Porous Asphalt Pavements

Kent Hansen
Director of Engineering
National Asphalt Pavement Association

What are Porous Pavements?

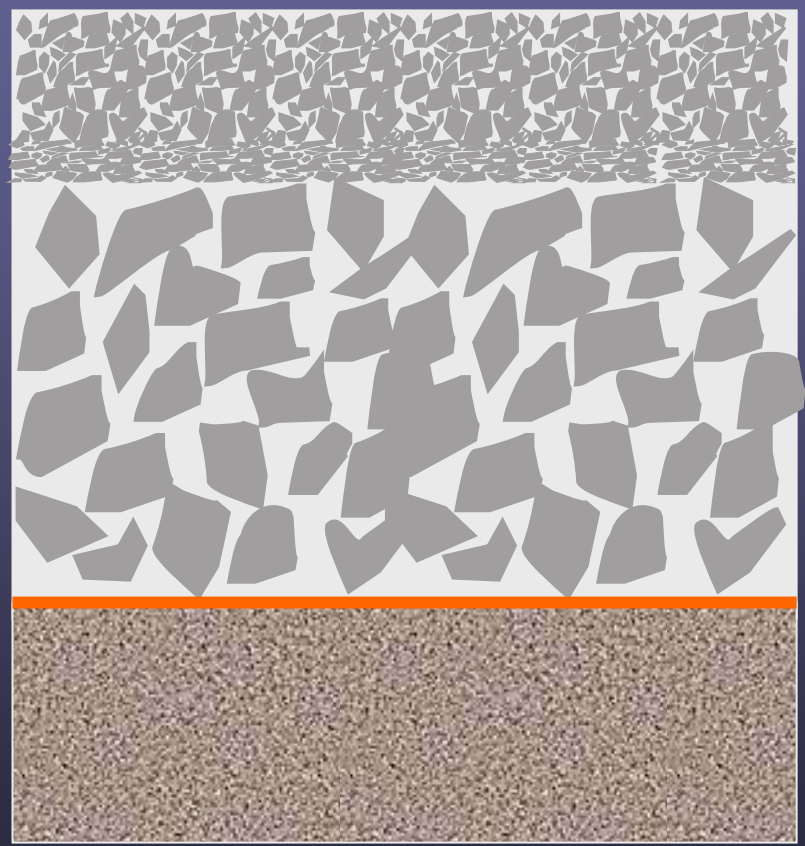
Open-Graded HMA ~ 2 ½”

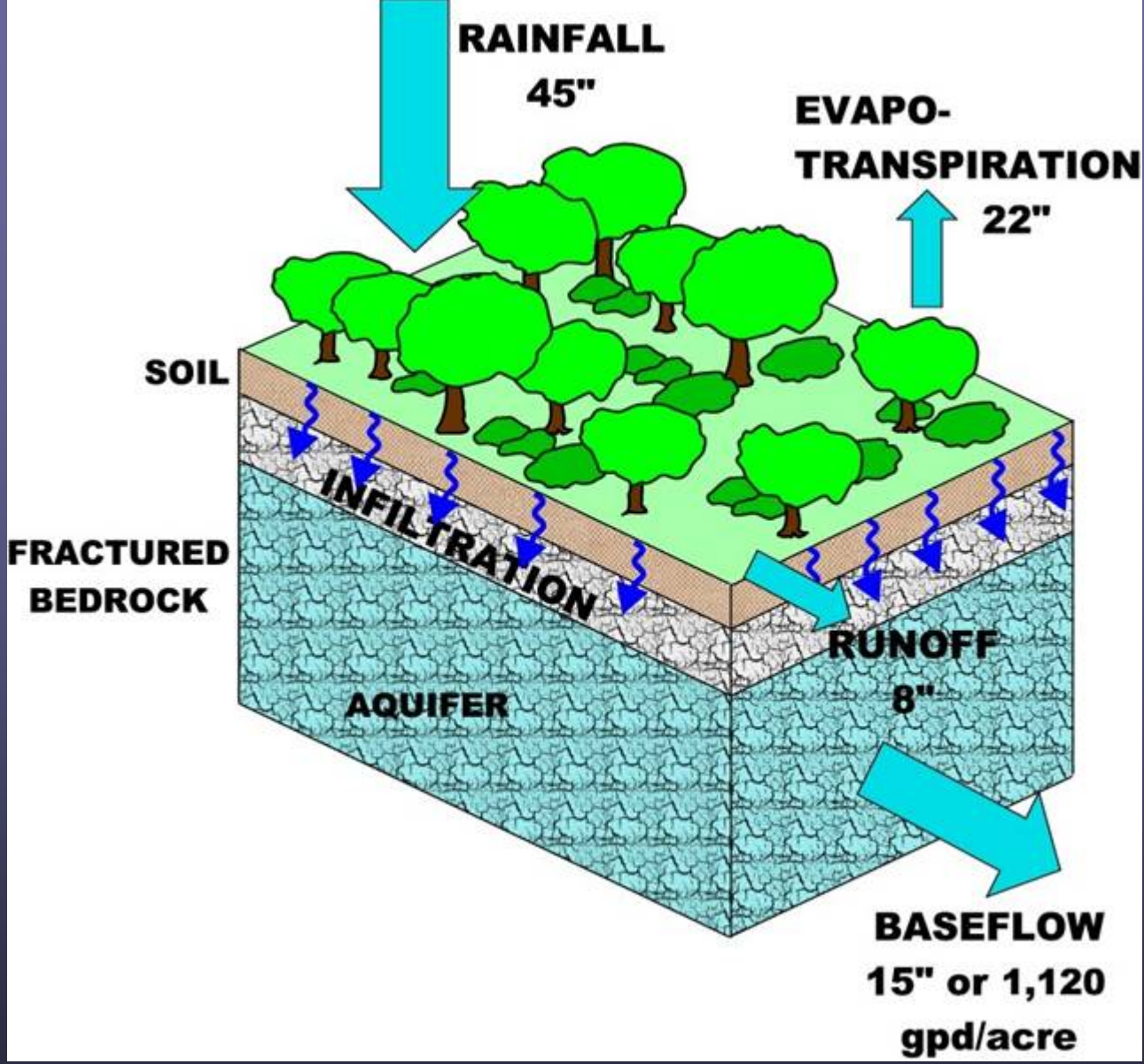
½” Agg. (#57) ~ 1 – 2” Thick

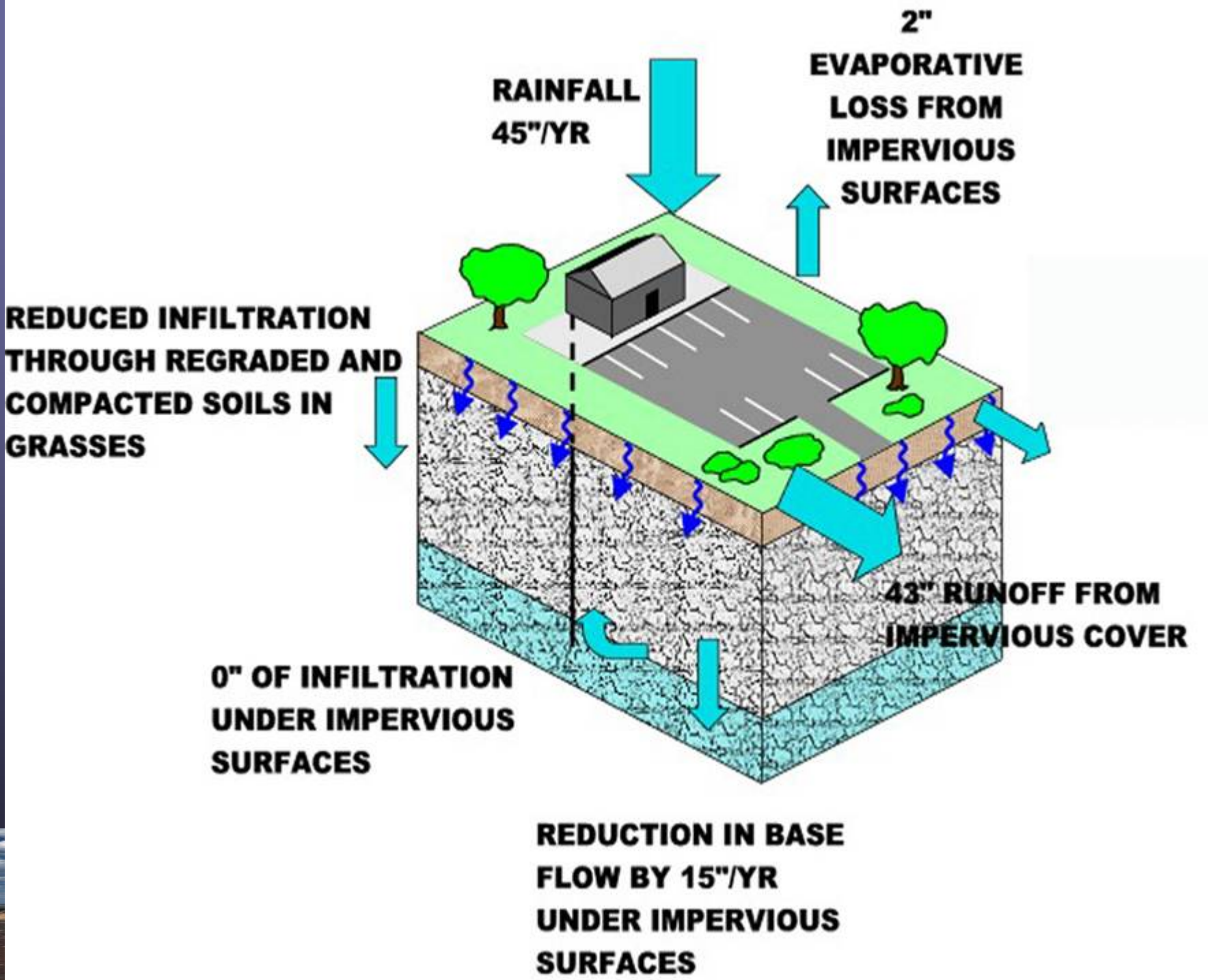
Clean Uniformly Graded 2”-3”
Crushed Agg. (#2) – 40% Voids

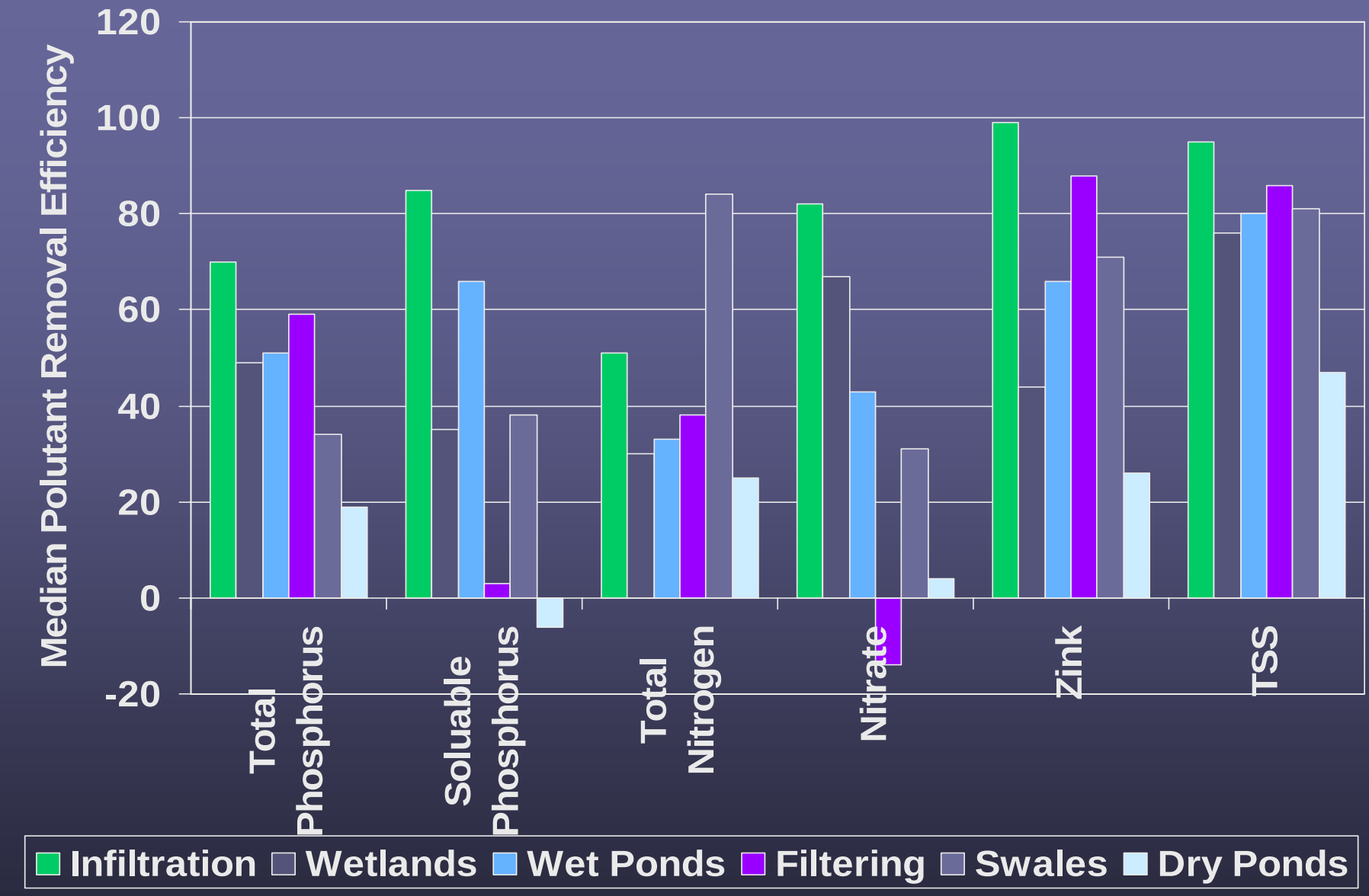
Non-Woven Geotextile

Uncompacted Subgrade




RAINFALL
45"
EVAPO-
TRANSPIRATION
22"
SOIL
FRACTURED
BEDROCK
INFILTRATION
RUNOFF
8"
AQUIFER
BASEFLOW
15" or 1,120
gpd/acre


2"
EVAPORATIVE
LOSS FROM
IMPERVIOUS
SURFACES
RAINFALL
45"/YR
REDUCED INFILTRATION
THROUGH REGRADED AND
COMPACTED SOILS IN
GRASSES
43" RUNOFF FROM
IMPERVIOUS COVER
0" OF INFILTRATION
UNDER IMPERVIOUS
SURFACES
REDUCTION IN BASE
FLOW BY 15"/YR
UNDER IMPERVIOUS
SURFACES


Median Polutant Removal Efficiency
120
100
80
60
40
20
0
-20
Total Phosphorus
Soluable Phosphorus
Total Nitrogen
Nitrate
Zink
TSS
Infiltration
Wetlands
Wet Ponds
Filtering
Swales
Dry Ponds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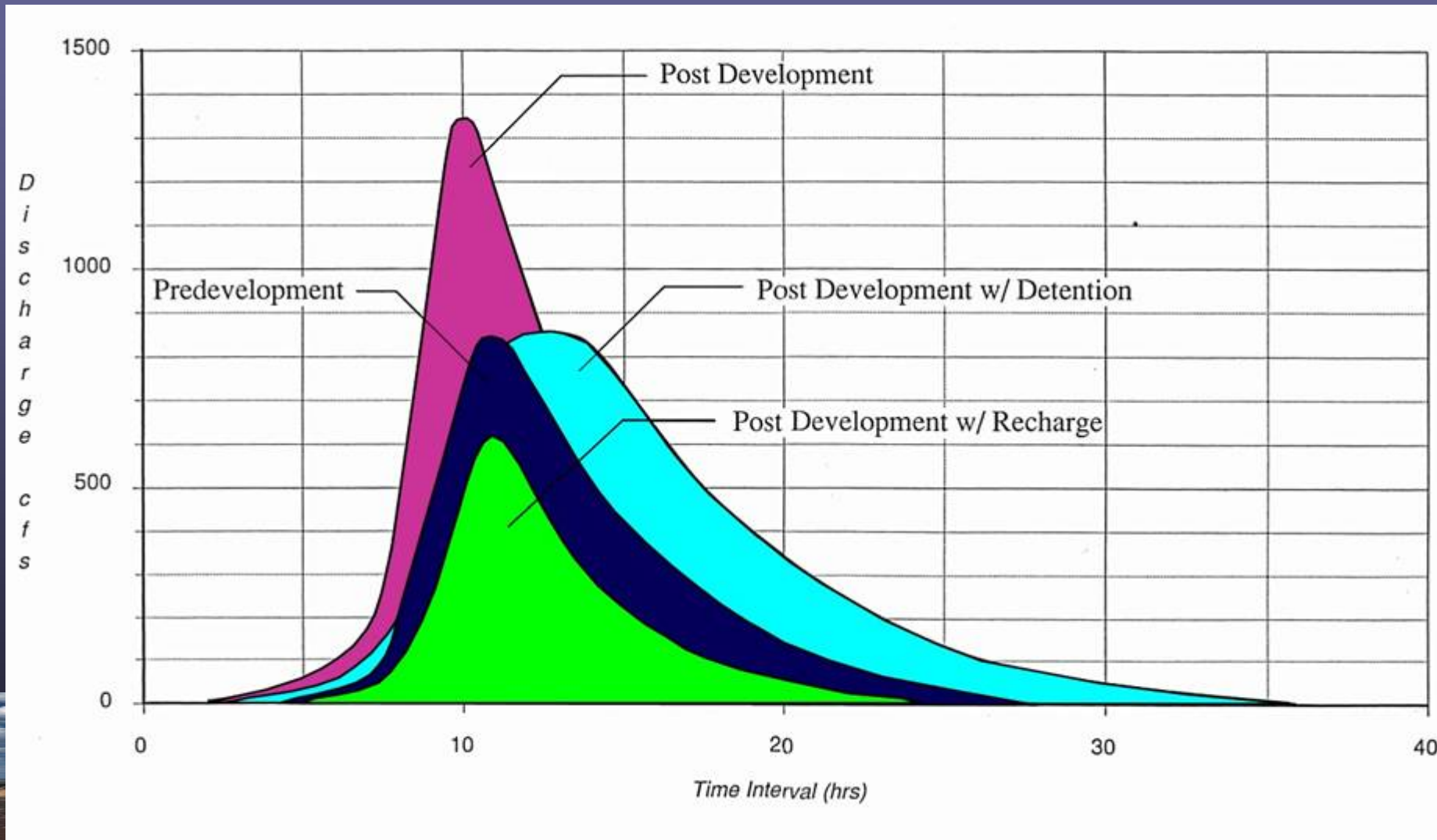
Comparison of Detention vs. Infiltration Design Systems



Porous bituminous pavement

- Developed by the Franklin Institute – 1972
- Tested in pilot projects during 1970's
- Development of geotextiles in 1979
- Current design since 1980
- CA has built over 150 projects since 1980
- Outstanding engineering project - 2000

Keys to Success – Site Conditions

- Soil permeability/infiltration rate
  - EPA recommends 0.5”/hour
  - 0.1”/hour still OK
- Depth to bedrock > 2’
- Depth to high water > 3’
- Fill – not recommended
- Frost
  - Pavement section should exceed frost depth?

Soils Investigation

- Borings and/or test pits
  - Test permeability
  - Determine depth to high water table
  - Determine depth to bedrock

Keys to Success - Design

- Slope – limit surface slope to 5%
  - Terrace when necessary
  - Use conventional HMA for steeper slopes
- Avoid piping water long distances
- Spread infiltration over largest area possible
  - 5:1 Impervious: Infiltration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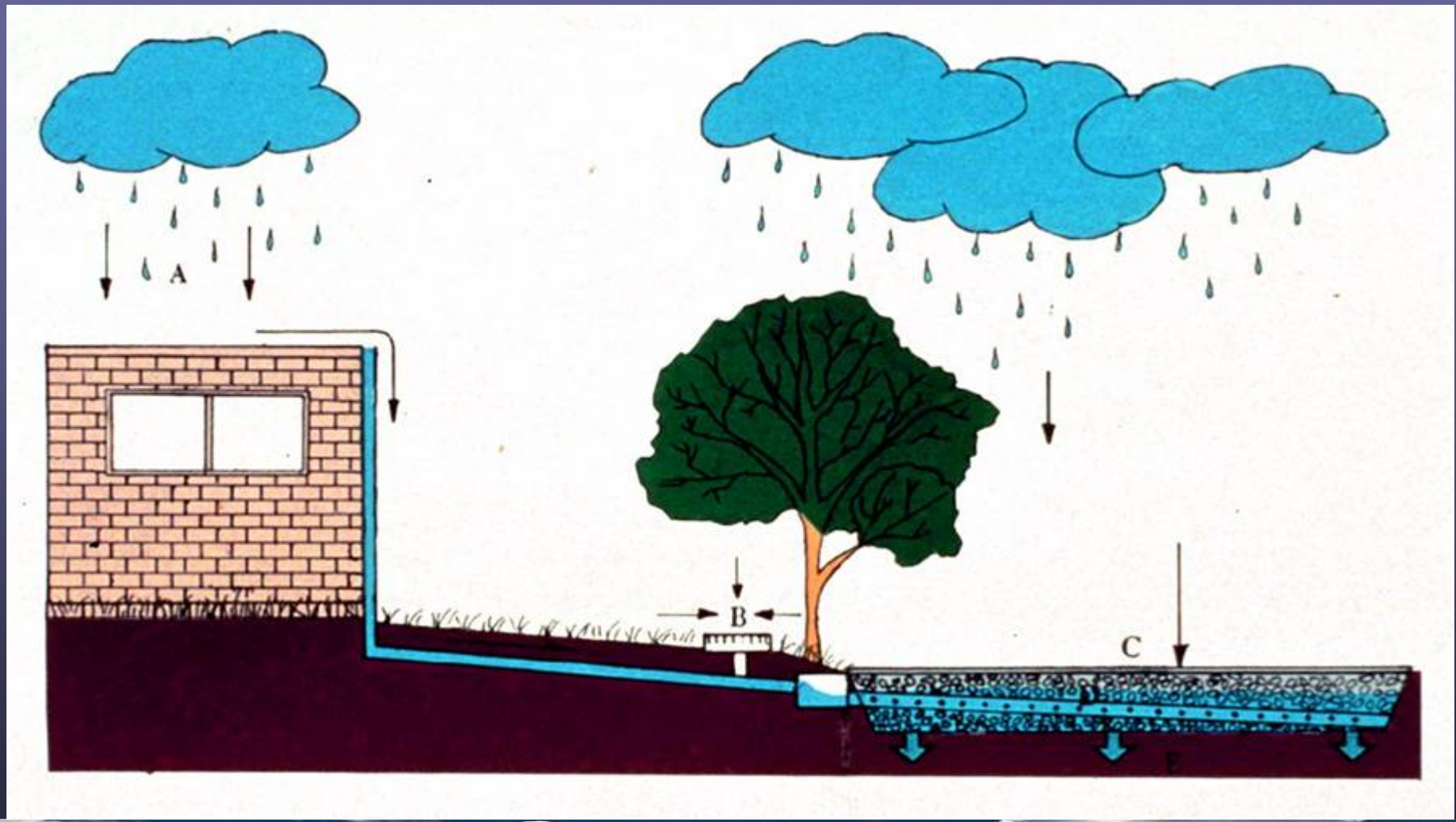
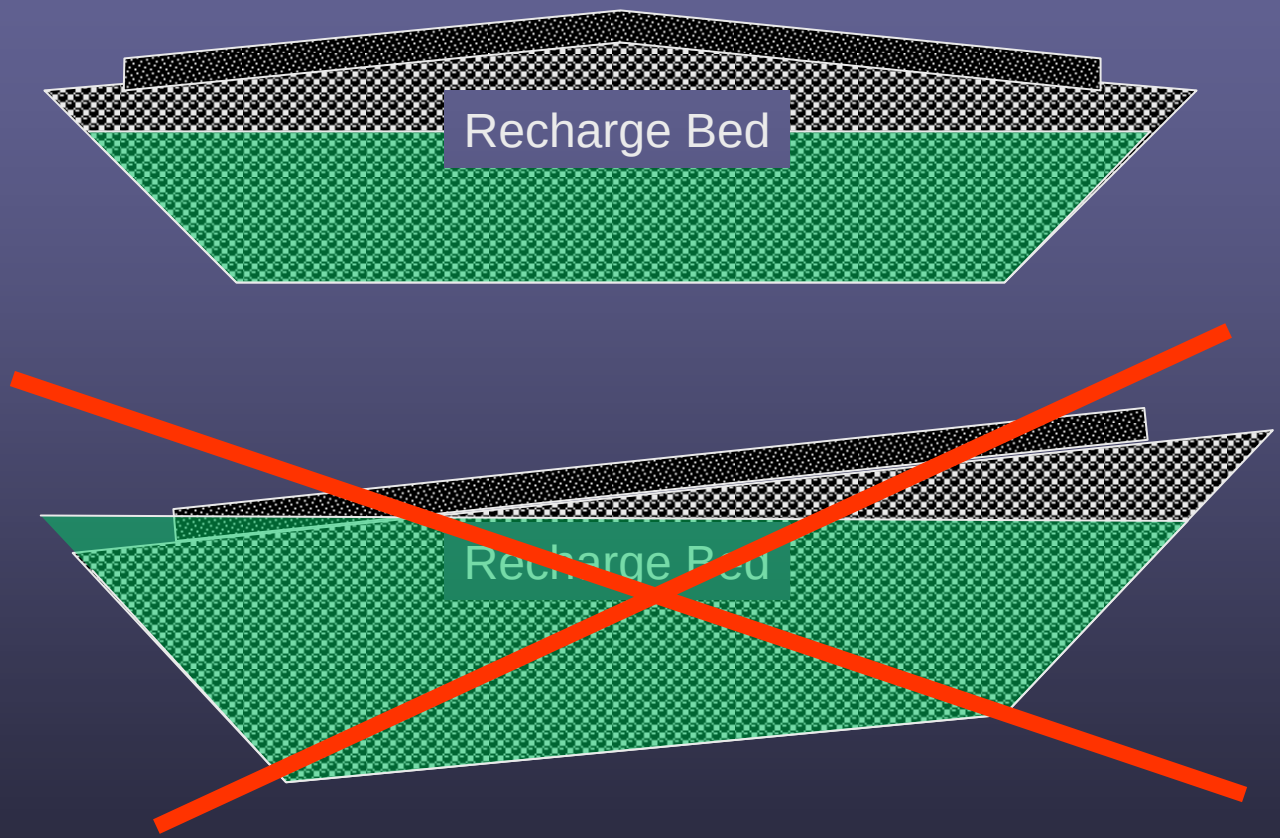
Avoid piping long distances



Bottom Must Be Flat



Design

Regulations

- Rainfall
  - Typical designs for 6 month/24 hr storm
  - Conservative design for 20 year/24 hr storm range from 1.4 to 15 in./24 hr.
- Meet Local & State wastewater mitigation requirements.

Keys to Success – Design

Usage / Vehicle Loading

Lightly loaded areas

- Parking lots
- Low volume roads (limited truck use)
- Recreational Areas

- Meet structural requirements
- Roads?

What about roads?

It does rain in Arizona


18 Years Later

Roads

- Challenges
  - Cuts and fills
  - Slope
  - Variable soil conditions
  - Utilities
- Limited use

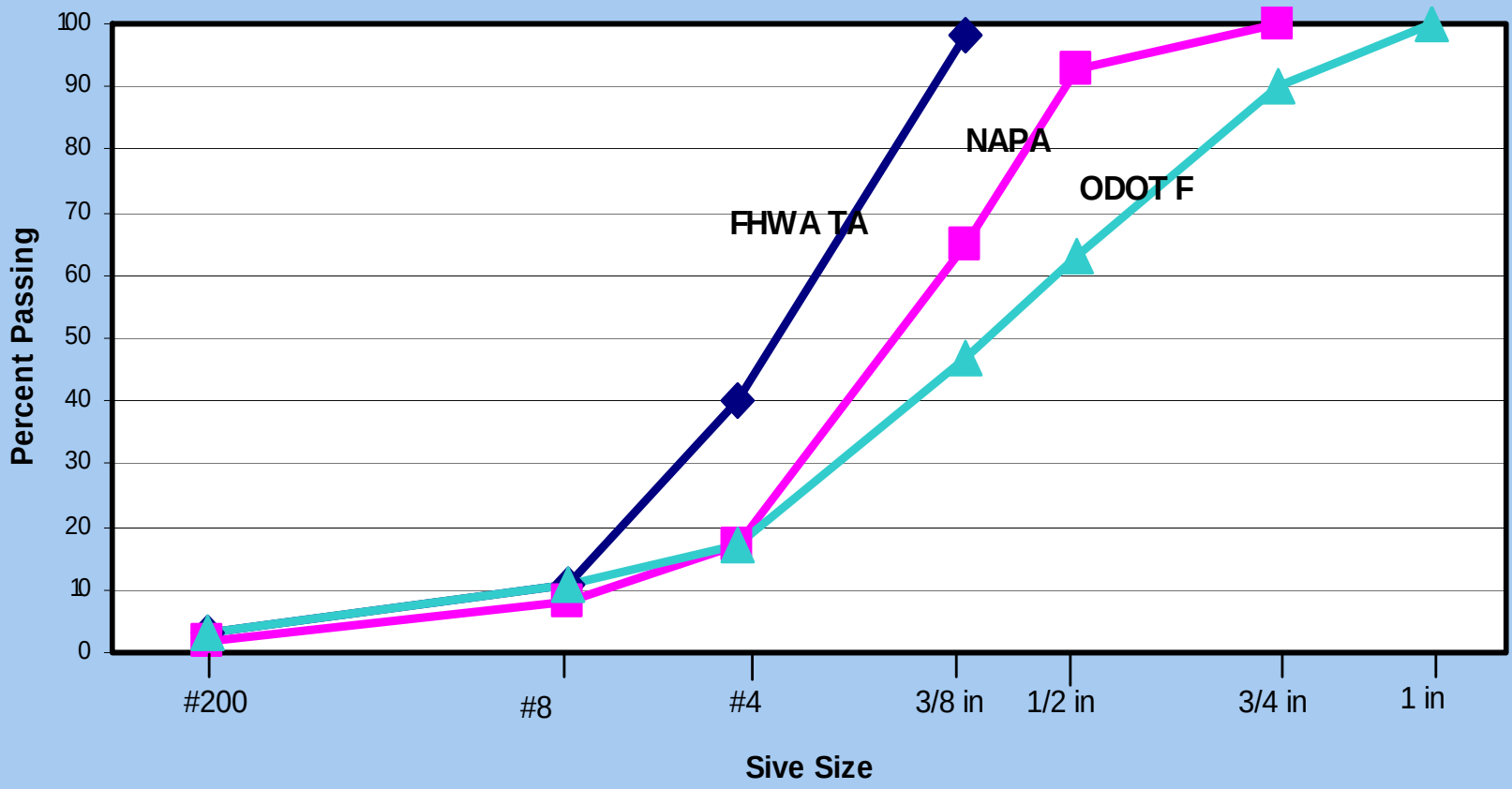
Keys to Success – Construction

- Build porous pavement last
  - Protect from construction debris
  - Protect from soil laden runoff
- Protect site from heavy equipment
  - Don’t compact subgrade
- Excavate to subgrade (soft footprint)
- Place filter fabric

Keys to Success – Construction

- Place reservoir course 1.5 to 3 in. stone (if granular source then 95% double fracture)
- Place 1-2 in layer of ½ in stone to stabilize the surface of the reservoir course
- Place porous asphalt course (2 to 4 in.) usually compacted with 2-3 passes with 10 ton roller.

Porous HMA Surface



Open-Graded HMA

- Binder Content 6.0-6.5%
- Should consider using stiffer asphalt
- Consider modified asphalt
- Consider fibers
- Thick OG HMA – 2 layers?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Construction Guidelines

Construction

- Restrict traffic for 24 hrs.
- Protect porous pavement from contamination.
  - Runoff sediment
  - Construction debris

Construction Guidelines

- Post Construction
  - Inspect for design compliance during storm event.
  - Confirm vegetation is established before removing temporary storm water measures
  - Do not sand or ash for snow or ice, liquid de-icing compounds may be used.
  - Sign for maintenance.

Maintenance

- Inspect several time first few months during storm events.
- Inspect annually thereafter.
- Pavement surface may be flushed or jet washed.
- Damage pavement can be repaired using dense hot mix provided <10% area.

Cost

- Cost of pavement structure more
- May be offset by reducing drainage structure costs

Keys to Success

- Make sure site conditions are acceptable
  - Permeability
  - Depth to groundwater and/or bedrock
- Design
  - Bottom of infiltration bed level
  - Limit surface slope < 5%
  - Runoff from adjacent areas will not plug pavement

Keys to success

- Construction
  - Don’t compact subgrade
  - Protect pavement from contamination
    - Build porous pavement late
    - Stabilize adjacent areas before construction
- Maintenance
  - Do not sand, or ash pavements
  - Install signage to warn maintenance personnel
  - Can patch with conventional asphalt < 10%

Morris Arboretum
Philadelphia, PA
1984

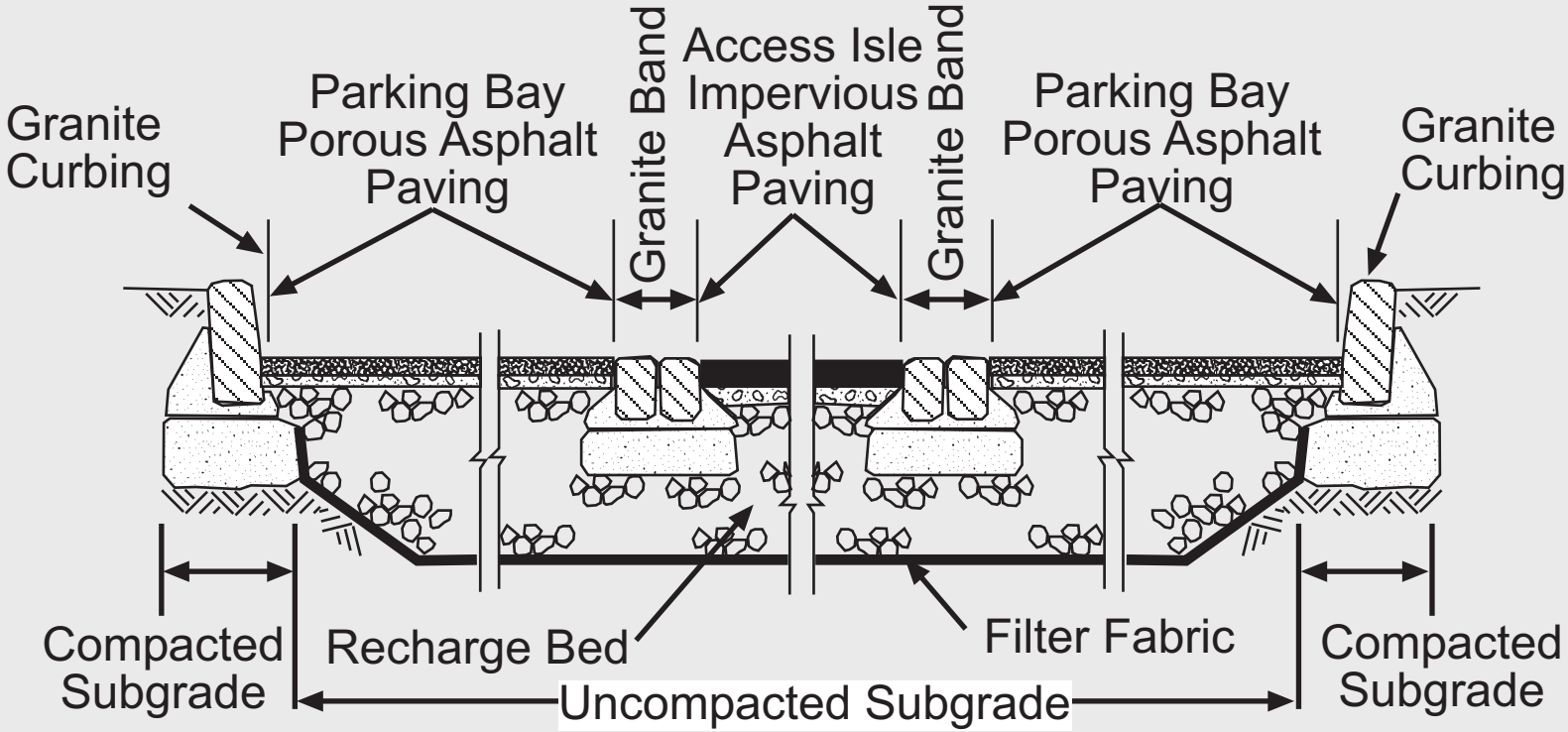

Diagram of infiltration bed at Morris Arboretum

Shared Medical Systems
Malvern, PA
1982


CAUTION
BUMP

Conclusions

- Porous pavements offer good alternative to conventional stormwater mitigation
- Site Conditions must be right
- Need to protect pavement from contamination during and after construction
- Properly designed and constructed will last more than 20 years

Information Series 131

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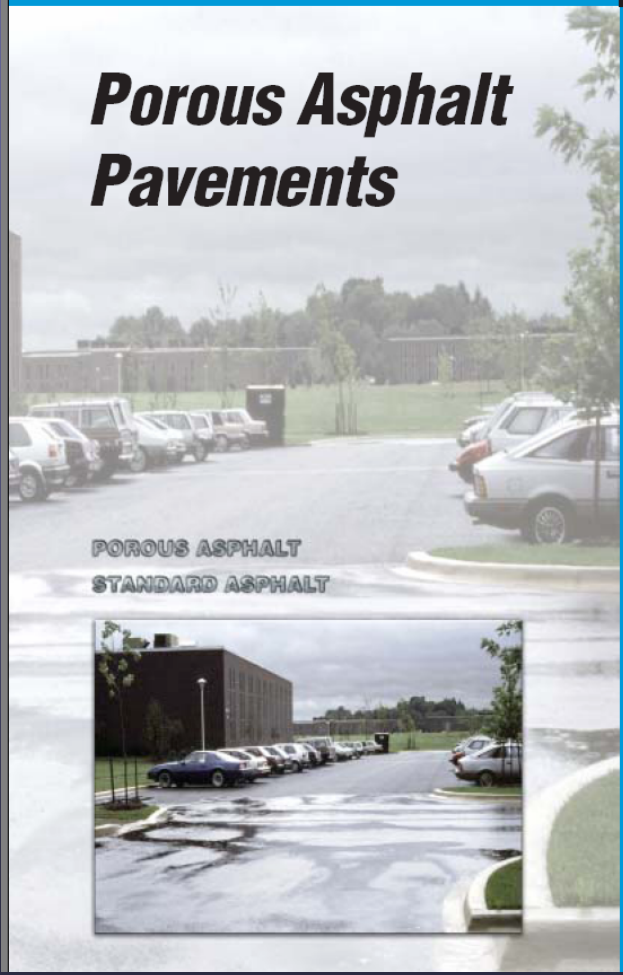

ASPHALT
100% RECYCLABLE