Mitigating Soil Compaction in Newly Developed Residential Landscapes

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Hillshade model from soilexplorer.net
Landscape Traffic

Home Building Process: 90-120 Days to construct a home

90-120 days of:

- Heavy vehicle traffic
- Wetting and Drying
- Vehicle vibration
Soil Compaction
Compaction Mitigation Study

5,000 homes -> Buildout of 30,000 homes
Active Adult Community – Marion, CO.

Average: 250 gal./home/day
OTOW: 190 g/h/d (CUP: 150 g/h/d)

January 2017 – January 2019 (Beyond?)
Treatments

9 Model Homes
- 3 compacted
- 3 tilled (5-6 in.)
- 3 tilled compost into soil
  \[4 \text{ yd}^3/1000 \text{ ft}^2\]
  \((1 \text{ in. into } 6 \text{ in.})\)

Just before sod laid

<table>
<thead>
<tr>
<th>Depth (in.)</th>
<th>Treatment</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td>Compact</td>
<td>Till</td>
</tr>
<tr>
<td>6-12</td>
<td>Compact</td>
<td>Compact</td>
</tr>
</tbody>
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Soil Profile Development
Bulk Density

Bulk Density (g/cc) | 0-15 cm

Bulk Density (g/cc) | 15-30 cm

- Compost+Till
- Control
- Till
Soil Water Release Curves

- Null
- Till
- Compost

Volumetric Water Content, $\theta$

Matric Pressure (Bar)
Turf Quality – September 17, 2017

Compacted

Tilled

Tilled w Compost
Chronosequence: Bulk Density

LAWNS

BEDS
Bigger Picture

Phase I – 9 model homes

Phase II – Plots on UF Campus
   Stress Turfgrass

Phase III – 28 Homeowners in OToW
   Water Savings, WQ, and Top Dressing

Chronosequence – 50 homes in OToW
Acknowledgements

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David Gruber, Earthscapes Unlimited
Questions?

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<tbody>
<tr>
<td>Depth to Refusal</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Weather Station

Forecast for Ocala, FL: 29.094N -82.288W > 72 ft

Current Conditions: Station reported 2 seconds ago

61.3°F
Feels Like 61.3°F

Dew Point: 60°F
Humidity: 97%
Precip Rate: 0 in/hr
Precip Accum: 0.00 in
Pressure: 30.23 in

Wind: ESE 0.0 mph
Gusts: 0.0 mph

UV: 0.0
Solar: 16 W/m²
Soil Moisture: --
Soil Temp: --
Leaf Wetness: --

7:14 AM  6:12 PM

View WunderMap
Irma’s Influence on Gainesville’s 2017 Precipitation Saga

**Accumulated Precipitation – Gainesville Area, FL (ThreadEx)**

- After Irma (Sept 11th): 64.08”
- Record Dry Start (May 23rd): 7.68”
- #2 all time: 1953: 73.30”

**Hurricane Irma Facts**
- Two day total = 12.40 inches
- Two daily records (previous Dora records):
  - 9/10 = 6.63 (4.69) inches
  - 9/11 = 5.77 (1.69) inches
- Two day rainfall record as well!

**Record Facts**
- 7.68 in (May 23rd) to 64.08 in (Sept 11)
- 111 day total = 56.40 inches
- Equivalent to seeing at least 0.51 inches of rain per day for 111 days
- Wettest year? 1953 with 73.30 inches
Volumetric Water Content, θ

8/1  8/6  8/11  8/16  8/21  8/26  8/31
M/D/2017

3 N  4 T  5 C
7 N  15 T  16 C
13 N  12 T  14 C
Infiltration Rates

- Constant Head Double Ring Infiltrometer Method (ASTM D3385)
- Conducted during April and May

<table>
<thead>
<tr>
<th></th>
<th>Compacted (Null) in./h</th>
<th>Tilled in./h</th>
<th>Till &amp; Compost in./h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 3</td>
<td>0.15</td>
<td>Lot 4</td>
<td>1.50</td>
</tr>
<tr>
<td>Lot 13</td>
<td>0.09</td>
<td>Lot 12</td>
<td>0.25</td>
</tr>
<tr>
<td>Lot 7</td>
<td>&lt; 0.04</td>
<td>Lot 15</td>
<td>&lt; 0.06</td>
</tr>
<tr>
<td>Lot 5</td>
<td></td>
<td>Lot 14</td>
<td>0.08</td>
</tr>
<tr>
<td>Lot 6</td>
<td></td>
<td>Lot 16</td>
<td>0.22</td>
</tr>
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Landscape Development Process

Master Grading Plan
Make me a landscape/lawn!
Soil Compaction

‘Ideal Soil’ (50% solid, 25% air, 25% water)

Compacted Soil

Soil Solid

Water

Air
Cone Penetrometer Measurements

Measures Pressure for Cone Penetrating Soil Profile

Maximum Pressure is 7,000+ kPa
(~200 lbs. over cone area)

Maximum Depth: 45 cm (18 in.)

Profiles collected
Baseline & Post-Treatment
Soil Compaction Profiles

- X-axis: Depth, in.
- Y-axis: Compaction, kPa

The graph shows the compaction profiles at different depths, with each line representing a different sample or condition.
Cone Penetrometer Profiles
Post-Treatments

Lot 3-N
Lot 13-N
Lot 7-N
Lot 4-T
Lot 12-T
Lot 5-C
Lot 14-C
Lot 16-C
<table>
<thead>
<tr>
<th>Undeveloped</th>
<th>New Yards</th>
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</thead>
<tbody>
<tr>
<td>Depth to Refusal (cm)</td>
<td>&gt;120</td>
</tr>
<tr>
<td>Bulk Density (g/cc)</td>
<td>1.23</td>
</tr>
<tr>
<td>Porosity (%)</td>
<td>51</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>1.7</td>
</tr>
<tr>
<td>pH</td>
<td>4.0</td>
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<tr>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>1.75</td>
</tr>
<tr>
<td></td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>6.4</td>
</tr>
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Data from Kayci Kowalski

![Effects of soil pH on nutrient availability](chart.png)
On Top of the World

- Can compaction mitigation improve water availability for turfgrass?

- Monitoring/Sampling:
  - Soil Moisture
  - On-site Weathers Station
  - High Frequency Water Use
  - Soils Properties
  - Turfgrass Biomass
  - ‘Green-ness’