Experimental Park Grows on a Landfill

To Parks Requiring Open Spaces
Jim Morgan
FYI
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■ EARLY woody colonizers such as gray birch and red cedar were planted at the edges of this meadow.

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IN 1990, the Hackensack Meadowlands Development Commission (HMDC) undertook a construction project to reclaim a six-acre section of a 200-acre sanitary landfill in Lyndhurst, New Jersey. Now known as the Kingsland Overlook, part of Richard W. DeKorte Park, the project was intended to enhance wildlife areas and provide facilities for environmental education and passive recreation. This was the first major installation of diverse native plant communities by this agency atop a capped sanitary landfill. The HMDC was able to experiment with different woody and herbaceous communities designed to mimic those found naturally in coastal northern New Jersey.

The project was intended to serve as a wildlife management model for future closed landfills in the district. To date—five years after installation—the park is functioning as expected: plant communities have generally thrived and begun to mature, there has been an increase in the diversity of animal species on the site, and an increase in the number and varieties of birds has been observed. Plus, we have expanded the HMDC Environment Center's education programs, and noted an increase in visitors to the park. The Kingsland Overlook project has received awards from the American Society of Landscape Architects, the New Jersey Native Plant Society, *New Jersey Monthly* magazine, the Perennial Plant Association, and others.

The HMDC, created in 1969 by an act of the New Jersey State Legislature, is an agency charged with three missions:

- To oversee the orderly development of the 32-sq mi Hackensack Meadowlands District.
- To manage the flow of solid waste within this district.
- To maintain the ecological balance of the district.

The Meadowlands District is centered around the Hackensack River, part of the larger Newark Bay Estuary. This estuary lies within the Atlantic Flyway and is a major stopping point for migratory birds. It is also just six miles west of New York City, and thus, the area is heavily urbanized and densely populated.

Despite its lyrical name, it is vast acres of tidal marshlands in northern New Jersey—formed after the retreat of massive glaciers during the last ice age—that are the core the Meadowlands District. This land has undergone dramatic changes over the years. Early European settlers logged once-extensive white cedar forests into extinction. Decades of diking, ditching, and damming changed the hydrology of the Meadowlands—reducing and redirecting the flow of both fresh and tidal waters to the marshes. The Meadowlands became the dumping grounds for the growing metropolitan areas of New York and New Jersey. By the 1960s, huge landfills rose above the brackish marshes, which were by then severely degraded and polluted. Many landfills were abandoned by their owners when they reached capacity and were left, with sparse soil cover, to the whims of nature.

As they aged, these landfills became habitat for many animal species. Ponds formed through differential settlement of the decomposing waste and provided nesting sites for waterfowl. Open meadows became nesting and foraging grounds for small mammals and reptiles. These areas in turn served as hunting grounds for raptors—birds of prey who feed on these small creatures. (This is an important development since raptors have lost extensive hunting and nesting habitats in the northeastern United States to suburban sprawl.)

While the wildlife value of old landfills is obvious, it is insufficient to leave them to their own devices—even if the hazards posed by the unchecked release of leachate and landfill gases into the environment are ignored. One problem is that the diversity of volunteer plant species is very low. The meadows are dominated by mugwort and artemisia, two herbaceous perennials that provide food or cover for a very limited number of animal species. Under these conditions field mice and marsh hawks thrive, but migratory songbirds (whose preferred habitats in the northeast have been drastically reduced) have very limited opportunities for nesting and feeding. According to a study undertaken by Rutgers University Department of Biological Sciences, many inactive landfills do not undergo the usual process of woodland succession (grasses to shrubs to trees to mature forest). The landfills tend to remain a weedy hill with perhaps a few shrubs. The researchers theorize that this is due to limited seed dispersal. The few plant species found on abandoned landfills are usually varieties that depend on the wind for seed dispersal. Fleshy-fruited, bird-dispersed plant species are slow to become established because of the physical distance from seed sources and the lack of perching places for the birds. Thus, while abandoned landfills are somewhat useful as wildlife habitat, they are much less productive than they might be.

Accelerating Mother Nature

HMDC's intent in the Kingsland Overlook project was to accelerate the process of natural succession by introduc-

ing native and naturalized plant species with high wildlife values. Without this augmentation, because of the landfills' remote location with respect to seed sources and animal dispersers, this process may have taken many years to occur, if at all.

The original objectives identified for the project were:

- To increase habitat diversity and encourage wildlife use.
- To expand facilities for the HMDC Environment Center's education programs.
- To observe the adaptability of plants to a closed landfill environment.
- To expand ongoing research on wildlife use of landfills.
- To serve as a wildlife management model for future landfill closures.
- To publicly demonstrate HMDC's landfill reclamation efforts.
- To disseminate and share the information and experience gained with interested parties.

To expand habitat diversity and encourage wildlife use, five distinct plant communities, demonstrating the process of natural succession, were designed to approximate native communities found in northern New Jersey. Each provides food and/or cover for a range of insects, birds, and mammals. A landscape architect consultant collaborated with HMDC staff landscape architects to research native plant communities and to devise planting plans based on this information. The design had to serve its ecological function while accommodating programmatic and functional requirements such as trails, seating, erosion control, and screening.

Experimenting and Testing Plant Communities

Earlier experiments with woody and herbaceous plants endemic to the region had been undertaken to determine which species would perform best under landfill conditions. These conditions include wind exposure, shallow soil depths, and steep slopes, which together result in a harsh environment. The lack of a natural soil profile and the shallow soil depth limited plant types to those with fibrous, horizonal rooting patterns.

Developing the five plant communities, arranged along a winding 2500 foot gravel path, provided the Environment Center's staff with facilities to support expanded environmental education programs, including courses in natural succession and landfill closure. Three seating areas were provided, one of which is large enough to function as an outdoor classroom.

Meadows. Two of the five communities, representing "early secondary succession," are meadows. Meadows are an important and increasingly scarce habitat in New Jersey. They provide refuge for ground-nesting birds like the song sparrow, savanna sparrow, and ring-necked pheasant. These and many other species are now sighted regularly in the Kingsland Overlook meadows. Rabbits, meadow voles, whitefooted mice, garter snakes, and milk snakes also nest and feed in this area. These in turn provide food for the red-tail hawk, marsh hawk, and other raptors.

Two types of meadows were established: an "Eastern coastal prairie," dominated by native warm-season grasses; and a "wildflower/butterfly meadow," containing a high percentage of wildflowers in addition to native grasses. The flowers increase the diversity of insect species such as monarch butterflies and bees. Both areas include white clover for its ability to fix atmospheric nitrogen and as a nurse cover for the slow-to-establish grasses. The meadow areas were established in June 1990 when the final grading of the planting soil took place. The meadows were hydroseeded, tracked with a bulldozer to securely embed seeds, and then straw mulched and tacked. A simple sprinkler system was installed to keep the meadows moist until germination. No mowing has been necessary to date, but as adjacent woody areas start to encroach, a method will be established for maintaining the meadow environment.

Late Woody Fields. A later stage of succession is represented in the "late woody fields." Plants were arranged in generic patterns based on those found where old meadows are beginning to give way to woodland. Hedgerows, thickets, and patches of herbaceous perennials were located within a continuous grassland matrix. Early woody colonizers such as grey birch and red cedar were planted in several sizes at the edges of the meadows, with irregular spacings to mimic the way they would appear in nature. Three sumac species were planted in "mounds" within the meadow. These groupings contain several sizes of each species, arranged with the larger plants toward the center, forming a mound effect typical of sumacs. Anticipated wildlife in these areas are much the same as in the meadow with the addition of songbirds like the black-capped chickadee, American goldfinch, and northern cardinal.

Young Woodland. Further along the successional timeline is the "young woodland." Here, red maple, pin oak, and green ash form a canopy over viburnums, aronia, and dogwood—all species that produce abundant quantities of fruit. An herbaceous layer of ferns and flowering perennials was added one year after the woody plants. This community was designed to attract species that rely on dense understory for food and cover; a habitat that is scarce in the Meadowlands.

Mature Forest. The fifth planting area represents a mature forest, a separate grouping from that represented by the deciduous young woodland. The "evergreen forest" is dominated by white pine, white fir, and Norway spruce, with a fringe planting of crabapples and viburnum. Mature evergreen forests are important perching and nesting places for owls, hawks, and bats. This planting also fulfilled some functional requirements by providing both a wind screen and a separation of the park from a still active haul road traversing an adjacent landfill.

Landfill Closure. Before the park was constructed, landfill closure improvements were installed. An underground slurry wall, 30 ft deep and 700 ft long, was installed along the toe of slope. This directs leachate to a collection pipe where it flows to a treatment facility. Methane and other natural gases are vented from the dike via PVC pipes to the surface. Active leachate collection is planned for the future. Landfill gases will be collected and treated for sale to local energy utilities.

The existing landfill slope had less than one foot of cover soil when HMDC began the landscape improvements. About six acres of the steep, east-facing slope was cleared and capped with a synthetic liner to separate the solid waste from the planting soil. This is in contrast to the usual landfill closure procedure, where synthetic liners are placed on the relatively flat plateau at the landfill's top. The HMDC's Solid Waste Engineering Division worked with JPS Elastomerics Corp. of Northampton, Massachusetts to develop a new type of liner that would resist slipping down steep slopes. They used polyethylene terephthalate ("PET") from 400,000 recycled plastic soda bottles to create spun fibers that were bonded to both sides of a chlorosulfonated polyethylene (CPSE) liner, increasing soil-to-membrane friction. This product is now available from Watersaver Company, Inc. of Cliffwood Beach, New Jersey, under the trade name Terra-Tuff.

Soil Preparation. After the liner was installed, 15,000 cu yd of topsoil were placed at depths ranging from 6 in. in the meadow areas to 3½ ft in the wooded zones. Soil amendments were added according to the needs of individual plant communities. The young woodland and evergreen forest communities (which would normally develop only after many seasons of growth and decay had contributed a generous layer of organic matter to the soil) received a high percentage of municipal leaf compost. The meadow areas and late woody fields, populated with undemanding pioneer species, received proportionally less.

Two micro-habitats were created for high-bush and low-bush blueberries by lowering soil pH. The pH was lowered to 5.0 by incorporating aluminum sulfate with the leaf compost. The pH level was initially maintained by mulching with pine needles.

Observing the Results

The Kingsland Overlook project met its intended objectives. There has been an in-

crease in the diversity of animal species, as well as an increase in the number of individual creatures feeding and/or nesting on the site. Regular visitors to the park (some of whom come on a daily basis) have been recording bird sightings in a register at the Environment Center. More than 200 species were sighted in the Hackensack Meadowlands in 1993. In addition, HMDC Environmental Operations staff members have regularly been making their own observations. In particular, species that require a dense understory for cover and food, such as the wood thrush and the brown thrasher, have increased. The scarlet tanager is frequently observed, as is the bobolink.

HMDC anticipates the continuation of this trend. As the plant communities mature, it is expected that both wildlife populations and species diversity will continue to increase, especially in the young woodland and the evergreen forest.

Lessons for Future Projects

There were some areas, however, where our expectations were not met. The blueberries, even though planted in specially prepared micro-habitats, experienced nearly complete mortality. Testing the pH revealed that it had risen to 6.3. In addition, the undeveloped tree canopy left the plants exposed to the sun and drying winds. No attempt at this time has been made to correct the pH. It is likely that we will undertake the task to adjust the pH and reintroduce the blueberries as the shade trees offer more protection.

Another area of high plant losses was in the scattered herbaceous layer of the young woodland. More than 90 percent of the ferns, anemone, creeping phlox, and foamflower were lost. Harsh weather and lack of shelter in the underdeveloped canopy were both factors. Weed competition also played a large part in the failure of these plantings. Therefore at the Lyndhurst Nature Reserve—a park-over-landfill project completed by the HMDC—the herbaceous plants were grouped in pockets along trails. Though a more artificial arrangement, it is easier to maintain and still provides wildlife benefits. Another option for future projects is to add herbaceous plants only after woody plants are well established and better able to compete with weeds for resources. While the woody plants are getting established, weeds will be removed before they go to seed.

Weed encroachment was, in fact, a problem in all areas because of the availability of weed seeds from the adja-

Recycling Program Diverts Debris from Earthquake Cleanup

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THE Los Angeles County Sanitation Districts operate four major landfills in metropolitan Los Angeles, managing over 17,000 tpd of waste. As operators of these sites the Sanitation Districts continue to develop innovative programs to conserve landfill capacity by diverting materials to beneficial reuses. One such program was initiated in the wake of the 1994 Northridge earthquake.

Immediately following the January 17 earthquake, the Calabasas Landfill began receiving an additional 1400 tpd of debris generated by earthquake cleanup efforts. To accommodate this material, the landfill operated under emergency conditions, which allowed it to accept tonnage above its permitted limit and which extended the operating hours of the landfill.

After several months of cleanup operations, it was obvious that the influx of earthquake debris to the landfill was likely to continue for an extended period of time. To ensure daily disposal capacity was available for both community refuse and earthquake debris, the Sanitation Districts initiated an aggressive recovery program to process recyclable materials from incoming loads of earthquake debris.

The recovery program is conducted at the Calabasas Landfill located near Augora, California, about 15 miles west of the earthquake epicenter. The landfill is owned by the County of Los Angeles and operated by the Sanitation Districts under a Joint Powers Agreement with the county. The use of the landfill is restricted to nearby cities, including portions of the city of Los Angeles, by a Los Angeles County ordinance.

■ MANUAL removal recovers 90 percent of recyclables from earthquake debris.

The landfill site did not receive any significant damage from the 6.7 magnitude Northridge earthquake, and was able to immediately begin accepting debris. Two days after the earthquake, the California Integrated Waste Management Board issued emergency regulations granting a waiver to the solid waste facilities permit. The waiver allowed Calabasas Landfill to receive additional tonnage above the 3500-tpd permit limit; to operate extended hours, including Sundays; and to accept waste from outside the defined area of service. On January 21, 1994, the Los Angeles County Board of Supervisors also issued an emergency order suspending certain land use permit conditions that restricted the amount of tonnage received, the hours and days of operation, and the areas of service.

The Calabasas Landfill typically receives an average of 2300 tpd per day of municipal solid waste. It is permitted to receive a maximum of 3500 tpd (six-day week). Initially, it was necessary to operate 11 hours per day, seven days a week to receive the additional 1400 tpd of earthquake debris.

By early July 1994, incoming earthquake debris had declined to approximately 1000 tpd, and the landfill returned to normal operating hours. However, this amount was still significant enough to have potential impacts on both the daily and long-term capacity of the site.

"Once the landfill was geared up to accept the additional tonnage from the earthquake, we began to look for ways to separate and reuse the materials both as an environmental initiative and to save landfill capacity," said Charles Carry, chief engineer and general manager for the Sanitation Districts.

Proposals Requested

To assist efforts to divert earthquake debris from disposal, the Sanitation Districts requested proposals from companies for processing the earthquake debris and identifying materials that could be recovered for recycling. Based on the proposals submitted, Hayden Brothers Engineering Contractors, Inc. was selected. A contract was executed August 24, 1994.

The terms of the contract require that Hayden Brothers process at least 500 tpd of earthquake debris and recover at least 80 percent of the debris for recycling. Specific items to be recovered included

cent landfill. Aggressive removal of artemisia, mugwort, horsetail, jimsonweed, and other unwanted plants is an ongoing project. There has been marked reduction in the number of weeds, especially in the meadows and the late woody fields where the new plants are now competing effectively. Since the site must serve people as well as wildlife, future management strategy will include continually removing undesirable plants in the seating areas, outdoor classrooms, ampitheater, and along trails.

Sharing Information

The HMDC has been sharing information gained through this project as well as other reclamation work. In November 1992, the agency hosted the annual conference of the New Jersey Solid Waste Advisory Council, which focused on end-use of sanitary landfills. With over 100 attendees, this proved to be the most successful conference in the council's history, with requests for copies of the proceedings continuing to this day. In 1991, HMDC hosted, in conjunction with the New Jersey Native Plant Society, a roundtable for landscape professionals from around the state. Here, professionals shared their experiences with techniques for propagating, installing, and maintaining landscapes of native plants. More recently, the HMDC staff organized a full-day *Site Reclamation Symposium* as part of the 1994 Annual Meeting of the New Jersey Chapter of the American Society of Landscape Architects. The HMDC is constantly receiving requests for guidance with similar projects from design professionals, other organizations, and institutions.

The Kingsland Overlook project has provided us with excellent information for future reclamation work. However, we concluded that solid waste managers everywhere should be planning for the long term when sites are developed. Landfills are typically shaped like flattened pyramids; trapezoids with 3:1 side slopes and a plateau on top, designed to maximize the amount of solid waste placed at the site. This results in an unnatural looking landform, one that is difficult to visually integrate into the surrounding landscape. In heavily developed areas, closed landfills should be seen as valuable open space and as opportunities to increase wildlife habitat. If, in the future, landfills can be designed with their ultimate end use in mind, we can achieve a better long-term ecological result while also meeting our solid waste needs. □□□

dirt, yard waste (tree trimmings), metals, concrete block, and wood. Non-recoverable material is hauled to the working face of the landfill for disposal. The contractor receives $25 for every ton of earthquake debris processed. To provide an incentive for achieving higher recovery rates, the contract includes a provision to pay Hayden Brothers $27/ton if the contractor recovers 90 percent or more.

The earthquake debris recovery program is a cooperative effort between the city of Los Angeles and the Sanitation Districts. After the earthquake, the city of Los Angeles established contracts with independent haulers to collect debris from throughout the quake-damaged area and transport it to various facilities, including Calabasas Landfill. The city pays a tipping fee of $22.97/ton for loads of inert earthquake debris and $37.82/ton for mixed debris. (Inert loads contain less than five percent organic materials and trash; all other loads are considered to be mixed loads.) The tipping fees received are used to fund the program.

By late September 1994, a processing line was in place at the landfill consisting of an in-feed hopper, deck screen, sorting belt, and crusher. On October 1, 1994, processing commenced to recover wood, metal, yard waste, dirt, brick, and concrete from incoming loads of earthquake debris.

The recovery operation consists of both manual and mechanical processing. Incoming loads are initially sorted manually to remove bulky items and other material that might interfere with the mechanical processing operation. Debris removed manually includes furniture and appliances, large pieces of lumber, and tree trimmings.

Subsequent to manual sorting, material is loaded into a 42-in. by 39-ft apron feeder that feeds to a 6-ft by 12-ft two-deck scalping screen. The top deck of the scalping screen has a matte with 3-in. openings. The lower deck is a steel screen with 1½-in. openings. The 1½-in. material, which is primarily dirt, is discharged by a 20-ft conveyor to a stockpile. A magnet located on the conveyor belt removes nails and other scrap metal.

Material passing over the deck screen is deposited onto a belt that has stations for 12 pickers. Laborers remove wood, metals, and trash from the belt and deposit the material into roll-off boxes located directly underneath the picking platform. The 42-in. wide by 50-ft long belt operates at various speeds, depending on the characteristics of the debris being processed. Debris that remains on the belt—mostly concrete and clay brick—is fed into a rock crusher. This material is crushed to approximately 3 in. or less and is conveyed to a stockpile.

About 45 people, including 8 operators and 37 laborers, are employed in the recovery process. In addition to the processing line, numerous pieces of mobile equipment are used. These include two excavators, four bucket loaders, and a tub grinder.

The contract with Hayden Brothers identifies each party's responsibility for managing the materials that are recovered. The contractor must market the wood, metal, and cardboard. The Sanitation Districts utilize the dirt, crushed concrete, and yard waste at the landfill. "We've been able to utilize the crushed concrete to establish wet weather operating areas at the landfill and have reduced the need to bring additional materials to the site for that purpose," said Steve Maguin, department head, Solid Waste Management Department, for the Sanitation Districts.

Large tree stumps and limbs are separated and sold to companies that cut them into a usable size for fire wood. All other wood is shredded and used for fuel in electric generating facilities, blended with soil for landscaping applications, or used at the landfill for weed and erosion control.

Yard waste (tree trimmings) is also shredded and is used as alternative daily cover at the landfill. Recovered metals are loaded into a roll-off bin and sold to a scrap metal company. The 1½-in. material, from the deck screen, is used as dirt cover at the landfill. The crushed concrete and brick is also used at the landfill to create wet weather operating areas and as a road base.

Impressive Results

Initially, the program processed about 500 tpd of debris. However, as operators became more familiar with the equipment and composition of the incoming material, processing capabilities increased. The city of Los Angeles has increased the amount of earthquake debris sent to the landfill for recovery to about 1500 tpd of debris.

"Recovery of materials has exceeded our expectations. The operation consistently recovers over 90 percent of the debris processed," said Carry.

From October 1994 through March 1995, the program has diverted over 97,000 tons of the 104,440 tons processed at the landfill to beneficial reuses. Recovered materials included 554 tons of metal; 1911 tons of wood; 47,437 tons of dirt; 41,873 tons of concrete; 1532 tons of green waste; and 31 tons of cardboard. The program is expected to continue to July.

"We think this program has been very effective in diverting debris from disposal," said Carry. "The experience gained in operating this program will be used to evaluate the recovery of material from construction and demolition loads received at other Sanitation Districts operated landfills." □□□