

GREEN PRACTICE DESIGN: FINDINGS IN PLANTS AND SOILS

URBAN WATERS NATIONAL TRAINING WORKSHOP

GREEN INFRASTRUCTURE AND STORMWATER MANAGEMENT

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UNIVERSITY OF THE
DISTRICT OF COLUMBIA
COLLEGE OF AGRICULTURE, URBAN SUSTAINABILITY
AND ENVIRONMENTAL SCIENCES

“Healthy Cities-Healthy People”



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East Capitol Urban Farm-3 acre Vacant Lot

THE CONUNDRUM

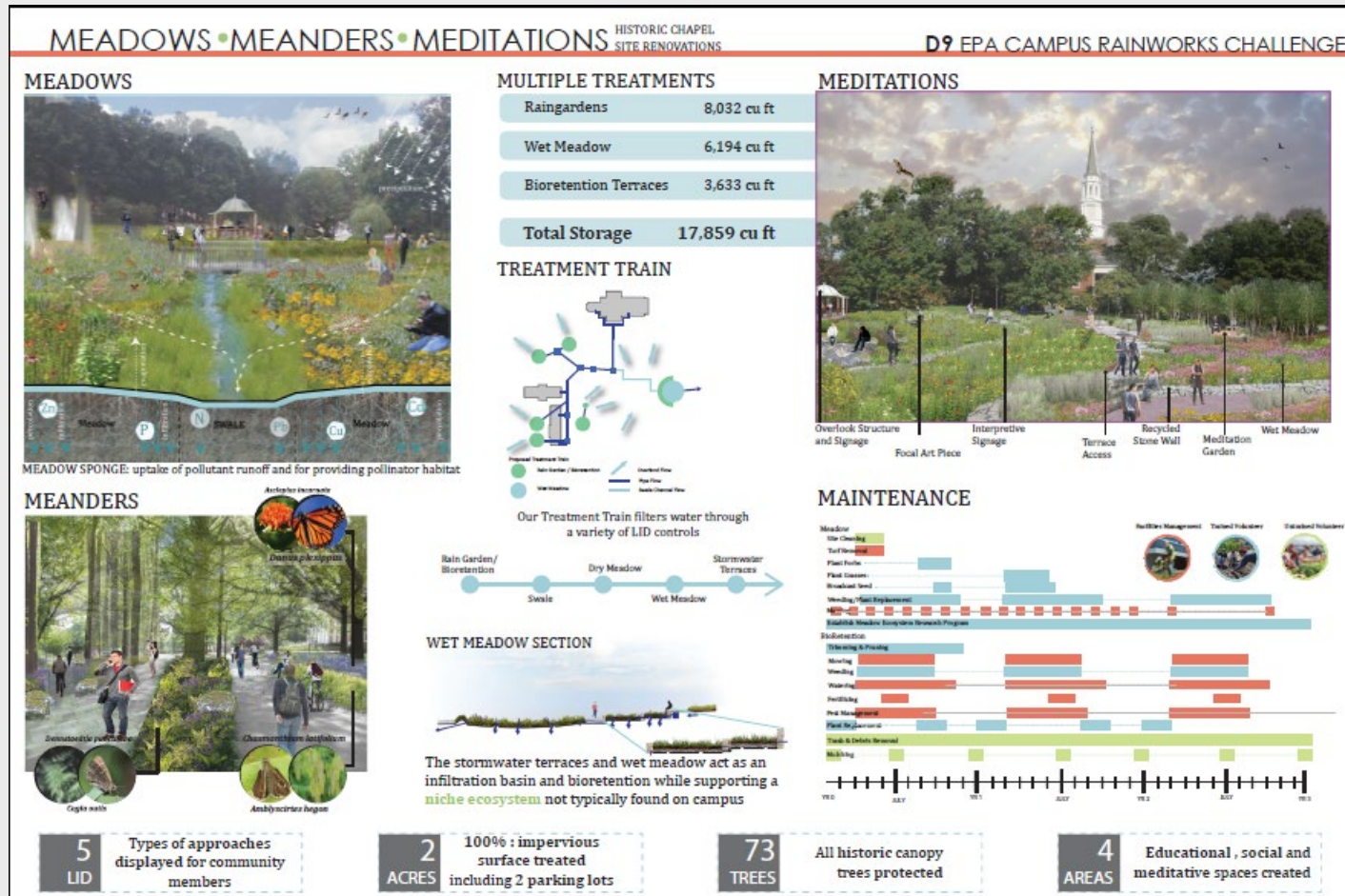


LOOKS MATTER



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IT LOOKS VERY PRETTY IN THE DRAWINGS



LITERATURE REVIEW

- COMMITTEE MEMBERS SUBMITTED APPROXIMATELY 40 ARTICLES IN 3 CATEGORIES “PLANT”, “SOIL”, “OTHER”
 - VERY FEW PLANT ARTICLES WERE FOUND AND OR SUBMITTED
- USED GENERAL SEARCH ENGINE “GOOGLE SCHOLAR” + “ASCE”
- ARTICLES WERE SCREENED BY CO-LEADERS OF LITERATURE REVIEW. REMOVED ARTICLES WITH ONLY SOIL BASIS.



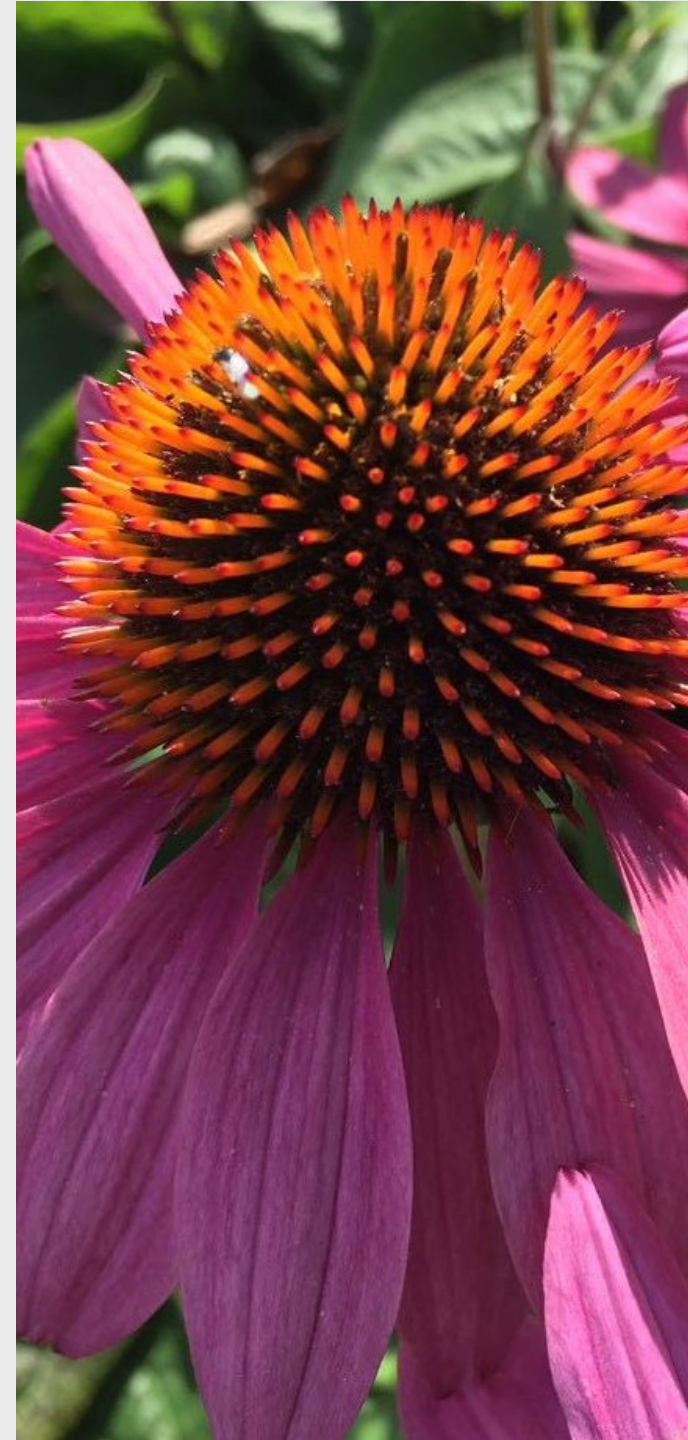
CO-BENEFITS OF GREEN INFRASTRUCTURE

- **ECOLOGICAL AND HABITAT**
- **HEAT ISLAND REDUCTION**
- **AIR QUALITY IMPROVEMENT (HEALTH AND WELL BEING)**
- **CARBON SEQUESTRATION**
- **AESTHETICS**
- **INCREASED TREE CANOPY**
- **INCREASED GREEN OPEN SPACE**
- **SAFETY**
- **ECONOMIC**



PLANTS BIOLOGICAL ROLE

- (1) SOIL WATER IS TAKEN UP BY THE PLANT AND EITHER INCORPORATED INTO THE BIOMASS OR EVAPOTRANSPIRATED
- (2) NITROGEN AND PHOSPHORUS TRANSPORTED BY THE WATER ARE INCORPORATED INTO THE PLANT'S BIOMASS
- (3) THE PLANT'S ROOT SYSTEMS REDUCE CLOGGING AND IMPROVE INFILTRATION RATES THROUGH THEIR EXPANSION INTO THE SOIL.
- (4) THE ROOT ZONE MICROBIAL ACTIVITY MAINTAINS NUTRIENT CYCLING AND SOIL PRODUCTIVITY IN THE SOIL



PLANTS MATTER

- WATER QUALITY IMPROVEMENT
- PLANTS CAN PROCESS UPWARDS OF 90% OF HEAVY METALS
- RESEARCHERS IN CHINA FOUND *PLANTAGO ASIATICA* L. AND *DIGITARIA SANGUINALIS* (L.) SCOP. FOR REMOVING POLLUTANTS.
- CORRELATION WITH PLANTS THAT HAD DEEPER ROOT SYSTEMS MAINTAINING PERMEABILITY OVER TIME



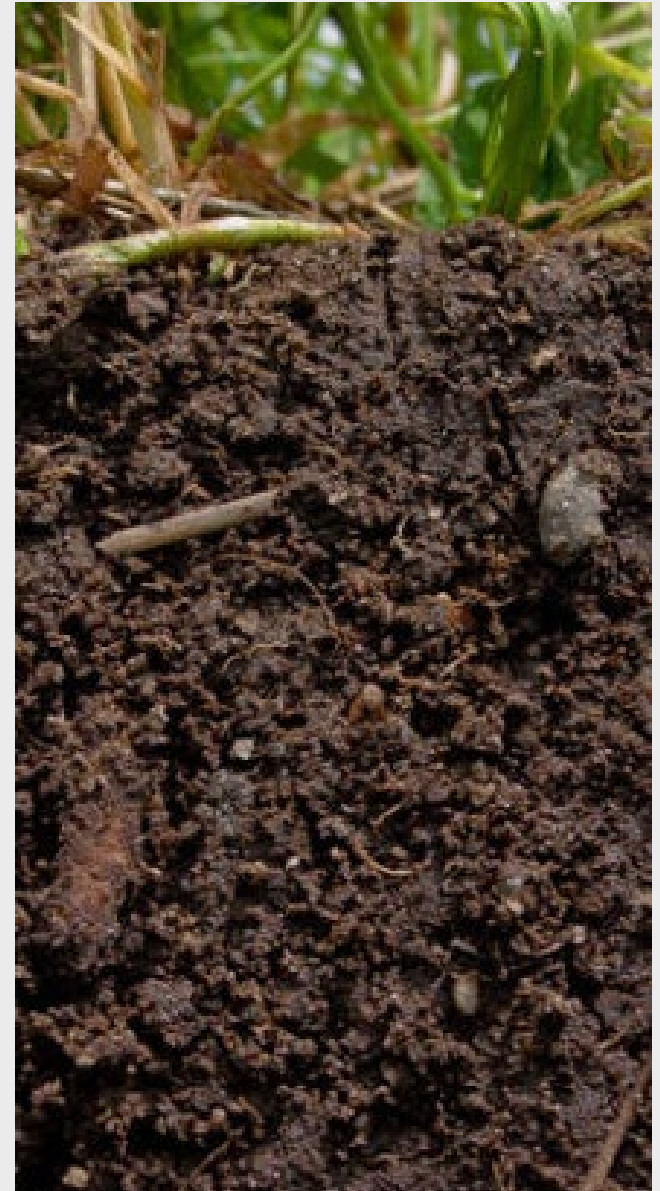
FACTORS AFFECTING PLANT GROWTH

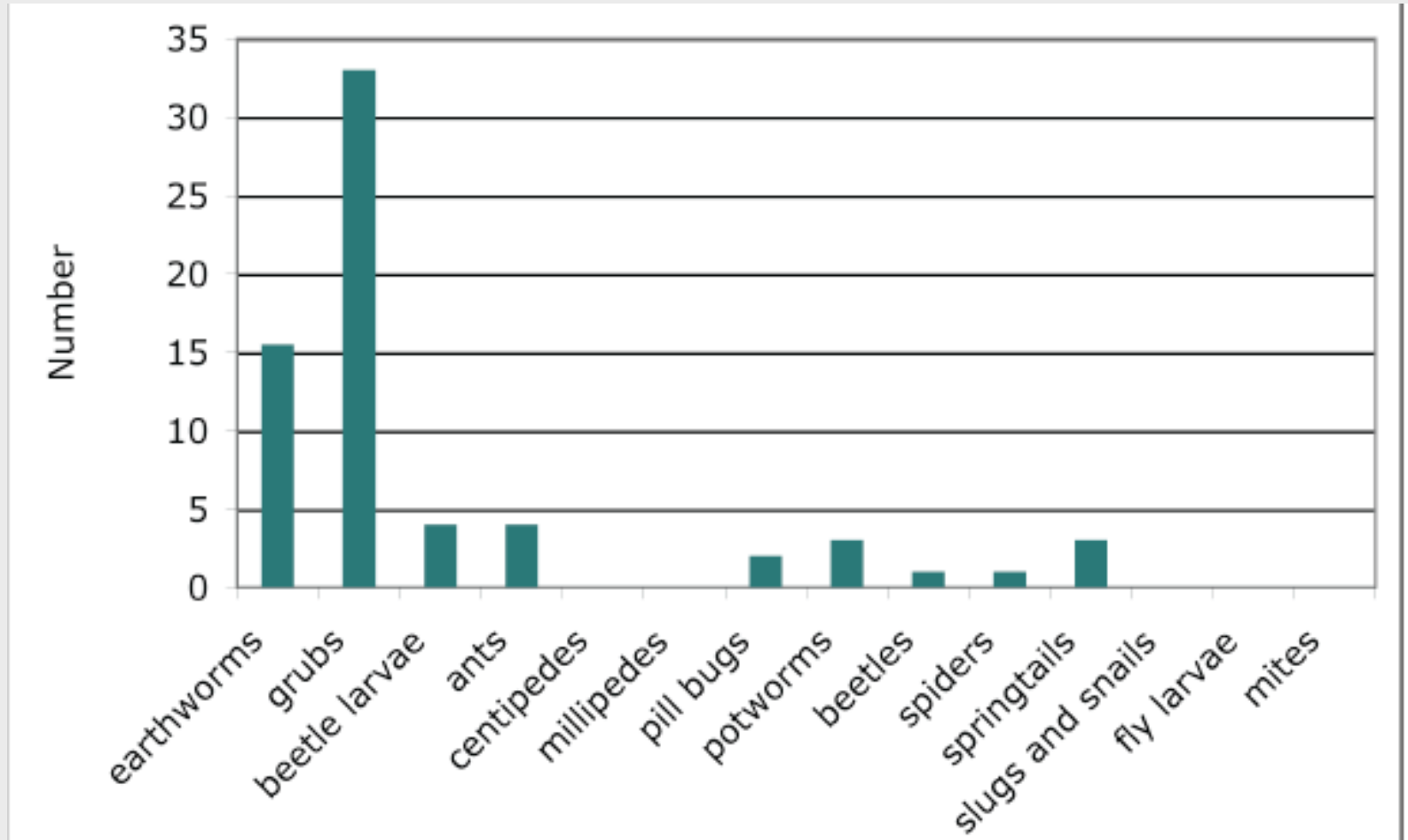
- SURVIVABILITY IN DIFFERENT DESIGN CONFIGURATIONS (HOW LONG WET AND DRY EFFECTS NUTRIENT UPTAKE)
- PLANT BIOMASS IS HIGHLY RELATED TO THE NUTRIENT REMOVAL
- DRYING BETWEEN STORMS CREATES VARIATIONS IN NUTRIENT UPTAKES
- USE OF SATURATED ZONE
- PLANTS SPECIES PERFORM NON UNIFORMLY IN NUTRIENT UPTAKE



SOIL FAUNA IMPROVES PERFORMANCE...

- **RAIN GARDEN SOILS DEVELOP BIOLOGICAL ORGANIC LAYER OVER TIME**
- **DIVERSITY OF ORGANISMS IN RAIN GARDENS...EARTH WORMS MOST PREVALENT**
- **ORGANIC LAYER DID NOT INHIBIT INFILTRATION**
- *SOIL FAUNA MAY SIGNIFICANTLY ALTER FUNCTION OF RAIN GARDEN...*
- *NEED TO BETTER UNDERSTAND SO CAN INCORPORATE INTO DESIGN*
- **SOIL PROFILE DEVELOPMENT AND HYDROLOGY INCREASE EFFECTIVENESS**





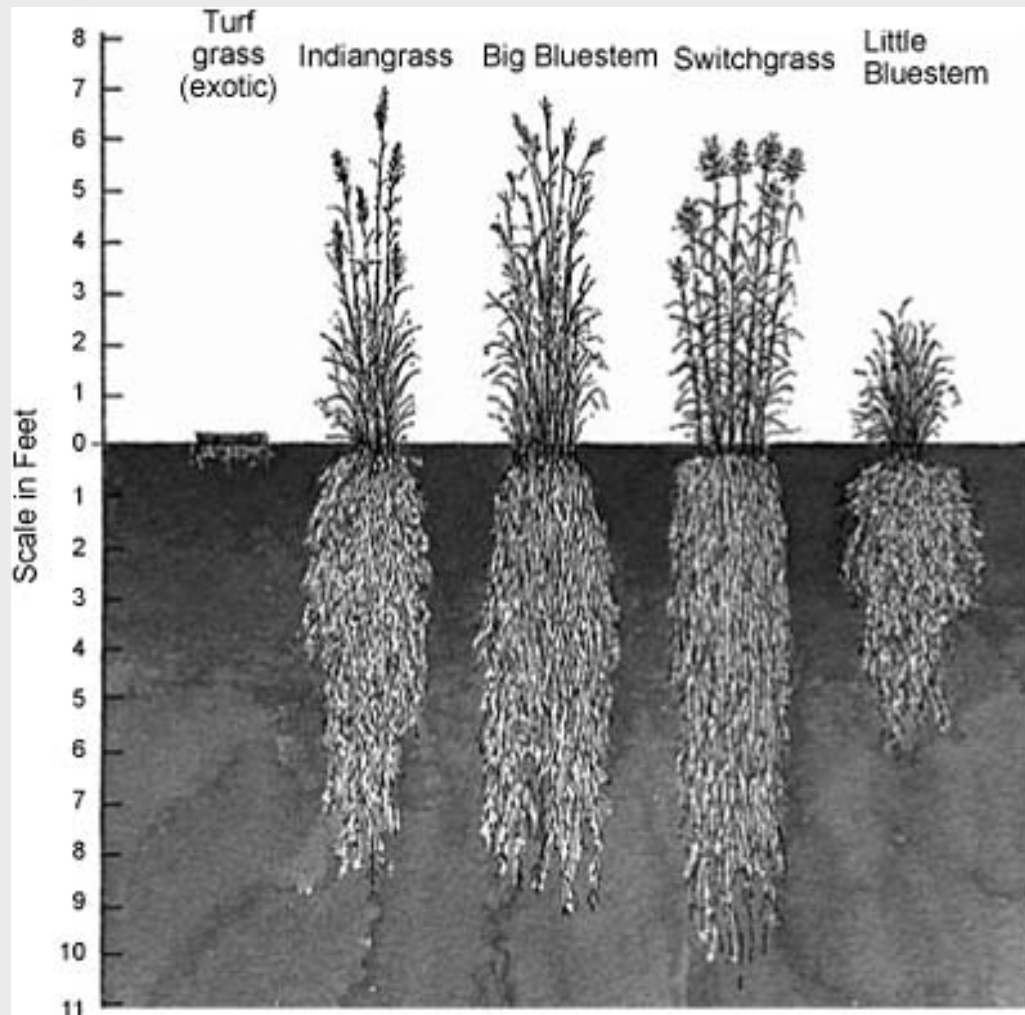
- AYERS, E.M. (2009) *PEDOGENESIS IN RAIN GARDENS: THE ROLE OF EARTHWORMS AND OTHER ORGANISMS IN LONG-TERM SOIL DEVELOPMENT*

ROLE OF ET AND BMP DESIGN

- CORRELATION BETWEEN VEGETATION COVER INCREASING OVER TIME AND THE INCREASE IN EVAPOTRANSPIRATION
- SOIL STRUCTURE CLASSES CRITICAL IN THE TAILORING OF EVAPOTRANSPIRATION IN RAIN GARDENS
- (SILT LOAM AND CLAY LOAM PERFORMED BEST)
- TRANSPIRATION INCREASE CAPACITY



NATIVE PLANT ROOT SYSTEM



PLANT PERFORMANCE...

Research into sand based manufacture Trees in sand based soil vs Loam

Sonti et al 2014



Smiley et al 2015



Smiley/Urban 2014

Slide images from James Urban

TRAINING AND COMMUNICATION

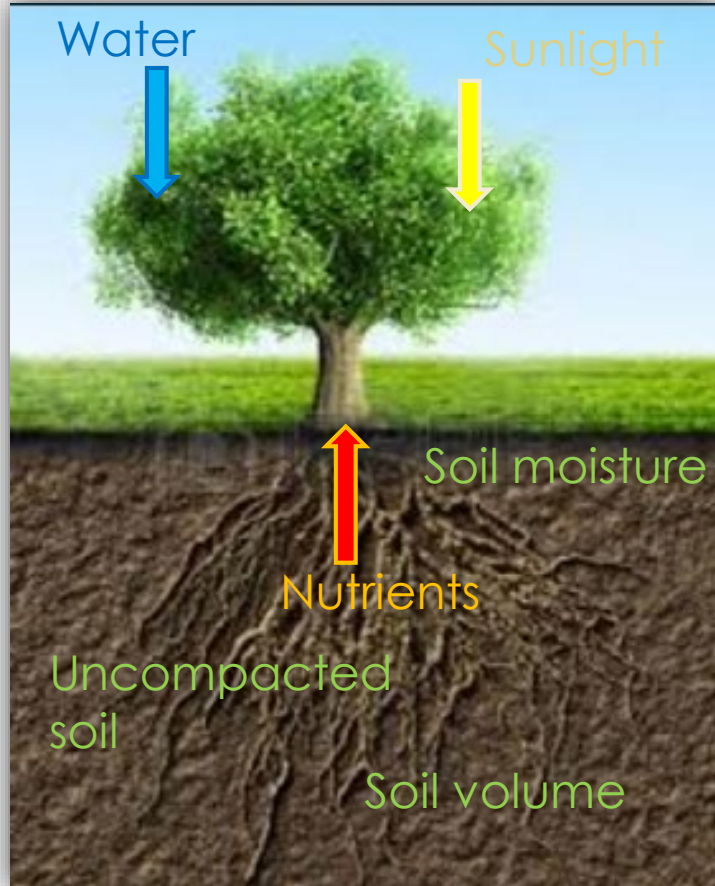


RESEARCH NEEDS

- PLANT PERFORMANCE DATA
- HOW DOES MAINTENANCE EFFECT PLANT GROWTH?
- UNDERSTANDING ROLE OF BIOTA
- PLANT COMMUNITIES FOR GREEN STORMWATER INFRASTRUCTURE SOIL TYPES
- ECOLOGY
- PERCEPTION

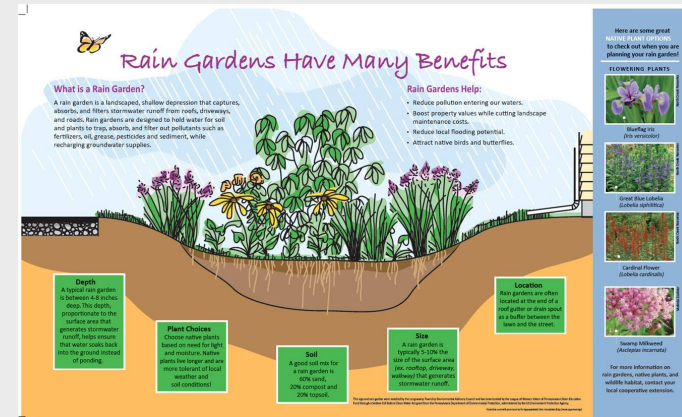


PLANT SELECTION IS SITE SPECIFIC



- CLIMATE
- SOIL
- LIGHT
- TEMPERATURE
- WATER IN QUALITY (PARKING LOT VERSUS HOUSE VERSUS LAWN)

COMMUNICATION



THE MAINTENANCE CREW DIDN'T KNOW THE PLANTS... ALL OF THE CARDINAL FLOWERS (RED & BLUE) WERE REMOVED BY THE CREW (MAINTENANCE WAS AFTER THEY FLOWERED); ACTUAL WEEDS WERE LEFT

THANK YOU

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