Sustainable Sites

RDN Workshop June 25, 2011
David Reid, FCSLA, Landscape Architect, Environmental Designer
Surrey ESA Networks & linear corridors
ESA Network: Develop with Care

Hub
>10 ha
Semi-natural or natural vegetation

Site
<10 ha
Semi-natural

Corridor
Most natural route between hubs; and ALR as a whole
Aquatic Habitat Greenways

Connection Example – Stream corridor

- Veteran Trees
- Eagle and Heron Trees
- Multi-aged forest stand for long-term survival and stability
- Standing Dead Trees – as Wildlife Habitat and future large organic debris
- Multi-storey vegetation for habitat variety
- Vegetated buffers for filtration of pollutants like sediment, nitrogen, phosphorus
- Vegetated banks for erosion control
- Cool temperature stream with riffles, pools, large organic debris for shade and cover from predators
- Overhanging vegetation for shade, cover and food production
- Springs, wetlands, side and backchannels for flood storage, base flows for fish rearing, and refuge from currents
Upland Habitat Greenways
& Steep Slope Management

Connection Example – Upland corridor
Green Shores

LOW WATER LINE

WALKWAY

10M RIPARIAN VEGETATION ZONE

FRESHWATER MARSH

BRACKISH MARSH

1-2M ROCKWEED BAND

SAND AND GRAVEL FLAT
Greenhouse Gas Emission Calculator
Alternative Transportation
Vegetation Planning

• Avoid heat gain
• Provide wind shelter
• Keep soils permeable
Geoexchange

**Four basic types of geothermal energy sources:**

**Horizontal loops** are often considered when adequate land surface is available. Pipes are placed in trenches, in lengths that range from 100 to 400 feet.

**Vertical loops** are the ideal choice when available land surface is limited. Drilling equipment is used to bore small-diameter holes from 75 to 300 feet deep.

**Pond (lake) loops** are very economical to install when a body of water is available, because excavation costs are virtually eliminated. Coils of pipe are simply placed on the bottom of the pond or lake.

**Open loop** systems are the fourth type and utilize ground water as a direct energy source. In ideal conditions, an open loop application can be the most economical type of geothermal system.

**Boiler/Tower Systems**

For efficiency upgrades where large geothermal systems are not viable, existing boiler/tower jobs are frequently retrofitted. Hybrid systems incorporate both geothermal loop coupled with down-sized conventional heat rejection or addition equipment (boiler or tower).
Surface Water Heat Exchange

- Submerged heat exchange loop in water connected to heat pumps
  - E.g. Brentwood College School ocean loop
    - Loop sunk 70 m offshore, 6 m deep (low tide)
    - DFO granted permission
    - 35% reduction in heating & cooling energy compared to conventional system
Solar Collectors for Domestic Water Pre-Heating

- Can significantly reduce hot water heating energy (30 – 60%)
- Need significant roof area
- Consider solar access
Contractor Training - Source Erosion Control
Rainfall Storage in Soil is 7% to 18% of Soil Volume
Infiltration rate of a sandy loam under continuous water sprinkling at a rate in excess of intake with a series of 4 surface conditions (Ferguson, 1994: 191).
Stormwater Variables of Absorbent Landscape

A schematic representation of the 12 stormwater variables of absorbent landscape. Keeping these variables in balance is the key to successful stormwater source control using absorbent landscape.
**USDA Soil Class** | **Saturated hydraulic conductivity (mm/hr)**
--- | ---
Sand | 210
Loamy sand | 61*
Sandy loam | 26*
Loam | 13
Silt loam | 6.8
Sandy clay loam | 4.3
Silt loam | 2.3
Silty clay loam | 1.5
Sandy clay | 1.2
Silty clay | 0.9
Clay | 0.6

**Typical Infiltration Rates**

*Target soil texture for growing medium Level 2 “Groomed” and Level 3 “Moderate” landscape areas in B.C. Landscape Standard, which represent a good balance between infiltration performance and water retention capabilities.

At 13mm (1/2")/ hour interflow, water moves at 321mm (1’) a day. At that rate, it would take +/- 3 months for water to flow as interflow through a 30m (100’) riparian buffer.

At 1mm / hour infiltration (till), a total of 24mm of rainfall is accepted over a 24 hour period.

Infiltration also occurs in fractured bedrock.
Impervious Area

- 70% impervious
- 35% impervious
- 59% impervious

Map showing different coverage within watersheds combined.
Infiltration Swale System
Partial Infiltration Swale with Reservoir and Subdrain

1. Weir Keyed into Swale Side Slope
2. Growing Medium (300mm Min.)
3. Sand
4. Existing Scarified Subsoil
5. Perforated Underdrain (150mm Dia. Min.)
6. Drain Rock Reservoir (300mm Min.)
7. Geotextile Along All Sides of Reservoir
8. Trench Dams at All Utility Crossing
Drain Reservoir and filter cloth, sand reservoir and overflow used as minor sediment trap for road wash while homes under construction.

Scarified, soils and plants installed after homes are built.
Newly planted

Establishment maintenance includes temporary watering, and normal landscape maintenance.
If surface crust develops remove by light cultivation of mulch areas, aeration of lawn areas.
Rain Garden

1. Tree, Shrub and Groundcover Plantings
2. Growing Medium Minimum 450mm Depth
3. Drain Rock Reservoir
4. Flat Subsoil - scarified
5. Perforated Drain Pipe 150mm Dia. Min.
6. Geotextile Along All Sides of Drain Rock Reservoir
7. Overflow (standpipe or swale)
8. Flow Restrictor Assembly
9. Secondary Overflow Inlet at Catch Basin
10. Outflow Pipe to Storm Drain or Swale System
11. Trench Dams at All Utility Crossings

Partial Infiltration Rain Garden
Rain Garden in Winter Flood
Rain Garden

Formal rain garden, Buckman Terrace, Portland, Oregon.

Informal rain garden, Water Pollution Control Laboratory, Portland, Oregon.
Rain Garden

- Portland Urban Stormwater Planters
Pervious Paving

Pervious paving reservoir base.

Pervious unit paving with aggregate joints at bike rack.
1. Permeable Pavers (Min. 80mm thickness)
2. Aggregate Bedding Course - not sand (50mm depth)
3. Open Graded Base (depth varies by design application)
4. Open Graded Sub-base (depth varies by design application)
5. Subsoil - flat and scarified in infiltration designs
6. Geotextile on All Sides of Reservoir
7. Optional Reinforcing Grid for Heavy Loads
8. Perforated Drain Pipe 150mm Dia. Min.
9. Geotextile Adhered to Drain at Opening
10. Flow Restrictor Assembly
11. Secondary Overflow Inlet at Catch Basin
12. Outlet Pipe to Storm Drain or Swale System. Locate Crown of Pipe Below Open Graded Base (no. 3) to Prevent Heaving During Freeze/Thaw Cycle
13. Trench Dams at All Utility Crossings
Tree debris in cracks does not impede infiltration

Reid Residence, Lantzville
Water Conservation

- Landscape & Irrigation Guide to Water Efficiency

- Four Steps to Water Conservation:
  - Smart Design
  - Smart Soil & Plantings
  - Smart Irrigation
  - Smart Maintenance
Guidelines

- **Smart Design**
- **Hydrozones**
  - High Water Use
    - Lawns - for active use only
    - Ornamentals - reserve for high-impact planting
  - Medium Water Use
    - Less water to look great all year round
    - Use drip or low volume irrigation
  - Low Water Use/ Unirrigated
    - Little or no water once established-native plants
    - Use permeable surfacing for unplanted areas
Guidelines

- Meeting a Water Conservation Target (15% - 30%)
  - Design 15% - 30% of site to not require watering
  - Limit turf to 25-50% of landscape
  - Lawn alternatives: ground cover, meadowgrass/ flowers, cobble, mulch, stone/ gravel, interlocking brick, permeable unit paving, decking, etc..
  - Use large areas of low water use plants
  - Ensure growing medium depth and quality and provide mulch
  - Use high efficiency irrigation and weather or sensor-based controllers
Simple Spreadsheet Inputs

<table>
<thead>
<tr>
<th>Landscape Type</th>
<th>Area (sq.m.)</th>
<th>Calculated Estimated Water Use (cu.m./yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unwatered pervious</td>
<td>82</td>
<td>0</td>
</tr>
<tr>
<td>High water use lawn</td>
<td>275</td>
<td>393</td>
</tr>
<tr>
<td>High water use plants</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Mod water use plants</td>
<td>138</td>
<td>99</td>
</tr>
<tr>
<td>Low water use plants</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Calculated Results**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Landscape Water Budget</td>
<td>550</td>
</tr>
<tr>
<td>Estimated Landscape Water Use</td>
<td>547</td>
</tr>
<tr>
<td><strong>Budget Exceeds Estimate, therefore OK</strong></td>
<td></td>
</tr>
</tbody>
</table>
Landscape Solutions
That Meet Targets
How should regions and communities grow?

- 1000 units in three different land use densities:
  - 1 Ha lots
  - Rural by Design
  - Compact Community
## Water conservation performance

<table>
<thead>
<tr>
<th></th>
<th>1. 1 Ha lot</th>
<th>2. Rural by Design</th>
<th>3. Compact Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Use (lpd average per household)</td>
<td>2,363</td>
<td>392</td>
<td>340</td>
</tr>
<tr>
<td>% reduction from RDN Water Service Area average use</td>
<td>0%</td>
<td>54%</td>
<td>60%</td>
</tr>
<tr>
<td>Annual cost over 25 yrs, no rainwater treatment</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Annual cost over 25 yrs, with rainwater treatment</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>
Land Use and Density Planning

Alternatives to sprawl?

Total Land Area = 1150 Ha

1 Ha lots - developed area = 1150 Ha
Rural by design - developed area = 112.5 Ha
Compact community  developed area = 56 Ha
Video: Case Study
Case Study Wrap-up
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Exercise:
5 minutes

1. Think of a project you are interested in (your residence, a client’s residence)

2. Sketch a site plan to locate building and driveway related to environmentally sensitive areas or trees (think of solar orientation.

3. Identify watering ‘hydrozones’ of high, medium, low or no plant watering.
I shall be telling this with a sigh
Somewhere ages and ages hence;
Two roads diverged in a wood, and I --
I took the one less traveled by,
And that has made all the difference.
Robert Frost