use of natural drainage ways for storm water detention. If the drainage way is usually dry, the MDEQ is not likely to object to its use for detention. However, if the drainage way usually contains water, the MDEQ would need to balance its value as a natural resource with the need for storm water detention. A part of that decision includes an evaluation of alternatives. So the MDEQ would approve use of natural wetlands or watercourses for in-line detention if (1) the need for detention has been demonstrated to protect downstream waters, (2) the environmental value of the wetland or watercourse is low, and (3) there are no other feasible alternatives.

Maintenance of existing in-line storm water detention systems require an MDEQ permit under the Inland Lakes and Streams Section of the Natural Resources and Environmental Protection Act of 1994 (Section 301, Act 451, PA 1994). All earth changing activity (construction) taking place within 500 feet of a wetland or watercourse needs to be permitted by the MDEQ. This includes removing sediment from detention basins. It is anticipated that the MDEQ would readily issue such permits to maintain existing facilities.

**DISCUSSION**

Specific analysis completed during this storm water master plan update consists of the following:

- A quantitative storm water runoff model to perform a hydrologic (flow) and hydraulic (capacity) analysis of the regional drainage system.

- A review of water quality data related to the recreational lakes.

A detailed discussion of this work is included in Appendices 3 and 4, respectively.

A discussion of the evaluation, findings, conclusions, and recommendations in regard to the issues and questions raised in the needs assessment is presented below.
FINDINGS IN RESPONSE TO IDENTIFIED PROBLEM AREAS

FLOODING AND STREAMBANK EROSION

Figure 3 clearly shows interrelated problems with high “flashy” flows, stream bank erosion, sedimentation, and resulting poor water quality concentrated in the Meadowbrook Lake area. From the flooding and drainage standpoint, this was the only area not identified as a localized drainage problem. Hydrologically, this area is located at the confluence of three major watercourses tributary to the Walled Lake Branch of the Middle Rouge River. Hydrologic analysis indicates that three regional detention basins located immediately upstream may not be functioning effectively. Specifically, the basins identified as providing little or no flood peak attenuation are the Bishop and C&O basins and Meadowbrook Lake (see Table 3.2 in Appendix 3). Hydraulic analysis shows that stream velocities in the Rouge River just upstream and downstream of Meadowbrook Lake exceed velocities in other major tributaries. This may explain the reported problems with stream bank erosion in this area (see Table 3.5 in Appendix 3.)

The standard regional detention basin outlet control recommended in 1983 Storm Water Master Plan is effective for control of not only the over bank flooding events, but the bankfull (1.5-year) events. However, it is not known whether all regional basins were constructed to this standard design. Rating curves given in the 1983 report for six of the regional detention basins indicate little or no attenuation of storm water flows. This is the case for the Bishop basin, which called for a large-flow outlet structure (see Figure 5.2 in Appendix 5), and the Taft, Cedar Springs, C&O, and Lexington Green basins, which simply included a rating curve. Also,
Meadowbrook Lake dam is a fixed broad-crested weir, which is nothing like the outlet structure recommended in the 1983 and 1992 Storm Water Master Plans. Other possible reasons for this inconsistency may include:

1. The 1-year storm outlet is plugged, resulting in loss of effective storage, and the 10-year storm outlet functions during the 1-year storm. The outlet may be plugged by debris (resulting in continuous water storage) or sediment (resulting in higher bottom elevation). For example, the C&O District Basin at 10 Mile Road and the C&O railroad tracks is reported by the City’s maintenance staff to be completely filled in with sediment. The Bishop basin is another example of where sediment accumulation may be eliminating the low flow discharge control.

2. The streambank erosion experienced at a given location is from localized causes (i.e., a hydraulic structure immediately upstream) not an ineffective basin. A culvert or concrete lining will result in the stream gaining energy that needs to be dissipated at the end of the structure. This sometimes results in erosion. Also fallen trees can cause changes in flow patterns that cause erosion.

The SWPPI commits to construction of new detention basins and dredging or retrofitting of existing basins if identified by a study.
Recommendation A

It is recommended that the City take a closer look at the regional detention basins identified in Table 3.2 in Appendix 3 of this report to determine if these basins are performing at a level to provide flood and streambank protection. This study would include an inventory of all 14 required detention basins, and include a hydrologic and hydraulic evaluation of the drainage districts tributary to Meadowbrook Lake and the Walled Lake branch of the Middle Rouge River including installation of a permanent flow measurement device at the Meadowbrook Lake dam. This investigation would determine if maintenance of regional detention basins, major road crossings, and typical channel cross sections is the answer, or if retrofits are required and/or feasible.

Recommendation B

The localized drainage and flooding problems identified in the needs assessment should be assigned a priority and funds appropriated for individual investigations to determine the cause, evaluate alternatives, and recommend a solution for each.

SEDIMENTATION

Although sedimentation was identified via the problem areas indicated in Figure 3, it really appears to be a policy concern. The City should consider the probable sources of sediment in storm water and take appropriate action to control those sources. It is highly probable that most of the sediment load originates on active construction sites, which would make an effective city-wide soil erosion and sedimentation control (SESC) program extremely important. Other potential sediment sources include soil improperly stabilized following construction and unstable eroding stream banks.

The City is presently undertaking an audit of their SESC program. They have retained a private consultant to review SESC plans and perform routine inspections. However, enforcement for violations should be taken seriously and fines imposed by the City when warranted.
Recommendation C

Because SESC of construction sites appears to be such a significant contributing factor to the cost of maintaining a viable storm water system, a concentrated effort to measure the effectiveness of the SESC program should be undertaken. Indicators such as the frequency of required lake dredging, cleanout of regional detention basins and catch basins, and proactively measuring the rate of sediment accumulation in lakes or water courses should be used to evaluate program effectiveness. This will require complete and accurate records to be kept. Additional recommendations and discussion on record keeping activities is provided in later sections.

One means for measuring the rate of sediment accumulation is to install inexpensive sediment collection devices near the outlets of storm sewers in lakes and streams. A “sedimentation index” can then be developed that will quantitatively compare sedimentation rates in areas of the City experiencing little construction with areas of the City experiencing significant construction. If the difference is small, then the sedimentation control program is achieving its goal.

WATER QUALITY

A review of the water quality data for Walled Lake and Meadowbrook Lake (located within the City), and Phoenix Lake and Newburgh Lake (located downstream in Wayne County), indicates that all four lakes are moderately to highly eutrophic (see Appendix 4). Walled Lake was the least eutrophic (highest quality) and Meadowbrook Lake was the most eutrophic (poorest quality). In addition, the macrophyte community in Walled Lake was diverse and abundant (an indication of high quality), while macrophytes were missing from Meadowbrook Lake (an indicator of poor quality) and Phoenix Lake. It was also concluded that water quality in the three lower lakes (Meadowbrook, Phoenix, and Newburgh) is reflective of water quality in the Middle branch of the Rouge River. This means that the lakes themselves do not change the water quality of the river very much.

Nutrients are the typical cause of lake quality impairments, and phosphorus is usually the limiting nutrient in lake environments. In other words, phosphorus is the pollutant most responsible for nuisance algae blooms in Michigan lakes. Low and medium density residential areas are the land uses that generate storm water most likely to contain very high levels of phosphorus (50 µg/L is considered typical for residential storm water; 3 µg/L is desired for good quality for lakes). Probable phosphorus sources include lawn and garden fertilizer, pet waste, wild animal waste, and illicit discharges of human sewage. The Walled Lake/Novi Wastewater Treatment Plant is another known source.
Recommendation D

The Walled Lake/Novi Wastewater Treatment Plant is operated by Oakland County (County). The City should consider contacting the County to ensure that everything is being done to minimize the discharge of phosphorus.

Recommendation E

For lakes with long residence times, monitoring could be accomplished cost-effectively by a multi-year spring water sampling and testing program. Water samples would be collected at multiple locations in each of Novi’s lakes once per year during the “spring turnover.” “Spring turnover” is that brief period in the spring, after the ice melts and before temperature stratification occurs. During this period the lake waters are well mixed, thus greatly reducing the effort needed to obtain representative samples of the lake as a whole. If the phosphorus concentrations are 3 µg/L or below, one would expect that the lake will not experience nuisance algal blooms during the summer and that the fertilizer application ordinance is effective. If the phosphorous concentrations are greater, the City should consider whether more effective enforcement of the ordinance is called for or whether an ordinance revision is needed. The City should consider technologies for removal of phosphorous from storm water only if attempts at source control are unsuccessful. This is due to the high cost of such technologies.

One means by which the expense of lake monitoring can be minimized is to enlist the assistance of citizens living on the lakes. The MDEQ has a program to assist citizen monitoring efforts. It is the Cooperative Lakes Monitoring Program (CLMP). The CLMP provides volunteers with sampling methods, training, workshops, technical support, quality control, and laboratory assistance to monitor lakes for indicators of nutrient enrichment and lake productivity. The primary purpose of the CLMP is to help citizen volunteers monitor indicators of water quality in their lake and to document changes in lake quality over time.

This program was utilized in gathering some of the data presented in Appendix 4 on Walled Lake. This program should be re-initiated for Walled Lake and initiated for Island Lake, Village Oaks Lake, Sandpoint Lake, Village Wood Lake, Shawood Lake, and Twelve Oaks Lake. The SWPPI commits to supporting local creek and lake protection groups. Due to the short residence time of Meadowbrook Lake, this
program alone would not be sufficient. Additional monitoring would be needed to properly assess Meadowbrook Lake both in the lake and in the tributary streams. The SWPPI identifies 0.05 mg/L (50 µg/L) phosphorus as a target value for the streams in dry weather.

Recommendation F

Novi’s current Fertilizer Use Ordinance should also be reviewed for effectiveness and modified as appropriate. Low impact development techniques are also very effective at reducing sediment and phosphorus in storm water and these techniques should be encouraged in new developments.

Recommendation G

Novi’s Storm Water Discharge Permit requires implementation of an IDEP that is intended to eliminate seepage from sanitary sewers and onsite sewage disposal systems (septic tanks). This program includes a method for determining the effectiveness of the effort, so the City should include methods to measure phosphorus as well as bacteria.
REVIEW OF POLICY CONCERNS

REVIEW OF MASTER PLAN STRATEGIES

One of the primary concerns of the City is whether to continue the regional detention basin approach or to abandon it in favor of an alternative approach, such as onsite detention or low impact development. Each approach has its advantages and disadvantages, so it is worthwhile to discuss these prior to making a recommendation.

REGIONAL DETENTION

A regional detention approach accommodates developers wishing to utilize their entire site without setting land aside for an onsite detention basin. With regional facilities, each basin is larger, but there are fewer to operate and maintain. Less overall land is consumed because larger facilities require proportionately less area for dikes, buffers, and fences. Larger facilities also provide more predictable performance.

The City has experienced difficulty implementing the regional approach as specified in the 1983 and 1992 Storm Water Master Plans. This was due in part, to difficulties in obtaining suitable land at an affordable cost. Some developers complained about the delays caused by these difficulties. Funding for regional facilities has also been difficult to obtain. Not all developable land in a district is ready to be developed at the same time, so developer “tap” fees do not cover the cost of building the basin. In addition, regulatory impediments have arisen since the 1983 and 1992 Storm Water Master Plans were adopted, making it more difficult and expensive to locate and construct regional basins. The MDEQ became concerned about the loss of wetlands to detention basins and the interference to fish migration caused by basin structures.
ONSITE DETENTION

An onsite detention approach is more conducive to different developments in a district proceeding at their own pace. Each developer provides the facilities needed for that development at no direct project cost to the City. However, the onsite approach results in many smaller basins, many of which can become “eyesores.” The sheer number of basins is difficult to track and access is a likely problem. Instead, the City must rely on the property owner to operate and maintain the facilities, which results in the need for an active over-sight and enforcement program. These are the very arguments that induced the City to adopt a regional detention policy in 1983.

LOW IMPACT DEVELOPMENT

In recent years, it has become widely recognized that storm water detention (both regional and onsite) deals only with control of the release rate of storm water runoff, and does not adequately address the increases in runoff volume. Also, there are real costs associated with these detention approaches that are typically borne by the municipality. Indirect costs incurred by the City due to significant increases in storm water runoff volumes include:

- Additional land costs for the greater storage volumes required in detention basins when release rates must be throttled down to well below predevelopment rates to offset cumulative downstream increases in flow due to the increased volume.

- Cost for stream bank stabilization projects and subsequent sediment removal projects due to instability of stream channels caused by volume increases.

- Cost of procuring additional floodplain storage, or loss of revenue from land needed for additional floodplain storage when detention does not adequately address cumulative downstream impacts of increased runoff volumes.
A third approach uses a concept known as LID. This approach is a new, comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. LID focuses on how the developed area of a site is planned and designed to minimize hydrologic impacts. LID uses a variety of site design and pollution prevention techniques to create a hydrologically functional and environmentally sensitive landscape. This may be accomplished by preserving existing wooded areas, minimizing the amount of impervious surface, using porous pavements, minimizing site grading, incorporating storm water re-use, native plantings, and using grassed swales and wetlands to increase runoff times of concentration. As a result, many of these practices are actually integrated throughout the site and deal with storm water at the source. This approach lends itself to being privately owned and operated thereby reducing the burden on the City to oversee numerous small onsite detention basins. However, it does require effective maintenance plans and dedication agreements for the Best Management Practices (BMPs).
A component of some storm water management strategies is a concept known as “no-detention zones” or “non-mandated detention zones.” This concept is based on the premise that it is better to deliver storm water runoff to the major conveyance system (river, stream) faster and not detain it so it does not coincide with upstream water and actually increase cumulative peak flows in the water course. Thus, it has become necessary to “over-restrict” the allowable detention basin release rates because post-development volumes have been allowed to increase. The “over-restriction” is necessary to maintain existing downstream floodplain levels, when low peaks but high volume from many individual developments all coincide.

The need for designating no-detention zones was evaluated during the hydrologic analysis component of this Storm Water Master Plan Update.

The hydrologic analysis indicated that providing for flood control was necessary in all drainage districts. This is illustrated in Table 3.4 in Appendix 3. A comparison of the last two columns shows that in every instance, but one (Bishop Creek), peak flows are the same or lower when detention is provided in all drainage districts.

However, there may be causes where the restrictive release rates necessary to provide for standard flood control may be relaxed. An exception to the student release rate requirement would be for those cases where a development discharges into an existing regional detention basin and the developer proves that adequate conveyance capacity in a ditch or storm sewer exists between the development and the regional facility. The City may also allow for a modified onsite detention requirement for flood control if the developer proves that onsite detention to the standard limits will have a negative impact on downstream flows, or that for discharges to lakes and wetlands, the modified release rate will have no measurable effect. In these cases, onsite detention release rates for flood control should be no greater than existing peak runoff rates.
CONCLUSIONS

From an operation and maintenance perspective, a regional approach is clearly preferable. However, the real difficulties that the City has had in implementing the regional approach cause one to conclude that an onsite approach is necessary. From a computer model point of view, there is little difference between regional and onsite detention so long as the same criteria are used for design. An onsite detention approach utilizing the existing storm water design criteria for the remaining 30% build-out should be adequate to mitigate increases in over bank flooding and channel forming flows as shown in Tables 3.4 and 3.6 in Appendix 3.

Real strides in stream protection can only be made when storm water runoff volume is controlled as well as runoff rates. Neither regional nor onsite detention used as a single storm water management strategy adequately address the volume issue.

Recommendation H

Therefore, it is recommended that the City no longer pursue construction of the regional detention basins proposed in the 1983 and 1992 Storm Water Master Plans. An onsite storm water detention strategy coupled with low impact development techniques should be required for new development.

Specific exceptions may include:

1. When there is a compelling reason to construct a regional detention basin that would serve multiple developments. Possible cases for construction of a regional basin where there are no environmental constraints include:

   • It is in the City’s best interest to initiate a regional basin project to avoid problems associated with a large number of small storm water basins or controls.

   • The City is willing to subsidize a regional basin on a development-driven project that would later serve other developments. This would better serve the public interest by avoiding maintenance of a large number of small storm water basins or controls. The City could subsequently recover its “subsidy costs” as other development occurs.

   • It is desired to address problems associated with existing development.
Future regional basins would most likely be constructed to a smaller scale and in a different location than those identified in the 1983 and 1992 Storm Water Master Plans due primarily to environmental constraints. The City could engage developers during preliminary design stages of a project to explore various storm water management options. A new regional detention basin would be constructed by the developer as part of the project and would be turned over to the City following construction. The City could contribute to the cost of construction of the basin, either monetarily or with other considerations. The basin would be designed to serve other properties in the area. Once the City obtains ownership, the basin becomes available to the other adjacent developments. These other developments would reimburse the City for the costs incurred during construction. This approach acknowledges the regulatory difficulties of using streams and wetlands for storm water management, utilizes the developers’ motivation to proceed at their own pace, reduces the need for expenditure of City funds, and reduces the need for the City to obtain easements and property. Other storm water management options may arise from the discussion with the developer, such as modification or expansion of an existing regional detention basin. Whatever option is selected, the City’s design criteria should be met.

2. When a regional storm water detention basin is available and storm water is conveyed to it through a pipe or a ditch with adequate capacity for design discharges, provisions for onsite flood control, stream protection, and/or water quantity volumes may not be necessary.

3. Where detailed hydrologic (flow) and hydraulic (capacity) modeling indicates that onsite detention for flood control will have a negative impact, or where a development discharges into a lake or wetland and a modified release rate would have no measurable effect on downstream water levels, onsite detention may be allowed to a lesser extent, to limit post development peak flows to existing peak flows.
STORM WATER DESIGN CRITERIA

The storm water design criteria included in Chapter 12, Articles III and VI of the City ordinance were reviewed for effectiveness and ease of implementation for the design and review of new development and re-development. The storm water rules of the Washtenaw County Drain Commissioner, upon which these sections are based, have been generally accepted as a model to provide for water resource and flood protection. Quantitative analysis was completed for each drainage district to show numerically that these rules should be effective at preventing flooding and accelerated downstream streambank erosion as a result of new development (see Table 3.4 and 3.6 in Appendix 3). In fact, onsite detention criteria reduces the 100-year peak discharge to below that predicted in the 1983 and 1992 Storm Water Master Plans at the outlet of drainage districts where regional detention was proposed, but not built.

Recommendation I

Therefore, it is recommended that the City continue to use the detention basin design criteria contained in the current storm water ordinance for onsite and viable regional basins. These criteria are three fold:

1. Standard Flood Control Volume: Restrict the allowable discharge to a rate of no more than 0.15 cfs per acre, and provide sufficient storage volume to control the 100-year flood.

2. Stream Protection Volume: Provide storage for the 1.5-year storm and discharge for a period of at least 24 hours (the bankfull discharge).

3. Water Quality Volume: Provide a water quality volume equal to that of the runoff from the first 0.5 inch of rain on the impervious area of the site (first flush).

Design tools have been developed for the City’s use in reviewing site plans and making a clear determination of required treatment volumes depending on the downstream receiving waterbody (lake, wetland, or natural stream with defined bed and banks versus an open ditch or storm sewer). A Required
Treatment Volume Worksheet for Storm Water Facilities and a table to determine the Treatment Suitability of Urban Storm Water Practices (or BMPs) are included in Appendix 6. It does not matter whether the development is located in a drainage district with an existing regional detention basin or not. Where adequate downstream capacity must be determined, it should be determined by the developer’s engineer for review by the City. The worksheet should be filled out by the developer’s engineer and submitted with all site developments.

Recommendation J

It is also recommended that for the purpose of clarity and ease of implementation, further definition be given to many of the concepts mentioned in the storm water rules, but presently not defined. A list of possible enhancements is as follows:

- The City ordinance allows for a spill containment volume. Documentation should be included to define those high risk land use activities or locations commonly referred to as “storm water hotspots,” so that this requirement is applied more uniformly. Specific design criteria for spill containment or treatment should also be included.

- Stream protection volume should be based on the actual storage volume (not the total volume of runoff produced during the rainfall) when extended detention is used to meet this criteria. This should be viewed as a positive by developers by not requiring them to hold the total volume of runoff, but only the storage volume required for stream protection.

- More specific design criteria should be provided for sediment forebays, which are an important maintenance component for storm water detention and infiltration basins.

- Geotechnical requirements for infiltration practices should be used cautiously. Geotechnical requirements should not only be specified in more detail to be clear, but should be used in an appropriate manner to help ensure the integrity of infiltration practices. Studies have shown that infiltration practices have the highest failure rate of all BMPs. Yet infiltration basin design volumes may vary drastically under the present rules, and rely solely on the percolation rate from one soil boring taken prior to construction with no factor of safety imposed. Sizing criteria for infiltration basins should then be revised.

- The City should consider including figures of the various BMPs to effectively communicate and clarify the multitude of design parameters required for each.
LOW IMPACT DEVELOPMENT OPTIONS

An important distinction must be made when discussing a reliance on infiltration options for storm water management. Reduction of impervious surfaces, infiltration, and storm water reuse are the only ways to deal with increases in the volume of storm water runoff and the negative effects discussed previously. However, a system of “retention” or infiltration basins, in lieu of “detention” basins is not being recommended here. Traditionally, infiltration basins are used to collect storm water runoff from the flood control event (100-year) and infiltrate this large volume back into the ground within 72 hours to be dry for the next event. Given the high groundwater prevalent throughout the City, it is doubtful that this type of a program would be successful.

Instead, the infiltration provided in conjunction with low impact development targets the more frequent runoff events and provides for secondary conveyance or a “treatment train” to pass all higher flows and volumes on to the next management practice. In addition, the overall concept of LID reduces the need to “dispose of” large volumes of storm water runoff in the first place.

The 1983 and 1992 Storm Water Master Plans discourage infiltration. Current language in the City ordinance (Appendix X, Part II, Section II.C.1.a) prohibits infiltration, and conflicts with other sections of the ordinance (12-70 B; 12-71(d)(4); Article VI, Appendix, Part Two, Section II.A.2). The City should resolve this conflict and proceed further, requiring developers to consider infiltration options prior to determining detention requirements. Infiltration options not only reduce the size and cost of detention facilities, but provide significant environmental benefit. The developer should be required to demonstrate that strategies were incorporated to maintain, as much as possible, the existing site hydrology by maximizing the use of interception and infiltration.

The City’s storm water rules provide a start through the language included in the following sections:

- 12-217(1)b storm water management plans
- 12-217(1)c storm water management plans
- 12-232(a)(5) site grading plans

A rain garden is one technique used to manage storm water runoff at its source.
Recommendation K

Further direction and provisions should be developed and incorporated into the City's ordinance to improve the effectiveness of the onsite storm water management approach. Demonstration projects could also be pursued and grant funding sought to proceed with a low impact development initiative.

PROTECTION OF LAKES AND WETLANDS

Impairments to lakes in previously-developed areas have been discussed. This section addresses protection of lakes and wetlands in those areas that still indicate the potential for future build-out.

Onsite storm water management with LID techniques is specifically geared to protect downstream water resources. This approach is recommended over continuing the practice of using existing lakes and wetlands as storm water management facilities. Further specific recommendations follow.

Recommendation L

The City should continue with the practice of allowing no direct storm sewer connections to wetlands without pretreatment (Sec. 12-217(4); Article VI, Appendix, Part Two, Section III). Lakes should be formally included in this language as well.

Recommendation M

It is recommended that opportunities be explored to disconnect direct lake discharges and construct storm water wetlands or other pretreatment facilities for Novi's lakes. This is may be implemented through a study including sampling of outfalls. Loading estimates can then be calculated to determine which outfalls contribute the most mass of a given parameter, and decisions made as to the cost-effectiveness of outfall elimination or retrofits.
RECORD KEEPING

Present City records of the storm water management system could be updated and improved. The SWPPI commits to continued use of its GIS as a tool to maintain information on the storm drain system, natural features, and septic systems within the City.

Recommendation N

The City should initiate a program to clearly identify all regional detention basins, storm sewers, and private storm water management facilities in the City GIS system and include provisions for maintenance records associated with each facility, both public and private.

Records should indicate whether or not each detention basin serves as a regional detention basin or as an onsite detention basin. An entity responsible for maintenance should be associated with each basin. Note that some basins built as part of a particular project on private property, also serve as regional detention basins pursuant to an agreement with the City, (i.e., 11 Mile District Basin). The basis of design and outlet configuration for each basin should be readily available so decisions can be made with regard to its continued adequacy for any proposed changes in land-use. The GIS should include a clear delineation for each basin.

Maintenance records should also be kept. Many communities utilize a proprietary Computerized Maintenance Management System (CMMS) for this type of information. A more robust program of Asset Management relates better to the recent changes in governmental accounting practices (GASB 34). Asset Management provides governmental managers the information they need to operate governmental functions as efficiently as businesses.

Private facilities should be required to submit evidence of proper operation, and City personnel should verify the adequacy of the facilities. The GIS or CMMS should be used to reliably store the information for future use. The SWPPI states that "tracking of the (maintenance) effort put forth for this activity may need to be strengthened and will be analyzed to determine if and where improvements can and should be made."
M A I N T E N A N C E

Maintenance issues identified in the needs assessment are addressed below.

Recommendation O

Access to detention basins and design of trash racks are two specific maintenance issues that should be included in the scope of services of the regional detention basin study (Recommendation A).

ACCESS TO CITY-OWNED REGIONAL DETENTION BASINS

Present City records show no easements or ownership of many of the Regional Detention Basins. Without City access to the basins, the City cannot be assured that they are functioning in accordance with the City’s storm water design criteria and the City cannot perform needed maintenance. Basins for which this is the case should be identified, and the City should proceed to verify and obtain clear access rights to all City-owned regional detention basins for proper operation and maintenance.

TRASH RACKS FOR REGIONAL DETENTION BASIN OUTLET STRUCTURES

Many of the grated small-flow outlets constructed for the regional detention basins were observed to be completely covered by debris and algae. One suggestion to improve the functionality and reduce the need for maintenance is to replace the flat grating over the openings with a “beehive” grate. The beehive grate would allow for the free flow of water over the top of the outlet weir while preventing floating debris from entering the structure and becoming jammed. The sides of the grate are fabricated at a steep angle to minimize the chance of debris “hanging up” on the outlet structure as the water level in the basin recedes. A sump and baffle (by way of a tee section) on the low-flow pipe should also be included in the retrofit to prevent the pipe from clogging. A concept sketch is illustrated in Figure 5.1 in Appendix 5. Final design details should be developed and applied to basin retrofits identified during the regional detention basin study (Recommendation A).
MAINTENANCE AGREEMENTS FOR PRIVATE STORM WATER FACILITIES

The City has recently started requiring maintenance agreements for all privately owned detention basins, whereby the developer or subsequent owner agrees to provide the needed maintenance and allows City inspection to verify compliance. In the event that maintenance is not provided, the City is authorized to provide the maintenance at the owner’s expense. However, numerous older, private basins exist without any means for the City to ensure proper operation and maintenance.

For newer basins with maintenance agreements, the City does not monitor or “police” these private systems to ensure that maintenance is occurring in accordance with the approved maintenance plan. The City is only notified when a problem arises. This approach has worked sufficient enough in the past when flooding was the only indicator of a problem. However, with the use of and reliance on an increasing number of water quality devices, lack of maintenance can render them ineffective without resulting in a catastrophic condition (like flooding) to prompt a complaint to the City. Therefore, the City may continue with this reactive approach, recognizing certain limitations, particularly in regard to water quality controls, or fund a program and position to regularly review the satisfactory completion of maintenance plan requirements.

Recommendation P

It is recommended that the City explore the cost/benefit of funding a program to pro-actively address maintenance issues for privately owned and operated storm water systems with maintenance agreements. This becomes increasingly important as low impact development techniques are implemented. Maintenance plans should be required for existing private systems when redevelopment occurs, which initiates a City review.
CATCH BASIN MAINTENANCE

A catch basin is an inlet to the storm drain system that typically includes a grate or curb inlet (where storm water enters the catch basin) and a sump to capture sediment, debris, and associated pollutants. Novi has almost 6,000 catch basins, most with 2-foot deep sumps. The performance of catch basins at removing sediment and other pollutants depends on the design of the catch basin (e.g., the size of the sump), and routine maintenance to retain the storage available in the sump to capture sediment. Maintenance should include keeping a log of the amount of sediment collected (Recommendation C), the date of removal, and the condition of the structure. Many cities utilize their GIS system to maintain these logs so cleaning schedules can be optimized (Recommendation N). Many studies have concluded that the optimal cleaning frequency is one to two times annually.

Two years ago, the City suspended its program to clean every catch basin at least once every four years. The consequences associated with inadequate catch basin cleaning include increased rates of sedimentation in lakes and streams, higher likelihood of storm sewer blockages, and inability to identify structural problems prior to significant roadway deterioration or private property damage. The SWPPI identifies a commitment to annually clean 20% of the City’s catch basins. In other words, each catch basin must be scheduled to be cleaned at least once every five years.

Recommendation Q

Inspection of catch basins should be reinstituted in conjunction with a regular cleaning program in conformance with the SWPPI. The location and condition of each should be entered into the City’s GIS. The structures needing repairs should be prioritized for repair. An independent engineering review of the City’s current procedures and specifications for storm sewer construction should be performed to ensure that the need for future repair is minimized.
FUNDING

Recommendation R

It is recommended that the City utilize developer fees to cover the costs associated with storm water management of all new development and significant re-development, with incentives given for low impact development. Since developer “tap” fees for regional storm water detention basins will be a declining source of revenue, an alternate fee schedule should be developed. All developments that discharge an increased volume of storm water downstream would pay a storm water fee consisting of either:

1. Regional detention “tap” fee (developers share in cost of City-owned regional detention basin).
2. Onsite detention fee (lower than regional fee, since the developer is providing land and paying construction cost, but still contributing to long-term City storm water costs). The fee would be prorated depending on the percentage of volume reduction provided by the development.

Developers providing regional basins designed to serve more than one lot or development would pay the onsite detention fee. These fees would be charged in addition to site plan review fees.

The City storm water projects and programs could then be supplemented by the additional sources of funding:

- Specific line items in the City's General Fund may be budgeted for storm water management. However, due to the many competing needs of the City for these funds, other sources should be utilized for storm water management whenever possible.

- Special Assessment Districts are well suited to provide funding for lake improvement projects. Payment is determined based on contribution and benefit.

- Chapter 20 of the Drain Code provides funding opportunities for drain projects conducted through the county drain commissioner. The Drain Code allows for bonding of large projects at the county level and provides an assessment mechanism for the City to specially assess individual property owners.

- Environmental grants such as those available through the federally funded Rouge River Program, the state funded Clean Michigan Initiative (CMI), and Section 319 of the federal Clean Water Act are all viable sources of funding for design and construction of projects that will improve water quality and for storm water educational activities (i.e., demonstration projects). It is recommended that the City apply
for a Section 319 or Rouge River grant to demonstrate low impact development techniques on a variety of different development types (residential, commercial, industrial, downtown, etc.)

- An enterprise fund or “utility” is a concept already used for generating revenue for water and sanitary services. Where implemented as a “storm water utility,” it is a steady source of income for storm water management programs. However, the politics associated with this concept applied to storm water or “rain,” and the public vote required to institute it, make this a less conventional funding mechanism and a more difficult prospect, albeit a very effective one. Since developer fees are expected to decline as maximum build-out is reached, a storm water enterprise fund may be a viable long-term funding option.

- The State Revolving Fund (SRF) provides low interest loans from the state of Michigan for municipal water pollution control projects including storm water. In recent years every municipal application for funding under this program has been granted. This program is primarily used for sewage treatment facilities, but may clearly also be used for storm water projects serving existing development. The City may wish to investigate this source of funding for capital improvements projects identified in subsequent professional engineering studies.

RECOMMENDATIONS AND COSTS

Recommendations made in the discussion section of the report are summarized in Table 4. Costs for the purpose of budgeting capital development funds are also provided. Those recommendations that would require long-term funding due to a newly created program or portion are indicated in the table.

CONFORMITY WITH WATERSHED MANAGEMENT PLANS

The City has identified four major areas of environmental concern through their partnership with the Middle One Subwatershed Advisory Group of the Rouge River Watershed. They are: highly fluctuating flows, sediment, phosphorus, and poor habitat scores. Table 4 indicates which recommendations directly address each of these areas of concern.
Table 4 – Summary of Recommendations (not in priority order)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Description</th>
<th>Budget</th>
<th>Ongoing Program Needing Funding</th>
<th>Addresses Area of Concern in Watershed Management Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Conduct further inventory and analysis to evaluate the effectiveness of the existing regional detention basins at meeting the City’s current water quality, stream protection, and flood control goals (particularly the Bishop, C&amp;O, and Taft Road basins). This would be completed as a hydrologic (flow) and hydraulic (capacity) study of the Walled Lake branch of the Middle Rouge River including a permanent flow measurement device at the Meadowbrook Lake dam. This effort would also provide useful information to fill some deficiencies identified in the City’s record-keeping review.</td>
<td>$60,000</td>
<td>X X</td>
<td>X</td>
</tr>
<tr>
<td>B</td>
<td>Initiate preliminary engineering to determine the cause, evaluate alternatives, and recommend a solution to the five localized flooding and drainage problems identified in the needs assessment.</td>
<td>20,000</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Develop a plan to measure the effectiveness of the SESC program through records of sediment accumulation in lakes, regional detention basins, and catch basins; and by proactively measuring differences in sediment accumulation rates in water courses to develop a “sedimentation index.”</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>D</td>
<td>Contact Oakland County to ensure that everything is being done to minimize the discharge of phosphorus from the Walled Lake Waste Water Treatment Plant.</td>
<td>N/A</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>E</td>
<td>Initiate/continue a lake monitoring program for Walled, Island, Meadowbrook, Village Oaks, Sandpoint, Village Wood, Shawood, and Twelve Oaks Lakes; and enlist the assistance of citizens living on the lakes in conjunction with the MDEQ CLMP.</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>F</td>
<td>Review the Fertilizer Use Ordinance (Chapter 12, Article VII) for effectiveness and modify as appropriate.</td>
<td>5,000</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>G</td>
<td>Include methods to measure phosphorus as well as bacteria as part of the IDEP.</td>
<td>N/A</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>H</td>
<td>Require onsite storm water detention coupled with LID techniques for all new developments and redevelopments. Utilize this approach unless the opportunity to provide for regional detention is feasible and in the City’s best interest.</td>
<td>N/A</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>I</td>
<td>Continue to use the detention basin design criteria contained in the current storm water ordinance for onsite and viable regional basins in conjunction with the worksheets provided in Appendix 6.</td>
<td>N/A</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Description</td>
<td>Budget</td>
<td>Ongoing Program Needing Funding</td>
<td>Addresses Area of Concern in Watershed Management Plans</td>
</tr>
<tr>
<td>----------------</td>
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<td>--------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>J</td>
<td>Develop specific language to enhance the storm water design criteria in the City’s ordinance. A detailed review of the sections within Chapter 12 (Articles III and VI including the Appendix) should be completed to ensure consistency between all sections.</td>
<td>15,000</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Develop and incorporate further language to promote and/or require certain elements of the LID approach into the City’s ordinance (in conjunction with Recommendation J). Pursue a demonstration project by seeking grant funding to proceed with a LID initiative.</td>
<td>15,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>L</td>
<td>Continue with the practice of allowing no direct storm sewer connections to wetlands without pretreatment. Update the City ordinance to include lakes in this language as well.</td>
<td>N/A</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Initiate a preliminary engineering study to explore opportunities to disconnect direct lake discharges and construct storm water wetlands or other pretreatment facilities for Novi's lakes.</td>
<td>20,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>N</td>
<td>Initiate a database/mapping update project to clearly identify all regional detention basins, storm sewers, and private storm water management facilities in the City GIS system. Include provisions for maintenance records associated with each facility.</td>
<td>50,000</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>Investigate the following maintenance issues as part of the regional detention basin study: (1) access rights to all City-owned regional detention basins for proper operation and maintenance; (2) retrofit opportunities to ensure design capacities and improve ease of maintenance of required detention basins.</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Determine reporting and review requirements for the operation and maintenance of existing private storm water systems and fund a program/position to administer it. Require maintenance agreements for existing private systems when redevelopment occurs.</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>Q</td>
<td>Request an independent review of current storm sewer specifications and reinstitute a program of routine catch basin cleaning and inspection to comply with SWPPI and to dovetail with Recommendations C and N. A prioritized list of structures needing repair should be developed from this effort.</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>Review and develop a fee structure to utilize developer fees to cover the costs of storm water management associated with new development and significant re-development. Develop a long-term strategy for funding the City’s storm water pollution control program.</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5 – Condensed Summary of Recommendations for Capital Improvement Plan (CIP)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Description</th>
<th>Budget</th>
<th>Ongoing Program Needing Funding</th>
<th>Addresses Area of Concern in Watershed Management Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, O</td>
<td>1. a) Inventory and analysis of the existing regional detention basins, and identify retrofit opportunities. b) Hydrologic (flow) and hydraulic (capacity) study of the Walled Lake branch of the Middle Rouge River to identify means to reduce flow fluctuations.</td>
<td>$60,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>B</td>
<td>2. Preliminary engineering for five localized flooding areas.</td>
<td>20,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td>3. Develop a plan to measure the effectiveness of the SESC program.</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>N</td>
<td>4. Initiate a database/mapping update project to clearly identify all regional detention basins, storm sewers, and private storm water management facilities in the City GIS system. Include provisions for maintenance records associated with each facility.</td>
<td>50,000</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>5. Review storm sewer specifications, review catch basin cleaning program.</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>H, I, J, K</td>
<td>6. Enhance storm water design criteria in ordinance and eliminate inconsistencies to promote LID</td>
<td>30,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D, E, F, G</td>
<td>7. Initiate/continue lake monitoring program and review phosphorous management</td>
<td>15,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>P</td>
<td>8. Determine reporting and review requirements for privately-owned storm water systems and develop program</td>
<td>10,000</td>
<td>Y</td>
<td>X</td>
</tr>
<tr>
<td>L, M</td>
<td>9. Explore opportunities to disconnect direct lake discharges and construct pretreatment</td>
<td>20,000</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>10. Review and develop a fee structure to utilize developer fees to cover the costs of storm water management associated with new development and significant re-development. Develop a long-term strategy for funding the City’s storm water pollution control program.</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 presents a condensed summary of recommendations that have been grouped together to form ten projects that may be incorporated into the City’s CIP. This ordered list may be used for planning and budgeting purposes.