

WATER RESOURCE APPRAISAL FOR UNDERWOOD CREEK
MENOMONEE RIVER WATERSHED

I. Description of the Subwatershed

Underwood Creek is a continuous tributary of the Menomonee River in Waukesha and Milwaukee Counties. For the purposes of determining hydraulic and pollutant contributions from specific areas of this subwatershed, Underwood Creek has been divided into three separate drainage areas: Dousman Ditch, Underwood South Branch and the Main stem of Underwood Creek. The main branch of Underwood Creek is 7.1 miles long (excluding the Dousman Ditch). The South Branch of Underwood Creek joins the Main Branch at near 124th St. and Bluemound Road. Together they drain approximately 16 square miles of the civil divisions of Milwaukee, West Allis, New Berlin, Wauwatosa, Elm Grove and Brookfield.

In 1976, approximately 80% of the watershed was in urban land uses with about 40% of this total devoted to residential uses. Significant portions of the the stream channel lie within public parkways or undeveloped private floodplains providing good access and aesthetic properties in an urbanized area.

Underwood Creek has undergone extensive stream channel modifications, reducing flooding potential to accomodate urban development and, to a lesser degree, agricultural drainage in the headwaters area. The entire 2.5 miles of the main branch in Milwaukee county (and the entire 2.3 miles of the South Branch of Underwood Creek) have a concrete channel bottom. A concrete conduit encloses another 0.1 mile segment in Elm Grove. Public opposition to further concrete lining halted additional channel modifications. The opposition was based on adverse aesthetic and environmental consequences.

There are 15 sanitary sewer relief devices and 6 WPDES permitted industrial sources which discharge non-contact cooling water directly to Underwood Creek. All of the industrial dischargers are currently meeting their assigned effluent limits and their impact on surface water quality is minimal (WDNR, 1980 and SEWRPC, 1976).

II. Water Resource Conditions

Underwood Creek downstream of Juneau Blvd. in Elm Grove has been granted a water quality variance for dissolved oxygen and bacteria. As stated under NR 104.02 (3)(a): Dissolved oxygen shall not to be less than 2 mg/l at any time, nor shall the membrane filter fecal coliform count exceed 1000 per 100 ml as a monthly geometric mean based on not less than 5 samples per month nor exceed 2,000 per 100 ml in more than 10% of all samples during any month.

Based on very limited field observations, active watershed-wide erosion did not appear to be limiting the existing biological or

recreational use of Underwood Creek. Bank erosion is extensive along an intermittent tributary which drains the Bishops Woods Office Park complex.

The impacts of nonpoint source runoff in the watershed is typical of urban watersheds in southeastern Wisconsin. The water quality impacts of urban runoff limits the biological and recreational use potential of Underwood Creek. Major urban runoff contributors include a large shopping center mall located at the headwaters of Underwood Creek, a commercial retail area in Elm Grove and the intensively urbanized area in Milwaukee county. Additional sources include runoff from a small area of agricultural row crop and sod farms in the headwater area. Contributions from the dominant light-density residential uses in the watershed are minimized by well-maintained grass-lined ditches.

The potential for erosion and nonpoint source pollution to Underwood Creek will increase if the remaining open lands are developed without implementing effective storm water control practices. One 208 Plan recommendation calls for the development of an urban storm water retention basin in the agricultural headwaters area. Besides being promoted for flood control, this basin, if designed and managed properly, can also be expected to provide the added benefit of reducing pollutant loadings to downstream segments and possibly as a groundwater recharge area for the stream.

The most important uncontrollable factor which may limit the present and future use potential of Underwood Creek is its extreme flow characteristics. The measured Q_7-10 and Q_7-2 are <0.1 ft³/sec and peak flows have been measured up to 2100 ft³/sec upstream of its confluence with the Menomonee River (USGS, 1982). Although low-flow conditions approach 0 ft³/sec. in the lower reaches of Underwood Creek, there is sufficient evidence to suggest that these same low-flow values are not characteristic of low-flow conditions in the middle and upper segments of the watershed. Chesters, et al. (1979) stated that heavy ground water pumpage from wells in the Menomonee River watershed may cause certain reaches of streams in the watershed to lose water to the shallow aquifer. In his report, one of these losing flow stream reaches has been identified as Underwood Creek segments 6 and 7. This condition was verified by field observations.

Extensive historical physical and chemical water quality data have been collected for Underwood Creek (WDNR, 1984; SEWRPC, 1976 and Zanoni, 1970). Sample stations were located just upstream of the confluence with the Menomonee River and at the storm sewer outlet which drains a large commercial area (Brookfield Square) in the headwaters area.

Results from these studies indicate that water quality conditions in Underwood Creek can be extreme. These extremes have been

documented in the lowermost, habitat-limited reaches. Despite these extreme water quality conditions, dissolved oxygen, temperature, pH and un-ionized ammonia did not routinely violate Wisconsin State full fish and aquatic life water quality standards. The cumulative effects of trace elements associated with urban runoff is unknown. Fecal coliform bacteria levels were also extreme, however it could not be determined if recreational use standards were violated due to insufficient monthly sample frequencies.

These studies did not determine the existing or predicted frequency of water quality standard violations or pollutant loads contributed by nonpoint sources versus point sources under all management alternatives. Such an analysis should presume that many of these pollutant contributions are from sources which are partially or entirely controllable.

An unknown discharge from the Brookfield Square storm sewer is also limiting Underwood Creek water quality. The discharge has been observed to be oily, soapy and cloudy on several occasions. Sediments below the outfall were oily and covered by a dense slime growth. Unsuccessful attempts were made to locate the source of this unpermitted and water quality limiting discharge.

The water quality impacts of intermittent sanitary sewer relief discharges to Underwood Creek are poorly understood. Based on limited information, SEWRPC (1976) estimated that 12-15% of the CBOD and 5-10% of the phosphorus load to Underwood Creek is contributed by sanitary relief devices. The water quality or human health impacts of toxic pollutants or infectious bacteria and viruses were not evaluated.

Note: Detailed Habitat Information In File UNDRHAB.WPM BY SEWRPC Subbasin Codes

In-stream habitat quality in the natural channel ranges from fair to poor and is capable of supporting intolerant and tolerant forage fish populations and tolerant macroinvertebrates.

Historically, fish collected from Underwood Creek in the early 1900's included a diverse population of intolerant and tolerant forage species (Fago, 1973). Fish collections obtained from the main branch and south branch of Underwood Creek in 1973 included sport, intolerant, tolerant and very tolerant forage species. Both of these earlier collections were collected from stream segments which have since been channelized in concrete.

Recently, qualitative fish samples were collected in 1984 from six stations in Underwood Creek. Results from this latest survey indicate a significant reduction in the types and numbers of intolerant and tolerant forage fish previously collected from Underwood Creek. Habitat destruction through concrete channelization may be responsible for the permanent loss of the

southern redbelly dace, largescale stoneroller and fantail darter.

The present fish community of Underwood Creek, upstream of the concrete channelized segments, is characterized as supporting an important self-sustaining population of intolerant blacknose dace, small sport fish such as sunfish and bullheads and large numbers and low diversity of tolerant forage fish including up to three year classes of white suckers.

Macroinvertebrate collections and Hilsenhoff Biotic Index (HBI) values indicated fair and poor water quality. Loss of habitat through channelization, nonpoint source pollution from the commercial land use areas (especially in the headwater and downtown Elm Grove areas), stream bank erosion, unpermitted discharges and low flow characteristics may be most limiting to macroinvertebrate populations.

Uncontrollable factors which may continue to limit the biological and recreational use potential of Underwood Creek include stream channelization and natural low-flow characteristics.

Controllable or partially controllable factors which limit the biological and recreational use potential of Underwood Creek include bank erosion, unpermitted point source discharge(s) in the Brookfield Square storm system, stream and stream bank shading by terrestrial vegetation, sanitary sewer overflows and runoff from urban areas particularly the 2-3 commercial land use areas and transportational related land use areas.

III. Water Resource Objectives

After evaluating the various use class criteria, it is recommended that the concrete segments of Underwood Creek south branch and main branch beginning at the Milwaukee-Waukesha county line be classified as use class E, a marginal fish and aquatic life stream (MAR-E). The remainder of Underwood Creek upstream of the Waukesha-Milwaukee county line shall be classified as use class C, a full fish and aquatic life stream (FAL-C). Water quality standards should be applied which protect these use class recommendations and the use classification of the Menomonee River.

The recommended water resource management objectives for Underwood Creek are provided below. They include objectives to be addressed by both the NPS and IRM planning processes.

A. Implement that portion of the 208 plan which calls for the storm water retention basins in the headwaters to control flooding. These should be designed with water quality concerns as well as water quantity (NPS, MUNICIPALITY, WZ).

B. Provide information and education activities aimed at sensitizing the public to the resource values, environmental damage caused by wetland alterations and channelization as well

as providing alternatives (IRM, UW, WM).

C. Reduce construction and bank erosion loadings of sediment and nutrients by __%. Wherever practical, selection of best management practices should consider activities which enhance fish, aquatic life and wildlife habitats. (NPS, COUNTY, LANDOWNERS, WM, FM, PARKS). The following practices should be included:

1. Establishment of parkway or other open space in the stream corridor;
2. Permanent grass-lined waterways in intermittent tributaries to the Menomonee River;
3. Proper installation and maintenance of erosion control measures;
4. Working on small portions of larger projects at any one time;
5. Use of wet and dry detention basins, centralized or otherwise, to retain pollutants on-site.

D. Reduce existing and future urban land use loadings of sediment, bacteria, nutrients, heavy metals and other toxic material to levels defined in the Nonpoint Source Pollution Abatement Plan. (NPS, MUNICIPAL, PRIVATE).

E. Selectively open densely shaded stream areas to encourage grass and shrub growth along stream banks and growth of in-stream primary producers (NPS, WRM, FM).

F. Develop and implement a comprehensive urban stormwater management plan on a site-by-site development project area and watershed area as a whole. This plan should include flood management and nonpoint source management plan elements. The current practice of grassed swales as opposed to curb and gutter for stormwater runoff conveyance should be continued (NPS, MUNICIPALITY).

G. Identify and control source(s) of the unpermitted discharges in the headwaters area and implement a pollution abatement plan (WW).

H. Develop and implement a toxic and hazardous waste monitoring survey for the Koppers Co. facility in West Allis. Stormwater and groundwater monitoring strategies should be included (WRM, SW, WW).

References

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(Undrwd.wpm)

Underwood Creek Habitat - Separate File from the Appraisal

Segment 3

Segment three begins a short distance downstream of Gebhardt Road and extends for 0.75 miles to the Pilgrim Road crossing. The land use in this drainage area is dominated by light residential and open lands such as parkways and Wirth Park.

Banks are sloped and heavily overgrown with grass. Channel width/depth ratios are good ranging from 6:1 to 10:1. As a result, no significant bank erosion was observed throughout the mainstream portion of this segment. However an intermittent tributary, which discharges to Underwood Creek just downstream of the railroad crossing, does have some extensive bank erosion. This tributary has been observed to contribute one-half of the stream flow to the main branch. A more extensive assessment should be planned for this tributary in order to evaluate the extent of erosion and the significance of nonpoint source pollutant contributions.

Stream widths range from 8-10 feet. Actual stream widths are deceptive since terrestrial vegetation extends over and grows in the stream channel.

Substrates are dominated by sand and gravel in mid channel and fine silts along the banks. Vegetation constricts stream flow toward the middle of the channel keeping it clear of fine sediments and restricts the finer sediments towards the channel sides.

This stream segment is generally a straight channel with terrestrial and aquatic plants providing most of the fish cover needs. Runs are the dominant feature of this segment and depths range from 1-1.5 feet. Pool habitat is generally lacking with the exception of a small pool at the upstream end of the North Avenue bridge and where in-stream vegetation has impounded water. Riffle areas are found at the beginning and end of this segment only.

Aquatic vegetation is very abundant, covering up to 50% of the channel area. *Sagitaria* spp. and *Potamogeton pectinatus* are the dominate primary producer in this segment while filamentous algae is less common.

Based on the habitat evaluation, fish and aquatic life habitat was judged to be fair to poor and is capable of supporting a tolerant to very tolerant forage fish population and tolerant macroinvertebrates.

Segment 4

Segment four begins at Pilgrim Road and extends for 1.0 miles to the outlet of a 1.0 acre pond located Brookfield's Pomona Park. Land use is very similar to that of segment 3. It is dominated by light residential and open lands. A 36" storm sewer discharges directly to the pond.

Stream banks are protected from erosion by extensive amounts of boulder and smaller rock material, mixed grasses, shrubs and trees. Overbank flows do not appear to be very common as the width/ratios are 3-15. No high water marks were located in the free-flowing segment. Bank erosion was evident only near the Pomona Park pond outlet where water is eroding at the outside of the concrete fixed sill and along the outside bends. Additional erosion is evident along the 36" storm sewer point of discharge.

The stream gradient through the free-flowing segment is steep (60 ft/mi). Velocities are >1 ft/sec and as a result the stream substrate is well scoured and clear of any fine material. Substrate is dominated by coarse sand to coarse gravel with lesser amounts of boulder material. Substrate within the Pomona Park pond is dominated by fine silt deposits.

Shallow runs and riffle areas are the dominant habitat feature in this segment of Underwood Creek. Depths in these area range from 0.3-0.5 feet. Plunge pools are present and depths range from 0.5-1.0 feet. Maximum depth of the Pomona Park pond is approximately 2.0 feet. Average depths have been reduced by siltation and loss of head due to failure of the dam.

In-stream vegetation is limited to sparse growths of non-filamentous algae. Primary producers are limited by the extensive shading in the free-flowing segment and turbid water and shifting substrate conditions within the pond.

Fish and aquatic life habitat in this segment was judged to be fair and capable of supporting an intolerant to very tolerant forage fish population and tolerant macroinvertebrate.

Segment 5

Segment five begins at the Pomona Park pond outlet and extends for 1.2 miles to North Avenue in Brookfield. The drainage area adjacent to this segment is dominated by light residential and open lands. The entire segment is located within public parkway or undeveloped floodplain. Some residential floodplain development is evident especially near Clearwater Road.

Stream bank erosion is more evident in this segment when compared to previous segments and is responsible for the increased width and decreased depths when compared to other stream segments. Bank vegetation is generally poor with many exposed raw areas. Lower bank building processes are no longer proceeding in this segment. Channel width/depth ratios are poor, ranging from 16:1 to 30:1. Scouring of the silty-clay banks rather than slumping is the

major mechanism for bank erosion. Erosion in this segment is compounded by exposed soil conditions in the floodplain. Deposits of silt and debris on top of the upper bank may indicate that channel capacity is frequently exceeded. Poor bank and floodplain vegetative cover appears to be the result of dense tree shading. Approximately 75-100% of this segment's stream banks and near floodplain is heavily shaded. Stream bank and floodplain erosion may be controlled by reducing the extent of ground shading by dense growths of trees. This would allow for the growth of grasses and for the lower bank building process to proceed as in the upper segments of the stream.

The stream channel is uniform throughout due to previous channelization. Shallow riffles and runs dominate the habitat in this stream segment. Stream width varies little, ranging from 12-15 feet. Pool habitat is generally lacking and restricted to a few areas above obstructions and adjacent to banks where exposed tree roots have scoured pools. Pool depths exceeded 1.0 feet only once in this segment, reaching 2.5 feet at one site. Riffle and run depths range from 0.1-0.3 feet and 0.5-0.75 feet, respectively.

Substrates in this segment are diverse ranging from compact clay to coarse gravel. Siltation is not extensive due to scouring velocities during high and low flow conditions.

Primary production in this segment is very limited due to the extensive shading of the stream.

Habitat was judged to be poor and is capable of supporting a tolerant to very tolerant forage fish population and tolerant macroinvertebrates.

Segment 6

Segment six begins at North Avenue and extends for 1.2 miles to Village Grounds Park in Elm Grove. Adjacent land use is similar to segment five upstream. Habitat characteristics are similar to habitats observed for segments four and five.

One unique characteristic of this segment is the extensive pool-like area formed at the downstream border of Village Grounds Park. This pool is formed by a concrete sill and channel. Channel widths through this pool reach range from 12-20 feet and depths range from 1-3 feet. Substrates are variable ranging from silt to coarse gravel. Banks are stable and densely vegetated by grasses. No evidence of frequent bank overflow could be found.

Primary producers are abundant in the unshaded pool area, covering 50-75% of the area. Dominant primary producers include *Elodea* spp., *Sagittaria* spp. and *Potamogeton pectinatus*. Floating mats of algae are also present. Primary producers are sparse in the free-flowing, shaded stream reach.

Low flow conditions may not be as limiting to this segment due to the extensive pool habitat. Habitat in this segment was judged to be fair and capable of supporting a tolerant to very tolerant forage fish population, small sized sport fish and tolerant to very tolerant macroinvertebrates.

Segment 7

Segment 7 extends from the beginning of the concrete channel in Village Grounds Park for approximately 1.0 miles until its confluence with the South Branch and the concrete main channel in Wauwatosa. Approximately 0.15 miles of stream are lined with or enclosed in concrete channels in this segment. Adjacent land uses in this segment are more diverse than other stream segments. Important land uses include open space, commercial areas, transportation, more intensive residential and light industrial. As a result of the increasing urbanization, the impact of nonpoint source pollutants and hydraulic loads on water quality are more important than upstream segments. Storm sewer outfalls are more common in this segment especially within the commercial areas. The large, abandoned Brookfield municipal/industrial landfill is located near the stream in this segment. Leachate has been detected and it's potential access and impact on Underwood Creek water quality is unknown.

Within the natural stream segments, bank erosion appears to be significant, especially the reach immediately between the concrete channel and Watertown Plank Road and the outside of a meander near Bluemound Road. Banks are steep (45) and narrow and have a limited amount and poor diversity of vegetative cover. Bank cover is dominated by a dense growth of trees and as a result of the extensive shading, ground cover is minimal. High water marks are also common and are as high as 4 ft. above base flow. Flooding has been documented in this segment.

Stream width ranges from 8-12 feet. Maximum depths in pools, riffles and runs are approximately 3, 0.3 and 1.0 feet, respectively. Substrate varies from silt to concrete and natural boulder size material. Considerable fish habitat is provided by numerous tree obstructions. Habitat is dominated by frequent riffles and shallow runs. Riffle/run ratios are very good.

Filamentous algae is extensive in this segment wherever shading is not limiting.

Despite the fact that bank scour, low flow and concrete channels exist in portions of this stream segment, overall habitat was judged to be fair to poor and capable of supporting an intolerant to very tolerant forage fish population and tolerant macroinvertebrates.

Segment 8

Segment 8 extends from the Waukesha-Milwaukee county border for approximately 2.5 miles until its confluence with the Menomonee River. All 2.5 miles of the main stem and all of the 1.1 miles of the south branch of Underwood Creek are channelized in concrete. This segment has the greatest diversity and density of impervious urban land uses throughout the watershed. In addition, stormwater conveyance systems in this segment are primarily conduits which are much more efficient transporters of pollutants than grassed waterways.

Nuisance growths of filamentous algae are present in this segment. Algae growth is frequently scoured during runoff events and no doubt contributes to organic and nutrient loadings to the Menomonee River downstream.

Overall, habitat in this concrete lined segment is capable of supporting only the most tolerant of macroinvertebrates and is incapable of sustaining any significant fish population.

Table . Streams of the Underwood Creek (UC) Subwatershed - 11.1 Square Miles. Milwaukee/Waukesha Counties

Name of Stream	Length (Miles)	Use Classification		Miles Supporting Potential Use Fully/Part/Not	Use Problems Source/Factor	Miles Assessed/ Monit'd	Miles Degraded	Miles Improved	Miles ^a Riparian Wildlife Habitat	Reference
		Current Use	Potential Use							
Perennial										
Underwood Creek (Mainstem)									7.3	12,17,18
<u>Stream Segment 1</u> EG008-9, UC001-6 (Headwaters to Juneau Boulevard in Elm Grove)	4.6	FAL-C	FAL-C	4.6/	PSI/SP -SSO/NUT, BAC, SED NPS-URB/SED, MET, TOX -CL/SED, NUT -CE/SED, LOSS HM/CHA, LOSS, FLOW	4.6/4.6	4.6	0.0		
<u>Stream Segment 2</u> EG010 (From Juneau Boulevard to Milwaukee/Waukesha County line)	0.9	FAL-C	FAL-C	0.9/	NPS-URB/SED, NUT, MET, TOX -CE/SED -SB/SED HM/CHA	0.9/0.9	0.9	0.0		
<u>Stream Segment 3</u> EG011 (From Milwaukee/Waukesha County line to confluence with Menomonee River)	2.5	MAR-E	MAR-E ^c	2.5/	PSM-SSO/BAC, NUT NPS-URB/NUT, BAC, SED MET, TOX	2.5/2.5	2.5	0.0		
TOTAL STREAM MILES	8.0									

a. Total of all streams. 15% forested cover types, 85% open space.

b. Page 11.

c. Should concrete removal occur, this use classification would be reviewed and upgraded if appropriate.

Table .. Streams of the South Branch Underwood Creek (SU) Subwatershed - 5.2 Square Miles. Milwaukee/Waukesha Counties

Name of Stream	Length (Miles)	Use Classification		Miles Supporting Potential Use Fully/Part/Not	Use Problems Source/Factor	Miles Assessed/ Monit'd	Miles Degraded	Miles Improved	Miles ^a Riparian Wildlife Habitat	References
		Current Use	Potential Use							
Perennial										
South Branch Underwood Creek										
Stream Segment UU001 T7N R21E, Sec. 30	1.1	MAR-E	MAR-E ^c	1.1/	HM/CHA, LOSS, FLOW	1.1/1.1	0.0	0.0	0.0	12,17,21,2
Stream Segment UU002 T7N R21E, Sec. 31 SWSW	1.2	MAR-E	MAR-E ^c	1.2/	PSI-SP/TOX HM/CHA, LOSS, FLOW	1.2/0	0.0	0.0		
TOTAL STREAM MILES	2.3				PSI-SP/TOX					

a. Total of all streams, no riparian wildlife habitat due to heavy urbanization.

b. Page 11.

c. Should concrete removal occur, these use classifications would be reviewed and upgraded if appropriate.

Stream Classification for Underwood Creek
Menomonee River Watershed
Milwaukee River Basin
Waukesha and Milwaukee Counties, Wisconsin
September, 1984
by Will Wawrzyn

INTRODUCTION

Objective

The objective of this stream classification is to determine the appropriate use designation for Underwood Creek based on the Stream Classification Guidelines for Wisconsin (Ball, 1982). The final designation is determined by evaluating the physical, chemical and biological factors which influence the potential resource value of this water body.

DESCRIPTION of the WATER RESOURCE

Underwood Creek is a continuous tributary of the Menomonee River in Waukesha and Milwaukee Counties. The creek discharges to the Menomonee River in T7N, R21E, Sec. 20, NE 1/4, NW 1/16. The main branch of Underwood Creek is 10.7 miles in length (including the Dousman Ditch headwaters area) and the South Branch of Underwood Creek is 1.1 miles in length (Map). Together they drain approximately 16 square miles of the civil divisions of Milwaukee, West Allis, New Berlin, Wauwatosa, Elm Grove and Brookfield. Approximately 80% of the watershed is in urban land uses and about 40% of this total is devoted to residential uses (SEWRPC, 1976).

Underwood Creek has undergone extensive stream channel modifications in order to accommodate urban development and reduce flooding potential and to a lesser degree, agricultural drainage in the headwaters area. The entire 2.5 miles of the main branch in Milwaukee county and the entire 1.1 miles of the South Branch of Underwood Creek have a concrete channel bottom. Another 0.1 mile segment in Elm Grove is enclosed in a concrete conduit. SEWRPC (1976) originally recommended that an additional 2.1 miles of Underwood Creek channel in the Village of Elm Grove undergo major and minor channelization to accommodate additional urban drainage. However, due to public opposition to the aesthetic and environmental consequences, an alternative plan recommended flood proofing of structures along the creek.

Average channel slopes for the main branch of Underwood Creek and Southern Branch of Underwood Creek are 20 and 6 feet per mile, respectively.

Significant portions of the the stream channel lie within public parkways or undeveloped private floodplains. The higher quality environmental corridors consist of upland and lowland hardwood forests, shrub and tamarack swamps. Approximately 30% of the watershed is devoted to open lands such as woods and swamps, parks and agricultural land uses.

Habitat Evaluation

Underwood Creek habitat evaluations were conducted on July 9 and 23 and October 4, 1984. Based on somewhat unique habitat characteristics, Underwood Creek has been broken up into six segments for ease of discussion. The most important uncontrollable factor which may limit the present and future use potential of Underwood Creek is its extreme flow characteristics. The measured $Q_{7,2}$ and $Q_{7,10}$ are $<0.1 \text{ ft.}^3/\text{sec.}$ and peak flows have been measured up to $2100 \text{ ft.}^3/\text{sec.}$ upstream of its confluence with the Menomonee River (USGS, 1982). Although low-flow conditions approach $0 \text{ ft.}^3/\text{sec.}$ in the lower reaches of Underwood Creek, there is sufficient evidence to suggest that these same low-flow values are not characteristic of low-flow conditions in the middle and upper segments of the watershed. Chesters, et al., (1979) stated that heavy ground water pumpage from wells in the Menomonee River watershed may cause certain reaches of streams in the watershed to lose water to the shallow aquifer. In his report, one of these losing flow stream reaches has been identified as Underwood Creek segments 6 and 7. This condition was verified by field observations on October 4, 1984 when approximately $3 \text{ ft.}^3/\text{sec.}$ of flow was observed in segment 4 of Underwood Creek while flow was barely detectable in segment 7 a few minutes later. Precipitation events or point source discharges were not responsible for the differences in observed flow.

Segment 1

Segment one includes the Dousman Ditch headwaters area and extends for approximately 1.0 mile east to Pilgrim Parkway in Brookfield. The adjacent drainage area is dominated by a large shopping center and adjoining commercial establishments, a fallow and active agricultural row crop and sod farm area and a light residential and parkway area.

Bank erosion was not observed to be significant except in the area where the Brookfield Square storm water discharge occurs. Elsewhere in this segment, banks are generally covered by a dense growth of mixed grasses.

High water marks were not seen in this segment and the frequency of overbank flow was not obvious. The numerous side channels appear to be providing additional water storage capabilities during high flow periods. Channel width/depth ratios are good, ranging from 3:1 to 6:1. These two factors may be minimizing the frequency of overbank flows.

Sediments are dominated by well-sorted deposits of silts to gravel and may be indicative of sediment erosion elsewhere in the watershed.

Riffle and pool-like habitats are generally lacking. The habitat is dominated by runs, with channel depths and widths being relatively uniform. Depths range from 0.5-1.0 feet and widths from 3-5 feet. Some additional fish habitat is provided by instream obstructions, undercut banks and overhanging vegetations. Instream vegetation is scarce and is represented by light growths of epilithic algae. No macrophytes were observed in this stream segment.

main branch. A more extensive assessment should be planned for this tributary in order to evaluate the extent of erosion and the significance of nonpoint source pollutant contributions.

Stream widths range from 8-10 feet. Actual stream widths are deceptive since terrestrial vegetation extends over and grows in the stream channel.

Substrate is dominated by sand and gravel in mid channel and fine silt along the banks. Vegetation constricts stream flow toward the middle of the channel keeping it clear of fine sediments and restricts the finer sediments towards the channel sides.

This stream segment is generally a straight channel with terrestrial and aquatic plants providing most of the fish cover needs. Runs are the dominant feature of this segment and depths range from 1-1.5 feet. Pool habitat is generally lacking with the exception of a small pool at the upstream end of the North Avenue bridge and where instream vegetation has impounded water. Riffle areas are found at the beginning and end of this segment only.

Aquatic vegetation is very abundant, covering up to 50% of the channel area. *Sagittaria* spp. and *Potamogeton pectinatus* are the dominate primary producer in this segment while filamentous algae is less common.

Based on the habitat evaluation, fish and aquatic life habitat was judged to be fair to poor and is capable of supporting a tolerant to very tolerant forage fish population and tolerant macroinvertebrates. (Table 2)

Segment 4

Segment four begins at Pilgrim Road and extends for 1.0 miles to the outlet of a 1.0 acre pond located Brookfield's Pomona Park. Land use is similar to that of segment 3. It is dominated by low density residential and open lands. A 36" storm sewer discharges directly to the pond.

Stream banks are protected from erosion by extensive amounts of boulder and smaller rock material, mixed grasses, shrubs and trees. Overbank flows do not appear to be very common as the width/depth ratios are 3-15. No high water marks were located in the free-flowing segment. Bank erosion was evident only near the Pomona Park pond outlet where water is eroding around the fixed concrete sill and along the outside bends. Additional erosion is evident along the 36" storm sewer point of discharge.

The stream gradient through the free-flowing segment is steep (60 ft./mi). At low flow velocities are >1 ft./sec. and as a result the stream substrate is well scoured and clear of fine material. Substrate is dominated by coarse sand and coarse gravel with lesser amounts of rubble. Substrate within the Pomona Park pond is dominated by silt.

Shallow run and riffle areas are the dominant habitat feature in this segment. Depths in these areas range from 0.3-0.5 feet. Plunge pools are present and depths range from 0.5-1.0 feet. Maximum depth of the Pomona Park pond is approximately 2.0 feet. Average depths have been reduced by siltation and failure of the dam.

Segment 6

Segment six begins at North Avenue and extends for 1.2 miles to Village Grounds Park in Elm Grove. Adjacent land use is similar to segment five upstream. Habitat characteristics are similar to habitats observed for segments four and five.

One unique characteristic of this segment is the pond-like area formed at the downstream border of Village Grounds Park. This pool is formed by a concrete sill and channel. Channel widths through this pool reach range from 12-20 feet and depths range from 1-3 feet. Substrates are variable ranging from silt to coarse gravel. Banks are stable and densely vegetated by grasses. No evidence of frequent bank overflow could be found.

Primary producers are abundant in this unshaded pool area, covering 50-75% of the area. Dominant primary producers include Elodea spp., Sagittaria spp. and Potamogeton pectinatus. Floating mats of algae are also present. Primary producers are sparse in the free-flowing, shaded stream reaches.

Low flow conditions may not be as limiting to this segment due to the extensive pool habitat. Habitat in this segment was judged to be fair and capable of supporting a tolerant to very tolerant forage fish population, small sized sport fish and tolerant to very tolerant macroinvertebrates. (Table 2)

Segment 7

Segment 7 extends from the beginning of the concrete channel in Village Grounds Park for approximately 1.0 miles until its confluence with the South Branch and the concrete main channel in Wauwatosa. Approximately 0.15 miles of stream are lined with or enclosed in concrete channels in this segment. Adjacent land uses in this segment are more diverse than other stream segments. Land uses include open space, commercial, transportation, higher density residential and light industrial. As a result of the increasing urbanization, the impact of nonpoint source pollutants and hydraulic loads on water quality are more limiting than upstream segments. Storm sewer outfalls are more common in this segment especially within the commercial areas. The large, abandoned Brookfield municipal/industrial landfill is located near the stream in this segment. Leachate has been detected and it's potential access and impact on Underwood Creek water quality is unknown.

Within the natural stream segments, bank erosion appears to be significant, especially the reach immediately between the concrete channel and Watertown Plank Road and as the stream approaches Bluemound Road. Banks are steep and narrow and have a limited amount and poor diversity of vegetative cover. Bank cover is dominated by a dense growth of trees and as a result of the extensive shading, ground cover is minimal. High water marks are also common and are as high as 4 ft. above base flow. Flooding has been documented in this segment.

Stream width ranges from 8-12 feet. Maximum depths in pools, riffles and runs are approximately 3, 0.3 and 1.0 feet, respectively. Substrate varies from silt to concrete and natural boulder size material. Considerable fish habitat is provided by numerous tree obstructions. Habitat is dominated by frequent riffles and shallow runs. Riffle/run ratios are very good.

bacteria levels were also extreme, however it could not be determined if recreational use standards were violated due to the insufficient monthly sample frequencies.

These studies did not determine the existing or predicted frequency of water quality standard violations or pollutant loads contributed by nonpoint sources versus point sources under all management alternatives. Such an analysis should assume that many of these pollutant contributions are from sources which are partially or entirely controllable.

Biological

Fish

Historically, fish collected from Underwood Creek in the early 1900's included a diverse population of intolerant and tolerant forage species (Fago, 1973) (Table 4). Of the 11 species collected, the redbreast dace and least darter are currently listed on the Wisconsin watch list. Fish collections obtained from the main branch and south branch of Underwood Creek in 1973 included fish species represented by all four fish classifications; sport, intolerant, tolerant and very tolerant forage species. Both of these earliest collections were obtained from stream segment 8 which has since been channelized in concrete.

More recently, qualitative fish samples were collected from Underwood Creek segments 1, 3, 4, 6 and 7 using a DC pulse fish shocker during May of 1984. Results from this latest survey indicate a significant reduction in the types and numbers of intolerant and tolerant forage fish previously collected from Underwood Creek. Habitat destruction through concrete channelization may be responsible for the demise of the southern redbelly dace, large scale stoneroller and fantail darter.

The present fishery of Underwood Creek, upstream of the concrete channelized segments, is characterized as supporting an important self-sustaining population of intolerant blacknose dace, small sport fish such as sunfish and bullheads and large numbers and low diversity of tolerant forage fish including up to three year classes of white suckers.

Benthos

Benthic macroinvertebrate samples were collected from Underwood Creek segments 3 and 7 using the standard Hilsenhoff Biotic Index (HBI) technique in the spring of 1984 (Table 5). HBI values for segment 3 and segment 7 were indicative of fair and poor water quality, respectively. Loss of habitat through channelization, nonpoint source pollution from the commercial land use areas (especially in the headwater and downtown Elm Grove areas), stream bank erosion, unpermitted discharges and low flow characteristics may be most limiting to macroinvertebrate populations.

Recreational Use

Based on continuous flow monitoring data, location of upper and lower banks and high water marks, by definition, Underwood Creek is considered navigable throughout its entire length.

including suckers. Stream channelization and concrete lining was most responsible for the loss of a diverse population and uncommon species of intolerant forage fish since 1973.

Uncontrollable factors which may continue to limit the biological and recreational use potential of Underwood Creek include stream channelization and natural low-flow characteristics.

Controllable or partially controllable factors which limit the biological and recreational use potential of Underwood Creek include bank erosion, unpermitted point source discharge(s) in the Brookfield Square storm system, stream and stream bank shading by terrestrial vegetation, sanitary sewer overflows and runoff from urban areas particularly the 2-3 commercial land use areas and transportational related land use areas. Controls for these factors which might cause a direct benefit to Underwood Creek water quality and help sustain or improve its present biological and recreational use potential include:

- (1) Implement the section of the 208 plan which calls for the construction of a storm water retention basin in the head waters area to control flooding. This plan should be modified to include a design which is conducive to flood control and optimal nonpoint source pollution control.
- (2) Limit future stream channelization projects through regulatory actions and encourage the development of alternative flood control practices, including land use zoning ordinances, which are compatible with the maintenance of water quality and aquatic life habitat.
- (3) Placement of stream bank erosion control devices in critical areas.
- (4) Open densely shaded stream areas to encourage grass and shrub growth along stream banks and instream primary producers.
- (5) Develop and implement a comprehensive urban storm water management plan on a site-by-site development project area and watershed area as a whole. This plan should include flood management and nonpoint source management plan elements. The current practice of grassed ditches for the conveyance of storm water runoff should be continued.
- (6) Identify and abate the source(s) of the unpermitted discharges in the headwaters area and implement a pollution abatement plan.
- (7) Develop and implement a toxic and hazardous waste monitoring survey for the Koppers Co. facility in West Allis. Storm water and groundwater monitoring strategies should be included.

The current use classification of Underwood Creek is a non-continuous, urban stream. After evaluating the various use class criteria, it is recommended that the concrete segments of Underwood Creek south branch and main branch beginning at the Milwaukee-Waukesha county line be classified as use class E, a marginal fish and aquatic life stream (MAR-E). The remainder of Underwood Creek upstream of the Waukesha-Milwaukee county line shall be classified as use class C, a full fish and aquatic life stream (FAL-C). Water quality

References

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Southeastern Wisconsin Regional Planning Commission. 1976. A Comprehensive Plan for the Menomonee River Watershed: Inventory Findings and Forecasts. Planning Report No. 26, Vol. 1, October.

United States Geological Service. 1982. Water Resources Data for Wisconsin. Water Year 1982. U.S.G.S. Report No. WI-82-1.

Wisconsin Department of Natural Resources. 1984. Section 24 Water Quality Standards Review for the Milwaukee Metropolitan Area. Bureau of Water Resource Management, Madison. May 16 correspondence to USEPA.

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4710P

Table 1

WPDES Permitted Discharges to Underwood Creek Watershed

Notre Dame Health Care Center

Permit # 55999

Limits and Monitoring Requirements: Status unknown

Comments: Facility discharges filter back wash and water softener backwash to a storm sewer which intern discharges to a seepage pit. Unknown as to whether or not a discharge occurs to a surface water. If a surface water discharge exists, it is most likely to the natural channel segment #7 of Underwood Creek.

Koppers Co., Inc. (Thiem Corp)

Permit # 41688

Limits and Monitoring Requirements: outfall 101 and 201

Flow (gpd)

BOD5 (10 mg/l)

Oil & Grease (15 mg/l)

outfall 301

Flow (gpd)

TSS (no limit)

outfall 001

BOD5 (10/15 mg/l)

Oil and Grease (15 mg/l)

TSS (no limit)

pH (6-9 su)

Comments: Facility manufactures chemical sealants, adhesives and foundry refractory coatings. Permit to discharge to Underwood Creek is for non-contact cooling water only. However, additional indirect discharges to the creek by the facility have or presently include contaminated yard runoff, truck washing products, spills, floor drains and groundwater. Based on recent records, floor drains have been bermed or sealed and the truck washing water has inappropriately been diverted away from the storm sewer and directly to the drainage ditch. Groundwater monitoring wells have been installed at three locations on the property and BOD5 and oil and grease levels were measured up to 156 and 93 mg/l, respectively. Although chemical storage tank areas are diked, no bottom liners are provided. Some storage areas have concrete floors. A more intensive wastewater survey and toxic and hazardous monitoring survey of non-contact cooling water (not runoff or groundwater) was required as a condition for the WPDES permit. Results indicate that the non-contact cooling water is uncontaminated prior to its discharge to the storm sewer system. The discharge is eventually to Underwood Creek in concrete segment #8. A list of the chemicals used at the facility are listed in Table 5. Additional spill/containment plans should be developed to insure no discharge of chemicals can occur to Underwood Creek and toxic and hazardous screening monitoring survey should be completed for groundwater and runoff at the facility.

Lakeview Hospital

Permit # 44105

Limits and Monitoring Requirements: Flow (gpd)
Temp. (90 F)
pH (6-9 su)
Additives (names/quantity)

Comments: Discharge of approximately 12,000 gpd is to concrete segment #8 of Underwood Creek via a storm sewer. A General Permit has inappropriately been recommended for this facility. Due to the continued use of biocide additives which contain nutrients, ammonia and oxygen demanding properties, a General Permit should not be issued at this time.

Kearney and Trecker Corp.

Permit # 33146

Limits and Monitoring Requirements: outfalls 001-004
Flow (mgd)
Temp. (120 F)
Chlorine (0.5 mg/l)
Additives (name/quantity)

Comments: Non-contact cooling water with biocide additives. Discharge is eventually to concrete segment #8 of Underwood Creek.

United Parcel Service

Permit # 42030

Limits and Monitoring Requirements: Flow (mgd)
Temp. (89 F)
BOD5 (30/60 mg/l)
TSS (30/60 mg/l)
Total P (1 mg/l)
Oil and Grease (10/15 mg/l)
pH (6-9 su).

Comments: Discharge consists of truck washing water and the discharge is to the natural channel segment #7 of Underwood Creek. This stream segment, extending from Juneau Blvd. in Elm Grove downstream to the Menomonee R., is presently classified as a variance stream per NR 104.02(3)(a)(1). Based on this reports recommended stream classification for this stream segment (FAL-C), the effluent limits for this stream should be reviewed and changed if need be, in order to meet the appropriate water quality standards.

Turner Heat Treating

Permit # 43664

Comment: General Permit for non-contact cooling water discharge with maximum temperature limits of 120° F. Discharge is to concrete segment #8 of Underwood Creek.

4710P

Table 2

Department of Natural Resources

STREAM SYSTEM HABITAT RATING FORM
Form 3200-68 1-85

Stream Underwood Cr. Reach Location 5 sq. 1 Dodsonville Reach Score/Rating 209

County Blount Date 9 July 81 Evaluator H. W. Wiggins Classification WTD

10
Common imp.
Blountfield Sq.
14
10 SCOUR 14
9
14 low impact
15
16
17
24
24
24
16
12

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 18	
Watershed Nonpoint Source No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 18	
Bank Erosion, Failure No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 14	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20	
Bank Vegetative Protection 90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18	
Lower Bank Channel Capacity Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 18	
Lower Bank Deposition Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18	
Bottom Scouring and Deposition Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20	
Bottom Substrate/ Available Cover Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22	
Avg. Depth Riffles and Runs Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24	
Avg. Depth of Pools Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24	
Flow, at Rep. Low Flow Cold >2 cfs 0 Warm >6 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24	
Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width) 5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20	
Aesthetics Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic sites. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered areas. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 18	

Column Totals:

Column Scores E ___ +G ___ +F ___ +P ___ = ___ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts and comments.

Stream Woodwood Reach Location Seg. 2 Fitzsim Rd. Reach Score/Rating 190-198
 County Waukeg Date 9 July 84 Evaluator W. WAWRZYNA Classification INT-D

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion 10	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 18
Watershed Nonpoint Source 14	No evidence of significant sources. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 18
Bank Erosion, Failure 8	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme high flows. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection 9	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 8	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity (8-10)	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 9	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition 15	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition 16	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/ Available Cover 17	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs 20	Cold >1' 0 Warm >1.5' 0	6" to 1' 0 10" to 1.5' 0	6 3" to 6" 18 6 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools 20	Cold >4' 0 Warm >5' 0	3' to 4' 0 4' to 5' 0	6 2' to 3' 18 6 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow 24	Cold >2 cfs 0 Warm >6 cfs 0	1-2 cfs 0 2-5 cfs 0	6 .5-1 cfs 18 6 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width) 16	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics 12	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16

Column Totals:

Column Scores E ___ +G ___ +F ___ +P ___ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts and comments.

20-24
20-24 ct
20-24 R/W
24
16
12

Stream Undanow #3 Gebhardt → Pilgrim Reach Score/Rating 17/181
 County Wauke Date 23 July 84 Evaluator W. WAWRZYN Classification INT-D

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion 10	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source 14	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agricultural). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure 8 - stream Feeder R.P.R. xim	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection 6	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity 3	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition 15	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition 8	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/Available Cover 12	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 6 10" to 1.5' 6	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 6 4' to 5' 6	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 6 2-5 cfs 6	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics 12	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16

Column Totals:

Column Scores E ___ +G ___ +F ___ +P ___ = ___ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts, and comments.

Stream Hudson Reach Location #4 Pleasant → Brown Reach Score/Rating 16/1
 County Wash Date 9 July 84 Evaluator W. W. W. W. Classification EAL-C/10
24 10/24

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source	No evidence of significant sources. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 8	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 18
Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 0 10" to 1.5' 0	6 3" to 6" 6 8" to 10"	18 <3" 18 <6"
Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	3' to 4' 0 4' to 5' 0	6 2' to 3' 6 3' to 4'	18 <2' 18 <3'
Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 0 2-5 cfs 0	6 .5-1 cfs 6 1-2 cfs	18 <.5 cfs 18 <1 cfs
Pool/Riffle, Run/Bend Ratio (distance between riffles ÷ stream width)	5-7. Variety of habitat. Deep riffles and pools. 10	7-15. Adequate depth in pools and riffles. Bends provide habitat. 16	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16

Column Totals: _____

Column Scores E _____ +G _____ +F _____ +P _____ = _____ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts and comments.

Most limiting

10
14
8
9
9
8
24
24
24

Rip-2AP
rubble - very stable

dep. in pool only

10 riffle shallows run - 8 ft

Stream Unkwood #5 Pond to N. Ave - Pond xy Reach Location Outlet Reach Score/Rating 212
 County Wauke Date 23 July Evaluator W. Wawrzy Classification FAL-D

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion <u>10</u>	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source <u>10</u>	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16
Bank Erosion, Failure <u>bank score</u> <u>16</u>	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection <u>15</u>	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity <u>14</u>	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 18
Lower Bank Deposition <u>12</u>	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 12	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition <u>16</u> <u>110</u>	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-60% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/Available Cover <u>17</u>	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs <u>24</u>	Cold >1' 0 Warm >1.5' 0	6" to 1' 8 10" to 1.5' 8	3" to 6" 18 6" to 10" 18	<3" 24 <6" 24
Avg. Depth of Pools <u>24</u>	Cold >4' 0 Warm >5' 0	3' to 4' 8 4' to 5' 8	2' to 3' 18 3' to 4' 18	<2' 24 <3' 24
Flow, at Rep. Low Flow <u>24</u>	Cold >2 cfs 0 Warm >5 cfs 0	1-2 cfs 8 2-5 cfs 8	.5-1 cfs 18 1-2 cfs 18	<.5 cfs 24 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width) <u>13</u>	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics <u>12</u>	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16

Column Totals:

Column Scores E ___ +G ___ +F ___ +P ___ = ___ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts and comments.

Stream Undwood Cr. Reach Location N. Ave. - Concrete - Milw. Co. Reach Score/Rating 192-197
 County Waushara Date July 23 Evaluator W. W. Sawyer Classification INT-D
Oct 4

Rating Item	Category				
	Excellent	Good	Fair	Poor	
14 Watershed Erosion	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16	
14 Watershed Nonpoint Source	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agriculture). 14	Obvious sources (major wetland drainage, high use urban or industrial area, feed lots, impoundment). 16	
8 Bank Erosion, Failure	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly beamed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20	
9 Bank Vegetative Protection	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18	
10 Lower Bank Channel Capacity	Amply for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16	
15 Lower Bank Deposition	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18	
16 Bottom Scouring and Deposition	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20	
12-17 Bottom Substrate/ Available Cover	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 22	
24 Avg. Depth Riffles and Runs	Cold >1' 0 Warm >1.5' 0	6" to 1' 0 10" to 1.5' 0	6 3" to 6" 6 6" to 10"	18 <3" 18 <6"	24 24
20 Avg. Depth of Pools	Cold >4' 0 Warm >5' 0	0 3' to 4' 0 4' to 5'	6 2' to 3" 6 3' to 4'	18 <2" 18 <3"	24 24
24 Flow, at Rep. Low Flow	Cold >2 cfs 0 Warm >6 cfs 0	0 1-2 cfs 0 2-5 cfs	6 .5-1 cfs 6 1-2 cfs	18 <.5 cfs 18 <1 cfs	24 24
14 Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width)	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20	
12 Aesthetics	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16	

Column Totals: _____

Column Scores E _____ +G _____ +F _____ +P _____ = _____ = Score

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See reverse side for additional habitat features, water quality impacts and comments.

Wauh-Milw C.
line

Stream Undewood C. Reach Location Concrete segment - all Reach Score/Rating 219
 County Milw Date 23 July Evaluator WAWRZYN Classification MAR-E
4 Oct 84

Rating Item	Category			
	Excellent	Good	Fair	Poor
Watershed Erosion 14	No evidence of significant erosion. Stable forest or grass land. Little potential for future erosion. 8	Some erosion evident. No significant "raw" areas. Good land mgmt. practices in area. Low potential for significant erosion. 10	Moderate erosion evident. Erosion from heavy storm events obvious. Some "raw" areas. Potential for significant erosion. 14	Heavy erosion evident. Probable erosion from any run off. 16
Watershed Nonpoint Source 16	No evidence of significant source. Little potential for future problem. 8	Some potential sources (roads, urban area, farm fields). 10	Moderate sources (small wetlands, tile fields, urban area, intense agricultural). 14	Obvious sources (major wetland drainage, high use urban or industrial areas, feed lots, impoundment). 16
Bank Erosion, Failure Concrete 4	No evidence of significant erosion or bank failure. Little potential for future problem. 4	Infrequent, small areas, mostly healed over. Some potential in extreme floods. 8	Moderate frequency and size. Some "raw" spots. Erosion potential during high flow. 16	Many eroded areas. "Raw" areas frequent along straight sections and bends. 20
Bank Vegetative Protection 18	90% plant density. Diverse trees, shrubs, grass. Plants healthy with apparently good root system. 6	70-90% density. Fewer plant species. A few barren or thin areas. Vegetation appears generally healthy. 9	50-70% density. Dominated by grass, sparse trees and shrubs. Plant types and conditions suggest poorer soil binding. 15	<50% density. Many raw areas. Thin grass, few if any trees and shrubs. 18
Lower Bank Channel Capacity 8	Ample for present peak flow plus some increase. Peak flow contained. W/D ratio <7. 8	Adequate. Overbank flows rare. W/D ratio 8-15. 10	Barely contains present peaks. Occasional overbank flow. W/D ratio 15-25. 14	Inadequate, overbank flow common. W/D ratio >25. 16
Lower Bank Deposition 9	Little or no enlargement of channel or point bars. 6	Some new increase in bar formation, mostly from coarse gravel. 9	Moderate deposition of new gravel and coarse sand on old and some new bars. 15	Heavy deposits of fine material, increased bar development. 18
Bottom Scouring and Deposition 20	Less than 5% of the bottom affected by scouring and deposition. 4	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 16	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. 20
Bottom Substrate/Available Cover 22	Greater than 50% rubble, gravel or other stable habitat. 2	30-50% rubble, gravel or other stable habitat. Adequate habitat. 7	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 17	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 22
Avg. Depth Riffles and Runs 24	Cold >1' 0 6" to 1' 6 Warm >1.5' 0 10" to 1.5' 6	6 3" to 6" 18 6 6" to 10" 24	6 2' to 3' 18 6 3' to 4' 24	18 <3" 24 18 <6" 24
Avg. Depth of Pools 24	Cold >4' 0 3' to 4' 6 Warm >5' 0 4' to 5' 6	6 2' to 3' 18 6 3' to 4' 24	6 .5-1 cfs 18 6 1-2 cfs 24	18 <1 cfs 24 18 <.5 cfs 24
Flow, at Rep. Low Flow 24	Cold >2 cfs 0 1-2 cfs 6 Warm >5 cfs 0 2-5 cfs 6	6 .5-1 cfs 18 6 1-2 cfs 24	6 .5-1 cfs 18 6 1-2 cfs 24	18 <.5 cfs 24 18 <1 cfs 24
Pool/Riffle, Run/Bend Ratio (distance between riffles + stream width) 20	5-7. Variety of habitat. Deep riffles and pools. 4	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 16	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 20
Aesthetics 16	Wilderness characteristics, outstanding natural beauty. Usually wooded or un-pastured corridor. 8	High natural beauty. Trees, historic site. Some development may be visible. 10	Common setting, not offensive. Developed but uncluttered area. 14	Stream does not enhance aesthetics. Condition of stream is offensive. 16

Column Totals:

Column Scores E ___ +G ___ +F ___ +P ___ = Score

<70 = Excellent, 71-129 = Good, 130-200 = Fair, >200 = Poor

See reverse side for additional habitat features, water quality impacts, and comments.

Table 3

STOPNET RETRIEVAL DATE 04/01/17 - INVENT - VERSION OF SEQ. 1411

413007 205940413007 07215204007
 47 03 17.0 044 02 46.0
 UNDETERMINED CD AT USA 45
 55070 DISCU ISTY
 WESTERN GREAT LAKES 142400
 LAKE MICHIGAN WESTERN SHORE
 21-15 790117
 0002 CLASS ON CSN-250 0443032-0579954

/TYPE/AMOUNT/STREAM

PARAMETER	NA.TOT	MG/L	NUMBE	MEAN	VARIANCE	STAN DEV	COEFF VAR	STAND SD	MAXIMUM	MINIMUM	RES DATE	EN
00929 SODIUM	NA.TOT	MG/L	2	42.0000	4.00000	2.00000	.047620	2.00000	44.0000	40.0000	75/06/15	75
00937 POTASSIUM	K.TOT	MG/L	2	4.75000	.245001	.049229	.211310	.049000	5.00000	3.70000	75/06/15	75
00940 CHLORIDE	TOTAL	MG/L	1-7	249.544	245150	445.120	1.03674	35.2743	450.000	14.0000	75/06/15	75
00945 SULFATE	SU4-TOT	MG/L	2	159.500	1104.50	33.2300	.209374	23.5000	143.000	3.00000	75/06/03	77
00955 SILICA	DISOLVEN	MG/L	7	4.77103	1.44707	1.20377	.252249	.494444	22.0000	2.00000	77/04/05	77
01002 ARSENIC	AS.TOT	UG/L	1	22.0000	.000000	.000000	.000000	.000000	10.0000	10.0000	75/06/25	77
01027 CADMIUM	CD.TOT	UG/L	10	10.0000	.000000	.000000	.000000	.000000	10.0000	10.0000	75/06/25	77
	TOT		11	11.0000	13.0000	3.61410	.322224	1.00000	22.0000	5.00000	75/06/25	77
			10	2.25000	17.7224	4.20443	1.47104	1.12512	15.7000	.200000	75/06/25	75
			1	.200000					.200000	.200000	75/06/03	77
	TOT		15	2.11333	14.7300	4.04107	1.93744	1.05631	16.7000	.200000	75/06/25	77
01034 CHROMIUM	CR.TOT	UG/L	13	54.7231	29444.5	171.504	2.42249	47.5914	429.000	3.40000	75/06/25	77
			7	3.00000	.000000	.000000	.000000	.000000	3.00000	3.00000	75/06/25	77
	TOT		14	44.2750	24040.2	145.114	1.21312	34.7754	424.000	4.00000	75/06/25	77
			14	100.042	76205.7	274.073	2.75940	40.1132	1172.00	4.00000	75/06/25	77
01042 COPPER	CU.TOT	UG/L	15	347.333	1034453	1014.24	2.93449	263.147	3.00000	3.00000	76/06/26	77
01051 LEAD	PB.TOT	UG/L	1	3.00000					4000.00	3.00000	75/06/25	77
			14	322.042	474434	684.740	3.06441	247.047	4000.00	3.00000	75/06/25	77
	TOT		11	240.000	343500	507.042	2.07444	141.424	2100.00	20.0000	75/06/25	77
01055 MANGNESE	MN	UG/L	7	40.0000	324.000	18.0000	.347347	4.37000	64.0000	24.0000	77/06/05	77
01067 NICKEL	NI.TOTAL	UG/L	4	20.0000	.000000	.000000	.000000	.000000	20.0000	20.0000	75/06/25	77
			11	30.5454	311.274	17.0430	.577507	5.21055	44.0000	4.00000	75/06/25	77
			1	4.00000					30.0000	30.0000	75/06/25	77
01077 SILVER	AG.TOT	UG/L	14	230.000	221747	470.942	2.04747	117.736	1040.00	30.0000	75/06/25	77
01092 ZINC	ZN.TOT	UG/L	11	5234.14	1075404	10304.3	1.37437	3124.47	34000.0	240.000	75/06/25	77
01105 ALUMINUM	AL.TOT	UG/L	11	4.21413	.343644	.603033	1.25154	.141421	5.00000	3.00000	75/06/25	77
01147 SELENIUM	SE.TOT	UG/L	4	13400.0	.244509	16337.4	1.20132	6642.33	44000.0	.000000	75/06/17	77
31501 TOT COLI	MF(MEMBR)	/100ML	7	4033.25	.102500	10130.0	2.51162	3429.74	27000.0	2.77000	75/06/09	77
31613 FEC COLI	M-FECALIN	/100ML	1	20000.0					20000.0	20000.0	75/06/24	77
			4	4024.04	.114500	10944.4	1.21560	3470.15	27000.0	2.77000	75/06/09	77
	TOT		5	6924.33	.242504	14207.4	2.33435	6614.84	40000.0	4.00000	75/06/03	77
31679 FECSTREP	MF M-ENT	/100ML	1	6.00000					20000.0	20000.0	75/06/11	77
32730 PHENOLS	TOTAL	UG/L	2	2.00000	.000000	.000000	.000000	.000000	.200000	.200000	75/06/11	77
39100 H2E PHTH	TOTAL	UG/L	2	.003500	.000000	.002121	.404042	.001500	.005000	.002000	75/06/11	77
39330 ALURIN	TOT UG/L	UG/L	2	.012500	.000112	.010607	.844524	.007500	.020000	.005000	75/06/11	77
39340 ODD	WHL SMPL	UG/L	2	.007500	.000013	.003536	.471405	.002500	.010000	.005000	75/06/11	77
39365 ODE	WHL SMPL	UG/L	2	.015000	.000050	.007071	.471404	.005000	.020000	.010000	75/06/11	77
39370 ODT	WHL SMPL	UG/L	2	.007500	.000013	.003536	.471405	.002500	.010000	.005000	75/06/11	77
39380 DIELDRIN	TOTUG/L	UG/L	2	.003500	.000005	.002121	.404042	.001500	.005000	.002000	75/06/11	77
39410 HEPTCHLR	TOTUG/L	UG/L	2	.006000	.000032	.005657	.942910	.004000	.010000	.002000	75/06/11	77
39420 HXCHLREP	TOTUG/L	UG/L	2	.006000	.000032	.005657	.942910	.004000	.010000	.002000	75/06/11	77
39440 MTHXYCLR	WHL SMPL	UG/L	2	.050000	.001900	.042424	.844524	.030000	.080000	.020000	75/06/11	77

77 LE 2

RETRIEVAL DATE 04/04/16
 2050AC413625
 57.0 008 04 03.0 5
 WATERS TO STATE UNDERWATER
 WISCONSIN
 IN GREAT LAKES 002605
 MICHIGAN WESTERN SHORE

PAGE: 100

770209 DEPTH 3276
 BAYMANT/ESTURY

INITIAL DATE	77/02/24	77/03/04	77/03/12	77/03/12	77/03/12	77/03/20	77/03/29	77/03/29	
INITIAL TIME-DEPTH-BOTTOM	0000	0000 0001 0000	0000 0002 0000	0000 0003 0000	0000 0004 0000	0000 0005 0000	0000 0006 0000	0000	
COLOR	PT-CO	UNITS	120	30	30	30	35	30	40
LAB	PH	SU	6.9	7.2			7.7	7.8	7.9
T ALK	CACO3	MG/L	77	54	170	138	168	180	160
RESIDUE	TOTAL	MG/L	1390	315	730	685	725	685	580
RESIDUE	TOT NFLT	MG/L	272	76	31	30	34	61	54
RESIDUE	VOL NFLT	MG/L	40	20	9	9	15	12	10
ORG N	N	MG/L	3.400	2.000	0.700	0.800	0.700	0.800	0.900
NH3+NH4-	N DISS	MG/L	1.200	0.240	0.070	0.140	0.090	0.040	0.030
NO2&NO3	N-DISS	MG/L	1.9	0.9	0.4	0.6	0.4	0.3	0.7
PHOS-TOT		MG/L P	1.100	0.560	0.140	0.110	0.140	0.130	0.130
PHOS-DIS	ORTHO	MG/L P	0.570	0.340	0.039	0.300	0.075	0.019	0.016
T ORG C	C	MG/L	75.5		9.5		9.5	15.0	12.0
TOT HARD	CACO3	MG/L	138		314	266	312	314	258
CHLORINE	TOTAL	MG/L	525	46	220	225	230	180	120
INITIAL DATE	77/04/02	77/08/13	77/08/13	77/08/13	77/08/13	77/08/13	77/08/13	77/08/13	
INITIAL TIME-DEPTH-BOTTOM	0000	0001 0000	0002 0000	0003 0000	0004 0000	0005 0000	0006 0000	0000	
T ALK	CACO3	MG/L	184						
RESIDUE	TOTAL	MG/L	770	510	2175	625	350	300	465
RESIDUE	TOT NFLT	MG/L	184	376	1782	486	163	106	97
RESIDUE	VOL NFLT	MG/L	14	45	160	52	20	13	19
ORG N	N	MG/L	0.600	1.400	2.600	1.300	0.090	0.800	1.100
NH3+NH4-	N DISS	MG/L	0.020 K	0.460	0.170	0.110	0.040	0.100	0.380
NO2&NO3	N-DISS	MG/L	1.2	0.6	0.5	0.7	0.6	0.4	0.1
PHOS-TOT		MG/L P	0.160	0.460	0.960	0.470	0.300	0.250	0.200
PHOS-DIS	ORTHO	MG/L P	0.011	0.129	0.001	0.042	0.090	0.043	0.032
T ORG C	C	MG/L	12.5		41.0				12.5
TOT HARD	CACO3	MG/L	308	73	146	91	94	122	214
CHLORINE	TOTAL	MG/L	135	17	35	19	25	28	83

Table 4

Historical Fish Distribution Data

Sample Date	Location	Species	Number	Tolerance
11/17/01	Main Branch (segment 8) @ mile 1.3?	Large scale	9	IT
		Stoneroller		
		Redside Dace*	10	IT
		Least Darter*	30	IT
7/15/24	Main Branch (segment 8) @ mile 1.3?	Large scale	8	IT
		Stoneroller		
		Common Shiner	6	T
		Bluntnose Minnow	16	T
		Blacknose Dace	4	IT
		Creek Chub	20	T
		White Sucker	9	T
		Brook Stickleback	4	T
		Fantail Darter	1	IT
		Johnny Darter	83	T
8/7/73	Main Branch (segment 8) @ mile 0.6 Sholes Park	Common Shiner	7	T
		So. Redbelly Dace	4	IT
		Blacknose Dace	20	IT
		Creek Chub	199	T
10/4/84	Main Branch (segment 7) @ mile 2.6	Sunfish (unsp)	1	S
		Bluegill	1	S
		Blacknose Dace	46	IT
		White Sucker	52	T
		Golden Shiner	1	T
		Central Mudminnow	2	VT
5/23/84	Main Branch (segment 7) @ mile 3.7 @ Juneau Ave. Elm Grove	Bluegill	6	S
		Pumpkinseed	6	S
		Black Bullhead	1	S
		Sunfish (unsp)	1	S
		Blacknose Dace	18	IT
		Creek Chub	35	T
		White Sucker	27	T
		Johnny Darter	1	T
		Fathead Minnow	5	VT

5/23/84	Main Branch (segment 6) @ mile 4.8 North Ave. @ east x-ing	Blacknose Dace	2	IT
		Creek Chub	19	T
		White Sucker	14	T
		Fathead Minnow	2	VT
10/4/84	Main Branch (segment 4) @ mile 6.2 @ Indian Cr. Road	Sunfish (unsp)	1	S
		Bluegill	1	S
		Green Sunfish	12	S
		Blacknose Dace	28	IT
		Johnny Darter	39	T
		White Sucker	18	T
		Creek Chub	53	T
Central Mudminnow	8	T		
5/24/84	Main Branch (segment 3) @ mile 7.2 North Ave. west x-ing	Blacknose Dace	7	IT
		White Sucker	1	T
		Creek Chub	1	T
		Brook Stickleback	100	T
10/4/84	Main Branch (segment 1) @ mile 8.4 Dousman Ditch area	Bluegill	1	S
		Sunfish (unsp)	1	S
		Central Mudminnow	7	T
		Brook	17	T
		Stickleback		
9/10/73	Southern Br. (segment 8) 0.9 mile upstream of main branch	Central Mudminnow	3	T
		Goldfish	16	VT
		Fathead Minnow	5	VT
		Creek Chub	2	T
		Green Sunfish	41	S
		Pumpkinseed	2	S
		Bluegill	9	S
		Largemouth Bass	1	S

* Currently contained on the Wisconsin watch species list.

Source: Fago, 1973

4710P

Table 5

MACROINVERTEBRATE IDENTIFICATION

Surface Water: Underwood Cr Site No.: _____ Sample No.: _____

Site Location: 3 Slough, Lake ... County: Waukegan

Sample Collected By: R. Randall Date: 5-2-50 Sample Type: _____

Sample Sorted By: R. Randall Date: 5-2-50 Identified By: R. Randall Date: 5-2-50

Chironomidae Mounted By: R. Randall Date: 7-9-50 Identified By: W. ... Date: 7-13-50

Oligochaeta Mounted By: _____ Date: _____ Identified By: _____ Date: _____

Subsample Mesh size 30 Chironomidae Mounted: _____

Taxa	Stage*	Count	Total No.	Biotic Index	Taxa	Stage*	Count	Total No.	Biotic Index
Chironomidae					Plecoptera				
Cricotopus sp		52		4					
Epkiefferiella sp		1		2					
Thienemannia sp		6		3	Odonata				
					Coleoptera				
					Ophioceros sp.	L	1		2
					Oligochaeta				
Other Diptera									
Empididae		1		3	Isopoda				
					Asellus submedius		46		5
					Gastropoda				
Trichoptera									
Cheumatopsyche sp.		1		3	Amphipoda				
					Gastropoda				
					Lepidoptera				
Ephemeroptera									
Stonaxon interperforatus		4		3	Other				

Total No. of Organisms 117 Total No. Per Sq. Ft. _____

*L - Larval; P - Pupal; A - Adult; I - Early Instar

Checked by: _____ Date: _____

Site HBI 417

MACROINVERTEBRATE IDENTIFICATION

Surface Water: Underwood Cr. Site No.: _____ Sample No.: _____
 Site Location: Woodbridge St. = 150' downstream of bridge County: Wayne
 Sample Collected By: R. Randall Date: 5-2-84 Sample Type: _____
 Sample Sorted By: R. Randall Date: 5-11-84 Identified By: R. Randall Date: 6-27-84
 Chironomidae Mounted By: R. Randall Date: 7-6-84 Identified By: R. Randall Date: 7-9-84
 Oligochaeta Mounted By: _____ Date: 30 Identified By: _____ Date: _____
 _____ Subsample Chironomidae Mounted: _____

Taxa	Stage*	Count	Total No.	Biotic Index	Taxa	Stage*	Count	Total No.	Biotic Index
Chironomidae			8		Plecoptera				
Cricotopus		10		4					
Chironomus tentaculatus		1		3					
Diamesa		1		2	Odonata				
					Coleoptera				
					Opticerus spp.	L	3		2
					Oligochaeta				
Other Diptera					Isopoda				
Antocha spp.		3		2	Asellus intermedius		34		5
Empididae spp.		1		3	Gastropoda				
Trichoptera					Amphipoda				
Hydropsyche bellasi		9		3	Crangonyx spp.		1		4
Cheumatopsyche		14		3					
Chimarra aterrima		10		2	Gastropoda				
Neophlix spp.		6		2					
Polychaeta spp.		1		2	Lepidoptera				
Ephemeroptera					Other				
Stenonema vittatum		12		3					

Total No. of Organisms 102

Total No. Per Sq. Ft. _____

*L - Larval; P - Pupal; A - Adult; I - Early Instar

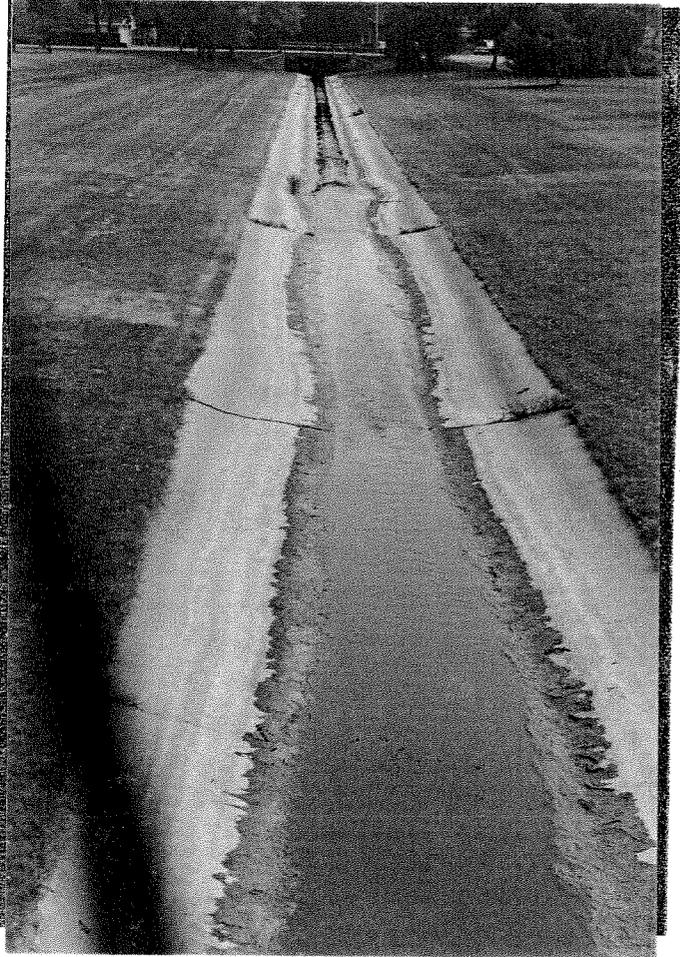
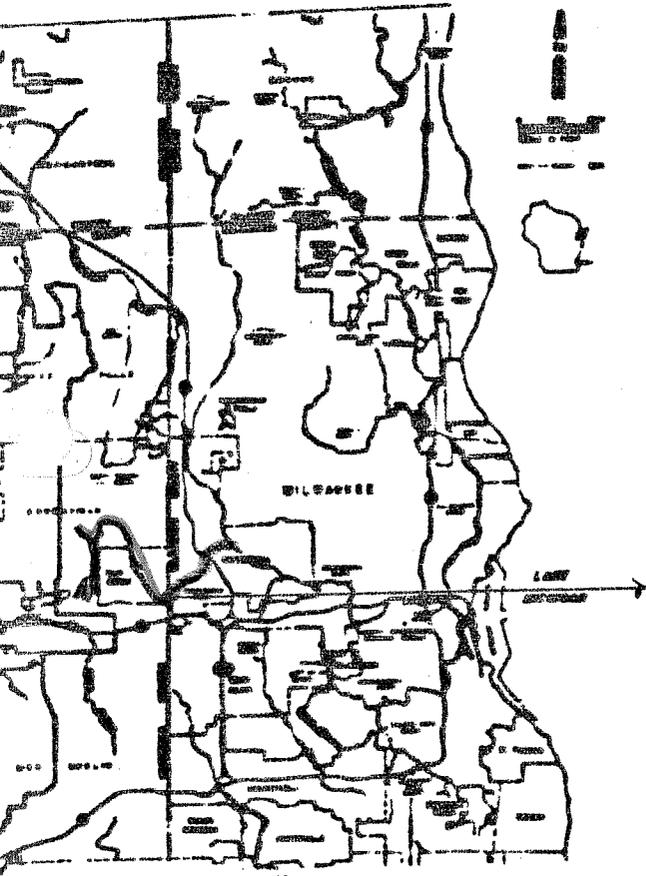
Checked by: _____ Date: _____

Site #31 3-5

Appendix I

(Pictorial Presentation)

Underwood Creek



Underwood Creek Looking South at bridge near Legion
,and Nicolet. Start of channelization.

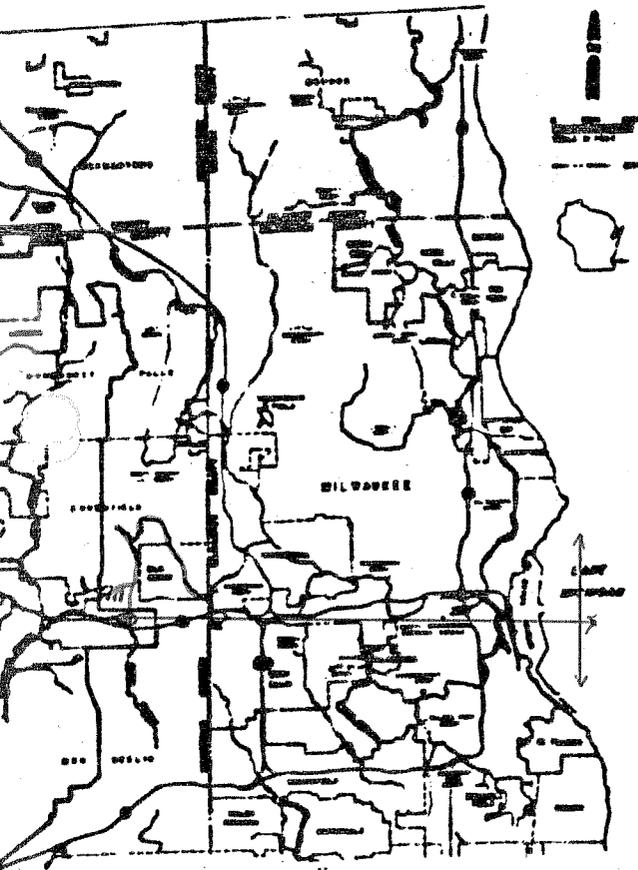
Milwaukee Co.

Date: July, 84

Underwood Creek

North branch of Underwood Creek above Dousman Ditch. Note flow diversion structure. Location in headwater area.

Waukesha Co.



Backwater area of the first of two dams in the headwater area.

First dam on Underwood Creek. Location is about 9 miles from confluence with Menomonee River.

Date: 10/ /85

