
# TECHNICAL BULLETIN

## Restoring Soil Quality on Construction Sites

***Reduce Compaction*** ***Increase Organic Matter*** ***Plant Native Turf***

Control with bluegrass mix on left. Treatment with sub-surface ripping, surface rototilling, compost , and buffalo and blue grama grasses on right.

Slotting or ripping tool used for subsurface soils on treatment side.

Native turf grass seed used for treatment side. Buffalo seed on left and blue grama grass seed on right.

Established turf. Native grasses on treatment side on left and bluegrass mix on control side on right.

**All** construction sites often have excessive erosion and compaction after topsoil removal, scraping, and mass grading. Compaction results in poor growth of lawns, shrubs, and trees. Also, reduced infiltration increases runoff of nutrients and pesticides and soil erosion contributing to stormwater pollution.

The Iowa Stormwater Education Program (ISWEP) is partnering with the Dr. Sally Logsdon at the USDA, ARS, National Laboratory of Agriculture and Environment in Ames to conduct studies to remediate soil compaction by focusing on soil quality. The research site is located at the Iowa Association of Municipal Utilities. The purpose of this study is to determine if compaction remediation are effective on a simulated urban site.

**EXPERIMENTAL PROCEDURE:**

A 15 m by 25 m (3.25 ft = 1 m) site with heavy clay soils was prepared for the project. Roundup™ was applied to the sod in the fall of 2007, and the sod was allowed to die. Following standard development practice the sod and topsoil were removed, the topsoil stockpiled onsite. In the spring of 2008 the area was graded to 1% slope, and the subsoil was compacted by trafficking with a tractor, which can be severe in moist soil due the tire scraping A shallow slotting tool that could be pulled by a tractor was made and used on the contour for the treatment of half of the area to a maximum of 15 cm (1 in = 2.54 cm) depth. The untreated topsoil was re-applied to the control side (~ 5 cm deep), some rototilling was needed to break-up the large clumps of clay. Topsoil (~5 cm deep) and compost (~10 cm deep) were applied to the treatment side and mixed by rototilling. Straw was used for erosion control.

A lawn mixture was planted May 2008 to the control side (30% Kentucky bluegrass, 40% perennial ryegrass, 30% creeping red fescue at a rate of 412 kg $Ha^{-1}$ Additional planting in July 2008 was by hand slot seeding. Short, warm season, native buffalo grass and blue grama grass, were each planted on the treatment side (194 kg $Ha^{-1}$ each, in May 2008; however, the buffalo grass did not emerge well and was replanted July 2008. The buffalo grass was seeded 0.3 cm deep with a rotary spreader. The blue grama grass seed was spread on the surface. Straw was added in June 2008 to protect the soil. Fertilizer (14 lbs. of 10-20-10) was applied June 2008 to the lawn area only. About every three weeks the area was mowed (6 to 7.5 cm height) and watered if needed.

**SOIL SAMPLING**

Six undisturbed soil cores (74 mm diameter, 76 mm long) (1 in = 25.4 mm) were collected from surface soil before soil disturbance in 2007 and again in the fall 2008 after disturbance and treatments were completed (five each treatment, surface (0-7.6 cm) and subsurface (8.0-15.6 cm) depths). The top of the subsurface depths were immediately beneath the surface applied soil or compost. The soil cores were used to measure bulk density which is a measure of soil compaction and saturated hydraulic conductivity (Ksat). Both arithmetic and geometric means for Ksat were calculated. Bulk density can be equated with compaction, the more dense the more compact. Saturated hydraulic conductivity is a measure of the speed of water movement through saturated soils. Additional samples were

*ISWEP which provides educational resources statewide to communities and other groups to inform and educate local stakeholders.*

***February 2013***

# TECHNICAL BULLETIN

## Restoring Soil Quality on Construction Sites

SOIL MOISTURE CONTENT AND RAINFALL SIMULATON

During the summer of 2008 a Hydra-probe was used to manually determine soil water content for each treatment. In August 2009, a rainfall simulator was used to evaluate infiltration, runoff, and soil erosion in 1.22 x 2.44 m plots, one per treatment. Run-off was collected at the down-slope end of the plot, where a V-shaped collector was placed above a collection trough to obtain runoff. Steady state conditions were assumed to have been established when runoff rates, measured at one-minute intervals, were constant for four consecutive minutes. Only steady state measurements were used for statistical analyses, measuring run-off rate every five minutes using a subsample. A soil core was collected to determine antecedent and post-rainfall soil moisture content for each plot. In September 2010, blocks of soil were sampled to examine roots and structure.

# STUDY RESULTS

### BULK DENSITY AND HYDRAULIC CONDUCTIVITY

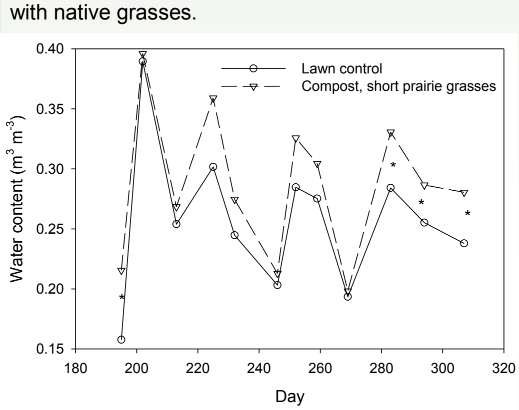
Table 1. Hydraulic conductivity (Ksat) and bulk density (BD) for experimental plots.

| Year | Treatment | Depth | Ksat† | CV | Ksat(geo)† | BD | CV |
|---|---|---|---|---|---|---|---|
| | | cm | cm $h^{-1}$ | g $cm^{-3}$ | | | |
| 2007 | Pretreatment | 0-7.6 | 6.43 | 104 | 2.08 | 1.39 | 7.5 |
| 2008 | Lawn Control Surface | 0-7.6 | 2.13 | 87 | 1.10 | 1.45 | 6.1 |
| | Lawn Control Subsurface | 8.0-15.6 | 6.92 | 182 | 0.17 | 1.75 | 5.8 |
| | Compost/Native Grasses Surface | 0-7.6 | 9.68 | 87 | 6.65 | 1.11 | 18.3 |
| | Compost/Native Grasses Subsurface | 8.0-15.6 | 1.16 | 207 | 0.07 | 1.70 | 3.7 |
| 2011 | Lawn Control Surface | 0-7.6 | 4.61 | | | 1.33 | |
| | Lawn Control Subsurface | 8.0-15.6 | | | | 1.62 | |
| | Compost/Native Grasses Surface | 0-7.6 | 11.04 | | | 0.91 | |
| | Compost/Native Grasses Subsurface | 8.0-15.6 | | | | 1.62 | |

**Summary:** Significant differences were difficult to observe because of variability, evident from the CV (coefficient of variability). This is common due to variability in macro-pores and cracks in the soil. One fast sample in the lawn subsoil sample skewed the results, as shown by the high CV and low geometric mean (Ksat, geo). The compost/native grasses treatment surface had numerically higher Ksat and lower bulk density than the lawn, though not significant. The bulk density was high in both subsoil sets of samples. The surface bulk density was significantly less than the subsurface bulk density for both lawn and compost treatments. The surface geometric Ksat was significantly faster compared with the subsurface for the compost treatment, but the depth differences were not significantly different for the lawn treatment (because of the one fast subsurface sample). Subsurface soils were more compacted than surface soils. Soil ripping did little to ameliorate the compaction of soils on the treatment plot. The compost and tilled soils on the treatment side were less compacted than the standard practice control.

### SOIL WATER CONTENT

Figure 1. Mean soil water content 0 to 4.5 cm from March through September, 2010, in the lawn/control area and in the area treated with compost and planted with native grasses.




**Summary:** The compost treatment had higher water contents than the lawn, The differences were greater in the spring when cool season grasses are more active in water uptake, and right after rain events.

### INFILTRATION RATES, SEDIMENT LOSS & WATER CONTENT

The lawn/control had greater infiltration rate but more sediment loss than the compost/native grasses treatment. These were preliminary results that require follow-up tests, additional infiltration tests will be reported in future bulletins; the compost/native grasses treatment had a greater increase in soil water content. Compost amended soils can hold more water than un-amended soil.

### ROOT STRUCTURE AND PENETRATION

The bottom depth for which roots were measured was between 9 and 12 cm for the lawn/control and 16-20 cm for the compost/ native grasses, extending below the depth of topsoil addition. The compost/native grasses treatment area had more roots penetrating through the topsoil addition, roots penetrated in all samples, around dense clods when necessary. All samples had evidence of mesofauna such as earthworms, pillbugs, centipedes, spiders, and even some insects.