Concentration vs. Loading

USGS

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Concentration

- The mass, weight, or volume of a constituent (e.g. phosphorus, sediment, etc.) relative to the volume of transporting fluid, or fluid-constituent mixture
- Typically reported in units like mg/L, μg/L, ppm, etc.

Discharge

- The **rate** of mass, weight, or volume transport of some constituent
- Typically reported in units like tons/day, lbs/day, kg/s, ft^3/s, etc.

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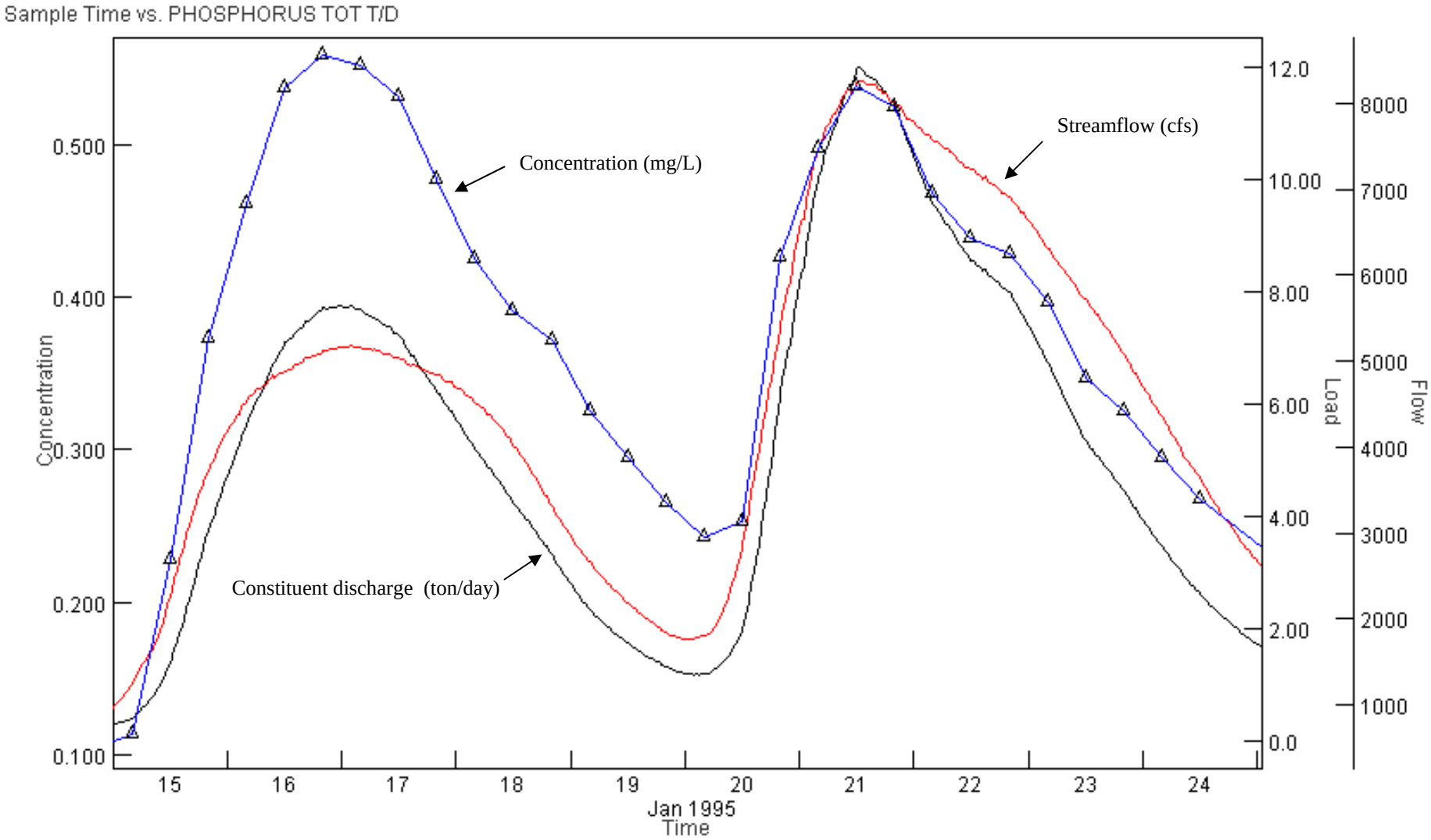
Computation of Instantaneous Constituent Discharge

$$Q_s = Q_w C k$$

- When streamflow (Q_w) is in cubic feet per second and concentration (C) is in milligrams per liter:

$$k = \left(\frac{62.4lb}{ft^3}\right)\left(\frac{86{,}400s}{day}\right)\left(\frac{ton}{2204.62lb}\right)\left(\frac{liter}{1x10^6 mg}\right) = 0.00245$$

  if constituent discharge (Q_s) is desired in <u>metric tons per day</u>


Sample Time vs. PHOSPHORUS TOT T/D
Concentration (mg/L)
Streamflow (cfs)
Constituent discharge (ton/day)
Concentration
Load
Flow
0.500
0.400
0.300
0.200
0.100
12.0
10.00
8.00
6.00
4.00
2.00
0.0
8000
7000
6000
5000
4000
3000
2000
1000
15
16
17
18
19
20
21
22
23
24
Jan 1995
Time

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Load

- The cumulative mass, weight, or volume of a constituent delivered to some location
- It is the integral of the constituent discharge curve
- Typically reported in units like tons, kilograms, pounds, cubic feet, etc.

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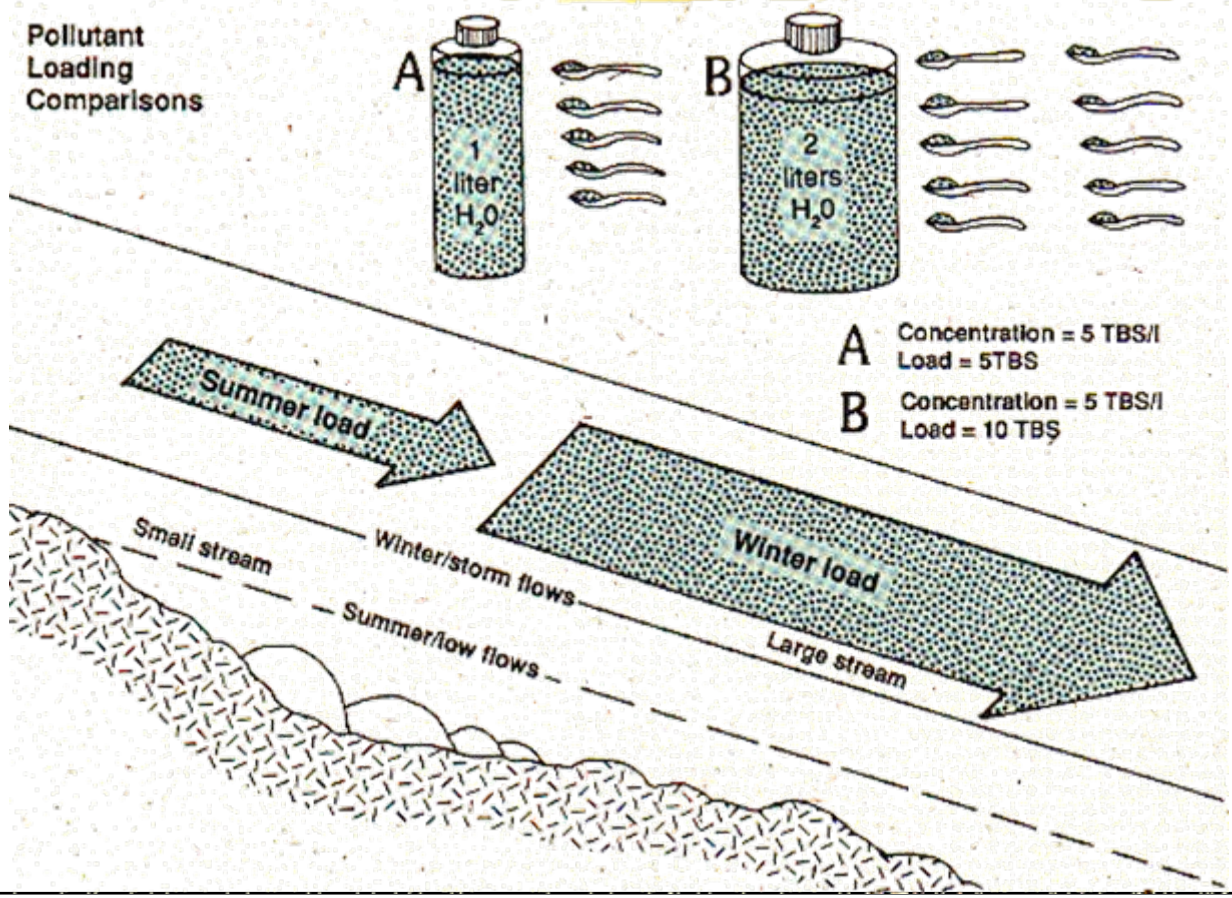
Concentration vs. load



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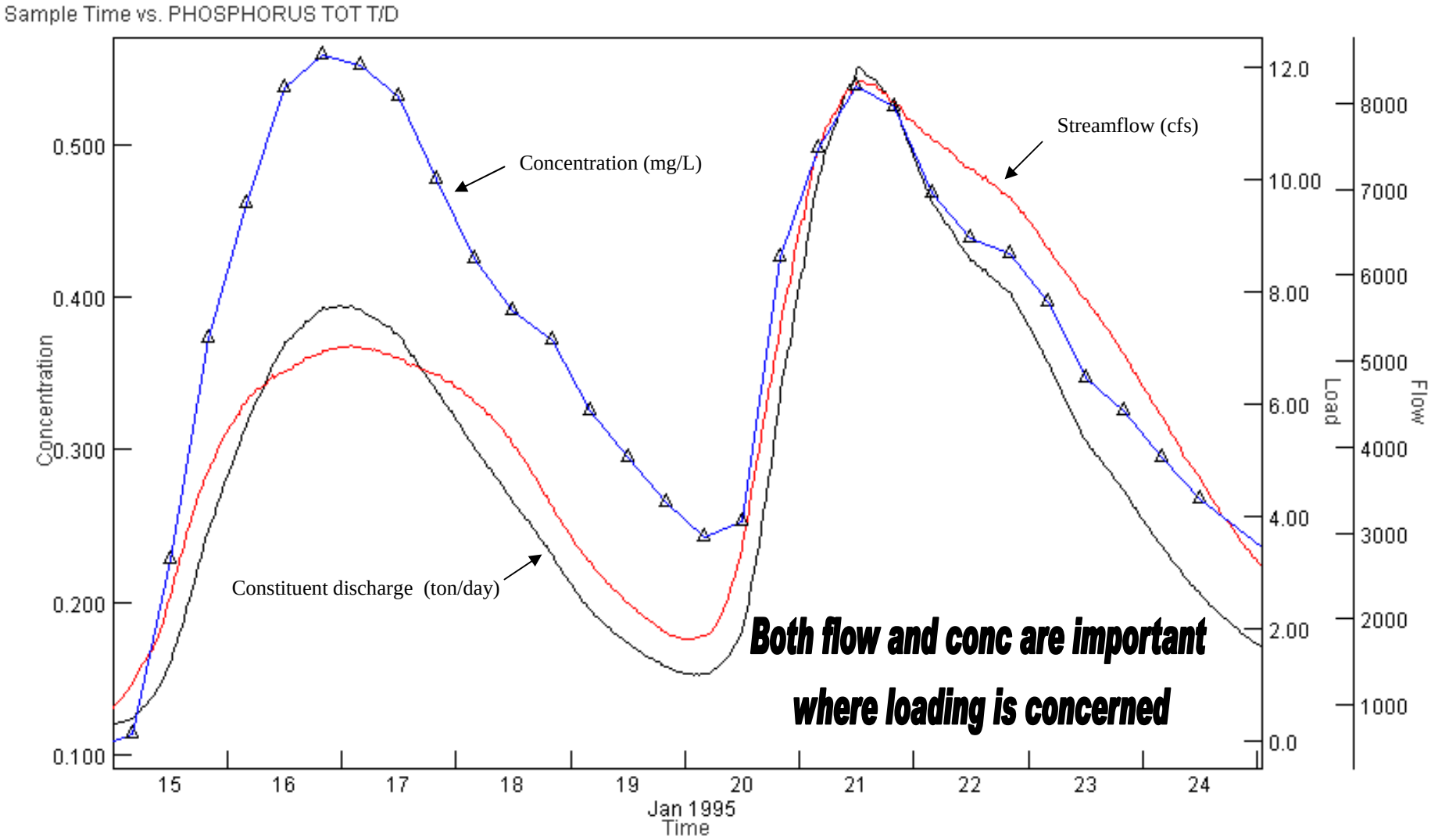
Graphic from Washington State, Department of Ecology


Sample Time vs. PHOSPHORUS TOT T/D
Concentration (mg/L)
Streamflow (cfs)
Constituent discharge (ton/day)
Both flow and conc are important
where loading is concerned
Concentration
Load
Flow
Jan 1995
Time
0.500
0.400
0.300
0.200
0.100
12.0
10.00
8.00
6.00
4.00
2.00
0.0
8000
7000
6000
5000
4000
3000
2000
1000
15
16
17
18
19
20
21
22
23
24

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Flow-weighted mean concentration

- Equals the load for a given time period divided by the product of the volume of streamflow for the period ($\bar{Q}t$) and a units conversion factor(k)
- Note: USGS usually reports *time-weighted* mean concentrations

$$\frac{1\ \text{TON}}{(\bar{Q}t)k}$$

Question

- So which is more important, concentration or load?

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Answer

- It depends on the questions being asked

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Concentration

- Important for questions related to:
  - Toxicity or nuisance concentrations
  - Compliance with water-quality standards

Load

- Important for questions related to:
  - Accumulated mass or volume
    - How quickly will the reservoir fill with sediment?
    - What is the effect of BMPs on reducing the amount of phosphorus delivered to the lake?

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Questions?

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