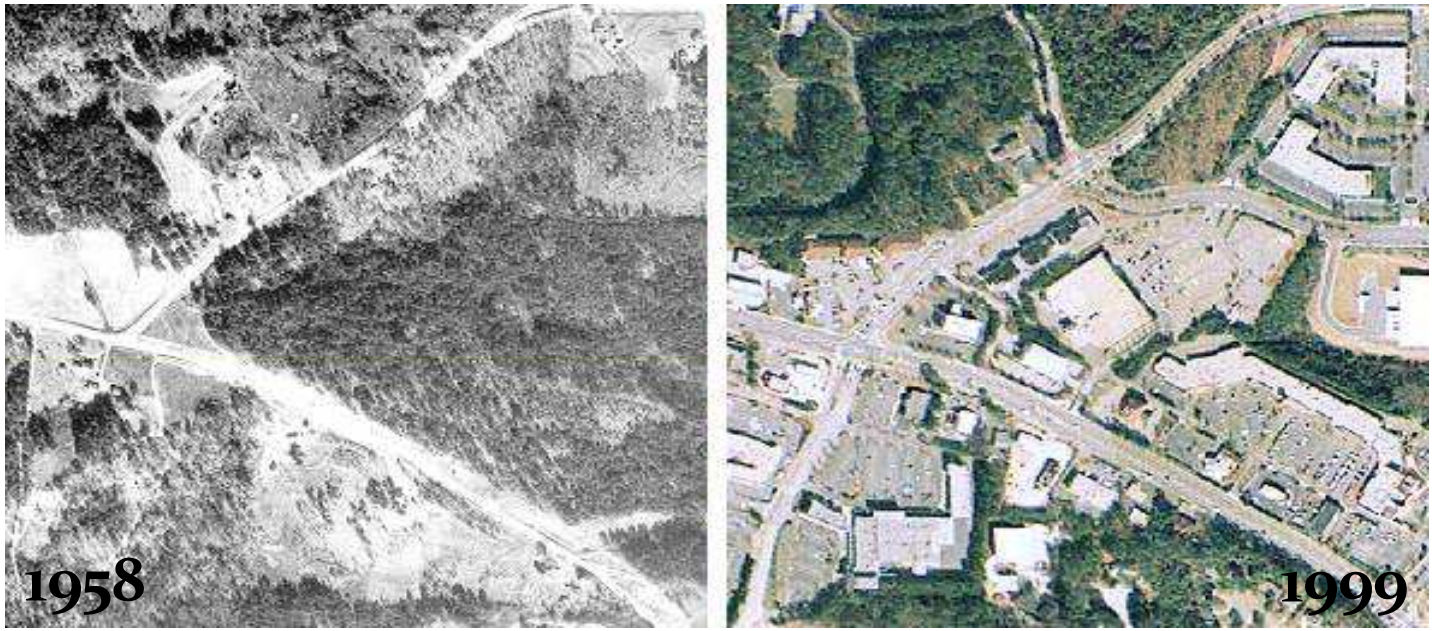
Hydrologic Impacts of Urban Development



As and area of land developments significant changes to the rainfall-runoff relationship can occur

Hydrologic Impacts of Urban Development

- Climate changed (heat island), thermal stream changes
- Topsoil removal exposing less permeable, less fertile, and sometimes more erodible sub soils

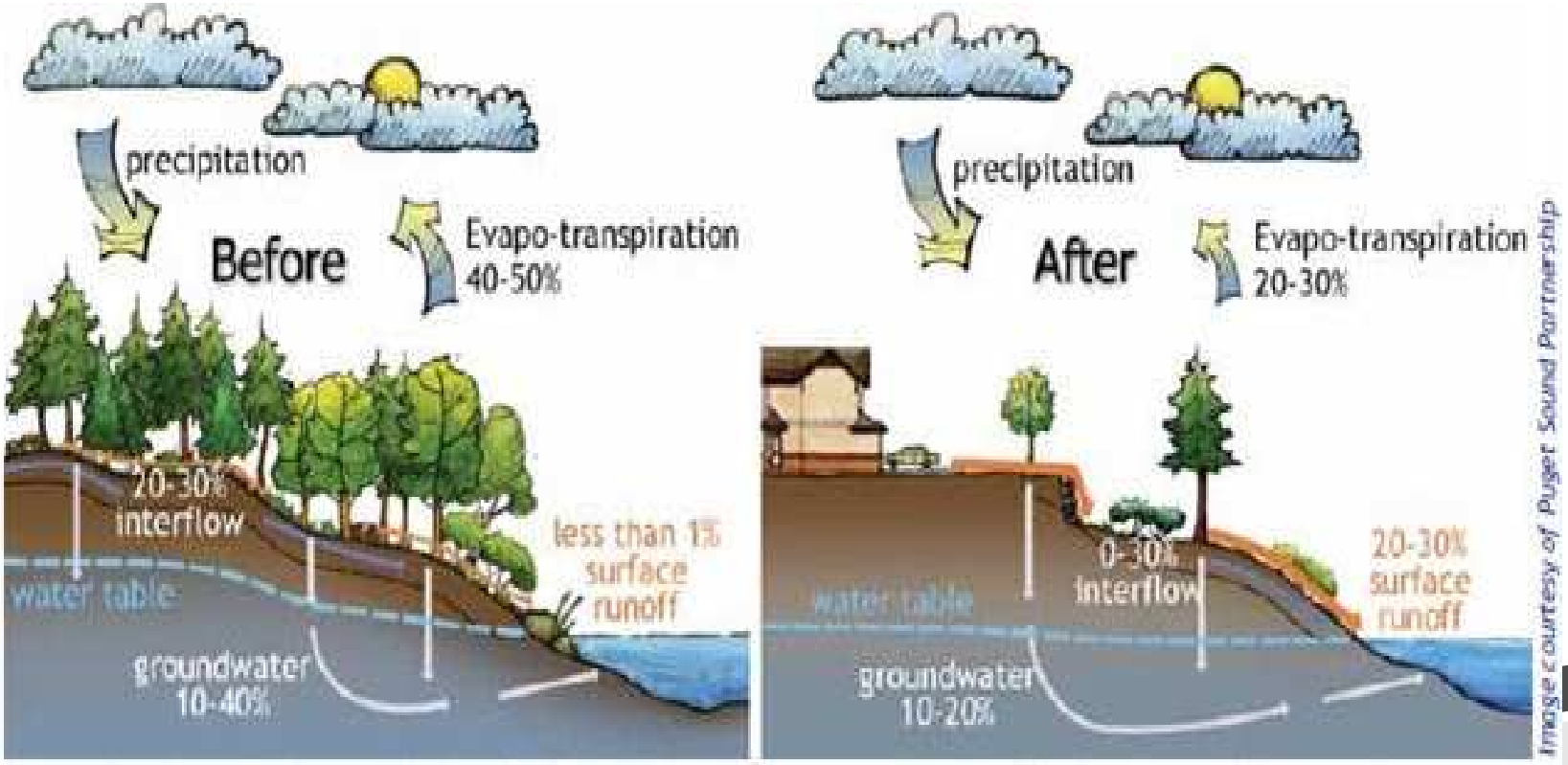
Hydrologic Impacts of Urban Development

- Topographic changes (drainage pattern changes)
- Changes in groundcover
- Contaminated runoff
- Decreased overland flow (less infiltration)

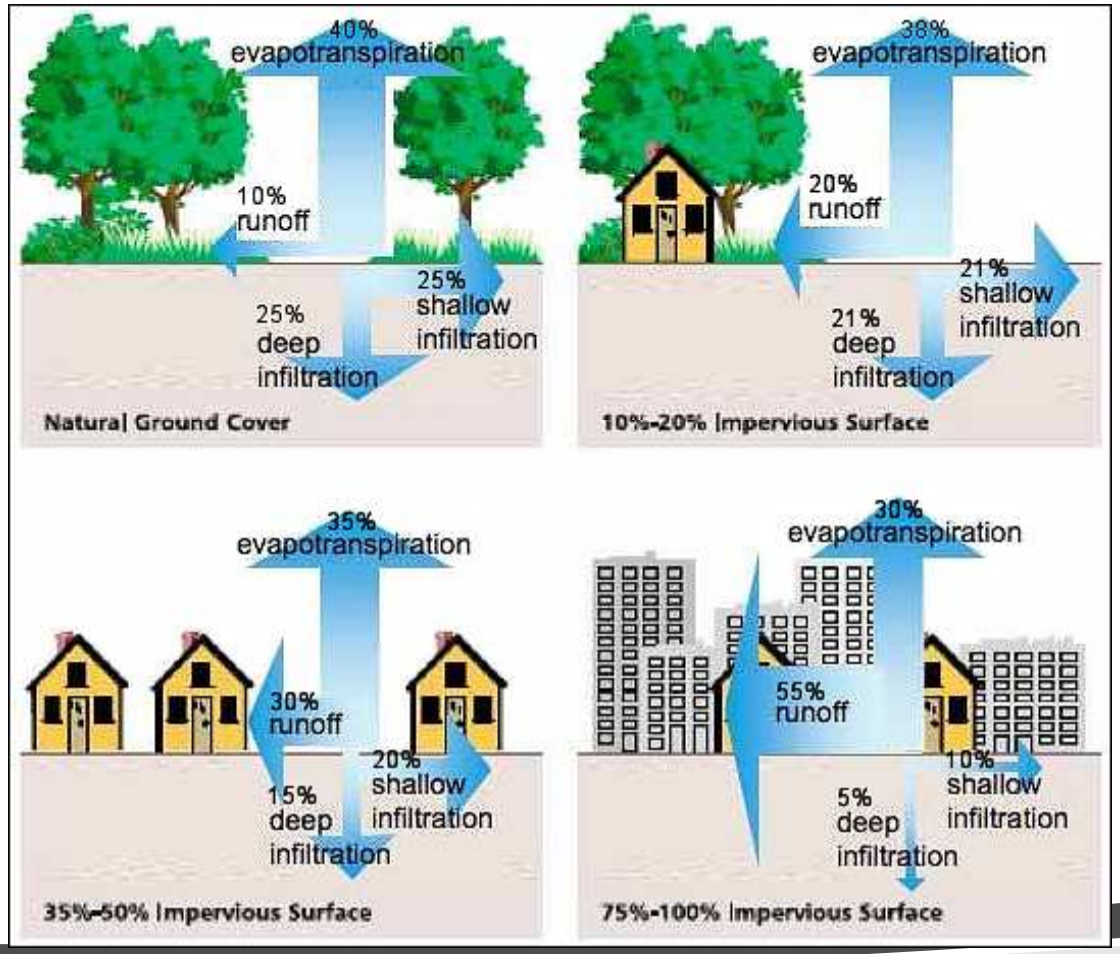
Hydrologic Impacts of Urban Development

- Channel modification
- Changes in stream hydrology
- Lower groundwater levels
- Potential downstream property damage

Hydrologic Impacts of Urban Development



Rainfall → Stormwater



Greater % impervious area:

- **greater runoff volume**
- **higher flow velocities**
- **greater pollutant load to stream**
- **stream erosion & downstream flooding**

Stormwater Related Problems

Major problems include-

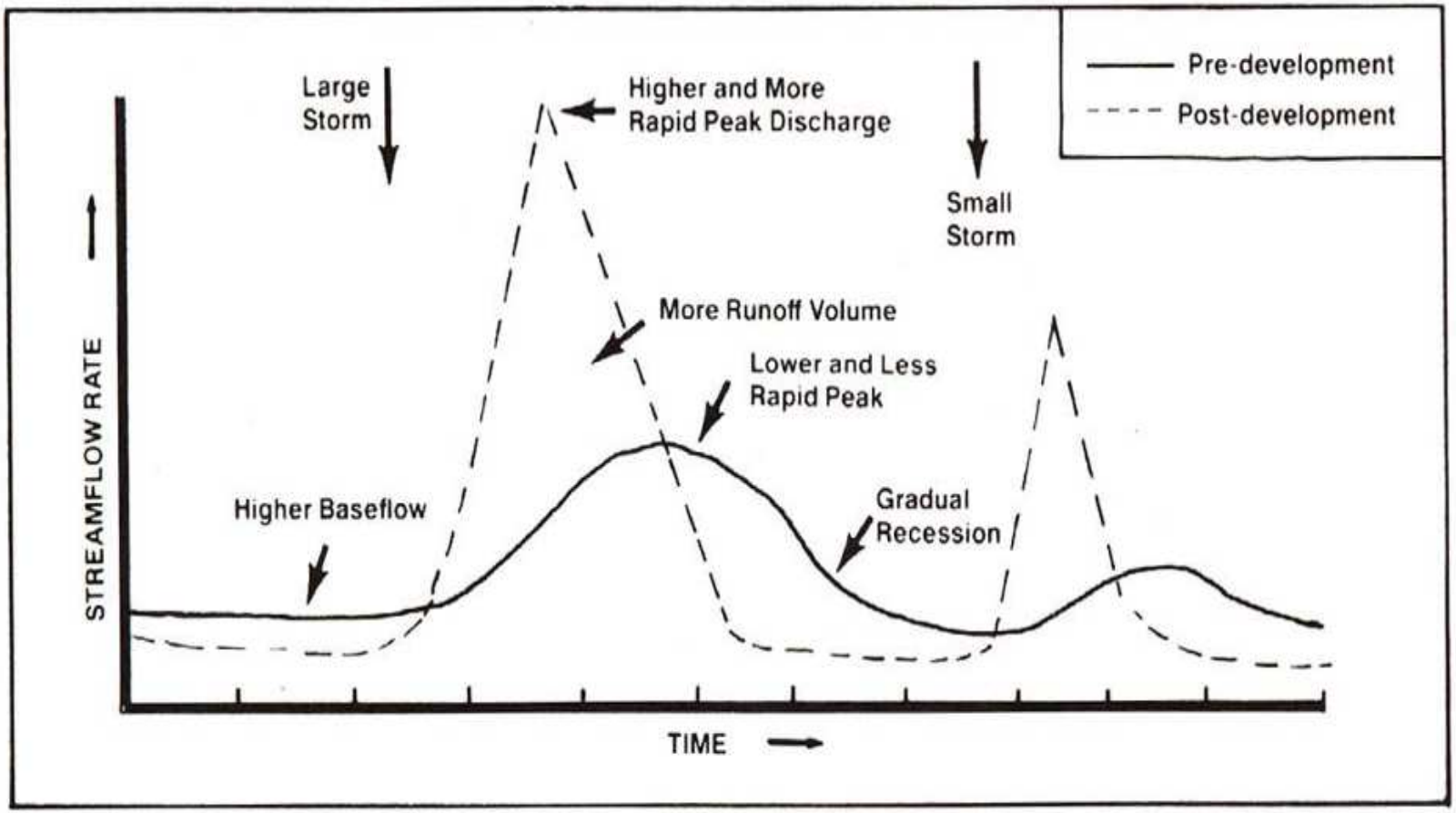
- As areas become developed, existing channels and streams may not be capable of handling the increases in runoff
- Increased peak discharges for a developed watershed can be *two to five times higher* than those for an undeveloped watershed

Stormwater Related Problems

Major problems include-

- Increased flooding of public and private property can occur
- Increased magnitude and frequency of flooding
- Accelerated stream channel erosion
- Water quality degradation impacts

Stormwater Related Problems



Stormwater Related Problems

The result…

Stormwater Related Problems

The result…

MS-19

Minimum Standard 19 provides for the protection of downstream properties and waterways from

- Sediment Deposition
- Erosion & damage due to...

MS-19 (three components)

increases in

- Volume
- Velocity

Volume X Velocity = Energy

- Peak Flow Rate of a stated frequency storm of 24 hour duration

MS-19

Minimum standard 19 states that stormwater must be discharged directly into a natural or man-made channel, pipe, or pipe system that can contain the design flow without eroding (i.e., is adequate).

Channel Analysis

Channel analysis is a critical component in determining channel adequacy.

MS-19

(a.)- Criteria

- Concentrated runoff shall be discharged into an adequate natural, man made channel or storm sewer system
- If runoff is discharged into a pipe or pipe system, downstream stability analysis at the outfall of the pipe or pipe system shall be performed

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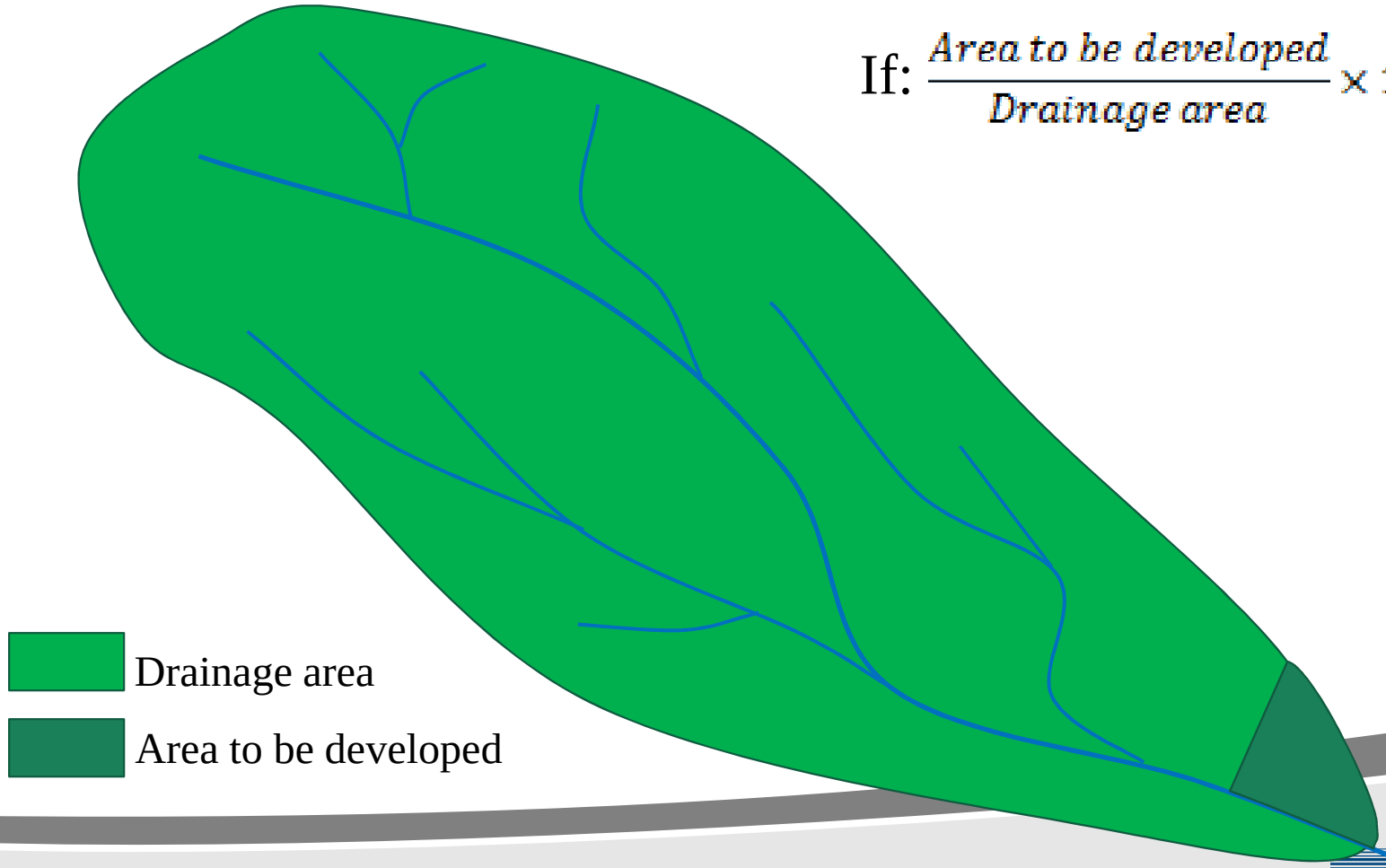
Determine Channel adequacy

1% rule	• Channel is assumed to be adequate
Natural Channel	• 2-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Man-Made Channel	• 10-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Stormwater Infrastructure (pipes)	• Be able to contain the capacity of a 10-year storm

1% Rule applies

If: $\frac{Area\ to\ be\ developed}{Drainage\ area} \times 100\% < 1\%$



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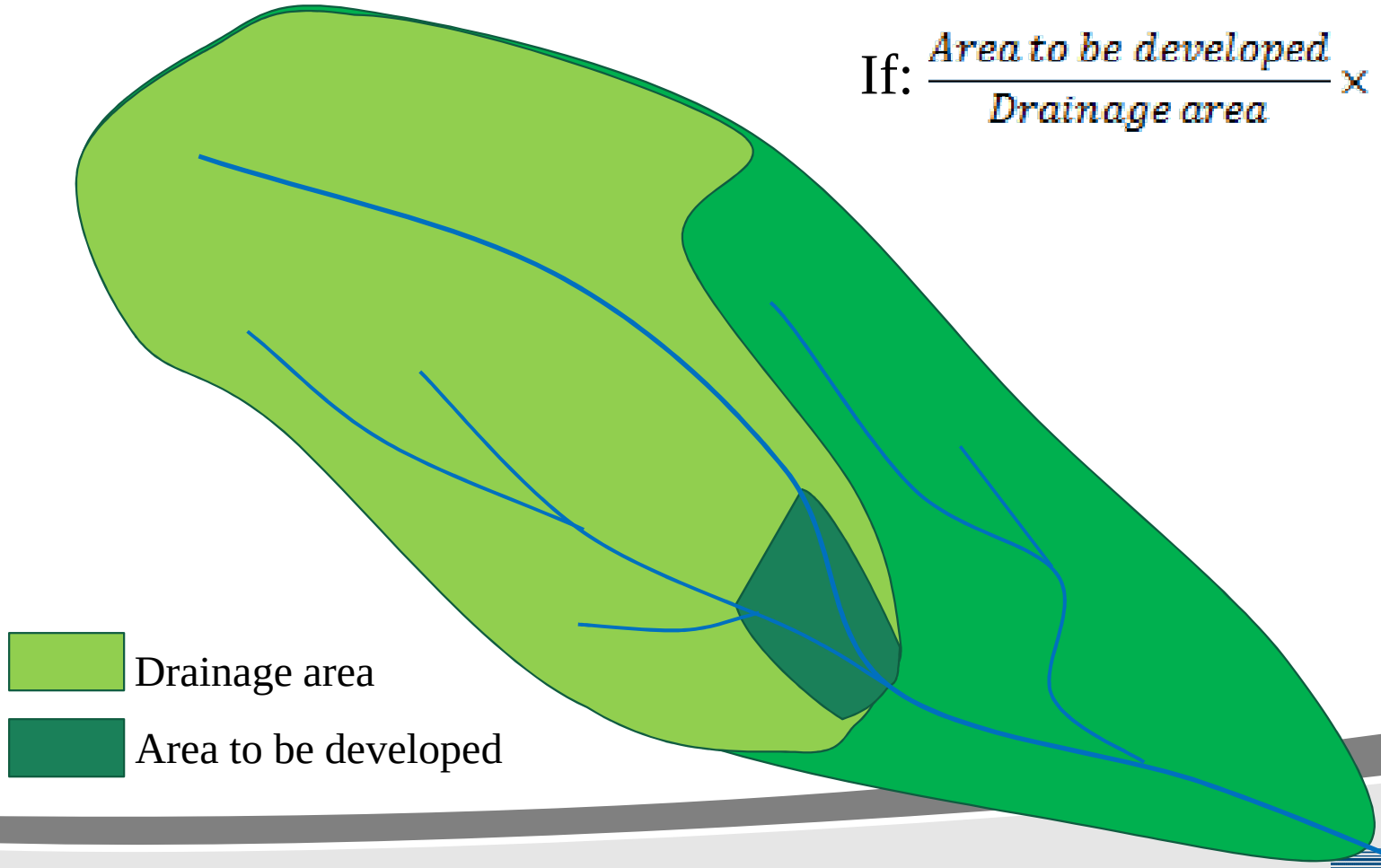
1% Rule does not apply

If: $\frac{Area\ to\ be\ developed}{Drainage\ area} \times 100\% > 1\%$



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Determine Channel adequacy

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Stormwater Infrastructure (pipes)	• Be able to contain the capacity of a 10-year storm

Natural Channels

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Determine Channel adequacy

1% rule	• Channel is assumed to be adequate
Natural Channel	• 2-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Man-Made Channel	• 10-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Stormwater Infrastructure (pipes)	• Be able to contain the capacity of a 10-year storm

Man-Made Channels

Man-Made Channels

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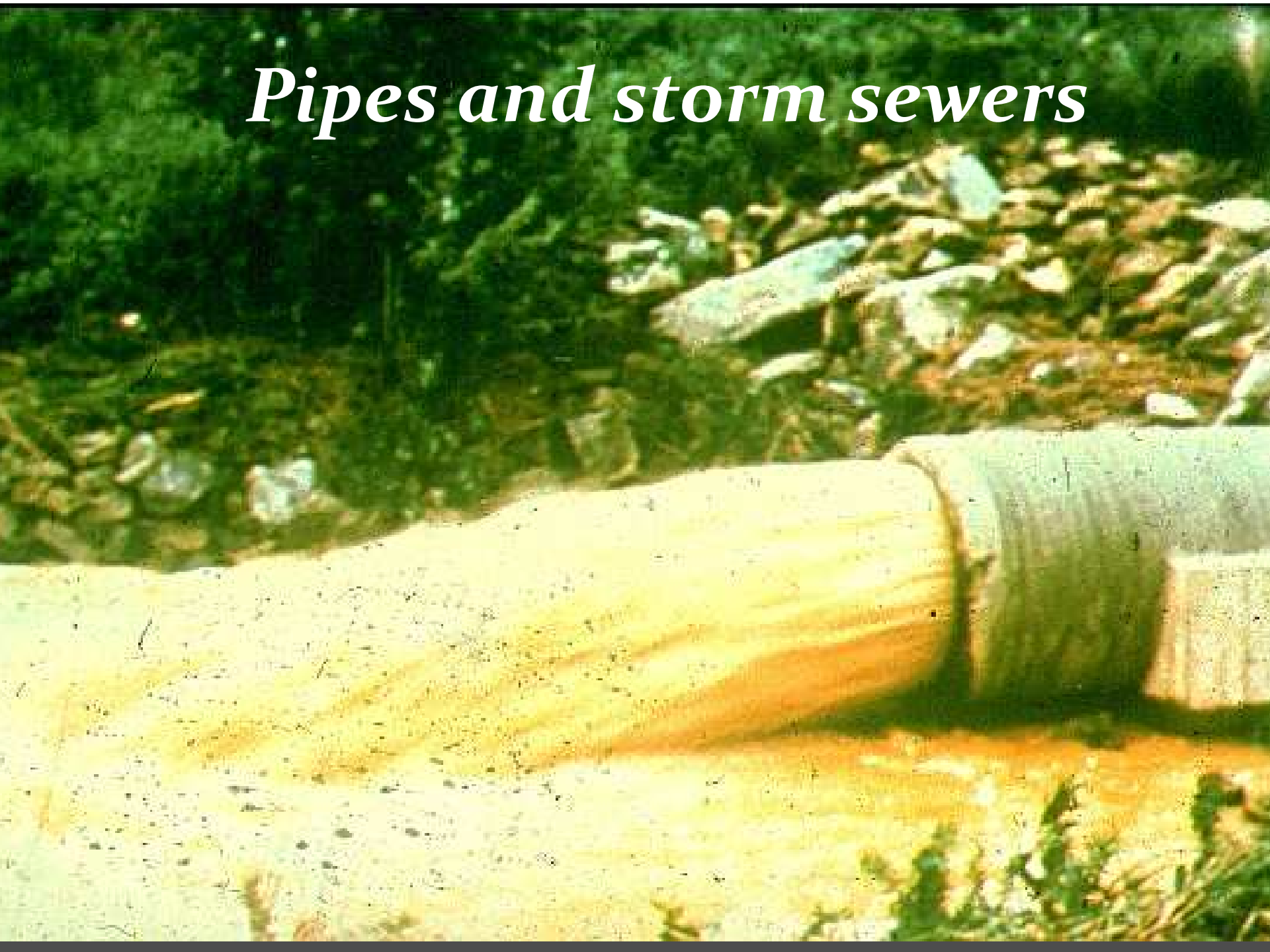
Determine Channel adequacy

1% rule	• Channel is assumed to be adequate
Natural Channel	• 2-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Man-Made Channel	• 10-year storm does not overtop bed and banks • 2-year storm does not cause erosion of bed and banks
Stormwater Infrastructure (pipes)	• Be able to contain the capacity of a 10-year storm

Pipes and storm sewers



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(c.) If the existing natural, man-made channel or pipe system is not adequate, the applicant shall…

- Improve the channel to be adequate for a ten year storm (10 yr. capacity & two year erosion); or
- Improve the pipe or pipe system for a ten year storm; or

MS-19

(c.) If the existing natural, man-made channel or pipe system is not adequate, the applicant shall…

- Develop a site that will not cause the pre-development runoff rate from a two-year storm to increase when discharging into a natural channel; or
- Develop a site that will not cause the pre-development runoff rate from a ten-year storm to increase when discharging into a man-made channel; or
- Provide a combination of channel improvements or other measures to prevent down stream erosion.

Non-Proprietary Stormwater Management BMPs

#	Practice	#	Practice
1	Rooftop Disconnection	11	Wet Swale
2	Sheetflow to vegetated filter or open space	12	Filtering Practice
3	Grass Channel	13	Constructed Wetland
4	Soil Amendments	14	Wet Pond
5	Vegetated Roof	15	Extended Detention Pond
6	Rainwater Harvesting		
7	Permeable Pavement		
8	Infiltration		
9	Bioretention		
9	Urban Bioretention		
10	Dry Swale		

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(d.) The applicant shall provide evidence of permission to make down stream improvements

(e.) All hydrologic analyses shall be based on the existing watershed conditions & the ultimate developed conditions of the project

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(f.) If the applicant chooses an option to include storm water detention, a stormwater management plan must be approved by the plan approving authority.

- **Must include provisions for maintenance (who, when, etc…)**

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(g.) The outfall of a detention facility shall be discharged into an adequate channel and must have energy dissipaters to provide a stable transition to the receiving channel.

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(h.) All on-site channels must be verified to be adequate

(i.) Increased volumes of sheet flows shall be diverted to a stable outlet, adequate channel, pipe system or detention facility.


On-site channel

MS-19

(j.) In applying stormwater runoff criteria, individual lots in a residential, commercial or industrial development shall not be considered separate projects. The ultimate developed conditions of the project shall be used.

MS-19

(k.) All measures used to protect properties and waterways shall be employed in a manner which minimizes impacts on the

- physical
- chemical &
- biological integrity of rivers, streams and other waterways of the state.

MS-19

(I.) For projects approved before July 1, 2014, if they can comply with the SWM "energy balance equation" in the stormwater regulations you satisfy MS-19

MS-19

(m.) Projects approved after July 1, 2014, must comply with the Virginia Stormwater Management Act including the Grandfathering provisions.

Energy balance equation (9VAC25-870-66)

$$Q_{post} \leq I.F. \times (Q_{pre} \times RV_{pre})/RV_{post} \quad \text{or}$$

$$(Q_{post} \times RV_{post}) \leq I.F. \times (Q_{pre} \times RV_{pre})$$

Where

- Q_{pre} =Pre-development peak flow rate (cfs)
- RV_{pre} = Pre-development runoff volume (in.)
- Q_{post} = Post-development peak flow rate (cfs)
- RV_{post} = Post development runoff volume (in.)
- I.F. = Improvement factor (0.8 for sites>1 acre, 0.9 for sites < 1 acre

MS-19

(n.) Meeting the requirements of the Virginia Stormwater Management Act satisfies MS-19.

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How do I know which projects must meet the new SWM Part IIB requirements?

Pages 30 and 31 of your PG contain easy to follow flow charts to determine if a project must meet the Part IIB or Part IIC requirements

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Past

- MS-19 (State-wide)
- Stormwater (CBPA localities)
- ≥10,000 ft^2 or more stringent
- Quantity based
- Management of discharge

Present

- VSMP Law and regulations
- Areas ≥1 acre (CBPA LDA ≥ 2,500 ft^2)
- Quality and quanity (Energy balance equation)
- Runoff reduction (Infiltration/re-use)
- After July 1, 2014
- Grandfathered projects and projects between 10,000 sqf and 1 acre not in CBPA areas will still be regulated by MS-19 until 2019 or 2024

Stormwater Management Past vs. Present

Stream Impacts

High Stormwater Volume and Velocity

- More impervious surfaces lead to less ground infiltration, more higher energy runoff
- Increased stream volumes and flow rates, flooding, more erosion

Pollutants in Stormwater Runoff

- Pollutants transported untreated to our waterways (nutrients, sediments, toxics, litter, debris, bacteria and pathogens, higher water temps)

Ecological Impacts

- Altered or lost habitats (aquatic, riparian)
- Reduced species richness and diversity
- Shift in ecological balance (aquatic food sources, opportunistic species)

Loss of Beneficial Uses

- Reduction in desirable fish species
- Shellfish contamination
- Contamination of drinking water sources
- Contamination of swimming beaches
- Loss of recreation and aesthetic value of state waters

Traditional vs. Modern Philosophies

Traditional

- Landowners had the right to dispose of stormwater by any means to suit their needs.
- This just transferred the problem downstream to someone else
- Created the need for EXPENSIVE storm water channels to improve drainage
- The cost of these improvements were paid for by the public

Traditional vs. Modern Philosophies

Modern (<2014)

- Uses stormwater retention, infiltration and decreasing impervious areas helps to reduce volumes and velocities down stream
- Seeks to preserve or at least simulate the natural drainage conditions that existed in pre-developed conditions.

Traditional vs. Modern Philosophies

Then

Nuisance

= Dispose of quickly

Now

Valuable Resource (if managed wisely)

= Supply underground aquifers (drinking water)

= Provide additional source of non-potable water

= Prevent/minimize damage to public and private resources

Traditional vs. Modern Philosophies

Modern Philosophy helped to spur innovative ways to control runoff

- Designers must learn to balance the traditional and modern ways of dealing with stormwater and implement efficient and effective measures

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MS-20

Don’t let THIS happen!

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