The Science Behind Green and Conventional Burial

Excerpt on Soil and Water

Soil

The two greatest concerns regarding green burial are around soil and water contamination. The two are intrinsically intertwined, both in their ability to encourage natural decomposition and to inhibit it. Site selection is almost entirely dependent upon both the presence of optimum soil and the location of water sources. This section is devoted to exploring how soil affects the location and operation of green burial cemeteries, not the other way around.

Specific characteristics of soil affect its ability to act as a filter for natural body waste or any product buried within it. These include biodegradable materials in green cemeteries as well as heavy metals and wood finishes that may leach from coffins and urns, and chemicals and byproducts from concrete vaults in conventional cemeteries.

Optimum soil conditions include sandy, loamy soils, with permeability coefficients of more than 10^{-3} m/s. Soils that are waterlogged and impervious, such as clay, impede decomposition and redirect water in ways that may not be conducive to cemetery health or efficient decomposition. Additionally, clay and organic matter may bind decomposition byproducts, slowing decay and creating an anaerobic situation.

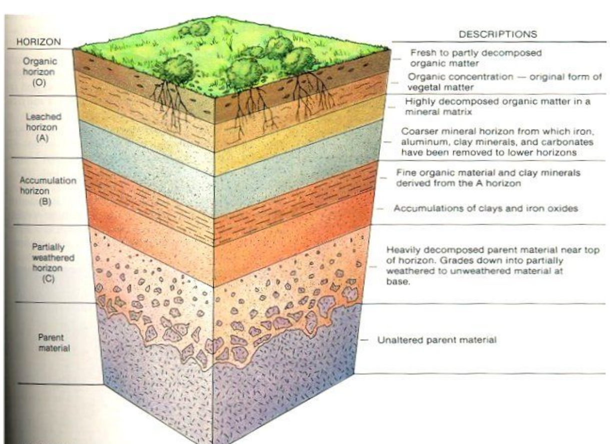

FIGURE 9–11
Cross section of a soil in the northeastern U.S. showing horizons.

Decomposition of organic matter in soils is accomplished largely by microorganisms. The rate and course of decomposition is influenced by climate, organic matter composition, and nutrient availability from the environment. Over 90% of the microbial activity in soil is in the upper foot; most plant roots are also quite shallow. Shallow burial is aerobic, accommodating rapid decomposition due to warmer temperatures in the summer.

Rather than being an inert material, soil contains a dynamic living ecosystem. This organic soil is thought to actually have the most bio-diverse ecosystems; only about 1 % of the organisms have been identified. One cup of undisturbed native organic soil may contain:

Organism	Number
Bacteria	200 billion
Protozoa	20 million
Fungi	100,000 meters
Nematodes	100,000
Arthropods	50,000

Humus, or the top organic soil layer improves soil structure by binding particles together into larger aggregates, creating pore space and improving air and water filtration. It also slowly releases nitrogen, phosphorus, and sulfur which over time is used by plants for growth and development. Humus buffers soil pH and can bind metals in soil, preventing heavy metal toxicities.

These unique and important qualities on the top organic soil layer highlight the importance of carefully removing soil strata when digging the grave and replacing it in the order it was removed.

Due diligence in choosing a site with appropriate soil is key. Soils maps ensure that a site is viable. Town or city engineers are resource personnel who can provide and help interpret local and US government soil overlay maps. Digging test pits and having them professionally analyzed prior to initiating cemetery status is advised.

It should also be noted that certain infectious agents survive in the soil such as hepatitis C survive in the soil, but are less infectious than when carried by a live person. Anthrax and botulism are endemic in most soils. There is no evidence for travel of these biologic agents in soils.

Other considerations are equally important criteria for ideal soil for green burial, including amount of organic matter present, alkalinity, salt levels, texture of the soil (large and loose to dense and impermeable), depth to bedrock, slope, presence of fractured or cavernous bedrock, and more.

Water

"There is little evidence of microbiological contamination of groundwater from burial…Microorganisms involved in the decay process (putrefaction) are not pathogenic." —PAHO

The potential for contamination of drinking water due to body decomposition, though possible and frankly expected if best management practices are not followed, is not definitively substantiated by studies at this time. Areas adjacent to conventional cemeteries, especially historical cemeteries, have been reported to have elevated results when core soil and water specimens were tested for contaminants in a handful of cases.

But there is no evidence that these findings are attributable to body decomposition processes. Due to the types of contaminants found, it is highly likely that the problems were caused by leachate from casket, vault, or embalming fluid or other incidental materials. No contamination has been reported from or near any green cemeteries in the US, Canada, Great Britain or Australia since their inception in 2003.

In areas near cemeteries where ground water has been found to have elevated organic compounds such as dissolved organic carbon concentrations, there has been discoloration, unpleasant odor, and changes in taste when chlorinated, but these compounds are not harmful in and of themselves.

Arsenic is still being found in water near cemeteries where Civil War soldiers who were embalmed and transported were buried. This finding, unfortunately, does not help us understand the contaminant properties of bodies on water sources below the grave separate from the casket, vault, and embalming leachate, either then or now.

In 1998, the World Health Organization published recommended guidelines for burying disaster victims in relation to water sources, suggesting that humans and animals be buried at least 250 meters from any well, borehole, or spring from which potable water supply is drawn, 30 meters away from any other spring or watercourse, and at least 10 meters from any field drain. While helpful in a disaster scenario, these figures are not particularly useful for determining water safety in a variety of potential green burial sites in the US.

Many states provide setback parameters for water, buildings and roads for home burial that may give some guidance for best practices in green cemeteries. Each region has unique conditions that must be taken into account.

When attempting to determine cemetery impact on water, it is important to acknowledge the differences between acceptable levels of nutrients and minerals in aquifers, lakes, streams, and rivers, and the levels that are considered polluting, contaminating, or toxic in each specific context.

This guide was prepared by Lee Webster for the GBC with assistance from Carl Anderson, M.S.; Kirsten Bass, MD, PhD; John Meagher, Executive Director, RESET; Lindsay Soyer, licensed FD; Merilynne Rush; and Steven Whitman, M.A., AIC. For the complete downloadable version, go to www.nhfuneral.org>GreenBurial