The State of West Virginia

Community Development Block Grant Mitigation (CDBG-MIT)

Capacity Building Session

Virtual Meeting Norms

Today's presentation will be recorded and posted for future reference.

All participants will be muted by default.

We encourage participation in the following ways:

Use the "Questions" function to ask questions. This will allow WV CAD to have a written record of all questions.

Use "raise hand" button and WV CAD will unmute one participant at a time.

Following the meeting, any questions or comments can be emailed to CDBGmitigation@wv.gov

Register! Presentation slides will be emailed to participants who registered for the hearing.

Joined the presentation with a group? If you're sharing a computer or logging in with a group, we only have 1 person's contact info. Please provide us with the names and emails of others so they can continue to receive updates.

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CAPITAL ACCESS

Introduction to Natural Infrastructure

Getting Started

- Ground Rules
- Objectives
- Review Audience Objectives / Greatest Concerns

Objectives

- Clarify and define alternative or natural infrastructure solutions
- Provide clear definitions and examples that contrast traditional to more innovative solutions
- Review and quantify the benefits and reasons they are being encouraged by the State
- Demonstrate economic benefits of natural infrastructure

Severe Storms & Flooding

What is Natural Infrastructure?

Section 502 of the Clean Water Act defines natural infrastructure as "...the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters."

Benefits of Natural Infrastructure

- Cost effective to install and/or maintain
- Durable
- Attractive
- Supports natural habitats as a solution for Environmental Review
- Allows for multiple uses such as park and recreational space
- Means of increasing resiliency against identified risk (helps prevent flooding against future severe storms)

Hazards of Excess Water

Traditional infrastructure that relies on paved surfaces and fabricated materials tends to be impermeable and vulnerable to clogging and degradation, which exacerbates hazards of excess water such as:

- Property damage and loss of life from flooding
- Accumulation of trash, debris and bacteria
- Breeding of mosquitoes
- Attraction of nuisance wildlife
- Disruption of habitats and eco-systems

Managing Storm Water with Traditional Infrastructure

1. When there is a heavy storm, rain falls on roofs, pavement, and parking lots. Traditional infrastructure design often relies on concrete and asphalt, which do not permit absorption of water.
2. Sloped surfaces and gutters then (ideally) direct water to storm sewers.
3. These sewers are connected through a series of underground pipes that carry water directly to the nearest river, lake or other waterway. (Contrast to sanitary sewers, which carry the water from the drains in our homes to wastewater treatment plants, where the water is treated before being discharged into waterways.)

Severe storms can overwhelm sewer systems and create localized flooding.

How is Natural Infrastructure Different?

- Permeable surfaces allow water to absorb into the ground or a roof – “soak and spread” method
- Natural alternatives to dams and levies protect communities located near rivers by allowing floodwaters to disperse and slow down
- Improves the quality of waterways by preventing discharge of polluted storm runoff
- Reduces costs associated with water purification and treatment

Natural: Vegetated Swale

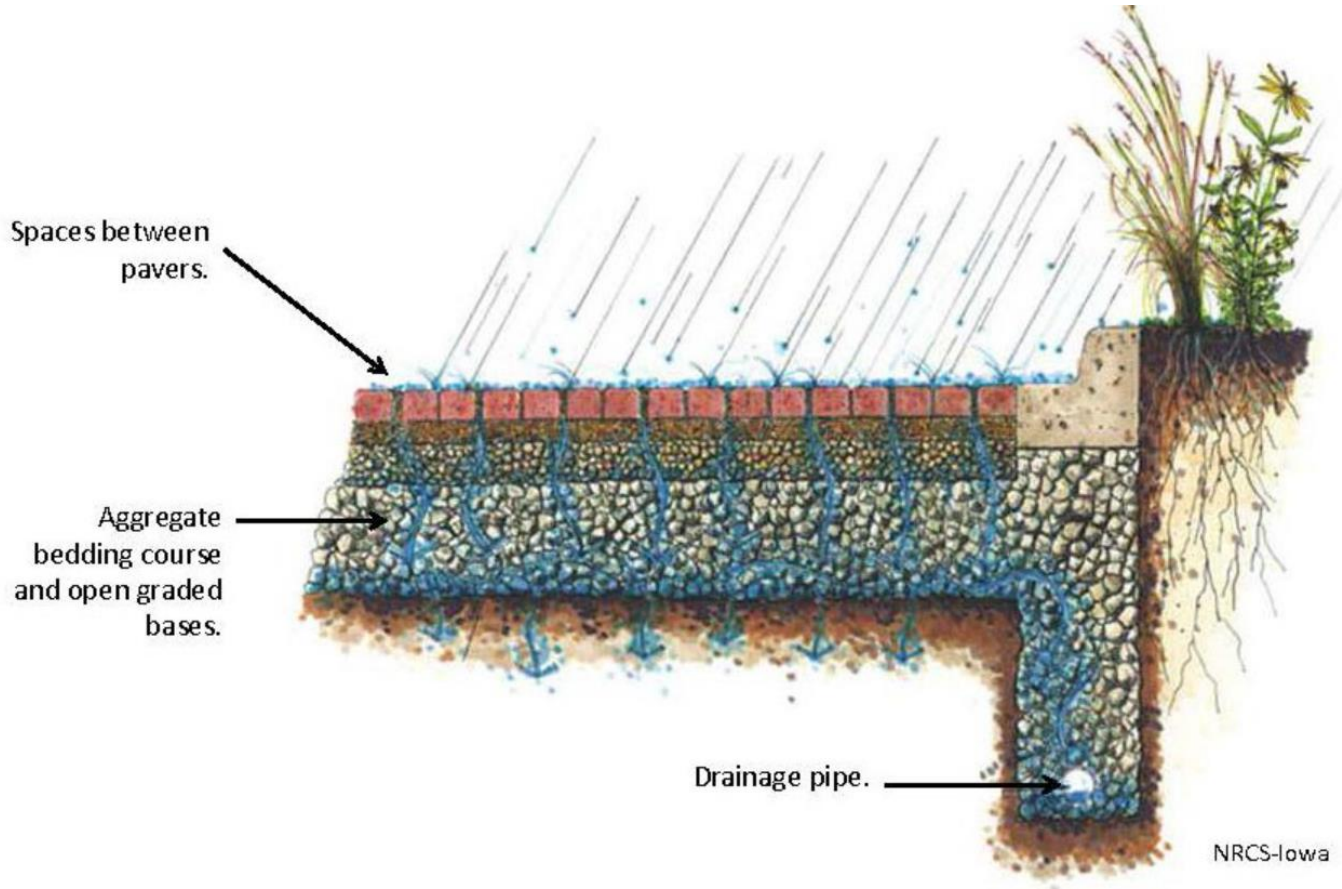
- Sloped, vegetated channels often placed along streets or parking lots to filter and convey stormwater away from infrastructure
- Also known as bioswales
- Reduces flooding and improves water quality
- Maintenance: Keep swale clear of debris and weeds and re-seed as necessary

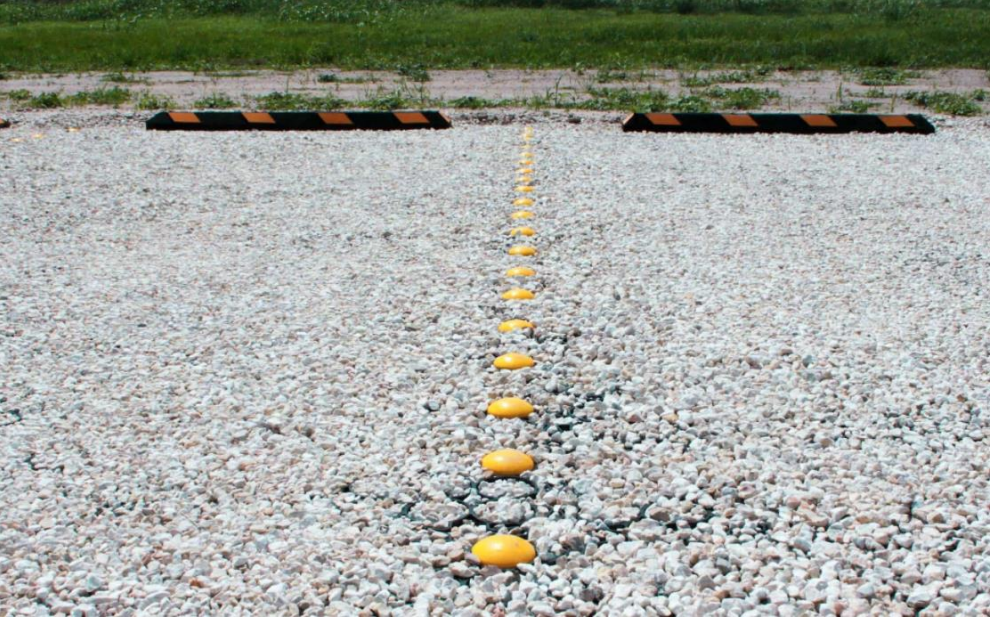
Traditional: Curb and Gutter System

- Sloped surfaces and gutters direct water to storm sewers
- Storm sewers are connected to a series of underground pipes that carry water directly to the nearest river, lake or other waterway
- Maintenance: Mechanical or manual cleaning required to prevent clogs. Structural elements must be replaced periodically to prevent failure.

Natural: Permeable Pavement

- Paved surface such as pervious concrete, porous asphalt or interlocking pavers that permits infiltration of stormwater into the ground
- May be used for sidewalks, parking lots and streets with light vehicular traffic
- Maintenance: Keep clean of sediment and debris. Avoid sand or chemical deicers in winter. Repair if spalled or broken.





Natural: Gravel Stabilizer Grids

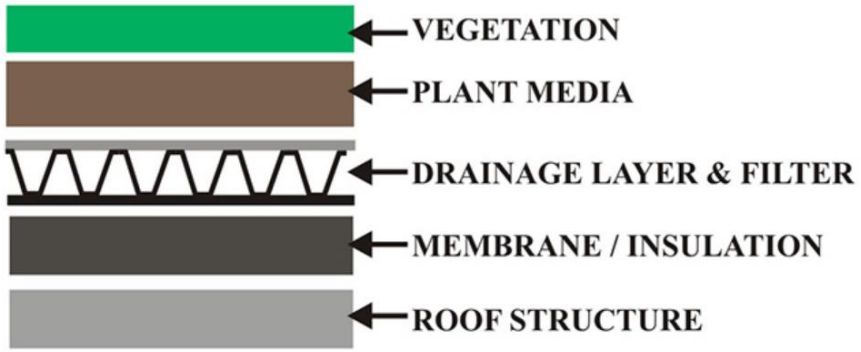
Connected gravel-filled cells on a permeable geotextile backing.
Advantages:

- Gravel does not sink, rut or migrate
- Can be snowplowed 1-2 inches above surface—remaining snow melts and infiltrates ground
- Porous surface discourages ice buildup
- ADA-compliant
- Maintenance: Keep free of weeds and debris, replenish with small amounts of gravel when/if needed

Traditional: Impervious Pavement

- May be used for roads, sidewalks, parking lots and gutters
- Typical materials are concrete and asphalt
- Does not permit infiltration of water which results in runoff or ponding
- Maintenance: Keep clear of weeds and debris. Repair or replace spalled or broken pavement and potholes. Reseal asphalt every 2-4 years.

Natural: Integrated Green Roof



Green Roof Cross Section

- Roof that is covered with vegetation and a growing medium, planted over a waterproofing membrane
- Vegetation slows, absorbs and evaporates stormwater to reduce runoff
- Other benefits include increased energy efficiency and noise absorption
- Maintenance: Ensure adequate watering, keep clear of weeds and debris, and fertilize periodically

Natural: Modular Green Roof

Consists of individual, pre-planted trays or modules that:

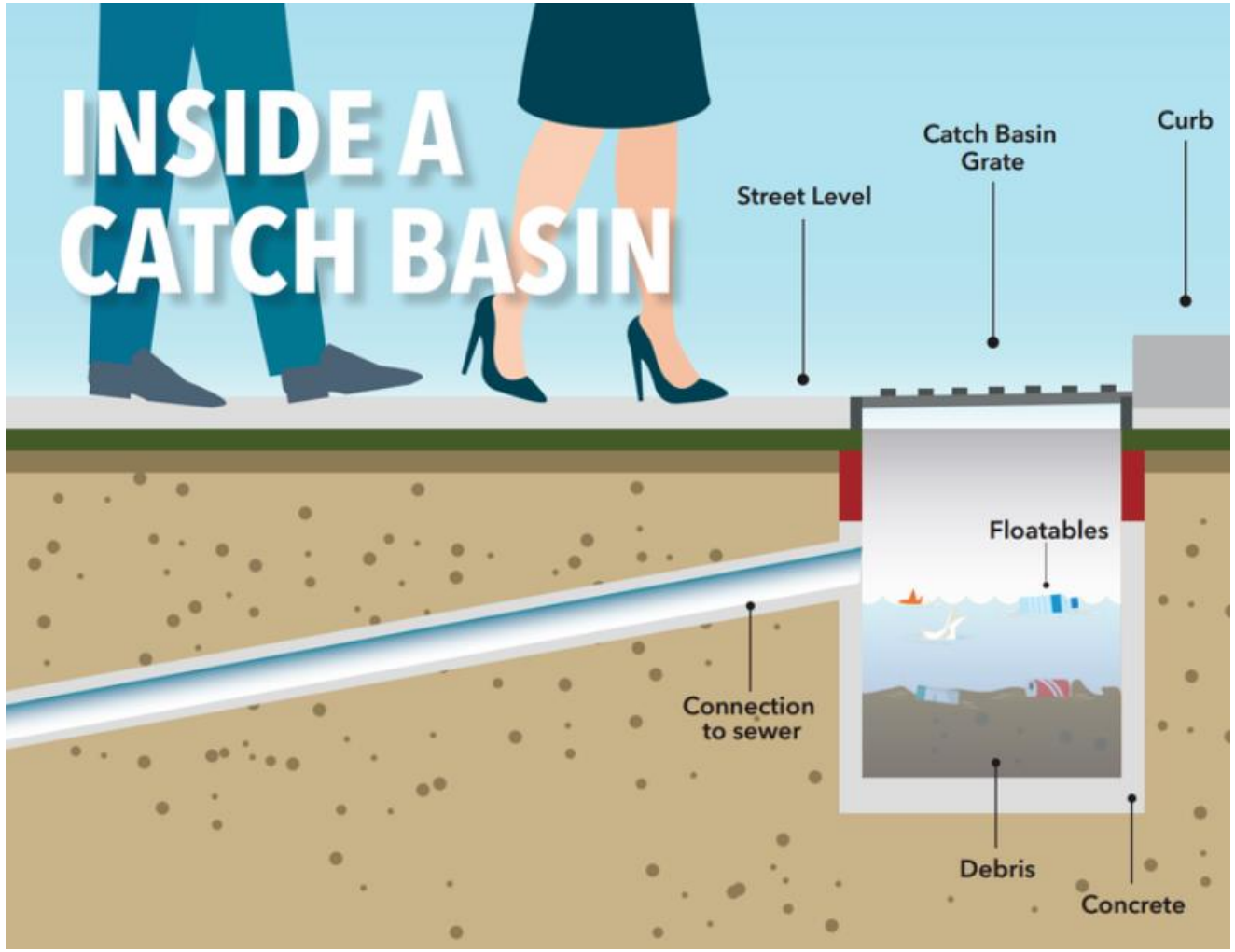
- Are less expensive and lighter weight than an integrated green roof
- Allow for custom layout of green roof coverage and make roof more serviceable
- Can provide stormwater management credits and reduce roof drain sizing
- Are easier to maintain and replace when/if needed

Traditional: Roofs of Various Materials

- Roofs may be asphalt, metal, single ply membrane, etc.
- Stormwater runoff is conveyed to a drainage system such as a gutter and then to the ground
- Maintenance: Repair leaks and keep drainage system free of clogs. Periodic replacement required depending on material.

Natural: Retention/Detention Pond

- Prevents flooding by creating storage space for stormwater resulting from hard, sudden rainfall
- Provides storage for piles of snow that have been removed from sidewalks and parking lots in winter months
- Maintenance: Keep clear of debris and sediment. Use native plants to reduce the need to mow and create a healthy eco-system



Traditional: Catch Basin

- Underground receptacle that catches and filters water before conveying to a treatment plant or waterway
- May be made of concrete or polypropylene
- Maintenance: Must be cleaned out regularly to prevent clogs and contamination. Basin and connection pipe must be kept in good structural condition to prevent sinkholes.

Landscape Design Considerations

- Natural infrastructure typically uses locally available native vegetation, but specific plant selection depends on the project
- Native plants often permit faster infiltration than regular grass Choose varieties that can withstand winter conditions including temperature fluctuations and deicing salt
- Projects that incorporate vegetation should account for plants going dormant in winter
- Maintenance requirements vary but generally include watering, weeding and removal of debris and sediment

Case Study: West Union, Iowa

Overview: The City of West Union partnered with the Iowa Department of Economic Development to implement natural infrastructure as part of a larger redevelopment plan.

Goals: Reduce flooding, ensure citizen safety, replace aging infrastructure, improve water quality and habitat in a nearby trout stream, and catalyze future investment in the historic downtown area.

Stormwater Solutions: Permeable paver system for the roadway and sidewalks, rain gardens and biofiltration areas.

Case Study: West Union, Iowa

Economic Analysis: The city compared the life-cycle costs (including capital and O&M costs) associated with the use of a permeable paver system in the downtown area to those associated with using traditional bituminous or Portland cement concrete pavement. Cumulative costs were analyzed over a 57-year project period.

Results: Results of the life-cycle analysis of different pavement types showed that although the use of porous pavement would initially be more expensive, the lower maintenance and repair costs associated with cold weather and drainage would result in cost savings in the long run. The study indicated that the city would begin to realize these cost savings by year 15 of the project. Estimated cumulative savings over the 57-year analysis period amount to close to $2.5 million.

Stormwater Management Resources

EPA Green Infrastructure Homepage

https://www.epa.gov/green-infrastructure/what-green-infrastructure

WV Dept. of Environmental Protection Green Infrastructure Homepage

https://dep.wv.gov/WWE/Programs/stormwater/MS4/green/Pages/default.aspx

Storm Smart Cities: Integrating Green Infrastructure into Local Hazard Mitigation Plans

https://www.epa.gov/sites/production/files/2018-04/documents/storm_smart_cities_508_final_document_3_26_18.pdf

Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs

https://www.epa.gov/sites/production/files/2015-10/documents/lid-gi-programs_report_8-6-13_combined.pdf

Landslides and Land Subsidence

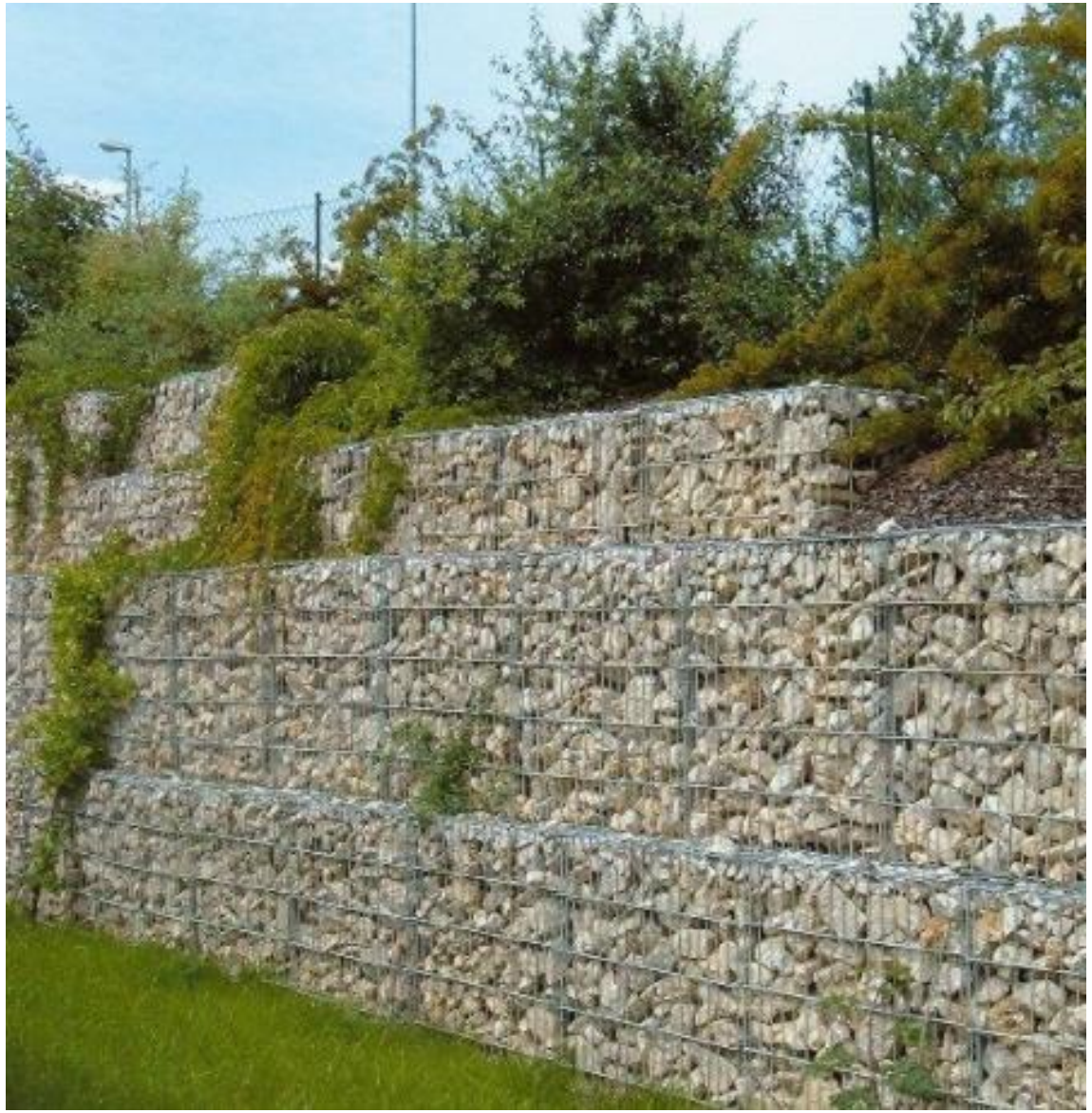
Potential Hazards with Steep Slopes

- Public safety concerns because of landslide potential
- Difficult for emergency vehicles to access in the event of a landslide
- Increase in soil erosion and runoff affecting water quality and natural habitats
- Difficult to access or maintain in severe weather

Traditional Options for Slope Stabilization

- Primary focus on structural components rather than vegetation
- Retaining walls may be constructed from pre-cast concrete, concrete blocks, modular blocks or other materials
- Retaining walls are typically backfilled with crushed rock or gravel that comes from quarries
- Conventional slope stabilization approaches are often more expensive to install and maintain

The following slides provide examples of natural alternatives.



Gabions

- Wire cages or boxes filled with rocks, broken concrete or other materials
- Used in construction of retaining walls, swales, dams and levies
- Stabilize soil and prevent erosion while permitting drainage
- Compatible surface for plant growth to create a vegetated wall
- Maintenance: Minimal if wire mesh is galvanized or PVC-coated. Inspect for corrosion and remove overgrown vegetation as necessary

Berms

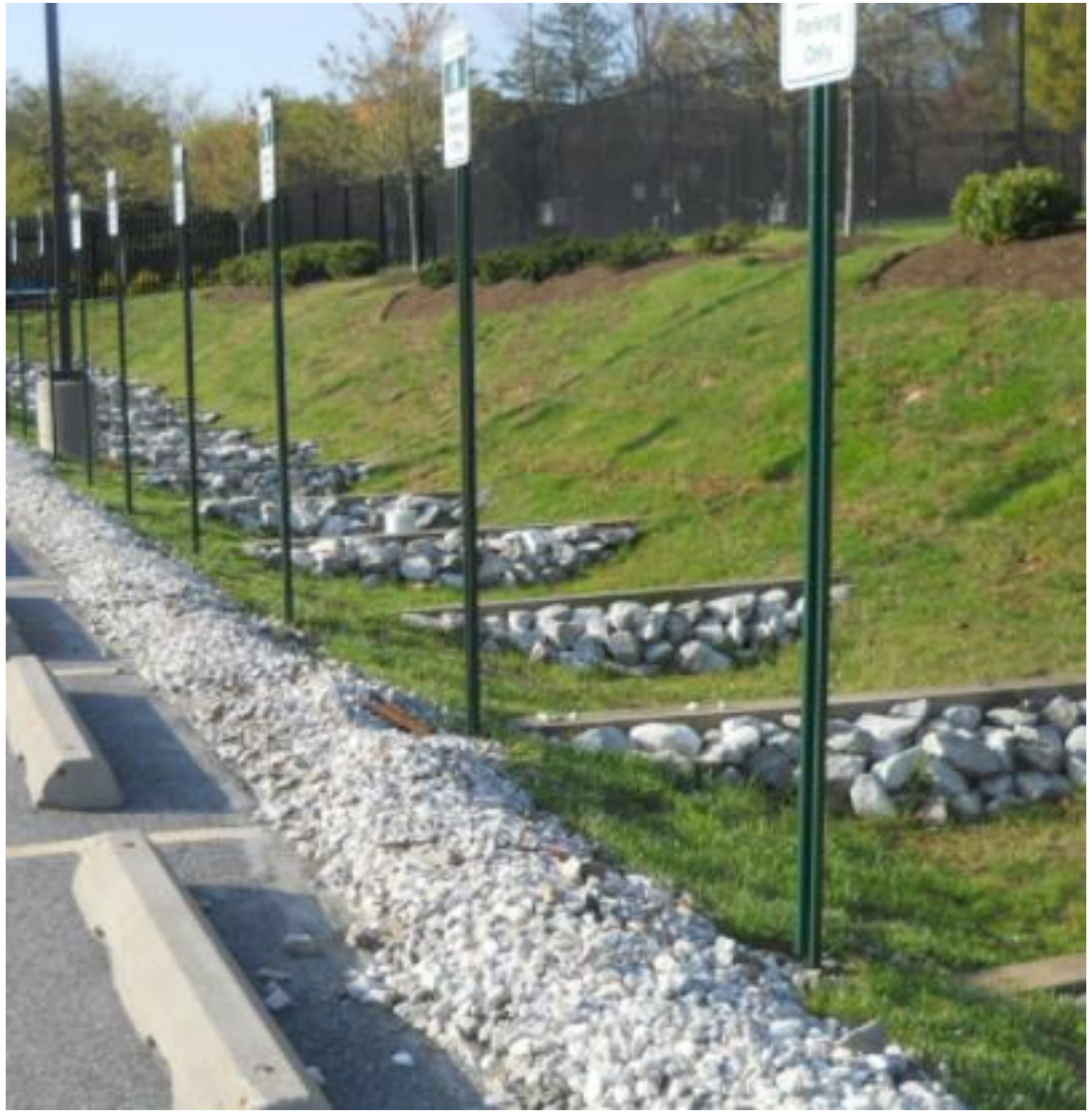
- A linear mound constructed from compacted soil or rocks
- Used to manage upslope runoff where there is a high risk of erosion
- Diversion berms divert runoff to another location
- Infiltration berms retain runoff and permit absorption of water for volume control
- Maintenance: Inspect after heavy rains to maintain berm’s dimensions and vegetative cover

Spiling, Brush Matting & Live Fascines

- Methods of using live branches (such as willow) to construct walls or other barriers
- Branches may be spiled (woven) around thicker posts, layered as mats or planted in trenches in bundles known as fascines
- Used to reinforce riverbanks or prevent soil slippage on slopes
- Over time, branches take root and further stabilize slope
- Maintenance: Ensure adequate moisture and protection from wildlife

Geosynthetics

- Synthetic products used to stabilize terrain
- Several different products including geotextiles and geogrids
- Highly durable and permeable
- Can be infilled with local materials, reducing need for quarried aggregate—therefore may be cheaper and more eco-friendly to install
- Maintenance: Decomposes under UV light and certain soils may clog. Ensure adequate soil coverage and drainage



Check Dams

- Small dam constructed across a swale, drainage ditch or waterway to reduce flow velocity and prevent channel erosion
- Can be made of rock, wood, earth or concrete
- Not for use on regulated rivers or streams without a permit from U.S. Army Corps of Engineers
- Often part of a system that may include other check dams and/or additional slope stabilization measures
- Maintenance: Ensure structural stability. Clean out accumulated debris and sediment

Planning Considerations for Slope Stabilization

- Look at alternative options such as relocating residents or facilities to safer locations and analyze the costs and benefits of relocation vs. construction
- Identify if there are lower-impact interventions that may reduce the hazard, such as diverting water upstream to prevent flash-flooding
- Incorporate slope preservation or revegetation into site planning
- Modify mitigation approach based on the degree of the slope - “spread and soak” activities may not effectively stabilize a steep slope but could help prevent water from getting to a sleep slope

Slope Management Resources

Addressing Green Infrastructure Design Challenges in the Pittsburgh Region: Fact Sheet Series
https://www.epa.gov/sites/production/files/2015-10/documents/pittsburgh-united-fact-sheets-508.pdf

Addressing Green Infrastructure Design Challenges in the Pittsburgh Region: Steep Slopes
https://www.epa.gov/sites/production/files/2015-10/documents/pittsburgh-united-steep-slopes-508.pdf

Soil Bioengineering for Upland Slope Stabilization
https://www.wsdot.wa.gov/research/reports/fullreports/491.1.pdf

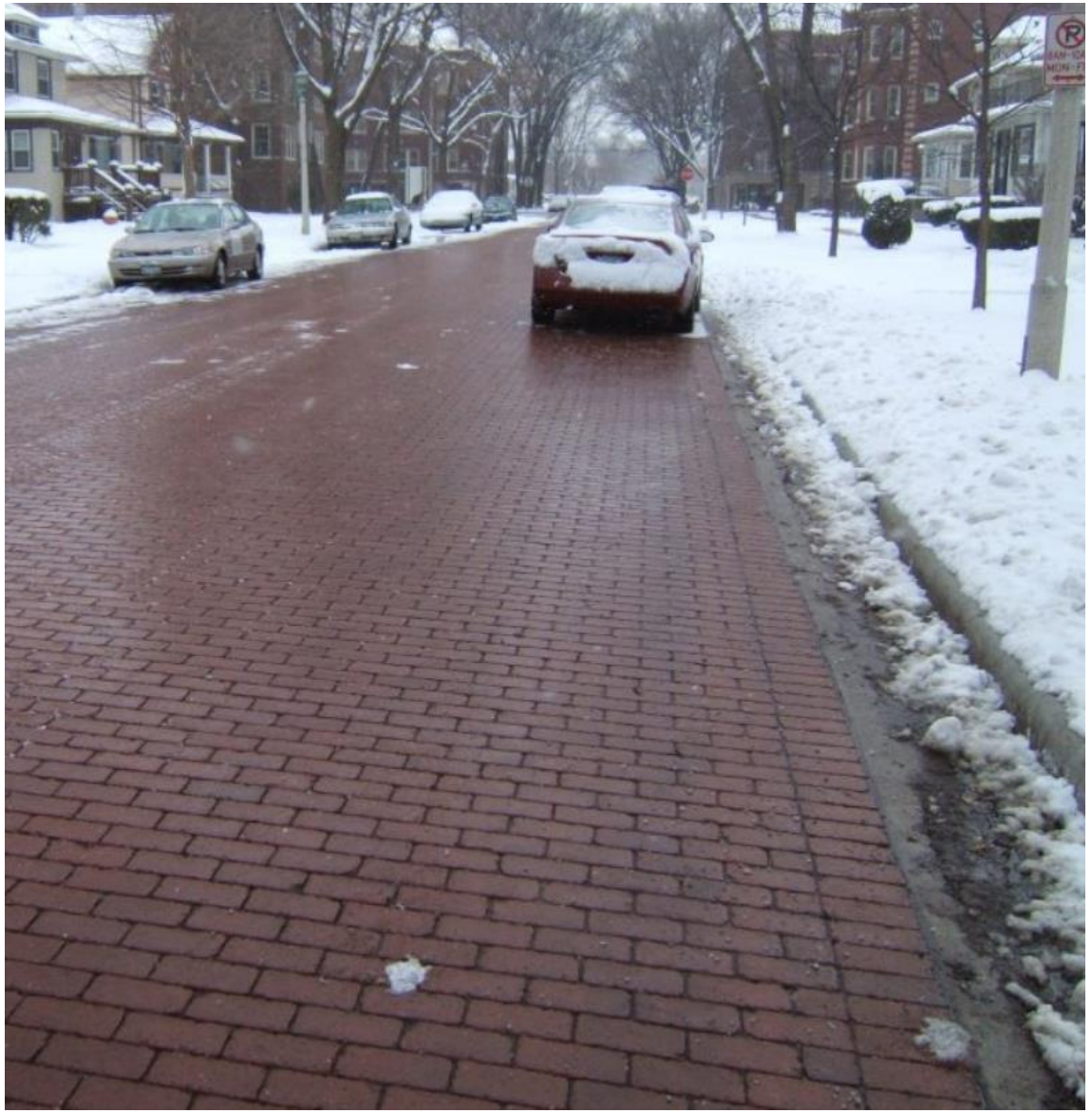
Winter Weather

Winter Weather Hazards

- Runoff from snow and ice melt
- Reduced infiltration due to frozen ground
- Extreme temperature fluctuation
- Snow
  - Loads on roofs and trees
  - Visibility
  - Access
- Ice
  - Damage to systems such as power lines and drainage systems
  - Slippage

Natural Infrastructure Considerations for Winter

- Design should account for increased flowrates from snow and ice runoff and performance under multiple freeze-thaw cycles
- Include sufficient open space for snow storage and meltwater infiltration (only if salt, sand and chemical deicers are not used)
- Permeable pavement permits drainage of meltwater which reduces black ice and the need for salt, sand or chemical deicers (note that sand will clog permeable pavement)



Economic Benefits of Natural Infrastructure

Natural Infrastructure Employment Opportunities

Natural infrastructure projects maintain many of the same employment opportunities that traditional infrastructure provides related to design, installation and maintenance. Opportunities include:

- Entry-level and mid-level employment within construction, landscaping and forestry
- Professional services such as horticulturalists, architects and engineers
- Suppliers of new, locally sourced materials necessary for natural infrastructure projects
- Opportunities to grow in sectors that workforce development supports

Benefits of Natural Infrastructure Jobs

Natural infrastructure jobs that focus on installation and maintenance often share many of the same positive attributes as traditional infrastructure jobs:

- Provides opportunity to meet Section 3 goals
- Still upholds Davis Bacon requirements

In addition:

- Maintenance can be less specialized and therefore create broader access to job opportunities
- Bureau of Labor Statistics projects growth of the “green jobs” sector in the coming decade

Additional Resources

Federal Register Notice:

2019-18607.pdf (govinfo.gov)

West Virginia CDBG-MIT Action Plan:

https://wvcad.org/infrastructure/mit

National Disaster Resilience Awardee Announcements on HUD Exchange:

https://www.hudexchange.info/news/hud-awards-1-billion-through-national-disaster-resilience-competition/

Questions?

Thank You!

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