E. coli Study and Lower Yamhill Basin Water Quality Monitoring Project

Final Report: Summary of Results

October 2011

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Chapter 1 – Background and Introduction

Background

Greater Yamhill Watershed

The Greater Yamhill Watershed Council (GYWC), formerly known as the Yamhill Basin Council (YBC), was founded in 1995, currently consisting of 11 Board Members and many council members representing interested stakeholders and watershed residents. The Yamhill watershed is located within Yamhill and Polk counties and includes the Yamhill River basin and the Chehalem Creek basin. The Yamhill River is a tributary of the Willamette River, flowing into the Willametter River near Dayton, Oregon, and Chehalem Creek flows into the Willamette River near Newberg, Oregon.

Lower Yamhill River and South Yamhill River Subwatersheds

The lower Yamhill River basin consists of approximately 445 miles of waterways and covers 93,000 acres in Polk and Yamhill Counties in Oregon. The South Yamhill River flows into the Yamhill River near McMinnville, which drains into the Willamette River near Dayton. Palmer Creek is the southern drainage basin for the Yamhill River. Salt Creek and its tributary, Ash Swale, are the southern drainage basins for the lower sections of the South Yamhill River. The eastern boundaries of the Salt Creek basin, Amity and Eola Hills, are areas with known water quantity problems.

The primary land use for this area is agriculture, which has great significance for this area's streams and rivers. Increased areas of cultivation have been achieved by tiling and draining wetter areas. These drainage systems allow water to be channeled off the surface and into streams making cultivation possible during the wetter part of the year. A result is that the area's hydrology has been altered.

People

The 2010 estimated population of Yamhill county is 99, 193. There is an estimated 16.7% increase in population since 2000 in Yamhill County, compared to the increase in total population in Oregon from 2000 to 2010 of 12%. (US Census Bureau, 2010).

Introduction

In 1998, as the first water quality monitoring efforts by the Greater Yamhill Watershed Council (GYWC), the council began continuous temperature monitoring in streams throughout the watershed.

The Greater Yamhill Basin Council (GYWC) conducted it's first more thorough water quality monitoring project in 2003-2004, basin-wide, at 25 sites, to get an overall snapshot of water quality throughout the watershed. This first more comprehensive monitoring project included measuring multiple parameters, including temperature, pH, conductivity, dissolved oxygen, turbidity, and bacteria. In addition, physical habitat was assessed at multiple sites, along with macroinvertebrate collection and identification to further assess water quality.

In 2005-2006, the GYWC conducted it's second water quality monitoring project, with a goal of narrowing in on the North Yamhill subwatershed, largely due to the rapid land use changes, and the growing urban areas within that subwatershed. This project included measuring for multiple water quality parameters, including temperature, conductivity, dissolved oxyten, turbidity, stream flow/discharge, and bacteria. Physical habitat was also assessed at multiple sites, in addition to macroinvertebrate collection and identification, as was done in the 2003-2004 basin-wide study. A complimenting riparian reference project was also completed in efforts to identify relatively undisturbed riparian areas as a tool for future restoration projects, and to better understand the plant communities at these relatively pristine sites.

This latest project in the Lower and South Yamhill subwatershed, conducted in 2007-2008, was a continued effort by the GYWC to compliment and add to exhisting baseline water quality data by focussing on the predominantly agriculture areas in the Lower and South Yamhill River basin. In addition, the intent was to further study areas of concern from the previous water quality monitoring projects, specifically the elevated bacteria levels on Panther Creek (in the North Yamhill subwatershed), identified in 2005-2006, and Cozine Creek, identified in 2003-2004.

This monitoring project was focussed on the lower Yamhill River basin and its three main southern drainage basins (Ash Swale, Palmer Creek, and Salt Creek) and one urban stream (Cozine Creek). Palmer Creek, is the main southern drainage basin for the Yamhill River near where the Yamhill River joins the Willamette River; Salt Creek and its tributary, Ash Swale, are the southern drainage basins for the lower South Yamhill River; Cozine Creek runs predominantly through the city of McMinnville before draining into the South Yamhill River.

The Oregon Watershed Enhancement Board (OWEB) awarded a monitoring grant to conduct this E. coli study and water quality monitoring project in the lower Yamhill River basin, in addition to generous supportive matching services and donations from the Greater Yamhill Watershed Council, McMinnville Water Reclamation Facility (WRF), Yamhill Soil and Water Conservation District (YSWCD), Oregon Department of Agriculture (ODA), Oregon Department of Environmental Quality (ODEQ), countless volunteers, and generous landowners.

GOALS of the E. coli Study and Lower Yamhill Basin Water Quality Monitoring Project

Monitor current conditions and assess water quality of Salt Creek, Ash Swale, Palmer Creek, Cozine Creek. Use this project and information collected to:

- Improve the GYWC Action Plan by helping to prioritize restoration efforts in Salt Creek, Ash Swale, Palmer Creek, Cozine Creek, and Panther Creek
- Provide locally gathered, high quality data that will may be used by local and state agencies
- Refine and fill in data gaps identified in the 2001 Watershed Assessments, and 2003 and 2007 Yamhill Basin Council monitoring projects
- Provide data for the Yamhill River Subbasin Local Advisory Committee
- Inform the GYWC and watershed residents on current watershed conditions
- Provide additional baseline data to compare against existing data in the watershed and compare against data collected in the future to identify short and long term changes
- Provide an opportunity for watershed education at monitoring sites on publicly owned lands, encouraging ownership and community
- Provide data to augment DEQ's ambient monitoring sites in the Yamhill basin
- Identify source areas of *E. coli* contamination and possible identification of sources to reduce or eliminate *E. coli* problems on Panther and Cozine Creeks
- Refine our understanding of water quality in each sub-basin (Palmer Creek, Salt Creek and Ash Swale)
- Prioritize areas in need of water quality improvement
- Assist in future projects to prioritize types of best management practices on private lands
- Share water quality information with stakeholders and decision-makers
- Maintain and strengthen established partnerships and develop new partnerships with landowners and local and state agencies
- Serve as an effective liaison between landowners and local and state agencies (such as SWCD, DEQ, ODA, etc)
- Work with our partners to reduce or eliminate any water quality problems found

KEY COMPONENTS of the E. coli Study and Lower Yamhill Basin Water Quality Monitoring Project

1. Baseline monthly grab-sample water quality monitoring of temperature, dissolved oxygen, turbidity, pH, conductivity, ammonia, total phosphorus, and E. coli in the Lower Yamhill River basin including Salt Creek, Ash Swale, Palmer Creek, and Cozine Creek.
2. Collection of stream discharge (flow) data at one site of each stream, Salt Creek, Ash Swale, Palmer Creek, and Cozine Creek, to determine general discharge through summer months.
3. Follow-up E. coli study on Panther and Cozine creeks from previous studies which indicated problem areas, in addition to baseline E. coli monitoring on Salt Creek, Ash Swale, Palmer Creek.

Fourteen sites were selected within the Lower Yamhill subwatershed. Three sites each on Salt Creek, Ash Swale, and Palmer Creek, and five sites on Cozine Creek (See figure 1). Figure 2 show a closer look at the Cozine Creek sites.

Four sites were selected on Panther Creek for the follow-up E. coli study (See Figure 3).

Table 1 lists the sites numbers, creek location (subwatershed), a brief description of location, and the monitoring parameters and frequency.

Figure 1. 2008/2009 Monitoring Sites

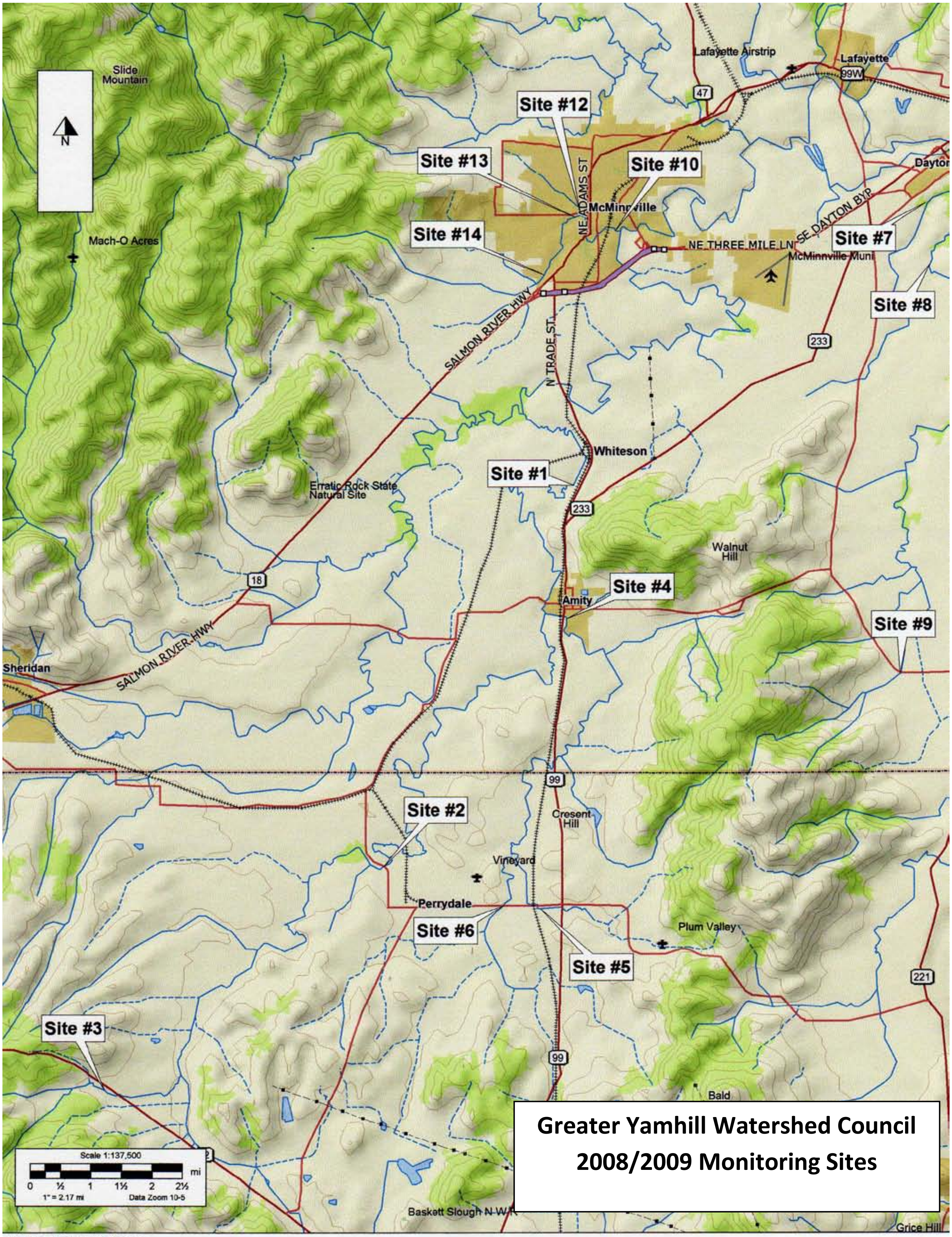

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Figure 2. Cozine Creek 2008/2009 Sites

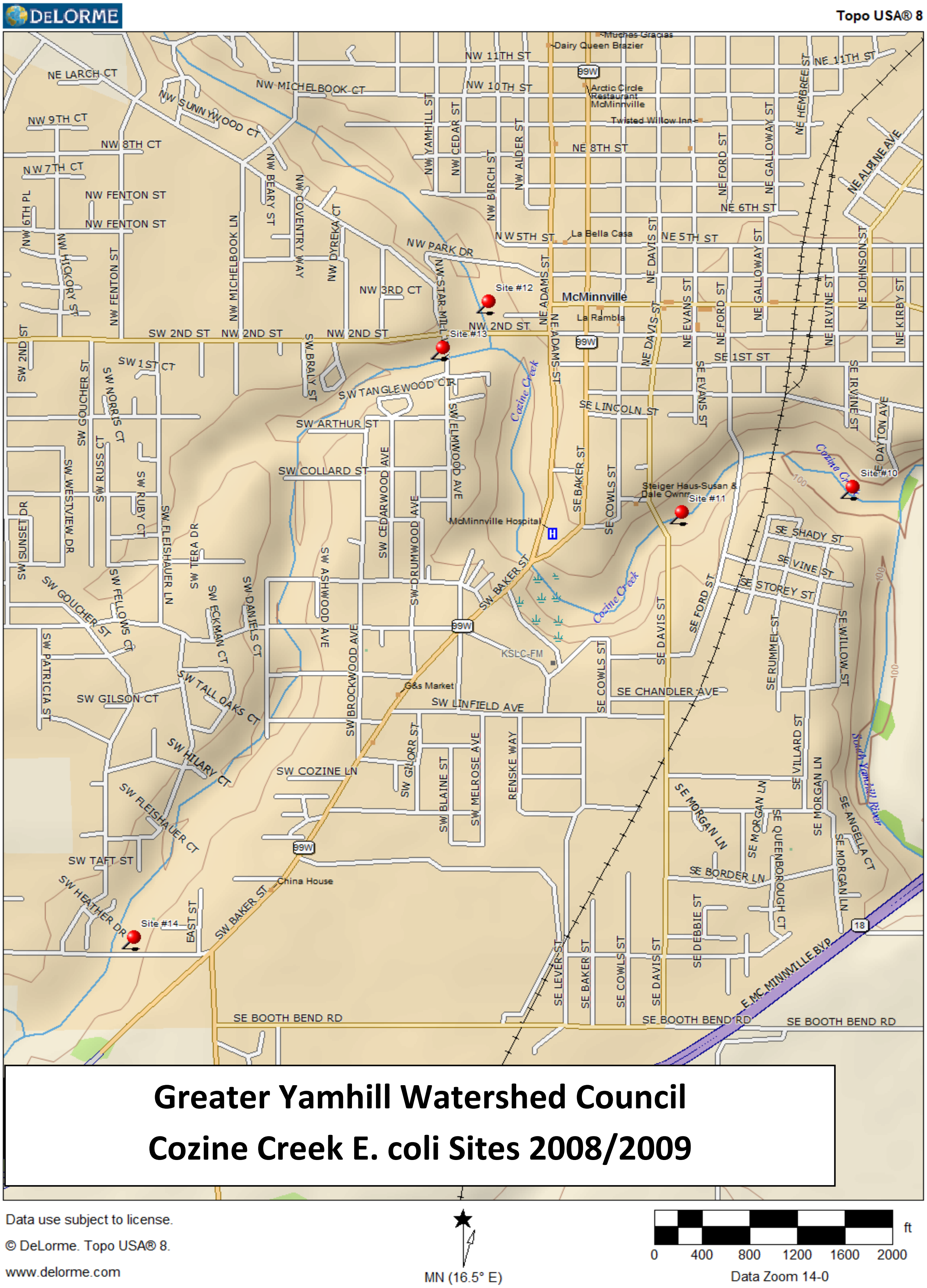


Figure 3. Panther Creek 2008/2009 E. coli Sites

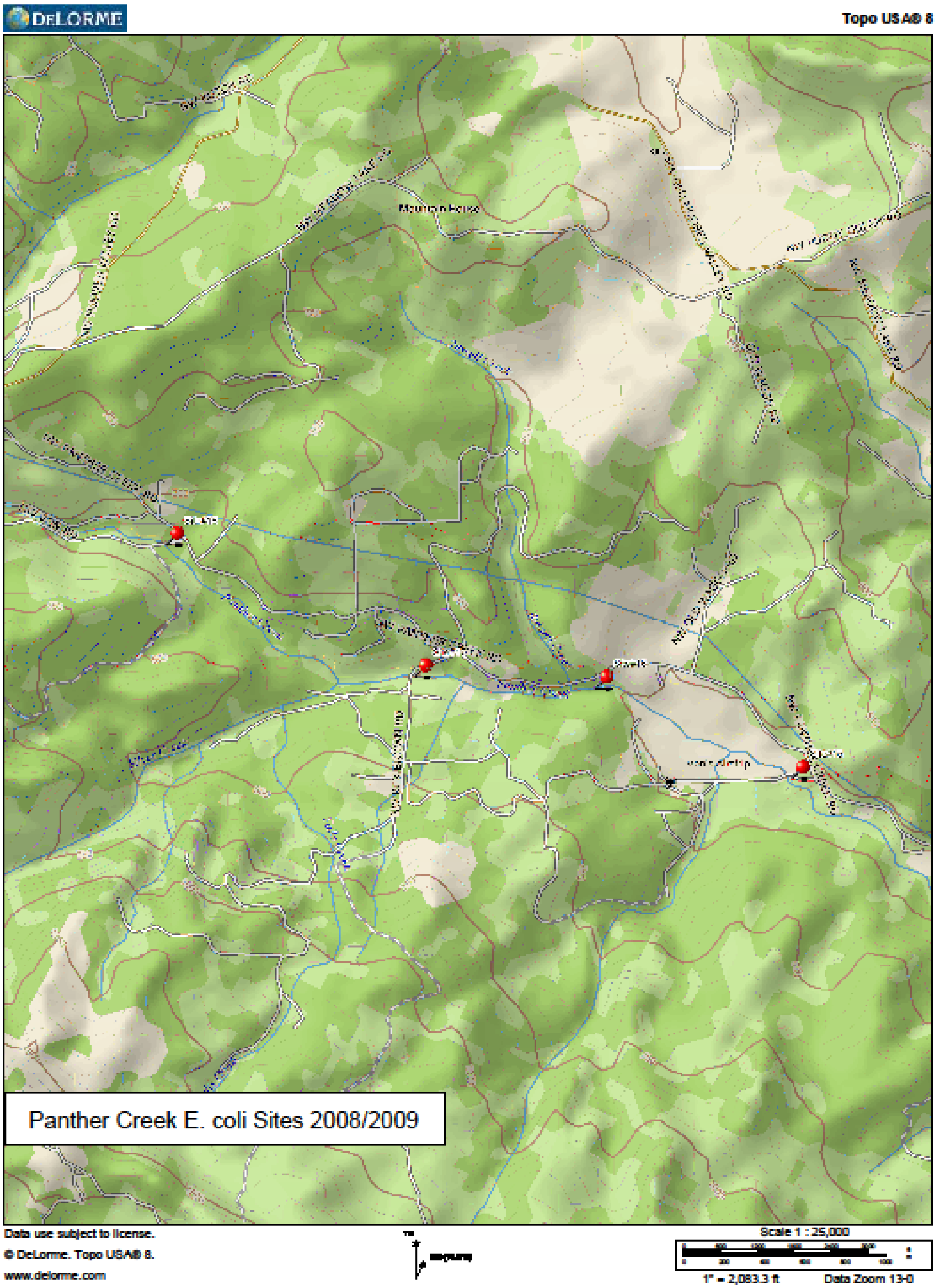


Table 1 Monitoring Site Locations and Frequency of Water Quality Sampling for 2008-2009.

Site #	Watershed	Location	Parameters
1	Salt Creek	Salt Creek at River Mile 1.5 (Hwy 99W)	• Suite*, monthly flow (May-Oct) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
2	Salt Creek	Salt Creek near Broadmead Rd.	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
3	Salt Creek	West Fork Salt Creek near Hwy 22 on Brown Rd.	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
4	Ash Swale	Ash Swale at Hwy 99W (Amity)	• Suite*, monthly flow (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
5	Ash Swale	Ash Swale at at A St. (Mccoy)	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
6	Ash Swale	Ash Swale at River Mile 7.30 (Bethel Rd.)	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
7	Palmer Creek	West Fork Palmer Creek at Webfoot Rd	• Suite*, monthly flow (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
8	Palmer Creek	East Fork Palmer Creek at Springtown Rd	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
9	Palmer Creek	Palmer Creek near Hopewell	• Suite* (May-October) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
10	Cozine Creek	Lower Cozine Creek off Shady Lane (near mouth)	• Suite*, monthly flow (May-Oct) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
11	Cozine Creek	Middle Cozine Creek (at Davis St bridge)	• *E. coli* (Aug-Sept)
12	Cozine Creek	East Fork Cozine Creek (at Library Park)	• Suite* (May-Oct) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
13	Cozine Creek	Middle Fork Cozine Creek (Elmwood St.)	• *E. coli*, temperature (Aug-Sept)
14	Cozine Creek	West Fork Cozine Creek (Old Sheridan Rd)	• Suite* (May-Oct) • *E. coli*, temperature (Aug-Sept) • Continuous temperature (May-Oct)
15	Panther Creek	Panther Creek (below Kane Creek)	• *E. coli*, temperature (Aug-Sept)
16	Panther Creek	Panther Creek (above Kane & below Russell Creek)	• *E. coli*, temperature (Aug-Sept)
17	Panther Creek	Panther Creek (below Silver Creek)	• *E. coli*, temperature (Aug-Sept)
18	Panther Creek	Panther Creek (below water plant)	• *E. coli*, temperature (Aug-Sept)

*Suite = monthly temperature, dissolved oxygen, pH, turbidity, conductivity, total phosphorus, and ammonia

Water Quality Parameters Monitored

Water Temperature
Water temperature is one of most critical water quality indicators and parameters. Temperature affects the metabolism of aquatic organisms and impacts their ability to thrive and survive.
High temperatures can be fatal to fish and other organisms. The DEQ has indicated a maximum standard of 7-day maximum average high of 64.4ºF (18 degrees C) or less. This standard was set for the survival of salmonids during the rearing period of the life cycle (summer months), but other species may have more or less tolerance to this standard.

Conductivity
While the DEQ has not set a standard range or maximum, conductivity in the Willamette Valley, a guideline is 180 µs/cm (Micro Siemens per centimeter) or less. Conductivity, or specific conductance, measures the ability of a sample to conduct electricity. Temperature and concentration of ions influences the conductivity of a sample. Conductivity is influenced by geology and stream flow. High conductivity may indicate human-related activities such as irrigation tail water and urban runoff, or the geologic influence from groundwater fed stream systems.

Turbidity
Turbidity is the ability of a sample (water column) to absorb or scatter light, and is used to estimate the amount of sediment being transport in a body of water. There is currently no ambient background standard, but a measurement of less than 3 nephlometric turbidity units (NTUs) is considered a low flow background guideline for preventing salmonid impaction (pers. comm., Tom Rosetta, DEQ, 2003) in the Willamette Valley Yamhill basin. The DEQ guideline indicates that activities may not increase turbidity more than 10% above background turbidity levels. Turbidity is an indicator of the presence of suspended fine sediment and aquatic organisms such as algae. High levels of turbidity may be harmful to salmonids and other aquatic organisms, as they can clog gills, suffocate fish eggs, and deposit in stream substrate space, impacting aquatic insect habitat. Turbidity also impacts the ability for sunlight to reflect from surface water, thus increasing water temperature.

pH
The DEQ has adopted pH standards that are intended to protect aquatic life. In general, pH should be between 6.5 and 8.5. Water pH is critical to fish habitat because it can affect fish egg production and survival, aquatic insect survival and emergence, and the toxicity of other pollutants such as heavy metals or ammonia. pH is measured on a scale of 1-14, with a value of 1 being acidic, 14 being basic, and 7 being neutral. The lower the pH is, the more acidic the water is.

Dissolved Oxygen
Dissolved oxygen (DO) is the amount of oxygen freely available in water and necessary for aquatic life. Low levels of DO can be fatal to fish and other aquatic species. DEQ has set a minimum standard of 8 mg O_2/L for cold water rearing and 11 mg O_2/L for salmon spawning. Many aquatic species use dissolved oxygen for metabolizing chemical energy. Cool water contains more DO, while warmer water contains less DO. Plant photosynthesis and aeration (such as in riffles and falls) increase DO, while animal respiration and aerobic decomposition of organic materials (Biological Oxygen Demand) decrease DO.

Total Phosphorus
Phosphorus is a nutrient. It is found in all living things. It can be harmful if found in excessive concentration in streams, as it assists in growth of aquatic plants and algae. Most water quality standards for total phosphorus are established to control the growth of aquatic plants and algae. Soluble Reactive Phosphorus should be less than

(or equal to) the total phosphorus of a water body. The EPA has a general guideline that total phosphorus should be less than 0.1 mg/L P. Some streams and rivers, such as the Tualatin River, have TMDL standards for total phosphorus that are less than 0.07 mg/L P (Lindbo, D.T. & Renfro, S.L., 2003).

Ammonia

Federal water quality standards for ammonia are based on the level at which ammonia becomes toxic to fish and aquatic life. Ammonia toxicity is dependent upon temperature and pH:

pH	Criteria Max Concentration (salmonids present) NH_3-N (mg/L)	Criteria Max Concentration (salmonids absent) NH_3-N (mg/L)	Criteria Continuous Concentration NH_3-N (mg/L)
6.5	32.5	48.8	3.48
7.0	24.0	36.1	3.08
7.5	13.3	19.9	2.28
8.0	5.60	8.40	1.27
8.5	2.13	3.20	0.57
9.0	0.88	1.32	0.25

(EPA, 1998)

In addition to standards based on ammonia toxicity, some watersheds have TMDL's established for ammonia to control nitrogenous biochemical oxygen demand. Specific bacteria can convert ammonia to nitrate, which can deplete the dissolved oxygen in a stream or river (Lindbo, D.T. & Renfro, S.L., 2003).

E. coli

Presence of *E. coli* in stream samples indicates that other pathogens may be present. Elevated values may be the result of humans, wildlife, domesticated animals, livestock, or malfunctioning septic systems. Precipitation also may influence *E. coli* levels, increasing values from runoff of animal wastes, groundwater influence from defective septic tanks, or decreasing values by dilution (pers. comm., Steve Hanson, DEQ, 2003). The state standard for *E. coli* calls for no more than 406 MPN/100 ml in any sample or a geomean of five samples taken over thirty days to contain no more than 126 MPN/100ml.

Flow

Flow or stream discharge is the volume of water relative to the velocity that flows through a waterway. Flow fluctuates throughout the season and is measured in cubic feet per second (CFS). Low flow summer months may contribute to diminished water quality, as dissolved oxygen decreases with slower flows, and slow or stagnant streams lose the ability to transport sediment, and aquatic plants and algae are more likely to grow rapidly with enough nutrients present.

Chapter 2 – Methods

The Water Quality Monitoring Technician the Water Quality Assistant, and accompanying volunteers, sampled according the Quality Assurance Project Plan (QAPP) which was written for this project (October, 2007). The QAPP was developed by the Greater Yamhill Basin Council members and staff with guidance from a technical review committee from ODA, DEQ, McMinnville Water Reclamation Facility, Yamhill Soil and Water Conservation District, and Polk Soil and Water Conservation District.

Protocols included in the QAPP were followed according to the *Water Quality Monitoring Technical Guide Book (OWEB, 1999)* for the following parameters:

- Temperature
- Dissolved oxygen
- Turbidity
- Conductivity
- pH

Protocols included in the QAPP which were followed for other parameters are as follows:

- Stream flow – Protocols from Watershed Assessment Section *Mode of Operations Manual* (ODEQ, 2004)
- Total Phosphorus – Protocols developed with the McMinnville Water Reclamation Facility following *Standard Methods* (Greenberg, A.E., 1992)
- Ammonia – Protocols developed with the McMinnville Water Reclamation Facility following *Standard Methods* (Greenberg, A.E., 1992)
- *E. coli* – Protocols developed with the McMinnville Water Reclamation Facility following Standard Methods (Greenberg, A.E., 1992)

For specific details of protocols and procedures followed, see the *E. coli Study and Lower Yamhill River Basin Monitoring Project 2008-2009 Quality Assurance Project Plan* (Appendix D).

Table 2 shows the parameter studies, the protocol used, sampling frequency, and the method and/or equipment used.

Table 2 - Protocols, Frequency, and Method/Equipment for 2008-2009.

Parameter	Protocol	Sampling Frequency	Method/Equipment
Temperature-Point	*Water Quality Monitoring Technical Guide Book* (OWEB, 1999)	Once a month, May-October	VWR NIST Traceable Thermometer
Conductivity	*Water Quality Monitoring Technical Guide Book* (OWEB, 1999)	Once a month, May-October	YSI Model 30 Conductivity Meter
Dissolved	*Water Quality*	Once a month, May-	Winkler titration with Hach OX-

Oxygen	*Monitoring Technical Guide Book* (OWEB, 1999)	October	DT (digital titrator and powdered reagents)
Turbidity	*Water Quality Monitoring Technical Guide Book* (OWEB, 1999)	Once a month, May-October	Hach 2100P Turbidimeter
pH	*Water Quality Monitoring Technical Guide Book* (OWEB, 1999)	Once a month, May-October	Orion Model 210A pH meter
Total Phosphorus	*Standard Methods (Processed & analyzed at WRF)*	Once a month, June-November	Standard Methods, 4500-PE, Analyzed at McMinnville WRF
Ammonia (NH_3-N)	*Standard Methods (Processed & analyzed at WRF)*	Once a month, June-November	Standard Methods, 4500 NH_3-F, Analyzed at McMinnville WRF
Additional:			
E. coli	*Standard Methods (Processed & analyzed at WRF)*	5 samples in 30 days in August-September	Quanti-Tray 2000 MPN Enumeration Test Procedure with Colilert reagents, Analyzed at McMinnville WRF
Temperature-Point	*Watershed Assessment Section Mode of Operations Manual* (ODEQ, 2004)	5 measurements in 30 days August-September at time of *E.coli* sample collection	VWR NIST Traceable Thermometer
Flow (Discharge)	*Watershed Assessment Section Mode of Operations Manual* (ODEQ, 2004)	Once a month, June-November	Marsh-McBirney Flow-Mate digital flow meter and top-setting wading rod
Temperature-Continuous	*Water Quality Monitoring Technical Guide Book* (OWEB, 1999)	May-October at 30-minute intervals	VWR NIST Traceable Thermometer; VEMCO temperature data loggers

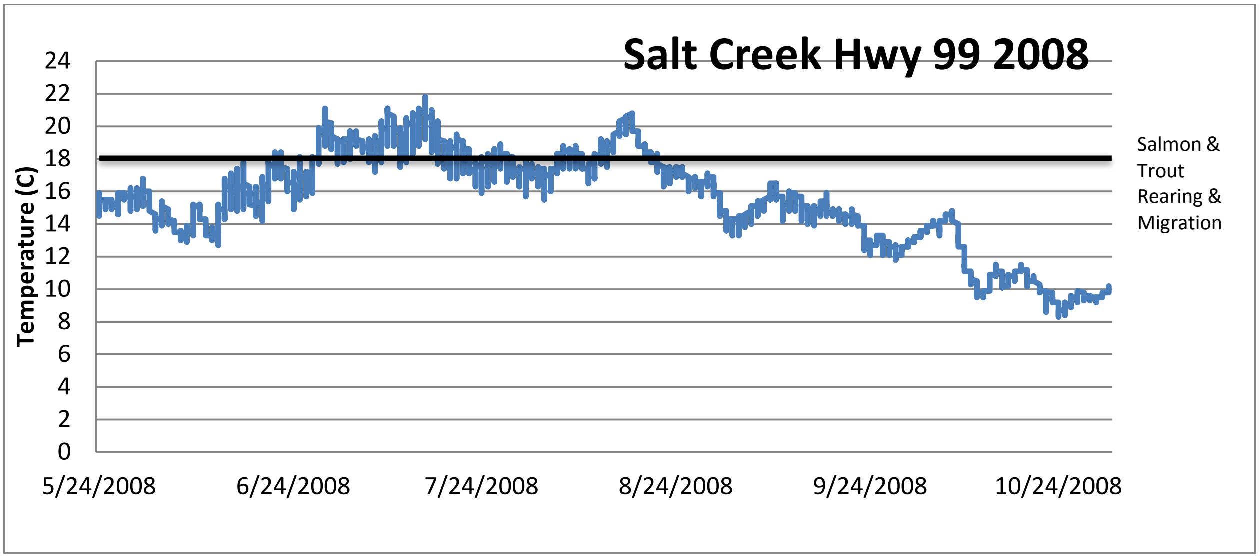
Chapter 3 – Results

Temperature

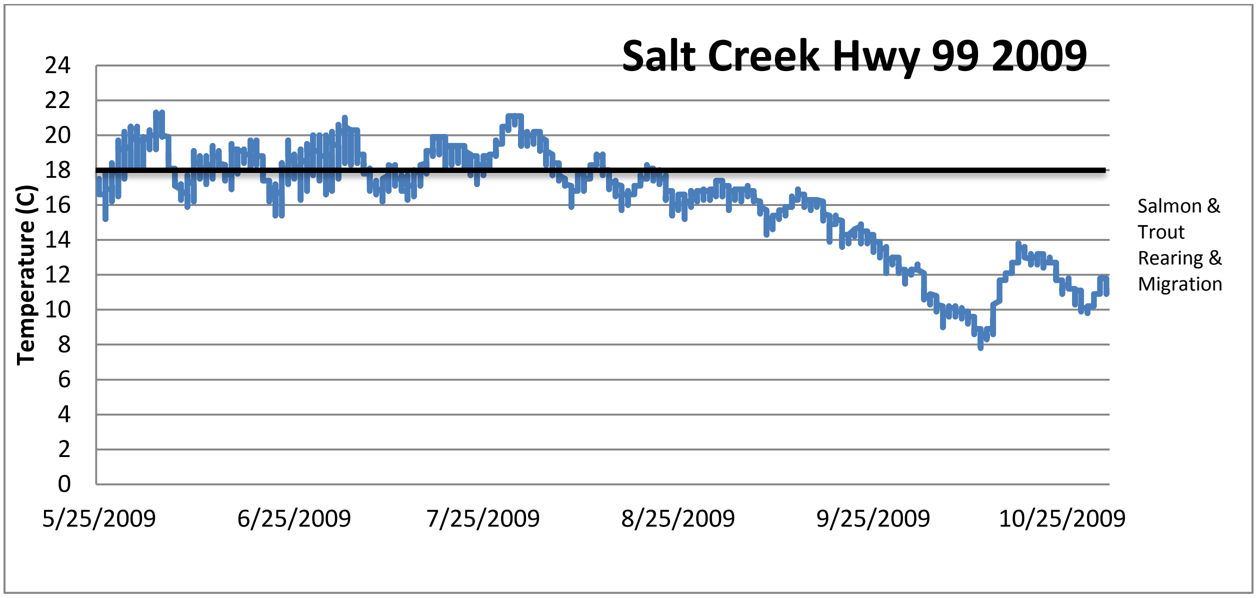
Temperature results are displayed as actual values. The DEQ temperature standard of 18ºC is displayed on each chart to give an indication of the water quality of each stream. The temperature data loggers were tied into the streams so as to try to avoid exposure to air during the low-flow summer months, however some peaks in temperature may be due to water levels lowering and the exposure of the temperature logger to ambient air.

This project was particularly challenging to find adequate stream depth and branches and/or trees to affix data loggers to that would assure data loggers were under the stream surface throughout the summer months. Many of the extremely high temperatures and larges fluctuations in daily temperature are due to a logger being exposed to the ambient air (e.g., see Ash Swale on Bethel Rd. in 2008). Logger could only be tied to a bridge, and it appeared as though water level was rising and falling throughout the summer fairly significantly).

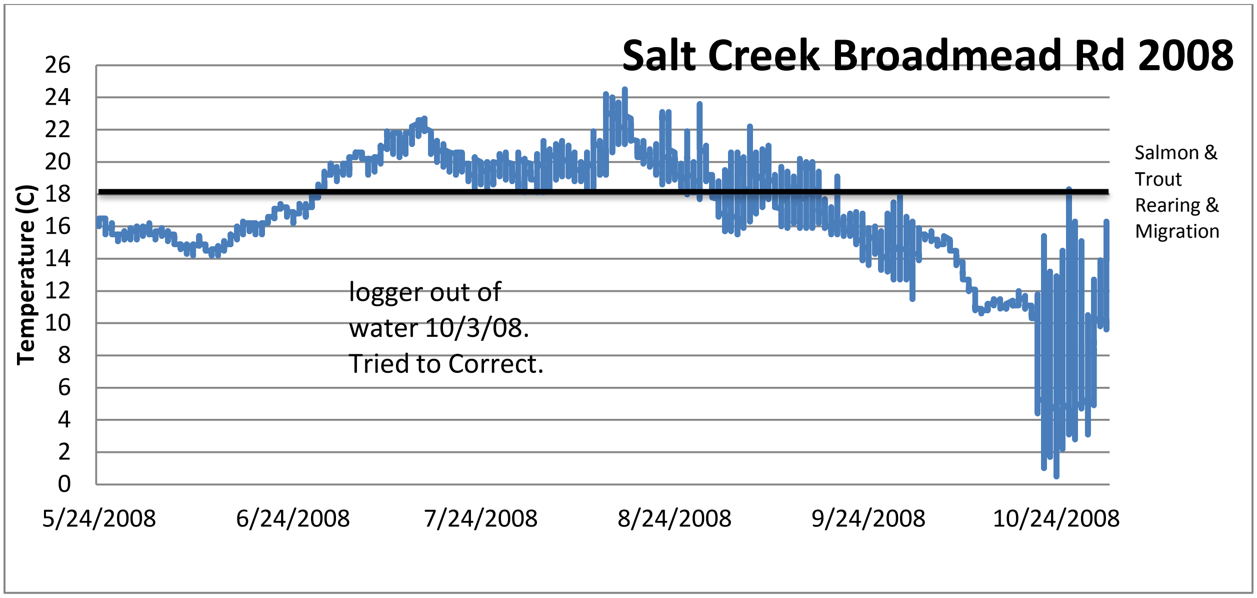
Salt Creek Site #1 2008



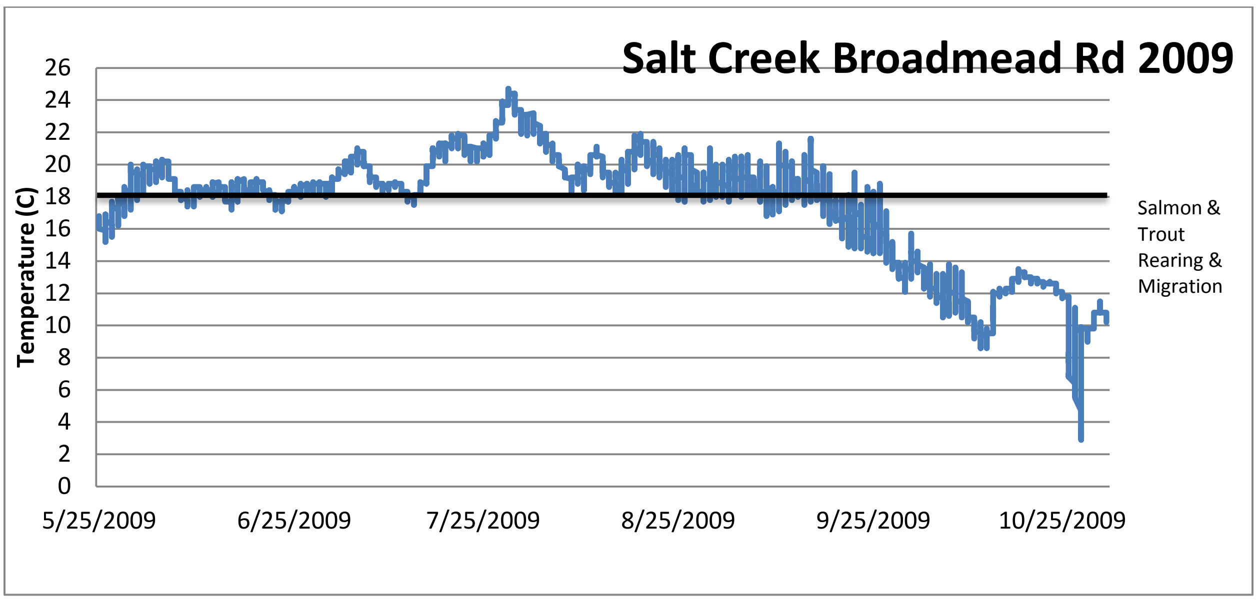
Salt Creek Site #1 2009



Salt Creek Site #2 2008



Salt Creek Site #2 2009



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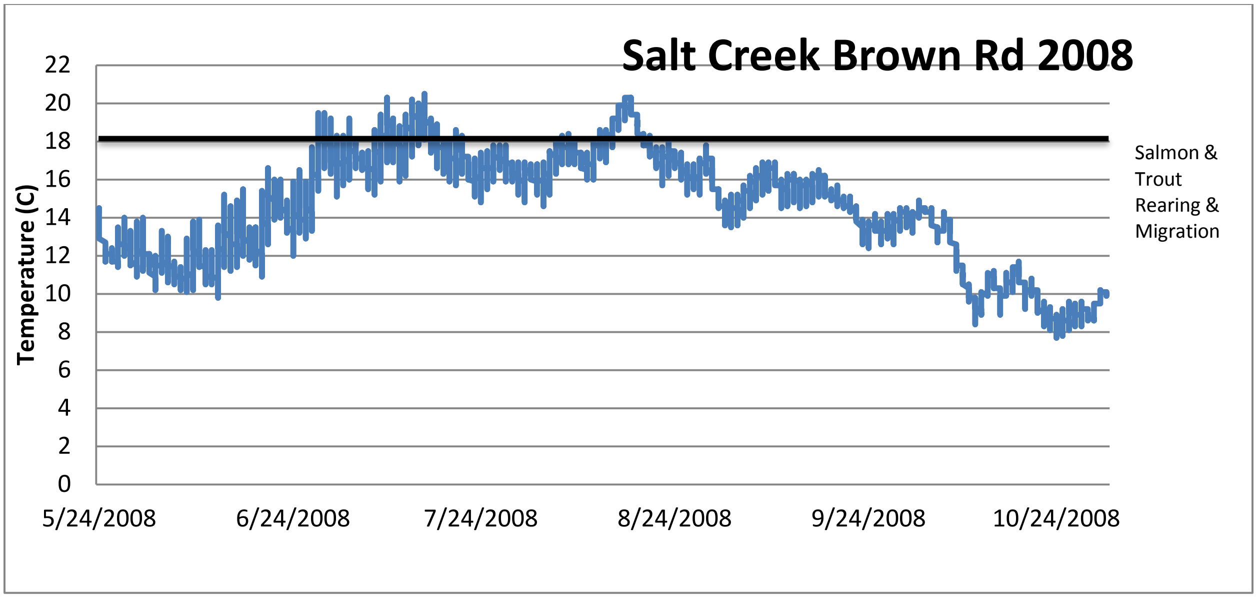
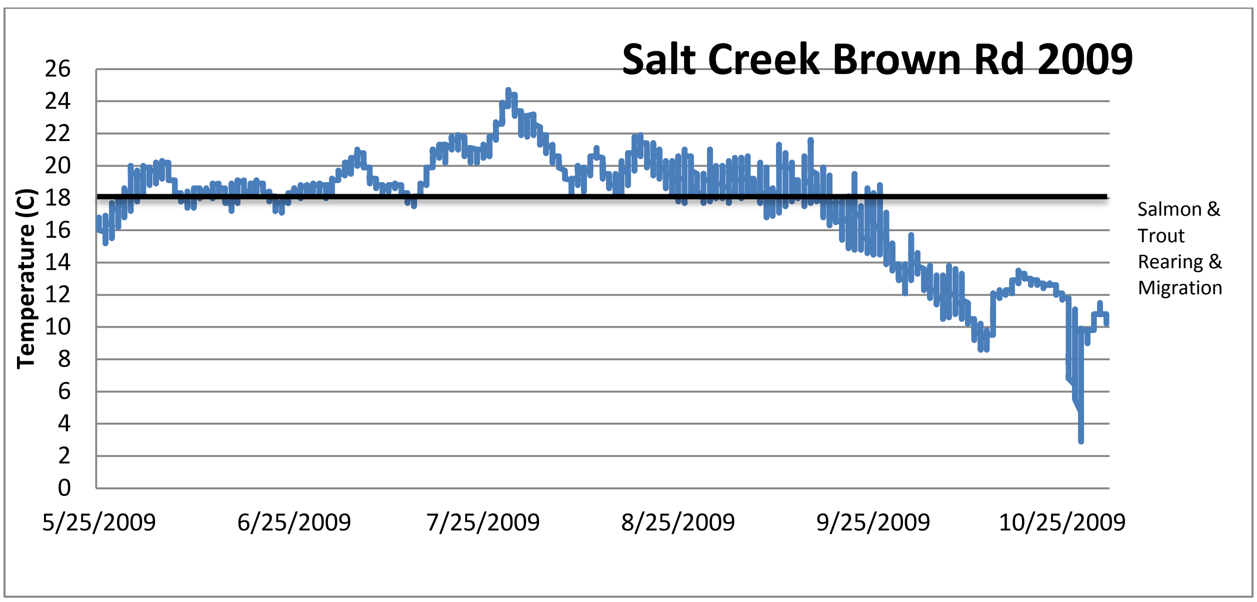
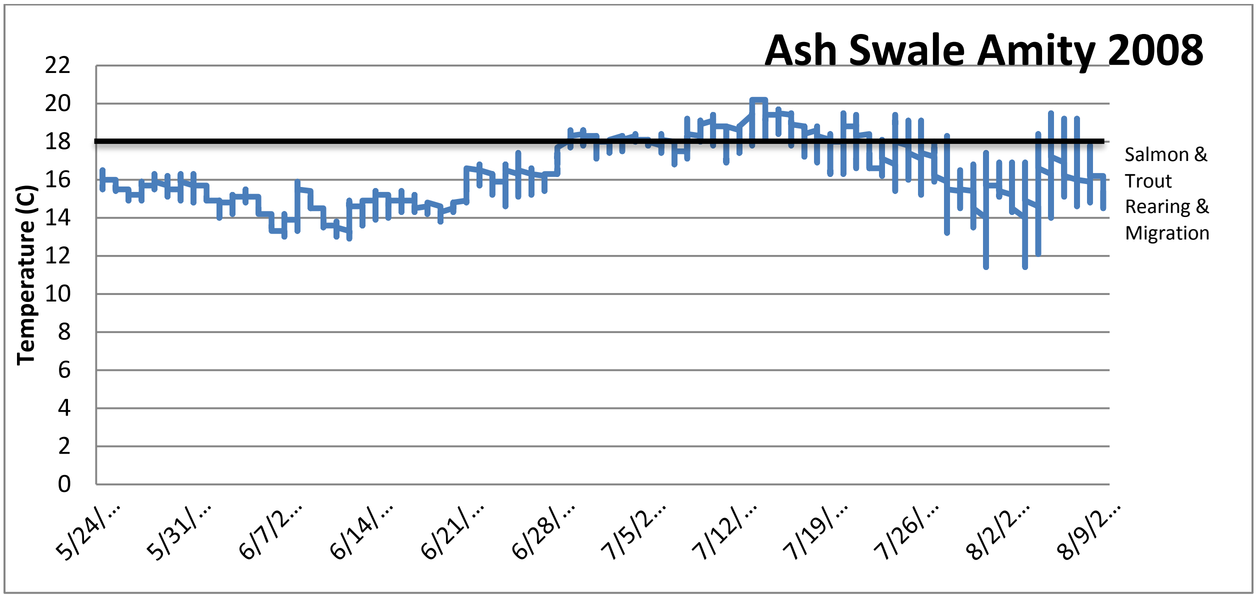


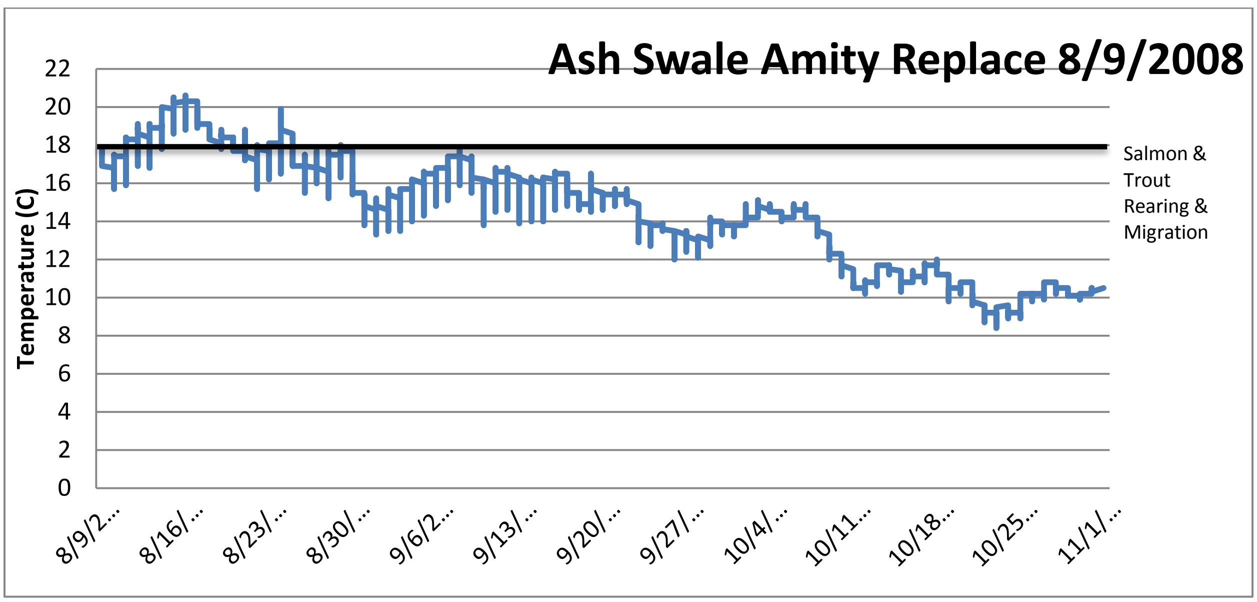
Salt Creek Site #3 2009



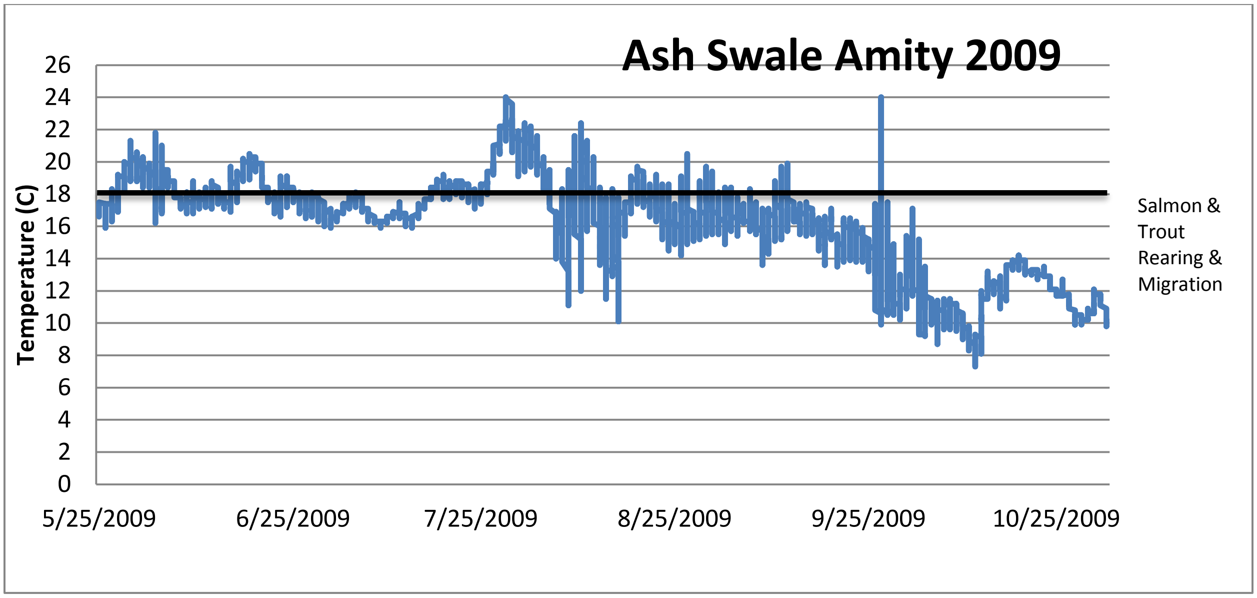
Ash Swale Site #4 2008 (May-August)



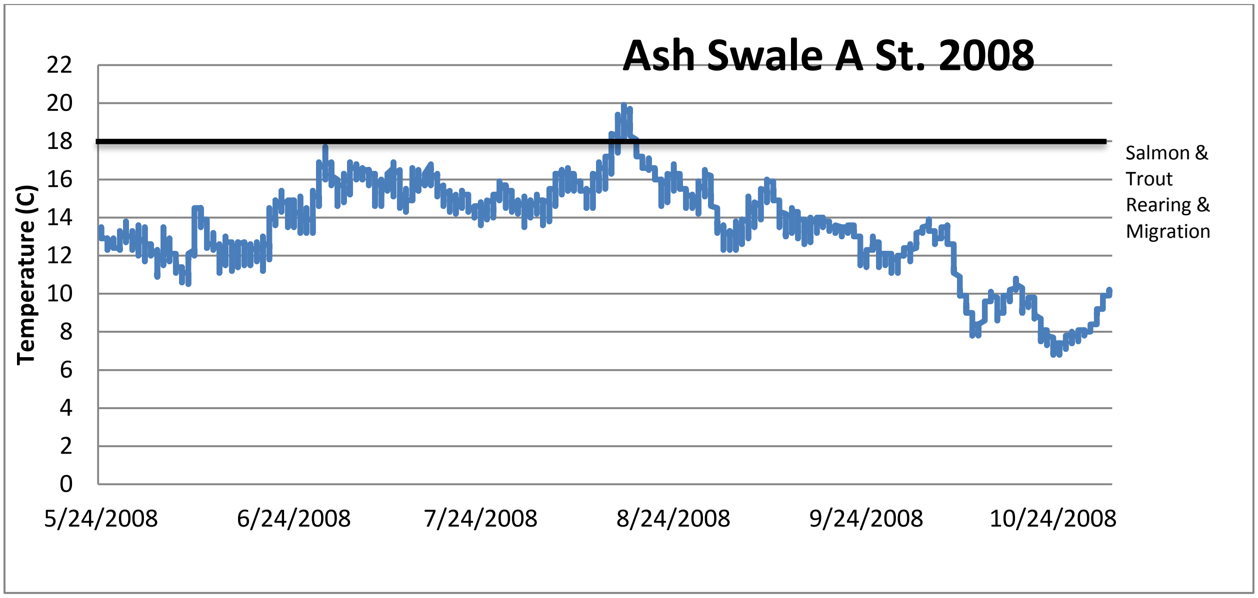
Ash Swale Site #4 2008 (August-October)



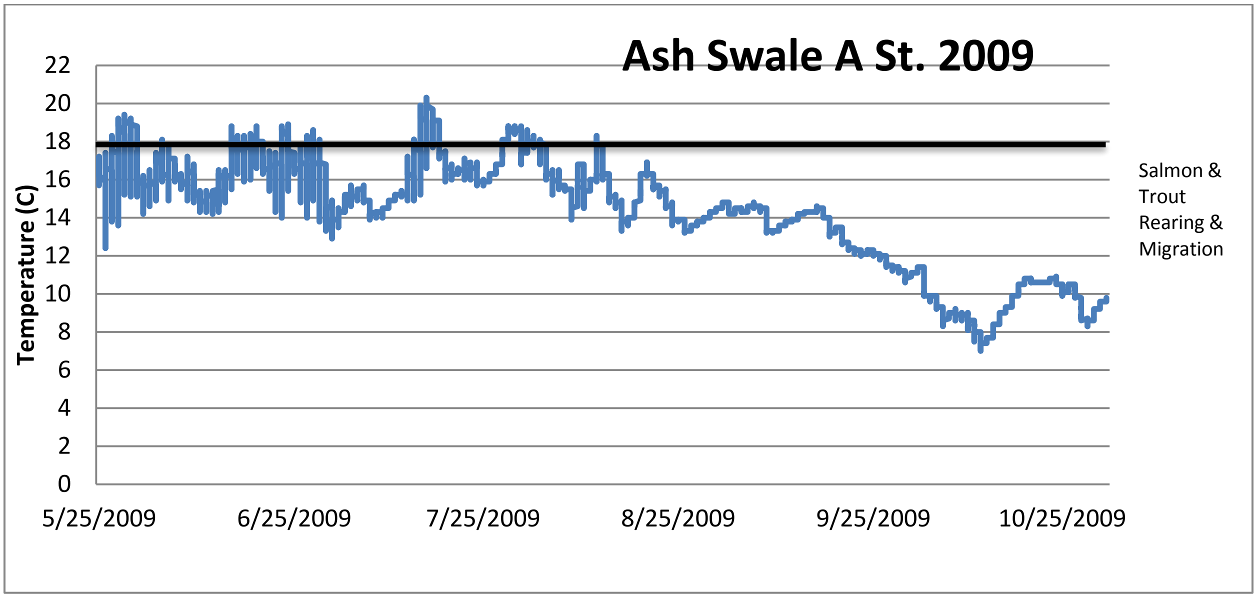
Ash Swale Site #4 2009



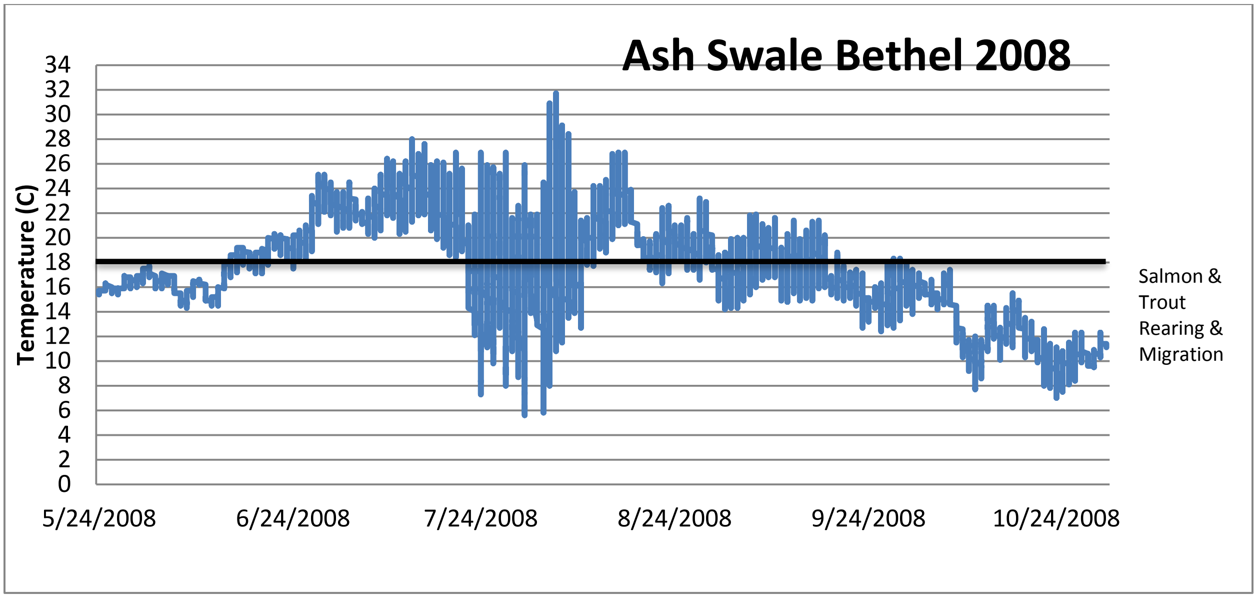
Ash Swale Site #5 2008



Ash Swale Site #5 2009



Ash Swale Site #6 2008



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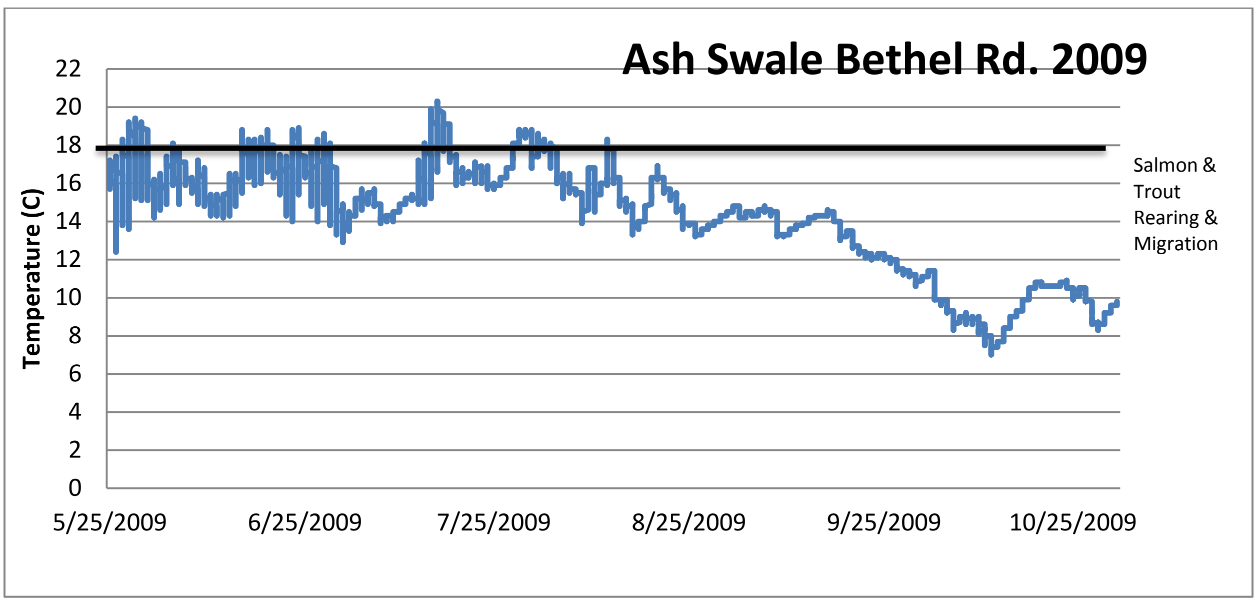
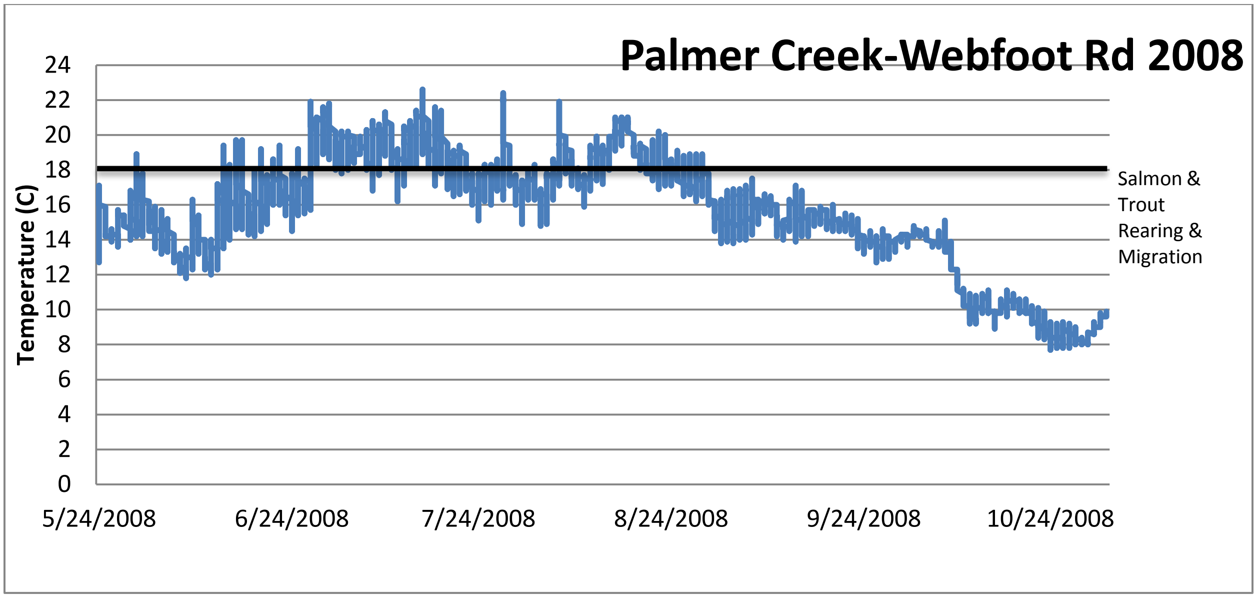
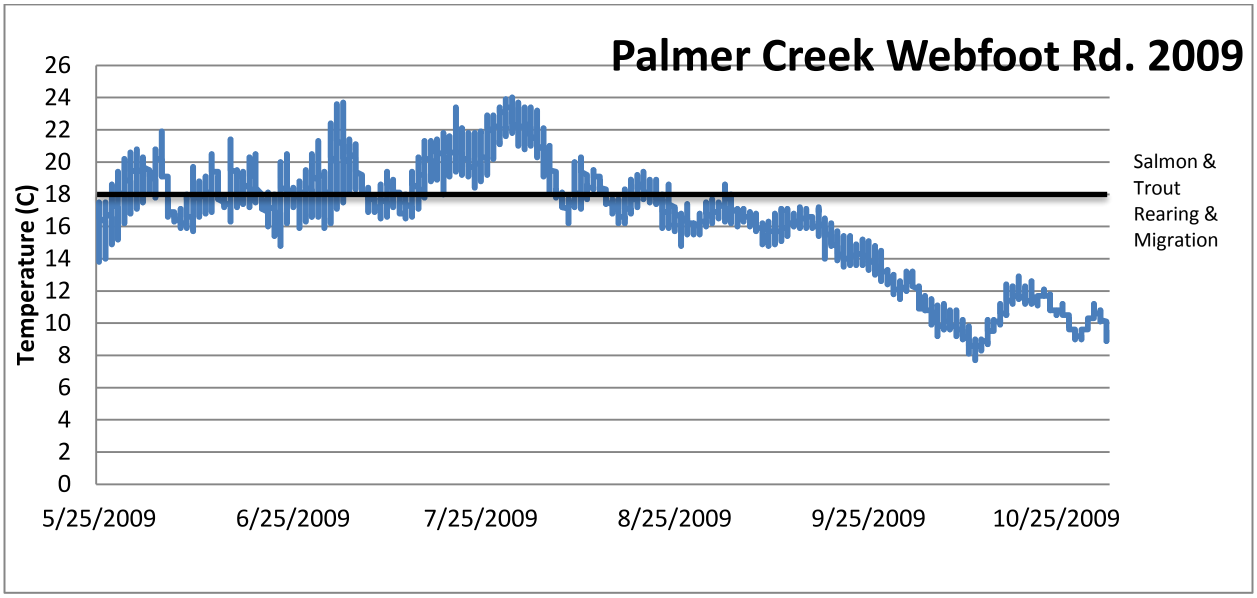


Palmer Creek Site #7 2008



Palmer Creek Site #7 2009



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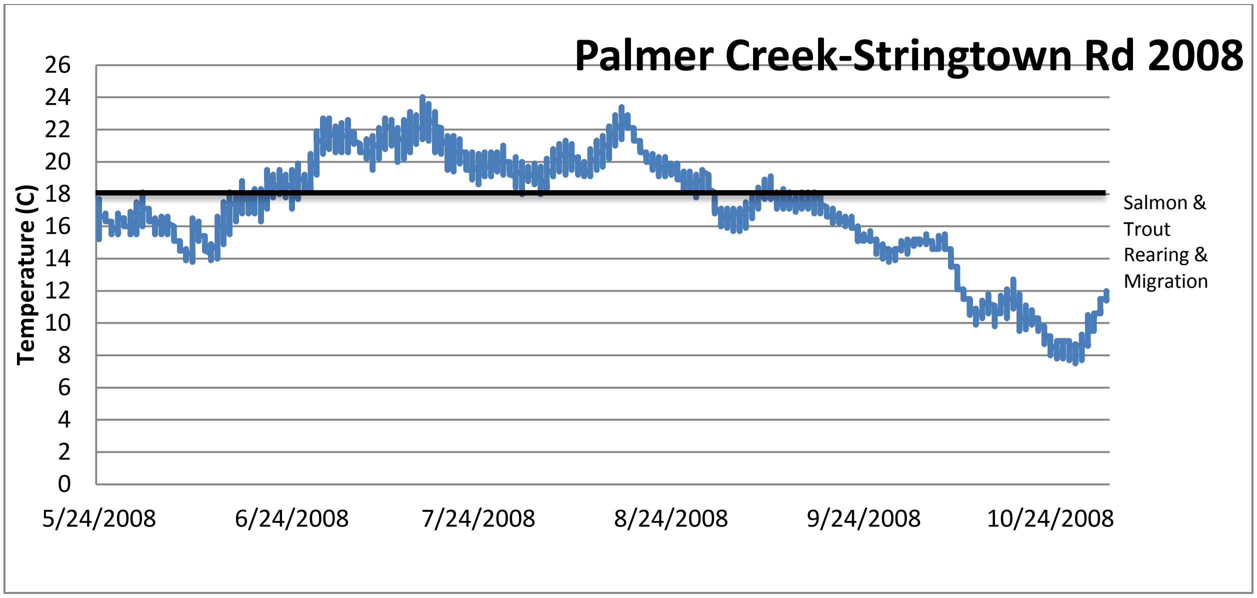
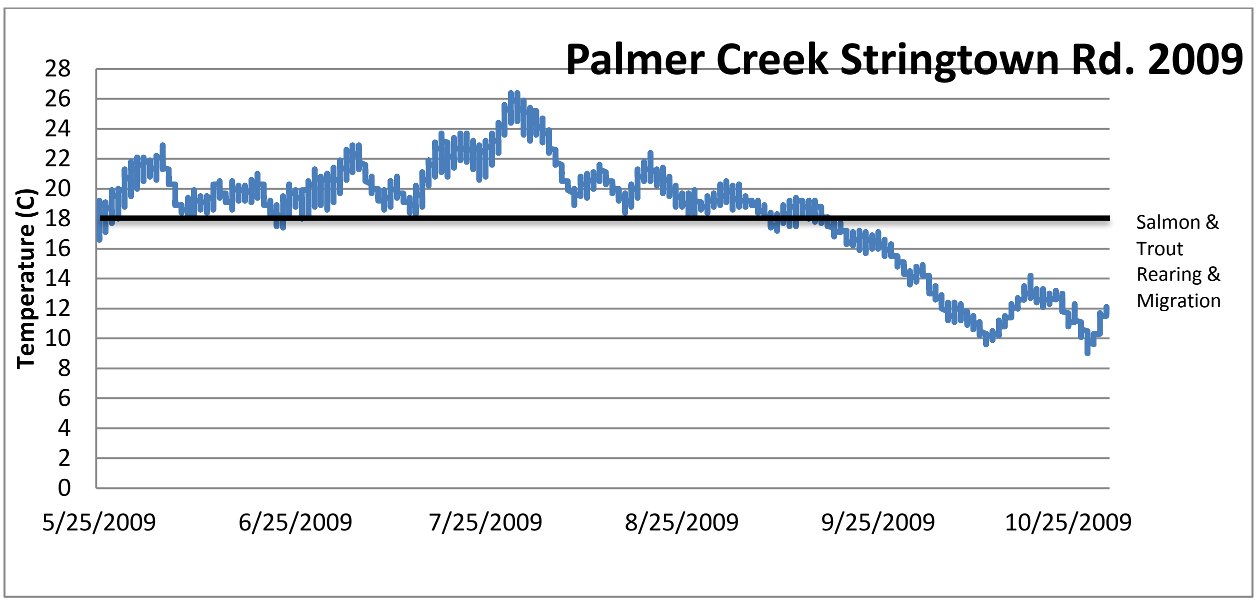


Palmer Creek Site #8 2009



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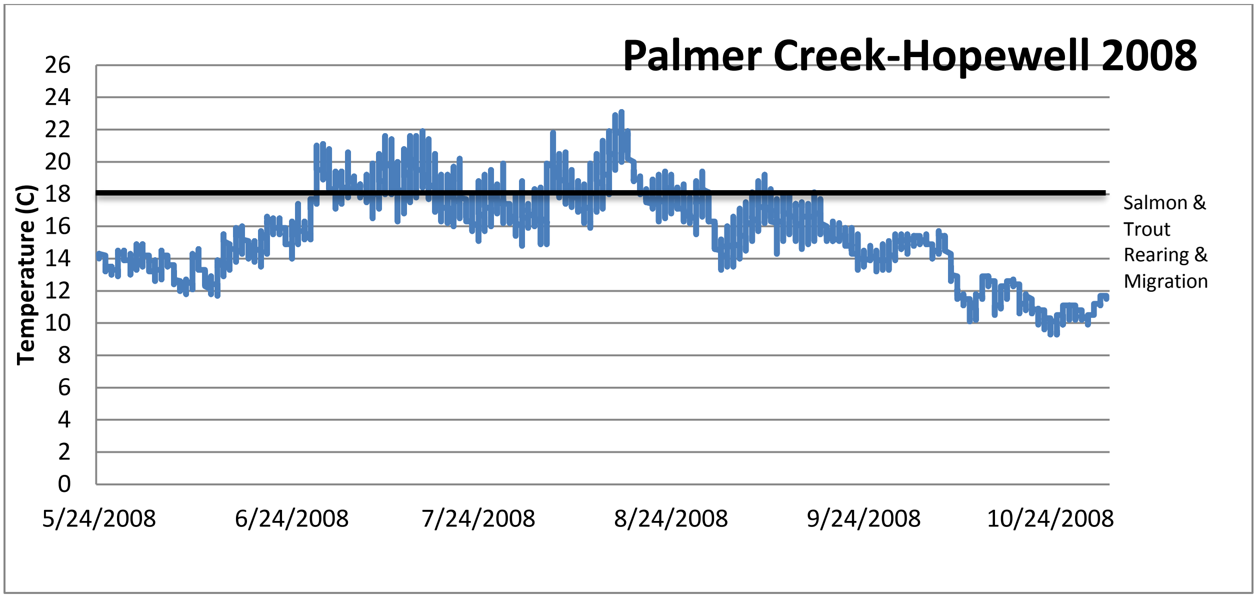

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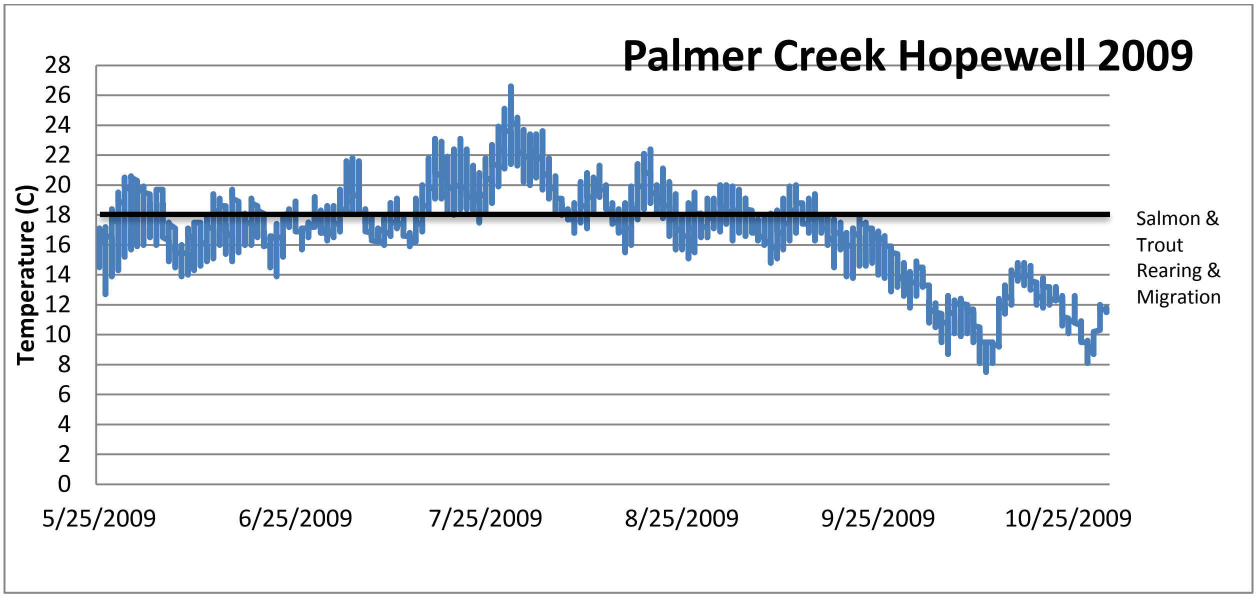
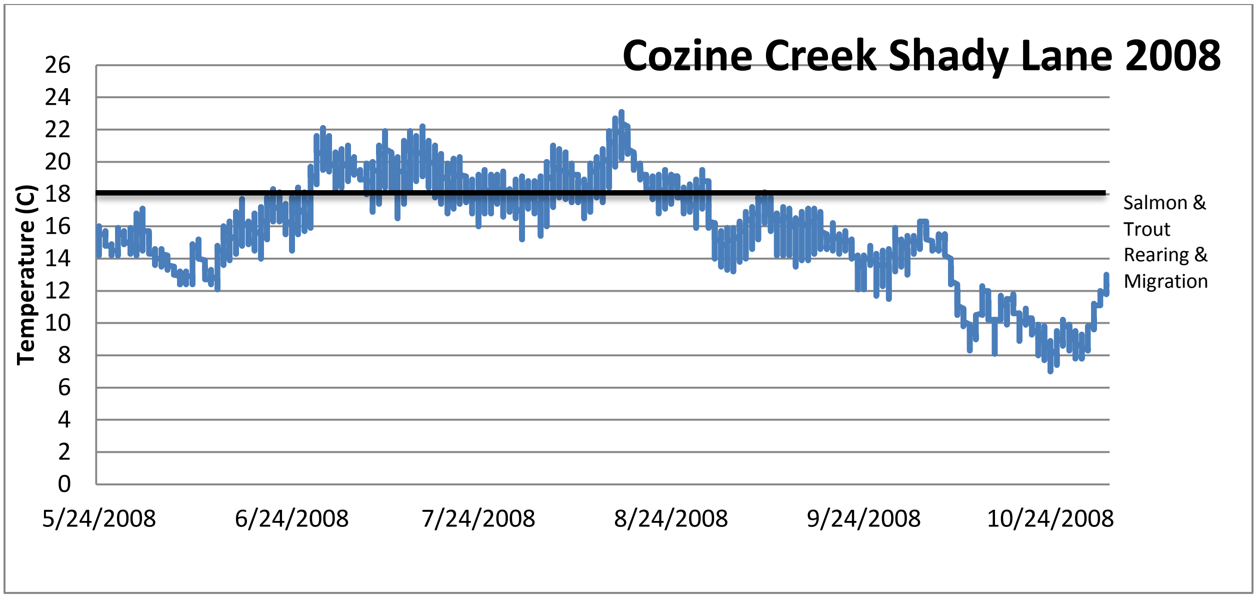
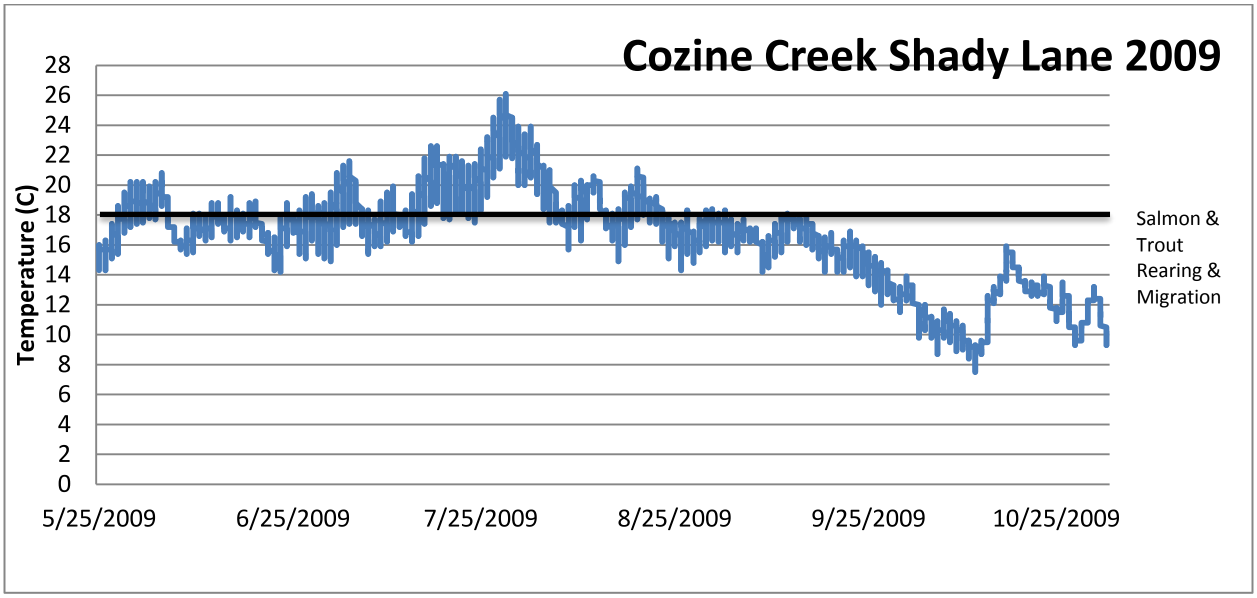


Cozine Creek Site #10 2008



Cozine Creek Site #10 2009



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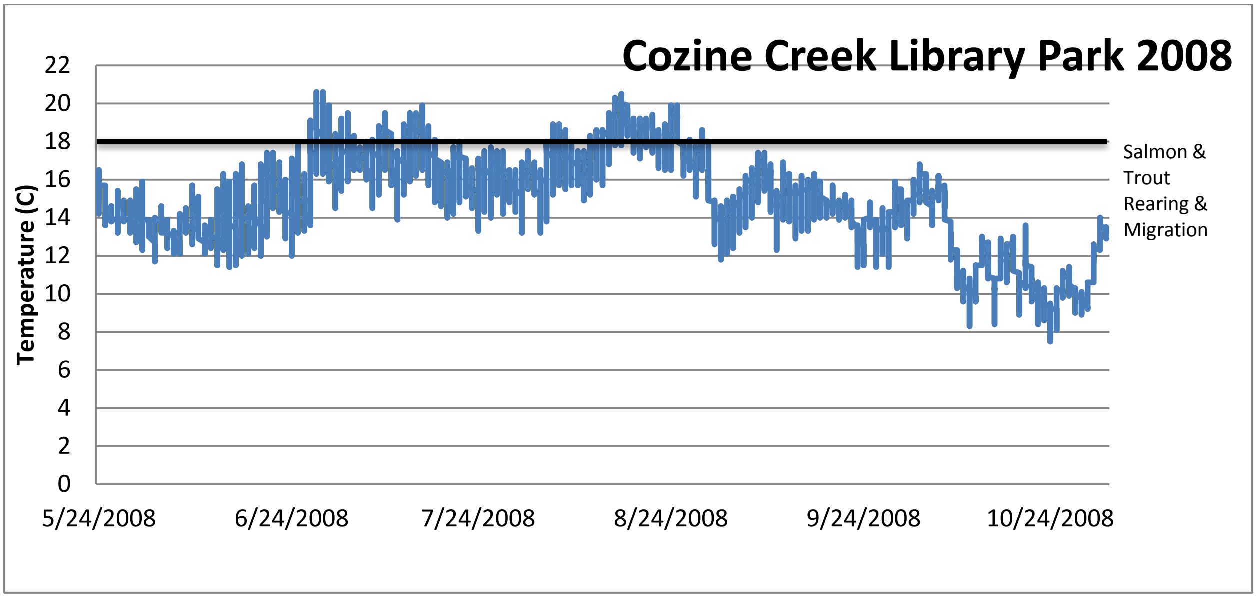
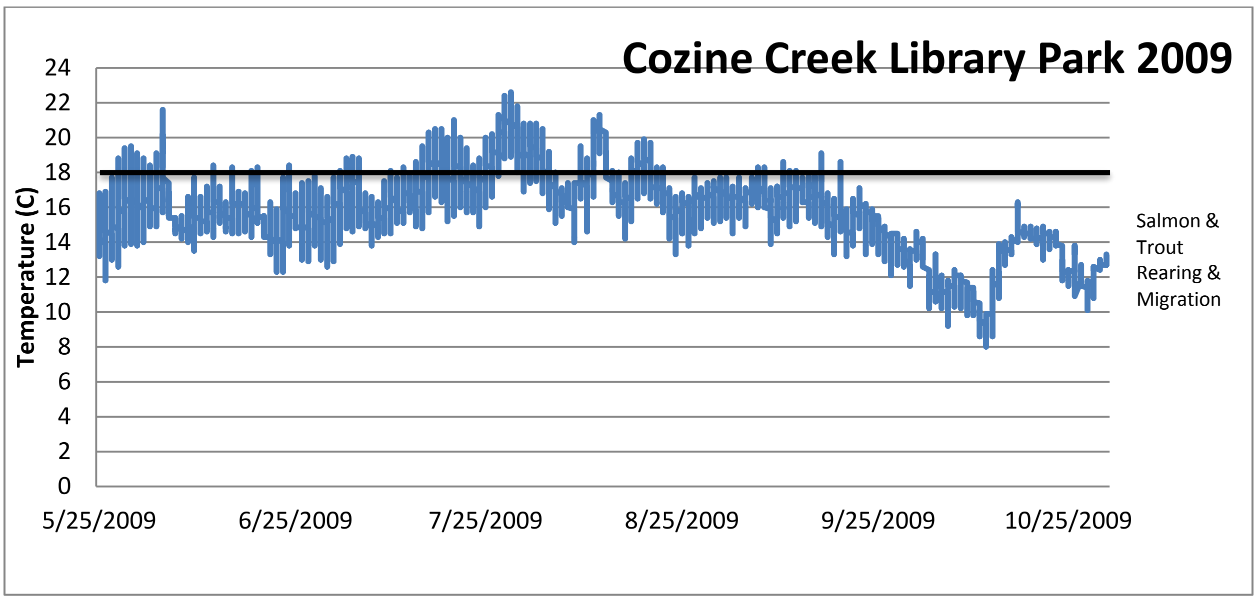
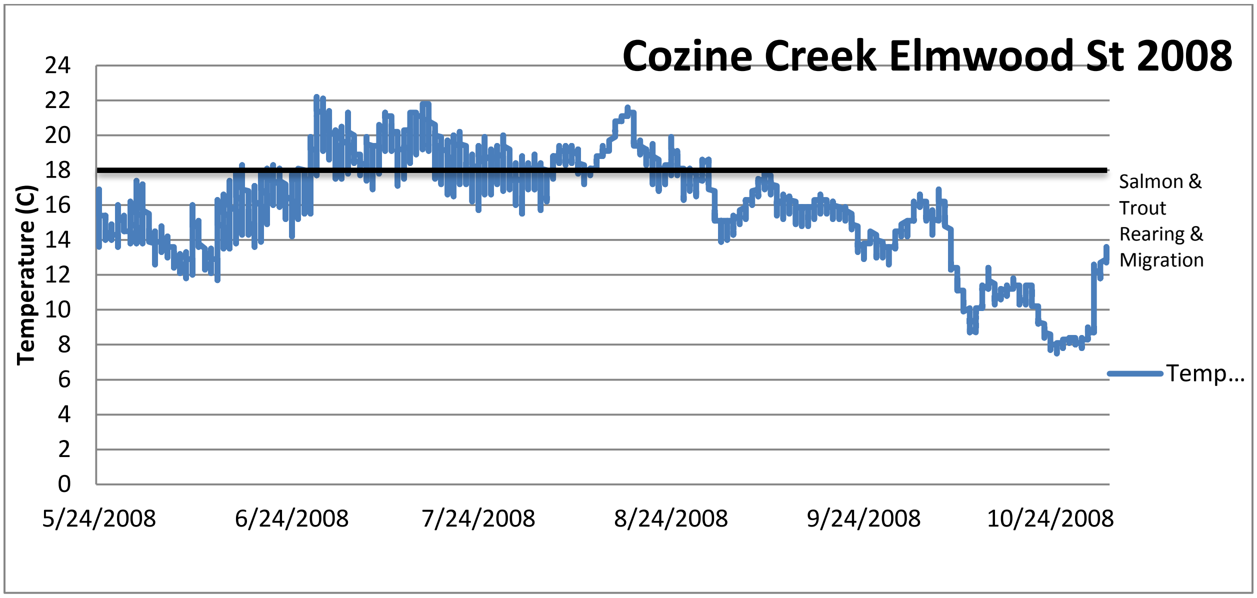


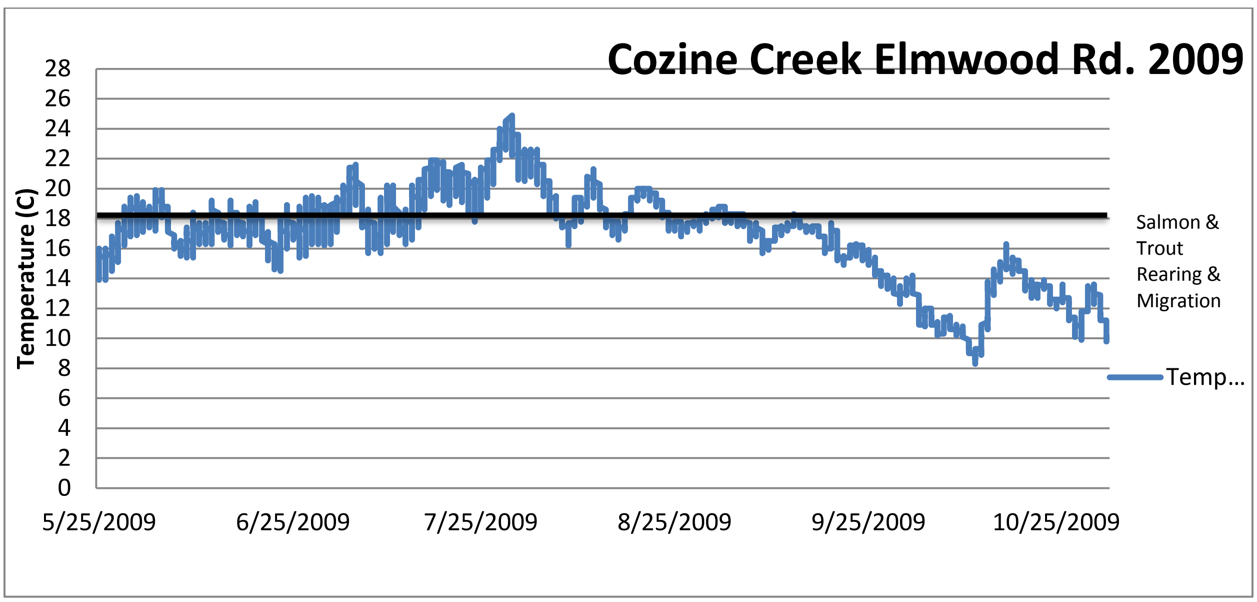
Cozine Creek Site #12 2009



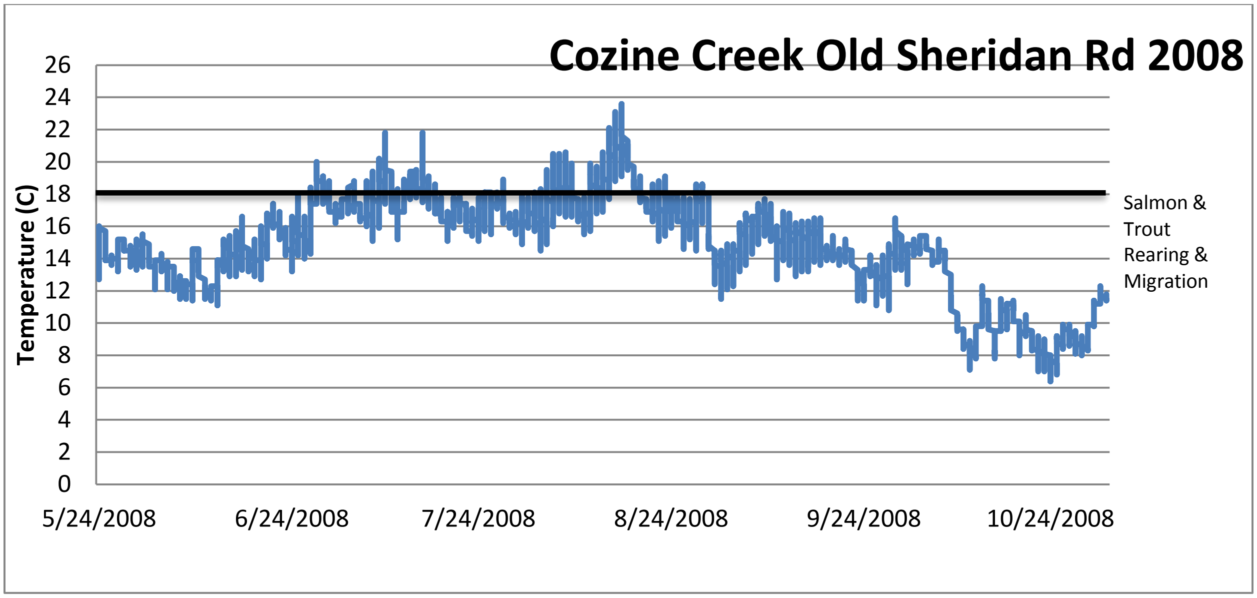
Cozine Creek Site #13 2008



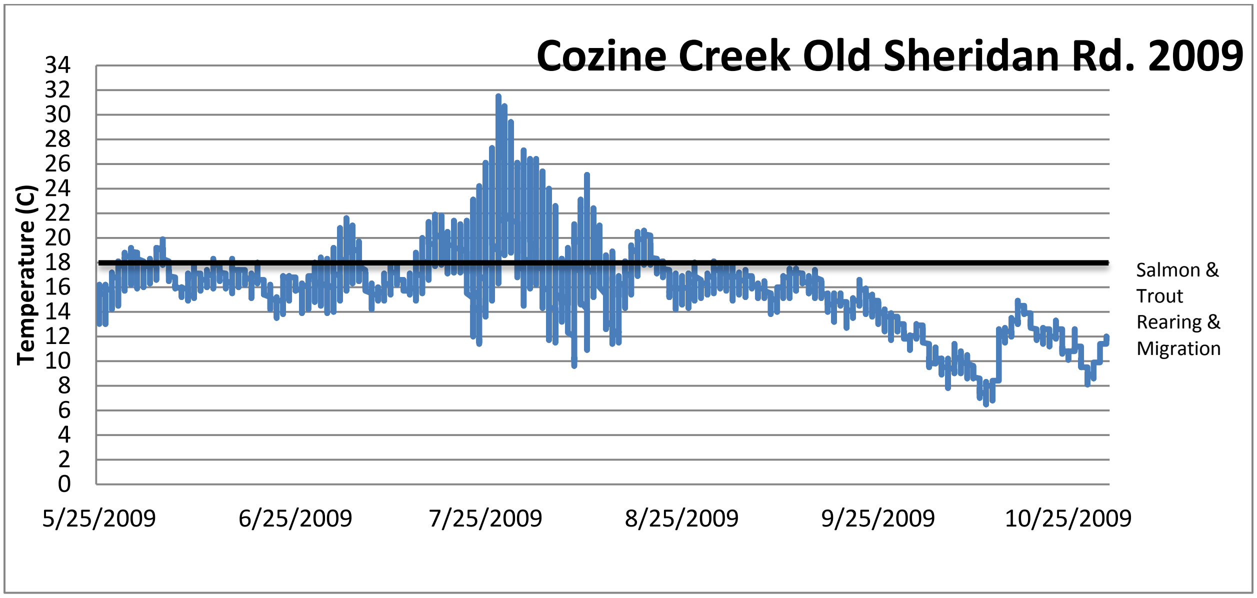
Cozine Creek Site #13 2009



Cozine Creek Site #14 2008

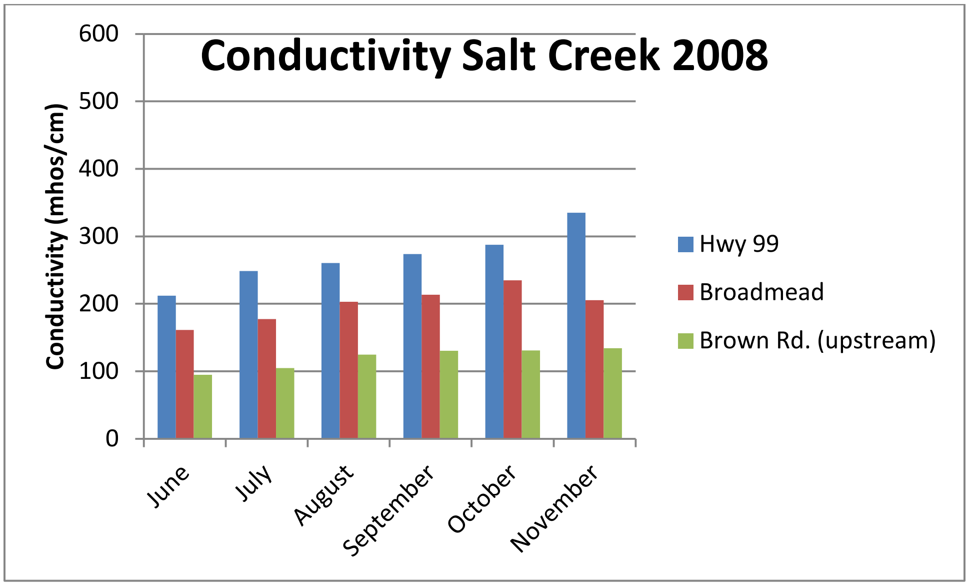


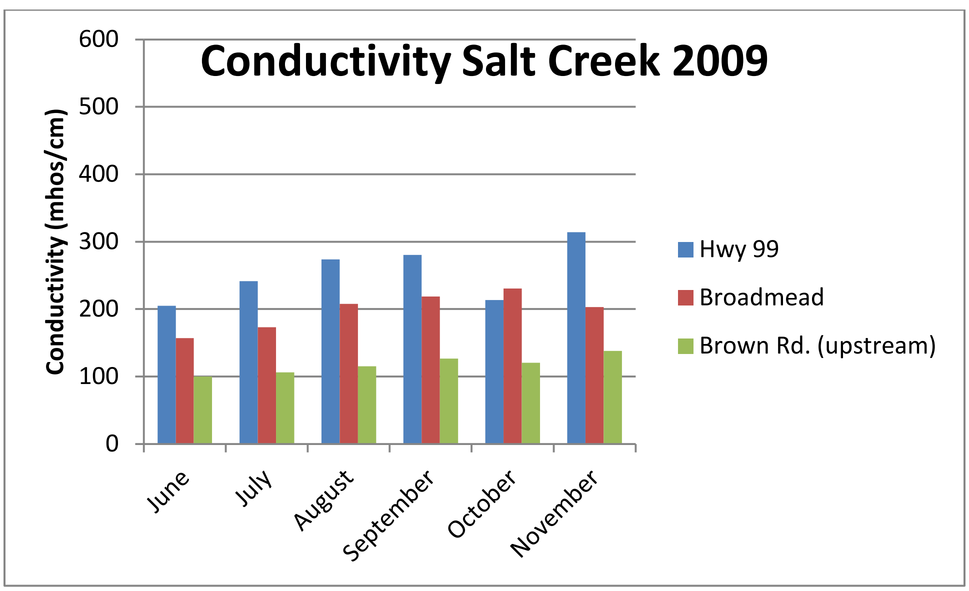
Cozine Creek Site #14 2009



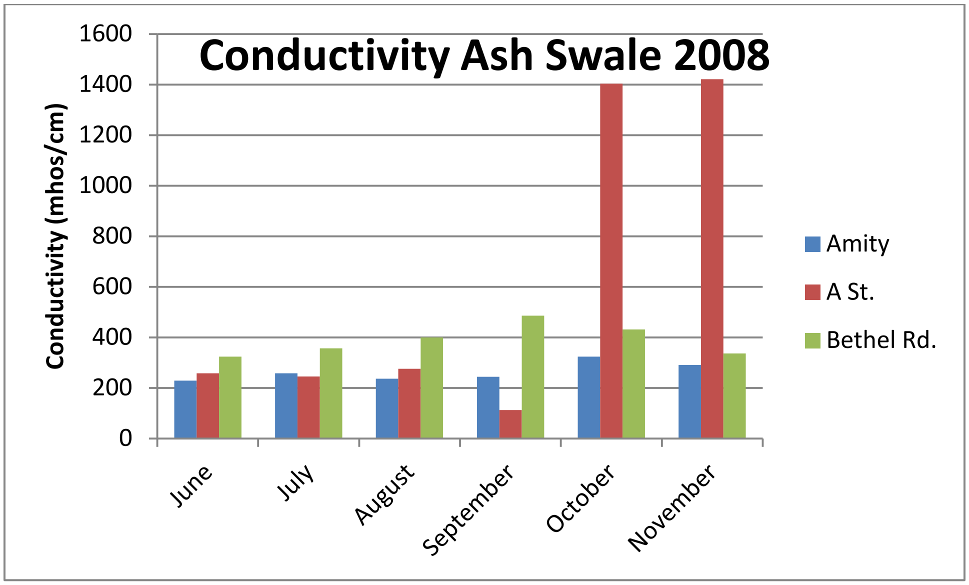
Conductivity

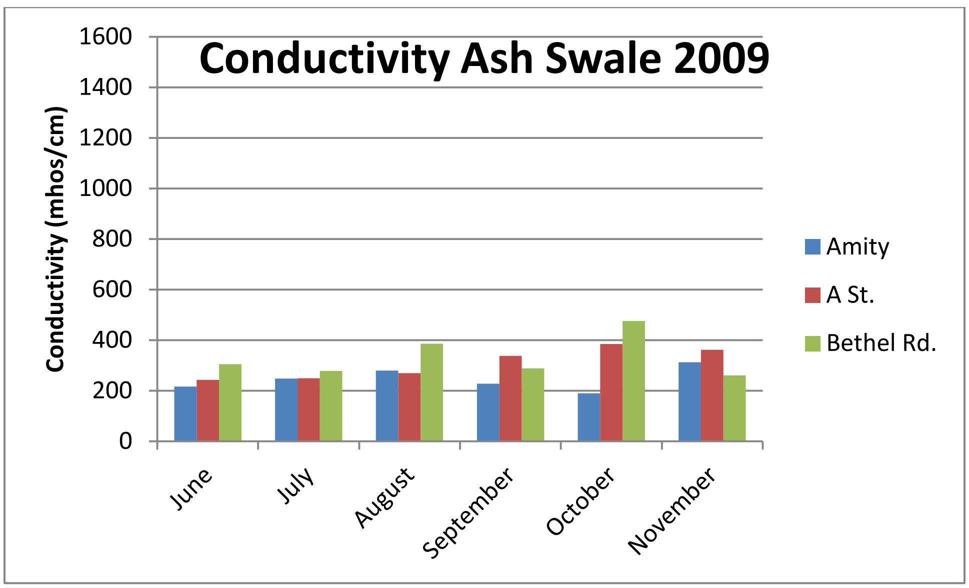
Conductivity on Salt Creek was consistently higher near the mouth at site #1 with a maximum value of 335 during November sampling in 2008. Broadmead Rd., site #2, had a maximum value of 235 mhos during sampling in October of 2008. At Brown Rd., site #3, near the headwaters fell below the standard during both 2008 and 2009. Conductivity, during both years, consistently was higher as you went downstream from the headwaters.



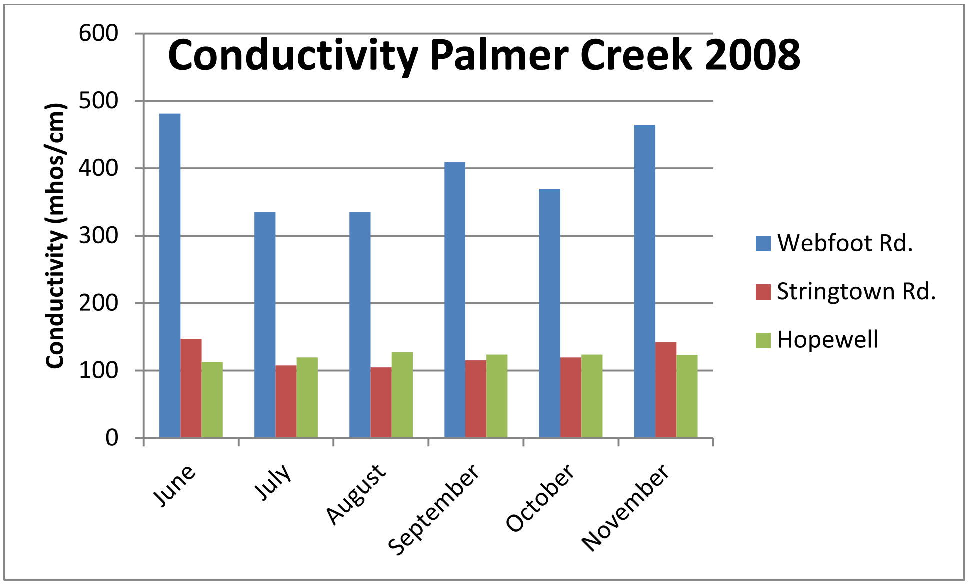


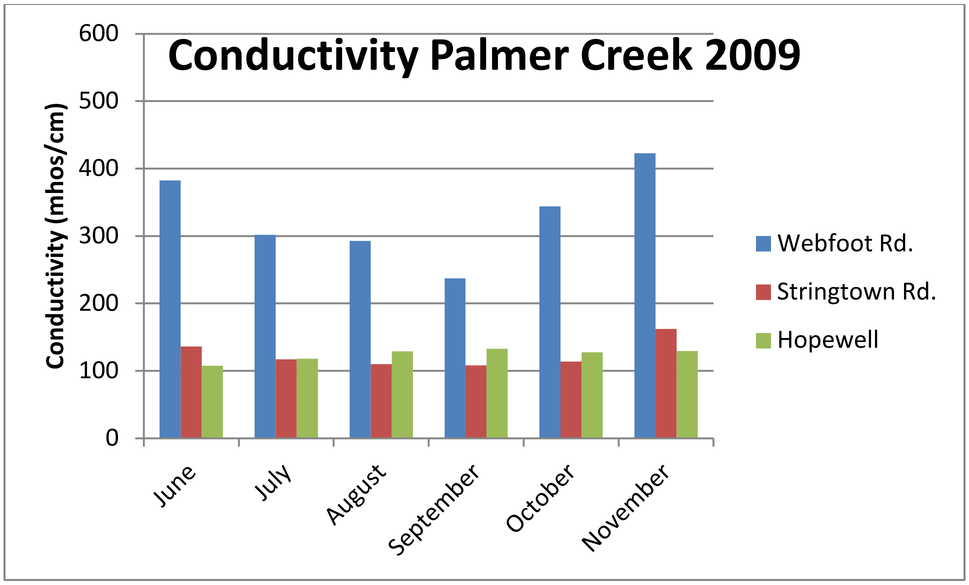
Conductivity on all sites on Ash Swale measured above the guideline of 180 mhos, except for once in September of 2008 at A St., site #5, where it was 113 mhos. Twice in 2008, conductivity was exceedingly high at this same site, with measurements of 1400 and 1423, during October and November, respectively.



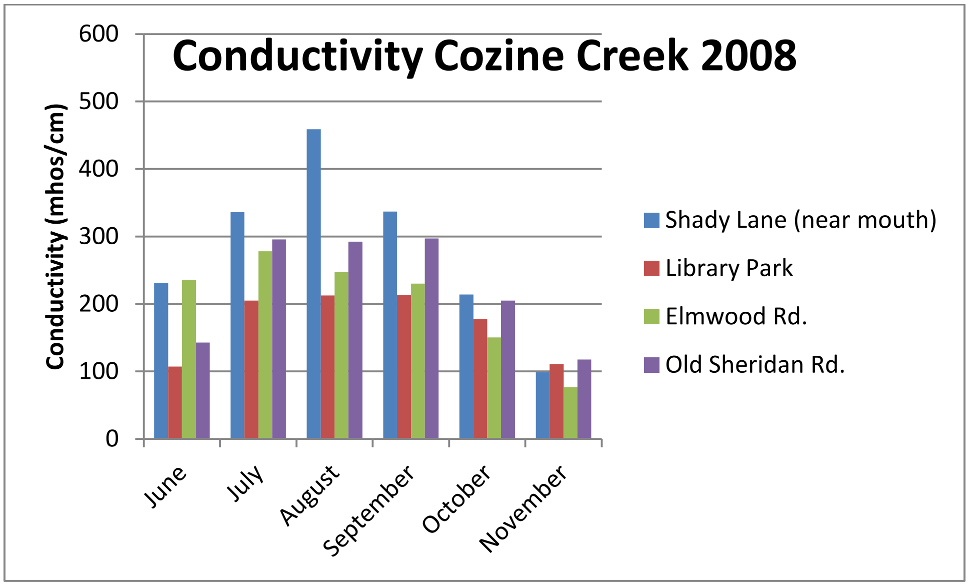


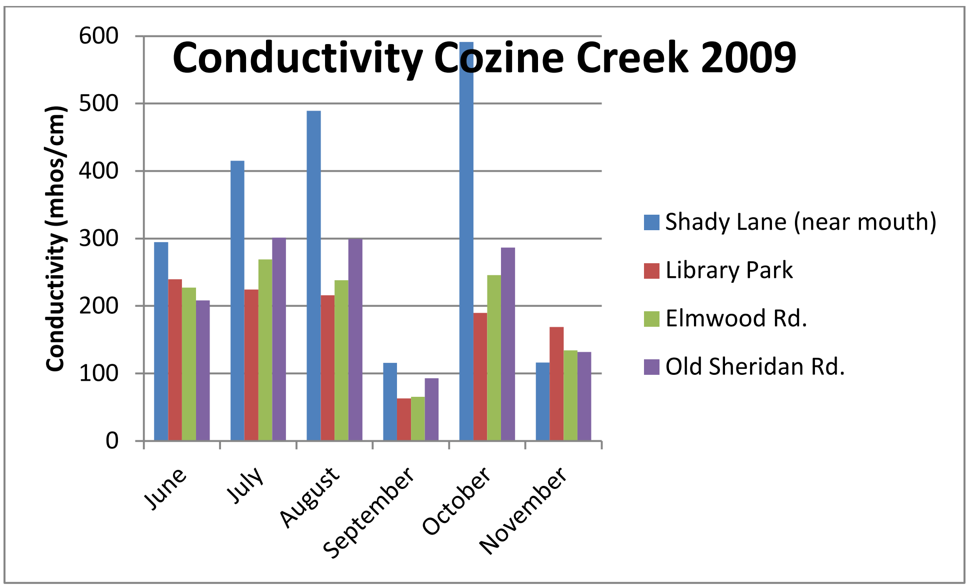
Conductivity on Palmer Creek fell below the guideline of 180 mhos for sites #8 and #9, at the east fork of Palmer Creek and upstream in Hopewell, respectively, during both sampling years. Conductivity was consistently higher at site #7, on Webfoot Rd., during both sampling seasons, with a maximum value of 481 mhos during June of 2008 and a minimum of 237 mhos during June of 2009.





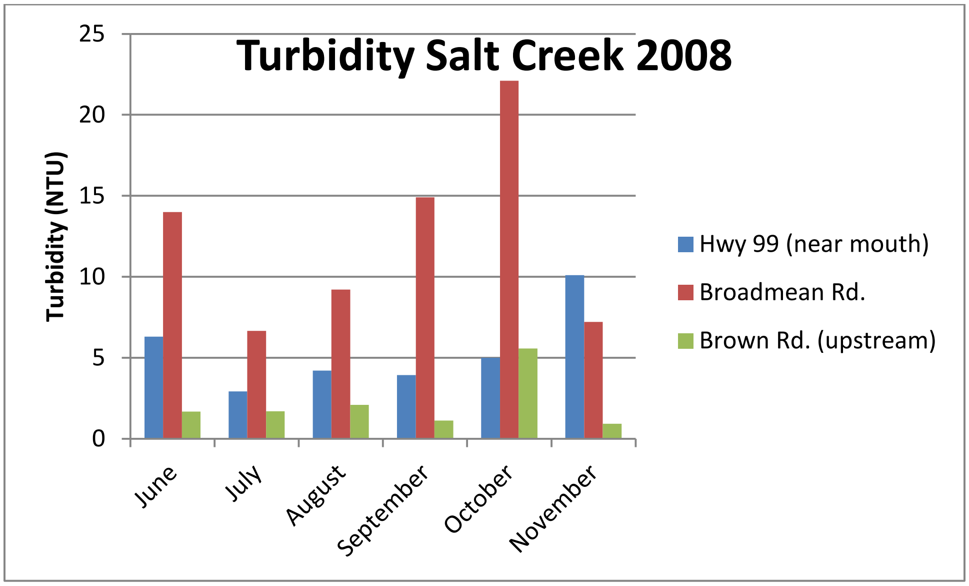
Conductivity on Cozine Creek consistently had values over the guideline of 180 mhos. During November of both years, values fell below the guideline, as well as during September of 2009. The highest values were consistently found near the mouth, at site #10, off of Shady Lane, with a maximum value of 459 mhos during August of 2008 and 489 mhos and 591 mhos during August and October of 2009, respectively.

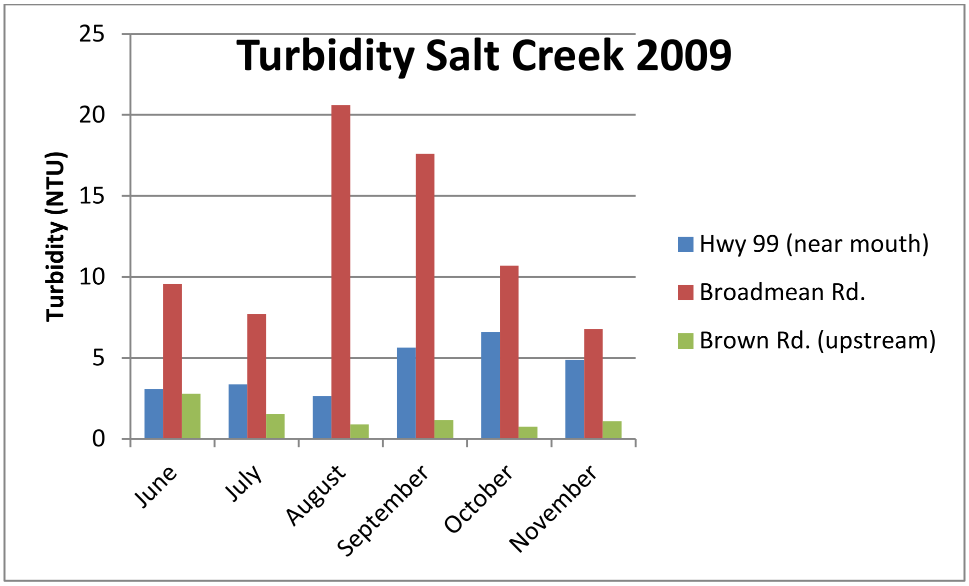




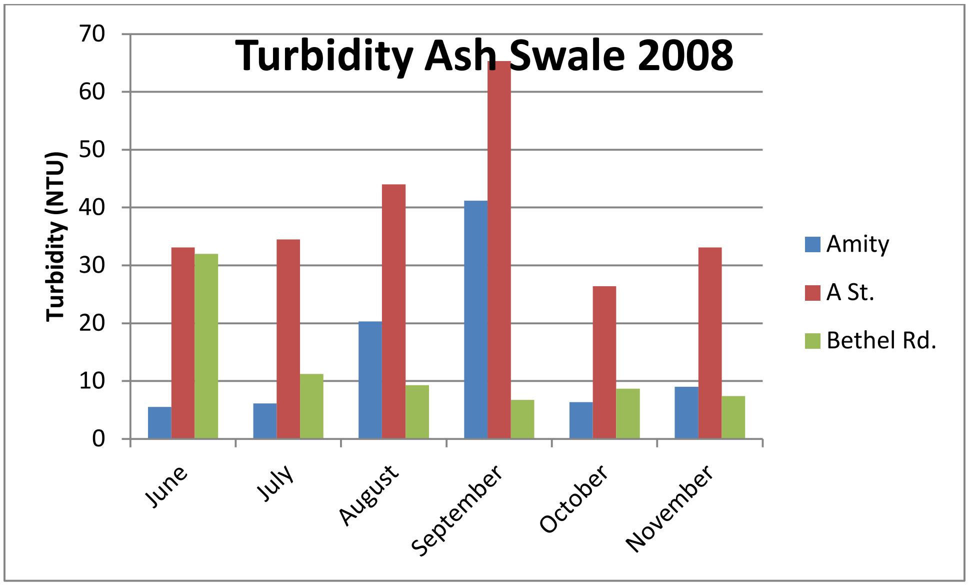
Turbidity

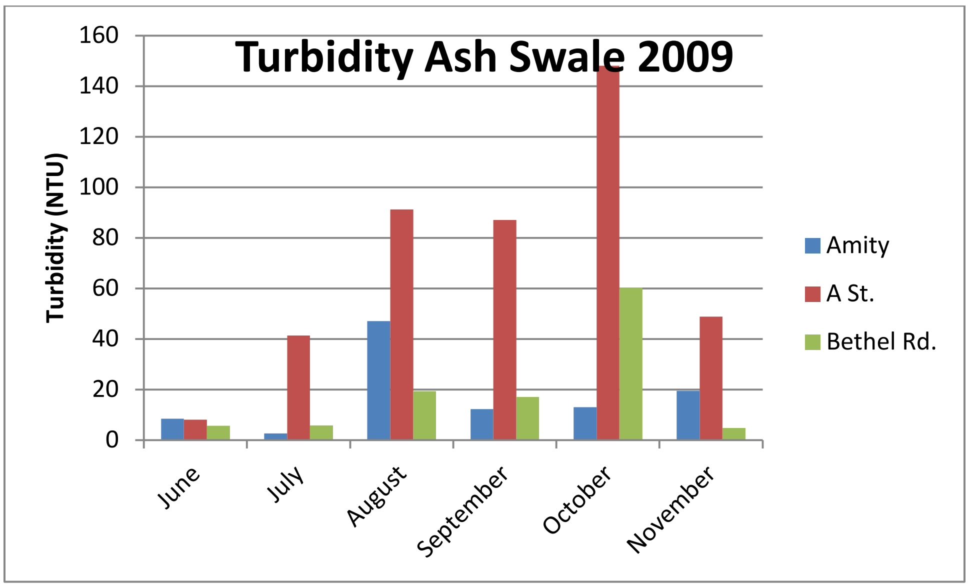
Turbidity on Salt Creek was found to be relatively low throughout the sampling season. Even at site #2 on Broadmead Rd., where the turbidity was the highest both years, the highest values were less than 25 NTUs.



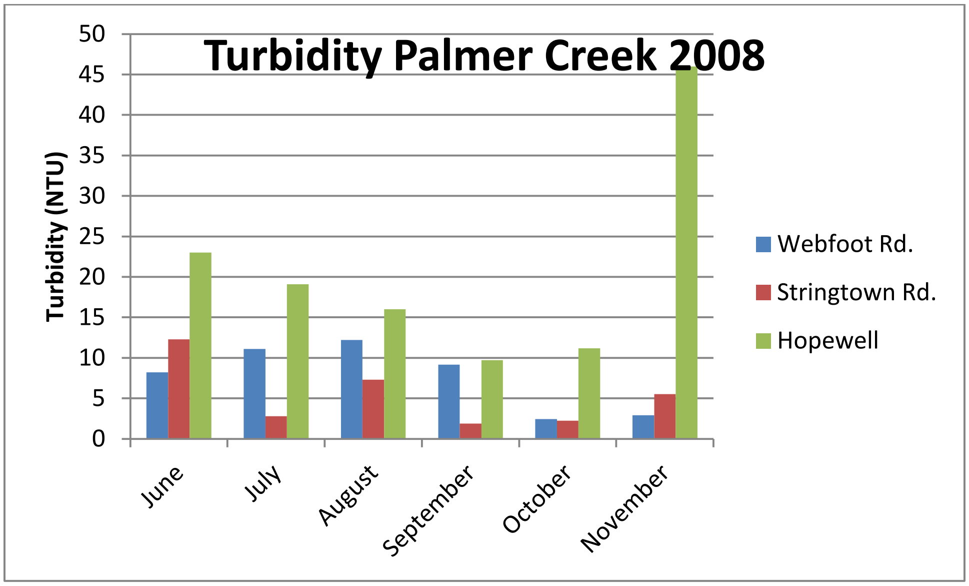


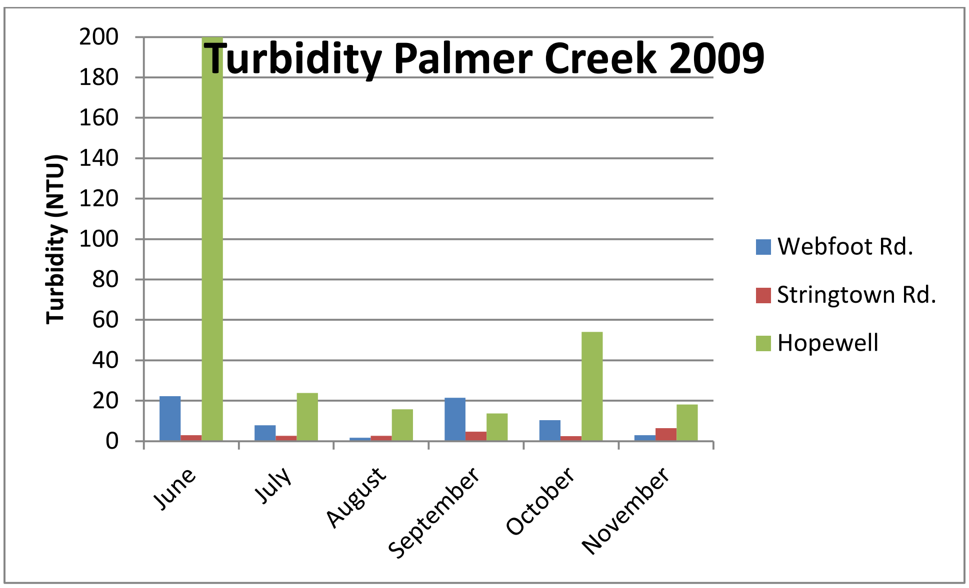
Turbidity on Ash Swale showed some fairly high values, especially site #5 at the A St. location with a high value of 65 NTUs in 2008, and in 2009 twice above 80 NTUs and once at 148 NTUs.



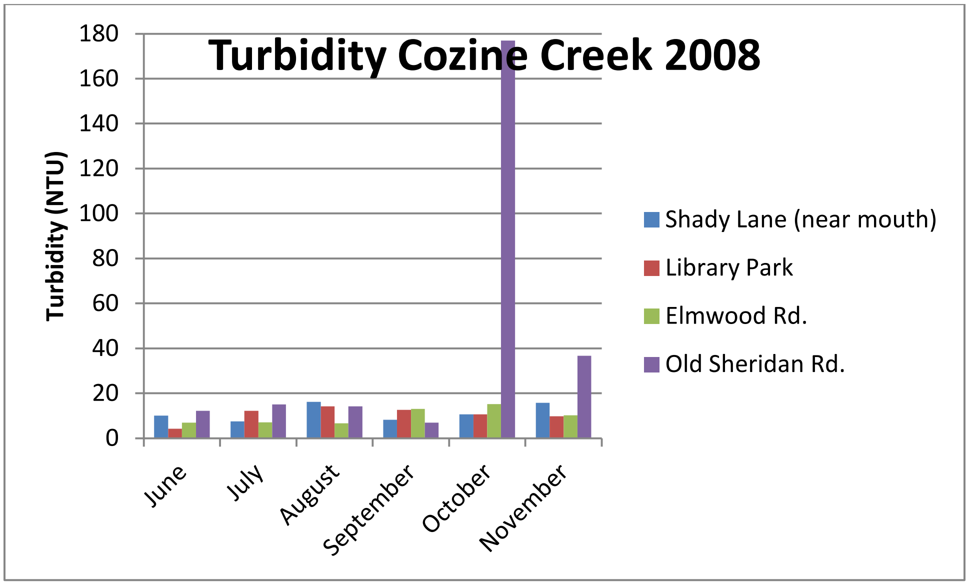


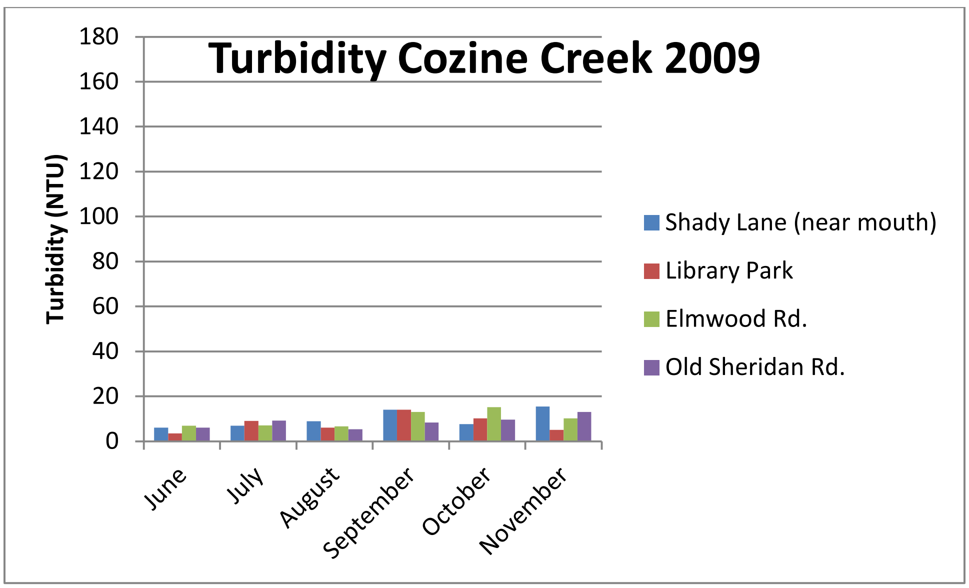
Turbidity on Palmer Creek at site #7 and #8, at Webfoot Rd., and Stringtown Rd., respectively, turbidity was relatively low with highest values 12 NTUs at Stringtown Rd. during 2008 and 22 NTUs at Webfoot Rd. during 2009. Site #9 at Hopewell had consistently higher values, and maximums of 46 NTUs during November of 2008 and an exceedingly high value of 2008 NTUs during June of 2009.





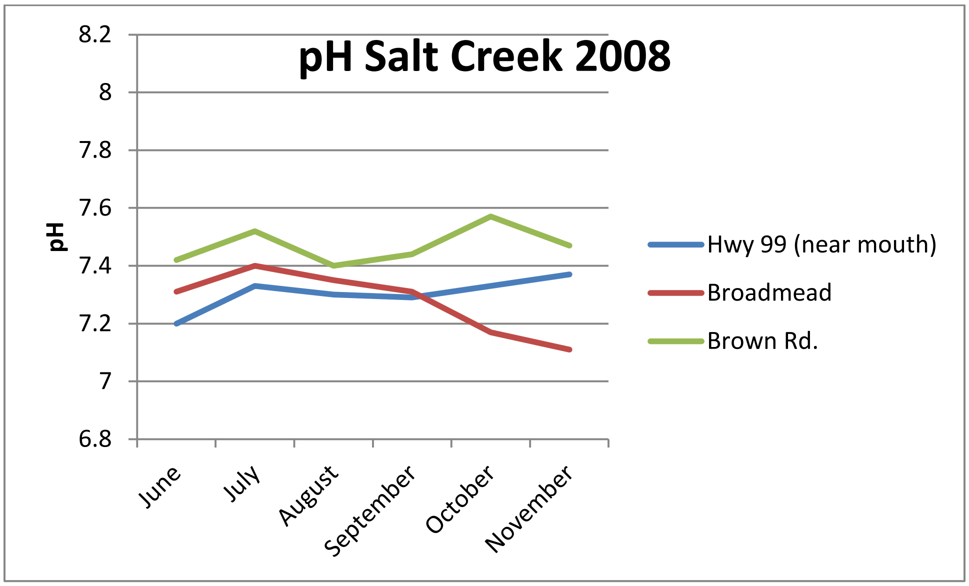
Turbidity on Cozine Creek was consistently relatively low during both years, 2008 and 2009, with maximum values below 16 NTUs at most sites. Site #14 at Old Sheridan Rd. did have a couple peak values of 177 NTU during October of 2008 and and 37 NTU during November of 2008.

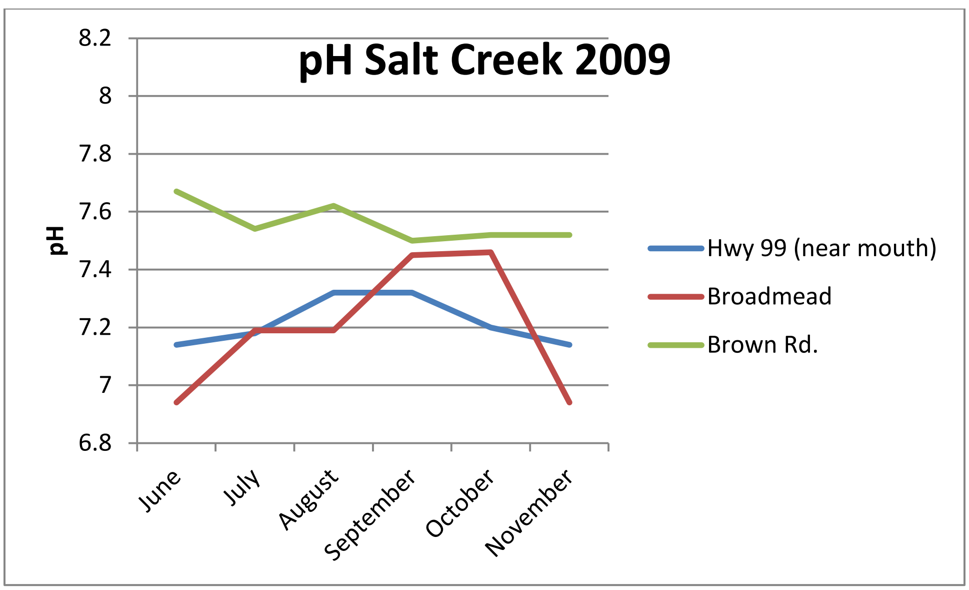


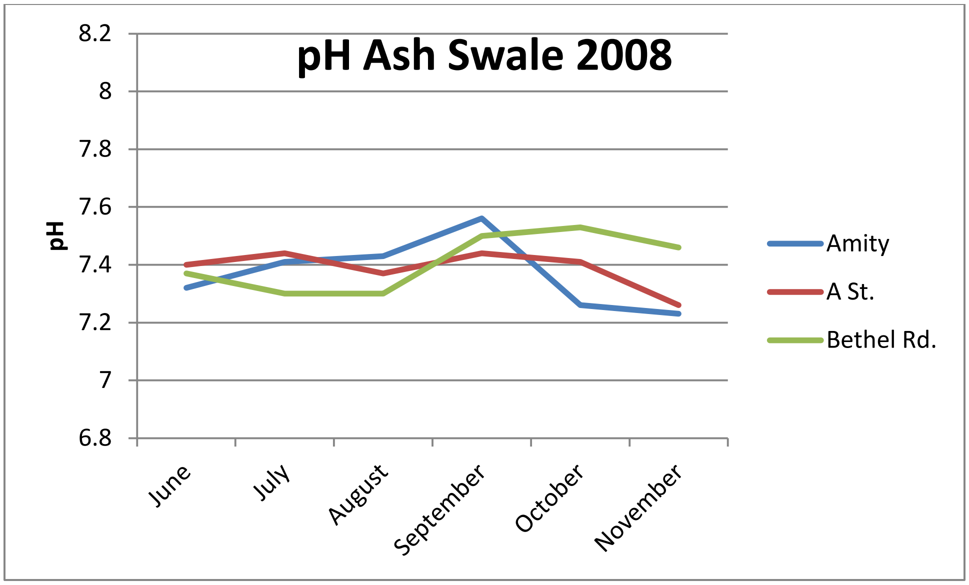


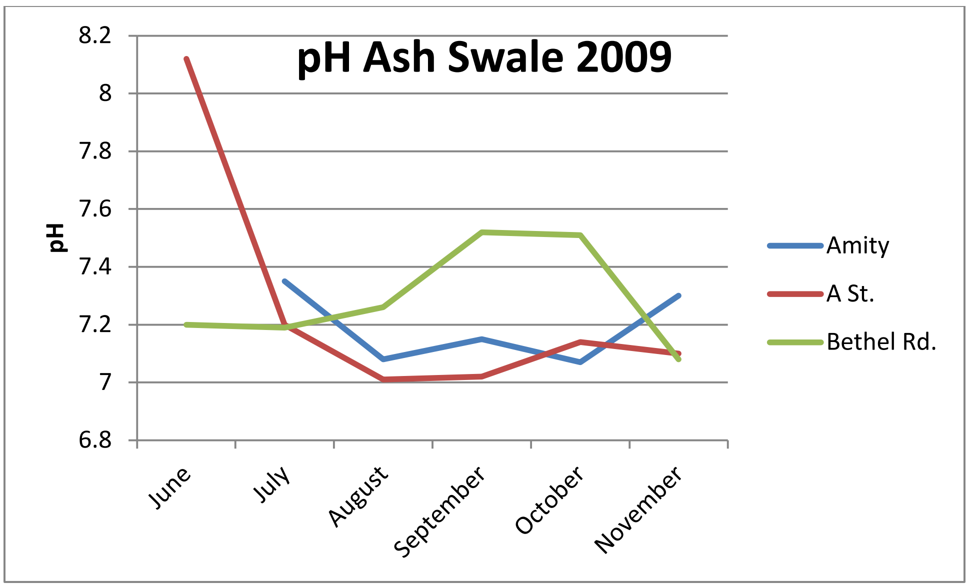
pH

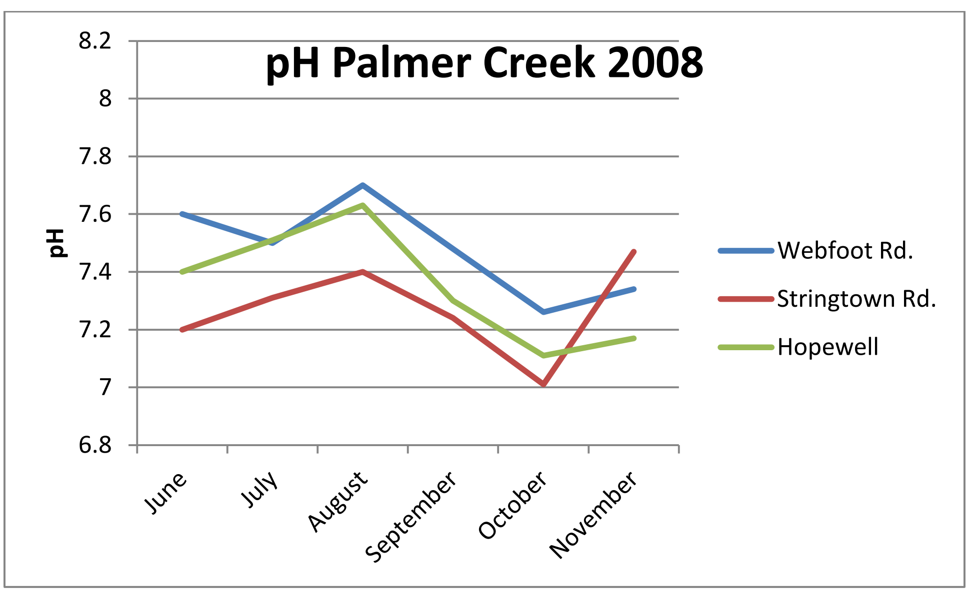
pH at all sites fell within the acceptable standard range of 6.5-8.5. Salt Creek at Broadmead Rd. had relatively low values of 6.9 during June and November of 2009. Ash Swale at A St., Site #5, had a relatively high pH of 8.1 during June of 2008. Stringtown Rd., site #8, on Palmer Creek had some relatively low values of 6.9, 6.9, & 6.8 during June, July, and August of 2008, respectively. On Cozine Creek, a relatively low value of 6.9 was measured at Libraray Park, site #10, in September 2009. At all sites, during 2008 and 2009, all pH values fell between the standard range, with very few measurements coming close to falling outside of that range.

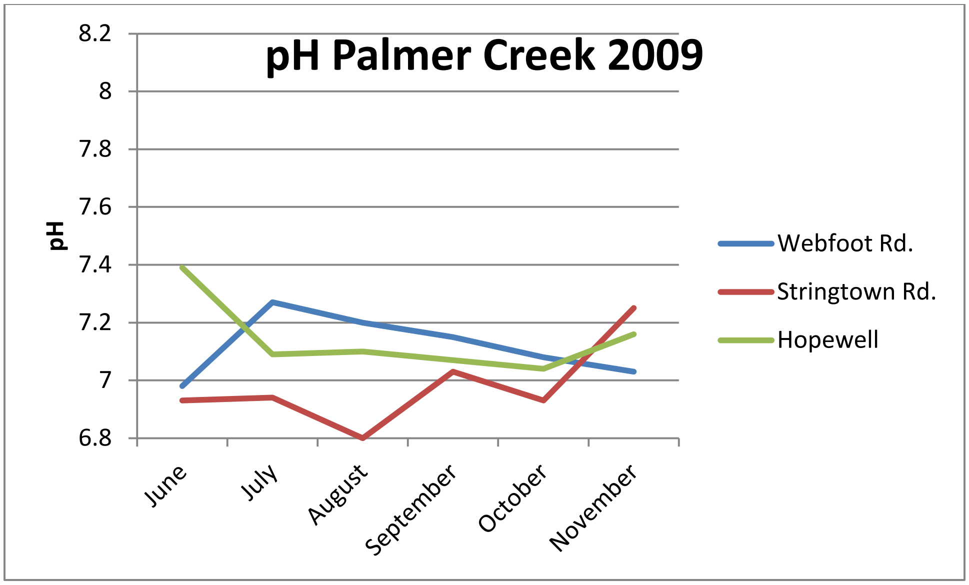


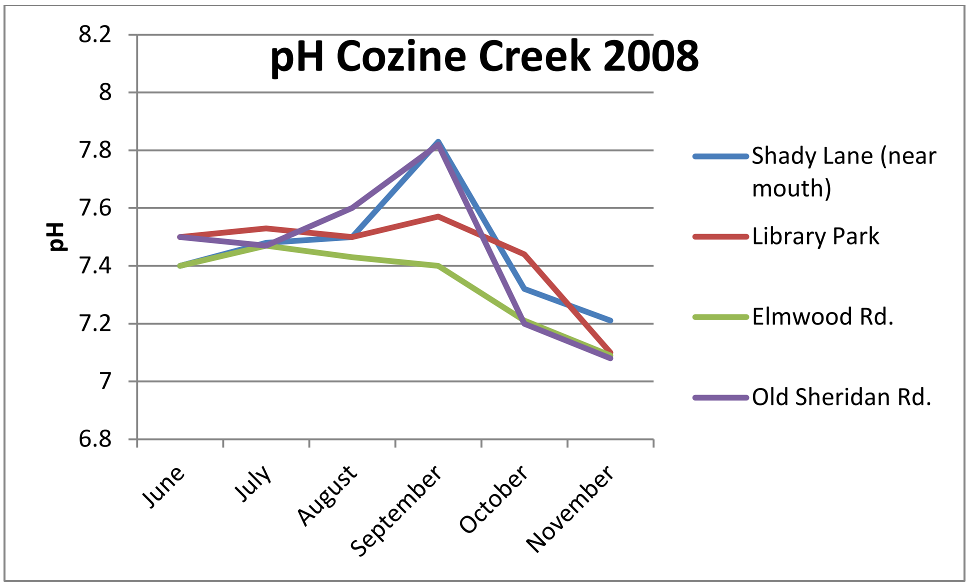


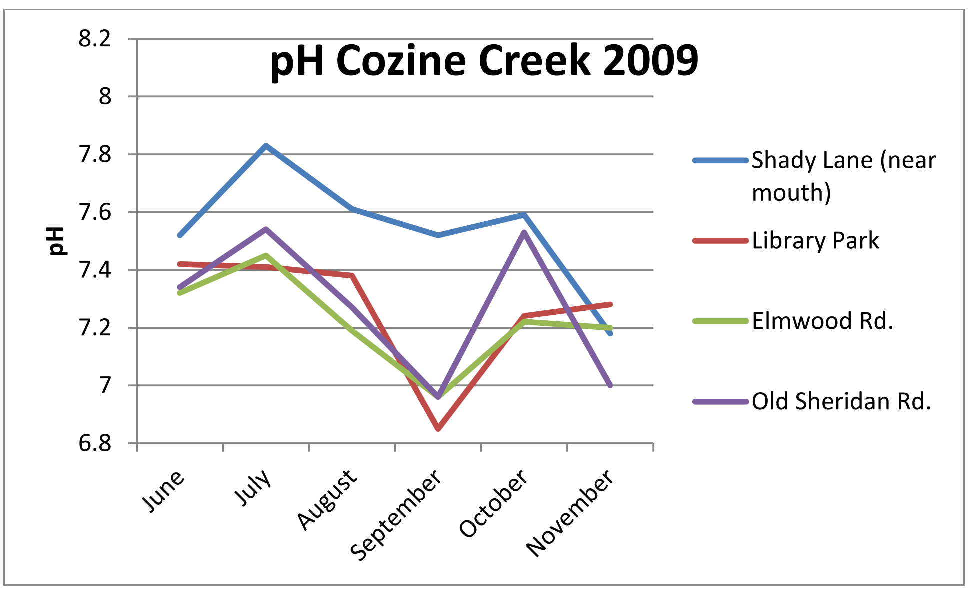

pH Ash Swale 2008
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Amity
A St.
Bethel Rd.


pH Ash Swale 2009
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Amity
A St.
Bethel Rd.


pH Palmer Creek 2008
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Webfoot Rd.
Stringtown Rd.
Hopewell

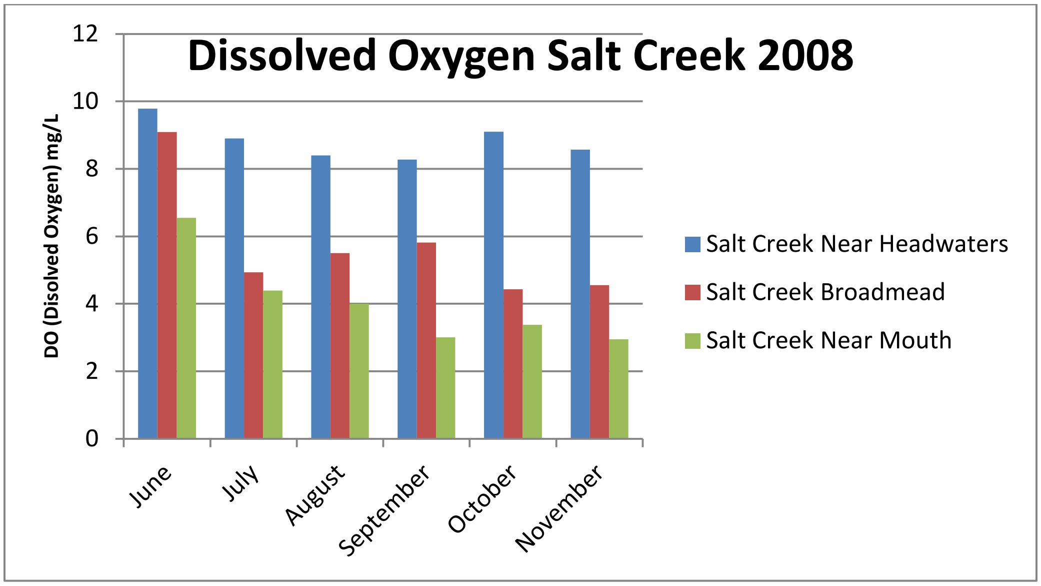

pH Palmer Creek 2009
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Webfoot Rd.
Stringtown Rd.
Hopewell

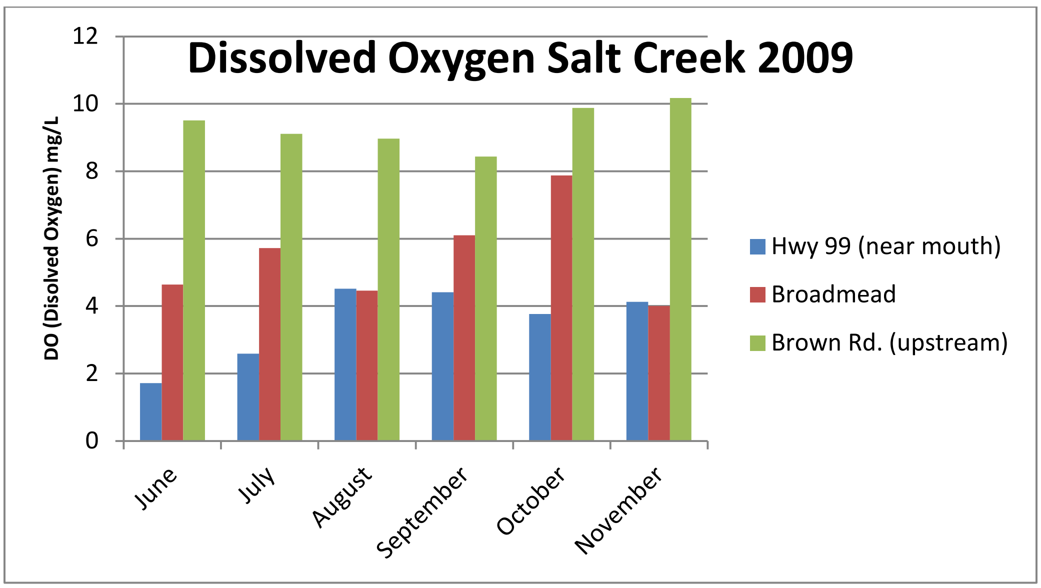

pH Cozine Creek 2008
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Shady Lane (near mouth)
Library Park
Elmwood Rd.
Old Sheridan Rd.


pH Cozine Creek 2009
pH
8.2
8
7.8
7.6
7.4
7.2
7
6.8
June
July
August
September
October
November
Shady Lane (near mouth)
Library Park
Elmwood Rd.
Old Sheridan Rd.

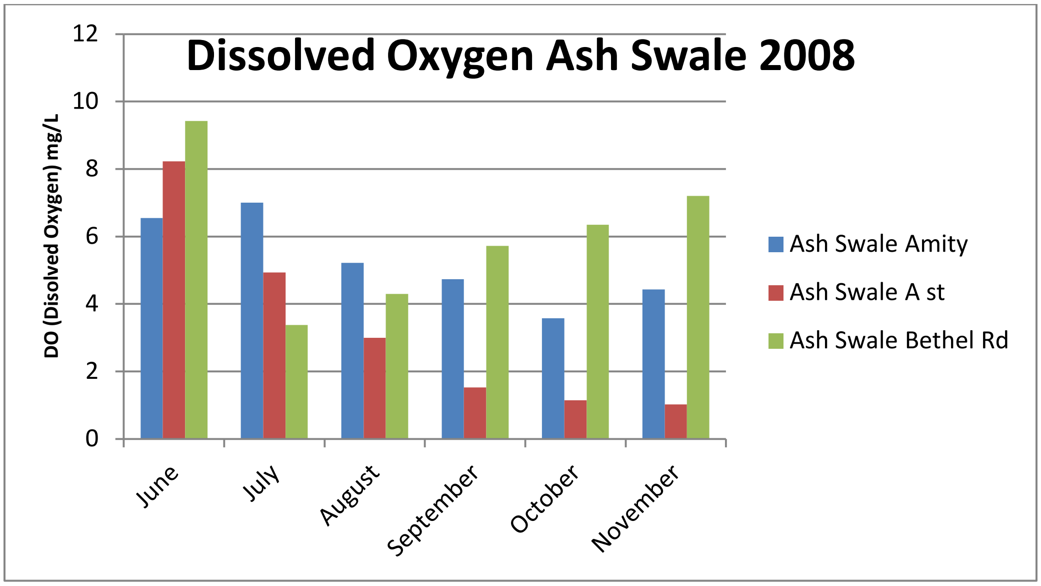
Dissolved Oxygen

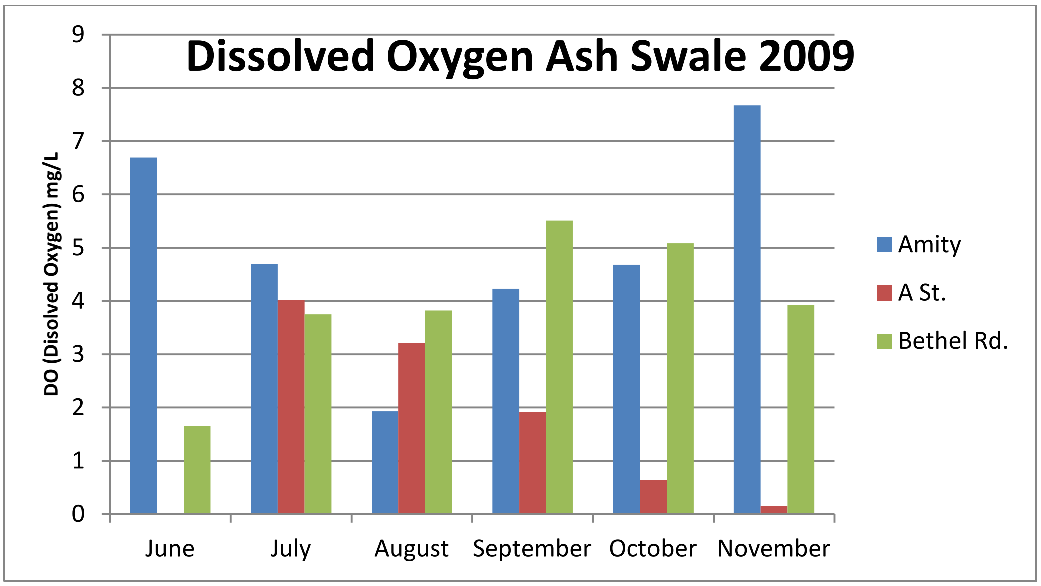
Dissolved oxygen on Salt Creek during both 2008 and 2009 at Salt Creek at site #3 off of Hwy 22 on Brown Rd. had values above the standard of 8 mg/L. Salt Creek at Broadmead Rd, site #2, had one value above the standard during 2008, at 9.1 mg/L during June of 2008 and one value during 2009 of 7.9 during October of 2009. Salt Creek near the mouth at site #1 off of Hwy 99 consistently had low DO values with a maximum of 6.6 mg/L in June of 2008 and a minimum of 1.7 in June of 2008.



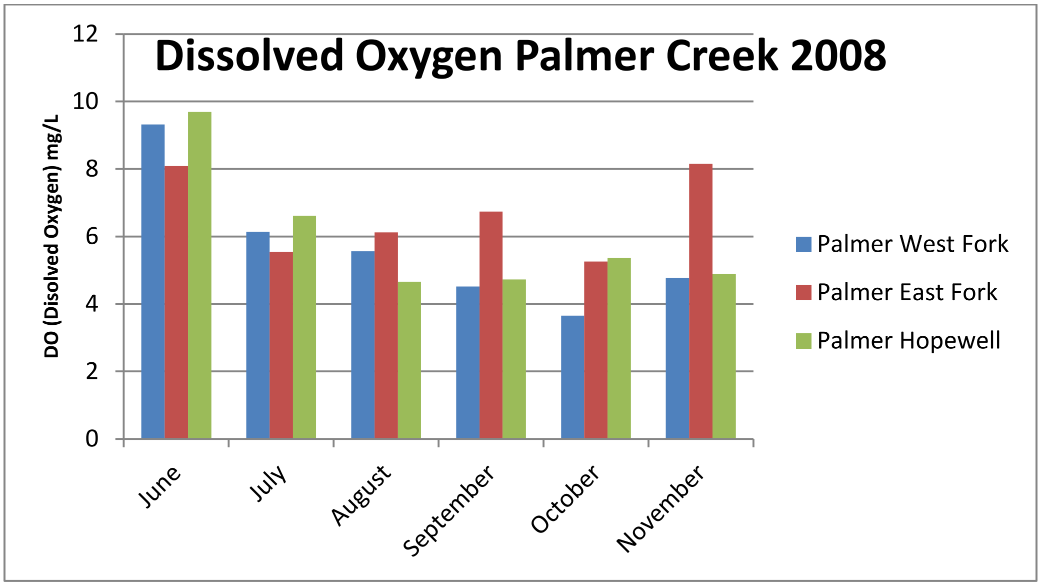


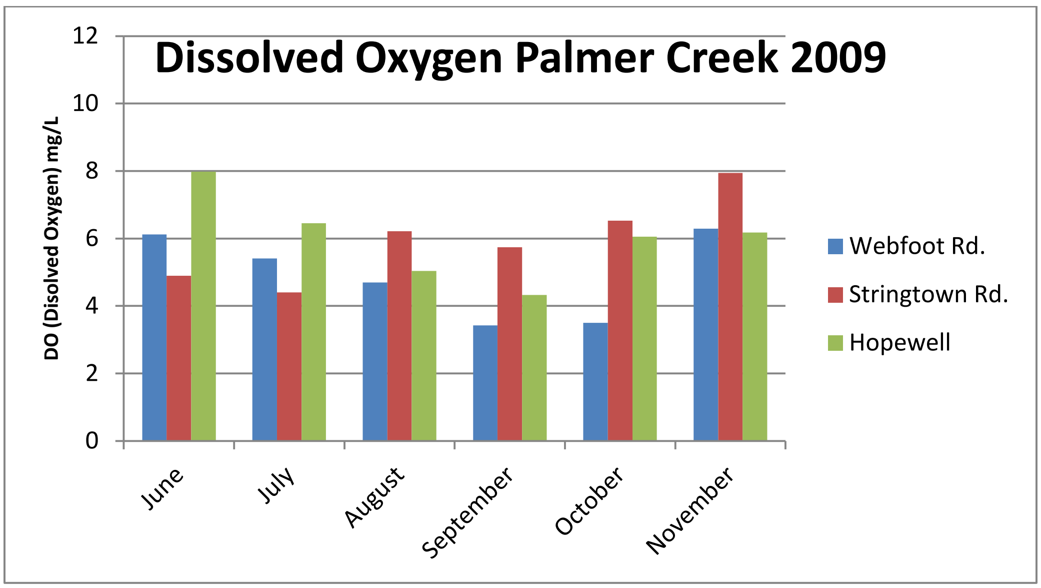
Dissolved oxygen was typically diminished on Ash Swale, with one value above the standard of 8 mg/L at site #6 at Bethel Rd. during June of 2008 at 9.42 mg/L and one value at site #5 at A St. of 8.2 mg/L, also in June of 2008. The lowest values of DO were found at site #5 at A St., with values of 1.0 mg/L and 1.1 mg/L during October and November of 2008, respectively, and .6 mg/L and .1 mg/L in October and November of 2009, respectively.



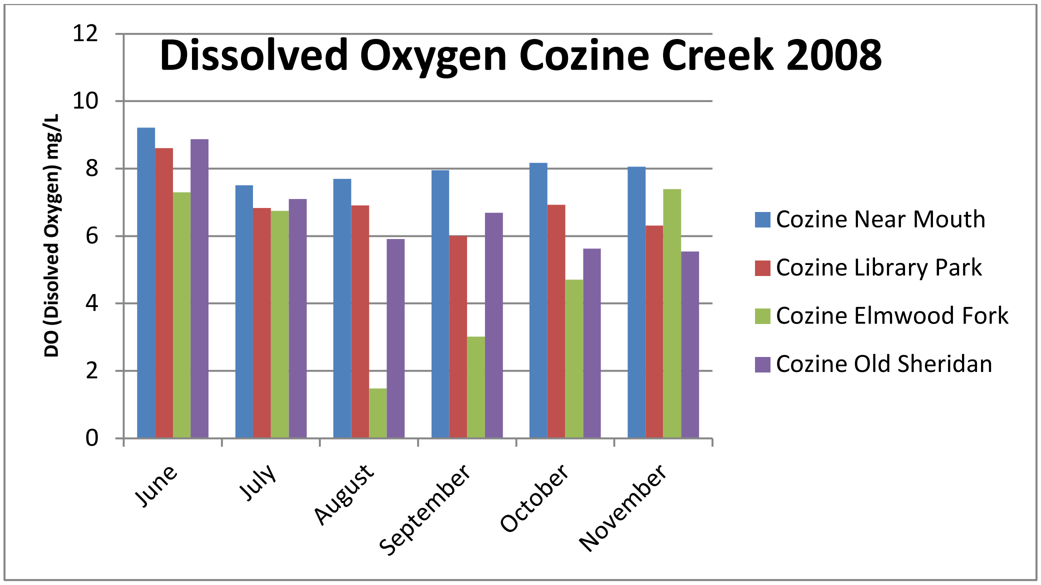


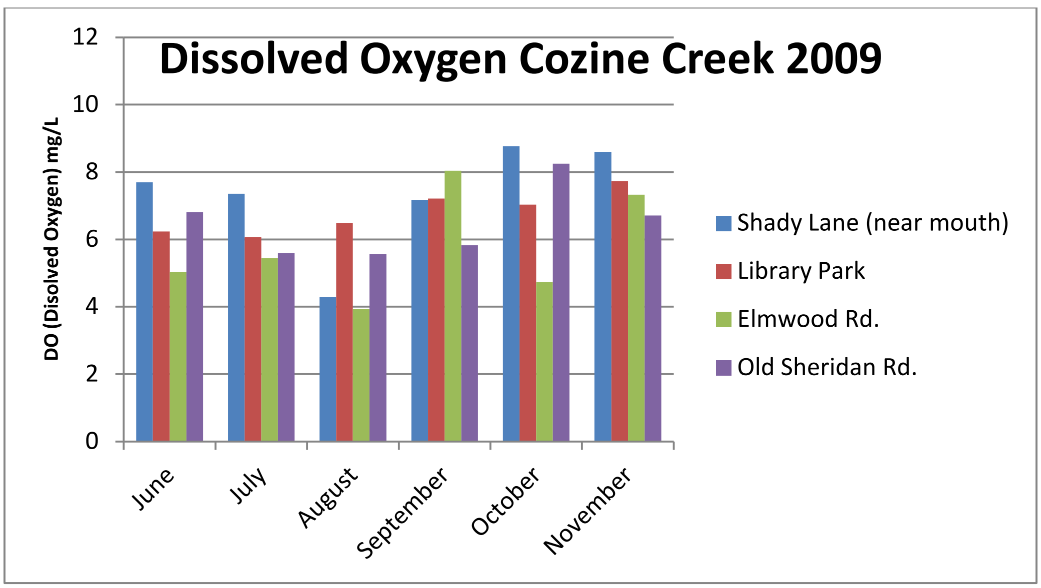
Dissolved oxygen on Palmer Creek met or exceeded the standard of 8 mg/L during both years at all sites during June of 2008 and once at site #8 at Stringtown Rd. (East Fork) during November of 2008. Typically, the lowest values were found at site #7 at Webfoot Rd. with a minimum of 3.7 mg/L during October of 2008 and 3.4 mg/L and 3.5 mg/L during September and October of 2009, respectively.





Dissolved oxygen on Cozine Creek met or exceeded the standard of 8 mg/L during 2008 at site #10 at Library at Shady Lane near the mouth, at site #12 at Library Park and site #14 at Old Sheridan Rd. during June of 2008, and again at site #10 on Shady Lane near the mouth during September, October, and November of 2008, and again at this same site in October and November of 2009. Site #14 at Old Sheridan Rd. again met the standard in October of 2009. The most significantly low values were found at site #13 on Elmwood Rd. (Middle Fork) with minimum valus of 1.5 mg/L during August of 2008 and 3.9 mg/L during August of 2009.

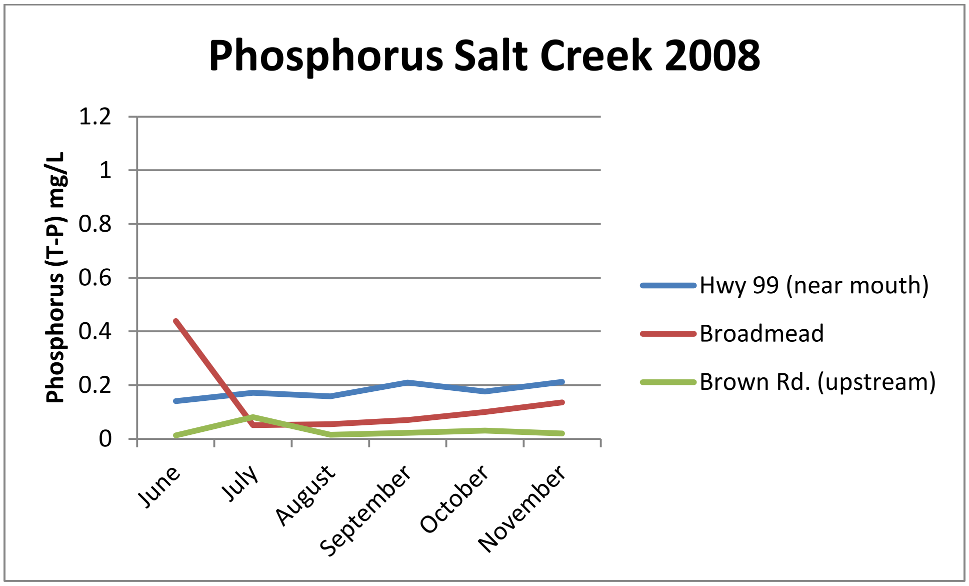


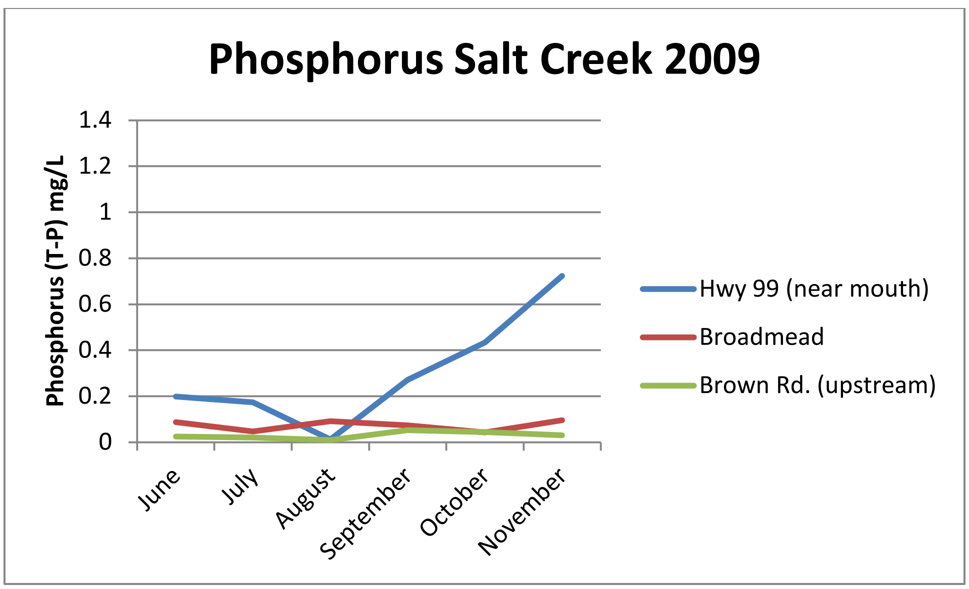


Nutrients – Phosphorus & Ammonia

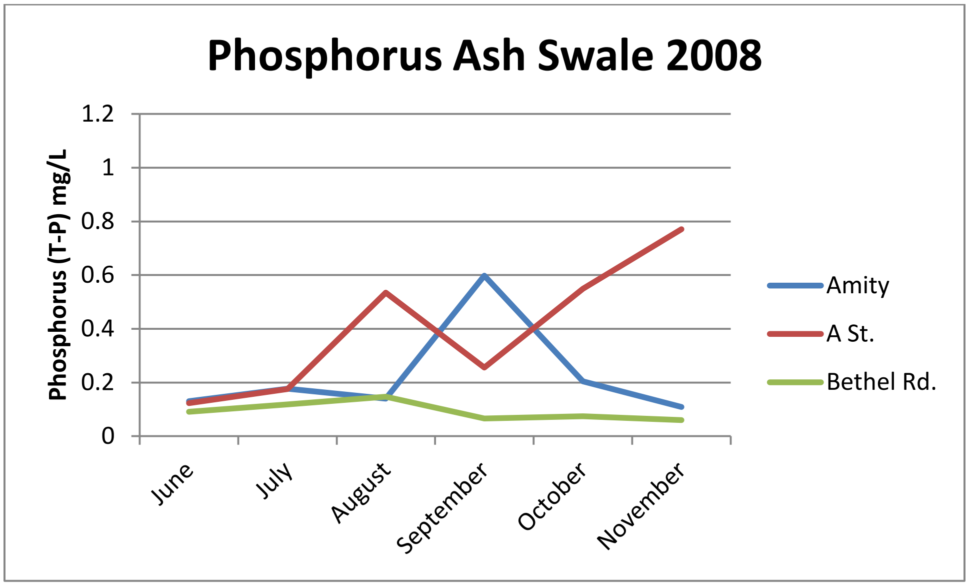
Phosphorus

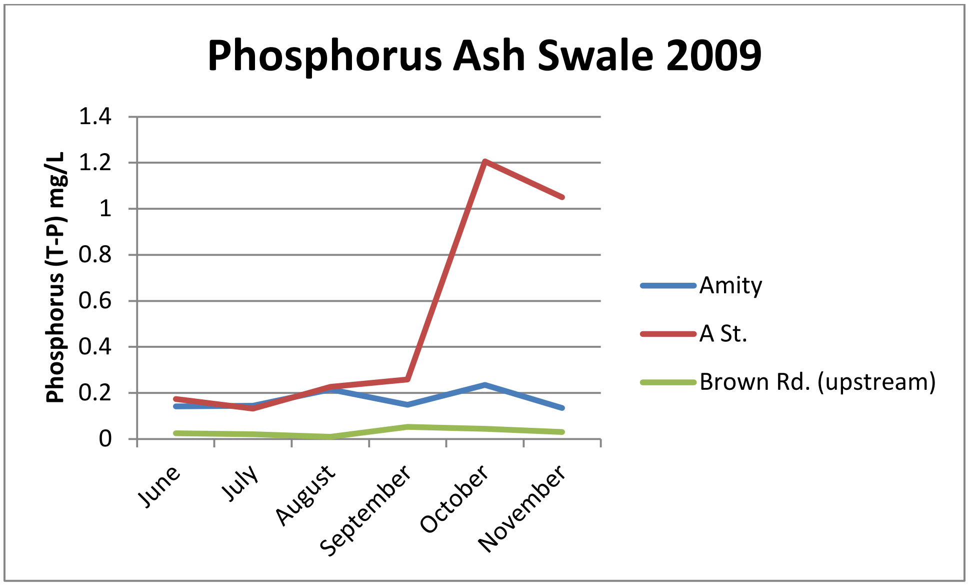
Phosphorus on Salt Creek exceeded the guideline of 0.1 mg/L T-P near the mouth at site #1 throughout most of 2008 and 2009 with maximum values of .21 mg/L during October and November of 2008 and .7 mg/L and .4 mg/L during October and November of 2009. Site #2 at Broadmead Rd. had maximum values of .4 during June of 2008.



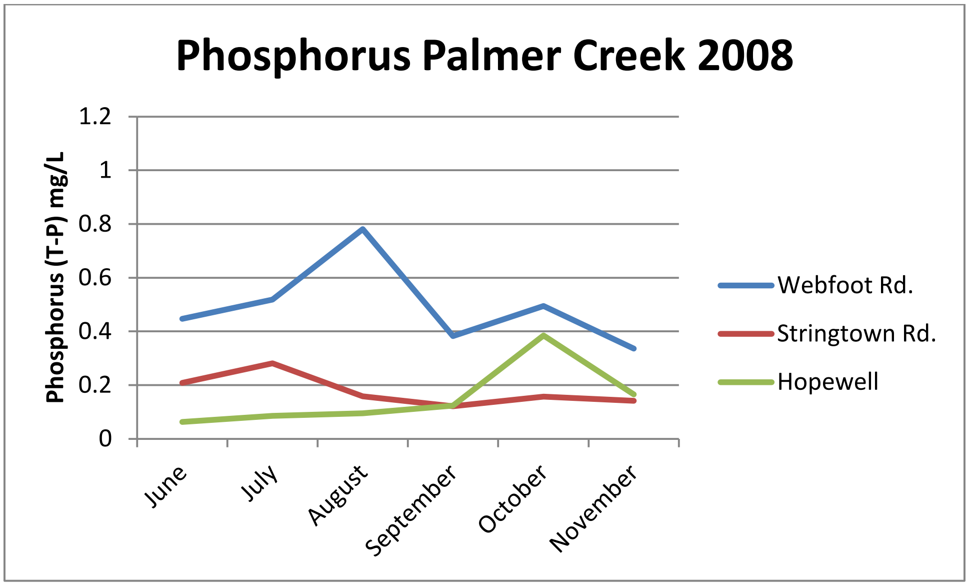


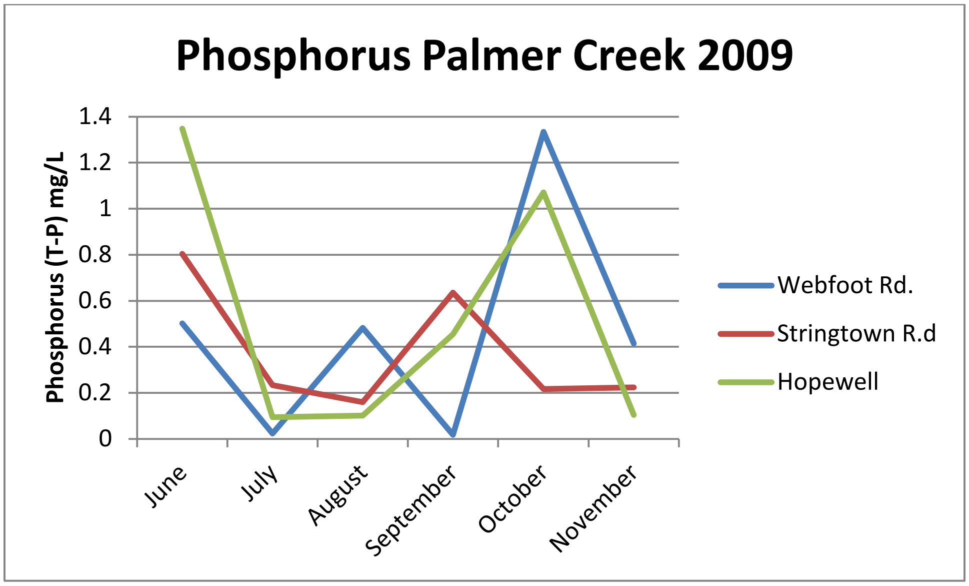
Phosphorus on Ash Swale at site #6 at Bethel Rd. only exceed the guideline of .1 mg/L during August of 2008, but only slightly at .15 mg/L T-P and did not exceed the guideline at all in 2009. Site #4 At Amity fell slightly above the guideline in July and August and peaked at .6 mg/L in August of 2008, dropping off to .2 mg/L and .1 mg/L in October and November of 2008. Values for site #4 fell between .014 mg/L and .23 mg/L during 2009. Site #5 at A St. showed the highest levels of phosphurs with maximums of .5 mg/L and.8 mg/L in August and November of 2008, respectiviely. In 2009, site #5 at A St. had maximums of 1.2 mg/L and 1.05 mg/L in October and November, respectively.



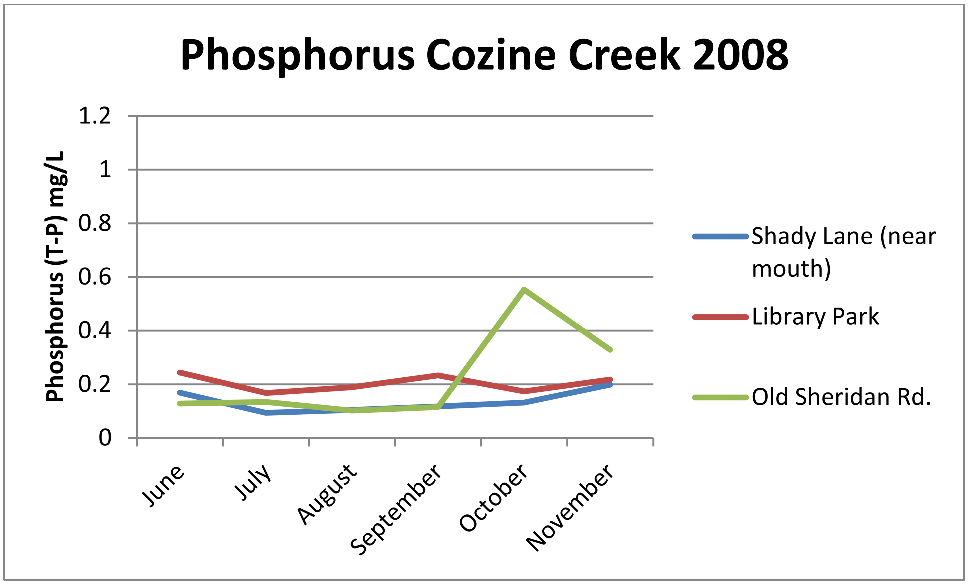


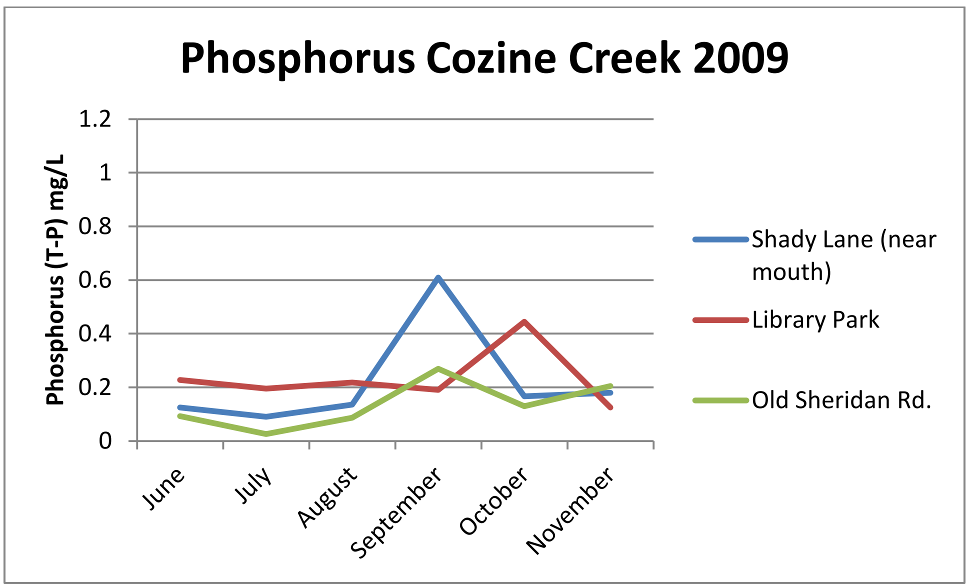
Phosphorus on Palmer Creek showed levels above the guideline of .1 mg/L mostly significantly at site #7 on Webfoot Rd., ranging between .3 mg/L and .8 (August) mg/L in 2008 and .01 mg/L and 1.3 mg/L (October) in 2009. Site #8 at Stringtown Rd. had a maximum value of .28 mg/L in July of 2008 and .8 and .6 mg/L in June and September of 2009, respectively. Site #9 at Hopewell had maximums of .38 mg/L in October of 2008 and 1.3 mg/L and 1.1 mg/L in June and October 2009, respectively.





Phosphorus on Cozine Creek

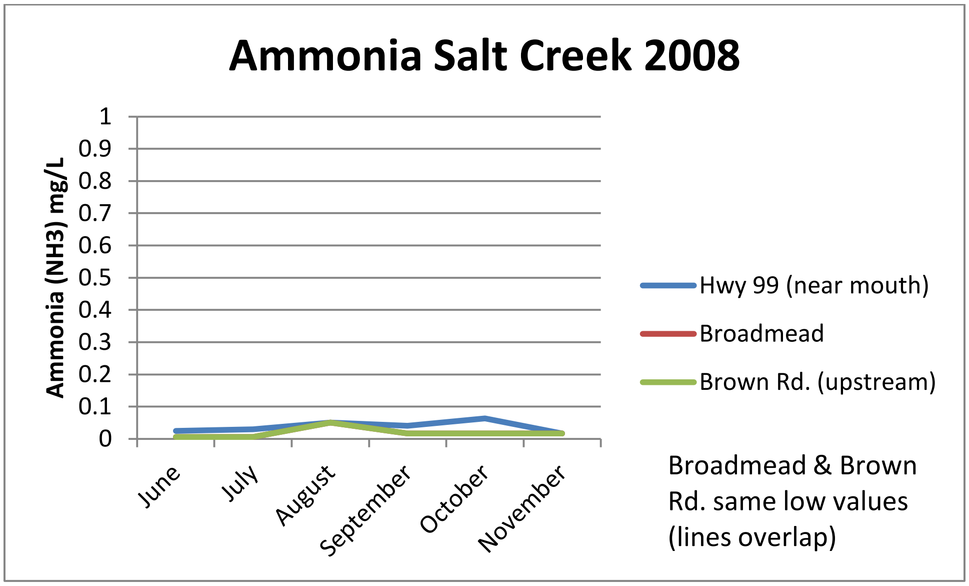


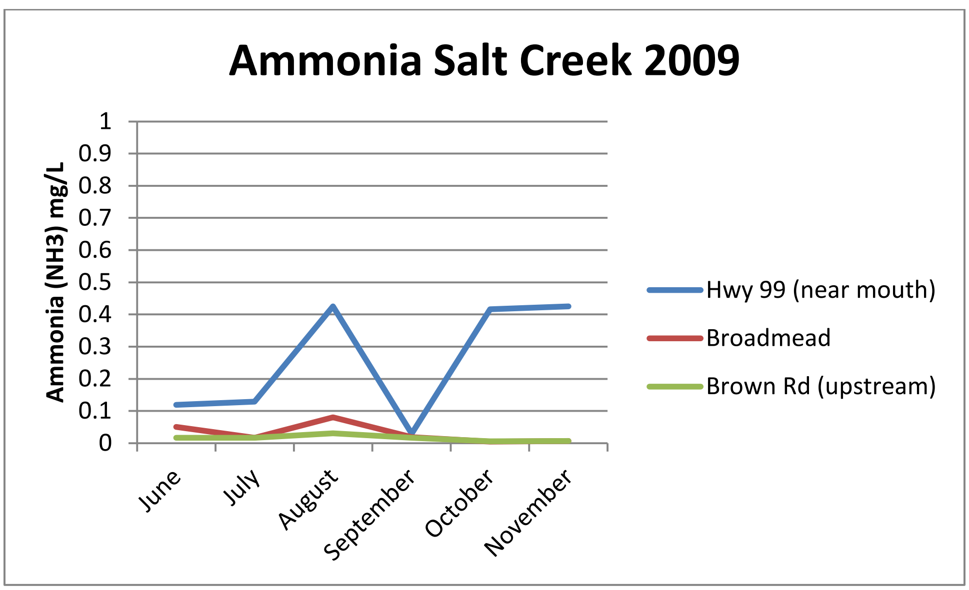


Ammonia

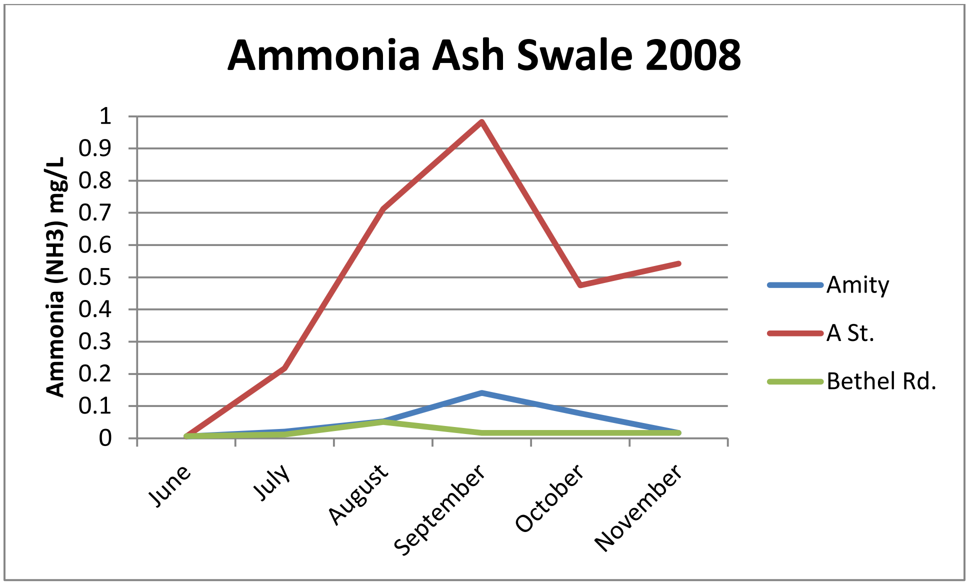
Because there is no specific standard for Ammonia and it is dependent on pH and temperature and typically Ammonia is measured for toxicity in averages over time, for the purposes of this study, findings that appear hight during our snapshot sampling will be emphasized.

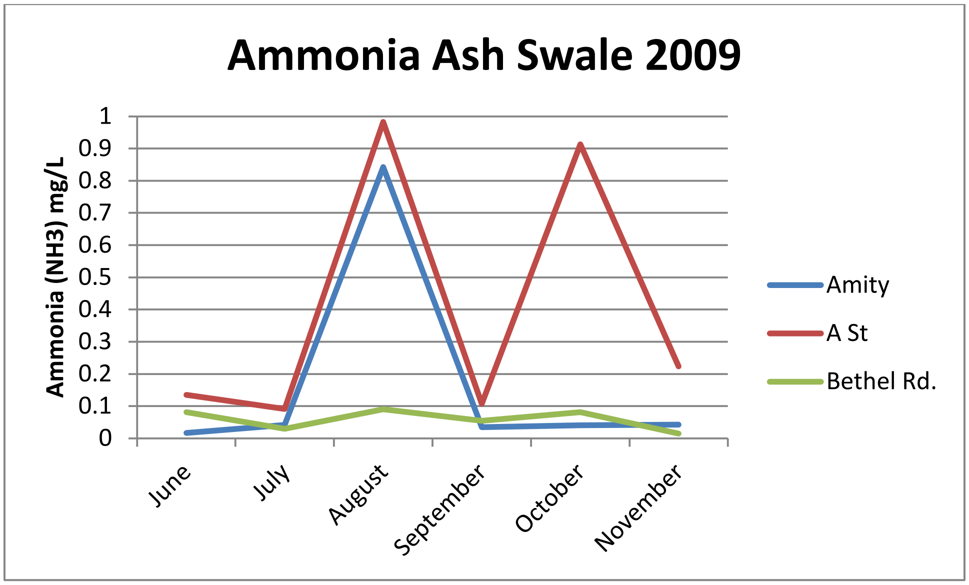
On Salt Creek, there appeared to be peaks in ammonia on Salt Creek at site #1 on Hwy 99 above .4 mg/L in August, October and November of 2009.



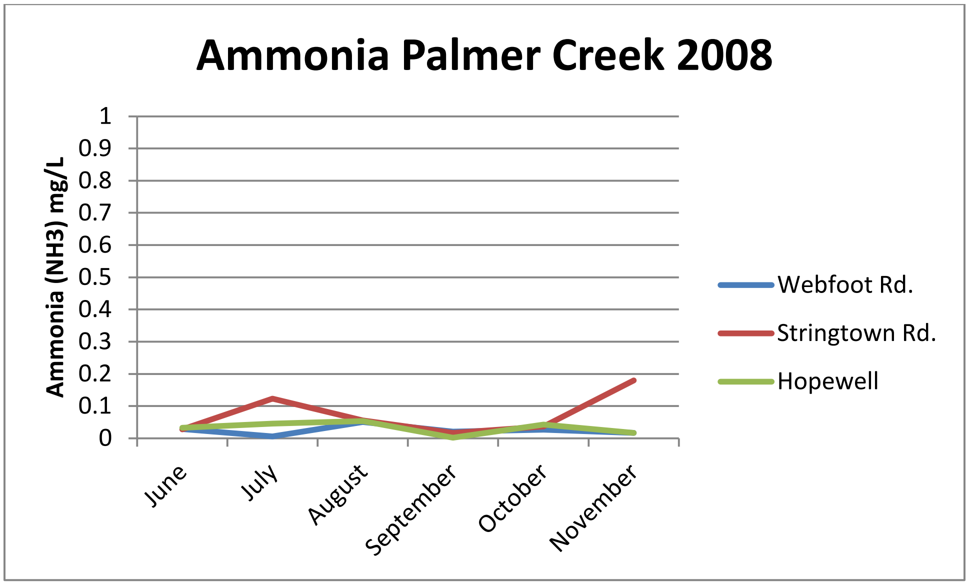


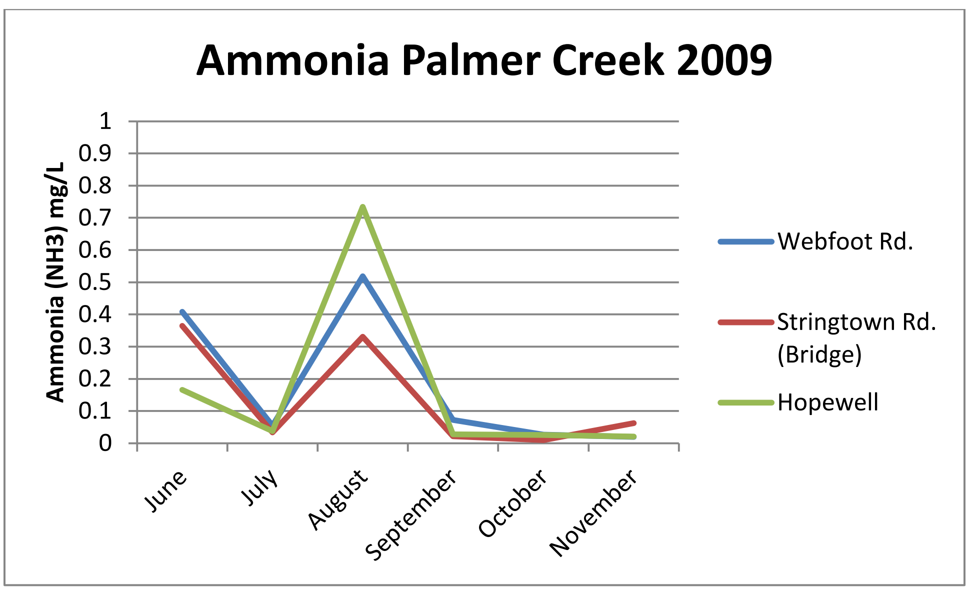
Ammonia on Ash Swale was most significant at the A St. Site, #5, with a range of .2 mg/L - .98 mg/L, peaking in September of 2008. At site #4 and #5, maximum values of .84 mg/L and .98 mg/L were found in August of 2009, and .91 mg/L at site #5 again in October of 2009.



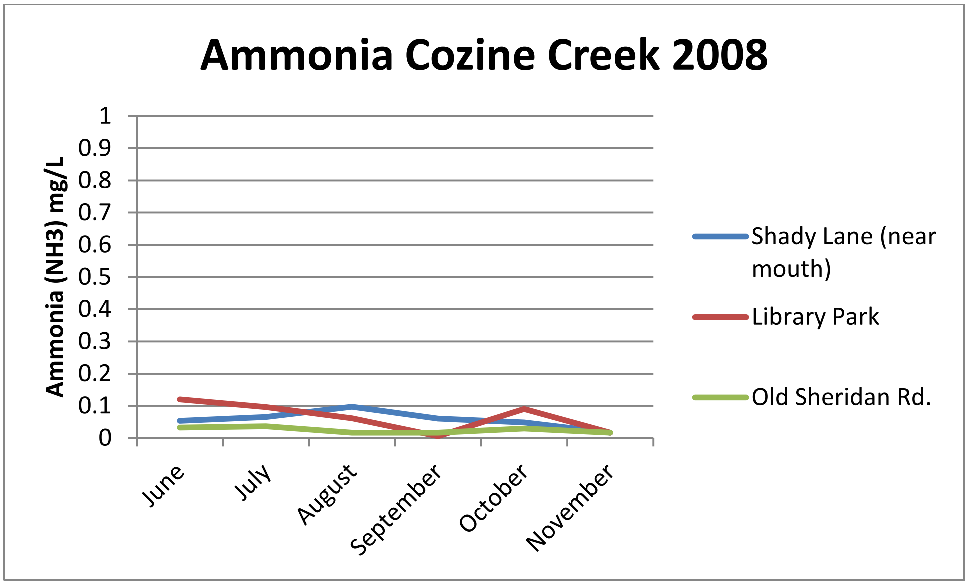


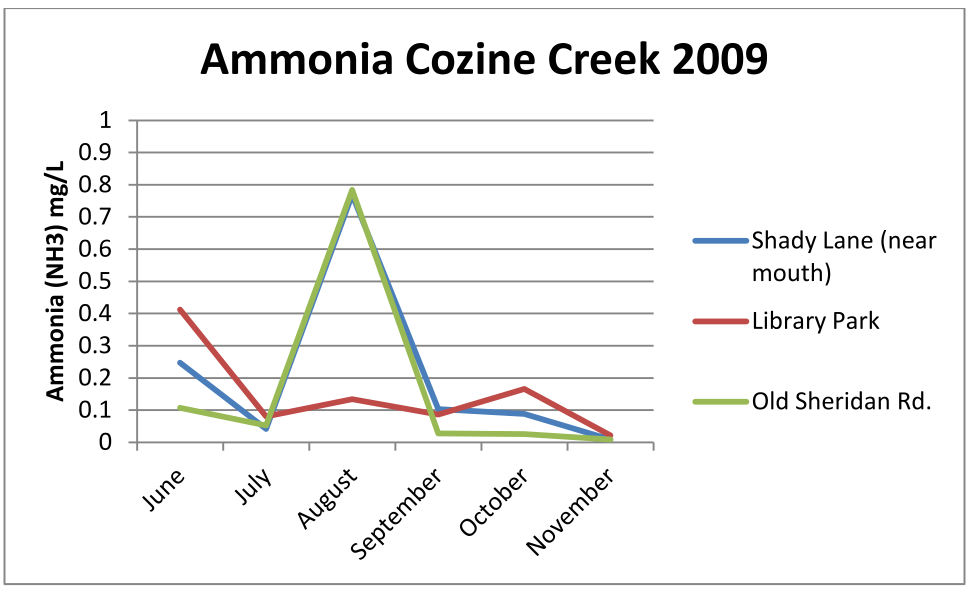
Ammonia on Palmer Creek had a maximum value of .73 at site #9 at Hopewell in August of 2009 as did the downstream sites #7 at Webfoot Rd. and #8 at Stringtown Rd. in 2009 with values of .33 mg/L and .52 mg/L, respectively





Ammonia levels on Cozine Creek were typically at .1 mg/L or below during 2008. In 2009, ammonia level maximums were at .8 mg/L in August at both site #10 near the mouth on Shady Lane and site #14 on Old Sheridan Rd.





E. coli

The DEQ standard for E. coli 126 cells/100mL. This is measured by taking the geomean (average) of 5 samples taken over a period of 30 days, for statistical significance. See Table 3 for results of all sites with value at sites that exceeded standard in bold.

None of the sites on Salt Creek exceeded the standard during 2008 or 2009.

All sites on Ash Swale exceeded the state standard in 2008, significantly on Ash Swale at A St. (site #5). Ash Swale at Amity (site #4) was high at 845 cells/100mL, but returned to a low level during 2008 with a result of 30 cell/100 mL.

On Palmer Creek, the only site that exceeded the standard both years was at site #7 on Webfoot Rd.

E. coli on Cozine Creek exceeded the standards at all 5 sites in 2008 and at 4 of the 5 sites in 2009. In 2009, the only site that fell below the state recommended standard of 126 cells/mL was at site #14 at Old Sheridan Rd.

The most publicly accessible of these sites was site #12 at Library Park in McMinnville, Oregon. It also had the highest average (geomean) levels of E. coli at 1390 cells/mL in 2008 and 1613 cells/mL in 2009.

Because of the public accessibility to this site and because of the significantly high values found at this site, as well as the other sites on Cozine Creek, which runs through the city of McMinnville, the council, in conjunction with the City of Mcminnville’s Water Reclamation Facility, decided to report findings earlier than anticipated to County Commissioners and the Yamhill County Public Health Department.

A press release was written and the media and public were informed of the high levels of E. coli on Cozine Creek during the month of September, 2008 (see appendix A). Signs were posted at all 5 sites by the City of McMinnville Public Works Department indicating caution to the public with a warning that high levels of bacteria may be present. The signs remained in 2008 and 2009.

Panther Creek E. coli monitoring showed the only site of the four sites tested for E. coli that did not meet E. coli standards was site #15 below Kane Creek which had values of 358 cell/mL and 406 cell/mL, respectively, during 2008 and 2009. This was the uppermost site in our 2005-2006 E. coli study, which also had the highest values, so this study was aimed at studying at this site and above to try to determine the general source of contamination.

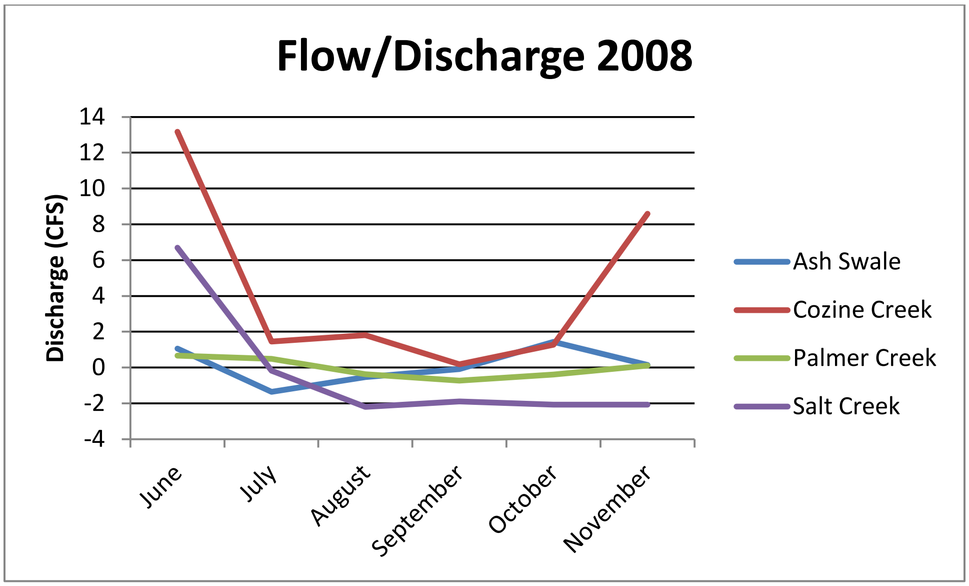
Table 3. E. coli Results 2008-2009 (values that exceeded standard are in **bold)**

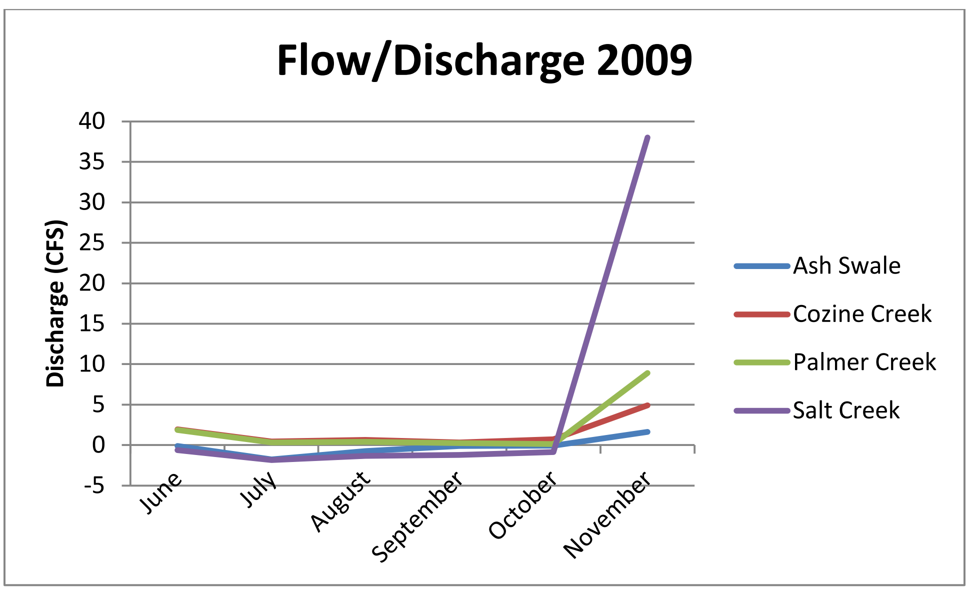
Site No./ID	2008 E. coli Geomean (>126 Cell/100 mL exceeds Standard)	2009 E. coli Geomean (>126 Cell/100 mL exceeds Standard)
1. Salt Creek Hwy 99	7	45
2. Salt Creek Broadmead Rd.	42	62
3. Salt Creek Brown Rd	16	22
4. Ash Swale Amity	**845**	30
5. Ash Swale A St.	**2420**	**615**
6. Ash Swale Bethel Rd.	**136**	**905**
7. Palmer Creek Webfoot Rd.	**224**	**177**
8. Palmer Creek Stringtown Rd.	50	46
9. Palmer Creek Hopewell	37	74
10. Cozine Creek Shady Lane	**559**	**754**
11. Cozine Creek Davis St. Bridge	**217**	**186**
12. Cozine Creek Library Park	**1390**	**1613**
13. Cozine Creek Elmwood	**424**	**739**
14. Cozine Creek Old Sheridan Rd.	**375**	68
15. Panther Creek Site #15 below Kane Creek	**358**	**406**
16. Panther Creek Site #16 above Kane Creek	39	99
17. Panther Creek	51	81
18. Panther Creek	25	43

Flow/Stream Discharge

Flow during 2008 was extremely low at most sites. Salt Creek had a positive flow during June of 2008 but remained stagnant the reminder of 2008. Ash Swale had very minimal flow throughout 2008 and was stagnant most of the summer with minimal flow in October of 2008. Palmer Creek had very small discharge of 0.67 CFS in June, .478 CFS in July, and 0.1 CFS in November 2008. Cozine Creek was the only Creek to have a positive flow throughout the summer months, with a maximum of 13 CFS in June of 2008 and a minimum of .17 CFS in September of 2008.

Flow during 2009 was slower and more stagnant than in 2008. Salt Creek had one positive flow during November at 38 CFS, which was a significant jump from being stagnant from June through October. Ash Swale was stagnant (no flow) until November, with a flow of 1.6 CFS. Palmer Creek had minimal flow, but positive, throughout the year with a maximum of 8.9 CFS in November and a minimum of .13 CFS in October. Cozine Creek, again was the only stream that continued to maintain positive discharge throughout the summer months, with a maximum of 4.9 CFS in November and a minimum of .34 CFS in September.





Chapter 4 – Conclusion and Recommendations

Conclusion with Recommendations

The data collected during the 2007-2008 E. coli and Lower Yamhill Basin Water Quality Monitoring Project provided the Greater Yamhill Basin Council with new and follow-up information as to the quality of the streams in the Lower Yamhill River Subwatershed, on Cozine Creek in the City of McMinnville, and Panther Creek in the North Yamhill Subwatershed.

This was a snapshot monitoring project, with monthly grab samples taken and yearly E. coli sampling done at each site. The results can be used as a general indicator or water quality at the sites sampled, and can be used as a valuable tool for future monitoring or restoration projects, and to encourage discussion amongst the community, landowners, and stakeholders.

Below is a summary of the significant findings summarized by creek (see charts and graphs in Chapter 3 for visual representation of:

Salt Creek:

- Turbidity on Salt Creek was consistently fairly low at all sites
- Salt Creek met the E. coli state standard both years at all three sites
- Dissolved oxygen met the state standard both years at the uppermost site on Salt Creek at Brown Rd. off of Hwy 22
- Dissolved Oxygen was consistently low on Salt Creek near mouth during summer months
- Most significant Phosphorus levels were found on salt creek near mouth (.4 mg/L and .7 mg/L) during 2009. This site had significant duckweed growth during the summer of 2009
- Salt creek had relatively higher values of Ammonia during three sampling events in 2009

Recommendations: Follow up with landowner at Salt Creek at Hwy 99 near the mouth, at least with photo monitoring, for duckweed over-population. Perhaps have a more comprehensive statistically valid nutrient study at this site to determine if nutrient loading is a consistent problem.

Ash Swale

- Conductivity was exceedingly high on Ash Swale at A St. during 2009 (site #5) with values over 1400 mhos
- There were high levels of turbidity on ash swale, especially at site #5 at A St.
- Ash swale had low dissolved levels dissolved oxygen, which were significantly diminished in October and November of 2008 and 2009 at A St. (site #5)
- Ammonia levels at site #5 had relatively elevated values in 2008 & 2009
- Site #4, in Amity had one value in 2009 which was relatively high value In 2009
- Extremely high phosphorus at A St.
- Site #6 at Bethel Rd. had relatively low phosphorus levels
- Site #4 at Amity had some peak levels of phosphorus during mid summer of 2008
- Site #4 at Amity exceeded state standards for E. coli fairly significantly in 2008 and dropped significantly in 2009 (significantly lower than the state standard) 2009

- Ash Swale at site #5 at A St. exceeded standards for E. coli both years, and significantly in 2008
- Ash Swale at site #6 at Bethel Rd. exceeded standard for E. coli significantly in 2009

Recommendations: Consider Ash Swale a priority area to further study and investigate for possible causes of E. coli contamination and nutrient loading. Present findings in Amity to better inform the community of issues on Ash Swale site in the City of Amity.

Palmer Creek

- Conductivity was consistently high on Palmer Creek at Webfoot Rd. (site #7) during both years
- June of 2009 a value of 2008 NTU was measured on Palmer at Hopewell. Reported to SWCD. ODA visited landowner to resolve tree farm drainage problem. July 2009 value decreased significantly
- Low dissolved oxygen values on palmer creek, especially at Webfoot Rd.
- Palmer creek has some significant phosphorus levels
- Webfoot Rd. (site #7) exceeded E. coli both years, although not significantly high

Recommendations: Consider Webfoot Rd. a priority site to further study, with elevated conductivity, E. coli, phosphorus, and decreased dissolved oxygen. Keep an eye on Palmer Creek at Hopewell.

Cozine Creek

- High conductivity on Cozine Creek near the mouth
- Turbidity high on Cozine during October 2008. Perhaps construction or other unknown disturbance to riparian area
- Cozine Creek at Elmwood Rd (Site #13) has low dissolved oxygen values, especially in August of both years.
- Cozine Creek at Shady Ln (Site #10) the mouth consistently had the highest dissolved oxygen values, probably due to flow and slope/drainage
- In August of 2009 the site on Old Sheridan Rd. (site #14) and Library Park site (#12) had levels of Ammonia at 0.8 mg/L (relatively high as compared to 2008 values of ~0.1 mg/L at all sites in 2008)
- On Cozine Creek, all sites were above the E. coli state standard in 2008, and all but one site (Old Sheridan) in 2009. Caution signs were posted at all sites in 2008. The City did repairs and removed signs in summer of 2010

Recommendations: Use the E. coli findings and repairs/corrections as an example of success in monitoring and creating and building partnerships! A big thanks to the Water Reclamation Facility for their pro-active response.

Panther Creek

- Only one of the four sites sampled, the lower site (#15), measured E. coli levels above the state standard. This was the uppermost site in our 2005-2006 study which had the highest levels of E. coli. In this current study, we were attempting to try to locate the source of E. coli contamination so we chose site #15 and sites above this site to try to narrow down the general contamination area

Recommendations: Now that we have possibly narrowed the contamination problem on Panther Creek to the area around site #15 below Kane Creek, follow- up with nearby landowners and inform them of the problem. Perhaps consider following up with another further E. coli bracketed study of this smaller area.

More general conclusions from data results include:

- pH for all sites fell within the range with some minor outliers. pH may be used for further analysis of ammonia at sites where there is concern or interest in following up. Due to ammonia being temperature and pH dependent
- There was consistently very little, and even at times backflow, at all sites except on Cozine Creek, which while water levels and flow slowed, discharge remained positive throughout both years.

This project was a success with a significant match in donated equipment, services, and volunteer time. Thirty-three volunteers from the community and council, and several technical support partners, contributed over 400 hours of time to this project. We matched the funds awarded by the Oregon Watershed Enhancement Board by 72%, one of our largest match contributions thus far.

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Appendix A – Newpapers articles, Press Releases, Media

Cozine Creek is declared unsafe

Published: September 27, 2008

Cozine Creek is declared unsafe

By NICOLE MONTESANO

Of the News-Register

Elevated levels of e.Coli bacteria in Cozine Creek have prompted the McMinnville Public Works Department to post signs at several locations, warning people - especially children, but also adults - not to play in the water. The signs went up Friday.

There are multiple strains of e.Coli, including the 0157:H7 strain famous for causing human illness. The city doesn't yet know whether the bacteria in Cozine include that particular variety.

"Finding bacteria in urban streams is not unusual" said Mike McNickle, program manager for Yamhill County Public Health. "But when the stream has high levels of e.Coli bacteria, it is a best practice to notify the public that contact with the stream could cause illness and should be avoided."

The Yamhill Basin Council discovered the problem in the course of weekly water quality testing begun last month under a grant-funded study.

An occasional finding of high bacteria levels, including high e.Coli levels, is not unusual, said Basin Council Coordinator Jean Reiher.

But when levels remained high for three consecutive weeks, the Basin Council notified the city, which called in McNickle and formed a team to address the problem. When two subsequent samples showed levels were remaining high, the Public Works Department posted warning signs and notified the News-Register.

The Basin Council also notified the city of Amity that it had detected high levels in Ash Swale.

McMinnville's public works director, David Renshaw, said signs had been posted at Lower City Park downtown, Heather Hollow Park on Old Sheridan Road, Cozine Creek's Davis Street and Elmwood Street crossings and the Lower Cozine near its discharge into the South Yamhill River off Dayton Street. The signs will remain up as long as the problem persists, he said.

The council has not yet determined the cause or point of origin of the elevated levels.

The study is being funded mainly with grant money from the Oregon Watershed Enhancement Board. The Yamhill Soil & Water Conservation District, McMinnville Water Reclamation Facility, Oregon Department of Environmental Quality and Oregon Department of Agriculture have all chipped in as well, and both YBC members and members of the broader community are volunteering their time to collect samples.

The terms of the grant don't allow the Basin Council to go outside the parameters of its study to conduct follow-up testing, Reiher said. She said the city has agreed to accept responsibility for that.

The testing will be conducted by the city's sewage treatment plant workers. Manager Ron Bittler said the plant is already set up to perform water quality tests, and conducts lab work on behalf of the Basin Council.

Bittler said members of the plant's staff walked the Cozine this week to select locations for sampling. He said they will begin testing at locations between Lower City Park and the Michelbook Golf Course.

"There are several drainages coming in there," he said. "We're trying to bracket where these higher sources are coming in. We're also going to hit the top of our four drainage basins, where they hit urban areas, coming in from agricultural areas."

The Basin Council's samples were quantitative, indicating total e.Coli levels exceeded limits set by the Oregon Department of Environmental Quality for safe recreational contact. Bittler said the treatment plant will conduct tests to determine the exact levels and strains of bacteria involved, as well as trying to ascertain where the contamination originates.

"Water quality problems such as this one generally have many sources that take time to identify and correct," McNickle said. "However, Yamhill County Public Health and the Yamhill Basin Council will join the city in working toward improving the water quality in Cozine Creek."

For more information, people may call the city at 503-434-7313, Yamhill County Public Health, at 503-434-7525 or the Yamhill Basin Council at 503-474-1047.

CUTLINE

PRESS RELEASE:

By: Jean Reiher and Denise Schmit, Yamhill Basin Council

Ron Bittler, City of McMinnville

Mike McNickle, Yamhill County Public Health

September 26, 2008

Today the City of McMinnville posted warning signs on several branches of Cozine Creek to warn residents of high bacteria levels in the water. The City learned of the problem when they were contacted by the Yamhill Basin Council (YBC), a local non-profit group, after their water quality monitoring in August and September showed high levels of *E. coli* bacteria. The levels of bacteria found in the water exceed the levels for safe recreational contact as determined by the Oregon Department of Environmental Quality (DEQ).

Five water samples were taken at each of five sampling sites on Cozine Creek in McMinnville and at one site on Ash Swale in Amity during August and September, to get a representative sampling of the water quality in the area.

Since the sampling sites on Cozine Creek and Ash Swale are easily accessible by the public, the YBC was concerned that local residents be notified of the problem. As a result, the City of McMinnville, in cooperation with the Yamhill Basin Council and the Yamhill County Public Health Department, posted signs at various locations on Cozine Creek informing the public about the high levels of bacteria.

The Yamhill County Public Health Department recommended further study of the stream to identify the sources of the bacteria. “Finding bacteria in urban streams is not unusual” said Mike McNickle, Program Manager for Yamhill County Public Health, “but when the stream has high levels of *E.coli* bacteria, it is a best practice to notify the public that contact with the stream could cause illness and should be avoided.” Since *E.coli* is a bacterium that is found in warm-blooded animals, including humans, birds, and other wildlife, there could be many sources causing the problem. A more thorough investigation could reveal the sources, which in turn could provide enough information to develop a clean-up plan. “Water quality problems such as this one generally have many sources that take time to identify and correct,” said McNickle. “However, Yamhill County Public Health and the Yamhill Basin Council will work with the City in working toward improving the water quality in Cozine Creek.”

It is important to note that the *E. coli* that has surfaced in the news in the last few years, which caused human illness from food products in the U.S, is a particular strain known as *E. coli 0157:H7*. The tests done in the YBC study were for total *E. coli* and not analyzed for particular strains. However, high *E. coli* levels in general are an indicator that the stream may not be safe for recreational public contact and people should take precautions when having contact with the water.

The YBC water quality study is funded by a grant from the Oregon Watershed Enhancement Board, donations from the Yamhill Soil and Water Conservation District, City of McMinnville Water Reclamation Facility, Oregon Department of Environmental Quality, Oregon Department of Agriculture, and volunteer time from the community and YBC members.

Until further data is collected and analyzed, Cozine Creek will continue to be posted at the following locations:

- Lower City Park

- Heather Hollow Park (Old Sheridan Road)
- Davis Street crossing
- Elmwood Street crossing
- Lower Cozine, near discharge into the South Yamhill (off Dayton Street)

Residents with questions or concerns are encouraged to contact any of the following agencies:

- City of McMinnville 503-434-7313
- Yamhill County Public Health 503-434-7525
- Yamhill Basin Council 503-474-1047

Kingfisher Notes — 4

The Kingfisher

Newsletter of the Yamhill Basin Council
Working to improve our watersheds

September 2008

Support the YBC!

Purchase a limited edition Kingfisher print (above), painted by local artist Terry Peasley.

Matted 11x14 cost $30; 16x20 cost $50. Framed prints available as well. Visit Hidden Treasures Gallery in McMinnville or call the YBC at (503) 474-1047 to order

Yamhill Basin Council

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John Bellonte	Co-Chair
Stan Christensen	Co-Chair

Staff

Jean Reiher	Watershed Coordinator
Denise Schmit	Monitoring Technician
Corissa Kurtze	Monitoring Assistant

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Confederated Tribes of Grand Ronde
Environmental Groups
Industrial Forestry
Natural Areas Parks & Recreation
Students
Small & Large Utilities
Small Woodlands Assoc.
Watershed Residents
Yamhill & Polk Counties
Yamhill SWCD

10 years of Water Quality Monitoring in the Yamhill Basin!

What and Where are We Measuring and Why is it Important?

By YBC Water Quality Monitoring Technician, L. Denise Schmit

The Yamhill Basin Council began water quality monitoring in 1998 with annual placement of continuous temperature data loggers during the summer months in streams throughout the Yamhill River watershed. In 2003, we began more comprehensive water quality monitoring basin-wide to get baseline data. The parameters studied included temperature, dissolved oxygen, pH, turbidity, conductivity, E. coli, and flow. Stream habitat and aquatic insects were also measured during this project. The same parameters were measured in our 2005/2006 water quality study, focused only in the North Yamhill River subwatershed. During the spring of 2007 & 2008 we partnered with Oregon DEQ to collect samples for baseline data of pesticide levels in our watershed. Results are being summarized.

In our current study for 2008/2009, our monitoring is focused in the Lower Yamhill River Basin on Salt Creek, Ash Swale, Palmer Creek, and Cozine Creek, and a more in-depth E. coli study of Panther Creek in the North Yamhill River subwatershed. We are also analyzing samples for phosphorus and ammonia concentrations. All of the parameters can be indicators of the overall health of the stream and the watershed or subwatershed. It is a holistic system, of which one parameter interacts with and/or affects other parameters.

Below is a brief explanation of each parameter we are currently measuring and why it is important in assessing water quality.

Temperature: Colder temperatures ranges are very important for the survival of fish and other aquatic life. Warmer temperatures contribute to increased algae and plant growth, and decreased dissolved oxygen.

Dissolved Oxygen (DO): The amount of oxygen saturated in the water. DO is very important for the survival of fish and other aquatic life. Cold temperature and good flow contribute to higher DO levels. Increased algae and plant growth decrease available DO.

pH: Indicates the acidity of the water. Higher acidity allows nutrients (e.g., phosphorus) which may be present in the streams from run-off, to be more soluble/available to for algae and aquatic plant growth, which increases turbidity, and lowers dissolved oxygen.

Turbidity: The clarity of the water, i.e. "murkiness". Measured by the amount of fine sediment suspended in the water. Higher turbidity leads to warmer water as the light/heat is absorbed more readily than in clearer water. Turbidity can also clog gills of fish and other aquatic life.

Conductivity: Estimates the amount of total dissolved salts in the water. High levels are unhealthy for fish and other aquatic life. Some possible sources of increased conductivity include increased temperature, septic and sewage systems, agricultural runoff, and natural geology (e.g. limestone).

E. coli: Bacteria from human/animal waste. Can be harmful to humans in high concentrations. Some possible sources are livestock, wildlife, and faulty septic systems.

Flow: The volume of water in a stream system measured in cubic feet per second. If a stream is not flowing quickly or is stagnant, the dissolved oxygen is reduced and temperature tends to increase. Lower flow leads to less dilution of pollutants, e.g., higher concentrations of E. coli, phosphorus, ammonia, pesticides, etc.

Phosphorus: A nutrient commonly found in fertilizers. Can contribute to increased algae and aquatic plant growth.

Ammonia: Toxic to fish and other aquatic life at higher levels. Possible sources are household products, fertilizers, and sewage effluent.

If you would like to receive email announcements for water quality monitoring opportunities or future water quality presentations, please email ybc_coordinator@co.yamhill.or.us or call 503.474.1047.

Cozine Creek deemed contaminated with E. Coli

– October 10, 2008 **Linfield Review**

Katie Paysinger
News editor

Public Health and City of McMinnville officials declared Cozine Creek a safety hazard last week and put up signs discouraging people from playing in the water. Strains of E. coli from an undiscovered source were found in every branch of the creek, prompting the new warnings.

Mike McNickle, program manager of the Public Health Department, said these strains of E.coli are not the same ones associated with the fast-food chain, Jack- in-the-Box, incident several years ago.

“The key is to determine where the source is coming from,” McNickle said, “and that is exactly what the city of McMinnville is now trying to do.”

The contamination was discovered in monthly water testings done at the creek. The testing is financed by the Oregon Watershed Enhancement Board Grant that the Yamhill Basin Council received. It is a three-year grant that was established this past summer.

The officials found E. coli in the creek several years ago but did not proceed any further investigation because it was in a single, isolated area, Watershed Coordinator Jean Reiher said.

Reiher also said the type of strains found are most likely generated from animal droppings, which can be washed away with the rain, or from a sewage leak, which would be harder to correct. Because of recent test results, they proceeded to warn the community that the E. coli was heavily saturating the area.

“It is also possible that the E. coli are breeding there, and it’s not an external source,” Reiher said. “Especially this time of year, because there is no water flow.”

Linfield’s Environmental Studies program has used the area for capstone classes before, Professor of Environmental Studies Tom Love said. However, the area is no longer predominantly used for academic purposes.

“Eventually, we could really do some serious conservation restoration,” Love said. “However, [the E. coli] really doesn’t affect what little to no use there is now.”

People are highly discouraged from playing in the water at the creek or letting their animals walk in it. Small children are especially susceptible to side effects from the E.coli because they are more likely to play in the water and then use their hands to eat something afterward, Reiher said.

Likely symptoms after consuming something with E. coli are intestinal upset, such as diarrhea and vomiting, as well as fever. The public health department urges anyone who has been in the creek and has these symptoms to call its office at 503-434-7525

Sewage leaking into Cozine Creek

Published: June 17, 2009

Sewage leaking into Cozine Creek

The News-Register staff

A sewage leak has been discovered in the vicinity of Northwest Ninth Street in McMinnville.

Until further notice, residents of the area should avoid water contact in Cozine Creek from Northwest Michelbook Lane to Lower City Park, according to Wastewater Services Manager Ernie Strahm. Warning signs have been posted.

A small amount of sewage is seeping into a storm drain that discharges into the northwest fork of Cozine Creek, upstream from Lower City Park. Sewer lines date back more than 80 years, so the leak comes as no huge surprise.

The city will conduct sampling of the storm line to ensure that the leak has been repaired and sewage has stopped flowing into Cozine Creek.

Anyone with questions or concerns should call 503-434-7313 during normal business hours - 8 a.m. to 5 p.m. weekdays. The after-hours number, 503-434-7316, should be reserved for emergencies.

CUTLINE

City repairs sewage leak

Published: June 20, 2009

City repairs sewage leak

The News-Register staff

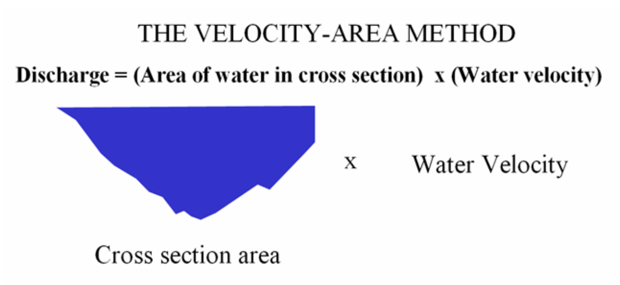
After a sewer line was discovered to be leaking sewage into Cozine Creek on Monday, the city of McMinnville hired a contractor to help repair the lines suspected of leaking, using a relatively new system of re-lining existing concrete pipes with new plastic sleeves. Repairs were completed Friday afternoon, but the city plans to leave warning signs up while it conducts tests of the creek water.

For more information, call the city sewage treatment plant at 503-434-7313, Monday through Friday from 8 a.m. to 5 p.m. For after-hours emergencies, call 503-434-7316.

Appendix B – Flow discharge methods

Stream Discharge: The volume of water which passes a stream transect in a given time, usually expressed in cubic feet per second (cfs) or cubic meters per second (cms).

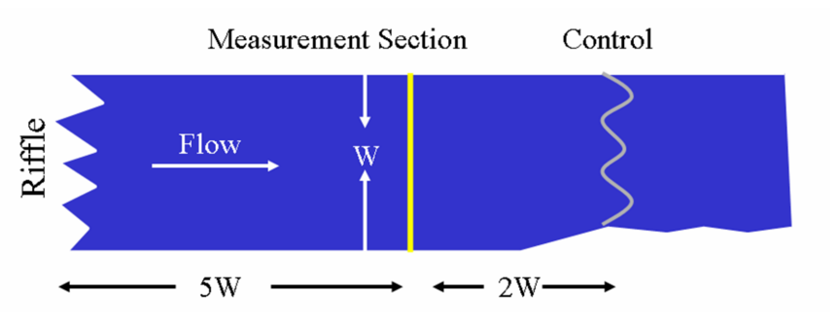
RANGE: Most streams measured using the method described below will range from 1 cfs to 200 cfs. During the dry season stream discharges, sometimes referred to as "flows", tend to decrease gradually. In contrast, over the course of a year the range of values for a stream vary so significantly that portraying the values on a normal graph is usually impractical. For example, the USGS has measured stream flow on the Willamette River at Salem for 88 years and have recorded values ranging from 2,470 cfs (1940) to 348,000 cfs (1923).



MEASUREMENT METHOD: We use the velocity area method to calculate stream discharge. This method estimates the area of the stream by breaking the stream channel into multiple smaller rectangular cells. The width of each cell is measured with a measuring tape or "tagline" that is strung across the stream perpendicular to the direction of flow. The depth is measured with a special wading rod called a "top setting rod". The field technician attaches a velocity meter to the top setting rod to measure the velocity of the water moving through the cell. Velocity meter types used by the DEQ include mechanical meters (standard Price AA and pygmy) or electromagnetic Marsh-McBirney FlowMate.

<u>Where to measure</u>:

Finding a good cross section of a stream for taking a flow measurement is critical to collecting an accurate measurement. The area above your cross section should be straight and uniform enough to allow for uniform flow. The streambed should be stable and free of large rocks, weeds, and protruding obstructions (USGS, 2000). The diagram to the left shows the preferred scenario for a flow site with 5 times the width of the channel straight above the cross section to the nearest riffle and 2 times the width downstream to the control that is "pulling" the water through the cross section. This control is often some type of increased steepness in the stream. You may alter a channel by removing rocks and debris before starting your measurement but never make any changes to the cross section once you start the measurement.



<u>How many measurements:</u>

For a high quality measurement the field staff should capture no more than 5% of the total flow in a single cell. This is particularly important in channels where the bottom is highly irregular. For this reason it is recommended that a stream be broken up into 20 to 30 separate cells when doing a stream discharge measurement. To minimize the number of cells needed on a relatively even bottomed cross section, a skilled technician will use wider cells in areas with lower stream velocities and depths and narrower cells in areas with deeper faster water.

The number of velocity measurements one takes in each cell is dependent on the type of flow meter used and the depth of the water. When using a Marsh-McBirney FlowMate or a standard Price AA meter take a single measurement at depths less than 2.5 ft. If using a pygmy meter a single measurement can be used only for depths less than 1.5 ft. Single depth measurements are taken at 60% of the total depth (that would be 0.6 ft from the surface at a 1 ft deep point). If more than one measurement is required you must take a measurement at 20% and 80% of the total depth.

Using the top setting rod:

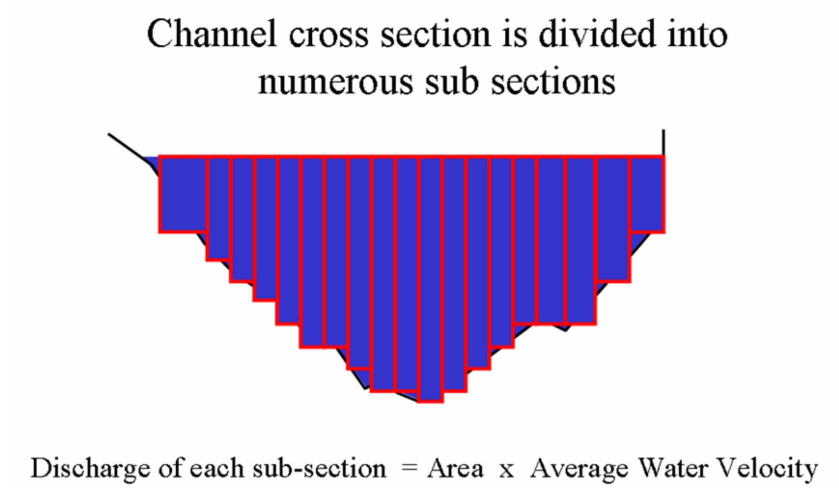
The top setting rod has an octagonal rod graduated for measuring depth in tenths of a foot. The round rod, to which you attach the flow meter, and handle are specially designed to allow you to quickly and easily set the velocity meter at the correct depth. The round rod is graduated to represent whole feet and the handle through which the rod slides is graduated to represent tenths of a foot. When you align the line marked 1 on the round rod, with the line marked 6 on the handle, the rod sets the velocity meter at 60% of the depth of a 1.6 ft total depth. By doubling or halving a total depth measurement, you can calculate the settings for measurements at 20% or 80% of depth, respectively. For example, with the depth of 1.6 ft. setting the rod to 3.2 would put the meter at 20% of the 1.6 ft depth and setting the rod at 0.8 would represent 80% of 1.6 ft depth.

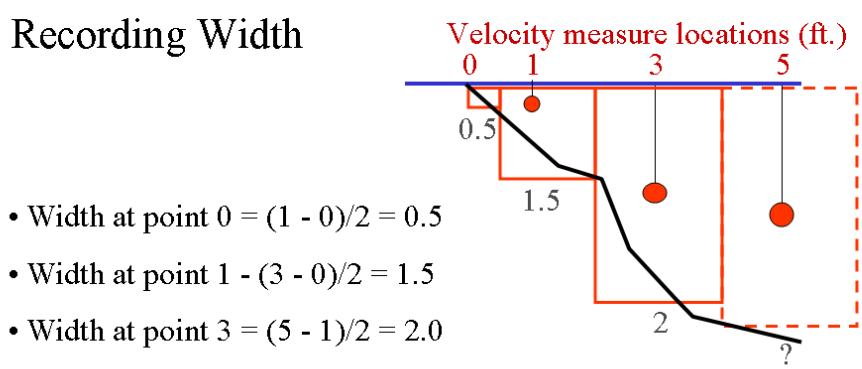
Measuring velocity:

When taking a flow measurement, the top setting rod should be held at the tagline which is pulled taught across the stream and secured on each bank. You should stand at least 3 inches behind the rod and eighteen inches to the side to allow water flow freely past the meter. Velocity measurements should be an average of 40 seconds of continuous recordings to accommodate for natural variations in local velocities. If water is not flowing perpendicular to the tag line you may need to adjust your velocity to prevent overestimating the total discharge. For detailed descriptions of how to take a stream discharge measurement see the U.S. Geological Survey Water Resources Division document *Measurement of Stream Discharge by Wading* by K. Michael Nolan and Ronald R. Shields published in 2000, Water Resources Investigations Report 00-4036.

EQUIPMENT CARE: The mechanical meter maintenance and use is described in the U.S.G.S. Office of Surface Water publication 85.07 and 85.14 for thorough description of use an maintenance of these meters. See the Marsh-McBirney FlowMate manual for information on use and maintenance of this equipment.

SAFTEY: Wading in streams can be very dangerous. Do not work alone. In water where you may be swept from your feet, wear a floatation device. Before attempting to wade across a stream look downstream for potential hazards such as rapids, low hanging branches or logs that can trap a swimmer. No stream discharge measurement is worth risking a serious injury or death.





Example data sheet

E. coli Study and Lower Yamhill Basin Water Quality Monitoring Project

Cell #	Tape Dist. (ft)	Width (ft)	Depth (ft)	Area (ft^2)	Meas. Depth (%)	Velocity (ft/sec)	Discharge (cfs)	% Total Discharge
1.	RWE 38	0.5	0		NA	0	0	0
2.	37	1.5	0.6	0.9	0.6	0.24	0.216	
3.	35	2	1.1	2.2	0.6	0.67	1.47	
4.	33		1.2					
5.	Etc.							

Discharge in each cell is calculated individually and summed. Calculating discharge in each cell as the measurement is taken is useful for identifying when you may have used too wide a cell.

<u>REFERENCE</u>:

USGS, 2000. *Measurement of Stream Discharge by Wading* By K. Michael Nolan and Ronald R. Shields

Water Resources Investigations Report 00-4036, version 1.1. ISBN: 0-607-96337-9

For sale by

USGS Information Services

Box 25286, Building 810

Denver Federal Center

Denver, CO 80225

(888) ASK-USGS

Appendix C – Data Quality Matrix

Data Quality Matrix
DEQ04-LAB-0003-GD
Version 3.0

Oregon Department of Environmental Quality
February 2004
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Data Validation Criteria for Water Quality Parameters Measured in the Field

Data Quality Level	Quality Assurance Plan	Water Temperature Methods	pH Methods	Dissolved Oxygen Methods	Turbidity Methods	Conductivity Methods	Bacteria Methods	Data Uses
A+	DEQ QAPP approved by DEQ QA Officer	Thermometer Accuracy checked with NIST standards A ≤ ± 0.5°C P ≤ ± 1.5°C	Calibrated pH electrode A ≤ ± 0.2 S.U. P ≤ ± 0.3 S.U.	Winkler titration or calibrated Oxygen meter A ≤ ± 0.2 mgL^{-1} P ≤ ± 0.3 mgL^{-1}	Nephelometric Turbidity meter A ≤ ± 5% Standard value P ≤ ± 5%	Meter with temp correction to 25°C A ≤ ± 7% of standard value P ≤ ± 10%	DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.6 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments)
A	External QAPP	External Data Thermometer Accuracy checked with NIST standards A ≤ ± 0.5°C P ≤ ± 1.5°C	External Data Calibrated pH electrode A ≤ ± 0.2 S.U. P ≤ ± 0.3 S.U.	External Data Winkler titration or calibrated Oxygen meter A ≤ ± 0.2 mgL^{-1} P ≤ ± 0.3 mgL^{-1}	External Data Nephelometric Turbidity meter A ≤ ± 5% Standard value P ≤ ± 5%	External Data Meter with temp correction to 25°C A ≤ ± 7% of standard value P ≤ ± 10%	External Data DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.6 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments)
B	Minimum Data Acceptance Criteria Met	Thermometer Accuracy checked with NIST standards A ≤ ± 1.0°C P ≤ ± 2.0°C	Any Method A ≤ ± 0.5 S.U. P ≤ ± 0.5 S.U.	Winkler titration or calibrated Oxygen meter A ≤ ± 1 mgL^{-1} P ≤ ± 1 mgL^{-1}	Any Method A ≤ ± 30% P ≤ ± 30%	Meter with temp correction to 25°C A ≤ ± 10% of standard value P ≤ ± 15%	DEQ Approved Methods Absolute difference between log-transformed values P ≤ 0.8 log	Regulatory, permitting, compliance (e.g., 303(d) and 305(b) assessments) with professional judgment
C		A > ± 1.0°C P > ± 2.0°C	A > ± 0.5 S.U. P > ± 0.5 S.U.	A > ± 2 mgL^{-1} P > ± 2 mgL^{-1}	A > 30% P > 30%	A > ± 10% P > ± 15%	Absolute difference between log-transformed values P > 0.8 log	Void data. Not used for 303(d) and 305(b) assessments
D		Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data	Missing Data
E	No QAPP provided	No Precision Checks	Any Method No Precision Checks	Any Method No Precision Checks or A ≤ ± 2 mgL^{-1} P ≤ ± 2 mgL^{-1}	Any Method No precision checks	Meter without routine calibration No precision checks	Any Method No precision checks	Informational purposes only
F	See accompanying notes							

Appendix D – Quality Assurance Project Plan*

***Available upon request. Soon to be posted to the Greater Yamhill Watershed Council Website at www.greateryamhillwatershedcouncil.org**

Appendix E – Physical/Chemical Data**

****Available upon request. Data will be stored at the Yamhill Basin Council Office and at the Oregon Department of Environmental Quality.**