WATER QUALITY FIELD STUDY

Objectives: Students will understand the importance and techniques of water quality sampling by:

1) performing in stream water quality tests measuring for pH, turbidity, dissolved oxygen, temperature and stream flow
2) practicing quality and detailed data recording methods
3) analyzing and making judgments on the quality of water based on collected data from all tests.

<u>Teaching Tips</u>
Get students focused with introductions and review safety guidelines.

Note: Caution should be taken when handling and disposing of chemicals. Waste chemicals should be poured into the container provided in the field kit and returned either to the classroom or to the The Freshwater Trust office for disposal rather than dumped into the stream or riparian area. Always wash your hands after you have completed the water quality testing procedures.

Briefly describe the activity (What we are going to do is….). A great way to describe water quality is to use one of the following metaphors:

a) The students are doctors performing a check up and the water source is their patient. More than one test must be conducted to find to true health of the river just like a doctor conducts multiple tests before making a diagnosis. Ask the students to brainstorm tests that a doctor might do to determine the health of a human being.

b) The students are auto mechanics looking under the hood of a car, the water source being the car. They must run certain tests on the car to determine what kind of work the vehicle needs. Ask the students to brainstorm tests that a mechanic might do to determine the quality of a vehicle.

Materials:
All needed materials are listed throughout the section within the specific water quality test descriptions. The Water Quality Data Form can be found at the end of this section and in the Field Trip Data Forms section of the binder.

Procedure:
All individual test procedures are listed throughout the section within the specific water quality test descriptions.

1. Divide the students into teams for each activity; temperature, dissolved

oxygen, pH, turbidity and stream flow. (temperature and turbidity are good tests to pair up for one team)

2. Pass out the equipment for each test with the directions. Have each group decide who will read the directions.

Note: Dissolved oxygen and stream flow should be done in moving water, preferably in a riffle, if it can be safely accessed. Boots are provided for the dissolved oxygen and stream flow sampling.

3. First help the dissolved oxygen group get started. This test takes the most time and can involve 3 or 4 students. Groups of two will work for the other activities.

   Temperature, pH, and turbidity can be done in several areas and compared if you have a larger group of students. Remember to **try to get all students involved**, and then check in with them as they move through the procedures. A comparative study can be done between the manual chemical tests and the Vernier digital LabQuests if time allows.

4. Float between students facilitating the activity.

For Discussion/wrap up: When all tests are complete, bring the group together to clean up, and organize the equipment.

For the wrap up, pass out the graphs and charts provided in the kit for the students to interpret their results.

Let each team report their results. Use the questions provided in the kit or formulate your own questions as they relate to the results of the tests. Include any specific characteristics of the site that may be relevant to water quality i.e. human impacts, vegetation, weather conditions, etc.

Water Temperature Background Information

Water temperature is one of the most important factors for survival of aquatic life. Most aquatic organisms acclimate to be the same temperature of the water that surrounds them. Their metabolic rates are controlled by water temperature. This metabolic activity is most efficient within a limited range of temperatures. If temperatures are too high or too low, productivity can decrease or metabolic function cease. The organism can die. These extremes, or lethal limits, vary for different species.

Lethal limits
Within the lethal limits there is an ideal range of temperatures. In this range, an organism is more efficient, and the species has a greater chance of success. Various species of fish have adjusted to upper and lower levels of an optimum temperature range. Spawning, hatching, and rearing temperature ranges vary from species to species. In this way, temperature determines the character and composition of a stream community.

In the Pacific Northwest, most streams have had populations of salmon and trout, which prefer temperatures between 40° and 65° F. In the summer when temperatures are highest and water flows lowest, juvenile fish live in the pools of smaller streams. Pools offer deeper, cooler, oxygen-rich water and increased protection from predators. Because of low water flows, fish can be confined to a limited area. A temperature rise in a rearing pool can kill fish by exceeding their lethal temperature limits.

Plant cover's role
With the exceptions of hot springs and thermal pollution, solar radiation is the cause of increased water temperatures. Shade from riparian vegetation plays a major role in keeping streams cool. During midsummer, adequate shade will keep a stream 7° to 12°F cooler than a stream exposed to direct sunlight. Even the shade from debris in the water will help keep temperatures low. If there is enough debris, temperatures can be 3° to 8°F cooler than if there was no shade. Once water has warmed, it does not cool rapidly, even if it flows into a shady stretch. It is important to recognize that water temperatures change from day to night and that cool-water areas exist in a stream.

Warmer temperatures encourage the growth of life forms that adversely affect fish and human health. Pathogens such as bacteria, as well as several parasitic organisms, thrive in warmer water.

Air temperature, surface area
As water in a stream mixes with air through exposure and turbulence at the surface, water is influenced by the air temperature. This mixing action can also increase the evaporation rate.

The greater the surface area of a body of water, the greater its exposure to both solar radiation and air is. Because of its increased surface area a wide, shallow stream will heat more rapidly than a deep, narrow stream.

<u>Streambed, streamflow, orientation, and sediments</u>
Color and composition of a streambed also affect how rapidly stream temperature rises. A dark bedrock channel will gain and pass to the stream more solar radiation than a lighter-colored channel. Similarly, solid rock absorbs more heat than gravel.

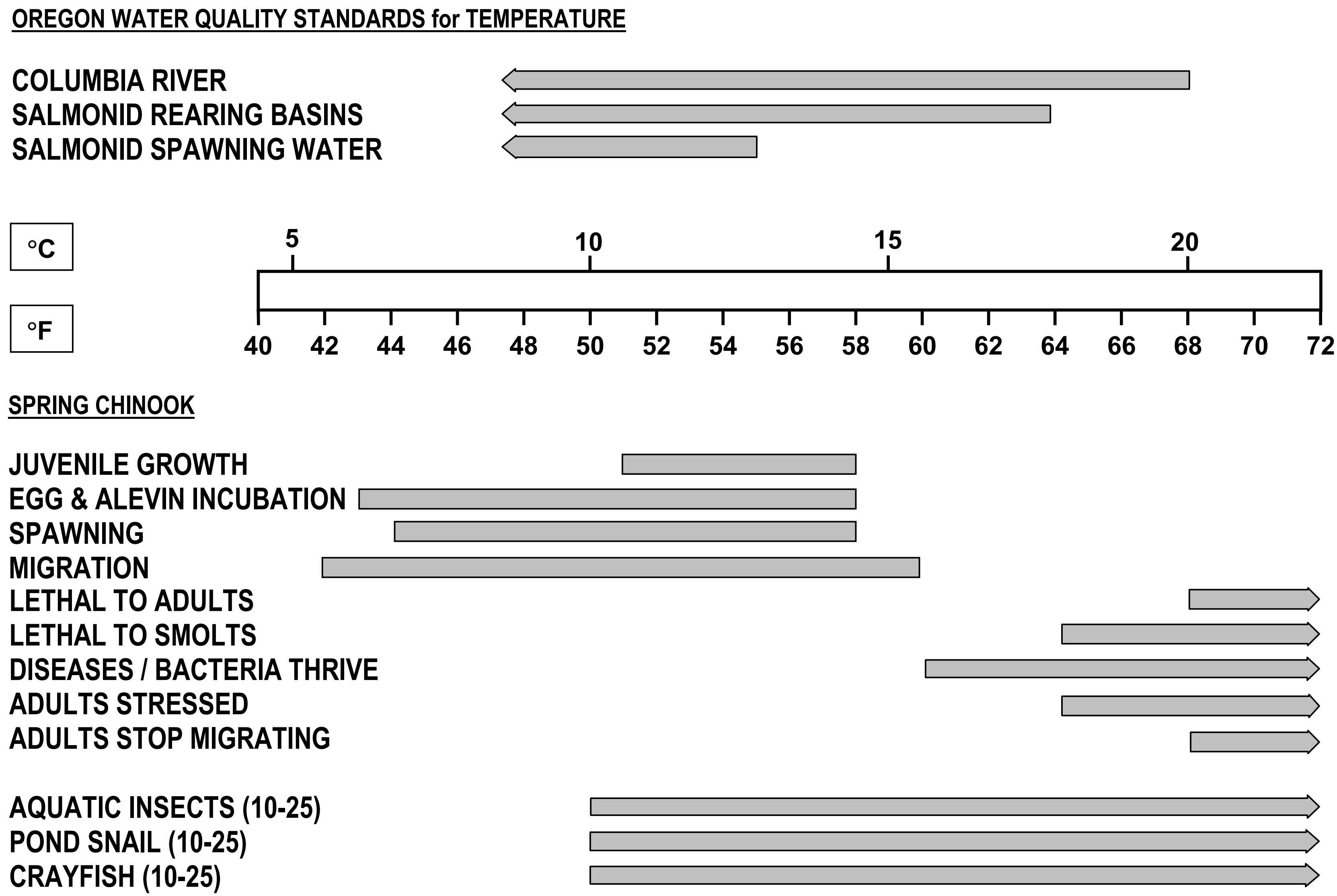
The stream flow or volume of water in a stream influences temperature. The larger a body of water, the slower it will heat. Rivers and large streams have more constant temperatures than smaller streams.

The direction a stream flows also affects how much solar radiation it will collect. Because of the angle of the sun's rays, southerly flowing streams receive more direct sunlight than steams flowing north. Eastward or westward flowing streams receive shading from adjacent ridges, trees, and riparian vegetation.

Sediments suspended in water can absorb, block, or reflect some of the sun's energy depending on their color and position in the water. Particles on or near the surface can have a beneficial influence through reflection, but those with a dark color increase the total energy absorbed from the sun.

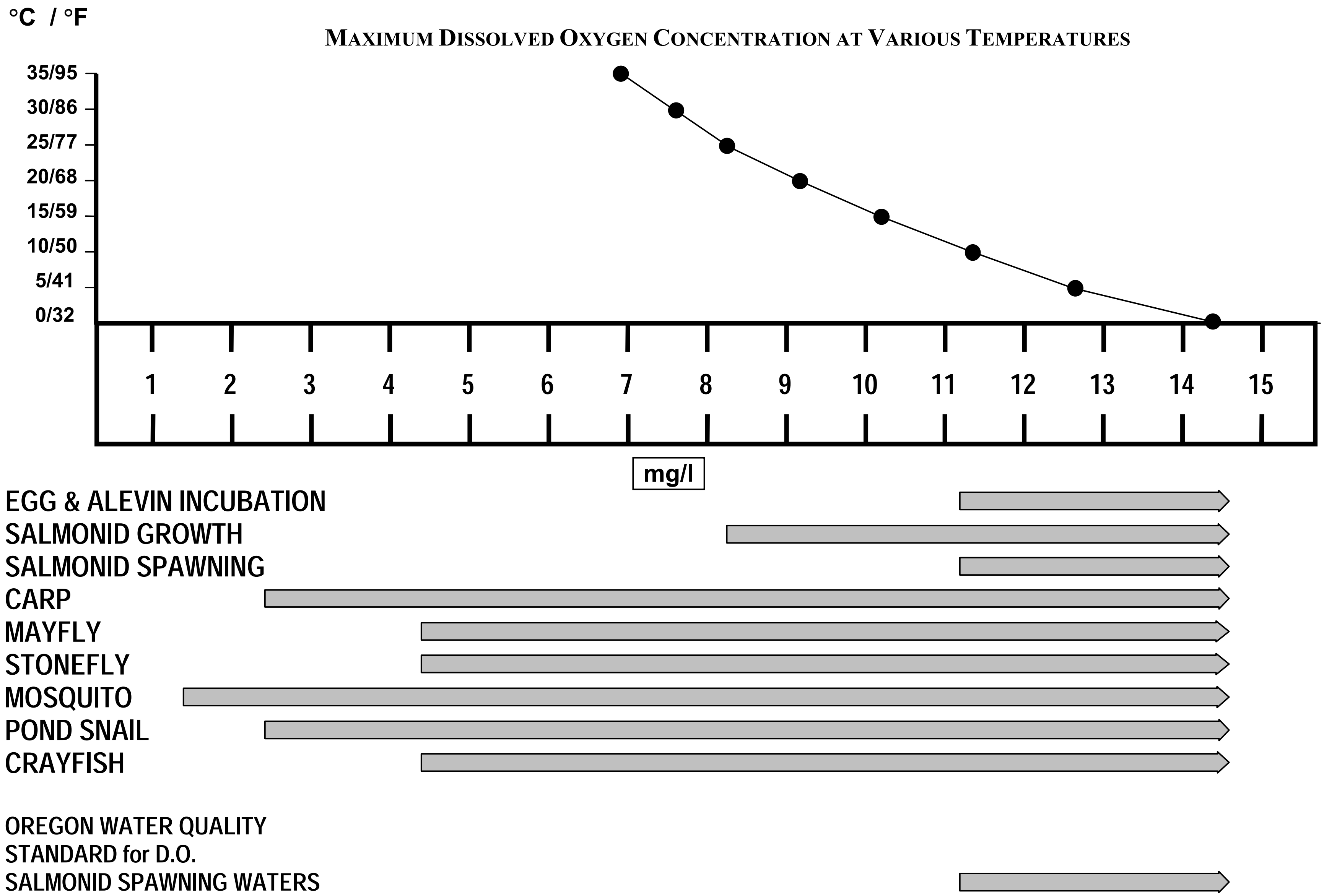
<u>Effects of thermal pollution</u>
Thermal pollution occurs when heated water is discharged into cooler streams or rivers.

This heated water generally has been used to cool power plants or industrial processes and can be as much as 20°F warmer than the water into which it is discharged. This increase in temperature can have drastic effects on downstream aquatic ecosystems.



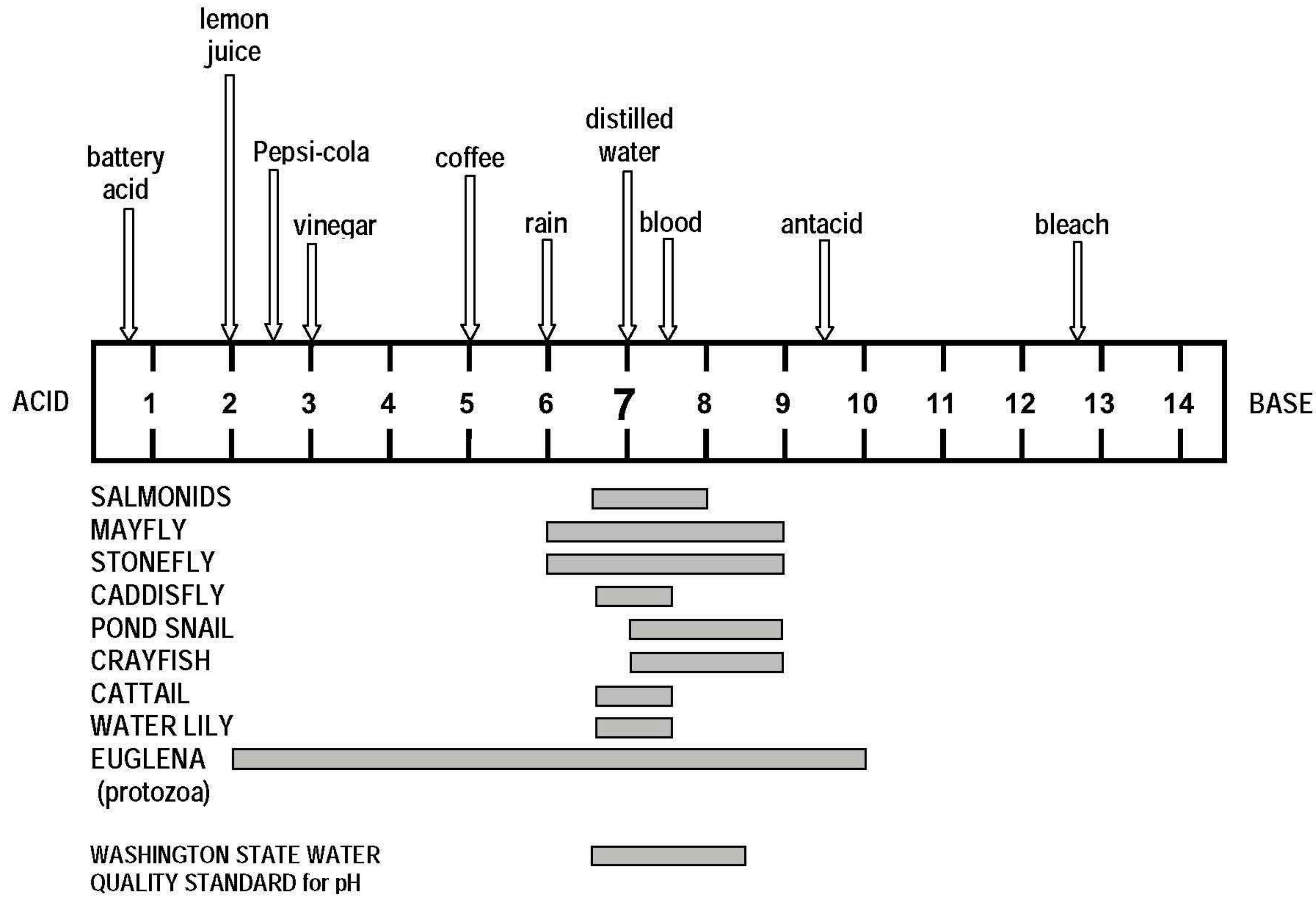
Optimum Temperature Limits for Aquatic Organisms

Compiled from Stream Scene, Streamkeepers Field Guide, DEQ Administrative Rules, Aquatic Project Wild, Investigating our Ecosystem



OPTIMUM DISSOLVED OXYGEN LIMITS FOR AQUATIC ORGANISMS

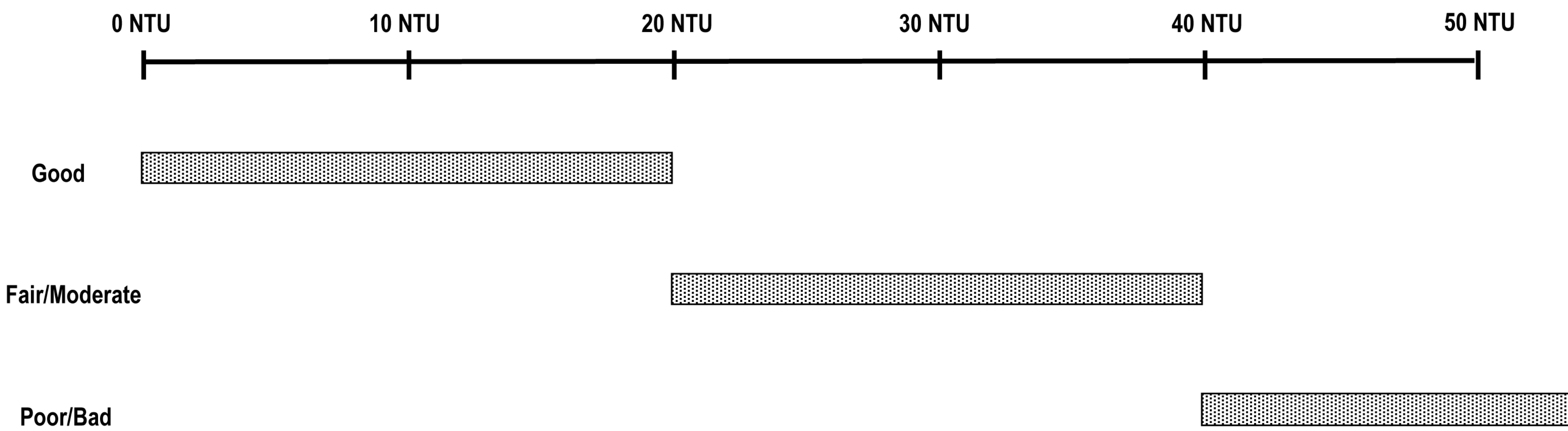
Compiled from Streamkeepers Field Guide, DEQ Adminstrative Rules, Aquatic Project WILD, Stream Scene, Investigating Our Ecosystem.



LETHAL pH LIMITS FOR AQUATIC ORGANISMS

Compiled from Stream scene, Investigating Our Ecosystem, Aquatic Project Wild, Streamkeeper's Field Guide

OPTIMUM TURBIDITY LEVELS FOR AQUATIC ORGANISMS



NTU = nephalometric turbidity unit

10 NTU: Level not to be exceeded for coldwater fisheries per state/federal water quality standards.

50 NTU: Turbidity level which interferes with site feeding; level not to be exceeded in any type of river/stream per State/Federal water quality standards.

Compiled from information regarding water quality from the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency.