

US EPA ARCHIVE DOCUMENT



Healthy Soils, Healthy Landscapes

Soil Strategies for Stormwater Management and Landscape Success



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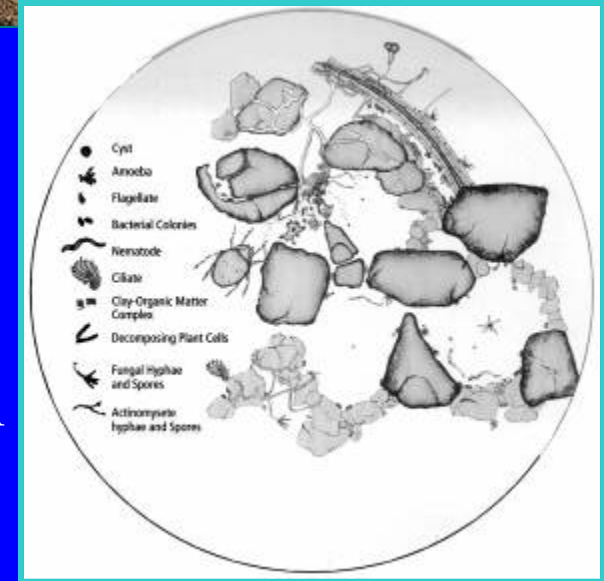
*Presentation to the ASLA and
IFLA 43rd World Congress,
Minneapolis, October 7, 2006*

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



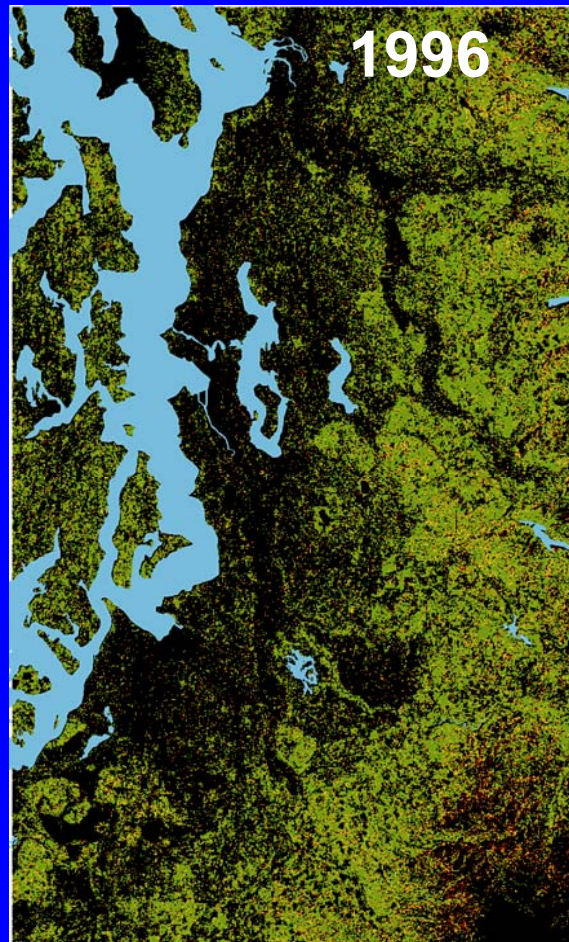
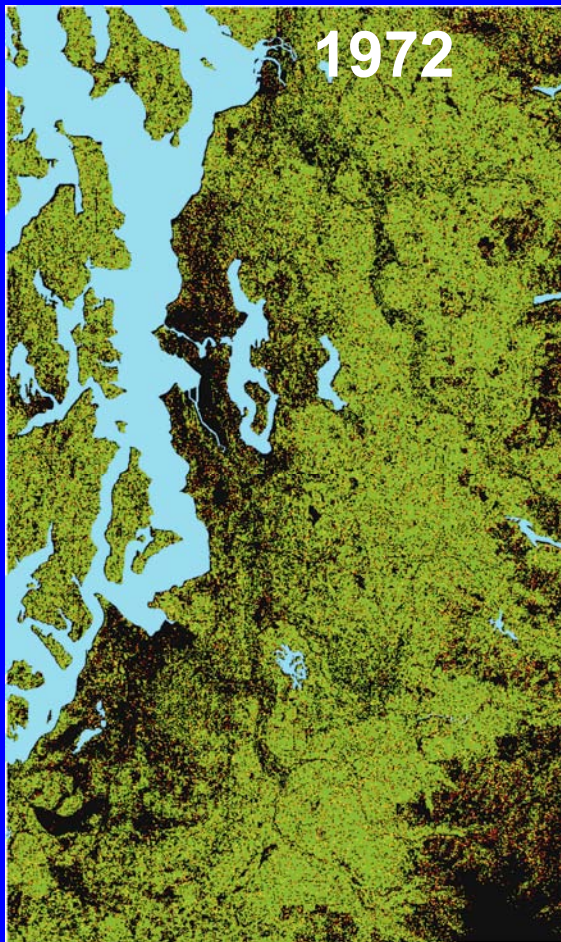
The Connection Between Soil and Water



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%).



Impervious surface (roads, buildings) increased proportionately.

WA population doubled 1962-98.

2.7 million more people by 2020!

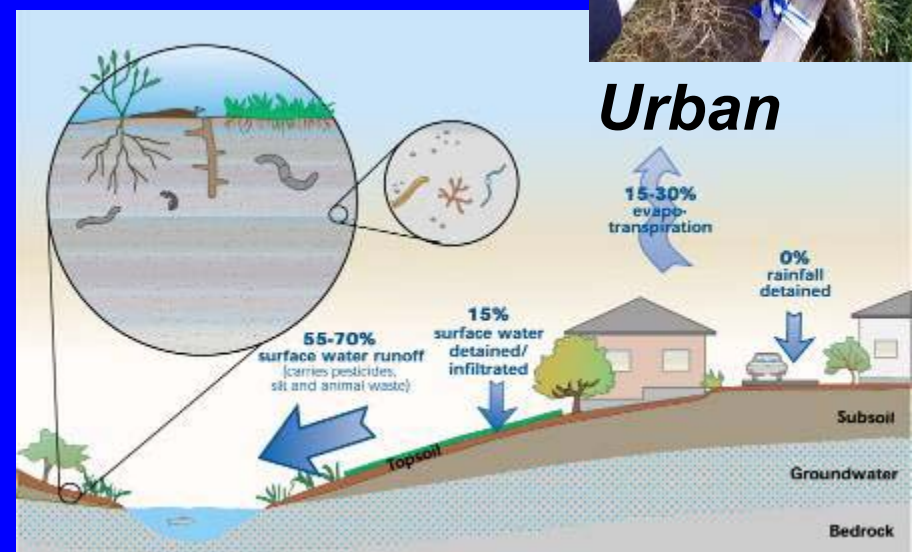
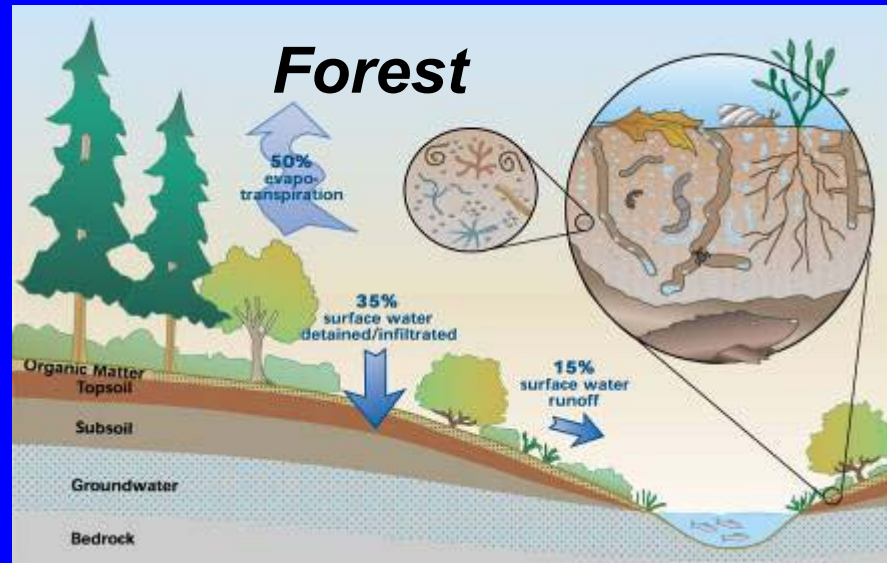
What happens to soils and soil functions as we turn forests into cities?

- ↑ 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



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

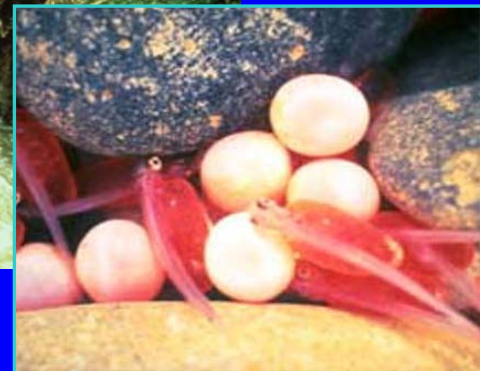
↑ pollutants (automotive, landscape fertilizer and pesticides)

↓ **groundwater recharge**

↓ summer low flows

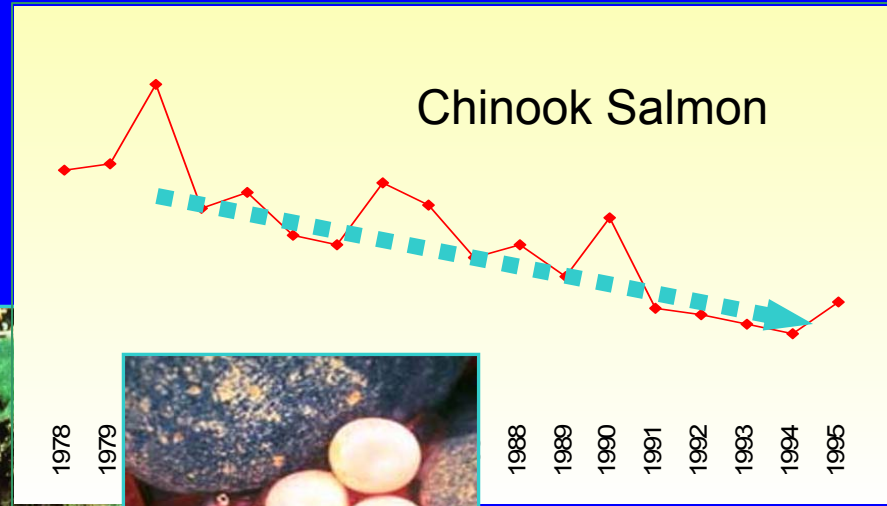
↑ summer stream temperature

↓ oxygen in spawning gravels



What are the impacts?

- Pollution
- Erosion
- Salmon decline
- Flooding & property damage
- Failing landscapes
- Unhappy customers



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 feed soil life



organic matter + soil organisms + time
creates \Rightarrow

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

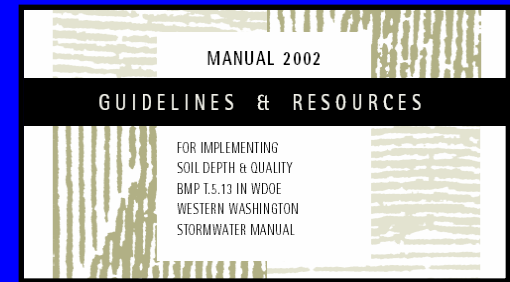
DOE BMP T5.13

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

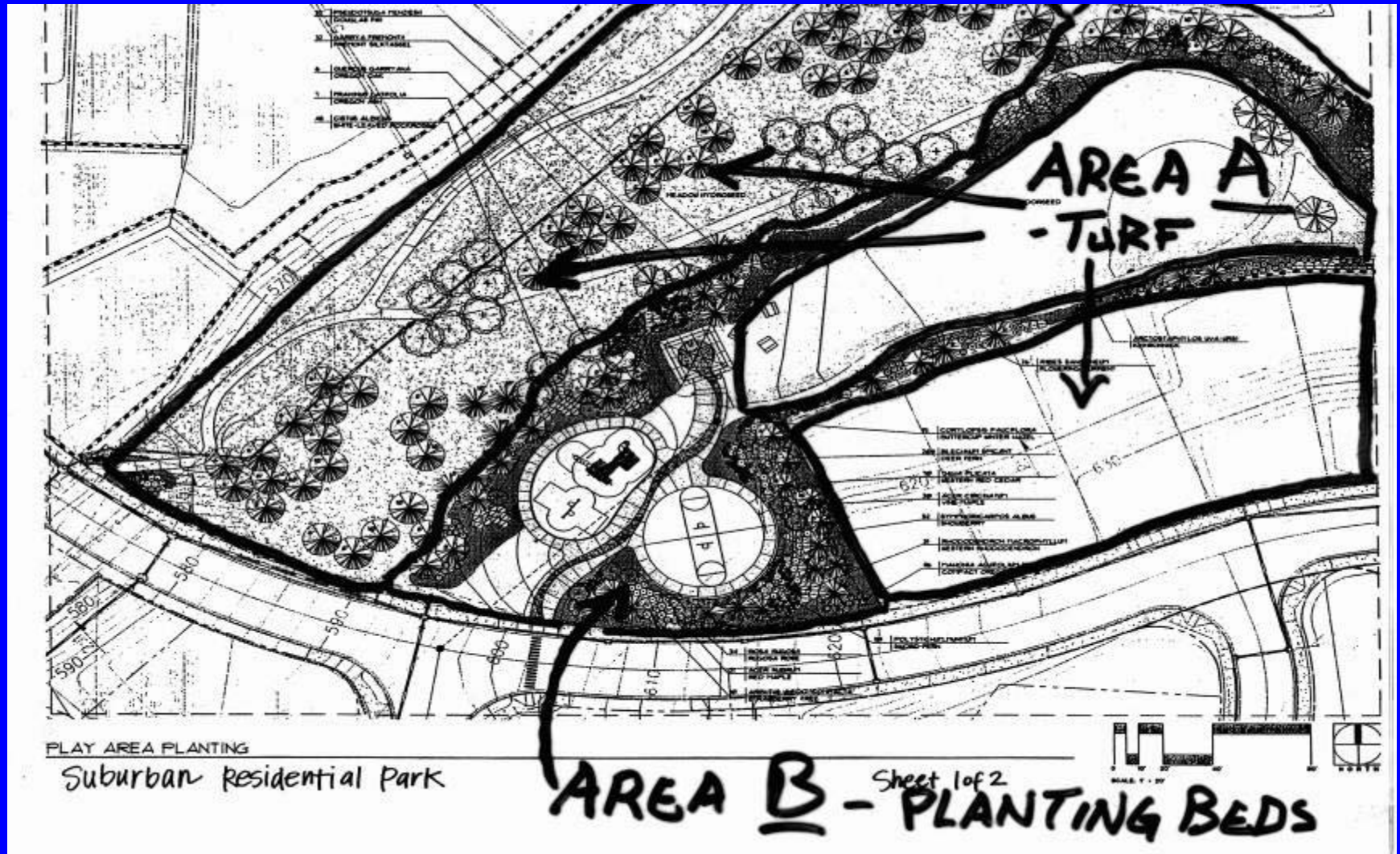
Guidelines Manual for Implementing BMP T5.13



- 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)

<input type="checkbox"/> Site plan showing, to scale:	<input type="checkbox"/> Areas of undisturbed native vegetation (no amendment required)
	<input type="checkbox"/> New planting beds and turf areas (amendment required)
	<input type="checkbox"/> Type of soil improvement proposed for each area
<input type="checkbox"/> Soil test results (required if proposing custom amendment rates)	
<input type="checkbox"/> Product test results for proposed amendments	

AREA # _____

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

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

<input type="checkbox"/> Product #1: _____	<input type="checkbox"/> Quantity: _____ cu. yds.
<input type="checkbox"/> Test Results: % organic matter _____ C:N ratio <25:1 (<35:1 for native plants)	_____ "moderately" to "very stable"
<input type="checkbox"/> Product #1: _____	<input type="checkbox"/> Quantity: _____ cu. yds.
<input type="checkbox"/> Test Results: % organic matter _____ C:N ratio <25:1 (<35:1 for native plants)	_____ "moderately" to "very stable"
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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

Recommended soil amendment rates
(for low-organic soils):

- 5% Soil Organic Matter Content for Turf
 - produced by about 15% compost amendment by volume
- 10% Soil Organic Matter Content for Landscape Beds
 - 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 & allow for settling
- 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

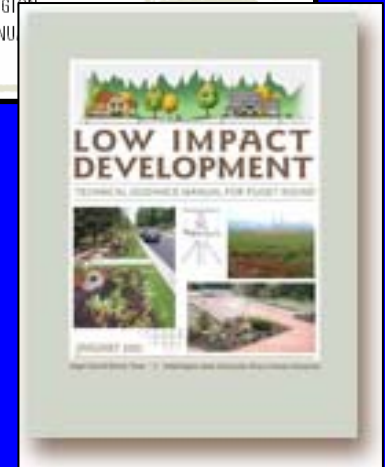
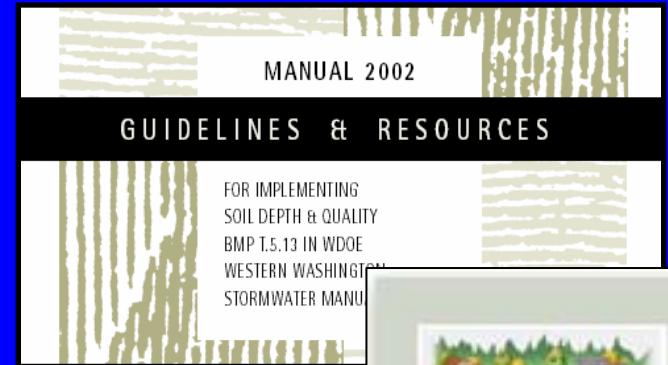
Links to useful soil BMP specifications:

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

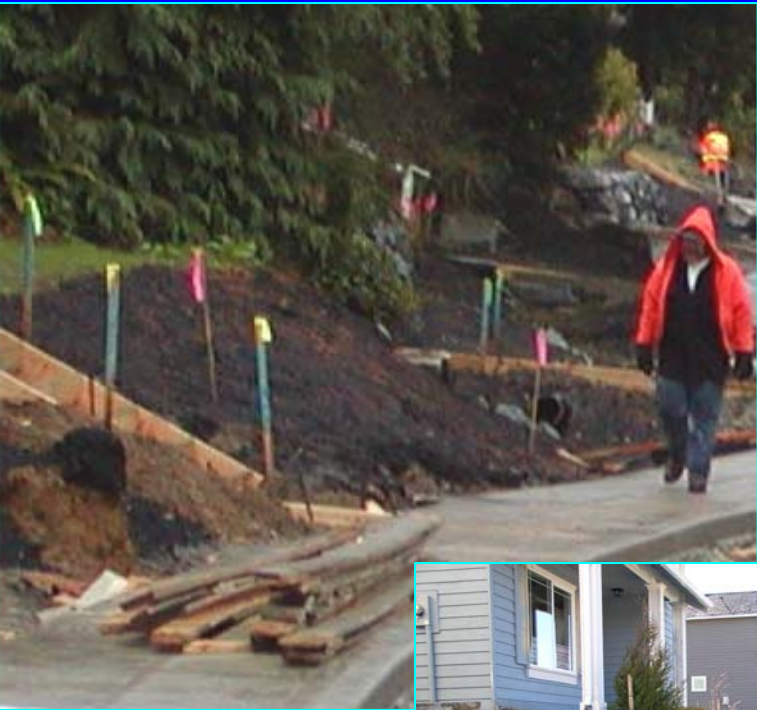
WsDOT “Soil Bioengineering” specs
<http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm>

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





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 \Leftrightarrow 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