Kidd, S. (2011) "*Table 2: Summary of standard parameter ranges for salmonid habitat and general stream water quality.*" Water Quality Monitoring Grant Report, Oregon Watershed Enhancement Board, Salem, Oregon. Published July 2011. [Link]

<table>
<tr><th>PARAMETERS</th><th>NEED</th><th>ACCEPTABLE RANGE</th><th>SOURCE</th></tr>
<tr><td rowspan="2">Dissolved Oxygen</td><td>Salmon Habitat</td><td>≥11ppm (<6 ppm Lethal)</td><td>DEQ regulatory standards</td></tr>
<tr><td colspan="3">Dissolved Oxygen (DO) Refers to the amount of oxygen dissolved in the water at a given temperature and atmospheric pressure. DO is critical to the entire biological community in surface water and is a key element of healthy salmon habitat. Ideally DO levels should be above 11ppm year round.</td></tr>
<tr><td rowspan="2">E. coli Bacteria</td><td>General</td><td><406 MPN/100ml (DEQ)<br>or<br><235 MPN/100ml (EPA)</td><td>DEQ regulatory standards (OAR 340-041),<br>EPA recommended Criteria</td></tr>
<tr><td colspan="3">Escherichia coli (E. coli) is a type of fecal coliform bacteria that comes from human and animal waste. If E. coli levels are high, then other disease-causing organisms may be present and a potential threat to human health exists. E. coli threshold levels identified by the EPA <235 MPN/100ml and DEQ <406 MPN/100ml.</td></tr>
<tr><td rowspan="2">pH</td><td>General</td><td>6.5-8.5</td><td>DEQ regulatory standards for the Willamette Basin</td></tr>
<tr><td colspan="3">pH is a measure of how acidic or basic the water is which can vary naturally both daily and seasonally. Water pH is critical to fish habitat because it can affect fish egg production and survival, aquatic insect survival/emergence and the toxicity of other pollutants. The ideal stream water pH range is 6-8.5.</td></tr>
<tr><td rowspan="2">Conductivity</td><td>General</td><td><150 µS/cm “typical” for streams in Willamette Basin and North Coast</td><td>OWEB Water Quality Technical Manual</td></tr>
<tr><td colspan="3">Conductivity is a measure of water’s ability to conduct electrical current which is determined by the amount of dissolved ions in the water. A stream’s normal conductivity range can be used as a baseline for comparison. Significant changes in conductivity could be an indicator of a discharge/pollution entering the stream. In our region streams typically have a conductivity of <150 µS/cm.</td></tr>
<tr><td rowspan="2">Turbidity</td><td>Salmon Habitat</td><td><10 NTU</td><td>University of Wisconsin Extension 2006</td></tr>
<tr><td colspan="3">Turbidity refers to how clear the water is. The greater the amount of suspended solids in the water, the murkier it appears and the higher the measured turbidity. High turbidity levels (>10 NTU) can modify light penetration and smother benthic habitats - impacting both organisms and eggs.</td></tr>
<tr><td rowspan="4">Temperature</td><td>Salmon Habitat: Year-round</td><td>18$^{o}$C 7-day moving average maximum (7dMAM)</td><td>DEQ regulatory standards for salmonid rearing habitat</td></tr>
<tr><td>Salmon Habitat: Healthy Adult</td><td>7.2-15.6$^{o}$C (>25 $^{o}$C Lethal)</td><td>OWEB Water Quality Technical Manual</td></tr>
<tr><td>Salmon Habitat: Healthy Juvenile</td><td>12.2-13.9$^{o}$C (>25 $^{o}$C Lethal)</td><td>OWEB Water Quality Technical Manual</td></tr>
<tr><td colspan="3">Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Temperatures outside of these ranges can cause stress and/or death. Our regional salmonid species require stream temperatures below 18°C, ideally in adult habitat it should remain below 15.6 °C and in juvenile habitat it should remain below 13.9 °C.</td></tr>
</table>

GK12 Workshop 2/26/2013 Additions to Sarah Kidd's OWEB Grant Report Table-Worked on by Sarah Kidd, Nicole A Bill Martin, and Brie Bui-Hirschberg :

| PARAMETERS | NEED | ACCEPTABLE RANGE |
|---|---|---|
| Nitrate-Nitrogen ($NO_3^-$) | **Drinking Water** | <10mg N/L (ppm) |
| | **Nitrate can get into water directly as the result of runoff of fertilizers containing nitrate. Some nitrate enters water from the atmosphere, which carries nitrogen-containing compounds derived from automobiles and other sources. Nitrate can also be formed in water bodies through the oxidation of other, more reduced forms of nitrogen, including nitrite, ammonia, and organic nitrogen compounds such as amino acids. Nitrogen- Nitrate ($NO_3^-$): Generally occurs in trace quantities in surface water. Reactive nitrogen (Nitrate) is the essential nutrient and has been identified as a limiting nutrient for growth. Nitrate may be found in concentrations up to 30 mg nitrate as nitrogen/L (19th Edition, Standard Methods, 1995). Naturally high levels of nitrate can be found in areas where nitrogen fixing plants (such as Alders) and alga are present. When nitrate concentrations become excessive and other essential nutrient factors are present, eutrophication and associated algal blooms can be become a problem (Fundamentals of Aquatic Toxicology, 1985). For the prevention of low dissolved oxygen (eutrophication) nitrate levels <0.45 mg N/L and for protecting eelgrass habitat nitrate levels <0.30 mg N/L have been identified in New Hampshire Estuaries. If nitrate-nitrogen exceeds 10 mg/L in drinking water, it can cause a condition called "blue baby syndrome" in infants. Some recent studies have indicated a possible connection between elevated nitrate concentrations and cancer.** http://water.usgs.gov/owq/FAQ.htm#Q19, http://www.dnr.mo.gov/env/esp/waterquality-parameters.htm, http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/gb_nitro_load_analysis.pdf | |
| Ammonium ($NH_4^+$) | **Drinking Water and Aquatic Ecology** | |
| | **Similar to Nitrate Reactive Nitrogen (Ammonium) is the essential nutrient and has been identified as a limiting nutrient for growth. Similar to Nitrate high levels of Ammonia can also lead to low dissolved oxygen levels through eutrophication. Ammonia and organic nitrogen can enter water through sewage effluent and runoff from land where manure has been applied or stored.** | |
| Total Nitrogen (TN) | **Drinking Water** | |
| | **Total nitrogen (TN) is a combination of Ammonium and Nitrate levels** | |
| Potassium(K) | **Aquatic Ecology** | <132 mg/L for fish and<br><1.16 mg/L for daphnia |
| | **Potassium is a dietary requirement for nearly any organism but a number of bacteria, because it plays an important role in nerve functions. Potassium plays a central role in plant growth, and low level limits growth. Potassium from dead plant and animal material is often bound to clay minerals in soils, before it dissolves in water. Consequently, it is readily taken up by plants again. Plants contain about 2% potassium (dry mass) on average, but values may vary from 0.1-6.8%. Mosquito larvae contain between 0.5 and 0.6% potassium and beetles contain between 0.6 and 0.9% potassium (dry mass). Seawater contains about 400 ppm potassium. It tends to settle, and consequently ends up in sediment mostly. Rivers generally contains about 2-3 ppm potassium. This difference is mainly caused by a large potassium concentration in oceanic basalts. Calcium rich granite contains up to 2.5% potassium. Potassium is a dietary requirement for us, and we take up about 1-6 g per day at a requirement of 2-3.5 g per day. The total potassium amount in the human body lies somewhere between 110 and 140 g and mainly depends upon muscle mass. In lab tests 50% of the aquatic organisms died at doses of 132 mg/L for fish and 1.16 mg/L for daphnia.<br>Source: http://www.lenntech.com/periodic/water/potassium/potassium-and-water.htm** | |

| | | |
|---|---|---|
| Na | **Aquatic Ecology** | Freshwater <5ppt,<br>Brackish 5-15ppt,<br>Saltwater 30ppt |
| | Aquatic organisms have varying tolerance limits for sodium which is based on the type of aquatic environment they evolved (such as the ocean or a freshwater lake). For billions of years sodium is washed out from rocks and soils, ending up in oceans, where it may remain for about 50.106 years. Seawater contains approximately 11,000 ppm sodium (>30 ppt). Rivers contain only about 9 ppm (<5ppt). Drinking water usually contains about 50 mg/L sodium. This value is clearly higher for mineral water. In soluble form sodium always occurs as $Na^+$ ions. Generally, humans require about 300 mg sodium chloride per day to warrant a balanced sodium level. People that have diarrhea or other health effects that increase salt requirements need a higher dietary amount of sodium than usual.<br>Source: http://www.lenntech.com/periodic/water/potassium/potassium-and-water.htm | |
| Silica (Si) | **Aquatic Ecology** | **No threshold, high levels are an indicator of rock weathering** |
| | Silica is part of various minerals, from which it may be released during weathering processes. It is also released under water during volcanic activity. Water in interspaces of marine sediments contains more silica than the sea surface. The present current causes silica to flow from sediments to seawater. In the surface layers of oceans silicon concentrations are 30 ppb, whereas deeper water layers may contain 2 ppm silica. Rivers generally contain 4 ppm silica. Silica is also essential for plant growth. Various plant species contain about 200-62,000 ppm (dry mass) of silica. Plants such as dandelions and bamboo contain silica in stems and leaves, increasing stability. These compounds are the result of slow dissolution of silica in water. Rivers transport large amounts of silica to sea. Most likely, less than 20% of dissolved silica is removed from rivers by means of biological or chemical transformation processes. | |

| Parameters | Need | Acceptable Range | Source |
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| Silica (Si) | **Aquatic Ecology** | **No threshold, high levels are an indicator of rock weathering** |
| | **Silica is part of various minerals, from which it may be released during weathering processes. It is also released under water during volcanic activity. Water in interspaces of marine sediments contains more silica than the sea surface. The present current causes silica to flow from sediments to seawater. In the surface layers of oceans silicon concentrations are 30 ppb, whereas deeper water layers may contain 2 ppm silica. Rivers generally contain 4 ppm silica. Silica is also essential for plant growth. Various plant species contain about 200-62,000 ppm (dry mass) of silica. Plants such as dandelions and bamboo contain silica in stems and leaves, increasing stability. These compounds are the result of slow dissolution of silica in water. Rivers transport large amounts of silica to sea. Most likely, less than 20% of dissolved silica is removed from rivers by means of biological or chemical transformation processes.<br><br>Silica is removed from waters naturally, through plankton fixation, sediment settling, or reactions of dissolved silica with clay minerals (reverse weathering). Diatoms and sea sponges apply silica for skeleton strengthening. Small hairs on nettles also consist of silica. Chickens and rats require silica for bone development. It is very likely that silicon is a dietary requirement for humans, as the skin and connective tissue contains significant amounts of this element. Silica is generally harmless when present in water, because it is naturally present in large amounts.<br>Source: http://www.lenntech.com/periodic/water/overview.htm** | |

| PARAMETERS | NEED | ACCEPTABLE RANGE | |
|---|---|---|---|
| | **Drinking Water<br>and<br>Aquatic Ecology** | <500mg/L<br>and<br><100-50 mg/L | |
| **Sulfate ($SO_4^{-2}$)** | **Sulfate ($SO_4^{-2}$) can be found in almost all natural water. The origin of most sulfate compounds is the oxidation of sulfite ores, the presence of shales, or the industrial wastes. Sulfate is one of the major dissolved components of rain. High concentrations of sulfate in the water we drink can have a laxative effect when combined with calcium and magnesium, the two most common constituents of hardness. In conditions where oxygen is limited (low DO) bacteria attack and reduce sulfates and hydrogen sulfide gas ($H_2S$) is formed.<br><br>Thresholds include - Drinking Water: 500 mg/L For Maintaining Aesthetics, Freshwater Aquatic Life: 100 mg/L Maximum concentration, not to be exceeded at any time, 50 mg/L Alert level to monitor health of aquatic moss populations on an occasional basis<br>Some soils and rocks contain sulfate minerals. As groundwater moves through these, some of the sulfate is dissolved into the water. Some minerals that contain sulfate are sodium sulfate (Glauber's salt), magnesium sulfate (Epsom salt), and calcium sulfate (gypsum).<br><br>People not used to drinking water with high levels of sulfate can experience dehydration and diarrhea. Kids are often more sensitive to sulfate than adults. As a safety measure, water with a sulfate level exceeding 400 mg/l should not be used in the preparation of baby food. Older children and adults become used to high sulfate levels after a few days<br>Source: http://www.lenntech.com/periodic/water/overview.htm** | | |
| **Ionic Strength** | **Aquatic Ecology** | | |
| | **Ionic strength is the concentration of ionic charge in solution. Increased ionic strength and changes in ionic composition may lead to shifts in community composition and function based on factors such as taxa-specific preferences and adaptations. Measurements of electrical conductivity, salinity, and total dissolved solids (TDS) are often used to represent the ionic strength of water and generally increase with increasing ion content (See these indicators for further threshold details). Ionic strength may significantly impact freshwaters through interactions with other stressors, and it may be difficult to distinguish among proximate stressors and interacting stressors.<br><br>Geologic and natural sources of ions, in combination with human activities (e.g., agricultural, resource extraction, and industrial practices), can contribute to changes in the ion content of streams and rivers. Human activities can increase ionic strength either directly (i.e., by introducing new ions to freshwater systems) or indirectly (i.e., by decreasing uptake of ions in a watershed, or by increasing delivery of ions to freshwater systems). For example, industrial, residential and commercial activities may be associated with direct discharges of ion-rich waters to surface water, via sources such as industrial or wastewater treatment plant effluents. These activities also are associated with increases in impervious surface cover, which can lead to increased delivery of ions to surface waters (e.g., due to increased deposition and surface runoff).<br>Source: http://www.epa.gov/caddis/ssr_ion_int.html** | | |
| | **Aquatic Ecology** | 1-2ppm | **No range considered toxic** |

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|---|---|---|---|
| **Calcium (Ca)** | **Calcium is an important determinant of water hardness, and it also functions as a pH stabilizer, because of its buffering qualities. Calcium also gives water a better taste. Rivers generally contain 1-2 ppm calcium, but in lime area rivers may contains calcium concentrations as high as 100 ppm. Seawater contains approximately 400 ppm calcium. Calcium occurs in water naturally. Water hardness influences aquatic organisms concerning metal toxicity. In softer water membrane permeability in the gills is increased. Calcium also competes with other ions for binding spots in the gills. Consequently, hard water better protects fishes from direct metal uptake. pH values of 4.5-4.9 may harm salmon eggs and grown salmons, when the calcium, sodium and chlorine content is low.**<br>**Source: http://www.lenntech.com/periodic/water/calcium/calcium-and-water.htm** | | |
| **Magnesium (Mg)** | **Aquatic Ecology** | Salt Water 1300 ppm<br>Fresh Water 4 ppm | **No range considered toxic** |
| | **Magnesium and other alkali earth metals are responsible for water hardness. Water containing large amounts of alkali earth ions is called hard water, and water containing low amounts of these ions is called soft water. Magnesium is present in seawater in amounts of about 1300 ppm. After sodium, it is the most commonly found cation in oceans. Rivers contain approximately 4 ppm of magnesium. A large number of minerals contain magnesium. Magnesium is then washed from rocks and subsequently ends up in water. It is unusual to introduce legal limits for magnesium in drinking water, because there is no scientific evidence of magnesium toxicity. A large number of minerals contain magnesium. Magnesium is then washed from rocks and subsequently ends up in water. It is unusual to introduce legal limits for magnesium in drinking water, because there is no scientific evidence of magnesium toxicity.**<br>**Source: http://www.lenntech.com/periodic/water/magnesium/magnesium-and-water.htm** | | |
| **Total Suspended Solids** | **Aquatic Ecology** | <20mg/l - Clear water<br>40-80 mg/l - Cloudy<br>150 mg/l - Very Cloudy | |
| | **Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter. Suspended solids are present in sanitary wastewater and many types of industrial wastewater. There are also nonpoint sources of suspended solids, such as soil erosion from agricultural and construction sites. As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. Most people consider water with a TSS concentration less than 20 mg/l to be clear. Water with TSS levels between 40 and 80 mg/l tends to appear cloudy, while water with concentrations over 150 mg/l usually appears dirty. The nature of the particles that comprise the suspended solids may cause these numbers to vary.**<br><br>**TSS can also destroy fish habitat because suspended solids settle to the bottom and can eventually blanket the river bed. Suspended solids can smother the eggs of fish and aquatic insects, and can suffocate newly-hatched insect larvae. Suspended solids can also harm fish directly by clogging gills, reducing growth rates, and lowering resistance to disease.**<br>**Source: http://www.michigan.gov/documents/deq/wb-npdes-TotalSuspendedSolids_247238_7.pdf** | | |
| | **Aquatic Ecology** | **Natural Range 1 ppb-200 ppb Depends on Geology** | |

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|---|---|
| **Total Phosphorous** | **Phosphorus, a necessary nutrient for both plants and animals, occurs naturally in many minerals. It is also found in organic material: dead leaves, lawn clippings, manure, and sewage. Phosphorus also is a major ingredient of agricultural fertilizers. Total phosphorus (TP) is the most commonly used measurement of phosphorus content.**<br><br>**Phosphorus concentration in unpolluted waters vary from less than 1 part per billion (ppb) to more than 200 ppb, depending on local geology and the natural level of organic material in the water.**<br><br>**Total phosphorus includes phosphorus bound to suspended sediment and contained in floating algae, as well as phosphorus dissolved in water. The impact of phosphorus on a lake depends on many things: geology, circulation, temperature, etc.**<br>**Source: http://files.dnr.state.mn.us/eii/factsheets/phosphorus_concentration.pdf** |