PLANNING AND ASSESSMENT OF BEST MANAGEMENT PRACTICES IN THE ROUGE RIVER WATERSHED

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ABSTRACT

The Rouge River National Wet Weather Demonstration Project in Wayne County, Michigan, has developed an approach to linking the performance of best management practices (BMPs) to receiving water impacts. The approach considers the various stages of the entire BMP process, including design, implementation, and a system of performance measurements at each stage.

INTRODUCTION

In the management of watersheds, measuring progress is an untamed frontier of professional practice. Watersheds present us with situations that defy accurate measurement. Consider the following contrasts between measurements for point source controls versus measurements for watershed management.

- While pollution controls for point sources typically involve large engineered facilities that can be equipped with sophisticated systems for measuring the quality of influent and effluent, watershed management entails numerous and geographically scattered projects making it more difficult to measure influent and effluent cost-effectively.

- While point source controls provide accountability to one single unit of governmental or business organization, watershed management often depends on the individual actions of tens or hundreds of organizations, each working with an individual set of priorities and budget limitations.

- While point source controls involve one particular technology, such as secondary treatment, or a bundled set of technologies, such as storage and treatment, watershed management may involve a detention basin in one area, a wetland with nutrient uptake in another, a street sweeping effort in yet another area. Each technology has its own set of measurement requirements and differing hydrologic factors.

- While point source controls typically are implemented with the ability to enforce compliance, watershed management involves numerous efforts for water quality protection that often are beyond the bounds of regulation, and therefore rely on voluntary efforts. Voluntary efforts by local units of government must compete with mandatory efforts for budgetary resources, and this makes it more difficult to achieve standard design criteria.

It is against this backdrop that the Rouge River National Wet Weather Demonstration Project (Rouge Project) sets out to link the performance of best management practices (BMPs) for wet weather pollution control to improvements in water quality in the Rouge River watershed. While there is abundant information on the technical performance of many BMPs in controlled settings for scientific or engineering performance analysis, there is much less information on the performance of BMPs in real urban watershed applications. The Rouge Project is filling this information gap by constructing and measuring the cumulative performance of BMPs in complex urban watershed settings.

In the context of this paper, the term "best management practices, or BMPs" is used as a generic term to mean any technology – either structural or non-structural – for the control of flows or pollutants that adversely impact a receiving stream. This paper examines the array of mechanisms that the Rouge Project has created to link and measure the performance of BMPs to water quality and ecosystem health improvements. The array of mechanisms considers all of the complex factors in watershed management which complicate the measurement process – dispersed geographic distribution of BMPs, multiple project owners, a wide variety of pollution control technologies, and the voluntary nature of many activities. The linking mechanisms used in the Rouge Project take into account the whole process of BMP development, from setting design criteria, to project implementation and post-construction monitoring, and watershed-wide assessments of progress.

PROJECT BACKGROUND

The Rouge Project, initiated in 1992 by the Wayne County, Michigan Department of Environment, has learned a great deal on what it takes to restore an urban waterway to its beneficial uses. The project is partially funded by Congressional appropriations managed by the U.S. Environmental Protection Agency (EPA). As an indicator of the project's success, continuous grants have been awarded to Wayne County each year since 1993. Some of the project funding is spent on watershed-wide activities such as sampling and monitoring, but the majority of the funding is passed to local communities and nonprofit groups for watershed management activities such as design and construction of pollution controls.

The Rouge River Watershed is largely urbanized, spans approximately 438 square miles, and is home to over 1.4 million people in 48 communities and 3 counties. The Rouge Project initially concentrated efforts on the control of combined sewer overflows (CSOs). The early objective of the project singled out the control of CSOs as a means to improve water quality in the river. However, as the project unfolded, the monitoring showed that other sources of pollution needed to be controlled before full restoration of the river would be achieved throughout the watershed. In fact, the data showed that even if all of the CSO discharges were totally eliminated, the waters still would not meet water quality standards. Based upon what was learned, the Rouge Project has taken a wide-angle lens view of pollution sources. The project now has a holistic approach to consider the impacts from all sources of pollution and use impairments of receiving waters. The project is therefore proceeding on parallel paths, controlling CSOs, while pursuing the watershed approach to address storm water management, flow management, non point sources, failing on-site sewage disposal systems, habitat and riparian restoration, and the development of new recreational opportunities.

One of the primary goals of the Rouge Project is to guide state and federal regulatory policy in wet weather pollution control. The chief way that the project guides policy is by demonstrating the implementation of BMPs for an urban river system, and by demonstrating workable governmental processes that support the implementation of watershed restoration. Critical to both the technology design and to the processes of

government is the ability to measure individual BMP performance and to measure the cumulative beneficial impacts of all efforts in the watershed.

The Rouge Project distinguishes itself among other watershed efforts by not relying on a single point of institutional accountability. The federal, state, county, and municipal units of government are in agreement that watershed management is the ultimate responsibility of each local municipality. The municipalities collaborate with each other, and they have formed alliances in seven subwatershed groups that range in size from about 20 square miles to over 80 square miles. The municipalities also support watershed-wide activities for monitoring, geographic information systems (GIS), technical information sharing, public involvement and grant administration. The Rouge Project has included a large number of voluntary activities, particularly in the arena of storm water management, where mandatory federal regulations will not take effect until 2002, and state policy has been through a voluntary General Permit since 1997.

THE SERIES OF STAGES

The Rouge Project uses a series of stages to link BMP performance to receiving water impacts. The project has found that it is necessary to proactively build the links so that useful measurements and conclusions can be obtained.

There are five stages that span the BMP process:

- Design criteria for BMPs,
- Assessment of water quality needs by subwatershed,
- Promotion of the implementation of the most effective BMPs in each subwatershed,
- Standard protocols for receiving water quality measurements, and
- Watershed wide monitoring program and data assessment.

Each of the stages has three principal components:

- A technical basis developed from engineering analysis;
- A basis of authority, which typically is a process of government, such as an ordinance, adaptation of existing regulation, new regulation, or as simple as a peer-supported voluntary guideline; and
- A physical measurement of the effectiveness of the stage, such as a performance monitoring program, a watershed monitoring program, or other type of assessment.

All three components are necessary. The technical basis provides the functional fit of the BMP into the engineered watershed ecosystem. An authority is needed to provide a reason and motivation for the BMP to be implemented in the context of other public needs – education, safety, transportation, etc. The measurement component is the way to test the success of implementation and assess the need for further action.

The concept of looking at the entire BMP process is important, because of: 1) the relatively long time span for BMP implementation; 2) the complexities of multiple parties responsible for implementation; and 3) the evolving learning curve of watershed management technologies.

The concept of a subwatershed is also important in the establishment of links between BMP performance and receiving water impacts. Subwatersheds allow us to tackle the larger problems of a watershed in a series of smaller bites. For example, a subwatershed that is a headwater area allows the suite of BMP solutions to focus on headwater protection, which may not require dealing with the complications of CSO controls typical in downstream areas of the Rouge watershed. The subwatershed provides a smaller geographic area, a smaller range of technical solutions, a smaller list of objectives, and a small group of stakeholders – overall, a more manageable problem to tackle. The delineation of subwatersheds may therefore be an important step in the BMP process. A discussion of the locally controlled subwatershed delineation process in the Rouge River watershed is given by Cave, et al., 1998.

DESIGN CRITERIA FOR BMPS

The first link between BMP performance and receiving water quality improvement comes at the beginning of the staged BMP process – that being the design criteria of the project.

Technical Basis

The Rouge Project has developed design criteria, or facilitated the development thereof, for a number of efforts to standardize design criteria for BMPs. Examples include:

- Development of a guide for planning and estimating costs for BMPs that is tailored to metropolitan Detroit applications. This guide presents a "public works director" view of design criteria and cost estimates for 23 categories of BMPs. Figure 1 shows an example entry from this guide. (Ferguson, et al., 2001)

- New design standards for storm water management in Wayne County which establish peak discharge rates, restrict activities in flood plains, and set forth provisions for operation and maintenance of storm water facilities. (WCDOE, 2000)

- Development of design criteria for demonstration size CSO storage and treatment basins. These criteria established a "demonstration" basin size to capture 0.17 inches of runoff compared to the state regulatory agency presumptive size of 0.35 inches of runoff. (Alsaigh, 1994)

- Water quality models for evaluation of river impacts. These tools are primarily used in work with the state regulatory agency (MDEQ) for CSO basin sizing and with performance evaluation of the basins and storm water detention pond operation. The water quality models utilize the US EPA SWMM and WASP models, and are configured for both dynamic and steady state simulations.

Wayne County has invested in a program of technology transfer to disseminate the design criteria that the Rouge Project develops. The technology transfer program includes an educationally acclaimed website (www.rougeriver.com), training programs and publications that are for audiences in the Rouge watershed and in other watersheds. The Rouge Project also offers a technical extension service for communities in the Rouge River watershed.

Type:	Non-Structural, Urban Source Control BMP.
Description:	Periodic inspection of on-site sewage disposal systems (OSDS) and regular pumping of septic tanks will prevent, detect and control spills, leaks, overflow and seepage from on-site sewage disposal systems.
Function:	Prevents premature failure of on-site sewage disposal systems and detects problems that will minimize pollution.
Application:	Maintenance practice.
Site Requirements:	Availability of a plan showing the location of the on-site sewage disposal systems.
Effectiveness:	Pumping of septic tanks on a regular basis and inspection of the on-site sewage disposal system can prevent premature failure and detect problems so that repairs can be less costly. An inspection of the on-site sewage disposal system is recommended every 5 years. Health Departments recommend a 3-year cleaning cycle for septic tanks.
Who Does It?	Can be done by municipal staff or by county health agency.
Design Requirements:	Risers on septic tanks make location, inspection and pumping easier. Pumping must be done by a Licensed Septage Waste Servicer. A Registered Sanitarian should perform inspections or a person certified as a septic system evaluator by the local health department or NSF International.
Basis for Cost:	Cost of regular inspections of on-site sewage disposal systems. Assumes 20 percent of a community's septic tanks are inspected each year so that a five-year cycle is maintained. Time for inspection usually takes 1 to 3 hours, but can take much longer if the location is not well defined. Cost per septic tank for pumping and proper disposal of the contents
Who Pays For It?	Paid for by municipality
Cost ($)	Inspection: $100/hour, 3 hours per site including reporting and travel time. (This time can be substantially more if the on-site sewage disposal system is difficult to locate.) Pumping: $100-$150/septic tank including disposal

FIGURE 1 - SEPTIC SYSTEM MAINTENANCE
(Excerpt From "Cost Estimating Guidelines: Best Management Practices And Engineered Controls", Rouge River National Wet Weather Demonstration Project)

Authority

Technical criteria need to have a basis of authority to assure that BMPs are implemented in accordance with the technical standards. The Rouge Project has been successful in taking its design criteria and working these into ordinances, regulations, model ordinances, etc. For example, the project implemented new storm water management standards for Wayne County in October 2000 (WCDOE, 2000). Key features of these standards include:

- Storm water outlet design, and sizing and location of the outlet with regard to stream capacity
- For drainage areas of 5 acres or more, the runoff rate must not exceed 0.15 cfs per acre for a 100-year storm; for less than 5 acres, the runoff rate must not exceed 0.15 cfs per acre for a 10-year storm

- Storm water runoff should conform to natural drainage patterns where feasible
- Storm water management systems should not generally be constructed within the 100-year flood plain; work within the flood plain has restrictions and requires compensatory storage and riparian habitat mitigation.

Another example of bringing technical criteria into law is the State of Michigan Wetlands Mitigation Bank. The Rouge Project worked with the State of Michigan Department of Environmental Quality to develop a wetlands banking system (State of Michigan, 1998). Units of government can apply for membership in the bank, and Wayne County was successful in becoming a member. The program establishes criteria for design, construction and maintenance of wetlands. At this time, over 10 acres of wetland are built or under construction for the bank.

A final example of the authority for promoting design criteria is in the CSO control program for 157 overflow points in the Rouge River. The authority was based on a court-ordered compromise under the US EPA and Michigan Department of Environmental Quality NPDES (National Pollutant Discharge Elimination System) program. The compromise ordered a phased approach to CSO control. Phase I required the elimination of raw sewage and the protection of public health for approximately 40 percent of the combined sewer area. The Phase 1 control plan was based on the technical design criteria (capture 0.17 inches of runoff) developed by the Rouge Project noted earlier. Under Phase I, six communities separated their sewers and eight communities constructed basins to evaluate varying sizes and control technologies of CSO basins.

Measurement

The third component in the design criteria stage is that of measurement. Design criteria are first established with computer models, engineering analyses, or results from other locations. The criteria need to be tested and examined, and ultimately refined based on the actual implementation in the watershed. The Wayne County Storm Water Management Program also requires post-construction monitoring, and we will learn from these new data. The Michigan Wetlands Banking Program requires 5 years of biological and water quality monitoring.

The CSO Phase 1 program has completed an extensive program of monitoring to determine if the demonstration size basins had met the water quality standards. A work group of staff from the Michigan Department of Environmental Quality, the NPDES permitted communities, and from the Rouge Project evaluated 2-years of measurements of basin influent and effluent and receiving water quality data. The Michigan Department of Environmental Quality has certified 6 of the 9 basins to date, and the design criteria that were established are being used to plan the next phase of controls.

ASSESS WATER QUALITY NEEDS BY SUBWATERSHEDS

In the previous examples, CSO locations were known and locations for wetlands banking sites were governed by land use opportunity. What happens when there is a watershed sector suffering from eutrophication in an impoundment, stream bank erosion, and high wet weather bacteria?

This the second stage of the BMP process when the issue is not the design criteria, but the questions are: what is the type of technical solution, and at what scale should it be applied? What are the most appropriate BMPs for the specific environmental needs?

Technical Basis

The technical works at this stage is to thoroughly and systematically analyze the needs of each part of the watershed. In the Rouge Project, this stage was completed through a series of subwatershed management plans. The subwatersheds can be classified in three categories: those in headwaters where issues involve preservation, open space is relatively plentiful, and development ordinances can be useful; those at the most downstream and developed reaches, where the land is fully developed, and the issues are restoration and redevelopment; and those in growing suburban areas, which have a mix of issues from the other areas.

The seven subwatershed management plans for the Rouge watershed specify a series of BMPs to be implemented over the next 5 years (Rouge Subwatershed Advisory Groups (7), 2001). General goals for the period after 5 years were established, and these goals will be formulated into more specific BMP implementation after the first 5 years of progress are complete. The BMPs have been identified through a collaborative planning process involving the local units of government and Counties responsible for performing the work, the general public, and the state regulatory agency. Over 900 BMPs have been identified for implementation by 38 communities and agencies in the watershed.

Authority

The subwatershed management plans were developed and implemented as part of the Michigan Storm Water General Permit of 1997 (State of Michigan, 1997). The US EPA has accepted the General Permit as meeting criteria for EPA's national Phase II storm water program, which takes effect in 2002. In tailoring the General Permit to the needs of the Rouge watershed, the Project has attempted to incorporate watershed planning components from other of water resource management programs, including:

- **TMDL Program:** Various segments of the Rouge River are listed on the federal Clean Water Act Section 303(d) list for various parameters. The Total Maximum Daily Loads (TMDLs) for these segments are not scheduled for completion until approximately 2005. The river will require multiple TMDLs (approximately 15) that may result in conflicting implementation strategies in the watershed as a whole. Under the USEPA's proposed TMDL regulations, use of the watershed approach is encouraged, an approach already being implemented in the Rouge Project.

- **Water Quality Trading Program:** The State of Michigan is in the process of completing its Water Quality Trading Program rules. Through this program, the trading of nutrients in impaired water bodies (for which TMDLs have not yet been developed) can only occur where an approved watershed management plan has been developed. Unlike other "approvable" watershed plans, the watershed management plan for the trading program must include a "cap" and allocations.

As described earlier, the seven subwatershed advisory groups in the Rouge Watershed have developed watershed management plans as required under the Michigan General Permit. Obviously it is desirable to develop only one "comprehensive watershed management plan" that will meet stakeholder goals and objectives as well as all applicable program requirements any other programs that emerge. Therefore, the Rouge Project subwatershed management plans have a goal of being comprehensive watershed management plans that will meet objectives of multiple programs. By doing so, both the watershed communities and regulatory agencies will save time, money and effort by having one plan that fulfills multiple objectives. In

addition, these comprehensive plans will provide much needed certainty to the communities, counties and other stakeholders in planning for watershed management activities and expenditures.

Measurement

The Michigan General Permit requires that each subwatershed management plan include a description of the measures that will be used to gauge progress on meeting the goals of the plan. As Rouge Project representatives met with the Michigan Department of Environmental Quality to examine the requirements for measurement, we determined that the MDEQ would be satisfied with rather general forms of measurement. As a result, the Rouge Project established an overall architecture for the measurement program, and key elements of the program are noted below:

- The BMPs identified by the stakeholders should be designed to address all known causes of water quality standards violations
- Each BMP is "scored" relative to its potential ability to improve major designated uses of the receiving water, including fish propagation, partial human body contact, boating, and aesthetic enjoyment
- Measurements of the effectiveness will be made based on in-stream flow and water quality monitoring stations, along with biological surveys
- The performance standards and budgeting assumptions for all the actions have been standardized throughout the watershed to help assure that the implementation approach for various BMPs is relatively standard
- At the end of the 5-year period, the water quality results achieved will be assessed, along with the costs and other implementation issues
- A subsequent 5-year program of BMPs will be developed through the upcoming federal Phase II storm water program

Now that subwatershed communities are planning local actions to improve Rouge River water quality, the potential of these actions to solve condition and use problems are being evaluated. Figure 2 shows the structure for developing an action score for each BMP. The effect rating for actions can be combined with condition and use ratings, as shown below, to produce an overall "action score" which is location-specific. Logically, the highest score should represent a case where the most appropriate action has the greatest beneficial effect on the worst river condition and use problems. Rating values have been assigned accordingly. Action scoring of this type is necessarily based on "expert opinion", not hard data; but the score numbers should provide a useful scale for comparing the likely benefits of applying different actions to different problems in different watershed situations.

The effectiveness of community actions is highly dependent on where and when actions occur, and how well they address river quality problems. In general, the most beneficial actions are those, which have the most ***direct*** effects. Other less beneficial actions have ***indirect*** or only ***potential*** effects. Some actions may be highly effective in one location or season and ineffective in another. Moreover, an action may improve one kind of river condition or use, and have no effect or even undesirable effects on others. In short, the effectiveness (or cost-effectiveness) of community actions can be evaluated only in the context of local river conditions and public uses.

The effects of community actions on Rouge quality can best be measured at monitoring stations where historical conditions are known. Prior data for river quality indicators at these stations provide a yardstick for monitoring future trends in condition or use quality. The data provide a basis for gauging the long-term

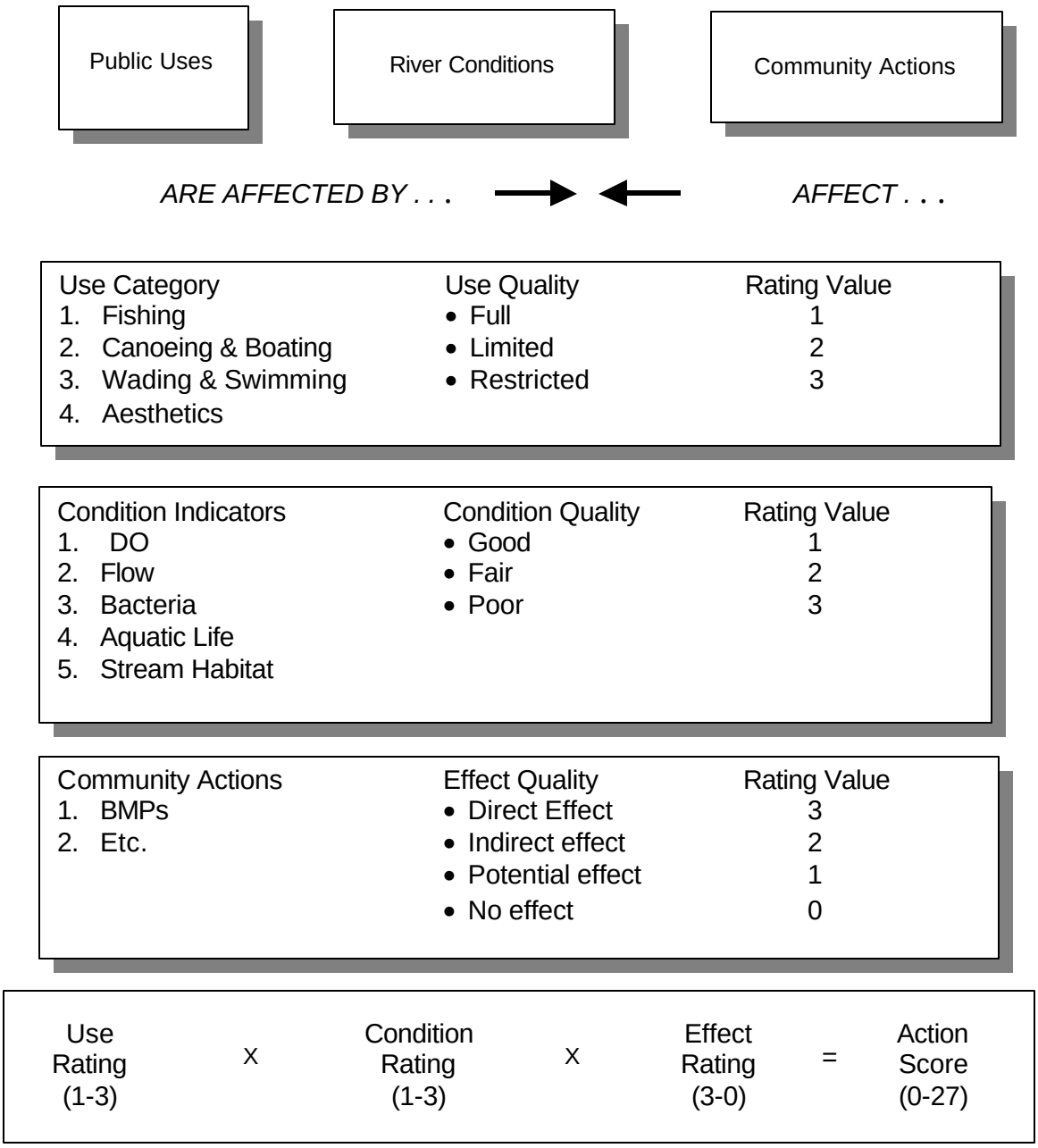

FIGURE 2 - ROUGE RIVER NATIONAL WET WEATHER DEMONSTRATION PROJECT: BMP ACTION SCORING SYSTEM

effectiveness of community actions as well. Site-specific ratings of various actions can help communities to design local programs, which yield the greatest returns for their money and effort.

PROMOTING THE IMPLEMENTATION OF THE MOST EFFECTIVE BMPS

As we come to the third stage of the whole BMP process, the design criteria have been established and the plan is in place for what BMPs are needed, where, and at what scale. The next challenge is implementation

-- how do we implement the plan and build the projects that best fit the environmental needs and meet the design criteria?

Successful implementation is difficult in watershed management because there is seldom one agency with funding and authority to perform all the work. In addition, implementation often relies partially on voluntary efforts. Consequently, there are no guarantees that design criteria will be used or that BMPs will be implemented in accordance with a desired schedule. The Rouge Project has relied again on its three-part formula of a sound technical basis, an authority, and a measurement system to make progress with implementation.

Technical Basis

The Rouge Project has developed a program management approach to promote the implementation or construction of BMPs that meet the design criteria and are in accordance with the plans. The most powerful tool that the Rouge Project has for implementation is a source of funding. The US EPA demonstration grant funds are primarily used for sponsoring projects by stakeholders in the watershed. Over 93% of all the grant funding received has been given as "subgrants" to communities for the design and construction of CSO, storm water, and non point source BMPs.

The subgrants are offered on a competitive process to communities, agencies and non-governmental organizations in the Rouge watershed that meet minimum qualifications. Since October 1997, the project has issued "Notices of Grant Availability" at approximately six-month intervals. The regularity of these grant notices is designed to facilitate the funding of projects by the grantee communities and agencies. The funding is a maximum of 50% on a reimbursement basis, so each grant recipient needs to encumber local matching funds for their projects, which can take six or more months.

The Notices of Grant Availability specify requirements for proposals from communities and establish a date for submittal and project evaluation criteria. The Notices also identify the types of activities that will be eligible for funding, and these activities have included:

- wetlands creation or restoration
- habitat and recreational opportunities
- storm water management
- on-site sewage disposal system management
- illicit discharge elimination
- public education on storm water
- geographic information system implementation
- other projects that implement the subwatershed management plans.

Figure 3 shows the evaluation criteria that have been used in recent competitive proposal selection. A technical review team comprised of representatives of the County and other independent agencies performs the proposal evaluation.

CRITERIA	WEIGHT
1. Consistency with the watershed management goals of the subwatershed management plan and the Rouge River restoration and its national demonstration goals. Higher scores will be given to those projects that most directly improve water quality.	30
2. Consistency with the community's or agency's Certificate of Coverage for the Storm Water General Permit and subsequent subwatershed management plan and storm water pollution prevention initiative	15
3. Availability of other funding sources. If other sources are available, scoring will be lower.	10
4. Performance of the community in timely execution and progress and expense reporting of projects under previous interagency agreements. .	20
5. Cooperative approaches with other communities or agencies.	10
6. Cost-effectiveness and timely schedule of the proposed project.	10
7. Clarity of the proposal and conformance to the submittal requirements.	5

FIGURE 3 - TYPICAL CRITERIA FOR PROPOSAL EVALUATION, ROUGE RIVER NATIONAL WET WEATHER DEMONSTRATION PROJECT

Authority

In this stage, the authority for the implementation effort rests with the Steering Committee of the Rouge River Watershed. This is a group representative of the counties, municipalities, subwatersheds, regulatory agencies and other parties with oversight over the project. It is a group of peer communities that governs by consensus. The Steering Committee reviews the notices of grant availability and the evaluation criteria, and then reviews and ratifies the selection process. The Steering Committee is an ad hoc group without legal authority, but is operates on a consensus basis. In 2002, the communities of the Rouge watershed began planning discussions to form a Local Management Assembly to replace the Steering Committee with a more formal organization having limited legal authority through inter-governmental agreements.

Measurement

In this stage of the whole BMP process, the most useful measurement is BMP implementability. Such measures should address any barriers to implementation, what would be done differently next time, and what lessons were learned. The project is seeking practical advice that is in the language of the local community public works department director.

Each subgrantee is required to submit a report that summarizes the implementation of the BMP project. The following are examples of reporting on the BMP implementation:

- Erosion Controls at Construction Sites – compared fabrics, fences, and hay; found hay most versatile
- Catch Basin Cleaning – found 3-year frequency optimal in terms of cost and effectiveness in maintaining catch basin functionality

- Stream Bank Stabilization - improved designs for bioengineered stabilization, as well as traditional stone bank protection; developed training for municipalities in stabilization design and construction practice

- Public Education Projects – resulted in surveys that measured public opinion (Powell, et al., 2000)

STANDARD PROTOCOLS FOR RECEIVING WATER MEASUREMENTS

The next stage in the whole BMP process is the use of standard protocols for field measurement. Once there are BMPs built according to design criteria and fulfilling watershed protection needs, then uniformity in measuring receiving water measurements is required.

Technical Basis

The Rouge Project has spent considerable effort in analyzing ecosystem health and receiving water quality, and then determining the key parameters to be measured.

Historically, the Rouge River has been damaged by industrialization and suburban expansion. The river's name reflects the inherent problem of erosion of the river's red clay soil banks even from the early days of French settlers 300 years ago. Since industrialization, public health agencies measured oils and greases and toxics such as mercury and PCBs in the sediments. The Rouge Project began a major annual monitoring program in 1993. Those surveys have shown the following pollutants to be the main problems in the Rouge:

- Dissolved oxygen deficits, particularly downstream of combined sewer overflows, but also upstream in impoundments and reaches of the river affected by sanitary discharges

- Extremes of flow – either due to increasing impervious areas and flash flooding, or due to extremely low flow

- Pathogens from combined sewers, leaking septic systems, sanitary sewer overflows, and illicit connections to storm drains

- Nutrients from lawn fertilizers and sanitary discharges

Metals and toxics have generally not been a problem, except in the sediments of the most downstream portion of the river. There are also some hot spots of sediment contamination, and one lake that had been contaminated with PCB in the sediments. This lake was dredged in 1997 and 1998, and it is an example of an easily measured BMP. The removal of the contamination could be measured, the bottom dredged deeper and fish stocked. Water quality measurements have confirmed the viability of the new fishery and new recreational uses of the lake. There is now more recreation, fishing, boating, and a triathlon celebrating its second year in 2001.

Authority

The Rouge Project has established definitive standards for measurement. Because it is a federally funded demonstration project, the protocols for all measurements are established in accordance with quality assurance and control standards established by the US Environmental Protection Agency. The US EPA provides grant funding for a portion of the sampling cost. The project has demonstrated the effectiveness of a variety of sampling and modeling techniques and has published the information on the Rougeriver.com web site. By using the web site, communities that need to develop less extensive sampling programs can benefit from the experience of the Rouge project.

A Field Sampling Plan (FSP) Preparation Guide has been developed. This guidance document serves as a template for the preparation of site-specific FSPs. The FSP Preparation Guide also serves as a review checklist for quality control reviews to ensure that the appropriate level of detail is provided in the FSP.

Activities that are undertaken routinely in a consistent manner are documented in Standard Operating Procedures (SOPs). SOPs are available for laboratory methods (e.g., the 5-day Biochemical Oxygen Demand Determination) and field sampling (e.g., sediment coring) techniques.

Each laboratory under contract to Wayne County is responsible for implementing a quality assurance program specifically designed for laboratory activities. As part of this program, laboratories must document and update SOPs regularly in their Quality Assurance Program Plans (QAPP). The Rouge Project maintains on file current copies of all subcontract laboratory QAPPs. Only EPA approved analytical methods are used for analyses of samples collected as part of the Rouge Project. For those activities, which require modification of existing SOPs or development of new SOPs, internal review and approval will be sought from EPA prior to their use.

Measurement

An example of the detail that the program has achieved is given by the evaluation of the Cedar Lake detention pond shown in Figure 4. In this example, rainfall, influent and effluent data were analyzed concurrently as part of the detailed examination of the wet detention pond.

WATERSHEDWIDE MONITORING PROGRAM AND DATA ASSESSMENT

The preceding stage of the entire BMP process yields an important end product -- a comprehensive means of measuring the collective contribution of many BMPs to the progress of water quality improvement. The Rouge Project has successfully monitored the watershed since 1994 through a system of 7 continuous flow and dissolved oxygen gages and dozens of dry weather grab sampling sites. Special studies have been conducted on an annual basis to develop more information on phosphorus loadings from fertilizer, sediment oxygen demands, time of travel, impoundment reaeration, and total residual chlorine, among other issues. As an example of a low cost method of evaluating ecosystem health, frog and toad surveys have been conducted for the last three years in headwater areas. These surveys, which have brought out an increasing number of public volunteers each year, provide useful information with the added benefit of bringing people to the resource which will hopefully assist with pollution prevention through increased awareness.

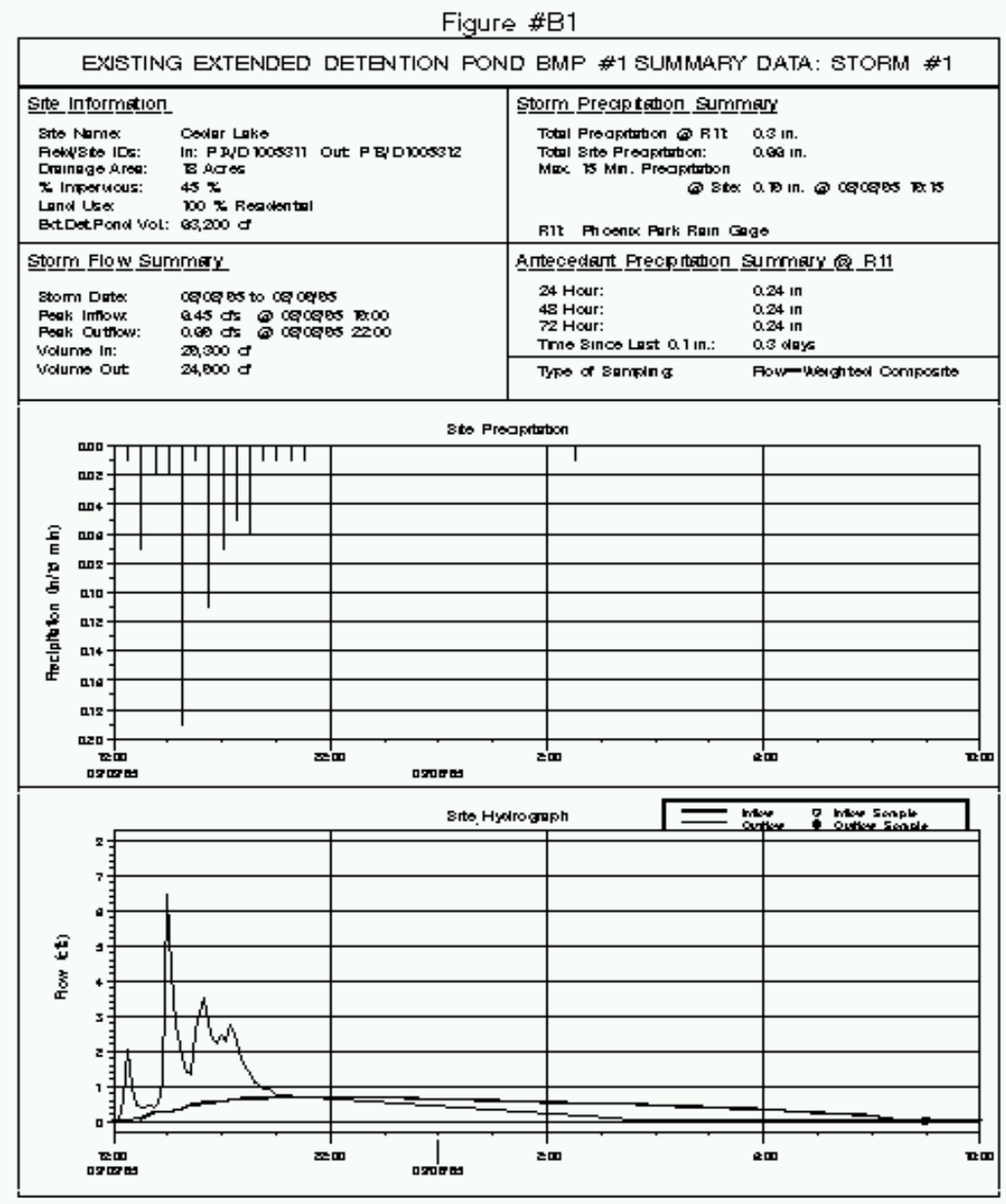

FIGURE 4 – MEASUREMENT OF CEDAR LAKE BMP PERFORMANCE

Through its annual surveys, the Rouge Project has been able to document a continuing improvement in dissolved oxygen downstream of the now controlled CSO discharges. The annual surveys also provide a basis for further investigation and correction of other pollution sources. Among the benchmarks that future annual surveys will consider are the following:

Flow variability

- Restrict peak flow rates at critical points
- Do not allow critical reach to meet the peak more than 10% of the time

Nutrients

- Phosphorus limited not more than 0.05 mg/l total phosphorus

Soil Erosion and Sedimentation

- Settleable solids or suspended solids not present in concentrations that interfere with designated uses

Dry Weather Total Suspended Solids

- Based on achieving desired aesthetic use, maintain or achieve TSS below 80 mg/l in dry weather

Loss of Natural Features

- Benchmark compared to status in year 2000

Passive and Active Recreation

- Dissolved oxygen standard 4 mg/l or 5 mg/l, depending on the location
- Bacteria standards

SUMMARY

The annual assessment of water quality completes the stages of the whole BMP process that the Rouge Project uses to measure the performance of BMPs with respect receiving water impacts. In the year 2000, the annual assessment showed that the Rouge River met the dissolved oxygen standards 94% of the time in its most downstream reaches. Only six years ago, the river was only meeting the dissolved oxygen standards in these reaches about 30% of the time, or less. Wildlife are responding, with ever increasing numbers and varieties of fish, birds, macroinverterbrates, and other species.

The staged approach to BMP performance allows the Rouge Project to measure, and continually improve each step of the watershed management process. This approach has allowed the Rouge Project to meet its two main goals; first, to make great progress in restoration in the Rouge watershed; and second, to share practical and transferable results with other watersheds and demonstrate the implementation of wet weather pollution control policy.

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or recommendation.

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KEY WORDS

BMP (Best Management Practice)
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