# Compost and Soil Improvement as Tools for Climate Resilient Landscapes

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STA Certified™ COMPOST
A program of the US Composting Council

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# INTRODUCTION

Soils are critical for the success of any landscaping project. As Landscape Architects, Engineers and Designers, soils are a critical tool to combat climate change and to increase resilience against the climate changes we are already experiencing. The single way to both improve soil quality and combat climate change is to increase the organic matter content in soils. The quickest, most effective and sustainable way to increase organic matter is to add it directly to soils. Compost is a stable source of organic matter, is readily available in most areas thanks in part to industry groups like the United States Composting Council. It can almost immediately improve soil quality and plant health. This guide is meant to provide a primer in soils, soil testing, and to show how compost can enhance any and every landscaping project, large or small to quantify the benefits that you can expect when you use compost. Enclosed are specifications, helpful tips and useful information for project owners, planners and all interested parties in how compost and compost uses offer tools as part of a "Climate Action Plan."

# THE SOIL

Soil is highly complex. There are multiple disciplines within the field of soil science. Soil chemistry, biology, physics, morphology and classification are the main ones. You don't however, need a PhD in soils to make a soil do what you need it to.

As a landscape architect, you likely want a soil to keep your plants healthy with a minimum of maintenance. You don't want it to wash away or to flood. And you would prefer to water and feed it as infrequently as possible. Here are some basic ways to characterize your soil.

## Texture

Soil consists of pore space, organic matter and minerals. The minerals are from rocks that have been ground down and weathered to form progressively smaller and smaller particles. The soil texture is a way to classify the size distribution of the particles in your soil. There are three types of particles when you are referring to soil texture:

- ✓ Sand
- ✓ Silt
- ✓ Clay

The difference between them is based solely on their size

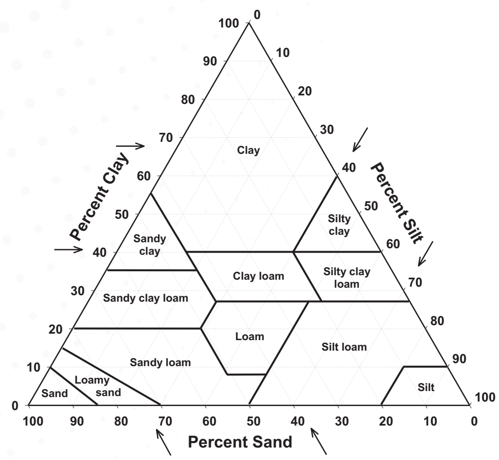
Soils are typically a blend of the three different types of particles. The dominant size fraction and associated soil texture classification will have major implications on how you work with the soil. You can't change the soil texture. You can work with the soil texture you have. Adding organic matter is the easiest way to overcome challenges associated with different soil textures.

## How to determine your soil texture

You can send soil samples to a lab to get a texture analysis. For example, the soil testing lab at Kansas State University charges $12.50 for a soil texture analysis https://www.agronomy.k- state.edu/outreach-and-services/soil-testing-lab/soil-analysis/producers-and-homeowners.html You can also test your soil texture by 'feeling' your soil.

Take a small amount of soil into your palm. Make sure it is wet. Feel the soil with your fingers. Can you feel individual particles? If so, you have sand in your soil.

If not - your soil is a silt or a clay. Roll the soil (moistened) into a ball and then with your fingers, see if you can make a ribbon out of your soil. If the ribbon holds and doesn't break, you have clay. If it breaks you have silt.




Soil texture is classified based on the relative proportions of sand, silt and clay. For example, you can have a sandy loam soil, one with mostly silt but a fair bit of sand. You can also have a loamy sand- mostly sand but with some silt.

## Here are some general characteristics of each type of soil

Clay soils consist of tiny particles that can stick together. They tend to be more inherently fertile than silts or sands. When wet, they will also hold onto water tightly, making them more drought resistant than other soils. Irrigate a clay soil very slowly to allow plenty of time for water to soak in rather than perch on the surface or runoff. They can also be easily compacted or 'heavy' making it hard for air and water to flow into and through them. Roots can also have a hard time penetrating a heavy clay soil. Getting water to soak into a clay soil can be a real problem. The best way to 'lighten' a clay soil is to add organic matter or compost. This will help those tiny particles come together into aggregates. It will lighten the soil, creating bigger pore spaces. Bigger pores translate into faster water infiltration, enhanced air flow and easier root growth.

Sandy soils consist of relatively gigantic particles. These particles are too heavy to erode in most storm events. Water soaks into and through these soils quickly. This makes them less likely to have standing water and more likely to show drought stress. Sandy soils require frequent irrigation. The giant particles have relatively low surface area, making them ineffective at holding onto nutrients. Adding organic matter to these soils will accomplish three things; it will help them hold onto water longer making for less frequent irrigation, it will help them hold onto nutrients longer making for less frequent fertilization and it will provide a slow-release source of nutrients for plants.

Silty soils or loams are the sweet spot between clays and sands. They tend to be high in nutrients and to allow for relatively quick water infiltration and good water retention. Because the particles are in between sands and clays in terms of size, they don't stick together but are light enough that they can erode. Soils around rivers are typically silts and are highly fertile as each flood deposits fresh silt on the riverbanks. Erosion is the biggest challenge with these soils.

Here, adding compost helps the silt particles form aggregates, allowing for water to soak in faster and making the soils less likely to erode. Note: soils are sometimes generically referred to as 'loam', but loam is actually a technical term for soils containing equal (approximately) amounts of sand, silt and clay.

## Bulk Density

Soil is very heavy- the top 6" of an acre of soil weighs about 1000 tons. A heavy soil is not a good soil. Making the soil weigh less is the easiest and most effective way to improve soil quality and/or functionality. Soil weight is typically measured and expressed as bulk density- or weight per unit of volume.

Rocks, the main ingredient of soil (in very small sizes) weigh about 2.65 grams per cubic centimeter (g cm3). A good soil, being at least 50% pore space should weigh no more than half of that or about 1.3 g cm3. Measuring the bulk density of your soil is not expensive or time consuming. There are special tools to measure bulk density- these can run you well over $1,000. You can also measure bulk density with an aluminum can, a hammer and a plank.

### Simplified method to measure bulk density

- Cut both ends off of an aluminum can. Make sure you know the volume of the can (volume is height x area.) The area is π r2 or 3.14 x the radius (half of the diameter) squared.
- Clear the surface of the soil and place the can on the surface. Put the plank over the can and gently hammer it into the soil until the top (upper rim) is level with the soil surface.
- Use a shovel to carefully dig out the can, making sure that the soil in the can stays put. Use a knife to scrape off any excess soil from the top and bottom of the can. The soil in the can is what you use to measure bulk density.
- Bulk density is a dry weight measure. Before you get the soil weight you need to make sure that it is dry. You can either let it air dry or you can accelerate the drying by putting the soil in a warm oven. Empty the contents of the can onto a baking sheet and place in a 300 ° oven for 2 hours. Alternatively, you can place on a paper bag and leave exposed to the air to dry (likely 24- 48 hours).
- Weigh the dry soil (in kg or g). The weight over the volume is the bulk density of the soil.

Reducing the bulk density of your soil is the best and easiest way to improve its quality and functionality. The fastest way to do this is to add organics such as composts to your soil. While the bulk density of a rock is 2.65 g cm3, the bulk density of compost is typically less than 0.5 g cm3.

Not only does adding organic matter reduce bulk density by mixing heavy with light, it also changes the way that the heavy is organized. The organic matter works as a glue to stick the heavier particles together into aggregates. The aggregates are a way to give more structure to the soil. More structure means more pore space. More pore space means lighter soil and lower bulk density.

## Bulk density and water

When soils have low bulk density, there is more room for soils to store water. It is also generally easier for water to soak into the soil. This reduces the potential for flooding. It also reduces the potential for soil to erode during storms. It is easy to measure how quickly water soaks into the soil. In fact, you can use the same tools that you used to measure bulk density.

When soil is very dry, it can be hydrophobic, or repel water. Pouring one unit of water into the soil and waiting a few minutes will help the soil to rewet sufficiently to allow for infiltration. If it is too dry, the water can runoff of the soil surface if it is added too quickly. Conversely, if the soil is saturated, all of the pore space will be filled with water and there will be no space for additional water to soak into. This test should not be done when the soil is saturated.

### Measuring water infiltration

- Clear the surface of the soil of any debris (leaves, branches).
- Mark a line on the outside and inside of the can to show how far you have to hammer it in to leave 10 cm (4") above the surface.
- Mark a second line inside the can at 5 cm (2") above the first.
- Hammer the can into the soil as described above, leaving 10 cm (4") above the soil
- Add water to the inside of the can to the 5 cm (2") line. That will give you a water depth of 5 cm (2"). The first time you do this will be to wet the soil.
- Wait a few minutes for the soil to wet and the water to be absorbed.
- Add a second quantity of water and see how long it takes to soak in.

Infiltration rates are typically expressed as centimeters per minute. This is the height of the water added in centimeters/ time to infiltrate into the soil. You can express your results in these units by dividing 5 cm/ the time until the water is absorbed.

Reducing the bulk density, something that can be accomplished almost instantaneously by adding compost, will result in faster water infiltration. This is very important in soils with clay and soils with low organic matter. In fact, rain gardens; specially designed soils to enhance water infiltration, are often made of an equal volume mixture of compost and sand.

## Salty soils

Soils in dry areas can accumulate excess salts. Soil salinity is a real concern and can limit plant growth. How salty a soil is measured by testing how effectively a soil solution can conduct electricity. The 'soluble' salts in a soil are positively charged ions. If there are a lot of them, they will easily conduct an electric charge. When you test your soil for excess salts, you are measuring its electrical conductivity or EC. The machines that do this are often also the machines that can measure how acid a soil is. This is also a routine test, offered at all soil testing labs. The price for an EC test at the Kansas State Lab is $7.25 per sample. The units for EC are either milliSiemens per meter (mS/m) or deciSiemens per meter (dS/m). A milliSiemen is 100x less than a deciSiemen. You will also often find the older unit of measure for EC being used; mmhos/cm. Mmhos/cm is equal to dS/m. Electrical conductivity values in normal soils are typically less than 1 dS/m. Low levels of salts that may impact some plants are 2-4 dS/m. Over 4 dS/m and you are likely to have problems with most plants. There are salt tolerant plants that are adapted to living in these environments.

If a soil is salty, it is most likely neutral or higher in pH. Acid soils tend to be well drained and water is one of the ways to eliminate excess salts. The typical salts you'll find in these soils are calcium, (Ca), magnesium (Mg), potassium (K) and sodium (Na). Sodium is the bad guy here. All of these 'salts' except for Na are necessary nutrients for plants. In addition to not being necessary for plants, Na can also hurt soils. Having excess Na in soils will tend to harm soil structure, making soils more like gels rather than aggregates. These soils are very difficult to irrigate and manage. One way to manage these soils is to add Ca. Improving the Ca: Na ratio is a way to limit the impact of excess Na. There are a range of soil tests geared to determining if excess Na is a concern. These include the exchangeable sodium percentage and the sodium adsorption ratio (SAR).

For a standard (not overly high in Na) soil, the best remedy is to add water. Make sure that the water itself isn't too salty and add enough to wash the excess salts out of the top horizon of the soil. That sounds great and easy on paper, but one of the issues for these soils is that there typically isn't a whole lot of water available to irrigate with.

Compost can help. Adding compost does not remove the excess salts. However, it dulls their impact. The organic matter in the compost helps the soils maintain their structure. It improves water infiltration and water holding capacity. This effectively increases the amount of water that is available to alleviate salt stress. It also lessens impacts to plants. Some farmers in arid areas (California and the southwestern U.S. states) use a combination of gypsum (calcium sulfate) and compost as a way to manage excess salts. For irrigated landscapes in arid areas, compost alone should be sufficient. For native landscapes in arid areas, compost will increase available moisture.

## Nutrients

All plants need nutrients to grow. The big three are nitrogen (N), phosphorus (P) and potassium (K). When you buy fertilizer there are typically three numbers (the "guaranteed analysis") on the bag. These, in order, refer to the N P K concentrations in the fertilizers.

## Nitrogen

For all plants except legumes, nitrogen is the nutrient that is needed in the greatest quantities that is also lowest in soils. Nitrogen in soils is typically present as organic N; associated with soil organic matter. There are also small amounts of mineral N. Mineral N is the term used for nitrogen that isn't associated with organic matter. Mineral N includes ammonia and nitrate.

Plants take up nitrogen either as ammonia or nitrate. In natural systems, most N in the soil will start out as organic N and transform through microbial processes to ammonia and then nitrate. It will then either be taken up by plants or soil organisms or return to the atmosphere through denitrification, the process where mineral N returns to a gaseous form.

The nitrogen in soils comes from our atmosphere, either directly or indirectly. The atmosphere consists of about 77% nitrogen gas. This is not a form of the nutrient that people or plants have access to. There are a range of natural processes that convert gaseous nitrogen to a mineral form that plants can use. The most important of these involve legumes, or plants that associate with soil microbes that are able to transform nitrogen gas into mineral nitrogen. Examples of legumes include clovers, alfalfa and vetches. There are also some trees that are able to fix nitrogen.

Alder is one example. You can enrich the soil in a landscape with nitrogen by including a mixture of nitrogen fixing plants.

Typically, landscapes are fertilized with nitrogen that has been produced through industrial processes. Commercial fertilizers use fossil fuels to take atmospheric nitrogen and turn it into ammonia. Common types of fertilizer nitrogen include anhydrous ammonia and MAP or mono ammonia phosphate. These forms of nitrogen are immediately plant available. They do not persist in soils, and can either be leached through the soil profile or transformed back to nitrogen gas through denitrification reactions.

There is a third way to enrich soils with nitrogen. All plants and human and animal waste materials contain nitrogen. By adding these materials to soils (typically done in a stabilized form as compost) it is possible to provide plants with a slow-release form of nitrogen. Adding organic N to soils is a way to enrich soil N but minimize the potential for nitrogen losses. Microbes gradually decompose the organic matter and in the process release N as mineral N. By using organics like composts instead of commercial fertilizers, it is possible to minimize or eliminate the need for regular use of synthetic fertilizers.

## Testing for soil nitrogen

It is possible to test soils for nitrate. This is done by extracting a soil sample with a reagent and measuring the nitrate that comes into the solution. As nitrate is only a tiny portion of total soil N, this test is not commonly used. Instead, you can test a soil for total carbon and nitrogen. This is typically done by combustion. The result will give you the percent concentration of nitrogen in the soil including organic N and mineral N. It will also give you the total carbon. The ratio of carbon to nitrogen in the soil as well as the total C will give you a sense of whether your soil has enough organic matter and if there should be sufficient available N over time. Organic matter is 57% carbon.

Total carbon in soil should range from 3-5%. It is very often lower. For new landscaping projects, the on-site soil may be very low in organic matter. With new construction, subsoils are often used. These materials are low in nutrients and have poor structure. In older, well developed and maintained landscapes, it is likely that you will find total carbon within this range or even higher. The carbon to nitrogen ratio in soil should be less than about 10:1 and the carbon should be above 3% for you to have sufficient N in a soil.

If you opt to provide N and/ or increase soil organic matter by adding compost, it is important to check the C:N ratio of the compost you are using. Some composts, such as those made from yard trimmings, can have a higher C:N ratio and these would not be a significant source of nitrogen for plants. Composts that contain animal manures, municipal biosolids (the solids from wastewater treatment) and food scraps, are typically higher in available N and can be an excellent source of both carbon and nitrogen to a soil.

## Phosphorus

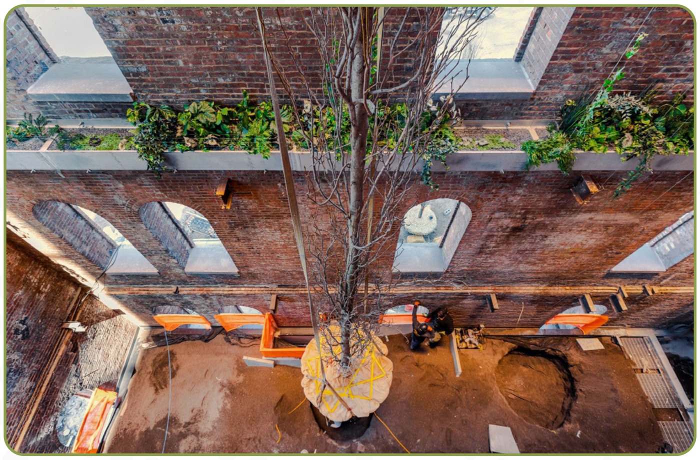
Like nitrogen, phosphorus is typically added to soils as phosphorus fertilizer. The source of phosphorus is mineral deposits of calcium phosphates. The US used to have extensive deposits of phosphorus in Idaho and Florida. Those are mostly exhausted. Now most of the phosphorus left to be mined is in Northern Africa. This has led to concerns that we are now past 'peak phosphorus' with worries that we will not have sufficient quantities of this nutrient to grow food in the coming decades.

At the same time that people are worried about exhausting reserves of P, we are also concerned about excess P in soils. When mined P became readily available as a fertilizer, extension agents encouraged farmers to apply plenty. Phosphorus can be very tightly bound in soils and the thought was extra P was like insurance. Only within the last few decades have people come to understand that excess P in soils can erode and enter surface water, causing eutrophication.

Because P has such low solubility, it erodes only when the particles of soil that it adheres to erode. If the soil is stable and stays in place, even during storm events, the potential for P movement is very small.

## How P binds in soils

Phosphorus can bind tightly to soil minerals, making it unavailable for plants. At more acidic soil pH (below 6), the phosphorus will form strong bonds with iron and aluminum. At higher pH (above 7) P will bind to calcium. By maintaining your soil pH between 6 and 7, you will maximize the fraction of total soil P that is plant available.



There are a range of soil tests to estimate plant available P and whether a soil has excess P. Tests to measure plant available P were developed for use in different regions of the US. The Bray and Olsen tests for available P were developed for neutral and high pH soils, respectively. In neutral and acidic soils, the plants will want access to P that is bound to iron or aluminum. The Bray extract attempts to mimic those conditions. In high pH soils (about 7.4), the P will be bound to calcium. The Olsen test tries to mimic those conditions. There are some tests that were developed to estimate plant available P under a wide range of soil conditions- Mechlich III is an example. A soil testing lab will typically use a method to measure P that is appropriate for the soils in its general area. Each test extracts only a fraction of the total phosphorus in the soil.

When you get results from a soil test, it will let you know if there is sufficient P for plant growth. Test results are generally reported as a number (ppm of available P) and an assessment of the P status of the soil. High, excess, low, moderate are some of the adjectives that may be used. If there is excess P in your soil, it is not necessary to add additional P fertilizers.

Like N, different sources of P will have different levels of plant availability. Adding phosphorus fertilizers will result in the highest fraction of available P. P can also be added as a component of animal manures, municipal biosolids and composts. A majority of the P in these materials will be organic P and will only become available as the soil microbes decompose the added organic matter. As with nitrogen, adding phosphorus to soils as a component of composts is a way to provide a long term, environmentally friendly

## Compost in soils

It can be said that whatever ails your soil, compost is the answer. As is clear from the above discussion, adding compost will improve soil physical properties (bulk density and water infiltration). It can ameliorate problems associated with salty soils. It can provide a long-term, environmentally friendly source of nutrients for plants. Most soils lack organic matter. Compost is a biologically stable form of organic matter, which means that it will not readily degrade in the soil. It is also a renewable and regulated product that can improve soils after a single application. When you add compost to soil, you will also sequester carbon. Each ton of compost (dry weight) can sequester over 1 ton of $CO_2$ through enhanced soil carbon storage. The actual amount of carbon stored will depend on the health of the soil, with higher storage potential in lower quality soils. For example, a study of long-term sites in Europe found that with an application of 2 tons of compost per year, soils stored between 0.18 and 0.42 tons of carbon or the equivalent of 0.66 to 1.55 tons of $CO_2$ each

# HEALTHY SOILS AND COMPOST

Healthy Soils are nature's ultimate buffer, a moderator of field and climatic conditions. Possessing significant amounts of stabilized organic matter, healthy soils:

- ✓ Possess an enhanced soil
- ✓ Resist erosion, as well as soil
- ✓ Better accept and hold water, making more available to plants
- ✓ Assist in stormwater management, by enhancing water percolation
- ✓ Hold and cycle nutrients to plants
- ✓ Feed soil microbes and resist soil borne diseases

These benefits create more climate resilient landscape soils, and soils that assist plant establishment and growth! Commercially manufactured compost is the most available and cost-effective form of stabilized organic matter in the marketplace.

## *How does compost use impact landscape architects and their clients?*

There are immediate and ongoing financial benefits to creating healthy soils and using compost on landscaping and construction projects! *It's like buying insurance!*

1. **Consistently enhances plant establishment, so reduces plant loss (and replacement costs)**
   *How: through enhanced water management and root penetration, disease suppression, providing plant nutrition and/or feeding beneficial soil microbes. Further, by reducing soil bulk density, plant roots more easily penetrate the soil, reducing its energy usage to do so.*
2. **Reduces ongoing cultural inputs, reducing plant establishment and maintenance costs**
   *How: by providing plant nutrients and enhancing their movement along with water to plants, nutrient and irrigation additions can be reduced. Further, plant damage and replacement can be reduced through natural disease suppression enhanced through compost addition.*
3. **Enhances site hydrology and moisture penetration, improving storm water management.**
   *This cannot only reduce the damage caused by intense rainstorms, but reduce the requirements for (or size of) required storm water management devices. This can reduce the cost of repairing areas of eroded soil, as well as reduce the cost of installing specific storm water management devices.*

   *How: by improving soil structure (large pore spacing and soil aggregation), as well as water acceptance and water holding capacity, water is more efficiently removed from the soil surface and moved vertically through the soil profile.*
4. **Reduces soil loss (erosion), therefore reducing the cost of site repair caused by water run-off (e.g., rill erosion, mulch movement, nutrient drift from the site)**
   *How: by improving soil structure (large pore spacing and soil aggregation) and water acceptance, water is more efficiently removed from the soil surface, and its velocity and lateral movement is reduced, thereby reducing its ability to dislodge and carry soil particles away.*

5. **Enhances plant growth, the speed in which grass cover is established and gardens, trees and shrubs grow, this impacts the overall beauty of the site and therefore the inherent value of the property**

The benefits and costs savings are everywhere from improving site soils. It just requires the landscape architect to illustrate both the short and long-term financial (and aesthetic) benefits…… not to mention the positive impacts on ameliorating climate change and its impacts to the landscape.

## Climate Change Amelioration Benefits of Compost Usage

1. **Can reduce the amount of fertilizer addition necessary to maintain the landscape**
   *How: Compost provides a significant amount of slow-release nutrition and increases soil cation exchange capacity, allowing for enhanced nutrient holding ability.*
2. **Can significantly reduce water usage (irrigation requirements)**
   *How: Compost not only holds water outright, but improves soil aggregation which creates large pore spaces in the soil, where water is held. Further, compost usage reduces soil crusting, making it easier for soil to accept water.*
3. **Can reduce pesticide usage**
   *How: Many composts possess natural disease suppressive properties, especially on soil-borne (bacterial and fungal) diseases.*
4. **Improves soil structure**
   *How: As certain soil microbes consume organic matter, they produce biologic glues that bind and aggregate smaller soil particles, while other microbes generate hyphae which does the same – in both cases creating large water stable pore spaces in the soil. In sandy soils, compost occupies void spaces, enhancing soil strength through similar biologic functions. In both cases, bulk density is reduced allowing for enhanced water, air and nutrient movement, and ease of plant root penetration.*
5. **Can reduce soil erosion and help manage storm water**
   *How: When incorporated into the soil, soil improves soil aggregation and water acceptance and penetration (as described earlier) helping to absorb larger volumes of water, reducing the volume that can carry soil particles away. Improving the soil strength can provide the same benefit. When used on slopes, coarse compost reduces slippage, greatly enhancing vegetation speed and rooting, while absorbing large volumes of water.*
6. **Enhances soil biota population and diversity**
   *How: Compost provides a good food source for beneficial soil and plant microbes, increasing their population, as well as the population of creatures that feed upon them (e.g., worms)*

# THE COMPOSTING INDUSTRY AND COMPOST SELECTION

The United States Composting Council (USCC) started in 1990 as an industry group composed of compost producers, technology providers, equipment manufacturers, municipal entities, and research scientists. These stakeholders came together to improve composting processes and professionalism in the industry, as well as better understand and promote compost products. The USCC and the non-profit Compost Research & Education Foundation (CREF), worked closely with the Environmental Protection Agency (EPA) and the U.S. Department of Agriculture (USDA) to develop the Test Methods for the Evaluation of Compost & Composting (TMECC) after reviewing decades of existing research and working with laboratory scientists. Structured similarly to the commonly used American Society of Testing & Materials (ASTM) standards, the TMECC provides a laboratory manual of testing methods related to the evaluation of compost. Using these standardized and specialized testing methods has enhanced the composting industry's ability to evaluate its products, as well as implement product standards required by end user and specifiers (find example landscape end use specifications in the Appendix).

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The TMECC is the foundation for the USCC's Seal of Testing Assurance (STA) Program. Hundreds of compost producers throughout the United States have enrolled their compost in this program, which requires testing on a regular basis from program qualified independent laboratories. This means that every participating compost producer will have up-to-date analysis of their compost using the TMECC methods for a variety of important product characteristics, including plant nutrients, moisture content, organic matter, pH, soluble salts, particle size, stability, maturity, select pathogens, and trace metals.

### Compost manufacturers participating in the STA program are required

- ✓ Complete on-going product testing (4-12 times/year)
  - Operate on-going sampling/testing regime, so historical product data is available
  - Using uniform sampling and analytical testing methods (from the — TMECC)
  - Using only STA Program certified labs.
- ✓ Disclose test data results (lab analyses) on a uniformly formatted label.
- ✓ Provide appropriate end use instructions to end users.

# Reviewing Compost Data Submittals

Specify and use only composts participating in the US Composting Council's national compost testing and information disclosure program, the Seal of Testing Assurance (STA) program. Make sure that the composter is participating in the program by obtaining test results on the program's official Compost Technical Data Sheet (CTDS) and is listed as a participant on the US Composting Council Seal of Testing Assurance website: https://www.compostingcouncil.org/page/participants (compost manufacturers can be located by state).

US COMPOSTING COUNCIL
*Seal of Testing Assurance*

**City of Raleigh**
Tim Gainer
900 North New Hope Road
Raleigh
NC 27610

*Product Identification*
LP-A

Date Sampled/Received: 28 Feb. 20 / 03 Mar. 20

## Compost Technical Data Sheet

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 tel: 831.724.5422 fax: 831.724.3188

| *Compost Parameters* | *Reported as (units of measure)* | *Test Results* | *Test Results* |
|---|---|---|---|
| Plant Nutrients: | %, weight basis | %, wet weight basis | %, dry weight basis |
| Nitrogen | Total N | 0.53 | 0.90 |
| Phosphorus | $P_2O_5$ | 0.15 | 0.25 |
| Potassium | $K_2O$ | 0.35 | 0.59 |
| Calcium | Ca | 0.55 | 0.95 |
| Magnesium | Mg | 0.14 | 0.24 |
| Moisture Content | %, wet weight basis | 41.8 | |
| Organic Matter Content | %, dry weight basis | 37.9 | |
| pH | units | 7.76 | |
| Soluble Salts (electrical conductivity $EC_5$) | dS/m (mmhos/cm) | 1.4 | |
| Particle Size or Sieve Size | % under 9.5 mm, dw basis | 99.8 | |
| Stability Indicator (respirometry) | | | *Stability Rating:* |
| $CO_2$ Evolution | mg $CO_2$-C/g OM/day | 3.1 | Stable |
| | mg $CO_2$-C/g TS/day | 1.2 | |
| Maturity Indicator (bioassay) | | | |
| Percent Emergence | average % of control | 86.7 | |
| Relative Seedling Vigor | average % of control | 108.5 | |
| Select Pathogens | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a) | Pass | *Fecal coliform* |
| | | Pass | *Salmonella* |
| Trace Metals | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3. | Pass | *As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn |

***Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.***

Laboratory Group: Mar20A Laboratory Number: 30046-1/1
Analyst: Assaf Sadeh www.controllabs.com

**Company & Product:** Check the company and location of the compost manufacturing and the product name against the information located on the US Composting Council Seal of Testing Assurance program website.

**Date:** Make sure you are reviewing a current CTDS, no more than 90-days old

**Compare compost analytical results against the numerical product requirements in the specification.**

Below are acceptable ranges for typical landscaping applications (and application rates).

Plant nutrient content requirements are not typically included in compost product specifications, because nutrients are supplemented through the addition of fertilizer during or after planting. *Note: fertilizer additions should be reduced within the specification when most composts are used.*

The following are acceptable compost parameter ranges for typical landscaping projects*

Moisture content – 30 – 60

Organic Matter content - 30 – 65

pH – 6.0 -8.5

Soluble Salts – maximum of 10**

Particle sizing*** – 95% or more passing 9.5mm / 3/8"

Stability – 4 or less

Maturity 80
80

Select Pathogens (Indicator organisms) – Pass (national requirements)

Trace Metals – Pass (national requirements)

*Plus - Physical Contaminants (inerts) - < 0.5% (0.25% film plastic) maximums – results found in analytical testing result detailed report*

*Acceptable ranges may be modified based on existing soil, plant requirements and compost application rates
**Sometimes maximum of 5, based on plant tolerances, soil characteristics and compost application rates
***Detailed particle size distribution data may be required for specific compost applications, results found in analytical testing result detailed report

If the compost falls out of the specified parameter ranges, it would be rejected, or additional support should be sought from a compost and/or soil expert. Compost testing submittals should be accompanied by a sample of the product.

Author: Ron Alexander, R. Alexander Associates, Inc. December 2023

# Interpreting the Seal of Testing Assurance Program Compost Technical Data Sheet Results

Make sure you are reviewing a current CTDS, no more than 90-days old. STA Program participants test from 4 to 12 times a year.

Moisture content is the measure of the amount of water in a compost product. It can impact ease of handling (if too wet or dry) and the cost of transport (affects weight of the product).

pH is a measure of how acid or basic the compost is. Based on the volume of compost added and the existing soil/media pH, compost's addition can raise or lower soil/media pH.

Particle size measures the volume of product that passes through a specific screen size. Composts with larger particles are excellent for use as a surface mulch, while finer composts are blended into soil or used as a turf topdressing.

Compost maturity is measured using a plant bioassay (growth trial). Poor growth can reflect an immature compost. All products will mature over time. A low rating suggests that the compost should be used at lower application rates.

Metal concentrations in composts are regulated by the EPA using risk-based standards. A 'Pass' means that metals in the compost are low enough to allow for the products unrestricted use. Note: many metals are essential plant nutrients and required for normal plant growth.

US COMPOSTING COUNCIL
*Seal of Testing Assurance*

**City of Raleigh**
Tim Gainer
900 North New Hope Road
Raleigh
NC 27610

***Product Identification***
LP-A

Date Sampled/Received: 28 Feb. 20 / 03 Mar. 20

## COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

| ***Compost Parameters*** | ***Reported as** (units of measure)* | ***Test Results*** | ***Test Results*** |
|---|---|---|---|
| Plant Nutrients: | %, weight basis | %, wet weight basis | %, dry weight basis |
| Nitrogen | Total N | 0.53 | 0.90 |
| Phosphorus | $P_2O_5$ | 0.15 | 0.25 |
| Potassium | $K_2O$ | 0.35 | 0.59 |
| Calcium | Ca | 0.55 | 0.95 |
| Magnesium | Mg | 0.14 | 0.24 |
| Moisture Content | %, wet weight basis | 41.8 | |
| Organic Matter Content | %, dry weight basis | 37.9 | |
| pH | units | 7.76 | |
| Soluble Salts *(electrical conductivity $EC_5$)* | dS/m (mmhos/cm) | 1.4 | |
| Particle Size or Sieve Size | % under 9.5 mm, dw basis | 99.8 | |
| Stability Indicator *(respirometry)* | | | *Stability Rating:* |
| $CO_2$ Evolution | mg $CO_2$-C/g OM/day | 3.1 | Stable |
| | mg $CO_2$-C/g TS/day | 1.2 | |
| Maturity Indicator (bioassay) | | | |
| Percent Emergence | average % of control | 86.7 | |
| Relative Seedling Vigor | average % of control | 108.5 | |
| Select Pathogens | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a) | Pass | *Fecal coliform* |
| | | Pass | *Salmonella* |
| Trace Metals | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3. | Pass | *As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn |

***Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.***

Laboratory Group: Mar20A    Laboratory Number: 30046-1/1

Analyst: Assaf Sadeh    www.controllabs.com

# Interpreting the Seal of Testing Assurance Program Compost Technical Data Sheet Results

Check the company and product name and the location against data on the Seal of Testing Assurance Program website to make sure you have the correct product data.

NPK is provided so fertility adjustments can be made. N&P in compost can release over a 3–5-year period, while most K is release within the first year.

Organic matter (OM) content is primarily in a stabilized (slow to degrade) form. Higher amounts of OM (30-60%) are desired in compost.

Electrical conductivity (EC) is the measure of soluble salt or ion content in compost. Note: composts EC levels are typically higher than the soil/media to which it is added, but it rarely affects long-term EC of the soil/media.

Stability is a measure of how biologically degraded the available carbon in the compost is. The lower the number, the more stable the carbon in the compost, which suggests a greater longevity in the soil and a minimal potential for odor.

These microbes are surrogates for the direct measurement of specific human pathogens (indicator organisms). A 'Pass' means that the compost is effectively pathogen free and can be handled and utilized safely.

US COMPOSTING COUNCIL
*Seal of Testing Assurance*

City of Raleigh
Tim Gainer
900 North New Hope Road
Raleigh
NC 27610

***Product Identification***
LP-A

Date Sampled/Received: 28 Feb. 20 / 03 Mar. 20

## COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

| *Compost Parameters* | *Reported as (units of measure)* | *Test Results* | *Test Results* |
|---|---|---|---|
| Plant Nutrients: | %, weight basis | %, wet weight basis | %, dry weight basis |
| Nitrogen | Total N | 0.53 | 0.90 |
| Phosphorus | $P_2O_5$ | 0.15 | 0.25 |
| Potassium | $K_2O$ | 0.35 | 0.59 |
| Calcium | Ca | 0.55 | 0.95 |
| Magnesium | Mg | 0.14 | 0.24 |
| Moisture Content | %, wet weight basis | 41.8 | |
| Organic Matter Content | %, dry weight basis | 37.9 | |
| pH | units | 7.76 | |
| Soluble Salts (*electrical conductivity $EC_5$*) | dS/m (mmhos/cm) | 1.4 | |
| Particle Size or Sieve Size | % under 9.5 mm, dw basis | 99.8 | |
| Stability Indicator *(respirometry)* | | | *Stability Rating:* |
| $CO_2$ Evolution | mg $CO_2$-C/g OM/day | 3.1 | Stable |
| | mg $CO_2$-C/g TS/day | 1.2 | |
| Maturity Indicator (bioassay) | | | |
| Percent Emergence | average % of control | 86.7 | |
| Relative Seedling Vigor | average % of control | 108.5 | |
| Select Pathogens | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a) | Pass | *Fecal coliform* |
| | | Pass | *Salmonella* |
| Trace Metals | PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3. | Pass | *As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn |

***Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.***

Laboratory Group: Mar20A Laboratory Number: 30046-1/1
Analyst: Assaf Sadeh www.controllabs.com

Author: Ron Alexander, R. Alexander Associates, Inc. December 2023

# Appendix A

# LANDSCAPE ARCHITECTURE / DESIGN SPECIFICATIONS FOR COMPOST USE

## SHORT FORMAT

- Turf Establishment with Compost
- Planting Bed Establishment with Compost
- Compost as a Landscape Backfill Mix Component
- Compost as a Landscape Mulch
- Compost as a Soil Blanket for Erosion Control
- Compost as a Filter Berm for Sediment Control

# SPECIFICATION
## TURF ESTABLISHMENT WITH COMPOST

Section _____,

**Description:**

This work shall consist of incorporating compost within the root zone to improve soil quality and plant growth. This specification applies to all types of turf establishment methods including seeding, sprigging, sodding, and hydroseeding.

**Materials:**

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 0.5% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.

**Product Parameters:**

| **Parameters**[1,6] | **Reported as** (units of measure) | **General Range** |
|---|---|---|
| pH[2] | pH units | 6.0 - 8.5 |
| Soluble Salt Concentration[2] (electrical conductivity) | dS/m (mmhos/cm) | Maximum 10 |
| Moisture Content | %, wet weight basis | 30 – 60 |
| Organic Matter Content | %, dry weight basis | 30 – 65 |
| Particle Size | % passing a selected mesh size, dry weight basis | 95% pass through 3/8” screen or smaller |
| Stability[3]<br>Carbon Dioxide Evolution Rate | mg $CO_2$-C per g OM per day | < 4 |
| Maturity[3] (Bioassay)<br>Seed Emergence and<br>Seedling Vigor | %, relative to positive control<br>%, relative to positive control | Minimum 80%<br>Minimum 80% |
| Physical Contaminants (inerts) | %, dry weight basis | < 0.5% (0.25% film plastic) |
| Chemical Contaminants[4] | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants[5]<br>Select Pathogens<br>Fecal Coliform Bacteria,<br>or Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)

[2] It should be noted that the pH and soluble salt content of the amended soil mix is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of a specific compost (soil conditioner) used to amend the soil. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.

[4] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[5] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[6] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

**Construction Requirements:**

- Compost shall be uniformly applied over the entire area at an average depth of 1 to 2 inches
- Incorporate to a depth of 6 to 8 inches (for a 20% to 30% inclusion rate) using a rotary tiller or other appropriate equipment. Higher inclusion rates are necessary for upgrading marginal soils.
- Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied before incorporation, as necessary.
- Rake soil surface smooth prior to seeding, sprigging, sodding, or hydroseeding.
- The soil surface shall be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Water thoroughly after seeding, sprigging, or sodding.
- Where necessary, topdress newly seeded and sprigged turf areas with a 1/4 inch layer of fine compost (3/8 inch screen, minus), then water to protect against hot, dry weather or drying winds.

**Method of Measurement:**

Compost will be measured by the cubic yard or the ton at the point of loading.

| |
|---|
| Soil Analysis: Before any soil preparation procedures ensue, a soil analysis shall be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil shall be appropriately amended to a range suitable for the turf species to be established. |
| The landscape architect/designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost. |

## SPECIFICATION
### PLANTING BED ESTABLISHMENT WITH COMPOST

Section _____,

**Description:**

This work shall consist of incorporating compost within the root zone in order to improve soil quality and plant growth. This specification applies to all types of plantings including; trees, shrubs, vines, ground covers, and herbaceous plants.

**Materials:**

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 0.5% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. For acid loving plants, only use a compost that has not received the addition of liming agents or ash by-products.

**Product Parameters:**

| **Parameters**[1,6] | **Reported as** (units of measure) | **General Range** |
|---|---|---|
| pH[2] | pH units | 6.0 - 8.5 |
| Soluble Salt Concentration[2] (electrical conductivity) | dS/m (mmhos/cm) | Maximum 10 |
| Moisture Content | %, wet weight basis | 30 – 60 |
| Organic Matter Content | %, dry weight basis | 30 – 65 |
| Particle Size | % passing a selected mesh size, dry weight basis | 95% pass through 3/8” screen or smaller |
| Stability[3]<br>Carbon Dioxide Evolution Rate | mg $CO_2$-C per g OM per day | < 4 |
| Maturity[3] (Bioassay)<br>Seed Emergence and<br>Seedling Vigor | %, relative to positive control<br>%, relative to positive control | Minimum 80%<br>Minimum 80% |
| Physical Contaminants (inerts) | %, dry weight basis | < 0.5% (0.25% film plastic) |
| Chemical Contaminants[4] | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants[5]<br>Select Pathogens | | |

| | | |
|---|---|---|
| Fecal Coliform Bacteria, or<br>Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)
2 It should be noted that the pH and soluble salt content of the amended soil mix is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of a specific compost (soil conditioner) used to amend the soil. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.
3 Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.
4 US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.
5 US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.
6 Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

**Construction Requirements:**

- Compost shall be uniformly applied over the planting area at an average depth of 1 to 2 inches.
- Incorporate uniformly to a depth of 6 to 8 inches using a rotary tiller or other appropriate equipment. Lower compost application rates may be necessary for salt sensitive crops or where composts possessing higher salt levels are used. For native species, not requiring much nutrition, use composts lower in nitrogen (and ammoniacal nitrogen) and stability (being stable to highly stable).
- Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied in conjunction with compost incorporation, as necessary.
- Rake soil surface smooth prior to planting.
- The soil surface shall be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance.
- Water thoroughly after planting.

**Method of Measurement:**

Compost will be measured by the cubic yard or the ton at the point of loading.

| |
|---|
| Soil Analysis: Before any soil preparation procedures ensue, a soil analysis shall be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil shall be appropriately amended to a range suitable for the turf species to be established. |
| The landscape architect/designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost. |

# SPECIFICATION
## COMPOST AS A LANDSCAPE BACKFILL MIX COMPONENT

Section _____,

**Description:**

This work shall consist of excavating a planting hole and blending compost with the excavated soil to improve soil quality and plant growth. This specification applies to all types of bare root, containerized, and balled and burlapped plant material.

**Materials:**

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. The product shall contain no substances toxic to plants and shall be reasonably free (< 0.5% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. For acid loving plants, provide only compost that has not received the addition of liming agents or ash by-products.

Composts containing available nutrients, primarily nitrogen, are preferred, while the use of unstable or immature compost is not approved. Care should be given when using composts possessing a basic pH (>7) near acid loving plants. A pH adjustment of the finished soil/compost mix may be necessary.

**Product Parameters:**

| **Parameters**[1,6] | **Reported as** (units of measure) | **General Range** |
|---|---|---|
| pH[2] | pH units | 6.0 - 8.5 |
| Soluble Salt Concentration[2] (electrical conductivity) | dS/m (mmhos/cm) | Maximum 10 |
| Moisture Content | %, wet weight basis | 30 – 60 |
| Organic Matter Content | %, dry weight basis | 30 – 65 |
| Particle Size | % passing a selected mesh size, dry weight basis | 95% pass through 3/8” screen or smaller |
| Stability[3]<br>Carbon Dioxide Evolution Rate | mg $CO_2$-C per g OM per day | < 4 |
| Maturity[3] (Bioassay)<br>Seed Emergence and<br>Seedling Vigor | %, relative to positive control<br>%, relative to positive control | Minimum 80%<br>Minimum 80% |
| Physical Contaminants (inerts) | %, dry weight basis | < 0.5% (0.25% film plastic) |

| | | |
|---|---|---|
| Chemical Contaminants[4] | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants[5]<br>Select Pathogens<br>Fecal Coliform Bacteria, or<br>Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)
2 It should be noted that the pH and soluble salt content of the amended soil mix is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of a specific compost (soil conditioner) used to amend the soil. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.
3 Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.
4 US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.
5 US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.
6 Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

**Construction Requirements:**

- Excavate a planting hole slightly shallower and 2 to 3 times the width of the root ball or container.
- Set the root ball on firm soil so that the top of the root ball will sit slightly higher than the final grade.
- Uniformly blend compost and excavated soil at a 1 compost : 2 or 3 soil ratio. For plants with lower nutritional requirements, use the 1: 3 ratio.
- Backfill and firm the soil blend around the root ball within the planting hole.
- Water thoroughly during and after planting.

**Method of Measurement:**

Compost will be measured by the cubic yard or the ton at the point of loading.

| |
|---|
| Soil Analysis: Before any soil preparation procedures ensue, a soil analysis shall be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil shall be appropriately amended to a range suitable for the turf species to be established. |
| The landscape architect/designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer’s recommendations. The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost. |

# SPECIFICATION
## COMPOST AS A LANDSCAPE MULCH

Section _____,

**Description:**

This work shall consist of applying compost to the soil surface after planting to help inhibit weed growth, conserve soil moisture, and reduce soil erosion.

**Materials:**

Compost mulch shall be a well decomposed, weed free organic matter source. It shall be derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated waste. The product shall contain no substances toxic to plants and be free (< 0.1% by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. For acid loving plants, only use a compost that has not received the addition of liming agents or ash by-products.

**Product Parameters:**

| **Parameters**[1,5] | **Reported as** **(units of measure)** | **General Range** |
|---|---|---|
| pH[2] | pH units | 5.5 – 9.0 |
| Soluble Salt Concentration[2] (electrical conductivity) | dS/m (mmhos/cm) | Maximum 10 |
| Moisture Content | %, wet weight basis | 25 – 60 |
| Organic Matter Content | %, dry weight basis | > 30 |
| Particle Size | % passing a selected mesh size, dry weight basis | 99% pass through 3” screen,<br>>25% passing 3/8” screen |
| Physical Contaminants (inerts) | %, dry weight basis | < 0.1 |
| Chemical Contaminants[3] | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants[4]<br>Select Pathogens<br>Fecal Coliform Bacteria, or<br>Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)
2 It should be noted that the pH and soluble salt content of the amended soil mix is more relevant to the establishment and growth of a particular plant, than is the pH or soluble salt content of a specific compost (soil conditioner) used to amend the soil. Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. Most ornamental plants and turf species can tolerate a soil/media soluble salt level of 2.5 dS/m and 4 dS/m, respectively. Seeds, young seedlings and salt sensitive species often prefer soluble salt levels at half the afore mentioned levels. When

specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to existing soil conditions.

[3] US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41ppm, Cadmium 39ppm, Copper 1,500ppm, Lead 300ppm, Mercury 17ppm, Molybdenum 75ppm, Nickel 420ppm, Selenium 100ppm, Zinc 2,800ppm.

[4] US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1000 MPN/gram of total solids.

[5] Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

When using compost for mulching, specific products may be considered more physically or visually acceptable for a given planting area. A representative sample of compost must be submitted to the Landscape Architect/Designer prior to field use since aesthetic preferences are subjective. Coarser-textured compost mulches are more effective in reducing weed growth and preventing water and wind erosion.

**Construction Requirements:**

- Compost mulch shall be uniformly applied over the entire area at an average depth of 2 to 3 inches as soon as possible after weed removal and planting.
- Avoid placing mulch against the trunk or stem of any plant material.
- Water thoroughly before and after mulching to saturate the root zone and entire mulch layer.
- All stones, roots, or other debris shall be removed from the surface of the mulched area.

**Method of Measurement:**

Compost will be measured by the cubic yard or the ton at the point of loading.

| |
|---|
| The landscape architect/designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost. |
| Generally, biosolids composts should not be applied at a depth greater than 2 inches, while most yard trimmings composts can be applied to a depth of 3 inches. Salt sensitive species typically prefer lower application rates. |

# Specification
## Compost as a Soil Blanket for Erosion Control

Section _____,

**Description:**

This work shall consist of applying compost to a sloped soil surface to reduce erosion for long term stabilization and to enhance riparian buffer areas.

**Materials:**

Soil blanket media shall be a composted, weed free organic matter source derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. Particle size shall be as described below in the product parameters table. The compost shall possess no objectionable odors, will be reasonably free (< 0.5% by dry weight) of man-made foreign matter and will meet the product parameters outlined below.

**Product Parameters:**

| **Parameters[1,4]** | **Reported as (units of measure)** | **Blanket Media to be Vegetated** | **Blanket Media to be left Un-vegetated** |
|---|---|---|---|
| pH[2] | pH units | 6.0 - 8.5 | N/A |
| Soluble Salt Concentration[2] (electrical conductivity) | dS/m (mmhos/cm) | Maximum 5 | Maximum 10 |
| Moisture Content | %, wet weight basis | 30 – 60 | 30 – 60 |
| Organic Matter Content | %, dry weight basis | 25 – 65 | 25-100 |
| Particle Size | % passing a selected mesh size, dry weight basis | • 3” (75 mm), 100% passing<br>• 1” (25mm), 90% to 100% passing<br>• 3/4” (19mm), 65% to 100%passing<br>• 1/4” (6.4 mm), 0% to 75% passing<br>• Maximum particle length of 6” (152mm) | • 3” (75 mm), 100% passing<br>• 1” (25mm), 90% to 100% passing<br>• 3/4” (19mm), 65% to 100%passing<br>• 1/4” (6.4 mm), 0% to 75% passing<br>• Maximum particle length of 6” (152mm) |
| Stability[3]<br>Carbon Dioxide Evolution Rate | mg $CO_2$-C per g OM per day | < 4 | < 8 |
| Maturity[3] (Bioassay)<br>Seed Emergence and<br>Seedling Vigor | %, relative to positive control<br>%, relative to positive control | Minimum 80%<br>Minimum 80% | N/A |
| Physical Contaminants (man-made inerts) | %, dry weight basis | < 0.5% (0.25% film plastic) | < 0.5% (0.25% film plastic) |

| | | | |
|---|---|---|---|
| Chemical Contaminants[3] | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants[4]<br>Select Pathogens<br>Fecal Coliform Bacteria, or<br>Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)
2 Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to the compost in use.
3 Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.
4 Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Use only a well-composted product that contains no substances toxic to plants where planting; immediate grass, wildflower, legume seeding or ornamental planting. Very coarse composts may need to be avoided if the slope is to be landscaped or seeded, as it will make planting and crop establishment more difficult. Composts containing fibrous particles that range in size produce a more stable mat.

**Construction Requirements:**

Compost mulch shall be uniformly applied to a depth described below. Areas receiving greater precipitation, possessing a higher erosivity index, or which will remain unvegetated, will require greater application rates.

| Annual Rainfall/Flow Rate | Total Precipitation & Rainfall Erosivity Index | Application Rate For Vegetated* Compost Surface Mulch | Application Rate For Unvegetated Compost Surface Mulch |
|---|---|---|---|
| Low | 1-25”, 20-90 | ½ - ¾ ” (12.5 mm – 19 mm) | 1” – 1 ½” (25 mm – 37.5mm) |
| Average | 26-50”, 91-200 | ¾ - 1” (19 mm – 25 mm) | 1 ½” – 2” (37 mm – 50 mm) |
| High | 51” and above, 201 and above | 1-2” (25 mm – 50 mm) | 2-4” (50mm – 100mm) |

*These lower application rates should only be used in conjunction with seeding, and for compost blankets applied during the prescribed planting season for the particular region.

Spread the compost uniformly on up to 1:2 slopes, then track (compact) the compost layer using a bulldozer or other appropriate equipment, if possible. Alternatively, apply compost using a pneumatic (blower) or slinger type spreader unit. Project compost directly at soil surface, thereby preventing water from moving between the soil-compost interface. Apply compost layer approximately 3 feet beyond the top of the slope or overlap it into existing vegetation. On highly unstable soils, use compost in conjunction with appropriate structural and diversion measures. Follow by seeding or ornamental planting if desired.

**Method of Measurement:**

Compost will be measured by the cubic yard or the ton at the point of loading.

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|---|
| The Landscape Architect/Designer shall specify the compost application rate depending upon specific site (e.g., soil characteristics, existing vegetation) and climatic conditions, as well as particular project related requirements. The severity of slope grade, as well as slope length, will also influence compost application. |

# SPECIFICATION
## COMPOST AS A FILTER BERM AND FILTER SOCK MEDIA FOR SEDIMENT CONTROL

Section _____,

**Description:**

This work shall consist of constructing a raised berm of compost, or placement of a compost filled sock, on a soil surface to contain soil erosion, control the movement of sediment off site, and to filter storm water.

**Materials:**

Filter berm media shall be a composted, weed free organic matter source derived from: agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; source-separated or mixed solid waste. Particle size may vary widely. The compost shall possess no objectionable odors, will be reasonably free (< 0.5% by dry weight) of man-made foreign matter and will meet the product parameters outlined below.

**Product Parameters:**

| **Parameters[1,4]** | **Reported as (units of measure)** | **Filter Berm to be Vegetated** | **Filter Berm to be left Un-vegetated** | **Filter Sock Media** |
|---|---|---|---|---|
| pH[2] | pH units | 6.0 - 8.5 | N/A | 5.0 - 8.5 |
| Soluble Salt Concentration[2]<br>(electrical conductivity) | dS/m (mmhos/cm) | Maximum 5 | N/A | Maximum 10 |
| Moisture Content | %, wet weight basis | 30 – 60 | 30 – 60 | < 60 |
| Organic Matter Content | %, dry weight basis | 25 – 65 | 25 – 100 | 25 – 100 |
| Particle Size | % passing a selected mesh size, dry weight basis | • 3" (75 mm), 100% passing<br>• 1" (25mm), 90% to 100% passing<br>• 3/4" (19mm), 70% to 100% passing<br>• 1/4" (6.4mm), 30% to 75% passing<br>Maximum:<br>• particle size length of 6" (152mm)<br>(no more than 60% passing 1/4" (6.4 mm) in high rainfall/flow rate situations) | • 3" (75 mm), 100% passing<br>• 1" (25mm), 90% to 100% passing<br>• 3/4" (19mm), 70% to 100% passing<br>• 1/4" (6.4mm), 30% to 75% passing<br>Maximum:<br>• particle size length of 6" (152mm)<br>(no more than 50% passing 1/4" (6.4 mm) in high rainfall/flow rate situations) | • 2" (50 m), 99% to 100% passing<br>• 3/8" (10 mm), maximum of 50% passing<br>Maximum:<br>• particle size length of 2" (50mm) |
| Stability[3]<br>Carbon Dioxide Evolution Rate | mg $CO_2$-C per g OM per day | < 4 | < 8 | < 8 |

| | | | | |
|---|---|---|---|---|
| Maturity[3] (Bioassay)<br>Seed Emergence and<br>Seedling Vigor | %, relative to positive control<br>%, relative to positive control | Minimum 80%<br>Minimum 80% | N/A | N/A |
| Physical Contaminants (man-made inerts) | %, dry weight basis | < 0.5% (0.25% film plastic) | < 0.5% (0.25% film plastic) | < 0.5% (0.25% film plastic) |
| Chemical Contaminants3 | mg/kg (ppm) | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels |
| Biological Contaminants4<br>Select Pathogens<br>Fecal Coliform Bacteria, or<br>Salmonella | MPN per gram per dry weight<br>MPN per 4 grams per dry weight | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels | Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels |

1 Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council)
2 Each specific plant species requires a specific pH range. Each plant also has a salinity tolerance rating, and maximum tolerable quantities are known. When specifying the establishment of any plant or turf species, it is important to understand their pH and soluble salt requirements, and how they relate to the compost in use.
3 Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered. Also, never base compost quality conclusions on the result of a single stability/maturity test.
4 Landscape architects and project (field) engineers may modify the allowable compost specification ranges based on specific field conditions and plant requirements.

Where seeding of the berm or sock is planned, use only well composted product that contains no substances toxic to plants. Avoid coarser composts if the berm is to be seeded, as it will make establishment more difficult.

**Construction Requirements:**

*Filter Berms* – Install parallel to the base of the slope or other affected areas, construct a berm of compost to the size specifications outlined in the table below.

| Annual Rainfall/Flow Rate | Total Precipitation & Rainfall Erosivity Index | Dimensions for the Compost Filter Berm (height x width) |
|---|---|---|
| Low | 1-25”, 20-90 | 1’x 2’ – 1.5’ x 3’ (30 cm x 60 cm – 45 cm x 90 cm) |
| Average | 26-50”, 91-200 | 1’x 2’ - 1.5’ x 3’ (30 cm x 60 cm – 45 cm x 90 cm) |
| High | 51” and above, 201 and above | 1.5’x 3’ – 2’ x 4’ (45 cm x 90 cm – 60cm x 120 cm) |

In extreme conditions and where specified by the Landscape Architect/Designer, a second berm shall be constructed at the top of the slope or silt fencing shall be installed in conjunction with the compost berm. Where the berm deteriorates, it shall be reconstructed. Do not use filter berms in any runoff channels (concentrated flows).

*Filter Socks* – Install parallel to the base of the slope or other affected areas, placing the compost filled sock to the size specifications described below. They may be used to filter sheet or concentrated flows of water. The filter sock can be filled on site or delivered already filled. The filter sock shall be produced from 5-mil thick polyethylene (HDPE) or polypropylene yarn, or cotton.

Socks may be 8, 12 or 18" in diameter, based on the specific application or slope length. When used to treat concentrated flows of water and on many sloped conditions, the filter socks should be staked into the ground (no trenching of the sock is required). Using 2' stakes (50 mm), pierce the middle of the sock and project the stake several inches into the ground. Once installed, the sock may be stepped on to assure proper and complete ground contact.

Socks may be sleeved in order to extend their length. Socks may be installed at the top, bottom, or throughout a slope, based on its length and severity.

**Method of Measurement:**

Compost will be measured by cubic yard at the point of loading.

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|---|
| The Landscape Architect/Designer shall specify the berm dimensions or sock size depending upon specific site (e.g., soil characteristics, existing vegetation) and climatic conditions, as well as particular project related requirements. The severity of slope grade, as well as slope length, will also influence compost application. |

# Landscape Architect Specifications for Compost Utilization

***Prepared for:***

**CWC/PNWER** www.cwc.org *and* **The US Composting Council** www.compostingcouncil.org

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