Healthy Soils, Healthy Landscapes

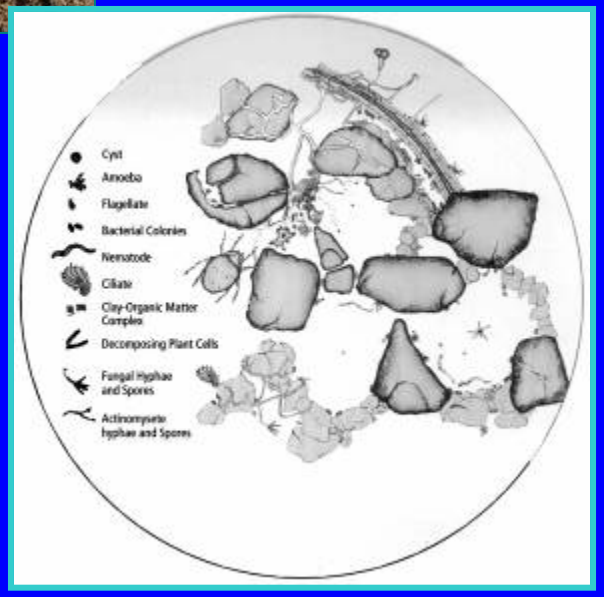
Soil Strategies for Stormwater Management and Landscape Success

David McDonald
Seattle Public Utilities
david.mcdonald@seattle.gov
www.SoilsforSalmon.org

Presentation to the ASLA and IFLA 43rd World Congress, Minneapolis, October 7, 2006

Based on Soil BMPs for Builders v2

Value of Healthy Soil



Billions of soil organisms:

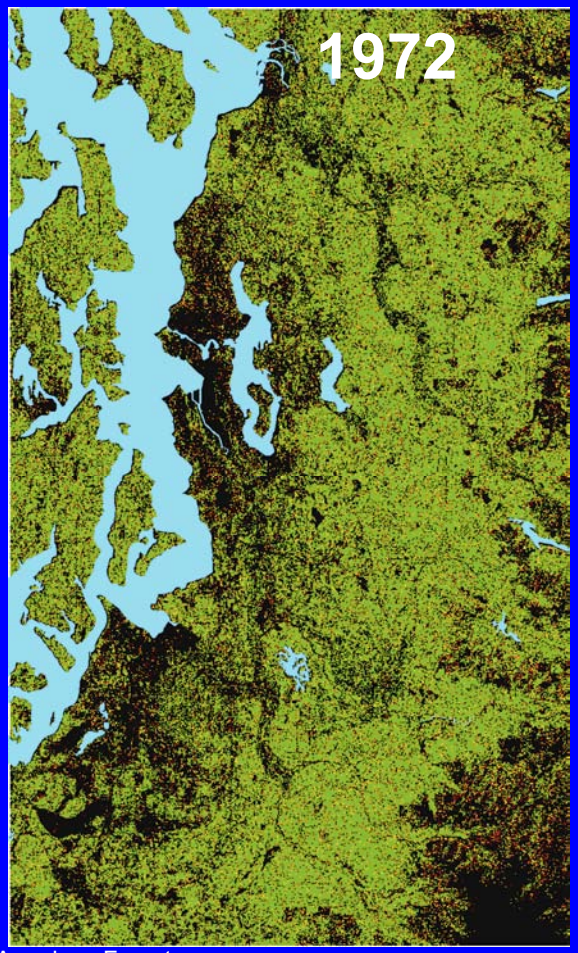
- Support healthy plant growth, fertilize, protect plants from disease
- Create soil structure, resist compaction
- Provide stormwater infiltration
- Prevent erosion
- Reduce summer water needs
- Filter out pollutants (oil, metals, pesticides, etc.)
- Reduce need for landscape chemicals

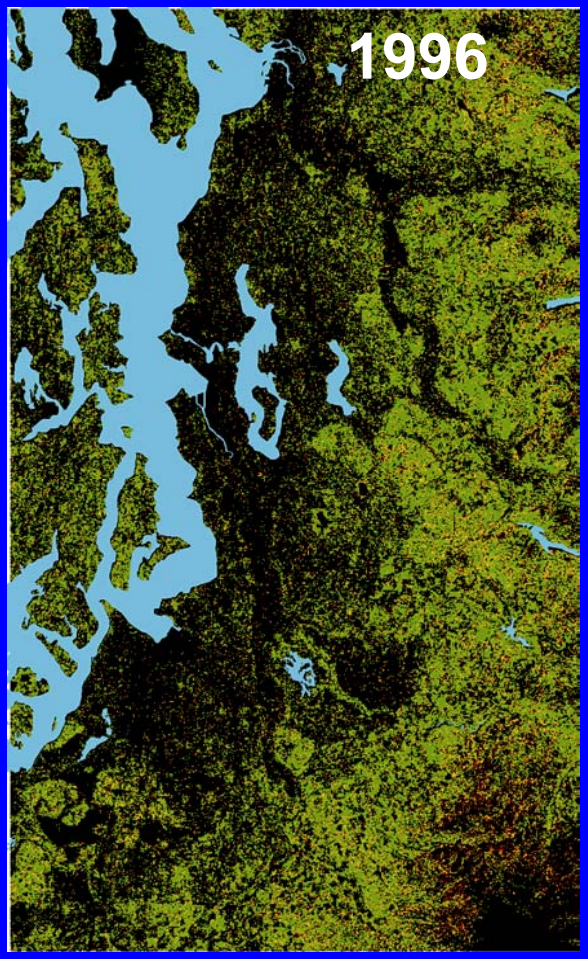
The Connection Between Soil and Water

The Stormwater Problem:

Impacts of turning spongy forests into cities

1972-1996: Amount of land with 50% tree cover decreased by 37% in Puget Sound region (from 42% of land down to 27%).





American Forests

Impervious surface (roads, buildings) increased proportionately.

WA population doubled 1962-98.

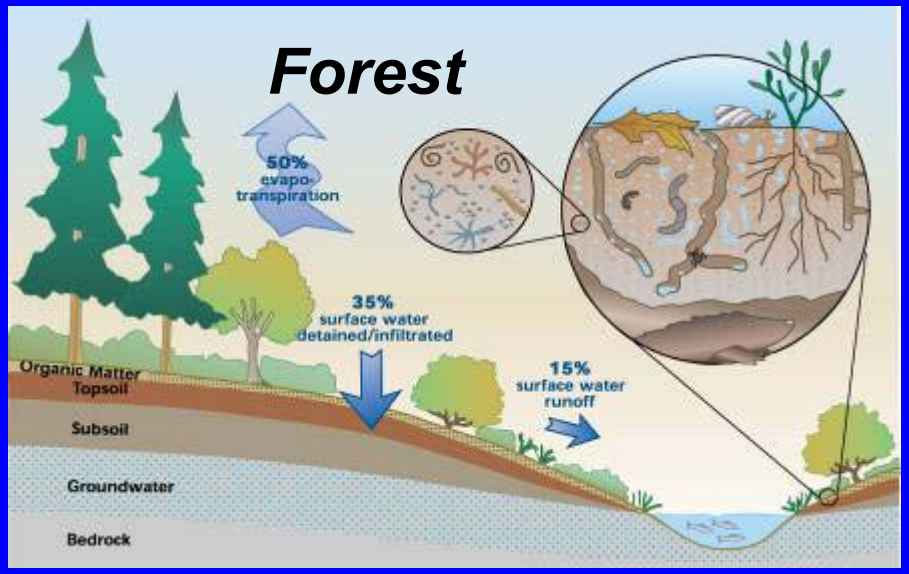
2.7 million more people by 2020!

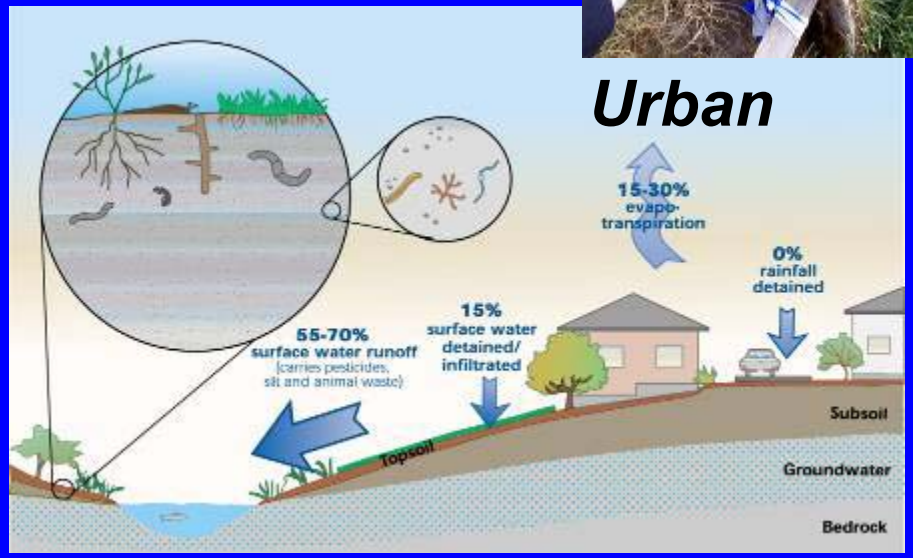
What happens to soils and soil functions as we turn forests into cities?

↑compaction
↑erosion
↑loss of topsoil
↓soil organisms
↓soil structure
↓natural fertility & disease prevention
↑impervious surface

cause:

↑winter runoff
↑need for irrigation & chemicals
↓biofiltration of pollutants





King County DNR

What happens to streams as we turn forests into cities?

↑runoff = ↑peak storm flows

↑erosion of stream bank and bed

↑fine sediment choking spawning gravels

↑pollutants (automotive, landscape fertilizer and pesticides)

↓groundwater recharge

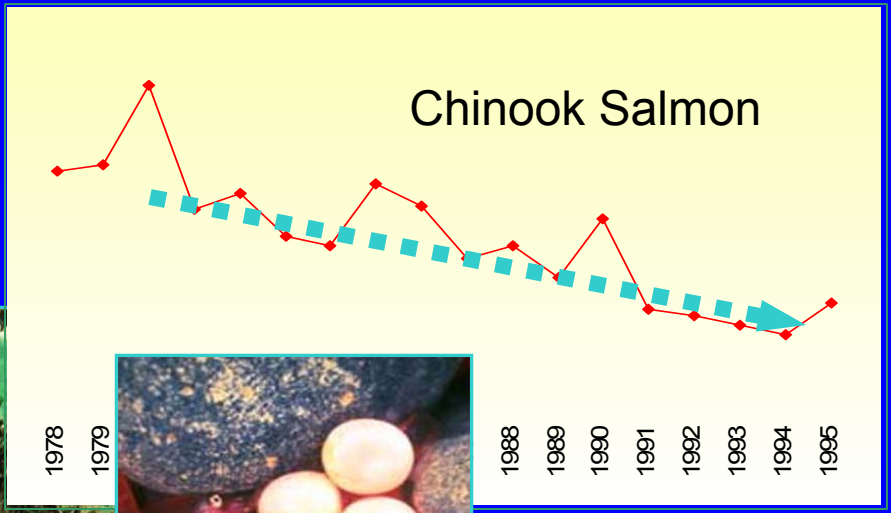
↓summer low flows

↑summer stream temperature

↓oxygen in spawning gravels

What are the impacts?

- Pollution
- Erosion
- Salmon decline
- Flooding & property damage
- Failing landscapes
- <u>Unhappy customers</u>



How can we restore soil functions, to improve plant growth, water quality, and reduce runoff?

- Prevent /reduce compaction
  - keep heavy machinery off where possible
  - rip compacted soils to loosen

- Incorporate compost into soil to <u>feed</u> <u>soil</u> <u>life</u>

organic matter + soil organisms + time
creates ⇒
soil structure, bio-filtration, fertility, & stormwater detention

Soil Best Management Practices (BMPs)

New Construction

- Retain and protect native topsoil & vegetation (esp. trees!)
  - Minimize construction footprint
  - Store and reuse topsoil from site
  - Retain “buffer” vegetation along waterways
- Restore disturbed soils by tilling 2-4" of compost into upper 8-12" of soil. Rip to loosen compacted layers.

Existing Landscapes

- Retrofit soils with tilled-in compost when re-landscaping
- Mulch beds with organic mulches (leaves, wood chips, compost), and topdress turf with compost
- Avoid overuse of chemicals, which may damage soil life

Benefits of Soil Best Practices

- More marketable buildings
- Better erosion control
- Easier planting, healthier plants, fewer callbacks
- More attractive landscapes, that sell the next job
- Easier maintenance for customers (healthier plants, fewer weeds, less need for water, fertilizer, pesticides)
- Reduced stormwater runoff, with better water quality
- Regulatory compliance (current and upcoming regs)

WA State Guidance on Soil BMPs: DOE *Stormwater Mgmt. Manual for Western WA*

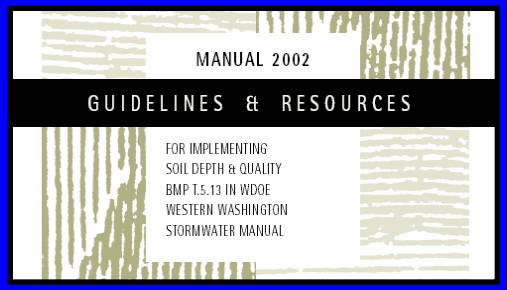
- Equivalency required for NPDES Phase I (big cities, counties, WsDOT)
  - Phase II (medium-sized cities) coming soon
- Volume V, Chapter 5 - "On-Site Stormwater Mgmt."
  - **BMP T5.13 Post-Construction Soil Quality and Depth**
- Flow model credits for runoff dispersion into amended soils

www.ecy.wa.gov/programs/wq/stormwater/manual.html

DOE BMP T5.13
Post-Construction Soil Quality and Depth

- Retain native soil and duff wherever possible
- All areas cleared and graded require 8 inch soil depth:
  - **Soil organic matter content 10% for landscape beds, 5% for turf areas**, (S.O.M. by loss on combustion method)
    - 10% S.O.M. results from roughly 25-30% compost by volume added to low-organic subsoil.
    - May use native topsoil, incorporate organic amendments into existing soil, or bring in topsoil blend to meet spec
  - pH 6-8, or original pH
  - Subsoil scarified 4 inches below 8-inch topsoil layer
  - Protected from compaction after amendment
  - Mulched after planting, & maintained by leaving organic debris

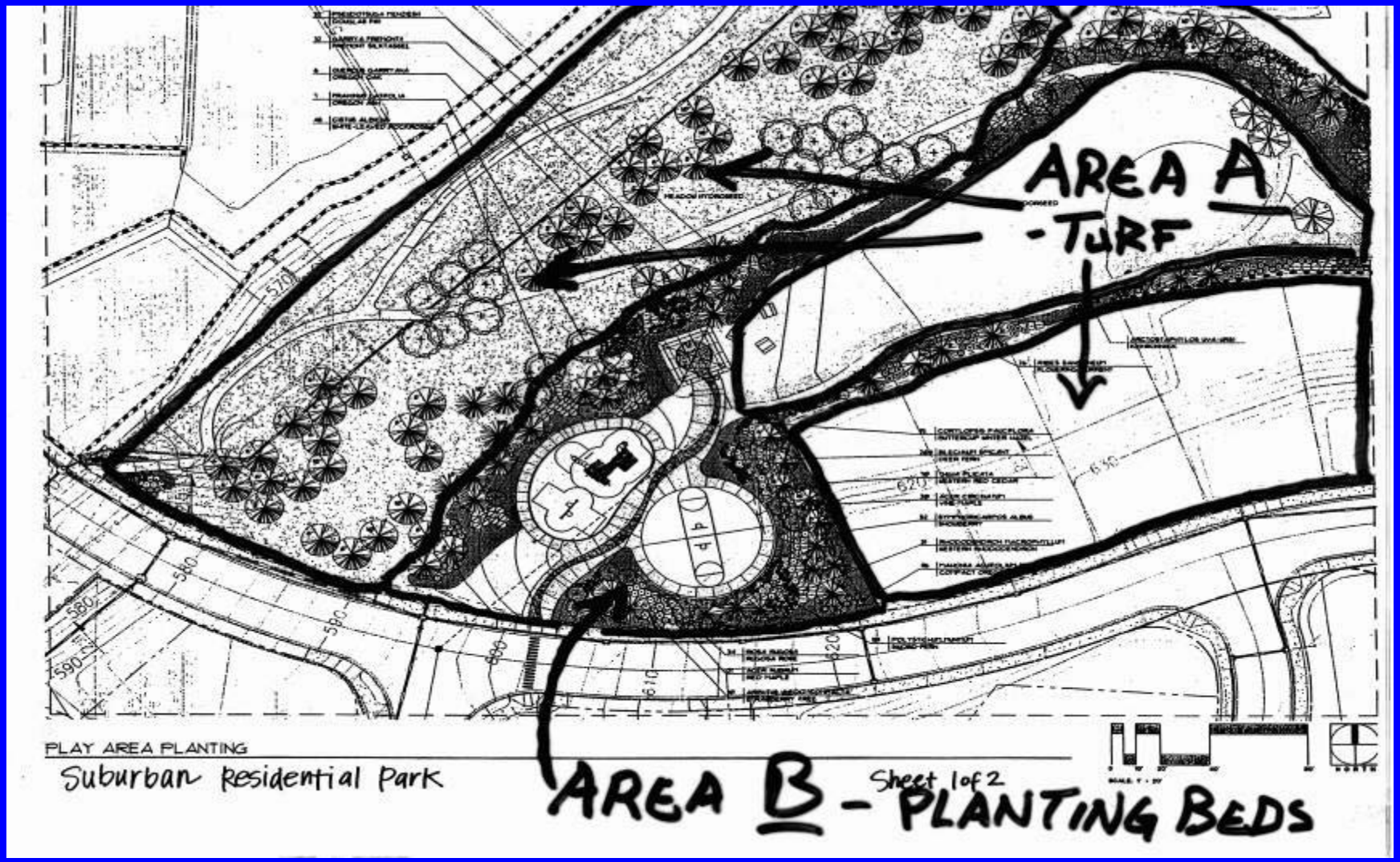
Guidelines Manual for Implementing BMP T5.13



- Manual developed regionally in consultation with experts
- Practical methods to achieve soil standards:
- Develop a "Soil Management Plan" for each site
- Four options for soil management in different areas of site:
  1) Leave native soil & vegetation undisturbed, protect from compaction
  2) Amend existing soil in place (with compost or other organic)
  3) Stockpile site topsoils prior to grading for reapplication
  4) Import topsoil meeting organic matter content standards
- Choose pre-approved or custom calculated amendment rates
- Simple field inspection and verification procedures
- Includes model specs written in CSI and APWA formats
- Available at: **www.soilsforsalmon.org**

Develop a "Soil Management Plan"

step 1: Identify areas needing different soil treatments



Soil Management Plan

step 2:
Compute amendment or amended topsoil and mulch needed for each area

MODEL "SOIL MANAGEMENT PLAN" FOR BMP T5.13

PROJECT INFORMATION **Page # ____ of ____ pages**

Complete all information in this section on page 1; only site address and permit number on additional pages.

Site Address / Lot No.:	
Permit Type:	**Permit Number:**
Permit Holder:	**Phone:**
Mailing Address:	
Contact Person:	**Phone:**
Plan Prepared By:	

ATTACHMENTS REQUIRED (Check off items attached meeting requirements)

___ Site plan showing, to scale:	___ Areas of undisturbed native vegetation (no amendment required) ___ New planting beds and turf areas (amendment required) ___ Type of soil improvement proposed for each area
___ **Soil test results (required if proposing custom amendment rates)**	
___ **Product test results for proposed amendments**	

AREA # ___

PLANTING TYPE	___ Turf ___ Planting Beds	___ Undisturbed native vegetation ___ Other: _____
SQUARE FOOTAGE: _____		
SCARIFICATION ___ Subsoil will be scarified	___ inch scarification needed to achieve finished total 12" loosened depth.	
PRE-APPROVED AMENDMENT ___ Topsoil import ___ Amend with compost ___ Stockpile and amend	____(inches compost or imported topsoil) X 3.1 _____= cu. yards / 1,000 sq. ft. X___ ,000s) sq.ft. _____ = cubic yards amendment	PRODUCT:_____ _____ QUANT:_____CU. YDS.
CUSTOM AMENDMENT ___ Topsoil import ___ Topsoil & compost lift ___ Amend ___ Stockpile and amend	Attach test results and calculations. ____(inches organic matter or topsoil import) X 3.1 _____= cu. yards / 1,000 sq. ft. X___ ,000s) sq.ft. _____ = cubic yards amendment	PRODUCT:_____ _____ QUANT:_____CU. YDS.
MULCH	____ ,000 sq.ft. X 6.2 _____ = cubic yards mulch	PRODUCT:_____ _____ QUANT:_____CU. YDS.

TOTAL AMENDMENT/TOPSOIL/MULCH FOR ALL AREAS (total all areas/pages on page)

☐ Product #1:_____	☐ Quantity: _____cu. yds.
☐ Test Results: ___ % organic matter ___C:N ratio <25:1 (<35:1 for native plants)	____ "moderately" to "very stable"
☐ Product #1:_____	☐ Quantity: _____cu. yds.
☐ Test Results: ___ % organic matter ___C:N ratio <25:1 (<35:1 for native plants)	____ "moderately" to "very stable"
☐ Product #1:_____	☐ Quantity: _____cu. yds.
☐ Test Results: ___ % organic matter ___C:N ratio <25:1 (<35:1 for native plants)	____ "moderately" to "very stable"

Date:	**Inspector:**	**Approved:**	**Revisions Required:**
Date:	**Inspector:**	**Approved:**	**Revisions Required:**

COMMENTS:_____

Clearing up the confusion about "% organic"

"% Soil Organic Matter Content" (S.O.M.) in lab soil tests is by loss-on-combustion method

- Most composts are 40-60% organic content by this method

<u>Recommended soil amendment rates</u> (for low-organic soils):

- <u>5% Soil Organic Matter Content for Turf</u>
  - produced by about 15% compost amendment by volume
- <u>10% Soil Organic Matter Content for Landscape Beds</u>
  - produced by 25-35% compost amendment by volume

How to Select Compost

Know your supplier!

- Field tests:
  - earthy smell - not sour, stinky, or ammonia
  - brown to black color
  - uniform particle range
  - stable temperature (does not get very hot if re-wetted)
  - moisture content
- Standards & Specs
  - US Compost Council "Seal of Testing Assurance" (STA)
  - State & DOT specs
- Mfr.-supplied info:
  - Meets state std. or USCC STA
  - C:N ratio
  - Weed-seed trials
  - Nutrients, salinity, contaminants
  - Size: "screen", % fines
- Soil/compost lab test info:
  - Nutrients
  - Salinity
  - pH
  - % organic content (OM)

Carbon to Nitrogen ratio of composts

- For turf & most landscapes
  C:N ratio of 20:1 to 25:1 - good nutrient availability for first year of growth (no other fertilizer needed)

- For native plants and trees
  C:N ratio of 30:1 to 35:1, and coarser (1” minus screen)
  - less Nitrogen better for NW natives, discourages weeds
  - for streamside, unlikely to leach nitrogen

Compost Application Methods

Four options for soil management in different areas of site:

- 1) Leave native soil & vegetation undisturbed, protect from compaction
- 2) Amend existing soil in place (with compost or other organic)
- 3) Stockpile site topsoils prior to grading for reapplication
- 4) Import topsoil meeting organic matter content standards

Compost application & incorporation methods:

- Blowing
- Spreading
- Tilling / ripping
- Blending off-site

Blowing & spreading

- Blower trucks

- Various construction grading equipment

- Other equipment : golf course & farm spreaders

Incorporating amendments into soil

- Range of equipment for different-sized sites
- Till in to 8” depth
- If compacted, rip to 12” depth before/while amending

Stockpile site soils & amend, (or import amended topsoil) after road & foundation work

- Allows mass grading
- Can reduce hauling & disposal costs
- Set grade to allow re-addition of topsoil & <u>allow for settling</u>
- Amend to spec offsite
- Spread after concrete work
- Rip in first lift,
  to reduce sub-grade compaction

Erosion Control Compost Applications

- Compost berms or blankets – slow water, bind surface soil, reduce erosion immediately
- Enhance survival/growth helps to stabilize slopes over long term.

Combine methods as needed for best water quality and flow control

WsDOT - Protecting Wetland Area from I-5 Runoff

Soil Amendment: A cost-effective solution for new development

- Much better plant survival = fewer callbacks

- Easier planting

- Can cut irrigation needs by 50% = 3-7 year payback on irrigation savings alone

Selling healthy soil to customers:

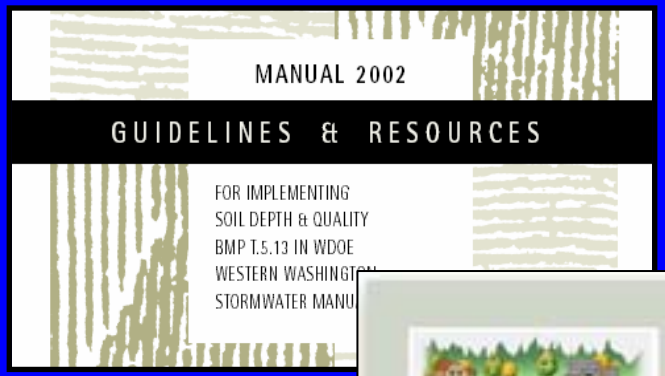
Value to builder/contractor

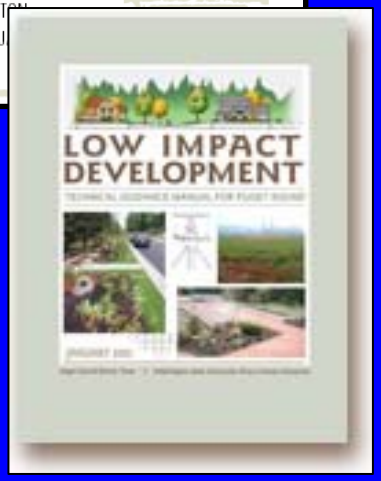
- Less plant loss = fewer callbacks
- Making money on materials and labor
- Quicker planting in prepped soil
- Easier maintenance
- Better appearance sells next job

Sell quality & savings to customer

- Better plant survival/ health/ growth/ appearance
- Lower water bills, easier care
- Reduced chemical needs = better for family health
- Better for salmon: reduces storm runoff, improves water quality

Links to useful soil BMP specifications:





Guidelines Manual for Implementing WDOE Soil Quality & Depth BMP (includes APWA & CSI specs)
www.soilsforsalmon.org

Puget Sound Action Team, LID Technical Manual
www.psat.wa.gov/Programs/LID.htm

WsDOT "Soil Bioengineering" specs
http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm

Seattle "Natural Drainage Systems" specs
www.seattle.gov/util/NaturalSystems

Building Soil
Foundation for Success

Putting Organic Amendments to Work

Redmond Ridge, Quadrant Corp.

- Large, master-planned development
- Forest left undisturbed where possible - no compaction
- Cleared vegetation & duff stockpiled for use as soil amendment
- Removed topsoils stockpiled

- All soils amended to 12” depth with organics
- **Early Problems:** Too much organic esp. for turf areas, organic materials not composted (landclearing & duff) - soft soil, excessive water retention, low N, plant/turf problems as result

Redmond Ridge: current method

- Grade site 12 in. below finish
- Install foundation, along with driveway & walkway rock pads
- Spread 14 in. amended soil mix, (will settle to 12 inches) rip in first lift to mix with subsoil
- Soils blended offsite from native duff plus compost
- Soil organic matter controlled to ~10%, pH and C:N ratio for optimal plant growth

Putting organics to work - SEA Streets

Street Edge Alternative onsite detention demo, Seattle Public Utilities and SDOT.

- Compost in wet and dry zones
- **98% reduction in runoff.**

www.seattle.gov/util/NaturalSystems/

Broadview Green Grid, Seattle
(right after Oct. 2004 “100 year” storm)

- Compost-amended soil in bio-retention swales
- Erosion control with compost blankets, berms, and socks

Riparian restoration - Seattle creeks

Compost mulch (2-3”)
reduces erosion,
restores soil functions,
promotes plant growth

Wood chip mulch on top (2-4”) controls weeds, prevents erosion, and provides a long term jump on organic litter ⇔ soil cycling

WsDOT projects around Washington

Erosion control and plant establishment on steep site using compost blankets

Chelan

Photos courtesy of Sandy Salisbury, WSDOT

WsDOT: Erosion control, water quality, successful landscapes with lower mtce. costs

SR 14, Vancouver
Coarse compost, blown in
Note erosion where not applied

Compost amendment,
ripped in

Extensive soil bio-engineering info at:

http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm

WsDOT
10 ft wide compost strip treats stormwater from 2 lanes of roadway

Parameter	Untreated Runoff	Compost filter strip treated	% Concentration Reduction	% Load Reduction
	mg/l			
TDS	52.7	55.5	-5	63
T. Phosphorus	0.089	0.26	-192	-2
COD	73.5	49.6	33	76
TSS	81	23	72	90
	ug/l			
Total Copper	28.18	9.14	68	89
Dissolved Copper	7.85	5.77	26	74
Total Lead	12.62	3.54	72	90
Dissolved Lead	0.5	0.05	90	97
Total Zinc	129.70	31.57	76	91
Dissolved Zinc	64.22	20.71	68	89

TDS=Total Dissolved Solids, COD=Chemical Oxygen Demand, TSS=Total Suspended Solids

Compost

No Compost

Which site is selling the next job?

A natural solution
– for healthier streams, happier customers, and successful landscapes

- Conserve existing soils and vegetation where possible.
- Restore natural functions in disturbed soils by reducing compaction and using organic amendments.

More Information:
www.SoilsforSalmon.org