Quantifying Thermal Regimes of Tributary Streams in the Allagash Wilderness Waterway

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A wild brook trout in the mainstem Allagash River, August 2025

PROJECT SUMMARY

Ambient water temperatures are a leading habitat parameter driving the distribution and persistence of stream fishes like brook trout (*Salvelinus fontinalis)*, a cold-water adapted species whose survival declines as water temperatures increase (Xu et al. 2010). Maine supports relatively intact populations of endemic brook trout, one of the more robust of which occurs in the Allagash River watershed in northwestern Maine. The Allagash watershed represents high value brook trout habitat that supports a popular recreational fishery within the state-owned Allagash Wilderness Waterway. Brook trout are a top predator in the flowing portions of this system that has been mostly immune to the rash of invasive fish introductions common across their native range. Trends in water temperature in the mainstem Allagash and low flow events, like that in 2020 when drought conditions dominated the region, have raised concern for the persistence of brook trout in a watershed long known for its excellent trout fishing. Projections of stream temperature and flow events corroborate this concern (Lawrence et al. 2014; Chambers et al. 2017). Coldwater tributary streams likely play a key role in sustaining brook trout during periods of thermal stress, highlighting the need for baseline temperature data to better understand population dynamics at the watershed scale. To address this, the Allagash Wilderness Waterway Foundation has undertaken an effort to collect temperature data from streams entering the Allagash Wilderness Waterway. Twenty-two tributaries and four locations within the mainstem of the Allagash River were monitored for ambient stream temperature data in 2022 and 2023. In 2024 the study continued with data collected from fourteen tributaries while in 2025 data was collected from fifteen tributaries. The goals of this study are to characterize the thermal regimes of the Allagash River and its tributaries, so that critical thermal refuge habitats and areas of conservation focus can be identified. We documented water temperatures in the Allagash River that exceeded the thermal stress and lethal limits for brook trout. The species must rely on microhabitats within the mainstem, that are largely unknown, or tributaries that provide thermal refugia. We identified fifteen tributaries that may provide such habitat, but how and to what extent brook trout are using these habitats to survive summer months has not been documented. In August 2024, a cursory survey of several river-tributary confluences documented little adult brook trout habitat at moderate to high river flows. A similar survey in August 2025, at flows below normal (<500 cfs) had similar results. More work is needed to identify how brook trout, at different life stages, are surviving thermally harsh summer months. Many of the tributaries currently providing potential thermal refuge are likely threatened by warming regimes. Our data represent four years of ambient water temperature monitoring in an ongoing effort to document baseline thermal conditions of tributary streams in the Allagash Wilderness Waterway. The implications of this work are relevant to brook trout conservation and land management in the Allagash watershed. It will inform future studies to better understand how brook trout persist in such a large and variable watershed.

INTRODUCTION

The Allagash Wilderness Waterway (AWW) is a 92-mile stretch of River and large lakes federally designated as a Wild and Scenic River in Northwest Maine. The watershed is unique in many ways including the fact that invasive species have had relatively minimal impact to endemic fishes. One of these, brook trout, remains in its historic ecological role as a top predator and is highly sought after by anglers. Throughout the watershed brook trout display multiple life history strategies that are heavily mediated by physical habitat including the water temperature regime of the watershed. The AWW is not unlike most Maine brook trout habitats in that mid to late summer weather renders large parts of aquatic systems unsuitable. Brook trout respond to these habitats, which are highly variable, with equally variable life histories. This adaptive mechanism allows the species to fully utilize available habitat and helps assure the species will be able to adapt to future changes. Historical water temperature data from the Allagash River indicates the watershed is warming at a rapid rate (Table 1). There is no historical information from the AWW tributaries. This has prompted the Allagash Wilderness Waterway Foundation to initiate a stream temperature monitoring project to provide current baseline information on thermal regime of the Allagash River and its major tributaries. In addition, this project is beginning to incorporate coarse, low-level habitat surveys to identify critical summer habitat for adult brook trout in the river as well as the presence of suitable spawning habitat. Identifying potential spawning habitat is coupled with the hope to eventually locate actual brook trout spawning sites.

Table 1. Means of monthly mean water temperatures in the Allagash River at the USGS gauge site near Allagash, ME, for years 1975-80, 2010-2015, and 2022-2024 (https://nwis.waterdata.usgs.gov).

	Monthly Mean Water Temperature in the Allagash River				
Time Period	**May ℃**	**June ℃**	**July ℃**	**August ℃**	**September ℃**
1975-1980	9.1	16.7	20.2	19.1	13.6
2010-2015	11.5	17.3	21.4	20.9	16.7
2022-2024	12.5	18.3	22.6	20.7	17.4
Increase from 1975-1980	**3.4**℃	**1.6**℃	**2.4**℃	**1.6**℃	**3.8**℃

The various life histories known to be present in the Allagash watershed were discussed in Frost (2023) and are based on unpublished information from MDIFW. Aquatic habitat in the Allagash watershed varies from first order streams to a large mainstem river and from small ponds to large oligotrophic lakes to lakes that show little stratification. This wide variation in habitat along with the relatively large geographic area (1,478 mi^2) has brought about these exceptional adaptations. Adfluvial trout originate as embryos in smaller tributary streams then migrate to a lake or pond to grow until sexually mature. Fluvial trout similarly originate in small streams but migrate to a mainstem river to grow to sexual maturity then return to their natal stream to spawn. Finally, resident trout complete their life cycle entirely within a single habitat, for example those in low order tributaries at the head of watersheds. Adult trout size follows a gradient of large to small across these life histories with the largest fish typically seen in the adfluvial strategy. Furthermore, age at maturation will follow a similar pattern with adfluvial fish achieving older ages while resident fish mature in just one or two years. Such adaptation across a large watershed like the Allagash, likely leads to increased population resilience and viability as described in metapopulation dynamics, i.e., the movement and dispersal of population units throughout a system (Nathan et al. 2018). The concept of metapopulations in Allagash brook trout has not been addressed by fisheries researchers; in fact, prior to this study only one brook trout spawning area had been documented in the river upstream of Allagash Falls and downstream of Lock Dam at the historic outlet of Chamberlain Lake. There is no data on relative size of each segment or where they reproduce, but water temperature regimes of the various habitats might play a large role in mediating this partitioning.

Thermal Criteria - Frost (2023) presented the rationale for selection of regional thermal criteria used in the first two years of this study and is summarized here (Table 2). Pertinent reviews in the wide selection of literature available on brook trout response to water temperatures were used as well as the experience of professionals in the State and region. We are most interested in the point at which brook trout begin to experience thermal stress and as a result initiate behavioral changes to seek out habitats with cooler temperatures. That threshold for this study is 18℃. Maximum daily water temperature is used as the key metric to discern among habitats that are suitable and unsuitable for brook trout. We categorize the various habitats further by addressing the chronic nature of elevated water temperatures; exposure to elevated temperature can disrupt normal bodily functions leading to an increased probability of mortality. Tributaries that remain under the maximum thermal optimum of 18℃ are considered high value habitats.

Table 2. Thermal criteria used in this study to categorize habitat for brook trout.

Thermal Criterion	Temperature ℃	Habitat Description
Thermal Optimum	< 18	High value
Upper Thermal Tolerance - UTT	> 20	Onset of thermal stress
Upper Incipient Lethal Temperature - UILT	> 23	Unsuitable/lethal if exposed >7 days

Implications - This study is a high-level evaluation of the thermal regime of the mainstem Allagash and many of its tributaries. The focus is to identify critical thermal refugia for brook trout in the system because we are concerned about negative effects that a warming climate could have on the system. In addition, we are beginning to evaluate specific habitat features related to thermal regime in the mainstem or tributaries. Specifically, we are interested in adult summer habitat, discrete spawning areas, and the number and quality of pools within the AWW tributaries. All are considered critical habitats for the species and ones that may be vulnerable to changing thermal regime. Knowledge of spawning areas will assist in evaluating the status of the various life history forms and how they persist together in the watershed. The results of this ongoing study are intended to provide baseline information for larger, more focused projects in the future.

METHODS

Study Area - The state owned and managed AWW includes, from south to north, Telos Lake, Round Pond, Chamberlain Lake, Allagash Lake, Allagash Stream, Eagle, Churchill, Umsaskis, and Long Lakes, Round Pond, and the Allagash River flowing north almost to the village of Allagash. A buffer strip, termed the restricted zone, of state-owned land follows the contour of the shoreline and extends roughly 500 feet beyond the high-water mark. The study area encompasses twenty-two AWW tributary streams and four mainstem locations in the Allagash River. Study streams were selected based on Maine Department of Inland Fisheries and Wildlife (MDIFW) fisheries biologist and AWW Ranger recommendations regarding historic brook trout use of those streams for thermal refugia. Emphasis was made to establish sampling locations within the restricted zone of the AWW to best represent water temperatures as they enter the AWW from the watershed. The study area comprises a representative array of aquatic environments typical of a northern Maine system. Forty-one percent (N=11) of sampling locations enter the Allagash River, 29% (N=8) enter lakes with weak summer thermal stratification, and 15% (N=4) enter a thermally stratified oligotrophic lake.

Temperature Sampling – Only four remote temperature loggers were redeployed during fall 2024 fieldwork. These loggers were left in place, collecting data throughout winter months. In previous years of this study, most loggers were left out throughout the winter months, however, we had a relatively high incidence of malfunction in 2024. So, most loggers were removed for the winter season after downloading data in fall of 2024. In 2025, three spring trips were made to check on loggers and deploy new ones. First, new loggers were placed at Glazier Brook and Thoroughfare Brook on June 5th. On June 8-9th tributaries accessible by river only were visited; either new loggers or loggers with new batteries were deployed. Two new sites were established on this trip, one at Musquacook Stream and one at Farm Brook, both of which have been sampled in previous years of this study. To avoid data loss, as occurred in 2024 due to malfunctioning loggers, two loggers were deployed in seven tributaries (Appendix A; Table 1). Tributaries chosen for this duplication of effort were those deemed to be most important for the study or where we had failed to collect data in previous years. Finally, on June 13th three remaining logger sites were visited at the southern portion of the study area where loggers left over winter were downloaded and loggers with new batteries were deployed. For the entire 2025 season, all loggers (except Churchill Brook and Upper Ellis Brook) were either new logger units or were old loggers with new batteries installed.

Fall river flows were lower than normal (<800 cfs) throughout late September and October during field trips to retrieve and download loggers. While low flows allow easy access to loggers, river travel is more difficult. The southern loggers (N=5), accessed by vehicle or boat, were visited on October 3rd except that the one logger accessible by boat, Churchill Brook, was not visited due to high winds on Churchill Lake. The four loggers were retrieved and downloaded. Due to dead batteries at Ellis Brook and Allagash Stream, loggers were not redeployed while Thoroughfare Brook and Telos Stream were both redeployed for the winter and 2026 season. The Glazier Brook logger was also visited, data was downloaded, and the logger was removed for the winter. The remaining 11 loggers were visited October 11-12 requiring an overnight camp stay at Five Finger campsite. River flows were 389 to 423 cfs. For the seven tributaries with two loggers deployed, only one logger was pulled and downloaded. None of these loggers malfunctioned so the data was downloaded, the logger was removed, and the second logger was left undisturbed for the winter. Similar to 2024, each tributary was inspected for brook trout spawning activity from the confluence up to the logger site, however, the 2025 trip was a full month earlier than in 2024, and likely prior to any spawning in the mainstem Allagash.

HOBO MX TidbiT 400 temperature loggers by ONSET® were programmed to record temperature values in degrees Celsius at thirty-minute intervals. The accuracy of each logger was validated using a handheld thermometer before deployment and twice during the study. PVC cases were constructed using two-inch schedule 40 socket caps, two-inch schedule 40 female hub adapters, and two-inch schedule 40 male plugs. Components were adhered together using heavy duty PVC cement and primer. Two holes were drilled in the cases for an attachment point and to allow water exchange over the logger. Each logger was anchored into the substrate with half-inch rebar, and each site was established behind a large rock within or adjacent to the thalweg to prevent damage and avoid dewatering. All sites were covered with large rocks to protect and hold down each encased logger (Figure 1). Sites were established above freshwater deltas to avoid inundation from the river or lake environment during high water events.

Of the 17 sites monitored for ambient water temperature data during 2025, 35% (N=6) of sites were accessible by road, 5% (N=1) were accessible by lake with a boat, and 59% (N=10) were accessible by river with a canoe. The Allagash watershed flows from south to north, so stations were typically visited in this manner. AWW Rangers provided watercraft and personnel assistance for lake and river access-only sites, as well as shuttles to and from boat launches.

Evaluation of River-Tributary Confluences as Thermal Refugia – We continued our evaluation of the trout holding areas at the mainstem-tributary confluences. These transitional habitats are potential thermal refugia for adult brook trout. Sudden high flows from rainstorms on our trip in 2024 hampered efforts to clearly see the river-tributary interface. We targeted the mid-summer period of late July/August when river flows were approaching median (approximately 850 cfs in early August) or less, and main river water temperatures exceeded 23°C. Brook trout are in their summer habitats at this time with a warm thermal regime dominating the mainstem. Trout behavior under these conditions is to seek out habitats with cool water that also provides protection from predators. Foraging is usually minimal due to elevated water temperatures, a sharp contrast to the early summer period (May and June) when brook trout can use much of the available mainstem habitat to move and forage freely. We floated the river from Umsaskis Lake to Michaud Farm during August 21 - 24, 2025. Nine tributary confluences were visited and examined for potential to hold adult brook trout. Data from 2024 were updated since river flow was much lower in 2025 during the survey. Where sampling did not take place due to weather in 2024, we collected detailed depths and temperatures. To corroborate the physical habitat, we snorkeled to determine whether brook trout were present. Typical snorkel methods were to enter the water well above the site, float with the current through the site making observations of the fish species present, if any, and if brook trout were present, recording the general size classes (i.e., >12 in and < 12 in). Tributary confluences visited were - Harding Brook; Whittaker Brook; Henderson Brook; Savage Brook; Five Finger Brook; McKinnon Brook; Ben Glazier Brook; Cunliffe Brook; and Ramsay Brook. Sites were selected based on data collected during this study and historical information from AWW Rangers who are familiar with those areas that hold brook trout and provide fishing opportunity.

Figure 1: Temperature logger encased in PVC housing before deployment (left), and an example of a monitoring site behind a large rock in the middle of the channel (right).

Tributary Pool Survey – To further evaluate where brook trout seek out refuge during warmer summer months in the AWW system, we began cursory surveys on select tributaries during the late summer trip. The lower reaches of Schedule, Five Finger, and Ben Glazier Brooks, were surveyed 0.9, 1.2, and 0.7 miles, respectively. We counted and rated pools according to standard protocol used by MDIFW (Gallagher2008). Pools were identified by obvious stretches of calm water with little to no visible water flow. Pools were counted, marked for location, photographed, and rated by class that considers size, cover and maximum water depth (Table 3). We approached each pool such that brook trout, if present, could be observed and noted. Deeper pools with good cover could not be fully seen so the presence or absence of trout could not be determined with any certainty in those habitats.

Statistical Analysis – All temperature data were cleaned for quality assurance/quality control and compiled in Microsoft Excel. Data summarization was conducted using the software system SAS 9.4. Output metrics were based on a literature search conducted before

Table 3. Pool characteristics by class (Gallagher 2008).

Class	General Characteristics	Water depth (ft)	% of Bottom with Cover[1]	Examples
1	Large, deep, good cover	> 3	> 30 overhanging or instream	"Swimming holes" or "angling gems" that are often named
2	Intermediate size, depth, cover	< 3	5 - 30	Large eddies behind boulders; undercut banks
3	Small, shallow, poor cover	< 2	< 5	Small eddies behind structure; shallow lateral pools

[1] Cover can be instream in the form of water depth, surface turbulence, or structure (boulder, wood) or overhead in the form of undercut banks, overhanging vegetation, or debris masses that extend above the water line

summer temperatures were downloaded. We looked for publications that best represented natural fluxes in experienced thermal stress. Field-based estimates or laboratory studies that incorporated thermal acclimation were considered for the critical thermal thresholds referenced presently. The daily mean, minimum, maximum, and range of temperature values were generated for each station. The sum of days (exposure) during sampling in which mean and maximum daily temperatures exceeded brook trout thermal thresholds of 18℃, 20℃, and 23℃ were computed for June, July, August, and September. Data from the first three years of the study are presented for comparison and data were pooled to present a more accurate depiction of thermal regimes in the study area. All computations in SAS 9.4 were exported into Microsoft Excel. Flow data from the Allagash River were retrieved from the United States Geological Survey (USGS) website (waterdata.usgs.gov) using Program R (RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/) and exported to Microsoft Excel for further analysis.

RESULTS

Sixteen (16) loggers were deployed for the entire summer season in 2025 and since the Churchill Brook logger was not checked in 2025 due to logistical issues, we collected data from 15 sites. Most logger sites were the same as in previous years of this study except for new logger sites at Farm Brook and Musquacook Stream. On August 24th a new logger site was established in the Unnamed Brook near Cunliffe Depot after we found adult brook trout holding in the pool at the brook/river interface. No issues of malfunction occurred in loggers for the 2025 season, and we assume the issues in 2024 were related to battery failure.

Exposure Time: Mean and Maximum Daily Temperatures – Allagash Stream and Ellis Brook continued to be the warmest habitats in the study, often exceeding the upper thermal threshold (20 °C), the point at which thermal avoidance begins (Table 5). Mean ambient water temperatures exceeded the UTT for 73% and 60% of days at Lower Allagash Stream and Upper Ellis Brook, respectively (Table 5). Maximum daily temperature exceeded the UTT 88% and 78% of the days, further reflecting the warm nature of these two tributaries (Table 8). Mean daily temperatures exceeded UILT, the threshold indicating unsuitable habitat, for 27% and 21% at Lower Allagash Stream and Upper Ellis Brook, respectively for the period June through August (Table 6). The maximum daily temperature for these tributaries exceeded the UILT 48% of days June through August (Table 9), though there is a clear outlier month of August 2023 that had no days exceeding this threshold. Other locations with notably high temperatures were Thoroughfare Brook, Schedule Brook, Telos Stream, and Musquacook Stream with maximum daily temperatures exceeding UTT 38%, 38%, 61% and 60% of the days June through August, respectively (Table 8). Mean daily temperatures exceeded UTT 17%, 8%, 22%, and 39% of the days for these four tributaries, respectively (Table 5).

Several tributaries had a wide separation in how maximum and mean daily temperatures exceeded the UTT. Schedule Brook and Glazier Brook both had relatively high incidences of maximums exceeding the UTT of 38% and 28% (Table 8), respectively, while the mean daily values over UTT were only 8% for both tributaries (Table 5). We noted a similar relationship for Churchill Brook (22% and 5%) for 2022 to 2024. These tributaries exhibited the greatest separation in number of days above the UTT for maximum and mean daily temperatures considering the tributaries that are potential brook trout habitat for much of the summer (i.e., Telos Stream at 61% and 22%).

Mean daily temperatures in Ramsay, Savage, and Shepherd Brooks did not exceed the UTT throughout the four years except for a single day on Shepherd Brook in June 2024 (Table 5), designating them the coolest group of tributaries in this study. A second tier of tributaries had only minimal exceedance of the mean daily UTT; Ben Glazier, Farm, McKinnon, and Whittaker Brooks had zero exceedance in most months with August 2025 as the outlier. These tributaries had 4, 4, 1, and 4 days exceeding the mean daily UTT, respectively, in August 2025 (Table 5) and even fewer days in August 2024 and June 2024. Mean daily temperature at Schedule Brook exceeded the UTT only 8% of the days (Table 5) while mean daily temperature exceeded the thermal optimum 34% of the time (Table 4). Harding and Glazier Brook had 3% and 8% of days exceeding the mean daily UTT but is based on data only from 2025 (Harding) and 2022 and 2025 (Glazier). Furthermore, Ben Glazier, McKinnon, Savage, Shepherd, and Whittaker Brooks had mean daily temperatures that exceeded 18℃ on 10% or less of the days across the study (Table 4). Ramsay Brook did not record a maximum nor a mean ambient water temperature above 18℃ during any month of the four-year study (Tables 4 and 7).

Annual Variation in Temperature and Hydrograph - The summers of 2022 and 2023 were generally wet, with flows rarely dropping below the median while 2024 was closer to normal with spikes in flow throughout the season after a very dry April and May (Figure 2). The spring peak in the hydrograph was abnormal in 2024 after a winter snowpack that was almost

Table 4. A count of days in which mean daily temperatures exceeded 18 ℃ for various months June through September 2022 through 2025. Mean value is for June through August only and N≥4 months.

	Count of Days Mean Temp GE 18℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	26	15	31	31	31	31	31	31	31	27	14	0	29	92%
U. Allagash Stream				30				1						
Ben Glazier Brook		0	1	6		2	2	0		5		0	2	7%
Bissonnette Bridge			31	31			31	31					31	100%
Churchill Brook	3		14	21	10		11	0	7		0		9	30%
Farm Brook		0	1			5	1			9		0	3	10%
Five Finger Brook			12	25			13	0					13	40%
Glazier Brook		2	9			7	7			9		0	7	22%
Grey Brook			0	15			0	0					4	12%
Harding		2		10		4		0		5		0	4	14%
Henderson Bridge			31				31							
L. Ellis Brook			29	31			23	23					27	85%
McKinnon Brook	2	1	2	10	7	6	2	0	6	5	0	0	4	13%
Michaud Farm			31	31			31	29					31	98%
Musquacook Stream		11		31		26		14		20		0	20	66%
Pleasant Stream			29				27						28	90%
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				31				29						
Savage Brook	2	1	3	8	0	3	1	0	5	4	0	0	3	9%
Schedule Brook	8	4	15	22	8	9	13	0	15	11	0	0	11	34%
Shepherd Brook	2	0	0	16	1	2	0	0	3	5	0	0	3	9%
Sweeney Brook			12				6							
Telos Stream		9	20	30		25	15	10		6		0	16	53%
Thoroughfare Brook	11	8	26	26	20	16	13	0	15	17	0	0	15	49%
U. Ellis Brook	24	15		31	31	31		26	26	23	6	3	26	83%
Whittaker Brook	1	1	3	7	3	2	2	0	8	5	0	0	3	10%

Table 5. A count of days in which mean daily temperatures exceeded 20℃ for various months June through September 2022 through 2025. Mean value is for June through August only and for N≥4 months.

	Count of Days Mean Temp GE 20℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	12	9	26	28	31	31	31	11	23	23	14	0	23	73%
U. Allagash Stream				17				0						
Ben Glazier Brook		0	0	0		0	0	0		4		0	1	2%
Bissonnette Bridge			30	31			31	19					28	90%
Churchill Brook	2		0	3	2		1	0	2		0		1	5%
Farm Brook		0	0			0	0			4		0	1	3%
Five Finger Brook			1	6			2	0					2	7%
Glazier Brook		0	1			5	1			5		0	2	8%
Grey Brook			0	0			0	0					0	0%
Harding		0		0		0		0		4		0	1	3%
Henderson Bridge			30				30							
L. Ellis Brook			23	13			28	0					16	52%
McKinnon Brook	1	0	0	0	0	0	0	0	2	1	0	0	0	1%
Michaud Farm			28	31			24	6					22	72%
Musquacook Stream		3		26		20		0		11		0	12	39%
Pleasant Stream			19				18							
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				31				5						
Savage Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Schedule Brook	2	1	2	2	4	2	1	0	5	5	0	0	2	8%
Shepherd Brook	1	0	0	0	0	0	0	0	0	0	0	0	0	0%
Sweeney Brook			0				0							
Telos Stream		5	7	17		11	4	0		3		0	7	22%
Thoroughfare Brook	6	0	9	6	8	5	8	0	5	7	0	0	5	17%
U. Ellis Brook	12	11		29	31	29		1	19	18	6	0	19	60%
Whittaker Brook	0	0	0	0	0	0	0	0	2	4	0	0	1	2%

Table 6. A count of days in which mean daily temperatures exceeded 23℃ for various months June through September 2022 through 2025. Mean value is for June through August only and for N≥4 months.

	Count of Days Mean Temp GE 23℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	3	2	10	6	13	10	22	0	8	9	0	0	8	27%
U. Allagash Stream				0				0					0	0%
Ben Glazier Brook		0	0	0		0	0	0		0		0	0	0%
Bissonnette Bridge			13	9			24	0					12	37%
Churchill Brook	0		0	0	0		0	0	0		0		0	0%
Farm Brook		0	0			0	0			0		0	0	0%
Five Finger Brook			0	0			0	0					0	0%
Glazier Brook		0	0			0	0			0		0	0	0%
Grey Brook			0	0			0	0					0	0%
Harding		0		0		0		0		0		0	0	0%
Henderson Bridge			14				7						11	34%
L. Ellis Brook			5	3			7	0					4	12%
McKinnon Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Michaud Farm			9	6			23	0					10	31%
Musquacook Stream		0		2		3		0		5		0	2	6%
Pleasant Stream			0				1						1	2%
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				17				0					9	27%
Savage Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Schedule Brook	0	0	0	0	0	0	0	0	0	3	0	0	0	1%
Shepherd Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Sweeney Brook			0				0						0	0%
Telos Stream		1	0	0		3	4	0		0		0	1	4%
Thoroughfare Brook	2	0	0	0	0	0	0	0	0	4	0	0	1	2%
U. Ellis Brook	3	3		14	9	12		0	5	5	0	0	6	21%
Whittaker Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%

Table 7. A count of days in which maximum daily temperatures exceeded 18 ℃ for various months June through September 2022 through 2025. Mean value is for June through August only and for N≥4 months.

	Count of Days Max Temp GE 18℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	30	16	31	31	31	31	31	31	31	31	19		29	95%
U. Allagash Stream				31				9						
Ben Glazier Brook		3	20	19		11	13	0		14		0	11	37%
Bissonnette Bridge			31	31			31	31					31	100%
Churchill Brook	9		26	28	24		17	2	17		0		18	57%
Farm Brook		5	12			14	7			13		0	10	33%
Five Finger Brook			28	30			26	5					22	72%
Glazier Brook		10	27			20	20			22		0	20	64%
Grey Brook			4	26			5	0					9	28%
Harding		4		25		10		0		13		0	10	34%
Henderson Bridge			31				31							
L. Ellis Brook			31	31			30	30					31	98%
McKinnon Brook	6	3	13	24	15	12	8	0	10	8	0	0	10	32%
Michaud Farm			31	31			31	30					31	99%
Musquacook Stream		20		31		30		27		26		0	27	86%
Pleasant Stream			31				30							
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				31				30						
Savage Brook	4	3	10	25	10	10	5	0	7	5	0	0	8	25%
Schedule Brook	16	12	31	30	17	26	25	5	19	25	1	3	21	66%
Shepherd Brook	9	2	13	25	13	13	11	0	8	10	0	0	10	34%
Sweeney Brook			17				14							
Telos Stream		17	28	31		31	24	27		16		5	25	80%
Thoroughfare Brook	18	15	29	30	26	24	18	8	22	28	4	2	22	70%
U. Ellis Brook	30	18		31	31	31		30	30	29	14	6	29	93%
Whittaker Brook	9	5	22	26	15	12	13	0	16	15	0	0	13	43%

Table 8. A count of days in which maximum daily temperatures exceeded 20℃ for various months June through September 2022 through 2025. Mean value is for June through August only and for N≥4 months.

	Count of Days Max Temp GE 20℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	24	14	31	30	31	31	30	27	28	29	12	0	27	88%
U. Allagash Stream				28				0						
Ben Glazier Brook		0	3	6		1	3	0		9		0	3	10%
Bissonnette Bridge			31	31			31	29					31	98%
Churchill Brook	5		13	10	7		8	0	5		0		7	22%
Farm Brook		1	1			4	0			7		0	2	5%
Five Finger Brook			16	24			16	0					14	45%
Glazier Brook		5	12			9	9			12		0	9	28%
Grey Brook			0	7			0	0					2	6%
Harding		2		6		3		0		6		0	3	9%
Henderson Bridge			31				31							
L. Ellis Brook			30	31			25	14					25	81%
McKinnon Brook	2	1	0	6	1	2	1	0	5	5	0	0	2	6%
Michaud Farm			31	31			31	20					28	91%
Musquacook Stream		11		31		28		5		22		0	19	60%
Pleasant Stream			30				27							
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				31				18						
Savage Brook	2	1	0	5	0	1	0	0	4	3	0	0	1	5%
Schedule Brook	11	7	20	21	10	12	11	0	15	17	0	0	12	38%
Shepherd Brook	3	1	0	10	0	2	3	0	1	5	0	0	2	7%
Sweeney Brook			4				2							
Telos Stream		13	26	29		27	17	14		6		2	19	61%
Thoroughfare Brook	12	9	22	18	15	9	10	0	11	19	0	0	12	38%
U. Ellis Brook	21	17		30	31	31		14	25	24	4	4	24	78%
Whittaker Brook	5	2	6	7	5	4	4	0	8	10	0	0	5	15%

Table 9. A count of days in which maximum daily temperatures exceeded 23℃ for various months June through September 2022 through 2025. Mean value is for June through August only and for N≥4 months.

	Count of Days Max Temp GE 23℃													
Stream	**Jun-24**	**Jun-25**	**Jul-22**	**Jul-23**	**Jul-24**	**Jul-25**	**Aug-22**	**Aug-23**	**Aug-24**	**Aug-25**	**Sep-24**	**Sep-25**	**Mean**	**%**
L. Allagash Stream	7	4	16	28	25	22	16	0	15	16	0	0	15	48%
U. Allagash Stream				5				0						
Ben Glazier Brook		0	0	0		0	0	0		3		0	0	1%
Bissonnette Bridge			18	19			19	0					14	45%
Churchill Brook	2		0	2	0		0	0	0		0		1	2%
Farm Brook		0	0			0	0			3		0	1	2%
Five Finger Brook			3	4			2	0					2	7%
Glazier Brook		2	0			0	0			5		0	1	5%
Grey Brook			0	0			0	0					0	0%
Harding		0		0		0		0		3		0	1	2%
Henderson Bridge			20				14							
L. Ellis Brook			22	19			11	0					13	42%
McKinnon Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Michaud Farm			23	28			18	2					18	57%
Musquacook Stream		5		13		12		0		12		0	8	27%
Pleasant Stream			16				14							
Ramsay Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Ramsay Ledge				25				0						
Savage Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Schedule Brook	5	3	3	3	2	2	2	0	4	7	0	0	3	10%
Shepherd Brook	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
Sweeney Brook			0				0							
Telos Stream		9	14	11		10	4	0		0		0	7	22%
Thoroughfare Brook	7	3	3	3	1	0	3	0	0	9	0	0	3	9%
U. Ellis Brook	10	10		24	24	23		0	14	14	0	0	15	48%
Whittaker Brook	0	0	0	0	0	0	1	0	2	5	0	0	1	3%

nonexistent in the region. Snowpack in spring 2025 was similarly low and in both years led to lower-than-normal flows in April and May. Later in 2025, July flows were somewhat normal but after July flows were significantly lower than the three previous years of the study (Figure 2). Rainfall in June boosted river flows to above normal while ambient water temperature was elevated this month. Air temperature data collected in Caribou set a record high in June 2024 (https://www.weather.gov/car/2024ClimateSummary). June air temperature was 3 – 4 degrees above average, the warmest June since records began in 1939, indicating we observed the warmest June in recorded history and possibly the warmest ambient water temperatures as well. Our data shows some high variability across years at sites sampled multiple years. The number of days maximum temperatures exceeded the UTT was notably greater in 2022 than in 2023 then returned closer to 2022 in 2024 (Figure 3). Most of the cooler tributaries had higher counts of days with maximum temperatures at the UTT or higher and this trend continued in 2025 as most of the tributaries had similar data. The warmer tributaries like Thoroughfare and Schedule Brooks had significantly more days at or higher than the UTT in 2025. Telos Stream, however, had far fewer days at or above the UTT in 2025 compared to 2022 and 2023 (Figure 3). Ben Glazier Brook had disparate data as well; days at or higher than UTT in 2022 and 2025

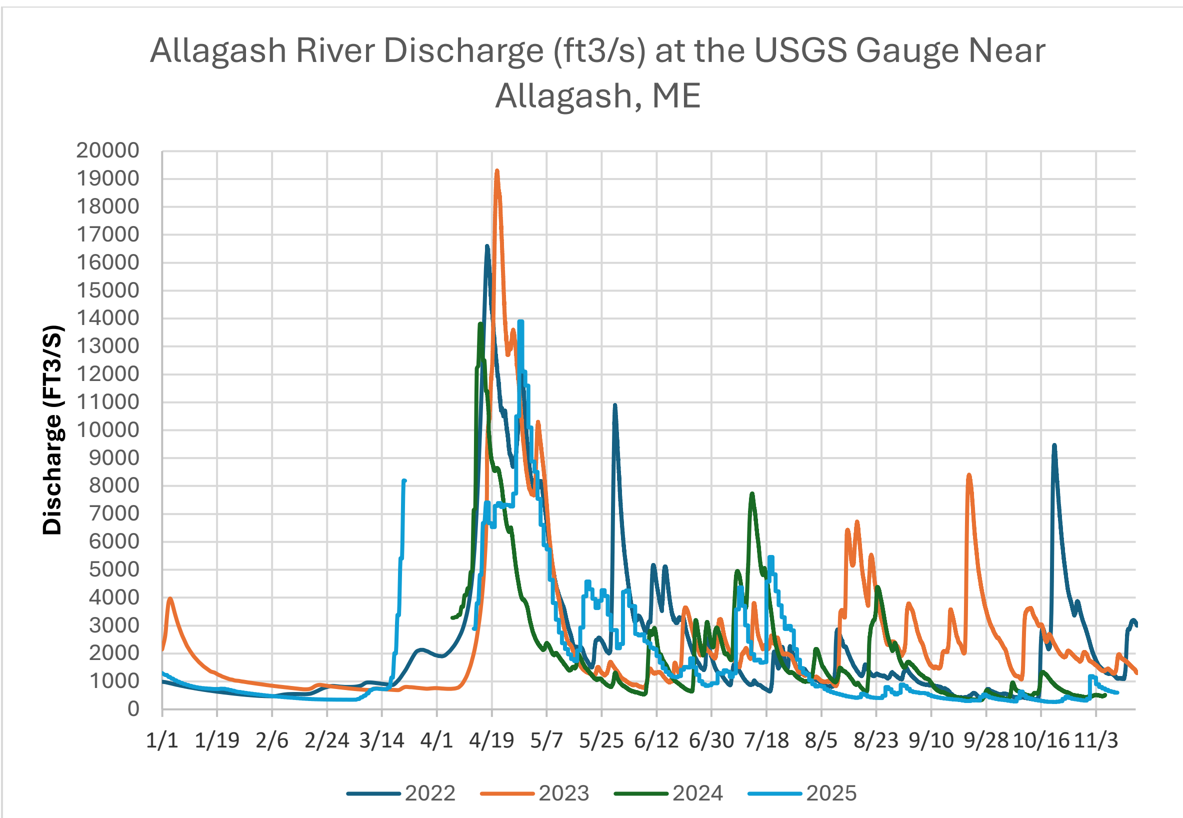


Figure 2. Discharge measured in cubic feet per second at the USGS gauge site in the Allagash River near Allagash, ME. Data courtesy https://nwis.waterdata.usgs.gov.

were 3 and 9, respectively. Unfortunately, the logger in Ben Glazier had battery issues and no data was collected in 2024. These data highlight that August 2023 was an exceptionally cool water month since counts at the UTT or higher were 0 for nearly all sites. The first four years of this study had extremes in water temperatures, both cool and warm.

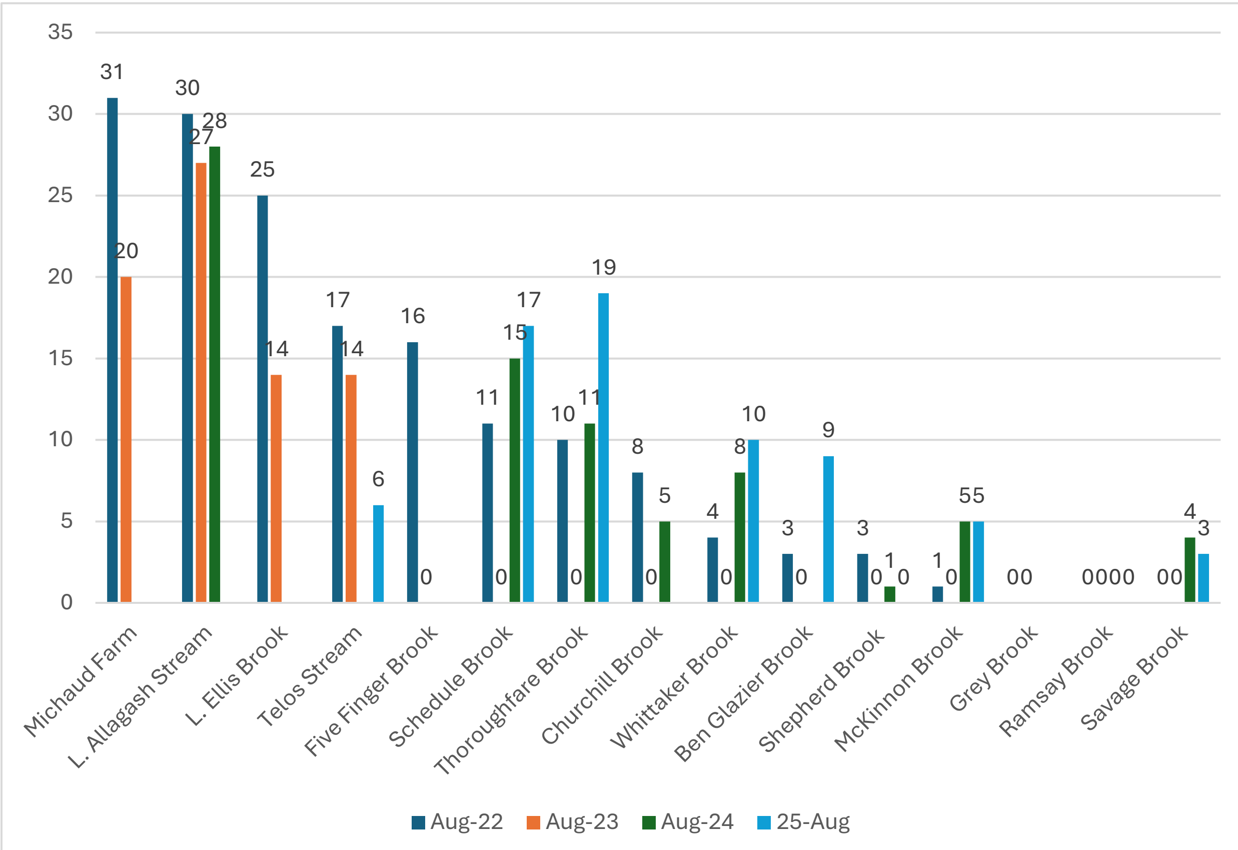


Figure 3. The total number of days in which daily maximum temperatures exceeded 20 ℃ in August of 2022 - 2025.

Evaluation of River-Tributary Confluences as Thermal Refugia – We found little suitable holding habitat for brook trout associated with the confluences of the nine tributaries examined (Table 10). Most of the sites had very shallow water at the confluence, mostly from 1.0-1.9 ft with occasional small pockets of deeper water. The area of cooling influence did not extend to deeper water even though many sites had much deeper water close by. River temperatures at the time of sampling were lower than what we targeted, ranging from 20.0 to 22.5 ℃, but the river had trended cooler just a few days prior to our trip. River flows were optimum for our work, ranging from 400 to 430 cfs, lower than the targeted median flow of 850 cfs. Brook trout were observed in only one location of the main river, the unnamed brook at Cunliffe Depot where 30 brook trout were holding in the cool water influence of the tributary. We estimated half were >12 in and likely were mature, adult fish. Incidentally, this was the coolest tributary mouth that we measured on this trip (Table 10). In 2024 flows were approaching 2,000 cfs when we sampled at Cunliffe making it nearly impossible to locate the holding area off the tributary. Like 2024, weather precluded us from sampling at Ramsay Ledge, the well-known, large pool just downstream of Ramsay Brook. Based on results from Cunliffe, we expect that Ramsay Ledge Pool provides thermal refugia habitat for adult brook trout in the summer.

Table 10. Tributary confluence data in the Allagash River. Bolded tributary name indicates brook trout were observed at time of sampling. Flow (mainstem River discharge, cfs; data courtesy https://nwis.waterdata.usgs.gov*) was taken from the United States Geological Survey river gage near Allagash, Maine. Water temperature data were taken with a hand-held thermometer.*

Tributary	Flow (cfs)	River Temp (C)	W Temp[1] (C)	W Depth[2] (feet)	Cover[3]	Refuge Potential[4]
Harding	430	22.5	18.5	2.0-2.5	None	None[5]
Whittaker	430	22.5	18.1	1.2-1.8	None	None[5]
Schedule	415	20.5	14.5	0.9-1.2	None	None
Savage	415	21.0	15.0	2.0-2.5	Low	Moderate[5]
Five Finger	415	21.0	19.5	2.0-2.3	Low	Moderate[5]
McKinnon	415	20.0	16.5	1.5-2.1	Low	Low[5]
Ben Glazier	415	21.5	17.8	1.2-1.6	None	None
Cunliffe	410	21.8	14.0	2.0-4.5	Low	Moderate
Ramsay[6]	400	21.0	14.5	0.9-1.6	None	None[5]

1 Measurement taken 25-50 ft up tributary
2 Measurements taken in cooling area of main river
3 Presence of boulder, large wood, or water depth >5 ft
4 At immediate tributary/river confluence
5 Deep water habitat nearby
6 Observations influenced by rain at time of sampling; site was dark and turbid

Tributary Pool Survey – The lower reaches of Schedule and Five Finger Brooks had a relatively high percentage of class 1 and 2 pools at around 50% (Table 11). Schedule had a single class 1 while Five Finger had four class 1 pools, a surprisingly high incidence of high-quality habitat. We observed no brook trout in either tributary during the surveys except for a small number just up from the main river in Schedule Brook. Very few trout were observed here even though water temperatures at the time were suitable for brook trout in both tributaries (Table 10) which reflects the very recent cooling trend. Ben Glazier Brook, however, had a much higher incidence of brook trout with 4 of 10 pools having trout present. Two of those pools were high quality, class 1 pools and both were associated with debris from an old beaver dam. The remaining eight pools were shallow, low quality (class 3) and two of these had trout present. Ben Glazier had the highest incidence of pools at 0.8 per 100 yd surveyed followed by Schedule and Five Finger Brook each with 0.4 pools per 100 yd.

DISCUSSION

Water temperature is an important habitat parameter limiting the distribution and persistence of stream fishes. Brook trout survival is significantly reduced as summer temperatures increase (Xu et al. 2010). Consequently, access to cold water refugia is critical during periods of elevated water temperatures. The Allagash River watershed above Allagash Falls is unique in that much of its native fish assemblage is intact, offering critical habitat to native brook trout with relatively little influence from invasive species. Physical habitat parameters are likely the greatest limiting factor for brook trout in the Allagash watershed, and current temperature regimes in the Allagash River highlight the importance of cold-water sources to the persistence of endemic brook trout there.

Water temperatures in the mainstem of the Allagash River are not suitable for brook trout survival during the summer months as documented in the first two years of this study (Frost 2023). Maximum daily water temperatures at three mainstem locations exceeded the UTT (20℃) for brook trout an average of more than 90% of the days in July and August of 2022 and 2023, and the UILT (23℃) for 40 – 60% of the days. Exposure to temperatures of that magnitude for greater than seven-days is not tolerated by brook trout (Wehrly et al. 2007). Summer water temperatures for at least two years, therefore, exceeded the stress threshold and lethal limit for brook trout in the mainstem Allagash River. We infer that fluvial brook trout that exploit the mainstem during favorable temperatures for growth and development must be mobile and seek thermal refuge in tributary streams along a longitudinal gradient, in spring seeps, and micro habitats that likely occur in the mainstem.

Like the main river in 2022 and 2023, temperatures in Upper Ellis Brook and Lower Allagash Stream commonly exceeded thresholds considered lethal to trout. Maximum water temperatures at these sites exceeded the UTT for more than 60% of the days June through August over the four years. However, tributaries that enter thermally stratified lakes, where there are adequate cold water and dissolved oxygen below the thermocline, may not be providing critical thermal refuge for adfluvial brook trout given there is refuge in the nearby lakes. Resident brook trout populations, on the other hand, are likely limited in these locations relying on stream connectivity for in-stream movements to thermal refuge during summer months. More work is needed to better understand the extent of movement and the thermal gradient in these complex tributary streams. To what extent these tributaries provide spawning habitat for adfluvial brook trout should be evaluated; the area of potential habitat is relatively large increasing the likelihood there is suitable habitat there. Locating spawning sites in all habitats for all life history strategies in the Allagash drainage should remain a priority for future work.

Like other river systems in northern Maine, brook trout persistence in the Allagash is highly dependent on cold water refugia since large areas of habitat become too warm for trout over extended time periods. During this study, several tributaries remained cold enough to support brook trout throughout the summer. Shepherd, Harding, Whittaker, Ramsay, Farm,

Table 11. Pool survey data from three tributaries to the Allagash River, August 2025.

Tributary/Pool #	Survey (mi)	Location	Pool Class	Max Depth	Cover	Brook Trout Observed
Schedule 1	0.9	46° 47' 25.86" N 69° 16' 40.87" W	3	1.1	Moderate	No
Schedule 2	0.9	46° 47' 24.90" N 69° 16' 42.05" W	2	2.1	Moderate	No
Schedule 3	0.9	46° 47' 24.28" N 69° 16' 47.11" W	3	1.5	Heavy	No
Schedule 4	0.9	46° 47' 23.34" N 69° 16' 48.90" W	2	2.3	Moderate	No
Schedule 5	0.9	46° 47' 27.06" N 69° 16' 58.00" W	3	2.1	None	No
Schedule 6	0.9	46° 47' 28.79" N 69° 16' 54.73" W	1	2.9	Moderate	No
Five Finger 1	1.2	46° 51' 29.93" N 69° 14' 48.42" W	3	1.6	Moderate	No
Five Finger 2	1.2	46° 51' 31.03" N 69° 14' 46.73" W	2	2.2	High	No
Five Finger 3	1.2	46° 51' 27.77" N 69° 14' 42.85" W	2	2.0	High	No
Five Finger 4	1.2	46° 51' 27.26" N 69° 14' 37.49" W	3	1.5	Low	No
Five Finger 5	1.2	46° 51' 22.68" N 69° 14' 30.29" W	1	3.0	High	No
Five Finger 6	1.2	46° 51' 20.82" N 69° 14' 26.77" W	1	3.1	Moderate	No
Five Finger 7	1.2	46° 51' 16.45" N 69° 14' 11.70" W	1	2.9	High	No
Five Finger 8	1.2	46° 51' 14.75" N 69° 13' 52.67" W	2	2.0	Low	No
Five Finger 9	1.2	46° 51' 9.26" N 69° 13' 51.43" W	1	2.9	High	No
Ben Glazier 1	0.7	46° 54' 29.79" N 69° 12' 55.25" W	3	1.5	Moderate	Yes
Ben Glazier 2	0.7	46° 54' 30.36" N 69° 12' 55.32" W	1	3.6	Moderate	Yes
Ben Glazier 3	0.7	46° 54' 30.85" N 69° 12' 56.55" W	1	2.0[1]	High	Yes
Ben Glazier 4	0.7	46° 54' 31.66" N 69° 12' 56.74" W	3	1.3	Low	No
Ben Glazier 5	0.7	46° 54' 34.94" N 69° 12' 53.97" W	3	1.5	Low	No
Ben Glazier 6	0.7	46° 54' 35.83" N 69° 12' 53.29" W	3	1.6	High	No
Ben Glazier 7	0.7	46° 54' 36.17" N 69° 12' 53.75" W	3	1.5	Moderate	No
Ben Glazier 8	0.7	46° 54' 36.75" N 69° 12' 55.24" W	3	1.4	Moderate	Yes
Ben Glazier 9	0.7	46° 54' 37.19" N 69° 12' 57.67" W	3	1.4	Low	No
Ben Glazier 10	0.7	46° 54' 37.13" N 69° 13' 4.45" W	3	1.6	Moderate	No

[1] Actual depth of this pool was much higher but could not be measured within the debris from an old beaver dam

Grey, and McKinnon Brooks provided cold water refugia when conditions in the mainstem were unfavorable. Furthermore, Ben Glazier, Farm, Shepherd, Harding, McKinnon, Savage, and Whittaker Brooks recorded mean daily temperatures that exceeded 18℃ less than 14% of days in June, July and August, while mean temperatures at Ramsay Brook did not exceed 18℃ for the duration of the first four years of this study. These tributaries represent unique thermal habitats; their importance to the persistence of brook trout in the system should be examined through more focused work to determine which life history stages are most dependent on them. The tributaries identified here are likely the most vulnerable to anthropogenic disruptions due to their small watershed areas (Meyer et al. 2007; Kanno et al. 2015), highlighting a need to better understand them in their role as brook trout habitat.

Some of the study streams had a relatively wide separation between recorded maximum daily temperatures that exceeded the UTT for a significant amount of time and mean daily temperatures that, in contrast, depicted cooler habitats with some potential for brook trout thermal refugia. For example, maximum daily temperatures at Schedule and Glazier Brooks, on average, exceeded the UTT more than about 33% of the days combined June through August, though each stream's mean daily temperatures exceeded the UTT 8% of the days for the same time period. Frost (2023) noted this same trend for these tributaries along with Five Finger and Churchill Brooks. This discrepancy between maximum and mean daily temperatures may suggest acute rather than chronic thermal stress events at these sites; air temperatures and solar radiation may have had a greater influence on these streams relative to other sampling locations. Brook trout exposure to thermal stress at these sites may be minimal, and their value as refuge should be investigated further focusing on more intensive sampling. Rather than a single point of measure that we have used in this study, a sampling design that evaluates thermal properties along a longitudinal gradient would be informative. These 'marginal' streams tend to be larger in size, lending themselves to easier brook trout movement from the Allagash mainstem, and supporting a much greater overall area of physical habitat than smaller streams. Knowing how much of these larger streams are serving as actual refuge areas, further upstream in their watersheds, would be highly beneficial in categorizing their status as critical habitats.

Water temperatures can vary significantly within individual streams, and it is important to note that our temperature loggers were stationed at points low in watersheds of tributary streams reflecting conditions entering the AWW. These data, therefore, represent macrohabitat at the lowest point in each tributary's watershed area, and likely overlook important microhabitat and other cold-water sources higher in the watershed. In the first two years of this study Frost (2023) attempted to examine the presence of microhabitat thermal features in the main-stem and two tributaries. That initial effort was unsuccessful but recognized the need to better understand where and how adult brook trout are using the mainstem River. Mainstem habitats provide depth, complexity, and resources to larger fluvial brook trout and should be identified. Furthermore, it is likely that tributary streams have these complex habitats as well, some of which include small tributaries and direct groundwater discharges that could be discovered with finer scale sampling.

In this study that spans four years, we have complete ambient temperature datasets for nine tributary streams with a fifth and final year planned for 2026. Assuming we recover data from Churchill Brook for the 2025 season, we will have complete datasets for ten tributaries. Variation in thermal regimes by month is beginning to appear in the data with each additional year. Data from Whittaker Brook, for example, shows this variation. For days when maximum temperature exceeded 18℃, the number of July days was 22, 26, 15, and 12 from 2022 through 2025 (Table 7). July 2023 was clearly an unusually warm month for ambient water temperatures. The number of August days that exceeded 18℃ was 13, 0, 16, and 15 from 2022 through 2025 with August 2023 being a clear outlier as an unusually cool, wet month. A fifth and final year, of data for this study will better define thermal regimes of the AWW.

Short-term temperature data should be interpreted with caution as they are vulnerable to year-to-year variability in climatic conditions. There seems to be an increasing frequency and intensity of high and low flows and temperatures. A good example of this is the climatic data summarized by the National Weather Service that placed 2024 as the warmest year since records began in 1939. We saw in this study that in 2023 ambient water temperatures varied significantly from the other two years, the most dramatic month being August. Results in the first two years were influenced by generally wet and mild summers followed by the record setting warm summer of 2024. Flows in the Allagash River remained at or above the median daily value (over 91 years of flow data) for most of the summer in 2022 and 2023 (Figure 2; https://nwis.waterdata.usgs.gov). As sampling duration increases, monitoring will likely yield temperature and flow regimes most representative of an average northern Maine summer and increase the confidence in our findings. Maintaining ongoing monitoring and incorporating other methods particularly regarding longitudinal temperature profiles, will improve our understanding of cold-water habitats in the Allagash River watershed.

Identifying Adult Brook Trout Critical Habitat

We began to investigate how to identify two important habitat features in the flowing reach of the Allagash River from Long Lake Dam to Michaud Farm. This reach of the mainstem River supports what we suspect to be the fluvial form of brook trout, one of three likely life history forms in the Allagash watershed. There is very little information on how brook trout utilize habitat at different life stages here. Where adult trout are during the thermally stressful months of summer and where those trout then reproduce weeks later in the fall is largely unknown. In 2024 we found essentially no thermal refuge habitat at the confluences of nine tributaries in early August at flows slightly above median. In 2025 surveys of those same habitats at flows much lower than median yielded similar results. Based on anecdotal reports, several of those tributaries can support trout in July and August; however, we saw little evidence that adult trout were present. Based on our observation, we now know that at flows of 500 – 2,000 cfs and water temperatures >23 ℃, there is little to no thermal refuge at those tributary confluences. The reach of Cunliffe Depot to Ramsay Ledge shows promise for this type of habitat, however, as we found a small number of adult trout in late August 2025. This reach should be investigated further for extended periods in late July through August to better determine adult brook trout presence.

We expanded summer survey work in 2025 to the lower reaches of three tributaries to identify where adult brook trout are holding during thermally stressful summer months. Pool habitat is a critically important physical feature in the aquatic landscape for brook trout populations in streams. It is unknown whether adult brook trout utilize pools of tributaries in the AWW; we saw many subadult trout in multiple tributaries during our August trip but none of these were larger than about eight inches. We found a surprising number of high-quality pools in two tributaries of this study but because of the dominating thermal regimes there, we saw no brook trout using them. These habitats could be important transitional areas during spring and early summer and other times of the year when water temperatures are more favorable. However, we saw no evidence of critical summer habitat although our surveys in 2025 were somewhat limited in scope. Additional sampling in the larger watersheds would be informative, particularly Five Finger Brook, Musquacook Stream, and Schedule Brook. Surveys should focus on upstream reaches where summer thermal conditions are likely more favorable for brook trout.

LITERATURE CITED

Chambers, B., S. M. Pradhanang, and A. J. Gold. 2017. Assessing thermally stressful events in a Rhode Island coldwater fish habitat using SWAT Model. Water 9, 667.

Frost, N. 2022. Quantifying thermal regimes of tributary streams in the Allagash Wilderness Waterway. Allagash Wilderness Waterway Foundation, Portland, Maine, 13 pp.

Frost, N. 2023. Quantifying thermal regimes of tributary streams in the Allagash Wilderness Waterway. Allagash Wilderness Waterway Foundation, Portland, Maine, 62 pp.

Kanno, Y., B. H. Letcher, A. L. Rosner, K. P. O'Neil, and K. H. Nislow. 2015. Environmental factors affecting brook trout occurrence in headwater stream segments. Transactions of the American Fisheries Society 144:373—382.

Lawrence, D. J., B. Stewart-Koster, J. D. Olden, A. S. Ruesch, C. E. Torgersen, J. J. Lawler, D. P. Butcher, and J. K. Crown. 2014. The interactive effects of climate change, riparian management, and a nonnative predator on stream-rearing salmon. Ecological Applications 24(4):895—912.

Gallagher, M. 2008. Stream Assessment: protocols for MDIFW stream data collection efforts. Maine Department of Inland Fisheries and Wildlife (MDIFW). 83 pp.

Nathan, L. R., A. B. Welsh, and J. C. Vokoun. 2018. Watershed-level brook trout genetic structuring: Evaluation and application of riverscape genetics models. Freshwater Biology 64:405—420.

National Water Information System. United States Geological Survey. https://nwis.waterdata.usgs.gov. Accessed 28 Dec 2024.

Wehrly, K. E., L. Wang, and M. Mitro. 2007. Field-based estimates of thermal tolerance limits for trout: incorporating exposure time and temperature fluctuation. Transactions of the American Fisheries Society 136:365—374.

Wenger, S. J., D. J. Isaak, C. H. Luce, H. M. Neville, K. D. Fausch, J. B. Dunham, D. C. Dauwalter, M. K. Young, M. M. Elsner, B. E. Rieman, A. F. Hamlet, and J. E. Williams. 2011. Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. Proceedings of the National Academy of Sciences of the USA 108:14175– 14180.

Xu, C. L., B. H. Letcher, and K. H. Nislow. 2010. Size-dependent survival of brook trout *Salvelinus fontinalis* in summer: effects of water temperature and stream flow. Journal of Fish Biology 76:2342—2369.

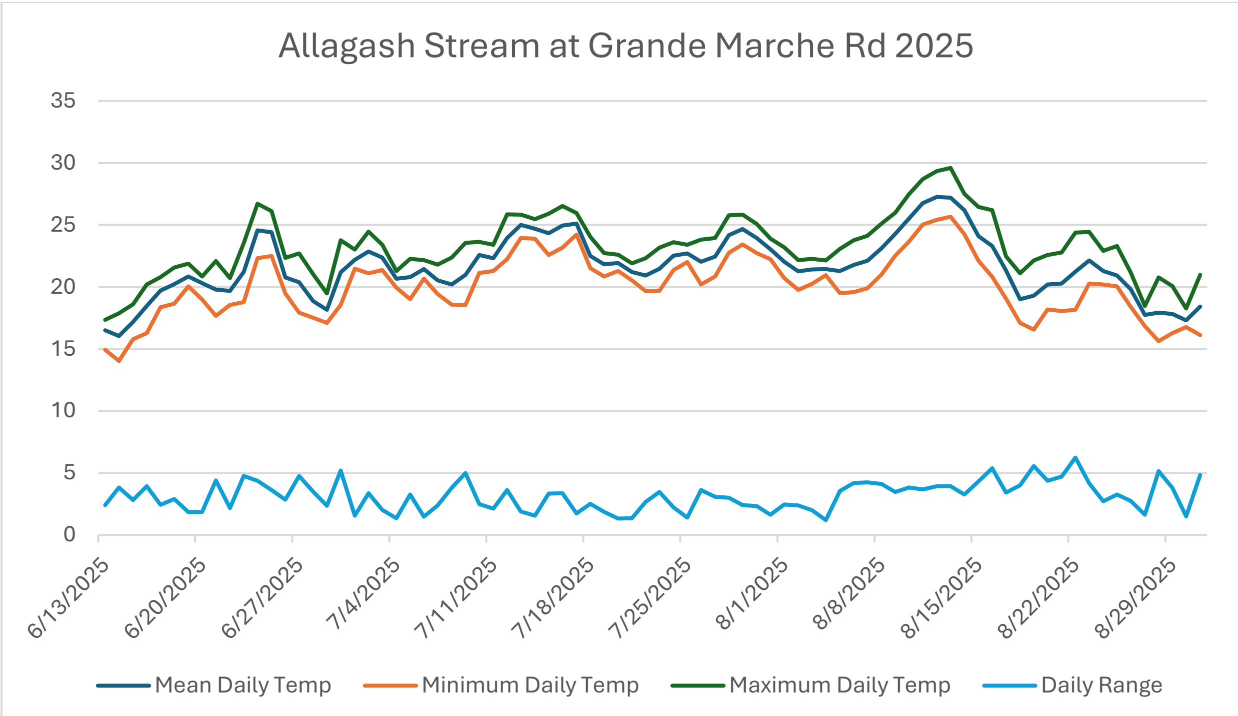
Appendix A

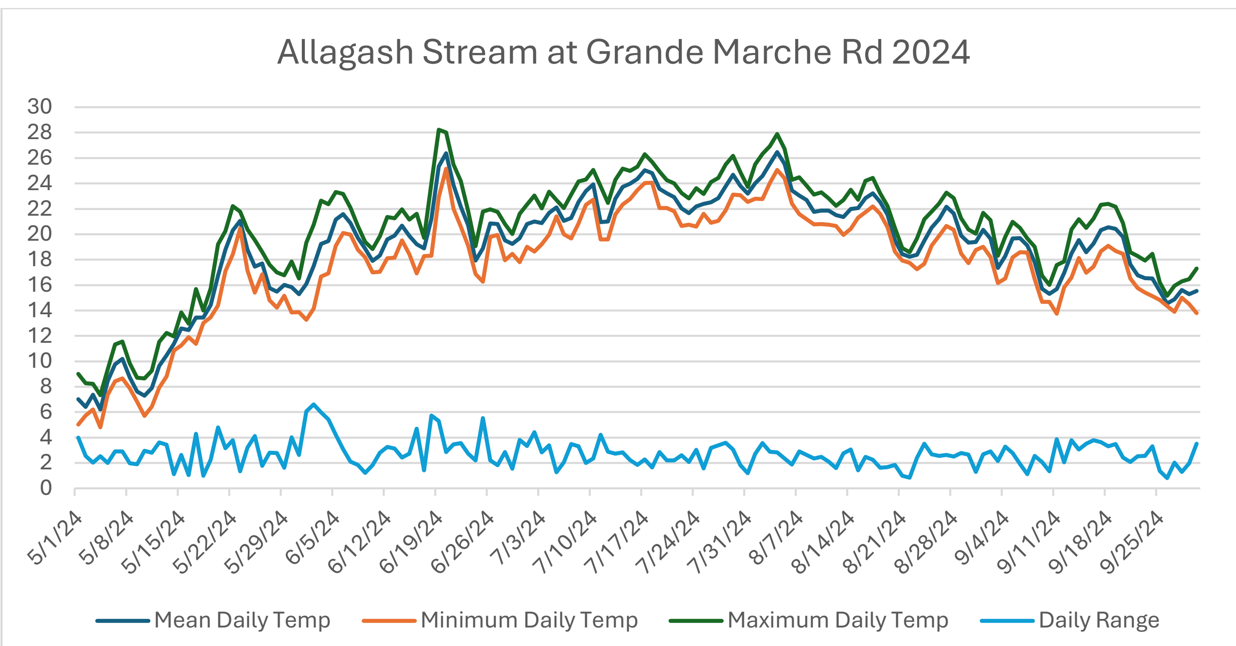
Table 1. Active temperature logger information, Fall 2025.

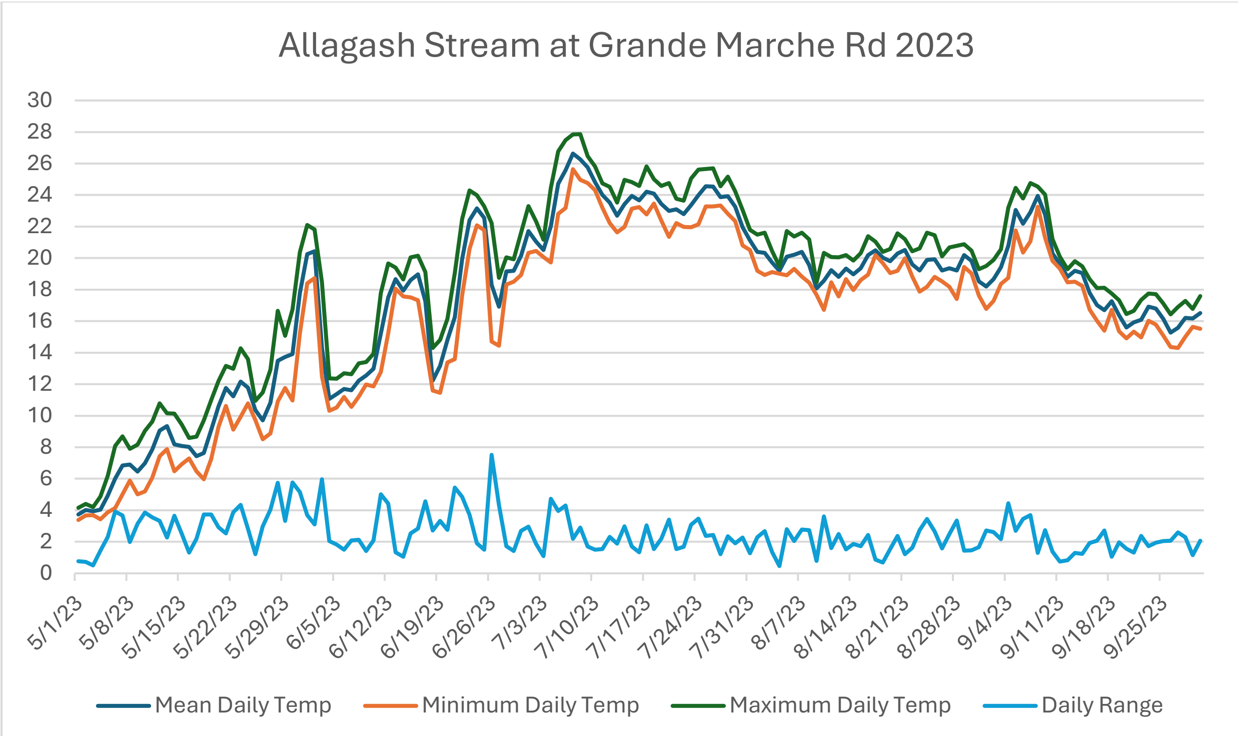
Tributary – Entry to AWW	Tributary To	Date Visited	Redeployed	Notes
Telos Stream – W	Telos Lake	10-3-25	Yes	
Ellis Brook @ Grande Marche Rd. – W	Chamberlain Lake	10-3-25	No	
Allagash Stream @ Grande Marche Rd - W	Chamberlain Lake	10-3-25	No	Dewatered
Thoroughfare Brook - W	Churchill Lake	10-3-25	Yes	Accessed by foot
Churchill Brook - W	Churchill Lake			Site not visited in 2025
Glazier Brook - E	Long Lake	10-3-25	No	
Shepherd Brook - E	Long Lake	10-11-25	Yes	Second logger left
Harding Brook - W	Allagash River	10-11-25	Yes	Second logger left
Whittaker Brook - W	Allagash River	10-11-25	Yes	
Schedule Brook - W	Allagash River	10-11-25	Yes	Second logger left
Musquacook Stream - E	Allagash River	10-11-25	No	New site in 2025
Savage Brook - W	Allagash River	10-11-25	Yes	Second logger left
McKinnon Brook - W	Allagash River	10-12-25	Yes	Second logger left
Ben Glazier Brook - W	Allagash River	10-12-25	Yes	Second logger left
Unnamed Brook - E	Allagash River			New site est. August 24, 2025
Ramsay Brook - E	Allagash River	10-12-25	Yes	Second logger left
Farm Brook - W	Allagash River	10-12-25	No	New site in 2025
Additional Loggers Deployed for Air Temperature				
Chamberlain Bridge	Retrieved 10-3-25; redeployed			
Churchill Dam	Retrieved 11-21-25; not redeployed			
Michaud Farm	Retrieved 10-12; redeployed			

Appendix B

Summer Thermal Regimes at Monitoring Locations






Allagash Stream at Grande Marche Rd 2023
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5/1/23
5/8/23
5/15/23
5/22/23
5/29/23
6/5/23
6/12/23
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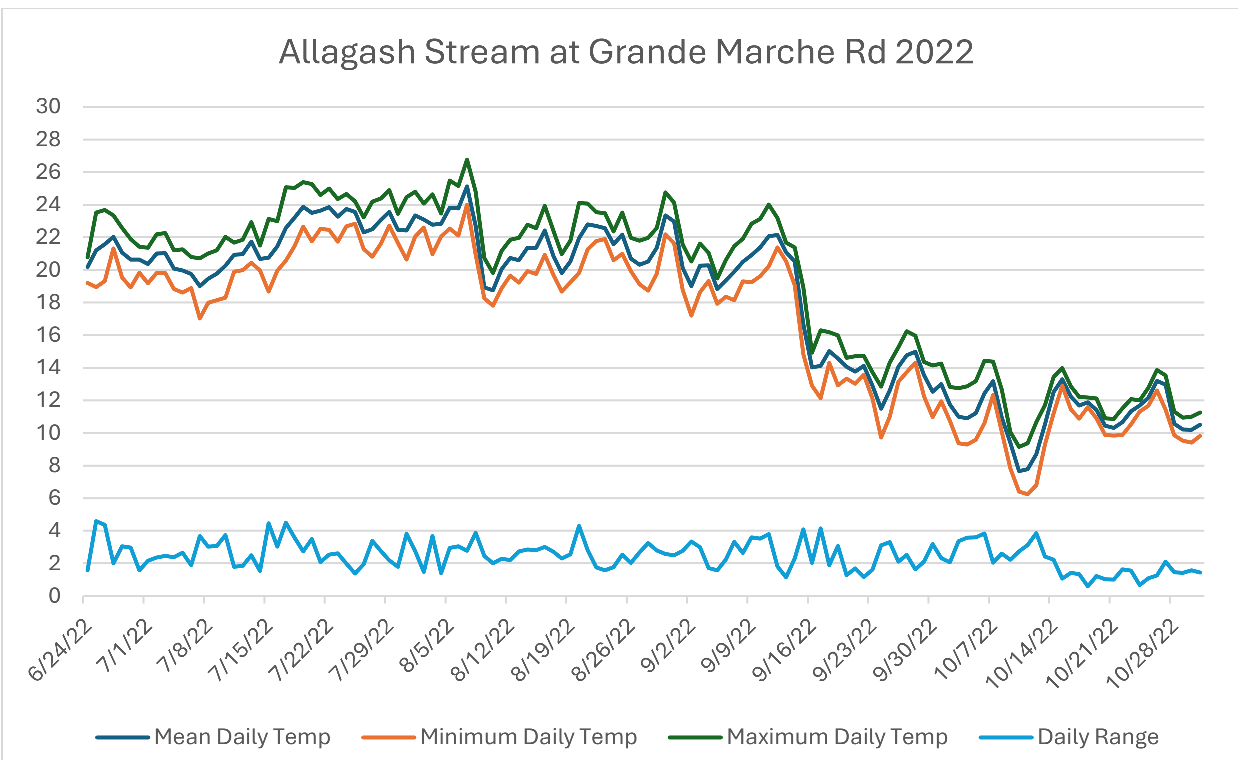
7/17/23
7/24/23
7/31/23
8/7/23
8/14/23
8/21/23
8/28/23
9/4/23
9/11/23
9/18/23
9/25/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Allagash Stream at Grande Marche Rd 2022
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7/22/22
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9/2/22
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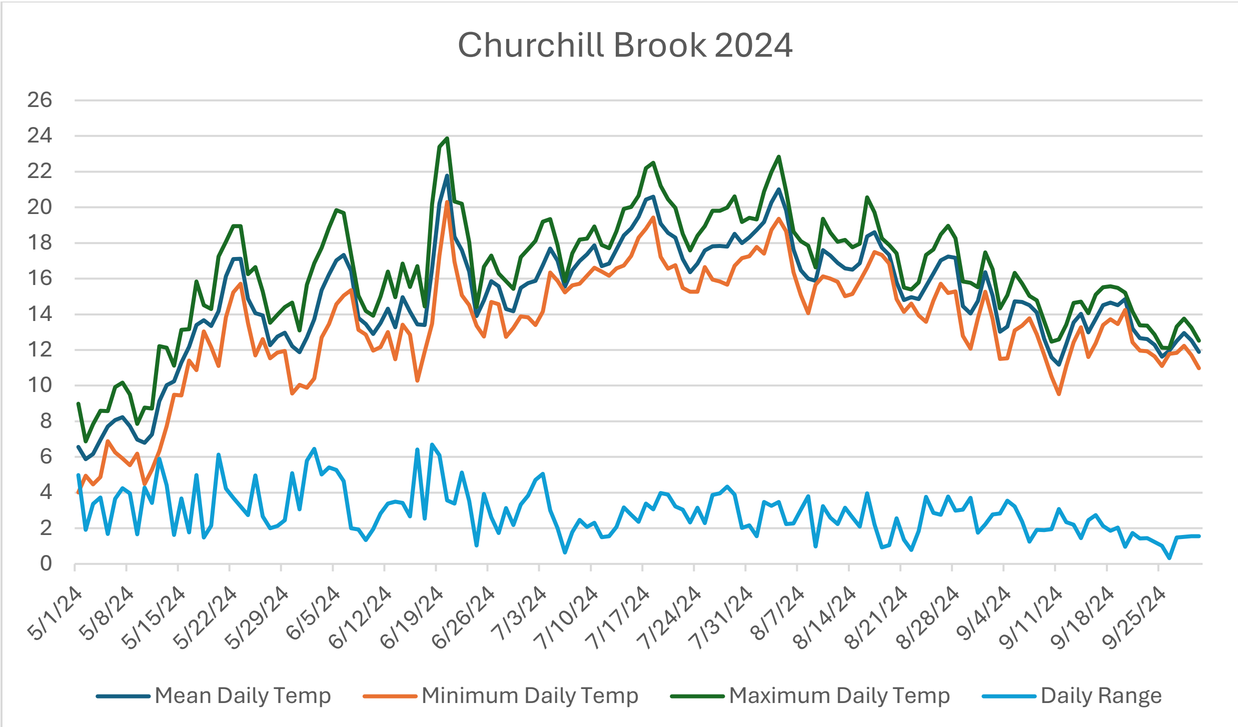
10/28/22
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Churchill Brook 2024
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5/15/24
5/22/24
5/29/24
6/5/24
6/12/24
6/19/24
6/26/24
7/3/24
7/10/24
7/17/24
7/24/24
7/31/24
8/7/24
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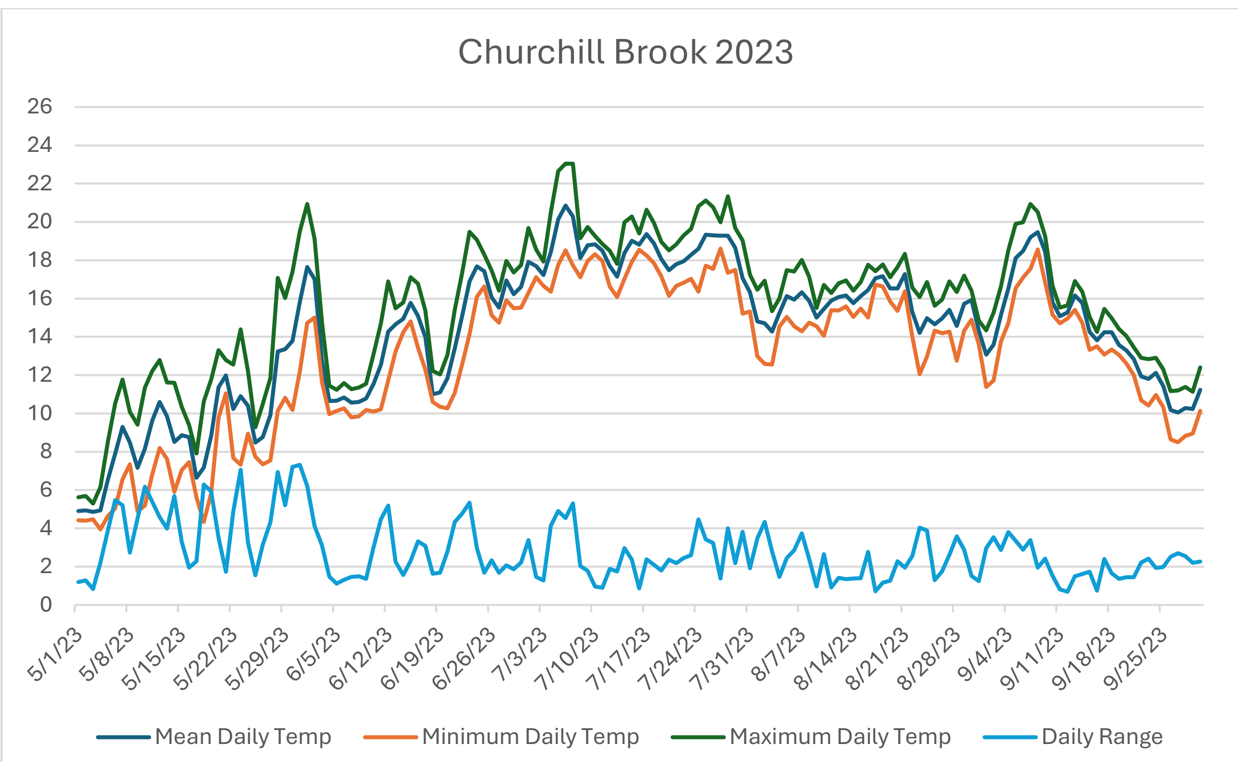
9/4/24
9/11/24
9/18/24
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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5/15/23
5/22/23
5/29/23
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6/19/23
6/26/23
7/3/23
7/10/23
7/17/23
7/24/23
7/31/23
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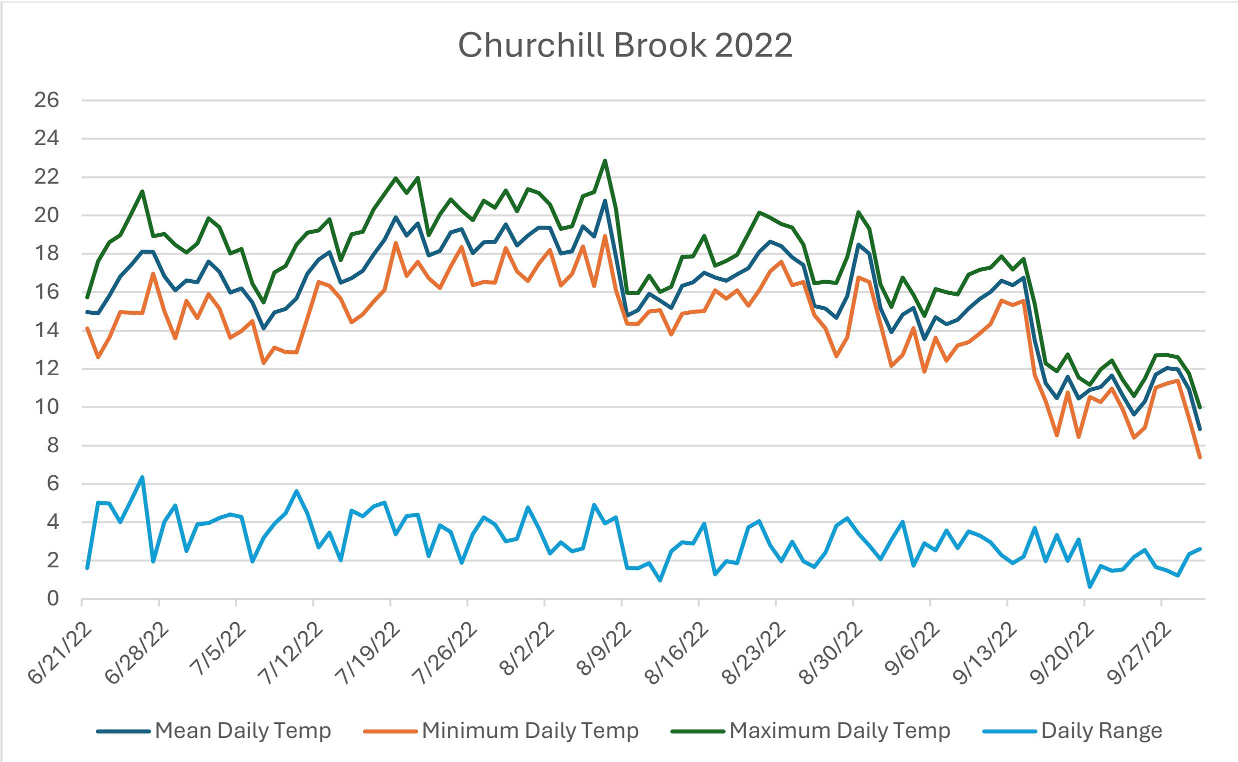
9/25/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range



Churchill Brook 2022
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7/5/22
7/12/22
7/19/22
7/26/22
8/2/22
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9/6/22
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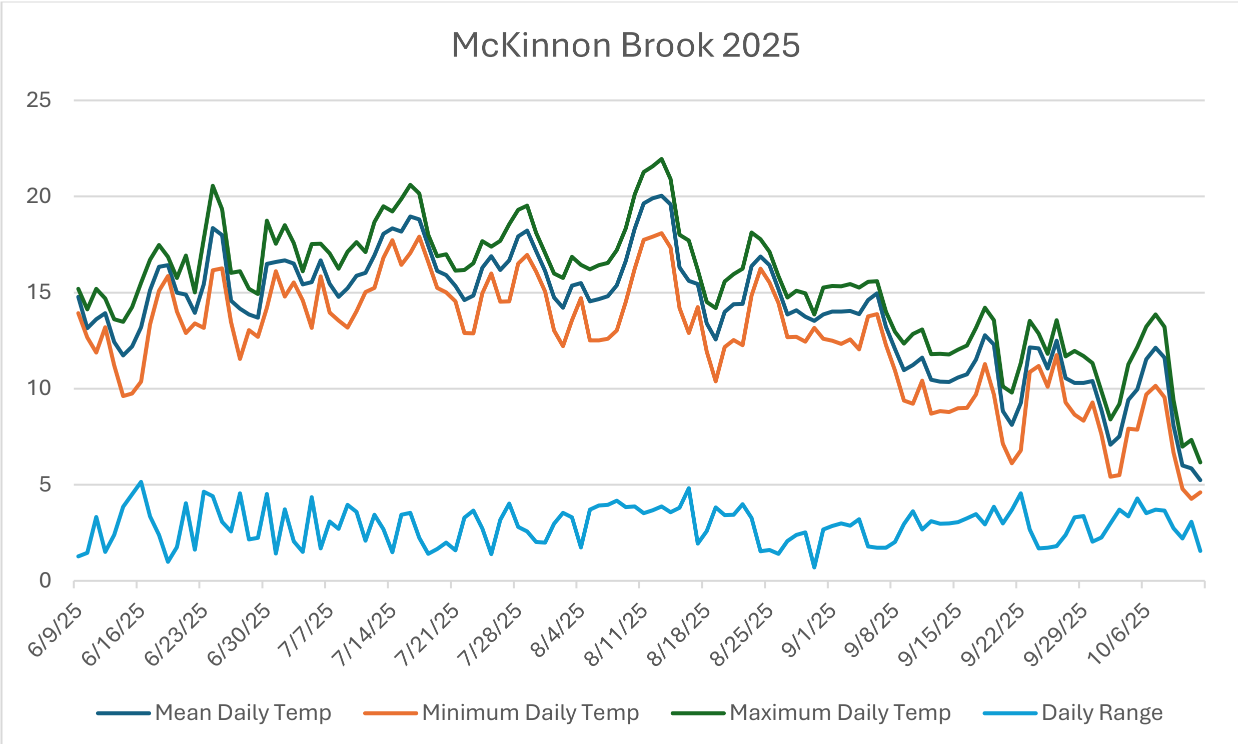
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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6/9/25
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7/28/25
8/4/25
8/11/25
8/18/25
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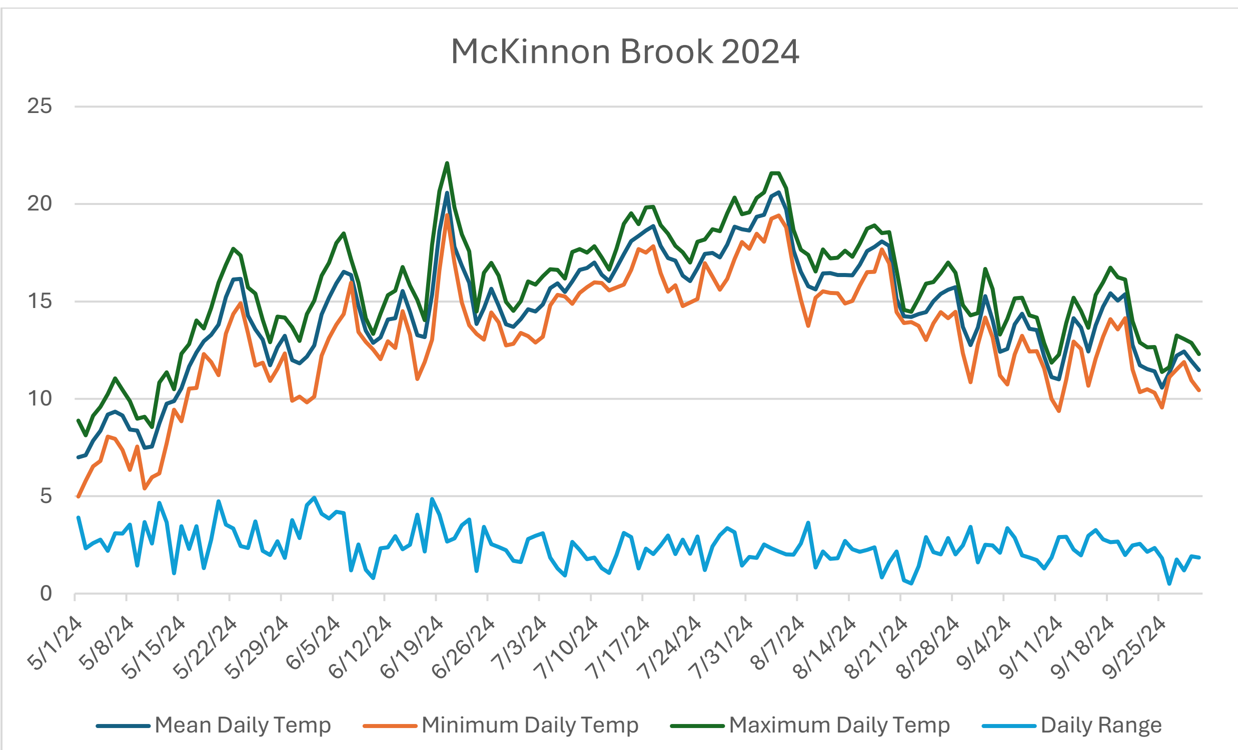
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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7/31/24
8/7/24
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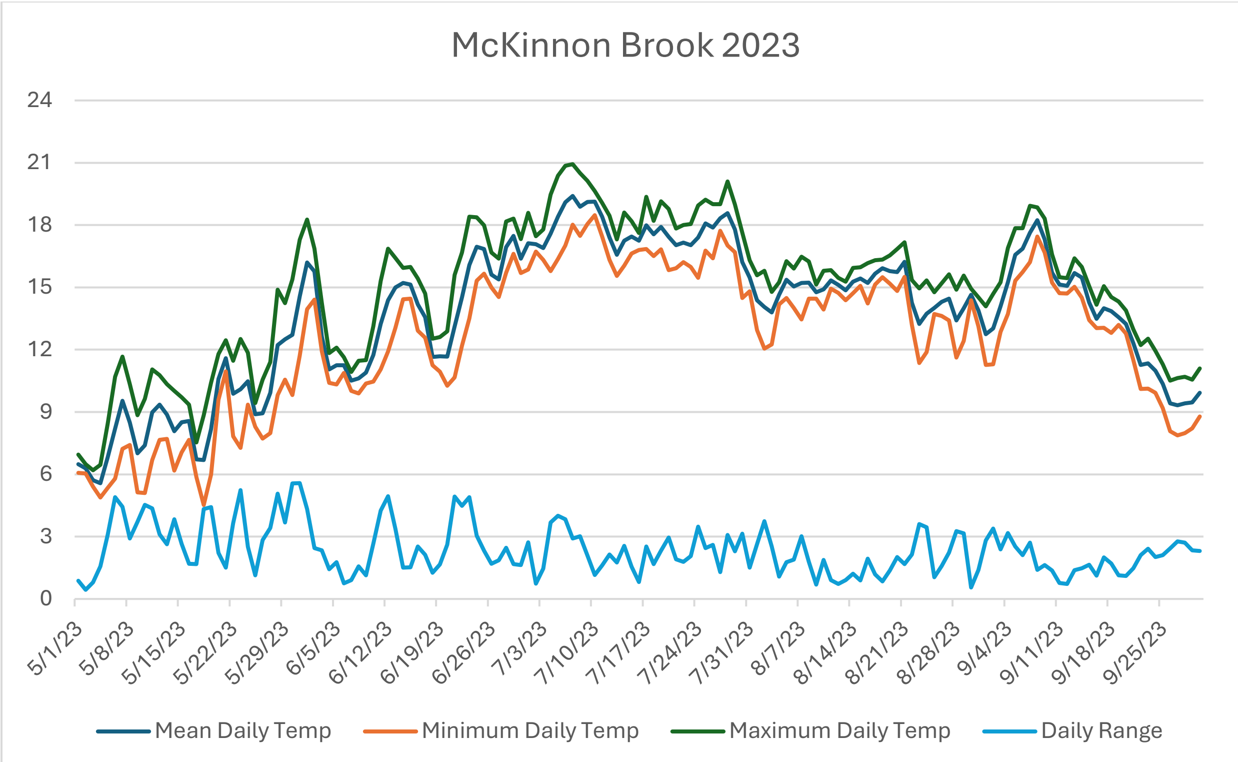
9/18/24
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


McKinnon Brook 2023
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7/31/23
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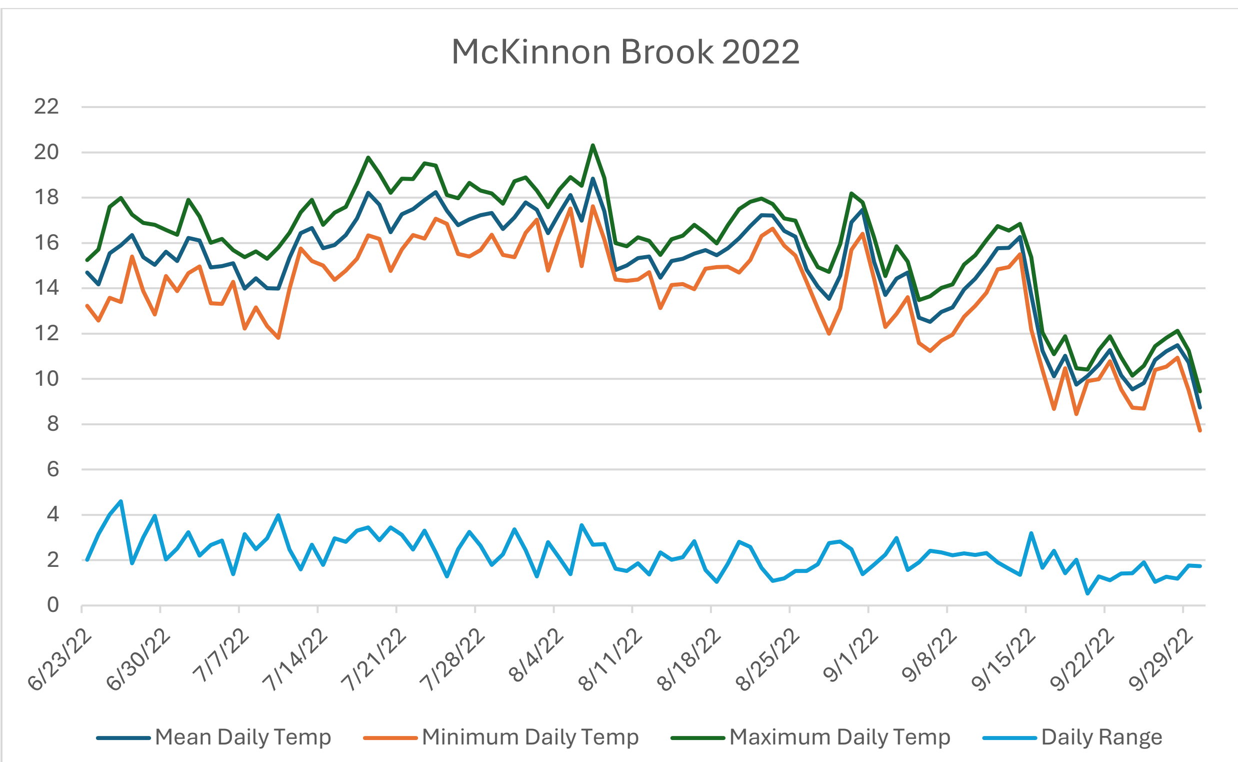
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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7/21/22
7/28/22
8/4/22
8/11/22
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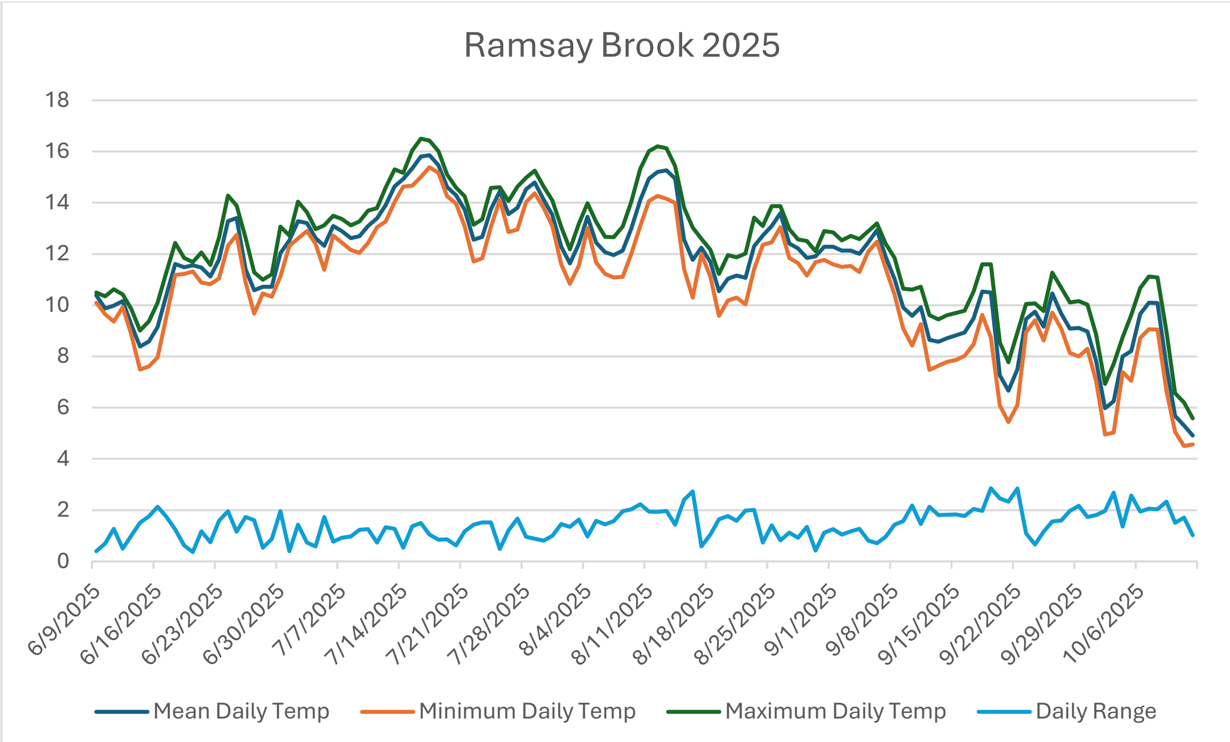
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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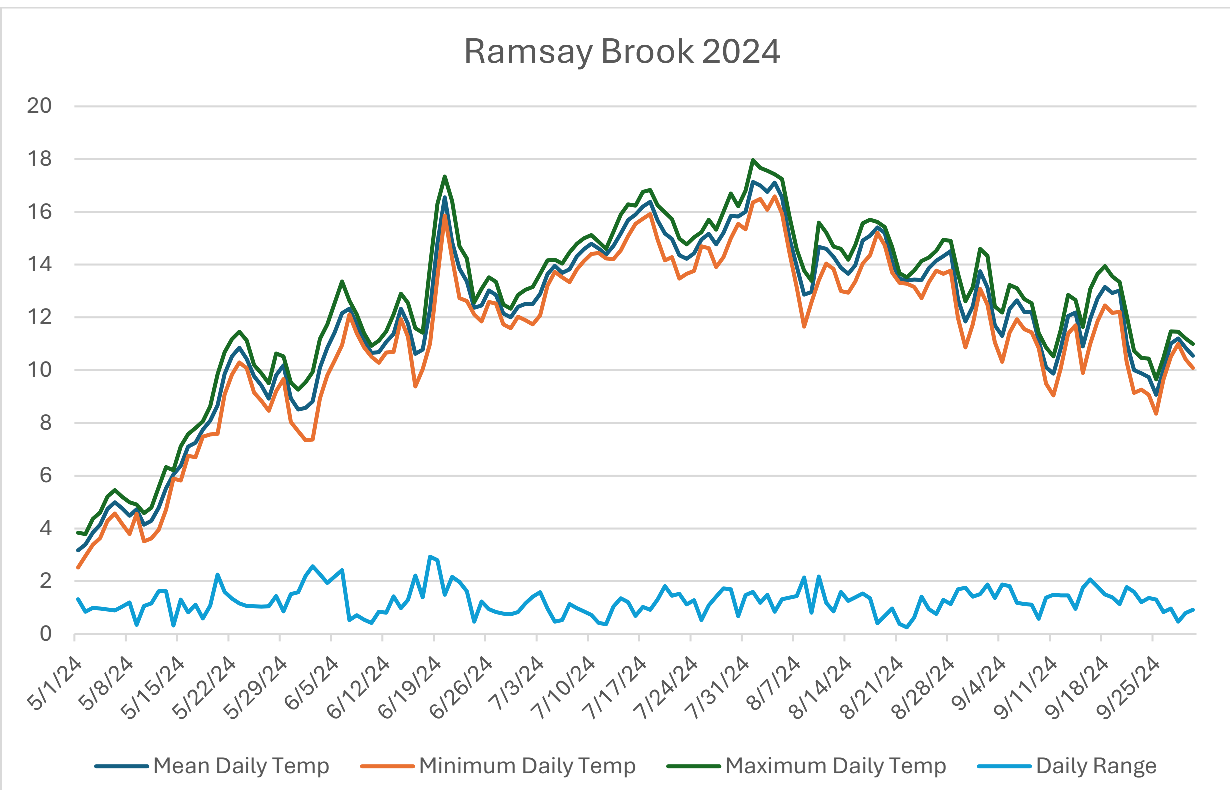
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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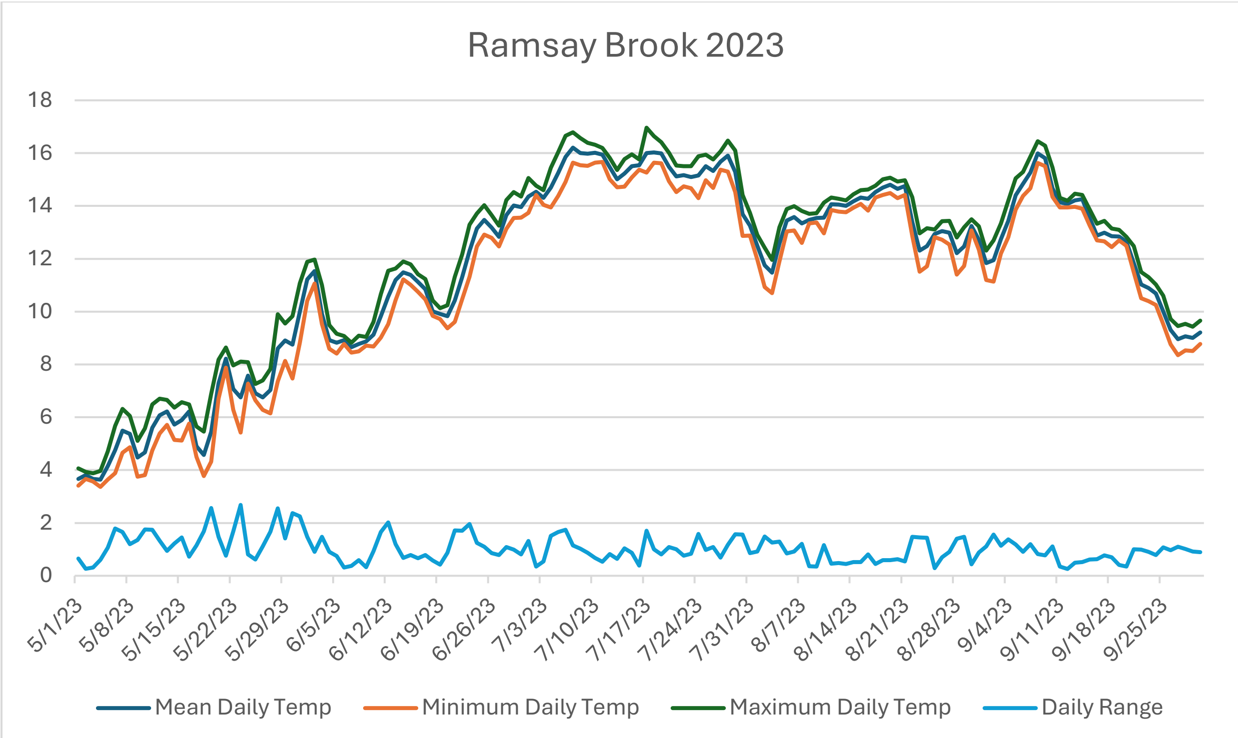
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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Mean Daily Temp
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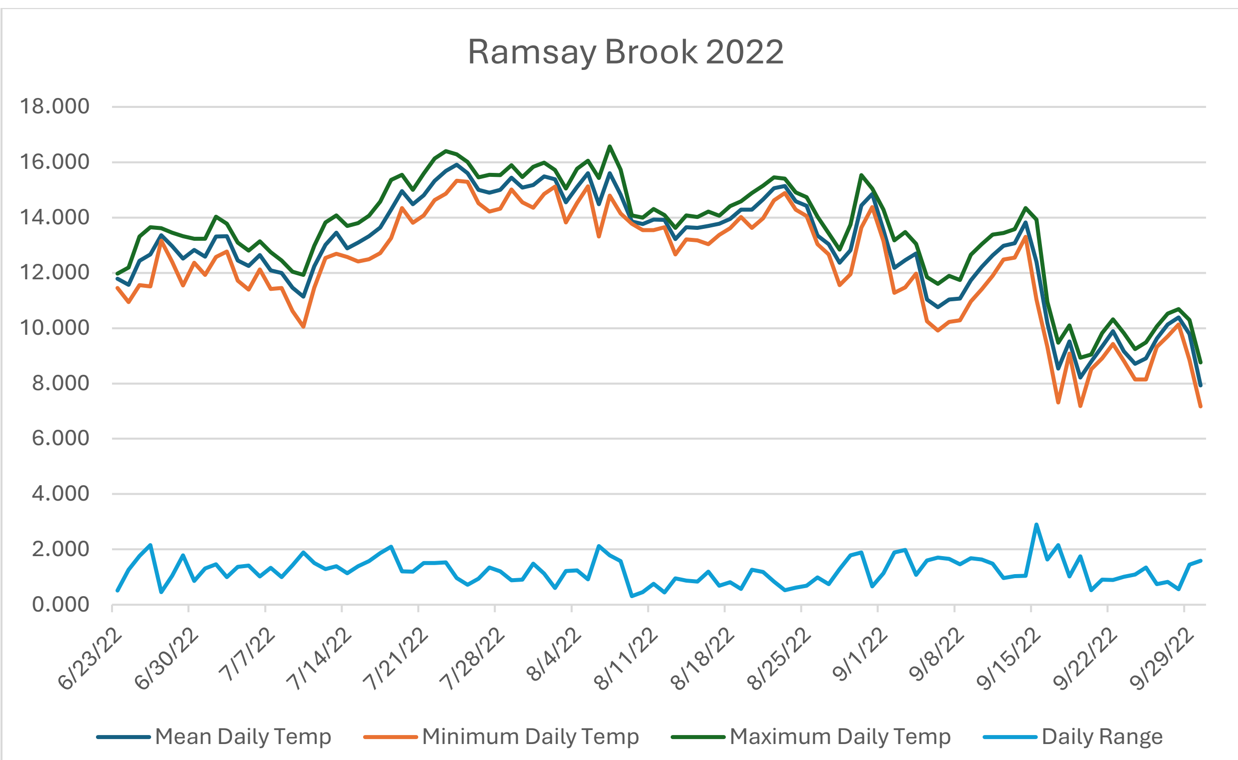
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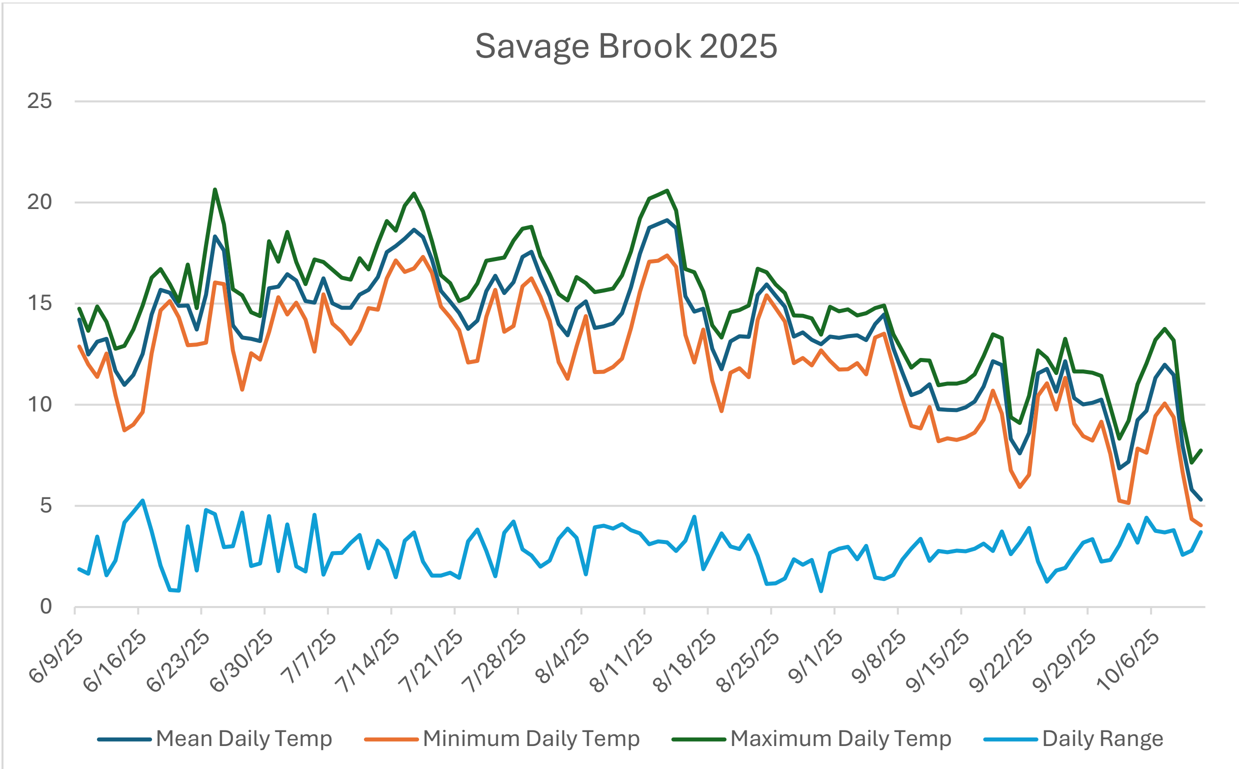
Maximum Daily Temp
Daily Range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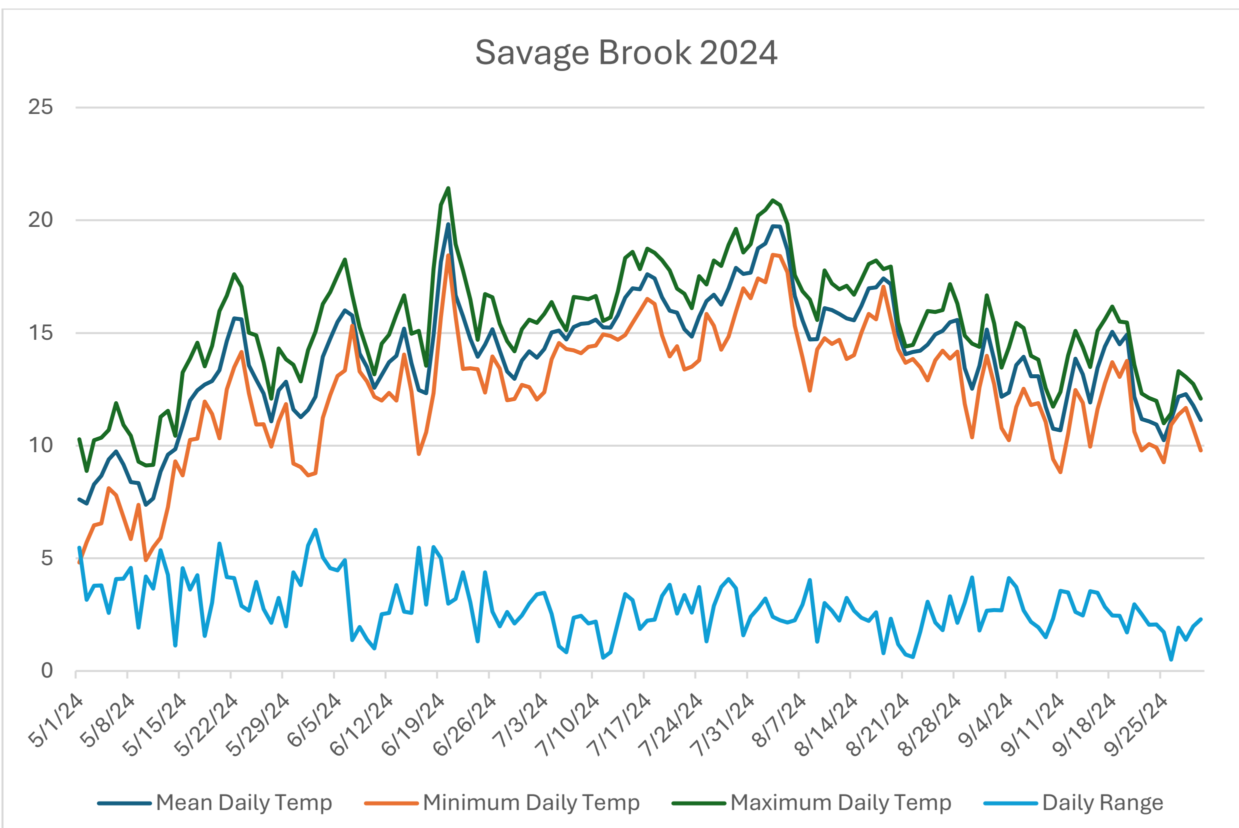
Savage Brook 2024
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Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
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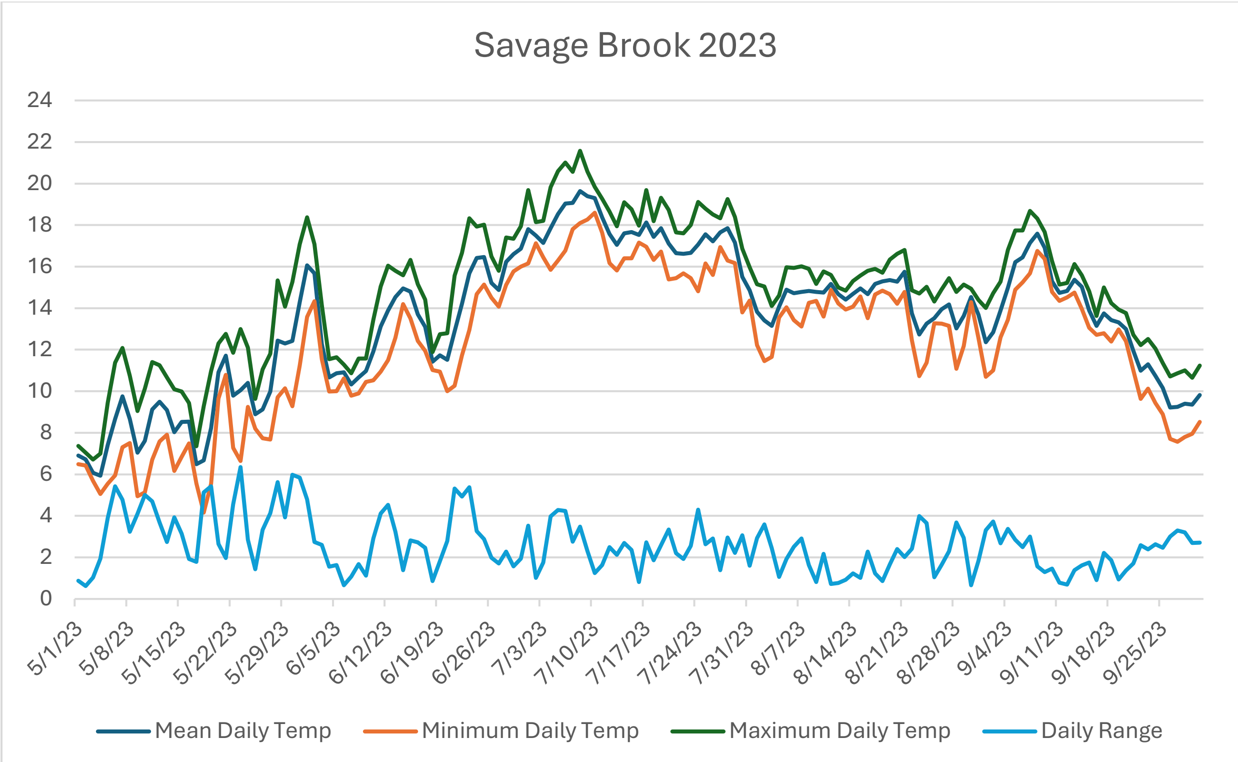
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Mean Daily Temp
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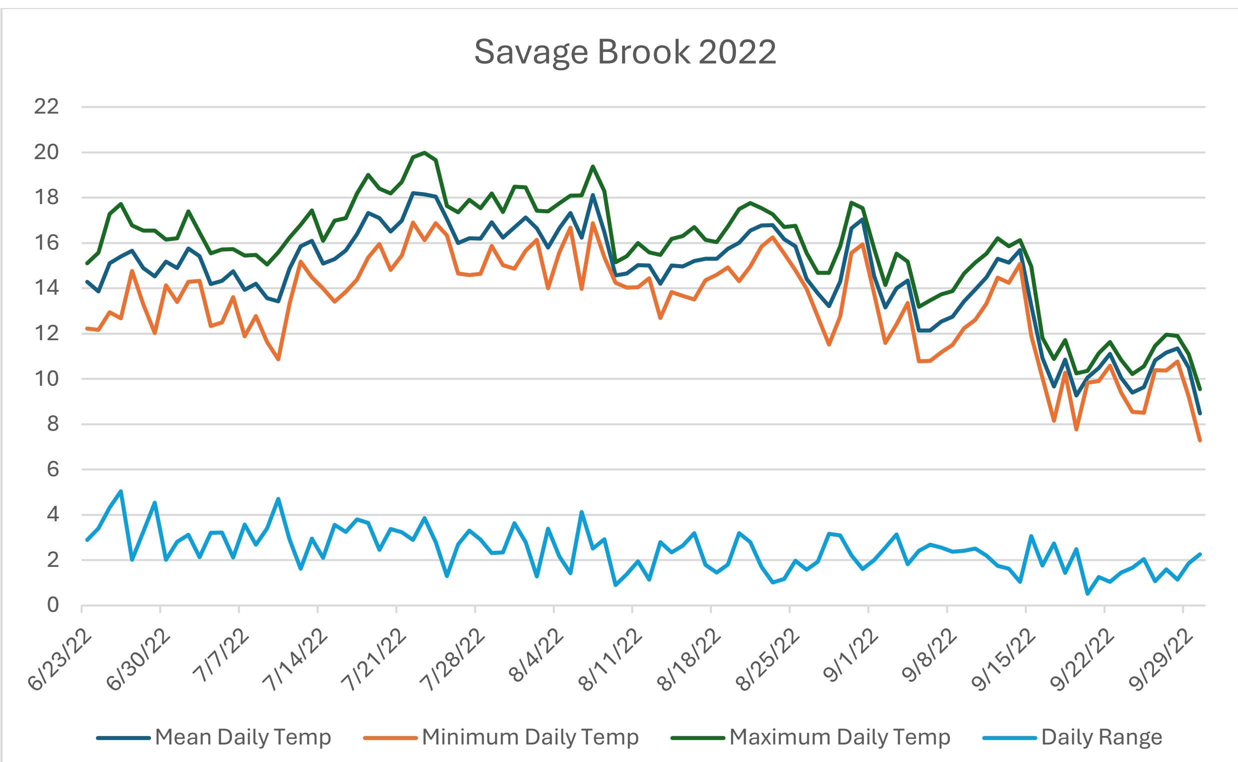
Daily Range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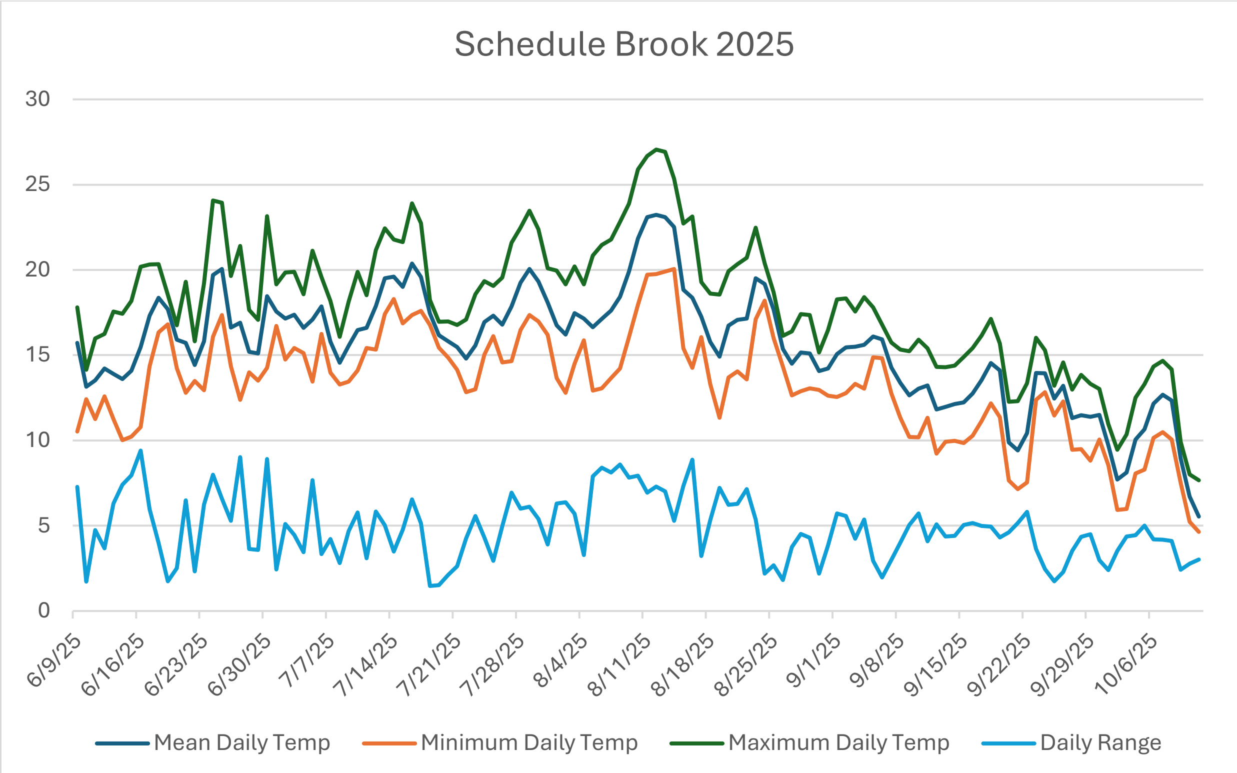
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range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Mean Daily Temp
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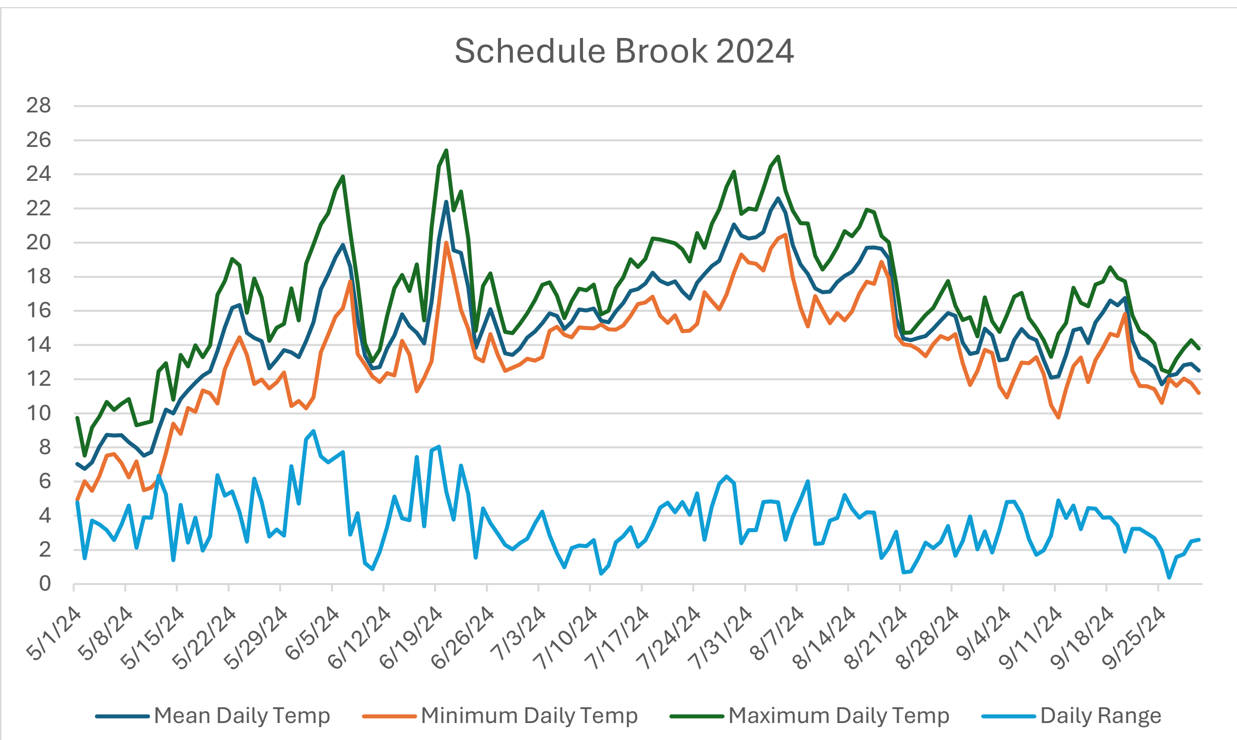
Maximum Daily Temp
Daily Range


Schedule Brook 2024
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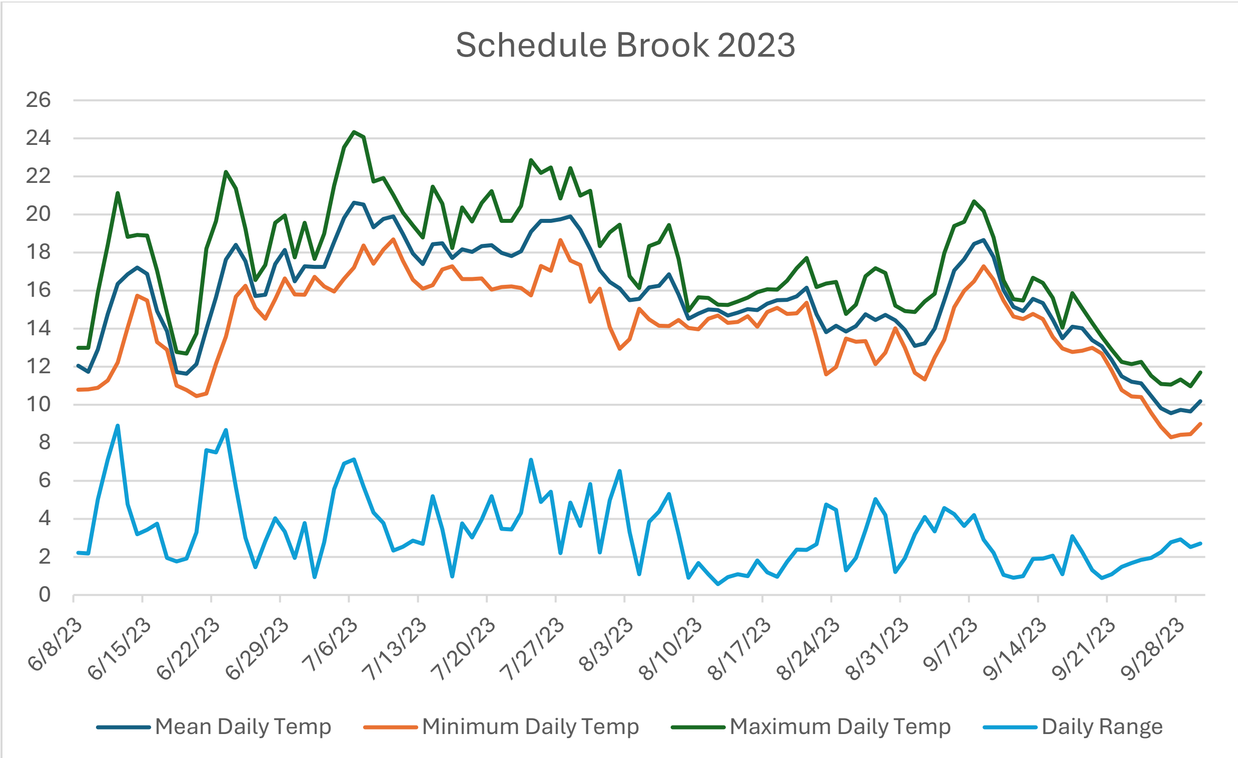
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Schedule Brook 2023
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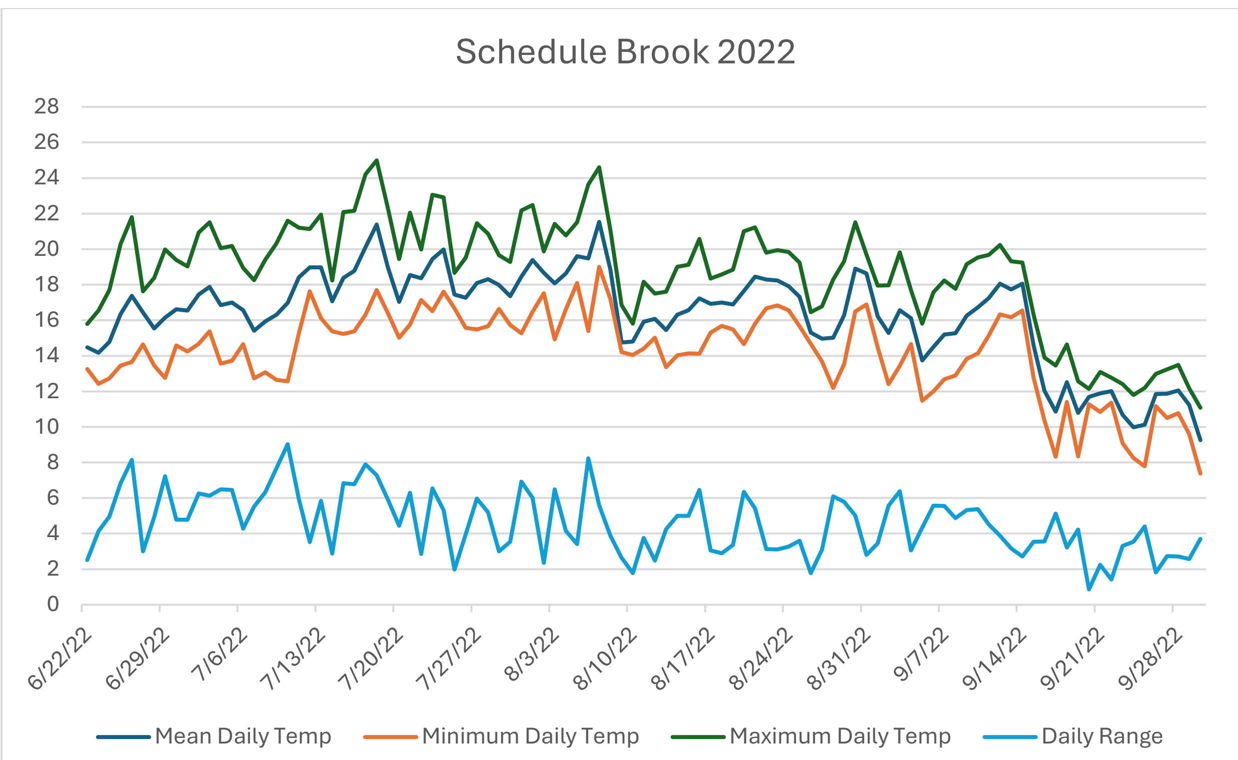
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Schedule Brook 2022
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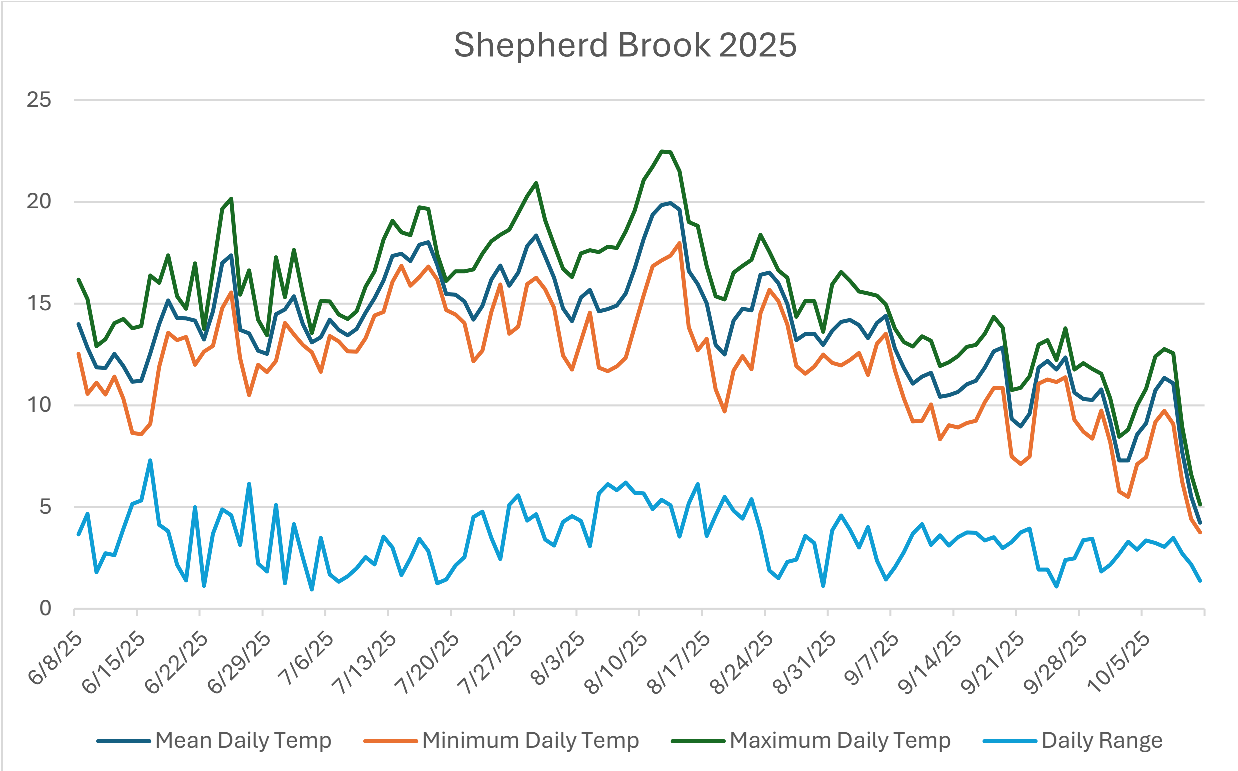
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Shepherd Brook 2025
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7/20/25
7/27/25
8/3/25
8/10/25
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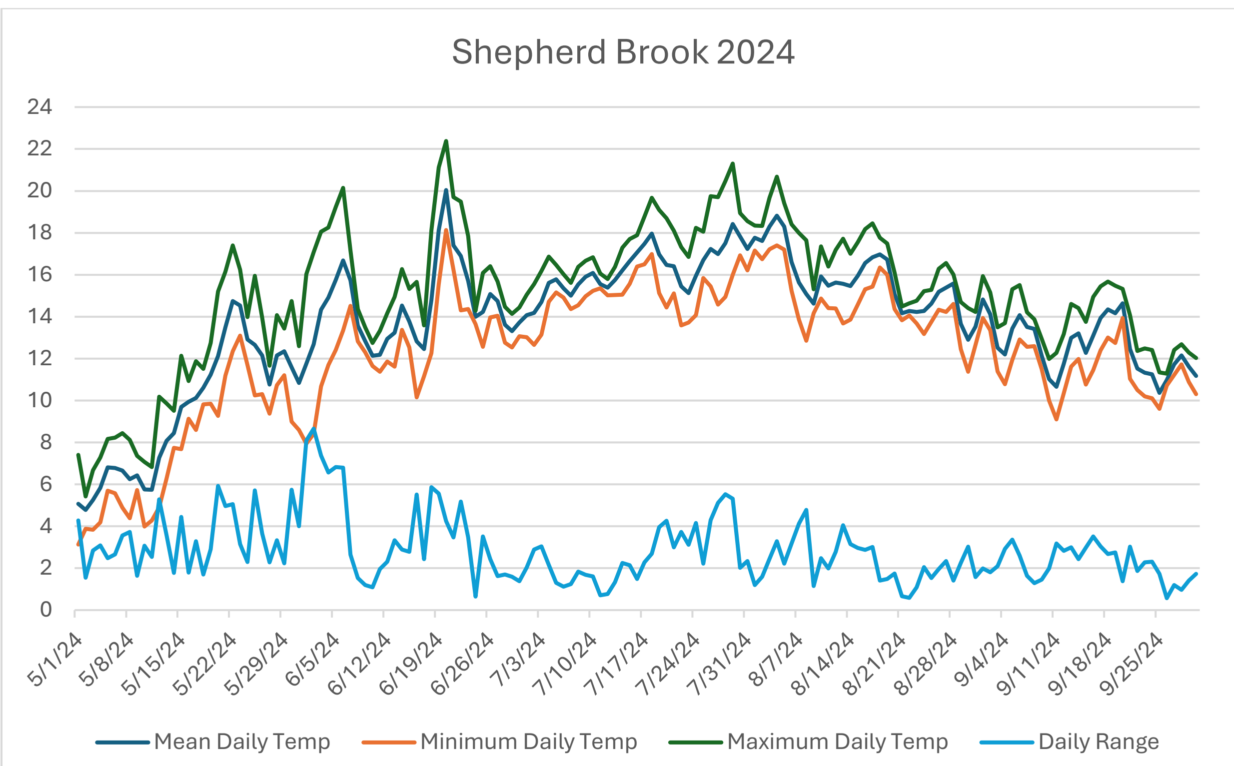
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Shepherd Brook 2024
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7/31/24
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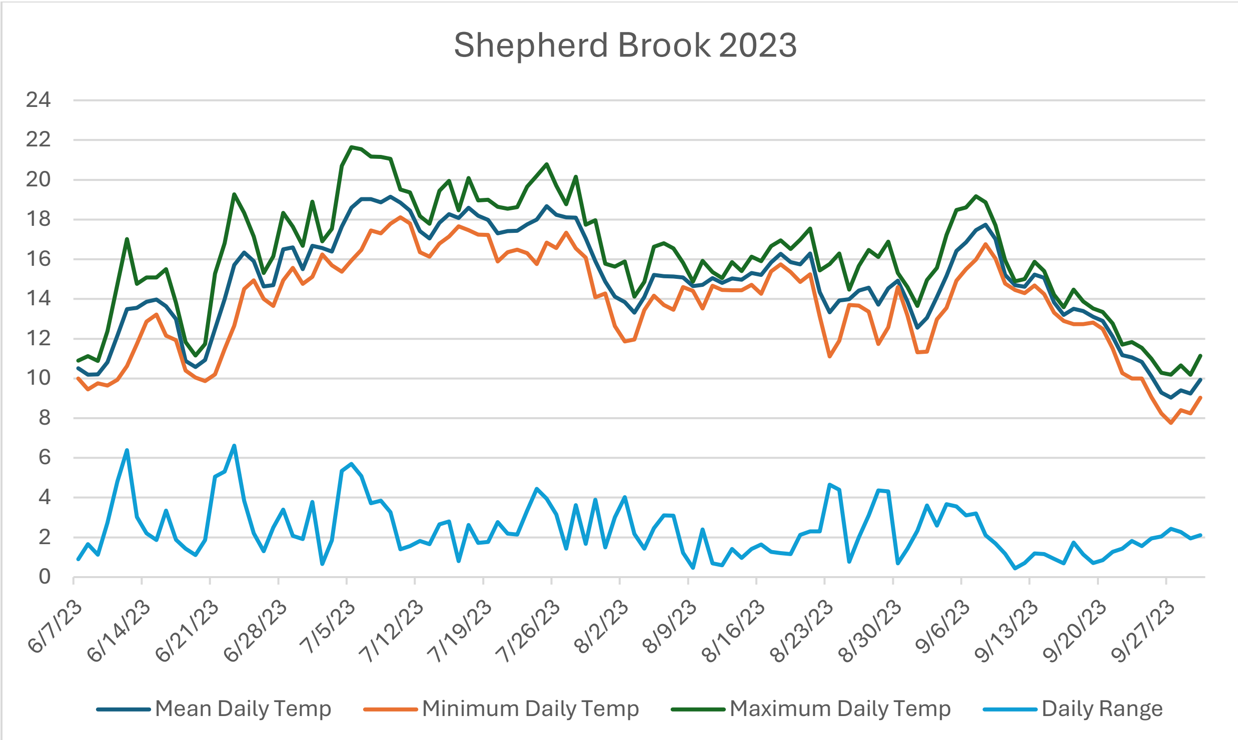
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Shepherd Brook 2023
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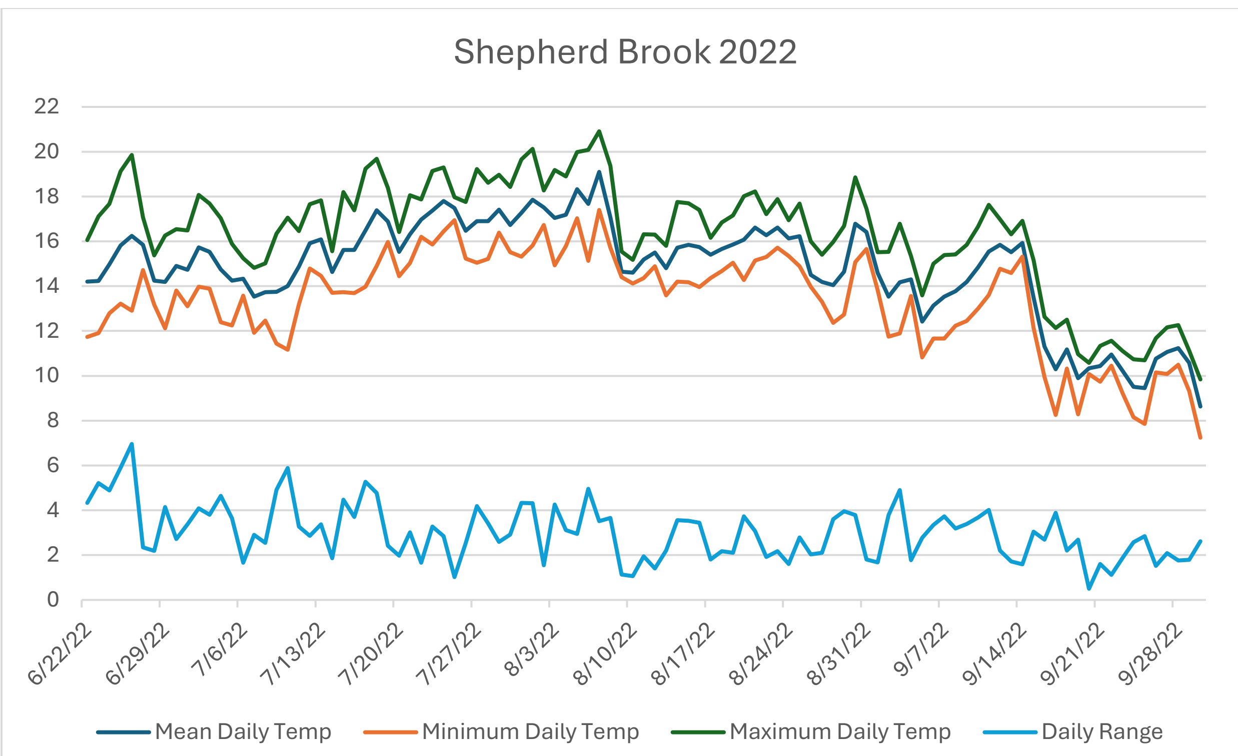
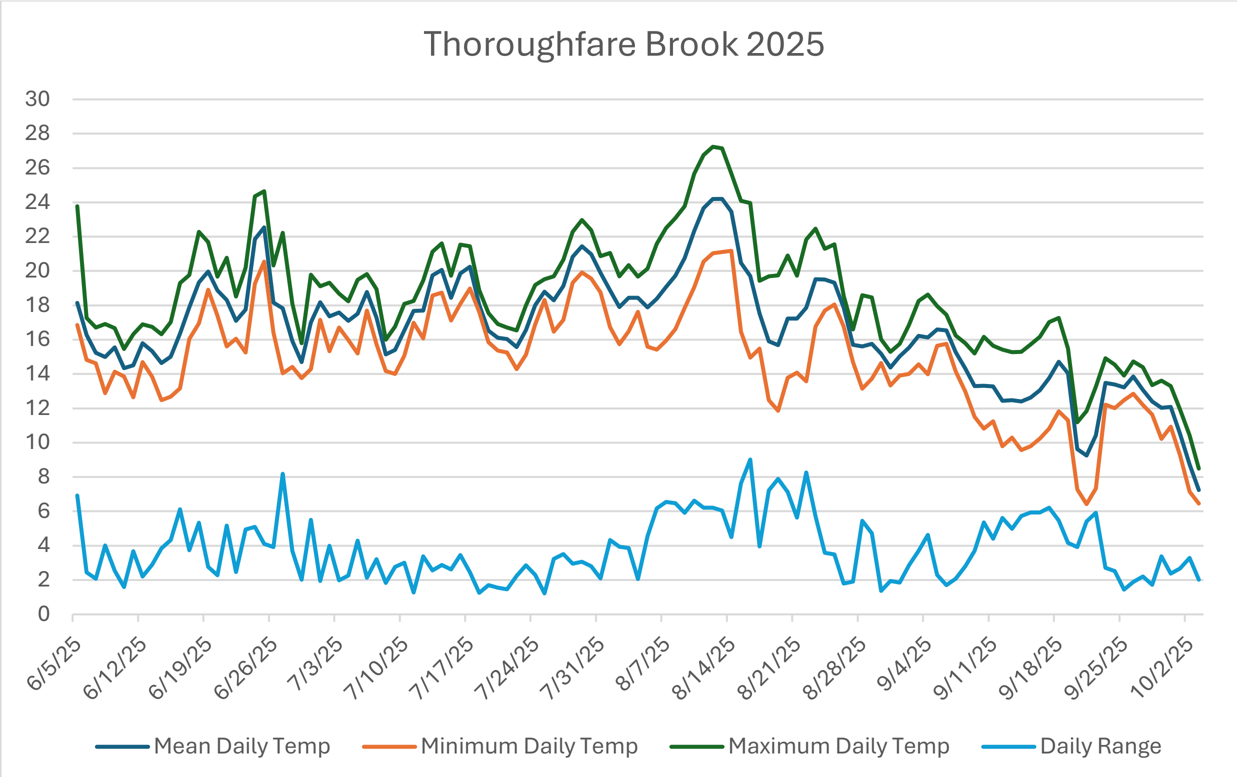
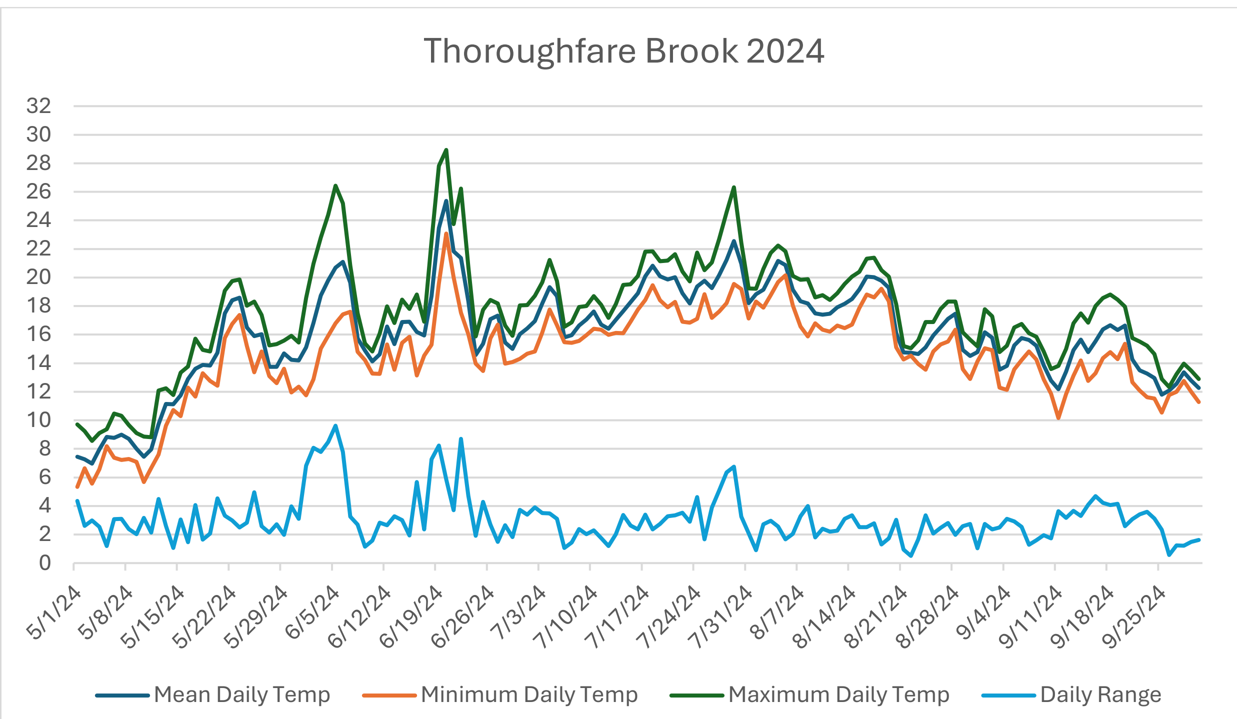
8/16/23
8/23/23
8/30/23
9/6/23
9/13/23
9/20/23
9/27/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

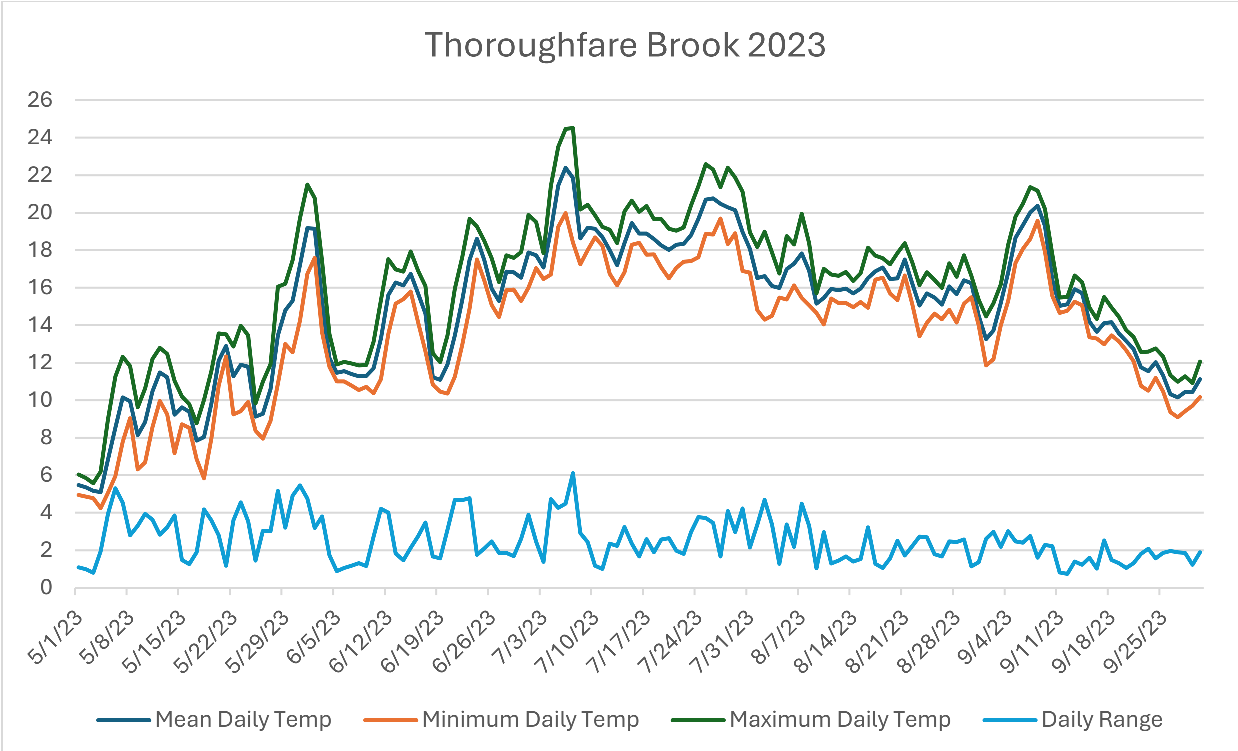

Shepherd Brook 2022
22
20
18
16
14
12
10
8
6
4
2
0
6/22/22
6/29/22
7/6/22
7/13/22
7/20/22
7/27/22
8/3/22
8/10/22
8/17/22
8/24/22
8/31/22
9/7/22
9/14/22
9/21/22
9/28/22
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

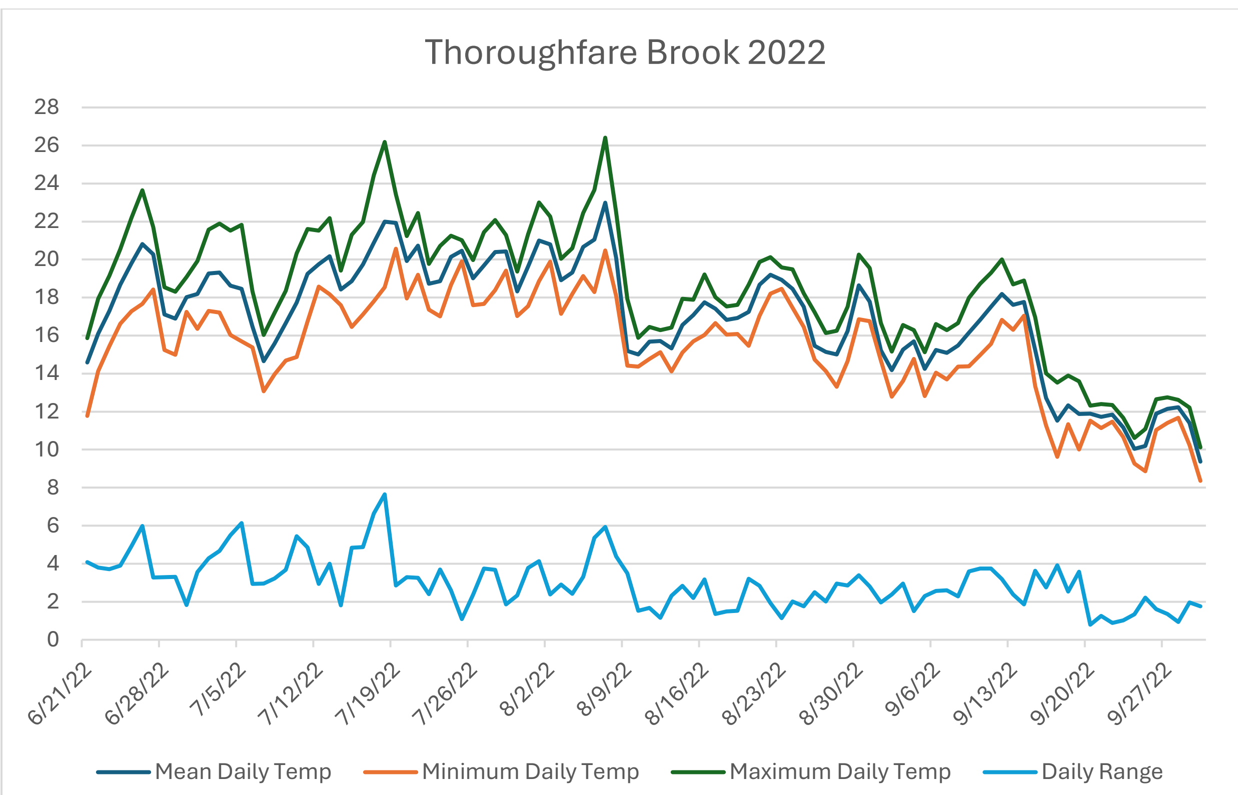


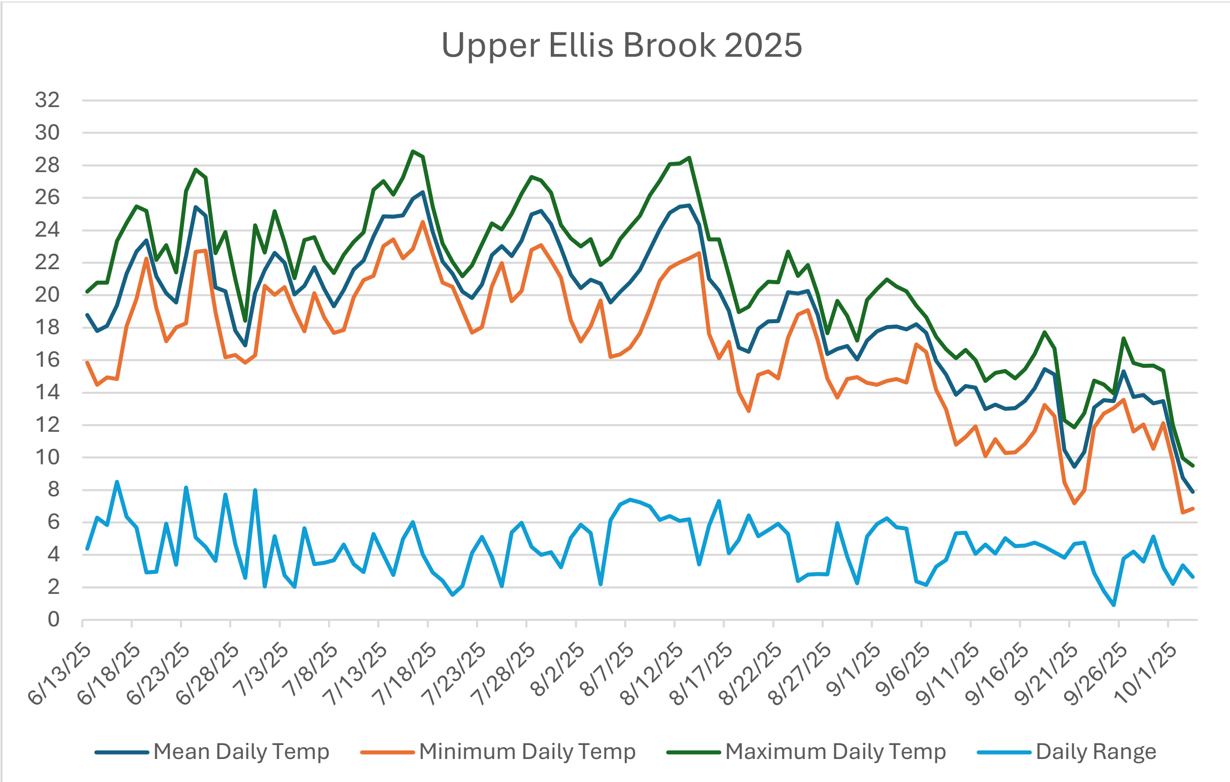
Thoroughfare Brook 2025
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/5/25
6/12/25
6/19/25
6/26/25
7/3/25
7/10/25
7/17/25
7/24/25
7/31/25
8/7/25
8/14/25
8/21/25
8/28/25
9/4/25
9/11/25
9/18/25
9/25/25
10/2/25
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

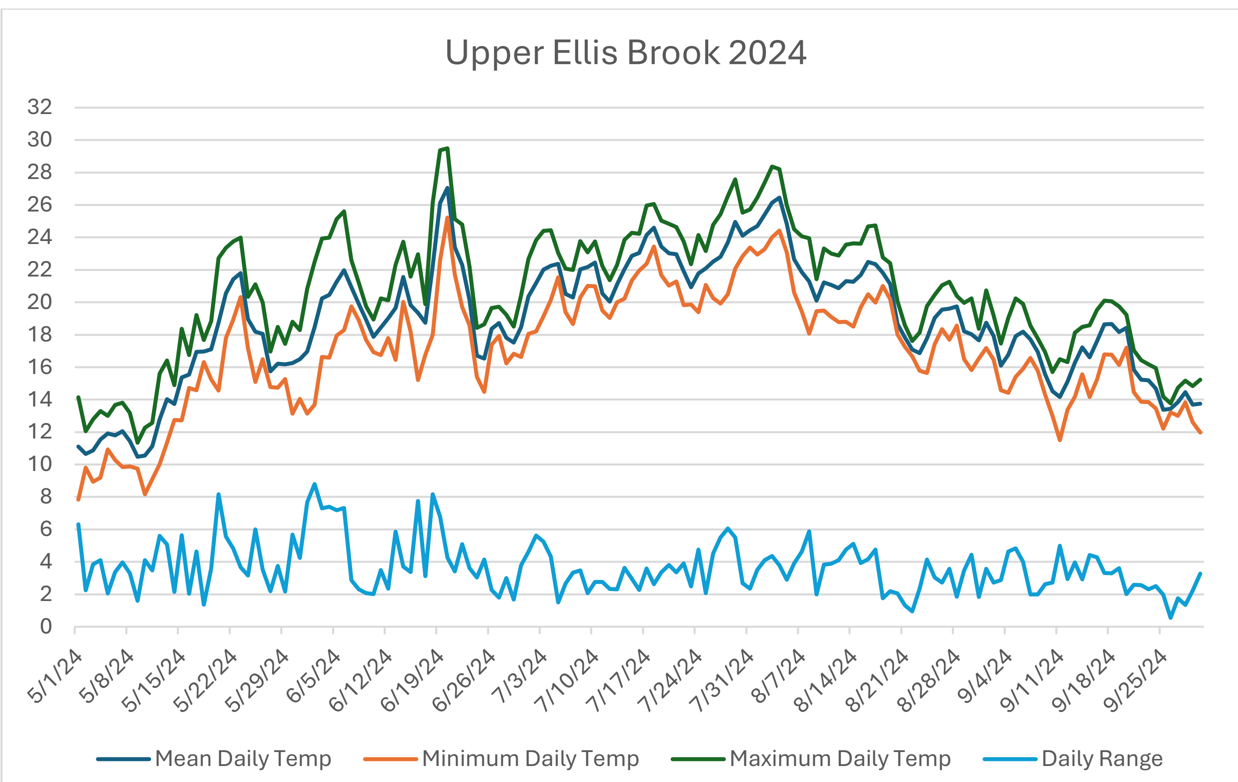


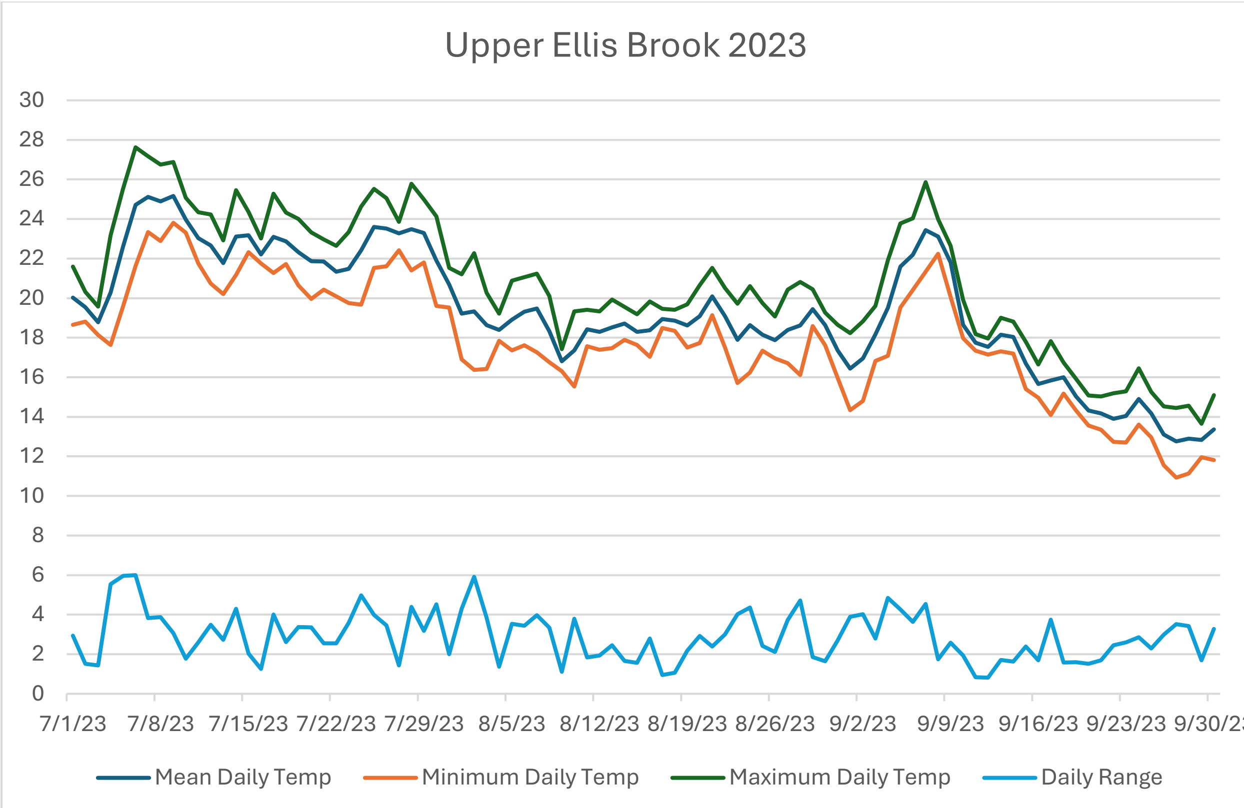
Thoroughfare Brook 2024
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
5/1/24
5/8/24
5/15/24
5/22/24
5/29/24
6/5/24
6/12/24
6/19/24
6/26/24
7/3/24
7/10/24
7/17/24
7/24/24
7/31/24
8/7/24
8/14/24
8/21/24
8/28/24
9/4/24
9/11/24
9/18/24
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

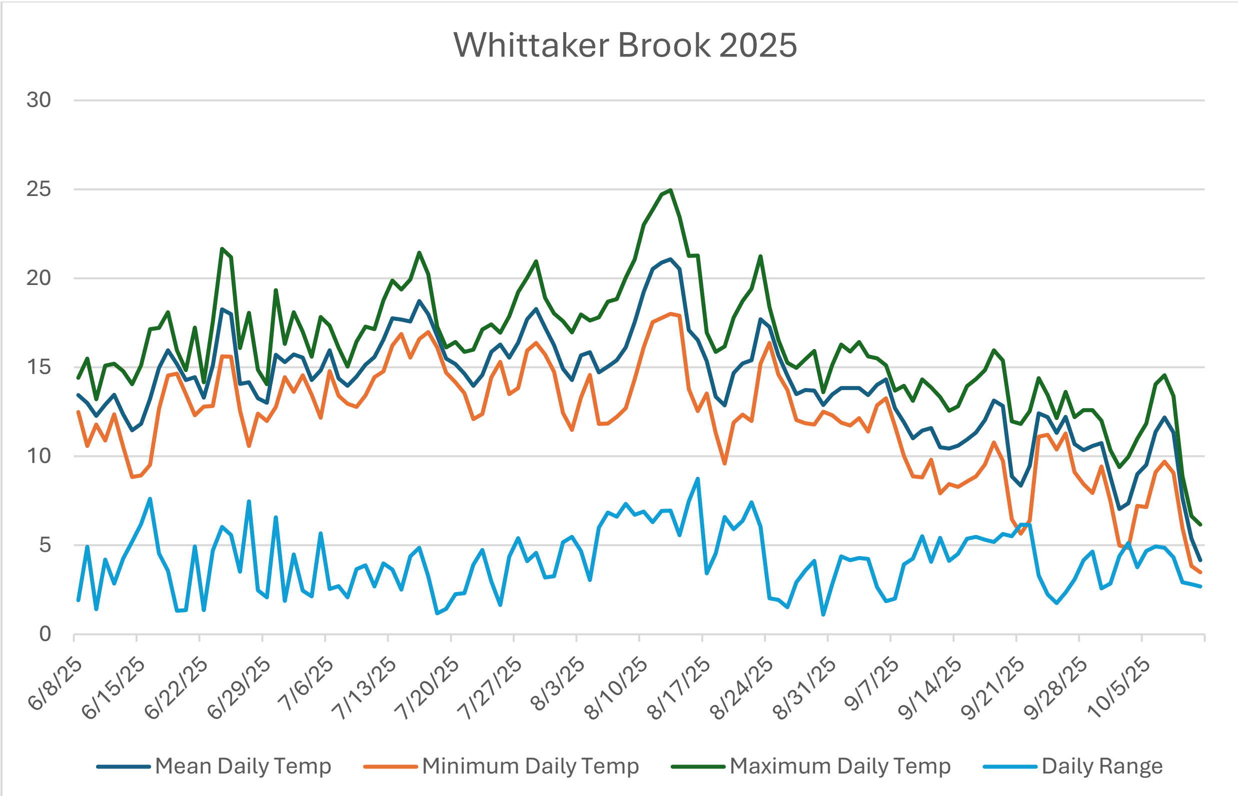

Thoroughfare Brook 2023
26
24
22
20
18
16
14
12
10
8
6
4
2
0
5/1/23
5/8/23
5/15/23
5/22/23
5/29/23
6/5/23
6/12/23
6/19/23
6/26/23
7/3/23
7/10/23
7/17/23
7/24/23
7/31/23
8/7/23
8/14/23
8/21/23
8/28/23
9/4/23
9/11/23
9/18/23
9/25/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

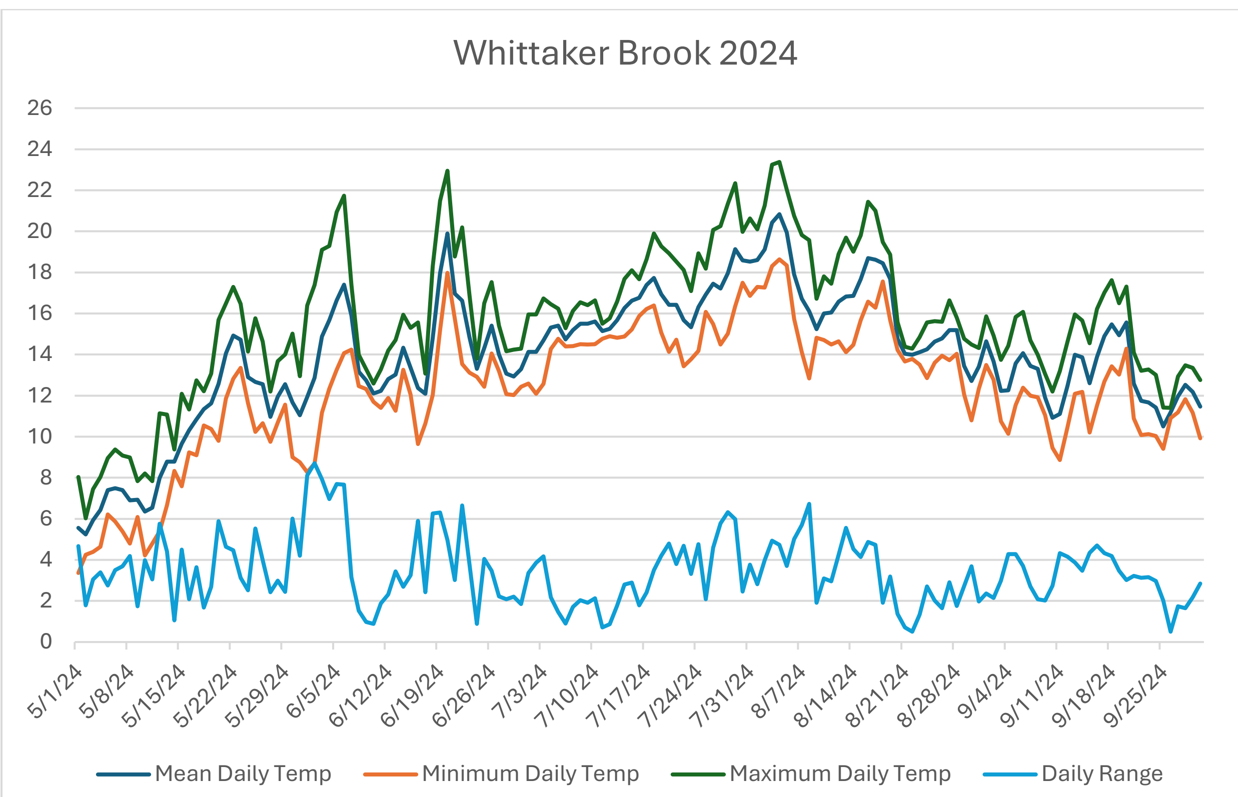

Thoroughfare Brook 2022
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/21/22
6/28/22
7/5/22
7/12/22
7/19/22
7/26/22
8/2/22
8/9/22
8/16/22
8/23/22
8/30/22
9/6/22
9/13/22
9/20/22
9/27/22
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

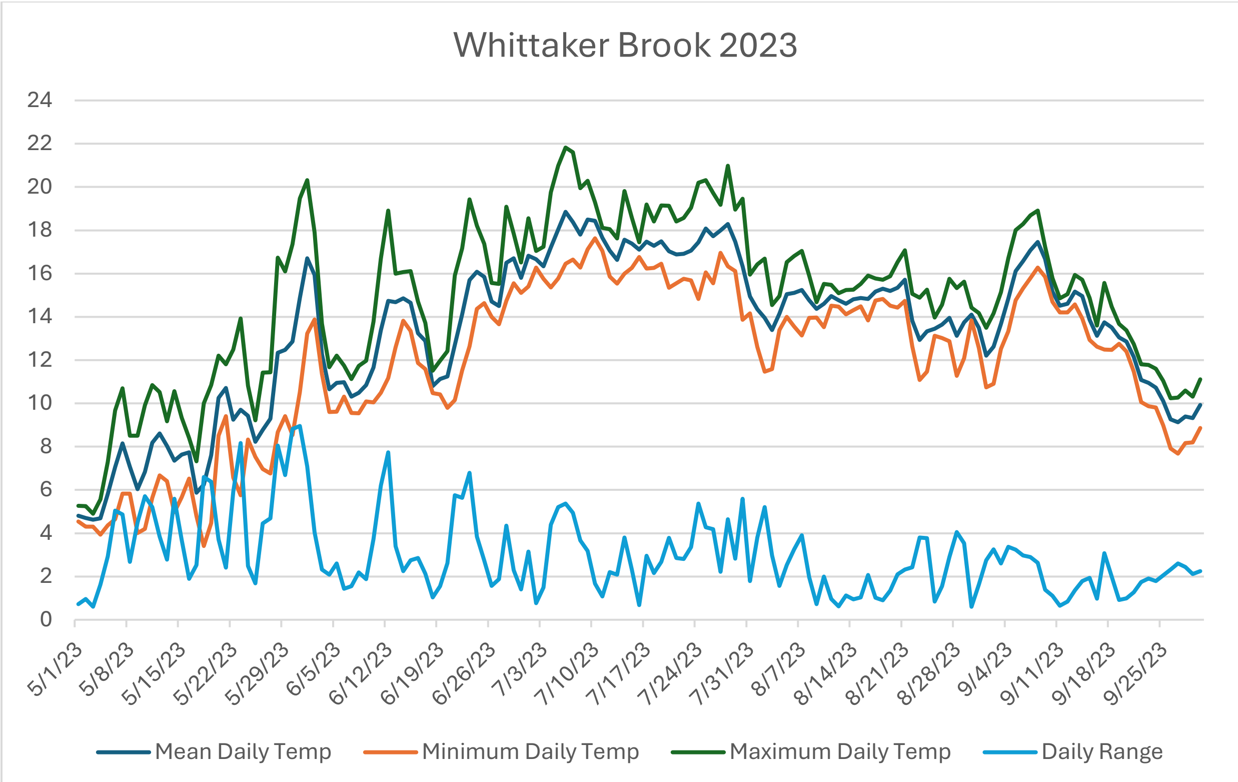

Upper Ellis Brook 2025
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/13/25
6/18/25
6/23/25
6/28/25
7/3/25
7/8/25
7/13/25
7/18/25
7/23/25
7/28/25
8/2/25
8/7/25
8/12/25
8/17/25
8/22/25
8/27/25
9/1/25
9/6/25
9/11/25
9/16/25
9/21/25
9/26/25
10/1/25
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

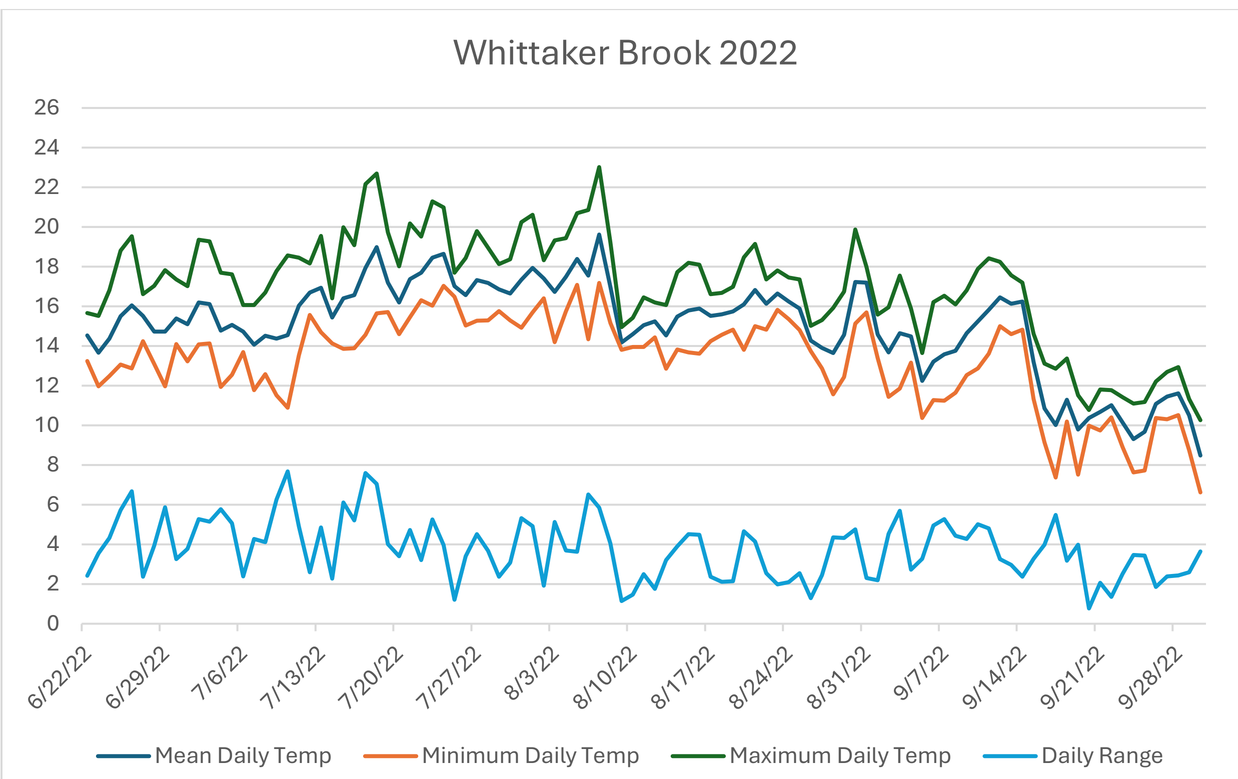

Upper Ellis Brook 2024
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
5/1/24
5/8/24
5/15/24
5/22/24
5/29/24
6/5/24
6/12/24
6/19/24
6/26/24
7/3/24
7/10/24
7/17/24
7/24/24
7/31/24
8/7/24
8/14/24
8/21/24
8/28/24
9/4/24
9/11/24
9/18/24
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

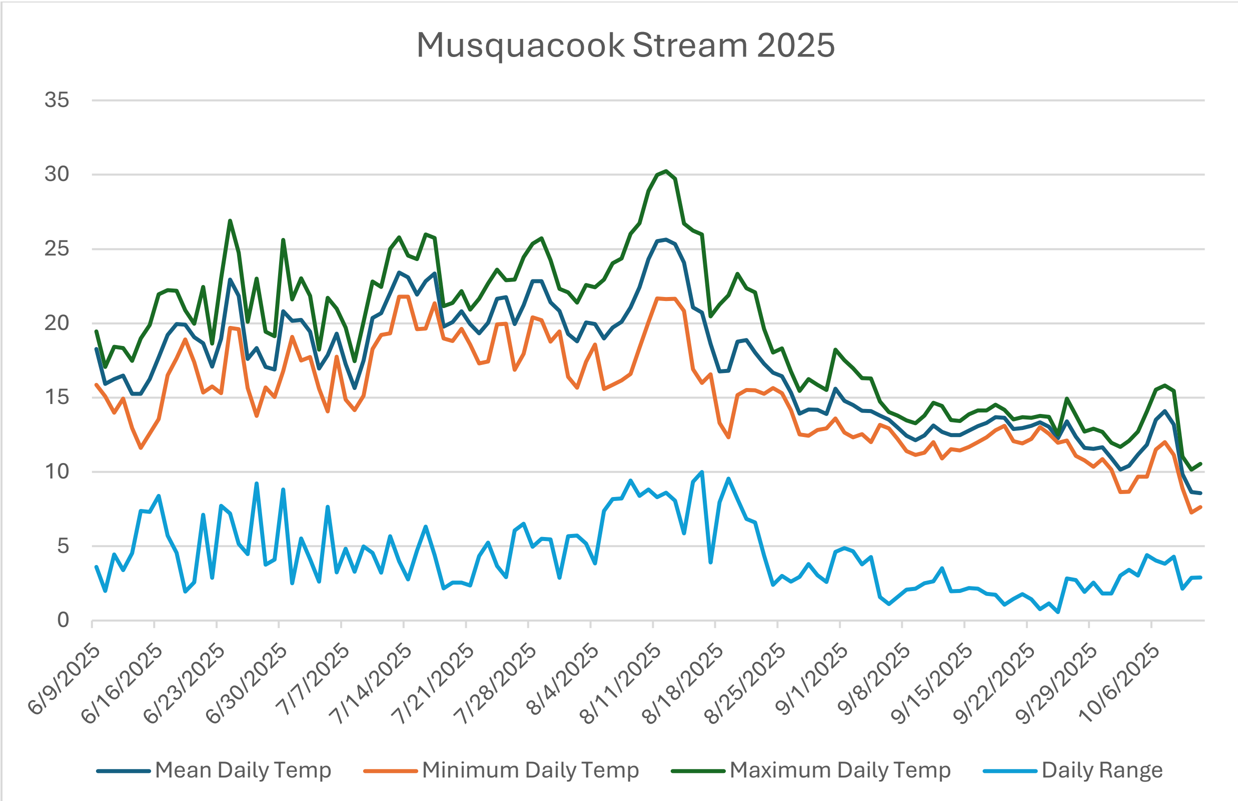

Upper Ellis Brook 2023
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7/1/23
7/8/23
7/15/23
7/22/23
7/29/23
8/5/23
8/12/23
8/19/23
8/26/23
9/2/23
9/9/23
9/16/23
9/23/23
9/30/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

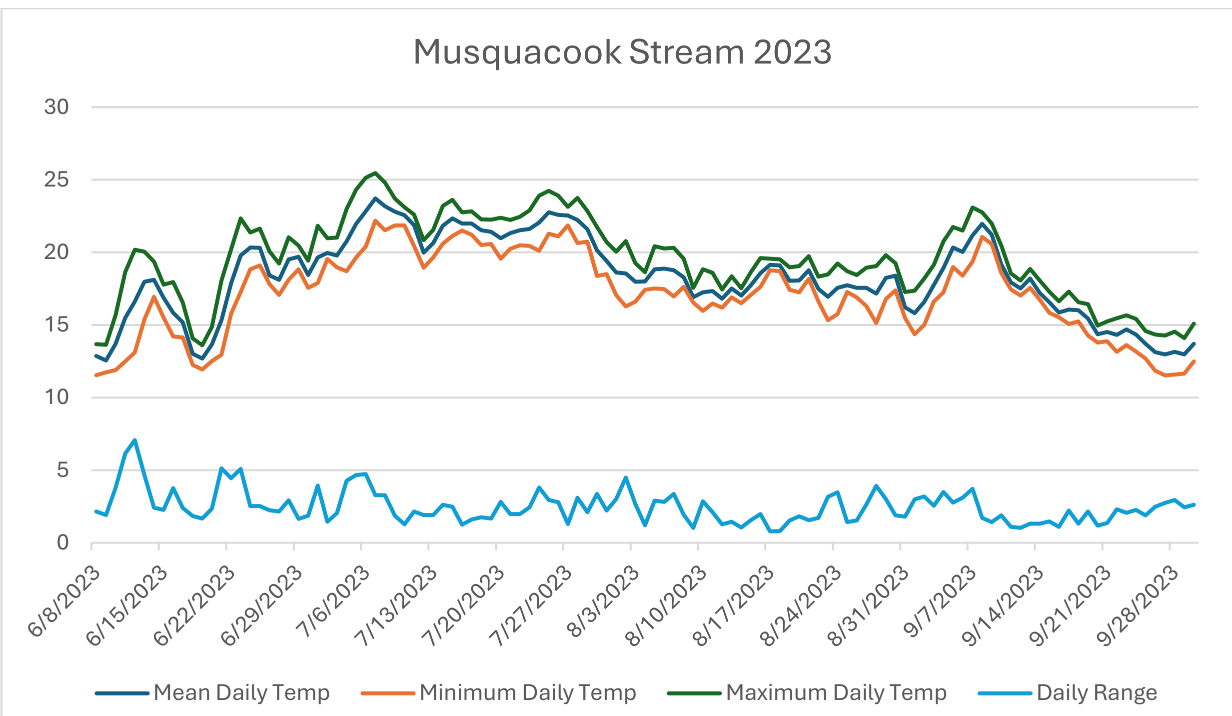

Whittaker Brook 2025
30
25
20
15
10
5
0
6/8/25
6/15/25
6/22/25
6/29/25
7/6/25
7/13/25
7/20/25
7/27/25
8/3/25
8/10/25
8/17/25
8/24/25
8/31/25
9/7/25
9/14/25
9/21/25
9/28/25
10/5/25
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

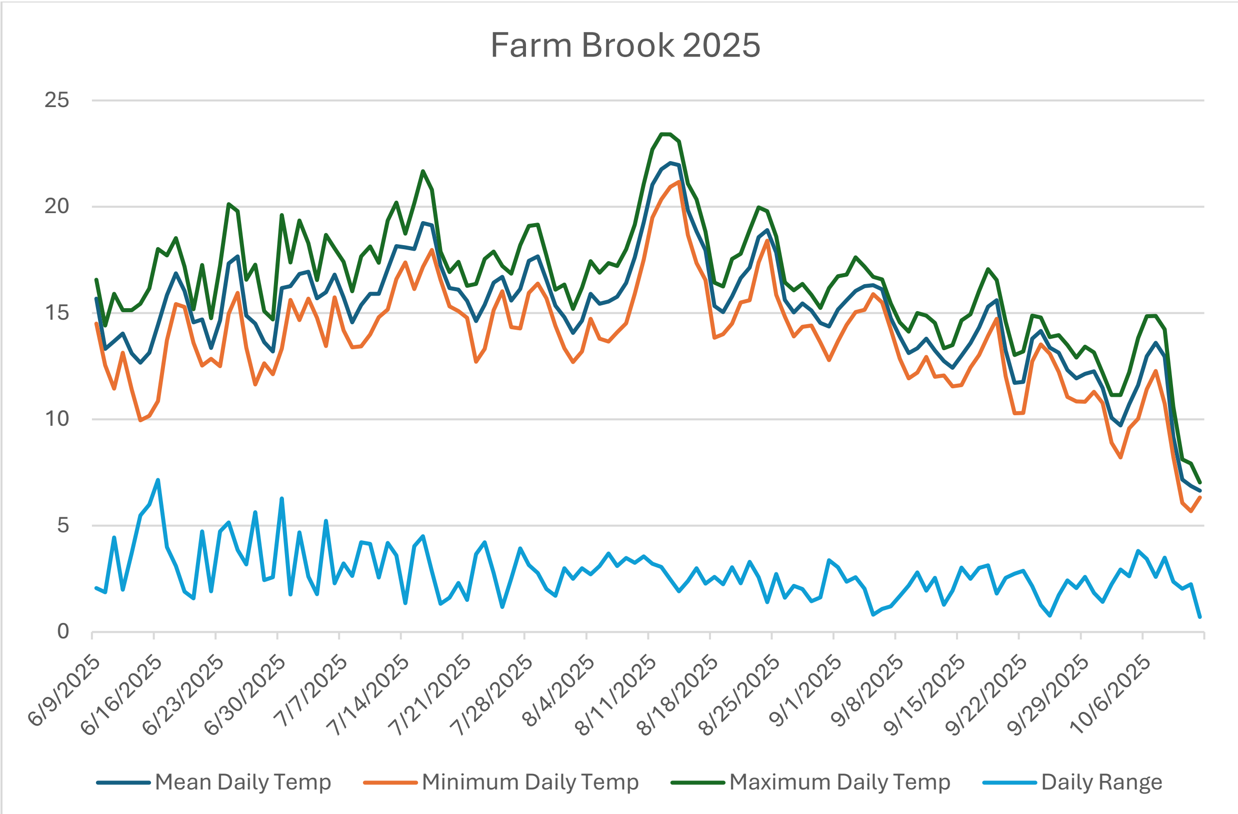

Whittaker Brook 2024
26
24
22
20
18
16
14
12
10
8
6
4
2
0
5/1/24
5/8/24
5/15/24
5/22/24
5/29/24
6/5/24
6/12/24
6/19/24
6/26/24
7/3/24
7/10/24
7/17/24
7/24/24
7/31/24
8/7/24
8/14/24
8/21/24
8/28/24
9/4/24
9/11/24
9/18/24
9/25/24
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Whittaker Brook 2023
24
22
20
18
16
14
12
10
8
6
4
2
0
5/1/23
5/8/23
5/15/23
5/22/23
5/29/23
6/5/23
6/12/23
6/19/23
6/26/23
7/3/23
7/10/23
7/17/23
7/24/23
7/31/23
8/7/23
8/14/23
8/21/23
8/28/23
9/4/23
9/11/23
9/18/23
9/25/23
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

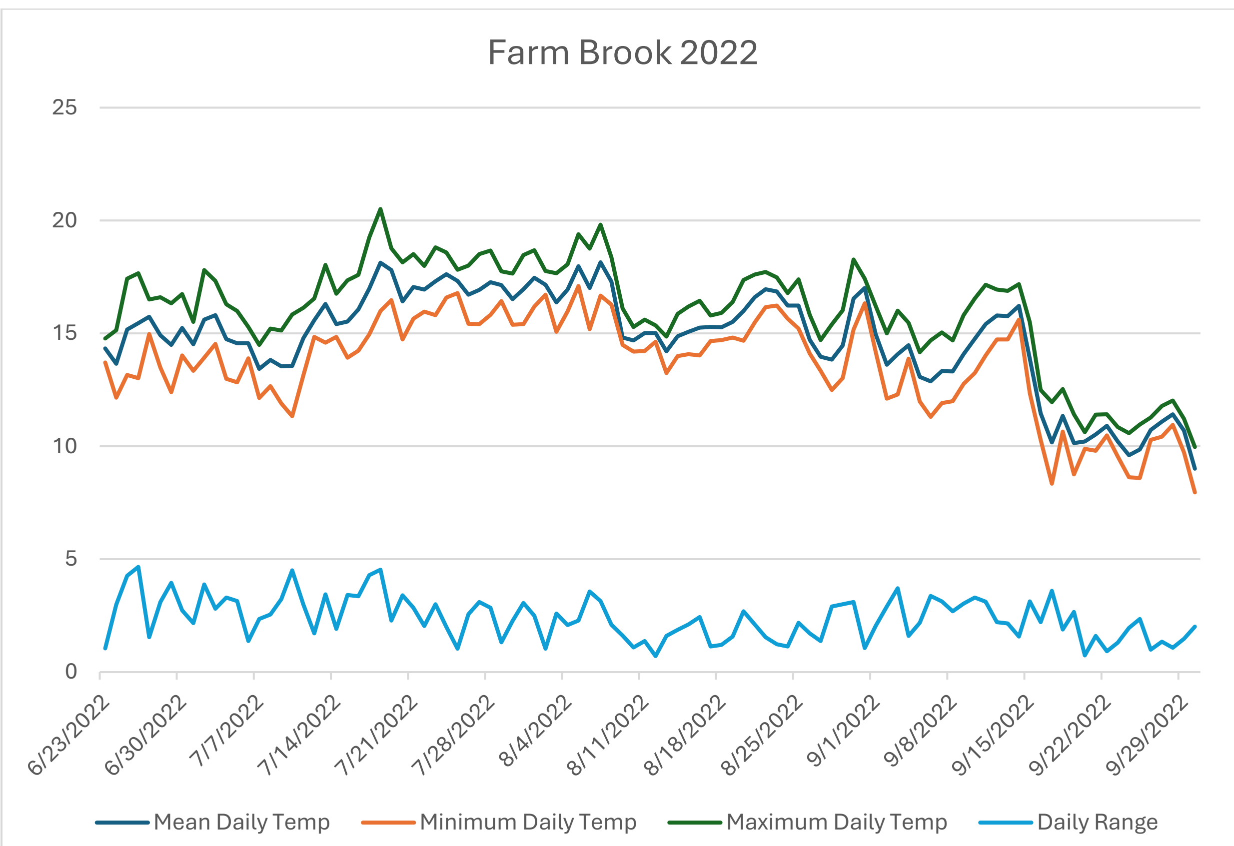

Whittaker Brook 2022
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/22/22
6/29/22
7/6/22
7/13/22
7/20/22
7/27/22
8/3/22
8/10/22
8/17/22
8/24/22
8/31/22
9/7/22
9/14/22
9/21/22
9/28/22
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Musquacook Stream 2025
35
30
25
20
15
10
5
0
6/9/2025
6/16/2025
6/23/2025
6/30/2025
7/7/2025
7/14/2025
7/21/2025
7/28/2025
8/4/2025
8/11/2025
8/18/2025
8/25/2025
9/1/2025
9/8/2025
9/15/2025
9/22/2025
9/29/2025
10/6/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

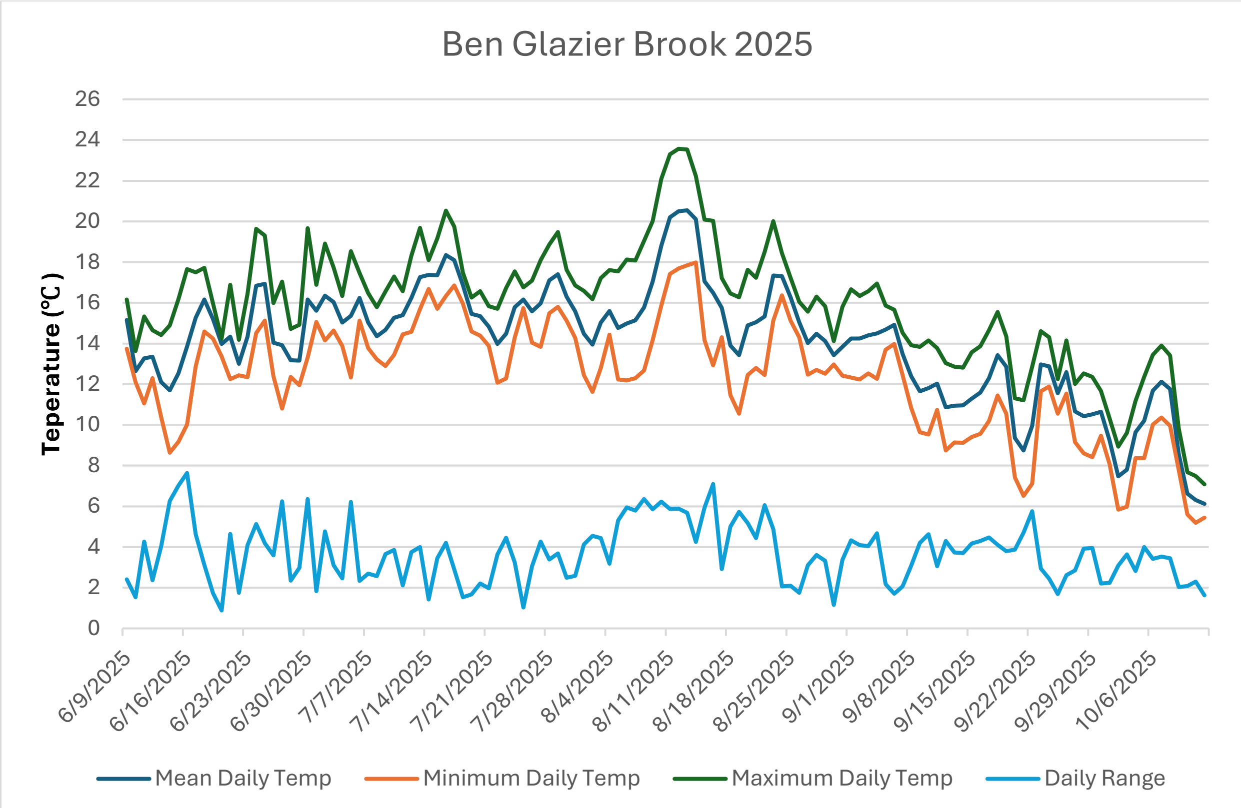

Musquacook Stream 2023
30
25
20
15
10
5
0
6/8/2023
6/15/2023
6/22/2023
6/29/2023
7/6/2023
7/13/2023
7/20/2023
7/27/2023
8/3/2023
8/10/2023
8/17/2023
8/24/2023
8/31/2023
9/7/2023
9/14/2023
9/21/2023
9/28/2023
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

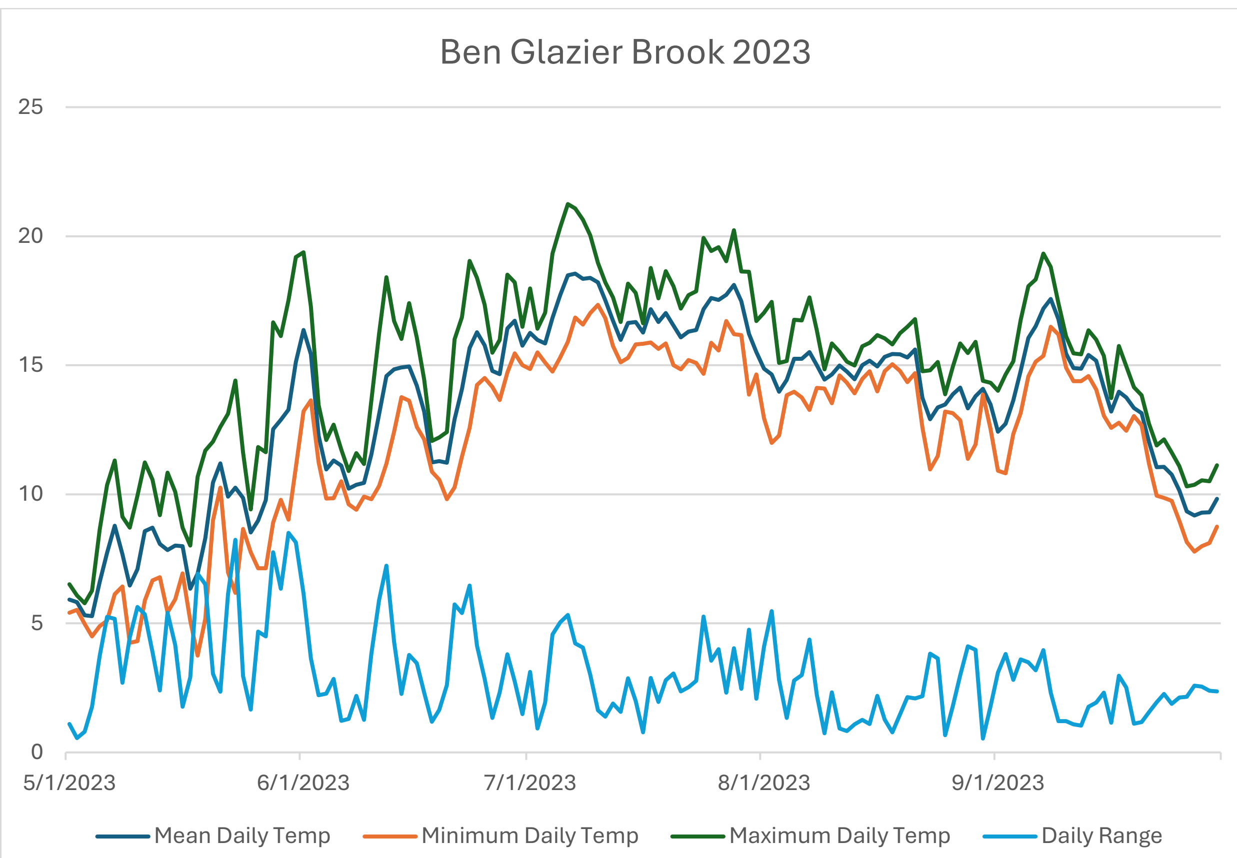


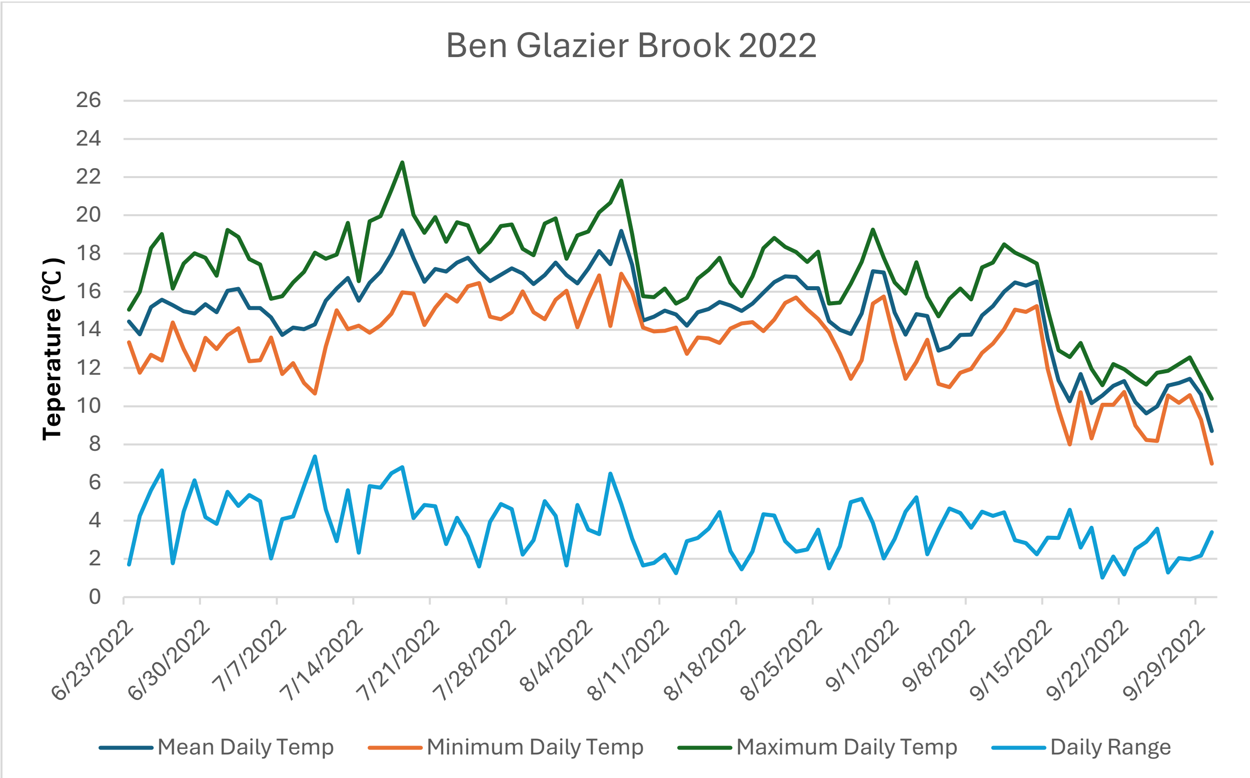
Farm Brook 2025
25
20
15
10
5
0
6/9/2025
6/16/2025
6/23/2025
6/30/2025
7/7/2025
7/14/2025
7/21/2025
7/28/2025
8/4/2025
8/11/2025
8/18/2025
8/25/2025
9/1/2025
9/8/2025
9/15/2025
9/22/2025
9/29/2025
10/6/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

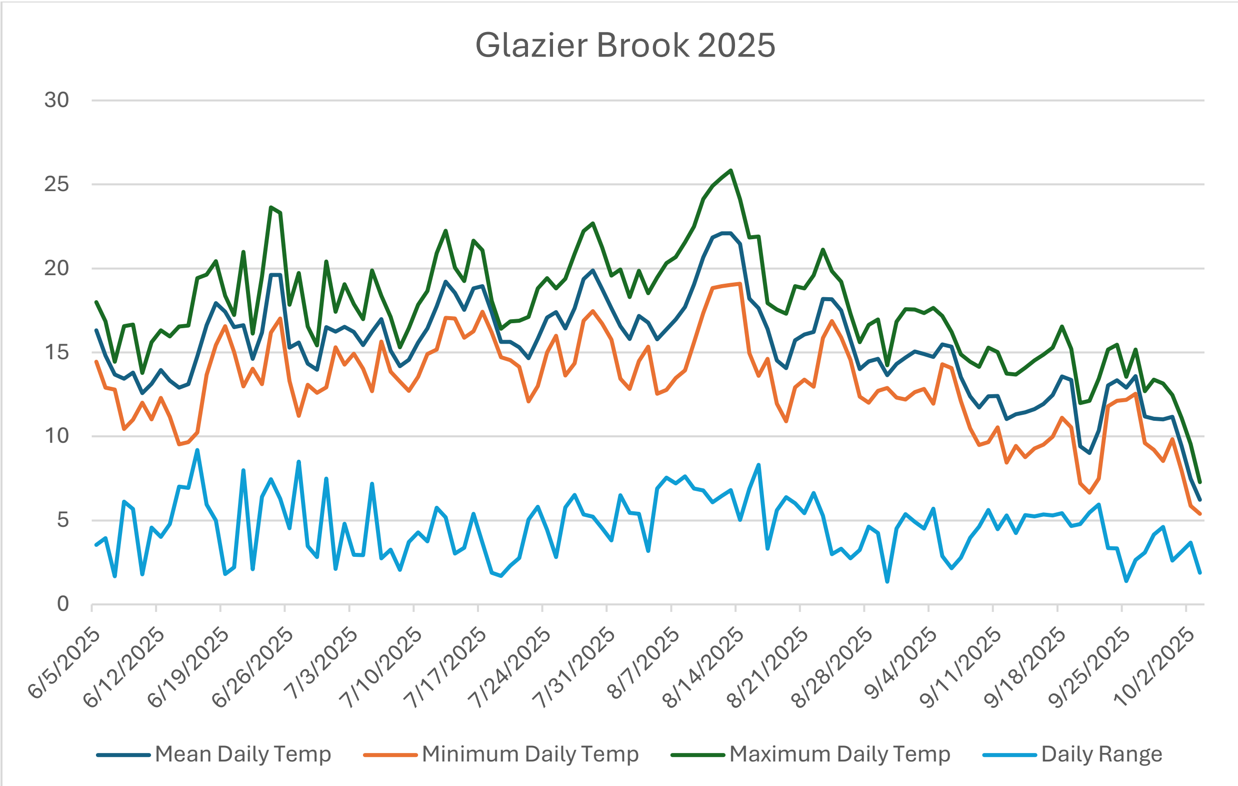


Farm Brook 2022
25
20
15
10
5
0
6/23/2022
6/30/2022
7/7/2022
7/14/2022
7/21/2022
7/28/2022
8/4/2022
8/11/2022
8/18/2022
8/25/2022
9/1/2022
9/8/2022
9/15/2022
9/22/2022
9/29/2022
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

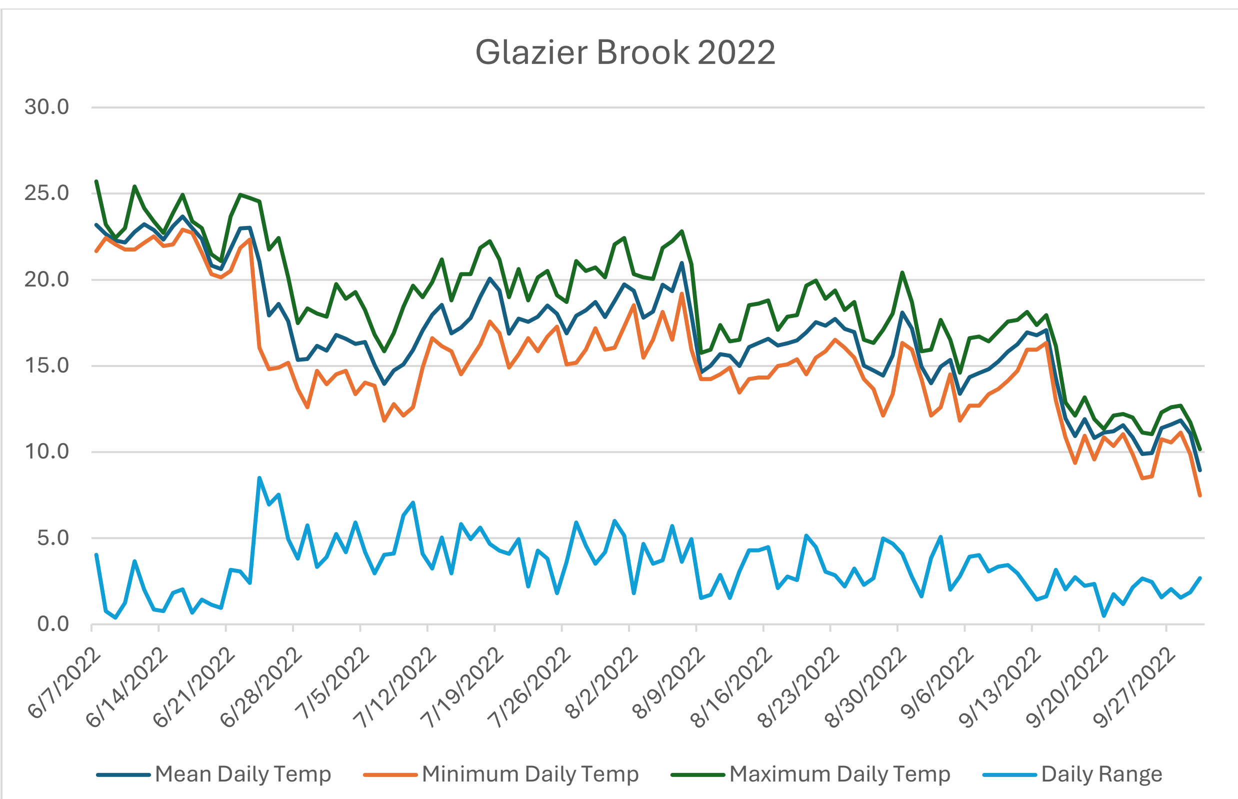

Ben Glazier Brook 2025
Teperature (℃)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/9/2025
6/16/2025
6/23/2025
6/30/2025
7/7/2025
7/14/2025
7/21/2025
7/28/2025
8/4/2025
8/11/2025
8/18/2025
8/25/2025
9/1/2025
9/8/2025
9/15/2025
9/22/2025
9/29/2025
10/6/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Ben Glazier Brook 2023
25
20
15
10
5
0
5/1/2023
6/1/2023
7/1/2023
8/1/2023
9/1/2023
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

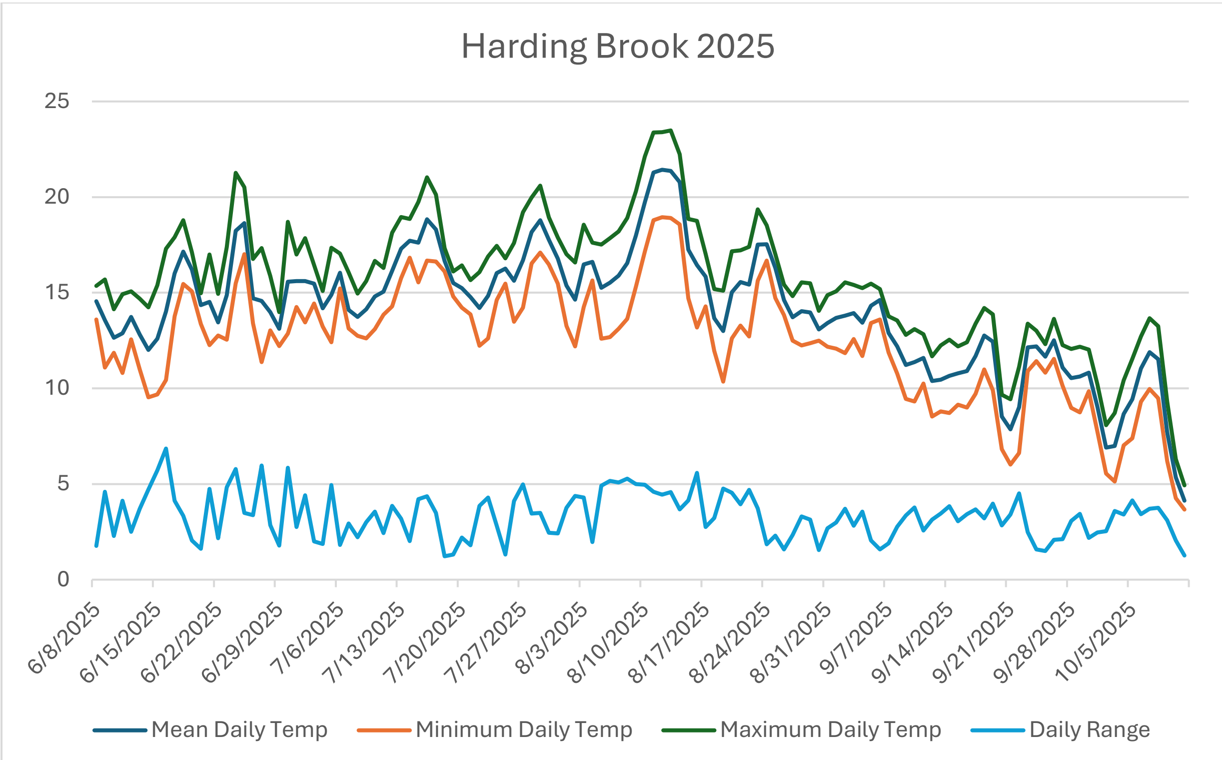

Ben Glazier Brook 2022
Teperature (°C)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
6/23/2022
6/30/2022
7/7/2022
7/14/2022
7/21/2022
7/28/2022
8/4/2022
8/11/2022
8/18/2022
8/25/2022
9/1/2022
9/8/2022
9/15/2022
9/22/2022
9/29/2022
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

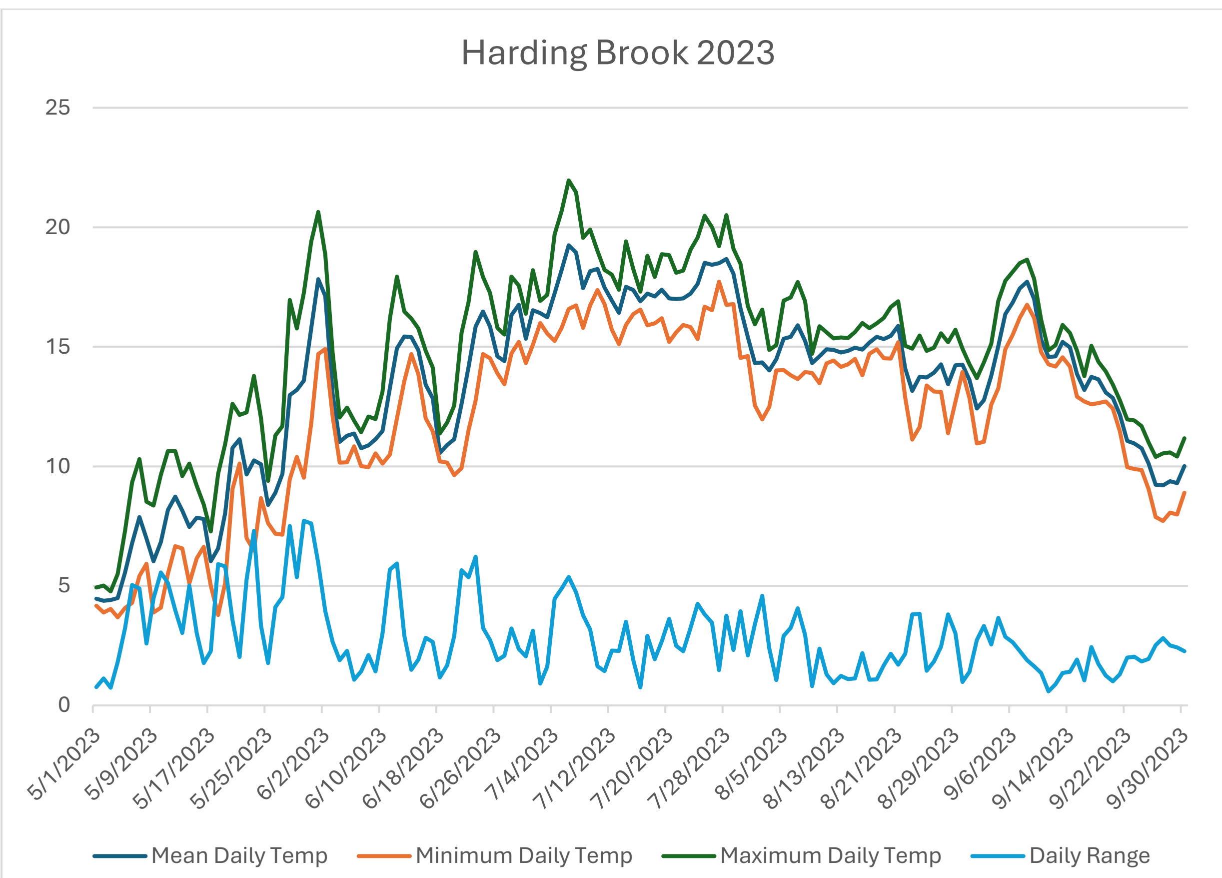


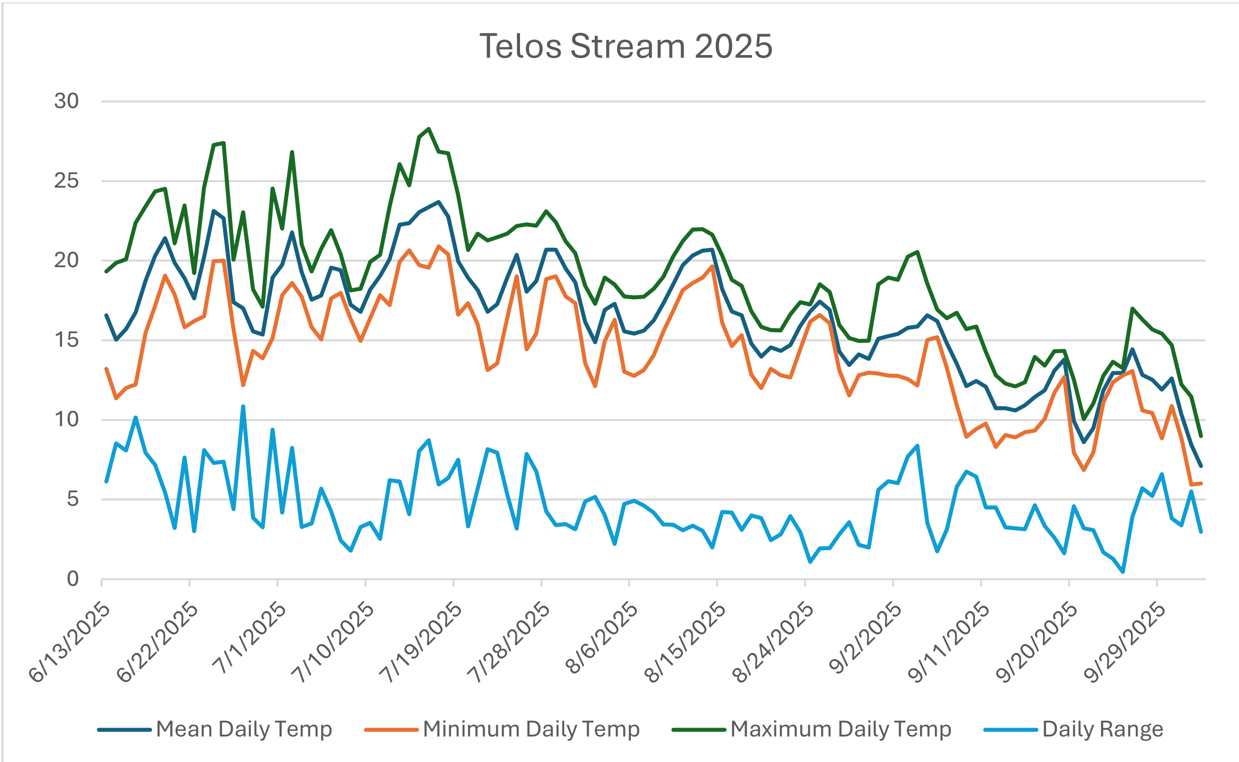
Glazier Brook 2025
30
25
20
15
10
5
0
6/5/2025
6/12/2025
6/19/2025
6/26/2025
7/3/2025
7/10/2025
7/17/2025
7/24/2025
7/31/2025
8/7/2025
8/14/2025
8/21/2025
8/28/2025
9/4/2025
9/11/2025
9/18/2025
9/25/2025
10/2/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range

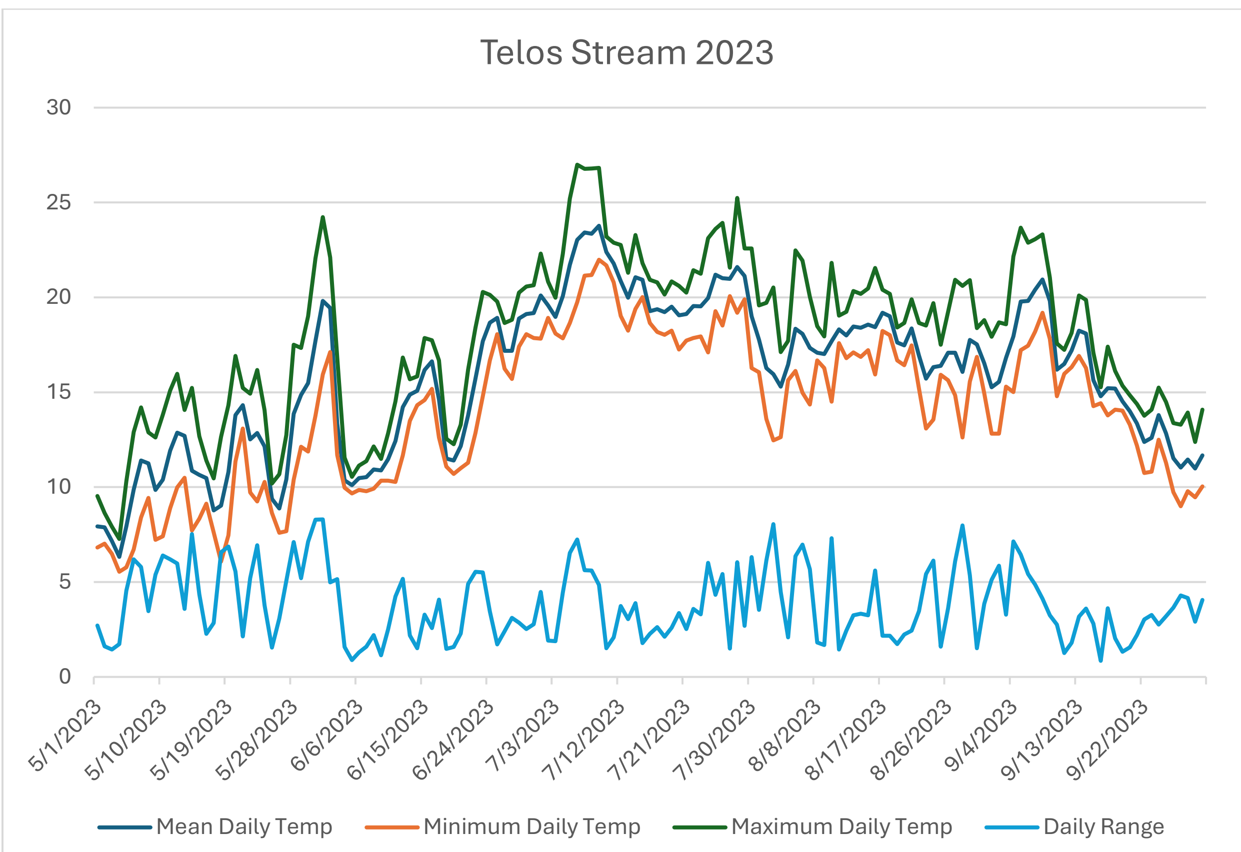


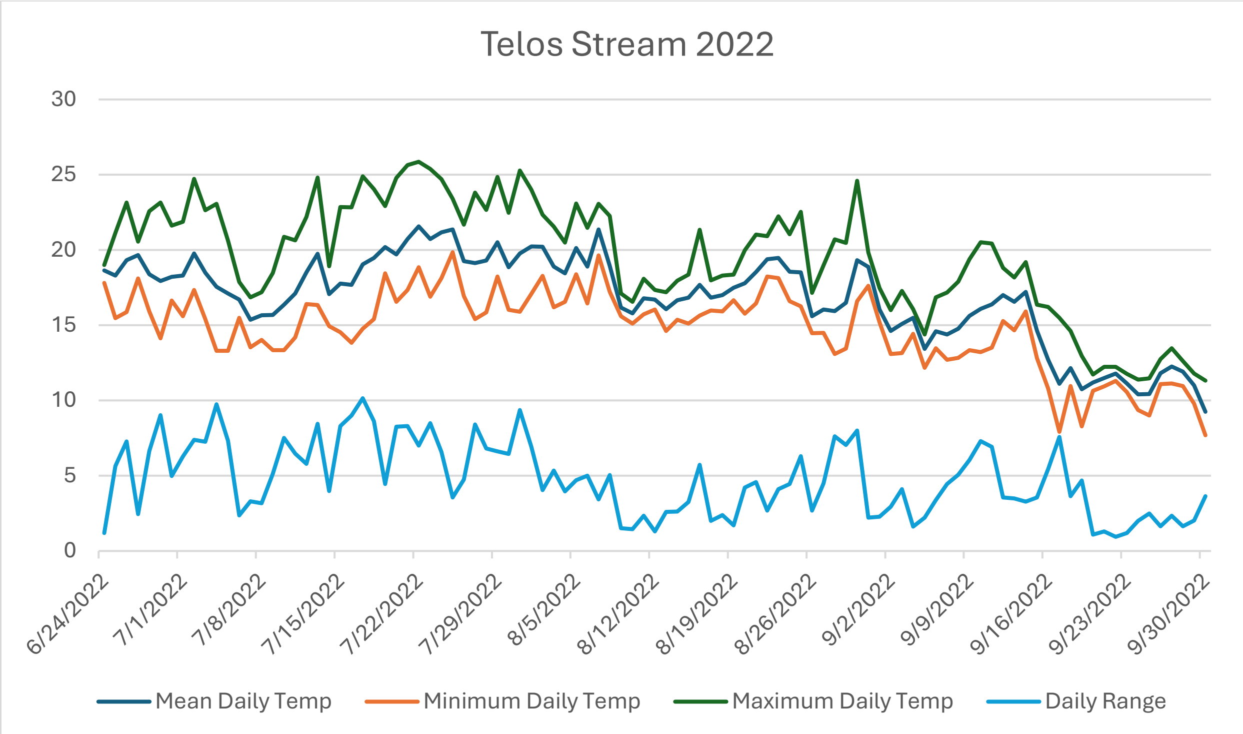
Glazier Brook 2022
30.0
25.0
20.0
15.0
10.0
5.0
0.0
6/7/2022
6/14/2022
6/21/2022
6/28/2022
7/5/2022
7/12/2022
7/19/2022
7/26/2022
8/2/2022
8/9/2022
8/16/2022
8/23/2022
8/30/2022
9/6/2022
9/13/2022
9/20/2022
9/27/2022
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Harding Brook 2025
25
20
15
10
5
0
6/8/2025
6/15/2025
6/22/2025
6/29/2025
7/6/2025
7/13/2025
7/20/2025
7/27/2025
8/3/2025
8/10/2025
8/17/2025
8/24/2025
8/31/2025
9/7/2025
9/14/2025
9/21/2025
9/28/2025
10/5/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Harding Brook 2023
25
20
15
10
5
0
5/1/2023
5/9/2023
5/17/2023
5/25/2023
6/2/2023
6/10/2023
6/18/2023
6/26/2023
7/4/2023
7/12/2023
7/20/2023
7/28/2023
8/5/2023
8/13/2023
8/21/2023
8/29/2023
9/6/2023
9/14/2023
9/22/2023
9/30/2023
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Telos Stream 2025
30
25
20
15
10
5
0
6/13/2025
6/22/2025
7/1/2025
7/10/2025
7/19/2025
7/28/2025
8/6/2025
8/15/2025
8/24/2025
9/2/2025
9/11/2025
9/20/2025
9/29/2025
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range


Telos Stream 2023
30
25
20
15
10
5
0
5/1/2023
5/10/2023
5/19/2023
5/28/2023
6/6/2023
6/15/2023
6/24/2023
7/3/2023
7/12/2023
7/21/2023
7/30/2023
8/8/2023
8/17/2023
8/26/2023
9/4/2023
9/13/2023
9/22/2023
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range



Telos Stream 2022
30
25
20
15
10
5
0
6/24/2022
7/1/2022
7/8/2022
7/15/2022
7/22/2022
7/29/2022
8/5/2022
8/12/2022
8/19/2022
8/26/2022
9/2/2022
9/9/2022
9/16/2022
9/23/2022
9/30/2022
Mean Daily Temp
Minimum Daily Temp
Maximum Daily Temp
Daily Range