Low Impact Development – Design Process

- Low Impact Development (LID) – Definition
- Stormwater Management Design Approach
- Site Design Strategies
- Source Control BMPs
- Treatment Control BMPs
- Alternative Compliance BMPs
- Discover and Data Collection
- Conceptual Design/Master Planning
- Schematic Design Process
UFC Definition of Low Impact Development:

LID is a stormwater management strategy designed to **mimic predevelopment hydrology** including; temperature, rate, volume and duration of flow

WA DOE and Puget Sound Definition of Low Impact Development:

Low Impact Development (LID) is a **stormwater and land use management strategy** that strives to mimic pre-disturbance hydrologic processes by emphasizing integrated management techniques.

HUD Definition of Low Impact Development:

Low Impact Development (LID) is an **approach to land development to conserve and protect natural resource systems.**
Stormwater Management Design Approach

Collect, Convey and Limit Peak Stormwater Flows
• Maximize flow conveyance and **attenuate peak flows through detention.**
  Limit to **Pre-Development Peak Flow.**
• Minimize flooding and property damage
• Control infrequent large storm flood events

Collect and Treat Stormwater
• Water quality treatment – **“first flush” storm events**
• Maximize volume of runoff treated by including all small storm events
Stormwater Management Design Approach

LID Hydrologic Strategy - Disconnect, Distribute, Decentralize
Manage runoff at source to mimic predevelopment hydrology and reduce impacts to the ecosystem

Site Design Strategies → Source Control BMPs → Retention & Biofiltration BMPs → Alternative Compliance BMPs

Source control – *An ounce of prevention is worth a pound of cure.* Benjamin Franklin
Site Design Strategies

- Conserve natural areas, soils and vegetation
- Minimize disturbances to natural drainages
- Minimize soil compaction.
- Direct runoff to landscaped areas and reduce directly connected impervious areas.
- Minimize impervious surfaces.
Source Control BMPs

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- Loading Docks
- Outdoor Trash Storage
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas
Source Control BMPs

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- **Loading Docks**
- Outdoor Trash Storage
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas

**SC-09: Loading Dock**

**Design Objectives**

<table>
<thead>
<tr>
<th>Maximum Infiltration</th>
<th>Provide On-Site Retention</th>
<th>Slow Runoff</th>
<th>Minimize Impervious Land Coverage</th>
<th>Implement LID</th>
<th>Prohibit Dumping of Improper Materials</th>
<th>Contain Pollutants</th>
<th>Collect and Convey</th>
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</thead>
</table>

**Description**

Several measures can be taken to prevent operations at loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the storm water conveyance system.

**Approach**

In designs for loading docks, containment is encouraged. Preventive measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.
Source Control BMPs

- Landscaped Areas
- Automatic Irrigation Systems
- Storm Drain Inlets
- Vehicle/Equipment Fueling
- Vehicle/Equipment Repair
- Vehicle/Equipment Washing/Cleaning
- Loading Docks
- Outdoor Trash Storage
- Outdoor Material Storage
- Outdoor Work Areas
- Outdoor Process Equipment Operations
- Parking Areas
Treatment Control BMPs

- Infiltration Basin
- Infiltration Trench
- Subsurface Infiltration
- Dry Well
- Bioretention Basin (Rain Garden)
- Permeable Pavement
- Harvesting / Reuse
- Green Roof
- Vegetated Bio-Filter (Bioretention Filter)
- Enhanced Swale (Dry Swale)
- Downspout Disconnection
- Vegetated Swale
- Vegetated Buffer Strip
- Detention Basin
- Manufactured Treatment Device
- Sand Filter
Treatment Control BMPs

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LID Retention BMPs
Treatment Control BMPs

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LID Retention BMPs

LID Biofiltration BMPs
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LID Retention BMPs

LID Biofiltration BMPs

Alternative Compliance BMPs – The Last Resort

LID – Design Process
Treatment Control BMPs - Retention

LID – Design Process

SECTION

LAVA SUMP DETAIL
Not to Scale
Treatment Control BMPs - Retention

LID – Design Process
Treatment Control BMPs - Retention

**Enhanced Swale (Private)**

- Existing ground
- Variates
- Precast concrete drain inlet size per plan
- Slope & elev per plan
- Variates
- Conc. header or slotted curb
- Slope per plan
- Ac pavement
- 2" mulch, see landscape dwgs
- 6" planter material
- Mirafi 140n filter fabric on all sides, top and bottom
- 18" min sandy loam

**Vegetated Bio-Filter (Private)**

- Variates
- Conc. header or slotted curb
- Pavement per plan
- 2" mulch
- 6" perf pipe
- 12" gravel layer wrapped in filter fabric
- Variates
- Conc. header or slotted curb
- Ex. city sidewalk
- 18" min sandy loam

LID – Design Process

Details - Plan
Treatment Control BMPs - Biofiltration
Treatment Control BMPs - Biofiltration
Treatment Control BMPs - Biofiltration
Treatment Control BMPs - Biofiltration
Alternative Compliance BMPs

LID – Design Process
Low Impact Development - Design Process

- Discovery and Data Collection
- Conceptual Design/Master Planning
- Entitlements/Environmental Permitting
- Schematic Design
- Design Development
- Construction Documents
- Construction Observation
- Project Closeout
- Operation and Maintenance
Low Impact Development - Design Process

Discovery and Data Collection

• Site Analysis
  • Topo – GIS, LiDAR, Survey
  • Soils – Percolation Rates, Groundwater
  • UHM Rainfall Atlas
  • UHM Evapotranspiration Rates
  • NOAA Atlas 14
  • Infrastructure

• Design Criteria
  • C&C Standards – Water Quality and Flood Control
  • Uniform Plumbing Code
  • FEMA, USACE, DLNR, SHPD

• Deliverable/Outcome – Existing Conditions Assessment
Low Impact Development - Design Process

Site evaluation and analysis - identify existing conditions and constraints.
Conceptual Design/Master Planning

- Choose your team
- Define scope, objectives and goals
- Studies/Fieldwork
  - Boundary/Topographic Survey
  - Geotechnical Investigation
  - Environmental Studies
- Identify Programmatic Requirements
  - Indoor and Outdoor Spaces
- Design Charrette – Come Prepared!
  - BMP ideas/menu
  - Hydrologic Data/Estimates
  - Quantity and Quality – Range of Events
  - ROM Cost and Sizing Metrics
- Design Work Sessions
- DPP Consultation

- Deliverable/Outcomes
  - LID Opportunities Plan
  - Strategic Stormwater Plan
  - Basis of Design
  - Drainage Master Plan
Low Impact Development - Design Process

Low Impact Development (LID) Opportunities

LID generally consists of 3 main components:
- Site Design Strategies that minimize runoff volume and preserve existing hydrology;
- Retention features (volume based) that retain water from small storm events and discharge overflows for larger storm events; and
- Bio-filtration features (flow-through based) that utilize natural processes to filter and treat and convey stormwater for all storm events.

The LID opportunities plan in Figure 15 indicates potential areas to incorporate LID features. However, selection of features to include in each project phase is dependent on site specific design and project limits of proposed phases.
Low Impact Development - Design Process

- Community Center Agriculture - Hydroponics and Aquaculture
- Household gardens through Aquaponics
- Grasspave driveways which act as a aquifer
- Edible landscaping to increase CO₂ Mass
- On site water retention for agriculture and general irrigation
- Water Treatment to usable R1 water

Kaupuni Community Prototype Site
Low Impact Development - Design Process

**Schematic Design**
- Revisit and Evaluate Concept Design
- Design Work Sessions
- Early and Continuous Design Coordination is Critical
  - Roof Design and Downspout Locations
  - Review Floor Plans, Sections and Elevations – integrate BMPs on facades, plan for gutters and downspouts
  - Building and Site Structural – integrate BMPs, note which infiltrate and which are lined, elevation coordination
  - MEP Site Infrastructure – AC, PV, Vaults, Lines, Transformers
  - Tree Disposition Plan – if you are saving trees, consult arborist, review impacts and adjust design, avoid root zone impact
  - Planting and Irrigation Plans – must be integrated and designed concurrent with BMP design
- Prepare Schematic Plans
- Prepare Basis of Design
  - Establish Design Approach
  - Establish Feasibility
  - BMP sizing and hydrology/hydraulics
  - Refine/Update ROM Costs
- DPP Consultation – Standards Compliance questions and Variances
- Deliverable/Outcomes
  - Site and Utility Plan
  - Drainage and Grading Plan
  - Post Construction BMP plan OR Strategic Stormwater Plan
  - Basis of Design
Low Impact Development - Design Process

BASIN BS-1
A = 0.27 ac
Q_{10} = 1.07 cfs
Discharge to dry swale
See Table XX for calculations

BASIN BF-1
A = 0.24 ac
Q_{10} = 1.54 cfs
Discharge to planters
See Table XX for calculations

BASIN SR-1
A = 0.40 ac
Q_{10} = 1.66 cfs
Discharge to grass areas and inlets
See Table XX for calculations

BASIN SR-2
A = 0.16 ac
Q_{10} = 1.04 cfs
Surface runoff to offsite grass areas
See Table XX for calculations

Details - Plan
Low Impact Development - Design Process

**Diagram:**
- **Finish Floor** (See Architectural Plans)
- **Building Structure, Wall and Footing** (See Structural Plans)
- **Building Wall** (See Structural Plans)
- **Low Impact Development**
- **Overflow Drain** (See Site Plan)
- **Planter Grade** (See Landscape Plans)
- **Downspout** (See Site Plan for Location)
- **2"-6" Rock** (Energy dissipater)
- **2" Mulch**
- **Waterproofing** (See Structural Plans)
- **Mirafl Geotextile Filter Fabric**
- **4" Perforated Pipe** Slope to Outlet
- **2% Slope Bottom to Drain**
- **5'-0"**
- **4" Outlet to Storm Drain System** (See Site Plan)
- **Top of Wall Elevation** (See Grading Plan)
- **Finish Grade** (See Grading Plan)
- **5'-0"**
- **24" (Min) Plating Area**
- **12" (Min) Gravel**
- **For Pipe Penetration Detail See Structural Plans**
- **Planter Box Wall** (See Structural Plans)

**BIO-Filtration "Rain Garden"**
- **Planter Box Integrated With Building Wall (Private)**
- **Not to Scale**
Low Impact Development - Design Process

BIO-FILTRATION "RAIN GARDEN"
AT GRADE PLANTER (PRIVATE)

NOT TO SCALE
Low Impact Development - Design Process

**NOTES:**

1. PROVIDE PROTECTION FROM ALL VEHICLE TRAFFIC, EQUIPMENT, STAGING, AND FOOT TRAFFIC IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING, AND AFTER CONSTRUCTION.

2. DIMENSIONS:
   - PONDING DEPTH (FROM BOTTOM TO OVERFLOW ELEVATION) = 6"
   - BOTTOM WIDTH = 4’ MINIMUM WIDTH
   - SIDE SLOPES = 3:1 MAXIMUM

3. OVERFLOW:
   - EACH RAIN GARDEN SHALL INCLUDE AN ESCAPE ROUTE (3’ MINIMUM) THAT ALLOWS STORM WATER TO DRAIN IN PERIODS OF HEAVY RAINFALL, AWAY FROM BUILDING FOUNDATIONS.

**SECTION "A" - "A"**

TYPICAL RAIN GARDEN DETAIL

NOT TO SCALE

Details - Plan
Low Impact Development - Design Process
Low Impact Development - Design Process

Post Construction BMP Plan
Low Impact Development - Design Process

POST CONSTRUCTION BEST MANAGEMENT PRACTICES (PRIORITY A2)

1. LID SITE DESIGN:
   A. All pervious areas will be landscaped or paved with permeable pavement.
   B. Runoff from impervious surfaces are directed to landscaped areas.

2. SOURCE CONTROL BMPs:
   A. Landscaped areas will have automatic irrigation systems. See landscape plan for details.
   B. Outdoor trash enclosures and storage areas will utilize covered bins and will be paved.
   C. Loading docks will drain to and will be treated by the infiltration system.
   D. Parking areas will drain to and will be treated by the infiltration system.
   E. Storm drain inlets will have stencils noting "dump no water" and "goes to ocean" stamped into the concrete on the top slab of the drain inlet. See detail sheet C503.
   F. All pervious areas will be landscaped. Biofiltration systems will be utilized and slopes will be minimized on-site.

3. LID TREATMENT CONTROL BMPs:

<table>
<thead>
<tr>
<th>WATER QUALITY TABLE</th>
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</thead>
<tbody>
<tr>
<td>WQ BMP</td>
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<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Bio-Retention Basins / Rain Garden</td>
</tr>
<tr>
<td>Enhanced Swale</td>
</tr>
<tr>
<td>Vegetated Bio-Filter / Raised Planter Boxes</td>
</tr>
<tr>
<td>Downspout Disconnection</td>
</tr>
<tr>
<td>Vegetated Areas (Collected)</td>
</tr>
<tr>
<td>Vegetated Areas (Sheet Flow)</td>
</tr>
</tbody>
</table>
Low Impact Development - Design Process

LID – Design Process

KCFCU Case Study
Low Impact Development - Design Process

KCFCU Case Study
Low Impact Development - Design Process
Low Impact Development - Design Process

KCFCU Case Study
Low Impact Development - Design Process

Crosswalk Before
Low Impact Development - Design Process

Enhanced Swale
Low Impact Development - Design Process

Crosswalk After
Low Impact Development - Design Process

Matsumoto Store Before
Low Impact Development - Design Process

Matsumoto Store After