



# Envirolok™

*Vegetated Retaining Walls from Agrecol®*

## Bioengineering Slope Protection

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# Agrecol®

**Native Seed, Plants & Restoration**



## ILMA-LAKES

ILLINOIS LAKES MANAGEMENT ASSOCIATION

# Green Infrastructure vs Gray Infrastructure

Green Infrastructure;  
Riparian Buffers  
Bioswales & Rain Gardens  
Green Roofs  
Native Vegetation

Gray Infrastructure;  
Culverts  
Tunnels  
Storm Drains  
RipRap



# What is a Sustainable Landscape?

A sustainable landscape is a stable and productive ecosystem that conserves the physical and biological processes occurring on that landscape.



# Sustainable Site Design

A sustainable landscape is designed to be both attractive and in balance with the local climate and environment and should require minimal resource inputs.



# What is Native Vegetation?

- Diverse and Successful Plant Communities
- Natural Selection for over 10,000 Yrs
- Hardy and Perennial to Ecoregion
- Co-evolved with Native Wildlife





# Native Vegetation modifies the mechanical properties of soil in several ways:

- Root Reinforcement
- Anchorage, arching, and buttressing
- Surface mat effect
- Wind loading
- Root wedging

# Native Vegetation and Water

## Quality



- Improves clarity by sequestering sediments and pollutants.
- Binds nutrients that would be used by algae.
- Provides food, shelter and nesting for wildlife.
- Can mitigate erosion and runoff.
- Creates spawning beds in emergent plants for fish.

# Important Ecological Services

- Improve water clarity by holding sediment in place.
- Take up nutrients that would be used by algae.
- Provide shelter for wildlife.
- Provide wildlife food and nesting areas.
- Reduce erosion and runoff.
- Provide spawning beds in sedges /emergent plants for fish.

80-90% of all lake life is born, raised and fed in the area where land and water meet.

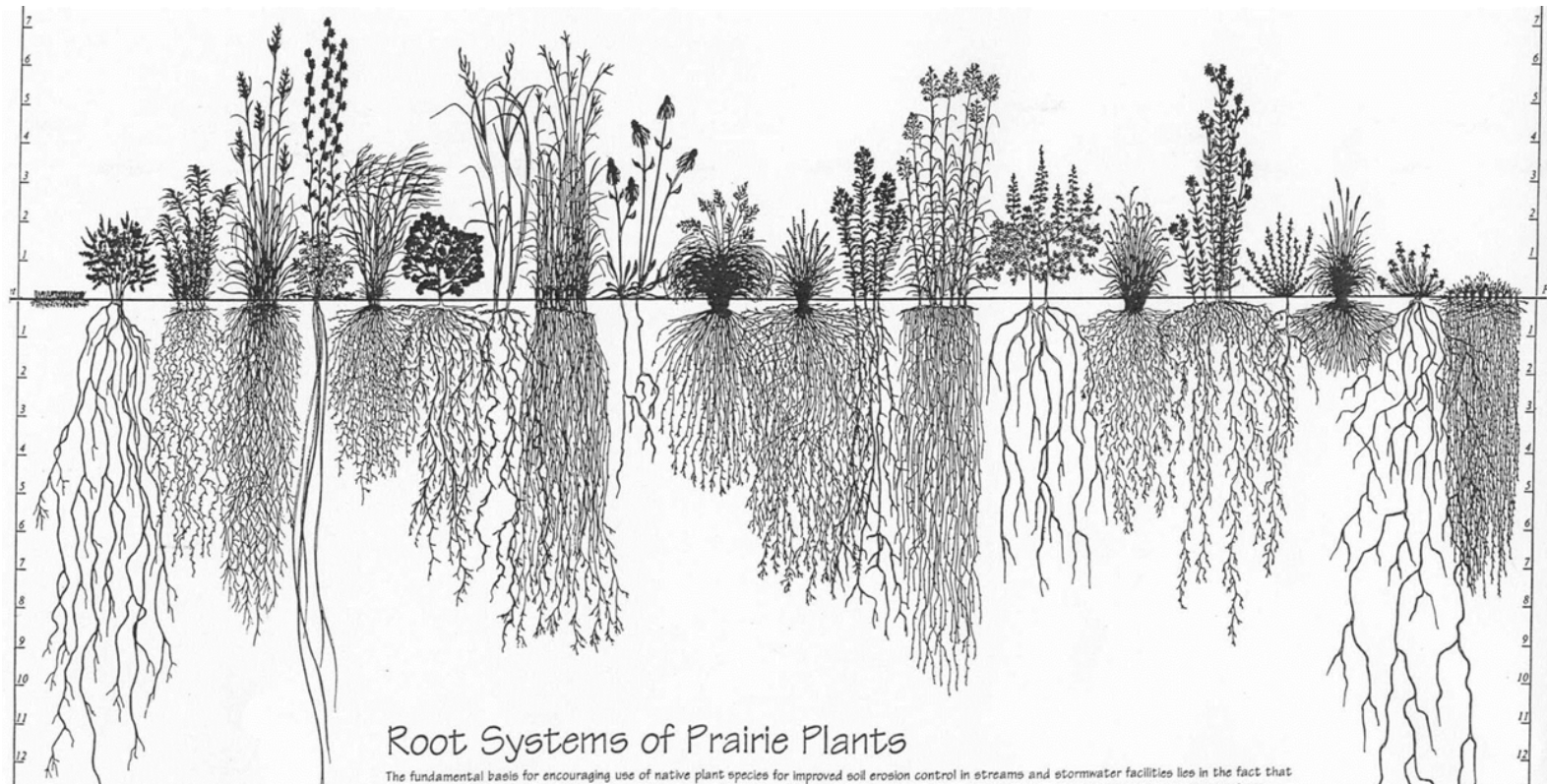




# Let's Compare BMP's

	<u>Turf grass</u>	<u>Natives</u>	<u>Rip Rap</u>
Root Depth	3 inches	15 feet	Huh?
Root Types	One	Seven	None
Species Diversity	Few	Hundreds	None
Cultural Requirements	Fertilize/ Herbicide/Mow	Nothing	Import Stone to Site
Erosion Tolerance	Minimal Sheet	Sheet and Slump	If Properly
Constructed			and
Maintained			
Wildlife Habitat	Absent	Abundant	Absent
Rain Absorption	Poor	Excellent	Poor
Sustainable?	Not so much	Yes!	Not really
Resilient?	Not so much	Yes!	Not so much

# Not a Fair Comparison!



- Have deeper roots that stabilize & reinforce soil - living Geogrid
- Lessen raindrop impact & erosion
- Stay upright in runoff to filter sediment
- Increase Infiltration and Percolation

# Native Root Systems

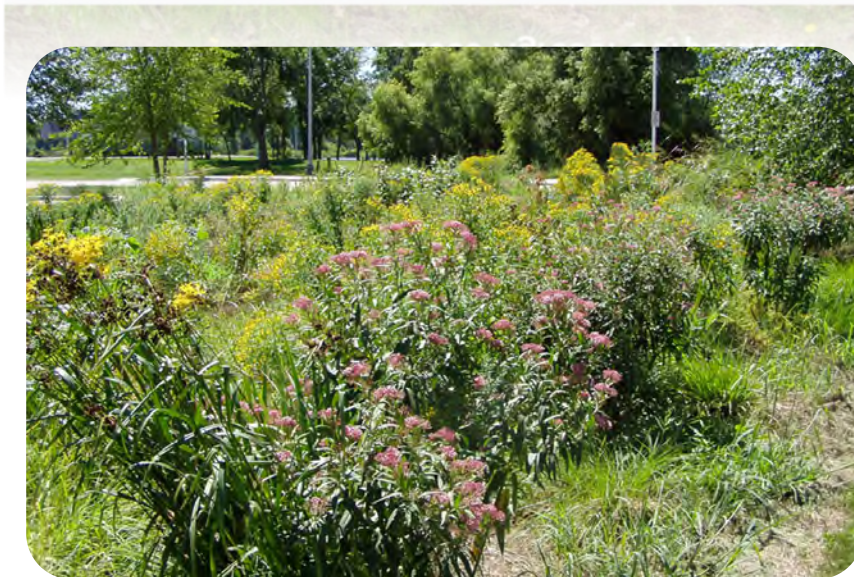
- 1/3 die each year creating long channels to transport water, oxygen and microbes.
- Cycle minerals from deep in the soil to the top horizons.
- Allow water infiltration from the surface to deep depths and then mine that same water during dry periods.
- Provide habitat for microbes that are excellent at purifying recharge groundwater.



# Infiltration



Turfgrass grass typical infiltration rate of 0.29 inches per hour.



Native Vegetation typical infiltration rate of 7.5 inches per hour

# A little about Agrecol...

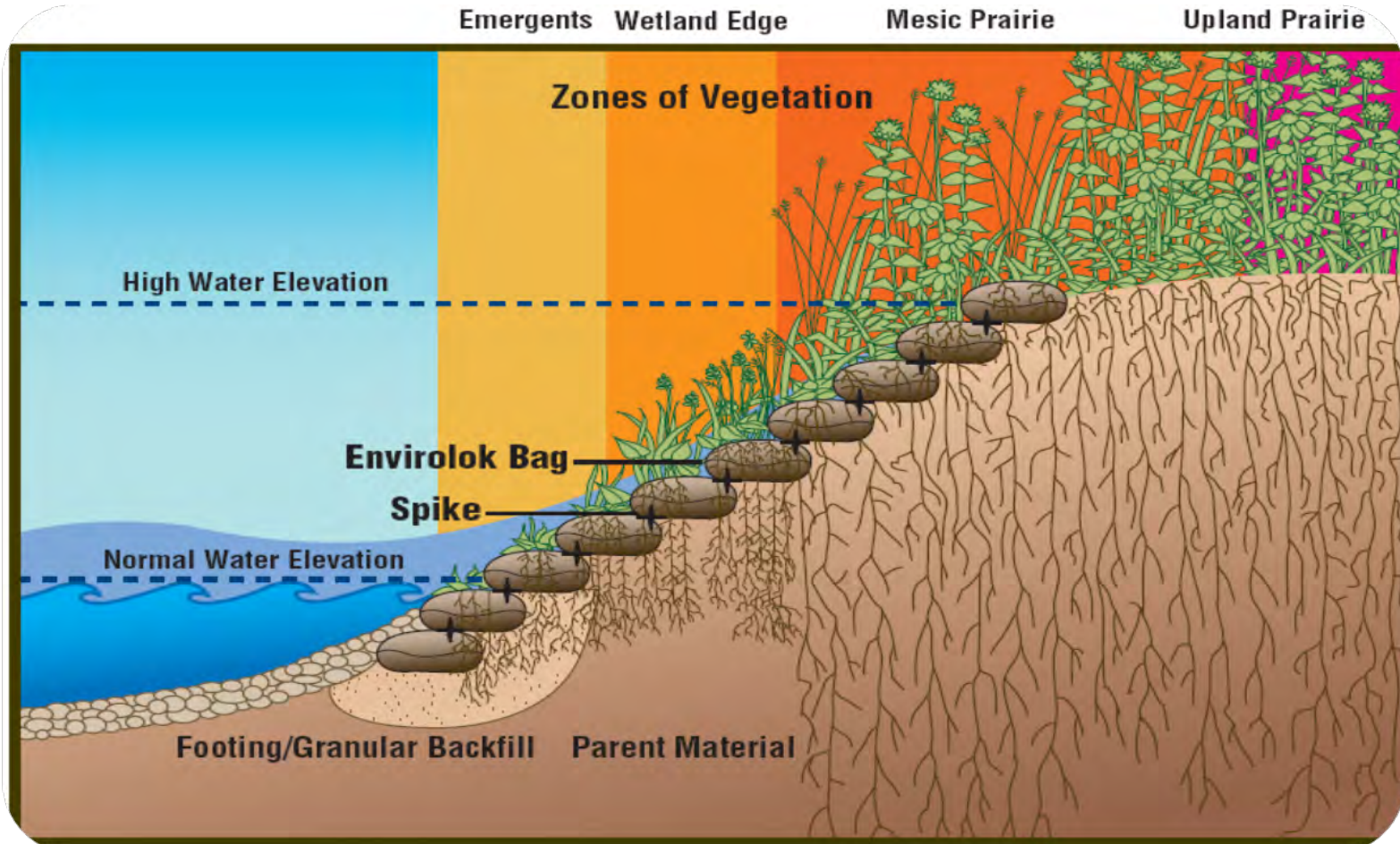
- 1,100 acres in production in SC WI
- Produce 3.5 million greenhouse plants yearly
- 300 species on 350 production beds
- Produce 100,000 lbs of pure live seed
- Envirolok™ vegetative green wall system



# So how do we do it?

- Prepare site!
- Goal: good soil structure: water infiltration & percolation
- Plant cover crops
- Plant only local ecotype high quality PLS tested seed
- Mulch with noxious weed-free straw
- Use woven/straw matting in high flow areas
- Consider polymer
- Maintenance plan for first three years!

# Vegetated Segmental Retaining Walls



Footing/Granular Backfill Parent Material

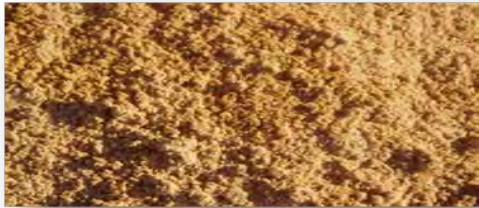
# Vegetated Segmental Retaining Walls

- Engineered plans
- Permits
- Bags
- Spikes
- Bag Stabilizers
- Bag Fill
- Drainage Sytem
- Labor & Equipment
- Geogrid reinforcement and/or ice guard
- Vegetation





## Bag Fill consists of;



60% Granular Sand



20% High Grade Compost



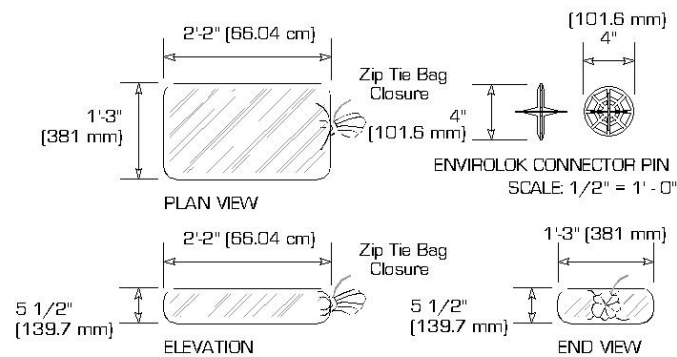
20% Topsoil

# Vegetated Segmental Retaining Walls

Seek the Advice of a Professional Engineer when;

- Greater than 4 feet
- Poor soil conditions
- Partially in water
- Area behind wall slopes towards wall
- Seepage present
- Loadings at top of wall
- High risk designs

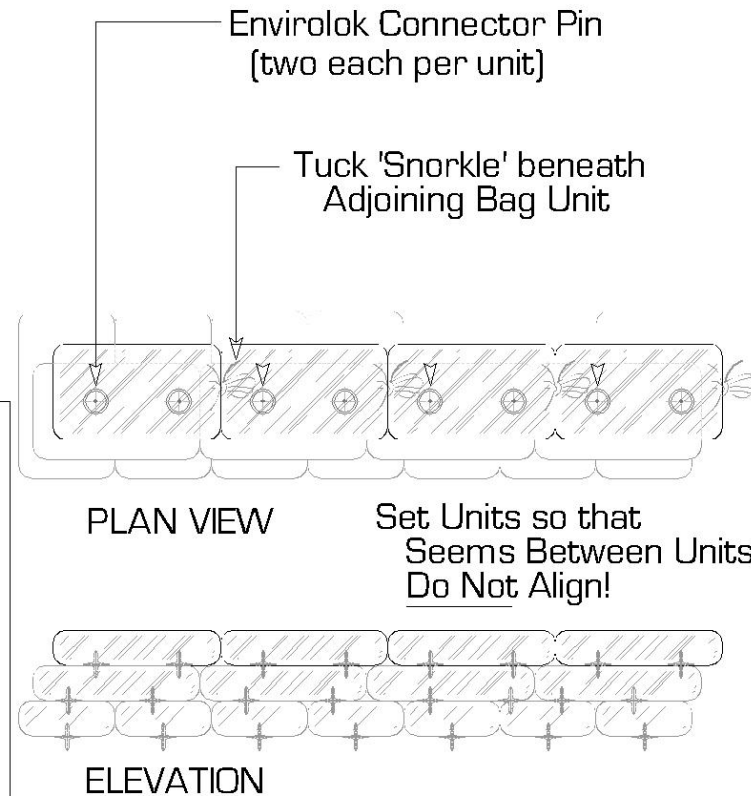
# Vegetated Segmental Retaining Walls



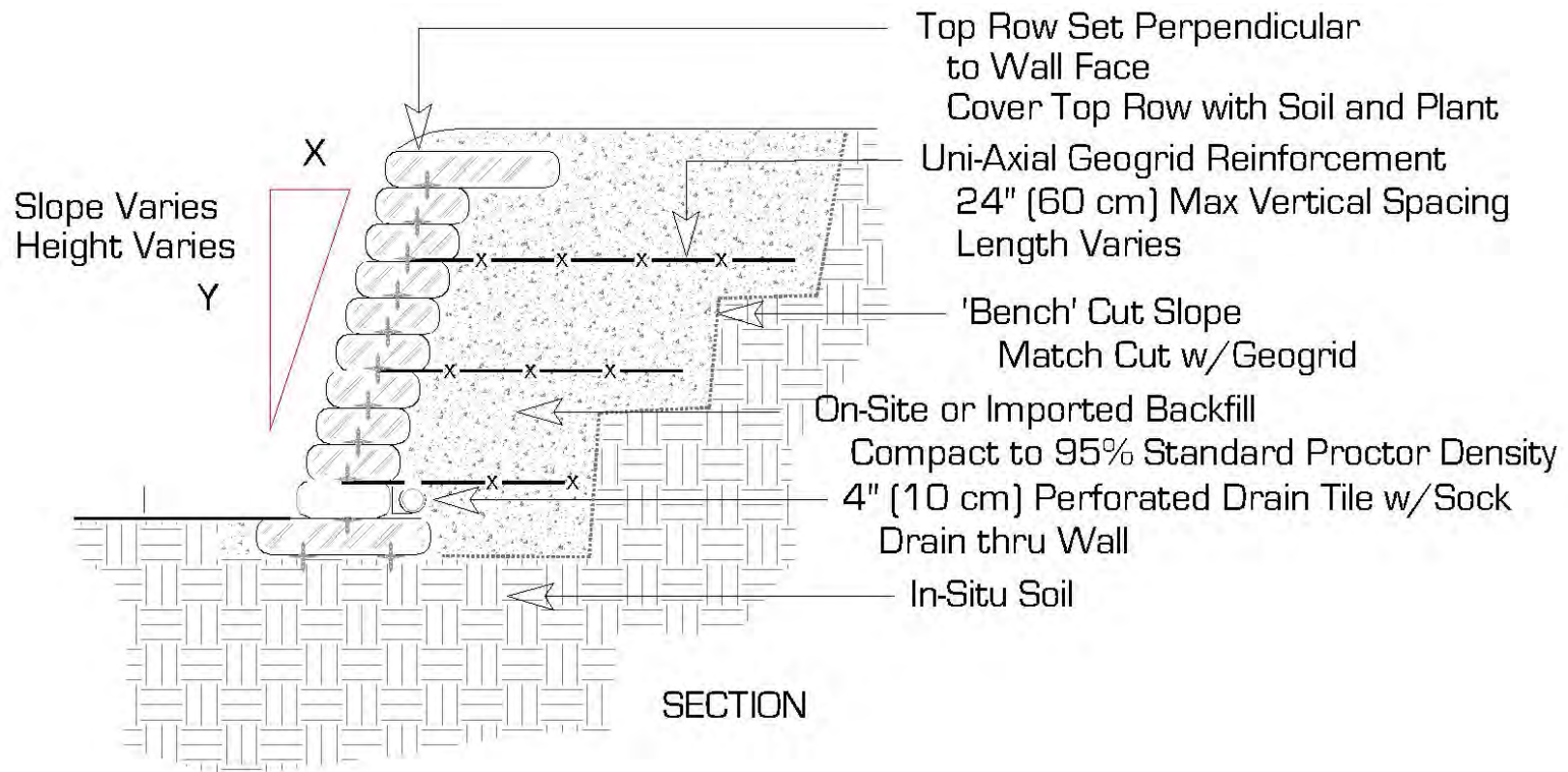
**ENVIROLOK SPECIFICATION:**  
 Calculated Unit Fill: 1.25 cu ft (.0354 m<sup>2</sup>)  
 Face Area: 1 sq ft (.093 m<sup>2</sup>)  
 Mattress Face Area: 2.7 sq ft (.25 m<sup>2</sup>) / unit

**NOTE:**

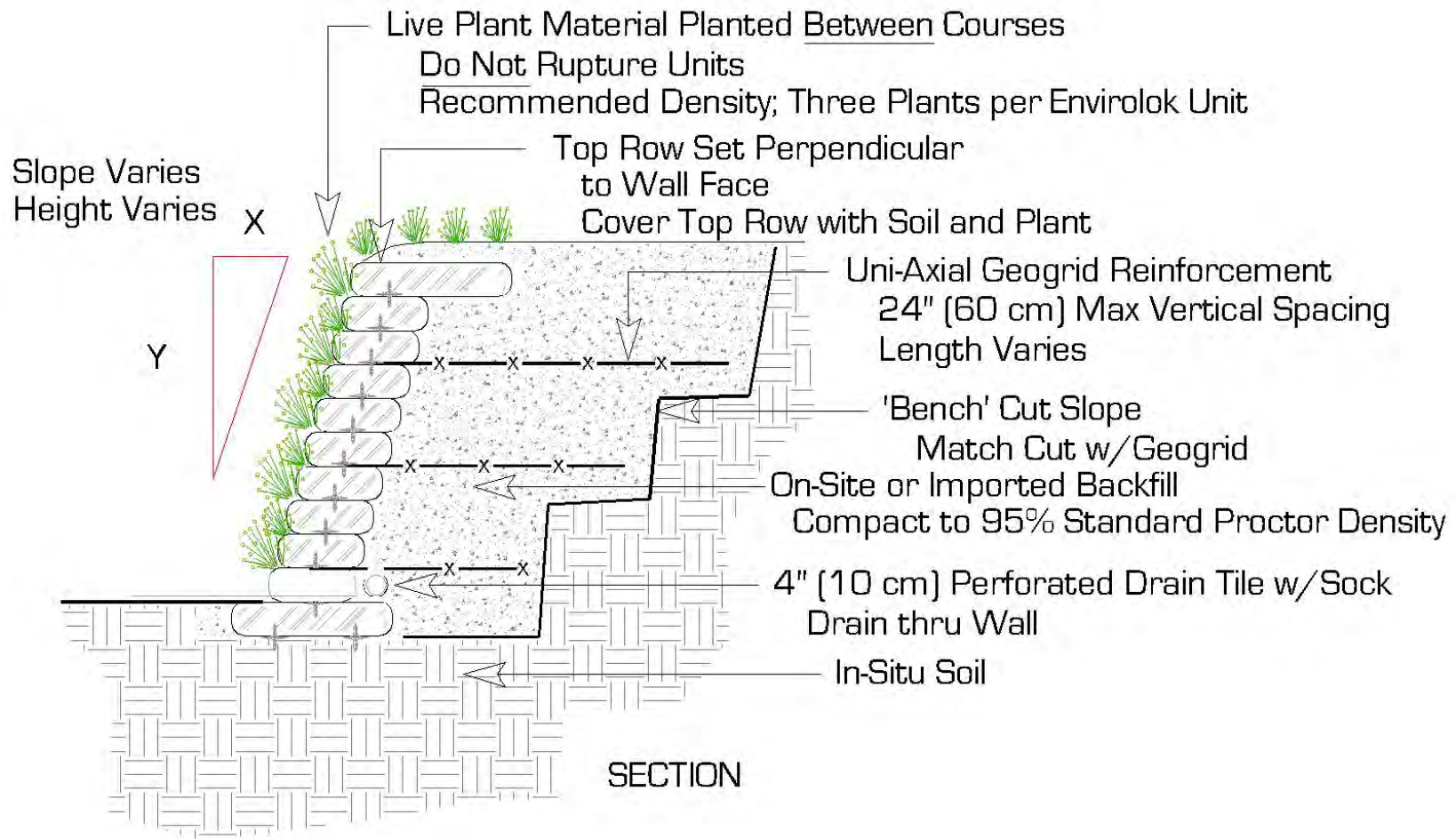
- \* Quantities required varies based on Unit filling and design layout
- \* One Envirolok Unit Consists of;
  - One Envirolok Bag
  - Two Connector Pins
  - One Zip Tie Bag Closure



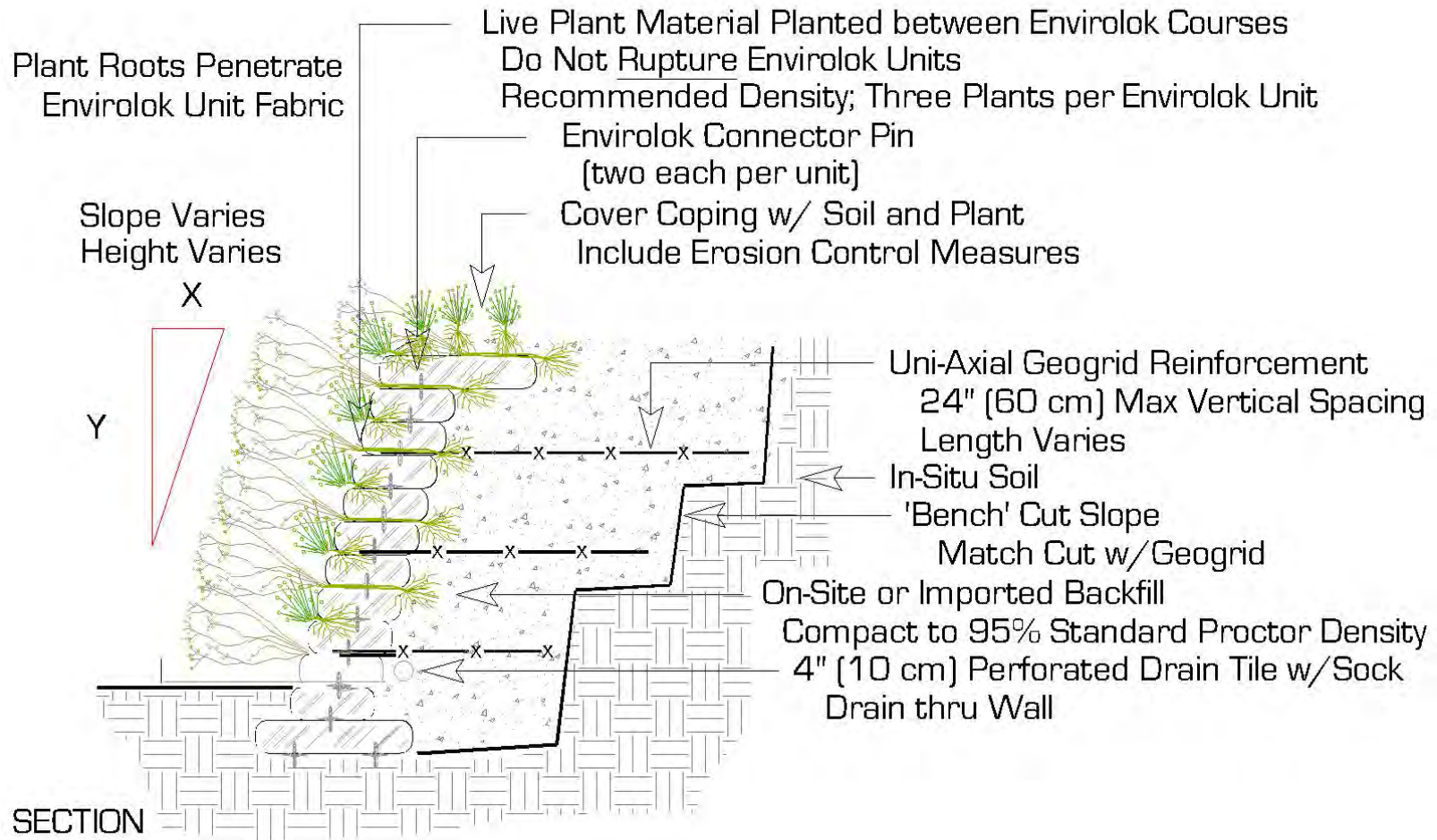
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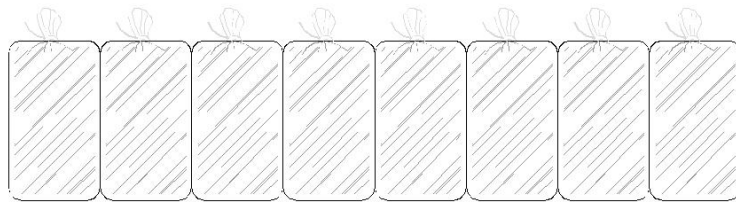
# Vegetated Segmental Retaining Walls



# Vegetated Segmental Retaining Walls



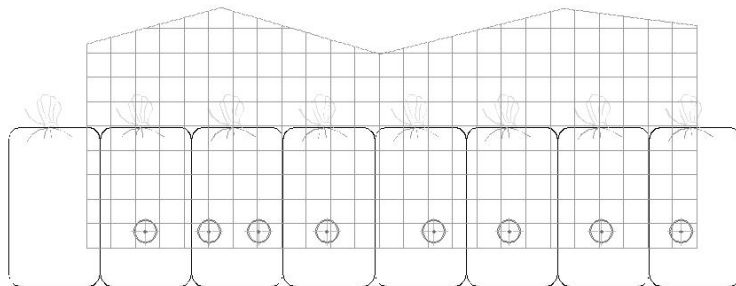
# Vegetated Segmental Retaining Walls



Wall Face

Uni-Axial Geogrid Re-Inforcement

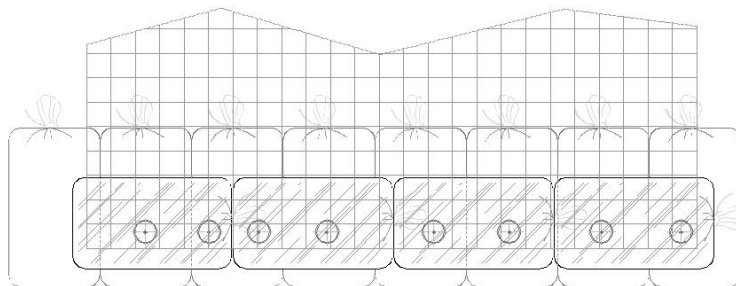
- 1) Install Base Row of Envirolok Units Perpendicular to Wall Face



Wall Face

Geogrid Machine/Strength Direction  
Length Varies

- 2) Install Geogrid over Envirolok Units
- 3) Install Envirolok Connector Pin Over Geogrid (Two Each per Unit)



Wall Face

PLAN

Geogrid Machine/Strength Direction  
Length Varies

- 4) Install Envirolok Units



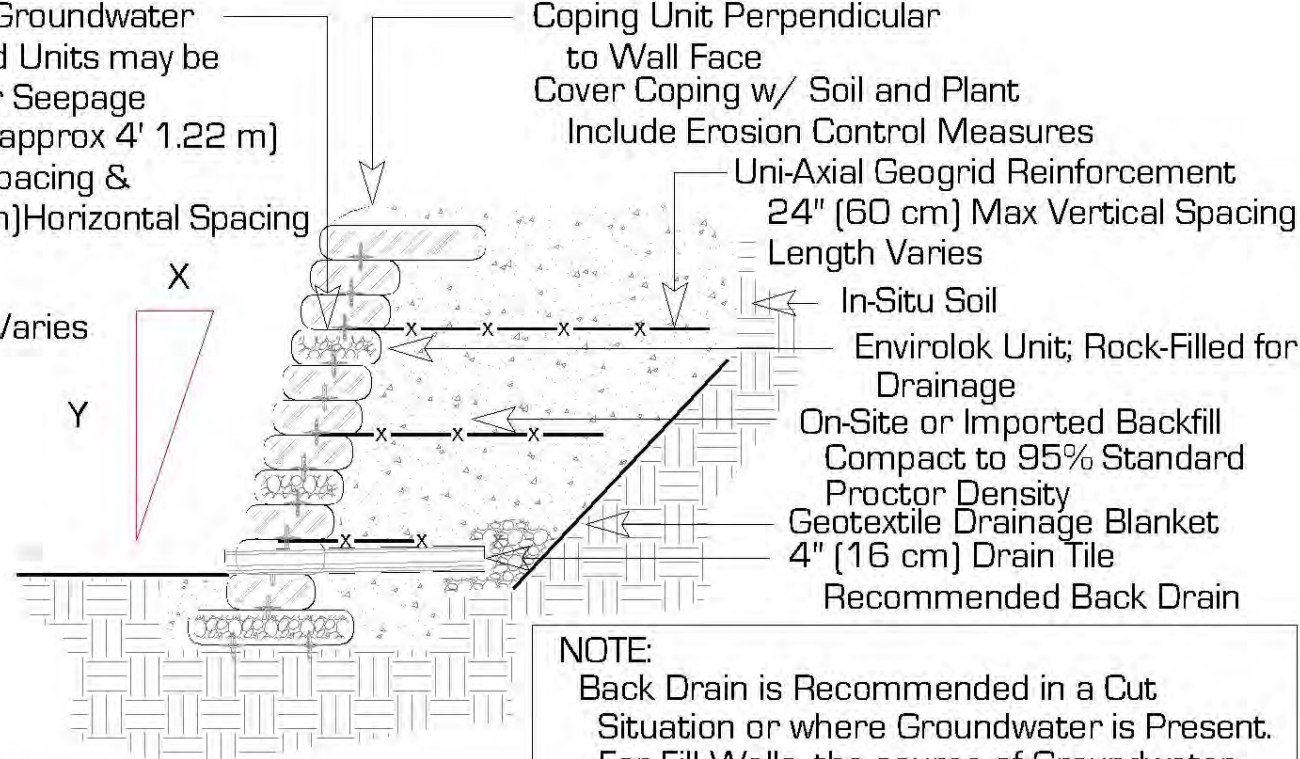


# Vegetated Segmental Retaining Walls

In Areas of Groundwater  
 Rock Filled Units may be  
 Placed for Seepage  
 Place Units approx 4' (1.22 m)  
 Vertical Spacing &  
 6' (1.83 m) Horizontal Spacing

Coping Unit Perpendicular  
 to Wall Face  
 Cover Coping w/ Soil and Plant  
 Include Erosion Control Measures

Uni-Axial Geogrid Reinforcement  
 24" (60 cm) Max Vertical Spacing  
 Length Varies

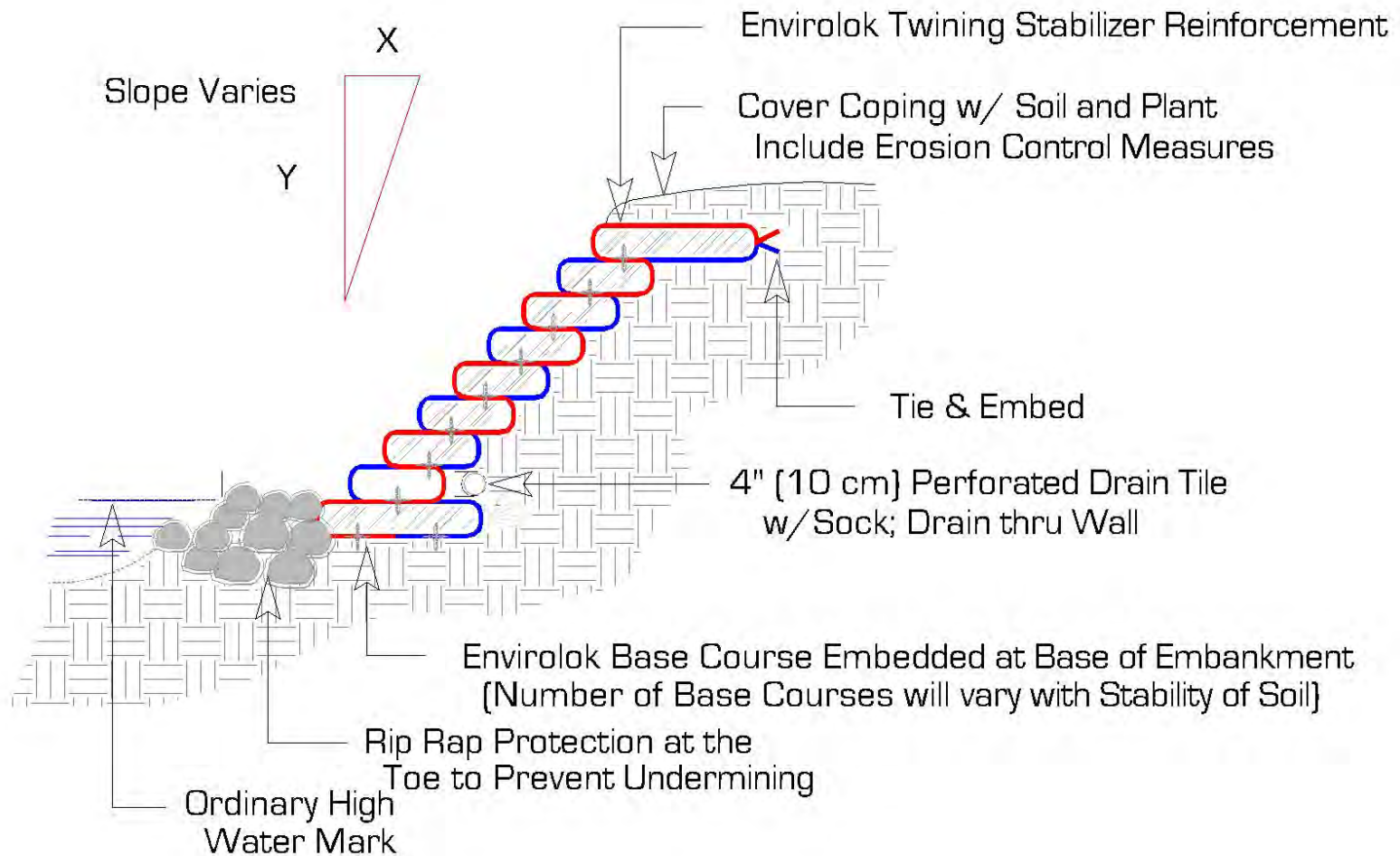


In-Situ Soil  
 Envirolok Unit; Rock-Filled for  
 Drainage  
 On-Site or Imported Backfill  
 Compact to 95% Standard  
 Proctor Density  
 Geotextile Drainage Blanket  
 4" (16 cm) Drain Tile  
 Recommended Back Drain

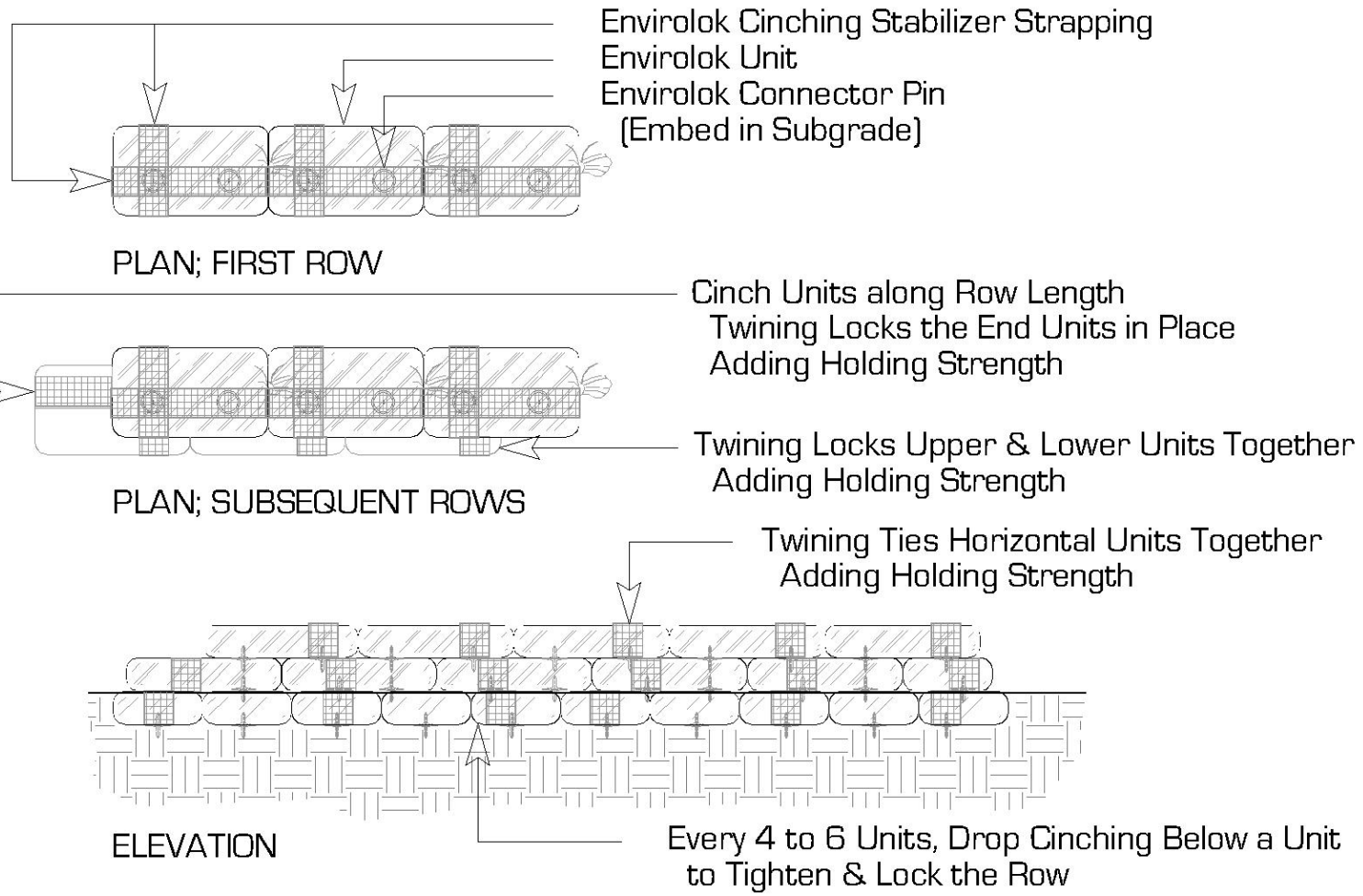
SECTION

**NOTE:**  
 Back Drain is Recommended in a Cut  
 Situation or where Groundwater is Present.  
 For Fill Walls, the source of Groundwater  
 may not Exist.  
 Back Drain could consist of a Geocomposite,  
 2/3 the Slope Height, 1/3 Coverage on  
 the Slope.

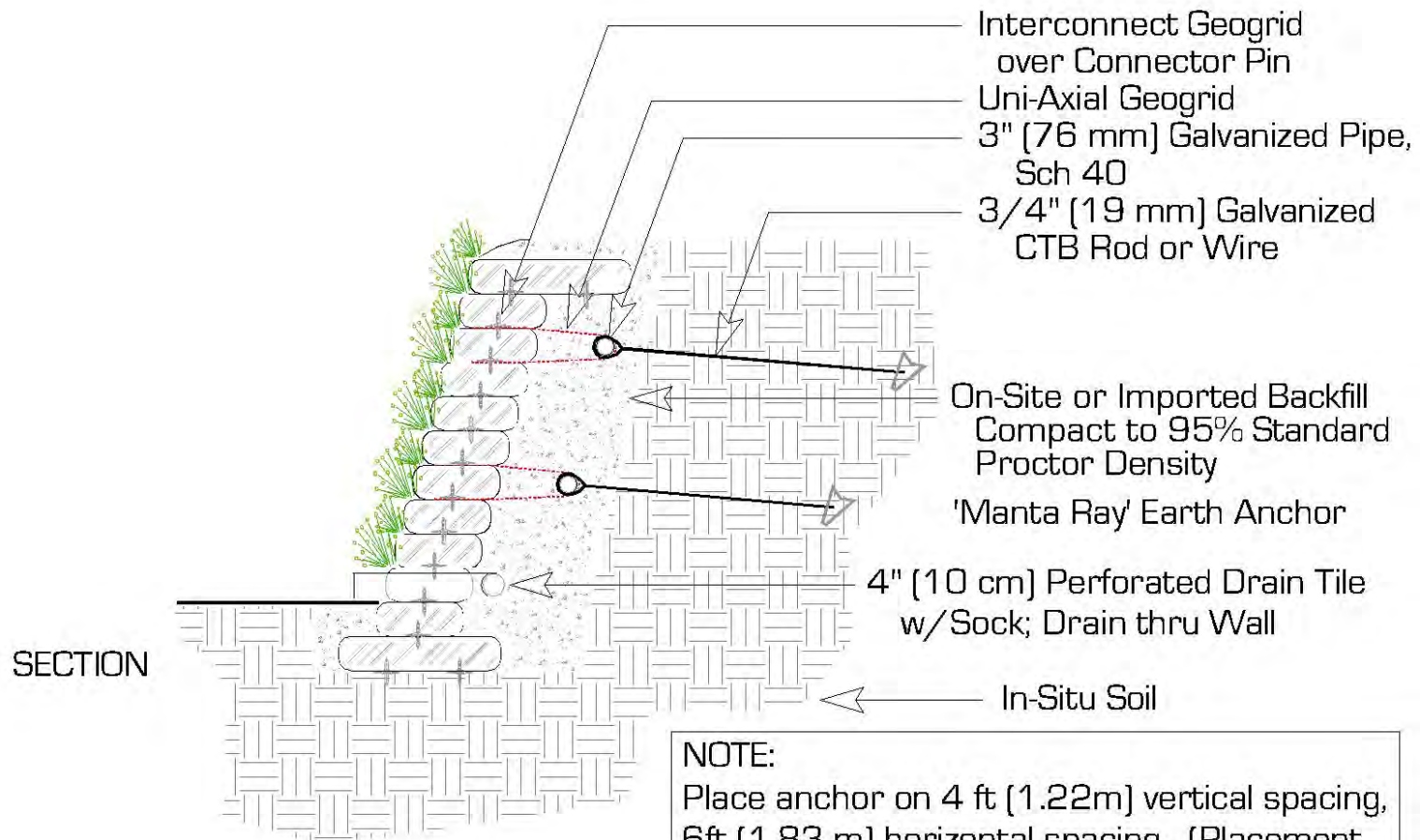
# Vegetated Segmental Retaining Walls



# Vegetated Segmental Retaining Walls

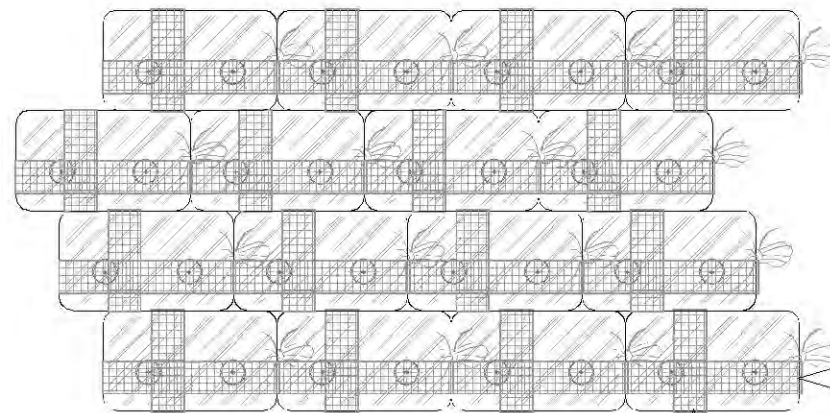


# Vegetated Segmental Retaining Walls



**NOTE:**  
Place anchor on 4 ft (1.22m) vertical spacing, 6ft (1.83 m) horizontal spacing. (Placement may vary with specific site conditions.)

# Vegetated Segmental Retaining Walls



PLAN VIEW

**NOTE:**

In Channel Applications without Continuous Envirolok Vegetated Swale, Embed the Units into the Channel Base 6" (152 mm) to Protect the Base from Undermining.

Cinch & Twine  
in Both Directions

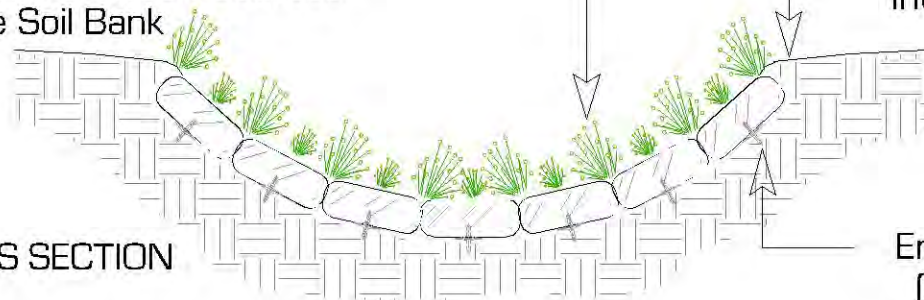
Live Plant Material  
Planted Between Courses  
Native Soil Bank

Cover Coping w/ Soil and Plant  
Include Erosion Control Measure

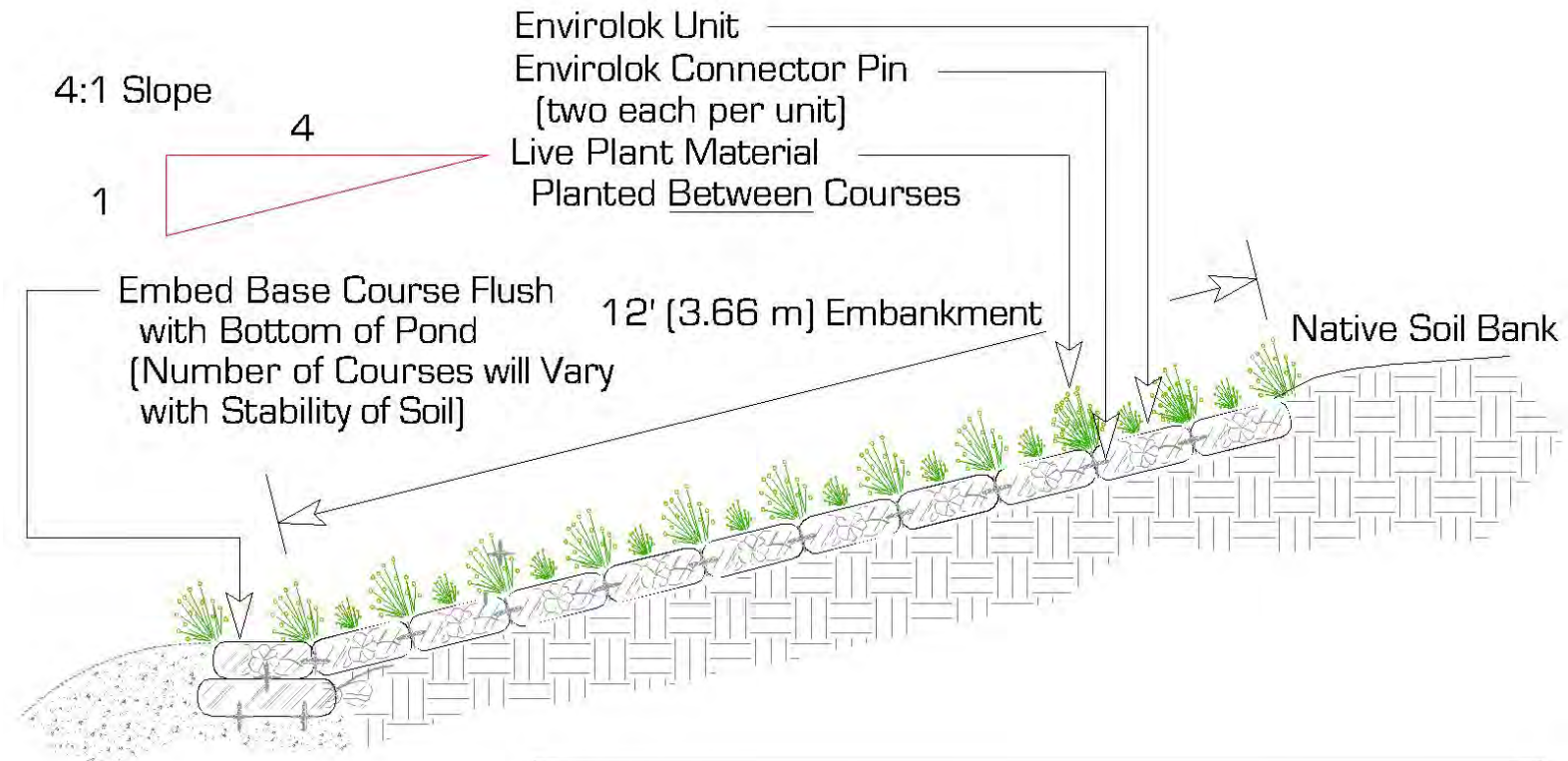
In-Situ Soil

CROSS SECTION

Envirolok Connector Pin  
(two each per unit)



# Vegetated Segmental Retaining Walls



SECTION

**NOTE:**

Mattress Face Area = 16.25 sq ft [1.5 m<sup>2</sup>] / In ft of Mat  
(Quantities vary based on Unit Filling and Placement)

## Case Study; Low Energy Shoreline



Even a low-energy shoreline benefits from stabilization and thriving vegetation.

Rushes and sedges create Mallard Duck nesting and feeding habitat.



## Case Study; Eroded Stream Bed



Flashy stream scours away erosion control measures, seed and soil.



## Case Study; Eroded Stream Bed



Soil is encapsulated in bag units and staked into place.

Vegetation will root through bag fabric.

## Case Study; Eroded Stream Bed



One year establishment.  
Vegetation has rooted through the bag fabric.

## Case Study; Eroded Stream Bed



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Flashy stream scours away shoreline. The site is washing away!

## Case Study; Eroded Stream Bed



Soil is encapsulated in bag units and staked into place.

Plugs installed during wall build and hydroseeded.

## Case Study; Eroded Stream Bed



Slope is stabilized and native vegetation established.

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## Case Study; Eroded Shoreline



Shoreline is highly eroded and washing downriver.

# Case Study; Eroded Shoreline



Filled bag units, geogrid, stabilizer, drain tile, granular base material, vegetation and backfill are staged and ready to move to project site.

## Case Study; Eroded Shoreline



Materials and equipment are moved to the project site via barge.



## Case Study; Eroded Shoreline



Heavy equipment for excavation and placing materials.

## Case Study; Eroded Shoreline



Placing granular base for stability.

## Case Study; Eroded Shoreline



Detail showing filled bag units, stabilizer, drain tile, and compacted backfill.

Vegetation is placed as the wall is built.

## Case Study; Eroded Shoreline



Detail showing filled bag units, stabilizer and vegetation.

## Case Study; Eroded Shoreline



Wall installed.  
Coping is  
protected and  
temp irrigation is  
installed.

# Case Study; Eroded Shoreline



Installed system with large woody stumps are cabled to shoreline.

## Case Study; Eroded Shoreline



Wall system hydroseeded with diverse seed mix.

## Case Study; Eroded Shoreline



Vegetation established and shoreline stabilized and protected.



# Case Study; Stream Restoration



Stream is diverted into the plastic pipe.

# Case Study; Stream Restoration



Vegetated  
segmental  
retaining wall  
installation  
underway.

## Case Study; Stream Restoration



Detail showing Geogrid reinforcement and stabilizer in place.

# Case Study; Stream Restoration



Wall system installed and plugged vegetation in place.

# Case Study; Stream Restoration



Wall system  
hydroseeded.

# Case Study; Stream Restoration



Plastic pipe  
eliminated and  
the stream  
flowing freely!

# Case Study; Riverbank Restoration



Riverbank has eroded and scoured for decades.

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# Case Study; Riverbank Restoration



Install  
sequence.

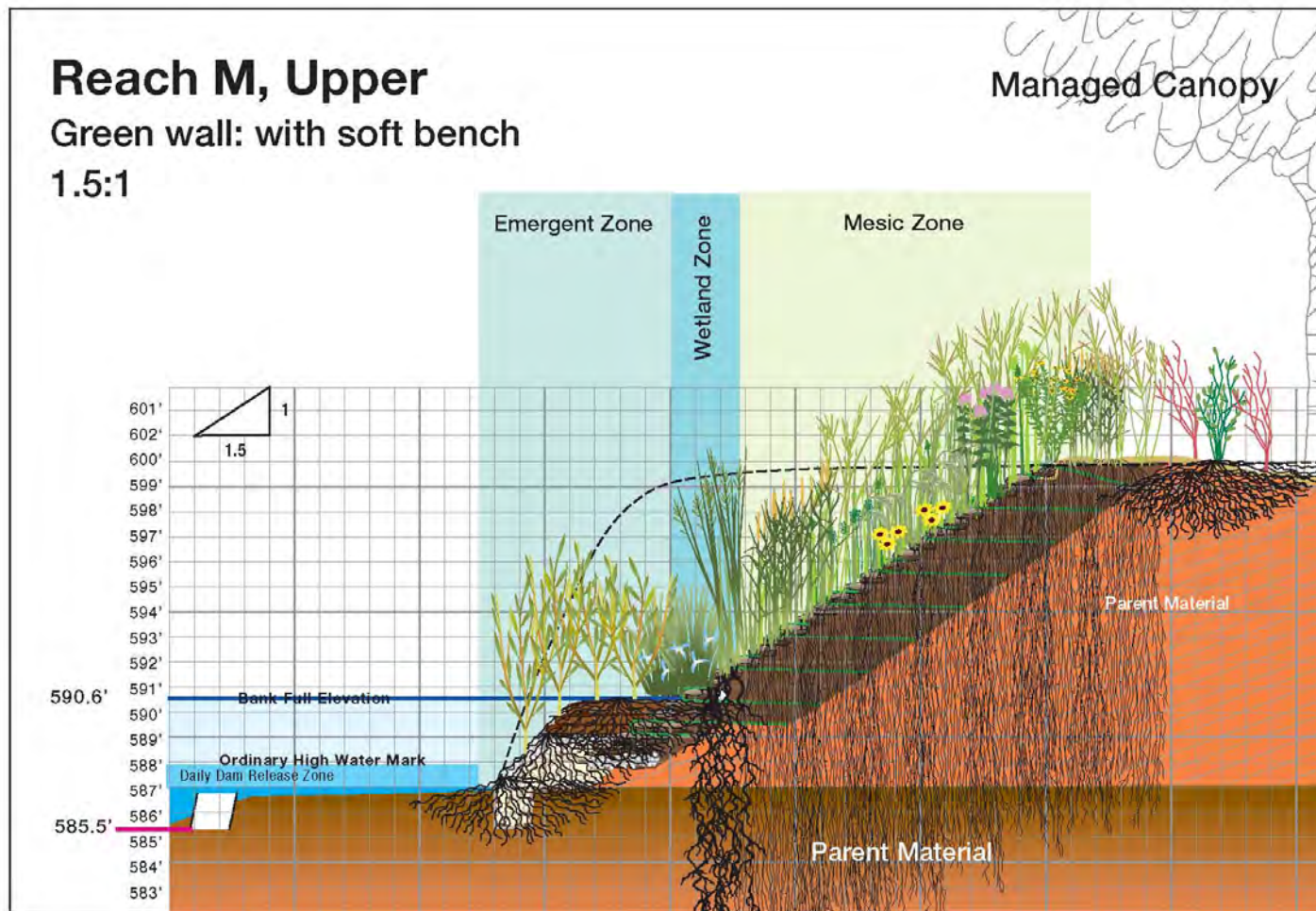


# Case Study; Riverbank Restoration



Shoreline  
protected and  
vegetated

# Case Study; Riverbank Restoration



# Case Study; Riverbank Restoration



Native  
vegetation  
thrives on the  
riverbank.

# Native Vegetated Mat

Core material fit  
to site  
requirements

Vegetation  
grown to  
specification

Minimizes  
chance of failure



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# Native Vegetated Mat

Growout in controlled greenhouse or hoop house contributes to quality control.

12-16 week growout period



# Native Vegetated Mat

Initial root growth is horizontal due to underlayment. Root systems bind growing medium (soil) to the core material, creating a sod-like mass.



# Native Vegetated Mat

Vegetation is grown in pre-cut mats; 40" x 11'. Sheeting underlayment allows for easy rolling and palletizing.



# Native Vegetated Mat

Mats can be rolled out on site and placed with staples or wood stakes. With adequate hydration, mats 'knit' down within thirty days.



JUL 14 2009



# Native Vegetated Mat

Shoreline is vegetated and root system is penetrating native soil within thirty days.



# LEED Credits



## Materials & Resources

Credit MR-2.1 – Construction Waste Management

Credit MR-2.2 – Construction Waste Management

Credit MR-4.1/4.2 – Recycled Content

Credit MR-5.1/5.2 – Regional Materials

## Innovation & Design Process

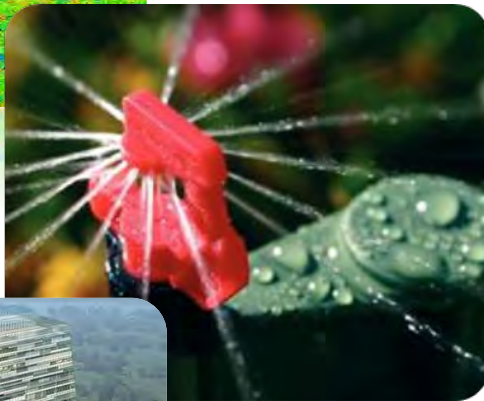
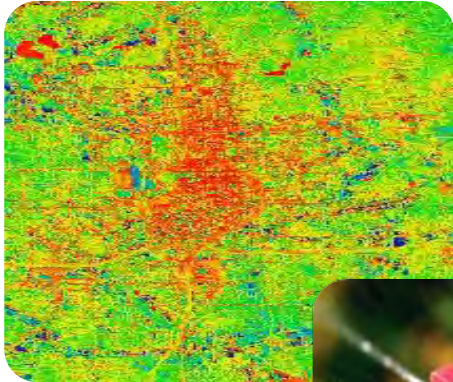
Credit ID-1.1 – Innovation in Design

Credit ID-1.2 – Innovation in Design

**15 Credits**



# SITES Credits



## Sustainable Sites

Credit SS-5.1 - Site Development

Credit SS-5.2 – Maximize Open Space

Credit SS-6.1 – Stormwater Design

Credit SS-6.2 – Stormwater Design

Credit SS-7.1 – Heat Island Effect

## Water Efficiency

Credit WE-1.1/1.2 – Water Efficient Landscaping

15

**SITES**  
SUSTAINABLE **SITES** INITIATIVE™

# Why Green Infrastructure?



“There are some who can live without wild things and some who cannot.”  
— Aldo Leopold

# Thank you!

Questions?



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