With participation from: Nile Creek Enhancement Society, Qualicum Beach Streamkeepers, Friends of French Creek Conservation Society, Mid Vancouver Island Habitat Enhancement Society, Nanoose Streamkeepers, Island Waters Fly Fishers, Departure Creek Streamkeepers, Vancouver Island University Fisheries & Aquaculture Department and Nanaimo & Area Land Trust

Regional District of Nanaimo
Community Watershed Monitoring Network
2014 Data Summary

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Program Outline

The purpose of this report is to present a summary of data collected as part of the Regional District of Nanaimo (RDN) Community Watershed Monitoring Network (CWMN) partnership. This partnership was initiated in 2011 by the RDN and the British Columbia (BC) Ministry of Environment (MOE) to collect data across the RDN. In its early stages the program will be used for data gathering with the goals of obtaining enough data to see watershed trends and raise watershed health awareness in local communities. Long term goals are to use multiple years of data to determine in which watersheds more detailed monitoring and/or improved watershed management need occur, and to assist in land use planning.

Partnerships are central to the monitoring program. In 2014 the RDN and MOE organized the program and trained participants in monitoring protocols. Ten stewardship groups within the RDN participated in the monitoring program, with safety gear, land access and funding for Quality Assurance/Quality Control lab analyses provided by Island Timberlands LP. Stewardship groups participating in 2014 were: Nile Creek Enhancement Society, Friends of French Creek Conservation Society, Qualicum Beach Streamkeepers, Mid Vancouver Island Habitat Enhancement Society, Nanaimo and Area Land Trust, Departure Creek Streamkeepers, Island Waters Fly Fishers, Nanoose Streamkeepers and Vancouver Island University Fisheries and Aquaculture Department.

A total of 51 different sites in 18 different watersheds were monitored in 2014, the fourth year of the program. Samples were collected weekly according to BC MOE sampling procedures (BC MOE, 2003) between August 12 and September 9, 2014 (summer low flow) by all the stewardship groups and between October 14 and November 12, 2014 (fall rains) by all the stewardship groups. It should be noted that as Tuesday, November 11 was a national holiday, all groups sampled on Wednesday, November 12 instead. Quality assurance/quality control (QA/QC) samples were collected by three groups. In this document, data are presented and compared to existing BC Water Quality Guidelines (BC MOE, 1997) and/or Englishman River Water Quality Objectives (Barlak *et al*., 2010; Table 1), applicable to other watersheds within the same ecoregion.

Table 1 - BC Water Quality Guidelines and/or Englishman River Water Quality Objectives.

Parameter	Guideline or Objective Value	Importance
Turbidity (Englishman River Water Quality Objective)	October to December: 5 NTU maximum January to September: 2 NTU maximum	Measures clarity or cloudiness of water. High values are associated with higher levels of other contaminants (e.g. bacteria).
Temperature (Englishman River Water Quality Objective)	Short Term, at any location in the river $\leq 17^{\circ}$C average weekly temperature. Long Term $\leq 15^{\circ}$C average weekly temperature. *Weekly averages could not be calculated with available data.	If too warm not aesthetically pleasing to drink and can affect health and survival of aquatic organisms.
Dissolved Oxygen (BC Water Quality Guideline for aquatic life)	30 day average 8 mg/L Instantaneous minimum 5 mg/L	If too low affects the health and survival of aquatic organisms.
Conductivity (no guideline)	No guidelines exist; coastal streams generally less than 80 μS/cm but can be more if significant ground water influences.	The more dissolved ions in water, the greater the electrical conductivity. Dilution decreases conductivity but groundwater influences or sediment introduced in water can increase it.

Exceedences and similarities to 2011, 2012 and 2013 data (Barlak, 2012 and 2013; Barlak and Fegan, 2014) are noted. After three years of data collection, the results were reviewed in the 2011 – 2013 Water Quality Trend Report (Barlak and Fegan, 2014) and testing at sites with consistently good water quality were suspended for three to five years. This will allow resources to be allocated to the expansion of the network, including additional sampling at new sites where needed. When any turbidity samples were less than 0 NTU, or not a true reading, calibration corrections were applied to all samples measured with the same instrument on that day and the corrected values presented here. When data collection was missed or a stream had no above ground surface flow the missing data point is represented by a missing bar in the applicable figure in this report. There will be another trend report produced for the sites that have three years of data between 2012-2014.

Data Summary
Summer and Fall 2014

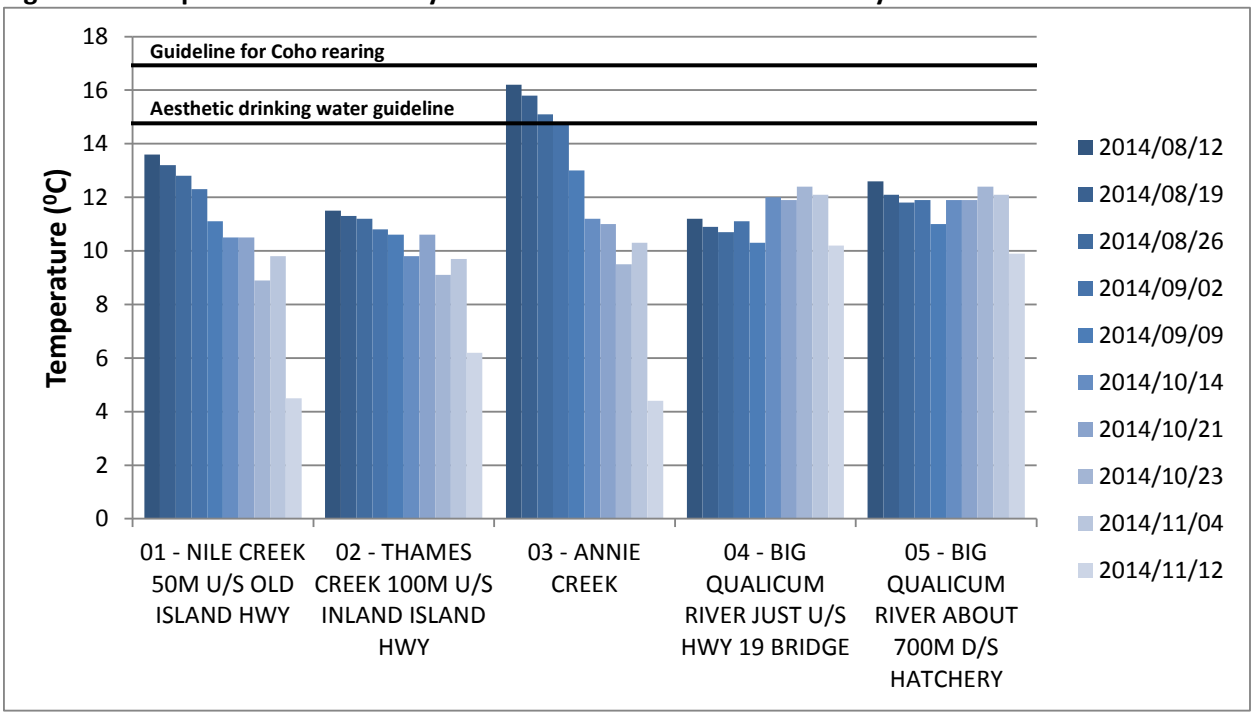
Nile Creek Enhancement Society

The RDN CWMN 2011 – 2013 Water Quality Trend Report (Barlak and Fegan, 2014) noted continuous good water quality in the lower Thames Creek site upstream of Highway 19A, the Upper Nile Creek site at Cochrane Main, and the Nile Creek site 25 metres upstream of the Nile Creek Hatchery. Monitoring at all three of these sites was suspended in 2014 for three to five years and three new sites were added by Nile Creek Enhancement Society (NCES). New sites monitored in 2014 by NCES include the Big Qualicum River upstream Highway 19 bridge, Big Qualicum River 700 metres downstream of the Big Qualicum River Hatchery, and on Annie Creek upstream of Highway 19A.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C for the first three weeks of the summer sample period in Annie Creek (Figure 1). There were no other potential exceedances of temperature guidelines.

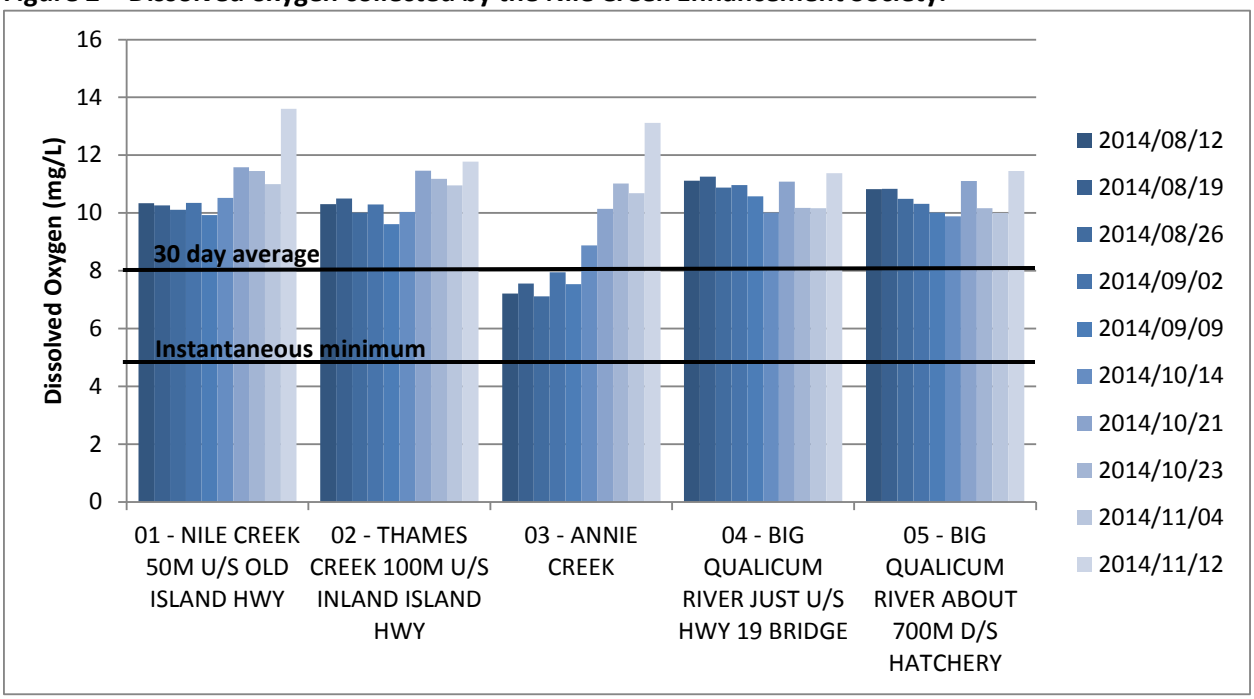
Figure 1 – Temperature collected by the Nile Creek Enhancement Society.



Dissolved Oxygen

Dissolved oxygen (DO) values for 2014 are shown in Figure 2. The 30 day average was below the guideline of 8 mg/L at the Annie Creek site during the entire summer sampling period, with an average value of 7.476 mg/L. There were no other exceedances of dissolved oxygen guidelines.

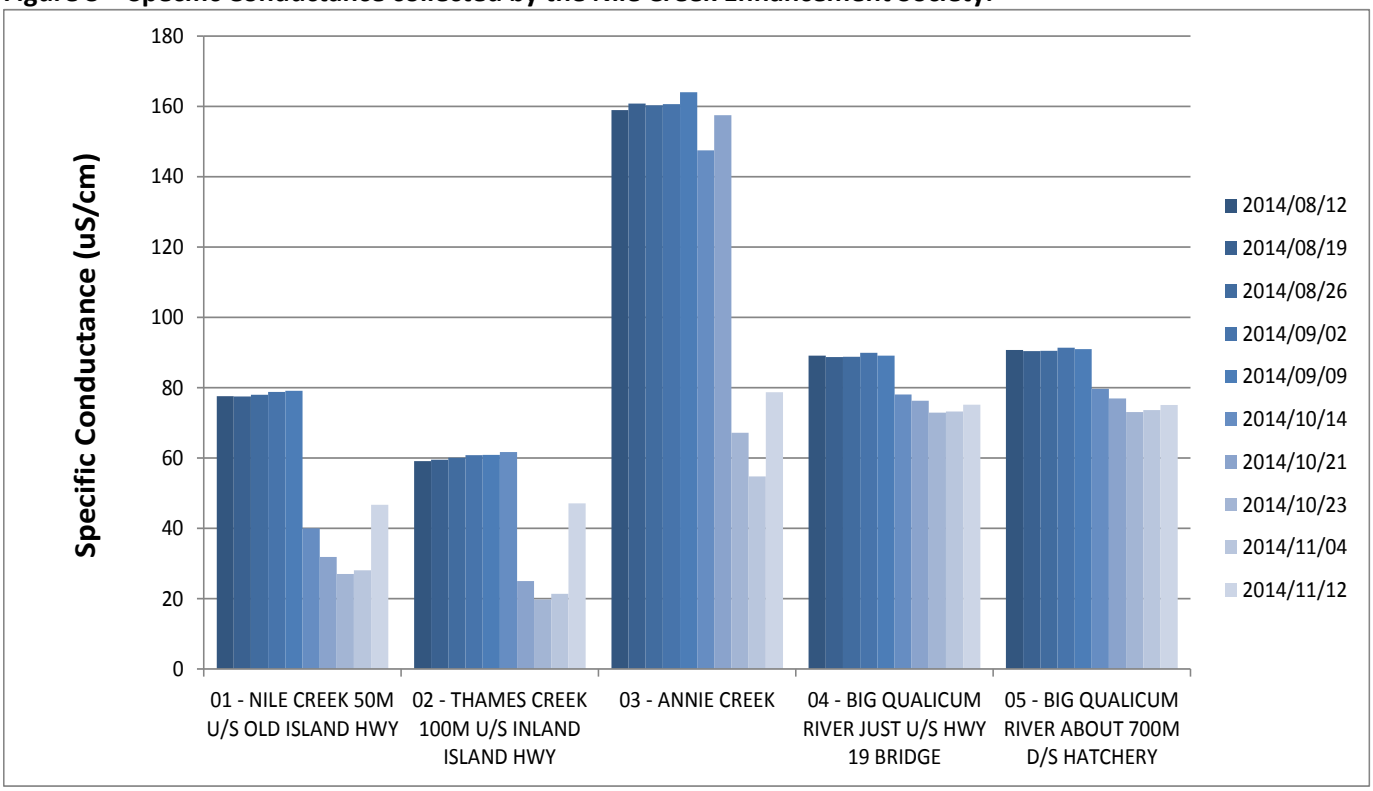
Figure 2 – Dissolved oxygen collected by the Nile Creek Enhancement Society.



Specific Conductance

Specific conductance was within the typical range for coastal British Columbia streams, with the exception of Annie Creek (Figure 3).

Figure 3 – Specific Conductance collected by the Nile Creek Enhancement Society.



Turbidity

Turbidity exceeded the objective of 2 NTU for all summer sampling dates in Annie Creek. Samples in Annie Creek also exceeded the fall objective of 5 NTU for all fall sampling dates (Figure 4). The October 23, 2014 exceedance corresponds closely with a rainfall event (Figure 5). No turbidity objectives were exceeded at any other sites.

Figure 4 – Turbidity collected by the Nile Creek Enhancement Society.

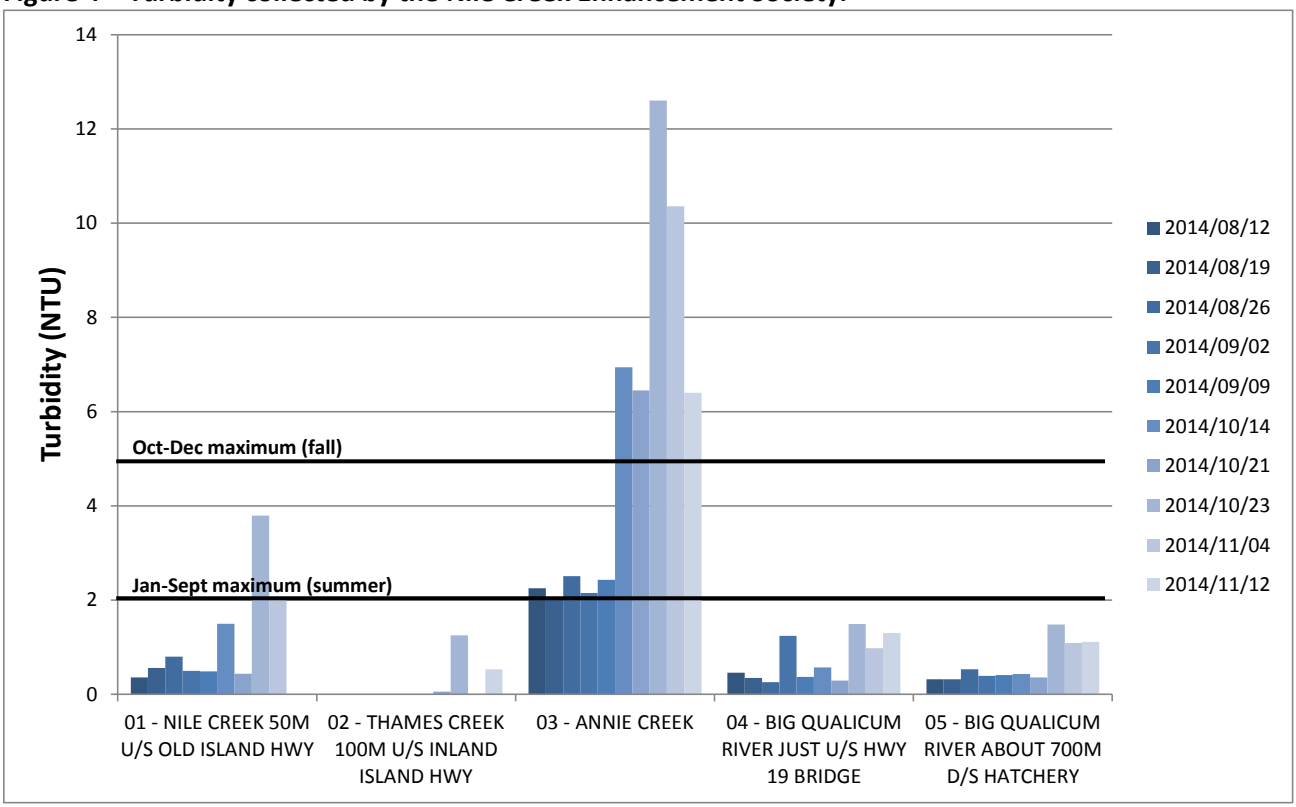
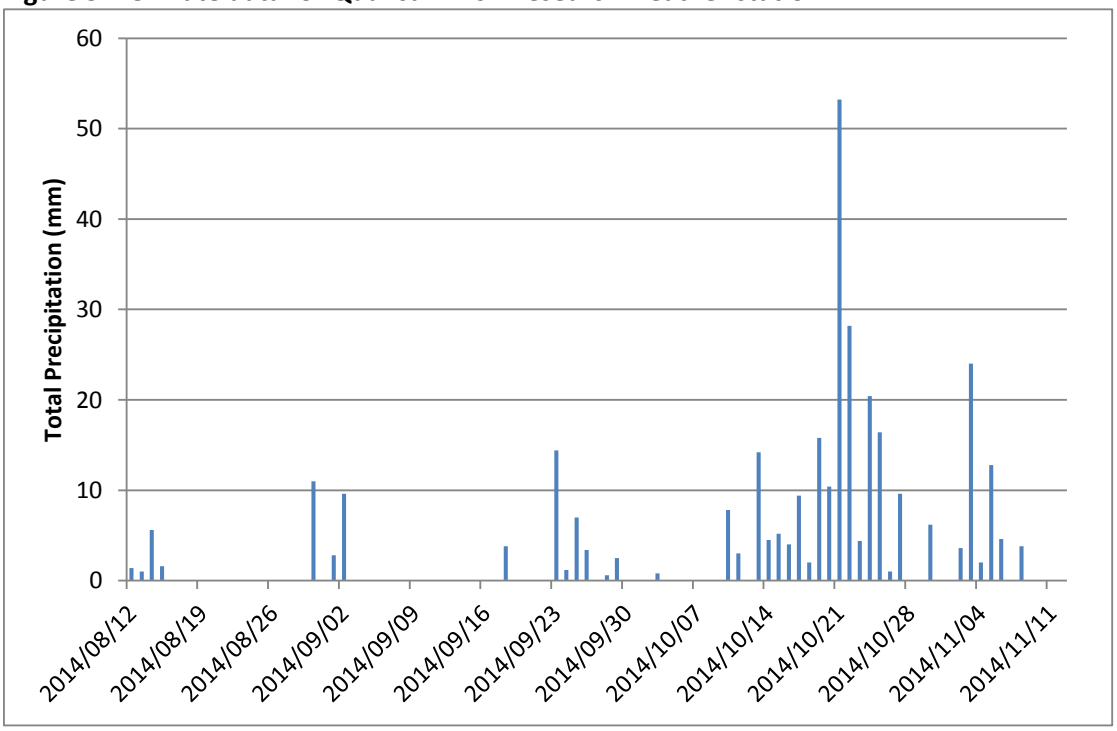


Figure 5 – Climate data for Qualicum Fish Research weather station.



The only exceedances in the 2014 monitoring program at the sites monitored by NCES volunteers were in Annie Creek. Since this was the first year of monitoring that site, continued monitoring is recommended to determine trends.

Qualicum Beach Streamkeepers

While the RDN CWMN Water Quality Trend Report, 2011 – 2013 (Barlak and Fegan, 2014) noted continuous good water quality in the Cameron River, Island Timberlands LP (a private landowner in the watershed) saw the benefit of continued monitoring at these sites as oversight of the upper watershed.

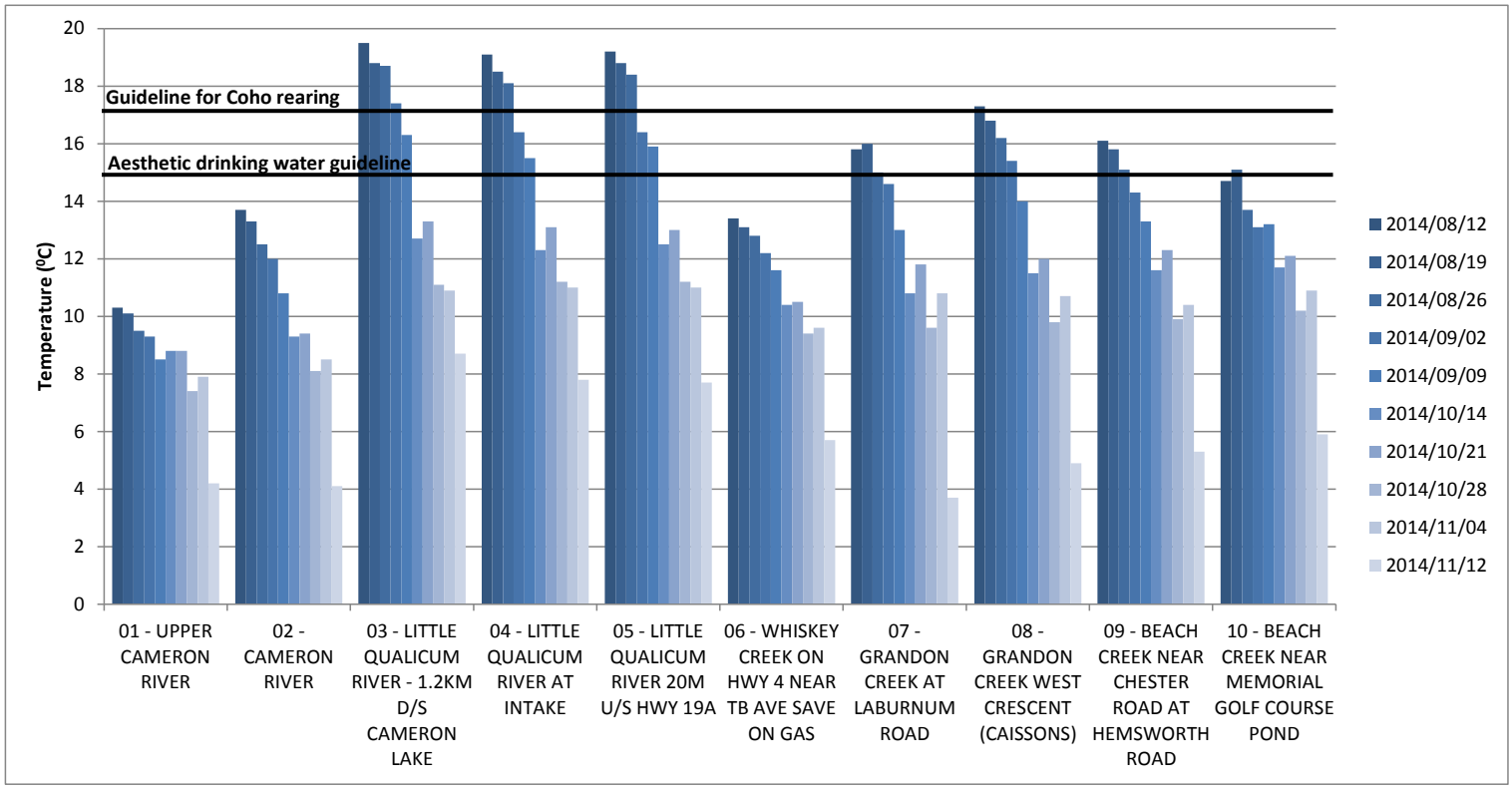
In 2014 a new site was added on the Little Qualicum River 20 metres upstream of Highway 19A to monitor potential water quality changes from farming in the area. Lab analysis for total phosphorous (summer sample period only) and E. coli (both sample periods) were performed at sites on Grandon and Beach Creeks.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C throughout the summer sample period in the Little Qualicum River, and for the first three weeks of sampling in Grandon Creek (Figure 6). Summer temperatures also had the potential to exceed the guideline for Coho rearing (17°C) during the first three weeks of summer sampling in the Little Qualicum River, and during the first week of sampling in the lower Grandon Creek site. This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures.

Data were similar to 2011, 2012 and 2013. The 2011 – 2013 trend report noted that assessment of riparian cover upstream of sites with the potential for temperature exceedances will help guide riparian area restoration activities.

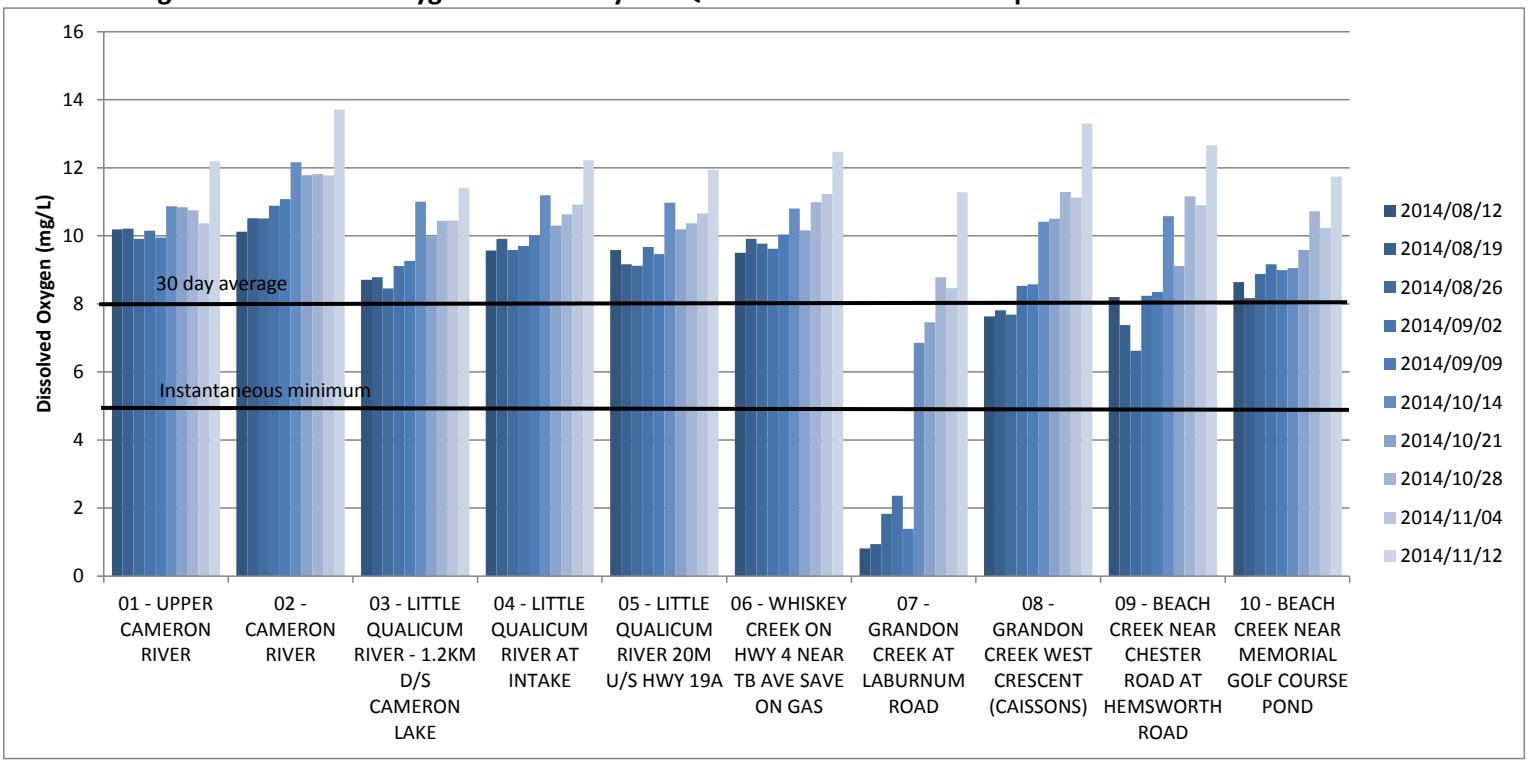
Figure 6 – Temperature collected by the Qualicum Beach Streamkeepers.



Dissolved Oxygen

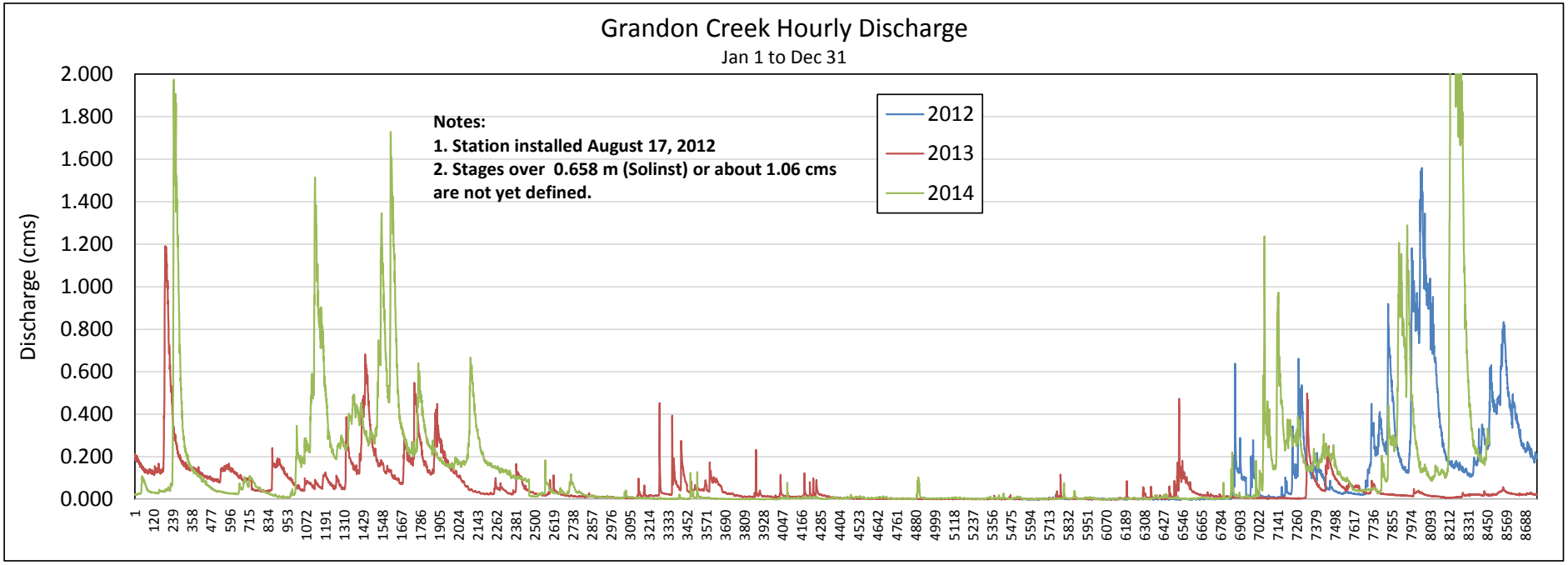
DO values for 2014 are shown in Figure 7. The dissolved oxygen level was below the instantaneous minimum aquatic life guideline of 5 mg/L in the upper Grandon Creek (Laburnum Road) site during the entire summer sampling period, with an average value of 1.47 mg/L. This compares with average summer sample period DO values for this site of 3.33 mg/L, 2.40 mg/L, and 2.25 mg/L for 2011, 2012, and 2013 respectively. The 2011 – 2013 trend report noted that Grandon Creek may be a naturally low flow stream in summer. The 30 day average was below the guideline of 8mg/L in Beach Creek at Hemsworth Road during the summer sample period (7.76 mg/L).

Figure 7 – Dissolved oxygen collected by the Qualicum Beach Streamkeepers.



The BC Conservation Foundation (BCCF) began collecting stream flow data on Grandon Creek in August 2012. Annual flows between 2012 (blue line), 2013 (red line) and 2014 (green line) are shown in Figure 8. The data are only defined to flows at ~1.06 m^3/s, anything higher is not necessarily correct (e.g. flows of ~3 m^3/s may be lower). Given BCCF stream flow data, Grandon Creek has very low flows during the summer months, with lower flows in 2014 than in 2013.

Figure 8 – Grandon Creek streamflow data collected by the BC Conservation Foundation.

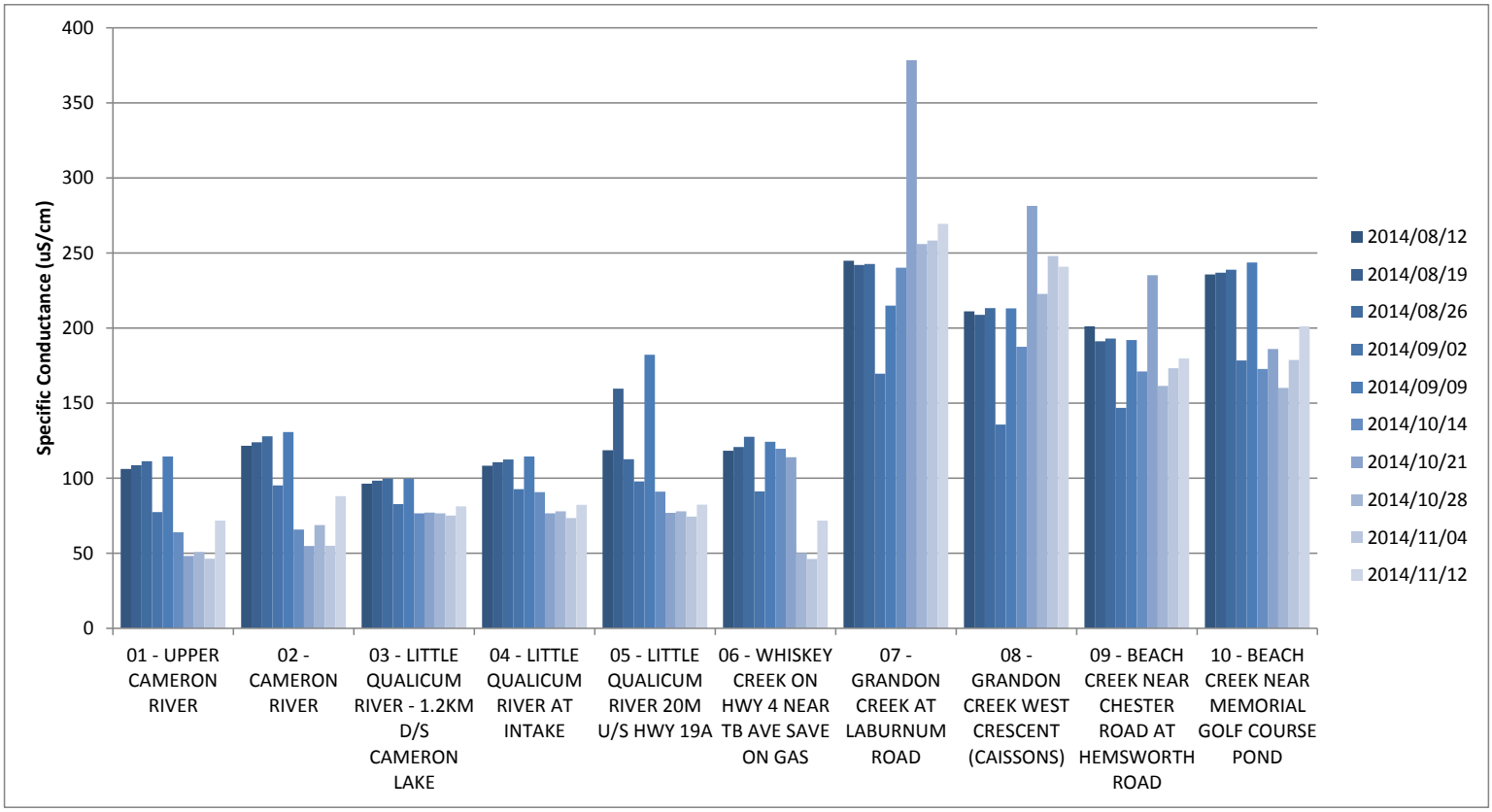


Specific Conductance

Specific conductivity data were similar to previous years (2011 through to 2013) with higher levels than those typical of coastal streams, particularly in Grandon and Beach Creeks (Figure 9). Higher conductivity levels were not correlated with turbidity increases in Cameron and Little Qualicum Rivers or Whiskey Creek during the summer sampling period. There was a drop in conductivity at all sites on September 2, 2014 relative to other monitoring days. This decrease may be explained by a rain event that came after three weeks of dry weather, resulting in greater dilution.

The Qualicum Beach Streamkeepers (QBS) noted that the new site on Little Qualicum River 20 metres upstream Highway 19A may be vulnerable to tidal influence. On September 9, 2014 volunteers sampled the site at 11:15 am. The tide was predicted to reach a high of 4.4 metres that day at 6:05 am and a low of 1.5 metres at 12:26 pm. Since the tide would have been ebbing and almost at its lowest level when sampling was conducted, tidal influence was not responsible for the spike in conductivity on September 9, 2014 at this new site.

Figure 9 – Specific conductance collected by the Qualicum Beach Streamkeepers.



Turbidity

Turbidity values less than zero were recorded at the Upper Cameron River site September 2, September 9, and November 12, 2014. Data were corrected by that value for all other sites on those dates to validate the data. Turbidity exceeded the objective of 2 NTU for all summer sampling dates at the upper Grandon Creek (Laburnum Road) site, and exceeded the fall objective of 5 NTU on October 21, 2014 (Figure 10). This fall exceedance correlates directly with a rainfall event (Figure 11). No turbidity objectives were exceeded at any other sites.

Figure 10 – Turbidity collected by the Qualicum Beach Streamkeepers.

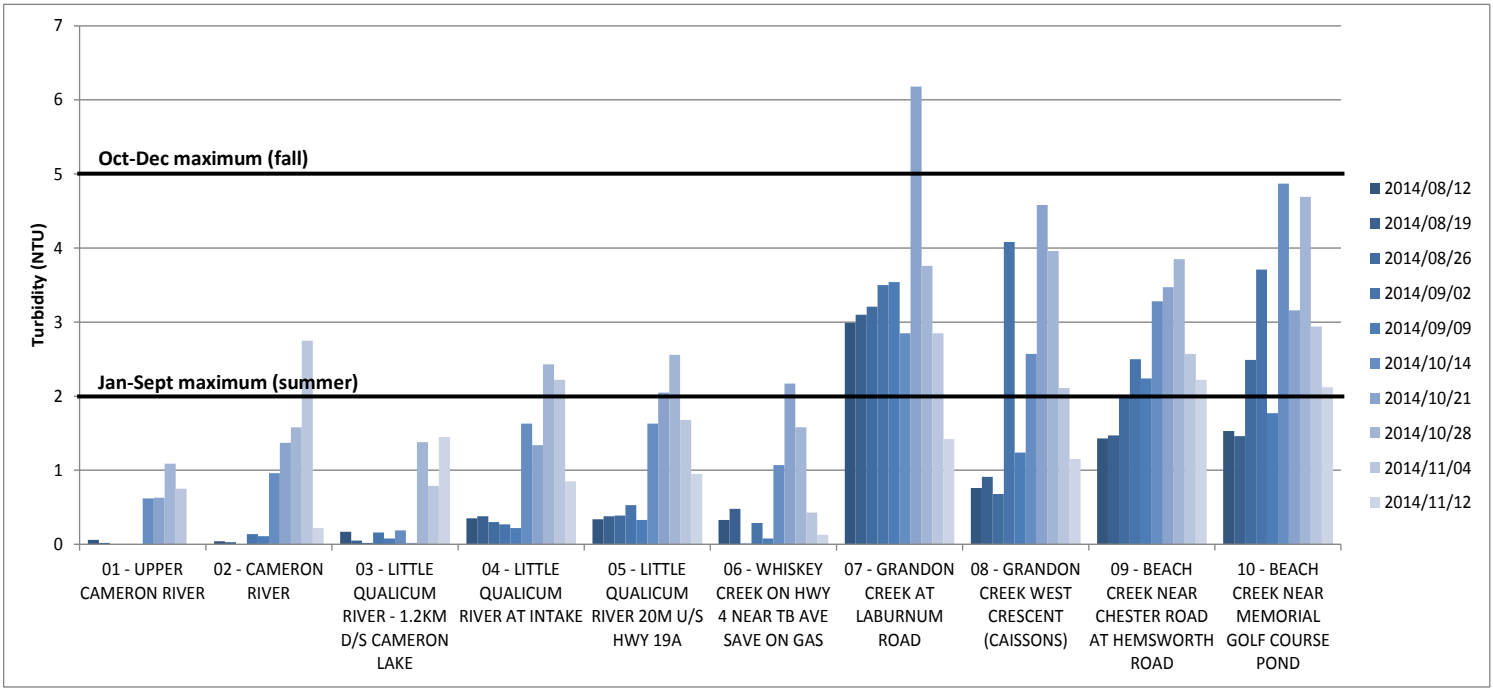
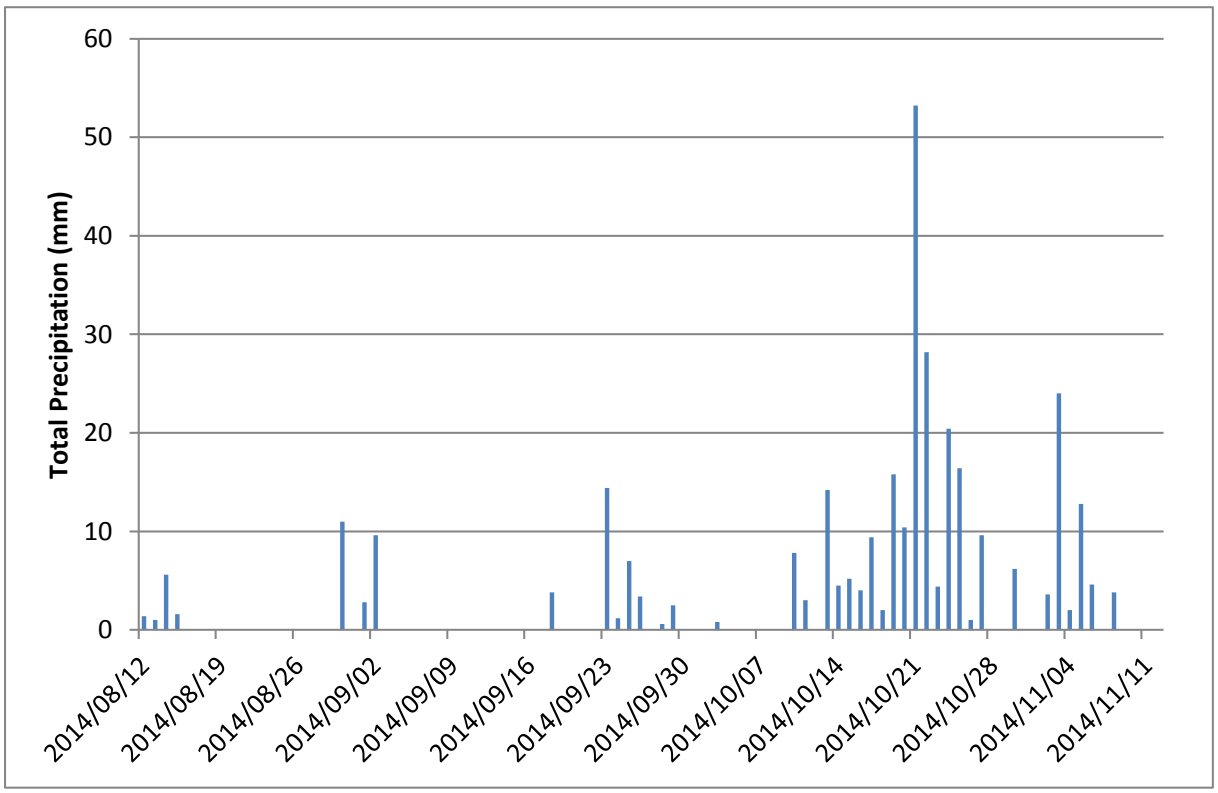


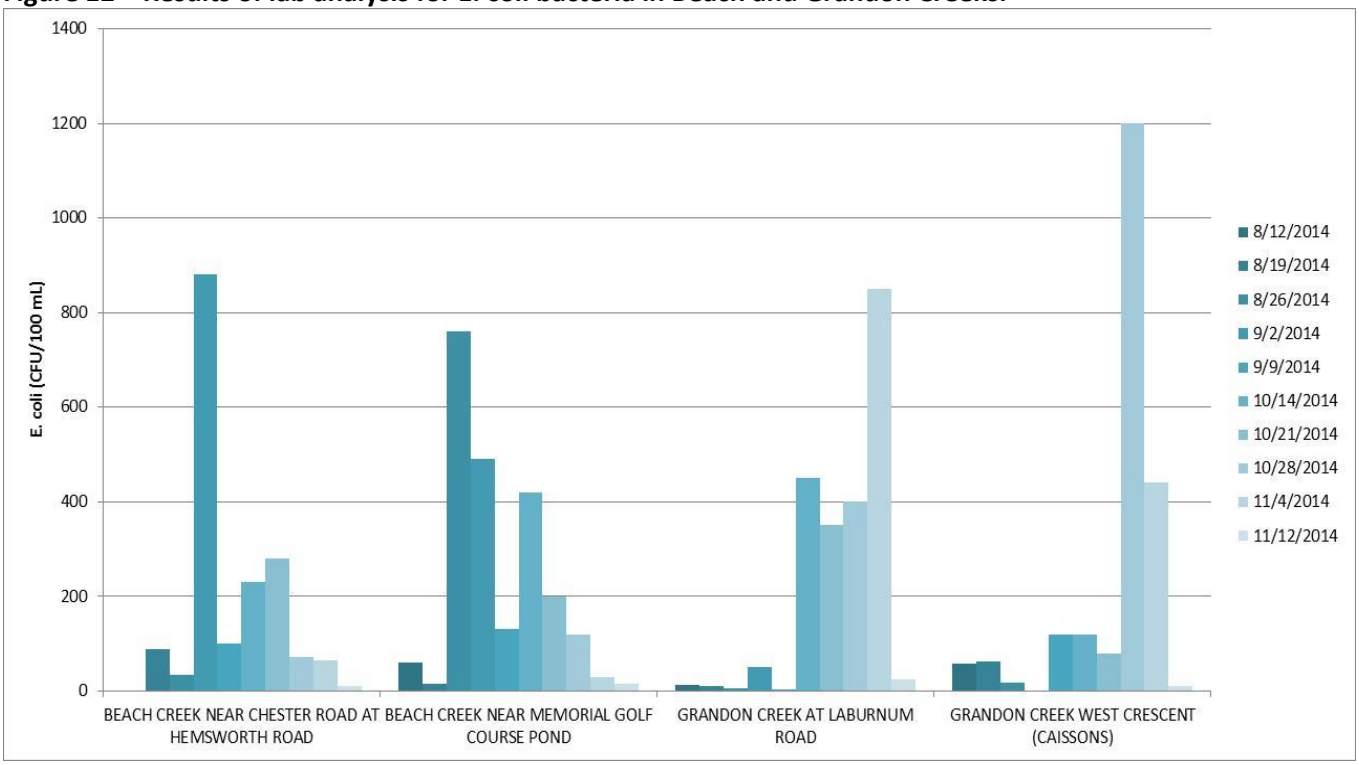
Figure 11 – Climate data for Qualicum Fish Research weather station.



Lab Analysis

Lab analysis for E. coli and total phosphorous (P) were undertaken on water samples from Beach and Grandon Creeks to gain more insight into low dissolved oygen and high turbidity readings in previous years (2011 through to 2013). Results revealed microbiological (E. coli) presence that spiked at various dates in the sampling period (Figure 12).

Figure 12 – Results of lab analysis for E. coli bacteria in Beach and Grandon Creeks.



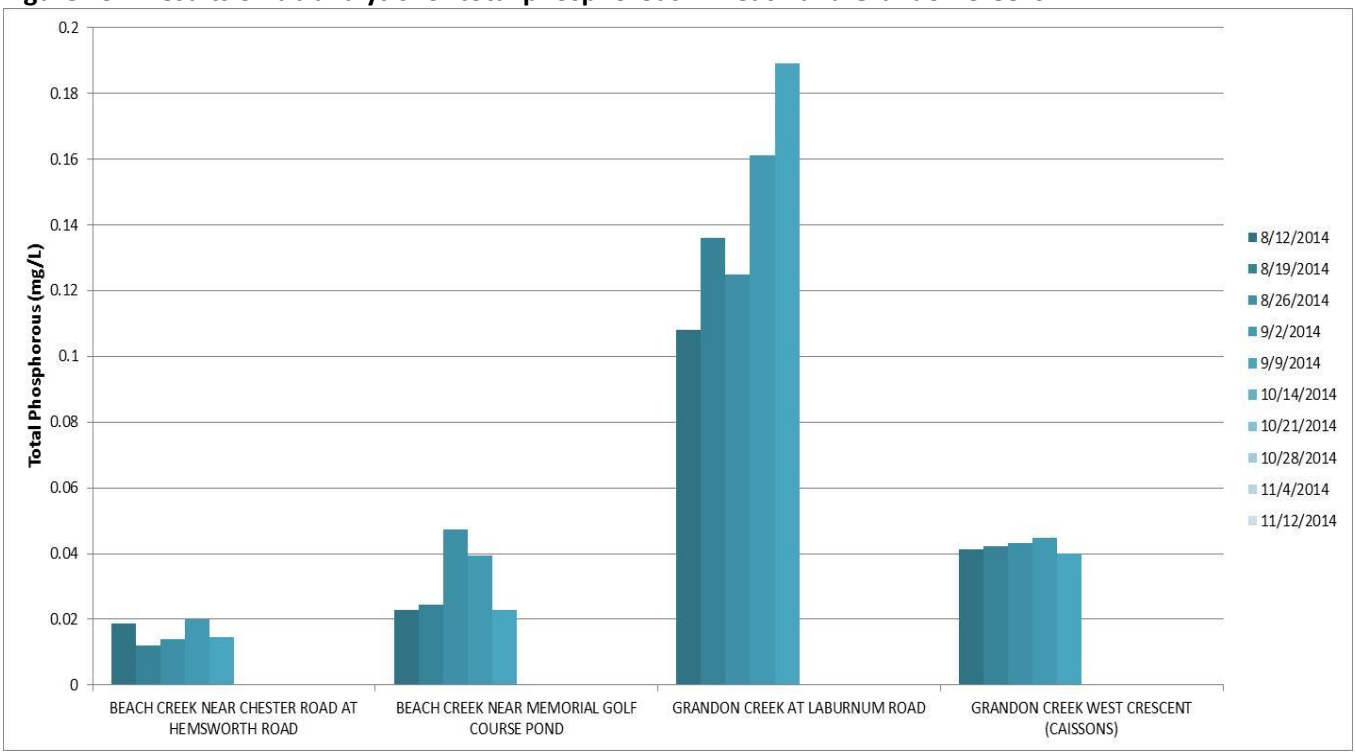
The guidelines for presence of E.coli in water are a geometric mean of less than 77 CFU/100 mL for primary contact (i.e. swimming) and 385 CFU/100 mL for secondary contact (i.e. boating) based on 5 weekly samples in 30 days. A preliminary evaluation of lab results showed E. coli in excess of 700 CFU/100 mL on August 26, 2014 at both sites on Beach Creek, 1200 CFU/100 mL on October 28, 2014 at the lower site on Grandon Creek (West Crescent), and in excess of 800 CFU/100 mL November 4, 2014 at the upper site on Grandon Creek. While the geometric mean has not been calculated, the results are exceeding the guideline. The fall spikes on Grandon Creek can be correlated with rain events (Figure 11).

Conversations between the Memorial Golf Course superintendent and the QBS revealed that a beaver living in Beach Creek as well the presence of deer and birds could be contributing bacteria at the lower site. The upstream Beach Creek site is approximately 100 yards above the Heritage Forest Trail in Qualicum Beach. Beach Creek flows through several residential properties connected to sanitary sewer before reaching the upstream sampling site. In order to determine the source of the bacteria in both Grandon and Beach Creeks more refined lab analysis would be required.

Because of the natural variability of P levels, no guideline exists for total P in Canadian freshwater systems. Instead, levels are compared with baseline data for each individual lake or river. Results of lab analysis for total P showed higher levels in the upper Grandon Creek site relative to the other three sites

sampled (Figure 13). The levels of total P were consistently high and not correlated with rain events (Figure 11).

Figure 13 – Results of lab analysis for total phosphorous in Beach and Grandon Creeks.



The QBS have identified two priorities for Grandon Creek: 1) mitigating harm from winter rain events (stormwater run-off); and, 2) improving summer flows. The QBS plan to undertake stream asessment using the Urban Salmon Habitat Program (USHP) methodology (Michalski et. al., 1997) to identify restoration priorities that would protect the stream from high winter flows. This work will be initiated in June 2015 with the assistance of the RDN and Fisheries Biologist Dave Clough.

Improving summer flows may be addressed by protecting upper watershed areas that are likely contributing to groundwater influence. Educational opportunities exist with a co-housing development underway on Laburnum Road, and an elementary school that wishes to improve drainage on their playing fields; both are in the upper Grandon Creek watershed. Following the USHP assessment, a study assessing groundwater influence on Grandon Creek could illuminate future recommendations for restoration in the upper watershed.

The RDN hosted a workshop for streamside landowners in May 2015 as a precursor to the USHP assessment with the goal of informing local residents about these initiatives and inspiring individual stewardship actions. The QBS have also been working with Town of Qualicum Beach on muncipal work affecting Grandon Creek.

Friends of French Creek Conservation Society

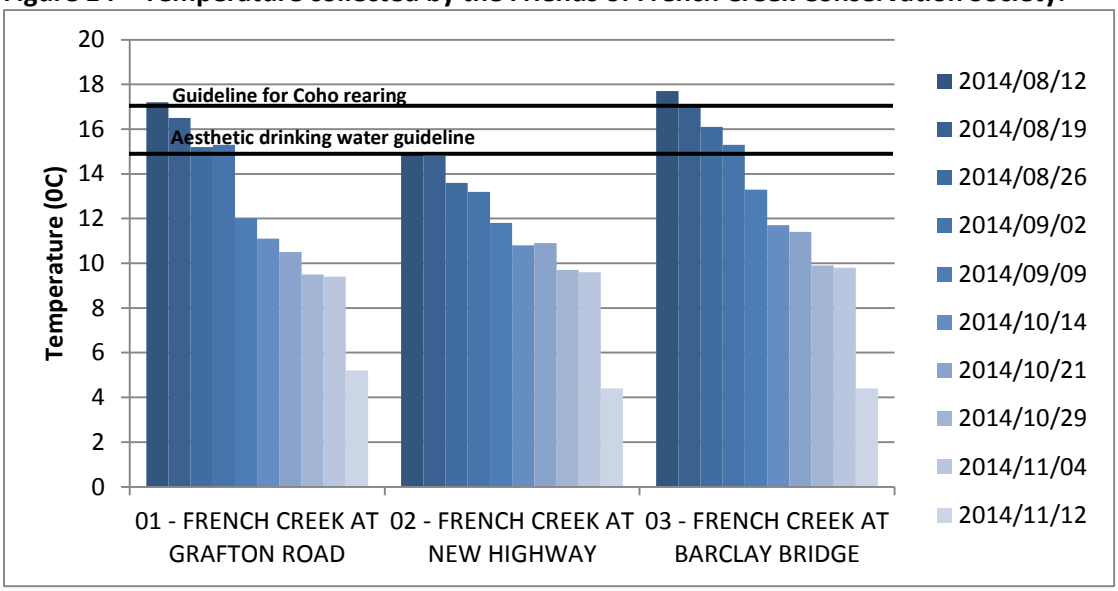
The 2014 Friends of French Creek Conservation Society (FFCCS) monitoring program did not change relative to previous years (2011 – 2013). Following recommendations from the RDN CWMN Water Quality Trend Report, 2011 – 2013 (Barlak and Fegan, 2014) lab analysis of water samples was added to the monitoring program to gain a better understanding of turbidity results.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15^{0}C for the first four weeks of summer sampling at the upper and lowermost sites (Grafton Road and Barclay Bridge, respectively), and for the first two weeks of sampling at the middle site (New Highway; Figure 14). Summer temperatures also had the potential to exceed the guideline for Coho rearing (17°C) for the first week of sampling at the upper site and for the first two weeks of sampling at the lowermost sampling site. This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures.

The 2011 – 2013 trend report noted slightly lower maximum and average temperatures at the middle monitoring site that could be the result of more in-stream or over-stream vegetative cover or the influx of ground water into French Creek near this site. The FFCCS volunteers noted that French Creek runs through a gully at the middle site, where a bridge and large maple trees provide shade to the creek. They also speculated about ground water influence, noting that the water seems colder there in the summer. As noted in this trend report, assessing riparian cover and hydrology upstream of the sample sites will provide a better understanding of potential influences on temperature trends in French Creek.

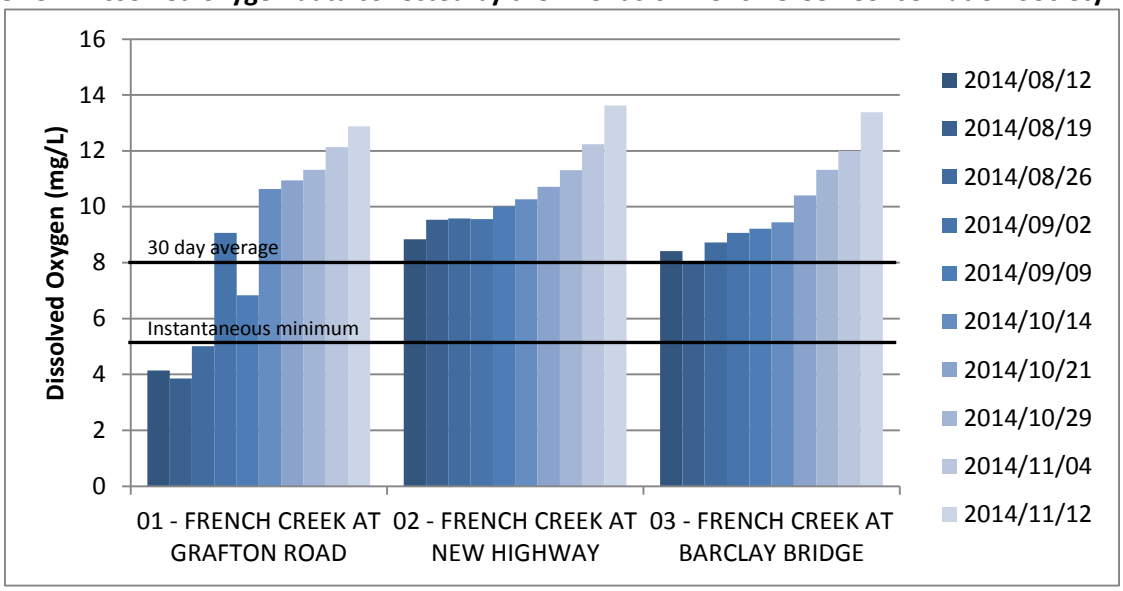
Figure 14 – Temperature collected by the Friends of French Creek Conservation Society.



Dissolved Oxygen

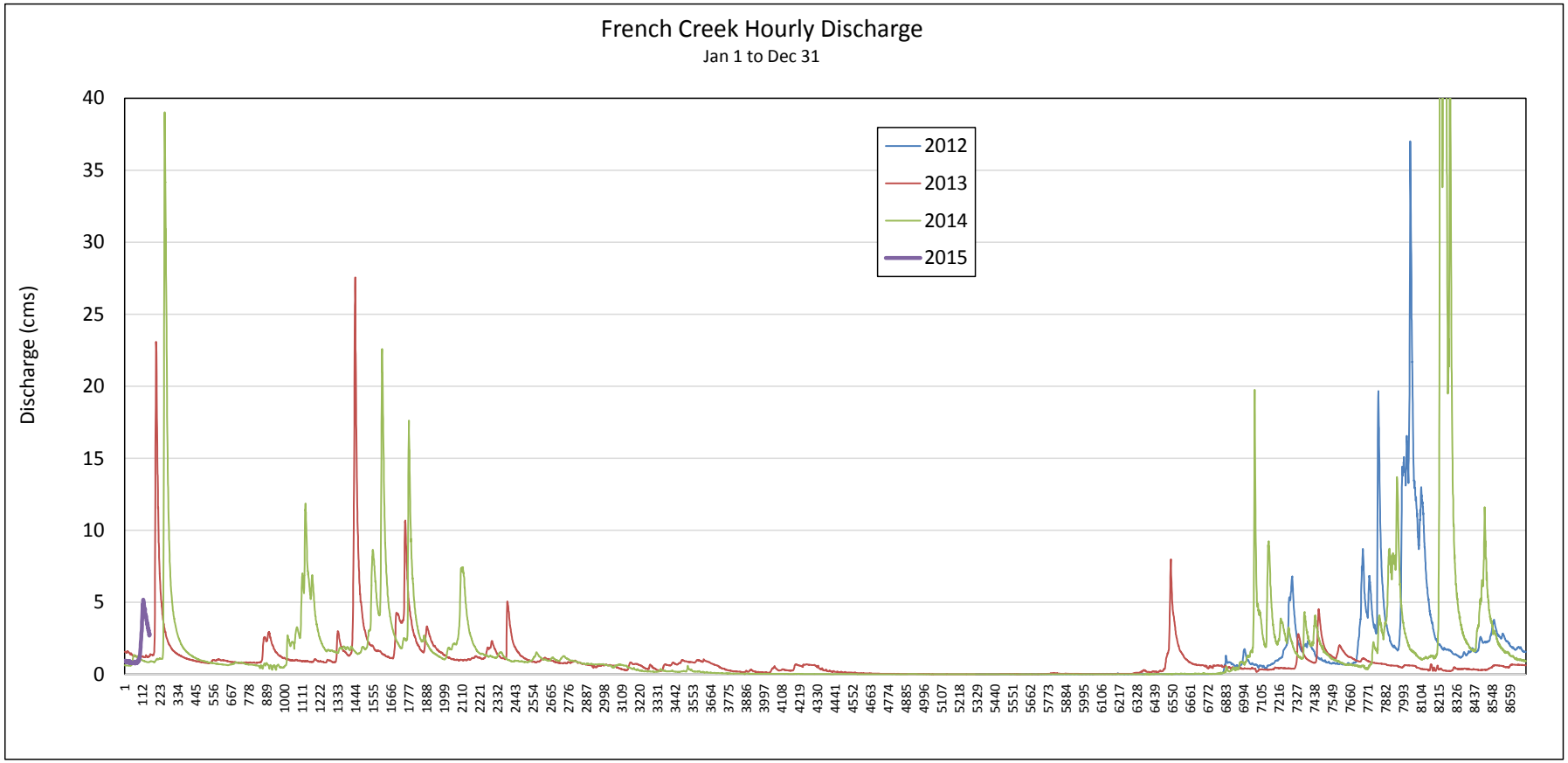
The dissolved oxygen level was below the instantaneous minimum aquatic life guideline of 5 mg/L in the upper site for the first three weeks of the summer sampling period (Figure 15). This is the first time the DO guideline has been exceeded since the FFCCS began monitoring in 2011. The 30 day average for the Grafton Road site was below the guideline of 8 mg/L during the summer sample period (average of 5.78 mg/L not shown). For the remaining sites, the 30 day average data are comparable to 2011, 2012 and 2013.

Figure 15 – Dissolved oxygen data collected by the Friends of French Creek Conservation Society.



The BC Conservation Foundation (BCCF) began collecting stream flow data on French Creek in August 2012. French Creek flows are shown in Figure 16. In 2013 (red line) and 2014 (green line), flows drop off in mid-April and are at 0 cm/s for all of July and August. Low or negligible flow could be a contributing factor in low dissolved oxygen levels observed in 2014.

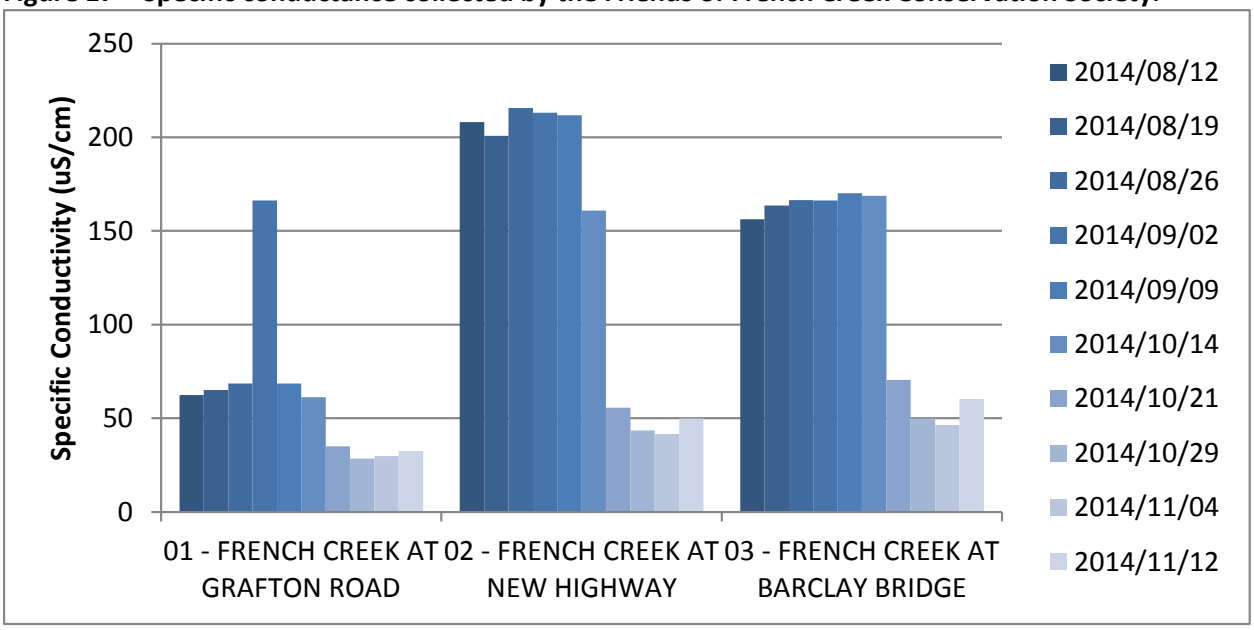
Figure 16 – Real time hydrometric flow data graph for French Creek.



Specific Conductance

Results of measuring conductivity are similar to previous years, the levels are higher than those typical of coastal streams in the lower two sampling sites on French Creek (Figure 16). As noted in the 2011 – 2013 trend report, this potentially is attributed to higher groundwater inputs.

Figure 17 – Specific conductance collected by the Friends of French Creek Conservation Society.



High conductivity on September 2, 2014 at the uppermost site was not correlated with high turbidity (Figure 18). However, the FFCCS volunteers noted that work on French Creek just upstream of the Grafton Road monitoring site began on September 2, 2014. The upstream work was a restoration project led by the Ministry of Transportation and Infrastructure (contact Sean Wong).

Turbidity

There were no exceedances of the summer turbidity objective of 2 NTU for all summer sampling dates (Figure 18). Turbidity exceeded the fall objective of 5 NTU at the Barclay Bridge site for three of the fall sampling dates (October 21, October 29, and November 4, 2014). Fall exceedances correlate with rainfall events (Figure 19).

Figure 18 – Turbidity collected by the Friends of French Creek Conservation Society.

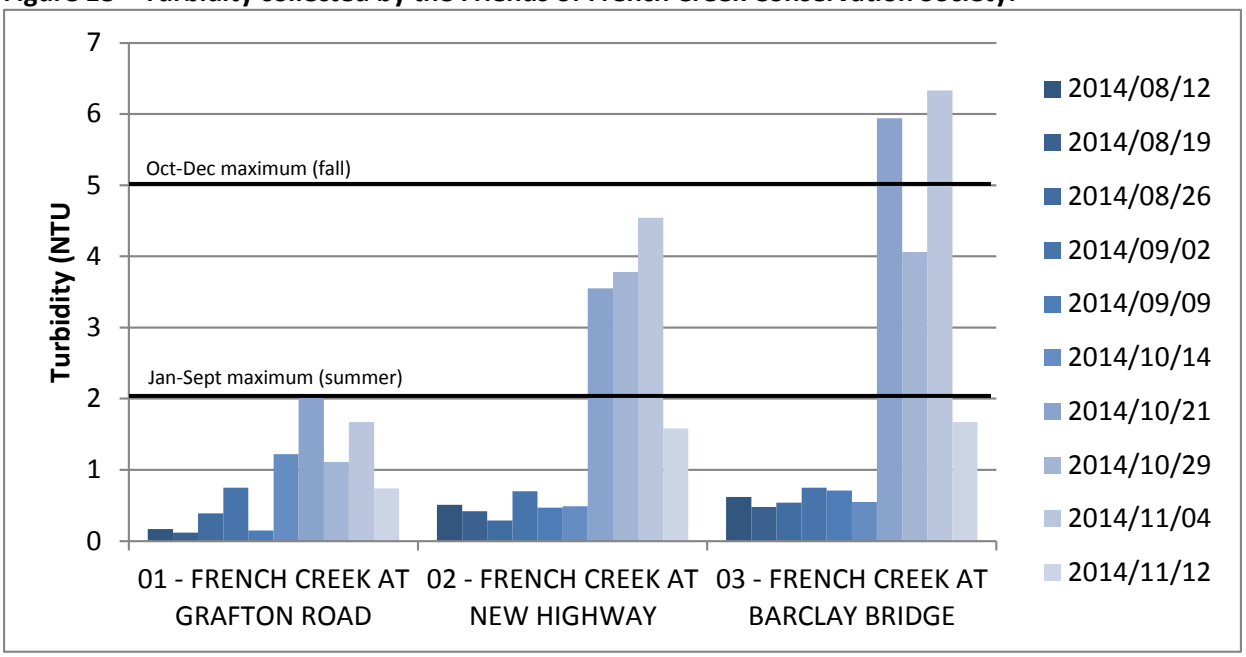
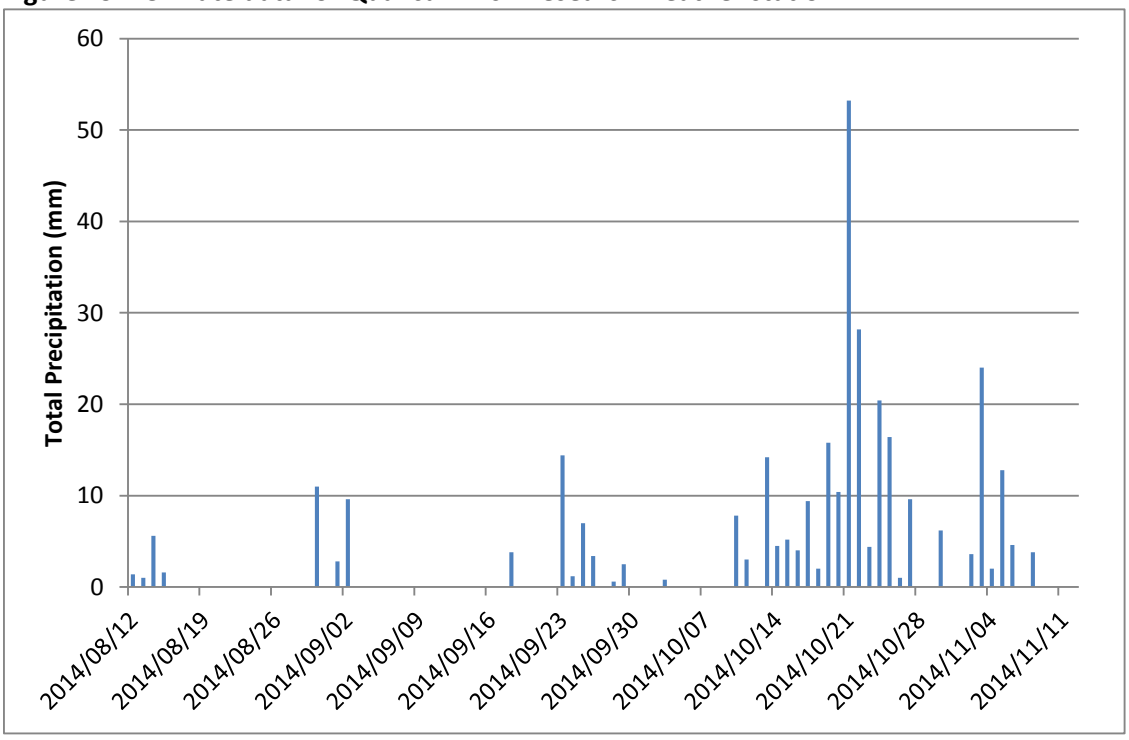


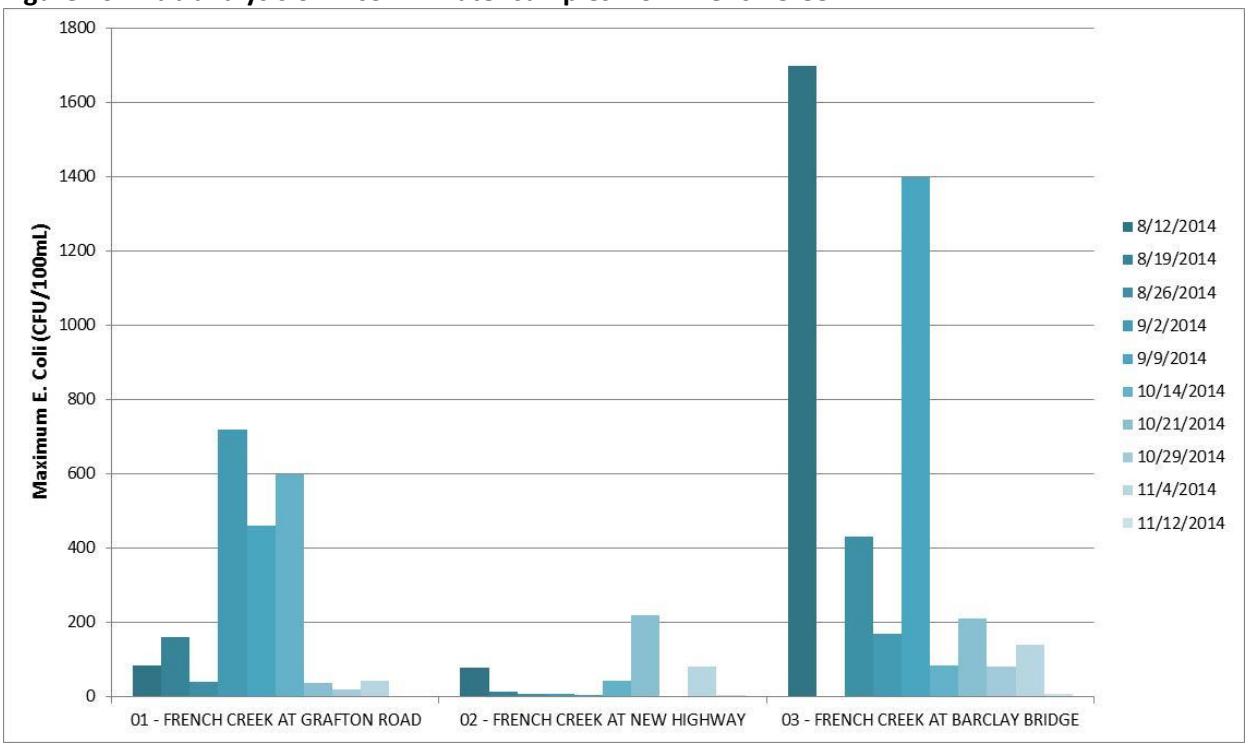
Figure 19 – Climate data for Qualicum Fish Research weather station.



Lab Analysis

In 2014 single sample lab tests for E. coli showed definite microbiological spikes in French Creek, particularly at the lowermost sample site at Barclay Bridge (Figure 20). The guidelines for presence of E.coli in water are a geometric mean of less than 77 CFU/100 mL for primary contact (i.e. swimming) and 385 CFU/100 mL for secondary contact (i.e. boating) based on 5 weekly samples in 30 days. A preliminary evaluation of lab results for E. coli in French Creek showed a bacterial excess of 1000 CFU/100 mL on 4 of the 5 sample dates. While the geometric mean has not been calculated, the results are exceeding the guideline at the lowermost monitoring site.

Figure 20 – Lab analysis of E. coli in water samples from French Creek.



While E. coli can be from human sources such as failing septic systems, the high values can also be attributed to agricultural manure spreading, livestock, dogs, deer, gulls, bears, or other wildlife. Research into septic and sewer connections in the area showed that many properties were included in sewer servicing in 2014 (Figure 21); one property in particular near the Barclay Bridge monitoring site was connected to sewer on August 29, 2014. Since lab analysis continued to show high values for E. coli in September 2014, this septic system noted could still be contributing bacteria unless it was pumped out immediately following sewer connection. It is also possible that there are other bacteriological inputs. The FFCCS volunteers noted that there are always between 20 - 50 ducks upstream of the Barclay Bridge monitoring site. Bacteria could also be from manure from forage/pasture land upstream (Figure 22).

Figure 21 – French Creek Sewer Service Area Boundary

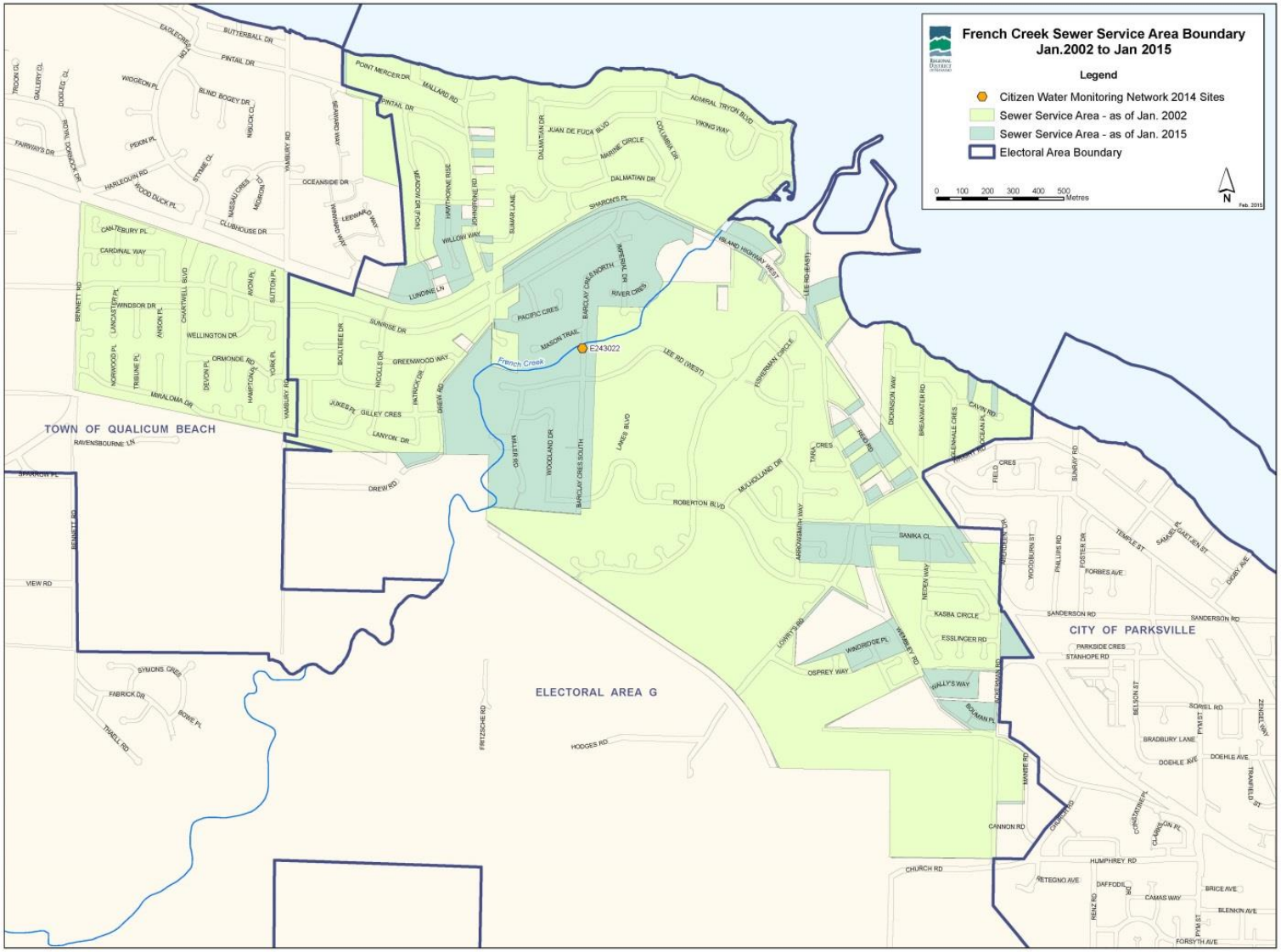
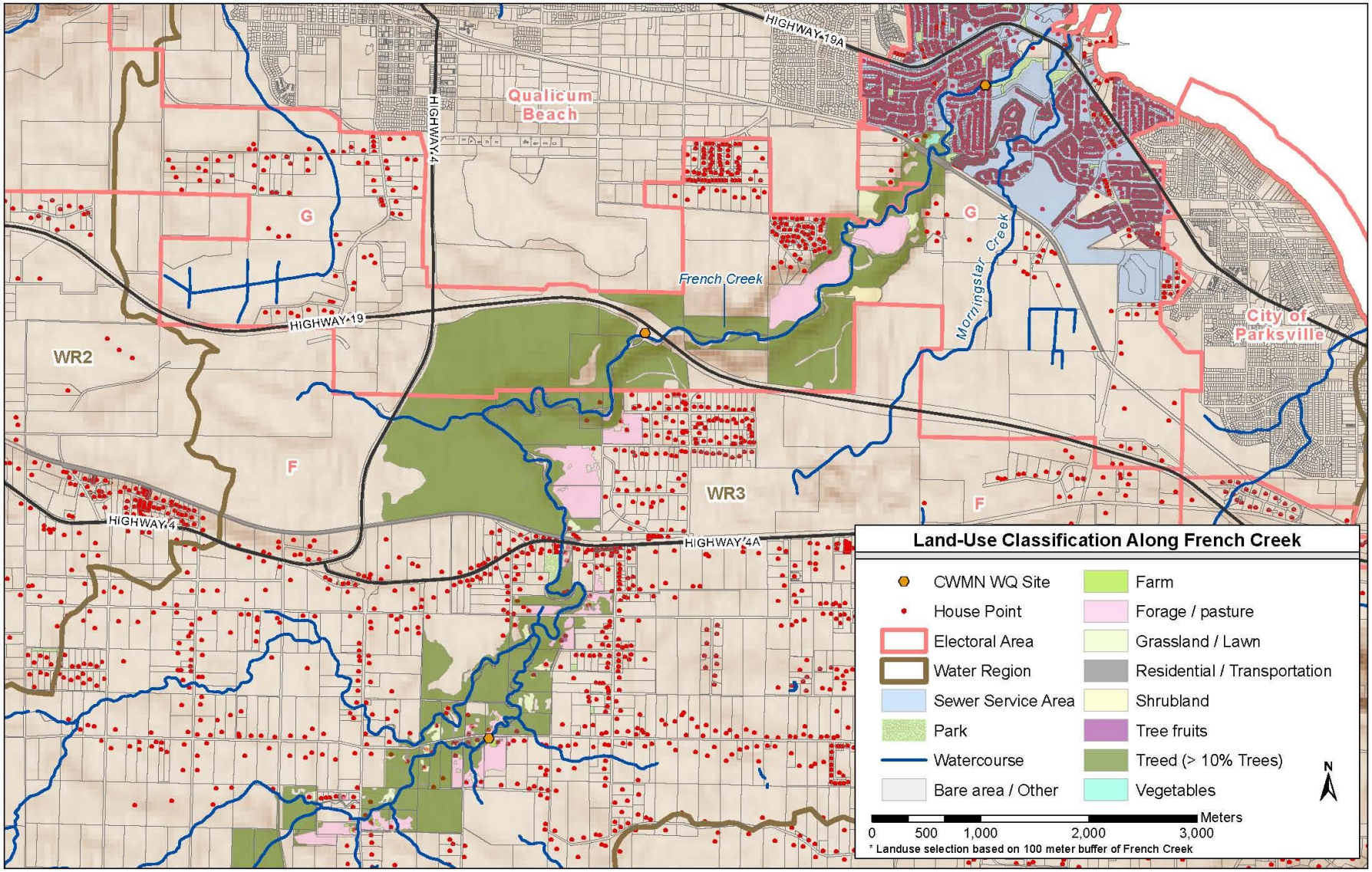
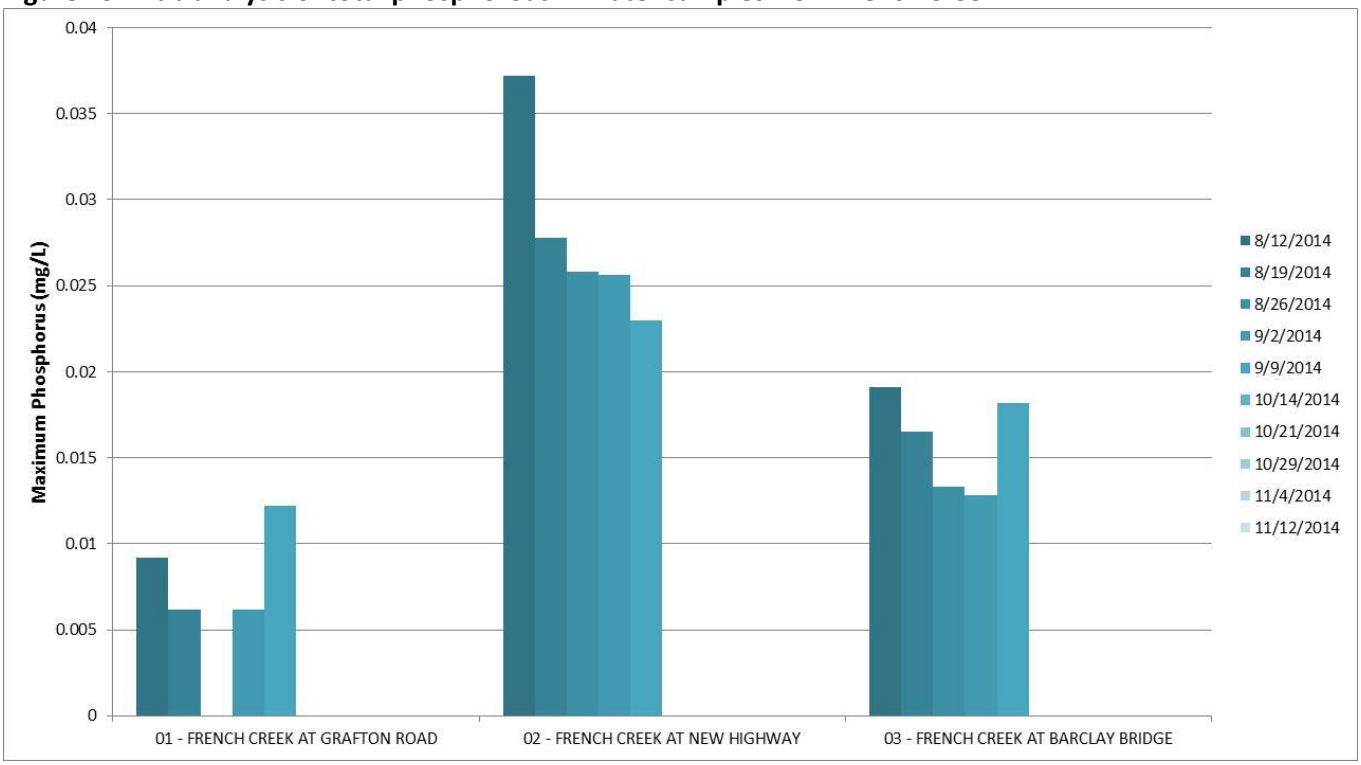


Figure 22 – Land Use Classification Along French Creek



Because of the natural variability of total phosphorous (P) levels, no guideline exists for total P in Canadian freshwater systems. Instead, levels are compared with baseline data for each individual lake or river. Lab analysis for P was undertaken in French Creek to gain more insight into low dissolved oygen and high turbidity readings in previous years, results from the lab analysis are seen in Figure 23.

Figure 23 – Lab analysis of total phosphorous in water samples from French Creek.



It should also be noted that volunteers observed the prescence of rock snot, or *Didymosphenia geminata*, in the creek at the Barclay Bridge monitoring site. This microscopic alga can be an indicator of low nutrient levels, and produces nuisance growth that can affect stream habitat.

Following recommendations from the 2011 – 2013 trend report, in June 2015 the FFCCS volunteers will be undertaking 2 days of training in the Urban Salmon Habitat Program (USHP) stream assessment methodology (Michalski et. al., 2001). This work will provide information about physical stream characteristics and help guide future restoration activities.

Mid Vancouver Island Habitat Enhancement Society

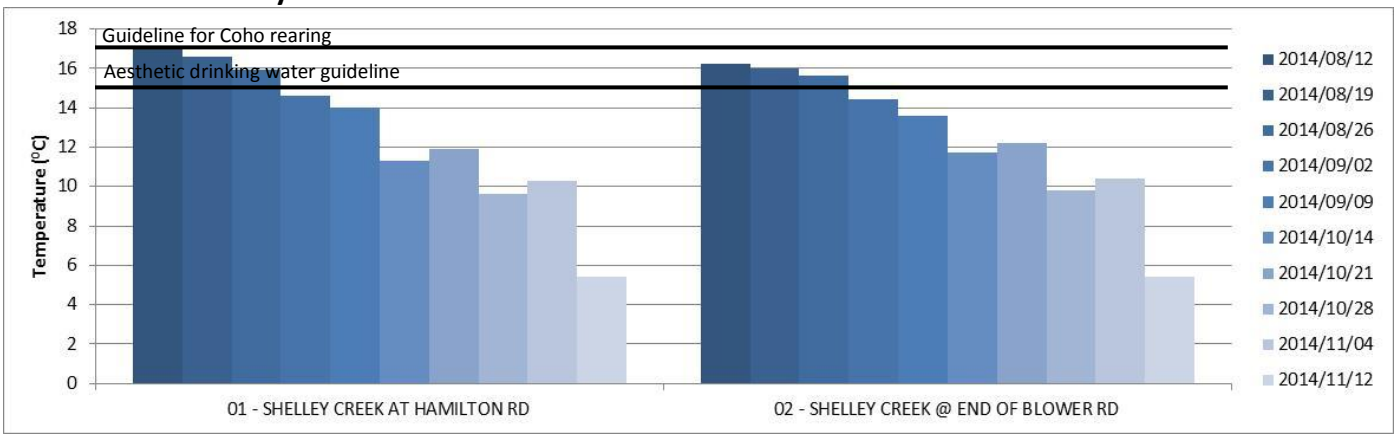
The Mid Vancouver Island Habitat Enhancement Society (MVIHES) volunteers have monitored water quality on several sites along the Englishman River and its tributaries, and Shelley Creek near the municipality of Parksville, as part of the CWMN since 2011. In 2014, monitoring at the Allsbrook Canyon Englishman River site was suspended because the RDN CWMN Water Quality Trend Report, 2011 – 2013 (Barlak and Fegan, 2014) showed continuous good water quality at that location. New sites were added on Centre Creek (just upstream of its confluence with the Englishman River), on Swayne Creek (a tributary to Morison Creek/Englishman River) and on Shelly Creek (upstream of Blower Road at Hamilton Road).

Lab analysis for QA/QC was performed on three sites in 2014 – Englishman River at Highway 19A, Shelly Creek at Blower Road, and Morison Creek upstream of the Englishman River. In addition, water samples were sent for lab analysis of total phosphorous (P) and E. coli presence from both sites on Shelly Creek, and the Swayne Creek and Morison Creek sites.

Temperature

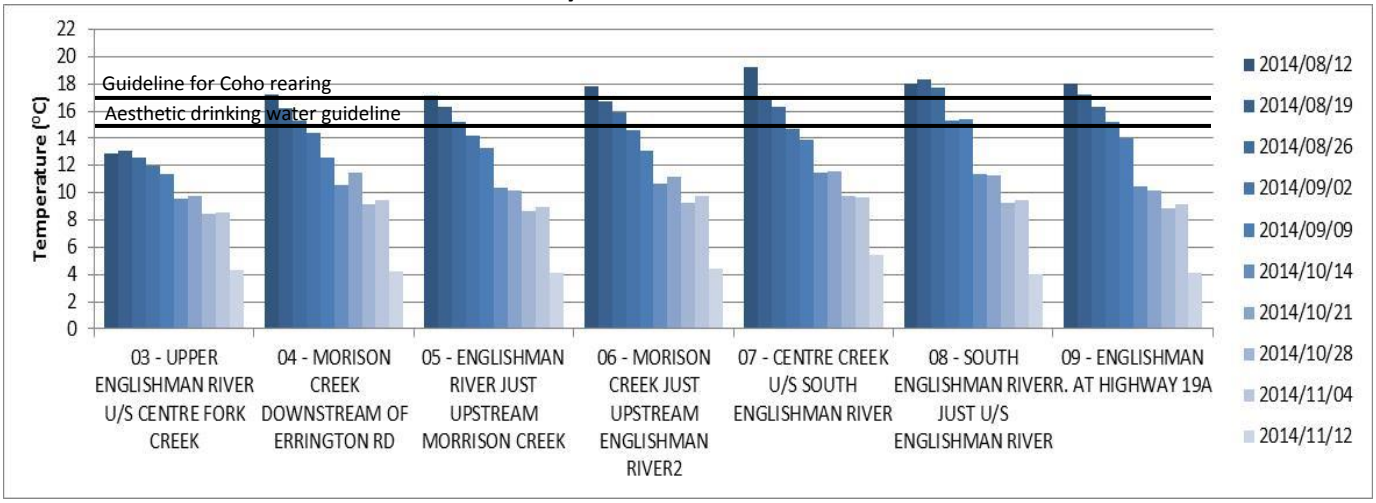
There was potential for exceedance of the aesthetic drinking water temperature guideline (weekly average $\leq 15^0$C) for the first three weeks of the summer sample period at both sites monitored on Shelly Creek (Figure 24).

Figure 24 – Temperature in Shelly Creek collected by the Mid Vancouver Island Habitat Enhancement Society.



There was also potential for exceedance of the aesthetic drinking water temperature guideline (weekly average $\leq 15^0$C) for the first three weeks of the summer sample period in all but the uppermost Englishman River site, and for the first four weeks of summer sampling in the two lowest Englishman River sites (Figure 23). Summer temperatures also had the potential to exceed the guideline for Coho rearing (weekly average $\leq 17^o$C) during the first week of summer sampling in all sites except the site on the Upper Englishman River, and during the second week of summer sampling in the two lowest Englishman River sites. This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures. The 2011 – 2013 trend report noted that assessment of riparian cover upstream of sites with the potential for temperature exceedances will help guide riparian area restoration activities.

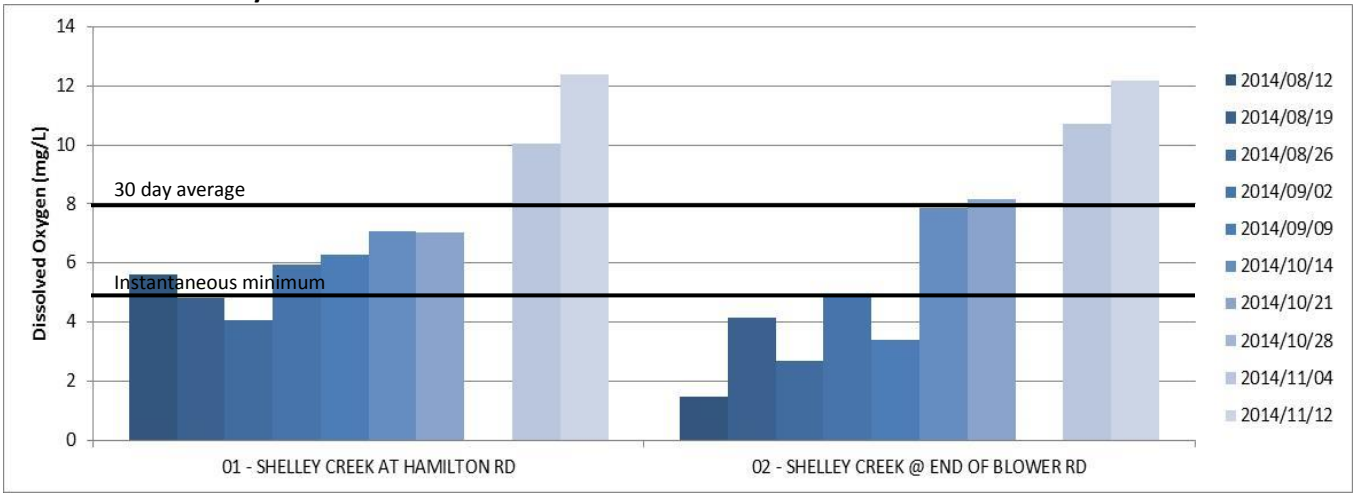
Figure 25 – Temperature in the Englishman River and upper tributaries collected by the Mid Vancouver Island Habitat Enhancement Society.



Dissolved Oxygen

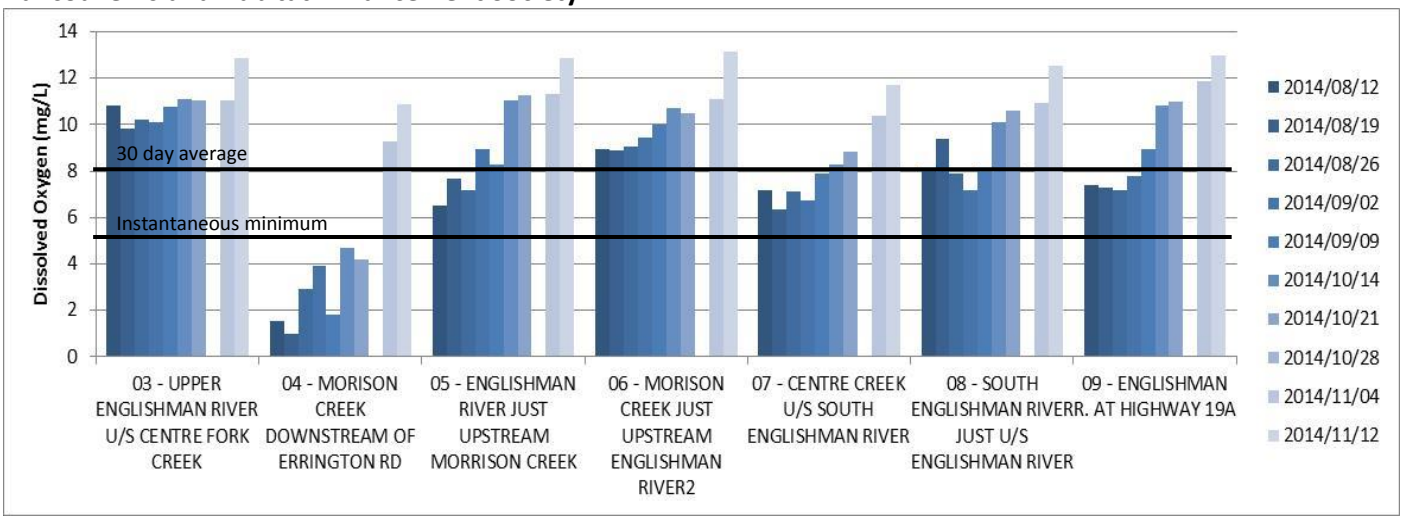
DO values in Shelly Creek are shown in Figure 26, no dissolved oxygen data was collected on October 28, 2014 due to equipment malfunction. The 30 day average was below the guideline of 8 mg/L in both the upper and lower Shelly Creek sites during the entire summer sample period (5.348 mg/L and 3.326 mg/L respectively, not shown in graph below). DO values were also below the instantaneous minimum aquatic life guideline of 5 mg/L in the upper Shelly Creek site in the third week of summer sampling, and in the lower Shelly Creek site for the entire summer monitoring period.

Figure 26 – Dissolved oxygen in Shelly Creek collected by the Mid Vancouver Island Habitat Enhancement Society.



Dissolved oxygen values in the Englishman River and upper tributaries are shown in Figure 27. The 30 day average was below the guideline of 8 mg/L in Swayne Creek downstream of Errington Road, Englishman River upstream Morison Creek, Centre Creek, and Englishman River at Highway 19A (2.242 mg/L, 7.712 mg/L, 7.046 mg/L, and 7.716 mg/L respectively, not shown in graph below). Dissolved oxygen was lower in the 2014 summer sample period than in previous years, DO exceedances may be related to low summer flow.

Figure 27 – Dissolved oxygen in Englishman River and upper tributaries collected by the Mid Vancouver Island Habitat Enhancement Society.



Specific Conductance

Specific conductance was similar to previous years – the levels are higher than those typical of coastal streams, particularly in Shelly Creek (Figure 28). Specific conductance was slightly higher at all sites in 2014 relative to previous years, which supports a drier year. Specific conductance is relatively high in the Morison Creek downstream of Errington Rd and South Englishman sites (Figure 29). This may be attributed to increased turbidity at the Morison Creek site (Figure 31), as well as possible groundwater influence at both sites.

There was a drop in conductivity at all sites on October 28, 2014 relative to other monitoring days. This may be explained by a rain event on October 21 that delivered more than 50 mm of rain in a 24 hour period (Figure 32), subsequently resulting in greater dilution.

Figure 28 – Specific conductance in Shelley Creek collected by the Mid Vancouver Island Habitat Enhancement Society.

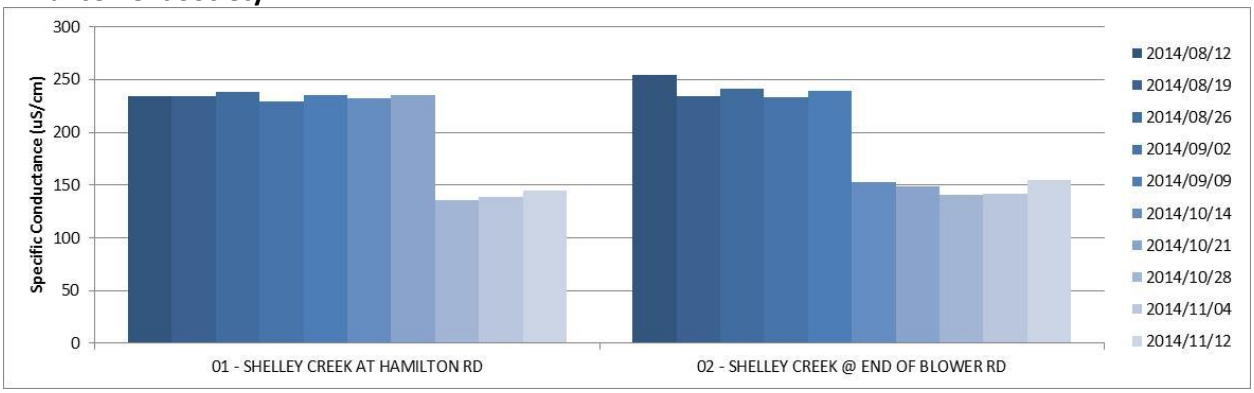
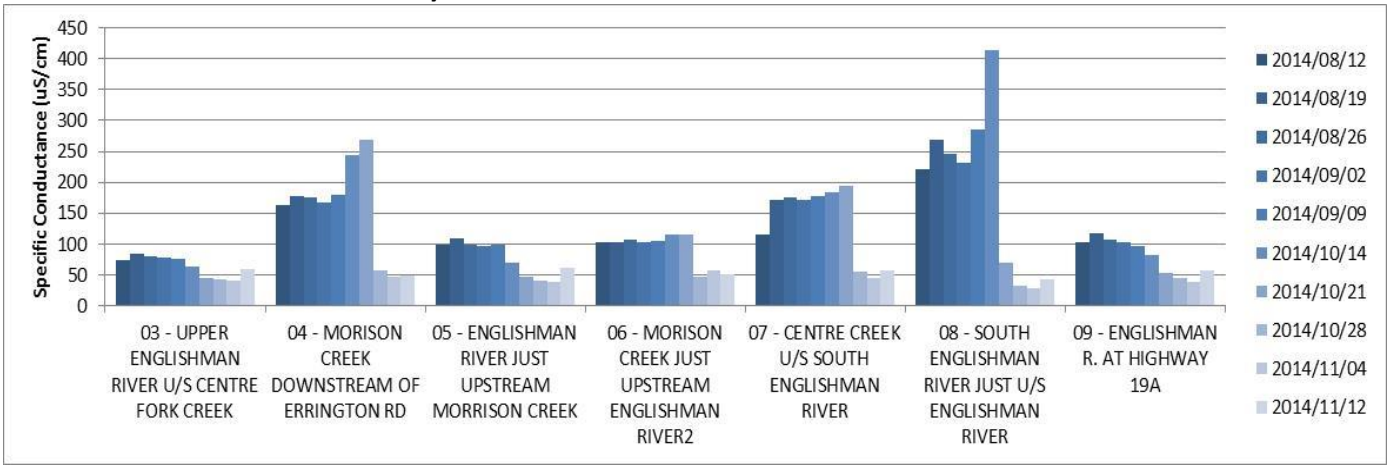


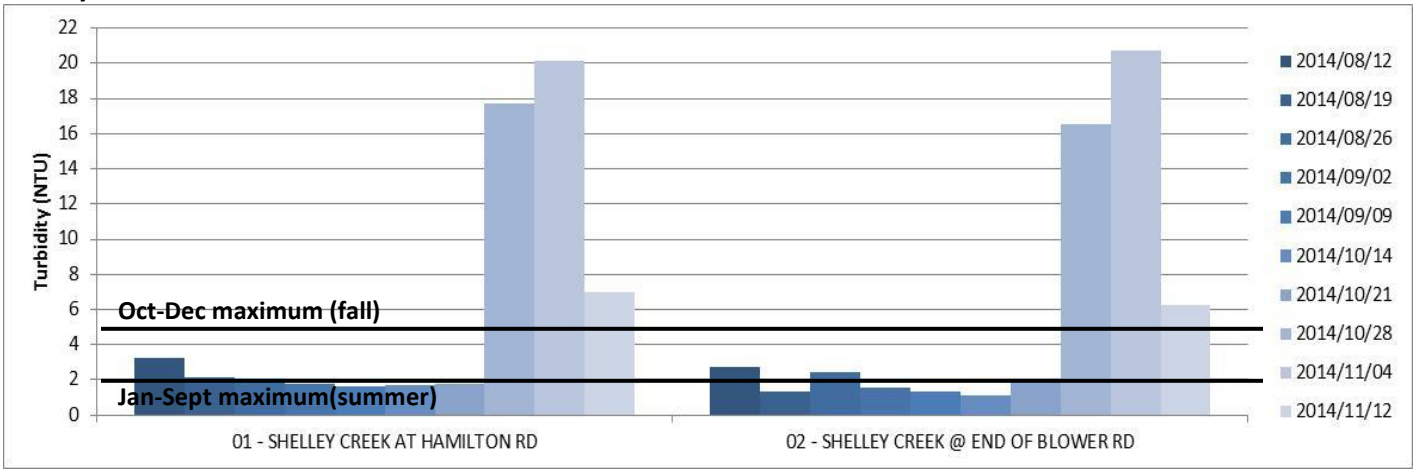
Figure 29 – Specific conductance in Englishman River and tributaries collected by the Mid Vancouver Island Habitat Enhancement Society.



Turbidity

Turbidity exceeded the January – September (summer) objective of 2 NTU for the first three weeks of sampling in the upper Shelly Creek site, and on August 12 and 26, 2014 at the lower Shelly Creek site(Figure 30). Dramatic exceedances in the last three weeks of fall monitoring on Shelly Creek correlate directly with a heavy rainfall event (Figure 9).

Figure 30– Turbidity in Shelly Creek collected by the Mid Vancouver Island Habitat Enhancement Society.



Turbidity exceeded the January – September (summer) objective of 2 NTU on three of the five days monitoring the upper site in Morison Creek, and on the first week of summer sampling at the lower Morison Creek site (just upstream Englishman River). Turbidity also exceeded the fall objective of 5 NTU on October 21, 28, and November 4, 2014 in the upper Morison Creek site, and on October 28, November 4, and 12, 2014 on the lower Morison Creek site. The fall exceedances correlate directly with rainfall events (Figure 9).

Figure 31 – Turbidity in Englishman River and tributaries collected by the Mid Vancouver Island Habitat Enhancement Society.

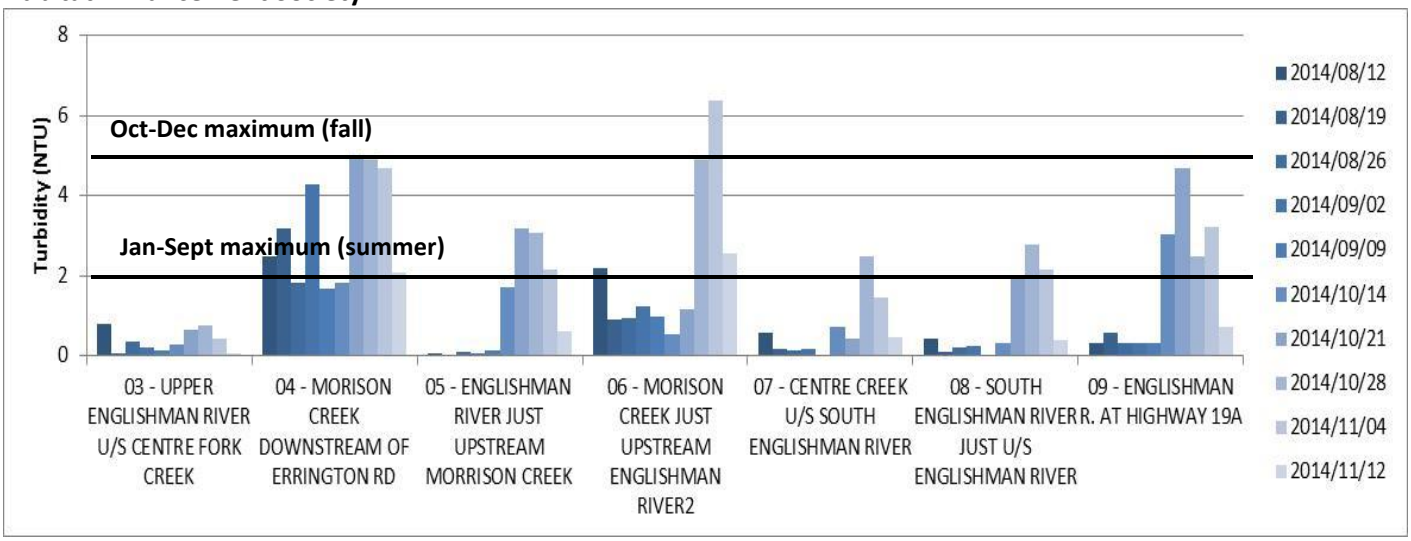
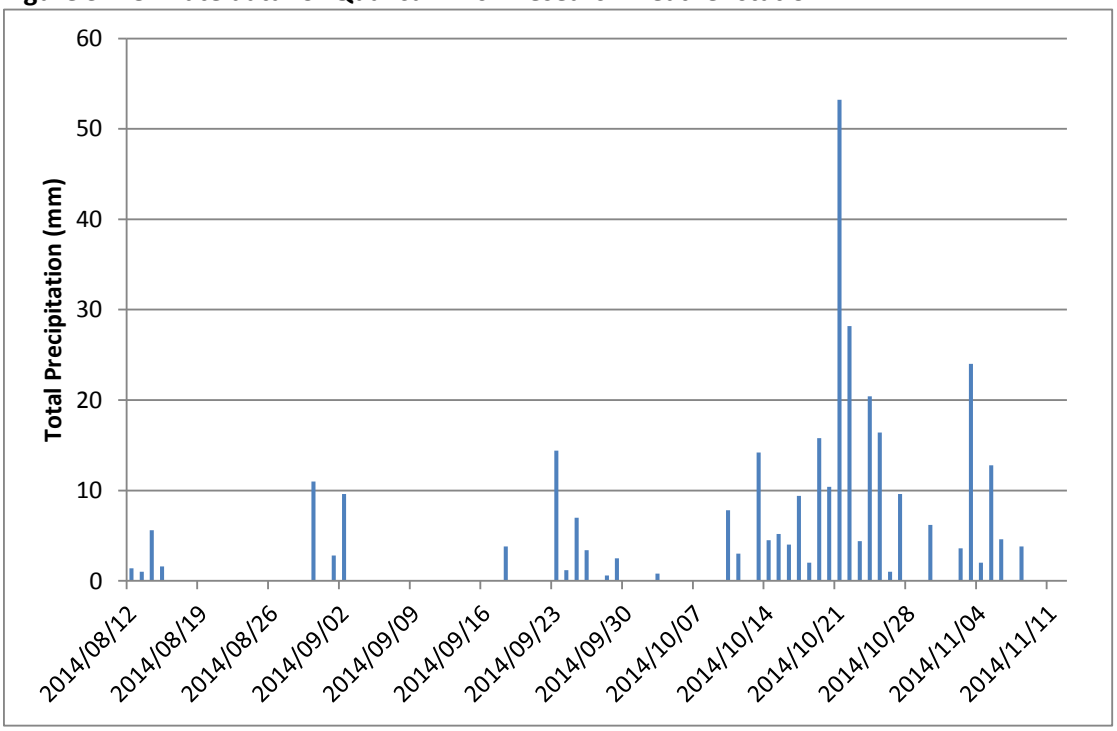


Figure 32. Climate data for Qualicum Fish Research weather station.



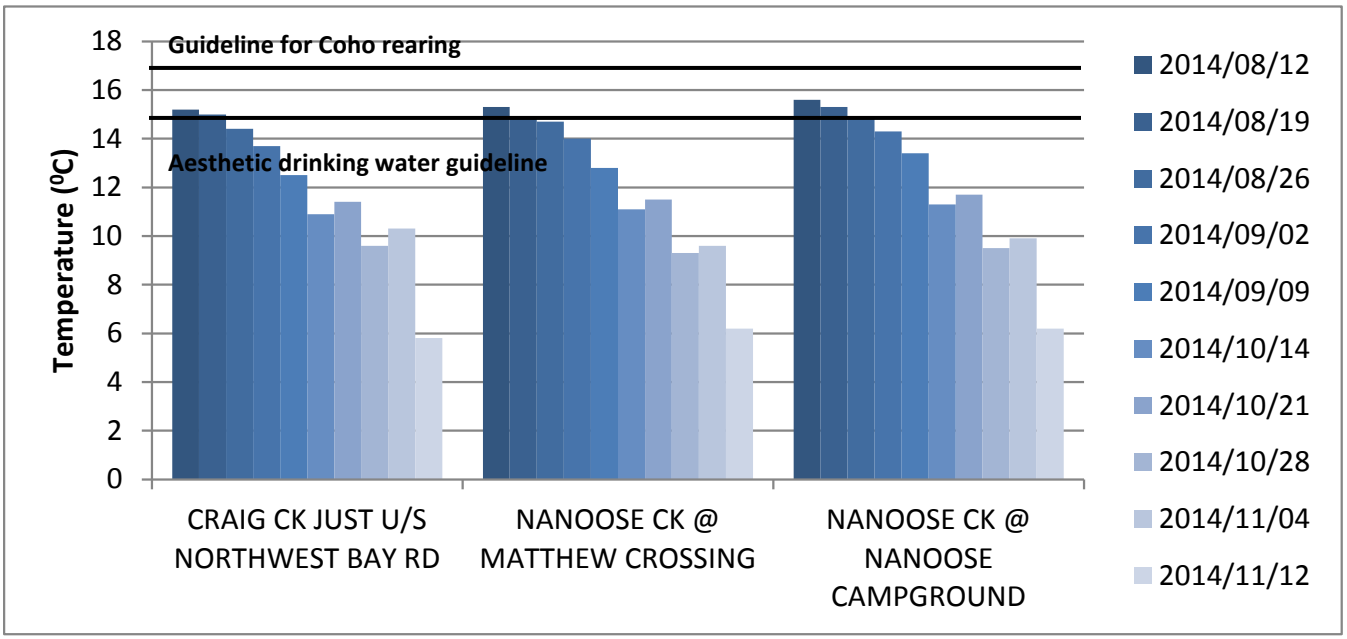
Lantzville-Nanoose Streamkeepers

2014 was the second year that Lantzville Nanoose Streamkeepers (LNS) participated in the Community Watershed Monitoring Network. Since good water quality was observed at several of the sites in 2013, and the volunteer commitment changed for 2014, the number of sites was reduced from twelve to three in order to continue monitoring priority areas.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C during the first two weeks of the summer sample period at all three monitoring sites (Figure 33). No other temperature guidelines had the potential for exceedance in this monitoring period.

Figure 33 – Temperature collected by Lantzville Nanoose Streamkeepers.

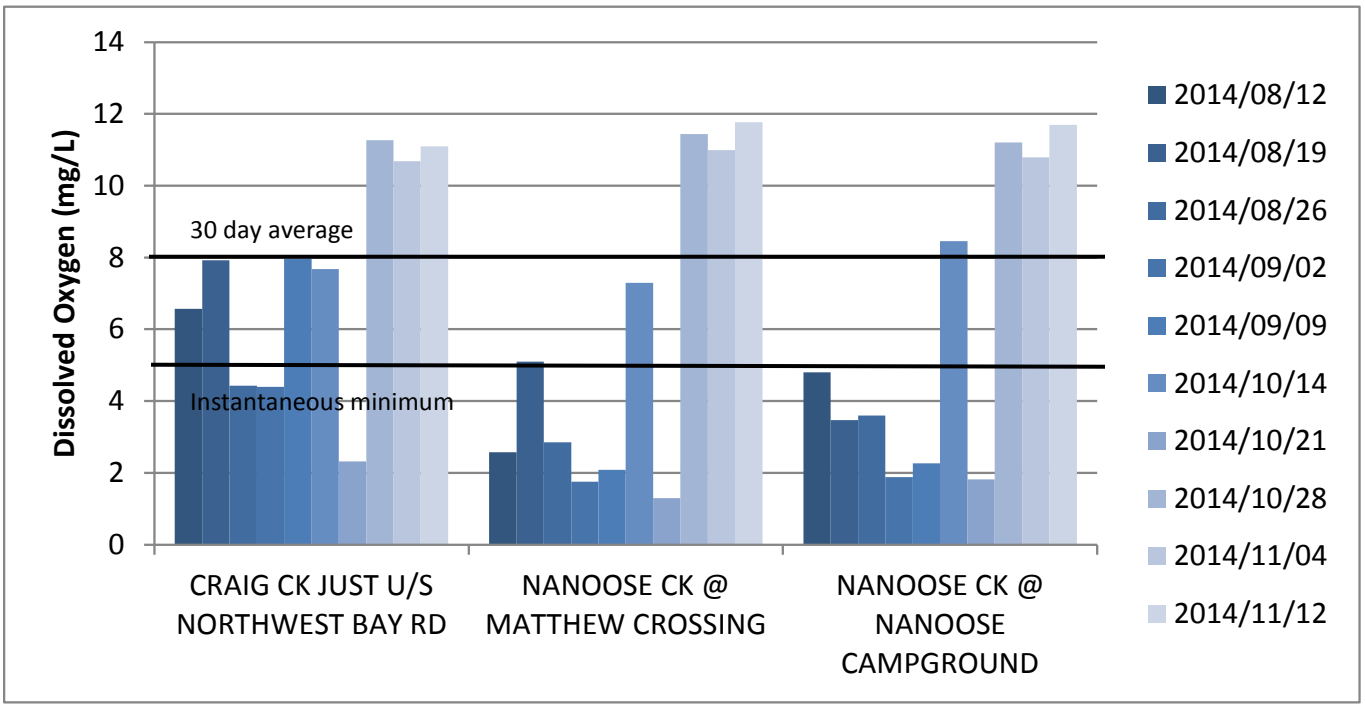


Dissolved Oxygen

Dissolved oxygen (DO) values for 2014 are shown in Figure 34. The 30 day average was below the guideline of 8 mg/L at all sites during the summer sampling period, with average values of 6.256 mg/L, 2.87mg/L, and 3.202 mg/L from upstream to downstream or left to right. (Average values are not shown in the graph below.) DO levels were also below the instantaneous minimum guideline for aquatic life of 5 mg/L in Craig Creek on August 26 and September 2, 2014, and for all summer monitoring dates in both Nanoose Creek monitoring sites.

Low dissolved oxygen values on October 21, 2014 relative to adjacent monitoring dates are likely due to calibration error or equipment malfunction. Taking this into account, no guidelines for DO were exceeded during the fall monitoring period.

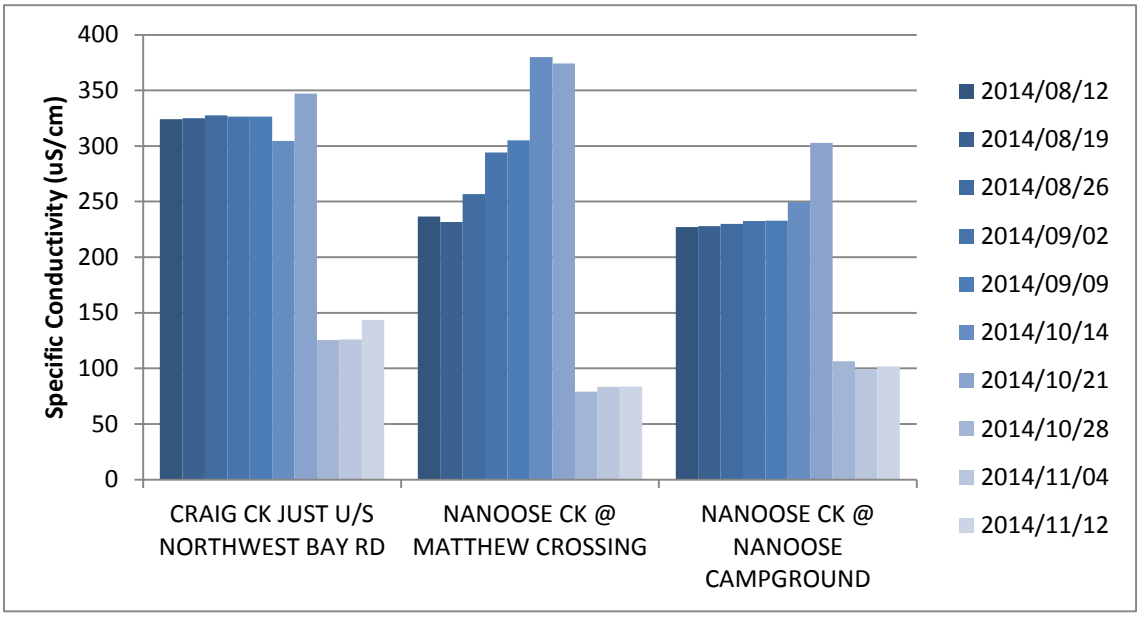
Figure 34 – Dissolved oxygen data collected by Lantzville Nanoose Streamkeepers.



Specific Conductance

Results of measuring specific conductance are similar to 2013 – the levels are higher than those typical of coastal streams. High conductivity may be due to groundwater influence at all times. Further data collection will help determine trends. Conductivity is not correlated with turbidity in 2014 (Figure 36).

Figure 35 – Specific Conductance collected by Lantzville Nanoose Streamkeepers.



Turbidity

Turbidity values less than zero (negative numbers) were recorded at both Nanoose Creek sites for all monitoring dates except September 2, 2014. Data were corrected for validation.

Turbidity exceeded the objective of 5 NTU on October 28, 2014 in Craig Creek only (Figure 36). This may be associated with a rainfall event; 23.6 mm of rain fell in the area on October 25, 2014 (Figure 37).

No turbidity objectives were exceeded at any other sites in 2014.

Figure 36 – Turbidity collected by the Lantzville Nanoose Streamkeepers.

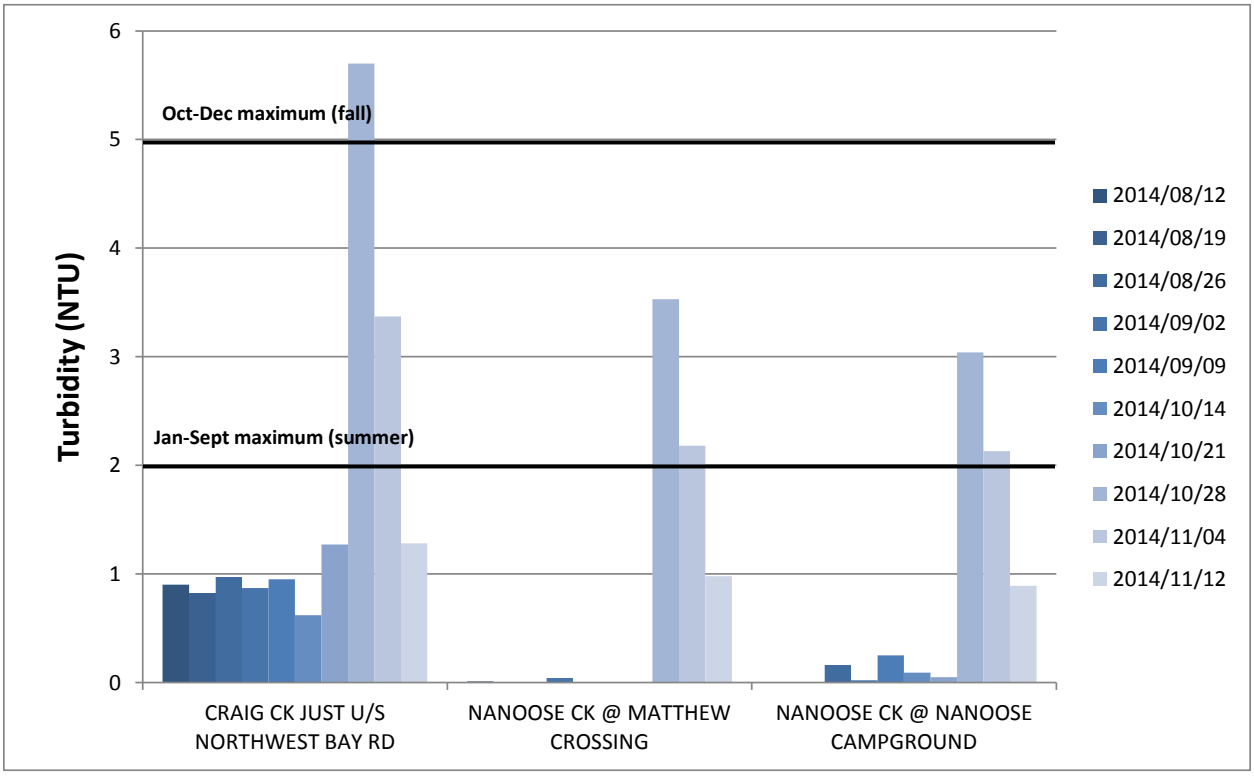
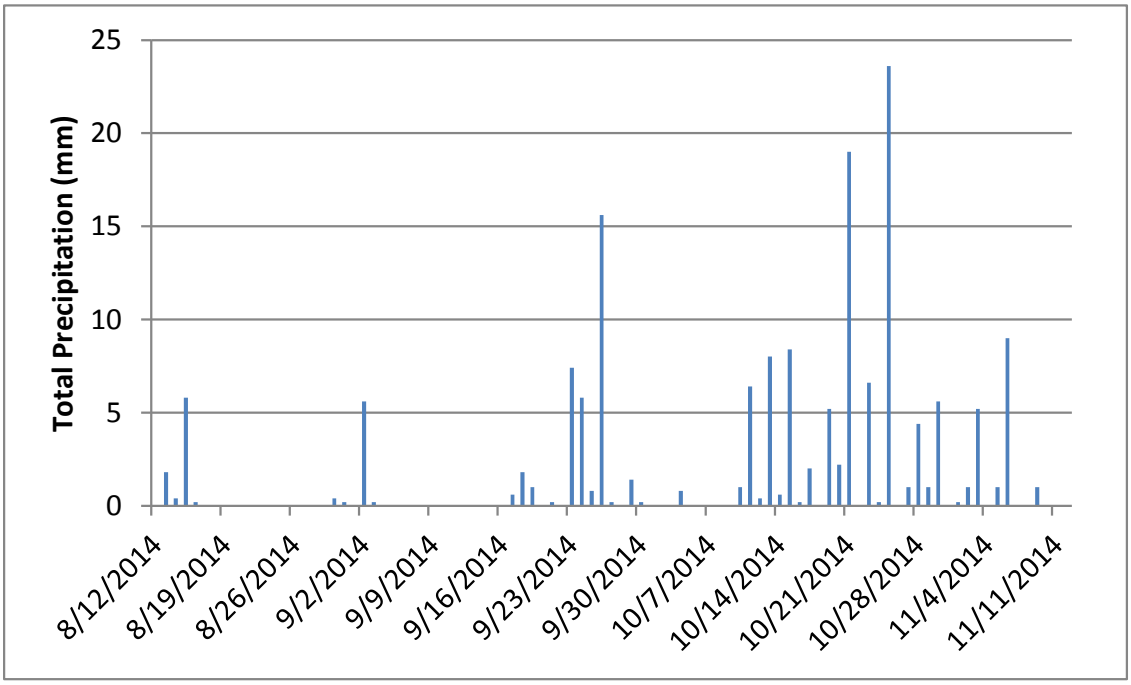


Figure 37. Climate data for Ballenas Island weather station.



Island Waters Fly Fishers

The Island Waters Fly Fishers performed data collection on surface water quality in Benson Creek, McGarrigle Creek, and the Millstone River in 2014. This was the group's third year of participation in the CWMN. There were no changes to the number or location of monitoring sites relative to previous years.

Temperature

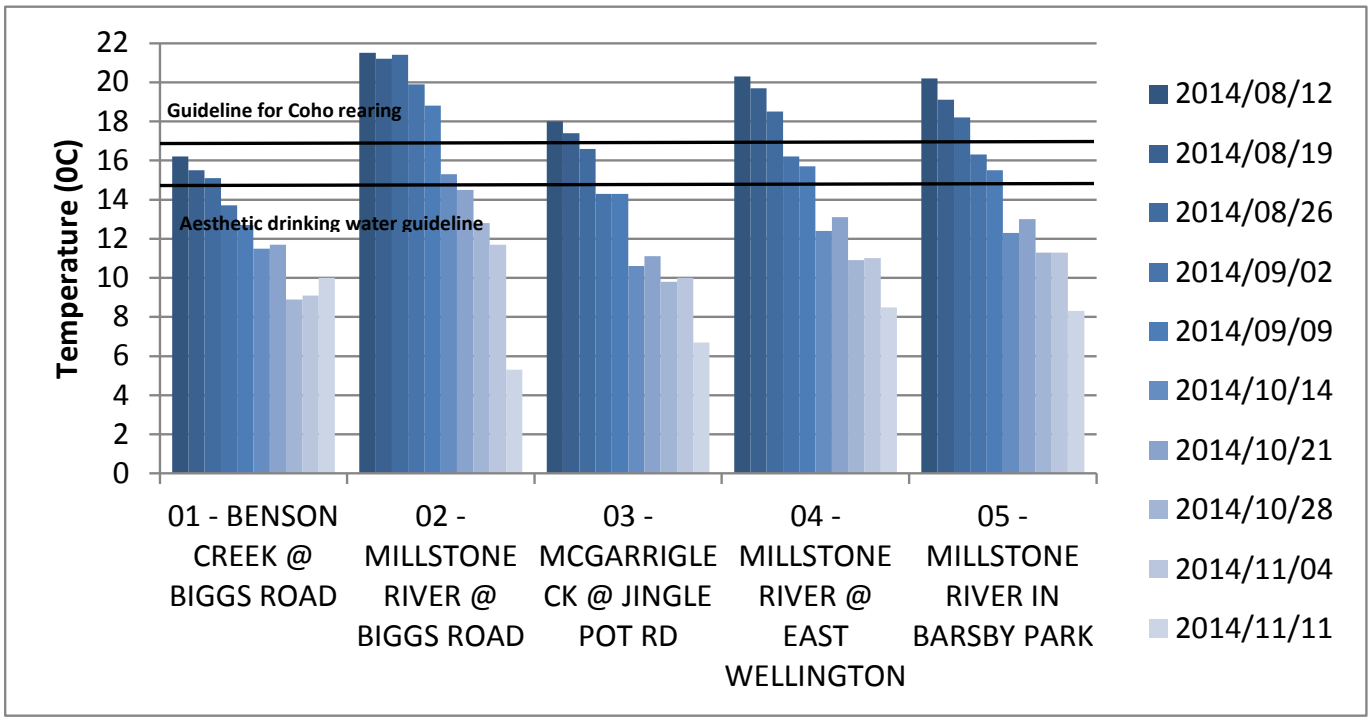
There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C for the first three weeks of the sampling period at all monitoring sites. There was potential for exceedance of the aesthetic drinking water objective in the Millstone River @ Biggs Rd for the entire five weeks of summer sampling (Figure 38).

Summer temperatures also had the potential to exceed the guideline for Coho rearing (17°C) during the first three weeks of summer sampling in all Millstone River monitoring sites, and for the entire summer sampling period at the uppermost Millstone River site @ Biggs Rd. In addition, summer temperatures had the potential to exceed the guideline for Coho rearing (17°C) during the first 2 weeks of monitoring in McGarrigle Creek.

The results of temperature monitoring are typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile

fish should be able to retreat to these during periods of elevated temperatures. Data were similar to 2011, 2012 and 2013.

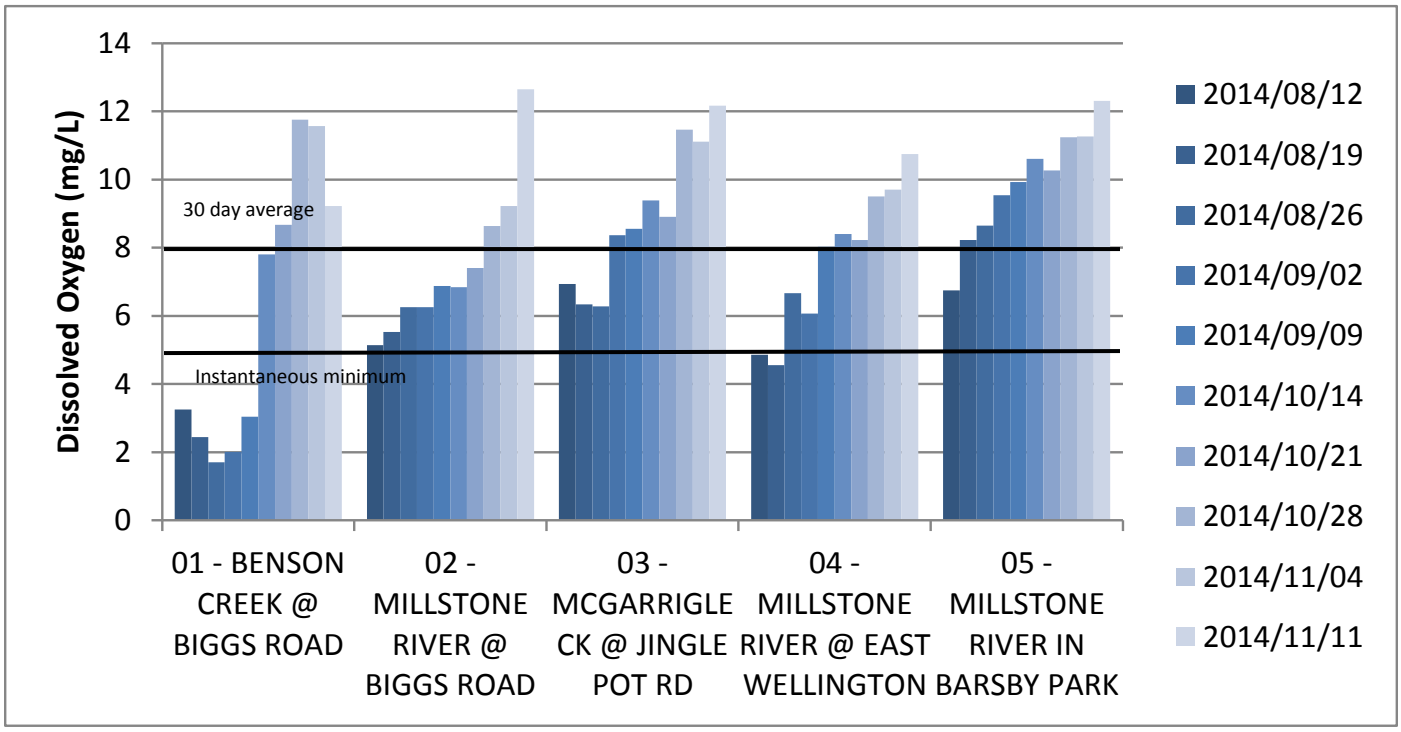
Figure 38 – Maximum Temperature data collected by the Island Waters Fly Fishers.



Dissolved Oxygen

Dissolved oxygen (DO) values for 2014 are shown in Figure 39. Average DO was below the 30 day average objective of 8 mg/L in all sites during the summer monitoring period with the exception of Millstone River in Barsby Park (average of 2.488 mg/L, 6.008 mg/L, 7.292 mg/L, 6.03 mg/L and 8.614 mg/L reading from left to right, or upstream to downstream). The 30-day average DO was also below the 5 mg/L instantaneous minimum for aquatic life in Benson Creek at Biggs Rd during the summer monitoring period.

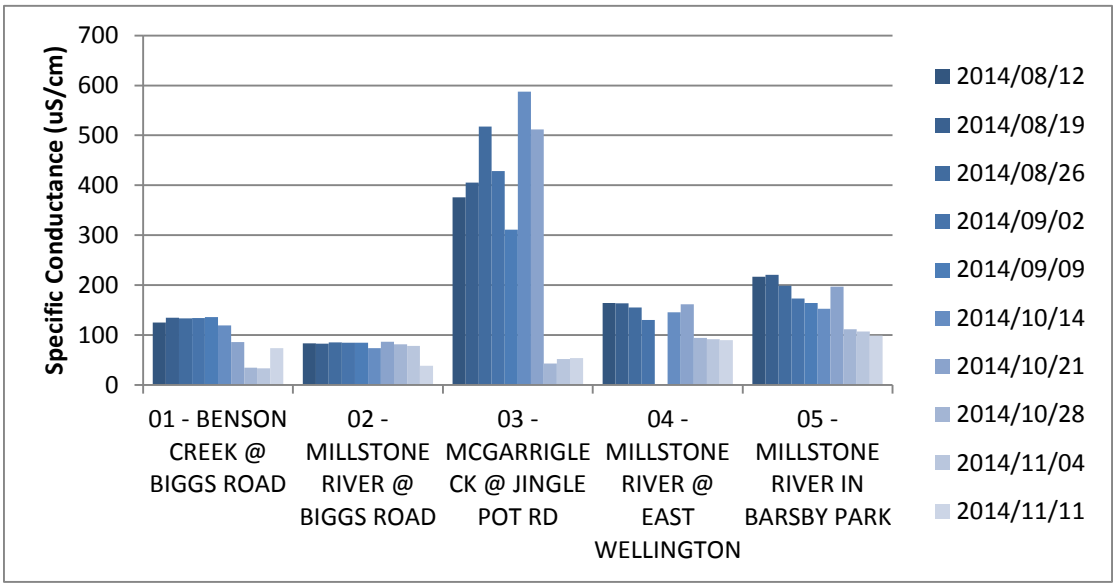
Figure 39 – Average dissolved oxygen collected by Island Waters Fly Fishers.



Specific Conductance

Results of measuring specific conductance are shown in Figure 40. Values are within the typical range for coastal streams with the exception of those recorded at McGarrigle Creek. High conductivity there is suspected to be the result of failing septic at a residential property upstream. The Ministry of Environment and RDN were notified in October 2014. The concern was reported to the MoE Environmental Reporting line and an Island Health officer was planning to visit the property.

Figure 40 – Maximum specific conductance collected by the Island Waters Flyfishers.



Turbidity

Turbidity (Figure 41) exceeded the January – September (summer) maximum objective of 2 NTU in McGarrigle Creek on September 9, 2014 and in the Millstone River on August 19, 2014. These exceedances are not correlated with a precipitation event, which suggests the results are due to anthropogenic activities.

Maximum turbidity values exceed the fall objective of 5 NTU on October 28, 2014 in McGarrigle Creek and the two lower Millstone River sites. These fall exceedances may be correlated with rainfall events (Figure 42).

Figure 41 – Maximum turbidity collected by the Island Waters Flyfishers.

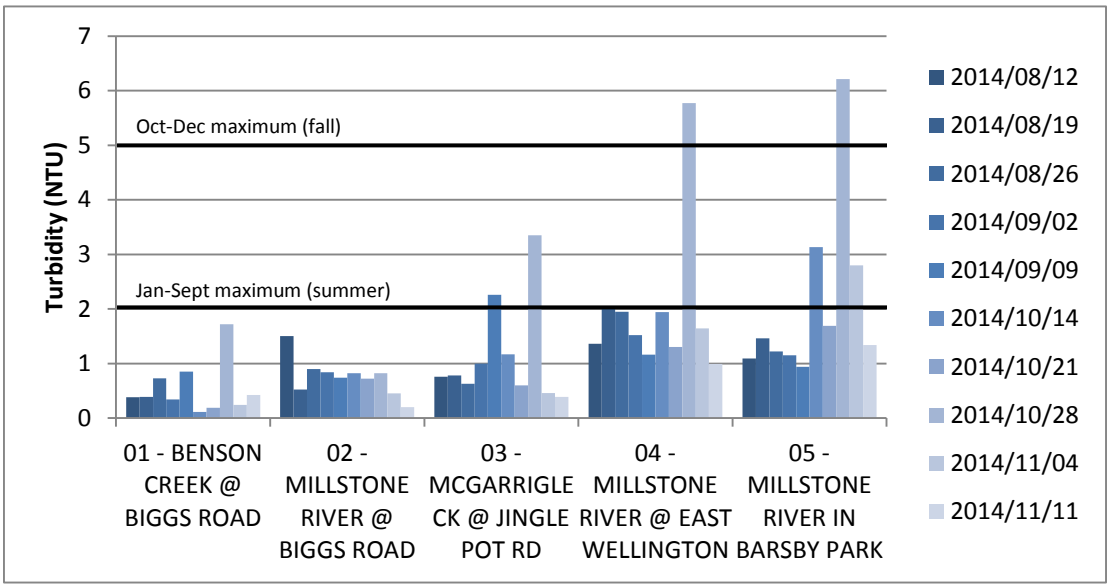
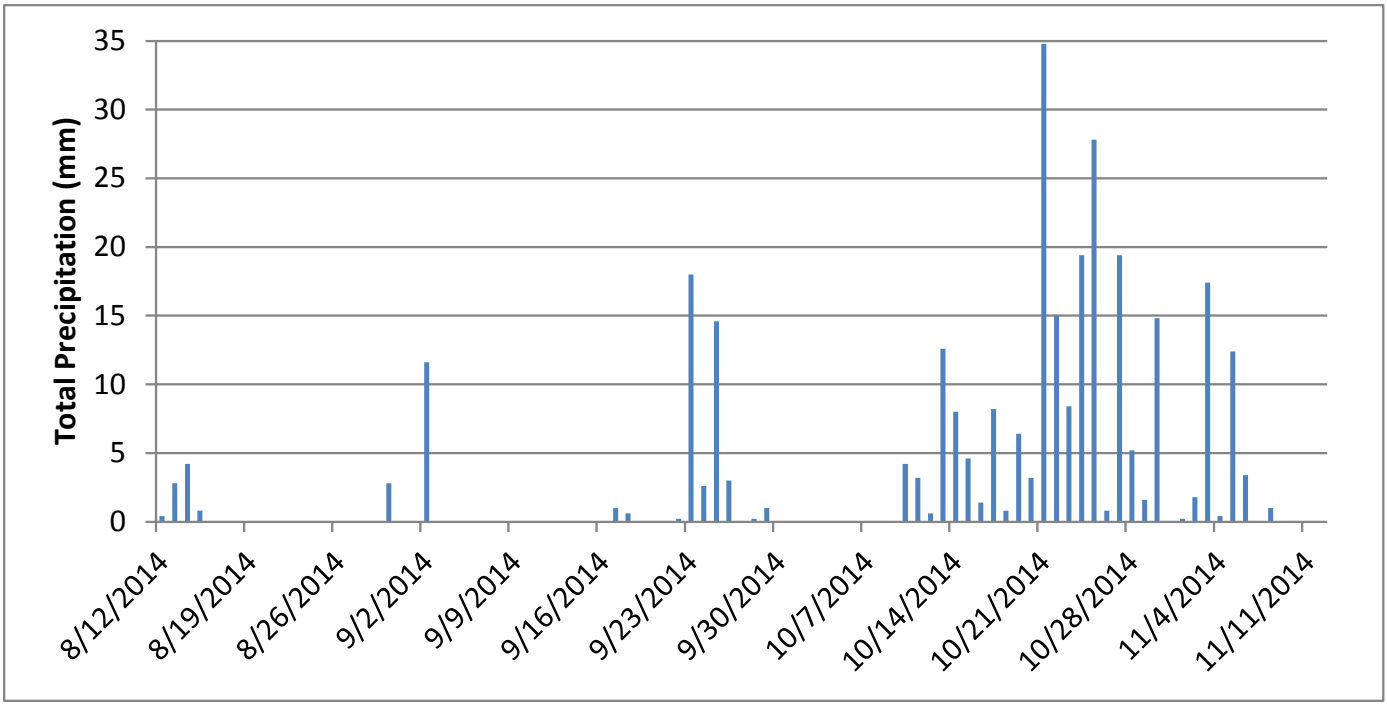


Figure 42. Climate data for Nanaimo Airport weather station.



Departure Creek Streamkeepers

The Departure Creek Streamkeepers collected data on surface water quality in Departure and Cottle Creeks in 2014. There were no changes to the number or location of monitoring sites relative to previous years. The sites in this group's monitoring program have been recommended as good candidates for lab analysis and QA/QC when budget funds are available.

Temperature

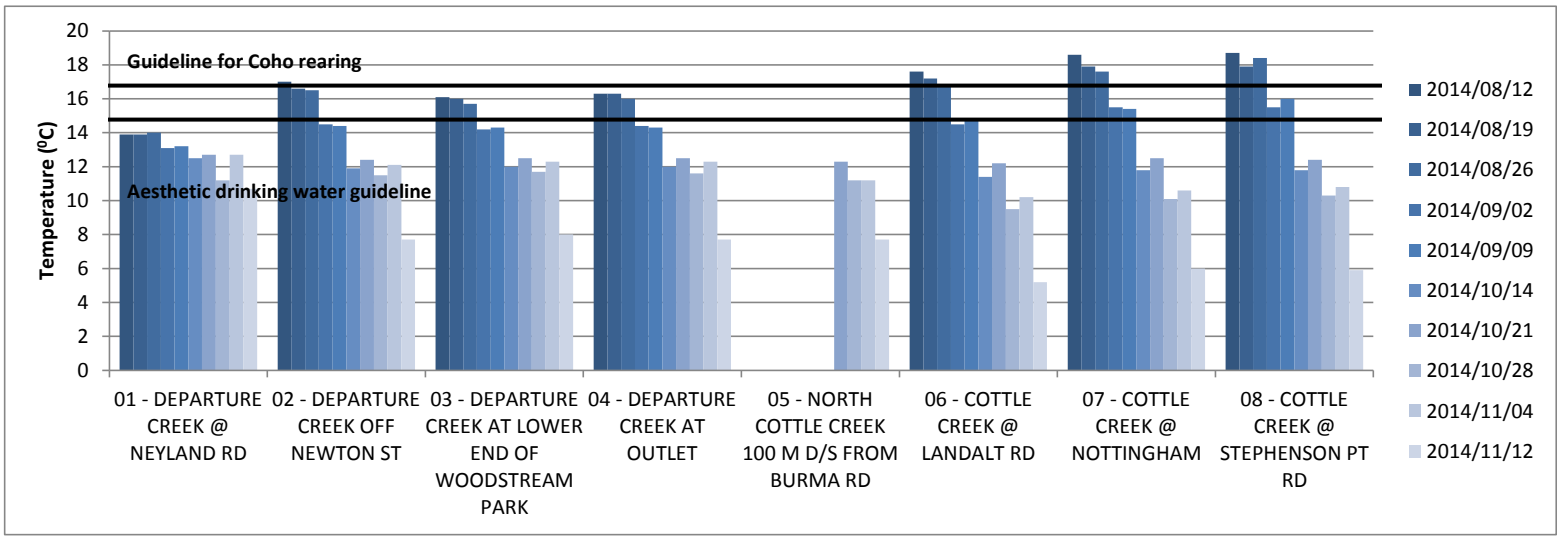
Results of temperature monitoring are shown in Figure 43. Sites 01 – 04 are in Departure Creek; sites 05 – 08 are in Cottle Creek. Sites are shown from upstream to downstream reading left to right.

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C for the first three weeks of the sampling period at the lower three Departure Creek sites, as well as Cottle Creek at Landalt Road. There was potential for exceedance of the aesthetic drinking water objective at the lower two Cottle Creek sites for the entire five weeks of summer sampling (Figure 43).

Summer temperatures also approached or exceeded the guideline for Coho rearing (17°C) during the first three weeks of summer sampling in Cottle Creek. No data were collected in the uppermost Cottle Creek site prior to October 21, 2014; before that date the creek was dry at that location.

The results of temperature monitoring are typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures. Data were similar to 2012 and 2013.

Figure 43 – Temperature data collected by the Departure Creek Streamkeepers.

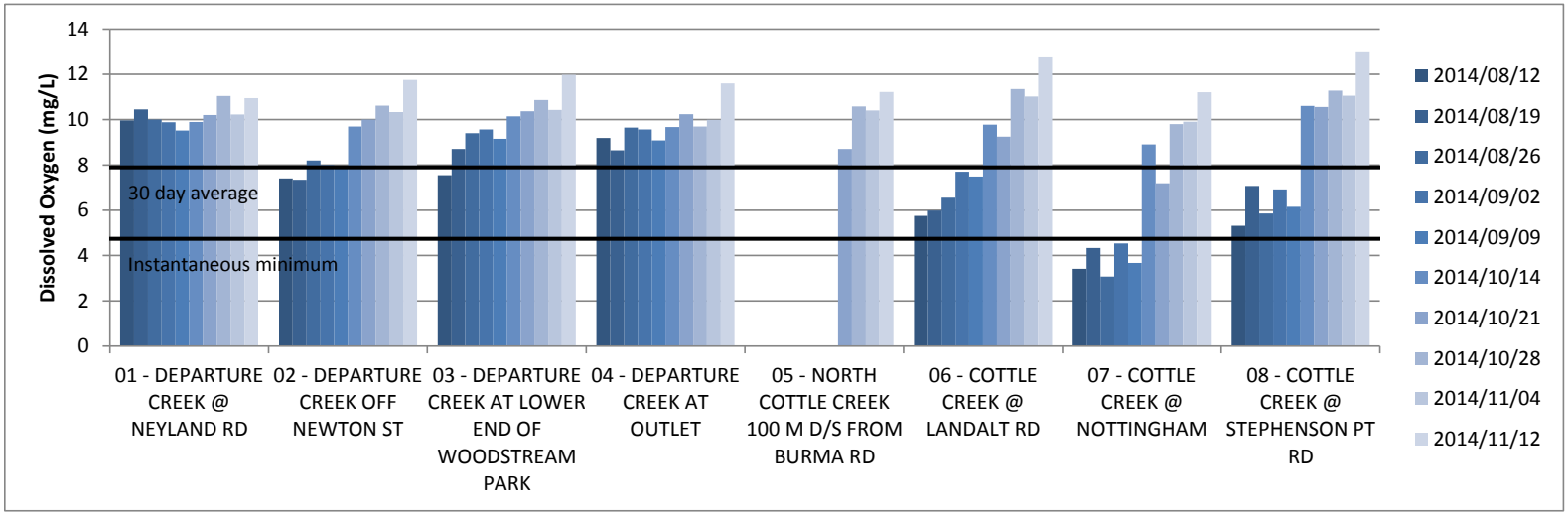


Dissolved Oxygen

Dissolved oxygen (DO) values for 2014 are shown in Figure 2. Average DO was below the 30 day average objective of 8 mg/L in Departure Creek off Newton (average of 7.77 mg/L), and all three lower sites on Cottle Creek (average of 6.70 mg/L, 3.81 mg/L, and 6.24 mg/L reading from left to right, or upstream to downstream) during the summer monitoring period.

DO was also below the 5 mg/L instantaneous minimum objective for aquatic life in Cottle Creek at Nottingham (average 3.81 mg/L) during the summer monitoring period.

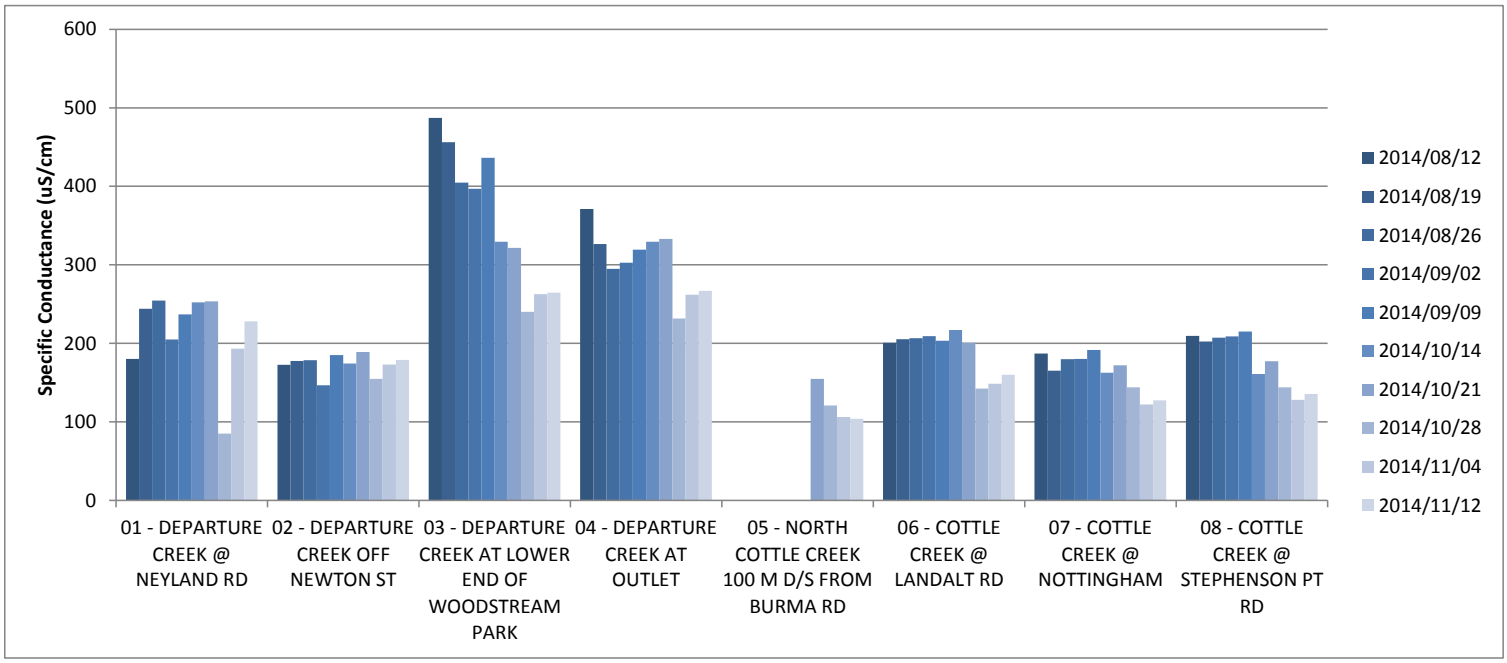
Figure 44 – Average dissolved oxygen collected by the Departure Creek Streamkeepers.



Specific Conductance

Results of measuring conductivity are similar to previous years – the levels are higher than those typical of coastal streams. This may be attributed to possible groundwater influence at all times. While higher conductivity can sometimes be related to turbidity, there is no direct correlation in this case.

Figure 45 – Maximum specific conductance collected by the Departure Creek Streamkeepers.



Turbidity

Turbidity exceeded the January – September maximum objective of 2 NTU for summer sampling dates in Departure Creek off Newton on August 19 and 26, 2014 and Departure Creek at outlet August 26 and September 9, 2014 (Figure 45). (Dark blue bars in graph represent summer monitoring results.) The log notes for August 26 at Departure Creek off Newton noted, "Some exposed bank on the south side about 15 m upstream. Rain last Wed/Thurs could have brought sediment down." On September 9 the log notes read, "bank erosion apparent" at the Departure Creek off Newton site.

Maximum turbidity values exceed the fall objective of 5 NTU on October 28, 2014 in Departure Creek at Neyland, and November 4, 2014 in Departure Creek at outlet. The fall exceedances directly correlate with rainfall events (Figure 46).

Figure 45 – Maximum turbidity collected by the Departure Creek Streamkeepers.

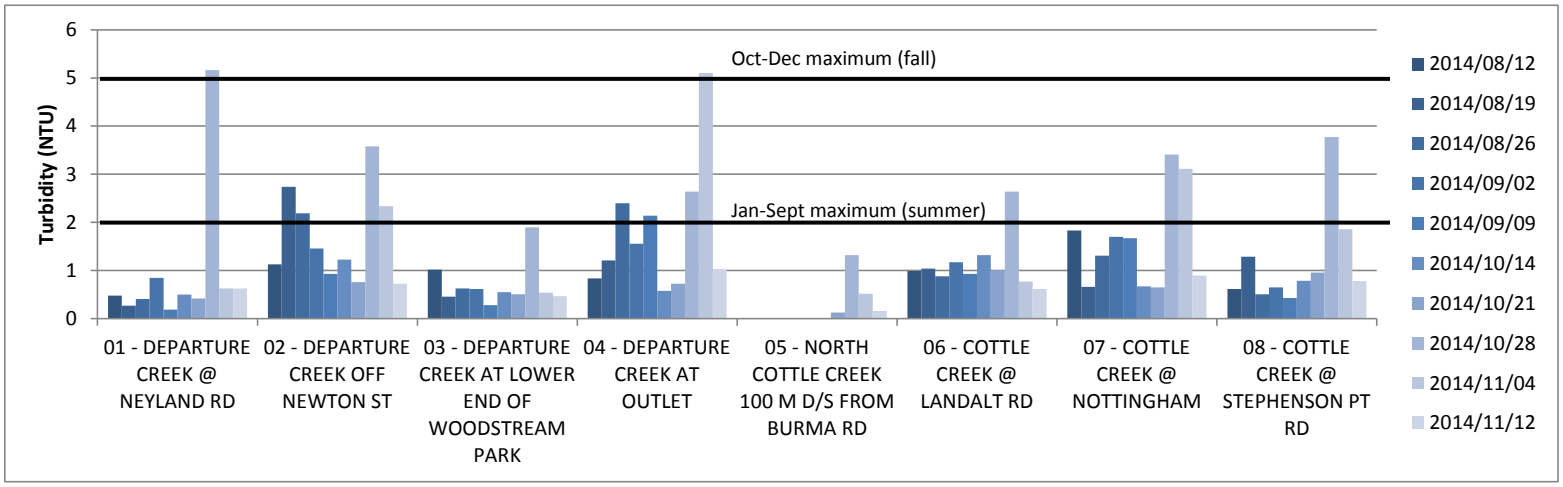
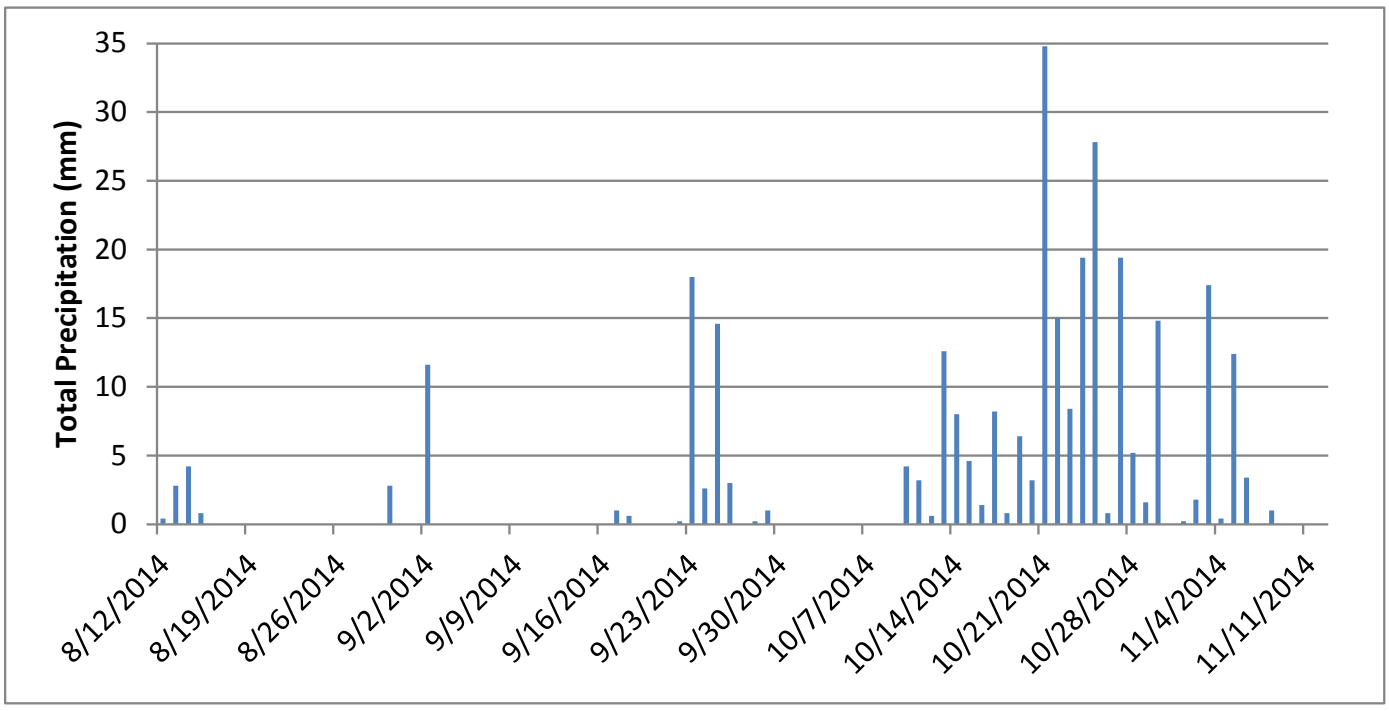


Figure 46. Climate data for Nanaimo Airport weather statio



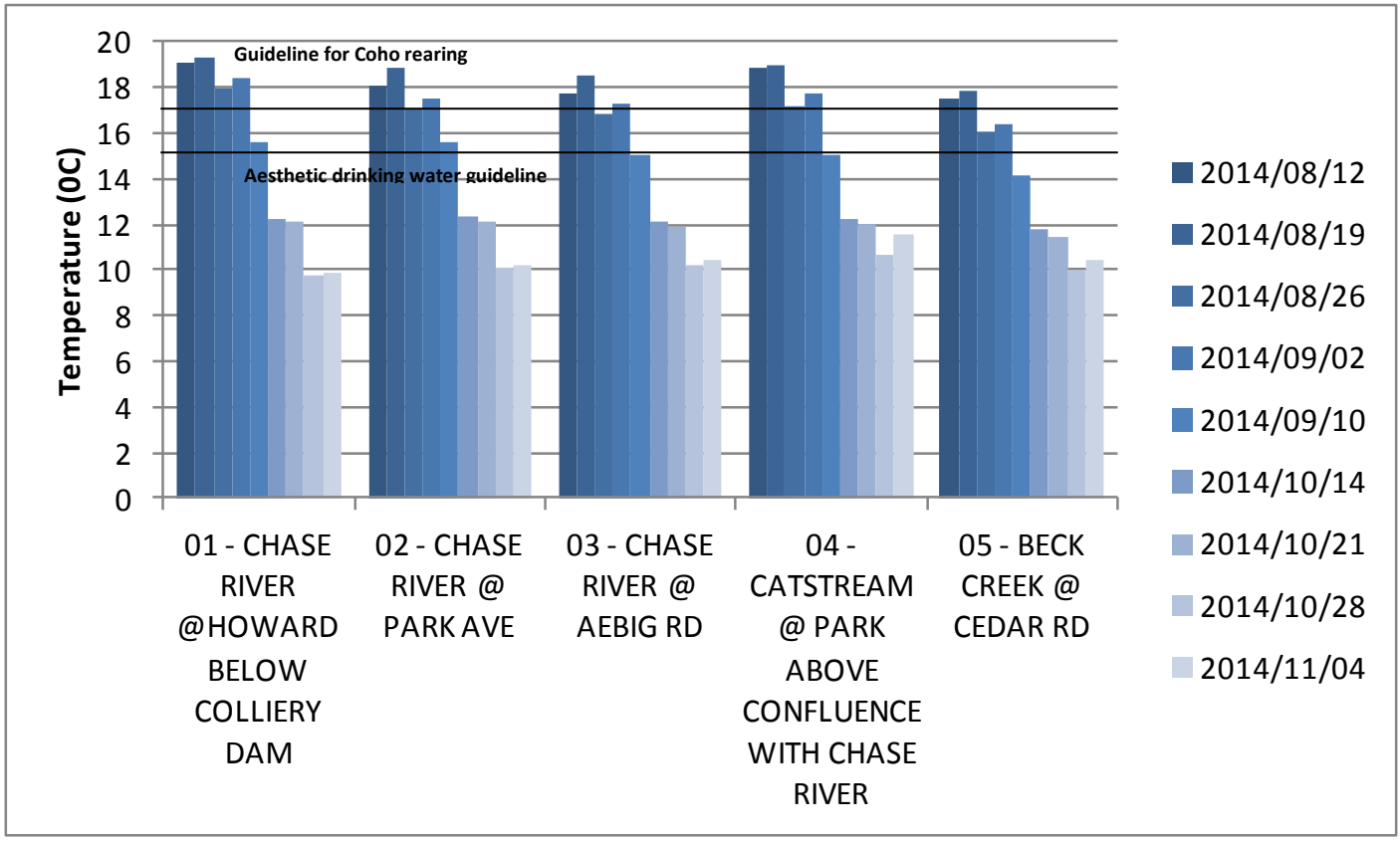
Vancouver Island University Fisheries and Aquaculture

2014 was the third consecutive year that the Vancouver Island University (VIU) Fisheries and Aquaculture Department participated in the CWMN. The same sites on the Chase River, Beck Creek and Cat Stream were monitored as in previous years.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline of 15 ^{0}C throughout the summer sample period at all sites on the Chase River and in the Cat Stream, and for the first four weeks of sampling in Beck Creek (Figure 47). Summer temperatures also had the potential to exceed the guideline for Coho rearing (17°C) during the first four weeks of summer sampling in the Chase River and Cat Stream, and the first two weeks of sampling in Beck Creek.

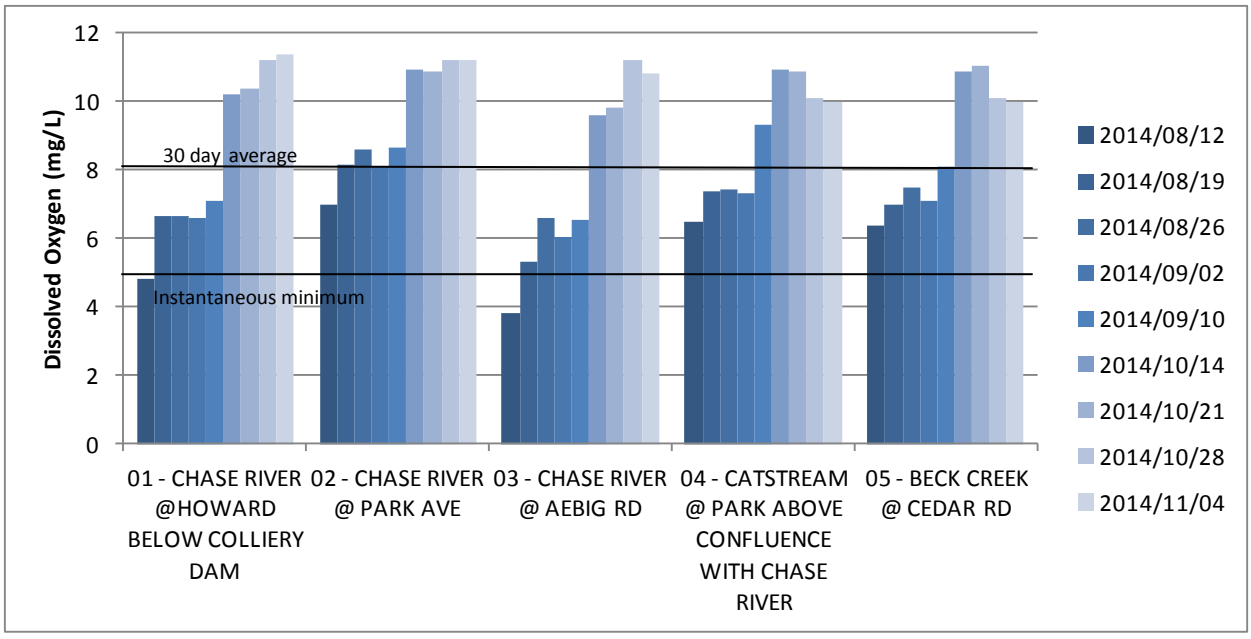
Figure 47 – Maximum temperature data collected by VIU.



Dissolved Oxygen

Dissolved oxygen (DO) values for 2014 are shown in Figure 48. The 30 day average was below the guideline of 8 mg/L for all sites during the summer sample period except Chase River at Park Avenue. At that site the 30 day average was 8.094 mg/L. Average DO values for the other sites were 6.36 mg/L (Chase @ Howard), 5.65 mg/L (Chase @ Aebig), 7.59 mg/L (Cat Stream) and 7.21 mg/L (Beck Creek). Maximum DO was below the instantaneous minimum guideline for aquatic life of 5 mg/L in the Chase River at Howard and the Chase River at Aebig on the first day of summer sampling – August 12, 2014.

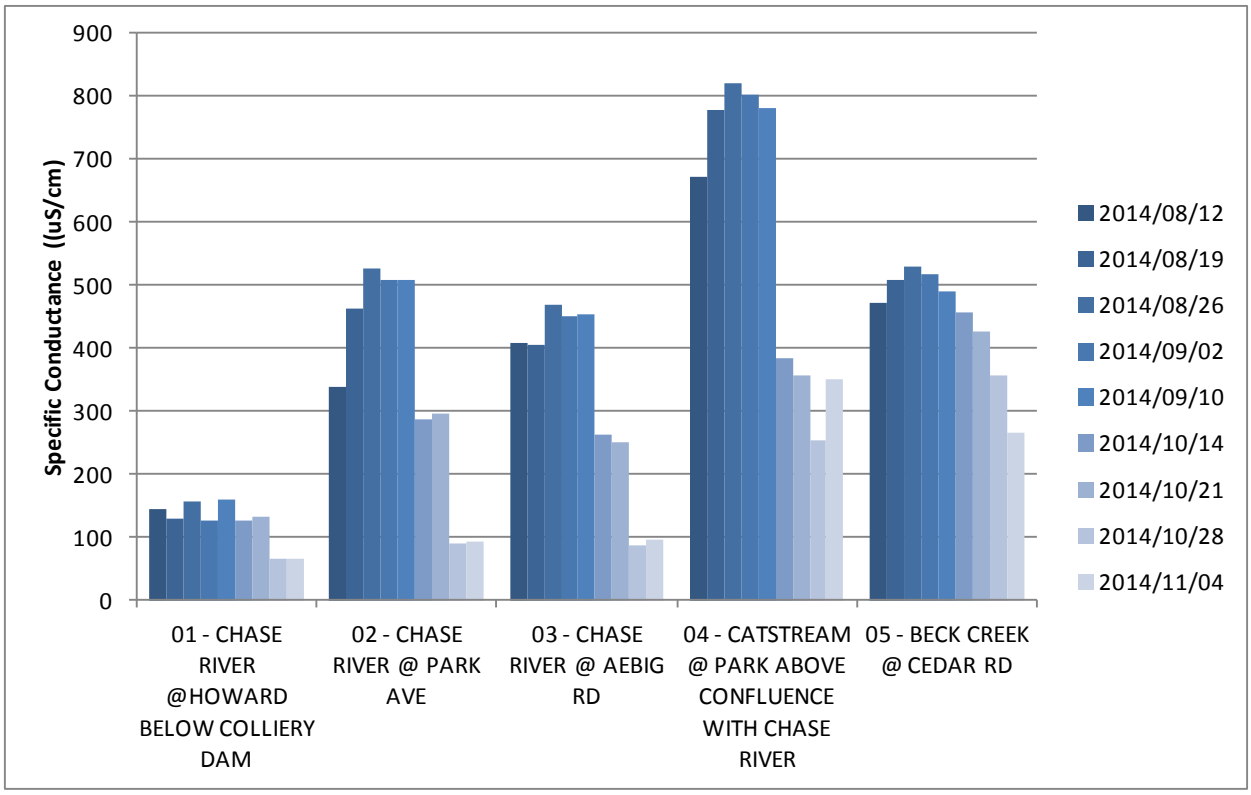
Figure 48 – Dissolved oxygen data collected by VIU.



Specific Conductance

Results of measuring specific conductance (Figure 49) are similar to previous years – the levels are higher than those typical of coastal streams at all sites except the Chase River @ Howard. This may be due to possible groundwater influence at all times. High conductivity is not directly correlated with high turbidity during this sampling period (Figure 50).

Figure 49 –Maximum specific conductance collected by VIU.



Turbidity

The only exceedance of the summer turbidity objective of 2 NTU occurred in the Chase River at Howard on August 19, 2014 (Figure 50).

The most significant rainfall event happened on October 21, 2014 (34.8 mm) (Figure 51). The fall objective of 5 NTU was exceeded in the two lower sites in the Chase River, and in the Cat Stream, one week after the heavy rainfall, on October 28, 2014. In addition, turbidity exceeded the fall objective of 5 NTU in Beck Creek @ Cedar Rd on October 14, 2014.

Turbidity objectives were not exceeded on any other dates in this monitoring period.

Figure 50 – Maximum turbidity collected by VIU.

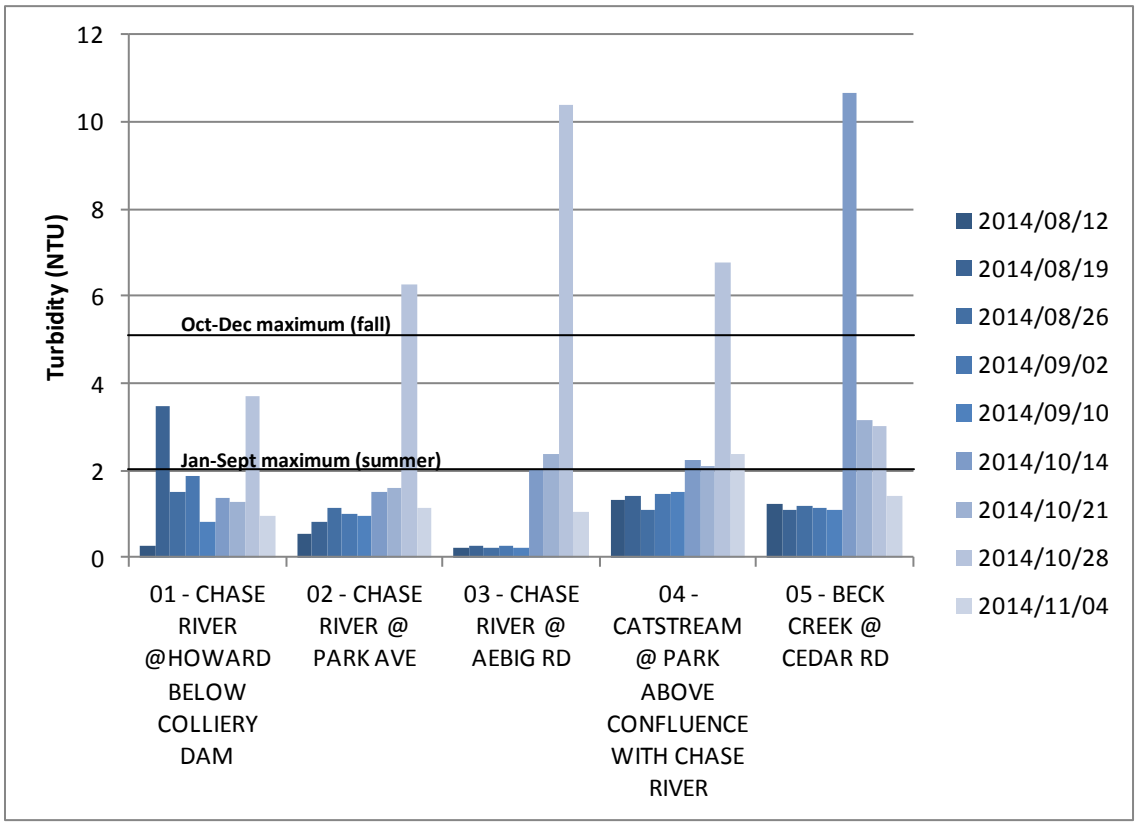
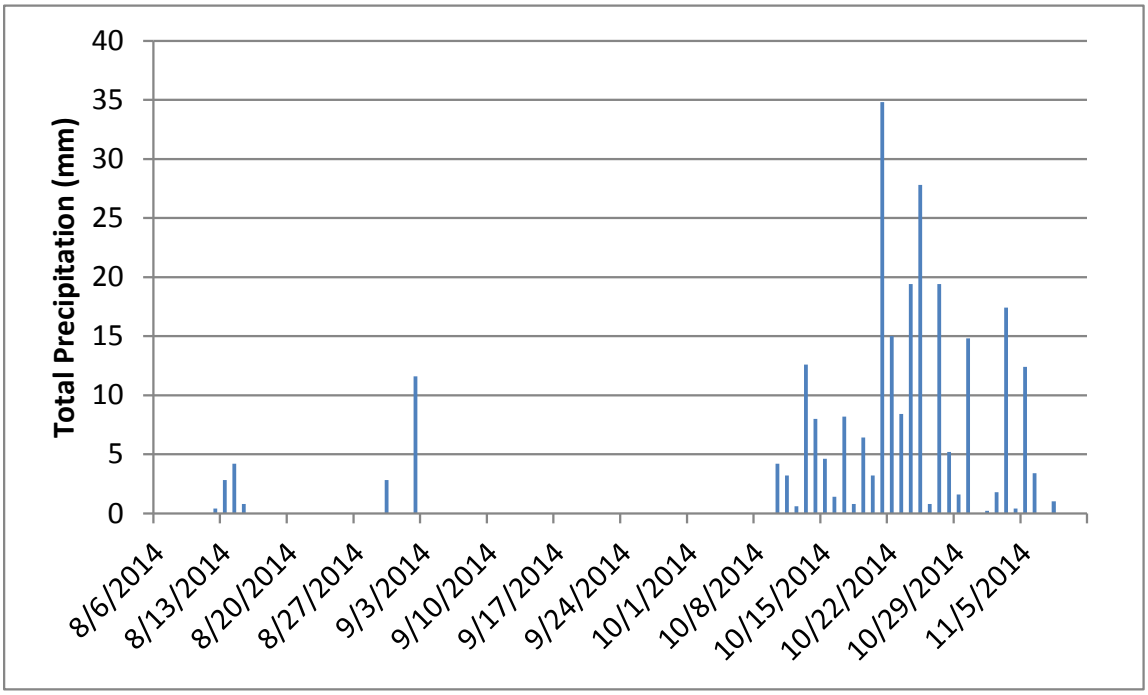


Figure 51. Climate data for Nanaimo Airport weather station.



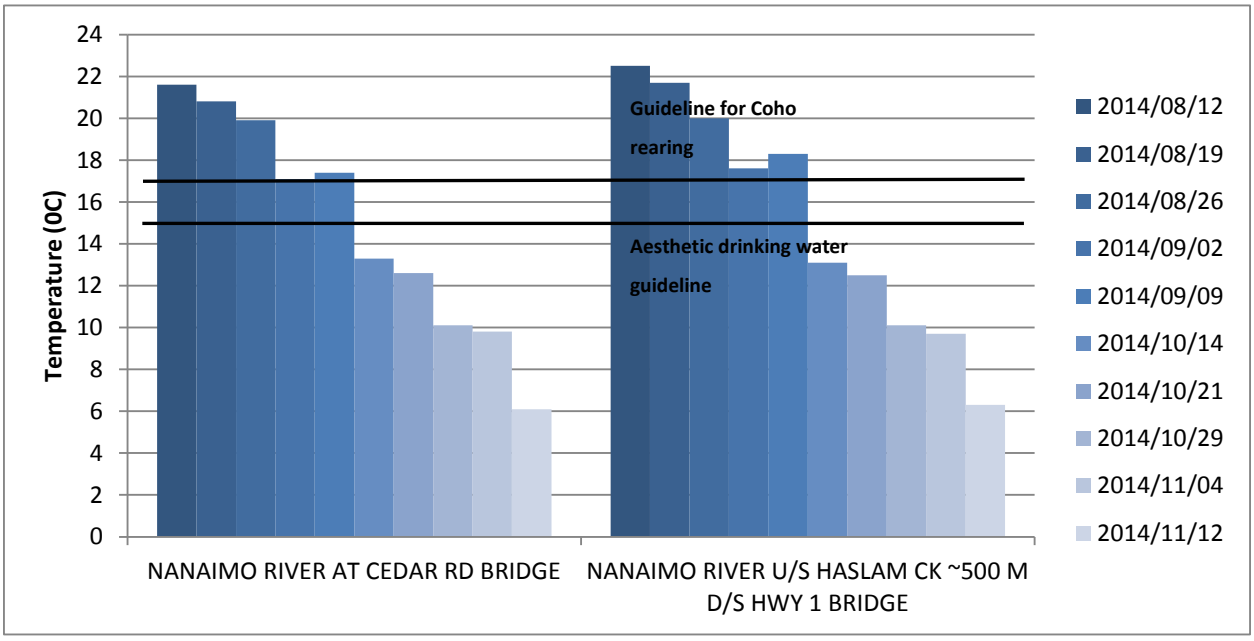
Nanaimo & Area Land Trust (NALT)

The sampling sites changed slightly for 2014 relative to previous years. Monitoring on Haslam Creek upstream Nanaimo River was suspended, while a new downstream site was added on the Nanaimo River under the Duke Point highway overpass.

Temperature

There was potential for exceedances of the aesthetic drinking water temperature guideline throughout the summer sample period in the Nanaimo River (Figure 52). Summer temperatures also had the potential to exceed the guideline for Coho rearing (17°C) throughout all five weeks of summer sampling at both Nanaimo River sites. This is typical of many east coast Vancouver Island streams where the lower portions are wide and shallow; as long as refuges remain with lower temperatures, juvenile fish should be able to retreat to these during periods of elevated temperatures. Data were similar to 2011, 2012 and 2013.

Figure 52. Temperature collected by the Nanaimo & Area Land Trust.



Dissolved Oxygen

Dissolved oxygen (DO) values are shown in Figure 53. The 30 day average was 7.794 mg/L at the Nanaimo River at Cedar Bridge site, and 7.588 mg/L at the Nanaimo River u/s Haslam Creek site during the summer sampling period. Both averages were lower than the objective of 8 mg/L. Low flow in the Nanaimo River may be the reason for low dissolved oxygen (Figure 3).

During previous sampling years (see RDN CWMN Water Quality Trend Report, 2011 – 2013), the average DO value did not drop below the 8 mg/L 30 day average guideline for the Nanaimo River u/s Haslam Creek site. There are no previous data for DO for the Nanaimo River at Cedar Road bridge site for comparison.

Figure 53. Dissolved oxygen collected by the Nanaimo & Area Land Trust.

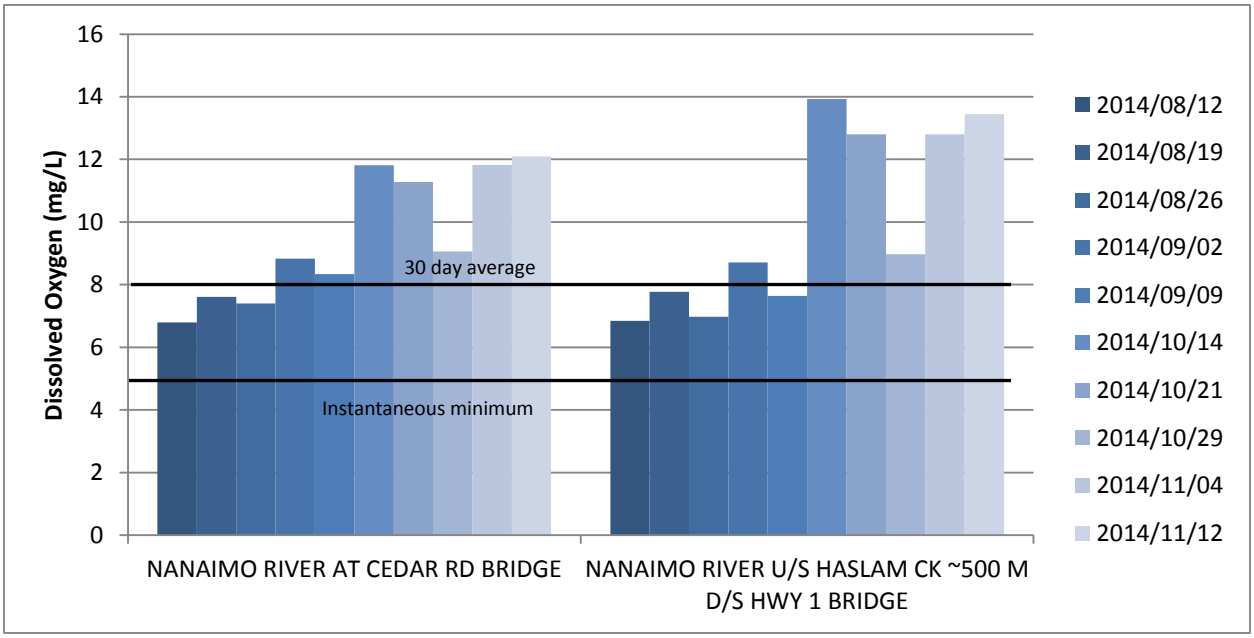
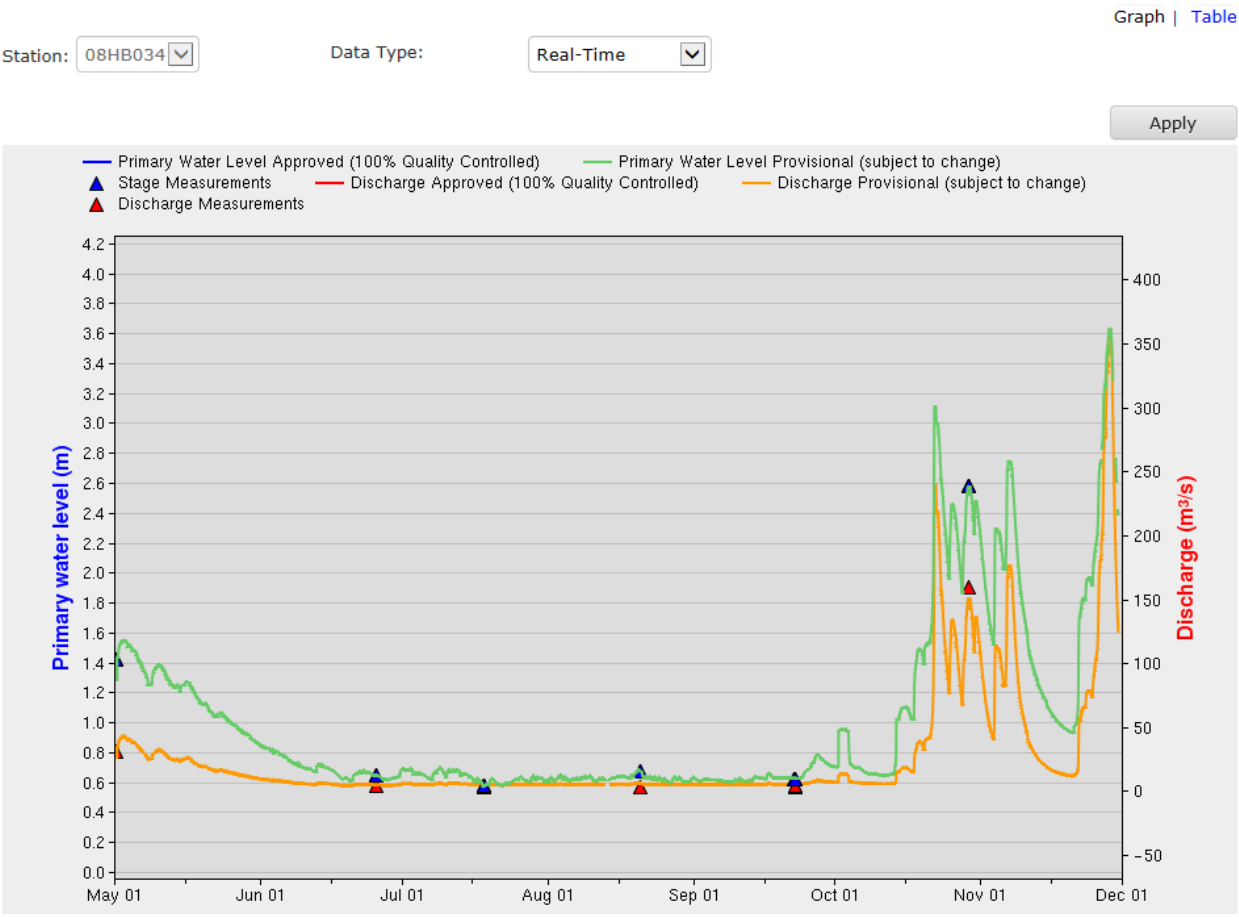


Figure 54

Real-Time Hydrometric Data Graph for NANAIMO RIVER NEAR CASSIDY (08HB034) [BC]



Nanaimo River flows between May – November 2014 are shown in Figure 54 (discharge, right axis, orange line).

Through June, July, August and well into September, the flows were between 4 -6 cubic metres per second. During this period, water level in the Nanaimo River was consistently around 0.6 m. This is lower than levels and flows observed in the summer period in 2011 and in the month of September in 2013 (2012 data unavailable; June July Aug 2013 data unavailable).

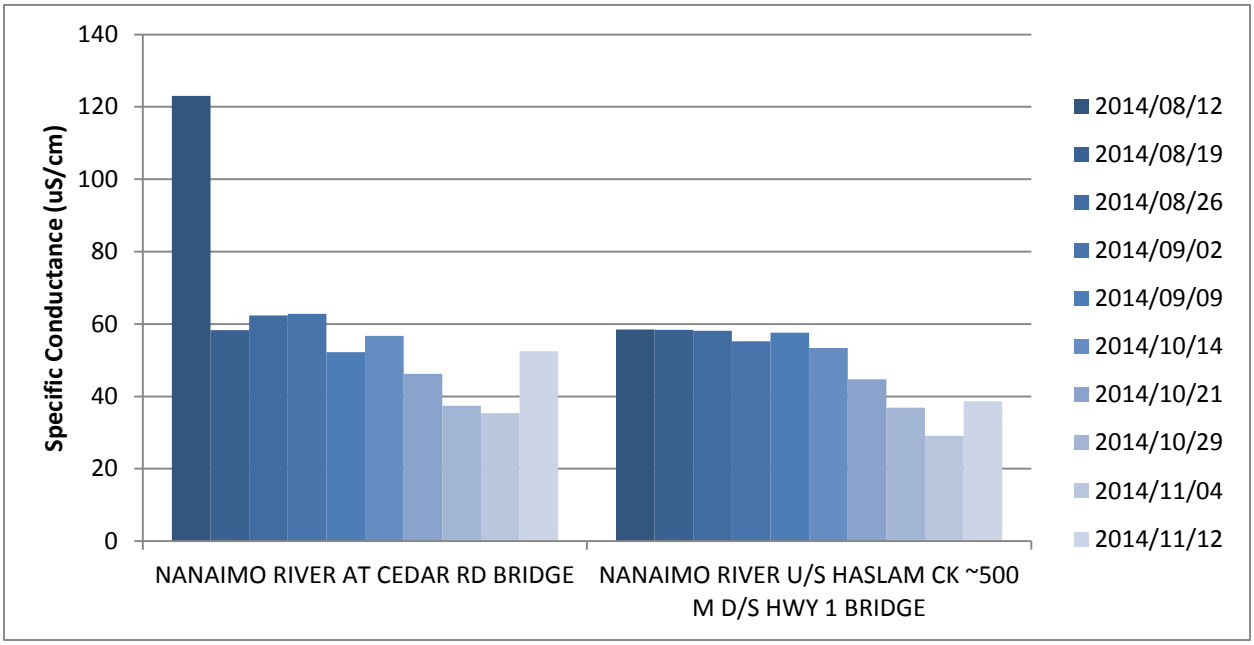
In the 2014 fall sampling period, October through November, the river flows averaged 66 cubic metres per second and levels came up to an average of 1.5 m.

Specific Conductance

2014 was the first year that the Nanaimo River at Cedar River Bridge was included as a sample site, so there are no data from 2013 for comparison.

The sample location was moved a few metres upstream, nearer the Duke Point overpass, after the first day of sampling due to volunteer safety concerns involving human activity. This change could explain the discrepancy in specific conductance between the first and subsequent monitoring days. A more upstream site would have been less likely to experience tidal influence. The spike in conductance was not associated with a spike in turbidity on August 12, 2014.

Figure 55. 2014 Specific Conductance collected by the Nanaimo & Area Land Trust.



Turbidity

Increases in turbidity (Figure 56). were associated with rainfall events (Figure 57) and no turbidity objectives were exceeded at either site

Figure 56. Turbidity collected by the Nanaimo & Area Land Trust.

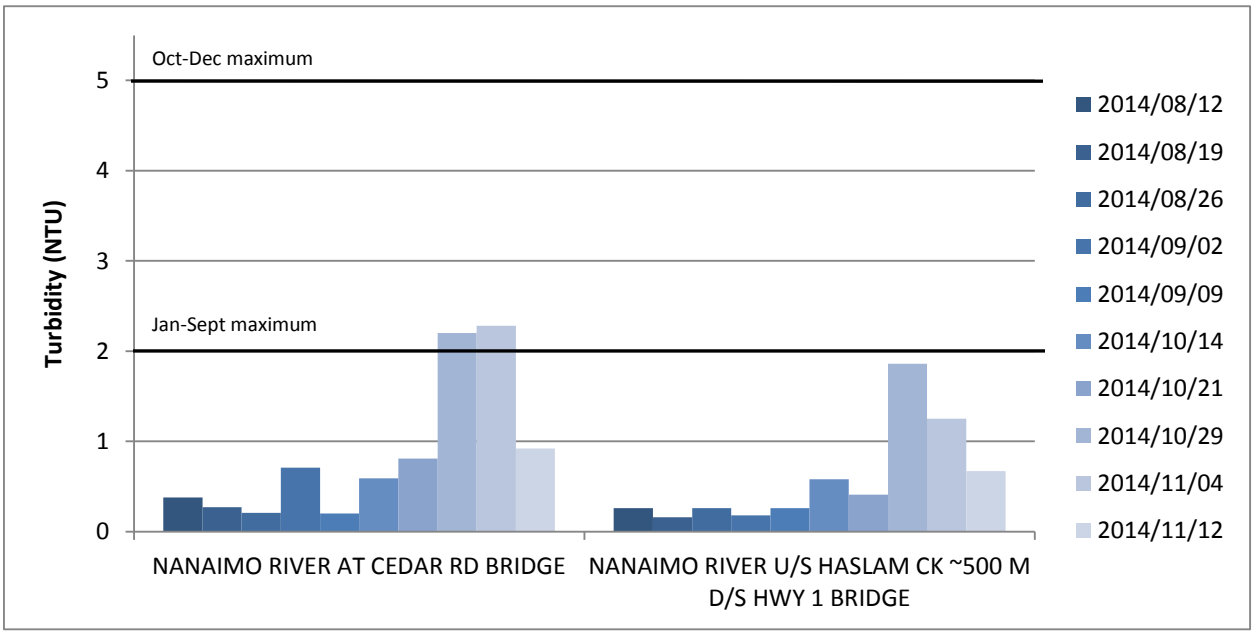
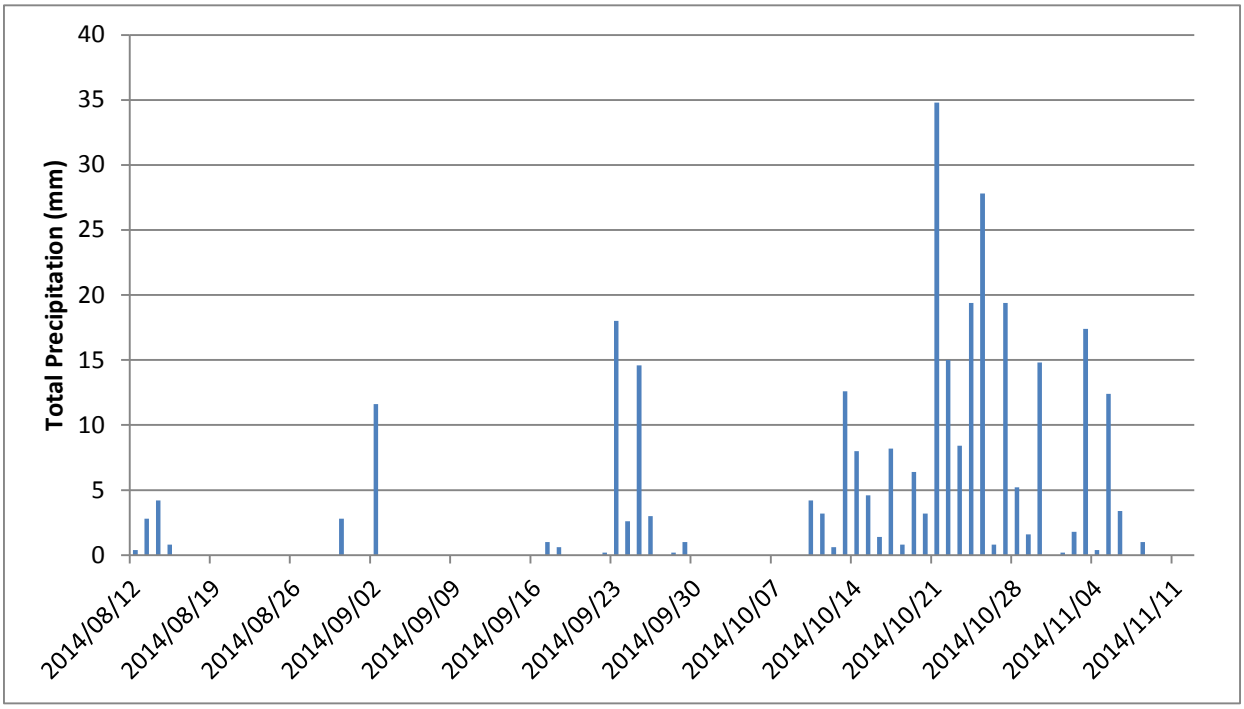


Figure 57. Climate data for Nanaimo Airport weather station.



Recommendations

- Discuss partnership potential with City of Nanaimo and Town of Qualicum Beach to link with stormwater management initiatives.
- Where P spikes were observed in 2014 sampling, look into options for agricultural outreach / best practices promotion with regards to nutrient management
- Perform physical stream assessment (USHP methodology) on French and Grandon Creeks as recommended in the 2011-2013 trend report to identify potential sources for water quality exceedances linked to the physical attributes of the creek.
- Where E.coli spikes were observed in 2014, look into options for dog owner outreach / targeted septic smart program delivery / manure application improved practices.