Soils for Salmon: Integrating Stormwater, Water Supply, and Solid Waste Issues in New Development and Existing Landscapes

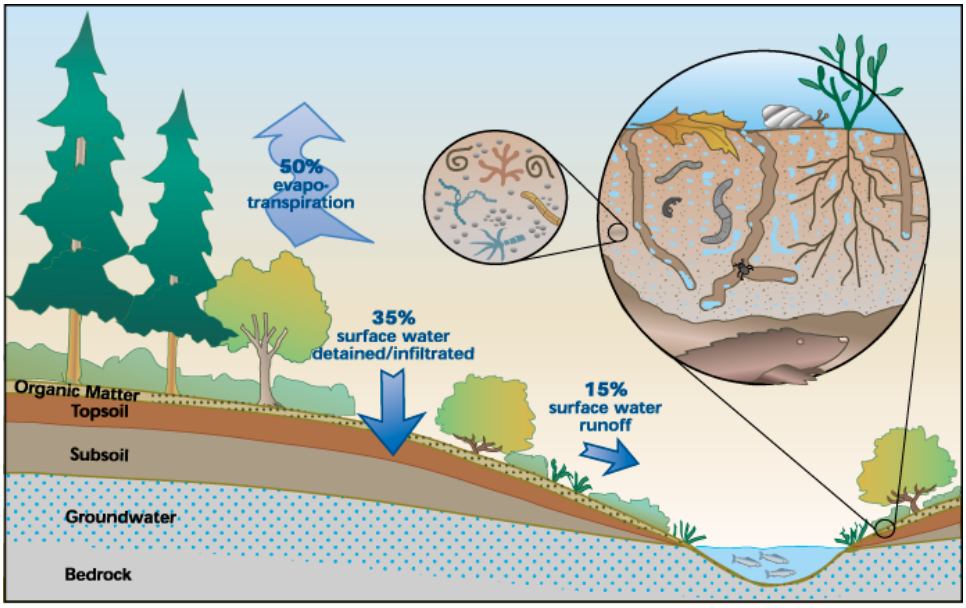
by David K. McDonald, Seattle Public Utilities
david.mcdonald@seattle.gov www.seattle.gov/util/rescons
for the
Washington Organic Recycling Council
www.SoilsforSalmon.org info@compostwashington.org

The Soils for Salmon initiative, a cooperative effort of agencies around the region, addresses the fundamental problem of the loss of soil functions as we turn native forests into cities and towns. Stormwater detention is one of those critical soil functions, but they also include soil structure (which affects the need for irrigation and chemical inputs in landscapes) nutrient and organic "waste" recycling (i.e. fertility), plant disease protection, and biofiltration of urban pollutants. These are the functions of living, biologically and organically rich soils. While nothing can fully restore the functions provided under native forest conditions, a soil protection and soil restoration strategy will be essential to reducing the impacts of development in this region.

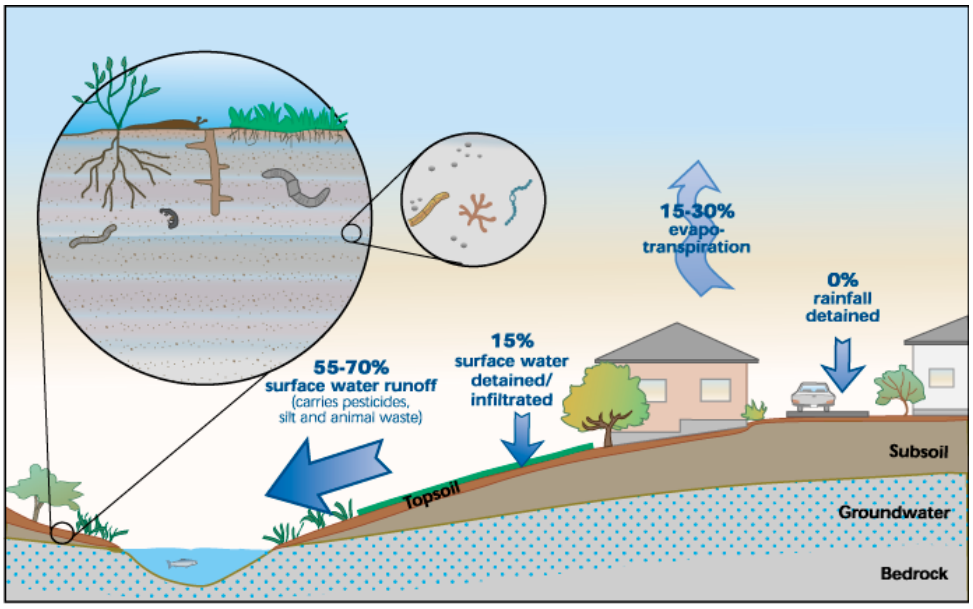
In new development, best management practices include retaining and reusing native soil and vegetation, reducing the construction footprint and minimizing soil compaction, and restoring function in disturbed soils by amending them with compost. Existing landscapes can be retrofitted by tilling in compost and using organic mulches. These practices have multiple benefits, and are cost-effective in terms of improved plant vigor and reduced need for water, fertilizer, and pesticides, as well as enhanced stormwater detention and water quality.

Why a Soil Strategy is Essential: The Connection Between Soil and Water

In native forests in the Puget Sound region, 50% of the rain that falls returns to the sky through evapotranspiration, to fall again as rain further inland. 35% or more is infiltrated into groundwater and the rest is detained in interflow through the upper soil layers.[1] Almost none runs off the surface. This function of soils and forest reduces damaging winter storm flow peaks, while recharging groundwater to provide "base flows" of cool water to streams in the summer.



Native soil / forest



Disturbed soil – after development

illustrations by King Co. DNRP

By comparison, in developed suburban areas, where soils have been stripped and compacted and most of the forest has been removed, less than 30% of rainfall is returned to the sky through evapotranspiration, and less than 16% is detained and infiltrated into groundwater. Impervious surfaces like roads and roofs of course detain none at all. The result is extremely fast runoff during storms, which erodes surface soil and stream banks, carries urban pollutants into streams, scours salmon redds and other aquatic life, and leaves spawning gravels choked with sediment. Groundwater is not recharged, so that summer base flows are reduced, leaving streams shallower and warmer. Stormwater detention structure regulations to date have reduced, but not prevented this damage.[1] Studies in this region show that the first 5-10% of constructed impervious area in a watershed, under current practices, results in significant damage to its ability to support native aquatic life, including salmon.[2]

Forests and native topsoils, and thus their stormwater management functions, are disappearing in the Puget Sound region. In a satellite photo analysis, between 1972 and 1996 the amount of land with more than 50% tree cover decreased by 37% (from 42% of land down to 27%).[3] Meanwhile population in Puget Sound doubled between 1962 and 1998, and continues to rise. The Census Bureau estimates that by 2020 Washington will add 2.7 million new residents, the equivalent of 5 new cities the size of Seattle, or 14 new Spokanes. We need a strategy to protect native soil function wherever possible during development, restore soil function on sites disturbed during development, and retrofit soils in existing urban areas.

Restoring Soil Function with Organic Amendments

Stormwater and erosion management One way to restore some of the forest's functions in urbanized areas is to restore soils by incorporating plenty of compost or other organic matter (2-4 inches of compost tilled into the upper 8-12 inches of soil, depending on soil type). One study demonstrated up to 50% reduction in winter storm runoff from plots of glacial till soil amended with compost, as compared to un-amended till soil.[4] Compost amendment works well with the glacial till, clay, sand or gravel soils common in developing areas of this region. Compost blankets on steep slopes and compost berms in place of silt fences have also proven capable of controlling short term erosion, while enhancing long term revegetation and slope stability.[5]

Added benefits Compost-amended soils also filter out urban pollutants such as hydrocarbons and heavy metals from cars, and pesticides or soluble fertilizers applied to landscapes, keeping them from reaching streams. By improving soil fertility and plant resistance, compost greatly reduces the need for pesticides and synthetic fertilizers, thus potentially further reducing nonpoint water pollution. Recycling of municipal yard and food waste, biosolids, construction and landclearing debris, and agricultural wastes into beneficial soil amendments reduces the demand for landfill space and reduces nutrient runoff to streams. And by improving soil moisture retention and plant rooting depth, compost greatly reduces summer irrigation needs, reducing peak demand on strained regional water supplies and allowing us to leave more water in rivers for fish.

Restoring soil life How does compost improve soil structure, fertility, bio-filtration and plant vigor? By providing food and homes for the incredibly diverse web of tiny creatures that make up the soil ecosystem. These organisms aggregate soil particles to create soil structure and pore spaces from the micro up to the macro scale. They break down organic pollutants and bind heavy metals. They recycle nutrients endlessly and make them available to plants. And they compete with and parasitize the pests and diseases that attack plants, creating naturally healthier more attractive landscapes that are easier to maintain.[6]

organic matter + soil organisms + time $\Rightarrow$ soil structure, fertility, bio-filtration, & stormwater detention

A cost-effective solution for new development For developers and landscape contractors, amending soils before planting results in much better plant survival, growth rates, disease and pest resistance, and thus better long term appearance and fewer callbacks, improving the bottom line. For homeowners, proper soil amendment reduces landscape maintenance needs and can pay for itself in the first few years based on water and chemical savings alone, not counting the value of stormwater and pollution reduction benefits.[7]

Improving soil function in existing development On existing sites, soils should be amended with compost when re-landscaping. Trees, especially native conifers, can be added wherever possible. Buffers of native plants can be planted adjacent to waterways. And existing landscapes can be mulched with organic mulches like wood chips, bark, leaves, grass clippings and compost on an annual basis to significantly improve soil function. Lawn areas can be topdressed with compost and shifted to ecologically sound turf management practices that enhance soil life and thus soil functions.[8]

Summary of Soils Best Management Practices

New Construction BMP's

- 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 (or deeper) before planting. (Use a tractor-mounted ripper to loosen compacted layers within 12" of surface.)

Existing Landscape BMP's

- Retrofit soils by tilling in compost when re-landscaping
- Mulch beds with organic mulches (leaves, wood chips, compost), and topdress turf with compost
- Avoid overuse of soluble chemical fertilizers and pesticides, which may damage soil life

Taking it to the Streets: Implementing a Soil Strategy Around the Region

Beginning in March 1999, the Washington Organic Recycling Council and member public agencies have sponsored Soils for Salmon seminars, conference presentations, and policy and education initiatives to raise awareness of the need for a soils strategy among policy makers and stormwater and development professionals. Progress includes:

- **Policy and Regulation** Soils BMP's have been included in the Washington State Dept. of Ecology Stormwater Management Manual, Puget Sound Water Quality Action Team Management Plan, and Seattle's Stormwater Manual. King County's draft Site Alterations ordinance revision would require restoration of soil functions in new development. The Tri-County (Snohomish, King and Pierce) Stormwater plan and the National Marine Fisheries Service Citizen's Guide to the 4(d) Rule both include soil amendment guidelines.
- **Public and Professional Education** King County and Seattle have developed extensive new public outreach on soils, composting, and natural landscaping practices. Professional education seminars have reached hundreds of landscape contractors, developers, architects, and public agency staff. The WA Organic Recycling Council sponsored a series of Stormwater & Soil Best Management Practice (BMP) workshops in 2002-03, with funding from the Puget Sound Action Team. The Master Builders Association of King and Snohomish Counties includes soil strategies in it's new "Built Green" Sustainable Building initiative.
- **Technical Standards** Snohomish County, where this initiative began, has sponsored development of science-based soil amendment specifications and inspection standards, which are applicable around the region. This work builds on research initiated by the City of Redmond and the University of Washington, among others. Research and specifications testing is also under way in Clark County, Seattle's Natural Drainage projects, a City of Tacoma/Washington State University project, and a Portland Metro/Oregon DEQ project.
- **Implementation** One site where soil amendment is working is at new Redmond Ridge development in King County, a large planned community where forest has been retained where possible, and all disturbed soils have been amended to a 12 inch depth, primarily with duff and organics recycled from site clearing. Another is the S.E.A. Streets demonstration project in Seattle, where a residential street retrofit includes soil amendment, detention swales, and native/low water use landscaping. The WA State Department of Transportation now uses organic amendments widely in road landscaping and in slope erosion control.

Challenges for the Future

Soil protection and restoration are clearly an essential part of Low Impact Development strategies for the Puget Sound region. Steps toward implementing this strategy include:

- Development of standard specifications and inspection procedures for soil amendment (through Snohomish Soil Improvement project).
- Research and field tests of appropriate amounts and types of amendment for different soil types.
- Quantification of the improvement in stormwater detention on different soil types.
- Widespread implementation on various sites, and reporting in case studies from those sites to build the practical knowledge base.
- Further adoption and testing of model soil protection/restoration regulations.
- Appropriate credit for soil amendment in the stormwater models that determine required detention pond sizing, and thus directly affect cost of development, to provide incentives for soil BMPs.
- Continuing outreach to stormwater management professionals, and especially to the development community: builders, contractors, planners, and developers.

References

[1] Beyerlein, Douglas, and Joseph Brascher. "Traditional Alternatives: Will More Detention Work?" in *Salmon in the City*, proceedings of conference in Mt. Vernon, WA, 1998, pp. 45-48. Copies available by calling WA State Univ. (253) 445-4575, or download at http://depts.washington.edu/cwws/Outreach/Publications/articles.html

[2] Horner, Richard R., and Christopher W. May. "Watershed Urbanization and the Decline of Salmon in Puget Sound Streams" in *Salmon in the City* conference proceedings, 1998, pp. 19-40. See source above.

[3] Smith, Dan. "The Case for Greener Cities." *American Forests*, Vol. 105, No. 3, Autumn 1999, pp. 34-39.
and Moll, Gary. "Trees are Money." *Imaging Notes*, Vol. 14, No. 1, Jan/Feb 1999.

[4] Kolsti, Kyle F., Burges, Stephen J., and Bruce W. Jensen. *Hydrologic Response of Residential-Scale Lawns on Till Containing Various Amounts of Compost Amendment.* Univ. of WA Center for Urban Water Resources, for WA Dept. of Ecology, 1995, pp. 1,88. Copies available from UW Engineering Professional Programs at (206) 543-5539

[5] Tyler, Rod. "Compost Filter Berms and Blankets". *Biocycle*, vol. 42, No. 1, Jan. 2001, pp. 26-33

[6] Coleman, David C., and D. A. Crossley, Jr. *Fundamentals of Soil Ecology*. San Diego; Academic Press (Harcourt Brace & Company), 1996, pp. 12-167.

[7] Chollak, Tracy, and Paul Rosenfeld. *Guidelines for Landscaping with Compost-Amended Soils*. City of Redmond Public Works, 1998, p. I.1-I.4. Download from City of Redmond website at http://www.ci.redmond.wa.us/insidecityhall/publicworks/environment/education.asp
and King County DNR/Cascadia Consulting, *Landscape Focus Group Findings: Compost Use*. Dec. 2000.

[8] McDonald, David K. *Ecologically Sound Lawn Care for the Pacific Northwest: Findings from the Scientific Literature and Recommendations from Turf Professionals*. City of Seattle Public Utilities, 1999, pp. 15-18. Download at http://www.seattle.gov/util/lawncare/LawnReport.htm or request free hard copy at (206)684-7560.

Resources

Background Science

Proceedings of the 1998 *Salmon in the City* conference http://depts.washington.edu/cwws/
This is the UW Center for Water and Watershed Studies website. Download the conference proceedings at http://depts.washington.edu/cwws/Outreach/Publications/articles.html This site also includes many other research papers on the effects of urbanization, stream restoration techniques, trials of permeable paving products, etc.

Soil Biology and Soil Functions: Why Soil Life Matters

US Dept. of Agriculture, NRCS Soil Quality Institute http://soils.usda.gov/sqi/
Download the excellent *Soil Biology Primer*, or order print copies from 1-800-THE SOIL

Soil Restoration and Compost Use

Washington Organic Recycling Council / Soils for Salmon http://www.compostwashington.org/ or **www.SoilsforSalmon.org** Complete background and up to date information on Soils for Salmon initiative, and useful links on compost use and soil restoration.

"The Relationship Between Soil and Water - How Soil Amendments and Compost Can Aid in Salmon Recovery" by Josh Marx, Andy Bary, Sego Jackson, David McDonald, and Holly Wescott, Seattle, 1999. http://dnr.metrokc.gov/swd/ResRecy/composting/soils4salmon.asp

U.S. Composting Council http://compostingcouncil.org/
The most authoritative source for information on compost specifications. Particularly useful to landscape professionals is the recently updated *Field Guide to Compost Use*.

Penn State Turfgrass Extension http://turfgrassmanagement.psu.edu/default.htm
Download Dr. Peter Landschoot's practical guide, *Using Composts to Improve Turfgrass Performance*

WA State Dept. of Ecology *Stormwater Management Manual for Western Washington*, see pp101-102 at http://www.ecy.wa.gov/pubs/9915.pdf for BMP T.5-13 "Post Construction Soil Quality and Depth", and see the Soils for Salmon website above for a useful manual for implementing that BMP.

WA Dept. of Transportation soil bio-engineering page, including a variety of techniques and specifications, http://www.wsdot.wa.gov/eesc/design/roadside/sb.htm

Seattle Public Utilities, SEA Street project soil specifications and other Natural Drainage design information at http://www.seattle.gov/util/NaturalSystems/default.htm ; best landscape practices (including soil) information at http://www.seattle.gov/util/rescons/plantNaturally

Puget Sound Action Team, Low Impact Development website includes a wide array of resources, at http://www.psat.wa.gov/Programs/LID.htm

For More Information Contact:
Washington Organic Recycling Council e-mail info@compostwashington.org
web www.compostwashington.org or **www.SoilsforSalmon.org**

Composting Council of Oregon http://www.compostingcouncilofor.org/SfS/SfShome.html and Soils for Salmon Oregon site http://www.soilsforsalmonoregon.org/