Waterford River
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Newfoundland Labrador

Government of Newfoundland & Labrador

Department of Environment and Conservation

Real Time Water Quality Monthly Report
Waterford River - St. John's, NL
July 23 to August 27, 2013

General

- Data from the Waterford River real-time station is regularly monitored by the Water Resources Management Division (WRMD).
- The instrument used for the deployment period from July 23 to August 27, 2013 was a YSI 6600 series multi-probe, which continuously measured water temperature, dissolved oxygen, pH, specific conductivity and turbidity. The duration of the deployment was 34 days.

Maintenance and Calibration of Instruments

- **Table 1** displays the dates when routine cleaning, maintenance and calibration were performed on the water quality probe during this deployment.

Table 1: **Table of Water Quality Probe Installation and Removal**

Date Deployed	Date Removed
July 23, 2013	August 27, 2013

- Water quality readings were taken with a second freshly cleaned and calibrated water quality instrument at the time of deployment and removal, in compliance with WRMD quality assurance and quality control protocol.

Deployment

- Deployment comparison rankings between the field instrument and the QAQC instrument are summarized in **Table 2**.

Table 2: Field sonde to QAQC sonde comparison rankings for deployment of the RTWQ instrument on July 23, 2013

Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	19.76	19.79	0.03	Excellent
pH	7.94	7.38	0.56	Fair
Specific Conductivity (µS/cm)	598.0	595.5	0.4	Excellent
Total Dissolved Solids (g/l)	0.3880	0.3807	0.0073	
Dissolved Oxygen (%-Sat)	100.8	114.5	13.7	
Dissolved Oxygen (mg/l)	9.21	10.30	1.09	Poor
Turbidity (NTU)	1.6	1.3	0.3	Excellent

- **Deployment rankings** of "excellent" for water temperature, specific conductivity and turbidity indicate successful cleaning and calibration, which enable these sensors to produce reliable data during the deployment period. A deployment ranking of "fair" for pH indicates that the difference between the pH measurements on the field sonde and the QAQC sonde at the time of deployment meets the QAQC protocol for Water Resources Management Division and pH data collected during this deployment are reliable; however, the "fair" ranking indicates that the difference between the pH measurements on the two instruments is approaching the acceptable limits of the protocol. A deployment ranking of "poor" for dissolved oxygen indicates that the difference between the DO readings on the field sonde and the QAQC sonde is outside the acceptable limits of the QAQC protocol for the Water Resources Management Division, and DO measurements during this deployment may not be reliable.

Removal

- Removal comparison rankings between the field instrument and the QAQC instrument are summarized in **Table 3**.

Table 3: Field sonde to QAQC sonde comparison rankings for removal of the RTWQ instrument on August 27, 2013

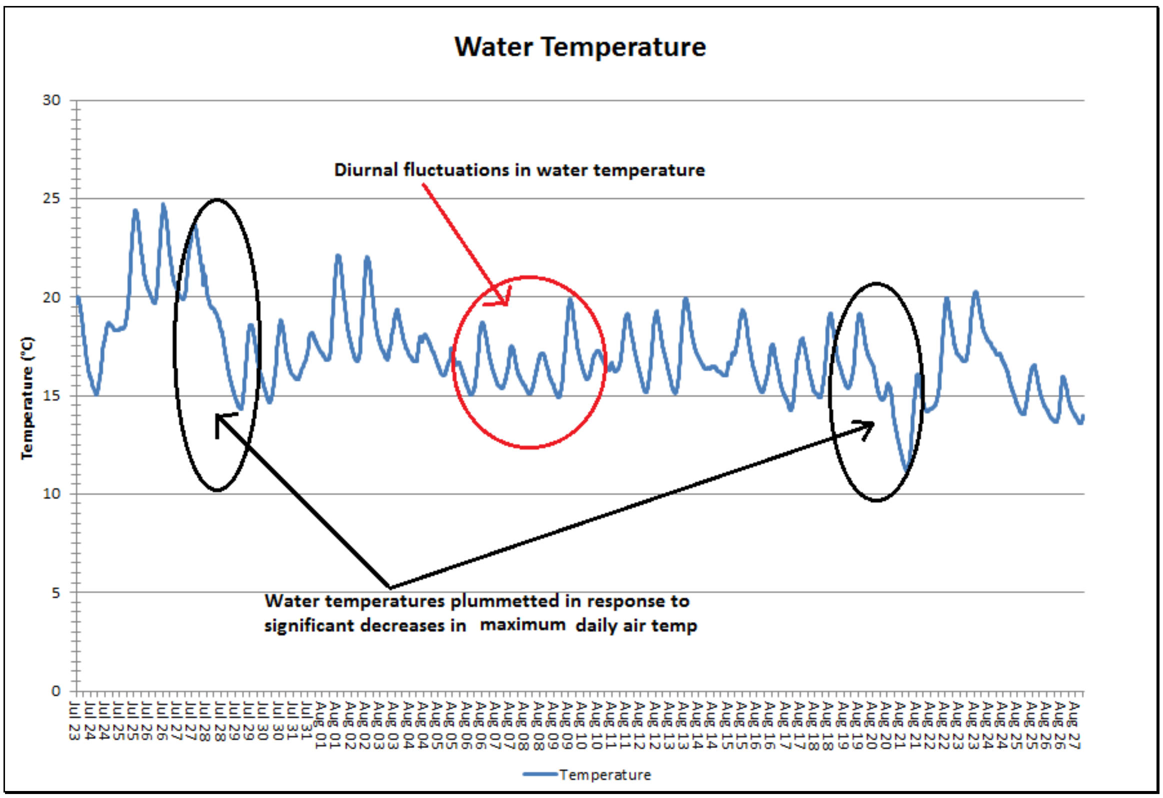
Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	14.00	14.26	0.26	Good
pH	8.31	7.40	0.91	Marginal
Specific Conductivity (µS/cm)	504.0	514.6	2.1	Excellent
Total Dissolved Solids (g/l)	0.3280	0.3295	0.0015	
Dissolved Oxygen (%-Sat)	100.1	84.9	15.2	
Dissolved Oxygen (mg/l)	10.30	8.67	1.63	Poor
Turbidity (NTU)	11.4	6.9	4.5	Good

- Removal rankings of “good” and “excellent” for water temperature, specific conductivity and turbidity increase confidence that the data collected for these parameters over the duration of this deployment are reliable. Removal rankings of “marginal” for pH and “poor” for dissolved oxygen indicate that the difference between each of these parameter measurements, on the field sonde compared to the QAQC sonde, is outside the acceptable range for Water Resources Management Division QAQC protocol. As a result, pH and dissolved oxygen data collected during this deployment may not be reliable.

Data Interpretation

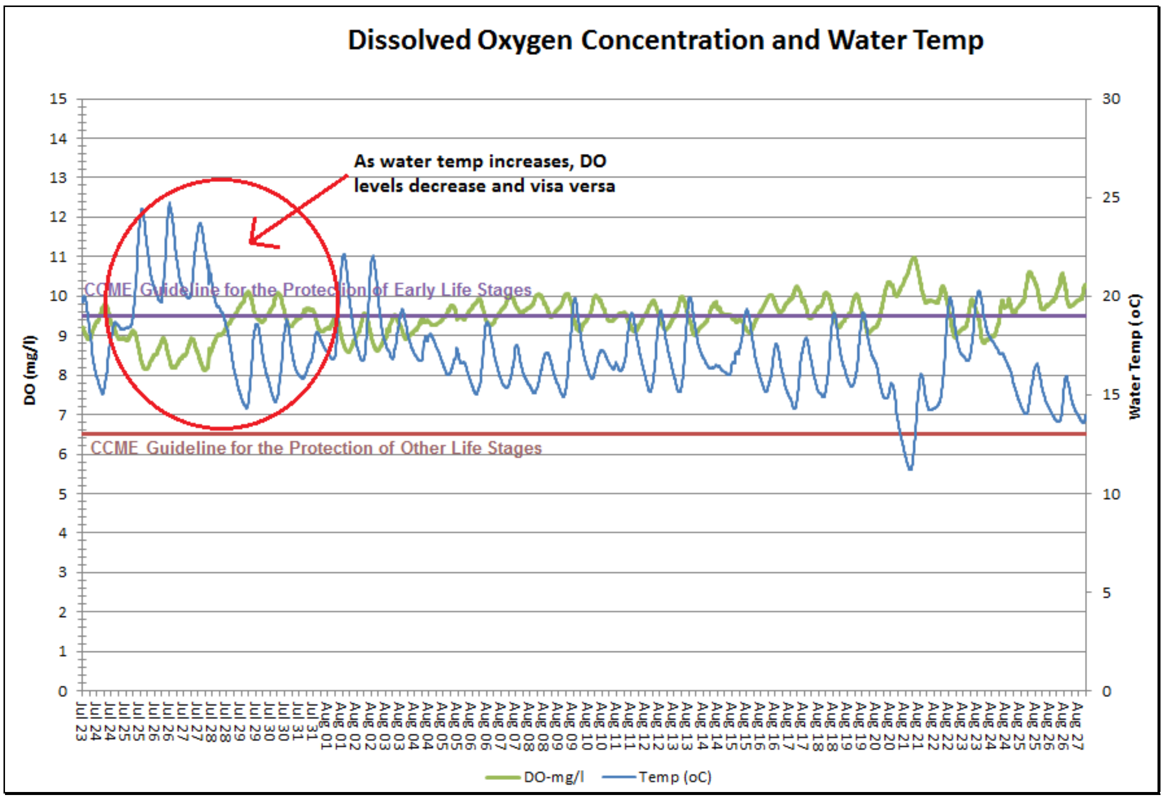
▪ A graph of **water temperature,** which fluctuated between 11.19 and 24.74°C during this deployment period, is shown in blue ink in **Figure 1**, below. Diurnal variation in water temperature is clearly seen with colder temperatures occurring at night and warmer temperatures occurring during the day, corresponding with cooler nightly air and warmer daily air temperatures. Two significant decreases in water temperature occurred during this deployment, corresponding with decreases in maximum daily air temperatures. The first occurred on July 28 when the maximum daily air temperature was approximately 9 degrees lower than the maximum daily air temperature the previous day. The second occurred on August 20 when the maximum daily air temperature was approximately 11 degrees cooler than the maximum daily air temperature the day before. Environment Canada's Daily Climate Data is shown in **Appendix 1,** at the end of this report.

Figure 1: Water Temperature



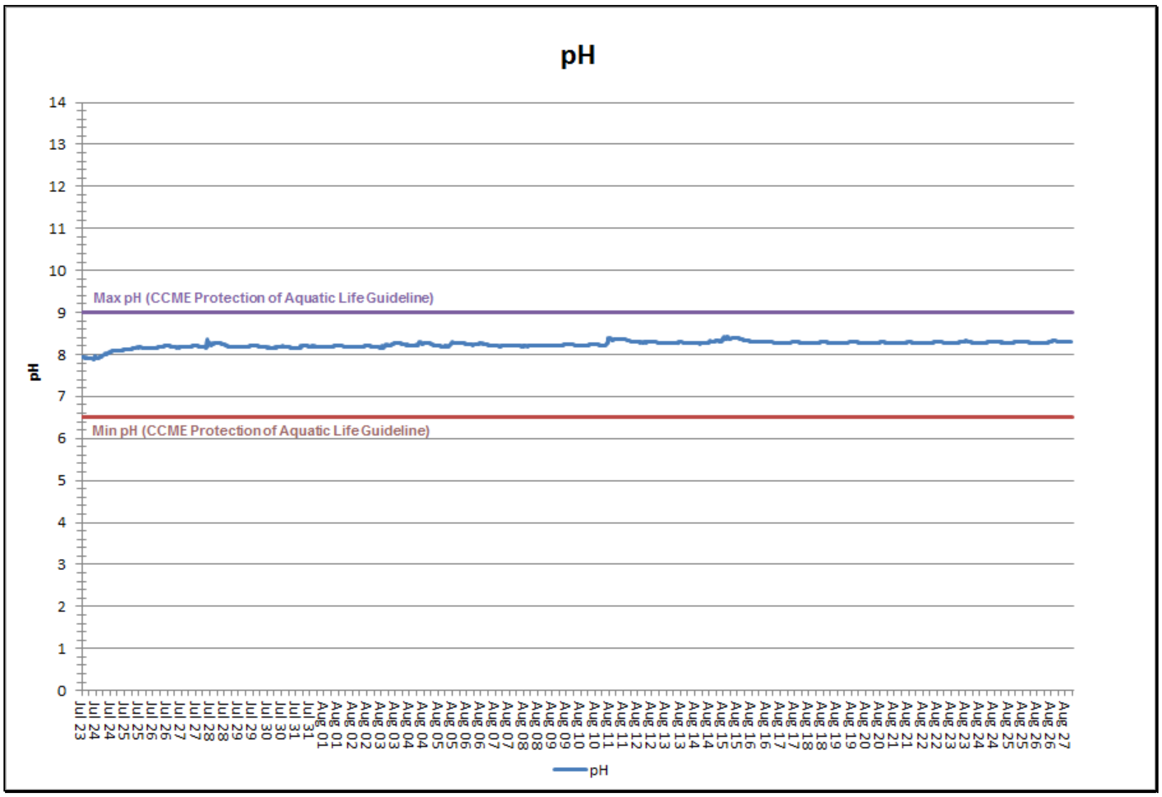
- **Dissolved Oxygen** (DO) measurements during this deployment ranged between 8.13 and 10.98 mg/l. DO concentrations during this deployment are shown in green in the graph in **Figure 2**, along with water temperatures which are shown in blue. The inverse relationship between dissolved oxygen concentration and water temperature is apparent in the graph, as DO levels decrease in response to increasing water temperatures, and DO levels increase in response to decreasing water temperatures. This relationship is based on the fact that the solubility of oxygen is greater in colder water than in warmer water. Many DO measurements were above the minimum guidelines recommended by the CCME for the protection of freshwater aquatic life, of 9.5 mg/L for early life stages and 6.5 mg/L for other life stages in cold water systems during this deployment. However, some DO values fell below 9.5 mg/L corresponding with the seasonally warmer water temperatures. It isn't unusual for DO concentrations to fall below 9.5mg/L for short durations, while seasonal water temperatures approach 20^{o}C and higher. It is important to acknowledge that QAQC comparison rankings for DO, both at the beginning and end of this deployment, were "poor," indicating that DO measurements for the duration of this deployment may not be reliable.

Figure 2: Dissolved Oxygen



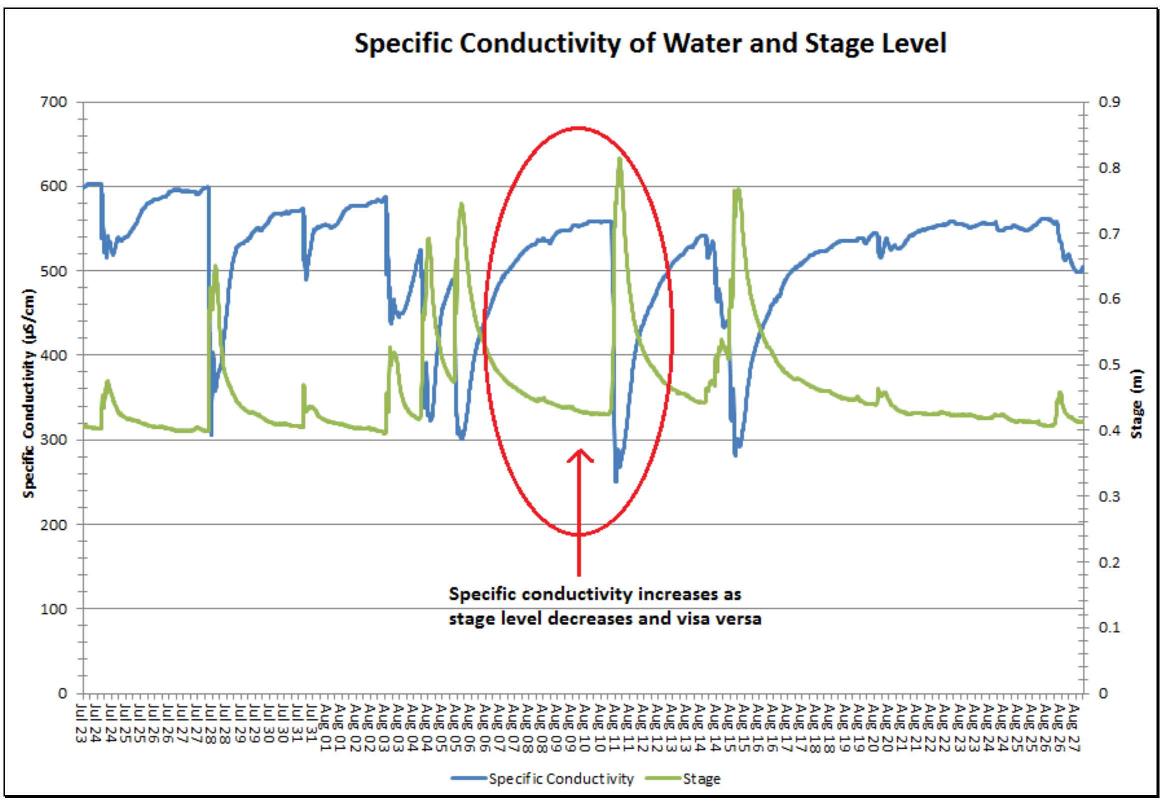
- The **pH** of water is a measure of the concentration of hydrogen ions, with pH decreasing as the concentration of hydrogen ions increases. The pH of water determines the solubility and biological availability of chemical constituents such as nutrients and heavy metals. Both natural (precipitation) and human (urban run-off) processes determine the pH of water. Metals tend to be more toxic at lower pH because they are more soluble. Photosynthesis uses up hydrogen molecules, which causes the concentration of hydrogen ions to decrease and therefore the pH to increase. For this reason, pH may be higher during daylight hours and during the growing season, when photosynthesis is at a maximum. pH values during this deployment period were quite stable, ranging from 7.89 to 8.41, as shown in blue in the graph in **Figure 3.** All pH measurements were within the CCME recommended guideline range for the protection of aquatic life, of 6.5 - 9.0 pH units. pH values for this deployment are shown in blue in the graph in **Figure 3.** It is important to acknowledge that the QAQC comparison ranking for pH at the beginning of this deployment was "fair" and at the end of this deployment was "marginal," indicating that data values may not be reliable for the duration of this deployment.

Figure 3: pH



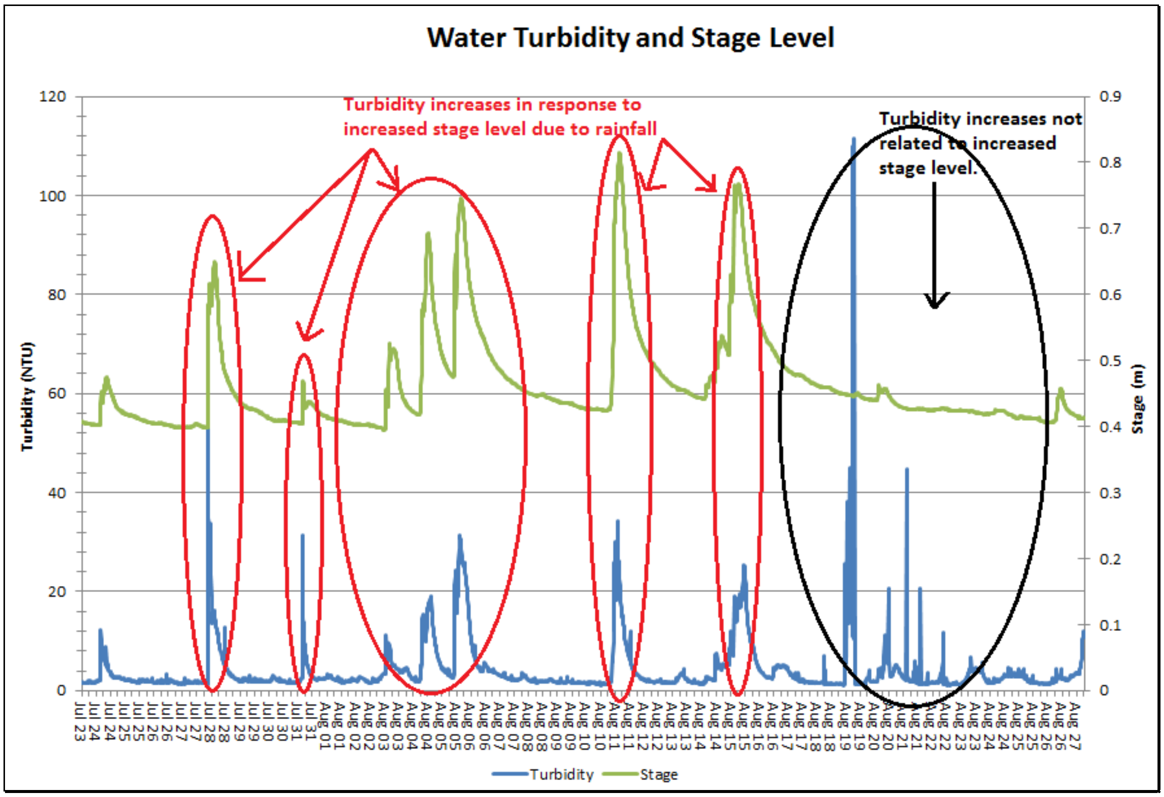
▪ **Specific conductivity (SpC)** measures the ability of water to pass an electrical current. Conductivity in streams and rivers is affected by the geology of the area through which the water flows. Streams that run through granite bedrock tend to have lower conductivity than those that flow through limestone and clay soils. High specific conductance readings are often influenced by urban run-off. The effects of urban run-off are dependent upon the season. During warmer temperatures, when road salt is not being used for ice control, rainfall and urban run-off can have a dilution effect, causing specific conductivity levels to decrease as stage height increases. However, during the winter months when road salting operations are in effect, urban run-off can result in spikes in specific conductivity. In **Figure 4,** below, specific conductivity (shown in blue) tends to increase during dry spells marked by decreases in stage level (shown in green); and conversely, specific conductivity decreases as stage level increases. This observation is supported by Environment Canada Daily Climate Data, presented in **Appendix 1,** at the end of this report. The climate data indicate significant rainfall occurred on July 27, August 4-5 and August 14-15, which coincide with concurrent spikes in stage level and dips in conductivity. Specific conductance values in Waterford River during this deployment period were within the expected range for this river at this time of year, ranging between 250 and 603µS/cm.

Figure 4: Specific Conductance and Stage



▪ **Turbidity** is a measure of water clarity, and the degree to which material suspended in water decreases the passage of light through the water. Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances. Turbidity values were at background levels of up to 8NTU for much of the deployment period, showing spikes in response to rainfall on July 27 and 31, and August 3-5, 11, 14-15 and 20. Turbidity measurements were variable from August 19-22, showing intermittent spikes during this period which didn't appear to correspond with rainfall (with the exception of 7mm of rain that fell on August 20). This could be an indication of land-based activities upstream impacting water quality. Turbidity is shown in blue in the graph in **Figure 5** below, and rainfall is represented as increased stage level in green.

Figure 5: Turbidity



Appendix 1:

Environment Canada Daily Climate Data (July 23-31, 2013)
St. John's International Airport

	Max Temp	Min Temp	Mean Temp	Total Rain	Max Wind Gust
July	°C	°C	°C	mm	km/h
23	23.8	11.7	17.8	0	54
24	25.9	12.4	19.2	7.2	72
25	28.3	21.5	24.9	TT	69
26	28.7	19.4	24.1	0	54
27	**28.4**	**19.1**	**23.8**	**20.4**	52
28	**19.2**	**9.4**	**14.3**	2.4	52
29	17.9	9.6	13.8	0	35
30	21.9	12.1	17	TT	50
31	24.9	14.8	19.9	**4.6**	59
*** TT = Trace**					

Environment Canada Daily Climate Data (August 2013)
St. John's International Airport

August 2013	Max Temp °C	Min Temp °C	Mean Temp °C	Total Rain mm	Max WindGust km/h
DAY					
01 -	24.4	15.7	20.1	Trace	44
02 -	24.8	14.7	19.8	Trace	<31
03 -	22.6	14	18.3	**11**	63
04 -	20.8	15.9	18.4	**22.4**	39
05 -	19.3	13.5	16.4	**22.2**	65
06 -	22.5	13.9	18.2	0	54
07 -	16.5	12.1	14.3	0.2	<31
8					
09 -	23.7	14.9	19.3	0	43
10					
11 -	23	13.9	18.5	**4**	78
12 -	23.7	13.9	18.8	0	56
13 -	25.3	13.3	19.3	0	46
14 -	20	14.6	17.3	**18**	44
15 -	22.9	14.4	18.7	**13.2**	63
16 -	17	11.4	14.2	0	57
17 -	23.5	11	17.3	0	37
18 -	21.4	14.4	17.9	0	46
19 -	**23.8**	**11.7**	**17.8**	Trace	65
20 -	**12.2**	**3.8**	**8**	**7**	57
21 -	18.9	3.8	11.4	0	63
22 -	24.4	16.1	20.3	0	72
23 -	24.3	18	21.2	0.2	72
24 -	19.5	9.7	14.6	5.8	43
25 -	13.2	9.6	11.4	0	33
26 -	19.5	10.6	15.1	3.2	43
27 -	22.6	13	17.8	0.6	41
28 -	22.4	9.8	16.1	4	48
29 -	12.4	9.4	10.9	3.6	46
30 -	18.9	12.4	15.7	18.6	65
31					

*Blank cells indicate no data available

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