Low Impact Development & Leadership in Energy and Environmental Design

Guam Stormwater Workshop
July 28, 2011

Session Objectives

LID
- Overview goals and processes
- Examples of BMPs and Integrated Management Practices (IMPs)
- Cost comparisons

LEED
- Overview of LEED program
- Sustainable Sites and Water Conservation credits

What is Low Impact Development (LID)?

- LID is development designed to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology
  - Hydrology measured in terms of groundwater recharge rates, surface flow patterns, and surface water temperature
- Integrated into the design of the development to retain a natural hydrologic cycle over the long-term intended use

Make these

function like **This**

Source accredited to Robert Goo of EPA, 6/23/09 EPA webcast.

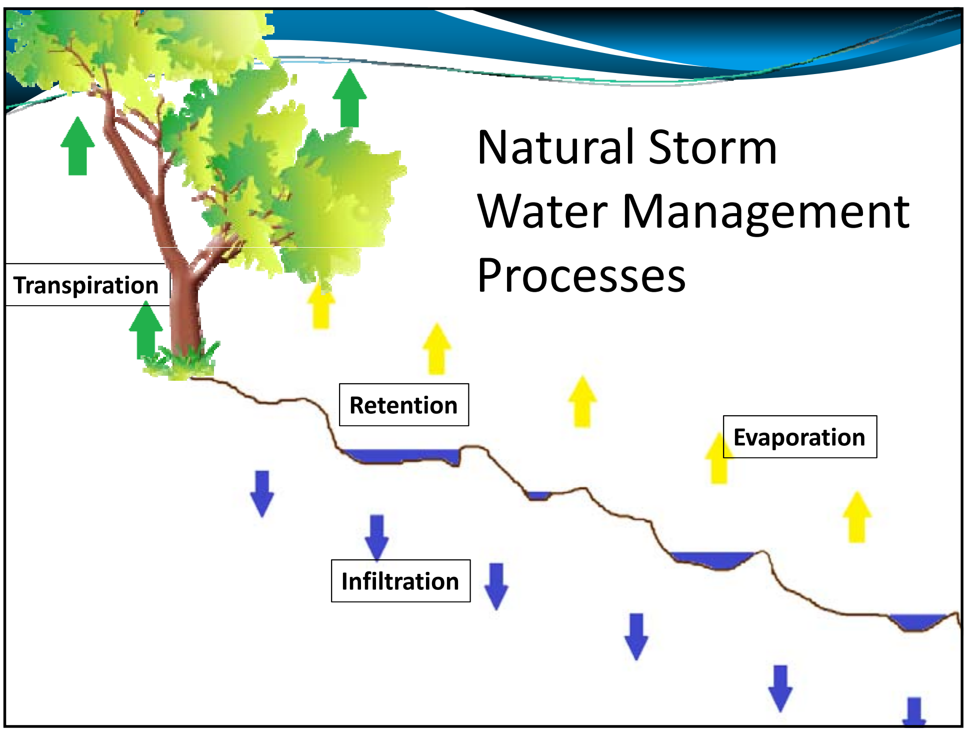
General LID Goals

Specific goals include maintaining the pre-development:

- Groundwater Recharge Rates
- Runoff Rate
- Volume of Runoff
- Duration of Runoff
- Runoff Temperature

Can be achieved through preservation and mimicry of natural systems.

Natural Storm Water Management Processes



LID in Northern Guam

- Preserving groundwater recharge rates to the Northern Guam Lens Aquifer
- Ensuring water quality of storm water discharges to sink holes

Hilton Hotel Sinkhole

LID is Component of Flood Control

- Minor Precipitation
  - Majority of storm water evaporates
- Normal Rainfall
  - LID management devices infiltrate, retain, transpire or evaporate majority of rainfall
- Major Storm Event
  - LID management devices handle some of initial storm water runoff
  - Flood management strategies required for remaining storm water (e.g., limit development in flood plain)

Elements of Low Impact Development

- Minimize the development footprint and impervious cover
- Retain storm water onsite through infiltration, storm water retention, evapotranspiration, and rain water harvesting
- Reduce peak volume and velocity of storm water runoff from developed sites
- Maintain lower water temperatures by reducing impervious cover and preserving or planting trees that provide shade

LID: IMPs and BMPs

Key principle in LID is Integrated Management Practices (IMPs)

BMPs → Storm water treated as waste product

- Typically larger central facilities (detention ponds)

IMPs → Stormwater treated as resource

- Numerous IMPs integrated into site design

Central Storage BMP

Decentralized IMP

LID - Design and Development Process

There are four general stages to integrate LID into a site

1 • Minimize Disturbance of Natural Hydrology

2 • Hydrologically Considerate Site Design

3 • Materials Selection

4 • Integrated Management Practices

First Stage of Integration:

<u>Minimizing Disturbance of Natural Hydrology</u>

1. Retain natural flow paths
   - Site design should include considerations for existing site flow paths and retain them to the maximum extent possible

   → Reduces impact of site development on downstream hydrology
2. Minimize clearing and grading
   - Retain as much existing tree cover as possible
   - Avoid removing vegetation wherever possible
   - Avoid disturbing or compacting of soils

   → Retains natural processes in larger percentage of site

Second Stage of Integration: Hydrologic Site Design

1. Minimize Impervious Areas
   - Maximize use of vertical structures to reduce impervious footprint (e.g., multi-story buildings or parking structures)
   - Avoid oversized parking structures
   - Narrower streets and pathways
   - Avoiding curb, gutter, and paved swales

   → Increases area available for infiltration and transpiration

Second Stage of Integration: Hydrologic Site Design (contd.)

2. Disconnect Impervious Areas
   - Install IMPs which do not allow storm water to flow freely from one impervious area to the next
   - Building downspouts do not empty onto impervious surface

   → Increases time of concentration of runoff and distributes integrated management devices throughout the site

Second Stage of Integration: Hydrologic Site Design (contd.)

3. Avoid direct flow paths
   - Align roads, driveways, and paths so that storm water is not provided a direct flow path off site

     → Reduces time of concentration and ensures that all storm water which falls on the site is routed through integrated management devices

Second Stage of Integration: Hydrologic Site Design (contd.)

4. Place structures on less permeable areas
   - Identify areas of the site with less permeable soils and place structures on these areas

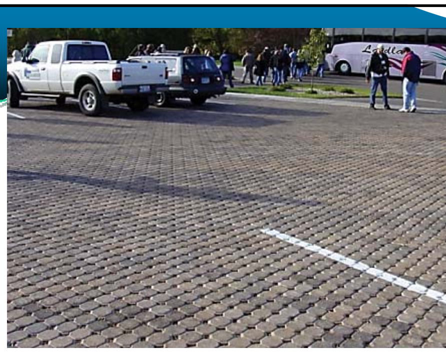
     → Reduces impact of site development on infiltration rates

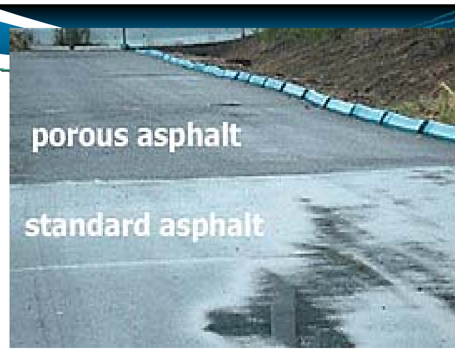
Third Stage of Integration:

Materials Selection

1. Permeable Pavement
    - Pervious Concrete
    - Porous Asphalt
    - Open-Jointed Blocks
    - Resin-Bound Paving
    - Single-Sized Aggregate

    → Converts traditionally impervious areas into sources for infiltration





Fourth Stage of Integration:
Integrated Management Practices

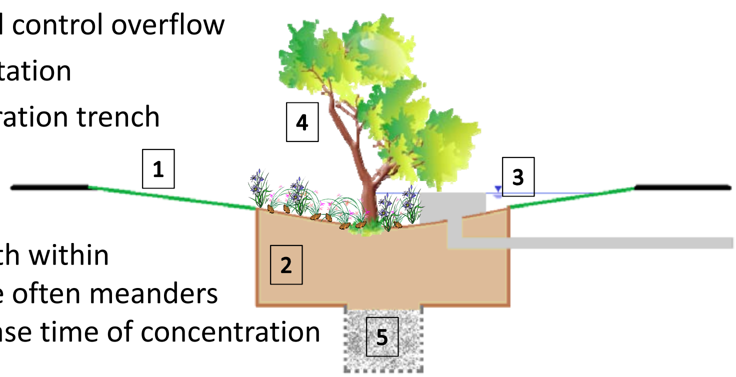
Integrated Management Practices (IMP's) are solutions to enhance site infiltration, evaporation, transpiration and retention

Examples Include:

- Bioswales
- Infiltration Basins/Trenches
- Dry Wells
- Soil Amendments to Increase Infiltration

IMP: Bioswales

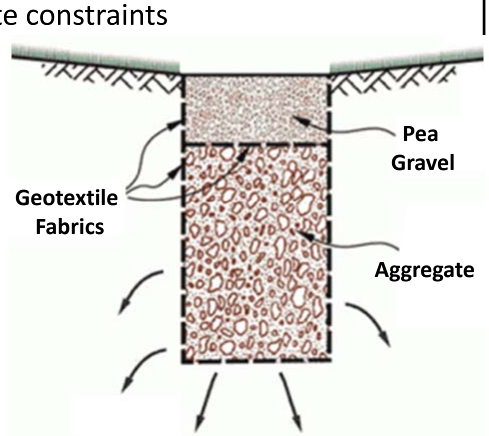
- Many variations, typically contain these elements:
  1. Sloped grass/vegetated buffer strips
  2. Sand/aggregate bed
  3. Flood control overflow
  4. Vegetation
  5. Infiltration trench



- Flow-path within bioswale often meanders to increase time of concentration

IMP: Infiltration Basin/Trenches

- Similar to bioswales, except without the vegetation
- Also can include flood control overflow structure
- Can be made any shape to fit site constraints
- Can be used as a creek bed for on-site storm water conveyance between other IMPs






IMP: Dry Wells

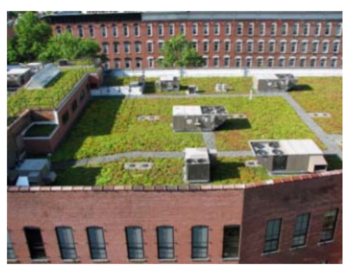
- Similar to infiltration basin
- Ideal for smaller sites.
- Can be integrated into infiltration trenches and bioswales


IMP: Soil Amendments

- Soil amendments for disturbed areas
- Increases infiltration rates
- For example, compost, mulch, lime, gypsum

Other IMPs

- Green Roofs



- Storm Water Inlet Pollution Control Devices

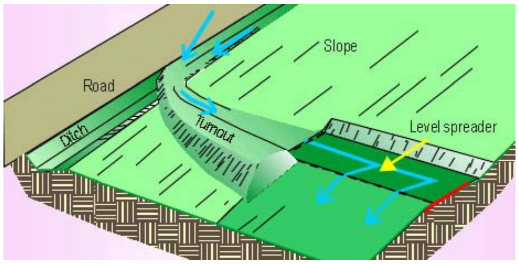
Other IMPs

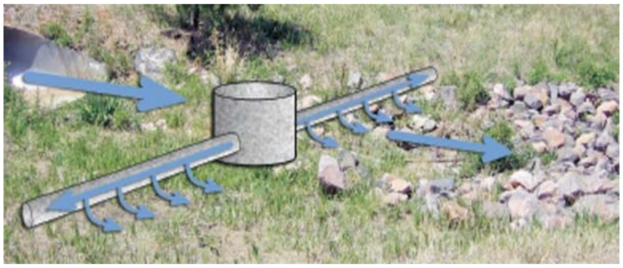
- Rainwater Harvesting

- Tree Box Filters

Other IMPs

- Storm Water Level Spreaders





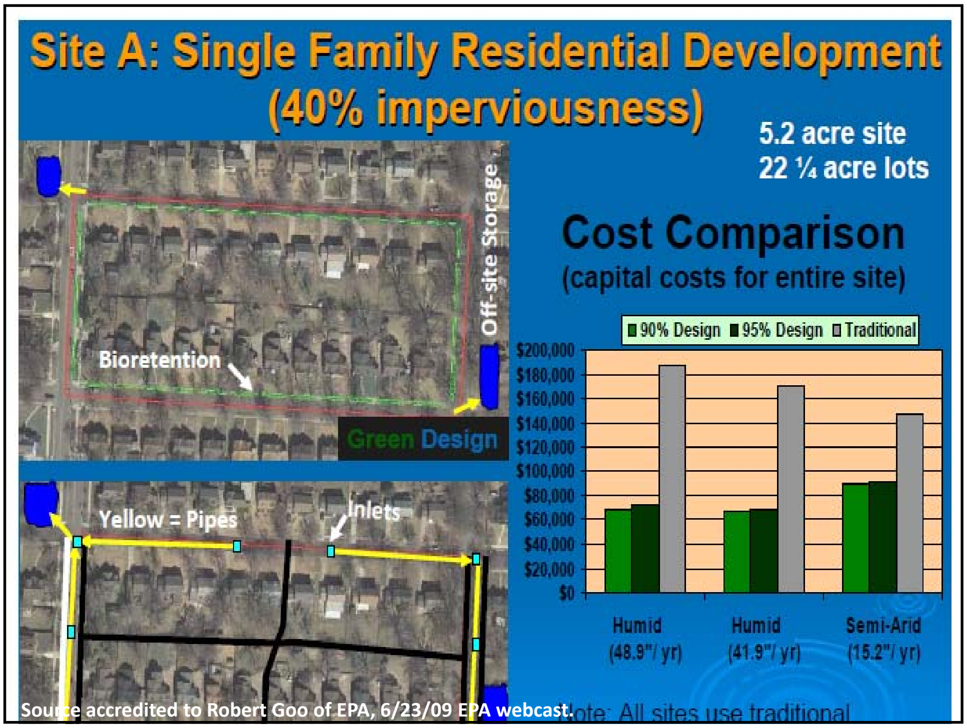
Soluble Pollutants and IMPs

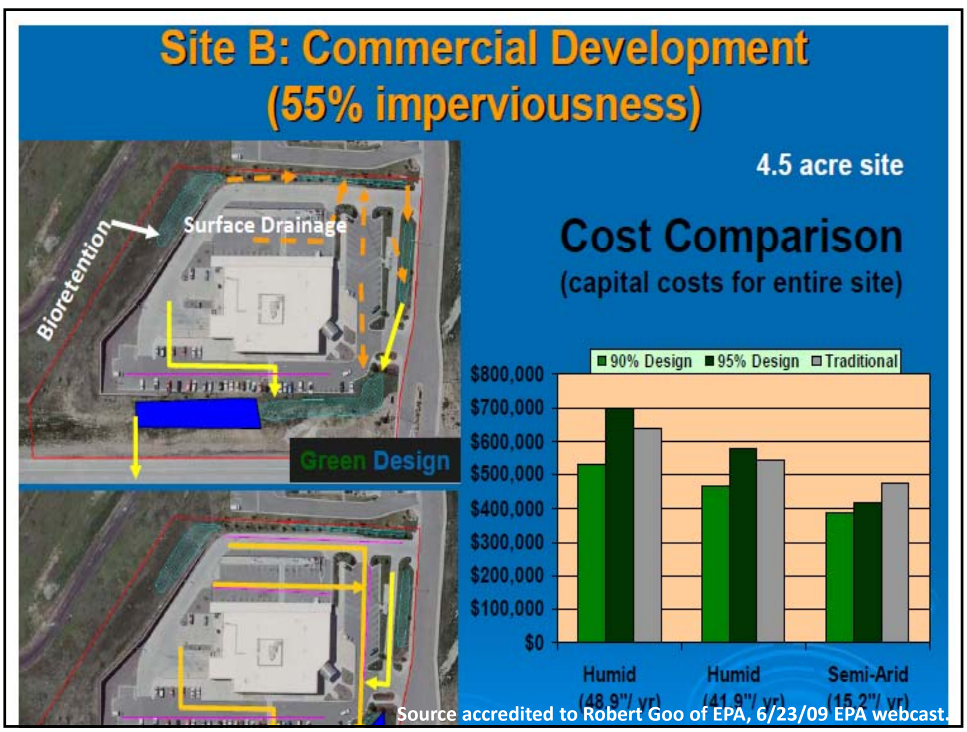
- Runoff from certain areas may contain soluble pollutants, so IMPs must be selected to protect groundwater
  - fueling areas,
  - industrial sites,
  - boat yards,
  - maintenance areas, etc.
- Certain LID practices, such as dry wells, may not be appropriate in these circumstances
- The best design standard for these facilities would be to minimize contact with storm water in the design phase
- Small-scale traditional treatment may be necessary (oil/water separator or vortex separators)

LID Cost Savings

Maximum savings are achieved through increasing focus on minimizing disturbances and proper hydrologic site design

- Minimizing disturbances results in savings in site work and landscaping
- Proper site design can lead to smaller footprints and materials costs
- Selecting appropriate materials and implementing IMPs results in reduced need for structural flood controls
- High infiltration rates in northern Guam make LID implementation even easier and cheaper


Site A: Single Family Residential Development
(40% imperviousness)
5.2 acre site
22 ¼ acre lots
Off-site Storage
Bioretention
Green Design
Cost Comparison
(capital costs for entire site)
90% Design
95% Design
Traditional
$200,000
$180,000
$160,000
$140,000
$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0
Yellow = Pipes
Inlets
Humid (48.9"/ yr)
Humid (41.9"/ yr)
Semi-Arid (15.2"/ yr)
Source accredited to Robert Goo of EPA, 6/23/09 EPA webcast.


Site B: Commercial Development
(55% imperviousness)
4.5 acre site
Bioretention
Surface Drainage
Green Design
Cost Comparison
(capital costs for entire site)
90% Design
95% Design
Traditional
$800,000
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
Humid
Humid
Semi-Arid
Source accredited to Robert Goo of EPA, 6/23/09 EPA webcast.

LID Summary Points

- Guam provides optimal opportunities for LID
  - High infiltration rates, continuous growing season, generally lower density development
- LID will not solve all problems
  - Flood control
  - Other BMPs in series
- LID does not necessarily cost more and can reduce project and lifecycle storm water costs

Leadership in Energy & Environmental Design (LEED)

GREEN BUILDING IMPACTS

LEED DELIVERS RESULTS

What is LEED?

- An internationally recognized green building certification system
- Providing third-party verification that a building or community was designed and built using strategies intended to improve performance in energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality
- Developed by the U.S. Green Building Council

LEED Rating Systems

- New Construction
- Existing Buildings: Operations and Maintenance
- Commercial Interiors
- Core & Shell
- Schools
- Retail
- Healthcare
- Homes
- Neighborhood Development

New Construction & Major Renovations

100 base points:

- Certified 40–49 points
- Silver 50–59 points
- Gold 60–79 points
- Platinum 80 points and above

Hierarchy:

- Project Checklist
  - Sustainable Sites
    - Storm Water Quantity
    - Storm Water Quality
  - Water Efficiency

LEED - New Construction & Major Renovations Project Checklist

- Sustainable Sites (26 possible Points)
- Water Efficiency (10 possible points)
- Energy and Atmosphere (35 possible points)
- Materials and Resources (14 possible points)
- Indoor Environmental Quality (15 possible points)

LEED Sustainable Sites
<u>26 Possible Points</u>

Prerequisite 1 Construction Activity Pollution Prevention	Required
Credit 1 Site Selection	1
Credit 2 Development Density and Community Connectivity	5
Credit 3 Brownfield Redevelopment	1
Credit 4.1 Alternative Transportation—Public Transportation Access	6
Credit 4.2 Alternative Transportation—Bicycle Storage and Changing Rooms	1
Credit 4.3 Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
Credit 4.4 Alternative Transportation—Parking Capacity	2
Credit 5.1 Site Development—Protect or Restore Habitat	1
Credit 5.2 Site Development—Maximize Open Space	1
Credit 6.1 Stormwater Design—Quantity Control	1
Credit 6.2 Stormwater Design—Quality Control	1
Credit 7.1 Heat Island Effect—Nonroof	1
Credit 7.2 Heat Island Effect—Roof	1
Credit 8 Light Pollution Reduction	1

LEED Credits

- Credit SSc6.1 – Storm Water Design—Quantity Control
  - Projects earn a point for creating a storm water management flow that generates no more runoff after development than before development

- Credit SSc6.2 – Storm Water Design—Quality Control
  - Projects earn a point for using IMPs to minimize pollutants in any rainwater than runs off the site

LEED Water Efficiency

<u>10 Possible Points</u>

- Prerequisite 1 Water Use Reduction — Required
- Credit 1 Water Efficient Landscaping — 2-4

Option 1	Reduce irrigation by 50% 2 pts.
Option 2	No potable water used for irrigation = 4 pts.

- Credit 2 Innovative Wastewater Technologies — 2

Option 1	50% sewage reduction
Option 2	Treat 50% on-site to tertiary

- Credit 3 Water Use Reduction — 2-4

Reduce Consumption 30% 2 pts,. 35% 3 pts., 40% 4 pts.

LEED Benefits

Building Owners

1. **Competitive Differentiator**
2. **Mitigate Risk**
3. **Attract Tenants**
4. **Cost Effective**
5. **Increase Rental Rates**

Building Tenants

1. **Happier Employees and Occupants**
2. **Public Relations and Community Benefits**
3. **Lower Operating Costs**
4. **Immediate and Measurable Results**
5. **Building Green Saves Energy and Water**

Additional Resources

- **EPA LID web page:** http://www.epa.gov/owow/NPS/lid/
- **EPA Green Buildings:** http://www.epa.gov/oaintrnt/projects/index.htm
- **Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices:** http://www.epa.gov/owow/NPS/lid/costs07/
- **U.S. Green Building Council:** http://www.usgbc.org/
- **Implementing Section 438 of the Energy Independence & Security Act, Robert Goo, EPA, June 23, 2009** http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=12955&destination=ShowItem