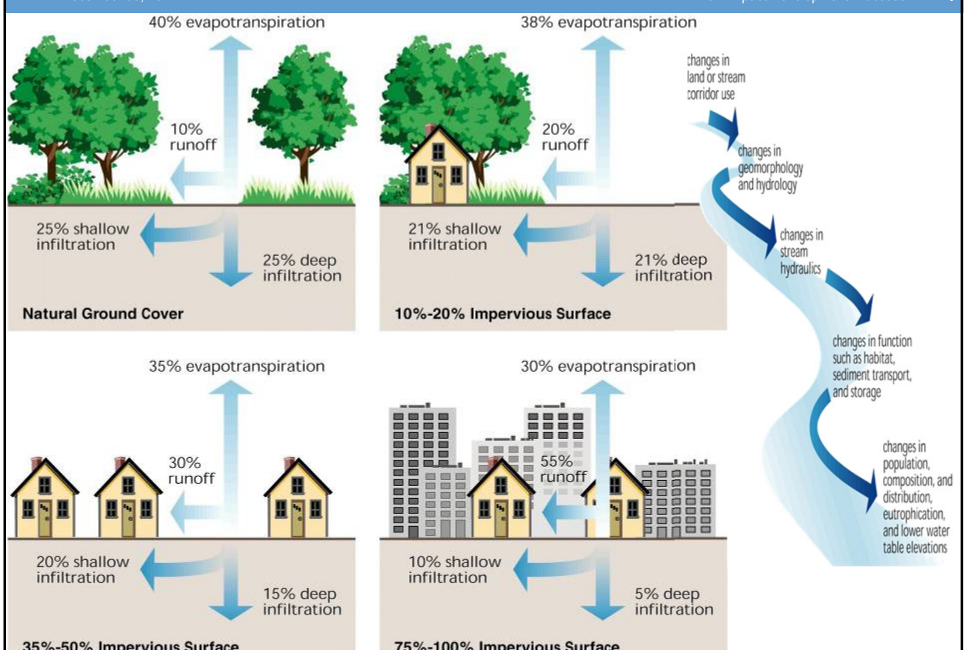
LOW IMPACT DEVELOPMENT

Incorporating LID Practices and Other Stormwater BMPs in Site Plans and Designs

WHAT IS LID?

Low Impact Development (LID)

An approach to land development (or re-development) that works with nature to ***manage stormwater as close to its source as possible***. LID employs principles such as **preserving** and **recreating natural landscape features**, **minimizing effective imperviousness** to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product.



Source: FISRWG 2001

Green Infrastructure

Systems and practices that use or **mimic natural processes** to infiltrate, evapotranspirate (the return of water to the atmosphere either through evaporation or by plants), or reuse stormwater or runoff on the site where it is generated. Green infrastructure can be used at a wide range of landscape scales in place of, or in addition to, more traditional stormwater control elements to support the principles of LID.

Smart Growth

A range of development and conservation strategies that help protect our natural environment and make our communities more attractive, economically stronger and more socially diverse

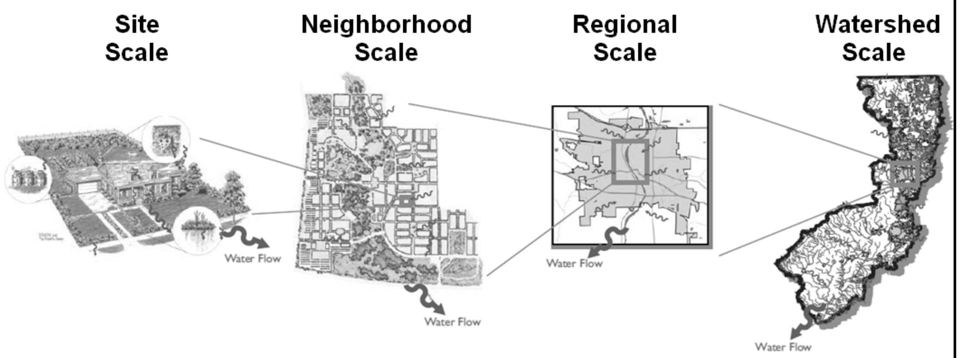
Jordan Cove Watershed Project
NEMO Program, University of Connecticut

Complete Streets

Integrates people and place in the planning, design, construction, operation and maintenance of our transportation networks.

SCALES OF IMPLEMENTATION

Scales of Implementation



Source: Conservation Design Forum

Regional or Watershed Scale

At the regional or watershed scale we . . .

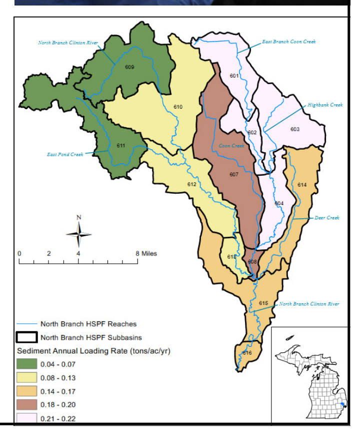
Set Targets

Based on:

- Community ideology
- Environmental needs

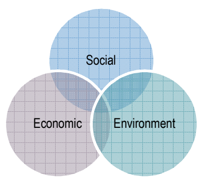
Study, Plan and Prioritize

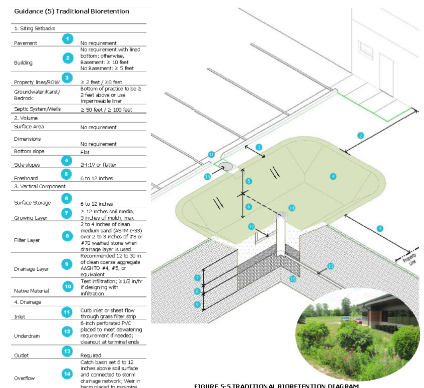
- Toolbox
- Programmatic Elements
- Source Identification
- Opportunity Assessment
- Needs vs Opportunities
- Prioritization and Selection



Regulations, Standards, Policies and Procedures

- Decide what's important
- Evaluate current situation
- Make changes
- Monitor progress and adapt



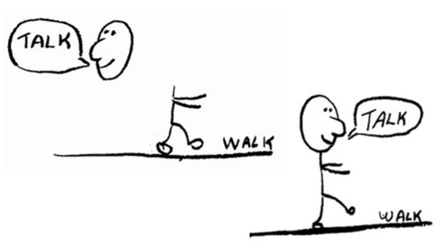


Guidance (5) Traditional Bioretention

1. Siting Setbacks		
Pavement	1	No requirement
Building	2	No requirement with lined bottom; otherwise, Basement: ≥ 10 feet No Basement: ≥ 5 feet
Property lines/ROW	3	≥ 2 feet / ≥0 feet
Groundwater/Karst/ Bedrock		Bottom of practice to be ≥ 2 feet above or use impermeable liner
Septic System/Wells		≥ 50 feet / ≥ 100 feet
2. Volume		
Surface Area		No requirement
Dimensions		No requirement
Bottom slope		Flat
Side slopes	4	2H:1V or flatter
Freeboard	5	6 to 12 inches
3. Vertical Component		
Surface Storage	6	6 to 12 inches
Growing Layer	7	≥ 12 inches soil media; 3 inches of mulch, max
Filter Layer	8	2 to 4 inches of clean medium sand (ASTM c-33) over 2 to 3 inches of #8 or #78 washed stone when drainage layer is used
Drainage Layer	9	Recommended 12 to 30 in. of clean coarse aggregate AASHTO #4, #5, or equivalent
Native Material	10	Test infiltration; ≥1/2 in/hr if designing with infiltration
4. Drainage		
Inlet	11	Curb inlet or sheet flow through grass filter strip
Underdrain	12	6-inch perforated PVC placed to meet dewatering requirement if needed; cleanout at terminal ends
Outlet	13	Required
Overflow	14	Catch basin set 6 to 12 inches above soil surface and connected to storm drainage network; Weir in berm placed to minimize

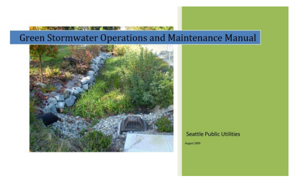
FIGURE 5-5 TRADITIONAL BIORETENTION DIAGRAM

Set the Tone

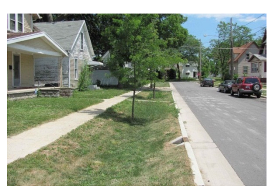


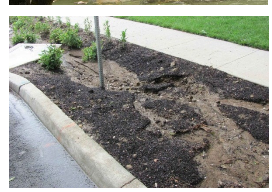
Vital Street and Sidewalk Investment Guidelines, Grand Rapids MI.
Low impact design will be the default design approach for street, sidewalk and right-of-way repair, improvement and reconstruction . . . to enable the City to achieve a minimum of Stormwater Management Level C investment by FY2022

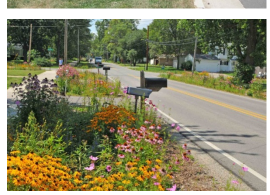
Pilots, Demonstrations and Prototypes

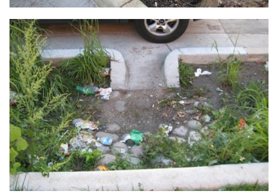


- Track Performance
- Measure Success
- Revisit Goals
- Periodic Updates
- Oversight
- Communication



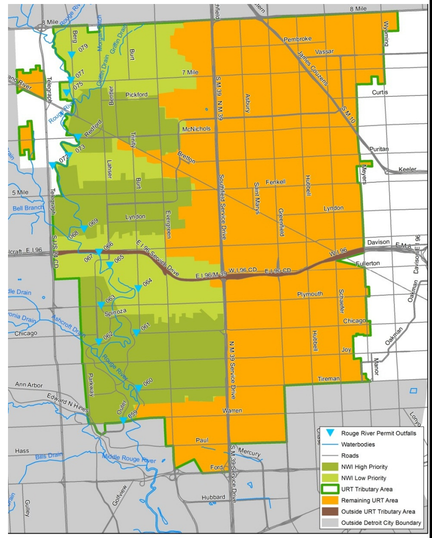






Detroit Example

- Policies, Procedures and Standards
  - ♦ Ordinances ♦ Drainage Manual
  - ♦ Design Standards ♦ O&M Guides
- Prototype Projects
  - ♦ Parcel Based ♦ Parks ♦ Roads
  - ♦ Stream Connections
- Continued Implementation
  - ♦ Downspouts ♦ Demolitions ♦ Trees
- Long Term Performance
  - ♦ Model Update ♦ Benefit Evaluation
  - ♦ LTCP Update
- Stakeholder and Community Engagement
  - ♦ Website ♦ Workshops ♦ Forum
  - ♦ Educational Campaign



Neighborhood Scale

- Flexibility in Land Planning and Locating Green Infrastructure
- Opportunities
  - Large centralized practices
  - Distributed systems
  - Gateways and corridors
  - Open space
  - Habitat and natural resource protection
- Meaningful Impact
  - Flooding problems
  - Sustainability goals

Site Scale

LID SITE DESIGN PRINCIPLES

Site Design Principles of LID

- Phase I: Site Assessment
- Phase II: Preliminary LID Design
- Phase III: Final Design

Phase I: Site Assessment	1) Identify Regulatory Needs
	2) Conduct Hydrologic and Geotechnical Survey
	3) Protect Key Hydrologic Areas
Phase II: Preliminary Design	4) Use Drainage and Hydrology as Design Elements
	5) Establish Clearing and Grading Limits
	6) Reduce/Minimize Total and Effective Impervious Area
	7) Determine LID Practices
Phase III: Final Design	8) Determine Approximate Size of LID Practices
	9) LID Final Design

Phase I: Site Assessment

- Step 1: Identify Regulatory Needs
- Step 2: Conduct Hydrologic and Geotechnical Survey
- Step 3: Protect Key Hydrologic Features

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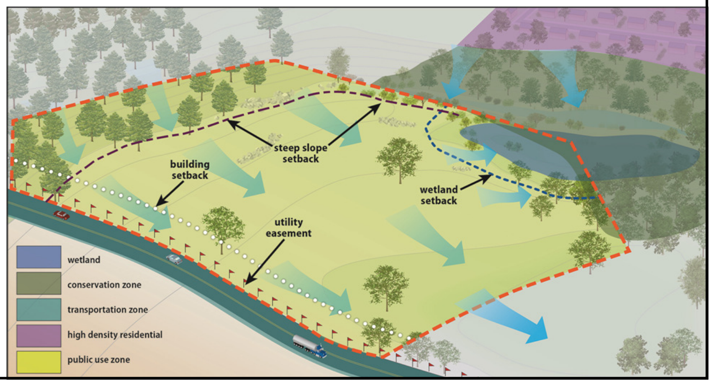
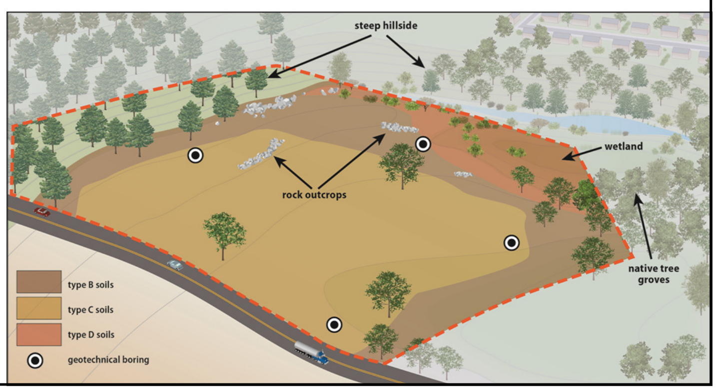
Step 1: Identify Regulatory Needs

- Identify applicable zoning, land use, subdivision, and other regulations
- Identify setbacks, easements, and utilities
- Identify targeted pollutants and pollutants of concern



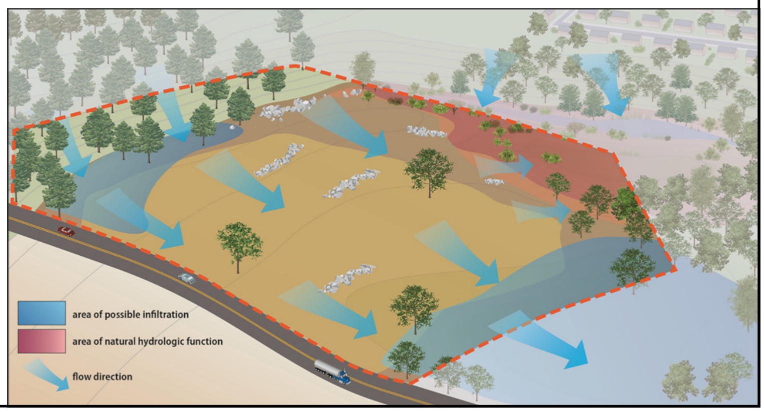
Step 2: Conduct Hydrologic, Geotechnical Survey

- Identify natural site features to be conserved or restored
- Conduct a geotechnical survey including drainage characteristics, hydrologic flow paths, and soil infiltration tests



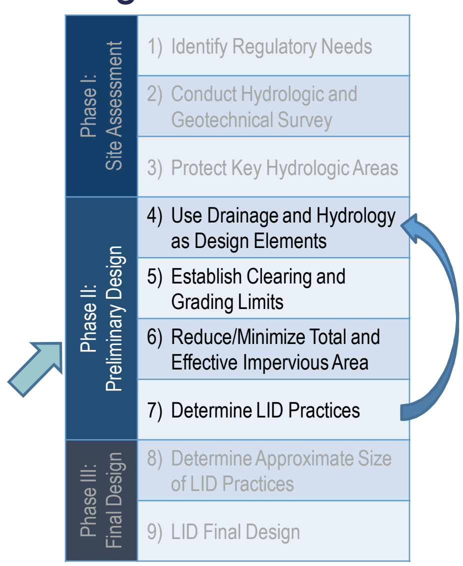
Step 3: Protect Key Hydrologic Features

- Protect areas of natural hydrologic function
- Protect possible areas for infiltration



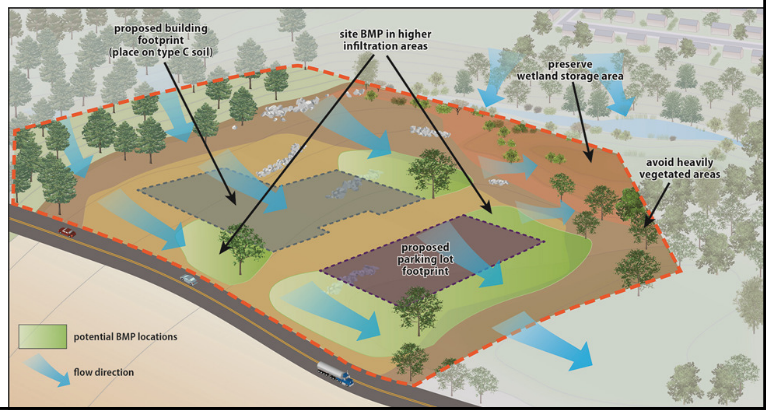
Phase II: Preliminary LID Design

- Step 4: Use Drainage and Hydrology as Design Elements
- Step 5: Establish Clearing and Grading Limits
- Step 6: Reduce/Minimize Total and Effective Impervious Area
- Step 7: Determine LID Practices



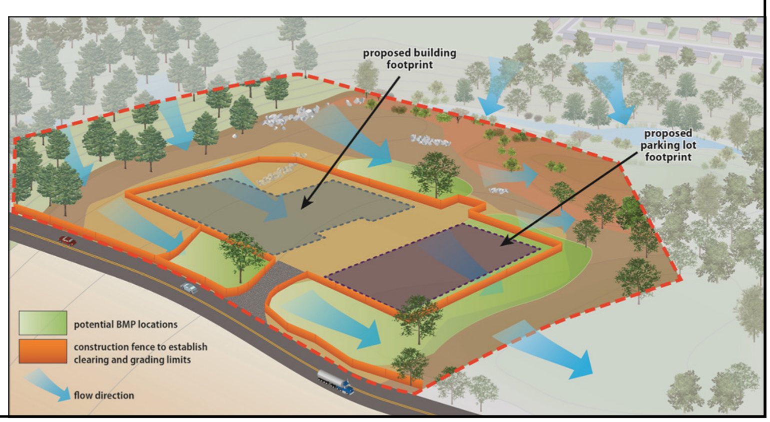
Step 4: Use Drainage and Hydrology as Design Elements

- Identify the spatial layout of the site using hydrologic flow paths and natural drainage as a feature
- Determine approximate locations for infiltration and conveyance BMPs



Step 5: Establish Clearing and Grading Limits

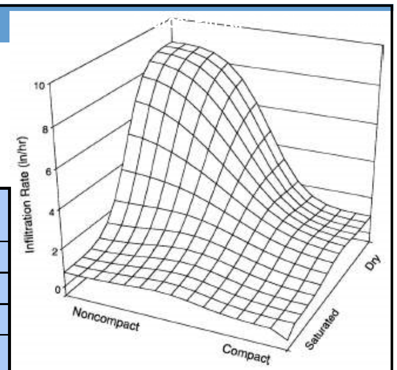
- Define the limits of clearing and grading
- Minimize disturbance to areas outside the limits of clearing and grading



Effects of Compaction on Infiltration Rates

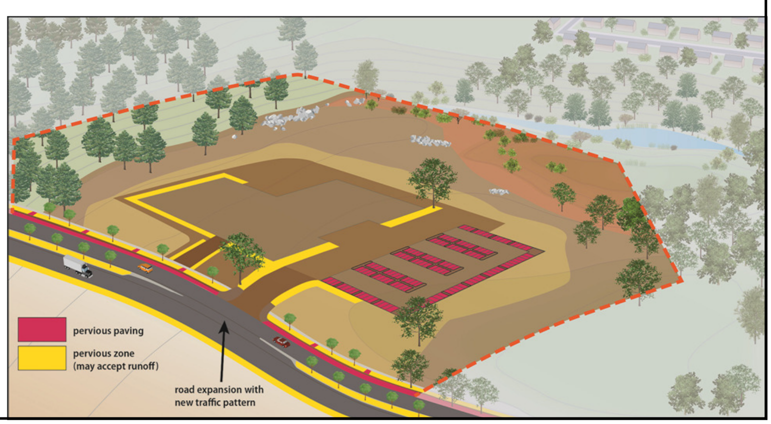
- Decreased infiltration
- Decreased root growth
- Increased runoff

Source: R. Pitt, S.E. Chen, S. Clark	Number of tests	Avg Infil (in/hr)	COV
Noncompacted sandy soils	**36**	**13**	**0.4**
Compacted sandy soils	**39**	**1.4**	**1.3**
Noncompacted and dry clayey soils	**18**	**9.8**	**1.5**
All other clayey soils (compacted and dry, plus all wetter conditions)	**60**	**0.2**	**2.4**



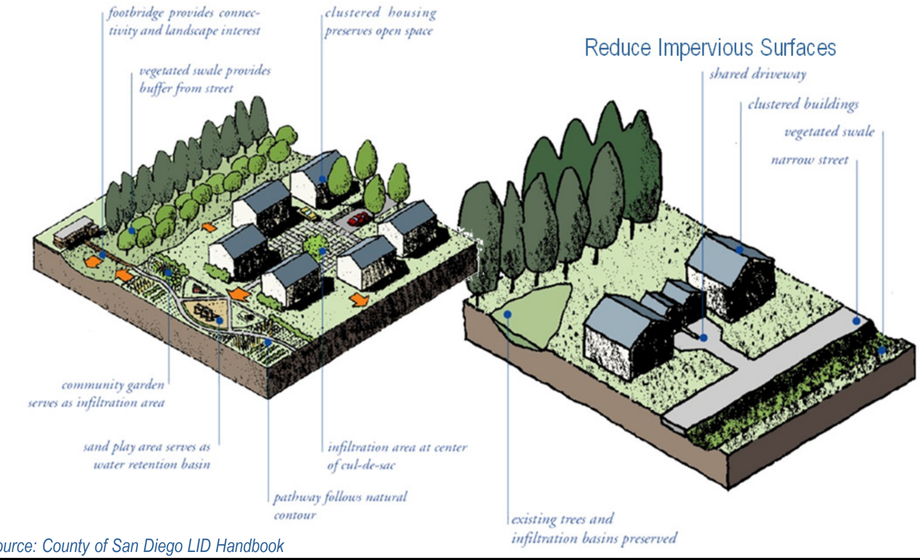
Step 6: Reduce/Minimize Total and Effective Impervious Area

- Investigate the potential for impervious area disconnection
- Evaluate the conceptual design to reduce impervious surfaces



Disconnect or Reduce Impervious Surfaces

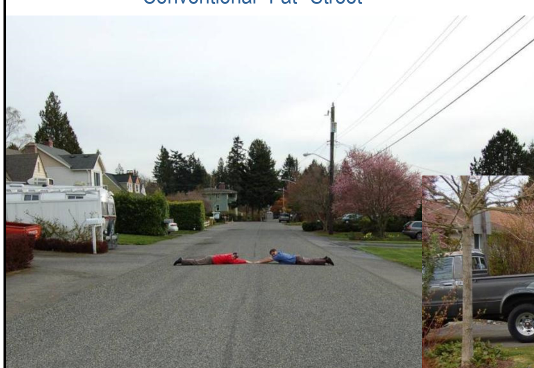
Impervious Area Disconnection



Source: County of San Diego LID Handbook

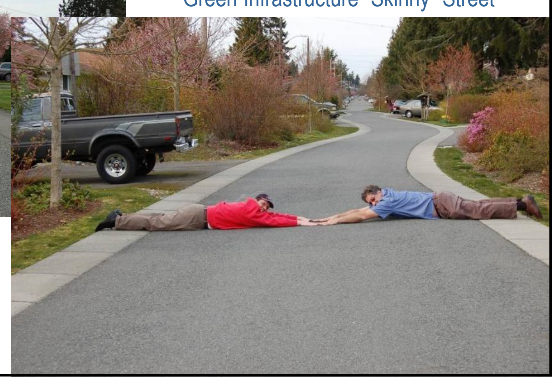
Disconnect or Reduce Impervious Surfaces

Conventional “Fat” Street



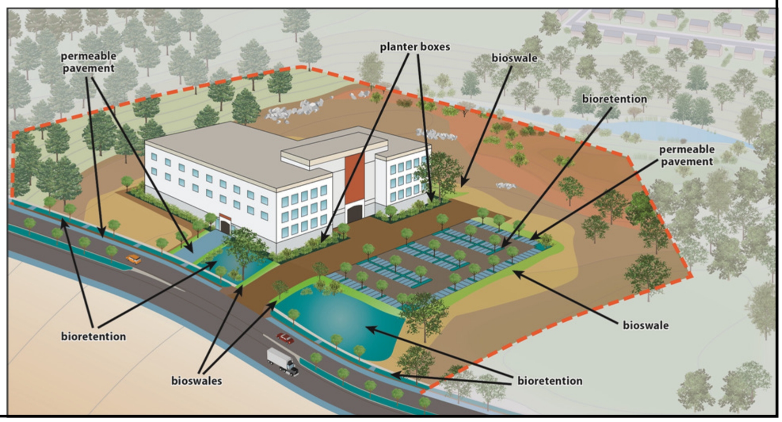
Source: NCSU-BAE

Green Infrastructure “Skinny” Street



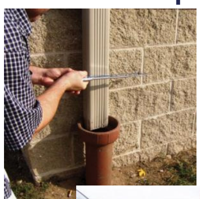
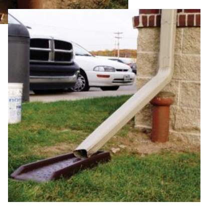
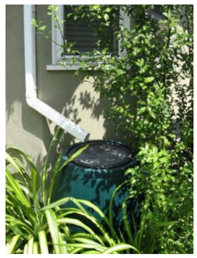
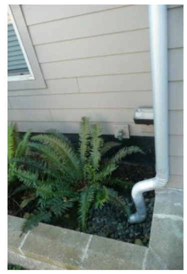
Step 7: Determine LID Practices

- Determine potential practices according to hydrologic and pollutant removal process needs and cost estimates



Roofs and Walls

Downspouts and Water Harvesting

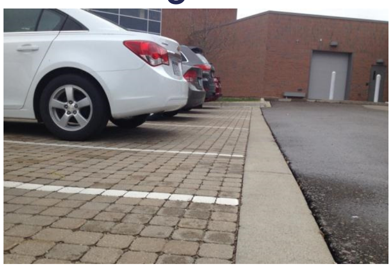
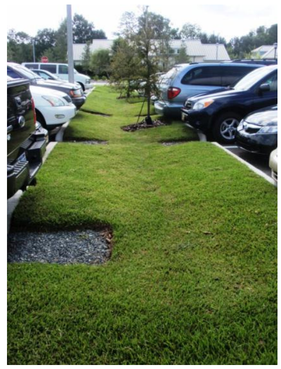





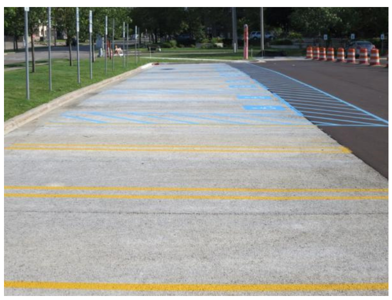


Bioretention




Parking Lots

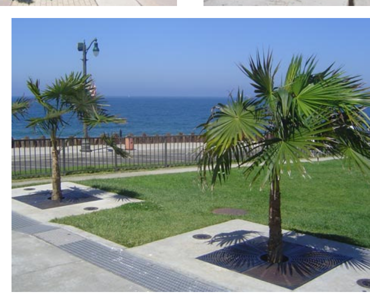



Trees







Roads, Alleys and Trails

Bioretention, linear

Bioretention, curb extension

Bioretention, dense urban areas

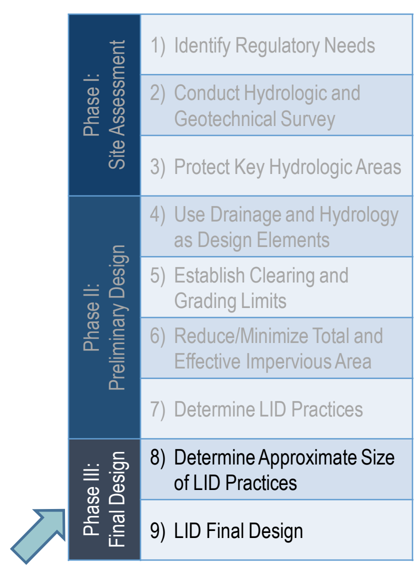
Results of Phase II – Preliminary Site Plan

- ✓Hydrologic flow paths and natural drainage features (Step 4)
- ✓Locations where infiltration and conveyance features could be located (Step 4)
- ✓Limits of clearing and grading (Step 5)
- ✓Results of an impervious area reduction analysis (e.g., parking area reduction, permeable pavement options) (Step 6)
- ✓Candidate BMPs and their approximate locations (Step 7)

This is an iterative process

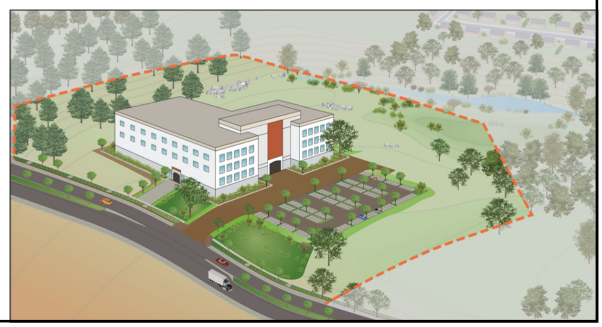
Phase III: Final Design

- Step 8: Determine Appropriate Size of LID Practices
- Step 9: Final Site Design



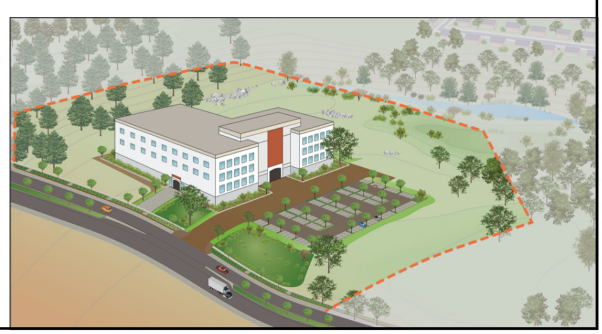
Step 8: Determine Appropriate Size of LID Practices

- Place practices at the appropriate locations
- Size practices to meet hydrologic design criteria



Step 9: Final Site Design

- Verify that geotechnical and drainage requirements have been met
- Complete designs such as finish details and notes
- Complete the site plans



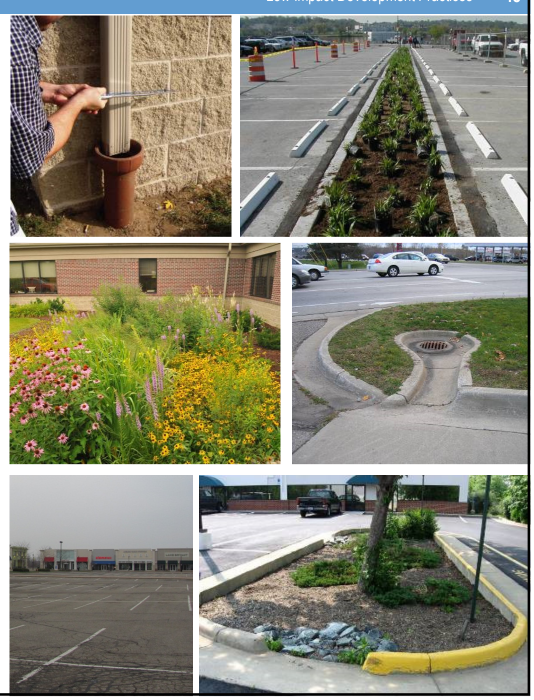
RETROFITS

How can we reduce impacts from existing development?

Look For

- Publicly owned land
- Willing property owners
- Roads (ROW)
- Open green spaces
- Existing BMPs that may be modified
- In-line storage opportunities
- Large parking lots
- Connected downspouts
- etc.

All the same practice types apply



QUESTIONS AND DISCUSSIONS

TETRA TECH

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