Low Impact Development

for

Linear Transportation Projects

Disclaimer

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Course Goal

Equip transportation planners, designers, specification writers, inspectors and technicians with…

- A basic knowledge of Low Impact Development (LID) techniques
- A practical understanding of how LID components can be designed
- A set of resources to apply to LID planning and design

Welcome!

- Personal Introductions
  - Name
  - Affiliation
  - Previous stormwater management experience
  - Familiarity with LID, including small-scale stormwater controls
  - Your expectations for the course

Participants

To benefit the most from this course, participants should already have…

- Basic knowledge of hydrology and hydraulics
- Basic knowledge of conventional techniques in stormwater management
- Basic knowledge of regulatory issues (NPDES, etc.)

LESSON 1

Course Introduction

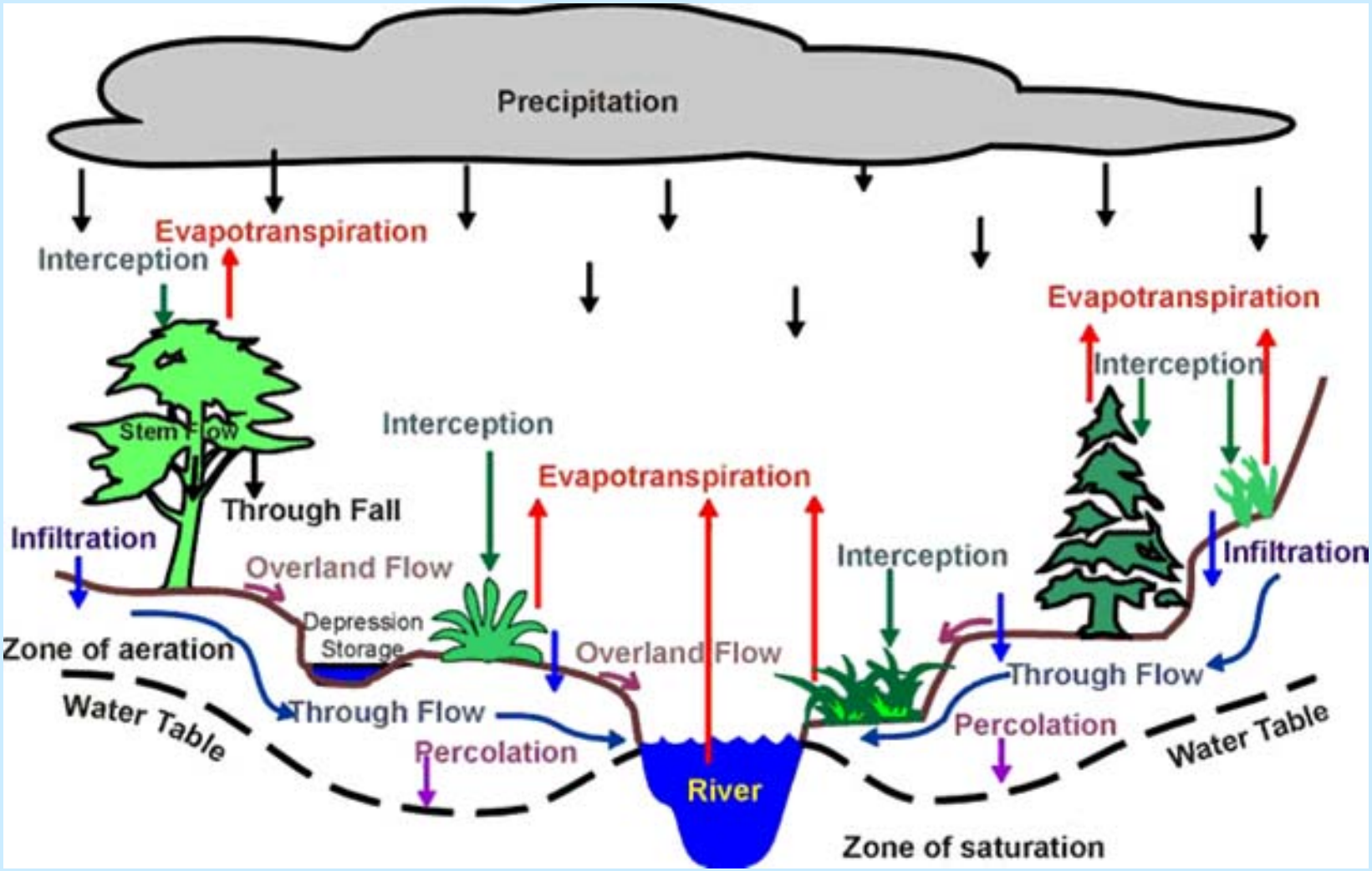
Objectives

- List advantages and disadvantages of LID
- Recognize LID design in terms of
  - Overall site versus individual components
  - Single event versus continuous event hydrologic analysis
  - Aesthetic versus technical aspects

Test Your Knowledge

PRE-TEST!

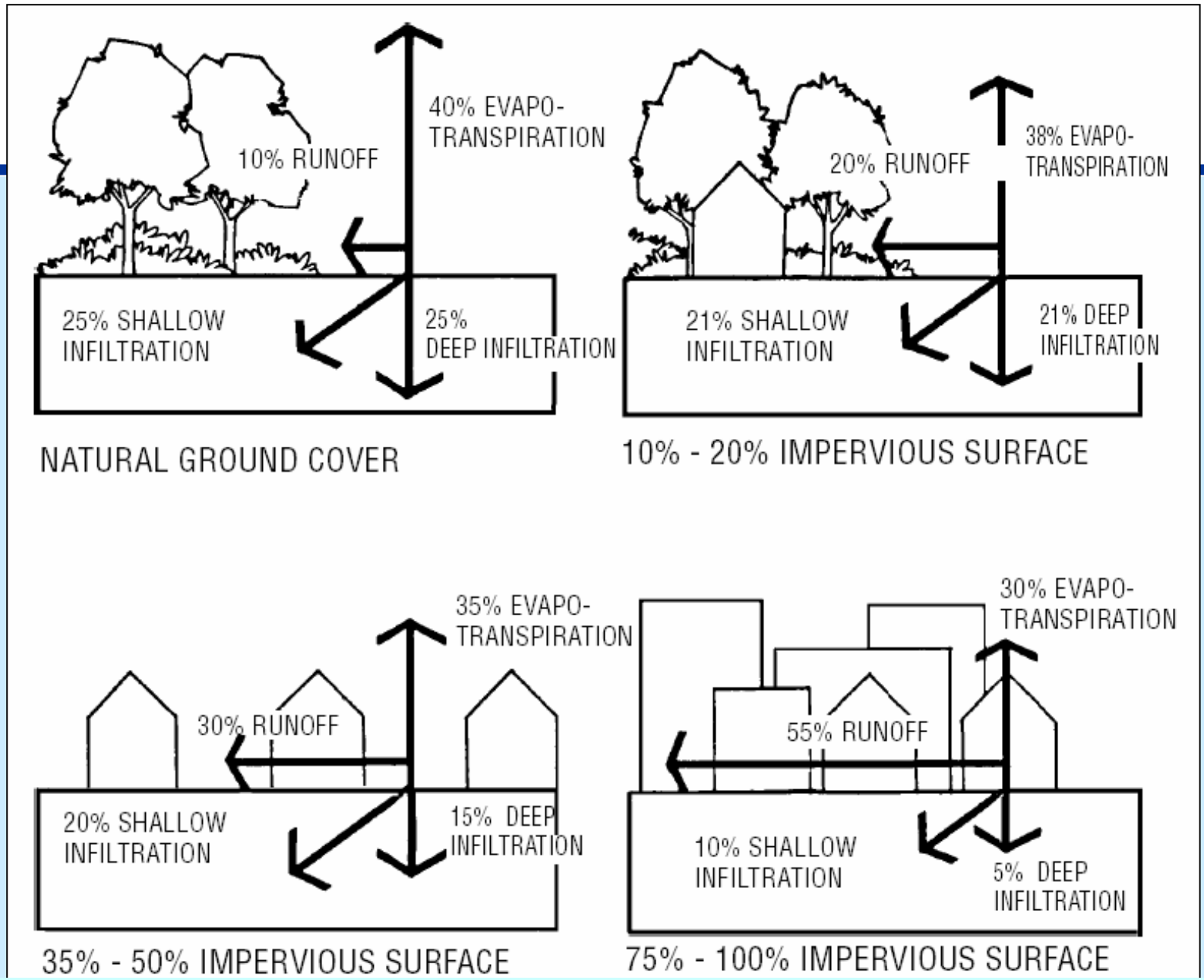
Baseline: Natural Hydrology



Source: http://www.r-can.com/sterilight/images/hydrologic-cycle.gif

Problem Statement (to start)

- Impervious surfaces shed more water more quickly than natural landscape
- Runoff carries a variety of pollutants into natural water bodies



Source: Tourbier, J. T., and R. Westmacott. Water Resources Protection Technology—A Handbook to Protect Water Resources in Urban Development. The Urban Land Institute. Washington, D.C. 1981.

Sources of Highway Pollutants

Particulates	Pavement wear, vehicles, atmosphere, maintenance
Nitrogen, Phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exhaust), tire wear (lead oxide filler material), lubricating oil and grease, bearing wear
Zinc	Tire wear (filler material), motor oil (stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guard rails, bridges, etc.), moving engine parts
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides and insecticides
Cadmium	Tire wear (filler material), insecticide application
Chromium	Metal plating, moving engine parts, break lining wear

Sources of Highway Pollutants (cont'd)

Nickel	Diesel fuel and gasoline (exhaust), lubricating oil, metal plating, bushing wear, brake lining wear, asphalt paving
Manganese	Engine parts wear
Cyanide	Anticake compound (used to keep deicing salt granular)
Sodium, Calcium, Chloride	Deicing salts
Sulphate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks or blow-by of motor lubricants, antifreeze and hydraulic fluids, asphalt surface leachate

Problem Statement (cont'd)

- Transportation projects can also cause
  - Thermal impacts
  - Higher frequency of runoff
  - Increased kinetic energy of runoff (What is impact downstream?)

Ecological Effects

- Sediment loads
  - Cause increased erosion
  - Smother stream habitats
- Chemical pollutant loads
  - Sicken or kill organisms
  - Accumulate in higher trophic levels in the food chain
  - Add nutrients causing algal blooms and subsequent oxygen deficit in water

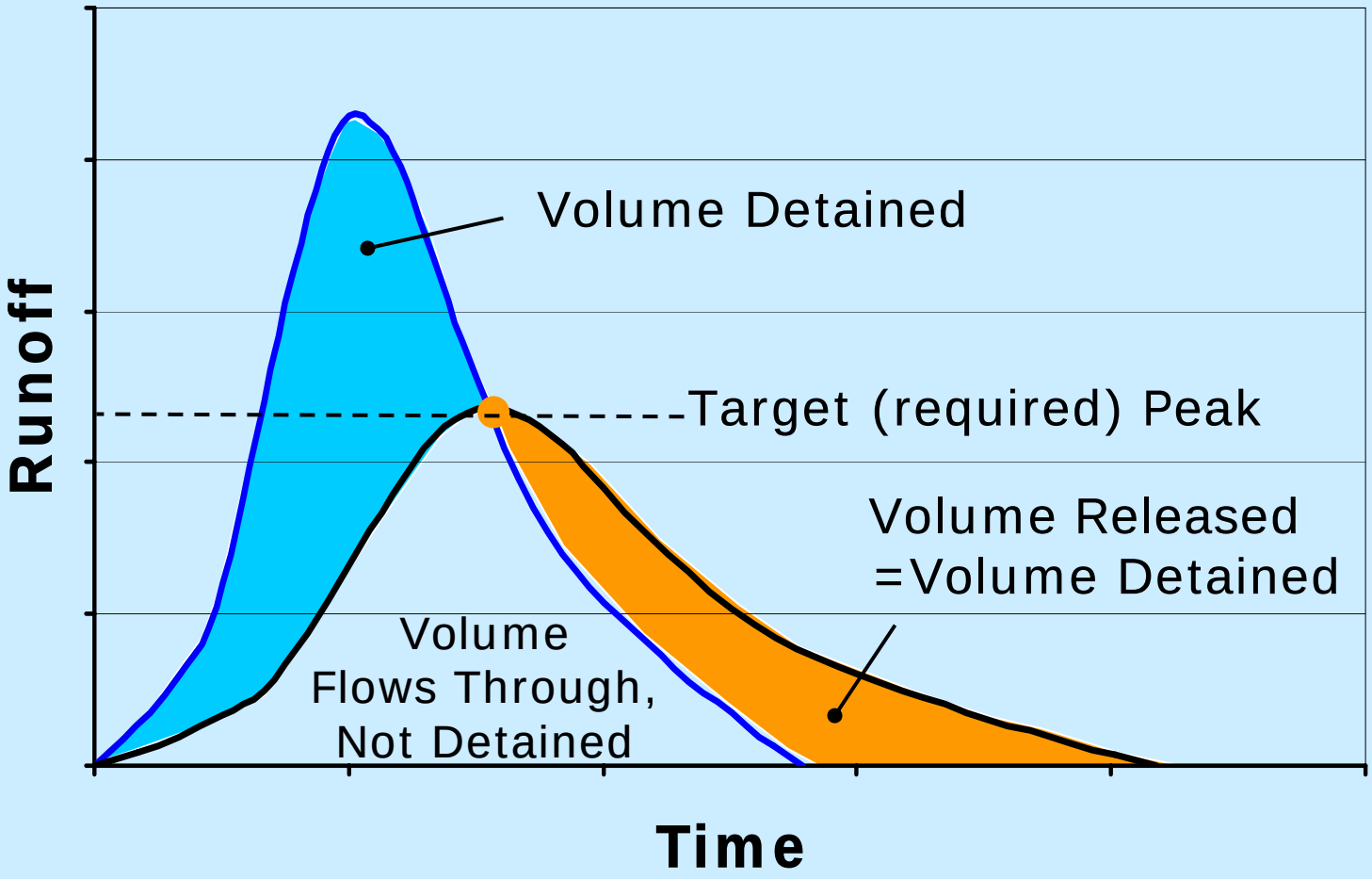
Scope of Conventional Design

- Conventional SWM objectives:
  - Drain water away from buildings and roadways quickly and efficiently
  - Keep water from creating flood problems off-site (downstream)
- Conventional SWM technique:
  - Convey runoff to collection pond
  - Use pond volume to *detain* runoff and release it slowly using constricted outlets

Conventional Peak Control

- Selected return periods
  - 1- to 2-year for erosion control
  - 10- to 15-year
- Reduce peak rates of runoff from those events to predevelopment levels

Detention Design



Areas for Improvement

- Water quality: Chemical, thermal
- Runoff volume reduction
- Runoff frequency reduction
- Runoff kinetic energy reduction
- Aesthetics
- Safety
- Groundwater recharge
- Maintenance requirements
- You name it ...(open for discussion)

Why LID?

- LID is a SWM design approach that seeks to provide *on-site* management using a variety of *distributed* landscape features and engineered devices that
  - capture rainwater,
  - slow down runoff,
  - enhance infiltration, and
  - filter out runoff pollutants
- "Source control": Managing runoff *as* it is being generated and *before* it flows together in large quantities.

The LID Ideal
(Hydrology)

- Provide natural levels of
  - Surface storage
  - Infiltration
  - Filtration
  - Runoff velocity
  - Interception
  - Evapotranspiration
  - Thermal control

LID Ideal
(beyond hydrology)

- Utilize water on-site to avoid tap water consumption
- Meet space limitations
- Avoid habitat disturbance
- Satisfy regulatory objectives

LID at Two *Site* Scales

- "Macro" site characteristics, e.g.
  - Lower slope, higher roughness
  - Lower imperviousness, more storage
  - Higher vegetation density
- "Micro" site characteristics, e.g.
  - Bioretention cells ("rain gardens")
  - Vegetated swales
  - Permeable pavement installations

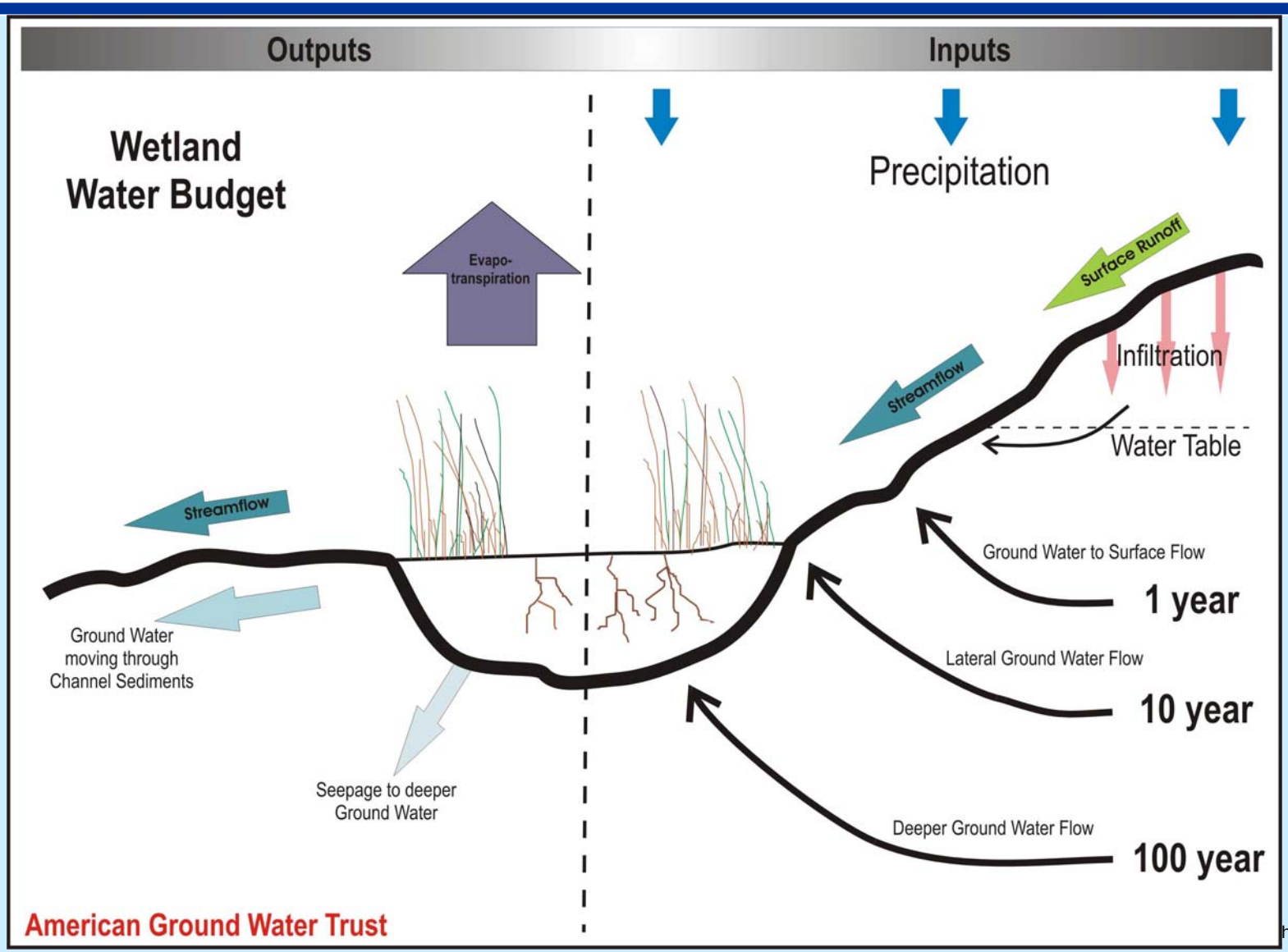
LID Incentives

- Ecologic (as already described)
- Economic: Reduce stormwater conveyance and management costs
- Safety and aesthetic (compared, for example, to detention ponds)
- Regulatory: Infiltration and WQ requirements
- Discuss: Any other incentives?

LID Disincentives

- Effort to learn new approaches
- Broader scope of design
  - Technical goals more than peak control
  - Across site, not just at outlet
- Higher level of design detail
- Some risk associated with new technologies
- Discuss: Any other disincentives?

Infiltration Supports Ecosystems



Thinking Ecologically

- LID motivated by opportunity to reduce *ecological* impacts, i.e., impacts on living organisms, but--
- LID stormwater design largely based on
  - *Physical* endpoints (runoff rates and volumes)
  - *Constituent* endpoints (pollutant loads)

LID Hydrology Can Be Analyzed at Different *Time* Scales

- Single rainfall event
  - Initial conditions assumed
  - No between-storm conditions modeled
  - ET not significant over storm duration
- Average Annual Storage
  - Volume captured for all storm events
  - Ponding and subsurface storage considered
- Continuous
  - Between-storm conditions modeled
  - ET and infiltration rates included

Two LID Project *Types*

- Architecture/Aesthetic/Qualitative
  - Place attractive LID components where space is available
  - Engineer to ensure ongoing function and appearance
- Engineering/Technical/Quantitative
  - Design LID components to meet specific runoff management targets (e.g. peak flow, volume, water quality)
  - Incorporate aesthetic elements that enhance value, function

Course Objectives

At the conclusion of this course, you will be able to

- List key SWM objectives
- Identify pertinent regulations
- Distinguish LID from conventional approaches
- Select effective SWM techniques for given runoff problems
- Perform typical LID design calculations
- Follow up with a variety of resources for further professional development

Course Format

- Lecture
- Your active participation!
- Demonstration and hands-on exercises
- Post-test

Course Materials

- Workbook

Ground Rules

- Punctuality
- Partnering
- Discussion encouraged
- Other literature
- Cell phones off

Questions? Answers!

Q&A