Bass Creek Watershed

Ottawa County, MI

Field Surveys
performed by DEQ staff
August and September 2003

SUMMARY OF BASS CREEK WATERSHED ASSESSMENT
OTTAWA, MICHIGAN

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INTRODUCTION

The Bass Creek Watershed is located in the central portion of Ottawa County. It originates in the western portion of Georgetown Township in an area characterized by agriculture and low to moderate density residential use. It flows in a westerly direction until it enters Robinson Township where it turns north to its convergence with the Grand River in Allendale Township. The majority of the watershed drains a predominantly agricultural area with low density residential use. Bass Creek has two major tributaries, Little Bass Creek and Worley Drain. After Worley Drain converges with Bass Creek the waterbody is designated Bass River. 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 Bass 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-eight road/stream crossing locations were surveyed during the assessment of the Bass Creek Watershed. Refer to Attachment A, Road Stream Crossings Inventory, for a summary of the survey locations conducted during August and September of 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 three 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 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 meter.

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-six locations, including twelve along the main stem of Bass Creek, were measured for temperature and pH. pH values ranged from 7.61 to 8.37, which are not outside of the normal range for streams within Michigan, however some values were outside of the range suitable for trout and aquatic invertebrates (6.5-7.5). Overall the average temperature was 68° F, with a range of 60° to 81°F. Two locations each had the highest temperature recorded at 81°F including BC-10 (76th north of Taylor) and LBC-04 (at 78th south of M-45). Elevated temperatures were due to little canopy cover and slow flow at BC-10 and an upstream impoundment at LBC-04.

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 a high occurrence of fish disease. Note that the maximum air temperatures during the survey ranged from 65°F

(on September 19) to 82°F (on August 22). 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, 56 substrate observations were recorded at twenty-eight locations. 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 are 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 Bass Creek Watershed approximately 34% were dominated (80 to 100% covered) by sand and 46% were dominated by silt, detritus or muck. 20% 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 16% of the sites had some amount of gravel present (although it was often only 10%). 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 Bass 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 56 observations made, 91% of the sites had overhanging vegetation, 27% had woody debris and 13% had undercut banks. No sites had deep pools or boulders. 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, 56 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 trash were the least common. Approximately 45% of the sites exhibited aquatic plants (including duckweed) while 36% exhibited floating algae, 32% of the sites exhibited filamentous algae and 25% of the sites exhibited turbidity. 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 eight survey locations were assessed, resulting in 112 observations of riparian vegetation width recorded. Most of the observations fell into the less than 10 feet category or the over 100 feet category at 43% and 36% respectively. The riparian width class of 30 to 100 feet was the least common and was observed at only 5% of the sites.

The streamside land cover, estimated bank erosion and percent stream canopy were evaluated at each of the twenty-eight survey locations for both the upstream and downstream stretches. In all, 56 observations were made for each of the above listed characteristics. Of the survey locations, 34% were recorded as having streamside land cover predominantly shrubs, 34% predominantly grasses, 31% dominated by trees, and one site was listed as having bare riparian vegetation. 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 Bass 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. Of the 56 observations made, 34% had less than 25% cover, 23% had between 25 and 50% cover and 43% had over 50% cover. Those portions of the stream with less than 25% canopy cover are the most at risk for allowing thermal pollution.

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 use within the watershed plays 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 crop land, forest and maintained lawn, followed by a lesser number of observations for shrub/old field, pasture and impervious surfaces.

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 channelization and streambank erosion 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

Bass Creek Subwatershed (Bass Creek headwaters to the mouth of Worley Drain)

Bass Creek originates in the agricultural fields and low to moderate residential neighborhoods of western Georgetown Township. Fifteen survey locations were evaluated on this portion of Bass Creek before the inlet of Worley Drain tributary. Stations in the Bass Creek subwatershed are denoted by BC prefixes. The land use in this area is dominated by agricultural use and low to moderate 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:

BC-01: 36th north of Bauer

Due to this site being dry water temperature and pH were not collected. Sand appeared to dominate the substrate and no major habitat components (overhanging vegetation, undercut banks, woody debris, aquatic vegetation, boulders and/or deep pools) were observed. Riparian vegetation was variable and ranged from more than 100 ft (on the downstream side) to less than 10 feet (on the upstream side). Riparian vegetation mostly consisted of grasses. Adjacent land uses included shrub/old field and pasture. Potential non point source pollution (NPS) was categorized as slight for grazing related activities, transportation and streambank erosion. Comments were*: Beef farm adjacent to drain on the upstream side, slight runoff from pasture evident.*

BC-02: 42nd south of Bauer

Water temperature was ~76°F and pH was measured at 7.61. Silt, detritus and muck appeared to dominate the substrate. Only overhanging vegetation was available for in-stream cover. Some floating algae, filamentous algae, and turbidity were observed. In general, little riparian vegetation (less than

10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses included shrub/old field, cropland and maintained lawn. Potential NPS pollution was categorized as high for urban residential runoff, moderate for crop related activities and slight for transportation, and streambank erosion. Comments were*: Very turbid, high nutrients, landowner suspects septic tank failures.*

BC-03: 42nd north of Baldwin

Water temperature was ~70°F and pH was measured at 7.45. Although substrate observations could not be made on the upstream side, the downstream side substrate was completely dominated by silt, detritus and muck. Overhanging vegetation and aquatic plant cover were available for in-stream habitat. Some aquatic plants and filamentous algae were observed. Little riparian vegetation (less than 10 feet) was observed on the upstream side, which consisted of shrubs. Moderate to abundant riparian vegetation was observed (30 ft to more than 100 ft) on the downstream side which consisted of shrubs and small trees. Adjacent land uses included forest and maintained lawn. Potential NPS pollution was categorized as high for urban residential runoff. Comments were*: One culvert partially obstructed by plant growth and woody debris.*

BC-04: 48th south of Bauer

Water temperature was ~66°F and pH was measured at 7.91. Silt, detritus and muck accounted for 100% of the bottom substrates. Only overhanging vegetation was available for in-stream cover. Abundant aquatic plants and filamentous algae were observed with only some turbidity present. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses consisted of maintained lawns. Potential NPS pollution was categorized as moderate to high for urban residential runoff and slight to moderate for transportation. Comments were*: Only one culvert flowing, very abundant algae, goes from stagnant to moderate flow due to elevation change.*

BC-05: 56th south of Bauer

Water temperature was ~63°F and pH was measured at 8.01. Sand appeared to dominate the substrate with lesser amounts gravel also present on the downstream side. Overhanging vegetation and woody debris was available for in-stream cover. Some turbidity and trash was observed on the upstream side. A moderate amount of riparian vegetation (10 to 30 ft) was observed both upstream and downstream which consisted of shrubs and trees. Adjacent land uses consisted of cropland. Potential NPS pollution was categorized slight for crop related activities, transportation and debris in water. Comments were*: One culvert not aligned properly.*

BC-06: Bauer west of 56th

Water temperature was ~65°F and pH was measured at 8.06. Silt and sand where represented in equal amounts on the upstream side while sand dominated the downstream side with lesser amounts of gravel also present. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Some aquatic plants, floating algae, and filamentous algae were observed. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses included cropland and maintained lawns. Potential NPS pollution was categorized as slight to high for urban residential runoff, slight for crop related activities and moderate for transportation. Comments were*: Some road failure on downstream side.*

BC-07: 56th north of Taylor

Water temperature was ~68°F and pH was measured at 8.10. Sand appeared to dominate the substrate with a small amount gravel also present on the downstream side. Only overhanging vegetation was available for in-stream cover. Some aquatic plants (downstream) and turbidity (upstream) was observed. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Only on the upstream right bank was riparian vegetation abundant (more than 100 ft). Adjacent land uses included shrub/old field, cropland and maintained lawns. Potential NPS pollution was categorized as slight to moderate for urban residential runoff and slight for crop related activities and transportation. Comments were*: No specific comments were recorded for this site.*

BC-08: Polk west of 56th

Water temperature was ~66°F and pH was measured at 8.16. Silt, detritus and muck dominated the substrate on both the upstream and downstream side. Only overhanging vegetation was available for in-stream cover. Some floating algae and trash was observed. Riparian vegetation was variable ranging from more than 30-100 feet on the downstream left bank to less than 10 feet on the upstream left bank. In general riparian vegetation consisted of shrubs. Adjacent land uses included forest, cropland and maintained lawns. Potential NPS pollution was categorized as slight to moderate for urban residential runoff, slight for crop related activities, and moderate for transportation. Comments were*: Depression in corn field adjacent to the stream indicates runoff may be outleting to the stream.*

BC-09: Bauer east of 66th

Water temperature was ~75°F and pH was measured at 7.54. Silt, detritus and muck dominated the substrate on both the upstream and downstream sides. Only overhanging vegetation was available for in-stream cover.

Abundant floating and filamentous algae was observed both upstream and downstream while only some aquatic plants were observed. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Only on the downstream left bank was riparian vegetation moderate (between 10 and 30 feet). Adjacent land uses included cropland and maintained lawns. Potential NPS pollution was categorized as moderate for crop related activities and slight for urban residential runoff transportation, and septic systems. Comments were*: No specific comments were recorded for this site.*

BC-10: 76th north of Taylor

Water temperature was one of the two highest temperatures recorded at ~81°F and pH was measured at 8.37. Silt, detritus and muck dominated the substrate on both the upstream and downstream sides. Only overhanging vegetation was available for in-stream cover. Some aquatic plants, floating and filamentous algae were observed. In general a moderate amount of riparian vegetation (10 to 30 feet) was observed which consisted of shrubs and grasses. Adjacent land uses included cropland and impervious surfaces. Potential NPS pollution was categorized as moderate to high for crop related activities and slight for transportation. Comments were*: Lots of scum and floating algae, drains many ag fields.*

BC-11: 76th south of Fillmore

Water temperature was ~72°F and pH was measured at 8.17. Due to level of turbidity and the cows in the water substrate observations were prohibited. Overhanging vegetation and woody debris were available for in-stream cover on the upstream side. Abundant turbidity and some filamentous algae were observed. Abundant riparian vegetation (more than 100 ft) was observed on the upstream side and consisted of shrubs, while streambanks on the downstream side were bare due to cattle access. Adjacent land uses included shrub/old field, pasture and cropland. Potential NPS pollution was categorized as high for grazing related activities and slight for crop related activities, transportation and urban residential runoff. Comments were*: 28 dairy cows in stream with no restricted access, highly eroding bare banks.*

Note: DEQ field staff spoke with the farmer and also referred the farm to the Michigan Department of Agriculture for follow up work.

BC-12: Fillmore west of 88th

Water temperature was ~63°F and pH was measured at 7.52. Sand accounted for 100% of the substrate for both the upstream and downstream sides. Only overhanging vegetation was available for in-stream cover. Some aquatic plants and floating algae were observed Abundant riparian vegetation (more than 100 ft) was observed on the upstream side and consisted of shrubs, while only little riparian vegetation (less than 10 feet) was observed on the

downstream side which consisted of grasses. Adjacent land uses included shrub/old field and maintained lawns. Potential NPS pollution was categorized as slight for transportation. Comments were*: No specific comments were recorded for this site.*

BC-13: 92nd south of Pierce

Water temperature was ~62°F and pH was measured at 7.97. Sand accounted for 100% of the substrate for both the upstream and downstream sides. Overhanging vegetation and woody debris were available for in-stream cover. No aquatic plants, floating or filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash was observed. Abundant riparian vegetation (more than 100 ft) was observed which consisted of shrubs and small trees. Adjacent land uses consisted of forest. Potential NPS pollution was categorized slight for transportation. Comments were*: No specific comments were recorded for this site.*

BC-14: Pierce west of 96th

Water temperature was ~63°F and pH was measured at 7.96. Silt and sand were present in equal amounts on both the upstream and downstream sides. Overhanging vegetation, and undercut banks were available for in-stream cover. Some aquatic plants were observed on the upstream side. Abundant riparian vegetation (more than 100 ft) was observed on the right bank both upstream and downstream, which consisted of small trees. Little riparian vegetation (less than 10 feet) was observed on the left bank both upstream and downstream which consisted of grasses and shrubs. Adjacent land uses included forest and maintained lawn. Potential NPS pollution was categorized as moderate for urban residential runoff and slight for transportation, channelization and streambank erosion. Comments were*: Water is being extracted for irrigation at this point.*

BC-15: Winans Street

Water temperature was ~60°F and pH was measured at 8.04. Although substrate observations were prohibited for the upstream side, silt, detritus and muck dominated the substrate on the downstream side. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Some aquatic plants, filamentous algae and turbidity were observed. Abundant riparian vegetation (more than 100 ft) was observed which consisted of forest and trees. Adjacent land uses included forest and maintained lawn. Potential NPS pollution was categorized as slight for transportation, urban residential runoff, channelization and streambank erosion. 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 transportation and road stream crossing (sand/gravel roads, road washout) erosion, nutrient runoff from adjoining crop land and maintained lawns and streambank erosion from cattle at 76th Street. In-stream habitat is restricted to overhanging vegetation in most areas. The farmstead was referred to the Michigan Department of Agriculture for providing unrestricted cattle access to Bass Creek, resulting in severe, yet localized streambank erosion.

Little Bass Creek Subwatershed

Little Bass Creek is the major tributary to Bass Creek with its headwaters originating in southeastern Allendale Township. It drains a predominantly agricultural area with some low to moderate density residential, and converges with Bass Creek just north of Winans Street. Six survey locations were completed along Little Bass Creek. Stations in the Little Bass Creek subwatershed are denoted by LBC prefixes. The following conditions and comments were recorded on the survey forms:

LBC-01: Alger west of 60th

Water temperature was ~74°F and pH was measured at 7.57. Due to amount of algae covering the water surface substrate observations were prohibited. Overhanging vegetation and aquatic plant cover was available for in-stream habitat. Abundant aquatic plants, floating and filamentous algae were observed both upstream and downstream. Little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses included cropland and maintained lawn. Potential NPS pollution was categorized as moderate to high for urban residential runoff, moderate for crop related activities, and slight to moderate for channelization. Comments were*: High nutrients from adjoining crops and farms.*

LBC-02: 72nd south of Pierce

Water temperature was ~77°F and pH was measured at 7.15. Sand appeared to dominate the substrate with lesser amounts of gravel also present. Only overhanging vegetation was available for in-stream cover. Some aquatic plants were observed on the upstream side. In general, abundant riparian vegetation was observed (more than 100 ft) which consisted of mainly shrubs. Adjacent land uses included shrub/old field, forest and cropland. Potential NPS pollution was categorized as slight for crop related activities, transportation, and channelization. Comments were*: water quality improved from Alger Road site.*

LBC-03: Pierce west of 80th

Water temperature was ~74°F and pH was measured at 7.91. Silt and sand were present n equal amounts of the upstream side while silt, detritus and muck dominated the downstream side. Only overhanging vegetation was available for in-stream cover. Some aquatic plants, floating algae, and foam were observed. Little riparian vegetation (less than 10 feet) was observed which consisted of mainly 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*: Culvert partially obstructed lots of foam and algae built up on fence that crosses the stream.*

LBC-04: 78th south of M-45

Water temperature here was one of the two highest temperatures recorded at ~81°F and pH was measured at 8.57. Due to amount of algae covering the water surface substrate observations were prohibited. Only overhanging vegetation was available for in-stream cover. Some aquatic plants and floating algae and filamentous algae were observed. In general little riparian vegetation (less than 10 feet) was observed which consisted of grasses and shrubs. Adjacent land uses included cropland and maintained lawns. Potential NPS pollution was categorized as high for crop related activities, upstream impoundment and septic systems and moderate for transportation. Comments were*: Upstream impoundment supplies irrigation water, road crossing erosion, mowed lawn right up to the edge.*

LBC-05: 84th south of M-45

Water temperature was ~74°F and pH was measured at 8.19. Sand appeared to dominate the substrate with lesser amounts of gravel also present. Only overhanging vegetation was available for in-stream cover. Some aquatic plants, floating algae and turbidity were observed on the upstream side while abundant turbidity was observed on the downstream side. In general, little riparian vegetation (less than 10 feet) was observed which consisted mainly of grasses. Adjacent land uses consisted of cropland. Potential NPS pollution was categorized as high for crop related activities, moderate for transportation, and slight for channelization. Comments were*: Farm field underdrain outlets here.*

LBC-06: 92nd south of M-45

Water temperature was ~74°F and pH was measured at 8.29. Silt and sand were present in equal amounts of the upstream side while sand and gravel where present on the downstream side. Overhanging vegetation and woody debris were available for in-stream cover. Some turbidity was observed on the upstream side. Abundant riparian vegetation was observed (more than 100 ft) which consisted of forest. Adjacent land uses included shrub/old field,

forest and maintained lawns. Potential NPS pollution was categorized as moderate for transportation and channelization and slight for hydrology. Comments were*: Stream returning to a more natural state.*

Although the water quality, channel, and riparian vegetation greatly improve by the time Little Bass Creek joins Bass Creek, a majority of the impacts to the stream result from inadequate riparian buffers, nutrient runoff from cropland, transportation non point source pollution and thermal pollution from sparse canopy cover and the impoundment at 78th Street.

Worley Drain Subwatershed

Worley Drain originates in the agricultural fields and nurseries in western Robinson Township and flows east to its convergence with Bass Creek north of M-45. Four survey locations were evaluated on Worley Drain. Stations in the Worley Drain subwatershed are denoted by WD prefixes. The land use in this area is dominated by agricultural use, low density residential and commercial nurseries. 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:

WD-01: 136th south of M-45

Water temperature was ~61°F and pH was measured at 7.52. Silt, detritus and muck appeared to dominate the substrate. Overhanging vegetation, woody debris and aquatic plant cover were available for in-stream habitat. Abundant aquatic plants and floating algae were observed on the upstream side while only some aquatic plants were observed on the downstream side. Little riparian vegetation (less than 10 feet) was observed which consisted of grasses. Adjacent land uses included shrub/old field, cropland, maintained lawns and impervious surfaces. Potential NPS pollution was categorized as high for crop related activities, moderate for urban residential runoff and slight for transportation. Comments were*: lots of nutrient inputs from nearby sod farms and nurseries, DO may be incorrect due to instrument error.*

WD-02: 120th south of M-45

Water temperature was ~60°F and pH was measured at 7.32. Silt, detritus and muck appeared to dominate the substrate. Only overhanging vegetation was available for in-stream cover. Abundant aquatic plants were observed both upstream and downstream while only some floating and filamentous algae, and bacterial sheen was observed. Little riparian vegetation (less than 10 feet) was observed which consisted of grasses. Adjacent land uses included cropland and impervious surfaces. Potential NPS pollution was categorized as high for crop related activities, moderate for channelization and slight for transportation. Comments were*: High nutrient input from nearby sod farm.*

WD-03: 112th south of M-45

Water temperature was ~69°F and pH was measured at 7.46. Silt, detritus and muck appeared to dominate the substrate. Only overhanging vegetation was available for in-stream cover. Abundant aquatic plants, floating algae, and bacterial sheen were observed both upstream and downstream. A moderate amount of riparian vegetation (10 to 100 feet) was observed which consisted of grasses and shrubs. Adjacent land uses included shrub/old field, cropland and impervious surfaces. Potential NPS pollution was categorized as moderate to high for crop related activities, moderate for upstream impoundment and streambank erosion and slight for transportation and hydrology. Comments were*: Upstream impounded, lots of iron bacteria and bacteria sheen over water.*

WD-04: 104th north of M-45

Due to steep banks and severely overgrown vegetation clear access could not be gained to the stream or the culverts therefore water temperature and pH were not collected at this site. Although substrate for the upstream side could not be assessed, silt, detritus and muck appeared to dominate the substrate on the downstream side. Overhanging vegetation and woody debris were available for in-stream cover only the downstream side. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash was observed. Abundant riparian vegetation was observed (more than 100 ft) which consisted of forest. Adjacent land use consists of forest. Potential NPS pollution was categorized slight for transportation and urban residential runoff. Comments were*: Very overgrown, could not see upstream flow or take water measurements, looks pretty natural.*

Worley Drain is a highly channelized waterbody carrying runoff waters away from sod farms and nurseries in this area. Riparian vegetation and canopy cover is sparse and high levels of silt substrates and algae indicated excessive nutrients and sediments running off the adjoining agricultural fields. The last road stream crossing location indicated improving conditions before the drain joined Bass Creek.

Bass River Subwatershed (from mouth of Worley Drain to convergence with the Grand River)

Bass River is the name denoted to the portion of Bass Creek flowing from its the mouth of Worley Drain to the convergence with Grand River. Three survey locations were completed along Bass River including BR-01, BR-02 and BR-03. The majority of the land use in this area is somewhat agricultural with some forested areas and low to medium density residential as well. The following conditions and comments were recorded on the survey forms:

BR-01: M-45 east of 104th

Water temperature was ~72°F and pH was measured at 8.23. Due to level of turbidity substrate observations were prohibited. Overhanging vegetation and woody debris were available for in-stream cover. Abundant turbidity was observed both upstream and downstream. Moderate to abundant riparian vegetation (30 to more than 100 ft) was observed which consisted of trees. Adjacent land uses included forest and maintained lawns. Potential NPS pollution was categorized as slight for transportation, streambank erosion and urban residential runoff. Comments were*: Clay based stream probably contributes to turbidity here.*

BR-02: Buchanan Street

Water temperature was ~61°F and pH was measured at 8.24. Sand appeared to dominate the substrate with lesser amounts of silt, detritus and muck also present. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. Some filamentous algae were observed on the downstream side. Abundant riparian vegetation was observed (more than 100 ft) which consisted of forest. Adjacent land use consists of forest. Potential NPS pollution was categorized as slight for transportation. Comments were*: Good floodplain here.*

BR-03: South Cedar north of Warner

Water temperature was ~61°F and pH was measured at 7.71. Silt, detritus and muck appeared to dominate the substrate with lesser amounts of sand also present. Overhanging vegetation, undercut banks and woody debris were available for in-stream cover. No aquatic plants, floating algae, filamentous algae, turbidity, bacterial sheen/slime, oil sheen, foam or trash was observed. Abundant riparian vegetation was observed (more than 100 ft) which consisted of forest. Adjacent land use consists of forest. Potential NPS pollution was categorized as slight for transportation. Comments were*: riprap has been added to reinforce bank where road drainage occurs.*

Bass River exhibits much different conditions from that of the rest of the watershed. Riparian vegetation is adequate to abundant, the channel is recovering and in-stream habitat is improving. Nonpoint source pollution from transportation runoff is a slight concern in Bass River.

Attachment A

Road Stream Crossing Inventory and Maps

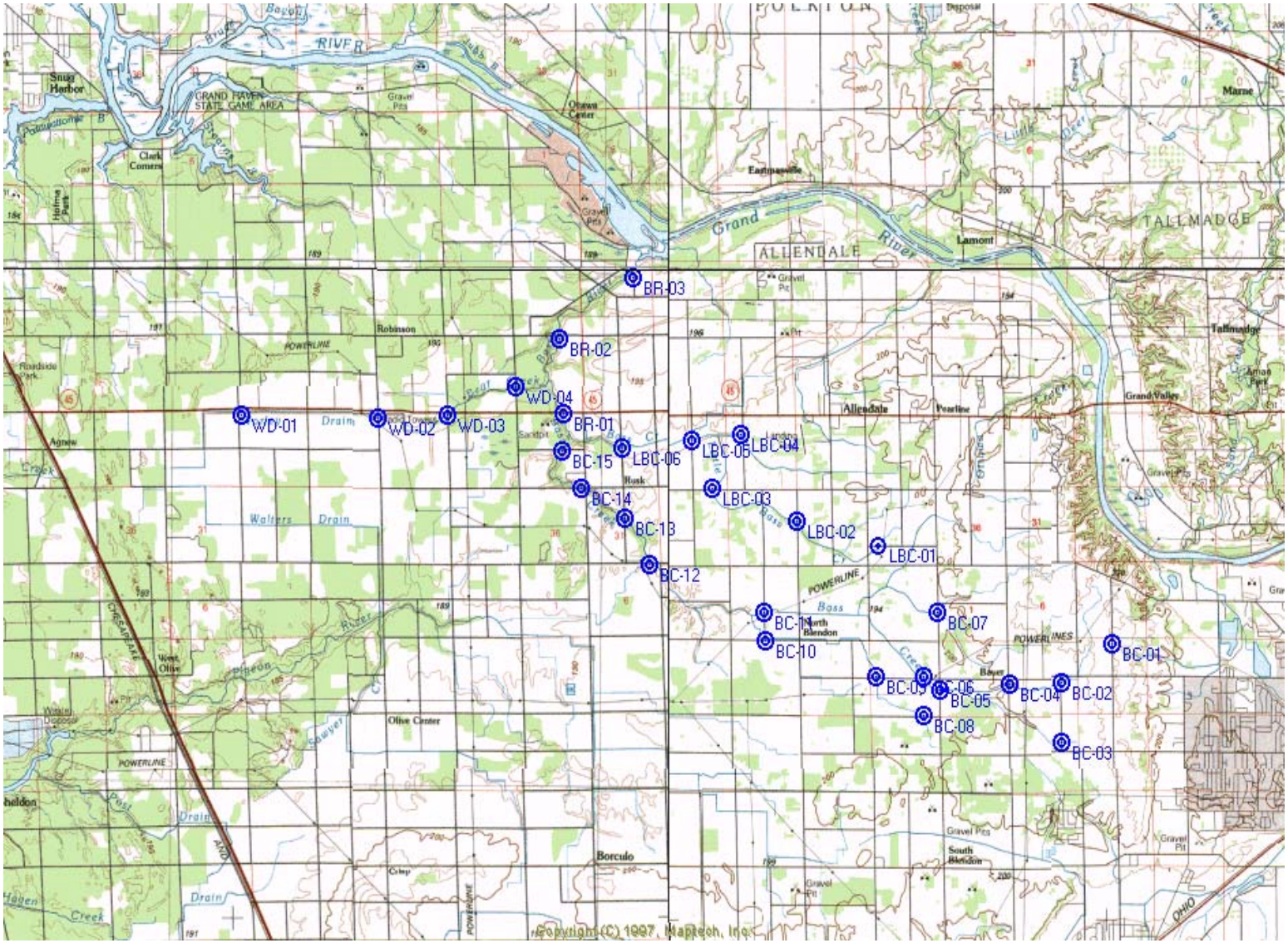
Road Stream Crossing Inventory for Bass Creek Watershed 2003

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
1	BC-01	Bass Creek	36th north of Bauer	Georgetown/Ottawa	Bass Creek	8/22/2003
2	BC-02	Bass Creek	42nd south of Bauer	Georgetown/Ottawa	Bass Creek	8/22/2003
3	BC-03	Bass Creek	42nd north of Baldwin	Georgetown/Ottawa	Tributary to Bass Creek	8/22/2003
4	BC-04	Bass Creek	48th south of Bauer	Blendon/Ottawa	Bass Creek	8/22/2003
5	BC-05	Bass Creek	56th south of Bauer	Georgetown/Ottawa	Bass Creek	8/22/2003
6	BC-06	Bass Creek	Bauer west of 56th	Blendon/Ottawa	Bass Creek	8/22/2003
7	BC-07	Bass Creek	56th north of Taylor	Blendon/Ottawa	Tributary to Bass Creek	8/22/2003
8	BC-08	Bass Creek	Polk west of 56th	Blendon/Ottawa	Tributary to Bass Creek	8/22/2003
9	BC-09	Bass Creek	Bauer east of 66th	Blendon/Ottawa	Tributary to Bass Creek	8/22/2003
10	BC-10	Bass Creek	76th north of Taylor	Blendon/Ottawa	Tributary to Bass Creek	8/22/2003
11	BC-11	Bass Creek	76th south of Fillmore	Blendon/Ottawa	Bass Creek	8/22/2003
12	BC-12	Bass Creek	Fillmore west of 88th	Blendon/Ottawa	Bass Creek	9/19/2003
13	BC-13	Bass Creek	92nd south of Pierce	Allendale/Ottawa	Bass Creek	9/19/2003
14	BC-14	Bass Creek	Pierce west 96th	Robinson/Ottawa	Bass Creek	9/19/2003
15	BC-15	Bass Creek	Winans Street	Robinson/Ottawa	Bass Creek	9/19/2003
16	LBC-01	Little Bass Creek	Alger west of 60th	Allendale/Ottawa	Little Bass Creek	8/29/2003
17	LBC-02	Little Bass Creek	72nd south of Pierce	Allendale/Ottawa	Little Bass Creek	8/29/2003
18	LBC-03	Little Bass Creek	Pierce west of 80th	Allendale/Ottawa	Little Bass Creek	8/29/2003
19	LBC-04	Little Bass Creek	78th south of M-45	Allendale/Ottawa	Trib to Little Bass Creek	8/29/2003
20	LBC-05	Little Bass Creek	84th south of M-45	Allendale/Ottawa	Little Bass Creek	8/29/2003
21	LBC-06	Little Bass Creek	92nd south of M-45	Allendale/Ottawa	Little Bass Creek	8/29/2003
22	WD-01	Worley Drain	136th south of M-45	Robinson/Ottawa	Worley Drain	9/19/2003
23	WD-02	Worley Drain	120th south of M-45	Robinson/Ottawa	Worley Drain	9/19/2003

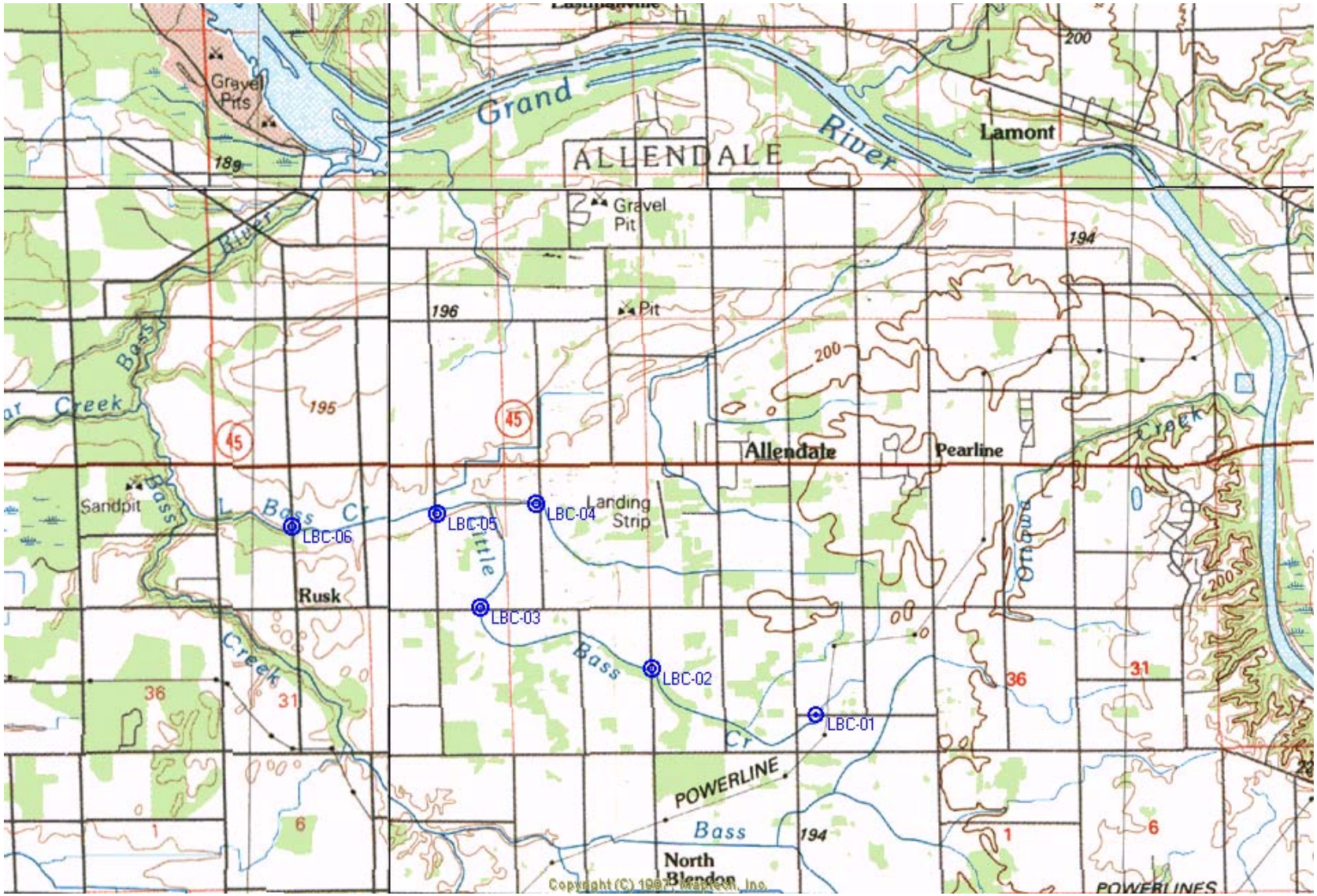
Road Stream Crossing Inventory for Bass Creek Watershed 2003 (continued)

Count	Site ID	Sub-Watershed Name	Location	Township/County	Stream Name	Inventory Date
24	WD-03	Worley Drain	112th south of M-45	Robinson/Ottawa	Worley Drain	9/19/2003
25	WD-04	Worley Drain	104th north M-45	Robinson/Ottawa	Bear Creek	9/19/2003
26	BR-01	Bass River	M-45 east of 104th	Robinson/Ottawa	Bass River	8/29/2003
27	BR-02	Bass River	Buchanan Street	Robinson/Ottawa	Bass River	9/19/2003
28	BR-03	Bass River	South Cedar north of Warner	Allendale/Ottawa	Bass River	9/19/2003

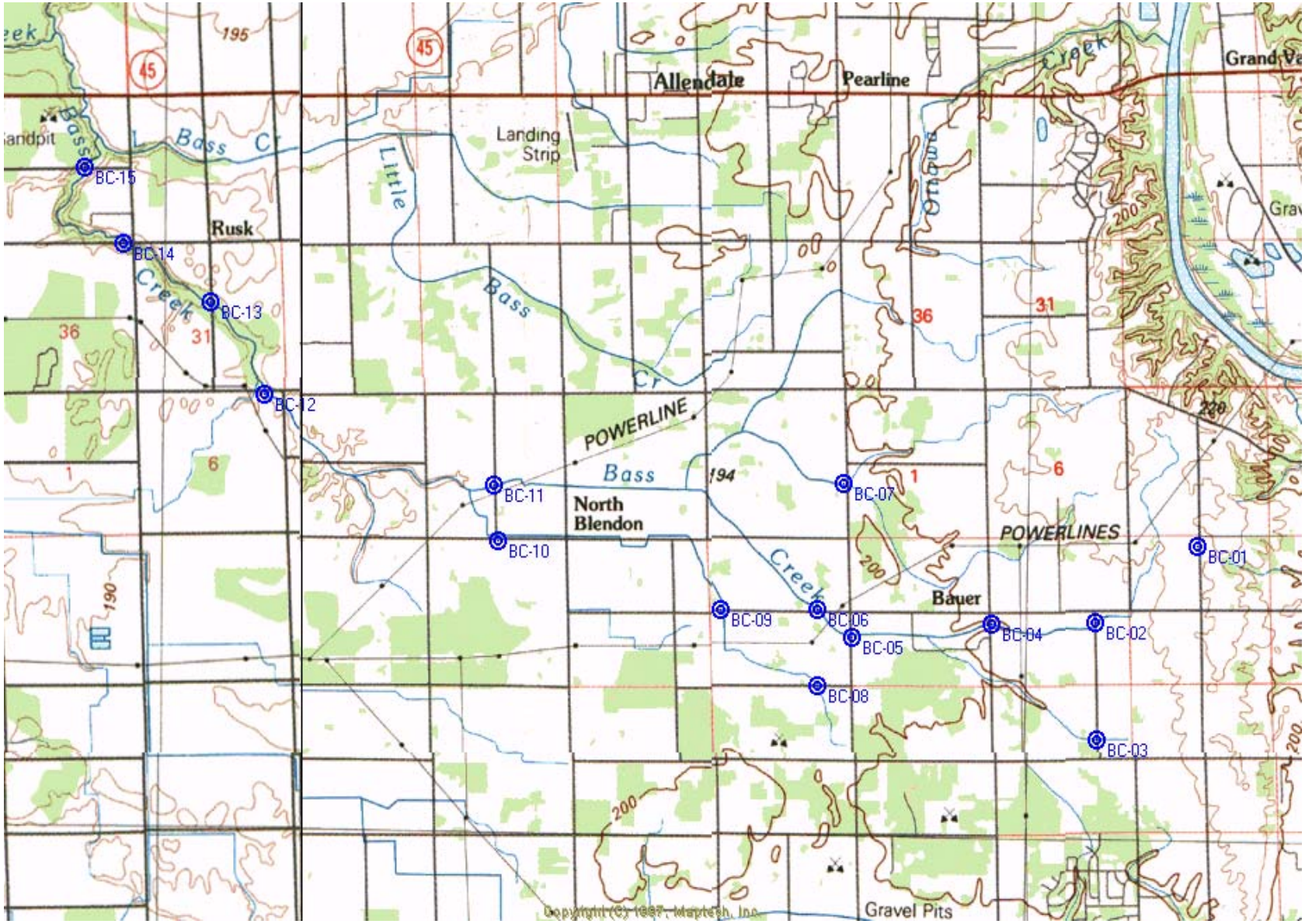
Map 1. All Bass Creek and Bass River Stations



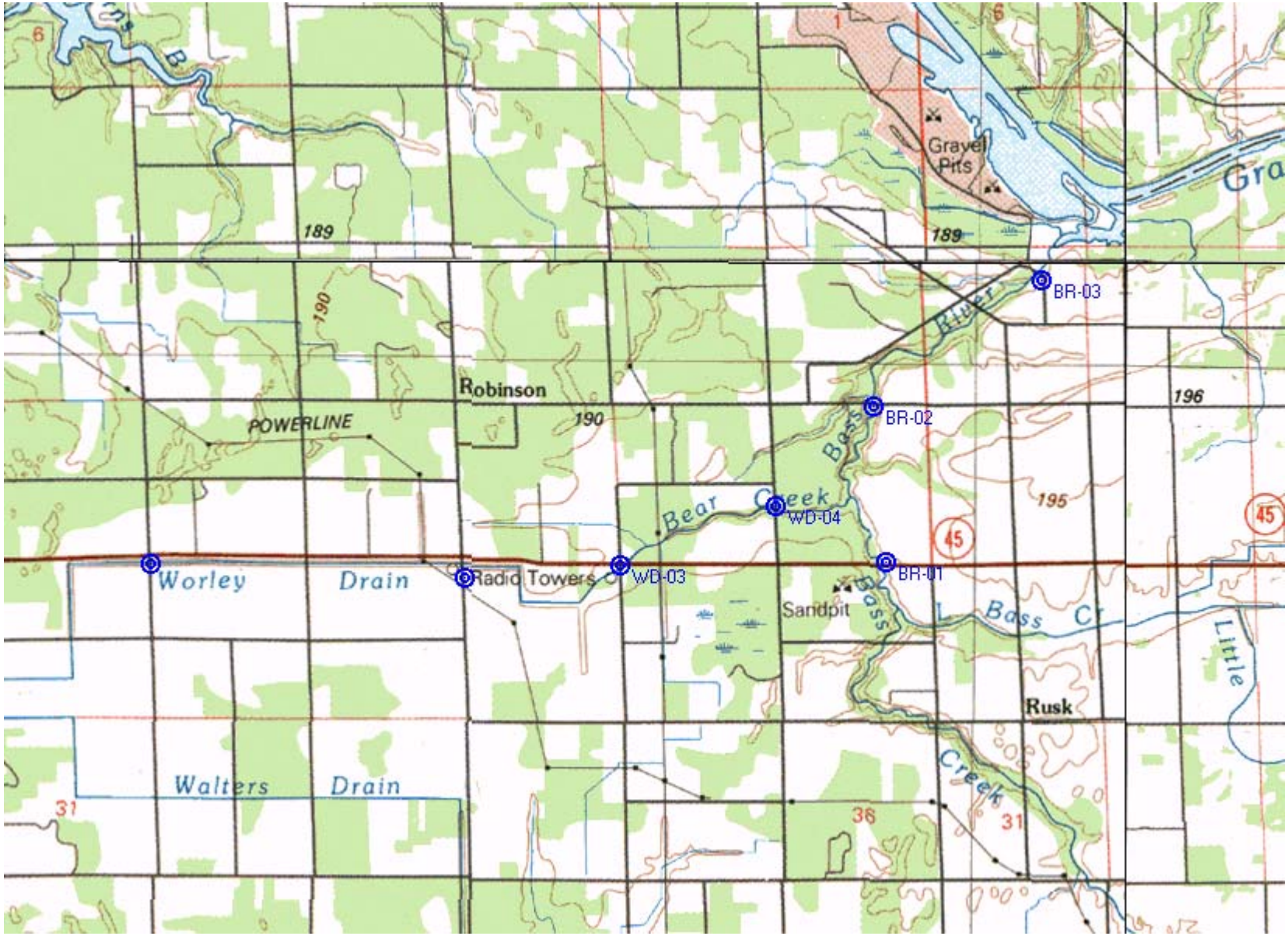
Map 2. Little Bass Creek (LBC) Stations



Map 3. Bass (BC) Creek Stations



Map 4. Bass River (BR) and Worley Drain (WD) Stations



Attachment B

Figures and Tables

Figure 1. Temperature and pH summary for the Bass Creek Watershed

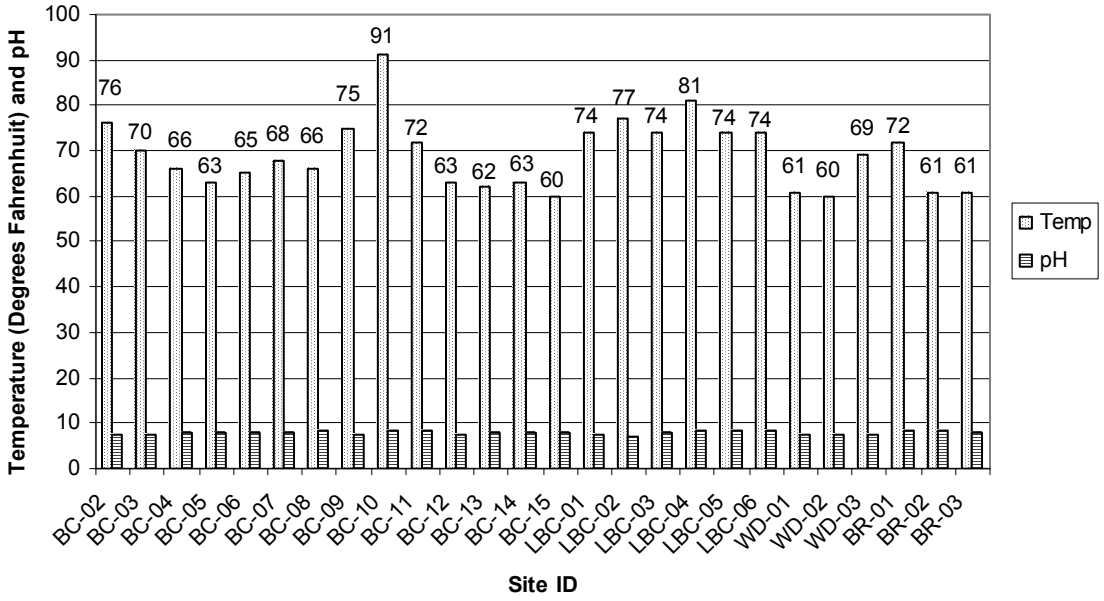


Figure 2. Temperature and pH summary for the mainstem sample locations from the headwaters of Bass Creek to the mouth of Bass River

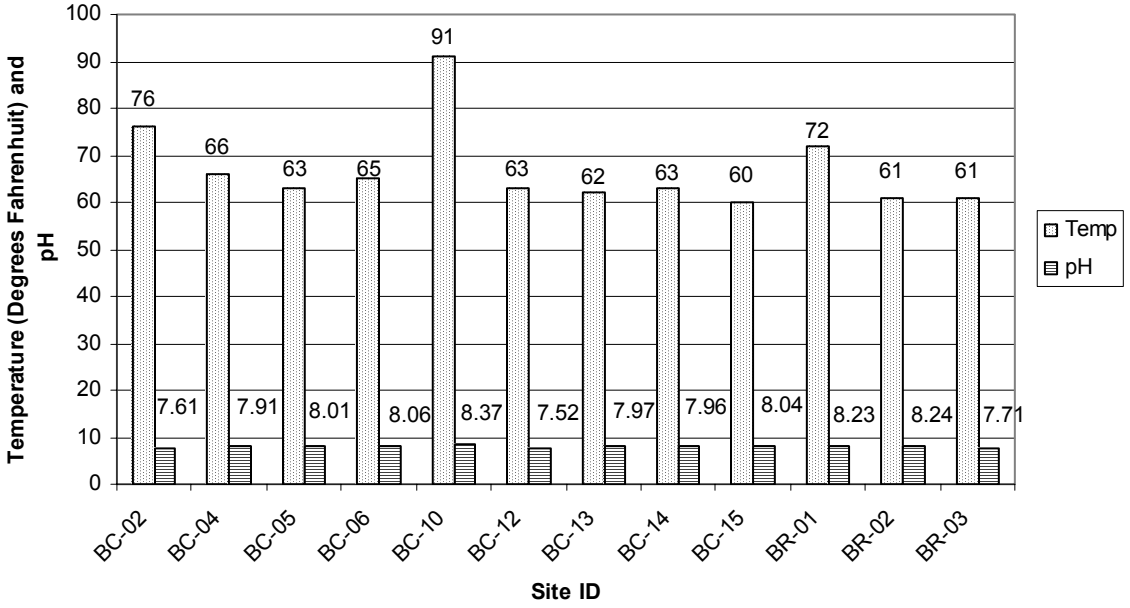


Figure 3. Percent substrate observations for each sample location in the Bass Creek Subwatershed

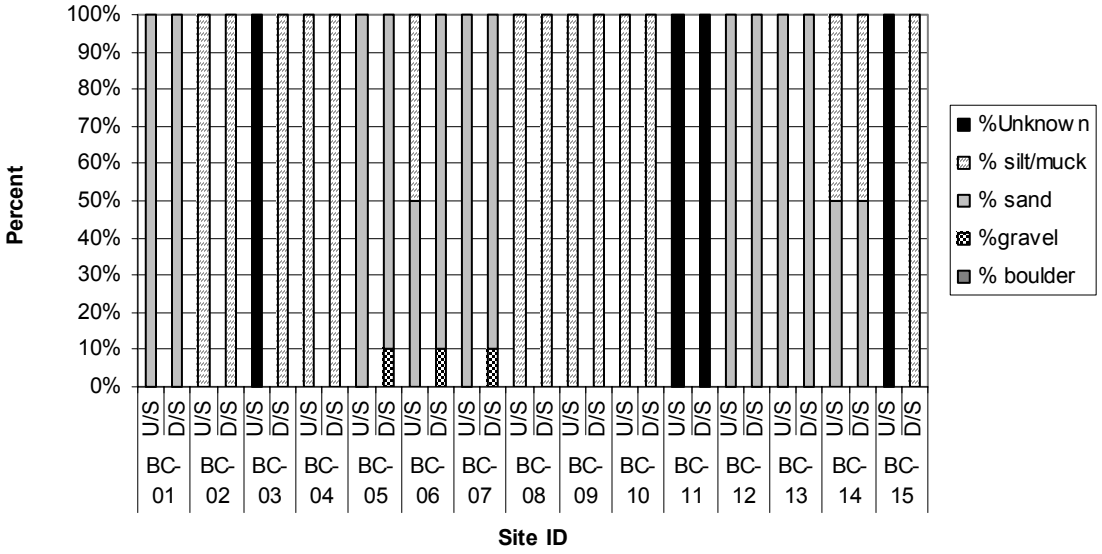


Figure 4. Percent substrate observations for each sample location in the Little Bass Creek Subwatershed

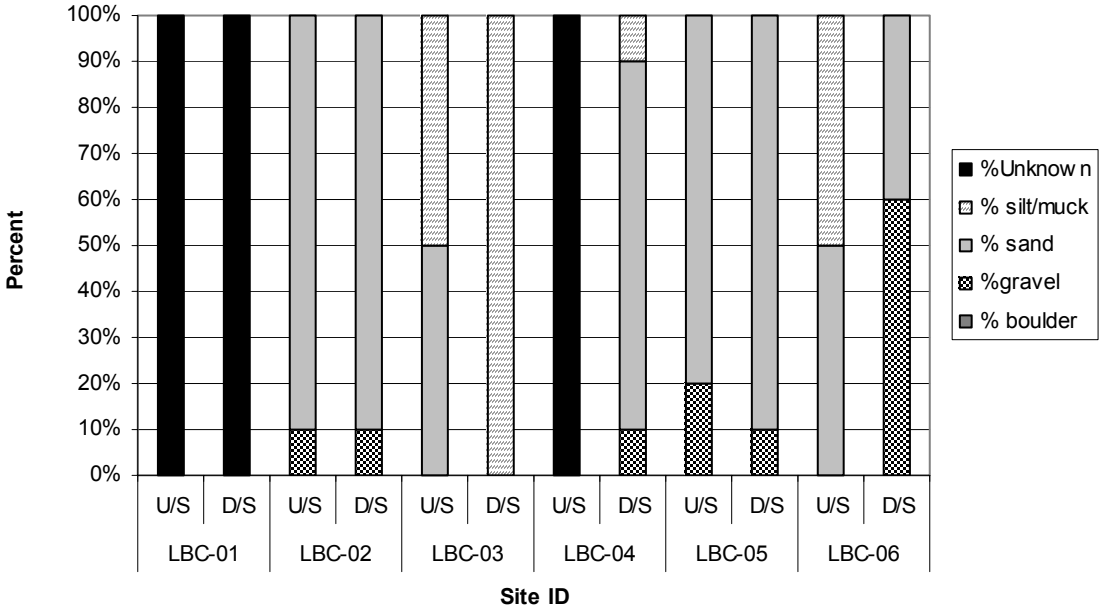


Figure 5. Percent substrate observations for each sample location in the Worley Drain Subwatershed

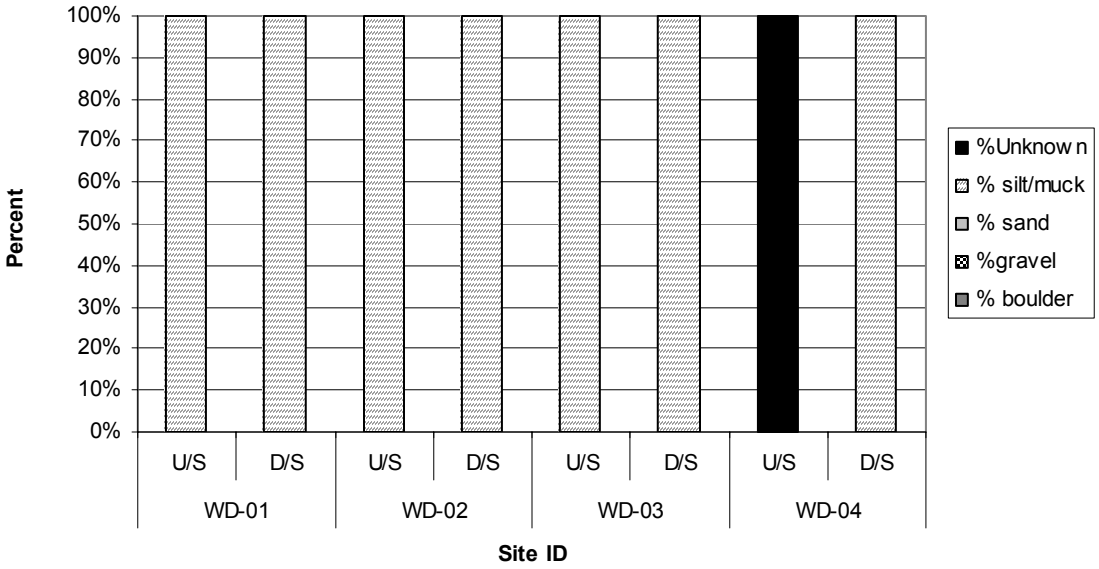


Figure 6. Percent substrate observation for each sample location in the Bass River Subwatershed

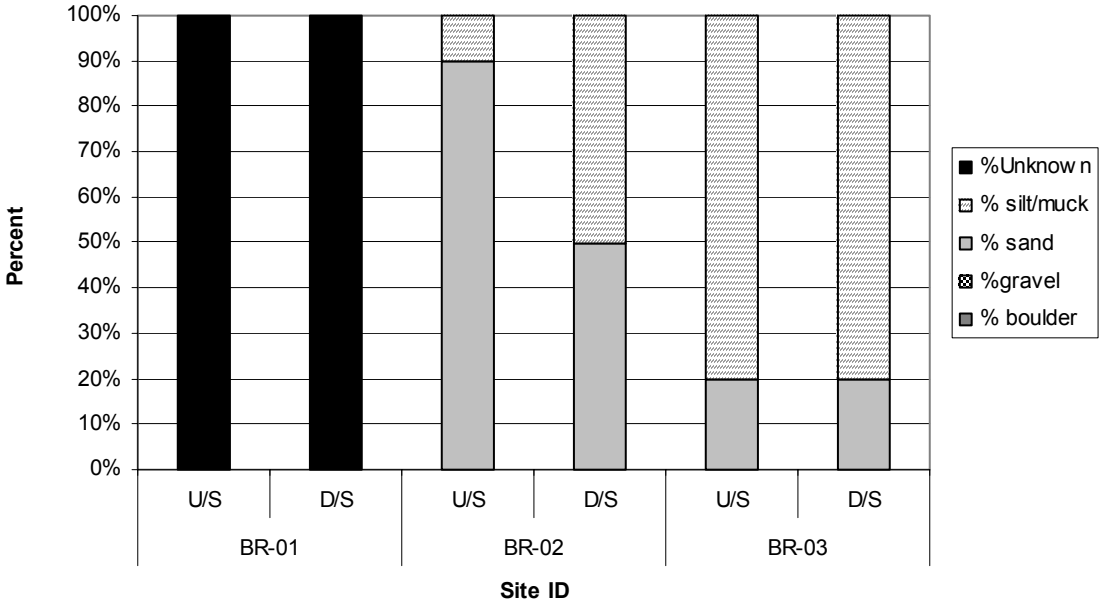


Figure 7. Percent substrate observation for the mainstem sample locations from the headwaters of Bass Creek to the mouth of Bass River

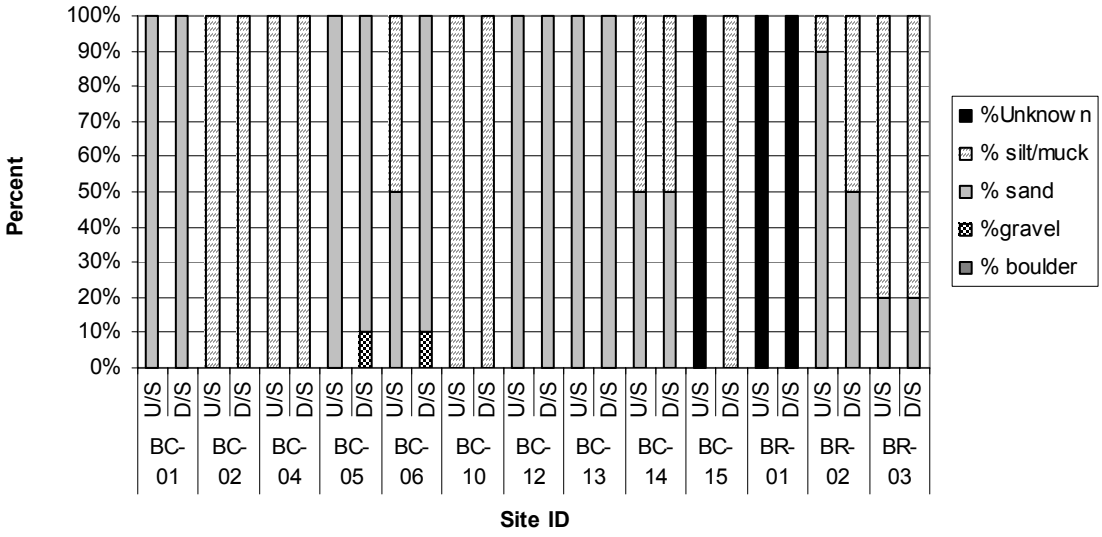


Figure 8. Summary of adjacent land uses

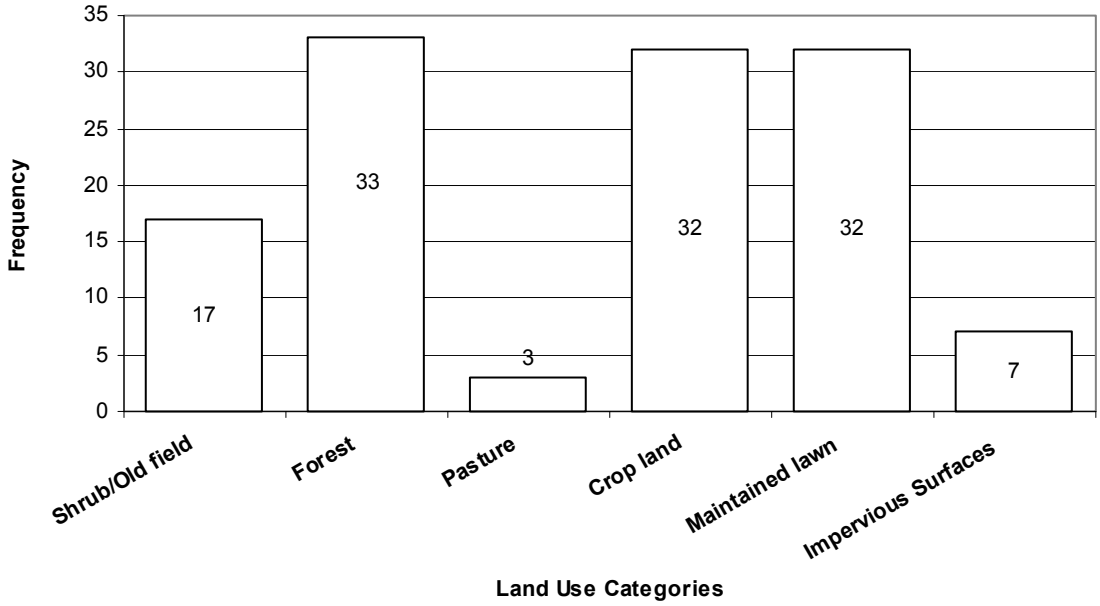


Figure 9. Weighted values for possible sources of non point source pollution (cumulative score for all locations)

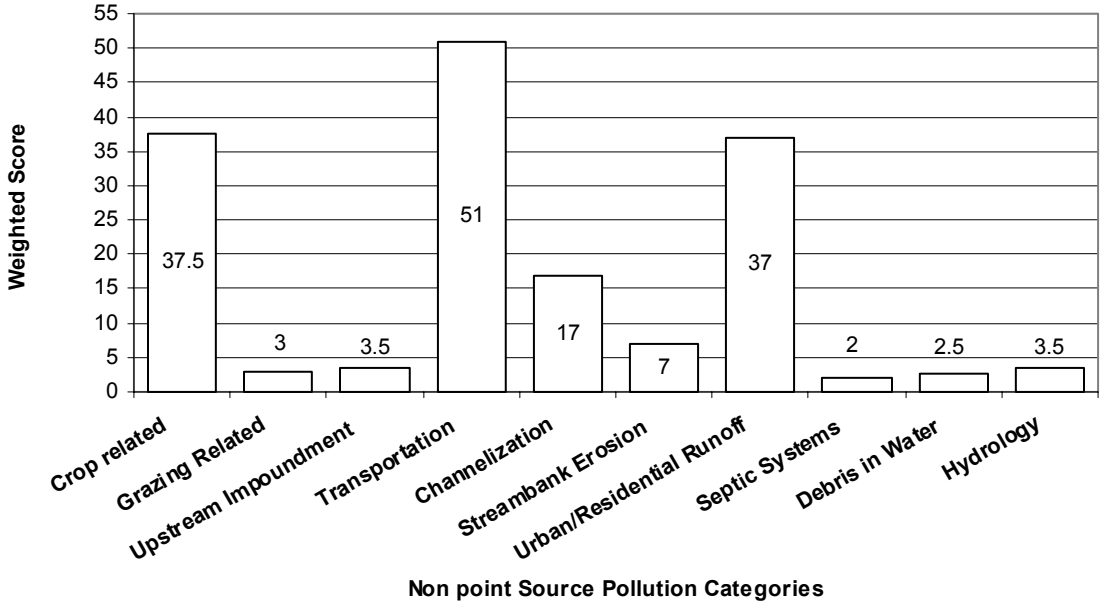


Table 1. Summary of observations made for in stream habitat and cover

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
BC-01	U/S						
	D/S						
BC-02	U/S		X				
	D/S		X				
BC-03	U/S		X			X	
	D/S		X				
BC-04	U/S		X				
	D/S		X				
BC-05	U/S		X				X
	D/S		X				
BC-06	U/S	X	X				X
	D/S	X					
BC-07	U/S		X				
	D/S		X				
BC-08	U/S		X				
	D/S		X				
BC-09	U/S		X				
	D/S		X				
BC-10	U/S		X				
	D/S		X				
BC-11	U/S		X				X
	D/S						
BC-12	U/S		X				
	D/S		X				
BC-13	U/S		X				X
	D/S		X				
BC-14	U/S	X	X				
	D/S		X				
BC-15	U/S	X	X				X
	D/S		X				
LBC-01	U/S		X			X	
	D/S		X				
LBC-02	U/S		X				
	D/S		X				
LBC-03	U/S		X				
	D/S		X				

Table 1. Continued

SITE ID		Undercut Banks	Overhanging Vegetation	Deep Pools	Boulders	Aquatic Plant Cover	Logs/Woody Debris
LBC-04	U/S		X				
	D/S		X				
LBC-05	U/S		X				
	D/S		X				
LBC-06	U/S		X				X
	D/S		X				X
WD-01	U/S		X			X	
	D/S		X				X
WD-02	U/S		X				
	D/S		X				
WD-03	U/S		X				
	D/S		X				
WD-04	U/S						
	D/S		X				X
BR-01	U/S		X				X
	D/S		X				X
BR-02	U/S	X	X				X
	D/S	X	X				X
BR-03	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
BC-01	U/S							
	D/S							
BC-02	U/S		P	A	P			
	D/S		P	P	P			
BC-03	U/S	A						
	D/S	P		P				
BC-04	U/S	A		A	P			
	D/S			A				
BC-05	U/S				P			P
	D/S							
BC-06	U/S		P	P				
	D/S	P						
BC-07	U/S				P			
	D/S	P						
BC-08	U/S		P					
	D/S		P					P
BC-09	U/S	P	A	A				
	D/S	P	A	A				
BC-10	U/S	P	P	P				
	D/S		A	P				
BC-11	U/S				A			
	D/S			P	A			
BC-12	U/S	P						
	D/S	P	P					
BC-13	U/S							
	D/S							
BC-14	U/S	P						
	D/S							
BC-15	U/S	P			P			
	D/S			P	P			
LBC-01	U/S	A	A	A				
	D/S	A	A	A				
LBC-02	U/S	P						
	D/S							
LBC-03	U/S	P						
	D/S	P	P				P	

Table 2. Continued

SITE ID		Aquatic Plants	Floating Algae	Filamentous Algae	Turbidity	Bacterial Sheen	Foam	Trash
LBC-04	U/S		P	P				
	D/S	P						
LBC-05	U/S	P	P		P			
	D/S				A			
LBC-06	U/S				P			
	D/S							
WD-01	U/S	A	A					
	D/S	P						
WD-02	U/S	A	P	P		P		
	D/S	A	P	P		P		
WD-03	U/S	A	A			A		
	D/S	A	A			A		
WD-04	U/S							
	D/S							
BR-01	U/S				A			
	D/S				A			
BR-02	U/S							
	D/S			P				
BR-03	U/S							
	D/S							

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	
BC-01	U/S	X					X			grasses
	D/S				X				X	grasses
BC-02	U/S				X	X				shrubs
	D/S	X				X				grasses
BC-03	U/S	X				X				shrubs
	D/S				X			X		trees
BC-04	U/S	X					X			shrubs
	D/S	X				X				grasses
BC-05	U/S		X				X			trees
	D/S		X				X			shrubs
BC-06	U/S		X			X				shrubs
	D/S	X				X				grasses
BC-07	U/S	X							X	trees
	D/S	X				X				shrubs
BC-08	U/S	X					X			shrubs
	D/S			X			X			shrubs
BC-09	U/S	X				X				grasses
	D/S		X			X				shrubs
BC-10	U/S		X				X			grasses
	D/S		X			X				shrubs
BC-11	U/S				X				X	shrubs
	D/S	X				X				bare
BC-12	U/S				X				X	shrubs
	D/S	X				X				grasses
BC-13	U/S				X				X	shrubs
	D/S				X				X	trees
BC-14	U/S	X							X	grasses
	D/S	X							X	trees
BC-15	U/S				X				X	trees
	D/S				X				X	trees
LBC-01	U/S	X				X				shrubs
	D/S	X				X				grasses
LBC-02	U/S				X				X	shrubs
	D/S				X		X			shrubs
LBC-03	U/S	X				X				grasses
	D/S	X				X				grasses

Table 3. Continued

SITE ID		Left Bank				Right bank				Streamside land cover
		< 10	10-30	30-100	>100	< 10	10-30	30-100	>100	
LBC-04										grasses
	D/S		X			X				grasses
LBC-05	U/S	X					X			grasses
	D/S	X				X				grasses
LBC-06	U/S				X				X	trees
	D/S				X				X	trees
WD-01	U/S	X				X				grasses
	D/S	X				X				shrubs
WD-02	U/S	X				X				grasses
	D/S	X				X				grasses
WD-03	U/S		X					X		shrubs
	D/S		X					X		shrubs
WD-04	U/S				X				X	trees
	D/S				X				X	trees
BR-01	U/S				X			X		trees
	D/S				X			X		trees
BR-02	U/S				X				X	trees
	D/S				X				X	trees
BR-03	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	Impervious Surfaces
BC-01	U/S	R		L			
	D/S	B					
BC-02	U/S	R				L	
	D/S	L			R	L	
BC-03	U/S					B	
	D/S		B			L	
BC-04	U/S					B	
	D/S					B	
BC-05	U/S				B		
	D/S				B		
BC-06	U/S				R	L	
	D/S					B	
BC-07	U/S	R			L	L	
	D/S				B	L	
BC-08	U/S		R			L	
	D/S		L		R	L	
BC-09	U/S				L	R	
	D/S					B	
BC-10	U/S				R		L
	D/S				L		R
BC-11	U/S	B			L		
	D/S			B			
BC-12	U/S	B					
	D/S					B	
BC-13	U/S		B				
	D/S		B				
BC-14	U/S		B				
	D/S					B	
BC-15	U/S		B				
	D/S		B			R	
LBC-01	U/S				L	R	
	D/S					B	
LBC-02	U/S	B					
	D/S		L		R		

Table 4. Continued

Site ID		Shrub/Old field	Forest	Pasture	Crop land	Maintained lawn	Impervious Surfaces
LBC-03	U/S				B		
	D/S				B		
LBC-04	U/S				L	R	
	D/S				B	R	
LBC-05	U/S				B		
	D/S				B		
LBC-06	U/S		B				
	D/S	L	R			R	
WD-01	U/S				R		L
	D/S	R				R	L
WD-02	U/S				L		R
	D/S				R		L
WD-03	U/S	L			R		R
	D/S	B			R		
WD-04	U/S		B				
	D/S		B				
BR-01	U/S		B				
	D/S		L			R	
BR-02	U/S		B				
	D/S		B				
BR-03	U/S		B				
	D/S		B				

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	Grazing Related	Upstream Impoundment	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Septic Systems	Debris in Water	Hydrology
BC-01	U/S		S		S		S				
	D/S						S				
BC-02	U/S				S		S	H	S		
	D/S	M						S			
BC-03	U/S							H			
	D/S							H			
BC-04	U/S				M			M			
	D/S				S			H			
BC-05	U/S	S								M	
	D/S	S			S					S	
BC-06	U/S	S			M			S			
	D/S				M			H			
BC-07	U/S	S			S			S			
	D/S	S			S			M			
BC-08	U/S				M			M			
	D/S	S						S			
BC-09	U/S	M			S			S			
	D/S							M	S		
BC-10	U/S	H			S						
	D/S	M			S						
BC-11	U/S	S			S						
	D/S		H		S			S			
BC-12	U/S				S						
	D/S				S						
BC-13	U/S				S						
	D/S				S						
BC-14	U/S				S	S	S				
	D/S				S	S		M			
BC-15	U/S				S		S				
	D/S				S	S	S	S			
LBC-01	U/S	M				M		M			
	D/S					S		H			

Table 5. Continued

Site ID		Crop related	Grazing Related	Upstream Impoundment	Transportation	Channelization	Streambank Erosion	Urban/Residential Runoff	Septic Systems	Debris in Water	Hydrology
LBC-02	U/S				S	S					
	D/S	S			S						
LBC-03	U/S	H			S						
	D/S	H			S	S					
LBC-04	U/S	H		H	M			H			
	D/S	H			M			M			
LBC-05	U/S	H			M	S					
	D/S	H			M	S					
LBC-06	U/S				M	M					
	D/S				M						S
WD-01	U/S	H			S						
	D/S				S			M			
WD-02	U/S	H			S	M		S			
	D/S	H			S	M					
WD-03	U/S	H		M	S	M					M
	D/S	M			S	M					S
WD-04	U/S				S			S			
	D/S				S			S			
BR-01	U/S				S		S				
	D/S							S			
BR-02	U/S				S						
	D/S				S						
BR-03	U/S				S						
	D/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)