Newton Creek and Hog Island Inlet
Post-remediation Assessment

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By Joe Graham and Craig Roesler

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1 Introduction

Newton Creek is a small, first order stream in Superior, Wisconsin. Hog Island Inlet is an embayment of the St. Louis River estuary, and is located at the mouth of Newton Creek (Figure 1). The creek and inlet receive the wastewater effluent from the Murphy Oil refinery (now Calumet Superior, LLC). Inadequate treatment of wastewater and spills at the refinery resulted in petroleum contamination of the creek and inlet. Biological surveys in 1972 found that Newton Creek was only inhabited by "sludge worms", with no survival of fish and other higher aquatic life forms (WDNR 1972). The benthic macroinvertebrate community in portions of Hog Island Inlet were severely impaired (WDNR 1995).

Substantial changes have been made since then. Significant improvements to wastewater treatment and spill containment at the refinery were completed. Remedial actions were performed to remove contaminated sediment from Newton Creek and Hog Island Inlet. Habitat improvement work was also done for the creek and inlet.

Newton Creek and Hog Island Inlet were added to the 303(d) list of impaired waters in 1998 for chronic aquatic toxicity impairments caused by PAH's, unspecified metals, and foams/flocs/scums/oil slicks. Additionally, a degraded benthic community was used as a basis for remedial action and 303(d) listing. The 1998 listing is based on pre-remediation conditions. Monitoring has been ongoing since 2006 to determine the current conditions, and allow evaluation of improvements.

Objectives of this assessment report are to:

- Review the findings of recent water quality, biological and sediment monitoring.
- Determine if the water body is "impaired" or if water quality standards are being met and the currently appropriate 303(d) listing status.
- Evaluate current sediment quality to determine if remediation goals are still met.
- Meet reporting requirements for EPA performance measure SP-12 special project monitoring.

2 Background Information

Newton Creek has a 1.5 mi^2 (4 km^2) drainage area. It drains a small wetland area just west of the refinery, but the majority of the flow in the creek originates from treated process wastewater discharges from the refinery with an average discharge flow rate of about 0.48 cfs. These discharges are regulated under WPDES Permit No. WI-0003085. Naturally occurring $Q_{7,2}$ and $Q_{7,10}$ flows are estimated to be zero (USGS 1979). The creek also receives stormwater runoff from the refinery and industrial and residential areas in the City of Superior. The creek flows northeast approximately 1.8 miles before emptying into Hog Island Inlet. Newton Creek was also historically affected by combined sewer overflows (CSO) until about 1980. CSO outfalls to the creek were eliminated with the construction of combined sewer treatment plants in the City of Superior (Romans 2011).

Hog Island Inlet is a sheltered, 18 acre shallow-water bay and wetland area on the southeastern side of Superior Bay. The inlet and Superior Bay are part of the St. Louis River estuary. Hog Island was created by the placement of dredged sediment in 1920's or 1930's, which left a narrow connection between the inlet and Superior Bay.

Newton Creek and Hog Island Inlet are located within the St. Louis River Area of Concern (AOC), designated through the Great Lakes Water Quality Agreement Update of 1987. Beneficial Use Impairments (BUIs) to the creek and inlet include those common in other areas within the AOC, such as loss of fish and wildlife habitat, degradation of fish and wildlife populations, and degraded benthos (NOAA 2011).

Several studies have documented the contamination of Newton Creek and Hog Island Inlet with diesel range organics (DRO), polycyclic aromatic hydrocarbons (PAHs), and metals (WDNR 1995, WDNR 1999, SEH 2000, SEH 2003, and others). In 1993-94 the Wisconsin Dept. of Natural Resources (WDNR) characterized sediment contamination within Newton Creek and Hog Island Inlet and concluded that there were severe ecological impairments due to petroleum contaminated sediments and identified individual effect levels for DRO and lead. Preliminary recommendations for sediment remediation for the creek and inlet were made.

Further studies evaluated human health concerns and determined that exposure to PAH-contaminated sediments and suspended sediments in the water column posed a slightly elevated carcinogenic risk to swimmers (SEH 2003). These further studies also confirmed the earlier findings of ecological impairments. Bioassays and benthic community sampling demonstrated acute and chronic toxicity, with a high likelihood of ecological risks and significant impacts to aquatic life in Newton Creek and water near its mouth in Hog Island Inlet.

In addition to DRO and PAHs, pollutants of concern included other petroleum byproducts (oils and grease) and metals (lead, chromium and mercury). Foams, flocs, and oil sheens

further contributed to degraded aesthetics. As a result of impairments, Newton Creek and Hog Island Inlet were added to the EPA list of impaired waters (303d List) for chronic aquatic toxicity (Table 1) in April, 1998.

WDNR divided Newton Creek into 12 segments, identified as Segments A through L, to organize site characterization and clean-up efforts (Figure 2). Murphy Oil agreed to clean up the refinery's impoundment and Segment A under a Memorandum of Understanding with WDNR. Murphy completed this work in 1997. Murphy Oil also installed a new wastewater treatment plant in 1995, and added an engineered wetland treatment unit in 2004.

Murphy Oil's efforts were followed by the interim remedial action (i.e. clean-up) on Segments B through K of Newton Creek in the summers of 2003 and 2004. During July – September of 2003 7,300 tons of contaminated creek sediment and adjacent floodplain soils were removed. In the summer of 2004 an additional 100 tons of sediment were removed from 200 feet of culvert beneath the BNSF railroad line. A chemical specific clean-up concentration was not used as the basis for the interim remedial action in Segments B through K. Instead, sediments that were visually contaminated with petroleum products were targeted for removal. The clean-up was jointly funded by the Wisconsin Coastal Management Program, U.S. EPA Great Lakes National Program Office (GLNPO), Wisconsin Great Lakes Harbors and Bays Fund and WDNRs' Environmental Repair Fund.

The final phase of the cleanup occurred between July and November, 2005, with removal of contaminated sediment from Segment L of Newton Creek and approximately fifteen acres of Hog Island Inlet. A site-specific remediation target concentration of 2,600 ug/kg PAH was used in the cleanup of Segment L and Hog Island Inlet. This project was the first in all the Great Lakes States to be completed using Great Lakes Legacy Act funding. Approximately, 60,520 tons of contaminated sediment were removed from Newton Creek and Hog Island Inlet in this final phase.

Post-remediation monitoring of Newton Creek and Hog Island Inlet was conducted in June, 2006 (SEH 2007). The monitoring included analyses of water, sediment, and benthic macroinvertebrates. Sediment toxicity testing for the inlet and several segments of Newton Creek were also done (Figure 3). Residual contamination at culverts and floodplain areas were mapped (Figure 4). Monitoring results showed that cleanup targets for PAH were met and the sediment did not appear to pose unacceptable risks to human health or the environment. Macroinvertebrate results indicated positive steps toward recovery. However, a hard clay substrate was left in Hog Island Inlet following removal of contaminated sediment. It appeared that more time would be required to develop a more typical substrate, with fine sediment and organic matter, before the macroinvertebrates in Hog Island Inlet could fully recover (Schmude, 2006).

Since the biological community did not appear to be fully recovered shortly following the cleanup of contaminated sediments, additional monitoring was done to document the progress of biological recovery. Monitoring was conducted during 2008-2011 to assess

Newton Creek and Hog Island Inlet for continued biological recovery. Monitoring included sampling of water, sediment, and macroinvertebrates, along with surveys of the fish community, and Hog Island Inlet aquatic macrophytes. Additional sediment chemistry and toxicity samples were collected from Newton Creek in 2012 and a Hog Island Inlet aquatic macrophyte survey was conducted in 2014.

A habitat restoration plan for Hog Island Inlet was developed in 2007. Portions of this plan were implemented by Douglas County in 2009-2011, and included invasive species control, aquatic habitat structures, as well as restoration of riparian buffers and native wetland vegetation. More information about this project can be found on the Lake Superior Research Institute's website at http://www.uwsuper.edu/lsri/hogisland/index.cfm .

3 Evaluation of Monitoring Results and Discussion

3.1 Newton Creek

3.1.1 Water Quality

Newton Creek was monitored for water quality at two sites (Figure 5) on 11 dates during 2008-2011 (Table 2). Field parameters were measured at five additional sites on one date in 2010 (Table 2).

Mean total phosphorus (TP) concentrations at the two sites (278 and 216 ug/l) greatly exceeded the 75 ug/l stream standard, so it is highly likely the standard is being exceeded. However, the monthly May to October samples needed for WisCALM assessment were not collected. Collection of the necessary monthly samples is underway for 2015. Calumet Superior LLC is currently on a nine year compliance schedule to reduce their wastewater effluent TP concentration to 75 ug/l.

Mean total nitrogen (TN) concentrations (total Kjeldahl nitrogen and nitrate plus nitrite nitrogen) at the two sites are high (6.4 and 5.1 mg/l). Nitrate plus nitrite-N concentrations as high as 14.3-17.5 mg/l were found on one date. Ammonia concentrations are below acute and chronic toxicity levels.

Conductivity is also high. Mean conductivity levels at the two sites were 962 and 880 umhos/cm.

Dissolved oxygen (D.O.) concentrations at all sites on all dates exceeded 5 mg/l. All D.O. measurements are daytime values. There may be some nocturnal depression of D.O. concentrations due to respiration by filamentous algae, which are abundant in Newton Creek during the summer (Photo 1).

Photo 1: Filamentous algae growth in Newton Creek on May 16th, 2012

There are some water quality differences between the upstream site (21st St. downstream of Murphy Oil) and the downstream site (NC-29, near 3rd St.). Temperature averages 2.3°C (4.1°F) higher at the upstream site. This is probably mostly due to the refinery effluent having some heat content greater than air temperature. The current refinery permit includes a daily maximum temperature limit of 86 °F at outfall 001, which is upstream of the engineered wetland. Effluent is likely to be further air-cooled as it flows down the creek channel. Some inflow of groundwater to the creek may also contribute to lower downstream temperatures, although past reports have indicated groundwater inflow to the creek was believed to be very limited.

The downstream site (NC-29, near 3rd St.) is more influenced by runoff and some possible groundwater inflow. These water sources tend to have lower concentrations of TP, TN, and conductivity, than the refinery effluent, so the downstream site had lower concentrations of these parameters.

Surface runoff has higher concentrations of total suspended solids (TSS) than the refinery effluent, so the downstream site had higher TSS and turbidity levels, and lower transparency.

Water samples from the two sites were tested for PAH's on 5 dates during 2008-2009. All PAH's were below detection limits.

Petroleum odors are not noticeable from the water of Newton Creek. However, petroleum odors become noticeable when wading in the creek and disturbing fine bottom sediments. This condition was documented near East 4th St. on September 12th, 2014, and on May 28th, 2013 (Roesler 2014).

Some foaming of Newton Creek water has been observed. A May 16th, 2012 photo (Photo 2) at the 21st St. culvert shows a noticeable amount of foam (Graham 2014). The creek water was also noticed to produce substantial foam when agitated, upstream of East 4th St. on September 12th, 2014.

Photo 2: Newton Creek below 21st St. on May 16th, 2012

3.1.2 Macroinvertenbrates

Five sites in Newton Creek were sampled for macroinvertebrates during 2003-2010 (Figure 6). Sample results are summarized in Table 3. The 3 sites with extensive data were sampled by Kurt Schmude. There are some issues with those samples:

- MIBI protocol specifies samples should be collected before June 1 or after September 1. Results from samples collected after June 1 should probably not be used for assessment.

- MIBI protocol specifies use of a kick net for sample collection. Schmude collected samples with a Hess sampler. Rocks within a 30 cm diameter ring to a depth of 10-15 cm were removed and brushed. Sediment remaining in sample area was disturbed by hand with a large spoon for 2-3 minutes and dislodged organisms were washed downstream into the collecting bag. It is unclear how this may have affected MIBI's or HBI's. Two samples collected by DNR staff using standard protocols during November 2010 produced MIBI and HBI results that were similar to results from Schmude's samples at that time.

The two furthest upstream sites had the best mean MIBI's. The three downstream sites had poorer mean MIBI's that were fairly similar. The %EPT's (ephemeroptera, plecoptera, and trichoptera) were zero until 2008, when some of these species began to be found. However, the MIBI's have declined in the most recent samples. 2009 and 2010 sample MIBI's averaged poor at all sites. Based on this, WisCALM guidance indicates Newton Creek should be listed as biologically impaired.

3.1.3 Fish Communities

Fish surveys were conducted at three sites on Newton Creek (Figure 6). Surveys were conducted three to four times at each site during 2008-2011 (Table 4). A total of 14 species were found. The most abundant species were brook sticklebacks, which comprised 29% of fish sampled, followed closely by white suckers and creek chubs which comprised 28.3% and 21.4%, respectively. Capture rates were highest in 2008. No other patterns were notable in the data.

The model-estimated natural community for Newton Creek is a warm headwater. Assessment of the sampled fish communities indicates the appropriate natural community at the lower two sites is cool cold headwater. For the upper site, a cool warm headwater community is indicated.

All sampled fish communities had 0% intolerant individuals and >75% tolerant individuals (overall tolerance to environmental degradation). This is atypical for headwater communities and indicates stressors are present.

For all headwater streams (other than coldwater), the appropriate fish IBI to apply is the small stream (intermittent) IBI. Small stream fish IBI scores and ratings are shown below:

Small Stream FIBI Scores and Ratings for Newton Creek		
NC-29 (above 2nd St.)	FIBI Score	FIBI Rating
2008	50	fair
2009	30	poor
2010	30	poor
2011	50	fair
E. 11th St.		
2008	30	poor
2009	20	poor
2010	<25 fish, not applicable	poor
2011	<25 fish, not applicable	poor
21st St.(below Murphy Oil)		
2008	40	fair
2010	30	poor
2011	60	fair

At the E. 11th St. site less than 25 fish were captured in 2010 and 2011. The FIBI guidance (Lyons 2006) indicates that an FIBI score should not be calculated in this case. However, sites with less than 25 fish captured are typically interpreted to have a poor FIBI rating.

Seven of the eleven surveys have a poor FIBI rating. The average FIBI rating for Newton Creek is poor. This indicates the stream is biologically impaired, based on WisCALM guidance.

Newton Creek is classified as an LFF (limited forage fish) stream. LFF streams typically have a fish community with 75-100% of individual fish present being tolerant to low dissolved oxygen levels. Fish surveys during 2008-2011 showed that less than 75% of individual fish present were tolerant to low dissolved oxygen levels. Percentages ranged from 7 to 71, with a mean of 36%. The current fish population in the creek exceeds the expectation for an LFF stream.

3.1.4 Sediment Quality

2010 Samples:

Sediment in Newton Creek was characterized for physical and chemical parameters in the fall of 2010 as part of the multiyear biological assessment project. Seven sediment samples were collected to assess residual contamination. Grab samples were collected using an Ekman dredge from five locations, one each in segments A, H, I, K and L, between September 20 and October 14, 2010. In addition, two quart mason jars were deployed as sediment traps in segments A and K, though one of the traps was not collected until spring of 2011 due to ice conditions. Sample locations are shown in Figure 7. Sediments were analyzed for PAHs, lead, total organic carbon (TOC), oil & grease, and particle size. Results are presented in Table 5.

Total PAH ($TPAH_{18}$, i.e. sum of 18 compounds) was lowest in segment L which was subject to numeric clean-up goals. Clean-up of sediment in segments B-K was based on visually contaminated sediment and higher concentrations of PAHs were found in 2010 compared to the 2004 and 2006 post-remediation samples from these segments. It is not clear if the numeric clean-up goals for the inlet and Segment L would be applicable to the visually driven clean-up in segments B-K. In the 2010 samples $TPAH_{18}$ and TOC were highest in the composite sample from segment H at 7,162 ug/kg and 5.4%, respectively. This sample also had the most fines (silt +clay) 49%. Sediment was not removed in the upstream portion of Segment H because it did not contain visual contamination based on the remedial investigation (SEH 2003). The 2010 TPAH concentrations in segment H, I, and K would exceed the 2005 remedial goals that were used for Segment L and Hog Island Inlet, if applicable, with levels above the action level for additional excavation (5,000 ug/kg) and the site-specific remediation target (2,600 ug/kg). Samples from segments A, H, I, K also would exceed the site-specific chronic ecological protection level of 2,000 to 3,000 ug/kg. The 2010 $TPAH_{18}$ levels are higher than the post-remediation levels found in 2004 and 2006 sediment trap samples, which ranged from non-detect to 759 ug/kg. Recontamination and/or mobilization of contaminated floodplain and/or bank materials that were left in place may explain 2010 results that are higher than those obtained shortly after the remedial action.

$TPAH_{18}$ concentrations in Newton Creek segments A, H, I, and K (1,612 to 7,162 ug/kg) are comparable to levels found in urban streams, including samples from Faxon Creek (1,528 to 5,376 ug/kg) that DNR collected during this same time period. However, fine particles (silt + clay) and TOC levels are notably higher in Newton Creek (23 – 49% fines, 1.3 to 5.4% TOC) compared to Faxon Creek (7-27% fines, 0.4 to 1.5% TOC). Oil & Grease results show a similar, but not as linear pattern to PAHs, with the lowest levels also be being found in Segment L. The magnitude of Oil & Grease levels appear to be somewhat lower than before the remedial action, but levels of Oil & Grease in Segments A, H, I, and K in 2010 still exceed the upper bound reference concentration of 2,900 ug/g used in the 1995 study.

A comparison of sediment results to consensus-based sediment quality guidelines (WDNR 2003) is also included in Table 5. Bulk sediment concentrations exceeded the Threshold Effects Concentration (TEC) for $TPAH_{18}$ (1,610 ug/kg) and lead (36 mg/kg) in samples from segments A, H, I, and K. Several individual PAH compounds also exceed their respective TEC levels for these same segments. Samples from Segments H, I, K had the most individual PAH compounds exceeding TEC values with the Midpoint Effects Concentration (MEC) also being exceeded for chrysene (728 ug/kg), dibenz(a,h)anthracene (84 ug/kg), fluoranthene (1,317 ug/kg), and pyrene (858 ug/kg) in one or more segments. No parameters exceeded probable effects concentration (PEC) on a bulk sediment basis.

The 2010 results for PAH are somewhat confounding since they are on the low end of concentrations where toxicity would be expected, yet they would appear to exceed the clean-up criteria that were used for a portion of the site (i.e. segment L). According to SEH reports, the clean-up goals for Newton Creek were based on results of toxicity tests and correlation of PAH levels to visually contaminated sediments in segments B-K or in the case of Segment L to site-specific clean-up criteria. The relatively low $TPAH_{18}$ clean-up level for this site may be difficult to sustain long-term for several reasons. Chief among these is that a large portion of the site relied on a visual clean-up goal and residual contamination was left in in place along the banks, at culverts, and within the floodplain. There is also potential for recontamination from continuing sources or new releases. It's also important to note that the PAH compounds analyzed only represent a narrow subset of the thousands of possible compounds in petroleum. The original effect levels that WDNR used in 1995 was based on a broader suite of hydrocarbons, measured as DRO.

2012 Samples:

WDNR collected sediment grab samples from Newton Creek and a background reference stream in October of 2012 (WDNR 2013a). These samples were collected to confirm findings of the 2010 sampling and included additional parameters that were analyzed in the 1995 WDNR study. One sample was collected from the Bear Creek reference site (BC@Z), and four samples were collected from Newton Creek; composite from Segments A & B (SEG A/B), Segment C (SEG C), Segment H (SEG H), and Segment L (SEG L). Surface samples were collected using a stainless steel scoop. Sample locations are shown in Figure 7. Sediments were analyzed for PAHs, DRO, TOC, cadmium, chromium, lead, mercury, ammonia-N and particle size. Samples were also submitted to the WSLH for whole sediment toxicity testing. Results for organics and toxicity are presented in Table 6 and results for inorganic parameters are in Table 7.

Minor sheens and petroleum odors were observed during sampling at all four Newton Creek locations. The field crew also noted the presence of soapy bubbles in the sample from Segment C. In Newton Creek sample TOC ranged from 0.17 to 3.6% and fine particles (silt +clay) ranged from 45 to 75%. The particle size and TOC content of the Bear Creek reference site was similar to Newton Creek samples.

$TPAH_{18}$ concentrations in Newton Creek ranged from 222 to 1,550 ug/kg, with the lowest and highest concentrations again occurring in Segments L and H, respectively. These levels are below the 2005 clean-up goal of 2,600 ug/kg and in contrast to the findings of the 2010 samples. DRO was not detected at the background site and ranged from 3 to 29 mg/kg in Newton Creek, with the highest concentrations in Segments A/B, C, and H. It should be noted that DRO results were qualified by the lab because the jars were overfilled since the lab did not send plastic syringes with the coolers and needed to subsample the mass necessary for analysis. However, this does not affect use of these data for general assessment. Results for lead, chromium, mercury, and ammonia are generally lower than the 1995 average concentrations for those same segments.

A comparison of sediment results to consensus-based sediment quality guidelines (WDNR 2003) is also included in Table 6 and Table 7. Bulk sediment concentrations do not exceed the Threshold Effects Concentration (TEC) for TPAH (1,610 ug/kg). The TEC is slightly exceeded for chromium (43 mg/kg) in segments A/B, C, and L and lead (36 mg/kg) in segment L.

Results of the WSLH toxicity test are presented in WSLH report number FX00415-419 and summarized in Table 6. This report concluded, *"None of the sediment samples tested had significant negative effects on survival of Hyalella azteca or Chrionomus tentans. In contrast, two of the sediment samples caused significant reduction in growth for Hyalella azteca, and four of the sediment samples caused significant reduction in growth for Chrionomus tentans."* The samples that caused chronic toxicity (i.e. significant reductions in growth) to *Hyalella* and/or *C. tenans* in Newton Creek were collected from segment A/B, segment H (only partially remediated based on lack of visual indicators – 2012 sample was collected from unexcavated portion of segment H), and segment C.

Segment L was excavated during the last phase of the project, was subject to the numeric clean-up goal, and has notably lower DRO results than the segments where toxicity was noted though the reference site also indicated toxicity with non-detect levels of DRO. The method for analyzing DROs was different in the past and it is not possible to directly compare the older results, and the corresponding 1995 WDNR DRO effects levels, to the 2012 results. The new method yields lower reported values. Something may be causing toxicity in Newton Creek sediments and the exact cause cannot be identified, but petroleum compounds cannot be ruled out completely since only small subset petroleum chemicals was analyzed (i.e. 18 PAH compounds).

Concentrations of sediment contaminants in Newton Creek are notably lower in 2012 compared to 2010, though they show a similar pattern with the lowest levels of contamination being found in segment L and highest in segment H. A historic rainfall event with rainfall totals over 8 inches in a 48-hour period occurred in June 2012. This storm resulted in significant flooding and high peak flows in local streams and was estimated to have a 100 to 500 year recurrence interval. This event may help to explain the lower levels

of contamination found in 2012 compared to 2010 since sediment could have been mobilized and transported downstream into Hog Island Inlet and Superior Bay. While no firm conclusions should be drawn from the 2012 data, the toxicity test results and olfactory observations suggest a level of uncertainty remains about sediment quality in Newton Creek.

3.2 Hog Island Inlet

3.2.1 Water Quality

Water Quality was monitored on five dates during 2008-2009 (Table 8). Total phosphorus concentrations averaged 70 ug/l, which is below the 100 ug/l standard for the St. Louis River. Dissolved oxygen concentrations were > 5 mg/l, the standard for warmwater fish and aquatic life waters. E. coli and fecal coliform bacteria concentrations were < 50/100 ml, indicating it is likely that the water quality standard for bacteria is being met. Chlorophyll a concentrations were moderately high and averaged 7.9 ug/l. Total nitrogen concentrations (total Kjeldahl nitrogen and nitrate plus nitrite nitrogen) were moderate and averaged 1.43 mg/l.

Newton Creek is a tributary to Hog Island Inlet. However, regular Lake Superior seiche pulses keep Hog Island Inlet water mixed with the St. Louis River estuary water. Mixing calculations using conductivity data for Newton Creek, Hog Island Inlet and the St. Louis River estuary indicate that the dominant water source for Hog Island Inlet is the St. Louis River estuary (77%). Physically and hydrologicly Hog Island Inlet behaves as an embayment of the St. Louis River estuary. It seems reasonable that water quality standards for the St. Louis River estuary should apply to Hog Island Inlet.

3.2.2 Macroinvertebrates

Benthic macroinvertebrate samples were collected from 3 sites in Hog Island Inlet and one adjacent control site (WI-2) (Figure 6) in 2006 and 2011(Schmude 2006, 2011).

In 2006, the macroinvertebrate samples at the control site (WI-2, Loon's Foot Landing) showed a better community than at the Hog Island Inlet sites. Densities of organisms and total taxa richness were significantly higher. It was postulated that the lack of organic debris on the recently excavated clay sediment surface was the reason for the differences (Schmude 2006).

In 2011, no significant differences were found in densities or total taxa richness of macroinvertebrates between the Hog Island Inlet sites and the control site. It appears the gradual deposition of organic debris has improved the sediment habitat in the inlet. The benthic macroinvertebrate communities in the inlet are now comparable to the nearby unimpacted control site.

3.2.3 Fish Community

Mini-fyke net fish surveys were conducted in Hog Island Inlet in 2004 (pre-remediation), 2008, and 2010 (Table 9). Mini-fyke nets have a 1" mesh exclusion panel, so only small and young-of-year fish are captured. The presence of adult game fish is not assessed. Diversity increased between the pre-remediation survey (nine species) and the post-remediation surveys (twenty-one total species for the two surveys).

The total number of fish captured during the pre-remediation 2004 survey was greater than in the 2008 and 2010 surveys. However, 98% of the fish captured in 2004 were black bullheads, an extremely tolerant fish. Total capture rates for fish other than bullheads were greater in 2008 and 2011.

The percentage of fish tolerant to overall environmental degradation was 98.4% in 2004. This percentage declined to 43.7% in 2008 and 4.9% in 2010. In conjunction with this shift, the combined percentages of fish with intermediate tolerance and intolerant fish rose from 1.6% in 2004 to 56.3% in 2008 and 95.1% in 2010. There has been a clear and dramatic improvement in the fish community of Hog Island Inlet since the remediation work was done.

3.2.4 Aquatic macrophytes

Post-remediation aquatic macrophyte surveys were conducted in Hog Island Inlet during 2008, 2010, and 2014. Point-intercept surveys (100 points) and meander surveys were done. The plant community improved from 2008 to 2010, but declined by 2014 (see summary table below).

The cause of the recent aquatic macrophyte decline is uncertain. A major flood event occurred in June of 2012 which altered plant communities elsewhere in the St. Louis River estuary due to sediment scouring and sediment deposition. A comparison of average water depths in the inlet between the 2010 and 2014 surveys, adjusted for Lake Superior water level changes, suggests sediment deposition occurred in Hog Island Inlet (Roesler 2014).

An increased presence of petroleum compounds in the sediment might also be a reason for the aquatic plant decline. During the 2010 aquatic macrophyte survey, a petroleum odor was noted at only six sampling sites. Four of the six sites were outside of the area where sediment was excavated. During the 2014 survey, a petroleum odor in the sediment was noticed at most sites (48) in the southern ¾ of the inlet. Flood scouring of residual petroleum contamination in Newton Creek in 2012 may have delivered this material to Hog Island Inlet sediment.

Summarized Hog Island Inlet Aquatic Macrophyte Survey Data			
Year	2008	2010	2014
Abundance*	11	98	10
No. of rake sampled species	4	8	6
No. of rake sampled species plus site visuals	13	18	11
*No. of sites with rake sampled plants times average rake fullness			

3.2.5 Sediment Quality

Chemical characterization of sediments in Hog Island Inlet was not conducted as part of this assessment. The most recent sediment chemistry results for Hog Island inlet are from the 2006 post-remediation sampling by SEH (SEH 2008). Results from three sediment cores collected in the inlet on June 14, 2006 yielded detections of 37.8 to 118.7 ug/kg $TPAH_{18}$, 18 – 28 mg/kg lead, and 1.6 to 4 % TOC. Inlet sediments collected for toxicity testing on June 22, 2006 were homogenized and chemically analyzed yielding detections of 10 to 1,227 ug/kg $TPAH_{18}$, 17 to 30 mg/kg lead, and 2.7 to 5.1% TOC. The 2006 SEH sampling indicated that the numeric clean-up goal of 2,600 ug/kg was met for Hog Island Inlet sediments. Sediment toxicity tests using *Hyalella Azteca* (28-day) indicated no significant reductions in survival or growth in inlet sediments compared to laboratory controls.

In 2011 DNR collected and analyzed sediment from wetlands in the isthmus that connects Hog Island to the mainland (WDNR 2012) (Figure 7). These wetland areas were outside the area that was remediated in 2005 and were sampled due to concerns about odors and sheens raised by habitat restoration workers. TPAH detections in the isthmus samples were generally below the site-specific clean-up goal of 2,600 ug/kg and all samples were below the 5,000 ug/kg action level for additional excavation. While levels in the isthmus samples were below the clean-up levels the levels of petroleum products may present a human health hazard. These findings prompted Henry Nehls-Lowe of the Wisconsin Dept. of Health Services to provide the following recommendation for the sediments in the Hog Island isthmus, “People who enter these areas are advised to use personal protection measures that prevents direct contact with the skin. Those who need to enter and wet wade in this area should don appropriate boots, waders, splash protection overalls, and gloves. Those who notice a slick or petroleum odors should leave the vicinity to avoid direct contact and inhalation of vapors that have the potential for causing adverse health responses. Volatilization of lighter fractions of these substances could pose a greater exposure concern on hot, windless days. Entering this area during lower ambient air temperatures and windy days could reduce risk.”

4 Assessment of Impaired Waters Status

4.1 Wisconsin Water Quality Standards (selected excerpts)

Newton Creek and Hog Island Inlet are identified as variance waters in Chapter NR 104, Wis. Adm. Code, Uses and Designated Standards.

Newton Creek

Newton Creek is classified as a limited forage fish (LFF) community. The dissolved oxygen (D.O.) criterion for an LFF stream is 3 mg/l. Measured D.O. concentrations during 2008-2011 consistently exceed 3 mg/l.

LFF streams typically have a fish community where 75-100% of individual fish present are tolerant to low dissolved oxygen levels (Ball and LaLiberte 2004). Newton Creek fish surveys during 2008-2011 showed a substantially better fish community was present with a mean of only 36% of fish being tolerant to low dissolved oxygen levels.

Hog Island Inlet

Hog Island Inlet is classified for fish and other aquatic life uses with the subcategory of great lakes communities. References to "great lakes communities" are no longer present in NR 102, but were present in older versions of NR 102 (February, 1989), below:

NR 102.04(4)(e) *Temperature and dissolved oxygen for cold waters*. Streams classified as trout waters by the department of natural resources (Wisconsin Trout Streams, publication 6-3600 (80)) or as great lakes or coldwater communities may not be altered from natural background temperature and dissolved oxygen levels to such an extent that trout populations are adversely impacted (emphasis added).

This language appears to have no applicability to Hog Island Inlet since there is no trout population present and no potential for a trout population to be present, other than the possible occasional presence of trout during seasonal cold water temperatures. Existing temperature and dissolved oxygen levels in Hog Island Inlet are believed to be at natural background levels.

NR 102.14(2)(c) The lower of the taste and odor criteria derived as specified in pars. (a) and (b) is applicable to surface waters classified as public water supplies. The taste and odor criteria derived as specified in par. (b) is applicable to Great Lakes, cold water, and warm water sport fish communities .

Taste and odor criteria are based on human consumption of water or aquatic organisms. Water in Hog Island Inlet is not being consumed by humans, and so there has been no need

to test for taste and odor criteria. There are no known reports of taste problems with fish or other aquatic organisms in Hog Island Inlet.

NR 102.04 (1)(c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

Petroleum odors are noticeable when sediment is disturbed in both Newton Creek and Hog Island Inlet.

NR 102.04 (1)(d) Substances in concentrations or combinations which are toxic or harmful to humans shall not be present in amounts found to be a public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

The presence of toxic substances at harmful levels is indeterminate due to positive indications of toxicity in 2012 Newton Creek samples.

NR 102.04 (4) CRITERIA FOR FISH AND AQUATIC LIFE. Except for natural conditions, all waters classified for fish and aquatic life shall meet the following criteria:
NR 102.04 (4)(a) *Dissolved oxygen*. Except as provided in par. (b) and s. NR 104.02 (3), the dissolved oxygen content in surface waters may not be lowered to less than 5 mg/l at any time.

Monitoring data for Newton Creek and Hog Island Inlet shows dissolved oxygen concentrations greater than 5 mg/l on all occasions. As an LFF, Newton Creek is probably not subject to this criterion.

NR 102.04 (4)(c) *pH*. The pH shall be within the range of 6.0 to 9.0, with no change greater than 0.5 units outside the estimated natural seasonal maximum and minimum.

Monitoring data for Newton Creek and Hog Island Inlet shows pH values within this range on all occasions.

NR 102.04 (6) CRITERIA FOR RECREATIONAL USE. As bacteriological guidelines, the membrane filter fecal coliform count may not exceed 200 colonies per 100 ml as a geometric mean and may not exceed 400 colonies per 100 ml in more than 10% of all samples during any month. Samples shall be required at least 5 times per month.

This type of monitoring was not done for Newton Creek and is rarely done for small streams. Two fecal coliform samples collected from Hog Island Inlet had an average count of 23.5 per 100ml. This suggests fecal coliform counts are not a chronic problem in Hog Island Inlet, but counts can fluctuate and tend to be higher following runoff events.

NR 102.06 (3)(a)37. A total phosphorus criterion of 100 ug/l is established for the following rivers or other unidirectional flowing water. St. Louis River from state line to the opening between Minnesota Point and Wisconsin Point at Lake Superior. NR 102.06 (3)(b) Except as provided in subs. (6) and (7), all other surface waters generally exhibiting unidirectional flow that are not listed in par. (a) are considered streams and shall meet a total phosphorus criterion of 75 ug/l.

Mean total phosphorus (TP) concentrations at the two Newton Creek sites (278 ug/l and 216 ug/l) greatly exceeded the 75 ug/l stream standard, so it is highly likely the standard is being exceeded. However, the monthly May to October samples needed for WisCALM assessment were not collected. Collection of the necessary monthly samples is underway for 2015. Calumet Superior LLC is currently on a nine year compliance schedule to reduce their wastewater effluent TP concentration to 75 ug/l.

Hog Island Inlet is an embayment of Superior Bay in the St. Louis River estuary. Newton Creek is a tributary to Hog Island Inlet. However, regular Lake Superior seiche pulses keep Hog Island Inlet water mixed with the St. Louis River estuary water. Mixing calculations using conductivity data for Newton Creek, Hog Island Inlet and the St. Louis River estuary indicate that the dominant water source for Hog Island Inlet is the St. Louis River estuary (77%). Physically and hydrologicly Hog Island Inlet behaves as an embayment of the St. Louis River estuary. It seems reasonable that water quality standards for the St. Louis River estuary should apply to Hog Island Inlet. Monitoring data for Hog Island Inlet shows total phosphorus concentrations less than 100 ug/l on all occasions (mean = 70 ug/l).

4.2 Application of WisCALM Thresholds and Assessment Guidance

WisCALM listing methodology (WDNR 2013b, table 14), lists conventional physical and chemical parameters and their impairment thresholds for rivers and streams. Parameters listed are – dissolved oxygen, temperature, pH, and total phosphorus. These parameters have been discussed in the water quality standard section 4.1 above. Only total phosphorus concentrations in Newton Creek are expected to exceed impairment thresholds.

Stream and river impairment assessment for recreational uses is limited to applying the water quality criterion for fecal coliform that is contained in NR 102.04 (6). This has been discussed above. – *Bacteriological guidelines.* The membrane filter fecal coliform count may not exceed 200 per 100 ml as a geometric mean based on not less than 5 samples per month, nor exceed 400 per 100 ml in more than 10% of all samples during any month.

This type of monitoring was not done for Newton Creek and is rarely done for small streams. Two fecal coliform samples collected from Hog Island Inlet had an average count of 23.5 per 100ml. This suggests fecal coliform counts are not a chronic problem in Hog Island Inlet, but counts can fluctuate and tend to be higher following runoff events.

WisCALM listing methodology also identifies guidelines for assessing contaminated sediments in rivers and streams. A sediment assessment for Newton Creek and Hog Island Inlet is contained elsewhere in this report.

WisCALM listing methodology also identifies guidelines for assessing biological indicators of impairment in rivers and streams. Natural community classifications determine which biological metrics are applied.

Fish communities found in Newton Creek indicate its natural community classification is a cool-warm to cool-cold headwater stream. The appropriate metric to apply is the small stream (intermittent) fish IBI. This IBI has averaged "poor" ratings at three sites over multiple years of monitoring. Guidance indicates Newton Creek should be considered impaired on this basis. (It is somewhat unclear how this meshes with the creek's LFF status, but Aaron Larson, keeper of the WisCALM guidance, has confirmed this is appropriate.) The most recent macroinvertebrate samples from Newton Creek (2009 & 2010) had MIBI values that average poor at all sites. Based on this, WisCALM guidance indicates that Newton Creek should be considered biologically impaired.

The natural community of Hog Island Inlet, as an embayment of the St. Louis River estuary, is presumably that of a large river. A river fish IBI would apply. A large river fish survey has not been conducted for Hog Island Inlet, and may not be suitable due to the inlet's unique characteristics. The mini-fyke net surveys suggest a reasonably healthy fish population is present in Hog Island Inlet.

4.3 Current 303d listing and potential de-listing

Newton Creek and Hog Island Inlet are both listed as impaired on the 2012 303d list due to chronic aquatic toxicity impairments caused by PAH's, unspecified metals, and foams/flocs/scums/oil slicks. The causes of the impairment have been substantially addressed by the actions that have been completed, including upgrades to industrial wastewater treatment and removal of contaminated sediment. There has been limited monitoring to determine whether chronic aquatic toxicity is still present. Recent toxicity testing of sediment samples from Newton Creek (2012) indicated that chronic toxicity may still be present. However, a sample collected from a control site in that study also indicated chronic toxicity, which complicates the interpretation of the results. Additional chronic toxicity testing is probably needed to reliably determine if the impairment had been eliminated.

Both the macroinvertebrate and fish communities present in Newton Creek have poor IBI's. Because of this WisCALM guidance indicates Newton Creek should currently be considered biologically impaired.

4.4 Sediment Quality

An objective of this report was to evaluate sediment quality to determine if remediation goals continue to be met. Based on recurring visual and olfactory indicators of petroleum contamination, sediment chemistry results that may exceed site-specific clean-up goals, potential indications of sediment toxicity compared to laboratory controls, and WDHS advice to restrict contact to adjacent sediments, there is some uncertainty about the long-term effectiveness of the interim remedial action for Newton Creek and Hog Island Inlet. Recontamination by ongoing sources or mobilization of residual contamination from floodplain soils and sediments remaining after implementation of the remedial action suggest that sources of contamination to Superior Bay and Lake Superior, though reduced in magnitude and mass, have not been eliminated and may be still be present at levels of concern for ecological and human health endpoints. While appropriate residual contamination levels for recreational and residential exposures to petroleum contaminants in sediment are unknown there remains uncertainly for human health concerns at this site based on WDHS advice to use personal protection measures that prevent direct contact with the skin when working in sediments of the adjacent isthmus with similar contaminant levels. Recreational uses of Newton Creek are documented in SEH 2003, *"Informal conversations with local residents indicate that local adolescents utilize the Newton Creek floodplain and Hog Island Inlet for recreational purposes. This was confirmed by SEH and WDNR observations during field activities at the site in July 2002, when several children were observed playing in the creek and floodplain."*

Continued periodic monitoring of the Newton Creek system may be necessary to evaluate sediment toxicity and to evaluate ecological recovery over time. Future investigations should include sediment toxicity testing with chronic endpoints (i.e. growth & reproduction). If identifying and quantifying an effect level for specific pollutants is desired, then paired chemical analyses for a broad range of compounds including, but not limited to, petroleum hydrocarbons and weathered-alkylated PAHs should also be included. Assessment of human health concerns and confirmation of levels that are protective of residential and recreational uses, without unreasonable restrictions on contact with sediments, should also be considered.

5 Conclusions

- The biological community in Newton Creek is impaired:
    - The macroinverbrate community has gotten progressively worse since the post remediation samples in 2006. 2009 and 2010 sample MIBI's averaged poor at all sites.
    - Seven of the eleven fish surveys yield a poor FIBI rating. The average FIBI rating for Newton Creek is poor. This indicates the stream is biologically impaired, based on WisCALM guidance.
- The condition of the biological community in Hog Island Inlet is uncertain due to recent decreases in aquatic macrophytes and a lack of macroinvertebrate data following the 2012 historic high flow event
- Phosphorus levels in Newton Creek likely exceed the applicable standard of 75 ug/L
- Petroleum odors are noticeable when sediment is disturbed in Newton Creek, Hog Island Inlet, and the wetlands that comprise the Hog Island isthmus
- Odors were indicated over a substantially larger area in Hog Island Inlet and an increase in sediment thickness were noted in 2014, likely influenced by 2012 high flow event. This indicates potential mobilization of contaminants from Newton Creek and its floodplain and deposition in the inlet.
- While the macroinvertebrate community in Hog Island Inlet showed significant improvement from 2006 to 2011, the current condition is uncertain and it may be degraded from the 2012 high flow even given the increased incidence of petroleum odors across the inlet.

- The presence of toxic substances at harmful levels is indeterminate given positive indications of toxicity in 2012 sediment samples from Newton Creek and the Bear Creek at CTH Z reference site.

- Based on 2012 sediment toxicity testing results, it is uncertain if the visually driven clean-up for Newton Creek and residual contamination left along stream banks and in floodplain soils is effective for long-term attainment of the site-specific remedial goals

- Use of TPAH18 for assessments of petroleum contaminated sediments below a refinery may not be adequate – need to consider a broader suite of compounds including, but not limited to, alkylated PAHs and total petroleum hydrocarbons

- WDHS has advised personal protection measures that prevent direct contact with the skin when working in sediments of the adjacent isthmus with similar contaminant levels to those found in Newton Creek sediments.

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The condition of Newton Creek and Hog Island Inlet has undoubtedly been improved through improved spill containment, advancements in wastewater treatment and the removal of petroleum contaminated sediments. Unlike the findings of the 1972 survey, the fauna of the creek is now inhabited by a more diverse community. It is no longer limited to "sludge worms" and several species of fish are able to survive. However, the biological community still appears to have some level of impairment due to confounding factors that are difficult to identify or quantify.

6 Recommendations

Due to the historic high flow event of June 2012 and the age of much of the available data for Newton Creek and Hog Island Inlet some uncertainty remains about the condition of these waterbodies. Based on this uncertainty and data indicating biological impairments, neither Newton Creek nor Hog Island Inlet should be removed from the impaired waters list at this time. However, the impaired category, impairments, and pollutant(s) in Table 1 may need to be updated as new data becomes available. Additional assessment of the chemical, physical, and biological integrity of these waters should be conducted. Specific recommendations for monitoring include:

- Collection of additional macroinvertebrate samples from Newton Creek and Hog Island Inlet to assess changes over time.

- Additional fish surveys should be conducted in Newton Creek and Hog Island Inlet to assess changes over time. Surveys for Hog Island Inlet should also consider using methods that will capture larger fish such as game fish, in addition to the smaller fish caught in mini-fyke nets.

- Additional aquatic macrophyte surveys should be conducted in Hog Island Inlet to assess changes over time and see if there is improvement following the 2012 high flow event.

- Chemical and physical assessment of sediments in Newton Creek and Hog Island Inlet should be conducted to evaluate the mobilization and deposition of petroleum contaminants during the 2012 high flow event. Consider both grab and trap (trough) methods.

- Conduct additional toxicity testing of sediment and water from both Newton Creek and Hog Island Inlet. Care needs to be taken in selecting an appropriate reference site given control performance problems experienced due to predation at the Loonsfoot Landing site (WL-2) and toxicity at the Bear Creek site at CTH Z (BC@Z).

- Conduct chemical specific testing for a broad suite of petroleum compounds (e.g. total petroleum hydrocarbons, alkylated PAHs, etc.) concomitantly with sediment toxicity testing.

- Chlorides are used for road deicing in the watershed and the refinery has variances on the level of chloride and mercury in their discharge to Newton Creek. Chemical specific testing for chloride, mercury, and other parameters should be conducted concomitantly with ambient water toxicity testing.

- Complete monthly (May-October) total phosphorus sampling for Newton Creek currently underway in 2015.

- An assessment of human health concerns and confirmation of levels that are protective of residential and recreational uses, without unreasonable restrictions on contact with sediments, should also be considered in cooperation with WDHS and DNR remediation and redevelopment staff.

7 References

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8 Figures

Figure 1: Study Area Location

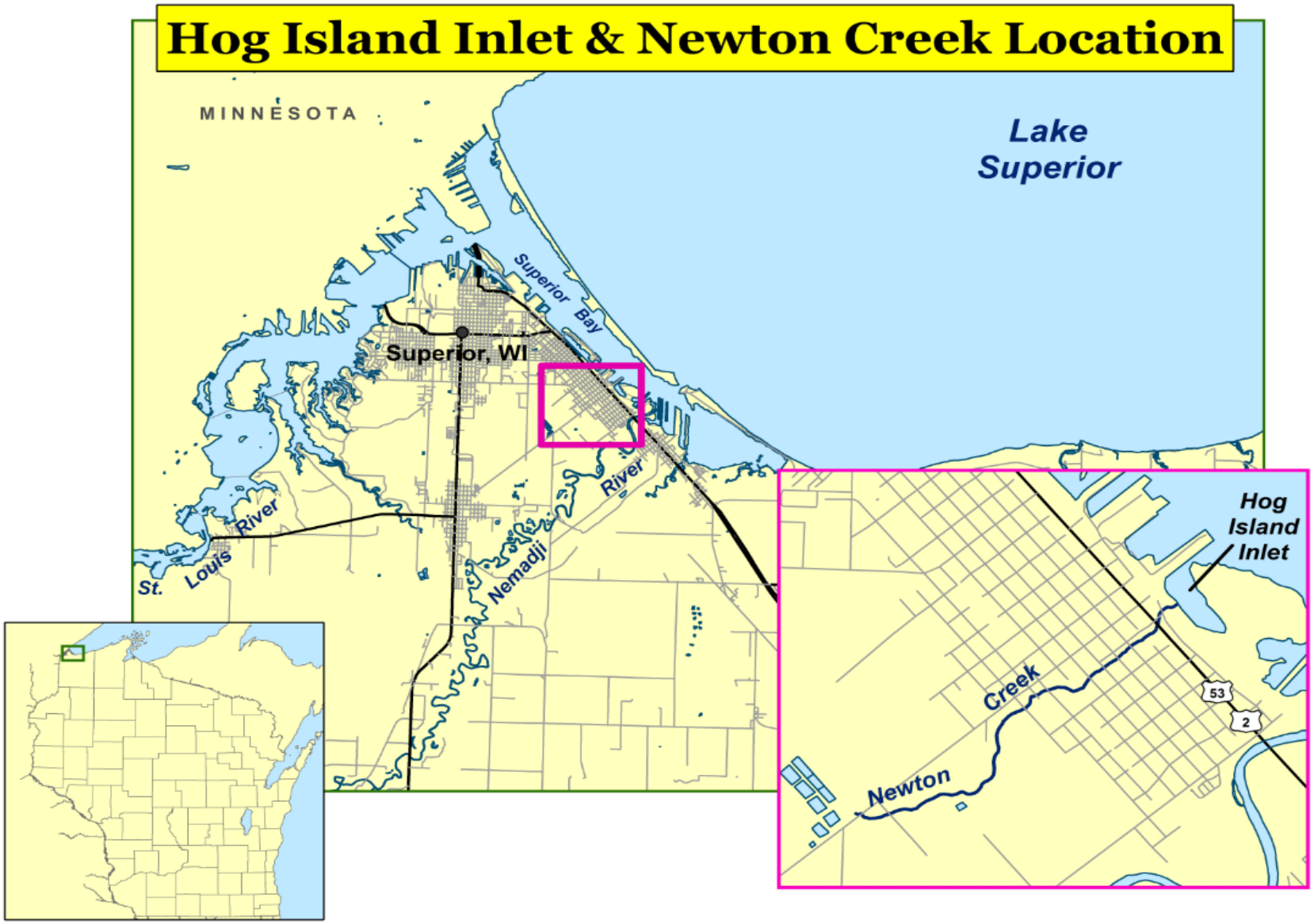


Figure 2: Newton Creek Segments A through L

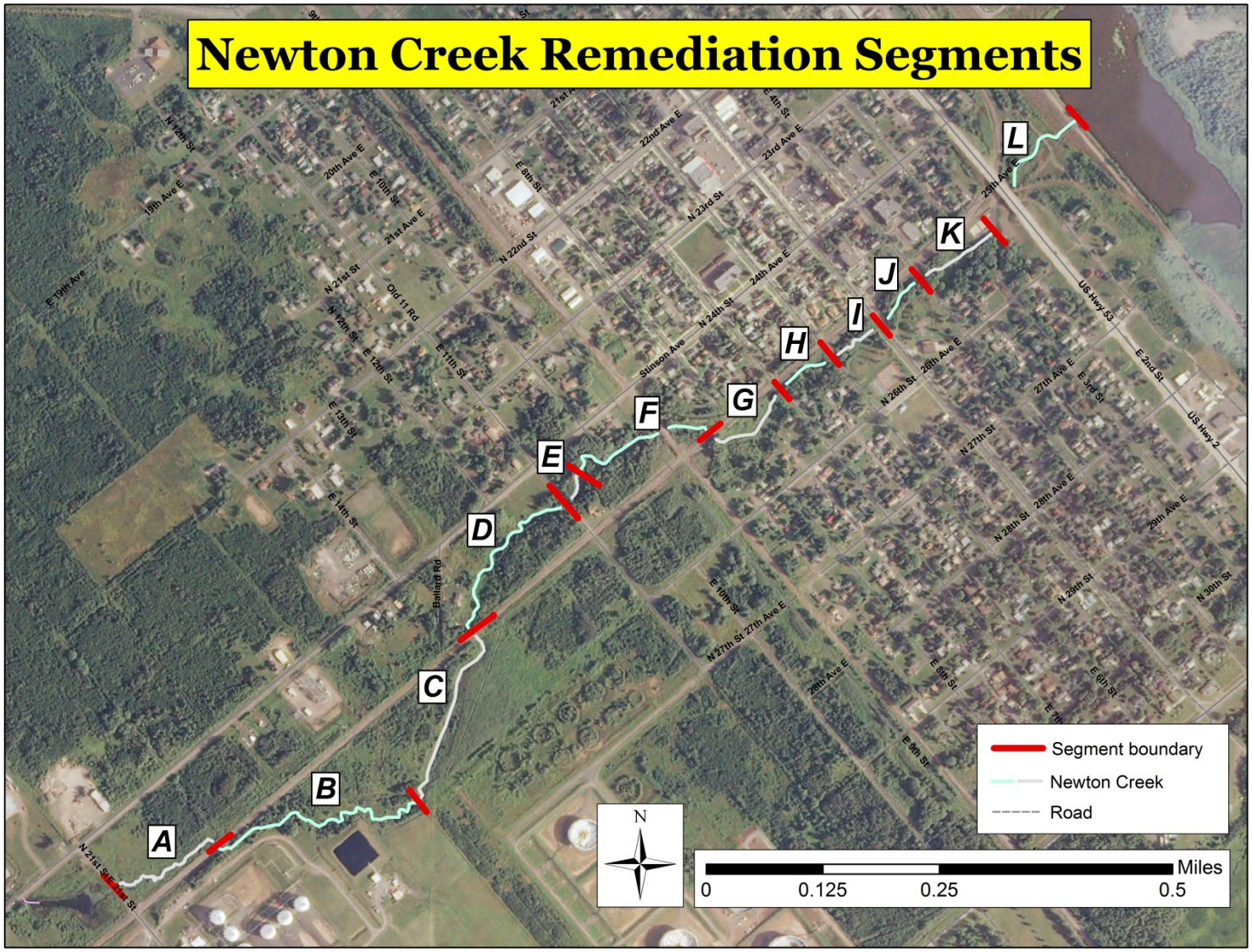


Figure 3: Post-remediation sampling locations by SEH Circa 2006

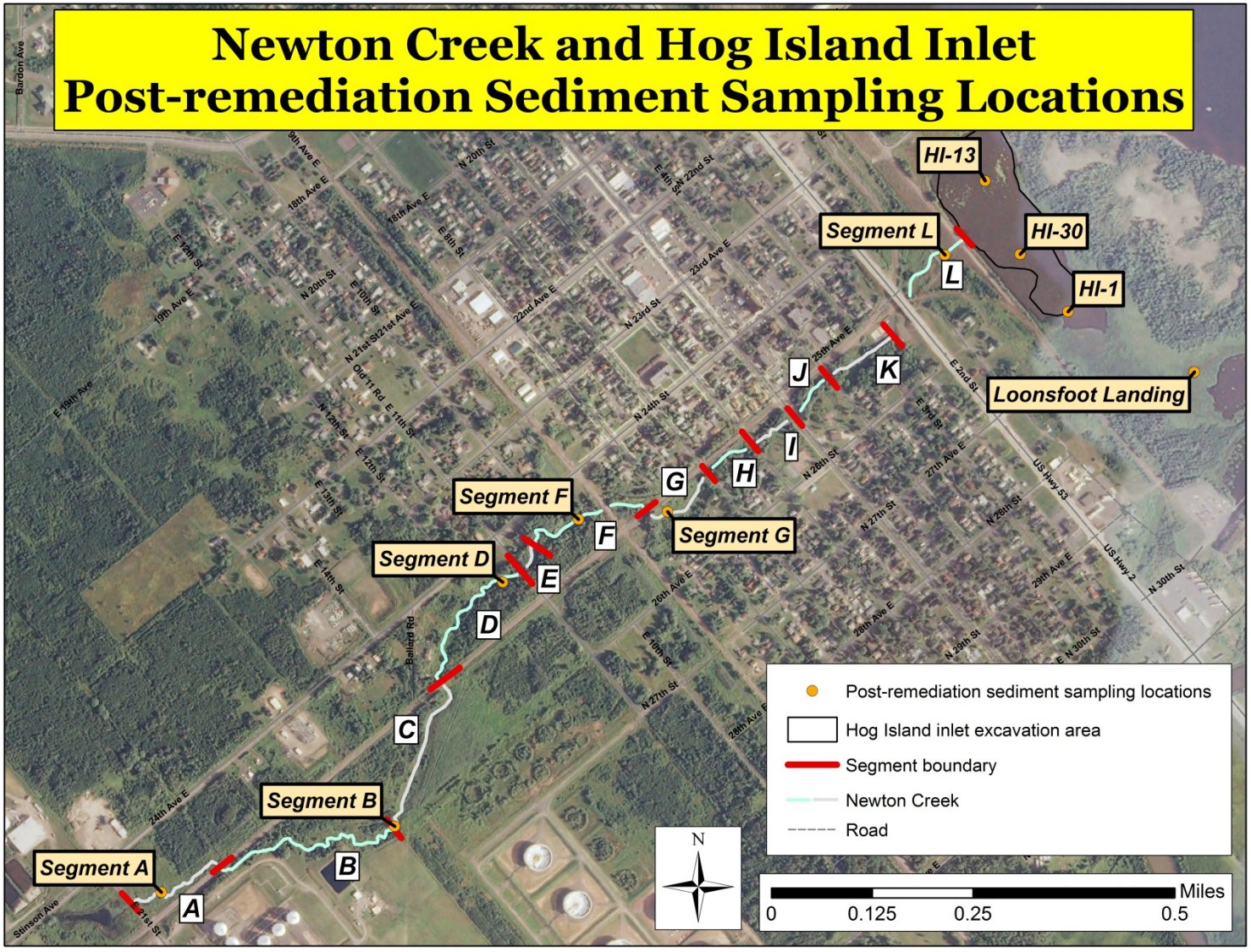


Figure 4: Residual contamination locations by SEH Circa 2006

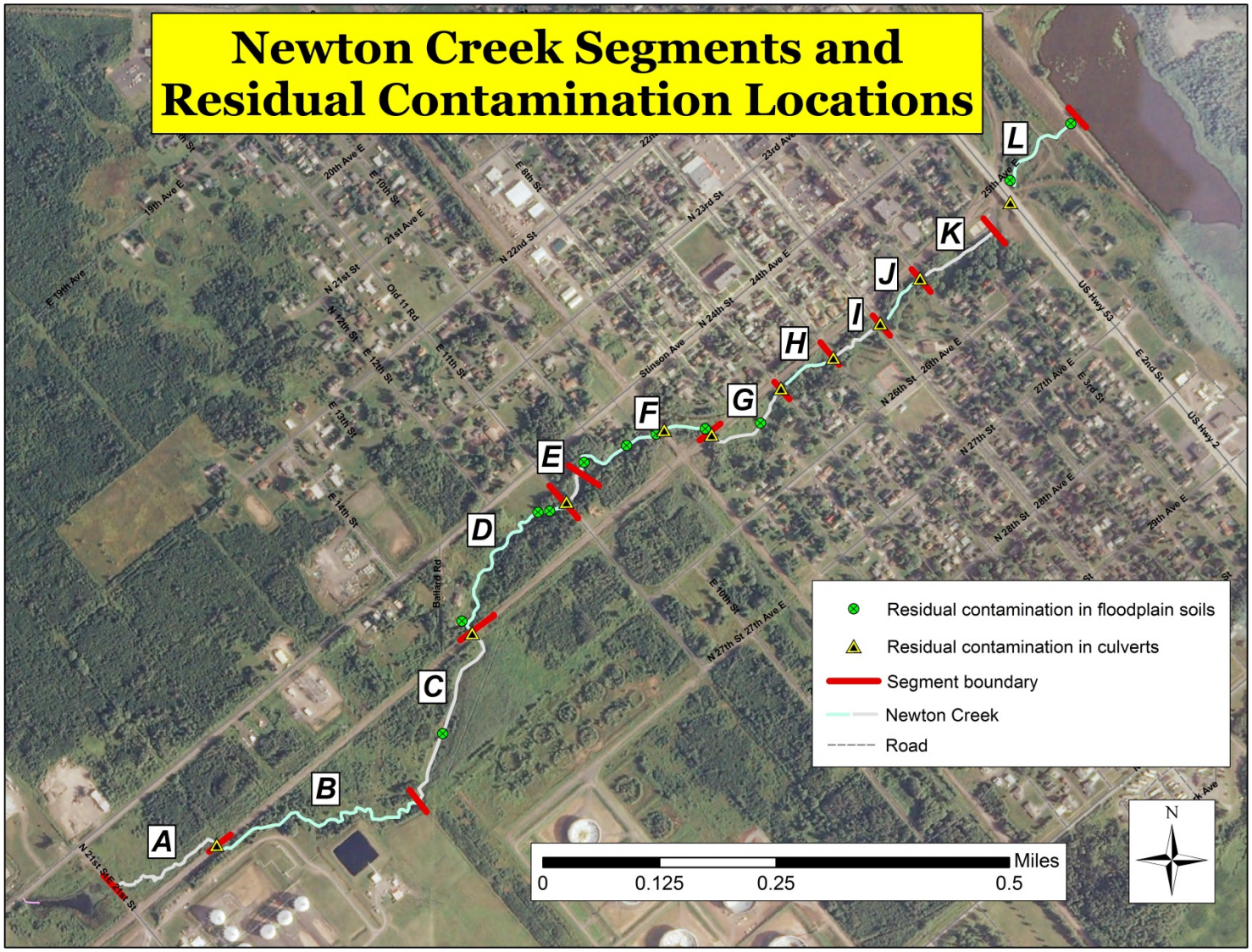


Figure 5: Newton Creek Water Quality Sampling Locations 2008 - 2011

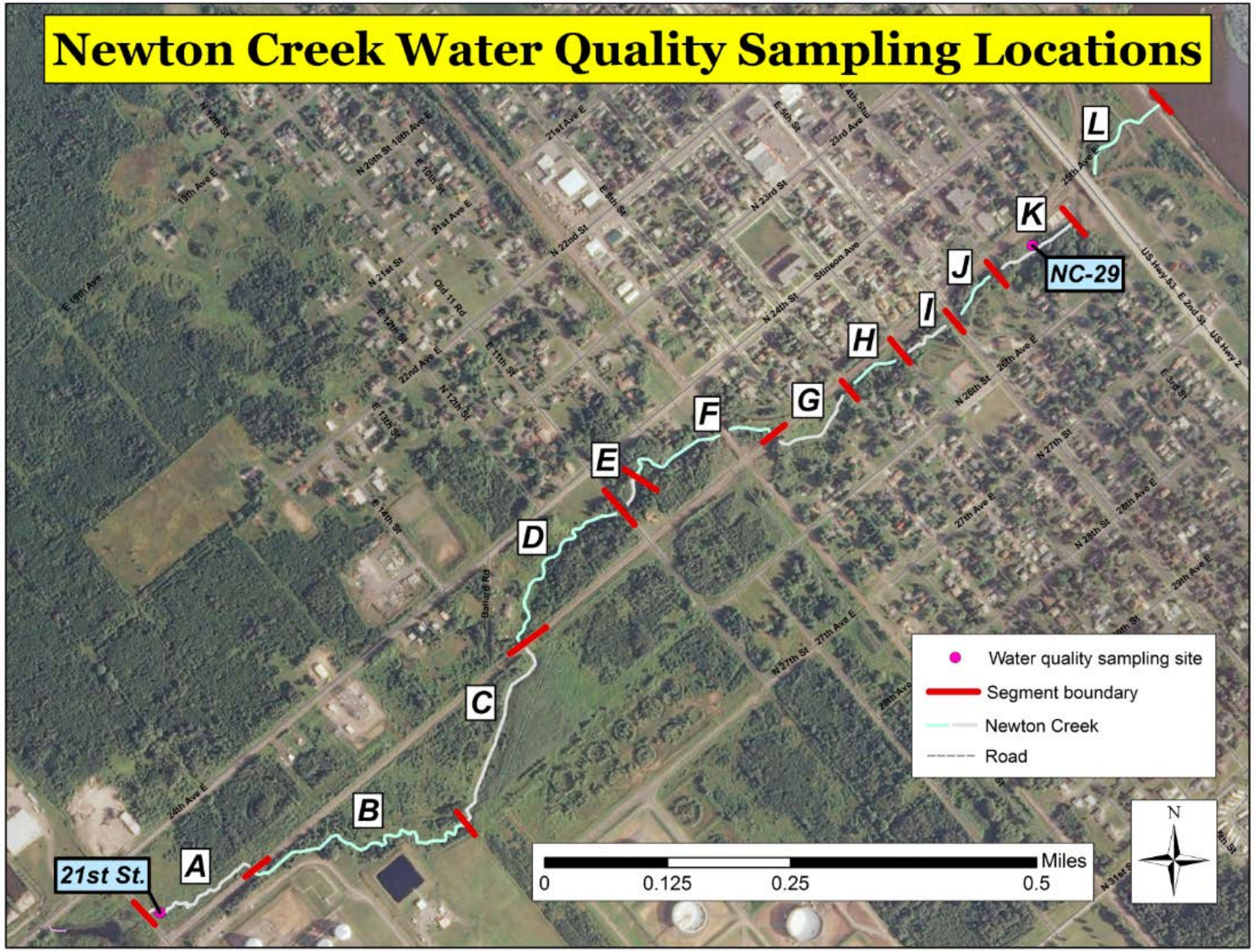


Figure 6: Newton Creek and Hog Island Inlet Macroinvertebrate and Fish Survey Locations 2003 - 2010

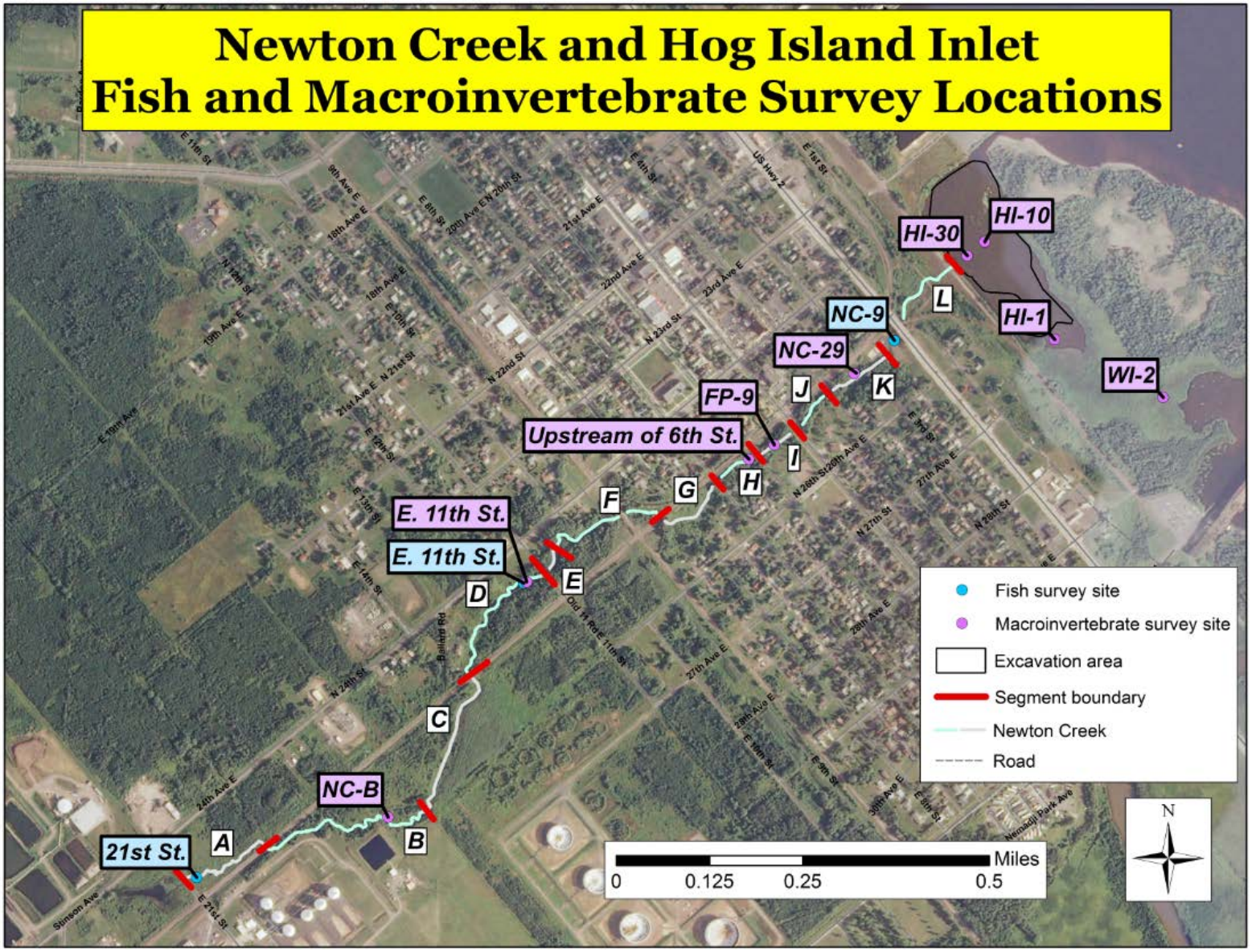
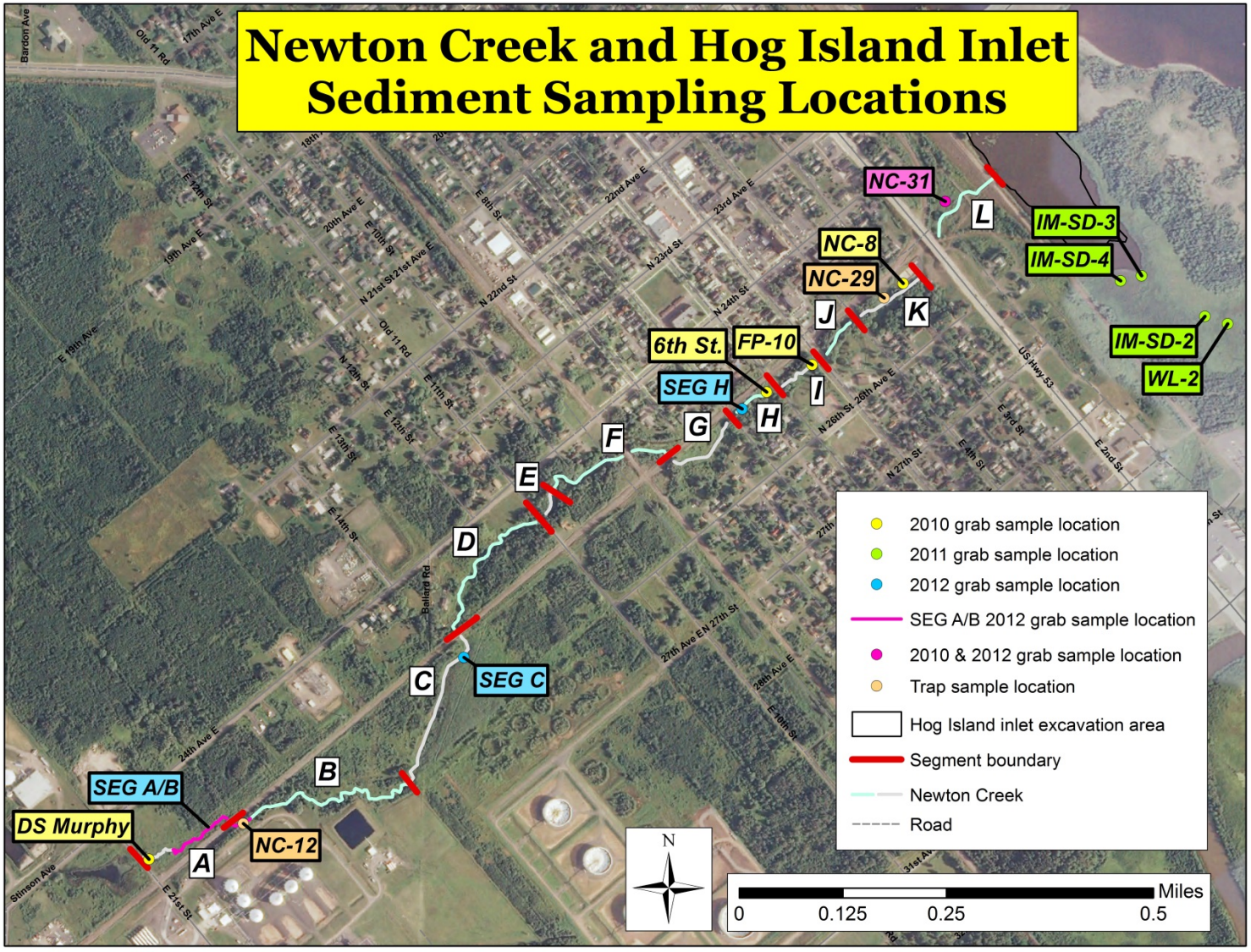


Figure 7: Newton Creek and Hog Island Inlet Sediment Sampling Sites 2010 - 2012



9 Tables

Table 1: Impaired waters listing summary for Newton Creek and Hog Island Inlet

Waterbody Name	Length Impaired	Impaired Water Category	Impairments	Impaired Water Status	Pollutants	Sources
Newton Creek 2843650	Entire Stream, 1.76 Miles	Contaminated Sediment	Chronic Aquatic Toxicity	EAP Project	Foams/Flocs, Slicks, PAHs, Unspecified Metals	Contaminated Sediments, Petroleum/Nat. Gas Production Activities
	Assessment	**Current Use**	**Attainable Use**	**Supporting Attainable Use**	**Designated Use**	**Supporting Designated Use**
	2000 or Earlier Methodology	Full body contact, general use, general advice, LAL, Human health support	Full body contact, general use, LFF, Fish Consumption, Human health support	Not Assessed, Not Supporting	Full body contact, general use, LFF, Fish consumption, Human health support	NR102 Classification, Classification Survey Pending
Hog Island Inlet (of Superior Bay) 2751300	**Acres Impaired**	**Impaired Water Category**	**Impairments**	**Impaired Water Status**	**Pollutants**	**Sources**
	18.51Acres	Contaminated Sediment	Chronic Aquatic Toxicity	303d Listed	Foams/Flocs, Slicks, PAHs, Unspecified Metals	Contaminated Sediments
	Assessment	**Current Use**	**Attainable Use**	**Supporting Attainable Use**	**Designated Use**	**Supporting Designated Use**
	2000 or Earlier Methodology	Full Body Contact, General Use, FAL, General Advice, Human Health Support	Full Body Contact, General Use, Cold, Fish Consumption, Human Health Support	Not Assessed, Not Supporting	Full Body Contact, General Use, Default FAL, Fish Consumption, Human Health Support	NR102 Classification

Table 2: Newton Creek Water Quality Data 2008 – 2011

NEWTON CREEK WATER QUALITY DATA 2008-2011

Sites listed from upstream to downstream

Newton Creek Site	Date	TP (ug/l)	Transparency (cm)	pH (s.u.)	D.O. (mg/l)	D.O. % sat	Temp (°C)	Conductivity (umhos/cm)	TSS (mg/l)	Ammonia-N (mg/l)	Total Kjeldahl-N (mg/l)	Nitrate plus nitrite-N (mg/l)	Turbidity (ntu)
21st St. DS Murpy Oil	07/01/2008	396	>120	8.1			25			0.037	1.1	0.919	2.9
	08/12/2008	420	45	7.5	7.5		22.4		9		1.73	0.101	5.2
	08/29/2008	245	64	7.5	6.9		20.3	582	7	0.06	1.15	1.54	8.9
	06/24/2009	288	93	7.5	5.7	66	22.2	1495	2	0.287	1.43	17.5	2.6
	08/18/2009	310		7.6	7.4	80.6	19.5	1588		0.081	1.08	11.5	1.1
	08/05/2010	255	>120	7.9	7.5	87.5	24.3			1.05	3.03	0.255	2.7
	08/18/2010	284	15	7.5	7.2	75.4	18	343	47	0.052	1.3	1.15	72.5
	10/06/2010	283	67	8	6.4	72	14.9		3				4.5
	10/26/2010	149	29	7.7	8	74	11.1		4				11.6
	11/16/2010		15	7.5	10.9	82.3	3.3		4				11.6
	04/19/2011	150	>120	8.1	14.2	115.6	6.5	803	5		1.23	6.11	7.6
mean =		278.0	65.5	7.7	8.2		17.0	962.2	10.1	0.3	1.5	4.9	11.9
			median above										
	means in red are not directly comparable to NC-29, Reach K site, since the sampling dates differ												
21st St. DS Murpy Oil (unmatched sample)	09/14/2009	208	>120	7.7	6.9	84.6	24.6			0.089	1.32	15.8	1.5

	Date	TP (ug/l)	Transparency (cm)	pH (s.u.)	D.O. (mg/l)	D.O. % sat	Temp (°C)	Conductivity (umhos/cm)
NC 12 Reach A	09/27/2010		100	7.8	11.3	93	6.6	
Just US of 6th St	10/14/2010		115	8.3	13.7	123.3	10.5	1344
FP 10	10/14/2010		115	8.3	13.7	123.3	10.5	1344

NC-29 Reach K	Date	TP (ug/l)	Transparency (cm)	pH (s.u.)	D.O. (mg/l)	D.O. % sat	Temp (°C)	Conductivity (umhos/cm)	TSS (mg/l)	Ammonia-N (mg/l)	Total Kjeldahl-N (mg/l)	Nitrate plus nitrite-N (mg/l)	Turbidity (ntu)
	07/01/2008	357	18	7.8	8		21.5		10	0.069	1.11	0.659	36.6
	08/12/2008	303	32	7.5	7.2		19.3		11	0.046	0.94	0.274	22.7
	08/29/2008	260	35	7.6	7.8		18.7	620	10	0.035	1.07	1.28	17.3
	06/24/2009	203	82	7.5	5.9	62.6	18.3	1478	4	0.094	1.29	14.3	7.4
	08/18/2009	311		7.6	8.5	89.1	17.4	1482	14	0.033	1.03	8.87	12.4
	08/05/2010	242	92	7.8	8.5	97.3	21.8		7		0.98	2.84	13.8
	08/18/2010	204	12	7.3	7.8	80.5	17.5	322	41	0.04	0.97	1.24	68.7
	10/06/2010	162	96	7.7	7.5	67.5	10.9		4				11.2
	10/26/2010	123	16	7.8	8.7	78.4	10.8		29				34
	11/16/2010	149	14	7.3	13	94.4	2		29				34
	04/19/2011	65	87	8.1	18.3	138.4	3.5	500	5	0.016	1.27	2.55	8.4
	mean =	216.3	33.5	7.6	9.2		14.7	880.4	14.9	0.048	1.08	4.00	24.2
			median above										

	Date	TP (ug/l)	Transparency (cm)	pH (s.u.)	D.O. (mg/l)	D.O. % sat	Temp (°C)	Conductivity (umhos/cm)
NC-8 near 3rd st.	09/20/2010		74	7.7	9.2	84.9	11.4	
NC 31 Reach L	10/14/2010		>120	8.2	13.5	123.1	10.8	1361

Table 3: Newton Creek Macroinvertebrate Survey Results 2003 to 2010

NEWTON CREEK MACROINVERTEBRATE DATA

Stations, left to right are upstream to downstream

MIBI = Macroinvertebrate index of biotic integrity; <2.5 = poor, 2.5-4.9 = fair, 5.0-7.4 = good, >7.5 = excellent

HBI = Hilsenhoff biotic index; ≤ 3.50 = excellent, 3.51-4.50 = very good, 4.51-5.50 = good, 5.51-6.50 = fair, 6.51-7.50 = fairly poor, 7.51-8.50 = poor, 8.51-10.00 = very poor

MIBI's in red are less than 2.5, which is rated as "poor"

MIBI's in green were collected outside of standard protocol time period

SWIMS NO.	DATE	MIBI	HBI	NO. OF SPECIES	% EPT INDIVIDUALS	% CHIRONOMIDAE INDIVIDUALS
10035013	10/30/2003	4.38	6.96	11	0	27
	10/30/2003	5.05	7.07	6	0	29
	06/03/2004	3.72	7.09	7	0	75
	06/03/2004	2.73	7.11	6	0	77
	10/21/2004	4.84	6.91	7	0	36
	10/21/2004	3.9	6.88	12	0	38
	06/07/2005	2.82	6.93	11	0	44
	06/07/2005	2.15	6.94	11	0	57
	11/03/2005	3.29	7.17	10	0	91
	11/03/2005	2.56	6.92	11	0	60
	11/10/2006	2.2	7.16	10	0	84
	11/10/2006	2.47	6.88	12	0	60
	05/23/2007	6.32	6.63	6	0	79
	05/23/2007	7.04	6.9	6	0	60
	11/20/2007	8.97	6.98	3	0	9
	11/20/2007	4.48	7.02	8	0	57
	05/21/2008	4.73	6.62	8	0	89
	05/21/2008	4.26	6.69	9	0	90
	11/04/2008	1.73	6.84	11	0	47
	11/04/2008	1.36	6.96	11	0	87
	06/03/2009	4.08	6.91	7	0	64
	06/03/2009	3.67	6.93	6	0	85
	11/03/2009	1.5	6.87	13	0	90
	11/03/2009	3.45	6.98	6	0	72
	11/03/2010	0.27	7.12	13	0	56
	11/03/2010	-0.15	6.95	13	0	70
	mean	3.53	6.94	9.0	0.0	62.8

SWIMS NO.	DATE	MIBI	HBI	NO. OF SPECIES	% EPT INDIVIDUALS	% CHIRONOMIDAE INDIVIDUALS
163011	10/30/2003	3.8	7.27	8	0	83
	10/30/2003	4.95	7.27	12	0	67
	06/03/2004	0.57	6.86	8	0	87
	06/03/2004	0.85	7.05	10	1	77
	10/14/2004	2.73	6.84	12	0	34
	10/14/2004	2.54	6.94	12	0	43
	06/07/2005	4.55	7.01	7	0	66
	06/07/2005	3.2	6.98	7	0	97
	11/03/2005	3.07	6.94	14	0	18
	11/03/2005	2.68	6.74	15	0	19
	11/10/2006	2.78	6.99	15	0	28
	11/10/2006	3.53	6.97	11	0	46
	05/23/2007	7.36	6.95	9	0	90
	05/23/2007	7.55	6.99	4	0	97
	11/20/2007	7.46	6.96	7	0	5
	11/20/2007	8.11	6.91	6	0	10
	05/21/2008	7.49	6.77	13	0	37
	05/21/2008	5.23	6.5	13	0	54
	11/04/2008	6.77	6.94	18	4	14
	11/04/2008	5.46	6.94	19	2	15
	06/03/2009	4.4	6.95	15	0	65
	06/03/2009	3.83	6.93	18	0	65
	11/03/2009	0.46	6.82	16	8	17
	11/03/2009	3.96	6.89	14	3	18
	11/03/2010	3.75	6.68	15	7	17
	11/03/2010	-1.23	6.8	22	12	41
	mean	4.07	6.92	12.3	1.4	46.5

Station described as NC-B (Newton Creek segment B)
46.69386, -92.05611
MIBI's range from -0.15 - 8.97 (poor to excellent)
HBI's range from 6.62 - 7.17 (fairly poor)
Worst MIBI's found in most recent samples (November 2009-2010; average = 1.27)

Station described as E. 11th St. (Newton Creek segment D)
46.69829, -92.0536
MIBI's range from -1.23 - 8.11 (poor to excellent)
HBI's range from 6.74 - 7.27 (fairly poor)
Worst MIBI's found in most recent samples (November 2009-2010; average = 1.74)

(Continued next page)

Table 3 (continued 2 of 2)

SWIMS NO.	DATE	MIBI	HBI	NO. OF SPECIES	% EPT INDIVIDUALS	% CHIRONOMIDAE INDIVIDUALS
10031895	11/02/2010	2.19	6.41	14	17	4
Station described as just upstream of 6th St.						
46.70079, 92.04739						
MIBI = poor						
HBI = fair						

SWIMS NO.	DATE	MIBI	HBI	NO. OF SPECIES	% EPT INDIVIDUALS	% CHIRONOMIDAE INDIVIDUALS
163338	10/30/2003	2.55	8.26	8	0	83
	10/30/2003	3.72	8.73	8	0	83
	06/03/2004	4.93	6.88	8	0	87
	06/03/2004	4.52	6.72	10	1	77
	10/21/2004	2.84	6.91	12	0	43
	10/21/2004	4.78	6.81	12	0	34
	06/07/2005	4.08	6.87	7	0	97
	06/07/2005	6.88	7.18	7	0	66
	11/03/2005	0.29	7.39	7	0	18
	11/03/2005	-1.14	7.25	15	0	19
	11/10/2006	-0.17	7.42	15	0	28
	11/10/2006	0.52	7.81	11	0	46
	05/23/2007	3.83	6.9	4	0	97
	05/23/2007	1.87	6.97	9	0	90
	11/20/2007	3.04	7.53	6	0	10
	11/20/2007	1.19	7.28	7	0	5
	05/21/2008	2.96	6.76	12	0	54
	05/21/2008	2.1	6.16	13	0	37
	11/04/2008	3.77	6.87	18	4	14
	11/04/2008	0.36	6.62	19	2	15
	06/03/2009	0.12	6.82	15	0	65
	06/03/2009	2.8	6.88	18	0	65
	11/03/2009	-0.03	7.16	14	3	18
	11/03/2009	-0.5	6.63	16	8	17
	11/03/2010	1.41	7.07	22	12	41
	11/03/2010	0.69	6.56	15	7	17
	mean	2.21	7.09	11.8	1.4	47.2
Station described as floodplain park area / Fp-9 (Newton Creek segment						
46.70113, -92.04683						
MIBI's range from -1.14 - 4.78 (poor to fair)						
HBI's range from 6.16 - 8.73 (fair - very poor)						
Poor MIBI's found in most recent samples (Nov. 2009-10; average = 0.39)						

SWIMS NO.	DATE	MIBI	HBI	NO. OF SPECIES	% EPT INDIVIDUALS	% CHIRONOMIDAE INDIVIDUALS
163325	11/02/2010	2.05	7.13	18	12	30
Station described as Reach K Nc-29						
46.70251, -92.04446						
MIBI = fair						
HBI = fairly poor						

Table 4: Newton Creek Fish Survey Results 2008 to 2011

NEWTON CREEK FISH SURVEY DATA, NATURAL COMMUNITY CALCULATIONS, AND SMALL STREAM IBI SCORES												
NC-9 near 3rd St. (LOWER)												
2008												
Fish Species	Number	Thermal	Size	Tolerance								
brook stickleback	4	transitional	small	tolerant		% Coldwater	0	% small	51	% intolerant	0	
common shiner	20	warmwater	medium	intermediate		% Transitional	85	% medium	48	% intermediate	12	
creek chub	90	transitional	small	tolerant		% Warmwater	15	% large	1	% tolerant	88	
eurasian ruffe	2	transitional	large	intermediate			CCH OR CWH		CCH OR CWH		CCH OR CWH	
fathead minnow	4	warmwater	small	tolerant							BUT >75% TOLERANT	
golden shiner	5	warmwater	medium	tolerant		CCH BEST FIT DUE TO LOW WW %?					AND 0% INTOLERANT	
johnny darter	2	transitional	medium	intermediate								
white sucker	65	transitional	medium	tolerant								
total =	192											
NC-9 near 3rd St. (LOWER)												
2009												
Fish Species	Number	Thermal	Size	Tolerance								
brook stickleback	16	transitional	small	tolerant		% Coldwater	0	% small	76	% intolerant	0	
common shiner	5	warmwater	medium	intermediate		% Transitional	87	% medium	24	% intermediate	8	
creek chub	29	transitional	small	tolerant		% Warmwater	13	% large	0	% tolerant	92	
fathead minnow	2	warmwater	small	tolerant			CCH OR CWH		CCH OR CWH		CCH OR CWH	
golden shiner	1	warmwater	medium	tolerant							BUT >75% TOLERANT	
white sucker	9	transitional	medium	tolerant		CCH BEST FIT DUE TO LOW WW %?					AND 0% INTOLERANT	
total =	62											

NC-9 near 3rd St. (LOWER)												
2010												
Fish Species	Number	Thermal	Size	Tolerance								
brook stickleback	18	transitional	small	tolerant		% Coldwater	0	% small	40	% intolerant	0	
common carp	1	warmwater	large	tolerant		% Transitional	95	% medium	50	% intermediate	13	
common shiner	2	warmwater	medium	intermediate		% Warmwater	5	% large	10	% tolerant	87	
creek chub	19	transitional	small	tolerant			CCH OR CWH		CCH OR CWH		CCH OR CWH	
fathead minnow	3	warmwater	small	tolerant							BUT >75% TOLERANT	
johnny darter	1	transitional	medium	intermediate		CCH BEST FIT DUE TO LOW WW %?					AND 0% INTOLERANT	
northern redbelly dace	1	transitional	small	intermediate								
trout perch	9	transitional	large	intermediate								
white sucker	49	transitional	medium	tolerant								
total =	103											
NC-9 near 3rd St. (LOWER)												
2011												
Fish Species	Number	Thermal	Size	Tolerance								
brook stickleback	44	transitional	small	tolerant		% Coldwater	0	% small	40	% intolerant	0	
common shiner	24	warmwater	medium	intermediate		% Transitional	84	% medium	58	% intermediate	18	
creek chub	18	transitional	small	tolerant		% Warmwater	16	% large	2	% tolerant	82	
trout perch	3	transitional	large	intermediate			CCH OR CWH		CCH OR CWH		CCH OR CWH	
white sucker	65	transitional	medium	tolerant					BUT >50% MEDIUM		BUT >75% TOLERANT	
total =	154					CCH BEST FIT DUE TO LOW WW %?					AND 0% INTOLERANT	

(Continued next page)

Table 4 (continued 2 of 3)

NC-9 near 3rd St. (LOWER)											
2008-2011 COMPOSITE											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	82	transitional	small	tolerant	% Coldwater	0	% small	48	% intolerant	0	
common carp	1	warmwater	large	tolerant	% Transitional	87	% medium	49	% intermediate	14	
common shiner	51	warmwater	medium	intermediate	% Warmwater	13	% large	3	% tolerant	86	
creek chub	156	transitional	small	tolerant		CCH OR CWH		CCH OR CWH		CCH OR CWH	
eurasian ruffe	2	transitional	large	intermediate						BUT >75% TOLERANT	
fathead minnow	9	warmwater	small	tolerant		CCH BEST FIT DUE TO LOW WW %?				AND 0% INTOLERANT	
golden shiner	6	warmwater	medium	tolerant							
johnny darter	3	transitional	medium	intermediate							
northern redbelly dace	1	transitional	small	intermediate							
trout perch	12	transitional	large	intermediate							
white sucker	188	transitional	medium	tolerant							
total =	511										
NC-9 near 3rd St. (LOWER)											
Small Stream IBI	IBI										
SCORE	RATING	YEAR									
50	FAIR	2008									
30	POOR	2009									
30	POOR	2010									
50	FAIR	2011									
E. 11th St. (MIDDLE)											
2008											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	8	transitional	small	tolerant	% Coldwater	0	% small	24	% intolerant	0	
creek chub	9	transitional	small	tolerant	% Transitional	96	% medium	76	% intermediate	1	
fathead minnow	2	warmwater	small	tolerant	% Warmwater	4	% large	0	% tolerant	99	
white sucker	54	transitional	medium	tolerant		CCH OR CWH		CCH OR CWH		CCH OR CWH	
pumpkinseed	1	warmwater	medium	intermediate				BUT >50% MEDIUM		BUT >75% TOLERANT	
total =	74					CCH BEST FIT DUE TO LOW WW %?				AND 0% INTOLERANT	
E. 11th St. (MIDDLE)											
2009					% Coldwater	0	% small	96	% intolerant	0	
Fish Species	Number	Thermal	Size	Tolerance	% Transitional	100	% medium	4	% intermediate	0	
brook stickleback	20	transitional	small	tolerant	% Warmwater	0	% large	0	% tolerant	100	
creek chub	7	transitional	small	tolerant		CCH OR CWH		CCH OR CWH		CCH OR CWH	
white sucker	1	transitional	medium	tolerant						BUT >75% TOLERANT	
total =	28					CCH BEST FIT DUE TO LOW WW %?				AND 0% INTOLERANT	
E. 11th St. (MIDDLE)											
2010					< 25 FISH CAPTURED						
Fish Species	Number	Thermal	Size	Tolerance							
creek chub	2	transitional	small	tolerant							
white sucker	17	transitional	medium	tolerant							
total =	19										
E. 11th St. (MIDDLE)											
2011					< 25 FISH CAPTURED						
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	11	transitional	small	tolerant							
total =	11										
E. 11th St. (MIDDLE)											
2008-2011 COMPOSITE											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	39	transitional	small	tolerant	% Coldwater	0	% small	45	% intolerant	0	
creek chub	18	transitional	small	tolerant	% Transitional	98	% medium	55	% intermediate	1	
fathead minnow	2	warmwater	small	tolerant	% Warmwater	2	% large	0	% tolerant	99	
white sucker	72	transitional	medium	tolerant		CCH OR CWH		CCH OR CWH		CCH OR CWH	
pumpkinseed	1	warmwater	medium	intermediate				BUT >50% MEDIUM		BUT >75% TOLERANT	
total =	132					CCH BEST FIT DUE TO LOW WW %?				AND 0% INTOLERANT	

(Continued next page)

Table 4 (continued 3 of 3)

E. 11th St. (MIDDLE)											
Small Stream IBI	IBI										
SCORE	RATING	YEAR									
30	POOR	2008									
20	POOR	2009									
none	POOR	2010									
none	POOR	2011									
21st St. below Murphy Oil											
(UPPER) 2008											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	159	transitional	small	tolerant		% Coldwater	0	% small	88	% intolerant	0
creek chub	51	transitional	small	tolerant		% Transitional	77	% medium	12	% intermediate	1
fathead minnow	72	warmwater	small	tolerant		% Warmwater	23	% large	0	% tolerant	99
white sucker	35	transitional	medium	tolerant			CCH OR CWH		CCH OR CWH		CCH OR CWH
pumpkinseed	3	warmwater	medium	intermediate							BUT >75% TOLERANT
total =	320					CCH BEST FIT DUE TO LOW WW %?					AND 0% INTOLERANT
21st St. below Murphy Oil											
(UPPER) 2010											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	5	transitional	small	tolerant		% Coldwater	0	% small	54	% intolerant	0
creek chub	9	transitional	small	tolerant		% Transitional	61	% medium	46	% intermediate	0
fathead minnow	24	warmwater	small	tolerant		% Warmwater	39	% large	0	% tolerant	100
golden shiner	4	warmwater	medium	tolerant			CWH		CCH OR CWH		CCH OR CWH
white sucker	29	transitional	medium	tolerant							BUT >75% TOLERANT
total =	71					CWH BEST FIT DUE TO WW %					AND 0% INTOLERANT

21st St. below Murphy Oil											
(UPPER) 2011											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	62	transitional	small	tolerant		% Coldwater	0	% small	56	% intolerant	0
common shiner	53	warmwater	medium	intermediate		% Transitional	64	% medium	44	% intermediate	35
creek chub	21	transitional	small	tolerant		% Warmwater	36	% large	0	% tolerant	65
fathead minnow	2	warmwater	small	tolerant			CWH		CCH OR CWH		CCH OR CWH
white sucker	14	transitional	medium	tolerant							BUT >75% TOLERANT
total =	152					CWH BEST FIT DUE TO WW %					AND 0% INTOLERANT
21st St. below Murphy Oil											
(UPPER)2008-2011 COMPOSITE											
Fish Species	Number	Thermal	Size	Tolerance							
brook stickleback	226	transitional	small	tolerant		% Coldwater	0	% small	75	% intolerant	0
common shiner	53	warmwater	medium	intermediate		% Transitional	71	% medium	25	% intermediate	10
creek chub	81	transitional	small	tolerant		% Warmwater	29	% large	0	% tolerant	90
fathead minnow	98	warmwater	small	tolerant			CWH		CCH OR CWH		CCH OR CWH
golden shiner	4	warmwater	medium	tolerant							BUT >75% TOLERANT
white sucker	78	transitional	medium	tolerant		CWH BEST FIT DUE TO WW %					AND 0% INTOLERANT
pumpkinseed	3	warmwater	medium	intermediate							
total =	543										
21st St. below Murphy Oil											
(UPPER)											
Small Stream IBI	IBI										
SCORE	RATING	YEAR									
40	FAIR	2008									
30	POOR	2010									
60	FAIR	2011									

Table 5: Newton Creek 2010 Sediment Grab and Trap Analytical Results

Sediment Analytical Results for 2010 Grab and Trap Samples from Newton Creek, Superior WI

Sample Type	Grab	Trap	Grab	Grab	Trap	Grab	Grab
SWIMS ID	163008	163308	10031895	163339	163325	163274	163327
Collection Date	09/20/2010	09/27/2010	10/14/2010	10/14/2010	04/21/2011	09/20/2010	10/14/2010
Segment	**A**	**A or B?**	**H**	**I**	**K**	**K**	**L**
PAHs (ng/g Dry Wt)	**DS Murphy**	**NC-12**	**6th St.**	**FP-10**	**NC-29**	**NC-8**	**NC-31**
1-Methylnapthalene	19	< 200	< 98	< 79	< 31	< 15	< 15
2-Methylnapthalene	**22**	< 53	< 110	< 65	**56**	< 8	< 8
Acenaphthylene	< 15	< 9	< 29	< 21	< 16	< 8	< 8
Acenapthene	< 8	< 18	< 24	< 21	< 31	< 15	< 15
Anthracene	**70**	**96**	**120**	**92**	**68**	18	< 8
Benzo(a)anthracene	**180**	**130**	**540**	**370**	**510**	**110**	53
Benzo(a)pyrene	**180**	130	**520**	**420**	**210**	140	65
Benzo(b)fluoranthene	170	130	**550**	**450**	**330**	170	90
Benzo(g,h,i)perylene	**200**	**260**	**470**	**390**	**180**	120	70
Benzo(k)fluoranthene	130	100	**510**	**370**	190	120	59
Chrysene	**200**	**190**	**720**	**530**	**930**	**170**	90
Dibenz(a,h)anthracene	**42**	< 45	**150**	**110**	**70**	**35**	27
Fluoranthene	410	180	**1200**	**880**	**1400**	230	130
Fluorene	39	< 42	< 59	< 150	< 53	< 8	< 8
Indeno(1,2,3-c,d)pyrene	170	140	**490**	**400**	**260**	150	79
Naphthalene	< 15	< 18	< 62	< 33	< 31	< 15	< 15
Phenanthrene	**300**	110	**510**	**330**	**440**	90	41
Pyrene	**300**	170	**1000**	**730**	**1100**	190	110
$TPAH_{18}$ (ng/g) [1,2]	**2,470**	**2,021**	**7,162**	**5,441**	**5,906**	**1,612**	891
Total Organic Carbon (ug/g)	14,800	23,900	54,440	53,500	43,700	20,400	12,800
$TPAH_{18}$ OCN[3] ng/g	**1,669**	846	1,316	1,017	1,351	790	696
Nondetects (%)	17	39	33	33	28	33	39
Total Solids (%)	66	55	42	48	32	66	66
Compounds not included in TPAH							
Benzo(e)pyrene	150	240	530	430	220	130	70
3,6-Dimethylnapthalene	< 15	< 58	< 93	< 21	< 38	< 15	< 15

	A	A or B?	H	I	K	K	L
	DS Murphy	**NC-12**	**6th St.**	**FP-10**	**NC-29**	**NC-8**	**NC-31**
Oil & Grease (mg/kg)	4,130	5,103	4,505	5,500	1,290	4,343	612
Lead (mg/kg)	**37**	**51**	**64**	**62**	**63**	22	18
Percent Solids	63.4	53.7	36.3	44.8	18.9	43.8	59.5
%Sand	56	61	51	64	68	77	65
%Clay	29	29	23	18	11	15	23
%Silt	15	10	26	18	21	8	12
Number of Grabs Attempts	13	Jar	13	15	Jar	13	16

[1] TPAH 18 summation done using same 18 indivdual compounds as previous SEH investigaitons by SEH

[2] Nondetects were substituted at 1/2 the detection level where % nondetects > 40%. The detection

[3] OCN - Organic carbon normalized concentration

Bold - detected level in sample exceeds Threshold Effects Concentraion (TEC) in WDNR 2003

Bold *and shaded* - detected level in sample exceeds Midpoint Effect Concentraion (MEC) in WDNR 2003

Table 6: Newton Creek 2012 Sediment Organics & Toxicity Results

Organics & Toxicity Testing Results for October 17-18, 2012 Newton Creek Samples, Superior WI

Newton Creek 2012 Sediment Characterization CAP_10_2012

PAHs (ng/g Dry Wt)	BC@Z	SEG A/B	SEG C	SEG H	SEG L
1-METHYLNAPHTHALENE	< 27	< 25	< 42	31	< 17
2-METHYLNAPHTHALENE	< 27	***30***	< 42	***46***	< 17
ACENAPHTHENE	< 27	< 25	< 42	< 25	< 17
ACENAPHTHYLENE	< 18	< 17	< 28	< 16	< 12
ANTHRACENE	< 18	41	< 2	< 46	< 12
BENZO (A) ANTHRACENE	31	53	< 42	***113***	< 17
BENZO (A) PYRENE	< 27	58	58	121	19
BENZO (B) FLUORANTHENE	38	71	89	126	21
BENZO (G H I) PERYLENE	< 27	90	81	89	< 17
BENZO (K) FLUORANTHENE	< 27	36	47	72	< 17
CHRYSENE	< 27	59	61	157	< 17
DIBENZO (A H) ANTHRACENE	< 27	< 25	< 42	< 31	< 17
FLUORANTHENE	64	92	94	180	28
FLUORENE	< 27	< 25	< 58	< 56	< 17
INDENO (1,2,3-C D) PYRENE	31	76	103	102	19
NAPHTHALENE	< 27	< 25	< 42	26	< 17
PHENANTHRENE	20	54	36	103	15
PYRENE	44	90	78	***210***	23
$TPAH_{18}$ (ng/g) [1,2]	381	892	817	1,550	222
Total Organic Carbon (ug/g)	15,100	18,100	36,000	27,300	1,760
$TPAH_{18}$ OCN[3] ng/g	354	493	274	568	1,813
Nondetects (%)	67	33	50	28	67
Total Solids (%)	55	59	36	61	86
Compounds not included in TPAH	**BC@Z**	**SEG A/B**	**SEG C**	**SEG H**	**SEG L**
Benzo(e)pyrene	< 27	85	83	138	< 17
2,7-Dimethylnaphthalene	< 18	< 42	< 28	< 52	< 12
Coronene	< 91	< 85	< 140	< 82	< 58
Retene	< 18	< 17	< 28	< 16	< 12

[1] TPAH 18 summation done using same 18 indivdual compounds as previous SEH investigaitons by SEH

[2] Nondetects were substituted at 1/2 the detection level where % nondetects > 40%. The detection level was used where % nondetects was less than 40% per CBSQG WDNR 2003

[3] OCN - Organic carbon normalized concentration

Bold - detected level in sample exceeds Threshold Effects Concentraions (TEC) in WDNR 2003

Diesel Range Organics[4]	BC@Z	SEG A/B	SEG C	SEG H	SEG L
DRO (mg/kg)	< 2	24	29	26	3

[4] Pace Analytical, Green Bay, WI Project No.: 4069213

Sediment Toxicity Testing[5] Survival	BC@Z	SEG A/B	SEG C	SEG H	SEG L
Midge (C tentans)					
Scud (H Azteca)					
Growth					
Midge (C tentans)	X	X	X	X	
Scud (H Azteca)	X	X			

X - indicates significant difference from laboratory control

[5] WSLH Report FX000415-419 February 28, 2013

Table 7: Newton Creek 2012 Sediment Inorganics Results

Inorganics Testing Results for October 17-18, 2012 Newton Creek Samples, Superior WI

Newton Creek 2012 Sediment Characterization CAP_10_2012

	BC@Z	SEG A/B	SEG C	SEG H	SEG L
CADMIUM (mg/kg)	0.2	0.1	0.3	0.2	0.1
CHROMIUM (mg/kg)	39.6	***48.5***	***49.9***	34.3	***48.5***
LEAD (mg/Kg)	11.0	21.0	27.0	***37.0***	21.0
MERCURY (mg/kg)	0.03	0.13	0.13	0.17	0.13
Ammonia-N (mg/L)	22.6	37.4	249.0	14.4	37.4
Percent Solids (%)	54.5	58.0	32.0	64.3	58.0
SAND (%)	35.0	25.0	32.0	55.0	25.0
SILT (%)	23.0	29.0	39.0	20.0	29.0
CLAY (%)	42.0	46.0	29.0	25.0	46.0

Bold - Detected level in sample exceeds Threshold Effects Concentraions (TEC) in WDNR 2003

Table 8: Hog Island Inlet Water Quality Data 2008 - 2009

Hog Island Inlet Water Quality Data 2008-2009

Date	TP (ug/l)	NH_3-N (mg/l)	TKN (mg/l)	NO_3+NO_2 (mg/l)	CHL a (ug/l)	E. coli no./100ml	Fecal coliform no./100ml	Temp. °C	pH (s.u.)	Dissolved Oxygen (mg/l)	Conductivity (umhos/cm)
07/01/2008	80	0.15	1.13	0.26	0.49	29.2		22.9	7.3	6.7	
08/05/2008	50	< detect	0.62	0.11	3.78	40	27	24.6	8.1	9.5	
08/29/2008	110	0.05	0.93	0.37	12.1			19.4	7.8	8.4	271
06/24/2009	50	0.02	1.04	1.51	9.82	47	20	20.6	7.6	8	353
08/18/2009	70	0.02	0.51	0.67	13.4			20.3	8.1	9.5	353
mean	70	0.05	0.85	0.58	7.9	38.7	23.5	21.6	7.8	8.4	325.7

Table 9: Hog Island Inlet Mini-Fyke Net Survey Results 2004 - 2010

HOG ISLAND INLET MINI-FYKE NETTING RESULTS, 2004-2010					
			No. captured/2 fyke nets		
Common Name	Scientific Name	Tolerance*	2004	2008	2010
Black bullhead	Ameiurus melas	tolerant	4972	252	75
Black crappie	Pomoxis nigromaculatus	intermediate		3	226
Bluntnose minnow	Pimephales notatus	tolerant		1	
Brook silverside	Labidesthes sicculus	intermediate		1	
Common carp	Cyprinus carpio	tolerant	13		17
Common shiner	Luxilus cornutus	intermediate	10	7	8
Emerald shiner	Notropis atherinoides	intermediate	27	7	
Eurasian ruffe	Gymnocephalus cernuus	intermediate		6	1
Golden shiner	Notemigonus crysoleucas	tolerant	17	56	17
Hornyhead chub	Nocomis biguttatus	intermediate	2	2	
Log perch	Percina caprodes	intermediate			2
Pumpkinseed	Lepomis gibbosus	intermediate		3	93
Pumpkinseed x bluegill	L. gibbosus x L. macrochirus	intermediate	40	322	1770
Rock bass	Amblopites rupestris	intolerant	2	6	10
Round goby	Neogobius malanostomus	intermediate		1	1
Spottail shiner	Notropis hudsonius	intolerant		31	1
Trout perch	Pecopsidae omiscomaycus	intermediate		1	
Tubenose goby	Ptoterorhinus marmoratus	intermediate			2
White perch	Morone americana	intermediate			1
White sucker	Catostomus commersonii	tolerant	3		1
Yellow perch	Perca flavescens	intermediate		8	25
		Total individuals	5086	707	2250
		No. of species	9	16	16
		No. tolerant species	4	3	4
		% tolerant individuals	98.4	43.7	4.9
		No. intermediate species	4	11	10
		% intermediate individuals	1.6	51.1	94.6
		No. intolerant species	1	2	2
		% intolerant indivduals	0.04	5.2	0.5
* overall tolerance to environmental degradation					