

Chapter 8: Methods of Measuring and Evaluating Progress

The Middle One Subwatershed Advisory Group (SWAG) agrees that a well-planned evaluation process will provide measures of the effectiveness of implementing this Subwatershed Management Plan. Measurement and evaluation is an important part of planning because it can indicate whether or not efforts are successful and provide a feedback loop for improving project implementation as new information is gathered over time. Also, if the subwatershed group is able to show results because of an evaluation program, the plan will likely gain more support from the partnering communities and agencies, as well as local decision makers, and increase the likelihood of project sustainability and success.

Monitoring and measuring progress in the subwatershed will be two-tiered. First, individual agencies and communities will monitor certain community and agency projects and programs on the community and agency levels to establish effectiveness. For example, a community-based lawn fertilizer education workshop will be assessed and evaluated by that community. Also, with the implementation of a community project such as the retrofitting of certain detention ponds, the individual community responsible for the implementation of that task would monitor water quality/quantity parameters before and after the retrofit to establish the improvements. Secondly, there will be a need to monitor progress and effectiveness on a regional – subwatershed or watershed – level in order to assess the ecological affects of the collective community and agency actions on the health of the river and its tributaries. In continuing to work as a subwatershed toward collective goals for the river, the SWAG recognizes the importance of a long-term water quality, quantity and biological monitoring program to determine where they should focus resources as they progress toward meeting those collective long term goals. Because these physical parameters will reflect improvements on a regional scale, and because it is most cost effective and consistent if sampling is done by one entity for an entire region, it is recommended that a sampling or monitoring program is established on a subwatershed or watershed scale.

8.1 Qualitative Program Evaluation Techniques: Tier 1

Qualitative Program Evaluation Techniques

As seen in the Subwatershed Action Plan (Chapter 7), as well as the Storm Water Pollution Prevention Initiatives (SWPPIs) of each individual community and agency, there are and will be many programs and projects implemented to improve water quality, water quantity and habitat in the Middle One Subwatershed over the short and long term through many different types of programs – from physical in stream improvements to public education programs. Finding creative ways to measure the effectiveness of each of these individual and often unique programs will be recorded for each task under the individual SWPPIs. However, a summary (**Table 8.1**) of the methods that are proposed in various SWPPIs will provide an indication of how these programs might be measured and monitored to evaluate success in both the short and the long term. Some of these evaluations may be implemented on a subwatershed or watershed basis, such as a public awareness survey to evaluate long term public education efforts, but most of these activities will be measured at the local, community level. By evaluating the effectiveness of these programs, communities and agencies will be better informed about public response and success of the programs, how to improve the programs and which programs to continue. Although these methods of measuring progress are not directly tied to measurements in the river, it is assumed that the success of these actions/programs, collectively and over time, will have a positive impact on the instream conditions and measurements of the river that are investigated concurrently as described in Tier 2 below. Whereas evaluating these programs and projects on a more qualitative basis is to determine short term programmatic successes, it is this success that will result in long term, quantitative impacts in the river.

Table 8.1: Middle One Summary of Qualitative Program Evaluation Techniques

Evaluation Methods	Types of programs/projects	What is Measured	Pros and Cons	Implementation	Examples
Public Surveys	Any public education or involvement program or project	Knowledge Behaviors Attitudes Awareness Concerns	Moderate cost. Often low response rate.	Pre and post surveys recommended. Mail, telephone, group setting. Could be done on either a local or watershed-wide basis. Repeating same survey on regular basis can show long-term trends.	1993, 1999 Rouge River Watershed Public Opinion Surveys. Plymouth Twp. HHW Day surveys. Canton Twp. CREEC group pre-survey.
Written Evaluations	Any public meeting or group education or involvement activity.	Benefit of activity based on increased knowledge and participant feedback.	Good response rate. Low cost. Improves continuing activities.	After an event, meeting, workshop, ask participants to fill out brief evaluation. Ask what was learned, what was missing, what could be done better. Participants return evaluations at site.	Evaluation of Homeowners Association Workshop in Canton.
Stream surveys/walks	Identifying riparian and aquatic improvements. Identifying recreational opportunities and needs.	Aesthetics Log jams Erosion Habitat Recreation potential	Best information from field investigation. Time consuming.	Identify parameters of interest. Create form for recording observations. Surveyor training for consistency. Compile findings geographically to identify sites of interest and concern.	Johnson Creek Reconnaissance Study.
BMP monitoring	Detention basin retrofits. Wetland restoration. Rain barrels. Street sweeping.	Water quality, water quantity improvements from specific BMP.	Site-specific. Quantitative.	Set up isolated BMP area pre and post BMP installation. Record parameters of stormwater discharge before and after installation to measure improvements.	Redford Township, Farmington Hills and Livonia roadway source control BMP studies.

Evaluation Methods	Types of programs/projects	What is Measured	Pros and Cons	Implementation	Examples
Photographic documentation	BMP installations, detention pond retrofits, aesthetic alterations (native landscaping, etc.).	Aesthetic changes. Before and after results.	Implementation easy, low cost. Good visual communication, documentation. Limited to visual description.	Visual evidence with photographs. Use photographs in educational pieces, website, etc.	Plymouth Township Tonquish Creek interpretation project. Johnson Creek/Salem Township streambank stabilization project.
Phone call/complaint records	Education efforts, advertising of contact numbers for complaints/concerns.	Number and types of concerns voiced by public. Location of problem areas.	Limited to opinions, input from members of public willing or motivated to contact you.	Persons answering phone, letters, emails track nature of related calls concerns on an ongoing log sheet.	Most communities developed complaint tracking methods for their Illicit Discharge Elimination Plans.
Quantification of participation	Public involvement and participation events.	Amount of people reached. Amount of waste collected.	Easy to calculate. Provides numerical measurement that is easy to understand and track.	Track participation with sign in sheets, registration lists, counts of people, counts of materials collected.	Tons of hazardous waste collected in Canton, Plymouth, Novi. Bags of debris collected at River Day sites. Numbers of participants in Detention Pond workshop in Canton.
Focus Groups	Behavior change, education programs.	Perceptions, viewpoints, concerns, barriers, behaviors.	Fast method for identifying motivators and barriers to behavior change. Can introduce new ideas.	Widely solicit for diverse participants, or hand-pick certain interested people. Could advertise opportunity in newsletter. Should be no more than 6-8 people per group. Plan questions, facilitate. Tape and transcribe discussion.	Washtenaw County Drain Commissioner, lawn care companies and residents focus groups.

8.2 In-Stream Monitoring Program: Tier 2

In-Stream Monitoring Program

In addition to measuring the effectiveness of certain specific programs and projects within communities or agencies, there would be a benefit to measuring the long term progress and effectiveness of the cumulative subwatershed efforts in terms of a water quality, quantity and biological monitoring. This physical sampling and monitoring program will be a larger and more long-term effort, at either a subwatershed or watershed level, most likely requiring a regional perspective and county or state support. This subwatershed or watershed-wide long-term monitoring will directly address each community's goal (Long Term Goal 6), to improve monitoring in the subwatershed. Communities and agencies in the subwatershed agree that there has not been adequate data collection (number of sites or frequency) to date to most effectively manage the subwatershed. This increased wet and dry weather water quality, water quantity, biological and other monitoring will afford communities and agencies better decision-making abilities based on more data as implementation of this plan and SWPPIs continues. This proposed monitoring program is described below.

8.2.1 Proposed In-stream Monitoring Program for Evaluation of Long Term Progress:

The Middle One Subwatershed, as part of the Rouge River National Wet Weather Demonstration Project, has been part of the ongoing monitoring efforts of the Rouge Program Office (RPO) throughout the last several years. Upon reviewing the data collected over the years, the Middle One SWAG would like to improve upon the type of parameters monitored, the number of locations in the Middle One, as well as the frequency of wet weather monitoring in the subwatershed. This improved monitoring program will help communities and agencies to more accurately identify water quality and water quantity impairments and their sources, as well as how these impairments are impacting the biological communities that serve as indicators of improvements. Implementation for some of the program may begin as early as the 2001 sampling season, but more likely in the 2002 sampling season when a specific plan can be determined and funding can be secured.

8.2.2 Monitoring Program Goals:

- Increase flow data to track preservation and restoration activities upstream.
- Collect wet and dry weather water quality data at new points in the headwaters of the subwatershed to better identify specific pollution source areas within the subwatersheds and within the communities, and reflect preservation and restoration activities upstream.
- Increase the amount of wet weather data collected in the headwaters to better identify wet weather sources of pollution.
- Increase biological data collected (fish, macroinvertebrates) and use these as indicators of the ultimate quality and health of the river ecosystem.
- Identify major riparian corridors and other natural areas in order to plan for recreational opportunities, restoration and linkages.
- Establish a long-term (annual, bi-annual, or as needed) monitoring program so that progress can be measured over time.
- Continue to review and revise currently established benchmarks and dates based on new data.
- Increase the use of volunteers where possible, for monitoring program (aesthetics, macroinvertebrates, frogs and toads) to encourage involvement and stewardship.

8.2.3 Establishing Parameters: Based on the goals of the subwatershed, the monitoring plan will measure Dissolved oxygen (DO), Bacteria (E.coli), Phosphorus (TP), total suspended solids and sediments (TSS), flow regime (cfs), fisheries and aquatic macroinvertebrates (insects and small bottom-dwelling animals), frogs and toads, temperature, aesthetics, lakes and impoundments, wetlands and recreational potential.

8.2.4 Establishing targets: When measuring parameters to assess whether or not a goal is being achieved, it is useful to establish targets against which observed measurements are compared. These targets, as listed in Table 8.5 below, are not necessarily goals themselves, because some of them may not be realistically obtainable. However, the targets do define either Water Quality Standards⁷⁴, as set forth by the State of Michigan, or scientifically supported numbers that suggest measurements for achieving water quality, quantity and biological parameters to support state designated uses such as partial or total body contact, and fisheries and wildlife. Using these long term, scientifically based targets as targets for success will assist the subwatershed in deciding how to improve programs to reach both restoration and preservation goals and know when these goals have been achieved. These targets are described below, as well as in Table 8.5 at the end of this chapter.

Dissolved oxygen (DO) has standards established by the Michigan Department of Environmental Quality (MDEQ) as state standards. For DO, the state has established a requirement of no less than 5.0 mg/l for all warm water fisheries, which include the river and all tributaries in the Middle One, except for Johnson Creek. Johnson Creek is considered a coldwater fishery, where DO can drop to no less than 7.0 mg/l. The Administrative Rules state:

“for waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(4), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision. For waters of the state designated for use for coldwater fish, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 6 milligrams per liter at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods, as provided in R 323.1090(4), a minimum of 7 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.”

Bacteria (E. coli) has standards established by the MDEQ as state standards. For the designated use of total body contact (swimming), the state requires measurements of no more than 130 E. coli per 100 milliliters as a 30 day geometric mean during 5 or more sampling events representatively spread over a 30 day period. Since recreational activities requiring total body contact are not a desired use for the subwatershed, this use and standard does not apply at this time. However, for the designated use of partial body contact, which is necessary for recreational activities such as wading, fishing, and canoeing, the state requires measurements of no more than 1000 E. coli per 100 milliliters based on the geometric mean of 3 or more samples, taken during the same sampling event. This use and standard will be appropriate for and applied to the main branch of the river and those tributaries with a base flow of, or greater than, 2 cubic feet per second.

Phosphorus (TP) for surface waters does not have a numerical standard set by the state. The state requires, however, that “nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the waters of the state.” Therefore, based on scientific research, we rely on suggested or recommended targets and continue to study this question on a national and regional level. Studies in the neighboring Huron River watershed demonstrate that 0.05 mg/l of total phosphorous is a scientifically based target for surface waters in order to prevent nuisance plant growth in receiving lakes and

⁷⁴ Part 4. Water Quality Standards. Promulgated pursuant to Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Effective: December 13, 1973, Latest revisions effective: April 2, 1999.

impoundments. Since the Middle Rouge through the Middle One subwatershed has several impoundments, it is reasonable to use this available data until research demonstrates that higher phosphorus concentrations can support fair to good aquatic diversity in river systems. Thus, 0.05 mg/l in dry weather can be used as a target for the Middle One, while studies to identify sources of TP in the subwatershed continue to determine an appropriate date by which we can expect to achieve 0.05 mg/l (or other target shown to support fair to good aquatic diversity, if found). Since more specific monitoring is needed to identify sources, a date to achieve 0.05 mg/l TP, or other number, will be estimated by 2003.

Total suspended solids (TSS) for surface waters does not have a numerical standard set by the state. However, the state requires that “the addition of any dissolved solids shall not exceed concentrations which are or may become injurious to any designated use.” To protect the designated uses of fisheries and wildlife habitat, as well as the desired recreational and aesthetic uses of the surface waters in the subwatershed, there are recommended targets established on a scientific basis. From an aesthetics standpoint, it is recommended that TSS less than 25 mg/l is “good”, TSS 25-80 mg/l is “fair” and TSS greater than 80 mg/l is “poor”. The TSS target, therefore, will be to maintain TSS below 80 mg/l in dry weather conditions.

Another measurement that can be used to determine sediment load is to determine the extent of embeddedness of the substrate (how much of the stream bottom is covered with fine silts) and the bottom deposition (what percentage of the bottom is covered with soft muck, indicating deposition of fine silts). These are measurements taken by the GLEAS protocol habitat assessment conducted by MDEQ every five years. Rating categories are from “poor” to “excellent”. The target for this measurement is to maintain the current ratings and improve ratings where possible.

Flow rates (cfs) for surface waters do not have a numerical standard set by the state. Although this sections attempts to define a peak flow target for certain points in the river and tributaries, it is most effective to use the health of the fish and macroinvertebrate communities (process described below) as the ultimate indicators of stream and river health.

The best scientifically based research for recommended flow targets in the Rouge River comes from the Wiley/Seelbach report entitled *Ecological Targets for Rehabilitation of the Rouge River* (1998). The study compared flows in the Rouge basin to similar basins in Michigan in order to make recommendations for target flow rates that support predicted fish communities in the Rouge River watershed. Target flow rates are calculated based on summer flows. In this plan, the target peak flow rate means that the target peak flow rate will not be exceeded 90% of the time or, conversely, the target rate will be exceeded for no more than 10% of the time. Observed flows were based on data over two years (1994-1995) and suggests some general trends to compare to targets, but should be augmented with more baseline data to inform the difference between target and observed measurements.

For the Middle One Subwatershed, given the available flow data at the time, the Wiley/Seelbach report indicated that base flow rates are sufficient to support predicted fish communities. However, the report indicated that peak flow rates are exceeding acceptable limits for the predicted fish communities. At sampling site DO2 (Middle Rouge @ Nine Mile Rd.), peak flow rates have become too high for predicted fish communities, exceeding the target limit of 8 cfs. Also, downstream at sampling site D08 (@ Phoenix Lake), peak flow rates exceed the target of 22 cfs. Johnson Creek also exceeds its peak flow target of 14 cfs. These target rates are compared to observed rates in 1994 and 1995 to suggest a percentage over which the observed may exceed the target. See Table 8.2 for recommended and observed peak flow comparisons.

Table 8.2: Recommended Peak Flow Rates at Certain Middle One Sites

Middle One Subwatershed Sampling Site	Location	Catchment area (sq-km)	Target peak flow (cfs)	Observed peak flow (cfs) (1994-1995 data)	Percent above target (1994-1995 data)
D02	Middle Rouge @ Nine Mile Rd.	50	8	12.50	60% above target
D03	Johnson Creek	66	14	19.80	43% above target
D08	Middle Rouge @ Phoenix Lake	146	22	24.82	13% above target

Again, more recent peak flow data is needed to more accurately compare observed flow to our targets. It is likely that stream gages will be located at D02, D03, and D08, to be managed by either local field staff or local resident stream stewards to collect more flow data to compare against these suggested target numbers.

In addition to collecting flow data at these sites, a new USGS stream gage will be installed and maintained at the downstream end of the subwatershed in 2001 and should provide new data that will assist in reviewing these suggested targets and establishing an appropriate target for the downstream end of the subwatershed. After new data is collected and studied, it may be determined that biological indicators, such as the presence and diversity of fish, should be used to monitor and assess targets for the flow parameter.

Fisheries: Again, there are no numerical or fish community standards set by the state. However, the Michigan Department of Environmental Quality⁷⁵ has developed a system to estimate the health of the predicted fish communities through a sampling method called the GLEAS 51 (Great Lakes Environmental Assessment Section) protocol. This method collects fish at various sites in the river and based on whether or not certain expected fish species are present, as well as other habitat parameters, fish communities are assessed as poor, fair, good, or excellent. The state conducts this protocol every five years in the Rouge River Watershed. The 1995 sampling in the Middle One at seven different sites suggested fisheries were generally “good” and “excellent” at Bishop Creek. The target will be to maintain GLEAS 51 scores of “excellent” at Bishop Creek, “good” at other sites, and attain GLEAS 51 scores of at least “good” at Nine Mile Rd. and Willow Creek at Lotz Rd. Since much has changed in the subwatershed over the past five years, the subwatershed commits to reviewing the forthcoming 2000 fish community data produced by the DEQ, which may suggest changes in these targets.

The GLEAS 51 protocol also identifies whether or not there are sensitive species present in the river, which would indicate a healthy ecosystem. Increasing populations of almost any fish (except exotic rough fish like carp or goldfish) would be an indication of improving environmental conditions in the river. Certain species, however, are especially useful for demonstrating improving conditions. These species tend to be sensitive to turbidity, prefer cleaner, cooler water, and their distribution in the Rouge Watershed is currently quite limited. The target is to continue to find species currently found, assuming that stable or increasing numbers mean that habitat and water quality is maintained or improved. The table below lists these sensitive species for the entire watershed, and those in **bold** have been found in the Middle One Subwatershed.

⁷⁵ Michigan Department of Environmental Quality, Surface Water Quality Division, Great Lakes Environmental Assessment Section, <http://www.deq.state.mi.us/swq/gleas/gleas.htm>

Table 8.3: Sensitive Fish Species of the Rouge River Watershed (bold = found in Middle One Subwatershed)

Common Name	Scientific Name
American brook lamprey	<i>Lampetra appendix</i>
Redside dace*	<i>Clinostomus elongatus</i>
Spotfin shiner	<i>Cyprinella spiloptera</i>
Hornyhead chub	<i>Nocomis biguttatus</i>
Northern hog sucker	<i>Hypentelium nigricans</i>
Stonecat	<i>Noturus flavus</i>
Mottled sculpin	<i>Cottus bairdi</i>
Starhead topminnow	<i>Fundulus dispar</i>
Rock bass	<i>Ambloplites rupestris</i>

* Listed as “Threatened” on the MDNR’s list of endangered, rare, and threatened species

Since biological indicators of stream and river health will serve as the ultimate measure of long-term progress in the subwatershed, this plan proposes to increase fisheries monitoring by increasing the frequency of the monitoring and possibly the amount of sampling points in the subwatershed. It is proposed to monitor either every 2 years, or with an annual effort with rotating sampling locations so that the subwatershed is more adequately covered. This would be an additional effort to supplement the MDEQ’s regular 5-year cycle.

Macroinvertebrates: Macroinvertebrates are small aquatic insects and animals whose presence can indicate certain long term water quality trends. Similar to the assessment of fish communities, the state has developed and implemented the GLEAS 51 protocol for assessing macroinvertebrate communities on a five-year cycle for the Rouge River Watershed. Currently, recent samples in the Middle One Subwatershed indicated that macroinvertebrate communities are in the range of “fair” and “good” in the Middle branch to “poor” and “very poor” in Johnson Creek. The monitoring target for macroinvertebrate communities will be to maintain GLEAS 51 scores of “good” between Haggerty and Newburgh Rds., maintain GLEAS 51 scores of at least “fair” in Johnson Creek, by 2005 and increase to “good” by 2015. Since much has changed in the subwatershed over the past five years, the subwatershed commits to reviewing the forthcoming 2000 macroinvertebrate data produced by the DEQ, which may suggest changes in these targets.

In addition to providing input for additional sampling sites to MDEQ’s 5-year cycle for macroinvertebrate sampling, this plan proposes to increase macroinvertebrate monitoring by increasing the frequency of the monitoring and possibly the amount of sampling points in the subwatershed. It is proposed to monitor either every 2 years, or with an annual effort with rotating sampling locations so that the subwatershed is more adequately covered. This would be an additional effort to supplement the MDEQ’s regular 5-year cycle. A combination of both professional aquatic biologists and volunteer monitors will be coordinated to complete this additional macroinvertebrate monitoring.

Frogs and Toads: Friends of the Rouge (FOTR) currently conducts, with the services of local volunteers, a Frog and Toad Survey from March through July each year. These programs will remain active, with an increase in survey sites as volunteer participation grows. The results will indicate over the long term, whether or not frog and toad populations are decreasing, staying the same or increasing. These results will suggest a reflection of land use changes and loss of habitat, such as wetlands. The results will be used to direct community priorities. The target is to

track and report frog and toad populations to detect trends in decline or increase over time and relate to land use changes and decisions regarding habitat protection or restoration.

Temperature: State standard R 323.1075 only lists temperature standards for point source discharges and mixing zones – not ambient water temperatures in surface water. However, recommendations for water temperature can be generated by assessing fish species’ tolerance to temperature change and this guidance is recorded in the statute. There are two different kinds of streams with regard to classification of temperature regimes, coldwater and warmwater streams.

Coldwater streams: In the Middle One, temperature regimes are a special concern in the coldwater tributary, Johnson Creek. Johnson Creek currently supports a stocked and reproducing brown trout fishery as well as a threatened minnow, the Reside dace. These species cannot tolerate certain higher summer temperature increases. Wiley and Seelbach (1998) suggest that the maximum average weekly temperature for July for brown trout, the most temperature sensitive species in the creek, is 21.5° Celsius. However, the state standards recommend that temperatures for coldwater fisheries not exceed temperatures greater than the monthly maximum temperatures listed in the table below. The maximum summer temperatures are slightly lower than Wiley and Seelbach, at a maximum of 20° C, or 68° F, and this will be used as a maximum summer temperature target for Johnson Creek.

Warmwater streams: Warmwater temperature regimes are a concern in all tributaries and the river. These systems support warm water fish communities, such as the central mudminnow and brook stickleback. These representative species cannot tolerate certain higher summer temperature increases. Wiley and Seelbach (1998) suggest that the maximum average weekly temperature for July for the central mudminnow community is 26.3° Celsius. Therefore, the target temperature for warm water creeks such as Tonquish and others should be maintained below 26.3° Celsius in summer months. The state standards recommend that temperatures for warm water fisheries not exceed temperatures greater than the monthly maximum temperatures listed in the table below. The maximum summer temperature in July and August are slightly higher than Wiley and Seelbach, at a maximum of 29.4° C, or 85° F, and this will be used as a maximum summer temperature target.

Table 8.4: Recommended Maximum Water Temperatures for Rouge River Watershed (°F; Rule 323.1075)

	J	F	M	A	M	J	J	A	S	O	N	D
Johnson Creek	38	38	43	54	65	68	68	68	63	56	48	40
Rest of River, warm water creeks	41	40	50	63	76	84	85	85	79	68	55	43

Aesthetics and recreation potential: There is no state standard for measuring aesthetics or recreation potential. However, the subwatershed believes that an area with high aesthetic qualities will add, in either a passive or active context, recreational opportunities for the public and a greater appreciation or awareness of the subwatershed’s natural resources. That is the purpose for looking at these two parameters over time.

Aesthetics: Measuring aesthetics of an area is inherently a qualitative effort. However, progress toward attaining aesthetically pleasing places can be measured and evaluated effectively using a standard tool, such as a survey, at regular intervals in time. It is recommended that an aesthetics survey for the subwatershed would include regular field investigations of specific sites in the subwatershed where aesthetics are of most concern, such as a park area or future park area, most likely along a stretch of the river or a tributary. Measurements in the survey, dependent upon community and subwatershed

priorities, should include assessing water clarity, ambient odors, vegetative diversity, wildlife use, streambank erosion, debris, evidence of public use, and other parameters that indicate positive or negative aesthetic qualities. If desired, a numerical ranking system (a scale of 1-5, for example) can be used to standardize responses and compare the aesthetic quality of sites over time. Aesthetics monitoring in the watershed has been done before, both at the RPO and at Friends of the Rouge. These efforts will be used to develop a program across the subwatershed. Volunteers and/or community field staff will most likely be utilized for this effort.

Recreation potential: Measuring and mapping areas with recreation potential should be a community and a subwatershed effort and should be done by or closely with local or county parks departments and staff. The first component of this effort is a one-time recreational opportunities study of the subwatershed to determine where opportunities, access, etc. can be improved. The goal is to identify areas in the subwatershed, both along the riparian corridor and on the landscape, that can provide passive recreation (such as photography, resting, bird watching), or active recreation (such as hiking, canoeing, fishing). Within the subwatershed, these areas should be linked where possible to provide linear corridors that connect, or greenways, for both people (hiking, biking trails) and wildlife. It is suggested that this activity would begin with mapping existing areas dedicated to recreation or preservation, and then completing a stream or river walk to record information including: evidence of current public use, potential for public access, linkages to other natural areas (greenways potential), ownership of property, vegetation types (forested, wetland area, in need of riparian cover, etc.), excessive woody debris, etc. This survey would include photographs of potential recreation areas and would assist communities and the subwatershed in prioritizing new areas for preservation and recreation for the public, offering the public more opportunity for using and appreciating the Rouge River's natural resources. Finally, these activities should lead to the identification of funding mechanisms for purchase of land and conservation easements, as well as any necessary infrastructure (construction of trails, boardwalks, canoe livery, etc.) that would support new or improved recreational opportunities. The second component to the above described one-time recreational opportunities study is to regularly record recreational use in certain areas over time to determine current use of recreation areas related to the river or tributaries. This effort could be easily combined with the aesthetics survey effort described above.

Lakes and Impoundments: The Middle One subwatershed begins at Walled Lake and has several impoundments downstream and in-line with the Middle Rouge River. These impoundments include Meadowbrook Lake, Phoenix Lake, and Wilcox Lake. The recreation potential and public awareness of these water bodies plays a large role in the success of the subwatershed's protection and restoration. To maintain or improve the potential use of these systems for recreation, it is important to monitor parameters such as fish populations, aesthetics, nutrient loads, phytoplankton, macrophyte communities, and bacteria. A study was completed in 1996, and indicated that most systems were moderately to highly eutrophic (contained nuisance plant growth). The study recommended that these systems be reexamined in three to five years. Criteria and protocol for fish monitoring will need to be developed; all other analysis can repeat the 1996 study to the extent practicable. The general target for lakes and impoundments is to generally improve desired recreational and aesthetic capacities and use.

Wetland Review: First, a wetland inventory may need to be conducted in the subwatershed to determine a baseline acreage and number of wetlands, or the wetland map from the previously developed Middle One Wetland Protection Plan may be utilized as a base. In order to track wetland fills, mitigations, restoration and protection in the headwaters, the subwatershed will annually review MDEQ wetland permit information and local records to establish net loss or gain in wetlands in the subwatershed. The target for this parameter is to track the net acres of wetland in the subwatershed to determine action for further protection or restoration activities.

8.2.5. General Use of the Recommended Long Term Monitoring Plan

The Recommended Long Term Monitoring Plan Table (Table 8.5) illustrated below serves as the description of the recommended parameters, general frequency of sampling and recommended parties responsible for the sampling in what would be a long term monitoring effort to measure the effect of the subwatershed members' collective actions toward protecting and restoring the river and its tributaries, as well as increasing the aesthetic and recreational qualities in the subwatershed. The broad and general plan below will serve as a menu from which the subwatershed can design specific, tailored monitoring plans for various years when data needs arise. The plan can be reviewed and revised as necessary to reflect the need for data to best determine future courses of action to benefit the river. Although communities and agencies in the subwatershed may be able to support the implementation of parts or all of the recommended plan, it is assumed that the work of coordinating and implementing this plan will need to be contracted out to the Rouge Program Office or other entity that will manage grant funding, local match, the field and lab work, volunteer coordination, as well as preparing and presenting a comprehensive annual report that summarizes the findings from monitoring that year. It is also assumed that this long term monitoring plan is developed when needed to learn more about the subwatershed and sources of water quality, quantity, and biological problems, and that each individual community and agency will need to be involved in developing plans that reflect these data needs.

Table 8.5: Recommended Middle One Long Term Monitoring Plan

Measurement Parameter	Long Term Target (s)	Party Responsible and Monitoring Procedure	Sampling sites	Frequency
WATER QUALITY <ul style="list-style-type: none"> • DO, E. coli, and Temp. grab sampling every other week over five month sampling season (10 samples) in dry weather. Plus five wet weather events. • TP, TSS grab sampling every other week over five month sampling season (4 samples) in dry weather. Plus five wet weather events. 				
1. Dissolved Oxygen (DO)	<p>For warmwater streams, maintain or achieve a daily average DO regime of 4.0 mg/l in warm weather seasons and 5.0 mg/l in other seasons, by 2005.</p> <p>For Johnson Creek, maintain a daily average DO regime of 6.0 mg/l in warm weather seasons and 7.0 mg/l in other seasons.</p>	<p>RPO to continue dry weather grab sample monitoring</p> <p>RPO to add new dry and wet weather grab sample monitoring to reflect more tributaries and the affect of communities</p> <p>RPO to add continuous meter at downstream end of subwatershed for DO and Temp.</p> <p>RPO to perform wet weather sampling – 5 wet weather events per year</p>	<p>14 total sites (5 existing RPO sites, 9 new sites).</p> <p>Includes one continuous monitoring (USGS) site at downstream end.</p> <p>GLEAS has established 7 sampling sites in the M1 subwatershed.</p>	<p>Dry weather: RPO performs every other week from June – October (10 samples/yr.).</p> <p>Wet weather: RPO performs five events per season.</p> <p>Continuous: DO and Temp</p>
2. Bacteria (E. coli)	<p>Maintain or achieve partial body contact in dry weather conditions (1,000 colonies per 100 ml) for main branch and tributaries with a base flow of, or greater than, 2 cfs, by 2010.</p>	<p>MDEQ conducts GLEAS habitat assessments at 7 sites in subwatershed.</p>		
3. Temperature	<p>Maintain or achieve a maximum summer temperature at or below 29.4° C (85°F) for warmwater fisheries, and 20° C (68°F) for Johnson Creek, by 2005.</p>			

4. Phosphorus (TP)	Using 0.05 mg/l TP in dry weather as a reference for systems with impoundments, study and identify sources of TP in subwatershed to determine date by which we can expect to achieve 0.05 mg/l TP (or other target shown to support fair to good aquatic diversity, if found), by 2003.			<p>Dry weather: Every six weeks from June – October (4 samples/yr.).</p> <p>Wet weather: RPO performs for five events per season.</p> <p>GLEAS: MDEQ conducts every 5 years.</p>
5.Solids / sediments (TSS)	Based on achieving desired aesthetic use, maintain or achieve TSS concentrations below 80 mg/l in dry weather conditions, by 2006. Based on GLEAS habitat assessment, maintain or improve current embeddedness and bottom deposition ratings.			
6. FOTR REP data integration (DO)	As above.	Improve SWAG coordination with Friends of the Rouge Education Project (REP) for student water quality data. Currently nine (9) schools involved in subwatershed.	FOTR REP data from school sites.	REP data available annually in summer.
Measurement Parameter	Long Term Target (s)	Party Responsible and Monitoring Procedure	Sampling sites	Frequency
<p>WATER QUANTITY</p> <ul style="list-style-type: none"> • Continuous monitoring (USGS) site at downstream end of subwatershed. • Plus additional, low-tech sampling at D02, D03, D08. 				
7. Flow Regime (cfs)	<p>To not exceed target peak flows for more than 10% of the time by 2020:</p> <p>@ D02: 8 cfs @ D03: 14 cfs</p>	<ul style="list-style-type: none"> • RPO to add USGS station at downstream end of Middle One • Coordinate volunteers to monitor staff gages to track flow measurements at D02, D03, and D08 • RPO to continue RPO/USGS flow monitoring at US2 downstream 	<p>Four (4) total sites:</p> <p>Downstream end of subwatershed. D02 D03 D08</p>	<p>New USGS continuous flow gage at downstream end, install 2001.</p> <p>Add low-tech flow</p>

	@ D08: 22 cfs These targets will be reviewed with data from D02, D03, D08, and new USGS gage in 2001. New targets may be set.	downstream • RPO to continue county rainfall monitoring		gages at D02, D03, D08.
Measurement Parameter	Long Term Target (s)	Party Responsible and Monitoring Procedure	Sampling sites	Frequency
BIOLOGICAL PARAMETERS				
8. General fish populations	Maintain GLEAS 51 scores of "excellent" at Bishop Creek, "good" at other sites, and attain GLEAS 51 scores of at least "good" at Nine Mile Rd. and Willow Creek at Lotz Rd., by 2015.	MDEQ to continue GLEAS 51 monitoring every 5 yrs. SWAG to work with MDEQ to give input on sites and sampling parameters each year.	Seven (7) sites as determined by MDEQ (with SWAG input)	Every 5 yrs.
	Maintain sensitive fish communities. Review 2000 MDEQ data and revise goals to reflect changes.	Need to contract work for more frequent fish monitoring to supplement MDEQ 5 yr. cycle.	MDEQ sites with additional sites as determined by SWAG.	Every 2 yrs. or annually with rotating stations for subwatershed coverage.
9. General macroinvertebrate populations	Maintain GLEAS 51 scores of "good" between Haggerty and Newburgh Rds., maintain GLEAS 51 scores of at least "fair" in Johnson Creek, by 2005 and increase to "good" by 2015. Review 2000 MDEQ data and revise goals to reflect changes. Involve members of the public in volunteer monitoring.	MDEQ to continue GLEAS 51 monitoring every 5 yrs. SWAG to work with MDEQ to give input on sites and sampling parameters each year.	Five (5) sites as determined by MDEQ (with SWAG input), might need to increase sites.	Every 5 yrs.
		Need to contract work for more frequent macroinvertebrate monitoring to supplement MDEQ 5 yr. cycle. Utilize volunteer stream adopters, FOTR programs.	MDEQ sites with additional sites as determined by SWAGs and volunteer monitors.	Every 2 yrs. or annually with rotating stations for subwatershed coverage.
10. Frog and Toad Surveys	Track and report frog and toad populations to detect trends in decline or increase over time and relate to land use changes, habitat protection.	Friends of the Rouge (FOTR) to continue working with community volunteers to monitor and report trends through GIS. FOTR needs support of communities and volunteers.	Sites to cover appropriate sections of the subwatershed as determined by FOTR.	Annually or as volunteer program recommends/allows.

Measurement Parameter	Long Term Target (s)	Party Responsible and Monitoring Procedure	Sampling sites	Frequency
OTHER PARAMETERS OF INTEREST				
11. Lakes / Impoundments	Criteria to be established. Generally, improve desired recreational and aesthetic capacities by 2015.	RPO to work with MDEQ and SWAG to develop criteria for lakes. Focus primarily on fish, nutrients, E. coli, aesthetics, phytoplankton counts, qualitative macrophyte surveys. Use 1994-1995 RPO Limnological Study as base. Need to contract work.	Walled Lake, Meadowbrook, Phoenix, Wilcox, Newburgh Lakes.	2001 develop criteria and procedure. Monitor every 3-5 years.
12. Wetland Review	Track net acres of wetland to determine status annually.	Conduct wetland inventory across subwatershed. Work with MDEQ Wetland Permitting to track fills, mitigations, etc. Utilize existing community staff to document.	Across subwatershed.	Conduct wetland inventory in subwatershed. Annual review and report of permitting activities and wetland status.
13. Aesthetics	Anecdotal information to guide priorities. Improve aesthetic conditions where feasible by 2010.	Develop consistent qualitative survey for field staff or volunteers to monitor certain sites for aesthetic improvements/changes and document use of area. Utilize volunteers, FOTR River Watchers, students, community field staff. Have training for volunteers and survey form on website.	Several sites designated by the subwatershed.	Annually
14. Recreation potential	Increase recreation potential and use in the subwatershed by 2007.	Develop plan for a river/stream walk/survey to identify and map potential recreation areas and needs in the subwatershed, especially along the river and tributaries. Identify funding for easements, purchase, and infrastructure. Utilize community field staff and recreation departments. Need to contract work for study.	Survey of subwatershed and riparian areas.	One time study to determine opportunities. Develop plan and implement. Evaluate using annual aesthetic surveys.
15. Monitoring Plan Management and Coordination	A comprehensive, coordinated analysis of the progress of the subwatershed and subsequent recommendations for actions based on data collected on an annual basis.	Coordinate all components of and parties responsible for various monitoring activities as listed above, collect and interpret data, develop annual report based on data collected, facilitation of plan review and development for following years. Need to contract work.	Subwatershed-wide.	Annually.