Sustainable Landscaping Basics, Options & Issues

WHY COMPOST? WHY SUSTAINABLE METHODS?
- Landscape architects, designers and contractors are forced to rehabilitate problematic sites
- Shrinking budgets

Poor Soil Qualities, Structure.....
- **Topsoil** – the surface or upper part of the soil profile, naturally generated medium consisting of sand, silt, clay, organic matter, trace amounts of nutrients
- **Subsoil** – are often devoid of organic matter and nutrients, and do not possess the physical structure required for optimum plant growth

- We are not often left true topsoil on project sites
- Compost improves soil structure, can even turn subsoil (sand) into functioning landscape soils

Soil Components
Characteristics of an ideal soil...we never have it!

About ¼ of the soil volume is solid particles

About ¼ of the soil volume is pore space

- Mineral Matter 45%
- Soil Air 25%
- Soil Water 25%
- Organic Matter 5%

Plus nutrients, microbes, other life forms.....
Fix soil to improve plant survivability

Changing Regulations

NPDES Phase II
Storm water management (and related erosion) is a greater issue

Source: www.SoilsforSalmon.org

Interest in ‘Green’ Building
- EPA – ‘Green Building': practice of maximizing the efficiency with which buildings and their sites use resources, while minimizing building impacts on human health and the environment, throughout the complete building life cycle.
- US Green Buildings Council - focuses more on the ‘building’ itself
- LEED = Leadership in Energy & Env’t. Design - credit system
- New building construction (LEED-NC credits)
  - Compost contributes in 3 (of 6) categories: Sustainable Sites, Water Efficiency, Materials & Resources
- Compost usage concepts: restoring habitats, decreasing storm water, helping to decrease urban heat islands & water use, using recycled & locally manufactured materials
**LEED Sustainable Site Credits**

- Category divided into 15 subcategories
  - Compost BMPs can contribute credits in 5 categories:
    - Prerequisite 1 – Construction activity pollution prevention
    - SS Credit 5.1 – Site Development: Protect and Restore Habitat
    - SS Credit 6.1 – Storm Water Design: Quantity Control
    - SS Credit 6.2 – Storm Water Design: Quality Control
    - SS Credit 7.2 – Heat Island Effect: Non-Roof
    - SS Credit 7.2 – Heat Island Effect: Roof
    - WE Credit 1.1 – Water Efficiency Landscape: Reduce 50%
    - WE Credit 1.1 – Water Efficiency Landscape: Reduce 100%
    - WE Credit 2 – Innovative Waste-water Technologies
    - MR Credit 4.1 – Recycled Cont: 10%
    - MR Credit 4.2 – Recycled Cont: 20%
    - MR Credit 5.1 – Reg’l Materials: 10%
    - MR Credit 5.2 – Reg’l Materials: 20%

**Sustainable Sites Initiative**

- The Sustainable Sites Initiative™ (SITES™) is an effort of the ASLA, the Lady Bird Johnson Wildflower Center (University of Texas at Austin) and the United States Botanic Garden to create voluntary national guidelines and performance benchmarks for sustainable land design, construction and maintenance practices.
- National rating system for sustainable landscapes
- Compost is specified for use in:
  - SSI Prerequisite Credit 7.2 – Restore Soils Disturbed During Construction
  - SSI Prerequisite Credit 7.3 – Restore Soils Disturbed by Previous Development
  - Innovation credits – may ways to use here

SSI methods = LEED credits (?)

**Customers are Demanding it**

- Irrigation & Green Industry Magazine: ‘green’ & ‘eco-friendly’ methods are in growing demand

**Recycling has Expanded**

- Yard trimmings
- Food residuals
- Biosolids
- Industrial by-products
- Woody materials
- Manure
- MSW

**Commercial Compost Production**

1) Feedstock preparation: grinding & mixing
2) High temperature composting phase
3) Lower temperature curing phase
4) Screening (sizing for specific applications)

**Compost / Composting**

Various types of composts in California
- 100 Commercial Licensed
- Many unlicensed – be careful
We’ve Built a Better Mousetrap!

Choices…….
are many in the marketplace

THEY’RE JUST NOT AS FUNCTIONAL!!

Typical installation and use scenarios

After ½” of rain, six weeks later
(Hydroseed & straw = no germination)

Compost blanket
Hydroseed & straw

Source: Filtrex
Source: TCEQ
Source: Filtrex International, LLC
Compost Blanket

Bio-Based Options

Bioengineering Sites with Compost

Compost Works Because it Provides Various Benefits

Physical:
- Improves soil structure
- Moisture management

Chemical:
- Modifies and stabilizes pH
- Increases cation exchange capacity
- Supplies nutrients

Biological:
- Supplies soil biota
- Suppresses plant diseases

Other:
- Binds/degrades contaminants
- Binds nutrients

Soil Structure: Physical Modification

Oxygen, water, nutrient, pesticide movement, pore space

Soil Aggregation

A well aggregated soil has a range of pore sizes. This medium size soil crumb is made up of many smaller ones. Very large pores occur between the medium size aggregates. Occurs physically and biologically.

Less wind and water erosion, better accepts water

Improved
- Tilth
- Reduced bulk density
- Improved rooting

Long Lasting Organic Matter - Lignin as % of Total Organic Carbon
Effect of Organic Matter on Available Soil Water

- ATTRA – each increase of 1% OM can increase soil WHC by 16,500 gallons H₂O/A
- Reduce irrigation 30-50% by ‘fixing’ soil first

Compost Restores Stormwater Infiltration Capacity

Source: University of Washington trials on glacial till soil. Reduce runoff by up to 50%

Compost Supplies Macro and Micro Nutrients

So can modify pre-plant fertilization packages
Also can replace lime and gypsum application

SOM is a Nutrient Reservoir:
- Cation exchange capacity (CEC) is the total amount of cations that a soil can retain
- The higher the soil CEC the greater ability it has to store plant nutrients (reservoir) > long-term fertility?
- Soil CEC increases as
  - The amount of clay increases
  - The amount of organic matter increases
  - The soil pH increases

Composting Creates High Temperatures:
(Naturally)
- Weed free
- Human/animal pathogen, and
- Plant disease destruction

Suppresses Soil-Borne Diseases

4 Mechanisms of Disease Suppression, via beneficial organisms:
1. Induced systemic resistance (ISR) or systemic acquired resistance (SAR) – turns on plant’s natural disease-fighting mechanisms
2. Antagonism (kills/harms disease organisms)
3. Competition for nutrients (and energy)
4. Competition for root colonization
**Soil Health**

- Physical
  - Root proliferation
  - Aeration
  - Water retention
  - Water infiltration and transmission

- Chemical
  - Nutrient retention and release
  - pH
  - Energy (C) storage
  - Toxicity prevention

- Biological
  - Pest suppression
  - N mineralization
  - OM decomposition
  - Habitat protection

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**How to Choose a Compost Product**

**Understand**
- Compost characteristics
- Soil characteristics
- Application (specific end use)

**Know**
- Your supplier
  - Staff, process, facility
- Go by the ‘spec’

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**Buy a Certified Product**

U.S. Composting Council
Seal of Testing Assurance Program

Specific nutrients, pH, OM, EC, moisture, heavy metals, particle size, pathogens, stability, maturity, and more

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**BASICS - Participating Composters:**

- Complete on-going product testing
  - Operate on-going sampling/testing regime
  - Using uniform sampling and analytical testing methods (from the TMECC)
  - Using only STA Program certified labs
- Disclose test data results (lab analyses) and provide appropriate end use instructions to end users

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**DOTs Requiring STA Certification**

- California - Caltrans
- Colorado
- Georgia
- Iowa
- North Carolina
- Pennsylvania
- Oregon
- South Carolina
- Texas
- Washington State
- Working: MI, MN, NY, WI

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**This is what a “good” compost looks like**
Compost Application

Soil Incorporant
- Turf establishment
- Garden bed preparation
- Reclamation/remediation
- Nursery production
- Roadside Vegetation

Surface Applied
- Garden bed mulch
- Erosion control media
- Turf topdressing

Growing Media Component
- Container/potting substrates
- Landscape (e.g. rooftop, raised planters)
- Backfill mixes (tree and shrub plantings)
- Golf course (e.g. tee, green, divot mixes)
- Manufactured topsoil

Summary
Will discuss, as per Caltran specs

General Landscape Applications

- Planting Beds
- Backfill Mixes
- Turf Establishment

Soil Amendment (Compost)

Apply 1-2" layer (specify within spec)
Incorporate to a 6-8" depth
(6 CY / 1,000 SF)

Remove clods, stones, etc. over 2" Smooth planting area
Plant as specified

Water plants in well
(fertilizer, lime, gypsum)

Reforestation project by the Presidio Trust
Excavate planting hole 2-3 width of rootball

Blend compost and existing soil – typically 2 : 1 by volume

Place plant
Backfill hole with soil blend
Firm occasionally
Water

Apply 1-2" layer (sometimes more) (specify within spec)

Remove clods, stones, etc. over 2"
Incorporate to 6-8" depth
Smooth prior to seeding or laying sod

Water and fertilize
Soil Amendment (compost) - Physical and Chemical Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
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<tbody>
<tr>
<td>pH</td>
<td>TMECC 04.11 A Elastometric</td>
<td>6.0 – 8.0</td>
</tr>
<tr>
<td>Soluble Salts</td>
<td>TMECC 04.10 A Electrical Conductivity 1:5 Shurry Method dS/m (mmhos/cm)</td>
<td>0 – 15.0</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>TMECC 03.09 A Total Solids &amp; Moisture at 70°C ± 2 deg C % Wet Weight Basis</td>
<td>30 – 60</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>Loss-On-Ignition/Organic Matter Method (LOI) % Dry Weight Basis</td>
<td>35 – 95</td>
</tr>
<tr>
<td>Maturity</td>
<td>TMECC 05.07 A Germination, % Relative to Positive Control</td>
<td>Seed Emergence 80 or Above 80 or Above</td>
</tr>
<tr>
<td>Stability</td>
<td>TMECC 05.08 A Carbon Dioxide Evolution Rate mg CO₂/g OM per day</td>
<td>≤ 8 or below</td>
</tr>
<tr>
<td>Particle Size</td>
<td>TMECC 02.02 B Sample Sieving for Aggregate Size Classification % Dry Weight Basis</td>
<td>≤ 25 % Passing through 1/4″ sieve ≤ 25 % ≤ 1/4″ Max. Length ≤ 4 inches</td>
</tr>
<tr>
<td>Pathogens</td>
<td>TMECC 07.01 A Fecal Coliform Bacteria &lt; 1000 MPN/g dry wt.</td>
<td>&lt;1000 (Pass)</td>
</tr>
<tr>
<td>Pathogens</td>
<td>TMECC 07.01 A Salmonella &lt; 3 MPN/4 grams dry wt.</td>
<td>&lt;3 (Pass)</td>
</tr>
<tr>
<td>Physical Contaminants</td>
<td>TMECC 02.02 C Plastic, Glass and Metal - &gt; 4mm fraction</td>
<td>Combined Total: ≤ 0.5</td>
</tr>
</tbody>
</table>

In handout...

Cost Comparison

Based on an area of 5,000 SF

Option 1 (install 6" of topsoil)
- Topsoil required: approx. 93 CY
- Unit price would be anywhere from $30 - $35/CY installed

GRAND TOTAL: $3,022 (Approximately $26,000/A)

Option 2 (install 2" of compost and amend into 6 inches of existing soil)
- Compost required: approx. 31 CY
- Unit price to install and amend would be anywhere from $40 - $45/CY installed

GRAND TOTAL: $1,318 (Approximately $11,500/A)

General Landscape Applications

- Mulching

Mulch > compost based

Apply uniform 2-3" layer (specify within spec)

Smooth evenly and water

- Specify and use coarser, woody fraction for best results
- Avoid tree/shrub/plant trucks/stems, don’t apply within 4’ of drainage ditches

Source: RAA / McGill Env'l Systems

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<tbody>
<tr>
<td>pH</td>
<td>TMECC 04.11 - A Elastometric pH 1:5 Slurry Method</td>
<td>pH Units 6.0 – 8.5</td>
</tr>
<tr>
<td>Soluble Salts</td>
<td>TMECC 04.10 - A Electrical Conductivity 1:5 Slurry Method</td>
<td>N/A</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>TMECC 04.09 - A Organic Matter Method</td>
<td>Total Solids &amp; Moisture % Wet Weight Basis 30 – 100</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>TMECC 05.07 - A Loss On Ignition (Organic Matter Method) % Dry Weight Basis</td>
<td></td>
</tr>
<tr>
<td>Maturity</td>
<td>TMECC 05.05 - A Germination and Vigor, % Relative to Positive Control Seed Emergence</td>
<td>Seedling Vigor N/A</td>
</tr>
<tr>
<td>Stability</td>
<td>TMECC 05.08 - B Carbon Dioxide Evolution Rate mg CO₂/g DM per day</td>
<td>N/A</td>
</tr>
<tr>
<td>Particle Size</td>
<td>TMECC 02.02 - B Sample Sieving for Aggregate Size Classification</td>
<td>% Dry Weight Basis</td>
</tr>
<tr>
<td>Pathogen</td>
<td>TMECC 07.01 - B Fecal Coliform Bacteria</td>
<td>&lt; 1000 MPN/gram dry wt.</td>
</tr>
<tr>
<td>Pathogen</td>
<td>TMECC 07.01 - B Salmonella</td>
<td>&lt; 3 MPN/4 grams dry wt.</td>
</tr>
<tr>
<td>Physical Contaminants</td>
<td>TMECC 02.02 - C Man Made Inert Removal and Classification: Plastic, Glass and Metal</td>
<td>% &gt; 4mm fraction Combined Total: &lt; 1.0</td>
</tr>
<tr>
<td>Physical Contaminants</td>
<td>TMECC 02.02 - C Man Made Inert Removal and Classification: Sharps (Sewing needles, hypodermic needles)</td>
<td>None Detected</td>
</tr>
</tbody>
</table>

**NOTE:** TMECC refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).

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### Landscape / Restoration Application

- **Site Restoration / Natives**

  **Compost (incorporate)**

  - Incorporate to a depth of 12-18"
  - Avoid pavement edges (within 2')

  **Apply 4" coarse, compost**

  Typically used on hot, dry sites where natives are established (low nutrient requirements)

  **Rake and compact, as required**

  **Seed/Vegetate**

  **Apply erosion control measures**
Caltrans research found....
Deep incorporation of compost improves soil characteristics including:
- Infiltration and permeability
- Water holding capacity
- Texture
- Nutrient levels and cycling
- Micro-organism populations
- Rooting depth
- Oxygen exchange and air space
- Vegetation Coverage

Compost (Incorporate) - Physical and Chemical Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>TMECC 04.01A - Elastometric</td>
<td>5.0-9.0</td>
</tr>
<tr>
<td>Soluble Solids</td>
<td>TMECC 04.01A - Total Solids &amp; Moisture at 70°C to 105°C Wet Weight Basis</td>
<td>0-10.0</td>
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<tr>
<td>Moisture Content</td>
<td>TMECC 04.01A - Total Solids &amp; Moisture at 70°C to 105°C Wet Weight Basis</td>
<td>30-40</td>
</tr>
<tr>
<td>Organic Matter Content</td>
<td>TMECC 04.01A - Loss-on-Ignition/Organic Matter Test (LOI) % Dry Weight Basis</td>
<td>20-30</td>
</tr>
<tr>
<td>Maturity</td>
<td>TMECC 04.01B - Germination and Vigor, % Relative to Positive Control Seed Emergence Seedling Germination</td>
<td>60 or above, 60 or above</td>
</tr>
<tr>
<td>Stability</td>
<td>TMECC 04.01B - Carbon Dioxide Evolution Rate mg CO₂/g OM per day</td>
<td>80 or below</td>
</tr>
<tr>
<td>Particle Size</td>
<td>TMECC 02.02 - Sample Sieving for Aggregate Size Classification % Dry Weight Basis</td>
<td>95% Pass, 5% Failure, Max. Length 3 inches</td>
</tr>
<tr>
<td>Pathogen</td>
<td>TMECC 02.02 - Fecal Coliform Bacteria = 100 MPN (gram dry wt)</td>
<td>&lt;1000 (Pass)</td>
</tr>
<tr>
<td>Pathogen</td>
<td>TMECC 02.02 - Salmonella: S-2100 gram dry wt</td>
<td>&lt;1.0 (Pass)</td>
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<tr>
<td>Physical Contaminants</td>
<td>TMECC 02.02 - Man Made Inert Removal and Classification: Plastic, Glass and Metal, % &gt; 4mm fraction</td>
<td>None Detected</td>
</tr>
<tr>
<td>Physical Contaminants</td>
<td>TMECC 02.02 - Man Made Inert Removal and Classification: Plastic, Glass and Metal, % &gt; 4mm fraction</td>
<td>None Detected</td>
</tr>
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</table>

Erosion/Sediment Control

- Erosion Control (Compost blanket)
- Compost Sock

Compost Blankets
1-2" depth (specify within spec), onto up to 2:1 slopes, apply 3’ above the top of the slope and into existing vegetation

Apply any necessary erosion control techniques

Source: TxDOT and TECQ
### Filter Socks

**Advantages:**
- Can be staked into place to allow use in concentrated flows of water
- When filled, socks are very heavy and have good soil contact (don’t have to ‘dig in’)
- Continuous socks can be created, unlimited length
- Are 3 dimensional, sediment is caught in the organic mass (pore spaces)
- Coarse particles allow water to flow through, while finer particles trap sediment

![Filter Socks Image](image-url)

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### Compost Blanket - Physical and Chemical Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>TS 431.00</td>
<td>6.0-8.5</td>
</tr>
<tr>
<td>Moisture Content</td>
<td>TS 431.00</td>
<td>50-70%</td>
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<tr>
<td>Organic Matter Content</td>
<td>TS 431.00</td>
<td>25% - 35% Dry Weight Basis</td>
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<tr>
<td>Bio-Organic Matter</td>
<td>TS 431.00</td>
<td>5% - 7% Dry Weight Basis (in compost)</td>
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<tr>
<td>Salinity</td>
<td>TS 431.00</td>
<td>0.01 Molar Equivalent</td>
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<tr>
<td>Nutrient Content</td>
<td>TS 431.00</td>
<td>N: 2%, P: 0.3%, K: 0.3%, Total C: 80 or Above</td>
</tr>
<tr>
<td>Density</td>
<td>TS 431.00</td>
<td>65 lbs/ft³</td>
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<tr>
<td>Carbon Dioxide Evolution Rate</td>
<td>TS 431.00</td>
<td>30 C/g OM per day</td>
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<tr>
<td>pH</td>
<td>TMECC 04.11</td>
<td>6.0 or Above</td>
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<tr>
<td>Soluble Salts</td>
<td>TMECC 04.10</td>
<td>30 dS/m (mmhos/cm)</td>
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<tr>
<td>Electrical Conductivity</td>
<td>TMECC 04.10</td>
<td>6.0 or Above</td>
</tr>
<tr>
<td>Organic Matter Content</td>
<td>TMECC 03.09</td>
<td>30% Passing, 3 inch 100% Passing, 1 inch 80% Passing, 1/4 inch 50% Passing, 1/8 inch 25% Passing, 1/16 inch 10% Passing, 1/32 inch 5% Passing</td>
</tr>
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</table>
| CEC | TMECC 03.09 | 65 Meq/100g (

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<td>30 C/g OM per day</td>
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<tr>
<td>CEC</td>
<td>TMECC 03.09</td>
<td>65 Meq/100g</td>
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Other Applications

Not outlined in the Caltrans specifications

Use in landscaping, (subsoils/sand) reclamation, brownfields, contaminated sites, etc.

Topsoil Manufacturing

Instead of spec'ing 6" of topsoil (of unknown quality), spec 2" of compost and incorporate into site soil

On-site soil blending/ improvement

Financial savings, plus superior soil
Transport 270 CY, instead of 540-810 CY
Can be ½ the cost…

Can use the same technology for...

Reclamation, Revegetation, Brownfields

but must make sure that the landscaper follows through
Polkemmet Case Study

Constructions of two 18 hole golf courses using in situ materials which consist of colliery waste and compost to a ratio of 70% colliery waste and 30% compost. The colliery waste is crushed to 10mm and the compost is added after the waste has been applied.

Incredible project cost savings

Sports Turf Establishment & Maintenance

Compost is used as organic matter source in sand based media

Same green 18 years later

85:15 v/v sand to compost blend can meet STRI/USGA standards
Turf Topdressing
- Turf Maintenance
- Partial Renovation

Other Stormwater Management
(and High Tech)
Applications for Compost

Rain gardens and bioretention ponds
Source: SOCCRA

Green roofs
Source: IDNR, R. Alexander Associates, Inc., Erth Products, LLC

Living or green walls
Source: Filtrexx International, LLC
QUESTIONS