CHAPTER II.9

URBAN WATERSHED MANAGEMENT (DETROIT, MICHIGAN)

Kelly A. Cave, P.E., Director, Watershed Management Division

Wayne County Department of Environment

415 Clifford, Detroit, Michigan 48226

ABSTRACT

The Rouge River National Wet Weather Demonstration Project (Rouge Project) is a watershed-based effort, sponsored by the U.S. Environmental Protection Agency (USEPA), to manage wet weather pollution to the Rouge River, a tributary to the Detroit River in southeast Michigan which is designated as a significant source of pollution to the Great Lakes system by the International Joint Commission. The Rouge River watershed is largely urbanized, spans approximately 438 square miles, and is home to over 1.5 million people in 48 communities and 3 counties. Sources of pollution to the river include industrial and municipal point sources, combined sewer overflows (CSOs), stormwater runoff, interflow from abandoned dumps, discharges from illicit connections, discharges from failed on-site septic systems, and resuspension of contaminated sediment. The Rouge Project has expanded from a program to build and evaluate alternative approaches to control CSOs to a comprehensive watershed based pollution abatement initiative.

The Rouge Project is demonstrating that a watershed-based pollution management program, which provides flexibility and real delegation of authority to local stakeholder agencies to decide *how* to achieve water quality goals, is achieving faster and more cost-effective restoration and protection of water resources. In addition, local involvement in addressing water quality problems is resulting in alternative designs for pollution controls, which incorporate multi-purpose, and aesthetic features that facilitate their acceptance by the general public. The Rouge Project is designing, constructing, and evaluating over 200 full-scale pilot pollution control and watershed restoration projects, including CSO basins, stormwater best management practices (BMPs), wetlands, abandoned dump clean ups,

habitat protection and restoration, and management of on-site sewage disposal systems. This chapter provides a summary of these pilot projects.

Addressing all of the sources of impairment in the Rouge River, however, necessitated strong consensus building among the 48 community governments, 3 county governments, state and federal government, industries, environmental groups, and private citizens to show that they had a stake in restoring the Rouge River and that their participation was vital. This chapter also describes the Rouge Project efforts to build institutional and regulatory frameworks necessary to accommodate a watershed approach to wet weather pollution management. Consensus building strategies, critical to the success of this effort, are also described and were used to engage numerous stakeholders, gain their support, provide them opportunities to influence decisions, and participate in actions to restore and sustain the Rouge River as a valuable community asset.

I. INTRODUCTION

In order to achieve water quality standards and associated designated uses within surface waters, it has become abundantly clear that pollution management must be addressed through a watershed approach. The watershed approach is a holistic approach that considers the impacts from all sources of pollution and use impairment in a receiving water. The historic implementation of water quality management programs in the United States (U.S.) at the federal and state levels has been to focus on point sources, which are the most obvious sources of pollution to water bodies. This program has worked well to control pollution from (large) point sources but has also left a patchwork of regulated and unregulated discharges of stormwater and nonpoint source pollution to surface waters. This patchwork is especially true in most urbanized areas where multiple local jurisdictions are located in the same watershed. More subtle sources of pollution, such as stormwater, are now emerging as the next priority for attention. The challenge is to develop of innovative solutions to achieve water quality objectives that may: 1) be more cost-effective, 2) be implemented in a more timely fashion and 3) be better able meet local needs. It has also become clear that water resources management must have the support of the general public in order to be effective and to become self-sustaining. A locally-driven watershed approach to pollution management as a means to achieve management goals is an exciting concept which has been discussed by many but for which there is limited practical experience. This is particularly true in urban situations where there are multiple sources of impairment to a water body and stiff competition for limited local resources to address the pollution sources. The Rouge River National Wet Weather Demonstration Project (Rouge Project) in southeastern Michigan (see Figure II.9.1) has provided an unique opportunity for a watershed-wide approach to restoring and protecting an urban river system by using a cooperative, locally-based approach to pollution control.

The Rouge Project has learned a great deal on what it takes to restore an urban waterway to its beneficial uses. The purpose of this document is to present some of the “lessons
The approach used in determining the lessons learned was built on the idea of asking, “what do we know now that we wish we knew at the start of the project, which would have saved us time and money.” Each of these “Lessons Learned” was developed based upon the extensive experience of the Rouge Project. The background for each of these lessons is explained citing specific experiences related to the Lesson Learned. By availing themselves of the information available from the Rouge Project, others will be able to save considerable time and money in the implementation of their own pollution control programs. Comprehensive information on the Rouge Project, including technical reports and other materials, is available from our website “http:\\www.rougeriver.com”.

A. BACKGROUND ON THE ROUGE PROJECT

The Rouge Project was initiated in 1992 by the Wayne County, Michigan Department of the Environment. The Project is a United States Environmental Protection Agency (USEPA) grant funded comprehensive program to manage wet weather pollution to restore the water quality of the Rouge River, a tributary of the Detroit River in Southeast Michigan. The Rouge River has been designated as a significant source of pollution to the Great Lakes system. The Rouge River watershed is largely urbanized, spans approximately 438 square miles, and is home to over 1.5

million people in 48 communities and 3 counties. The communities and subwatersheds comprising the Rouge River watershed are shown in Figure II.9.2.

The eastern side of the watershed consists of much of the older industrial areas in southeast Michigan. The western side of the watershed consists of newer suburban development and areas under heavy development pressure. The diverse nature of the Rouge River watershed can be seen in Figure II.9.3. The Rouge River consists of 4 main branches totaling approximately 130 miles. All sanitary and combined sewers in the watershed are connected to the Detroit Wastewater Treatment Plant that discharges outside of the watershed into the Detroit River. Twenty percent of the watershed is served by combined sewers. Separate sanitary and storm sewers serve most of the remaining areas of the watershed with the exception of isolated pockets and rural areas in the headwaters that still have on-site septic systems. Historically, the major sources of pollution to the river were industrial and municipal point sources, wet weather sanitary sewer bypasses, and combined sewer overflows (CSOs). The point sources and sanitary sewer overflows have been successfully controlled by an aggressive National Pollutant Discharge Elimination System (NPDES) permitting process administered by the state regulatory agency (Michigan Department of Environmental Quality (MDEQ)). However, the river still failed to meet water quality standards due to a wide range of sources such as CSOs, stormwater runoff, illicit connections, failing septic systems, interflow from abandoned dumps, and resuspension of contaminated bottom sediment.

The Rouge River had been identified as one of forty three tributary areas of concern (AOC) in the Great Lakes system by the International Joint Commission Water Quality Board in 1985. A remedial action plan (RAP) documenting water pollution problems and proposing corrective actions was prepared for the Rouge River in 1989 and updated in 1994. The Rouge River RAP cited the remediation of the CSO discharges in the combined sewer area of the lower watershed as a priority, but also recognized the importance of controlling sources of pollution emanating from non-point and stormwater discharges in the upper watershed served by separate storm and sanitary sewers, and on-site septic systems (Bean, et al., 1994). The Rouge Project was born out of a desire and critical need to manage the multiple sources of pollution in this large, urban watershed in a prioritized, comprehensive manner. The U.S. federal government began sponsoring this effort in 1992 to develop and demonstrate technical, institutional, and regulatory options and processes to protect and restore a large, multi-jurisdictional, urban watershed.

The early focus of the Rouge Project was on the control of combined sewer overflows (CSOs) in the older urban core portion of the downstream areas of the Rouge watershed. The Rouge Project initiated the watershed-wide management approach in southeast Michigan by facilitating CSO control and permitting based on common requirements throughout the watershed. Rouge communities served by combined sewers have entered into permits with the MDEQ and the United States Environmental Protection Agency (USEPA) requiring a base level of abatement construction throughout the watershed followed by assessment of water quality impacts and future construction phases to meet public health and water quality standards. This approach is a significantly departure from previous point source permits, which were typically issued on an individual basis and often not coordinated with other pollution control activities affecting the same water body.

Combined sewer overflow (CSO) control is being implemented in phases, with Phase 1 recently completed. Eight communities constructed 10 retention treatment basins to serve 35.1 sq. mi. of combined sewer system. Each of these basins is sized for different design storms or to employ different innovative technology. In addition, many of the CSO basins are multi-purpose facilities, such as the basin shown in Figure II.9.4, which provides a community park and playground on the top of the basin. One retention/treatment tunnel is under construction in one community containing 3.2 sq. mi. of combined sewers. Several communities separated their sewers; the drainage area of these projects totaled 3.4 sq.mi.. A two-year evaluation study of the CSO control program was recently completed (Hufnagel, et al., 2000; Kluitenberg, et al., 2000). The design, operation, and cost information gained from the evaluation of Phase 1 control facilities, coupled with efforts to control stormwater and other pollution sources in the watershed, will provide the basis for the Phase 2 CSO control efforts.

Concurrent with the initial development of the CSO control strategy, the Rouge Project initiated a comprehensive data collection effort which included gathering information about watershed features and characterizing existing water quality and ecosystem health. The first water quality sampling under the project began in 1993 and by the end of 1994 a supporting geographic information system and watershed modeling effort was in full operation with baseline, automated water quality monitoring sites located throughout the watershed (Mullett, et al., 1994). Water quality and ecosystem health monitoring has involved an extensive effort in the collection, management, and analysis of data on rainfall, stream flow, instream water quality, CSO and stormwater quality, biological communities and habitat, instream bottom sediment, air deposition, and aesthetic conditions. In addition, the monitoring program includes measurement of the performance of various structural pollution controls, wetlands, and pollution prevention activities. The initial sampling, later confirmed during subsequent sampling in 1995 through the present, documented significant pollution problems in the Rouge River watershed upstream from the CSO discharges. State water quality limits for bacteria and dissolved oxygen were regularly exceeded even in dry weather periods in the upper watershed and highly variable flows caused flooding, exacerbated bank erosion and increased sedimentation that affected the lower river. This information, shown by the example in Figure II.9.5, confirmed the suspicions of many that the discharges from separated storm systems in heavily urbanized areas can be a significant sources of pollution including coliform. The Rouge watershed assessment tools have proved to be critical in garnering public support for the river restoration efforts and have provided the general public, local decision-makers, and regulatory agencies with information to prioritize and tailor pollution control solutions to specific river reaches while coordinating efforts throughout the watershed.

Based upon what was learned, the focus of the Rouge Project became more holistic to consider the impacts from all sources of pollution and use impairments in a receiving water. The Rouge Project began to identify the most efficient and cost effective controls of wet weather pollution, while assuring maximum use of the resource. For example, over 60 pilot innovative stormwater control technologies are also being evaluated under the Rouge Project by 25 different communities and agencies. Categories of pilot stormwater management projects currently underway include wetlands creation and restoration, structural practices such as grassed swales and detention ponds, erosion controls, stream bank stabilization and habitat restoration to name a few. Figure II.9.6 shows a linear sand filter, one of the pilot stormwater management projects constructed and evaluated under the Rouge Project.

The Rouge Project has learned that illicit connections and failing septic tanks are major sources of pollution problems in the Detroit urban area (Johnson, et al., 1998). Innovative ways to deal with these sources of pollution have been initiated.

A suite of computer models has been developed by the Rouge Project to simulate the water quality and quantity response of the Rouge River during wet weather events for existing and future conditions under various CSO and stormwater runoff management alternatives. This has lead to a very useful public communication tool on water quality indices tied to actions needed to restore the Rouge River. A comprehensive geographic information system (GIS) and relational databases were designed and implemented to manage the wealth of data collected under the Project. In addition, a special data exploration tool, DataView, was developed to support routine analyses of large time series data sets (Rood, et al., 1995). DataView is user-friendly and readily transferable to other locations. Related to DataView is the Rouge Information Manager also a user-friendly, readily transferable tool (an "electronic file cabinet") for accessing multi-media information about the Rouge River restoration effort.

These tools have been vital in the success of the strong consensus building activities necessary to show the 48 community governments, 3 county governments, state and federal government, industries, environmental and community groups, and private citizens that they had a stake in restoring the Rouge River and that their participation was vital to the success of the comprehensive watershed management program. These consensus building strategies used to engage numerous stakeholders, gain their support, provide them opportunities to influence decisions, and participate in actions to restore and sustain the Rouge River as a valuable community asset. The Rouge Project's public education/public information program has been demonstrated to be a very effective component of the consensus building process (Powell, et al., 2000). While there are many elements of the public education program, as illustrated in FigureII.9.7, one very important element is the involvement of youth in this effort. As one example, in the annual Rouge Water Festival held in May each year, 52 fifth grade classes from over 27 schools (nearly 1,500 students) participate in this hands-on festival where they learned about the importance of water in all aspects of our lives. Over 100 schools are currently involved in education efforts of the Project.

The Rouge Project has spent considerable effort to build institutional and regulatory frameworks necessary to accommodate a watershed approach to wet weather pollution management. Part of this framework is a watershed-based general permit for municipal stormwater discharges issued under the National Pollutant Discharge Elimination System (NPDES) program. This stormwater permit program was developed jointly by the Rouge communities and the Michigan Department of Environmental Quality (MDEQ) and is based on the concept of cooperative, locally-based watershed management (Cave, et al., 1998). Communities and agencies in over 95 percent of the watershed have applied for coverage under this innovative, watershed-based permit program. The MDEQ permit requires permittees to participate in watershed management planning for a self-determined subwatershed unit. The subwatershed management plans form the basis for implementing watershed goals and objectives that will result in improved water quality and pollution control. The Rouge communities will also use these watershed management plans to achieve other program objectives, such as those under the federal TMDL program and the state Clean Michigan Initiative (Cave, et al., 2000).

The local communities, agencies, industries, and citizens have been working together in seven subwatershed advisory groups to develop and implement management strategies for various segments of the river. The Rouge Project has recently been the catalyst for the Rouge River Gateway Partnership, a collaborative effort among county government, corporations, local communities and academic and cultural institutions which is guiding redevelopment to restore the 7 mile section of the lower Rouge River. This section of the river includes a 4-mile concrete channel and a 3-mile section of navigable dredged waterway downstream of the channelized section. As shown in Figures II.9.8 and II.9.9, the Gateway Project will create an 7-mile greenway link for this area, providing the public access and linking the park system along Hines Drive to the Detroit River waterfront (Rouge Project, 2000). This will demonstrate to other communities how it is possible to reclaim waterways that have been essentially removed from public access and use.

II. LESSONS LEARNED TO DATE

As stated above, the Rouge Project has learned a great deal on what it takes to restore an urban waterway to its beneficial uses. The purpose of this chapter is to present some of the “lessons learned” to date. The approach used in determining the lessons learned was built on the idea of asking, “what do we know now that we wish we knew at the start of the project, which would have saved us time and money.” Each of these thirteen “Lessons Learned” was developed based upon the extensive experience of the Rouge Project. The background for each of these lessons is explained citing specific experiences related to the Lesson Learned. By availing themselves of the information available from the Rouge Project, other watershed efforts will be able to save considerable time and money in the implementation of their own watershed protection program.

A. THE WATERSHED APPROACH

1. Lesson learned: We have known for years that the only way to effectively achieve water quality and ecosystem protection in an urban river system is to look at all problems and their solutions from a holistic watershed perspective. The Rouge River Project experience gives us tangible measures of the benefits of this approach-- hundreds of millions of dollars being saved.

The Rouge River Project has undertaken a number of actions to demonstrate how to restore an urban river. Those actions include but are not limited to combined sewer overflow (CSO) controls, stormwater management (including flow reductions), stream restoration, and wetland creation and enhancement. The largest traditional point sources of pollution, CSOs, have been controlled, or are programmed for control.

When the Rouge Project began its main focus was on the control of CSOs because the perception was if CSOs, the largest point source of pollution, were controlled, most of the River would meet water quality standards. The monitoring and modeling program quickly demonstrated that even if all of the CSOs were totally eliminated from discharging to the Rouge River, the designated uses of the River would still not be met because of other sources of pollution such as stormwater runoff and lack of environmental habitat. In order to achieve water quality standards and associated designated uses within the Rouge River, it has become abundantly clear that pollution management must be addressed in a holistic fashion that considers the inter-relationship between the impacts from all sources of pollution and use impairments in a receiving water. Water quality protection at the watershed level is not a single capital project, nor a series of projects. In essence it is a “way of life” and the problems must be approached that way. The U.S. Environmental Protection Agency’s (U.S. EPA) Watershed Framework document also discusses this philosophy (U.S. EPA, 1996).

The Project has enough preliminary data to make a rough cost comparison between utilizing a watershed approach to achieve desired water quality objectives as compared to the historical approach of addressing the causes of water quality degradation individually. This preliminary data indicates cost savings for the Rouge River Watershed citizens could easily approach several hundred million dollars.

2. Lesson Learned: In a large watershed it is most effective to restore or protect water quality and ecosystem health by looking at subwatersheds within the overall watershed. In the Rouge River Project, our focus on 20 to 50 square mile subwatersheds has allowed us to move from a purely regulatory driven CSO program to voluntary community-based efforts for stormwater management.

Environmental protection relies on a mix of federal, state and increasing levels of local resources. Use of local resources requires a search for and identification of common environmental interests. Most people have a strong environmental interest in their community; fewer have a strong interest in the environment with which they cannot identify. Therefore, subwatersheds give a means for focusing the local resources to address local problems due to the interest people have in their immediate surroundings. The U.S. EPA's *Top Ten Watershed Lessons Learned* document also discusses the need for identifiable goals to focus local resources (US EPA, 1997).

Focusing on subwatersheds has many advantages. First of all, smaller areas are more manageable in terms of addressing water quality problems. Second, people identify more with a subwatershed than a larger watershed. Local ownership of pollution problems and their solution is critical. Schueler in his paper, *Crafting Better Urban Watershed Protection Plans*, also suggests that subwatersheds having a drainage area of 518 to 3,885 hectares (2 to 15 square miles) in size provide the best scale from both a technical and a political basis on which to base management plans (Schueler, 1996). Third, it is easier to analyze the various sources of water quality problems in the subwatershed and decide how to get a handle on the priority of dealing with those problems. It is critical to establish a hierarchy of pollution sources in a subwatershed-point sources and nonpoint sources based upon the adverse water quality impacts of those sources. It is very important to keep reinforcing, at a subwatershed level, the concept of not randomly leaping on pollution sources but to prioritize the control of those sources to get desired environmental protection. It may take a long time to correct some of these pollution sources so it is important to prioritize the control programs. Fourth, it is critical to assess the cumulative watershed impacts to quantitatively assess the physical and biological processes and then fashion the subwatershed solutions. Fifth, before river restoration can be initiated, it is critical to understand the cause of stream disturbance and disequilibrium conditions. Without this understanding, the restoration often treats the symptoms rather than effecting a cure. Sixth, it is easier to manage a process that has a smaller set of stakeholders and competing interests. Seventh, it is easier to convince people that water quality improvements will require lots of little and possibly inexpensive actions and not exclusively massive capital programs. Eighth and finally, the tools needed to solve a subwatershed water quality problem must be geared to that subwatershed. The management plan that is developed must be tailored to address subwatersheds specific problems.

Each of the above listed advantages has associated cost implications. It is very important to use innovation in the watershed approach. By a consensus based approach, focusing the local resources to address the local water quality problems can be addressed and solved faster and cheaper.

B. THE CONTROL OF COMBINED SEWER OVERFLOWS (CSOS)

1. Lesson Learned: The control program for CSOs must be flexible and tailored to the site specific situation in order to achieve the most timely and cost effective solution(s).

The State of Michigan has had design standard requirements for the control of CSOs for a number of years. On the basis of those design standards, the Michigan Department of Environmental Quality (MDEQ) issued NPDES permits to the appropriate communities. Certain of the issued permits were challenged. There followed a period of negotiation between the permittees and MDEQ. The permittees, supported by the Rouge River Project, entered into negotiations with the State, which resulted in alternative design standards for certain CSO control facilities. These alternative design standards reflect site specific considerations and would result in the same level of water quality protection. The modified design standards resulted in a savings of over $300 million to the CSO communities in the initial phases of the Project.

CSOs are brief, intermittent pollution sources with long-term water quality consequences. The Rouge River Project has demonstrated that after sewer systems are optimized, CSO outfalls generally discharge for less than 100 hours per year. Most other communities in the U.S. will have similar CSO discharge duration. Cost-effective CSO control for the Rouge River has reduced the duration of discharge to 20 to 40 hours per year. This discharge has received first flush capture, and the more dilute flow that follows the first flush are screened, disinfected, and have some degree of solids and biochemical oxygen demand (BOD) removal. These same CSO controls have provided an extra degree of "insurance" for water quality protection by virtually eliminating the chance for any dry weather discharge from the combined sewer system.

One can look at the cost of CSO control in different ways. Using the Rouge River Project Phase 1 experience, the capital cost is $15,000 per acre, while the annualized cost equates to $10,000 per day of water quality protection. Either way, these represent extremely high fixed costs to deal with an intermittent source. The high fixed cost requires flexibility in the development of CSO controls because of the wide array of local conditions and priorities within a community. As stated above, by using design standards that reflect site-specific considerations the potential for cost savings is enormous. The Rouge Project estimates that modified design standards resulted in a savings of over $300 million to the CSO communities in the initial phases of the Project.

Therefore, by developing a site specific CSO control program that is integrated into an overall watershed management plan which prioritizes the pollution problems to be addressed, considerable cost savings can be realized.

2. Lesson Learned: For large and costly CSO control programs, implementing the program in phases can save time and money and foster critical support from local communities.

The installation of CSO controls is very expensive. Therefore it is critical that decisions on those controls be based on the best available information. Phasing of the installation of controls in complex CSO situations allows for reasonable steady progress to achieve water quality goals in the shortest possible time in a cost-effective manner. Phasing allows time to understand and to develop control programs on related sources of pollution that are adversely affecting water quality; to develop and implement sewer system optimization efforts; to determine what is necessary for public health protection; and to determine what is necessary for the achievement of water quality standard considering all sources of waste to the river system in the most cost and time effective manner by allowing time to develop better baseline information for designing subsequent phases. The phased approach has some CSO controls being installed on part of the overall system, a period of evaluation of the effectiveness of the control technology used to meet the design standards including evaluating the impact on the resource and then making the decisions on the design standards and treatment technology to be used on the rest of the CSO system.

A fundamental premise of the Rouge River Project was to demonstrate various design standards and control technologies for CSO controls. This demonstration would occur in two phases. Phase 1 specified 17 communities to install CSO controls. Under Phase 1, six communities have separated their sewers and eight communities have constructed 10 retention treatment basins utilizing various treatment technologies and design standards. A two-year evaluation study of the completed CSO control basins was recently completed to assess compliance with the design standard used for each basin and to assess the positive water quality impacts on the receiving stream of the controlled CSO discharge. The results of the evaluation study coupled with efforts to control stormwater and other pollution sources in the watershed will provide the basis for the Phase 2 CSO control program on the remaining CSO sources in the watershed. Phase 2 will require all of the CSO communities to install CSO controls necessary to protect public health by a date certain. Phase 2 controls will be based in part upon the information learned in Phase 1. The additional advantage of phasing is creates opportunities for communities to work together to develop joint projects that are mutually beneficial and more cost effective in correcting pollution problems.

Preliminary results from the CSO basin evaluation study completed to date are providing extremely useful information. The information gained from the evaluation of design storms and control technologies will be extremely useful nationwide in determining cost effective CSO controls to meet water quality standards. Information on the size of the CSO basins and their operation has the potential for savings hundreds of millions of dollars in the Rouge Watershed. The savings across the country will even be more substantial.

As stated earlier, it is critical to have strong local support for CSO control programs if they are to succeed. The best way to generate and sustain that support is to clearly demonstrate the benefits of the CSO control program. Those benefits are already becoming evident in the Rouge Watershed. For example, over 100 miles of river are now CSO-free. This translates into the water quality downstream of controlled CSOs is as good as the water quality upstream. The result is the natural beauty of the river is being restored along with its ecological health. In addition, the economic benefits are also becoming more evident because of the increased recreational usage of the River.

C. THE CONTROL OF STORMWATER

1. Lesson Learned: In urban areas, stormwater discharges have just as large adverse water quality impacts as CSO discharges, but the control of stormwater sources is more politically and technically complex. The Rouge River Project recognizes these differences, and is demonstrating the necessity of using a different approach to managing stormwater.

Stormwater runoff occurs during and after each rainfall event whereas CSOs may only occur during the heavier storms. As has been discussed extensively in the literature (e.g., Center for Watershed Protection, 2000), the sources of stormwater in urban areas are many and varied, as are the resulting adverse water quality impacts. The Rouge Project has documented that water quality standards are regularly exceeded because of discharges from stormwater in the watershed. Unlike CSOs where the ownership of the outfall pipe is known, often the "ownership" of the source of the stormwater is not clear. The watershed approach has proven to be the most effective way to address stormwater issues. The watershed approach is locally driven, encourages voluntary participation by communities and other public agencies, requires the development of a comprehensive plan to address the problems, defines actions and iterative steps leading to comprehensive, watershed-wide stormwater management. In the Rouge watershed, the local communities, working through the Rouge Project, assisted the MDEQ in the development of a watershed-based general stormwater NPDES permit (Cave, et al., 1998). This regulatory framework encourages communities to cooperate in a watershed approach to address pollution problems. As discussed in U.S. EPA's *Top Ten Watershed Lessons Learned* document, "watershed work is about partnerships….because partnerships equal power" (U.S. EPA, 1997).

Overall stormwater management includes structural, vegetative or management practices to treat, prevent or reduce stormwater runoff. Therefore the solutions to stormwater problems are difficult and time consuming to develop and implement.

The cost implications of this lesson are many. The associated potential for cost savings is therefore also evident. For example, use of the watershed approach to prioritize the water quality problems and then their solution has the potential to save a great deal of money. As will be discussed in the next lesson, tying stormwater control to other public works projects is a sure winner and saves money.

2. Lesson Learned: Integrating stormwater control projects into ongoing public works plans and actions of local governments results in more timely management of stormwater.

Local governments often have a number of projects or actions planned or underway in the community such as street sweeping, drainage control programs, and related efforts. By showing the local officials the benefits of integrating the stormwater control program into the local plan of these other projects or actions, implementation of the stormwater program will proceed much quicker. This fosters local control over the outcome of the overall project or action, which also is a key to overall acceptance and then success.

This concept of integrating efforts is closely tied to the Lesson Learned on combining stormwater work with the phasing of work. For example, the Rouge River Project has demonstrated this by creating and then seeing the success of the three county Roads and Drainage Roundtable which has resulted in the road commissioners integrating into their day-to-day thinking the needs of watershed protection as impacted by road and drainage work. In summary, local units of government can substantially improve instream water quality by reviewing and adjusting how they perform a number of their daily public works activities

This Lesson Learned has obvious implications for substantial cost savings. Communities need to think of and create opportunities to marry public works and stormwater work, which results in significant cost savings and more timely environmental protection. Such a marriage involves other agencies whose prime mission is not water quality protection. This combining helps everyone involved.

D. GENERAL PUBLIC SUPPORT

1. Lesson Learned: Achieving pollution abatement in a more timely, cost effective fashion must have general public support which can be assisted by combining the watershed approach with the concept of phasing needed pollution controls**.**

The public needs time to understand the complexities of restoring a degraded river and to then respond with the needed support including the commitment/will and the financial support. The Rouge River Project has learned that the general public does not fully understand/appreciate a goal of "meeting water quality standards". What they do understand and appreciate is whether a waterway is fishable and swimmable. They accept that if all of the sewage is not removed from the water it is not swimmable; if toxics preclude fish consumption the water is not fishable; and if habitat is destroyed there will be no fish and therefore the water is not fishable. In summary, if the conditions of the river discourage fishing, swimming and other recreation, attention must be directed at correcting the problems.

Generally local commitments to address pollution problems in a watershed will come in small increments with the demand to demonstrate the value of those increments if support is to be sustained. Therefore, a phased program and the pursuit of a multitude of pollution sources/problems are essential. The Rouge River Project has taken this lesson to heart and has undertaken a number of locally driven watershed based projects in order to demonstrate how to restore an urban river. Those projects include but are not limited to CSO controls, stormwater management, stream restoration, addressing failed septic tank problems, correcting illicit connections, wetland creation and enhancement and stormwater flow reductions. The Project also has implemented a phased approach to the installation of CSO controls.

The Project has enough preliminary data to make a rough cost comparison between utilizing a watershed approach to achieve desired water quality objectives as compared to the historical approach of addressing the causes of water quality degradation individually. This preliminary data indicates cost savings for the Rouge River Watershed citizens could easily approach several hundred million dollars.

The Rouge Project has learned it is cost effective to spend adequate funds on developing base public support. Without that support it will not be possible to achieve the needed water pollution control program to restore beneficial uses. This public support will save money in the long run.

E. PUBLIC EDUCATION AND INVOLVEMENT

1. Lesson Learned: Broad-based public education and involvement programs are critical to the overall success of watershed projects, particularly in urban areas.

One of the major goals of the Rouge River Project is public involvement and education. Each person who lives in the watershed needs to be educated as to how their individual daily actions affect the conditions of the River. Public support depends upon public awareness and education. Education and involvement drives action. Therefore public education efforts should be viewed as a campaign with intensity and high stakes. The approach employed should leverage the tremendous environmental education and media movement already in place.

The Rouge River Project solicits community input through a number of directed activities. Some of the programs that have worked are: getting education programs going in the schools in the area; getting people out to the stream to look at it and to experience it; showing the people some obvious things that have been done to get successes in improved water quality and then widely publicizing the results so people see that things are being implemented and not just planning and talking; making people aware of the River which renews their interest in it; and placing signs at each River crossing to increase awareness. A technical project such as this always faces the challenge of conveying data in a logical way so that the layperson understands the issues. The Project has stressed the focus of restoring uses versus raising water quality. People understand restoring uses to the river versus the abstract concept of raising water quality. The Project developed a graphical presentation on water quality indices which has fostered a good focused debate on some key issues of what is the end objective to be achieved (Smith, et al., 1997). This became the heart of the development of watershed management plans for subwatersheds.

Another important lesson has been on the need to measure, communicate and account for progress. U.S. EPA's Top Ten Watershed Lessons Learned document states "Having good data systems in place to measure and communicate progress is a critical part of watershed work" (U.S. EPA, 1997). They not only keep watershed issues on people's radar screens but assist in sharing successes and facing new challenges to the watershed.

As discussed in the above Lesson Learned, the Project has enough preliminary data to make a rough cost comparison between utilizing a watershed approach to achieve desired water quality objectives as compared to the historical approach of addressing the causes of water quality degradation individually. This preliminary data indicates cost savings for the Rouge River Watershed citizens could easily approach several hundred million dollars.

F. INFORMATION SYSTEMS

1. Lesson Learned: A data management and information system that can effectively communicate to the broad public is critical to achieving success in watershed/water quality restoration projects.

In order to make informed decisions on water quality improvements in a watershed system, it is necessary to have access to and to be able to process large amounts of data. It is important to consider <u>very early</u> in the process how the data will be compiled and analyzed. In other words, consider what type of data and information system is needed to accomplish the desired objective of analysis and communication of results. What is being demonstrated by the data system needs to "come through" as a clear message. The involvement of local officials in the process is critical to the long-term success of the information system. Most local governments have or soon will have GIS systems to aid them in decision making. Every effort should be made to bring together the local units of government in the watershed to establish ways to share information between data systems and to get commonality in information going into the various data/information systems. This cooperation fosters watershed based decisions versus individual city based decisions.

The Rouge River Project has developed two effective data management and information systems that are easily transferable to others for use. DataView is a user friendly data exploration tool developed to support routine analysis of large time series data sets. The system allows for tabular data viewing, data plotting, generating summary statistics, spatial display and data export. The Rouge Information Manager is a user-friendly tool for accessing and displaying information. It serves as a portable electronic filing cabinet to be used by anyone to access information on monitoring data, GIS maps, modeling alternatives, public involvement, wetlands, stream restoration, illicit connections, and other technical data. It contains maps, technical reports, photos and videos, which can be displayed.

Information systems can be very costly. By shopping around it should be possible to adapt an already existing system to meet your needs. This will result in considerable cost savings. As stated earlier, the Rouge Project information system is easily transferable to others.

Also keep in mind the cost savings that will result by having a well-informed public that supports the water quality goals trying to be achieved.

G. MONITORING VERSUS MODELING

1. Lesson Learned: Achieving a balance between monitoring and modeling can save money and time in implementing a wet weather water quality management program.

When addressing wet weather impact on water quality in waterways, the natural tendency is to want to establish an extensive monitoring program to fully document the cause and effect of the water quality problems. Monitoring programs are time consuming and expensive. Related to monitoring is the use of models to define present conditions and to project future options. The objective should be to achieve a balance between monitoring and modeling. The Rouge River Project has learned there are several key aspects related to that balance.

First of all, you must think through how you will use <u>any</u> data collected from a monitoring program to make a subsequent decision. The natural tendency is to collect much too much data on a large suite of chemicals. By asking a series of hard questions, the amount of monitoring data collected can probably be reduced significantly with the concomitant cost savings. Some of those hard questions are as follows: How will I <u>specifically</u> use the data on this specific chemical to reach a decision? How much data do I need on this specific chemical to reach a decision? Do I need screening level data or extensive data to reach a decision? Are models available to help predict the future water quality conditions in this waterbody based upon changed waste inputs? If so, what are the <u>minimum</u> data needed to support the model so that the prediction is within reasonable bounds, i.e. within a reasonable percentage of accuracy? How can I use the model to the maximum extent possible to save cost and only use limited monitoring to fill in gaps as needed?

By the same token, a project can get consumed with modeling and the need to develop the perfect model. One must be careful to not continue to gather data to continually feed a model mindlessly. By asking a series of hard questions on modeling you can have significant cost savings. Some of those hard questions are as follows: Are models a currently available to help predict the future water quality conditions in this waterbody based upon changed waste inputs so that I do not have to develop a new model from scratch? If so, what are the minimum data needed to support the model and what is the minimum modeling effort needed so that the prediction is within reasonable bounds, i.e. within a reasonable percentage of accuracy? How can I use the model to the maximum extent possible to save costs remembering the concept of getting answers "within reasonable bounds"? Remember to keep asking yourself "what do you want to model"? If you do not keep asking that, your model could grow topsy. It must always be remembered that monitoring and modeling are tools to get to the end but these tools should never be confused as being the end.

The idea is to use simple models at first drawing on available water quality sampling information. Let the modeling show where additional data are needed to define location and parameters. Then continue a combination of modeling and monitoring to achieve the desired objectives.

As an example to demonstrate the economics of monitoring and modeling, the amount of money spent by the Rouge River Project to characterize the resource has been approximately $5,000 to

$7,500 per mile per year. (Calculations based on total monitoring costs over the life of the Project and the number of main stream miles). A long term monitoring program is estimated to be approximately $2,500 per mile per year. Compare that to modeling costs, which can be calculated to be $2,000 to $3,000 per mile per year. The long term modeling costs are $750 per mile per year. The ratio of monitoring costs to modeling costs increases from 2.5:1 for the short-term work to 3.3:1 for the long-term work.

In summary, local monitoring programs are needed. They can be minimized and still provide a good basis for planning and decision making. Some key steps to remember are:

1. Collect and analyze existing data.
2. Compare existing data to findings elsewhere such as the Rouge River Project and determine what conclusions can be drawn. Use simple models at this point to help make sense of the data.
3. Plan new data collection and monitoring to fill gaps in information and to further investigate known pollution problems in the watershed.

An overarching lesson associated with monitoring and modeling is the need to avoid paralysis by analysis. Monitoring and modeling can do much to prioritize restoration activities but certain common sense activities should be implemented given only minimal data. Existing national data is often sufficient to flag those items. Some examples include septic field inspection and correction of problems, illicit connection removal and downspout disconnection.

As stated in the above example, the potential for cost savings by doing a mix of monitoring and modeling is enormous! In addition, a sound mix of modeling and monitoring will save time which also translates into money saved.

H. INSTITUTIONAL AND FINANCIAL ARRANGEMENTS

1. Lesson Learned: The toughest problems to be addressed and solved in wet weather and watershed protection programs are developing and implementing the institutional and financial arrangements needed to sustain the program. The technical issues are easy by comparison. Early and continued efforts should be directed towards developing workable institutional and financial arrangements.

The sources of stormwater runoff to surface waterways are many and varied with “ownership” often unclear. CSO discharges are identifiable but can be costly to control. Other sources of waste that cause water quality degradation such as dry weather pollutant sources (sediments, septic tank leakage, illicit connections) are a considerable problem in urban areas. Other considerations such as quantity of flow in an urban stream and the “flashiness” of that flow can adversely impact water quality and the program to restore beneficial uses. Habitat issues are an important consideration related to beneficial uses of the waterways. Urban growth and related land use patterns can have major impacts on water quality restoration programs. All of these challenges are related to the institutional and financial arrangements needed to accomplish the desired end objective of a restored waterway.

The Rouge River Project has learned some important matters in this area. For example, there is a need to demonstrate to the residents of a watershed/urban area that all are paying their fair share of the waterway restoration costs. There is a general acceptance of the concept that every city and county must do a set of minimum activities to address water quality problems and certain cities and counties will have to do more due to their specific set of water quality problems/issues. Residents need to be shown that the benefits of water quality improvement are worth the costs. Interjurisdictional agreements get local communities committed to the projects objectives and garners the day to day support needed to accomplish the necessary objectives.

In order for a watershed project to be successful an "institution" to oversee the progress is not necessarily needed. What is critical is the need for effective institutional arrangements. These can be as simple as utilizing forms of interjurisdictional cooperation or remaking or combining existing institutional arrangements. These solutions will mirror the complexity of the problem to be solved.

A key element of the institutional and financial concerns deals with the Federal and State regulatory agencies. Getting regulatory agency buy-in to all aspects of a watershed project is critical to its overall success. Regulatory inertia is very strong to continue down the historical paths that have been followed in the past. Therefore trying new methods of institutional and financial arrangements can be a tough sell. It is critical that the Federal and State regulatory agencies have staff and managers fully involved in all aspects of a watershed project in order to witness the advantages of trying new approaches to address problems.

There are substantial cost implications associated with institutional and financial arrangements. The Project has learned that it is well worth the time spent up front looking at these topics. Waiting until the end of a project and to then use a piecemeal approach versus a coordinated approach will be a waste of time and money. It takes time to solve these issues. Many meetings are necessary to address this topic but they are worth the cost in the long run.

I. FLOW AS A WATER QUALITY ISSUE

1. Lesson Learned: In urban areas, quantity of stream flow is very important in assessing water quality degradation and ecosystem health and the subsequent correction of the problems. By solving problems with high flow, many water quality and ecosystem health problems will also be solved.

In urban areas, the streams experience high flows during wet weather events. These high flows cause or aggravate problems for several reasons including: scouring of banks and the resulting turbidity problems; subsequent sediment deposition and its related adverse impacts on habitat and beneficial uses; adverse impacts on wetland habitat; the physical destruction of the river banks which adversely impacts land values; and the wide variation in flows which adversely impacts swimming, wading, boating and fishing. Wetlands in urban areas are very beneficial because they provide good storage for water, which tempers flow variability, improves water quality and provides good habitat for aquatic life as well as other wildlife. Yet, highly variable flows adversely impact these needed wetlands.

Often, the damage caused by flooding and stream bank erosion on private property, the loss of recreational opportunities (i.e., flooded golf courses in flood plains), and traffic disruptions caused by flooding will gain the attention of the public quicker and will be a stronger reason for citizens commitment to invest in pollution control. By building detention ponds or other improvements to solve flooding problems, the pollution problems may also be largely solved. The Rouge River Project is showing possibility of solving a number of its wet weather pollution problems in the context of regional detention and floodway improvement projects.

As stated in an earlier Lesson, water quantity issues can often be integrated with other public works plans and actions so that the solution positively impacts water quality as well as water quantity. For example stream bank erosion needs to be controlled by cities in order to protect property. Integrating water quality considerations into how the erosion control is accomplished and maintained has a double benefit. Therefore it is important to consider water quantity issues in the development of the programs to address urban quantity of flow issues.

Cost savings opportunities are there to be realized while addressing flow issues.

J. GENERAL

1. Lesson Learned: Do not be afraid of taking advantage of dumb luck and legislative/political will.

This speaks for itself. The corollary is bad luck also happens. When that occurs, learn from the "mistake" or event and move on in a positive, smarter fashion.

III. CONCLUSION

The Rouge Project in southeastern Michigan is a working demonstration of a watershed-wide approach to restoring and protecting an urban river system by using a cooperative locally based approach to pollution control. Since 1992, the Rouge Project has implemented over $400 million of water pollution control, environmental restoration, and recreation projects. Total expenditures under the project are expected to exceed $530 million by the year 2003. (Note: These totals do not include related Rouge work by the City of Detroit for CSO controls outside of the Rouge Watershed, which is estimated to be in excess of $2 billion.)

A number of successes have been achieved to-date, but a number of challenges remain. The year 1998 was a point when noticeable measurements of environmental progress along the Rouge River could first be made. Dissolved oxygen was higher at several sites along the river in the last two years compared to earlier findings in 1994 and 1995. This success can be attributed to CSO controls, illicit connection elimination, and better public, industry and community awareness of pollution prevention. Also, there are more sightings of larger and more diverse species of fish. The CSO basins have collectively captured and sent to treatment an estimated 4 billion gallons of overflow per year since the first basins went on-line in 1997. The illicit discharge teams have eliminated 12.5 million gallons per day of dry weather discharges, and the Newburgh Lake project has eliminated the PCB fish advisory and restored a major recreational resource in the Rouge. The school-based education program operated by the Friends of the Rouge is in nearly 100 schools, and the annual Rouge Water Festival draws over 1,400 students per year.

The CSO data suggests that large storms may have a different water quality impact than small storms. This could result in significantly reduced costs when communities move from implementation of nine minimum controls to long term control plans. Recreational use in the watershed has increased by opening up a stretch of the river to canoeing. This action has created new hopes and expectations for further increased use. The individual stormwater communities have begun to understand how they are part of the water quality problems. Although they are traditionally very independent, they are finding ways to work together voluntarily to address issues such as illicit connections, public education and implementation of BMPs. The Rouge Project is moving towards integration of all pollution sources and use attainment into a unified, consistent watershed management approach, but it is recognized that is has not yet been achieved.

The Rouge Watershed presents a unique management challenge because there are no significant point sources which can be controlled by the action of a single agency, or from which to readily establish an effluent trading scheme. Quite the opposite, the Rouge is dozens of communities, hundreds of major commercial, industrial and institutional properties, and hundreds of thousands of residential homeowners. The environmental management goal of the project is the control of flow and wet weather pollution to achieve flow and quality to meet water quality standards. The institutional management goal is to find ways to effectively work with the parties within the watershed boundary to meet the environmental goal.

The Rouge Project is an overwhelming success so far. Water quality is improving, and the demonstration techniques have resulted not only in concrete and steel structures, but in real institutional changes that integrate the work of stormwater and watershed improvement into the basic institutions of government. The Rouge Project approach demonstrates that a watershed can be "managed." Most importantly, the Rouge River is being restored. It is hoped that by utilizing the information learned from the Rouge Project, others can save considerable time and money as they implement a wet weather control program.

IV. ACKNOWLEDGMENTS

This chapter is a summary of select elements from the ongoing efforts of many individuals and organizations who are involved in the restoration of the Rouge River. The work of Dale S. Bryson to assist with development of the "lessons learned" is especially noted. The author is honored to represent the numerous contributors of this successful partnership to restore and protect a large urban waterway.

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VI. FIGURES

Figure II.9.1. Location of Rouge River Watershed in Southeast Michigan, USA (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

Figure II.9.2. Subwatersheds and Communities of the Rouge River Watershed, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

Figure II.9.3. Diverse Characteristics of Rouge River Watershed, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

Figure II.9.4. Aerial View of Inkster Combined Sewer Overflow Basin in Rouge River Watershed, Inkster, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

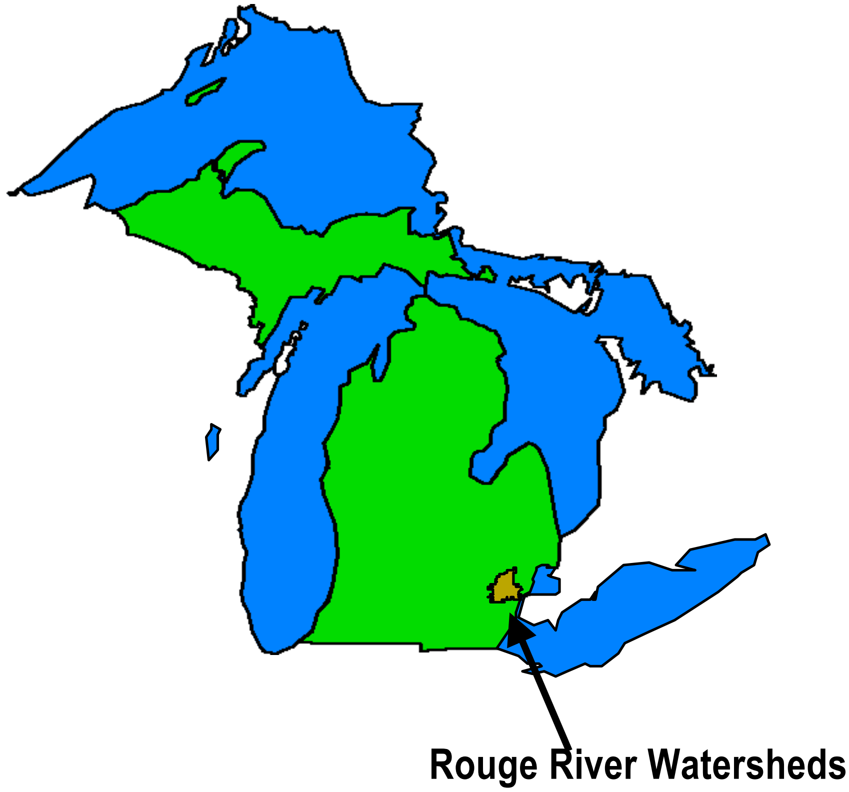
Figure II.9.5. Comparison of Sources of E. Coli Bacteria, Rouge River Watershed, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

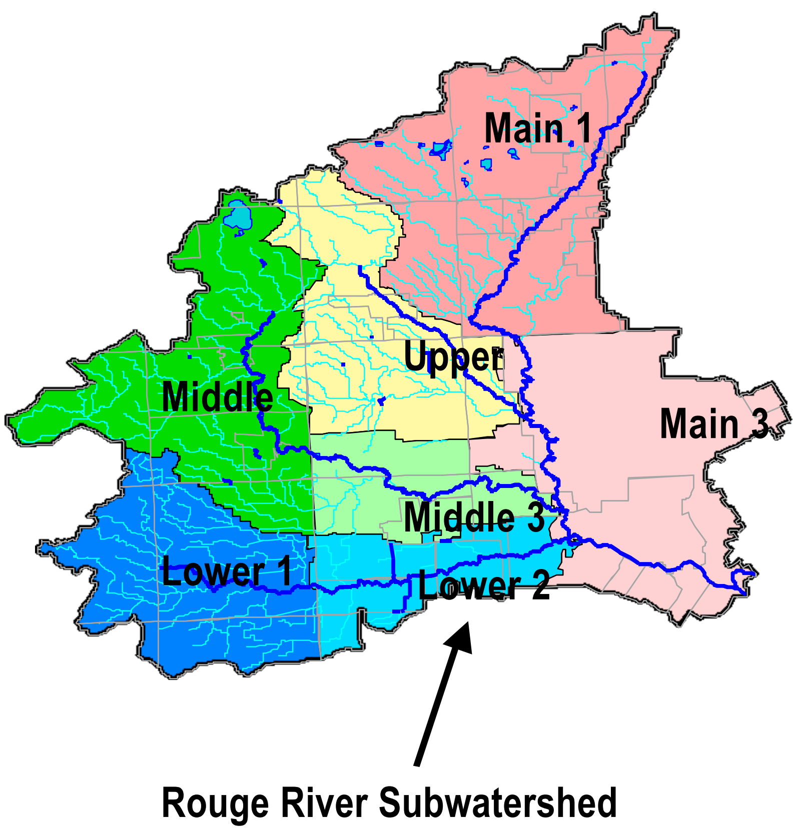
Figure II.9.6. Linear Sand Filter Retrofit to Urban Area for Stormwater Management, Wayne, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

Figure II.9.7. Public Education and Involvement Materials Developed by Rouge River National Wet Weather Demonstration Project, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan).

Figure II.9.8. Rouge Gateway Master Plan, a Comprehensive Destination and Interpretive Program Plan, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan). (Available in color on accompanying CD-ROM).

Figure II.9.9. Conceptual Greenway Along Lower Rouge River, Part of Rouge Gateway Master Plan, Michigan, USA. (From Rouge River National Wet Weather Demonstration Project, Detroit, Michigan). (Available in color on accompanying CD-ROM).


Rouge River Watersheds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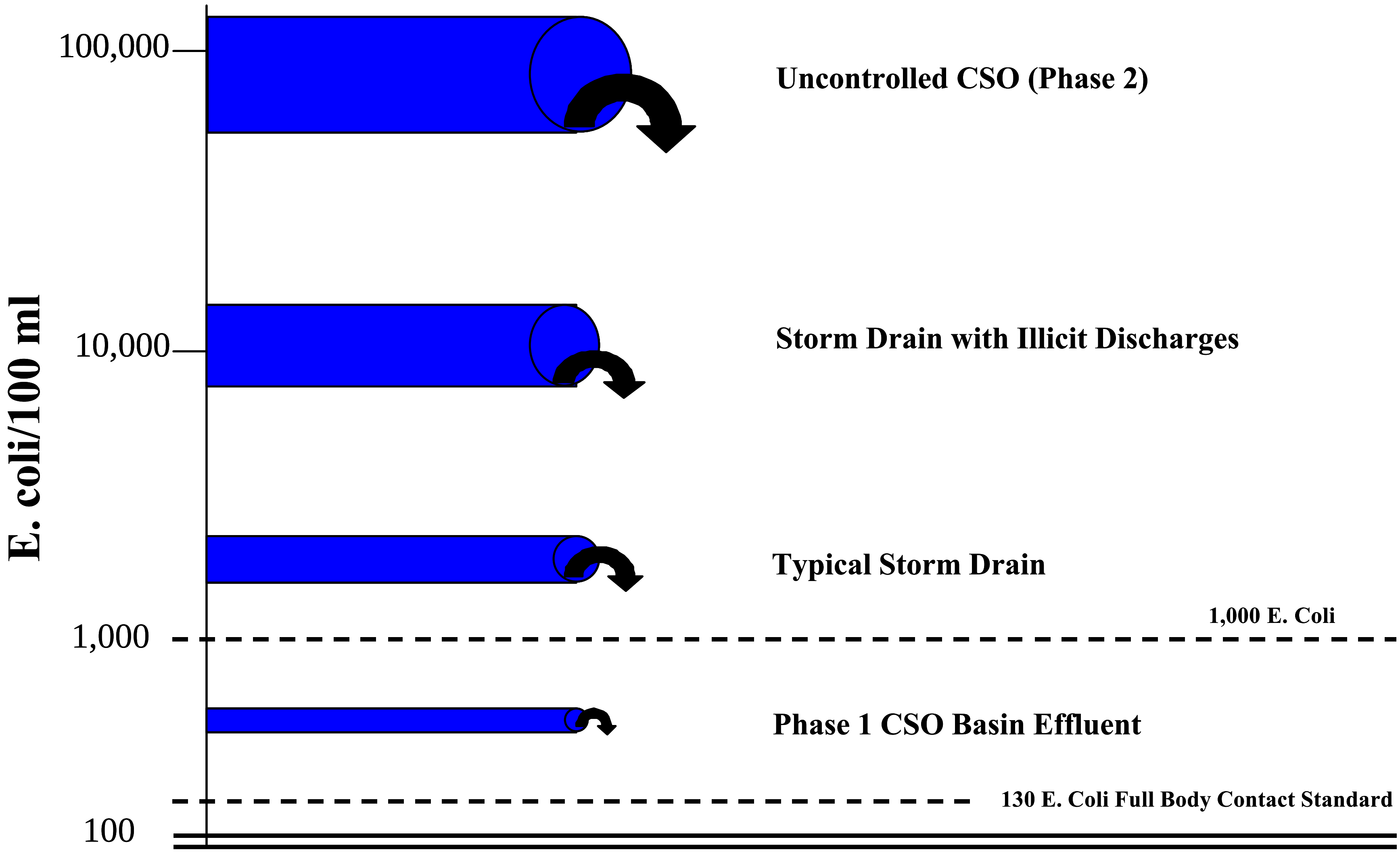
Rouge River Subwatershed


E. coli/100 ml
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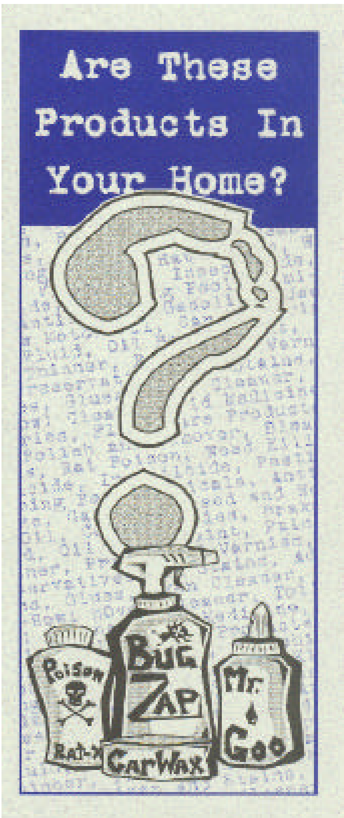
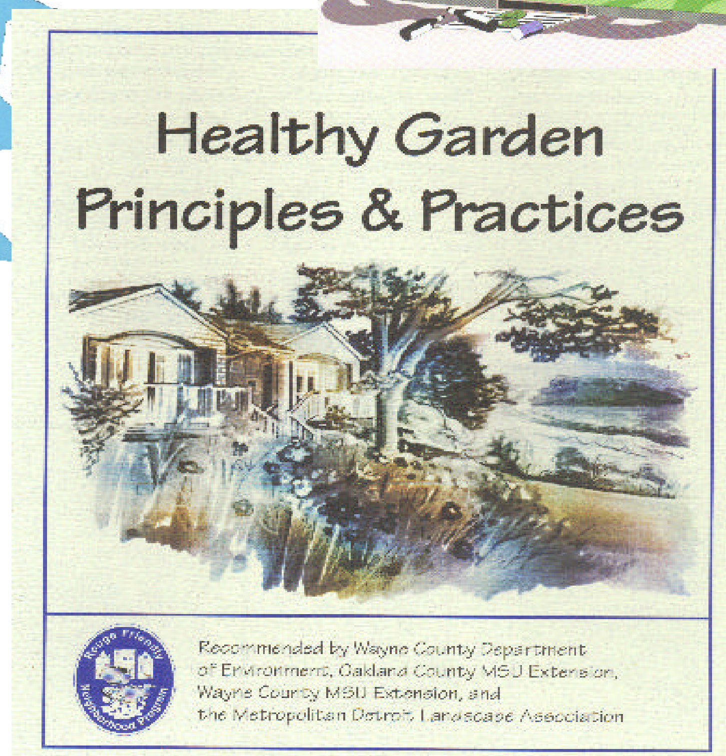
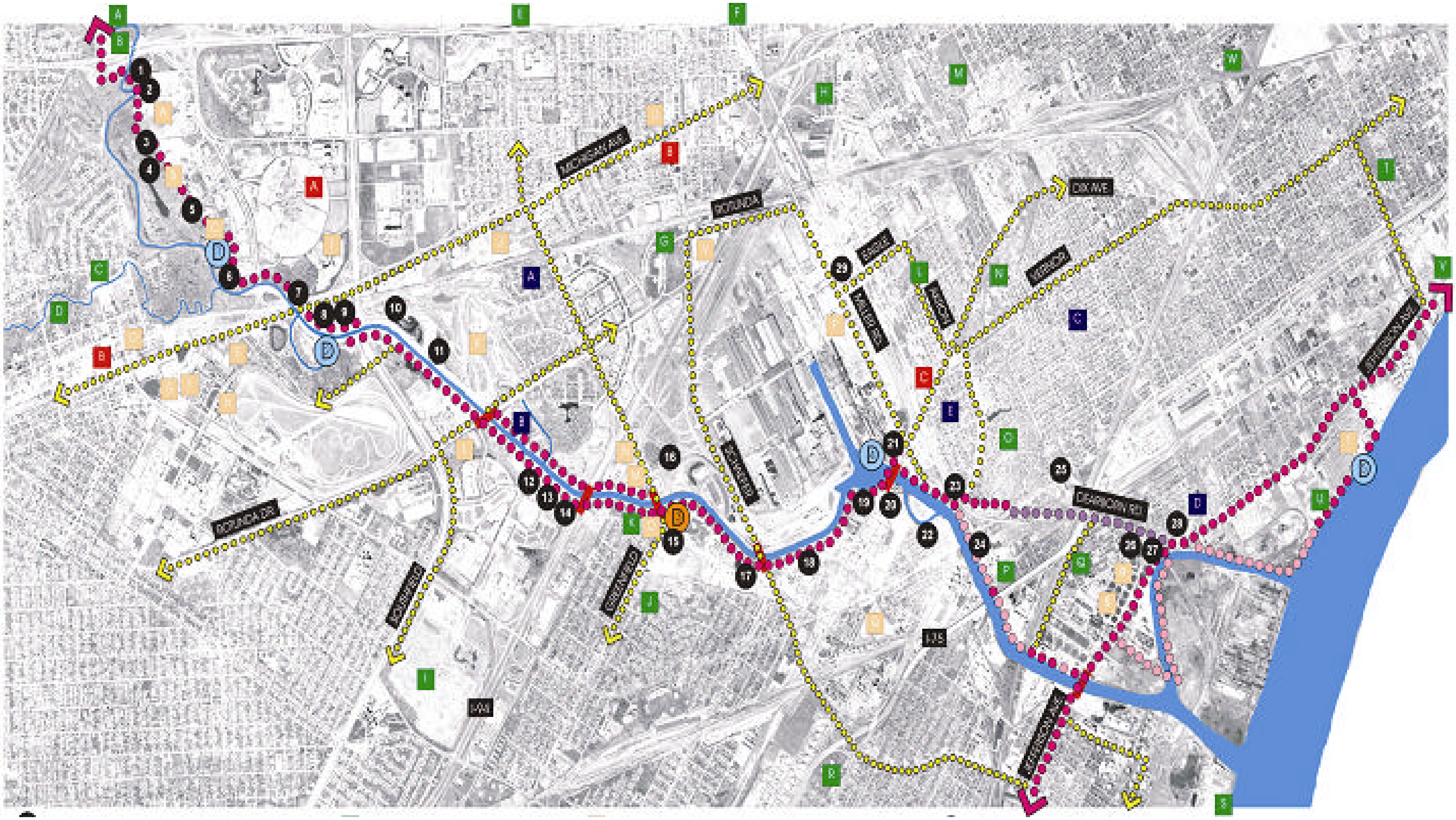

Are These Products In Your Home?
Poison
Bug Zap
Mr. Goo
Car Wax


I think that I saw a
fish on my street


Storm Drains Aren't Garbage Cans


Healthy Garden Principles & Practices
Recommended by Wayne County Department of Environment, Oakland County MSU Extension, Wayne County MSU Extension, and the Metropolitan Detroit Landscape Association


STORM DRAINS AREN'T GARBAGE CANS!
CALL THE ROUGE HOTLINE (313) 961-0730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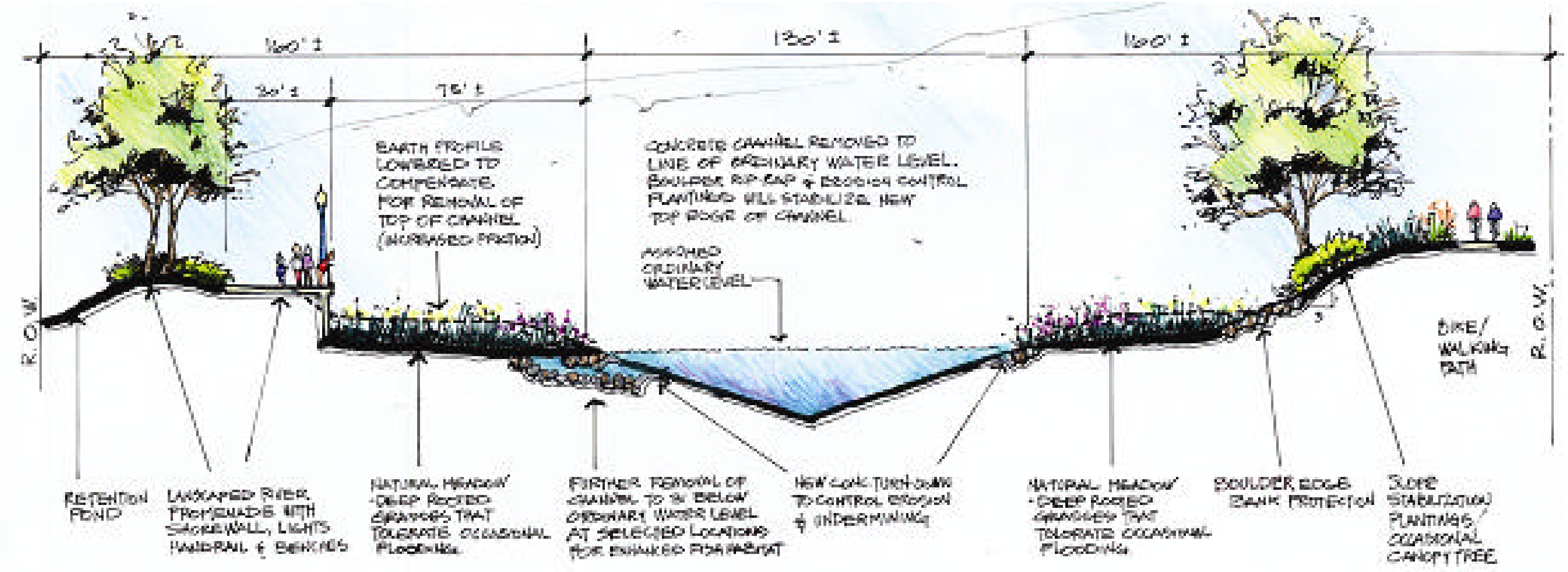
160' ±
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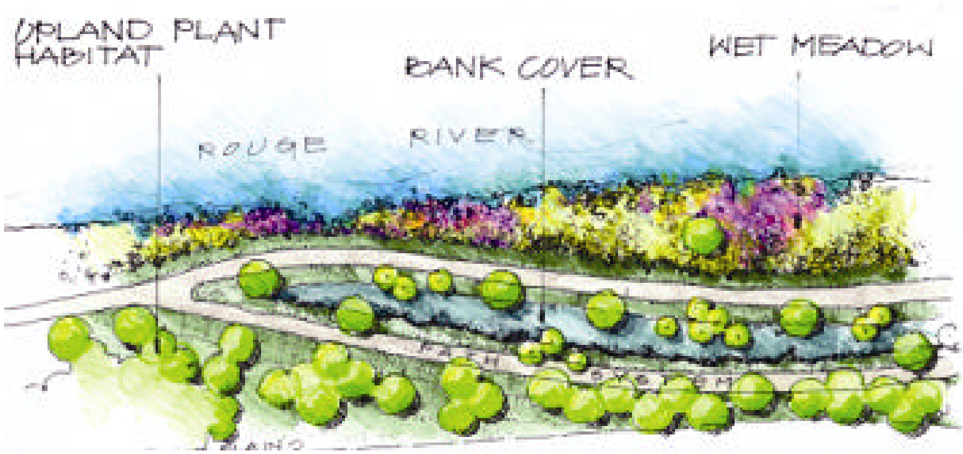
EARTH PROFILE LOWERED TO COMPENSATE FOR REMOVAL OF TOP OF CHANNEL (INCREASED FRICTION)
CONCRETE CHANNEL REMOVED TO LINE OF ORDINARY WATER LEVEL. BOULDER RIP RAP & EROSION CONTROL PLANTINGS WILL STABILIZE NEW TOP EDGE OF CHANNEL
ASSUMED ORDINARY WATER LEVEL
R.O.W.
R.O.W.
RETENTION POND
LANDSCAPED RIVER PROMENADE WITH SHOREWALL, LIGHTS HANDRAIL & BENCHES
NATURAL MEADOW - DEEP ROOTED GRASSES THAT TOLERATE OCCASIONAL FLOODING
NEW CONC. TURN-DOWN TO CONTROL EROSION & UNDERMINING
NATURAL MEADOW - DEEP ROOTED GRASSES THAT TOLERATE OCCASIONAL FLOODING
BOULDER EDGE BANK PROTECTION
SLOPE STABILIZATION PLANTINGS / OCCASIONAL CANOPY TREE
BIKE/ WALKING PATH


UPLAND PLANT HABITAT
BANK COVER
WET MEADOW
ROUGE
RIVER