



U.S. Environmental Protection Agency
Superfund Redevelopment Initiative

REUSE OPPORTUNITIES AT CAPPED
SUPERFUND
SITES

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ormer landfills, abandoned hazardous waste dumps and other contaminated properties throughout the United States are now home to renewable energy facilities, shopping centers, homes, parks and wildlife habitat. These areas, once thought to be of limited or no value, are increasingly recognized as infill resources that can provide much-needed services for communities.

EPA has developed several detailed technical reports – available on the [Superfund Redevelopment website](#) – focused on the reuse of sites where the remedy calls for on-site containment of contaminated material.

To further assist communities interested in pursuing reuse opportunities at these sites, this report discusses leading examples of capped-area reuses across the country, highlighting recent trends and key factors and considerations that make these uses possible.





WHAT IS CAPPING?

Capping involves placing a cover over contaminated material such as landfill waste or contaminated soil. Caps do not destroy or remove contaminants but they can perform functions such as keeping contaminants in place. Caps reduce the amount of rainwater or snowmelt seeping through the material below, which could carry contaminants into groundwater. Caps can prevent erosion, prevent the wind from spreading contamination, prevent stormwater runoff from distributing contaminated materials, and even control the release of harmful gases.

The capping design for a site depends on several factors, including the types and concentrations of contaminants, the size of the site, the amount of rainfall the area receives, and the future use of the property. Construction of a cap can range from placing a single layer of a material over lightly contaminated soil to using several layers of different materials to isolate more highly contaminated wastes.

Some examples of types of caps are an asphalt, concrete or compacted clay cover, a vegetative cover with plants and soil, a drainage layer that is usually composed of sand and gravel and which may contain slotted pipes, a geomembrane cover or strong plastic-like material. Sites can use just one of these types of caps or several of them, depending on what is required by the remedy.

SUPERFUND REDEVELOPMENT

EPA works with communities nationwide to safely return Superfund sites to productive use. Each day, EPA's Superfund program focuses on making sure people can live and work in vibrant, healthy places.

Today, more than 800 cleaned-up Superfund sites have been returned to productive use, or have reuses planned for them. These areas are seeing new life as places of recreation, commerce, alternative and renewable energy development, ecological habitat, housing and agriculture. More than 70,000 jobs at these sites have resulted in more than \$4.9 billion in annual employment income.

FOR MORE INFORMATION, PLEASE VISIT
www.epa.gov/superfund-redevelopment-initiative



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OWERING THE FUTURE: RENEWABLE ENERGY

New technologies have made it easier to place solar energy facilities on top of capped areas. Recent projects at sites in Indiana and Massachusetts show these technologies in action.



REILLY TAR & CHEMICAL INDIANAPOLIS, INDIANA

Maywood Solar Farm is built on top of a former landfill at an old industrial property. The 10.8-megawatt facility includes over 36,000 ground-mounted, fixed-tilt solar panels.

Technological advances in panel mounting and framing systems made the project possible; the facility's solar panel systems have minimal impact on the integrity of landfill covers and avoid placement of undue weight on landfilled areas. Project developers used a driven pile-based solar module mounting system rather than the concrete ballast system commonly used at landfills.

The driven pile system provides stability for the solar panels and framing while avoiding soil excavation or adding weight. The only excavations were for utility poles to transfer power off site to the electrical grid. In total, soil movement was reduced by an estimated 93 percent over conventional solar construction methods.

In total, contractors installed several thousand piles. In the few places where piles could not be driven to proper depth to achieve engineering goals, the design used poured-form ballast-support systems, enabled by the selected adaptive racking system. The project also

EPA AND RENEWABLES

EPA places a high priority on the development of renewable energy and green remediation projects as part of addressing formerly contaminated properties. Through efforts such as the Superfund Redevelopment and RE-Powering America's Land initiatives, EPA works to identify Superfund, Brownfield and mining sites with renewable energy.

EPA provides technical resources for site managers, developers, energy managers and other stakeholders interested in using renewable energy resources at these sites. Please see the Resources section of the report for more information.

THIS PAGE LEFT TO RIGHT Pile installation; mounting rack installation; and Maywood Solar Farm today.



included an innovative wire management approach; use of aboveground cable trays enabled the project to avoid digging trenches between each row of panels and burying wire below ground. These design choices helped minimize soil cover disruption during construction.

Project Nuts and Bolts

- 43-acre project
- 4,549 piles
- 1,400 solar panel racking tables
- 36,556 polycrystalline, fixed-tilt solar panels
- Eight inverters

Project Outcomes

Electricity from Maywood Solar Farm will help reduce carbon dioxide-equivalent emissions by an estimated 13,235 metric tons per year – equal to the amount of annual carbon produced for energy use in more than 1,800 homes. The total cost of the project was about \$30 million. Of that amount, about \$4 to \$6 million was invested in the local economy in the form of labor, construction costs and materials.

SULLIVAN'S LEDGE NEW BEDFORD, MASSACHUSETTS

At the Sullivan's Ledge site, utility SunEdison used an aboveground system mounted on concrete pads rather than the in-ground ballast system commonly used at landfills. The concrete pads provide stability for the solar panels and framing while avoiding soil excavation, and allow the landfill cap to remain undisturbed.

Project work plans included detailed engineering drawings, an operations and maintenance plan, and an evaluation report by a licensed professional stating that a solar facility would not negatively impact the landfill cap. The documents had extensive requirements, including limitations on vehicle traffic on the cap and limitations on damage to the ground surface. The requirements were highly detailed. The tire pressure of work vehicles, for example, had to be below a certain pressure.

BOTH PAGES LEFT TO RIGHT Panel mounting system consists of panels and ballast blocks mounted to concrete pads; spacing between the panels allows for cap maintenance; installed solar panels at Sullivan's Ledge.



Design plans called for photovoltaic (PV) modules mounted on aboveground racks. Each rack would be stabilized by concrete ballast blocks with low bearing pressure to avoid damaging the cap. The panels would be connected by cables above and below ground. The design also called for a temporary access road across the cap during installation. Access to gas recovery and monitoring wells remained unobstructed. Plans also addressed any possible erosion of the cap and made sure panels were adequately spaced to allow for maintenance activities.

Project Nuts and Bolts

- 5,490 PV modules installed on 1,220 concrete ballast blocks.
- Rack and ballast block sizes made smaller (1,500 to 2,550 pounds instead of 4,000 pounds) to reduce potential for settlement and associated impacts on underlying cap layers.

- Type of rack changed so fewer concrete ballasts needed.
- Any trenches where excavation would exceed 18 inches required hand-excavated test pits in advance.
- Excavation could not exceed 24 inches below grade.

Project Outcomes

The 12-acre utility-scale solar facility has been operating at capacity since 2014. It produces about 2.4 million kilowatt hours of electricity annually. Today, the 1.8-megawatt facility is a leading example of how Superfund sites with capped areas can support renewable energy development.

“EPA’s role was to help facilitate the project, while making sure the remedy remained protective. The cap had to be in the same condition after installation as it was before.”

~ EPA site attorney Ruthann Sherman

G OING GREEN: NATURAL AREAS, WILDLIFE HABITAT, POLLINATORS

Capped areas support restored natural areas that are home to diverse plants and wildlife, including pollinators. This process – ecological revitalization – returns land from a contaminated state to one that supports functioning and sustainable habitat. It provides remarkable benefits – improving soil health, supporting diverse vegetation, sequestering carbon, and protecting surface water and groundwater – in addition to providing habitat and recreation opportunities.





LANDIA CHEMICAL COMPANY

LAKELAND, FLORIDA

Cleanup of this former pesticide and fertilizer facility included a clay cover. Excavated areas were filled with crushed limestone to reduce soil and groundwater acidity. The clay cover placed over these areas supports the soil remedy, minimizes contaminant movement, and provides space for native plants and trees to thrive. As the trees mature, they will remove contaminants and reduce stormwater infiltration.

Project Outcomes

The site is now home to over 1,000 plants, including 30 varieties of grasses, sagebrush, maple trees, slash pines and poplar trees. Native seed mixes provide a groundcover of wildflowers, grasses and shrubs, many of which can grow in shallow water and swamp-like conditions and attract bees, wasps, butterflies and birds. The mixes also include swamp milkweed, a host plant that provides food for monarch butterflies. The project also plays an important broader role, increasing connectivity of the area's ecological corridors, which provide vital habitat for migrating birds and pollinators.

THIS PAGE The remedy at the Landia Chemical Company site provides space and opportunity for habitat restoration.

POLLINATORS 101

A pollinator is an insect or animal that moves pollen within or to another flower, fertilizing the plant. There are about 200,000 species of pollinators, including bees, butterflies, wasps, beetles, birds and bats.

Many types of plants, including vegetable and fruit crops, require pollination to bear fruit. Recent declines in pollinator populations – and bees in particular – have raised concerns about the future of food supplies worldwide.

Pollinators – most often honey bees – are responsible for one in every three bites of food you take, and increase our nation's crop values each year by more than 15 billion dollars.



BUNKER HILL NORTHERN IDAHO

At some sites, caps are an active part of the reuse as well as the remedy, containing contamination and making ecological restoration possible. West Page Swamp, for example, was once a tailings repository for a mill that processed zinc and lead ore. Soil material included highly contaminated lead and zinc tailings, materials so toxic that the swamp showed no evidence of ecosystem function at all.

A wetland restoration project placed a cap of biosolids – including compost, wood ash and wood waste – over the soil. This cap reduced the accessibility and bioavailability of the underlying tailings and provided nutrients for plant growth, helping to restore ecosystem function.

Project Nuts and Bolts

- Tailings in the area were removed to a depth of 0.7 meters.
- Outlet end of the wetland closed to maintain a water depth of 2 feet.
- Cap movement and settling monitored at 12 and 24 months.
- Effluent quality (suspended solids, pH, species, and water quality) monitored monthly.
- Plant establishment and their uptake of metals also monitored.

Project Outcomes

The wetland is now fully functioning and provides 11 acres of wildlife habitat.

KEY CONSIDERATIONS

Any site—including a capped site—has the potential for ecological revitalization, regardless of size or location. While a variety of habitats can be considered for ecological revitalization, matching the habitat in the surrounding area will have the greatest chance of success.

Ecological revitalization can be managed for a variety of habitats such as meadow, prairie, riparian buffers and forest, and for wildlife such as nongame species, birds, and migratory butterflies.

If a cap is properly designed, roots of native species will not compromise the cap. Roots, including taproots, grow laterally once they reach a cap. Research has found no significant damage to a cap as a result.

BRIEF SITE HIGHLIGHT

At the E.I. DuPont De Nemours & Co., Inc. site in Newport, Delaware, landfill areas have been cleaned up and now support a solar farm and pollinator meadows.



PHOTOS TOP TO BOTTOM Solar array and pollinator habitat at the E.I. DuPont De Nemours & Co., Inc. site in northern Delaware.
OPPOSITE PAGE LEFT TO RIGHT The West Page Swamp before restoration; during initial tilling activities; and view of the reestablished wetlands following restoration.



BEST PRACTICES FOR CAPPED SITES

General

Buildings and utilities

Consider where building sites and utilities (e.g., electrical lines) will need to be placed. Create clean utility corridors and clean building sites to avoid having to disturb the cap.

Cover penetrations

- a) Determine the types of structures needed for the planned reuse (e.g., light poles).
- b) Determine whether and where cover penetrations will be allowed or should be avoided.
- c) Take steps to prevent breaches of the cover system (e.g., visible warning layers, biota barriers, One Call excavation notification systems).

Gas management

Design buildings to prevent vapor intrusion.

Monitoring wells, gas vents and other aboveground infrastructure

Locate in places that will not interfere with the planned reuse.

Institutional controls

Make sure all necessary land use controls are in place (e.g., to restrict excavation, to restrict construction in areas with vapor intrusion concerns).

Landfill-Specific

Geotechnical engineering assessments

Determine how the landfill closure process can support intended reuses.

Settlement/subsidence

Conduct a geotechnical evaluation to look at whether expected settlement will affect planned reuses. Various steps can be taken to handle expected settlement. Special design techniques may be required to reduce settlement impacts and long-term maintenance costs.

Capped areas are often part of complex systems. Detailed planning and analysis is needed to make sure reuses and remedies are compatible.



Stormwater runoff

Site capping can significantly increase runoff and the need for stormwater controls. Surface drainage must be directed away from steep slopes or collected. To avoid underground piping, which may cause problems with gas collection and settlement, storm drainage should be handled, where possible, on the surface with swales and open channels.

Surface slope

Consider the slope required by environmental regulators for proper drainage and the slope needed for the planned reuse.

Side slopes

Consider and vary the degree of slope where possible to give a natural appearance. Benched slopes provide an opportunity for pathways and drainage controls.

Buildings and utilities

Include special design approaches for structures and utility services on landfills. Utilities can be placed in trenches and wrapped with geotextile to minimize settlement damage. Structures should be lightweight with spread footings and include methane venting and monitoring systems. Geotextile use under pavements can reduce pavement maintenance.

KEY SOLAR DESIGN CONSIDERATIONS FOR LANDFILL SITES

- Cover characteristics/weight limitations
- Landfill cover penetration restrictions
- Vegetative cover management/mitigating erosion impacts
- Anchoring system selection and design
- Construction and solar system weight considerations
- Snow/wind loading requirements
- Compatibility with institutional controls
- On-site utility requirements

BRIEF SITE HIGHLIGHTS

At the Brick Township Landfill in central New Jersey, the site's 24,000 solar panels are mounted on ballasted skids, avoiding the need for posts penetrating the cap. The cap's grade was designed for increased southern exposure to increase the amount of solar energy reaching the panels.



At the Kentwood Landfill in Kentwood, Michigan, EPA staff worked with local and state officials to enable the municipal reuse of part of this 72-acre site for materials storage. Through a coordinated team effort, the locality was able to locate the storage area on the site's landfill cap while ensuring the protectiveness of the remedy. The project also made possible the construction of a new public library next to the landfill.



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GETTING OUTSIDE: PARKS AND RECREATION

Capped sites are often well suited for recreation facilities. The on-site containment of wastes often requires vegetated cover systems that, with minor modifications, are highly compatible with a wide variety of recreational uses.





LEXINGTON COUNTY LANDFILL AREA COLUMBIA, SOUTH CAROLINA

At this former municipal landfill, the community led an innovative cleanup effort and returned the site to recreational use. Lexington County covered the area with a geosynthetic clay liner (GCL) followed by a layer of tire chips, a fabric filter and 18 inches of soil to support a vegetative cover. The County’s public works employees put the cap in place. While this approach added time to the construction schedule, it resulted in significant cost savings.

Project Nuts and Bolts

- Cap components (from bottom to top): 12-inch intermediate cover and base (the GCL), 6-inch layer of tire chips, geotextile filter fabric, and 12 to 18 inches of soil for vegetative support. GCL panels installed with minimum panel overlap of 6 inches; seams sealed with bentonite powder.
- To lower costs, the County used more than 30,000 cubic yards of recycled tires in the drainage layer of the cap. The tire-chip layer

relieves pressure on the GCL; its weight (33 pounds per cubic foot) was significantly less than sand or stone. Tire chips are also significantly cheaper than sand or stone.

- Cap design included stormwater management features – a landfill cap berm and downchutes to carry stormwater down landfill side slopes and away from the cap.
- GCL tied to downchutes around the perimeter of the flat-top portion of the cap. The down chutes were also lined with the GCL.

Project Outcomes

The local government collaborated with site agencies and the University of South Carolina to redevelop the northern part of the site into “the Coop,” a 9-acre golf practice facility for the university’s golf teams. The site’s irrigation system uses treated ground water to help maintain grasses and the golf facilities. The locality also located a recycling center on site.

THIS PAGE Views of “the Coop,” the University of South Carolina’s 9-acre golf practice facility.



DAVIE LANDFILL BROWARD COUNTY, FLORIDA

After Broward County closed this landfill – known locally as “Mount Trashmore” – it coordinated the cleanup with installation of extensive park infrastructure, including roads, stormwater drainage and landscaping. Landfill waste was covered with a minimum of 18 inches of limerock, and topped with about 6 inches of topsoil and vegetation. In areas where shrubs and trees were planted, soil depth was increased to between 2 and 4 feet.

Project Outcomes

Vista View Park opened in July 2003, and the County expanded it in November 2009. Activities in the park include horseback riding, biking, a trail with fitness stations, rollerblading, paragliding, primitive camping, radio-controlled plane flying and boating, catch-and-release fishing, and many other types of passive use. There are two playgrounds; one of them was certified by Boundless Playgrounds for exceeding the minimum requirements of the Americans with Disabilities Act.



Returning capped sites to use helps prevent trespassing, illegal dumping and other nuisance issues common at vacant and abandoned sites.

THIS PAGE Rolling hills and fitness trails at Vista View Park offer exercise opportunities as well as picnic shelters and playgrounds.

BRIEF SITE HIGHLIGHT

At the DuPage County Landfill/Blackwell Forest Preserve in Warrenville, Illinois, the site's 40-acre capped landfill now hosts year-round recreation, including hiking, cross-country skiing, fishing and a winter tubing hill, as well as ecological restoration and environmental educational areas. Vegetation on the landfill cover was replaced with prairie grass indigenous to the region.



BUILDING UP: COMMERCIAL REUSES AND PARKING

Capped sites can support structures as well. Integrating reuse plans with the early stages of cleanup planning creates opportunities for phased construction, saving time and money, and helps minimize disturbances to capped areas once a site's remedy is in place.



THIS PAGE Capped areas are often used for parking facilities.



PJP LANDFILL

JERSEY CITY, NEW JERSEY

This 87-acre landfill – located along the Hackensack River just west of downtown Manhattan – was used by heavy industry for almost two decades. Extensive planning and coordination by EPA, state agencies and developers integrated remedy and reuse considerations, enabling construction of a warehouse on top of part of the landfill. For example, vapor ventilation and monitoring systems were part of the foundation of the warehouse. The vapor ventilation system prevents the exposure of workers to unsafe levels of landfill gases. The system collects landfill gases beneath the building and pumps them to an outdoor carbon filtration unit. The landfill gas monitoring system tracks landfill gas concentrations in the warehouse, making sure concentrations do not reach unsafe levels.

Original plans for the cap called for grading the ground surface at a slope of 6 percent to minimize maintenance costs. Given this slope would not support recreational uses, the local government proposed a 2 percent slope instead. Site agencies signed off on the more gradual slope to help facilitate the area’s recreational reuse.

Project Nuts and Bolts

- Cap covers 92,000 cubic yards of waste.
- Total of 400,000 cubic yards of fill and recycled crushed aggregate imported.
- Deep dynamic compaction performed over 1.7-million-square-foot area, compressing waste by dropping a heavy (16-ton) weight from a 60-foot crane over 120,000 times.
- Total of 1,500 lineal feet of 48-inch to 54-inch storm piping installed, including storm outfall structures at the Hackensack River.

CMC Systems

- Warehouse is supported by a relatively new technology, a “Controlled Modulus Column” foundation system (CMC). The systems allow shallow foundations on sites that traditionally require deep foundations. The technology uses displacement augers that displace the soil laterally, densifying soil around it. The hole is backfilled with cement grout under moderate pressure that also densifies surrounding soils. The system is capped by a granular well-compacted platform that

BOTH PAGES LEFT TO RIGHT Capping, compression and wetlands restoration at the PJP Landfill Superfund site; tire shredding before construction of the site’s cap; the LEED-certified Pulaski Distribution Center, built on top of the PJP Landfill cap.



serves as a load transfer layer to transmit the load from the structure to the semi-rigid CMCs. The load is then transmitted to a stronger bearing stratum below, or shed into surrounding soils at greater depth.

CMC System Benefits

- Reduced costs when compared to traditional pile foundations or excavation and replacement of unsuitable soils; less construction materials are required.
- Faster installation than piles.
- Avoids excavation and replacement of poor quality soils and limits spoil, reducing waste generation.
- Avoids driving long steel piles to bedrock.
- Reduces the cost of the structure by substituting pile caps, grade beams and structural slabs with spread footings and slabs-on-grade.

- Reduces the carbon footprint associated with foundations by significantly reducing concrete and steel quantities.

Project Outcomes

For decades, subsurface fires at the PJP Landfill produced billowing smoke and caused widespread concern. Today, following extensive cleanup, economic and ecological revitalization have changed the landscape forever. This once-vacant landfill now hosts the Prologis Pulaski Distribution Center as well as wetland habitat, green space and a riverfront walkway, with additional recreation plans on the horizon. Businesses on site provide about 1,225 jobs, nearly \$51 million in estimated annual employee income and over \$1.8 billion in estimated annual business sales revenues.

Today, following extensive cleanup, economic and ecological revitalization have changed the landscape forever.



OHIO RIVER PARK

NEVILLE ISLAND, PENNSYLVANIA

This former municipal landfill is now a multimillion dollar sports and entertainment complex. Facilities on the site's 7-acre multi-layer cap include an athletic field, track and field areas, bleachers and a Golf Dome. To make this possible, settlement plates covered with clean soil were placed over areas with planned surface structures. Potential settlement was monitored for three months; results verified that the weight of the planned surface structures would not disturb the cap.

The site was regraded to make it completely level for redevelopment, which required another 3 to 8 feet of clean soil – about 12 feet total – on top of the multilayer cap. The fill also elevated the area above the floodplain and made sure there was space for utility or sewer lines for the new facilities. Building footers for the Golf Dome were placed 2.5 feet deep and are 10 to 12 feet long. Their design was modified to be wider and shallower than usual to ensure even weight distribution and to keep the footers in the clean fill layer above the cap.

Project Nuts and Bolts

- The multi-layer cap includes a subgrade layer, a barrier layer, a drainage layer and a vegetative cover layer.

- The subgrade layer consists of engineered fill and a liner foundation and provides a firm foundation for the barrier layer construction, as well as an adequate slope to ensure drainage from the drainage and vegetative layers.
- Engineered fill was placed six inches below the liner subgrade layer.
- The liner subgrade material is composed of fine-grained soil (silt and clay) that is free of any materials that might damage the overlying synthetic liner.
- The barrier layer consists of a high-density polyethylene liner that is 40 millimeters thick. The drainage layer consists of a non-woven geotextile.
- The vegetative cover layer supports vegetative growth, provides frost protection, and minimizes the potential for damage from surface activities and root penetration.

Project Outcomes

Robert Morris University's Island Sports Center is a regional sports and recreation destination. Located near downtown Pittsburgh, the state-of-the-art center offers ice skating, hockey, miniature golf and an indoor driving range. A theater complex and restaurant are located on the western side of the site.

THIS PAGE LEFT TO RIGHT Robert Morris University's Island Sports Center offers ice skating, hockey, miniature golf and an indoor driving range.

BRIEF SITE HIGHLIGHTS

At the Norwood PCBs site in Massachusetts, the cap serves as a central parking area for the Shoppes at Elmway Farms, a shopping center with 56,000 square feet of retail space.



At the Hercules 009 Landfill in Brunswick, Georgia, the remedy included a landfill cap to reduce rain infiltration and direct contact with treated soil. An adjacent car dealership worked with site parties to reuse the area. The dealership fenced and paved the top of the capped landfill, creating a parking lot that enhances the remedy, adding an extra layer to isolate contaminants and prevent rain infiltration.



At the Southside Sanitary Landfill near Indianapolis, one of the largest methane-powered greenhouses in the United States, pulls more than 2.2 million cubic feet of methane gas each day from the landfill. All energy used in the 6.5-acre greenhouse is extracted from decomposing waste in the adjacent landfill.



LESSON LEARNED

Integrate remedy and reuse.

Planning for reuse before a remedy and cap(s) have been designed optimizes opportunities for shared infrastructure, tailored features and cost savings over the short and long term. For sites where a remedy is already in place, engineering assessments can determine whether the area can physically support the planned reuse.

Be part of a team. Community engagement is important.

Projects that enjoy broad community support can lead to new partnerships and are more likely to get built. The projects also provide opportunities to share information and address local health concerns and related issues.

Follow the lead of local governments.

Municipalities often own or operate facilities at capped sites and have cleanup responsibilities. As the organizations responsible for their communities' general welfare, local governments are particularly well-positioned to host redevelopment projects, bring together diverse stakeholders, and use planning tools and incentives to foster reuse outcomes.

Get technical.

These projects are often complex undertakings requiring legal, technical, financial and policy expertise. Partnerships and tools such as power purchase agreements help make sure that these complexities need not deter interest in reuse projects at capped sites.

Consider phasing uses in over time.

As landfills and other capped areas stabilize and maintenance requirements step down, the range of reuse options can increase. For example, biocrops for fuels could transition to a livestock or a wildlife park. Later, the area could host driving ranges and ballparks and eventually transition into a full-access public park with structures and parking.

Address institutional controls early, as part of the remedy.

Seeking community input and involvement can maximize their effectiveness. These land use controls protect human health (e.g., prevent excavation) and guide redevelopment activities. They provide parties with detailed guidance, can be flexible and responsive to reflect different reuses, and can be monitored and managed by local governments over time.

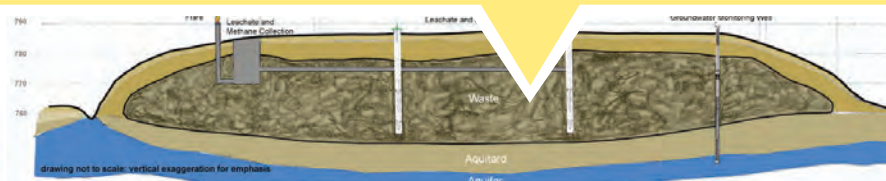
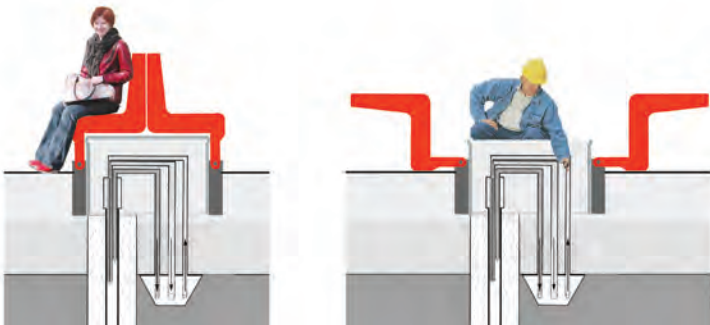
Build on past experience.

The Superfund remedial process can provide information to fulfill environmental permitting and other regulatory requirements for a range of reuse projects at capped sites. Superfund sites are among the most comprehensively documented and evaluated areas of land in the United States. See the Resources section on page 26 for additional information.

BRIEF SITE HIGHLIGHTS

Community outreach was an integral part of reuse planning efforts for the H.O.D. Landfill in Antioch, Illinois. A series of visual diagrams helped community members understand landfill features and the compatibility of recreational reuses. Today, site uses include athletic fields, open space and a methane co-generation plant.

Wellhead Seat Bench Detail
1"=1'-0"



This award-winning gas-to-liquid fuel technology demonstration project at a landfill outside Oklahoma City converts methane gas into clean-burning diesel fuel and wax. A total of 120 wells were drilled into the 105-acre area to access the gas. A vacuum then pulls the gas to the surface. Gas flows may continue for up to 30 years.



RESOURCES

General

EPA's Superfund Redevelopment Initiative

www.epa.gov/superfund-redevelopment-initiative

Closed Waste Sites as Community Assets: A Guide for Municipalities, Landfill Owners and Regulators:

nepis.epa.gov/Exe/ZyPDF.cgi/P100LHOS.PDF?Dockey=P100LHOS.PDF

Considerations for Development on or Adjacent to a Closed Solid Waste Landfill

www.whitehouse.gov/sites/whitehouse.gov/files/images/Blog/PPAP_2016.pdf

Redevelopment Potential of Landfills: A Case Study of Six New Jersey Projects

www.witpress.com/elibrary/wit-transactions-on-ecology-and-the-environment/55/982

Renewable Energy

EPA's RE-Powering America's Land Initiative

www.epa.gov/re-powering

Re-Powering America Best Practices for Siting Solar Photovoltaics on Municipal Solid Waste Landfills

www.epa.gov/re-powering/best-practices-siting-solar-photovoltaics-municipal-solid-waste-landfills

Re-Powering America Renewable Energy Interactive Mapping Tool

www.epa.gov/re-powering/re-powering-mapping-and-screening-tools

Solar Energy Industries Association

www.seia.org

Database of State Incentives for Renewables & Efficiency (DSIRE)

www.dsireusa.org

DOE Sunshot Initiative

energy.gov/eere/sunshot/sunshot-initiative

NREL Renewable Energy Resource Maps

www.nrel.gov/renewable_resources

NREL Solar Advisor Model

www.nrel.gov/analysis/sam

Ecological Revitalization and Pollinators

EPA Ecological Revitalization webpage

www.epa.gov/superfund-redevelopment-initiative/ecological-revitalization-restoring-lands

EPA Ecological Revitalization Report: Turning Contaminated Properties into Community Assets

www.epa.gov/remedytech/ecological-revitalization-turning-contaminated-properties-community-assets

CLU-IN EcoTools

clu-in.org/ecotools

National Pollinator Partnership Action Plan

www.whitehouse.gov/sites/whitehouse.gov/files/images/Blog/PPAP_2016.pdf

EPA Information on Protecting Bees and Other Pollinators from Pesticides

www2.epa.gov/pollinator-protection

Recreation

Reusing Superfund Sites – Recreational Use of Land Above Hazardous Waste Containment Areas

semspub.epa.gov/work/11/174085.pdf

Commercial Reuse

Reusing Superfund Sites – Commercial Use Where Waste is Left on Site

semspub.epa.gov/work/11/174617.pdf

Redevelopment of Brownfield Sites Using Controlled Modulus Columns

geoserver.ing.puc.cl/info/conferences/PanAm2011/panam2011/pdfs/GEO11Paper777.pdf

Construction on Former Landfills

faculty.engineering.asu.edu/kavazanjian/wp-content/uploads/2011/08/32_Construction-on-Old-Landfills.pdf



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