Simplistic Load Models

Two Models

- Flow Duration Curve
- Load Duration Curve

Basic Process

1. Develop Flow Duration Curve
2. Estimate load given flow and concentration data—select appropriate conversion factors
3. Develop Load Duration Curve
4. Plot observed data with Load Duration Curve

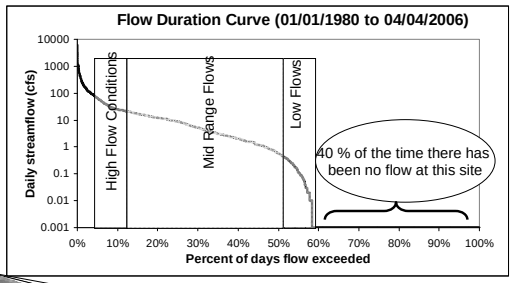
Flow Duration Curves

» What are they?
How do you make one?

What is a Flow Duration Curve?

- Describes the percent of time a flow rate is met or exceeded
- Cumulative frequency of flow data over a period of time

FDC—Plum Creek near Uhland



Making a FDC

- Gather daily flow rate data
- Load data into a spreasheet
- Sort the data from largest to smallest
- Rank number each data point (1 for the largest point, 2 for the next largest, etc)
- Calculate percentage of days flow was exceeded:

$$\text{percent} = \frac{\text{rank}}{\text{total number of points}} \times 100$$

Load Estimation

- How do you estimate load with given data?

Flow, Concentration, and Load

- Load is calculated using flow rate and concentration:

$$load = flow\ rate \times concentration \times conversion\ factor$$

- A conversion factor will likely be needed to make the units match

Typical Units

- Stream flow rate often in cfs (ft^3/s)
- Permitted flow rate often in mgd
- Concentration often in mg/L
- E. coli counts often in org/100mL
- Load often in lb/day, tons/day, or G-org/day

Handy Conversion Constants

- $1 ft^3 = 28.317$ L
- 1 gal = 3.785 L
- $1 m^3 = 1000$ L
- 1 lb = 453.592 g
- 1 ton = 2000 lb
- 1 day = 86,400 s

Conversion Factors

$$load = flow\ rate \times concentration \times conversion\ factor$$

Want Load In	Flow Is In	Concentration Is In	Conversion Factor
lb/day	cfs	mg/L	5.394
tons/day	cfs	mg/L	0.00269
lb/day	mgd	mg/L	8.344
tons/day	mgd	mg/L	0.00417
G-org/day	cfs	org/100mL	0.0245
G-org/day	mgd	org/100mL	0.0379

Load Duration Curves

- What are they?
  How do you make one?

LDCs Defined

- A graph showing the percentage of time a variable meets or exceeds a pre-defined threshold value
- The percentage of time a water quality parameter exceeds the published standard

Threshold Loads

- Calculate your "threshold" load using your sorted and ranked flow data and the appropriate water quality standard for the constituent of interest
- Apply a 10% margin of safety by dividing your threshold values by 1.1

$$threshold = \frac{flow * standard * conversion\ factor}{1.1}$$

Observed Data

- How do you calculate observed loads?

Daily Load Estimates

- Use daily flow rates and observed concentration to get daily load estimates

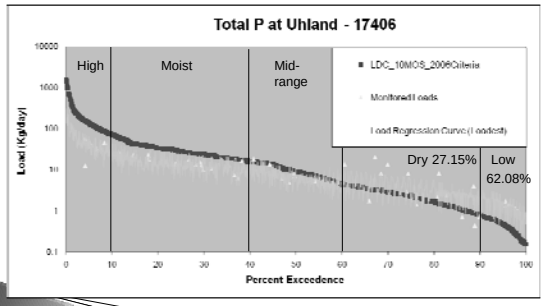
$$load = flow\ rate \times concentration \times conversion\ factor$$

- Repeat for all observed concentration data

Compare Flow Rates

- For each observed load point
  - Find the percent days exceeded for the flow rate using your Flow Duration Curve
  - Percent days exceeded on the Flow Duration Curve is the same as percent days exceeded on the Load Duration Curve
  - Use percent days exceeded values to plot observed load values on the Load Duration Curve

LCD—Plum Creek near Uhland



Interpretation

- Observed load values located above the Load Duration Curve indicate allowable daily loads have been exceeded
- Clustering of data may help identify when problems occur—loads in excess of standards occur primarily during low flow or during high flow periods

LDC Uses

- Easy-to-understand visual display of water quality
- Helps cull extreme condition data
  - Percentage of 0–10% may represent extreme hydrologic events that may prove difficult to control
  - Percentage of 99–100% may be associated with extreme drought
- May help identify nonpoint or point source issues

LDC Uses

- May help identify seasonal trends
- Can facilitate comparisons from one location to another
- May help develop water quality goals
- Can help identify additional sampling needs