

**City of River Falls
North Kinnickinnic River Monitoring Project**

2007 Summary



**Report prepared by SEH Inc., for the
City of River Falls Engineering Department
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City of River Falls
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Project Introduction:

The Kinnickinnic River is one of the premier, naturally sustaining trout fisheries in the Upper Midwest, primarily producing brown trout. There has been a lot of concern about how new development in River Falls may affect the river, especially due to storm water runoff from impervious surfaces in these urbanizing areas. Not only can storm water runoff contribute chemicals from lawns, cars, etc., but the thermal impacts of untreated storm water are also a concern, as described on the North Kinnickinnic River Monitoring Project website (see “The Thermal Impacts of Storm Water”). In 2002, the City adopted a new [Storm Water Management Ordinance](#), which is designed to protect the Kinnickinnic River from the negative impacts of storm water runoff associated with new development. For new development and re-development projects, the City of River Falls Storm Water Management Ordinance requires that, for a 1.5-inch, 24-hour rainfall event, the post-development runoff volume and peak flow rate must not exceed the pre-development runoff volume and peak flow rate. To achieve this requirement, developers must provide on-site infiltration of storm water.

To take an active role in the river's health and well-being, the City of River Falls implemented the North Kinnickinnic River Monitoring Project in 2004. The goal of the project is to evaluate the effectiveness of our Storm Water Management Ordinance for preventing degradation of the Kinnickinnic River due to new City development. The project scope includes four primary monitoring elements:

- Temperature Monitoring
- Water Quality Monitoring
- Base Flow Surveys
- Macroinvertebrate Monitoring

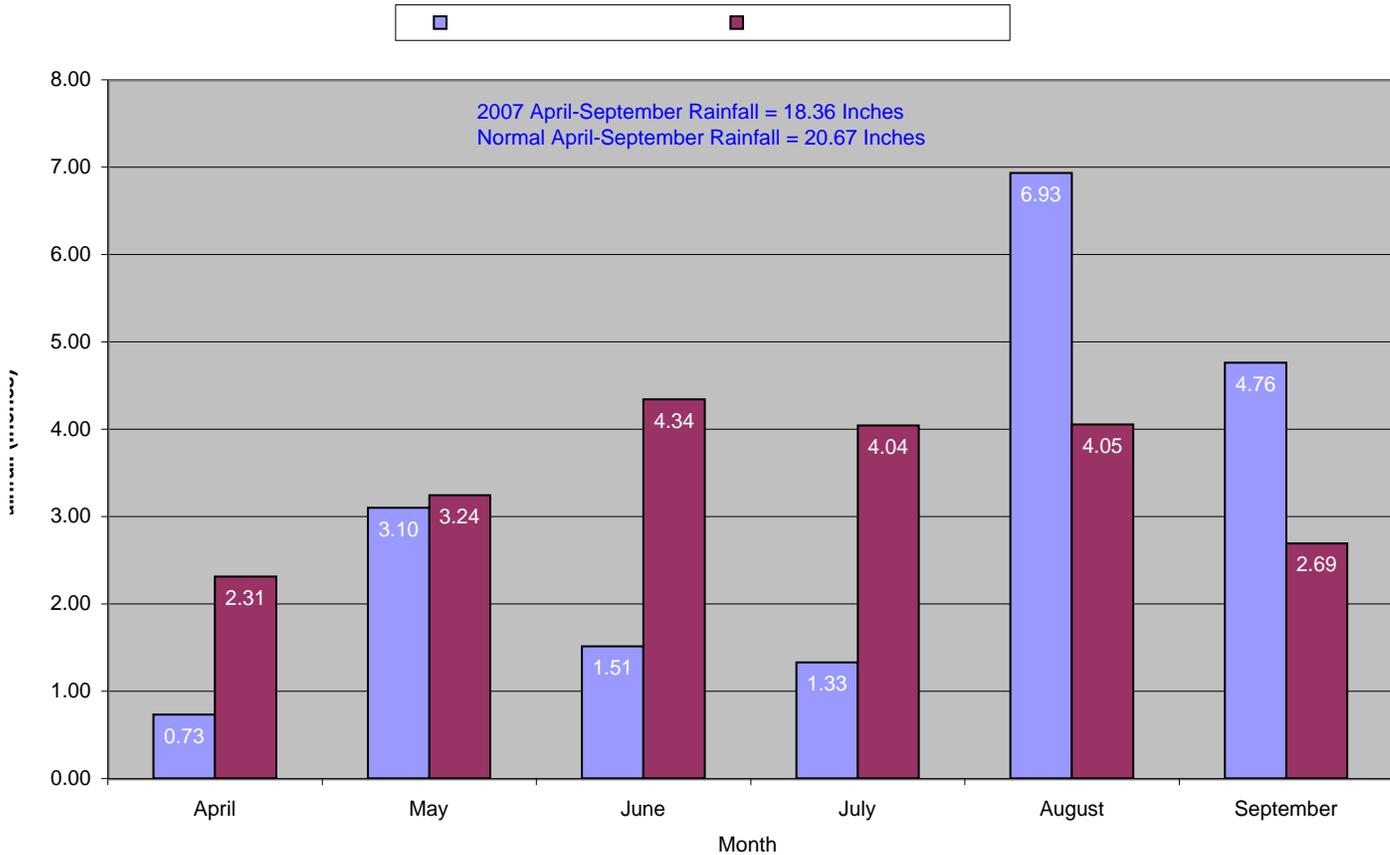
The City will examine the long-term results of each of these four monitoring elements to determine whether the new storm water ordinance is protecting the river as new development occurs. The project will use an “upstream/downstream” approach to determine if storm water management practices in the Sterling Ponds subdivision protect downstream river conditions. We will also take a focused look at the performance of the on-site storm water management practices that are incorporated into new developments. Our hope is that, due to the ordinance requirements, the thermal, water quality, and biological impacts of new development will be undetectable or greatly reduced.

River Falls Precipitation:

Due to the major influence of precipitation on river flow, temperature, and water quality, an analysis of seasonal precipitation is conducted as a part of this project. A total of 18.36 inches of precipitation was recorded in River Falls during the April-September 2007 period, 2.31 inches less than the normal total of 20.67 inches for this time period. Rain fell on 67 days, or 37% of the April-September 2007 period.

Except for August and September, all months during the April-September 2007 period were drier than normal (as presented in the figure below), with monthly rainfall deficits ranging from 0.14 inch to 2.83 inches. The greatest rainfall deficits occurred in June and July, with the lowest monthly rainfall amount (1.33 inch) recorded in July. August was the wettest month (6.93 inches), exceeding the normal monthly rainfall amount by 2.88 inches. Until mid-August 2007, the North Kinnickinnic River Monitoring Project Area continued to be affected by a region-wide drought that began in early 2006.

River Falls Monthly Rainfall: April-September 2007



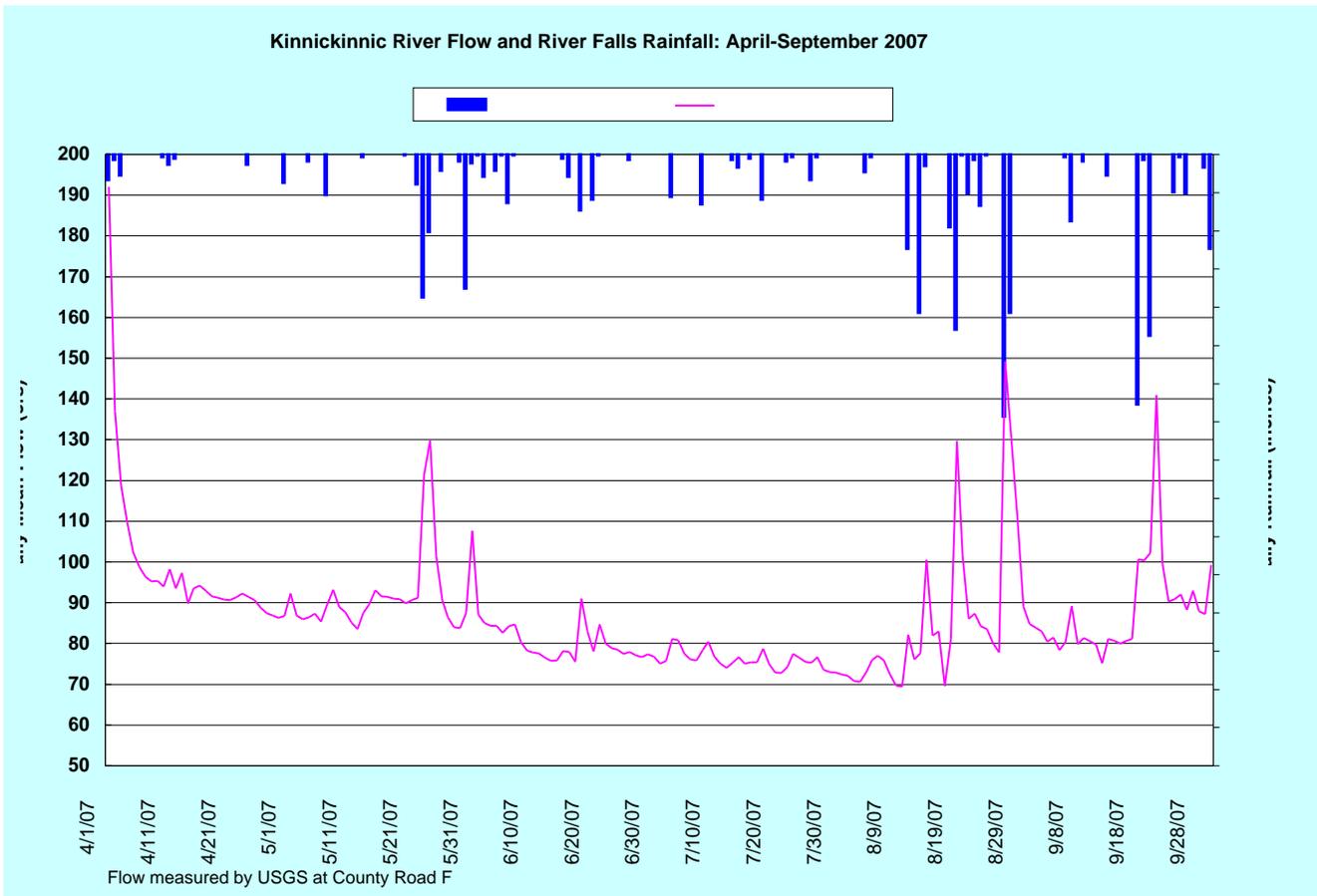
Besides being drier than normal, the April-September 2007 monitoring period was warmer than normal. The mean air temperature in River Falls during the April-September 2007 period was 65.4° Fahrenheit (F), 2.2° F higher than the normal mean of 63.2° F for this time period. With the exception of April, all months during the April-September 2007 period were warmer than normal. The months of May and September were nearly 4° F warmer than normal, while the month of June was 3° F warmer than normal. The month of April was slightly colder than normal.

The City of River Falls Storm Water Management Ordinance would have provided infiltration of approximately 98% (18.00 inches) of the total rainfall (18.36 inches) that occurred during the April-September 2007 period. This percentage was determined using some conservative estimates further described in the 2007 technical report.

Kinnickinnic River Flow:

The flow of the Kinnickinnic River is a reflection of strong ground water contributions, as well as precipitation-induced storm water runoff from predominantly agricultural and urban land uses throughout the 165-square mile Kinnickinnic River Watershed. The daily mean (average) flow of the Kinnickinnic River at County Highway F during the April-September 2007 period is presented in the figure below. Daily rainfall, as

measured in River Falls at Sterling Ponds, is also presented in the figure below.



The Kinnickinnic River hydrograph suggests that seven significant runoff events occurred during the April-September 2007 period. One of these seven significant runoff events occurred in late March and April, due to early spring rains. Two larger rain events on May 23 (0.94 inch) and May 30 (0.88 inch) produced only moderate increases in the Kinnickinnic River hydrograph, with peak daily mean flows of 130 cubic feet per second (cfs) and 108 cfs, respectively. Two larger rain events on August 13 (1.04 inches), and August 19 (1.15 inches) also produced very moderate increases in the Kinnickinnic River hydrograph, with peak daily mean flows of 101 cfs and 130 cfs, respectively. Large, back-to-back rain events on August 27-28 (2.76 inches) and large, nearly back-to-back rain events on September 18 and September 20 (2.83 inches) produced the largest runoff events of the summer, with peak daily mean flows of 149 cfs and 141 cfs, respectively. During dry periods between runoff events, the Kinnickinnic River maintained a base flow condition of approximately 70-90 cfs at County Highway F. The six rainfall and runoff events in May, August, and September were the focus for evaluating possible storm water impacts in the North Kinnickinnic River Monitoring Project Area in 2007, and are further analyzed in 2007 technical report.

Temperature Monitoring:

The thermal impacts of untreated storm water discharges to segments of the Kinnickinnic River within the City of River Falls, especially in the downtown and Glen Park areas, have been clearly documented. Information about the thermal impacts of untreated storm water runoff can be found in the “*Thermal Impacts*” section of the North Kinni Monitoring website.



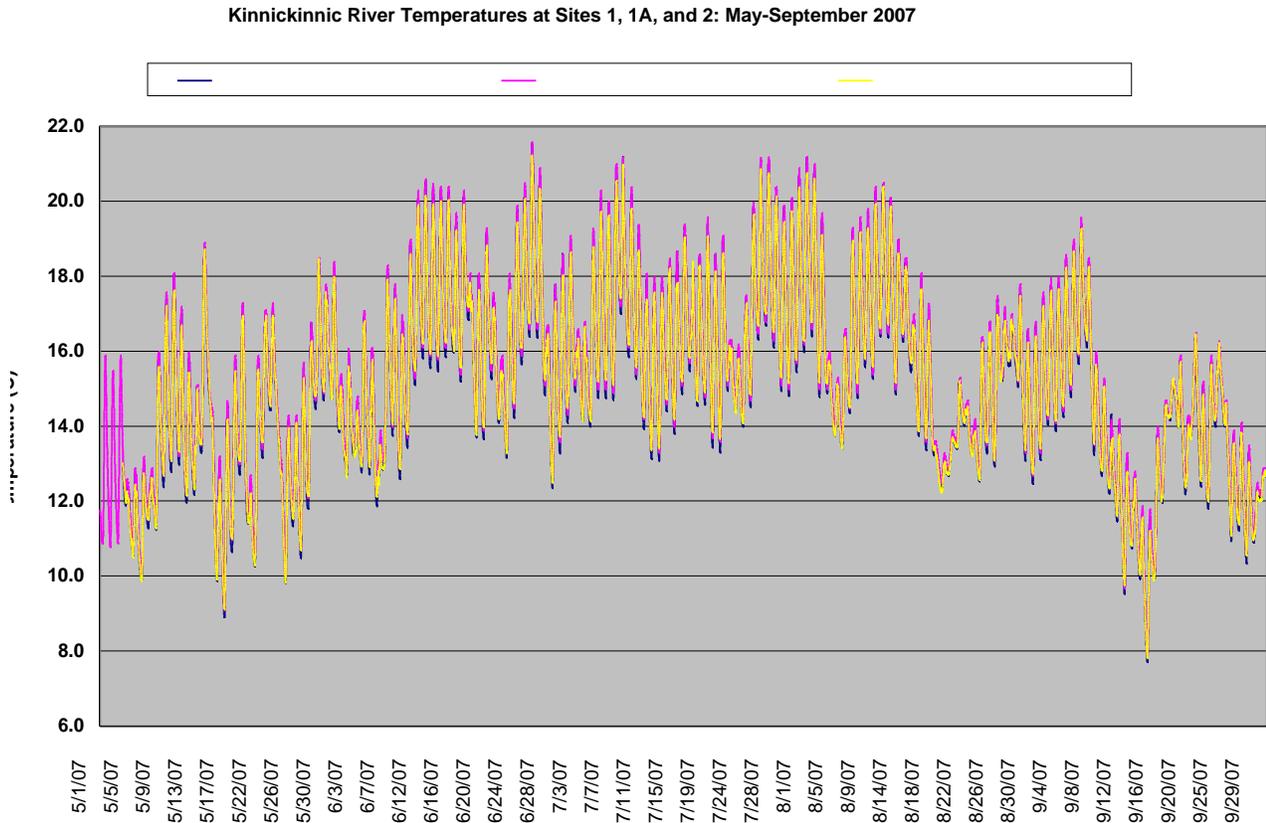
A direct storm sewer discharge to the Kinnickinnic River at Division Street

The intent of the City of River Falls Storm Water Management Ordinance is to prevent storm water impacts on the Kinnickinnic River, including thermal pollution, in areas of the city with new development, such as the Sterling Ponds subdivision.

Kinnickinnic River Temperature Monitoring Results:

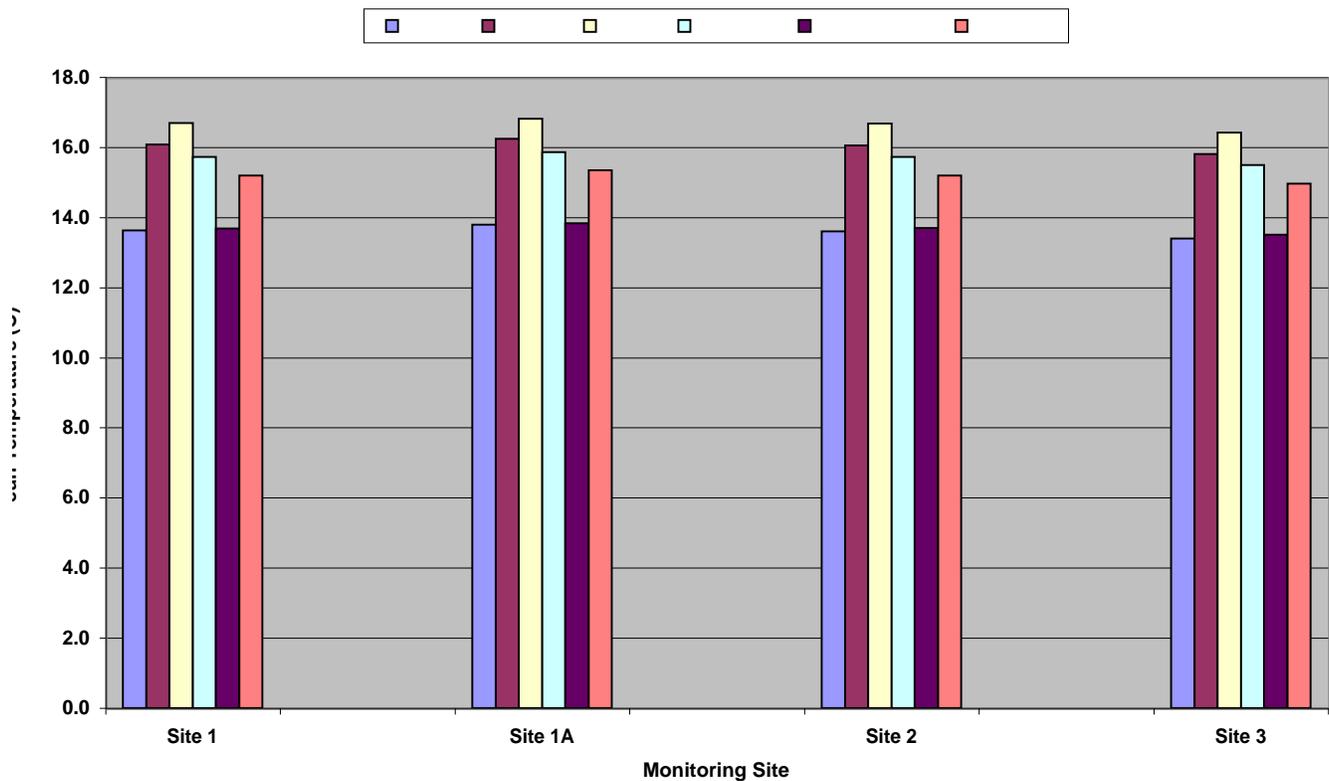
May-September (summer) 2007 temperature monitoring data were obtained for the Kinnickinnic River at Sites 1, 1A, 2, and 3. River temperatures at these four monitoring sites averaged 15.2° C and ranged from 7.7-21.6° C over the course of the summer. For the third consecutive year, higher-than-normal river temperatures probably prevailed in the North Kinnickinnic River Monitoring Project Area during the summer of 2007, since the 2007 summer average air temperature of 20.7° C (69.3° F) was noticeably higher than the normal summer average air temperature of 19.2° C (66.5° F). The 2007 summer average air and river temperatures were the highest summer average temperatures recorded since the North Kinnickinnic River Monitoring Project began in 2004.

The most direct way to determine if any thermal impacts occurred in the Kinnickinnic River as a result of the Sterling Ponds subdivision is to compare the temperature monitoring data at Site 1, located immediately downstream from Sumner Creek, to the temperature monitoring data at Sites 1A and 2, located immediately upstream from Sumner Creek. In 2007, upstream summer temperatures at Sites 1A and 2 were nearly identical to downstream summer temperatures at Site 1, as shown below.



The 2007 monthly and summer mean (average) temperatures at Sites 1, 1A, 2, and 3 were also nearly identical, as shown below.

Monthly and Summer Mean Temperatures at Kinnickinnic River Monitoring Sites:
May-September 2007



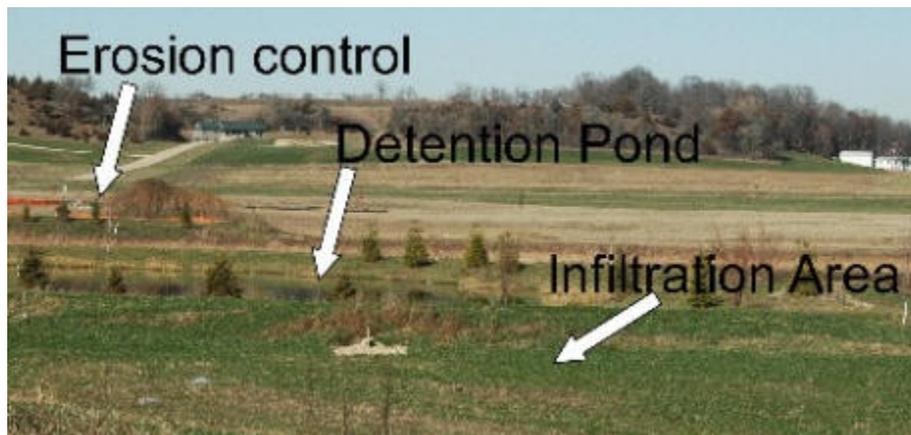
The summer 2007 temperature regime in the Kinnickinnic River at Sites 1, 1A, and 2 was excellent for coldwater macroinvertebrate and brown trout communities. Approximately 77% of all temperatures recorded at Sites 1, 1A, and 2 during the May-September 2007 period were less than or equal to (\leq) 17° C, which is the top of the optimum temperature range for a healthy coldwater macroinvertebrate community. A temperature of 17° C is also considered to be the optimum for brown trout survival. Approximately 94% of all temperatures recorded at Sites 1, 1A, and 2 during the May-September 2007 period were \leq 19° C, which is the top of the optimum temperature range for brown trout growth. Approximately 98% of all temperatures recorded at Sites 1, 1A, and 2 during the May-September 2007 period were \leq 20° C, which is the top of the optimum temperature range for brown trout survival. River temperatures exceeding 20° C were only recorded on 23 dates during the June-August period, when air temperatures averaged 32° C (90° F).

Downstream from Sumner Creek and Sterling Ponds, no storm water-related thermal impacts were apparent at Site 1 after summer rain events, including eight significant rainfall events in May, August, and September 2007.



Sumner Creek and Sterling Ponds Temperature Monitoring Results:

May-September (summer) 2007 temperature monitoring data were obtained for Sumner Creek at Site 6 (upstream from Sterling Ponds) and at Sites 4 and 4A (downstream from Sterling Ponds). Site 4 is located immediately downstream from Sterling Ponds, while Site 4A is located 1.5 miles downstream, near the mouth of Sumner Creek. Temperature monitoring data for the Sterling Ponds storm water management practices were obtained in the wet detention pond (Site 5P), at the wet pond discharge to the infiltration basin (Site 5IB), and at the wet pond discharge to Sumner Creek (Site 5MHW). The Sumner Creek and Sterling Ponds temperature monitoring results helped document the effectiveness of the City of River Falls Storm Water Management Ordinance in 2007.

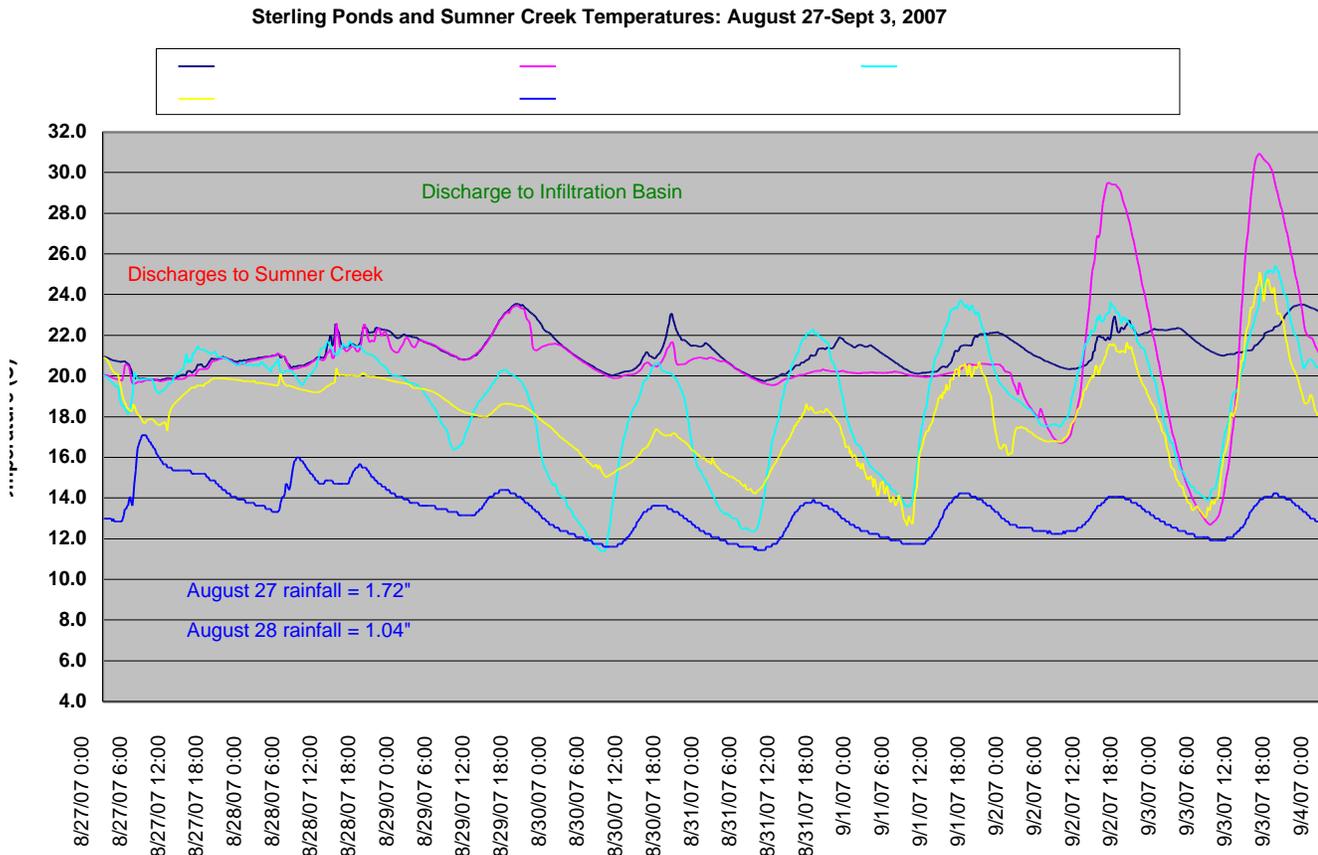


Storm water best management practices in place at Sterling Ponds

Temperature monitoring data indicate that the storm water management practices at Sterling Ponds prevented thermal impacts on the Kinnickinnic River during the May-September 2007 period. The summer mean temperature of the Sterling Ponds wet detention pond at Site 5P was 21.4° C, but much of this warm storm water was effectively infiltrated in the wet pond and/or discharged to the adjacent infiltration basin. With the exception of three large rain events in August and September, all summer rainfall events were fully infiltrated, as required by the River Falls Storm Water Management Ordinance. 56 rain events, ranging in magnitude from 0.01-1.64 inches, represent a total of 13.68 inches of precipitation, or 78% of the total summer rainfall amount (17.63 inches).

The Sterling Ponds wet detention pond only discharged to Sumner Creek after three large rain events in August and September. During these events, the wet detention pond discharged warmer water (17.5-21.7° C) to the Sumner Creek drainage way, often for extended time periods (3-5 hours). These warm storm water discharges produced notable thermal spikes in Sumner Creek at Site 4, but were not responsible for the thermal spikes observed in lower Sumner Creek, at Site 4A. The wet pond discharges to Sumner Creek also had no thermal impacts on the Kinnickinnic River at Site 1. The duration of the August and September storm water discharges to Sumner Creek was relatively short (3-5

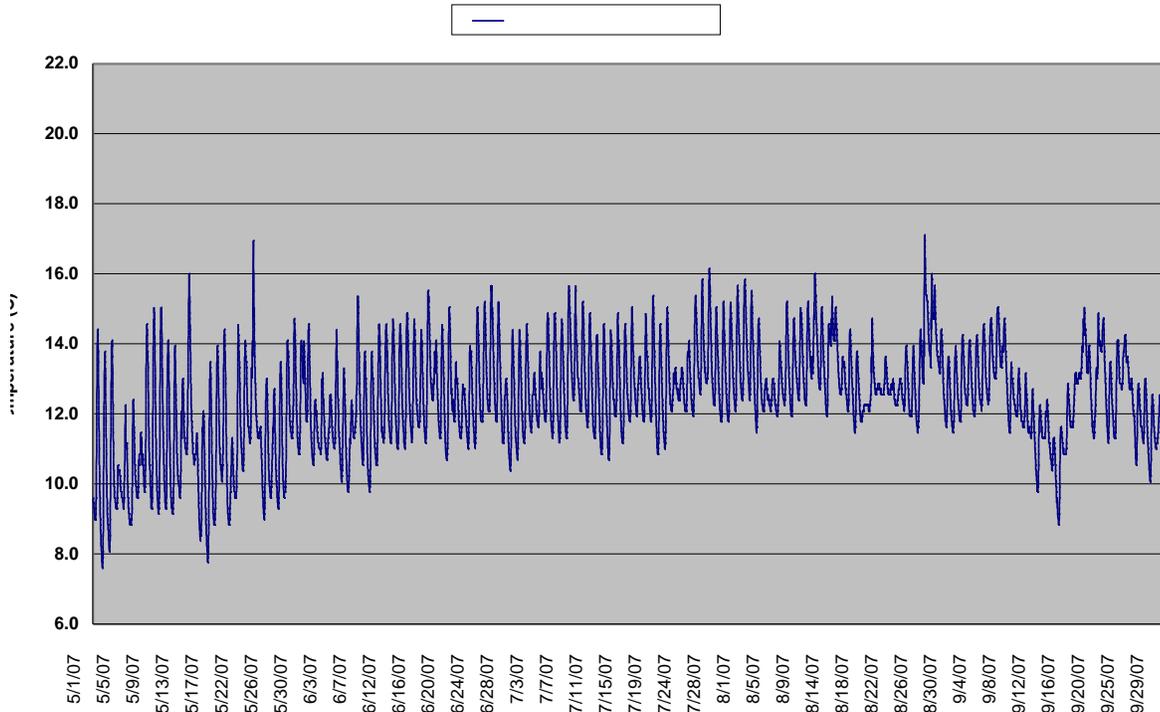
hours), compared with lengthy discharges of storm water to the Sterling Ponds infiltration basin, suggesting that the majority of storm water from these three large rain events was infiltrated rather than discharged to the creek. The Sterling Ponds and Sumner Creek temperature monitoring results for the two large rain events in late August are shown below.



Temperature monitoring of the Sterling Ponds storm water practices during the 2005-2007 period indicates that storm water discharges to Sumner Creek are common during rain events larger than 1.5 inches, and during back-to-back rain events, when rainfall amounts exceed one inch and time periods between rain events are less than 48 hours. Modifications made to the control structure for the Sterling Ponds wet pond outlet seemed to improve infiltration capacity for these types of events in 2007. Rain events larger than 1.5 inches exceed the intent of the River Falls Storm Water Management Ordinance, so storm water discharges to Sumner Creek might be expected. Storm water discharges to Sumner Creek during back-to-back rain events, when rainfall amounts are less than the 1.5-inch ordinance requirement, may need further attention. Climatological data should be analyzed to determine the frequency of back-to-back events of this nature. Modifications to the storm water management ordinance should be made accordingly.

Permanent flow occurred in lower Sumner Creek at Site 4A throughout the summer. The summer mean temperature (12.5° C) reflects strong spring flow. The creek potentially provides a good thermal environment for a brook trout fishery, and is an important contributor of cold water to the Kinnickinnic River. However, thermal spikes of notable magnitude (0.7-4.1° C) occurred at this location during the eight largest summer rain events. These spikes (shown below) are unrelated to the storm water discharges at Sterling Ponds, and seem to have a more local cause that needs further investigation.

Sumner Creek Temperature at Site 4A: May-September 2007



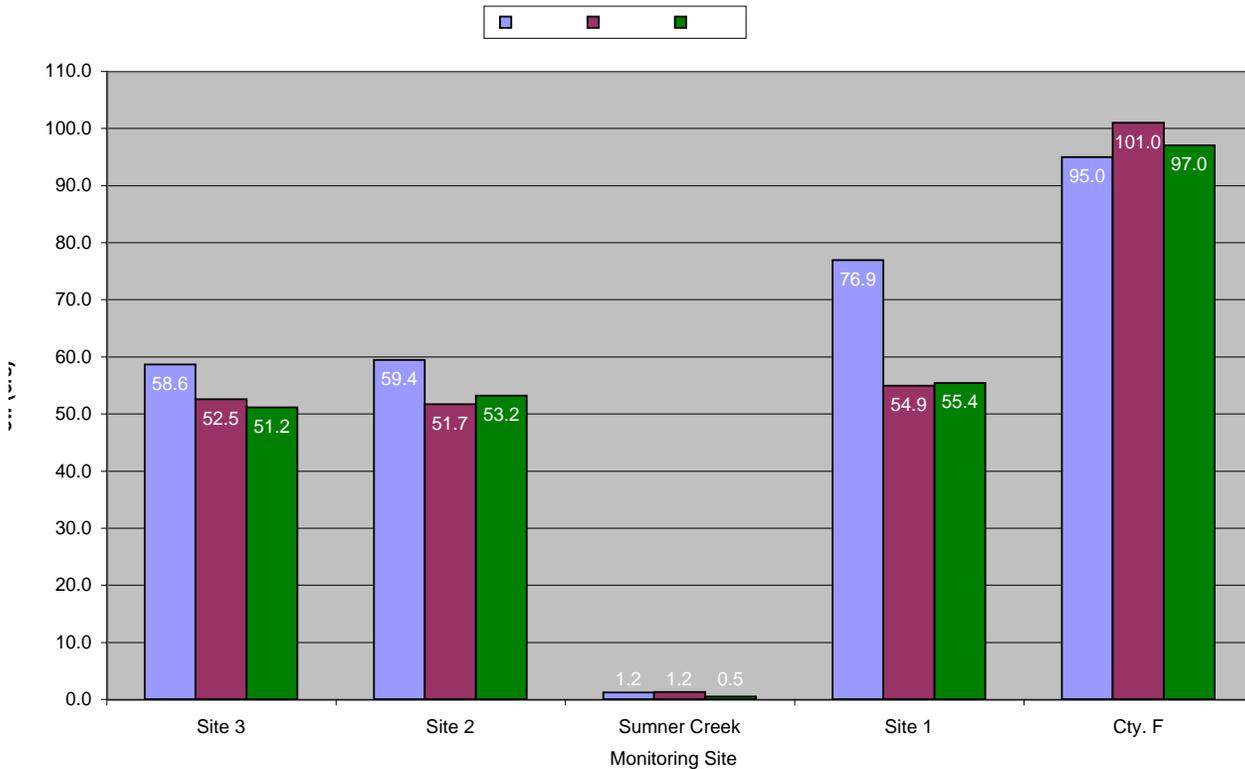
Base Flow Surveys:

In May (spring) and October (autumn) 2007, base flow surveys were conducted at Sites 1 -3 in the Kinnickinnic River and at the mouth of Sumner Creek (Site 4A) within the North Kinnickinnic River Monitoring Project Area. The Kinnickinnic River was assumed to be in a base flow condition when 3-4 days of “flat-line” flow were observed at the USGS stream flow gauging station located at County Highway F (as described in the 2007 technical report). During the April-September 2007 period, the Kinnickinnic River generally maintained a base flow condition of approximately 70-90 cfs at County Highway F. Spring base flow surveys have been conducted for two consecutive years (2006-2007), while autumn base flow surveys have been conducted for three consecutive years (2005-2007).

The autumn 2007 base flow survey results are presented below, with a comparison to the autumn 2005 and autumn 2006 survey results. In autumn 2007, Kinnickinnic River base

flows increased very slightly from upstream (Site 3) to downstream (Site 1), with Sumner Creek providing a small contribution upstream of Site 1. The autumn 2006 and autumn 2007 Kinnickinnic River base flows in the project area (Sites 1-3) were markedly reduced compared to autumn 2005, likely due to below-normal precipitation during the summers of 2006 and 2007.

Autumn Baseflow Conditions in the Kinnickinnic River and Sumner Creek: 2005-2007



More information on the spring and autumn base flow survey results can be found in the 2007 technical report. Based upon several years of base flow survey data, it seems apparent that climatic variability can cause significant annual changes in base flows within the North Kinnickinnic River Monitoring Project Area. One goal of the River Falls Storm Water Management Ordinance is to maintain strong base flow conditions in the Kinnickinnic River by requiring storm water management practices that promote infiltration of rainfall, thereby maintaining shallow aquifer levels, as well as the springs that provide cold water for the river. Annual spring and autumn base flow surveys will provide a baseline for determining if base flow conditions will be sustained in the future as development progresses in the North Kinnickinnic River Monitoring Project Area.

Macroinvertebrate Monitoring:

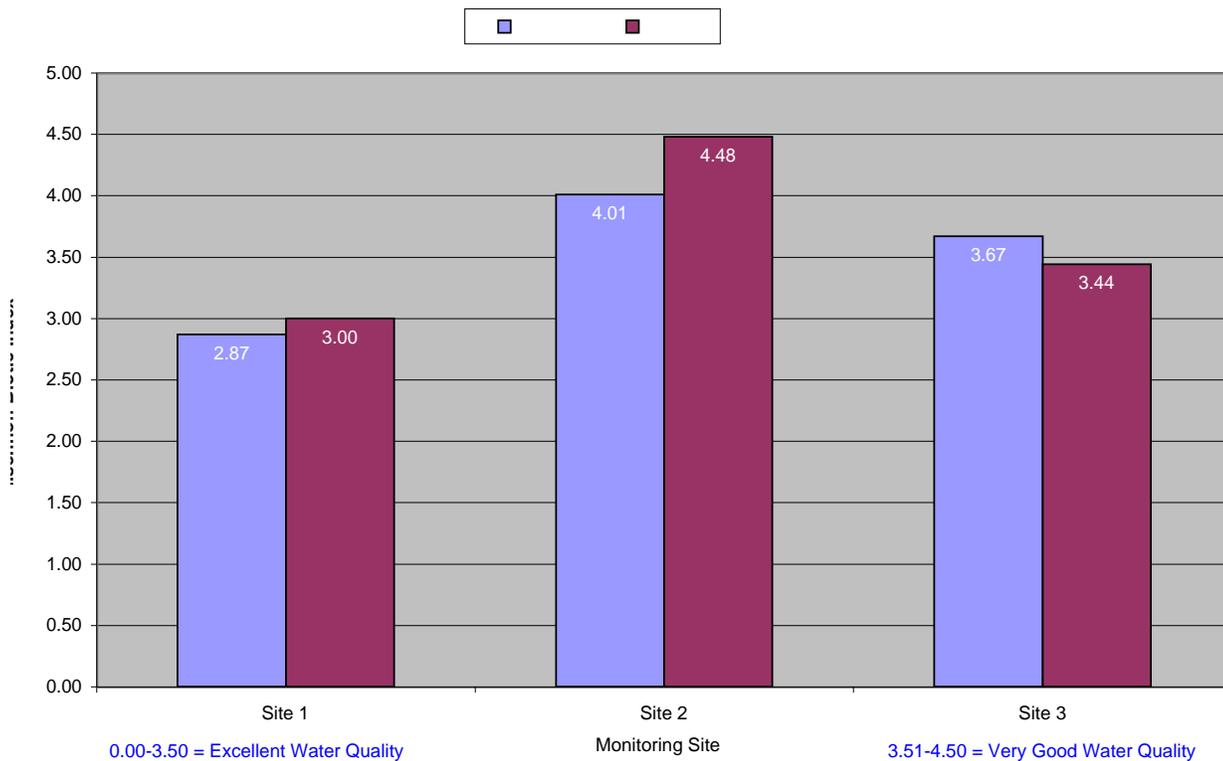
Biological indicators such as macroinvertebrates (aquatic insects) are often used to complement physical and chemical measurements in stream monitoring programs. Because macroinvertebrates live in the stream environment for a year or more, they are excellent indicators of past as well as present water quality conditions. Annual macroinvertebrate samples are collected at Sites 1-3 within the North Kinnickinnic River Monitoring Project Area. Organisms are identified and counted in the laboratory, and various biological indices can then be calculated for each monitoring site. The index values are indicative of water quality, depending upon the pollution tolerances of the macroinvertebrates collected at the monitoring sites.

The Hilsenhoff Biotic Index (HBI) is particularly useful for determining the influence of organic pollution on macroinvertebrates. The Wisconsin Department of Natural Resources has used this index for many years in long-term stream monitoring efforts. Each macroinvertebrate taxon (genus and/or species) has been assigned a specific tolerance value, ranging from 0 (extremely intolerant of organic pollution) to 10 (extremely tolerant of organic pollution). The more intolerant taxa that are present, the lower the HBI value, indicating better water quality, as follows:

HBI Value	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly Poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

The 2004-2005 macroinvertebrate HBI values at Sites 1-3 are presented below. These 2004 and 2005 data were generated to establish a macroinvertebrate-based water quality baseline at the start of this monitoring project. In 2004 and 2005, HBI values at Site 1 were indicative of excellent water quality, HBI values at Site 2 were indicative of very good water quality, and HBI values at Site 3 were indicative of very good-excellent water quality. Macroinvertebrate monitoring was again conducted in May 2006 and May 2007, but the sample analysis has not yet been completed by the University of Wisconsin-Stevens Point laboratory. Annual HBI values and other macroinvertebrate indices will continue to be posted as they become available.

Kinnickinnic River Macroinvertebrates: Hilsenhoff Biotic Index



Water Quality Monitoring:

No runoff event-based water quality monitoring was conducted in 2007. With below-normal precipitation during the April-September period, very few significant runoff events occurred in the North Kinnickinnic River Monitoring Project Area. Given more normal precipitation and runoff conditions, the water quality monitoring component of this project will be initiated in 2008.

North Kinnickinnic River Monitoring Project Indicators:

As a part of the North Kinnickinnic River Monitoring Project, key physical and biological indicators have been monitored to evaluate the effectiveness of the River Falls Storm Water Management Ordinance for preventing degradation of the Kinnickinnic River due to development-related storm water impacts. These key indicators, which have been monitored since the onset of the project in 2004, include:

- Total rainfall in River Falls during the April-September period
- % April-September rainfall infiltrated, per the River Falls Storm Water Management Ordinance
- Summer (May-September) average air temperature in River Falls

- Summer (May-September) average temperatures in the Kinnickinnic River and Sumner Creek
- % of the summer Kinnickinnic River temperatures favorable for biota
- % of the summer Sumner Creek temperatures favorable for biota
- Spring base flow conditions in the Kinnickinnic River and Sumner Creek
- Autumn base flow conditions in the Kinnickinnic River and Sumner Creek
- Kinnickinnic River macroinvertebrate HBI values

The North Kinnickinnic River Monitoring Project Indicators for the 2004-2007 period can be found on the project website. As monitoring continues in the future, these indicators can evaluate the annual effectiveness of the River Falls Storm Water Management Ordinance and track long-term trends that document protection of the Kinnickinnic River.