Compost Use On State Highway Applications

COMPOST USE ON STATE HIGHWAY APPLICATIONS

Project Background

Thanks to funding provided by a United States Environmental Protection Agency (USEPA) cooperative agreement (number X82826301), The Composting Council Research and Education Foundation (CCREF), in conjunction with the United States Composting Council (USCC) has completed the enclosed document in order to promote compost use on state and local 'roadside' applications. Aside from helping to assure healthy plant growth and reduced plant loss, the use of compost in roadside applications, can also reduce the production of greenhouse gases. This is accomplished in two ways. First, by promoting the use of composting as an alternative waste management strategy to landfilling and lagooning of organic by-products, known sources of methane production, and secondly, through the use of compost itself. The use of compost has demonstrated the ability to sequester carbon within the soil. For additional information on USEPA programs, go to their website at www.epa.gov.

Though this grant, the CCREF has completed various data collection efforts, in order to develop a tool that may allow State Departments of Transportation (DOT), as well as other roadside management organizations, specify the use of compost with greater ease and confidence. Further, this information package will assist these organizations to better locate potential suppliers of compost, foster communications between related highways organizations and allow compost use with greater success.

Overall Objectives

1. Assist States in incorporating the use of compost in landscape/building specifications in building, construction, highway seeding, planting, erosion control and other applicable projects.
2. Educate State and local DOT's about the various methods of compost utilization, as well as its many economic, agronomic, and environmental benefits.
3. Broaden the definition of *compost* in the list of landscape products recognized by the transportation industry to include a wider range of organic feedstocks.

Acknowledgements

The CCREF and the USCC would like to thank the USEPA for providing the funding necessary for completing this project. We would also like to acknowledge the assistance provided by the USEPA's, Office of Solid Waste, and project manager, Jean Schwab, for assistance through out the project. Also, the project could not have been completed without the assistance provided by the various State Departments of Transportations, as well as some of their contractors.

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1.0 INTRODUCTION

This document has been developed to assist those individuals and organizations involved in the maintenance and management of roadsides and highways. It is understood that the proper and sustainable management of 'roadsides' relies on professionals that possess varying and specific skill sets. Today, with greater emphasis being placed on environmental sustainability, as well as reducing the environmental impacts of roadways, the growth of compost utilization in landscape, erosion/sediment control and other environmental applications is imminent. Through the development and distribution of this document, the United States Environmental Protection Agency (USEPA) and the United States Composting Council (USCC) hopes to provide the 'transportation' industry, which encompasses roads and highways staff, policy makers, product specifiers, project designers and engineers, environmental officers, landscapers, and other interested parties, with the tools necessary to use composted products to meet their specific project requirements.

Although composted products are manufactured from 'recycled' materials, and many agencies are promoting the use of recycled products, its usage has actually grown because of its functionality and cost effectiveness. Compost is often less expensive than other soil amendments. With this said, it should be understood that the use of compost in specific applications may actually increase the construction costs on certain projects. However, the maintenance costs related to that same project, would be reduced. For example, experience and research has proven that by using compost in roadside planting projects, an acceptable vegetative stand can be developed much faster, and the survival rate of landscape plants in improved. So, although the initial cost of installation may have been greater, long-term costs are no doubt lower. Therefore, in some cases, the life cycle cost (analysis) of project must be considered. In cases like these, it is important that both DOT design/construction and maintenance staff be in communication, and understand the longer-term benefits of using compost on the project. Besides, in many cases, innovative applications for compost simply out perform standard practices and products used today.

What is Compost?[1]

Compost is the product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth. Compost bears little physical resemblance to the raw material from which it originated. Compost is an organic matter resource that has the unique ability to improve the chemical, physical, and biological characteristics of soils or growing media. It contains plant nutrients but is typically not characterized as a fertilizer.

How is Compost Produced?[2]

Compost is produced through the activity of aerobic (oxygen-requiring) microorganisms. These microbes require oxygen, moisture, and food in order to grow and multiply. When these resources are maintained at optimal levels, the natural decomposition process is greatly accelerated. The microbes generate heat, water vapor, and carbon dioxide as they transform raw materials into a stable soil conditioner. Active composting is typically characterized by a high-temperature phase that sanitizes the product and allows a high rate of decomposition, followed by a lower-temperature phase that allows the product to stabilize while still decomposing at a lower rate. Compost can be produced from many feedstocks.

2.0 WHY USE COMPOST?

Compost is an extremely versatile product, possessing a variety of innate benefits. Today, these benefits are better understood, and measurable. Compost has the unique ability to improve the properties of soils physically (structurally), chemically (nutritionally), and biologically. But aside from its technical benefits, the simple fact is that both research and field experience have documented that vegetation and other plants established with compost grow healthier and faster, and are able to better persist in harsh conditions. Although many equate the benefit of compost use to lush green growth, caused by the plant-available nitrogen, the real benefits of using compost are long-term and related to its content of living-organic matter. [3]

2.1 BENEFITS TO COMPOST USE ON ROADSIDE APPLICATIONS

As mentioned earlier, there are a variety of benefits to using compost on roadside applications (Figure 1). In this section, these benefits are discussed in greater detail.

Improved Structure: Compost can greatly enhance the physical structure of soil. In fine-textured (clay, clay loam) soils, the addition of compost will reduce bulk density, improve friability (workability) and porosity, and increase its gas and water permeability, thus reducing erosion. When used in sufficient quantities, the addition of compost has both an immediate and long-term positive impact on soil structure. It resists compaction in fine-textured soils and increases water-holding capacity and improves soil aggregation in coarse-textured (sandy) soils. The soil-binding properties of compost are due to its humus content. Humus is a stable residue resulting from a high degree of organic matter decomposition. The constituents of the humus act as a soil 'glue,' holding soil particles together, making them more resistant to erosion and improving the soil's ability to hold moisture.

Moisture Management: The addition of compost may also provide greater drought resistance and more efficient water utilization. Therefore, the frequency and intensity of irrigation may be reduced. Since compost can hold many times it own weight in moisture, its use can greatly assist the establishment of roadside plantings. Recent research also suggests that the addition of compost in sandy soils can facilitate moisture dispersion by allowing water to more readily move laterally from its point of application.

Modifies and Stabilizes pH: The addition of compost to soil may modify the pH of the final mix. Depending on the pH of the compost and of the native soil, compost addition may raise or lower the pH of the final mix. Therefore, the addition of a neutral or slightly alkaline compost to acidic soil will increase soil pH if added in appropriate quantities. In specific conditions, compost has been found to affect soil pH even when applied at quantities as low as 10-20 tons per acre. The incorporation of compost also has the ability to buffer or stabilize soil pH, whereby it will more effectively resist pH change.

Increases Cation Exchange Capacity: Compost will also improve the cation exchange capacity of soils, enabling them to retain nutrients longer. It will also allow crops to more effectively utilize nutrients, while reducing nutrient loss by leaching. For this reason, the fertility of soils is often tied to their organic matter content. Improving the cation exchange capacity of sandy soils by adding compost can greatly improve the retention of plant nutrients in the root zone.

Provides Nutrients: Compost products contain a considerable variety of macro and micronutrients. Although often seen as a good source of nitrogen, phosphorous, and potassium, compost also contains micronutrients essential for plant growth. Since compost contains relatively stable sources of organic matter, these nutrients are supplied in a slow-release form. On a pound-by-pound basis, large quantities of nutrients are not typically found, in compost in comparison to most commercial fertilizers. However, compost is usually applied at much greater rates; therefore, it can have a significant cumulative effect on nutrient availability. The addition of compost can affect both fertilizer and pH adjustment (lime/sulfur addition). Compost not only provides some nutrition, but often makes current fertilizer programs more effective.

Provides Soil Biota: The activity of soil organisms is essential in productive soils and for healthy plants. Their activity is largely based on the presence of organic matter. Soil microorganisms include bacteria, protozoa, actinomycetes, and fungi. They are not only found within compost, but proliferate within soil media. Microorganisms play an important role in organic matter decomposition which, in turn, leads to humus formation and nutrient availability. Microorganisms can also promote root activity as specific fungi work symbiotically with plant roots, assisting them in the extraction of nutrients from soils.

Suppresses Plant Diseases: Disease incidence on many plants may be influenced by the level and type of organic matter and microorganisms present in soils. Research has shown that increased population of certain microorganisms may suppress specific plant diseases such as pythium and fusarium as well as nematodes. Efforts are being made to optimize the composting process in order to increase the population of these beneficial microbes.

Binds Contaminants: Compost has the ability to bind heavy metals and other contaminants, reducing both their leachability and absorption by plants (bioavailability). Therefore, sites contaminated with various pollutants may often be improved by amending the native soil with compost. The same binding affect allows compost to be used as a filter media for storm water treatment and has been shown to minimize leaching of pesticides in soil systems.

[Much of the information in section 2.1 has been adapted from 'The Field Guide to Compost Use' published by the US Composting Council 1996][3]

Figure 1 Benefits of Using Compost [4]

1. Improves the soil structure, porosity, and bulk density, thus creating a better plant root environment.
2. Increases infiltration and permeability of heavy soils, reducing erosion and runoff.
3. Improves water holding capacity in sandy soils, reducing water loss and leaching.
4. Supplies a variety of macro and micronutrients.
5. Controls or suppresses certain soil-borne plant pathogens and nematodes.
6. Supplies significant quantities of organic matter.
7. Improves cation exchange capacity (CEC) of soils, improving their ability to hold nutrients for plant use.
8. Supplies beneficial microorganisms to soils.
9. Improves and stabilizes soil pH.
10. Can bind and degrade specific pollutants.

Adapted from *'The Field Guide to Compost Use',* US Composting Council 1996.

2.2 COMPOST APPLICATIONS

Although unable to be discussed in detail, there are a variety of potential roadside applications for compost (Figure 2). Today, the use of compost on roadsides has grown past the more typical landscape applications, discussed in later sections of this report, and now includes a variety of 'high tech' applications which include erosion and sediment control, reclamation, bioremediation, storm water management and wetland mitigation. In order to document the successful utilization of compost in a variety of applications, Section 3 provides various State DOT 'case studies' which were documented from throughout the country. It should be understood, however, that this document focuses on the use of compost in typical landscape applications. As mentioned in the previous section, the benefits of using compost in these applications are well understood and have been documented over a long period of time. Specifications developed for the proper use of compost in typical landscape applications is described in Section 4 of this document.

Figure 2 Potential 'Roadside' Applications for Compost

- Soil Incorporant
  - Turf establishment
  - Garden Bed Preparation
  - Reclamation / Remediation
  - Roadside Vegetation
  - Wetlands Establishment
- Growing Media Component
  - Landscape (e.g., rooftop, raised planters)
  - Backfill Mixes (tree and shrub planting)
  - Golf Course (e.g., tee, green, divot mixes)
  - Manufactured Topsoil
  - Wetland Establishment
- Surface Applied
  - Garden Bed Mulch
  - Erosion Control Blanket
  - Silt/Sediment Control Berm
  - Turf Topdressing

With so much interest in environmental sustainability in the proximity of roadsides, as well as 'low impact' design, we would be remiss to mention specific environmental applications where compost has shown great promise.

Erosion and Sediment Control

A very promising, and rapidly expanding, application for compost is as an erosion and sediment control material. Various research, as well as, field trials, has shown that compost can often out perform conventional slope stabilization methods, such as hydroseeding, hay/straw mulching, geotextile blankets, etc. Compost, composted mulches and compost blends are used as a soil 'blanket' or 'cover', and typically placed on up to a 2:1 slopes at an application rate of 2 to 4 inches. Lesser application rates are possible in areas of lower flow and on less severe slopes. This compost layer not only absorbs the energy of the rainfall, which causes the movement of soil particles, but can also absorb a substantial volume of moisture, as well as reduce its flow velocity, improving moisture percolation into the soil. These organic 'soil blanket' products are typically applied using a bulldozer, grading blade or pneumatic blower. The courser or woodier composts used in erosion control are often not seeded following application, but may be seeded at a later time, once the product stabilizes. Research performed for Portland Metro, an environmental regulatory body based in Portland, Oregon, further showed that yard trimmings compost was capable of not only controlling erosion, but also of filtering, binding and degrading contaminants from the storm water passing through the organic layer.[5]

Research and field experience has also shown that the use of compost filter berms, which can be placed at the base of slopes and around construction sites, are very effective in sediment control. These filter berms are typically 1 ? to 2 feet tall by 3 to 4 feet wide. They act as excellent sediment filters and can even be used in conjunction with silt/sediment fences in areas of heavy flow. Research completed by the New England Transportation Consortium found that even certain 'wood waste materials can be effective as mulch for erosion control or as a filter berm at construction sites, (used) to prevent eroded soil from leaving the site.'[6] Equipment now exists which can apply these products efficiently, and typically at a cost equal to or less than traditional methods (sediment fencing). The Portland Metro research also documented that compost filter berms (83% reduction) can be twice as effective as sediment fences (39% reduction) in reducing total solids (TS) in runoff.[7]

Reclamation

Compost has been used extensively in revegetation and reclamation of marginal and low quality soils. These problem sites benefit through improving soil quality, reducing erosion, enhancing plant establishment, immobilizing toxic metals and supplying microbes. In research performed by Dr. William Sopper of Penn State University, compost (and biosolids) were applied to a gravely site, possessing a low pH and organic matter content, and contaminated with zinc. Within fifteen months of the application, the hillside was covered by a combination of orchard grass, tall fescue and crown vetch. Newly planted trees showed a survival rate of over 70%.8 In this example, the compost not only supplied plant nutrition and moderated soil pH, but also established a nitrogen and organic matter cycle in the soil and immobilized heavy metals, by both reducing their leachability and absorption by plants.9 By establishing vegetation on soils contaminated with heavy metals, water erosion can be minimized, thus reducing the transfer of pollutants. The physical structure of the compost amended soil is also improved, increasing soil porosity and moisture infiltration, thus reducing run-off. This benefits both the environment and plant growth. Compost used is this application is often applied at soil inclusion rates of 20 to 50%, or at rates of 25 to 175 tons per acre.

Wetlands

Organic matter in the soils of wetlands in the United States has decreased steadily over the last three decades. According to Dr. Donald Hey, an expert in flood plain management, 'over 100 million acres of U.S. wetlands have been drained, and our wetlands now contain only about half the amount of organic matter they contained in the 17th century. As a result, annual floods have worsened, ground water quality has deteriorated, and wildlife diversity has declined. Compost, with its high organic matter content, can absorb up to four times its weight in water and can replace essential organic material in wetlands'10. As urbanization continues to expand, wetlands are often destroyed in the construction of roads and other structures. Today, environmental regulations are in place which require the re-establishment of wetlands as a means of improving water quality. The goal of any wetlands mitigation project is to develop a wetland that functions well in terms of hydrology, soil properties and plant community composition. Thereby, a highly organic, microbially active soil must be developed which possesses similar physical and chemical properties to those of native wetland soils.

Compost is an excellent component to manufactured wetland soils because of its high organic matter content, water holding capacity and microbial activity. Although used effectively throughout the country in wetland mitigation, to develop an effective wetlands media using compost, it is important to understand the soluble salt and nutrient levels of the compost and their relationship to the wetland plants being established. When developing wetland construction mixes, it is important to develop a blend which has similar characteristics to the surrounding soils, and for that reason, manufacturing wetlands mixes must be done on a case by case basis.[11]

[Much of the information in section 2.2 has been adapted from the 'Compost Markets Grow With Environmental Applications' article first published in the April, 1999 Biocycle Magazine, published by JG Press, Emmaus, PA.]

3.0 CURRENT COMPOST USAGE BY STATE DOTS

In order to determine the current usage of composted products by State DOTs, as well as their potential for increased usage, various information was gathered by surveying all 50 State DOTs. Once collected, this data was compiled into the following information sets: State DOT Compost Success Stories (case studies), Catalogue of State DOT Compost Usage Experience (50 State Summaries) and State DOT Compost Specifications tables. A list of the State DOT Landscape 'Contacts', as well as the a list of State DOT Environmental Officers, Maintenance Contacts and Directors, is found in the Appendix B.

To better illustrate the successful utilization of compost, and composted products, on State DOT and other highway related applications, a series of fact sheets which describe various compost utilization projects documented from across the United States were developed. We have provided case studies that illustrate a variety of potential applications for compost, as well as case studies from a variety of geographical regions, representing different climatic conditions and soil types. By providing these case studies, we hope to show highway managers that compost can be used successfully, across the country, in a variety of applications and conditions.

3.1 STATE DOT COMPOST SUCCESS STORIES (CASE STUDIES)

Case studies include:

Connecticut DOT – Landscape Plantings

Connecticut DOT – Wetlands Creation

Florida DOT – Turf Establishment

Idaho Transportation Department – Vegetation Establishment

New Hampshire DOT – Wildflower & Roadside Plantings

Oregon DOT – Erosion Control

Texas DOT – On Site Topsoil Manufacturing

Texas DOT – Revegetating Difficult Slopes

Virginia DOT – Wildflower Plantings

Washington State DOT – Soil Bioengineering

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CONNECTICUT DOT – ROADSIDE PLANTINGS

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Connecticut Department of Transportation (ConnDOT) recently completed a project in Fall, 1997 using compost in planting backfill for trees and shrubs.

The objective of the use of compost on this project was to demonstrate that compost was effective in amending soils used in planting trees and shrubs.

Spent mushroom substrate compost was used in planting backfills for trees and shrubs. The planting backfill in the compost-amended areas consisted of one part compost to two parts planting soil. Follow-up surveys the following year identified no plant mortalities in the compost-amended soil, compared to 40% mortalities in the standard ConnDOT control plants.

METHODOLOGY

The project was located in Wethersfield, CT at the Interstate 91/Route 3 interchange construction project that was ready for landscaping. Two planting areas were designated, one having a southeastern exposure, the other having a northwest exposure. The plantings in these two areas were divided so that some plants received treatment with compost and others of the same species were designated as controls.

Compost used in this project was derived from spent mushroom substrate. Compost was donated by EarthGro, Inc. (Lebanon, CT).

In the Fall of 1997, several species of trees and shrubs were planted, including: Sugar Maple, Eastern White Pine, Doublefile Viburnum, Border Forsythia, Dwarf Winged Euonymus and Northern Bayberry, as shown in Figure 1.

Figure 1 – I-91/Route 3 Interchange Plantings

These were planted in accordance with the ConnDOT planting specifications, with the exception that, in the treated plants, compost was substituted for peat. Planting backfill in the treated areas consisted of one part compost to two parts planting soil. All plants were mulched with wood chips after installation.

RESULTS

Using compost to amend the planting soil was very successful according to ConnDOT and CTDEP. An inventory was conducted in May, 1998 which consisted of counting all the plant material and identifying which ones needed replacement. During this inventory, it was noted that none of the plants planted with compost needed replacement (i.e. the mortality rate was zero percent), compared to a mortality rate of approximately 40% in the standard ConnDOT control plants. Another inspection conducted in September, 1998 confirmed that the survival rate for the compost amended plants was still 100% (Figures 2 and 3). There were no apparent differences in the condition between plants planted with compost and those planted without compost. Another survey is planned for Summer 2001.

Figure 2

In July 1998, ConnDOT adopted Supplemental Specifications, which contain revisions that allow compost to be substituted for peat on any ConnDOT construction project designed after that date. Specifications can be found at http://www.dot.state.ct.us/814aSections/index _menu.html under Division III Materials Section, Sections M.13.06 – Compost & M.13.07.13 – Peat.

Figure 3

ECONOMICS

As this was a research project and the compost was donated, no project-specific data is available.

For More Information

"Field Trial – Compost Used with Planting Soil, Project 159-177, I-91/Route 3 Interchange, Wethersfield, CT", Report No. 116(42)-2-99-3, January, 1999, Connecticut Department of Transportation

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CONNECTICUT DOT – WETLANDS CREATION

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Connecticut Department of Transportation (ConnDOT) recently completed a project in October 1999 using compost for wetlands creation on a project at Bradley International Airport in Windsor, CT.

The objectives of the use of compost on this project were to:

- Provide additional organic matter to site soils to support growth of wetland vegetation that is free of invasive plants
- Improve soil fertility to eliminate the need for supplemental fertilizers

The site was a 4.4 acre agricultural field near the airport. The site was excavated 1 to 2 feet deep, and the stockpiled topsoil was mixed with 14,000 cubic yards of compost. The mix was regraded over the site and seeded with a wetlands seed mix. ConnDOT returned in the second year to plant wetlands species trees and shrubs. First year results show good vegetation growth over the site. Total project costs were $185,283.

METHODOLOGY

The project was located in north central Connecticut and included the establishment of new wetland areas to remediate wetlands that were impacted during the construction of a new ethylene glycol deicing facility at the airport. The general contractor was Lane Construction Co. (Meriden, CT). Work consisted of excavating an existing agricultural field to a depth of approximately 1 to 2 feet, and then blending compost with topsoil to convert it into a "wet meadow" and forested wetland area.

The glycol facility impacted about 3 acres of existing wetlands along Seymour Hollow Brook. ConnDOT decided to convert 4.4 acres of an old field into a new wetlands area. Compost was obtained from the City of Manchester about 15 miles from the job site and also obtained from a nearby commercial composting facility. Both composts were derived from yard trimmings.

Compost testing is required for typical agronomic parameters (pH, moisture, organic matter content) as well as odor and maturity. In general, for compost use as a soil amendment, ConnDOT draft specifications require a ?" to 2" layer, rototilled to a depth of 3". In this project, however, ConnDOT wanted to formulate a specific soil blend of 15-20% organic matter, which was accomplished by sampling soil and compost to create a blending recipe of 3 parts soil to 1 part compost (on a volume basis).

The contractor scraped and stockpiled topsoil from the 4.4 acre wetland creation site with a 5 CY bucket payloader. The site was excavated 1 to 2 feet. The topsoil was then mixed with 14,000 cubic yards of compost and the blended soil reapplied. The compost-soil mix was spread with a payloader and a bulldozer, as shown in Figure 1. The site was then regraded.

Figure 1 – Spreading Compost

In order to ensure proper hydrologic function of the wetland, the microtopography was created by the tracks of the bulldozer driven erratically throughout the site, as shown in Figure 2.

Figure 2 – Bulldozer Microtopography

Once the site was graded to the desired contours, the contractor spread a wetlands seed mix over the area with a hydroseeder. In wetlands creation projects, ConnDOT applies only wetlands seed mixture for the first year, to ensure that good germination and wetlands performance occurs. Once verified, ConnDOT contractors will return and plant wetland species trees and shrubs in accordance with the wetland landscaping plan. In this case, the plantings are designed to evolve into a scrub shrub/forested wetland. In Spring 2000, ConnDOT contractors planted wetland

species manually using an all-terrain vehicle (ATV) with a trailer. This was used to avoid damage to the site by heavy equipment

RESULTS

First year results showed good grass growth in the wet meadow as it was a normal precipitation year in that part of Connecticut. Figure 3 illustrates the results.

Figure 3 – Wetlands Result

ECONOMICS

Costs for composts used in this project were $10-$12 per CY. Installation cost was $3 - $4 per CY. Total project cost was $185,283. CT DOT uses a unit price for compost purchase and installation, and a lump sum bid for installation (which includes contractor overhead). Seeding and vegetation planting are a lump sum bid item.

For More Information

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FLORIDA DOT – TURF ESTABLISHMENT

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Florida DOT (in association with the University of Florida) has recently completed a three-year project to evaluate the use of composted materials on Florida roadsides.

The objectives of this project were to:

- Provide fundamental information for proper utilization of composted wastes on roadsides
- Assist FDOT in establishing standards and specifications for using composts
- Provide FDOT with educational and promotional materials on using composts

Composts typical of those available in Florida were characterized in the laboratory and tested in greenhouse and roadside trials over a two-year period.

Amendment of road-shoulder soil with composts improved grass seeding establishment and subsequent growth. An application rate of 45 tons per acre was generally sufficient to improve establishment and persistence of utility turf. There were no adverse effects observed with applications up to 135 tons/acre.

Bid prices for compost and transportation were $18/cubic yard. Labor was paid for separately and varied from $10/CY to $25/CY of compost.

METHODOLOGY

Three composts typical of those that might be generally available were used in this project. One was made of biosolids and yard trimmings, the second with biosolids and municipal solid waste (MSW), and the third with yard trimmings only. Composts were obtained from Bedminster Bioconversion Corp. (Sevierville, TN), Enviro-Comp Services, Inc. (Jacksonville, FL), and Palm Beach Solid Waste Authority (West Palm Beach, FL).

Three roadside test sites on major highways were selected:

- Copans Rd. interchange with Interstate 95 – shoulders of off/on ramps where grass cover was poor and planting was in the limestone road base without topsoil;
- State Road 50 two miles west of I-75 – an area of deep, droughty sand with sparse vegetative cover;
- U.S. Route 19/98 north of Salem – an area of high water table and good soil cover of grasses, sedges and broadleaf plants

Figures 1 and 2 show the nature of native soils in the FDOT project area.

Figure 1

Figure 2

These highway shoulders were amended with compost as shown in Figure 3.

Figure 3

Compost materials were added at rates of 45, 90, and 135 tons per acre. Site soils and compost samples were analyzed for physical and chemical characteristics. FDOT specifications for the use of compost require that the material meet the health and safety requirements of the Florida Dept. of Environmental Protection and it contain no visible foreign matter with a permitted size range of ?" to 6". In addition, the Project Engineer may elect to sample the in-place compost for texture, pH and organic matter content.

The upper 8" of road-shoulder soil was rototilled with a 6 ft. wide PTO driven machine after compost application and broadcast seeded with the FDOT standard mixture of bahiagrass (80%) and bermudagrass (20%) at a rate of 200 kg/ha. The areas were lightly mulched with straw after seeding, cut into the soil with a coulter, and the soil firmed with a rubber wheel.

RESULTS

Compost application to these roadside soils initially decreased soil bulk density, but the effect was mostly lost within six months. This was attributed to the more rapid breakdown of added organic matter in the subtropical Florida climate. The amount of Plant Available Water held by amended soil was greater than that held by unamended soil. Much of this increase was lost after about six months (with the exception of the 135 tons/acre application). This appeared to be due to the better vegetation growth and less erosion at one of the sites. Figure 4 shows the effect of compost-amended soil on vegetation.

Figure 4

Compost application had no effect on soil pH at the end of the 6-month evaluation period. Electrical conductivity was increased following application (due to soluble salts in the composts), but decreased markedly by the 3-month sampling due to leaching by rainfall.

Compost application increased the fertility status of the soils as evidenced by the increases in concentration of plant nutrients like phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg), with biosolids composts adding more nutrients than yard trimmings composts. Concentrations of all nutrients increased with increasing compost application rates. Compost application also increased the concentrations of the micronutrients iron (Fe), zinc (Zn), copper (Cu) and manganese (Mn), but not to levels that would be injurious to plants.

One year after compost was incorporated and seed planted on the road shoulder, vegetative cover remained greater for all plots that received compost than for those which had not. Vegetative cover was generally not improved significantly above the 45 tons/acre rate of compost amendment.

ECONOMICS

Bid prices for compost and transportation were $18/cubic yard. Labor was paid forseparately and varied from $10/CY to $25/CY of compost.

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Robert J. Black, et. al. "Evaluation of Composted Materials to be Utilized in Florida Roadside and Median Plantings", University of Florida Institute of Food and Agricultural Sciences, February, 1999

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IDAHO TRANSPORTATION DEPT. – VEGETATION ESTABLISHMENT

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Idaho Transportation Department (ITD) recently completed a project in fall, 2000 using compost for mulch on a project in Southwestern Idaho

The objectives of this project were to:

- Provide additional organic matter to roadside soils to support growth of vegetation
- Add fertility to substandard soils

Composts were successfully used as a soil amendment and mulch in this project. Dairy manure compost was spread onto shallow slopes at a 20 CY/acre rate and anchored to the surface with a cultivator. A formulated organic soil amendment product was hydro-applied on steeper slopes at a rate of 2000 lbs/acre. Cost for furnishing and installing (and anchoring) the dairy manure compost mulch was $530.14/acre. Cost for furnishing and installing the organic soil amendment product was $1,011.71/acre.

The material was successfully applied in the fall of 2000. Results in Spring, 2001show excellent seed germination and plant growth.

METHODOLOGY

The project was located in southwestern Idaho along Interstate 84 from the Oregon State Line to the Black Canyon interchange. The General Contractor was Idaho

Sand and Gravel (Boise, ID) and the reclamation subcontractor was Wildlands, Inc. (Richlands, WA).

Work consisted of applying soil amendment to two different types of roadside areas: slopes greater than 3:1 and slopes less than 3:1. There were 18.6 hectares (45.96 acres) of slopes greater than 3:1, and 98.8 hectares (244.13 acres) of slopes less than 3:1.

Project Specifications required two different work elements for two different slope conditions:

For slopes less than 3:1 – Furnish and install approved compost mulch at the rate of 37.373 cubic meters/hectare (m3/ha) (approx. 20 CY/acre). Anchor the mulch by incorporating it into the underlying soil at a 2" depth.

For slopes greater than 3:1 – Furnish and install Quattro Fertile Fiber at the rate of 2,000 lbs/acre.

Approved composts for use by ITD must meet the EPA 40 CFR Part 503 requirements for a Class A compost and must meet Solvita maturity levels of 5 or higher. Maturity testing is required for every 2 hectares of compost use.

The approved compost for slopes less than 3:1 was dairy manure compost obtained from Compost West (Nampa, ID). The Quattro Fertile Fiber used on the steeper slopes is a compost-based product made from chicken manure with a guaranteed analysis (N-P-K) of 6-4-1. This product also included seed, tackifier and soil stimulant in the mix. Quattro Fertile Fiber was obtained from Quattro Environmental (Coronado, CA). Haul distance from the source of compost to the job site was less than 30 miles.

On the slopes less than 3:1, compost was spread over the working areas with a truck-mounted manure spreader (Ag Equipment, Inc. Caldwell, ID). The spreader had a capacity of 18 cubic yards. The compost application rate was 20 cubic yards/acre. The compost mulch was anchored by incorporating it with a Triple K cultivator to a depth of 2". Grass was then seeded into this layer by drill seeding.

On the steeper slopes (over 3:1), the Quattro Fertile Fiber was hydroapplied with a Finn 330 hydroseeder equipped with mechanical agitation to keep the organic soil amendment product in suspension.

RESULTS

The slopes were treated with both products in Fall, 2000. As of May 2001, good germination and early growth was observed, however it has been a dry and hot Spring in Idaho, and continued growth and vigor is dependent on rainfall.

ECONOMICS

The bid prices for the work specified was:

- $1,200/hectare ($485.62/acre) to furnish and install dairy manure compost on the slopes of less than 3:1 pitch
- $2,500/hectare ($1,011.71/acre) to furnish and install Quattro Fertile Fiber on the steeper slopes
- $110.00/hectare ($44.52/acre) to anchor the compost mulch on the lesser slopes

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NEW HAMPSHIRE DOT – WILDFLOWER & ROADSIDE PLANTINGS

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The New Hampshire Department of Transportation (NHDOT) has been using compost on projects for both wildflower and roadside landscape planting projects.

The objective of this effort is:

- To use compost to enhance existing soils

METHODOLOGY

NHDOT uses compost in both wildflower and roadside plantings. NHDOT constructs about 10 acres/year of wildflower beds, using 2700 cubic yards of compost annually. In the wildflower beds, a 2" layer of compost is applied over the site, then it is rototilled into the soil to a depth of 4". It is then graded using a York rake, or an equivalent method, to establish a somewhat firm but still friable seedbed. The success of each wildflower bed varies due to the existing ground conditions. In most cases, wet areas produce a totally different result than areas that are dry. This can also be true when considering the planting zones.

Although the wildflower program has utilized municipally generated compost, the bulk of compost has been purchased from commercial compost dealers throughout the Northeast.

NHDOT's specifications for compost used in wildflower beds calls for material made from "source-separated compostable materials". Biosolids are excluded at present. The specifications also require a minimum organic content of 30%, particle size of less than 0.5 inch, and product that is stable and completely composted.

In roadside plantings, NHDOT requires the use of compost in the planting pits. Approximately 1,000 cubic yards are used annually. NHDOT requires that 6 cubic feet of compost and 3 cubic feet of sphagnum peat moss be thoroughly mixed with one cubic yard of acceptable loam. This mix is then used to backfill around the root ball in the planting pit. Compost used in this application must contain a minimum of 50% organic matter.

RESULTS

NHDOT has had good experience with the use of compost in wildflower beds, especially in areas of poor soils. Without doubt, the areas that use compost have continuously achieved higher results. Another benefit is that sites can be re-planted when the existing planting has become non-productive. NHDOT has also observed more vigorous and extensive vegetation on abandoned sites, previously amended with compost, when compared to other surrounding lands (not amended with compost). In roadside plantings, NHDOT has noticed that the compost has substantially improved the existing soils without causing the plant roots to become pot bound.

ECONOMICS

As the use of compost has been paid for under the specific item for which it has been used (i.e. lump sum bids for wildflower bed construction); no specific cost data exists.

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OREGON DOT – EROSION CONTROL

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Oregon Department of Transportation (ODOT) has been using compost on projects for controlling erosion.

The objectives of this demonstration project were to test the effectiveness of compost blankets and berms on a long, steep slope that was in close proximity to an environmentally sensitive resource.

METHODOLOGY

The project was located in Portland, Oregon on the southwest corner of Scholls Ferry Road and SW Raab Road. The project site is a long fill associated with a road realignment. The site had an average slope of three to one.

Compost was used both as an erosion control blanket and as a filter berm. The total area treated was approximately 45,000 square feet. Approximately 900 linear feet of filter berms were installed. Yard trimmings compost was obtained from Lakeside Reclamation, about 8 miles distant from the site. The compost was applied to four plots, each approximately 100 ft. by 100 ft (10,000 sq. ft.). Compost blankets were applied in October 2000 to each plot. Two plots received a 2" thick blanket (one was seeded with perennial rye, one was unseeded). Two plots received a 1" blanket (one was seeded with perennial rye, the other was unseeded). Filter berms were installed parallel to the base of the slope and the top of the slope.

The compost was tested for pathogens, toxins, and salts in compliance with the U.S. Composting Council's Test Methods for the Examination of Compost and Composting (TMECC). The compost was applied pneumatically, using an Express Blower. The seed was applied at the same time through a separate line that allowed for mixing with the compost prior to ground placement, using proprietary equipment from Rexius Forest Products, Inc. Figure 1 illustrates one of the project sites.

Figure 1 – Project Site

RESULTS

ODOT staff conducted a site visit in late November 2000, approximately 3 weeks after compost installation. Rainfall was normal for the period. The seeded plots showed good vegetation growth (see Figure 2). No erosion was observed in the plots.

Figure 2 – Emerging Grass Growth

Another site visit is planned for Fall 2001.

ECONOMICS

As this was a demonstration project, there was no cost for the compost. ODOT staff estimated project costs would have been $9,300 if ODOT had to pay for the compost and installation. On a per linear foot basis, the filter berm cost was estimated at $2.50 per linear foot.

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TEXAS DOT – ON SITE TOPSOIL MANUFACTURING

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Texas Department of Transportation (TxDOT) recently completed a project in January 1999 to improve vegetation growth with onsite topsoil manufacturing.

The objective of this project was to demonstrate how the utilization of compost could effectively improve soil quality to support grasses vegetation.

The slope was treated with 500 cubic yards of a feedlot manure compost. The compost was mixed in with native soils and seeded. Forty days after application, the site was showing good germination.

This project was done by TXDOT maintenance personnel. Compost cost was $15 per cubic yard. Labor costs were $1,010 for transportation and application.

METHODOLOGY

State Highway 108, 10 miles north of Stephenville, TX was widened in 1997. Two years later, TXDOT officials were concerned that vegetation had not been established on the roadsides. In January 1999, they purchased 500 cubic yards of manure compost from Compost Performance Systems in Stephenville, approximately 25 miles from the project site.

TXDOT maintenance personnel hauled the compost to the site in dump trucks. They initially planned to use a fertilizer spreader to spread the material, but found that the moisture content of the compost would not allow it (was too high). As an alternative, they applied the compost in a series of smaller piles, then used a motorgrader to spread the compost to a 2" depth across the 3+ acre site. They then disked the compost into the soil to a depth of 3" using a tractor-pulled disk harrow, dragged the site smooth with an I-beam pulled behind a tractor and seeded the site with a winter grass seed mix (triticale). Only one side of the road was treated with compost in order to evaluate its effectiveness against an untreated control area.

Compost use in TxDOT projects is defined by TxDOT Special Specification Item 1027, "Furnishing and Placing Compost". This specification defines three grades of compost use and requires testing for particle size, organic matter, soluble salts, maturity, pH, time and temperature standards and EPA Part 503 testing for biosolids compost.

RESULTS

Rainfall in that part of Texas that spring was sparse, with only 0.6" of rain falling during the 45-day germination period. TXDOT maintenance personnel noted that seed germination was much better in the compost-amended areas than in the control areas. A year later, TXDOT personnel noted that strong vegetation growth continues in the compost-amended areas.

ECONOMICS

The compost cost $15/cubic yard. TXDOT personnel hauled the compost to the site and applied the compost. Labor costs for transportation and application were $1,010.

TXDOT has committed to using more compost in the future on roadside vegetation and erosion control projects.

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Texas Compost Use Specifications at **http://www.dot.state.tx.us/insdtdot/orgchart/des/landscape/compost/specifications.htm**

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TEXAS DOT – REVEGETATING DIFFICULT SLOPES

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Texas Department of Transportation (TxDOT) recently completed a project in July 1999 using compost for revegetating a badly eroded and bare slope along IH 20 in Big Spring, Texas.

The objective of this project was to demonstrate how the utilization of compost could effectively revegetate a barren slope

The slope was treated with 100 cubic yards of a feedlot manure compost, further amended with wood chips for erosion control (TxDOT's "Erosion Control Compost"). The compost-chip mix covering the site successfully resisted a 2" heavy rainfall which occurred soon after application. Two months after application, the site was heavily vegetated by a healthy, stable grasses vegetation community.

This project was done as a demonstration project at no cost to TXDOT. The Texas Natural Resources Conservation Commission (TNRCC) paid for the compost and the contractor applied the material at no charge.

METHODOLOGY

In May 1999, TxDOT (working with the Texas Natural Resource Conservation Commission) undertook a project to reclaim and revegetate a badly eroded and bare overpass slope along IH 20 in Big Spring.

The site was constructed in 1968 and had been barren for nearly 30 years. The site was approximately ? acre in size (about 50 ft. by 650 ft.). TxDOT had seeded, hydromulched and blanketed the site many times without success. Figure 1 shows the pre-remediation eroded site and sparse vegetation.

Figure 1 – Original Slope

Compost use in TxDOT projects is defined by TxDOT Special Specification Item 1027, "Furnishing and Placing Compost". This specification defines three grades of compost use and requires testing for particle size, organic matter, soluble salts, maturity, pH, time and temperature standards and EPA Part 503 testing for biosolids compost.

Compost was obtained from South Plains Compost (Lubbock, TX). The compost was produced from feedlot manure, cotton burrs and yard trimming wood chips. The wood chips (3" minus screen size) were added to the compost to help resist wind erosion at the site. The mix ratio was 3 parts compost to 1 part wood chips (on a volume basis).

The compost-wood chip mix was applied to the site with a Rexius blower truck (EcoMulch, Bossier City, LA) to a depth of 3" overall and at a depth sufficient to fill in the erosion gullies on the site. Approximately 100 cubic yards of compost was applied. Figure 2 shows the application of the compost.

Figure 2 – Applying Compost

As the compost was applied, the seed was fed through a hopper attached to the Rexius Truck. The TxDOT specified mix (for western Texas) of Blue Grama, Sideoats Grama, Buffalograss, and Green Sprangletop was used. Normal precipitation in the area during May is 3"; a 2" rainfall occurred in late May 1999. The wood chip-amended compost resisted erosion and washoff during this storm. An ancillary benefit of the compost/chip mix was to retain moisture for longer periods, which was a benefit to grass germination.

RESULTS

By July, 1999, a thick stand of grass was established on the slope, as shown in Figure 3.

Figure 3 – Vegetation Established on Slope

The untreated area can be seen on the right of the photo in Figure 3. This was the first time vegetation had been established on this slope since it was constructed in 1968.

ECONOMICS

This project was done as a demonstration project at no cost to TXDOT. The Texas Natural Resources Conservation Commission (TNRCC) paid for the compost and the contractor applied the material at no charge.

TXDOT has committed to using more compost in the future on roadside vegetation and erosion control projects.

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"Texas Makes Inroads With Highway Use of Compost", *Biocycle*, Vol. 42, No. 2, February 2001

Big Spring Site Compost Demonstration Pictures at **http://www.dot.state.tx.us/insdtdot/orgchart/des/landscape/compost/examples.htm**

Texas Compost Use Specifications at **http://www.dot.state.tx.us/insdtdot/orgchart/des/landscape/compost/specifications.htm**

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VIRGINIA DOT – WILDFLOWER PLANTINGS

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Virginia DOT (VDOT) has completed several projects using compost in wildflower bed and grass establishment.

The objectives of these projects were to:

- To add organic matter to the existing soil, which had been compacted after the removal of topsoil

Eight sites were treated between March and May 2000 with 2,233 cubic yards of lawn and yard trimmings compost from a regional authority. A two-inch compost layer was incorporated to a depth of 6" with a rototiller. Wildflower mix was applied on seven sites and grass seed mix on one site.

Good germination and growth occurred at all but one site. Project costs were $0.18 per square foot. The total area treated was 360,000 square feet. Total project costs were $64,800. These costs included all labor, equipment, materials, and hauling involved in getting the work completed.

METHODOLOGY

VDOT selected eight sites in the southeastern portion of the state, including sites in Williamsburg, Portsmouth, Suffolk, and Chesapeake. Sites varied in size from 0.46 acres to 2 acres. One site was to have grass established on it, while the other seven were to be planted with wildflower seeds. All of the sites were flat and possessed compacted subsoils (topsoils had been stripped away during construction).

Yard trimmings compost was provided by the Southeastern Public Service Authority (SPSA) in Suffolk, VA. Distance from the compost source to the construction sites varied from less than 5 miles to 49 miles one-way.

VDOT specifications for compost include standards for pH, moisture, particle size, stability, maturity, soluble salts and nutrients, among other things. VDOT also requires compost meet the heavy metal limitations of the 40 CFR Part 503 regulations.

Project bid specifications included eliminating existing vegetation by disking, spreading 2" of compost over the area to be treated, and rototilling the compost into the existing soil to a 4" depth. The compost was spread by the delivery dump trucks and leveled with a landscape box. The treated area was rototilled (after compost spreading) to a total depth of 6". Grass seed was hydroseeded, while wildflower mix was broadcast.

RESULTS

Results to date are good, according to VDOT staff. Comparing the grass establishment to other grass sites, VDOT estimates a 30% to 40% increase in coverage.

ECONOMICS

Project costs were $0.18 per square foot of surface treated. The total area treated was 360,000 square feet. Total project costs were $64,800. These costs included all labor, equipment, materials, and hauling involved in getting the work completed.

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WASHINGTON STATE DOT

PROJECT SUMMARY

Many State Departments of Transportation (DOTs) are using composts made from recycled organic materials in their construction projects. The Washington State DOT (WSDOT) recently completed a project involving soil bioengineering on problematic slopes. Compost was used as part of the soil bioengineering solution.

The objectives of this project were to:

- Provide viable alternatives called soil bioengineering or "living" approaches for slope and shallow rapid landslide stabilization along different roadside environments.
- Educate WSDOT personnel in site selection and evaluation, and soil bioengineering techniques including construction, monitoring, and maintenance.
- Provide soil bioengineering decision making skills.
- Produce a report of the research project results.
- Educate the public about soil bioengineering alternatives.

The soil bioengineering work involved:

- Willow wall construction
- Willow walls with a brushlayer base
- Live cribwall construction
- Cordon construction
- Brushlayering
- Cedar bender board fencing
- Planting diverse native vegetation
- Seeding
- Biosolids compost application on two sites.

The following conclusions are based on experience acquired during the design and construction phases of this project:

- Class A composted biosolids used on the Chelan site correlate to enhanced plant growth.
- Soil bioengineering projects can be constructed and used successfully on WSDOT projects. All three project sites are revegetating and appear stable.
- Communication and education are important components of any "new" technology.
- An interdisciplinary team, continuously involved in the project, is critical for success.

METHODOLOGY

Three sites were selected for this project:

- State Route 971 – above Lake Chelan at Mile Post 8.22; a north facing slope, 630 ft. long by 70 ft. high; a chronic source of surface erosion and ditch maintenance needs (the Chelan site)
- State Route 101 – near Lost Creek at Mile Post 174; a west facing slope, 180 ft. long by 86 ft. high; a site characterized by heavy marine clays (the Lost Creek Site)
- State Route 101 – near Raymond at Mile Post 60.35; an east facing slope, 591 ft. long by 112 ft. high; a site characterized by lacustriine soils and continual erosion (the Raymond site)

Class A Biosolids compost was used on the Chelan and Lost Creek sites. WSDOT specifications for compost require that the material be a "stable, decomposed organic solid waste that is the result of the accelerated, aerobic biodegradation and stabilization". The material must meet compost quality standards for pH, particle size, maturity, soluble salts, organic matter and inerts. Product acceptance is based upon the submittal of test results as well as feedstock verification. An additional requirement at the Chelan site was that the composted biosolids have a carbon to nitrogen ratio of 35:1. The use of a high carbon ratio product was used to suppress weeds and to enhance long-term survival of woody vegetation.

At the Chelan site, GroCo biosolids compost, obtained from Mt. Rainier Blower Services, was blown with a pneumatic blower truck onto two-thirds of the slope in December 1999 (see Figure 1).

Figure 1 – Applying Compost (Chelan Site)

The project specification was for a one-inch layer, but the contractor laid on a thicker cover because of the moisture content in the compost, and ran out of material before covering the entire site. The uncovered area was used as a control. The compost was incorporated into the soil using hand labor, but only within the terraces; the rest of the area had compost applied to the surface. The contractor building the terraces reported that the soil was much easier to work after compost application. The entire Chelan site was vegetated in April 2000, using Idaho fescue and annual ryegrass and was planted with a mixture of native shrubs and trees.

Compost was applied to the Lost Creek site in November 1999. Due to scheduling difficulties, compost was blown on by blower truck before the willow wall terraces were constructed, causing erosion problems and difficult footing for the construction crew.

RESULTS

At the Chelan site, when work resumed in March 2000, erosion had occurred in the control section, but in the section treated with compost, no erosion was observed. By the end of June, grass was established on all terraces, however, where the composted biosolids were applied, the annual ryegrass was thicker, greener, and withstanding drought conditions better than the control section (Idaho fescue) without compost (see Figure 2).

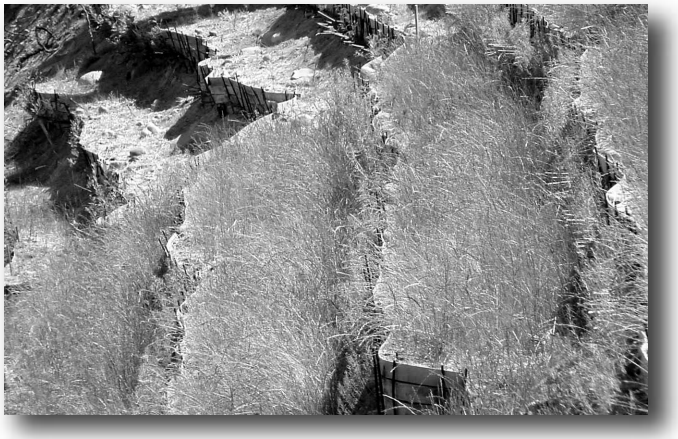

Figure 2 – Chelan Site Vegetation Established

During the first year the shrubs and trees showed no measurable difference in growth rate between the two sections of the slope. In March of 2001 the control section, without compost, experienced a small slope failure. The remainder of the slope, with compost, was stable through the spring thaw. The terraces were repaired and additional compost was applied to the former control area.

ECONOMICS

A summary of the costs for the Chelan project follows:

Item	***Cost***
Total WCC Crew Time (10.5 weeks)	$26,250.00
Total Materials Cost	$ 3,945.24
Vegetation Costs	$ 2,640.80
Biosolid Compost Application	$ 1,329.00
RA'S Salary and Per Diem	$ 5,522.00
Contractor/Excavation Costs	$ 7,296.10
Total Cost for Project	$46,983.14
Cost per Square Foot	$ 1.96

Costs for the Lost Creek Project were as follows:

Item	***Cost***
Total WCC Crew Time (8 weeks)	$20,000.00
Total Materials Cost	$ 210.82
Vegetation Costs	$ 1,131.64
Biosolid Compost Application	$ 3,200.00
RA Salary and Per Diem	$ 3,712.00
Geotechnical Rock Apron	$15,020.00
Total Cost for Project	$30,774.46
Cost per Square Foot	$ 3.55

A cost benefit study was conducted on these sites. Preliminary results indicate that soil bioengineering is approximately 60% of the cost of traditional engineering for surface erosion and shallow rapid landslides, has additional environmental benefits, and is equally effective at stabilizing these features. Final results are pending and will be published on the WSDOT website.

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Lewis, L., et. al. "Soil Bioengineering for Upland Slope Stabilization", Washington State Dept. of Transportation Research Report WA-RD 9227, October 2000

3.2 CATALOGUE OF STATE DOT COMPOST USAGE EXPERIENCE (50 STATE SUMMARIES)

To provide further background regarding the use of compost by each State's DOT, a summary of related information is included. Following these case studies are three (3) tables which possess relevant data from existing state compost specifications. The tables compile the data in three (3) formats; they are 1) soil incorporant compost specifications, 2) surface applied compost specifications (soil mulching and erosion/sediment control), and 3) all State compost specifications.

Summary of Findings

During the initial stages of the project, surveying of State DOT representatives was completed in order to collect information regarding the compost purchasing habits of each State's DOT, as well as pertinent specifications. Through these data collection efforts, it was determined that 31 state DOTs currently have compost, or related product, specifications. Some states specify compost by name, while some allow it as an 'approved equal' to other soil conditioners, and some specify it's use through "special provisions". These special provisions are often precursors to the development and approval of an official specification. Although certain states only specify the use of specific types (feedstock) of compost, most states allow the use of a variety of compost types. Of the 31 states specifying compost use, 26 specify it for soil amending (including topsoil blending) purposes, 11 for planting backfill mixes, and 10 for erosion control.

Data collection also determined that state DOTs used approximately 480,350 cubic yards of compost in 2000 (Figure 3), and an estimated 139,160 acres of land were 'planted' by State DOTs. Although difficult to determine on a state-by-state basis, it is likely that 95% of this acreage was seeded with grasses (some sodded), and 5% was planted with ornamental plants, shrubs and trees. We were unable to determine the percentage breakdown of acreage that was seeded for aesthetics versus those seeded for erosion control purposes (slope stabilization). However, with the amount of acreage treated by State DOTs in a 'typical year', it is obvious that there is great potential to expand the usage of compost by State DOTs.

Figure 3 – Estimated Compost Usage by State

State DOT	Compost Use Specification	Estimated Current Useage - cu. yds.[a]	Estimated Annual Potential Usage - acres[b]
ALASKA	yes	250	200
ALABAMA	no	0	1,000
ARIZONA[d]	no	0	0
ARKANSAS	no	0	1,000
CALIFORNIA	yes	225,000	25,000
COLORADO	yes	n/a	200
CONNECTICUT[f]	yes	n/a	n/a
DELAWARE[c]	yes	n/a	$50,000/yr.- 3 years
FLORIDA	yes	n/a	2,000
GEORGIA[e]	yes	10,000	2,000
HAWAII	no	0	0
IDAHO	yes	10,000	150
ILLINOIS[g]	yes	n/a	n/a
INDIANA	no	0	200
IOWA	yes	12,000	2,000
KANSAS[f]	yes	n/a	n/a
KENTUCKY	no	0	300
LOUISIANA	no	0	2,500
MAINE[b]	yes	17,000	n/a
MARYLAND	yes	75	n/a
MASSACHUSETTS	yes	n/a	n/a
MICHIGAN	yes	n/a	n/a
MINNESOTA	yes	10,000	3,000
MISSISSIPPI	no	0	1,500
MISSOURI	no	0	4,000
MONTANA	yes	600	1,000
NEBRASKA[d]	no	0	150
NEVADA	no	0	n/a
NEW HAMPSHIRE	yes	3,500	10
NEW JERSEY	yes	50	10
NEW MEXICO	no	0	2,000
NEW YORK	yes	n/a	400
NORTH CAROLINA	yes	0	250
NORTH DAKOTA	no	0	300
OHIO	yes	75	n/a
OKLAHOMA	no	0	2,000
OREGON	yes	3,600	60
PENNSYLVANIA	yes	n/a	1,000
RHODE ISLAND	no	0	1,000
SOUTH CAROLINA	yes	100	n/a
SOUTH DAKOTA	no	0	250
TEXAS	yes	100,000	80,000
UTAH	yes	8,000	400
VERMONT	no	n/a	n/a
VIRGINIA[f]	yes	n/a	30
WASHINGTON	yes	80,000	400
WEST VIRGINIA	no	0	10
WISCONSIN	yes	100	750
WYOMING	yes	n/a	4,000
TOTAL		**480,350 yd3**	**139,160 Acres**

a - estimate based on most recent year's usage

b - annual usage will vary considerably (as much as 50%), based on actual landscaping completed

c - MOU in place requiring the expenditure of listed dollar amount on compost

d - state DOT believes that organic matter addition in planting is detrimental to long term plant viability

e - usage includes "aged" wood chips in quantity

f - specification is either in draft form or too new to make projections

g - specification is for a blended soil which includes compost as a component

State DOT Data Summaries

Following are a series of data summaries which were developed following detailed interviews with each State DOT. The individuals that were interviewed during this process were identified as the most likely person within the specific State's DOT to specify the use of compost.

1. Alaska

Contact Name/ Title: Jerry Ruehle, Regional Environmental Coordinator
Organization: Alaska Department of Transportation
Address: 3132 Channel Dr., Juneau, AK 99801-7898
Phone: 907-269-0534
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DOT Website: www.dot.state.ak.us

Specifications and uses

The AKDOT has no general specification for compost products. They do, however, have a "special provision" allowing the use of compost in a backfill planting mix. This has existed since 1997. It approves one specific supplier (Dean Environmental Services) or equal. They have a soil organic matter specification that reads "not less than 3% to not more than 20%".

Compost Feedstocks

"Compost products shall contain composted plant waste derived from the aerobic decomposition of recycled plant waste."

Application Rates

5 cubic feet of compost to 1 cubic yard of topsoil backfill mix

Usage and Potential

The AKDOT currently uses only minimal amounts of compost. It was estimated that their usage was only "a couple of hundred yards per year." They do landscape approximately 200 acres/year. 100% of landscape construction is contracted out. Almost all landscape maintenance is handled by local government agencies.

Compost Product Testing

The only compost standards are that the compost "shall have a moisture content that has no visible free water or dust produced when handling the material." There are no testing or certification requirements listed.

State Directives

Mr. Ruehle was not aware of any state directives regarding compost use.

Comments

There appear to be very few compost facilities in Alaska outside of the Dean Environmental facility listed in the special provision. The cold weather and limited amount of landscape work actually completed by the AKDOT may explain the general lack of interest and use of compost products.

2. Alabama

Contact Name/ Title: Ron Newsome, Assistant Maintenance Engineer, Roadway
Organization: Alabama Department of Transportation
Address: 1409 Coliseum Blvd., Montgomery, AL 36130
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E-mail Address: newsomer@dot.state.al.us
DOT Website: www.dot.state.al.us

Specifications and uses

The ALDOT has no specification for compost products and no experience using them. They also have no minimum organic matter specification in their topsoil specs.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The ALDOT plants at least 1,000 acres of primarily wildflowers annually. They manage over 100,000 acres of roadside. Significant quantities of compost could be used. 100% of landscape construction and maintenance is completed by state work forces.

Compost Product Testing N/A

State Directives

Mr. Newsome was not aware of any state directives regarding the use of compost products.

Comments N/A

3. Arkansas

Contact Name/ Title: Phillip Moore, Botanist
Organization: Arkansas State Highway & Transportation Department
Address: PO 2261, Little Rock, AR 72203
Phone: 501-569-2281
E-mail Address: Phillip.Moore@ ahtd.state.ar.us
DOT Website: www.ahtd.state.ar.us

Specifications and uses
The ARDOT does not have a specification for compost use. It has occasionally been used by special provisions on an experimental basis in roadside enhancement projects. It was tried in place of chemical fertilizer and as an organic soil amendment. Trials date back to 1993.

Compost Feedstocks
Compost derived from chicken litter and yard waste/"sewage sludge" has been used in their experiments.

Application Rates
Application rates of the chicken litter vary from 500 lbs./acre to 2000 lbs./acre as a replacement for chemical fertilizer on wildflower/native grass seeding test plots. The yard waste/"sewage sludge" compost was applied at rates of ?" and 1" prior to planting wildflowers and grass seed.

Usage and Potential
No significant quantities of compost have been used by the ARDOT yet. The ARDOT awarded contracts for 1,395 acres of seeding in 1999. This figure will vary from year to year. 100% of landscape construction is contracted out. All maintenance is done using the state work force, but very little landscape maintenance is actually done outside of mowing grass.

Compost Product Testing
The only testing completed for the experimental plots were health and safety testing by state and federal agencies.

State Directives
Mr. Moore was aware of state directives regarding the use of compost products, but claims they have been ineffective.

Comment
Mr. Moore would like to receive more information on compost use, other state DOT experiences in erosion control and cost benefit comparisons. He was pleased with both the compost experiments he was involved in (fertilizer replacement and soil amending). He also questions the current capacity of Arkansas compost producers to produce adequate supplies of compost.

4. Arizona

Contact Name/ Title: Cliff Taylor, Natural Resources Manager
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E-mail Address: CTaylor@ dot.state.az.us
DOT Website: www.dot.state.az.us

Specifications and uses
The AZDOT does not have a specification for compost use in their landscape manual.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential N/A **Compost Product Testing** N/A

State Directives
Mr. Taylor was not aware of any formal state directives regarding the use of compost products.

Comment
It is the belief of the AZDOT, based on the research conducted by the University of Arizona (Terry Mikel, Ph.D. - Cooperative Extension contact for the AZDOT), that native plants do best when planted directly into the natural desert landscape soil along with a time released fertilizer. They claim that when compost had been tried, back in the late 1980's, plant roots remained in the compost amended soil and did not extend into surrounding soil, resulting in an unstable plant as the plant grew.

5. California

Contact Name/ Title: Jack Broadbent and John Haynes, Senior Landscape Architects
Organization: California Department of Transportation
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DOT Website: www.dot.ca.gov

Specifications and uses

The CADOT has a specification for compost used for erosion control "materials to embankment and excavation slopes 1:4 (vertical:horizontal) or steeper, and other areas designated by the Engineer". They also have a "special provision" allowing the use of compost as a mulch that has been in place since about 1995. It has also been used occasionally as a soil amendment, but nothing formal exists in print defining this application.

Compost Feedstocks

Compost used for erosion control (hydroseeding or seed mulch) shall be derived from green material consisting of chipped, shredded or ground vegetation or clean processed wood products, or a Class A, E.Q. biosolids compost, or a combination of green material and biosolids compost.

The compost mulch feedstocks are "woody materials (which) shall consist of chipped, shredded or ground green materials such as shrubs, tree trimmings or clean processed wood products." "Wood chips produced from tree trimmings may also contain leaves and small twigs." "Green material shall be processed and have an internal temperature of 56 degrees C° for a minimum of 15 consecutive days". The material must be turned a minimum of 5 times during this processing period, and cured for 90 days thereafter.

Application Rates

Erosion control compost application rates are project specific. 3" to 6" of compost is specified for use as mulch. No soil amendment application rates are listed.

Usage and Potential

The CADOT used 140,150 cubic yards of compost mulch in new construction in 1998-99. There were approximately 85,500 cubic yards used in landscape maintenance. The state maintains approximately 25,000 acres of landscape annually. There are over 230,000 acres of roadside. There are no figures for compost used as a soil amendment. 100% of landscape construction is contracted out. All landscape maintenance is handled by the CADOT work force. It was estimated by Mr. Haynes that even greater quantities of compost were used for erosion control applications.

Compost Product Testing

There is a specific time and temperature requirement (56 degrees C∞ for a period of 15 consecutive days) for all compost products. There are also particle size requirements for both applications and a 0.1% maximum inert content limit. Compost maturity/stability and soluble salts, and moisture testing are required for the erosion control compost.

State Directives

The CADOT is encouraged to use recycled products wherever possible and reports/records of such usage are filed. There is, however, no category for organics in this recycled product procurement report.

Comments

The average statewide price for compost mulch is $6.00/cu. yd. (delivered), although much of what is used by the DOT is available to them at no cost. Mr. Broadbent suggested working with the California Integrated Waste Management Board to increase the use of compost products. He expressed a general satisfaction regarding the performance of compost mulch. Their only negative experience resulted from the application of unclean, urban "green waste" prior to specifications being in place.

6. Colorado

Contact Name/ Title: Mike Banovich, Landscape Architect
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Specifications and uses

The CODOT has had a specification for compost products since about the late 1980's. It is listed for use as a general soil amendment and as part of a backfill mix.

Compost Feedstocks

Cow or sheep manure and wood residue are listed as allowable compost feedstocks. Biosolids may be added in the near future.

Application Rates

4 cubic yards of compost per 1,000 square feet is the soil amendment application. The backfill rates are 0.50 cu. ft. per tree and 0.10 cu. ft. per shrub.

Usage and Potential

113 acres were landscaped by the CODOT in 1997, the most recent record on file. Annual landscaping can run between 100 to 300 acres per year. 100% of landscape construction is contracted out. A 1 year maintenance provision is included with these contracts. There is only minimal maintenance completed by the state work force after this 1 year period.

Compost Product Testing

There are both compost product standards and product testing required. The finished compost is tested for organic matter (30% minimum), pH (5.0 to 8.5) and C:N ratio (between 20/1 and 35/1), as well as temperature/time requirements.

State Directives

Mr. Banovich was not aware of any state directives regarding compost use.

Comments

Mr. Banovich has been satisfied with the performance of compost. He suggested working with the state health department regarding the biosolids compost issues.

7. Connecticut

Contact Name/ Title: Emile Fournier, Landscape Designer III
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DOT Website: www.state.ct.us/dot

Specifications and uses

The CTDOT has had a draft specification for compost use since 1998. They are currently meeting in committee with the CTDEP and the University of Connecticut to prepare a finished specification. Various documents, compost trial reports and draft specifications are included with this report. Draft compost specifications have been prepared for soil erosion control, backfill mixes, turf establishment and top dressing.

Compost Feedstocks

Compost derived from leaves and grass (yard trimmings) and source separated organics are currently listed as feedstocks. No biosolids are being considered for approval at this time.

Application Rates

Application rates vary depending on use. Rates are still being discussed by the 'compost working group' described above. Preliminary rates are as follows:

Erosion control - minimum depth of 50 mm (approx. 2")
Backfill mix - 1 part compost to 2 parts site soil
Turf establishment (general soil amendment) - ?" to 2", tilled to a depth of 3"
Topdressing - ?"

Usage and Potential

Mr. Fournier could not provide an estimate of the compost use potential by the CTDOT. He did not have the acreage figures for roadside landscaping. 100% of landscape construction is contracted out. All maintenance is done using the state work force, but very little landscape maintenance is actually done outside of mowing grass.

Compost Product Testing

There has been a compost testing program proposed in the draft specifications. It will include tests for the usual agronomic parameters (pH, moisture, organic matter content, etc.), as well as more compost specific tests such as odor and maturity.

State Directives

Mr. Fournier is not aware of any state directives regarding the use of compost products over peat or natural topsoil.

Comment

The CTDOT has taken a very scientific approach to assuring that compost products be used correctly in their state. They are very interested in the USCC STA program and would like information and direction on it as soon as possible, given that they are formulating a specification and testing program now. Their proposed use of compost in erosion control is innovative and not a typical state DOT specification.

8. Delaware

Contact Name/ Title: Chip Rosan, Roadside Environmental Supervisor
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DOT Website: www.state.de.us/deldot/

Specifications and uses

The DEDOT does not have a specification for compost use. They do, however, have a Memorandum of Understanding ("MOU") in effect with the Delaware Department of Natural Resources and Environmental Control and the Delaware Economic Development Office that is effectively serving as a specification. This MOU has been in place since late 1999. Compost derived from poultry litter is approved for use as a soil amendment under this MOU.

The DEDOT did have, as far back as 1991, a specification for both biosolids compost and co-composted biosolids/municipal waste for use as a soil amendment. The current status of these specifications is questionable since the Delaware facility that produced these products has not been in operation for several years.

Compost Feedstocks

Poultry litter only.

Application Rates

"Compost shall be applied 1" thick over the ground" and "mixed into the top 6" of soil"

Usage and Potential

Mr. Rosan could not, based on the relatively new existence of this "specification", project how much compost could be used. The MOU requires that the DEDOT spend $50,000/year to purchase poultry litter compost, for a 3 year period. It also requires that the compost be used on 5 demonstration projects. 100% of landscape construction is contracted out. These contracts include a 3 year maintenance provision. There is minimal additional maintenance beyond this period.

Compost Product Testing

No formal testing program exists. The compost does have to meet standards for pH, moisture, particle size and soluble salts.

State Directives

The MOU is a state directive concerning the use of poultry litter compost.

Comment

The program is too new to be able to comment on product performance.

9. Florida

Contact Name/ Title: Gary Henry, Landscape Architect
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DOT Website: www.dot.state.fl.us

Specifications and uses

The FLDOT placed a formal a specification for compost use into the January 2000 edition of their landscape manual, although compost had been used previously by the DOT. It is specified for use as a mulch and as a soil amendment. Specific producers are listed in the specifications.

Compost Feedstocks

Compost derived from yard waste, yard waste and manure, municipal solid waste ("MSW") and biosolids are all approved feedstocks.

Application Rates

The only application rate specified is for the use of compost as a soil amendment. Compost is to be "uniformly spread 75 mm (minimum)" (3") and "mixed with the underlying soil to a combined depth of 150mm" (6"). The general application rate for mulch is a 2" minimum layer.

Usage and Potential

Mr. Henry could not estimate what amount of compost had been used due to the recent addition of it to the manual. The FLDOT landscape approximately 2,000 to 3,000 acres/year with most of this being grass seeding, so significant amounts could be used in the future. Specifications require that this soil contain 10% organic matter initially. 100% of landscape construction and 95% of maintenance is contracted out.

Compost Product Testing

There are minimal standards and testing requirements for compost used on FLDOT projects beyond the health and safety requirements imposed by the FLDEP (Department of Environmental Protection). The project engineer has the right to sample the in-place compost for texture, pH and organic matter content. Compost mulch may contain no visible foreign matter. The permitted particle size range is between ?" to no greater than 6".

State Directives

There is a 1992 Florida statewide directive encouraging the use of compost.

Comment

Mr. Henry wants to give compost a 2 year test period before passing judgment on its performance in FLDOT landscape work. He is very interested in the USCC STA program and would consider implementing this as a requirement for Florida compost suppliers.

10. Georgia

Contact Name/ Title: Abbe Hoctor, Landscape Architect
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Address: 2 Capital Square, Atlanta, GA 30334
Phone: 404-657-6053
E-mail Address: abbe.hoctor@dot.state.ga.us
DOT Website: www.dot.state.ga.us

Specifications and uses

The GADOT has had a compost specification since 1995, and possibly as early as 1992 in some form. It is listed for use under the heading of organic soil additives.

Compost Feedstocks

Compost feedstock reference is generic, consisting of "organic materials which have undergone biological decomposition".

Application Rates

No general application rates are specified. Compost application is project specific. Typical applications are 2" to 3" of compost incorporated into 6" of existing soil.

Usage and Potential

Ms. Hoctor did not think that much compost was currently being used in landscape construction projects. Approximately 10,000 cu. yds./year of wood chips (not composted) are being used as mulch. The GADOT maintains about 5,400 acres of landscape area. 90% of new landscape construction is contracted out. This work includes a 2 year maintenance requirement. 90% of landscape maintenance is done by the state work force after this time.

Compost Product Testing

There are only minimal compost standards and no testing requirements in the GADOT specifications. Product standards include color, pH, and references to minimal odor, stabilization and human pathogens. The Georgia Department of Administrative Services has a health and safety compost standard that is comparable to the EPA Part 503 specifications.

State Directives

The Georgia Department of Administrative Services requires that "compost and mulch made from organic material that is recovered from Georgia's non-hazardous waste stream" be given preference over other products in landscape construction.

Comments

Ms. Hoctor's limited exposure to compost use has been positive.

11. Hawaii

Contact Name/ Title: George Tonaki, Landscape Architect
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DOT Website: hinc.hinc.hawaii.gov/hinc/dot/

Specifications and uses

There is no compost specification listed in the HIDOT "Master Guidelines" manual. Mr. Tonaki did indicate that compost had been used occasionally as a general soil amendment.

Compost Feedstocks N/A

Application Rates

Compost, when it was used, was used at the manufacturers recommended application rates.

Usage and Potential

The HIDOT does very little landscaping, according to Mr. Tonaki. He claimed that there was very little land area actually landscaped or potentially available to be landscaped within the land owned by the HIDOT. 100% of new landscape construction and 75% of maintenance is contracted out.

Compost Product Testing N/A

State Directives

Mr. Tonaki indicated that he was aware of a directive giving preference to the use of local recycled products in landscape work, but not specifically to compost.

Comments

The Master Guidelines manual was just revised in December of 1999. New proposed sections on planting soil and planting make no actual reference to compost. There is a specification for "nitrogen stabilized" wood chips under the mulch and soil amendment heading.

12. Idaho

Contact Name/ Title: Gene Ross, Roadside Landscape Manager & Program Coordinator
Organization: Idaho Department of Transportation
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E-mail Address: gross@itd.state.id.us
DOT Website: www.state.id.us/itd/

Specifications and uses

The IDDOT has had a specification for the use of compost as a mulch in slopes "flatter than 1 vertical to 3 horizontal" for about 3 years.

Compost Feedstocks

There are no feedstocks specifically approved in the compost specifications. There are 3 producers listed as possible sources for compost.

Application Rates

The application rate specified for the use of compost as mulch is a minimum 20 cubic yards per acre.

Usage and Potential

Approximately 10,000 cu. yds. of compost were used in 2000. This quantity will vary from year to year. The IDDOT landscapes between 50 to 300 acres/year. 100% of landscape construction is contracted out. All maintenance is done using the state work force, but they use very little compost due to budgetary constraints.

Compost Product Testing

The only compost standards/test requirements are that the compost meet the EPA part 503 regulations for Class A compost and that the supplier provide Solvita maturity test results of 5 or greater to assure the compost is mature. The maturity test is required for very 2 hectares of compost use.

State Directives

Mr. Ross was not aware of any state directives regarding the use of compost products.

Comment

Mr. Ross is very interested in the USCC STA program and would consider implementing this as a requirement for Idaho compost suppliers. He claims that there is a lot of aged manure being promoted as compost in Idaho. He has seen very good results using compost as a mulch.

13. Illinois

Contact Name/ Title: Charles Gouveia, Roadside Maintenance Manager
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DOT Website: www.state.il.us

Specifications and uses

The ILDOT has had a specification for the use of compost as a soil amendment for about 10 years, since the legislature passed a ban on the disposal of yard waste in landfills. The compost actually becomes part of the "topsoil and compost" specification due to the way the specification is written.

Compost Feedstocks

Yard waste is the primary source of approved compost feedstock. Biosolids compost is not used due to "permitting problems".

Application Rates

A manufactured topsoil consisting of "a maximum of 40% compost by volume shall be substituted for the topsoil" is permitted by specification. The application rate specified for the use of this compost/topsoil is dictated by the specific project grading plans.

Usage and Potential

Mr. Gouveia could provide no estimate of compost use or potential use due to the way the specifications are structured. It is used primarily in urban areas where soil is poor and compost supply is available. 100% of landscape construction and "most" of the maintenance is contracted out.

Compost Product Testing

The ILDOT has only minimal compost quality standards/test requirements. They require that the compost be produced by and meet the requirements of the ILEPA standards for "general use compost" (analogous to part 503 regulations for Class A compost) and that the compost be relatively free of man made materials and "be capable of supporting and germination of seeding".

State Directives

Mr. Gouveia referred to a legislative ban on yard waste in landfills as the closest state directive to encouraging compost use.

Comment

Mr. Gouveia is very interested in the USCC STA program and would consider implementing this as a requirement for Illinois compost suppliers. He claims that there is little compost available outside of the Chicago metropolitan area in Illinois.

14. Indiana

Contact Name/ Title: Clyde Lovelady and David Lamb, Landscape Specialists
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Address: Room 125, 100 N. Senate Ave., Indianapolis, IN 46204
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E-mail Address: cloveady@ indot.state.in.us
DOT Website: source.isd.state.in.us/acin/do

Specifications and uses

The INDOT has no specification for compost products. Peat moss is the primary source of organic matter. There is no minimum specification for organic matter in planting mixes.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The INDOT plants between 200 to 300 acres per year. The potential for compost use is there, should they begin to utilize the product. 95% of landscape construction is contracted out. Contracts include a 2 to 3 year maintenance requirement. Very little maintenance is done after this period.

Compost Product Testing N/A

State Directives

Mr. Lamb is not aware of any state directives concerning the use of recycled organic products.

Comments

The INDOT does maintain a compost site for "road kill". Very little compost is produced from this site and it is used locally.

15. Iowa

Contact Name/ Title: Mark Masteller, Chief Landscape Architect and Dave Heer, Earthwork Field Engineer
Organization: Iowa Department of Transportation
Address: 800 Lincoln Way, Ames, IA 50010
Phone: 515-239-1424
E-mail Address: dheer@max.state.ia.us
DOT Website: www.dot.state.ia.us

Specifications and uses

The IADOT has had a specification for compost products since about 1998. They claim that there isn't a need for soil amending in most landscape applications due to the high quality of the natural soils. Compost is listed as a soil amendment material.

Compost Feedstocks

Their general specification includes yard debris compost only. They have, however, included "source separated compostable materials, separated at the point of waste generation that may include, but are not limited to, leaf and yard trimmings, food scraps, food processing residuals, forest residues and bark, and soiled and/or unrecyclable paper, and biosolids" in specific project specifications.

Application Rates

4" of compost and 1" of sand incorporated to a depth of 10" to 12" in planting bed preparation

Usage and Potential

12,000 cubic yards of compost were used in 1999. The IADOT seeds approximately 2,000 to 2,500 acres/year, so the potential for compost use is great.100% of landscape construction is contracted out. Approximately 95% of landscape maintenance is handled by the state work force.

Compost Product Testing

There are minimal compost standards and no testing requirements for the yard debris compost used in "special provisions for amended soil".

State Directives

The Iowa Department of Natural Resources is encouraging the DOT to use more compost.

Comments

Mr. Masteller was satisfied with the performance of compost products. He indicated that Iowa State University is currently running tests on the use of compost for erosion control. He was very interested in implementing the USCC STA program as a condition for acceptance of compost products on IADOT projects.

16. Kansas

Contact Name/ Title: Richard D. Ross, Landscape Architect
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Address: Docking State Office Bldg., Rm. 814N, Topeka, KS 66612-1568
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DOT Website: protol.dot.state.ks.us

Specifications and uses

The KSDOT has just added a specification for compost products within the past year (2000). It is listed as "being suitable for general gardening, soil incorporation and plant backfill."

Compost Feedstocks

No specific feedstocks are listed. The compost must, however, come from a Kansas permitted composting facility.

Application Rates

1 ?" of compost incorporated to a finished depth of 6" for turf and planting areas. A mix of 1 part compost to 5 parts soil from the planting hole, for tree/shrub backfill mixes.

Usage and Potential

The KSDOT has just used compost on their first project. They had no projections as to the ultimate potential use of compost at this. 100% of landscape construction and maintenance is contracted out.

Compost Product Testing

The KSDOT does require that compost be tested for a list of parameters. In addition, they also require that a Solvita Compost Maturity Test, be submitted for any compost product proposed for use on a DOT project.

State Directives

Mr. Ross was not aware of any state directives regarding compost use.

Comments

The KSDOT is just getting started with the use of compost. Mr. Ross indicated that they would like the USCC to review their specifications and provide input back to him.

17. Kentucky

Contact Name/ Title: Melvin Ramsey, Landscape Architect
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DOT Website: www.kytc.state.ky.us

Specifications and uses

The KTC has no specification for compost products, nor do they plan on having one. Both the University of Kentucky and the local nursery association has advised the KTC that soils should not be amended when planting. They claim that plant root balls will tend to stay within the amended backfill mix and ultimately fail to thrive.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The KTC plants between 300 to 400 acres per year. The potential for compost use in Kentucky remains, should they change their opinion on the use of compost. 100% of landscape construction is contracted out. All mowing is contracted out. Very little additional maintenance is done.

Compost Product Testing N/A

State Directives

Mr. Ramsey is not aware of any state directives concerning the use of recycled organic products.

Comments N/A

18. Louisiana

Contact Name/ Title: Sidney Babin, Chief Landscape Architect
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Specifications and uses

There is no true specification for compost products listed by the LADOT. They use a lot of pine bark and manure, but these products are not composted. In fact, "excessively decomposed pine bark will be rejected" is language that is part of their specifications. Pine bark has been in the specifications for over 35 years and manure has been included since the late 1980's.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The LADOT used over 5,000 cu. yds. of mulch in 1999. They estimate that approx. 2,500 to 3,000 acres of roadside are landscaped or seeded annually. 100% of new landscape construction with a 1year maintenance provision is contracted out. Little additional maintenance extends beyond this time period. An effort is made to employ local community wherever possible.

Compost Product Testing N/A

State Directives

Mr. Babin was not aware of any state directive encouraging compost use.

Comments

There appears to be a huge supply of pine bark available in Louisiana at very low cost to the LADOT. This is what they use for the majority of both their mulching and soil amending needs.

19. Maine

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Specifications and uses

The MEDOT has had a specification for compost products since the early 1990's. It is approved for use in any application as a soil amendment and it is defined under the heading "peat humus". "Wood waste" is specifically approved for erosion control filter berm construction.

Compost Feedstocks

Compost derived "from source separated materials that may include leaf and yard trimmings, food scraps, food processing residues, manure and other agricultural residuals, or biosolids" are listed as acceptable feedstocks.

"Wood waste erosion control mix" consists of a variety of woody feedstocks listed under the heading of mulch.

Application Rates

Wood waste erosion control mix shall be spread to a minimum depth of 100 mm (4"). There are no application rates listed in the specification book for general soil amending with compost. Application rates are project specific depending on what is being planted and on the organic matter content of the native soil at the job site. Tree pits are specified to contain 1/3 organic matter, of some kind, by volume.

Usage and Potential

The MEDOT used 5,000 cu. yds. of wood waste erosion control mix in 1999 and had used 7,200 cu. yds. at the time of this survey. They used 17,200 cu. yds. of loam in 1999 and had used 32,900 cu. yds. in 2000, at the time of this survey. Loam usage can include other sources of organic matter besides compost. Loam must contain 10% to 20% organic matter content by volume. They do not have a way to determine compost usage volume on new landscape construction projects. 700 cu. yds. of biosolids compost was used in the fall of 2000 for a wildflower seeding project. 95% of landscape construction is contracted out. There is no on-going maintenance of landscaped areas.

Compost Product Testing

There are minimal standards for composted products included in the specifications, but no actual outside testing is required. Standards include particle size, soluble salts, pH and a Dewar self heating test for peat humus. Mr. LaRoche claims that the MEDOT "knows the supplier" of their primary source of compost (biosolids), eliminating the need for additional testing. Wood waste erosion control mix has size, pH and soluble salts standards.

State Directives

Mr. LaRoche was aware of a state directive concerning the use of recycled organic products published sometime in the 90's, but did not think it was effective or an incentive to use compost. He believes that the elimination of natural loam and topsoil will increase compost product use.

Comments

Mr. LaRoche has been pleased with the performance of compost products by the MEDOT. He claims that the primary source of compost is biosolids based and his mulch is wood waste based. There does not appear to be any significant source of yard waste compost available for use by the MEDOT. He believes that compost amended soils perform better than topsoil under drought conditions and is currently experimenting with a hydroseeded compost/wildflower seed.

20. Maryland

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Specifications and uses

The MDDOT has had a specification for compost products since at least 1993, and possibly longer, and they are currently in the process of being updated. It is approved for use as a backfill mix additive for tree and shrub planting, but can be approved for other uses as a general soil amendment. Most of the topsoil in the state meets the 1.5% minimum organic matter content requirement and requires no amending. Any soil that falls below 1% is rejected and cannot be amended.

Compost Feedstocks

Biosolids compost and source-separated compost derived from "tree leaf" and "non-tree leaf" (lawn clippings) are approved feedstocks.

Application Rates

No application rates are listed in the specification book. They are project specific based on what is being planted and on the characteristics of the native soil on the job site.

Usage and Potential

The MDDOT only uses about 75 cu. yds. per year of compost. Mr. Cober claims that the products just have not been available for DOT usage, as they are being purchased primarily by the private industry at higher prices than the DOT would pay. 98% of landscape construction and 95% of landscape maintenance is contracted out.

Compost Product Testing

There are standards for composted products included in the specifications. Biosolids compost must be approved by the MDDEP for health and safety standards. Additional MDDOT standards include particle size, soluble salts, re-heating, moisture and pH. Source separated compost must be approved for distribution by the Maryland Dept. of Agriculture which has a compost operator certification program. A soluble salt standard, particle size, re-heating, moisture and pH are additional requirements of the MDDOT for these types of compost products

State Directives

Mr. Cober was not aware of any state directives regarding the use of compost products.

Comments

Mr. Cober has been satisfied with the performance of compost on MDDOT products, but emphasized that little is actually used. He is interested in the activity of the state compost association and the USCC STA program.

21. Massachusetts

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Specifications and uses

A draft specification for compost should be in place within the next 6 months. Compost has been used on a very limited, project specific basis for about 2 or 3 years. It will be specified for use as an "organic soil additive".

Compost Feedstocks

Any compost that meets or exceeds the requirements of the Massachusetts Department of Environmental Protection is acceptable for use on DOT projects. This includes biosolids compost that meets the EPA's part 503 standards for Class A, E.Q. product.

Application Rates

The objective of the MADOT will be to achieve a finished soil with an organic matter content of between 4% to 10%, depending on what is being planted. Compost can be added in "lifts not to exceed 100 mm (approx. 4"). After each lift, the soil shall be well-mixed into the soil layer beneath it."

Usage and Potential

Potential usage cannot be estimated at this time since application rates will vary from project to project depending on the organic matter content of the project site soil and the plants to be established. 100% of landscape construction is contracted out. Landscape maintenance is split approximately 50/50 between outside contractors and state work forces.

Compost Product Testing

Compost testing, in addition to the health and safety requirements of the Mass. DEP, is required. These tests include a Solvita maturity test, which must be used in the presence of a highway department engineer.

State Directives

Mr. Batchelor was aware of a general state recycling mandate, but nothing specific for organic materials.

Comments

Compost is a relatively new product to the Mass. Highway Department.

22. Michigan

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DOT Website: www.mdot.state.mi.us

Specifications and uses

The MIDOT has had a specification for compost products since 1995. It is listed for use as a generic "special provision for compost" (soil amendment). It has recently been listed as a "special provision for slope restoration" (2000).

Compost Feedstocks

Compost derived from yard clippings or other materials is specified under the generic compost heading. Compost derived from "vegetative material (such as yard trimmings), wood or bark" is specified for slope restoration.

Application Rates

The generic compost specification application rate is project plan specific. The slope restoration mix consists of compost, seed and tackifier and is applied at a depth of 1" (25 mm).

Usage and Potential

There was no way to estimate current usage according to Mr. Bokovoy. He did claim that compost use had been increasing annually and that it is currently being used on approximately 15% to 20% of all landscape projects. This is primarily on "right of way" projects for grass seeding which encompasses "thousands of acres annually". 100% of landscape construction is contracted out with a 2 year maintenance provision included with these contracts. There is only minimal, if any, maintenance completed by the state work force after this period.

Compost Product Testing

There are both compost product standards and product testing required. These differ somewhat for the two compost uses listed above. They include pH, soluble salts, organic matter and other standards. An undefined maturity test is also specified. Compliance with the EPA CFR 40, Part 503 regulations is also required even though biosolids are not listed in the specification.

State Directives

Mr. Bokovoy was not aware of any state directives regarding compost use.

Comments

Mr. Bokovoy has been satisfied with the performance of compost. He is very interested in the USCC STA program and would like to see this implemented by the MIDOT.

23. Minnesota

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Specifications and uses

The MNDOT has used compost since as early as 1988. A formal specification has been in place since 1995. It is specified for use as a soil amendment for turf establishment and landscape planting. Compost is specified according to feedstock as described below. The MNDOT is currently working on an experimental use of compost as a biofiltration agent to build wetlands. They have applied a 6" layer of compacted compost, using 12,000 cu. yds., over a 6 acre site (2,0000 cu. yds./acre). The initial results are promising and a final report will be written in the spring of 2001.

Compost Feedstocks

The MNDOT assigns only certain compost feedstocks to specific uses. This is done as follows:

- Grade 1 compost - animal manure compost for use in turf establishment
- Grade 2 compost - yard debris compost for use as a landscape planting medium
- Grade 3 compost - 90% or more of yard debris compost, with a maximum of 10% animal manure compost, for turf establishment

Biosolids as a compost additive or co-compost material shall be acceptable if it meets all specifications for Grade 1 compost.

Application Rates

The MNDOT requires a 4% organic matter content in their finished "ready to plant" soil. Application rates for compost are determined by measuring the organic matter content of the project site soil and of the compost to be used, and then determining how much compost will be needed to meet the 4% minimum standard. Typically, this results in a 1" to 2" application of Grade 1 compost or a 3" to 4" application of Grade 2 compost.

Usage and Potential

Mr. Stenlund estimated that between 5,000 to 20,000 cu. yds. of compost are used annually by the MNDOT, depending on how much landscaping is being done in a given year. There are approximately 3,000 to 4,000 acres landscaped annually, so the ultimate compost use potential is much higher than what is currently being utilized. 100% of landscape construction is contracted out. All landscape maintenance is completed by the state work force.

Compost Product Testing

An extensive compost product standard and testing protocol exists. Compost must be tested prior to delivery to the job site by the project engineer. These tests include a maturity test, a seed germination test, proof of PFRP and an array of other physical and chemical tests.

State Directives

Mr. Stenlund indicated that the Minnesota Office of Environmental Assistance has been actively encouraging the use of compost products.

Comments

Mr. Stenlund is aware of the USCC STA program and has tried to model the MNDOT's testing program around early drafts he has read. He would like to receive updated information on this program. He would also like the state to elevate the quality of compost products available for use and wants all compost to meet Minnesota Grade 1 standards.

24. Missouri

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Specifications and uses

The MTDOT does not have a formal specification for compost products. Mr. Swanigan was aware of some turkey manure compost being used on a few jobs. There is no minimum organic matter specification for landscape planting soils.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The MODOT landscapes approximately 1% to 2% of their 385,000 acres (3,850 to 7,700 acres) annually. Approximately 50% of landscape construction is contracted out. Approximately 95% of landscape maintenance is done by state work forces.

Compost Product Testing N/A

State Directives

Mr. Swanigan was not aware of any state directives regarding the use of compost products.

Comments

Mr. Swanigan believes that a combination of limited product availability and high transportation costs have thus far minimized the use of compost by the MODOT.

25. Mississippi

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DOT Website: www.mdot.state.ms.us

Specifications and uses

The MSDOT does not have a specification for compost products. Their manual was last updated in 1990. They have no minimum organic matter standard in their specifications. No soil amending is required as a result.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The MSDOT could landscape as much as "thousands of acres per year" according to Mr. Thompson. He emphasized that this figure is highly variable. Approximately 60% of landscape construction is contracted out. Approximately 90% of landscape maintenance is done by state work forces.

Compost Product Testing N/A

State Directives

Mr. Thompson was not aware of any state directives regarding the use of compost products.

Comments

Mr. Thompson suggested contacting several groups in order to encourage compost utilization in Mississippi. Both "Keep Mississippi Beautiful" and "Keep Jackson Beautiful" might be interested in compost. He also indicated that the Transportation Research Board ("TRB") has a senior landscape architect (Carol Braun at 651-296-1648) who works with all state DOT's, as a point of contact.

26. Montana

Contact Name/ Title: Phil Johnson, Reclamation Specialist
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DOT Website: www.mdt.mt.gov

Specifications and uses

The MTDOT does not have a formal specification for compost products. It does, however, list compost in its "seeding special provisions" for use as a mulch. It is approved only for use on areas that must be drill seeded and mulched, on slopes steeper than 3:1, and "on a 15' wide strip adjacent to the finished pavement, along both roadsides". There is no minimum organic matter requirement for general planting site soils.

Compost Feedstocks

Compost producers, not feedstocks, are approved. The 3 approved producers in Montana supply biosolids compost only.

Application Rates

Compost applied as a mulch on slopes is specified at 1,000 dry pounds per acre. It is applied using hydroseeding equipment. There is no application rate specified for the roadside mulch application.

Usage and Potential

The MTDOT re-seeds approximately 1,200 acres per year. Only about 600 cubic yards of compost were used in 2000. 100% of landscape construction is contracted out. These contracts include a 1 maintenance provision. There is no additional maintenance beyond this period.

Compost Product Testing

The only testing required are the health and safety requirements of the Montana Department of Environmental Quality, which are the same as the EPA's part 40 CFR Part 503 regulations.

State Directives

Mr. Johnson was not aware of any state directives regarding the use of compost products.

Comments

Mr. Johnson believes that the MTDOT gets good results using compost as a mulch on slopes.

27. Nebraska

Contact Name/ Title: Art Thompson, Landscape Architect
Organization: Nebraska Department of Roads
Address: PO 94759, Lincoln, NE 68509-4759
Phone: 402-479-4839
E-mail Address: not available by request of Mr. Thompson
DOT Website: www.dor.state.ne.us

Specifications and uses

The NEDOT does not have a specification for compost products. They have experimented with yard waste compost for use as a seed topdressing mix over the last 6 years. Mr. Thompson claims that national and state forest services are opposed to compost use due to a "flower pot" effect, which limit the roots from leaving the backfill mix thereby jeopardizing plant viability. He also believes that amended soils are not beneficial in non-maintained areas.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The NEDOT re-seeds approximately 20 to 30 lanes miles per year. Each lane mile has 60 feet of roadside to seed.

100% of landscape construction is contracted out. These contracts include a 1 year maintenance provision. There is minimal additional maintenance completed by state forces beyond this period.

Compost Product Testing N/A

State Directives

Mr. Thompson was not aware of any state directives regarding the use of compost products.

Comments

The NEDOT is looking into the use of some composted manure.

28. Nevada

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DOT Website: www.nevadadot.com

Specifications and uses

The NVDOT does not have a specification for compost products. They are, however, about to embark on a statewide DOT master plan development project that may change this. The first meeting took place on Nov. 16, 2000 and the plan will probably take 2 years to complete. Mr. Payne is the first landscape architect hired by the NVDOT in about 25 years.

There is no minimum organic matter requirement for soils. Each planting site is reviewed for need.

Compost Feedstocks N/A **Application Rates** N/A

Compost Product Testing N/A

State Directives

Mr. Payne was not aware of any state directives concerning compost use.

Comments

Mr. Payne is very interested in learning more about the USCC STA program and in receiving compost use information. He indicated that he would consider building the STA program into the master plan being developed.

29. New Hampshire

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DOT Website: www.dot.state.nh.us

Specifications and uses

The NHDOT has a specification for compost products. Source separated composts are formally approved for use as a soil amendment in seedbed establishment. A specification for "non-sludge" based compost products has been in place since 1998. Special provisions allowing the use of compost in backfill planting mixes are written for specific projects. The soil in New Hampshire, in general, is "very good" requiring minimal amending.

Compost Feedstocks

"Source separated compostable materials, separated at the point of waste generation, that may include, but not limited to, leaves and yard trimmings, food scraps, food processing residues, manure and/or agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper" are approved for use on wildflower establishment. "Municipal waste water treatment sludge" was specifically excluded in the specification amendment of 12/23/98. However, a manufactured loam mixture that contains biosolids compost has been used in backfill mixes (on a job specific basis only).

Application Rates

Wildflower bed preparation can consist of either 2" of compost tilled into 4" of soil or 6" of compost applied to the surface of the prepared area. The actual use is dictated by the specific project description. A project specific special provision for compost used as part of a backfill planting mix specifies 6 cu. ft. of compost per cu. yd. of acceptable loam.

Usage and Potential

The NHDOT constructs about 10 acres/year of wildflower beds, using a minimum of 2" of compost (2,700 cu. yds./yr.). Approximately 1,000 cu. yds. of compost goes into shrub and tree planting annually. 100% of landscape construction with a 1 ? year maintenance requirement is contracted out.

Compost Product Testing

The NHDOT has both a set of standards and testing requirements for compost. These include organic matter content, moisture, particle size, stability (undefined) and pH. The compost must also "be approved by the Engineer prior to use".

State Directives

There was a state directive 'of some kind regarding compost use around 1993'. It was designed to "encourage contractors to use locally produced compost", but was not very formal in structure.

Comments

Mr. Giunta is very interested in learning more about the USCC STA program. The NHDOT has been very innovative in the past and is currently working with representatives from the NH Division of Economic Development (James Robb at 603-271-2591) to discuss ways of increasing compost use. They think that the landscape industry is moving away from amending planting backfill mixes due to conflicting success stories. The NHDOT is considering using compost for wetland construction if regulations and NIMBY's allow.

30. New Jersey

Contact Name/ Title: John Spedding, Landscape Architect
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E-mail Address: johnspedding@dot.state.nj.us
DOT Website: www.state.nj.us/transportation

Specifications and uses

The NJDOT has had a specification for compost since 1989. The specification is for composted "sewage sludge" (only), for use as a general organic soil amendment. The NJDOT requires that topsoil contain a minimum of 2.75% organic matter.

Compost Feedstocks

Biosolids compost is the only compost currently approved by the NJDOT. They have been approached by yard waste compost suppliers, but have not acted thus far to include other compost products in their specifications.

Application Rates

There are no specific application rates specified beyond the need to increase the organic matter content to 2.75%.

Usage and Potential

Mr. Spedding does not believe that more than about 50 cu. yds. of compost is used on NJDOT jobs annually. This is primarily due to a lack of biosolids compost supply. The NJDOT does landscape approximately 100 acres/year, at a minimum, so much more compost could be used. 99% of landscape construction and maintenance is contracted out.

Compost Product Testing

The only product standards and testing required pertain to moisture content and pH. The New Jersey Department of Environmental Protection is responsible for approving all biosolids compost for sale, using EPA's 503 standards for product safety.

State Directives

Mr. Spedding was vaguely aware of some legislation passed encouraging the use of recycled products in general, but does not think that it was useful regarding the use of compost.

Comments

Mr. Spedding has been generally satisfied with the results of biosolids compost use. The NJDOT has experienced some odor problems with the use of this compost in the past.

31. New Mexico

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DOT Website: www.nmshtd.state.nm.us

Specifications and uses

The NMSHTD has no specifications for compost products. Only native plants are used in landscape construction, which they believe require no organic matter amendment of any sort.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The NMSHTD has no experience or usage of compost products. They seed approximately 2,000 to 3,000 acres per year, so there is a large potential market for compost products. 100% of landscape construction is contracted out. 100% of landscape maintenance is done using the state work force.

Compost Product Testing N/A

State Directives

Mr. Stem was not aware of any state directive regarding the use of compost.

Comments N/A

Usage and Potential

Mr. Payne could not estimate potential usage since no records of landscape work exist. 100% of landscape construction and maintenance is contracted out.

32. New York

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DOT Website: www.dot.state.ny.us

Specifications and uses

The NYDOT had approved compost and has a specification for it's use as an "organic material used in conjunction with amending or manufacturing topsoil". There is no specification for the direct use of compost in landscape applications.

Compost Feedstocks

All feedstocks, including leaves, yard trimmings, food scraps, biosolids, food processing residuals, manure, soiled paper, other source separated organic residuals are approved compost sources. However, biosolids compost must adhere to a higher level of testing than do the other compost products.

Application Rates

No application rates for compost are specified since it is only approved for use as an amendment to raise the organic matter content of topsoil. Topsoil must contain between 2% and 20% in organic matter content.

Usage and Potential

Mr. Nagel cannot estimate the annual usage of compost due to the way the products are used. The NYDOT landscapes between 300 to 500 acres/year and plants about 10,000 trees, shrubs and flowers. 100% of landscape construction is contracted out. All maintenance is completed by state work forces, but very little is actually done besides mowing grass and spreading mulch.

Compost Product Testing

A relatively basic analysis of compost products is all that the NYDOT requires for their testing program. Biosolids compost does require more extensive testing, which is comparable to the EPA part 503 biosolids regulations.

State Directives

There are no state directives or preferences of which Mr. Nagel is aware.

Comments

Mr. Nagel has been satisfied with the results of compost used by the NYDOT. He is very interested in implementing the USCC STA program. He believes that contractors in the state need to be made more aware of compost availability and benefits before significantly more will be used on DOT projects.

33. North Carolina

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DOT Website: www.dot.state.nc.us/DOT

Specifications and uses

The NCDOT has a procurement specification in the form of a Request For Quotation ("RFQ") for compost. It was written in 1996. Its use is primarily as an organic fertilizer and limited source of organic matter for the establishment of wildflower beds. Yard waste, not necessarily compost, is used in large quantities across the state as a mulch. There is no NCDOT specification for this and product quality appears to be very variable.

Compost Feedstocks

The specification is specifically written for poultry litter compost, although Mr. Smith indicated that other sources would be considered. Other waste derived compost products, including biosolids, may be used as a filler ("material added to the poultry litter compost in order to augment pH or alter nutrient content or fill space") with the poultry litter compost. Approved compost suppliers are listed by the NCDOT.

Application Rates

Project specific. Nutrient value must be declared and guaranteed.

Usage and Potential

The NCDOT has stopped using compost in the last 2 years due to lack of supply. The NCDOT plants hundred's of acres of wildflowers annually and could use several thousand cubic yards per year, if it were available and cost effective. Several thousand cubic yards of yard waste are used annually as mulch. Approximately 70% of landscape construction and 50% of landscape maintenance is contracted out. The remainder is done using the state work force.

Compost Product Testing

The NCDOT has a very extensive product standards and testing program included in the RFQ. They work closely with the North Carolina State University which runs many of the tests for them. Testing includes nutrient content (N-P-K), pH, moisture, composting criteria, soluble salts and, in some cases, actual growth plot testing.

State Directives

Mr. Smith was aware of a state directive encouraging the use of recycled products wherever feasible, but believes that this is cost prohibitive regarding compost in many situations.

Comments

Mr. Smith has been satisfied with the performance of compost in the state's wildflower program.

34. North Dakota

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DOT Website: www.state.nd.us/dot

Specifications and uses

The NDDOT has no specification for compost products and have not considered the use of them on DOT projects. The state has, however, contracted much of the design work out to an independent landscape architect at the North Dakota State University (Dennis Colliton at 701-231-8011). He claims that an organic matter content of 12%, which could include compost as an amendment, has been part of typical planting specifications that he has prepared for almost 10 years. This is typically supplied by the addition of manure.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The NDDOT landscapes and seeds several hundred acres a year, mostly the result of grading projects. 100% of landscape construction is contracted out. 100% of landscape maintenance is done using the state work force.

Compost Product Testing N/A

State Directives

Mr. Kubischta was not aware of any state directives encouraging the use of compost products.

Comments N/A

35. Ohio

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DOT Website: www.dot.state.oh.us

Specifications and uses

The OHDOT has had a vague compost specification since 1997. It is listed for use as part of a planting backfill mix. There is no soil amending required for seeding projects and there in no minimum organic matter specification.

Compost Feedstocks

Ohio "EPA rated Class IV rated compost" is listed as the only approved feedstock. This grade of compost consists of "source separated yard waste, (with) authorized bulking agents" only.

Application Rates

A mix of 1/3 compost with 1/3 sand and 1/3 soil is the listed application rate.

Usage and Potential

The OHDOT only uses between 50 to 100 cubic yards of compost per year. They do very little landscaping, according to Mr. Sherman. 100% of new landscape construction is contracted out, but only as part of highway building projects. There is no landscape maintenance completed except for mowing.

Compost Product Testing

There are no compost standards and no testing requirements within the OHDOT specifications.

State Directives

Mr. Sherman was not aware of any state directives concerning compost use.

Comments

Ms. Sherman indicated that he found minimal interest in compost use on the part of Ohio road contractors. He suggested that the private sector engineering associations needed education in order for compost to become an accepted product for roadside landscape use.

36. Oklahoma

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DOT Website: www.okladot.state.ok

Specifications and uses

The OKDOT has no specification for compost products. They do, however, have a 15% minimum organic matter content required in planting soils.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The OKDOT landscapes and seeds a minimum of 2,000 acres a year. They have had some experience in using "sludge", but not compost. 100% of landscape construction and maintenance is contracted out.

Compost Product Testing N/A

State Directives

Ms. Dolan was not aware of any state directives encouraging the use of compost products.

Comments N/A

37. Oregon

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DOT Website: www.odot.state.or.us

Specifications and uses

The ORDOT has had a compost specification since about 1984 and new specifications will be published early in 2001. Compost is listed as a soil conditioner in these new specifications.

Compost Feedstocks

Mushroom compost and composted yard debris are specifically listed under the soil conditioner heading. Mr. Edgecomb did indicate that biosolids compost had been used but these are not included in the new specifications.

Application Rates

Application rates vary depending on what is being planted and on the existing organic matter content of the project site soil. An organic matter content of 2% is required for finished topsoil. Application rates are as follows:

- **Cultivated Planting Areas, non-lawn** – 2" (50 mm) of compost incorporated into 12" (300 mm) of bed soil
- **Non-cultivated planting areas** - add as needed with backfill at each plant pit to achieve desired organic matter content
- **Sod lawn and seeded lawn areas** - add 0.5 cu. meters/100 sq. meters, or as recommended by soil testing

Usage and Potential

The ORDOT purchased approximately 3,600 cu. yds. of compost in 1999. They complete about 60 acres of new landscape construction per year. They maintain about 1,000 acres in total. 100% of landscape construction is contracted out. This includes a 1 year maintenance requirement. Any landscape maintenance beyond this time is completed by state work forces.

Compost Product Testing

There are minimal standards and testing requirements within the ORDOT specifications.

State Directives

There is an Oregon Governor's Proclamation encouraging the use of recycled products.

Comments

The ORDOT has been using compost for so long that it has become just another commodity "that works as it is supposed to work", according to Mr. Edgecomb.

38. Pennsylvania

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DOT Website: www.ppt.psu.edu

Specifications and uses

The PADOT has had a specification for composted "sewage sludge" since the mid 1980's for use as a mulch and as a soil amendment. Specifications were amended in 1996 to include paper mill sludge compost and compost derived from agricultural, food and organic yard waste for use as a soil amendment for backfill mixes for planting and transplanting.

Compost Feedstocks

Feedstocks include sewage sludge (biosolids) and agricultural, food and yard organic matter.

Application Rates

A mixture of 1 part compost to 3 parts soil is specified for the backfill mix. Compost is specified for use as a mulch, but specific application rates are not listed.

Usage and Potential

Mr. Whaley cannot estimate the annual usage of compost due to the way the products are used. There is no state contract and no specified compost contract price. The PADOT owns over 100,000 acres of roadside, so obviously, much more compost could be used. 100% of landscape construction is contracted out. A 1 year maintenance period is included in the construction contracts. All additional maintenance is completed by state work forces, but very little is actually done besides mowing grass and spreading mulch.

Compost Product Testing

No arbitrary testing is required although compost product standards have been established.

State Directives

State Act 101 requires state agencies and municipalities to use recycled materials wherever possible.

Comments

Mr. Whaley has been satisfied with the results of compost use by the PADOT. He did experience some odor complaints as a result of the use of biosolids compost at various times. He believes that more compost is needed in order to get landscape construction companies using more of the product on state projects. A large landscape construction project has begun around the state capital in Harrisburg. This "capital beltway" project does have compost specified and could be a landscape showplace for compost use.

39. Rhode Island

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DOT Website: www.state.ri.us

Specifications and uses

The RIDOT has no specification for compost products. They do add loam to create a 4% organic matter content when doing general planting and 10% when building wetlands.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The RIDOT landscapes and seeds a minimum of 1,000 acres a year. 95% of landscape construction is contracted out. These projects possess up to a 3 year maintenance requirement. There is minimal maintenance beyond that point.

Compost Product Testing N/A

State Directives

Ms. Petrarca was not aware of any state directives encouraging the use of compost products.

Comments

Ms. Petrarca claims that landscape contractors have expressed no interest in using compost and that the state has neither the time nor money to pursue developing a compost use program at this time.

40. South Carolina

Contact Name/ Title: Timothy Edwards, Landscape Architect
Organization: South Carolina Department of Transportation
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E-mail Address: EdwardsFT@dot.state.sc.us
DOT Website: www.dot.state.sc.us

Specifications and uses

The SCDOT has had a specification for compost products since 1989. It is approved for use in a backfill mix, for filling plant pits. They also have a special provision for the use of compost in soil preparation for the planting of Cannas and Daylilies. The SCDOT does not have a minimum organic matter specification for soil.

Compost Feedstocks

Mushroom and cow manure compost are specifically approved, with "other types of organic compost" capable of being approved by the landscape architect.

Application Rates

The general backfill mix consists of 25% compost mixed with 75% soil. The "special provision" application rates require that a 6" layer of compost be applied and mixed into 12" of soil.

Usage and Potential

Mr. Edwards could not estimate the annual acreage landscaped by the SCDOT. He believed that only about 50 tons of compost was being used by the DOT on an annual basis. 100% of landscape construction and 75% of maintenance is contracted out.

Compost Product Testing

The SCDOT has no formal standards or testing program. The specification only requires that the compost "be decomposed enough so as to not cause burning of plant material." They do require proof that the compost does not contain seeds of the Tropical Soda Apple, a noxious weed.

State Directives

Mr. Edwards was not aware of any state directives encouraging the use of compost products.

Comments

Ms. Edwards would like a more formal testing program to be implemented by the SCDOT.

41. South Dakota

Contact Name/ Title: Sharon Kayser, Landscape Architect
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DOT Website: www.state.sd.us/state/

Specifications and uses

The SDDOT does not have a specification for compost products. They have never used compost.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

Ms. Kayser guessed that the SDDOT landscapes "thousands of acres" each year. About 95% of landscape construction and maintenance is done by the state work force.

Compost Product Testing N/A

State Directives

Ms. Kayser was not aware of any state directives encouraging the use of compost products.

Comments

Ms. Kayser has been approached by compost suppliers and would like to specify and see compost used by the SDDOT, but has no authority to make that happen. That direction would need to come from the Secretary of Transportation.

42. Tennessee

Contact Name/ Title: Patrick Thurman, Landscape Architect
Organization: Tennessee Department of Transportation
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DOT Website: www.state.tn.us/transport

Specifications and uses

The TNDOT does not have a specification for compost products. They have never used compost. They also do not have a minimum organic matter specification. Mr. Thurman claimed that the natural soil contained adequate amounts of organic matter due to the abundance of coniferous trees (and the resulting pine needles) in the state.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The TNDOT plants about 200 to 300 acres of wildflower each year. About 98% of landscape construction and maintenance is done by the state work force.

Compost Product Testing N/A

State Directives

Mr. Thurman was not aware of any state directives encouraging the use of compost products.

Comments N/A

43. Texas

Contact Name/ Title: Barrie Cogburn, Landscape Architect
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Specifications and uses

The TXDOT has one of the more sophisticated and aggressive compost use and specification programs in the United States at both the DOT and legislative levels. The specification was originally created in 1993, and is currently being redone. Compost is approved for use as a general soil amendment, to manufacture topsoil, and for erosion control as a soil mulch and filter berm mulch.

Compost Feedstocks

Compost produced from "leaves and yard trimmings, biosolids, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper" are all permitted. Class B biosolids and mixed municipal solid waste are specifically prohibited.

Application Rates

Application rates are as follows:

Manufactured Topsoil - 5% to 30% compost

General Use and Erosion Control (slopes less than 2:1 steepness) - surface applications that are applied at project specific application rates

Filter Berm Mulch - a berm with dimensions ranging from 1' to 2' high by 2 ?' to 4' wide

Usage and Potential

Ms. Cogburn claimed that the TXDOT is committed to using at least 100,000 cubic yards of compost per year. They used 12,000 cu. yds. in August 2000 alone. The TXDOT landscapes/seeds approximately 80,000 acres/year. 100% of new landscape construction is contracted out. 80% of landscape maintenance is done by the state work force.

Compost Product Testing

The TXDOT has a very detailed compost standards and testing program that varies depending upon the 4 specified end uses. It includes testing for particle size, organic matter, soluble salts, maturity, pH, time and temperature standards and EPA part 503 testing for biosolids.

State Directives

The Texas Recycling Law HB 1340 and environmental campaigns like Clean Texas 2000, along with national initiatives are taken very seriously by the TXDOT and the use of compost is very widespread.

Comments

Ms. Cogburn is known as the "compost lady" within the TXDOT. She is a strong advocate of compost use and has experienced very good results with the use of compost products. The TXDOT has printed several case studies concerning their success with compost use. They are very interested in implementing USCC STA program.

44. Utah

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DOT Website: www.sr.ex.state.ut.us

Specifications and uses

The UTDOT does not have a specification for compost in their landscape manual. They do, however, occasionally write "special provisions" for specific projects. Compost has been used as a general soil amendment and for top dressing turf. It has been used on UTDOT projects for about 8 years.

Compost Feedstocks

Compost derived from animal manure and yard trimmings. Turkey manure is plentiful in Utah.

Application Rates

The specified application rate is to place a 2" (50 mm) layer of compost over the soil and incorporate it to a depth of 8" (200 mm).

Usage and Potential

Mr. Johnson estimates that the UTDOT uses between 7,000 and 9,000 cu. yds. of compost annually. The UTDOT seeds about 400 acres/year. 100% of landscape construction is contracted out. All maintenance is done using the state work force, but very little landscape maintenance is actually done outside of mowing grass.

Compost Product Testing

There are minimal testing requirements listed in the "special provisions". Test analysis results for compost scheduled for delivery to a UTDOT project site must be submitted 7 days prior to delivery. It is visually inspected and tested for salt content and pH.

State Directives

Mr. Johnson is not aware of any state directives regarding the use of compost products.

Comments

Mr. Johnson would like to learn more about the USCC STA program and perhaps implement it as a standard for compost suppliers to the UTDOT. He has been generally satisfied with the performance of compost on DOT projects.

45. Vermont

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DOT Website: www.aot.state.vt.us

Specifications and uses

The VTAOT has no specification for compost products. There is "a lot of good topsoil" still available in the state. The VTAOT also attempts to match plantings to soil type, thereby minimizing the need for added organic matter.

Compost Feedstocks **N/A** **Application Rates** **N/A**

Usage and Potential

There are only 2 compost facilities in the state and their products are too expensive for AOT usage, according to Mr. Dusablon. The VTAOT does very little landscape construction. 100% of landscape construction and 95% of maintenance is contracted out.

Compost Product Testing N/A

State Directives

Mr. Dusablon was not aware of any state directives regarding compost use.

Comments

Vicky Viens of the Vermont Agency of Natural Resources has been trying to promote greater compost use within the state

46. Virginia

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DOT Website: www.vdot.state.va.us

Specifications and uses

The VADOT has a draft specification for compost products currently under development. It shall be specified as a general soil amendment and possibly for erosion control purposes too

Compost Feedstocks

The only feedstock currently being approved is "composted yard waste which shall consist of leaves, branches and grass clippings".

Application Rates

2" of compost tilled into no less than 4"of existing soil

Usage and Potential

The VADOT has experimented with the use of compost in wildflower bed plantings, but has not used significant amounts of compost in these projects. They landscape about 30 acres each year. 100% of landscape construction and 80% of maintenance is contracted out.

Compost Product Testing

There are standards included in the draft specifications for pH, moisture, particle size, stability, maturity, soluble salts and nutrients. The VADOT also requires that the yard waste compost meet the heavy metal requirements of the EPA Part 503 regulations.

State Directives

Mr. Oristaglio was not aware of any state directives regarding compost use.

Comments

Mr. Oristaglio is very interested in implementing the USCC STA program in Virginia.

47. Washington

Contact Name/ Title: Bob Barnes and Mark Maurer, Landscape Architects
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DOT Website: www.wsdot.wa.gov

Specifications and uses

The WADOT has had a general specification for compost products since at least 1996. It is used as a general soil amendment, for erosion control and for biofiltration, although actual use directions are not listed in their general specifications. They work on a project specific basis. The WADOT uses a grade system consisting of AA (compost suitable for use within 30' of wetland and stream sides) and Grade A compost which is suitable for use anywhere.

Compost Feedstocks

They approve the use of a compost that is "stable, decomposed organic solid waste that is the result of the accelerated, aerobic biodegradation and stabilization". It must originate from a "minimum of 65% by volume from recycled plant waste. A maximum of 35% by volume of other approved organic waste and/or biosolids may be substituted for plant waste".

Application Rates

Application rates are project specific, but typically consist of a 3" application of compost incorporated into 10" to 12" of soil. Typical biofiltration "strips or swales" consist of 3" of compost mixed into 10" to 12" of soil, covering an area that is 10' wide along the side of the roadway.

Usage and Potential

Mr. Maurer estimates that the WADOT uses between 60,000 to 100,000 cubic yards of compost annually. This quantity has been more or less consistent over the past several years. 60% of landscape construction is contracted out, which includes a 3 year maintenance requirement for general landscaping and 5 to 10 year maintenance for wetland construction. There is a $50,000 cap on landscape construction projects. 80% of maintenance is completed by contractors. 40% of landscape construction and 20% of maintenance is completed by public work forces (usually city or county and not the WADOT).

Compost Product Testing

There are compost quality standards included in the specifications for pH, particle size, maturity, soluble salts, organic matter and inerts. Product acceptance is based upon the submittal of test results for these standards as well as feedstock verification, and other product certifications.

State Directives

Washington state did publish a mandate back in 1992 requiring the use of compost by the WADOT, cities and counties in landscape projects. This mandate reads as follows:

City and County Projects

"Any contract awarded in whole or in part for applying soils, soil covers or soil amendments to road right of way shall specify compost materials to be purchased" as follows:

7/1/92 through 6/30/94 = 25% of total dollar amount
after 7/1/94 = 75% of total dollar amount

WADOT Projects

The WADOT was required to purchased compost for "soil cover or soil amendment" use, as follows:

7/1/96 through 6/30/97 = 25% of the total dollar amount
7/1/98 through 6/30/99 = 50% of the total dollar amount

Comments

Mr. Maurer is very interested in the USCC STA program. He indicated that compost use by the WADOT is actually starting to decline due to both the "sunsetting" of the 1992 mandate and the desire by the WADOT to incorporate less nitrogen into native soils. He believes that adding nitrogen sources to native soils encourages the growth of "pioneer weeds". They are using higher carbon sources (usually semi-composted brush, wood chips, etc.) as organic amendments to prevent this.

48. West Virginia

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DOT Website: www.state.wv.us/wvdot

Specifications and uses

The WVDOT has no specification for compost products. They have 3 "roadkill" compost facilities in operation. The limited product produced at these sites is simply spread 3" to 4" thick over high limestone soil areas.

Compost Feedstocks N/A **Application Rates** N/A

Usage and Potential

The WVDOT maintains about 10 acres of wildflowers and 2 acres of other landscaping. 100% of landscape construction and maintenance is completed by state work forces.

Compost Product Testing N/A

State Directives

Mr. Kesner was not aware of any state directives regarding compost use.

Comments N/A

49. Wisconsin

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DOT Website: www.dot.state.wi.us

Specifications and uses

The WIDOT has had a specification for compost products since the mid 1960's. It is listed for use as part of the "backfill material". The WIDOT has no minimum organic matter specification for topsoil.

Compost Feedstocks

"Compost shall be a standard commercial compost of cattle, sheep or poultry manure or other organic material acceptable to the engineer."

Application Rates

1 part compost to 6 parts topsoil

Usage and Potential

The WIDOT uses less than 100 cubic yards of compost per year. They do landscaping of some sort on 500 to 1,000 acres annually. 100% of landscape construction is contracted out, which includes a 2 year plant guarantee. The WIDOT has no state landscape maintenance work force. Any required maintenance is handled by counties.

Compost Product Testing

There are no compost product standards and no required testing.

State Directives

Mr. Stark was not aware of any state directives regarding compost use.

Comments N/A

50. Wyoming

Contact Name/ Title: John Sampson, Agronomist
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Phone: 307-777-4416
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DOT Website: www.wydotweb.state.wy.us

Specifications and uses

The WYDOT has had a specification for compost products since 1993. It is listed for use as a "Type V fertilizer" and in a "special provision" for landscaping work as both an organic soil amendment and as an organic fertilizer.

Compost Feedstocks

Animal manure is the only approved feedstock, with two suppliers listed in the specifications.

Application Rates

Application rates are specified based on the specific needs of the landscape projects.

Usage and Potential

The WYDOT uses very little compost due to both limited product availability and the cost of transportation. 4,000 to 5,000 acres are planted each year, primarily in grass. Trees and shrubs don't do well in the harsh Wyoming climate. 99% of landscape construction and maintenance is contracted out.

Compost Product Testing

There are both compost product standards and some testing required on compost used both as a fertilizer and as a soil amendment. They are:

Type V fertilizer - NPK, organic matter and moisture with commercial testing laboratory certification

Organic Soil Amendment - organic matter, inerts and pH, with no certification need listed

There is a concern that too many test requirements will discourage product usage.

State Directives

Mr. Sampson was not aware of any state directives regarding compost use.

Comments

Mr. Sampson claims that there is a serious lack of compost supply in Wyoming, and this supply is inadequate to meet the needs of the WYDOT. Production is limited, in part, due to a lack of adequate carbon sources to mix with the large quantities of animal manure that is available for composting. He has had to import compost from out of state on occasion to meet the needs of some WYDOT landscape projects.

3.3 COMPILED STATE DOT COMPOST SPECIFICATIONS TABLES

In order to examine various State DOT compost specifications at a glance, following are three (3) compiled specifications tables Specifications tables include:

- Soil incorporation compost specifications – compost used 'in the soil'
- Soil mulching and erosion/sediment control specifications – compost used 'on the soil'
- All specifications

State	Compost Application(s)	Feedstock(s)	Application Rate	Compost Specifications Particle Size	pH	Moisture	Organic Matter (dry wt.)	
Alaska	backfill mix	plant waste	5 cu. ft. compost:1 cu. yd. soil	n/a	n/a	no visible free water or dust	n/a	
California	mulch-SPECIAL PROVISION (decorative mulch and erosion control)	woody materials such as shrubs, tree trimmings or clean, processed wood products-may contain leaves and small twigs	3" to 6" on soil surface	1/2" to 3"	n/a	n/a	n/a	
	mulch for erosion control	green material consisting of chipped, shredded or ground vegetation or clean, processed recycled wood products or Class A, E.Q. biosolids or a combination of green material and biosolids	project specific	screened through a 1/4" screen	n/a	35% maximum, or adjusted application to equal 35%	n/a	
Colorado	soil amendment	cow or sheep manure and wood residue	4 cu. yds. per 1,000 sq. ft.	1/2" max.	5.0 to 8.5	n/a	30% min.	
	backfilling	same	0.5 cu. ft. per tree and 0.1 cu. ft. per shrub	same	same	n/a	same	
Connecticut	turf establishment (soil amendment)-DRAFT	leaves and yard trimmmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper	1/2" to 2"	< 25 mm, with twigs at 50 mm max.	5.5 to 8.0	35% to 60%	30% min.	
	soil erosion control -DRAFT	same	50 mm minimum	same	same	same	same	
	backfill mix -DRAFT	same	1 part compost:2 parts soil	same	same	same	same	
	topdressing -DRAFT	same	1/2"	same	same	same	same	
Delaware	soil amendment-SPECIAL PROVISION	poultry litter	1"	100% passing a 1" screen	5.7 to 7.5	less than 40%	n/a	
Florida	soil amendment	yard waste, yard waste and manure, municipal solid waste and biosolids	75 mm	project specific	project specific	n/a	project specific	c
	mulch	same	approx. 2"	1/2" to 6"	n/a	n/a	n/a	
Georgia	soil additives (soil amendment)	organic materials	project specific	n/a	5.0 to 8.0	n/a	n/a	
Idaho	mulch for erosion control	unspecified -specific suppliers listed	20 cu. yds./acre	n/a	n/a	n/a	n/a	
Illinois	topsoil and compost (soil manufacturing*) *specifications listed are for blended topsoil	organic waste	40% compost:60% soil	*majority shall pass a 1" screen	*5.0 to 8.0	n/a	*1% to 10%	
Iowa	soil amendment- SPECIAL PROVISION	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, soiled and/or unrecylable paper and biosolids	4"	< 1.0"	6.0 to 8.0	less than 60%	30% min.	
Kansas	soil amendment and backfill	unspecified -specific suppliers listed	1 1/2"	1/2" or smaller	6.0 to 7.5	30% to 40%	less than 35%	
Maine	soil amendment and backfill	source separated leaf and yard trimmings,	project specific	100% < 25 mm	4.5 to 8.0	n/a	35% min.	
	Aged wood waste is approved for use in an erosion control mix- mulch SPECIAL PROVISIONS	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals and biosolids	project specific	100% passing 6", 70-85% passing .75"	5.0 to 8.0	n/a	20% to100%	
	same-erosion control mix - sediment barrier	same	project specific (minimum 12" high and 2' wide)	same	same	n/a	same	
Maryland	soil amendment and backfill	biosolids, and source separated compost approved for distribution by the Maryland Dept. of Agriculture	project specific	max. of 90% passing 4.75 mm, max. of 25% passing .425 mm and max. of 2.2% passing .075 mm	6.0 to 7.5	30% to 55%	n/a	< 5.0 m and <
Massachusetts	organic soil additives (amendment)- DRAFT	biodegradable matter, including biosolids	up to 100 mm	25 mm max.	5.5 to 7.5	35% to 55%	40% min.	
Michigan	compost specification (soil amendment)	yard clippings or other approved materials	project specific	3/4" maximum diameter	5.0 to 8.5	no visible free water or dust	10% to 50%	
	slope restoration- SPECIAL PROVISION	vegetative material and wood or bark	25 mm for seed, compost and tackifier mix	3 to 38 mm	5.5 to 8.0	30% to 35%	n/a	
Minnesota	turf establishment- grade 1 compost	animal derived material	project specific-typically 1" to 2"	10 mm max.	5.5 to 8.0	35% to 55% with a 700 to 1600 lbs./yd. bulk density	30% min.	
	landscape planting- grade 2 compost	leaves and yard waste	project specific-typically 3" to 4"	19 mm max.	5.5 to 8.5	same, except max. bulk density can be 1600 lbs./yd.	same	
	turf establishment- grade 3	90% leaves and yard waste, 10% animal manure	same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	
Montana	mulch on slopes- SPECIAL PROVISION	unspecified- specific suppliers listed	1,000 dry pounds/acre	n/a	n/a	n/a	n/a	
New Hampshire	soil amendment- SPECIAL PROVISION	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper	2"	< 0.5"	6.0 to 8.0	35% to 60%	30% min.	
	backfill mix - SPECIAL PROVSION	same	3 cu. ft. of compost to 1 cu. ft. of loam	same	same	same	same	
New Jersey	soil amendment	biosolids	project specific to raise soil organic matter content to 2.75%	n/a	6.0 min.	55% max.	n/a	
New York	soil amendment	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper and biosolids	project specific to raise soil organic matter content to 2% to 20%	< 12.5 mm	6.0 to 8.0	35% to 60%	30% min.	
North Carolina	project procurement specifications (RFQ) for an organic fertilizer/soil amendment	poultry litter	project specific	100% must pass a 5/8" screen	5.7 to 7.5	40% max.	n/a	
Ohio	backfill mix	source separated yard waste	1/3 by volume	n/a	n/a	n/a	n/a	

t Specifications Chart Right half, 2 of 2

Soluble Salts	Maturity/Stability	Nutrients/Other Elements	Temperature/Time	C/N	Inert Content (wt.)	Other
n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	90 day curing period	n/a	56 deg. C for 15 consecutive days, with 5 turns		0.1% max.	n/a
n/a	7 min. using Solvita test	n/a	135 deg. F for 15 consecutive days with 5 turns, followed by a minimum 90 day curing process. Biosolids must meet USEPA 40 CFR #503 Regs. for Class A, E.Q. compost	n/a	same	n/a
n/a	n/a	n/a	140 deg. F for 70 to 90 days	20/1 to 30/1	n/a	non-offensive odor
n/a	n/a	n/a	same	same	n/a	same
4.0 mmhos/cm	6 min.using Solvita test	n/a	n/a	n/a	0.1% max.	no objectionable odor, no resemblence to feedstock
same	same	n/a	n/a	n/a	same	same
same	same	n/a	n/a	n/a	same	same
same	same	n/a	n/a	n/a	same	same
< 4.0 mmhos/cm	n/a	n/a	n/a	n/a	n/a	no noxious weed seeds
4.0 mmhos/cm, but can be leached if above	n/a	n/a	n/a	n/a	n/a	must meet FLDEP rules for unrestricted distribution
n/a	n/a	n/a	n/a	n/a	n/a	same FLDEP rules and shall contain no glass, plastic or metal shards
n/a	mature	n/a	n/a	n/a	n/a	dark brown or black color, no human pathogens, minimal odors
n/a	5 min. using Solvita test	n/a	USEPA 40 CFR #503 Regs for Class A compost	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	1.0% max., 4 mm max. size	must comply with IEPA health standards, no glass or metal shards
< 5.0 mmhos/cm	n/a	n/a	n/a	n/a	n/a	n/a
< 5.0 mmhos/cm	6 or 7 using Solvita test	N = 0.8% or above, P= 1.0% or above	n/a	n/a	n/a	800 to 1,000 lbs./cu. yd. bulk density
< 4.0 mmhos/cm	stability shall be > 5 as measured by	n/a	n/a	n/a	n/a	
< 4.0 mmhos/cm	n/a	n/a	n/a	n/a	free from refuse, physical contam-inants	free from materials toxic to plant growth, large portions of silts, clay or fine sands are not acceptable, organic portion must be fibrous and elongated
same	n/a					
0 mmhos/cm for source separated id < 10 mmhhos/cm for biosolids	"will not reheat upon stacking"	n/a	n/a	n/a	n/a	biosolids must be approved by the Maryland Dept. of the Environment
max. 4.0 mmhos/cm	6 using Solvita test, stability shall be >10 as measured by the Dewar Self Heating test	n/a	USEPA 40 CFR #503 Regs for Class A compost	11 to 25:1	1.0% max.	no unpleasant odors
1.0 to 5.0 mmhos/cm	mature	n/a	USEPA 40 CFR #503 Regs for Class A compost	10 to 20:1	less than 1.0%	dark brown or black color, registered Mich. Dept. of Agriculture, no objectionable odor
n/a	mature	n/a	n/a	n/a	n/a	
max. 10.0 mmhos/cm	5 min. using Solvita test, 80% to 100% seed germination test scores,	NPK ratios of 2-2-1 to 4-4-2	a PFRP process must be used	6 to 20:1	3.0% max. at 4 mm	state Pollution Control and USEPA Part 503 C contaminent limits, registered for sale with the
same	same	n/a	same	same	same	State of Minnesota apply to all 3 compost grades
same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	
n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	"certified stable"	n/a	n/a	n/a	n/a	n/a
n/a	same	n/a	n/a	n/a	n/a	shall be relatively free of objects larger than 25 mm (1") in diameter
n/a	n/a	n/a	n/a	n/a	n/a	must be NJDEP approved
< 4.0 mmhos/cm	"must be stable according to current test methods"	n/a	n/a	n/a	n/a	must meet NYDEC regulations
< 40 mmhols/cm	minimal reheating upon stockpiling	must be within % of claimed nutrients	composting method dependent	n/a	n/a	registered as a fertilizer wuth the NC Deptartment of Agriculture, Cu and Zn limits (2 lbs./ton)
n/a	n/a	n/a	n/a	n/a	n/a	Ohio Class IV compost is the only permitted product

Oregon	soil conditioner	yard debris mushroom compost	project specific project specific	n/a n/a	n/a n/a	n/a n/a	n/a n/a	
	cultivated planting area	yard debris or mushroom compost	50 mm minimum					
	non-cultivated planting area	yard debris or mushroom compost	project specific					
	sod lawn and seeded areas	yard debris or mushroom compost	0.5 cu. m/100 sq. m					
	mulch berm for sediment control - SPECIAL PROVISION	bark/wood mulch	1-1.5' high, 2.5-3' wide	99% passing 1", 90% passing .75", 30% or less passing 3/8", 98% under 3" in length	5.0 to 8.0	<60%	minimum 70%	
	compost berm for sediment control - SPECIAL PROVISION	leaves and yard trimmings, Class A biosolids, foiod scraps, manures, paper fiber, wood, bark or combinations	same	same	5.5-8.0	same	same	
Pennsylvania	soil amendment	paper mill compost	not specified, project specific	13 mm max.	6.5 to 7.5	n/a	70% min.	
	soil amendment and mulch	sewage sludge	not specified, project specific	10 mm to 80 mm	6.0 min.	n/a	50% min.	
	soil amendment	agricultural, food and yard waste	not specified, project specific	pass 25 mm screen	5.5 to 8.0	35% to 55%	n/a	< 3.0
	backfill mix	all composts listed above	25% by volume					
South Carolina	backfill mix	animal manure, mushroom compost or other types as specifically approved	25% by volume	n/a	n/a	n/a	n/a	
	Canna planting	same	6"	n/a	n/a	n/a	n/a	
Texas	manufactured topsoil	leaves and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper and biosolids	5% to 30% by volume	100% passing 1" screen	5.5 to 8.5	n/a	30% min.	< 5.0
	erosion control	leaves and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper and biosolids	project specific	100% passing 5/8", <70% greater than 3/8", (wood chips blended with compost must be 3" in length or less, with 100% passing a 2" screen, and <10% passing a 1" screen)	5.5 to 8.5	n/a	30% to 65%	< 5.0
	mulch/filter berm	same	1' to 2' high by 2 1/2' to 4' wide	98% passing 1" screen, 90% passing 3/4" and < 30% passing 3/8"	5.0 to 8.5	< 60%	70% min.	
Utah	soil amendment- SPECIAL PROVISION	animal manures, straw, yard trimmings, sawdust or other forest wood products	50 mm	4 mm max. thickness	5.5 to 7.0	n/a	n/a	
Virginia	soil amendment- DRAFT	yard waste	2"	100% passing 1" screen	5.5 to 8.0	35% to 55%	n/a	3.0 mm
	erosion control- DRAFT	same	n/a	n/a	n/a	n/a	n/a	
Washington	soil amendment	minimum of 65% plant waste by volume, a maximum of 35% of other approved organic waste and/or biosolids	project specific - typically 3"	100% passing 25 mm screen	5.5 to 8.5	n/a	30% min.	< 4.0
	erosion control	same	project specific - typically 3"	same	same	n/a	same	
Wisconsin	backfill mix	cattle, sheep or poultry manure or other organic material acceptable to WIDOT	1 part compost to 6 parts topsoil	n/a	n/a	n/a	n/a	
Wyoming	organic fertilizer	animal manures - supplier listed	project specific	n/a	n/a	35% max.	100%	
	soil amendment- SPECIAL PROVISION	same	project specific	n/a	5.5 to 8.0	n/a	100%	

n/a	n/a	n/a	57 degrees C for 15 days	n/a	n/a	max. of 10% bacteria and fungus
n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	<1% visible man-made foreign matter	
n/a	compost portion shall not resemble the raw material from which it was derived	n/a	n/a	n/a	same	
n/a	n/a	n/a	n/a	n/a	n/a	25% ash max., weed free,
n/a	n/a	"heavy" metal limits	21 days composting + 30-60 curing	n/a	n/a	100% water holding capacity,
< 3.0 mmhols/cm	n/a	USEPA Part 503 Class A, E.Q. limits	n/a	n/a	< 1.0%	produced by PADEP permitted site
specifications are compost feedstock dependent as listed above						
n/a	should not cause "burning" of plants	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a
< 5.0 mmhols/cm	"finished" per Solvita test	n/a	USEPA 40 CFR #503 Regs for Class A compost	n/a	no visible content	must meet TX Natural Resources Conservation Commission health and safety standards
< 5.0 mmhos/cm	mg CO2-C per g (TS, OM) per day 8 or below and 80% seed germination and vigor	"heavy" metal limits USEPA Part 503 Class A, E.Q. limits	USEPA 40 CFR #503 Regs for Class A compost	n/a	no visible content	must meet TX Natural Resources Conservation Commission health and safety standards
n/a	n/a	n/a	same	n/a	same	same
n/a	n/a	n/a	n/a	n/a	no visible content	dark brown to black, no offensive odors
3.0 mmhols/cm or less	1 year old min., "stable, must demonstrate enhanced plant growth"	USEPA Part 503 Class A metal limits, N=0.5-2.5%, P=0.2-2.0%,K=0.3-1.5%	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	n/a	n/a
< 4.0 mmhols/cm	"stable", 5 min. using Solvita test	n/a	n/a	n/a	< 1.0%	meeting WA State Dept. of Ecology standards, Grade AA compost can be applied within 30' of wetlands and stream sides, Grade A
same	same	n/a	n/a	n/a	same	is for use on all other locations
n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	min. of 6% N (5.5% insoluble), 1% Phosphoric Acid, 3% Potash	n/a	n/a	n/a	must comply with Wyoming Fertilizer law
n/a	n/a	n/a	n/a	n/a	see other	free from sticks, clay subsoil, stones weed stolens and seeds

State	Compost Application(s)	Feedstock(s)	Application Rate	Compost Specifications Particle Size	pH	Moisture	Organic Matter (dry wt.)
Alaska	backfill mix	plant waste	5 cu. ft. compost:1 cu. yd. soil	n/a	n/a	no visible free water or dust	n/a
Colorado	soil amendment	cow or sheep manure and wood residue	4 cu. yds. per 1,000 sq. ft.	1/2" max.	5.0 to 8.5	n/a	30% min.
	backfilling	same	0.5 cu. ft. per tree and 0.1 cu. ft. per shrub	same	same	n/a	same
Connecticut	turf establishment (soil amendment)-DRAFT	leaves and yard trimmmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper	1/2" to 2"	< 25 mm, with twigs at 50 mm max.	5.5 to 8.0	35% to 60%	30% min.
	backfill mix -DRAFT	same	1 part compost:2 parts soil	same	same	same	same
	topdressing -DRAFT	same	1/2"	same	same	same	same
Delaware	soil amendment-SPECIAL PROVISION	poultry litter	1"	100% passing a 1" screen	5.7 to 7.5	less than 40%	n/a
Florida	soil amendment	yard waste, yard waste and manure, municipal solid waste and biosolids	75 mm	project specific	project specific	n/a	project specific
Georgia	soil additives (soil amendment)	organic materials	project specific	n/a	5.0 to 8.0	n/a	n/a
Illinois	topsoil and compost (soil manufacturing*) *specifications listed are for blended topsoil	organic waste	40% compost:60% soil	*majority shall pass a 1" screen	*5.0 to 8.0	n/a	*1% to 10%
Iowa	soil amendment- SPECIAL PROVISION	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, soiled and/or unrecylable paper and biosolids	4"	< 1.0"	6.0 to 8.0	less than 60%	30% min.
Kansas	soil amendment and backfill	unspecified -specific suppliers listed	1 1/2"	1/2" or smaller	6.0 to 7.5	30% to 40%	less than 35%
Maine	soil amendment and backfill	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals and biosolids	project specific	100% < 25 mm	4.5 to 8.0	n/a	35% min.
Maryland	soil amendment and backfill	biosolids, and source separated compost approved for distribution by the Maryland Dept. of Agriculture	project specific	max. of 90% passing 4.75 mm, max. of 25% passing .425 mm and max. of 2.2% passing .075 mm	6.0 to 7.5	30% to 55%	n/a
Massachusetts	organic soil additives (amendment)- DRAFT	biodegradable matter, including biosolids	up to 100 mm	25 mm max.	5.5 to 7.5	35% to 55%	40% min.
Michigan	compost specification (soil amendment)	yard clippings or other approved materials	project specific	3/4" maximum diameter	5.0 to 8.5	no visible free water or dust	10% to 50%
Minnesota	turf establishment- grade 1 compost	animal derived material	project specific-typically 1" to 2"	10 mm max.	5.5 to 8.0	35% to 55% with a 700 to 1600 lbs./yd. bulk density	30% min.
	landscape planting- grade 2 compost	leaves and yard waste	project specific-typically 3" to 4"	19 mm max.	5.5 to 8.5	same, except max. bulk density can be 1600 lbs./yd.	same
	turf establishment- grade 3	90% leaves and yard waste, 10% animal manure	same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1
New Hampshire	soil amendment- SPECIAL PROVISION	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper	2"	< 0.5"	6.0 to 8.0	35% to 60%	30% min.
	backfill mix -SPECIAL PROVISION	same	3 cu. ft. of compost to 1 cu. yd. of loam	same	same	same	same
New Jersey	soil amendment	biosolids	project specific to raise soil organic matter content to 2.75%	n/a	6.0 min.	55% max.	n/a
New York	soil amendment	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper and biosolids	project specific to raise soil organic matter content to 2% to 20%	< 12.5 mm	6.0 to 8.0	35% to 60%	30% min.
North Carolina	project procurement specifications (RFQ) for an organic fertilizer/soil amendment	poultry litter	project specific	100% must pass a 5/8" screen	5.7 to 7.5	40% max.	n/a
Ohio	backfill mix	source separated yard waste	1/3 by volume	n/a	n/a	n/a	n/a
Oregon	soil conditioner	yard debris	project specific	n/a	n/a	n/a	n/a
		mushroom compost	project specific	n/a	n/a	n/a	n/a
	cultivated planting area	yard debris or mushroom compost	50 mm minimum				
	non-cultivated planting area	yard debris or mushroom compost	project specific				
	sod lawn and seeded areas	yard debris or mushroom compost	0.5 cu. m/100 sq. m				
Pennsylvania	soil amendment	paper mill compost	not specified, project specific	13 mm max.	6.5 to 7.5	n/a	70% min.
	soil amendment	sewage sludge	not specified, project specific	10 mm to 80 mm	6.0 min.	n/a	50% min.
	soil amendment	agricultural, food and yard waste	not specified, project specific	pass 25 mm screen	5.5 to 8.0	35% to 55%	n/a
	backfill mix	all composts listed above	25% by volume				
South Carolina	backfill mix	animal manure, mushroom compost or other types as specifically approved	25% by volume	n/a	n/a	n/a	n/a
	Canna planting	same	6"	n/a	n/a	n/a	n/a
Texas	manufactured topsoil	leaves and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper and biosolids	5% to 30% by volume	100% passing 1" screen	5.5 to 8.5	n/a	30% min.
Utah	soil amendment- SPECIAL PROVISION	animal manures, straw, yard trimmings, sawdust or other forest wood products	50 mm	4 mm max. thickness	5.5 to 7.0	n/a	n/a
Virginia	soil amendment- DRAFT	yard waste	2"	100% passing 1" screen	5.5 to 8.0	35% to 55%	n/a
Washington	soil amendment	minimum of 65% plant waste by volume, a maximum of 35% of other approved organic waste and/or biosolids	project specific - typically 3"	100% passing 25 mm screen	5.5 to 8.5	n/a	30% min.
Wisconsin	backfill mix	cattle, sheep or poultry manure or other organic material acceptable to WIDOT	1 part compost to 6 parts topsoil	n/a	n/a	n/a	n/a
Wyoming	organic fertilizer	animal manures - supplier listed	project specific	n/a	n/a	35% max.	100%
	soil amendment- SPECIAL PROVISION	same	project specific	n/a	5.5 to 8.0	n/a	100%

Soil' Compost Specifications Chart Right half, 2 of 2

er (dry wt.)	Soluble Salts	Maturity/Stability	Nutrients/Other Elements	Temperature/Time	C/N	Inert Content (wt.)	Other
a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
nin.	n/a	n/a	n/a	140 deg. F for 70 to 90 days	20/1 to 30/1	n/a	non-offensive odor
ie	n/a	n/a	n/a	same	same	n/a	same
nin.	4.0 mmhos/cm	6 min.using Solvita test	n/a	n/a	n/a	0.1% max.	no objectionable odor, no resemblence to feedstock
ie	same	same	n/a	n/a	n/a	same	same
ie	same	same	n/a	n/a	n/a	same	same
	< 4.0 mmhos/cm	n/a	n/a	n/a	n/a	n/a	no noxious weed seeds
ict ific	4.0 mmhos/cm, but can be leached if above	n/a	n/a	n/a	n/a	n/a	must meet FLDEP rules for unrestricted distribution
	n/a	mature	n/a	n/a	n/a	n/a	dark brown or black color, no human pathogens, minimal odors
10%	n/a	n/a	n/a	n/a	n/a	1.0% max., 4 mm max. size	must comply with IEPA health standards, no glass or metal shards
nin.	< 5.0 mmhos/cm	n/a	n/a	n/a	n/a	n/a	n/a
35%	< 5.0 mmhos/cm	6 or 7 using Solvita test	N = 0.8% or above, P= 1.0% or above	n/a	n/a	n/a	800 to 1,000 lbs./cu. yd. bulk density
nin.	< 4.0 mmhos/cm	stability shall be > 5 as measured by the Dewar Self Heating test	n/a	n/a	n/a	n/a	n/a
	< 5.0 mmhos/cm for source separated and < 10 mmhhos/cm for biosolids	"will not reheat upon stacking"	n/a	n/a	n/a	n/a	biosolids must be approved by the Maryland Dept. of the Environment
in.	max. 4.0 mmhos/cm	6 using Solvita test, stability shall be >10 as measured by the Dewar Self Heating test	n/a	USEPA 40 CFR #503 Regs for Class A compost	11 to 25:1	1.0% max.	no unpleasant odors
50%	1.0 to 5.0 mmhos/cm	mature	n/a	USEPA 40 CFR #503 Regs for Class A compost	10 to 20:1	less than 1.0%	dark brown or black color, registered Mich. Dept. of Agriculture, no objectionable odor
in.	max. 10.0 mmhos/cm	5 min. using Solvita test, 80% to 100% seed germination test scores,	NPK ratios of 2-2-1 to 4-4-2	a PFRP process must be used	6 to 20:1	3.0% max. at 4 mm	state Pollution Control and USEPA Part 503 C contaminent limits, registered for sale with the State of Minnesota apply to all 3 compost grades
	same	same	n/a	same	same	same	
rade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	same as grade 1	
in.	n/a	"certified stable"	n/a	n/a	n/a	n/a	n/a
	n/a	same	n/a	n/a	n/a	see other	shall be relatively free of objects larger than 25 mm (1") in diameter
	n/a	n/a	n/a	n/a	n/a	n/a	must be NJDEP approved
n.	< 4.0 mmhos/cm	"must be stable according to current test methods"	n/a	n/a	n/a	n/a	must meet NYDEC regulations
	< 40 mmhols/cm	minimal reheating upon stockpiling	must be within % of claimed nutrients	composting method dependent	n/a	n/a	registered as a fertilizer wuth the NC Deptartment of Agriculture, Cu and Zn limits (2 lbs./ton)
	n/a	n/a	n/a	n/a	n/a	n/a	Ohio Class IV compost is the only permitted product
	n/a	n/a	n/a	57 degrees C for 15 days	n/a	n/a	max. of 10% bacteria and fungus
	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	25% ash max., weed free,
	n/a	n/a	"heavy" metal limits	21 days composting + 30-60 curing	n/a	n/a	100% water holding capacity,
	< 3.0 mmhols/cm	n/a	USEPA Part 503 Class A, E.Q. limits	n/a	n/a	< 1.0%	produced by PADEP permitted site
	specifications are compost feedstock dependent as listed above						
	n/a	should not cause "burning" of plants	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	< 5.0 mmhols/cm	"finished" per Solvita test	n/a	USEPA 40 CFR #503 Regs for Class A compost	n/a	no visible content	must meet TX Natural Resources Conservation Commission health and safety standards
	n/a	n/a	n/a	n/a	n/a	no visible content	dark brown to black, no offensive odors
	3.0 mmhols/cm or less	1 year old min., "stable, must demonstrate enhanced plant growth"	USEPA Part 503 Class A metal limits, N=0.5-2.5%, P=0.2-2.0%,K=0.3-1.5%	n/a	n/a	n/a	n/a
	< 4.0 mmhols/cm	"stable", 5 min. using Solvita test	n/a	n/a	n/a	< 1.0%	meeting WA State Dept. of Ecology standards, Grade AA compost can be applied within 30' of wetlands and stream sides, Grade A is for use on all other locations
	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	min. of 6% N (5.5% insoluble), 1% Phosphoric Acid, 3% Potash	n/a	n/a	n/a	must comply with Wyoming Fertilizer law
	n/a	n/a	n/a	n/a	n/a	see other	free from sticks, clay subsoil, stones weed stolens and seeds

State	Compost Application(s)	Feedstock(s)	Application Rate	Compost Specifications Particle Size	pH	Moisture	Organic Matter (dry wt.)
California	mulch-SPECIAL PROVISION	woody materials such as shrubs, tree trimmings or clean, processed wood products-may contain leaves and small twigs	3" to 6" on soil surface	1/2" to 3"	n/a	n/a	n/a
	mulch for erosion control	green material consisting of chipped, shredded or ground vegetation or clean, processed recycled wood products or Class A, E.Q. biosolids or a combination of green material and biosolids	project specific	screened through a 1/4" screen	n/a	35% maximum, or adjusted application to equal 35%	n/a
Connecticut	soil erosion control -DRAFT	leaves and yard trimmmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper	50 mm minimum	< 25 mm, with twigs at 50 mm max.	5.5 to 8.0	35% to 60%	30% min.
Florida	mulch	yard waste, yard waste and manure, municipal solid waste and biosolids, preference shall be given to uncontaminated woody materials	approx. 2"	1/2" to 6"	n/a	n/a	n/a
Idaho	mulch for erosion control	unspecified -specific suppliers listed	20 cu. yds./acre	n/a	n/a	n/a	n/a
Maine	Aged wood waste is approved for use in an erosion control mix- mulch SPECIAL PROVISIONS	source separated leaf and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals and biosolids	project specific	100% passing 6", 70-85% passing .75"	5.0 to 8.0	n/a	20% to100%
	same-erosion control mix - sediment barrier	same	project specific (minimum 12" high and 2' wide)	same	same	n/a	same
Michigan	slope restoration- SPECIAL PROVISION	vegetative material and wood or bark	25 mm for seed, compost and tackifier mix	3 to 38 mm	5.5 to 8.0	30% to 35%	n/a
Montana	mulch on slopes- SPECIAL PROVISION	unspecified- specific suppliers listed	1,000 dry pounds/acre	n/a	n/a	n/a	n/a
Oregon	mulch berm for sediment control - SPECIAL PROVISION	bark/wood mulch	1-1.5' high, 2.5-3' wide	99% passing 1", 90% passing .75", 30% or less passing 3/8", 98% under 3" in length	5.0 to 8.0	<60%	minimum 70%
	compost berm for sediment control - SPECIAL PROVISION	leaves and yard trimmings, Class A biosolids, foiod scraps, manures, paper fiber, wood, bark or combinations	same	same	5.5-8.0	same	same
Pennsylvania	soil amendment and mulch	sewage sludge	not specified, project specific	10 mm to 80 mm	6.0 min.	n/a	50% min.
Texas	erosion control	leaves and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled and/or unrecyclable paper and biosolids	project specific	100% passing 5/8", <70% greater than 3/8", (wood chips blended with compost must be 3" in length or less, with 100% passing a 2" screen, and <10% passing a 1" screen)	5.5 to 8.5	n/a	30% to 65%
	mulch/filter berm	same	1' to 2' high by 2 1/2' to 4' wide	98% passing 1" screen, 90% passing 3/4" and < 30% passing 3/8"	5.0 to 8.5	< 60%	70% min.
Virginia	erosion control- DRAFT	yard waste	n/a	n/a	n/a	n/a	n/a
Washington	erosion control	minimum of 65% plant waste by volume, a maximum of 35% of other approved organic waste and/or biosolids	project specific - typically 3"	100% passing 25 mm screen	5.5 to 8.5	n/a	30% min.

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Soluble Salts	Maturity/Stability	Nutrients/Other Elements	Temperature/Time	C/N	Inert Content (wt.)	Other
n/a	90 day curing period	n/a	56 deg. C for 15 consecutive days, with 5 turns	n/a	0.1% max.	n/a
n/a	7 min. using Solvita test	n/a	135 deg. F for 15 consecutive days with 5 turns, followed by a minimum 90 days curing process Biosolids must meet USEPA 40 CFR #503 Regs for Class A, EQ	n/a	0.1% max.	n/a
4.0 mmhos/cm	6 min.using Solvita test	n/a	n/a	n/a	0.1% max.	no objectionable odor, no resemblence to feedstock
n/a	n/a	n/a	n/a	n/a	n/a	must meet FLDEP rules for unrestricted distribution same FLDEP rules and shall contain no glass, plastic or metal shards
n/a	5 min. using Solvita test	n/a	USEPA 40 CFR #503 Regs for Class A compost	n/a	n/a	n/a
< 4.0 mmhos/cm	n/a	n/a	n/a	n/a	free from refuse, physical contam-inants	free from materials toxic to plant growth, large portions of silts, clay or fine sands are not acceptable, organic portion must be fibrous and elongated
same	n/a					
n/a	mature	n/a	n/a	n/a	n/a	dark brown or black color, registered Mich. Dept. of Agriculture, no objectionable odor
n/a	n/a	n/a	n/a	n/a	n/a	n/a
n/a	n/a	n/a	n/a	n/a	<1% visible man-made foreign matter	
n/a	compost portion shall not resemble the raw material from which it was derived	n/a	n/a	n/a	same	
n/a	n/a	"heavy" metal limits USEPA Part 503 Class A, E.Q. limits	21 days composting + 30-60 curing	n/a	n/a	25% ash max., weed free, 100% water holding capacity, produced by PADEP permitted site
< 5.0 mmhos/cm	mg CO2-C per g (TS, OM) per day 8 or below and 80% seed germination and vigor	"heavy" metal limits USEPA Part 503 Class A, E.Q. limits	USEPA 40 CFR #503 Regs for Class A compost	n/a	no visible content	must meet TX Natural Resources Conservation Commission health and safety standards
n/a	n/a	n/a	same	n/a	same	same
n/a	n/a	n/a	n/a	n/a	n/a	n/a
< 4.0 mmhols/cm	"stable", 5 min. using Solvita test	n/a	n/a	n/a	< 1.0%	meeting WA State Dept. of Ecology standards, Grade AA compost can be applied within 30' of wetlands and stream sides, Grade A is for use on all other locations

4.0 COMPOST SPECIFICATION FOR SOIL INCORPORATION

Research efforts performed during this project demonstrated that State DOT compost specifications have become more detailed in nature, both in specific application instructions and in the numerical product standards themselves. The compost characteristics most frequently included in State DOT specifications are outlined in Figure 3. Identifying these compost characteristics was necessary for the development of a 'Model DOT Compost Specification'. It is the goal of this project that this model specification be used by many states as a template for their own compost specifications. In this way, compost specifications used throughout the country can become more uniform in nature, and so may the test methods used in their analysis. It is also understood that State DOTs may need to modify the model specifications to meet the specific requirements of their state.

Figure 3 - Most Common Compost Parameters Specified

Parameter	Frequency
pH	23
Particle size	19
Soluble salts	16
Organic Matter	14
Moisture content	13
Stability/Maturity	9/6
Pathogens	9
Heavy Metals	9
Inerts	7

The development of a Model DOT Compost Specification is necessary to allow more extensive usage of the product, in both 'public' and 'private' sector projects, and in order to allow organizations to specify and purchase compost with more confidence. Movement towards a national compost specification (standard) will not only help to develop more continuity among existing state and regional specifications, but also improve interstate commerce. To provide the necessary data and context, the model specification includes both 'boiler plate' compost usage instructions and suggested numerical standards. Access to the appropriate analytical test methodologies necessary to evaluate compost are also provided (Appendix A). The suggested numerical compost standards outline both the specific parameters (characteristics) to consider, as well as the specific numerical standards related to each characteristic.

Historically, developing numerical standards for compost has proven to be difficult because high quality compost products can be produced using a variety of feedstocks (e.g., yard trimmings, biosolids, manure, etc.), because soil characteristics and plant requirements vary with location and type, and because compost can be used for a variety of applications. For these reasons, any suggested compost standard must allow for adjustment by the project engineer, designer, or equivalent, in order to allow them to meet the requirements of a specific project (e.g., specific application, soil conditions, plant requirements, available compost products, application rates). The development of a 'feedstock independent' numerical standard for compost is more useful, if it is done so compost applications that require a product which requires similar characteristics, and if it considers standard compost application rates.

The following model compost specification was developed for composts used as a 'soil incorporant' (incorporated into the soil) on typical landscape applications. These landscape applications include garden/planting bed establishment/ renovation, tree/shrub planting backfill mixes, and turf establishment/renovation.

4.1 MODEL COMPOST SPECIFICATION – PRODUCT AND APPLICATION

Figure 4 Model Compost Specificationfor General Landscape Applications (soil amending)

Parameters[1,6]	Reported as (units of measure)	General Range
pH[2]	pH units	5.0 - 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	98% pass through 3/4" screen or smaller
Stability[3] Carbon Dioxide Evolution Rate	mg CO_2-C per g OM per day	< 8
Maturity[3] (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (inerts)	%, dry weight basis	< 1
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] Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight 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.

Using the Model Compost Specification

In order to properly use the Model Compost Specification, several issues must be considered and points made clear.

1. The Model Compost Specification assumes that specific application rates (outlined in the following application specifications) are used, that the appropriate plant species for indigenous soil and climatic conditions are used, and that the compost is applied just before planting.

- *It should be understood that compost products that fall outside the general specification range are not necessarily poor quality products or unusable, they may simply require different application specifications.* A good example is an animal manure compost which possesses a soluble salt content outside the general range. This nutrient rich product may simply need to be applied at a lower application rate, or be thoroughly watered in order to leach some of the salts. Another example could be the use of a compost product which possesses a stability or maturity rating outside the general range. In this case, the compost product could be applied and incorporated into the soil several weeks before planting is going to occur (if project requirements allow for this).

2. Landscape architects and project engineers should be allowed to modify the numerical ranges within the Model Compost Specification based on specific field conditions, plant requirements and the expected compost application rate.

- The ability to modify both the product and application specifications are necessary to meet specific conditions. Obviously, every state and region possesses specific soil conditions (e.g., pH and soluble salt content), so in order to allow specifiers to adjust the specification to meet their specific conditions, modification must be allowed. A good example is using the specification in an area of the country (e.g., Utah) where the level of soluble salts in the soil are much greater than in most other areas of the country. In this scenario, indigenous plant species can tolerate higher salt levels, therefore a compost which possesses a greater content of soluble salts may be usable.

3. Whenever possible, before any soil preparation procedures ensue, a soil analysis should be completed by a reputable laboratory. This will assist the landscape architect or project engineer to determine if the Model Compost Specification requires modification.

4. 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.

5. Stability/Maturity rating is an area of compost science that is still evolving, and as such, other various test methods could be considered for use in compost specification and evaluation. Also, never base conclusions for compost stability/maturity on the result of a single test.

6. Recommended compost testing methodologies and sampling procedures are provided in the *Test Methods for the Examination of Composting and Compost* (TMECC) manual published by the USCC and the United States Department of Agriculture. For more information, log onto www.tmecc.org.

Model Compost Application Specifications

Section _____, Turf Establishment with Compost

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, or source-separated or mixed solid waste. The product shall contain no substances toxic to plants, will possess no objectionable odors and shall not resemble the raw material from which it was derived.

Product Parameters:

Figure 4 Model Compost Specificationfor General Landscape Applications (soil amending)

Parameters[1,6]	Reported as (units of measure)	General Range
pH[2]	pH units	5.0 - 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	98% pass through 3/4" screen or smaller
Stability[3] Carbon Dioxide Evolution Rate	mg CO_2-C per g OM per day	< 8
Maturity[3] (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (inerts)	%, dry weight basis	< 1
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] Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

Construction Requirements:

Compost shall be uniformly applied over the entire area at an average depth of 1 to 2 inches* and incorporated to a depth of 5 to 7 inches (for a 20% to 30% inclusion rate) using a rotary tiller or other appropriate equipment. Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied before incorporation, as necessary[t]. 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.

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.

* The Landscape Architect/Designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations.

t The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost.

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.

Section _____, Planting Bed Establishment with Compost

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, or source-separated or mixed solid waste. The product shall contain no substances toxic to plants, 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:

Figure 4 Model Compost Specificationfor General Landscape Applications (soil amending)

Parameters[1,6]	Reported as (units of measure)	General Range
pH[2]	pH units	5.0 - 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	98% pass through 3/4" screen or smaller
Stability[3] Carbon Dioxide Evolution Rate	mg CO_2-C per g OM per day	< 8
Maturity[3] (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (inerts)	%, dry weight basis	< 1
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] Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

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 with higher salt levels are used. Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied in conjunction with compost incorporation, as necessary[t]. 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.

* The Landscape Architect/Designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations.

t The use of stable, nutrient rich composts will reduce initial fertilizer requirements by the amount of available nutrients in the compost.

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 all plant species to be established.

Section _____, Compost as a Landscape Backfill Mix Component

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, or source-separated or mixed solid waste. The product shall contain no substances toxic to plants, 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.

Product Parameters:

Figure 4 Model Compost Specificationfor General Landscape Applications (soil amending)

Parameters[1,6]	Reported as (units of measure)	General Range
pH[2]	pH units	5.0 - 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	98% pass through 3/4" screen or smaller
Stability[3] Carbon Dioxide Evolution Rate	mg CO_2-C per g OM per day	< 8
Maturity[3] (Bioassay) Seed Emergence and Seedling Vigor	%, relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants (inerts)	%, dry weight basis	< 1
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] Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

Construction Requirements:

Excavate a planting hole slightly shallower and 2 to 3 times the width of the rootball or container. Set the rootball on firm soil so that the top of the rootball will sit slightly higher than the final grade. Uniformly blend compost and excavated soil at a 1 compost : 2 soil ratio*. Backfill and firm the soil blend around the rootball 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.

* The Landscape Architect/Designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations.

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 amended to a range suitable for the plant species to be established.

4.2 COMPOST CHARACTERISTICS AND THEIR IMPORTANCE

Described in this section are the compost characteristics that are often considered the most important in compost quality evaluation, and are therefore included in the model compost specification. These characteristics represent the basic chemical, physical, and biological data needed to assure successful compost use and overall satisfaction. Considering these characteristics will also assist you in determining which compost products possess the characteristics needed for your specific application. Since growing conditions and plant requirements differ, we can benefit greatly from accurate characterization data pertaining to the compost products we use. This data will allow you and your contractors to use compost in a way that best meets your particular requirement, or specific situation. By obtaining accurate characterization data, you can more easily obtain compost that is appropriate for a specific application, as well as use it in a way that best meets your particular requirements. To assist compost end users and specifiers in this effort, the USCC has developed the *Test Methods for the Evaluation of Composting and Compost (TMECC)* manual and the Seal of Testing Assurance Program (STA).

In its current form, the STA program is a compost testing and information disclosure program which uses uniform testing and sampling protocols. The STA program allows compost buyers to more easily purchase the products they desire, or require for a particular project. It also allows them to more systematically compare compost products, since all products will use a uniform program label. All participants will make test results available to inquiring customers using the "Compost Technical Data Sheet", a uniform product label. The STA program not only approves laboratories involved in the STA Program, but also requires them to use standard test methods and sampling procedures outlined in the USCC's TMECC manual. The TMECC manual is a technical manual of standardized test methods developed for analytical labs. For more information, log onto **www.compostingcouncil.org** or www.tmecc.org.

Compost Characteristics

pH – pH is the measure of soil/media acidity or alkalinity. The pH scale ranges from 0 to 14, with a pH of 7 indicating neutrality. A pH change of 1 unit means a 10-fold increase or decrease in pH. Most composts have a pH of between 5 and 8.5. Each specific plant species requires a specific pH range. Based on the amount of compost applied, as well as it's pH, its addition can affect the pH of the soil or growing media. Therefore, to estimate the effect, which in turn will affect maintenance practices or system management, pH is a necessary parameter of which to be aware. Soil pH is often adjusted through the utilization of materials such as lime (to raise pH) and sulfur (to lower pH). When liming agents are used in the production of the compost product you use, or are present in the source materials of the compost, it may be more or less appropriate for your specific application, because it will be more difficult to buffer.

Soluble Salts (Conductivity) – Soluble salts refers to the amount of soluble ions in a solution of compost and water. The concentration of soluble ions is typically estimated by determining the solution's ability to carry an electrical current, i.e., electrical conductivity. The units of measure for soluble salts are either mmhos/cm or dS/m (they are 1:1 equivalent). Plant essential nutrients are actually supplied to plants in a salt form. While some specific soluble salts, (e.g., sodium, chloride), may be more detrimental to plants, most composts do not contain sufficient levels of these salts to be a concern in landscape applications. Plant species have a salinity tolerance rating and maximum tolerable quantities are known. Excess soluble salts can cause phytotoxicity to plants. Compost may contribute to, or dilute, the cumulative soluble salts content of a growing media or soil. Reduction in soluble salts content can be achieved through thorough watering at the time of planting. Most composts have a soluble salt conductivity of 1.0 to 10.0 dS/m, whereas typical conductivity values in soil range from 0 to 1.5 in most areas of the country.

Nutrient Content – Nitrogen (N), Phosphorus (P, usually expressed as P2O5), and Potassium (K, usually expressed as K20) are the three nutrients utilized by plants in the greatest quantities, and therefore, are the nutrients most often contained in commercial and retail fertilizers. When purchased in bags of fertilizer, these three nutrients are measured and expressed on a dry weight basis, in the form of a percentage (%). In compost, nutrient content may be expressed on a dry, or wet weight (as received) basis. Knowing the content of these nutrients will help you make correct decisions regarding the addition of supplemental fertilization. Although concentrations of nutrients found in compost are typically not high, in comparison to most fertilizer products, compost is usually applied at much greater rates, and therefore, can represent a significant cumulative quantity. The nutrient content of compost products vary widely; however, biosolids and animal manure based composts typically contain more total nutrition. The use of certain composts may reduce or eliminate the necessity to fertilize certain plants during the first 6 –12 months following its application. In general, nutrients found in compost are in an 'organic' form thus released slowly as the compost decomposes.

Organic Matter – Organic matter content is the measure of carbon-based materials in compost. Organic matter content is typically expressed as a percentage of dry weight. Organic matter in an important ingredient in all soils and plays an important role in soil structure, nutrient availability, and water holding capacity. Being aware of a product's organic matter content is useful for estimating the age and physical properties of the compost. It may also be necessary for determining compost application rates on certain applications, such as turf establishment and agricultural crop production. In these applications, standard agricultural soil test kits are often used to determine recommended application rates of

organic matter. However, these application rates are specified as the quantity of organic matter needed on a per acre basis. Therefore, the organic matter content of the compost must be known in order to convert the suggested application rate into a usable form (tons/acre). There is no ideal organic matter content for compost, and it may vary widely, ranging from 25 to 70%.

Moisture Content – Moisture content is the measure of the quantity of water present in a compost product; expressed as a percentage of total weight. The moisture content of compost affects its bulk density (weight per unit volume) and, therefore, affects handling and transportation. Overly dry compost (below 35%) can be dusty and irritating to work with, while very wet compost (60% and above) can become heavy and clumpy, making its application more difficult and delivery more expensive. A preferred moisture percent for finished compost is often considered to be 40 -50%.

Particle Size – The way in which compost particle size is measured, and expressed, is typically based on the product's end use. For most applications, merely specifying the product's maximum particle size, or the screen size through which it passes, is sufficient. A compost product's particle size may also determine its usability in specific applications. For example, a compost product with a maximum particle size of 1/2 inch or greater may not be acceptable as a turf top-dressing, whereas a product with a maximum particle size of 1/4 to 3/8 inch or less could be acceptable. Most composts that are used as soil amendments are screened through a 3/8 or 1/2 inch screen.

Maturity (bioassay) – Maturity is the degree or level of completeness of composting. Maturity is not described by a single property and therefore, maturity is best assessed by measuring two or more compost characteristics. Some immature composts may contain high amounts of free ammonia, certain organic acids or other water-soluble compounds which can limit seed germination and root development, or cause odor. All uses of compost require a mature product free of these potentially phytotoxic components.

Stability (respirometry) – Stability refers to a specific stage of organic matter decomposition during the composting process, which is related to the type of organic compounds remaining and the resultant biological activity in the material. The stability of a given compost is important in determining the potential impact of the material on nitrogen availability in soil or growing media, as well as maintaining consistent volume and porosity in container growing media. Most soil amending type compost applications require a stable to very stable product that will prevent nutrient tie up and maintain or enhance oxygen availability in soil.

Inerts (physical contaminants) – Man-made inerts consist of materials created by humans and may be a part of the waste stream. These include: textiles, glass, plastic, and metal objects. When put into the composting process, these materials are not decomposed but may be degraded to some extent in physical characteristics, primarily through size reduction. These materials can decrease the value of the finished compost product because they offer no benefit to the compost and, in many cases, are aesthetically offensive. A common means of controlling man-made inerts is to minimize their entry into the waste stream being composted. Control is also accomplished through separation at the source during feedstock recovery at the composting facility, or during product refinement, (e.g., screening, ballistic separation). Other 'non' man-made inerts, such as stones, rocks, twigs, may also be found in compost and are considered to be aesthetically offensive. Only minimal levels of inert materials are considered o be acceptable.

Trace Metals (chemical contaminants) – Trace metals are elements whose concentrations are regulated due to the potential for toxicity to humans, animals, or plants. Regulations governing the trace metal content of composts derived from certain feedstocks have been promulgated on both the state and federal levels. Similar limits have even been developed for fertilizers and certain other horticultural and agricultural products. Specific trace elements, often referred to as heavy metals include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum nickel, selenium, and zinc. The quantity of these elements are measured on a dry weight basis and expressed as mg/kg (milligram per kilogram) or ppm (parts per million). Many of these elements are actually needed by plants for normal growth, although in limited quantities. Therefore, measuring the concentration of these elements, as well as other plant nutrients, can provide valuable management data relevant to the fertilizer requirements of plants and subsequent fertilizer application rates. Certain heavy metals and trace elements are also known to cause phytotoxic effects in plants (when available in very high quantities), and specific plant species are known to be more sensitive than others. These elements include boron, manganese, molybdenum, nickel, and selenium. However, these elements are not typically found in compost in detrimental quantities. All composts that contain regulated feedstocks must meet state and/or federal safety standards in order to be marketed.

Weed Seeds* and Pathogens (biological contaminants) – Pathogens are disease causing organisms that may be present in raw wastes or by-products. Both plant and human pathogens are found in living organisms and are present at some background levels in the environment. Therefore, the composting process must eliminate or reduce pathogens to a level that is below the threshold where the danger of transmitting diseases will occur. Both pathogens and weed seeds are inactivated or destroyed by elevated temperatures, which occur over a period of time, within the composting process. The time-temperature relationship that is used as the *'Process to Further Reduce Pathogens'* (an US EPA defined process) effectively destroys both weed seeds and pathogens in compost. Therefore, by monitoring the time-temperature relationship, we can ensure plant and human pathogen destruction in compost, as well as weed free destruction.

**It should be noted that composts which contain viable noxious weed seeds should not be utilized. This specific product parameter can be required within the text of any specification, however it is a difficult parameter for which to actually test.*

4.3 EXAMPLES OF STATE DOT COMPOST SPECIFICATIONS

Several state DOTs have recently developed compost specifications, based on their field experience and research, as well as new scientific data and test methods. The following two examples provide both a compost 'product' specification, as well as an 'application' specification (instructions for specific end uses). The USCC's Model Compost Specification follows this same logical format.

Texas Department of Transportation – Item 161
FURNISHING AND PLACING COMPOST

161.1. Description. Furnish and place compost as shown on the plans or as directed.

161.2. Materials. The type of compost or compost mixture required, based on the intended use, is shown on the plans and consists of one or more of the following:

- Compost Manufactured Topsoil (CMT) consisting of 75% topsoil soil blended with 25%

  compost measured by volume. CMT will be Blended On-Site (BOS) or Pre-Blended (PB) as specified on the plans. Use topsoil in accordance with Article 160.2, "Materials."

- Erosion Control Compost (ECC) consisting of 50% wood chips blended with 50%

  compost measured by volume. Use fresh or partially composted wood chips less than or equal to 3 in. in length with 100% passing a 2 in. screen and less than 10% passing a 1 in. screen.

- General Use Compost (GUC) consisting of 100% compost.

Furnish compost that has been produced by aerobic (biological) decomposition of organic matter. Compost feedstock may include, but is not limited to, leaves and yard trimmings, biosolids, food scraps, food processing residuals, manure or other agricultural residuals, forest residues, bark, and paper. Compost must not contain any visible refuse or other physical contaminants, material toxic to plant growth, or over 5% sand, silt, clay or rock material. Mixed municipal solid waste compost and Class B biosolids, as defined in the United States Environmental Protection Agency Code of Federal Regulations (USEPA, CFR), Title 40, Part 503 are unacceptable. Compost must meet all applicable USEPA, CFR, Title 40, Part 503 Standards for Class A biosolids and TNRCC health and safety regulations as defined in the Texas Administrative Code (TAC), Chapter 332. Compost must have been processed to meet the time and temperature standards in TAC Chapter 332 Subchapter B Part 23 (for control of noxious weeds, and pathogen and vector attraction), and the requirements shown in Table 1, "Physical Requirements for Compost." All physical requirements are in accordance with the United States Department of Agriculture and the United States Composting Council, "Test Methods for the Examination of Composting and Compost" (TMECC).

Table 1, "Physical Requirements for Compost."

Organic Matter Content: 30-65% (dry mass) in accordance with TMECC 05.07-A, "Loss on Ignition Organic Matter Method"
Particle Size: 100% passing 5/8 in., 70% greater than 3/8 in. in accordance with TMECC 02.02-B, "Sample Sieving for Aggregate Size Classification"
Soluble Salts: 5.0 max.* dS/m in accordance with TMECC 04.10-A, "Electrical Conductivity for Compost"
Fecal Coliform: Pass in accordance with TMECC 07.01-B, "Fecal Coliforms"
pH: 5.5 – 8.5 in accordance with TMECC 04.11-A, "Electrometric pH Determinations for Compost"
Stability: 8 or below in accordance with TMECC 05.08-B, "Respirometry"
Maturity: greater than 80% in accordance with TMECC 05.05-A, "Biological Assays"
Heavy Metals: Pass in accordance with TMECC 04.06, "Heavy Metals and Hazardous Elements" and TMECC 04.13-B, "Atomic Absorption Spectrophotometry"

* A soluble salt content up to 10.0 dS/m for compost used in Compost Manufactured Topsoil will be acceptable.

Before delivery of the compost, provide a notarized document that includes the following:

- the feedstock by percentage in the final compost product,
- a statement that the compost meets federal and state health and safety regulations,
- a statement that the composting process has met time and temperature requirements,
- a copy of the lab analysis, less than four months old, preformed by a Seal of Testing Assurance certified lab verifying that the compost meets the physical requirements as described in

The compost is subject to testing by the Engineer at the composting facility or at the project site.

161.3. Construction.

A. Compost Manufactured Topsoil (CMT). Remove and dispose of any trash, wood, brush, stumps or any other objectionable material from the topsoil before blending.

1. **Blended On-site (BOS).** Apply in a uniform layer and incorporate into existing topsoil to the depth shown on the plans. When rolling is specified, use a light corrugated drum roller.
2. **Pre-Blended (PB).** Furnish CMT and apply in a uniform layer to the depths shown on the plans. When rolling is specified, use a light corrugated drum roller.

B. Erosion Control Compost (ECC). Use only on slopes 3:1 or flatter. Apply in a uniform layer as shown on the plans or as directed. When rolling is specified, use a light corrugated drum roller.

C. General Use Compost (GUC). Apply in a uniform layer as a top dressing on established vegetation to the depth shown on the plans. Do not bury existing vegetation. If GUC is used as a backfill ingredient, in a planting soil mixture, for planting bed preparation, or as a mulch, apply as shown on the plans.

161.4 Measurement. This item will be measured by the following class asshown on the plans:

A. Class 1. By the 100 foot-station along the baseline of each roadbed.

B. Class 2. By the square yard complete in place.

C. Class 3. By the cubic yard in vehicles at the point of delivery.

D. Class 4. By the cubic yard in the stockpile as computed by the method of average end areas.

E. Class 5. By the cubic yard in its original position as computed by the method of average end areas.

161.5 Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Compost Manufactured Topsoil (BOS)," "Compost Manufactured Topsoil (PB)," "Erosion Control Compost" and "General Use Compost" for the depth specified. This price is full compensation for securing any necessary source and for furnishing materials; for excavation, loading, hauling, stockpiling, and placing; furnishing and operating equipment; and labor, fuel, material, tools, and incidentals. "Sprinkling" and "Rolling" will not be paid for directly, but will be subsidiary to this Item.

SECTION 751
LOAM BORROW AND TOPSOIL REHANDLED AND SPREAD

DESCRIPTION

751.20 General.

The work under this item consists of furnishing and placing loam and related items on an approved area in accordance with these specifications and in close conformity with the lines and grades shown on the plans or established by the Engineer. The work includes the placing, spreading and grading of loam borrow for seeded and planted areas, preparation of soil for plant material, amendment of loam as required to produce planting soil mix, and provision of soil additives required to adjust for pH requirements of specific plants.

MATERIALS

751.40 General.

Material shall meet the requirements specified in the following Subsections of Division III, Materials:

Loam Borrow	M1.05.0
Topsoil and Plantable Soil Borrow	M1.07.0
Organic Soil Additives	M1.06.0
Inorganic Amendments	M6.01.0

Samples and Submittals

At least 30 days prior to ordering, the Contractor shall submit to the Engineer representative samples, certifications, and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Engineer. Delivered materials shall closely match the approved samples. Approval of test results does not constitute final acceptance. The Engineer reserves the right to reject on or after delivery any material which does not meet the Specifications.

Soil Additives for Loam

- Additives shall be used to counteract soil deficiencies as recommended by the soil analysis.
- Organic matter used as an amendment to soil shall be manufactured compost.
- Lime or sulfur shall be used to bring soil to acceptable pH levels, per soil test reports.
- For silty soils, those with more than 20 percent passing the 75 mm, and poorly drained soils in general, mix in gypsum at a rate of 5kg/m3 .
- Incorporate soil amendments thoroughly into loam, per recommendations of test reports, to meet the specified requirements for loam prior to delivering the material on site.

CONSTRUCTION METHODS

751.60 Preparation of Areas on Which Loam or Topsoil are to be Placed.

All areas to receive loam shall be free of construction debris, refuse, compressible or decayable materials and standing water. The area upon which the above materials are to be placed shall be raked, harrowed or dragged to form a smooth surface. All stones larger than 50 millimeters undesirable growth over 50 millimeters and debris shall be removed from the area and disposed of by the Contractor outside the location.

When directed by the Engineer, additional suitable material available from excavation or furnished under Item 150, Ordinary Borrow, shall be spread as required to repair gullies or depressions. The labor, equipment and materials necessary to place, compact and grade the additional material shall be paid for under the respective item from which the material is obtained.

751.61 Placing Loam or Topsoil.

The Contractor shall notify the Engineer when areas to receive loam are ready for inspection and approval. Placement of loam fill material shall not begin until the Engineer has approved the subgrade.

Loam shall not be handled or placed when subgrade or loam are frozen or saturated, i.e. when squeezed sample shows any sign of free moisture.

The Engineer shall reject the use of the Contractor's equipment or procedures if they are unsuitable for or are likely to damage or over-compact underlying structure or materials.

Loam shall be placed in lifts not to exceed 100 mm. After each lift, the soil shall be well-mixed into the soil layer beneath it. Compaction of each lift shall be minimal, sufficient only to achieve the required grades. Over-compaction of existing soils or fills that would be detrimental to planting objectives shall be corrected by tilling or other means at no additional cost.

Grade stakes shall be set to check finished grades. Deviation from lines and grades that are greater than 25 mm shall not be permitted.

Contractor shall supply additional loam as necessary so that following finish the grading and compaction operations, the placed loam shall conform to the depth required.

Finish grades shall exhibit no abrupt changes, and shall blend evenly with the undisturbed finish grade.

During hauling operations, the roadway surfaces shall be kept clean and any loam or other dirt which may be brought upon the surface shall be removed promptly and thoroughly before it becomes compacted by traffic. If necessary, the wheels of all vehicles used for hauling shall be cleaned frequently and kept clean to avoid bringing any dirt upon the surface. The Contractor shall take all reasonable precautions to avoid injury to existing or planted growth.

751.62 Topsoil Rehandled and Spread.

Topsoil which is obtained on the site from piles of topsoil previously excavated and stacked in accordance with the relevant provisions of Section 120 and designated as topsoil to be rehandled and spread shall be used as required, and as directed by the Engineer, on areas to be seeded or planted.

The topsoil must meet the requirements of M1.05.0 and be approved before it is spread. The Contractor will be required, without additional compensation, to take corrective action as directed, in order to make the topsoil suitable for its intended use.

The Contractor is required under the item of seeding to adjust the acidity by the addition of limestone as determined by testing as required under Subsection 765.61 and to apply the fertilizer as required under Subsection 765.62.

COMPENSATION

751.80 Method of Measurement.

The quantity of Loam Borrow, or Topsoil Rehandled and Spread shall be determined by measurement in place after compaction to the depth specified on the plans or as directed, and to the volume so ascertained there shall be added 20% to compensate for such loss as may be due to settlement, shrinkage and penetration into the underlying material.

The volume of Topsoil Rehandled and Spread including added percentage for settlement shall not exceed the total volume of Item 125, Topsoil Excavated and Stacked, less any waste.

751.81 Basis of Payment.

Loam Borrow and Topsoil Rehandled and Spread will be paid for at the contract unit price per cubic meter, complete in place, which prices shall also include the grading of areas where stockpiles of topsoil are removed.

751.82 Payment Items.

751.	Loam Borrow	Cubic Meter
752.	Topsoil Rehandled and Spread	Cubic Meter

M1.05.0 Loam Borrow.

Loam borrow shall be free of debris and other extraneous matter Loam borrow shall be fertile, friable soil obtained from naturally well-drained areas or shall be the product of a commercial sand and gravel processing facility. It shall be uncontaminated by salt water, foreign matter, or substances harmful to plant growth. Loam shall not contain rocks, clods, or any material greater than 50 mm.

Loam borrow shall have the following mechanical analysis:

Sieve Size	Percent Passing
2.00mm	85-100
425mm	35-85
75 mm	10-35
<20 mm	<5

Testing shall be on material that has passed the 2.0 mm sieve. Loam borrow shall contain 4-10 percent organic matter as determined by the loss on ignition of oven-dried samples. Lawn areas shall have an organic content of at least 4 percent. For woody planting, organic content shall be 7-10 percent. Salinity (electrical conductivity) shall be less

than 1.0 mmho/cm as determined by a 1:2 (by volume) soil-to-water mix. Salt test samples shall not be oven dried. The acidity range of the Loam borrow shall be pH 5.5 to 7.0.

Contractor shall provide testing submittals as follows:

- One 10 kg representative sample per source of loam
- For sources providing >1000 cubic meters, one additional 10 kg representative sample for each 1000 cubic meter unit of soil

In addition, five random representative 10 kg samples of on-site stockpiles of delivered loam, as directed by the Engineer, shall be collected and packaged in the presence of the Engineer.

Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Engineer.

Testing and analysis will be at the Contractor's expense. Soil samples shall be dry. Tests for particle gradation, organic content, and pH shall be performed by an Agricultural Experiment Station testing laboratory or other testing laboratory approved by the Engineer. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies, and for additives necessary to accomplish particular planting objectives noted. University of Massachusetts Agricultural Extension Service methods for soil and soil additive analysis shall be used.

No Loam borrow shall be delivered to the site until the review and approval of loam test results by the Engineer.

M1.06.0 Organic Soil Additives.

The Contractor shall submit for approval a written list of all vendors of manufactured compost, including location of compost facility and feedstock materials. All vendors shall submit certified results of regular periodic testing by an approved testing facility. Certification shall be per Massachusetts Highway Department approved compost certification programs.

In addition, the contractor shall provide representative 3 liter samples from each proposed source for testing and analysis at the Contractor's own expense. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Engineer. Tests for levels of toxic elements and compounds shall be performed by a private testing laboratory approved by the Engineer. Tests for soil chemistry and pH may be performed by an Agricultural Experiment Station testing laboratory or other testing laboratory approved by the Engineer.

Compost shall be a well-decomposed humus material derived from the aerobic decomposition of biodegradable matter, free of viable weed seeds and other plant propagules (except airborne weed species), foreign debris such as glass, plastic, etcetera and substances toxic to plants. Compost shall be suitable for use as a soil amendment and shall support the growth of ornamental nursery stock and turf establishment. It shall be in a shredded or granular form and free from hard lumps. Food and agriculture residues, animal manure, or other biosolids that meet the above requirements and are approved by the Massachusetts Department of Environmental Protection are acceptable as source materials.

The level of toxic elements and compounds in organic matter shall be below the Massachusetts Department of Environmental Protection Type I standards for sludge and the United States Environmental Protection Agency standards for Class A "Exceptional Quality Sludge", whichever is more stringent. Levels of pathogens shall be below both federal and state thresholds.

Composted material with an unpleasant odor, such as that of ammonia or fecal material shall be rejected by the Engineer.

Compost shall have the following properties:

- maximum particle size of 25 mm
- stability =<10 mg CO2 - C/g BVS day, or
  =<10 degrees C above ambient temp (deWar self-heating test), or
  => 6 using Solvita test kit
- moisture content between 35-55 %
- pH range between 5.5 and 7.5
- minimum organic matter content of 40% (min. dry weight)
- maximum electrical conductivity of 4 mmhos/cm (dS/m)
- maximum of 1 percent foreign matter
- C:N ratio range of 11-25:1

If used, the Solvita test kit shall be procured by the Contractor, and the compost samples shall be tested on site by the Contractor, in the presence of the Engineer. Cost of testing shall be incidental to the pay item.

An extended list of commercial sources of compost material is available from the Division of Consumer Programs, Bureau of Waste Products, Massachusetts Department of Environmental Protection.

M1.07.0 Topsoil.

Topsoil and Plantable Soil Borrow shall consist of fertile, friable, natural topsoil, reasonably free of stumps, roots, stiff clay, stones larger than 25 millimeter diameter, noxious weeds, sticks, brush or other litter.

Prior to stripping the topsoil from the construction project, it shall have demonstrated by the occurrence upon it of healthy crops, grass or other vegetative growth, that it is reasonably well drained and capable of supporting plant growth. Material classified as Topsoil can only be obtained within the project limits.

SECTION M6
ROADSIDE DEVELOPMENT MATERIALS

M6.00.0 General.

This section shall contain materials used for soil conditioning, seeding, general planting, and care of plants.

M6.01.0 Inorganic Amendments.

Limestone shall consist of pulverized limestone obtained by grinding either calcareous or dolomitic limestone so that 95% of the material will pass a 850 micrometer sieve and at least 50% will pass a

150 micrometer sieve. The limestone shall have a neutralizing value satisfactory to the Engineer, and shall be only such as will have been marketed in accordance with those provisions of General Laws, as amended, which relate to commercial fertilizers.

Sulfur for adjustment of loam pH shall be commercial or flour sulfur, unadulterated, and shall be delivered in containers with the name of the manufacturer, material analysis, and net weight appearing on each container.

Gypsum for soil structure amendment and de-icing salt mitigation shall be agricultural grade, 80 percent calcium sulphate (CaSO4 ? 2H2O), in granular or slurry form, with 100 percent passing a 2 mm screen, and 90% passing through 150 mm screen. Gypsum may be derived from natural sources or from recycled wallboard.

M6.02.0 Fertilizer.

Fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product.
Fertilizer for grass seeding shall have the following composition by mass.

	10-20-10
Nitrogen (N)	10% Minimum
Available Phosphoric Acid (P_2O_5)	20% Minimum
Water Soluble Potash (K2O)	10% Minimum

Fertilizer for general planting shall be commercial grade 10-10-10.

No fertilizer shall be used which has not been marketed in accordance with the provisions of General Laws, as amended, relating to fertilizers.

M6.02.1 Bone Meal.

Bone meal shall be fine-ground, steam-cooked, packing house bones with a minimum analysis of 23% phosphoric acid and 1.0% of nitrogen by mass.

5.0 EXPANDING COMPOST USAGE

Excellent opportunity exists to expand the usage of compost on roadside applications. It is likely that in years to come, greater volumes of compost will be used not only in landscape applications, but also in erosion/sediment control and other 'environmental' applications. Figure 5 illustrates the potential expansion for compost use by State DOTs, based on typical acreage that is 'planted' annually by State DOTs and typical compost application rates. The majority of compost is currently being used by State DOTs in construction related projects (not maintenance), and it is likely that this trend will continue. However, compost could certainly be used by State DOT maintenance departments for turf topdressing and mulching of planting beds. Another method for State DOTs to obtain greater success in vegetation/planting establishment and survival is for them to require minimum organic matter content standards in the soils used on their projects. Several State already have these standards in place, and several allow for a substandard soil (low in organic matter content) to be used if upgraded to the proper organic matter content through the addition of compost. In effect, this type of creative specification allows State DOTs to obtain superior quality soils, while their contractors can avoid the expense and difficulty of locating and securing a source of high quality topsoil.

Figure 5 Estimated and Potential Compost Use

State DOT	Compost Use Specification	Estimated Current Useage - cu. yds.a	Estimated Annual Potential Usage - acresb	1"-134 yds./acre Application Rate - total cubic yards	1.5"-201 yds./acre Application Rate - total cubic yards	2.0"-269 yds./acre Application Rate - total cubic yards
ALASKA	yes	250	200	26,800	40,200	53,800
ALABAMA	no	0	1,000	134,000	201,000	269,000
ARIZONAd	no	0	0	-	-	-
ARKANSAS	no	0	1,000	134,000	201,000	269,000
CALIFORNIA	yes	225,000	25,000	3,350,000	5,025,000	6,725,000
COLORADO	yes	n/a	200	26,800	40,200	53,800
CONNECTICUTf	yes	n/a	n/a	n/a	n/a	n/a
DELAWAREc	yes	n/a	$50,000/yr.- 3 years	n/a	n/a	n/a
FLORIDA	yes	n/a	2,000	268,000	402,000	538,000
GEORGIAe	yes	10,000	2,000	268,000	402,000	538,000
HAWAII	no	0	0	-	-	-
IDAHO	yes	10,000	150	20,100	30,150	40,350
ILLINOISg	yes	n/a	n/a	n/a	n/a	n/a
INDIANA	no	0	200	26,800	40,200	53,800
IOWA	yes	12,000	2,000	268,000	402,000	538,000
KANSASf	yes	n/a	n/a	n/a	n/a	n/a
KENTUCKY	no	0	300	40,200	60,300	80,700
LOUISIANA	no	0	2,500	335,000	502,500	672,500
MAINEb	yes	17,000	n/a	n/a	n/a	n/a
MARYLAND	yes	75	n/a	n/a	n/a	n/a
MASSACHUSETTS	yes	n/a	n/a	n/a	n/a	n/a
MICHIGAN	yes	n/a	n/a	n/a	n/a	n/a
MINNESOTA	yes	10,000	3,000	402,000	603,000	807,000
MISSISSIPPI	no	0	1,500	201,000	301,500	403,500
MISSOURI	no	0	4,000	536,000	804,000	1,076,000
MONTANA	yes	600	1,000	134,000	201,000	269,000
NEBRASKAd	no	0	150	20,100	30,150	40,350
NEVADA	no	0	n/a	n/a	n/a	n/a
NEW HAMPSHIRE	yes	3,500	10	1,340	2,010	2,690
NEW JERSEY	yes	50	100	13,400	20,100	26,900
NEW MEXICO	no	0	2,000	268,000	402,000	538,000
NEW YORK	yes	n/a	400	53,600	80,400	107,600
NORTH CAROLINA	yes	0	250	33,500	50,250	67,250
NORTH DAKOTA	no	0	300	40,200	60,300	80,700
OHIO	yes	75	n/a	n/a	n/a	n/a
OKLAHOMA	no	0	2,000	268,000	402,000	538,000
OREGON	yes	3,600	60	8,040	12,060	16,140
PENNSYLVANIA	yes	n/a	1,000	134,000	201,000	269,000
RHODE ISLAND	no	0	1,000	134,000	201,000	269,000
SOUTH CAROLINA	yes	100	n/a	n/a	n/a	n/a
SOUTH DAKOTA	no	0	250	33,500	50,250	67,250
TEXAS	yes	100,000	80,000	10,720,000	16,080,000	21,520,000
UTAH	yes	8,000	400	53,600	80,400	107,600
VERMONT	no	n/a	n/a	n/a	n/a	n/a
VIRGINIAf	yes	n/a	30	4,020	6,030	8,070
WASHINGTON	yes	80,000	400	53,600	80,400	107,600
WEST VIRGINIA	no	0	10	1,340	2,010	2,690
WISCONSIN	yes	100	750	100,500	150,750	201,750
WYOMING	yes	n/a	4,000	536,000	804,000	1,076,000
TOTAL		**480,350 yd3**	**139,160 Acres**	**18,647,440**	**27,971,160**	**37,294,880**

The USCC expects that the proper use of the Model Compost Specification (Section 4) will not only assist in the expanded utilization of compost by State DOTs, but also help to assure successful use of compost 'in the field'. The USCC believes that the further use of the Seal of Testing Assurance Program within State DOT product approval and evaluation processes will also assist them in becoming more comfortable with specifying compost (information on the STA Program is attached). Some State DOTs have already suggested that any compost products they specify will be required to be enrolled in an ongoing product testing program, such as the Seal of Testing Assurance Program, while others have stated that they will allow USCC certified composts which possess adequate testing records to forgo certain product testing requirements they employ.

The concept of creating more sustainable roadside environments fits in well with the use of compost. Further, the role of 'healthy' soils, those rich in stable organic matter and microbial life, in the survival of vegetation and erosion/sediment control can be correlated to the long-term integrity of roads and lower life cycle construction/management costs.

For additional information, contact the USCC at 717-238-9759 or at www.compostingcouncil.org.

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[9] The Composting Council Research and Education Foundation, The Soil and Water Connection (page 22), March, 1997.

[10] U.S. E.P.A., *Innovations in Compost Use – Reforestation, Wetlands Restoration, and Habitat Revitalization,* October 1997.

[11] Alexander, R., *Blending Improves Marketability of Compost,* Composting News. January 1999.

Appendices

Compost Analytical Testing Methodologies

State DOT Contacts - Tables

- DOT Landscape Contacts
- DOT Environmental Officers
- DOT Maintenance Contacts
- DOT Directors

APPENDICES

Compost analytical testing methodologies

2001 Approved STA Analytical Methods

STA Requiremer	TMECC Method Numl	Parameter	Method Name
YES	03.09-A	Moisture Content	TOTAL SOLIDS AND MOISTURE, % wet basis
YES	04.01-A	TOC	COMBUSTION WITH CO2 DETECTION, Carbon, % dw basis
YES	04.02-D	TN	TOTAL NITROGEN BY COMBUSTION
YES	04.03-A	P	TOTAL PHOSPHORUS, Determined as elemental P, reported as P2O5
YES	04.04-A	K	TOTAL POTASSIUM, Determined as elemental K, reported as K2O
YES	04.05	Ca	
YES	04.05	Cl	
YES	04.05	Mg	
YES	04.05	Na	
YES	04.10-A	ECe (soluble salts)	1:5 SLURRY METHOD, MASS BASIS
YES	04.11-A	pH	1:5 SLURRY pH
YES	05.05-A	Bioassay	EMERGENCE AND RELATIVE GROWTH (DIRECT SEEDING): Seedling germination and vigor, cucumber seeded in 50:50 blend of vermiculite:compost, %
YES	05.07-A	OM	LOSS ON IGNITION ORGANIC MATTER METHOD, ashed at 550C for 2h, % dw basis
YES	05.08-B	Respirometry	CARBON DIOXIDE EVOLUTION RATE, mg CO2-C per g (TS, OM) per day
OPTIONAL	04.02-B	NO3-N	
OPTIONAL	04.02-C	NH4-N	
OPTIONAL	04.06	As	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Cd	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Cu	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Hg	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Mn	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Mo	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Ni	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Pb	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Se	(EPA 503 regulated contaminant)
OPTIONAL	04.06	Zn	(EPA 503 regulated contaminant)
OPTIONAL	05.02-A	C:N ratio (2 methods)	CARBON TO NITROGEN RATIO, unitless ratio
OPTIONAL	05.02-E	Cd:Zn ratio	CADMIUM TO ZINC RATIO, unitless ratio
OPTIONAL	07.00	Pathogens	(EPA 503 regulated contaminant) Background Information
OPTIONAL	07.01	Pathogens	(EPA 503 regulated contaminant) COLIFORM BACTERIA, MPN per g dw basis
OPTIONAL	07.02	Pathogens	(EPA 503 regulated contaminant) SALMONELLA
OPTIONAL	07.03	Pathogens	ENTEROCOCCI
OPTIONAL	07.04	Pathogens	PARASITIC HELMINTHS
OPTIONAL	07.05	Pathogens	RECOVERY AND ASSAY OF TOTAL CULTURABLE VIRUSES
NO	04.07	Ag	
NO	04.07	Ba	
NO	04.09	CEC	CATION EXCHANGE CAPACITY FOR COMPOST
NO	04.05	Co	
NO	04.06	Cr	
NO	04.05	Fe	
NO	- no method in TMECC	PO4-P	
NO	04.05	S	
NO	- no method in TMECC	saturated paste percentage	
NO	04.07	Sb	
NO	04.05	SO4-S	
NO	04.06	Sr	Strontium
NO	04.08	TIC	INORGANIC CARBON
NO	04.06	V	Vanadium
NO	04.03-B	Water-Soluble P	soluble elements (<0.45 micron) by ICP from a 1:20 extract

State DOT	Contact Person-Title	Address	Telephone	E-mail	Compost Uses
ALASKA	Jerry Ruehle Environmental Coordinator	3132 Channel Dr. Juneau, AK 99801-7898	907-269-0534	Jerry_Ruehle@dot.state.ak.us	*backfill mix
CALIFORNIA	Jack Broadbent Sr. Landscape Architect	1120 N St., Box 942874 Sacramento, CA 94274-0001	916-653-0361	jack_broadbent@dot.ca.gov	*mulch
COLORADO	Mike Banovich Landscape Architect	4201 E. Arkansas Ave. Denver, CO 80222	303-257-9542	michael.banovich@dot.state.co.us	soil amendment, backfill mix
CONNECTICUT	Emile Fournier Landscape Designer 3	2800 Berlin Tpk., Box 317546 Newington, CT 06131-7546	860-594-2612	emile.fournier@po.state.ct.us	*erosion control, top dressing, backfill mix, turf establishment
DELAWARE	Chip Rosan Roadside Environmental Supv.	Bay Rd. Rt. 113, Box 778 Dover, DE 19903	302-760-2185	crosan@mail.dot.state.de.us	*soil amendment
FLORIDA	Gary Henry Landscape Architect	605 Suwannee St. Tallahassee, FL 32399-0450	850-922-7210	gary.henry@dot.state.fl.us	mulch, soil amendment
GEORGIA	Abbe Hoctor Landscape Architect	2 Capital Square Atlanta, GA 30334	404-657-6053	abbe.hoctor@dot.state.ga.us	soil amendment
IDAHO	Gene Ross Roadside Landscape Mgr.	Box 7129 Boise, ID 83707-7129	208-334-8416	gross@itd.state.id.us	mulch
ILLINOIS	Charles Gouveia Roadside Maintenance Mgr.	2300 S. Dirksen Parkway Springfield, IL 62764	217-782-2984	gouveiach@nt.dot.state.il.us	soil amendment
IOWA	Dave Heer Earthwork Field Engineer	800 Lincoln Way Ames, IA 50010	515-239-1424	dheer@max.state.ia.us	soil amendment
KANSAS	Richard Ross Landscape Architect	Docking State Office Bldg. Rm. 814N, Topeka, KS 66612	785-296-8399	ross@ksdot.org	soil amendment, backfill mix
MAINE	Robert LaRoche Supv. Landscape Architecture	State House Station 16 Augusta, ME 04333-0016	207-287-5735	robert.laroche@state.me.us	soil amendment
MARYLAND	Don Cober Technical Resource Specialist	707 N. Calvert St. Baltimore, MD 21202	410-545-8596	dcober@sha.state.md.us	backfill mix, soil amendment
MASSACHUSETTS	George Batchelor Landscape Architect	10 Park Plaza Boston, MA 02116	617-973-7857	george.batchelor@state.ma.us	*soil amendment
MICHIGAN	Jeff Bokovoy Landscape Architect	425 W. Ottawa St. Lansing, MI 48933	517-373-0162	bokovoyj@mdot.state.mi.us	*soil amendment, slope restoration
MINNESOTA	Dwayne Stenlund Senoir Ecologist	Mail Stop 620, 395 John Ireland Blvd., St. Paul, MN 55155-1899	651-284-3787	dwayne.stenlund@dot.state.mn.us	soil amendment
MONTANA	Phil Johnson Reclamation Specialist	2701 Prospect Ave., Helena, MT 59620-1001	406-444-7657	phjohnson@state.mt.us	*mulch
NEW HAMPSHIRE	Guy Giunta Roadside Development Eng.	78 Regional Dr. Concord, NH 03302	603-271-6476	ggiunta@dot.state.nh.us	soil amendment
NEW JERSEY	John Spedding Landscape Architect	1035 Parkway Ave., CN 600 Trenton, NJ 08625	609-530-5675	johnspedding@dot.state.nj.us	soil amendment
NEW YORK	Charles Nagel Asst. Dir. Landscape Architecture Bur.	State Office Campus Albany, NY 12232	518-457-4460	cnagel@gw.dot.state.ny.us	soil amendment
NORTH CAROLINA	Derek Smith Vegetation Mgt. Section Engineer	NCDOT-REV, Box 25201 Raleigh, NC 27611	919-733-2520	dcsmith@dot.state.nc.us	*organic fertilizer
OHIO	Bill Sherman Landscape Architect	1980 West Broad St. Columbus, OH 43223	614-752-0399	bill.sherman@dot.state.oh.us	backfill mix
OREGON	Paul Edgecomb Landscape Architect	355 Capitol St. Salem, OR 97310-3871	503-986-3550	paul.g.edgcomb@odot.state.or.us	soil amendment
PENNSYLVANIA	John Whaley	555 Walnut St., Forum Plaza	717-783-5036	dwhaley@dot.state.pa.us	mulch, soil amendment,

*specifications exist as either a special provision or in draft form

	Landscape Architect	Harrisburg, PA 17101-1900			backfill mix
SOUTH CAROLINA	Timothy Edwards Landscape Architect	Silas Pearman Bldg., 955 Park St., Columbia, SC 29202	803-737-1953	edwardsft@dot.state.sc.us	backfill mix
TEXAS	Barrie Cogburn Landscape Architect	125 E. 11th St. Austin, TX 78701-2483	512-416-3086	bcogburn@dot.state.tx.us	soil amendment, erosion control, topsoil mfg., mulch
UTAH	Terry Johnson Landscape Architect	Region 1, 169 N. Wall St., Box 12580, Ogden, UT 84412	801-399-5921	tjohnson@dot.state.ut.us	*soil amendment, top dressing
VIRGINIA	Ken Oristaglio Environmental Program Mgr.	1401 E. Broad St. Richmond, VA 23219	804-371-6825	oristaglio_kl@vdot.state.va.us	*soil amendment, erosion control
WASHINGTON	Mark Maurer Landscape Architect	310 Maple Park, Box 47300 Olympia, WA 98504-7300	360-705-7242	maurerm@wsdot.wa.gov	soil amendment, biofiltration, erosion control
WISCONSIN	Richard Stark Landscape Architect	4802 Sheboygan Ave., Box 7910 Madison, WI 53707-7910	608-266-3943	richard.stark@dot.state.wi.us	backfill mix
WYOMING	John Sampson Agronomist	5300 Bishop Blvd. Cheyanne, WY 82009-3340	307-777-4416	jsamso@dot.state.wy.us	*organic fertilizer, soil amendment

State DOT Contacts where no written compost specification currently exists

ALABAMA	Ron Newsome Asst. Maintenance Engineer,Roadway	1409 Coliseum Blvd. Montgomery, AL 36130	334-242-6247	newsomer@dot.state.al.us
ARKANSAS	Phillip Moore Botanist	PO 2261 Little Rock, AR 72203	501-569-2281	Phillip.Moore@ahtd.state.ar.us
ARIZONA	Cliff Taylor Natural Resources Manager	206 S. 17th Ave. Phoenix, AZ 85007	602-712-7398	CTaylor@dot.state.az.us
HAWAII	George Tonaki Landscape Architect	727 Kakoi St. Honolulu, HI 96819	808-831-6795	n/a
INDIANA	Clyde Lovelady Landscape Specialist	Rm. 125, 100 N. Senate Ave. Indianapolis, IN 46204	317-232-5509	clovelady@indot.state.in.us
KENTUCKY	Melvin Ramsey Landscape Architect	State Office Bldg., 501 High St. Frankfurt, KY 46022	502-564-4780	mramsey@mail.kytc.state.ky.us
LOUISIANA	Sidney J. Babin Chief Landscape Architect	PO 94245 Baton Rouge, LA 70804-9245	225-379-1550	Sbabin@dotmail.dotd.state.ls.us
MISSISSIPPI	Dave Thompson Landscape Architect	PO 1850, Maintenance Division Graham, MS 39215	601-968-3881	dgthompson@mdot.state.ms.us
MISSOURI	Rand Swanigan Roadside Management Specialist	PO 270 Jefferson City, MO 65102	593-751-2855	swanir@mail.modot.state.mo.us
NEBRASKA	Art Thompson Landscape Architect	PO 94759 Lincoln, NE 68509-4759	402-479-4839	n/a
NEVADA	Don Payne Landscape Architect	1263 S. Stewart St. Carson City, NV 89712	775-888-7537	epayne@dot.state.nv.us
NEW MEXICO	Grady Stem Landscape Architect	1120 Cerrilos Rd. Santa Fe, NM 87504	505-827-5688	grady.stem@nmshtd.state.nm.us
NORTH DAKOTA	Ben Kubischta Senior Manager, Local Gov't. Division	608 E. Boulevard Ave. Bismark, ND 58505-0700	701-328-3555	bkubisch@state.nd.us
OKLAHOMA	Micky Dolan Agronomist, Roadway Design	200 NE 21st St. Oklahoma City, OK 73105	405-521-6771	mdolan@odot.org
RHODE ISLAND	Barbara Petrarca Landscape Architect	State Office Bldg., 2 Capital Hill Providence, RI 02903	401-222-2023 ext. 4090	bptrarca@dot.state.ri.us
SOUTH DAKOTA	Sharon Kayser Landscape Architect	700 East Broadway Ave. Pierre, SD 57501-2586	605-773-3265	sharon.kayser@state.sd.us
TENNESSEE	Patrick Thurman Landscape Architect	700 James K. Polk Bldg., 5th & Deaderick Sts. Nashville, TN 37243-0349	615-741-2027	pthurman@mail.state.tn.us
VERMONT	Craig Dusablon Landscape Coordinator, Maint. Div.	1333 State St. Montpelier, VT 05633	802-527-5448	craig.dusablon@aot.state.vt.us
WEST VIRGINIA	Terry Kesner District Operating Supervisor	1900 Kanawha Blvd., Bldg. 5 Charleston, WV 25305-0440	304-289-3521	tkesner@dot.state.wv.us

*specifications exist as either a special provision or in draft form

APPENDICES

State DOT Contacts - Tables

DOT Environmental Officers

State	Contact	Address	Telephone	Fax	E-mail
Alabama	Alfredo Acoff Environmental Coordinator	1409 Coliseum Blvd. Montgomery, AL 36130-3050	334-242-6143	334-262-0826	acoffa@dot.state.al.us
Alaska	Bill Ballard Statewide Environmental Coordinator	3132 Channel Dr., Room 105 Juneau, AK 99801-7898	907-465-6954	907-465-5240	bill_ballard@dot.state.ak.us
Arizona	Joe Neblett, Jr. Sr. Transportation Planner	206 S. 17th Ave., Rm. 330B Phoenix, AZ 85007-3213	602-712-8871	602-712-3046	mneblett@dot.state.az.us
Arkansas	Marion Butler Environmental Division Head	PO 2261, 10324 Interstate 30 Little Rock, AR 72203-2261	501-569-2281	501-569-2009	mbsd180@ahtd.state.ar.us
California	Gary Winters Acting Chief, Environmental Program Manager	PO 942874, 1120 N St., MS 32 Sacramento, CA 94274-0001	916-653-7136	916-653-7757	gary_winters@dot.ca.gov
Colorado	George S. Gentile Section Manager, Intermodel Planning/Environment	4201 E. Arkansas Ave. Denver, CO 80202	303-757-9795	303-757-9149	george.gerstle@dot.state.co.us
Connecticut	Edgar T. Hurle Director of Environmental Planning	PO 317546/2800 Berlin Turnpike Newington, CT 06131-7546	860-594-2920	860-594-3028	edgar.hurle@po.state.ct.us
Delaware	Joseph Wutka Asst. Director, Project Development	PO 778, Bay Rd., Rt. 113 Dover, DE 19903-0778	302-760-2111	302-760-2251	n/a
District of Columbia	Maurice Keys Environmental Program Coordinator	2000-14th St. NW, 7th Floor Washington, DC 20009	202-671-2740	202-939-7185	mkeys@dpw.dcgov.org
Florida	Leroy Irwin Manager, Environmental Mgt. Office	605 Suwannee St., MS 37 Tallahassee, FL 32399-0450	850-922-7201	850-922-7217	leroy.irwin@dot.state.fl.us
Georgia	Harvey D. Keepler State Environmental/Location Engineer	3993 Aviation Circle, NE Atlanta, GA 30336	404-699-4444	404-699-4440	harvey.keepler@dot.state.ga.us
Hawaii	Ronald Tsuzuki Planning Engineer	869 Punchbowl St. Honolulu, HI 96813-5097	808-587-1830	808-587-2167	ronald_tsuzuki@exec.state.hi.us
Idaho	Dennis Clark Environmental Section Manager	PO 7129 Boise, ID 83707-1129	208-334-8203	208-334-8025	dclark@itd.state.id.us
Illinois	Carla J. Berroyer Chief of Urban Program Planning	2300 S. Dickson Parkway Springfield, IL 62764-0002	217-782-7868	217-785-0468	berroyercj@nt.dot.state.il.us
Indiana	Steve Cecil Deputy Commissioner Planning and Intermodal Transportation	100 N. Senate Ave., Rm. N755 Indianpolis, IN 46204-2273	317-232-5535	317-232-0238	scecil@indot.state.in.us
Iowa	Thomas J. Sally Deputy Dir., Support Services Bureau	800 Lincoln Way Ames, IA 50010	515-239-1464	515-239-1994	tsally@iadot.e-mail.com
Kansas	Scott P. Vogel Bureau of Design	Docking State Office Bldg., 915 Harrison Topeka, KS 66612	785-296-0164	n/a	vogel@ksdot.org
Kentucky	John L. Carr, P.E. Deputy SHE for Intermodal Programs	State Office Bldg., 501 High St., 10th Fl. Frankfurt, KY 40622	502-564-3730	502-564-2277	jcarr@mail.kytc.state.ky.us
Louisiana	Vincent G. Russo Environmental Engineer Administrator	1201 Capital Access Rd., PO 94245 Baton Rouge, LA 70804-9245	225-248-4190	225-248-4188	vrusso@dotdmail.dotd.state.la.us
Maine	Duane A. Scott Program Manager	16 State House Station Augusta, ME 04333-0016	207-287-5736	207-287-3292	duane.scott@state.me.us
Maryland	Susie M. Jacobs Chief, Environmental Programs	707 N. Calvert St. Baltimore, MD 21200	410-545-8610	410-209-5003	sjacobs@sha.state.md.us
Massachusetts	Luisa Paiewonsky Director of Transportation Planning & Development	10 Park Plaza, Rm. 3227 Boston, MA 02116-3973	617-973-7858	617-973-8035	luisa.paiewonsky@state.ma.us
Michigan	Peter Olliia Environmental Coordinator	Transportation Bldg., 425 W. Ottawa St. PO 30050, Lansing, MI 48909-7550	517-373-1908	517-373-9255	ollilap@state.mi.us
Minnesota	Leonard G. Eilts Director, Environmental Services	Transportation Bldg., 395 John Ireland Blvd., St. Paul, MN 55155-1899	651-284-3751	651-779-5109	leonard.eilts@dot.state.mn.us
Mississippi	Claiborne Barnwell Environmental Division Engineer	401 North West St., PO 1850 Jackson, MS 39215-1850	601-359-7920	601-359-7355	bbarton@mdot.state.ms.us
Missouri	Mark S. Kross Division Engineer, Preliminary Studies	105 West Capitol Ave., PO 270 Jefferson City, MO 65102-0270	573-751-4606	573-526-2819	krossm@mail.modot.state.mo.us
Montana	Joel Marshik Manager, Environmental Services	2701 Prospect Ave., PO 201001 Helena, MT 59620-1001	406-444-7632	406-444-7245	jmarshik@state.mt.us
Nebraska	Arthur B. Yonkey Engineer, Project Development Division	1500 Highway 2, PO 94759 Lincoln, NE 68509-4759	402-479-4795	402-479-3629	ayonkey@dor.state.ne.us
Nevada	Jeff Fontaine Deputy Director	1263 S. Stewart St. Carson City, NV 89712-0002	702-888-7440	775-888-7201	hichavez@dot.state.nv.us
New Hampshire	Willaim R. Hauser Administrator, Bur. of Environmental Affairs	John O. Morton Bldg., 1 Hazen Dr. Rm. 109, PO 483, Concord, NH 03302-0483	603-271-3226	603-271-2653	bhauser@dot.state.nh.us

State DOT Contacts - Tables

DOT Environmental Officers (continued)

New Jersey	Andras Fekete Mgr., Bur.of Environmental Services	1035 Parkway Ave., PO 600 Trenton, NJ 08625-0600	609-530-2824	609-530-3893	Akekete@dot.state.nj.us
New Mexico	Charlie V. Trujillo Deputy Secretary of Transportation Planning and Design	1120 Cerrillos Rd., PO 1149 Santa Fe, NM 87504-1149	505-827-5258	505-827-5469	charlie.trujillo@nmshtd.state.nm.us
New York	Gary R. McVoy Director, Environmental Analysis Bur.	1223 Washington Ave. Albany, NY 12232-0473	518-457-5672	518-457-6887	gmcvoy@gw.dot.state.ny.us
North Carolina	Janet D'Ignazio Chief Planning & Environmental Officer	1 South Wilmington St., PO 25201 Raleigh, NC 27611-5201	919-733-2520	919-733-9150	jdignazio@dot.state.nc.us
North Dakota	Tim Horner Director, Office of Transportation Program Services	608 E. Boulevard Ave. Bismark, ND 58505-0700	701-328-2515	701-328-1404	thorner@state.nd.us
Ohio	Timothy Hill Administrator, Bur. of Environmental Services	1980 W. Broad St., 3rd Floor Columbus, OH 43223-1102	614-466-7100	614-728-7368	tim.hill@dot.state.oh.us
Oklahoma	David Stieb Division Engineer, Planning	200 N.E. 21st St. Oklahoma City, OK 73105-3299	405-521-6916	405-521-6917	dstreb@odot.org
Oregon	Lori Sundstrom Manager, Environmental Services	1158 Chemeketa St., N.E. Salem, OR 97301-2528	503-986-3491	503-986-3524	lori.l.sundstrom@odot.state.or.us
Pennsylvania	Sue McDonald Acting Bureau Director	Forum Place, 555 Walnut St., 7th Floor Harrisburg, PA 17101-1900	717-787-1024	717-772-0834	smcdona@dot.state/pa.us
Rhode Island	William D. Ankner, Ph.D. Director	2 Capitol Square Providence, RI 02903-1124	401-222-2481	401-222-2086	wda@dot.state.ri.us
South Carolina	Blanche S. Sproul Environmental Manager	Silas N. Pearman Bldg., 955 Park St. PO 191, Columbia, SC 29202-0191	803-737-1414	803-737-1394	sproulbs@dot.state.sc.us
South Dakota	James D. Nelson Environmental Manager	700 E. Broadway Ave. Pierre, SD 57501-2586	605-773-3098	n/a	jim.nelson@state.sd.us
Tennessee	Dennis Cook Asst. Chief Engineering, Planning	700 James K. Polk Bldg., 5th & Deaderick Nashville, TN 37243-0339	615-741-3339	615-741-0865	Dcook@mail.state.tn.us
Texas	Dianna F. Noble Director, Environmental Affairs	125 E. 11th St. Austin, TX 78701-2483	512-416-2734	512-416-2746	dnoble@dot.state.tx.us
Utah	Brent Jensen Chief Environmental Engineer	4501 South 2700 West Salt Lake City, UT 84119-5998	801-965-4327	801-965-4338	bjensen@dot.state.ut.us
Vermont	John T. Narowski Transportation Environmental Chief	133 State St. Montpelier, VT 05633-5001	802-828-5265	802-828-2334	john.narowski@state.vt.us
Virginia	Earl T. Robb Division Administrator, Environmental Engineer	1401 East Broad St. Richmond, VA 23219	804-786-4559	n/a	robb_et@vdot.state.va.us
Washington	Jerry Aib Director, Environmental Services	310 Maple Park, PO 47331 Olympia, WA 98504-7331	360-705-7305	360-705-6833	aibjerr@wsdot.wa.gov
West Virginia	Randolph T. Epperly, Jr. Deputy State Hwy. Engineer - Project Development	1900 Kanawha Blvd. East, Bldg. 5 Charleston, WV 25305-0440	304-558-6266	304-558-4076	repperly@mail.dot.state.wv.us
Wisconsin	Carol D. Cutshall Director, Bureau of Environment	4802 Sheboygan Ave., Room 451, PO 7965, Madison, WI 53707-7965	608-266-9626	608-266-7818	ccutshal@mail.state.wi.us
Wyoming	Robert D. Milburn State Planning Engineer	5300 Bishop Blvd., PO 1708 Cheyenne, WY 82003-1708	307-777-4412	307-777-4759	bmilbu@missc.state.wy.us

APPENDICES

State DOT Contacts - Tables

DOT Maintenance Contacts

State	Contact	Address	Telephone	Fax	E-mail
Alabama	John E. Lorentson State Maintenance Engineer	1409 Coliseum Blvd. Montgomery, AL 36130-3050	334-242-6272	334-242-6378	lorentsonj@dot.state.al.us
Alaska	Frank T. Richards Statewide Maintenance Engineer	3132 Channel Dr. Juneau, AK 99801-7898	907-465-3906	907-586-8365	frank_richards@dot.state.ak.us
Arizona	James Dorre Asst. State Engineer, Maintenance Group	206 S. 17th Ave., Rm. 176A Phoenix, AZ 85007-3213	602-712-7410	602-712-9877	jdorre@dot.state.az.us
Arkansas	James Barnett State Maintenance Engineer	PO 2261, 10324 Interstate 30 Little Rock, AR 72203-2261	501-569-2231	501-569-2014	jdbe243@ahtd.state.ar.us
California	Randall H. Iwasaki Deputy Director Maintenance and Operations	PO 942874, 1120 N St., MS 49 Sacramento, CA 94274-0001	916-654-6823	916-654-6608	randell_iwasaki@dot.ca.gov
Colorado	Edward Fink Maintenance and Operations Superintendent	15055 S. Golden Rd., Bldg. 45 Golden, CO 80401	303-273-1840	303-273-1854	ed.fink@dot.state.co.us
Connecticut	Louis R. malerba Transportation Maintenance Administrator	PO 317546/2800 Berlin Turnpike Newington, CT 06131-7546	860-594-2604	860-594-3008	louis.malerba@po.state.ct.us
Delaware	Charles Lightfoot District Maintenance Engineer	250 Bear-Christiana Rd. Bear, DE 19701	n/a	n/a	chucklightfoot@mail.dot.state.de.us
District of Columbia	Luke DiPompo Chief, Bridge Construction	2000-14th St. NW, 6th Floor Washington, DC 20009	202-671-2628	202-645-6129	LDipompo@dpw.dcgov.org
Florida	Sharon E. Holmes, P.E. State Maintenance Engineer	605 Suwannee St., MS 52 Tallahassee, FL 32399-0450	850-488-8814	850-488-4418	sharon.holmes@dot.state.fl.us
Georgia	Buddy Gratton, P.E. State Maintenance Engineer	2 Capitol Square, S.W. Atlanta, GA 30334-1002	404-656-5314	404-657-7266	buddy.gratton@dot.state.ga.us
Hawaii	Charles Yonamine Division Maintenance Engineer	869 Punchbowl St., Room 20 Honolulu, HI 96813-5097	n/a	n/a	charles_yonamine@exec.state.hi.us
Idaho	Dave Jones Maintenance Engineer	PO 7129 Boise, ID 83707-1129	208-332-7893	208-334-8595	djones@itd.state.id.us
Illinois	Joseph S. Hill Chief of Operations	2300 S. Dickson Parkway Springfield, IL 62764-0002	217-782-7231	217-782-6828	hilljs@nt.dot.state.il.us
Indiana	Mike Bowman Highway Support Manager	100 N. Senate Ave., Rm. N855 Indianpolis, IN 46204-2218	n/a	n/a	mbowman@indot.state.in.us
Iowa	John R. Selmer Office of Maintenance Operations	800 Lincoln Way Ames, IA 50010	515-239-1589	515-239-1639	jselmer@max.state.ia.us
Kansas	Dean M. Testa Chief of Construction & Maintenance	Docking State Office Bldg., 915 Harrison Room 881, Topeka, KS 66612	785-296-3576	785-296-6944	Dean@ksdot.org
Kentucky	Cliff Linkes Deputy SHE for Construction & Operations	State Office Bldg., 501 High St. Frankfurt, KY 40622	502-564-3730	502-564-2277	clinkes@mail.kytc.state.ky.us
Louisiana	Karl J. Finch Chief, Maintenance Division	1201 Capital Access Rd., PO 94245 Baton Rouge, LA 70804-9245	225-379-1234	225-379-1861	kfinch@dotdmail.dotd.state.la.us
Maine	Marc H. Guimont Director, Bur. of Maintenance & Operations	16 State House Station Augusta, ME 04333-0016	207-287-2058	207-623-2526	marc.guimont@state.me.us
Maryland	Russell A. Yurek Deputy Chief Engineer - Maintenance	7491 Connelley Dr. Hanover, MD 21076	410-582-5505	410-582-9861	ryurek@sha.state.md.us
Massachusetts	Gordon A. Broz Deputy Chief Engineer, Highway Operations	10 Park Plaza, Rm. 3170 Boston, MA 02116-3973	617-973-7740	617-973-8037	gordon.broz@state.ma.us
Michigan	Calvin Roberts Engineer of Maintenance	6333 Old Lansing Rd. Lansing, MI 48917	517-322-3333	517-322-2699	robertsc@mdot.state.mi.us
Minnesota	Mark R. Wikelius Director, Maintenance	Transportation Bldg., 395 John Ireland Blvd. St. Paul, MN 55155-1899	651-297-3590	651-297-3160	mark.wikelius@dot.state.mn.us
Mississippi	John D. Vance Maintenance Engineer	401 North West St., PO 1850 Jackson, MS 39215-1850	601-359-7111	601-359-7126	jvance@mdot.state.ms.us
Missouri	Don Hillis, P.E. State Maintenance Engineer	105 West Capitol Ave., PO 270 Jefferson City, MO 65102-0270	573-751-2785	573-751-6555	hillid@mail.modot.state.mo.us
Montana	John Blacker Chief, Maintenance Division	2701 Prospect Ave., PO 201001 Helena, MT 59620-1001	406-444-6158	406-444-7643	jblacker@state.mt.us
Nebraska	Paul M. Cammack State Maintenance Engineer	1500 Highway 2, PO 94759 Lincoln, NE 68509-4759	402-479-4542	402-479-4325	pcammack@dor.state.ne.us
Nevada	Frank G. Taylor Chief Engineer, Maintenance	1263 S. Stewart St. Carson City, NV 89712-0002	775-888-7050	702-888-7211	ftaylor@dot.state.nv.us
New Hampshire	Stephen W. Gray Administrator, Bureau of Highway Maintenance	John O. Morton Bldg., 1 Hazen Dr. PO 483, Concord, NH 03302-0483	603-271-2693	603-271-3914	sgray@dot.state.nh.us
New Jersey	F. Rodney Roberson Asst. Commissioner of Operations	1035 Parkway Ave., PO 600 Trenton, NJ 08625-0600	609-530-2590	609-530-3894	rodroberson@dot.state.nj.us
New Mexico	Dennis Ortiz Supervisor, Maintenance Section	1120 Cerrillos Rd., PO 1149 Santa Fe, NM 87504-1149	505-827-5498	505-827-3114	dennis.ortiz@nmshtd.state.nm.us
New York	Clifford A. Thomas Asst. Commissioner for Operations	1220 Washington Ave., Bldg. 5, Rm. 503 Albany, NY 12232	518-457-7475	518-457-5583	cthomas@gw.dot.state.ny.us
North Carolina	Lacy D. Love, P.E. State Maintenance Engineer	1 South Wilmington St., PO 25201 Raleigh, NC 27611-5201	919-733-3725	919-733-9150	llove@dot.state.nc.us
North Dakota	Jerome L. Horner Maintenance & Engineering Services	608 E. Boulevard Ave. Bismark, ND 58505-0700	701-328-4443	701-328-4545	jhorner@state.nd.us
Ohio	Keith C. Swearingen Administrator, Office of Maintenance Adminstration	1980 W. Broad St. Columbus, OH 43223-1102	614-466-3264	614-644-0587	kswearin@dot.state.oh.us

State DOT Contacts - Tables

DOT Maintenance Contacts (continued)

Oklahoma	John M. Fuller State Maintenance Engineer	200 N.E. 21st St. Oklahoma City, OK 73105-3299	405-521-2557	405-522-6598	jfuller@odot.org
Oregon	Doug Tindall Maintenance Engineer	800 Airport Rd. Salem, OR 97301-4798	503-986-3005	503-986-3032	douglas.j.tindall@odot.state.or.us
Pennsylvania	Donald F. Wise Chief, Maintenance Division	Forum Place, 555 Walnut St. Harrisburg, PA 17101	n/a	n/a	dwise@dot.state.pa.us
Rhode Island	John D. Nickelson Administrator, Hwy. & Maintenance Oper.	2 Capitol Square Providence, RI 02903-1124	401-222-2378	401-222-2086	jnick@dot.state.ri.us
South Carolina	Huley Shumpert Asst. State Maintenance Engineer	Silas N. Pearman Bldg., 955 Park St. PO 191, Columbia, SC 29202-0191	803-737-1290	n/a	shumperthg@dot.state.sc.us
South Dakota	Mike Durick Director of Operations	700 E. Broadway Ave. Pierre, SD 57501-2586	605-773-3286	605-773-3921	mike.durick@state.sd.us
Tennessee	Gerald Gregory Director, Maintenance	700 James K. Polk Bldg., 5th & Deaderick Suite 400, Nashville, TN 37243-0339	615-741-2027	615-741-2508	ggregory@mail.state.tn.us
Texas	Joe S. Greff Director, Maintenance Section	125 E. 11th St. Austin, TX 78701-2483	512-416-3195	512-416-2652	jgreff@dot.state.tx.us
Utah	no listing	n/a			
Vermont	David C. Dill Director of Maintenance	National Life Bldg., Drawer 3 Montpelier, VT 05633-5001	802-828-2709	802-828-2848	david.dill@state.vt.us
Virginia	Dan Iisten Maintenance Engineer	1221 East Broad St. Richmond, VA 23219-2035	804-786-2847	804-225-4979	liston_d@vdot.state.va.us
Washington	Ken Kirkland Chief Maintenance Engineer	310 Maple Park, PO 47300 Olympia, WA 98504-7300	360-705-7851	360-705-6808	kirklak@wsdot.wa.gov
West Virginia	Julian W. Ware, P.E. Director, Highways Operations Division	1900 Kanawha Blvd. East, Bldg. 5 Room 350, Charleston, WV 25305-0430	304-558-2801	304-558-2912	jware@dot.state.wv.us
Wisconsin	David Vieth Director, Bureau of Highway Operations	4802 Sheboygan Ave., PO 7986, Madison, WI 53707-7986	608-267-8999	608-267-7856	david.vieth@dot.state.wi.us
Wyoming	Ken L. Shultz, P.E. State Maintenance Engineer	5300 Bishop Blvd., PO 1708 Cheyenne, WY 82003-1708	307-777-4051	307-777-4765	kshult@state.wy.us

APPENDICES

State DOT Contacts - Tables

DOT Directors

State DOT	Contact Person-Title	Address	Telephone
ALASKA	Joseph L. Perkins Commissioner	3132 Channel Dr. Juneau, AK 99801-7898	907-466-3901
CALIFORNIA	Jose Medina Director	1120 N St., Box 942874 Sacramento, CA 94274-0001	916-654-5267
COLORADO	Tom Norton Executive Director	4201 E. Arkansas Ave. Denver, CO 80222	303-757-9201
CONNECTICUT	James F. Sullivan Commissioner	2800 Berlin Tpk., Box 317546 Newington, CT 06131-7546	860-594-3000
DELAWARE	Anne P. Canby Secretary	Bay Rd. Rt. 113, Box 778 Dover, DE 19903	302-760-2303
FLORIDA	Tom Barry Secretary	605 Suwannee St. Tallahassee, FL 32399-0450	850-414-5205
GEORGIA	Wayne Shackelford Commissioner	2 Capital Square Atlanta, GA 30334	404-656-5212
IDAHO	Dwight Bowser Director	Box 7129 Boise, ID 83707	208-334-8807
ILLINOIS	Kirk Brown Secretary	2300 S. Dirksen Parkway Springfield, IL 62764	217-782-5597
IOWA	Mark F. Wandro Director	800 Lincoln Way Ames, IA 50010	515-239-1111
KANSAS	Dean Carlson Secretary	Docking State Office Bldg., 915 Harrison Topeka, KS 66612	785-296-3461
MAINE	John Melrose Commissioner	State House Station 16 Augusta, ME 04333-0016	207-287-2551
MARYLAND	John D. Porcari Secretary	10 Elm Rd., PO 8755 BWI Airport, MD 21240-0755	410-865-1000
MASSACHUSETTS	Kenvin J. Sullivan Secretary	10 Park Plaza Boston, MA 02116	617-973-8080
MICHIGAN	James R. Desana Director	425 W. Ottawa St. Lansing, MI 48933	517-373-2114
MINNESOTA	Elwyn Tinklenberg Secretary	395 John Ireland Blvd. St. Paul, MN 55155	651-297-2930
MONTANA	Marv Dye Director	2701 Prospect Ave., Helena, MT 59620-1001	406-444-6201
NEW HAMPSHIRE	Leon S. Kenison Commissioner	PO 483, Hazen Dr. Concord, NH 03301-0483	603-271-3734
NEW JERSEY	James Weinstein Commissioner	1035 Parkway Ave., CN 600 Trenton, NJ 08625	609-530-3536
NEW YORK	Joseph H. Boardman Commissioner	Bldg. 5, State Office Campus Albany, NY 12232	518-457-4422
NORTH CAROLINA	David T. McCoy Secretary	PO 25201, 1 South Wilmington St. Raleigh, NC 27611	919-733-2520
OHIO	Gordon D. Proctor Director	1980 West Broad St. Columbus, OH 43223	614-644-2335
OREGON	Grace Crunican Director	355 Capitol St. Salem, OR 97310-3871	503-986-3204
PENNSYLVANIA	Bradley L. Mallory Secretary	555 Walnut St., Forum Plaza Harrisburg, PA 17101-1900	717-787-5574
SOUTH CAROLINA	Elizabeth S. Mabry Executive Director	Silas Pearman Bldg., 955 Park St. St., Columbia, SC 29202	803-737-1300
TEXAS	Charles W. Heald Executive Director	125 E. 11th St. Austin, TX 78701-2483	512-305-9501
UTAH	Thomas R. Warne Executive Director	4501 S. 2700 West Salt Lake City, UT 84119	801-965-4027
VIRGINIA	Shirley J. Ybarra Secretary	1401 E. Broad St. Richmond, VA 23219	804-786-6675
WASHINGTON	Sid Morrison Secretary	310 Maple Park, Box 47300 Olympia, WA 98504-7300	360-705-7054
WISCONSIN	Charles H. Thompson Secretary	4802 Sheboygan Ave., Box 7910 Madison, WI 53707-7910	608-266-1114
WYOMING	Sleeter C. Dover Director	5300 Bishop Blvd. Cheyanne, WY 82009-3340	307-777-4484

State DOT Contacts - Tables

DOT Directors (continued)

State DOT Directors where no written compost specification currently exists

ALABAMA	G. M. Roberts Director	1409 Coliseum Blvd. Montgomery, AL 36130	334-242-6311
ARIZONA	Mary Peters Director	206 S. 17th Ave. Phoenix, AZ 85007	602-712-7227
ARKANSAS	Dan Flowers Director	PO 2261, 10324 Interstate 30 Little Rock, AR 72203	501-569-2211
HAWAII	Kazu Hayashida Director	869 Punchbowl St. Honolulu, HI 96813-5097	808-587-2150
INDIANA	Cristine Klika Commissioner	100 N. Senate Ave. Indianapolis, IN 46204	317-232-5526
KENTUCKY	James C. Codell Secretary	State Office Bldg., 501 High St. Frankfurt, KY 46022	502-564-4890
LOUISIANA	Kam Movassaghi Secretary	PO 94245 Baton Rouge, LA 70804-9245	225-379-1200
MISSISSIPPI	Kenneth I. Warren Executive Director	PO 1850, 401 North West St. Jackson, MS 39215	601-359-7002
MISSOURI	Henry Hungerbeeler Director	PO 270 Jefferson City, MO 65102	573-751-4622
NEBRASKA	John L. Craig Director	PO 94759 Lincoln, NE 68509-4759	402-479-4615
NEVADA	Tom E. Stephens Director	1263 S. Stewart St. Carson City, NV 89712	775-888-7440
NEW MEXICO	Pete Rahn Secretary	1120 Cerrilos Rd. Santa Fe, NM 87504	505-827-5110
NORTH DAKOTA	Tom Freier Director	608 E. Boulevard Ave. Bismark, ND 58505-0700	701-328-2642
OKLAHOMA	Neal McCaleb Secretary	200 NE 21st St. Oklahoma City, OK 73105	405-521-2631
RHODE ISLAND	William D. Ankner Director	State Office Bldg., 2 Capital Hill Providence, RI 02903	401-222-2481
SOUTH DAKOTA	Ron Wheeler Secretary	700 East Broadway Ave. Pierre, SD 57501-2586	605-773-3265
TENNESSEE	John Bruce Saltsman Commissioner	700 James K. Polk Bldg., 5th & Deaderick Sts. Nashville, TN 37243-0349	615-741-2848
VERMONT	Brian Searles Secretary	1333 State St. Montpelier, VT 05633	802-828-2657
WEST VIRGINIA	Samuel H. Beverage Secretary	1900 Kanawha Blvd., Bldg. 5 Charleston, WV 25305-0440	304-558-3505