Occidental Chemical Corporation Montague, Michigan RCRA Case Study

Decomissioned Michigan Chemical Plant Transforms into Prairie and Savannah

This is the first in a series of case studies from EPA's Technology Innovation and Field Services Division (TIFSD) focused on ecological revitalization as part of contaminated site remediation and reuse. The purpose of these case studies is to provide site managers with ecological reuse information including, recommendations based on experience and observations, people to contact, and access to a network of sites having an ecological reuse component.

This is the story of the transformation of a former chemical manufacturing site into thriving wetland, prairie, and woodland habitat. The closure of Occidental Chemical Corporation (Oxy) facility in Montague, Michigan in 1983 left behind soil and ground water contaminated with chlorinated organic chemicals. Habitat preservation is an Oxy corporate principle so after meeting the EPA cleanup standards they also provided an ecological asset for the community. The surrounding countryside is a mix of hardwood forests, pine plantations, dunes and grasslands, homes, summer cottages, beaches and towns, in the Lake Michigan basin. Rather than leave a brownfield in its wake, a few individuals at Oxy spearheaded the transformation of the former chemical manufacturing site into a thriving prairie, savannah, woodland, and wetland habitat. The restoration plans included amending soils, creating wetlands, and planting native grasses, shrubs, and trees as well as long-term stewardship activities and the creation of recreational opportunities.

Oxy successfully established habitat at the site through financial commitment at a corporate level as well as the dedication of employees who implemented the habitat management plan. Oxy drew on previously established relationships with state and local agencies as well as other stakeholders for technical support and materials. In addition, Oxy employees talked to the community about their efforts at the site and found that the community was in favor of ecological revitalization at the former factory.

Ecological Revitalization = the process of returning land from a contaminated state to one that supports functioning and sustainable habitat.

Topics Highlighted in this Case Study:

- • Attractive Nuisance
- • Bioavailability
- ✓ Community Involvement
- • Erosion
- ✓ Invasive Species
- ✓ Predator Control
- • Recreation
- ✓ Soil Amendments
- ✓ Use of Native Plants
- ✓ Use of Volunteers
- • Water Management
- • Wildlife Habitat
  - ✓ Freshwater Wetland
  - ✓ Prairie
  - • Saltwater Wetland
  - • Savannah
  - • Stream
  - ✓ Woodland

Background

- The 880-acre site is located in Montague, Michigan.
- The facility manufactured chlorine, sodium hydroxide, and hydrochloric acid, and hexachlorocyclopentadiene, a toxic chemical used in pesticide production. The facility has been inactive since 1983 and production facilities were demolished in 1996; there are no plans to reactivate facility operations.
- About 506,000 cubic yards of organic wastes was disposed in unlined settling ponds over approximately 50 acres of the site. The wastes contaminated ground and surface water both on and off the site with the following chlorinated organic chemicals: chloroform, carbon tetrachloride, trichloroethylene, perchlorethylene, hexachlorobutadiene, hexachlorocyclopentadiene, octochlorocyclopentene, and hexachlorobenzene. Groundwater discharges to White Lake, and sediments in the lake were also contaminated.
- Remedial efforts started in 1981-1982, when most of the waste on the surface was removed and disposed in a lined landfill. Remediation also included excavation of contaminated soil, dredging of contaminated sediment, and pumping and treating contaminated groundwater.
  - » Contaminated soil was placed in a lined landfill which is maintained through a Resource Conservation and Recovery Act (RCRA) post-closure long-term management plan. The 10-acre landfill contains approximately 970,000 tons of contaminated soil.
  - » Isolated areas of contaminated soil were removed and disposed off-site and contaminated sediment was dredged, dewatered, and disposed off-site pursuant to the 2001 RCRA corrective action final remedy.
  - » A groundwater treatment system currently operates to contain a contaminated plume to be protective of human health and the environment. The water treatment facility has been in continuous operation since 1982 and pumps approximately one million gallons per day. Treated groundwater is discharged under a National Pollutant Discharge Elimination System (NPDES) permit to White Lake.
  - » A contaminated 2-acre equalization pond was drained, decontaminated using pressure washing and vacuuming, re-lined with a synthetic plastic liner covered with clay, and allowed to refill with rainwater.
- The remediation is protective of human health and the environment. The remedy disturbed much of the soil on more than a 100-acre area; and much of this area has been transformed into plant and wildlife habitat.

Oxy Site Equalization Ponds in 1996

Ecological Revitalization

Oxy's plan called for a sustained effort to protect the environment, including actively promoting habitat preservation and biodiversity. Oxy employees proposed to revegetate the site with native grasses to provide wildlife habitat. Oxy began the restoration process by collaborating with the Wildlife Habitat Council (WHC) to form a

Oxy Site Equalization Ponds in 2007

Native species planted include big and little bluestem, Indian grass, switch grass, wild rye, and more than a dozen native wildflower species.

small team of stakeholders who planned and designed habitat restoration to accommodate a variety of wildlife. Each team member played a key role in the restoration. The restored 65-acre habitat is a mix of (predominantly) open prairie, forest, and wetland. The remaining 800+ acres owned by Oxy is mostly forest which is being managed under a State-approved Forest Stewardship program as part of the restoration work.

Oxy used existing relationships with state and local agencies, such as the Muskegon Conservation District and Pheasants Forever, to develop a management plan for the forested area and purchase native seed for the restored habitat area. Because the Oxy site borders the city of Montague, parts of the revitalization are easily visible from the road. To keep the local community informed, Oxy employees, who are members of the local public advisory committee, provide updates during committee meetings and never miss an opportunity to talk about the site to the community. Showing the community that the company takes pride in the community and its property has gone a long way towards building public trust.

The restoration steps included (1) amending sandy soils with organic matter, (2) collecting, and then sowing native grass seed, planting shrubs and trees, and (3) excavating soils to create wetlands. The vegetation is being monitored for survival, species composition, and invasive plant species. Ongoing management includes replanting and seeding (as needed), selectively removing plants, and implementing prescribed burns to remove invading woody stems from the prairie portion of the habitat area.

Besides the ecological restoration work, Oxy is in a unique position to offer property to the township for public soccer fields and a bike path. While public access is not possible on the entire site because of institutional controls, Oxy plans to sell a 16-acre parcel of the property to the township for expansion of an existing park. The plans to use some of the property to connect a bike path to complement the nearby 22-acre Hart-Montague State Park Bike Trail still need to be resolved due to public-access restrictions.

Mixing Proper Soil

As any farmer or gardener knows, when it comes to growing plants it's all about the soil. At Oxy, the original thin organic layer had been stripped during the building and operation of the chemical plant and the remediation of the contaminated soil, leaving only sand as a growing medium. The wildlife team at Oxy coordinated with a nearby dairy farm to take used bedding material from the calf barns (a mixture of sand, wood shavings, and manure) -- a mutually beneficial arrangement -- to add organic matter to the soil. The bedding material is composted on site and then applied to the soil. Oxy consulted with the Michigan Department of Environmental Quality (MDEQ) regarding the use of bedding material as a soil amendment. MDEQ had no issues with using the soil amendment and no testing was required. Soil test plots were used to

Soil Amendments – How Do They Do It?

- **Logistics:** Oxy selects a ½-acre area with sandy soil and poor vegetation growth. Weeds are removed and 6 to 8 inches of soil amendment is applied to the top of the soil using a mechanical manure spreader. The material is incorporated into the soil using a disc cultivator. An annual nursery crop as well as native perennial grass seed is planted immediately after applying soil amendments to help stimulate seed germination and give the sandy soil enough structure to hold moisture and help the prairie grasses become established.
- **Why it works:** The Oxy site is located in a rural area with a major dairy operation located less than 5 miles away. The dairy provides bedding material to Oxy which hires a local trucking firm to deliver it to the site. Oxy uses its own labor and equipment, purchased specifically for the restoration project to compost and apply the soil amendment. This labor intensive process is cost-effective in part because the employees have volunteered their time for an effort they support.

determine the best mixture of sand and organic matter for the type of prairie vegetation planned for the site.

Incorporating Native Seed

A nearby native grassland owned by Oxy has been one source of seed for the restoration. The wildlife team harvests the seed and transfers it to the site. A significant quantity of local native seed was also purchased through Pheasants Forever, one of the restoration partners.

The first year, a nursery crop of Canada wild rye (*Elymus canadensis*) was planted to stabilize the soil and prevent weeds from becoming established. This is generally the process used at large-scale restoration sites. Native seed was then broadcast into the prepared soil. The fields are now mostly self-sustaining, lush and colorful prairie transformation.

Planting in loose sand is difficult. Sand easily shifts and can either expose or bury recently planted seed. The wildlife team used a standard seed drill and modified the drilling technique to make sure the depth of seed was correct to improve chances of germination. In addition, the soil amendments discussed above helped to stabilize the sand and reduce shifting. More than 45 acres of the site have been cultivated, planted, and maintained with native annual and perennial plants and grasses and are now mostly a self-sustaining, lush and colorful prairie transformation.

Purchasing Seed: Most of the seed for ecological revitalization of the Oxy site was purchased through Pheasants Forever or was readily available at the local seed mill.

Creating Habitat

- Oxy captured the opportunity to use a former equalization pond as habitat. Already excavated, the pond was cleaned, recontoured, and vegetated with native plants to create pond and wetland habitat, and a buffer zone. The 2-acre pond is already home to ducks, amphibians, insects, and other wildlife.
- The wetland buffer zone is being established using cattails, and the wildlife team plans to incorporate native wetland shrubs.
- More than 300 native trees and shrubs have been planted with planning assistance from the local soil conservation district.

With ecological revitalization well under way, the wildlife team has begun some of the maintenance activities to sustain the habitat and has plans to further the project:

Soil amendment generated using local farm waste and on-site compost area.

Soil amendment added to a 1/2 -acre area with sandy soil and poor vegetation growth.

Native prairie grasses planted after soil amendment is incorporated into the soil.

Stakeholders Involvement

- **Oxy** – Began its own revitalization project after the EPA final remedy was implemented.
- **EPA** – Oversaw cleanup of contamination under the authority of RCRA Corrective Action.
- **Michigan Department of Natural Resources and Environment (MDNRE) (formerly MDEQ)** – Approved the use of soil amendment at the site; approved the NPDES permit for the site and conducts inspections to ensure compliance.
- **Michigan Department of Natural Resources** – Approved a forest management plan.
- **Wildlife Habitat Council** – Is Oxy's partner in habitat protection, restoration, and enhancement.
- **Pheasants Forever** – Provided native grasses and wildflower seed and consultation to revegetate disturbed areas.
- **Soil Conservation District** – Forester provided a forest management plan for the timber areas of the site.
- **Community Members** – Provided input on final use of the site. The community was in favor of ecological revitalization instead of redevelopment.

July 2006 Letter From MDEQ Regarding the NPDES Permit:

"All areas evaluated were in compliance at the time of the inspection. Also, noteworthy was the remarkable success of your native grassland plantings and similar restoration efforts that you've undertaken with guidance from the Wildlife Habitat Council. It appears that this former chemical manufacturing site is well on its way to becoming a fine habitat for ducks, pheasants, and other wildlife. These extra efforts are appreciated."

- Prescribed burning in prairie and oak savannah areas to mimic the natural occurrence of fire and pursue biological control techniques for an invasive species (spotted knapweed) (completed April 2010).
- Continue compiling the site's species inventory and work with the Ruffed Grouse Society to manage habitat.
- Implement the forest management plan, which includes thinning red pine and removing invasive tree species to improve habitat and growth potential of trees.
- Partner with the Muskegon Conservation District, the National Oceanic and Atmospheric Administration (NOAA), and EPA to acquire a Great Lakes Restoration Initiative grant to complete invasive species removal and wetland augmentation along the White Lake shoreline (application is awaiting notification).
- Develop an outfall hydroelectric system to capture energy from the discharge of the water treatment outfall.
- Develop measureable conservation outcomes, including:
  - » Ecosystem credit markets – a feasibility study is planned to evaluate and quantify possible credits
  - » Wetland mitigation offsets
  - » Terrestrial carbon sequestration credits

In addition, the wildlife team is considering adding raptor perches and an osprey nesting platform.

Lessons Learned

1. **Consider predators in selecting native plant species:** Oxy planted sunflowers along the road at the site, but these were eaten by deer. Oxy is researching native species that are less attractive to deer and other wildlife.
2. **Don't overlook local resources:** The Oxy site is located close to Lake Michigan, so excavated areas consisted of beach sand. Large amounts of soil amendments were needed to increase the sand's organic content and allow native plants to grow. Oxy chose manure as a soil amendment and developed a partnership with a nearby dairy. Weekly shipments of manure provide soil amendment for the site while also helping to remove excess manure from the dairy. Learn more about the use of soil amendments at contaminated sites in EPA's document titled, The Use of Soil Amendments for Remediation, Revitalization, and Reuse, which can be found at http://www.clu-in.org/download/remed/epa-542-r-07-013.pdf.
3. **Consider a variety of invasive species control methods:** Spotted knapweed is an invasive plant species that typically grows on disturbed soil and outcompetes all other plants in the area. Spotted knapweed is present at the site, and has been treated with herbicides for eradication. In 2010, a prescribed burn is planned in the prairie habitat area to mimic the natural occurrence of fire and help native species become established. Also, a biological control method using a weevil that specifically controls spotted knapweed is planned for the future.
4. **Ecosystem revitalization provides a variety of benefits:** In addition to creating habitat at the site, there are a variety of benefits gained from ecological revitalization. Benefits include improved community interaction and public relations as well as gaining trust and respect from local, state and federal agencies. In addition, ecosystem services benefits can include terrestrial carbon sequestration and storage, climate regulation, clean water, natural recreation areas, wildlife habitat, species diversity, pollination, flood and erosion control, food production, fiber, cultural practices, scenic landscapes, soil formation, nutrient cycling, aesthetics, and more. These "free" services are increasingly viewed as having economic value, and markets such as wetland mitigation and carbon credit trading may be developed.
5. **Soil Amendment Source is Critical.** When using manure as soil amendment, it is important to select the appropriate type of manure. Cow, sheep, and chicken manure all provide a good, clean source of nitrogen. However, horse manure should not be used for an ecological revitalization project. Horse manure is not a good source of nitrogen. In addition, horses are fed a mixture of grains, including exotic species. The exotic seed is then present in the manure and could easily introduce exotic plant species at a site.

Native Prairie Grass Planting

Additional Information

Web sites to obtain additional information on the Oxy site and ecological revitalization include the following:

Wildlife Habitat Council Occidental Petroleum Site Restoration Summary
http://www.wildlifehc.org/Registry_CertifiedSites/cert_sites_detail2.cfm?LinkAdvID=100110

EPA RCRA Corrective Action Site Progress Profile
http://iaspub.epa.gov/Cleanups/RcraProfile.jsp?handler_id=MID006014906

Oxy's Biodiversity and Habitat Preservation Activities
http://www.oxy.com/Social_Responsibility/hes_performance/Pages/biodiversity.aspx

EPA's Eco Tools Web site
http://www.clu-in.org/ecotools/

Ecological Revitalization: Turning Contaminated Properties Into Community Assets
http://www.clu-in.org/download/issues/ecotools/Ecological_Revitalization_Turning_Contaminated_Properties_into_Community_Assets.pdf

Frequently Asked Questions About Ecological Revitalization of Superfund Sites
http://www.clu-in.org/download/remed/542f06002.pdf

Revegetating Landfills and Waste Containment Areas Fact Sheet
http://www.clu-in.org/download/remed/revegetating_fact_sheet.pdf

Ecological Revitalization and Attractive Nuisance Issues
http://www.epa.gov/tio/download/remed/542f06003.pdf

For additional information on the Oxy site, you can also contact the Oxy or EPA project managers:

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