Landfill Reclamation of Cells 1 and 2
Collier County Landfill, Naples, Florida
EXECUTIVE SUMMARY

Collier County’s Solid Waste Management Department is responsible for ensuring that the County Landfill has sufficient capacity available for disposal of County’s solid waste. Accordingly, the Department prepared an Integrated Solid Waste Management Strategy (ISWMS) approved by the Board of County Commissioners in December 2006. The ISWMS is based on four guiding principles: (1) Environmental and Growth Management Compliance, (2) Airspace Preservation, (3) Operational Excellence and (4) Best Value Service.

In accordance with the ISWMS, the County implemented the reclamation project of unlined disposal areas (Cells 1 and 2) at the Landfill to build new, lined disposal areas where they were located. The project described for this nomination was completed ahead of schedule in December 2008 for a cost of $6.7 million saving over $1 million in recovered soils and other recyclables and an estimated $100 million in valuable landfill air space.

The idea of reclaiming old unlined landfills was first conceived by the County in the mid-1980’s when a pilot tests, as part of what was believed to be the first planned reclamation project in the country, were conducted and later funded by the USEPA for the Municipal Solid Waste Innovative Technology Evaluation program.
1. DESIGN AND CONSTRUCTION

The Collier County Landfill is located at 3750 White Lake Boulevard, Naples, Collier County, Florida, and approximately 300 acres in size. The landfill includes active and inactive areas (i.e., “cells”) used for the disposal of the garbage and rubbish generated in Collier County.

Cells 1 and 2 were unlined disposal areas, comprising approximately 32 acres, located near the northeast corner of the Landfill. These two cells were filled with solid waste from 1976 through 1979, and subsequently closed by the County and covered with a soil cap.

As part of the long term solid waste management strategy, Collier County started exploring various alternatives for re-using Cells 1 and 2. Realizing the potential uses of the 32 acres, a landfill reclamation study for Cells 1 and 2 was initiated in 1986. This project has been widely acclaimed as the first planned landfill reclamation project in the United States. In 1991, the U.S. Environmental Protection Agency selected the reclamation of Cells 1 and 2 as a demonstration project for the Municipal Solid Waste Innovative Technology Evaluation (MITE) program.

This study proved successful for recovering landfill cover material (i.e., soil). Approximately ten (10) acres of the southwest corner of Cells 1 and 2 were mined recovering 50,000 tons of soil suitable for landfill cover. The County also recovered significant amounts of ferrous metal and aluminum.

When the Collier County Solid Waste Management Department first developed the reclamation plan, their main objectives were:

- Decrease site closure costs
- Reduce the risk of ground-water contamination from an unlined landfill
- Recover soil for use as landfill cover
- Recover recyclable materials

In order to continue with the County’s strategy to design a cost effective landfill reclamation plan for Cells 1 and 2, a Site Characterization Study and Pilot Tests were completed by the County from 2001 through 2005. A total of thirty (30) test pits, thirty-six (36) soil borings to a depth of thirty (30) feet below surface placed in 200-foot square grids, and fifteen (15) gas monitoring probes were installed during these investigations. The results were incorporated in the final Landfill Reclamation Plan.
The test pits and the boring logs provided valuable information to determine the feasibility of reclaiming the remaining twenty-two (22) acres of Cells 1 and 2, and designing the landfill reclamation plan.

The Site Characterization Study for Cells 1 and 2 was based on the results of thirty (30) test pits spread out in a grid pattern over the footprint of Cells 1 and 2. These test pits were installed at approximately 200-foot centers. The vertical profile of the existing Cells 1 and 2 were developed by measuring the elevation of the top and bottom of each test pit, and the average thickness of the waste in Cells 1 and 2 was estimated to be approximately 10 feet deep including the soil cover. The field soil boring logs revealed that the waste was buried down to caprock that was measured at 7.5 to 8 feet above mean sea level (msl) along the north side of Cells 1 and 2, and approximately 4 to 7 feet above msl near the southern part. Based on the results of this study and the density results from the soil testing, approximately 380,000 cubic yards of waste were estimated to be in place within the landfill cells.

Basis of Landfill Reclamation Plan

- Total volume of waste and soils buried was estimated to be 378,922 bank cubic yards (bcy).
- A fluff factor of 1.25 was estimated for the waste after excavation.
- Total volume of waste and soils after excavation was estimated to be 473,715 loose cubic yards (lcy).
- The material composition is approximately 50 percent MSW and 50 percent soil by volume.
- The density of the soil was estimated to be 0.9585 tons/cubic yard.
- The density of the waste was estimated to be 0.603 tons/cubic yard.

In April 2007, the County issued a request for proposals (RFP # 07-4138) for reclamation of Cells 1 and 2, and after about eight (8) months of negotiations with the selected contractor, Waste Management Inc, of Florida, the contract was approved by the Collier County Board of Commissioners in October 2007. All the permits and approvals from state and local agencies were obtained in November with reclamation activities commencing in December 2007.
Landfill Reclamation Plan

The reclamation of Cells 1 and 2 at the Collier County Landfill was designed to implement the construction activities in accordance with a phasing plan commencing with the clearing of the existing vegetation on each phase, removing the surface debris, followed by a baseline survey certified by a professional land surveyor. The survey was updated on a monthly basis and at the completion of each phase of construction, and to the County for invoicing purposes.

A general description of the various work tasks are provided below.

**Mobilization**

During the mobilization all the necessary equipment, insurance, and bonds, setting-up temporary on-site field offices, and temporary utilities were obtained. In addition, this task also included obtaining all approvals and permits, construction of staging and equipment storage areas, preparation of a baseline survey of the project area, construction of barricades and security fencing, acquisition and installation of a leachate storage tank, acquisition and installation of the Odor Control System, and acquisition and delivery of all equipment, odor masking chemicals, and other supplies.

**Land Clearing and Removal of Surface Debris**

The foliage and vegetation, including trees, were first removed and transferred to designated areas for processing into mulch. In addition, this task also included removal of debris, including but not limited to tires, concrete pieces, carpet remnants, dry wall pieces, white goods and other bulky items located at the surface of the project area. Due to the highly irregular surface of the existing Cells 1 and 2 disposal areas some regrading was necessary to provide a suitable working surface for machinery and personnel.

**Soil Stripping and Stockpiling**

Soil stripping included removal of the existing soil cap that is over the solid waste in the project area, stockpiling of the soil, removal of the debris in the soil, including tires, concrete, and other bulky items, and placing soil over the exposed solid waste in the working face of the excavation at the end of each day of operations.

**Stormwater and Leachate Management**

This work task was included in the contract as a contingency to manage stormwater and leachate by use of pumps, berms, ditching and other methods to contain, control, store, and dispose of stormwater and leachate, as necessary. A 60,000 gallon frac tank was installed for collecting contaminated stormwater and leachate should it become necessary during South Florida’s wet season operations. The Environmental Controls section below discusses this in more detail.
CQA/CQC, Materials Testing, and Surveying

This work task included performing CQA/CQC tasks needed to ensure compliance with this Reclamation Plan and the Agreement between the County and the contractor, collecting, testing, and analyzing samples of in-situ soils, fines, leachate, and other liquids, surveying the work area before excavating any solid waste, surveying the work area and determining the amount of material that has been excavated, and preparing reports concerning the results of the CQA/CQC, materials testing, and surveys.

Excavation, Sorting, Screening, Loading, and Hauling of Separated Materials to Staging Area

This work task included excavating solid waste and soil from the project area, processing of the excavated material by using screening equipment to separate fines from residual waste, removing of recyclable material and unacceptable waste from the excavated material, placing recyclable material and unacceptable waste in staging areas on-site for transfer to designated recycling or disposal locations located off-site, and establishing safe grades in and around the perimeter of the excavated area.

Transfer Recyclable Materials and Unacceptable Waste

Once the excavated material was processed the recovered soils were transferred to designated areas for use as a cover material. All the recovered material was taken to the County’s scale house at the site for weighing, transferring recyclable materials to an appropriate off-site facility for recycling, and the unacceptable waste to an appropriate location for disposal.

Transfer Fines and Residual Waste

This work task included loading and transferring fines to an active landfill cell or designated area for use as initial cover, loading and transferring residual waste to the active working face of the landfill for disposal, loading impacted soil that cannot be used as initial cover and transferring such material to the active working face of the landfill for disposal.
Demobilization
This work task included removing equipment and barricades, restoring staging and storage area, and establishing safe grades in and around the project area.

Reclamation Equipment and Procedures
The contractor was required to generally follow the excavation in a “progressive method”. Excavation commenced in one section of the work area and proceeded across in a controlled manner. Prior to excavation, the entire work area was cleared of any trees and large brush. The stripped vegetation was stockpiled with the other unprocessed yard waste. The “working face” of the excavation was minimized to control odors and generation of leachate. All other areas remained covered with the existing soil cap until such time as they are to be excavated. Immediately prior to excavation, the soil cap (estimated to be 12 to 24 inches in depth) was stripped off of the area in the next stage of the progression. The contractor minimized the size of the area where the soil cap was removed in anticipation of excavating the solid waste.

Equipment and Personnel Requirements
As part of the plan approved by the County, the Contractor was required to provide equipment to perform the following activities, as a minimum. These requirements were modified based on the field conditions:

- Soil Stripping and Excavation
- Material Separation, Sorting and Screening
- Stockpile Management
- Material Loading
- Stormwater & Leachate Management
- General Excavation Activities

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>PERSONNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Truck</td>
<td>(1) Supervisor</td>
</tr>
<tr>
<td>Water Tanker</td>
<td>(2) Foreman</td>
</tr>
<tr>
<td>Link Belt 160 Track Excavator</td>
<td>(5) Operators</td>
</tr>
<tr>
<td>Link Belt 460 Track Excavator w/Thumb Attachment</td>
<td>(1) General Laborer</td>
</tr>
<tr>
<td>550 John Deere Excavator</td>
<td>(1) Technician</td>
</tr>
<tr>
<td>544 John Deere loader</td>
<td></td>
</tr>
<tr>
<td>938 Cat loader</td>
<td></td>
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<tr>
<td>Powerscreen 725/1800 Trommel Screener</td>
<td></td>
</tr>
<tr>
<td>D6N Cat Dozer</td>
<td></td>
</tr>
<tr>
<td>Volvo A30 D Articulated Truck</td>
<td></td>
</tr>
</tbody>
</table>
Project Schedule

Seasonal weather patterns in South Florida are an important consideration for planning construction schedules. They become even more important when you to plan landfill mining activities. Since the project started in December 2007 and was expected to be completed in about twelve (12) months, delays during the wet rainy season from June through November were to be expected.

With careful planning and working with the Contractor to increase the production rate with additional equipment and labor, the County was able to increase the production rate from approximately 21,000 cubic yards during the first full month of January 2008 to 74,000 cubic yards during the month of March 2008. The project was about 80% completed by the end of June. The remaining 20% was completed by the end of December 2008.

Reclamation Summary, Cost and Benefits

The summary of municipal solid waste excavated and processed for this project is shown in the charts and tables in this section. Overall, 54% of the excavated material was screened and used as initial cover material at the active landfill.
### Volume Excavated, cu yds

<table>
<thead>
<tr>
<th></th>
<th>Waste</th>
<th>Soil</th>
<th>Total</th>
<th>Total Remaining In-Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec-07</td>
<td>733</td>
<td>1,925</td>
<td>2,658</td>
<td>320,050</td>
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<tr>
<td>Jan-08</td>
<td>9,163</td>
<td>11,427</td>
<td>20,589</td>
<td>299,460</td>
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<tr>
<td>Feb-08</td>
<td>17,548</td>
<td>21,340</td>
<td>38,887</td>
<td>260,573</td>
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<tr>
<td>Mar-08</td>
<td>26,984</td>
<td>46,572</td>
<td>73,557</td>
<td>187,016</td>
</tr>
<tr>
<td>Apr-08</td>
<td>15,436</td>
<td>32,464</td>
<td>47,900</td>
<td>139,116</td>
</tr>
<tr>
<td>May-08</td>
<td>16,593</td>
<td>28,125</td>
<td>44,719</td>
<td>94,398</td>
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<tr>
<td>Jun-08</td>
<td>17,796</td>
<td>18,720</td>
<td>36,516</td>
<td>57,882</td>
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<tr>
<td>Jul-08</td>
<td>17,712</td>
<td>7,500</td>
<td>25,212</td>
<td>32,670</td>
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<tr>
<td>Aug-08</td>
<td>24,660</td>
<td>7,346</td>
<td>32,006</td>
<td>664</td>
</tr>
<tr>
<td>Sep-Dec 08</td>
<td>325</td>
<td>339</td>
<td>664</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total PTD</strong></td>
<td>146,950</td>
<td>175,758</td>
<td>322,708</td>
<td></td>
</tr>
</tbody>
</table>

### Waste-Soil Production Ratio

- Solid Waste Excavated (estimated) bcy: 54%
- Soil Excavated (estimated) bcy: 46%

Recovered soil stockpiled for use as initial cover.
Other materials recovered and recycled include 5,800 tons of concrete, 800 tons of tires and 195 tons of metal.

With an average processing rate of approximately 33,000 cubic yards per month, and a unit cost of $20 per cubic yard to excavate and process the municipal solid waste, the landfill reclamation project was completed well ahead of schedule and within the budgeted allotment.

The following chart shows the budgeted and the actual costs for completing the project.

<table>
<thead>
<tr>
<th>Item</th>
<th>Budgeted Costs</th>
<th>Actual Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Cost</td>
<td>$ 6 million</td>
<td>$ 5.9 million</td>
</tr>
<tr>
<td>Contingencies</td>
<td>$ 1.5 million</td>
<td>$ 0.8 million</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$ 7.5 million</td>
<td>$ 6.7 million</td>
</tr>
</tbody>
</table>

2. ENVIRONMENTAL CONTROLS

Prior to commencing landfill mining activities, there were a lot of concerns about potential environmental impacts from exposing municipal solid waste. These issues were addressed as described in the following paragraphs.

Vector Control

Vectors are defined as flies, birds, rodents or other disease carrying insects. During the pre-design phase of the project in 2004 and 2005, an evaluation for vectors was conducted by County contractors by excavating a 60-foot by 60-foot test pit to a depth of 5 feet and allowed to remain open for a period of two (2) months. No odors, birds, flies, rodents or other insects were noted during regular inspections of the excavated areas during the test time period. A second test was conducted when approximately 3,000 cubic yards of material was excavated from another area of Cells 1 and 2. This evaluation also proved negative for vectors.

Dust Control

As part of the contract, the County required the contractor to conduct real time air monitoring for particulates whenever the reclamation operations were underway. At a minimum, the contractor was required to use a water truck for the control of dust.
A total of three monitoring locations were used, including upwind, downwind and direct work area monitoring locations. The monitoring locations were adjusted, as needed, to effectively monitor Cells 1 and 2 in the event of changing wind conditions. The real time particulate monitoring data was collected at the breathing zone height using a MIE Data Ram or functional equivalent. The instruments were equipped with a data logger and downloaded for reporting purposes.

**Landfill Gas Controls**

During excavation of test pits, landfill gas was found in pockets of debris in the bucket of the track excavator at several locations on Cells 1 and 2. The gas quickly dispersed upon exposing the material to the atmosphere. Therefore, as part of the construction specifications, the contractor was required to measure methane gas with a portable landfill gas meter. No methane gas was reported during construction activities.

**Odor Controls**

Controlling odors for this landfill reclamation job was one of the important considerations for the County. During the pre-design phase, there was no evidence of objectionable odors from excavation of municipal solid waste from Cells 1 and 2. However, in order to comply with Collier County's Odor Control Policy, the construction specifications required implementation of an odor control system around the immediate vicinity of the project areas as shown in the photo. The misting system shown in the adjacent photo turned out to be very effective, as there were no complaints of objectionable odors from the surrounding communities.

**Stormwater and Leachate Controls**

Before excavation of waste commenced, the contractor installed a stormwater diversion berm around the work area to ensure that stormwater does not flow into it. This procedure minimized generation of leachate from stormwater coming into contact with solid waste.

One of critical issues that had to be addressed during the design phase was management of leachate during the wet season from June through November. Since the water table rises to 2-3 feet below grade at the landfill, it was very important to have a contingency plan to pump the leachate out the work area before it discharges to the surrounding environmentally sensitive areas.
A Leachate Management Plan was developed and put into place by the contractor, and the County made provisions, in the contract, for a standby 60,000 gallon frac tank to pump leachate and/or stormwater in the event there was a need to during tropical storms or hurricane events. Using additional equipment and resources, the contractor was able to complete more than 80% of the project prior to the on-set of the rainy season, and there was no need to implement the Leachate Management Plan.

**Groundwater and Soil Testing**

In order to ensure that there was no groundwater or soil contamination associated with the landfill reclamation project, a monitoring program using a combination of pre-existing monitoring wells and "test-as-you-go" sampling locations was implemented.

The testing program included a comprehensive list of parameters including the following:

- EPA Test Methods 6010 or 6020;
- Total Ammonia by EPA Method 350.1;
- Mercury by EPA Methods 7470/7471;
- Nitrate by EPA Method 353.2;
- Sodium by EPA Method 6010; and
- Chlorinated Pesticides by EPA Method 8081A.

Any recovered material that did not meet the State criteria for initial cover was managed and disposed as solid waste in the Collier County Landfill.

**Contingency Plan for Management of Hazardous Materials**

Based on the results of pre-design investigations, there was no evidence to show that the landfill cells contained any hazardous materials. However, since incidental amounts of hazardous waste from households or small businesses are often co-mingled with municipal solid waste, Collier County had a contingency plan and a $878,000 budget in place to manage any hazardous material and to pay for any unknown or unforeseen conditions that are encountered at the site. Unforeseen conditions included such things as additional liquid storage tanks, trucking and disposal of liquids, additional odor control measures, and handling and disposal of contaminated soils excavated during the reclamation activities. There was no need to take funds out of this contingency budget since no hazardous materials were encountered.
3. IMPLEMENTATION OF SUSTAINABILITY

By careful planning and design considerations, Collier County implemented a sustainable project taking into consideration the following factors:

1. The Design of Landfill Reclamation Plan was developed in order to provide beneficial reuse of an old 32-acre unlined landfill that not only had the potential to contaminate the groundwater and surface waters over the long term but also emitting methane, a greenhouse gas that is 21% more potent that carbon dioxide. With this reclamation project, all the residual municipal solid waste that could not be reused after processing was disposed of in a lined landfill with a very efficient leachate and a landfill gas collection system that will be connected to a landfill gas-to-energy plant for generation of power.

2. By reclaiming an old landfill and using the recovered area to build a new one has generated more than $100 million of landfill air space. This project has resulted in saving the natural resources by not having to site a new landfill and building the necessary infrastructure to meet the County’s needs for an equivalent landfill air space on environmentally sensitive un-disturbed lands.

3. Landfill gas generated from municipal solid waste that will be disposed of in the new cells will be collected and be part of the system that will deliver methane to a proposed landfill gas-to-energy plant that will generate revenue for the County on a long term basis.
4. PUBLIC ACCEPTANCE, APPEARANCE AND AESTHETICS

Nobody wants to see a landfill or any activities on landfills that could cause odors, vectors and other traffic or nuisance conditions in their neighborhood. With this understanding and the Not-in-My-Back-Yard (NIMBY) syndrome, Collier County officials realized early during the planning stages that siting new landfills or expanding within the general vicinity of the existing landfill will not be readily acceptable to the local community. So it was only natural to find a compatible re-use opportunity for the 32-acre landfill that would be easily accepted by the public with little or no controversies.

Prior to the kickoff of the project, a Public Meeting was held at a local Community Center prior to presenting the contract to the Board of County Commissioners for approval. A detailed Fact Sheet with photographs showing how the reclamation project will be implemented and the controls that will be in place to control odors and other potential environmental issues was made available to the public. Based on the response from the local media and judging from the response from the County Commissioners, the project was well received.

A short video that describes the success of mining Collier County Landfill Cells 1 and 2 is posted to the Collier County web site (http://www.colliergov.net/Index.aspx?page=119).
5. INNOVATION AND CREATIVITY

The Collier County Solid Waste Management Department has been one of the pioneers in landfill reclamation projects in the country. The idea of reclamation of Cells 1 and 2 at the Collier County Landfill was first conceived in the mid-1980’s. In 1986, Collier County initiated what is believed to be the first planned landfill reclamation project in the United States, and was closely watched by solid waste managers and regulators all over the country.

In 1991, the U.S. Environmental Protection Agency selected the reclamation of Cells 1 and 2 as a demonstration project for the Municipal Solid Waste Innovative Technology Evaluation (MITE) program. Based on the data available from the Collier County demonstration project, the USEPA, in July 1997, produced the document EPA530-F-97-001, titled "Landfill Reclamation" that is used as guidance for planning landfill reclamation projects all over the world.