PERDIDO LANDFILL RECLAMATION PROJECT UPDATE

Sandra P. Jennings, PE
Escambia County Division of Solid Waste Management
13009 Beulah Road,
Cantonment, Florida
E-mail: spjennin@co.escambia.fl.us

Ronald C. Hixson
Escambia County Division of Solid Waste Management
13009 Beulah Road,
Cantonment, Florida
E-mail: rchixson@co.escambia.fl.us

Pradeep Jain, PhD, PE
Innovative Waste Consulting Services, LLC
6628 NW 9th Blvd. Suite 3
Gainsville, Florida
E-mail: pjain@iwcs.biz

ASTRACT

The Escambia County Division of Solid Waste Management (DSWM) owns and operates the Perdido Landfill, which contains both unlined and lined municipal solid waste (MSW) disposal areas and other waste management operations and facilities. Site-specific constraints limit the DSWM's ability to expand the landfill into the adjacent areas for future landfill operations. Additionally, the top elevation of the closed landfill cells (which span approximately 45 acres) is about 100 feet lower than the facility's permitted closure height and its slopes are less steep than those typically used in modern landfill operations. Furthermore, a pilot study showed that a substantial amount of soil was used in the historical landfilling operations in the unlined area. The unlined area has also been identified as a cause of groundwater impacts at the site (an issue that is currently being remediated). In light of these factors, a landfill reclamation project was considered to recover landfill airspace, recover soil, reduce future groundwater impacts by removing the waste buried in the unlined area, and to optimize the airspace use at the site. The DSWM has taken a phased approach to evaluate the technical and economic feasibility of the project and contracted with a construction firm in 2009 to reclaim approximately 20 acres of the unlined cells. This paper presents DSWM's landfill reclamation project evaluation approach and experiences from the project, including a summary of experiences pertaining to reclamation operations, impact on the other landfill operations, reclamation rates, and cost.

INTRODUCTION

Municipal solid waste (MSW) landfill reclamation (also frequently described as landfill mining) refers to the process of excavating previously-disposed materials from a landfill to recover soil, metal, glass, plastic, other combustibles, and the landfill volume itself (Morelli 1990, Nelson 1994, US EPA 1997). Landfill mining has been practiced to a limited extent throughout the United States. Several factors have motivated landfill operators to consider and implement landfill reclamation at their sites. The primary reasons are: (1) to address groundwater impacts caused by wastes in unlined landfills by removing the contamination source; (2) to create new capacity for future landfilling activities; and (3) to reduce closure costs by reducing the footprint area of landfill. An additional benefit to landfill reclamation reported in some cases is the recovery of recyclables for resale, particularly metals. When used as part of an integrated strategy for sustainable landfilling, reclamation may also serve as a means of recovering stabilized solid waste as part of bioreactor landfill operation (Nelson, 1994, Reinhart and Townsend, 1997).

After a rigorous technical and economic feasibility evaluation, the Escambia County Division of Solid Waste Management (DSWM) opted to reclaim approximately 20 acres of unlined cells at the Perdido Landfill (Escambia County, Florida). The anticipated benefits to reclaiming this area includes the creation of additional airspace for the county's future waste disposal needs and the removal of wastes which currently contribute to groundwater impacts at the site. This paper presents DSWM's project approach and experience and an update on the project.

SITE DESCRIPTION AND PROJECT MOTIVATIONS

DSWM owns and operates the Perdido Landfill. The site contains both closed and active Class I landfill areas, an active Class III waste area, and other related waste management operations and facilities. Figure 1 presents a layout of the site. From 1981 through part of 1990, Class I waste was disposed into approximately 45 acres of unlined landfill cells using the trench-and-fill disposal method. Construction and demolition (C&D) debris was later disposed in some portions of the unlined cells. The first engineered Subtitle D cell (Section 1), which is adjacent to the unlined cells, was constructed in 1990. Since then several lined cells – Sections 2A, 2B, 3A, 3B, 3C, and 4 – were developed at the site. Waste is currently disposed of in Section 4. Section 3C, which had a design capacity of 7 years, filled in 3 years because of increased disposal tonnages from Hurricanes Ivan and Dennis in 2004 and 2005, respectively. Section 4 was in design and permitting process at that time.

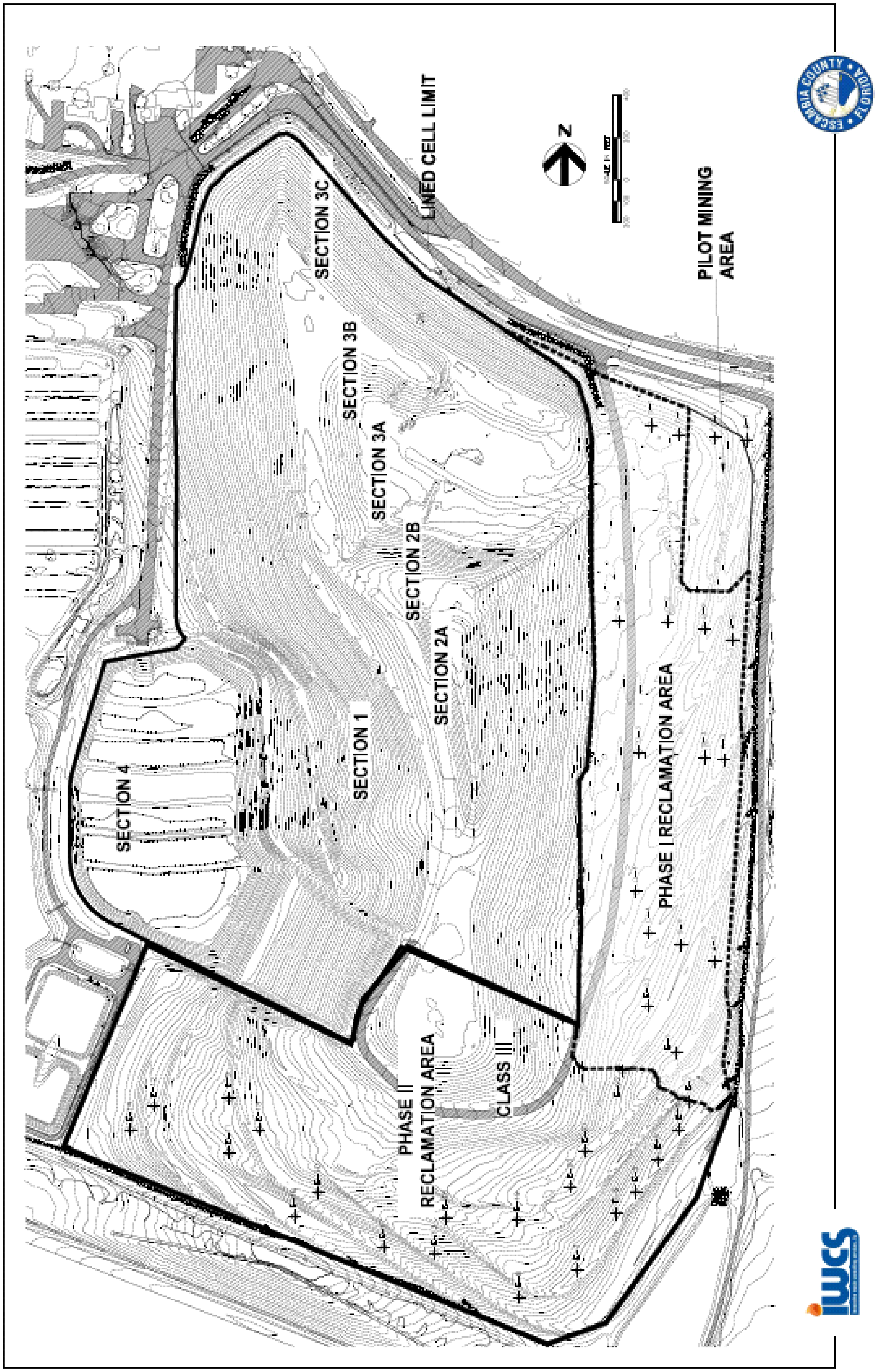

Figure 1. Site Layout

Because of the unexpected increase in waste disposal at the site, DSWM began exploring reclamation of the unlined cells in 2006 to develop lined cells to accommodate the County's waste disposal needs subsequent to the filling of Section 4. The unlined landfill area appeared to be a good candidate for landfill reclamation for the following reasons:

- The airspace above this area represented significant capacity for future waste disposal; the slopes were less steep than typically used in modern landfill operations, and the top elevation of these cells were 100 ft lower than the permitted elevation of the lined cells at the site. The reclamation of the unlined cells would increase utilization efficiency of the site's airspace, thus prolonging the time before the DSWM must secure new disposal capacity.
- Landfill gas and leachate migration associated with these cells have resulted in groundwater impacts outside the footprint of the landfill area; remediation activities are ongoing. The reclamation of these cells would reduce the future potential of environmental impacts and consequently reduce resources devoted to remediation by removing the contamination source.
- The maintenance of this site area has been challenging because of leachate outbreaks (seeps) and differential settlement. The reclamation of these cells would reduce maintenance issues and cost associated with seeps and settlement of these cells.
- The soil reclaimed by screening waste excavated from these cells would provide a source of cover soil for the future disposal activities at the site, therefore, reducing the need for borrow sites.

TECHNICAL AND ECONOMIC FEASIBILITY ASSESSMENT

In 2006, DSWM contracted Jones Edmunds & Associates, Inc (Jones Edmunds), which sub-contracted Innovative Waste Consulting Services, LLC (IWCS), to conduct a detailed technical and economic feasibility assessment for reclaiming the unlined cells at Perdido Landfill. In the first phase, IWCS conducted a desktop economic and technical feasibility analysis by collecting information from landfill reclamation projects conducted in the past. In the second phase, 39 boreholes were advanced to tag the waste bottom and eight test pits were excavated to collect site-specific waste composition data. The preliminary economic feasibility analysis was updated based on the data collected in the second phase. The key lessons learned from the first two phases of the evaluation are summarized as follows; details of this investigation can be found elsewhere (Jennings 2008; IWCS 2009). :

- The borehole data indicated that the historical topographic data available for the unlined cells were reasonably accurate representations of the landfill bottom. Estimates indicated that approximately 1.5 million cubic yards of material in the unlined cells (final cover soil and waste) could be mined without any substantial mining of the Class III waste that is deposited over a portion of the unlined cells.
- The thickness of final cover soil, which was measured at the 39 borehole locations, ranged from about 0.5 ft to 13 ft and comprised about 30% of the total volume of the material present in the unlined areas.
- The soil/fines fraction of the bulk excavated material (which consisted of a mixture of soil and MSW) was estimated to be 24% of the volume (60% by weight) of the material excavated from the unlined cells (this excludes the final cover fraction). This volume of soil also does not include the soil contained in the berms that separate the trenches of waste in the lower portion of the unlined cells.
- Leachate seepage was observed in two of eight test pits, suggesting that leachate seepage control may be an operational issue during full-scale mining.
- A waste screening evaluation suggested that a screen with an opening size between 1 inch and 3 inches would result in effective segregation of soil from the excavated waste material. Sufficient contact time between the material and the screen was observed to be critical for efficient soil separation.

In the third phase of its reclamation feasibility assessment, the DSWM conducted a pilot-scale landfill mining project to confirm some of the findings of the previous investigations and to further evaluate site- and project-specific operational issues and costs. The waste excavation, screening, and transportation activities for the pilot project were performed by Aero Training & Rental, Inc. (Destin, Florida) between early June 2008 and mid-November 2008. Approximately 46,000 cubic yards of waste were excavated from a 3-acre section of unlined landfill cells located east of Section 3C. The details of this project are presented in IWCS (2009). The findings of the pilot-scale project are summarized as follows:

- Soil constituted approximately 70% (by volume) of the excavated material (this figure excludes the final cover soil that was initially removed before excavation).
- The trommel screen was found to be more effective and more efficient than a shaker screen in separating soil from waste materials.
- No hazardous waste or asbestos-containing material was encountered during the pilot-scale project.
- Wetting of the waste from rainfall negatively impacted screen performance and hindered movement of dump trucks in and out of the mining area.
- Waste screening was determined to be the rate-limiting step of the project.
- Waste shredding before screening did not significantly improve soil separation from the excavated waste.

FULL-SCALE RECLAMATION PROJECT

Project Scope

Based on the findings of these evaluations, DSWM decided to reclaim a portion of the unlined cells, which entailed excavation of the final cover soil and MSW from the unlined cells, screening the excavated MSW to recover soil and fine materials (referred to herein as *reclaimed soil*), and transportation and disposal of the screened MSW in the active lined cell. DSWM decided to implement the full-scale project in two phases. DSWM contracted with IWCS to develop a Request-for-Proposal (RFP) to solicit proposals from qualified contractors in late 2008 for Phase I of the reclamation project, which entailed excavation of approximately 150,000 cubic yards (yd^3) of the final cover soil and approximately 450,000 cubic yards of the MSW (including soil) from approximately 20 acres of unlined cells. DSWM submitted a permit application for the reclamation activity and constructing lined cells on the reclaimed area (prepared by HDR, Inc.) to the Florida Department of Environmental Protection and received the permit in early 2009. IWCS was contracted to manage the full-scale mining effort.

Contracting Challenges and Approach

Defining a specific work scope was challenging because of uncertainities such as the actual waste and soil volumes to be excavated and unknowns such as whether dust, odor, and litter would be an issue, as well as frequency and volume of hazardous waste that could be encountered during waste excavation. To address these challenges, the RFP was structured using a combination of a unit-price contract and a lump sum contract. A unit price (\$/in-place yd^3) was selected for tasks such as soil excavation, waste excavation and screening, and special waste handling, while a lump sum price was solicited for items such as mobilization, demobilization, and environmental controls such as leachate and stormwater management, dust control, and litter control. In addition, a price quote was solicited for a number of contingencies such as unit price for containing and transporting asbestos containing materials and hazardous waste, and excavating and transporting waste to the active cell at the site for disposal without screening.

Also, several performance criteria were specified based on experience from the pilot mining project. The performance criteria included specification of 10% (by weight) as the maximum allowable soil content in the screened waste and specification of 3 inch as the maximum screening opening size. The RFP was published in April 2009 and the contract with the winning bidder (Aero Training & Rental, Inc.) was finalized in September 2009.

In-place Volume and Composition Estimation

DSWM surveys the area on a quarterly basis to estimate the in-place volume of the airspace reclaimed and provides to the contractor for billing purposes. However, this volume represents both the final cover soil and excavated waste volume and an estimation of in-place volume of these individual components is necessary for the contractor to bill DSWM for the reclamation activities.

The contractor and the DSWM agreed to estimate the in-place volume of the final cover soil by excavating 35 test pits and measuring the soil depth across the Phase I reclamation area before starting the project. Each test pit was approximately 10 ft × 5 ft in size and the excavation was advanced until waste was encountered. The average depth of the final cover in the mining area was determined to be approximately 6.7 ft. The in-place volume of the final cover soil excavated, transported, and stockpiled over a pay period is ultimately estimated by multiplying the average final cover soil depth by the area the soil is excavated from during the pay period.

The in-place volume of the excavated waste is calculated by subtracting the estimated final cover soil volume from the overall in-place volume (estimated based on the quaterly topgraphic survey). An estimate of the excavated waste composition was also required for contractual purposes. The waste composition (screened waste, reclaimed soil, regulated asbestos containing material, prohibited waste, and hazardous waste) is estimated by tracking the truckload counts of different waste materials transported from the reclamation area. Assuming that all the components of excavated materials (e.g., soil, waste, tires) undergo equal expansion upon excavation, the proportions of truckload counts provide an estimate of the excavated waste composition (by volume).

Equipment and Process Description

The contractor progressively mobilized six excavators, six 20-yd^3 articulated off-road trucks, two trommel screens, and three dozers at the site for the project. The final cover soil is excavated and stockpiled on site before starting waste excavation. The final cover is progressively removed during mining to minimize the exposed waste surface area. The waste is excavated in trenches. As presented in Figure 2, one excavator (CAT 325DL) equipped with a 1.25-yd^3 bucket is dedicated to both the final cover soil and waste excavation, as well as the loading of off-road trucks.

Figure 2. Waste Excavation and Transportation Operation

The waste is excavated in 10-to-20-ft-wide and 5-to-10-ft deep trenches aligned in the north-south direction. The trenches are started from north of the reclamation area and continued 200-500 ft towards the south. The waste excavation sequence results in exposed steep waste slopes. The excavation locations were sequenced such that the depth of the vertical waste face does not exceed 10 ft. This approach of waste excavation results in 10-to-20-ft-wide and 5-to-10-ft deep step(s) as shown in Figure 3.

Figure 3. Steps Resulting from Waste Excavation

The articulated off-road trucks transport the excavated waste to trommel screens. An excavator (CAT 320CL) loads the waste onto the trommel screens (Figure 4). The excavated waste is segregated into two fractions: the fraction passing through the 3-inch screen (reclaimed soil) and the fraction retained on the screen (referred herein as *screened waste*). The reclaimed soil is temporarliy stockpiled near the screen and then sent to Section 4 for use as daily cover. Largely, the reclaimed soil production rate has been adequate to meet the site's daily cover soil need. The DSWM staff and IWCS engineers randomly conduct visual inspections of the screened waste quality to evaluate the soil content of the screened waste.

Figure 4. Waste Screening Operation

One major aspect of the operations has dealt with the management of whole waste tires, which were permitted for disposal when the cell was originally filled but are currently banned from disposal in Florida landfills. Therefore, excavated whole tires are separated from the screened waste, stored in a 40-yd^3 roll-off box and eventually transported to the on-site tire management area (Figure 5).

Figure 5. Whole Tires Separation

The contractor takes routine measurements of the excavation area's air quality (methane, carbon monoxide, hydrogen sulfide, and oxygen). The exposed waste surfaces where no excavation is planned are covered with either a 6-inch soil layer or 6-mil polyethylene sheet to minimize exposed waste surfaces and limit the formation of leachate (Figure 6).

Figure 6. Covering the Exposed Waste Surfaces

Project Status

Based on a topographic survey of the reclamation area conducted on June 30, 2010, approximately 80,000 yd^3 of the unlined cells airspace has been reclaimed since the start of the project. Out of the total 80,000 yd^3, approximately 48,000 yd^3 consists of the final cover soil and the balance (about 32,000 yd^3) is waste. Figure 7 presents the composition of the waste excavated through June 30, 2010. The reclaimed soil constituted more than 60% (by volume) of the excavated waste. The loose volume of whole waste tires was about 750 yd^3, or 1% of the total. No asbestos-containing materials or hazardous wastes have been encountered to date. The average daily reclamation rate for April-June 2010 quarter was estimated to be approximately 750 in-place yd^3 per day. The average daily reclamation rate has been lower than antcipated primarily because of higher than average rainfall since the start of the project. Also, frequent screen breakdowns have impacted the reclamation rate.

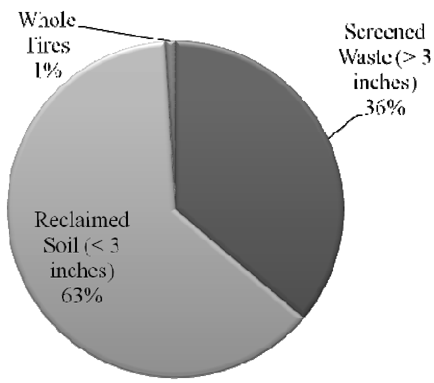

Figure 7. Excavated Waste Composition as of June 30, 2010

ACKNOWLEDGEMENTS

The authors wish to thank their families and the staff of the Perdido Landfill.

REFERENCES

IWCS (2009). Landfill Reclamation Demonstration Project. A report prepared by Innovative Waste Consulting Services, LLC and submitted to Florida Department of Environmental Protection and Escambia County Division of Solid Management http://www.dep.state.fl.us/waste/quick_topics/publications/shw/recycling/InnovativeGrants/IGYear9/finalreport/Perdido_Landfill_Mining_Report_final.pdf .

Jennings, S (2008). Landfill Waste Mining at Perdido Class I Landfill in Escambia County, Florida. WasteCon 2008, October 19-23, 2008, Tampa, FL.

Morelli J, (1990). Landfill Reuse Strategies. Biocyle, April, 60-61.

Nelson H, (1994). Landfill Reclamation Strategies. Biocyle, October 1994, 41-44.

Reinhart D, and Townsend T (1997). Landfill Bioreactor Design and Operation. Lewis Publishers, Boca Raton FL, USA.

US EPA, (1997). Landfill Reclamation. Office of Solid Waste and Emergency Response (5305W) EPA530-F-97-001, July, Washington D.C.