Yellowstone cutthroat trout, the USFWS found that the petition did not present sufficient information indicating listing the Yellowstone cutthroat trout was warranted (66 FR 11244). In January 2004, a civil suit filed in Colorado (Civil Action number 04-F-0108[OEs]) challenged this finding. The basis of this lawsuit was a decline in Yellowstone cutthroat trout abundance associated with habitat degradation or loss. The examples listed included livestock grazing, logging, mining, other human activities, and dewatering of streams. A settlement of the lawsuit initiated a status review under ESA, which affirmed the finding that listing Yellowstone cutthroat trout as a threatened species was “not warranted” (71 FR 8819). In May of 2006, petitioners issued a 60-day notice of intent to sue, indicating challenges to these findings are probable.

3.0 Shields River Subbasin Characterization

The Shields River Subbasin encompasses approximately 289,000 acres and flows into the Yellowstone River, east of Livingston, Montana (Figure 3-1). The Shields River valley is primarily agricultural land, and production of cattle, hay, and small grains is the foundation of the local economy. Rangeland makes up the majority of the land use at 59% (USWA 2001). Major towns in the region include Wilsall and Clyde Park, and agriculture provides the major economic base for these small communities. Private land ownership in the watershed constitutes 81% of the area, while the Forest Service administers 16% of land base, primarily in the headwater reaches on the east and west sides of the watershed (USWA 2001). BLM (0.4%) and state lands (2.5%) are typically small parcels (≤ 1 section) and are scattered throughout the watershed.

Most streams have headwaters in the mountains that form the eastern and western extents of the watershed and many of these streams flow through the GNF. The Crazy Mountains bound the watershed on the east, and the Bridger and Bangtail ranges form the western boundary. Elevations range from 4,300 feet at the mouth of the Shields River to 11,000 feet at the summit of Crazy Peak in the Crazy Mountains. The Bridger Range rises to an elevation of 9,500 feet. As most streams originate at high elevations, snowmelt is the primary driver of the hydrology resulting in a spring rise, followed by a decline to base flows by fall, although irrigation activities have altered the hydrograph from the natural regime. A few streams originate at lower elevations and function like warm-water prairie streams with lower gradients, finer bed material, and a less pronounced spring runoff.

Precipitation in the Shields River valley generally falls between 13 to 15 inches per year; however, the weather station at Wilsall reports a mean of just over 20 inches for the period of record from 1957 to 2004 (WRCC 2005). The Bridger Range in the west has an annual precipitation of over 50 inches, and the Crazy Mountains in the east average around 60 inches of annual precipitation. About 68% of the annual precipitation falls from April through September, and approximately 32% of the annual precipitation falls in the months of May and June for the entire watershed (WRCC 2005).

Thick layers of sedimentary rock underlie the majority of the watershed; however, localized areas of volcanic rock are common. Uplift of sedimentary rock formed the Bridger Range, and the Crazy Mountains were the result of large igneous intrusions. Four general soil types occur throughout the watershed: soils formed sedimentary rock in upland areas, from alluvium on high terraces, soils formed from alluvium on low terraces and soils formed on mountain slopes. Soils formed from sedimentary rock in upland areas are the most common and tend to be moderately fine to fine in texture. These soils are well drained and are commonly clay loam or silty clay loam. Soils formed from alluvium on high terraces are typically well-drained clay loam or clay with a gravelly or cobbly substratum. Alluvial soils formed on low terraces are typically deep and range from well drained to poorly drained. Textures of these soils also range from moderately coarse to fine. Soils formed on mountain slopes occur on steep slopes, are well drained, moderately deep, and have high amounts of rock fragments throughout (Davis and Shovic 1996).

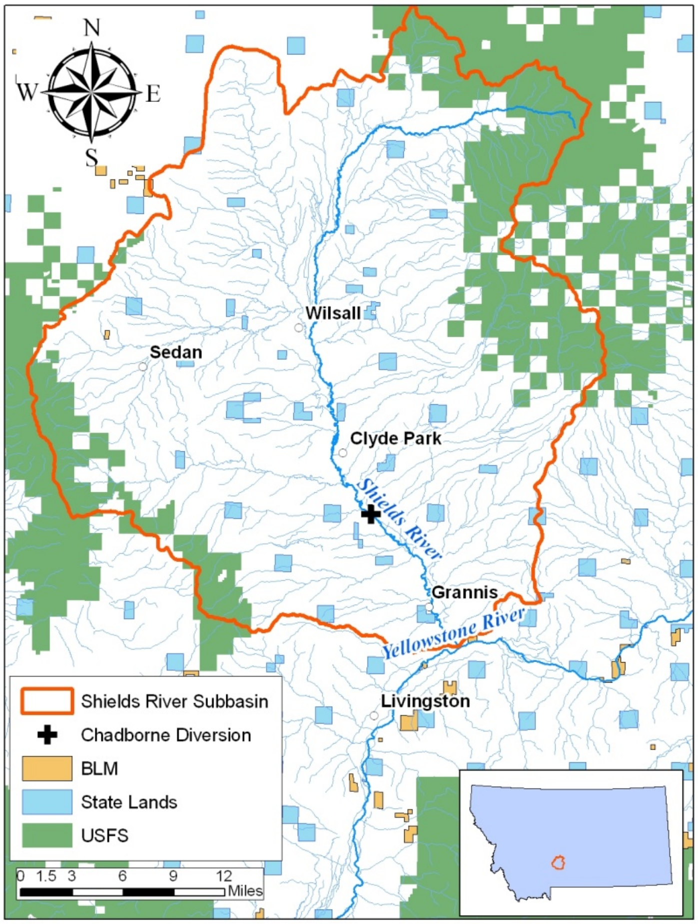

Figure 3-1: Overview of the in the Shields River watershed showing landownership.

4.0 General Conservation Strategies

Efforts to conserve and restore Yellowstone cutthroat trout in the Shields River watershed will focus on the key factors limiting their abundance and distribution in the basin. Habitat quality, water quantity and quality, competition with nonnative species, genetic introgression, and predation all reduce Yellowstone cutthroat trout in the Shields River Subbasin to some extent. Identifying limiting factors and designing projects to ameliorate their effects will remain at the core of restoration and conservation efforts.

4.1 Repair and Retrofit of Chadbourne Diversion and Associated Operations

Maintaining the Chadbourne diversion as a barrier to upstream movement of rainbow trout, and increasing its effectiveness at blocking fish are key conservation needs for the Shields River watershed upstream of this structure. Chadbourne diversion was built in 1908, and is currently in disrepair. Its structural failure would allow the abundant rainbow trout in the river system below free access to the Shields River and its tributaries. FWP and the Lower Shields River Canal Company are collaborating to repair and secure the diversion. Construction is slated to begin August of 2013.

Another potential component of the Chadbourne repairs and retrofits may be to install a bypass channel to allow selective passage of fishes. The channel would lead to a stock pen, where fisheries workers will identify fish ascending the ladder. Native fishes would be placed upstream of the diversion, and rainbow trout would be returned to the river downstream. The intent of this component of dam repairs and alterations is to restore connectivity for native fishes. This action is consistent with a goal of Yellowstone cutthroat trout conservation, which includes restoration and conservation of life history strategies, including migratory patterns.

4.2 Water Quality and Quantity

4.2.1 Water Quality

The total maximum daily load (TMDL) process is the primary water quality planning effort relevant to Yellowstone cutthroat trout conservation in the Shields River Subbasin. TMDL refers to the amount of a pollutant a body of water can assimilate and still support its beneficial uses. In simple terms, a TMDL plan has numeric goals for restoring water quality. Section 303(d) of the Clean Water Act requires development of TMDL plans for water-quality-impaired segments of streams, lakes, and wetlands. DEQ completed a TMDL plan that provides a general approach to restoring water quality with respect to sediment loading within the Shields River Subbasin (DEQ 2009). The SVWG collaborated with DEQ and a local consulting firm to develop a watershed restoration plan that details potential means of reducing sediment loading and identifies potential projects (Confluence 2012).

Many of the impairments listed for this watershed on the 303(d) list are related to water supply management and land use practices within or adjacent to the riparian corridor. Siltation, riparian degradation, low flows, and widening of some streams were noted in the stream surveys conducted by the Forest Service and FWP (Inter-Fluve 2001, Jones and Shuler 2004, May 1998, May et al. 2003, Shepard 2004). These results confirm that flow alteration, siltation, and riparian degradation are key impairments in the watershed. Timber harvest and associated road building on both public and private lands contribute to sedimentation and channel alterations.

Understanding the operational definitions used by the DEQ and Environmental Protection Agency (EPA) is important in understanding the role the TMDL plan will have in watershed level restoration in the Shields River Subbasin. These agencies make a distinction between pollutants, substances or conditions that are measurable in the water column or on the streambed, and pollution, which includes disturbances such as bank erosion or dewatering, which add pollutants to a body of water. TMDL plans address only pollutants directly. As sediment was the only pollutant on the 303(d) list during TMDL development for the Shields River Subbasin, the TMDL and watershed restoration plans address sediment.

Watershed assessment activities conducted to support TMDL planning will prove useful in Yellowstone cutthroat trout conservation. This effort included an extensive evaluation of aerial imagery, which classified stream reaches based on channel morphology, riparian condition, land use, and restoration potential. This assessment will provide a screen to identify potential restoration projects on all streams in the watershed. The SVWG, in conjunction with DEQ, will take the lead on this effort. FWP will provide technical assistance in project planning and grant applications.

The TMDL (DEQ 2009) identified roads and hillslope erosion as sources of sediment loading to streams. The Forest Service has expansive plans to decommission and reclaim roads throughout the GNF, with substantial efforts slated for the Smith Creek watershed, in the headwaters of the Shields River. These actions will include recontouring eight miles of road, and decommissioning of 15 miles of road within the basin. The intent of these actions is to reduce sediment loading to streams, which will greatly benefit resident fish in the Smith Creek drainage and the Shields River. The watershed restoration plan (Confluence 2012) details priorities and potential approaches to reducing sediment loading from other roads and hillsides.

4.2.2 Water Temperature

Warm water temperatures relating to a variety of land uses can potentially limit habitat suitability for Yellowstone cutthroat trout and can give relatively tolerant nonnative fishes a competitive edge. Irrigation withdrawals decrease the volume of water, which allows the remaining water to heat more readily. (Conversely, irrigation return flows, when contributed from groundwater, can cool stream temperatures.) Similarly, removal of riparian shrubs and trees decreases shading of the water surface, and contributes to channel widening. Moreover, climate change presents a current and looming threat with projected effects on water temperature and quantity. Recent warming has already driven significant changes in the hydroclimate, with a shift towards more rainfall and less snow in the western US (Knowles et al. 2006). Likewise, the peak of spring snowmelt is two weeks earlier in recent years, and this trend is likely to continue (Stewart et al. 2004). Probable effects of climate change in the western US, including Montana, will be increased water shortages and warmer water temperatures during late summer, which unfortunately coincides with periods when irrigation demands exceed water supply and water temperatures are naturally at their highest (L.S. Dolan, DNRC, personal communication; D. Issac, USFS, personal communication).

Data allowing evaluation of thermal regime come from several sources. The USGS has been monitoring daily stream temperatures at its gage station located about 1.5 miles upstream of the confluence with the Yellowstone River since 1999 (Figure 4-1). FWP has five monitoring stations on the Shields River and deployed thermographs on numerous tributaries during the 2000s.

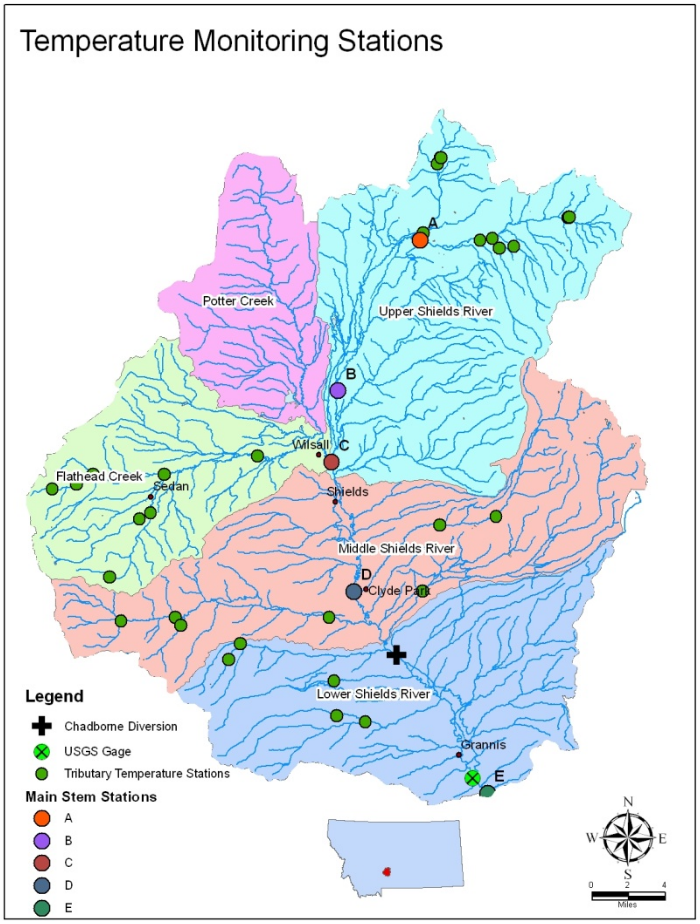

Figure 4-1: Water temperature monitoring stations in the Shields River Subbasin.

Ideally, interpretation of temperature data uses thermal tolerances and optima developed for the target species. These values have not yet been determined for Yellowstone cutthroat; however, a thermal study on the closely related westslope cutthroat trout provides a surrogate in evaluating potential thermal stress to Yellowstone cutthroat trout (Bear et al. 2007). This study identified 19.6 °C (67 °F) as the upper incipient lethal temperature (UILT) for westslope cutthroat trout, which is the temperature at which 50% of a test population survives for 60 days of exposure. Optimum temperatures were those where peak growth occurred and were between 13 and 15 °C (55 and 59 °F). Although a number of factors limit the certainty in applying the optima and UILT to Yellowstone cutthroat trout, this study is the best information we have currently to evaluate habitat suitability relating to temperature and the potential for thermal stress.

One consideration in the use of this research for Yellowstone cutthroat trout is that incidental observations suggest Yellowstone cutthroat trout may be less sensitive to thermal loading than westslope cutthroat trout (B.B. Shepard, Wildlife Conservation Society, personal communication). Furthermore, this investigation examined one life history stages (age-0 fish) and older fish may vary in their thermal optima or tolerance. Nevertheless, application of westslope cutthroat trout values to Yellowstone cutthroat trout provides a conservative approach to conserving Yellowstone cutthroat trout in face of uncertainty over thermal tolerances and optima for the subspecies. Conclusions drawn from the available data will acknowledge the considerable uncertainty.

Another important consideration in interpreting thermal optima is that this is the range where fish experience peak growth in the laboratory, but does not suggest that Yellowstone cutthroat trout cannot thrive in waters where the mean or maximum daily temperatures exceed this range. In nature, optimal conditions of various types may occur during brief windows for many species. Moreover, these laboratory studies hold temperatures steady with no daily variation, whereas stream temperatures show diel fluctuations following air temperatures and insolation of stream surfaces. Inclusion of the optimal ranges on the following figures is meant to be an informative comparison to measured optima, but does not imply that streams with mean or maximum temperatures that frequently exceed the thermal optima cannot support thriving populations of Yellowstone cutthroat trout.

The use of UILT as a measure of thermal stress brings similar limitations. In the laboratory, temperatures remain constant over the 60 days of exposure and fish do not experience the natural, daily temperature fluctuations that would provide respite from warm daytime temperatures. Moreover, this study design does not account for inter-day variability, where some days will be cooler and others warmer. As the controlled laboratory study did not account for natural variation within and across days, interpretation of recorded temperatures should acknowledge the considerable uncertainty in applying these values to field conditions. Evaluation of the frequency of occurrences over optima and the UILT, and the degree to which temperatures exceed these levels, allows inference on the role of thermal regime in shaping Yellowstone cutthroat trout distribution in the watershed and the potential for fish to experience thermal stress.

Other uncertainty associated with applying laboratory studies to field conditions is that it ignores fish behavior and movement relating to temperature. Fish are adept at finding upwellings of cooler groundwater within an otherwise warm stream. Alternatively, adult fish can move to other streams providing thermal refugia. Current research in the headwaters of the Shields River watershed is evaluating the role of temperature in shaping growth, brook trout invasion, and fish movement. Research of this type will provide a refined approach to evaluating how temperature shapes abundance, persistence, movement, and growth of Yellowstone cutthroat trout. Future iterations of this strategy will incorporate new research as a means to conserve Yellowstone cutthroat trout in the Shields River watershed, and elsewhere within their historic range.

Application of criteria prescribed in FWP's drought management policy for fishing closures provides another approach to evaluating suitability of temperature to support cold-water fisheries (FWP 2007b). According to the policy, daily maximum water temperature thresholds reaching or exceeding 73 °F (23 °C) during three consecutive days triggers a fishing closure. This analysis examined the number of periods meeting fishing closure thresholds, and the maximum number of consecutive days equaling or exceeding 73 °F.

Evaluation of daily maximum temperatures at the USGS gage station record indicates the lower main stem has a thermal regime potentially unfavorable to the of Yellowstone cutthroat trout in most summers. The USGS began daily monitoring of water temperatures in September of 1999, providing up to 62 days of monitoring for July and August for most years, although no data were available for 2007, or August of 2011 (Table 4-1). From 2000 to 2008, maximum daily temperatures occurring from July through August equaled or exceeded the UILT for westslope cutthroat trout on a majority of days, which suggests some thermal stress to Yellowstone cutthroat trout (Figure 4-2). The frequency of days in which temperatures exceeded the UILT was often substantial, with maximum daily temperatures greater than 70 °F on most of days in some years. Data were not available for 2007; however, as an exceptionally dry and warm year, water temperatures were likely less suitable for support of cold-water fisheries, especially sensitive Yellowstone cutthroat trout. Thermal regime was slightly less stressful to Yellowstone cutthroat trout in 2009 and 2010, with just under half of days reaching temperatures greater than the UILT for westslope cutthroat trout. In 2011, snowpack was at, or near, record levels, and maximum water temperatures rarely exceeded the UILT; however, data were available for July only, so late summer water temperatures are unknown.

Mean daily temperatures reflect maximum temperatures and cooling in the evening and nighttime hours (Figure 4-3). In most years, mean daily temperatures typically exceeded the optimal range and even the UILT on several occasions. The exception was 2011, when on the majority of days the mean daily temperature was within the optimal range. These data cover only July temperatures, so no inference is possible for temperatures during August. Overall, these results indicate that in most years, warm water temperatures were possible a limiting factor for Yellowstone cutthroat trout, and negatively affected the suitability of this habitat for Yellowstone cutthroat trout during the summer months. As noted above, these values of thermal optima and UILT do not reflect field conditions, diel fluctuations in stream temperature, and were not developed specifically for Yellowstone cutthroat trout.

Table 4-1Number of days with water temperature data for USGS gage station 6195600.

Year	*Number of Days with Temperature Monitoring Data*
1999	0
2000	58
2001	62
2002	59
2003	62
2004	62
2005	62
2006	62
2007	0
2008	60
2009	62
2010	60
2011	27
Total	636

Comparisons of average and maximum daily temperatures at the gage station near the mouth of the Shields River indicate they were highly correlated, with a correlation coefficient of 0.93 (Figure 4-4). Although a substantial number of maximum daily temperatures fell above the fishing closure threshold of 73 ^{o}F, cooler temperatures during evening through morning resulted in average temperatures that were less than the UILT, suggesting fish get respite from peak water temperatures. Evaluation of the number of hours a fish can survive temperatures 73 ^{o}F or greater, while controlling for cooler parts of the day would be informative in setting goals for water temperature that provide for support of Yellowstone cutthroat trout as a beneficial use.

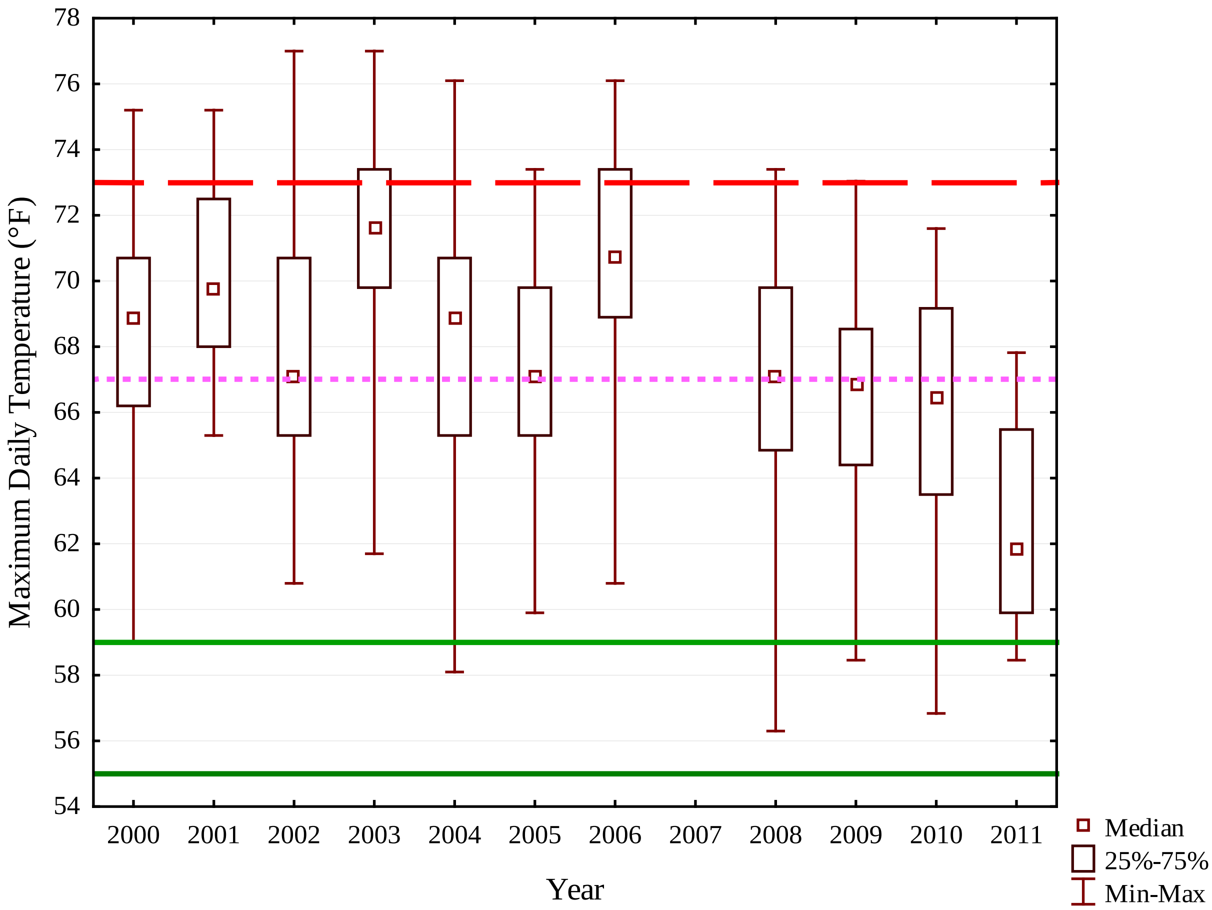

Figure 4-2: Distributional statistics for maximum daily water temperatures measured at USGS gage station 6195600 during July and August for the period of record, and comparison to thermal optimum and UILT of westslope cutthroat trout and drought closure criteria (> 3 days at 73 °F).

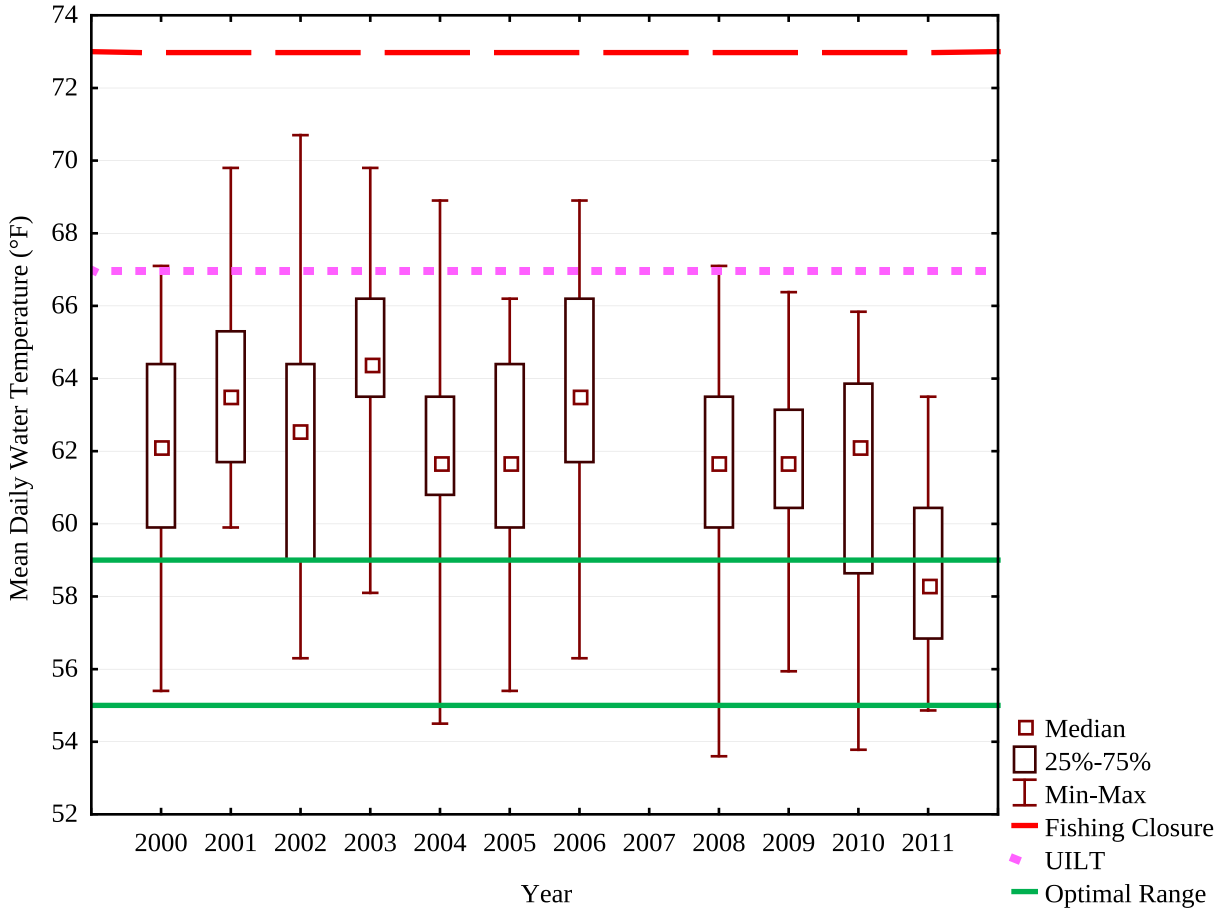

Figure 4-3: Distributional statistics for mean daily water temperatures measured at USGS gage station 6195600 during July and August, from 2000 through 2008, and comparison to thermal optimum and tolerances of westslope cutthroat trout.

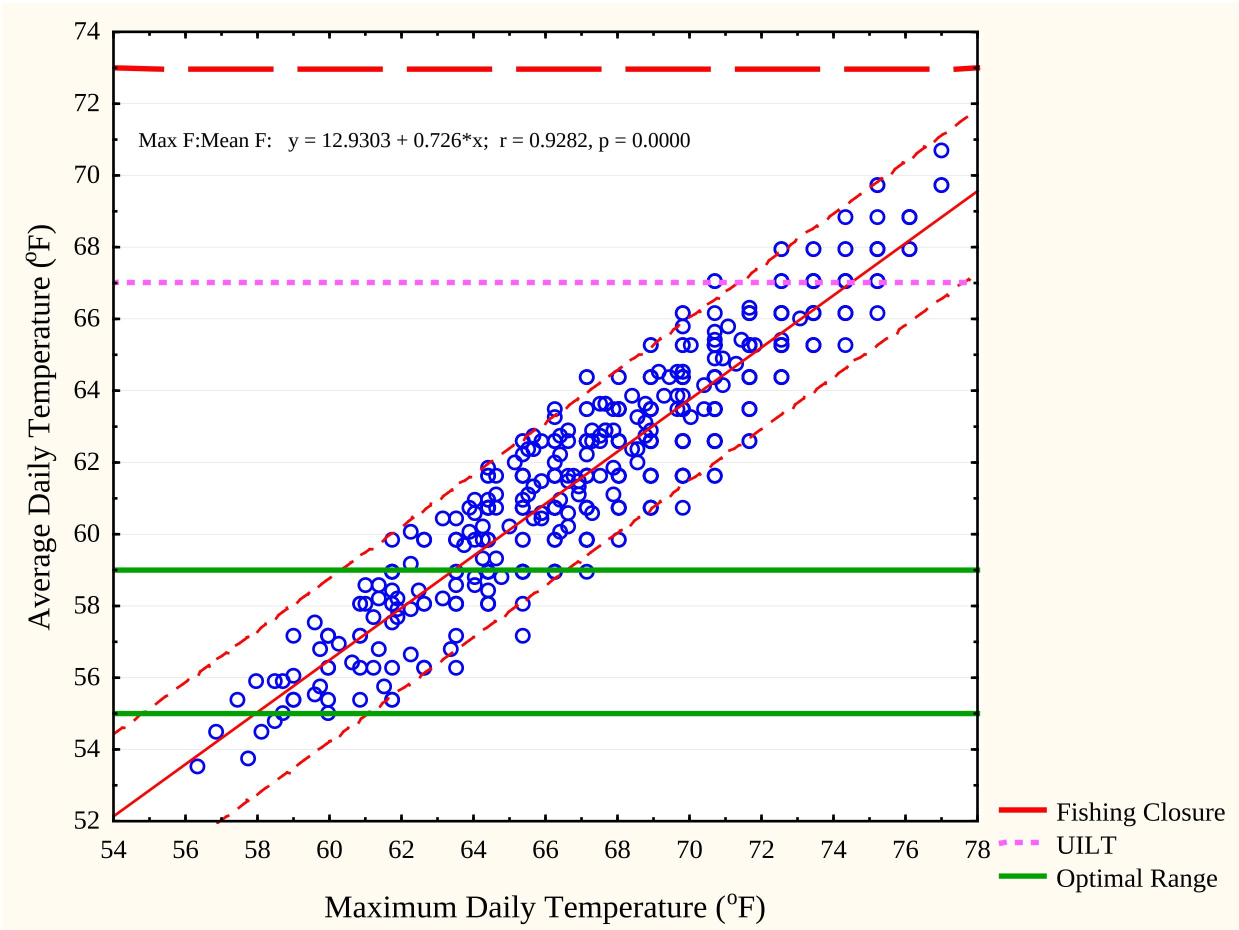

Figure 4-4: Comparison of average and maximum daily temperatures from USGS gage station 6195600.

Application of FWP fishing-closure-policy triggers to monitoring data at the USGS gage station indicates at least one fishing closure was warranted in five of eight years (Table 4-2). The number of periods with temperature exceeding the threshold was variable, from 1 to 4. In some years, maximum daily temperature exceeded 73 °F for extended periods. For example, maximum daily temperatures exceeded 73 °F for 13 consecutive days in 2003, and 10 days in 2006.

Table 4-2: Number of qualifying occasions triggering a fishing closure (maximum daily temperature ≥ 73 ° for 3+ consecutive days), and maximum number of consecutive days ≥ 73 °F for water temperatures measured at USGS gage station 6193500.

Year	*Number of Occasions Triggering Fishing Closure*	*Maximum Number of Consecutive Days exceeding 73 °F*
2000	0	2
2001	4	4
2002	1	4
2003	2	13
2004	1	4
2005	0	1
2006	2	10
2008	0	1
2009	0	1
2010	0	0
2011	0	0

FWP has been monitoring water temperatures at main stem sampling sites periodically from the late 1990s until the present. Analysis of most years' data is underway. Pending completion of this larger data analysis effort, this report addresses stream temperatures measured in 2007. As 2007 was an exceptionally warm year, these results represent a worst-case scenario in terms of stream temperatures in the Shields River. These data allow evaluation of the thermal regime across the length of the Shields River, and allow inference on what thermal regime may have been at the USGS gage station in 2007, the year lacking temperature monitoring.

In 2007, maximum daily water temperatures at all but the uppermost station were substantially higher than the UILT and the threshold for fishing closures (Figure 4-5). Water temperatures remained elevated throughout July, with August bringing some relief from daytime highs, which sometimes exceeded 80 °F. The monitoring station near Clyde Park frequently had the warmest temperatures, suggesting daily monitoring at the USGS gage may underestimate temperatures occurring upriver. Evaluation of mean daily water temperatures further shows the tendency for temperatures to be warmer at station D, near Clyde Park (Figure 4-6).

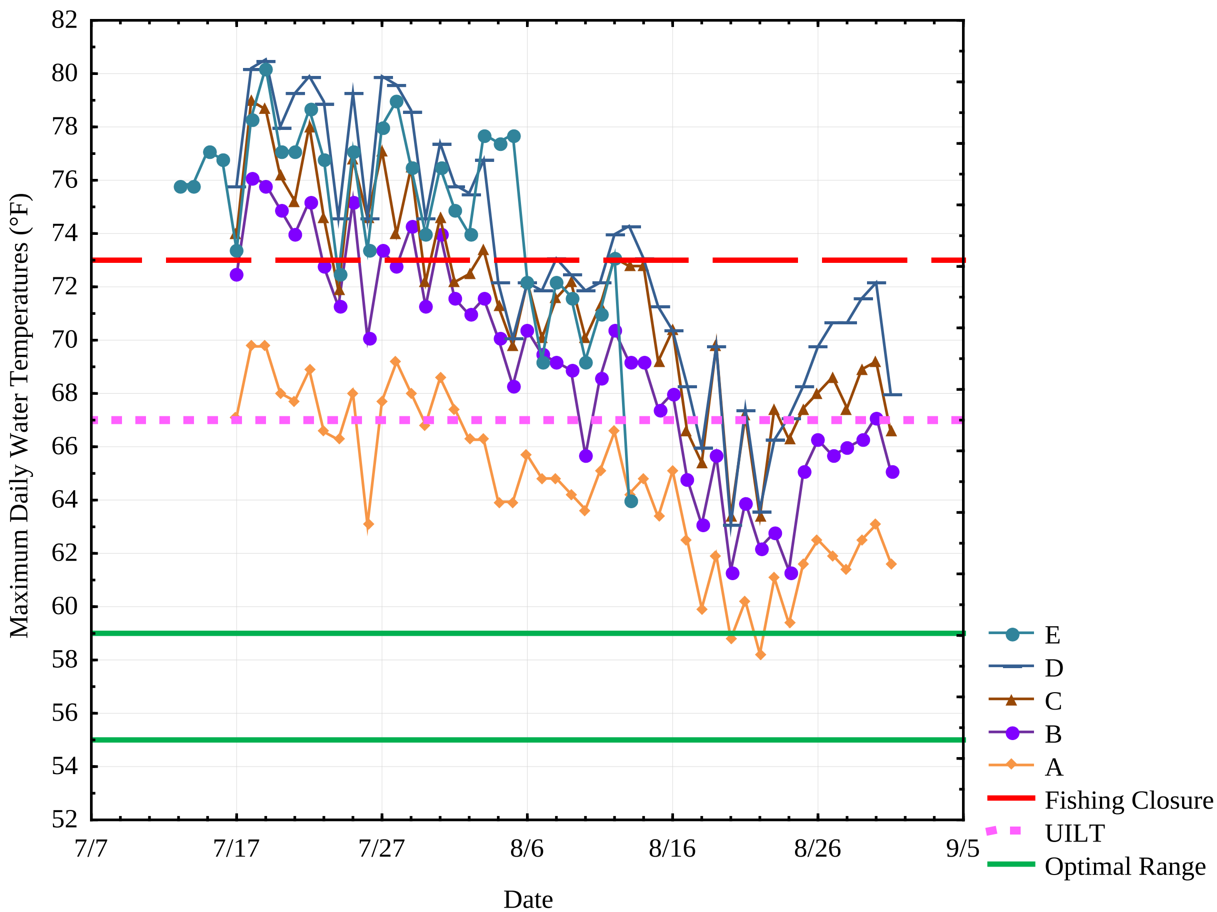

Figure 4-5: Maximum daily stream temperatures at FWP monitoring stations on the Shields River in 2007 (see Figure 4-1 for station locations).

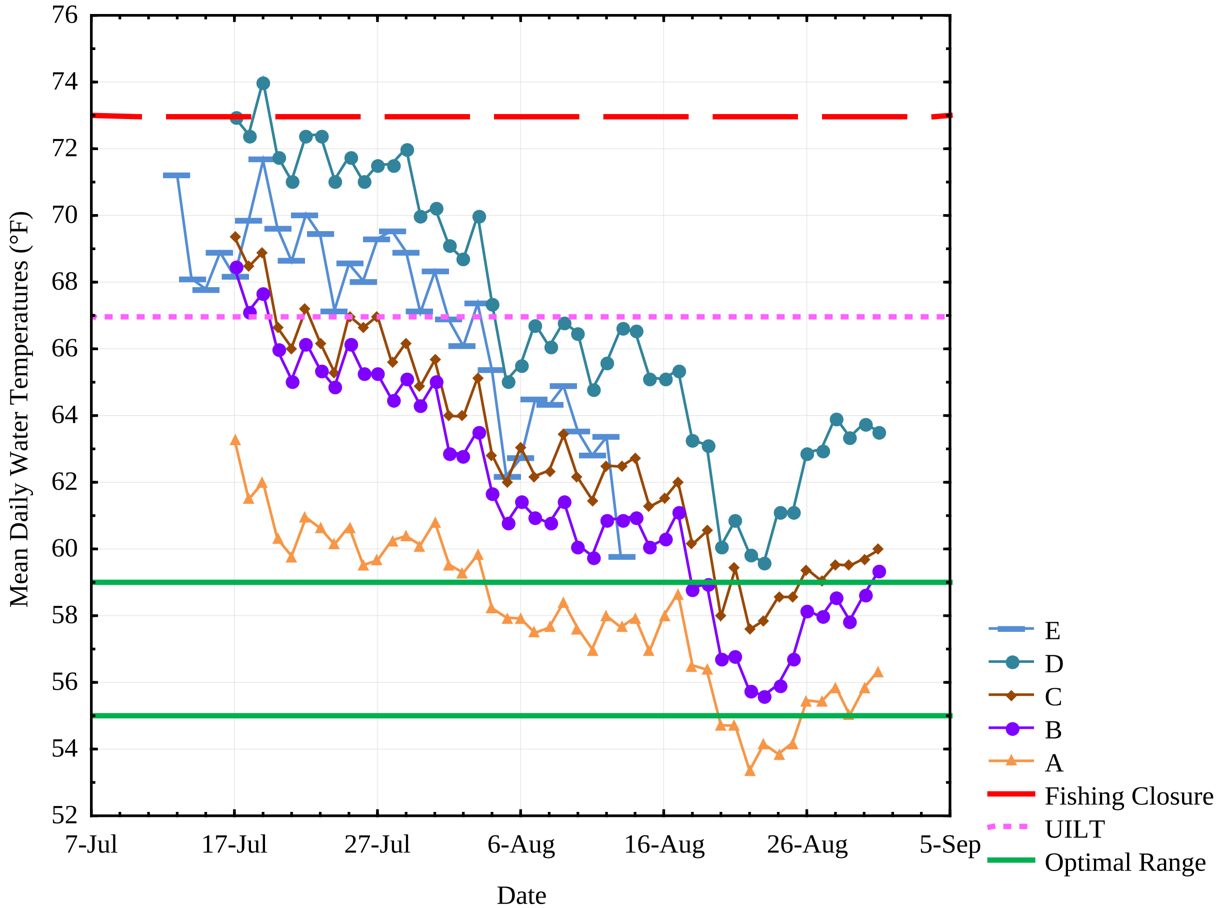

Figure 4-6: Mean daily stream temperatures at FWP monitoring stations on the Shields River in 2007 (see Figure 4-1 for monitoring station locations.)

FWP temperature monitoring on the tributaries included mostly headwater sites, although several stations occurred within the valley portions of some tributaries (Figure 4-1). Most stations within the Flathead Creek watershed were at relatively high elevation, and water temperatures tended to be cool through July and August (Figure 4-7). At the Cache Creek sites, and at Fairy Creek, maximum daily temperatures were frequently greater than the optimal range, but considerably lower than the UILT. The middle and south forks of Flathead Creek were exceptionally cool, with maximum daily temperatures less than or within the optimal range. The lowest sampling station on Flathead Creek had the highest water temperatures, which exceeded the UILT on approximately 20% of days, and ranged as high 74 °F on one occasion. Opportunities to decrease thermal loading through restoration of riparian shading, channel morphology, and water use efficiency may be available in Flathead Creek.

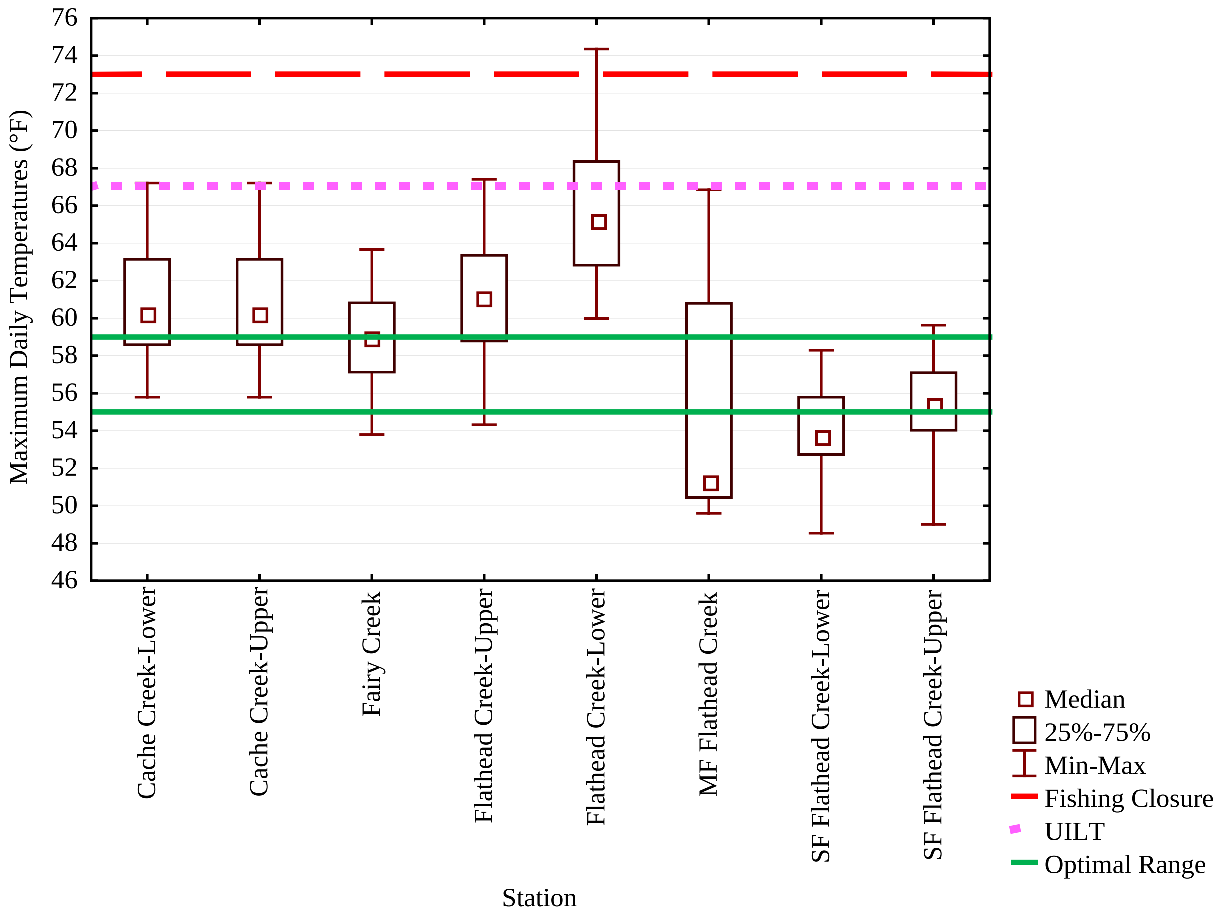

Figure 4-7: Distributional statistics for maximum daily temperatures measured on tributaries in the Flathead Creek 5th code HUC in July and August of 2002 (N = 62 per station).

FWP deployed thermographs over several years in the Upper Shields River Watershed (5th code HUC). Monitoring in 2003 found cool temperatures in Deep Creek, which were typically lower than the optimal range (Figure 4-8). The upper site on Mill Creek had maximum temperatures typically within the optimal range. The lower station on Mill Creek, and the South Fork Shields River were often higher than the optimal range, but less than the UILT, indicating thermal stress was not impairing Yellowstone cutthroat trout populations. The thermograph on lower Smith Creek registered relatively warm water temperatures for a headwater site, and most maximum daily temperatures were greater than the UILT. Investigating the sources of thermal loading may guide conservation actions to maintain cooler temperatures in Smith Creek. The apparently elevated temperatures in Smith Creek may give invading brook trout a competitive advantage.

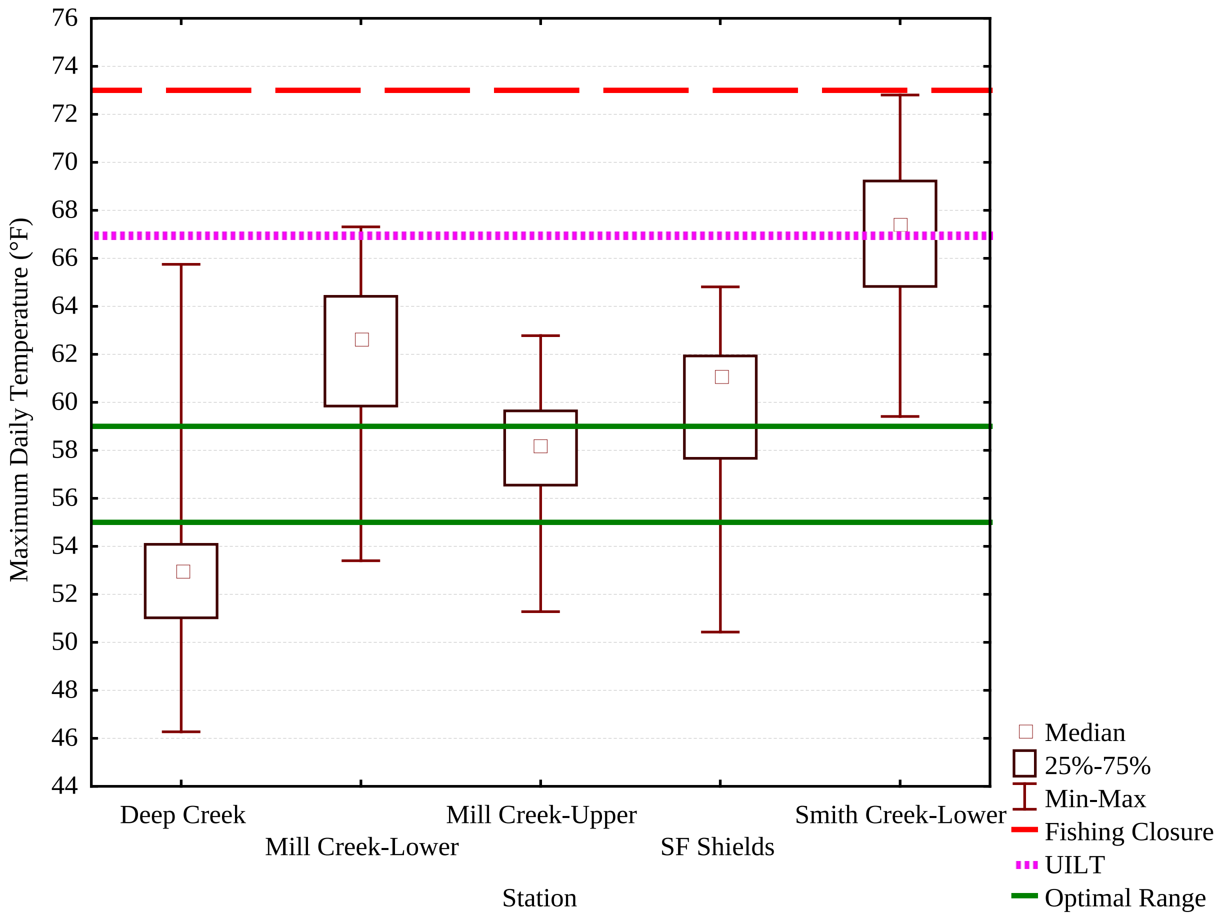

Figure 4-8: Distributional statistics for maximum daily temperatures measured on tributaries in the Upper Shields River 5th code HUC in July and August of 2003 (N = 62 per station).

Temperature monitoring in the Upper Shields River Watershed in 2005 occurred on Smith Creek and Dugout Creek. Maximum daily temperatures were cool, and were mostly within the optimal range (Figure 4-9). The upper and middle stations on Smith Creek were considerably cooler than measured at the lower station in 2003. These results suggest the reach between the middle and lower station is the major recipient of thermal loading.

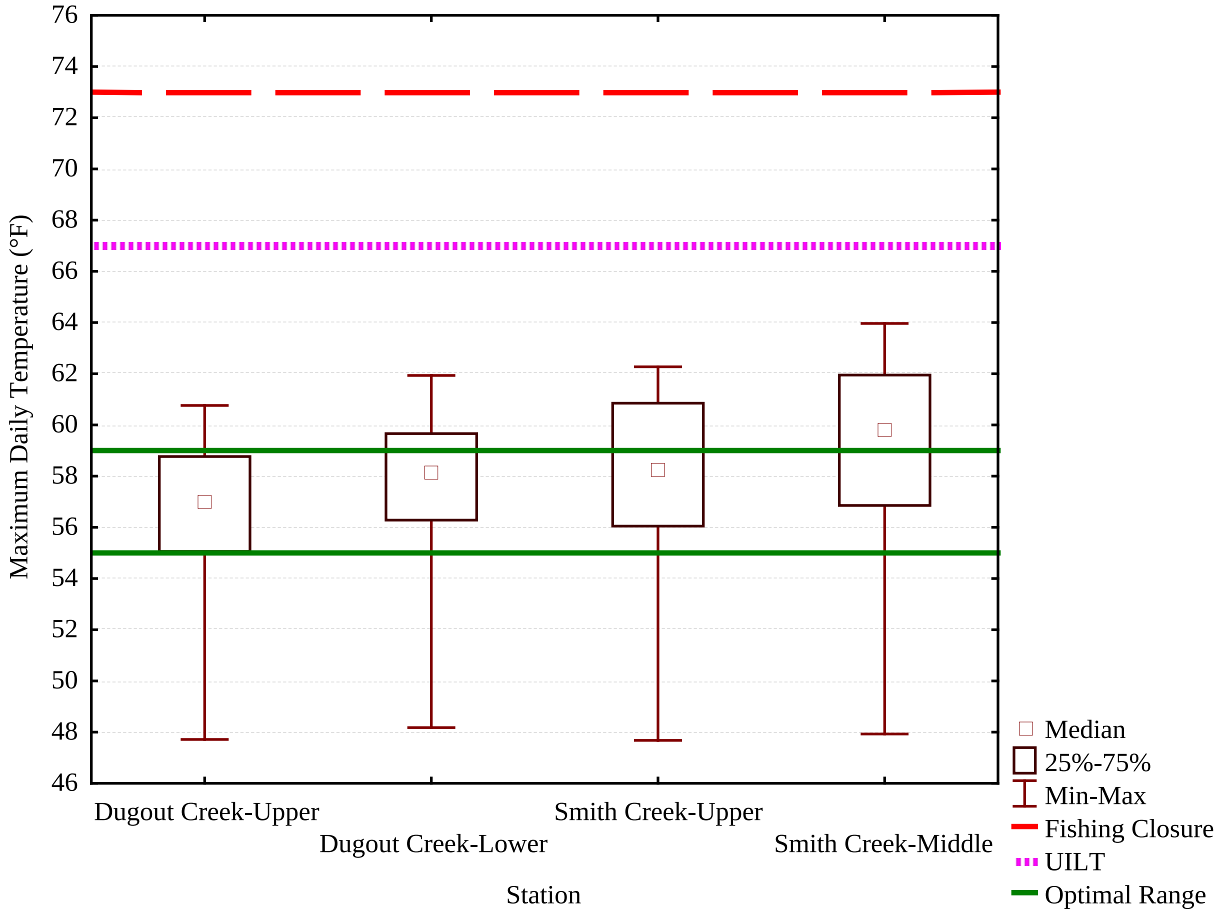

Figure 4-9: Distributional statistics for maximum daily temperatures measured on tributaries in the upper Shields River 6th code HUC in July and August of 2005 (N = 62 per station).

Temperature monitoring in the Upper Shields River Watershed suggested 2006 had a slightly warmer summer than 2005 (Figure 4-10). Maximum daily temperatures at the lower station on Dugout Creek typically exceeded the optimal range, although readings were still considerably lower than the UILT. The upper station on Smith Creek had similar values, with only rare occurrences of temperatures greater than the UILT.

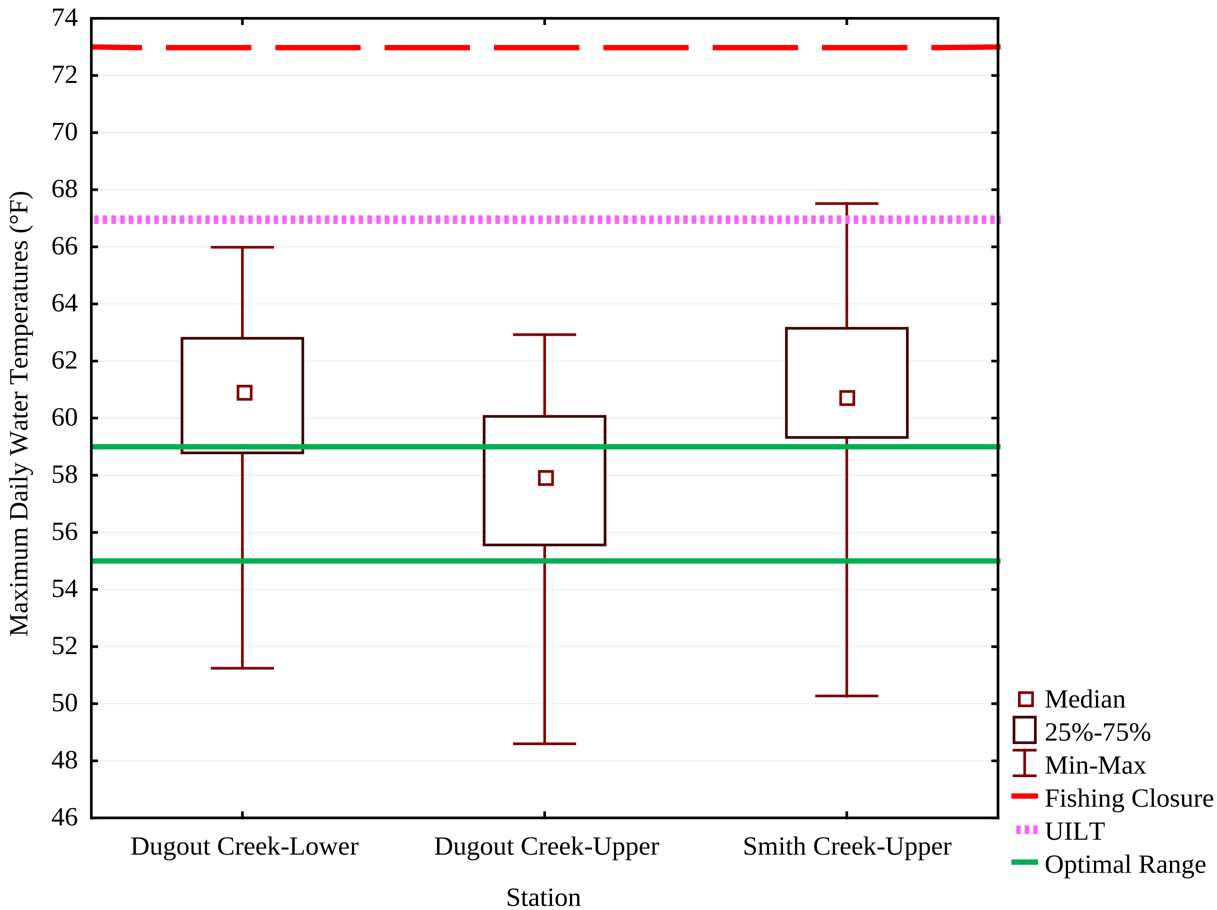

Figure 4-10: Distributional statistics for maximum daily temperatures measured on tributaries in the upper Shields River 6th code HUC in July and August of 2006 (N = 62 per station).

In 2002, FWP deployed thermographs at several locations in the Brackett Creek watershed, which lies in the Middle Shields River Watershed. Maximum daily temperatures at the lowest monitoring station on Brackett Creek exceeded the UILT on nearly 70% of days, suggesting sublethal stress to Yellowstone cutthroat trout (Figure 4-11). At the upper Brackett Creek station, and on Skunk Creek, maximum daily temperatures were typically within the optimal range. Temperatures on Horse Creek exceeded the optimal, but were always below the UILT, suggesting thermal stress was not limiting Yellowstone cutthroat trout.

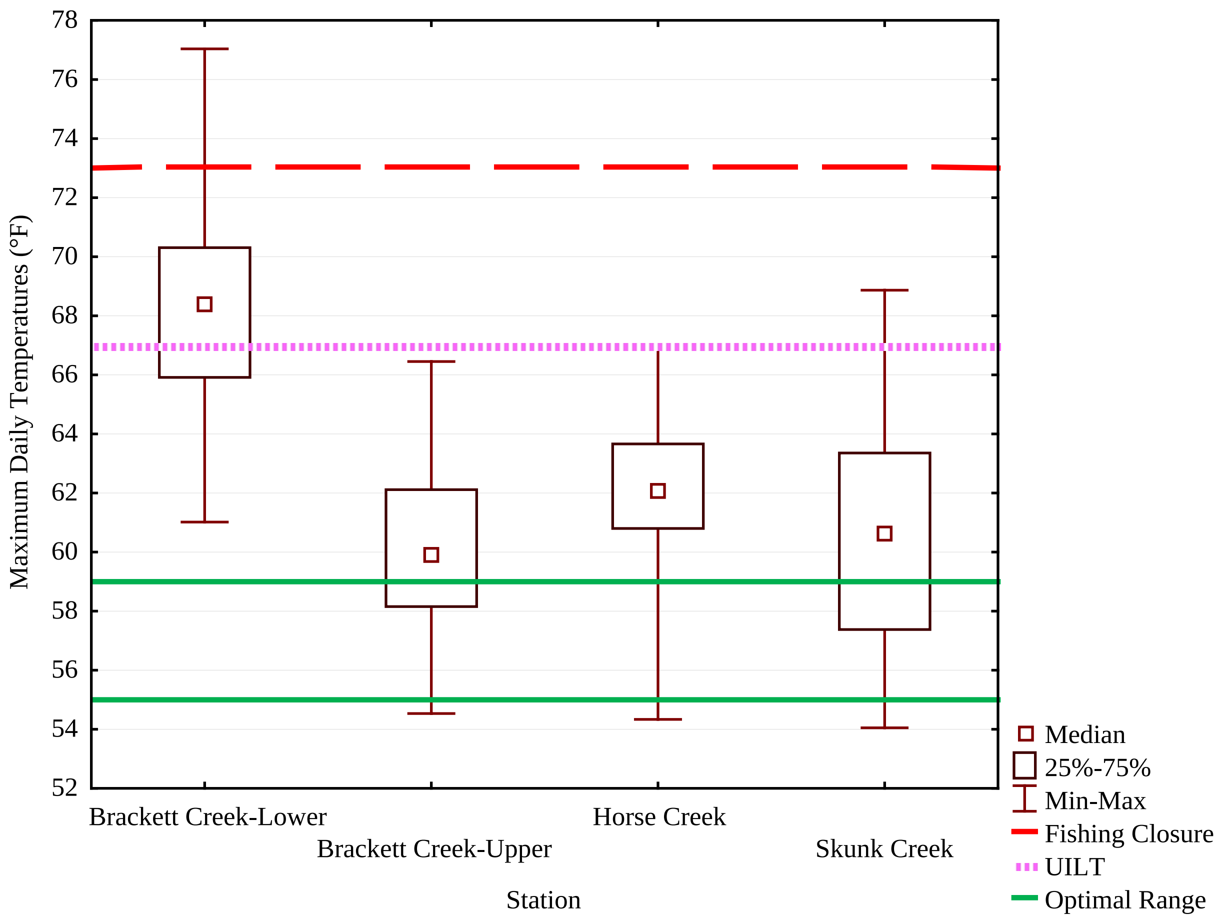

Figure 4-11: Distributional statistics for maximum daily water temperatures measured on tributaries in the Brackett Creek watershed in July and August of 2002 (N = 62 per station).

In 2003, FWP monitored temperatures in Cottonwood Creek and Rock Creek on the west side of the Middle Shields River Watershed (Figure 4-12). Thermal loading between stations on Cottonwood Creek was substantial, with an average of 4 °F gained across the four miles. Nonetheless, temperatures at the lower station were typically less than the UILT. Maximum daily temperatures at the Rock Creek station exceeded the UILT on about 35% of days, which suggests sublethal stress to Yellowstone cutthroat trout.

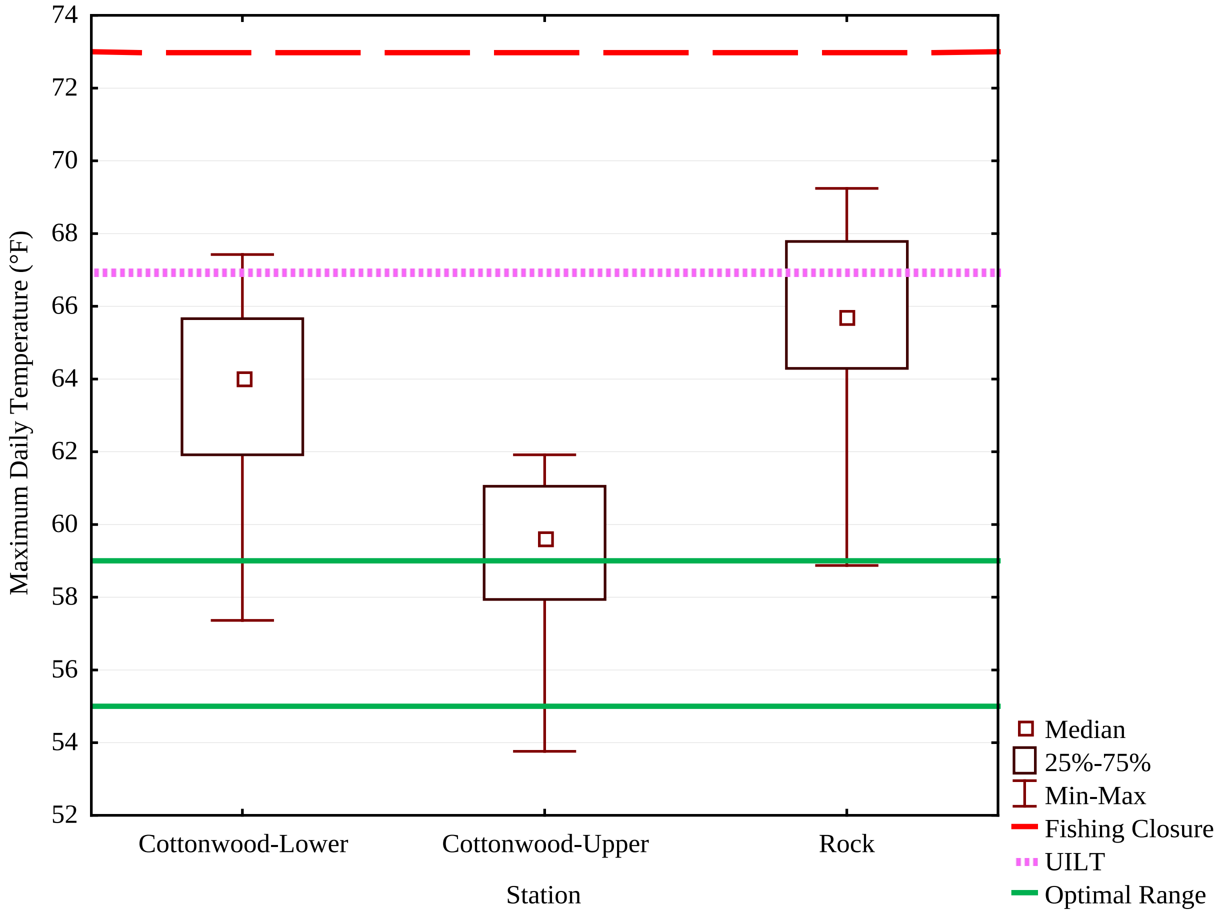

Figure 4-12: Distributional statistics for maximum daily water temperatures measured on Cottonwood and Rock creeks in July and August of.

FWP monitored temperatures at two locations in the Canyon Creek drainage in 2002 (Figure 4-13). Thermographs were installed on 7/10/2003 at the Canyon and Grouse Creek stations, resulting in 53 days of data. Maximum daily temperatures were typically above the optimal range. At the Grouse Creek station, temperatures did not meet or exceed the UILT. Maximum daily water temperatures at the Canyon Creek station exceeded the UILT on 9 of the 62 days. These results suggest minimal thermal stress in Canyon Creek and no thermal stress in Grouse Creek in 2002.

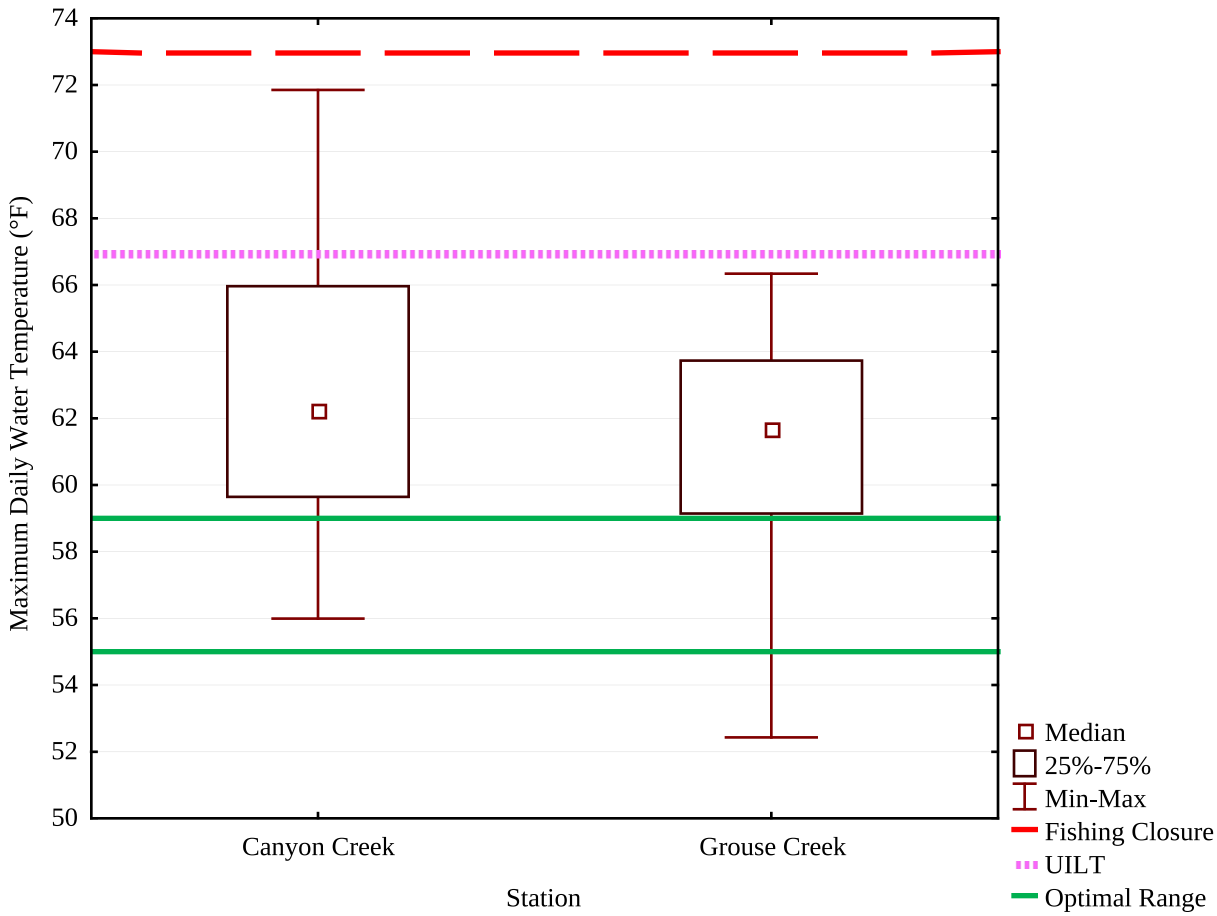

Figure 4-13: Distributional statistics of maximum daily water temperatures measured on streams in the lower Shields 5th order HUC in July and August 2002. (N = 62 per station.)

Comparison of daily maximum and average temperatures for all tributary sites from 2000 through 2012 indicate a high degree of concordance between these variables (Figure 4-14). The correlation coefficient approached 0.90 and the p value was exceptionally small. The analysis indicates that for the majority of the tributary monitoring stations, temperature rarely reaches stressful levels and a sizeable proportion of these data are within or cooler than the optimal range.

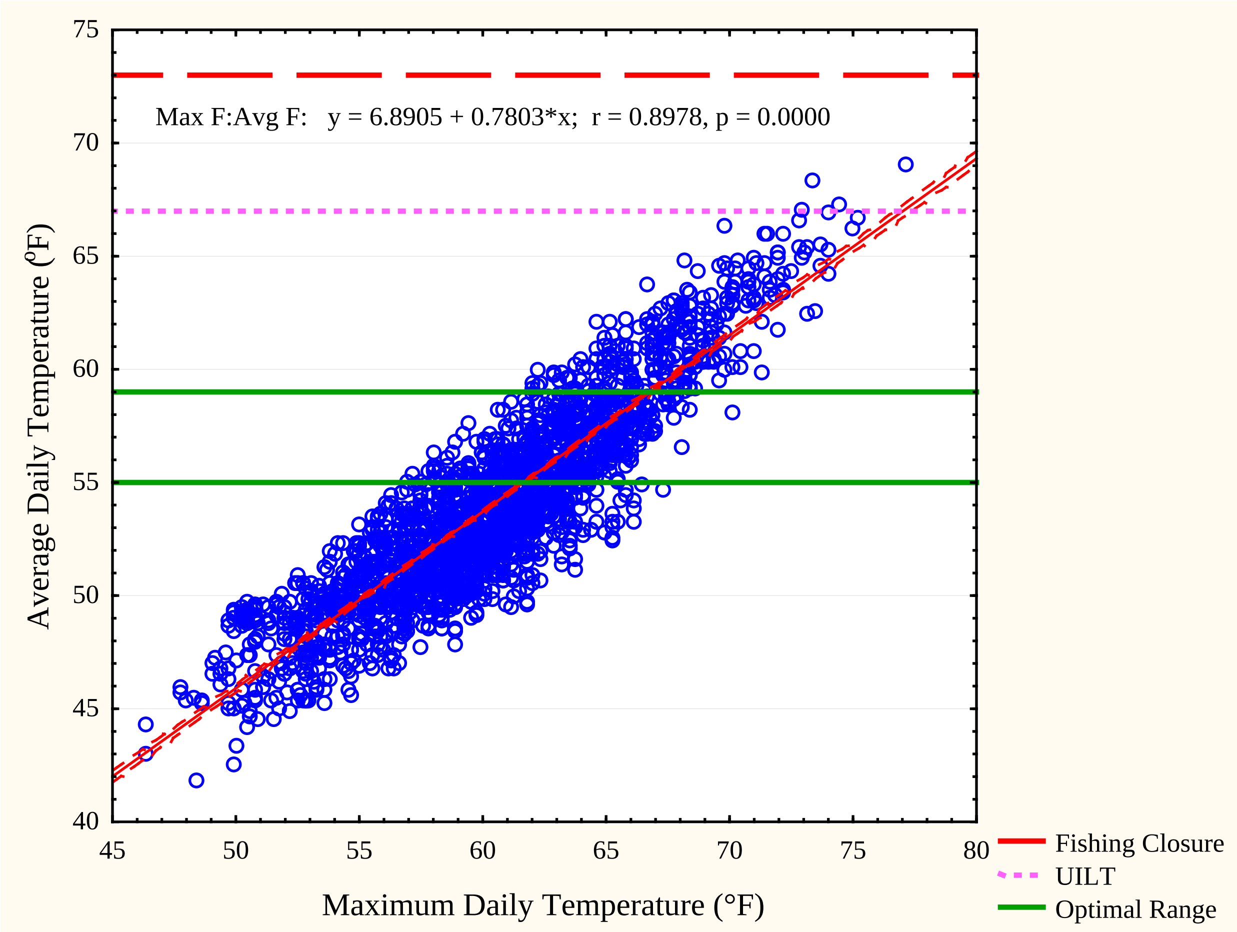

Figure 4-14: Comparison of average and maximum daily temperatures from tributary monitoring stations in the Shield River Subbasin.

Additional investigations are warranted to support conservation of Yellowstone cutthroat trout in the Shields River watershed with respect to the influence of thermal loading as a limiting factor. Researchers at the USGS, in collaboration with the Wildlife Conservation Society, have begun to evaluate stream temperatures measured at numerous locations throughout the watershed and relate these data to Yellowstone cutthroat trout growth and movements, and brook trout invasion. Another useful investigation would be development of a thermal model, such as the stream network temperature model (SNTEMP) developed by the USGS (Bartholow 2000). This model evaluates the role of three key factors (channel geometry, riparian shading, and stream flow) on water temperature, which allows development of targets to promote a suitable temperature regime to support coldwater fish. Laboratory and field studies investigating thermal tolerance of Yellowstone cutthroat trout would likewise guide conservation planning for Yellowstone cutthroat trout in the Shields River watershed, and elsewhere.

Most temperature monitoring has occurred on the main stem of the Shields River, or on its headwater tributaries. Evaluating temperature regimes within valley portions of tributaries would fill a substantial data gap, and would guide conservation activities for promoting water temperatures favorable for Yellowstone cutthroat trout.

In summary, warm water temperatures likely present a considerable constraint on Yellowstone cutthroat trout in portions of the Shields River watershed. Causal factors include irrigation withdrawals and reductions in habitat quality that increase solar inputs to the water surface. Climate change is bringing warmer summer temperatures and diminished summer stream flows, which complicates efforts to maintain cooler temperatures. The conservation approach will begin with identification of human-caused sources of thermal loading. FWP and its partners would then work towards voluntary implementation of practices that decrease the potential for streams to reach temperatures that are stressful to Yellowstone cutthroat trout.

4.2.3 Water Quantity

Low summer stream flows in the Shields River and several of its tributaries present a considerable constraint on the ability of these streams to support Yellowstone cutthroat trout. Graphical analysis of daily stream flows at the gage near the mouth of the Shields River demonstrate a potential effect of irrigation withdrawals on stream flow, with a relatively abrupt drop in average stream flow following the peak (Figure 4-15). In a stream not altered by irrigation withdrawals, the declining limb would be more gradual. Although irrigation withdrawals have potential to dewater streams to an extent that warm water temperatures and reduced habitat availability negatively affect fish, not all streams with irrigation withdrawals experience dewatering to a harmful extent. FWP maintains a list of dewatered streams, where irrigation withdrawals likely result in conditions unfavorable to support of cold-water fisheries (Table 4-3 and Figure 4-16).

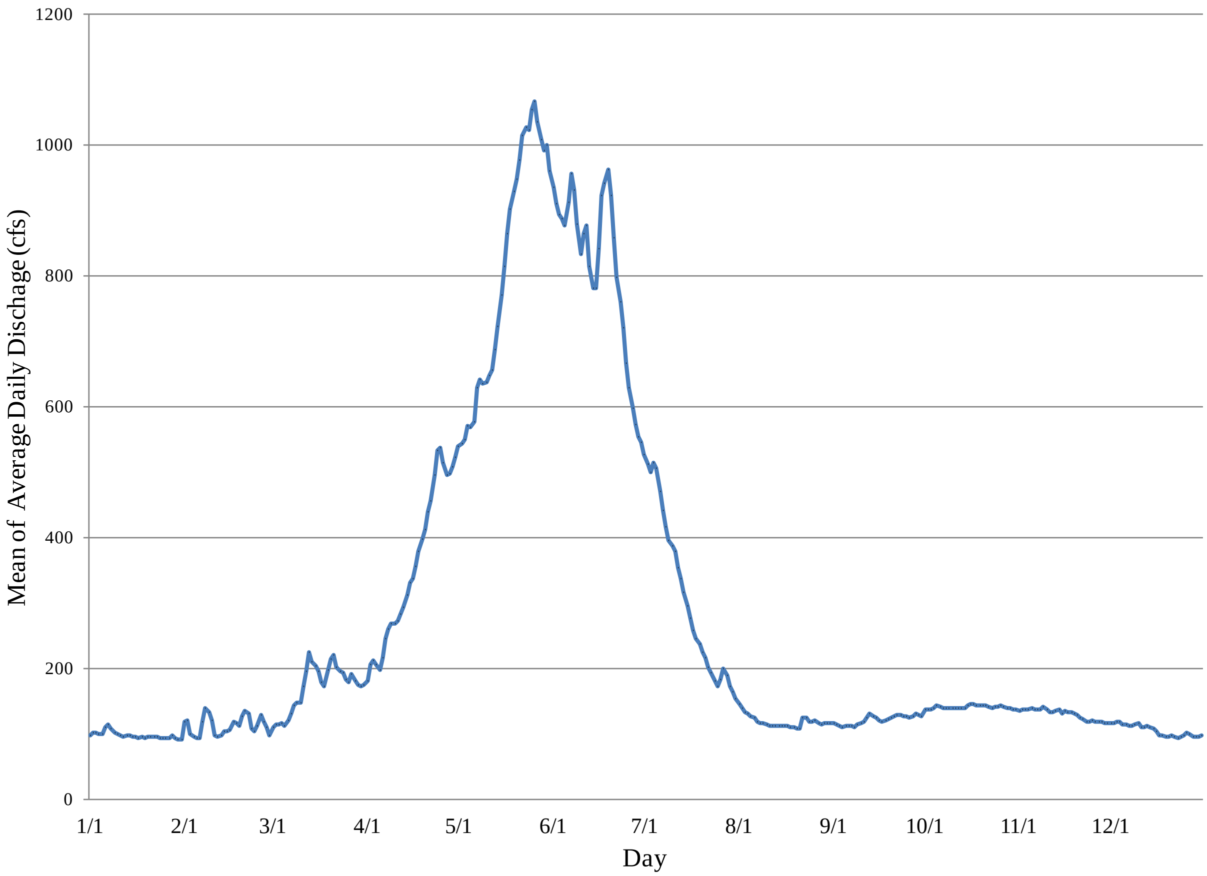

Figure 4-15: Average of mean daily stream flows from the USGS station near the mouth of the Shields River for the period of record (10/1/0978 though 4/8/2012).

Table 4-3: Streams included on FWP's list of dewatered streams.

Stream	***Rating***	***Dewatered River Miles***	***Streams with Water Reservation***
Bangtail Creek	Chronic	0 to 5	
Brackett Creek	Periodic	0 to 16.8	✓
Canyon Creek	Chronic	0.0 to 0.07	
Cottonwood Creek	Chronic	0 to 6	✓
Flathead Creek	Periodic	0 to 12	✓
Rock Creek	Chronic	0 to 2	✓
Shields River	Periodic	0 to 65.2	✓
Willow Creek	Chronic	0 to 11.8	

Chronic dewatering refers to streams where dewatering is a significant problem in virtually all years. Periodic dewatering applies to streams where dewatering is only a problem in drought or water short years.

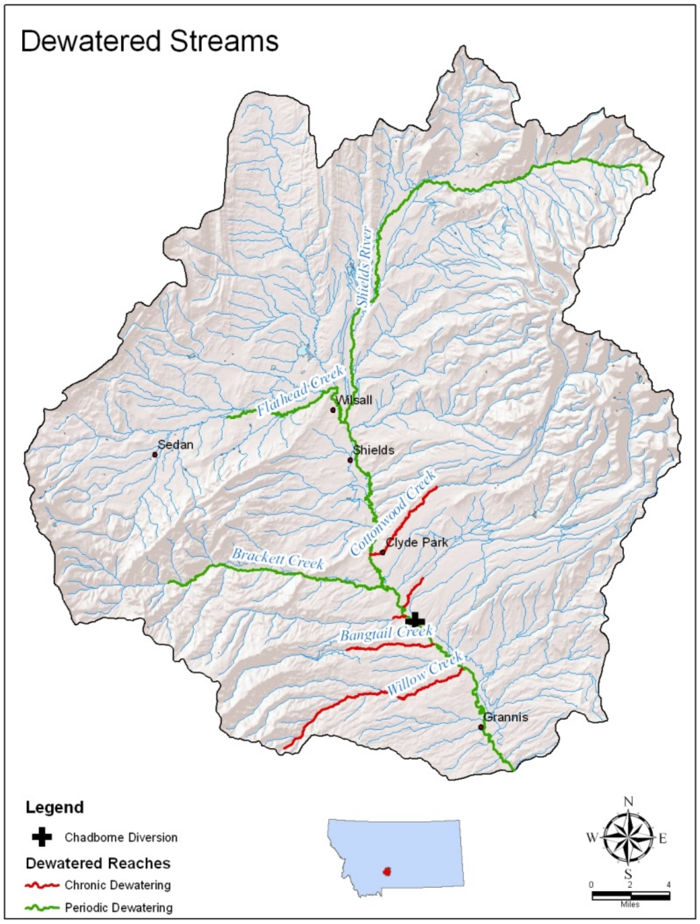

Figure 4-16: Streams designated as chronically or periodically dewatered in the Shields River watershed.

Five of the eight dewatered streams, in addition six other streams, have established water reservations under the Montana Water Use Act of 1973. This act established a mechanism for the protection of in-stream values through a systematic and comprehensive approach (Section 85-2-316, MCA). The act developed a process for future diversionary and consumptive uses by the state, the federal government, or any political subdivision or agency of state or federal government, to reserve water for existing or future beneficial uses, or to maintain a minimum flow for water quality (Section 85-2-316, MCA). In 2005, an amendment to the statute allowed individuals, associations, partnerships, or corporations to reserve water for in-stream flow (85-2-408(2) (b), MCA). Conservation organizations such as Trout Unlimited have been leasing water rights under this statute.

Promoting in-stream flow faces numerous challenges. Although FWP has in-stream flow reservations for over 170 stream segment and time frame combinations among the five streams with reservations[5], these reservations have a priority date of December 15, 1978, whereas many water rights in the watershed date to the late 1800s, giving these rights considerable seniority over FWP's reservations. Furthermore, water users rely on surface water for their livelihood; therefore, solutions to flow management must be compatible with the economic and social realities in an agricultural watershed. Other potential complications include unintended consequences in implementation of practices meant to keep flows in streams, but instead alter recharge processes that maintain late season flows in some streams (DNRC 2005). An example would be converting from flood irrigation to pivot, when recharge from flood irrigation was a source of late season stream flow. The combination of economic, hydrologic, and ecological issues relating to dewatering in the Shields River watershed results in a complex issue with no easy solutions.

Another concern is that even with the most efficient irrigation scenarios, irrigation demands on the Shields River will exceed the available water supply during late summer (L. S. Dolan, DNRC, personal communication). Moreover, dewatering has occurred in spring when the onset of irrigation occurred before substantial higher elevation snow melt. These issues may present considerable obstacles to maintaining in-stream flows during critical periods.

Despite the challenges, many opportunities exist to promote in-stream flows. The strategy is to work collaboratively with water users, while conducting the requisite investigations to promote an effective approach that meets user's needs, and potentially compensating water rights holders who contribute water to in-stream flows. Fundamental to this approach will be an understanding of existing conditions, available conservation opportunities, and limitations. The objective of this section is to summarize the available information and describe the components that will shape the approaches for promoting in-stream flows in the Shields River watershed.

Agriculture is the primary land use within the Shields River Subbasin. Open range comprises a large portion of the watershed, but significant irrigated lands and water diversions place a strong demand on the river and its tributaries during the summer season. In 2000, an irrigation study of in the upper basin (Compston 2002) identified approximately 5,000 acres of lands as irrigated with waters originating in the upper Shields watershed (excluding lands irrigated by Meadow Creek and the South Fork Shields River). During 2000, 90% of these lands were irrigated for grass or alfalfa hay, with the remaining 10% in grains (USWA 2001). The majority of the irrigation (80%) was flood systems, with smaller percentages using side-roll (12%) and center-pivot (8%) sprinklers.

[5] See the MFISH database for in-stream flow reservations for streams in the Shields River Subbasin (HUC 10070003) (http://fwp.mt.gov/fishing/mFish/)

Compston (2002) found that 2000 was a lower than average water year, and that water supply did not meet irrigators' needs after early July. By late August, the water supply was estimated to meet one-fifth of the total water need by irrigators. Many ditches were shut down in early July. Despite the low water year, the findings suggest that even in a median flow year, water supplies within the upper Shields are not sufficient to meet the irrigation demand past mid-July. Moreover, even under the most efficient irrigation scenarios, irrigation demands on the Shields River would still exceed the available water supply during the late summer (L.S. Dolan, DNRC, personal communication). Likewise, streams may be dewatered in spring if the irrigation season begins before the onset of snowmelt (L. S. Dolan, DNRC personal communication).

In the mid-1970s, FWP investigated flow regimes in order to determine flows required to support fish. The method used in establishing the minimum flow was the percent exceedance approach, which FWP has since replaced with the wetted perimeter method (Leathe and Nelson 1989). The percent exceedance approach calculated the flow exceeded 90% of the time for the period of record for a given stream. The percent exceedance approach yields values that are dependent on the temporal coverage of the existing data, have an unknown relationship to biological requirements, and reflect flows occurring in an altered hydrograph. In contrast, the wetted perimeter method prescribes minimum flows based on flows sufficient to inundate riffles. The rationale is that inundated riffles maintain in-stream productivity of invertebrates, and sufficient water is available to fill pools.

A limitation of the wetted perimeter approach is that it does not address flows to maintain a suitable thermal regime in streams experiencing dewatering. As discussed in 4.2.2 Water Temperature, development of a thermal model that accounts for channel geometry, streamside shading and stream flow provides an alternative to determine minimum flows to address temperature loading. Application of both approaches would be ideal to guide decision-making in the Shields River watershed. See section 6.6 Water Temperature for the conceptual approach to modeling the relationships among stream flow, channel geometry, shading, and water temperature.

Maintenance of minimum flows is not the only flow related concern for the Shields River and its tributaries. Promotion of peak flows of sufficient magnitude and duration to rework the streambed, transport bed load, and form pool habitat is another consideration. The available flow data do not allow evaluation of this potential in the Shields River. Collecting flow data across the hydrograph at key locations in the watershed would allow evaluation of the sufficiency of existing flows to perform channel maintenance functions.

Established gauge stations provide the majority of the information on stream flows in the Shields River watershed and will support future planning efforts. The USGS has operated seven gauge stations in the basin, with most being operational for a short period in the 1920s or 1930s (Table 4-4). The exception is the gauging station located near the mouth of the Shields River, near Livingston, which began operation from 1978 and is still active.

Table 4-4: USGS gauge stations and period of record for streams in the Shields River Subbasin.

Station Number	***Station Name***	***Begin***	***End***
6193000	Shields River near Wilsall, MT	5/1/1935	1/24/1938
6193500	Shields River at Clyde Park, MT	3/31/1921	12/25/1923
6194000	Brackett Creek near Clyde Park, MT	4/1/1921	12/26/1923
6194500	Canyon Creek near Chadbourne, MT	3/23/1923	4/14/1923
6195000	Bangtail Creek near Chadbourne, MT	3/23/1923	6/30/1923
6195500	Willow Creek near Chadbourne, MT	3/24/1923	4/28/1923
6195600	Shields River near Livingston, MT	10/1/1978	current

Low-cost, temporary flow monitoring devices, such as Trutracks™, provide a cost-effective means to augment the understanding of stream flow across the basin. The conservation strategy for the Shields River watershed will include development of a hydrological monitoring plan that will inform the adaptive management of stream flows, identify opportunities for water savings, and allow characterization of groundwater/surface water interactions.

Low mid-summer stream flows are a key factor limiting Yellowstone cutthroat trout populations, as well as influencing agricultural productivity in the basin. Conservation of water supplies through improved irrigation and conveyance efficiency may be a key component of conservation of Yellowstone cutthroat trout in the Shields River watershed. Working closely with the water users and the local watershed group, along with agency partners, will be an important step in implementing water conservation practices. Water leases through FWP or nonprofit groups may provide another avenue to promote in-stream flows.,

Although water use efficiency will undoubtedly be among the tools in promoting in-stream flows in the Shields River watershed, a study suggests reliance on irrigation efficiency is overly simplistic given the basin’s complex hydrology (DNRC 2005). Seemingly inefficient practices actually promote late-season flows in some streams. For example, flood irrigation or leaking ditches may actually be beneficial to some streams in late summer. Therefore, water use planning in the basin needs to proceed cautiously and consider water rights, forage production requirements, and mechanisms of stream recharge. Efforts to conserve in-stream flows should include a monitoring component to support the adaptive management of water conservation in the basin.

Innovative practices, such as using flood irrigation during spring runoff may serve the dual purpose of promoting groundwater recharge for late season stream flows, and removing transported sediment from surface waters (B.B. Shepard, Wildlife Conservation Society, personal communication). Land application of sediment-rich waters would benefit soil productivity, just as the settling of sediments on floodplains during overbank flows increases soil fertility. Identification of existing but abandoned infrastructure for flood irrigation would be a component of this potential approach. To date, this method is untested; however, pilot studies would be useful in evaluating the utility of this method in promoting stream flow improvement and sediment load reductions.

Irrigation in the Shields River watershed is almost exclusively a surface-water issue; however, increasing residential land use taps the groundwater within the watershed as well. The over 1200 wells in the Shields River watershed have the potential to produce a total estimated yield of approximately 32,000 gallons per minute (GWIC database download 9/5/2012). These wells vary in depth from less than 75 feet to greater than 800 feet, with nearly 39% being relatively shallow at less than 75 feet (Table 4-5). The wells less than 75 feet have potential to yield over 15,500 gallons per minute.

Table 4-5: Number of wells in the Shields River watershed in each depth category (MBMG 2005).

Depth Category (feet)	*Count*	*Percent of Total*
0 - 74	488	39%
75 - 149	355	29%
150 - 224	202	16%
225 - 300	93	8%
> 300	100	8%
Total	1238	100%

Pressure on groundwater resources has varied across time, with 59% of the wells drilled since 1990 (Table 4-6). Although groundwater may not seem as important to Yellowstone cutthroat trout conservation as surface water, interactions between groundwater and surface water affect surface water supplies, and is a factor to consider in long-term planning. Reducing surface water withdrawals may have an immediate and direct effect on the amount of water available to Yellowstone cutthroat trout within a stream. Increasing demands on groundwater may play a part in reduced surface water supplies within the watershed, particularly in areas where wells appear to be concentrated, such as near the towns of Clyde Park, Grannis, and Wilsall, and near Skunk Creek along Brackett Creek (Figure 4-17). Moreover, nearly 40% of wells are relatively shallow (Table 4-7) and may affect recharge of surface water. The general concentration of wells along the main stem of the Shields River may also be intercepting waters that would recharge the river in low water periods (Figure 4-17). The relatively shallow depth of the majority of wells supports this hypothesis.

Table 4-6: Number of wells drilled in the Shields River watershed by time interval (GWIC database download 9/5/2012)

Period	*Number of Wells*	*Percent of Total*
Before 1910	40	3%
1910 - 1950	72	6%
1951- 1960	25	2%
1961 - 1970	56	5%
1971 - 1980	163	13%
1981 - 1990	151	12%
1991 - 2000	331	27%
2001 - 2010	400	32%
Total	973	100

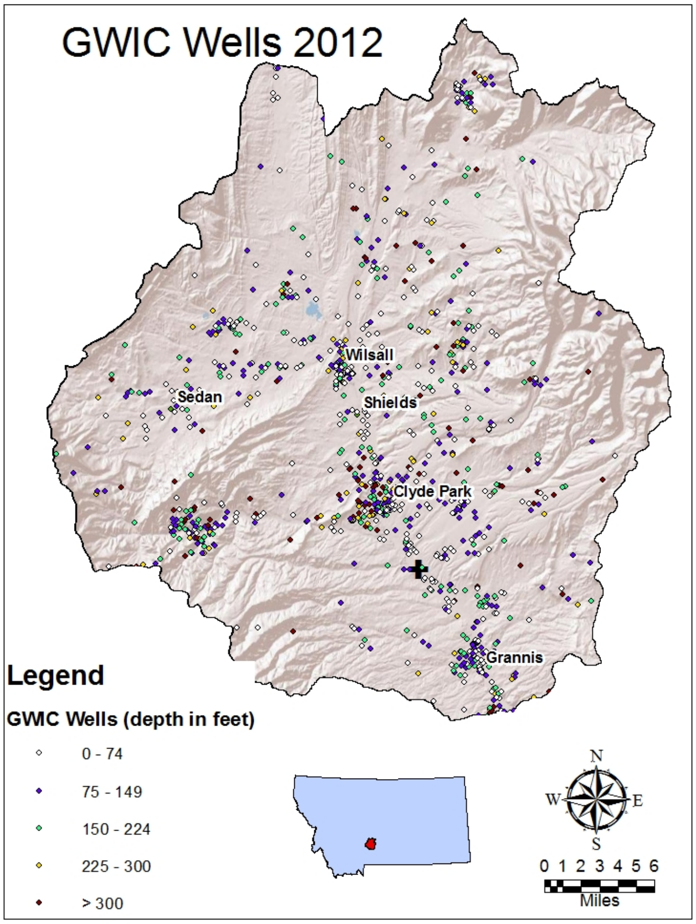

Figure 4-17: Groundwater wells and developed springs recorded by Montana Bureau of Mines and Geology in their Groundwater Information Center (GWIC) database for the Shields River Subbasin (GWIC download 9/5/2012)

Table 4-7: Depth of wells drilled in the Shields River watershed (GWIC database download 9/5/2012)

Well Depth (feet)	*Number of Wells*	*Percent of Total*
0 – 74	488	39%
75 – 149	355	29%
150 – 224	202	16%
225 – 300	93	8%
> 300	100	8%
Total	1238	100%

In summary, managing stream flows to benefit Yellowstone cutthroat trout in the Shields River and its tributaries will be a challenging endeavor given the competing interests in water availability, complex basin hydrology, and economic realities in an agricultural watershed. Climate change may be an additional factor, with its tendency to alter precipitation patterns and reduce stream flows. Nevertheless, opportunities exist to increase summer stream flows. The conservation strategy will emphasize cooperation and collaboration with water users, potential compensation for contributed flows, assistance in promoting irrigation efficiency, and a sound monitoring plan to promote the adaptive management of stream flow in the Shields River watershed. Collaborators in the process will include FWP, the SVWG, NRCS, and water users. Private conservation groups such as Trout Unlimited will also be collaborators.

4.3 Habitat Quality

4.3.1 Evaluated Habitat Conditions

The Forest Service and FWP have conducted habitat and electrofishing surveys of many of the tributaries in the Shields River watershed. Although not every tributary has been surveyed, adequate information exists to characterize broad habitat conditions within each of the 5th code HUCs displayed in Figure 1-1**.** Recent major survey efforts used to complete this section of the report include a survey of the Shields River tributaries (Shepard 2004), which focused on the western side of the drainage, and the Forest Service surveys of major tributaries on Forest Service administered lands (Jones and Shuler 2004, Forest Service file data 2006, 2007, 2008). In addition, Tohtz (1999b) and subsequent field biologists gathered information on east side tributaries both on and off Forest Service administered lands. Forest Service administered lands encompass much of the headwaters areas in the eastern side of the drainage.

In general, Shepard (2004) found the habitat on the western side of the watershed to be in functioning condition in most tributary streams; however, the lower portions of many tributaries had extremely low flows because of irrigation withdrawals and drought occurring during sampling. Disturbance from livestock grazing along stream channels was widespread, but was severe only at a few locations. Some areas appeared to be recovering following improvements in livestock management. Road and timber harvest effects to stream channels were apparent at several locations. High levels of fine sediment were evident in many of the western-side streams; however, the sources of this fine sediment were often difficult to identify. Shepard (2004) also recorded high water temperatures at some sites, and noted that high temperature may be limiting trout in some locations. The Forest Service surveys found similar conditions on the eastern-side tributaries. Many areas had siltation or bank instability listed as potentially limiting factors for fish habitat.

In 1998, representatives from the Forest Service and FWP flew over several tributaries within the Shields River basin to evaluate fish habitat and stream condition (Shuler 1999, Tohtz 1999b). The fisheries biologists flew over the main stem of the Shields River, Smith, Porcupine, North and South Fork Elk, Dry, Elk, Daisy Dean, South Fork Horse, Horse, and Cottonwood creeks and documented impaired reaches while making general recommendations on restoration opportunities. Results of this assessment guided specific conservation strategies described in Section 5.0 Data Review and Conservation Strategies and Opportunities by Stream/Watershed.

The TMDL planning effort also provides information on habitat quality through its investigations of bank erosion throughout the basin (DEQ 2009). This effort involved on-the-ground evaluations of bank erosion in selected reaches, combined with analyses of aerial photos to identify stream reaches with potential to be experiencing bank erosion associated with land use practices. Field data were incorporated into an erosion model (Rosgen 2001), which estimated load of sediment from bank erosion for each 6^{th} code HUC, and a potential sediment load reduction with restoration of bank stability and riparian function. Information from the TMDL planning is the foundation of the recently completed watershed restoration plan that identifies potential treatments and priorities in reducing sediment delivery to streams from bank erosion, roads, and hillslope erosion.

An important consideration with using the available information on habitat quality is its age, with some evaluations being decades old. These investigations would not necessarily reflect current land use practices and ongoing efforts by landowners to implement BMPs. Moreover, basin-wide flooding in 2011 resulted in marked channel adjustments in numerous streams. Nonetheless, the existing information provides a useful, initial screen in identifying opportunities for habitat restoration.

4.3.2 Habitat Management

High quality fish habitat requires sufficient water quantity and quality flowing through functional, dynamic stream channels that transport sediments efficiently, lined by healthy riparian areas that provide cover and nutrients and stabilize stream banks. The Forest Service is responsible for habitat management on its administered lands. A variety of state and federal agencies have jurisdiction over streams and wetlands on private and public lands. The Natural Streambed and Land Preservation Act (310 law), the Stream Protection Act (SPA) (124 permit), Short-Term Water Quality Standard for Turbidity Related to Construction Activity (318 Authorization), and the private pond laws are examples of state laws that require permitting and inspection of a proposed projects that may affect stream habitat. Federal laws also play a role in habitat protection, such as the Clean Water Act's Section 404, which regulates the placement of fill in state waters, or the National Forest Management Act. Agency cooperators will continue to work with landowners through the permitting processes to ensure that high quality habitats can be maintained.

4.3.3 Habitat Restoration

Although many of the streams in the Shields River watershed are in excellent condition, a variety of land and water management practices has altered the health and stability of some streams. Many opportunities exist to restore high quality habitats in the Shields River watershed and benefit Yellowstone cutthroat trout. Actions such as changes in grazing management, fencing, off-channel livestock watering stations, maintenance of riparian buffers along stream corridors, and other innovative projects that enhance or improve stream function, water quality and quantity, are necessary to conserve and restore Yellowstone cutthroat trout in the Shields River watershed. Positive, cooperative working relationships with landowners, the SVWG, and cooperating agencies are critical for implementing habitat restoration projects. Beginning in 2003, FWP established a position for a fish biologist to provide technical and financial to private landowners seeking to implement conservation projects on their properties. FWP also administers the Future Fisheries Improvement Program, which provides grants to landowners to restore habitats on their lands. Many other state, federal, and nongovernmental organizations have grant programs targeted towards restoring stream habitats. Successful projects have been underway in the Shields River Subbasin for several years. Chapter 0 summarizes habitat restoration projects undertaken by Forest Service, FWP, and private landowners.

Technical assistance from NRCS and the Montana State University Extension Service will play a role in development of grazing management strategies that meet forage production goals and protect riparian health and function. Grazing specialists from these entities bring expertise that considers upland and riparian health, and the understanding that promoting healthy, nutritious forage in the uplands will benefit riparian areas, as livestock will exert less pressure on streams.

The TMDL plan (DEQ 20009) and its ancillary watershed restoration plan (Confluence 2012) will also guide identification of potential projects and solutions to restore habitat quality and reduce sediment loading. The watershed plan includes conceptual approaches to decreasing sediment loading and identifies over 50 projects with known or potential landowner interest. Federal 319 funds may be available for projects identified in the watershed restoration plan.

4.3.4 Connectivity

Managing Yellowstone cutthroat trout in the Shields River watershed as a metapopulation requires connectivity within the basin to ensure gene flow and allow recolonization where localized disturbance has extirpated existing populations. Features that limit connectivity within agricultural and forested watersheds like the Shields include impassable culverts at road crossings and irrigation structures. Eliminating these fish passage barriers will be an important component of Yellowstone cutthroat trout conservation in the Shields River watershed.

The strategy to address connectivity in the Shields River watershed will be a multi-step process. Conducting an inventory of diversions and road crossings is the first stage, followed by evaluation to determine the potential to block fish passage. To date, the GNF has already inventoried its road crossings and assessed each for ability to pass fish. Identification of fish barriers in the rest of the basin has not followed a formal process. Development of a database of road crossings, irrigation diversions, and dams will guide field investigations to evaluate passage. Potential fish barriers will be prioritized based on cost and potential benefit to Yellowstone cutthroat trout. In some cases, certain barriers may be beneficial by preventing upstream movement of nonnatives, and maintaining these barriers would be a conservation priority.

Collaborators in this process include a variety of entities. Parties responsible for road management include the state, county, Forest Service, and private landowners. Modifications to irrigation diversions will require the collaboration of ditch companies and individual irrigators. FWP will work with these groups to promote fish passage where passage is desirable.

4.3.5 Entrainment in Irrigation Ditches

Irrigation diversions pose a threat to Yellowstone cutthroat trout populations, as fish can become entrained and lost to the system. For example, an investigation of habitat use and movements of Yellowstone River fish found 3 of 44 radio-tagged Yellowstone cutthroat trout died following entrainment into irrigation ditches (DeRito 2004). Fish loss has the potential to be significant, especially in drought years when ditches carry more flow than stream channels. Reduction or elimination of entrainment is possible through several approaches, including managing ditch shut off to allow fish an opportunity to return to the stream, and construction of fish screens.

Rapid shutdown of ditch operations leads to fish becoming stranded in irrigation ditches. Staggering the shut down over three days prompts fish to move up the ditch until they reach the river or find refugia such as pools. Maintaining ditches so they retain a uniform and smooth channel will further encourage fish to return to the stream by limiting holding areas.

Installation of fish screens on irrigation diversions is another approach to preventing loss of Yellowstone cutthroat trout to irrigation ditches. Several types of fish screens are available such as turbulent fountains, Coanda screens, and rotating drum screens. Numerous funding sources are available to pay for these improvements.

Although fish screens are important potential tools in reducing entrainment of adult and juvenile Yellowstone cutthroat trout, these are expensive to install and maintain, and should be justified following investigation of fish losses to individual ditches. Furthermore, investigations into habitat use and seasonal movements of Yellowstone cutthroat trout in Shields watershed streams are warranted to identify key spawning and rearing areas. Diversions with observed entrainment of adults or fry would be prioritized for screens.

FWP will bear primary responsibility for working with irrigators on practices to reduce entrainment of Yellowstone cutthroat trout into irrigation diversions. Partners will include the SVWG, ditch companies, and individual irrigators. FWP will work toward an inventory of irrigation diversions to identify those with potential for substantial entrainment of Yellowstone cutthroat trout. In addition, a diversion inventory would identify impassable structures, and head gates where modifications or repairs may increase water use efficiency.

4.4 Fisheries Management

The State of Montana's fisheries management policy is to establish and promote self-sustaining populations of wild fish in rivers and streams. Meeting this policy requires maintenance of high quality habitat, monitoring of fish populations, and management of exploitation by anglers. Fishing pressure in the Shields River Subbasin is relatively low, and unlikely to affect local fish populations negatively. Fishing regulations will continue to protect Yellowstone cutthroat by requiring catch-and-release only fishing. Other trout may be kept at the rate of five in possession per licensed angler per day during the regular fishing season for the Shields River (see http://fwp.mt.gov/fishing/regulations/ for the most recent fishing regulations).

Conservation of Yellowstone cutthroat trout requires managing not only the existing populations, but also learning how introduced species interact with and affect Yellowstone cutthroat trout in their native habitats. Nonnative salmonids regularly displace cutthroat trout following invasion into new waters in the western United States (Behnke 1992, Gresswell 1988, Young 1995) and this displacement is happening in the Shields River watershed. Brook trout are rapidly supplanting Yellowstone cutthroat trout in headwaters in the Shields River watershed. Rainbow trout exert a major, irreversible impact on Yellowstone cutthroat trout through hybridization. Recent research suggests negative consequences on fitness for hybridized westslope cutthroat trout (Muhlfeld et al. 2009). That Yellowstone cutthroat trout suffer similar decreases in fitness when hybridized is conjectural; however, fisheries management should consider this possibility until the requisite studies are conducted. Until more information on interspecific interactions is available, FWP intends to manage the Shields River Subbasin to minimize interspecific competition between Yellowstone cutthroat trout and nonnative species by prohibiting stocking of nonnative species in the watershed.

FWP’s goal is to monitor trout populations in the Shields River and tributaries on a rotating basis. Electrofishing is the primary technique for population monitoring. Long-term sampling sections have been established on the main stem Shields River, but additional sections should be established in the upper Shields River watershed and tributaries to document population trends and adapt management strategies.

Removal of nonnatives is a commonly used approach in conserving native inland salmonids. Options include mechanical removal, and application of piscicide, such as rotenone. Piscicide is the most effective option in most circumstances, although suppression and mechanical removal are feasible and cost effective approaches in some situations (Shepard 2010). The conservation strategy to promote Yellowstone cutthroat trout in sympatry with rainbow trout, brown trout, or brook trout follows several steps. First is to identify streams where Yellowstone cutthroat trout co-occur with competing species. Each stream will be evaluated for factors relating to potential for effective removal of competing species, such as proximity of other potential sources of nonnative fishes and complexity of the habitat. Following the required environmental review process (MEPA or NEPA), removal will occur in streams with a high potential for success. Suppression will follow an adaptive management approach, where subsequent monitoring results inform future efforts. In many cases, construction of a barrier may be warranted to prevent reinvasion of nonnative fishes into treated waters.

A substantial number of streams are candidates for removal or suppression of nonnative salmonids. Of the 61 streams evaluated, 59 still support Yellowstone cutthroat trout (Table 4-8). Brook trout are likely present in just under half, and brown trout are probable in 22 of these streams. Rainbow trout are probable in five of the 61 streams. Yellowstone cutthroat trout co-occur with just one nonnative species in 20 of the 61 streams.

Table 4-8: Known or suspected presence of Yellowstone cutthroat trout, brown trout, brook trout, and rainbow trout in streams within the Shields River watershed above the Chadbourne diversion (MFISH database). A=abundant, C=common, R=rare, U=unknown

Fifth Code HUC	*Stream*	*Brook Trout*	*Brown Trout*	*Rainbow Trout*	*Yellowstone Cutthroat Trout*
Upper Shields	Shields River	A	C		C
	Bennett Creek	A			A
	Buck Creek				A
	Clear Creek				A
	Crandall Creek	A			
	Daisy Dean Creek				A
	Deep Creek	A			A
	Dugout Creek				A
	East Fork Smith Creek				R
	Elk Creek		A		A
	Goat Creek	A			A
	Horse Creek	A		A	R
	Lodgepole Creek				A
	Meadow Creek	A	A		A
	Middle Fork Horse Creek				A
	Mill Creek	A	A		A
	North Fork Daisy Dean Creek				A
	North Fork Elk Creek				A
	North Fork Horse Creek	A			A
	Porcupine Creek		A		A
	Scofield Creek				A
	Smith Creek	C	A		R
	South Fork Daisy Dean Creek				A
	South Fork Elk Creek				A
	South Fork Horse Creek	A			A
	South Fork Shields River	A	A		A
	Turkey Creek				A
Potter	Potter Creek				A
	Cottonwood Creek	C			
Flathead	Cache Creek	A	A		A
	Carrol Creek	A			A
	Dry Creek	A			A
	Fairy Creek	A	A		A
	Green Canyon Creek				A

Fifth Code HUC	***Stream***	***Brook Trout***	***Brown Trout***	***Rainbow Trout***	***Yellowstone Cutthroat Trout***
	(Table 4-8 continued)				
	Flathead Creek	C	R		A
	Middle Fork Muddy Creek				
	Muddy Creek	A	A		A
	North Fork Flathead Creek	A			A
	South Fork Carrol Creek				A
	South Fork Flathead Creek				A
Middle Shields	Brackett Creek	A	C	A	A
	Fox Creek				A
	Horse Creek			A	A
	Middle Fork Brackett Creek	A			A
	Miles Creek		A		A
	Nixon Creek		A		A
	North Fork Brackett Creek	A	A		A
	Skunk Creek	A	A		A
	South Fork Brackett Creek				A
	Weasel Creek				A
	Cottonwood Creek	A	A	A	C
	East Fork Rock Creek				A
	East Fork Spring Creek		A		A
	Hammond Creek	A	A		A
	Indian Creek				A
	Rock Creek	C	C		U
	Grouse Creek	A			A
	Spring Creek		A		A
Lower Shields	Bridgman Creek	A			A
	Canyon Creek	A	A		A
	Sheep Creek				A

4.5 Private Pond Permitting

FWP is authorized to regulate the importation of fish for stocking as well as the stocking of fish pursuant to MCA 87-3-105, 87-5-711, and 87-5-713. The list of species that can be considered for planting in private ponds is provided in MCA 87-5-714 and ARM 12.7.701.

Montana places a high value on its wild and native fisheries. The introduction of nonnative fish can have a detrimental effect on the distribution and abundance of native fish populations through predation, competition, and hybridization. As stated in FWP's private pond policy, to avoid the threat of hybridization with extant native fish populations, FWP **WILL NOT** issue a permit for the stocking of rainbow or westslope cutthroat trout in private ponds within tributary drainages that support or are connected to habitats that support Yellowstone cutthroat trout conservation populations. To avoid the threat of competition with extant native species populations, FWP **WILL NOT** issue a permit for:

1) the stocking of brook trout in private ponds within tributary drainages that support or are connected to habitats that support westslope or Yellowstone cutthroat trout conservation populations; or
2) the stocking of brown trout in private ponds within tributary drainages that support or are connected to habitats that support westslope or Yellowstone cutthroat trout conservation populations.

In addition, all ponds must provide and maintain adequate screening of surface water connections to the pond in order to keep wild fish out of the pond, as well as preventing escape of fish stocked in the pond. Pond permitting regulations require that private pond must stock fish obtained from an approved aquaculture facility. FWP approves these facilities on an annual basis to ensure that various fish diseases and aquatic invasive species are not transferred to a private pond and subsequently to wild populations.

Private ponds are subject to review and permit renewal every ten years. Ponds that are found to be in violation of the above policy will be required to come into compliance, or the permit will not be renewed and the existing fishery will be removed.

5.0 Data Review and Conservation Strategies and Opportunities by Stream/Watershed

5.1 Shields River

5.1.1 Shields River Historical and Current Conditions

The Shields River originates in the Crazy Mountains, and flows for 65 miles until its confluence with the Yellowstone River (Figure 5-1). With the exception of its upper 6 miles, which are on the GNF, the Shields River flows nearly entirely through privately owned lands. The Shields River has been the focus of considerable study to determine fish distribution and population trends. In addition, several studies have evaluated habitat condition and stream flow, which are relevant to restoration planning for Yellowstone cutthroat trout.

Fisheries investigations in the Shields River watershed began in the 1950s, with a combination of creel census records and field surveys providing information on cutthroat trout presence and relative abundance of other species (Hanzel 1959). Cutthroat trout rated as being second or third