Fisheries Management Techniques FT 211

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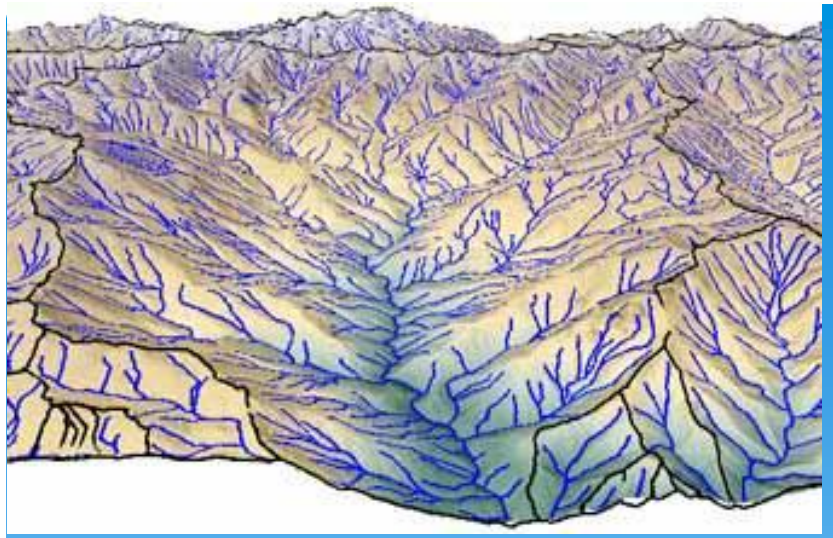
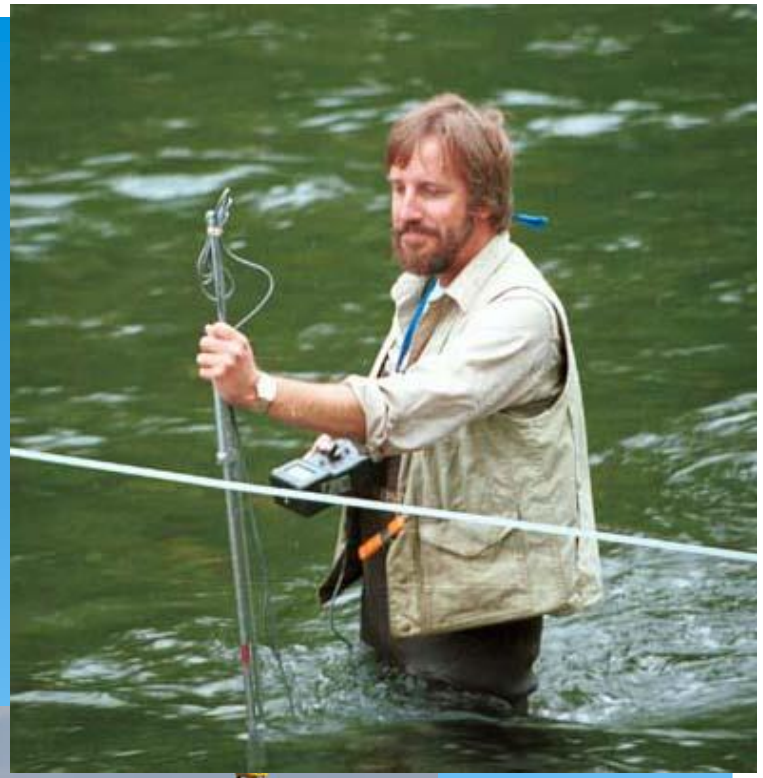
University of Alaska Southeast

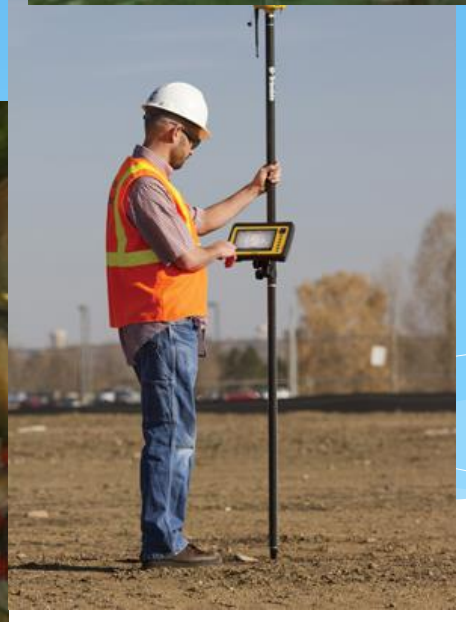
Fisheries Technology



Chapter 4

Aquatic Habitat Measurements





This Module will Contain

This Module will Contain 8 Main areas

- Aquatic Habitat Overview
- Habitat Mapping
- Geomorphology
- Hydrology
- Substrate
- Water Quality
- Stream Habitat Classification
- Lake and Reservoir Habitats

Student Learning Outcomes

Students will be able to:

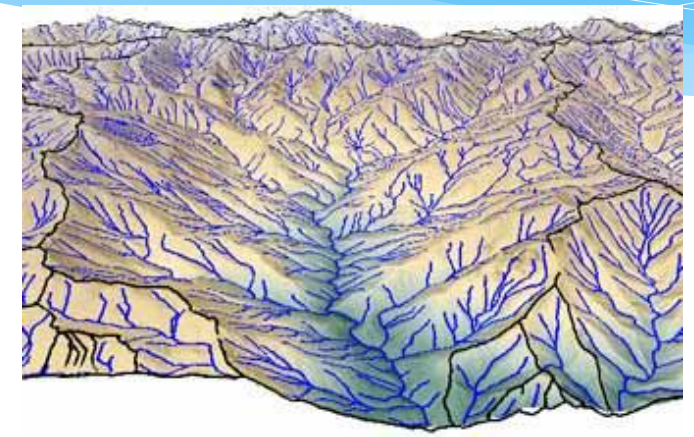
- Summarize the importance of aquatic habitats and the types of measurements used to assess them
- Identify common types of habitat mapping and strengths associated with each
- Describe Geomorphology and outline common measurement techniques
- Describe Hydrology and outline common measurement techniques
- Illustrate the importance of substrate in aquatic habitats and summarize associated assessment techniques
- Define different water quality parameters and how they might be assessed
- Summarize the different stream habitat classifications and distinctions between
- Dewscribe lake and reservoir habitats and associated sampling techniques

Why do we Measure Habitat?

- Inventorying
  - Establish a baseline
- Analyzing Habitat Quality
  - Good or bad for fish
  - Identify limiting factors
- Monitoring effects of land use
  - Hydropower, cattle grazing, urbanization
- Assessing improvement activities
  - After logging, stream channelizing, dam outflow
- How would you design a study to conduct such investigations?
- Which habitat variables would you measure to answer questions?
- What measurement techniques would you use?

Habitat Measurements Include

- Physical
  - Shape, size, area
- Chemical
  - Nutrients, contaminants
- Biological
  - Plants & critters

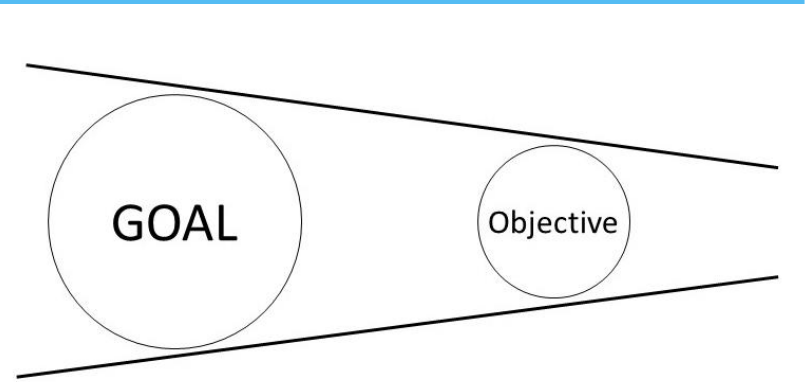


Habitat Quality Influences

- Numbers
  - Good habitat can be highly productive
- Sizes
  - Different habitat is necessary at different life stages
- Species of fish
  - Varying habitat preferences

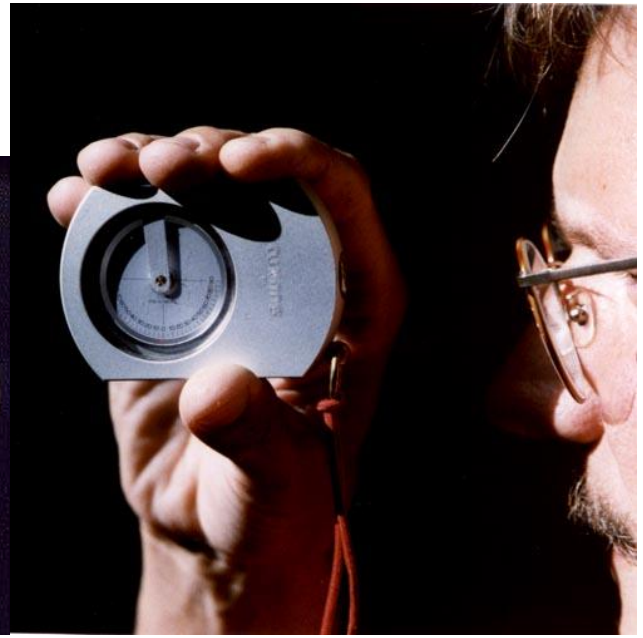
Habitat Variable selection

- Define objectives
  - Narrow in scope (easy to collect too much data)
- Select relevant habitat characteristics
  - Temp. vegetation, velocity
- Select most appropriate method to measure characteristics
  - Thermometer, satellite imagery, stream gauge
- Use of standard methods
  - Replicable, accepted



Techniques selected

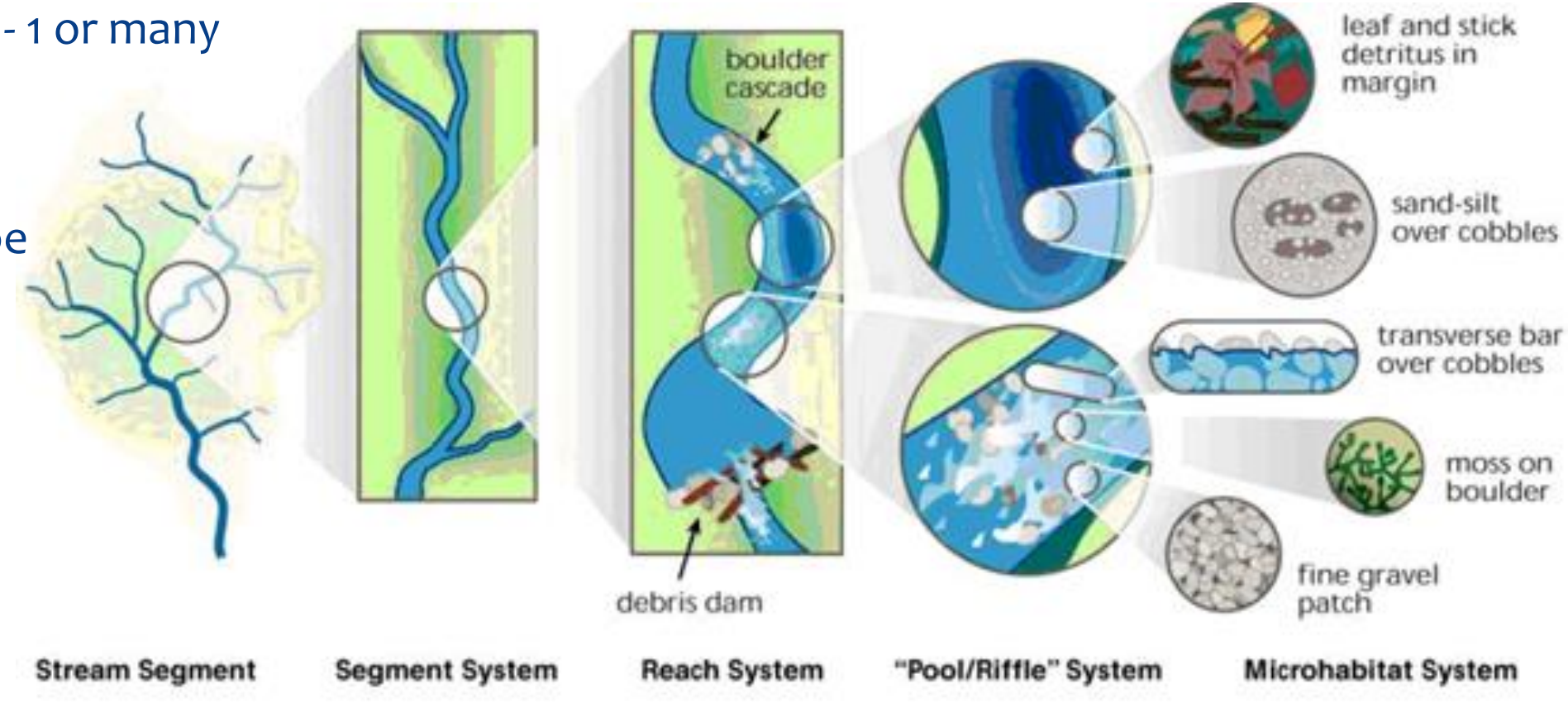
- Repeatable – Compare results over time or space
- Accurate – Information should be similar to true value
- Precise – Lots of variability is bad
- Meet budget - $$ is always a factor



Define spatial and temporal boundaries

Global – Micro habitat

- Space
  - Watershed - 1 or many
  - Stream
  - Segment
  - Habitat Type
- Time
  - Geologic
  - Years
  - Season
  - Days



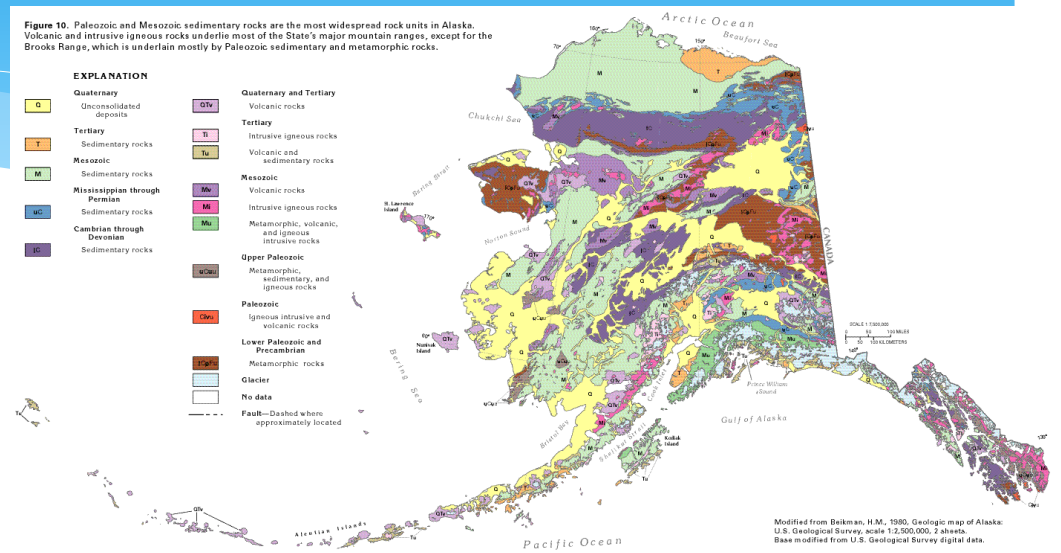
Self Check 1

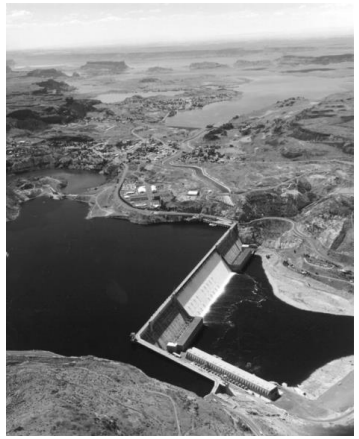
- Select all the reasons we might measure aquatic habitats
  - Inventory and establish a baseline
  - Analyzing Habitat Quality for fish
  - Monitoring effects of a hydropower project
  - Assessing a stream rehabilitation project
  - **All of the above**
- Aquatic habitat can be broken down into 3 basic catagories
  - Flow, discharge, and vegetation
  - **Biological, Chemical, Physical**
  - Terrestrial, Aquatic, subterranean
  - Small, Medium, Large

Habitat Mapping

Use of existing maps & photos

- Aerial photos
  - snow, fires, floodplain, vegetation
- Topographic maps
  - aquatic habitats, contour lines
- Maps of geology
  - soils, vegetation, climate
- GIS – Calculation of Habitat features

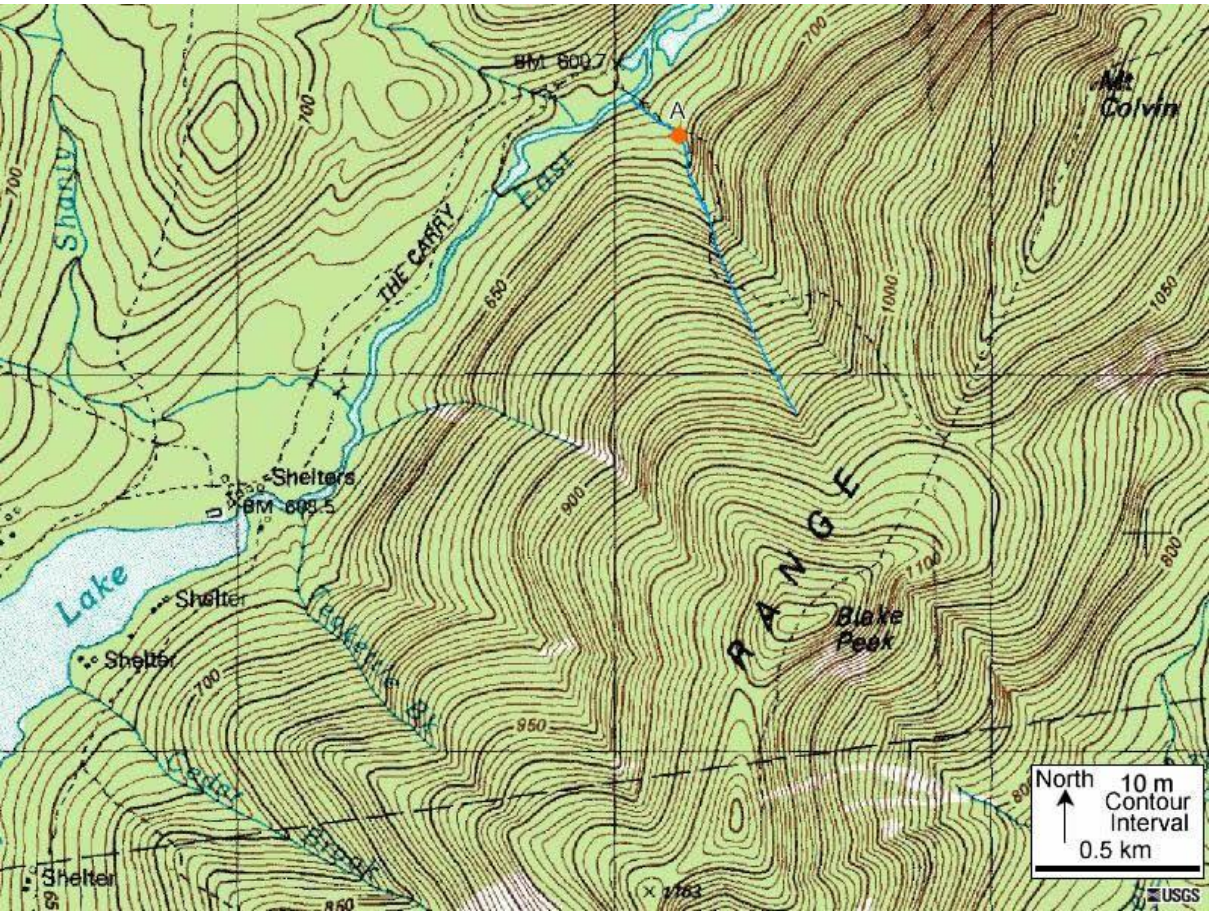


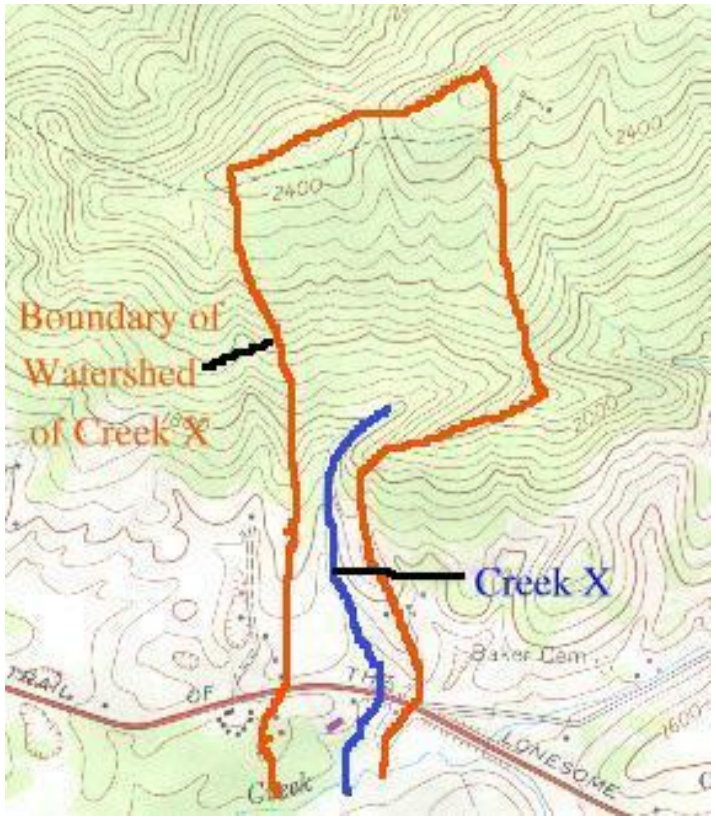


Aerial Photographs

Topographic maps

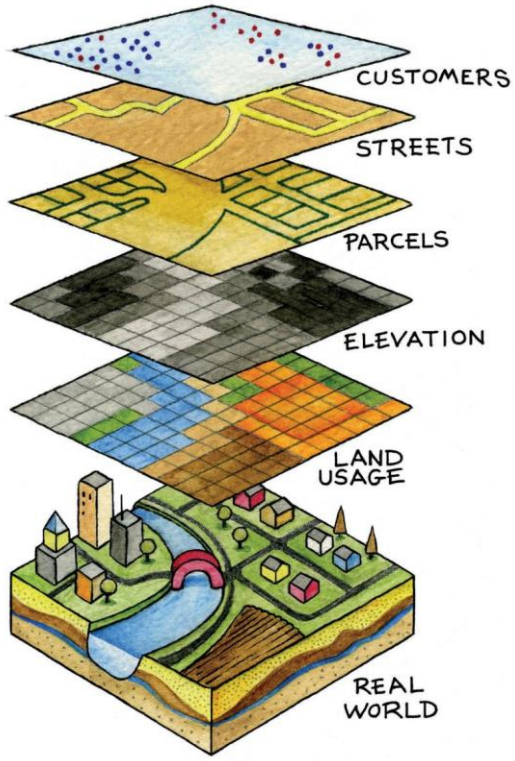
- Habitats and Contour lines

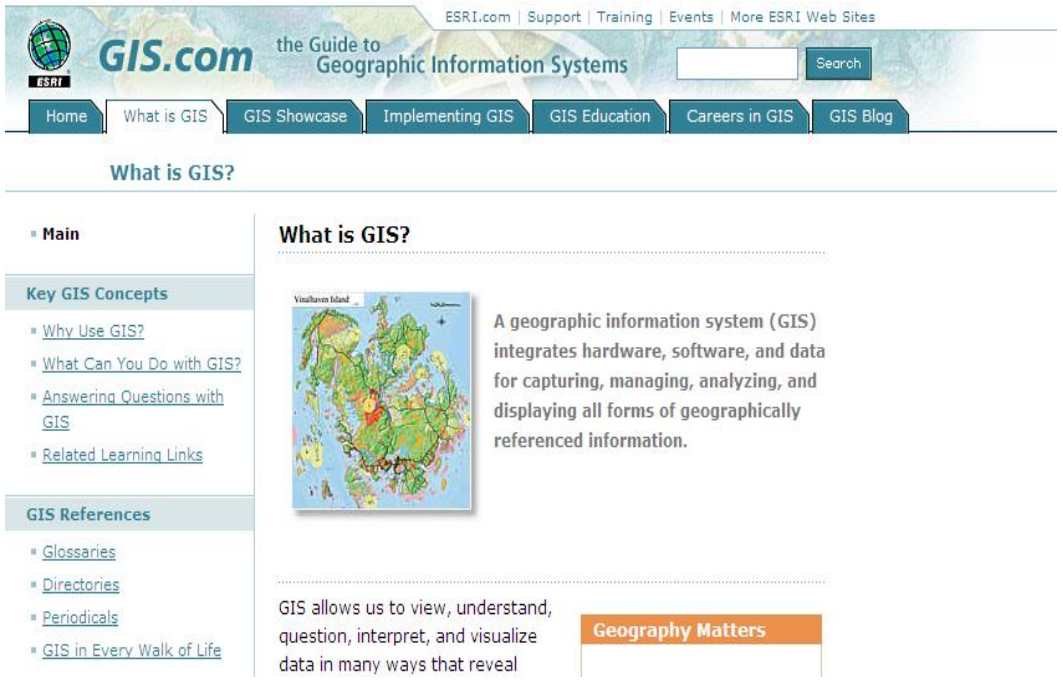




GIS – Geographic Information System

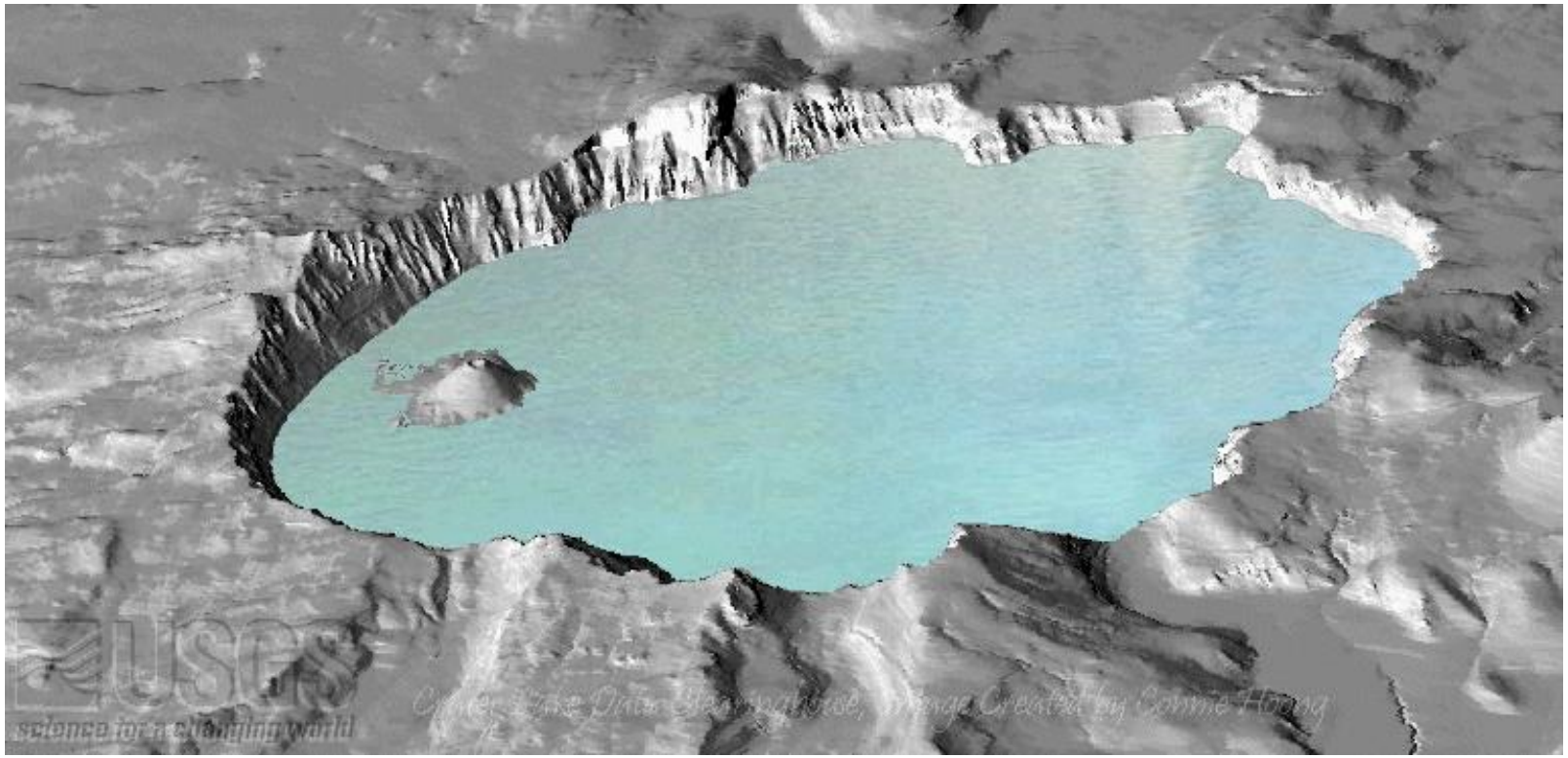
- **GIS** - a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data
- Free software
- www.gis.com
- $$ in GIS





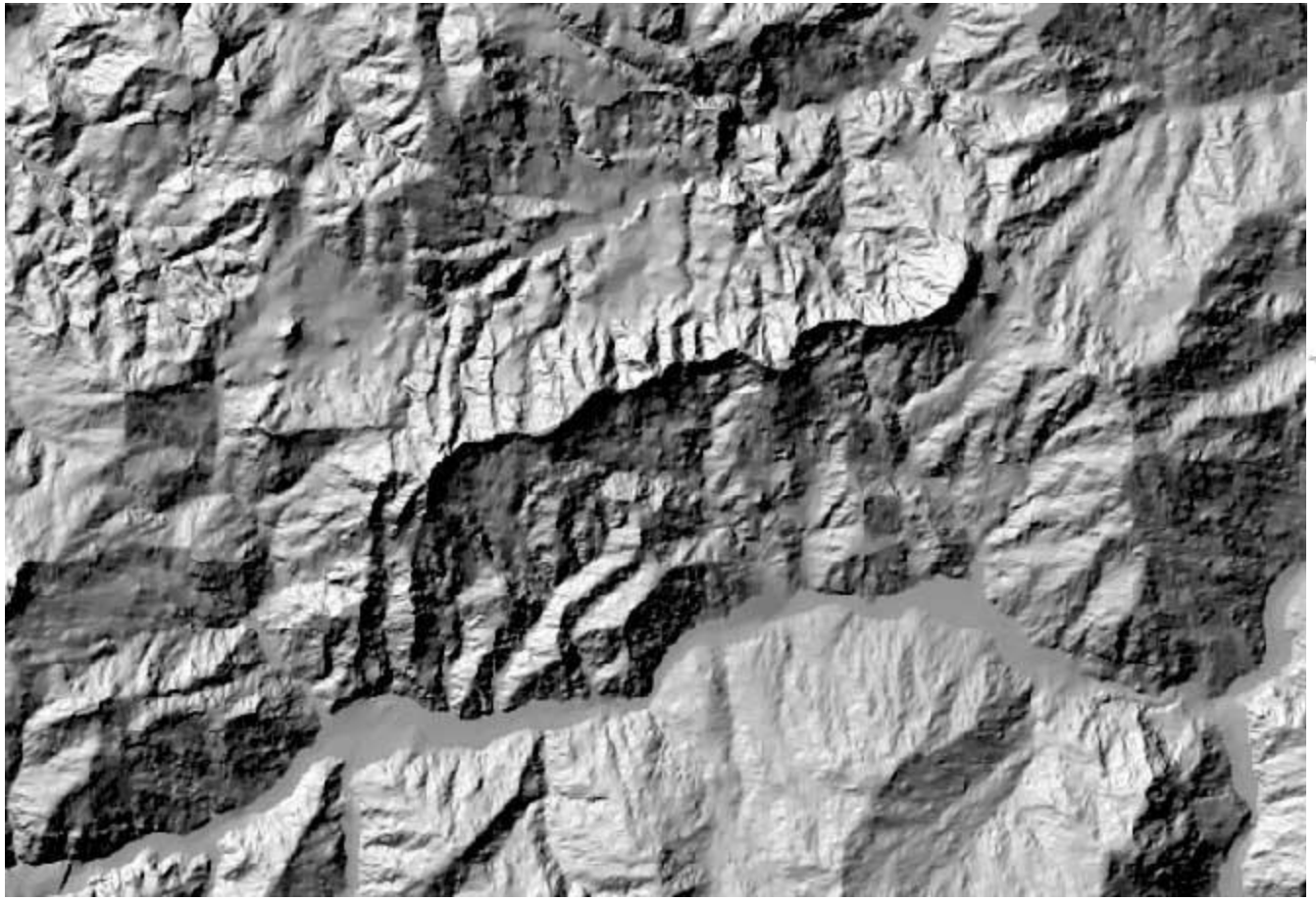
GIS

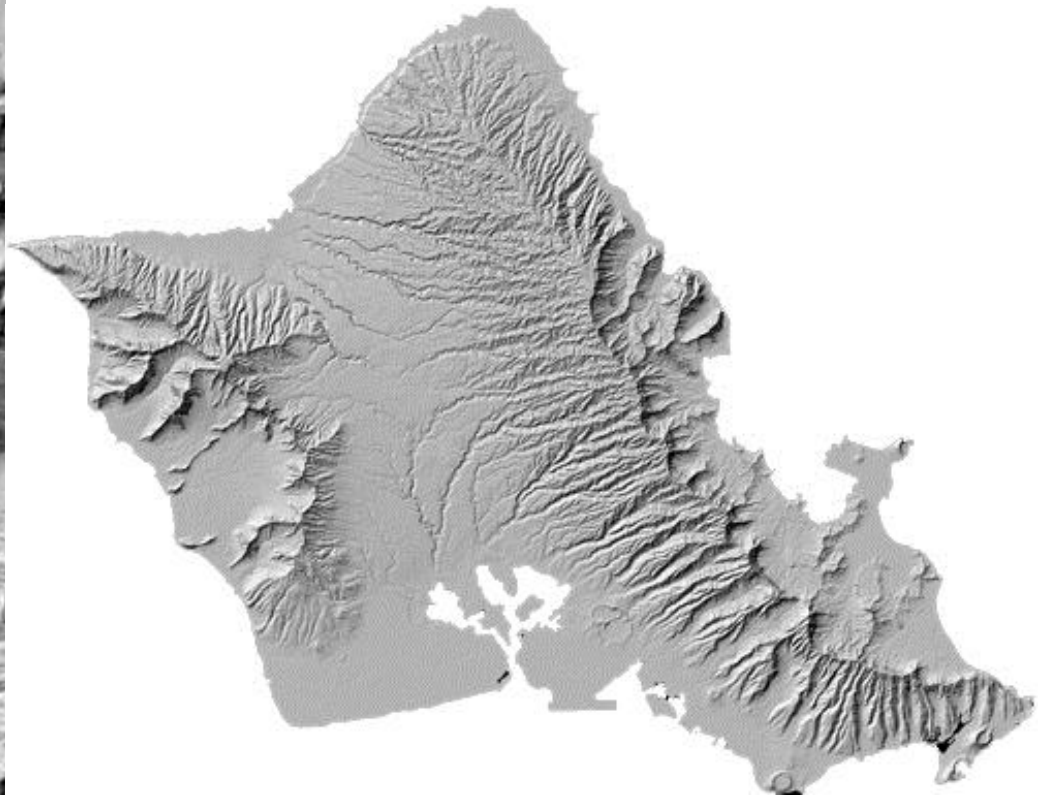
- LIDAR – light detection and ranging - lasers
- Can Calculate (effortlessly)
  - Watershed boundaries
  - Watershed area
  - Catchment basin
  - Stream length
  - Stream order



GIS & Digital Elevation Models

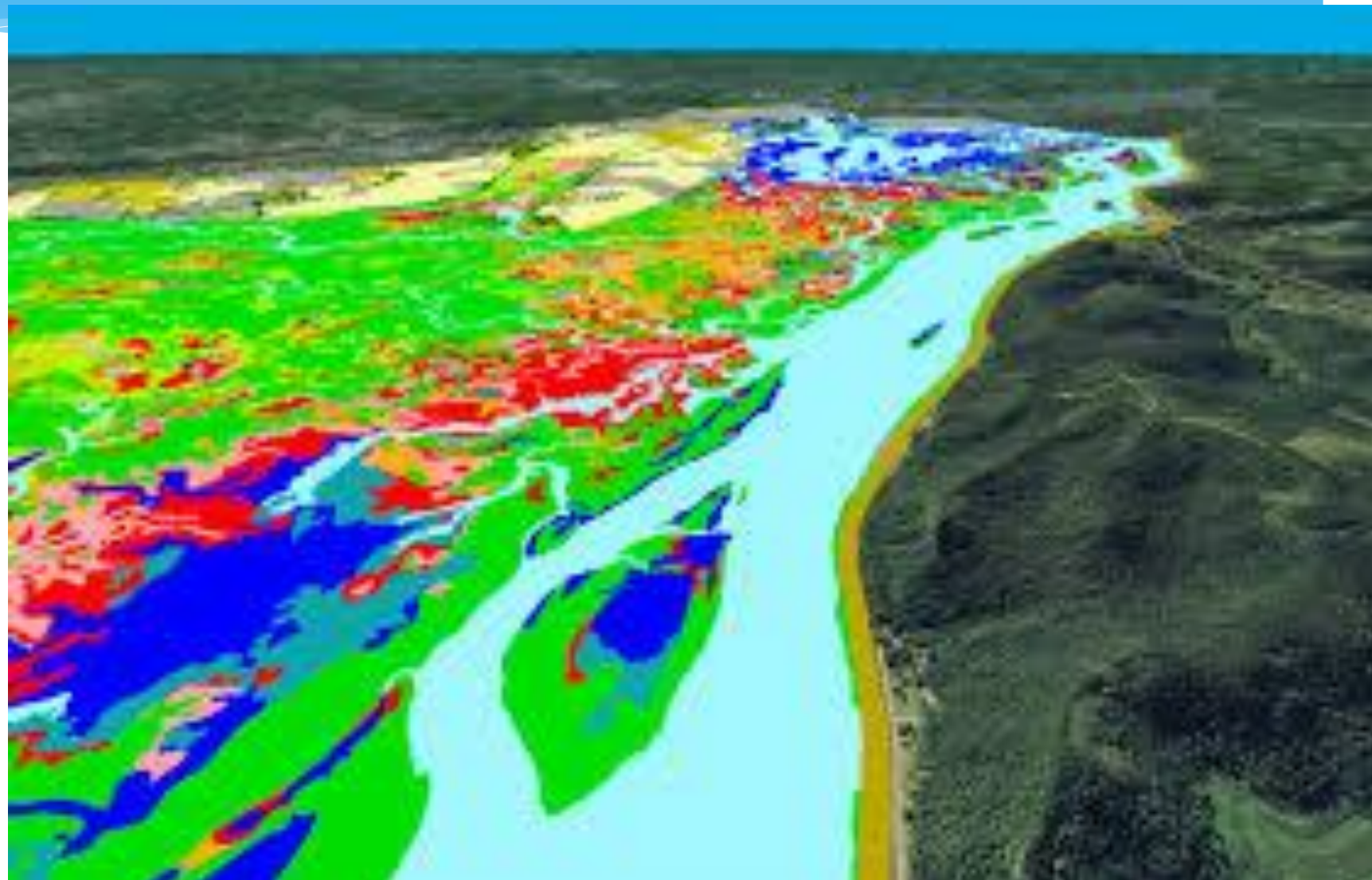
- Digital Elevation Models (DEM)





GIS & Habitat

- Can model habitat types to imagery
  - Even aquatic habitat



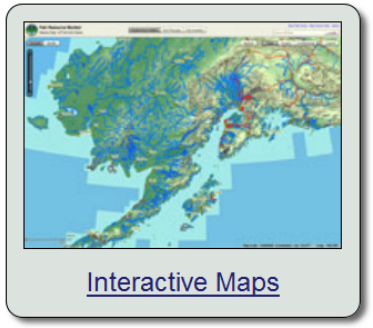
ADF&G Mapping

Maps & GIS

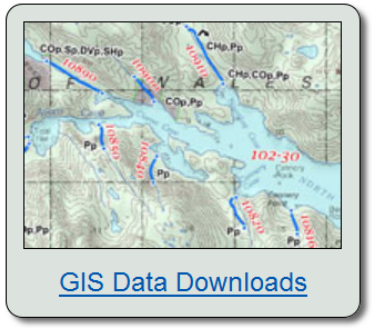
Maps, interactive map viewers, and GIS data are available for detailed geographic (spatial) information on a variety of lands and waters related topics. ADF&G houses current and legacy data that land, fish and wildlife managers, scientists, and recreationists may find useful. This data includes information on species distribution, subsistence harvest, refuges, and stocked lakes.

GIS (Geographic Information Systems) is a powerful analysis tool that can display many forms of geographically referenced information that helps us to visualize relationships, patterns, and trends. GIS allows a quick and easy way to understand and share information.

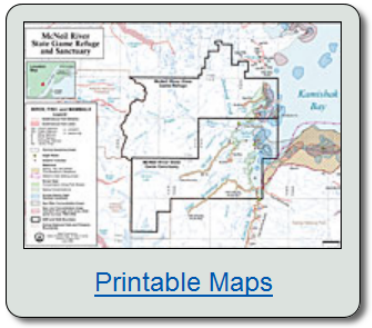
Digital devices now in conjunction with mapping applications can be used to help you better understand where you are in the field. You can create a custom hunt map to print, or for use on a mobile device, based on Game Management Unit (GMU), by Species, by Hunt Number, or by Hunt Type.



Interactive Maps



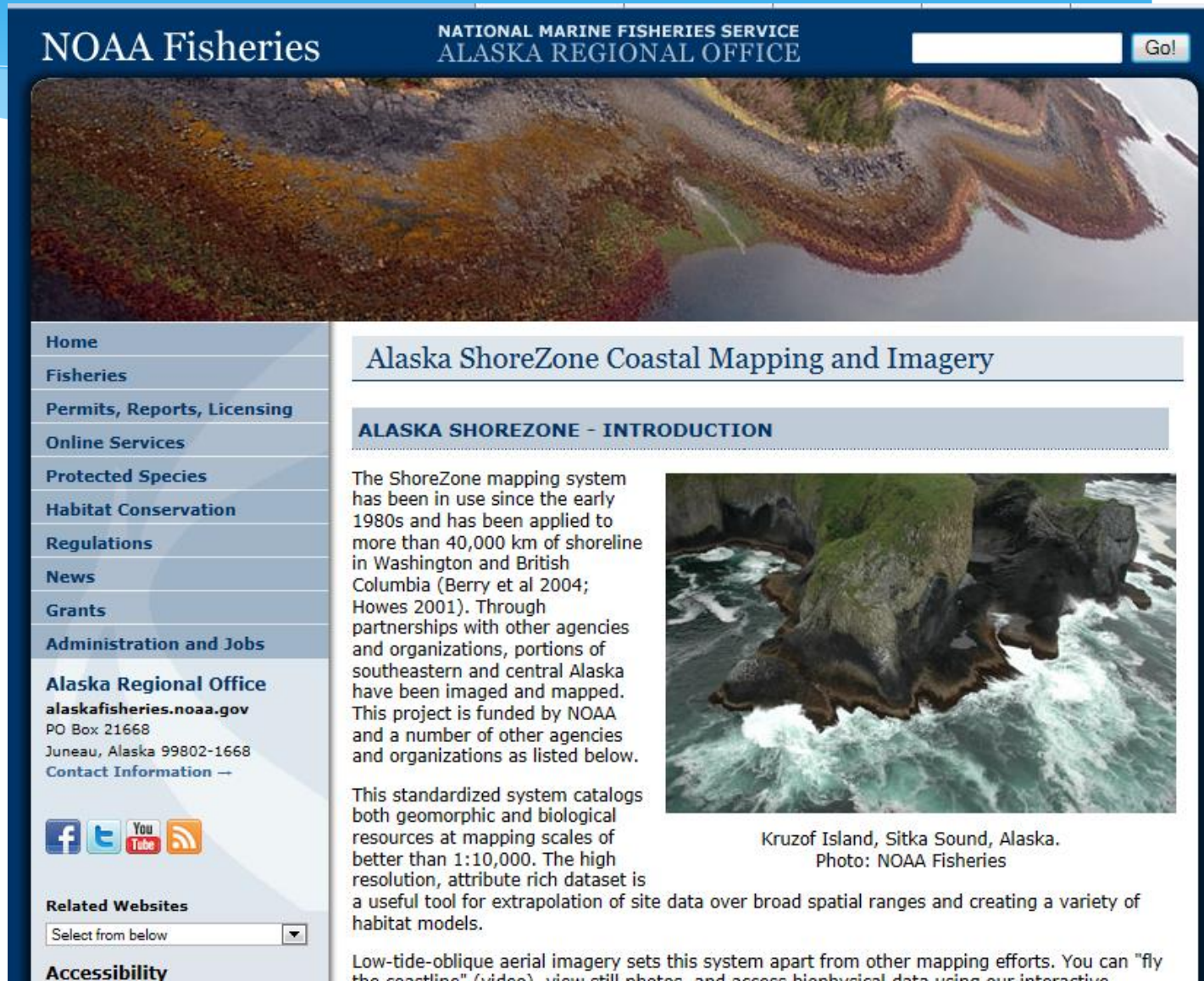
GIS Data Downloads



Printable Maps

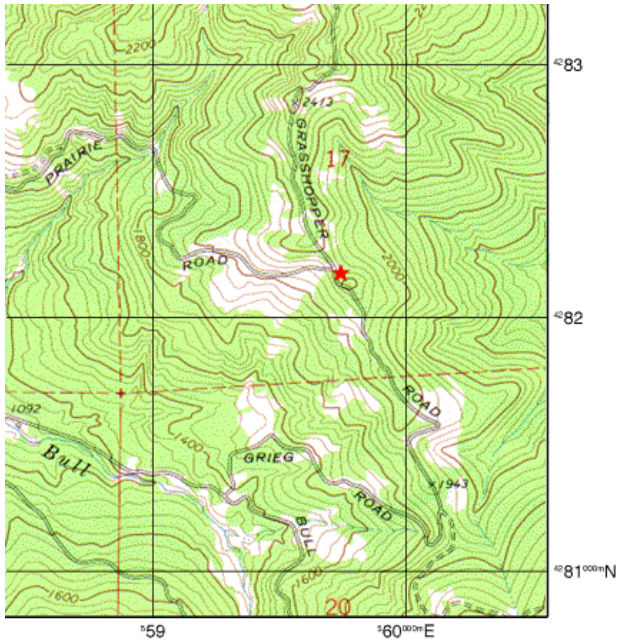
NOAA ShoreZone Mapping

- Entire Shoreline of Alaska Flown
- Ground-trothed to get habitat classification correct



Position - Features can be located by

- Latitude and longitude
- Universal transverse mercator (UTM) coordinates
- Township and range coordinates of public lands



GPS is the future

- Accuracy down to cm
- Mapping habitat variables
  - Redd size and location
  - Riffle length and width
  - Location of passage Obs
- Truthing GIS

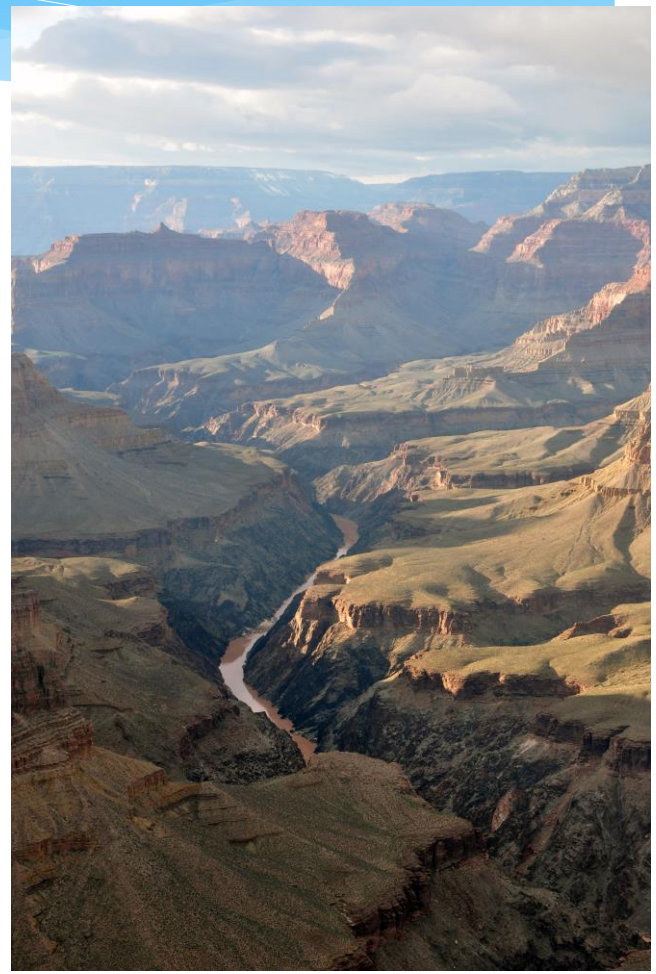
Self Check

- GIS stands for
  - Geographic information standard
  - **Geographic Information System**
  - Galactic information satellite
  - Genesis information system

- Which of the following provides location information down to cm level
  - **Latitude and longitude (GPS)**
  - Universal transverse mercator (UTM) coordinates
  - Township and range coordinates of public lands

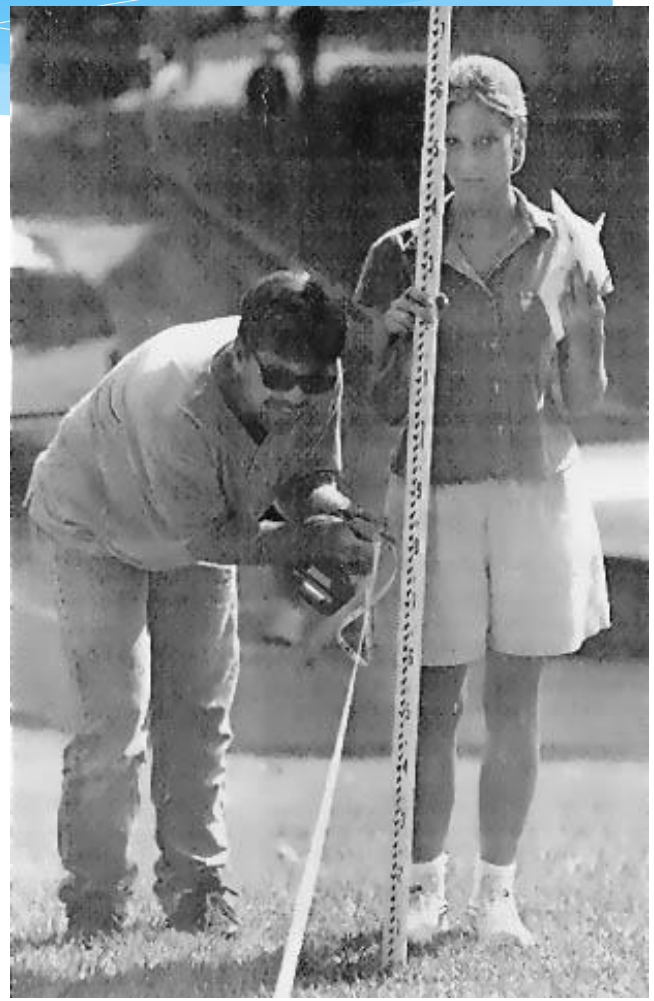
Aquatic Habitat Terminology

- Geomorphology – The shape of something
  - The scientific study of the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the earth's surface.
- Hydrology – The study of water
  - Study of the movement, distribution, and quality of water in streams and Rivers (elsewhere too)



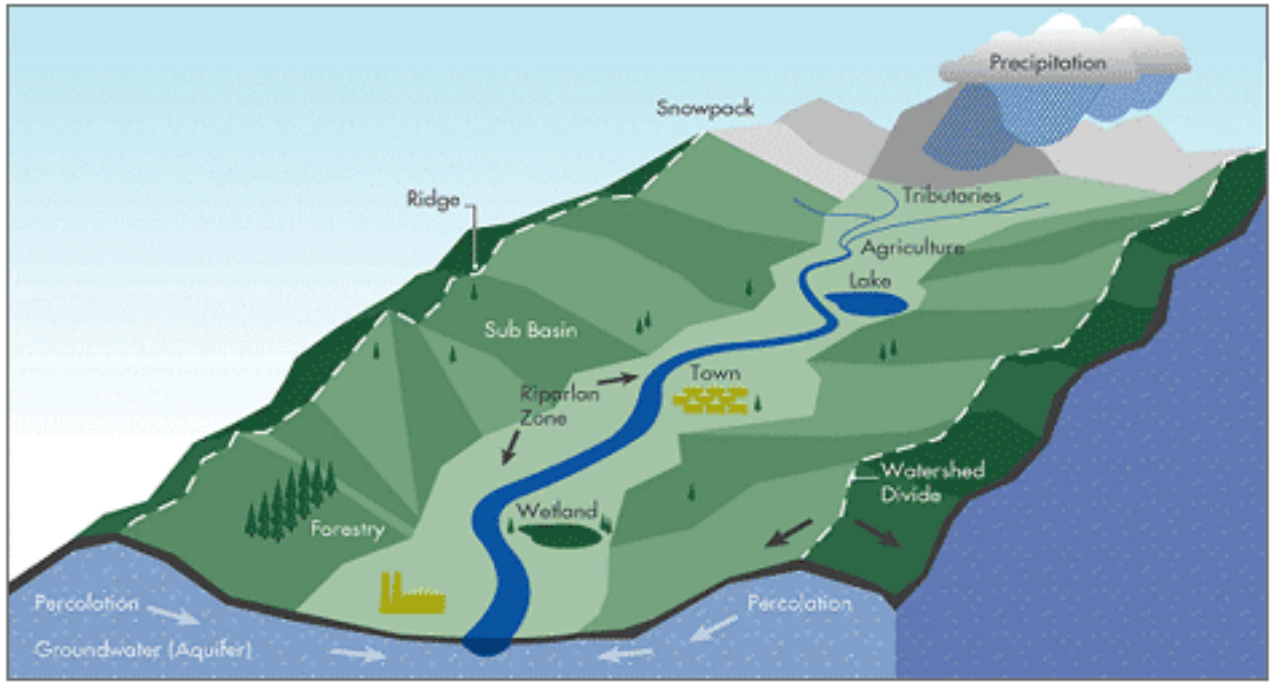
Geomorphic features

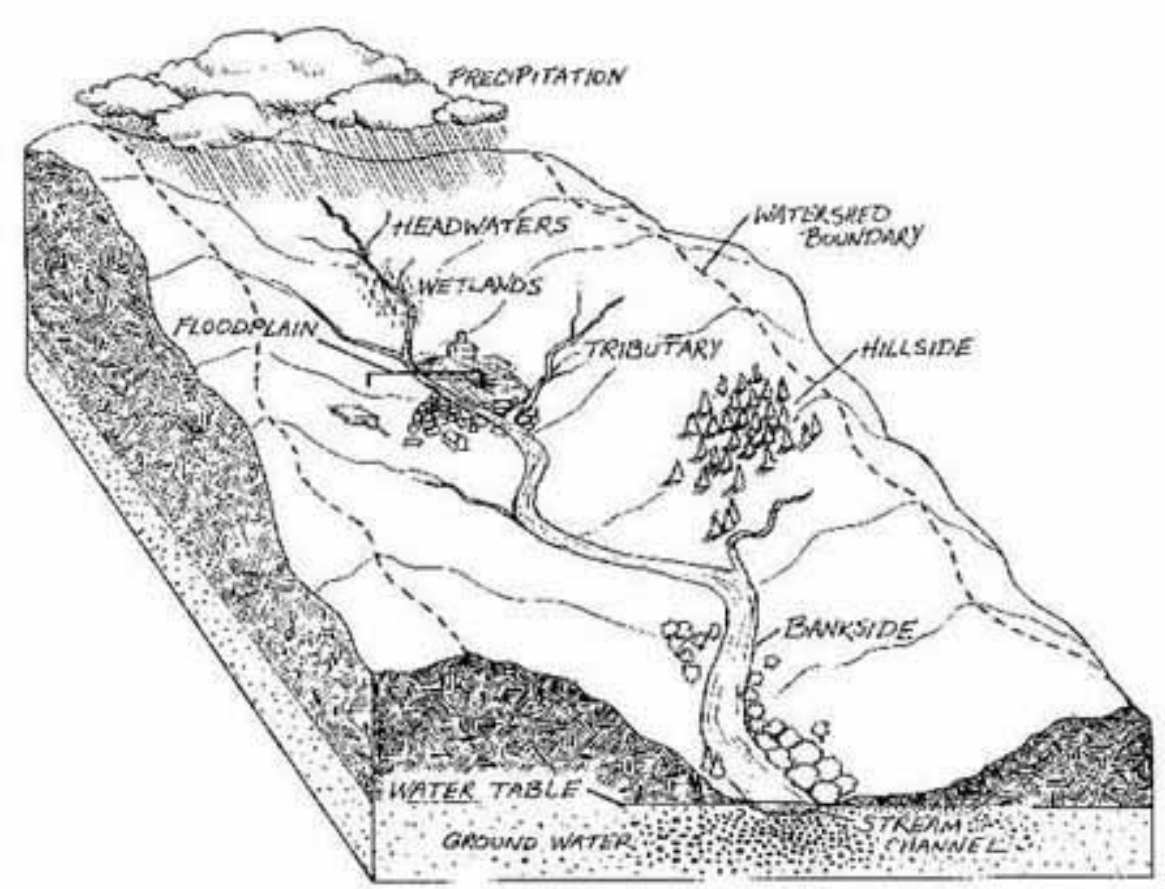
- Basin (Watershed) size
- Drainage density
- Stream Order
- Stream gradient
- Sinuosity



Watershed area Influences

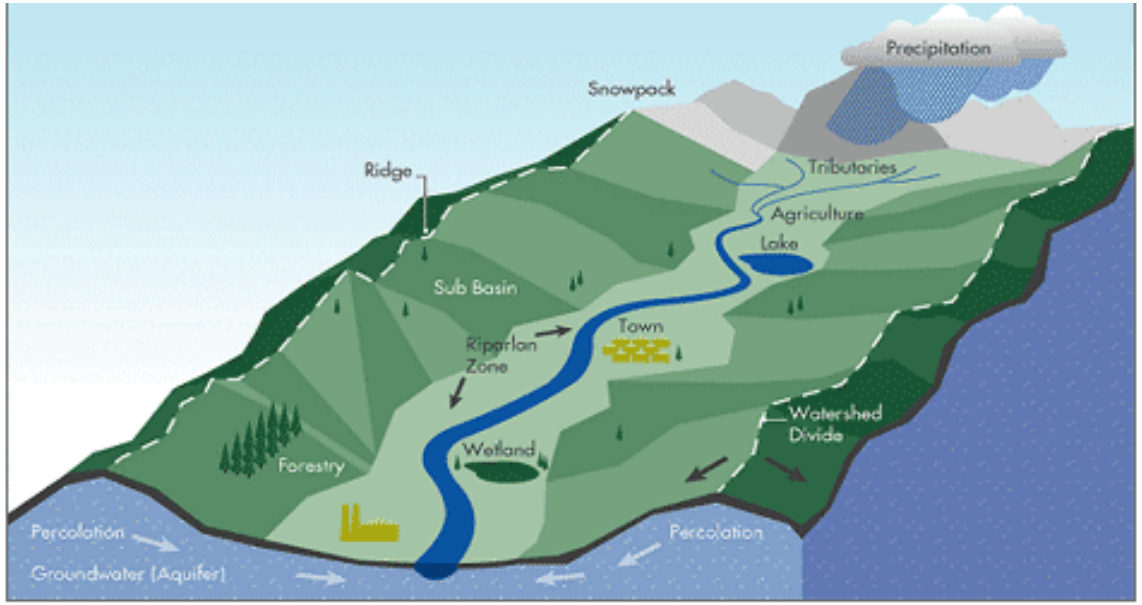
- Amount of water yielded
- Number and size of streams
- Sediment transport

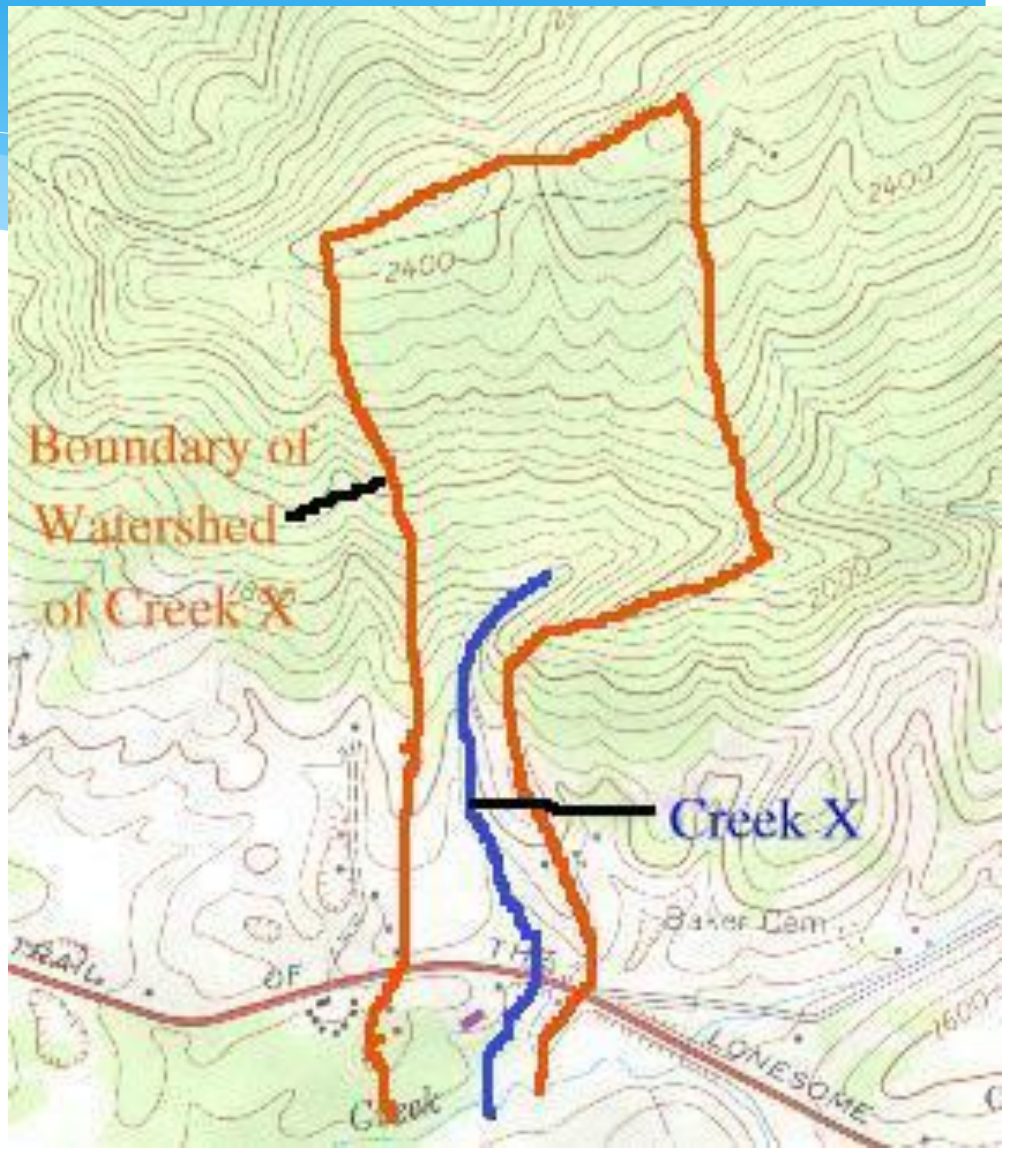




Watershed area Measured

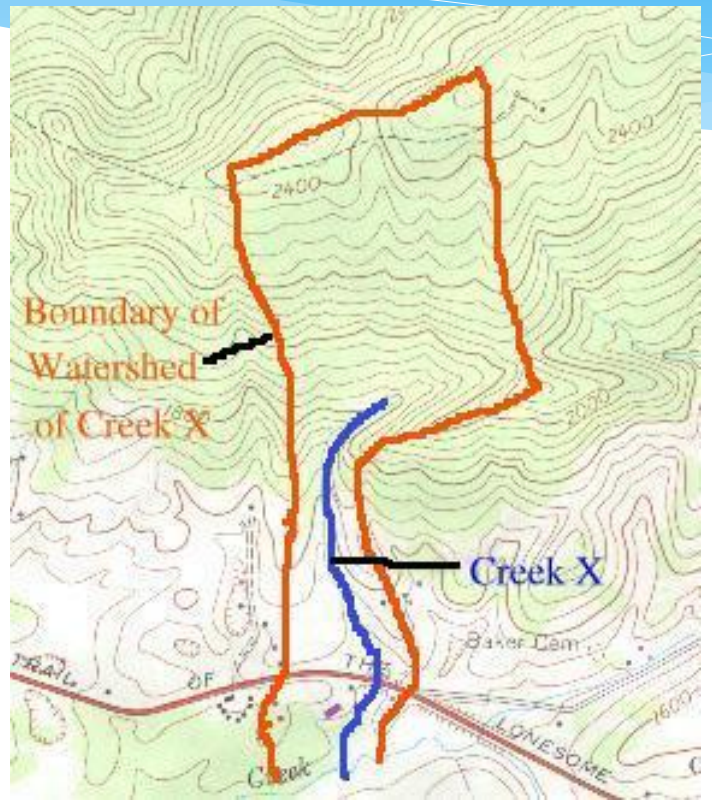
- Tracing boundaries
- Calculating area
- **REALLY IN GIS**
  - Even Google Earth

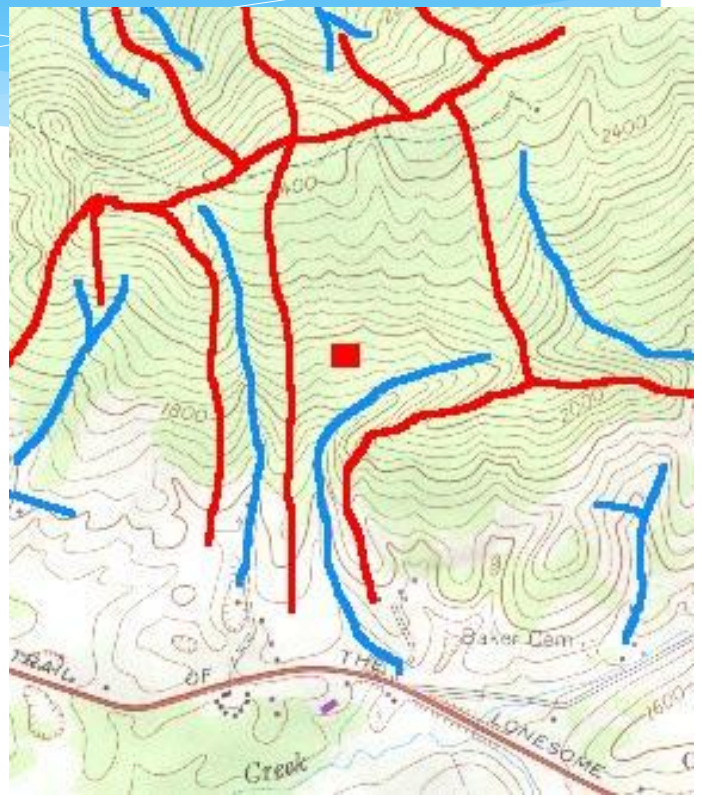




Drainage Density

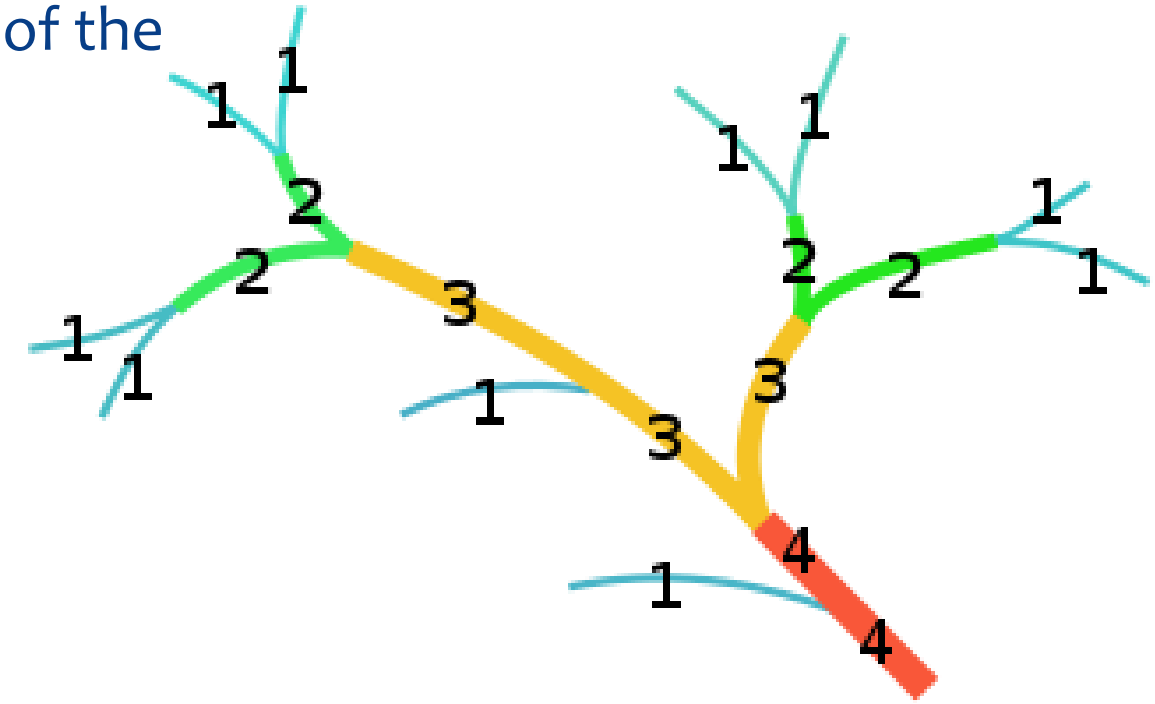
- Dividing total stream length of watershed by the watersheds area
  - Measure of how well or how poorly a watershed is drained by stream channels.





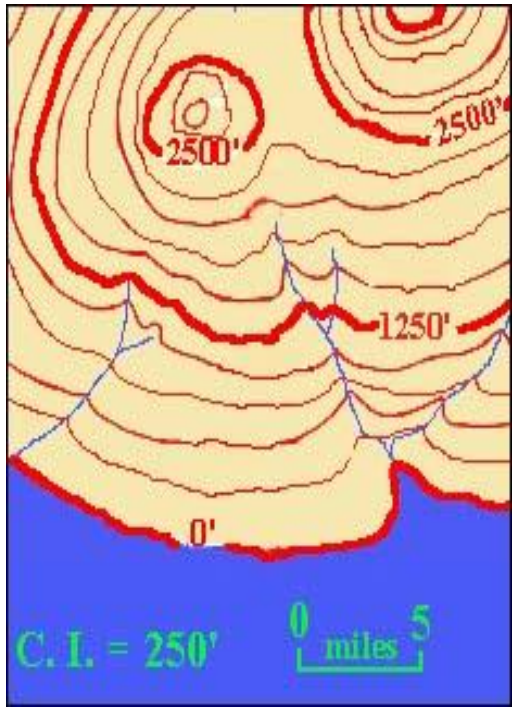
Stream order - rank of relative size

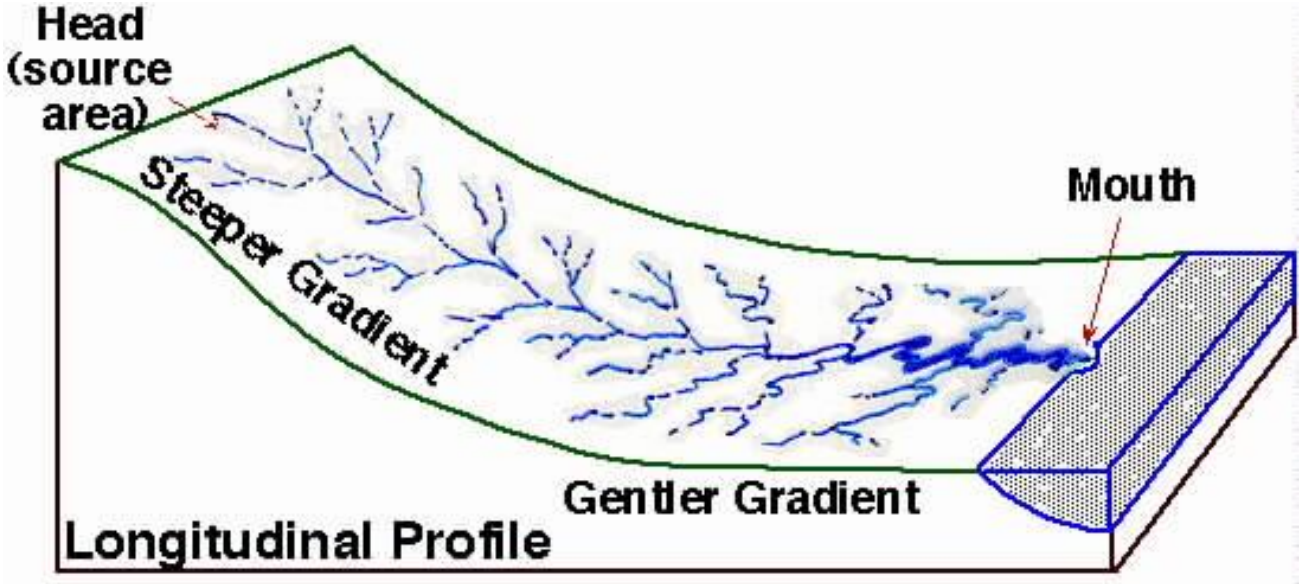
- 1st order-smallest unbranched on headwater
- 2nd order-two first order streams meet
- 3rd order-two second order streams meet
- Note...order increased only when two of the same order join



Stream Gradient

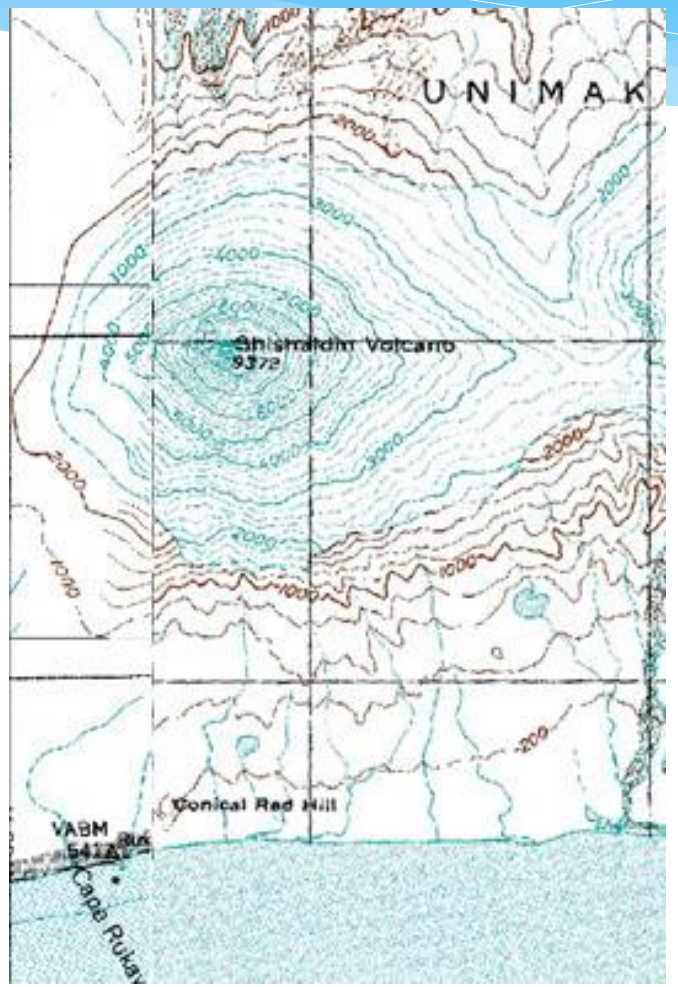
- Slope – rise (or fall) over run
- Number of contour lines crossed / distance
- Meters per km; feet per mi; or percent





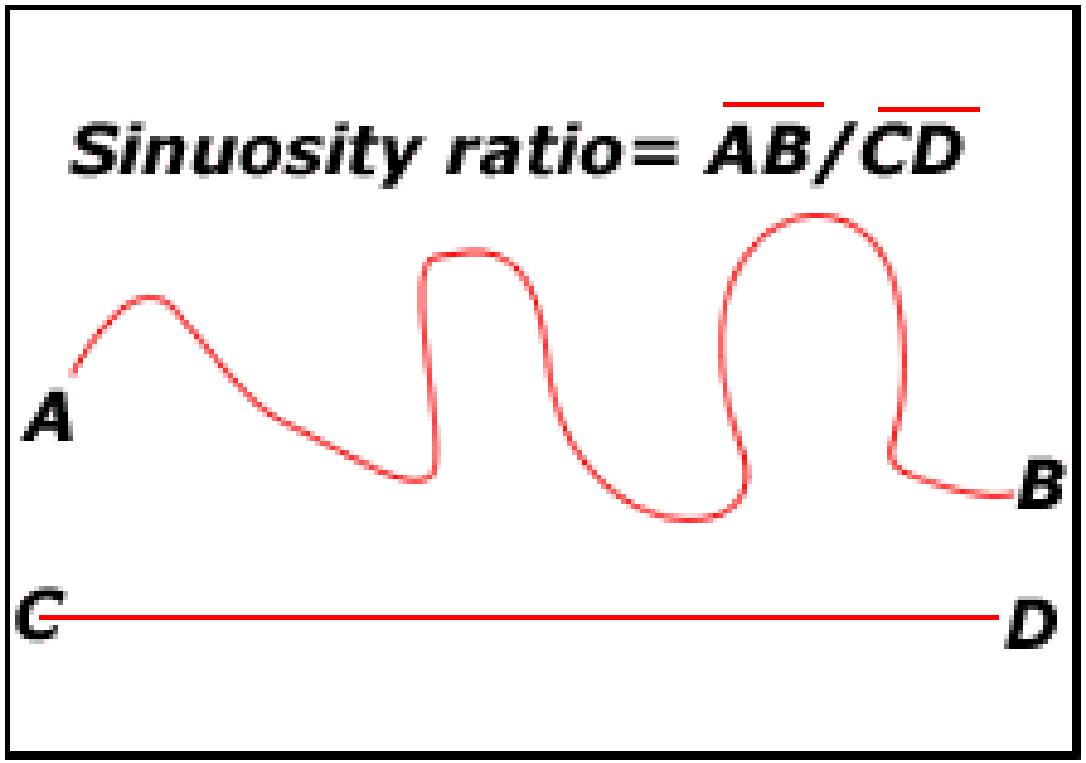
Gradient Calculated by

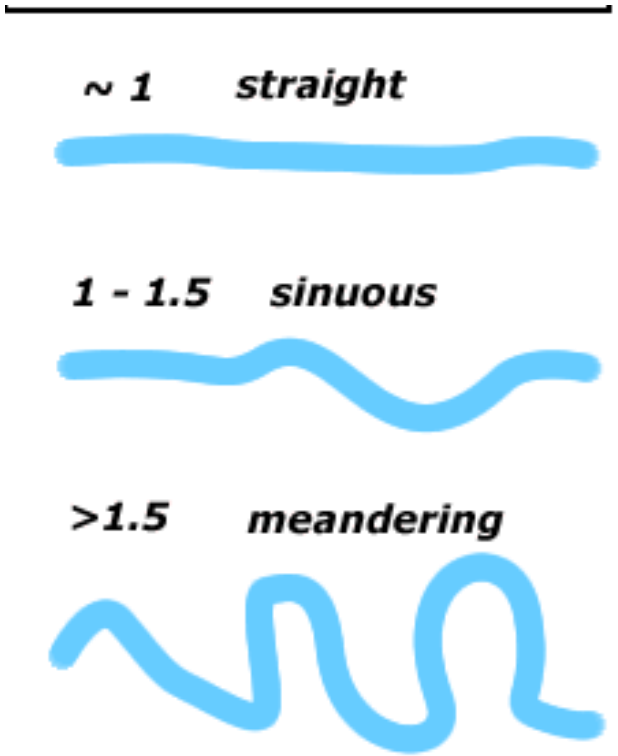
- Topographic maps
- Stadia rod measures
- Inclinometer



Sinuosity

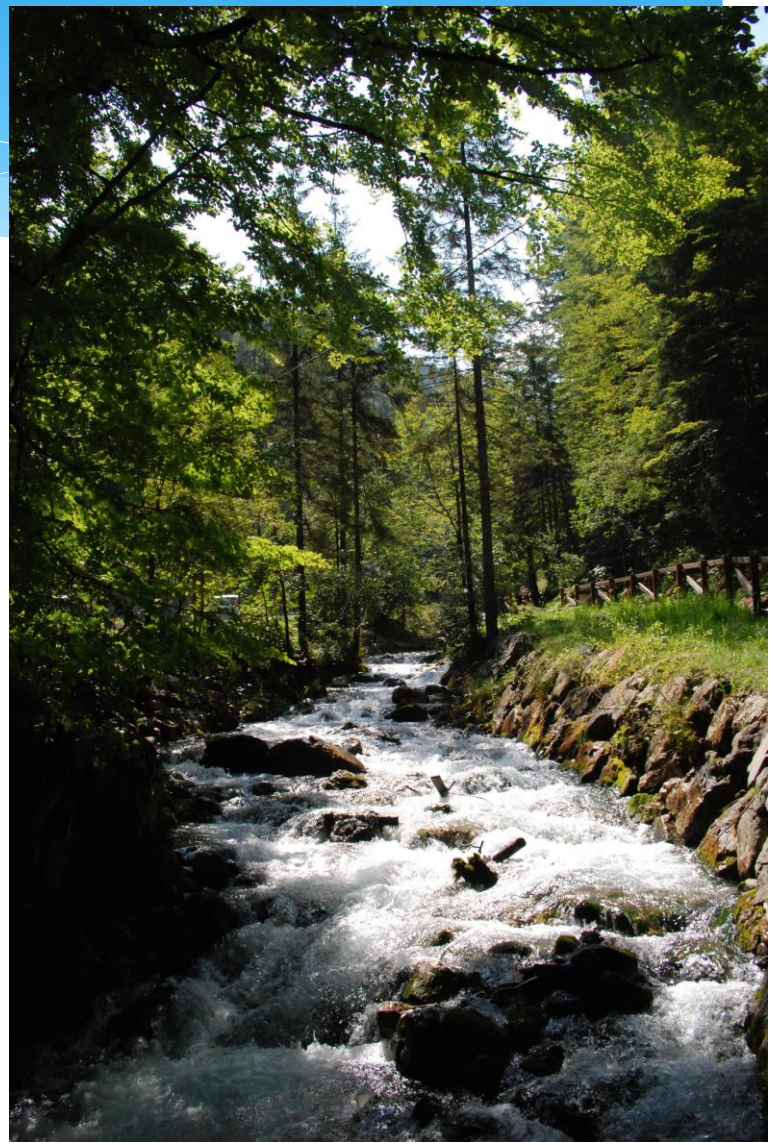
- How much the stream meanders





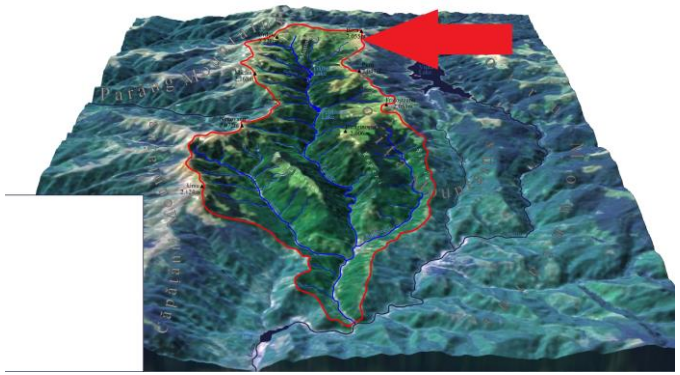
Sinuosity - how curvy?

- Low sinuosity
  - Steep gradients
  - Little pool development
- High sinuosity
  - Undercut banks
  - Large, deep pools



Self Check

- What is identified by the red line outline in the above picture
  - **Watershed Area**
  - Drainage density
  - Stream Order
  - Stream gradient
  - Sinuosity



- Sinuosity is a measure of how steep the stream or river is
  - True
  - **False**

Stream Habitat Classification

Group stream & river characteristics into different habitat types

- Pool – Slow and Deep
- Glide – Slow and Shallow
- Run – Fast and Deep
- Riffle – Fast and shallow. Water surface tension is not broken, resulting in undulations
- Rapid – Water surface tension is broken, creating whitecaps
- Cascade – A series of small falls close together
- Waterfall – Water falls vertically or near vertically without obstruction

Habitat Classification

Pool **Riffle** **Waterfall**

Slow
Moving
Low
Gradient

Glide/Run

Rapid/Cascade

Fast
Moving
Steep
Gradient

Self Check

- A Run typically has faster moving water than a Cascade
  - True
  - **False**

- The above image represents what kind of stream habitat
  - Pool
  - Glide
  - Run
  - Riffle
  - Rapid
  - **Cascade**

Cover & Protection

Important in creating good habitat

- Boulders
- Woody Debris
- Aquatic vegetation
- Riparian vegetation
  - Water turbulence and depth
  - Riparian features

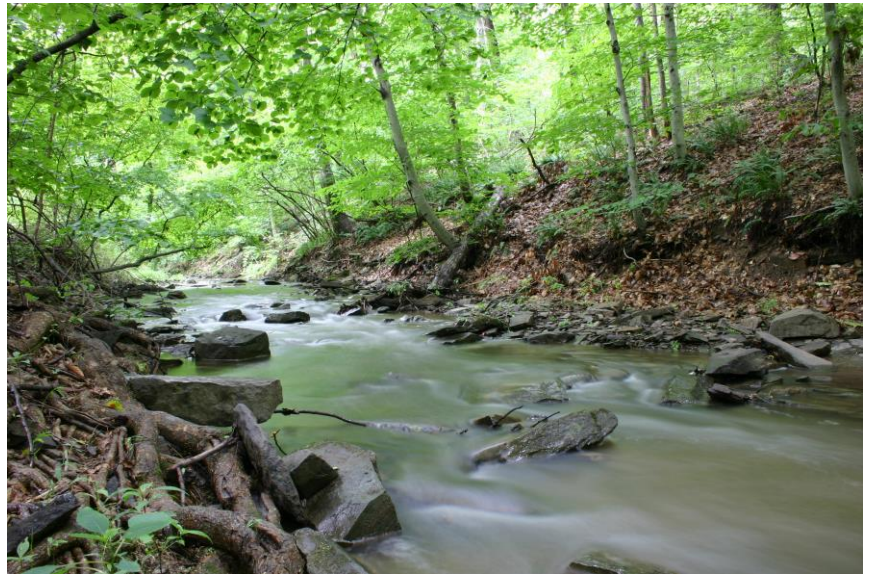
Cover requirements vary by

- Species – Burbot vs salmonids
- Life stage – Juveniles need cover, adults resting places
- Season – Overwintering habitat juvenile Coho

Stream shading measure

Riparian Vegetation & Shading

- Densiometer
- Solar radiometer
- iPhone ??

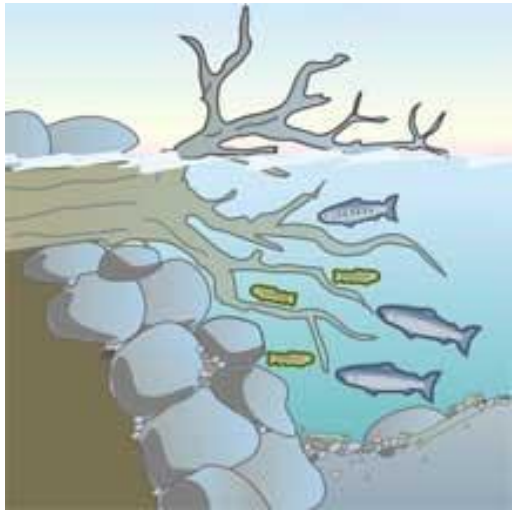


Bank Stability Measure

- Related to riparian vegetation
- Visual rating system
- Proportion of study area with actively eroding banks
- Impacts channel evolution
- Drive-in

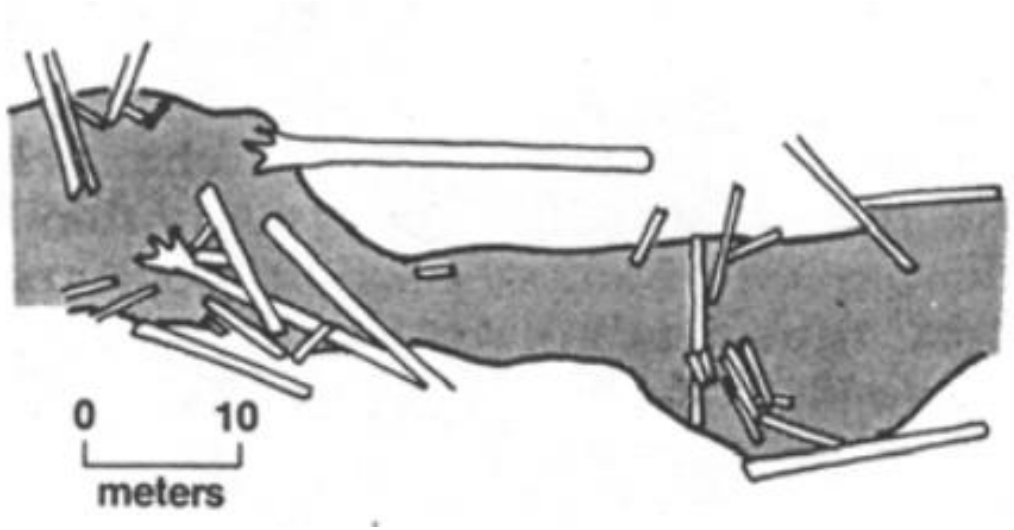
Large woody debris (LWD)

- Stabilizes channels
- Forms pools
- Traps spawning gravel/organic matter
- Habitat for macro invertebrates
- Provides cover for fish



Large woody debris (LWD)

- Count (tally)
  - Grouped into bin sizes
- Measure
  - Each piece along reach > size X
    - Length & diameter (both ends)



Self Check

- LWD stands for
  - Lake wetted diameter
  - Large wood diameter
  - **Large woody debris**
  - Least water depth

- Stream shading can be measured using all of the following except
  - Densiometer
  - Solar Radiometer
  - iPhone
  - **Inclinometer**

Substrate composition

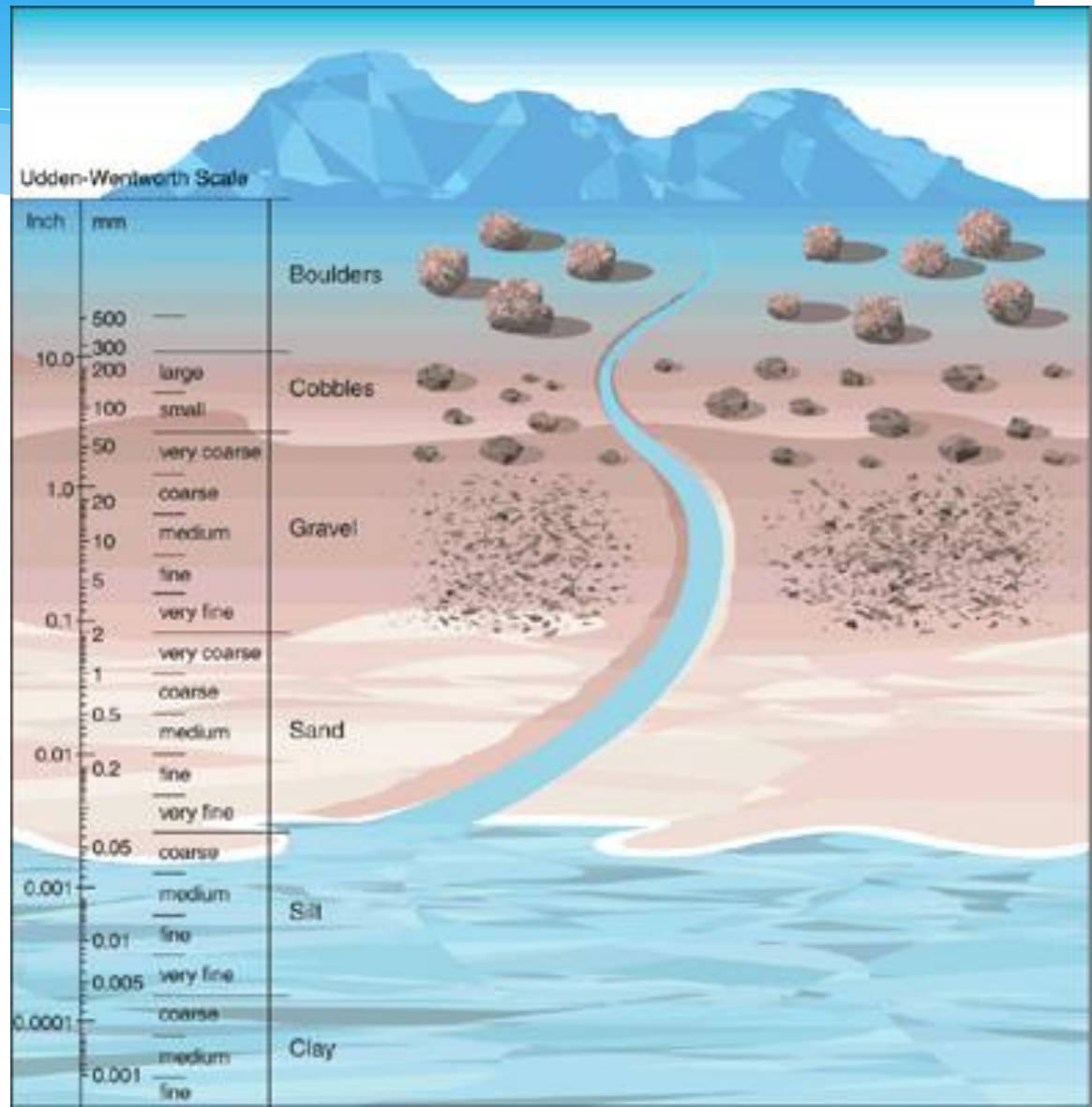
- Quality of spawning habitat
- Fish cover
- Benthic macro invertebrates composition
- Benthic macro invertebrates production

Substrate

- Classification by
  - Visual
  - Wentworth scale
- Subsurface substrate composition
  - Estimate effect on embryo survival

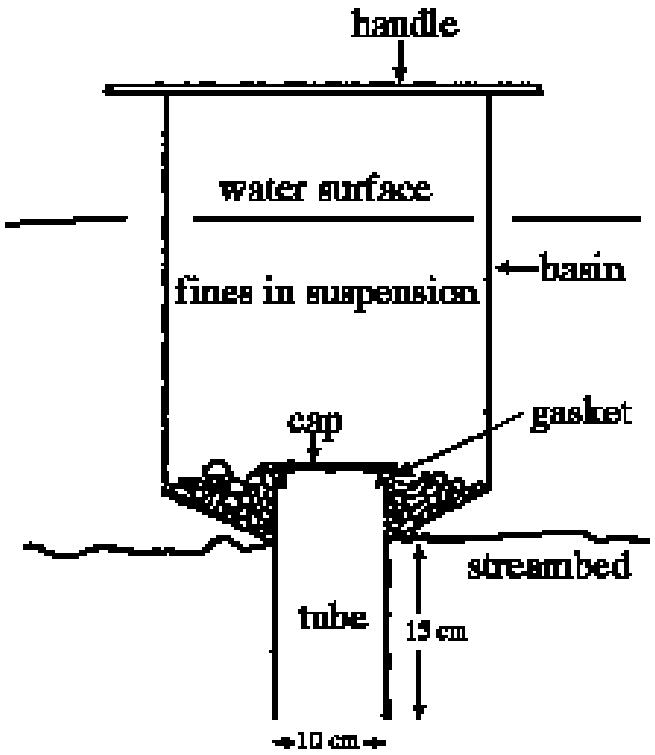
Wentworth Scale

- Standard classification system for particle diameter
  - Gravelometer



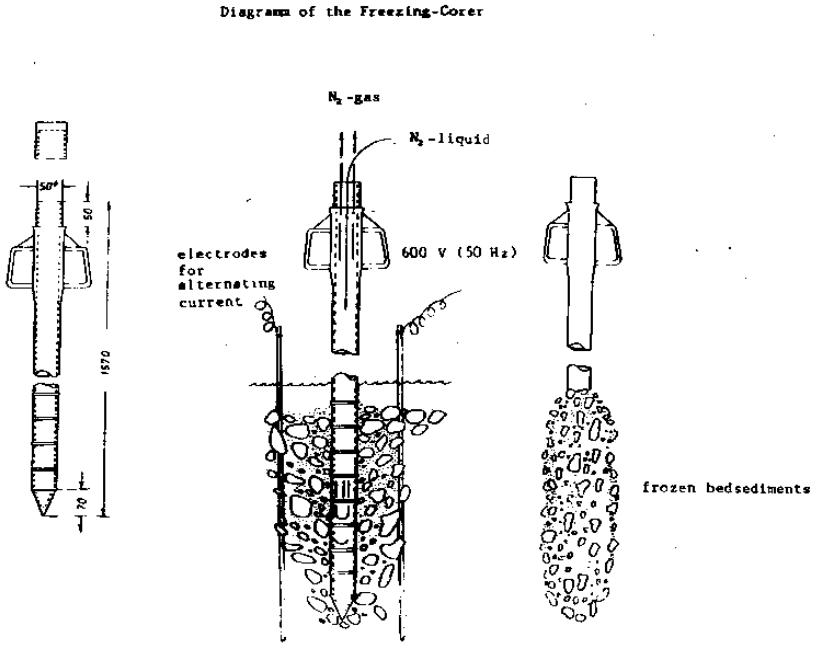
McNeil sampler

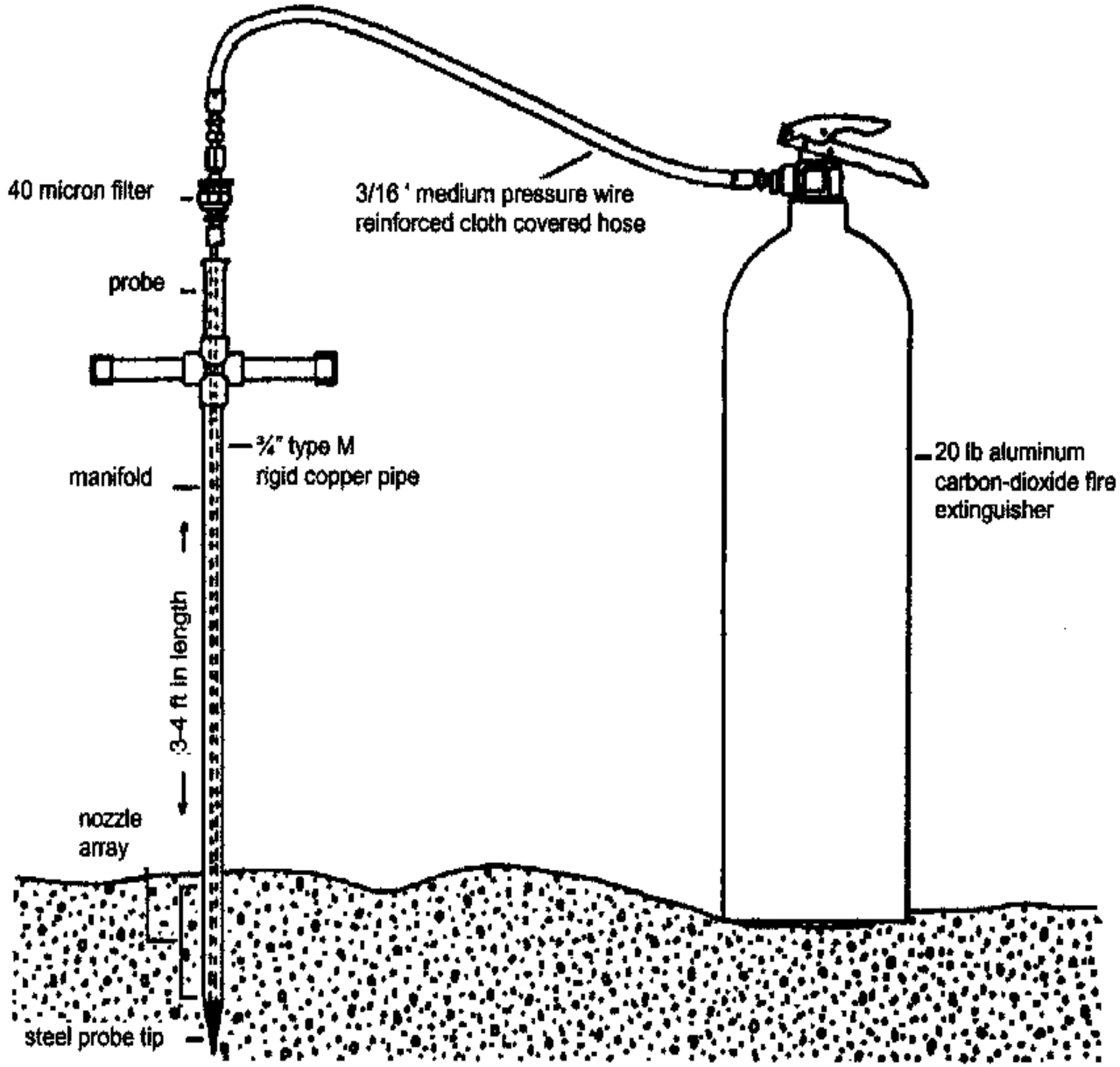
- More portable
- Less costly
- Easy operation



Freeze core sampler

- Analyze vertical stratification
- More complete collection of fine sediment
- Sample deeper water





Done
Internet
100%

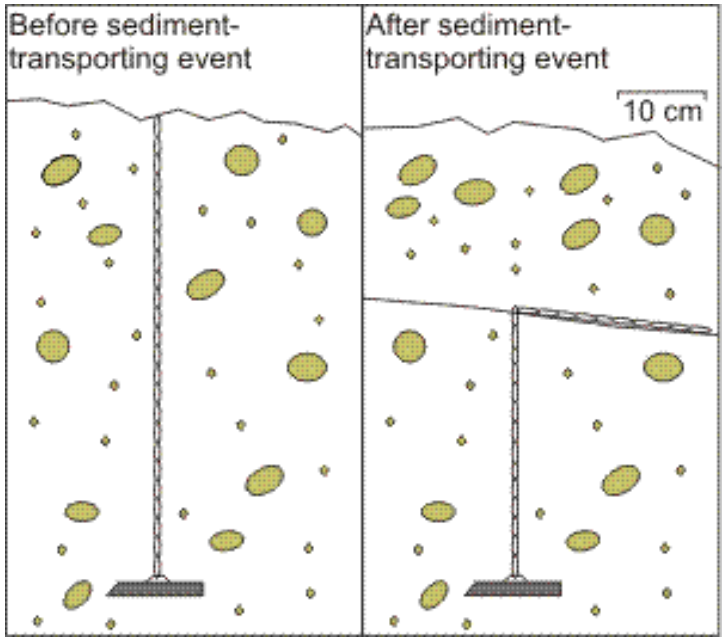
Erosion & sedimentation

Activities that increase erosion & sedimentation

- Flooding
- Road building
- Logging
- Grazing
- Mining

Erosion and Sedimentation

- Repeated measure of channel cross sections
- Scour chains aggradation and degradation



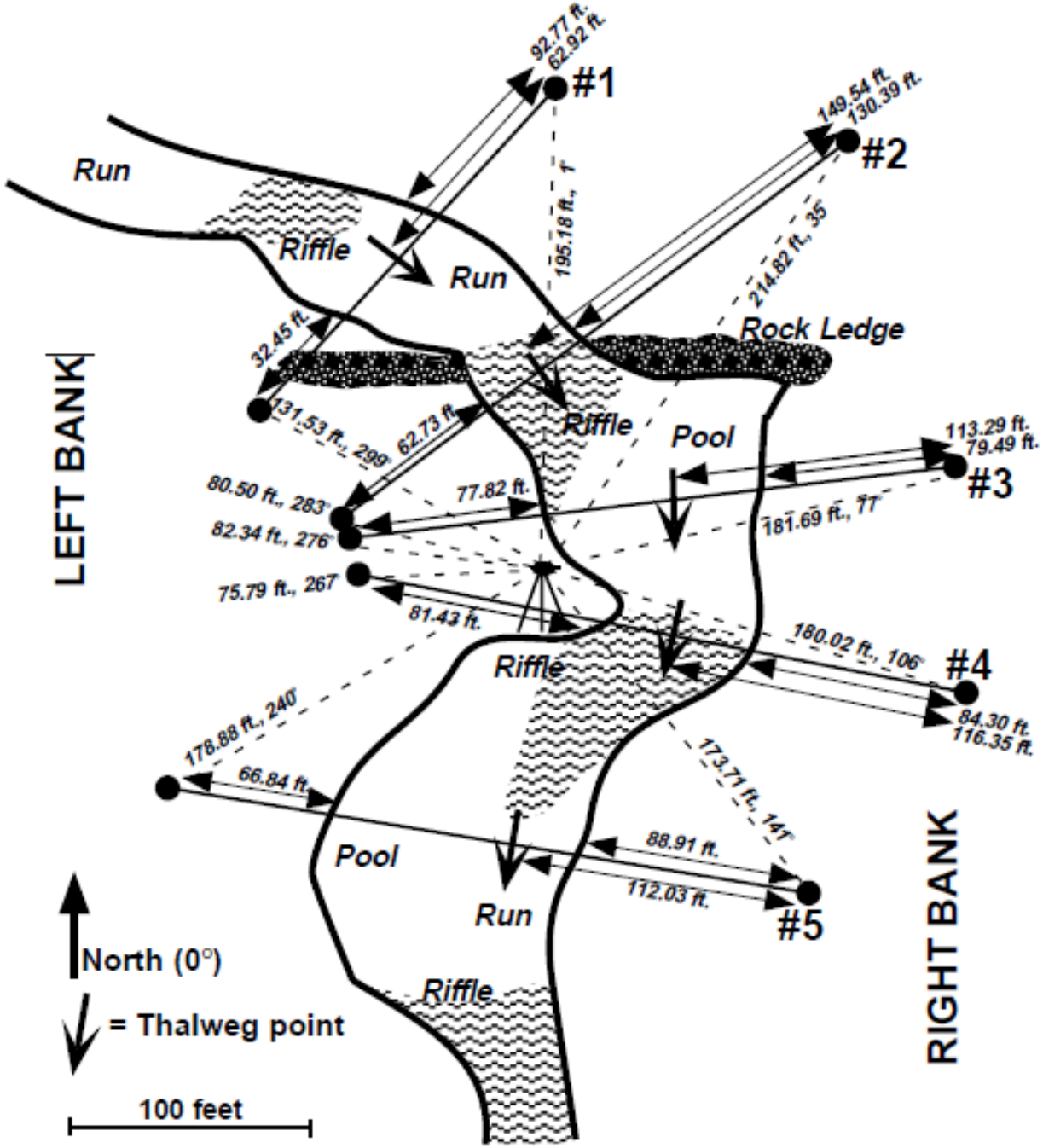
Self Check

- Substrate composition can be extremely important to fish and aquatic organisms
  - **True**
  - False

- Which of the below is not a tool to measure sobstrat
  - McNeil Sampler
  - **Dirt Sifter**
  - Freeze Corer
  - Scour Chains
  - Gravelometer

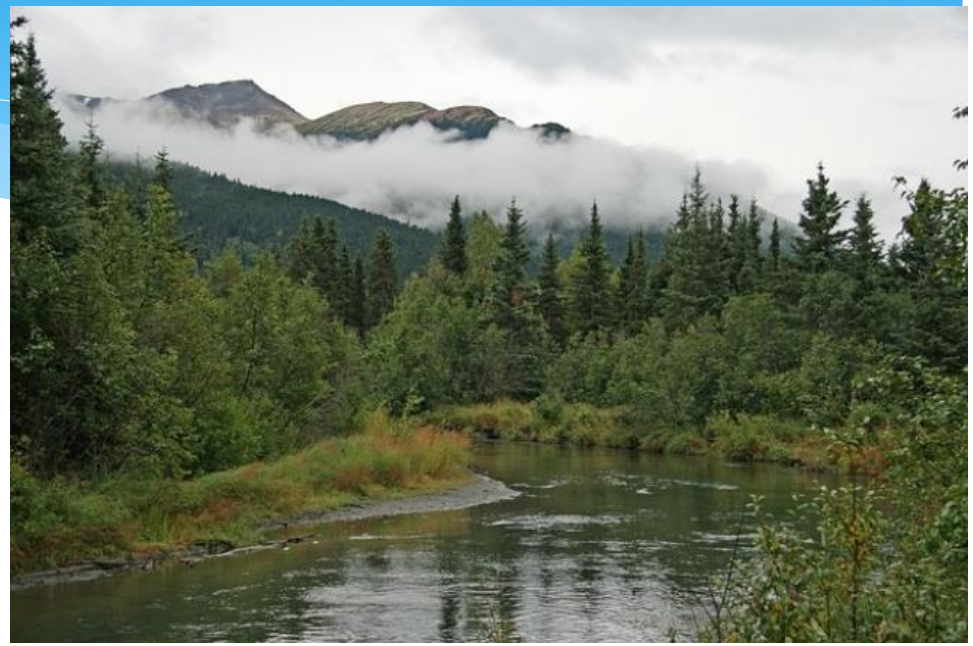
Stream Measurements - Transect Vs Habitat Sampling

- Transect
  - Systematically measured
  - Visually estimated
- Habitat based
  - Divides area to habitat types
  - Visually estimates habitat features


92.77 ft.
62.92 ft.
#1
Run
Riffle
Run
195.18 ft., 1°
149.54 ft.
130.39 ft.
#2
214.82 ft., 35°
32.45 ft.
Rock Ledge
131.53 ft., 299°
62.73 ft.
Riffle
Pool
113.29 ft.
79.49 ft.
#3
80.50 ft., 283°
77.82 ft.
82.34 ft., 276°
181.69 ft., 77°
75.79 ft., 267°
81.43 ft.
180.02 ft., 106°
#4
Riffle
84.30 ft.
116.35 ft.
178.88 ft., 240°
66.84 ft.
173.71 ft., 141°
88.91 ft.
Pool
112.03 ft.
#5
Run
Riffle
LEFT BANK
RIGHT BANK
North (0°)
= Thalweg point
100 feet

Geomorphic features influence

- Lake / river productivity
- Composition of stream habitat
- Fish species & abundance

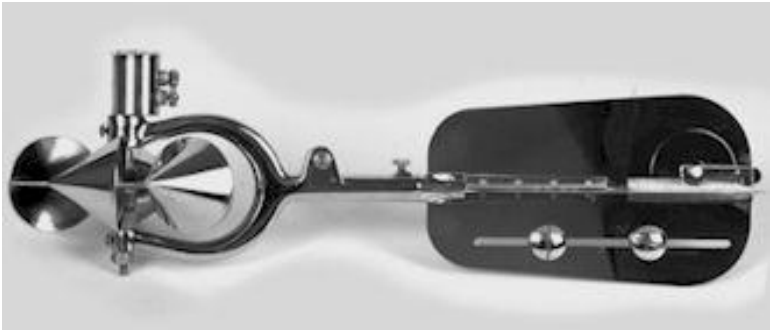


Hydrology - Velocity Flow & Discharge

- How much water & How fast
- Changes over time
- Function of Season Climate
  - Habitat
- Impact habitat quality / quantity
- Fish passage

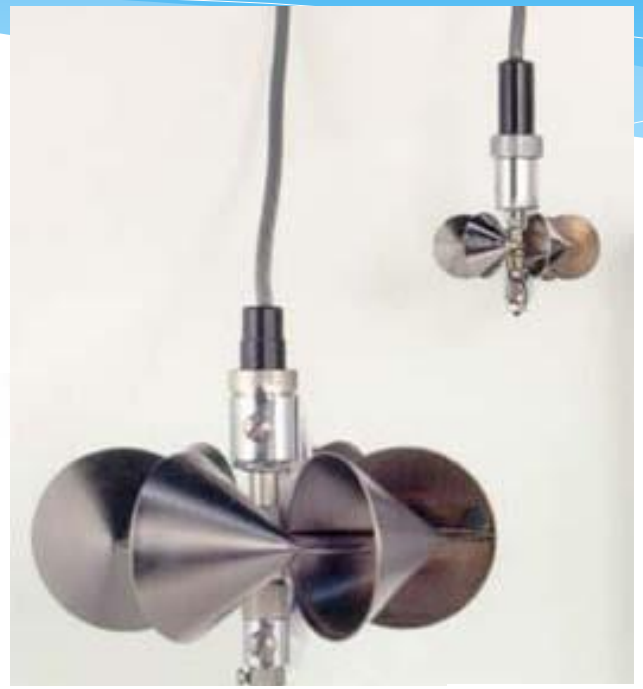
Velocity Measure - speed

- Distance over time
  - m / sec
- Floating object
- Movement of dye
- Mechanical current meter
- Electrical current meter

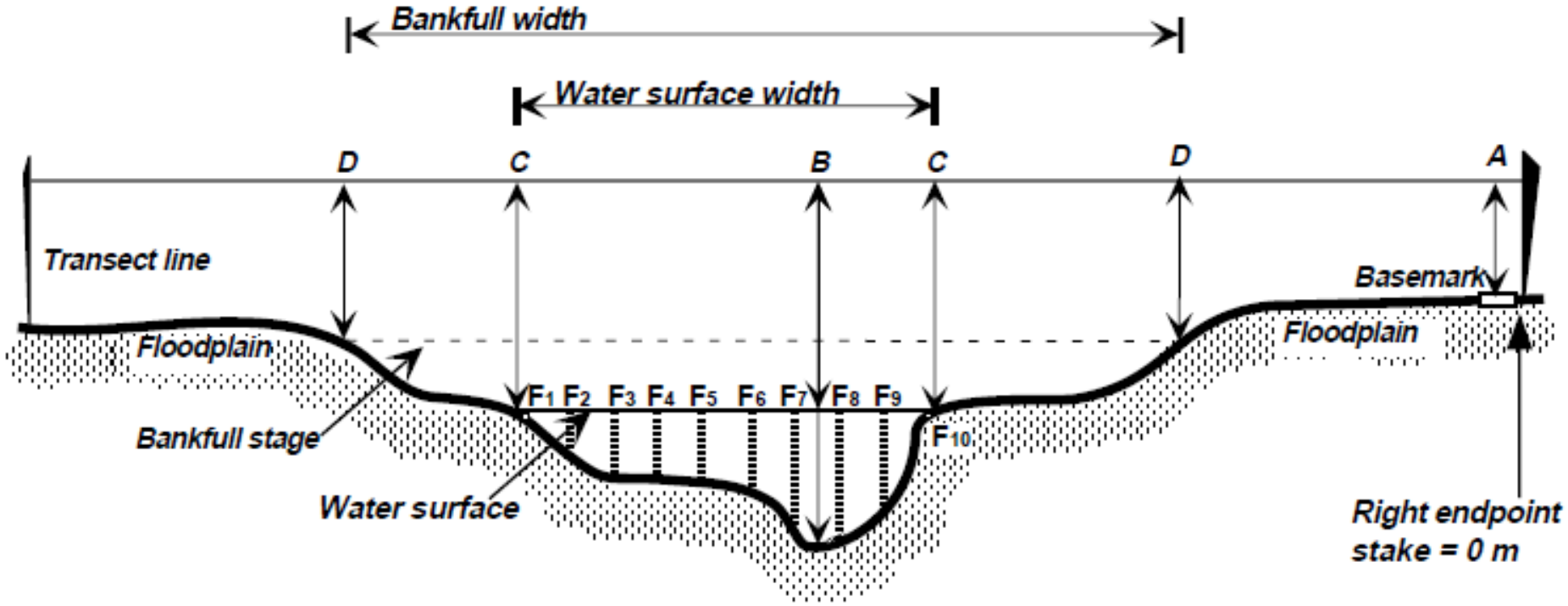


Velocity meters

- Propeller
- Cup
- Electromagnetic
- Acoustic



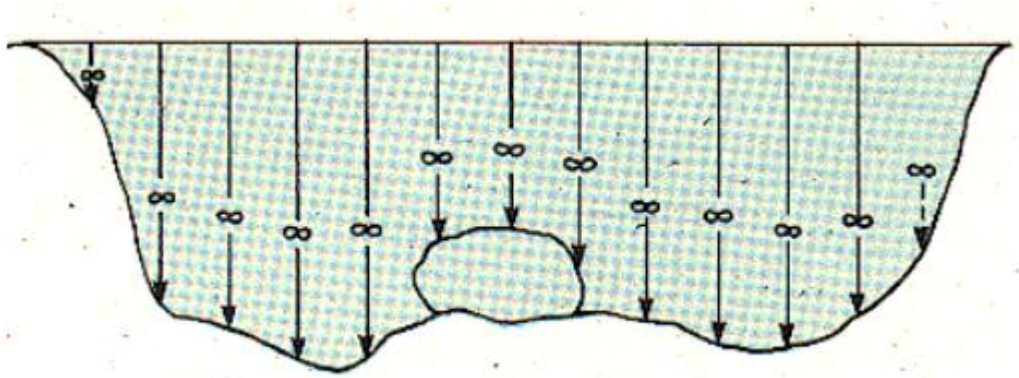
Stream Width

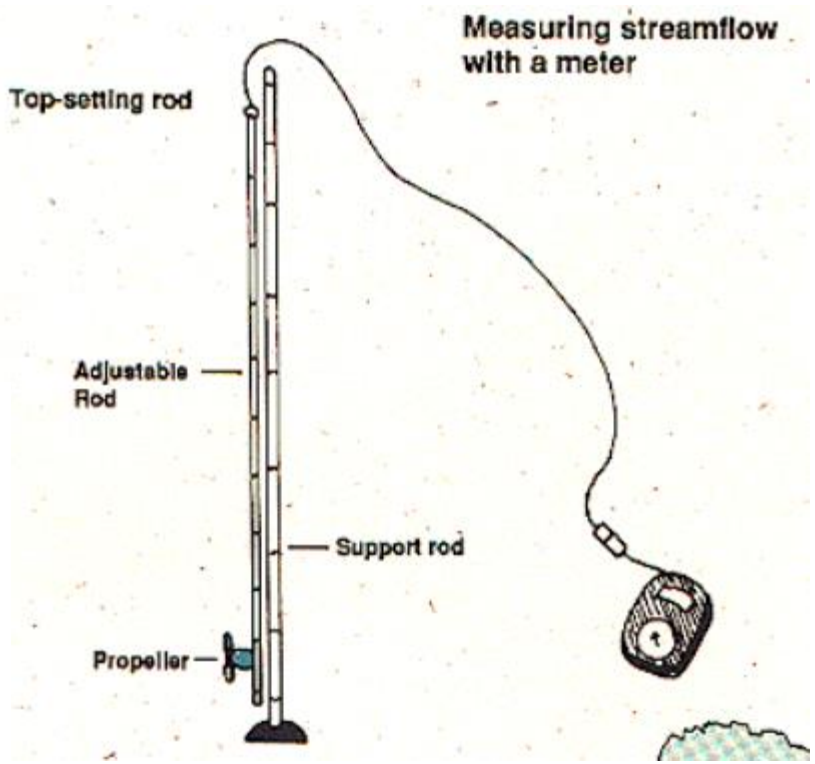


- Thalweg – deepest point in the channel (B)

Stream Flow

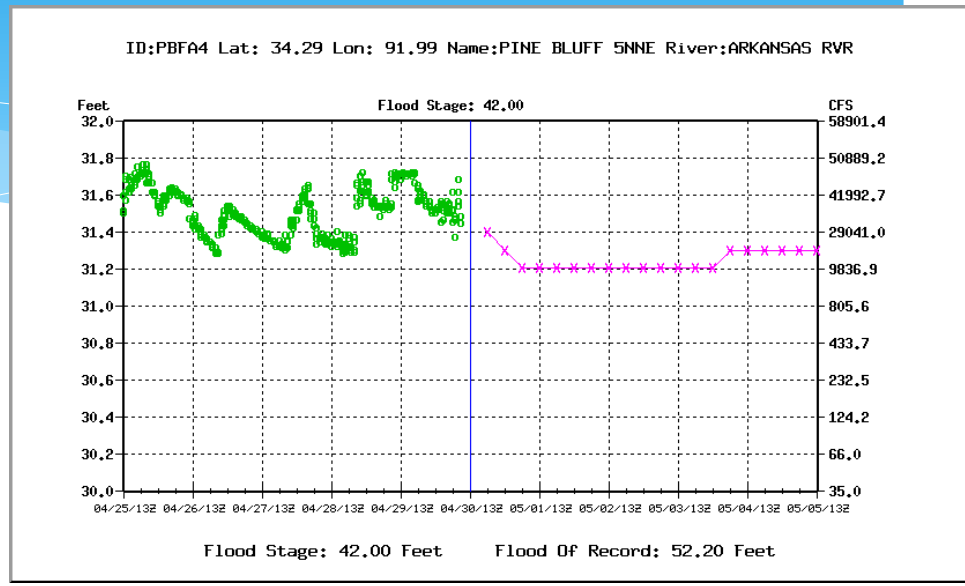
- 10 – 20 points
- Total depth X 0.6 to get average depth
- Avg depth x velocity = discharge

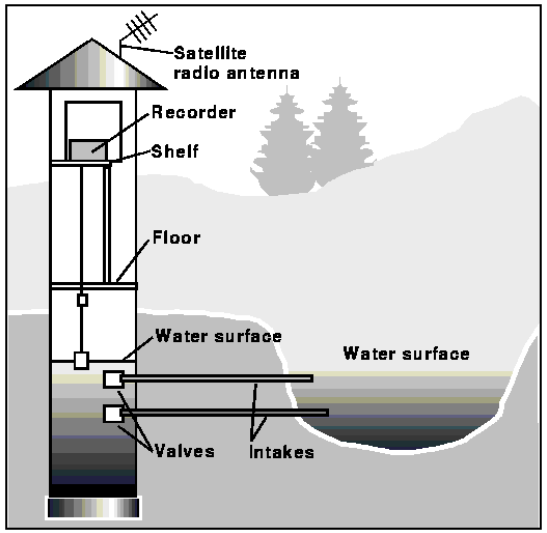


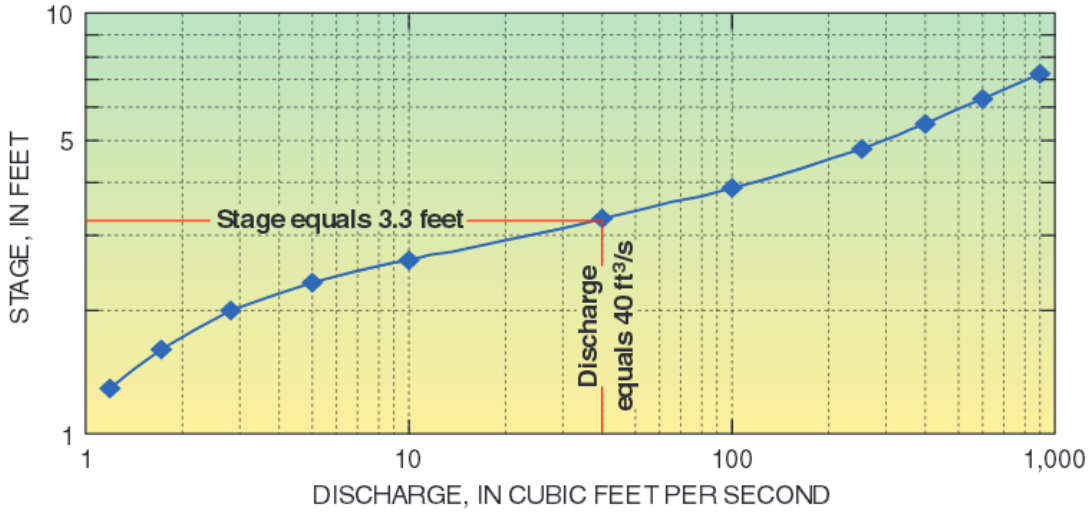


Discharge measured

- Gauging stations
  - Measure stream height – convert to discharge
- Hydrographs
  - Graphs of stream discharge
    - Actual & Predicted

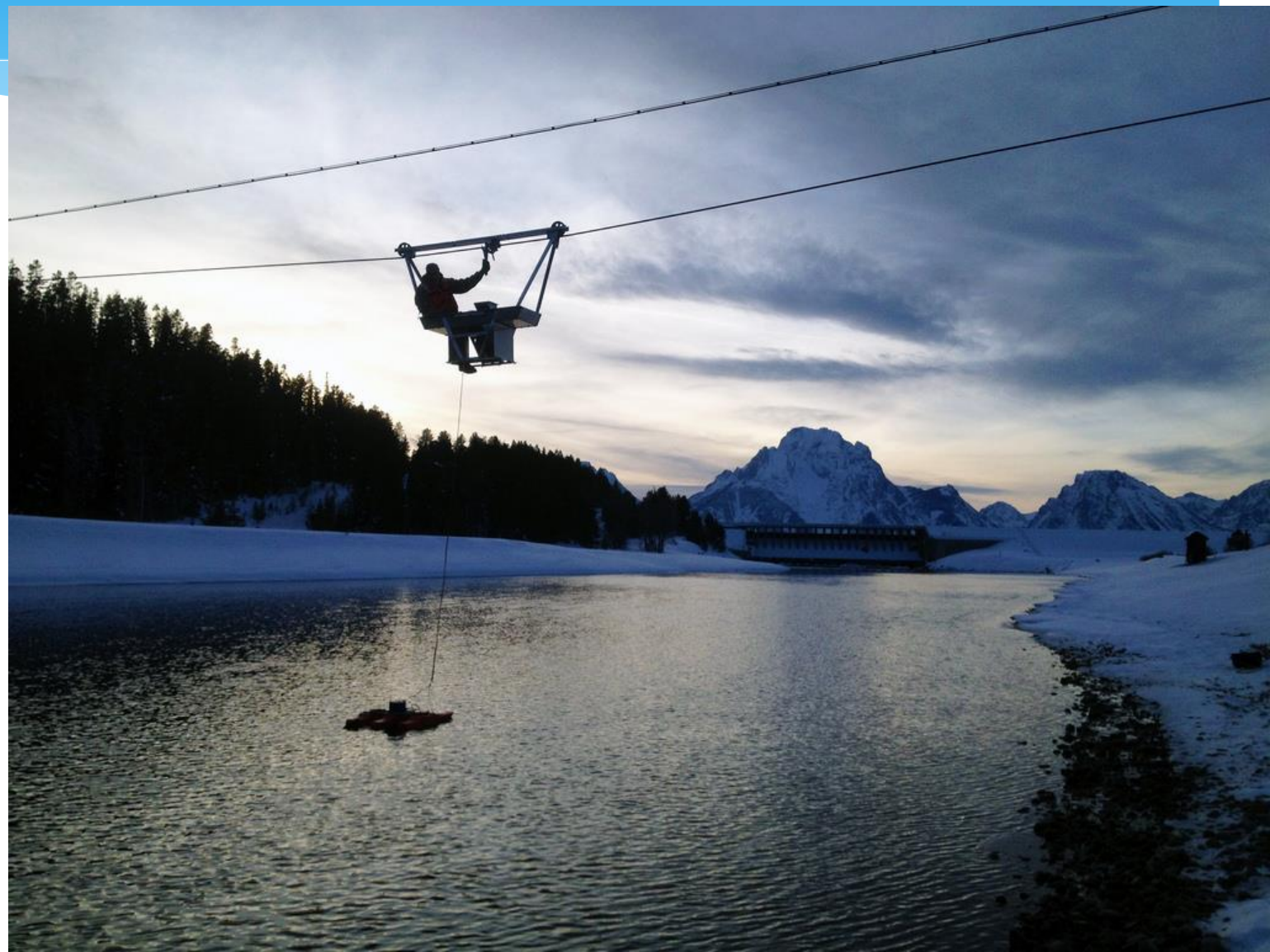






Discharge in Big Rivers

- Grand Teton NP&P



USGS hydrologic technician Bob Reaves collects streamflow measurements from the cableway at the USGS streamgage on the Snake River near Moran, WY. Jackson Lake Dam is shown in the background

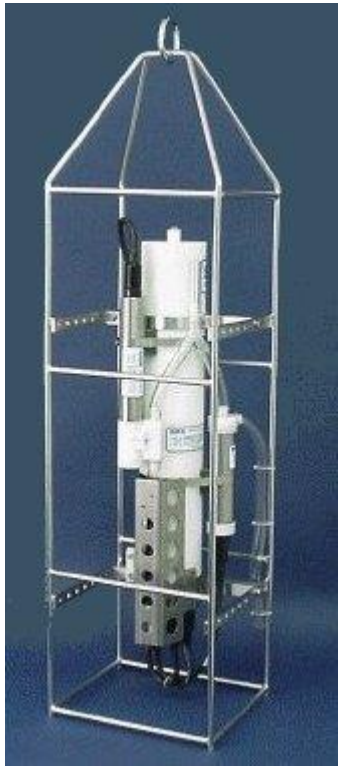
Self Check

- How could You measure Stream Velocity without a velocity meter
  - Get the information from GIS
  - Use a GPS
  - **Time how long it takes a stick to float 10 meters downstream**
  - A velocity meter is the only way to get velocity information

- Select the parameters needed to measure stream discharge
  - Width & Depth
  - Width & Velocity
  - **Width, Depth, Velocity**
  - Depth & Velocity

Water Quality

- Numerous standards APHA EPA
- Electronic sensors/ meters
  - Yellow Springs Instruments (YSI)
  - ICM Perstorp
  - Hydrolab
  - Orion



Water Quality

- Temperature - field
- Dissolved Oxygen - field
- pH - field
- Nutrients - lab
- Chlorophyll - lab
- Suspended Solids / turbidity - field
- Salinity - field

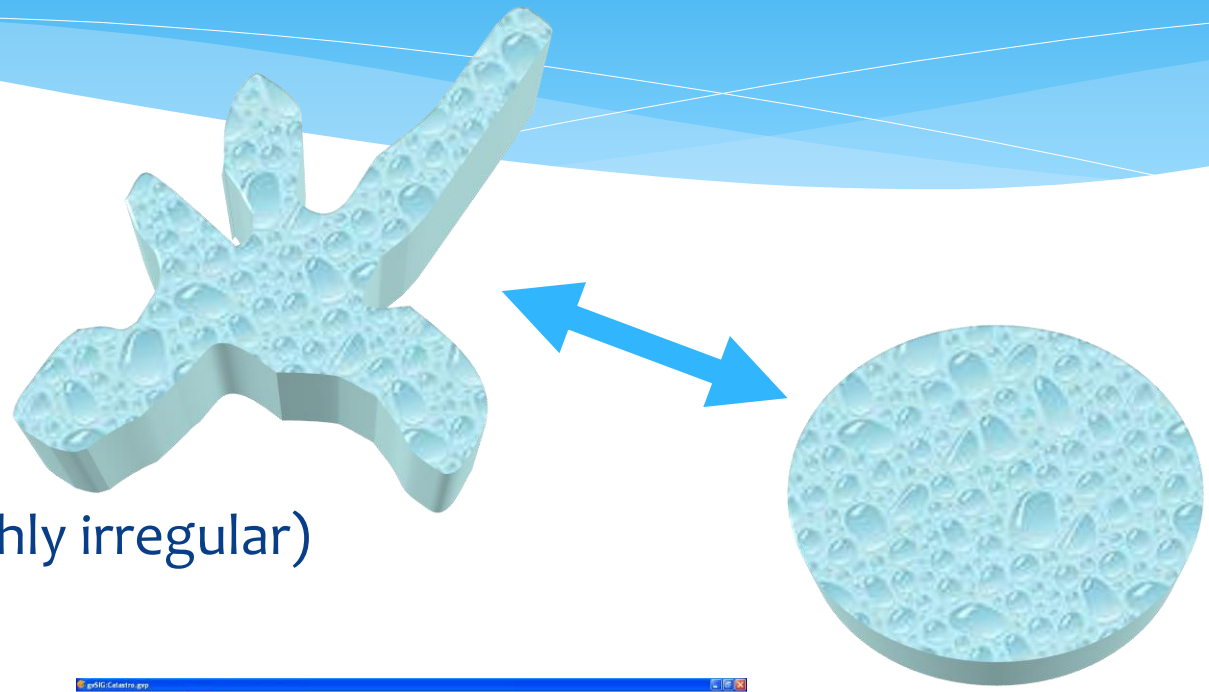
Self Check

- Water Quality can be limiting to fish and aquatic organisms
  - **True**
  - False

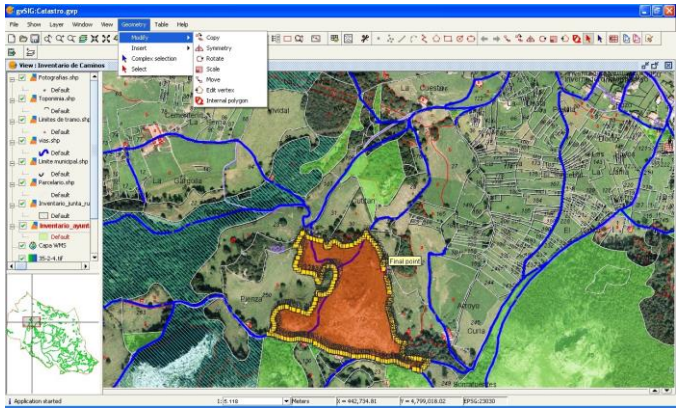
- Technology is making it easier to collect water quality information in the field
  - **True**
  - False

Lake and Reservoir Morphology

- Area (how big)
- Depth (how deep)
  - Maximum Depth
  - Average Depth
- Volume (how much)
  - Area X Average Depth = Volume
- Shape or Irregularity (circle vs highly irregular)
- Watershed Area

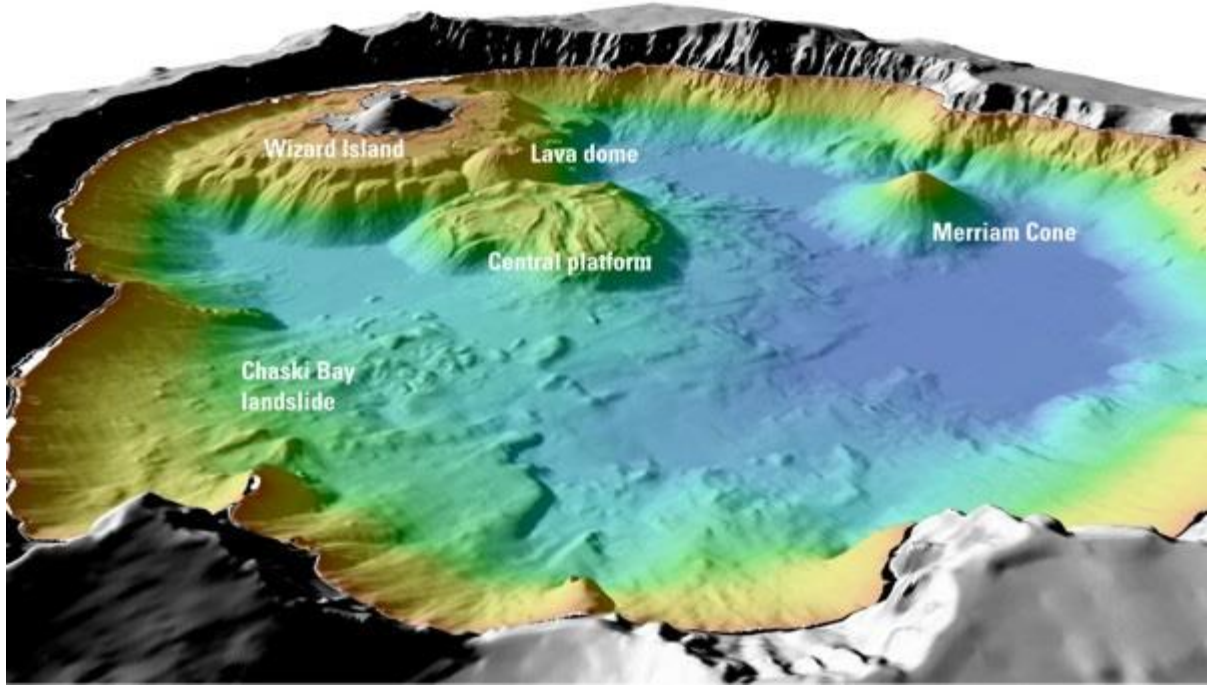


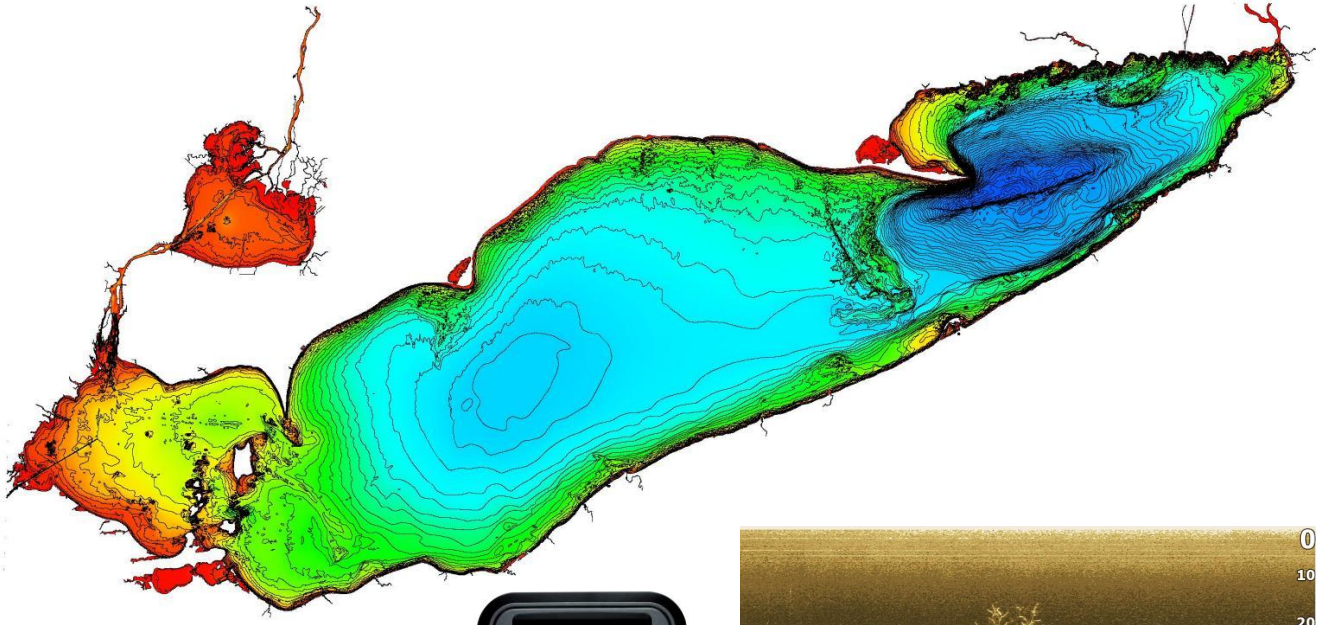
- Most can be measured using
  - GIS
  - Google Earth

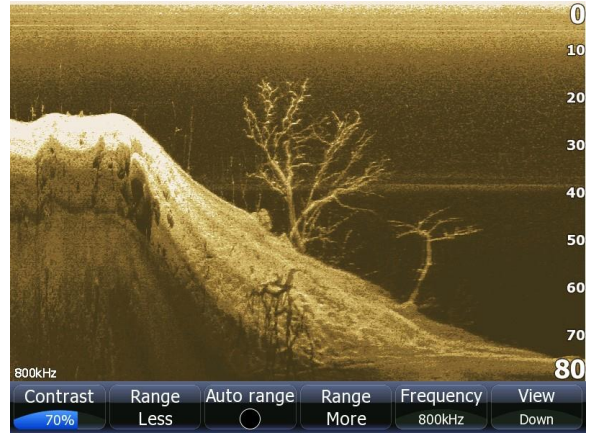


Depth measure

- Electronic echo sounders
- Weighted sounding cables

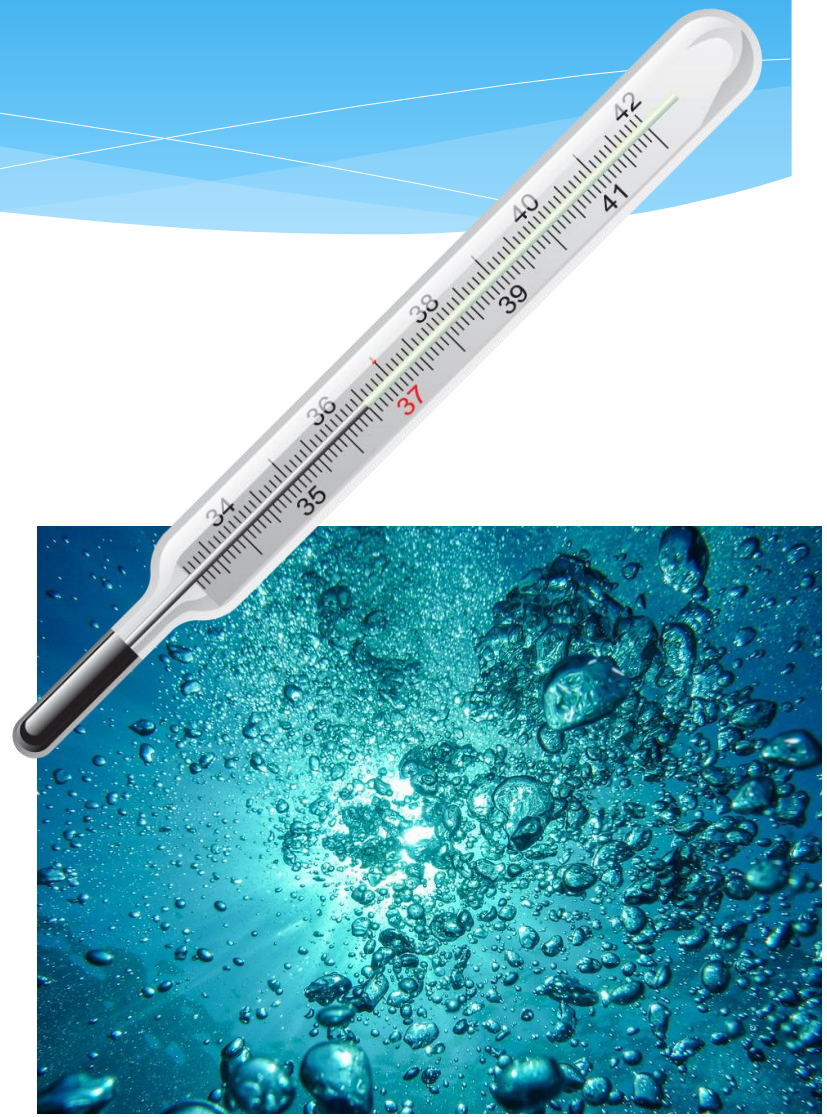






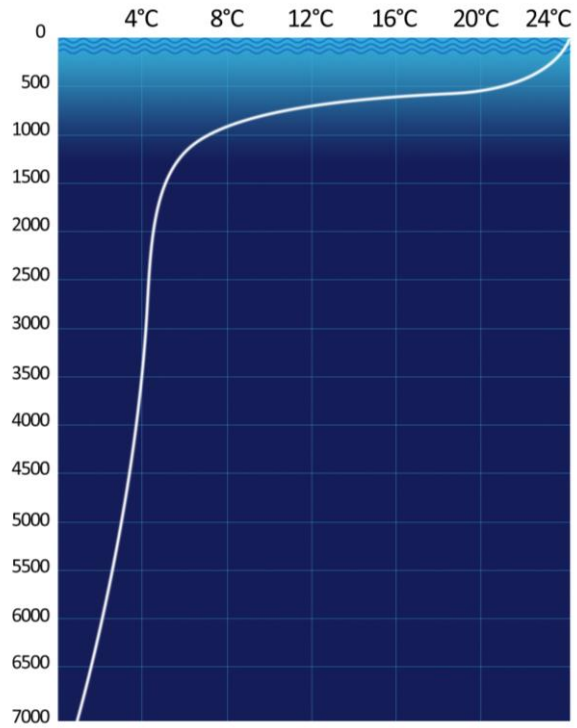
Physiochemical attributes

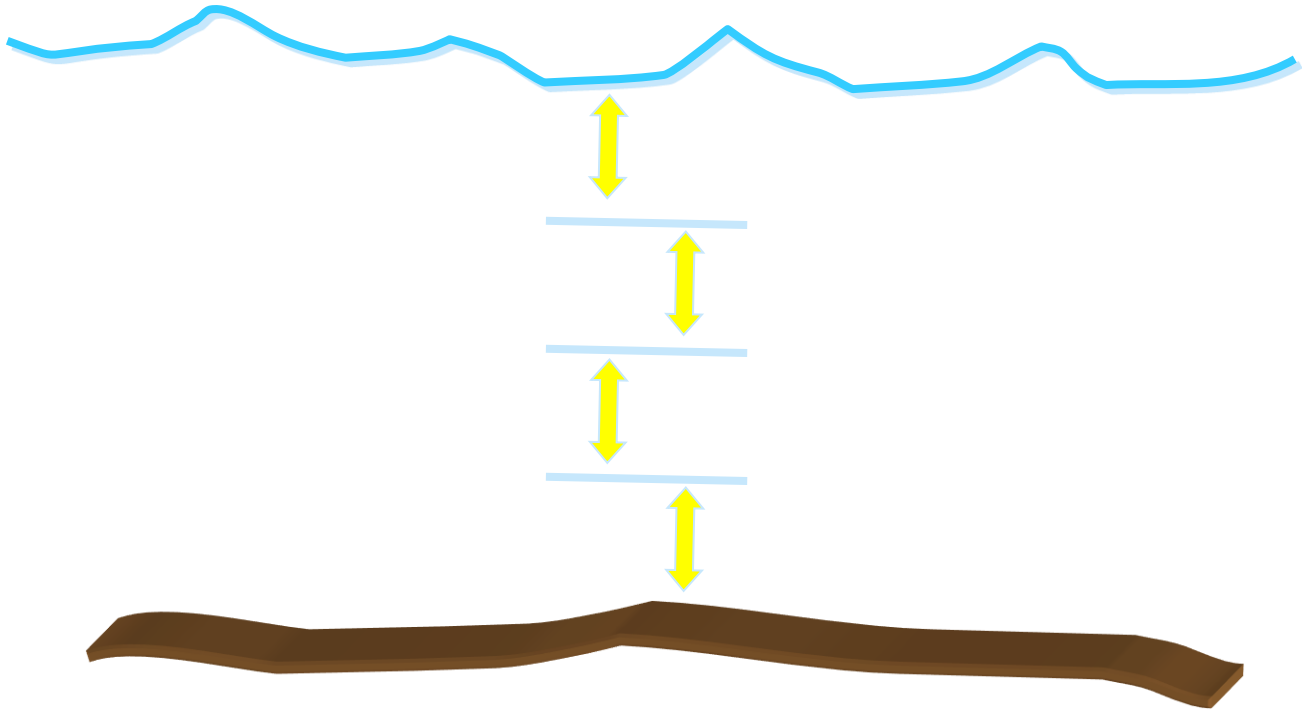
- Temperature
- Dissolved oxygen
- Transparency
- Note: All affect water quality



Measurements

- 1-m intervals
- surface to bottom
- ‘Water Profile’

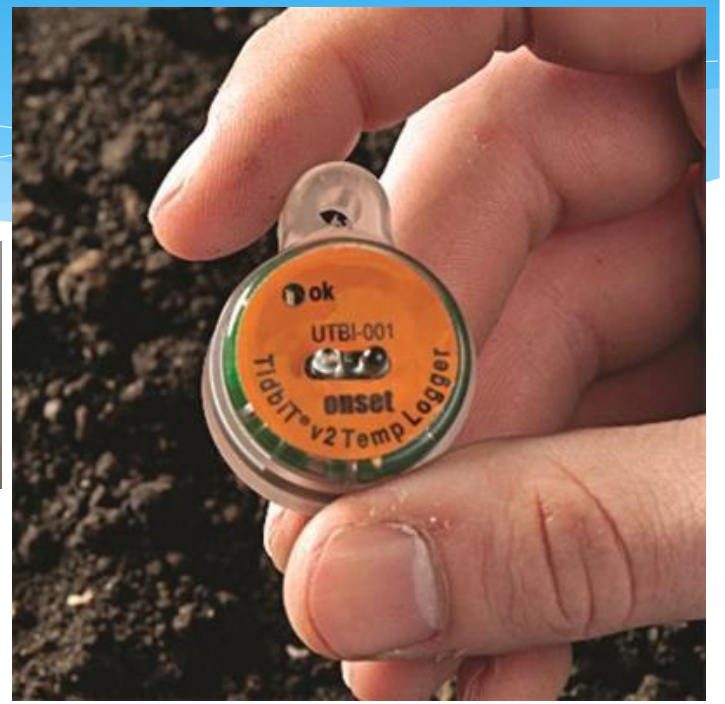


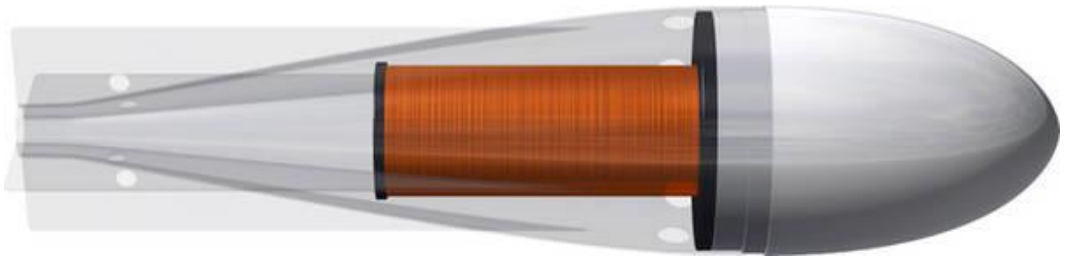


Temperature

Metabolic Processes

- Mercury thermometer
- Reversing thermometer
- Bathythermograph
- Electronic thermister
- CTD





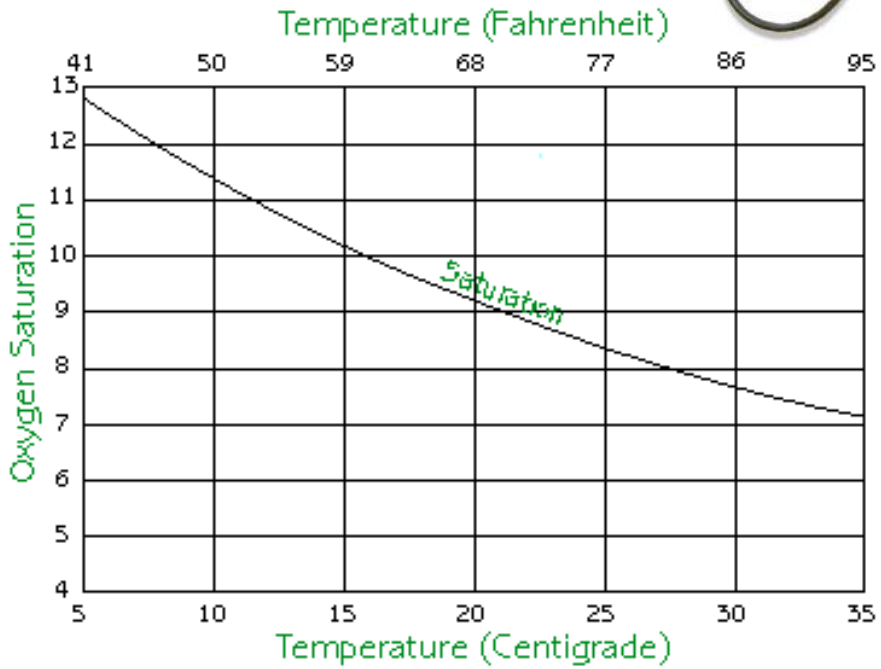
Dissolved Oxygen

Changes with Water Temp

Measured with Electronic sensors

Impacts Fish distribution

- Varies by Species
  - Trout & Salmon O_2
  - Whitefish, Catfish O_2
- Life Stage
- Prey Species



Water Transparency

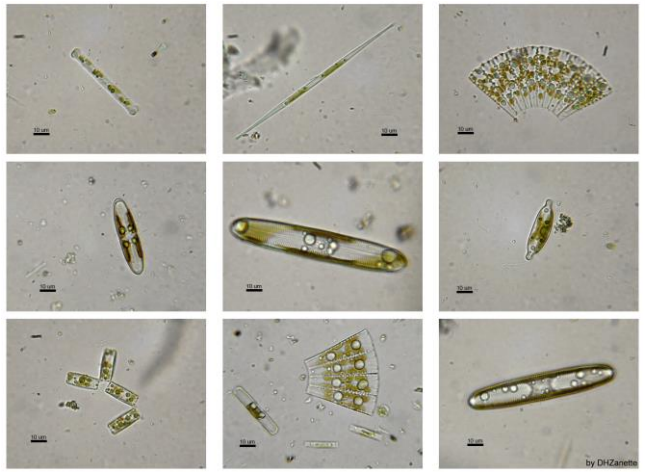
Impacted by

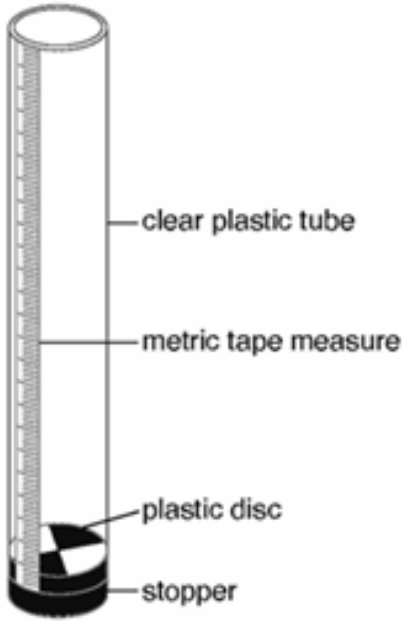
- Suspended particles
- Plankton

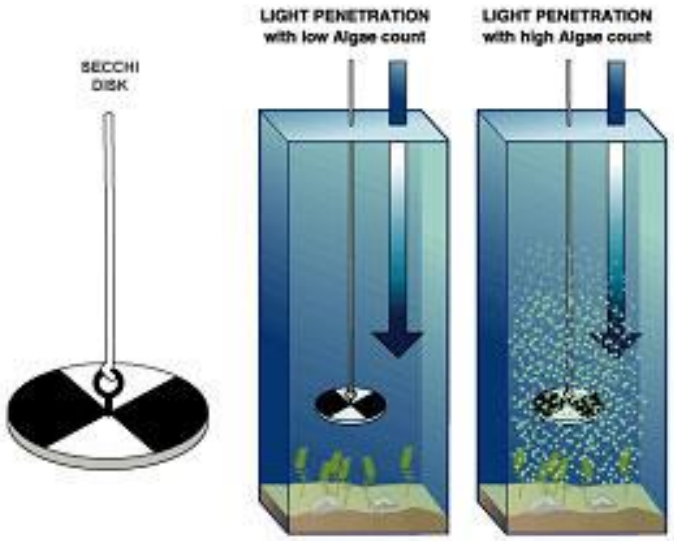
Proxy for Production

Measure using Secchi disk

- Turbidity tube







Lake and Reservoir Classifications

- Oligotrophic – low nutrient levels
- Eutrophic – high nutrient concentrations

Eutrophic

- High Phosphorous (fertilizer)
- High Chlorophyll a
- Low secchi disk depth

$PO_4 =$

Self Check

- A lake with high levels of nutrients, lots of algae, and low Secchi Depth readings would be classifited as
  - Oligotrophic
  - Eutrophic
  - Mesotrophic
  - Heterotrophic
- The amount of dissolved oxygen in water increases as you increase temperature
  - True
  - False

This is just a taste

- There are books and even PhD's on the topics
- Oceanography FT 110
- Aquatic Ecology / Limnology FT 270

Review

- Aquatic Habitat Overview
- Habitat Mapping
- Geomorphology
- Hydrology
- Substrate
- Water Quality
- Stream Habitat Classification
- Lake and Reservoir Habitats