



Landfill Airspace Efficiency

The Right Equipment And The Right Amount of Soil

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Agenda

PART 1

- Airspace Measurement Best Practices
 - Airspace Utilization Density (AUD)
 - Landfilled Waste Density
 - Landfill Cover Soil Utilization
 - Cover Soil vs. Density
 - Role of Alternate Daily Cover

PART 2

- Achievement of Airspace Goals
 - Post-Collection Safety
 - Personnel & Leadership
 - Equipment Selection
 - Equipment Maintenance

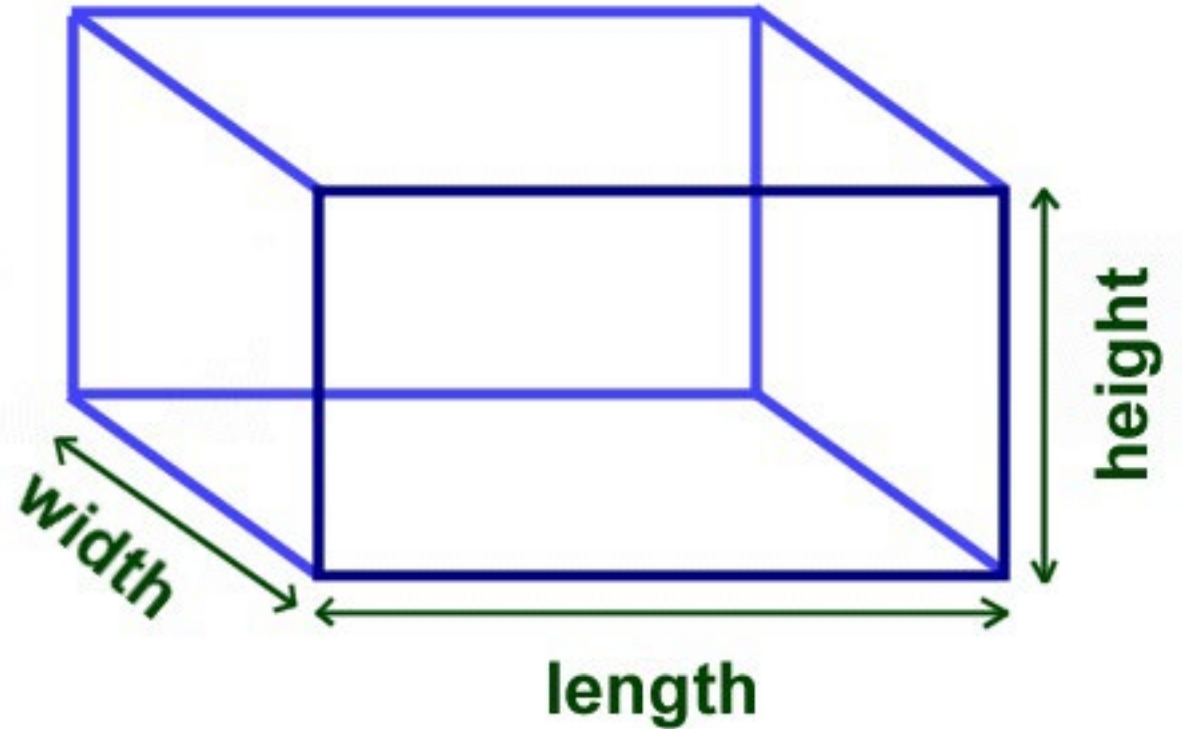


Part 1

Airspace Measurement Best Practices

What Are We Measuring?

- Airspace – The volume of space which is permitted for disposal
 - Saleable commodity
 - Community Resource
- Bulk Density – Weight of a unit volume
 - Weight / Unit Volume
 - Pounds per Cubic Yard



What Are We Measuring?

- Landfilled Waste Density
 - Compaction efficiency reporting parameter
- Airspace Utilization Density (AUD)
 - Primary landfill performance reporting parameter



Landfill Airspace Utilization

Landfilled Waste Density

Weight (of waste)

Volume (of waste)

Volume in this equation should not include soil



Example Waste Densities

<u>Location</u>	<u>Density (lb/cy)</u>
Curb Side	150-300
In Truck	500-1,000
Working Face	
Before Compaction	400-600
After Compaction	750-1,500



Landfill Airspace Utilization

Airspace Utilization Density

$$\frac{\text{Weight (of waste)}}{\text{Volume (of airspace)}}$$

Volume in this equation should include soil, material used in roads, etc.



Effect of Including or Excluding Cover Soil Volume on Density

- Weight of Waste – 1,000 pounds
- Waste-to-Soil Ratio – 4:1 (80% waste, 20% soil by volume)

AUD including soil – 800 lb/CY (1.25 CY total volume consumed)

LWD excluding soil – 1,000 lb/CY (1 CY of waste)

Note: To achieve 1,200 lb/CY excluding soil, waste must be compacted to half its volume out of the truck.

Landfill Airspace Utilization

AUD has short-term and long-term values.

Short Term – Quarterly, Annual

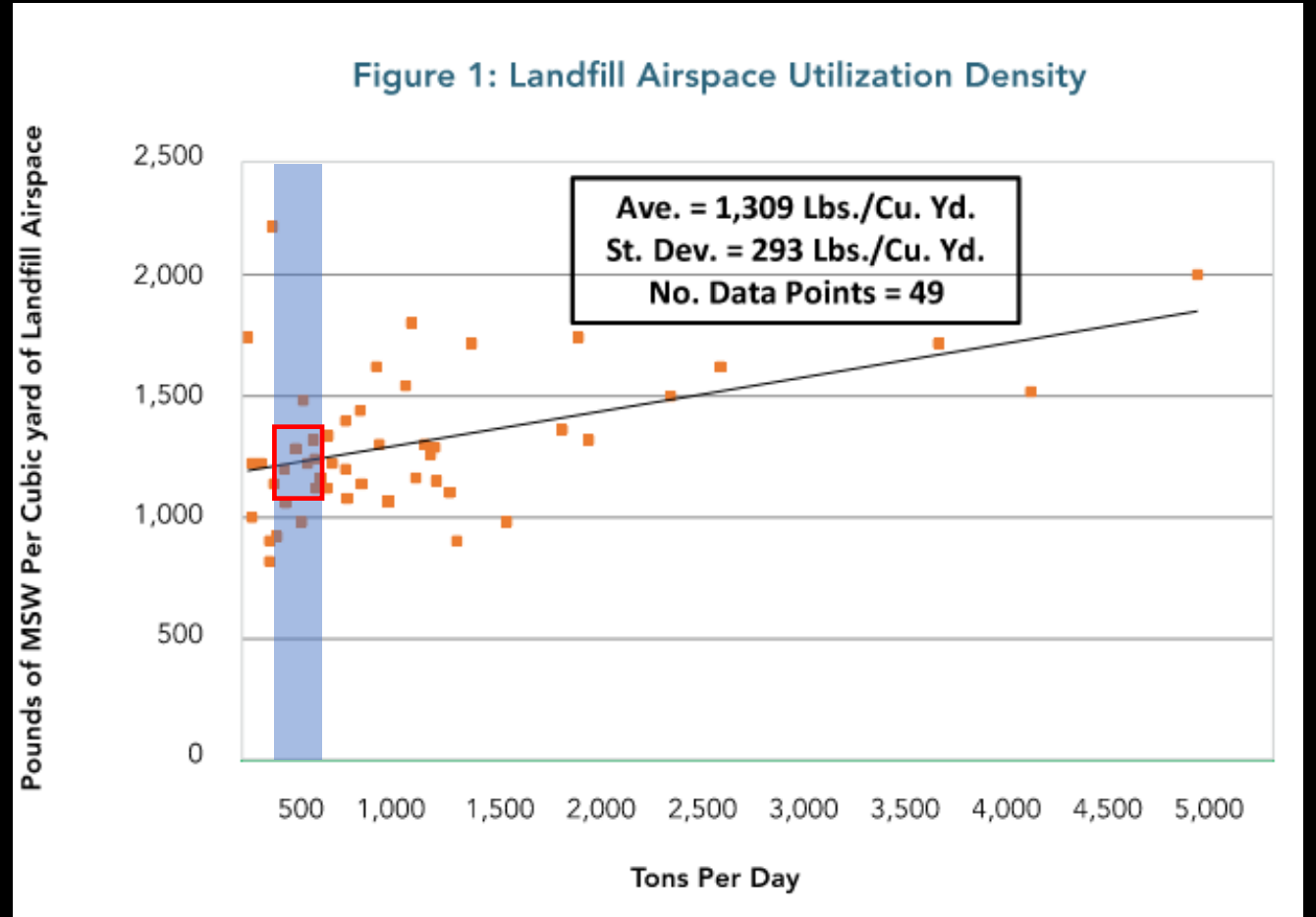
Long Term – Lifetime

Increases over time due to decomposition and settlement



AUD Statistics

- 2018 study completed by the SWANA Applied Research Foundation
- 500 tpd landfill
 - Avg: 1,250 AUD
 - St. Dev.: 293 lb/CY
- Statistical Normal is: 1,100 to 1,400



Source: May 2018, Solid Waste Association of North America (SWANA) Applied Research Foundation; *Benchmarking The Performance and Costs of MSW Landfills*

Landfill Cover Soil Utilization

The quantity of cover material used directly affects AUD

Decreasing cover usage increases AUD



Landfill Cover Soil Utilization

Soil Usage Ratios

Many (most) sites use a waste-to-cover ratio as an operational performance indicator

Waste-to-Soil Ratio and Percent Volume of Cover Material Relationship	
Waste-to-Soil Ratio	% Of Volume Consumed by Soil
1:1	50%
2:1	33%
3:1	25%
4:1	20%
5:1	17%
6:1	14%
7:1	13%
8:1	11%
9:1	10%
10:1	9%

Landfill Cover Soil Utilization

Soil usage per ton of waste may be a better metric because it encourages increased waste compaction

A site achieving 800 lb/CY LWD and a 4:1 waste:soil ratio uses significantly more soil as a site achieving 1,200 lb/cy LWD and a 4:1 waste:soil ratio



Let's Dig Into Cover Soil Usage

- 500 tpd at 800 lb/CY LWD and 4:1 waste to soil ratio
 - Waste occupies 1,250 CY ($500 * 2000 \div 800$)
 - Soil occupies 312 CY (0.62 CY/ton)
 - Total airspace used 1,562 CY – 640 lb/CY AUD
- 500 tpd at 1,200 lb/CY LWD and 4:1 waste to soil ratio
 - Waste occupies 833 CY
 - Soil occupies 208 CY (0.41 CY/ton)
 - Total airspace used 1,040 CY – 960 lb/CY AUD

BOTH sites achieve 4:1 ratios, but one uses 2/3 the soil.

Using the soil metric of CY soil per ton of waste allows you to identify and reward practices that minimize cover soil used.

SWANA reports the average is about 0.40 CY per ton

Landfill Cover Soil Utilization

Soil Tracking

- # Trucks
- Truck Capacity
- % full

$$7 \text{ trucks} * 29.7 \text{CY} * 95\% = 200 \text{CY}$$

$$200 \text{CY} \div 0.4 \text{ CY/ton} = 500 \text{ ton}$$



Role of Alternate Daily Cover

- Daily soil cover is a thin layer of compacted soil on top of exposed waste, typically placed by a dozer.
- Daily cover is important
 - Prevents fires
 - Prevents fugitive odor
 - Prevents blowing litter
 - Prevents scavenging
 - Prevents vector propagation



Role of Alternate Daily Cover

- ADCs gained attention in 1993 when the EPA published “*The Use of Alternate Materials for Daily Cover at Municipal Solid Waste Landfills*” (EPA/600/SR-93/172)
- Evaluated
 - Characteristics
 - Material and equipment requirements
 - Methods of preparation and application
 - Climatic considerations
 - Operational considerations
- Found that
 - Easily applied
 - Satisfied regulatory requirements
 - Saved capacity
 - Effectively facilitated management of leachate and landfill gas



Source: New Waste Concepts, Inc.

Role of Alternate Daily Cover

- What is ADC exactly?
- EPA definition “*Alternative Daily Cover (ADC) is cover other than soil, such as spray slurries, tarps, foams, vegetative waste and ash*”
- RCRA Subtitle D changed landfill operations dramatically for the better with daily cover requirements
- Soil cover has no Return on Investment
- EPA gave the industry a way to lower disposal cost to combat rising development costs



Source: Tarpomatic, Inc.

Role of Alternate Daily Cover

- Soil daily cover can consume up to 20% of landfill volume
 - 500 ton/day facility at 4:1 waste:soil ratio this is:
 - 200 CY soil per day (60,000 CY/year)
 - Every 5 years you save 1 year of airspace
 - 120 tons per day of airspace
 - 36,000 tons per year @ 300 days of operation
 - \$720,000 per year @ \$20.00 per ton
 - 100 ton/day facility at 4:1 waste:soil ratio this is:
 - \$150,000 per year



Source: EPI Environmental Products, Inc.



Part 2

Achievement of Airspace Goals

How Do We Get There?

1. Do we have the correct safety culture?
2. Do we have qualified & professional staff?
3. Do we have the right equipment?
4. Do we have the right maintenance culture?



SAFETY

What does a robust safety culture look like?

How much time do we spend reacting to safety incidents and injuries?

How much time do we spend training and mentoring?

DUKE Energy OSHA TCIR < 1.0!



SAFETY

- Are all “accidents” preventable?
- Does Leadership prioritize, teach and mentor a world-class safety culture?
- Have we achieved the “Brother’s Keeper” status? (Brother’s/Sister’s)



SAFETY

What's Wrong With This Picture?



SAFETY

- What's wrong with this picture?



Personnel

What does our training program look like?

Safety:

Annual Training and OSHA?
Monthly, Weekly, Daily?

Equipment:

Peer Training?
Manufacturer Training?
Technology Updates and Refresher Training?
Equipment Certifications?

Operations:

Do we have a plan?
Bottlenecks & Gridlock?
Are we conducting a symphony?

SHARE THE WHY!



Personnel

Leadership

- Do we spend time daily in operations?
- Do we see front-line employees daily?
- Do we know everyone's name?
- Are we pro-active or reactive?
- Do we formally meet with all staff on a regular basis?
- Do we keep up with operations technology?
- Are we knowledgeable about our equipment?

If leadership cares, everyone cares.



Personnel

- What's wrong with this picture?



Equipment

- What's wrong with this picture?



Equipment

- Do we have the proper amount of horsepower at the face?
- Low Horsepower can create employee stress and turnover, customer frustration
- High horsepower will cause excessive and unnecessary operating and maintenance costs.



Equipment

Do we have the right support equipment?

LGP Dozer for slope maintenance and daily cover.

Water Trucks / Dust Control.

Road Maintenance / Motor Grader.

Proper support equipment improves facility safety, customer experience, employee engagement and operational efficiency.



Maintenance

How can we have zero unplanned downtime?

Do we have an operator centric program?

Properly trained operators can:

- Detect machine issues in the moment.
- 360 Walkaround 3X per day.
- Sees and feels equipment every day.



Maintenance

Do we invest in training for maintenance staff?
Do we have a goal for machine life?
Do we have a goal for G.E.T. life?

Do we clean undercarriages daily?



Do we have a schedule for wheels, undercarriage, and cutting edge replacements?

Do we track component life?



SAFETY

= Employee Engagement

= Productivity

= World Class Operations



SAFETY IS A MINDSET



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QUESTIONS?

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