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GREEN REMEDIATION

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The notion that cleaning up contaminated property should be a net benefit to the environment seems obvious. From the earliest days of Superfund, many realized that in some cases the cure could be more dangerous than the disease. It made little sense to make a community endure massive numbers of heavy trucks sharing the road for years with school buses and carpools to "remediate" an old landfill by digging it up and hauling it to another community.

In protecting human health and the environment, we should try to optimize our use of resources to balance protection with resource conservation—we should seek to reduce the "environmental footprint" of remedial actions while continuing to be protective.

Over the last ten years or so, the concept of "green remediation" has grown. In 2006, the National Society of Professional Engineers added a new section to its code of ethics; it states that engineers must "strive to adhere to the principles of sustainable development in order to protect the environment for future generations." In 2008, the Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response (OSWER) published a technology primer titled *Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites* (Apr. 2008). The Interstate Technology & Regulatory Council (ITRC) expanded the concept to cleanups generally with its 2011 technical guidance, *Green and Sustainable Remediation: A Practical Framework.*

EPA focuses on five core elements of a green cleanup:

1. Minimize total energy use and maximize use of renewable energy;
2. Minimize air pollutants and greenhouse gas emissions;

3. Minimize water use and impacts to water resources;
4. Reduce, reuse, and recycle material and waste; and
5. Protect land and ecosystems.

EPA's Green Remediation Focus website (http://www.clu-in.org/greenremediation/tab_d.cfm) includes 31 case studies illustrating how the core elements were considered at specific remediation sites. There are some common approaches reflected in the case studies:

- Unpowered technologies (e.g., passive treatment systems such as limestone filters for drainage) and solar-powered technologies are used where feasible.
- Natural processes (e.g., phytoremediation or enhanced natural attenuation) can be both sustainable and protective.
- Minimize unnecessary site disturbance, keep earthwork (cut and fill) in balance, and/or use the same trucks to transport waste from the site and to transport clean backfill from off-site.
- Instead of buying new remediation equipment such as carbon filters or air strippers, re-use equipment from other sites.
- Recover materials from deconstruction for use on-site or elsewhere (e.g., crush concrete from old site structures for use as aggregate).

These sorts of techniques have been used at hundreds of remediation sites. For example, the former Telegraph Road landfill in northern Virginia is enrolled in Virginia's Voluntary Remediation Program (VRP). The landfill operated between 1977 and 1984, with waste covering about 60 acres to a depth of 50 feet. The site is located near Fort Belvoir, a rapidly growing military installation 15 miles south of the Pentagon. Given the proximity of the existing road network and utility infrastructure, and the demand for office and light industrial space in the corridor, redevelopment of the landfill would be smart growth.

However, there were several challenges to successful redevelopment of the site. A large landfill gas extraction system had been operating since the 1980s along one side of the landfill to control gas migration. But 20 years after the site closed, the rate of landfill gas generation was much smaller, and as a result, the gas extraction system only operated one or two days per week and used more supplemental propane fuel than landfill gas. The gas extraction system was replaced with a smaller gas migration control system consisting of vent wells equipped with solar-powered blowers to vent the small amounts of gas generated at the site.

Construction of buildings and storm water retention tanks atop the closed landfill produced significant amounts of excavated material. Removing thousands of cubic yards of excavated material to a licensed landfill would have required hundreds of trucks to haul material down the highway. Greenhouse gas emissions alone would have been over 50 tons, not to mention the costs of wear and tear on roads and bridges, safety, other air pollutants, etc.

Fortunately, Virginia law allows its Department of Environmental Quality (VDEQ) to designate remediation waste management units (RWMUs) within contiguous areas of contamination at VRP sites. A RWMU is an area of the site where excavated wastes can be visually screened and placed without the need for a formal solid waste disposal permit. Each RWMU is covered with an engineered cap when it reaches capacity. Three such units were constructed at the Telegraph Road landfill under VDEQ oversight. EPA's area of contamination policy, first announced in the preamble to the 1992 amendments to the Superfund National Contingency Plan, provides the federal framework for on-site management of remediation wastes (e.g., RWMUs), so long as the state concurs with the approach. Today, the former Telegraph Road landfill is the site of a 115,000-square-foot FedEx Ground distribution center, with space on the site for additional office or light industrial buildings.

The Route 66 creosote pit site in Flagstaff, Arizona, provides another example of the application of green remediation principles to reduce the environmental footprint of a remediation project. For more than 100 years, the site had been used for various industrial uses—railroad yard, electric power plant, and laundry—and the creosote pit, once used to treat railroad ties and power poles, required cleanup before the property could be redeveloped.

Soil contaminated with creosote from wood-preserving operations can be considered a listed hazardous waste, and for the Route 66 creosote pit to dispose of excavated soils as a hazardous waste would have been expensive and required each truck to travel 80 miles (160 miles round-trip) to deliver the excavated material to a hazardous waste facility. A better approach was to work with the Arizona Department of Environmental Quality and EPA to determine that the waste did not require management as a hazardous waste (a so-called contained-out determination), thus allowing excavated material to be disposed of in a nearby non-hazardous waste landfill about 12 miles away (25 miles round trip). An added bonus was that the nearby landfill was close to a source of soil that could be used to backfill the excavation, thus further reducing the truck mileage needed to complete the job (after depositing contaminated soil at the landfill and cleaning the beds, trucks could pick up clean soil on their way back to the creosote pit).

Optimizing truck traffic saved over 1000 gallons of diesel fuel and ten tons of greenhouse gas emissions. Other green elements of the Route 66 creosote pit cleanup included using 10,000 gallons of reclaimed water instead of potable water for dust control, converting a tree that had to be removed into mulch for site restoration, and using native species to revegetate the site.

Today the Route 66 creosote pit site is a bus transfer facility, the first step in a planned redevelopment of this part of the south side of Flagstaff and the Flagstaff Urban Trail.

Green remediation makes good sense. In addition to using fewer resources, green remediation measures attract positive community interest—neighbors and government officials alike take pride in projects that employ sound environmental stewardship while cleaning up the environment for future generations.

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