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Use of Compost by Municipalities and Homeowners

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Why Compost Organics?

As urban populations continue to grow, so does the production of trash. More trash, also known as municipal solid waste (MSW), means landfills reach capacity sooner and have shorter life expectancies. To reduce the volume of MSW being sent to landfills, cities and towns have adopted methods for reduction, such as recycling. Many states and municipalities in the United States require homeowners and businesses to collect and recycle plastics, papers, and other items that used to be sent to landfills. More recently, municipalities have begun collecting food and yard waste to reduce the amount of organic MSW ending up in landfills and reducing environmental impacts.

In Wisconsin, roughly 37% of residential MSW (the trash collected from homes) is classified as organic (MSW Consultants 2010), which could potentially be diverted from the landfills and reused. The components of organic MSW that are currently landfilled that could be processed and reused include food scraps, which make up 18% of Wisconsin's residential MSW, and yard waste, which makes up 7% of Wisconsin's residential MSW (MSW Consultants 2010). Improving the diversion of organic waste could extend landfill lifetime, which would benefit communities both environmentally and economically.

Like recycling of plastics and other materials, organic wastes diverted from landfills must be processed to be reused. One common method is composting. Composting is a biological process in which microorganisms that use oxygen (aerobic microorganisms) break down organic materials, such as food scraps and yard waste, into a product called compost. Compost can then be used as a fertilizer in gardens and in green spaces around the community, among other applications.

Promoting composting in cities and towns has the potential to reduce MSW organics from reaching landfills. Currently in the United States, 52% of the organic fraction of MSW is landfilled while 36% is separated and composted (US EPA 2019), meaning there is a lot of room to redirect organic waste away from landfills. Improving use of and access to composting has the potential to significantly reduce the amount of MSW reaching landfills in Wisconsin and around the United States. Composting organic MSW has increased in recent years due to municipal compost drop-off sites and curbside pickup of household organics (Streeter and Platt 2017) that facilitate the transport of MSW organics to composting facilities (Figure 1). Further expansion of these programs has the potential to increase the rate of composting of organic MSW, extending the life of municipal landfills. Additionally, promoting home composting (Figure 2) in urban areas could reduce the amount of MSW organics reaching landfills and lessen environmental impacts related to transportation (Oliveira et al. 2017). The Wisconsin Department of Natural Resources (WDNR) and University of Wisconsin–Madison Division of Extension provide excellent resources that help homeowners and residents set up and manage at-home composting systems (see additional resources on the back page of this document).

Scott Sanford

Figure 1. Aeration of compost at a large-scale composting site.

Alison Mahoney

Figure 2. Home composting bins are commercially available, such as the bin featured above, or constructed on-site using readily available building materials.

Using Compost in Urban Environments

While composting has many benefits, one current issue for cities and towns looking to expand composting programs is encouraging community use of the finished compost product. Adding compost to soil has a variety of benefits including improving soil health and providing plant essential nutrients. There are multiple beneficial uses for compost in urban landscapes that can result in improved soil health, stormwater management, and runoff water quality. Some areas where compost can be used in cities and towns include green spaces, rain gardens, and green roofs.

Residential and Municipal Green Space

Impervious surfaces (such as pavement and roofs) restrict water from moving naturally into the soil, which can increase runoff from rain or snowmelt and result in flooding. Establishing more green spaces or infiltration areas, such as rain gardens, natural areas, or properly managed lawns, can increase the movement of rainwater into the soil rather than result in runoff. Decreasing runoff can reduce issues with flooding, as well as erosion and contaminant movement.

Although green space improves movement of water into the soil, soil compaction, which is common in urban areas, can limit infiltration. Compaction occurs when soil particles become more tightly packed together (Figure 3), decreasing the available space between soil particles for air or water movement. Compaction reduces the total amount of water that can move into the soil as well as the speed at which water infiltrates, ultimately increasing runoff during rainfall events. Additionally, compaction can limit plant root growth and productivity, exacerbating infiltration and erosion issues. Using compost in combination with soil aeration or other compaction alleviation strategies can increase soil pore space, thereby improving water infiltration and reducing flooding.

There are two general methods for applying compost to green spaces: surface blanket and incorporation. Surface blanket application is where compost is applied in a single layer (typically 2–3 inches) on the soil surface accompanied by seeding of grass or other vegetation. Surface application can provide erosion control benefits for exposed soils similar to that of straw mats. However, surface blanket application of compost does not reduce soil compaction, as it is just applied on top of the soil (Loper et al. 2010; Logsdon et al. 2017).

Incorporation, or mixing the compost with the soil, involves spreading the compost over the soil (typically a 2-inch depth) and then mixing it into the soil (typically 6–8 inches deep) with tillage equipment. By mixing compost into the soil, soil health can be greatly enhanced. Over the long term, compost additions result in improved soil structure by providing the necessary organic matter to soil microbes for aggregating soil particles, or combining sand, silt, and clay particles to make larger particles known as aggregates. Soil aggregation reduces compaction by increasing the amount and size of pores between soil aggregates, improving air and water movement. Changes to soil compaction and porosity from compost additions allow water to move into the soil faster and increase the amount of water the soil can retain. This is an improvement to using tillage or aeration of soil on its own, as the compost can increase soil aggregate stability, potentially resulting in improved soil trafficability and long-term benefits (Badalíková and Bartlová 2014). Additionally, mixing compost into the soil with tillage has been shown to increase stormwater infiltration and reduce runoff volume and movement of sediment and nutrients from green spaces (Mohammadshirazi et al. 2016; Logsdon et al. 2017). Studies have shown mixing 2 inches of organic MSW compost into the soil (2–10 inches deep) can reduce runoff volumes between 50% to 85% and sediment loss between 60% to 91% (Olson et al. 2013; Mohammadshirazi et al. 2016; Logsdon et al. 2017).

Compost application can also help with establishing vegetation, which can further reduce runoff and pollutant transport. Vegetation on the surface of soil reduces the flow velocity of runoff, which decreases the risk of soil sediment being carried offsite. When soils are compacted, establishing plants can be difficult as plant roots cannot penetrate the compacted soil structure. Adding compost can increase vegetation growth by improving soil structure but also by providing plants essential nutrients. Evanylo et al. (2016) measured increased plant growth over time when compost was added to green spaces as compared to those spaces managed with traditional fertilizers. Soil nutrient testing indicated a slower release of nutrients over the growing season from compost as compared to the fertilizer additions. The slow release of nutrients combined with increased water holding capacity were responsible for the increased plant growth over time. Slow release of nutrients can also reduce nutrient losses from runoff because nutrients are released slowly as the plant grows, increasing nutrient plant uptake.

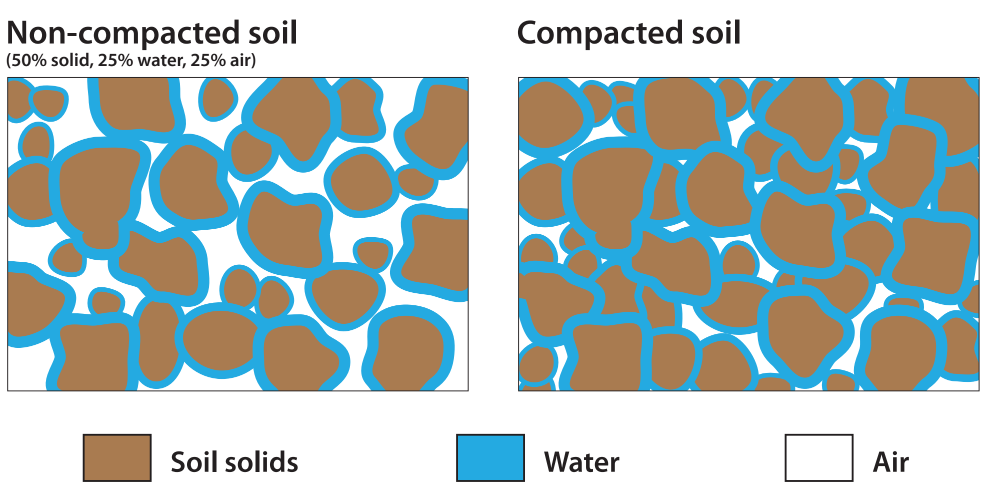

Figure 3. Comparison of non-compacted soil and compacted soil.

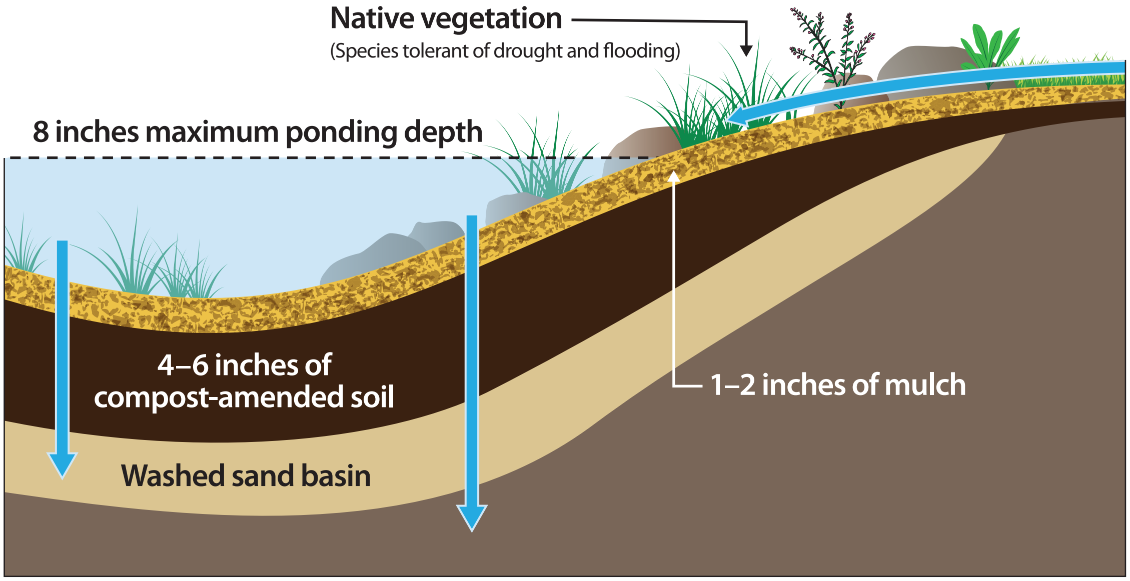

Figure 4. Cross-section of rain garden (adapted from WDNR 2018).

Rain Gardens

Rain gardens are becoming popular in the United States not only for their aesthetic appeal but also as tools to help manage stormwater. Rain gardens are engineered systems designed to capture and filter runoff from impervious surfaces, such as roofs or parking lots. These systems can be small, such as those implemented at residential homes, or large, such as those installed in parking lots. To promote water movement into the soil, rain gardens have multiple mulch and soil layers (Figure 4). Typically, the layers, known collectively as the soil system, include 20%–30% compost to increase infiltration, improve water holding capacity, and provide essential nutrients for plant growth (Peterson 2008). The WDNR has developed a detailed guide for development of rain gardens in Wisconsin (see WDNR 2018) and recommends applying a 2-inch compost layer over the soil and tilling it to a depth of 4 to 6 inches to improve infiltration into clay soils or to improve water retention in sandy soils.

Green Roofs

Like rain gardens, green roofs can reduce stormwater runoff. Traditional asphalt or metal roofs, which are impervious surfaces, result in runoff as they collect and discharge water, often via gutter systems, and may contain chemicals that can cause water contamination. Green roofs allow for rainfall to be captured in a soil system containing plants, providing both stormwater management and aesthetic benefits (Figure 5). Depending on the amount of annual precipitation in an area, green roofs on buildings can capture up to 50% of precipitation, significantly reducing stormwater runoff (Morgan et al. 2013). The soil medium used on green roofs is typically made up of soil, lightweight aggregates, and 5% to 10% compost to meet specifications of weight, porosity, and stability (Ampim et al. 2010; Sherman 2005). It is important to note that buildings with green roofs require special engineering to hold the additional weight of the materials and to avoid issues with the additional moisture; green roofs cannot be added to roofs that were not designed for this purpose.

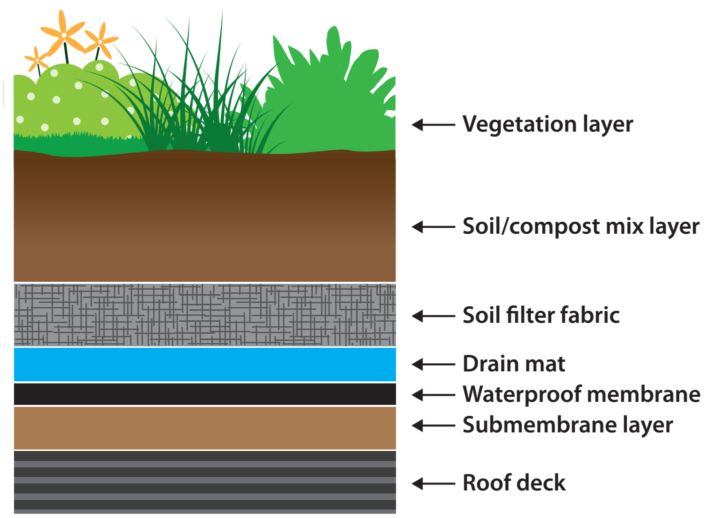

Figure 5. Cross-section of a green roof (adapted from US Composting Council 2008).

Summary

The organic fraction of MSW can be composted to reduce the volume of waste sent to landfills. To encourage the separation, collection, and composting of the organic fraction of MSW, application of urban compost needs to be further developed and implemented in urban areas. Potential applications of compost include establishing green spaces, urban tree planting, rain gardens, and green roofs. All of these applications not only improve the recycling of organic MSW, but they also all have documented benefits for stormwater management.

Additional Resources

Do-It-Yourself Compost Bin Series

https://learningstore.extension.wisc.edu/collections/urban-community-gardens

Home Composting: Reap a Heap of Benefits

https://dnr.wisconsin.gov/topic/Recycling/compost.html

Rain Gardens: A Guide for Homeowners and Landscapers

https://dnr.wisconsin.gov/topic/Stormwater/raingarden

References

Ampim, P., J.J. Sloan, R.I. Cabrera, D.A. Harp, and F.H. Jaber. 2010. "Green Roof Growing Substrates: Types, Ingredients, Composition and Properties." *Journal of Environmental Horticulture* 28(4): 244–252. doi: 10.24266/0738-2898-28.4.244

Badalíková, B., and J. Bartlová. 2014. "Effect of Various Compost Doses on the Soil Infiltration Capacity." *Acta Universitas Agriculturae et Silviculturae Mendelianae Brunensis* 62(5): 849–858. doi: 10.11118/actaun201462050849.

Evanylo, G.K., S.N. Porta, J. Li, D. Shan, J.M. Goatley, and R. McGuire. 2016. "Compost Practices for Improving Soil Properties and Turfgrass Establishment and Quality on a Disturbed Urban Soil." *Compost Science and Utilization* 24(2): 136–145. doi: 10.1080/1065657X.2015.1096866.

Logsdon, S.D., P.A. Sauer, and M.J. Shipitalo. 2017. "Compost Improves Urban Soil and Water Quality." *Journal of Water Resources and Protection* 09(04): 345–357. doi: 10.4236/jwarp.2017.94023.

Loper, S., A.L. Shober, C. Wiese, G.C. Denny, C.D. Stanley, and E.F. Gilman. 2010. "Organic Soil Amendment and Tillage Affect Soil Quality and Plant Performance in Simulated Residential Landscapes." *HortScience* 45(10): 1522–1528. doi: 10.21273/hortsci.45.10.1522

Mohammadshirazi, F., V.K. Brown, J.L. Heitman, and R.A. McLaughlin. 2016. "Effects of Tillage and Compost Amendment on Infiltration in Compacted Soils." *Journal of Soil and Water Conservation* 71(6): 443–449. doi: 10.2489/jswc.71.6.443.

Morgan, S., S. Celik, and W. Retzlaff. 2013. "Green Roof Storm-Water Runoff Quantity and Quality." *Journal of Environmental Engineering (United States),* 139(4): 471–478. doi: 10.1061/(ASCE)EE.1943-7870.0000589

MSW Consultants. 2010. 2009 *Wisconsin State-Wide Waste Characterization Study.*

Oliveira, L.S.B.L., D.S.B.L. Oliveira, B.S. Bezerra, B.S. Pereira, and R.A.G. Battistelle. 2017. "Environmental Analysis of Organic Waste Treatment Focusing on Composting Scenarios." *Journal of Cleaner Production,* 155: 229–237. doi: 10.1016/j.jclepro.2016.08.093

Olson, N.C., J.S. Gulliver, J.L. Nieber, and M. Kayhanian. 2013. "Remediation to Improve Infiltration into Compact Soils." *Journal of Environmental Management* 117: 85–95. doi: 10.1016/j.jenvman.2012.10.057.

Peterson, W. (Editor). 2008. *Rain Gardens: Iowa Rain Garden Design and Installation Manual.*

Sherman, R. 2005. "Compost Plays Key Role in Green Roof Mixes." *BioCycle* 46(3): 29.

Streeter, V., and B. Platt. 2017. "Residential Food Waste Collection Access in the U.S." *BioCycle* December 2017.

US Compost Council. 2008. *Using Compost in Stormwater Management.*

US EPA. 2019. *Advancing Sustainable Materials Management: 2017 Fact Sheet.*

Wisconsin Department of Natural Resources (WDNR). 2018. *Rain Gardens: A Guide for Homeowners and Landscapers.* Retrieved from https://dnr.wi.gov/topic/Stormwater/documents/RainGardenManual.pdf

Wisconsin Department of Natural Resources (WDNR). 2017. *Home Composting: Reap a Heap of Benefits.* Retrieved from https://dnr.wi.gov/topic/Recycling/use.html

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