Materials in Today’s Presentation

- Regulatory Basis for Financial Assurance & Cost Estimation
- Cost Estimating Resources
- Brief introduction to RACER Capabilities
- Cost Estimate Case Study for Landfill Closure & Post-closure
Cost Estimating Tools on Conference Website

- Maxey cost estimation presentation
- Guidance for Subpart G Closure & Subpart H Cost Estimating
- Sample RACER remedial action printouts
- Keystone landfill cost estimate
- Subpart H financial requirements
EPA Regulatory Basis for Cost Estimation

- RCRA Closure & Post-Closure
- Municipal Solid Waste Landfill Closure
- Corrective Action, RCRA
- Superfund Remedial Action
- Underground Injection Wells
- PCBs
- CERCLA 108(b)
## Closure Plan Contents

<table>
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<tr>
<th>Closure Plan Activities</th>
<th>Closure Regulatory Citation From Part 264, Subpart G</th>
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<td>Facility Description</td>
<td>111, Closure Performance Standard</td>
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<td>Closure Activities</td>
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Cost Estimating for RCRA Financial Assurance

• Regulatory Requirements for Closure, Post-Closure & Corrective Action
• Based upon Closure, Post-Closure & Corrective Action Plans
Facility cost estimates are required for Closure & Post-closure

- Facility cost estimates shall be based upon closure & post-closure plans
- Closure plan includes procedures & schedules for closing individual units & for final closure of the facility
- Based on estimates of the maximum inventory of hazardous waste present on site at any given time
- Plan includes descriptions of decontamination methods
- Post-closure maintenance usually is based upon 30-year periods of performance
Facility Cost Estimates Shall Reflect the Most Expensive Options

- Estimates shall reflect the maximum permitted quantities or volumes
- May need to provide either for new onsite disposal units, or for offsite T&D
- Estimates shall be predicated upon concurrent closure activities
Facility Cost Estimates Shall Reflect Third Party Costs

- Estimates shall not be based upon the use of in-house resources even if available
- Parent companies & subsidiaries shall not be considered to be third parties
- Use market-based pricing based upon outside, independent contractor services
Facility Cost Estimates Shall Preclude Salvage Credits & Zero Costs for Wastes Generated During Closure

- Potential salvage values – such as reusable drums or tanks – shall not be incorporated into cost estimate to offset costs
- Disposal costs for recycling of hazardous or non-hazardous materials with potential economic value shall not be assigned “zero” values
Update Estimates Annually for Inflation or Changes

- To account for inflation, either: recalculate estimates annually using current pricing, or multiply original estimate by an inflation factor

- If new units are added, expanded or closed, the cost estimate must be updated to reflect the changed conditions
Facility cost estimates are required for closures & post-closures

- Facility cost estimates shall be based upon closure & post-closure plans
- Each activity listed in a permit or plan shall be included & priced in the estimates
- Post-closure maintenance usually is based upon 30-year periods of performance
REGULATORY GUIDANCE

CostPro Software

- Developed by EPA in mid-1990’s
- Based on various Subparts of Part 264
- Used primarily for estimating costs of closure and post-closure
- Follows methodology of OSWER Directive 9476.00-6 (1986)
CostPro Modules

- Container Storage Area
- Tanks
- Surface Impoundments
- Waste Piles
- Land Treatment
- Landfills
- Incinerator/Boiler/Industrial Furnace

- Drip Pads
- Containment Buildings
- Decontamination
- Sampling & Analysis
- Monitor Well Installation
- Transportation
- Treatment & Disposal
CostPro Procedure

- Identify waste management units
- Identify closure & post closure activities
- Complete inventory work sheets
- Complete primary & secondary worksheets
- Evaluate cost summary worksheets
RACER Software

- Developed by USAF in early 1990’s for CERCLA/RCRA
- Used primarily for estimating costs of corrective actions
- Also includes some models for closures and post-closures, including various cap designs
- RACER has illustrations, costs, flowsheets, even if it is not used for estimates
- RACER can be used at feasibility study stage to improve remedy selection
Example RACER Technologies

- Cleanup & landscaping
- Load & haul
- Feasibility Study
- UST Site Assessment
- Air Stripping
- Carbon Adsorption
- Coagulation/ Flocculation
- Solidification/ stabilization
- Off-site Transportation & Disposal
- Slurry Walls
- UXO Clearance
- Asbestos Removal
Suncor Refinery

- Operating refinery in Denver, CO
- Past releases have resulted in soil and groundwater contamination
- Currently using containment to halt off-site migration
Remedial Action Component Selection Using RACER

Remedial Action Wizard Guides Technology Selection:

1. Step 1 – Choose media: GW + fuels/semivolatiles as contaminants
2. Step 2 – For fuels, select among: air sparging, in-situ biodegradation, slurry wall, permeable reactive barrier, bioslurping
3. Step 3 – Choose technology for semivolatiles
4. Step 4 - Technology list (next slide)
Program Uses for RA Wizard

- CERCLA Feasibility Study Options Selection
- Provision of Financial Assurance for RCRA CA 550
Oxygen Injection System

- Air Sparging
- Overhead Electrical Distribution
- Decontamination Facilities
- Residual Waste Management
- Professional Labor Management
- 8 Groundwater Monitor Wells
- Corrective Measures Design
- Operations and Maintenance
Anatomy of a Landfill

Creating A Cell
Each day an area is level and graded and a layer of compacted soil is placed over the previous day's leachate layer. The landfill is then covered with a layer of soil. A completed cell may be added to or may be left as a final cell.

Holding Pond
The leachate formed in a landfill may be pumped into a holding pond. The leachate is broken down through evaporation, then taken to a waste treatment facility.

Soil Layer
A 6 to 12 layer of soil is added over the final cell and this layer is compactioned. The average layer may add to the landfill to create this block type of soil.

Granular Drainage Layer
The action of leachate may form small trickles of water. Drainage pipes are placed in the granular layer to collect leachate and carry it to a leachate collection system.

Textile Mat
A tarp is placed over the granular layer to prevent leachate from discharging into the groundwater.

Plastic Liner
This polyethylene liner is designed to prevent leachate from discharging into the groundwater.

Geotextile Mat
A fabric, textile material protects the plastic landfill liner from the grouted in the asphalt course layer.

Leachate (Arrows)
Leachate is a byproduct of leachate flow in the landfill. It is handled with a series of leachate collection systems and a leachate treatment facilities.

Liner Seams
Sections of the plastic landfill liner are bonded together by heat welding. Seams are treated while the landfill is in use for strength and impermeability.

Landfill Walls
The walls of the landfill are lined with a geosynthetic composite material that is impervious to liquid and vapor.

Buffer Area
The buffer area, where water may be removed to cover the landfill, is the area within the pit. Compaction waste, inert materials such as wood and concrete, may be buried in the buffer area.

Site Analysis
A study must be made of an area before it can be approved as a landfill site. The analysis examines the wildlife living in the area, as well as the condition of the soil, bedrock, and below.

Compacted Clay
Compacted clay must separate a layer of soil from groundwater. If not, then the clay can become a leachate beneath the soil. This layer is compactioned to create the block type of soil.

End Use
When a landfill is declared full, it can be covered with a synthetic liner and a layer. The area may then be converted into a park, golf course, or other open-space project.

Landfill Managers and Constructors for Local Governments
Typical RCRA Cover

Top Cover (6 inches)
Soil Cover (18 inches)
Composite drainage net (double-sided) (12 inches sand)
40 mil HDPE liner (24 inches)
Compacted clayliner (24 inches)
Composite drainage net (double-sided)
Leveling Layer (6 inches)
Vent Layer
Impermeable Layer (24 inches)
Drainage Layer

6 inches
30 inches
<table>
<thead>
<tr>
<th>Material</th>
<th>Diameter Range Limits (mm)</th>
<th>Typical Permeability (cm/sec)</th>
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<tbody>
<tr>
<td>Boulder</td>
<td>256&lt;</td>
<td>0.1</td>
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<tr>
<td>Cobble</td>
<td>64 to 256</td>
<td>0.01</td>
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<tr>
<td>Pebble</td>
<td>2 to 64</td>
<td>0.001</td>
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<tr>
<td>Sand</td>
<td>1/16 to 2</td>
<td>$10^{-4}$</td>
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<tr>
<td>Silt</td>
<td>1/256 to 1/16</td>
<td>$10^{-5}$</td>
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<tr>
<td>Clay</td>
<td>&lt; 1/256</td>
<td>$10^{-7}$</td>
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<tr>
<td>Taxes</td>
<td>Cap Estimate</td>
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<tr>
<td>-------------------------------------------</td>
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<td></td>
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<tr>
<td>• Wage income</td>
<td>• Construction layers</td>
<td></td>
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<tr>
<td>• Interest income</td>
<td>• Sources of clay, sand, fill &amp; haul distances</td>
<td></td>
</tr>
<tr>
<td>• Asset sales</td>
<td>• Width, length &amp; depth of cover</td>
<td></td>
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<tr>
<td>• Personal exemptions</td>
<td>• Stormwater control</td>
<td></td>
</tr>
<tr>
<td>• Tax deductions</td>
<td>• Gas collection system</td>
<td></td>
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<tr>
<td>• 401(k) deductions</td>
<td>• Geomembrane, geotextile costs</td>
<td></td>
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<td></td>
<td>• Location determines labor costs</td>
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Basis of Cap Estimate

- Landfill is 250 ft x 500 ft, 2.9 acres, 15 ft deep
- Clay cost: $16.50 per cubic yard
- Geomembrane: $0.41/ft²
- Sand cost: $21.85 per cubic yard
- Topsoil cost: $33.15 per cubic yard
- Geotextile: $9.09/yd²
- Fill cost: $18.25 per cubic yard
- Soil material can be adjacent to site (1 mile) or close (within 20 miles)
CostPro Outputs for Keystone Landfill

- LF-2: Summary
- LF-3: Installation of Undifferentiated Fill
- LF-4: Installation of Clay Layer
- LF-5: Installation of Geomembrane
- LF-6: Installation of Drainage Layer
- LF-7: Installation of Earthen Layer
- LF-8: Installation of Topsoil
- LF-9: Establishment of Vegetative Cover
- LF-12: Installation of a Gas Collection System
- LF-14: Installation of a Storm Water Control
- LF-15: Survey Plat
- LF-16: Certification of Closure
CostPro Outputs for Keystone Post-Closure

- PC-2: Removal of Leachate
- PC-3: Site Security
- PC-4: Maintenance of Vegetative Cover
- PC-5: Maintenance & Inspection
- PC-6: Groundwater Monitoring
- PC-7: Deed Notation
- PC-11: Certification of Post-Closure
Important Topics for Understanding of Cost Estimates

- Sampling & analysis
- Waste disposal
- Waste transportation
- Remedial operations
- Materials costs
- CostPro estimates closure/post-closure costs
- RACER estimates remedial action costs
Information Sources for Review of Cost Estimates

- RCRA Part B Permit
- Closure Plan
- Facility cost estimate
- Work plan
- Mine Plan of Operations
- Company annual reports, 10(k)
Tips for Cost Estimate Review

• Know what facility is doing with decontamination & other water
• Verify easily understood disposal costs
• Thoroughly review facility submissions to understand what is being presented
Typical Errors in Facility Estimates

- Low waste disposal costs
- Low materials costs
- Low sampling costs
- No maintenance of ongoing remedial operations