

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
JULY 2008

STAFF REPORT

BIOLOGICAL AND WATER CHEMISTRY SURVEYS OF SELECTED STATIONS IN THE
LOOKING GLASS RIVER WATERSHED
SHIAWASSEE AND CLINTON COUNTIES, MICHIGAN
JULY AND AUGUST 2007

Introduction

Biological, chemical, and physical habitat conditions of the Looking Glass River watershed in Clinton and Shiawassee Counties were assessed by Surface Water Assessment Section staff in July and August of 2007. The primary objectives of the assessments were:

1. **To support the development of water quality-based effluent limits (WQBELs) for National Pollutant Discharge Elimination System (NPDES) permits.**
2. **Identify nonpoint sources (NPS) of water quality impairment.**
3. **Evaluate the effectiveness of the NPS Program.**
4. **Assess the current status and condition of individual water bodies and determine if Michigan Water Quality Standards (WQS) are being met.**
5. **Gather water quality data needed for Fiscal Year (FY) 2008 and FY 2009 Total Maximum Daily Load (TMDL) development or delisting.**
6. **Satisfy monitoring requests submitted by internal and external customers.**
7. **Reassess streams listed on the Clean Water Act Section 303d list as Category 4c.**

The macroinvertebrate community and physical habitat was qualitatively assessed at each of 23 stations (Table 1, Figures 1a,b,c), and the fish community was qualitatively assessed at 1 of those stations, using the Great Lakes and Environmental Assessment Section (GLEAS) Procedure 51 (available upon request, MDEQ, 1990; Creal et al., 1996) for wadeable streams. The macroinvertebrate and fish communities were assessed and scored with metrics that rate water bodies from excellent (+5 to +9 [macroinvertebrates], +5 to +10 [fish]) to poor (-5 to -9 [macroinvertebrates], -5 to -10 [fish]). Scores from +4 to -4 are rated acceptable. Negative scores in the acceptable range are considered tending towards a poor rating, while positive scores in the acceptable range are tending towards an excellent rating. Two overriding factors immediately classify a fish community as poor: the inability to collect over 50 fish at a station, and/or the presence of anomalies in greater than two percent (%) of the fish community. Habitat evaluations are based on 10 metrics, with a possible maximum total score of 200. A station habitat score of >154 is characterized as having excellent habitat, 105-154 is good, 56-104 is marginal, and <56 is poor. Water samples were also collected and preserved according to Michigan Department of Environmental Quality (MDEQ) protocol (MDNR, 1994).

Two site selection methods were used to assess the Looking Glass watershed in 2007: stratified random and targeted. A probabilistic monitoring approach, using stratified random site selection to address statewide and regional questions about water quality, was used to select several stations within the Maple and Looking Glass River watersheds (MDEQ, 2006 draft). The Maple River watershed biosurvey was conducted separately from the Looking Glass River watershed survey and is addressed in a separate report. In addition to probabilistic monitoring, sites within the Looking Glass River watershed were selected for targeted monitoring to fulfill specific monitoring requests, assess known or potential areas of concern, collect information and assess

attainment of designated uses from areas where historic information was lacking, or to provide information for NPDES activities.

Watershed Information

The Looking Glass River watershed is approximately 312 mi² with 178 miles of perennial streams (MIRIS, 2007). Most of the watershed is in Shiawassee and Clinton Counties, with small areas in Ingham, Ionia, Livingston, and Eaton Counties. The headwaters begin east and south of the village of Morrice and the city of Perry in Shiawassee County. The river then flows approximately 40 miles to the confluence with the Grand River, in the city of Portland, Ionia County. Landuse is dominated by agriculture (47%), followed by a mix of grass/pasture area (21%), forest (18%), water (10%), residential (3%), and commercial and industrial (1%; Purdue, 2007).

The watershed is located in the Ionia District Ecosystem (Albert et al., 1986). The Ionia District consists of gently rolling ground moraine and land use is dominated by agriculture. All stations are located in the Southern Michigan and Northern Indiana Till Plains Ecoregion (Omernik and Gallant, 1988). The entire Looking Glass watershed is designated as a warmwater stream.

The most recent assessment of the Looking Glass River watershed was conducted in 2002 (Roush, 2003). Stations sampled in 2002 had habitat ratings ranging from poor to excellent, and macroinvertebrate ratings ranged from acceptable to excellent.

2007 Macroinvertebrate and Habitat Biosurvey Sampling Results

Grub Drain

Grub Drain was sampled at Cork Road (Station 1). The riffle/run habitat scored good (113; slightly-impaired; Table 2a). A lack of woody debris was evident. The substrate was dominated by sand, followed by a mix of embedded gravel and silt. The riparian area was impacted by a yard on one side that was maintained to the edge of the stream. The macroinvertebrate community scored acceptable (0; Tables 2b, c).

Unnamed Tributary to the Looking Glass River

An unnamed tributary was sampled adjacent to Winegar Road east of Shaftsbury Road (Station 2). The glide/pool habitat scored good (103; slightly-impaired; Table 2a). The stream was only 2 feet wide and 1 inch deep and flowed through a wetland area. The stream bottom was extremely soft which was expected due to the wetland nature of the stream. The stream flowed closely along the south side of Winegar Road, which resulted in a lower riparian area score. The macroinvertebrate community scored in the lower end of acceptable (-4, Tables 2b, c). This lower score is not likely the result of degraded conditions, but due to the wetland nature of the stream.



Figure A: Clise Drain upstream of Cutler Road.

Clise Drain

Clise Drain was sampled at Cutler Road (Station 3). The glide/pool habitat was rated at the low end of marginal (60; moderately impaired; Table 2a). This stream is a maintained agricultural drain with a straight channel, lack of woody debris, and

a riparian zone consisting of primarily grasses (Figure A). The stream was approximately 3 inches deep with little stream velocity. Pool variability was absent and the substrate consisted of silt that was more than 2 feet deep in places. The macroinvertebrate community scored acceptable (-2; Tables 2b, c). Fish were sampled at this station and scored poor. Only 37 central mudminnows (*Umbra limi*) were found in a 900 foot sample reach that was electrofished for 40 minutes (Table 2d). The low diversity and numbers of fish can most likely be attributed to the lack of habitat in the stream due to drain maintenance activities. Clise Drain was also observed at Clise Road. The drain was barely flowing and was choked with duckweed. The stream channel was very similar to conditions at the Cutler Road crossing.

Mud Creek

Mud Creek was sampled at Angle Road (Station 4). The glide/pool habitat at this station was rated at the high end of good (126; slightly impaired; Table 2a). The station was in a grassy wetland area. There was a large amount of siltation (> 2 feet deep in areas). Overhanging vegetation was the dominant epifaunal substrate. The macroinvertebrate community scored acceptable (-2; Tables 2b, c). Mud Creek was also observed at Cutler Road. The site was wetland habitat, and the stream had large, shallow pools with little surface velocity. The stream bottom substrate was very soft, and likely consisted of seep silt.

Kellogg Drain

Kellogg Drain was sampled at Winegar Road (Station 5). Kellogg Drain is a tributary to the Perry Drain. The glide/pool habitat at this station was rated at the low end of marginal (60; moderately impaired; Table 3a). This stream is a maintained agricultural drain with a straight channel, lack of woody debris, and a riparian zone consisting of primarily grasses and little to no tree canopy. Filamentous algae were abundant. Pool variability was nearly absent due to the large amount of siltation in the channel. The macroinvertebrate community scored acceptable (1; Tables 3b, c).

Vermillion Creek

Vermillion Creek was sampled at 3 stations. The most upstream station (Station 6) was sampled at Lansing Road. Stations 7 and 8 were sampled at Peacock Road and Cutler Road, respectively. The glide/pool habitat at Station 6 was rated as good (110; slightly impaired; Table 3a). The station had a large wooded floodplain. Large woody debris was abundant, but was covered with a layer of silt, and therefore negatively impacting colonization potential. Aquatic vegetation was absent, and although a small amount of cobble was present, it was deeply embedded. The stream banks had many areas of erosion and were deeply incised (> 5 feet high in places) and the stream appeared very flashy. Large sandbars were present in the stream channel due to sediment deposition. The macroinvertebrate community at Station 6 scored acceptable (1; Tables 3b, c).

The glide/pool habitat at Station 7 was rated as good (116; slightly impaired; Table 3a). The habitat at this station was similar to Station 6. The riparian area consisted of a wooded floodplain. Woody debris was abundant but covered in silt. A small amount of rootwad was the only other available epifaunal substrate. Large sandbars were present in the stream channel due to sediment deposition. The macroinvertebrate community at this station scored acceptable (1; Tables 3b, c).

The glide/pool habitat at Station 8 was rated as good (143; slightly impaired; Table 3a). This station was located in a wetland area and had a slow surface velocity. Woody debris and some aquatic vegetation were available for epifaunal substrate; however, there was a fine layer of silt

covering the woody debris. The substrate consisted of primarily silt that was more than 2 feet deep in places. The macroinvertebrate community at Station 8 scored acceptable (1; Tables 3b, c).

Looking Glass River (upper reaches)

The Looking Glass River was sampled at 4 stations in the upper portion of the watershed (Stations 9, 10, 11, and 12). Station 9 (the most upstream station) was sampled at Godfrey Road. The riffle/run habitat at Station 9 was rated marginal (96; moderately impaired; Table 4a). The Looking Glass has been historically straightened and dredged in this portion of the watershed. Cobble and gravel were present; however, riffles were 50% embedded. Large woody debris was lacking. The river appeared flashy and the stream channel was deeply incised (up to 4 feet) (Figure B). Debris was piled up at the double box culvert, further suggesting flashiness. The macroinvertebrate community scored acceptable (2; Tables 4b, c).



Figure B: Looking Glass River upstream of Godfrey Road.

Station 10 was sampled at Cork Road. The glide/pool habitat at Station 10 was rated as good (121; slightly impaired; Table 4a). The riparian area at this station was very intact with a large wooded floodplain. Although not recently dredged, it was apparent that the river has historically been straightened at this station. The epifaunal substrate consisted of a mix of woody debris, rootwads, and cobble. There was a large amount of erosion and the stream appeared very flashy. A fine layer of silt was present on the substrates, and sand bars due to sedimentation were present. The macroinvertebrate community scored acceptable (-1; Tables 4b, c).

Station 11 was sampled at Morrice Road. This station was one and one-half miles downstream of Station 10. The riffle/run habitat was rated as marginal (87; moderately impaired; Table 4a). The river flows along Morris Road for a portion of this station and the riparian area has been altered on that side of the stream. Aquatic vegetation and rootwads were the dominant epifaunal substrate. Woody debris and cobble were also present, but were deeply embedded. There was a large amount of sedimentation at this station and the water level seemed somewhat low. The macroinvertebrate community scored acceptable (2; Tables 4b, c).

Station 12 was sampled at Colby Lake Road. The glide/pool habitat was rated as marginal (95; moderately impaired; Table 4a). The riparian area consisted of a wooded floodplain and one yard that was mowed to the edge of the river. The substrate at this station was very soft and silt was more than 3 feet deep in many places. Cobble and gravel was absent. Woody debris was deeply embedded and surfaces were covered with silt. Many of the tree roots were exposed due to erosion and some had fallen into the stream channel. The macroinvertebrate community scored at the low end of acceptable (-3; Tables 4b, c).

Remy-Chandler Drain

The Remy-Chandler Drain watershed begins in the urban areas of Lansing and East Lansing. The stream channel has historically been altered and it is actively managed as a county drain. The drain was sampled at 3 stations (Stations 13, 14, and 15).

Station 13 was sampled at State Road and was the most upstream station in the Remy-Chandler Drain watershed. The glide/pool habitat at Station 13 was rated as poor (43; severely impaired; Table 5a). The station had very steep banks where the channel has been incised more than 30 feet deep. The riparian area consisted of closely cropped grass. There was very little flow in the stream. The substrate was dominated by sand and silt. Sand deposition was evident in the form of sand bars at the road culvert (Figure C). Epifaunal substrate was absent except for the large amount of aquatic vegetation. Pools were almost absent due to the large amount of sedimentation. The macroinvertebrate community scored at the low end of acceptable (-3; Tables 5b, c).

Figure C: Remy-Chandler Drain upstream of State Road.



Station 14 was sampled at Wood Road. The glide/pool habitat was rated as marginal (65; moderately impaired; Table 5a). The stream channel is straight at this station and flows through a channel that is incised for than 50 feet deep (Figure D). The riparian area consisted of grass to the top of the steep banks where there are trees on one side of the stream and an agriculture field on the other. The stream flows under I-69 just upstream of this station via 2 culverts. The Wood Road culvert is 20 feet in diameter due to the deep ravine (Figure C). The substrate at Station 14 was dominated by silt and sand. Epifaunal substrate was absent except for the large amount of *Elodea* species and some overhanging grass. Cobble and gravel could be felt but was buried under the sediment. The macroinvertebrate community scored acceptable (0; Tables 5b, c).



Figure D: Remy-Chandler Drain upstream of Wood Road

Station 15 was sampled downstream of Howe Road. Upstream of Howe Road is a gravel pit pond that Remy-Chandler Drain flows through. The riffle/run habitat was rated as marginal (89; moderately impaired; Table 5a). The banks have been stabilized at this station with a large amount of rip rap. The stream velocity is increased at this station compared to upstream stations due to the increased gradient downstream of the gravel pit pond. It appeared that the riparian area is actively maintained and sprayed with herbicide as much of the upper riparian vegetation was dying and brown. The substrate at Station 15 consisted of a large amount of cobble but was covered with silt. The cobble was less abundant further downstream where less rip rap covered the stream bank. The water temperature was very warm at this station (78 degrees Fahrenheit) due to the upstream ponded area. The macroinvertebrate community scored acceptable (1; Tables 5b, c).

Looking Glass River (near Dewitt)

The Looking Glass River was sampled at 1 random station at Dewitt Road (Station 16) and at 2 additional



Figure E: Looking Glass River upstream of Dewitt Road, looking downstream.

stations, upstream (Station 17) and downstream (Station 18) of the Southern Clinton County Wastewater Treatment Plant (SCC WWTP). The glide/pool habitat at Station 16 was rated as good (107; slightly impaired; Table 6a). There was a good diversity of epifaunal substrate at this station. Cobble and gravel were available, but were deeply embedded. Aquatic macrophytes and woody debris were also present. Sedimentation was evident in the form of sand bars. The riparian area vegetation has been greatly reduced at this station. The station is in a park that has a maintained yard right to the edge of the stream. There are several large trees along the stream bank within the park. The stream bank is being deeply eroded along the park side and the trees are in danger of falling into the river (Figure E). The macroinvertebrate community scored acceptable (2; Tables 6b, c).

Station 17 and 18 were sampled upstream and downstream respectively of the SCC WWTP outfall. The outfall can be accessed via Winsome Road across from the WWTP off of Herbison Road. There is a storm drain that discharges to the Looking Glass River just upstream of the outfall. At Station 17, the glide/pool habitat was rated as marginal (103; moderately impaired; Table 6a). Cobble and woody debris was available as epifaunal substrate, but sand was the dominant substrate and somewhat limited colonization potential. In addition, a fine layer of silt covered the woody debris. The water level was low due to a lack of precipitation this year. The riparian area was a mix of woods and lawns that had some large trees. The macroinvertebrate community scored acceptable (3; Tables 6b, c).

The glide/pool habitat at Station 18 was rated as marginal (103; moderately impaired; Table 6a). Cobble and woody debris was again available as epifaunal substrate. There was less sediment deposition compared to the upstream station, due to the increased flow from the WWTP discharge. There was a noticeable increase in the amount of aquatic macrophytes, but there was also an increase in the amount of sunlight reaching the river. The riparian area was again a mix of woods and lawns that had some large trees. The macroinvertebrate community scored acceptable (1; Tables 6b, c).

Summers Drain

Summers Drain was sampled north of Stoll Road, east of the intersection with Lowell Road (Station 19). The glide/pool habitat was rated as marginal (85; moderately impaired; Table 6a). The stream was less than 3-feet wide and only 4-inches deep and is most likely groundwater fed as the water temperature recorded was 61 degrees Fahrenheit. Emergent plants and a handful of cobble substrate provided the only epifaunal substrate. Some sedimentation was evident. The stream channel has been obviously relocated to allow for the road. The upper portion of the watershed is being heavily impacted by the new housing developments and sedimentation at Stoll Road near Airport Road. The macroinvertebrate community scored at the low end of acceptable (-3, Tables 6b, c). Isopods made up 76% of the taxa found, and the percent isopod, snail, and leech metric was near 80%. High percentages of these organisms are evidence of stream degradation (MDEQ, 1990). The stream's small watershed size and limited flow combined with past agricultural drain maintenance activity and current housing developments in the watershed, has likely had an impact on the quality of this stream. The stream has not been sampled during past years to be compared to the 2007 survey results.

Husted and Landenburg Drain

Husted and Landenburg Drain was sampled upstream of Clark Road (Station 20). The riffle/run habitat was rated as good (128; slightly impaired; Table 7a). There was a large amount of riffles present that were approximately 30% embedded. Woody debris was present, but a fine layer of silt covered it. The stream appeared to be somewhat flashy as there were a lot of tree roots exposed. The riparian vegetation was somewhat reduced by a power line and a road at this

station. In other parts of the Husted and Landenburg Drain watershed the riparian area has been greatly altered and reduced to grasses due to agriculture and drain maintenance activities. The macroinvertebrate community scored acceptable (2; Tables 7b, c).

Moyer Drain

Moyer Drain was sampled at McCrumb Road (Station 21) north of the village of Eagle. The riffle/run habitat was rated as good (137; slightly impaired; Table 7a). The lower portion of this station was a riffle area with cobble substrate, while the upstream portion was a lower gradient area with overhanging vegetation and a pool with silt substrate. The stream was very shallow in spots due to pooling of water due to woody debris piles. The riparian area consisted of a grassy wetland and wooded area. The macroinvertebrate community scored acceptable (0; Tables 7b, c). We followed this stream to its confluence with the Looking Glass River. A landowner had concerns about a neighboring landowner logging near the stream and crossing the stream with heavy machinery. The damage was documented and a summary was forwarded to the MDEQ Land and Water Management Division.

Looking Glass River (downstream reach)

The Looking Glass River was sampled at 2 stations in the lower part of the watershed (Stations 22 and 23). Station 22 was sampled at Howe Road. The riffle/run habitat was rated as good (126; slightly impaired; Table 7a). The riparian area was a wooded floodplain on one side and a lawn with partial wooded areas on the other. The bottom substrate consisted of a mix of sand and gravel with some areas of cobble. Pools were generally absent and the water level seemed slightly low. There was a lot of algae and periphyton covering the cobble. This station had a very open canopy and the river receives a good deal of sun throughout the day. The macroinvertebrate community scored acceptable (3; Tables 7b, c). This station had a total of 46 taxa, which was the greatest number of taxa found at any station within the watershed in 2007.

Station 23 was the most downstream Looking Glass River station and was sampled at Monroe Road, approximately 3 miles east of Portland. The riffle/run habitat (Figure F) was rated as good (146; slightly impaired; Table 7a), and had the highest habitat score for any station sampled in the watershed in 2007. The station had a large amount and diversity of epifaunal substrate in the form of cobble and gravel. The natural flow of the reach was somewhat altered by an area where rocks were built up across the width of the stream and restricted flow through a 6 foot section of the river. This restriction caused an increase in stream velocity. Siltation was minimal in this reach due to the higher water velocity. There was also good habitat variety and pool diversity at this station. Erosion potential was high at this station because in one area the riparian zone consisted of a house located on a high bluff with only large trees left as vegetative protection. The macroinvertebrate community at this station scored excellent (7; Tables 7b, c). This station was the only one sampled in the Looking Glass River in 2007 that scored an excellent macroinvertebrate rating.



Figure F: Looking Glass River upstream of Monroe Road.

Water Sample Results

Water samples were taken upstream of the SCC WWTP outfall and upstream of the Capitol Crossings Mobile Home Park (MHP) sanitary outfall (Tables 8). For the parameters assessed, Michigan WQS were met at all stations.

Summary of Results of Monitoring Objectives

1. Support WQBEL development for NPDES permits.

The following NPDES permits are located within the Looking Glass River watershed and were addressed with the 2007 sampling.

- 1) **Perry Wastewater Sewage Lagoon (WWSL)** (MIG580388) discharges treated sanitary wastewater seasonally from outfall 001 to the Perry Drain No. 2. The facility is required to report the monthly average total phosphorus discharge concentration. We made observations of Perry Drain No. 2 upstream and downstream of the facility. Upstream observations were made upstream of highway M-52 and along Bath Road near M-52. Upstream of M-52 the drain is part of a wetland area with very slow moving water and numerous emergent plants. The drain has been channelized and relocated along Bath Road and functions as a roadside ditch. The drain's riparian zone consists of only a small buffer of grass. Filamentous alga chokes the drain. Downstream observations of Perry Drain were made at the Bath Road crossing and Lansing Road. The drain at Bath Road had more flow than the stations observed upstream. The drain was in full sun, and there were a large amount of aquatic macrophytes; however, the filamentous alga was absent and the macrophytes were not present at levels that would be considered a nuisance. Perry Drain at Lansing Road is similar in size and flow to the Bath Road crossing. There is more shade at this crossing, and not as many macrophytes were present.
- 2) **Countryside Village MHP** (MI0025054) discharges treated sanitary wastewater seasonally from 3 outfalls to the Perry Drain No.2. They have a total phosphorus monthly average limit of 2.0 milligrams per liter. Observations of Perry Drain No. 2 were made upstream and downstream of the facility. Upstream observations were made at Britton Road. The drain is a maintained agricultural ditch with a riparian area that provides some shade to the stream, filamentous algae were present in the stream channel and the substrate was composed of silt and sand. Little woody debris or other epifaunal substrate was present. Observations were made directly downstream of the outfalls on Countryside Village property. The drain looked very similar to the upstream station. The lagoons themselves were completely covered with duckweed and this condition was reported to district staff.
- 3) **Laingsburg WWSL** (MIG580227) discharges treated sanitary wastewater seasonally from outfall 001 to a wetland near the Looking Glass River (Station SV-2, Figure 1a). The facility is required to report the monthly average total phosphorus discharge concentration. The facility's current permit states that the facility directly discharges to the Looking Glass



Figure G: Wetland at Laingsburg WWTP

River; however, a site visit confirmed that the outfall discharges to a wetland area and then to a county drain before discharging to the Looking Glass River. The next NPDES permit for this facility will note this change and identify the wetland as the receiving water, if the present discharge location is retained.

- 4) **SCC WWTP** (MI0021008) discharges treated sanitary wastewater from outfall 001 to the Looking Glass River. A water sample was taken upstream of the facility for metals, total phosphorus, and hardness analysis (Station 17, Table 8). For the parameters assessed, all WQS were met. The macroinvertebrate community was rated acceptable at both the upstream (Station 17) and downstream (Station 18) stations (Figure 2). The habitat was rated marginal at the upstream station and good at the downstream station.
- 5) **Capitol Crossings MHP** (MI0056553) discharges treated sanitary wastewater through outfall 001 to Moyer Drain. The macroinvertebrate community and physical habitat were sampled downstream of the facility at McCrumb Road and were rated acceptable and good, respectively. A water sample was taken upstream of the facility for metals, total phosphorus, and hardness analysis (Station SV-1, Figure 1c, Table 8). For the parameters assessed, all WQS were met. Just upstream of the outfall, the stream comes directly out of a culvert that travels from the south under the I-96 expressway. The outfall was not discharging on the day of sampling. There was very little flow and a large abundance of algae within the stream channel was observed (Figure G).

2. Identify nonpoint sources of water quality impairment.

The following additional NPS issues were identified from the 2007 sampling and were reported to Water Bureau District staff.

Looking Glass River at Old State Road. Cattle were observed in the stream upstream of the road crossing. Banks were being trampled due to cattle access. MDEQ Lansing District NPS staff referred this issue to the Department of Agriculture.

Remy-Chandler Drain. In preparation for the 2007 field season, Lansing District NPS staff noted concerns from a local watershed group regarding sedimentation issues in the Remy-Chandler Drain as a result of a large increase in development and construction in this watershed. The drain was observed at several road crossings. There were no specific sources of sedimentation visible from the road crossings; however, the entire watershed is obviously a maintained drain with limited riparian zone vegetation, and deeply incised channels that have a large amount of erosion potential. Macroinvertebrate communities were rated as acceptable at Stations 13, 14, and 15. The habitat was rated as poor at Station 13 and at the low end of marginal at Stations 14 and 15.

Summers Drain at Stoll Road near Airport Road. A large amount of housing development construction was occurring along Stoll Road near the Airport Road intersection. Stoll Road was being widened and paved. A significant amount of sedimentation due to the construction was occurring in Summers Drain at the Stoll Road crossing. Best management practices had been set up, but were not being maintained and were not effective in preventing sediment from entering the stream channel

3. Evaluate the effectiveness of the NPS Program.

A 319 grant has been awarded to the Clinton Conservation District (CCD) to develop an Upper Looking Glass Watershed Plan. As part of this project the CCD had hired a consultant (Wetland and Coastal Resources Inc. [WCR]) to conduct aquatic biological surveys in the watershed. WCR used Procedure 51 to sample 10 stations in 2006. Of the 10 stations they sampled, 4 were indicated as not meeting the macroinvertebrate community designated use. These stations included: Mud Creek at Cutler Road, Vermillion Creek at Cutler Road, Perry Drain No. 2 at Reuss Road, and an Unnamed Tributary at Winegar Road. WCR results also suggested that the warmwater fish community designated use was not being met in Clise Drain at Cutler Road. The data for these stations collected in 2007 are as follows:

Mud Creek at Cutler Road was not sampled in 2007. The stream at this road crossing was very wetland-like and there was almost no surface water flow and therefore, was not suitable for a Procedure 51 assessment. Mud Creek was sampled a little more than a mile upstream of Cutler Road, at Angle Road. The macroinvertebrate community was meeting designated uses at that station.

Vermillion Creek at Cutler Road. The macroinvertebrate community was meeting designated uses at this station (Station 8, Tables 3b, c)

Perry Drain No.2 at Reuss Road was not sampled in 2007. The drain was sampled less than a mile downstream at Winegar Road after the confluence with Kellogg Drain. The macroinvertebrate community was meeting designated uses at that station (Station 5, Tables 3b, c).

Unnamed Tributary at Wingegar Road. The macroinvertebrate community was meeting designated uses at this station (Station 2, Tables 2b, c).

Clise Drain at Cutler Road. The macroinvertebrate community was meeting designated uses at this station (Station 3, Tables 2b, c). The warmwater fish community was not meeting designated uses (Table 2d). Only 37 central mudminnows (*Umbra limi*) were found in a 900 foot sample reach that was electrofished for 40 minutes (Table 2d). This stream is a maintained agricultural drain with a straight channel, lack of woody debris, and a riparian zone consisting of primarily grasses. The low diversity and numbers of fish can most likely be attributed to the lack of habitat in the stream due to past and current drain maintenance activities.

In addition to the sampling conducted by WCR, the Friends of the Looking Glass volunteer group have been conducting macroinvertebrate surveys in the Looking Glass River. In 2003, the Remy-Chandler Drain at State Road was noted as having a poor macroinvertebrate community. The macroinvertebrate community was rated at the lower end of marginal in 2007 at this station (Station 13, Tables 5b, c). As noted above, the habitat at this station rated as poor. The drain is an actively maintained agricultural and urban drain.

4. Assess the current status and condition of individual waters of the state and determine whether designated uses are being met.

Some combination of water and/or sediment chemistry sampling, aquatic macroinvertebrate and fish community assessment, habitat assessment, or site visit observations was conducted at a total of 23 stations. Thirteen of these stations are considered status stations which were chosen with a randomized design. Ten of these stations are targeted stations.

The other indigenous wildlife and aquatic life designated use was being met at all 23 stations. The warmwater fisheries designated use was not being met in Clise Drain at Cutler Road.

In 2007, 97% \pm 5% (using a 95% confidence interval) of the Maple River and Looking Glass River watersheds were estimated to be supporting the “other indigenous wildlife and aquatic life” designated use component of R.323.1100(1)(e) of the Michigan Water Quality Standards. This estimate is based on 40 stratified random sites selected within the 2 watersheds. Details of these results will be available in a future report.

5. Gather water quality data needed for FY 2008 and FY 2009 TMDL development or delisting.

There were no water bodies in the Looking Glass watershed needing a TMDL in 2008. One 6.5 mile section of Vermillion Creek from Woodbury Road upstream to the headwaters at County Line Lake is listed as a Category 5 for pathogens levels exceeding WQS and requires a TMDL in 2009. A Category 5 Water Body is a water body where available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (LeSage and Smith, 2008). The listing is a result of an observed discharge of a residential septic tank on the southeast corner of the Beardslee Road/Braden Road intersection. The Shiawassee County Health Department was notified, and they reported that a new on-site system was installed. The need for a TMDL will be reevaluated. In 2007, we visited this intersection and did not observe anything suggesting the continued existence of a discharge.

6. Satisfy monitoring requests submitted by internal and external customers.

MDEQ Lansing District NPS staff noted that they had a citizen complaint about the unnamed drain around the Laingsburg WWSL having sediment that was very black and having a strong odor. The facility’s outfall actually discharges to a wetland area and then to the county drain before discharging to the Looking Glass River. MDEQ Lansing District compliance staff and the WWSL operators were not aware of any complaints. There is no public access available to the drain, and we observed the Looking Glass River downstream of the confluence of the drain and did not observe any unusual odor.

7. Reassess streams listed on the Clean Water Act Section 303d list as Category 4C.

Perry Drain No. 2 (also known as Kellogg Drain in downstream sections) is listed as a Category 4C stream from Tyrell Road (which is located 1 mile upstream of the confluence with the Looking Glass River) upstream to the headwaters. In 2003, the drain was sampled at Bath Road and WQS (including the macroinvertebrate community) were being met. In 2007, Kellogg Drain was sampled at Winegar Road, which is 1 mile upstream of Tyrell Road. The macroinvertebrate community was rated as acceptable and this rating would be expected at Tyrell Road as well. This suggests that the “other indigenous wildlife and aquatic life” designated use is being met in this drain.

The Looking Glass River is also listed as a Category 4c stream from Fenner Road upstream to the headwaters excluding Perry Drain No. 2. Four stations sampled in 2007 (3 stations on the Looking Glass River and 1 station in Grub Drain) are located within this Category 4c reach. Macroinvertebrate communities were rated as acceptable at all stations, which suggests that the “other indigenous wildlife and aquatic life” designated use is being met in this reach of river.

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Surface Water Assessment Section, Water Bureau

Literature Cited

- Albert, D.A., S.R. Denton, and B.V. Barnes. 1986. Regional Landscape Ecosystems of Michigan. School of Natural Resources, University of Michigan. Ann Arbor, Michigan.
- Creal, W., S. Hanshue, S. Kosek, M. Oemke, and M. Walterhouse. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. MDEQ Staff Report No. MI/DEQ/SWQ-96/068. Revised May 1998.
- LeSage, S.W. and J. Smith. 2008. Water Quality and Pollution Control in Michigan, 2008, Sections 303(d), 305(b), and 314 Integrated Report. MDEQ Report No. MI/DEQ/WB-08/007. Michigan Department of Environmental Quality, Water Bureau, Lansing, Michigan.
- MDEQ. 1990. GLEAS Procedure 51 - Qualitative Biological and Habitat Survey Protocols for Wadeable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, and May 2002, and April 1008 (Draft).
- MDEQ. 2006 draft. Water Bureau, Surface Water Assessment Section, Procedure (# to be assigned). Biological Trend Monitoring Procedure for Wadeable Streams.
- MDNR. 1994. Quality Assurance Manual for Water, Sediment, and Biological Sampling. Surface Water Quality Division, Lansing, Michigan. MI/DEQ/SWQ-98/083.
- MIRIS. 2007. Database Coverage from the Michigan Resource Information Database. Land and Water Management Division, Michigan Department of Natural Resources, Lansing, MI.
- Omernik, J. and A. Gallant. 1988. Ecoregions of the Upper Midwest States. USEPA, Environmental Research Laboratory. EPA/600/3-88/037.
- Purdue. 2007. Long-Term Impact Assessment Models. Purdue Research Foundation, West Lafayette, Indiana. ERL: <http://www.ecn.purdue.edu/runoff>.
- Roush, D. 2003. A Biological Assessment of Stoney Creek, Goose Creek, and the Looking Glass River, Clinton, Ionia, and Shiawassee Counties, Michigan. Michigan Department of Environmental Quality, Surface Water Quality Assessment Section, Water Division, Lansing, Michigan. Report No. MI/DEQ/WD-03/120.

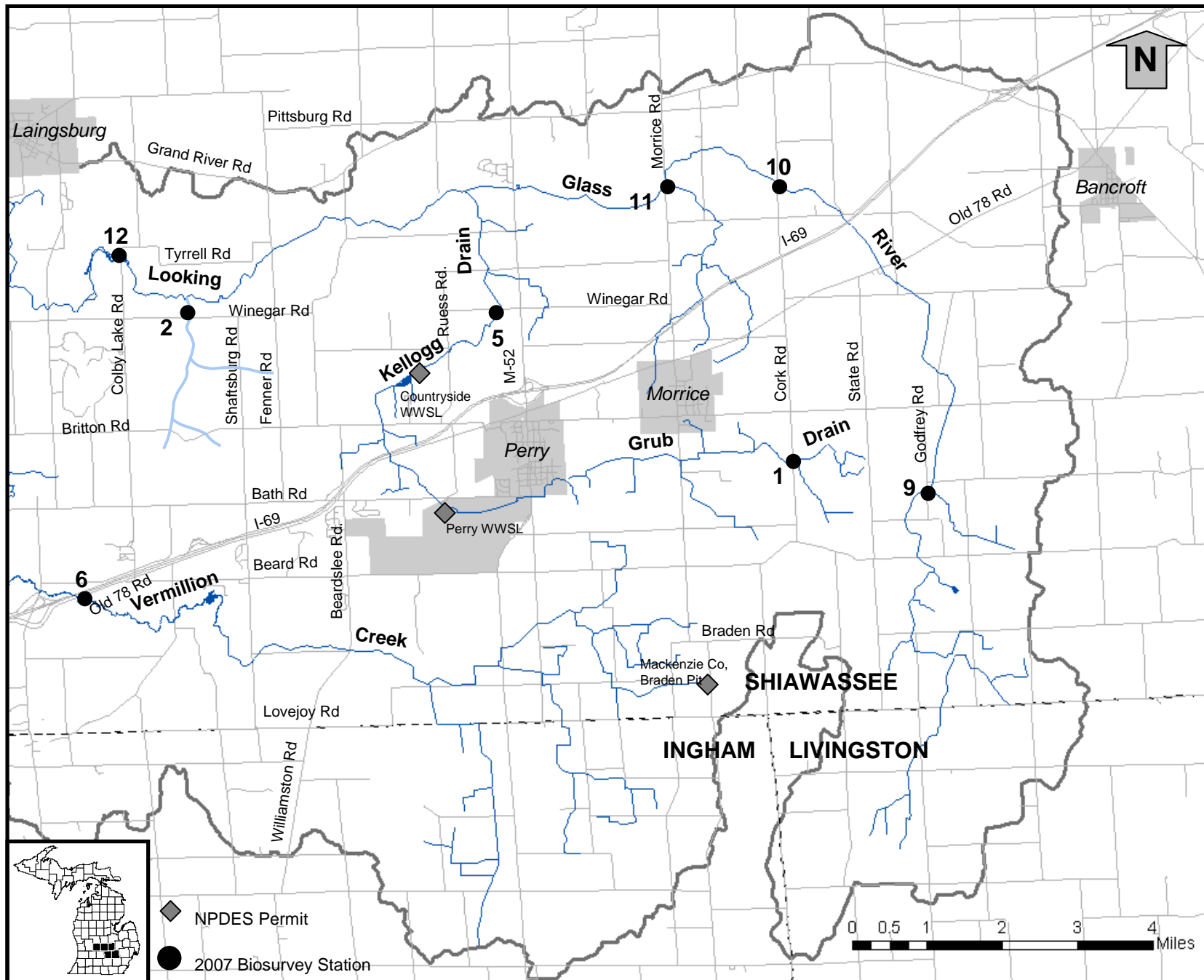


Figure 1a: Biosurvey stations in the eastern portion of the Looking Glass River watershed, July and August 2007.

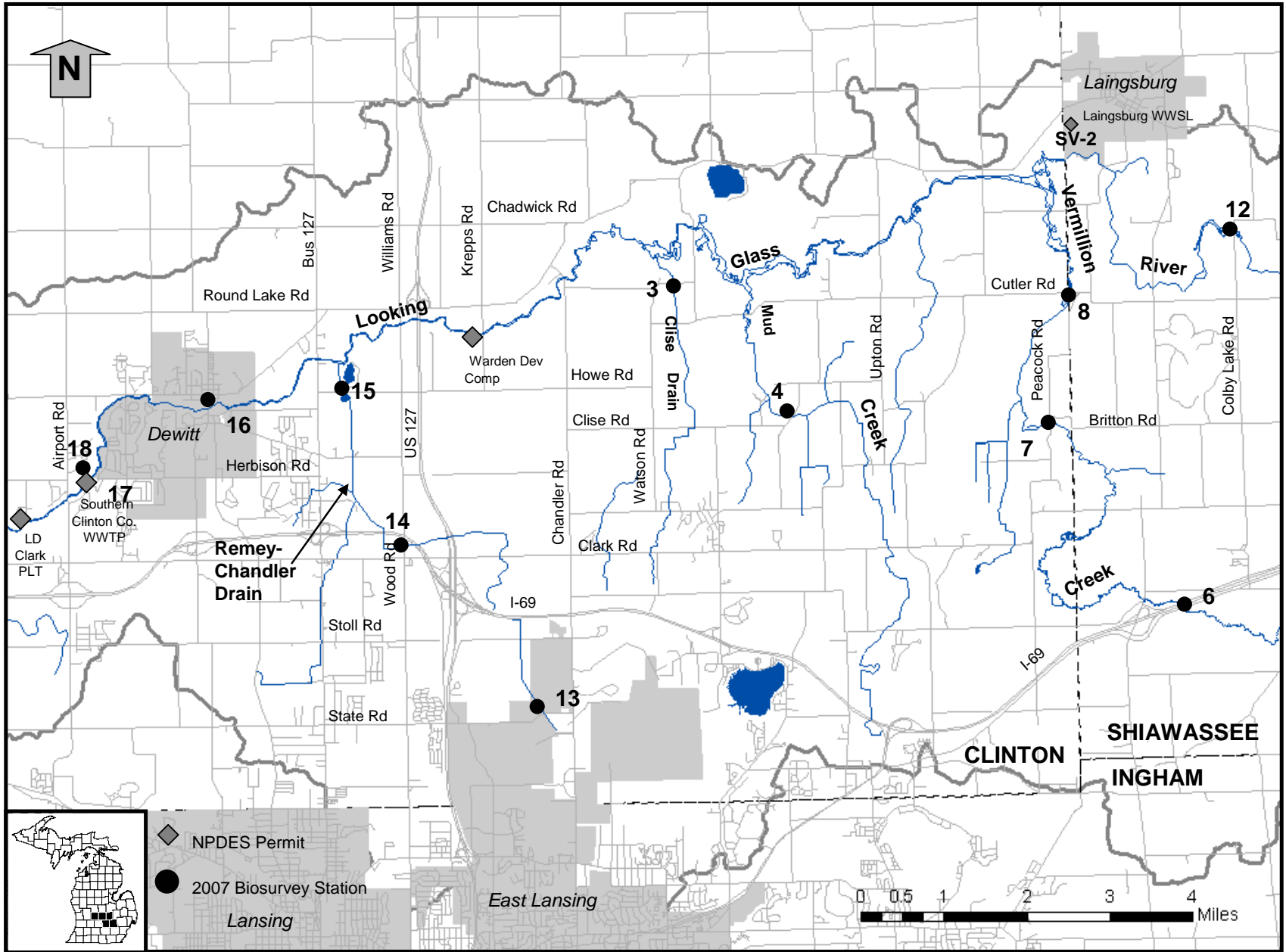


Figure 1b: Biosurvey stations in the central portion of the Looking Glass River watershed, August 2007.

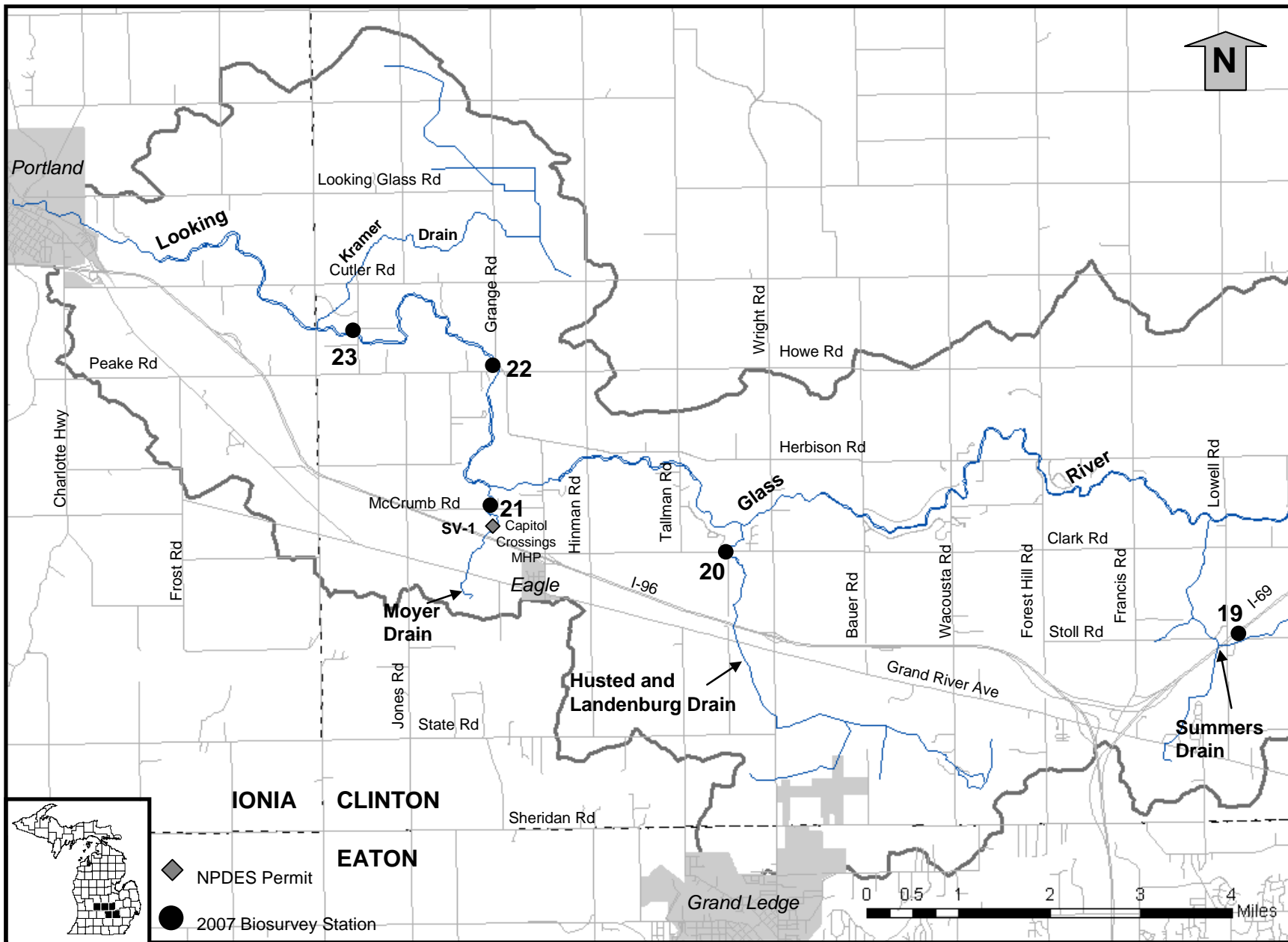


Figure 1c: Biosurvey stations in the western portion of the Looking Glass River watershed, August 2007.

Table 1. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Looking Glass River watershed, Shiawassee and Clinton Counties, MI. July and August 2007.

Site #	Storet #	Station Type	Waterbody	Site Location	Latitude	Longitude	Habitat Evaluation		Macroinvertebrate Community	
							Rating	Score	Rating	Score
1	780221	Random	Grub Drain	Cork Road	42.8252	-84.1500	Good	121	Acceptable	0
2	780230	Targeted	Unnamed Tributary	Winegar Road	42.8555	-84.3069	Marginal	103	Acceptable	-4
3	190149	Targeted	Clise Drain	Cutler Road	42.8566	-84.4580	Marginal	60	Acceptable	-2
4	190153	Random	Mud Creek	Angle Road	42.8364	-84.4305	Good	126	Acceptable	-2
5	780154	Random	Kellogg Drain	Winegar Road	42.8558	-84.2256	Marginal	80	Acceptable	1
6	780226	Random	Vermillion Creek	Lansing Road (Old 78)	42.8019	-84.3379	Good	110	Acceptable	1
7	190132	Random	Vermillion Creek	Peacock Road	42.8344	-84.3690	Good	116	Acceptable	1
8	190176	Targeted	Vermillion Creek	Cutler Road	42.8571	-84.3958	Good	143	Acceptable	-3
9	780223	Random	Looking Glass River	Godfrey Road	42.8192	-84.1152	Marginal	96	Acceptable	2
10	780231	Random	Looking Glass River	Cork Road	42.8786	-84.1525	Good	121	Acceptable	-1
11	780225	Random	Looking Glass River	Morrice Road	42.8790	-84.1821	Marginal	87	Acceptable	2
12	780222	Random	Looking Glass River	Colby Lake Road	42.8669	-84.3246	Marginal	95	Acceptable	-3
13	190154	Targeted	Remey-Chandler	State Road	42.7852	-84.4904	Poor	43	Acceptable	-3
14	190155	Random	Remey-Chandler	Wood Road	42.8150	-84.5230	Marginal	65	Acceptable	0
15	190177	Targeted	Remey-Chandler	Howe Road	42.8421	-84.5364	Marginal	89	Acceptable	1
16	190083	Random	Looking Glass River	Dewitt Rd./Bridge Street	42.8398	-84.5692	Good	107	Acceptable	2
17	190133	Targeted	Looking Glass River	u/s SCC WWTP	42.8268	-84.5986	Marginal	103	Acceptable	3
18	190134	Targeted	Looking Glass River	d/s SCC WWTP	42.8270	-84.5981	Good	115	Acceptable	1
19	190156	Random	Summers Drive	Stoll Road	42.7987	-84.6380	Marginal	85	Acceptable	-3
20	190112	Targeted	Husted and Landenburg Drain	Clark Road	42.8141	-84.7495	Good	128	Acceptable	2
21	190152	Targeted	Moyer Drain	McCrum Road	42.8214	-84.8011	Good	137	Acceptable	0
22	190178	Random	Looking Glass River	Howe Road	42.8428	-84.7977	Good	126	Acceptable	3
23	190136	Targeted	Looking Glass River	Monroe Road	42.8487	-84.8275	Good	146	Excellent	7

Habitat Scoring

Poor < 56 Good 105-154 Marginal 56-104 Excellent >154

Macroinvertebrate Scoring

Poor < -4 Acceptable -4 to +4 Excellent > +4

Table 2a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Shiawassee and Clinton Counties, July and August, 2007.

	Station 1 Grub Drain @ Cork Road RIFFLE/RUN	Station 2 Unnamed Tributary to Looking Glass River @ Winegar Road GLIDE/POOL	Station 3 Clise Drain @ Cutler Road GLIDE/POOL	Station 4 Mud Creek @ Angle Road GLIDE/POOL
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover	10	5	1	6
Embeddedness*	8			
Velocity/Depth Regime*	14			
Pool Substrate Characterization**		10	6	10
Pool Variability**		5	1	2
Channel Morphology				
Sediment Deposition	7	5	4	5
Flow Status - Maint. Flow Volume	8	6	5	9
Flow Status - Flashiness	9	9	8	10
Channel Alteration	10	13	8	13
Frequency of Riffles/Bends*	16			
Channel Sinuosity**		10	1	17
Riparian and Bank Structure				
Bank Stability (L)	8	8	6	9
Bank Stability (R)	8	8	6	9
Vegetative Protection (L)	6	7	5	8
Vegetative Protection (R)	3	7	5	8
Riparian Veg. Zone Width (L)	4	8	2	10
Riparian Veg. Zone Width (R)	2	2	2	10
TOTAL SCORE (200):	113	103	60	126

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	7/31/2007	8/13/2007	8/13/2007	7/30/2007
Weather:	Sunny	Sunny	Sunny	Sunny
Air Temperature:	77 Deg. F.	75 Deg. F.	65 Deg. F.	85 Deg. F.
Water Temperature:	71 Deg. F.	70 Deg. F.	61 Deg. F.	81 Deg. F.
Ave. Stream Width:	7 Feet	2 Feet	5 Feet	5 Feet
Ave. Stream Depth:	0.5 Feet	0.17 Feet	0.25 Feet	0.5 Feet
Surface Velocity:	1.2 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	4.2 CFS	0.17 CFS	0.625 CFS	0.75 CFS
Stream Modifications:	Dredged, Canopy Removal, Snagging	Relocated	Dredged, Canopy Removal, Snagging	Dredged
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	780221	780230	190149	190153
Stream Name:	Grub Drain	Unnamed Trib to Looking Glass Riv	Clise Drain	Mud Creek
Road Crossing/Location:	Cork Road	Winegar Road	Cutler	Angle Road
County Code:	78	78	19	19
TRS:	05N03E19	05N01E02	06N01W32	05N01W09
Latitude (dd):	42.8252	42.85552	42.85304	42.83681
Longitude (dd):	-84.15	-84.30693	-84.45767	-84.43008
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 2b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Clinton and Shiawasee Counties, July and August 2007.

TAXA	Grub Drain @ Cork Road 7/31/2007 STATION 1	Unnamed Trib to Looking Glass River @ Winegar Road 8/13/2007 STATION 2	Clise Drain @ Cutler Road 8/13/2007 STATION 3	Mud Creek @ Angle Road 7/30/2007 STATION 4
PLATYHELMINTHES (flatworms)				
Turbellaria	2	2	15	1
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	9	11	
Oligochaeta (worms)		13	32	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	19	76	15	96
Decapoda (crayfish)	3	10		3
Isopoda (sowbugs)			14	
Arachnoidea				
Hydracarina			1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	1		21	
Caenidae			25	
Heptageniidae				3
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	3		
Libellulidae		4	2	10
Macromiidae			2	
Zygoptera (damselflies)				
Calopterygidae	11	11		7
Coenagrionidae			3	
Hemiptera (true bugs)				
Belostomatidae			1	1
Corixidae			38	5
Gerridae	1	1		
Notonectidae	1	6	1	1
Pleidae	1		2	1
Saldidae	1			
Veliidae			4	
Megaloptera				
Sialidae (alder flies)	2	12	1	22
Trichoptera (caddisflies)				
Helicopsychidae	9			
Hydropsychidae	65			
Leptoceridae	2			
Limnephilidae				3
Molannidae	1			1
Philopotamidae	1			
Coleoptera (beetles)				
Dytiscidae (total)	1	4	30	
Halplilidae (adults)	1	2	6	
Hydrophilidae (total)		1	1	
Scirtidae (adults)				2
Dryopidae	1	4		
Elmidae	35	1		5
Diptera (flies)				
Ceratopogonidae		1	1	1
Chironomidae	29	11	25	16
Tipulidae	2			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1		
Hydrobiidae	1	5	1	2
Lymnaeidae				4
Physidae	74	17	1	4
Planorbidae	8	1	1	5
Viviparidae	1	17		64
Pelecypoda (bivalves)				
Sphaeriidae (clams)	8	45	1	35
Unionidae (mussels)	1			
TOTAL INDIVIDUALS	284	257	255	293

Table 2c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Clinton and Shiawasee Counties, July and August 2007.

METRIC	Grub Drain @ Cork Road 7/31/2007 STATION 1		Unnamed Trib to Looking Glass River @ Winegar Road 8/13/2007 STATION 2		Clise Drain @ Cutler Road 8/13/2007 STATION 3		Mud Creek @ Angle Road 7/30/2007 STATION 4	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	1	24	1	26	1	24	1
NUMBER OF MAYFLY TAXA	1	0	0	-1	2	1	1	0
NUMBER OF CADDISFLY TAXA	5	1	0	-1	0	-1	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	0.35	-1	0.00	-1	18.04	0	1.02	-1
PERCENT CADDISFLY COMPOSITION	27.46	0	0.00	-1	0.00	-1	1.37	-1
PERCENT DOMINANT TAXON	26.06	0	29.57	0	14.90	1	32.76	0
PERCENT ISOPOD, SNAIL, LEECH	29.93	-1	19.46	-1	10.98	-1	26.96	-1
PERCENT SURFACE AIR BREATHERS	2.11	1	5.45	1	32.55	-1	3.41	1
TOTAL SCORE		0		-4		-2		-2
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 2d. Qualitative fish sampling results for Clise Drain, Looking Glass River Watershed, Clinton County, August, 2007.

TAXA	Clise Drain Cutler 8/13/2007 STATION 1
Umbridae (mudminnows)	
<i>Umbra limi</i> (Central mudminnow)	37
TOTAL INDIVIDUALS	37
Number of hybrid sunfish	0
Number of anomalies	0
Percent anomalies	0.000
Percent salmonids	0.000
Reach sampled (ft)	900
Area sampled (sq ft)	4,500
Density (# fish/sq ft)	0.008
Gear	bps

Table 2e. Fish metric evaluation for Clise Drain, Looking Glass River Watershed, Clinton County, August, 2007.

METRIC	Clise Drain Cutler 8/13/2007 STATION 1
	Value Score
TOTAL NUMBER OF TAXA	1
NO. OF DARTER, SCULPIN, MADTOM TAXA	0
NUMBER OF SUNFISH TAXA	0
NUMBER OF SUCKER TAXA	0
NUMBER OF INTOLERANT TAXA	0
PERCENT TOLERANT	100.00
PERCENT OMNIVOROUS TAXA	100.00
PERCENT INSECTIVOROUS TAXA	0.00
PERCENT PISCIVOROUS TAXA	0.00
% SIMPLE LITHOPHILIC SPAWNER TAXA	0.00
TOTAL SCORE	
FISH COMMUNITY RATING	POOR

Comments:
Sampling Time - 40 minutes

Table 3a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Shiawassee and Clinton Counties, July and August, 2007.

	Station 5 Kellogg Drain @ Winegar Road GLIDE/POOL	Station 6 Vermillion Creek @ Lansing Road (Old 78) GLIDE/POOL	Station 7 Vermillion Creek @ Peacock Rd GLIDE/POOL	Station 8 Vermillion Creek @ Cutler GLIDE/POOL
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover	5	4	5	7
Embeddedness*				
Velocity/Depth Regime*				
Pool Substrate Characterization**	10	7	6	8
Pool Variability**	5	12	14	10
Channel Morphology				
Sediment Deposition	5	5	5	14
Flow Status - Maint. Flow Volume	9	9	9	10
Flow Status - Flashiness	7	2	3	8
Channel Alteration	8	15	16	18
Frequency of Riffles/Bends*				
Channel Sinuosity**	5	13	16	15
Riparian and Bank Structure				
Bank Stability (L)	4	4	4	8
Bank Stability (R)	4	4	4	6
Vegetative Protection (L)	5	9	8	10
Vegetative Protection (R)	5	9	8	10
Riparian Veg. Zone Width (L)	4	9	9	10
Riparian Veg. Zone Width (R)	4	8	9	9
TOTAL SCORE (200):	80	110	116	143

HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/1/2007	8/1/2007	8/1/2007	7/30/2007
Weather:	Sunny	Partly Cloudy	Sunny	Sunny
Air Temperature:	95 Deg. F.	75 Deg. F.	80 Deg. F.	75 Deg. F.
Water Temperature:	81 Deg. F.	73 Deg. F.	72 Deg. F.	73 Deg. F.
Ave. Stream Width:	7 Feet	12 Feet	17 Feet	12 Feet
Ave. Stream Depth:	0.6 Feet	2 Feet	2 Feet	1 Feet
Surface Velocity:	0.7 Ft./Sec.	0.1 Ft./Sec.	0.1 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	2.94 CFS	2.4 CFS	3.4 CFS	1.2 CFS
Stream Modifications:	Dredged, Canopy Removal, Snagging	Dredged	None	Dredged
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	780154	780226	190132	190176
Stream Name:	Kellogg Drain	Vermillion Creek	Vermillion Creek	Vermillion Creek
Road Crossing/Location:	Winegar Road	Lansing Road (Old 78)	Peacock Road	Cutler Road
County Code:	78	78	19	19
TRS:	05N02E04	05N01E28	05N01W12	05N01W01
Latitude (dd):	42.85589	42.80146	42.8345	42.857132
Longitude (dd):	-84.22542	-84.33945	-84.3686	-84.366315
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Clinton and Shiawasee Counties, August 2007.

TAXA	Kellogg Drain @ Winegar Road 8/1/2007 STATION 5	Vermillion Creek @ Lansing Road (Old 78) 8/1/2007 STATION 6	Vermillion Creek @ Peacock Road 8/1/2007 STATION 7	Vermillion Creek @ Cutler Road 7/30/2007 STATION 8
PLATYHELMINTHES (flatworms)				
Turbellaria	1			6
ANNELIDA (segmented worms)				
Hirudinea (leeches)				7
Oligochaeta (worms)	2	1	10	10
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	8	40	11	135
Decapoda (crayfish)	1	3	1	1
Isopoda (sowbugs)		1		1
Arachnoidea				
Hydracarina	3			5
Insecta				
Ephemeroptera (mayflies)				
Baetidae	7		14	
Caenidae	20	16	4	7
Heptageniidae		16	4	
Leptophlebiidae			1	
Tricorythidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	2	1	1
Gomphidae	1	1	1	
Libellulidae				3
Zygoptera (damselflies)				
Calopterygidae	57		12	18
Coenagrionidae	81			28
Hemiptera (true bugs)				
Belostomatidae	6			2
Corixidae	3		16	36
Gelastocoridae	1			
Gerridae			1	
Nepidae	4			1
Notonectidae		3	55	3
Pleidae		1		5
Megaloptera				
Sialidae (alder flies)	5	11	2	2
Trichoptera (caddisflies)				
Helicopsychidae		1		
Hydropsychidae	1	3	9	3
Leptoceridae	12	10	10	3
Limnephilidae	1	2	15	1
Molannidae	1	5		
Philopotamidae		1	1	
Lepidoptera (moths)				
Pyalidae				1
Coleoptera (beetles)				
Dytiscidae (total)	2			13
Gyrinidae (adults)			1	
Halplidae (adults)	6	1		
Hydrophilidae (total)	1			
Dryopidae	3	7	24	4
Elmidae	7	81	15	13
Diptera (flies)				
Ceratopogonidae				5
Chironomidae	25	30	25	13
Culicidae	1			
Tabanidae		1		
Tipulidae		2	2	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	2	1	2	
Hydrobiidae	2	1	4	
Lymnaeidae			1	
Physidae	6	23	1	1
Planorbidae	13	3		
Viviparidae	7			
Pelecypoda (bivalves)				
Pisidiidae	2			
Sphaeriidae (clams)	15	1	9	1
TOTAL INDIVIDUALS	310	268	252	329

Table 3c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Clinton and Shiawasee Counties, August 2007.

METRIC	Kellogg Drain @ Winegar Road 8/1/2007 STATION 5		Vermillion Creek @ Lansing Road (Old 78) 8/1/2007 STATION 6		Vermillion Creek @ Peacock Road 8/1/2007 STATION 7		Vermillion Creek @ Cutler Road 7/30/2007 STATION 8	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	35	1	28	1	28	1	29	1
NUMBER OF MAYFLY TAXA	3	1	2	0	4	1	1	-1
NUMBER OF CADDISFLY TAXA	4	0	6	1	4	0	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	9.03	0	11.94	0	9.13	0	2.13	-1
PERCENT CADDISFLY COMPOSITION	4.84	0	8.21	0	13.89	0	2.13	-1
PERCENT DOMINANT TAXON	26.13	0	30.22	0	21.83	0	41.03	-1
PERCENT ISOPOD, SNAIL, LEECH	9.68	0	10.82	-1	3.17	1	2.74	1
PERCENT SURFACE AIR BREATHERS	7.74	0	1.87	1	28.97	-1	18.24	0
TOTAL SCORE		1		1		1		-3
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 4a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Shiawassee County, July and August, 2007.

	Station 9 Looking Glass River @ Godfrey Road RIFFLE/RUN	Station 10 Looking Glass River @ Cork Road GLIDE/POOL	Station 11 Looking Glass River @ Morris Road RIFFLE/RUN	Station 12 Looking Glass River @ Colby Lake Road GLIDE/POOL
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover	10	13	6	3
Embeddedness*	10		3	
Velocity/Depth Regime*	10		11	
Pool Substrate Characterization**		9		6
Pool Variability**		10		5
Channel Morphology				
Sediment Deposition	15	10	5	5
Flow Status - Maint. Flow Volume	7	9	7	9
Flow Status - Flashiness	1	2	5	5
Channel Alteration	12	15	11	15
Frequency of Riffles/Bends*	2		5	
Channel Sinuosity**		8		13
Riparian and Bank Structure				
Bank Stability (L)	2	5	6	4
Bank Stability (R)	2	4	3	5
Vegetative Protection (L)	7	8	9	9
Vegetative Protection (R)	7	8	4	4
Riparian Veg. Zone Width (L)	8	10	9	3
Riparian Veg. Zone Width (R)	3	10	3	9
TOTAL SCORE (200):	96	121	87	95

HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	7/31/2007	7/31/2007	7/31/2007	8/1/2007
Weather:	Sunny	Sunny	Sunny	Sunny
Air Temperature:	77 Deg. F.	81 Deg. F.	84 Deg. F.	85 Deg. F.
Water Temperature:	69 Deg. F.	73 Deg. F.	74 Deg. F.	Deg. F.
Ave. Stream Width:	8 Feet	15 Feet	20 Feet	23 Feet
Ave. Stream Depth:	0.3 Feet	1.5 Feet	1 Feet	3 Feet
Surface Velocity:	1 Ft./Sec.	0.1 Ft./Sec.	1 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	2.4 CFS	2.25 CFS	20 CFS	6.9 CFS
Stream Modifications:	Dredged	Dredged	Relocated	No Dredging
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	780223	780231	780225	780222
Stream Name:	Looking Glass River	Looking Glass River	Looking Glass River	Looking Glass River
Road Crossing/Location:	Godfrey Road	Cork Road	Morris Road	Colby Lake Road
County Code:	78	78	78	78
TRS:	05N03E21	06N03E31	06N02E26	06N01E34
Latitude (dd):	42.84186	42.8786	42.87882	42.8669
Longitude (dd):	-84.11173	-84.15253	-84.18219	-84.3246
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 4b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Shiawase County, July and August 2007.

TAXA	Looking Glass River @ Godfrey Road 7/31/2007 STATION 9	Looking Glass River @ Cork Road 7/31/2007 STATION 10	Looking Glass River @ Morris Road 7/31/2007 STATION 11	Looking Glass River @ Colby Lake Road 8/1/2007 STATION 12
PORIFERA (sponges)				2
PLATYHELMINTHES (flatworms)				
Turbellaria	2			
BRYOZOA (moss animals)	1			1
ANNELIDA (segmented worms)				
Oligochaeta (worms)		2	7	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	37	98	70	189
Decapoda (crayfish)	7	7	1	
Arachnoidea				
Hydracarina				2
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae				1
Baetidae	1		9	3
Caenidae		2		
Ephemeridae		1		
Heptageniidae	8	9	8	1
Tricorythidae			1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		1	2	
Gomphidae	1		1	
Libellulidae	1		1	1
Zygoptera (damselflies)				
Calopterygidae	6	9	23	1
Hemiptera (true bugs)				
Belostomatidae			1	4
Corixidae	9	17	2	36
Gerridae		1	1	
Nepidae		1		1
Notonectidae			1	1
Pleidae				12
Saldidae				5
Veliidae				3
Megaloptera				
Sialidae (alder flies)	1	10	1	4
Trichoptera (caddisflies)				
Brachycentridae	1		1	
Helicopsychidae	10	1	4	
Hydropsychidae	14	3	37	1
Leptoceridae	5	5	6	2
Limnephilidae		10	3	1
Molannidae			1	
Philopotamidae			1	
Phryganeidae	1			
Polycentropodidae				1
Uenoidae			1	
Coleoptera (beetles)				
Dytiscidae (total)				13
Gyrinidae (adults)			2	
Haliplidae (adults)				1
Dryopidae	6	2	7	1
Elmidae	11	20	11	4
Diptera (flies)				
Chironomidae	20	8	38	10
Culicidae		4		1
Simuliidae			25	
Tabanidae	1	3	2	
Tipulidae	4			
MOLLUSCA				
Gastropoda (snails)				
Ancyliidae (limpets)			9	1
Hydrobiidae		1		
Physidae		5	13	3
Planorbidae			2	
Viviparidae		6	4	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	23	12	28	
TOTAL INDIVIDUALS	170	238	324	307

Table 4c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Shiawasee County, July and August 2007.

METRIC	Looking Glass River @ Godfrey Road 7/31/2007 STATION 12		Looking Glass River @ Cork Road 7/31/2007 STATION 13		Looking Glass River @ Morris Road 7/31/2007 STATION 14		Looking Glass River @ Colby Lake Road 8/1/2007 STATION 15	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	22	0	25	1	34	1	30
NUMBER OF MAYFLY TAXA	2	0	3	0	3	0	3	0
NUMBER OF CADDISFLY TAXA	5	1	4	0	8	1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	5.29	0	5.04	0	5.56	0	1.63	-1
PERCENT CADDISFLY COMPOSITION	18.24	0	7.98	0	16.67	0	1.63	-1
PERCENT DOMINANT TAXON	21.76	0	41.18	-1	21.60	0	61.56	-1
PERCENT ISOPOD, SNAIL, LEECH	0.00	1	5.04	0	8.64	0	1.30	1
PERCENT SURFACE AIR BREATHERS	5.29	1	9.66	0	2.16	1	25.08	-1
TOTAL SCORE		2		-1		2		-3
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 5a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Clinton County, August, 2007.

	Station 13 Remy-Chandler Drain @ State Road GLIDE/POOL	Station 14 Remy-Chandler Drain @ Wood Road GLIDE/POOL	Station 15 Remy-Chandler Drain @ Howe Road RIFFLE/RUN
HABITAT METRIC			
Substrate and Instream Cover			
Epifaunal Substrate/ Avail Cover	2	3	9
Embeddedness*			6
Velocity/Depth Regime*			16
Pool Substrate Characterization**	7	8	
Pool Variability**	2	6	
Channel Morphology			
Sediment Deposition	2	5	17
Flow Status - Maint. Flow Volume	3	6	9
Flow Status - Flashiness	6	7	5
Channel Alteration	5	3	5
Frequency of Riffles/Bends*			6
Channel Sinuosity**	1	5	
Riparian and Bank Structure			
Bank Stability (L)	4	4	3
Bank Stability (R)	4	4	5
Vegetative Protection (L)	2	4	2
Vegetative Protection (R)	2	4	2
Riparian Veg. Zone Width (L)	2	3	2
Riparian Veg. Zone Width (R)	1	3	2
TOTAL SCORE (200):	43	65	89

HABITAT RATING:	POOR (SEVERELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

	8/2/2007	8/2/2007	8/14/2007
Date:	8/2/2007	8/2/2007	8/14/2007
Weather:	Sunny	Partly Cloudy	Cloudy
Air Temperature:	90 Deg. F.	95 Deg. F.	65 Deg. F.
Water Temperature:	82 Deg. F.	79 Deg. F.	78 Deg. F.
Ave. Stream Width:	11 Feet	15 Feet	10 Feet
Ave. Stream Depth:	0.5 Feet	0.7 Feet	0.75 Feet
Surface Velocity:	0.2 Ft./Sec.	0.25 Ft./Sec.	1.25 Ft./Sec.
Estimated Flow:	1.1 CFS	2.625 CFS	9.375 CFS
		Dredged, Canopy Removal, Snagging, Relocated, Bank	Dredged, Canopy Removal, Snagging, Impounded, Bank
Stream Modifications:	Dredged,Canopy Removal,Snagging,Re located, Bank Stabilization	Stabilization	Stabilization
Nuisance Plants (Y/N):	N	N	N
Report Number:			
STORET No.:	190154	190155	190177
Stream Name:	Remy-Chandler Drain	Remy-Chandler Drain	Remy-Chandler Drain
Road Crossing/Location:	State Road	Wood Road	Howe Road
County Code:	19	19	19
TRS:	05N02W25	05N02W15	05N02W03
Latitude (dd):	42.78524	42.815	42.842134
Longitude (dd):	-84.49041	-84.523	-84.536389
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 5b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

TAXA	Remy-Chandler Drain @ State Road 8/2/2007 STATION 13	Remy-Chandler Drain @ Wood Road 8/2/2007 STATION 14	Remy-Chandler Drain @ Howe Road 8/14/2007 STATION 15
PLATYHELMINTHES (flatworms)			
Turbellaria	2	5	8
ANNELIDA (segmented worms)			
Hirudinea (leeches)			1
Oligochaeta (worms)	15	25	
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	1	24	2
Decapoda (crayfish)	1	1	1
Isopoda (sowbugs)	1		
Arachnoidea			
Hydracarina		1	1
Insecta			
Ephemeroptera (mayflies)			
Baetidae	5	13	11
Caenidae	23	44	
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	1	
Libellulidae	1		1
Zygoptera (damselflies)			
Calopterygidae		1	39
Coenagrionidae	159	84	26
Lestidae			1
Hemiptera (true bugs)			
Belostomatidae	6	1	1
Corixidae	13	5	
Gerridae		1	1
Nepidae	1	1	1
Notonectidae		1	
Pleidae	1	1	1
Saldidae			2
Veliidae		1	1
Trichoptera (caddisflies)			
Helicopsychidae			1
Hydropsychidae		1	26
Hydroptilidae			1
Leptoceridae	1	1	10
Philopotamidae			9
Polycentropodidae			6
Lepidoptera (moths)			
Pyrilidae			1
Coleoptera (beetles)			
Dytiscidae (total)		1	1
Haliplidae (adults)	26	20	5
Hydrophilidae (total)	7	1	2
Scirtidae (adults)		1	
Elmidae	5	31	3
Diptera (flies)			
Ceratopogonidae	1		
Chironomidae	56	69	92
Simuliidae			6
Tipulidae	1		4
MOLLUSCA			
Gastropoda (snails)			
Physidae	2	6	25
Planorbidae	1	1	7
Viviparidae	1		
Pelecypoda (bivalves)			
Sphaeriidae (clams)			1
Unionidae (mussels)		1	
TOTAL INDIVIDUALS	331	343	298

Table 5c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

METRIC	Remy-Chandler Drain @ State Road 8/2/2007 STATION 13		Remy-Chandler Drain @ Wood Road 8/2/2007 STATION 14		Remy-Chandler Drain @ Howe Road 8/14/2007 STATION 15	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	24	0	28	1	33	1
NUMBER OF MAYFLY TAXA	2	0	2	0	1	0
NUMBER OF CADDISFLY TAXA	1	-1	2	0	6	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	8.46	0	16.62	0	3.69	0
PERCENT CADDISFLY COMPOSITION	0.30	-1	0.58	-1	17.79	0
PERCENT DOMINANT TAXON	48.04	-1	24.49	0	30.87	0
PERCENT ISOPOD, SNAIL, LEECH	1.51	1	2.04	1	11.07	-1
PERCENT SURFACE AIR BREATHERS	16.31	0	9.91	0	5.03	1
TOTAL SCORE		-3		0		1
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 6a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Clinton County, August, 2007.

	Station 16 Looking Glass River @ Dewitt Road (Bridge Street) GLIDE/POOL	Station 17 Looking Glass River @ u/s Southern Clinton Co WWTP GLIDE/POOL	Station 18 Looking Glass River @ d/s Southern Clinton Co WWTP GLIDE/POOL	Station 19 Summers Drain @ Stoll Road GLIDE/POOL
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover Embeddedness*	13	10	12	5
Velocity/Depth Regime*				
Pool Substrate Characterization**	16	8	11	9
Pool Variability**	13	6	6	6
Channel Morphology				
Sediment Deposition	10	9	11	9
Flow Status - Maint. Flow Volume	7	7	7	5
Flow Status - Flashiness	4	5	5	9
Channel Alteration	13	16	16	7
Frequency of Riffles/Bends*				
Channel Sinuosity**	8	12	12	5
Riparian and Bank Structure				
Bank Stability (L)	6	7	5	8
Bank Stability (R)	4	6	6	8
Vegetative Protection (L)	5	6	3	3
Vegetative Protection (R)	3	3	9	5
Riparian Veg. Zone Width (L)	4	3	3	2
Riparian Veg. Zone Width (R)	1	5	9	4
TOTAL SCORE (200):	107	103	115	85

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/2/2007	8/3/2007	8/3/2007	8/3/2007
Weather:	Partly Cloudy	Sunny	Sunny	Sunny
Air Temperature:	95 Deg. F.	80 Deg. F.	80 Deg. F.	72 Deg. F.
Water Temperature:	80 Deg. F.	75 Deg. F.	72 Deg. F.	61 Deg. F.
Ave. Stream Width:	40 Feet	35 Feet	35 Feet	3 Feet
Ave. Stream Depth:	3 Feet	2 Feet	3 Feet	0.33 Feet
Surface Velocity:	0.6 Ft./Sec.	0.9 Ft./Sec.	1 Ft./Sec.	0.5 Ft./Sec.
Estimated Flow:	72 CFS	63 CFS	105 CFS	0.495 CFS
Stream Modifications:	Canopy Removal	Canopy Removal	Canopy Removal	Dredged, Canopy Removal, Relocated
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	190104	190133	190134	190156
Stream Name:	Looking Glass River	Looking Glass River	Looking Glass River	Summers Drain
Road Crossing/Location:	Dewitt Road (Bridge Street)	u/s Southern Clinton Co WWTP	d/s Southern Clinton Co WWTP	Stoll Road
County Code:	19	19	19	19
TRS:	05N02W08	05N02W18	05N02W18	05N03W23
Latitude (dd):	42.8398	42.8268	42.827	42.79885
Longitude (dd):	-84.5692	-84.5986	-84.5981	-84.63851
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys
 ** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 6b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

TAXA	Looking Glass River @ Dewitt Road (Bridge Street) 8/2/2007 STATION 16	Looking Glass River @ u/s Southern Clinton Co WWTP 8/3/2007 STATION 17	Looking Glass River @ d/s Southern Clinton Co WWTP 8/3/2007 STATION 18	Summers Drain @ Stoll Road 8/3/2007 STATION 19
PORIFERA (sponges)			1	
PLATYHELMINTHES (flatworms)				
Turbellaria	1		7	5
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		1
Oligochaeta (worms)		7	16	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	113	35	6	1
Decapoda (crayfish)	1		1	
Isopoda (sowbugs)		15		212
Arachnoidea				
Hydracarina		3		2
Insecta				
Ephemeroptera (mayflies)				
Baetidae	20	4	2	
Caenidae	2	2		
Heptageniidae	6	8	5	
Tricorythidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshmidae	1	1		1
Gomphidae			1	
Libellulidae		1		
Zygoptera (damselflies)				
Calopterygidae	1		1	
Coenagrionidae	17	1	3	4
Plecoptera (stoneflies)				
Perlidae		2		
Hemiptera (true bugs)				
Belostomatidae	1		2	
Corixidae	5	14	1	1
Gerridae	1		1	
Notonectidae	2	1		1
Pleidae		1	2	
Saldidae				1
Megaloptera				
Sialidae (alder flies)	1	7		
Trichoptera (caddisflies)				
Brachycentridae	1	3	7	
Hydropsychidae	5	10	23	2
Hydroptilidae				1
Leptoceridae	9	1	4	1
Limnephilidae	1	1		
Philopotamidae	1	2	1	2
Polycentropodidae	14	4	25	
Uenoidae		1	3	
Lepidoptera (moths)				
Pyalidae			1	
Coleoptera (beetles)				
Dytiscidae (total)				1
Gyrinidae (adults)	2			
Halpiidae (adults)	4			4
Psephenidae (adults)		1		
Scirtidae (adults)	1		4	
Dryopidae		4		
Elmidae	16	10	11	5
Diptera (flies)				
Ceratopogonidae	1			
Chironomidae	20	94	144	15
Culicidae		1		1
Dixidae			1	
Simuliidae	10		2	1
Tabanidae	1			1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	3	1	1	
Hydrobiidae	5	1	2	
Lymnaeidae		20	2	1
Physidae	3	10	2	8
Planorbidae	1	4	1	1
Pleuroceridae			1	
Pelecypoda (bivalves)				
Pisidiidae	1			
Sphaeriidae (clams)	6	18	1	2
Unionidae (mussels)	1		1	
TOTAL INDIVIDUALS	280	289	286	279

Table 6c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

METRIC	Looking Glass River @ Dewitt Road (Bridge Street) 8/2/2007 STATION 16		Looking Glass River @ u/s Southern Clinton Co WWTP 8/3/2007 STATION 17		Looking Glass River @ d/s Southern Clinton Co WWTP 8/3/2007 STATION 18		Summers Drain @ Stoll Road 8/3/2007 STATION 19	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	37	1	34	1	34	1	26	1
NUMBER OF MAYFLY TAXA	4	1	3	0	2	0	0	-1
NUMBER OF CADDISFLY TAXA	6	1	7	1	6	1	4	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	10.36	0	4.84	0	2.45	-1	0.00	-1
PERCENT CADDISFLY COMPOSITION	11.07	0	7.61	0	22.03	0	2.15	-1
PERCENT DOMINANT TAXON	40.36	-1	32.53	0	50.35	-1	75.99	-1
PERCENT ISOPOD, SNAIL, LEECH	4.64	0	17.99	-1	3.15	1	79.93	-1
PERCENT SURFACE AIR BREATHERS	5.71	1	6.23	1	3.50	1	3.23	1
TOTAL SCORE		2		3		1		-3
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 7a. Habitat evaluation for selected stations in the Looking Glass River Watershed, Clinton County, August, 2007.

	Station 20 Husted-Landenburg Drain @ Clark Road RIFFLE/RUN	Station 21 Moyer Drain @ McCrumb Road RIFFLE/RUN	Station 22 Looking Glass River @ Howe Road RIFFLE/RUN	Station 23 Looking Glass River @ Monroe Road RIFFLE/RUN
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover	13	10	15	18
Embeddedness*	13	12	10	13
Velocity/Depth Regime*	14	11	10	16
Pool Substrate Characterization**				
Pool Variability**				
Channel Morphology				
Sediment Deposition	17	14	10	10
Flow Status - Maint. Flow Volume	6	5	7	8
Flow Status - Flashiness	3	9	6	8
Channel Alteration	13	18	15	15
Frequency of Riffles/Bends*	18	8	11	18
Channel Sinuosity**				
Riparian and Bank Structure				
Bank Stability (L)	5	7	8	4
Bank Stability (R)	5	7	8	7
Vegetative Protection (L)	7	9	9	9
Vegetative Protection (R)	5	9	4	6
Riparian Veg. Zone Width (L)	4	9	10	9
Riparian Veg. Zone Width (R)	5	9	3	5
TOTAL SCORE (200):	128	137	126	146

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/14/2007	8/14/2007	8/15/2007	8/15/2007
Weather:	Sunny	Partly Cloudy	Partly Cloudy	Cloudy
Air Temperature:	82 Deg. F.	75 Deg. F.	70 Deg. F.	75 Deg. F.
Water Temperature:	68 Deg. F.	66 Deg. F.	71 Deg. F.	73 Deg. F.
Ave. Stream Width:	12 Feet	5 Feet	85 Feet	35 Feet
Ave. Stream Depth:	0.33 Feet	0.5 Feet	1.5 Feet	2 Feet
Surface Velocity:	0.8 Ft./Sec.	0.5 Ft./Sec.	0.7 Ft./Sec.	1.3 Ft./Sec.
Estimated Flow:	3.168 CFS	1.25 CFS	89.25 CFS	91 CFS
Stream Modifications:	Dredged, Relocated	None	None	Canopy Removal
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	190112	190152	190178	190136
Stream Name:	ndenburg Drain	Moyer Drain	Looking Glass River	Looking Glass River
Road Crossing/Location:	Clark Rd	McCrumb	Howe Road	Monroe Rd
County Code:	19	19	19	19
TRS:	05N04W23	05N04W17	05N04W09	05N04W06
Latitude (dd):	42.81361	42.82121	42.84301	42.8487
Longitude (dd):	-84.7489	-84.80112	-84.79909	-84.8275
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 7b. Qualitative macroinvertebrate sampling results for selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

TAXA	Husted-Landenburg Drain @ Clark Road 8/14/2007 STATION 20	Moyer Drain @ McCrumb Road 8/14/2007 STATION 21	Looking Glass River @ Howe Road 8/15/2007 STATION 22	Looking Glass River @ Monroe Road 8/15/2007 STATION 23
PLATYHELMINTHES (flatworms)				
Turbellaria			1	3
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1		1	
Oligochaeta (worms)		8	7	5
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	16	1	13	3
Decapoda (crayfish)	7	1	2	1
Isopoda (sowbugs)	12	1	27	12
Arachnoidea				
Hydracarina		3	1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	1		1	13
Caenidae			4	1
Ephemerellidae			4	31
Ephemeridae			2	1
Heptageniidae	8	1	11	10
Isonychiidae			4	15
Potamanthidae			1	
Tricorythidae			11	10
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	4	1	
Gomphidae				1
Zygoptera (damselflies)				
Calopterygidae	24	12	12	20
Coenagrionidae		7		2
Plecoptera (stoneflies)				
Perlidae			2	5
Pteronarcyidae			1	
Hemiptera (true bugs)				
Belostomatidae				1
Corixidae	1		9	10
Gerridae	1	1	1	4
Nepidae	1		5	
Notonectidae			1	1
Megaloptera				
Corydalidae (dobson flies)	3			
Sialidae (alder flies)	3		2	
Neuroptera (spongilla flies)				
Sisyridae			1	
Trichoptera (caddisflies)				
Brachycentridae			1	4
Glossosomatidae	1		2	
Helicopsychidae			7	1
Hydropsychidae	8	8	8	42
Hydroptilidae		1		6
Lepidostomatidae				1
Leptoceridae	10	8	5	9
Limnephilidae		1	1	
Molannidae	1	17		
Philopotamidae	9			
Polycentropodidae	2		3	4
Psychomyiidae	1			
Uenoidae			3	1
Coleoptera (beetles)				
Gyrinidae (adults)				1
Haliphidae (adults)				1
Hydrophilidae (total)		4		
Psephenidae (adults)			5	
Dryopidae	1	1	4	2
Elmidae	70	48	62	34
Diptera (flies)				
Athericidae	3			
Ceratopogonidae		2		1
Chironomidae	11	59	10	33
Culicidae			1	1
Simuliidae	3		1	11
Tabanidae	2	4	2	3
Tipulidae				1
MOLLUSCA				
Gastropoda (snails)				
Hydrobiidae				1
Physidae	3	53	1	6
Planorbidae		8	1	
Pleuroceridae			1	
Viviparidae			3	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	3	4	23	
Unionidae (mussels)	1		1	1
TOTAL INDIVIDUALS	208	257	270	313

Table 7c. Macroinvertebrate metric evaluation of selected streams in the Looking Glass River Watershed, Clinton County, August 2007.

METRIC	Husted-Landenburg Drain @ Clark Road 8/14/2007 STATION 20		Moyer Drain @ McCrumb Road 8/14/2007 STATION 21		Looking Glass River @ Howe Road 8/15/2007 STATION 22		Looking Glass River @ Monroe Road 8/15/2007 STATION 23	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	1	24	1	46	1	41	1
NUMBER OF MAYFLY TAXA	2	0	1	0	8	1	7	1
NUMBER OF CADDISFLY TAXA	7	1	5	1	8	1	8	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	2	1	1	1
PERCENT MAYFLY COMPOSITION	4.33	0	0.39	-1	14.07	0	25.88	1
PERCENT CADDISFLY COMPOSITION	15.38	0	13.62	0	11.11	0	21.73	0
PERCENT DOMINANT TAXON	33.65	0	22.96	0	22.96	0	13.42	1
PERCENT ISOPOD, SNAIL, LEECH	7.69	0	24.12	-1	12.59	-1	6.07	0
PERCENT SURFACE AIR BREATHERS	1.44	1	1.95	1	8.15	0	6.07	1
TOTAL SCORE		2		0		3		7
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		EXCELLENT

Table 8. Water sample analysis results for selected stations in the Looking Glass River watershed, Clinton County, MI, August 2007

		Looking Glass River @ upstream of SCC WWTP	Moyer Drain @ downstream I-96
Date		08/03/2007	08/14/2007
Storet #		190133	190183
Biosurvey Station		Station 17	Station SV-1
Arsenic, Total	µg/L	2.7	< 1
Barium, Total	µg/L	84	33
Cadmium, Total	µg/L	< 0.2	< 0.2
Calcium, Total	mg/L	82.3	90.3
Chromium, Total	µg/L	< 1	< 1
Copper, Total	µg/L	< 1	< 1
Lead, Total	µg/L	< 1	< 1
Magnesium, Total	mg/L	29.8	25.4
Mercury, Total	µg/L	<0.2	<0.2
Nitrogen, Total Kjeldahl	mg N/L	--	0.24
Selenium, Total	µg/L	< 1	1.8
Silver, Total	µg/L	< 0.2	< 0.2
Zinc, Total	µg/L	< 10	< 10
Phosphorus, Total	mg/L	0.06	0.04
Hardness-Calculated	mg/L	328	330

-- Not analyzed

All stations meeting WQS