

# QUALITY ASSURANCE PROJECT PLAN

for Best Management Practice Water Quality Sampling

Associated with the  
Portage and Arcadia Creeks  
Section 319 Nonpoint Source Pollution Transition Grant

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October 31, 2005

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3.1	BMP Sites Selected by the Steering Committee
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## Section 1: Distribution List

Agency:	Janelle Hohm, Michigan Department of Environmental Quality-Surface Water Quality Division, Kalamazoo District Office
Grantee:	William Reed, Executive Director, Forum of Greater Kalamazoo, Kalamazoo, Michigan - project administration and management
Subcontractor:	Mark Kieser, Principal Scientist, Kieser & Associates, Kalamazoo, Michigan - technical project management  Brian Boyer, Engineering Manager, Kieser & Associates - quality assurance, corrective action, fieldwork and analysis  Jeffrey Spoelstra, Project Scientist, Kieser & Associates - fieldwork and analysis

## Section 2: Introduction

A Section 319 Nonpoint Source Pollution Grant was awarded to The Forum of Greater Kalamazoo during 2004. This “Transition Grant” supports activities related to updating the Portage and Arcadia Creeks Watershed Management Plan (WMP) in order to qualify it for approval under the United States Environmental Protection Agency nine elements requirements.

One task defined in the Transition Grant work plan involves grab sampling at existing and future Best Management Practice (BMP) sites. The Steering Committee recommended several existing and proposed BMP sites during regular meetings in 2004 and 2005. Existing BMPs are to be sampled in order to establish differences between inflow and outflow water volume and concentration of parameters of interest. Other sites are to be sampled to quantify loading conditions prior to BMP implementation in order to allow before and after BMP implementation comparisons.

The Kalamazoo Water Reclamation Plant (KWRP) has agreed to process samples in their laboratory as an in-kind contribution to the project qualifying as local match. Sue Foune is the KWRP director. Parameter concentrations in soils were also identified by the Steering Committee as important for one targeted BMP site. Soil analysis will also occur at the KWRP. Soil samples will be collected at one site of interest to compare soil phosphorus content in areas that experience heavy and light waterfowl traffic.

This QAPP is abbreviated due to the existence of a previous QAPP approved in 2001 under the previous 319 Watershed Management Planning Grant. The 2001 QAPP covered QAQC details of surface water sampling associated with the development of the WMP including autosampling with ISCO autosampling devices and instream grab sampling during wet and dry

weather conditions. The same general procedures are still in place for the project team. New information is specific to BMP sampling of sites selected by the Steering Committee.

### **Section 3: Project Description and Goals**

The goal of this project will be to update the existing WMP and generate a nine elements approved WMP for both Arcadia and Portage Creeks, adjacent tributaries draining to the Kalamazoo River. The plan will focus on short and long-term goals to improve water quality, incorporating stakeholders' needs and expressed desires in a flexible framework. A Steering Committee of interested and key stakeholders will direct the course and direction of these efforts with the basis of communications maintained through an independent internet website dedicated solely to this project and future related efforts.

The objective of the project will be to provide the community with a plan to implement desired goals for water quality improvements and protection, as well as a consistent venue to communicate, adapt and revise the overall plan as new information is obtained and milestones completed. The plan will serve as a template for established jurisdictions to adopt short-term and long-term goals that accommodate existing infrastructure and established community visions, as well as allow growing areas of these watersheds to enact new policies and practices, which better address water quality protection.

There are several tasks involved in the development of a nine elements approved WMP for Portage and Arcadia Creeks. One area that will be used to evaluate current and future management options is BMP monitoring. As such, this Quality Assurance Project Plan (QAPP) has been prepared to ensure the production of reliable and accurate data that can aid in the assessment and selection of Best Management Practices (BMPs) for the watersheds. The Steering Committee has identified and approved sampling of several BMPs highlighted in Table 3.1.

### **Section 4: Project Organization and Responsibility**

The FORUM for Greater Kalamazoo will serve as the Administering body for this project. Mr. William Reed, Acting Executive Director of the FORUM, will serve as Director for grant administration and institutional coordination.

All technical elements of this project will be conducted by the consulting team of KIESER & ASSOCIATES (K&A), as subcontractor to the FORUM. K&A will conduct all sampling, sample handling, data analysis and reporting. The analytical laboratory to be utilized for the analysis of total phosphorus and total suspended solids is the Kalamazoo Water Reclamation Plant.

## Section 5: Data Quality Objectives

Runoff conditions can be highly variable, changing drastically between storm events. Coordinated sampling has been performed to date in Arcadia and Portage Creeks during the initial WMP development. Historical data from local instream sampling during wet and dry weather are available to use for quality checks. Data obtained for each event will be compared with other data received and historic average and extreme observations. Any outliers will be identified, and the Quality Assurance Manager (QAM) will investigate the circumstances leading to the derivation of that value.

Precipitation data collected at the Portage ISCO is checked against other available publicly available meteorological observations of the area (K&A, 2001).

The table below displays the expected range of results and precision limits for the sampling parameters. Due to the highly variable nature of wet weather sampling of runoff, this expected range of concentrations will be used only as general guidance for assessment of data quality. The precision limits will be used to validate analytical results for quality control samples (duplicates) generated by the laboratory. The precision limits represent the relative percent difference (RPD) between the results of a set of duplicate samples as calculated in:

$$\text{RPD: } \frac{(C - C')}{(C + C')/2} \times 100\% \quad \begin{array}{l} C = \text{the larger of the two values} \\ C' = \text{the smaller of the two values} \end{array}$$

Data Quality Objectives:

Parameter	Expected Range of Results	Precision
Total Phosphorus	20 – 3,000 µg/L	10%
Total Suspended Solids	0 – 150 mg/L	10%

If the RPD is greater than 10% the associated sample result is an estimate.

To establish a quantitative measure of accuracy, for total phosphorus, the laboratory runs a blank, a curve, spikes the sample with a known to determine percent recovery (a range of 80-120% is considered acceptable), and runs a duplicate. The laboratory analyzes QC samples quarterly. For solids the lab runs samples in duplicate. Solids QC samples are also run quarterly. The lab also runs DMR-qa blind studies annually. Copies of the lab bench sheets are available upon request. The overflow contract lab, KAR laboratories of Kalamazoo, has a comparable QC program. Concerns with accuracy will be reported with results.

To establish a qualitative measure of representativeness, the QAM will review field notes, field measured parameters, and rainfall rates to verify that cross-sectional velocity measurements and field measured parameters recorded during grab sampling verify the presence, intensity, and any variation in the field-measured condition and rate of stormwater runoff. For all storms sampled, the QAM will compare the runoff condition and hydrograph to the size of

storm and resultant composite sample results from the laboratory. Event Mean Concentrations resulting from laboratory analysis for each storm at each site will be compared to the relative size and intensity of the runoff event.

To establish a qualitative measure of comparability the QAM will note any deviation from standard sample collection and handling methods noted in field notes. The QAM will review chain of custody documentation and laboratory results to note any deviation from standard sample preparation, analytical procedures, holding times, stability issues, and QA protocols established in the standardized EPA methods for total phosphorus and total suspended solids analysis.

The data quality objective for data completeness will be that at least 90% of the generated raw data will pass QA/QC review. The QAM will verify that a minimum of three grab samples representing the approximate rise, peak, and fall of the hydrograph were collected and combined into a composite sample and analyzed to establish an EMC. The QAM will note any sampling conditions that resulted in the collection of fewer than three grab samples per site per storm (e.g., short, intense, storms) used for compositing.

## **Section 6: Monitoring Program and Sampling Procedures**

### **Section 6-1: General Monitoring Program**

Samples and measurements will be taken at each BMP selected by the Steering Committee. Grab samples will be taken during wet weather and sample composites will be analyzed for total phosphorus and total suspended solids. Flow will be estimated or calculated using measured velocities and channel/pipe dimensions. K&A will attempt to capture at least one sample during the rise, one during the peak, and one during the fall of the hydrograph at each appropriate BMP site for flow-weighted compositing. Samples will be acidified in the field using acid provided by the contract lab. Composite concentrations and event runoff volumes will be used to calculate event loads and event mean concentrations (EMC).

Soil samples will also be collected in areas of Milham Park, Kalamazoo during dry weather. Sample sites will compare soil concentrations of phosphorus between sites of heavy and light waterfowl traffic.

### **Section 6-2: General Flow Measurement Procedures**

During wet weather visits to the sampling locations, velocity at each of the sampling locations will be measured using a cross-section approach with a Marsh-McBirney Flow-Mate Model 2000 portable flow meter in a channel or pipe. The depth of the water and the width of flow at the water line will be measured at the point of discharge. Flow will be measured in triplicate at approximately 6/10 of the water depth at horizontal stations spaced at intervals. The cross-sectional areas of each horizontal segment and the average velocity will be multiplied and summed for each segment to calculate discharge at each cross-section. The "Portage and

Arcadia Creek Field Notes" sheet will be used to record all data collected during the flow measurements (K&A 2001).

### **Section 6-3: Specific Steering Committee Selected BMP Sampling Narrative**

The following five specific BMPs (top of Table 3.1) were selected by the Steering Committee for sampling in order to characterize performance of existing BMPs or to establish baseline conditions at sites where BMPs will likely be implemented. A brief narrative describes the sampling and analysis to be conducted at each BMP site. Sampling frequencies recommended by the Steering Committee are listed in Table 3.1.

#### *Maple School Rain Garden*

Rooftop runoff will be collected at the Maple Street School Rain Garden at one of the following, 1) the rain garden culvert, 2) the rain garden inflow, or 3) an available downspout depending on the timing and intensity of the rain event. Multiple sampling points have been identified because small, low intensity events do not produce enough runoff to trigger flow into the rain garden.

Runoff volume may be estimated based on design specifications of the rain garden. Rooftop EMC will be calculated for all storms sampled. Since runoff currently infiltrates in the rain garden soils or seeps out of the catch basin into surrounding soils the outgoing load to Axtell Creek is assumed to be zero.

#### *Stormceptor at Stockbridge*

Runoff will be collected at the inflow and outflow of the Stockbridge Avenue Stormceptor "Aqua Swirl", owned by the City of Kalamazoo. Incoming volume will be collected as water enters the unit's catch basin. Outgoing volume to Portage Creek will be sampled at the end of the outfall pipe. Water velocity will be measured at the outfall.

Flow will be calculated using measured velocity and known pipe dimensions. Parking lot EMC will be calculated. BMP pollutant reduction will be calculated by subtracting outgoing loads from incoming loads. Results will be compared to manufacturers specifications.

#### *Milham Park Soils*

Composite surface soil samples will be collected at two test areas in Milham Park. One test area will be selected that represents areas of heavy waterfowl traffic. A second test area will be selected that represents low waterfowl traffic. A maximum of six subsamples will be collected randomly in the test areas at a depth of zero to one half inch below the surface. Subsamples in each area will be combined into a 100 ml composite sample and total phosphorus concentrations will be compared.

### *Milham Park Lawn Overland Flow*

Overland runoff will be collected in Milham Park in an existing area where surface flow crosses a mowed lawn area and discharges directly to Portage Creek. Samples will be collected and velocity will be measured at the point of discharge where sheet flow narrows to a gully near the streambank. Event volume will be calculated to establish the event load.

### *Walnut Street Parking Lot Runoff*

Runoff will be collected at an outfall pipe to Portage Creek from a parking lot near East Walnut Street and Portage Avenue in Kalamazoo. Velocity at the end of the outfall pipe will be measured.

Flow will be calculated using measured velocity and known pipe dimensions. Event volume and EMC will be calculated and used to establish an event load.

## **Section 6-4: Composite Procedures**

Once water samples are collected, the bottles are immediately placed into a cooler with ice packs and transported to Kieser & Associates.

Flow-weighted sample volume per time period will be calculated for compositing at appropriate BMP sites. For a given grab sample, half of the previous time period runoff contribution and half of the following time period runoff contribution are added, and the percentage of the total event runoff volume represents a particular grab sample volume added to the composite. For example, if 40% of the event runoff occurred during the designated time period before and after grab sample X, then 40% of the composite sample will consist of volume from grab sample X. Sample volumes are then combined from individual bottles into the composite sample and analyzed to determine event mean concentrations (EMCs) of desired parameters.

## **Section 6-5: Water Quality Field Measurements**

When grab samples are collected, additional volume will be captured in a separate, rinsed container and instrumentation will be used to obtain field measurements of water temperature, dissolved oxygen content, and pH at the time of sampling. Field equipment includes a digital YSI Conductivity/Temperature Meter, digital YSI Dissolved Oxygen/Temperature Meter, and digital Campbell Scientific pH meter.

## **Section 7: Custody Procedures**

All bottles are marked with a sample label identifying sampling locations, parameters to be analyzed, the collection date, time and initials of field personnel who collected the sample (K&A, 2001). A standard KWRP chain of custody form will be filled out identifying the project

name, number, site, date, sample ID, sample containers, sampling method, sample matrix, requested analytical parameters, date and time of transfer and signature of personnel transferring sample custody. The chain of custody form will be placed on top of the contents sealed in a zip-lock bag. The packed cooler will be transported to the analytical laboratory. Once the samples have been analyzed for the parameters requested on the chain of custody document, a hard copy of the results will be mailed to the K&A office.

## Section 8: Calibration Procedures and Frequency

All field equipment will be calibrated based on manufacturers recommendations prior to each use. Field equipment will be cleaned and inspected before and after each use. Field equipment includes a digital YSI Conductivity/Temperature Meter, digital YSI Dissolved Oxygen/Temperature Meter, and digital Campbell Scientific pH meter.

## Section 9: Analytical Procedures

Laboratory samples will be analyzed by the methods outlined in the Standard Methods for the Examination of Water and Wastewater (APHA, 1998). Duplicate samples of each parameter will be analyzed for every tenth sample for each sampling event (or a maximum of one per event). Samples will be analyzed for total phosphorus and total suspended solids. The table below displays the analytical method, detection level, and holding times for each parameter. This table also identifies the contract laboratory that will conduct these analyses (KWRP). The KWRP routinely processes various samples for the City of Kalamazoo and is subject to MDEQ regulatory oversight.

### Analytical Methods and Techniques

Parameter	Analytical Method Reference EPA/SW-846	Technique	Detection Level (µg/L)	Sample Holding Time	Analytical Laboratory
Total Phosphorus	365.4	BD Auto Ascorbic Acid Reduction	20	28 days	KWRP
Total Suspended Solids	160.2	Non-filtered Suspended Solids 105 °C	4,000	7 days	KRWP

## **Section 10: Internal Quality Control Checks**

Since the collection of water samples will be rainfall and BMP dependent, the samples are not collected at the same time during the day. Laboratory duplicates are performed for every tenth sample that will be submitted.

## **Section 11: Data Reduction, Validation and Reporting**

The data from each sample analyzed at the contract laboratory will be returned to K&A in a hard copy format. The data will be compared between sites and dates.

Analysis of the analytical data from each monitoring location will include the preparation of total pollutant load or load reduction for each monitored parameter.

If the data fall outside of the expected range of results, the QAM will be notified and corrective action, as outlined in Section 15, will be initiated. In addition, analytical data received from the contract laboratory will be reviewed for comments provided on issues such as holding time exceedances, matrix interference and elevated detection limits.

As the project progresses, the data will be compiled, analyzed, and presented in the final WMP.

## **Section 12: Performance and Systems Audits**

Performance audits of the analytical data received from the KWRP laboratory will be conducted following validation of analytical data from each sampling event. Results of the audit will be recorded on the Performance Audit Checklist (K&A, 2001). If the quality of data generated is not sufficient, appropriate response and action will be evaluated by the QAM and acted upon.

Internal system audits to verify quality assessment and quality control procedures will be conducted periodically throughout the project by the QAM. In addition, adherence to system operating procedures will also be checked. Results of the audit will be recorded on the Internal System Audit Checklist (K&A, 2001). If discrepancies with the quality assurance and quality control procedures outlined in this quality assurance project plan are identified during the audit, the situation will be recorded on the log sheet and remedied immediately.

## **Section 13: Preventative Maintenance**

To ensure the least amount of complications possible, the field equipment consisting of a Marsh McBirney Doppler Velocity Meter, YSI dissolved oxygen meter, YSI conductivity meter,

and Campbell Scientific pH meter, will be calibrated according to manufacturers specifications. Instruments will be cleaned before and after each use. Batteries will be checked continuously and spare batteries will be available in the field.

New or washed sample bottles will be provided by the KWRP.

## **Section 14: Data Quality Assessment**

The project success will be measured by data reproducibility and the ability to infer conditions of runoff and BMP performance. EMCs will be correlated to runoff areas treated by the BMPs. National BMP standards will be researched and average BMP efficiencies will be compared to the final results.

## **Section 15: Corrective Action**

Corrective action will be taken any time errors, deficiencies or out-of-control circumstances occur. Corrective action can be an immediate response to remedy a spontaneous or non-recurring problem such as equipment malfunction. Long-term corrective action will be necessary to correct recurring problems.

All test results beyond control limits will be recorded by the analyst in a bound logbook, and the QAM will be notified immediately. The QAM will then determine the proper course of action. The following routine will be observed for out-of-control results found with any K&A monitoring equipment. This routine will be performed in sequence until the problem is resolved, at which time the process may be terminated.

- 1) The analyst documents out-of-control results in the logbook and notifies the QAM.
- 2) All raw data, equations and calculations are verified.
- 3) The calibration of the instrument will be checked with a known standard or measurement.
- 4) The instrument will be shut down for re-calibration, cleaning, tuning, alignment, etc., as recommended by the manufacturer.

The contract laboratories will be responsible for internal quality control and quality assurance checks on the samples that they analyze. K&A will be responsible for the field-collected data and examination of the results produced by the laboratories.

## **Section 16: Quality Assurance Reports to Management**

Quality assurance information includes the following items, as appropriate:

- Assessment of data accuracy and completeness.
- Results of performance and/or system audits.

- Significant quality assurance/quality control problems and recommended solutions.
- Discussion of whether the quality assurance objectives were met and the impact of these results.
- Limitations on the use of the measurement data.

## **Section 17: References**

American Public Health Association (APHA), American Water Works Association & Water Environment Federation. 1998. Standard Methods for the Examination of Water and Wastewater. 20<sup>th</sup> ed. APHA. Washington, D.C.

Kieser & Associates (K&A). Quality Assurance Project Plan for Monitoring and Water Quality Sampling Associated with the Portage and Arcadia Creeks Section 319 Nonpoint Source Pollution Grant. April 26, 2001

**Table 3.1. Portage Arcadia BMP Monitoring Options as Selected by the Steering Committee**

Location	Subwatershed	Area Sampled/ Pollutant Source	Pre/Post or Up/Down	BMP Implemented	Transferable Item	Recommended ?	Number of Samples
Maple School Rain Garden	Axtell	roof top runoff	up/down	2003	roof top emc, dry deposition study	yes for transition grant	4-5 storms
Stormceptor at Stockbridge	Portage	parking lot runoff, stormceptor outflow	up/down	various throughout watershed	parking lot emcs, stormceptor efficiency	yes for transition grant	composite of 2-3 storms
Milham Park soils	Portage	grassed areas of heavy waterfowl area vs. no- waterfowl area	pre implementation	future grant	waterfowl contributions, erosion loading	yes for transition grant	composite sample at each test area
Milham Park lawn overland flow	Portage	water sample of grassed runoff in heavy waterfowl area vs. non- waterfowl area	pre implementation	future grant	waterfowl contributions, overland flow	yes for transition grant	composite of 2 storms
Walnut Street parking lot runoff sluice to Portage Creek	Portage	edge of sluice from parking lot	pre implementation	future grant	parking lot emcs	yes for transition grant	composite of 2 storms
Woods Lake	non- contributing	in and out of treatment system	post implementation, pre implementation data was from design phase	year?	lake treatment system efficiency	COK sampling required?	
COP STEP project	Portage	out of treatment system	post implementation, pre implementation data was from design phase	2004	regional treatment system efficiency		
COP Consolidated Drain	Portage	out of treatment system	post implementation, pre implementation data was from design phase	2001	regional treatment system efficiency		
Maple and Howard Streets runoff to Axtell Creek	Axtell	road runoff, storm sewer drainage unit loading	pre implementation	future grant	road runoff emcs, localized loading values		composite of 2 storms
Residential downspout		roof top runoff	pre implementation	future downspout disconnect program	roof top emc, dry deposition study		2 residences
D&W detention basin	Portage	in and out of basin	up/down	2001?	parking lot emcs, detention basin efficiency		composite of 2 storms
Commerce Park	West Fork	in and out of treatment system, highway runoff	up/down	2004	transportation emc, parking lot emc, basin efficiency		composite of 2 storms
Various streambanks	any	streambank soils	pre implementation	for streambank restoration areas	TP concentration in watershed to apply to erosion loading estimates		