

## STATUS OF LANDFILL RECLAMATION AND ITS APPLICABILITY TO SOLID WASTE MANAGEMENT

Joanne R. Guerriero  
Malcolm Pirnie, Inc.

### ABSTRACT

With many landfills scheduled to close and decreasing land area available for waste disposal, some municipalities are considering landfill reclamation, an innovative approach for maximizing utilization of landfill space. The feasibility of landfill reclamation depends upon site-specific factors as well as the project goals. Implementation of this technology will require cost-effective integration of the process with other available and appropriate solid waste management technologies in an environmentally sound manner.

### INTRODUCTION

With many landfills scheduled to close and decreasing land area available for waste disposal, municipalities and industries are developing a multi-phase approach to solid waste management, including waste minimization, recycling, composting, resource recovery and landfilling. Additionally, some are considering landfill reclamation, an innovative approach for maximizing utilization of landfill space. Landfill reclamation is the excavation of a landfill using conventional mining technology to recover and reuse resources. Landfill reclamation, may have many beneficial results. It may:

- extend the life of existing landfill sites and reduce the need for siting new landfills
- decrease the area requiring closure
- remediate an environmental concern by removing a contaminant source
- reclaim marketable recyclables
- capture energy through waste combustion

However, there are numerous issues and concerns to be addressed in planning such a project including equipment; operations; health and safety; environmental impacts; materials management; contingency plans for hazardous waste; economics; local, state and/or federal regulations; and legal and administrative issues.

In order to facilitate the utilization of this technology where applicable, the Solid Waste Association of America (SWANA) has developed a Landfill Reclamation Task Group to gather and disseminate information regarding this technology. The Task Group is currently developing technical guidance and procedures from existing case studies on health and safety, materials handling, equipment, economics and other aspects of the process. The overall goal is to encourage the use of landfill reclamation at landfills where its benefits can be realized.

### EXISTING PROJECTS

The feasibility of landfill reclamation depends upon site-specific factors as well as project goals. Feasibility studies and full-scale projects have been conducted in numerous states including Florida, New York, Pennsylvania, Massachusetts, New Hampshire and Delaware, as well as in Ontario, Canada and Europe. Each project was undertaken to obtain a specific benefit(s). Several projects implemented to-date are discussed below.

The Collier County, FL, project was the first publicized effort to reclaim soil and recyclable materials from an existing sanitary landfill. Beginning in 1988, two cells of the Naples Landfill, encompassing 26 acres (10.5 hectares) of an old portion of the landfill, were reclaimed by a front-end loader as a demonstration project. Based on success of the demonstration project, Collier County decided to continue landfill reclamation activities. (3)

Collier County was granted a permit for landfill reclamation by the Florida Department of Environmental Regulation. The permit stated that the refuse passing through the screen could be used as landfill cover and the remaining refuse could be "reburied or temporarily stored for recycling" in a lined portion of the landfill. Since the soil in Florida is composed primarily of sand, the process is also separating approximately 15 percent of the ferrous metal in the waste to a quality acceptable for recycling, that is, unhindered by soil residue more typically found on landfilled ferrous metal. The project was originally initiated to reclaim material for burning in a waste-to-energy plant as the supplementary fuel, in place of wood chips. Even though the waste-to-energy was not implemented, the project is still economically feasible based on reuse of the recovered soil as landfill cover. (3)

The Town of Thompson, CT implemented landfill reclamation in 1989 to quickly generate much needed disposal space in their existing landfill. The Town received permission from the Connecticut Department of Environmental Protection to excavate approximately one acre in an older portion of an existing landfill identified by test pits to contain primarily ash from dump burning. Reclamation in the ash area would be easier and quicker to implement since a majority of the reclaimed material is reusable dirt. The project was cost-effective when the cost of mining and resulting available disposal capacity was compared to the cost of disposal at an incinerator. The Town gained approximately 18 months of disposal capacity, allowing additional time for long-term planning of their solid waste management program. (2)

In anticipation of the closures of numerous landfills in New York State over the next several years, and based on the Collier County project, the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Environmental Conservation (NYSDEC) have undertaken research and development (R&D) projects to assess the feasibility and cost-effectiveness of landfill reclamation. If deemed favorable, landfill reclamation could decrease the area requiring closure, decrease long-term monitoring requirements, and allow for upgrade of the facility to a lined landfill or utilization of the reclaimed land for another purpose. In addition, NYSERDA was particularly interested in capturing the potential energy in the combustible and recyclable materials in the landfill. (9)

The first project was conducted at a five-acre (2 hectares) municipal solid waste (MSW) landfill in Edinburgh, NY. This facility was chosen partially due to the unlikely occurrence of industrial waste in the landfill based on its service area and disposal history. This project addressed excavation and separation techniques; appropriate uses for reclaimed material including a test burn of reclaimed refuse at a resource recovery facility (RRF); specifications for work plan, health and safety monitoring and contingency plans; and economic factors. The results of the study indicated that reclamation was feasible at Edinburgh landfill and in fact, the Town has continued reclamation activities beyond the one-acre reclaimed as part of the R&D study. (9)

Based on successful results of the Edinburgh project, NYSERDA has sponsored additional studies at six landfill sites

throughout the State of New York (Tonawanda, Hague, Chester, Horicon, Moriah and Colonie) to evaluate the feasibility of landfill reclamation under different site conditions. Based on the studies conducted, reclamation is proceeding at Hague and Tonawanda. Results of the feasibility studies do support the need to identify landfill conditions and reclamation options before implementing a full-scale reclamation project. (10)

Several landfill reclamation projects have been implemented in Pennsylvania. The Lancaster County Solid Waste Management Authority (the Authority) is excavating the landfill and burning refuse in the RRF. The goals of the project are to reclaim landfill space, increase energy production at the RRF and recover ferrous metals and cover soil. The rate of excavation is dependent on the availability of processing capacity at the RRF and trucks for transport of the waste. Ash residue and unprocessibles are disposed in a lined landfill at the same site. In 1992, the Authority reclaimed approximately 1,000 cubic yards (765 cubic meters) of cover soil each week and sent approximately 2,000 cubic yards (1530 cubic meters) of reclaimed refuse to the RRF. (4)

The York County Solid Waste Authority (YCSWA) is evaluating the potential for landfill reclamation at its MSW landfill in Hopewell, PA to reclaim landfill space and reduce the potential for groundwater contamination by removing the contaminant source. A feasibility study was conducted in 1991 to consider environmental, technical and economic factors. Utilizing site-specific information generated by a field investigation, and considering existing solid waste disposal practices in the municipality and reasonable assumptions regarding landfill reclamation, the study illustrated that landfill reclamation was economically viable depending on project implementation. The YCSWA is proceeding with additional studies to develop an implementation plan for landfill reclamation and further assess the economic factors. (5)

In Bethlehem, PA, the City reclaimed a portion of the existing landfill to adjust final grades before closure. Regrading the landfill facilitated closure construction as well as maximized airspace utilization for the vertical expansion currently under construction. The City first conducted a demonstration project for reclamation during construction of the first cell of landfill expansion to illustrate the benefits of the project. The demonstration project was successful in meeting Pennsylvania Department of Protection's (PADER) specific guidance criteria for maximum slopes for expansion construction and gained daily cover and airspace for future operations. Also, the odor and litter problems anticipated by PADER were not realized. This will allow for implementation of landfill reclamation during construction of subsequent landfill expansion cells realizing larger cost savings. (1)

## CONSIDERATIONS

The landfill reclamation studies and projects conducted to date have illustrated that the technology may not be appropriate or feasible for all landfills. Proper planning is essential for implementation of a successful project. There are technical, economic, environmental, regulatory, contractual and administrative issues to be addressed before implementing a landfill reclamation

project. Feasibility or pilot-scale studies are typically conducted to characterize the landfill to be reclaimed; to develop an implementation plan for reclamation including equipment, personnel needs and materials management; and to conduct an economic analysis for the process. Regulatory requirements should also be identified before proceeding with this technology. Several of these issues are discussed below.

### Materials Management

Management of the reclaimed materials removed from the landfill is one key issue to be addressed before implementing a reclamation project. The composition of landfills will vary and is a function of age, climate, land use within the region, solid waste management practices during filling operations and the screening process utilized. For example, data collected from existing projects indicate that the ratio of refuse to soil differ at each landfill (see Table 1). For example, Collier County is reporting 20 to 25% refuse and 75 to 80% soil while the estimated percents of refuse and soil at the York County landfill is reversed. (3) (4) (5) (10)

Potential disposal options for reclaimed material will be dependent on its quality and quantity as well as the availability of solid waste disposal options within the geographic or governmental region. Refuse may be separated into recyclables, processibles/organics and nonprocessibles. Bulky material such as metals and tires may be recyclable. A tub grinder could be used to break up brush and tree trunks. Ongoing research projects are considering the possibility of separating and recycling other materials. The most likely route for disposal of the processibles or organic fraction is at a RRF or through composting. Refuse remaining after recyclables and processibles are disposed would be returned to a landfill as nonprocessibles. Soil may be utilized on-site and off-site for landfill cover, as general fill or as compost material. However, laboratory testing of the soil to determine its physical and chemical characteristics is required by most state regulatory agencies before approval is granted for refuse.

### Economics

Costs associated with landfill reclamation will be project-specific and include costs for excavating and screening of the material, management of the reclaimed materials and miscellaneous costs associated with the project. The costs for excavating and screening materials include equipment, labor and O&M costs. Data available on existing projects estimate these costs to range from \$.50/cy to \$6/cy (\$0.65/m<sup>3</sup> to \$7.85/m<sup>3</sup>). Costs for materials management will be incurred for tipping fees and transportation. These costs will be partially offset by revenue, if any, generated from marketing recyclables. Additional costs will be incurred for items such as testing of materials, administrative tasks, and hazardous waste handling.

For landfill reclamation to be cost-effective, the costs associated with undertaking a reclamation project should be offset by the benefit(s) gained through the process, that is, the savings (or avoided costs) in airspace gained, closure area reduced or resources

gained. As an example, the economic feasibility of landfill reclamation at the Hopewell Landfill in York County was analyzed by comparing costs for reclamation vs. no-action over the project planning period. The reclamation scenario developed for the analysis included reuse of the landfill capacity and considered variations in the rate of reclamation and conceptual plans for landfill development. The no-action scenario considered formal closure of the landfill and utilization of disposal capacity at a private landfill. Comparison of costs for these scenarios illustrates that the economic feasibility of reclamation for the York County landfill is dependent on the implementation plan for the project. (5)

### Regulatory Status

Landfill reclamation is not yet widely accepted by Federal and most State regulatory agencies. The case studies conducted to-date have been addressed by applicable regulatory agencies on a project-by-project basis. The success of these initial projects has led to expansion of the interest and acceptance of this innovative technology.

The USEPA sponsored a study of the Collier County, FL project under its municipal solid waste innovative technology evaluation (MITE) program and was also a co-sponsor of the landfill reclamation feasibility study in Edinburg, NY. In October 1993, the New York State Department of Environmental Conservation (NYSDEC) formally included landfill reclamation in that state's solid waste management regulations. Other states are beginning to consider similar projects in their region. A summary of existing state regulations regarding landfill reclamation will be published shortly by SWANA's Task Force on Landfill Reclamation.

The current regulatory status of a landfill site as well as the state's stance on the technology are important factors in the success or failure of landfill reclamation at that site. Identification of each should be accomplished as part of the evaluation of feasibility. Discussions should be held with appropriate local, State and Federal agencies early in the planning process to address their issues and concerns in the feasibility/pilot study.

### **SUMMARY**

The trend into the 21st century is to develop creative alternatives or solutions for solid waste management, and landfill reclamation could be one alternative for landfills. Traditionally, landfills are considered the "final resting place" for solid waste. Through landfill reclamation, material that originally was thought to be buried forever is now being excavated and recycled or reused. Implementation of this technology will require cost-effective integration of the process with other available and appropriate solid waste management technologies in an environmentally sound manner.

### **REFERENCES**

1. Campman C. and M.E. Everett, October 1995. "Vertical Expansion and Landfill Reclamation", City of Bethlehem Landfill, Bethlehem, PA.

2. Cobb, C. C. and K. Ruckstuhl, August 1988. "Landfill Mining: Giving Garbage a Second Chance", Solid Waste & Power.
3. Collier County Solid Waste Department, September, 1991, publication on Landfill Mining presented at Seminar.
4. Lancaster County Solid Waste Management Authority, Landfill Reclamation Brochure, Spring 1993.
5. Malcolm Pirnie, Inc., September 1991. Landfill Mining Feasibility Study for York County Solid Waste and Refuse Authority.
6. Minnesota Pollution Control Agency, January 14, 1993. personal communication with W. Myer.
7. Morelli, J., April 1990. "Landfill Refuse Strategies, Part II", Biocycle.
8. New York State Department of Environmental Protection, October 1993. 6 NYCRR Part 360-2.18.
9. New York State Energy Research and Development Authority, May 15, 1992. Town of Edinburgh Landfill Reclamation Demonstration Project.
10. New York State Energy Research and Development Authority, June 6, 1994. personal communication with J. Reis.

#### **BIOGRAPHY**

Ms. Guerriero is a senior project engineer with Malcolm Pirnie, Inc. in their corporate headquarters in White Plains, New York. For the past nine years she has been involved in various aspects of solid waste projects - environmental assessments, planning, regulatory affairs, and design. Her recent project work has focused on planning and design for expansion and closure of existing landfills as well as development of new ones.

**Table 1. Landfill Components**

	% Refuse (by volume)	% Soil
Collier County, FL	20	80
Edinburgh, NY	25	75
Lancaster, PA	80	20
York County, PA	70	30
Tonawanda, NY	70	30
Hague, NY	50	50
Horicon, NY	30	70
Chester, NY	75	25
Moria, NY	50	50