Setting the Course for Improved Water Quality –

Monitoring and Data Collection

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A TMDL training program for local government leaders and other water resource managers – Session 8

Your project to date

- ✓ Scoped the project
- ✓ Conducted data inventory
- ✓ Began review of existing data
- ✓ Developed data goals
- ✓ Continued data review
- ✓ Identified data gaps, and
- ✓ Developed Monitoring Plan
- Collect new data

This session

Filling data gaps by collecting data in the field

Overview of field data-collection methods*

- *flow*
- *stage*
- *water quality*

*You will likely need a number of other data collection activities *(e.g., physical, biological, geomorphological, etc.)* to meet all of your data goals

Remember your

Monitoring Plan

- Keep your goals in mind
- Follow your plan
- Follow established procedures

But, remain open to adapting your plan

Suppose your data collection goals are:

- Determine current conditions
  (e.g. existing pollutant loads, biological integrity, etc.)
- Determine contributions from pollutant sources
- Determine conditions under which pollutants are delivered
- Define pollution reduction targets for pollutant(s)

Data collection goal – example we will follow

Determine existing water quality conditions

Specifically: Determine current pollutant loads

How to determine pollutant load?

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Solve this equation:

Flow X **Pollutant concentration** = **Pollutant load (mass) per unit time**

- Flow measurements
  Stage measurements
- Water quality samples of pollutants of concern
- Need data quality / quantity to get accurate results!

NOTE! If any of these data sets are absent, collected incorrectly or compromised by an inadequate number of samples, results will likely be <u>erroneous!</u>

First, determine flow

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How do we obtain flow data?

USGS gathers flow/stage data for some streams

↓

Many streams ***not*** studied

↓

Must gather flow data for those streams

Obtaining flow data

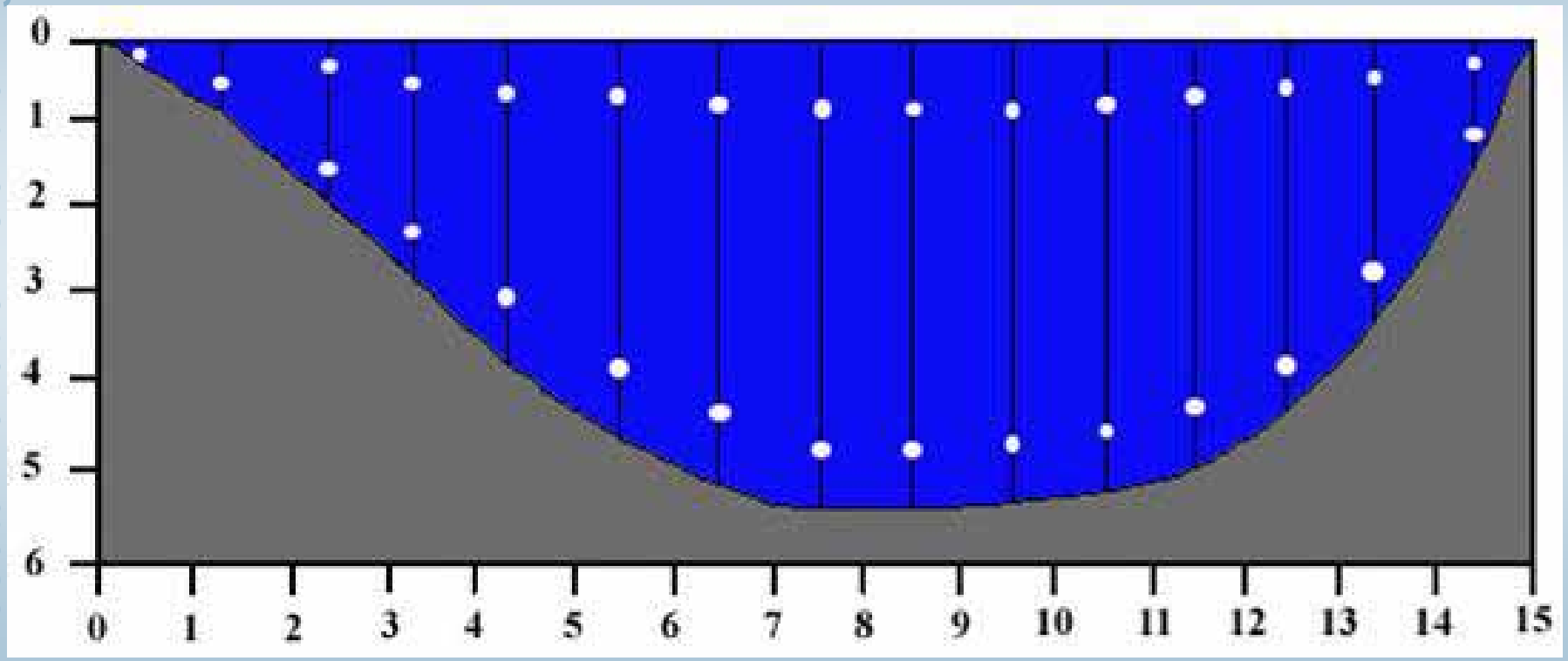
Basic steps

1. Collect flow measurements in the field
2. Use measurements to develop a rating curve
3. Use rating curve + measured and recorded stage data to calculate flow

How it's done

Flow measurements are first taken in the field

Quantity = ∑(Velocity x Area)



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Flow monitoring equipment & techniques we may use. . .

Measuring flow with wading rod

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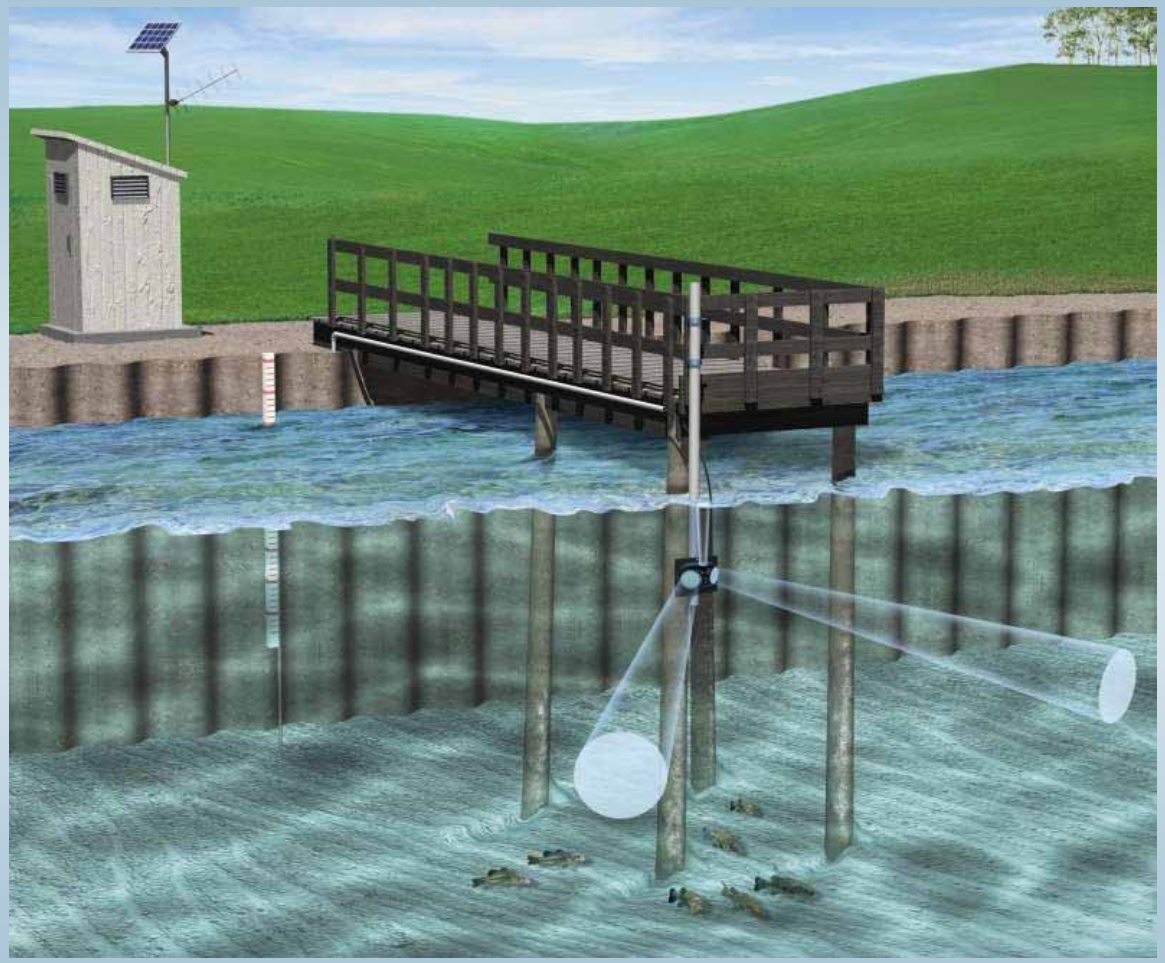
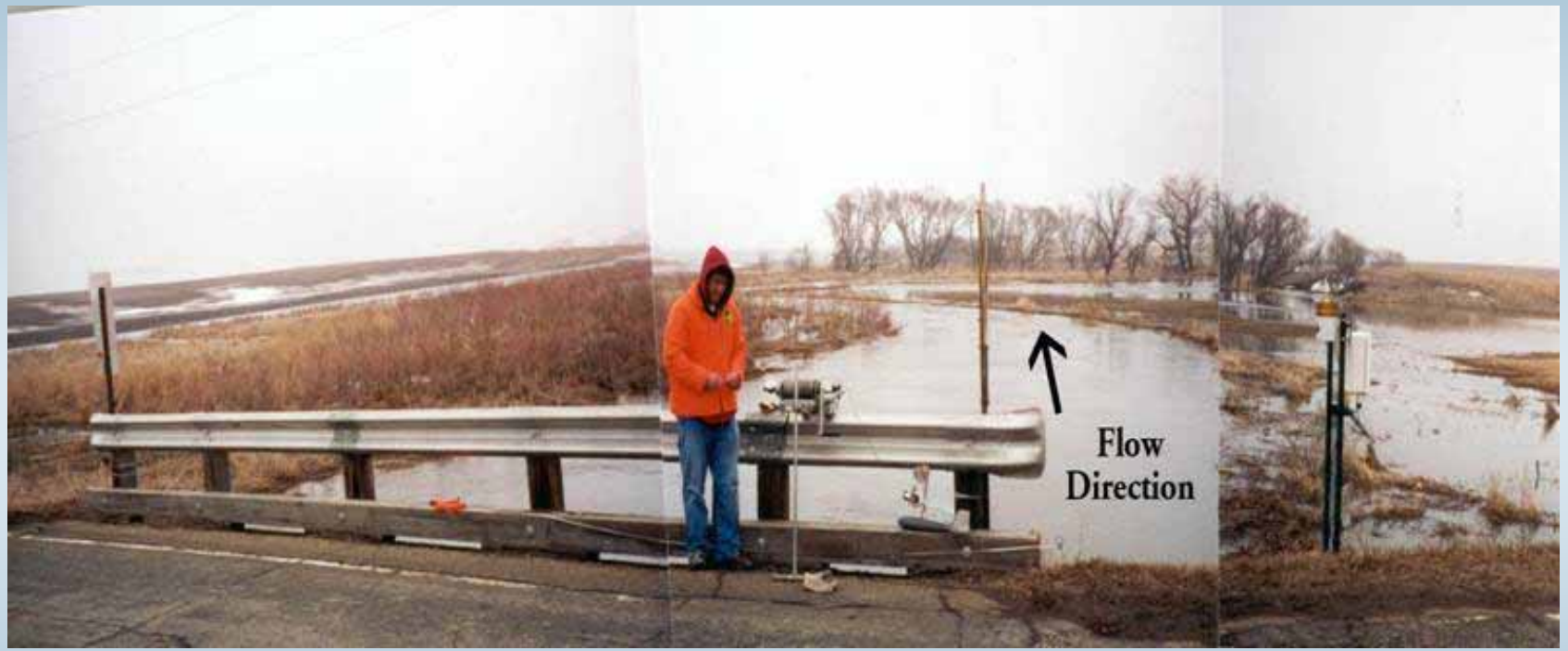
Field flow-measuring equipment – velocity meters



Side-looking Area Velocity Meter

Measuring flow with bridgeboard and weight



Measuring flow with bridge crane and weight

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Measuring flow with acoustic doppler current profiler

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Obtain an accurate flow value

Trained, experienced staff must
follow strict USGS methods / procedures

Rating curve

The equation for the line of best fit developed by regressing stage vs. flow

Rating Curve – Hawk Creek Maynard

A word about rating curves

Hydrologists must:

- Collect sufficient flow measurements to develop an accurate rating curve
- Validate rating curves every year – collect more data, at least every 4-5 weeks throughout monitoring season & range of flows
- Not extrapolate beyond the bounds of the highest flow measurement
- Watch for inaccurate data or shifts in rating curves when working up flow data – floods, vegetation, stream channel widening, downcutting, agrading, degrading
- Make data shifts as needed

Stage measurements

- Stage measures water body surface elevation
- Frequent measurements yield more accurate results
- Output recorded & stored in on-site data logger
- Data displayed in 15-minute increments

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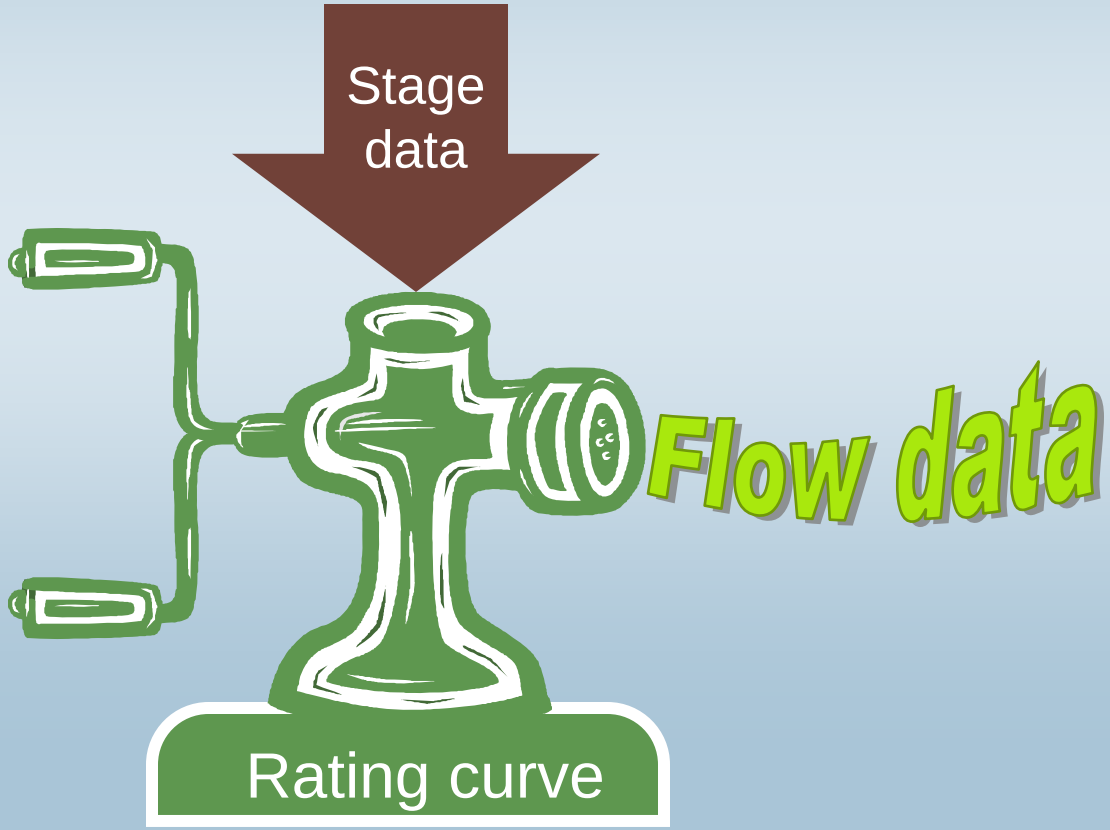
Why stage data is important

- Easy to gather continually
- Use a rating curve to convert stage to flow data



To convert stage data to flow data

1. Enter stage measurements into rating curve; compute flow
2. Express flow in cubic feet per second
3. Compute ***daily average flows*** from stage data recorded at 15 minute or 1 hour intervals

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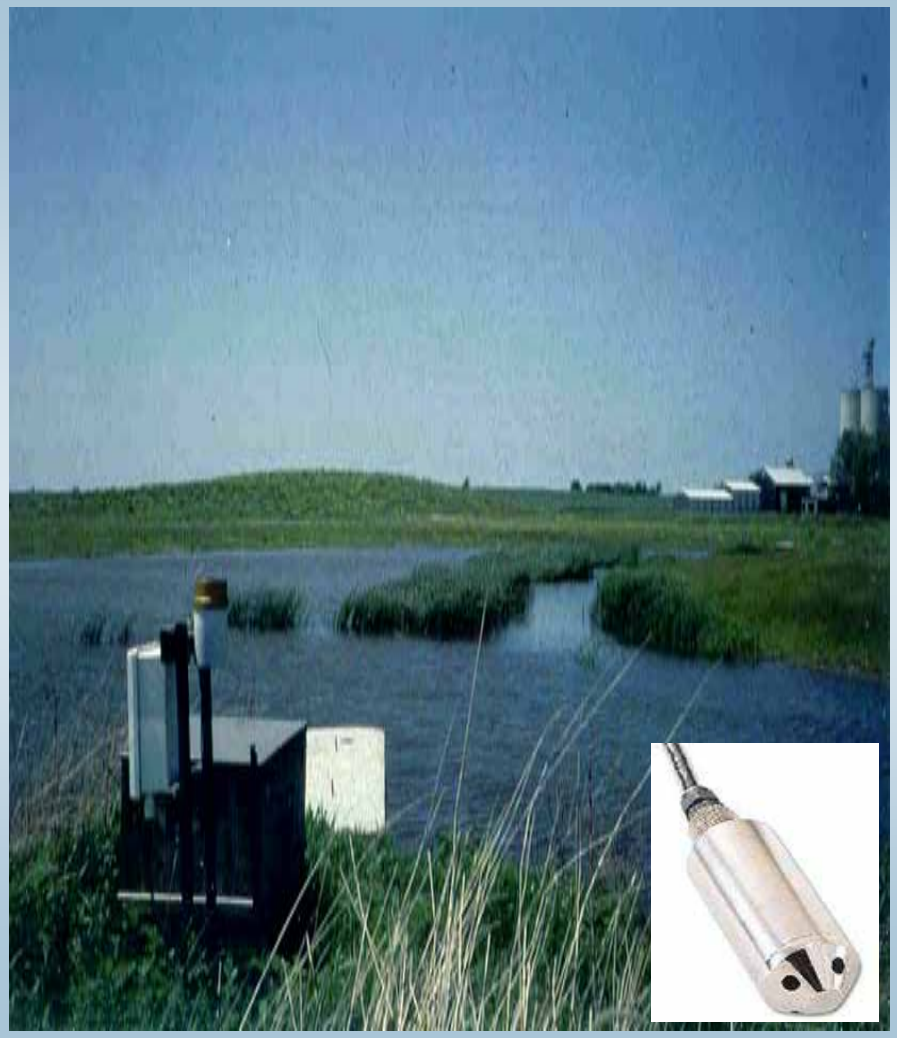
Stage measurements equipment/techniques we may use

Equipment that records stage data

- Measure river stage with automated tools:
  - Submerged pressure transducer
  - Ultrasonic transducer
  - Float and weight assembly
  - Gas bubbler
- Review stage data in the field *to ensure quality*



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Monitoring set-up

Review: computing flow in a river

Collect field flow measurements across full range of measured **stage values**

Collect continuous field stage data with in situ sensors

Use data set to develop rating curve

Rating curve converts stage data to flow data

Gather water quality data

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Flow X Pollutant concentration = Load (mass) per unit time

Determining pollutant concentrations

Field measurements

Take field measurements *(DO, turbidity, temperature, pH, etc.)* **using appropriate meters**

Determining pollutant concentrations

Lab analysis

- **Collect water quality samples for lab analysis**
- **Analyze to determine pollutant concentrations** for pollutants of concern *(use only certified labs)*
- **Review lab data within 3 weeks** *to ensure quality (samples only held at lab for 4 weeks)*

Think about. . .

- Inadequate sampling yields poor results
- Most critical to sample: moderate to high flow periods *(spring – early summer)*
- Stagger grab sampling within the range of flows
- Collect appropriate number of samples per Monitoring Plan

Water quality monitoring equipment/techniques we may use

Water quality monitoring equipment/techniques

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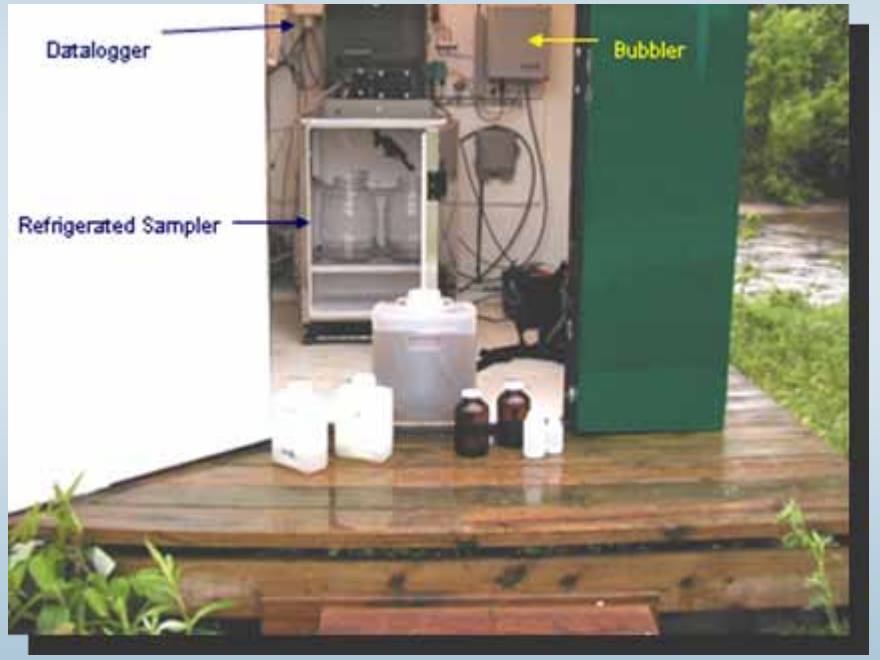
Automatic sampling



Water quality monitoring equipment/techniques

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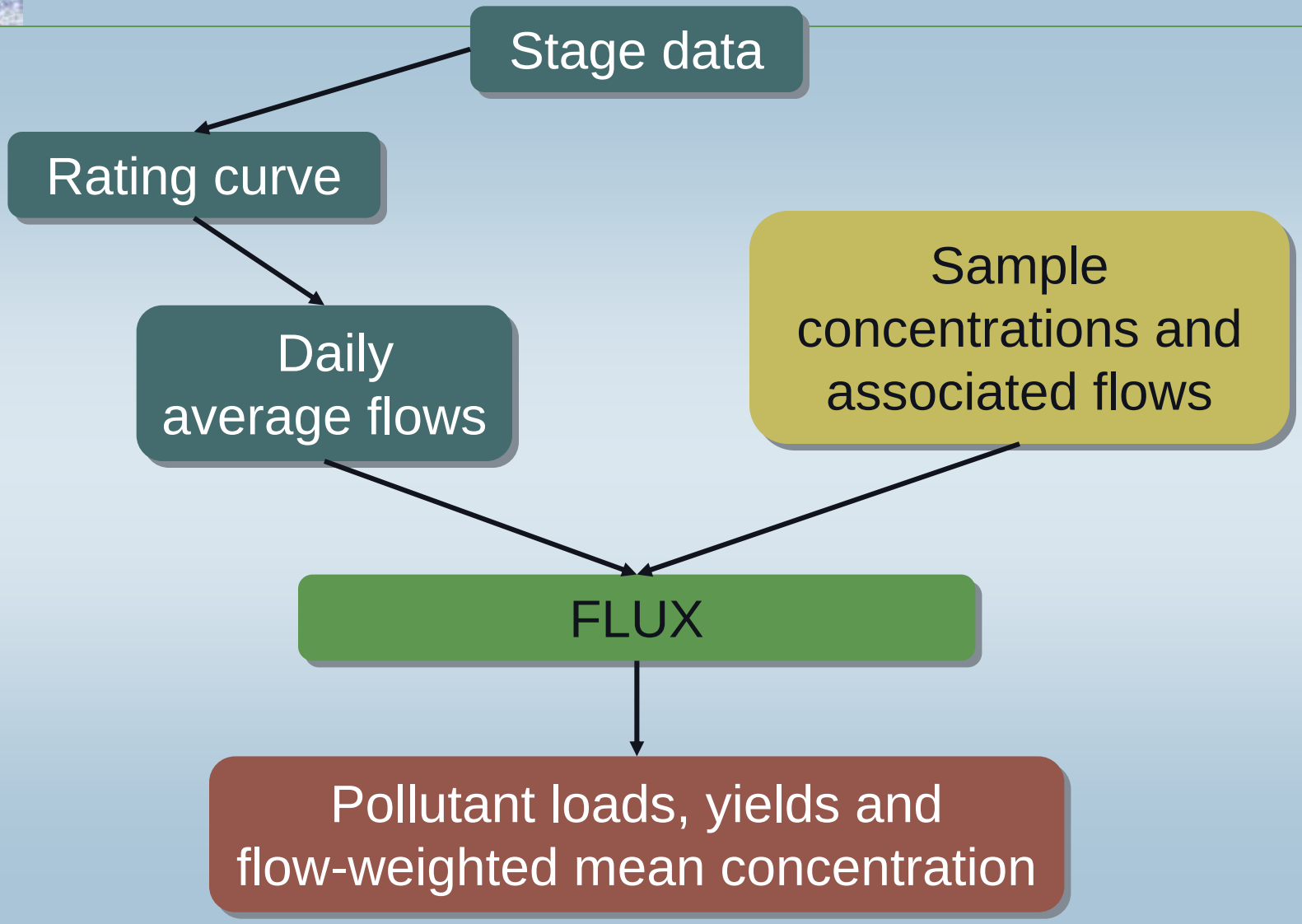
Grab sampling

Pollutant load

Flow X Pollutant concentration = Pollutant load (tons) per unit time

- Load = amount of specific pollutant discharged to a water body over a given time period
- To characterize loads, use several years of data to account for climatic variations
- If monitoring procedures standardized, can compare loads to other sites/streams

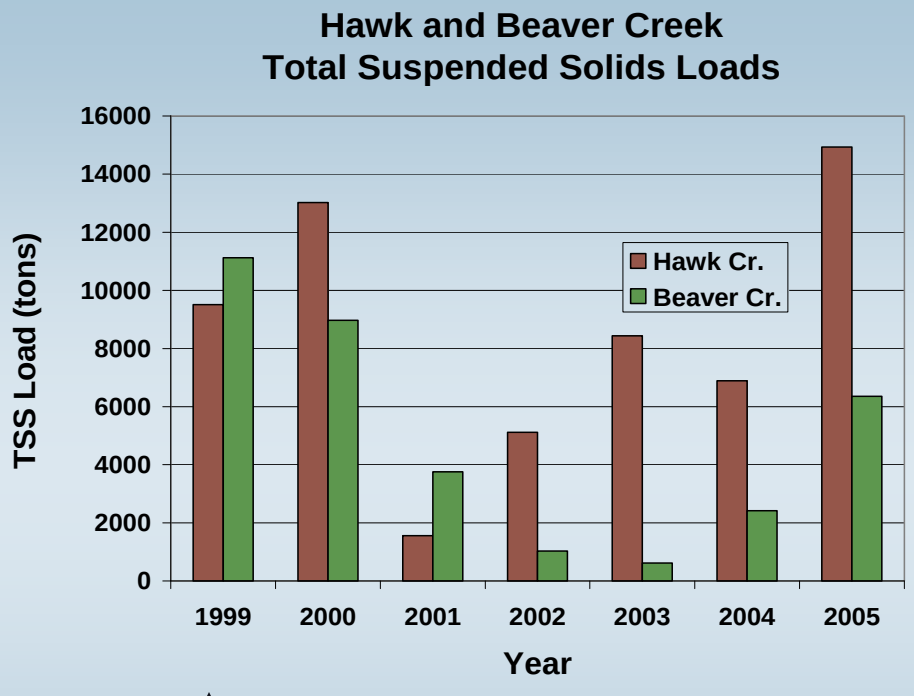
Put it all together



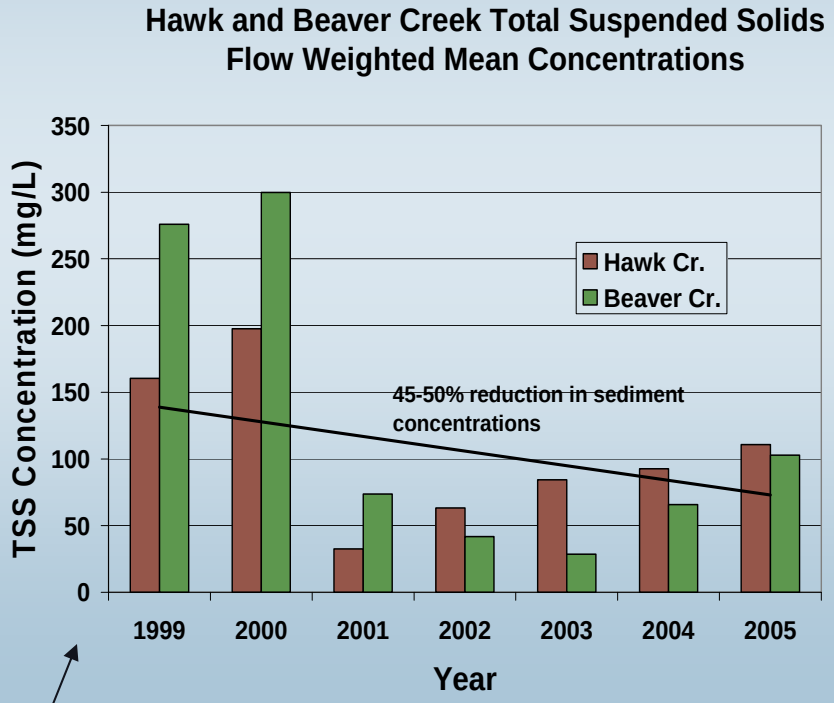
FLUX – What does it do?

- Used to estimate pollutant concentrations for days when samples were not collected (tons per year)
- Output is a pollutant load
  - Flow weighted mean concentration
    The *average concentration of a pollutant* that has passed by a particular monitoring site during a monitoring season or annually
  - Time-series data (such as daily loads)
    To estimate storm loadings

Examples of FLUX results



Shows need to monitor over several years to account for climatic variability



Allows us to see trends over time by eliminating the impact of flow

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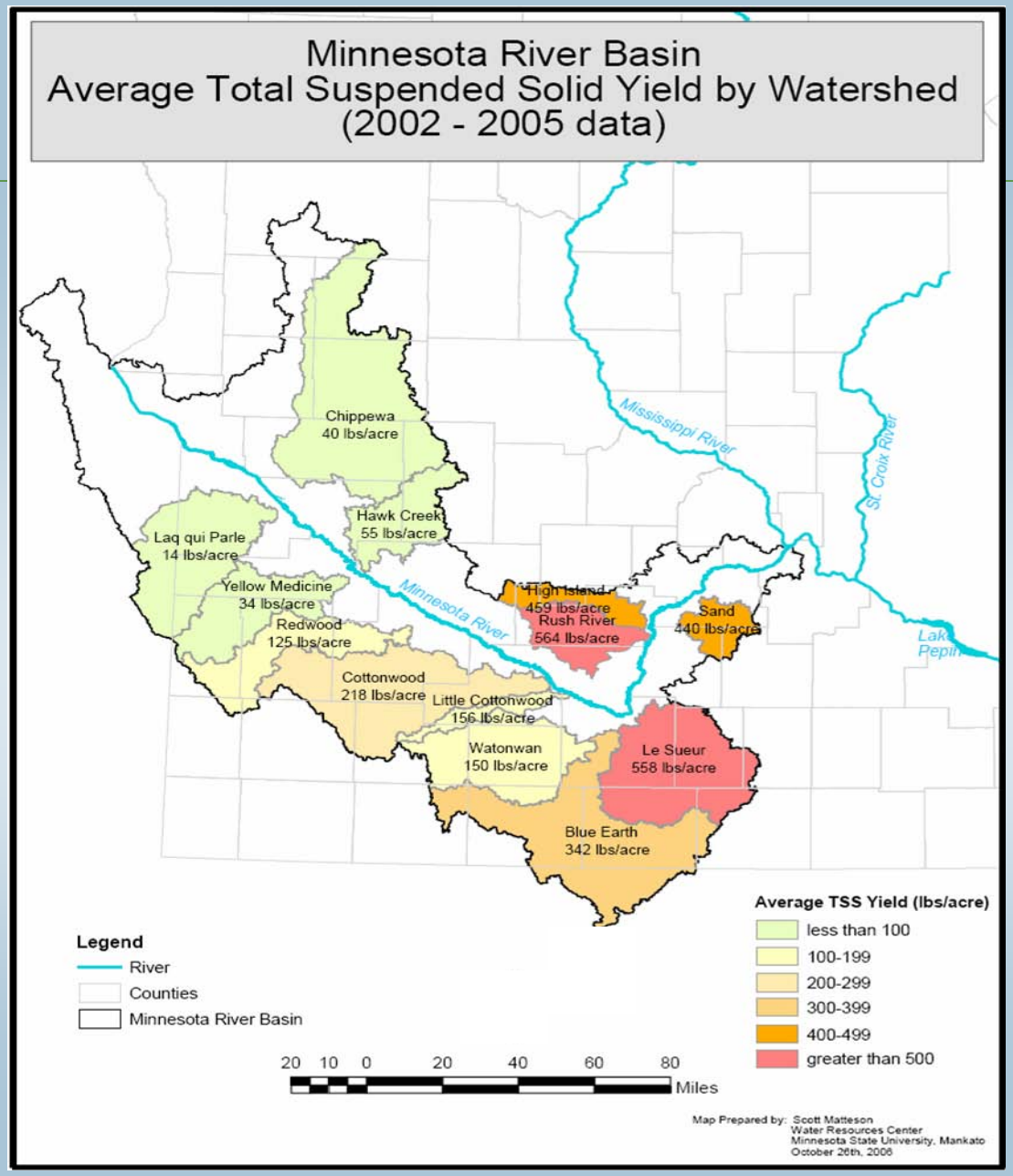
Comparing yields across watersheds



Summary

- This module presents one example of how you might collect the data you need to fill a major data gap
- Follow appropriate methods and techniques for other components in the Monitoring Plan (i.e., biological, geomorphological, physical monitoring)

“If nature were not beautiful,
it would not be worth knowing. . .

and if nature were not worth knowing,
life would not be worth living.”

–Henri Poincare (1855-1912)

More information

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Contact

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