Unit 2: Debris Quantity Forecasting and Estimating

Objectives

2.1 Discuss the importance and differences between debris forecasting and estimating

2.2 Forecast and estimate the quantity and mixture of debris using various techniques

2.3 Address debris forecasting and estimating issues in debris planning

Forecasting vs. Estimating

Debris Forecasting

- Pre-disaster plan development

Debris Estimating

- Post-disaster plan implementation

Debris Forecasting Techniques

- Historical Analysis
- Community-based risk analysis
- Computer-based prediction analysis

Forecasting

Historical Analysis

- Analyze prior events
- Interview staff
- Review changes in conditions:
  - Land use changes
  - Landfill capacity changes
  - Response capability of community
  - Laws and regulations

Forecasting

Community-Based Risk Analysis

- Use maps to indicate areas of similar land use
  - Urban, industrial, rural, mixed
- Develop a representative sample of debris quantities of each area
- Project debris quantity estimate for each area

Forecasting

Computer-Based Prediction Analysis

- Types of models
  - USACE
  - Private industry

Debris Forecasting
USACE Model – Manual

- Formula: Q = C(H)(V)(B)(S)
  - Q = Volume of debris in cubic yards
  - C = Storm category factor
  - H = Number of households
  - V = Vegetative characteristic
  - B = Commercial/business/industrial use multiplier
  - S = Precipitation multiplier

Debris Forecasting
Private Industry Models

- Other debris forecasting models may be available through other private vendors or other public sources.

Debris Estimating Techniques

- Ground measurement
- Aerial photography
- GIS
- Combination of techniques

Estimating Roadside Debris Piles

Mixed Debris

C&D Debris

Ground Measurements

- Equipment
- Estimating aids:
  - Defining debris area
  - Formulas
  - Tables

Debris Estimating Formulas

- One-story building:

$$\frac{L' \times W' \times H'}{27} = \_\_\_\_ \text{ CY} \times .33 = \_\_\_\_ \text{CY}$$

- Mobile homes:

$$\frac{L' \times W' \times H'}{27} = \text{CY}$$

- Debris piles:

$$\frac{L' \times W' \times H'}{27} = \_\_\_\_ \text{CY}$$

Debris Estimating Table

Vegetative Cover Multiplier (Yard Waste)

Typical House	None	Light (1.1)	Medium (1.3)	Heavy (1.5)
1000 SF.	200 cy	220 cy	260 cy	300 cy
1200 SF.	240 cy	264 cy	312 cy	360 cy
1400 SF.	280 cy	308 cy	364 cy	420 cy
1600 SF.	320 cy	352 cy	416 cy	480 cy
1800 SF	360 cy	396 cy	468 cy	540 cy
2000 SF	400 cy	440 cy	520 cy	600 cy
2200 SF	440 cy	484 cy	572 cy	660 cy
2400 SF	480 cy	528 cy	624 cy	720 cy
2600 SF	520 cy	572 cy	676 cy	780 cy

Formula for one story structure: $\frac{\text{square feet x 8 feet}}{27}$ x .20 x VCM = cy

This chart and calculations are inclusive of the structure and contents

Debris Forecasting
USACE Flood Debris Model

- Used to calculate debris quantity from a flood event only when the structure is not destroyed.
- Formula: Square footage x .02 = cubic yards of debris
- 2400 sq. ft. x .02 = 48 cubic yards

USACE Formulas

- The USACE formulation model for calculating:
  - Loads to haul and times
  - Number of sectors
  - Reduction rates
  - Manpower for monitoring

USACE Formulas - Loads to haul and times

- 120-Day mission (Example)
- 2,000,000 cy per sector and one TDSR per sector
- A 4 C.Y. loader will load a 20 C.Y. truck in 10 min.
- Average haul distance is 15 miles
- 12-hour work day

USACE Formulas - Loads to haul and times

- Calculations:
- Loading = 60min / 10min/load = 6 loads per hour
- Assuming 1 hr for lunch and 1 hour down time,
- 12 -2 = 10 hrs x 6 = 60 loads per day per loader
- 60 loads x 20 cy per load = 1200 cy per day per loader
- Truck time, 15-mile haul
- = 30 min travel, 15 unloading, 25 min return = 70 min, 70/10 min/load = 7 trucks, use 8
- = 8 trucks per loader

USACE Formulas - Loads to haul and times

- Calculations:
- Loading = 60min / 10min/load = 6 loads per hour
- Assuming 1 hr for lunch and 1 hour down time,
- 12 -2 = 10 hrs x 6 = 60 loads per day per loader
- 60 loads x 20 cy per load = 1200 cy per day per loader
- Truck time, 30-mile haul
- = 50 min travel, 15 unloading, 45 min return = 110 min, 110/10 min/load = 11 trucks,
- Use 12 = 12 trucks per loader

USACE Formulas - Loads to haul and times

- Calculations:
- 1200 cy per day per loader
- 8 trucks per loader
- 2,000,000 C.Y. / 120 days for mission = 16,666 C.Y./day
- 16,666 C.Y./1200 = 13.8 or 14 loaders
- 14 loaders x 8 trucks/loader = 112 trucks

USACE Formulas – Reduction Rates

- 12-hour work day
- Incineration rate = 160 C.Y. per hour, 24-hour operation
  - 160 x (24-5)19 hrs/day = 3000 C.Y./day
- Grinding rate = 180 C.Y. per hour, 10-hour operation
  - 180 x 10 = 1800 C.Y./day

USACE Formulas – Monitoring Manpower

Manpower:

- One inspector per loading operation = 14
- Six inspectors per TDSR
  - One - Site Team Leader
  - Two - Tower Operations
  - One - Reduction Operations
  - Two - Night Shift = 6

20/zone

Mobile Home Park Debris Estimating

Typical single wide = 290 cubic yards

Typical double wide = 415 cubic yards

Units of Measure

- Volumetric (Cubic Yards)
- Weight (Tons)

Approximate Conversions

Construction and Demolition (C&D)

- CY of C&D debris to tons–divide by 2
- Tons of C&D to CY–multiply by 2

Woody Debris

- CY of hardwoods to tons–divide by 4
- Tons of hardwoods to CY–multiply by 4
- Tons of softwoods to CY–multiply by 6

Estimating Using Aerial Photography

Tornado Damage

Estimating Using Aerial Photography

Tornado Damage

Review Activity 2.1 – Debris Forecasting and Estimating