"URBAN STORM WATER IMPACTS ON A COLDWATER RESOURCE"

ABSTRACT

Urban Storm Water Impacts on a Coldwater Resource

The Kinnickinnic River in west-central Wisconsin is classified as a state "outstanding resource water", and is a premiere Midwest trout stream, with a self-sustaining brown trout population. River Falls, Wisconsin (population 10,500), located in the heart of the Kinnickinnic River watershed, is developing rapidly because of its proximity to the Minneapolis/St. Paul, MN metropolis. With increasing residential, commercial, and industrial development, concerns about urban storm water impacts on the Kinnickinnic River are also increasing. These impacts include higher stream flows, thermal pollution, and sedimentation, all of which pose threats to trout and aquatic habitat. In response to the concern about thermal pollution, the Kiap-TU-Wish Chapter of Trout Unlimited established a temperature monitoring network in 1992, at four Kinnickinnic River locations throughout River Falls. Data-logging thermometers continuously record stream temperatures at 10-minute intervals, clearly demonstrating storm water-induced thermal changes. Rapidly-increasing stream temperatures are often evident at locations downstream from storm water outfalls during summer rainfalls, and storm water temperatures may exceed 80 degrees F. The thermal impacts of two small municipal hydropower impoundments have also been documented. Storm event-based composite sampling of residential, commercial, and industrial areas of River Falls (1992) suggests that these areas are highly susceptible to soil erosion, with sediment concentrations greater than the NURP average. Concentrations of some sediment-associated metals are also high. In 1994, River Falls adopted a storm water management plan for the Kinnickinnic River. Plan recommendations include a limitation of 10-12% effective impervious area within the city, proper detention pond design to mitigate thermal impacts, stringent erosion control ordinances, additional storm water BMPs, and increased public awareness and involvement. Substantial funding for BMP implementation may be provided by the Kinnickinnic River Priority Watershed Project administered by the Wisconsin Department of Natural Resources.

Key Words: Trout, Storm water, Thermal Pollution, Sedimentation

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INTRODUCTION

The Kinnickinnic River in west-central Wisconsin is classified as a state "outstanding resource water", and is a premiere Midwest trout stream, with a self-sustaining brown trout population. Approximately 1,500 to 7,500 trout per mile reside in the upper Kinnickinnic River, above the City of River Falls, while 1,500 to 4,000 trout per mile reside in the lower river, below the City.

River Falls, Wisconsin (population 10,500), located in the heart of the Kinnickinnic River watershed, is developing rapidly because of its proximity to the Minneapolis/ St. Paul, MN metropolis. The City experienced a 16% growth rate during the 1980s, compared to a state-wide growth rate of 3%. Growth estimates project a population of 16,500 by the year 2010. This estimate is conservative, however, since it does not include growth in the surrounding townships, where agricultural lands are rapidly being converted to rural residential uses.

With counties in western Wisconsin already designated as part of the Minneapolis/St. Paul (Twin Cities) Planning Area, and with rapid growth anticipated in River Falls, concerns about development impacts on the Kinnickinnic River are well-founded, given the history of development in the Twin Cities Area. Although a number of trout streams once existed in the Twin Cities Area, these high quality waters have become increasingly rare due to the adverse effects of urbanization. At present, only 14 trout streams remain, representing just 25 miles of naturally- reproducing trout populations. Through the Metro Trout Stream Watershed Protection Initiative, the Minnesota Department of Natural Resources, in cooperation with the Twin Cities Chapter of Trout Unlimited, is targeting these streams for preservation.

The Kinnickinnic River is a valuable trout stream representing a major natural amenity of the River Falls community. Although trout populations in the river are currently high, the effect of storm water from the City of River Falls and surrounding towns has the potential to degrade the physical and biological characteristics of the Kinnickinnic River and its tributaries. Storm water impacts include higher stream flows, thermal pollution, and sedimentation, all of which pose threats to trout and aquatic habitat.

In response to the concern about thermal pollution, the Kiap-TU-Wish Chapter of Trout Unlimited established a temperature monitoring network in 1992, at four Kinnickinnic River locations throughout River Falls. To study the impact of sedimentation and other urban pollutants, storm event-based composite sampling of residential, commercial, and industrial areas of River Falls was also conducted in 1992 by Short Elliott Hendrickson (SEH), a water resource consultant.

Trout are an important indicator species of environmental quality, especially in an urbanizing area. As such, the protection of the water quality of the Kinnickinnic River is critical to the environmental and economic future of River Falls. Development along the Kinnickinnic River needs to be carefully planned to protect the existing resource. To this end, a three-year (1992-1994) planning effort has been conducted by SEH, producing a Kinnickinnic River Water Management Plan for the City of River Falls. In 1995, the Kinnickinnic River was designated as a state "priority watershed" by the Wisconsin Department of Natural Resources (WDNR). The Kinnickinnic River Priority Watershed Project will provide funding over a ten-year period for implementation of nonpoint source best management practices (BMPs), including those for abatement of storm water impacts.

MATERIALS AND METHODS

Thermal Monitoring:

Stream Temperature

In 1992, thermal monitoring stations were established at 4 Kinnickinnic River locations throughout River Falls:

Quarry Road (Upper City Limits) (Middle River)
Cedar Street (Commercial and Residential Area) (Middle River)
Upper Glen Park (Downstream from 2 City Impoundments) (Lower River)
Lower Glen Park (Lower City Limits) (Lower River)

The Kiap-TU-Wish Chapter of Trout Unlimited purchased and installed the stream temperature monitoring equipment.

The temperature monitors are Ryan TempMentor datalogging thermometers, manufactured by Ryan Instruments, Redmond, WA (Figure 1). The instrument allows storage of 6400 temperature measurements in a range from -32 C to +70 C (0.1 C resolution; 0.3 C accuracy). The thermistor temperature sensor is mounted on a cable that attaches to the TempMentor, allowing the sensor to be located up to 100 feet away from the thermometer.

The TempMentor has variable temperature-logging intervals ranging from 1 second to two hours. A 10-minute logging interval is used for Kinnickinnic River studies, allowing a 44-day deployment time. The 10-minute logging interval provides good sensitivity for detecting rapidly-rising stream temperatures during storm events.

TempMentor deployment and data retrieval are conducted in the field, with a lap-top IBM-compatible PC (Figure 1). The accompanying software creates a data report and thermograph for each data set.

Each TempMentor is housed in an in-ground, locking shelter, to ensure security. The sensor cable extends through an underground plastic conduit, to the streambed (Figure 1).

Storm Water Temperature

From June-August, 1992, a single TempMentor was deployed in a storm sewer draining a highly impervious, 13-acre commercial area in downtown River Falls. The TempMentor was housed in a modified milk can suspended from the grate at the top of the access hole. The sensor cable extended from the milk can through a plastic conduit to the bottom of the concrete storm sewer, at a location 20 feet from the discharge point to the Kinnickinnic River.

A 10-minute temperature logging interval was employed. During dry periods, the TempMentor logged cool, ambient air temperatures within the storm sewer. During rain events, the TempMentor logged storm water temperatures, which were markedly higher than the air temperatures, allowing a clear delineation of the onset and duration of the rain event, in addition to storm water temperatures throughout the event.

Storm Water Quality Monitoring:

From June-August, 1992, Short Elliott Hendrickson (SEH) conducted automated event-based monitoring of storm water quality in River Falls. Storm water from representative subwatersheds of three urban areas was sampled: residential (29 acres), commercial (13 acres), and industrial (80 acres).

An American Sigma 800 SL portable sampler was used for sample collection. Storm water flow rate was monitored continuously by the sampler's integral flow meter. Flow depth information was obtained with a pressure transducer mounted on the bottom of the storm sewer.

For each storm event, discrete samples were collected, with more frequent sampling at the beginning of the event to better characterize first flush. All discrete samples were flow-composited prior to analysis.

Storm event selection for monitoring followed the EPA NPDES storm water monitoring requirements to the greatest extent practicable. Samples were collected during measurable storm events (greater than 0.1 inch) occurring at least 72 hours from the previously measurable storm event. The rainfall characteristics used for event selection have been summarized by SEH (1995).

Three acceptable storm events were monitored in the residential and commercial subwatersheds, while a single storm event was monitored in the industrial subwatershed.

Each flow-composited storm water sample was analyzed for the following water quality variables: total suspended solids, total Kjeldahl nitrogen, total phosphorus, copper, lead, and zinc. For the suite of water quality variables analyzed, 1992 storm water quality results for River Falls were compared with EPA (1983) National Urban Runoff Program (NURP) results.

<u>Kinnickinnic River Water Management Plan:</u>

Recognizing that protection of Kinnickinnic River water quality is critical to the environmental and economic future of River Falls, and that development along the Kinnickinnic River needs to be carefully planned to protect the existing resource, the City of River Falls applied for and received a federal EPA 205J water quality planning grant in 1991.

The EPA 205J grant ($94,000), administered by the Wisconsin Department of Natural Resources (WDNR), was supplemented by funding from the City of River Falls ($16,900) and the Kiap-TU-Wish Chapter of Trout Unlimited (TU) ($4,200). In-kind contributions of staff were provided by the four local townships, the Kinnickinnic River Land Trust (KRLT), and the University of Wisconsin-River Falls (UW-RF), as well as WDNR, the City of River Falls, and TU.

Short Elliott Hendrickson (SEH) of St. Paul, MN, a water resource consultant, was selected to develop the Kinnickinnic River Water Management Plan, in partnership with the WDNR, City of River Falls, townships, TU, KRLT, and UW-RF. The total cost of the three-year (1992-1994) planning effort was $115,100, not including the in-kind staff contributions of all partners except SEH.

<u>WDNR Priority Watershed Program:</u>

In 1995, the Kinnickinnic River was selected by the WDNR for inclusion in the state priority watershed program. This program will provide annual funding over a ten-year period for implementation of both urban and agricultural BMPs throughout the Kinnickinnic River watershed, potentially including some of the suggested BMPs in the City of River Falls' Kinnickinnic River Water Management Plan.

RESULTS AND DISCUSSION

Thermal Monitoring:

Stream Temperature

A typical thermograph (July-August 1993) at Quarry Road, an upstream location unaffected by City of River Falls storm water discharges, is presented in Figure 2. Stream temperature is markedly influenced by extremes in ambient air temperature (Table 1), which produce a pronounced diurnal variation, as well as increasing and decreasing weather-related trends over several-day periods. Strong groundwater discharge and canopy shading maintain a cool average stream temperature for trout, and help temper extreme air temperatures. Impacts of precipitation (Table 1) on stream temperature are minimal.

A typical thermograph (July-August) at Cedar Street, an urban location immediately downstream from four storm water discharges draining residential and commercial areas in River Falls, is presented in Figure 3. Diurnal variations and day-to-day weather-related trends in stream temperature at Cedar Street mirror those at Quarry Road; and the average, minimum, and maximum temperatures for the monitoring period are similar at both locations. However, impacts of precipitation (Table 1) on stream temperature at Cedar Street are pronounced, with storm water-induced temperature spikes of varying magnitudes associated with most rain events.

A typical storm water-induced temperature spike at Cedar Street, caused by a 1.34 inch rainfall on July 25, 1993, is presented in Figure 4. With the onset of rain and storm water discharge at approximately 2:20 A.M., a rapid 10-degree F temperature increase occurred during a 20-minute period, likely associated with a "first flush" of storm water over warm, impervious surfaces. As the rain event progressed, the stream temperature gradually returned to a baseline condition by 5:30 A.M. A less-pronounced storm water-induced temperature spike, characterized by a rapid 5-degree F temperature increase, was also apparent at Lower Glen Park (Figure 5), a considerable distance (0.9 mile) downstream from a large storm water discharge at Bartosh Canyon. However, no temperature spike was evident at Quarry Road (Figure 6), upstream from City storm water discharges. July 25, 1993 stream temperatures at all three monitoring locations (Cedar Street, Lower Glen Park, and Quarry Road) are superimposed in Figure 7. The higher baseline temperature at Lower Glen Park, compared to Cedar Street and Quarry Road (Figure 7), reflects the thermal impact of the two City hydropower impoundments.

Storm Water Temperature

A thermograph (June 1992) of storm water temperatures in a storm sewer draining a highly impervious 13-acre commercial area in downtown River Falls is presented in Figure 8. Rain events during 10 days in June 1992 produced peak storm water temperatures ranging from 59.5 to 82.6 degrees F. Rainfall amounts during these 10 days (Table 2) ranged from 0.01 inch to 2.05 inches. The marked variation in storm water temperatures is likely influenced by a number of factors, including temperature of the impervious surface drained, the time of day when rainfall occurs, amount of rainfall, and intensity and duration of rainfall.

Plots of storm water temperatures during four rain events (June 13-18, 1992) in the commercial River Falls subwatershed are presented in Figure 9.

During a 0.01-inch rainfall beginning at 5:30 P.M. on June 13, with an ambient air temperature near the daily maximum of 90 degrees F (Table 2), a peak storm water temperature of 82.6 degrees F was measured.

During a 0.33-inch rainfall beginning at 9:00 P.M. on June 14, with an ambient air temperature somewhat lower than the daily maximum of 85 degrees F, a peak storm water temperature of 74.8 degrees F was measured.

During a 0.65-inch rainfall beginning at 6:30 A.M. on June 16, with an ambient air temperature near the daily minimum of 59 degrees F, a peak storm water temperature of 64.6 degrees F was measured.

The 2.05-inch rainfall on June 17 occurred during three distinct events beginning at 1:30 A.M. (air temperature somewhat higher than the daily minimum of 61 degrees F), 3:50 P.M. (air temperature near the daily maximum of 71 degrees F), and 8:00 P.M. (air temperature somewhat lower than the daily maximum of 71 degrees F). The early morning and evening events produced similar peak storm water temperatures (68.7 degrees F and 67.1 degrees F), while the afternoon event produced a slightly higher peak temperature (71.8 degrees F).

During all rain events in June 1992, storm water temperatures peaked rapidly, then decreased more slowly, reflecting a "first flush" of warmer storm water similar to that influencing stream temperature at Cedar Street.

Storm Water Quality Monitoring:

Results of storm water quality monitoring in residential, commercial, and industrial River Falls subwatersheds (June-August 1992) are presented in Table 3. A comparison of the combined River Falls results to EPA (1983) NURP monitoring results indicates that the median total suspended solids (TSS) concentration in River Falls storm water (200 mg/l) is twice as high as the NURP median (100 mg/l). Median concentrations of total Kjeldahl nitrogen (TKN) and total phosphorus (TP) in River Falls storm water are also higher than the NURP median concentrations. Median concentrations of metals (Cu, Pb, Zn) in River Falls storm water are less than the NURP median concentrations.

Kinnickinnic River Water Management Plan:

The City of River Falls Kinnickinnic River Water Management Plan was completed by SEH in April, 1995. The problem statement and mission statement for the plan are presented in Table 4. The ten major goals of the plan are presented in Table 5. Recommendations for plan implementation and tools for urban storm water management are presented in Table 6.

WDNR Priority Watershed Program:

Financing for implementation of the Kinnickinnic River Water Management Plan will be greatly aided by the WDNR priority watershed program. In 1995, the Kinnickinnic River was designated as a state priority watershed. The Kinnickinnic River Priority Watershed Project will provide substantial funding over a 10-year period for implementation of nonpoint source BMPs, including those for abatement of urban storm water impacts, as recommended by the Kinnickinnic River Water Management Plan.

CONCLUSIONS

The Kinnickinnic River in west-central Wisconsin is a state "outstanding resource water" and a premiere Midwest trout stream, with a self-sustaining brown trout population of 1,500 to 7,500 fish per mile. The City of River Falls, (population 10,500), located in the heart of the Kinnickinnic River watershed, is developing rapidly because of its proximity to the Minneapolis/St. Paul, MN metropolis. Although the current condition of the coldwater resource is good, there is a growing concern about the storm water impacts of current and future development. These impacts include higher stream flows, thermal pollution, and sedimentation, all of which pose threats to trout and aquatic habitat.

Recent (1992-1995) monitoring of storm water and stream temperatures by the Kiap-TU-Wish Chapter of Trout Unlimited indicates that thermal impacts are already evident. Rapid increases in stream temperature (up to 10 degrees F) are frequently evident at locations downstream from storm water outfalls during summer rainfalls, and storm water temperatures may exceed 78 degrees F, the upper lethal limit for brown trout. The thermal impact of two City impoundments produces downstream temperatures that are at least 3-6 degrees F warmer than upstream temperatures. Storm water quality monitoring of residential, commercial, and industrial areas of River Falls (1992) suggests that these areas are greatly susceptible to soil erosion, with sediment concentrations twice as high as the NURP average.

Recognizing that protection of Kinnickinnic River water quality is critical to the environmental and economic future of River Falls, and that development along the Kinnickinnic River needs to be carefully planned to protect the existing resource, the City of River Falls applied for and received a federal EPA 205J water quality planning grant in 1991. Short Elliott Hendrickson (SEH) of St. Paul, MN, a water resource consultant, was selected to develop the Kinnickinnic River Water Management Plan, in partnership with the Wisconsin Department of Natural Resources, City of River Falls, townships, Trout Unlimited, Kinnickinnic River Land Trust, and University of Wisconsin-River Falls. The total cost of the three-year (1992-1994) planning effort was $115,100.
Key recommendations of the Kinnickinnic River Water Management Plan include: a limitation of 10-12% effective impervious area within the City; proper detention pond design to maximize thermal mitigation and achieve a minimum sediment removal efficiency of 85%; stringent erosion control ordinances; additional storm water BMPs; and increased public awareness and involvement.

Substantial funding for implementation of the Kinnickinnic River Water Management Plan may be provided by a 10-year Kinnickinnic River Priority Watershed Project administered by the Wisconsin Department of Natural Resources.

LITERATURE CITED

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Galli, John. 1990. Thermal Impacts Associated with Urbanization and Storm Water Management Best Management Practices - Final Report.

Short Elliott Hendrickson. 1995. City of River Falls Water Management Plan for the Kinnickinnic River and its Tributaries. SEH, St. Paul, MN. 286 p.

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The partnerships established as a result of this project (City of River Falls, townships, Trout Unlimited, Kinnickinnic River Land Trust, University of Wisconsin-River Falls, Wisconsin Department of Natural Resources, and Short Elliott Hendrickson) have been invaluable. It is my hope that these partnerships can continue to function and grow, to ensure the future vitality of this unique and outstanding resource: the Kinnickinnic River.

LIST OF FIGURES AND TABLES

Figure 1

Kinnickinnic River Thermal Monitoring Site

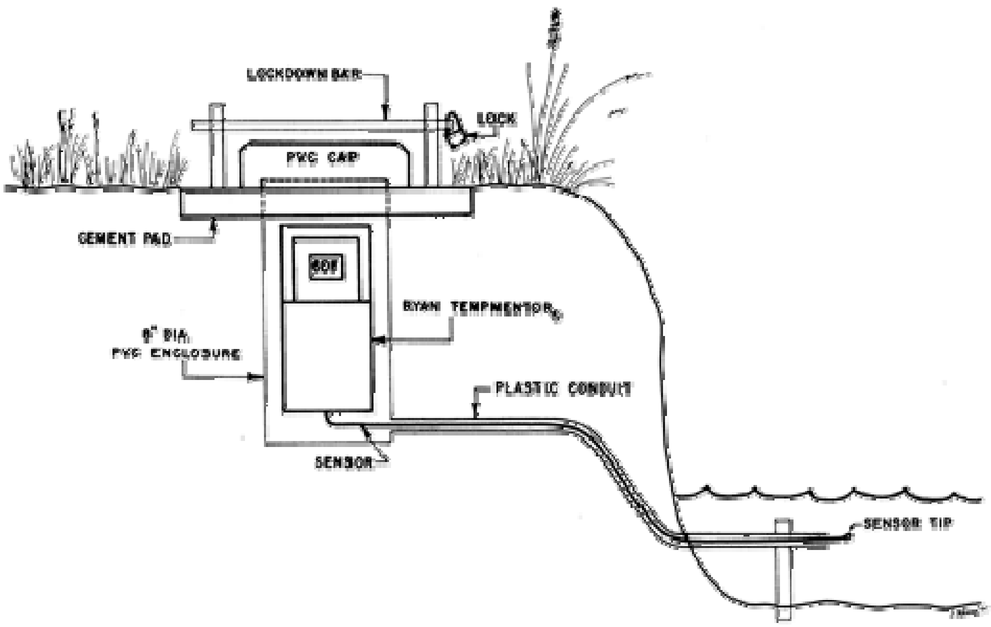
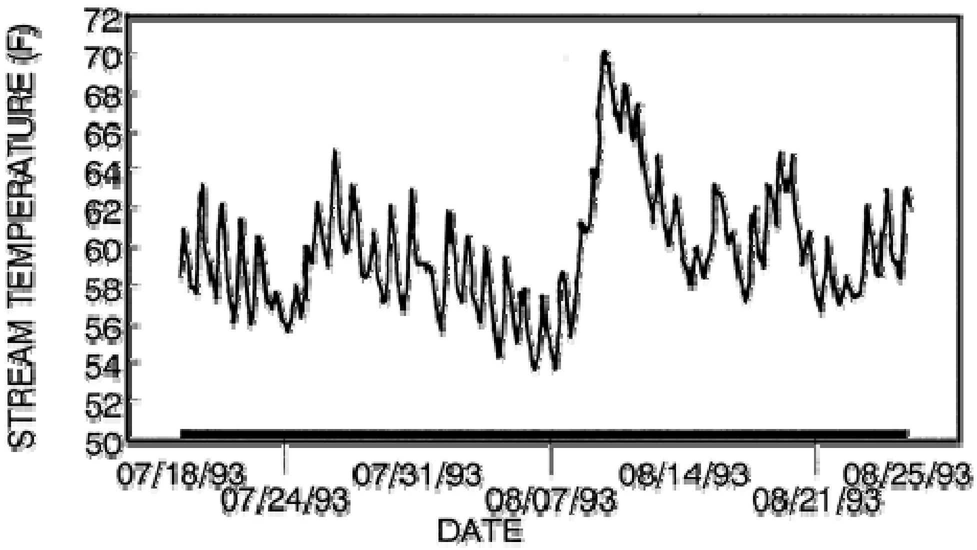


Figure 2

Quarry Road Thermograph
Kinnickinnic River at Quarry Road

July 18 - August 25, 1993



Stream Temperature Summary: Average= 59.7 F Minimum= 53.6 F Maximum= 70.2 F

Figure 3

Cedar Street Thermograph with Storm Water-Induced Temperature Spikes (*)
Kinnickinnic River at Cedar Street

July 17- August 24, 1993

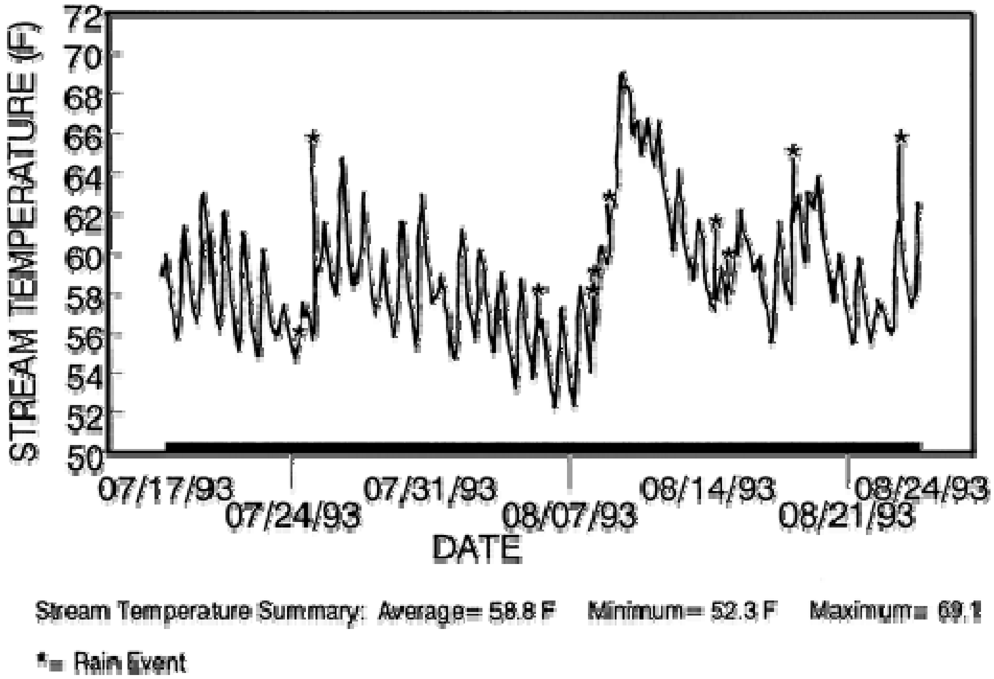


Figure 4

Cedar Street Thermograph with Storm Water-Induced Temperature Spike
Kinnickinnic River at Cedar Street

July 25, 1993

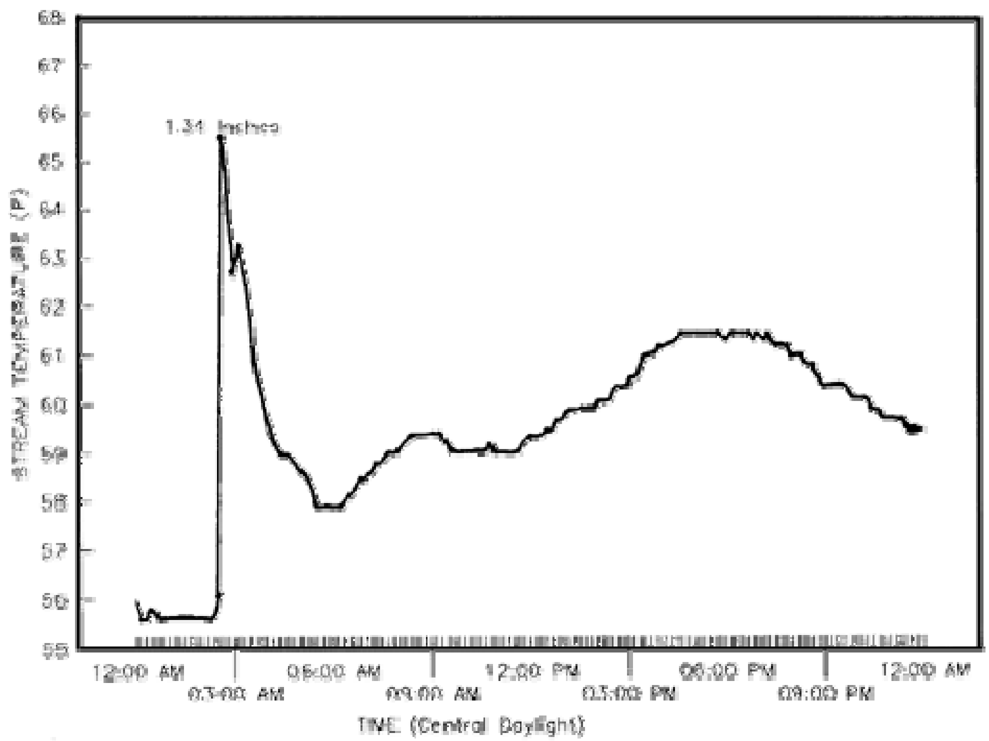


Figure 5

Lower Glen Park Thermograph with Storm Water-Induced Temperature Spike
Kinnickinnic River At Lower Glen Park

July 25, 1993

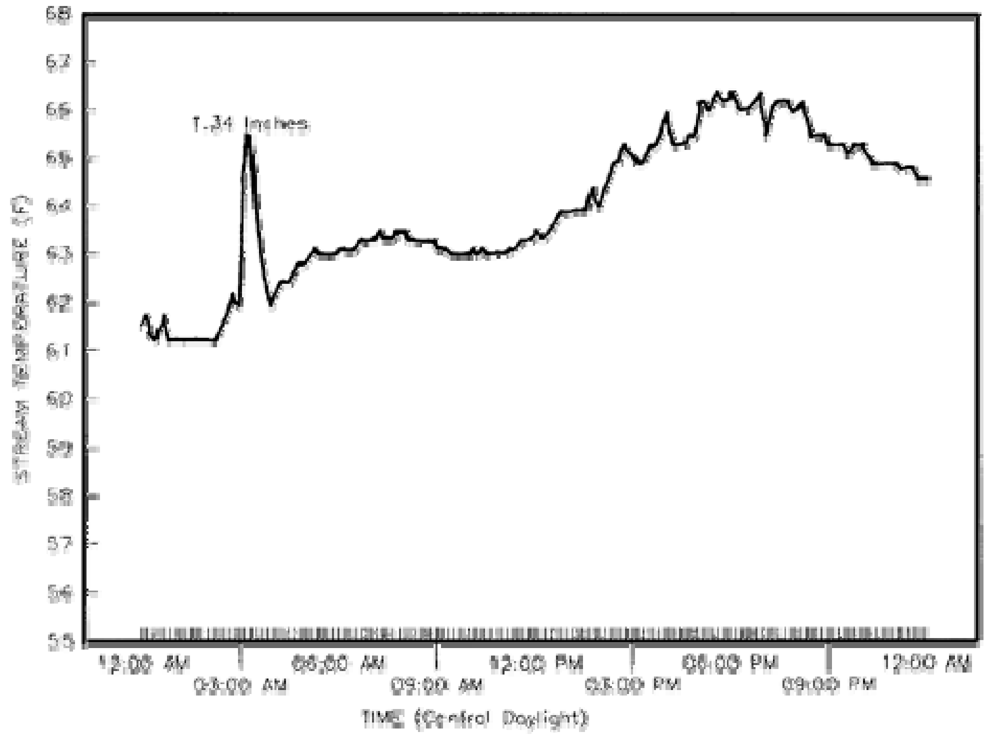


Figure 6

Quarry Road Thermograph
Kinnickinnic River at Quarry Road

July 25, 1993

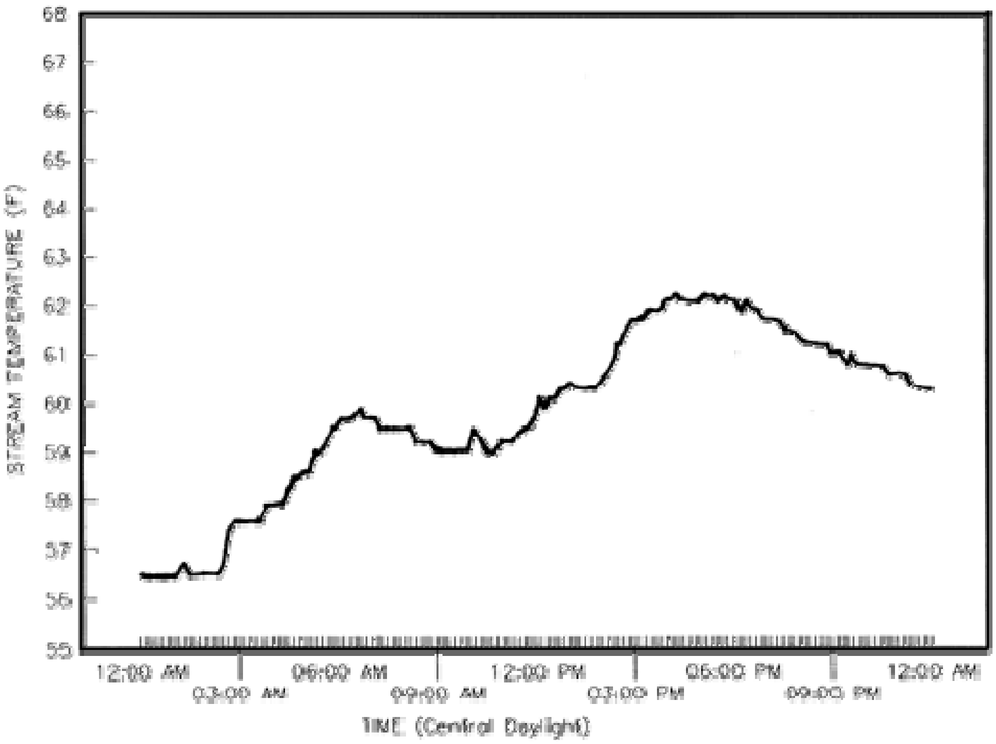


Figure 7

Comparison of Cedar Street, Lower Glen Park, and Quarry Road Thermographs

July 25, 1993

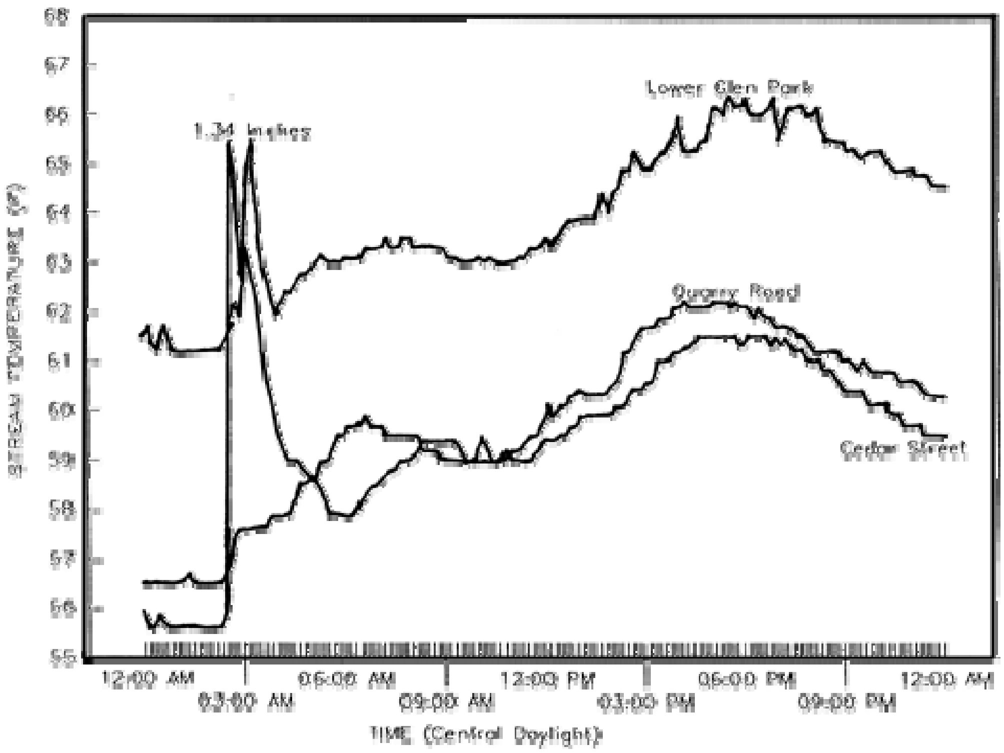


Figure 8

Storm Water Temperatures in a Commercial River Falls Subwatershed
(As Represented By Temperature Spikes*)

June 1992

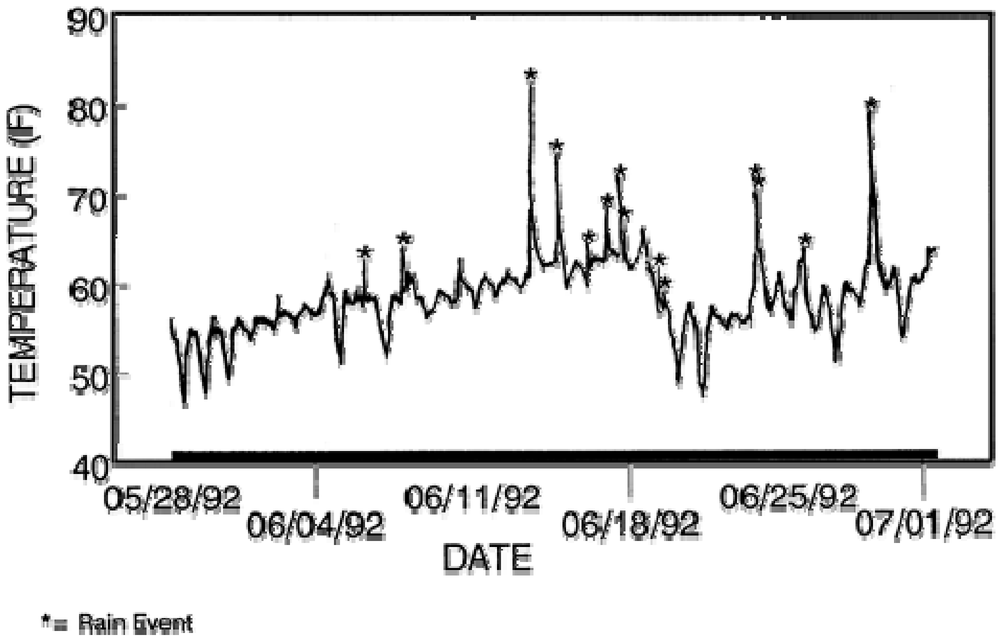


Figure 9

Storm Water Temperatures during Four Rain Events in a Commercial River Falls Subwatershed
(As Represented By Temperature Spikes)

June 13-18, 1992

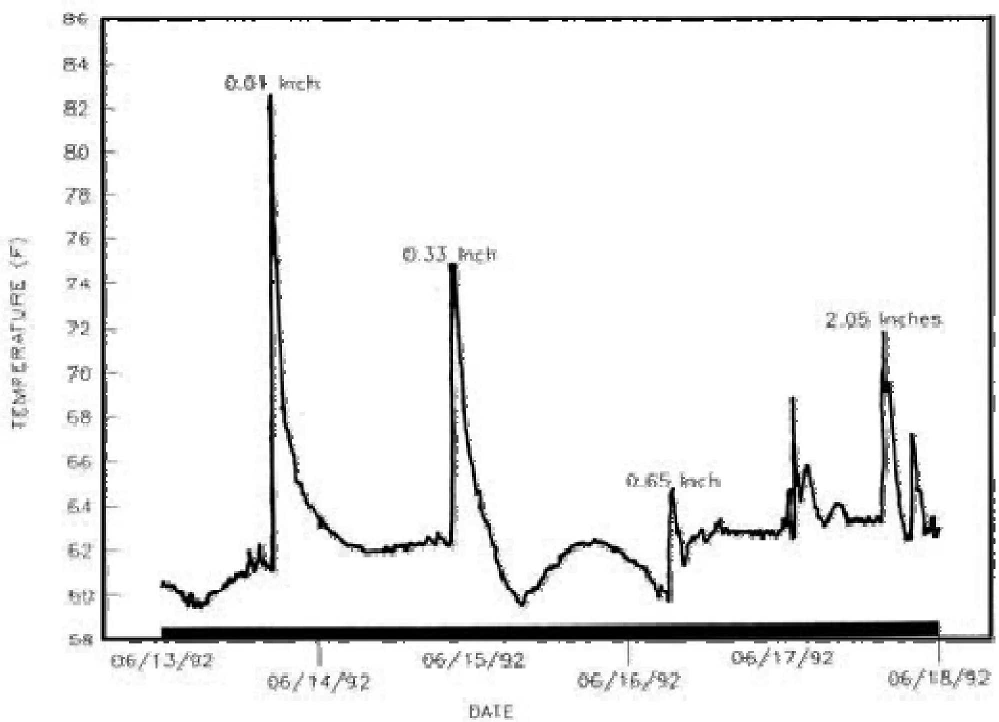


Table 1

Ambient Air Temperatures and Precipitation

July - August 1993

Date	Maximum	Minimum	Average	Departure from Normal	Precipitation (Inches)*
July 17	83	69	76	+2	0.02
18	85	66	76	+2	None
19	77	62	70	-4	Trace
20	79	57	68	-6	None
21	78	60	69	-5	None
22	76	61	69	-5	None
23	71	66	69	-5	None
24	77	66	72	-2	0.01
25	77	68	73	-1	1.34
26	84	65	75	+1	None
27	85	67	76	+2	0.13
28	77	66	72	-2	None
29	82	61	72	-2	None
30	85	59	72	-2	None
31	79	67	73	-1	0.20

Temperatures measured at Mpls./St. Paul Airport
*Rainfall measured in River Falls, WI

Date	Maximum	Minimum	Average	Departure from Normal	Precipitation (Inches)*
August 1	79	60	70	-4	0.14
2	75	58	67	-6	None
3	69	55	62	-11	Trace
4	74	49	62	-11	None
5	74	53	64	-9	0.24
6	71	51	61	-12	0.05
7	75	52	64	-9	None
8	82	61	72	0	1.58
9	89	67	78	+6	1.41
10	88	64	76	+4	None
11	88	68	78	+6	None
12	88	69	79	+7	None
13	81	65	73	+1	None
14	78	63	71	0	0.49
15	85	68	77	+8	0.75
16	79	65	72	+1	Trace
17	85	60	73	+2	None
18	79	66	73	+3	2.05
19	83	63	73	+3	None
20	77	61	69	-1	None
21	79	60	70	+1	None
22	76	64	70	+1	None
23	80	67	74	+5	0.06
24	89	64	77	+8	0.26
25	89	68	79	+11	None
Period	89	49	72	-1	8.73

Temperatures measured at Mpls./St. Paul Airport
*Rainfall measured in River Falls, WI

Table 2

Ambient Air Temperatures and Precipitation

June 1992

Date	Maximum	Minimum	Average	Departure from Normal	Precipitation (Inches)*
1	80	55	68	+4	None
2	83	55	69	+5	None
3	85	58	72	+7	None
4	77	57	67	+2	None
5	80	50	65	0	None
6	72	50	61	-5	0.10
7	72	44	58	-8	None
8	65	53	59	-7	0.33
9	80	59	70	+3	None
10	84	61	73	+6	None
11	89	59	74	+4	None
12	92	60	76	+9	None
13	90	66	78	+10	0.01
14	85	64	75	+7	0.08
15	78	60	69	+1	0.25
16	76	59	68	0	0.65
17	71	61	66	-3	2.05
18	79	63	71	+2	0.05
19	63	45	54	-15	0.04
20	66	41	54	-15	None
21	66	39	53	-17	None
22	59	52	56	-14	Trace
23	76	55	66	-4	0.09
24	75	56	66	-4	0.11
25	71	53	62	-9	0.01

26	70	50	60	-11	None
27	75	49	62	-9	None
28	85	60	73	+2	1.09
29	73	56	65	-6	Trace
30	72	55	64	-7	Trace
Month	76	55	66	-2	4.86

Air temperatures measured at Mpls./St. Paul Airport
Precipitation measured in River Falls, WI
Normal precipitation for the month of June is 4.07 inches

Table 3

River Falls Storm Water Quality (1992) Compared to NURP Monitoring Results

NURP: National Urban Runoff Program

Residential Subwatershed

Water Quality Variable (mg/l)	River Falls Median	NURP Median
TSS (Total Suspended Solids)	240.0	101.0
TKN (Total Kjeldahl Nitrogen)	2.6	1.90
TP (Total Phosphorus)	0.75	0.38
Cu (Copper)	0.030	0.033
Pb (Lead)	0.015	0.144
Zn (Zinc)	0.110	0.135

Commercial Subwatershed

Water Quality Variable (mg/l)	River Falls Median	NURP Median
TSS (Total Suspended Solids)	150.0	69.0
TKN (Total Kjeldahl Nitrogen)	2.1	1.20
TP (Total Phosphorus)	0.50	0.20
Cu (Copper)	0.030	0.029
Pb (Lead)	0.080	0.104
Zn (Zinc)	0.190	0.226

Industrial Subwatershed

Water Quality Variable (mg/l)	River Falls Median
TSS (Total Suspended Solids)	250.0
TKN (Total Kjeldahl Nitrogen)	2.5
TP (Total Phosphorus)	0.50
Cu (Copper)	0.030
Pb (Lead)	0.050
Zn (Zinc)	0.210

These data represent only one storm event. No NURP data are available for direct comparison.

All Subwatersheds

Water Quality Variable (mg/l)	River Falls Median	NURP Median
TSS (Total Suspended Solids)	200.0	100.0
TKN (Total Kjeldahl Nitrogen)	2.6	1.50
TP (Total Phosphorus)	0.50	0.38
Cu (Copper)	0.030	0.034
Pb (Lead)	0.050	0.140*
Zn (Zinc)	0.140	0.160

*NURP monitoring was completed prior to the decrease in leaded gasoline use.

Table 4

Kinnickinnic River Water Management Plan: Problem and Mission Statements

PROBLEM STATEMENT

The increase in urban runoff, with its associated thermal and sediment pollution from present and future development in the City of River Falls, can have a detrimental impact on the coldwater fishery of the Kinnickinnic River.

MISSION STATEMENT

The City of River Falls, in cooperation with the Wisconsin Department of Natural Resources (WDNR), Trout Unlimited, and the University of Wisconsin-River Falls, will implement a regional water quality plan which will accommodate anticipated community development while controlling the quality and quantity of storm water runoff, and properly manage and protect ground water resources and the physical habitat of the Kinnickinnic River and its tributaries.

Table 5

Kinnickinnic River Water Management Plan:
Goals

1. Flood Control: Control flooding and minimize public capital expenditures.

2. Water Quality: Achieve water quality standards in the Kinnickinnic River and its tributaries, and in City lakes (impoundments), consistent with intended uses and classifications.

3. Recreation, Fish, and Wildlife: Protect and enhance water recreational facilities, fish and wildlife habitat.

4. Public Participation, Information, and Education: Increase public participation and knowledge in management of the water resources of the community.

5. Ground Water: Promote ground water recharge, prevent contamination of the aquifers, and protect spring areas.

6. Wetlands: Maintain wetland acreage and increase the wetland values within the City.

7. Erosion Control: Prevent soil erosion.

8. Regulatory Responsibility: Assume responsibility for managing water resources within the City, and recognize the regulatory authority of other local, state, and federal entities.

9. Finance: Finance water resources projects by means that are equitable to all citizens.

10. Records Management and Documentation: Preserve historical data, records, and files pertaining to the water resources of River Falls.

Table 6

Recommendations for Plan Implementation and Tools for Urban Storm Water Management

Limit Watershed Imperviousness

Studies by Galli (1990) of six urban streams in Maryland identified watershed imperviousness as the largest influence on the thermal regime of free-flowing streams. Other factors influencing stream temperature include riparian canopy coverage, air temperature, and stream order/size. Galli noted that storm water generally increases stream temperatures. His studies suggest that, to adequately support a coldwater fishery, preventing adverse thermal and sediment impacts from storm water runoff, impervious surfaces within a watershed should not exceed 10-12% of the watershed area. This "effective percent impervious" area is site-specific, and needs to be "fine-tuned" for the Kinnickinnic River watershed, through continuing thermal monitoring and development of a thermal model.

The Kinnickinnic River Water Management Plan identifies present and future development in each of the 7 minor watersheds of the Kinnickinnic River Watershed, and projects a percent impervious area for each minor watershed. Aggressive storm water management practices, focusing on thermal mitigation, must be implemented in each minor watershed to reduce the projected percent impervious area to the "effective percent impervious" area. This plan will support River Falls development as long as the "effective percent impervious" criterion can be met in each minor watershed, thus supporting the coldwater resource.

Design BMPs to Mitigate Thermal, Sedimentation, and Hydrologic Impacts of Storm water

Galli (1990) evaluated the thermal effectiveness of four BMPs: an infiltration dry pond, an artificial wetland, an extended detention dry pond, and a wet pond. Galli's studies can likely be extrapolated to some extent, to develop recommended BMPs for River Falls. By developing the first BMPs as pilot projects with adequate monitoring, the effectiveness of thermal mitigation can be maximized. The recommended minimum TSS removal efficiency for River Falls storm water treatment areas is 85%.

Adopt, Implement, and Enforce Local Ordinances

The City of River Falls has several codes and ordinances that relate to surface water management. Ordinances that will help the City realize the goals of the Kinnickinnic River Water Management Plan include those for: storm water, shoreland, and floodplain management; erosion control; groundwater, wetland, and environmental protection; land development density; and public utilities.

Create Residential, Industrial, and Commercial Source Control Programs for On-Site Storm Water Management (Pollution Prevention)

As one example, the University of Wisconsin-River Falls has created a wetland to receive storm water runoff from several campus parking lots.

Temper Development Through Public Land Acquisition and Conservation Easements (Land Trusts)

The Kinnickinnic River Land Trust (KRLT) was incorporated in 1993. A non-profit, tax-exempt organization, its mission is to protect the natural resources, scenic beauty, and water quality of the Kinnickinnic River. KRLT works in partnership with landowners, farmers, organizations, and businesses to permanently protect land. Landowners who want to keep their land natural and undeveloped use a conservation easement, which limits development, but allows a full range of uses for agriculture, recreation, and open space.

Involve the Public, the Local Education System, and Environmental Organizations

Examples may include: a River Falls storm sewer stenciling program; informational handouts for City residents; media packets; community events that focus on the Kinnickinnic River; involvement of youth/seniors/community service organizations/businesses in Kinnickinnic River projects (including citizen and student monitoring programs); involvement of environmental organizations like Trout Unlimited and the Kinnickinnic River Land Trust; and development of an environmental curriculum, focusing on the Kinnickinnic River Watershed, for area schools and the University of Wisconsin-River Falls.

Table 7

Preferred Temperatures for Trout

BROWN TROUT

Optimum Temperature Range: 53-68° F

Upper Lethal Limit: 78° F

BROOK TROUT

Optimum Temperature Range: 55-66° F

Upper Lethal Limit: 77° F