Quality Assurance Project Plan (QAPP) for Quarterly Water Quality Monitoring of Huron Creek

Houghton, MI

Prepared By:

Linda D. Kersten, Dr. Alex S. Mayer

Michigan Technological University, Center for Water & Society

Prepared For:

Michigan Department of Environmental Quality (MDEQ)

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Signature of MDEQ Reviewer Date

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1.0 INTRODUCTION

The Huron Creek watershed is an approximate 3.4 square mile watershed that is located in north central Houghton County in the Upper Peninsula of Michigan (Figure 1). Water quality monitoring, geomorphology and biological surveys are planned to be completed on Huron Creek as part of the creation of a watershed management plan. This document provides a description of monitoring and quality assurance methods to be used in the form a Quality Assurance Project Plan (QAPP). This QAPP has been prepared in accordance with the Michigan Department of Environmental Quality's (MDEQ) guidance document "*Quality Assurance Project Plan (QAPP) Guidance for Water Quality Monitoring."* The following sections are included:

- Project Management
- Study Design
- Measurement/Data Acquisition
- Assessment and Oversight
- Data Validation and Usability

A references section and distribution list are included at the end of this document.

2.0 PROJECT MANAGEMENT

2.1 Project/Task Organization

Key Personnel

Dr. Alex Mayer – Director, Michigan Tech Center for Water & Society
Department of Geological & Mining Engineering & Sciences
Michigan Technological University
1400 Townsend Drive Houghton, MI 49931
Phone: 906-487-3372, Fax: 906-487-3371, asmayer@mtu.edu

Linda Kersten - Graduate Candidate, Environmental Engineering
Department of Civil and Environmental Engineering
Michigan Technological University
1400 Townsend Drive Houghton, MI 49931
Phone: 920-660-1686, Fax: 906-487-2943, ldkerste@mtu.edu

White Water Associates, Inc.
429 River Lane, P.O. Box 27
Amasa, Michigan USA 49903
Phone: 906-822-7889, Fax: 906-822-7977
Project Contact: Bette Premo, bette.premo@white-water-associates.com

Michigan Department of Community Health – Houghton Office
1402 E. Sharon Avenue
Houghton, MI 49931
Phone: 906-487-3011

Roles and Responsibilities

Dr. Alex Mayer and the Center for Water & Society (CWS) will provide oversight of monitoring activities, data management and analysis, and quality assurance. Linda Kersten will coordinate and complete water quality monitoring, as well as manage data and analyze results.

White Water and Associates, Inc., and the Michigan Department of Community Health will provide analytical laboratory testing.

2.2 Problem Definition and Background

There are several existing environmental conditions in the watershed that have raised concern for the water quality of Huron Creek, as well as the watershed as a whole. These conditions are considered to have potential for negative environmental impact. They include:

- Existing water quality
- Past mining activities
- Leachate from unlined landfills
- Aging or inappropriately designed septic systems
- Concentrated urban development (storm water quality/quantity concerns)

Existing Water Quality

Huron Creek is on the "Further Evaluation" section of the Michigan 303(d) list, primarily due to water quality concerns associated with landfill leachate and commercial development upstream. The creek empties into the Portage Canal, which is hydraulically connected to the source of drinking water for the City of Houghton.

Past Mining Activities

Two copper mines operated within the watershed during the copper boom from 1852 to 1945. These mines ran stamping mills that created an excess of stamp sands (Figure 2) that may be leaching copper, arsenic, and/or mercury into the watershed. Erosion of stamp sands from deposits located directly on the stream banks has contributed to sediment buildup in the stream.

Landfill Leachate

Two landfills are located within the boundaries of the Huron Creek watershed (Figure 2). The first landfill opened in the 1950's and was closed in the early 1970's. The boundaries and impact of this landfill are reasonably well defined. This capped landfill is leaching flocculent slime, high levels of dissolved solids, and ammonia, affecting water quality and recreational use of the stream. The second landfill opened upon the closure of the first. The boundaries, period of operation, and impacts of this landfill have not been investigated sufficiently. These issues are currently being addressed by the City of Houghton.

Septic Systems

A number of residential zones in the watershed have aging septic systems (Figure 2) with lot sizes too small for efficient drain fields. Initial microbiological testing did not indicate water quality impacts from septic systems. However, more extensive testing is required for appropriate evaluation of this issue.

Urban Development

Between 1978 and 2005, the Huron Creek watershed's developed areas increased by 15.4%. Currently, 29.8% of the watershed is considered to be developed (Figure 3). 13.6% of the watershed is estimated to be covered by impervious surfaces. This percent of impervious surface cover categorizes the watershed as impacted by the U.S. Environmental Protection Agency. Common impacts related to these trends include increased runoff from roofs and parking lots containing road salts, sediments, and automobile pollutants.

Direct impacts from development have included filling of several wetlands and the re-routing of Huron Creek on two separate occasions.

Continued water quality monitoring, biological assessment and geomorphology surveys will be designed to address and evaluate these potential concerns. Conclusions drawn from evaluated data will be used to recommend best management practices (BMPs) for the watershed management plan, thereby minimizing or eliminating impacts. The watershed management plan is currently being written by Linda Kersten and Dr. Alex Mayer of the MTU Center for Water & Society. Monitoring results will be made available to the public through the final watershed management plan.

2.3 Project/Task Description

Water Quality Sampling (Dry Weather)
Water quality sampling for Huron Creek will take place quarterly[1] at 5 locations along the creek (Figure 4). Grab samples of creek water will be obtained at each location, and analyzed for various field parameters and laboratory-determined parameters. Field parameter analysis will be completed in-stream at the time of collection using the appropriate probe or meter. Laboratory analysis will be completed by an outside contract laboratory. Measurement and analytical methods are described in more detail in section 3.0.

2.4 Data Quality Objectives

All laboratory analysis will be completed by White Water and Associates, Inc (WWA) and the Michigan Department of Community Health (MDCH)[2]. Both laboratories hold state (Michigan) and federal quality assurance/quality control (QA/QC) certification.

All field analysis will be completed by Linda Kersten and other assistants who will follow the methods described in this QAPP. The level of quality required for field analysis is such that the resulting data:

- Falls within a reasonable range of expected and/or previously collected data
- Is above the detection limits of the instruments used to collect the data
- Is reported within the number of significant digits that is appropriate for the accuracy of the instruments used
- Under similar conditions, can be easily reproduced within a reasonable range of accuracy. (i.e. a second reading taken to verify the first should be within reasonably close range of the first)

Precision of laboratory analyzed samples will be monitored through the use of duplicate samples. The precision of data collected in the field will be monitored through the use of duplicate measurements of the same grab sample. Precision will be calculated using the following formula for Relative Percent Difference (RPD):

$$RPD = [ABS(Cs - Cd) / (0.5 \times (Cs + Cd))] \times 100$$

Where Cs = Concentration of sample
Cd = Concentration of duplicate
ABS( ) = Absolute value function

Data is considered to be below acceptable precision levels when analysis of the duplicate yields an RPD greater than 20%. Data meeting this criteria will be flagged. When repeated RPDs >

[1] August, November, February, May

20% occur, sampling and test methods will be examined and modified to decrease the RPD. Duplicate sampling is further discussed in section 4.0.

Accuracy of laboratory results will be monitored through the methods outlined in WWA and MDCH's QA/QC plans. Accuracy of field parameter data will be monitored by consistently calibrating instruments in accordance with manufacturer's instructions. This includes following recommended methods and calibration frequencies. If the accuracy of a sample or set of sample results is under question (i.e. the result does not fall within a reasonable range or is below detection limits), the data will be flagged indicating it as such. This will be followed by checking the calibration of the instruments at the laboratory following the survey.

Representativeness of the population of samples will be examined after every quarterly sampling event. Currently, 5 sampling locations will be used over 3.3 miles of creek (this is the entire length of Huron Creek). If a portion or portions of the creek warrant additional sampling locations, a revision will be made to the QAPP and submitted to the MDEQ for review. It is not anticipated that the number of sample locations will be reduced.

Comparability of laboratory analyzed samples will be reviewed through WWA and MDCH's QA/QC plan. Comparability of field data will be maintained through the use of consistent sampling and monitoring methods. If resulting data does not appear to be comparable to past data sets (i.e. data is magnitudes of order outside of previous ranges, etc.) additional samples will be analyzed and compared to either validate or negate the data.

Completeness of a ≥95% is expected from laboratory analysis completed by WWA and MDCH. ≥90% completeness is also expected of all field data analysis, depending on environmental conditions.

Table 1 below summarizes quality assurance criteria for quarterly water quality monitoring:

Table 1 - Data Quality Assurance Criteria

Procedure	Accuracy	Precision	Representativeness/ Comparability	Completeness
Water Quality Monitoring (Field Analysis)	- Calibrate & Check Instruments - Check for Results in Reasonable Range	Analyze Duplicates, Check RPD	- Review Number of Samples/Sample Locations - Compare Results with Past Data Sets	≥90%
Water Quality Monitoring (Lab Analysis - Independent Lab)	Per QA/QC Plans of WWA & MDCH	Analyze Duplicates, Check RPD	- Review Number of Samples/Sample Locations - Compare Results with Past Data Sets	≥95%

2.5 Training Requirements

All water quality sampling and results analysis will be completed by Linda Kersten and/or Dr. Alex Mayer. Any persons assisting in these tasks will be trained prior to the survey or sampling event in the following:

- Proper use and calibration of instruments
- Proper sampling technique
- Proper data collection/interpretation

Persons assisting in these activities will be MTU undergraduate or graduate students, or persons from the community who have an interest in the project.

2.6 Documentation and Records

Results of water quality testing will be maintained on Excel spreadsheets and kept by Dr. Alex Mayer at the MTU CWS. The records will be kept on file and will not be discarded or deleted. All water quality data will be entered into a STORET-ready spreadsheet for submittal to MDEQ. Original files of results produced by outside laboratories will also be maintained at the MTU CWS.

3.0 STUDY DESIGN

3.1 Project Goals

Quarterly (dry weather) water quality monitoring activities are designed for evaluation of:

- A near-source "undisturbed" location (near Green Acres Road)
- Locations downstream of some disturbance, old mining and/or development (near Wal-Mart and the "Frog Pool" location)
- A location directly downstream of the landfill located west of Razorback Drive ("downstream landfill") location
- A location near the mouth of the creek that reflects water quality of entire drainage area (Houghton Waterfront Park location).

The chosen field and laboratory parameters are designed to address and monitor the following item's effects on water quality:

- Past mining activities (stamp sand deposits)
- Leachate from pre-modern landfills
- Aging septic systems
- Increasing urban development
- Provide a characterization of "background" water quality in the creek (for comparison)

3.2 Sampling and Parameter Details

Table 2 below provides a summary of sample collection methods, sampling frequencies and periods, and number of sampling locations. Table 3 summarizes the parameters to be measured and total number of samples.

Table 2 – General Sample Collection Summary

Procedure	Task	Collection	Sample Frequency	Sampling Period[3]	Sample Labeling
Water Quality Sampling	Dry Weather Sampling	grab sample	Quarterly	Year-round	Date, Time, Location, Sampler

[3] Quarterly, year-round sampling by MTU will be completed through May 2008 at a minimum. Who completes future sampling will be indicated as part of the Huron Creek Watershed Management Plan.

Table 3 – Parameters and Number of Samples

Task	Parameter Name	Field / Lab	# of Sampling Sites	# of Measurements/Samples Per Site
Water Quality Sampling (Quarterly/Dry Weather)	Dissolved Oxygen	Field	5	1
	pH	Field	5	1
	Conductivity	Field	5	1
	Turbidity	Field	5	1
	Temperature	Field	5	1
	Alkalinity	Lab	5	1 - 250 mL bottle
	Hardness (t)[1]	Lab	5	1 - 500 mL bottle
	Iron (t)	Lab		
	Manganese (t)	Lab		
	Arsenic (t)	Lab		
	Barium (t)	Lab		
	Cadmium (t)	Lab		
	Chromium (t)	Lab		
	Copper (t)	Lab		
	Lead (t)	Lab		
	Mercury (t)	Lab		
	Selenium (t)	Lab		
	Silver (t)	Lab		
	Zinc (t)	Lab		
	Ammonia Nitrogen	Lab	5	1 - 500 mL bottle
	Nitrate/Nitrie-N	Lab		
	Total Kjeldahl Nitrogen	Lab		
	Total Phosphorus	Lab		

1. (t) = Total

3.3 Data Analysis and Interpretation

Water quality data will be compiled in a tabular format that is conducive to comparison of values over time, and for quick identification of regulatory exceedances. This data will also be compiled graphically to provide for analysis of temporal trends. Trends will be further identified using the T-test with an α (alpha) value of 0.05 representing a significant trend.

4.0 MEASUREMENT / DATA ACQUISITION

4.1 Sampling Process

For all field sampling procedures, when unexpected weather conditions occur, sampling will either be delayed or postponed until ideal conditions exist. Sampling will occur as soon as possible after the originally scheduled sampling date and/or time.

Safety is not a major concern in the Huron Creek area. Most sampling locations are not difficult to access. Some locations do have steep banks or slopes, but they can be avoided by accessing the creek up or down stream, and traveling along the creek to the desired location.

4.2 Sample Handling, Cleaning and Custody Requirements

- Handling – Water samples will be collected in bottles provided by contract laboratories, or in those that have been rinsed several times with deionized water and dried. Water bottles will be filled with an air space remaining at the top, sealed and placed immediately in a cooler with ice such that the sample temperature remains at or below 4 degrees Celsius. Samples will be collected beginning with sites having the least environmental contamination and ending with sites suspected of having the most contamination.

- Cleaning and Decontamination – Probes used to take in situ measurements will be rinsed with deionized water prior to use for each sampling location and after the last use.

- Labeling – Labels will be applied to each sample collected indicating the sample location, date, time and sampler.

- Chain-of-Custody – A chain-of-custody form will be filled out for all samples submitted to analytical laboratories outside of MTU. These forms are provided by the laboratories. The form to be used (provided by WWA) is attached to this report.

4.3 Sample Analytical Methods

Details of water quality sample analytical methods and sampling equipment is provided in Table 4 below:

Table 4 – Sample Analytical Methods and Equipment

Procedure	Laboratory Test	Test Standard/Equipment	Detection Limit
Water Quality Sampling (Quarterly/ Dry Weather)	Michigan 10 Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver, Copper and Zinc	SW 846 6010/7000 Series	Arsenic 1 ug/L, Barium 1 ug/L, Cadmium 0.6 ug/L, Chromium 0.8 ug/L, Lead 0.6 ug/L, Mercury 0.1 ug/L, Selenium 1 ug/L, Silver 0.2 ug/L, Copper 0.7 ug/L, Zinc 1 ug/L
	Total Phosphorus	SM 4500	0.01 mg/L
	Total Kjeldahl Nitrogen	351.2	0.05 mg/L
	Ammonia Nitrogen	220.3	0.05 mg/L
	Nitrate-Nitrite Nitrogen	SM 4500	0.05 mg/L
	Alkalinity	310.2	5 mg/L
	Hardness	130.2	0.1 mg/L
	pH	Accumet Model 50 pH/Temp Meter	--
	Conductivity	Orion Model 135 Conductivity Meter	--
	Dissolved Oxygen	YSI DO Meter Model 58	--
	Turbidity	Hatch 2100P Turbidimeter	--
	Total Suspended Solids	WWA Lab SOP-A-593-01-2006[1]	--
	Temperature	Accumet Model 50 pH/Temp Meter	--

4.4 Quality Control Samples

For each quarterly sampling event, one set of duplicate samples will be collected at a designated monitoring location. These samples will be used to analyze precision of laboratory results.

4.5 Equipment Inspection and Calibration

Monitoring probes used in field analysis will be tested prior to the sampling event to ensure they are functioning properly. Each probe will also be calibrated in the field the day of the sampling event prior to its first use. Calibrations will be completed in accordance with manufacturer guidelines. If a probe appears to not be functioning or calibrating properly, the appropriate maintenance or repair will be completed prior to field monitoring.

5.0 DATA VALIDATION AND USABILITY

Water quality data will be review by Linda Kersten and Alex Mayer for validation and usability. This will be completed in accordance with review methods described in section 2.4. Data that is identified as meeting the quality control criteria will be used in identifying critical areas and pollutant sources in the watershed.

6.0 REFERENCES

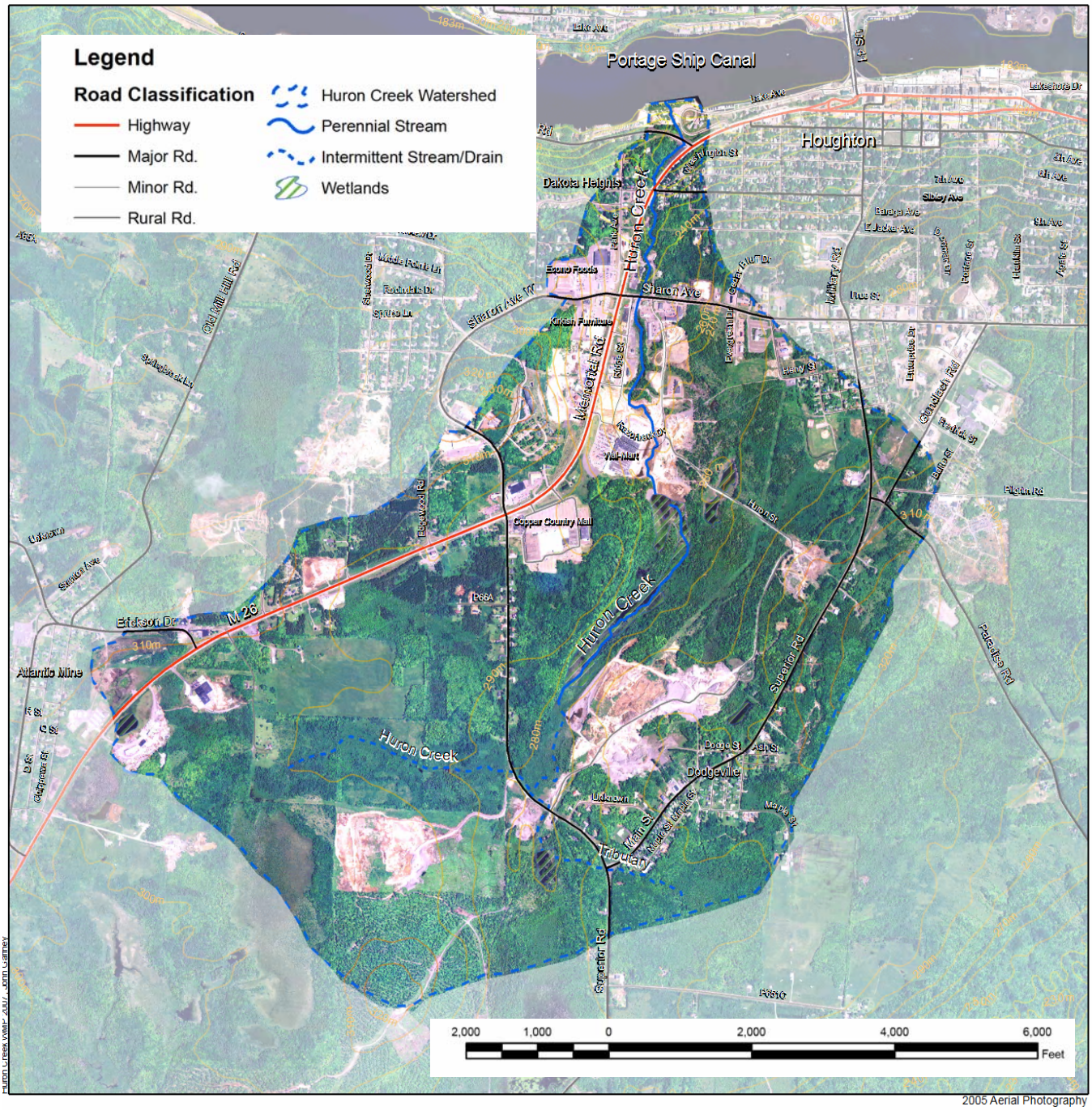
Annis Water Resources Institute - GVSU. *Quality Assurance Project Plan for the White River Watershed Planning Project.* 2007

Michigan Department of Environmental Quality. *Quality Assurance Project Plan (QAPP) Guidance for Water Quality Monitoring.*

7.0 DISTRIBUTION LIST

- Joe Rathbun, NPS Monitoring Coordinator, Michigan Department of Environmental Quality
- Chad Kotke, NPS Grants Coordination, Michigan Department of Environmental Quality
- Center for Water and Society, Michigan Technological University

FIGURES



Complied By: John Gaffney, Michigan Tech University Spring 2007
Data Sources: Michigan Geographic Data Library, Linda Kersten, Michigan Tech
Projection: NAD 1983 UTM Zone 16N

Figure 1– Huron Creek Watershed

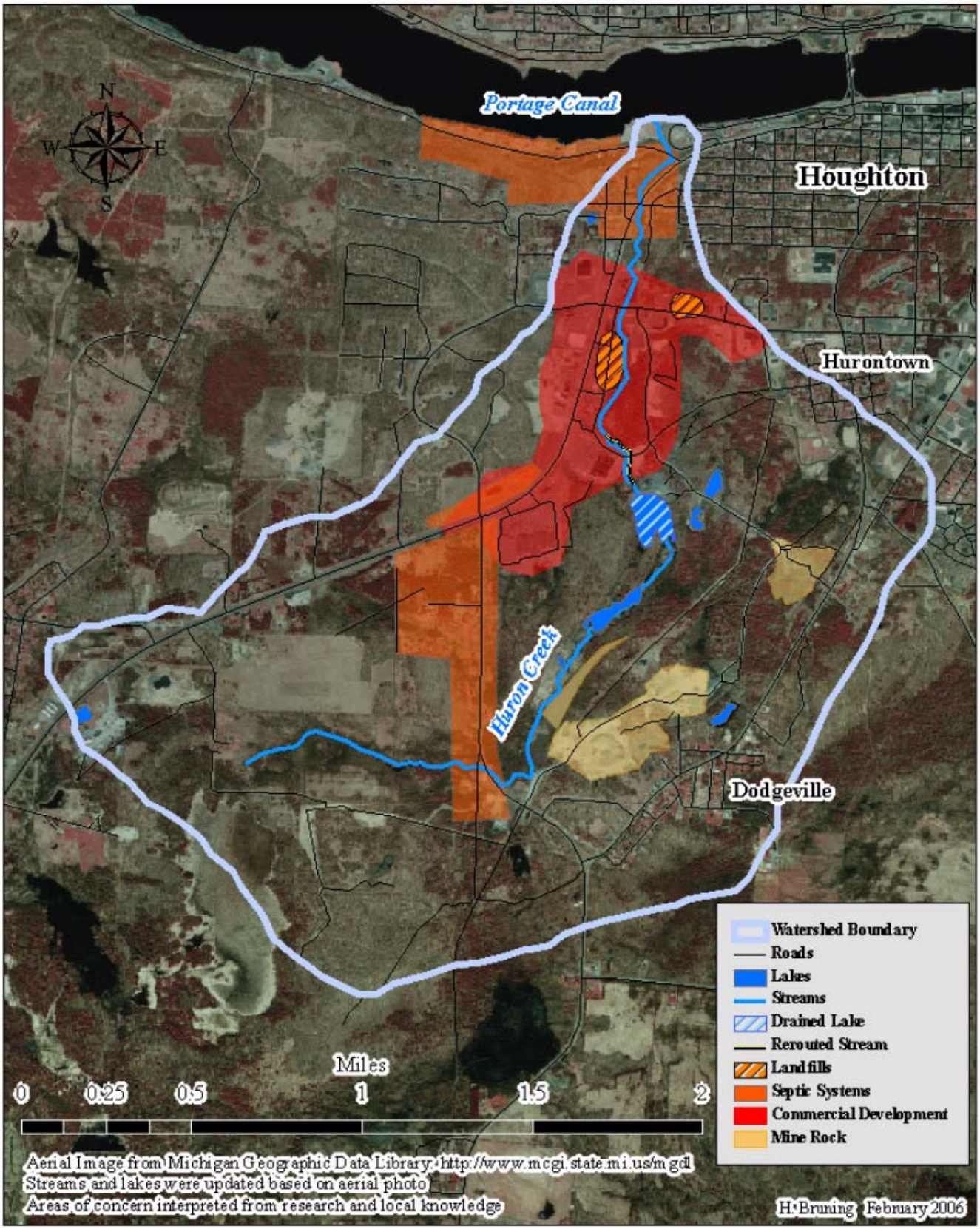


Figure 2 – Huron Creek Watershed Existing Environmental Impacts

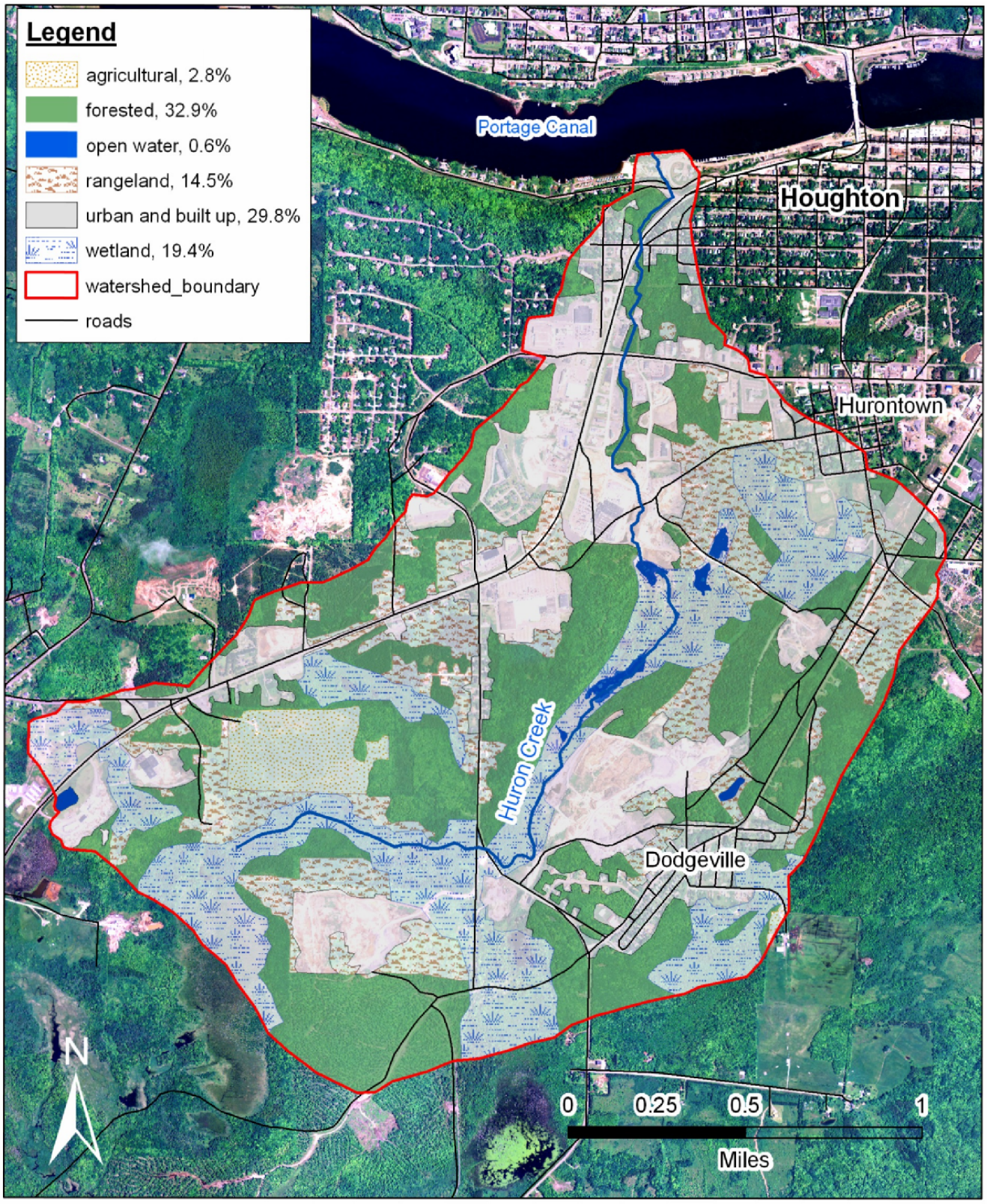


Figure 3 – 2005 Huron Creek Watershed Land Use Map

Created By: Linda Kersten, 12/20/06
Map Projection: NAD 1927 UTM Zone 16N

Data Source: 2005 NAIP 1-meter Digital Orthophoto

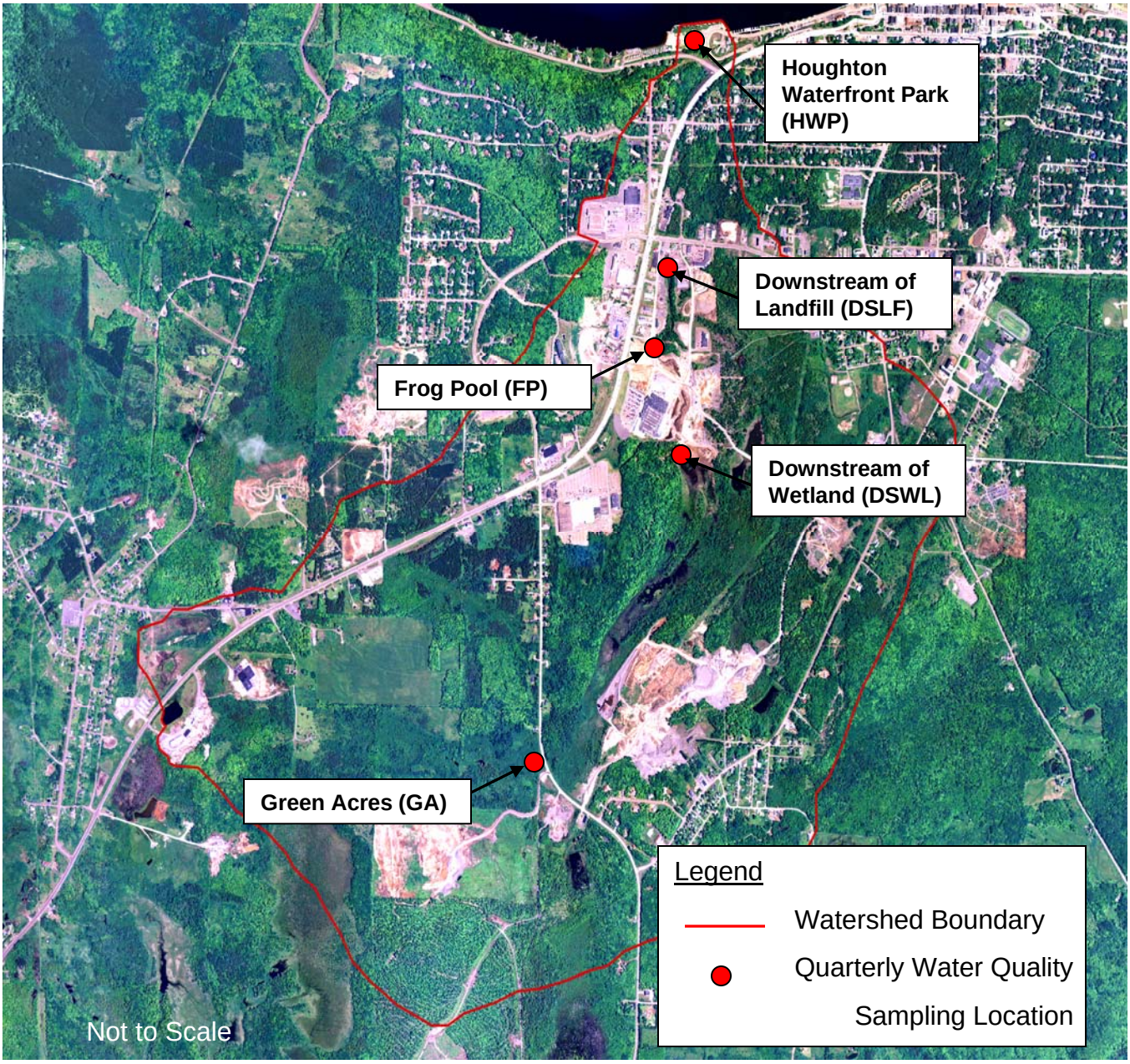


Figure 4 – Huron Creek Quarterly Water Quality Sampling Locations

Created By: Linda Kersten, 8/17/07
Map Projection: NAD 1927 UTM Zone 16N

Data Source: 2005 NAIP 1-meter Digital Orthophoto

APPENDIX

White Water Associates Chain-of-Custody Form

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

J.O.#	CLIENT NAME ADDRESS PHONE #	ANALYSIS TYPE REQUESTED
SAMPLER'S SIGNATURE		

SAMPLE LOCATION	SAMPLE I.D.#	TIME	DATE	SAMPLE TYPE											REMARKS:
				Grab	Composite	Matrix									

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Received by:

Relinquished by:	Date:	Time:	Received by Laboratory:	Date Time	Remarks:

WHITE WATER ASSOCIATES, INC.
429 River Lane, P.O. Box 27
Amasa, Michigan 49903
Phone (906) 822-7373, Fax -7977