Clackamas River Basin Water Quality Summary 2010

DEQ 319

Clackamas River Basin Council
Clackamas, Oregon
2010

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1.0 Introduction

This document is focused on the findings of water quality variables measured by Clackamas River Basin Council (CRBC) between August 26 2010 and October 28 2010. These variables are interpreted in order to identify limiting factors present in different reaches of the Clackamas River Basin. Eight basin locations were chosen in order to provide a picture of water quality throughout the lower basin including Clear, Little Clear, Spring, Foster, Eagle, and North Fork Deep Creeks, as well as the Clackamas main stem. This project was funded through the Department of Environmental Quality (DEQ).

2.0 Water Quality Testing

The parameters taken from stream sites include temperature (°C), pH (SU), conductivity (umhos), chlorophyll (RFU), dissolved oxygen (mg/L), and turbidity (NTU). With the exception of turbidity, parameters were measured with the YSI 6820 V2 water quality probe. Turbidity was measured separately using the HACH 2100Q turbidimeter. Before use, instruments were calibrated to Oregon Department of Environmental Quality standards in order to insure accurate results when in the field. Testing was done once per week for a two month period from late August through most of October.

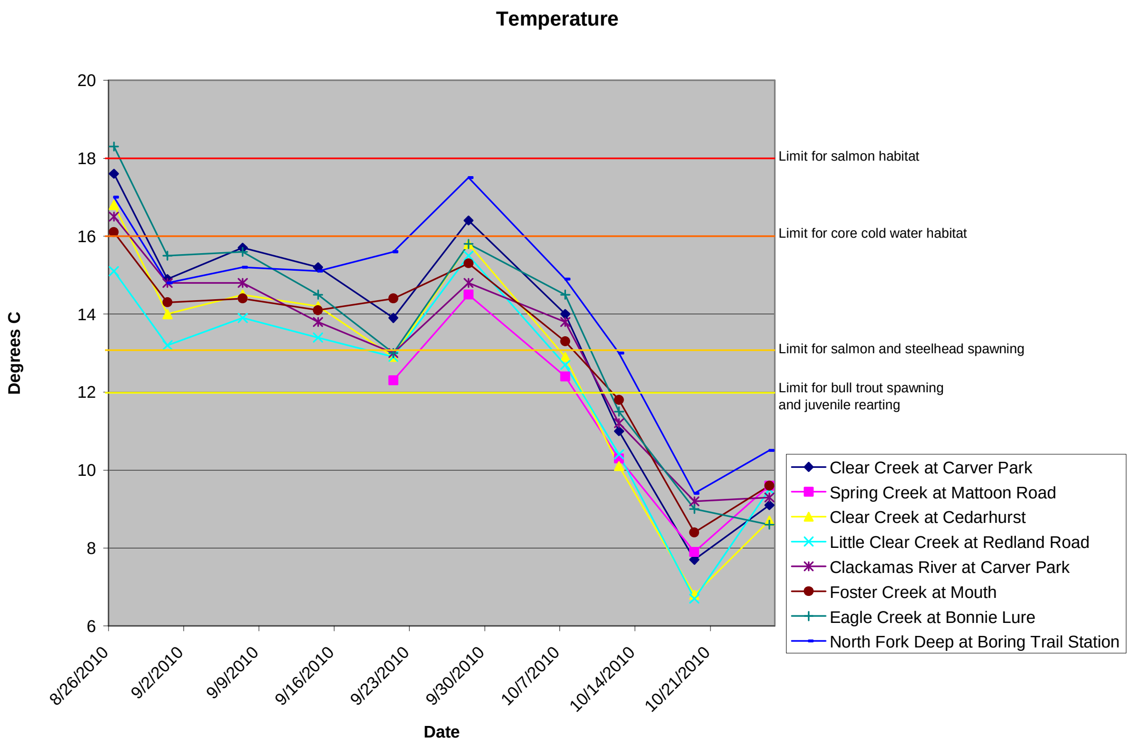
Based on parameter readings, conclusions were made on the health of the stream at each measured locations. Interpretations on the state of each waterway were determined using the benchmarks provided in the Department of Environmental Quality's 2009 Willamette Basin Assessment (Mulvey, Leferink, and Borisenko 74). A table of the benchmarks (See Figure 1) shows how collected data was categorized based on the parameters observed in the field.

Figure 1. Benchmarks of tested parameters

Benchmarks		
Parameter	**Good**	**Poor**
Conductivity (umhos)	<93	>137
Turbidity (NTU)	<6	>22
pH (SU)	6.5-8.5	<6.5 or >8.5
Temperature (°C)	<12°C for bull trout spawning and juvenile rearing habitat, <13°C for salmon and steelhead spawning habitat, <16°C for core cold water habitat, <18°C for salmon	
Dissolved Oxygen (mg/L)	>8	<8

3.0 Water Quality Variables
3.1 Temperature

Figure 2. Temperature variability in the Clackamas Basin at tested sites



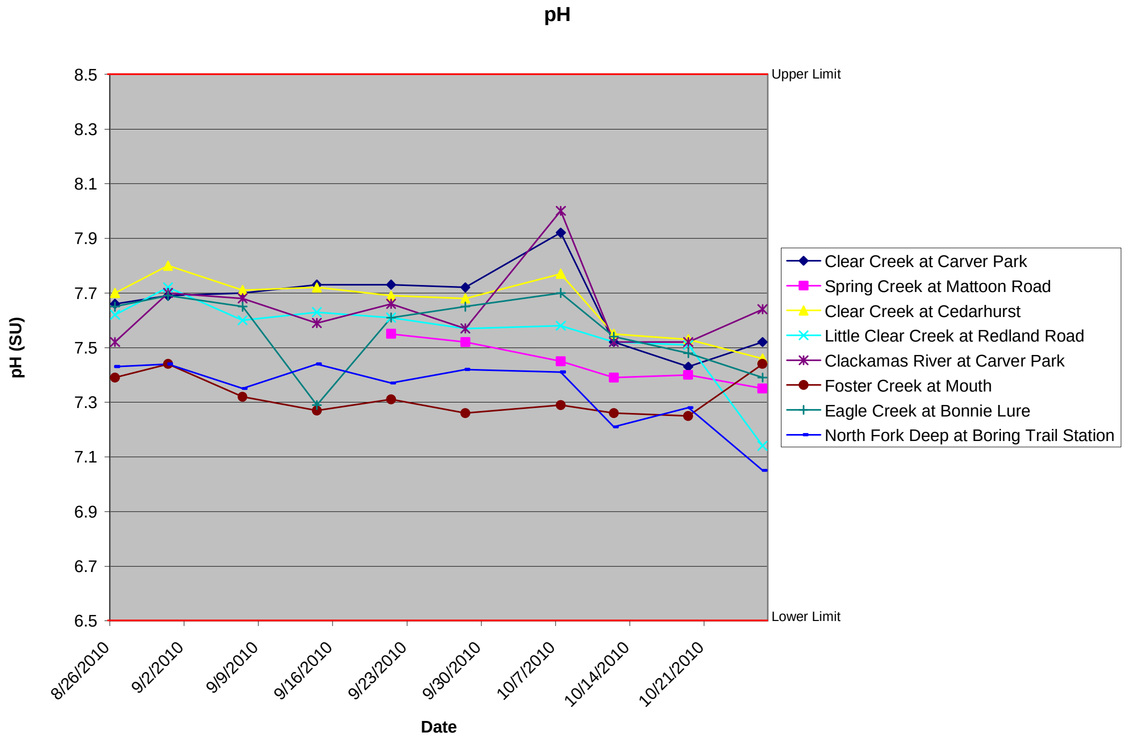
Temperature has a wide range of effects on the functionality of a stream system. Cool water temperatures are necessary for the essential biologic function of aquatic fish and wildlife. Increased water temperature reduces dissolved oxygen amounts in a stream system, while also contributing to toxic algae blooms and the increased survivability of pathogens. Lower water temperature is also a significant indicator for spawning salmon, and a necessity for juvenile salmon development.

Increases in water temperature are shown to be caused by human interaction with the surrounding landscape. Reduced riparian canopy cover, irrigation withdrawals, runoff from impervious surfaces, and discharge for industrial wastewater facilities have been identified as leading causes of water temperature increase in the Clackamas River Basin (Student Watershed Research Project 2).

Water temperature remained below the 18°C threshold besides our first reading at Bonnie Lure, and most streams remained below 16°C by September as daytime temperatures started to fall (See figure 2). This shows fairly healthy stream temperatures going into the salmon spawning season. North Fork Deep Creek at Boring Trail Station was noticeably higher in temperature, which may be due to a majority of the creek residing on agricultural lands. Clear, Little Clear, and Spring Creek sites all displayed the lowest temperatures, and reside in mostly forested landscapes, meaning the healthiest habitat for salmon.

3.2 pH

Figure 3. pH variability in the Clackamas Basin at tested sites



pH indicates the level of acidity/alkalinity in a water sample. Industrial processes, automotive byproducts, and algae blooms are all known to affect stream pH levels. A pH reading between 6.5 and 8.5 indicates a health functioning stream for wildlife and salmon (Mulvey, Leferink, and Borisenko 26-27).

All readings taken at our eight different reference sites show normal pH levels well within restriction limits (See figure 3). Both Foster Creek at the mouth, as well as North Fork Deep Creek at Boring Trail Station showed more acidic readings on occasion. Agricultural practices near these creeks may have some affect on the lowered pH readings.

3.3 Dissolved Oxygen

Figure 4. Dissolved Oxygen variability in the Clackamas Basin at tested sites

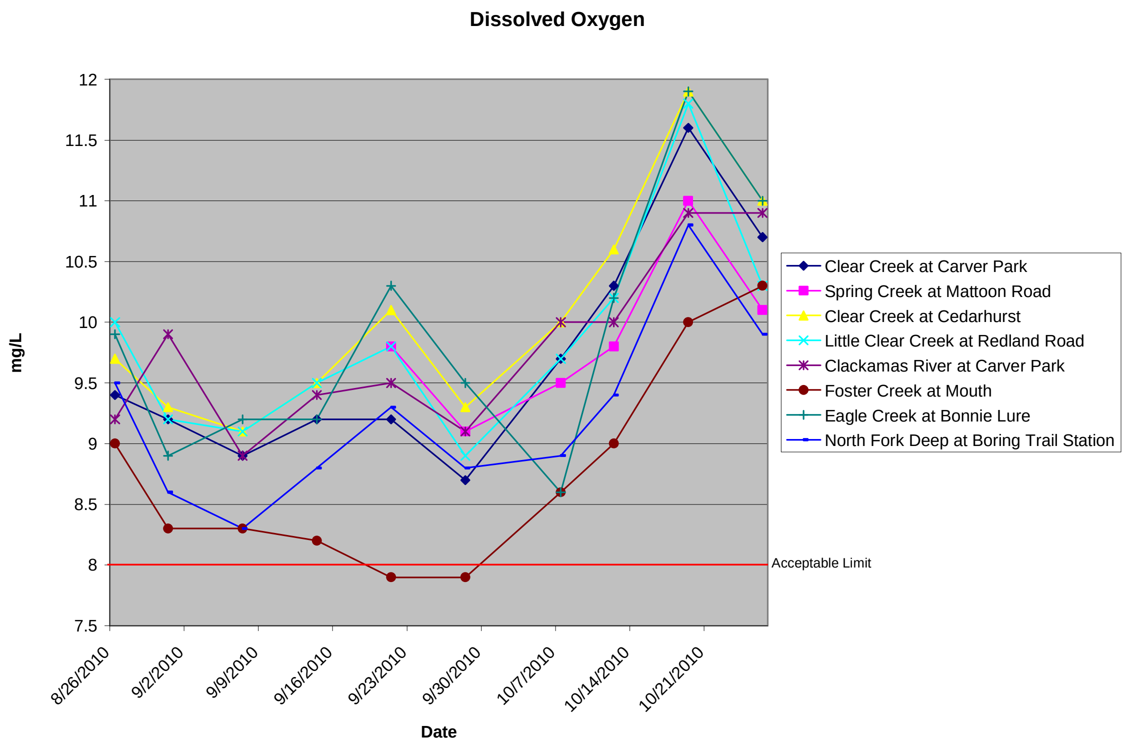
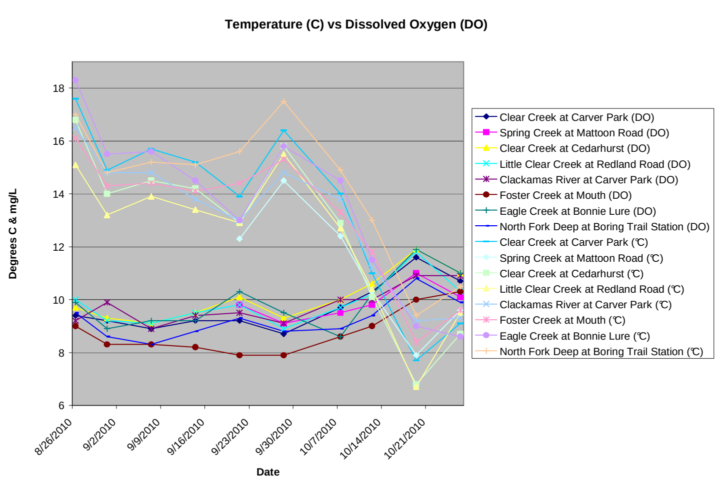


Figure 5. Temperature vs. Dissolved Oxygen



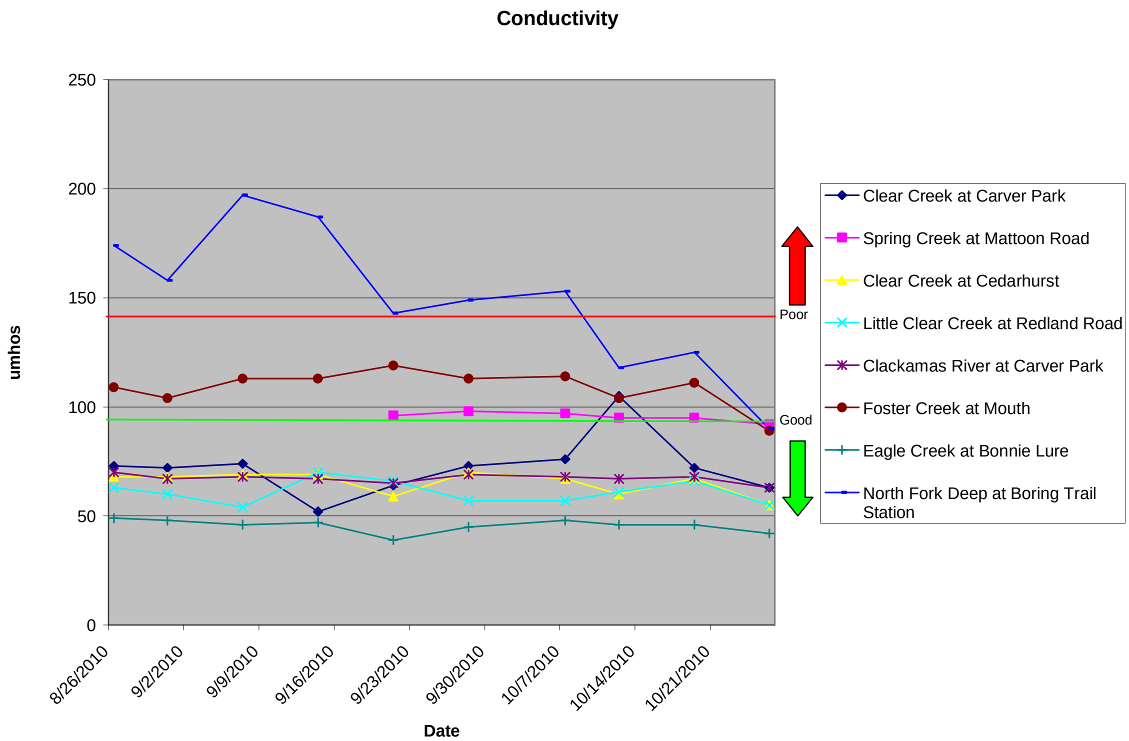
All organisms dependant on aquatic respiration rely upon sufficient levels of dissolved oxygen present in their ecosystem. Dissolved oxygen has an inverse relationship to water temperature. Lower temperatures allow for higher amounts of oxygen to be dissolved into the water. This correlation can be seen by comparing the temperature and dissolved oxygen graphs (See figure 5).

Dissolved oxygen content can be affected by many other factors in addition to water temperature. Lower barometric pressure, which can be affected by elevation and weather patterns, reduces the amount of oxygen present in water. Organism uptake, as well as decomposition of organic materials also cuts down on oxygen levels. Photosynthesis and turbidity are contributing factors to the oxygen content of streams.

Most of the oxygen levels reported remained above the 8 mg/L needed for healthy aquatic ecosystems (See figure 4). It was noted that Foster Creek at the mouth lacked enough water for most of the sampling period to make it all the way to the sampling site, which may have contributed to low dissolved oxygen readings. Sites tested in the Clear Creek Sub-basin (includes Spring Creek) all tested for higher levels of dissolved oxygen, showing healthy stream function.

3.4 Conductivity

Figure 6. Conductivity variability in the Clackamas Basin at tested sites

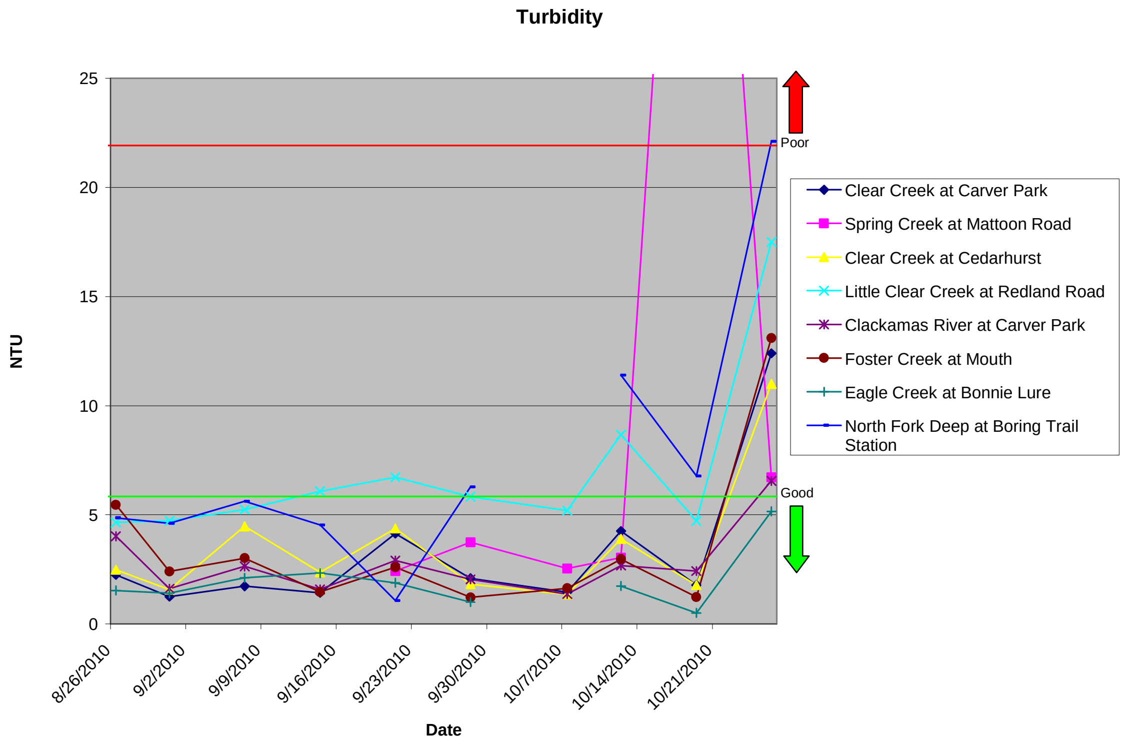


Conductivity in this case is referring to the ability to conduct electricity based on the amount of dissolved salts present in the stream water. Salts can become absorbed through natural means, for example, contact with rock compositions more susceptible to dissolution like limestone. Excess ions can also be acquired through human activities such as fertilizers, urban runoff, and wastewater disposal (Conductivity).

An overload of salts can cause damage to a stream ecosystem. Physiological affects to plants and animals are a result of increased levels of ions. Based on the Department of Environmental Quality's standards, only North Fork Deep Creek at Boring Trail Station seems to be rated poor up until October 14th (See figure 6). The water at this site retained a rust color through most of the testing period, which may have contributed to its high conductivity readings. Raised temperature also increased conductivity readings, which could have contributed to Boring Trail Stations poor reading. The Foster Creek site had fair readings throughout most of the testing period. This may be due to the lack of fresh water input, as the stream only connected with the mouth towards the end of testing.

3.5 Turbidity

Figure 7. Turbidity variability in the Clackamas Basin at tested sites



(Note: On 10/19/2010 the turbidity reading at the Spring Creek site was 55.05 NTU. This point wasn't displayed due to the scale of the graph.)

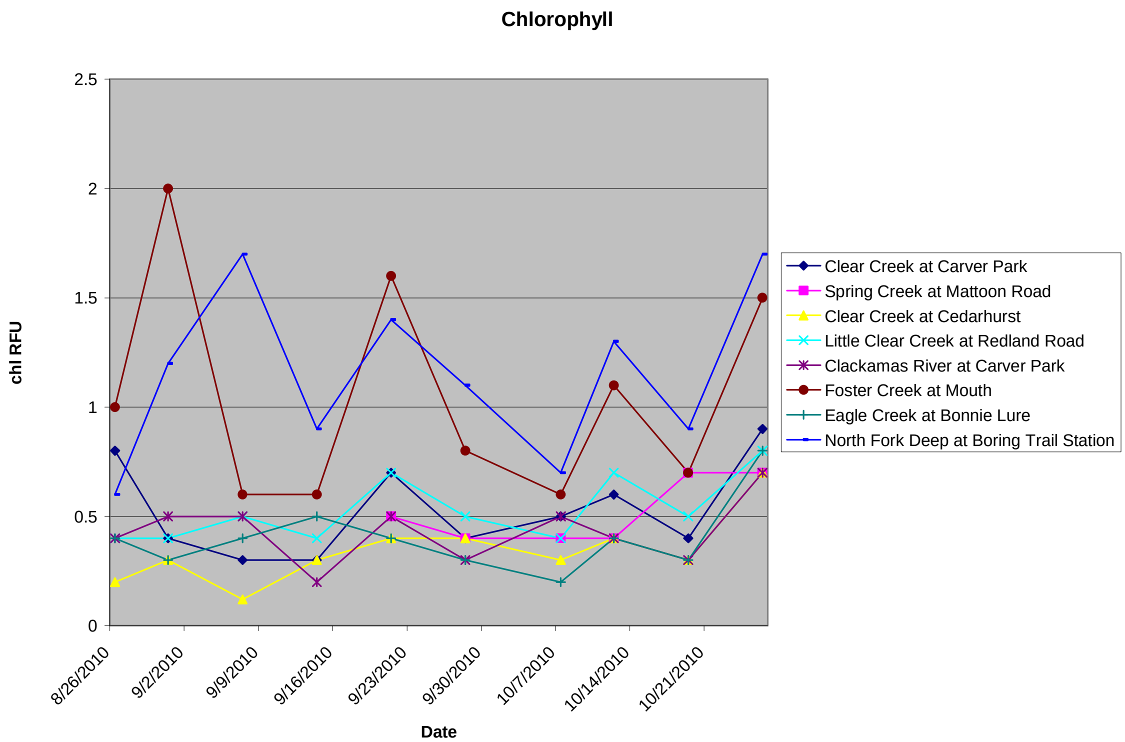
Turbidity is defined as the amount of suspended solids present in a body of water. The higher amount of solids present in a water sample, the higher the turbidity reading will become. High turbidity readings translate to unhealthy streams and rivers for salmon and other aquatic wildlife.

High amounts of solids present in stream water affect gill function and reduce visibility for fish. Excess levels of sediment also smother fish and amphibian eggs. Raised levels of turbidity can be caused by bank erosion through stream side alterations, agricultural practices, construction, and any other riparian disturbance (Mulvey, Leferink, and Borisenko 27).

For the most part turbidity levels remained below the poor ranking for the eight selected testing sites. There is one noticeable spike on October 21st at the Spring Creek at Mattoon Road site (See figure 7). This spike was due to road construction taking place that day near the site. All sites showed a small spike on the 14th of October, and then a larger spike on the 28th. The larger spike is likely due to continuous rainfall for the week leadinig up to the sampling day. The National Weather Service also recorded over a quarter of an inch of rainfall for that day.

3.6 Chlorophyll

Figure 8. Chlorophyll variability in the Clackamas Basin at tested sites



Measuring the amount of chlorophyll present at a sampling site allows the observer to track and record the amount of phytoplankton or algae on hand. Chlorophyll is an essential component of photosynthesis, which plants use to create oxygen from carbon dioxide. Tracking the amount of algae in a water system allows you to interpret a streams health.

Raised nutrient levels caused mainly by wastewater inputs and agricultural runoff are responsible for increased algae growth. Algae blooms, once dead, fall to the bottom of the water and start to decompose. Decomposition requires oxygen, which results in large areas deprived of enough oxygen to sustain life, better known as dead zone.

The benchmarks of a healthy optical chlorophyll measurement are not defined in the 2009 Willamette Basin Assessment. The highest readings from Boring Trail Station and Foster Creek at Mouth are consistent with the less healthy readings taken of all other parameters. There do appear to be spikes in chlorophyll levels on 9/21/10, 10/12/10, and 10/26/10. These seem to correspond to spikes in turbidity readings, suggesting that perhaps these higher chlorophyll readings could correspond to rain events.

4.0 Interpretation by Landscape

Each creek sampled is characterized as either urban, agriculture, or forested, based on percent land cover in each sub-basin. Clear/Spring (64%), Little Clear (74.1%), and Eagle (72.9%) Creeks reside in predominantly forested landscapes. Foster (55.6%) and North Fork Deep (57%) Creeks are both on a majority of agriculture lands, while the lower Clackamas River is a mix of uses (22.7% urban, 43.1% forested, 29.7% agriculture). Looking at each land classification, we may be able to identify which land use practices need the most adjustment based on poor water quality readings (Bauer, Salminen, and Runyon 56,67,72,77).

Both Foster Creek at the mouth, as well as North Fork Deep Creek at Boring Trail Station seem to have the most issues when it comes to high temperatures and conductivity readings, as well as high chlorophyll levels, which could be a result of these creeks residing mostly on agriculture lands. These creeks also read the lowest dissolved oxygen levels. These issues may be due to elevated water temperatures, increased nutrient levels, and larger sediment loads, common with agricultural practices.

The rest of the sites measured remained within healthy limits for each parameter. The unhealthiest forested stream appeared to be Clear Creek at Carver Park. These readings may be due to our sampling location at the mouth of the creek. Sampling at the end of a waterway shows all human disturbances carried out upstream, reducing desirable water characteristics. Even though the lower Clackamas River has many land uses, it appeared to stay fairly constant and healthy, perhaps due to the large volume of water present in this basin.

The sites at Mattoon Road, Cedarhurst, Redland Road, and Bonnie Lure all showed healthy stream characteristics. These sites reside on mostly forested, highly shaded areas of the Clackamas Basin, which contribute to the healthy readings. These creeks provide exceptional habitat for salmon and other aquatic wildlife.

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