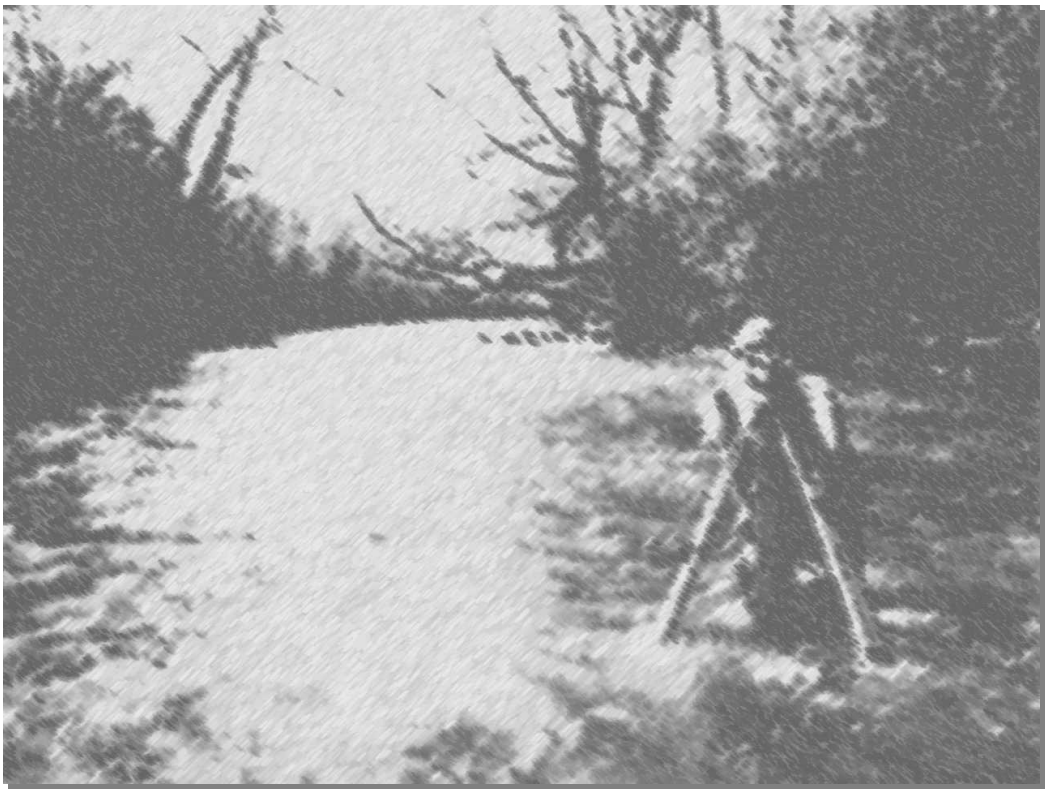
LOWER ROOT RIVER STREAM MORPHOLOGY ASSESSEMENT



Wisconsin Department of Natural Resources
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Water Quality Biologist
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INTRODUCTION

"The shape of the cross section of a river channel at any location is a function of the flow, the quantity and character of the sediment in movement through the section, and the character or composition of the materials making up the bed and banks of the channel." Leopold (1964)

OR

"The river is the carpenter of its own edifice." Leopold (1994)

There are eight variables that determine the form a river takes. Leopold, L., et. al. (1964) They are width, depth, velocity, discharge, slope, channel roughness, sediment load, and sediment size. A river will attempt to reach a state of dynamic equilibrium amongst these eight variables. Adjustments to one variable will result in changes among the others. With this in mind, it is possible to measure certain stream characteristics, and use these characteristics to group and organize streams into similar types. In addition, researchers have assessed certain fish habitat improvement structures and their impacts upon channel stability. By comparing the fish habitat structures and their impacts to the stream type for that channel, it is possible to choose fish habitat structures that will not result in stream channel instability.

This project, funded through the Root-Pike Watershed Initiative Network and the Wisconsin Department of Natural Resources, attempts to assign a Channel Type score to individual stream reaches within specific wadable portions of the Root River. The Root River itself originates in New Berlin in Milwaukee County, and flows 43 miles through Milwaukee and Racine Counties to empty into Lake Michigan in the City of Racine.

There were 16 reaches within the Root River that were surveyed and assigned a Channel Type score. The reaches surveyed were from Island Park in the City of Racine,upstream to the mouth of Hoods Creek. The Channel Type scores were obtained using the methods developed by David Rosgen of Wildland Hydrology, and elaborated upon in his textbook- Applied River Morphology, (1996). The Applications Chart on pgs. 8-24 and 8-25 of Rosgen's textbook gives the suitability of fish habitat structures for a specific Channel Type score. This document summarizes information collected for each surveyed reach and gives the corresponding Rosgen Channel Type score, and lists the fish habitat structures that are appropriate to that Channel Type score.

Where fish habitat structures have been recommended, it is important to note that the recommendations pertain to that structures impact on channel stability only, and are not a measure of the appropriateness of that structure for attracting fish. The recommendations in this document can, however, serve to initiate discussion regarding fish habitat improvement, and narrow the list of potential improvement structures.

The following chapters describe the methods used in the Root River Morphology survey, provide fish habitat improvement structure information and diagrams, and summarize the information collected for the individual surveyed reaches. Raw data and information not conveyed in this report, including detailed substrate monitoring information, is kept on file and is available from the Department of Natural Resources Sturtevant Service Center, 9531 Rayne Road, Sturtevant, WI 53177.

METHODS

The methods used for obtaining a Rosgen Stream Type Score were taken from "Applied River Morphology, 1996 Wildland Hydrology Pagosa Springs, CO" and are as follows:

Survey Steps

1.) Identify Reach
   a. Measure and flag a reach containing 5 riffle structures or rough continuity of form/hydrological impacts
2.) Identify Morphological Classification Transect riffle that is representative of reference reach
3.) Identify 3 bankfull stage indicators and run Classification Transect
4.) Determine average bankfull depth by taking 10 bankfull elevations equi-spaced across Classification Transect
5.) Determine maximum depth
6.) Determine flood-prone width
7.) Photograph and spacialy locate (using GPS) the Classification Transect
8.) Determine Channel Material size throughout the reach
9.) Determine reach slope
10.) Determine reach sinuosity
11.) Assign Rosgen Stream Type Score
   a.) Width/Depth Ratio
   b.) Entrenchment Ratio
   c.) Sinuosity
   d.) Channel Materials
   e.) Slope

Discussion

The specific reaches ranged in length from 700 feet to 2000 feet in length. Each reach measured was judged by the author of this report to be of a reasonably similar geomorphologic character. That is, there were no significant deviations in form or bank structure within that specific stream reach.

Bankfull Stage Identification

Bankfull stage is the channel forming discharge, carrying the largest amount of sediment over time. It is the stage where the stream just starts to access its' floodplain. Typically, the bankfull stage accomodates the two-year storm flow or less.

The bankfull stage elevation was identified through identification of visual/physical indicators. These indicators included: 1.) Breaks in bank slope 2.) Tops of point bars 3.) Evidence of rock staining

Entrenchment Ratio

The entrenchment ratio is the ratio of the width of the flood-prone area to the surface width of the bankfull channel.

The entrenchment ratio was obtained by dividing the flood-prone width by the bankfull width. The flood prone width is taken at twice the maximum depth of the bankfull stage.

Width/Depth Ratio

The Width/Depth Ratio is defined as the ratio of bankfull surface width to the mean depth of the bankfull channel.

The width/depth ratio was obtained by dividing the bankfull width by the average bankfull depth.

Channel Materials

Channel materials are the substrate particles that make up the bed and banks within a bankfull channel.

Ten transects were distributed throughout the surveyed reference reach, with distribution approximately equal to run/riffle ratio (where riffles were in existance). For example, if a 100-foot reach consisted of 70 feet of run, and 30 feet of riffle, seven transects were sighted across run portions, and three transects were sighted across riffles. Each transect was then divided into 10 equally spaced intervals. At each interval, a measurment of the intermediate sediment particle size of the first particle touched was then taken. The sediment particle sizes for the whole reach were then broken into size categories and totaled by percent. The particle group making up the cumulative 50th percentile for the reach was then taken as representative of the channel materials.

Slope

Slope is the change in stream elevation over a distance.

Slope was obtained by taping off a known distance between riffle structures, and using a survey rod and level to measure the difference in height. Alternately (in the cases of Reaches 14 –16,) the slope was obtained by using USGS Topographical maps, measuring the elevation change and distance between two (or more) contour lines on the surveyed reach.

Sinuosity

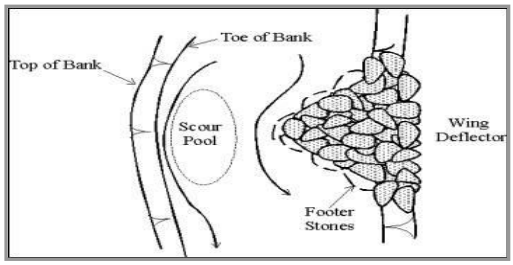
Sinuosity is defined as the ratio of stream length to valley length,

Sinuosity was obtained using USGS topographical maps, measuring the stream length within the reference reach and the direct line distance between the reference reach beginning and end. The stream length was then divided by the direct line distance to obtain sinuosity.

FISH HABITAT STRUCTURES

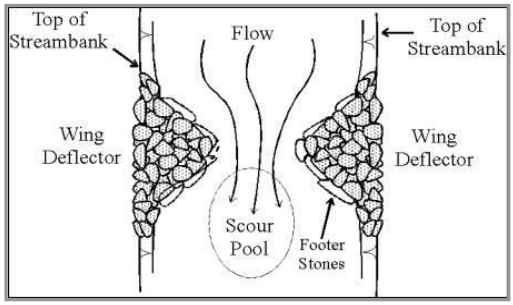
SINGLE WING DEFLECTORS

Direct stream flows, increase velocities, and form small pools



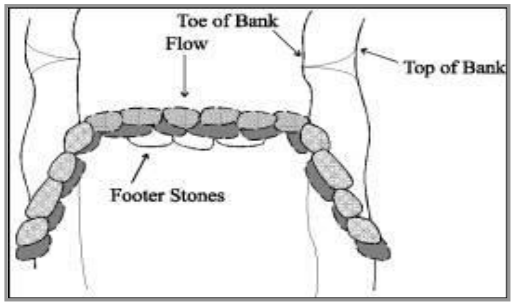
DOUBLE WING DEFLECTORS

Narrow channel, increase velocities, and form scour pools



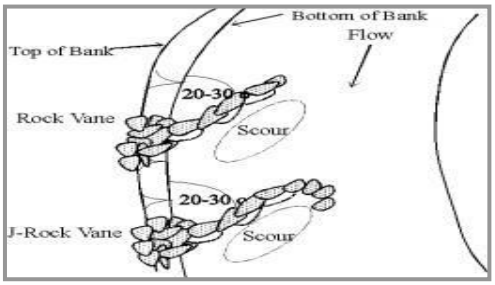
CROSS VANE

Create in-stream cover, divert sheer stress, create grade control, and provide gravel sorting



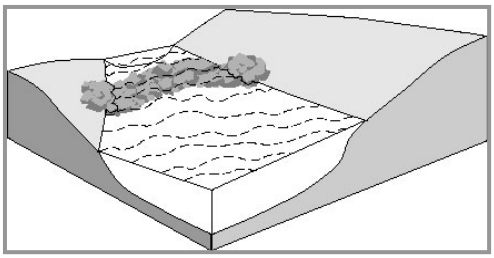
ROCK VANE, J-HOOK

Reduce erosion, stabilize stream banks, and create pools



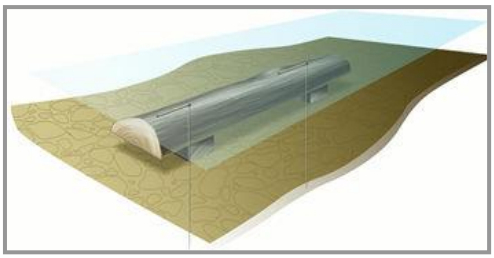
WIERS (W-Weir)

Create in-stream cover, create velocity and depth



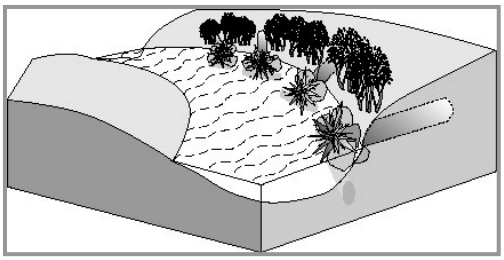
HALF-LOG COVER

Provide overhead cover



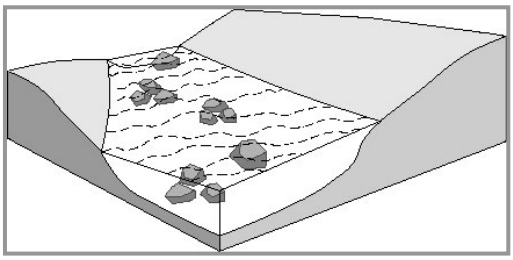
ROOT WADS

Provide cover, create pools



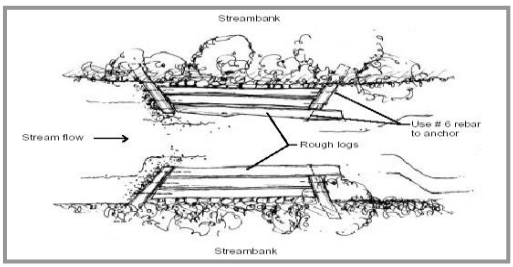
BOULDER PLACEMENT

Provide in-stream cover



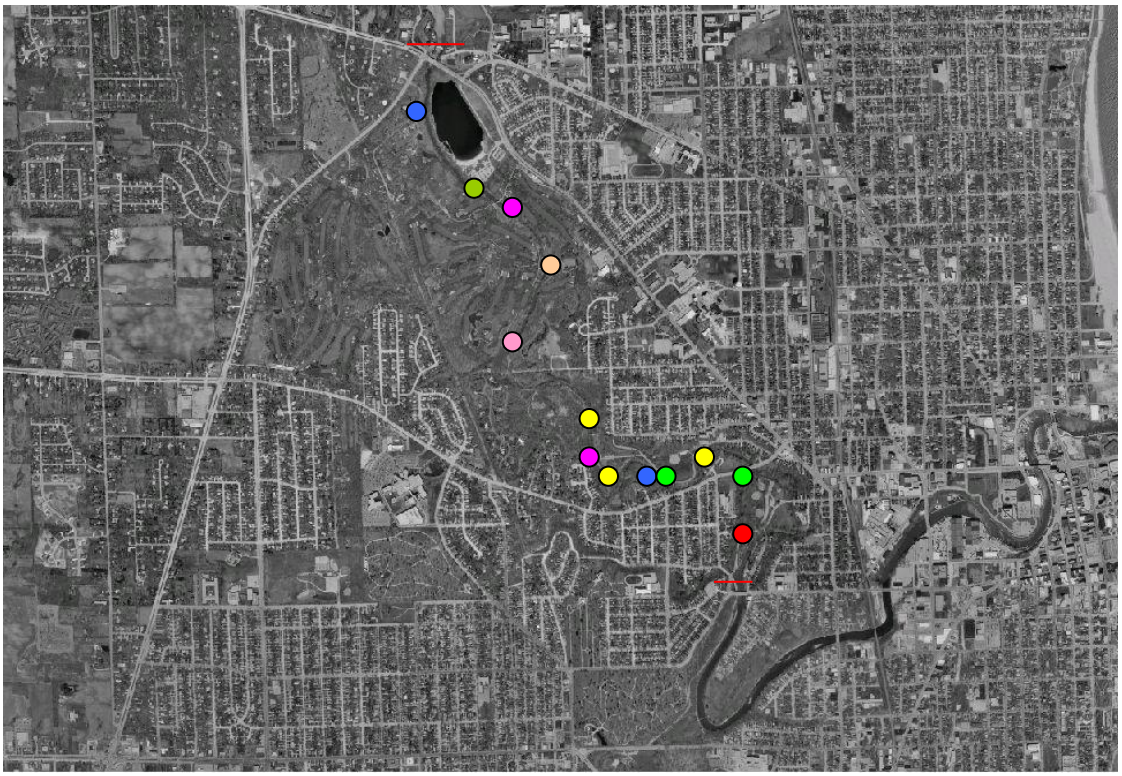
CHANNEL CONSTRICTOR

Narrow and deepen channel



Note: see REFERENCES for citations

PROJECT OVERVIEW – DOWNSTREAM OF HORLICK DAM



REACH 1

Location:

Lat: 42º 43’ 43.7”

Long: -87º 48’ 18.9”

Description:

Start of Station: 164 feet upstream of 6th St. bridge, west branch of Root River at Island Park

Reach Length: 900 feet

Substrate: Medium Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders

note: dashed line denotes approximate bankfull height

Reach 1 Summary

Bankfull Width: 45.7 feet
Flood Prone Width: 51.2 feet
W/D Ratio: 21.25
Entrenchment Ratio: 1.12
Average Depth: 2.15 feet
Maximum Depth: 3 feet
Channel Materials: Medium Gravel
Slope: .00003 ft./ft.
Sinuosity: 1.11
Rosgen Channel Type: F4

REACH 2

Location:

Lat: 42º 43’ 51.7” N

Long: -87º 48’ 16.31” W

Description:

Start of Station: 33 feet upstream of footbridge, west branch of Root River at Island Park

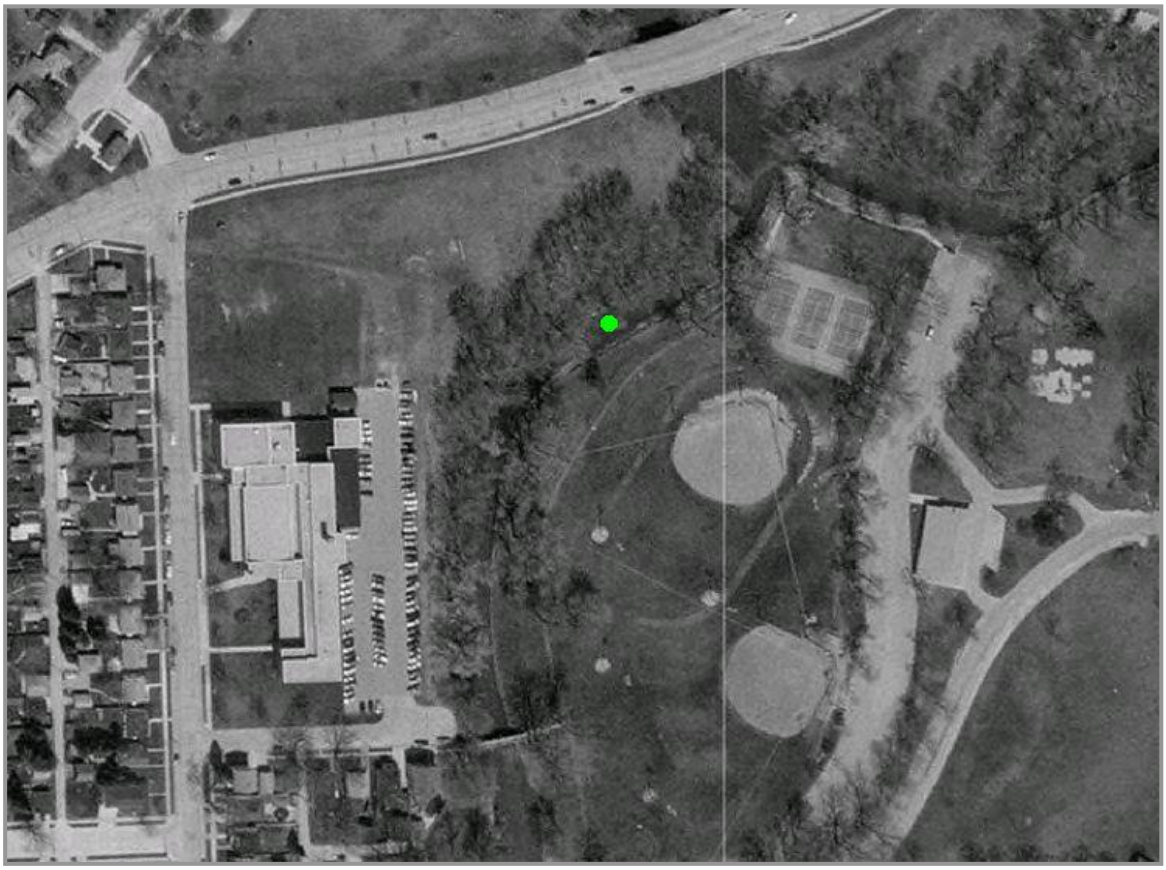
Reach Length: 800 feet

Substrate: Coarse Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders



note: dashed line denotes approximate bankfull height

Reach 2 Summary

Bankfull Width: 45.7 feet
Flood Prone Width: 51.9 feet
W/D Ratio: 24.3 ft./ft.
Entrenchment Ratio: 1.13 ft./ft.
Average Depth: 1.88 feet
Maximum Depth: 2.7 feet
Channel Materials: Coarse Gravel
Slope: .002 ft./ft.
Sinuosity: 1.03 ft./ft.
Rosgen Channel Type: F4

REACH 3

Location:

Lat: 42° 43’ 58.4”

Long: -87° 48’ 22.8”

Description:

Start of Station: Spring Street Bridge, downstream of Lincoln Park

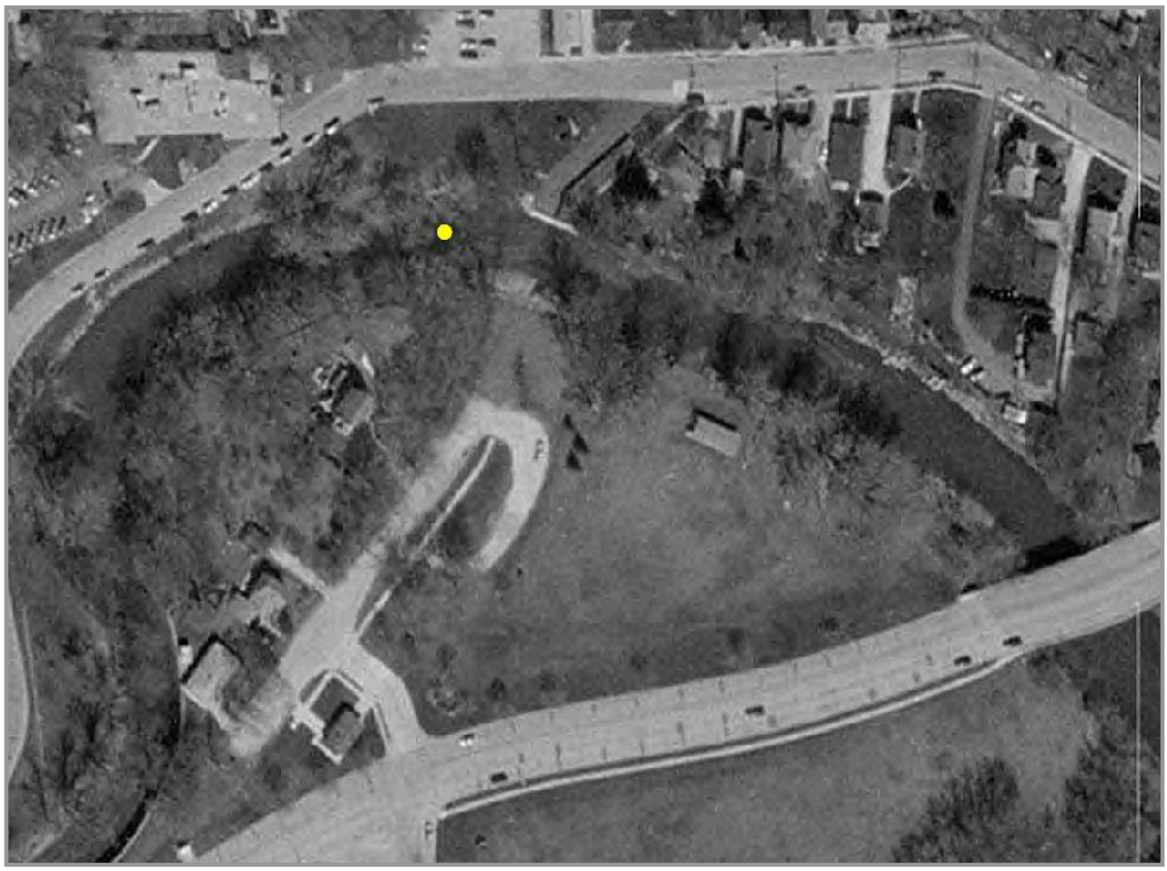
Reach Length: 1035 feet

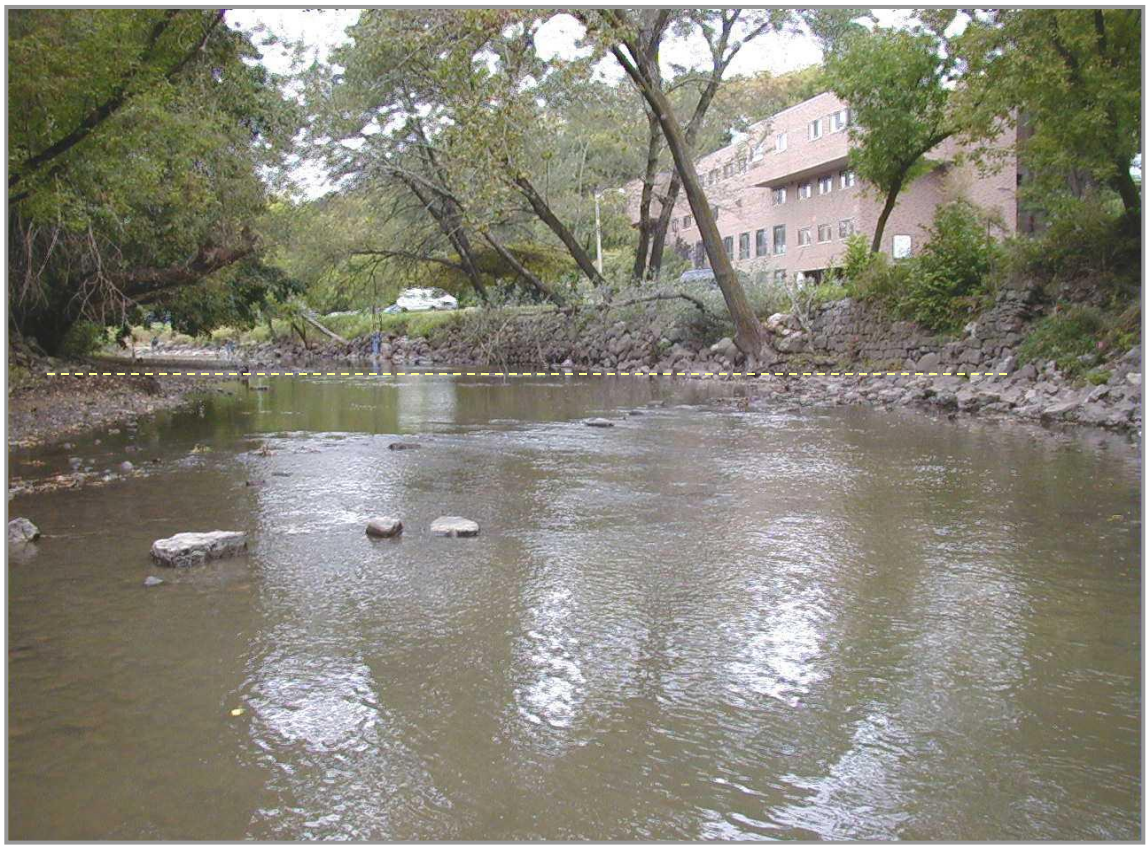
Substrate: Very Coarse Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders





note: dashed line denotes approximate bankfull height

Reach 3 Summary

Bankfull Width: 63.2 feet
Flood Prone Width: 67.8 feet
W/D Ratio: 33.61 ft./ft.
Entrenchment Ratio: 1.07 ft./ft.
Average Depth: 1.88 feet
Maximum Depth: 2.9 feet
Channel Materials: Very Coarse Gravel
Slope: .0005 ft./ft.
Sinuosity: 1.16 ft./ft.
Rosgen Channel Type: F4

REACH 4

Location:

Lat: 42° 43’ 52.9”

Long: -87° 48’ 28.1”

Description:

Start of Station: 1035 feet upstream of Spring Street Bridge, within Lincoln Park

Reach Length: 875 feet

Substrate: Coarse Gravel

Classification: B4

Recommended Habitat Structures: Random and Bank placed boulders, Single and Double Wing Deflector, Channel Constrictor, Half-log cover, Cross Vane, “W” Weir, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: None

note: dashed line denotes approximate bankfull height

Reach 4 Summary

Bankfull Width: 47.9 feet
Flood Prone Width: 68 feet
W/D Ratio: 22.17 ft./ft.
Entrenchment Ratio: 1.42 ft./ft.
Average Depth: 2.16 feet
Maximum Depth: 5.3 feet
Channel Materials: Coarse Gravel
Slope: .0008 ft./ft.
Sinuosity: 1.35 ft./ft.
Rosgen Channel Type: B4

REACH 5

Location:

Lat: 42° 43’ 54.8”

Long: -87° 48’ 38”

Description:

Start of Station: At end of rock wall, upstream of “old” foot bridge in Lincoln Park

Reach Length: 870 feet

Substrate: Very Coarse Gravel

Classification: C4

Recommended Habitat Structures: Cross Vane, Bank Root Wads, J-Hook, Rock Vanes, Single and Double Wing Deflectors, Channel Constrictor, Half log cover

Poor Habitat Structures: Random Boulder Placement

note: dashed line denotes approximate bankfull height

Reach 5 Summary

Bankfull Width: 64.6 feet
Flood Prone Width: 175 feet
W/D Ratio: 25.14 ft./ft.
Entrenchment Ratio: 2.71 ft./ft.
Average Depth: 2.57 feet
Maximum Depth: 3.6 feet
Channel Materials: Very Coarse Gravel
Slope: .001 ft./ft.
Sinuosity: 1.01 ft./ft.
Rosgen Channel Type: C4

REACH 6

Location:

Lat: 42° 43' 54.4"

Long: -87° 48' 47.2"

Description:

Start of Station: Middle of bend, downstream of Root River Weir

Reach Length: 800 feet

Substrate: Coarse Gravel

Classification: B4

Recommended Habitat Structures: Random and Bank placed boulders, Single and Double Wing Deflector, Channel Constrictor, Half-log cover, Cross Vane, "W" Weir, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: None

note: dashed line denotes approximate bankfull height

Reach 6 Summary

Bankfull Width: 36.1 feet
Flood Prone Width: 53.3 feet
W/D Ratio: 28.42 ft./ft.
Entrenchment Ratio: 1.48 ft./ft.
Average Depth: 1.27 feet
Maximum Depth: 1.6 feet
Channel Materials: Coarse Gravel
Slope: .005 ft./ft.
Sinuosity: 1.13 ft./ft.
Rosgen Channel Type: B4

REACH 7

Location:
Lat: 42° 43’ 59.6”
Long: -87° 48’ 52.4”
Description:
Start of Station: At top of bend, upstream of Root River Weir
Reach Length: 800 feet
Substrate: Coarse Gravel
Classification: F4
Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes
Poor Habitat Structures: Random or Bank placed boulders

note: dashed line denotes approximate bankfull height

Reach 7 Summary

Bankfull Width: 84.6 feet
Flood Prone Width: 99 feet
W/D Ratio: 30.32 ft./ft.
Entrenchment Ratio: 1.17 ft./ft.
Average Depth: 2.79 feet
Maximum Depth:: 3.9 feet
Channel Materials: Coarse Gravel
Slope: .0004 ft./ft.
Sinuosity: 1.0 ft./ft.
Rosgen Channel Type: F4

REACH 8

Location:
Lat: 42° 44’ 5.3”
Long: -87° 48’ 52.6”
Description:
Start of Station: Upstream of bend
Reach Length: 700 feet
Substrate: Very Coarse Gravel
Classification: B4* (Out of parameters on w/d ratio and sinuosity ratio)
Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes
Poor Habitat Structures: None

note: dashed line denotes approximate bankfull height

Reach 8 Summary

Bankfull Width: 73.2 feet
Flood Prone Width: 112.5 feet
W/D Ratio: 42.07 ft./ft.
Entrenchment Ratio: 1.54 ft./ft.
Average Depth: 1.74 feet
Maximum Depth: 2.4 feet
Channel Materials: Very Coarse Gravel
Slope: .002 ft./ft.
Sinuosity: 1.0 ft./ft.
Rosgen Channel Type: B4 (out of parameters on w/d ratio and sinuosity ratio)

REACH 9

Location:

Lat: 42° 44' 18.3"

Long: -87° 49' 9.2"

Description:

Start of Station: Upstream of second wood bridge at Colonial Park

Reach Length: 1400 feet

Substrate: Very Coarse Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders

note: dashed line denotes approximate bankfull height

Reach 9 Summary

Bankfull Width: 59.7 feet
Flood Prone Width: 65 feet
W/D Ratio: 70.23 ft./ft.
Entrenchment Ratio: 1.09 ft./ft.
Average Depth: .85 feet
Maximum Depth: 1.2 feet
Channel Materials: Very Coarse Gravel
Slope: .004 ft./ft.
Sinuosity: 1.34 ft./ft.
Rosgen Channel Type: F4

REACH 10

Location:

Lat: 42° 44' 28.7"

Long: -87° 49' 2.7"

Description:

Start of Station: 85 feet downstream of Racine Country Club cart bridge

Reach Length: 1200 feet

Substrate: Small Cobble

Classification: F3

Recommended Habitat Structures: Random and Bank placed boulders, Single and Double Wing Deflector, Channel Constrictor, Half-log cover, Cross Vane, "W" Weir, Root Wads, J-Hook, Rock Vanes, Gravel Placement

Poor Habitat Structures: None

note: dashed line denotes approximate bankfull height

Reach 10 Summary

Bankfull Width: 67.0 feet
Flood Prone Width: 73.1 feet
W/D Ratio: 57.26 ft./ft.
Entrenchment Ratio: 1.09 ft./ft.
Average Depth: 1.17 feet
Maximum Depth:: 4.6 feet
Channel Materials:: Small Cobble
Slope: .003 ft./ft.
Sinuosity: 1.07 ft./ft.
Rosgen Channel Type: F3

REACH 11

Location:

Lat: 42° 44’ 39.7”

Long: -87° 49’ 8.8”

Description:

Start of Station: Downstream of rock wall on rt. bank, 400 feet upstream of RCC foot bridge

Reach Length: 1200 feet

Substrate: Very Coarse Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders

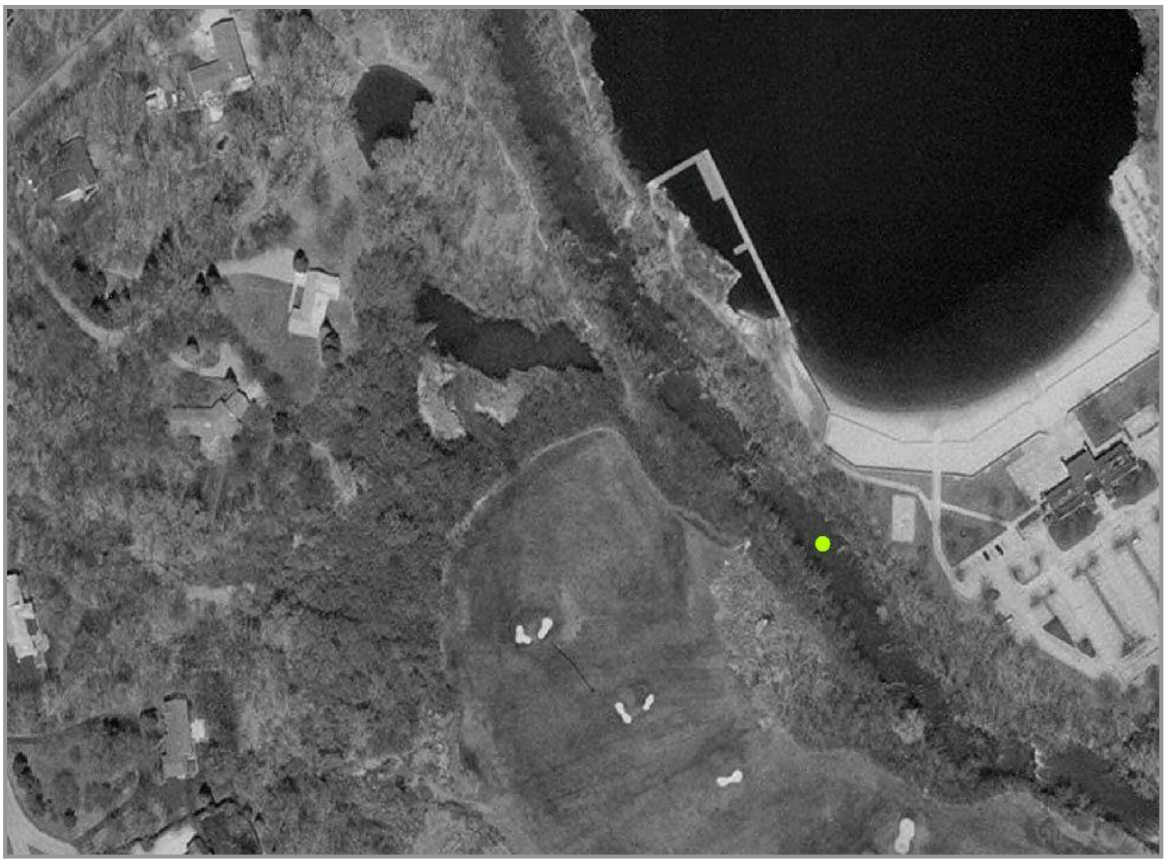
note: dashed line denotes approximate bankfull height

Reach 11 Summary

Bankfull Width: 50.0 feet
Flood Prone Width: 65.0 feet
W/D Ratio: 31.05 ft./ft.
Entrenchment Ratio: 1.3 ft./ft.
Average Depth: 1.61 feet
Maximum Depth: 2.0 feet
Channel Materials: Very Coarse Gravel
Slope: .0004 ft./ft.
Sinuosity: 1.06 ft./ft.
Rosgen Channel Type: F4

REACH 12

Location:
Lat: 42° 44’ 47.3”
Long: -87° 49’ 22.1”
Description:
Start of Station: Final riffle on RCC golf course
Reach Length: 1245 feet
Substrate: Bedrock
Classification: F1
Recommended Habitat Structures: Bank Placed Boulder, Submerged Shelter, Single Wing Deflector
Poor Habitat Structures: Random placed boulders, double wing deflector, gravel



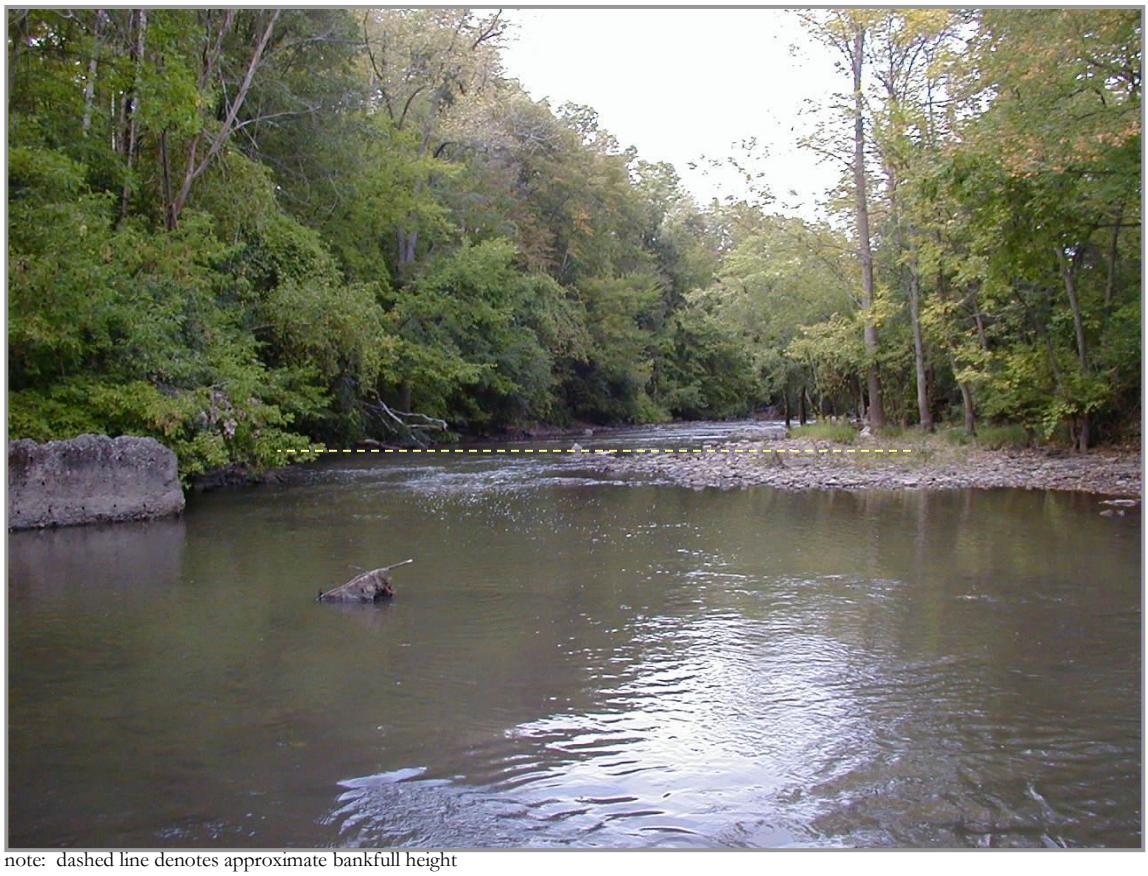
note: dashed line denotes approximate bankfull height

Reach 12 Summary

Bankfull Width: 73.2 feet
Flood Prone Width: 101.5 feet
W/D Ratio: 49.79 ft./ft.
Entrenchment Ratio: 1.39 ft./ft.
Average Depth: 1.47 feet
Maximum Depth:: 3.2 feet
Channel Materials: Bedrock
Slope: .008 ft./ft.
Sinuosity: 1.04 ft./ft.
Rosgen Channel Type: F1

REACH 13

Location:
Lat: 42° 44’ 56.9”
Long: -87° 49’ 28.8”
Description:
Start of Station: Start of large pool, adjacent to Quarry Lake
Reach Length: 1200 feet
Substrate: Cobble
Classification: F3* (Note: Out of parameters on w/d ratio)
Recommended Habitat Structures: Random and Bank placed boulders, Single and Double Wing Deflector, Channel Constrictor, Half-log cover, Cross Vane, “W” Weir, Root Wads, J-Hook, Rock Vanes, Gravel Placement
Poor Habitat Structures: None

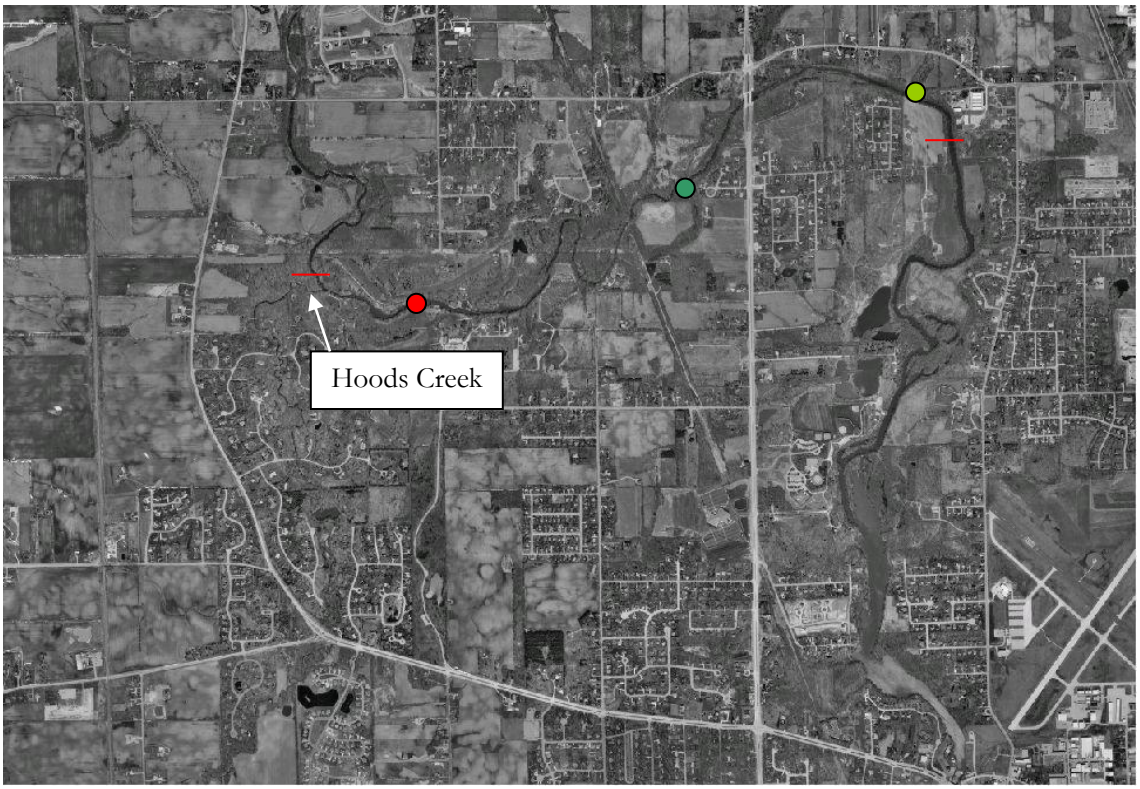


note: dashed line denotes approximate bankfull height

Reach 13 Summary

Bankfull Width: 76 feet
Flood Prone Width: 88.8 feet
W/D Ratio: 112.59 ft./ft.
Entrenchment Ratio: 1.17 ft./ft.
Average Depth: .675 feet
Maximum Depth: 2.8 feet
Channel Materials: Small/Large Cobble
Slope: .002 ft./ft.
Sinuosity: 1.02 ft./ft.
Rosgen Channel Type: F3 (out of parameters – w/d ratio exceeded)

PROJECT OVERVIEW – UPSTREAM OF HORLICK DAM



REACH 14

Location:

Lat: 42° 47’ 2.833”

Long: -87° 49’ 31.306”

Description:

Start of Station: 3590 feet downstream of Highway 31 bridge

Reach Length: 1400 feet

Substrate: Fine sand

Classification: F5

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes, Random or Bank placed boulders

Poor Habitat Structures: Spawning Gravel Placement

note: dashed line denotes approximate bankfull height

Reach 14 Summary

Bankfull Width: 101.2 feet
Flood Prone Width: 114.5 feet
W/D Ratio: 29.98 ft./ft.
Entrenchment Ratio: 1.13 ft./ft.
Average Depth: 3.48 feet
Maximum Depth: 3.9 feet
Channel Materials: Fine Sand
Slope: Low
Sinuosity: 1.0 ft./ft.
Rosgen Channel Type: F5

REACH 15

Location:
Lat: 42° 46’ 49.5”
Long: -87° 50’ 29.3”
Description:
Start of Station: 656 feet upstream of Highway 31 bridge
Reach Length: 1710 feet
Substrate: Medium Gravel
Classification: F4
Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes
Poor Habitat Structures: Random or Bank placed boulders

note: dashed line denotes approximate bankfull height

Reach 15 Summary

Bankfull Width: 63.3 feet
Flood Prone Width: 72.1 feet
W/D Ratio: 43.0 ft./ft.
Entrenchment Ratio: 1.14 ft./ft.
Average Depth: 1.47 feet
Maximum Depth: 1.75 feet
Channel Materials: Medium Gravel
Slope: Low
Sinuosity: 1.48 ft./ft.
Rosgen Channel Type: F4

REACH 16

Location:

Lat: 42° 46’ 30.355”

Long: -87° 51’ 27.026”

Description:

Start of Station: 88 feet upstream of Johnson Park footbridge

Reach Length: 1971 feet

Substrate: Fine Gravel

Classification: F4

Recommended Habitat Structures: Single Wing Deflector, Cross Vane, Root Wads, J-Hook, Rock Vanes

Poor Habitat Structures: Random or Bank placed boulders

note: dashed line denotes approximate bankfull height

Reach 16 Summary

Bankfull Width: 104.5 feet
Flood Prone Width: 119 feet
W/D Ratio: 47.07 ft./ft.
Entrenchment Ratio: 1.14 ft./ft.
Average Depth: 2.22 feet
Maximum Depth: 2.74 feet
Channel Materials: Fine Gravel
Slope: Low
Sinuosity: 1.07 ft./ft.
Rosgen Channel Type: F4

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