Accurately Predicting Landfill Site Life

SWANA Old Dominion Chapter

July 2010

Geosyntec consultants

Thomas Ramsey, P.E.

Why is it important to predict landfill site life?

- Short-term: Know when to build the next cell or the next landfill.
- Financial: Accrue accurately for closure and post-closure care.
- Long-term: Solid waste planning.

What is Site Life?

- Time before airspace is consumed (for a specific cell or for entire site)

- Remaining Life (days) =

$$\frac{\text{Remaining Volume (cy)} \times \text{Waste Density (tons/cy)}}{\text{Waste Filling Rate (tons/day)}}$$

Remaining Airspace Volume (cy)

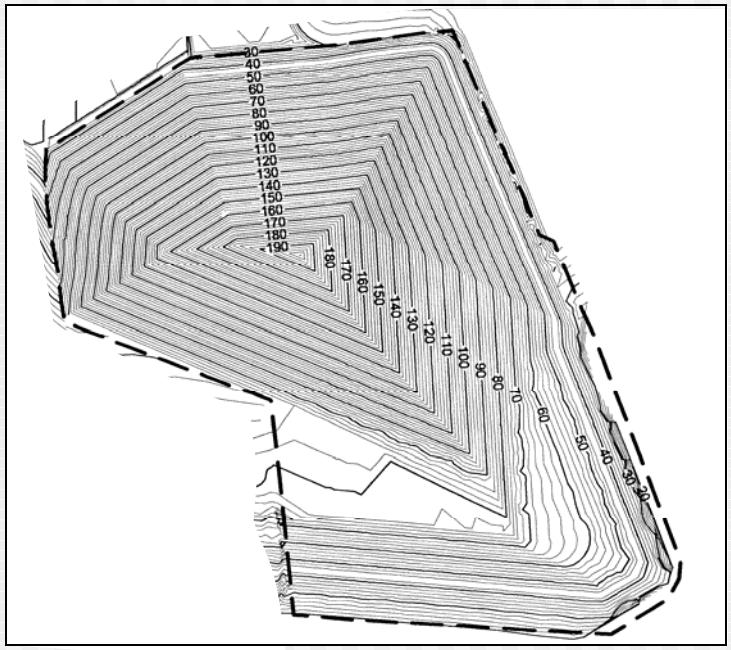
1. Compare Final (Design) Grades to Existing Grades
2. Generate Cut/Fill Contours (Isopach)
3. Examine Isopach to make sure cut is “real” cut and fill is “usable” fill

Remaining Airspace Volume (cy)

1. Compare Final Grades to Existing Grades

Existing Grades

Final (Design) Grades



Remaining Airspace Volume (cy)

2. Generate Cut/Fill Contours (Isopach)

Remaining Airspace Volume (cy)
3. Examine Isopach

- Some of the cut could be:
  - real overfill of waste
  - soil stockpile
- Some of the fill could be unusable:
  - on side slopes
  - thin layer not worth filling

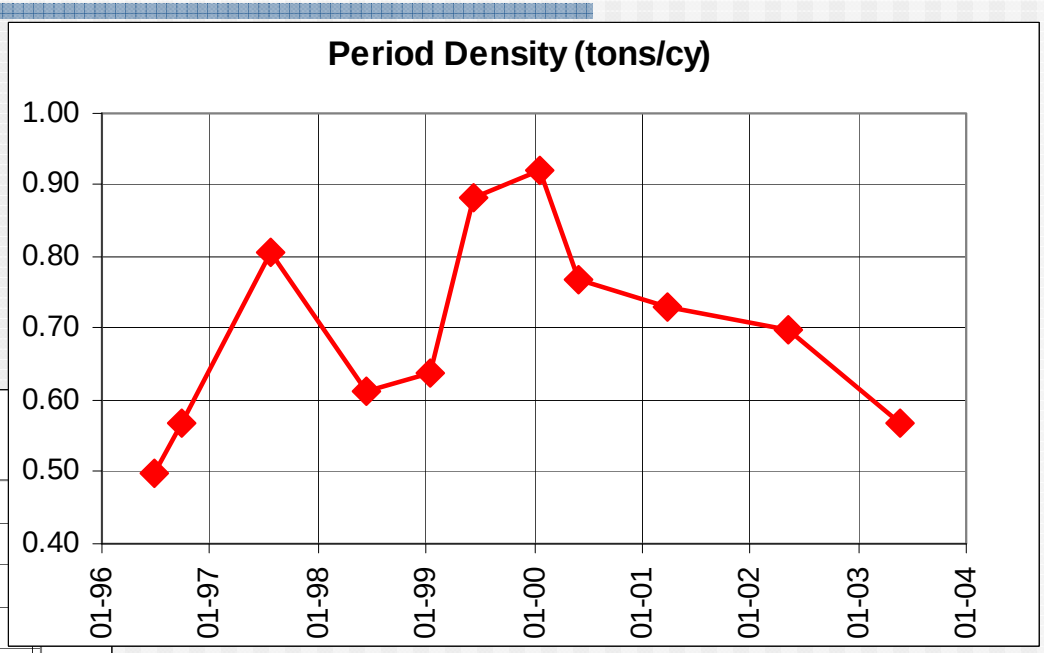
Definition of Waste Density

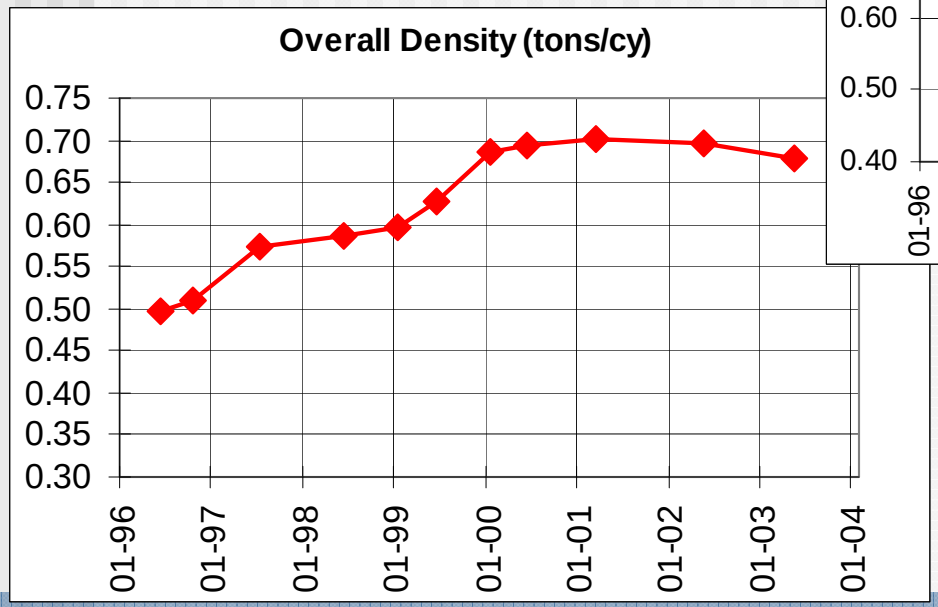
- Waste Density is defined herein as

$$\frac{\text{Weight of Waste at Gate (tons)}}{\text{Consumed Airspace (cy)}}$$

- Daily and intermediate cover is addressed in consumed airspace

Waste Density Achieved





Geosyntec consultants

Issue

- We can tell what happened in the past, but can we predict the future??
- There are no well-established models available today that can accurately predict site life.

Site Life Model

- Remaining Life (days) =

$$\frac{\text{Remaining Volume (cy)} \times \text{Waste Density (tons/cy)}}{\text{Waste Filling Rate (tons/day)}}$$

Factors that Affect Remaining Volume

- Factors:
  - Fill to grade
  - Set waste limits accurately
  - Establish strong vegetation on slopes

Conceptually simply, but can be difficult in reality!

Factors that Affect Waste Density

- Degree of waste compaction (weight of compactor and number of passes)
- Depth of landfill (settlement)
- Daily cover use (soil vs. alternative)
- Type of waste
- Leachate recirculation or injection

Waste Density Data in the Literature

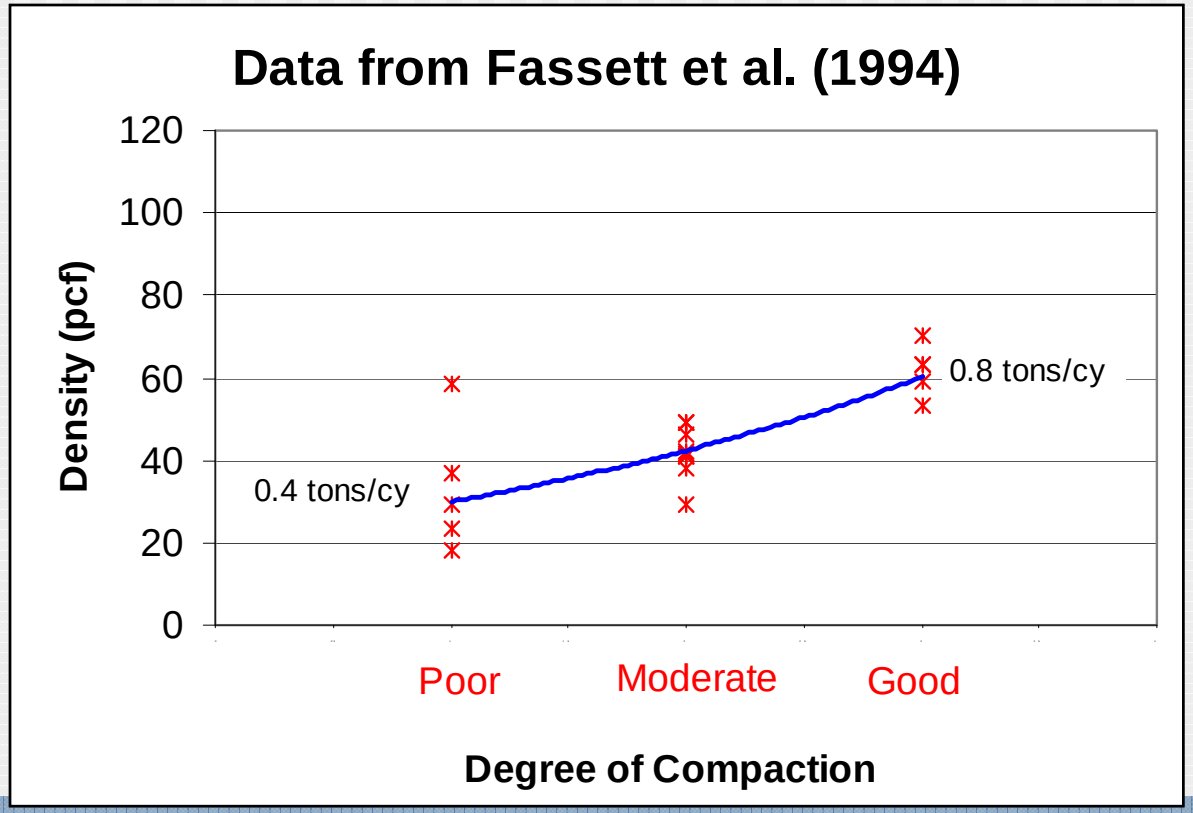
Source	Density (tons/cy)
Sowers (1968)	0.41 - 0.81
NAVAFAC (1983)	0.27 - 0.81
NSWMA (1985)	0.59 - 0.95
Landva and Clark (1986)	0.77 - 1.13
Tchobanoglous et al. (1993)	0.31 - 0.63
Fasset et al (1994)	0.27 - 1.28

Factors that Affect Waste Density

- Degree of waste compaction

Factors that Affect Waste Density

- Degree of waste compaction



Factors that Affect Waste Density

- Degree of waste compaction

Environmental Science Associates and Pryde Roberts (1995) conducted a survey on 24 landfills in California.

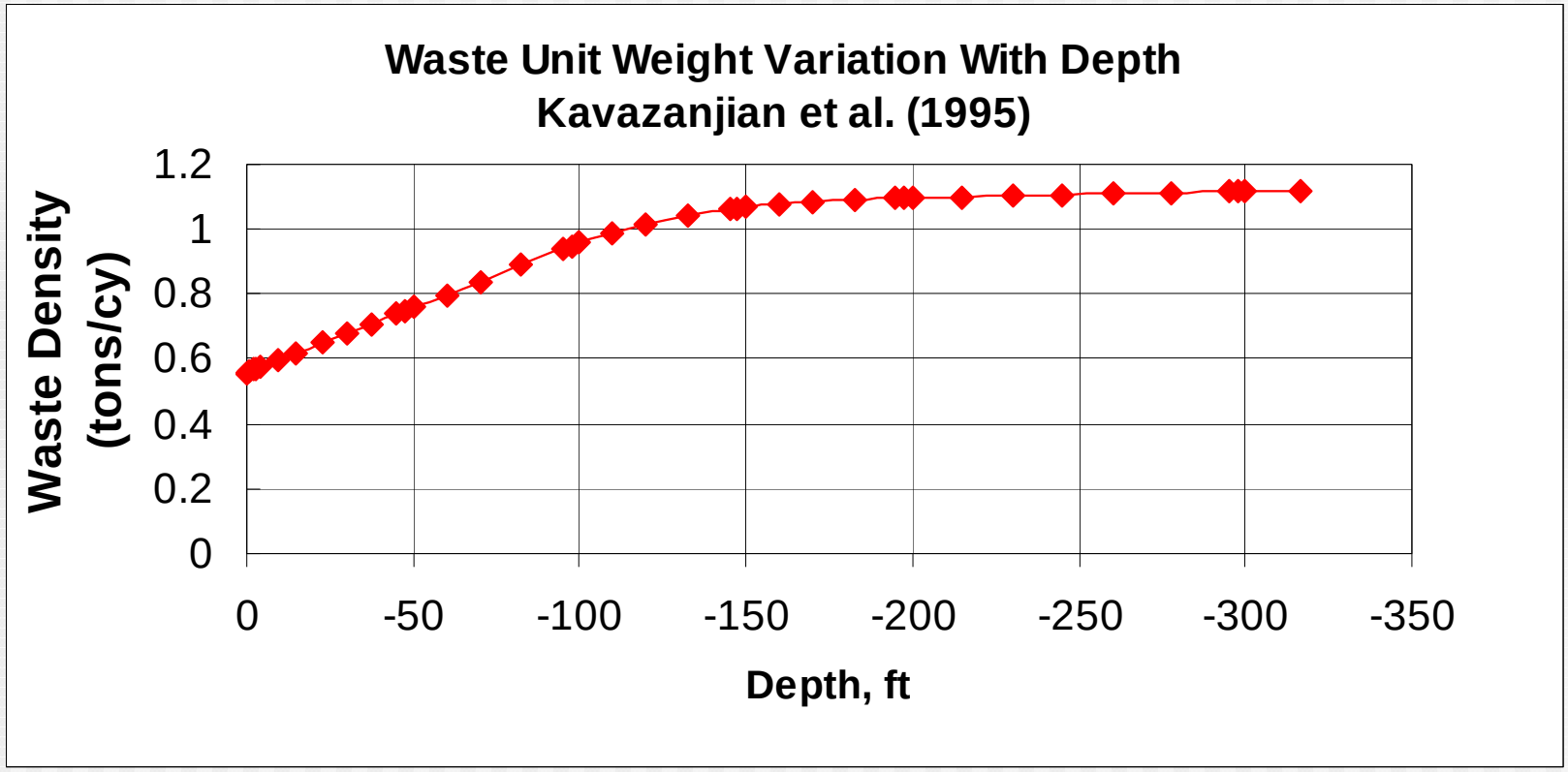
0.18 tons/cy with zero passes

0.61 tons/cy with 5 passes

0.70 tons/cy after 10 passes

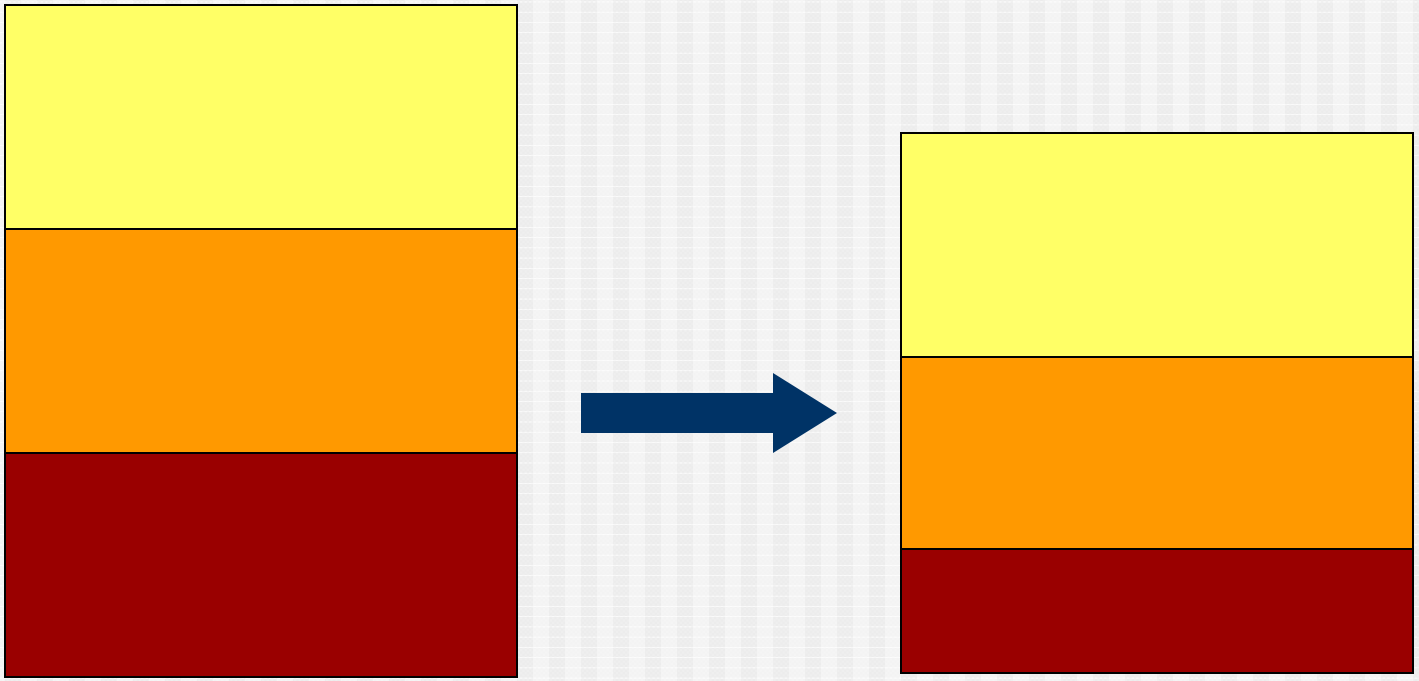
Factors that Affect Waste Density

- Depth of landfill (settlement)



Factors that Affect Waste Density

- Depth of landfill (settlement)



Factors that Affect Waste Density

- Daily cover
  - soil versus alternatives
- Intermediate or long-term cover
  - removing thick soil layers before placing new waste

Factors that Affect Waste Density

- Type of waste

Recycling tends to remove lighter materials (paper, plastics, metal containers)

Sludge raises density

Bulky C/D wastes lower density

Contaminated soils or other high unit-weight wastes

Factors that Affect Waste Density

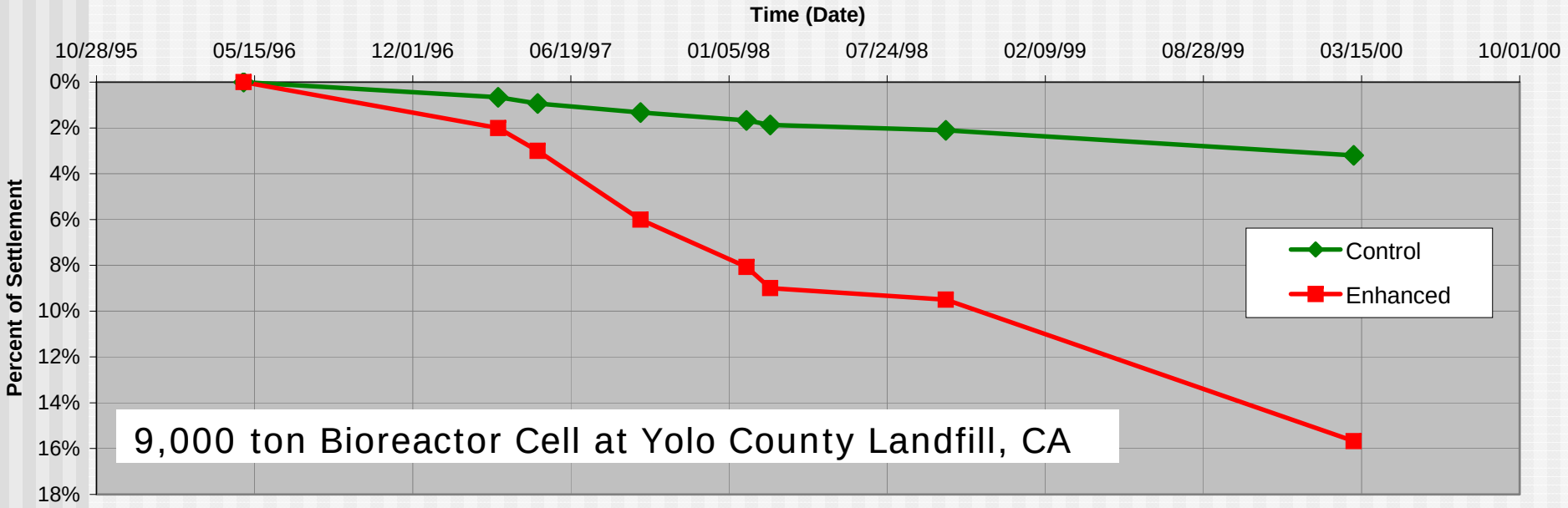
- Leachate recirculation or injection

Increases settlement because it accelerates waste decomposition (i.e., faster rate of settlement)

Increases settlement because the waste is heavier (higher self loading)

Factors that Affect Waste Density

- Leachate recirculation



From MSW Management Journal (Sep/Oct 2003)

Future Waste Filling Rate?

- Factors:
  - Population growth and the economy
  - Waste diversion from landfills
  - Regulatory restrictions
  - Catastrophic events

- Not much control over these

Recap

- Remaining Life (days) =

$$\frac{\text{Remaining Volume (cy)} \times \text{Waste Density (tons/cy)}}{\text{Waste Filling Rate (tons/day)}}$$

- Simple Model, but the devil is in the details.
- Have to consider site-specific data and anticipated conditions