

MASTER GARDENER WATER QUALITY TRAINING MODULE #4

LOW IMPACT DESIGN IN A RESIDENTIAL SETTING

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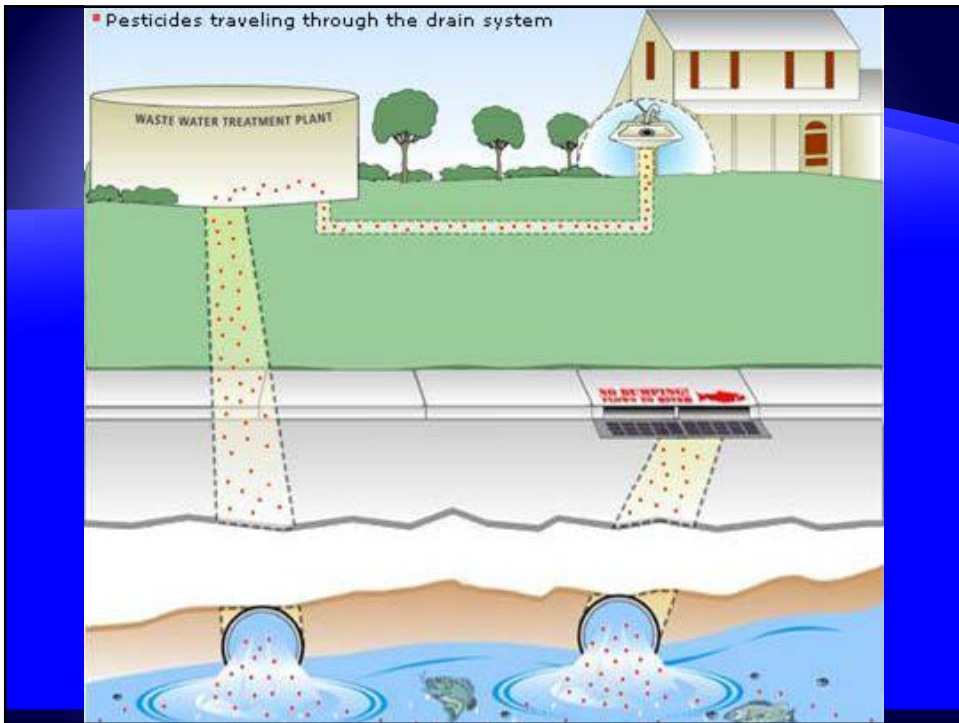
Natural Landscapes and Water

- ◆ Rainwater
 - ◆ Less than 15% leaves as surface runoff.
 - ◆ Approx. 50% is evaporated or is transpired through plants.
 - ◆ 35% is detained or infiltrates into groundwater.
- ◆ Healthy Soils
 - ◆ Organic material retains water allowing micro and macro organisms to degrade pollutants.



Impacts of Conventional Landscaping on Water Quality

- ◆ Increase in impervious surfaces.
 - Streets, sidewalks, rooftops, patios, driveways, and walkways.
 - Surface water runoff increases to 50-70%.
 - Majority of rainfall runs off site.
- ◆ Disturbed and Paved Soils
 - Limited ability to filter pollutants due to lack of sufficient organic matter.
- ◆ Increased use of fertilizers and pesticides
 - Chemicals mobilized by rain and irrigation.





Landscaping to Reduce Water Runoff and Protect Water Quality

- ◆ Increase infiltration or storage of surface runoff to mitigate pollutant movement.
- ◆ Conserve water to reduce pollutant movement.
- ◆ Prevent pest problems to reduce pesticide applications.

Increase Infiltration & Storage of Surface Runoff

- Landscape Elements Decreasing Infiltration
 - Hardscape
 - Rooftops
 - Driveways
 - Sidewalks
 - Parking lots
 - Slopes/Mounding
 - Soil Compaction
 - Drainage

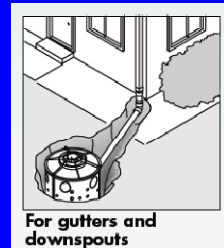
Solutions for Rooftop Runoff

- Rain collection devices
 - Cisterns – aboveground collection devices
 - Rain barrels – residential use
 - Allows for collection and use of rainwater for irrigation.



Solutions for Rooftop Runoff

- Diversion to mulched or planted areas
 - Proper placement of downspouts.
 - Integration of downspouts with gravel or plastic manufactured dry wells.
 - Example: FLO-WELL Storm Water Leaching System



Solutions for Driveway Runoff

- Utilize brick, pavers, pervious concrete, or other materials that allow for more infiltration than concrete.



Solution for Driveway Runoff

- ◆ Slope driveway runoff towards vegetated areas.
- ◆ Install driveway interceptor or slot drains.



Source: LandscapeNetwork.com

Solutions for Runoff from Sidewalks

- ◆ Avoid impervious walkways connected to driveways and sidewalks.
- ◆ Utilize decomposed granite with a binder or permeable concrete.
- ◆ Slope surfaces towards a buffer zone to increase infiltration and microbial breakdown of pesticides.



Flagstone pathway
set in decomposed
granite with binder

Estimated C-Factors* for Hardscape Surfaces

Paving Surface	C-Factor
Concrete	0.80
Asphalt	0.70
Pervious Concrete	0.60
Cobbles	0.60
Pervious Asphalt	0.55
Natural Stone w/o grout	0.25
Turf Block	0.15
Brick w/o grout	0.13
Unit Pavers on Sand	0.10
Crushed Aggregate	0.10
Grass	0.10
Gravel over Porous Plastic	0.05

* Coefficient of runoff calculated for small storm events only.
Source: California Stormwater Quality Association BMP Handbook

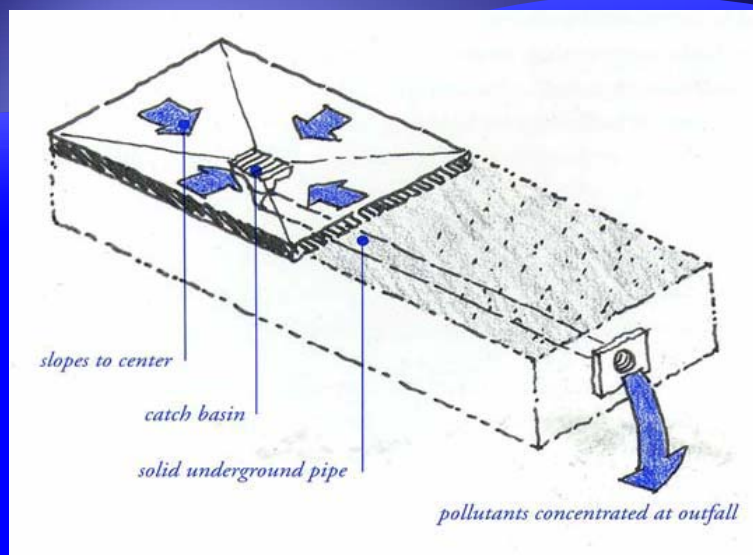
What is a buffer zone?

- ◆ Definition
 - ◆ An artificially created or sustained existing area adjacent to a critical water-related ecosystem (lake, stream, river, or wetland).

Benefits of a Buffer Zone

- ◆ Slows surface runoff
 - ◆ Promote infiltration
- ◆ Traps Sediment
 - ◆ Removes associated chemicals (phosphorus, pesticides, pathogens, and heavy metals)
- ◆ Beneficial environment for chemical breakdown
- ◆ Stabilization
- ◆ Eliminates directly connected impervious areas

Example of Directly Connected Impervious Surfaces



Source: Figure 2-6 in the California Stormwater Quality New Development and Redevelopment Handbook

Types of Buffer Zones

- ◆ Riparian buffers
- ◆ Filter strips
- ◆ Grassed waterways
- ◆ Contour grass strips
- ◆ Shallow detention basins



Riparian Buffer



Grassed Waterways



Filter Strips or Grass Swale



How Does a Buffer Zone Improve Water Quality?

- ◆ Intercepts and captures sheet flow from impervious surfaces
- ◆ Treatment of irrigation and storm water
 - ◆ Microbial soil processes (i.e. pesticide breakdown)
 - ◆ Infiltration
 - ◆ Evapotranspiration
 - ◆ Plants (i.e. uptake of nutrients, heavy metals, etc...)

Factors Affecting Buffer Zone Effectiveness

- ◆ Length
- ◆ Depth to groundwater
- ◆ Infiltration Rate
- ◆ Type of Vegetation
- ◆ Soil Type
- ◆ Residence Time
- ◆ Slope



Solutions for Slope Runoff

- ◆ If possible, eliminate mounding of soil that creates downward slopes toward impervious surfaces.



Solutions for Slope Runoff

- ◆ At base of slope utilize infiltration trenches or swales.
- ◆ Select appropriate plant materials for slopes.
- ◆ Pesticide and fertilizer applications, especially granular types, may have a higher likelihood of off-site movement under poor irrigation.

Impact of Soil Compaction on Runoff

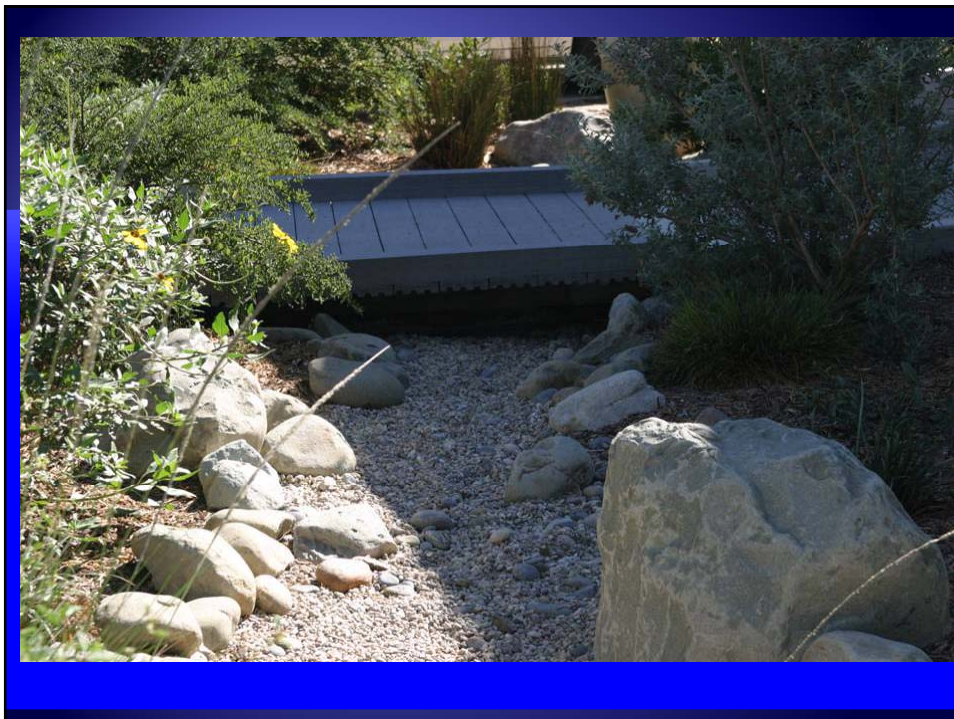


- ◆ If possible, limit the use of heavy equipment and constant foot traffic.
- ◆ Do not work soil when it is too wet or dry.
- ◆ Tillage should be limited to the incorporation of organic matter.
- ◆ Aerate turfgrass on a regular basis.

Drainage Solutions to Reduce Water Runoff

- ◆ Utilize perforated pipe
 - ◆ Mesh sock around pipe to prevent sedimentation inside pipe.
- ◆ Direct runoff from impervious surfaces into vegetative areas of the landscape
 - ◆ Be aware of landscape drain locations
- ◆ Incorporate drainage as a design element
 - ◆ Vegetated swale and buffers
 - ◆ Drywell
 - ◆ Detention pond

Perforated pipe covered with filter sock.



Design to Conserve Water

- ◆ Link between water quality and water conservation.
- ◆ Excess irrigation and poorly designed systems can carry pollutants into storm drains.
- ◆ Limited infiltration = higher runoff volumes and less water storage by the soil.



Water Conservation Practices Benefiting Water Quality

- ◆ Use of compost and mulch
 - ◆ Increases infiltration and permeability of soil.
 - ◆ Reduces herbicide applications.
 - ◆ Provides beneficial environment for soil microbes to degrade pollutants.



Water Conservation Practices Benefiting Water Quality

- ◆ Minimize the size of non-recreation lawn areas.
- ◆ Utilize warm season turfgrass species.
 - ◆ Zoysia
 - ◆ Seashore Paspalum
 - ◆ St. Augustinegrass
- ◆ Utilize alternative grass species in non-recreation areas.



Zoysiagrass



Seashore Paspalum

Water Conservation Practices Benefiting Water Quality

- ◆ Utilize plants native or adapted to your region as the backbone of the landscape
- ◆ Hydrozone
 - Group plants according to watering needs.



Water Efficient Plant Terminology

- ◆ Drought tolerance
 - A plant with the ability to survive in a dry environment
- ◆ Xerophyte
 - Plants that exist in dry environments
 - Do not necessarily "like" dry conditions

Drought Tolerance Mechanisms

- ◆ Avoidance
 - ◆ Drought Escape
 - ◆ Water Conserving***
 - ◆ Effective Water Uptake
- ◆ Tolerance
 - ◆ Turgor Maintenance
 - ◆ Antioxidants- protective tissues
- ◆ Efficiency
 - ◆ Maintenance of growth under dry conditions



Common Characteristics of Water Efficient Plants



- ◆ Overall structure
 - ◆ Deep root system
 - ◆ Internal water storage
 - ◆ Strong internal cell structure for support

Common Characteristics of Water Efficient Plants cont.

- ♦ Leaf Adaptations
 - ♦ Smaller
 - ♦ Thicker - often waxy
 - ♦ Gray, light-green, or blue-green in color to reflect light
 - ♦ Hairy
 - ♦ Uneven surfaces to protect pores



Water Conservation Practices Benefiting Water Quality

- ♦ Use the latest technology to assist with irrigation scheduling and application.

- ♦ ET Controllers



- ♦ Soil Moisture Sensors



Design to Prevent Pest Problems

- A key concept in Integrated Pest Management.
- Design considerations result in healthier plants less prone to diseases and insect attacks.
 - Fewer broad spectrum pesticide applications = reduced chance of pesticides in runoff
 - Utilize least toxic pesticides or pesticides in bait stations.

Design Considerations to Prevent Pest Problems

- Avoid overplanting.
 - Provide adequate spacing between plants to improve air circulation.
 - Competition for light and water compromises plant growth.
- Eliminate or minimize the use of plant species known to be susceptible to pests.
 - Most effectively done for plant diseases such as powdery mildew and anthracnose.

Design Considerations to Prevent Pest Problems

- Select resistant varieties of plants
 - Example - Susceptibility of Chinese Elm to Anthracnose
 - Cultivars - Evergreen and True Green (susceptible)
 - Drake (resistant or less susceptible)



Design Considerations to Prevent Pest Problems

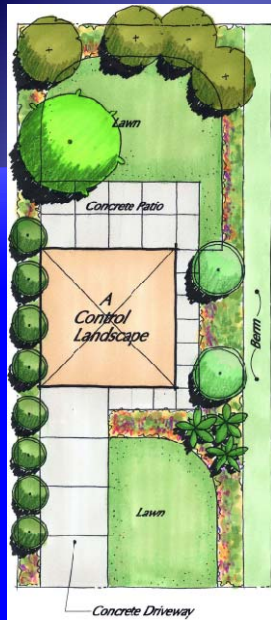
- Avoid planting species associated with common pests in critical landscape areas where pesticide treatment can not be avoided.
 - Example: *Jacaranda mimosifolia* planted as a street tree or in a parking lot.
 - Aphid infestations are common.
 - Honeydew production falling on vehicles results in need for treatment.

Conclusions

- Maximize techniques that direct surface runoff into vegetative swales, grassed waterways, infiltration devices, or detention ponds.
- Properly maintain pollution prevention devices to maximize their pollutant removal efficiency.
- Familiarize yourself with the drainage patterns and location of landscape drains at a site in order to eliminate controllable pollutant discharges.
- Be aware of possible impacts of infiltration on groundwater.

Residential-Scale Water Runoff Demonstration Project

- Investigate movement of pesticides commonly utilized in residential landscapes
- Identify potential source controls
 - Alternative least toxic pesticides and application methods
 - Water detention/retention BMPs
 - Infiltration BMPs
- Training facility
 - Landscape Professionals
 - Residential Homebuilders
 - UCCE Master Gardeners



Standard Landscape Design

- ◆ High % of impervious surfaces.
- ◆ Solid pipe drainage to street.
- ◆ Large tall fescue lawn area.
- ◆ Poor irrigation design.
- ◆ Tropical and subtropical plant material.





Retrofit Landscape Design

- ◆ Increased use of pervious surfaces.
- ◆ Plant material adapted to S. California.
- ◆ Perforated drainage pipe.
- ◆ Warm season turfgrass species.
- ◆ Plants grouped into hydrozones.
- ◆ Improved irrigation system.





Watermark Electronic Module or Multiple Hydrozone System (www.irrometer.com)

- **Watermark Electronic Module**
 - Wired to controller
 - Set dial to wetter or drier based on observing landscape.
- **Watermark Multiple Hydrozone System**
 - Allows soil moisture to be monitored in up to 8 different hydrozones.





Low Impact Landscape Design

- ◆ Previous surfaces utilized on driveway, patio, and walkways.
- ◆ Mostly California natives.
- ◆ Lawn replaced by meadow grasses.
- ◆ Dry wells for roof runoff.
- ◆ Drip and low volume spray irrigation.





