2012 Eagle Creek Temperature Study

Annual Report

Prepared for:

Lower Minnesota River Watershed District

By: Scott Soil and Water Conservation District

Lower Minnesota River Watershed District

SCOTT Soil & Water Conservation District

Background: This study was initiated by the Lower Minnesota River Watershed District (LMRWD) to evaluate the impact storm water runoff from Highway 101 has on temperatures of Eagle Creek, a DNR designated trout stream. Brown Trout are very sensitive to temperature as it impacts growth rate, habitat and food resources. The optimal temperature range for adult brown trout is approximately 12.4 – 17.6° Celsius (Bell, 2006). Temperature loggers were placed upstream and downstream of Highway 101 by Bonestroo in June of 2006 (see Figure 1), and have been recording stream temperature since that time. In October 2012, a midstream logger was placed just upstream of a pond tributary to monitor its impact on stream temperatures. The loggers record continuous temperature data in 15-minute intervals. Scott Soil and Water Conservation District (SWCD) contracts with the LMRWD to collect and report the temperature data. Rainfall data is provided for this study at the Watershed Outlet Monitoring Program (WOMP) Station from March 1st through October 31st. (see Figure 1 for location).

Figure 1. Location of temperature loggers and WOMP station

Results: Under most conditions, temperature results track atmospheric temperatures. During winter months, the downstream water is cooler because it is exposed to cold air longer than upstream water. During summer months, the downstream water is warmer because it is exposed to warm air longer.

During warm summer days, water temperatures occasionally exceeded the optimal range for trout, but for only a few hours at a time. This is likely due to warmer air temperatures (Figure 2 and Figure 5). Noticeable warming of water temperatures downstream of highway 101 also occured following some rain events, while the upstream logger did not respond as drastically (see Figure 3). This downstream warming may be caused by multiple variables. One is that rainwater heats up after landing on and flowing across the hot highway pavement before entering the stream . A second possible variable to consider is overflow from the pond located between Highway 101 and the railroad tracks, which discharges into Eagle Creek from the west (see Figure 4). The downstream temperature logger is located approximately 30 feet downstream of this input. This pond holds water which is likely warmed by a combination of solar energy and storm water inflow from the area south of Hwy 101. Large amounts of warm water may be released during rain events as the pond fills and overflows. An investigation conducted on August 19, 2009, during a 2-inch rain event (see Figure 4) shows numerous temperature monitoring locations on Eagle Creek upstream and downstream of the pond tributary, including the tributary itself. The temperature of Eagle Creek rises almost 2°C directly after the tributary discharges into Eagle Creek. The tributary water is almost 5°C higher than Eagle Creek. According to this study, temperature spikes appear to be due less from direct Highway 101 runoff, but rather more significantly, a combination of the warm ponded water, runoff from Highway 101, and an increase of water volume leaving the pond. The temperature of the pond may

not actually increase during storm events, but rather the volume of water discharging into Eagle Creek is perhaps the stronger influence on temperature rise. This greatly exceeds the small increase in temperature that typically occurs during dry periods that could be attributed to atmospheric warming of the stream. Even though the temperature exceeds the optimal range for trout by only a few degrees and for only a short period, these rapid temperature increases could be stressful to fish.

Water quality, in addition to water temperatature, is an important factor influencing the health of trout streams. Overall, water quality of Eagle Creek appears good and brown trout are making a comeback (Peterson, 2008), water temperatures rarely exceed optimal range, and most of the riparian area is in a natural state. However, the state water quality standard for Class 2A waters maintain there shall be "no material increase" in temperature. Future monitoring will help track whether the construction that took place in 2011 will reduce the temperature spikes in Eagle Creek following rain events.

Notes: In 2012 new loggers were installed in both the upstream and downstream locations. The upstream logger was placed in a location that is unlikely to get buried in sediment. A midstream logger was added in October and was installed just upstream of the pond tributary.

Recommendations: Road construction took place on Highway 101 in 2011, including the stretch of road that crosses Eagle Creek. Some runoff was to be reduced to Eagle Creek and instead diverted to a storm water holding pond. By continuing monitoring efforts, the opportunity exists to determine how much influence the roadway has on stream temperature after construction has been completed and runoff is minimized. The midstream logger will help to determine how much of an impact the stormwater holding pond has on the downstream water temperatures of Eagle Creek.

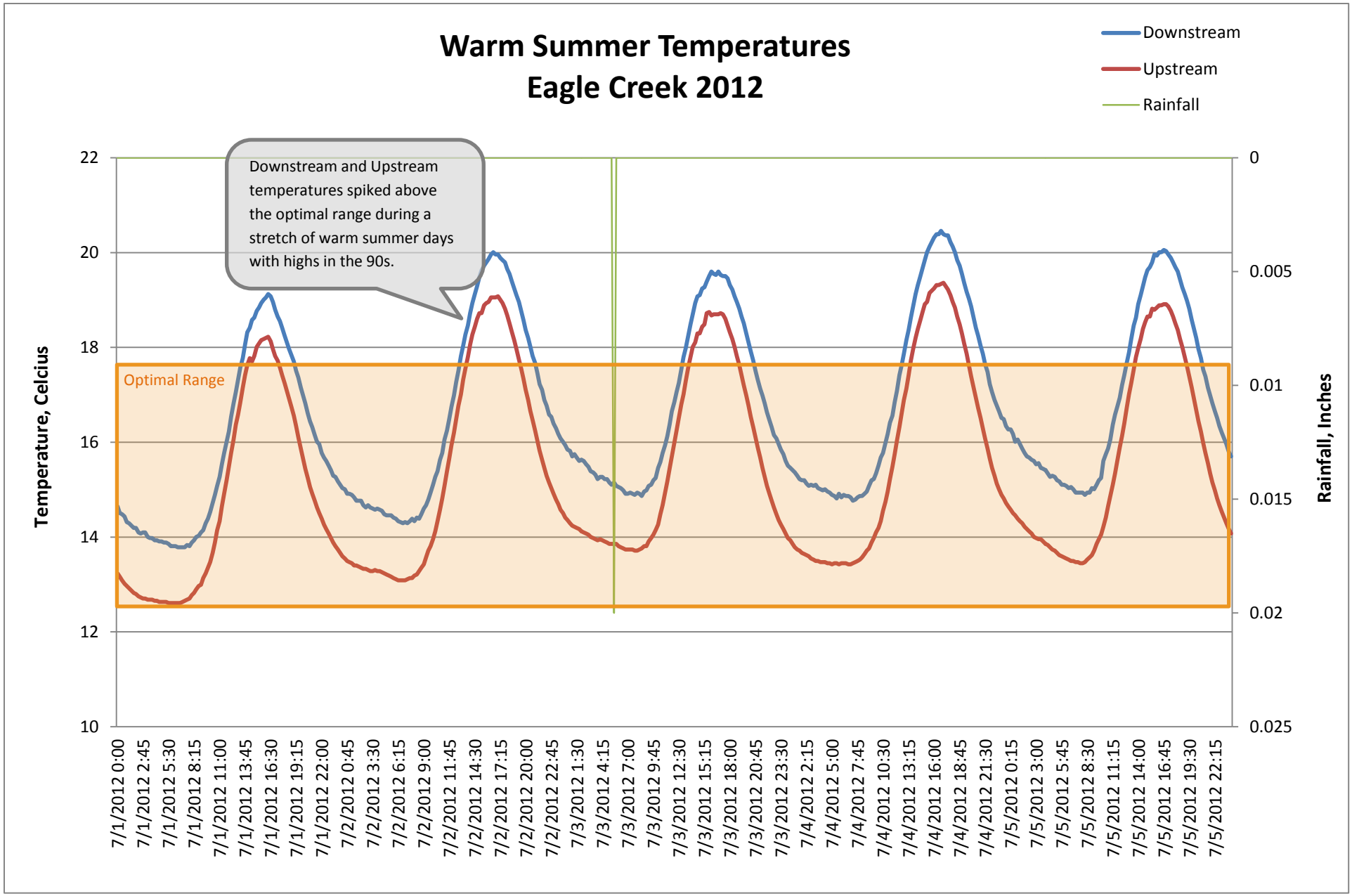


Figure 2. Warm Summer Temperatures in Eagle Creek. During warm summer days, the optimal range is exceeded for a few hours during mid-day.

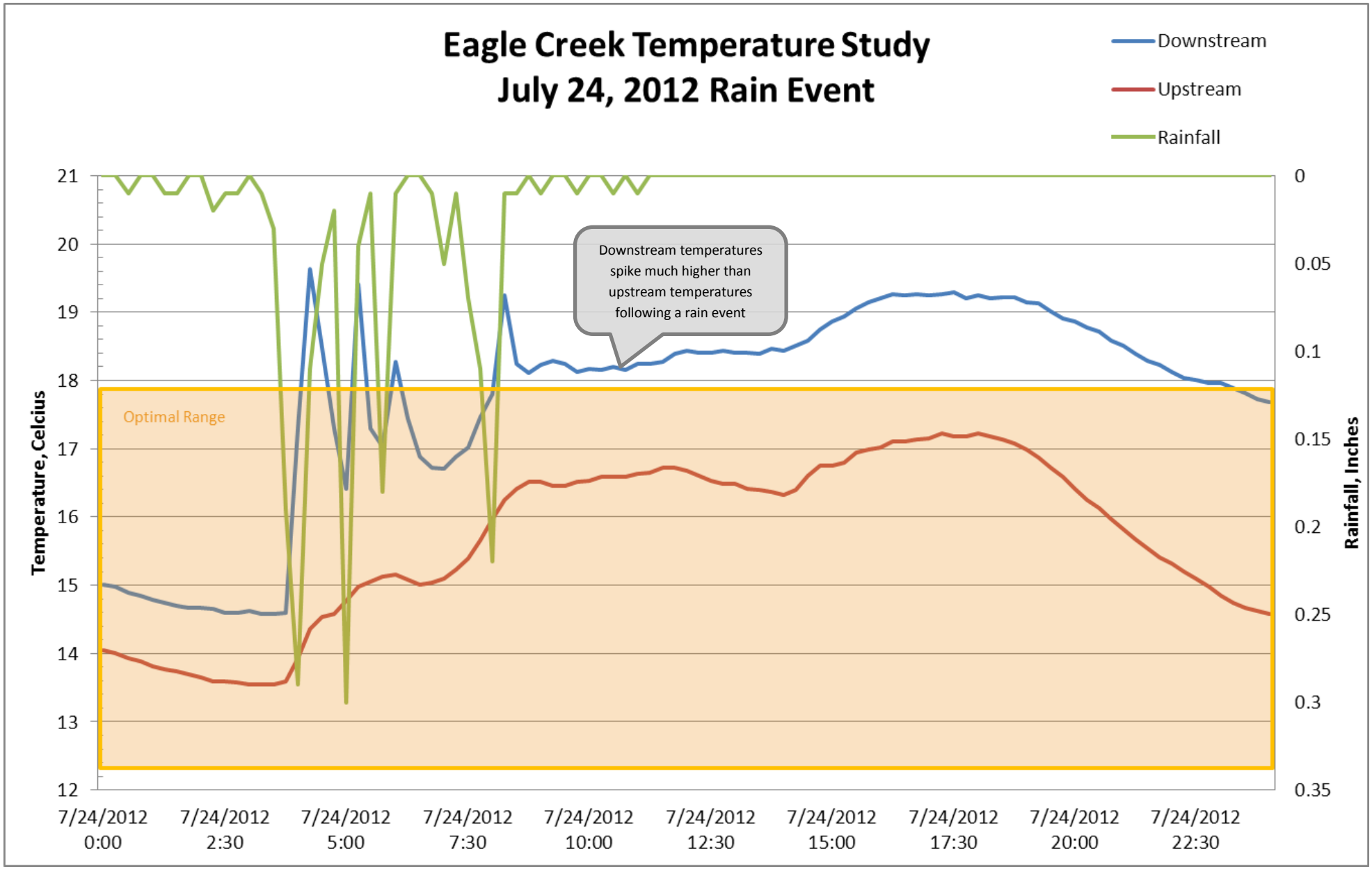


Figure 3. Rain Event Response. This graph represents the temperature deviations following a rain event.

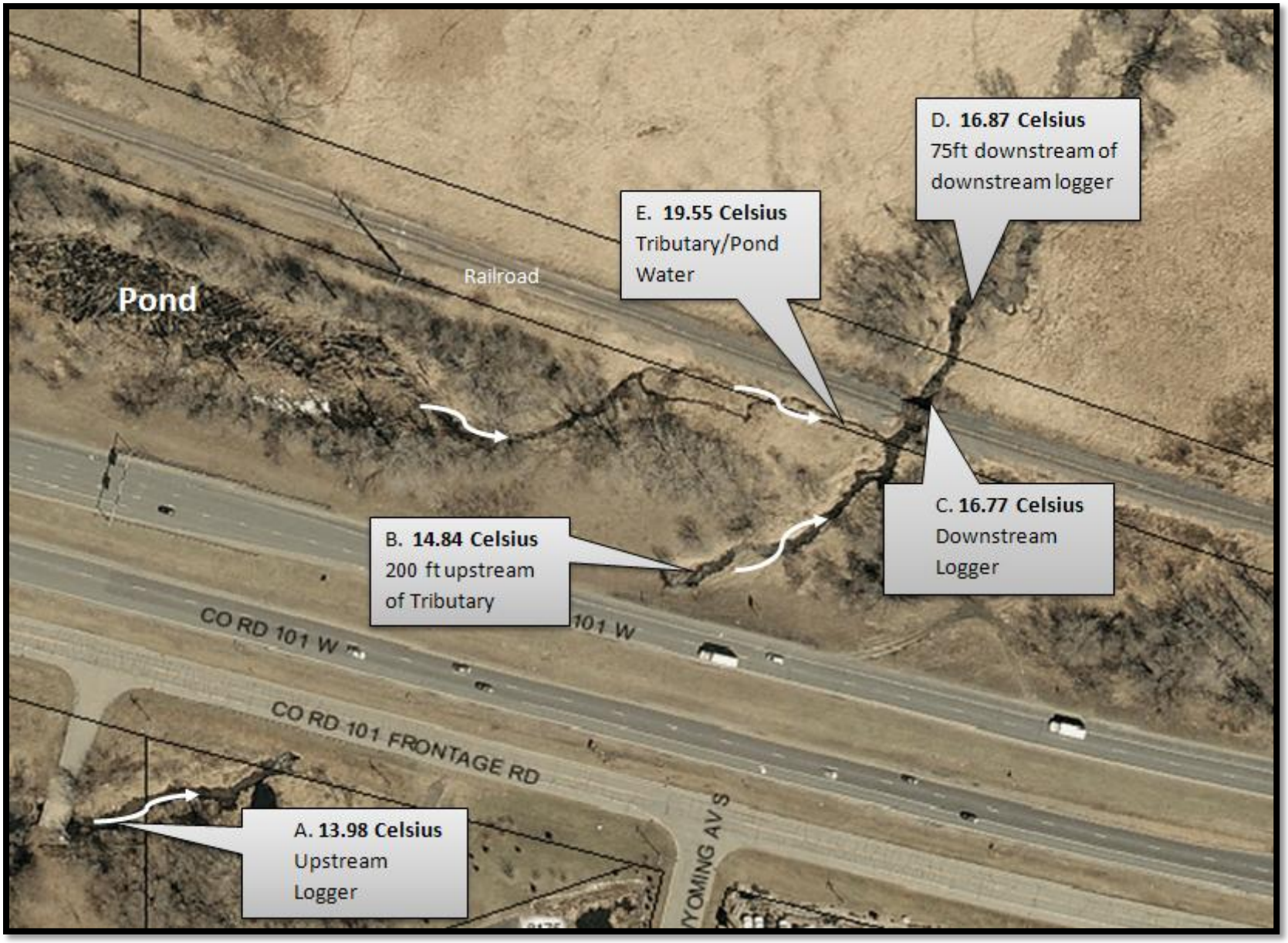


Figure 4. Investigative Temperature Monitoring During Rain Event. White arrows indicate flow direction. Callouts indicate temperature values taken at approximately 4:00pm on August 19, 2009 during a 2" rain event. Notice temperature increase between (B) and (C). Tributary (E), which comes from the pond, is contributing warmer water than the direct contribution from Highway 101 (estimated that 5–10 cfs water coming from tributary during time of measurement).

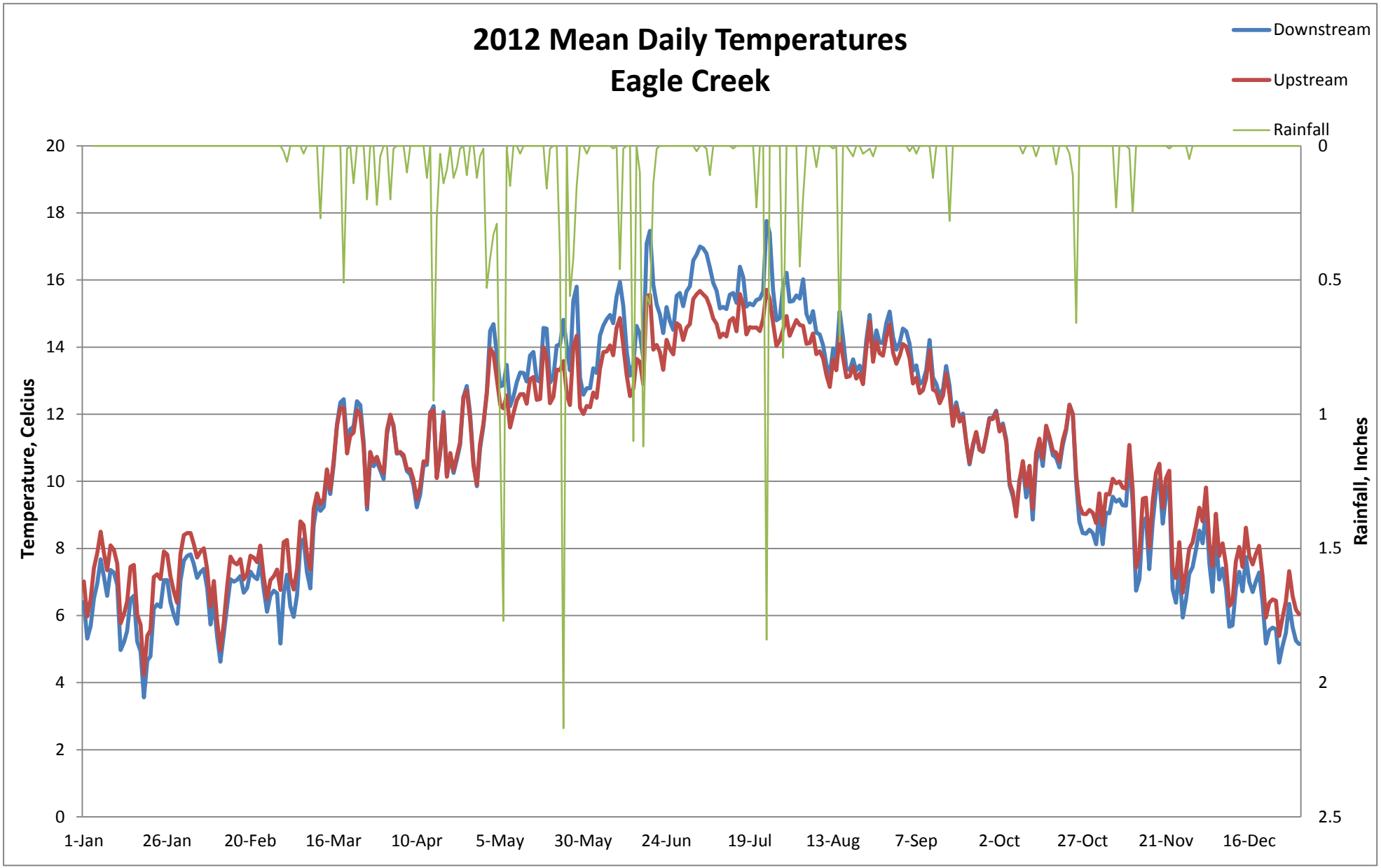
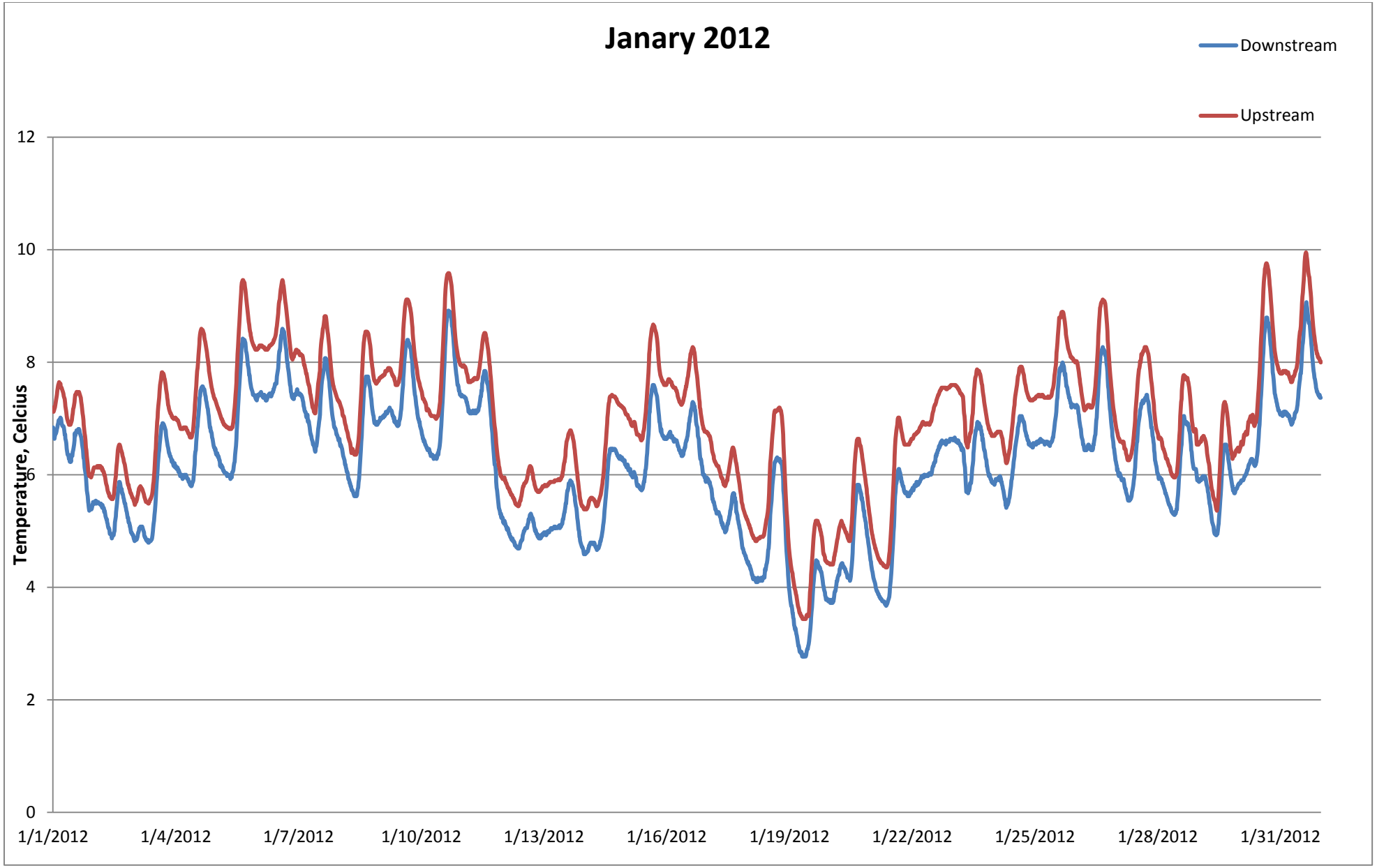
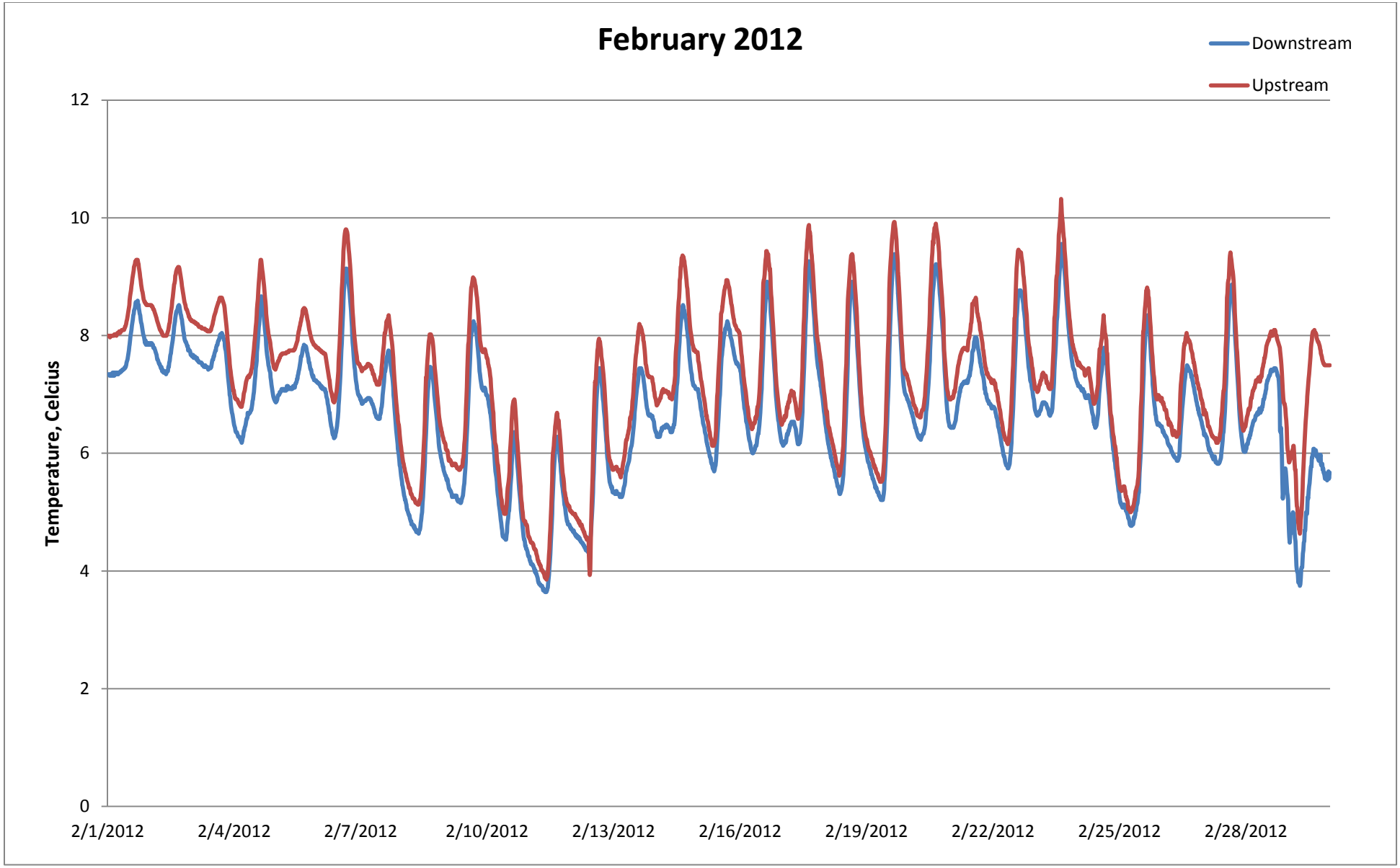
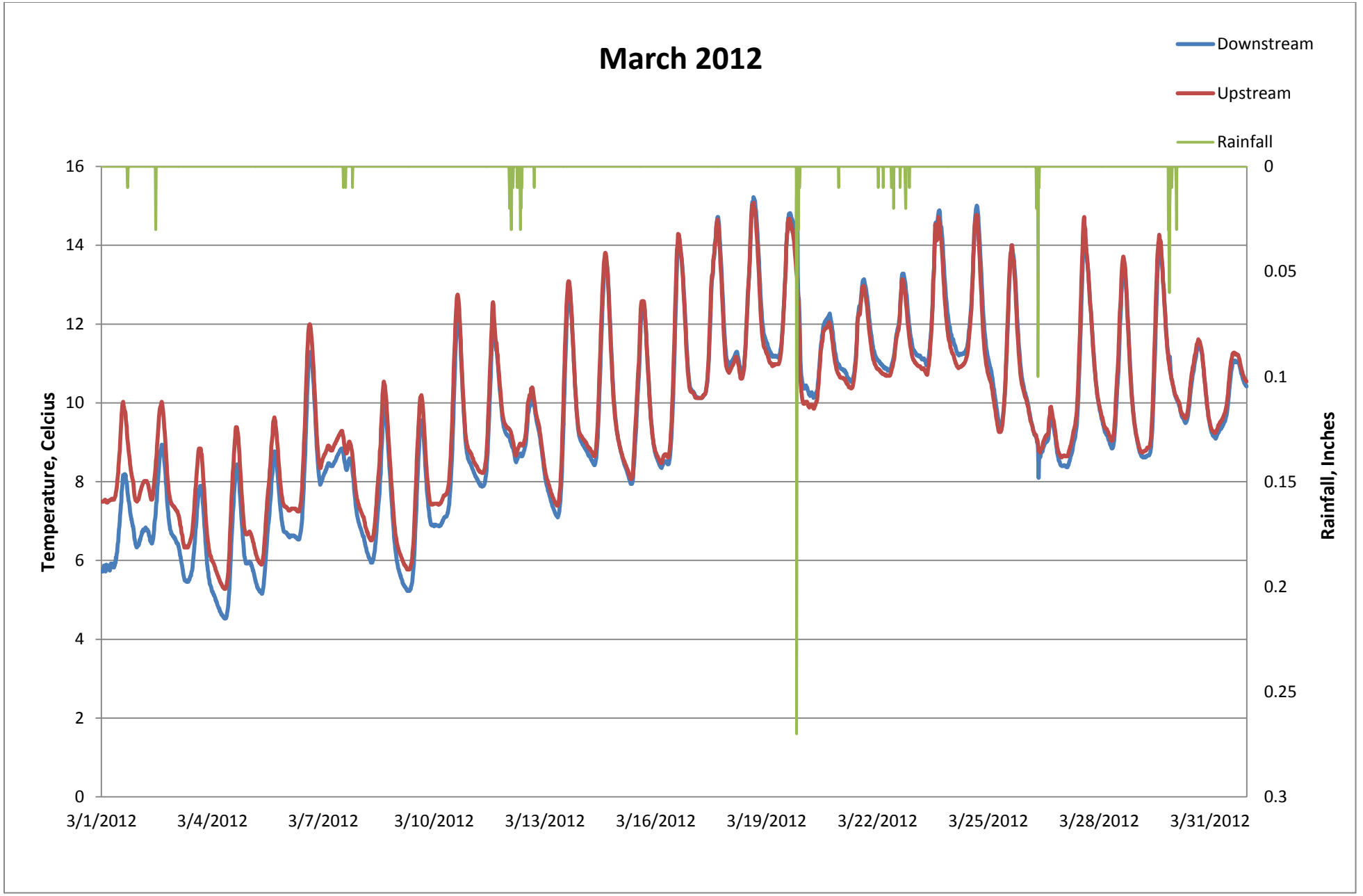
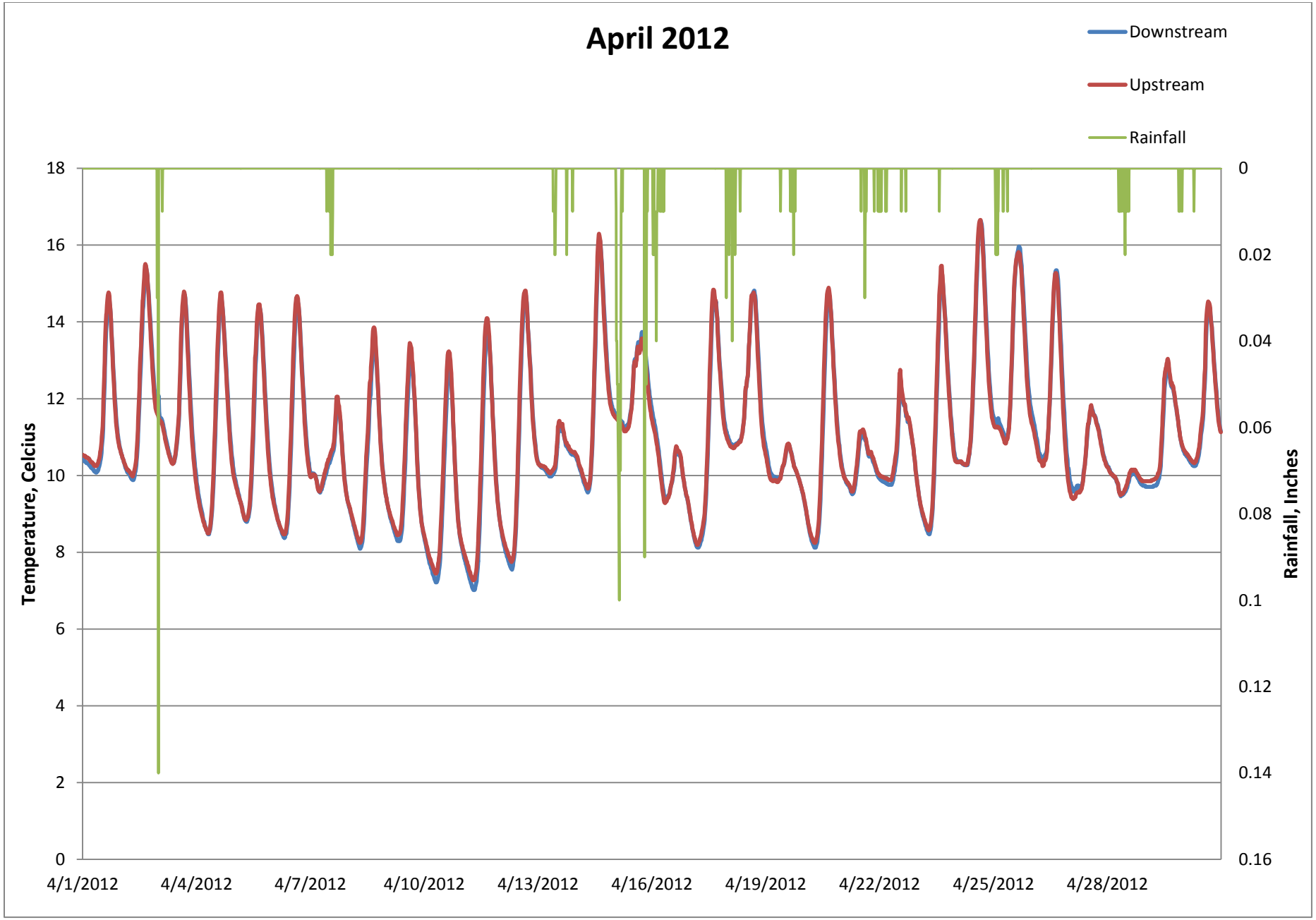


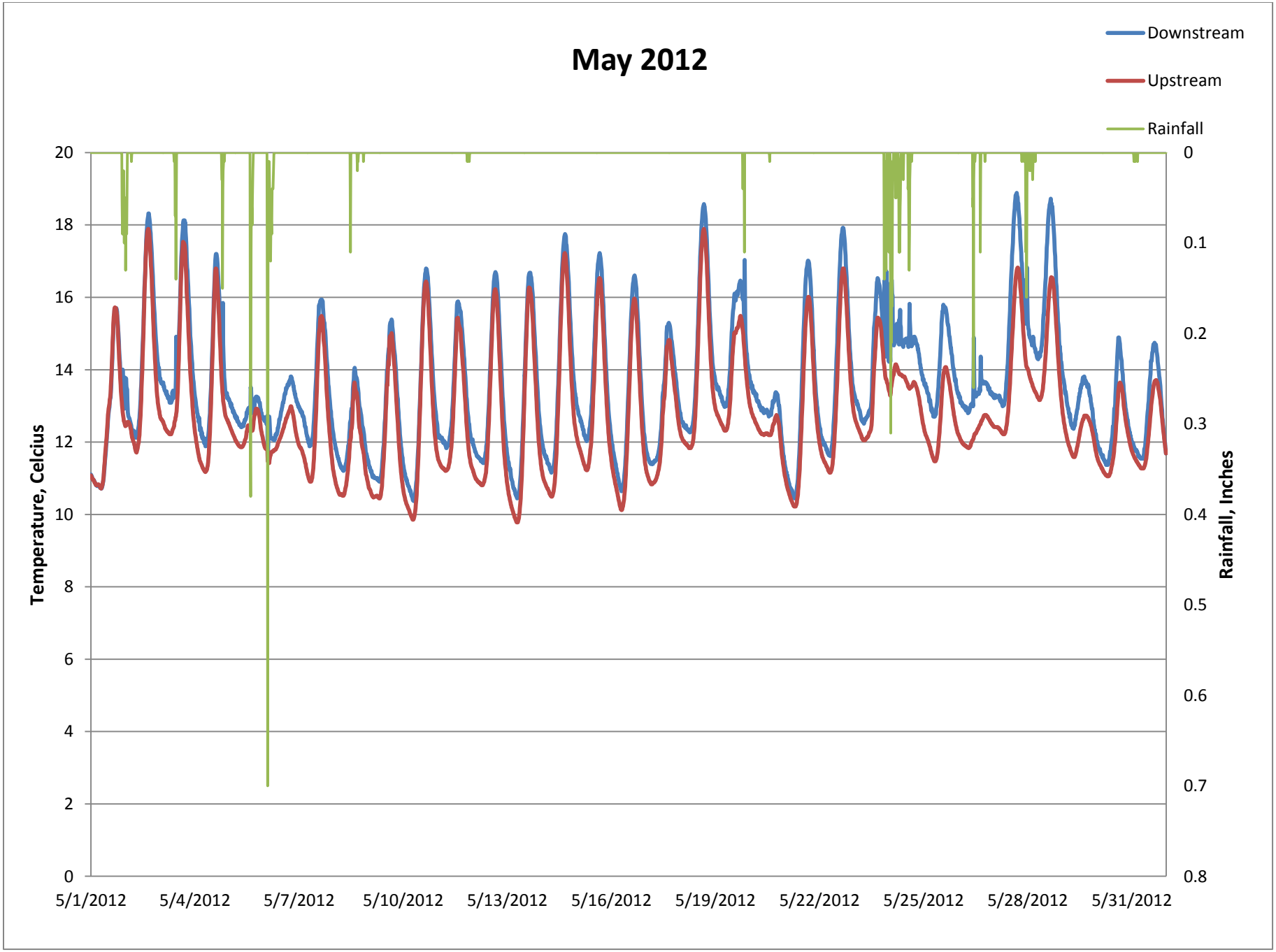
Figure 5. Mean Daily Temperature Values.

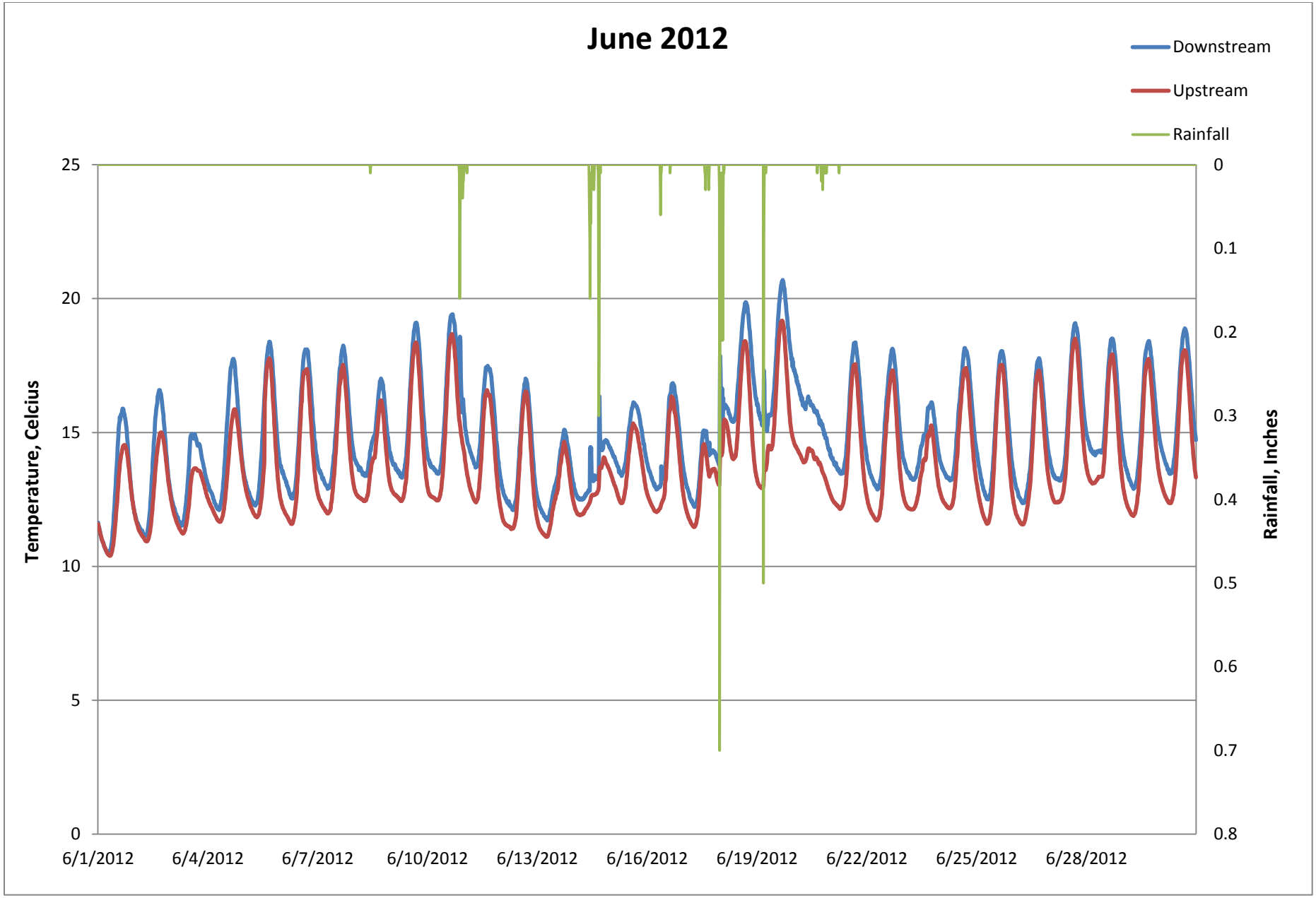

Janary 2012
Downstream
Upstream
Temperature, Celcius
12
10
8
6
4
2
0
1/1/2012
1/4/2012
1/7/2012
1/10/2012
1/13/2012
1/16/2012
1/19/2012
1/22/2012
1/25/2012
1/28/2012
1/31/2012

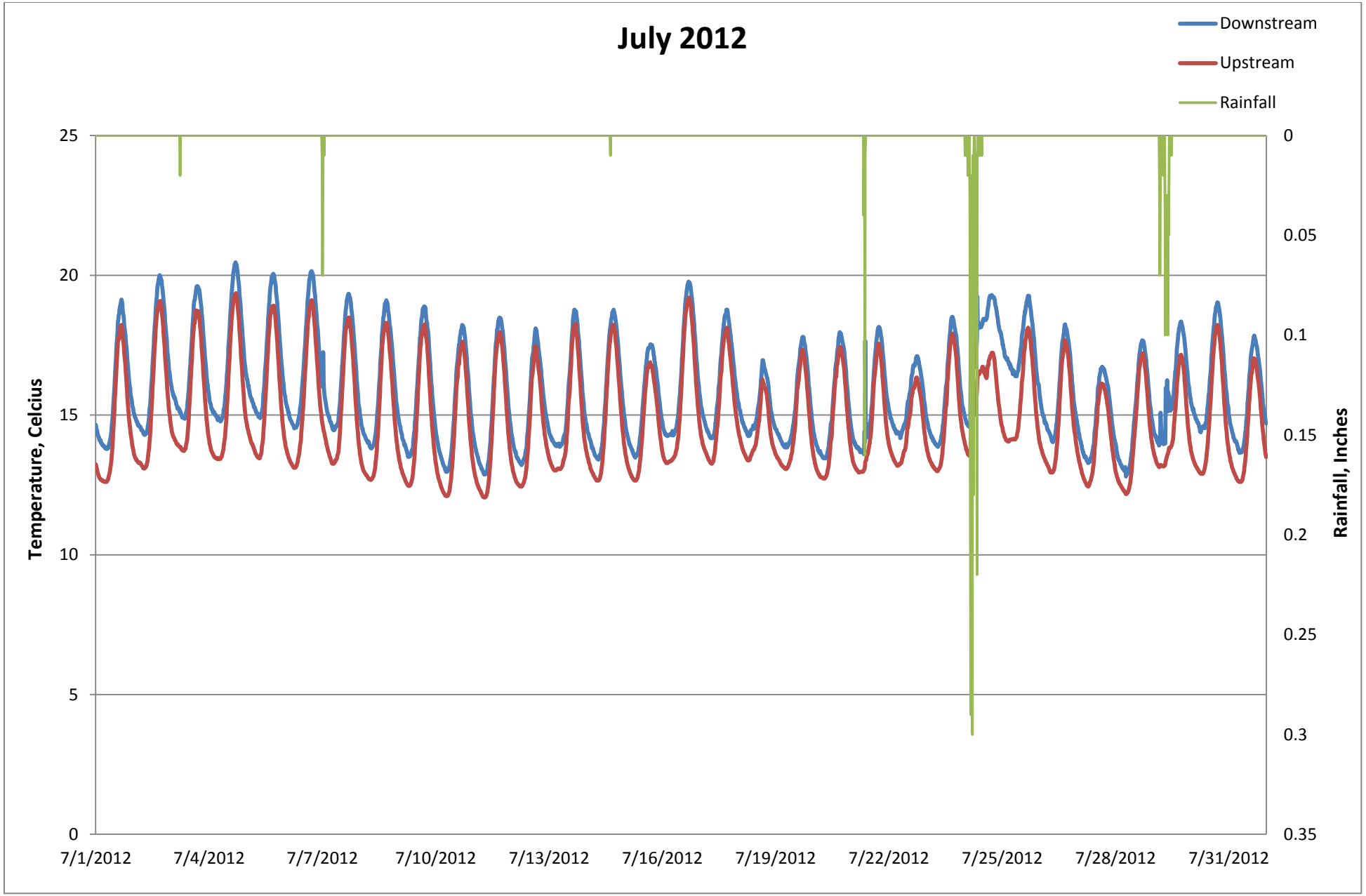

February 2012
Downstream
Upstream
Temperature, Celcius
12
10
8
6
4
2
0
2/1/2012
2/4/2012
2/7/2012
2/10/2012
2/13/2012
2/16/2012
2/19/2012
2/22/2012
2/25/2012
2/28/2012

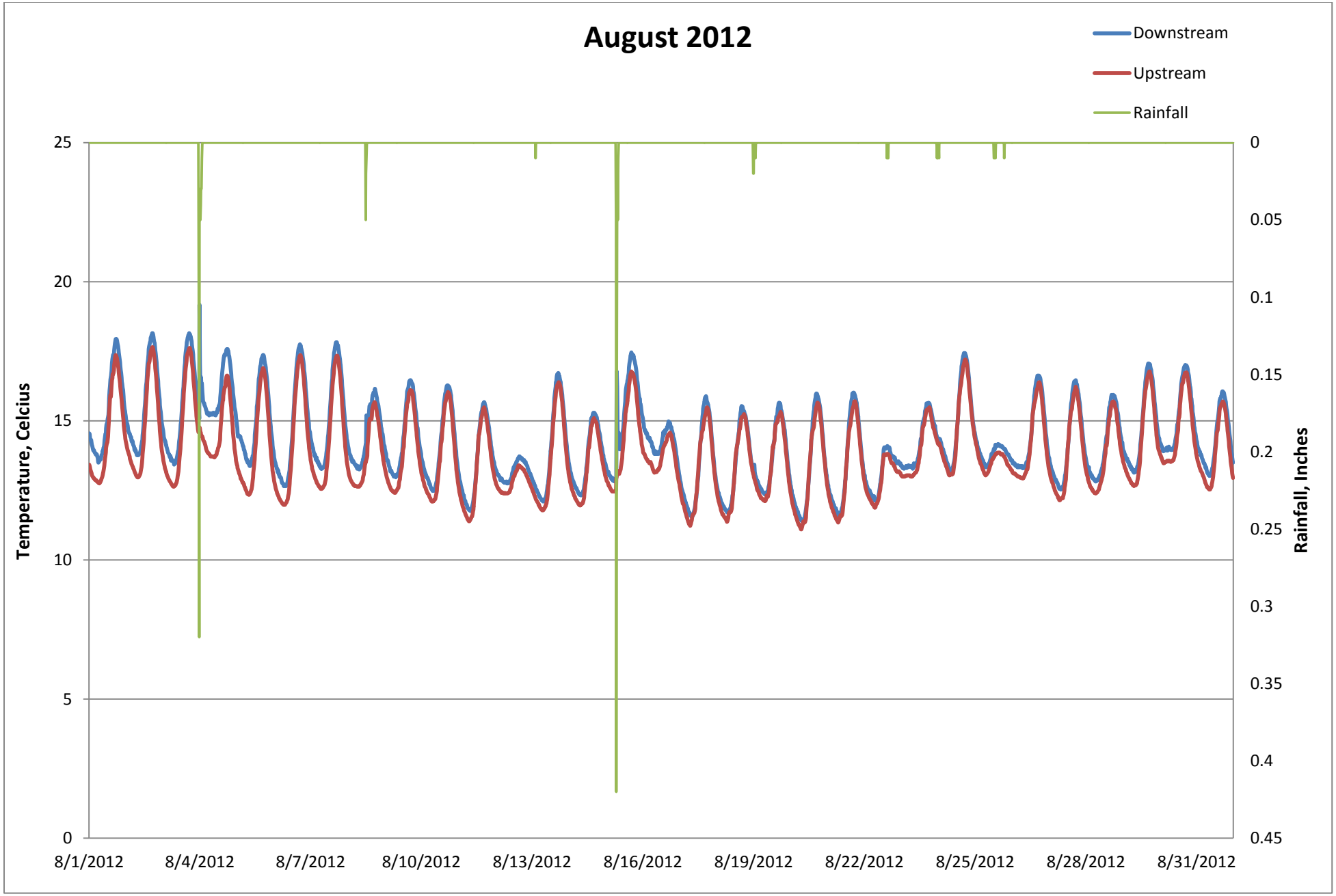

March 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
16
14
12
10
8
6
4
2
0
0
0.05
0.1
0.15
0.2
0.25
0.3
3/1/2012
3/4/2012
3/7/2012
3/10/2012
3/13/2012
3/16/2012
3/19/2012
3/22/2012
3/25/2012
3/28/2012
3/31/2012

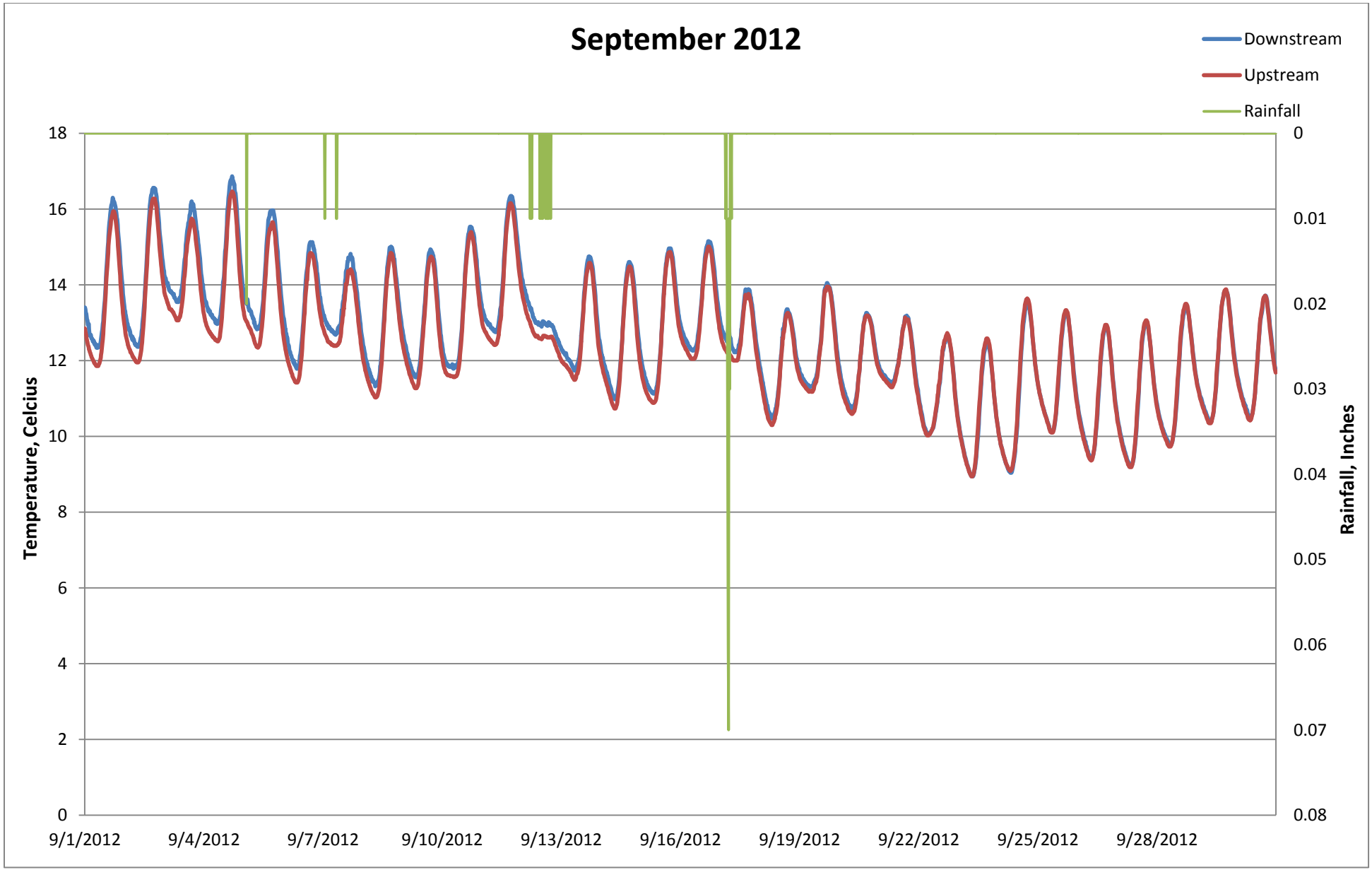

April 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
18
16
14
12
10
8
6
4
2
0
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
4/1/2012
4/4/2012
4/7/2012
4/10/2012
4/13/2012
4/16/2012
4/19/2012
4/22/2012
4/25/2012
4/28/2012

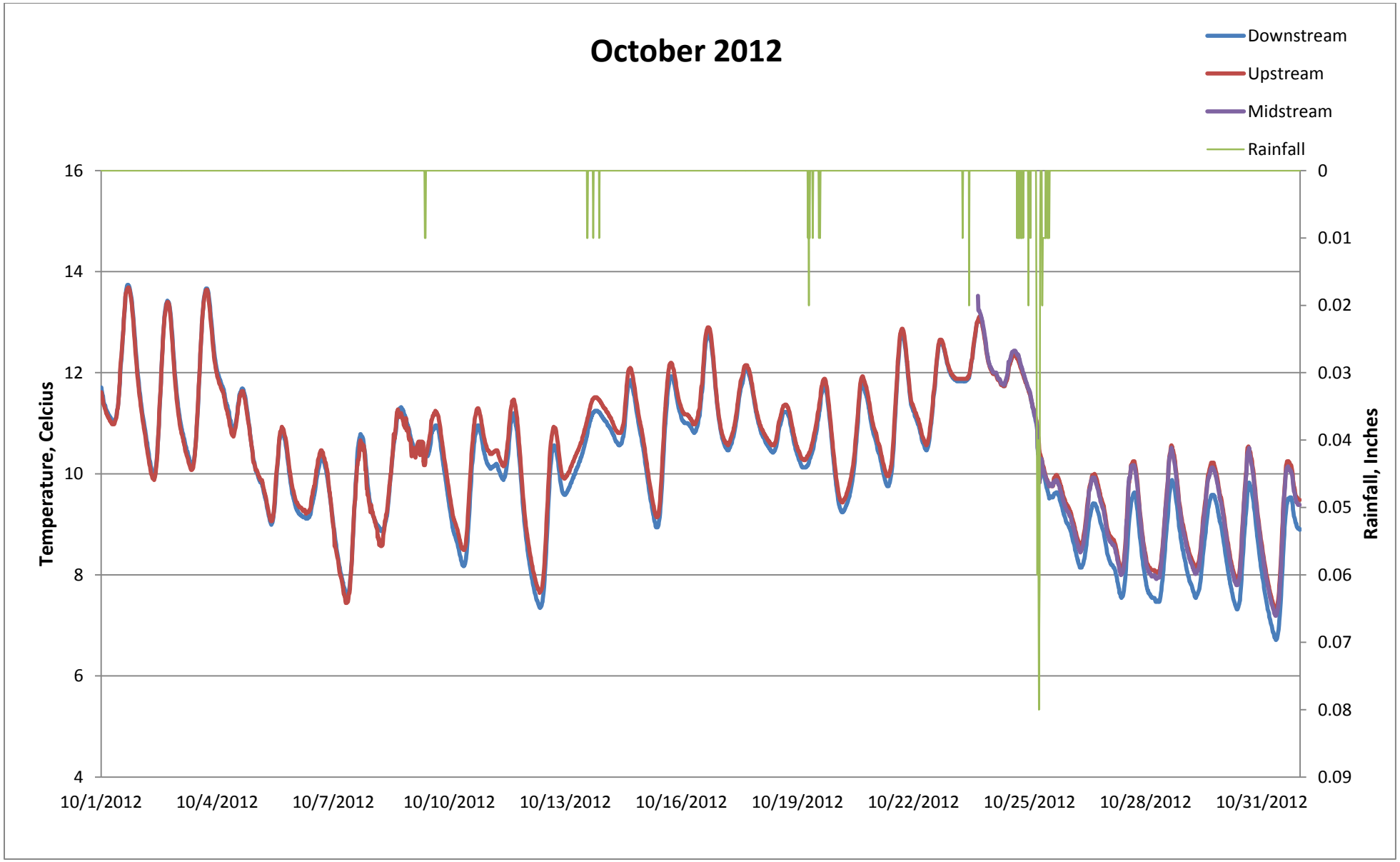

May 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
20
18
16
14
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
5/1/2012
5/4/2012
5/7/2012
5/10/2012
5/13/2012
5/16/2012
5/19/2012
5/22/2012
5/25/2012
5/28/2012
5/31/2012

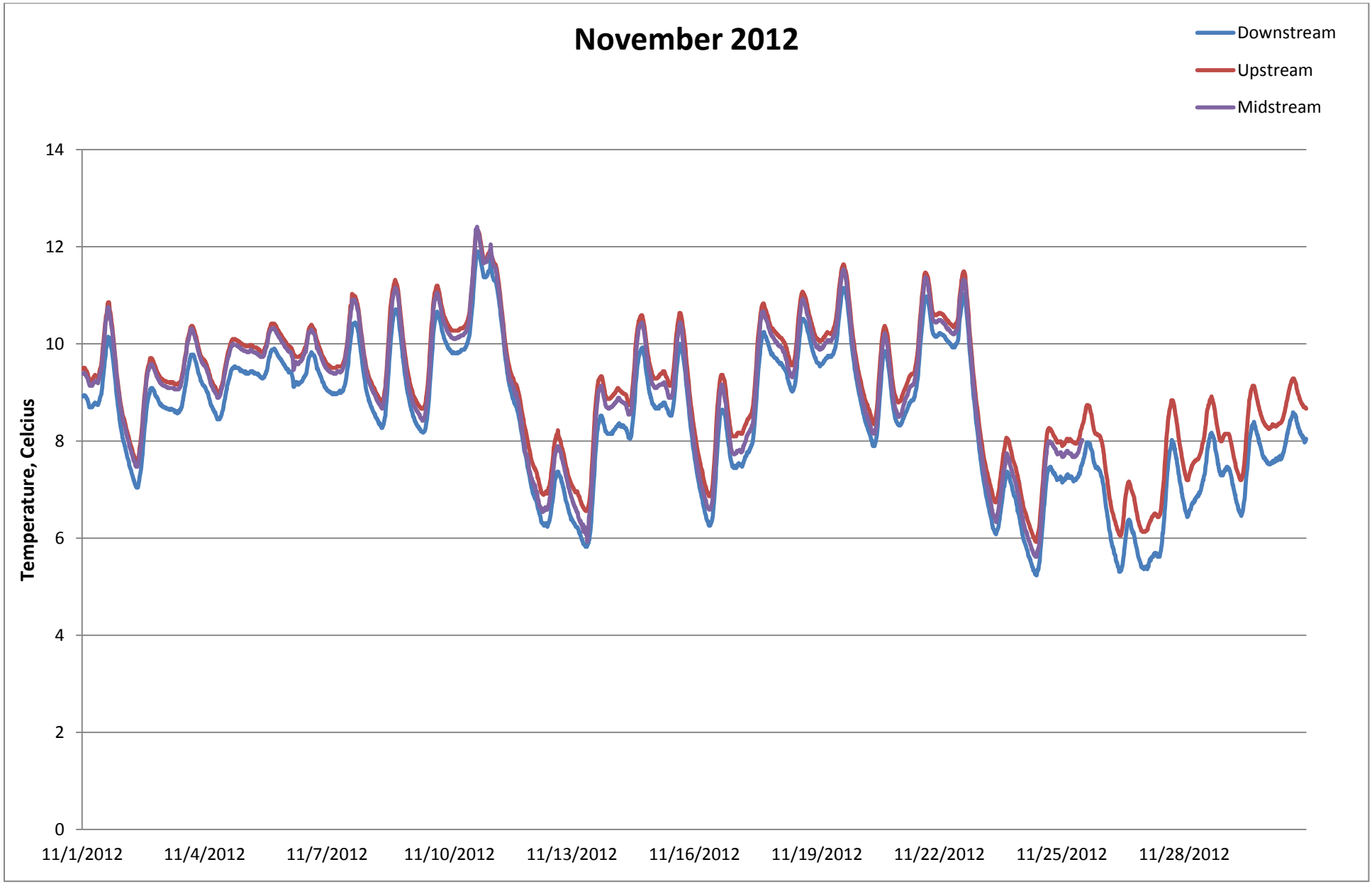

June 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
6/1/2012
6/4/2012
6/7/2012
6/10/2012
6/13/2012
6/16/2012
6/19/2012
6/22/2012
6/25/2012
6/28/2012

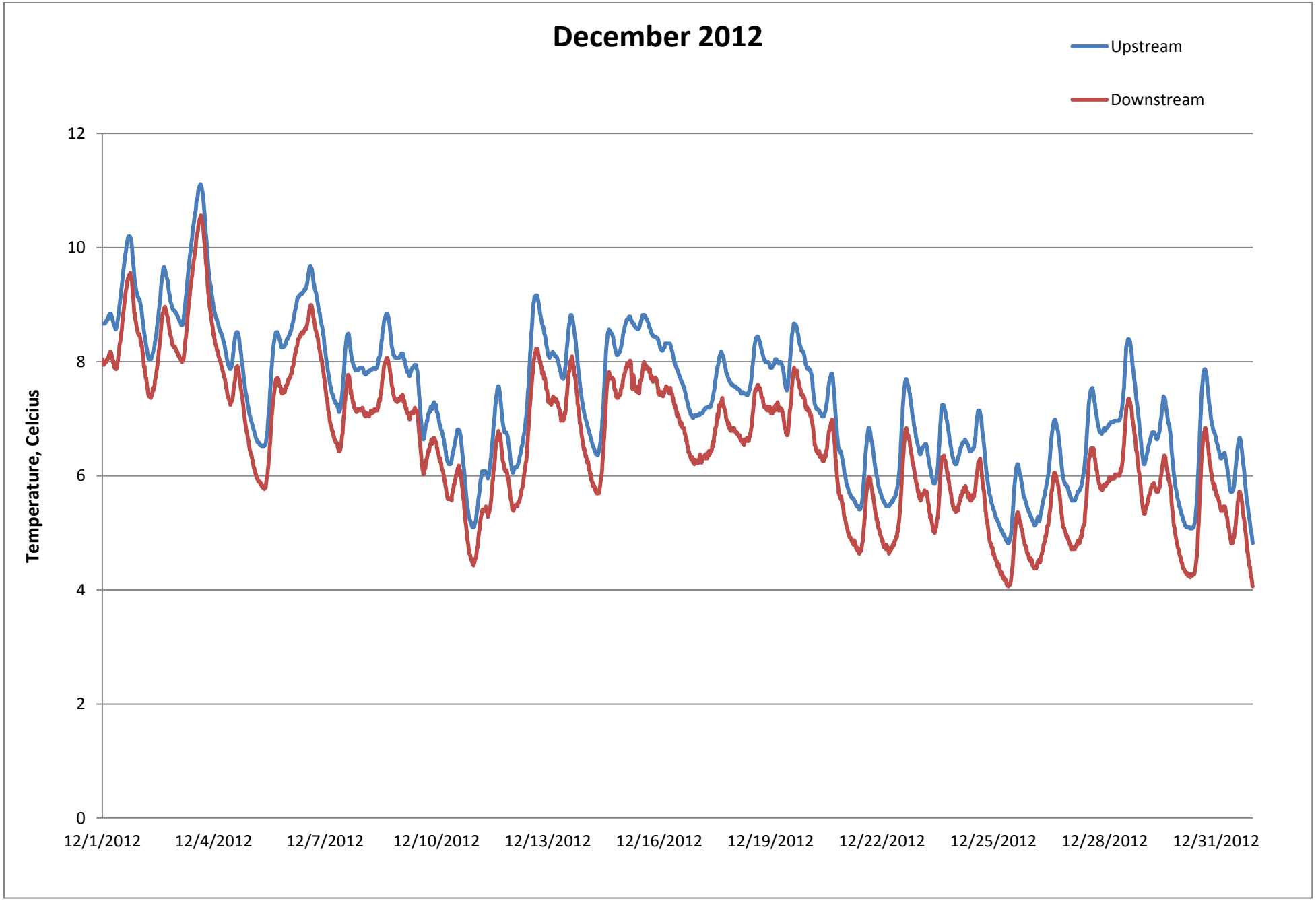

July 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
7/1/2012
7/4/2012
7/7/2012
7/10/2012
7/13/2012
7/16/2012
7/19/2012
7/22/2012
7/25/2012
7/28/2012
7/31/2012


August 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
25
20
15
10
5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
8/1/2012
8/4/2012
8/7/2012
8/10/2012
8/13/2012
8/16/2012
8/19/2012
8/22/2012
8/25/2012
8/28/2012
8/31/2012


September 2012
Downstream
Upstream
Rainfall
Temperature, Celcius
Rainfall, Inches
18
16
14
12
10
8
6
4
2
0
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
9/1/2012
9/4/2012
9/7/2012
9/10/2012
9/13/2012
9/16/2012
9/19/2012
9/22/2012
9/25/2012
9/28/2012


October 2012
Downstream
Upstream
Midstream
Rainfall
Temperature, Celcius
Rainfall, Inches
16
14
12
10
8
6
4
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
10/1/2012
10/4/2012
10/7/2012
10/10/2012
10/13/2012
10/16/2012
10/19/2012
10/22/2012
10/25/2012
10/28/2012
10/31/2012


November 2012
Downstream
Upstream
Midstream
Temperature, Celcius
14
12
10
8
6
4
2
0
11/1/2012
11/4/2012
11/7/2012
11/10/2012
11/13/2012
11/16/2012
11/19/2012
11/22/2012
11/25/2012
11/28/2012


December 2012
Upstream
Downstream
Temperature, Celcius
12
10
8
6
4
2
0
12/1/2012
12/4/2012
12/7/2012
12/10/2012
12/13/2012
12/16/2012
12/19/2012
12/22/2012
12/25/2012
12/28/2012
12/31/2012

Works Cited:

Bell J.M., 2006. The Assessment of Thermal Impacts on Habitat Selection, Growth, Reproduction, and Mortality in Brown Trout (*Salm trutta* L): A Review of the Literature. Prepared for the Vermillion River EPA Grant #WS 97512701-0 and the Vermillion River Joint Powers Board. Applied Ecological Services, Inc.

Peterson, David. (2008, October 1). "Without a doubt: More trout in Eagle Creek." *Star Tribune*. 2008. Star Tribune. 21 May 2009 [http://www.startribune.com/local/south/29842934.html?elr=KArksi8cyaiUo8cyaiUiD3aPc:_Yyc:aUU].