SCRWRF

NPDES permit renewal application

WA-0093317

January 2021

File 2 of 2

Receiving Water Studies

- Temperature

-Conventional Parameters

SPOKANE COUNTY

UTILITIES DIVISION

N. BRUCE RAWLS, P.E., DIRECTOR

A DIVISION OF THE PUBLIC WORKS DEPARTMENT

December 27, 2012

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2012 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between June 1, 2012 and November 1, 2012.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data including data anomalies. The attached data report also includes recommendations for implementing the receiving water study in 2013.

The receiving water study identified numerous factors that influence water temperature in the study area that are beyond the control of Spokane County. The attached data clearly indicates that the temperature of the Spokane River in the study area is affected by ground water from the Spokane Valley Rathdrum Prairie (SVRP) aquifer and seasonal, ambient air temperature fluctuations that affect the temperature of the surface water held behind Upriver Dam, located just upstream of the study area.

Another factor that had an effect on the temperature study was the significant seasonal variation of the river stage and flow during the study period.

As noted above, the attached data report includes recommendations for future temperature studies to address the issues identified above. Spokane County is committed to collecting high quality, accurate data as part of this receiving water study; we look forward to discussing these recommendations with you for eventual incorporation into a revised QAPP. Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2012 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

December 27, 2012

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1 INTRODUCTION

This report presents the results of the 2012 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations for the 2013 study.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: 1) Temperature Monitoring, 2) Conventional Parameters, and 3) Toxic Parameters. This report addresses the temperature element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the outfall during the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf .
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document; however, if the Permittee wishes to use

measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from WDOE. Additional discussion of the QAPP accompanies the Field Activities section of this report.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run

measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs in the same area. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1.

Downstream Location:
The downstream data collection location is approximately 350 ft. downstream of the facility discharge. The width of the river at this location ranged from approximately 210 ft. to 150 ft. during the course of the study. Access to the downstream location is relatively limited due to thick underbrush; access directly upstream and downstream is impeded by large trees, whose branches extend over the water which make it difficult to deploy data loggers. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape, with depth increasing quickly from the shoreline. The thalweg is in the middle of the channel. The shore is rocky soil with some boulders. No groundwater seeps or springs were visible from the shoreline. Figure 2 shows an aerial photo of the downstream site taken on 8/20/2011.

Upstream location:
The upstream data collection location is approximately 430 ft. upstream of the facility discharge point. The width of the river at this location ranged from approximately 220 ft. to 140 ft. during the course of the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel and the thalweg is located closer to the north side of the river. Access to the site is very limited with difficult access due to trees and significant underbrush. The location was chosen based on best access, likely due to the power lines that run overhead. The shore at this site is comprised of large boulders. Spring flows were not observed along the shoreline when the data loggers were deployed in early June; significant spring flows were visible during periods of low flow, generally after July 1 and through November 1. Figure 3 shows an aerial photo of the upstream site taken on 8/20/2011.

During the course of the study, and based on anomalous data due to the presence of aquifer water, the upstream main data logger was moved approximately 100 ft. downstream of the primary location on August 17, 2013. At this location the bench did not extend as far into the river and the thalweg was wider and closer to the middle than at the original upstream location. The secondary upstream location is also shown on Figure 3.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP with one exception. The QAPP states:

> *County staff will secure in-river thermistors in place by anchoring conduit to the riverbed and placing it at the end of the conduit. There will be holes drilled in the conduit to allow fresh water to free flow through it. A cable will be attached to the thermistors so that they can be retrieved.*

Based on encountered difficulties and safety concerns associated with designing and securing conduit to the riverbed, the data loggers were secured to the end of a 3 ft. length of chain attached to a 25 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/chain/thermistor combination was then manually deployed into the river (see Figure 4).

Field visits to each location were made on a monthly basis to download data, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The data loggers were initially deployed on May 31, 2012 and data recording began at 12:00 am on June 1, 2012. The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible. All data loggers were retrieved on November 1, 2012.

Modifications/Changes During the Study
The upstream data loggers were not vandalized or stolen during the course of the study, likely due to the difficult access.

After review of the July data it was apparent that the location of the upstream data loggers may not be representative of the river temperature found in the thalweg (see Study Results section, below), so the upstream main data logger was moved approximately 100 feet downstream on August 17, 2012.

On September 10, 2012 County personnel observed the downstream backup data logger was stolen and the downstream main data logger was pulled in and left on shore. As the downstream backup data logger was stolen all of the data since the previous download on August 17, 2012 was lost. The data from the downstream main data logger was lost for the period of time it was on shore between approximately 4 pm on September 8, 2012

and September 10, 2012. A new data logger, downstream backup II, was deployed on September 11, 2012.

As specified in the QAPP, CH2M Hill measures temperature of the effluent just prior to the chlorine contact chamber. The data is collected continuously, but was provided to the County for the study period at 30 minute intervals. Of note: effluent temperature data collected from June 1, 2012 to June 22, 2012 was deemed invalid, due to trapped air in the vicinity of the probe. A modification was made to the temperature probe location and the data after June 22, 2012 is deemed valid. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven day running average are presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Downstream Main	Upstream Backup	Downstream Backup	Effluent
June	14.47	15.40	15.11	15.44	18.46
July	14.56	19.93	17.81	20.37	22.50
August	15.06	14.64	15.37	16.90	22.57
September	13.36	14.07	13.19	14.16	22.05
October	13.03	13.81	13.03	13.96	21.47

As noted earlier in this report, the facility discharge point is located in a reach of the river that is affected by warmer water during the summer months from the Upriver Dam reservoir as well as cooler water from the SVRP aquifer. The temperature data indicates significant temperature differences across a single cross section of the river as the two different sources mix.

This study was conducted to determine if effluent from the facility is increasing river temperature downstream of the discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit.

Data collected during the study period was inconclusive; at times the upstream temperature was lower than the downstream temperature and at other times it was the reverse. The data demonstrated the challenge of measuring river temperature in a reach of the river that has significant groundwater inflow, especially at times when the cool groundwater is mixing with surface water heated by high ambient air temperatures during the summer months.

There were three general scenarios that resulted in three distinct data profiles: 1) high river flows, 2) low river flows and high to mid ambient air temperature, and 3) low river flows and low ambient air temperature. The three scenarios are discussed, below.

High River Flows
This period lasted from approximately June 1st to June 29th. During this time all data loggers collected very similar temperature data. This was due to the magnitude of river flow in relation to groundwater inflow. During this period river flows were 2 orders of magnitude greater than groundwater inflow, which diluted the impact lower temperature groundwater would have on overall river temperature. Also during this time ambient air temperature averaged 15.6 ^{0}C, approximately 4.3^{0}C above measured groundwater inflow of 11.3^{0}C.

Lower River Flows and High to Mid Ambient Air Temperature
This period was from approximately June 29th to October 2nd, and represents the majority of the study. During this period there was significant variation between all data loggers, at times over 10^{0}C. Also during this period there was not a consistent pattern between the upstream and downstream locations; at times both upstream data loggers recorded cooler temperatures than both data loggers in the downstream location and at other times the two upstream data loggers recorded temperatures between the two downstream data loggers. The data also shows some significant changes in temperature when the data loggers were retrieved and redeployed. At times temperature patterns of individual data loggers changed immediately after redeployment by as much as 4^{0}C.

Data logger deployment was always as far into the river as possible, but the exact location was, to some degree, random. During the course of the study it became apparent that the effects of groundwater inflow, both from seeps on the shoreline and from inflow through the river bottom, varied from one specific data logger location to another within the upstream and downstream locations.

Also during this period the difference between groundwater inflow temperature and the river temperature increased due to high ambient air temperatures and a longer residence time in the Upriver Dam operating reservoir. This temperature difference was another factor that accentuated the variability between specific data logger locations that were in relative close proximity.

Both the upstream and downstream locations demonstrated this variability, though it was more pronounced at the upstream location, apparently due to the shape of the channel. The upstream location, as shown in Figure 3, is on a bench with shallow water. At lower flows the thalweg is apparently on the opposite (north) side of the river; therefore the data loggers were deployed into an area of relatively high groundwater inflow with less mixing than other portions of the river reach. The variability, though, was not limited to the upstream location. The downstream location was apparently not on a bench and the thalweg was in the middle of the river yet still demonstrated significant variability depending on specific data logger location after deployment. As an example, at the end of July the upstream data loggers differed by 4^{0}C and the downstream data loggers

differed by 2 ^{0}C. The relative temperatures between data loggers were also variable, as demonstrated below.

Relative High To Low Temp. ↓

August 3rd before retrieval	August 3rd after deployment
Downstream Backup	Downstream Backup
Downstream Main	Upstream Backup
Upstream Backup	Upstream Main
Upstream Main	Downstream Main

In summary, temperature data collected during this time period indicates the general trend of river temperature in this reach of the river, but the variability of the data depending on the specific location where the data logger landed after deployment precludes it from conclusively evaluating the impact of the facility discharge on river temperature.

Lower River Flows and High Ambient Air Temperature
As ambient air temperatures decreased in autumn the temperature difference between groundwater inflow and the river decreased significantly. As a result, the variability between the data loggers was reduced. However, the upstream location still demonstrated influence from ground water inflow during this period. During the final 10 days of the study it appeared that the groundwater inflow temperature was warmer than the river temperature, resulting in upstream location temperatures higher than the downstream location.

5 CONCLUSIONS

The data collected for the study was conclusive with respect to the minimal effect of the SCRWRF discharge on ambient river temperature at relatively high river flows but was inconclusive with respect to the effect of the SCRWRF discharge on ambient river temperature at relatively low river flows.

For informational purposes, the potential impact of the SCRWRF discharge on the river temperature for relatively low river flows can be calculated given the temperature and volume of the river and the discharge. The final temperature of a mixture of two bodies of water with different temperatures can be calculated as follows:

$$T = (v_1t_1 + v_2t_2)/(v_1+v_2),$$

Where:
T=final temperature,
v_1=river flow,
v_2=effluent flow,

t_1=river temp,
t_2=effluent temp

The values specific to the river and the facility discharge at the time most likely to show an impact are as follows:

1) V_1 = 1000 cfs; during the first week of September the river was at its lowest flow at the Spokane USGS gage. The flow estimated at the facility discharge location based on the Spokane and Post Falls gages was approximately 1,000 cfs.

2) V_2 =9.9 cfs; the facility was discharging approximately 6.8 million gallons per day during that period which is approximately 9.9 cfs.

3) T_1 = 12.25; at the time of the largest difference between the measured river temperature and the facility discharge the average of the two upstream data loggers was 12.25 ^{0}C.

4) T_2 = 22.1^{0}C; the facility discharge temperature at the time of the largest difference between the measured river temperature and the facility discharge was 22.1^{0}C.

Given those values the resulting temperature of the discharge and river mixed would be 12.32^{0}C, or 0.07^{0}C greater. This represents the calculated upper bound of the temperature increase that could be attributed to the SCRWRF discharge, and during most of the study period it would very likely be lower. For reference, the temperature difference measured between the upstream and downstream locations during the study period were, at times, two orders of magnitudes greater than the above-calculated increase.

6 RECOMMENDATIONS

Spokane County suggests the following recommendations for consideration of the 2013 Receiving Water Temperature Study.

Modify deployment methods and locations of the data loggers to avoid the areas of SVRP aquifer inflow to the Spokane River. This would potentially involve accessing the river from the north side and involve alternate methods of deployment. Ideally, the data loggers would be located above the river bottom in the deepest sections of the river to minimize the influence of discharge from the SVRP aquifer.

Modify the timing of the study to address the relatively higher flows in late spring/early summer. The data loggers were deployed on June 1, 2012 when the river was flowing at over 10,000 cfs; in the following month river flows rose to over 23,000 cfs before receding to approximately 5,000 cfs. These fluctuations in flow had a significant effect on river stage (estimated to be at least 5-feet in the study area) and affected the locations of the data loggers. Spokane County suggests the timing of the study be modified to deploy the data loggers following the spring runoff and after the river flow stabilizes in the range of 5,000 cfs or less.

Table 1 - Daily Temperature Data

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
6/1/12	12.50	12.70	12.60	12.70						
6/2/12	13.10	13.20	13.20	13.30						
6/3/12	13.20	13.30	13.30	13.30						
6/4/12	13.40	13.50	13.40	13.50						
6/5/12	13.10	13.20	13.20	13.20						
6/6/12	12.30	12.30	12.40	12.40						
6/7/12	11.90	12.00	11.90	12.00		12.79	12.89	12.86	12.91	
6/8/12	12.30	12.30	12.30	12.30		12.76	12.83	12.81	12.86	
6/9/12	12.00	12.10	12.10	12.10		12.60	12.67	12.66	12.69	
6/10/12	11.80	11.90	11.80	11.90		12.40	12.47	12.44	12.49	
6/11/12	12.60	12.70	12.70	12.70		12.29	12.36	12.34	12.37	
6/12/12	13.00	13.00	13.00	13.00		12.27	12.33	12.31	12.34	
6/13/12	12.70	12.70	12.70	12.80		12.33	12.39	12.36	12.40	
6/14/12	12.60	12.70	12.70	12.70		12.43	12.49	12.47	12.50	
6/15/12	13.30	13.30	13.30	13.30		12.57	12.63	12.61	12.64	
6/16/12	13.50	13.50	13.50	13.50		12.79	12.83	12.81	12.84	
6/17/12	14.10	14.10	14.10	14.10		13.11	13.14	13.14	13.16	
6/18/12	13.50	13.50	13.60	13.60		13.24	13.26	13.27	13.29	
6/19/12	12.70	12.80	12.80	12.80		13.20	13.23	13.24	13.26	
6/20/12	14.10	14.20	14.10	14.20		13.40	13.44	13.44	13.46	
6/21/12	14.70	14.80	14.80	14.80		13.70	13.74	13.74	13.76	
6/22/12	14.60	14.70	14.70	14.70		13.89	13.94	13.94	13.96	
6/23/12	14.70	14.90	14.90	14.90	18.20	14.06	14.14	14.14	14.16	
6/24/12	14.80	14.90	14.90	14.90	18.32	14.16	14.26	14.26	14.27	
6/25/12	14.40	14.80	14.90	14.90	18.50	14.29	14.44	14.44	14.46	
6/26/12	13.70	14.20	14.50	14.50	17.82	14.43	14.64	14.69	14.70	
6/27/12	14.40	15.00	15.20	15.30	18.27	14.47	14.76	14.84	14.86	
6/28/12	14.60	15.60	15.90	16.00	18.69	14.46	14.87	15.00	15.03	
6/29/12	14.10	15.60	16.00	16.10	18.75	14.39	15.00	15.19	15.23	18.36
6/30/12	14.00	15.70	16.40	16.40	18.89	14.29	15.11	15.40	15.44	18.46
7/1/12	13.70	15.80	16.50	16.50	18.64	14.13	15.24	15.63	15.67	18.51
7/2/12	13.80	16.50	17.20	17.20	18.94	14.04	15.49	15.96	16.00	18.57
7/3/12	13.00	16.00	16.80	16.80	18.50	13.94	15.74	16.29	16.33	18.67
7/4/12	13.60	16.50	17.30	17.40	18.74	13.83	15.96	16.59	16.63	18.74
7/5/12	13.00	16.30	17.50	17.50	18.89	13.60	16.06	16.81	16.84	18.76
7/6/12	15.00	16.40	17.20	17.50	19.41	13.73	16.17	16.99	17.04	18.86
7/7/12	15.60	16.20	17.40	17.60	19.57	13.96	16.24	17.13	17.21	18.96
7/8/12	15.70	16.00	17.10	17.70	19.67	14.24	16.27	17.21	17.39	19.10
7/9/12	15.50	16.10	17.10	17.80	19.79	14.49	16.21	17.20	17.47	19.22
7/10/12	13.50	16.30	17.60	18.40	20.11	14.56	16.26	17.31	17.70	19.45
7/11/12	12.60	17.00	18.10	19.10	20.46	14.41	16.33	17.43	17.94	19.70
7/12/12	12.70	17.20	18.80	19.50	20.39	14.37	16.46	17.61	18.23	19.91
7/13/12	12.90	17.30	19.70	20.40	21.43	14.07	16.59	17.97	18.64	20.20
7/14/12	12.80	18.20	20.40	20.80	21.95	13.67	16.87	18.40	19.10	20.54
7/15/12	12.40	17.90	19.80	20.30	20.59	13.20	17.14	18.79	19.47	20.67
7/16/12	12.10	17.80	19.80	20.10	21.47	12.71	17.39	19.17	19.80	20.91
7/17/12	12.30	18.20	20.20	20.50	21.61	12.54	17.66	19.54	20.10	21.13
7/18/12	12.10	18.00	20.10	20.60	21.58	12.47	17.80	19.83	20.31	21.29
7/19/12	12.40	17.30	19.50	19.90	22.16	12.43	17.81	19.93	20.37	21.54
7/20/12	12.20	16.90	19.00	19.80	22.36	12.33	17.76	19.83	20.29	21.67
7/21/12	12.50	16.20	18.50	19.10	22.14	12.29	17.47	19.56	20.04	21.70

Table 1 - Daily Temperature Data

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
7/22/12	12.50	16.10	18.70	19.50	22.60	12.30	17.21	19.40	19.93	21.99
7/23/12	11.90	15.80	18.70	19.30	21.76	12.27	16.93	19.24	19.81	22.03
7/24/12	12.40	15.80	17.80	18.60	21.89	12.29	16.59	18.90	19.54	22.07
7/25/12	11.90	15.20	17.30	18.40	22.42	12.26	16.19	18.50	19.23	22.19
7/26/12	11.20	15.20	16.20	17.50	22.68	12.09	15.89	18.03	18.89	22.27
7/27/12	11.30	14.60	15.00	16.90	22.65	11.96	15.56	17.46	18.47	22.31
7/28/12	11.20	14.60	14.60	16.50	22.39	11.77	15.33	16.90	18.10	22.34
7/29/12	11.20	14.90	14.30	16.60	22.12	11.59	15.16	16.27	17.69	22.27
7/30/12	11.40	14.60	14.30	16.50	22.59	11.51	14.99	15.64	17.29	22.39
7/31/12	11.30	14.70	13.90	16.40	22.68	11.36	14.83	15.09	16.97	22.50
8/1/12	11.30	14.20	14.20	16.40	22.90	11.27	14.69	14.64	16.69	22.57
8/2/12	11.50	14.10	14.30	16.30	21.88	11.31	14.53	14.37	16.51	22.46
8/3/12	15.00	15.10	14.00	16.30	21.52	11.84	14.60	14.23	16.43	22.30
8/4/12	14.70	15.60	14.30	16.70	21.67	12.34	14.74	14.19	16.46	22.19
8/5/12	14.80	15.20	14.10	16.60	22.12	12.86	14.79	14.16	16.46	22.19
8/6/12	14.70	15.60	14.50	16.60	21.97	13.33	14.93	14.19	16.47	22.11
8/7/12	14.80	15.20	13.80	16.40	22.25	13.83	15.00	14.17	16.47	22.04
8/8/12	14.70	14.70	14.50	16.60	22.26	14.31	15.07	14.21	16.50	21.95
8/9/12	14.90	15.40	14.00	16.80	22.20	14.80	15.26	14.17	16.57	22.00
8/10/12	15.00	14.80	13.90	16.80	22.28	14.80	15.21	14.16	16.64	22.11
8/11/12	15.00	15.90	14.30	16.90	22.34	14.84	15.26	14.16	16.67	22.20
8/12/12	15.80	16.00	14.40	17.30	22.22	14.99	15.37	14.20	16.77	22.22
8/13/12	15.20	15.40	14.30	17.20	22.17	15.06	15.34	14.17	16.86	22.24
8/14/12	14.60	14.80	13.60	16.70	22.17	15.03	15.29	14.14	16.90	22.23
8/15/12	14.00	14.40	14.20	16.30	22.17	14.93	15.24	14.10	16.86	22.22
8/16/12	13.60	13.00	12.90	15.70	22.35	14.74	14.90	13.94	16.70	22.24
8/17/12	14.50	11.70	14.20	14.60	22.37	14.67	14.46	13.99	16.39	22.26
8/18/12	14.30	11.40	14.00		22.51	14.57	13.81	13.94	16.30	22.28
8/19/12	14.00	11.20	13.50		22.30	14.31	13.13	13.81	16.10	22.29
8/20/12	14.00	11.30	13.40		22.25	14.14	12.54	13.69	15.83	22.30
8/21/12	13.70	12.10	13.20		22.23	14.01	12.16	13.63	15.53	22.31
8/22/12	13.40	11.50	13.00		22.19	13.93	11.74	13.46	15.15	22.32
8/23/12	13.30	11.60	13.00		22.14	13.89	11.54	13.47	14.60	22.29
8/24/12	13.20	11.80	12.90		22.04	13.70	11.56	13.29		22.24
8/25/12	13.20	11.90	12.80		21.87	13.54	11.63	13.11		22.15
8/26/12	13.00	11.90	12.60		21.73	13.40	11.73	12.99		22.06
8/27/12	13.20	11.80	12.60		21.93	13.29	11.80	12.87		22.02
8/28/12	13.20	11.70	12.70		22.09	13.21	11.74	12.80		22.00
8/29/12	13.20	11.90	12.70		22.08	13.19	11.80	12.76		21.98
8/30/12	13.10	11.80	12.70		22.10	13.16	11.83	12.71		21.98
8/31/12	12.90	11.80	12.40		22.14	13.11	11.83	12.64		21.99
9/1/12	12.70	11.60	12.90		22.27	13.04	11.79	12.66		22.05
9/2/12	12.70	11.70	13.10		21.75	13.00	11.76	12.73		22.05
9/3/12	12.70	11.80	13.10		21.77	12.93	11.76	12.80		22.03
9/4/12	12.90	11.80	13.10		21.95	12.89	11.77	12.86		22.01
9/5/12	13.10	11.70	13.40		21.89	12.87	11.74	12.96		21.98
9/6/12	13.60	11.80	13.80		21.84	12.94	11.74	13.11		21.94
9/7/12	13.60	11.70	13.80		22.22	13.04	11.73	13.31		21.96
9/8/12	13.60	11.70	13.80		21.91	13.17	11.74	13.44		21.90
9/9/12	13.40	11.80			21.90	13.27	11.76	13.50		21.93
9/10/12	13.30	11.80	13.70		21.58	13.36	11.76	13.60		21.90

Table 1 - Daily Temperature Data

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
9/11/12	12.00	12.00	13.30	13.00	21.27	13.23	11.79	13.63	13.00	21.80
9/12/12	12.00	12.00	12.90	12.80	21.45	13.07	11.83	13.55	12.90	21.74
9/13/12	12.00	12.00	13.00	12.90	21.60	12.84	11.86	13.42	12.90	21.71
9/14/12	12.00	12.00	13.10	13.10	21.67	12.61	11.90	13.30	12.95	21.63
9/15/12	12.70	12.70	13.60	13.50	21.68	12.49	12.04	13.27	13.06	21.59
9/16/12	12.90	12.90	14.00	14.00	21.66	12.41	12.20	13.37	13.22	21.56
9/17/12	12.90	12.90	14.10	14.00	21.66	12.36	12.36	13.43	13.33	21.57
9/18/12	12.30	12.30	13.80	13.70	21.70	12.40	12.40	13.50	13.43	21.63
9/19/12	13.00	13.00	13.80	13.70	21.49	12.54	12.54	13.63	13.56	21.64
9/20/12	13.30	13.30	14.30	14.20	21.71	12.73	12.73	13.81	13.74	21.65
9/21/12	12.90	12.90	14.20	14.30	21.79	12.86	12.86	13.97	13.91	21.67
9/22/12	13.20	13.20	14.20	14.30	21.42	12.93	12.93	14.06	14.03	21.63
9/23/12	13.10	13.10	14.10	14.20	21.28	12.96	12.96	14.07	14.06	21.58
9/24/12	13.50	13.50	14.00	14.10	21.50	13.04	13.04	14.06	14.07	21.56
9/25/12	13.20	13.20	13.90	14.00	21.45	13.17	13.17	14.07	14.11	21.52
9/26/12	13.10	13.10	13.80	14.00	21.38	13.19	13.19	14.07	14.16	21.50
9/27/12	13.00	13.00	13.80	13.90	21.47	13.14	13.14	14.00	14.11	21.47
9/28/12	13.00	13.00	13.90	14.00	21.68	13.16	13.16	13.96	14.07	21.46
9/29/12	13.10	13.10	13.80	14.00	21.55	13.14	13.14	13.90	14.03	21.47
9/30/12	13.00	13.00	13.90	14.00	21.54	13.13	13.13	13.87	14.00	21.51
10/1/12	12.80	12.80	13.60	13.80	21.25	13.03	13.03	13.81	13.96	21.47
10/2/12	12.80	13.20	13.50	13.40	21.28	12.97	13.03	13.76	13.87	21.45
10/3/12	12.90	12.20	13.20	12.30	20.67	12.94	12.90	13.67	13.63	21.35
10/4/12	12.40	11.80	12.70	11.90	20.65	12.86	12.73	13.51	13.34	21.23
10/5/12	12.10	11.70	12.40	11.60	20.46	12.73	12.54	13.30	13.00	21.06
10/6/12	11.90	11.50	12.20	11.50	20.48	12.56	12.31	13.07	12.64	20.90
10/7/12	11.80	11.40	12.20	11.50	20.66	12.39	12.09	12.83	12.29	20.78
10/8/12	11.80	11.60	12.20	11.50	20.61	12.24	11.91	12.63	11.96	20.69
10/9/12	11.80	11.40	12.10	11.40	20.60	12.10	11.66	12.43	11.67	20.59
10/10/12	11.80	11.50	12.20	11.50	20.51	11.94	11.56	12.29	11.56	20.57
10/11/12	11.80	11.50	12.10	11.40	20.56	11.86	11.51	12.20	11.49	20.55
10/12/12	11.70	11.40	12.00	11.30	20.26	11.80	11.47	12.14	11.44	20.53
10/13/12	11.60	11.40	11.80	11.30	20.28	11.76	11.46	12.09	11.41	20.50
10/14/12	11.60	11.30	11.90	11.30	20.21	11.73	11.44	12.04	11.39	20.43
10/15/12	11.90	11.30	12.10	11.40	20.28	11.74	11.40	12.03	11.37	20.39
10/16/12	11.60	11.30	12.20	11.40	20.08	11.71	11.39	12.04	11.37	20.31
10/17/12	11.60	11.30	11.90	11.30	19.72	11.69	11.36	12.00	11.34	20.20
10/18/12	11.10	11.10	11.30	11.00	19.88	11.59	11.30	11.89	11.29	20.10
10/19/12	11.30	11.00	11.60	11.20	19.95	11.53	11.24	11.83	11.27	20.06
10/20/12	11.20	11.20	11.60	11.20	19.93	11.47	11.21	11.80	11.26	20.01
10/21/12	11.00	10.90	11.10	10.90	19.36	11.39	11.16	11.69	11.20	19.89
10/22/12	10.60	10.70	10.70	10.70	19.22	11.20	11.07	11.49	11.10	19.74
10/23/12	10.40	10.70	10.30	10.60	19.37	11.03	10.99	11.21	10.99	19.63
10/24/12	10.30	10.70	10.30	10.60	19.24	10.84	10.90	10.99	10.89	19.57
10/25/12	10.30	10.60	10.30	10.60	19.11	10.73	10.83	10.84	10.83	19.46
10/26/12	10.10	10.40	10.10	10.50	18.98	10.56	10.74	10.63	10.73	19.32
10/27/12	10.10	10.30	10.10	10.40	18.85	10.40	10.61	10.41	10.61	19.16
10/28/12	10.30	10.50	10.40	10.60	19.06	10.30	10.56	10.31	10.57	19.12
10/29/12	10.70	10.90	10.80	10.80	19.00	10.31	10.59	10.33	10.59	19.09
10/30/12	11.00	11.00	11.10	11.00	18.93	10.40	10.63	10.44	10.64	19.02
10/31/12	11.10	11.10	11.30	11.10	19.02	10.51	10.69	10.59	10.71	18.99


Figure 1: Data Collection Locations
2012 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility Discharge
Upstream Data Logger Deployment Location II
Spokane River
Downstream Data Logger Deployment Location
Upstream Data Logger Deployment Location I
Spokane County Sewer System North Valley Interceptor Pump Station
Spokane Community College

Figure 2: Downstream Location Aerial Photo

2012 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2012 Receiving Water Study-Temperature

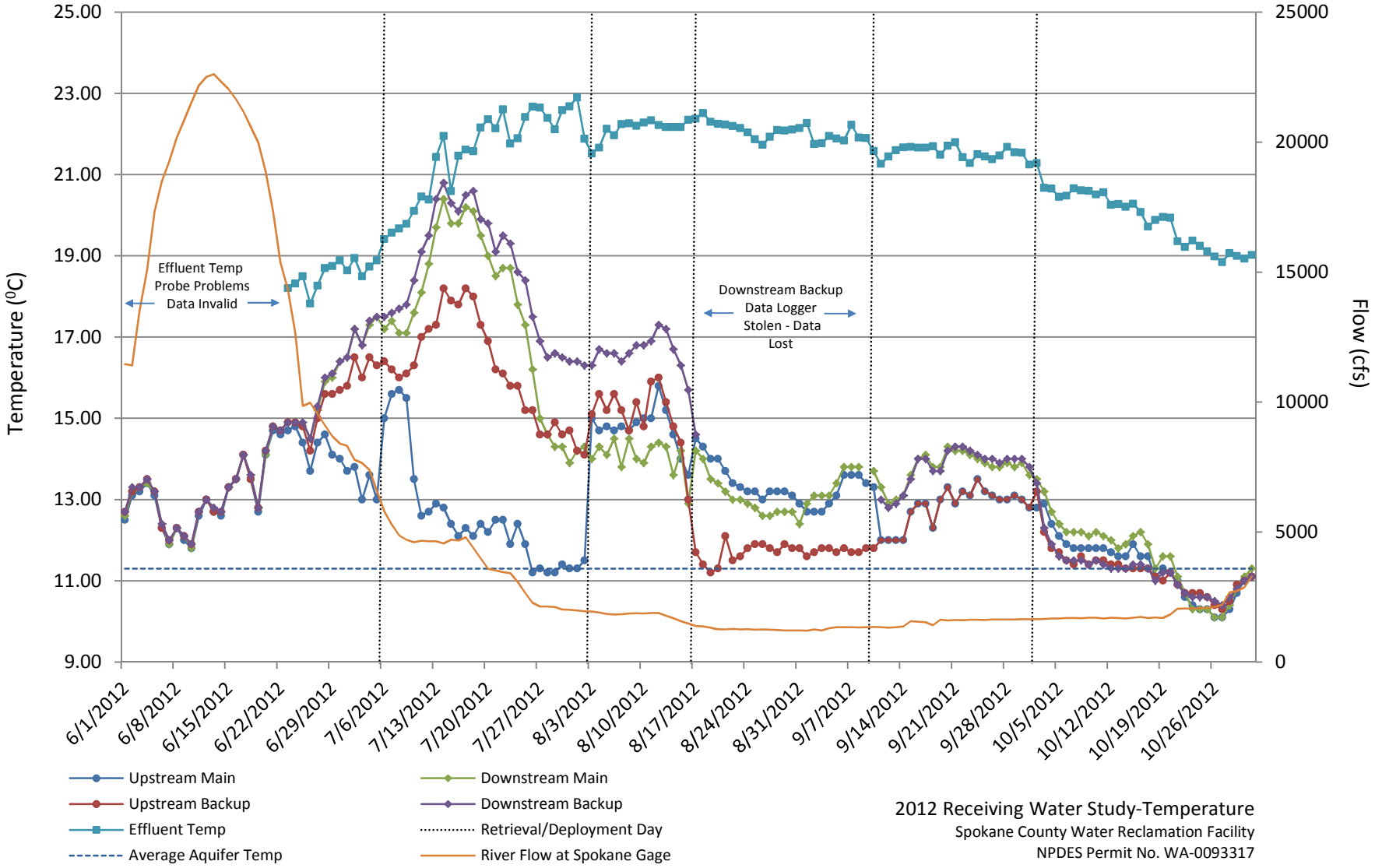
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Data Logger Deployment

2012 Receiving Water Study-Temperature

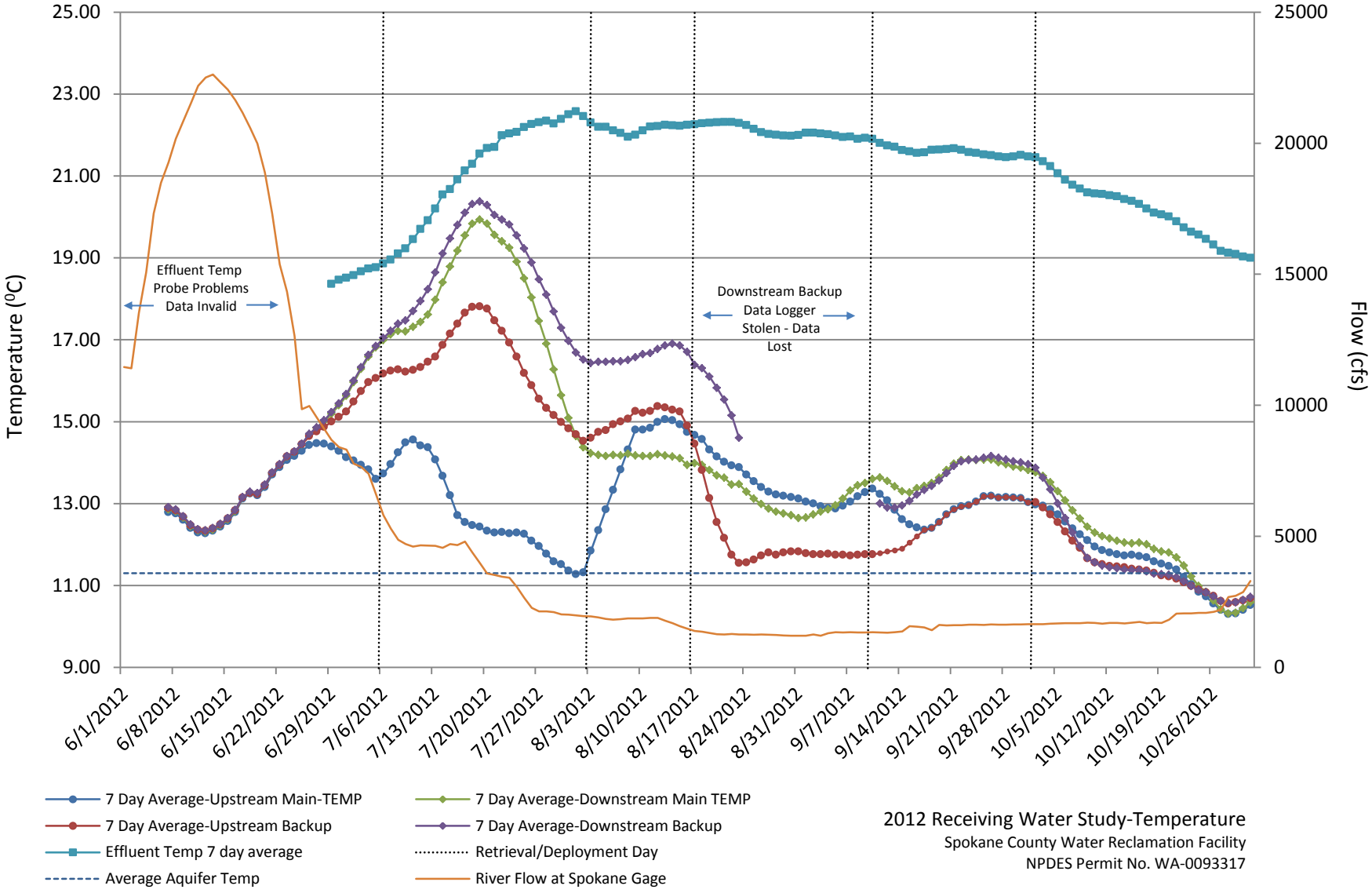
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5 - Daily Maximum Temperature



2012 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 6 - 7 Day Rolling Average of Daily Maximum Temperature



2012 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Rob Lindsay

Interval Frequency: 00:30

Data Logger ID #: 2009602

Data Logger Name: Upstream Main

Location: $47^0$40’33.43”/-$117^0$20’41.87”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
5/31/12	10:00	Deploy	11.7	8.5	Anchor block deployed approx. 2 feet (into river) from waters edge. Cable deployed full length.
7/6/12	15:20	Retrieve	12.2	7.5	River level is down. Anchor block is approximately 15 ft. from waters edge (from river)
7/6/12	15:30	Deploy	13.9	9.0	Moved anchor block 2 ft. (into river) from waters edge. Cable deployed full length.
8/3/12	9:20	Retrieve	11.1	8.0	Anchor block found out of water right at waters edge. Spring flow into the river noted along shore in vicinity of upstream loggers.
8/3/12	9:25	Deploy	12.7	8.5	Anchor block not moved. Cable deployed full length.
8/17/12	10:20	Retrieve	12.4	8.5	Anchor block out of water near waters edge.
8/17/12	10:25	Deploy	13.9	10.2	Anchor block moved approximately 100 ft. downstream
9/10/12	13:30	Retrieve	12.5	9.8	Anchor block out of water near waters edge. Measured near shore shallow water; temp 11.20
9/10/12	13:35	Deploy	13.3	8.7	Anchor block not moved. Cable deployed full length
10/2/12	14:00	Retrieve	12.4	9.0	Anchor block out of water near waters edge. Measured near shore shallow water; temp 11.20
10/2/12	14:05	Deploy	11.9	10.0	Anchor block not moved. Cable deployed full length
11/1/12	10:00	Retrieve	11.0	10.25	

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Rob Lindsay

Interval Frequency: 00:30

Data Logger ID #: 1048348

Data Logger Name: Upstream Backup

Location: $47^0$40’33.43”/-$117^0$20’41.87”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
5/31/12	10:05	Deploy	11.8	4.9	Anchor block deployed approx. 2 feet (into river) from waters edge. Cable tangled during deployment and only extended 75% of the length. Attempted to retrieve but became stuck. River flow prevented dislodging the data logger. The location of data logger appeared to be in sufficient depth and flow.
7/6/12	15:20	Retrieve	15.3	2.6	River level is down. Anchor block is approximately 15 ft. from waters edge (from river). Data logger found in shallow water.
7/6/12	15:30	Deploy	15.4	7.8	Moved anchor block 2 ft. (into river) from waters edge. Cable deployed full length.
8/3/12	9:20	Retrieve	11.8	4.4	Anchor block found out of water, right at waters edge. Spring flow into the river noted along shore in vicinity of upstream loggers.
8/3/12	9:25	Deploy	12.7	8.5	Anchor block not moved. Cable deployed full length.
8/17/12	10:20	Retrieve	10.8	3.8	Anchor block out of water near waters edge.
8/17/12	10:25	Deploy	11.0	3.7	Anchor block not moved. Cable deployed full length.
9/10/12	13:30	Retrieve	11.5	3.6	Anchor block out of water near waters edge. Measured near shore shallow water; temp 11.20
9/10/12	13:35	Deploy	11.4	3.4	Anchor block not moved. Cable deployed full length
10/2/12	14:00	Retrieve	12.0	3.8	Anchor block out of water near waters edge. Measured near shore shallow water; temp 11.20
10/2/12	14:05	Deploy	11.3	4.4	Anchor block not moved. Cable deployed full length
11/1/12	10:00	Retrieve	11.0	5.9	

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Rob Lindsay

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Downstream Main

Location: $47^0$40’33.41”/-$117^0$20’54.02”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
5/31/12	10:05	Deploy	11.8	10.7	Anchor block deployed approx. 2 feet (into river) from waters edge. Cable deployed full length
7/6/12	15:20	Retrieve	16.0	9.8	River level is down. Anchor block is approximately 15 ft. from waters edge (from river).
7/6/12	15:30	Deploy	15.6	10.3	Moved anchor 2 feet into the river from waters edge. Cable deployed full length.
8/3/12	9:20	-	-	-	Unable to retrieve data logger because it was stuck.
8/3/12	-	-	-	-	
8/17/12	10:20	Retrieve	11.7	8.3	Anchor block out of water near waters edge.
8/17/12	10:25	Deploy	14.1	10.0	Anchor block not moved. Cable deployed full length.
9/10/12	13:30	Retrieve	-	0	Data Logger found on shore out of water.
9/10/12	13:35	Deploy	13.7	9.8	Anchor block repositioned upstream 5 feet in a less visible location 3 feet back from waters edge. Cable deployed full length. Measured near shore shallow water; temp - 13.5
10/2/12	14:00	Retrieve	13.3	8.6	Anchor block out of water near waters edge. Measured near shore shallow water; temp 13.3
10/2/12	14:05	Deploy	13.4	10.3	Anchor block not moved. Cable deployed full length
11/1/12	10:00	Retrieve	11.1	10.3	Final retrieval for 2012 temperature monitoring

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Rob Lindsay

Interval Frequency: 00:30

Data Logger ID #: 1048349/2009627

Data Logger Name: Downstream Backup/Downstream Backup II

Location: $47^0$40’33.41”/-$117^0$20’54.02”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
5/31/12	10:05	Deploy	11.9	11.5	Anchor block deployed approx. 2 feet (into river) from waters edge. Cable deployed full length
7/6/12	15:20	Retrieve	16.4	6.0	River level is down. Anchor block is approximately 15 ft. from waters edge (from river).
7/6/12	15:30	Deploy	16.4	11.5	Moved anchor 2 feet into the river from waters edge. Cable deployed full length.
8/3/12	9:20	Retrieve	15.3	8.7	Anchor block near waters edge.
8/3/12	9:30	Deploy	15.5	9.6	Anchor block not moved. Cable deployed full length
8/17/12	10:20	Retrieve	14.3	9.0	Anchor block out of water near waters edge.
8/17/12	10:25	Deploy	-	-	Anchor block not moved. Cable deployed full length.
9/10/12	13:30	Retrieve	-	-	Data Logger missing. Cable and anchor block still present.
9/11/12	13:35	Deploy	13	9.8	Deploy new data logger ID 2009627. Cable deployed full length
10/2/12	14:00	Retrieve	12.4	9.8	Anchor block out of water near waters edge. Measured near shore shallow water; temp 13.30
10/2/12	14:05	Deploy	12.4	9.8	Anchor block not moved. Cable deployed full length
11/1/12	10:00	Retrieve	11.0	10.2	Final retrieval for 2012 temperature monitoring

SPOKANE COUNTY

UTILITIES DIVISION

KEVIN R. COOKE, P.E., DIRECTOR

A DIVISION OF THE PUBLIC WORKS DEPARTMENT

December 30, 2013

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2013 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2013 and November 1, 2013.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

Attachment

Cc w/out Att.: Dave Moss – Spokane County Utilities

1026 WEST BROADWAY AVENUE, 4TH FLOOR • SPOKANE, WA 99260-0430
PHONE: (509) 477-3604 • FAX: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2013 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

December 30, 2013

Table of Contents

Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2013 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations for the 2014 study.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the outfall during the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf .
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document; however, if the Permittee wishes to use

measuring devices from another company, it must demonstrate the accuracy is equivalent.

6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. The revisions were approved in February 2013. Specific QAPP revisions are discussed in the following sections of this report.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS

Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs in the same area. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. Based on recommendations from the 2012 Report, data collection locations were moved from the south side of the river to the north side of the river. Figure 2 and Figure 3 show the 2012 and 2013 data collection locations for the downstream and upstream locations respectively.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the course of the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush, as was the case with the 2012 study locations. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape, with depth increasing quickly from the shoreline. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. No groundwater seeps or springs were visible from the shoreline. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the course of the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. The shape of the river channel at this location was the principle reason for moving the data collection location from the south side of the river to the north side. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush, as was the case with the 2012 study locations. The shore at this site is comprised of large boulders. No groundwater seeps or springs were visible from the shoreline. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

3 FIELD ACTIVITIES

Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The rationale for the changes is described in the 2012 report. The changes were approved by Ecology in the revised QAPP in February 2013.

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to the end of a 3 ft. length of chain attached to a 25 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/chain/thermistor combination was then manually deployed into the river (see Figure 4).

Field visits to each location were made on a monthly basis to download data, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The data loggers were initially deployed on June 26, 2013 and data recording began at 12:00 am on July 1, 2013. The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible. All data loggers were retrieved on November 4, 2013.

The primary challenge during the 2013 study was the loss of data loggers from theft or cable breaks. The first field visit after deployment was on July 24th at which time both upstream data loggers and the main downstream data logger were all recovered and redeployed with no problems. The downstream backup data logger was found on shore, and the temperature data indicated that it had been on shore since July 21st. After downloading the data it was redeployed.

On August 22nd, the next field visit, both upstream data loggers were missing, likely stolen. All data collected after the previous download on July 24th was lost. At the downstream location the cable for the downstream backup data logger was found broken, and data since July 24th was lost. The downstream main data logger was stuck in between boulders, and not recovered at that time. On August 26th a new upstream data logger was deployed. No additional data loggers were on hand, so two additional data loggers were ordered and upon receipt on September 3rd were deployed.

On September 18th, the third field visit, both upstream data loggers and the downstream backup data logger were recovered and redeployed, the downstream main data logger was still stuck in between boulders and not recovered.

On the next field visit, October 16th, the cable for the upstream backup data logger was found broken, and the downstream back up data logger was missing, likely stolen. At that time there were no replacement data loggers on hand. Since there were only 15 days remaining in the study period and new data loggers would not be received for several days, the upstream and downstream back up data loggers were not replaced.

On October 22nd the downstream main data logger was retrieved after being stuck in between some boulders since August 22nd. It was redeployed in an area where it was not likely to become stuck. Temperature increased approximately 1 °C after redeployment likely because it was deployed into shallower water.

During each field visit every effort was made to position the anchor block out of plain view, and hide it in the brush and/or rocks. It is difficult to hide the cable in the water and this may be how the data loggers are seen.

As specified in the QAPP, CH2M Hill measures temperature of the effluent just prior to the chlorine contact chamber. The data is collected continuously, but was provided to the County for the study period at 30 minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven day running average are presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Downstream Main	Upstream Backup	Downstream Backup	Effluent
July	19.17	19.00	19.54	17.89	21.72
August	-	17.26	-	-	22.56
September	16.29	14.40	16.13	15.71	22.47
October	12.69	11.30	-	-	20.90

This study was conducted to document the impact to the river, if any, downstream of the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. The study indicates that no impacts are observed.

As noted earlier in this report, the SCRWRF discharge point is located in a reach of the river that is gaining water from the SVRP Aquifer. Water from the SVRP Aquifer is cooler than the river during the summer months and therefore the temperature of the river decreases moving downstream in this reach. This is evident in the temperature data; there were no instances during the study period in which the downstream temperature is greater than the upstream temperature.

5 CONCLUSIONS

The study, as conducted, indicates that facility discharge does not have a measurable impact on the temperature of the river. This is due to the inflow of cool, SVRP Aquifer water in the reach of the river in which the discharge point is located and the magnitude of the river flow in relation to the facility discharge. The facility discharge is approximately 12 cfs, while the river flow did not fall below 1000 cfs during the study period; as such the facility discharge is at most 1.2 % of river flow.

Results from the 2012 Temperature study were impacted by the placement of the data loggers in an upstream location that was not well mixed and had a high percentage of inflow from the SVRP Aquifer. In 2013 the data loggers were moved to the north side of the river and deployed into a well-mixed portion of the river. This location allowed the collection of temperature data that was more representative of the entire river flow.

6 RECOMMENDATIONS

The changes made in 2013 addressed the issues identified in the 2012 report. To address the issue of broken cables in 2013, we are planning to utilize cables with plastic coating so they do not rust and potentially break. To address the issue of stolen data loggers we plan to make every effort to place the anchor blocks out of plain view, and we are also planning to place notification of the ownership and purpose of the data loggers on the anchor blocks.


Figure 1: Data Collection Locations
2013 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2013 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

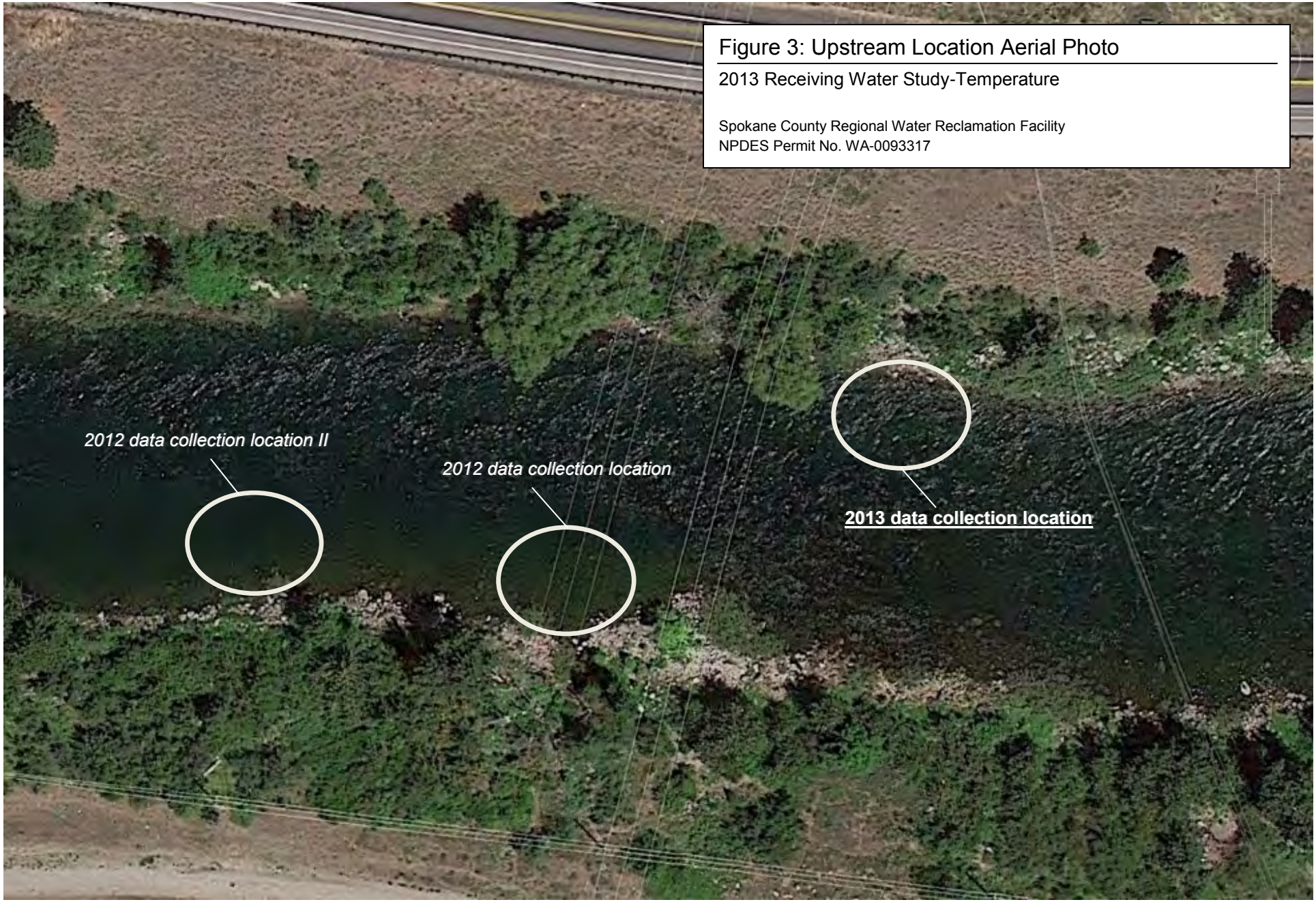


Figure 3: Upstream Location Aerial Photo

2013 Receiving Water Study-Temperature

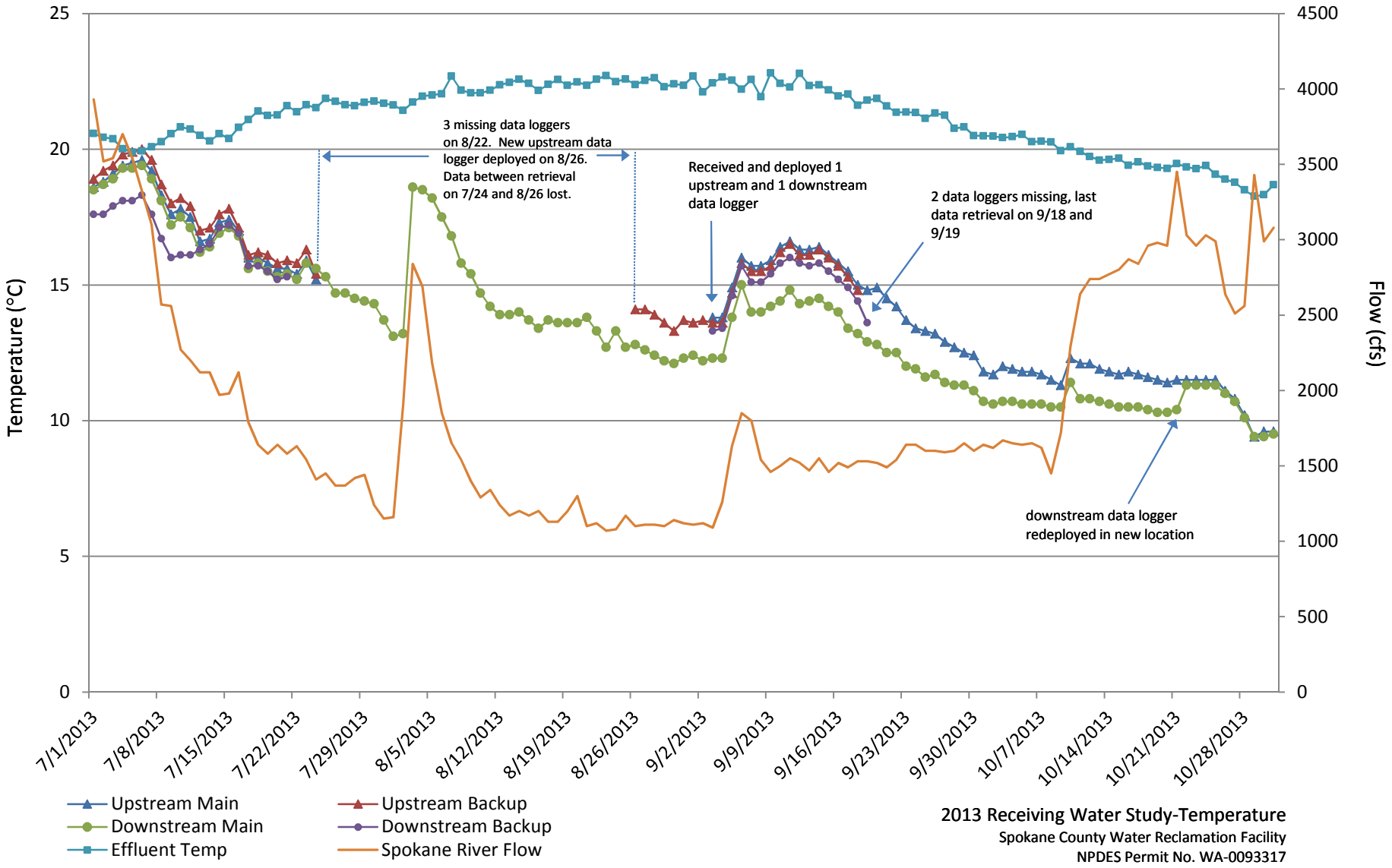
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Data Logger Deployment

2013 Receiving Water Study-Temperature

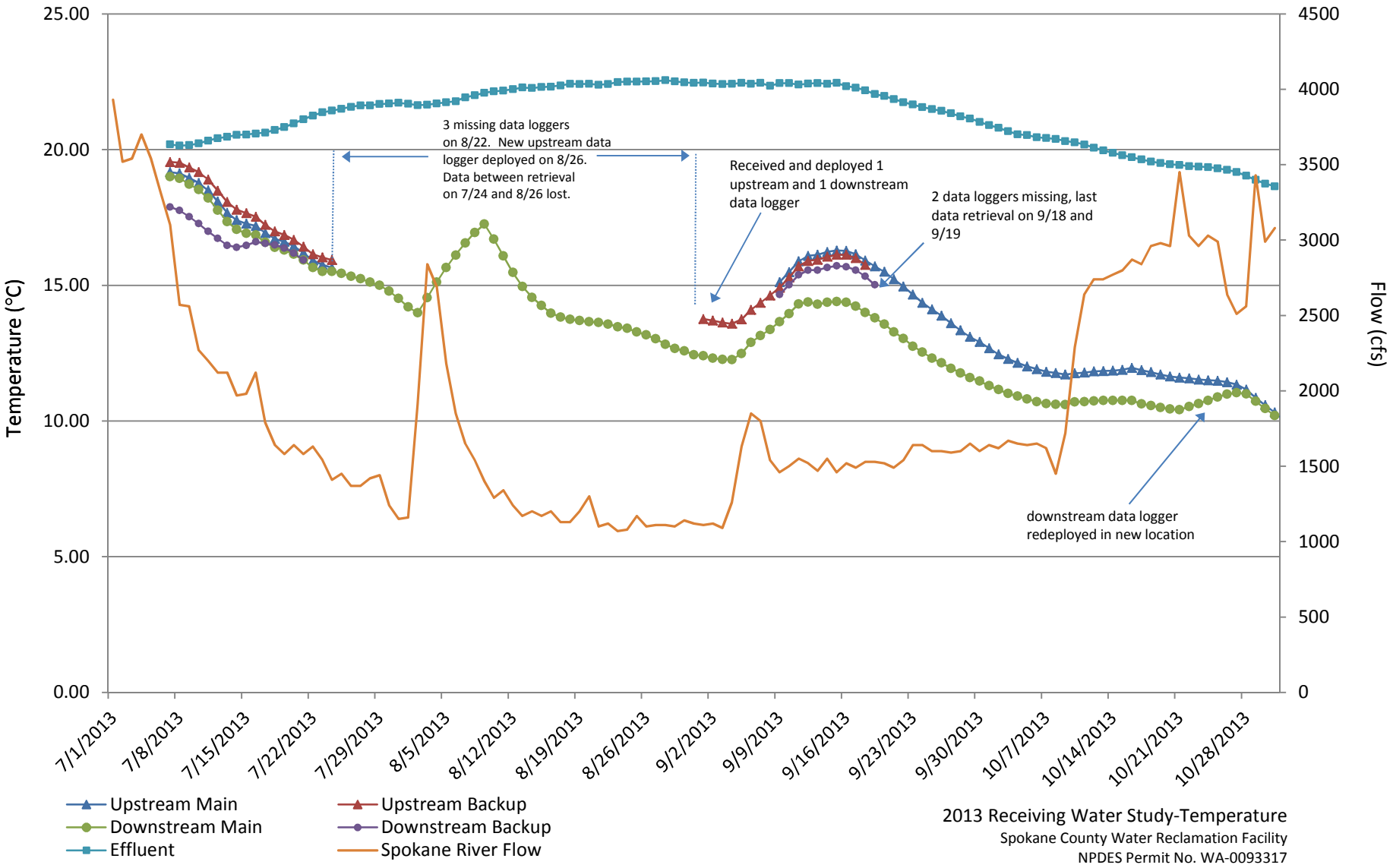
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5 - Daily Maximum Temperature



2013 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 6 - 7 Day Rolling Average of Daily Maximum Temperature



2013 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
7/1/12	18.60	18.90	18.50	17.60	20.58					
7/2/12	18.80	19.20	18.70	17.60	20.44					
7/3/12	19.10	19.40	18.90	17.90	20.39					
7/4/12	19.40	19.80	19.30	18.10	20.01					
7/5/12	19.50	19.90	19.30	18.10	19.89					
7/6/12	19.60	20.00	19.40	18.30	19.94					
7/7/12	19.20	19.60	18.90	17.60	20.09	19.17	19.54	19.00	17.89	20.19
7/8/12	18.30	18.70	18.10	16.70	20.27	19.13	19.51	18.94	17.76	20.15
7/9/12	17.60	18.00	17.20	16.00	20.57	18.96	19.34	18.73	17.53	20.17
7/10/12	17.80	18.20	17.50	16.10	20.82	18.77	19.17	18.53	17.27	20.23
7/11/12	17.50	17.90	17.10	16.10	20.74	18.50	18.90	18.21	16.99	20.33
7/12/12	16.60	17.00	16.20	16.30	20.51	18.09	18.49	17.77	16.73	20.42
7/13/12	16.70	17.10	16.40	16.50	20.30	17.67	18.07	17.34	16.47	20.47
7/14/12	17.30	17.60	16.90	17.10	20.57	17.40	17.79	17.06	16.40	20.54
7/15/12	17.40	17.80	17.10	17.20	20.39	17.27	17.66	16.91	16.47	20.56
7/16/12	17.00	17.10	16.80	16.90	20.80	17.19	17.53	16.86	16.60	20.59
7/17/12	16.00	16.10	15.60	15.70	21.09	16.93	17.23	16.59	16.54	20.63
7/18/12	16.00	16.20	15.80	15.70	21.41	16.71	16.99	16.40	16.49	20.72
7/19/12	15.80	16.10	15.50	15.50	21.24	16.60	16.86	16.30	16.37	20.83
7/20/12	15.60	15.80	15.30	15.20	21.26	16.44	16.67	16.14	16.19	20.97
7/21/12	15.60	15.90	15.40	15.30	21.60	16.20	16.43	15.93	15.93	21.11
7/22/12	15.40	15.80	15.20	not available	21.38	15.91	16.14	15.66	not available	21.25
7/23/12	15.90	16.30	15.80	not available	21.63	15.76	16.03	15.51	not available	21.37
7/24/12	15.20	15.40	15.60	not available	21.53	15.64	15.93	15.51	not available	21.44
7/25/12	not available	not available	15.30	not available	21.87	not available	not available	15.44	not available	21.50
7/26/12	not available	not available	14.70	not available	21.76	not available	not available	15.33	not available	21.58
7/27/12	not available	not available	14.70	not available	21.64	not available	not available	15.24	not available	21.63
7/28/12	not available	not available	14.50	not available	21.60	not available	not available	15.11	not available	21.63
7/29/12	not available	not available	14.40	not available	21.73	not available	not available	15.00	not available	21.68
7/30/12	not available	not available	14.30	not available	21.77	not available	not available	14.79	not available	21.70
7/31/12	not available	not available	13.70	not available	21.69	not available	not available	14.51	not available	21.72
8/1/12	not available	not available	13.10	not available	21.63	not available	not available	14.20	not available	21.69
8/2/12	not available	not available	13.20	not available	21.43	not available	not available	13.99	not available	21.64
8/3/12	not available	not available	18.60	not available	21.73	not available	not available	14.54	not available	21.65
8/4/12	not available	not available	18.50	not available	21.95	not available	not available	15.11	not available	21.70
8/5/12	not available	not available	18.20	not available	22.00	not available	not available	15.66	not available	21.74
8/6/12	not available	not available	17.50	not available	22.04	not available	not available	16.11	not available	21.78
8/7/12	not available	not available	16.80	not available	22.69	not available	not available	16.56	not available	21.92
8/8/12	not available	not available	15.80	not available	22.17	not available	not available	16.94	not available	22.00
8/9/12	not available	not available	15.40	not available	22.08	not available	not available	17.26	not available	22.09
8/10/12	not available	not available	14.70	not available	22.07	not available	not available	16.70	not available	22.14
8/11/12	not available	not available	14.20	not available	22.17	not available	not available	16.09	not available	22.17
8/12/12	not available	not available	13.90	not available	22.37	not available	not available	15.47	not available	22.23
8/13/12	not available	not available	13.90	not available	22.46	not available	not available	14.96	not available	22.29
8/14/12	not available	not available	14.00	not available	22.57	not available	not available	14.56	not available	22.27
8/15/12	not available	not available	13.70	not available	22.42	not available	not available	14.26	not available	22.31
8/16/12	not available	not available	13.40	not available	22.17	not available	not available	13.97	not available	22.32
8/17/12	not available	not available	13.70	not available	22.39	not available	not available	13.83	not available	22.36
8/18/12	not available	not available	13.60	not available	22.57	not available	not available	13.74	not available	22.42
8/19/12	not available	not available	13.60	not available	22.35	not available	not available	13.70	not available	22.42
8/20/12	not available	not available	13.60	not available	22.48	not available	not available	13.66	not available	22.42

not available - data not available because the data logger was not recovered and all data since previous download was lost

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
8/21/12	not available	not available	13.80	not available	22.36	not available	not available	13.63	not available	22.39
8/22/12	not available	not available	13.30	not available	22.57	not available	not available	13.57	not available	22.41
8/23/12	not available	not available	12.70	not available	22.71	not available	not available	13.47	not available	22.49
8/24/12	not available	not available	13.30	not available	22.49	not available	not available	13.41	not available	22.50
8/25/12	not available	not available	12.70	not available	22.59	not available	not available	13.29	not available	22.51
8/26/12	not available	14.10	12.80	not available	22.38	not available	not available	13.17	not available	22.51
8/27/12	not available	14.10	12.60	not available	22.53	not available	not available	13.03	not available	22.52
8/28/12	not available	13.90	12.40	not available	22.63	not available	not available	12.83	not available	22.56
8/29/12	not available	13.60	12.20	not available	22.29	not available	not available	12.67	not available	22.52
8/30/12	not available	13.30	12.10	not available	22.41	not available	not available	12.59	not available	22.47
8/31/12	not available	13.70	12.30	not available	22.35	not available	not available	12.44	not available	22.46
9/1/12	not available	13.60	12.40	not available	22.70	not available	13.76	12.40	not available	22.47
9/2/12	not available	13.70	12.20	not available	22.11	not available	13.70	12.31	not available	22.43
9/3/12	13.80	13.60	12.30	13.30	22.44	not available	13.63	12.27	not available	22.42
9/4/12	13.80	13.60	12.30	13.40	22.65	not available	13.59	12.26	not available	22.42
9/5/12	14.90	14.70	13.80	14.60	22.54	not available	13.74	12.49	not available	22.46
9/6/12	16.00	15.80	15.00	15.70	22.21	not available	14.10	12.90	not available	22.43
9/7/12	15.70	15.50	14.00	15.10	22.57	not available	14.36	13.14	not available	22.46
9/8/12	15.70	15.50	14.00	15.10	21.93	not available	14.63	13.37	not available	22.35
9/9/12	15.90	15.70	14.20	15.40	22.81	15.11	14.91	13.66	14.66	22.45
9/10/12	16.40	16.20	14.40	15.80	22.42	15.49	15.29	13.96	15.01	22.45
9/11/12	16.60	16.50	14.80	16.00	22.29	15.89	15.70	14.31	15.39	22.39
9/12/12	16.30	16.10	14.30	15.80	22.79	16.09	15.90	14.39	15.56	22.43
9/13/12	16.30	16.10	14.40	15.70	22.35	16.13	15.94	14.30	15.56	22.45
9/14/12	16.40	16.30	14.50	15.80	22.37	16.23	16.06	14.37	15.66	22.42
9/15/12	16.10	16.00	14.20	15.50	22.18	16.29	16.13	14.40	15.71	22.46
9/16/12	15.80	15.70	14.00	15.20	21.96	16.27	16.13	14.37	15.69	22.34
9/17/12	15.50	15.30	13.40	14.90	22.03	16.14	16.00	14.23	15.56	22.28
9/18/12	15.00	14.80	13.20	14.40	21.62	15.91	15.76	14.00	15.33	22.18
9/19/12	14.80	not available	12.90	13.60	21.81	15.70	not available	13.80	15.01	22.04
9/20/12	14.90	not available	12.80	not available	21.87	15.50	not available	13.57	not available	21.98
9/21/12	14.50	not available	12.50	not available	21.59	15.23	not available	13.29	not available	21.86
9/22/12	14.20	not available	12.50	not available	21.35	14.96	not available	13.04	not available	21.75
9/23/12	13.70	not available	12.00	not available	21.37	14.66	not available	12.76	not available	21.66
9/24/12	13.40	not available	11.90	not available	21.34	14.36	not available	12.54	not available	21.56
9/25/12	13.30	not available	11.60	not available	21.14	14.11	not available	12.31	not available	21.50
9/26/12	13.20	not available	11.70	not available	21.33	13.89	not available	12.14	not available	21.43
9/27/12	12.90	not available	11.40	not available	21.25	13.60	not available	11.94	not available	21.34
9/28/12	12.70	not available	11.30	not available	20.76	13.34	not available	11.77	not available	21.22
9/29/12	12.50	not available	11.30	not available	20.82	13.10	not available	11.60	not available	21.15
9/30/12	12.40	not available	11.10	not available	20.50	12.91	not available	11.47	not available	21.02
10/1/12	11.80	not available	10.70	not available	20.49	12.69	not available	11.30	not available	20.90
10/2/12	11.70	not available	10.60	not available	20.48	12.46	not available	11.16	not available	20.81
10/3/12	12.00	not available	10.70	not available	20.42	12.29	not available	11.01	not available	20.68
10/4/12	11.90	not available	10.70	not available	20.46	12.14	not available	10.91	not available	20.56
10/5/12	11.80	not available	10.60	not available	20.55	12.01	not available	10.81	not available	20.53
10/6/12	11.80	not available	10.60	not available	20.27	11.91	not available	10.71	not available	20.45
10/7/12	11.70	not available	10.60	not available	20.29	11.81	not available	10.64	not available	20.42
10/8/12	11.50	not available	10.50	not available	20.27	11.77	not available	10.61	not available	20.39
10/9/12	11.30	not available	10.50	not available	19.94	11.71	not available	10.60	not available	20.31
10/10/12	12.30	not available	11.40	not available	20.09	11.76	not available	10.70	not available	20.27

not available - data not available because the data logger was not recovered and all data since previous download was lost

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
10/11/12	12.10	not available	10.80	not available	19.91	11.79	not available	10.71	not available	20.19
10/12/12	12.10	not available	10.80	not available	19.73	11.83	not available	10.74	not available	20.07
10/13/12	11.90	not available	10.70	not available	19.60	11.84	not available	10.76	not available	19.97
10/14/12	11.80	not available	10.60	not available	19.62	11.86	not available	10.76	not available	19.88
10/15/12	11.70	not available	10.50	not available	19.66	11.89	not available	10.76	not available	19.79
10/16/12	11.80	not available	10.50	not available	19.40	11.96	not available	10.76	not available	19.72
10/17/12	11.70	not available	10.50	not available	19.53	11.87	not available	10.63	not available	19.64
10/18/12	11.60	not available	10.40	not available	19.38	11.80	not available	10.57	not available	19.56
10/19/12	11.50	not available	10.30	not available	19.33	11.71	not available	10.50	not available	19.50
10/20/12	11.40	not available	10.30	not available	19.29	11.64	not available	10.44	not available	19.46
10/21/12	11.50	not available	10.40	not available	19.47	11.60	not available	10.41	not available	19.44
10/22/12	11.50	not available	11.30	not available	19.34	11.57	not available	10.53	not available	19.39
10/23/12	11.50	not available	11.30	not available	19.28	11.53	not available	10.64	not available	19.37
10/24/12	11.50	not available	11.30	not available	19.40	11.50	not available	10.76	not available	19.36
10/25/12	11.50	not available	11.30	not available	19.07	11.49	not available	10.89	not available	19.31
10/26/12	11.10	not available	11.00	not available	18.89	11.43	not available	10.99	not available	19.25
10/27/12	10.80	not available	10.70	not available	18.77	11.34	not available	11.04	not available	19.18
10/28/12	10.20	not available	10.10	not available	18.50	11.16	not available	11.00	not available	19.04
10/29/12	9.40	not available	9.40	not available	18.27	10.86	not available	10.73	not available	18.88
10/30/12	9.60	not available	9.40	not available	18.32	10.59	not available	10.46	not available	18.75
10/31/12	9.60	not available	9.50	not available	18.69	10.31	not available	10.20	not available	18.65

not available - data not available because the data logger was not recovered and all data since previous download was lost

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009602 & 2024052

Data Logger Name: Upstream Main

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/26/13	15:30	Deploy	16.4	3.20	Anchor block deployed on waters edge. Cable deployed full length
7/24/13	8:25	Retrieve	14.7	1.45	Recovered and downloaded data.
7/24/13	9:00	Deploy	14.7	1.55	Cable deployed full length.
8/21/13	9:00	Retrieve	12.6	1.27	Data logger not recovered, likely stolen
9/3/13	9:300	Deploy	13.5	2.04	Deployed data logger 2024052
9/18/13	10:10	Retrieve	14.7	2.15	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.6 °C, temp probe 14.52 °C.
10/16/13	13:30	Retrieve	11.6	2.30	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—
10/16/13	14:00	Deploy	11.5	2.41	Cable deployed full length.
11/4/13	14:00	Retrieve	9.6	2.44	Recovered and downloaded data. 2013 temperature completed, data logger not redeployed.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 1048348 & 1054269

Data Logger Name: Upstream Backup

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/26/13	15:00	Deploy	16.6	9.3	Anchor block deployed on waters edge. Cable deployed full length. Logger 1048384.
7/24/13	8:25	Retrieve	14.9	0.8	Recovered and downloaded data. Data logger was found in shallow water near shore.
7/24/13	8:30	Deploy	-	-	Cable deployed full length. (temp and depth not know because data logger not recovered)
8/21/13	8:40	Retrieve	-	-	Data logger not recovered, likely stolen.
8/26/13	9:30	Deploy	14.0	5.7	Deployed logger 1054269.
9/18/13	9:45	Retrieve	14.5	6.58	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.6 °C, temp probe 14.52 °C.
9/18/13	10:00	Deploy	14.7	2.15	Cable deployed full length.
10/16/13	13:30	Retrieve	11.6	2.40	Data logger missing, steel cable broke. Did not have replacement on hand. By the time we would receive one the study period would be close to over so we did not replace Upstream backup.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Downstream Main

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/26/13	15:30	Deploy	16.3	3.14	Anchor block deployed on waters edge. Cable deployed full length
7/24/13	8:25	Retrieve	14.7	1.45	Recovered and downloaded data.
7/24/13	9:00	Deploy	14.7	1.55	Cable deployed full length.
8/21/13	9:00	Retrieve	12.6	1.27	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.8 °C, temp probe 13.75 °C.
8/21/13	9:300	Deploy	12.9	2.31	Cable deployed full length.
9/18/13	10:10	Retrieve	-	-	Unable to retrieve data logger, stuck in rocks.
10/16/13	13:30	Deploy	-	-	Unable to retrieve data logger, stuck in rocks.
10/22/13	13:30	Retrieve	10.3	3.0	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.6 °C, temp probe 11.50 °C.
10/22/13	14:00	Deploy	11.3	1.37	Deployed on shorter cable to reduce chances of getting stuck in rocks.
11/4/13	14:00	Retrieve	9.5	1.34	Recovered and downloaded data. 2013 temperature study completed, data logger not redeployed.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009627 & 2024060

Data Logger Name: Downstream Backup

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/26/13	15:30	Deploy	15.9	3.06	Anchor block deployed on waters edge. Cable deployed full length. Logger 2009627
7/24/13	8:45	Retrieve	14.7	1.45	Recovered and downloaded data. Data logger found on shore, data indicates it was put on shore on 7/21.
7/24/13	9:00	Deploy	-	-	Cable deployed full length. (temp and depth not noted on survey form because data logger not recovered)
8/21/13	9:00	Retrieve	-	-	Data logger not found. Appears that the steel cable broke. Additional data loggers not available for redeployment, additional data loggers ordered.
9/3/13	13:30	Deploy	13.1	1.9	Data logger 2024060 deployed. Cable deployed full length.
9/19/13	14:00	Retrieve	13.2	1.59	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.5 °C, temp probe 14.5 °C.
9/19/13	14:10	Deploy	-	-	Cable deployed full length. (temp and depth not noted because data logger not recovered)
10/16/13	13:30	Retrieve	-	-	Data logger missing, likely stolen. Did not have replacement on hand. By the time we would receive a replacement the study period would be close to over so we did not replace downstream backup.

SPOKANE COUNTY

UTILITIES DIVISION
KEVIN R. COOKE, P.E., DIRECTOR
A DIVISION OF THE PUBLIC WORKS DEPARTMENT

December 31, 2014

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2014 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2014 and November 1, 2014.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

Attachment

Cc w/out Att.: Dave Moss – Spokane County Utilities

1026 WEST BROADWAY AVENUE, 4TH FLOOR • SPOKANE, WA 99260-0430
PHONE: (509) 477-3604 • FAX: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2014 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

December 30, 2014

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Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2014 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations for the 2015 study.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the outfall during the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf .

5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP prior to the 2014 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie

(SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs in the same area. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2014 study were the same as the 2013 study.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the course of the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the course of the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

Due to the differences in channel shape between the two locations, data loggers in the upstream location are in deeper water in comparison to the downstream location. Also the majority of the river flow in the upstream location is within a smaller cross sectional area than the downstream location; therefore the flow velocity is faster in the upstream location than the downstream location.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were deployed on June 26, 2014 with the exception of the backup upstream data logger. It was deployed on July 16, 2014 because one of the anchor blocks, which were left in place after the 2013 study, was under water on June 26, 2014 and could not be accessed at that time.

The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (see Figure 4).

Field visits to each location were made on a monthly basis to download data, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The data loggers were initially deployed on June 26, 2014 and data recording began at 12:00 am on July 1, 2014. The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible. All data loggers were retrieved on November 4, 2013.

During the 2014 study no data loggers were lost or stolen. The upstream backup data logger was not retrieved during the September and October field visits but was retrieved at the end of the study.

As specified in the QAPP, CH2M Hill measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but

was provided to the County for the study period at 30 minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven day running average are presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
July	19.30	19.60	19.46	19.37	23.18
August	15.43	15.59	15.05	15.05	23.19
September	14.07	14.80	15.02	15.02	22.79
October	13.91	14.69	14.91	14.91	24.53

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Over the study period the average temperature of the upstream data loggers was both above and below the average temperature of the downstream data loggers. The difference between the two locations, though, was less than 1°C for a majority of the study period. There are several factors that complicate the assessment of impacts from the SCRWRF discharge on river temperature:

- There is significant groundwater inflow in the study area. The influence of groundwater inflow on river temperature is dependent on the temperature and quantity of groundwater, both of which can only be estimated.
- There are differences in the river depth and velocity at the specific data logger locations between the upstream and downstream locations.
- The SCRWRF discharge is, at most, approximately 1% of total river flow.
- There are differences in temperature throughout any given cross section of the river, and determining the true average river temperature would require multiple measurements across the river at various depths.
- Unknown and complicating effect of relatively warm, stored water in the Upriver Dam reservoir on the study area.

Given the difference in the magnitude of the SCRWRF discharge and river flow, temperature differences between the upstream and downstream locations are most likely

related to aquifer inflow in this reach of the river and changes in ambient temperature over the study period.

5 CONCLUSIONS

The study, as conducted, indicates that there is a very small difference in temperature between the upstream and downstream locations. The difference, though, is not consistently increasing or decreasing, but shifts throughout the study period. Given the complicating factors described above it is not possible to determine the SCRWRF's contribution to temperature changes from field measurements. Based on a simple mixing model the potential impact of the SCRWRF discharge is less than 0.1°C, which is insignificant in comparison to the other factors impacting temperature in this reach of the river.

6 RECOMMENDATIONS

We conclude from above that the calculated impact of the SCRWRF discharge on river temperature is minimal, and that field measurements are not suitable to determine the impact of SCRWRF discharge to river temperature in this reach of the river. Therefore we recommend a meeting to discuss the viability and necessity of conducting the 2015 study as described in the Permit.


Figure 1: Data Collection Locations
2014 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2014 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2014 Receiving Water Study-Temperature

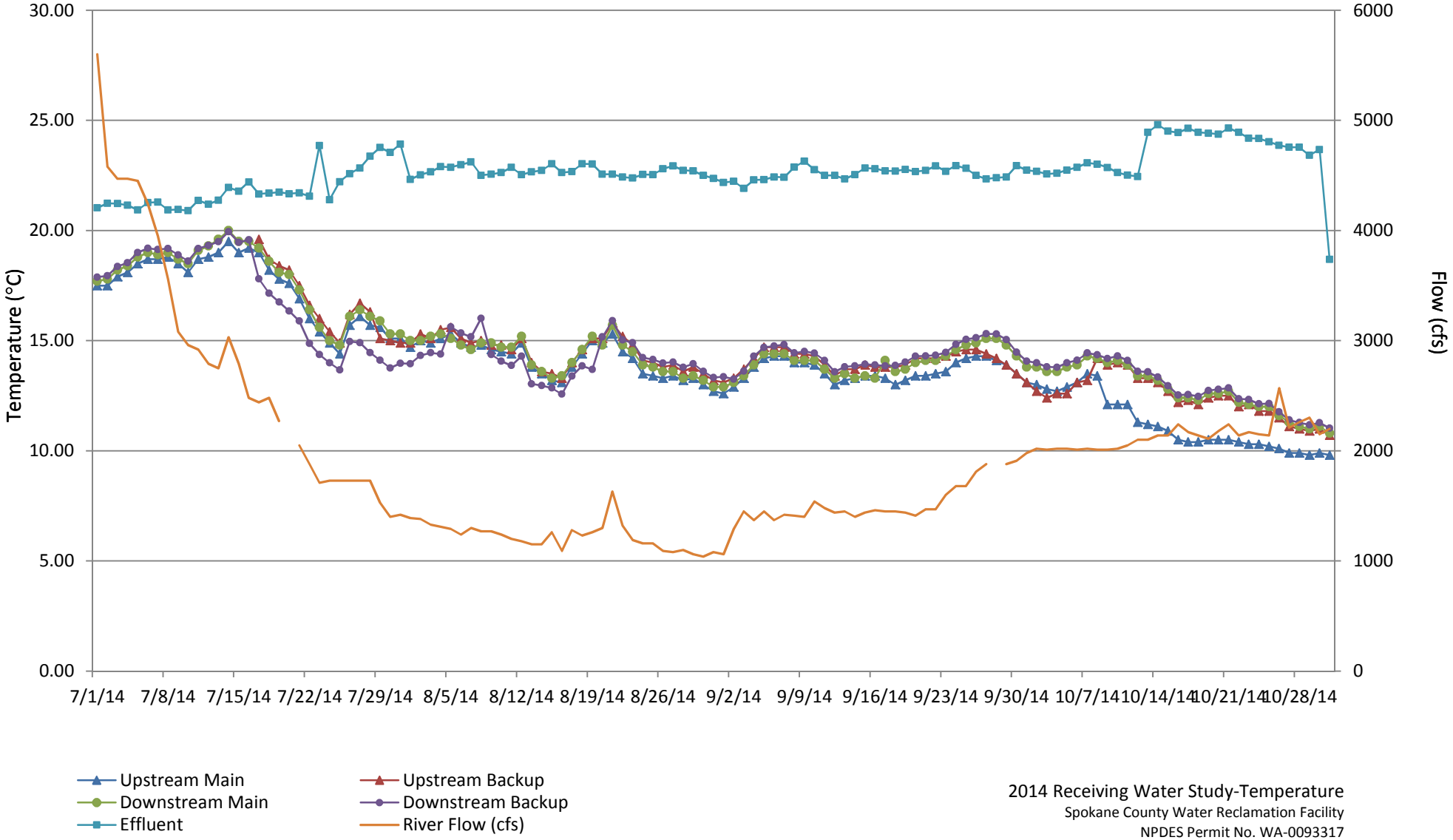
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Data Logger Deployment

2014 Receiving Water Study-Temperature

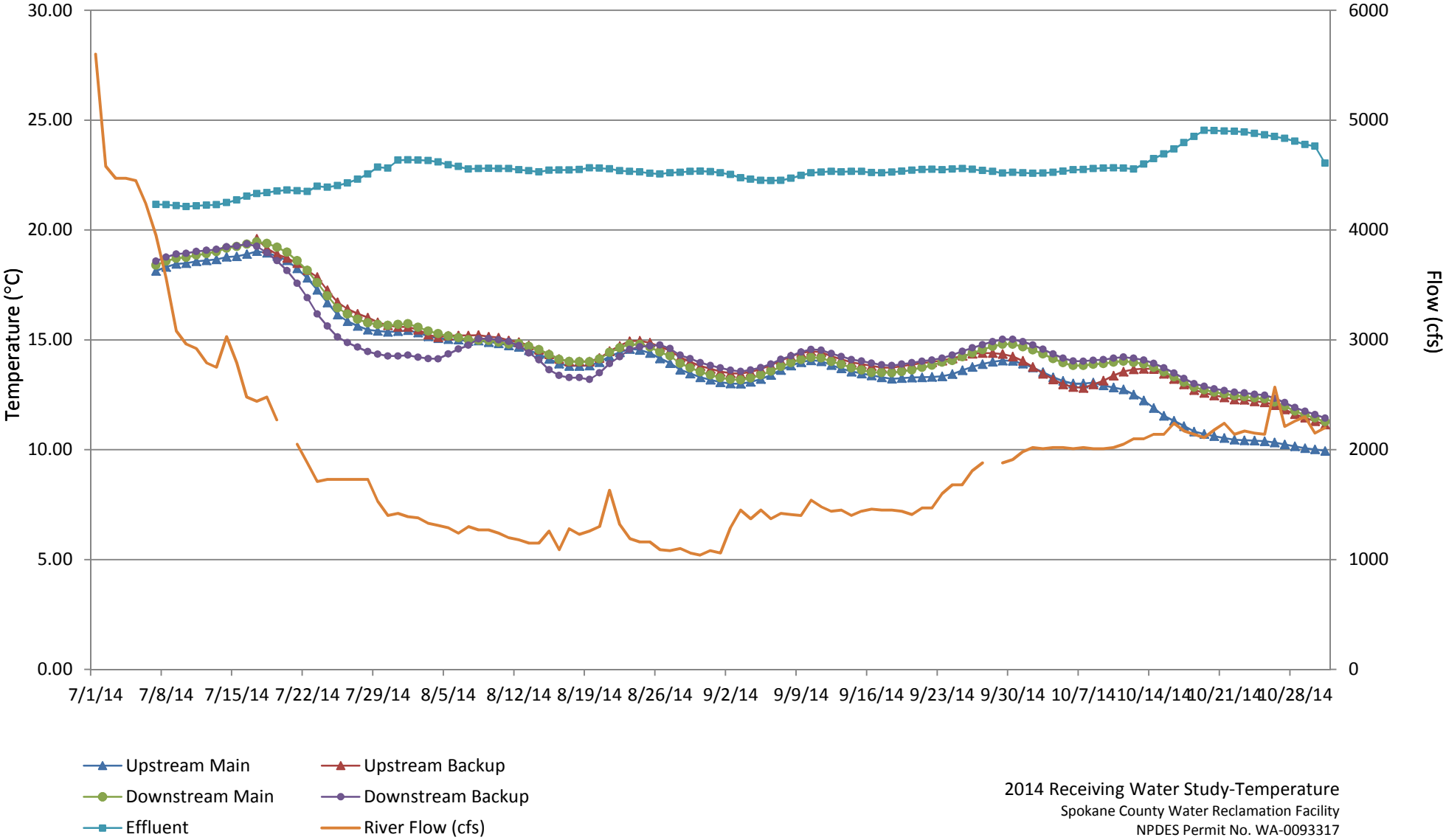
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5 - Daily Maximum Temperature



2014 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 6 - 7 Day Average of Daily Maximum Temperature



2014 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
7/1/14	17.50	*	17.70	17.88	21.03					
7/2/14	17.50	*	17.80	17.95	21.23					
7/3/14	17.90	*	18.20	18.37	21.22					
7/4/14	18.10	*	18.40	18.54	21.15					
7/5/14	18.50	*	18.80	19.00	20.94					
7/6/14	18.70	*	19.00	19.19	21.27					
7/7/14	18.70	*	18.90	19.14	21.29	18.13		18.40	18.58	21.16
7/8/14	18.80	*	19.00	19.18	20.94	18.31		18.59	18.77	21.15
7/9/14	18.50	*	18.70	18.89	20.96	18.46		18.71	18.90	21.11
7/10/14	18.10	*	18.50	18.61	20.90	18.49		18.76	18.94	21.06
7/11/14	18.70	*	19.10	19.18	21.37	18.57		18.86	19.03	21.09
7/12/14	18.80	*	19.30	19.32	21.20	18.61		18.93	19.07	21.13
7/13/14	19.00	*	19.60	19.49	21.37	18.66		19.01	19.12	21.15
7/14/14	19.50	*	20.00	19.95	21.95	18.77		19.17	19.23	21.24
7/15/14	19.00	*	19.50	19.46	21.79	18.80		19.24	19.27	21.36
7/16/14	19.20	*	19.50	19.58	22.21	18.90		19.36	19.37	21.54
7/17/14	19.00	19.60	19.20	17.81	21.66	19.03	19.60	19.46	19.26	21.65
7/18/14	18.20	18.70	18.60	17.15	21.70	18.96	19.15	19.39	18.97	21.70
7/19/14	17.80	18.40	18.10	16.75	21.74	18.81	18.90	19.21	18.60	21.77
7/20/14	17.60	18.20	18.00	16.35	21.67	18.61	18.73	18.99	18.15	21.82
7/21/14	16.90	17.50	17.30	15.89	21.71	18.24	18.48	18.60	17.57	21.78
7/22/14	16.00	16.60	16.40	14.87	21.56	17.81	18.17	18.16	16.91	21.75
7/23/14	15.40	16.00	15.60	14.37	23.86	17.27	17.86	17.60	16.17	21.99
7/24/14	14.90	15.40	15.00	13.99	21.39	16.69	17.26	17.00	15.62	21.95
7/25/14	14.40	14.90	14.80	13.67	22.22	16.14	16.71	16.46	15.13	22.02
7/26/14	15.70	16.20	16.10	14.96	22.58	15.84	16.40	16.17	14.87	22.14
7/27/14	16.10	16.70	16.40	14.91	22.83	15.63	16.19	15.94	14.67	22.31
7/28/14	15.70	16.30	16.10	14.46	23.37	15.46	16.01	15.77	14.46	22.54
7/29/14	15.60	15.10	15.90	14.11	23.77	15.40	15.80	15.70	14.35	22.86
7/30/14	15.10	15.00	15.30	13.76	23.54	15.36	15.66	15.66	14.27	22.82
7/31/14	15.10	14.90	15.30	13.97	23.92	15.39	15.59	15.70	14.26	23.18
8/1/14	14.70	14.90	15.00	13.95	22.32	15.43	15.59	15.73	14.30	23.19
8/2/14	15.00	15.30	15.00	14.33	22.53	15.33	15.46	15.57	14.21	23.18
8/3/14	14.90	15.10	15.20	14.45	22.66	15.16	15.23	15.40	14.15	23.16
8/4/14	15.10	15.50	15.30	14.39	22.90	15.07	15.11	15.29	14.14	23.09
8/5/14	15.30	15.60	15.10	15.63	22.87	15.03	15.19	15.17	14.35	22.96
8/6/14	14.90	15.10	14.80	15.35	22.98	15.00	15.20	15.10	14.58	22.88
8/7/14	14.70	14.90	14.60	15.17	23.12	14.94	15.20	15.00	14.75	22.77
8/8/14	14.80	15.00	14.90	16.01	22.51	14.96	15.21	14.99	15.05	22.80
8/9/14	14.60	14.80	14.90	14.37	22.56	14.90	15.14	14.97	15.05	22.80
8/10/14	14.50	14.80	14.70	14.07	22.63	14.84	15.10	14.90	15.00	22.80
8/11/14	14.40	14.60	14.70	13.87	22.87	14.74	14.97	14.81	14.92	22.79
8/12/14	14.90	15.10	15.20	14.29	22.54	14.69	14.90	14.83	14.73	22.74

* Data logger not deployed due to inaccessible anchor block

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
8/13/14	13.80	14.00	13.90	13.04	22.66	14.53	14.74	14.70	14.40	22.70
8/14/14	13.50	13.60	13.60	12.96	22.73	14.36	14.56	14.56	14.09	22.64
8/15/14	13.20	13.50	13.30	12.85	23.03	14.13	14.34	14.33	13.64	22.72
8/16/14	13.10	13.30	13.40	12.57	22.63	13.91	14.13	14.11	13.38	22.73
8/17/14	13.80	14.00	14.00	13.39	22.67	13.81	14.01	14.01	13.28	22.73
8/18/14	14.40	14.60	14.60	13.85	23.03	13.81	14.01	14.00	13.28	22.75
8/19/14	15.00	15.10	15.20	13.69	23.02	13.83	14.01	14.00	13.19	22.82
8/20/14	14.90	15.10	14.80	15.17	22.56	13.99	14.17	14.13	13.50	22.81
8/21/14	15.30	15.80	15.70	15.91	22.56	14.24	14.49	14.43	13.92	22.79
8/22/14	14.50	15.20	14.80	15.03	22.43	14.43	14.73	14.64	14.23	22.70
8/23/14	14.20	14.80	14.50	14.91	22.38	14.59	14.94	14.80	14.56	22.66
8/24/14	13.50	14.10	13.90	14.23	22.54	14.54	14.96	14.79	14.68	22.65
8/25/14	13.40	14.00	13.80	14.14	22.54	14.40	14.87	14.67	14.73	22.58
8/26/14	13.30	13.80	13.60	13.98	22.80	14.16	14.69	14.44	14.77	22.54
8/27/14	13.40	13.90	13.60	14.03	22.93	13.94	14.51	14.27	14.60	22.60
8/28/14	13.20	13.60	13.30	13.79	22.73	13.64	14.20	13.93	14.30	22.62
8/29/14	13.30	13.80	13.40	13.95	22.70	13.47	14.00	13.73	14.15	22.66
8/30/14	13.00	13.50	13.20	13.61	22.51	13.30	13.81	13.54	13.96	22.68
8/31/14	12.70	13.20	12.90	13.33	22.37	13.19	13.69	13.40	13.83	22.65
9/1/14	12.60	13.10	12.90	13.36	22.18	13.07	13.56	13.27	13.72	22.60
9/2/14	12.90	13.30	13.10	13.25	22.23	13.01	13.49	13.20	13.62	22.52
9/3/14	13.30	13.70	13.40	13.62	21.91	13.00	13.46	13.17	13.56	22.38
9/4/14	13.80	14.20	13.90	14.29	22.29	13.09	13.54	13.26	13.63	22.31
9/5/14	14.20	14.70	14.40	14.69	22.31	13.21	13.67	13.40	13.74	22.26
9/6/14	14.30	14.70	14.40	14.76	22.43	13.40	13.84	13.57	13.90	22.25
9/7/14	14.30	14.70	14.40	14.82	22.42	13.63	14.06	13.79	14.11	22.25
9/8/14	14.00	14.40	14.10	14.44	22.88	13.83	14.24	13.96	14.27	22.35
9/9/14	14.00	14.40	14.10	14.51	23.15	13.99	14.40	14.10	14.45	22.48
9/10/14	13.90	14.30	14.10	14.43	22.76	14.07	14.49	14.20	14.56	22.61
9/11/14	13.50	13.90	13.70	14.10	22.50	14.03	14.44	14.17	14.54	22.63
9/12/14	13.00	13.40	13.30	13.59	22.50	13.86	14.26	14.01	14.38	22.66
9/13/14	13.20	13.70	13.50	13.81	22.34	13.70	14.11	13.89	14.24	22.65
9/14/14	13.30	13.70	13.30	13.85	22.54	13.56	13.97	13.73	14.10	22.67
9/15/14	13.40	13.90	13.40	13.93	22.84	13.47	13.90	13.63	14.03	22.66
9/16/14	13.40	13.80	13.30	13.90	22.81	13.39	13.81	13.51	13.94	22.61
9/17/14	13.30	13.80	14.10	13.85	22.70	13.30	13.74	13.51	13.86	22.60
9/18/14	13.00	13.80	13.60	13.87	22.70	13.23	13.73	13.50	13.83	22.63
9/19/14	13.20	13.90	13.70	14.03	22.77	13.26	13.80	13.56	13.89	22.67
9/20/14	13.40	14.20	14.00	14.29	22.68	13.29	13.87	13.63	13.96	22.72
9/21/14	13.40	14.20	14.10	14.31	22.73	13.30	13.94	13.74	14.03	22.75
9/22/14	13.50	14.20	14.10	14.34	22.93	13.31	13.99	13.84	14.08	22.76
9/23/14	13.60	14.30	14.30	14.47	22.69	13.34	14.06	13.99	14.17	22.74
9/24/14	14.00	14.50	14.60	14.83	22.94	13.44	14.16	14.06	14.31	22.78

* Data logger not deployed due to inaccessible anchor block

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
9/25/14	14.20	14.60	14.80	15.06	22.82	13.61	14.27	14.23	14.48	22.79
9/26/14	14.30	14.60	14.90	15.13	22.50	13.77	14.37	14.40	14.63	22.76
9/27/14	14.30	14.40	15.10	15.31	22.34	13.90	14.40	14.56	14.78	22.71
9/28/14	14.10	14.20	15.10	15.30	22.40	14.00	14.40	14.70	14.92	22.66
9/29/14	13.90	13.90	14.80	15.05	22.43	14.06	14.36	14.80	15.02	22.59
9/30/14	13.50	13.50	14.30	14.48	22.94	14.04	14.24	14.80	15.02	22.63
10/1/14	13.10	13.10	13.80	14.07	22.74	13.91	14.04	14.69	14.91	22.60
10/2/14	13.00	12.70	13.80	13.99	22.69	13.74	13.77	14.54	14.76	22.58
10/3/14	12.80	12.40	13.60	13.81	22.57	13.53	13.46	14.36	14.57	22.59
10/4/14	12.70	12.60	13.60	13.79	22.59	13.30	13.20	14.14	14.36	22.62
10/5/14	12.90	12.60	13.80	13.99	22.74	13.13	12.97	13.96	14.17	22.67
10/6/14	13.10	13.10	13.90	14.11	22.87	13.01	12.86	13.83	14.03	22.74
10/7/14	13.50	13.20	14.30	14.44	23.07	13.01	12.81	13.83	14.03	22.75
10/8/14	13.40	14.20	14.20	14.36	23.01	13.06	12.97	13.89	14.07	22.79
10/9/14	12.10	13.90	14.00	14.19	22.86	12.93	13.14	13.91	14.10	22.82
10/10/14	12.10	14.00	14.10	14.31	22.63	12.83	13.37	13.99	14.17	22.83
10/11/14	12.10	13.90	13.90	14.10	22.51	12.74	13.56	14.03	14.21	22.82
10/12/14	11.30	13.30	13.40	13.61	22.45	12.51	13.66	13.97	14.16	22.77
10/13/14	11.20	13.30	13.40	13.58	24.46	12.24	13.69	13.90	14.08	23.00
10/14/14	11.10	13.10	13.20	13.35	24.80	11.90	13.67	13.74	13.93	23.25
10/15/14	10.90	12.70	12.80	12.95	24.51	11.54	13.46	13.54	13.73	23.46
10/16/14	10.50	12.20	12.40	12.53	24.45	11.31	13.21	13.31	13.49	23.69
10/17/14	10.40	12.30	12.40	12.55	24.64	11.07	12.97	13.07	13.24	23.97
10/18/14	10.40	12.10	12.30	12.47	24.46	10.83	12.71	12.84	13.01	24.25
10/19/14	10.50	12.40	12.60	12.74	24.42	10.71	12.59	12.73	12.88	24.53
10/20/14	10.50	12.50	12.60	12.79	24.37	10.61	12.47	12.61	12.77	24.52
10/21/14	10.50	12.50	12.70	12.85	24.66	10.53	12.39	12.54	12.70	24.50
10/22/14	10.40	12.00	12.20	12.36	24.46	10.46	12.29	12.46	12.61	24.49
10/23/14	10.30	12.10	12.10	12.33	24.19	10.43	12.27	12.41	12.58	24.46
10/24/14	10.30	11.80	12.00	12.13	24.18	10.41	12.20	12.36	12.52	24.39
10/25/14	10.20	11.80	12.00	12.15	24.03	10.39	12.16	12.31	12.48	24.33
10/26/14	10.10	11.50	11.60	11.77	23.87	10.33	12.03	12.17	12.34	24.25
10/27/14	9.90	11.10	11.30	11.40	23.78	10.24	11.83	11.99	12.14	24.17
10/28/14	9.90	11.00	11.10	11.28	23.78	10.16	11.61	11.76	11.92	24.04
10/29/14	9.80	10.90	11.00	11.18	23.41	10.07	11.46	11.59	11.75	23.89
10/30/14	9.90	11.00	11.10	11.27	23.67	10.01	11.30	11.44	11.60	23.82
10/31/14	9.80	10.70	10.80	11.03	18.69	9.94	11.14	11.27	11.44	23.04

* Data logger not deployed due to inaccessible anchor block

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 1056190

Data Logger Name: Upstream Main

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/25/14	11:45	Deploy	15.9	6.18	Anchor block deployed on waters edge. Cable deployed full length
7/16/14	9:40	Retrieve	19.1	4.25	Recovered and downloaded data.
7/16/14	10:00	Deploy	18.9	6.59	Data logger anchor block moved closer to waters edge. Cable deployed full length.
8/20/14	9:00	Retrieve	14.1	4.75	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.7 °C, temp probe 14.66 °C.
8/20/14	9:20	Deploy	13.1	4.55	Cable deployed full length.
9/17/14	12:40	Retrieve	13.1	4.61	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.3 °C, temp probe 13.66 °C.
9/17/14	13:00	Deploy	13.1	4.11	Cable deployed full length.
10/8/14	13:00	Retrieve	11.5	4.84	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.5 °C, temp probe 14.50 °C.
10/8/14	13:20	Deploy	11.5	4.95	Cable deployed full length.
11/4/14	9:00	Retrieve	9.6	5.08	Completion of data collection; data logger retrieved.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Upstream Backup

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/25/14	11:45				Anchor block inaccessible due to water level. Data logger not deployed.
7/16/14	9:40	Deploy	19.4	2.3	Data logger deployed.
8/20/14	9:00	Retrieve	14.4	2.1	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.9 °C, temp probe 14.81°C.
8/20/14	9:20	Deploy	14.7	2.1	Cable deployed full length.
9/17/14	12:40	Retrieve			Unable to retrieve data logger. Rather than risk loosing , left in place.
10/8/14	13:00	Retrieve			Unable to retrieve data logger. Rather than risk loosing , left in place.
11/4/14	9:00	Retrieve	10.4	2.1	Completion of data collection; data logger retrieved.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2024052

Data Logger Name: Downstream Main

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/25/14	11:20	Deploy	16.3	1.46	Anchor block deployed on waters edge. Cable deployed full length
7/16/14	10:10	Retrieve	19.5	1.01	Recovered and downloaded data.
7/16/14	10:20	Deploy	19.3	1.02	Cable deployed full length.
8/20/14	9:45	Retrieve	14.4	1.02	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.7 °C, temp probe 14.58 °C.
8/20/14	10:00	Deploy	14.4	1.02	Cable deployed full length.
9/17/14	13:55	Retrieve	13.1	1.21	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.0 °C, temp probe 13.80 °C.
9/17/14	14:10	Deploy	13.6	1.15	Cable deployed full length.
10/08/14	13:40	Retrieve	14.1	1.00	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.5 °C, temp probe 14.5 °C.
10/08/14	14:00	Deploy	14.1	1.05	Cable deployed full length.
11/4/14	14:00	Retrieve	10.5	1.2	Recovered and downloaded data. 2014 temperature study completed, data logger not redeployed.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 140805

Data Logger Name: Downstream Backup

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/25/14	11:20	Deploy	16.38	5.76	Anchor block deployed on waters edge. Cable deployed full length
7/16/14	10:10	Retrieve	19.58	2.42	Recovered and downloaded data.
7/16/14	10:20	Deploy	17.77	4.54	Cable deployed full length.
8/20/14	9:45	Retrieve	13.08	4.21	Recovered and downloaded data.
8/20/14	10:00	Deploy	14.65	3.65	Cable deployed full length.
9/17/14	13:55	Retrieve	13.68	3.6	Recovered and downloaded data.
9/17/14	14:10	Deploy	13.78	3.1	Cable deployed full length.
10/08/14	13:40	Retrieve	14.31	3.77	Recovered and downloaded data.
10/08/14	14:00	Deploy	14.36	3.76	Cable deployed full length.
11/4/14	14:00	Retrieve	10.67	3.99	Recovered and downloaded data. 2014 temperature study completed, data logger not redeployed.

SPOKANE COUNTY

UTILITIES DIVISION

KEVIN R. COOKE, P.E., DIRECTOR

A DIVISION OF THE PUBLIC WORKS DEPARTMENT

December 30, 2015

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2015 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2015 and October 31, 2015.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

Attachment

Cc w/out Att.: Dave Moss – Spokane County Utilities

1026 WEST BROADWAY AVENUE, 4TH FLOOR • SPOKANE, WA 99260-0430
PHONE: (509) 477-3604 • FAX: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2015 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

December 30, 2015

Table of Contents

Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2015 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the outfall during the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf .

5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP prior to the 2015 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie

(SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2015 study were the same as the 2014 and 2013 study.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the course of the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the course of the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at

this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

Due to the differences in channel shape between the two locations, data loggers in the upstream location are in deeper water in comparison to the downstream location. Also the majority of the river flow in the upstream location is within a smaller cross sectional area than the downstream location; therefore the flow velocity is faster in the upstream location than the downstream location.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were deployed on June 29, 2015. The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (see Figure 4).

Field visits to each location were made on a monthly basis to download data, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The data loggers were initially deployed on June 29, 2015 and data recording began at 12:00 am on July 1, 2014. The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible. All data loggers were retrieved on November 3, 2015.

During the 2015 study no data loggers were lost or stolen. The upstream main data logger was found to be out of calibration by +0.85 °C during the August 4, 2015 field visit. Due to the significant excursion this data logger was removed and replaced on August 19, 2015 with another data logger. The upstream backup data logger continued to collect suitable data during this time period. The downstream backup data logger was not retrieved during the August 4, 2015 field visit because it was stuck between boulders. It was retrieved on August 19, 2015.

As specified in the QAPP, CH2M Hill measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was provided to the County for the study period at 30 minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven day running average are presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
July	14.75	15.50	14.80	14.10	23.88
August	13.81	13.70	13.40	12.50	23.76
September	14.07	12.60	12.60	11.80	23.33
October	12.01	11.90	12.20	11.40	22.08

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Over the study period the average temperature of the upstream data loggers was consistently above the average temperature of the downstream data loggers. This is due to the significant influence of groundwater inflows within the study reach. The average difference between the two locations over the course of the study, though, was less than 1°.

5 CONCLUSIONS

The study indicates the river temperature is lower downstream of the SCRWRF discharge due to the significant groundwater inflow in the study reach

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures in the study reach and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
7/1/15	14.45	15.1	14.8	14.1	22.36					
7/2/15	14.15	14.8	14.6	13.7	22.47					
7/3/15	14.35	15	14.8	14	22.52					
7/4/15	14.15	14.7	14.2	12.2	22.53					
7/5/15	14.75	15.5	14.8	12.6	22.27					
7/6/15	14.35	15	14.4	12.1	22.38					
7/7/15	14.15	14.8	14.5	11.9	22.64	14.34		14.59	12.94	22.45
7/8/15	13.95	14.6	14.3	12.2	22.65	14.26		14.51	12.67	22.49
7/9/15	14.05	14.7	14.3	12.2	22.86	14.25		14.47	12.46	22.55
7/10/15	13.55	14.2	13.8	11.6	22.94	14.14		14.33	12.11	22.61
7/11/15	13.55	14.1	13.8	11.6	22.73	14.05		14.27	12.03	22.64
7/12/15	13.35	14	13.8	11.5	22.99	13.85		14.13	11.87	22.74
7/13/15	13.65	14.3	14	11.8	22.92	13.75		14.07	11.83	22.82
7/14/15	13.65	14.3	14.1	11.7	23.17	13.68		14.01	11.80	22.89
7/15/15	13.55	14.1	13.9	11.4	22.97	13.62		13.96	11.69	22.94
7/16/15	13.55	14.2	13.9	11.4	22.98	13.55		13.90	11.57	22.96
7/17/15	13.55	14.2	14	11.6	22.81	13.55	14.17	13.93	11.57	22.94
7/18/15	13.55	14.2	14.1	11.5	23.05	13.55	14.19	13.97	11.56	22.98
7/19/15	13.95	14.5	14.3	11.8	23.17	13.64	14.26	14.04	11.60	23.01
7/20/15	13.75	14.4	14.2	11.8	23.21	13.65	14.27	14.07	11.60	23.05
7/21/15	13.95	14.6	14.3	11.7	23.22	13.69	14.31	14.10	11.60	23.06
7/22/15	13.75	14.5	14.2	11.7	22.95	13.72	14.37	14.14	11.64	23.05
7/23/15	13.45	14.1	13.9	11.6	23.07	13.71	14.36	14.14	11.67	23.07
7/24/15	13.05	13.6	13.5	11.2	23.22	13.64	14.27	14.07	11.61	23.13
7/25/15	12.65	13.2	13	10.9	23.07	13.51	14.13	13.91	11.53	23.13
7/26/15	12.45	13.1	12.8	10.8	23.04	13.29	13.93	13.70	11.39	23.11
7/27/15	12.35	13	12.9	10.8	23.07	13.09	13.73	13.51	11.24	23.09
7/28/15	12.65	13.3	13.2	11	23.29	12.91	13.54	13.36	11.14	23.10
7/29/15	12.65	13.2	13.1	10.8	23.59	12.75	13.36	13.20	11.01	23.19
7/30/15	13.05	13.6	13.4	11.1	23.50	12.69	13.29	13.13	10.94	23.26
7/31/15	13.05	13.7	13.6	11.2	23.88	12.69	13.30	13.14	10.94	23.35
8/1/15	12.95	13.6	13.4	11	23.34	12.74	13.36	13.20	10.96	23.39
8/2/15	13.05	13.7	13.4	11	23.11	12.82	13.44	13.29	10.99	23.40
8/3/15	12.75	13.3	13	10.9	23.02	12.88	13.49	13.30	11.00	23.39
8/4/15	12.55	13.3	13.2	11.3	23.28	12.86	13.49	13.30	11.04	23.39
8/5/15		13.2	12.9	11	23.31	12.90	13.49	13.27	11.07	23.35
8/6/15		13.2	12.9	10.9	23.60	12.87	13.43	13.20	11.04	23.36
8/7/15		13.4	13.2	11	23.13	12.83	13.39	13.14	11.01	23.26
8/8/15		13.3	13.2	10.9	23.21	12.78	13.34	13.11	11.00	23.24
8/9/15		13.3	13	11	23.48	12.65	13.29	13.06	11.00	23.29
8/10/15		13.2	13.1	10.8	23.06	12.55	13.27	13.07	10.99	23.30
8/11/15		13.5	13.3	11.4	23.48		13.30	13.09	11.00	23.32
8/12/15		13.4	13.3	11.1	23.62		13.33	13.14	11.01	23.37

*Upstream main temperature values from 7/1/15 to 8/4/15 adjusted +0.85 degrees celcius based on calibration data.

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
8/13/15		13.6	13.4	11.2	23.67		13.39	13.21	11.06	23.38
8/14/15		13.1	12.9	10.9	23.76		13.34	13.17	11.04	23.47
8/15/15		13.2	13.1	10.9	23.48		13.33	13.16	11.04	23.51
8/16/15		13.2	13.1	11	23.13		13.31	13.17	11.04	23.46
8/17/15		13.2	13	10.7	23.10		13.31	13.16	11.03	23.46
8/18/15		13	12.9	10.7	23.17		13.24	13.10	10.93	23.42
8/19/15	13.81	13.2	13.1	12.5	23.43	13.81	13.21	13.07	11.13	23.39
8/20/15	13.17	12.9	12.7	12.2	23.42	13.49	13.11	12.97	11.27	23.36
8/21/15	12.83	12.5	12.2	11.7	23.31	13.27	13.03	12.87	11.39	23.29
8/22/15	13.37	13.1	12.8	12.4	23.00	13.30	13.01	12.83	11.60	23.22
8/23/15	12.89	12.6	12.4	12	23.04	13.21	12.93	12.73	11.74	23.21
8/24/15	12.89	12.6	12.4	12	22.98	13.16	12.84	12.64	11.93	23.19
8/25/15	12.95	12.7	12.5	12	23.19	13.13	12.80	12.59	12.11	23.20
8/26/15	13.03	12.7	12.4	12	23.34	13.02	12.73	12.49	12.04	23.18
8/27/15	13.04	12.7	12.4	12	23.20	13.00	12.70	12.44	12.01	23.15
8/28/15	12.85	12.6	12.2	11.8	23.27	13.00	12.71	12.44	12.03	23.15
8/29/15	12.75	12.4	12.1	11.7	23.27	12.91	12.61	12.34	11.93	23.19
8/30/15	12.53	12.2	12	11.5	23.08	12.86	12.56	12.29	11.86	23.19
8/31/15	12.49	12.2	12	11.5	22.85	12.81	12.50	12.23	11.79	23.17
9/1/15	12.44	12.1	12	11.5	22.89	12.73	12.41	12.16	11.71	23.13
9/2/15	12.27	12	11.8	11.3	22.98	12.62	12.31	12.07	11.61	23.08
9/3/15	12.63	12.3	12.2	11.6	22.95	12.57	12.26	12.04	11.56	23.04
9/4/15	12.53	12.2	12.1	11.6	22.84	12.52	12.20	12.03	11.53	22.98
9/5/15	12.37	12	11.7	11.3	22.65	12.47	12.14	11.97	11.47	22.89
9/6/15	11.9	11.6	11.4	10.9	22.48	12.38	12.06	11.89	11.39	22.81
9/7/15	11.81	11.5	11.5	10.9	22.68	12.28	11.96	11.81	11.30	22.78
9/8/15	11.73	11.5	11.5	10.9	22.45	12.18	11.87	11.74	11.21	22.72
9/9/15	11.9	11.8	11.8	10.9	22.78	12.12	11.84	11.74	11.16	22.69
9/10/15	12.11	12.2	12.1	11.4	22.58	12.05	11.83	11.73	11.13	22.64
9/11/15	12.19	12.4	12.3	11.6	22.80	12.00	11.86	11.76	11.13	22.63
9/12/15	12.35	12.6	12.5	11.8	23.33	12.00	11.94	11.87	11.20	22.73
9/13/15	12.01	12.4	12.1	11.5	22.79	12.01	12.06	11.97	11.29	22.77
9/14/15	11.81	12.1	11.8	11.2	22.79	12.01	12.14	12.01	11.33	22.79
9/15/15	11.79	12	11.8	11.1	22.44	12.02	12.21	12.06	11.36	22.79
9/16/15	11.59	11.7	12	11	22.36	11.98	12.20	12.09	11.37	22.73
9/17/15	11.27	11.3	11.5	10.6	22.22	11.86	12.07	12.00	11.26	22.68
9/18/15	11.24	11.2	11.7	10.7	22.12	11.72	11.90	11.91	11.13	22.58
9/19/15	11.35	11.4	11.9	10.8	22.29	11.58	11.73	11.83	10.99	22.43
9/20/15	11.51	11.7	12.3	11.1	22.36	11.51	11.63	11.86	10.93	22.37
9/21/15	11.59	11.9	12.2	11.2	22.33	11.48	11.60	11.91	10.93	22.30
9/22/15	11.65	12	12.3	11.1	22.55	11.46	11.60	11.99	10.93	22.32
9/23/15	11.71	12	12.6	11.3	22.46	11.47	11.64	12.07	10.97	22.33
9/24/15	11.42	11.6	11.9	10.9	22.30	11.50	11.69	12.13	11.01	22.34

*Upstream main temperature values from 7/1/15 to 8/4/15 adjusted +0.85 degrees celcius based on calibration data.

Table 1 - Daily Temperature

Date	Daily Maximum Temperature					7-Day Average of Daily Maxium Temperature				
	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent	Upstream Main	Upstream Backup	Downstream Main	Downstream Backup	Effluent
9/25/15	11.35	11.6	12.3	11	22.25	11.51	11.74	12.21	11.06	22.36
9/26/15	11.34	11.5	12.1	11	22.23	11.51	11.76	12.24	11.09	22.35
9/27/15	11.42	11.7	12.2	11.1	22.14	11.50	11.76	12.23	11.09	22.32
9/28/15	11.34	11.5	12.1	10.9	21.86	11.46	11.70	12.21	11.04	22.25
9/29/15	11.21	11.5	12.1	10.8	22.02	11.40	11.63	12.19	11.00	22.18
9/30/15	11.17	11.4	12.1	10.8	21.98	11.32	11.54	12.11	10.93	22.11
10/1/15	11.18	11.5	11.9	10.7	21.85	11.29	11.53	12.11	10.90	22.05
10/2/15	11.17	11.4	11.7	10.7	22.08	11.26	11.50	12.03	10.86	22.02
10/3/15	11.35	11.7	12.2	10.9	21.94	11.26	11.53	12.04	10.84	21.98
10/4/15	11.45	11.7	12.2	11	21.80	11.27	11.53	12.04	10.83	21.93
10/5/15	11.33	11.6	12.2	10.9	21.67	11.27	11.54	12.06	10.83	21.91
10/6/15	11.32	11.4	11.9	10.8	21.62	11.28	11.53	12.03	10.83	21.85
10/7/15	11.09	11.1	11	10.5	21.57	11.27	11.49	11.87	10.79	21.79
10/8/15	11.24	11.3	11.2	10.8	21.70	11.28	11.46	11.77	10.80	21.77
10/9/15	11.29	11.3	11.3	10.9	22.05	11.30	11.44	11.71	10.83	21.76
10/10/15	11.43	11.5	11.5	11.1	21.72	11.31	11.41	11.61	10.86	21.73
10/11/15	11.34	11.5	11.4	11	21.82	11.29	11.39	11.50	10.86	21.73
10/12/15	11.48	11.5	11.5	11	21.43	11.31	11.37	11.40	10.87	21.70
10/13/15	11.29	11.5	11.4	10.9	21.68	11.31	11.39	11.33	10.89	21.71
10/14/15	11.99	11.9	11.8	11.3	21.73	11.44	11.50	11.44	11.00	21.73
10/15/15	12.01	11.9	11.8	11.4	21.40	11.55	11.59	11.53	11.09	21.69
10/16/15	11.93	11.8	11.7	11.3	21.39	11.64	11.66	11.59	11.14	21.60
10/17/15	11.77	11.6	11.6	11.2	22.00	11.69	11.67	11.60	11.16	21.64
10/18/15	11.71	11.6	11.5	11	21.83	11.74	11.69	11.61	11.16	21.64
10/19/15	11.65	11.4	11.3	10.9	21.99	11.76	11.67	11.59	11.14	21.72
10/20/15	11.81	11.7	11.6	11.2	21.82	11.84	11.70	11.61	11.19	21.74
10/21/15	11.74	11.5	11.4	10.9	21.79	11.80	11.64	11.56	11.13	21.75
10/22/15	11.73	11.5	11.4	11	21.65	11.76	11.59	11.50	11.07	21.78
10/23/15	11.59	11.4	11.3	10.9	21.65	11.71	11.53	11.44	11.01	21.82
10/24/15	11.41	11.2	11.1	10.6	21.43	11.66	11.47	11.37	10.93	21.74
10/25/15	11.17	10.9	10.8	10.3	21.14	11.59	11.37	11.27	10.83	21.64
10/26/15	11.09	10.8	10.8	10.3	21.18	11.51	11.29	11.20	10.74	21.52
10/27/15	11.45	11.2	11.2	10.7	21.40	11.45	11.21	11.14	10.67	21.46
10/28/15	11.45	11.2	11.2	10.7	21.23	11.41	11.17	11.11	10.64	21.38
10/29/15	11.21	11	10.9	10.4	21.13	11.34	11.10	11.04	10.56	21.31
10/30/15	11.21	11	10.9	10.4	21.11	11.28	11.04	10.99	10.49	21.23
10/31/15	11.35	11.1	11	10.6	21.00	11.28	11.03	10.97	10.49	21.17

*Upstream main temperature values from 7/1/15 to 8/4/15 adjusted +0.85 degrees celcius based on calibration data.


Figure 1: Data Collection Locations
2015 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2015 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2015 Receiving Water Study-Temperature

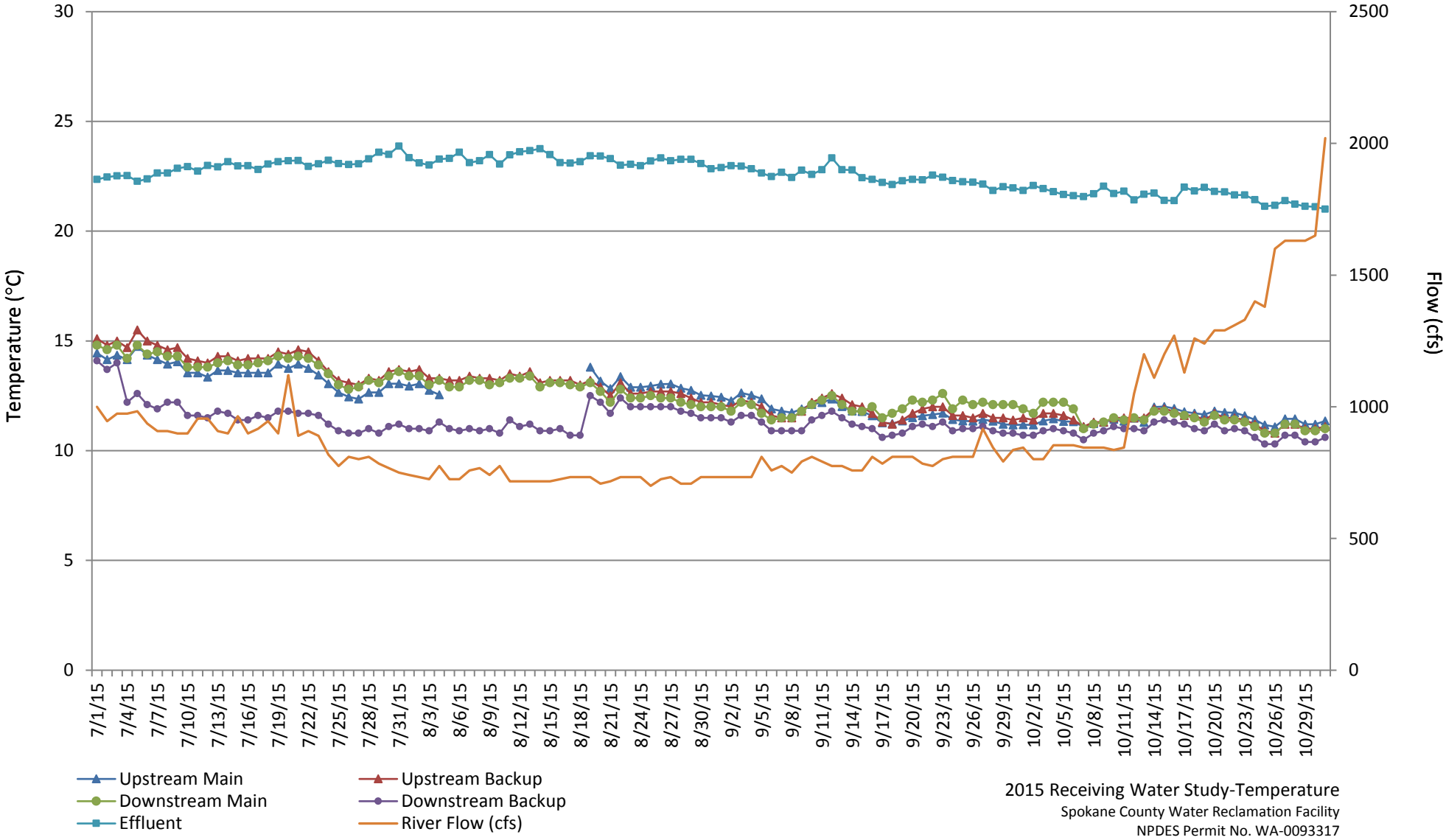
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Data Logger Deployment

2015 Receiving Water Study-Temperature

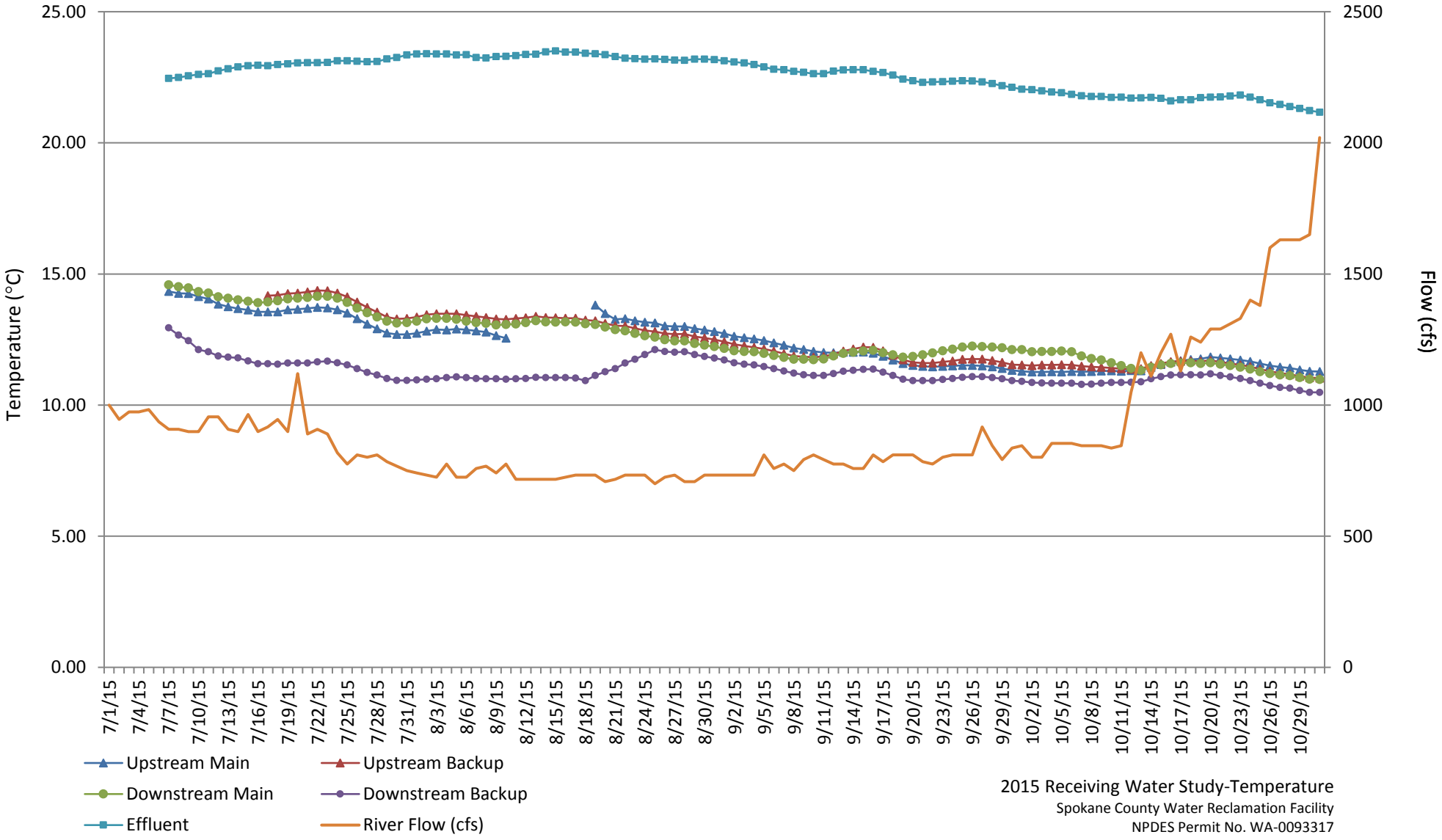
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5 - Daily Maximum Temperature



2015 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 6 - 7 Day Average of Daily Maximum Temperature



2015 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 1065595/71391

Data Logger Name: Upstream Main

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/29/15	15:30	Deploy	13.3	2	Anchor block deployed on waters edge. Cable deployed full length
8/4/15	13:30	Retrieve	11.7	2	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.6 °C, temp probe 13.45 °C. Due to significant excursion from NIST certified probe, data logger removed.
8/19/15	10:50	Deploy	13.81	4.5	Replacement data logger deployed.
9/8/15	13:30	Retrieve	11.73	4.5	Data logger retrieved. Model of data logger does not allow field downloading, therefore data not downloaded. Calibration checked in situ - Data logger—11.73 °C, temp probe 11.75 °C.
9/8/15	13:40	Deploy	11.6	4.5	Cable deployed full length.
10/6/15	13:40	Retrieve	11.29	4.5	Data logger retrieved. Model of data logger does not allow field downloading, therefore data not downloaded. Calibration checked in situ - Data logger—11.32 °C, temp probe 11.62 °C.
10/6/15	13:50	Deploy	11.32	4.5	Cable deployed full length.
11/3/15	13:40	Retrieve	10.89	6	Completion of data collection; data logger retrieved.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Upstream Backup

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/29/15	14:30	Deploy	14.6	9	Data logger deployed.
8/4/15	13:50	Retrieve	13.0	8.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.5 °C, temp probe 13.54°C.
8/4/15	14:00	Deploy	13.3	8.5	Data logger redeployed
9/8/15	14:00	Retrieve	11.5	8.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.6 °C, temp probe 11.68°C.
9/8/15	14:10	Deploy	11.5	8.5	Data logger redeployed
10/6/15	14:05	Retrieve	11.4	8.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.6 °C, temp probe 11.65°C.
10/6/15	14:15	Deploy	11.4	8.5	Data logger redeployed
11/3/15	13:40	Retrieve	10.7	9	Recovered and downloaded data; 2015 temperature study completed, data logger not redeployed.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2024052

Data Logger Name: Downstream Main

Location: 47^{0}40’34.81”/-117^{0}20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/29/15	14:30	Deploy	14.7	7	Anchor block deployed on waters edge. Cable deployed full length
8/4/15	13:50	Retrieve	13	8	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.7 °C, temp probe 13.80°C.
8/4/15	14:00	Deploy	13	8	Cable deployed full length.
9/8/15	14:00	Retrieve	11.5	7.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.9 °C, temp probe 11.98 °C.
9/8/15	14:10	Deploy	11.4	7.5	Cable deployed full length.
10/6/15	14:05	Retrieve	11.8	8	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.7 °C, temp probe 11.60 °C.
10/6/15	14:15	Deploy	11.3	8	Cable deployed full length.
11/3/15	13:40	Retrieve	14.1	8	Recovered and downloaded data; 2015 temperature study completed, data logger not redeployed.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 1056190

Data Logger Name: Downstream Backup

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/29/15	15:30	Deploy	13.4	5	Anchor block deployed at waters edge. Cable deployed full length
8/4/15	13:50	Retrieve	10.6	5	Data logger stuck between boulders, unable to retrieve without entering river.
8/19/15	11:00	Retrieve	10.5	4.5	Data logger retrieved after being stuck between boulders. Recovered and downloaded data.
8/19/15	11:10	Deploy	12.1	4.5	Cable deployed full length
9/8/15	14:00	Retrieve	10.9	4.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.10 °C, temp probe 12.05°C.
9/8/15	14:10	Deploy	10.8	4	Cable deployed full length.
10/06/15	14:15	Retrieve	10.8	3.5	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.8 °C, temp probe 11.2°C.
10/06/15	13:40	Deploy	10.8	3.5	Cable deployed full length.
11/3/15	14:00	Retrieve	10.2	4.5	Recovered and downloaded data. 2015 temperature study completed, data logger not redeployed.

Spokane County
Environmental Services
Kevin R. Cooke, P.E., Director

December 28, 2016

Diana Washington
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2015 Data Report

Dear Diana:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2016 and October 31, 2016.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7578 if you have any questions or concerns.

Sincerely,

Mike Hermanson
Project Manager, Water Resources Section
Spokane County Environmental Services

Attachment

Cc w/out Att.: Dave Moss – Spokane County Environmental Services

1026 West Broadway Avenue, 4th Floor • Spokane, WA 99260-0430
Phone: (509) 477-3604 • Fax: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2016 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Environmental Services
1004 North Freya Street
Spokane, WA 99202

December 28, 2016

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Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2016 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the outfall during the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf .

5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP prior to the 2016 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie

(SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2016 study were the same as the 2015, 2014 and 2013 studies.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the course of the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the course of the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at

this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were deployed on July 1, 2016 at approximately 9:30 am. The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (see Figure 4).

Field visits to each location were made on a monthly basis to download data if possible, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible.

Upon retrieval on November 1, 2016 the upstream backup data logger could not be located, and the downstream backup data logger anchor block was found, but the data logger was not there. Both backup data loggers were retrieved at the October 4, 2016 field visit, therefore the data loggers were lost between October 4, 2016 and November 1, 2016. Due to the version of the lost data loggers field downloads from the backup data loggers was not possible, and therefore not available for this report. Both the primary upstream and primary downstream data loggers were retrieved and all data downloaded. The purpose of deploying two data loggers at each location is to increase the probability of collecting one complete data set at each location, which was achieved during the study.

As specified in the QAPP, CH2M Hill measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was provided to the County for the study period at 30 minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven-day running average is presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Downstream Main	Effluent
July 1	6.41	16.14	22.71
August 1	4.47	13.84	23.55
September 13	.40	13.26	23.23
October 1	3.44	13.29	22.40

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Over the study period the daily maximum temperature of the upstream data logger was both above and below the daily maximum temperature of the downstream data logger. The temperature difference between the two locations did not exceed 1.1 $^{\circ}$C; the average difference between the two locations was 0.02 $^{\circ}$C.

5 CONCLUSIONS

The study indicates the river temperature is essentially the same upstream and downstream of the SCRWRF discharge.

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
7/1/16	17.7	17.3	21.54			
7/2/16	17.6	17.5	21.41			
7/3/16	17.4	17.2	21.40			
7/4/16	16.8	16.4	21.25			
7/5/16	15.7	15.3	21.06			
7/6/16	15.6	15.5	21.40			
7/7/16	14.1	13.8	21.30	16.41	16.14	21.34
7/8/16	13.9	13.5	21.59	15.87	15.60	21.34
7/9/16	14.1	13.7	21.42	15.37	15.06	21.34
7/10/16	14.3	13.9	21.35	14.93	14.59	21.34
7/11/16	14.8	14.5	21.39	14.64	14.31	21.36
7/12/16	15.5	15.2	21.43	14.61	14.30	21.41
7/13/16	16.3	16	21.85	14.71	14.37	21.47
7/14/16	16.6	16.3	21.81	15.07	14.73	21.55
7/15/16	16	15.6	21.60	15.37	15.03	21.55
7/16/16	15.5	14.9	21.55	15.57	15.20	21.57
7/17/16	14.3	13.6	21.80	15.57	15.16	21.63
7/18/16	13.8	13.5	21.80	15.43	15.01	21.69
7/19/16	13.8	13.1	22.42	15.19	14.71	21.83
7/20/16	13.3	12.8	21.85	14.76	14.26	21.83
7/21/16	13.8	13.1	22.08	14.36	13.80	21.87
7/22/16	12.9	12.4	21.78	13.91	13.34	21.90
7/23/16	13.1	13.1	21.91	13.57	13.09	21.95
7/24/16	14.9	14.5	22.12	13.66	13.21	21.99
7/25/16	15.3	14.8	22.41	13.87	13.40	22.08
7/26/16	15.4	14.2	22.55	14.10	13.56	22.10
7/27/16	14.8	14.2	22.80	14.31	13.76	22.24
7/28/16	14.8	14	22.69	14.46	13.89	22.33
7/29/16	14.8	13.9	22.90	14.73	14.10	22.48
7/30/16	13.9	13.7	22.87	14.84	14.19	22.62
7/31/16	13.9	13.6	22.74	14.70	14.06	22.71
8/1/16	13.7	13.3	22.53	14.47	13.84	22.73
8/2/16	13.2	13.1	22.51	14.16	13.69	22.72
8/3/16	12.4	12.8	22.40	13.81	13.49	22.66
8/4/16	12.6	12.9	22.67	13.50	13.33	22.66
8/5/16	12.7	13	22.60	13.20	13.20	22.62
8/6/16	12.7	13.1	22.59	13.03	13.11	22.58
8/7/16	12.3	12.6	22.50	12.80	12.97	22.54
8/8/16	12.1	12.6	22.50	12.57	12.87	22.54
8/9/16	12.2	12.3	22.35	12.43	12.76	22.52
8/10/16	11.9	12.2	22.57	12.36	12.67	22.54
8/11/16	12.2	12.6	23.15	12.30	12.63	22.61
8/12/16	12.5	13	23.00	12.27	12.63	22.66

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
8/13/16	12.6	13.3	23.19	12.26	12.66	22.75
8/14/16	12.7	13.2	23.30	12.31	12.74	22.86
8/15/16	12.9	13.4	23.38	12.43	12.86	22.99
8/16/16	12.9	13.4	23.48	12.53	13.01	23.15
8/17/16	12.7	13.2	23.55	12.64	13.16	23.29
8/18/16	12.4	13.2	23.55	12.67	13.24	23.35
8/19/16	12.4	13.2	23.84	12.66	13.27	23.47
8/20/16	12	13.1	23.75	12.57	13.24	23.55
8/21/16	11.9	12.9	23.20	12.46	13.20	23.54
8/22/16	11.8	12.8	23.20	12.30	13.11	23.51
8/23/16	11.8	12.9	23.02	12.14	13.04	23.44
8/24/16	11.9	13	23.06	12.03	13.01	23.37
8/25/16	11.6	12.7	23.42	11.91	12.94	23.36
8/26/16	11.3	12.3	23.20	11.76	12.81	23.26
8/27/16	11.4	11.8	23.28	11.67	12.63	23.20
8/28/16	11.5	12.1	23.07	11.61	12.51	23.18
8/29/16	11.7	12.3	23.29	11.60	12.44	23.19
8/30/16	11.4	11.8	23.33	11.54	12.29	23.23
8/31/16	11.3	12	23.34	11.46	12.14	23.27
9/1/16	11.1	11.7	23.15	11.39	12.00	23.23
9/2/16	11.4	11.7	22.92	11.40	11.91	23.20
9/3/16	11.2	11.7	22.76	11.37	11.90	23.12
9/4/16	11.1	11.7	22.89	11.31	11.84	23.10
9/5/16	11	11.5	22.88	11.21	11.73	23.04
9/6/16	11.3	11.5	22.75	11.20	11.69	22.96
9/7/16	11.3	11.6	22.90	11.20	11.63	22.89
9/8/16	12.4	12.5	22.80	11.39	11.74	22.84
9/9/16	13	13.1	23.04	11.61	11.94	22.86
9/10/16	12.9	13.1	22.73	11.86	12.14	22.85
9/11/16	13.2	13.3	22.80	12.16	12.37	22.84
9/12/16	13	13.1	22.44	12.44	12.60	22.78
9/13/16	12.7	12.8	22.71	12.64	12.79	22.77
9/14/16	12.5	12.7	22.63	12.81	12.94	22.74
9/15/16	12.7	12.6	22.75	12.86	12.96	22.73
9/16/16	12.9	12.7	22.77	12.84	12.90	22.69
9/17/16	12.7	12.5	22.36	12.81	12.81	22.64
9/18/16	12.6	12.4	22.49	12.73	12.69	22.59
9/19/16	12.6	12.4	22.40	12.67	12.59	22.59
9/20/16	12.8	12.6	22.29	12.69	12.56	22.53
9/21/16	13.2	13	22.20	12.79	12.60	22.47
9/22/16	13.1	12.9	22.26	12.84	12.64	22.40
9/23/16	13.2	13	22.26	12.89	12.69	22.32
9/24/16	13.1	12.9	22.13	12.94	12.74	22.29

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
9/25/16	13.2	13.1	22.23	13.03	12.84	22.25
9/26/16	13.5	13.4	22.39	13.16	12.99	22.25
9/27/16	13.3	13.2	22.54	13.23	13.07	22.29
9/28/16	13.6	13.5	22.55	13.29	13.14	22.34
9/29/16	13.5	13.3	22.55	13.34	13.20	22.38
9/30/16	13.6	13.4	22.43	13.40	13.26	22.40
10/1/16	13.4	13.1	22.09	13.44	13.29	22.40
10/2/16	13	12.8	21.93	13.41	13.24	22.35
10/3/16	12.4	12.2	21.73	13.26	13.07	22.26
10/4/16	12.2	11.9	21.69	13.10	12.89	22.14
10/5/16	12.1	12.1	21.71	12.89	12.69	22.02
10/6/16	12.8	12.8	21.98	12.79	12.61	21.94
10/7/16	12.9	12.8	21.84	12.69	12.53	21.85
10/8/16	12.8	12.7	21.60	12.60	12.47	21.78
10/9/16	13.1	13	21.74	12.61	12.50	21.76
10/10/16	12.9	12.8	21.31	12.69	12.59	21.70
10/11/16	12.5	12.4	21.14	12.73	12.66	21.62
10/12/16	12.4	12.2	20.95	12.77	12.67	21.51
10/13/16	12.1	12	20.82	12.67	12.56	21.34
10/14/16	12.4	12.3	20.78	12.60	12.49	21.19
10/15/16	12.4	12.3	20.88	12.54	12.43	21.09
10/16/16	12.4	12.4	20.91	12.44	12.34	20.97
10/17/16	12.4	12.3	20.73	12.37	12.27	20.89
10/18/16	12	11.9	20.59	12.30	12.20	20.81
10/19/16	12	11.8	20.63	12.24	12.14	20.76
10/20/16	12.1	12	20.73	12.24	12.14	20.75
10/21/16	11.8	11.7	20.77	12.16	12.06	20.75
10/22/16	11.9	11.8	20.83	12.09	11.99	20.74
10/23/16	11.8	11.7	20.61	12.00	11.89	20.70
10/24/16	11.9	11.7	20.79	11.93	11.80	20.71
10/25/16	12	11.9	20.77	11.93	11.80	20.73
10/26/16	12	11.9	20.60	11.93	11.81	20.73
10/27/16	11.7	11.6	20.52	11.87	11.76	20.70
10/28/16	11.7	11.6	20.48	11.86	11.74	20.66
10/29/16	11.6	11.5	20.25	11.81	11.70	20.57
10/30/16	11.6	11.4	20.40	11.79	11.66	20.54
10/31/16	11.5	11.4	20.00	11.73	11.61	20.43


Figure 1: Data Collection Locations
2016 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2016 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2016 Receiving Water Study-Temperature

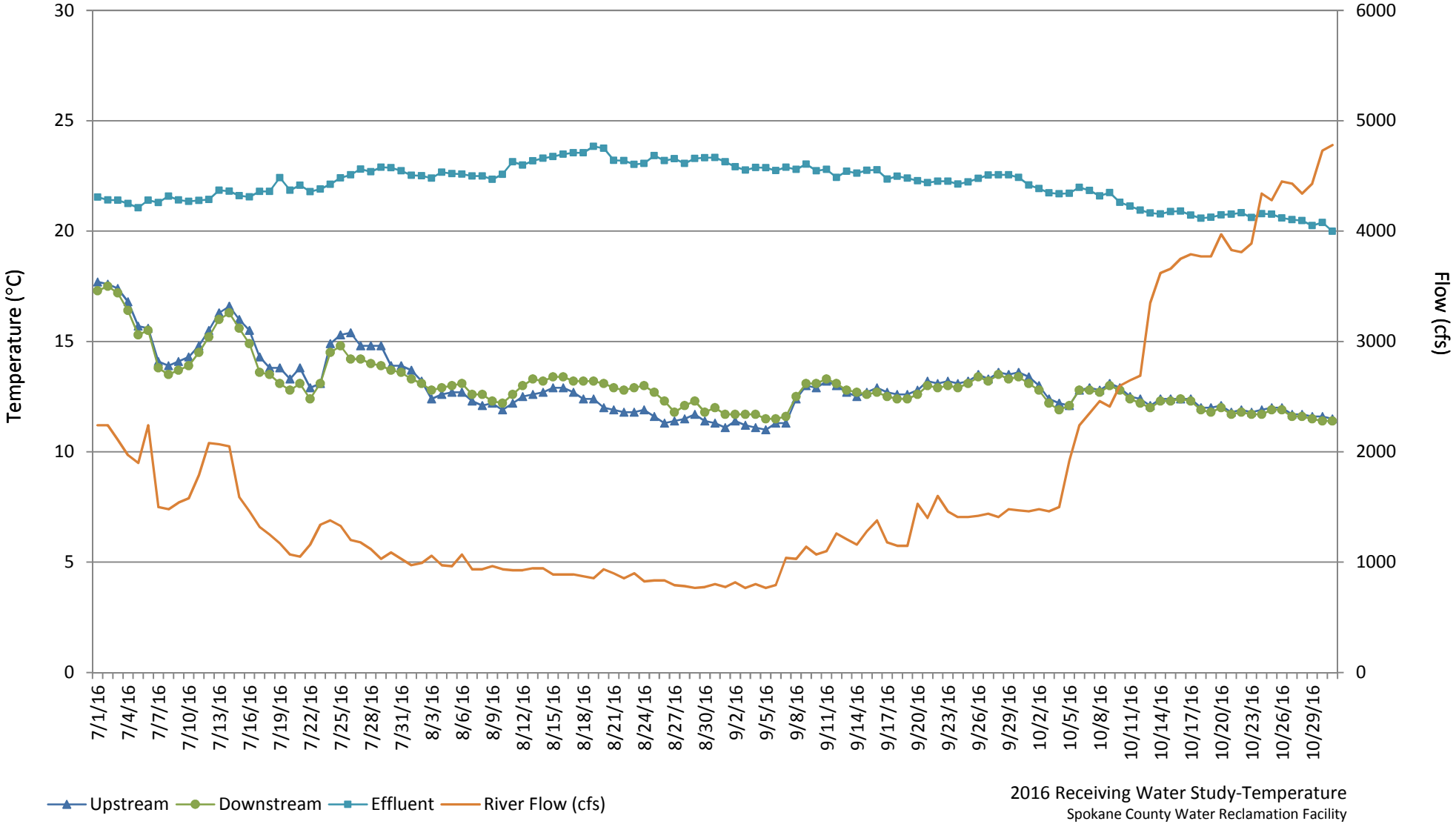
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Data Logger Deployment

2016 Receiving Water Study-Temperature

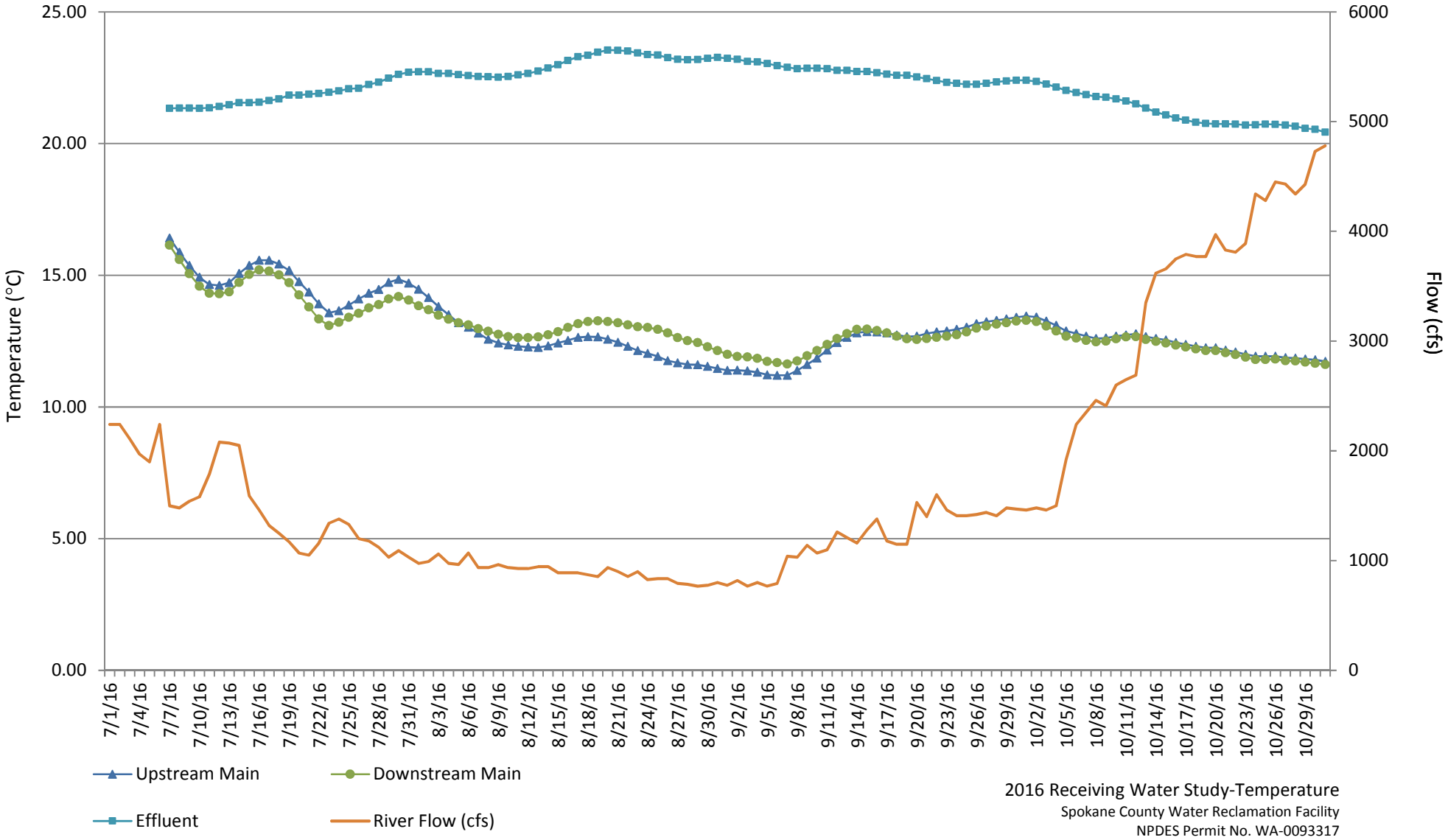
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5 - Daily Maximum Temperature



2016 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 6 - 7 Day Average of Daily Maximum Temperature



2016 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility
NPDES Permit No. WA-0093317

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Upstream

Location: $47^{0}40'34.95"/-117^{0}20'39.15"$

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
7/1/16	9:00	Deploy	17.3	8	Anchor block deployed on waters edge. Cable deployed full length
8/2/16	13:30	Retrieve/ Deploy	13.4	8	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.40°C, temp probe 13.457°C.
9/6/16	13:30	Retrieve/ Deploy	11.4	8	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.4 °C, temp probe 11.6 °C.
10/6/15	13:40	Retrieve/ Deploy	12.1	9	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.1 °C, temp probe 12.27 °C.
11/1/15	13:40	Retrieve	-	-	Completion of data collection; data logger retrieved.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Mike Hermanson/Ben Brattebo

Interval Frequency: 00:30

Data Logger ID #: 2024052

Data Logger Name: Downstream Main

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
7/1/16	9:00	Deploy	16.8	9	Anchor block deployed on waters edge. Cable deployed full length
8/2/16	13:30	Retrieve/ Deploy	13.20	10	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.20°C, temp probe 13.42°C.
9/6/16	13:30	Retrieve/ Deploy	11.0	9	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—11.0 °C, temp probe 11.46 °C.
10/6/15	13:40	Retrieve/ Deploy	12.23	10	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.23 °C, temp probe 11.8 °C.
11/1/15	13:40	Retrieve	-	-	Completion of data collection; data logger retrieved.

Spokane County
Environmental Services
Kevin R. Cooke, P.E., Director

December 21, 2017

Ms. Diana Washington, P.E.
Washington Department of Ecology- Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Submitted via email to: DWAS461@ ECY.WA.GOV

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study - Temperature; 2017 Data Report

Dear Diana:

In accordance with the subject National Pollutant Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 3, 2017 and October 31, 2017.

As required by the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7521 or bbrattebo@spokanecounty.org if you have any questions or concerns.

Sincerely,

Ben Brattebo, P.E.
Water Reclamation Engineer

Attachment

cc: file

1026 West Broadway Avenue, 4th Floor • Spokane, WA 99260-0430
Phone: (509) 477-3604 • Fax: (509) 477-4715 • TDD: (509) 477-7133

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2017 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Environmental Services
1004 North Freya Street
Spokane, WA 99202

December 21, 2017

Table of Contents

Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2017 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature monitoring element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the SCRWRF outfall between the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: https://fortress.wa.gov/ecy/publications/documents/0303052.pdf.
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific

equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP prior to the 2017 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the

SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2017 study were the same as the 2013 through 2016 studies.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were deployed on July 3, 2017 at approximately 10:00 am. The data loggers were deployed on July 3 because it was the first work day in the month of July 2017. The data loggers were set to record the data logger depth and temperature at 30 minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20 ft. steel cable. The cable was attached to a 40 lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (Figure 4).

Field visits to each location were made monthly to download data if possible, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October, the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible.

The primary (SN 2024052) and backup (SN 112009638) downstream data loggers were retrieved and all data were downloaded. The primary (SN 71391) and backup (SN 111056190) upstream data loggers were downloaded periodically throughout the 2017 sample season. The primary logger reached memory capacity on October 20, 2017 and stopped recording data. The backup logger could not be located during the final site visit on November 13, 2017. The primary upstream logger was not recovered at the termination of the 2016 sampling season due to high water and was deployed over-winter, which contributed to the limitation of logger memory capacity. The memory limitation and the loss of the backup logger resulted in incomplete data acquisition for a total of 11 days at the upstream site from October 20, 2017 to October 31, 2017. Two data loggers are routinely deployed at each location is to increase the probability of collecting one complete data set per sampling year, but tampering with the loggers and mechanical limitations prevented collection of a complete data set at the upstream site.

As specified in the QAPP, CH2M measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was

provided to the County for the study period at 30-minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 1 and Figures 5 & 6. The monthly maximum of the seven-day running average is presented below in Table 2.

Table 2 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream Main	Downstream Main	Effluent
July*	14.66	18.37	22.50
August	13.61	15.09**	23.17
September	14.17	14.27	23.26
October	13.99	14.07	21.97
*July temperature affected by logger placement, see Figure 5. **Data from August 25-28 removed due to low flow period when logger was exposed to atmosphere.			

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Over the study period, the daily maximum temperature of the upstream data logger was both above and below the daily maximum temperature of the downstream data logger. Data recorded during the month of July at the upstream site are cooler than the downstream site, potentially due to logger placement impacted by groundwater inflows. These observations are supported by 2017 temperature data; a relocation of both upstream and downstream primary and backup loggers during the August 3 site visit had a dramatic effect on logger synchronization between upstream and downstream sites and primary and backup loggers (Figure 5). Furthermore, the overall decrease in downstream temperature (17.3-15.2°C) from July 3, 2017 to August 3, 2017 is consistent with the declining river flow, as cool groundwater inflows make up a larger part of stream flow and inconsistent with the slight increase in effluent temperature (21.4-22.8°C) over the same time interval (Figure 5). We surmise that the upstream loggers were initially placed in groundwater dominated pools and repositioned on August 3, 2017 to more surface water dominated pools.

Anomalous temperatures were measured by both primary and backup loggers at the downstream site when river temperature increased from 11.9°C to 21.3°C followed by a

precipitous decrease to 12.5°C in 24 hours between August 26, 2017 and August 27, 2017. The hydrograph for this period (USGS, 12422500) illustrates a low flow period in the Spokane River between August 26, 2017 and September 5, 2017. It is likely that the loggers were temporarily exposed to the atmosphere during this event. Additionally, upon recovery of the loggers on September 14, 2017 it was evident that both loggers had been moved by someone and some of the attachment hardware had been stolen. Both loggers were submerged in shallow water during recovery, but not from their previous placement. The data for this interval were removed in the calculation of monthly maxima at the downstream site, but were not removed from the upstream site as phenomenon did not appear to occur at the upstream site. No data were removed from Figures 5 and 6 to illustrate the temperature anomaly.

When all the data are included, the temperature difference between the upstream and downstream sites did not exceed 10.45°C and the average difference between the two sites was 0.99°C. After removing the July upstream data and the anomalous warming event from the downstream data, the temperature difference between the two locations did not exceed 1.36°C and the average difference between sites was 0.09°C.

5 CONCLUSIONS

The study indicates that Spokane River water temperature at sites upstream and downstream of the SCRWRF discharge were consistent with one another under normal measurement conditions as established in the QAPP. Measurement device deployment location and river discharge are likely the greatest determinates of measured water temperature in this reach of the river as evidenced by the dramatic change in temperature after logger replacement and anomalous warming at low flow. Our data indicate a consistency between upstream and downstream temperatures independent of effluent temperature for all periods when the loggers appear to be representatively measuring in-situ water temperature.

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

7 REFERENCES

U.S. Geological Survey 2016. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), accessed October 17, 2017, at URL https://waterdata.usgs.gov/nwis/uv?site_no=12422500.

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
7/3/16	14.30	17.30	21.40			
7/4/16	14.60	17.80	21.50			
7/5/16	14.80	18.20	21.80			
7/6/16	15.10	18.70	22.00			
7/7/16	14.80	18.70	22.00			
7/8/16	14.60	18.50	21.60			
7/9/16	14.40	18.60	21.80	14.66	18.26	21.73
7/10/16	14.00	18.10	21.80	14.61	18.37	21.79
7/11/16	13.60	17.40	21.70	14.47	18.31	21.81
7/12/16	13.00	16.70	22.10	14.21	18.10	21.86
7/13/16	12.80	16.30	22.00	13.89	17.76	21.86
7/14/16	12.70	16.10	21.90	13.59	17.39	21.84
7/15/16	12.90	16.00	22.00	13.34	17.03	21.90
7/16/16	13.20	16.80	21.90	13.17	16.77	21.91
7/17/16	12.90	16.70	21.90	13.01	16.57	21.93
7/18/16	12.90	16.80	22.10	12.91	16.49	21.99
7/19/16	12.90	15.70	22.40	12.90	16.34	22.03
7/20/16	12.80	15.30	22.10	12.90	16.20	22.04
7/21/16	12.40	14.80	22.00	12.86	16.01	22.06
7/22/16	12.50	14.60	22.60	12.80	15.81	22.14
7/23/16	12.50	14.90	22.50	12.70	15.54	22.23
7/24/16	12.60	15.40	22.40	12.66	15.36	22.30
7/25/16	12.50	15.30	22.50	12.60	15.14	22.36
7/26/16	12.40	15.40	22.50	12.53	15.10	22.37
7/27/16	12.30	14.90	22.40	12.46	15.04	22.41
7/28/16	12.20	15.10	22.50	12.43	15.09	22.49
7/29/16	12.10	14.90	22.50	12.37	15.13	22.47
7/30/16	11.90	15.10	22.40	12.29	15.16	22.46
7/31/16	11.90	15.30	22.40	12.19	15.14	22.46
8/1/16	11.60	14.90	22.80	12.06	15.09	22.50
8/2/16	11.40	15.20	22.80	11.91	15.06	22.54
8/3/16	13.90	13.80	23.10	12.14	14.90	22.64
8/4/16	13.50	13.40	23.10	12.33	14.66	22.73
8/5/16	13.90	13.80	22.80	12.59	14.50	22.77
8/6/16	13.80	13.60	22.90	12.86	14.29	22.84
8/7/16	13.60	13.50	23.10	13.10	14.03	22.94
8/8/16	13.40	13.30	23.10	13.36	13.80	22.99
8/9/16	13.20	13.20	23.10	13.61	13.51	23.03
8/10/16	13.20	13.00	23.20	13.51	13.40	23.04
8/11/16	12.90	12.90	23.20	13.43	13.33	23.06
8/12/16	12.90	12.90	23.10	13.29	13.20	23.10
8/13/16	12.70	12.50	22.90	13.13	13.04	23.10
8/14/16	12.60	12.70	22.90	12.99	12.93	23.07

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
8/15/16	12.70	12.80	23.20	12.89	12.86	23.09
8/16/16	12.70	12.80	23.10	12.81	12.80	23.09
8/17/16	13.00	12.90	23.20	12.79	12.79	23.09
8/18/16	13.00	12.90	23.10	12.80	12.79	23.07
8/19/16	12.90	12.90	23.10	12.80	12.79	23.07
8/20/16	12.80	12.70	22.80	12.81	12.81	23.06
8/21/16	12.70	12.50	23.40	12.83	12.79	23.13
8/22/16	12.50	12.40	23.40	12.80	12.73	23.16
8/23/16	12.30	12.30	23.20	12.74	12.66	23.17
8/24/16	12.50	12.20	23.20	12.67	12.56	23.17
8/25/16	12.80	19.40	23.00	12.64	13.49	23.16
8/26/16	12.10	15.90	22.90	12.53	13.91	23.13
8/27/16	11.70	21.30	23.10	12.37	15.14	23.17
8/28/16	11.60	12.30	23.10	12.21	15.11	23.13
8/29/16	11.60	12.30	23.40	12.09	15.10	23.13
8/30/16	11.50	12.30	23.30	11.97	15.10	23.14
8/31/16	11.90	12.20	23.20	11.89	15.10	23.14
9/1/16	11.80	12.50	23.30	11.74	14.11	23.19
9/2/16	11.80	12.50	23.30	11.70	13.63	23.24
9/3/16	11.60	12.30	23.20	11.69	12.34	23.26
9/4/16	11.60	12.30	23.10	11.69	12.34	23.26
9/5/16	11.80	11.80	23.10	11.71	12.27	23.21
9/6/16	12.20	12.00	23.20	11.81	12.23	23.20
9/7/16	13.00	12.80	23.20	11.97	12.31	23.20
9/8/16	13.20	13.00	23.20	12.17	12.39	23.19
9/9/16	13.40	13.10	23.10	12.40	12.47	23.16
9/10/16	13.50	13.30	23.00	12.67	12.61	23.13
9/11/16	13.50	13.30	23.10	12.94	12.76	23.13
9/12/16	13.50	13.20	23.20	13.19	12.96	23.14
9/13/16	13.20	13.10	23.40	13.33	13.11	23.17
9/14/16	13.20	12.80	23.00	13.36	13.11	23.14
9/15/16	12.90	12.90	23.40	13.31	13.10	23.17
9/16/16	12.50	12.70	22.40	13.19	13.04	23.07
9/17/16	12.30	12.20	22.30	13.01	12.89	22.97
9/18/16	12.40	12.60	22.20	12.86	12.79	22.84
9/19/16	12.50	12.10	22.30	12.71	12.63	22.71
9/20/16	13.10	12.70	21.60	12.70	12.57	22.46
9/21/16	13.80	13.40	21.60	12.79	12.66	22.26
9/22/16	13.70	13.50	21.80	12.90	12.74	22.03
9/23/16	13.70	13.70	21.70	13.07	12.89	21.93
9/24/16	14.00	14.10	21.70	13.31	13.16	21.84
9/25/16	14.10	14.20	21.90	13.56	13.39	21.80
9/26/16	14.10	14.20	22.10	13.79	13.69	21.77

Table 1 - Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maxium Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
9/27/16	14.60	14.60	22.10	14.00	13.96	21.84
9/28/16	14.40	14.60	22.10	14.09	14.13	21.91
9/29/16	14.30	14.50	22.10	14.17	14.27	21.96
9/30/16	13.50	13.70	21.90	14.14	14.27	21.99
10/1/16	12.90	12.70	21.60	13.99	14.07	21.97
10/2/16	12.20	11.90	21.50	13.71	13.74	21.91
10/3/16	12.00	11.90	21.40	13.41	13.41	21.81
10/4/16	12.50	12.50	21.20	13.11	13.11	21.69
10/5/16	12.70	12.80	21.40	12.87	12.86	21.59
10/6/16	12.50	12.70	21.30	12.61	12.60	21.47
10/7/16	12.30	12.50	21.10	12.44	12.43	21.36
10/8/16	12.20	12.30	21.00	12.34	12.37	21.27
10/9/16	11.90	12.10	21.00	12.30	12.40	21.20
10/10/16	11.70	11.90	20.90	12.26	12.40	21.13
10/11/16	11.90	11.70	20.80	12.17	12.29	21.07
10/12/16	11.90	11.50	20.70	12.06	12.10	20.97
10/13/16	11.40	11.00	20.40	11.90	11.86	20.84
10/14/16	11.20	10.80	20.40	11.74	11.61	20.74
10/15/16	11.30	11.00	20.50	11.61	11.43	20.67
10/16/16	11.50	11.10	20.60	11.56	11.29	20.61
10/17/16	11.40	11.10	20.50	11.51	11.17	20.56
10/18/16	11.20	10.70	20.30	11.41	11.03	20.49
10/19/16	11.40	11.00	20.50	11.34	10.96	20.46
10/20/16	NA	10.90	20.30	NA	10.94	20.44
10/21/16	NA	10.70	20.00	NA	10.93	20.39
10/22/16	NA	10.80	19.80	NA	10.90	20.29
10/23/16	NA	10.60	20.00	NA	10.83	20.20
10/24/16	NA	10.50	20.00	NA	10.74	20.13
10/25/16	NA	10.50	20.20	NA	10.71	20.11
10/26/16	NA	10.50	19.90	NA	10.64	20.03
10/27/16	NA	10.40	20.00	NA	10.57	19.99
10/28/16	NA	10.30	19.80	NA	10.51	19.96
10/29/16	NA	10.30	19.50	NA	10.44	19.91
10/30/16	NA	10.00	19.50	NA	10.36	19.84
10/31/16	NA	9.60	19.50	NA	10.23	19.77


Figure 1: Data Collection Locations
2017 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2017 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2017 Receiving Water Study-Temperature

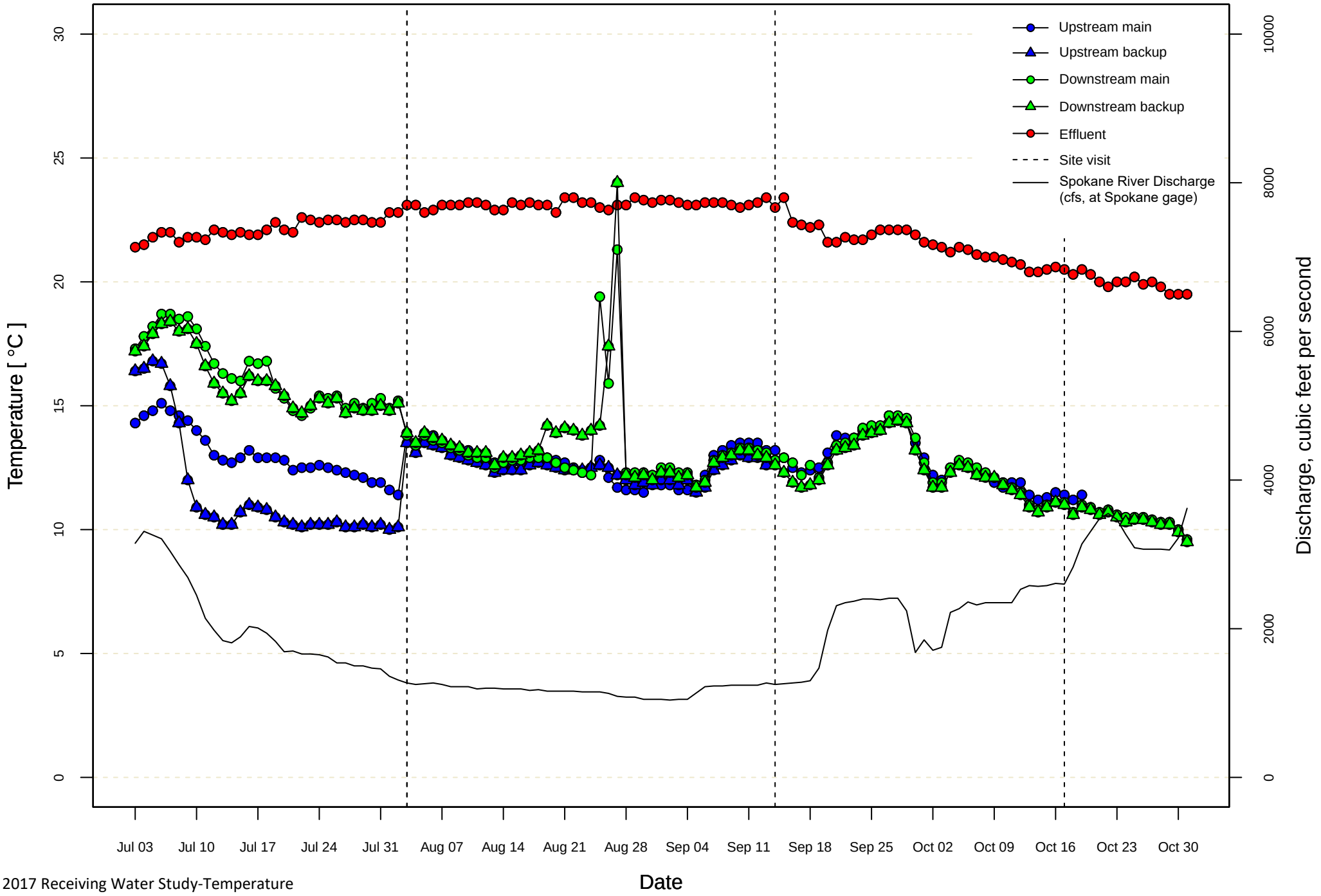
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Typical Data Logger Deployment

2017 Receiving Water Study-Temperature

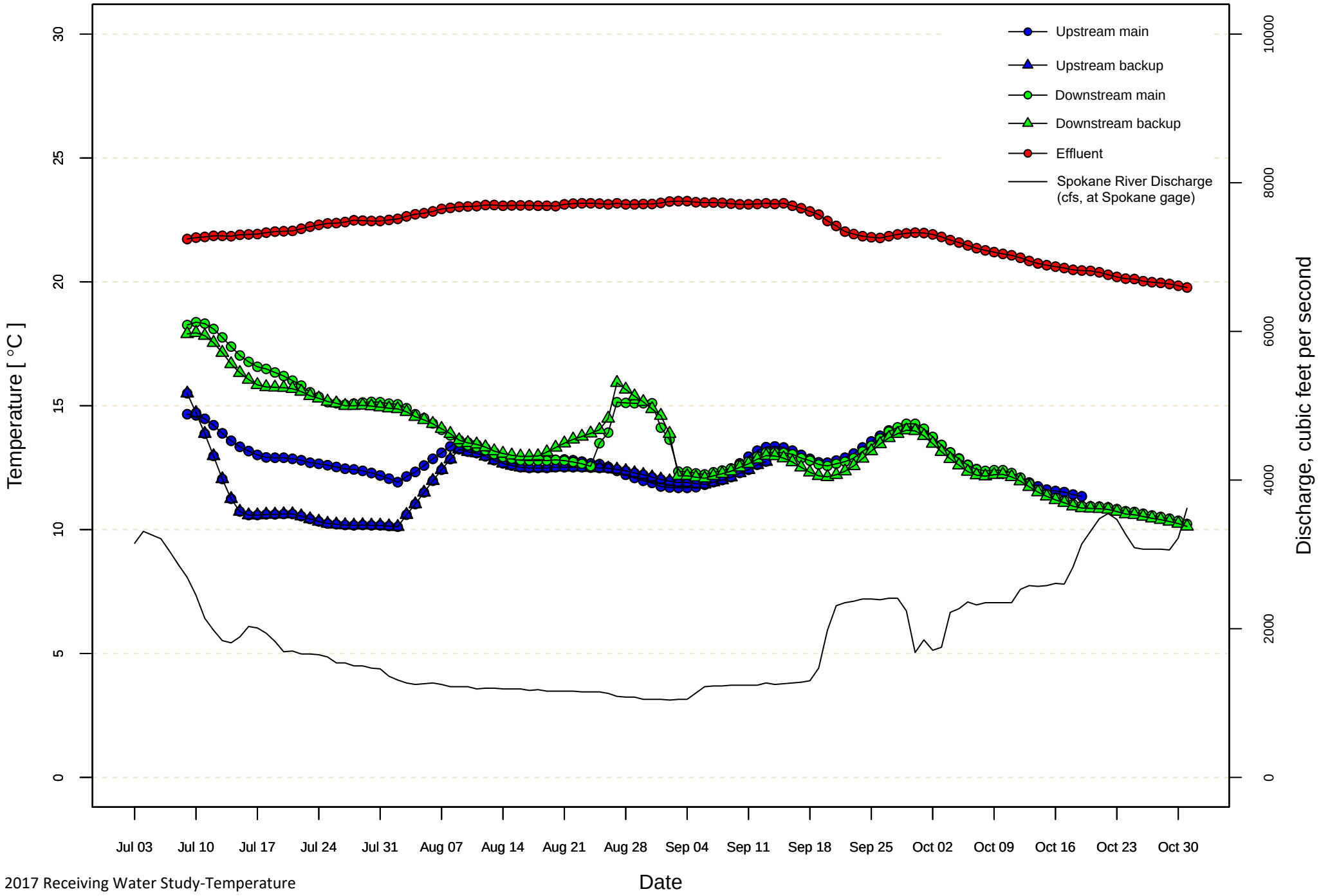
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5. Daily maximum temperature



2017 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility NPDES
Permit No. WA-0093317

Figure 6. 7−day average of maximum daily temperature



2017 Receiving Water Study-Temperature
Spokane County Water Reclamation Facility NPDES
Permit No. WA-0093317

Appendix A

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Mike Hermanson/Ben Brattebo/Jonathan Jones

Interval Frequency: 00:30

Data Logger ID #: 2009638

Data Logger Name: Upstream Main

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
7/3/2017	9:55	Logger deployed	14.3	4.6	Upstream block not found and appears to be under ~3' of water. Downstream anchor block deployed on water’s edge. Cable deployed at full length.
8/3/2017	9:15	Logger located but not downloaded	10.7	2.6	Recovered and downloaded data.
8/3/2017	9:30	Logger deployed		2.9	Cable deployed full length
9/14/2017	10:00	Logger recovered	13.0	3.0	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.3 °C, temp probe 13.3 °C.
9/14/2017	10:15	Logger deployed		NA	Cable deployed full length.
10/17/2017	12:45	Logger recovered	11.4	NA	Recovered but not downloaded.
10/17/2017	13:00	Logger deployed		NA	Cable deployed full length
11/13/2017	11:53	Logger recovered and downloaded	NA	NA	Data logger retrieved. Level logger stopped logging on 10/20/2017. due to full memory. Calibrated data logger at office with NIST certified temp probe. Data logger—21.08 °C, temp probe 21.0 °C.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream

Samplers: Mike Hermanson/Ben Brattebo/Jonathan Jones

Interval Frequency: 00:30

Data Logger ID #: 2024052

Data Logger Name: Downstream Main

Location: $47^{0}40'34.81"/-117^{0}20'55.69"$

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
7/3/2017	11:00	Logger deployed	17.3	3.5	Anchor block deployed on water's edge. Cable deployed full length.
8/3/2017	9:40	Logger recovered	13.9	1.3	Calibrated data logger at shore with NIST certified temp probe. Data logger—13.9 °C, temp probe 14.2 °C.
8/3/2017	9:45	Logger deployed	13.5	1.3	Anchor block deployed on water's edge. Cable deployed full length.
9/14/2017	10:15	Logger recovered	13.0	1.8	Logger not downloaded. Logger was moved and carabiners taken. Calibrated data logger at shore with NIST certified temp probe. Data logger—13.0 °C, temp probe 13.5 °C.
9/14/2017	10:30	Logger deployed		1.8	Anchor block deployed on water's edge. Cable deployed full length.
10/17/2017	13:05	Logger recovered	11.0	2.1	Logger not downloaded.
10/17/2017	13:20	Logger deployed		2.1	Anchor block deployed on water's edge. Cable deployed full length.
11/13/2017	12:05	Logger recovered and downloaded	7.9	3.7	Completion of data collection; calibrated data logger at office with NIST certified temp probe. Data logger—21.60 °C, temp probe 21.6 °C.

Spokane County
Environmental Services
Kevin R. Cooke, P.E., Director

December 10, 2018

Ms. Diana Washington
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Submitted via Ecology PARIS portal

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2018 Data Report

Dear Diana:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2018 and October 31, 2018.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7521 if you have any questions or concerns.

Sincerely,

Ben Brattebo, P.E.
Water Reclamation Engineer

Attachment

1026 West Broadway Avenue, 4th Floor • Spokane, WA 99260-0430
Phone: (509) 477-3604 • Fax: (509) 477-4715 • TDD: (509) 477-7133

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2018 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Environmental Services
1004 North Freya Street
Spokane, WA 99202

December 10, 2018

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Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2018 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, Jacobs, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9. A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature monitoring element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the SCRWRF outfall between the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: https://fortress.wa.gov/ecy/publications/documents/0303052.pdf.
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific

equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.
6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP prior to the 2018 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the

SVRP aquifer to the Spokane River (United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2018 study were the same as the previous temperature 2013 through 2017 studies.

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one primary and one back up at both the upstream and downstream locations. The data loggers were deployed on June 22, 2018 at approximately 9:30 am. The data loggers were set to record the data logger depth and temperature at 30-minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20-ft. steel cable. The cable was attached to a 40-lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (Figure 4).

Field visits to each location were made monthly to download data if possible, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October, the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible.

When possible, all data was downloaded periodically from each of the four data loggers, primary and backup for each site. The following events prevented a consistent download of the data from each of the four data loggers, throughout the sampling season.

- August 14th, 2018: The backup upstream logger was missing (presumably stolen) during the field visit and was replaced the following day
- October 9th: The primary upstream logger had a communication error and was unable to be downloaded
- October 9th: The primary downstream logger was missing and was unable to be downloaded. The missing logger was likely stolen and was not replaced.

Two data loggers are routinely deployed at each location to increase the probability of collecting one complete data set per sampling year, but vandalism and/or stealing of the loggers can prevent collection of a complete data set. The precaution taken to deploy two loggers at each site resulted in at least one working data logger, at each site, throughout the study period, despite the afore mentioned complications. There were no gaps in data collection in the 2018 season because there was at least one working logger at each site throughout the sample period.

As specified in the QAPP, Jacobs measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was provided to the County for the study period at 30-minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 2 and Figures 5 & 6. The monthly maximum of the seven-day running average is presented below in Table 1.

Table 1 – Monthly Maximum of 7 Day Running Average of Daily Max Temp in ^{0}C

Month	Upstream	Downstream	Effluent
July	16.7	16.7	22.8
August	14.2	14.3	23.6
September	14.2	13.3	23.2
October	12.7	11.9	22.3

Table 1 Summary of monthly maximum 7-day average of temperature in the Spokane River, Spokane, WA

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Data recorded during the months of August, September and October at the upstream site are on average, warmer than the downstream site, potentially due to logger placement impacted by groundwater inflows at the downstream site (Table 1). Monthly maximum data recorded in July showed no difference in temperature between the upstream and downstream sites on average (Table 1). Furthermore, the overall decrease in downstream temperature (17.1-12.5 ℃) from July 18, 2018 to September 3, 2018 is consistent with the declining river flow, as cool groundwater inflows make up a larger part of stream flow.

5 CONCLUSIONS

The study indicates that Spokane River water temperature at sites upstream and downstream of the SCRWRF discharge were within the natural variation expected in this reach of the river and those conditions as established in the QAPP. Measurement device deployment, location, and river discharge are likely the greatest determinates of measured water temperature in this reach of the river. Our data indicate a consistency between

upstream and downstream temperatures independent of effluent temperature for all periods when the loggers appear to be representatively measuring in-situ water temperature.

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

7 REFERENCES

U.S. Geological Survey 2018. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), accessed November 1, 2018, at URL https://waterdata.usgs.gov/nwis/uv?site_no=12422500.

Appendix A

Table 2. Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Maximum Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
6/22/2018	17.3	16.6	20.5			
6/23/2018	17.3	16.7	20.6			
6/24/2018	17.8	17.1	20.7			
6/25/2018	17.8	17.1	20.7			
6/26/2018	16.8	16	20.7			
6/27/2018	16.7	16	20.7			
6/28/2018	16.9	16.2	20.7	17.2	16.5	20.7
6/29/2018	15.5	15	20.7	17.0	16.3	20.7
6/30/2018	15.5	15	20.7	16.7	16.1	20.7
7/1/2018	15.4	14.9	20.9	16.4	15.7	20.7
7/2/2018	15.6	15.2	20.6	16.1	15.5	20.7
7/3/2018	15.3	14.7	20.8	15.8	15.3	20.7
7/4/2018	15.7	15.2	20.8	15.7	15.2	20.7
7/5/2018	16.4	15.9	21.2	15.6	15.1	20.7
7/6/2018	16.3	16	21.3	15.7	15.3	20.8
7/7/2018	16.5	16.2	21.2	15.9	15.4	20.8
7/8/2018	16.8	16.3	21.4	16.1	15.6	20.9
7/9/2018	17.1	16.6	21.4	16.3	15.8	20.9
7/10/2018	16.6	16	21.2	16.5	16.0	21.0
7/11/2018	15.8	15.3	21.4	16.5	16.0	21.1
7/12/2018	16.2	15.6	21.7	16.5	16.0	21.1
7/13/2018	16.1	15.7	21.8	16.4	16.0	21.2
7/14/2018	16.6	16	21.8	16.5	15.9	21.3
7/15/2018	16.9	16.6	21.9	16.5	16.0	21.4
7/16/2018	16.8	16.9	22	16.4	16.0	21.4
7/17/2018	16.9	16.9	22.1	16.5	16.1	21.5
7/18/2018	17.1	17.1	22.2	16.7	16.4	21.6
7/19/2018	16.8	17	22.1	16.7	16.6	21.7
7/20/2018	16.0	16.4	22.0	16.7	16.7	21.8
7/21/2018	15.1	15.6	21.9	16.5	16.6	21.9
7/22/2018	14.7	15.4	22.0	16.2	16.5	21.9
7/23/2018	14.3	15.3	22.5	15.8	16.2	22.0
7/24/2018	14.5	14.6	22.6	15.5	15.9	22.0
7/25/2018	14.3	14.6	22.8	15.1	15.6	22.1
7/26/2018	14.2	14.5	22.8	14.7	15.2	22.1
7/27/2018	14.1	14.0	22.7	14.5	14.9	22.2
7/28/2018	14	14.3	22.9	14.3	14.7	22.3
7/29/2018	14.1	14.3	23.0	14.2	14.5	22.4

Date	Daily Maximum Temperature			7-Day Average of Daily Maximum Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
7/30/2018	14.0	14.3	23.1	14.2	14.4	22.5
7/31/2018	14.5	14.0	23.0	14.2	14.3	22.6
8/1/2018	14.1	14.2	23.2	14.1	14.2	22.7
8/2/2018	14.1	14.5	22.9	14.1	14.2	22.8
8/3/2018	13.9	14.2	22.7	14.1	14.3	22.9
8/4/2018	13.9	13.9	22.7	14.1	14.2	22.9
8/5/2018	13.9	14.3	22.9	14.1	14.2	22.9
8/6/2018	14.2	14.4	23.1	14.1	14.2	22.9
8/7/2018	14.3	14.4	23.1	14.1	14.3	22.9
8/8/2018	14.3	14.4	23.4	14.1	14.3	22.9
8/9/2018	14.2	14.2	23.5	14.1	14.3	23.0
8/10/2018	14.1	14.1	23.6	14.1	14.2	23.0
8/11/2018	14.0	14.1	23.3	14.1	14.3	23.0
8/12/2018	14.2	14.1	22.9	14.2	14.2	23.1
8/13/2018	14.0	14.1	23.0	14.2	14.2	23.2
8/14/2018	13.5	13.6	23.2	14.0	14.1	23.2
8/15/2018	13.7	13.0	23.5	14.0	13.9	23.3
8/16/2018	13.8	13.1	23.9	13.9	13.7	23.3
8/17/2018	13.7	12.8	23.8	13.8	13.5	23.3
8/18/2018	13.6	12.9	23.6	13.8	13.4	23.3
8/19/2018	13.5	12.7	23.3	13.7	13.2	23.4
8/20/2018	13.5	12.8	23.3	13.6	13.0	23.4
8/21/2018	13.3	12.6	23.6	13.6	12.8	23.4
8/22/2018	13.0	12.3	23.7	13.5	12.7	23.5
8/23/2018	12.6	12.0	23.4	13.3	12.6	23.5
8/24/2018	12.6	12.0	23.3	13.2	12.5	23.5
8/25/2018	12.5	12.0	23.0	13.0	12.3	23.5
8/26/2018	12.2	11.6	22.8	12.8	12.2	23.5
8/27/2018	12.3	11.7	22.8	12.6	12.0	23.4
8/28/2018	12.2	11.8	23.3	12.5	11.9	23.4
8/29/2018	12.4	11.9	23.7	12.4	11.9	23.3
8/30/2018	12.6	12.1	23.5	12.4	11.9	23.3
8/31/2018	12.5	12.0	23.0	12.4	11.9	23.2
9/1/2018	12.5	12.1	23.0	12.4	11.9	23.2
9/2/2018	12.5	12.1	22.9	12.4	12.0	23.2
9/3/2018	12.5	12.1	23.0	12.5	12.0	23.2
9/4/2018	12.9	12.3	23.0	12.6	12.1	23.2
9/5/2018	13.6	12.8	23.4	13.9	12.2	23.2
9/6/2018	14.3	13.5	23.6	14.1	12.4	23.2

Date	Daily Maximum Temperature			7-Day Average of Daily Maximum Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
9/7/2018	14.3	13.5	23.4	14.4	12.6	23.2
9/8/2018	14.4	13.5	23.0	14.6	12.8	23.2
9/9/2018	14.4	13.6	22.9	14.9	13.0	23.2
9/10/2018	14.2	13.1	22.8	15.2	13.2	23.2
9/11/2018	13.9	12.8	22.7	15.3	13.3	23.2
9/12/2018	13.5	12.5	22.7	14.1	13.2	23.1
9/13/2018	13.4	12.5	22.8	14.0	13.1	23.1
9/14/2018	13.6	12.7	23	13.9	13.0	23.1
9/15/2018	13.7	12.8	22.9	13.8	12.9	23.0
9/16/2018	13.6	12.6	22.5	13.7	12.7	22.9
9/17/2018	13.4	12.5	22.6	13.6	12.6	22.9
9/18/2018	13.2	12.3	22.8	13.5	12.6	22.8
9/19/2018	13.2	12.4	22.8	13.4	12.5	22.8
9/20/2018	13.1	12.1	22.4	13.4	12.5	22.8
9/21/2018	13.1	12.1	22.4	13.3	12.4	22.7
9/22/2018	13.1	12.1	22.2	13.2	12.3	22.7
9/23/2018	13.1	12.2	22.2	13.2	12.2	22.7
9/24/2018	12.9	12.1	22.4	13.1	12.2	22.6
9/25/2018	13.0	12.2	22.6	13.1	12.2	22.6
9/26/2018	13.0	12.1	22.7	13.0	12.1	22.5
9/27/2018	13.0	12.1	22.6	13.0	12.1	22.5
9/28/2018	13.2	12.3	22.4	13.0	12.2	22.4
9/29/2018	12.8	12.0	21.9	13.0	12.1	22.4
9/30/2018	12.3	11.4	21.5	12.9	12.0	22.4
10/1/2018	11.9	11.1	22.1	12.7	11.9	22.3
10/2/2018	12.3	11.3	21.9	12.6	11.8	22.3
10/3/2018	12.4	11.6	21.7	12.6	11.7	22.2
10/4/2018	12.0	11.1	21.8	12.4	11.5	22.1
10/5/2018	11.7	10.9	21.4	12.2	11.3	21.9
10/6/2018	11.5	10.8	21.3	12.0	11.2	21.8
10/7/2018	11.6	10.8	21.2	11.9	11.1	21.6
10/8/2018	11.5	10.6	21.4	11.9	11.0	21.5
10/9/2018	11.6	10.8	21.0	11.8	10.9	21.4
10/10/2018	11.7	11	21.4	11.7	10.9	21.4
10/11/2018	11.5	10.8	21.1	11.6	10.8	21.3
10/12/2018	11.6	10.8	21.3	11.6	10.8	21.2
10/13/2018	11.8	11	21.1	11.6	10.8	21.2
10/14/2018	11.3	10.6	21.0	11.6	10.8	21.2
10/15/2018	11.3	10.6	21.0	11.5	10.8	21.1

Date	Daily Maximum Temperature			7-Day Average of Daily Maximum Temperature		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
10/16/2018	11.3	10.6	21.0	11.5	10.8	21.1
10/17/2018	11.3	10.5	21.0	11.4	10.7	21.1
10/18/2018	11.2	10.5	20.8	11.4	10.7	21.0
10/19/2018	11.2	10.5	20.9	11.3	10.6	21.0
10/20/2018	11.4	10.7	20.7	11.3	10.6	20.9
10/21/2018	11.4	10.7	20.7	11.3	10.6	20.9
10/22/2018	11.4	10.7	20.6	11.3	10.6	20.8
10/23/2018	11.4	10.6	20.7	11.3	10.6	20.8
10/24/2018	11.5	10.8	20.7	11.4	10.6	20.7
10/25/2018	11.2	10.5	20.5	11.4	10.6	20.7
10/26/2018	11.2	10.5	20.4	11.4	10.6	20.6
10/27/2018	11.4	10.7	20.3	11.4	10.6	20.6
10/28/2018	11.3	10.5	20.1	11.3	10.6	20.5
10/29/2018	10.9	10.2	20.2	11.3	10.5	20.4
10/30/2018	10.9	10.1	20.2	11.2	10.5	20.3
10/31/2018	10.8	10	19.9	11.1	10.4	20.2


Figure 1: Data Collection Locations
2018 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility Discharge
Spokane River
Downstream Data Logger Deployment Location
Upstream Data Logger Deployment Location I
Spokane County Sewer System North Valley Interceptor Pump Station
Spokane Community College

Figure 2: Downstream Location Aerial Photo

2018 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2018 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 4: Typical Data Logger Deployment

2018 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5. Daily Maximum Temperature 2018

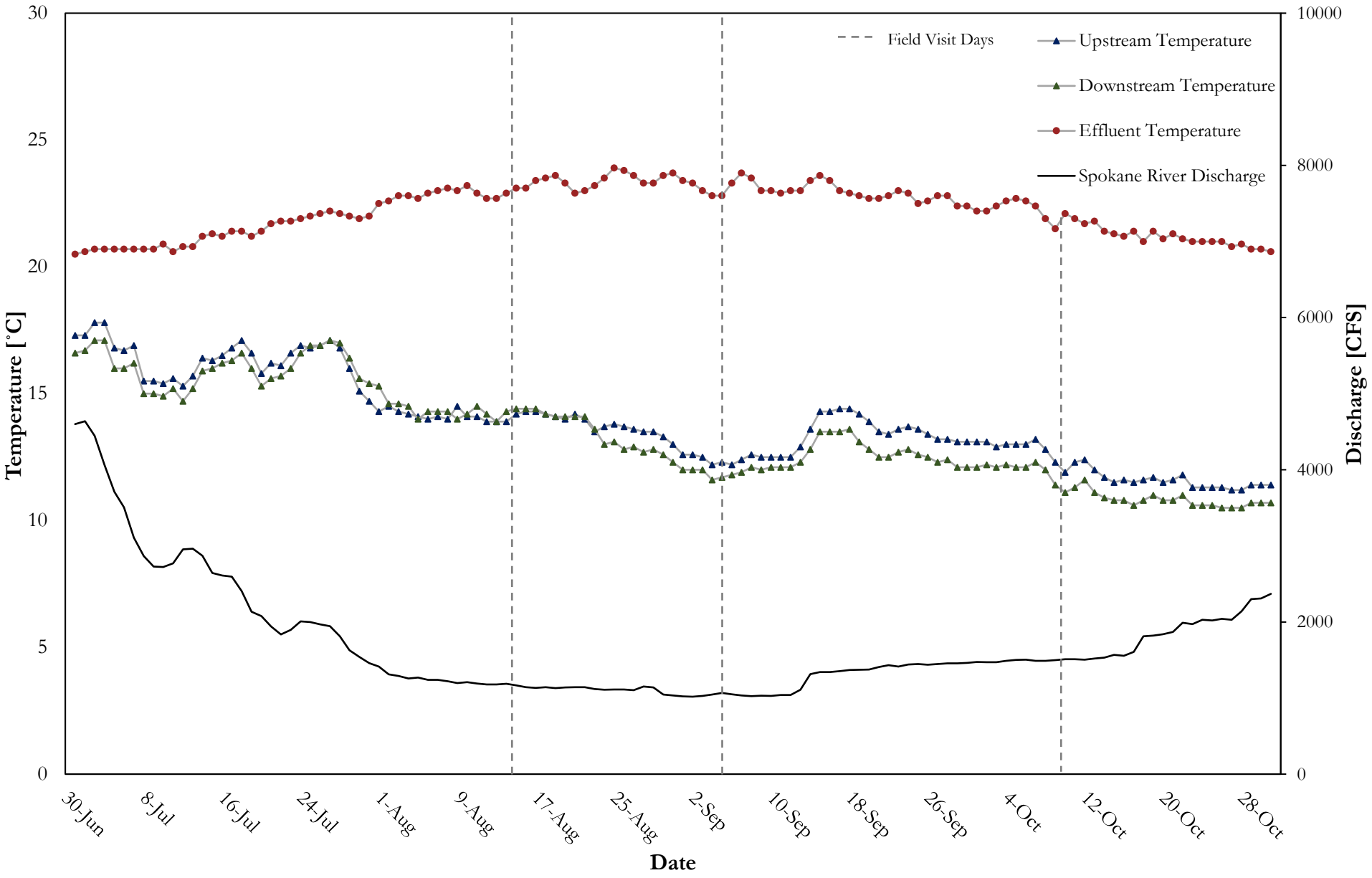
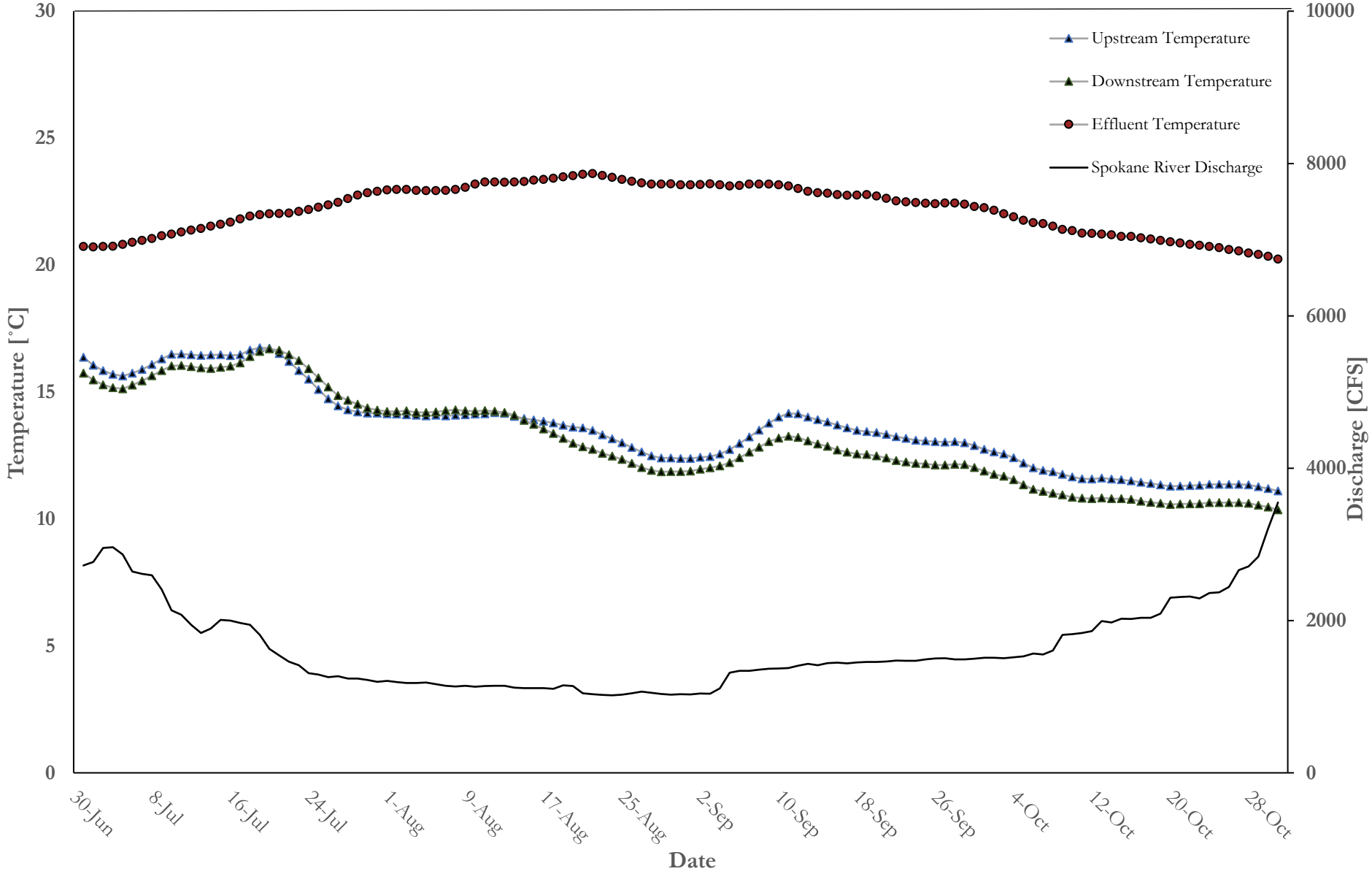


Figure 6. 7-day Average Of Maximum Daily Temperature 2018



Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Ben Brattebo/Amy Sumner/Nicki Feiten

Interval Frequency: 00:30

Data Logger ID #:

Primary: 112089189

Backup: 112024762

111056190 (Replacement 8/14/18)

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/22/2018	9:18	Logger deployed	16.1	5.4	Cable deployed full length. Need new block for downstream site; cable anchored to tree.
8/14/2018	11:20	Logger recovered	13.5	1.9	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger—14.2 °C, temp probe 13.8 °C. The backup logger was presumably stolen and replaced the next day.
8/14/2018	11:44	Logger deployed	13.5	5.1	Backup logger cable deployed full length.
8/15/2018	10:13	Logger deployed	-	-	New backup logger was deployed at full length.
9/5/2018	13:18	Logger recovered	12.5	5.4	Logger recovered and checked with NIST temp probe. Data logger 13.7 °C, temp probe 13.6 °C.
9/5/2018	13:34	Logger deployed	12.7	3.6	Cable Deployed to full length
10/9/2018	15:10	Logger recovered	11.6	4.2	Recovered and downloaded data, Checked data logger at shower with NIST certified temp probe. Data logger: 12.0 °C , temp probe: 11.4 °C. Communication error between primary logger and level loader, no data collected from primary logger, all data downloaded from backup logger.
10/9/2018	15:22	Logger deployed	11.6	2.9	Cable deployed to full length
11/8/2018	13:00	Logger recovered for season	9.5	5.9	Logger and cable removed from river. Cement blocks stored for season.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Ben Brattebo/Amy Sumner/Nicki Feiten

Interval Frequency: 00:30

Data Logger ID #:

Primary:112024052

Backup: 112009638

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Logger Depth (ft)	Comments
6/22/2018	9:37	Logger deployed	NA	3.6	Cable deployed full length.
8/14/2018	11:55	Logger recovered	13.6	0.6	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—14.2 °C, temp probe 14.3 °C.
8/14/2018	12:05	Logger deployed	12.9	3.2	Cable deployed full length.
9/5/2018	13:48	Logger recovered	12.1	3.2	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger- 13.7°C, temp probe 13.7°C.
9/5/2018	13:59	Logger deployed	12.1	2.8	Cable deployed to full length.
10/9/2018	15:32	Logger recovered	12.5	3.6	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger: 12.5, temp probe 11.6. Backup logger was likely stolen and was not replaced
10/9/2018	15:35	Logger deployed	10.8	2.6	The backup logger cable deployed to full length
11/8/2018	13:15	Logger Recovered for Season	8.8	5.1	Logger and cable removed from river. Cement Blocks stored on bank for season

Spokane County
Environmental Services
Kevin R. Cooke, P.E., Director

December 17, 2019

Ms. Diana Washington, P.E.
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe St
Spokane WA 99205

Submitted via Ecology Water Quality Permitting Portal

Subject: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2019 Data Report

Dear Diana:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2019 and October 31, 2019.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7521 if you have any questions or concerns.

Sincerely,

Ben Brattebo, P.E.
Water Reclamation Engineer

Attachments

1026 West Broadway Avenue, 4th Floor • Spokane, WA 99260-0430
Phone: (509) 477-3604 • Fax: (509) 477-4715 • TDD: (509) 477-7133

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2019 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Environmental Services
1004 North Freya Street
Spokane, WA 99202

December 17, 2019

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Tables

Appendix A

Attached Figures

1 INTRODUCTION

This report presents the results of the 2019 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, Jacobs, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9. A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature monitoring element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9.A, as follows:

Section S9.A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the SCRWRF outfall between the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: https://fortress.wa.gov/ecy/publications/documents/0303052.pdf.
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific

equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.

6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time period for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP for the 2019 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the

SVRP aquifer to the Spokane River (United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2019 study were the same as the previous temperature studies (2013 through 2018).

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on 7/2/2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on 7/2/2013.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one main and one backup at both the upstream and downstream locations. The data loggers were deployed on June 25, 2019 at approximately 9:30 am. The data loggers were set to record the data logger depth and temperature at 30-minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20-ft. steel cable. The cable was attached to a 40-lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (Figure 4).

Field visits to each location were made monthly to download data if possible, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October, the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible.

When possible, all data was downloaded periodically from each of the four data loggers, main and backup for each site. The following events prevented a consistent download of the data from each of the four data loggers, throughout the sampling season.

- July 23, 2019: The upstream backup logger was unable to be downloaded in the field, and was deemed faulty when loaded in the office
- August 26, 2019: The upstream backup logger and both the downstream main and backup loggers were stolen
- August 27, 2019: Two replacement loggers were deployed, one upstream and one downstream
- September 24, 2019: Four new Hobo data loggers were calibrated and deployed, between 2:30-3 pm
- September 26, 2019: Download of all four data loggers to ensure data collection
- November 04, 2019: Three data loggers were retrieved from the river and stored for season, backup logger at downstream site was likely stolen

Two data loggers are routinely deployed at each location to increase the probability of collecting one complete data set per sampling year, but vandalism and/or stealing of the loggers can prevent collection of a complete data set. The precaution taken to deploy two

loggers did not result in at least one working data logger, at each site, throughout the study period as intended. Stolen data loggers at the downstream location resulted in missing data. There was a gap in data collection in the 2019 season between July 23rd and September 26th in the downstream location. Upon the August 26th field visit, both downstream loggers were noticed stolen, a new replacement logger was deployed on August 27th. On August 26thOne upstream logger was stolen and the other was unable to be downloaded in the field. Upon successful download in the office the logger was redeployed in the upstream location on August 27th.

In September, we decided to switch the temperature monitoring loggers to be Hobo U22-001. This change was made to reduce the cost of replacing stolen loggers. These replacement loggers are accurate to 0.2˚C, meeting the requirement of the Department of Ecology requirements (*Continuous Temperature Sampling Protocols).*

As specified in the QAPP, Jacobs measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was provided to the County for the study period at 30-minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 2 and Figures 5 & 6. The monthly maximum of the seven-day running average is presented below in Table 1.

Table 1- Monthly Maximum of 7 Day Running Average of Daily Max Temp in ˚C

Month	Upstream	Downstream	Effluent
July	17.9	17.1	22.6
August	14.9	*	23.6
September	13.8	*	23.5
October	12.5	13.0	21.6

Table 1 Summary of monthly maximum 7-day average temperature in the Spokane River Spokane WA
***Data not available because data loggers were stolen.**

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring river temperature above and below the location of the discharge as required by the NPDES permit. Average monthly maximum data recorded in July showed a decrease in temperature (17.9-17.1 ℃) between the

upstream and downstream sites on average (Table 1). Due to continued theft of loggers, there is a gap in data at the downstream site from July 23rd to September 26th.

5 CONCLUSIONS

As a result of the repeated theft of downstream data loggers, the change in temperature between the upstream and downstream site locations was unable to be determined. Measurements taken in July and October indicate the water temperatures at these locations were similar to previous years. Effluent temperatures recorded throughout the study period also reflect similar temperatures as recorded in previous years.

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

7 REFERENCES

Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends Section, Publication 0303052, 1–43 (Accessed December 2019) Spokane, WA. URL https://fortress.wa.gov/ecy/publications/publications/0303052.pdf

U.S. Geological Survey 2019. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation), accessed December 2019, at URL https://waterdata.usgs.gov/nwis/uv?site_no=12422500.

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URL https://ecology.wa.gov/DOE/files/fc/fc0c7af0-a29c-4b14-a0c9-a7f9a32d164a.pdf

Appendix A

Table 2. Daily Temperature

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
7/1/2019	17.1	16.5	21.2			
7/2/2019	17.1	16.4	21.2			
7/3/2019	17.1	16.4	21.1			
7/4/2019	16.8	16.1	21.3			
7/5/2019	17	16.3	21.2			
7/6/2019	16.6	16	21.3			
7/7/2019	16.5	15.8	21.1	16.9	16.2	21.2
7/8/2019	17.1	16.6	21.4	16.9	16.2	21.2
7/9/2019	17.8	17.1	21.8	17.0	16.3	21.3
7/10/2019	17.9	17	21.5	17.1	16.4	21.4
7/11/2019	17.5	16.7	21.7	17.2	16.5	21.4
7/12/2019	17	16.2	22	17.2	16.5	21.5
7/13/2019	16.6	15.7	22	17.2	16.4	21.6
7/14/2019	15.6	14.7	21.7	17.1	16.3	21.7
7/15/2019	15.1	14.1	21.7	16.8	15.9	21.8
7/16/2019	14.2	13.3	21.6	16.3	15.4	21.7
7/17/2019	13.8	12.9	21.7	15.7	14.8	21.8
7/18/2019	14.2	13.3	21.7	15.2	14.3	21.8
7/19/2019	14.7	13.8	21.7	14.9	14.0	21.7
7/20/2019	14.7	14.3	21.5	14.6	13.8	21.7
7/21/2019	14.6	14.3	21.9	14.5	13.7	21.7
7/22/2019	14.2	14.1	22.2	14.3	13.7	21.8
7/23/2019	14	13.3	22.5	14.3	13.7	21.9
7/24/2019	14	Logger Stolen	21.9	14.3	13.9	21.9
7/25/2019	14.2	Logger Stolen	22.1	14.3	14.0	22.0
7/26/2019	14.2	Logger Stolen	22.6	14.3	14.0	22.1
7/27/2019	13.8	Logger Stolen	22.4	14.1	13.9	22.2
7/28/2019	14.1	Logger Stolen	22.1	14.1	13.7	22.3
7/29/2019	14.1	Logger Stolen	22.3	14.1	13.3	22.3
7/30/2019	13.8	Logger Stolen	22.6	14.0	Logger Stolen	22.3
7/31/2019	14.1	Logger Stolen	22.5	14.0	Logger Stolen	22.4
8/1/2019	14.1	Logger Stolen	22.5	14.0	Logger Stolen	22.4
8/2/2019	14.2	Logger Stolen	22.6	14.0	Logger Stolen	22.4
8/3/2019	14.4	Logger Stolen	22.4	14.1	Logger Stolen	22.4
8/4/2019	14.2	Logger Stolen	22.4	14.1	Logger Stolen	22.5
8/5/2019	14.2	Logger Stolen	22.8	14.1	Logger Stolen	22.5
8/6/2019	14.5	Logger Stolen	23.1	14.2	Logger Stolen	22.6
8/7/2019	14.1	Logger Stolen	23	14.2	Logger Stolen	22.7

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
8/8/2019	14.3	Logger Stolen	23.2	14.3	Logger Stolen	22.8
8/9/2019	14.1	Logger Stolen	22.6	14.3	Logger Stolen	22.8
8/10/2019	14.1	Logger Stolen	23.1	14.2	Logger Stolen	22.9
8/11/2019	13.6	Logger Stolen	22.5	14.1	Logger Stolen	22.9
8/12/2019	13.9	Logger Stolen	22.9	14.1	Logger Stolen	22.9
8/13/2019	14.5	Logger Stolen	23.1	14.1	Logger Stolen	22.9
8/14/2019	14.9	Logger Stolen	23	14.2	Logger Stolen	22.9
8/15/2019	14.9	Logger Stolen	23.2	14.3	Logger Stolen	22.9
8/16/2019	14.6	Logger Stolen	22.9	14.4	Logger Stolen	23.0
8/17/2019	14.4	Logger Stolen	22.6	14.4	Logger Stolen	22.9
8/18/2019	14.2	Logger Stolen	22.9	14.5	Logger Stolen	22.9
8/19/2019	14	Logger Stolen	22.9	14.5	Logger Stolen	22.9
8/20/2019	14.2	Logger Stolen	23.3	14.5	Logger Stolen	23.0
8/21/2019	14	Logger Stolen	23.3	14.3	Logger Stolen	23.0
8/22/2019	14	Logger Stolen	23.2	14.2	Logger Stolen	23.0
8/23/2019	13.7	Logger Stolen	23.2	14.1	Logger Stolen	23.1
8/24/2019	13.6	Logger Stolen	23.1	14.0	Logger Stolen	23.1
8/25/2019	13.7	Logger Stolen	23	13.9	Logger Stolen	23.1
8/26/2019	13.5	Logger Stolen	23.1	13.8	Logger Stolen	23.2
8/27/2019	12.3	Logger Stolen	23.3	13.5	Logger Stolen	23.2
8/28/2019	12.7	Logger Stolen	23.5	13.4	Logger Stolen	23.2
8/29/2019	12.7	Logger Stolen	23.1	13.2	Logger Stolen	23.2
8/30/2019	12.5	Logger Stolen	23.2	13.0	Logger Stolen	23.2
8/31/2019	12.6	Logger Stolen	23.6	12.9	Logger Stolen	23.3
9/1/2019	12.3	Logger Stolen	23.5	12.7	Logger Stolen	23.3
9/2/2019	12.3	Logger Stolen	23.4	12.5	Logger Stolen	23.4
9/3/2019	12.4	Logger Stolen	23.4	12.5	Logger Stolen	23.4
9/4/2019	12.8	Logger Stolen	23.5	12.5	Logger Stolen	23.4
9/5/2019	13.4	Logger Stolen	23.3	12.6	Logger Stolen	23.4
9/6/2019	13.3	Logger Stolen	23	12.7	Logger Stolen	23.4
9/7/2019	13.3	Logger Stolen	22.9	12.8	Logger Stolen	23.3
9/8/2019	13	Logger Stolen	22.7	12.9	Logger Stolen	23.2
9/9/2019	13	Logger Stolen	22.7	13.0	Logger Stolen	23.1
9/10/2019	13.4	Logger Stolen	22.8	13.2	Logger Stolen	23.0
9/11/2019	13.4	Logger Stolen	23.1	13.3	Logger Stolen	22.9
9/12/2019	13.8	Logger Stolen	23	13.3	Logger Stolen	22.9
9/13/2019	13.5	Logger Stolen	22.9	13.3	Logger Stolen	22.9
9/14/2019	13.3	Logger Stolen	22.6	13.3	Logger Stolen	22.8
9/15/2019	13.3	Logger Stolen	22.8	13.4	Logger Stolen	22.8

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
9/16/2019	13.4	Logger Stolen	22.7	13.4	Logger Stolen	22.8
9/17/2019	13.2	Logger Stolen	22.6	13.4	Logger Stolen	22.8
9/18/2019	13.3	Logger Stolen	22.4	13.4	Logger Stolen	22.7
9/19/2019	13	Logger Stolen	22.4	13.3	Logger Stolen	22.6
9/20/2019	12.9	Logger Stolen	22.4	13.2	Logger Stolen	22.6
9/21/2019	13	Logger Stolen	22.5	13.2	Logger Stolen	22.5
9/22/2019	12.8	Logger Stolen	22.5	13.1	Logger Stolen	22.5
9/23/2019	12.8	Logger Stolen	22.4	13.0	Logger Stolen	22.5
9/24/2019	13.7	Logger Stolen	22.7	13.1	Logger Stolen	22.5
9/25/2019	13.8	13.5	22.2	13.1	Logger Stolen	22.4
9/26/2019	13.6	14.2	22.3	13.2	Logger Stolen	22.4
9/27/2019	13.5	14.1	22.4	13.3	Logger Stolen	22.4
9/28/2019	13.4	13.2	21.4	13.4	Logger Stolen	22.3
9/29/2019	13.0	12.9	21.3	13.4	Logger Stolen	22.1
9/30/2019	12.0	12.2	21.5	13.3	13.4	22.0
10/1/2019	12.4	12.8	21.6	13.1	13.3	21.8
10/2/2019	12.4	13.0	21.4	12.9	13.2	21.7
10/3/2019	12.4	12.5	21.4	12.7	13.0	21.6
10/4/2019	12.0	12.3	21.3	12.5	12.7	21.4
10/5/2019	12.2	12.8	21.4	12.4	12.6	21.4
10/6/2019	12.3	12.8	21.2	12.3	12.6	21.4
10/7/2019	12.4	12.5	21.5	12.3	12.7	21.4
10/8/2019	12.5	12.5	21.3	12.3	12.6	21.4
10/9/2019	12.0	12.0	20.5	12.3	12.5	21.2
10/10/2019	11.3	11.9	20.7	12.1	12.4	21.1
10/11/2019	11.3	11.7	20.4	12.0	12.3	21.0
10/12/2019	11.1	11.4	20.9	11.9	12.1	20.9
10/13/2019	11.1	11.2	20.7	11.7	11.9	20.9
10/14/2019	11.3	11.7	20.9	11.5	11.8	20.8
10/15/2019	11.5	11.7	20.8	11.4	11.7	20.7
10/16/2019	11.5	11.8	20.9	11.3	11.6	20.8
10/17/2019	11.8	12.1	20.8	11.4	11.7	20.8
10/18/2019	11.6	11.8	20.5	11.4	11.7	20.8
10/19/2019	11.2	11.1	20.2	11.4	11.6	20.7
10/20/2019	10.9	11.0	20.2	11.4	11.6	20.6
10/21/2019	10.6	10.7	20.3	11.3	11.4	20.5
10/22/2019	11.1	11.2	20.3	11.2	11.4	20.5
10/23/2019	11.1	11.2	20.3	11.2	11.3	20.4
10/24/2019	10.7	10.8	20	11.0	11.1	20.3

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
10/25/2019	10.7	10.9	20.2	10.9	11.0	20.2
10/26/2019	10.6	10.7	19.8	10.8	10.9	20.2
10/27/2019	9.9	10.0	19.7	10.7	10.8	20.1
10/28/2019	9.7	9.9	19.6	10.5	10.7	20.0
10/29/2019	9.0	8.9	19.3	10.2	10.3	19.8
10/30/2019	8.5	8.6	18.8	9.9	10.0	19.6
10/31/2019	8.4	8.6	18.9	9.5	9.7	19.5


Figure 1: Data Collection Locations
2019 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility Discharge
Spokane River
Downstream Data Logger Deployment Location
Upstream Data Logger Deployment Location I
Spokane County Sewer System North Valley Interceptor Pump Station
Spokane Community College

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Ben Brattebo/Amy Sumner/Nicki Feiten

Interval Frequency: 00:30

Data Logger ID #:

Main: 112089189,20686981(Hobo)

Backup: 2024747, 20686982(Hobo)

Location: 47^{0}40'34.95"/-117^{0}20'39.15"

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Comments
6/25/2019	9:10	Loggers deployed	16.5	Cable deployed full length.
7/23/2019	9:15	Loggers recovered	13.6	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger—13.6 °C, temp probe 13.7 °C.
7/23/2019	9:20	Loggers deployed	13.6	Cable deployed full length.
8/26/2019	9:11	Logger recovered	NA	One logger discovered missing, likely stolen. One Logger unable to be field downloaded. Taken to office and downloaded, redeployed the next day.
8/27/2019	9:32	Logger deployed	11.7	Logger redeployed, (112089189). Cable Deployed to full length. Decision to change brand of
9/24/2019	14:30	Loggers recovered	12.5	Recovered logger and downloaded data.
9/24/2019	14:32	New loggers deployed	12.5	Two New Hobo Logger Deployed. (20686981,20686982). Cables deployed to full length.
9/26/2019	10:18	Loggers recovered	13.0	Loggers downloaded. Checked data loggers at shore with NIST certified temp probe. 13.0 °C, temp probe 13.0 °C.
9/26/2019	10:25	Loggers deployed	13.0	Cable deployed to full length.
11/04/2019	11:15	Loggers recovered	NA	Loggers recovered for season.

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Ben Brattebo/Amy Sumner/Nicki Feiten

Interval Frequency: 00:30

Data Logger ID #:

Main: 112024052,112104212,20686984 (Hobo)

Backup: 1056189, 20686983 (Hobo)

Location: $47^0$40'34.81"/-$117^0$20'55.69"

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Comments
6/25/2019	9:23	Loggers deployed	NA	Cable deployed full length.
7/23/2019	9:46	Loggers recovered	13.3	Recovered and downloaded data. Calibrated data logger at shore with NIST certified temp probe. Data logger—12.7 °C, temp probe 13.7 °C. Since logger was off by 1 degree, the back up logger was used for data collection. The back up logger calibration was: Data logger—13.3°C, temp probe 13.9 °C
7/23/2019	9:49	Loggers deployed	13.3	Cable deployed full length.
8/26/2019	10:30	Loggers discovered missing	NA	Upon recovery of loggers both the downstream main and back up loggers were discovered missing including the cables.
8/27/2019	9:45	New Logger deployed	NA	New data logger deployed (112104212). Cable deployed to full length. Decision to change brand of loggers to reduce cost of replacements
9/24/2019	14:40	Logger discovered missing	NA	Logger likely stolen
9/24/2019	14:58	New Loggers deployed	NA	New Hobo loggers deployed. (20686984,20686983). Cables deployed to full length.
9/26/2019	10:46	Loggers recovered	13.0	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger: 13.0 °C, temp probe 13.0 °C.
9/26/2019	10:55	Loggers deployed	13.0	Cable deployed to full length
11/04/2019	11:17	Logger recovered for season	NA	Back up logger was likely stolen. Main logger recovered for season.

Figure 2: Downstream Location Aerial Photo

2019 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2019 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

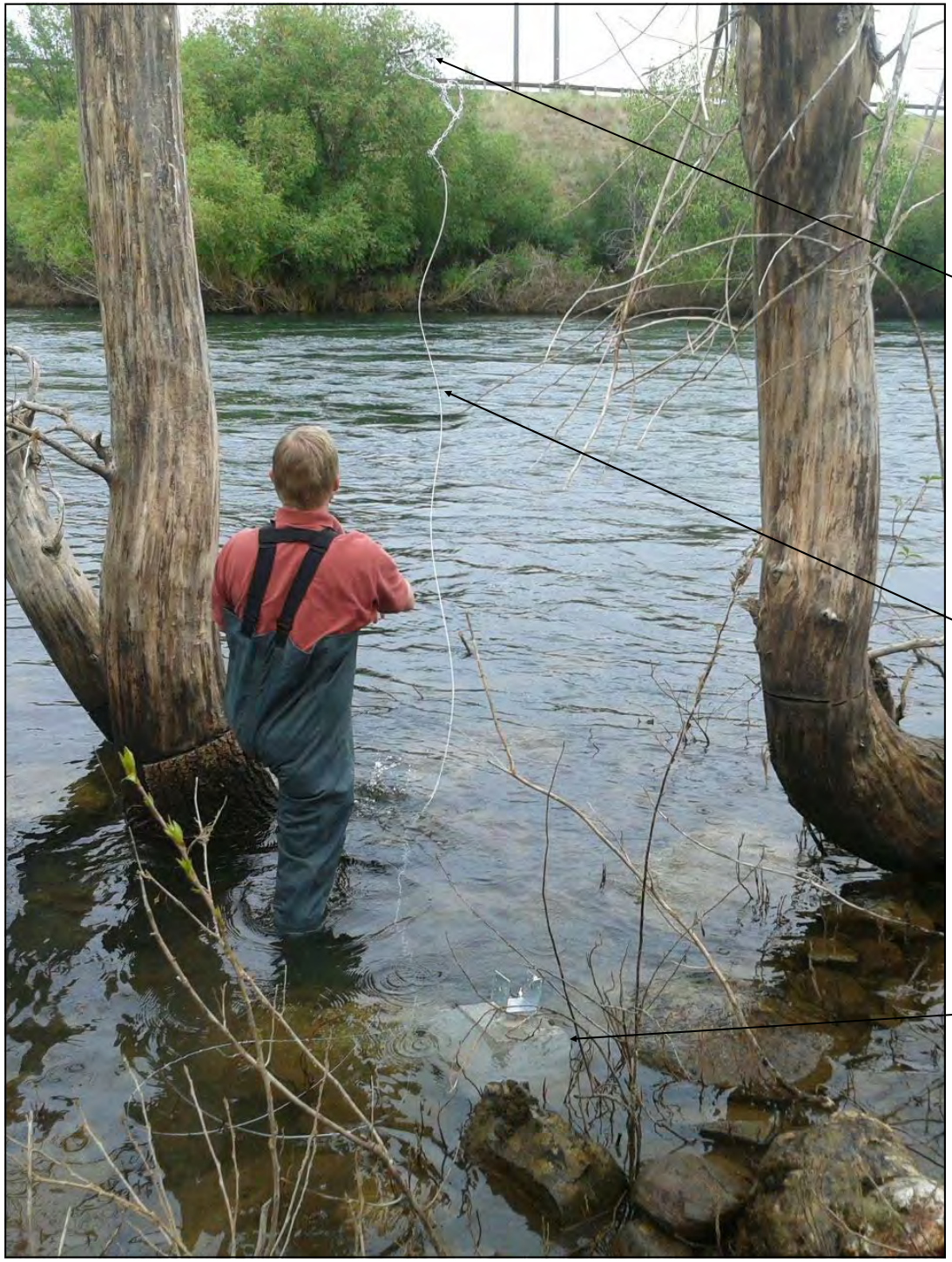


Figure 4: Typical Data Logger Deployment

2019 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5. Daily Maximum Temperature 2019

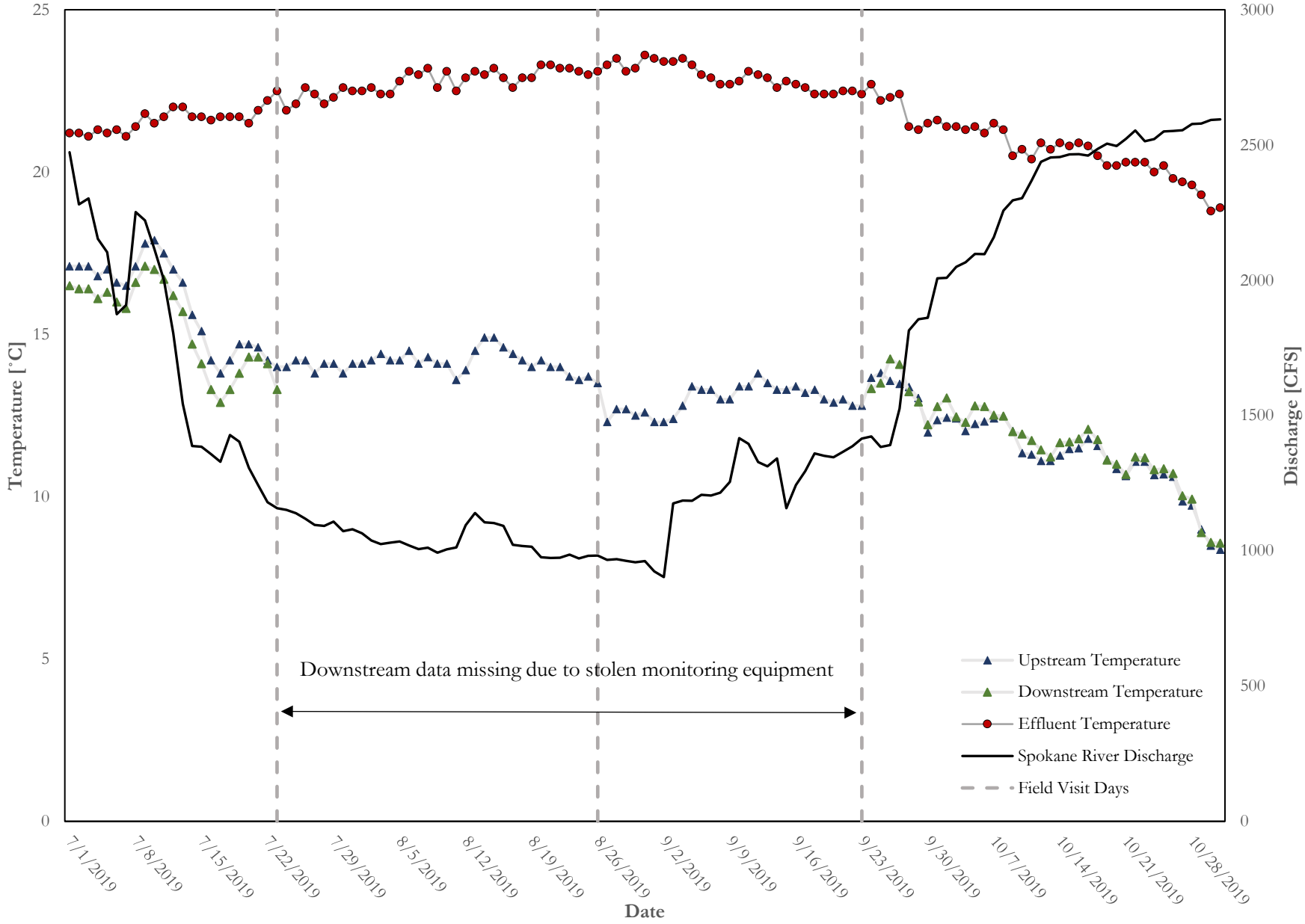
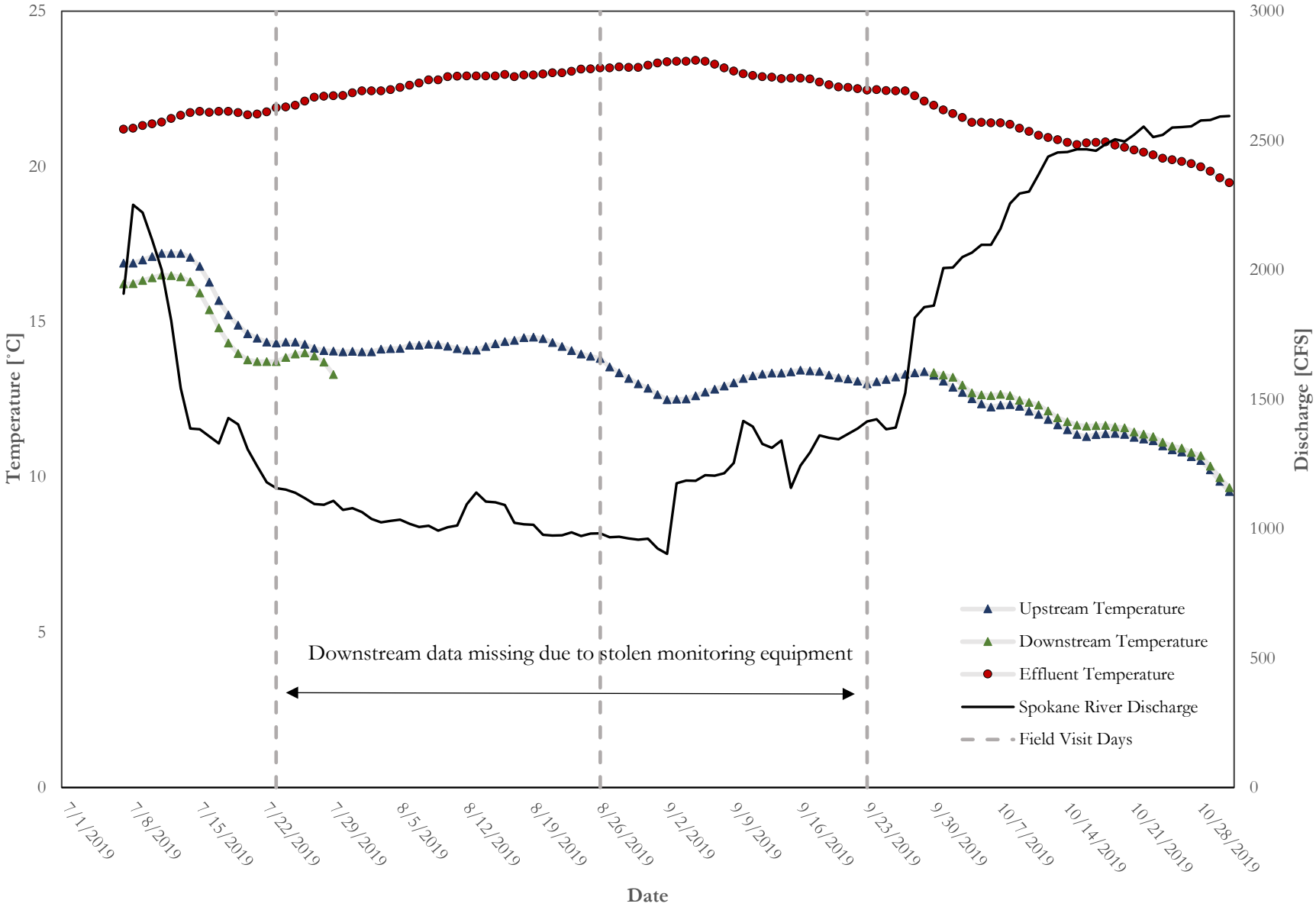


Figure 6. 7-day Average of Maximum Daily Temperature 2019



Spokane County
Environmental Services
Kevin R. Cooke, P.E., Director

December 28, 2020

Ms. Diana Washington, P.E.
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe St
Spokane WA 99205

Submitted via Ecology Water Quality Permitting Portal

Subject: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Temperature; 2020 Data Report

Dear Diana:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between July 1, 2020 and October 31, 2020.

As required by the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all water temperature information collected and a discussion of the data. Please contact me at 509-477-7521 if you have any questions or concerns.

Sincerely,

Ben Brattebo, P.E.
Water Reclamation Engineer

Attachments

1026 West Broadway Avenue, 4th Floor • Spokane, WA 99260-0430
Phone: (509) 477-3604 • Fax: (509) 477-4715 • TDD: (509) 477-7133

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2020 Data Report

Receiving Water Study – Temperature

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Environmental Services
1004 North Freya Street
Spokane, WA 99202

December 22, 2020

Table of Contents

Tables

Appendix A

Attached Figures

1 INTRODUCTION

This report presents the results of the 2020 Receiving Water Temperature Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, temperature data, data analysis, conclusions, and recommendations.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, Jacobs, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9. A-Temperature Monitoring, S9. B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses the temperature monitoring element. Relevant permit requirements from the NPDES Permit No. WA-0093317 are found in Section S9. A, as follows:

Section S9. A - Temperature Monitoring
For temperature monitoring the Permittee must:

1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf). A model Quality Assurance Plan specific for temperature is available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.
3. Measure temperature in the ambient water upstream and downstream of the SCRWRF outfall between the months of June through October of each year.
4. Use micro-recording temperature devices known as thermistors to measure temperature. Ecology's Quality Assurance Project Plan Development Tool *(Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends)* contains protocols for continuous temperature sampling. This document is available online at: https://fortress.wa.gov/ecy/publications/documents/0303052.pdf.
5. Calibrate the devices as specified in this document unless using recording devices certified by the manufacturer. Ecology does not require manufacture-specific

equipment as given in this document; however, if the Permittee wishes to use measuring devices from another company, it must demonstrate the accuracy is equivalent.

6. Set the recording devices to record at one-half-hour intervals.
7. Report temperature monitoring data as: daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The model Quality Assurance Plan shows an example of these calculations.
8. Use the temperature device manufacturer's software to generate (export) an Excel text file of the temperature data for each June-October period. Send this file and placement logs to Ecology by December 31 of the monitoring year. The placement logs should include the following information for both thermistor deployment and retrieval: date, time, temperature device manufacturer ID, location, depth, whether it measured air or water temperature, and any other details that may explain data anomalies.
9. Submit the temperature data for the season (June through October) at end of the year with the placement logs.

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. No comments were received from Ecology. In January 2013 revisions to the QAPP, based on recommendations presented in the 2012 Data Report-Temperature (2012 Report), were submitted to Ecology. Two changes were made to the temperature study in 2013: 1) data collection locations were moved from the south side of the river to the north side, and 2) the time for data collection was changed from June 1 to October 31, to July 1 to October 31. The changes were approved by Ecology in the revised QAPP in February 2013. No changes were made to the QAPP for the 2020 study.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane Washington and discharges to the Spokane River in a location directly north of the facility. The discharge location is approximately 4,500 feet downstream of Upriver Dam which is owned and operated by the City of Spokane. The dam is operated as a run of the river dam, but does have a small operating reservoir. The Upriver Dam reservoir increases the residence time of the water which affects water temperature depending on seasonal ambient air temperature.

The SCRWRF discharge is located in a reach of the Spokane River that is also affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane. On an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the

SVRP aquifer to the Spokane River (United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data Collection Locations

Data collection locations are shown in Figure 1. The locations used in the 2020 study were the same as the previous temperature studies (2013 through 2019).

Downstream Location:
The downstream data collection location is approximately 500 ft. downstream of the facility discharge. The width of the river at this location was approximately 160 ft. during the study. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape. The thalweg appears to be in the middle of the channel. The shore is primarily boulders. Figure 2 shows an aerial photo of the downstream site taken on July 2, 2013.

Upstream location:
The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. The width of the river at this location was approximately 140 ft. during the study. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. Access to the downstream location is down a relatively steep slope, but is not impeded by trees or significant under brush. The shore at this site is comprised of large boulders. Figure 3 shows an aerial photo of the upstream site taken on July 2, 2013.

3 FIELD ACTIVITIES

Four data loggers were deployed for the study; one main and one backup at both the upstream and downstream locations. The data loggers were deployed on June 18, 2020 at approximately 8:30 am. The data loggers were set to record the river temperature at 30-minute intervals. Field activities were conducted in accordance with the QAPP.

Data loggers were secured to a 20-ft. steel cable. The cable was attached to a 40-lb. concrete block with a metal post. The cable/thermistor combination was then manually deployed into the river (Figure 4).

Field visits to each location were made monthly to download data if possible, check the location of the anchor block, and make sure the data logger had not been vandalized or stolen. Information pertaining to each field visit is presented on the *Continuous Temperature Survey Forms* in Appendix A.

The anchor blocks were positioned near-shore in the water such that the data loggers could be deployed to the maximum extent into the river while the anchor block was still at an accessible depth. Since the river level changes from June to October, the anchor block positions were moved as necessary so that the data loggers were deployed the maximum extent possible.

When possible, all data was downloaded periodically from each of the four data loggers, main and backup for each site. The following events prevented a consistent download of the data from each of the four data loggers, throughout the sampling season.

- June 24, 2020: One downstream logger was found missing
- July 14, 2020: A new downstream backup logger was launched to replace one that was found missing.
- September 22, 2020: All four loggers were missing from the study site
- October 1, 2020: Four new replacement loggers were deployed
- October 15, 2020: One upstream logger was missing and the rest were downloaded. The missing backup logger was not replaced this season
- November 3, 2020: Three data loggers were retrieved from the river, downloaded and stored for season.

Two data loggers are routinely deployed at each location to increase the probability of collecting a complete data set per sampling year. Despite this precaution, vandalized or stolen data loggers can result in missing data. A data gap occurred between August 13, 2020 and October 1, 2020 due all four loggers being stolen and then replaced as noted above.

Upon the September 22, 2020 field visit, all four loggers were noticed stolen, new replacement loggers were deployed on October 1, 2020.

As specified in the QAPP, Jacobs measures temperature of the effluent just prior to the chlorine contact chamber at the SCRWRF. The data is collected continuously, but was provided to the County for the study period at 30-minute intervals. Effluent temperature information is included in Tables 1 and 2 and Figures 5 and 6.

4 STUDY RESULTS

The NPDES permit specifies that temperature data be reported as daily maximum, seven-day running average of the daily maximums, and the monthly maximum of the seven-day running average. The daily maximums and seven-day running average for each data logger and effluent temperature are presented in Table 2 and Figures 5 & 6. The monthly maximum of the seven-day running average is presented below in Table 1.

Table 1- Monthly Maximum of 7 Day Running Average of Daily Max Temp in ˚C

Month	Upstream	Downstream	Effluent
July	17.7	17.6	22.5
August	16.4*	16.4*	23.2
September	**	**	23.1
October	14.8	14.8	22.6

Table 1 Summary of monthly maximum 7-day average temperature in the Spokane River Spokane WA
*** Data for partial month of August before loggers were stolen (August 1, 2020- August 13, 2020)**
****Data not available because data loggers were stolen.**

5 CONCLUSIONS

As a result of the repeated theft of downstream data loggers, the change in temperature between the upstream and downstream site locations was unable to be consistently determined. Measurements taken in July and October indicate the water temperatures at these locations were similar to previous years. Effluent temperatures recorded throughout the study period also reflect similar temperatures as recorded in previous years.

This study was conducted to document the impact to river temperature, if any, from the SCRWRF discharge. This was done by measuring the river temperature above and below the location of the discharge as required by the NPDES permit. River and effluent temperatures measured during the 2020 study period are within the expected range recorded in previous years. Due to the theft of loggers, there is a data gap in from August 13, 2020 to October 1, 2020. Therefore, the change in river temperature was unable to be

consistently determined. However, the monthly maximums of the 7-day running average of daily maximums (Table 1) for July and October show a downstream decrease (17.7-17.6 ˚C) and stable temperatures (14.8-14.8 ˚C), respectively. Partial data collected in August showed the monthly maximums of the 7-day running average of daily maximums (Table 1) had no change in temperature downstream from August 1, 2020 to August 13, 2020 (16.4˚C-16.4˚C). From the data, the effluent temperatures do not appear to affect the river temperature.

6 RECOMMENDATIONS

We conclude from the multiple years of the temperature receiving water study that the groundwater inflow in the study river reach is the dominant factor in summertime river temperatures and that inclusion of a temperature receiving water study in subsequent permits is not warranted.

7 REFERENCES

Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends Section, Publication 0303052, 1–43 (Accessed December 2019) Spokane, WA. URL https://fortress.wa.gov/ecy/publications/publications/0303052.pdf

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URL https://ecology.wa.gov/DOE/files/fc/fc0c7af0-a29c-4b14-a0c9-a7f9a32d164a.pdf

Appendix A

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
7/1/2020	16.5	16.5	20.3	16.8	17.2	20.6
7/2/2020	15.4	15.4	20.7	16.5	16.9	20.5
7/3/2020	16.0	16.0	20.8	16.3	16.6	20.6
7/4/2020	16.4	16.5	20.7	16.5	16.8	20.6
7/5/2020	16.6	16.7	20.6	16.6	16.9	20.6
7/6/2020	17.3	17.3	20.9	16.9	17.0	20.7
7/7/2020	17.5	17.5	20.9	17.1	17.0	20.7
7/8/2020	16.9	16.9	20.9	17.3	17.2	20.8
7/9/2020	17.4	17.4	20.6	17.5	17.3	20.8
7/10/2020	17.7	17.7	20.7	17.4	17.3	20.8
7/11/2020	17.6	17.6	21	17.3	17.3	20.8
7/12/2020	17.7	17.7	21	17.3	17.3	20.9
7/13/2020	17.1	17.0	20.6	17.2	17.2	20.8
7/14/2020	16.9	16.8	21.1	17.1	17.2	20.8
7/15/2020	16.8	16.7	21.1	17.0	17.2	20.9
7/16/2020	16.7	16.6	21	17.0	17.2	20.9
7/17/2020	16.9	16.8	21.2	17.2	17.3	21
7/18/2020	17.1	17.1	21.6	17.4	17.4	21.1
7/19/2020	17.7	17.6	21.7	17.5	17.5	21.2
7/20/2020	18.1	18.0	21.9	17.7	17.5	21.4
7/21/2020	18.2	18.1	22.2	17.7	17.6	21.5
7/22/2020	18.0	17.9	22.1	17.7	17.5	21.7
7/23/2020	17.7	17.7	22	17.6	17.4	21.8
7/24/2020	17.2	17.0	21.9	17.4	17.3	21.9
7/25/2020	16.9	16.8	21.9	17.1	17.1	21.9
7/26/2020	17.0	16.9	22	16.8	16.9	22
7/27/2020	16.8	16.7	22.5	16.6	16.6	22.1
7/28/2020	16.1	16.1	22.7	16.4	16.4	22.2
7/29/2020	15.7	15.9	22.5	16.2	16.2	22.2
7/30/2020	16.2	16.3	22.7	16.0	16.1	22.3
7/31/2020	16.0	16.2	22.9	15.8	16.0	22.5
8/1/2020	15.4	15.6	22.4	15.8	15.9	22.5
8/2/2020	15.6	15.9	22.6	15.9	15.9	22.6
8/3/2020	15.8	16.0	22.4	15.9	15.9	22.6
8/4/2020	16.2	16.4	22.4	15.9	15.8	22.6
8/5/2020	16.2	16.5	22.6	15.9	15.8	22.6
8/6/2020	16.3	16.1	22.2	15.8	15.7	22.5
8/7/2020	15.7	16.2	22.2	15.6	15.5	22.4
8/8/2020	15.2	15.2	22.3	15.4	15.3	22.4
8/9/2020	14.9	15.4	22.5	15.1	15.0	22.4
8/10/2020	15.0	15.2	22.6	14.8	14.8	22.4
8/11/2020	14.7	14.9	22.7	14.4	14.5	22.4
8/12/2020	14.2	14.2	22.3	14.1	14.2	22.4
8/13/2020	13.7	13.4	22.4	13.9	13.9	22.4
8/14/2020	Loggers Stolen	Loggers Stolen	22.5	Loggers Stolen	Loggers Stolen	22.5
8/15/2020	Loggers Stolen	Loggers Stolen	22.9	Loggers Stolen	Loggers Stolen	22.6
8/16/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	22.6
8/17/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	22.7
8/18/2020	Loggers Stolen	Loggers Stolen	23.3	Loggers Stolen	Loggers Stolen	22.8
8/19/2020	Loggers Stolen	Loggers Stolen	23.4	Loggers Stolen	Loggers Stolen	22.9
8/20/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
8/21/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23.1
8/22/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	23.2
8/23/2020	Loggers Stolen	Loggers Stolen	22.9	Loggers Stolen	Loggers Stolen	23.2
8/24/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23.2
8/25/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23.1
8/26/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	23.1
8/27/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23.1
8/28/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	23.1
8/29/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	23
8/30/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	23
8/31/2020	Loggers Stolen	Loggers Stolen	22.9	Loggers Stolen	Loggers Stolen	23
9/1/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23
9/2/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	23
9/3/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	23
9/4/2020	Loggers Stolen	Loggers Stolen	23.4	Loggers Stolen	Loggers Stolen	23
9/5/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	23.1
9/6/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	23.1
9/7/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	23.1
9/8/2020	Loggers Stolen	Loggers Stolen	22.5	Loggers Stolen	Loggers Stolen	23
9/9/2020	Loggers Stolen	Loggers Stolen	22.7	Loggers Stolen	Loggers Stolen	23
9/10/2020	Loggers Stolen	Loggers Stolen	22.9	Loggers Stolen	Loggers Stolen	23
9/11/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	22.9
9/12/2020	Loggers Stolen	Loggers Stolen	22.6	Loggers Stolen	Loggers Stolen	22.8
9/13/2020	Loggers Stolen	Loggers Stolen	22.4	Loggers Stolen	Loggers Stolen	22.7
9/14/2020	Loggers Stolen	Loggers Stolen	22.6	Loggers Stolen	Loggers Stolen	22.7
9/15/2020	Loggers Stolen	Loggers Stolen	22.7	Loggers Stolen	Loggers Stolen	22.7
9/16/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	22.8
9/17/2020	Loggers Stolen	Loggers Stolen	23.2	Loggers Stolen	Loggers Stolen	22.8
9/18/2020	Loggers Stolen	Loggers Stolen	23.1	Loggers Stolen	Loggers Stolen	22.8
9/19/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	22.9
9/20/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	22.9
9/21/2020	Loggers Stolen	Loggers Stolen	23	Loggers Stolen	Loggers Stolen	23
9/22/2020	Loggers Stolen	Loggers Stolen	22.9	Loggers Stolen	Loggers Stolen	23
9/23/2020	Loggers Stolen	Loggers Stolen	22.8	Loggers Stolen	Loggers Stolen	23
9/24/2020	Loggers Stolen	Loggers Stolen	22.5	Loggers Stolen	Loggers Stolen	22.9
9/25/2020	Loggers Stolen	Loggers Stolen	22.4	Loggers Stolen	Loggers Stolen	22.8
9/26/2020	Loggers Stolen	Loggers Stolen	22.3	Loggers Stolen	Loggers Stolen	22.7
9/27/2020	Loggers Stolen	Loggers Stolen	22.4	Loggers Stolen	Loggers Stolen	22.6
9/28/2020	Loggers Stolen	Loggers Stolen	22.5	Loggers Stolen	Loggers Stolen	22.5
9/29/2020	Loggers Stolen	Loggers Stolen	22.6	Loggers Stolen	Loggers Stolen	22.5
9/30/2020	Loggers Stolen	Loggers Stolen	22.7	Loggers Stolen	Loggers Stolen	22.5
10/1/2020	Loggers Stolen	Loggers Stolen	22.6	Loggers Stolen	Loggers Stolen	22.5
10/2/2020	13.0	13.3	22.8	13.6	13.7	22.6
10/3/2020	13.2	13.3	22.6	13.4	13.5	22.6
10/4/2020	13.1	13.3	22.4	13.2	13.3	22.6
10/5/2020	13.1	13.3	22.4	13.1	13.2	22.6
10/6/2020	13.1	13.3	22.5	13.1	13.1	22.6
10/7/2020	13.1	13.3	22.6	13.1	13.1	22.6
10/8/2020	13.1	13.4	22.4	12.9	13.0	22.5
10/9/2020	13.2	13.6	22.5	13.2	12.9	22.5
10/10/2020	12.7	12.5	21.9	13.0	12.8	22.4

Date	Daily Maximum Temperature			7-Day Average of Daily Max Temp		
	Upstream	Downstream	Effluent	Upstream	Downstream	Effluent
10/11/2020	12.1	12.3	21.8	12.7	12.7	22.3
10/12/2020	14.9	12.2	21.8	12.5	12.5	22.2
10/13/2020	11.8	11.9	21.6	12.3	12.3	22.1
10/14/2020	11.5	11.5	21.5	12.1	12.1	22
10/15/2020	11.5	12.2	21.5	12.1	12.0	21.8
10/16/2020	11.4	11.3	21.5	11.6	11.8	21.7
10/17/2020	11.5	11.4	21.6	11.6	11.7	21.6
10/18/2020	11.7	11.6	21.2	11.6	11.6	21.5
10/19/2020	11.7	11.7	21.4	11.5	11.4	21.5
10/20/2020	11.8	11.8	21.5	11.4	11.3	21.5
10/21/2020	11.5	11.5	21.3	11.3	11.2	21.4
10/22/2020	11.1	11.0	21.1	11.0	11.0	21.4
10/23/2020	10.7	10.6	20.6	10.8	10.8	21.2
10/24/2020	10.5	10.5	20.2	10.6	10.7	21
10/25/2020	10.1	10.1	20.2	10.4	10.5	20.9
10/26/2020	10.0	10.0	20.3	10.3	10.4	20.7
10/27/2020	10.1	10.1	20.2	10.2	10.3	20.6
10/28/2020	10.2	10.2	20.2	10.2	10.2	20.4
10/29/2020	10.3	10.3	20.4	10.2	10.2	20.3
10/30/2020	10.4	10.4	20.3	10.1	10.2	20.3
10/31/2020	10.1	10.1	19.9	10.1	10.1	20.2

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Upstream **Samplers:** Nicki Feiten/Amy Sumner

Interval Frequency: 00:30

Data Logger ID #:

Main: 20686982, 20900873(Hobo)

Backup: 20686981, 20900872(Hobo)

Location: $47^0$40’34.95”/-$117^0$20’39.15”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Comments
6/18/2020	8:15	Loggers deployed	NA	Cable deployed full length.
6/24/2020	7:40	Loggers recovered	16.0	Recovered and downloaded data. Checked data logger at shore with NIST certified temp probe. Data logger: 13.6 °C, temp probe: 13.7 °C.
7/14/2020	9:20	Loggers recovered	16.3	Loggers recovered. Checked data logger at shore with NIST certified temp probe. Data logger: 16.3 °C, temp probe: 16.3 °C
8/13/2020	9:50	Logger recovered	13.4	Loggers recovered. Checked data logger at shore with NIST certified temp probe. Data logger: 13.5 °C temp probe: 13.4 °C
9/22/2020	8:26	Loggers Missing	13.5	Both loggers missing from site. Temperature measured with NIST certified temp probe: 13.5°C
10/01/2020	10:30	Loggers Deployed	13.0	Two new loggers were deployed. River temperature was measured with NIST certified temp probe: 13.0 °C
10/15/2020	10:30	Loggers recovered	-	Loggers recovered for download. NIST certified temperature probe lost power and was unable to measure stream temperature. Data Logger: 11.2°C
11/03/2020	10:23	Loggers recovered	9.6	Loggers recovered for season. Temp probe: 9.6°C

Continuous Temperature Survey Form—NPDES Permit No. WA-0093317 Receiving Water Temperature Study

Station Name: Downstream **Samplers:** Nicki Feiten/Amy Sumner

Interval Frequency: 00:30

Data Logger ID #:

Main: 20868795**,** 20868802 (Hobo)

Backup: 20763835, 20868790 (Hobo)

Location: $47^0$40’34.81”/-$117^0$20’55.69”

Deployment & Retrieval Information

Date	Time	Activity	Water Temp (^{0}C)	Comments
6/18/2020	8:35	Loggers deployed	NA	Cable deployed full length.
6/24/2020	7:55	Logger recovered. One missing.	16.2	Recovered and downloaded data from one logger. One logger was stolen/missing. Checked data logger at shore with NIST certified temp probe. Data logger—16.2, temp probe 16.2 °C.
7/14/2020	9:20	One Logger recovered	16.6	Recovered and downloaded one logger. Launched new backup logger (20868795). Checked data logger at shore with NIST certified temp probe. Data logger: 16.6 °C, temp probe 16.6°C.
8/13/2020	8:10	Loggers recovered	13.3	Loggers recovered for download. Checked loggers at shore with NIST certified temp probe. Data Logger: 13.4˚C, temp probe: 13.3˚C
9/22/2020	14:40	Loggers Missing	13.4	Both loggers missing from site. Temperature measured with NIST certified temp probe: 13.4°C
10/01/2020	11:00	Loggers Deployed	13.0	Two new loggers were deployed. River temperature was measured with NIST certified temp probe: 13.0 °C
10/15/2020	10:50	Loggers recovered and downloaded	-	Loggers recovered for download. NIST certified temperature probe lost power and was unable to measure stream temperature. Data Logger: 11.2°C
11/03/2020	11:38	Loggers recovered for season	9.6	Loggers recovered for season. Temperature measured with NIST certified temp probe: 9.6°C


Figure 1: Data Collection Locations
2020 Receiving Water Study-Temperature
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
E. Upriver Dr.
Facility
Discharge
Spokane River
Downstream
Data Logger
Deployment Location
Upstream
Data Logger
Deployment Location I
Spokane County Sewer System
North Valley Interceptor
Pump Station
Spokane Community
College

Figure 2: Downstream Location Aerial Photo

2020 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 3: Upstream Location Aerial Photo

2020 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

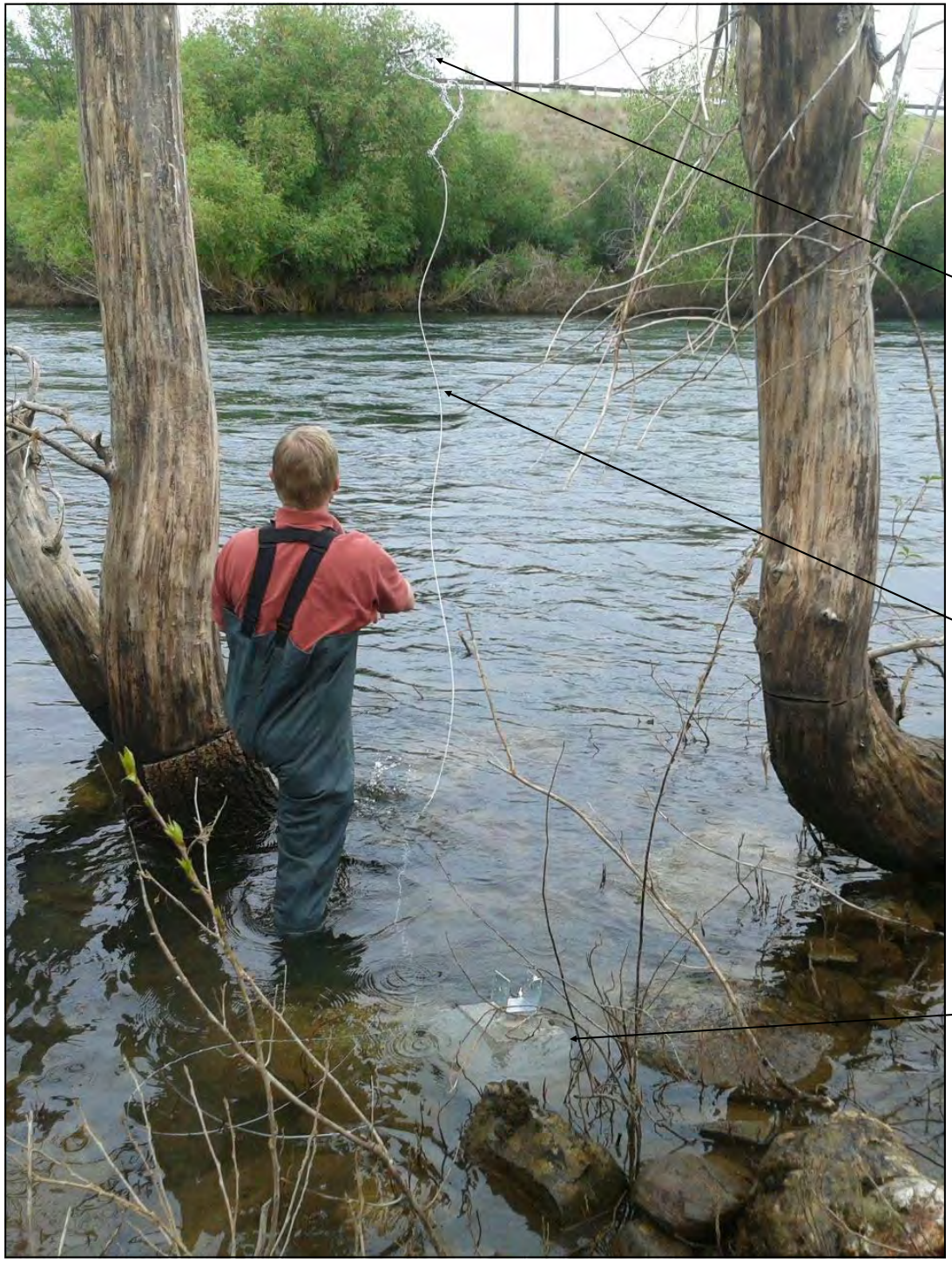


Figure 4: Typical Data Logger Deployment

2020 Receiving Water Study-Temperature

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

Figure 5. Daily Maximum Temperature 2020

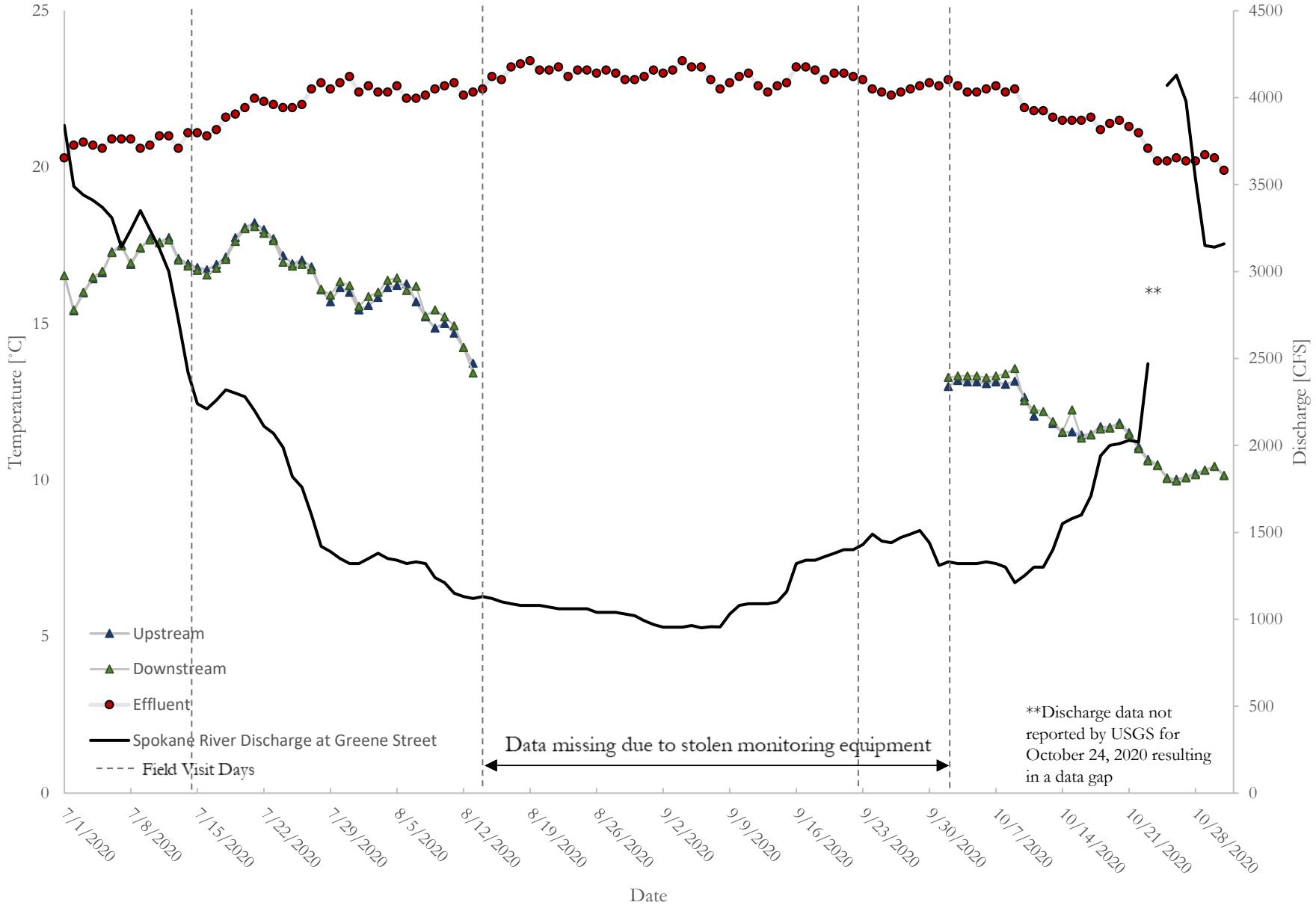
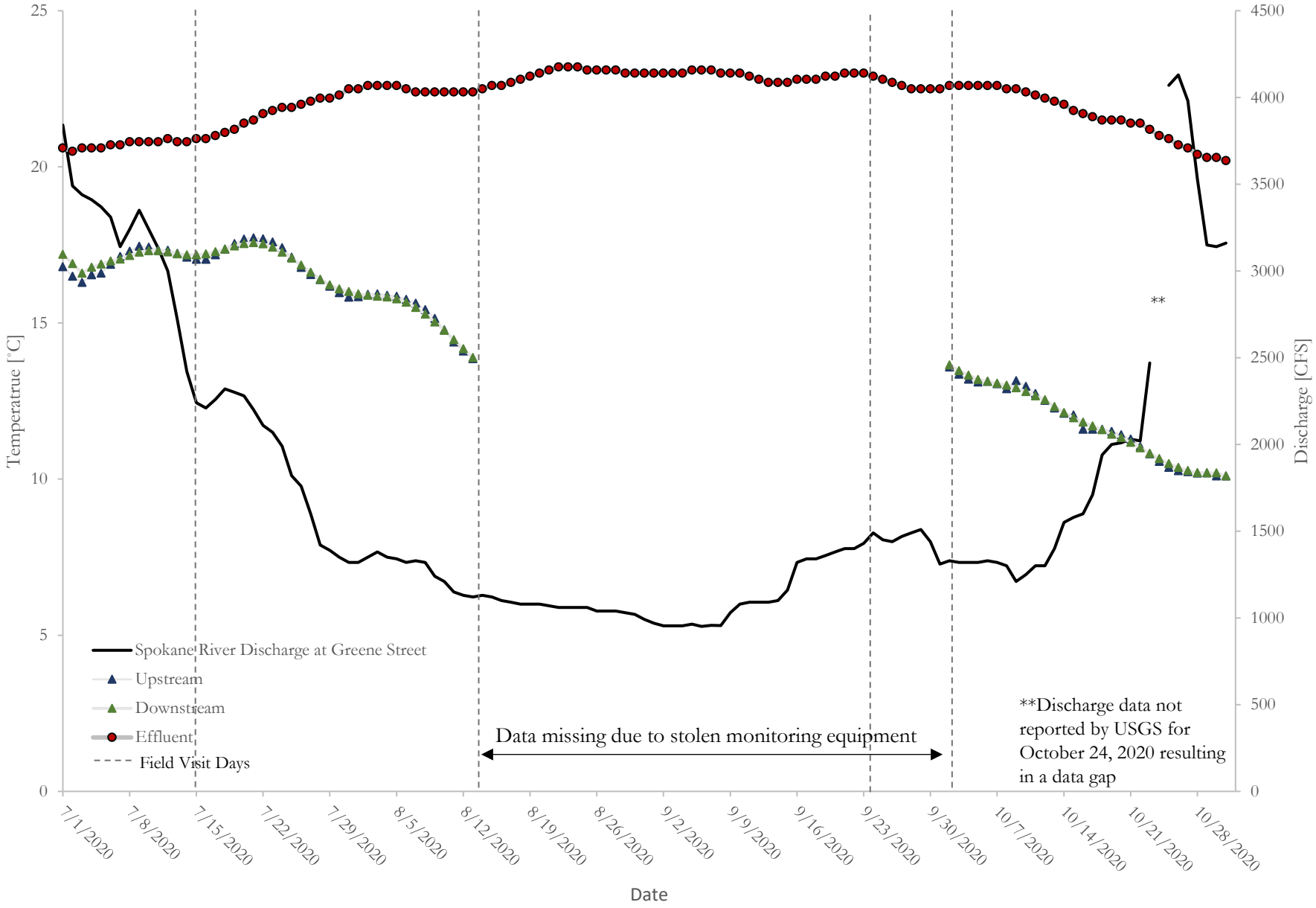


Figure 6. 7-day Average of Maximum Daily Temperature 2020



SPOKANE COUNTY
UTILITIES DIVISION
KEVIN R. COOKE, P.E., DIRECTOR
A DIVISION OF THE PUBLIC WORKS DEPARTMENT

March 12, 2014

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Conventional Parameters; 2013 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between February, 2013 and November, 2013.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all conventional parameter information collected and a discussion of the data. Additionally, per the terms of permit, the data spreadsheet in EIM format has been transmitted via e-mail on March 12, 2014, along with this report.

Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

Attachments: 2013 Data Report, Receiving Water Study – Conventional Parameters

1026 WEST BROADWAY AVENUE, 4TH FLOOR • SPOKANE, WA 99260-0430
PHONE: (509) 477-3604 • FAX: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2013 Data Report

Receiving Water Study – Conventional Parameters

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

March 12, 2014

Table of Contents

Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2013 Receiving Water Conventional Parameters Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, analytical & field data, and data analysis.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses element S9.B-Conventional Parameters. Relevant permit requirements from the NPDES Permit No. WA-0093317 found in Section S9.B follows:

> Section S9.B – Conventional Parameters
> For other conventional parameters listed in S2 the Permittee must:
>
> 1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
> 2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf).
>
>   Follow the clean sampling techniques (Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels, EPA publication No. 821-R-95-034, April 1995)
> 3. For conventional parameters, collect at least ten receiving water samples and analyze the samples in the 2nd and 4th year of the permit for:
>
>   Hardness, alkalinity, pH, NH_3-N, NO2+NO3, dissolved oxygen, total phosphorus, and total reactive phosphorus.

4. In addition, analyze the samples for both the total and dissolved fractions for the following metals in the 2nd and 4th year of the permit: zinc, lead, and cadmium
5. Conduct all chemical analysis using the methods and the detection levels identified in Appendix A.
6. Submit the results of the study to Ecology by March 15 of the following year. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
7. The Receiving Water Data Report must also include electronic copies of the chemical data formatted according to Ecology's Environmental Information (EIM) System templates available at the link below http:/www.ecy.wa.gov/eim/MyEIM.htm

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. Based on Ecology comments and subsequent meetings with Ecology staff the QAPP was revised and resubmitted in January 2013. The QAPP was approved by appropriate Ecology staff on February 25, 2013.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane, Washington and discharges to the Spokane River in a location north of the facility. The discharge is located on the south side of the river at approximately river mile 78.8, approximately 0.8 miles downstream of the City of Spokane's Upriver Dam.

The SCRWRF discharge is located in a reach of the Spokane River that is affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane; on an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the hydraulic head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the SVRP aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam and the Greene Street Bridge the river can gain as much as 260 cfs from the SVRP aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific

Investigations Report 2007-5041) indicate a gain of 344 cfs in the same area. For comparison, the SCRWRF discharges approximately 12 cfs.

Data collection locations are shown in Figure 1 and Figure 2. The downstream data collection location is approximately 500 ft. downstream of the facility discharge. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape, with depth increasing quickly from the shoreline. The thalweg appears to be in the middle of the channel. The shore is primarily boulders.

The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. The shore at this site is comprised of large boulders. No groundwater seeps or springs were visible from the shoreline.

3 FIELD ACTIVITIES

Field activities were conducted in accordance with the approved QAPP (Spokane County, 2013). Spokane River samples were collected with a peristaltic pump through Teflon lined polyethylene tubing. A 20 ft. piece of polyvinyl chloride (PVC) pipe was used to extend the tubing laterally into the river and submerge the tubing approximately 1 ft. below water surface. This technique allowed collection of samples from a well-mixed location in the river and below the water surface. This technique worked well and no problems were experienced.

Three quality control samples were collected for each sampling event, a field duplicate, field blank and equipment blank. A field duplicate was collected at either the upstream or downstream location; the location was chosen at random. A 9-liter Nalgene carboy of deionized water was brought to the downstream sample site for the field blank and equipment blank samples. The field blank was collected directly from the carboy, and the equipment blank was deionized water from the carboy collected through the sampling apparatus.

The effluent samples were collected by facility operators, CH2M Hill. The samples were a 24-hour time weighted composite sample collected downstream from the chlorine contact chamber.

Field data including dissolved oxygen, pH, temperature, and conductivity, was collected at each sampling location. Dissolved oxygen was collected with the YSI ProODO water

quality meter, an optical dissolved oxygen meter. Temperature, pH, and conductivity were collected with a YSI 556 Multi-Parameter water quality meter. Both meters were calibrated prior to each sampling event. The probes of each meter were deployed approximately 5 feet into the river. No problems were experienced collecting the field parameters.

Samples were submitted to both CH2M Hill Applied Sciences Laboratory (ASL), and Aquatic Research Inc. (AR). Samples were analyzed for total and dissolved cadmium, zinc, and lead at ASL, and total phosphorus, total reactive phosphorus, ammonia, nitrite+nitrate, alkalinity, and hardness at AR.

Non-metals effluent data collected by CH2M Hill were utilized for the first 6 sampling rounds of this study, as described in the QAPP. CH2M Hill submitted those samples to Anatek Laboratory. It was determined after the 6th sampling round that using the same lab to run all samples for the same parameter was a more consistent approach, so non-metals effluent samples were submitted to AR, instead of Anatek, for analysis for sampling rounds 7-10.

4 RESULTS AND DATA ANALYSIS

Analytical results are presented in Table 1 and field collected data is presented in Table 2. An electronic file with data formatted according to Ecology's Environmental Information Management (EIM) system format accompanies this report, as specified in Section S9.B.7 of the NPDES permit.

The purpose of the receiving water study is to evaluate measurable differences in water quality between sampling locations upstream and downstream of the facility discharge. An appropriate test to determine if there are statistically significant differences between two data sets with logical pairings is the paired Wilcoxon signed-rank test (USGS, 2002). The statistical software package STATA 11.2 was utilized to compare the upstream and downstream data sets for each analytical parameter. Output from each test is provided in Appendix A. The results of the analysis indicate that at a 95% significance level there is no statistical difference between the analyte concentrations at the upstream and downstream sampling locations.

5 QUALITY ASSURANCE

Table 3 presents the results of the quality assurance samples, including the field duplicate, field blank, and equipment blank. Sample concentrations above the method detection limit but below the reporting limit were given a J flag.

Quality assurance goals specified in the QAPP were met with the following exceptions.

- The laboratory grade deionized water from the Millipore System at the facility lab and from Anatek utilized for the blank and equipment blank samples for the first three sampling events were contaminated with analytes of interest. After the third sampling event deionized water provided by Culligan was utilized. Deionized water provided by Culligan was not contaminated throughout the remaining duration of the project.
- Total reactive phosphorus for the field blank on 2/27/13 was initially run with a filtered sample, and therefore did not represent total reactive phosphorus. The sample was not rerun because the total phosphorus analysis for the field blank indicated that the deionized water was contaminated.
- The samples collected on 8/21/13 for total and dissolved metals arrived at the laboratory at 7.6 °C, 3.6 °C above the specified temperature of 4 °C. The samples were preserved in the field, shipped in a cooler with ice, and based on the temperature upon receipt were not out of the temperature specification for long, so in our opinion it was appropriate to run the samples.
- The dissolved metals field blank sample collected on 11/13/13 had measurable concentrations of cadmium, lead, and zinc. Field staff indicated problems with the bottle lids of laboratory provided bottles. Contamination could have been introduced during the sampling procedure, or through the faulty lid. The total metals results for the same sample did not have measurable quantities of cadmium, lead, or zinc, nor did the total and dissolved metals equipment blank sample have measurable quantities of cadmium, lead, or zinc. Based on the preceding information it is our opinion that it is appropriate to present the sample results without a data flag. The faulty bottles were reported to the lab, and the lab noted that other clients had reported similar problems. The lab indicated they resolved the problem.
- The QAPP specifies acceptance criteria for laboratory duplicates, but not field duplicates. Laboratory duplicates are a measure of analytical precision, while field duplicates area measure of both sampling and analytical precision. All field duplicates met the acceptance criteria specified in the QAPP for laboratory duplicates with the exception of total lead for the sample collected on 11/13/13. The total lead result for that sample was given a J flag.
- The total reactive phosphorus result for 7/24/13 is 0.059 mg/L greater than total phosphorus. Total reactive phosphorus should be equal to or less than total phosphorus. This total reactive phosphorus value is also an outlier in the data set. Based on this information the result was rejected, and not considered in the data analysis.

6 REFERENCES

Helsel, D.R., Hirsch, R.M., 2002, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 4, Hydrologic Analysis and Interpretation, Chapter A3, Statistical Methods in Water Resources, 524 p.

Hsieh, P.A., Barber, M.E., Contor, B.A., Hossain, Md. A., Johnson, G.S., Jones, J.L., and Wylie, A.H., 2007, Ground-water flow model for the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho: U.S. Geological Survey Scientific Investigations Report 2007-5044, 78 p.

Kahle, S.C. and Bartolino, J.R., 2007, Hydrogeologic framework and ground-water budget of the Spokane Valley-Rathdrum Prairie aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho: U.S. Geological Survey Scientific Investigations Report 2007-5041, 48 p., 2 pls.

Spokane County Water Reclamation, 2013, Spokane County Regional Water Reclamation Facility, NPDES Permit No. WA-0093317 Quality Assurance Project Plan, Receiving Water Study-Conventional Parameters, 25 p.


Figure 1: Data Collection Locations
2013 Receiving Water Study-Conventional Parameters
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
N. Havana St.
E. Upriver Dr.
Facility Discharge
Spokane River
Downstream Sampling Location
Upstream Sampling Location
Spokane County Sewer System North Valley Interceptor Pump Station
Spokane Community College


Figure 2: Effluent Sampling Location
2013 Receiving Water Study-Conventional Parameters
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
50 25 0 50 Feet
N
Spokane County Regional Water Reclamation Facility
Effluent Sampling Location

Table 1 -Laboratory Analytical Results

Spokane County Regional Water Reclamation Facility 2013 Receiving Water Study

	2/27/2013	3/20/2013	4/17/2013	6/5/2013	6/26/2013	7/24/2013	8/21/2013	9/18/2013	10/16/2013	11/13/2013
	Total Phosphorus (mg/L)									
Upstream	0.010	0.011	0.008	0.006	0.006	0.003	0.004	0.005	0.005	0.004
Downstream	0.010	0.011	0.008	0.006	0.006	0.004	0.004	0.004	0.004	0.004
Effluent	0.023	0.037	0.043	0.059	0.026	0.055	0.055	0.036	0.037	0.036
	Total Reactive Phosphorus (mg/L)									
Upstream	0.003	0.003	0.002	0.002	0.002	0.002	<0.001	<0.001	<0.001	0.002
Downstream	0.004	0.003	0.002	0.002	0.002	0.002	<0.001	0.001	0.001	0.002
Effluent	0.010	0.010	0.010	0.040	0.020	0.114[R,1]	0.040	0.028	0.034	0.031
	Ammonia (mg/L)									
Upstream	<0.010	0.023	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.014
Downstream	<0.010	<.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Effluent	6.71	0.361	2.33	0.379	0.178	0.258	0.066	0.095	0.032	0.394
	Nitrate+Nitrite (mg/L)									
Upstream	0.263	0.114	0.166	0.235	0.224	0.8	0.893	0.665	0.372	0.407
Downstream	0.267	0.095	0.12	0.234	0.224	0.839	0.928	0.697	0.383	0.417
Effluent	21.4	17.2	19.4	15.5	9.82	11.4	8.79	12.7	8.64	14.7
	Alkalinity (mg/L)									
Upstream	44.8	32.3	39.3	46.3	45	108	122	96.8	65.0	64.1
Downstream	45.6	31.0	32.5	45.8	45.8	107	125	96.4	61.2	65
Effluent	116	92	100	123	162	128	148	121	143	137
	Hardness (mg/L)									
Upstream	43.0	28.5	36.7	41.6	37.5	93.6	106	87.6	58.4	60.4
Downstream	44.6	26.8	30.5	41.0	39.5	101	107	92.4	57.9	60.2
Effluent	136	155	138	166	130	150	138	149	137	147
	Total Cadmium (ug/L)									
Upstream	0.27[J]	<0.030	0.15[J]	0.044[J]	0.10[J]	<0.030	<0.030	0.051[J]	0.10[J]	0.11[J]
Downstream	0.39[J]	0.073[J]	0.15[J]	<0.030	0.086[J]	<0.030	<0.030	0.055[J]	0.086[J]	0.11[J]
Effluent	0.39[J]	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Total Lead (ug/L									
Upstream	1.08	1.49	2.32	1.51	0.92	0.66	0.55	0.48[J]	0.64	0.38[J]
Downstream	1.03	1.46	2.35	1.09	0.91	0.77	0.48[J]	0.43[J]	0.58	0.41[J]
Effluent	0.19[J]	0.55	0.15	0.14[J]	0.12	0.17[J]	0.15[J]	0.16[J]	0.43[J]	0.14[J]
	Total Zinc (ug/L)									
Upstream	55.1	53.4	58.2	36.3	33	14	8.65	12	25.3	34
Downstream	54.4	53.9	61.3	36.0	31.9	17.1	8.41	11	25.2	33.8
Effluent	34.6	37.5	26.8	23.5	15.2	15.8	15.5	15.7	13.9	19.6
	Dissolved Cadmium (ug/L)									
Upstream	0.21[J]	<0.030	0.081[J]	<0.030	0.051[J]	<0.030	<0.030	0.046[J]	0.078[J]	0.089[J]
Downstream	0.25[J]	<0.030	0.11[J]	0.069[J]	0.046[J]	<0.030	<0.030	0.043[J]	0.056[J]	0.097[J]
Effluent	0.35[J]	<0.030	<0.030	0.055[J]	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Dissolved Lead (ug/L)									
Upstream	0.23[J]	0.21[J]	0.51	0.22[J]	0.10[J]	0.12[J]	0.26[J]	0.12[J]	0.12[J]	0.062[J]
Downstream	0.22[J]	0.21[J]	0.55	0.21[J]	0.10[J]	0.098[J]	0.23[J]	0.11[J]	0.12[J]	0.062[J]
Effluent	0.15[J]	0.97	0.14[J]	0.14[J]	0.15[J]	0.19[J]	0.14[J]	0.18[J]	0.42[J]	0.15[J]
	Dissolved Zinc (ug/L)									
Upstream	54.5	47.1	52.5	32.8	27.9	11.7	7.81	11.2	23.1	32.2
Downstream	52.4	48.7	56.0	27.6	29.1	10.6	7.09	10.5	22.6	32.5
Effluent	36.6	30.2	28	21.2	16.1	17.7	16.1	17.6	14.5	22.2

1-This total reactive phoshporus result is 0.059 mg/l greater than total phoshporus for the same sample. Total reactive phosphorus should be equal to or less than total phosphorus. This value is also an outlier in the data set. Therefore the data is rejected.

J-estimated value below reporting limit

R-data is rejected

Table 2-Field Measurment Results

Spokane County Regional Water Reclamation Facility 2013 Receiving Water Study

	2/27/2013	3/20/2013	4/17/2013	6/5/2013	6/26/2013	7/24/2013	8/21/2013	9/18/2013	10/16/2013	11/13/2013
	Dissolved Oxygen (mg/L)									
Upstream	14.10	12.02	11.42	9.26	8.11	7.74	7.99	8.01	9.08	9.80
Downstream	14.44	12.10	12.08	9.44	8.22	7.82	8.09	8.34	9.20	9.95
	pH									
Upstream	5.45	7.15	7.05	6.92	7.00	6.92	6.87	7.44	7.55	6.59
Downstream	6.08	7.12	7.02	7.29	7.19	7.55	7.55	7.73	7.70	7.40
	Temperature (°C)									
Upstream	4.53	4.90	6.30	13.80	16.21	15.40	13.90	14.52	11.70	8.95
Downstream	4.49	4.80	5.90	14.00	16.50	15.20	13.74	14.60	11.80	8.91
	Conductivity (µS/cm)									
Upstream	105	70	90	80	83	182	227	184	128	129
Downstream	99	65	76	77	81	184	229	151	127	125
River Flow[2] (cfs)	4,670	10,300	13,200	6,320	5,320	1,340	1,060	1,440	2,840	3,080

1 -pH measurements taken with the probe on or very near the river sediment were found to be lower than the majority of the water column. After the first samping event the probe was deployed such that it would not sit on the sediment.

2 - river flow measured at USGS Gage 12421500 Spokane River at Spokane, WA

Table 3-Quality Assurance Analytical Results

Spokane County Regional Water Reclamation Facility 2013 Receiving Water Study

	2/27/2013[1]	3/20/2013[1]	4/17/2013[1]	6/5/2013[2]	6/26/2013[2]	7/24/2013[1]	8/21/2013[1]	9/18/2013[1]	10/16/2013[2]	11/13/13[1]
	Total Phosphorus (mg/L)									
Field Duplicate	0.009	0.014	0.007	0.007	0.006	0.004	0.006	0.005	0.004	0.005
Field Blank	0.003	0.01	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Equipment Blank	0.004	0.01	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Total Reactive Phosphorus (mg/L)									
Field Duplicate	0.004	0.002	0.002	0.002	0.002	0.002	<0.001	0.001	0.001	0.002
Field Blank		0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Equipment Blank	0.001	0.008	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Ammonia (mg/L)									
Field Duplicate	0.011	<0.010	0.015	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Field Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Equipment Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Nitrate+Nitrite (mg/L)									
Field Duplicate	0.269	0.109	0.115	0.241	0.210	0.831	0.92	0.697	0.372	0.416
Field Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Equipment Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
	Alkalinity (mg/L)									
Field Duplicate	46.4	29.5	32.1	46.6	45.6	110	124	98	60.3	64.6
Field Blank	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Equipment Blank	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
	Hardness (mg/L)									
Field Duplicate	43.4	26.4	30.9	40.3	38.9	102	110	91.9	58.6	60.8
Field Blank	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Equipment Blank	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
	Total Cadmium (ug/L)									
Field Duplicate	0.38[J]	0.042[J]	0.14[J]	0.051[J]	0.087[J]	<0.030	<0.030	0.059[J]	0.093[J]	0.69
Field Blank	0.30[J]	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Equipment Blank	0.45[J]	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Total Lead (ug/L									
Field Duplicate	1.04	1.48	2.3	1.11	0.95	0.41[J]	0.46[J]	0.45[J]	0.57	1.92
Field Blank	0.068[J]	0.13[J]	<0.041	<0.041	<0.041	0.063[J]	<0.041	<0.041	<0.041	<0.041
Equipment Blank	<0.041	<0.041	<0.041	<0.041	<0.041	0.047[J]	<0.041	<0.041	<0.041	<0.041
	Total Zinc (ug/L)									
Field Duplicate	54.5	53.9	59.7	35.4	32.9	13.6	8.38	11.5	24.9	41.7
Field Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
Equipment Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
	Dissolved Cadmium (ug/L)									
Field Duplicate	0.25[J]	<0.030	0.11[J]	0.059[J]	0.078[J]	<0.030	<0.030	0.034[J]	0.066[J]	0.082[J]
Field Blank	0.31[J]	<0.030	<0.030	0.034[J]	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Equipment Blank	0.24[J]	<0.030	<0.030	0.065[J]	<0.030	<0.030	<0.030	<0.030	<0.030	0.89
	Dissolved Lead (ug/L)									
Field Duplicate	0.24[J]	0.20[J]	0.53	0.22[J]	0.14[J]	0.11[J]	0.23[J]	0.12[J]	0.11[J]	0.067[J]
Field Blank	<0.041	<0.041	<0.041	<0.041	<0.041	0.065[J]	<0.041	<0.041	<0.041	<0.041
Equipment Blank	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041	2.3
	Dissolved Zinc (ug/L)									
Field Duplicate	54.3	48.4	54.2	28.2	28.6	10.6	7.1	10.3	23.5	33.2
Field Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
Equipment Blank	3.66[J]	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	47.9

J-estimated value below reporting limit

Field duplicate locations 1=Downstream, 2=Upstream

Statistical Analysis of Upstream and Downstream Analytical Data

Below is the output from the Wilcoxon signed-rank test of paired upstream and downstream data for each analyte.

Total Phosphorus:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	2	17	13.5
negative	1	10	13.5
zero	7	28	28
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -35.00
adjusted variance 61.13
Ho: var1 = var2
z = 0.448
Prob > |z| = 0.6544

Total Reactive Phosphorus:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	0	0	13.5
negative	3	27	13.5
zero	7	28	28
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -35.00
adjusted variance 61.13
Ho: var1 = var2
z = -1.727
Prob > |z| = 0.0842

Ammonia:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	2	19	9.5
negative	0	0	9.5
zero	8	28	36
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -51.00
adjusted variance 45.25
Ho: var1 = var2
z = 1.412
Prob > |z| = 0.1579

Nitrate+Nitrite:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	3	18	27
negative	6	36	27
zero	1	1	1
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -0.25
adjusted variance 96.00
Ho: var1 = var2
z = -0.919
Prob > |z| = 0.3583

Alkalinity:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	6	35	27.5
negative	4	20	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros 0.00
adjusted variance 96.13
Ho: var1 = var2
z = 0.765
Prob > |z| = 0.4443

Hardness:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	5	21	27.5
negative	5	34	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros 0.00
adjusted variance 96.25
Ho: var1 = var2
z = -0.663
Prob > |z| = 0.5076

Total Cadmium:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	3	21	22.5
negative	3	24	27.5
zero	4	10	10
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -7.50
adjusted variance 88.63
Ho: var1 = var2
z = -0.159
Prob > |z| = 0.8734

Total Lead:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	7	40.5	22.5
negative	3	14.5	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros 0.00
adjusted variance 96.13
Ho: var1 = var2
z = 1.326
Prob > |z| = 0.1849

Total Zinc:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	7	31	27.5
negative	3	24	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros 0.00
adjusted variance 96.25
Ho: var1 = var2
z = 0.357
Prob > |z| = 0.7213

Dissolved Cadmium:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	3	16	24.5
negative	4	33	24.5
zero	3	6	6
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -3.50
adjusted variance 92.75
Ho: var1 = var2
z = -0.883
Prob > |z| = 0.3775

Dissolved Lead:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	5	35	22.5
negative	1	10	22.5
zero	4	10	10
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -7.50
adjusted variance 88.63
Ho: var1 = var2
z = 1.328
Prob > |z| = 0.1842

Dissolved Zinc:

Wilcoxon signed-rank test

sign	obs	sum || ranks	expected
positive	6	32	27.5
negative	4	23	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros 0.00
adjusted variance 96.25
Ho: var1 = var2
z = 0.459
Prob > |z| = 0.6465

SPOKANE COUNTY

UTILITIES DIVISION

KEVIN R. COOKE, P.E., DIRECTOR

A DIVISION OF THE PUBLIC WORKS DEPARTMENT

March 10, 2016

Ms. Ellie Key
Washington Department of Ecology - Eastern Regional Office
4601 North Monroe
Spokane WA 99205

Re: NPDES Permit No. WA-0093317; Spokane County Regional Water Reclamation Facility Receiving Water Study – Conventional Parameters; 2015 Data Report

Dear Ellie:

In accordance with the subject National Pollution Discharge Elimination System (NPDES) waste discharge permit (permit), Spokane County is pleased to submit the attached data package for the Spokane River receiving water study for the period between February, 2015 and November, 2015.

Per the terms of the permit and associated Quality Assurance Project Plan (QAPP), the attached data package includes all conventional parameter information collected and a discussion of the data. Additionally, per the terms of permit, the data spreadsheet in EIM format has been transmitted via e-mail on March 10, 2016, along with this report.

Please contact me at 509-477-7576 if you have any questions or concerns.

Sincerely,

Rob Lindsay
Manager, Water Resources Section
Spokane County Division of Utilities

Attachments: 2015 Data Report, Receiving Water Study – Conventional Parameters

1026 WEST BROADWAY AVENUE, 4TH FLOOR • SPOKANE, WA 99260-0430
PHONE: (509) 477-3604 • FAX: (509) 477-4715 • TDD: (509) 477-7133

SPOKANE COUNTY
WATER RECLAMATION

Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317

2015 Data Report

Receiving Water Study – Conventional Parameters

Prepared for:
Washington Department of Ecology – ERO
4601 North Monroe Street
Spokane, WA 99205

Prepared by:
Spokane County Division of Utilities
1004 North Freya Street
Spokane, WA 99202

March 15, 2016

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Attached Tables

Attached Figures

Appendix A

1 INTRODUCTION

This report presents the results of the 2015 Receiving Water Conventional Parameters Study (study) for the Spokane County Regional Water Reclamation Facility (SCRWRF). The study was conducted to meet requirements of National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-0093317. This report includes background information, data collection activities, analytical & field data, and data analysis.

Background

Spokane County (County) owns the SCRWRF; it provides treatment for wastewater before discharging to the Spokane River. The SCRWRF is operated by a 3rd party operator, CH2M Hill, under contract to the County.

NPDES permit WA-0093317 includes a Receiving Water Study (Section S9). The Receiving Water Study is comprised of three elements: S9.A-Temperature Monitoring, S9.B-Conventional Parameters, and S9.C-Toxic Parameters. This report addresses element S9.B-Conventional Parameters. Relevant permit requirements from the NPDES Permit No. WA-0093317 found in Section S9.B follows:

> Section S9.B – Conventional Parameters
> For other conventional parameters listed in S2 the Permittee must:
>
> 1. Submit a Sampling Quality Assurance Project Plan (QAPP) for Ecology review and approval by March 1, 2012. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
> 2. Conduct all sampling and analysis in accordance with the guidelines given in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf).
>
>   Follow the clean sampling techniques (Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels, EPA publication No. 821-R-95-034, April 1995)
> 3. For conventional parameters, collect at least ten receiving water samples and analyze the samples in the 2nd and 4th year of the permit for:
>
>   Hardness, alkalinity, pH, NH_3-N, NO2+NO3, dissolved oxygen, total phosphorus, and total reactive phosphorus.

4. In addition, analyze the samples for both the total and dissolved fractions for the following metals in the 2nd and 4th year of the permit: zinc, lead, and cadmium
5. Conduct all chemical analysis using the methods and the detection levels identified in Appendix A.
6. Submit the results of the study to Ecology by March 15 of the following year. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
7. The Receiving Water Data Report must also include electronic copies of the chemical data formatted according to Ecology's Environmental Information (EIM) System templates available at the link below http:/www.ecy.wa.gov/eim/MyEIM.htm

On March 1, 2012 the County submitted a draft QAPP for the study to Ecology. The QAPP, in essence, is a detailed plan for the study and includes the study schedule, personnel, monitoring equipment descriptions, data collection locations, data quality objectives, etc. Based on Ecology comments and subsequent meetings with Ecology staff the QAPP was revised and resubmitted in January 2013. The QAPP was approved by appropriate Ecology staff on February 25, 2013. The permit requires conventional parameters receiving water sampling and analysis in the 2nd and 4th years of the permit cycle. This report presents the results for the 4th year.

2 STUDY AREA

The SCRWRF is located at 1004 N. Freya Street, Spokane, Washington and discharges to the Spokane River in a location north of the facility. The discharge is located on the south side of the river at approximately river mile 78.8, approximately 0.8 miles downstream of the City of Spokane's Upriver Dam.

The SCRWRF discharge is located in a reach of the Spokane River that is affected by groundwater inflows. The Spokane River and Spokane Valley Rathdrum Prairie (SVRP) aquifer exchange water throughout its path from Lake Coeur d'Alene to Lake Spokane; on an annual average basis approximately 718 cubic feet per second (cfs) transfers from the Spokane River to the SVRP aquifer and 861 cfs transfers from the SVRP aquifer to the Spokane River (Table 2, United States Geological Survey, Scientific Investigations Report 2007-5041). The direction of flow between the two is dependent on the hydraulic head difference between the river and aquifer.

In the vicinity of SCRWRF discharge, below Upriver Dam and above the Greene Street Bridge, the Spokane River is gaining water from the SVRP aquifer. The groundwater flow model developed by the United States Geological Survey for the SVRP aquifer (USGS Scientific Investigations Report 2007-5044) indicates that between Upriver Dam

and the Greene Street Bridge the river can gain as much as 260 cfs from the SVRP aquifer. Seepage run measurements in August 2006 (Table 6, USGS Scientific Investigations Report 2007-5041) indicate a gain of 344 cfs in the same area, and flow measurements taken in August 2015 indicated a gain of 327 cfs in the river reach between Upriver Dam and Greene Street. For comparison, the SCRWRF discharges approximately 12 cfs.

Data collection locations are shown in Figure 1 and Figure 2. The downstream data collection location is approximately 500 ft. downstream of the facility discharge. There is no bathymetry data for this location, but from visual assessment at the site and aerial photography it appears that the channel is a V or U shape, with depth increasing quickly from the shoreline. The thalweg appears to be in the middle of the channel. The shore is primarily boulders.

The upstream data collection location is approximately 630 ft. upstream of the facility discharge point. There is no bathymetry data for this location, but from a visual assessment at the site and aerial photography it appears that there is a bench that extends approximately 40 ft. into the channel on the south side of the river and the thalweg is located closer to the north side of the river. The shore at this site is comprised of large boulders. No groundwater seeps or springs were visible from the shoreline.

3 FIELD ACTIVITIES

Field activities were conducted in accordance with the approved QAPP (Spokane County, 2013). Spokane River samples were collected with a peristaltic pump through Teflon lined polyethylene tubing. A 20 ft. piece of polyvinyl chloride (PVC) pipe was used to extend the tubing laterally into the river and submerge the tubing approximately 1 ft. below water surface. This technique allowed collection of samples from a well-mixed location in the river and below the water surface. This technique worked well and no problems were experienced.

Three quality control samples were collected for each sampling event, a field duplicate, field blank and equipment blank. A field duplicate was collected at either the upstream or downstream location; the location was chosen at random. A 9-liter Nalgene carboy of deionized water was brought to the downstream sample site for the field blank and equipment blank samples. The field blank was collected directly from the carboy, and the equipment blank was deionized water from the carboy collected through the sampling apparatus.

The effluent samples were collected by facility operators, CH2M Hill. The samples were a 24-hour time weighted composite sample collected downstream from the chlorine contact chamber.

Field data including dissolved oxygen, pH, temperature, and conductivity, was collected at each sampling location. Dissolved oxygen was collected with the YSI ProODO water quality meter, an optical dissolved oxygen meter. Temperature, pH, and conductivity were collected with a YSI 556 Multi-Parameter water quality meter. Both meters were calibrated prior to each sampling event. During the September sampling event the meter was calibrated according to specification, but pH field measurements were well outside the normal range of values. The meter was sent to the manufacturer for evaluation and it was determined that a corroded connection was causing intermittent meter malfunction.

Samples were submitted to both CH2M Hill Applied Sciences Laboratory (ASL), and Aquatic Research Inc. (AR). Samples were analyzed for total and dissolved cadmium, zinc, and lead at ASL, and total phosphorus, total reactive phosphorus, ammonia, nitrite+nitrate, alkalinity, and hardness at AR.

4 RESULTS AND DATA ANALYSIS

Analytical results are presented in Table 1 and field collected data is presented in Table 2. An electronic file with data formatted according to Ecology's Environmental Information Management (EIM) system format accompanies this report, as specified in Section S9.B.7 of the NPDES permit.

The purpose of the receiving water study is to evaluate measurable differences in water quality between sampling locations upstream and downstream of the facility discharge. An appropriate test to determine if there are statistically significant differences between two data sets with logical pairings is the paired Wilcoxon signed-rank test (USGS, 2002). The statistical software package STATA 11.2 was utilized to compare the upstream and downstream data sets for each analytical parameter. J flagged values were utilized at the reported value and U flagged values were utilized at half of the reported value. Output from each test is provided in Appendix A. The results of the analysis indicate that at a 95% significance level there is no statistical difference between the analyte concentrations at the upstream and downstream sampling locations.

5 QUALITY ASSURANCE

Table 3 presents the results of the quality assurance samples, including the field duplicate, field blank, and equipment blank. Sample concentrations above the method

detection limit but below the reporting limit were given a J flag. All quality assurance goals specified in the QAPP were met with the exception of detections in a small number of field and equipment blanks, as described below.

The field blank is a sample of deionized water collected at the sample location, and the equipment blank is the same deionized water collected through the sampling apparatus. The purpose of the equipment blank is to determine if the sampling apparatus introduces contaminants into the sample. The purpose of the field blank is twofold: 1. Determine if contaminants are introduced during the sample collection process, principally from the atmosphere, and 2. Determine if the deionized water used for the equipment blank was contaminated prior to the passing through the sampling apparatus for collection of the equipment blank. Detections in the field and equipment blanks and the corrective actions are described below.

- Total lead was detected in the field blank on June 2, 2015, August 4, 2015 and November 3, 2015. It was detected in the equipment blank on August 4, 2015. Since the equipment blank detection was accompanied by a field blank detection of similar magnitude, the equipment blank detection does not indicate contamination from the sampling apparatus. Detections in the field blank could indicate an atmospheric contaminant or a contaminant in the deionized water. Given that all detections in the field blank were below the method reporting limit and an order of magnitude less than the sample results, the sample results were given a J flag, but not rejected.
- Dissolved lead was detected in the field blank on July 7, 2015 at a concentration below the method reporting limit. The associated results were also below the method reporting limit, and as such, were given a J flag. The J flag was determined to be sufficient to indicate the uncertainty in the measurement.
- Total cadmium was detected in the field blank on April 7, 2015 and September 9, 2015. In each case the result was 0.002 ug/L over the method detection limit and below the method reporting limit. The associated results were also below the method reporting limit, and as such, were given a J flag. The J flag was determined to be sufficient to indicate the uncertainty in the measurement.
- Dissolved cadmium was detected in the field blank and equipment blank on September 8, 2015. Since the equipment blank detection was accompanied by a field blank detection of similar magnitude, the equipment blank detection does not indicate contamination from the sampling apparatus. The field blank and associated results were all below the method reporting limit, and as such given a J flag. The J flag was determined to be sufficient to indicate the uncertainty in the measurement.

6 REFERENCES

Helsel, D.R., Hirsch, R.M., 2002, Techniques of Water-Resources Investigations of the United States Geological Survey, Book 4, Hydrologic Analysis and Interpretation, Chapter A3, Statistical Methods in Water Resources, 524 p.

Hsieh, P.A., Barber, M.E., Contor, B.A., Hossain, Md. A., Johnson, G.S., Jones, J.L., and Wylie, A.H., 2007, Ground-water flow model for the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho: U.S. Geological Survey Scientific Investigations Report 2007-5044, 78 p.

Kahle, S.C. and Bartolino, J.R., 2007, Hydrogeologic framework and ground-water budget of the Spokane Valley-Rathdrum Prairie aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho: U.S. Geological Survey Scientific Investigations Report 2007-5041, 48 p., 2 pls.

Spokane County Water Reclamation, 2013, Spokane County Regional Water Reclamation Facility, NPDES Permit No. WA-0093317 Quality Assurance Project Plan, Receiving Water Study-Conventional Parameters, 25 p.


Figure 1: Data Collection Locations
2015 Receiving Water Study-Conventional Parameters
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
150 75 0 150 Feet
N
N. Havana St.
E. Upriver Dr.
Facility Discharge
Spokane River
Downstream Sampling Location
Upstream Sampling Location
Spokane County Sewer System North Valley Interceptor Pump Station
Spokane Community College


Figure 2: Effluent Sampling Location
2015 Receiving Water Study-Conventional Parameters
Spokane County Regional Water Reclamation Facility
NPDES Permit No. WA-0093317
50 25 0 50 Feet
N
Spokane County Regional Water Reclamation Facility
Effluent Sampling Location

Table 1 -Laboratory Analytical Results

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

	2/3/2015	3/3/2015	4/7/2015	5/5/2015	6/2/2015	7/7/2015	8/4/2015	9/8/2015	10/6/2015	11/3/2015
	Total Phosphorus (mg/L)									
Upstream	0.006	0.006	0.009	0.007	0.007	0.006	0.006	0.004	0.005	0.007
Downstream	0.006	0.006	0.009	0.008	0.008	0.005	0.005	0.004	0.003	0.005
Effluent	0.024	0.028	0.033	0.033	0.036	0.081	0.050	0.026	0.019	0.013
	Total Reactive Phosphorus (mg/L)									
Upstream	<0.001	0.002	0.005	0.003	0.002	<0.001	0.002	0.003	0.002	0.004
Downstream	<0.001	0.002	0.004	0.002	0.002	0.002	0.002	0.003	0.002	0.005
Effluent	0.014	0.019	0.021	0.025	0.034	0.074	0.048	0.026	0.015	0.011
	Ammonia (mg/L)									
Upstream	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Downstream	<0.010	<0.010	0.013	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Effluent	4.78	2.59	0.261	0.259	0.251	0.192	0.121	0.25	0.094	0.371
	Nitrate+Nitrite (mg/L)									
Upstream	0.145	0.205	0.164	0.298	0.282	0.966	0.948	0.936	0.859	0.534
Downstream	0.126	0.179	0.162	0.344	0.288	0.949	0.965	0.938	0.877	0.555
Effluent	9.6	17.9	16.8	16.7	18	16.2	16.9	15.4	1.35	20.1
	Alkalinity (mg/L as $CaCO_3$)									
Upstream	32.5	37.5	27.5	43.8	39.1	104	119	125	119.0	69
Downstream	30.8	34.4	28.6	45	42.6	104	118	133	118	67.8
Effluent	136	101	72	77	92.7	46.5	100	93.5	101	68.3
	Hardness (mg/L as $CaCO_3$)									
Upstream	31.2	38.3	30.5	46.4	45.6	118	129[1]	122	118	66.9
Downstream	29.2	34.9	31.1	47.7	46.2	119	123	123	118	66.4
Effluent	141	135	133	145	149	145	135	138	138	123
	Total Cadmium (ug/L)									
Upstream	<0.030	0.10[J]	0.27[J]	0.11[J]	0.099[J]	<0.030	<0.030	0.038[J]	<0.030	<0.030
Downstream	<0.030	0.071[J]	0.25[J]	0.10[J]	0.11[J]	<0.030	<0.030	0.044[J]	<0.030	<0.030
Effluent	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.035[J]	<0.030	<0.030
	Total Lead (ug/L)									
Upstream	1.07	0.52	3.53	1.25	1.3[J]	0.64	0.61[J]	0.42[J]	0.44[J]	0.71[J]
Downstream	1.06	0.54	3.6	1.24	1.18[J]	0.5	0.54[J]	0.34[J]	0.45[J]	0.7[J]
Effluent	0.16[J]	0.15[J]	0.15[J]	0.18[J]	0.17[J]	0.19[J]	0.12[J]	0.14[J]	0.16[J]	0.13[J]
	Total Zinc (ug/L)									
Upstream	52.7	46.7	54.6	38.6	35.5	9.54[J]	5.56[J]	5.65[J]	6.75[J]	17.4
Downstream	53.1	46.8	55.3	38.3	33	7.45[J]	4.88[J]	4.70[J]	6.03[J]	17.2
Effluent	25.8	26.3	26	24.2	22.7	25.5	16.5	17.4	14.9	15
	Dissolved Cadmium (ug/L)									
Upstream	<0.030	0.047[J]	0.24[J]	0.082[J]	0.060[J]	<0.030	<0.030	<0.030	<0.030	<0.030
Downstream	<0.030	0.057[J]	0.22[J]	0.078[J]	0.051[J]	<0.030	<0.030	0.039[J]	<0.030	<0.030
Effluent	<0.030	<0.030	<0.030	<0.032	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
	Dissolved Lead (ug/L)									
Upstream	0.077[J]	0.091[J]	0.79	0.48[J]	0.23[J]	0.31[J]	0.34[J]	0.27[J]	0.30[J]	0.17[J]
Downstream	0.088[J]	0.010[J]	0.92	0.48[J]	0.22[J]	0.27[J]	0.32[J]	0.21[J]	0.24[J]	0.15[J]
Effluent	0.15[J]	0.15[J]	0.13[J]	0.15[J]	0.15[J]	0.15[J]	0.12[J]	0.22[J]	0.14[J]	0.15[J]
	Dissolved Zinc (ug/L)									
Upstream	50.2	42.5	50.2	35.2	28.6	6.94[J]	5.02[J]	5.19[J]	6.65[J]	15.9
Downstream	51.6	44	48.6	35	28.1	6.32[J]	4.46[J]	4.26[J]	5.98[J]	15.4
Effluent	26.8	26.6	25.5	23.3	20.7	21	17.3	17.3	15.1	15.7

J-estimated value below reporting limit

1-The primary sample value was inconsistent with the field duplicate and other samples taken during similar conditions, therefore the field duplicate value was used.

Table 2-Field Measurment Results

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

	2/3/2015	3/3/2015	4/7/2015	5/5/2015	6/2/2015	7/7/2015	8/4/2015	9/8/2015	10/6/2015	11/3/2015
	Dissolved Oxygen (mg/L)									
Upstream	11.64	11.60	11.13	8.44	8.12	8.24	8.14	8.14	8.42	9.21
Downstream	11.98	11.76	11.13	9.57	8.22	8.27	8.27	8.22	8.69	9.17
	pH									
Upstream	6.07	6.63	7.06	6.84	7.44	7.09	7.88	*	7.49	7.72
Downstream	6.95	7.56	7.06	7.45	7.78	7.93	8.02	*	7.76	7.74
	Temperature (°C)									
Upstream	4.79	4.90	6.99	11.65	17.24	14.63	13.31	11.75	11.62	11.01
Downstream	4.64	4.78	6.99	11.84	17.36	14.57	13.60	11.82	11.85	10.96
	Conductivity (µS/cm)									
Upstream	77	83	71	109	102	239	260	260	232	110
Downstream	71	79	71	105	100	241	258	258	231	110
River Flow[2] (cfs)	10,100	9,650	10,900	4,280	3,910	845	708	733	792	1,910

* meter malfunction

2 - river flow measured at USGS Gage 12421500 Spokane River at Spokane, WA

Table 3-Quality Assurance Analytical Results

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

	2/3/15[1]	3/3/15[2]	4/7/15[1]	5/5/15[2]	6/2/15[1]	7/7/15[2]	8/4/15[1]	9/8/15[1]	10/6/15[1]	11/3/15[2]
Total Phosphorus (mg/L)										
Field Duplicate	0.005	0.006	0.009	0.008	0.007	0.006	0.005	0.004	0.003	0.007
Field Blank	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Equipment Blank	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Reactive Phosphorus (mg/L)										
Field Duplicate	<0.001	0.003	0.003	0.002	0.002	<0.001	0.002	0.003	0.002	0.004
Field Blank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Equipment Blank	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ammonia (mg/L)										
Field Duplicate	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Field Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Equipment Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nitrate+Nitrite (mg/L)										
Field Duplicate	0.14	0.182	0.167	0.339	0.268	0.941	0.952	0.935	0.862	0.554
Field Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Equipment Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Alkalinity (mg/L as $CaCO_3$)										
Field Duplicate	32	34.4	28.6	44.5	43	107	118	100	122	68
Field Blank	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Equipment Blank	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
Hardness (mg/L as $CaCO_3$)										
Field Duplicate	31.2	34.7	30.7	47.2	45.4	120	129	125	117	66.4
Field Blank	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Equipment Blank	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00	<2.00
Total Cadmium (ug/L)										
Field Duplicate	<0.030	0.091[J]	0.24[J]	0.11[J]	0.093[J]	<0.030	<0.030	0.045[J]	<0.030	<0.030
Field Blank	<0.030	<0.030	0.032[J]	<0.030	<0.030	<0.030	<0.030	0.032[J]	<0.030	<0.030
Equipment Blank	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Total Lead (ug/L)										
Field Duplicate	1.01	0.52	3.51	1.26	1.25[J]	0.5	0.64[J]	0.39[J]	0.45[J]	0.69[J]
Field Blank	<0.041	<0.041	<0.041	<0.041	0.073[J]	<0.041	0.088[J]	<0.041	<0.041	0.066[J]
Equipment Blank	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041	0.087[J]	<0.041	<0.041	<0.041
Total Zinc (ug/L)										
Field Duplicate	51.5	46.1	53.4	38.2	33.2	8.18[J]	5.65[J]	5.38[J]	6.63[J]	17.4
Field Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
Equipment Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
Dissolved Cadmium (ug/L)										
Field Duplicate	<0.030	0.054[J]	0.24[J]	0.068[J]	0.060[J]	<0.030	<0.030	0.043[J]	<0.030	<0.030
Field Blank	<0.030	<0.030	<0.030	<0.032	<0.030	<0.030	<0.030	0.035[J]	<0.030	<0.030
Equipment Blank	<0.030	<0.030	<0.030	<0.032	<0.030	<0.030	<0.030	0.041[J]	<0.030	<0.030
Dissolved Lead (ug/L)										
Field Duplicate	0.084[J]	0.10[J]	0.79	0.50[J]	0.23[J]	0.26[J]	0.34[J]	0.26[J]	0.27[J]	0.15[J]
Field Blank	<0.041	<0.041	<0.041	<0.041	<0.041	0.065[J]	<0.041	<0.041	<0.041	<0.041
Equipment Blank	<0.041	<0.041	<0.041	<0.043	<0.041	<0.041	<0.041	<0.041	<0.041	<0.041
Dissolved Zinc (ug/L)										
Field Duplicate	49.2	42.9	49.6	34.4	28.6	6.28[J]	4.71[J]	4.97[J]	6.20[J]	14.9
Field Blank	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50
Equipment Blank	<2.50	<2.50	<2.50	<2.63	<2.50	<2.50	<2.50	<2.50	<2.50	<2.50

J-estimated value below reporting limit

Field duplicate locations 1=Downstream, 2=Upstream

Appendix A -Statistical Analysis of Upstream and Downstream Analytical Data

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

Total Phosphorus (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.006	0.006	0.024
3/3/2015	0.006	0.006	0.028
4/7/2015	0.009	0.009	0.033
5/5/2015	0.007	0.008	0.033
6/2/2015	0.007	0.008	0.036
7/7/2015	0.006	0.005	0.081
8/4/2015	0.006	0.005	0.05
9/8/2015	0.004	0.004	0.026
10/6/2015	0.005	0.003	0.019
11/3/2015	0.007	0.005	0.013

Wilcoxon signed-rank test

sign |	obs	sum ranks	expected
positive |	4	32	22.5
negative |	2	13	22.5
zero |	4	10	10
all |	10	55	55

unadjusted variance 96.25
adjustment for ties -1.25
adjustment for zeros -7.50
adjusted variance 87.50
Ho: upstream = downstream
z = 1.016
Prob > |z| = 0.3098

Total Reactive Phosphorus (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.0005	0.0005	0.014
3/3/2015	0.002	0.002	0.019
4/7/2015	0.005	0.004	0.021
5/5/2015	0.003	0.002	0.025
6/2/2015	0.002	0.002	0.034
7/7/2015	0.0005	0.002	0.074
8/4/2015	0.002	0.002	0.048
9/8/2015	0.003	0.003	0.026
10/6/2015	0.002	0.002	0.015
11/3/2015	0.004	0.005	0.011

Wilcoxon signed-rank test

sign |	obs	sum ranks	expected
positive |	2	16.5	17
negative |	2	17.5	17
zero |	6	21	21
all |	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -22.75
adjusted variance 73.38
Ho: upstream = downstream
z = -0.058
Prob > |z| = 0.9535

Ammonia (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.005	0.005	4.78
3/3/2015	0.005	0.005	2.59
4/7/2015	0.012	0.013	0.261
5/5/2015	0.005	0.01	0.259
6/2/2015	0.005	0.005	0.251
7/7/2015	0.005	0.005	0.192
8/4/2015	0.005	0.005	0.121
9/8/2015	0.005	0.005	0.25
10/6/2015	0.005	0.005	0.094
11/3/2015	0.005	0.005	0.371

Wilcoxon signed-rank test

sign |	obs	sum ranks	expected
positive |	0	0	9.5
negative |	2	19	9.5
zero |	8	36	36
all |	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -51.00
adjusted variance 45.25
Ho: upstream = downstream
z = -1.412
Prob > |z| = 0.1579

Appendix A -Statistical Analysis of Upstream and Downstream Analytical Data

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

Nitrate+Nitrite (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.145	0.126	9.6
3/3/2015	0.205	0.179	17.9
4/7/2015	0.164	0.162	16.8
5/5/2015	0.298	0.344	16.7
6/2/2015	0.282	0.288	18
7/7/2015	0.966	0.949	16.2
8/4/2015	0.948	0.965	16.9
9/8/2015	0.936	0.938	15.4
10/6/2015	0.859	0.877	1.35
11/3/2015	0.534	0.555	20.1

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	4	22	27.5
negative	6	33	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros 0.00
adjusted variance 96.25
Ho: upstream = downstream
z = -0.561
Prob > |z| = 0.5751

Alkalinity (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	32.5	30.8	136
3/3/2015	37.5	34.4	101
4/7/2015	27.5	28.6	72
5/5/2015	43.8	45	77
6/2/2015	39.1	42.6	92.7
7/7/2015	104	104	46.5
8/4/2015	119	118	100
9/8/2015	125.0	133	93.5
10/6/2015	119	118	101
11/3/2015	69	67.8	68.3

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	5	25	27
negative	4	29	27
zero	1	1	1
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -0.25
adjusted variance 95.88
Ho: upstream = downstream
z = -0.204
Prob > |z| = 0.8382

Hardness (mg/L)

Date	Upstream	Downstream	Effluent
2/3/2015	31.2	29.2	141
3/3/2015	38.3	34.9	135
4/7/2015	30.5	31.1	133
5/5/2015	46.4	47.7	145
6/2/2015	45.6	46.2	149
7/7/2015	118	119	145
8/4/2015	129	123	135
9/8/2015	122	123	138
10/6/2015	118	118	138
11/3/2015	66.9	66.4	123

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	4	29	27
negative	5	25	27
zero	1	1	1
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -0.25
adjusted variance 95.88
Ho: upstream = downstream
z = -0.204
Prob > |z| = 0.8382

Appendix A -Statistical Analysis of Upstream and Downstream Analytical Data

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

Total Cadmium (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.015	0.015	0.0015
3/3/2015	0.1	0.071	0.0015
4/7/2015	0.27	0.25	0.0015
5/5/2015	0.11	0.1	0.0015
6/2/2015	0.099	0.11	0.0015
7/7/2015	0.015	0.015	0.0015
8/4/2015	0.015	0.015	0.0015
9/8/2015	0.038	0.044	0.035
10/6/2015	0.015	0.015	0.0015
11/3/2015	0.015	0.015	0.0015

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	3	26	20
negative	2	14	20
zero	5	15	15
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -13.75
adjusted variance 82.50
Ho: upstream = downstream
z = 0.661
Prob > |z| = 0.5089

Total Lead (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	1.07	1.06	0.16
3/3/2015	0.52	0.54	0.15
4/7/2015	3.53	3.6	0.15
5/5/2015	1.25	1.24	0.18
6/2/2015	1.3	1.18	0.17
7/7/2015	0.64	0.5	0.19
8/4/2015	0.61	0.54	0.12
9/8/2015	0.42	0.34	0.14
10/6/2015	0.44	0.45	0.16
11/3/2015	0.71	0.7	0.13

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	7	42	27.5
negative	3	13	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.50
adjustment for zeros 0.00
adjusted variance 95.75
Ho: upstream = downstream
z = 1.482
Prob > |z| = 0.1384

Total Zinc (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	52.7	53.1	25.8
3/3/2015	46.7	46.8	26.3
4/7/2015	54.6	55.3	26
5/5/2015	38.6	38.3	24.2
6/2/2015	35.5	33	22.7
7/7/2015	9.54	7.45	25.5
8/4/2015	5.56	4.88	16.5
9/8/2015	5.65	4.7	17.4
10/6/2015	6.75	6.03	14.9
11/3/2015	17.4	17.2	15

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	7	44	27.5
negative	3	11	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros 0.00
adjusted variance 96.25
Ho: upstream = downstream
z = 1.682
Prob > |z| = 0.0926

Appendix A -Statistical Analysis of Upstream and Downstream Analytical Data

Spokane County Regional Water Reclamation Facility 2015 Receiving Water Study

Dissolved Cadmium (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.015	0.015	<0.030
3/3/2015	0.047	0.057	<0.030
4/7/2015	0.24	0.22	<0.030
5/5/2015	0.082	0.078	<0.032
6/2/2015	0.06	0.051	<0.030
7/7/2015	0.015	0.015	<0.030
8/4/2015	0.015	0.015	<0.030
9/8/2015	0.015	0.039	<0.030
10/6/2015	0.015	0.015	<0.030
11/3/2015	0.015	0.015	<0.030

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	3	22	20
negative	2	18	20
zero	5	15	15
all	10	55	55

unadjusted variance 96.25
adjustment for ties 0.00
adjustment for zeros -13.75
adjusted variance 82.50
Ho: upstream = downstream
z = 0.220
Prob > |z| = 0.8257

Dissolved Lead (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	0.077	0.088	0.15
3/3/2015	0.091	0.01	0.15
4/7/2015	0.79	0.92	0.13
5/5/2015	0.48	0.48	0.15
6/2/2015	0.23	0.22	0.15
7/7/2015	0.31	0.27	0.15
8/4/2015	0.34	0.32	0.12
9/8/2015	0.27	0.21	0.22
10/6/2015	0.3	0.24	0.14
11/3/2015	0.17	0.15	0.15

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	7	41	27
negative	2	13	27
zero	1	1	1
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros -0.25
adjusted variance 95.88
Ho: upstream = downstream
z = 1.430
Prob > |z| = 0.1528

Dissolved Zinc (ug/L)

Date	Upstream	Downstream	Effluent
2/3/2015	50.2	51.6	26.8
3/3/2015	42.5	44.0	26.6
4/7/2015	50.2	48.6	25.5
5/5/2015	35.2	35	23.3
6/2/2015	28.6	28.1	20.7
7/7/2015	6.94	6.32	21
8/4/2015	5.02	4.46	17.3
9/8/2015	5.19	4.26	17.3
10/6/2015	6.65	5.98	15.1
11/3/2015	15.9	15.4	15.7

Wilcoxon signed-rank test

sign	obs	sum ranks	expected
positive	8	38	27.5
negative	2	17	27.5
zero	0	0	0
all	10	55	55

unadjusted variance 96.25
adjustment for ties -0.13
adjustment for zeros 0.00
adjusted variance 96.13
Ho: upstream = downstream
z = 1.071
Prob > |z| = 0.2842

Spokane County Regional Water Reclamation Facility
Receiving Water Sampling
Spokane River and effluent samples
2013 through 2016

Notes:
<: not detected at detection limit
J: Estimated value below reporting limit

Spokane River Upstream Site (upstream of SCRWRF outfall)													
Grab Date	Total Phosphorus (mg/L as P)	Total Reactive Phosphorus (mg/L as P)	Ammonia (mg/L as N)	Nitrate+Nitrite (mg/L as N)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Total Cadmium (ug/L as Cd)	Total Lead (ug/L as Pb)	Total Zinc (ug/L as Zn)	Dissolved Cadmium (ug/L as Cd)	Dissolved Lead (ug/L as Pb)	Dissolved Zinc (ug/L as Zn)	River Flow on sample date (at Spokane Gage in cfs, at noon)
2/27/2013	0.010	0.003	<0.010	0.263	44.8	43.0	0.27J	1.08	55.1	0.21J	0.23J	54.5	4,670
3/20/2013	0.011	0.003	0.023	0.114	32.3	28.5	<0.030	1.49	53.4	<0.030	0.21J	47.1	10,300
4/17/2013	0.008	0.002	<0.010	0.166	39.3	36.7	0.15J	2.32	58.2	0.081J	0.51	52.5	13,200
6/5/2013	0.006	0.002	<0.010	0.235	46.3	41.6	0.044J	1.51	36.3	<0.030	0.22J	32.8	6,320
6/26/2013	0.006	0.002	<0.010	0.224	45	37.5	0.10J	0.92	33	0.051J	0.10J	27.9	5,320
7/24/2013	0.003	0.002	<0.010	0.8	108	93.6	<0.030	0.66	14	<0.030	0.12J	11.7	1,340
8/21/2013	0.004	<0.001	<0.010	0.893	122	106	<0.030	0.55	8.65	<0.030	0.26J	7.81	1,060
9/18/2013	0.005	<0.001	<0.010	0.665	96.8	87.6	0.051J	0.48J	12	0.046J	0.12J	11.2	1,440
10/16/2013	0.005	<0.001	<0.010	0.372	65.0	58.4	0.10J	0.64	25.3	0.078J	0.12J	23.1	2,840
11/13/2013	0.004	0.002	0.014	0.407	64.1	60.4	0.11J	0.38J	34	0.089J	0.062J	32.2	3,080
1/29/2014	0.006	0.002	0.03	0.322	54.4	51.8	0.054J	0.44J	43.2	<0.030	0.080J	39.7	3,230
2/19/2014	0.01	0.005	0.03	0.234	43.5	41.2	0.21J	1.34	53.1	0.091J	0.19J	46.7	4,220
3/18/2014	0.008	0.004	0.014	0.039	24.9	26.2	0.12J	1.85	56.4	0.056J	0.32J	53.7	23,200
4/16/2014	0.015	<0.001	0.016	0.065	26.8	27.9	0.19J	3.28	52.7	0.16J	0.92	51.9	16,900
5/21/2014	0.008	0.002	<0.010	0.062	24.1	22.5	0.23J	3.03	41.4	0.17J	0.6	35.1	18,600
6/25/2014	0.006	0.003	<0.010	0.284	43.5	41.4	0.11J	0.99	31.6	0.086J	0.16J	28.7	5,230
7/16/2014	0.007	0.004	<0.010	0.503	66.9	64.1	0.1J	0.57	20.8	0.084J	0.09J	16.4	2,440
8/20/2014	0.004	0.002	<0.010	0.861	104	91.9	<0.03	0.17J	9.43J	<0.03	0.36J	9.05J	1,240
9/17/2014	0.005	0.002	<0.010	0.702	92.3	87.3	<0.03	0.49J	14.6	0.064J	0.18J	9.72J	1,390
10/08/14	0.008	0.003	<0.010	0.501	71.2	67.9	<0.03	0.68	19.1	<0.03	0.13J	14.3	1,980
11/4/2014	0.006	0.002	<0.010	0.529	67.8	68.1	0.071J	0.51	21.8	0.1J	0.52	21.1	2,110
12/10/2014	0.007	0.002	<0.010	0.188	39.5	38.5	0.14J	0.88	48.2	0.069J	0.071J	38.2	4,730
1/8/2015	0.005	0.002	0.013	0.188	36	35.3	0.15J	0.81	49.4	0.10J	0.16J	43.6	6,470
2/3/2015	0.006	<0.001	<0.010	0.145	32.5	31.2	<0.030	1.07	52.7	<0.030	0.077J	50.2	9,740
3/3/2015	0.006	0.002	<0.010	0.205	37.5	38.3	0.10J	0.52	46.7	0.047J	0.091J	42.5	9,710
4/7/2015	0.009	0.005	0.012	0.164	27.5	30.5	0.27J	3.53	54.6	0.24J	0.79	50.2	10,900
5/5/2015	0.007	0.003	<0.010	0.298	43.8	46.4	0.11J	1.25	38.6	0.082J	0.48J	35.2	4,280
6/2/2015	0.007	0.002	<0.010	0.282	39.1	45.6	0.099J	1.3	35.5	0.060J	0.23J	28.6	3890
7/7/2015	0.006	<0.001	<0.001	0.966	104	118	<0.030	0.64	9.54J	<0.030	0.31J	6.94J	854
8/4/2015	0.006	0.002	<0.010	0.948	119	96.4	<0.030	0.61	5.56J	<0.030	0.34J	5.02J	708
9/8/2015	0.004	0.003	<0.010	0.936	125	122	0.038J	0.42J	5.65J	<0.030	0.27J	5.19J	733
10/6/2015	0.005	0.002	<0.010	0.859	119	118	<0.030	0.44J	6.75J	<0.030	0.30J	6.65J	792
11/3/2015	0.007	0.004	<0.010	0.534	69	66.9	<0.030	0.71	17.4	<0.030	0.17J	15.9	1900
12/8/2015	0.004	0.002	0.016	0.595	74.3	81.1	0.073J	0.53	27.4	0.048J	0.064J	24.4	1720
1/5/2016													3710
2/2/2016	0.007	0.004	<0.010	0.164	34.6	37.3	0.13J	1.19	46.1	0.077J	0.077J	41.3	7380
3/8/2016	0.007	0.002	<0.010	0.152	30.1	39.5	0.17J	1.57	58.8	0.13J	0.36J	54.9	13200
4/12/2016	0.013	0.007	<0.010	0.082	26.3	no data	0.13J	3.31	55	0.067J	0.7	45.8	15600
5/4/2016	0.008	0.002	0.012	0.174	35.5	43.2	0.13J	1.38	37.1	0.11J	0.40J	32.8	7680
6/7/2016	0.007	0.003	<0.010	0.24	39.8	37.7	0.12J	1.19	36.9	0.083J	0.34J	33.1	5360
7/12/2016	0.004	<0.001	<0.010	0.656	67.4	74.7	0.12J	0.6	16.5	0.074J	0.12J	14.2	2020
8/2/2016	0.004	0.002	<0.010	0.951	59.3	117	<0.03	0.38J	7.47J	<0.03	0.16J	6.18J	927
9/6/2016	0.007	0.002	<0.010	1.08	132	130	<0.03	0.37J	4.88J	<0.03	0.2J	3.87J	750
10/4/2016	0.003	<0.001	<0.010	0.703	89.2	85	<0.03	0.66	16.6	<0.03	0.14J	13.3	1440
11/1/2016	0.003	<0.001	<0.010	0.249	45.6	42.8	<0.03	0.83	38.2	<0.03	0.088J	34.1	4370

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Spokane River Downstream Site (downstream of SCRWRF outfall)												
Grab Date	Total Phosphorus (mg/L as P)	Total Reactive Phosphorus (mg/L as P)	Ammonia (mg/L as N)	Nitrate+Nitrite (mg/L as N)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Total Cadmium (ug/L as Cd)	Total Lead (ug/L as Pb)	Total Zinc (ug/L as Zn)	Dissolved Cadmium (ug/L as Cd)	Dissolved Lead (ug/L as Pb)	Dissolved Zinc (ug/L as Zn)
2/27/2013	0.010	0.004	<0.010	0.267	45.6	44.6	0.39J	1.03	54.4	0.25J	0.22J	52.4
3/20/2013	0.011	0.003	<.010	0.095	31.0	26.8	0.073J	1.46	53.9	<0.030	0.21J	48.7
4/17/2013	0.008	0.002	<0.010	0.12	32.5	30.5	0.15J	2.35	61.3	0.11J	0.55	56.0
6/5/2013	0.006	0.002	<0.010	0.234	45.8	41.0	<0.030	1.09	36.0	0.069J	0.21J	27.6
6/26/2013	0.006	0.002	<0.010	0.224	45.8	39.5	0.086J	0.91	31.9	0.046J	0.10J	29.1
7/24/2013	0.004	0.002	<0.010	0.839	107	101	<0.030	0.77	17.1	<0.030	0.098J	10.6
8/21/2013	0.004	<0.001	<0.010	0.928	125	107	<0.030	0.48J	8.41	<0.030	0.23J	7.09
9/18/2013	0.004	0.001	<0.010	0.697	96.4	92.4	0.055J	0.43J	11	0.043J	0.11J	10.5
10/16/2013	0.004	0.001	<0.010	0.383	61.2	57.9	0.086J	0.58	25.2	0.056J	0.12J	22.6
11/13/2013	0.004	0.002	<0.010	0.417	65	60.2	0.11J	0.41J	33.8	0.097J	0.062J	32.5
1/29/2014	0.006	0.002	0.023	0.33	56	52	0.056J	0.41J	46.4	<0.030	0.081J	40.2
2/19/2014	0.009	0.005	0.027	0.235	43.4	41	0.21J	1.29	52.2	0.092J	0.18J	45.8
3/18/2014	0.009	0.003	0.017	0.038	24	25	0.080J	1.9	56.5	0.039J	0.32J	52.6
4/16/2014	0.013	0.001	0.015	0.054	25.8	26.6	0.19J	3.51	54.8	0.15J	0.94	52.3
5/21/2014	0.007	0.001	<0.010	0.053	24.1	22.1	0.21J	2.96	40.4	0.18J	0.64	36.6
6/25/2014	0.005	0.003	<0.010	0.291	45.1	41.8	0.11J	0.96	30.6	0.086J	0.18J	28.8
7/16/2014	0.006	0.004	<0.010	0.514	69.2	65.9	0.093J	0.57	18.3	0.075J	0.089J	16
8/20/2014	0.005	0.002	<0.010	0.886	107	91.4	<0.03	0.18J	8.69J	<0.03	0.32J	9.13J
9/17/2014	0.006	0.002	<0.010	0.731	94	89.1	<0.03	0.46J	12	<0.03	0.18J	8.94J
10/08/14	0.006	0.003	<0.010	0.522	75	68.7	<0.03	0.53	17.1	<0.03	0.13J	13.2
11/4/2014	0.006	0.002	<0.010	0.553	72.2	69.1	0.074J	0.45J	20.6	0.085J	0.46J	19.3
12/10/2014	0.007	0.002	<0.010	0.18	39.2	38.9	0.12J	0.86	45.1	0.09J	0.11J	37.8
1/8/2015	0.006	0.002	<0.010	0.18	34.9	35.1	0.14J	0.84	51.2	0.080J	0.085J	43.1
2/3/2015	0.006	<0.001	<0.010	0.126	30.8	29.2	<0.030	1.06	53.1	<0.030	0.088J	51.6
3/3/2015	0.006	0.002	<0.010	0.179	34.4	34.9	0.071J	0.54	46.8	0.057J	0.010J	44.0
4/7/2015	0.009	0.004	0.013	0.162	28.6	31.1	0.25J	3.6	55.3	0.22J	0.92	48.6
5/5/2015	0.008	0.002	0.01	0.344	45	47.7	0.10J	1.24	38.3	0.078J	0.48J	35
6/2/2015	0.008	0.002	<0.010	0.288	42.6	46.2	0.11J	1.18	33	0.051J	0.22J	28.1
7/7/2015	0.005	0.002	<0.010	0.949	104	119	<0.030	0.5	7.45J	<0.030	0.27J	6.32J
8/4/2015	0.005	0.002	<0.010	0.965	118	123	<0.030	0.54	4.88J	<0.030	0.32J	4.46J
9/8/2015	0.004	0.003	<0.010	0.938	133	123	0.044J	0.34J	4.70J	0.039J	0.21J	4.26J
10/6/2015	0.003	0.002	<0.010	0.877	118	118	<0.030	0.45J	6.03J	<0.030	0.24J	5.98J
11/3/2015	0.005	0.005	<0.010	0.555	67.8	66.4	<0.030	0.7	17.2	<0.030	0.15J	15.4
12/8/2015	0.005	0.002	<0.010	0.601	76.5	72.3	0.049J	0.49J	25.4	<0.030	0.066J	23.2
1/5/2016	0.004	0.002	<0.010	0.358	53.5	71.3	0.054J	0.54	35.1	<0.030	0.11J	33.1
2/2/2016	0.007	0.003	<0.010	0.16	33.4	36.4	0.15J	1.14	45.5	0.080J	0.071J	41.5
3/8/2016	0.01	0.002	<0.010	0.148	28.8	40.1	0.16J	1.49	58.4	0.12J	0.35J	55.7
4/12/2016	0.012	0.007	<0.010	0.073	25.8	no data	0.11J	3.34	56.1	0.063J	0.71	46.8
5/4/2016	0.008	0.002	0.013	0.181	37	42.2	0.14J	1.39	36.9	0.10J	0.42J	33.4
6/7/2016	0.007	0.003	<0.010	0.236	39.9	37.1	0.13J	1.11	35.8	0.077J	0.19J	33.1
7/12/2016	0.004	<0.001	<0.010	0.671	79.8	77	0.074J	0.58	17.4	0.056J	0.15J	14.3
8/2/2016	0.003	0.002	<0.010	0.968	60.1	116	<0.03	0.28J	6.42J	<0.03	0.17J	5.63J
9/6/2016	0.003	0.002	<0.010	0.97	132	128	<0.03	0.3J	4.18J	<0.03	0.2J	3.74J
10/4/2016	0.003	<0.001	<0.010	0.733	91.2	88.9	<0.03	0.59	14.4	<0.03	0.13J	12.4
11/1/2016	<0.002	<0.001	<0.010	0.281	45.5	43.2	<0.03	0.75	37.5	<0.03	0.11J	35.3

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SCRWRF Effluent (24 hour composite sample)												
Days of 24 hr composite	Total Phosphorus (mg/L as P)	Total Reactive Phosphorus (mg/L as P)	Ammonia (mg/L as N)	Nitrate+Nitrite (mg/L as N)	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Total Cadmium (ug/L as Cd)	Total Lead (ug/L as Pb)	Total Zinc (ug/L as Zn)	Dissolved Cadmium (ug/L as Cd)	Dissolved Lead (ug/L as Pb)	Dissolved Zinc (ug/L as Zn)
2/26-27/2013	0.0228	0.01	6.71	21.4	116	136	0.39J	0.19J	34.6	0.35J	0.15J	36.6
3/19-20/2013	0.0365	0.01	0.361	17.2	92	155	<0.030	0.55	37.5	<0.030	0.97	30.2
4/16-17/2013	0.043	0.01	2.33	19.4	100	138	<0.030	0.15	26.8	<0.030	0.14J	28
6/4-5/2013	0.0585	0.04	0.379	15.5	123	166	<0.030	0.14J	23.5	0.055J	0.14J	21.2
6/25-26/2013	0.0259	0.02	0.178	9.82	162	130	<0.030	0.12	15.2	<0.030	0.15J	16.1
7/24/2013										<0.030	0.19J	17.7
8/21/2013	0.055	0.04	0.066	8.79	148	138	<0.030	0.15J	15.5	<0.030	0.14J	16.1
9/18/2013	0.036	0.028	0.095	12.7	121	149	<0.030	0.16J	15.7	<0.030	0.18J	17.6
10/16/2013	0.037	0.034	0.032	8.64	143	137	<0.030	0.43J	13.9	<0.030	0.42J	14.5
11/13/2013	0.036	0.031	0.394	14.7	137	147	<0.030	0.14J	19.6	<0.030	0.15J	22.2
1/28-29/2014	0.03	0.019	2.66	16.5	116	138	<0.030	0.20J	25.9	<0.030	<0.041	<2.50
2/18-19/2014	0.022	0.015	9.09	11.9	168	133	<0.030	0.22J	22.8	<0.030	0.21J	22.5
3/17-18/2014	0.05	0.019	1.66	25.4	130	138	<0.030	0.17J	23.1	<0.030	0.17J	24.5
4/15-16/2014	0.038	0.017	3.51	14.7	150	132	<0.030	0.15J	19.1	<0.030	0.18J	22.6
5/20-21/2014	0.03	0.019	0.02	16.8	110	140	<0.030	0.16J	18.9	<0.030	0.16J	19.3
6/24-25/2014	0.03	0.028	0.021	23.5	102	136	<0.03	0.15J	18.2	<0.03	0.15J	19.2
7/15-16/2014	0.033	0.029	0.026	18.5	101	137	<0.03	0.17J	20	<0.03	0.16J	21.4
8/19-20/2014	0.047	0.044	0.065	18	110	132	<0.03	0.17J	16.2	<0.03	0.18J	34.4
9/16-17/2014	0.055	0.046	0.16	18.8	105	145	<0.03	0.31J	21.8	<0.03	0.22J	18.3
10/7-8/2014	0.058	0.051	0.043	13.4	101	144	<0.03	0.17J	21.7	<0.03	0.15J	20.6
11/3-4/2014	0.038	0.032	1.01	16	118	159	<0.03	0.15J	18.1	<0.03	0.13J	17.1
12/9-10/2014	0.031	0.02	7.79	8.08	138	153	<0.03	0.13J	27.7	<0.03	0.14J	20.4
1/7-8/2015	0.018	0.014	7.27	11.9	138	152	<0.030	0.29J	30	<0.030	0.14J	27.3
2/2-3/2015	0.024	0.014	4.78	9.6	136	141	<0.030	0.16J	25.8	<0.030	0.15J	26.8
3/2-3/2015	0.028	0.019	2.59	17.9	101	135	<0.030	0.15J	26.3	<0.030	0.15J	26.6
4/6-7/2015	0.033	0.021	0.261	16.8	72	133	<0.030	0.15J	26	<0.030	0.13J	25.5
5/4-5/2015	0.033	0.025	0.259	16.7	77	145	<0.030	0.18J	24.2	<0.032	0.15J	23.3
6/1-2/2015	0.036	0.034	0.251	18	92.7	149	<0.030	0.17J	22.7	<0.030	0.15J	20.7
7/6-7/2015	0.081	0.074	0.192	16.2	46.5	145	<0.030	0.19J	25.5	<0.030	0.15J	21
8/3-4/2015	0.05	0.048	0.121	16.9	100	135	<0.030	0.12J	16.5	<0.030	0.12J	17.3
9/7-8/2015	0.026	0.026	0.25	15.4	93.5	138	0.035J	0.14J	17.4	<0.030	0.22J	17.3
10/5-6/2015	0.019	0.015	0.094	1.35	101	138	<0.030	0.16J	14.9	<0.030	0.14J	15.1
11/2-3/2015	0.013	0.011	0.371	20.1	68.3	123	<0.030	0.13J	15	<0.030	0.15J	15.7
12/7-8/2015	0.014	0.004	1.19	16.1	67	126	<0.030	0.11J	12.9	<0.030	0.087J	14
1/4-5/2016	0.011	0.006	1.637	15.6	111	130	<0.030	0.26J	11.2	<0.030	0.11J	11
2/1-2/2016	0.008	0.002	1.54	24.8	34	141	<0.030	0.12J	16.7	<0.030	0.10J	16.3
3/7-8/2016	0.011	0.002	0.129	24.3	46.3	130	<0.030	0.15J	15.2	<0.030	0.17J	15.4
4/11- 12/2016	0.009	0.002	0.121	17.5	11	no data	<0.030	0.12J	20.9	<0.030	0.13J	21.2
5/3-4/2016	0.007	0.002	2.19	18.9	33.4	131	<0.030	0.15J	16.4	<0.030	0.13J	17.1
6/6-7/2016	0.005	0.002	0.101	16.8	42.7	136	<0.030	0.18J	15.8	<0.030	0.13J	16.3
7/11-12/2016	0.011	0.004	1.03	13.6	77.7	141	<0.03	0.14J	11.7	<0.03	0.13J	11.8
8/1-2/2016	0.02	0.008	0.13679538	13.9	88.9	141	<0.03	0.14J	12.5	<0.03	0.13J	12.5
9/5-6/2016	0.03	0.026	0.52	10.8	88	142	<0.03	0.13J	12.2	<0.03	0.12J	12.4
10/3-4/2016	0.074	0.063	0.118	14.7	80.7	142	<0.03	0.11J	22.7	<0.03	0.13J	22.8
)/31-11/1/2016	0.033	0.024	0.036	11.3	83	122	<0.03	0.15J	18.2	<0.03	0.16J	18.9