



Rush Creek Watershed

Ottawa and Kent Counties, MI

Field Surveys
performed by DEQ staff
October and November 2003

SUMMARY OF RUSH CREEK WATERSHED ASSESSMENT KENT AND OTTAWA COUNTY, MICHIGAN

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INTRODUCTION

The Rush Creek watershed is located in the southeastern portion of Ottawa County and the southwestern portion of Kent County. It originates in the southeastern portion of Blendon Township (Ottawa County) in an area characterized by low to moderate density residential and forested land uses, although portions of all tributaries flow through agricultural areas as well. The cities of Hudsonville, Jenison and Grandville are urban areas located along Rush Creek. Department of Environmental Quality (DEQ) field staff surveyed road/stream crossings within the watershed to quickly assess the health of the watershed. The survey combined both qualitative and quantitative assessment of Rush Creek and its tributaries and provided a basis upon which to identify any potential sources of non point source pollution negatively affecting the watershed. In total, twenty-four road/stream crossing locations were surveyed during the assessment of the Rush Creek Watershed. Refer to Attachment A, Road Stream Crossings Inventory, for a summary of the survey locations conducted during October and November 2003, as well as survey location maps. Site identification codes were developed using two or three letter identifiers for the subwatershed followed by the two digit site location number. Sites were numbered successively from the headwaters to the mouth.

METHODS

The DEQ's stream crossing watershed survey procedure was developed as a quick screening tool to assess general water quality and possible pollutant sources, causes and problems within the watershed. The survey procedure provides standardized visual assessments that can be conducted by DEQ staff or trained volunteers. Only observations that can be made from the road stream crossings are recorded; recording "educated guesses" or suspicions is prohibited. Because this assessment is based on visual observations, designed to be conducted quickly and by many different types of people and knowledge backgrounds, the survey results are only qualitative in nature.

A minimum of 30% of the road stream crossings within a watershed are to be surveyed with attention given to balanced geographical coverage and assessment across major land use changes and possible pollutant sources. Surveys are always conducted in one general direction (either upstream to downstream OR downstream to upstream), and the attempt is made to keep the surveyors and weather conditions consistent to limit bias and subjectivity between surveyors and field days. This survey was conducted from the upstream to downstream direction in four days by two DEQ field staff. The right and left bank designations were always assigned based on looking downstream at each road stream crossing location.

At each survey location the following stream conditions are visually assessed:

- Weather and any rain event conditions
- Culvert/bridge conditions
- Channel conditions (width, depth, high water mark, riffles, pools, natural, maintained, recovering)
- Stream appearance (color, turbidity, algae, aquatic plants, trash, oil sheen, bacteria, foam)
- Substrate composition (boulder, gravel, silt, sand, unknown)
- In-stream Cover (undercut banks, overhanging vegetation, woody debris, pools, boulders, plants)
- Stream corridor (riparian vegetation type and width, bank erosion, canopy cover, adjacent land use)
- Potential Pollutant Sources (source and pathway identification)

At each survey location the following stream conditions are directly measured:

- Water temperature
- Dissolved oxygen content
- pH
- flow velocity
- latitude and longitude coordinates (GPS)

In addition each site was photo-documented with a digital picture taken in the downstream direction, upstream direction and of the road crossing itself. Refer to the DEQ's *Stream Crossing Watershed Survey Procedure* for further information and a complete description of the above conditions. Please note that although some dissolved oxygen levels and pH data were collected at some sites and recorded on the survey sheets, they will not be summarized here due to unstable readings and unreliable calibrations of the dissolved oxygen and pH meters.

OBSERVATIONS

Water Temperature and pH

Survey locations were assessed in the order of upstream sites (in the headwaters) to downstream sites (towards the mouth). Twenty-four locations, including ten along the main stem of Rush Creek, were measured for temperature and pH. pH values ranged from 3.4 to 7.92, which indicated that the pH meter was probably not working correctly, therefore pH will not be summarized in the following report. Overall the average temperature was 51.7° F, with most stations at either 45 or 46° F. One location, at Quincy Road east of 32nd Avenue, was 65° F which was the highest recorded temperature within the watershed. This comparatively high reading was due to unknown sources.

Normal stream temperatures capable of supporting a coldwater fishery with few diseases are below 57°F. Walleye, northern pike and some trout are adapted to temperatures between 57° to 68°F while temperatures over 68°F are suitable for fish communities characterized by bass, crappie, bluegill, carp and sucker with occurrence of fish disease high. While temperatures recorded here seem low it is important to note that this survey was not conducted during the hottest summer months when temperature becomes a limiting factor to some species. Temperatures will appear cool because the survey was

conducted during the fall. Maximum air temperatures during the four field days of this survey ranged from 41°F (on November 7) to 68°F (on October 31). Refer to Figure 1 in Attachment B, which depicts the temperature and pH levels at all locations surveyed and to Figure 2, for only those temperatures and pH measurements for the mainstem locations.

Substrate

Substrate was observed and quantified for both the upstream and downstream stretch at each survey location. In all, forty-eight substrate observations were recorded. Substrate type is important when considering habitat suitability for desired species within the system (i.e. trout and other fish species). Cobble and gravel substrates with a low degree of embeddedness are the most suitable for reproduction in many fish species and is important for macroinvertebrates as well. Evidence of silt and sand dominated substrate could indicate problems within the watershed such as erosion and sedimentation. Among the survey locations within the Rush Creek Watershed approximately 10% were dominated (80 to 100% covered) by sand and 17% were dominated silt, detritus or muck. 31% of the sites were unable to be categorized due to turbidity. None of the sites observed appeared to be dominated by cobble or gravel however 27% of the sites had some amount of gravel present (although it was always less than 50%). Refer to Figures 3 through 6 for substrate data for each of the subwatersheds separately. Refer to Figure 7, in Attachment B, for a graph depicting the substrate composition for those survey locations located along the main channel of Rush Creek.

In-Stream Cover

The presence of in-stream cover was assessed at each location for both the upstream and downstream stretches. In-stream cover, such as overhanging vegetation, undercut banks, deep pools, boulders, plant cover and large woody debris provide habitat for macroinvertebrates and aquatic organisms such as amphibians and fish. Of the 48 observations made, 79% of the sites had overhanging vegetation and 31% of the sites had woody debris. Undercut banks and boulders were each found in approximately 19% and 2% of the remaining sites respectively. Refer to Table 1, in Attachment B for a summary of the in-stream cover observations made at each survey location.

Physical Appearance

The physical appearance of the stream at each survey location was assessed based on the presence or absence of aquatic plants, floating algae, filamentous algae, bacterial slimes, turbidity, oil sheen, foam and/or trash. In all, forty-eight physical appearance observations were recorded and rated as either present or abundant. No oil sheens were observed at any of the sites. In general foam, bacterial sheens and floating and filamentous algae were the least common. Approximately 50% of the sites exhibited turbidity, 27% of the sites exhibited trash and 21% of the sites exhibited aquatic plants (including duckweed). Refer to Table 2, in Attachment B for a summary of the physical appearance observations made for each survey location.

Stream Corridor

The riparian vegetation was assessed at each survey location for both the right and left banks of the upstream and downstream stretches. The presence of riparian vegetation reduces the amount of surface water runoff to streams, provides a filter strip for nutrients within runoff waters, provides overhanging vegetation for stream habitat, provides a source of woody debris, stabilizes stream banks against erosion and determines the availability of sufficient stream canopy cover for temperature regulation. Twenty four survey locations were assessed, resulting in 96 observations of riparian vegetation width recorded. A majority of the observations made (53%) indicated riparian vegetation extended less than 10 feet from the stream channel while 36% of the observations fell into the between 10 and 30 feet category. The least amount of observations were made for the riparian width class of 30 to 100 feet at 4% and for the over 100 meters category at 7%. This analysis indicates that the Rush Creek watershed has many areas in need of greater riparian vegetation width.

The streamside land cover, estimated bank erosion and percent stream canopy were evaluated at each of the twenty-four survey locations for both the upstream and downstream stretches. In all, forty-eight observations were made for each of the above listed characteristics. Of the survey locations, 23% were recorded as having streamside land cover predominantly shrubs, 33% predominantly grasses and 44% dominated by trees. In general, vegetation such as grasses and shrubs and residential and agricultural land uses, are associated with narrow riparian widths. More extensive riparian vegetation is usually associated with forests and old fields. Overall erosion of the banks was not a major problem in the Rush Creek Watershed with approximately 93% of the sites described as having none or low bank erosion. Refer to Table 3, in Attachment B for the distribution of riparian width and vegetation observations made for both the right and left bank at each survey location.

Stream canopy cover is important for providing shade and maintaining cool temperatures within the stream. Cooler temperatures also help keep dissolved oxygen levels from depleting, an important habitat requirement for many fish species and other aquatic organisms. An almost equal number of observations were recorded for each of the three cover classes. Of the 48 sites assessed, 18 sites had less than 25% cover, 13 sites had between 25 and 50% cover and 17 sites had over 50% cover.

Adjacent Land Uses

Adjacent land uses were recorded at each survey location for both the upstream and downstream stretches as well as both the right and left banks. Because the entire section of stream that can be seen from the road crossing is evaluated, multiple land uses can be recorded for each site. Land uses within the watershed play an important role in nutrient input, erosion, and in-stream conditions that affect water quality, quantity and habitat. Refer to Attachment B, Table 4 and Figure 8 for a summary of all the adjacent land uses recorded within the watershed. The most common adjacent land uses were maintained lawns, cropland, forest, shrub/old field and impervious surfaces followed by a lesser number of observations for pasture, animal feeding operations and disturbed ground.

Potential pathways of non-point source pollution

During the completion of the road stream crossing surveys, field staff also evaluated the *potential* for non point source pollution. This assessment focuses on the severity of *potential* pollutant *inputs*, not pollutant *impacts*. As part of this evaluation process field staff look for 1.) a possible pollutant source, 2.) a potential pathway to the waterbody and 3.) potential severity of the input. Because each potential source was given a ranking of slight, moderate and high for severity, the values recorded were weighted before they were summed for each category (Refer to Figure 9, Attachment B). Observations recorded as slight were considered to be the basis for comparison, therefore observations recorded as moderate were multiplied by 1.5 and observations recorded as high were multiplied by 2. Potential non point source pollution from transportation, crop related sources and urban residential runoff were the most serious while streambank erosion, channelization and hydrology were also considered common sources of NPS pollution. Refer to Table 5 in Attachment B for a summary of the non point source pollution observations identified for each survey location.

RESULTS

Northwestern Rush Creek Subwatershed (Unnamed Tributary and Rush Creek headwaters)

Rush Creek originates in southeastern Blendon Township and is joined by an unnamed tributary from southwestern Georgetown Township. Seven survey locations were evaluated on this portion of Rush Creek from the headwaters to the crossing at Balsam Drive. Stations in the northwestern subwatershed are denoted by NWR prefixes. The land use in this area is a mix of agriculture, commercial areas and low to high density residential. Refer to Attachment C for site photos and to Attachment D for site survey forms. The following conditions and comments were recorded on the survey forms:

NWR-01: 64th north of Port Sheldon

Due to dry conditions, water temperature and substrate observations were prohibited at this site. No in-stream cover was observed for this site. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Riparian vegetation was variable and ranged from less than 10 feet (ft) on the banks of the downstream side to more than 100 ft on the upstream side and consisted of shrubs and small trees. Adjacent land uses included cropland, impervious surfaces, forest and an animal feeding operation. Potential non point source pollution (NPS) was categorized as moderate for crop related activities and slight for urban residential runoff and transportation. Comments were: *Stream was dry, channel runs along the road.*

NWR-02: 56th north of Port Sheldon

Water temperature was ~56°F. Silt, detritus and muck accounted for 100% of the substrate on the upstream side while both silt and sand appeared to dominate the substrate on the downstream side. Some overhanging vegetation and woody debris (upstream side) was available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Little riparian vegetation (less than 10 feet) was observed downstream which consisted of grasses. A moderate amount of riparian vegetation (10 to 30 ft) was observed upstream which consisted of shrubs and trees. Adjacent land uses included forest, maintained lawn, and disturbed ground. Potential NPS pollution was categorized as moderate for urban residential runoff and slight for transportation. Comments were: *Maintained lawns on downstream side with little riparian buffer, construction ongoing within 500ft of upstream side.*

NWR-03: 48th north of Port Sheldon

Water temperature was ~49°F. Silt, sand and gravel appeared in almost equal amounts on the upstream side. Substrate observations were inadvertently omitted for the downstream side. Some overhanging vegetation and woody debris (upstream side) was available for in-stream cover. Some aquatic plants were observed on the downstream side. In general, abundant riparian vegetation (30 to more than 100 ft) was observed both upstream and downstream, with the exception of the upstream right bank which had less than 10 ft. Vegetation generally consisted of small trees and shrubs. Adjacent land uses included shrub/old field, an animal feeding operation and maintained lawns. Potential NPS pollution was categorized as moderate for urban residential runoff, animal feeding operations and transportation. Comments were: *Potential impacts from animal feeding operation.*

NWR-04: 40th south of Port Sheldon

Water temperature was ~50°F. Silt and sand comprised equal parts of the upstream substrate while observations were prohibited on the downstream side due to abundant turbidity. Only overhanging vegetation (downstream side) was available for in-stream cover. Some aquatic plants and abundant turbidity were observed on the downstream side, while only some turbidity was observed upstream. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream, and consisted of grasses. Adjacent land uses consisted of cropland. Potential NPS pollution was categorized as high for crop related activities and slight for transportation and channelization. Comments were: *Adjacent sod farm/turfgrass-no riparian buffer.*

NWR-05: Van Buren west of 40th

Water temperature was ~53°F. Silt, detritus and muck accounted for 100% of the substrate on both the upstream and downstream sides. Only overhanging vegetation (upstream and downstream) was available for in-stream cover. Aquatic plants were observed both upstream and downstream while some filamentous algae were observed downstream. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream, and consisted of grasses. Adjacent land use consisted of cropland. Potential NPS pollution was categorized as high for crop related activities and slight for transportation. Comments were: *Railroad ties in stream, hardly any buffer from adjacent sod farm which has bare exposed soil.*

NWR-06: 36th north of Van Buren

Water temperature had decreased here to ~49°F. Due to level of turbidity, substrate observations were prohibited for the upstream side. However, silt, sand and gravel appeared on the downstream side. Only overhanging vegetation (downstream side) was available for in-stream cover. Aquatic plants and turbidity were observed both upstream and downstream. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream, and consisted of grasses. Adjacent land use consisted of cropland. Potential NPS pollution was categorized as high for crop related activities, moderate for transportation and slight for channelization. Comments were: *1 of 3 culverts is partially obstructed, very turbid water on upstream side, field underdrains outlet here.*

NWR-07: Balsam south of Port Sheldon

Water temperature had increased to ~55°F. Silt, sand and gravel appeared on both the upstream and downstream sides. Some overhanging vegetation and woody debris (downstream side) was available for in-stream cover. Abundant aquatic plants were observed upstream while trash was observed downstream. In general, little riparian vegetation (less than 10 ft) was observed both upstream and downstream, and consisted of grasses and shrubs. Adjacent land uses included shrub/old field and maintained lawns. Potential NPS pollution was categorized as slight to high for urban residential runoff and slight for transportation and mining (gravel sand operation). Comments were: *Gravel sand operation within 100 ft of stream, adjacent landowner mowing right up to the edge.*

The majority of the impacts to the stream in this area seem to result from transportation erosion or erosion due to the road stream crossing as well as runoff from adjacent croplands and residential lawns. Very little in stream habitat was observed in these reaches mainly due to channelization and very little riparian vegetation. The areas near NWR- 04, 05 and 06 could be a critical area of nutrient and sediment runoff from the sod farms in the area. In all areas, riparian buffers should be extended.

Western Central Subwatershed (Unnamed tributary flowing into Rush Creek)

The western central subwatershed consists of an unnamed tributary that flows from the area near the small village of Zutphen (south of I-196) north through Hudsonville to Rush Creek. It drains heavily agricultural areas in its headwaters to moderately urban areas where it converges with Rush Creek just west of Balsam Drive. Five survey locations were completed along this tributary, denoted by WCR prefixes. The following conditions and comments were recorded on the survey forms:

WCR-01: Quincy east of 40th

Water temperature was ~51°F. Silt, detritus and muck, appeared to dominate both the upstream and downstream substrates. Some overhanging vegetation and woody debris was available for in-stream cover. Some turbidity was observed both upstream and downstream. Riparian vegetation was variable and ranged from more than 100 ft (upstream banks) to less than 10 ft on the downstream right bank. Vegetation was dominated by shrubs and trees. Adjacent land uses included forest and maintained lawns. Potential NPS pollution was categorized as moderate to high for transportation, moderate for streambank erosion and slight for urban residential runoff. Comments were: *Some erosion occurring near culvert due to steep banks and gully forming flow from road runoff.*

WCR-02: Quincy east of 32nd

Water temperature here was the highest recorded for the watershed at ~65°F. Silt, detritus and muck, appeared to dominate both the upstream and downstream substrates. Some overhanging vegetation and woody debris (upstream side) was available for in-stream cover. Some filamentous algae (upstream and downstream) and some turbidity (downstream) was observed. A moderate amount of riparian vegetation, 10 to 30 ft (upstream) and 30-100 ft (downstream) was observed, and consisted of grasses, shrubs and trees. Adjacent land uses included shrub/old field, forest and impervious surfaces. Potential NPS pollution was categorized as slight for transportation. Comments were: *Looks like a surface water drive trib, with no flow currently.*

WCR-03: New Holland west of 32nd

Water temperature had decreased to ~56°F. Silt and sand made up equal parts of the upstream substrate while observations were prohibited on the downstream side due to turbidity. Some overhanging vegetation and woody debris (upstream side) was available for in-stream cover. A bacterial sheen was observed both upstream and downstream while some turbidity was also noted downstream. In general little riparian vegetation (less than 10 feet) was observed which consisted of trees and shrubs. Adjacent land uses included forest and maintained lawn. Potential NPS pollution was categorized as high for urban residential runoff and golf courses and slight for transportation.

Comments were: *Lots of lawn clippings deposited in this area, no riparian vegetation further downstream.*

WCR-04: 32nd north of Barry

Water temperature was ~55°F. Silt and sand appeared in almost equal amounts on both the upstream and downstream sides. Overhanging vegetation, undercut banks and woody debris were available both upstream and downstream. Some turbidity and trash was observed upstream and downstream. Little riparian vegetation (less than 10 feet) was observed on the right bank while a moderate amount of riparian vegetation (10 to 30 ft) was observed on the left bank. Vegetation was dominated by shrubs and trees. Adjacent land uses included impervious surfaces and maintained lawn. Potential NPS pollution was categorized as moderate for transportation and urban residential runoff, and slight for recreational activities. Comments were: *Both culverts creating plunge pools, left side of downstream reach armored with concrete slabs, Hudsonville High School just upstream, this site is just downstream from the golf course.*

WCR-05: Oak west of Balsam

Water temperature had increased here to ~56°F. Silt and sand appeared in almost equal amounts on both the upstream and downstream sides. Some overhanging vegetation and woody debris (upstream side) was available for in-stream cover. Some turbidity was observed upstream and foam downstream. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream, and consisted of grasses. Adjacent land uses included impervious surfaces and maintained lawn. Potential NPS pollution was categorized as moderate for channelization and debris in water, slight to moderate for urban residential runoff, and slight for transportation, streambank erosion, hydrology and sources unknown. Comments were: *Lots of trash in stream including small propane canister, 4 dead fish on downstream side, right side of downstream reach completely concrete, no vegetation at all. Upstream looks more natural.*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffers, urban residential runoff (including the Hudsonville golf course), and transportation non point source pollution. Turbidity was commonly noted at survey locations in this subwatershed indicating sediment runoff from adjacent land uses and excessively silty and sandy substrates. Also common to this watershed were highly channelized reaches armored by concrete which disrupts the natural stream flow and meandering pattern. The dead fish noted at site WCR-05 are a concern, although the cause was unknown.

Eastern Central Subwatershed (unnamed tributary that flows into Rush Creek)

The eastern central subwatershed consists of an unnamed tributary that flows north from the Angling Road area (south of I-196) through Hudsonville to Rush Creek. It drains heavily agricultural areas in its headwaters to moderately urban areas where it converges with Rush Creek before Rush Creek crosses Port Sheldon. Four survey locations were completed along this tributary, denoted by ECR prefixes. The following conditions and comments were recorded on the survey forms:

ECR-01: Jackson east of 32nd

Due to dry conditions, water temperature and substrate observations were prohibited at this site. No in-stream cover was observed for this site. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash were observed. Abundant riparian vegetation (more than 100 ft) was observed downstream while a little (less than 10 ft) to a moderate (10 to 30 ft) amount of riparian vegetation was observed upstream. In general the upstream vegetation was dominated by grasses while the downstream vegetation was dominated by trees. Adjacent land uses included shrub/old field, pasture, impervious surfaces, forest and maintained lawn. Potential NPS pollution was categorized as high for streambank erosion and hydrology, and slight for transportation, channelization and sources unknown. Comments were: *Dry at time of survey although perched culvert and streambank erosion evident, can't figure out the reason for such high flows that are indicated by this amount of erosion. Talked to adjacent landowner who said that stream channel was redirected 20 to 25 years ago as part of home development.*

ECR-02: Barry east of 32nd

Water temperature was ~57°F. Silt, sand and gravel were observed on the upstream side while equal amounts of sand and gravel were noted for the downstream side. Overhanging vegetation and woody debris were available both upstream and downstream for in-stream cover. Some foam and trash were observed downstream. Little riparian vegetation (less than 10 feet) was observed downstream while a moderate amount of riparian vegetation (10 to 30 ft) was observed upstream. In general downstream vegetation was dominated by shrubs while upstream vegetation was dominated by trees. Adjacent land uses included cropland and maintained lawn. Potential NPS pollution was categorized as slight for crop related activities and urban residential runoff. Comments were: *Water looks way down, many sump drainage pipes exposed.*

ECR-03: Van Buren west of Edson

Water temperature was ~46°F. Sand appeared to dominate the upstream and downstream substrate with lesser amounts of silt also present. Only overhanging vegetation (upstream and downstream) was available for in-

stream cover. Abundant turbidity was observed upstream, while some turbidity and foam were observed downstream. Little riparian vegetation (less than 10 feet) was observed upstream while a moderate amount of riparian vegetation (10 to 30 ft) was observed downstream. Vegetation was dominated by grasses both upstream and downstream. Adjacent land uses included shrub/old field and cropland. Potential NPS pollution was categorized as moderate to high for crop related activities, and slight for transportation and channelization. Comments were: *Water turbid from previous rains, pictures show comparison in water depth.*

ECR-04: Van Buren east of Edson

Water temperature was ~47°F. Silt, detritus and muck, appeared to dominate both the upstream and downstream substrates. Only overhanging vegetation (upstream and downstream) was available for in-stream cover. Some turbidity was observed both upstream and downstream. Little riparian vegetation (less than 10 feet) was observed both upstream and downstream, and consisted of grasses and shrubs. Adjacent land uses included cropland and maintained lawn. Potential NPS pollution was categorized as moderate for crop related activities, and slight for transportation. Comments were: *No specific comments were recorded for this site.*

The majority of the impacts to the stream in this area seem to result from inadequate riparian buffers, urban residential and cropland runoff, and transportation non point source pollution. Turbidity was commonly noted at survey locations in this subwatershed although most of the turbidity could probably be attributed to previous rain events in the area. Also common to this watershed were highly channelized reaches with little in stream habitat. The most notable site within this subwatershed was ECR-01 at Jackson east of 32nd which showed evidence of high flows and moderate to severe streambank erosion although the stream was dry at the time of the survey. Conversations with the adjacent residential landowner revealed that the stream had been relocated from its natural location to accommodate the residential property. Observed erosion and intermittent high flows could partially be a result of previous relocation of the stream channel. This areas is recommended for further study.

Eastern Drain (designated drain that flows into Rush Creek)

A designated drain flows from the City of Grandville to Rush Creek with its headwaters originating south of 44th street near the Rivertown Crossings Mall. It drains residential areas as well as heavily commercialized, urban areas where it converges with Rush Creek north of Tyler Street. Four survey locations were completed along the drain, denoted by EDR prefixes. The following conditions and comments were recorded on the survey forms:

EDR-01: 44th west of Wilson

Water temperature was ~46°F. Silt and sand were observed in equal amounts on the upstream side while silt, sand, and gravel appeared on the downstream side. Overhanging vegetation (upstream and downstream) and undercut banks and woody debris (only downstream) were available for in-stream cover. Some trash was observed upstream. Little riparian vegetation (less than 10 feet) was observed upstream while a moderate amount of riparian vegetation (10 to 30 ft) was observed downstream. Vegetation was dominated by trees both upstream and downstream. Adjacent land uses included cropland and impervious surfaces. Potential NPS pollution was categorized as slight for urban residential runoff and channelization. Comments were: *Buffer looks pretty good on downstream side, looks pretty natural.*

EDR-02: Canal east of I-196

Water temperature was not collected at this site. Sand and gravel were observed for both the upstream and downstream sides with lesser amounts of silt, detritus and muck also present. Only overhanging vegetation (upstream and downstream) was available for in-stream cover. Some turbidity (downstream) and some trash (upstream) were observed. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses consist of maintained lawns. Potential NPS pollution was categorized as moderate for urban residential runoff. Comments were: *Water is somewhat impounded on downstream side, channel is much wider.*

EDR-03: Kenowa north of 44th

Water temperature was ~46°F. An equal amount of sand and gravel was observed for both the upstream and downstream sides. Only overhanging vegetation (upstream and downstream) was available for in-stream cover. Some trash was observed downstream. Little riparian vegetation (less than 10 feet) was observed downstream while a moderate amount of riparian vegetation (10 to 100 ft) was observed upstream. Vegetation was dominated by grasses both upstream and downstream. Adjacent land uses included shrub/old field, impervious surfaces, and maintained lawns. Potential NPS pollution was categorized as slight to moderate for urban residential runoff and slight for transportation and channelization. Comments were: *No specific comments were recorded for this site.*

EDR-04: Tyler Street west of Kenowa

Water temperature was not collected at this site. Due to level of turbidity substrate observations were prohibited. Only undercut banks were available for in-stream cover. In general a moderate amount of riparian vegetation (10 to 30 ft) was observed which consisted of shrubs and trees. Adjacent land

uses included shrub/old field, impervious surfaces, and maintained lawn. Potential pollution NPS was categorized as slight transportation and urban residential runoff. Comments were: *No specific comments were recorded for this site.*

Although this is a designated drain water quality should still be a concern as it flows into Rush Creek and ultimately the Grand River. Most of the impacts to the drain result from channelization and urban residential runoff.

Rush Creek Subwatershed (Lower reaches of Rush Creek until it converges with the Grand River)

The lower subwatershed includes the final reaches of Rush Creek as it flows northeast from the city of Jenison to its convergence with the Grand River. Four survey locations were completed along the lower reaches of Rush Creek denoted by RC prefixes. The majority of the land use in this area is commercial and urban land use. The following conditions and comments were recorded on the survey forms:

RC-01: Port Sheldon east of Chicago Drive

Water temperature was ~45°F. Due to level of turbidity, substrate observations were prohibited. Only overhanging vegetation and woody debris were available for the upstream side only. Some aquatic plants, floating algae and turbidity were observed. In general a moderate amount of riparian vegetation (10 to 30 ft) was observed which consisted of grasses, shrubs and trees. Adjacent land uses included shrub/old field, cropland and maintained lawn. Potential NPS pollution was categorized as slight for crop related activities and transportation. Comments were: *Some erosion evident from road ditch drainage although some work has been done, silt fences and grass seed.*

RC-02: 12th north of Port Sheldon

Water temperature was not collected at this site. Due to level of turbidity on the upstream side substrate observations were prohibited. Sand appeared to dominate the downstream substrate with lesser amounts of silt and gravel also present. Overhanging vegetation and undercut banks were available both upstream and downstream. Abundant turbidity and some trash was observed on the upstream side while only turbidity was observed downstream. In general a moderate amount of riparian vegetation (10 to 30 ft) was observed which consisted of shrubs and trees. Adjacent land uses consist of maintained lawns. Potential NPS pollution was categorized as slight to moderate for urban residential runoff and slight for transportation and recreational. Comments were: *looks like adjacent landowners might be raking leaves into stream, needs more riparian buffer.*

RC-03: Cottonwood northwest of Port Sheldon

Water temperature was ~50°F. Due to level of turbidity on the upstream side substrate observations were prohibited. Sand appeared to dominate the downstream substrate with lesser amounts of gravel also present. Some overhanging vegetation and woody debris (downstream side) was available for in-stream cover. Some turbidity, foam and trash were observed. Little riparian vegetation (less than 10 feet) was observed on the right bank while a moderate amount of riparian vegetation (10 to 30 ft) was observed on the left bank. Vegetation consisted of grasses, shrubs and trees. Adjacent land uses included shrub/old field and maintained lawns. Potential NPS pollution was categorized as moderate for urban residential runoff and slight for transportation and channelization. Comments were: *The channel on the upstream side has a diverted engineered channel so that the stream is forced to flow through and around a residential property.*

RC-04: Old M-21

Water temperature was ~45°F. Due to level of turbidity substrate observations were prohibited. Overhanging vegetation, undercut banks, and boulders (downstream only) were available for in-stream cover. Some turbidity and trash were observed. A moderate amount of riparian vegetation (10 to 30 ft) was observed both upstream and downstream and consisted of shrubs and trees. Adjacent land uses included impervious surfaces, forest, and maintained lawn. Potential NPS pollution was categorized as slight for transportation and urban residential runoff. Comments were: *Boulders are creating adequate aeration, need some runoff control from road crossing erosion.*

The lower reaches of Rush Creek were extremely turbid which could have been the result of previous rains in the area but could partially be the result of large amount of sediments being carried from storm water runoff and agricultural and residential land uses throughout the watershed. Overall the amount of impervious surface cover and little riparian vegetation in some areas of lower Rush Creek could lead to high flows with greater erosive power in the future.

Attachment A

Road Stream Crossing Inventory and Maps

Road Stream Crossing Inventory for Bass Creek Watershed 2003

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
1	NWR-01	Northwestern Rush Creek	64th north of Port Sheldon	Blendon/Ottawa	Tributary to Rush Creek	10/24/2003
2	NWR-02	Northwestern Rush Creek	56th north of Port Sheldon	Blendon/Ottawa	Tributary to Rush Creek	10/24/2003
3	NWR-03	Northwestern Rush Creek	48th north of Port Sheldon	Blendon/Ottawa	Tributary to Rush Creek	10/24/2003
4	NWR-04	Northwestern Rush Creek	40th south of Port Sheldon	Georgetown/Ottawa	Tributary to Rush Creek	10/24/2003
5	NWR-05	Northwestern Rush Creek	Van Buren west of 40th	Georgetown/Ottawa	Tributary to Rush Creek	10/24/2003
6	NWR-06	Northwestern Rush Creek	36th north of Van Buren	Georgetown/Ottawa	Tributary to Rush Creek	10/24/2003
7	NWR-07	Northwestern Rush Creek	Balsam south of Port Sheldon	Georgetown/Ottawa	Tributary to Rush Creek	10/24/2003
8	WCR-01	Western Central Rush Creek	Quincy east of 40th	Jamestown/Ottawa	Tributary to Rush Creek	10/31/2003
9	WCR-02	Western Central Rush Creek	Quincy east of 32nd	Jamestown/Ottawa	Tributary to Rush Creek	10/31/2003
10	WCR-03	Western Central Rush Creek	New Holland west 32nd	Georgetown/Ottawa	Tributary to Rush Creek	10/31/2003
11	WCR-04	Western Central Rush Creek	32nd north of Barry	Georgetown/Ottawa	Tributary to Rush Creek	10/31/2003
12	WCR-05	Western Central Rush Creek	Oak west of Balsam	Georgetown/Ottawa	Tributary to Rush Creek	10/31/2003
13	ECR-01	Eastern Central Rush Creek	Jackson east of 32nd	Georgetown/Ottawa	Tributary to Rush Creek	10/31/2003
14	ECR-02	Eastern Central Rush Creek	Barry east of 32nd	Georgetown/Ottawa	Tributary to Rush Creek	10/31/2003
15	ECR-03	Eastern Central Rush Creek	Van Buren west of Edson	Georgetown/Ottawa	Tributary to Rush Creek	11/7/2003
16	ECR-04	Eastern Central Rush Creek	Van Buren east of Edson	Georgetown/Ottawa	Tributary to Rush Creek	11/7/2003
17	EDR-01	Eastern Drain to Rush Creek	44th west of Wilson	Grandville/Kent	Drain to Rush Creek	11/12/2003
18	EDR-02	Eastern Drain to Rush Creek	Canal east of I-196	Grandville/Kent	Drain to Rush Creek	11/12/2003
19	EDR-03	Eastern Drain to Rush Creek	Kenowa north of 44th	Georgetown/Ottawa	Drain to Rush Creek	11/12/2003
20	EDR-04	Eastern Drain to Rush Creek	Tyler Street west of Kenowa	Georgetown/Ottawa	Drain to Rush Creek	11/12/2003
21	RC-01	Rush Creek	Port Sheldon east of Chicago Drive	Georgetown/Ottawa	Rush Creek	11/7/2003
22	RC-02	Rush Creek	12th north of Port Sheldon	Georgetown/Ottawa	Rush Creek	11/12/2003
23	RC-03	Rush Creek	Cottonwood northwest of Port Sheldon	Georgetown/Ottawa	Rush Creek	11/12/2003
24	RC-04	Rush Creek	Old M-21	Georgetown/Ottawa	Rush Creek	11/12/2003

Note: To view Rush Creek Station Maps please see attached excel file

Attachment B
Figures and Tables

Figure 1. Temperature and pH summary for the Rush Creek Watershed
Note: Some stations lack pH data

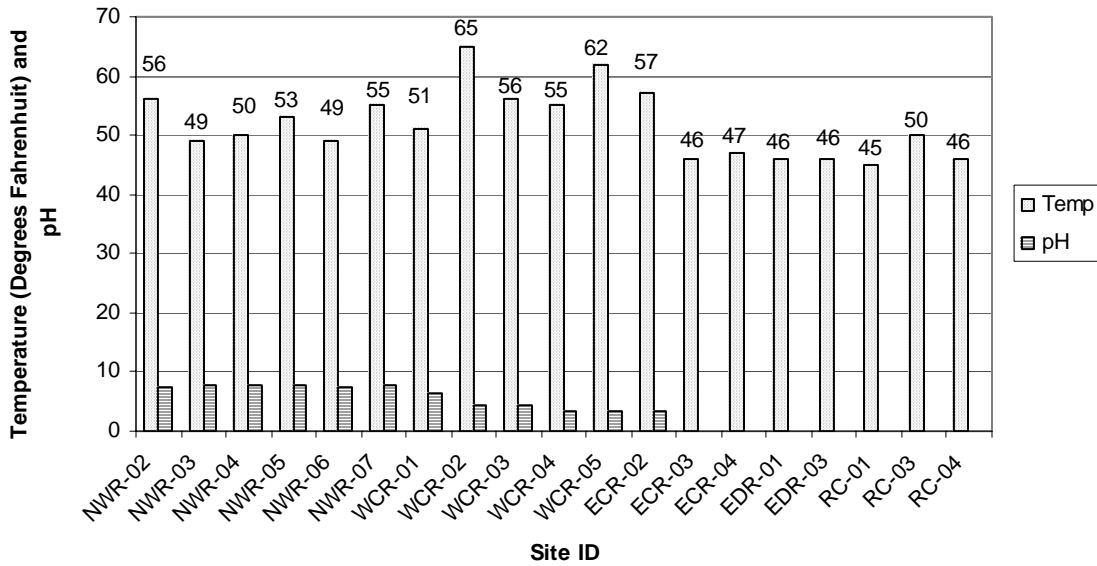


Figure 2. Temperature and pH summary for the mainstem sample locations from the headwaters to the mouth of Rush Creek
Note: some stations lack pH data

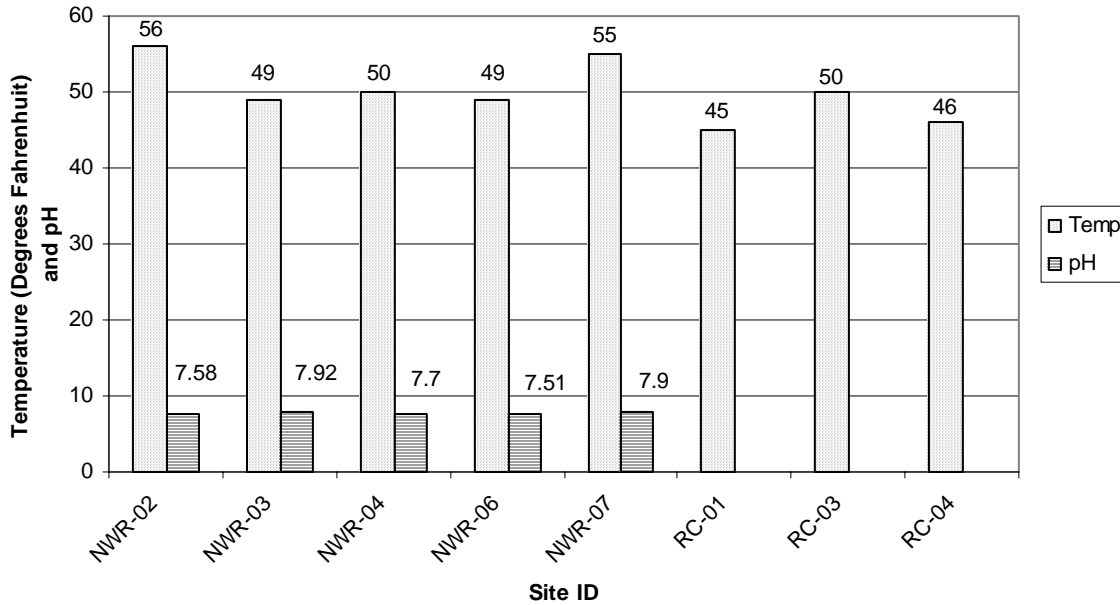


Figure 3. Percent substrate observations for each sample location in the Northwestern Rush Creek Subwatershed

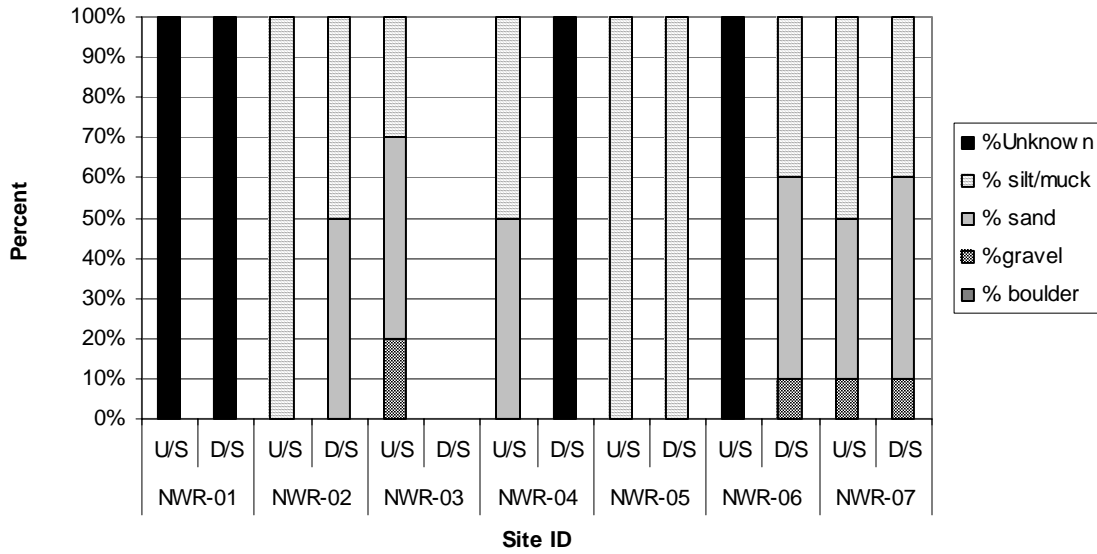


Figure 4. Percent substrate observations for each sample location in the Western Central Rush Creek Subwatershed

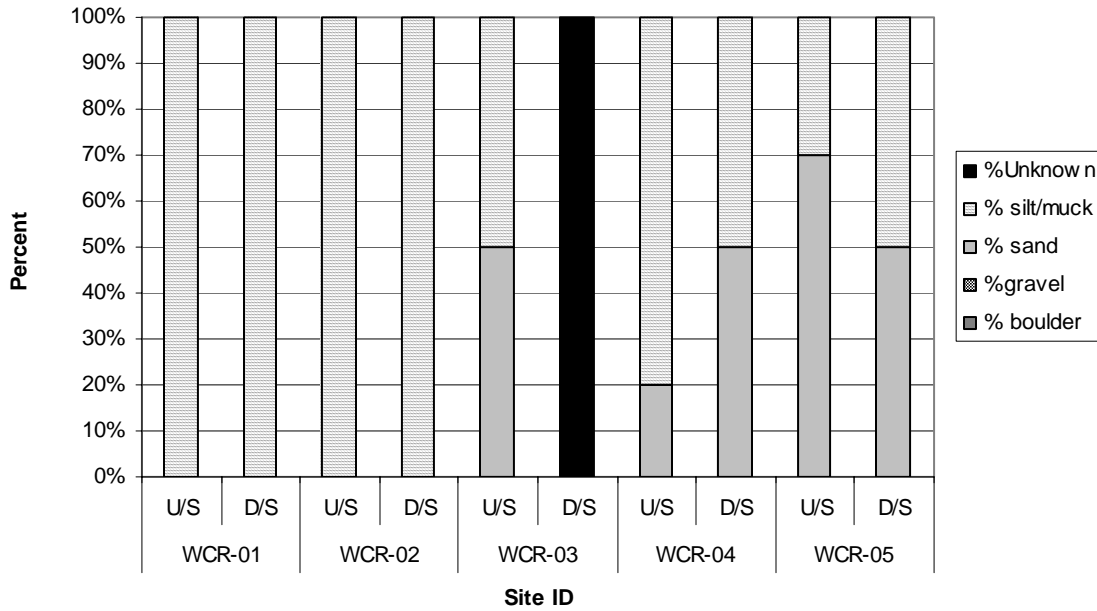


Figure 5. Percent substrate observations for each sample location in the eastern Central Rush Creek Subwatershed

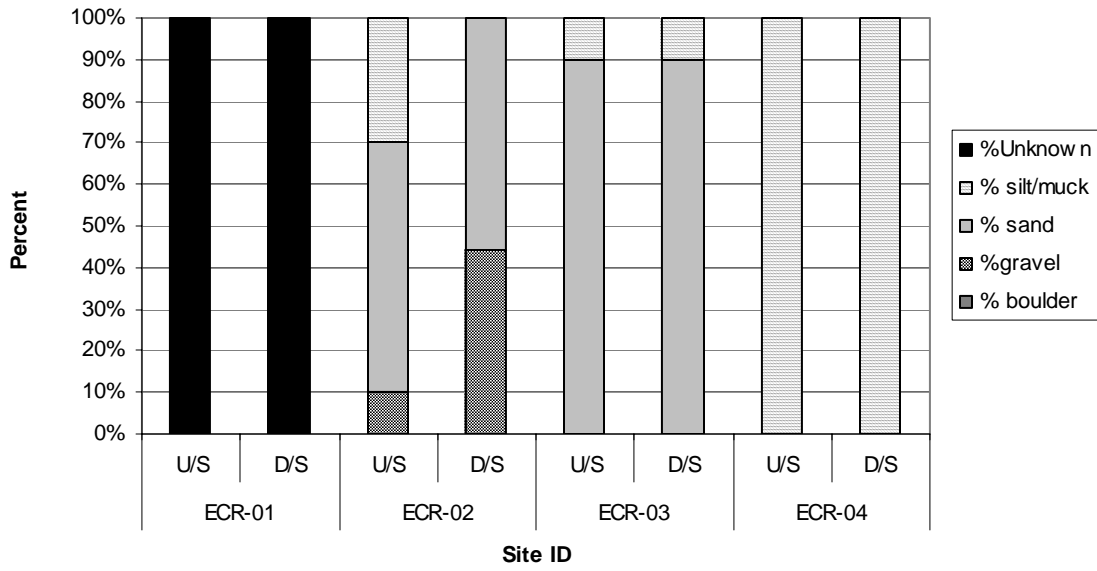


Figure 6. Percent substrate observation for each sample location in the Eastern Drain to Rush Creek (EDR) and the Rush Creek Subwatersheds

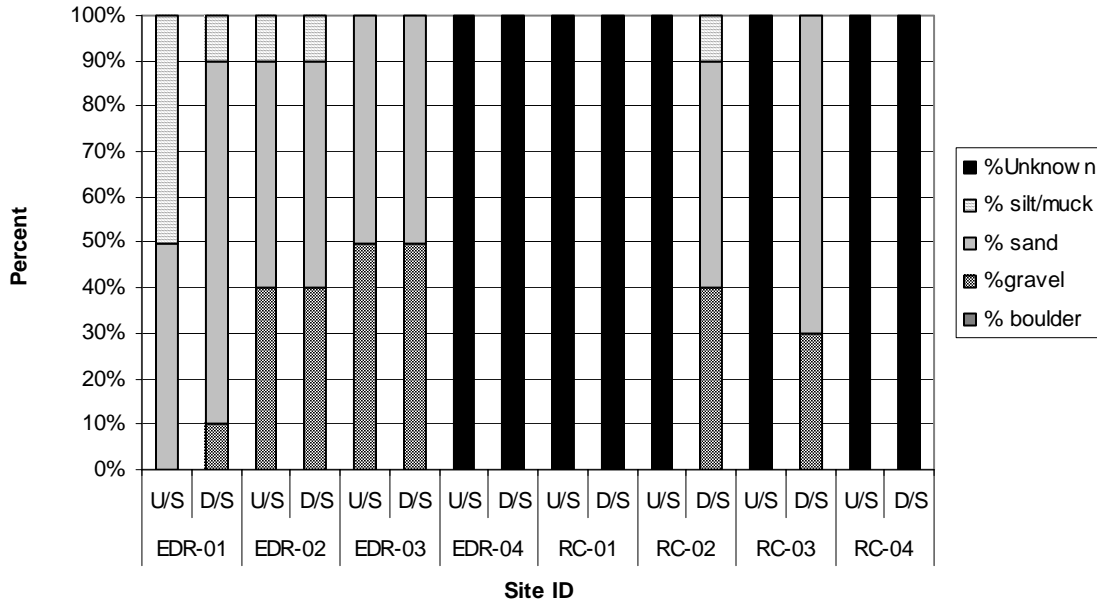


Figure 7. Percent substrate observation for the mainstem sample locations from the headwaters th the mouth of Rush Creek

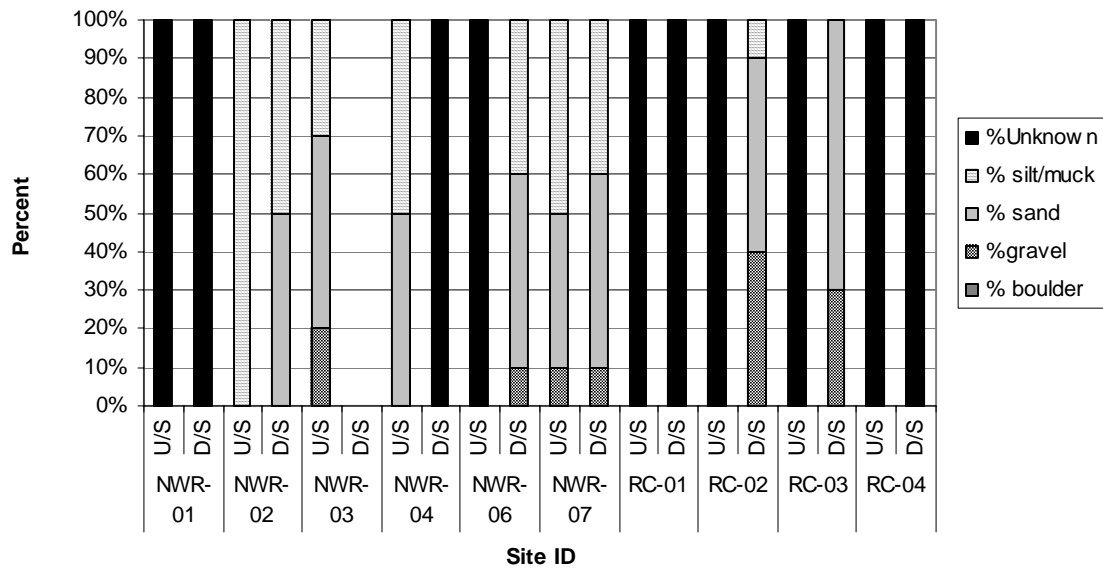


Figure 8. Summary of adjacent land uses

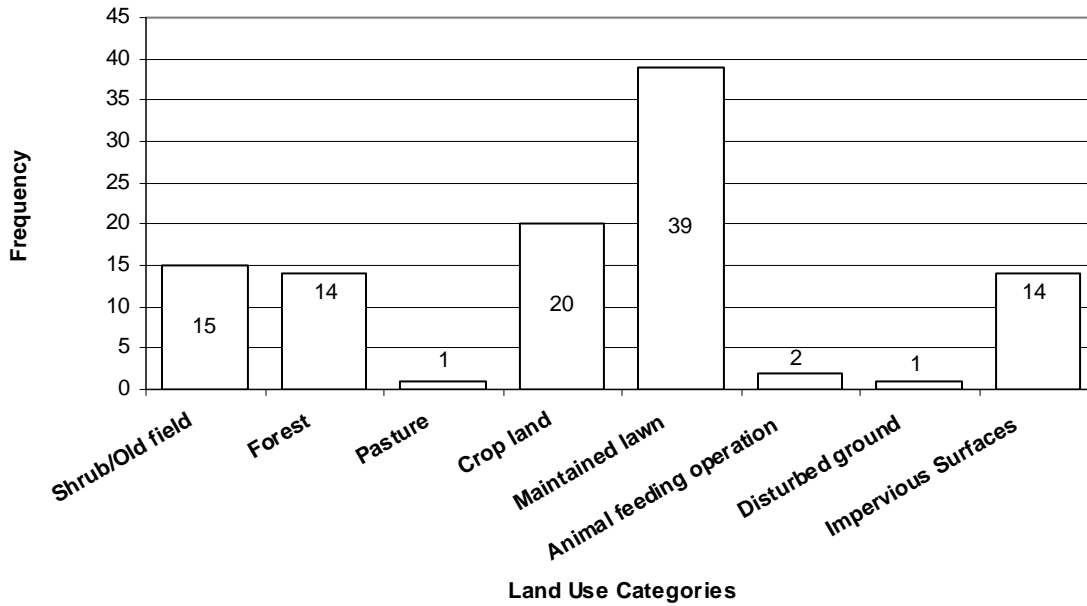


Figure 9. Weighted values for possible sources of non point source pollution (cumulative score for all locations)

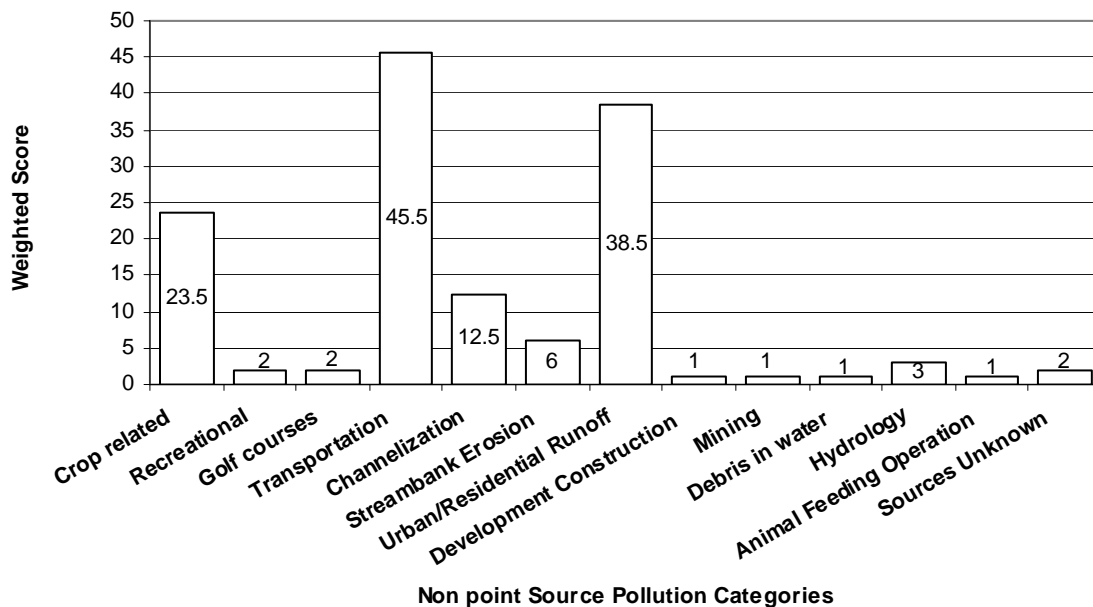


Table 1. Summary of observations made for in stream habitat and cover

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
NWR-01	U/S						
	D/S						
NWR-02	U/S		X				X
	D/S		X				
NWR-03	U/S		X				X
	D/S		X				
NWR-04	U/S						
	D/S		X				
NWR-05	U/S		X				
	D/S		X				
NWR-06	U/S						
	D/S		X				
NWR-07	U/S		X				
	D/S		X				X
WCR-01	U/S		X				X
	D/S		X				X
WCR-02	U/S		X				X
	D/S		X				
WCR-03	U/S		X				X
	D/S		X				
WCR-04	U/S	X	X				X
	D/S	X	X				X
WCR-05	U/S		X				X
	D/S		X				
ECR-01	U/S						
	D/S						
ECR-02	U/S		X				X
	D/S		X				X
ECR-03	U/S		X				
	D/S		X				
ECR-04	U/S		X				
	D/S		X				
EDR-01	U/S		X				
	D/S	X	X				X
EDR-02	U/S		X				
	D/S		X				

Table 1. Continued

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
EDR-03	U/S		X				
	D/S		X				
EDR-04	U/S	X					
	D/S	X					
RC-01	U/S		X				X
	D/S						
RC-02	U/S	X	X				
	D/S	X	X				
RC-03	U/S		X				
	D/S						X
RC-04	U/S	X	X				
	D/S	X	X		X		

U/S= upstream direction

D/S= downstream direction

X denotes presence but does not indicate abundance

Table 2. Summary of observations made for physical appearance

SITE ID		Aquatic Plants	Floating Algae	Filamentous Algae	Turbidity	Bacterial Sheen	Foam	Trash
NWR-01	U/S							
	D/S							
NWR-02	U/S							
	D/S							
NWR-03	U/S							
	D/S	P						
NWR-04	U/S				P			
	D/S	P			A			
NWR-05	U/S	P						
	D/S	A		P				
NWR-06	U/S	P			A			
	D/S	P			P			
NWR-07	U/S	A						
	D/S							P
WCR-01	U/S				P			
	D/S				P			
WCR-02	U/S			P				
	D/S			P	P			
WCR-03	U/S					P		
	D/S				P	P		
WCR-04	U/S				P			P
	D/S				P			P
WCR-05	U/S				P			
	D/S						P	
ECR-01	U/S							
	D/S							
ECR-02	U/S							
	D/S						P	P
ECR-03	U/S				A			
	D/S				P			P
ECR-04	U/S	P	P					P
	D/S	P	P					
EDR-01	U/S							P
	D/S							
EDR-02	U/S							P
	D/S				P			

Table 2. Continued

SITE ID		Aquatic Plants	Floating Algae	Filamentous Algae	Turbidity	Bacterial Sheen	Foam	Trash
EDR-03	U/S							
	D/S							P
EDR-04	U/S				P			
	D/S				P			
RC-01	U/S	P	P		P			
	D/S				P			
RC-02	U/S				A			P
	D/S				P			
RC-03	U/S						P	P
	D/S				P		P	
RC-04	U/S				P			P
	D/S				P			P

U/S= upstream direction
D/S= downstream direction

A denotes abundance
P denoted presence

Table 3. Summary of observations made for riparian width (ft) and vegetation

SITE ID		Left Bank				Right bank				Streamside land cover
		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100	
NWR-01	U/S		X						X	trees
	D/S	X				X				shrubs
NWR-02	U/S		X				X			trees
	D/S	X				X				grasses
NWR-03	U/S				X	X				trees
	D/S			X					X	trees
NWR-04	U/S	X				X				grasses
	D/S	X				X				grasses
NWR-05	U/S	X				X				grasses
	D/S	X				X				grasses
NWR-06	U/S	X				X				grasses
	D/S	X				X				grasses
NWR-07	U/S	X				X				grasses
	D/S	X					X			shrubs
WCR-01	U/S				X					trees
	D/S				X	X	X			shrubs
WCR-02	U/S		X				X			trees
	D/S			X				X		grasses
WCR-03	U/S	X				X				trees
	D/S	X					X			shrubs
WCR-04	U/S		X			X				trees
	D/S		X			X				trees
WCR-05	U/S	X				X				trees
	D/S	X				X				shrubs
ECR-01	U/S	X					X			grasses
	D/S				X				X	trees
ECR-02	U/S		X				X			trees
	D/S	X				X				shrubs
ECR-03	U/S	X				X				grasses
	D/S		X				X			grasses
ECR-04	U/S	X				X				shrubs
	D/S	X				X				grasses
EDR-01	U/S	X				X				trees
	D/S		X				X			trees

Table 3. Continued

SITE ID		Left Bank				Right bank				Streamside land cover
		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100	
EDR-02	U/S	X				X				shrubs
	D/S	X					X			shrubs
EDR-03	U/S		X					X		grasses
	D/S	X				X				grasses
EDR-04	U/S		X			X				trees
	D/S		X				X			trees
RC-01	U/S	X					X			trees
	D/S		X				X			grasses
RC-02	U/S		X				X			trees
	D/S	X					X			trees
RC-03	U/S		X			X				shrubs
	D/S		X			X				shrubs
RC-04	U/S		X				X			trees
	D/S		X				X			trees

U/S= upstream direction
D/S= downstream direction

Table 4. Summary of adjacent land uses

Site ID		Shrub/Old field	Forest	Pasture	Crop land	Maintained lawn	Animal feeding operation	Disturbed ground	Impervious Surfaces
NWR-01	U/S		B				L		
	D/S				R				L
NWR-02	U/S		B					L	
	D/S					B			
NWR-03	U/S	L				R			
	D/S	B				R	L		
NWR-04	U/S				R				L
	D/S				B				
NWR-05	U/S				B				
	D/S				B				
NWR-06	U/S				B				
	D/S				B				
NWR-07	U/S	R				L			
	D/S					B			
WCR-01	U/S		L			R			
	D/S		L			R			
WCR-02	U/S		B						L
	D/S	B							
WCR-03	U/S		R			B			
	D/S		R			L			
WCR-04	U/S					L			R
	D/S					L			R
WCR-05	U/S					L			R
	D/S					L			R
ECR-01	U/S	L		L					R
	D/S		B			R			
ECR-02	U/S				L	R			
	D/S					B			
ECR-03	U/S				B				
	D/S	R			L				
ECR-04	U/S				B				
	D/S				R	L			
EDR-01	U/S					B			R
	D/S					B			

Table 4. Continued

Site ID		Shrub/Old field	Forest	Pasture	Crop land	Maintained lawn	Animal feeding operation	Disturbed ground	Impervious Surfaces
EDR-02	U/S					B			
	D/S					B			
EDR-03	U/S	B							R
	D/S					B			
EDR-04	U/S					R			L
	D/S	R							L
RC-01	U/S	L				R			
	D/S	R			L				
RC-02	U/S					R			L
	D/S					B			
RC-03	U/S	L				R			
	D/S	L				R			
RC-04	U/S		R						L
	D/S		L			R			

U/S= upstream direction
D/S= downstream direction

R denotes the land use was located on the right bank
L denoted the land use was located on the left bank
B denoted the land use was located on both banks

Note: Right and left bank designations are always assigned looking downstream for each survey location.

Table 5. Summary of potential sources of non-point source pollution identified for each location

Site ID		Crop related	Recreational	Golf courses	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Development Construction	Mining	Debris in water	Hydrology	Animal Feeding Operation	Sources Unknown
NWR-01	U/S	M			S			S						
	D/S	M			S									
NWR-02	U/S				S				S					
	D/S				S			M						
NWR-03	U/S				S			M						
	D/S				S								S	
NWR-04	U/S	H			S	S								
	D/S	H			S	S								
NWR-05	U/S	H			S									
	D/S	H			S									
NWR-06	U/S	H			M	S								
	D/S	H			M	S								
NWR-07	U/S				S			H		S				
	D/S				S			S						
WCR-01	U/S				H		M	S						
	D/S				M		M	S						
WCR-02	U/S				S									
	D/S				S									
WCR-03	U/S				S			H						
	D/S			H	S			H						
WCR-04	U/S				M			M						
	D/S		S		M			M						
WCR-05	U/S				S		S	M				S		
	D/S				S	M		S			M			S
ECR-01	U/S				S									
	D/S				S	S	H					H		S
ECR-02	U/S	S						S						
	D/S							S						
ECR-03	U/S	H			S	S								
	D/S	M			S	S								
ECR-04	U/S	M			S									
	D/S	M			S			S						

Table 5. Continued

Site ID		Crop related	Recreational	Golf courses	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Development Construction	Mining	Debris in water	Hydrology	Animal Feeding Operation	Sources Unknown
EDR-01	U/S					S		S						
	D/S							S						
EDR-02	U/S							M						
	D/S							M						
EDR-03	U/S				S	S		S						
	D/S				S	S		M						
EDR-04	U/S				S			S						
	D/S				S			S						
RC-01	U/S				S			S						
	D/S	S			S									
RC-02	U/S				S			S						
	D/S		S		S			M						
RC-03	U/S				S	S		M						
	D/S				S			M						
RC-04	U/S				S									
	D/S				S			S						

U/S= upstream direction
D/S= downstream
direction

S denotes the potential source was slight
M denotes the potential source was moderate
H denotes potential source was heavy

Note: Observations made in these categories indicate a potential for pollution from the source to occur not a confirmed source of pollution

Attachment C

**Site Photographs
(refer to attached powerpoint file)**