Practical Considerations for Flood Management and Planning

Erin Kepple, Water Resource Manager

Southwestern Pennsylvania Commission
Water Resource Center

http://www.spcwater.org/

Water Resource Center

Need for Regional Approach for Water Resource Planning

- Established Summer 2013
- Initial focus on Stormwater Mgt (Act 167)

- Regional- 10 County Area
  - 15,076 miles total stream length
  - 4,824 miles impaired
  - 667 impaired miles are stormwater-related

Primary Objectives for WRC:

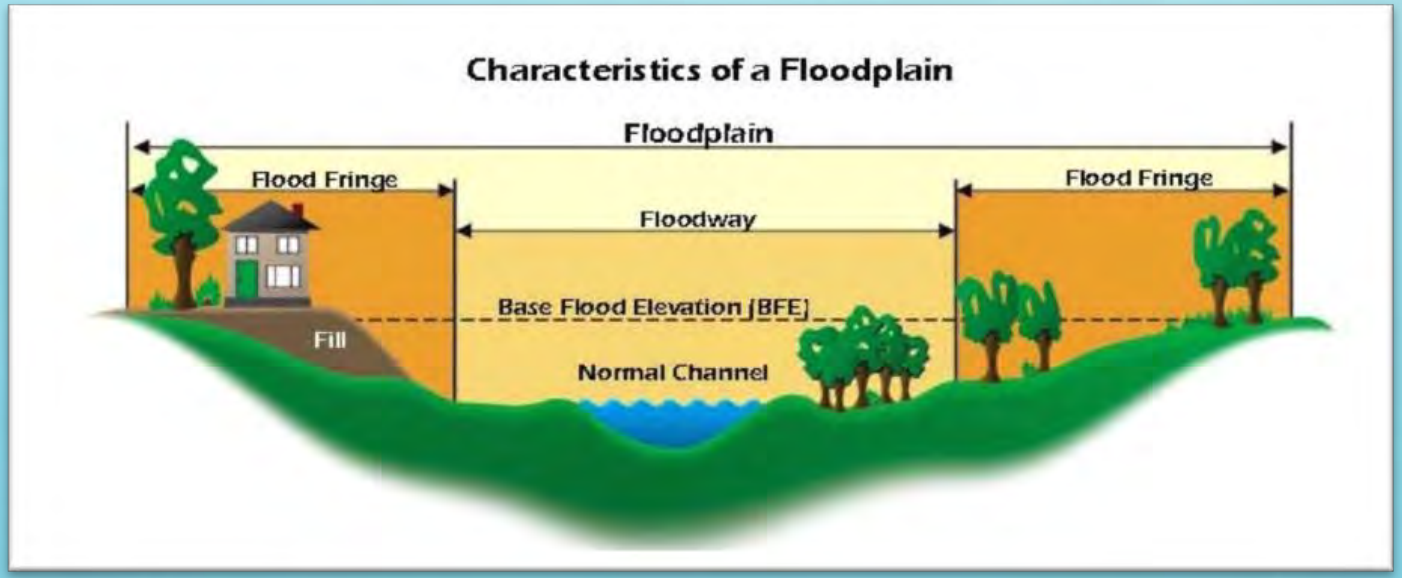
- Education
- Technical Assistance
- Information Clearinghouse
- Regional Coordination / Cooperation

Topics Covered

- Practical options for managing flood waters
  - Replacement or expansion of wetlands
  - Planting native vegetation in the floodplain
  - Installment of Stormwater Best Management Practices
- Common misconceptions/mistakes that make flooding worse
- Understanding when to remove woody debris from rivers and streams
- Environmental compliance

Managing Flood Waters

- Best: Naturally allow the transport of floodwater to slow by increasing the amount of retention time over an entire watershed and keeping human infrastructure away from streambanks and floodplains.
- New development should not occur within the floodplain if possible and removal of buildings and restoration of floodplains to open space would represent the ultimate natural solution for developed flood-prone areas.



Managing Flood Waters

In previously developed or disturbed floodplain areas, options to increase floodwater retention time can include:

- Replacement or Expansion of Wetlands
- Planting Native Vegetation in the Floodplain
- Installment of Stormwater Best Management Practices
  - Structural
  - Non-structural

Managing Flood Waters: Options

<u>Replacement or Expansion of Wetlands</u>:

- Wetlands act as natural sponges: absorb and slow floodwaters, evaporate water into the atmosphere and recharge groundwater.
- Wetlands trap sediment and debris as the speed of the water slows and the debris settles out.
- By reducing the rate and amount of stormwater entering the river or stream, wetlands lessen the destructiveness of the flood.

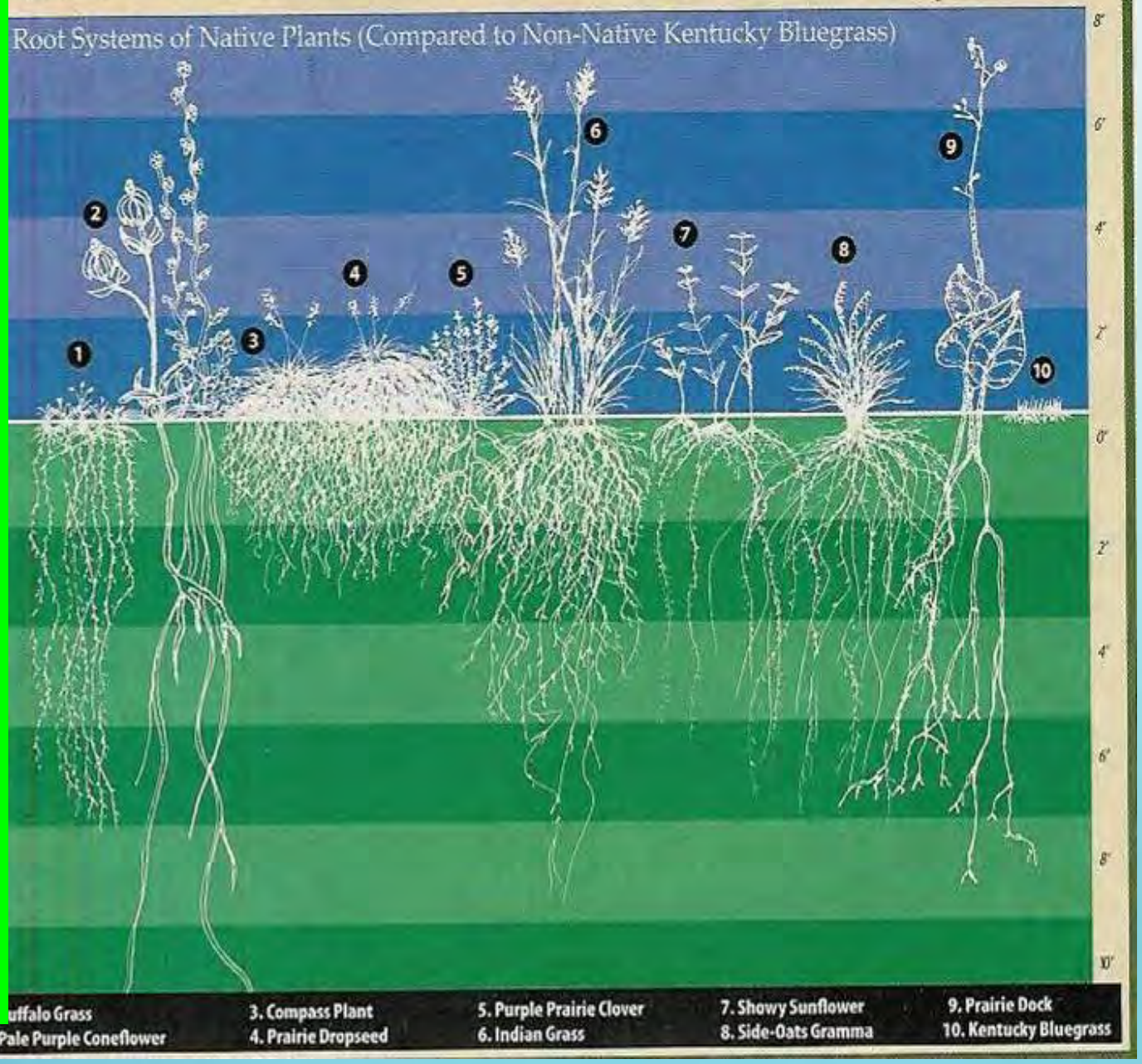
Managing Flood Waters: Options

Restoring Floodplains: Planting Native Vegetation

- Native plants, shrubs and trees that are naturally found in environments that periodically flood are adapted for survival in wet conditions.
- Some species have intricate rooting systems and are more flexible to bend when floodwaters are moving swiftly around them.
- Native plants help to slow floodwaters and hold the soil in place.

8ft
6
4
2
0
2
4
6
8
10

Figure 1. Comparison of native prairie and turf grass root and shoot growth



From Stormwater Magazine Mar/Apr 2007, page 69 "Not All Green Space is Created Equal" by Scott Dierks

Installment of Stormwater Best Management Practices

- Act 167- County-Wide Stormwater Management Planning
  - Future development and redevelopment
  - Ordinance adoption and enforcement
- The Pennsylvania Department of Environmental Protection (DEP) has developed a Stormwater Best Management Practice (BMP) Manual that showcases various acceptable stormwater BMPs for the reduction or retention of stormwater runoff. The manual can be found at the following link: http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305
- Best Management Practices
  - Non-structural
  - Structural

Non-Structural Best Management Practices

- "Low Impact Development" and "Conservation Design" refer to an environmentally sensitive approach to site development and stormwater management that minimizes the effect of development.
- Non-Structural BMPs encourages the treatment, infiltration, evaporation, and transpiration of precipitation close to where it falls while helping to maintain a more natural and functional landscape.

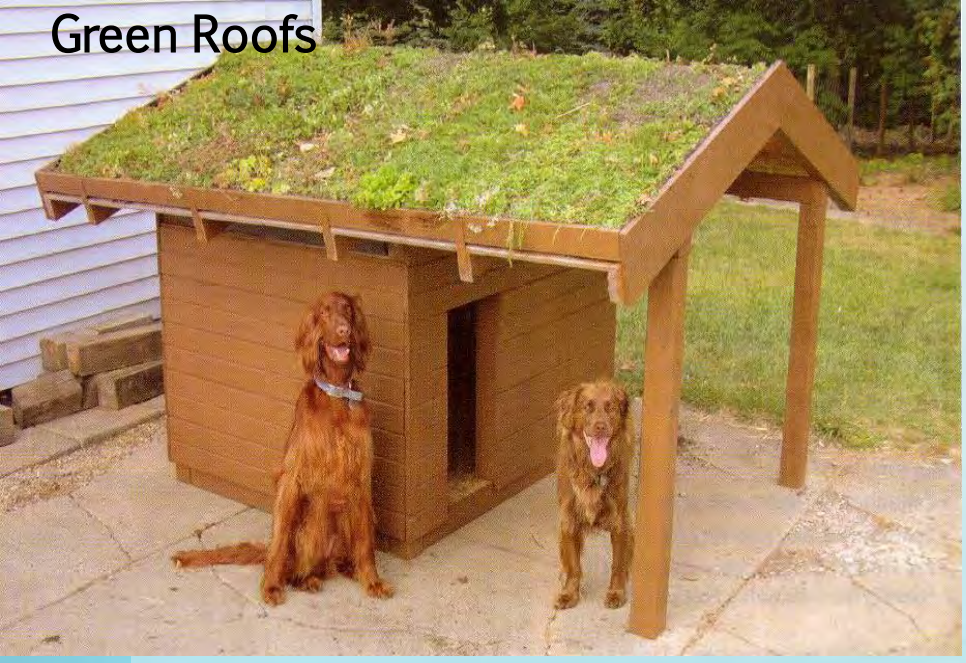
- <u>Non-Structural BMPs</u>
  - Protect Sensitive and Special Value Resources
  - Cluster and Concentrate
  - Minimize Disturbance and Minimize Maintenance
  - Reduce Impervious Cover
  - Disconnect/Distribute/Decentralize
  - Source Control

Structural Best Management Practices

- Most of the Structural BMPs fall into the category of Volume/Peak Rate Reduction. Some of these BMPs possess excellent water quality protection capabilities as well.
- Volume/Peak Rate Reduction by Infiltration BMPs (Pervious Pavement with Infiltration Bed, Infiltration Basin, Subsurface Infiltration Bed, Infiltration Trench, Rain Garden / Bioretention, Dry Well / Seepage Pit, Constructed Filter, Vegetated Swale and Filter Strip, Infiltration Berm & Retentive Grading)
- Volume/Peak Rate Reduction BMPs (Vegetated Roof, Runoff Capture & Reuse)

Structural Best Management Practices

- Runoff Quality/Peak Rate BMPs (Constructed Wetland, Wet Pond/ Retention Basin, Dry Extended Detention Basin, Water Quality Filters & Hydrodynamic Devices)
- Restoration BMPs (Riparian Buffer Restoration, Landscape Restoration, Soils Amendment & Restoration, Floodplain Restoration)
- Other BMPs and Related Structural Measures (Level Spreader, Special Detention Areas – Parking Lot, Rooftop)


Green Roofs


Bioswale


Stormwater Bumpout


Planted Riparian Buffer

Misconceptions that Create Problems

- When “Helping” isn't “Helping”. Practices that have negative impacts on the environment and <u>can increase flooding</u>
  - Problem: Dredging-Deepening Streams (Lowering Streambed)
  - Problem: Channelization (Straightening Curves)
  - Problem: Traditional Armoring Banks (Riprap)
  - Problem: Raising (Creating Berms Adjacent to Stream Channel)

Problem- Dredging: Deepening Streams (Lowering Streambed)

- Increases the stream's velocity which causes downstream flooding.
- Causes a short-term siltation that is harmful to aquatic communities.
- Creates instability and increased erosion in the streambed and banks as the stream tries to re-establish grade.
- Can potentially cause an abrupt vertical drop (headcut). Headcuts can form where there is active erosion or where the streambed has been significantly disturbed.

Problem- Dredging

- Deposits more material into or beyond the channelized section creating the need for periodic removal of the material; continuing ecological damage.
- The removal of large rocks often leaves a stream bed with small, uniform-size rocks. This destroys important habitats of aquatic plants, fish, amphibians, and aquatic insects. Large rocks are important for cover, oxygenated water, feeding and reproduction.

Problem- Channelization (Straightening Curves)

- Decreases the stream's resistance to flow because meanders/bends that naturally slow water are removed
- Increases the stream's velocity. Increased velocity of water causes increased erosion within and beyond the area that has been channelized. Increased flooding downstream.
- Removal of streambank trees and vegetation in order to straighten the stream channel causes streambanks to become unstable.
- No riparian zone/buffer

Problem-Armoring Banks (Riprap)

- Riprap or other traditional streambank armoring techniques increase stream velocity because there are no friction points to slow moving water down.
- The riprap moves erosion problems further downstream from increased water velocities and direction of water flow being diverted to other areas of streambank.
- Little to no vegetation along the streambank for natural habitat.
- Requires continuous monitoring and maintenance.

Problem- Raising Banks (creating berms adjacent to stream channel)

- Disconnects stream from the floodplain; increasing flooding downstream
- Accelerated erosion and instability

What Can Be Done?

- Realistic expectations of projects (can't prevent floods but can help minimize impacts)
- Solutions to flooding problems should incorporate public safety, infrastructure and environmental concerns
- Proper planning, design (multiple design goals?) and construction provides long-term stability
- How do you make improvements or design new projects?
  - Armoring Banks: (Riprap)

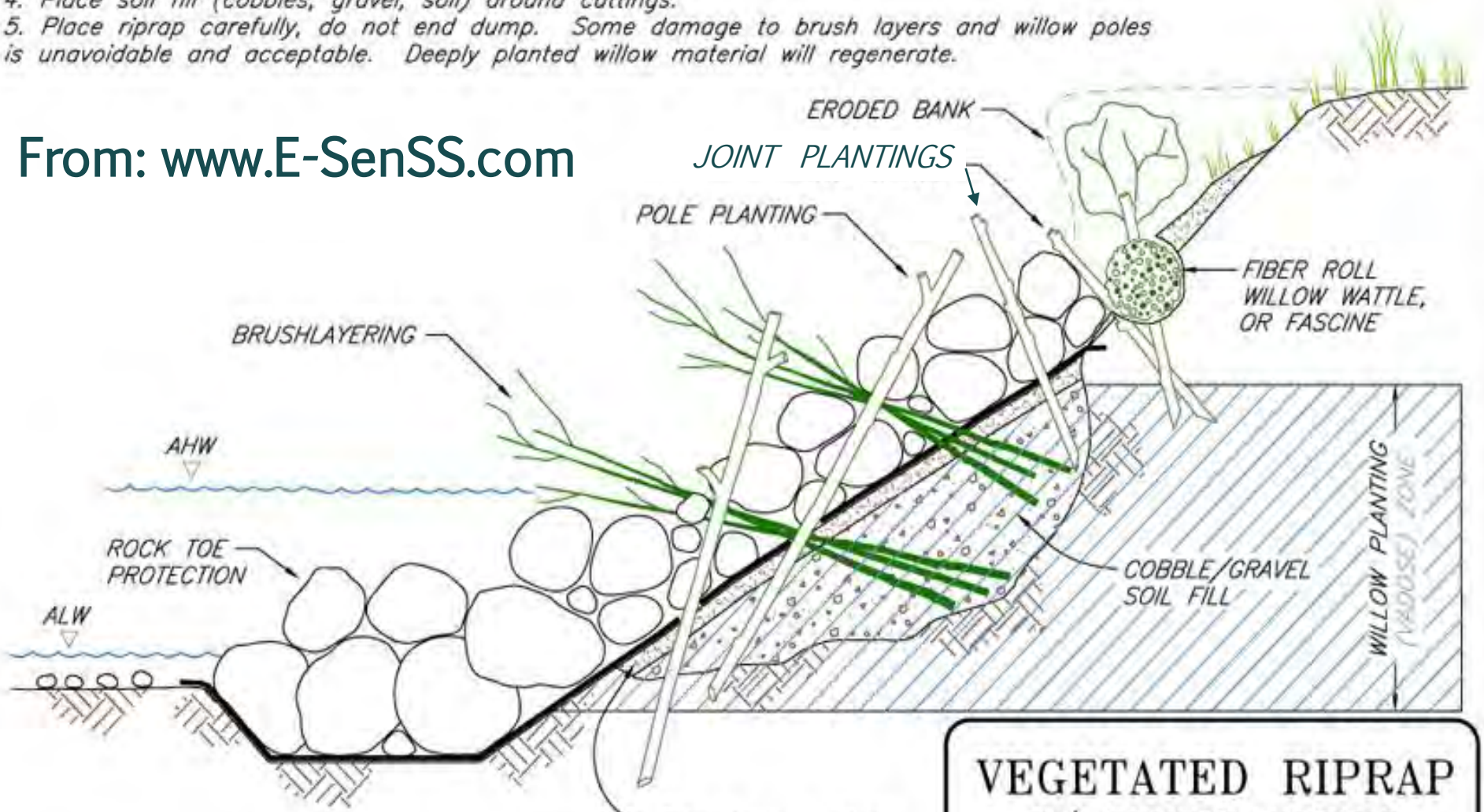
Armoring Banks (Riprap)

- Unavoidable in certain circumstances and often chosen method of streambank stabilization
- How to Make it Better? Use Bioengineering Methods!
  - The use of living plant materials to stabilize streambanks
  - Most bioengineering gives Mother Nature a jump start (plant those native species, tall, short, fast growing, slow growing, etc.)
  - Many types of bioengineering techniques
  - Use for new or retrofitted projects

Rooted stock plants in place, ready for additional soil to fill in void spaces around riprap

NOTES:
1. Install willow pole planting and brushlayering during bank grading and riprap placement to ensure good contact with 'native ground' and/or soil fill.
2. Willow poles and brush layers should extend down into expected soil moisture zones (vadose).
3. Cut small holes or slits in filter fabric as necessary.
4. Place soil fill (cobbles, gravel, soil) around cuttings.
5. Place riprap carefully, do not end dump. Some damage to brush layers and willow poles is unavoidable and acceptable. Deeply planted willow material will regenerate.

From: www.E-SenSS.com



Weighted toe, designed to self-adjust into scour hole

VEGETATED RIPRAP
W/ BRUSHLAYERING & POLE PLANTING & JOINT PLANTING

FILE: VRBLPP

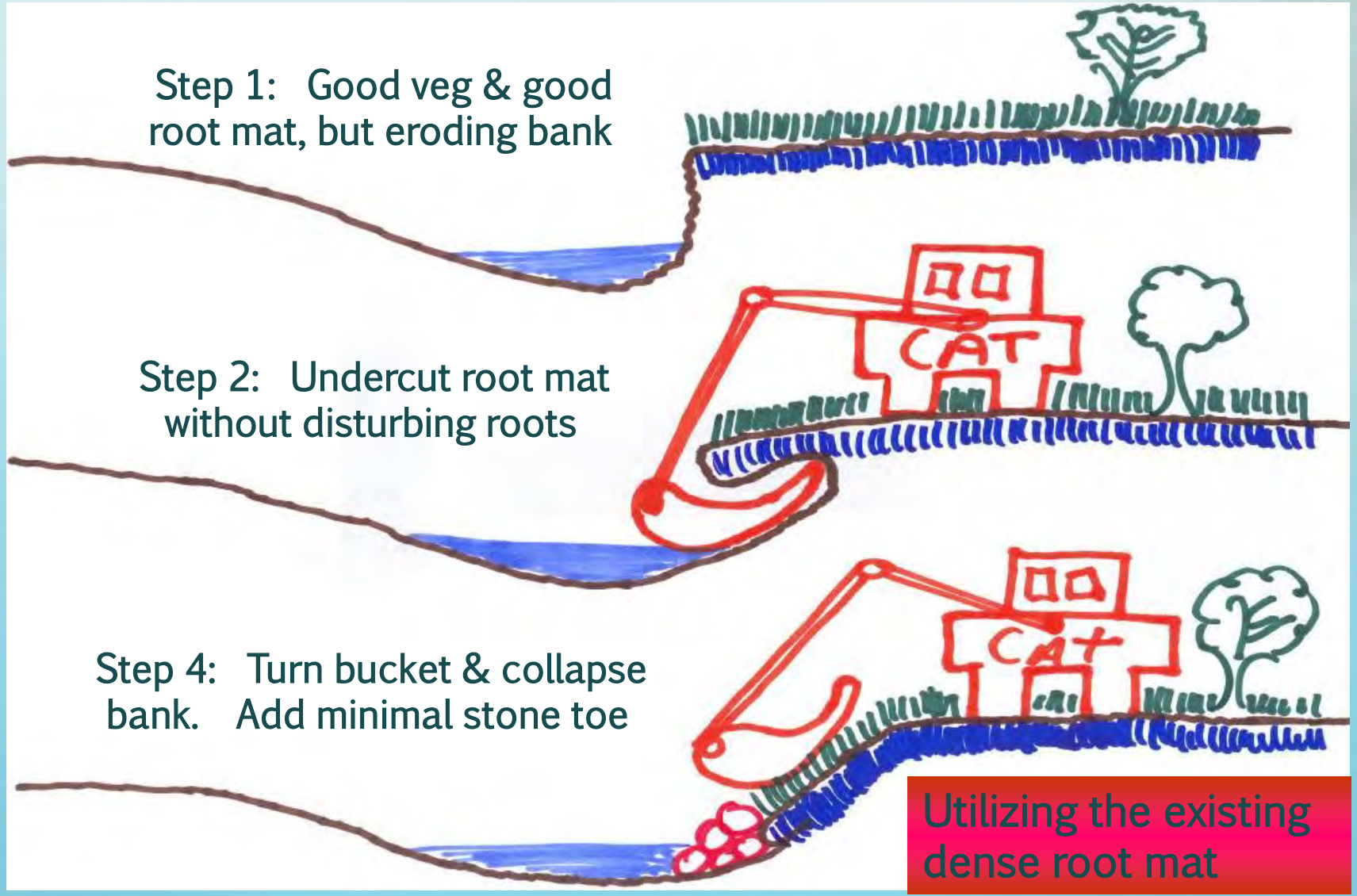
After 1 yr


After 2 yrs

Understanding When to Remove Debris From Rivers and Streams

- Woody debris that poses little risk to infrastructure are best left in place (provide ecological benefit)
- Debris that pose a risk to infrastructure such as roads, bridges or homes, should be removed.
- Trash should be separated from woody debris and disposed of properly. Woody debris can then be used for things such as firewood, taken to local composting services or chipped and used as mulch.

Practical Solutions: What Can You Do?

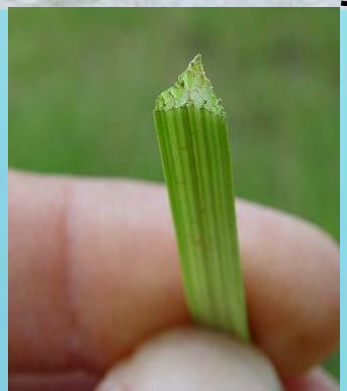


Ditches, Culverts and Storm Drains

- Ditches and culverts require excavation and other work for a variety of reasons. Sometimes erosion brings in excess soil so the ditches can't handle the water run-off they were designed to take.
- Improving a ditch may also be necessary if it regularly fails to handle flood control for the area. Ditches should be vegetated to minimize erosion.
- Storm drains should be maintained and cleaned out regularly

When Do You Need a Permit? General Concepts

Don't let your operators be "confused by the dirt"



"Sedges Have Edges, Rushes Are Round"

Suggested Steps To Obtaining A Permit

1. Notify the agency about your project. The agency will provide assistance to ensure that you apply for the appropriate type of permit for your project.
2. Discuss the project, any potential issues and desired time line for completion. A pre-application site visit is helpful and a requirement for some types of permits.
3. Make sure all applications are complete and accurate when the permit is submitted. Incomplete applications can delay the approval process.
4. Submit applications as soon as possible to allow for adequate review time and/or if any changes to the project are necessary. (The completion of biological assessments are often a requirement of permit applications.)
5. Continue to have open communication with the permitting agency personnel throughout the process.
6. Upon receiving your permit approval, ensure that all work is completed subject to the permit conditions.

What Can Be Done Without A Permit?

- Remove trees and debris from the stream from **top of streambank**
- Clean and maintain existing structures
- Stormwater Management Planning (ACT 167)
- Land Use Planning
- Local ordinance adoption and enforcement

Most Common Permitting Options for Completing Work in Streams/ Floodways/ Floodplains as a Result of Damage During Storm/Flood Events

- **Emergency Permits**: May be issued within hours
- **GP-3:** Bank rehabilitation, bank protection and gravel bar removal
- **GP-5:** Pipeline crossings
- **GP-7:** Minor road crossings
- **GP-8:** Temporary road crossings
- **GP-11:** Maintenance/Replacement of existing Water Obstructions and Encroachments
- **Individual Joint Permit Application:** Projects not covered by General Permit(s)
- **USACE:** For Federal Authorization – sometimes may be attached to state authorization

Making the Best of the Situation