

2004 Temperature Report for Falkland Creek

Trout Unlimited Canada Technical Report
No. ON-004



Prepared for:
Middle Grand Chapter
Paris, Ontario

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Background

Falkland Creek is a small, cold tributary of the Nith River located near Paris, Ontario. The lower reaches of the Grand River Watershed, home of the Nith watershed is dominated by sand, clay and till plains which are the result of deposition of a post-glacial lake. The Oxford till plain and the Mount Elgin ridges cover small portions of the south-western corner of the watershed. These areas support significant wetlands providing habitat for number species (Ivey, 2002). Falkland Creek originates west of Paris, Ontario and south of the Nith River. It flows out of the northern border of the Norfolk Sand plain and captures significant groundwater as it flows east for several kilometres just south of Regional Rd. 2. As it approaches the crest of the old spillway that the Nith River flows through near Regional Rd. 34, its gradient increases and it begins to capture even more groundwater before tumbling down the valley wall to the Nith.

Falkland Creek is home to numerous fish species including largemouth bass, common shiner, blacknose dace, longnose dace, white sucker, northern hog sucker, rainbow darter, creek chub, Johnny darter, central mudminnow, bluntnose minnow, rock bass (G.R.C.A. 2005). Migratory Rainbow trout have historically also been found within the lower sections this creek. Brook trout were once common in the stream and now, rainbow trout from Lake Erie are beginning to colonize it as well.

Salmonids, especially brook trout, are often considered indicators of water quality. Therefore these data will be compared to the thermal preferences of brook trout. Thermal preferences of salmonids have been well studied both in the laboratory and in the field. Though the upper thermal tolerance of brook trout is commonly known to be approximately 24°C (Power 1980, Grande and Andersen 1991), it has been well documented that their preferred range is 4-20°C (Power 1980 and references therein). In order to better understand a brook trout's ability to fully and efficiently utilize its environment it is necessary to understand that neither of these temperature ranges illustrates optimums for specific life stages. Optimal range for physical activity, growth and metabolism is 10-19°C (Power 1980 and references therein), but critical temperatures at particular life history stages further limit available brook trout habitat. During the summer season, temperatures should not exceed 19°C and spawning maximums should not exceed 12°C with the optimum below 9°C. Temperature is well known to affect swimming performance and the overall

cost of swimming. That is to say that increases in temperature lead to increases in critical swimming velocity (Heggenes and Traaen 1988, Tang and Boisclair 1995).

The goal of this monitoring program is to identify the current temporal and longitudinal temperature variability as well as identify critical areas limiting water quality within the creek. This will help establish the 'best bet' locations for rehabilitation and mitigation. The final goal of this program is to monitor the long term changes in temperature in order to assist our understanding of the effects of changes within the system such as rehabilitation efforts.

Methods

Temperatures were monitored in Falkland Creek as part of a larger monitoring and restoration program. Temperature data loggers (Hobo Water Temperature Pro®) were launched at multiple locations within Falkland Creek to gather data on longitudinal temporal variability. A total of 5 loggers were launched, all on June 27, 2004. Each logger was pre-programmed to record temperature every fifteen minutes starting on the hour and then was attached to a 12" x 12' patio stone with soft wire. The Hobo was placed face down in the approximate center of the tributary to eliminate direct warming from sunlight and where necessary covered by other rocks. Sample sites were chosen based on topographic maps and river walks. The sites represent “nick” points (changes in gradient) in the system and/or flank significant water features such as road crossings.

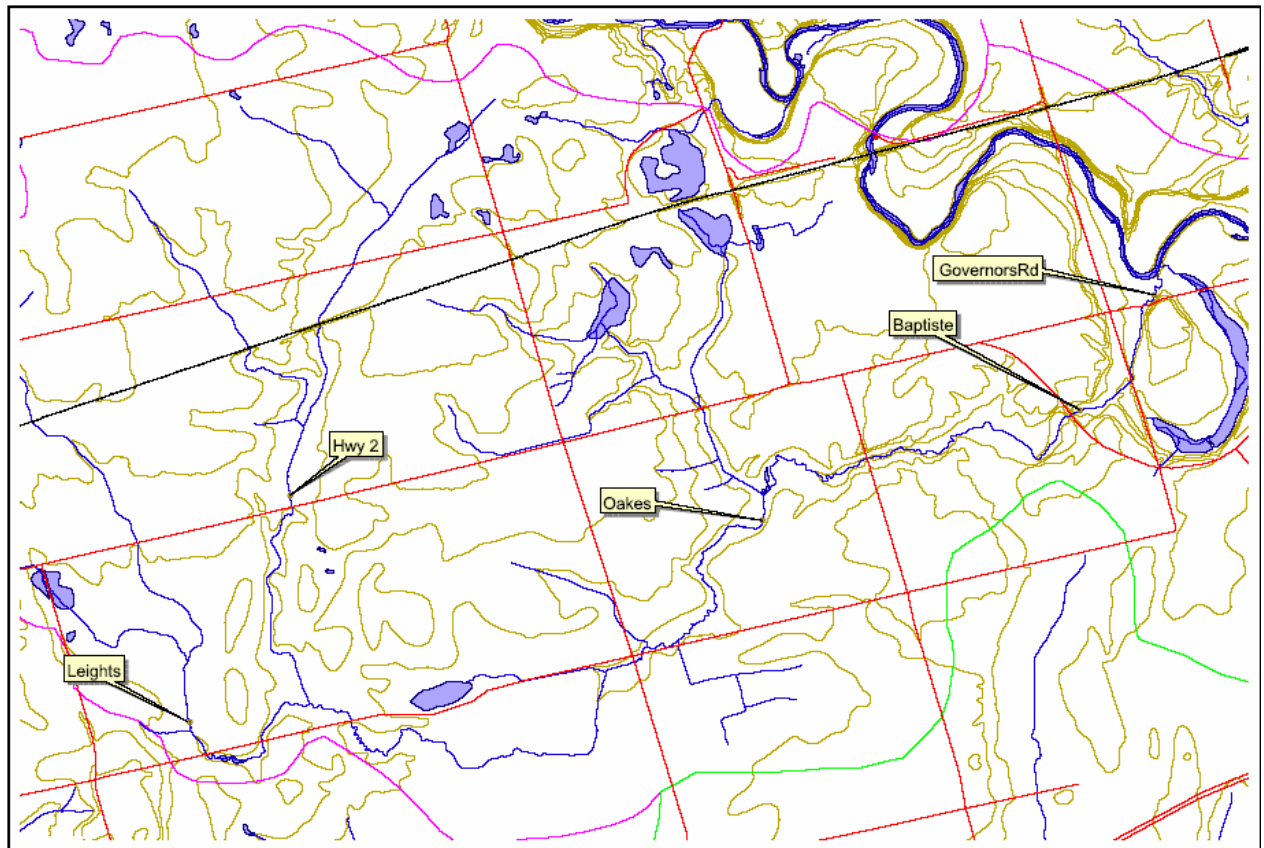


Figure 1: Study Site - 2004 Falkland Creek temperature logging locations. Locations are approximate.

Data were collected 24 hours a day at each site from June through November for all sites. The data that was retrieved was compiled using Microsoft Excel to create a seamless seasonal temperature plot for each location within the tributary. Erroneous data were removed where

justification existed (e.g. where the logger was exposed to air due to low water levels). Data were summarized and daily averages, maximums, minimums and temperature ranges were plotted for each sampling location and plotted comparing sites.

Data and Results

All sites are within the optimal summer temperature range for brook trout except for site Oaks, whose maximum summer temperature exceeded this range, and for site Governors (Figure 2). All sites however display overall average summer temperatures below the upper thermal maximum for brook trout of 24°C (Figure 2). There is an expected pattern of warming from upstream to downstream, with a peak at the middle site (Oaks) (Figures 2, 3, 4, 5 and 8). Trimean average and maximum temperatures illustrate a similar trend (Figures 9 and 10). Trimean average and maximum temperatures were calculated weekly to identify potential sustained temperature trends. Timean calculations buffer against single extreme events and account for long term trends which may be more indicative of the actual stress on organisms within the system.

Site specific temporal data reveals that for the duration of the summer season, Oaks possessed the highest maximum, average and minimum temperatures compared to all other sites and Hwy 2 the lowest (Figures 3, 4 and 5). This trend changed in September when temperatures converge and the sites display extremely similar temperatures and trends (Figures 3, 4, and 5).

During the summer months, June until August, site Hwy 2 shows a much larger variation in daily temperature range and hourly rate of change compared to the other sites (Figures 6 and 7). After August the amount of variation decreases. Sites Babtiste, Oaks and Governors all show similar, lower variations in their daily temperature range and hourly rate of change for the entire monitoring season (Figures 6 and 7).

Longitudinal data suggest a marked increase in temperature from Leigh to Oaks, an overall cooling trend to Babtiste and then a warming trend. This would suggest that a massive amount of groundwater is entering the system shortly before the spillway channel. It also suggests that the reach between Leigh and Oaks is heating water up as well.

Summary Plots

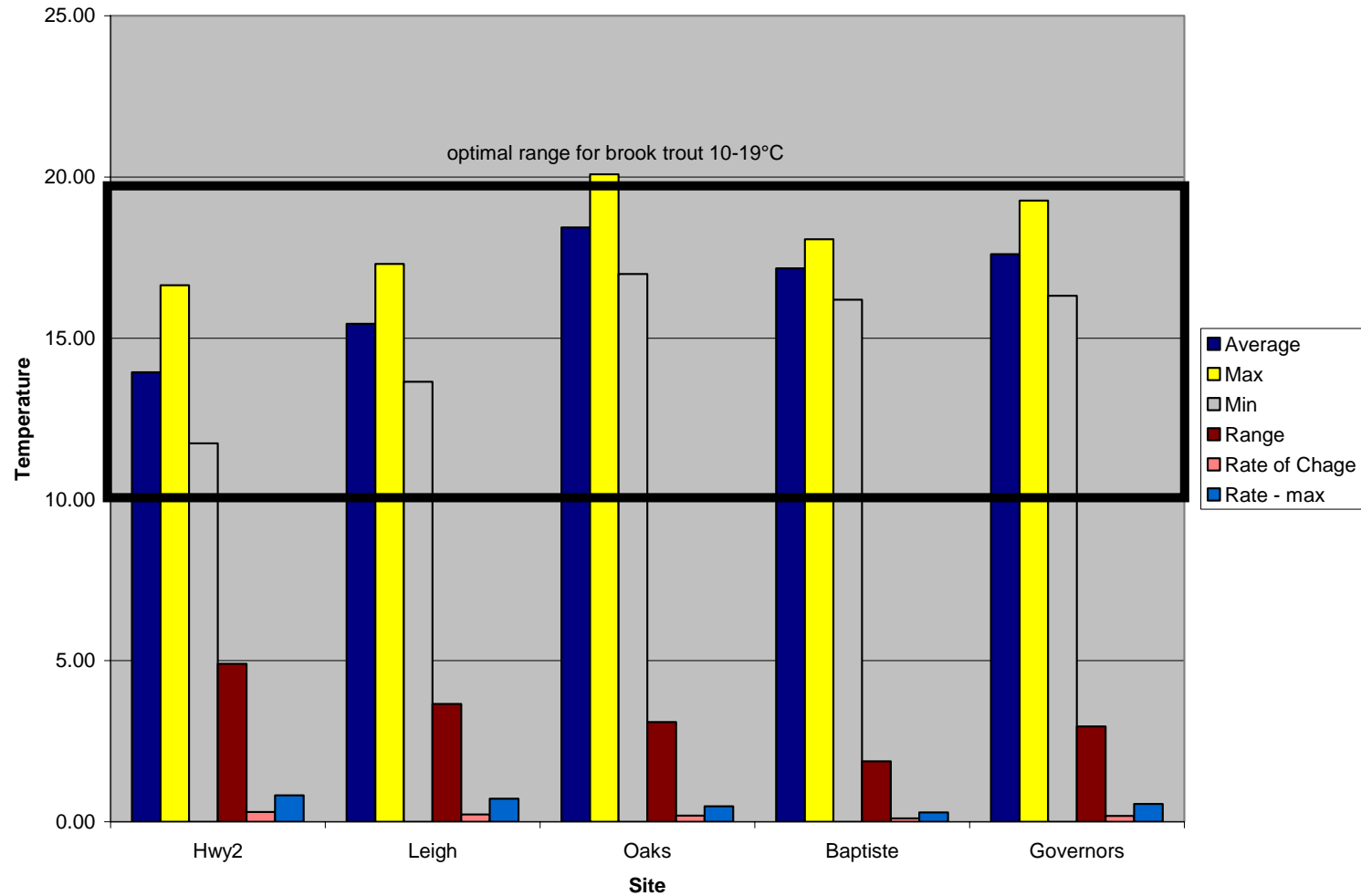


Figure 2: Summary of summer data from all sites. Average daily temperature, average maximum and minimum temperature, average daily range, average daily rate of change and absolute maximum rate of change were calculated for July and August.

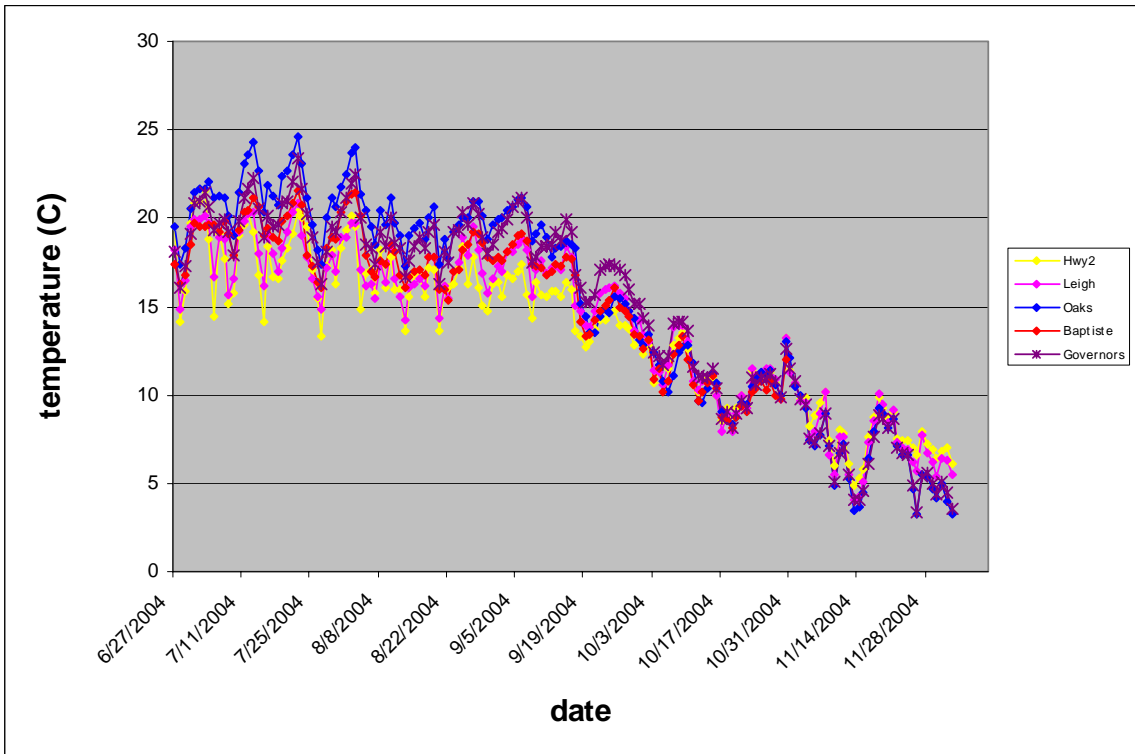


Figure 3: Maximum daily temperature for all sites

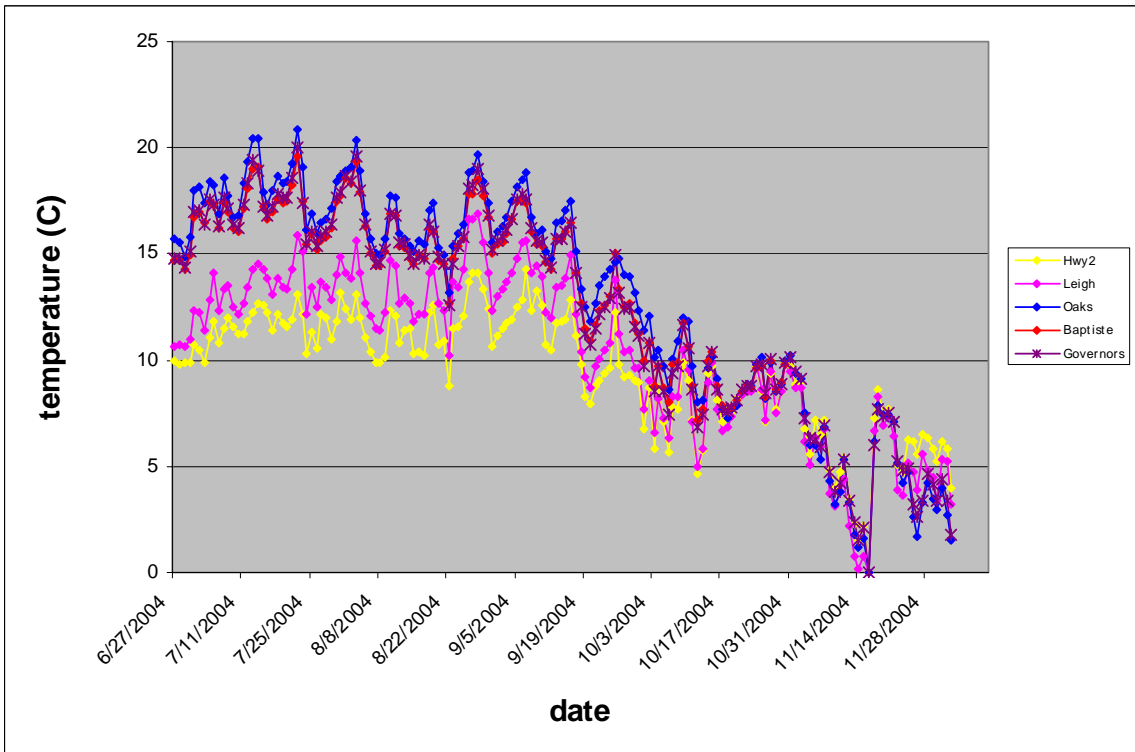


Figure 4: Minimum daily temperature for all sites.

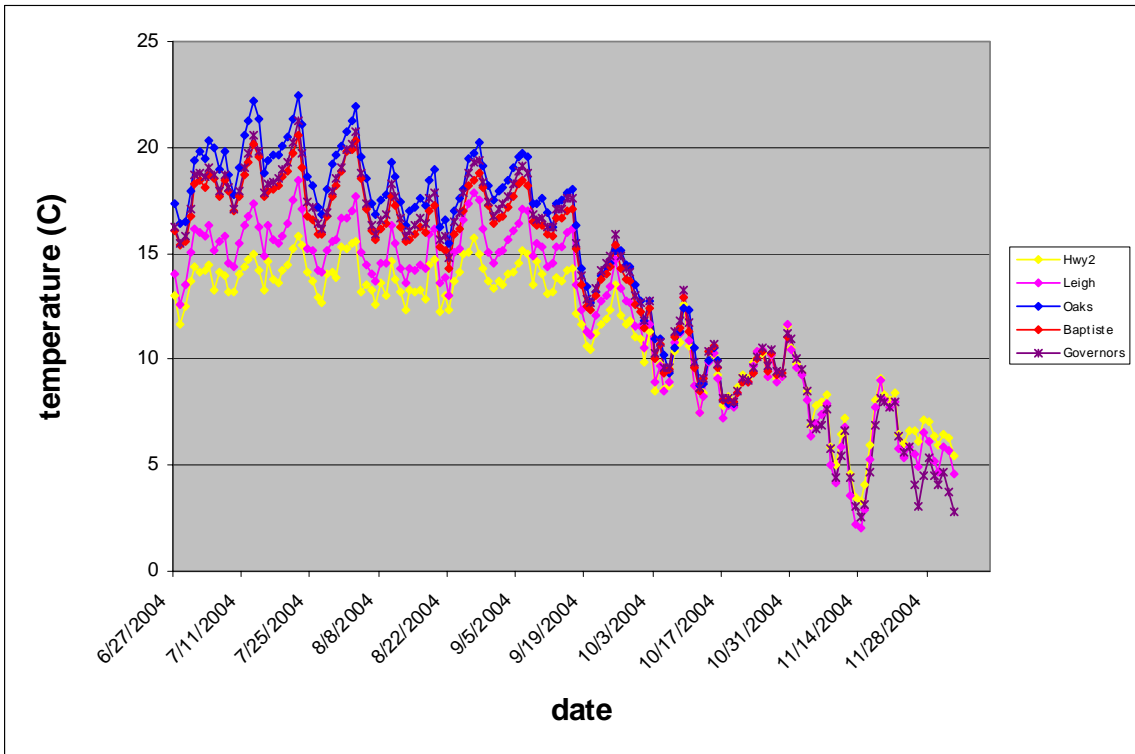


Figure 5: Average daily temperature (°C) for all sites

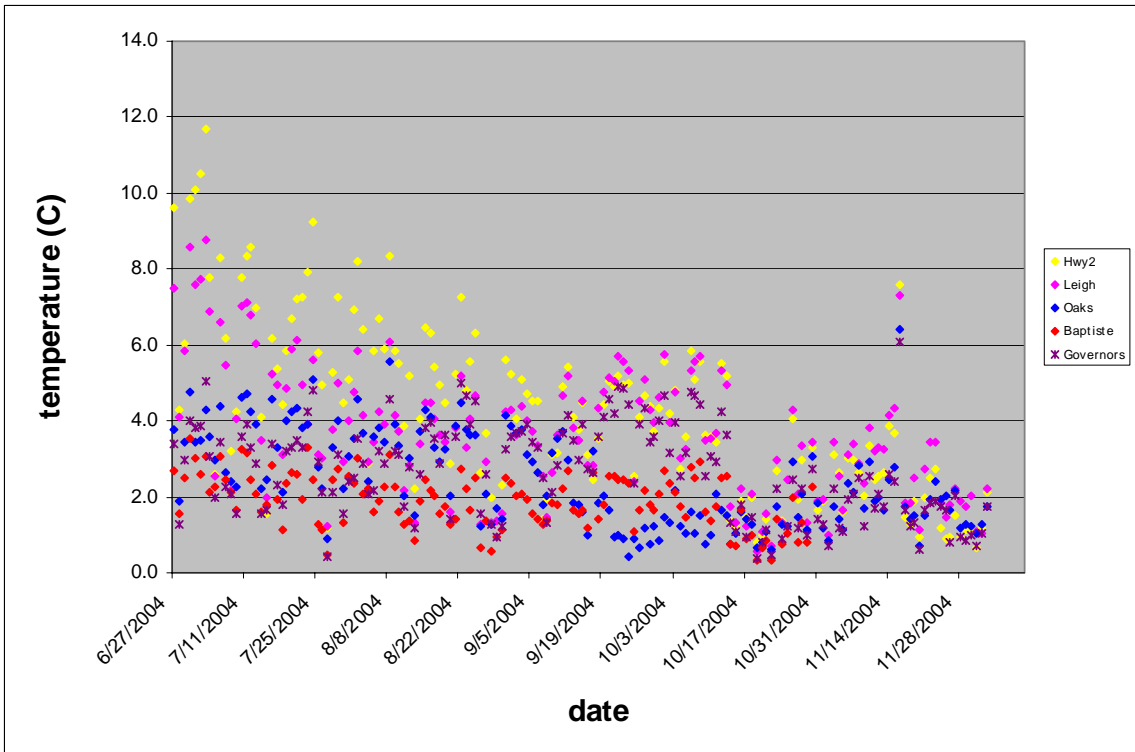


Figure 6: Daily range in temperature at all sites.

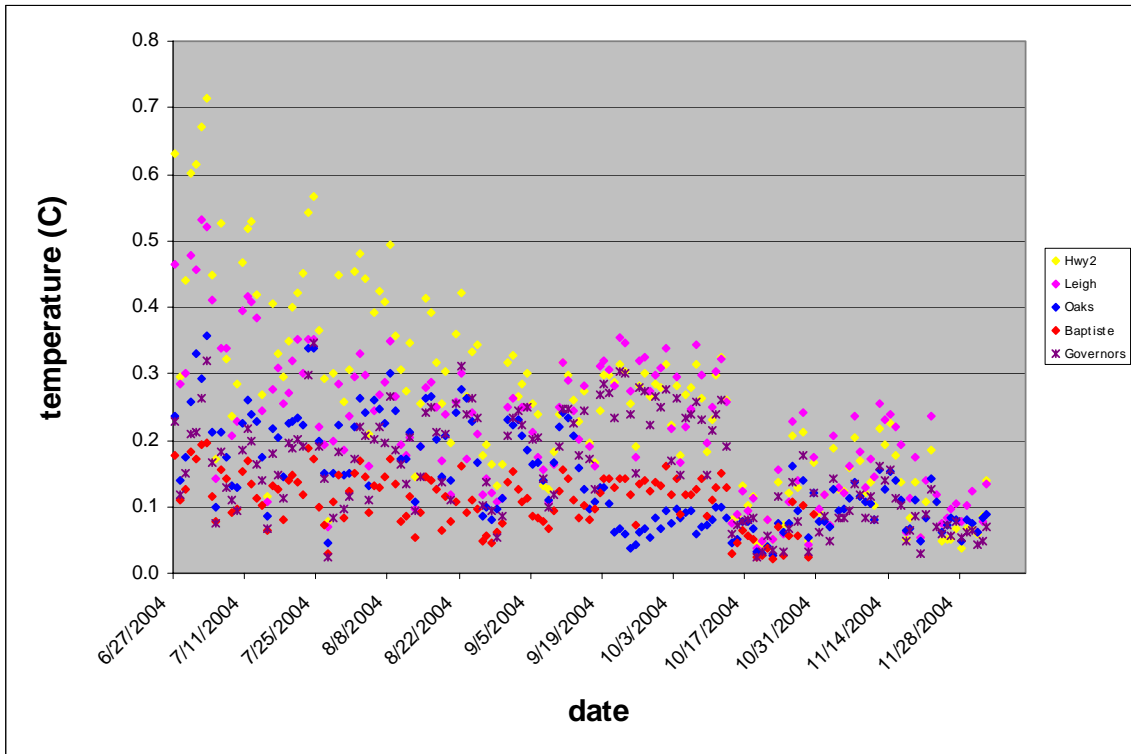


Figure 7: Average daily hourly rate of change in temperature at all sites

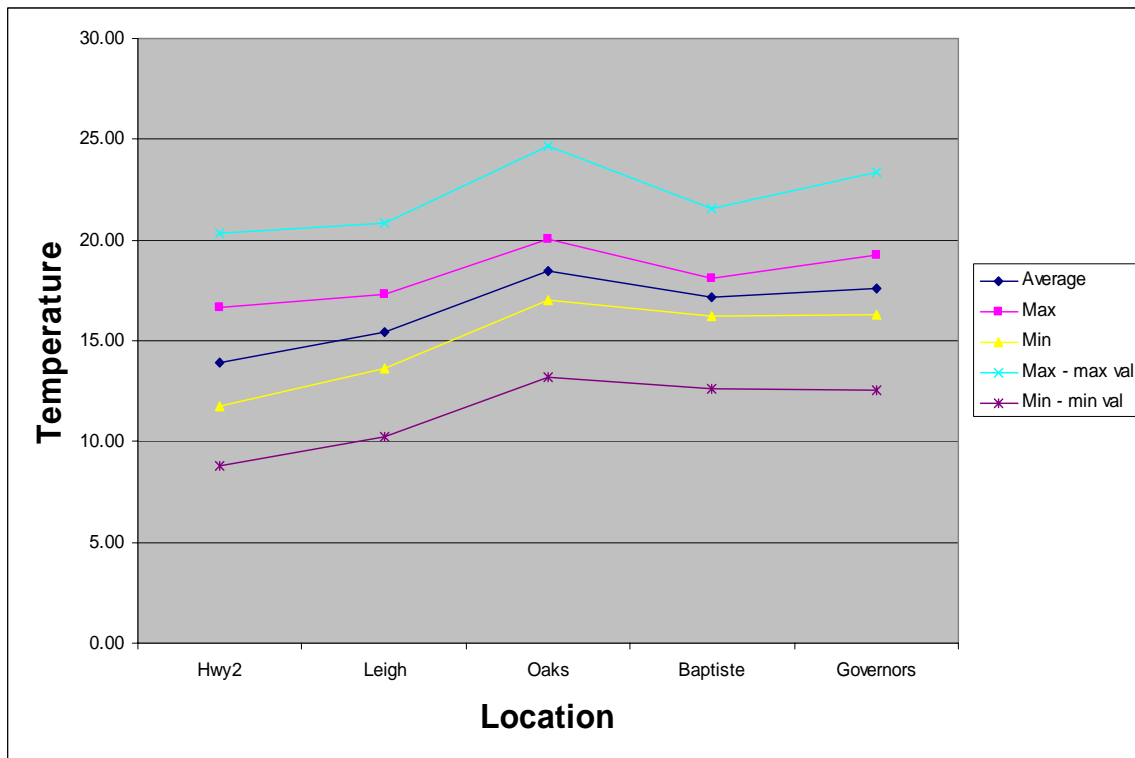


Figure 8: Longitudinal chart showing change in temperature from upstream to downstream during peak summer months (July and August)

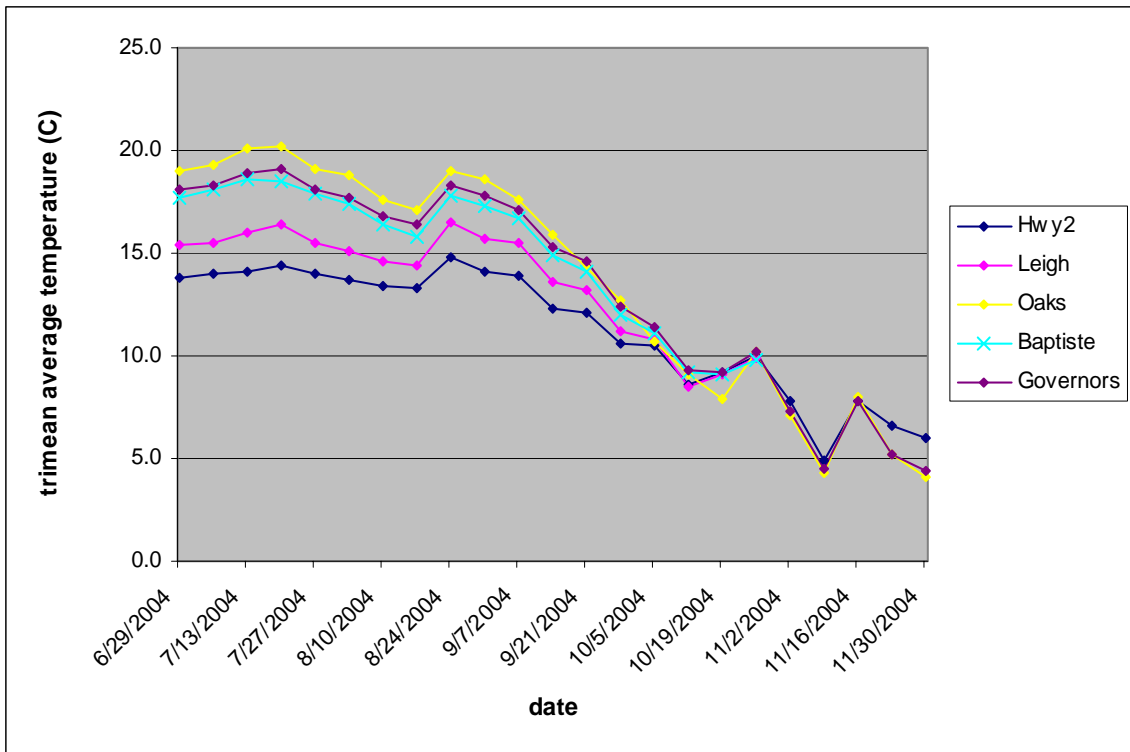


Figure 9: Trimean average temperature

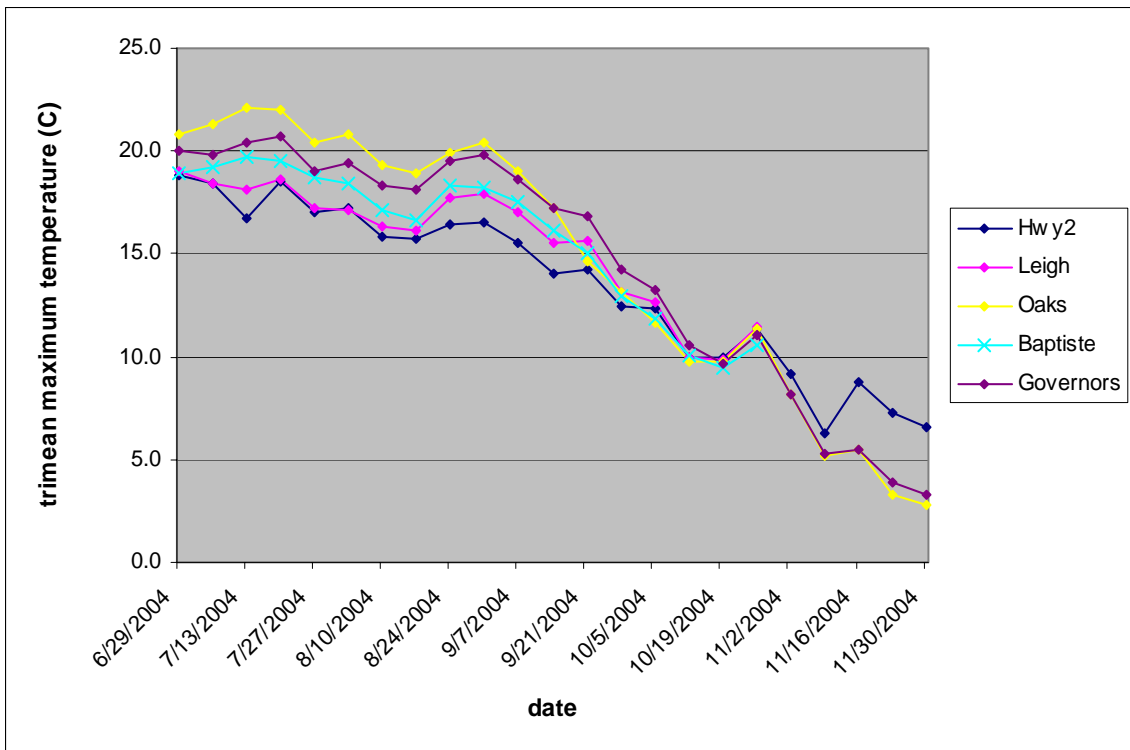


Figure 10: Trimean maximum temperature

Implications

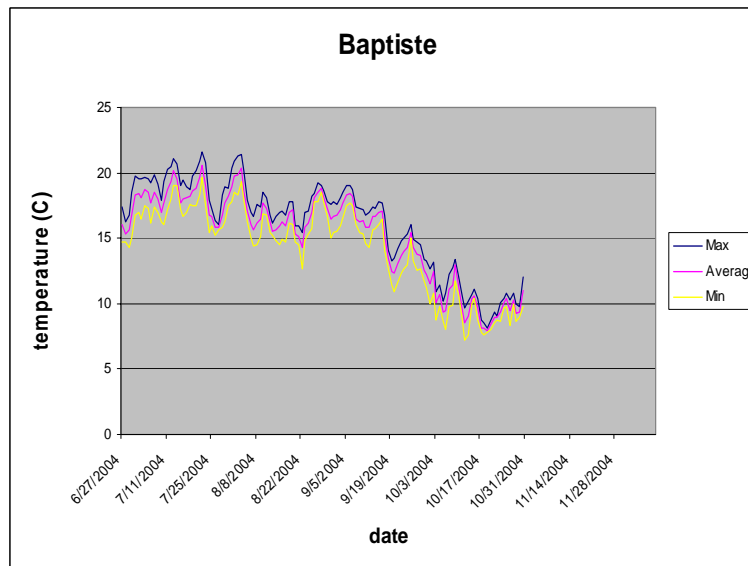
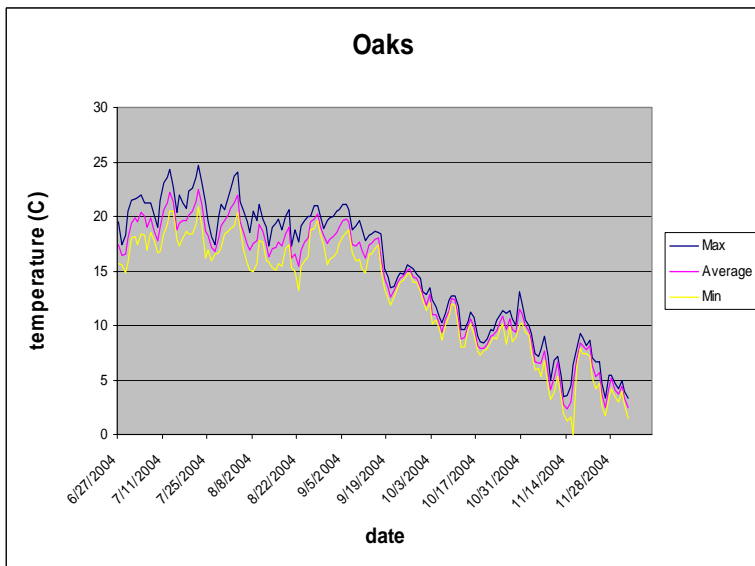
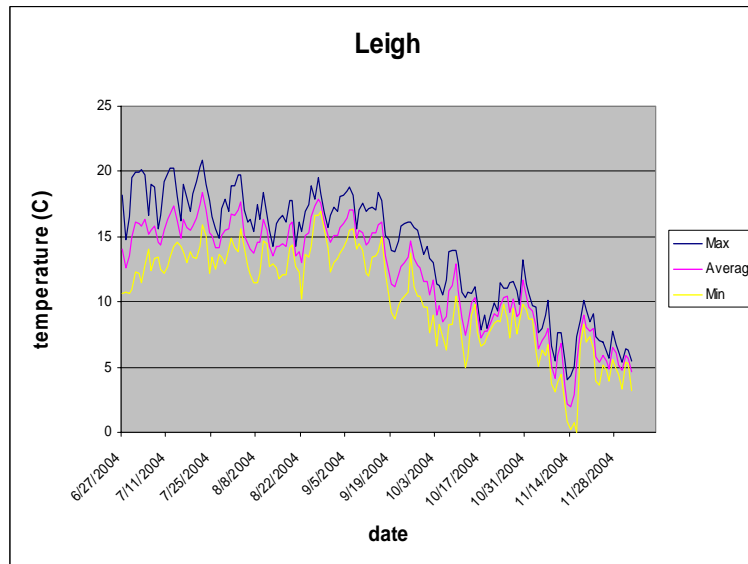
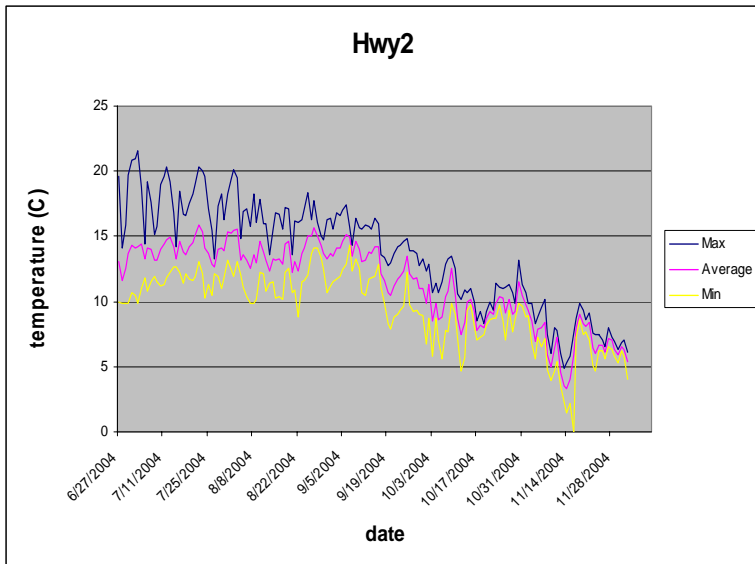
Temperatures for Falkland Creek display predicted and expected increases from upstream to downstream sites. There appears to be a sharp change in the rate of temperature increase from Leigh to Oaks compared to between Highway 2 and Leigh. The peak observed at Oaks combined with the lower readings at Babtiste suggests significant groundwater contributions between these sites and a great potential for mediation of warming at Oaks. The logger at Oaks is immediately upstream of a large wide beaver dam which caused an impoundment upstream. This impoundment slows water allowing temperatures to rise and creates a thermal sink. This may be the cause of the rapid temperature increase between Leigh and Oaks. However, it may be prudent to spot check temperatures half way between Leigh and Oaks to see if this is the case. This information may have implications to restoration planning in the future. The creek recovers downstream of Oaks and does not continue to warm. Reducing temperatures at Oaks by allowing the creek to flow freely and water levels to drop will have significant affect on temperatures observed at downstream sites.

With the exception of Oaks, temperatures at all sites fall well within tolerable ranges for coldwater fish like brook trout. This creek shows great potential for the maintenance and rehabilitation of coldwater communities.

Further monitoring at theses sites will clarify the temporal stability of these trends as well as identify potential affects of rehabilitation efforts. Further monitoring will also aid in the identification of additional areas for temperature mitigation to maintain a system conducive to healthy cool and coldwater communities.

Appendix A Individual Site Data

Displaying Daily Average & Minimum/Maximum Temperatures



References

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