North Country

Stormwater Tradeshow & Conference

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Infiltration Practices, Sizing & Design

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The Purpose & Characteristics of Infiltration Systems

- A standard stormwater management practice
- Help with groundwater recharge
- Provide moderate to high pollutant removal
- Best used in conjunction with other practices
- Have longevity of less than 5 years without multiple pretreatment

The Infiltration Practices:

- Infiltration trench
- Dry well
- Infiltration basin

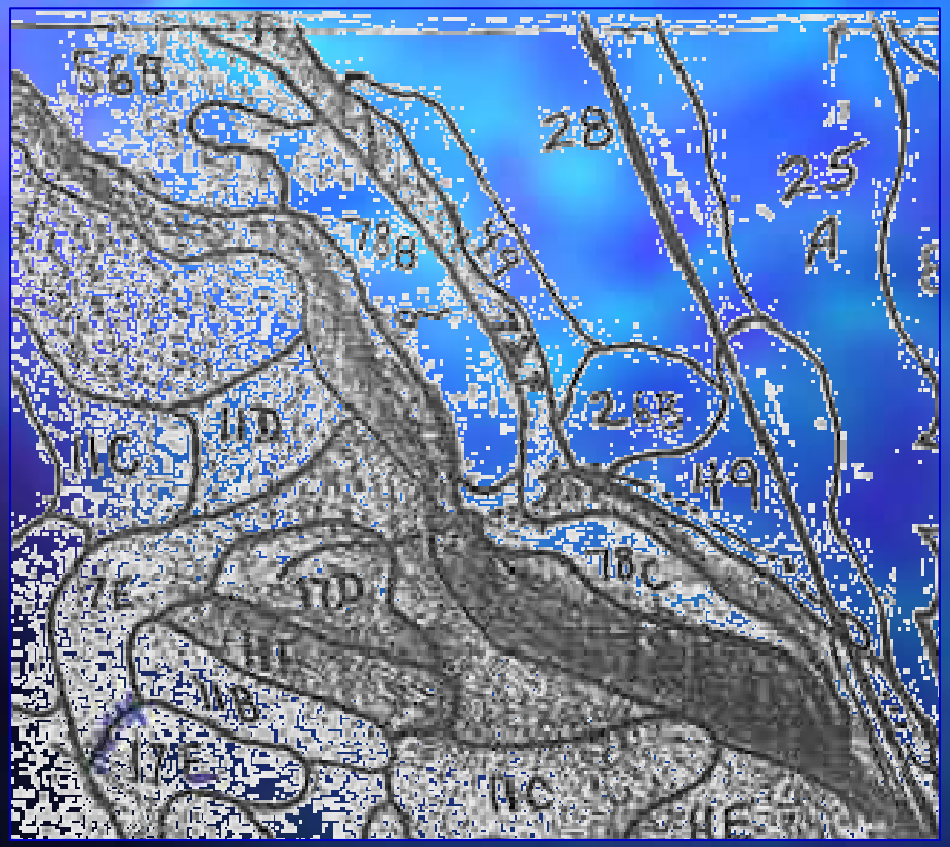
The Components :

- Feasibility
- Conveyance
- Pre-treatment
- Treatment
- Landscaping
- Maintenance

Feasibility

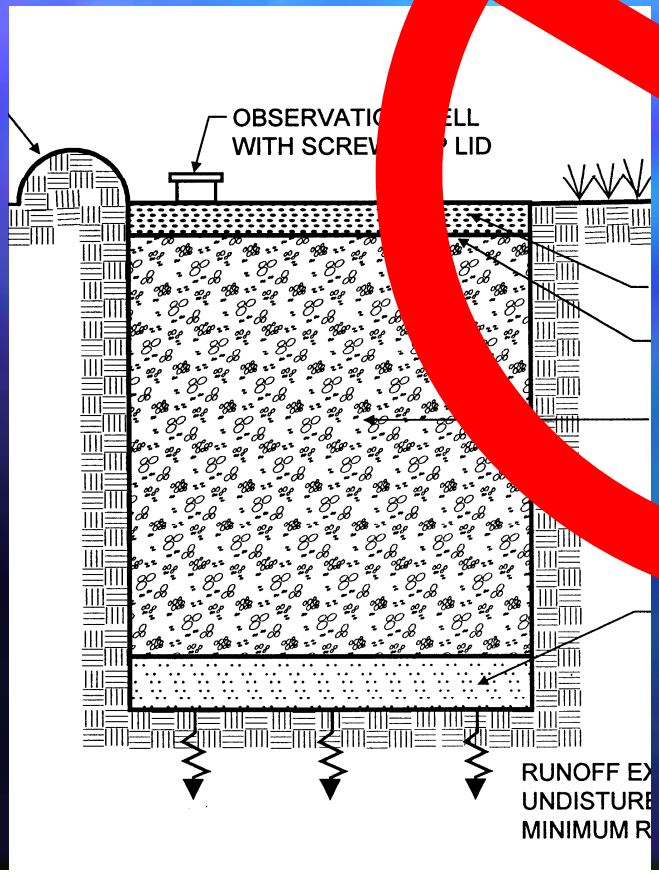
- Maximum contributing area 10 acres (depending on design type)
- Cannot be located on slopes > 15% or within fill soils
- Bottom must be $\geq$ 3 feet above high water table or bedrock layer (4' for aquifers)
- 100 feet from water supply well
- Setback 25 feet down-gradient from structures

Soils Are a Feasibility Factor



- Soil infiltration rate, f_c, $\geq$ 0.5 inches/hour
- Soil clay content < 20% and silt/clay content < 40%
- Soil survey maps need to be confirmed with on-site investigation

"Hotspots" and Infiltration



- Cannot be used if contributing drainage is a hotspot
- Must be treated before infiltration

Conveyance

- Conveyance system to and from facility
  - Design to deliver and pass excess water at non-erosive velocities (< 3.5 fps)
  - Off-line design should be used if flow is delivered by storm drain pipe or along main conveyance system
  - Fully de-water the facility in 48 hours

Pretreatment

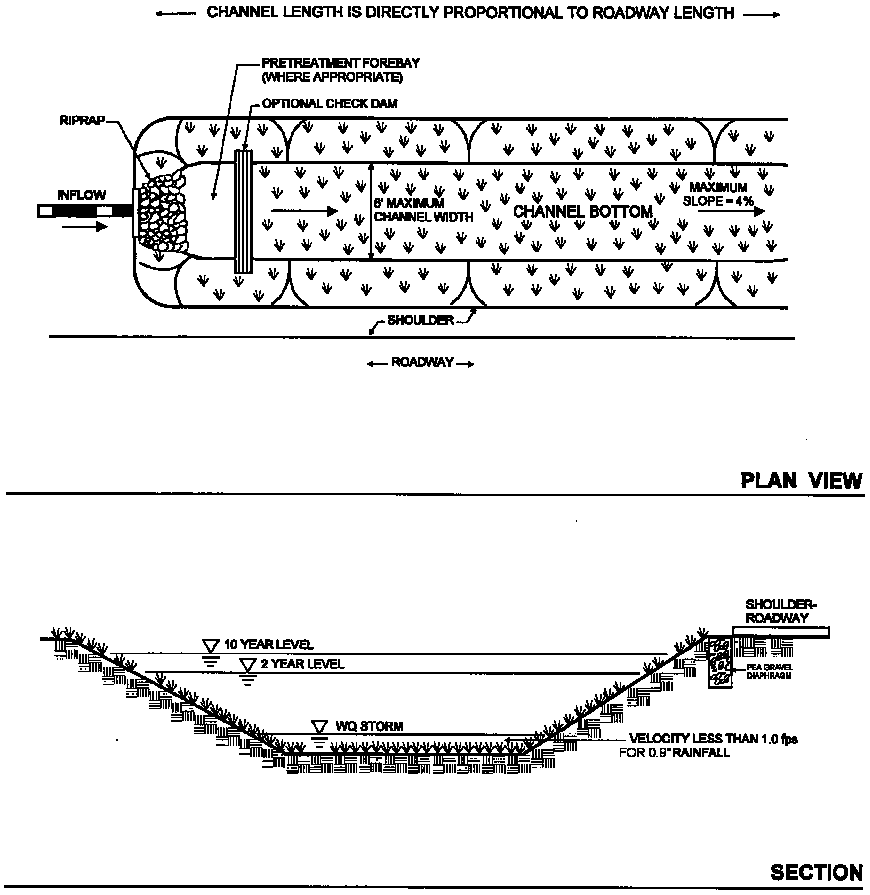
- 25% WQv pretreatment minimum
- 50% if soil infiltration rate >2.0 in/hr
- 100% if infiltration rates >5.0 in/hr

Pretreatment Measures

- Grass channel
- Grass filter strip
- Sand layer (upper or bottom)
- Pre-treatment chamber
- Plunge Pool
- Underground trap for dry well
- Bank run gravel layer

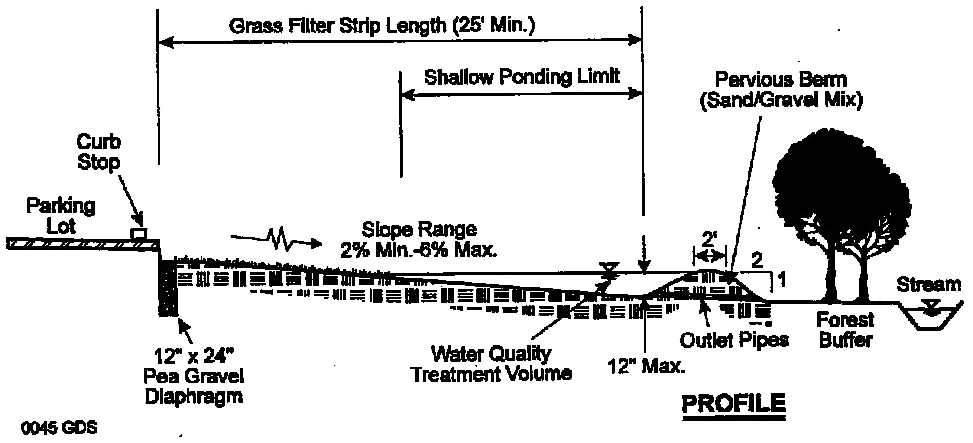
Grass Channel

- Size 10-minute travel time.
- Not a volume-based design.
- Otherwise similar to the dry swale.



Filter Strip

- Capture volume behind the berm.
- Slope between 2% and 4%




This slide shows how the larger particulate solids settle out at this site even before entering the pretreatment swale.
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Treatment

- Design to exfiltrate the WQ_v less pretreatment volume (for basins with sedimentation or stilling basin)
- Design storage reservoir to de-water WQ_v within 48 hours after storm
- Assume a porosity value of 0.4 used for stone reservoirs
- Downstream detention needed for Cp_v and Q_p

Treatment

- Capture entire treatment volume in the practice
- Account for porosity (about 0.4) in dry wells and infiltration trenches.
- Bottom should be completely flat.

Water Quality Criteria (WQ_v)

Criteria: Capture and treat 90% of the annual runoff events

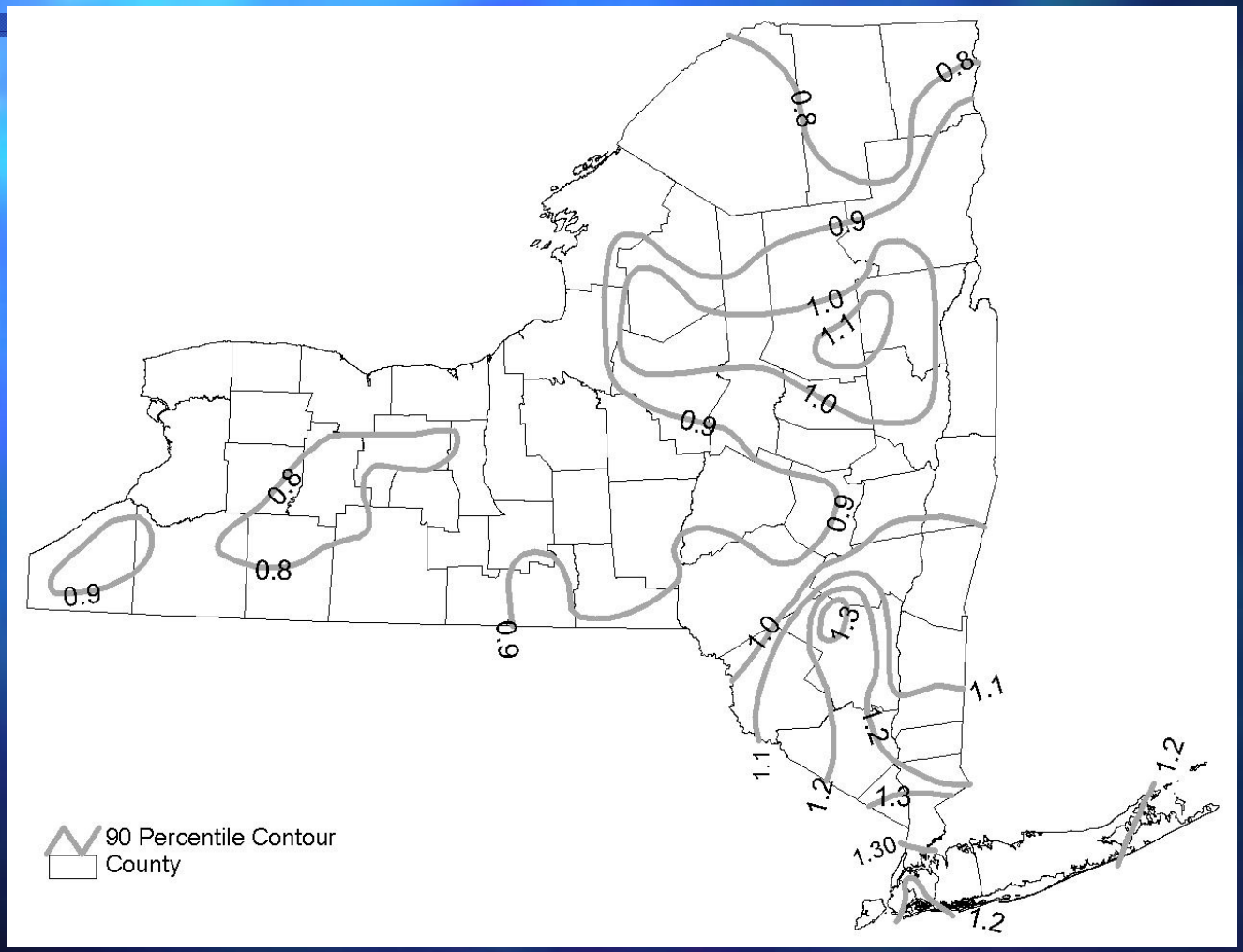
$WQ_v = (P)(R_v)(A)/12$

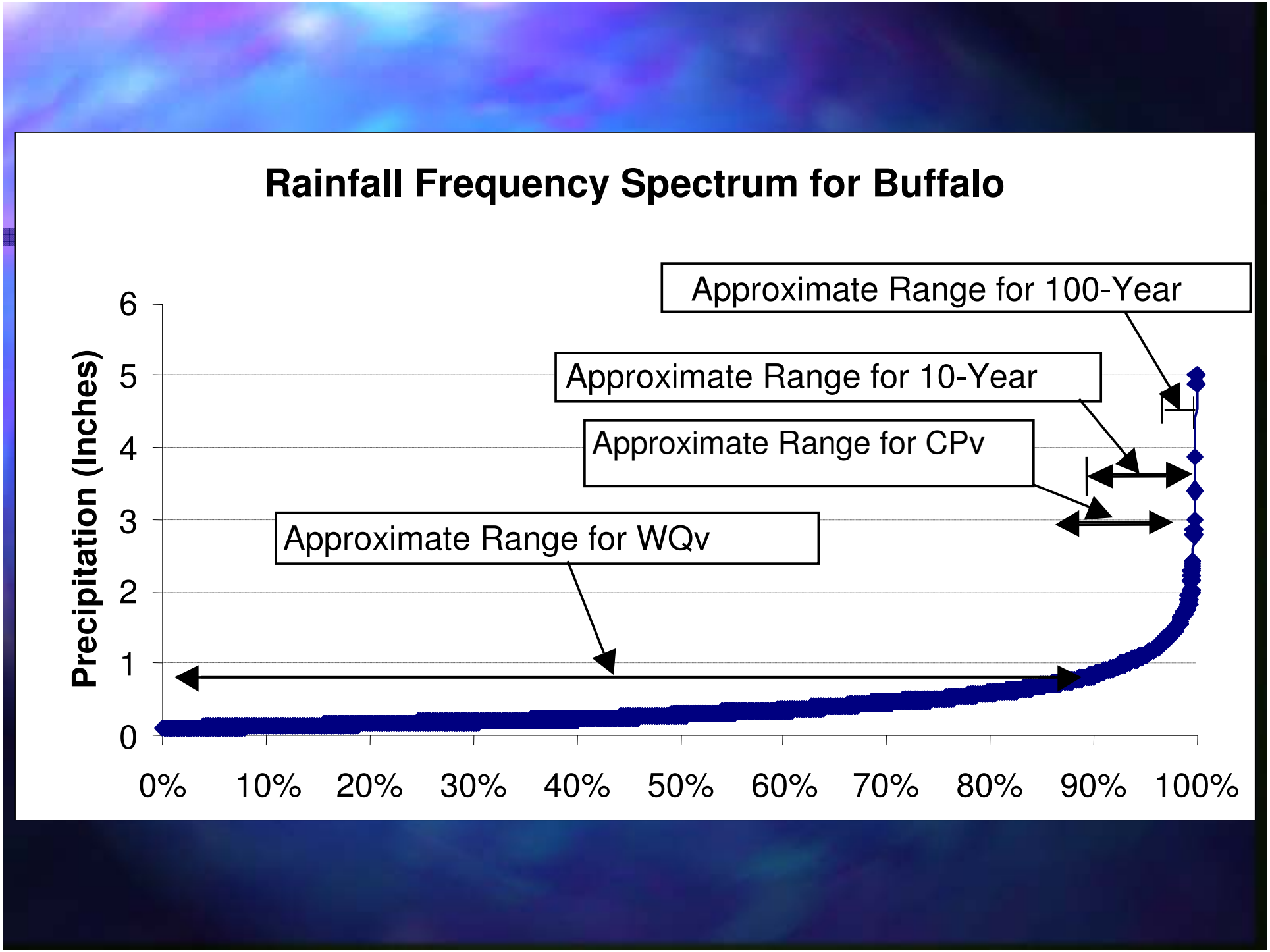
Where:

WQ_v	=	Water Quality Volume (acre-feet)
P	=	90% storm depth (inches)
R_v	=	runoff coefficient (based on %I)
R_v	=	0.05+0.009I
I	=	Impervious Cover (%)
A	=	site area (acres)

Minimum R_v of 0.2

90% Rainfall in New York



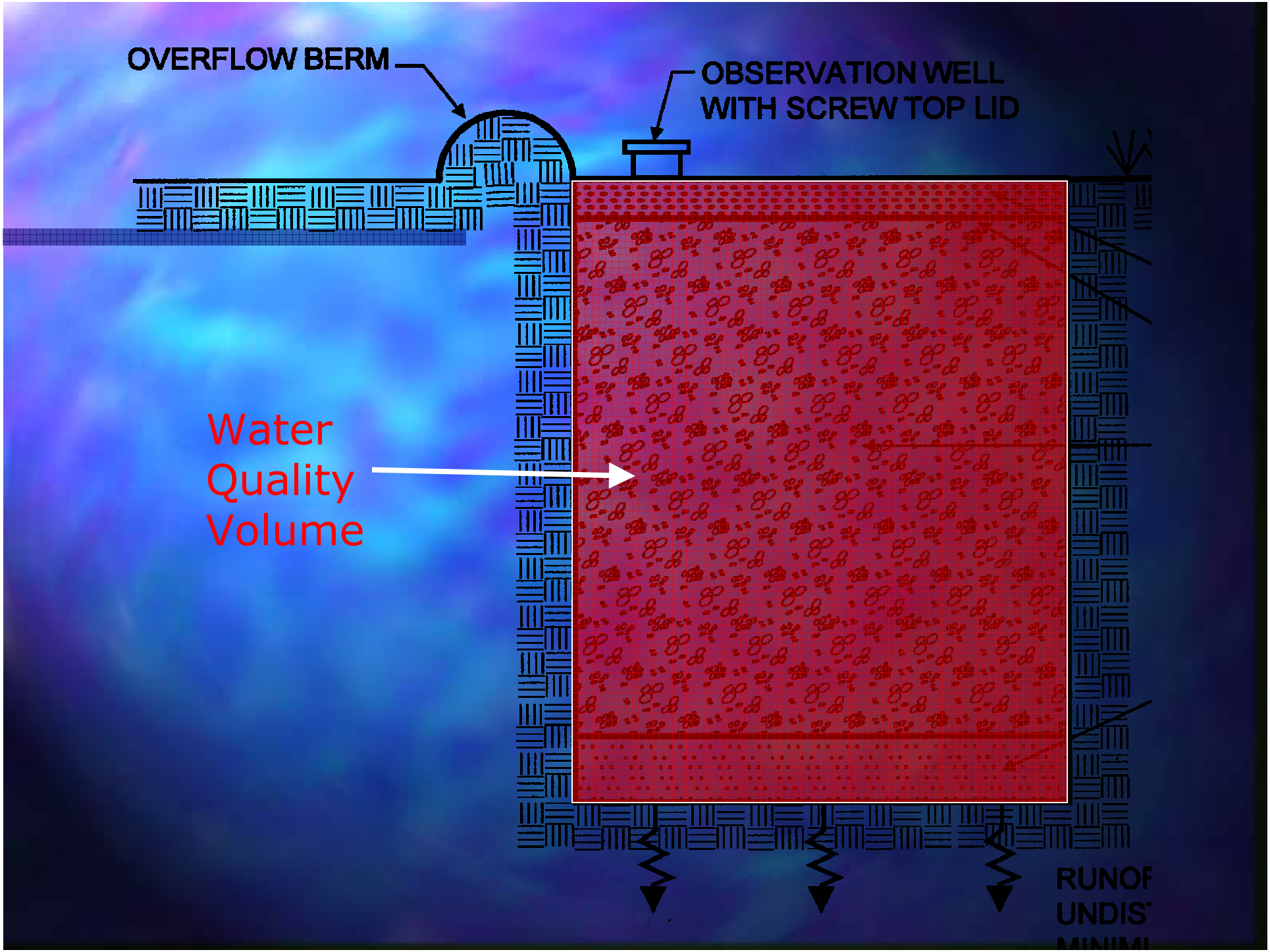

Rainfall Frequency Spectrum for Buffalo
Precipitation (Inches)
0
1
2
3
4
5
6
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Approximate Range for 100-Year
Approximate Range for 10-Year
Approximate Range for CPv
Approximate Range for WQv

Suitable Controls for Almost Complete Elimination of Runoff Associated with Small Rains (<0.5 in.)

- Disconnect roofs and pavement from impervious drainages
- Grass swales
- Porous pavement walkways
- Rain barrels and cisterns

Suitable Controls for Treatment of Runoff from Intermediate-Sized Rains (0.5 to 1.5 in.)

- Initial portion will be captured/infiltrated by on-site controls or grass swales
- Remaining portion of runoff should be treated to remove particulate-bound pollutants

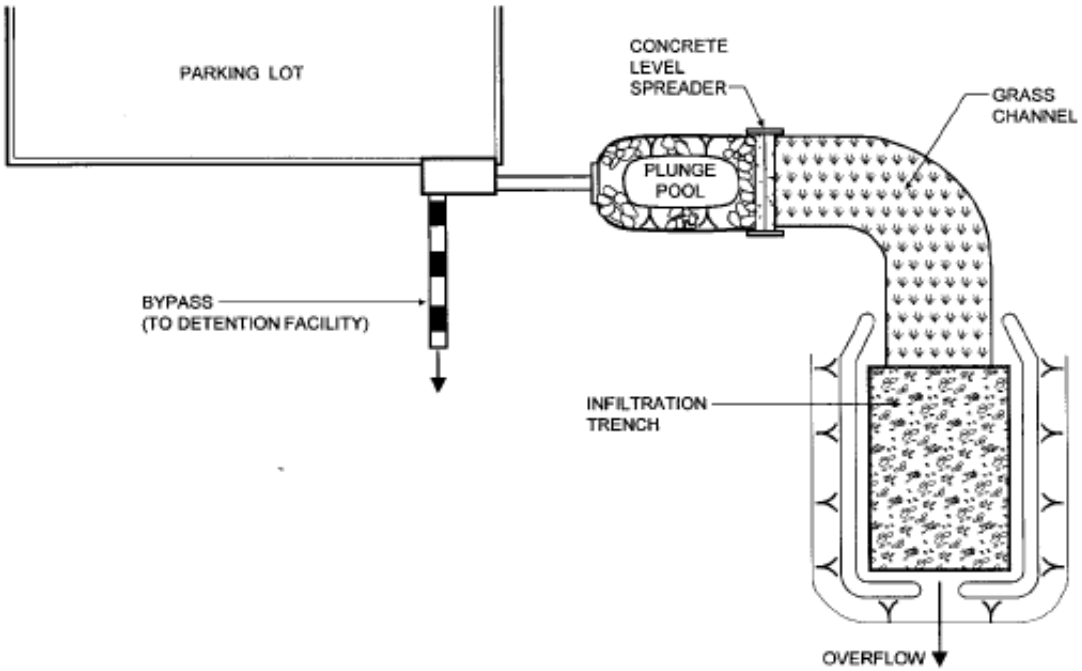

OVERFLOW BERM
OBSERVATION WELL
WITH SCREW TOP LID
Water
Quality
Volume
RUNOF
UNDIS

Infiltration

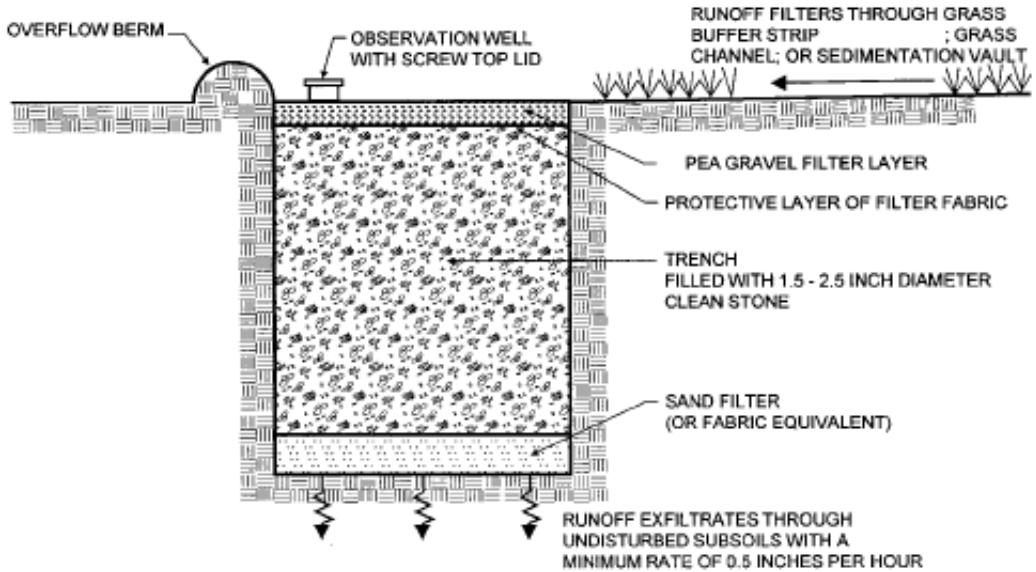
Trench

Treatment:

- Field verification of soil permeability essential
  - f_c > 0.5 in/hr
- Require infiltration tests and test pit/soil boring at location of proposed facility
  - One test pit/soil boring per 50 ft of trench to depth of 4 ft below bottom of proposed facility bottom
- Geotextile fabric should interface between the trench sidewalls and stone reservoir and top gravel filter
- A 6-inch sand filter layer should be placed on the bottom of the infiltration trench



PLAN VIEW



SECTION

Treatment, cont'd

Surface area of trench is determined by:

$$A_t = V_w / (nd_t)$$

Where:

A_t = surface area of trench

V_w = design volume entering trench (e.g., WQ_v)

n = porosity

d_t = trench depth based on the depth required above seasonal groundwater table or a depth less than d_{max} (4 ft), whichever is smaller


This slide shows an infiltration trench receiving runoff from a parking lot. Note the PVC observation well and clean-out in the background.
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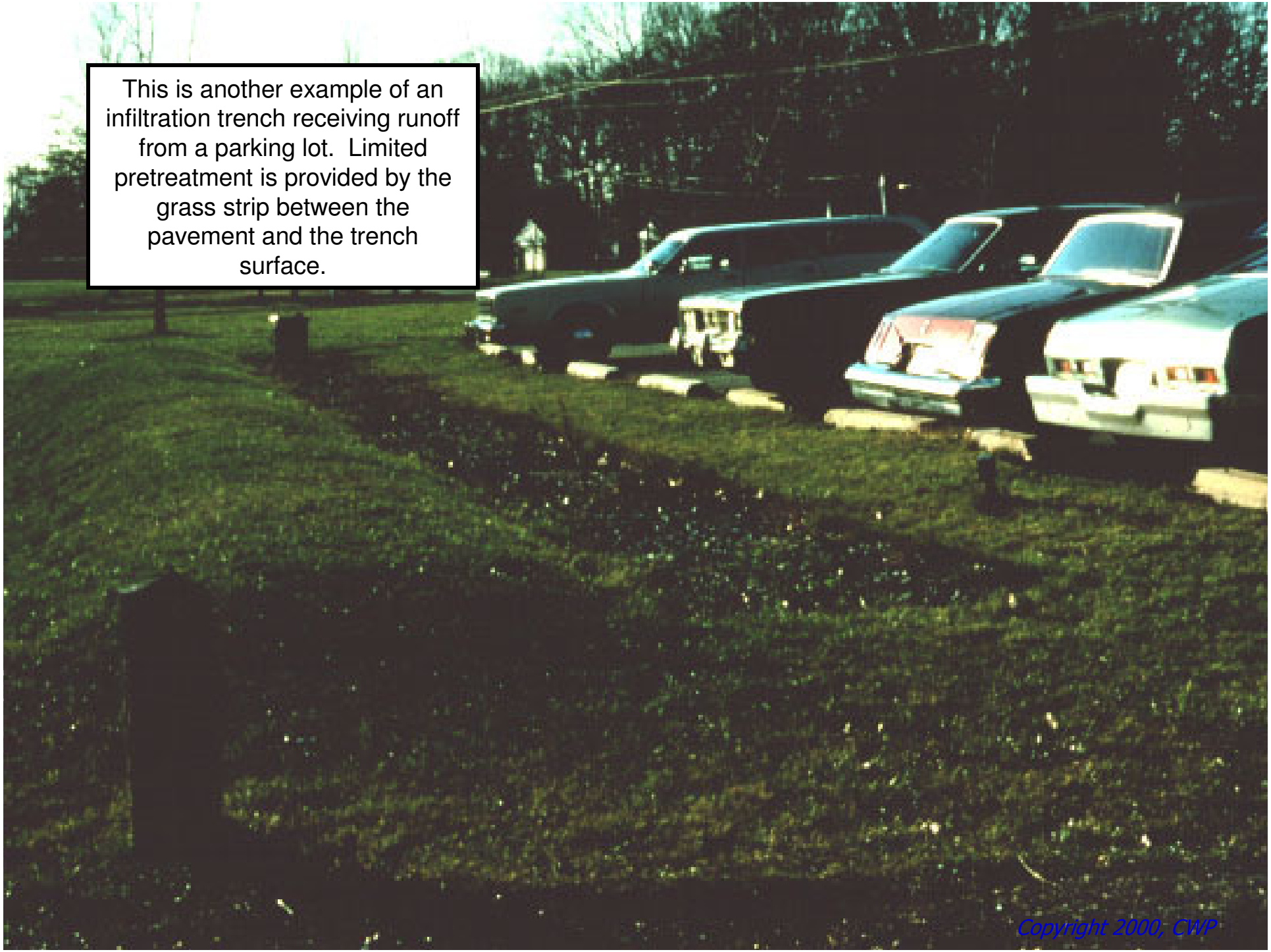
This is another example of an infiltration trench receiving runoff from a parking lot. Limited pretreatment is provided by the grass strip between the pavement and the trench surface.
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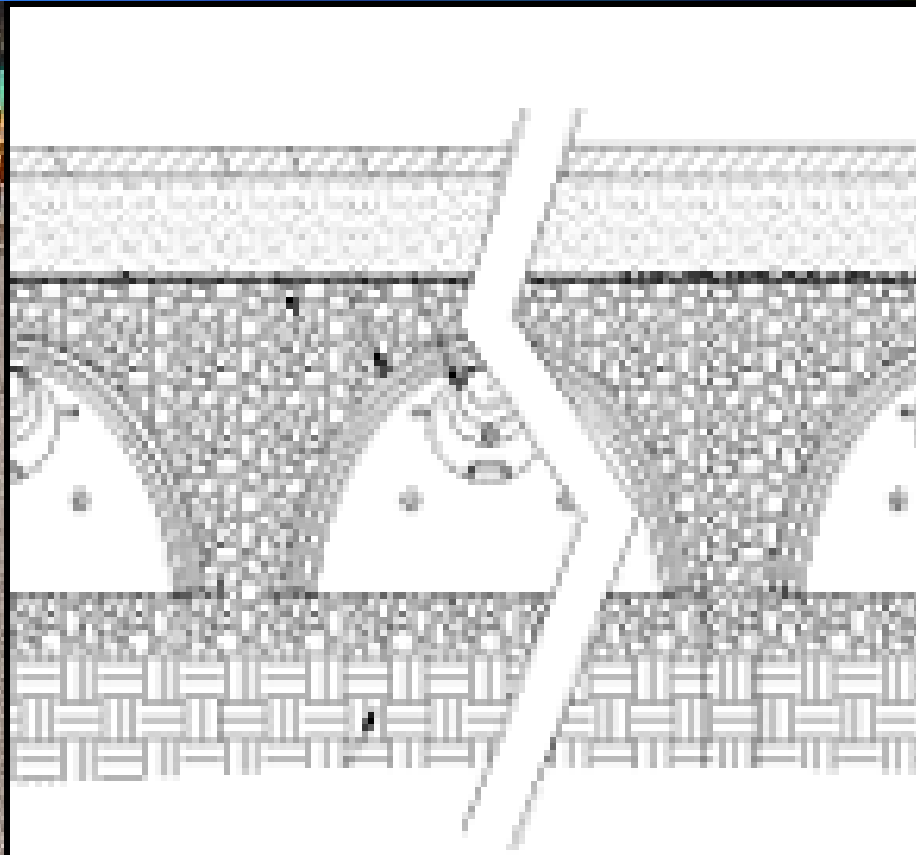
Subsurface Infiltration Chambers

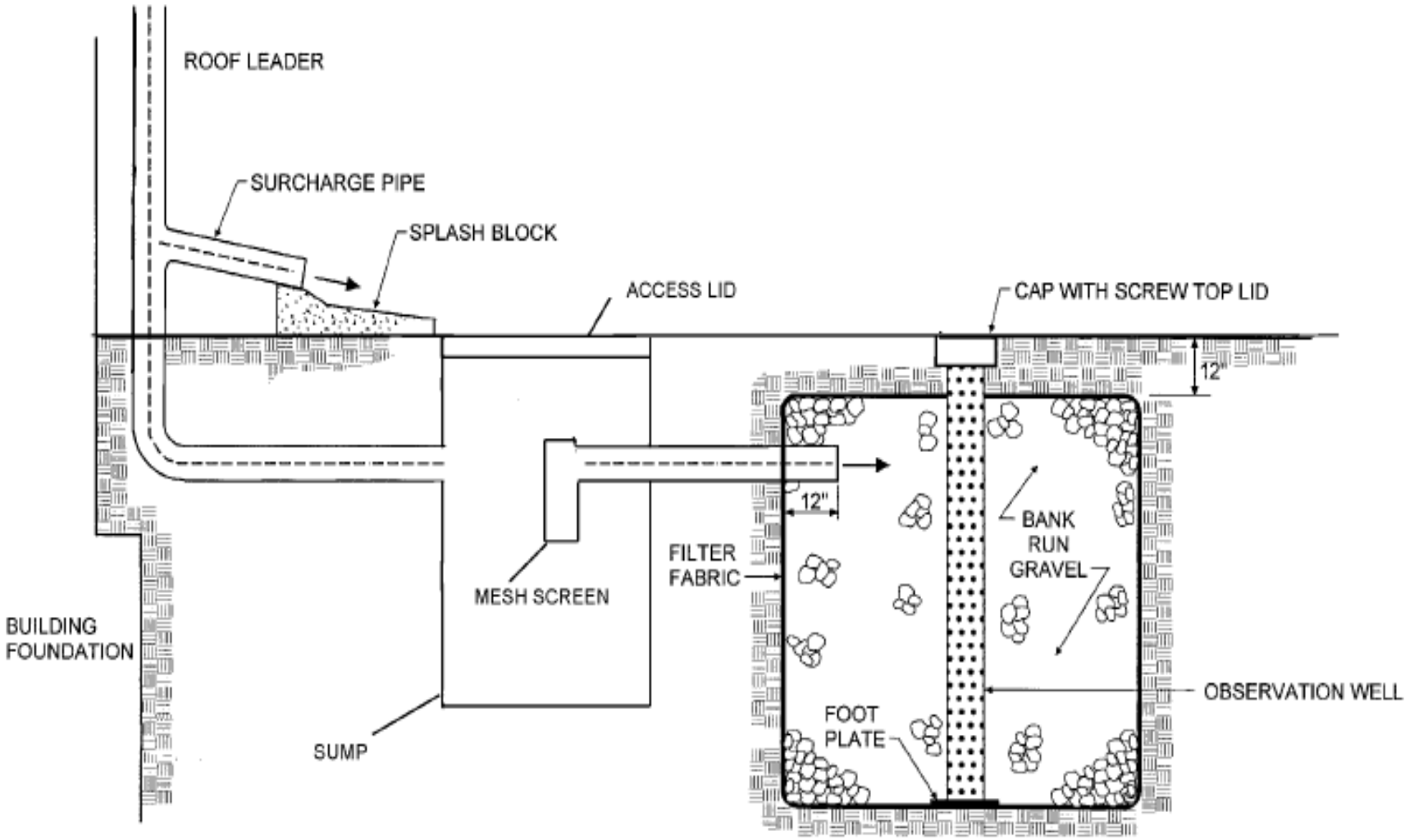


Treatment:
Dry Well

- Similar to infiltration trench design
- Suitable for rooftop runoff treatment
- Maximum 1 acre drainage area
- Observation well required
- Sump pit, trap, pretreatment
- Prefabricated Design

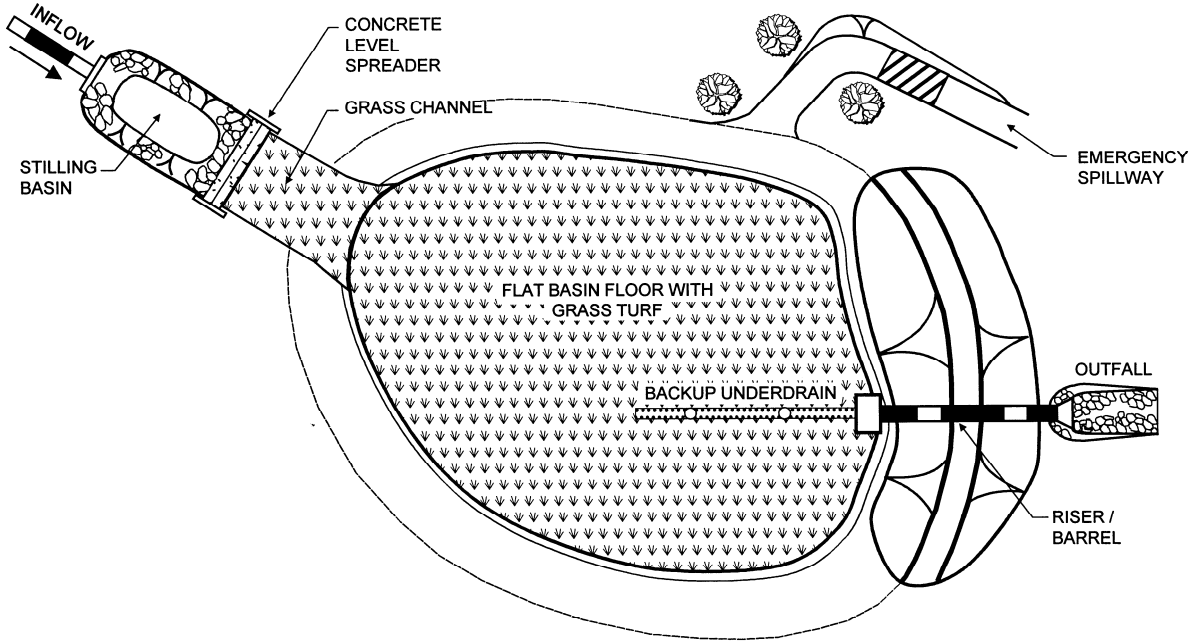
http://www.epa.gov/safewater/uic/pdfs/fact_class5_stormwater.pdf

Figure 6.13 Dry Well (I-3)

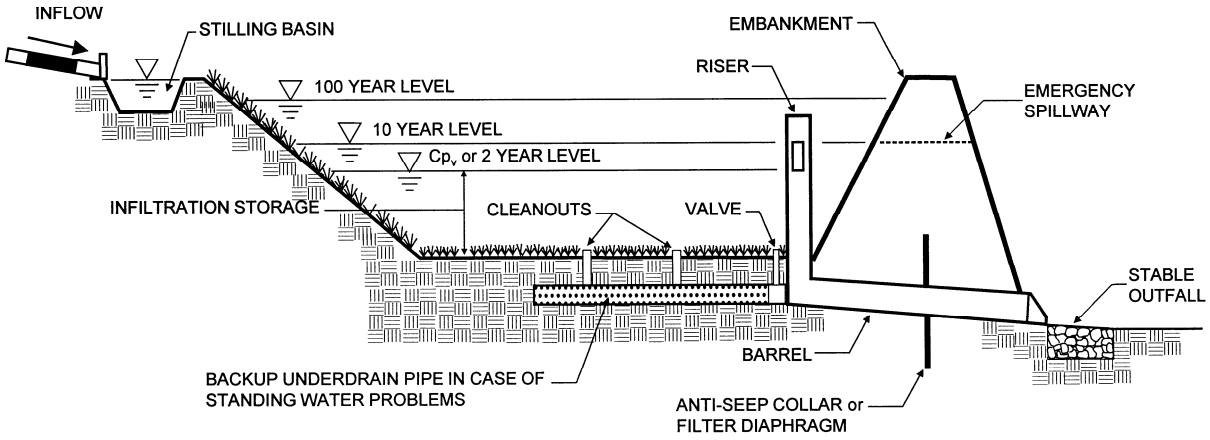


Treatment:
Infiltration Basin

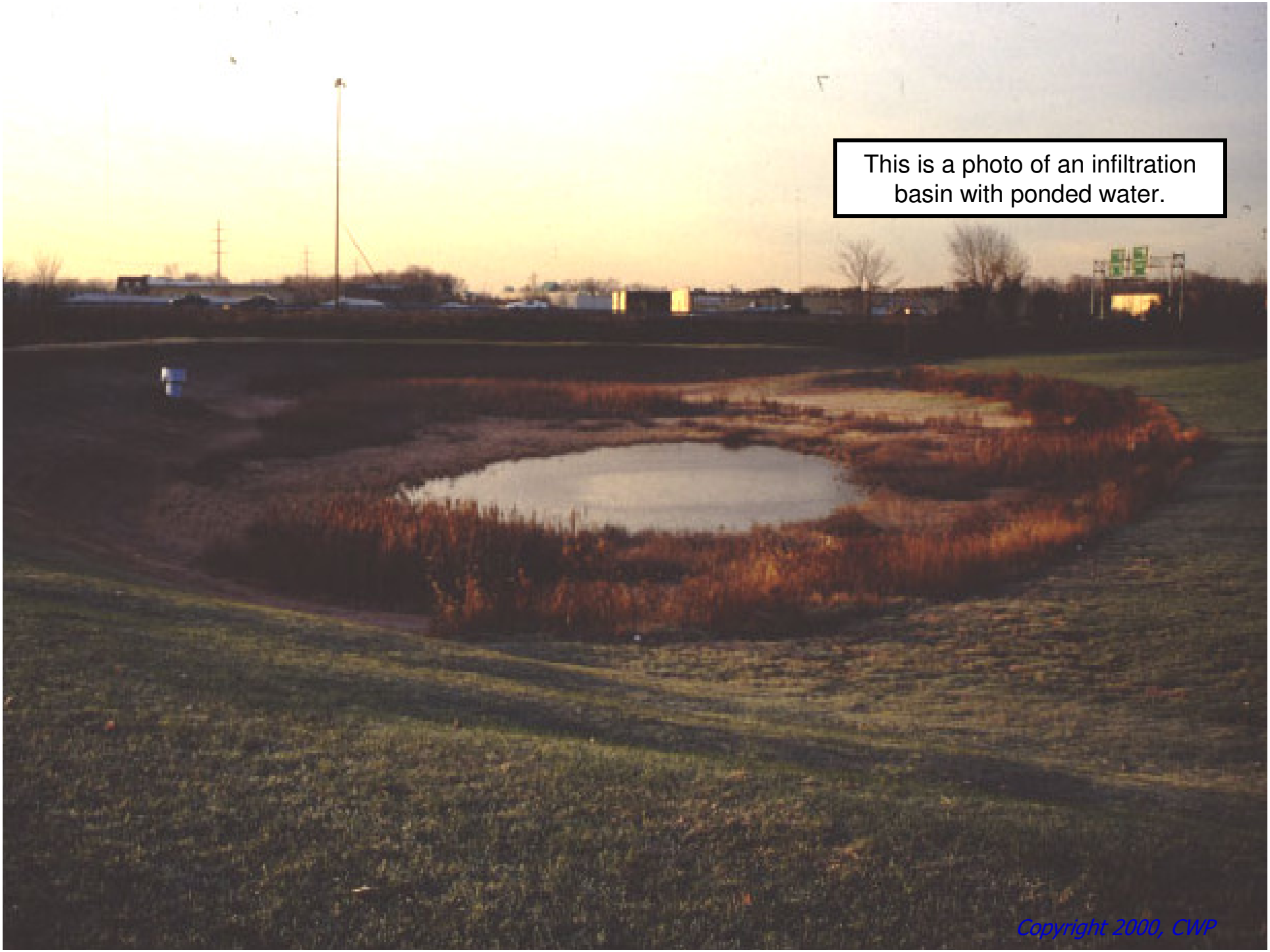
- Failure rates of 25 to 100% recorded in the field.
- Pretreatment with settling basin is recommended.
- Partially excavated basins should not be used as sedimentation basins during construction.
- Final excavation deferred until all contributing areas have been stabilized or protected.
- A 6 to 12 inch layer of filter material recommended to prevent the buildup of impervious deposits on the soil surface.



PLAN VIEW



PROFILE


This is a photo of an infiltration basin with ponded water.
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Infiltration Basin
Design Manual Method

Bottom surface area of basin is determined by:

$$A_b = V_w / d_b$$

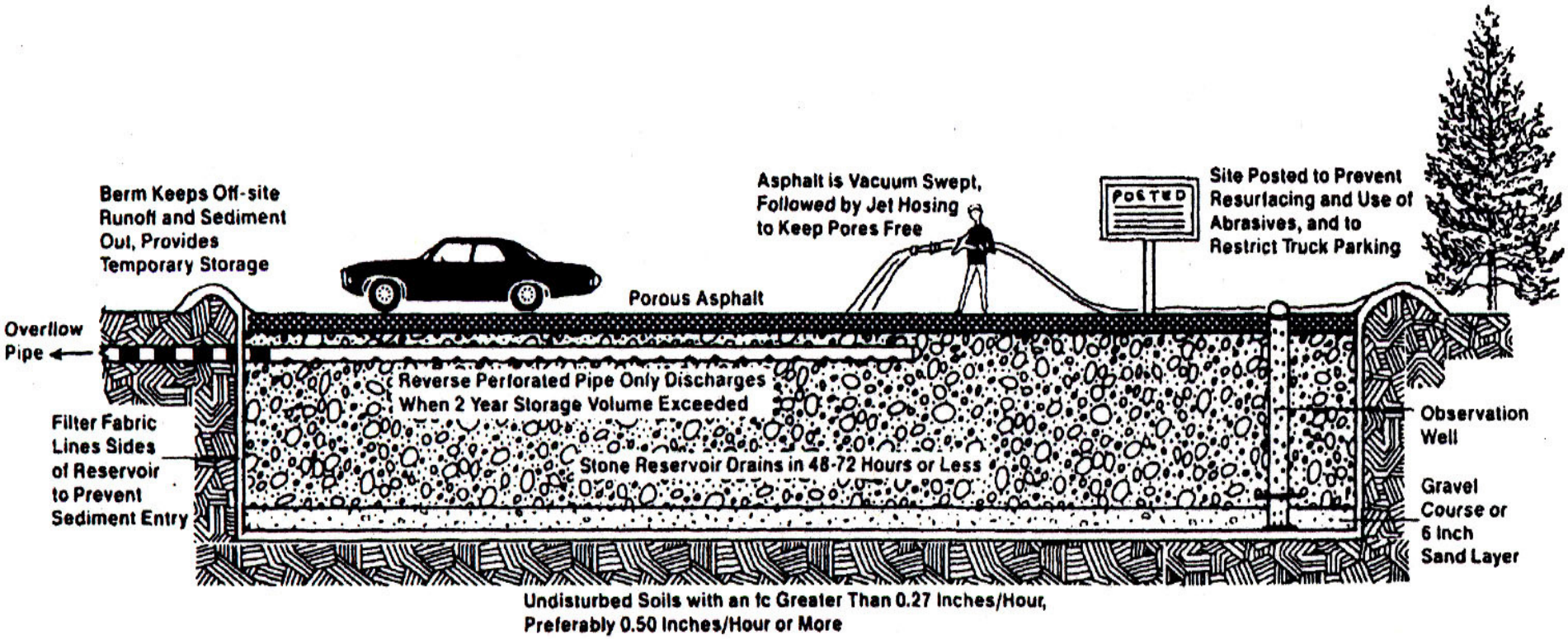
Where:

A_b	=	bottom surface area of basin
V_w	=	design volume entering basin (e.g., WQ_v)
d_b	=	basin depth based on the depth required above seasonal groundwater table or a depth less than d_{max} (4 ft), whichever is smaller

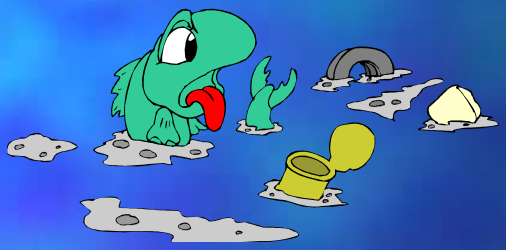
Landscaping

- Dense vegetative cover should be established over the contributing pervious drainage areas
- Should not be constructed until all of the contributing drainage area has been completely stabilized
- Infiltration basins should establish dense vegetation on the basin side slopes and floor

Porous Pavement



Why Don't Stormwater Practices Last Forever?



Sediment and Debris

Vandals

Forces of Nature

Time

Plant Growth/ Die-Off

Infiltration: Typical Problems

- Clogging
- Sediment build-up
- Standing water
- Woody vegetation
- Cracked observation well
- Overflow channel


Without adequate pretreatment, infiltration trenches will easily clog, as this slide shows.
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This is another photo of an infiltration basin that is not performing as designed due to a clogged surface.
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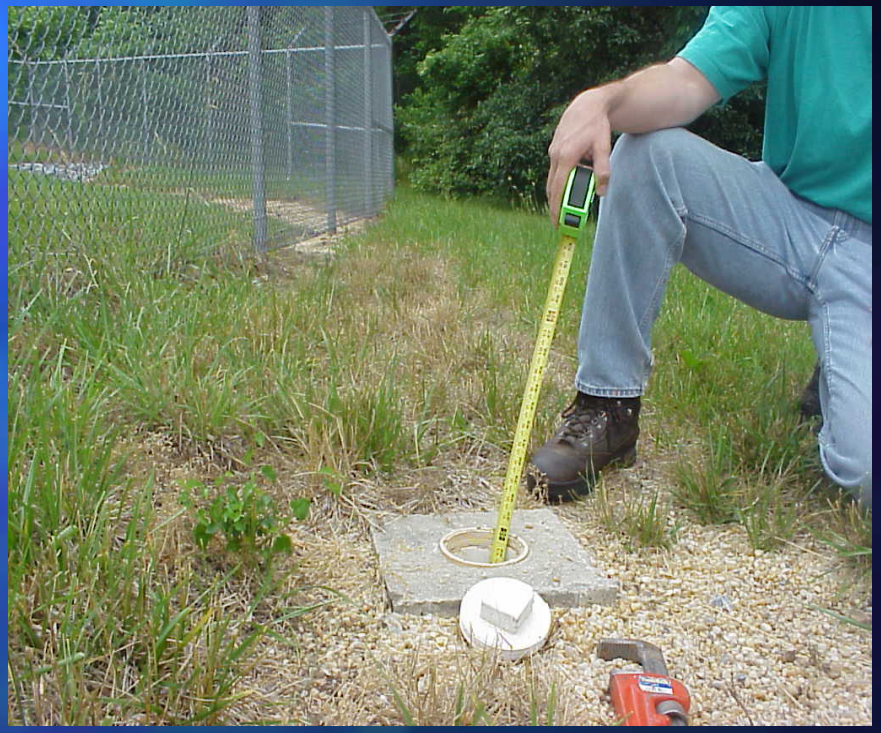
Key Inspection Equipment - II

- Inspection checklists
- As-built drawings
- Past inspection reports

Source: DNREC

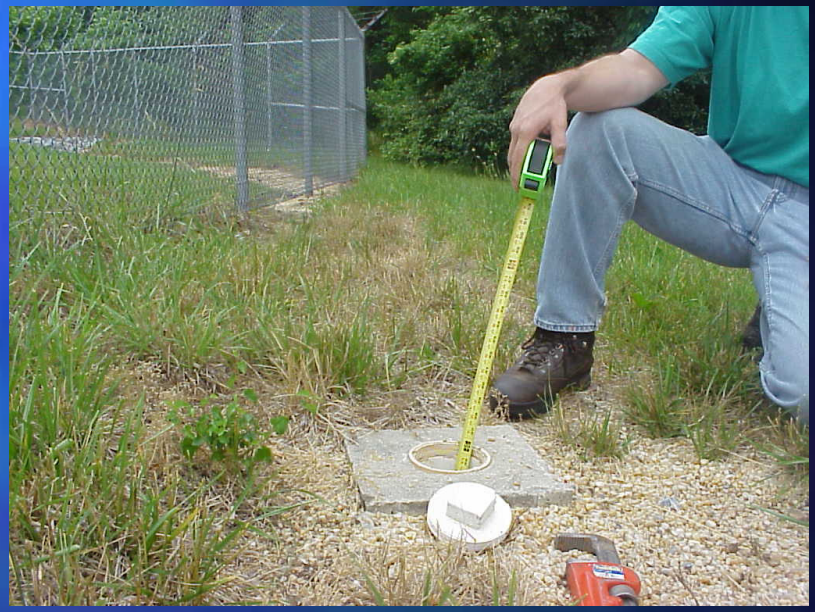
Infiltration Systems:
Maintenance Criteria

- Observation well installed in infiltration trench
- Extreme care during construction stage
  - No coverage with impermeable surface
  - Avoid sediment entry
  - Do not use as sediment control device



Observation Well

- From as-builts, know distance from rim to trench bottom.
- Measure distance to water.
- Best conducted 48 hours after rainfall.



Infiltration Systems:
Maintenance Criteria

- OSHA standards for trench excavation
- Underdrain pipe system recommended for de-watering
- Direct access for maintenance and rehabilitation
- Longevity
  - Poor to moderate of first generation
  - Redundant pretreatment
  - Regular maintenance

Summary

- Capture and temporarily store the water quality volume allowing it to infiltrate into the soil over a two day period.
- Help meet groundwater recharge
- Best used in conjunction with other treatment practices
- Limitations:
  - Avoid possible risks of groundwater contamination
  - Have longevity of less than 5 years without multiple pretreatment
  - Cannot be used if contributing drainage is a hotspot