Groundwater Discharge into Silver Creek, Oneonta, NY

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Abstract

The study of Oneonta, New York's Silver Creek through the use of thermal imaging along with conductivity measurements was proven to be a success. Silver Creek has a drainage area of 1.46 mi^2 upstream from where surveying took place. The creek is a small distributary to the Susquehanna river. Thermal images helped visually determine where groundwater seeps into a surface water body. Images showing warm or cold spots (depending on the streams average temperature) also showed a large increase of a conductivity value. Conductivity helps identify and conclude an alternate water source is being added to the creek. Silver Creek showed numerous groundwater springs upstream in an alluvial stream setting. Little to no infiltration of groundwater was found downstream, in a bedrock stream setting. Conductivity values showed additional sources of water had a great effect on the remaining body of water when the source was sufficient enough. In one location the conductivity values reached an alarming value. Precipitation was also shown to influence the streams conductivity on a week to week basis. High precipitation values lead to a decrease in the creek's overall conductivity values. Temperature values are all in degrees Fahrenheit, precipitation values in inches, and conductivity values in micro siemens.

Study Area

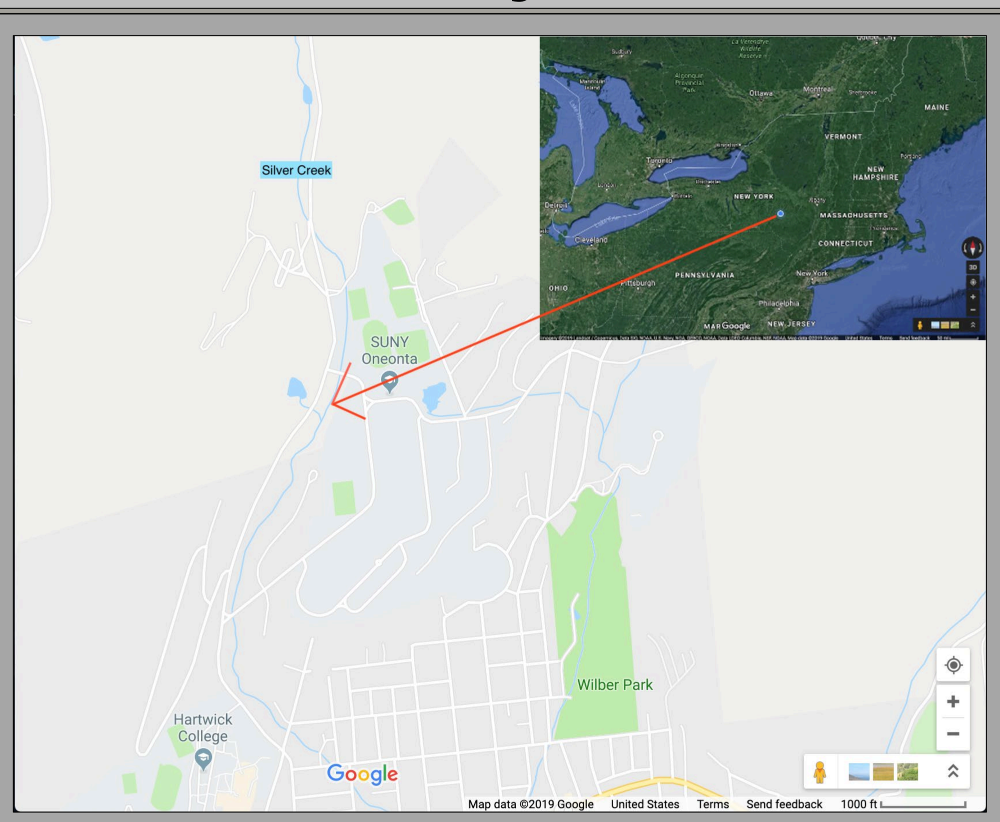

Figure 1: Project location

Area is in Oneonta, New York. Located on SUNY Oneonta's campus.

Thermal Imaging

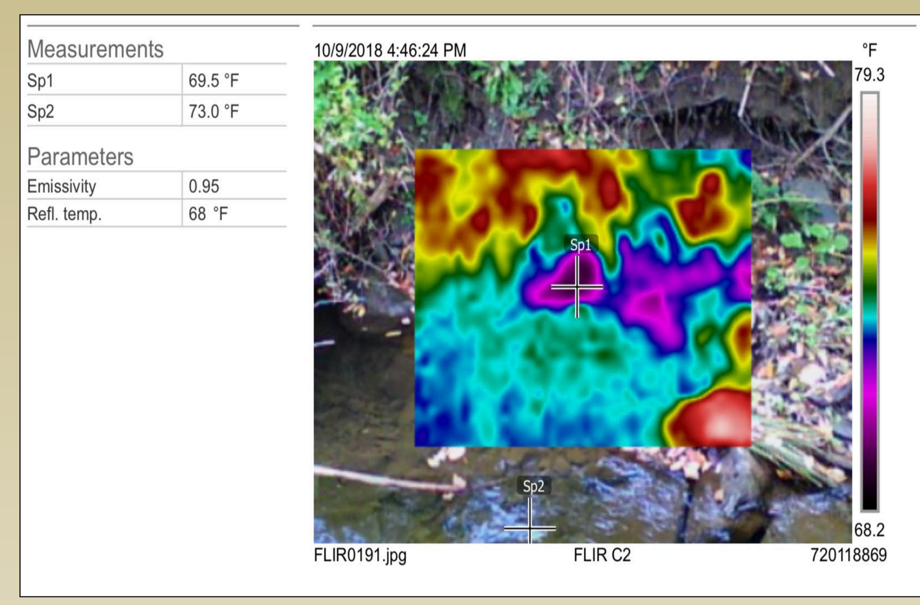

Figure 2 : Seepage of groundwater represented by the purple and dark blue. (colder temperature)

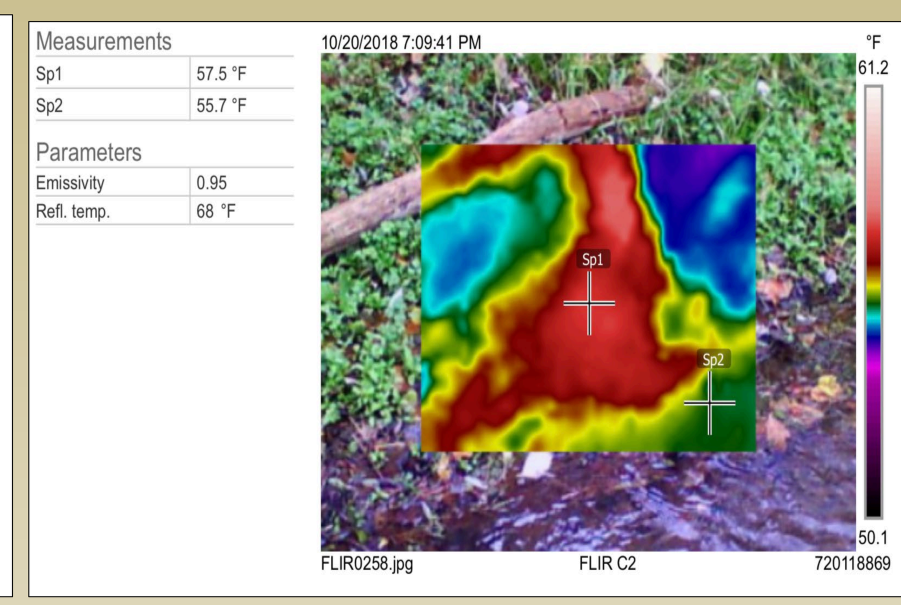

Figure 3: Seepage of groundwater represented by the red. (warmer temperature)

Thermal images to identify Groundwater

Depending on the streams average temperature, groundwater can appear as hot spots or cold spots. Figure 4 is an example of groundwater being shown as a warmer value relative to the streams average temperature. Groundwater maintains a relatively stable temperature year round, while the surface water fluctuates greatly through short periods of time.

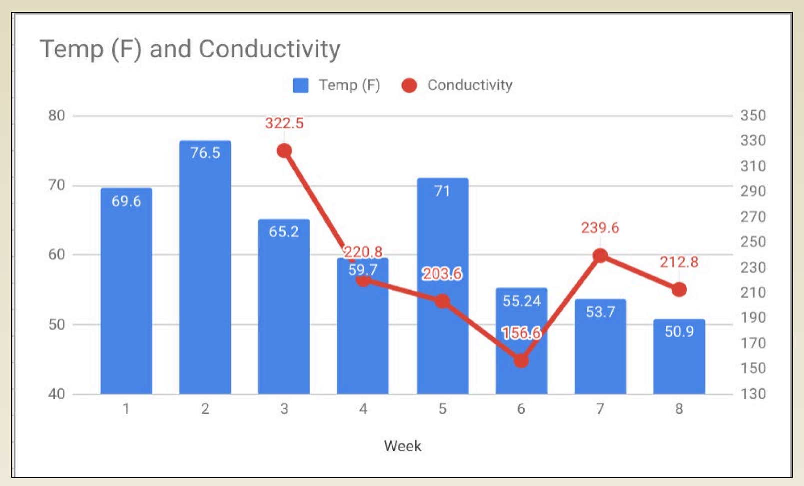

Figure 4: Weekly average temperature plotted with weekly average conductivity.

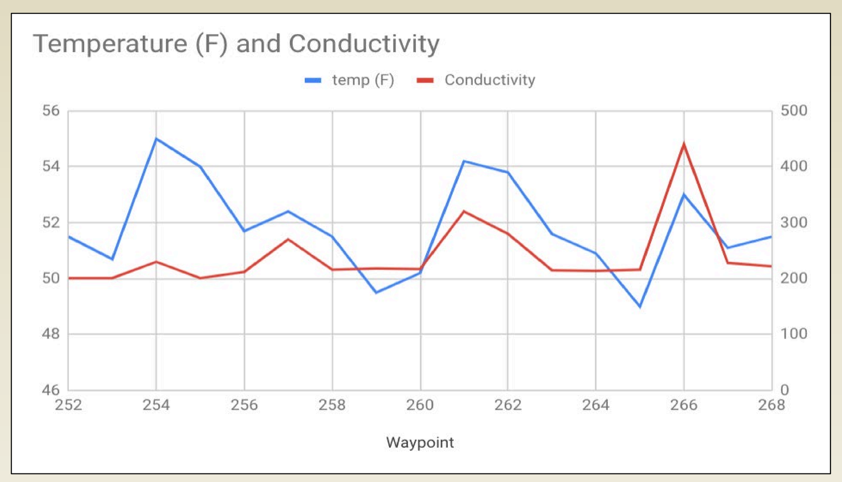

Figure 5: Temperature values plotted with conductivity values of each waypoint for week 8 of research.

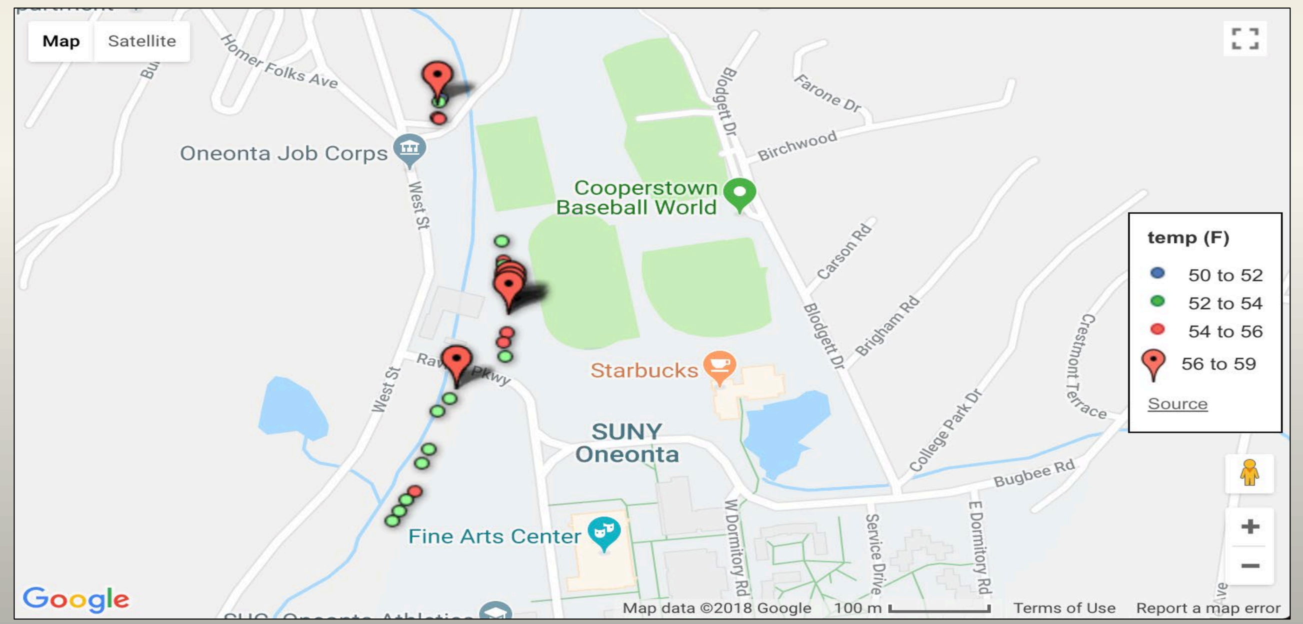

Figure 6: Temperature values mapped out on a Google Fusion table

Conductivity

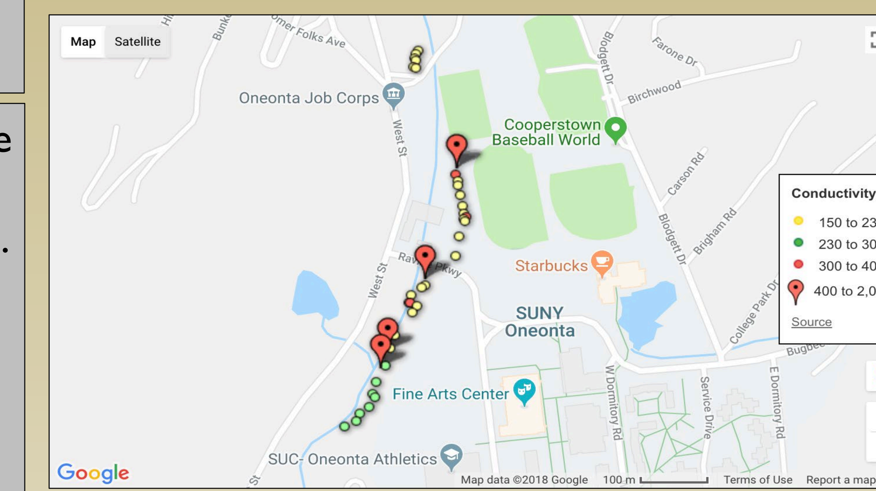

Figure 8: Temperature values mapped out on a Google Fusion table.

The highest conductivity spring was 1570 µS with a discharge of 0.16 ft^3/s. This discharge was estimated using a mixing relation and salt solution gauging. Combined with Silver Creek's discharge of 9.73 ft^3/s the contribution from the spring raised Silver Creek's conductivity by 21 µS, to 321 µS.

Methods

- Thermal images of Silver Creek were taken (with a Flir C2 camera) at weekly intervals mainly where noticeable changes in the stream temperature were.
- Conductivity measurements were also recorded at each of the image locations, along with the waypoint of the location.
- Discharge of the stream was calculated by using a salt slug method. A sample of the stream water was brought to the lab to find the salt concentration.

Figure 9: Flir C2 camera

Figure 10: Conductivity reader

Conclusions

- Thermal imaging is a very fast and effective way to map out and visually see groundwater seepage points in streams.
- Conductivity is another way to examine where groundwater is infiltrating a stream
- The streams average temperature varies greatly even at weekly rates. The groundwater temperatures maintained a relatively stable rate, even when the air temperature was dropping each week.
- For best observations, pictures should be taken in the fall months, when groundwater temperatures are at their highest from the hot summer months and air temperature is dropping. This creates a larger difference between surface water and groundwater.
- Precipitation plays a role in the streams average conductivity and even with the groundwater's conductivity.
- At silver creek the groundwater was relatively shallow upstream in the fluvial stream bed. Downstream, bedrock was present in the stream bed, preventing groundwater from making its way to the surface.
- Alarming conductivity values are seen at one distributary location, ultimately changing the average stream conductivity downstream.

Effects of Precipitation

Figure 7: Conductivity values plotted with weekly precipitation values.

The precipitation values used were three days before the survey and the precipitation the day of surveying. Conductivity appears as a line using the right axis while precipitation is a bar, using the left axis. All precipitation values were found on Weather Underground, Binghamton's station. An inverse relation can be seen by analyzing the graph; spikes in precipitation cause a sufficient decrease in conductivity values. A lack of precipitation causes the conductivity values in the stream to increase.

References

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