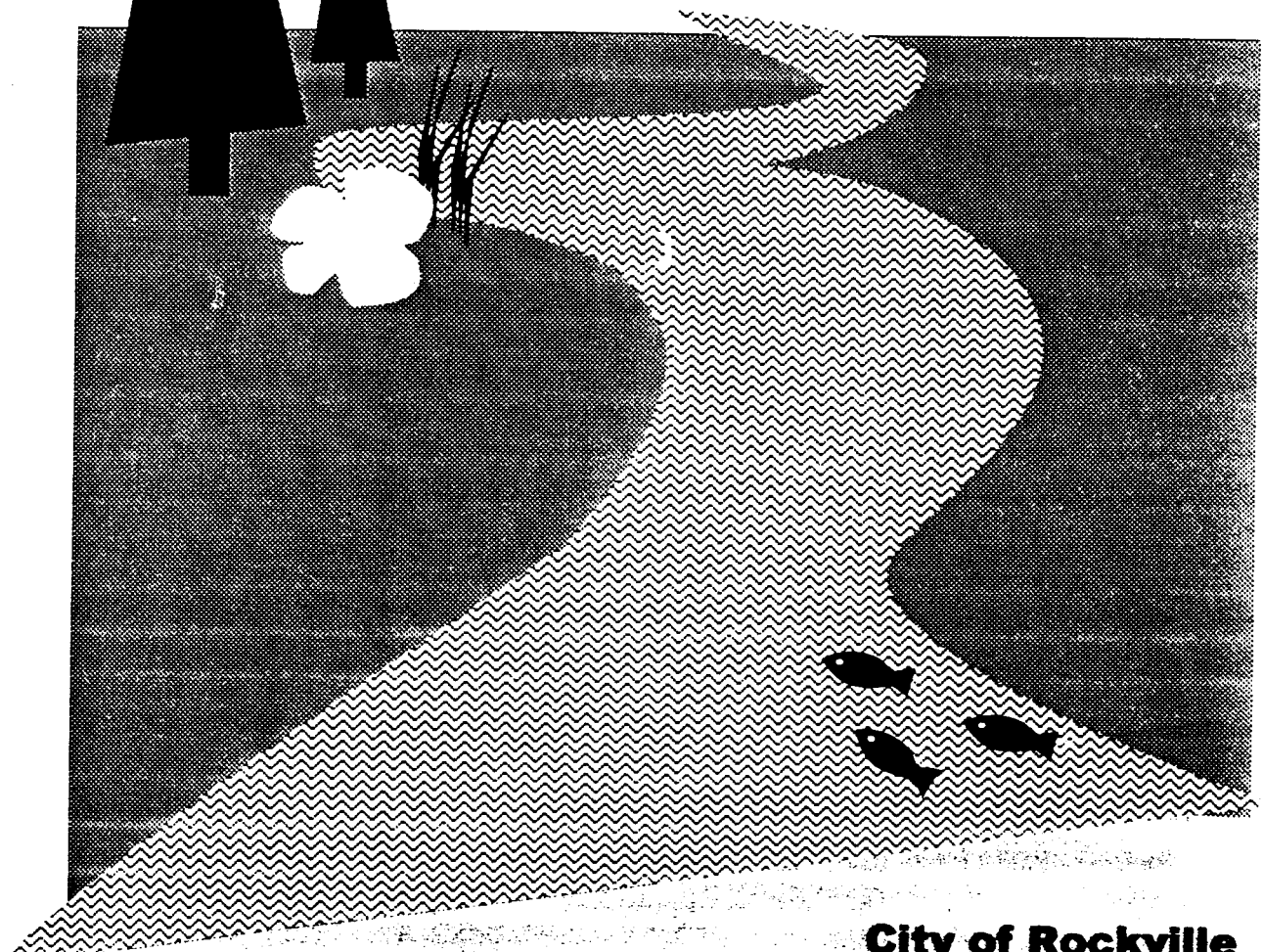


Cabin John Watershed Management Plan



City of Rockville
February 1996



**CABIN JOHN WATERSHED
MANAGEMENT PLAN**

-FINAL REPORT-

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**THE CITY OF ROCKVILLE
DEPARTMENT OF PUBLIC WORKS
STORMWATER MANAGEMENT DIVISION**

**ADOPTED FEBRUARY 26, 1996
BY
THE MAYOR AND COUNCIL OF ROCKVILLE**



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Review of the Public Information Process

Several public information meetings were held to keep the citizens of Rockville informed about this watershed study and the potential impacts it has on them. Through each step of the process, meetings provided an opportunity for the residents to learn more about the Cabin John watershed and express their concerns and opinions on the proposed improvements to the watershed.

The public information process does not end with the Mayor and Council's approval of the plan. The design process will again solicit community comments that will enable each project to satisfy both the needs of the environment and Rockville's citizens.

Executive Summary

The Cabin John watershed is located in the southern section of Rockville. It drains 3.6 square miles of heavily urbanized area through approximately eight miles of stream in three tributaries and seven subwatersheds. Although small, the Cabin John watershed affects both the Potomac River and the Chesapeake Bay.

Rockville adopted its Stormwater Management (SWM) program in 1978, when the city was over 75 percent developed and the Cabin John watershed was over 80 percent developed. City policy requires the discharge from a 10-year post-development storm to be released at the rate of the 2-year pre-development storm in which the site is assumed to have been in meadow condition. Created to prevent localized flooding, the policy was revised in 1986 to also provide water quality control.

Conducting a management plan for the whole watershed was first recommended by the Stormwater Management Task Force, formed in 1991 to assist the Mayor and Council in assessing the City's overall program. In addition, the task force recommended legislation to establish a water quality monitoring program, implement a comprehensive watershed maintenance program, increase public education and outreach, and develop new funding methods for long term operation and maintenance of the program. This watershed management plan is intended to reconcile the competing needs of an urbanized area while protecting the streams that exist in it.

Montgomery County's **Rapid Stream Assessment Technique (RSAT)** methodology was used to develop the plan.

As a result of the Cabin John watershed study and proposed changes to the State's SWM regulations, the City is proposing five actions: replace 10/2 control with one-year extended detention control for larger developments; expand the stormwater program to include a variety of water resource and enhancement projects; require approval of the SWM concept early in the development process; require annual certification of private SWM facility operation; and develop a memorandum of understanding with Montgomery County over compliance, monitoring, and enforcement as they relate to the National Pollution Discharge Elimination System (NPDES).

After reviewing the COG recommendations and conducting preliminary hydrologic-hydraulic analyses, staff proposes the following actions: **Fleet Street:** Construct an extended detention shallow marsh at a cost of \$172,300 per acre-foot in the later years of the SWM program; **Mount Vernon Place:** Convert an existing dry detention facility by adding a permanent pool and regrading to increase the storage capacity for quality control at a cost of \$23,300 per acre-foot, to be implemented in FY 96; **Hungerford Swim Center:** Construct an off-line excavated wet pond and levee system parallel to Cabin John Parkway to control the first one-half inch of run-off and decrease the two-year storm at a cost of \$37,800 per acre-foot, to be implemented in FY 96; **Dawson Farm:** Convert an existing dry detention facility to an extended detention shallow marsh at a cost of \$26,700 per acre-foot, with implementation in FY 2000; **Wootton Parkway:** Construct two weirs within the existing stream channel to provide extended detention and

improve water quality at a cost of \$108,800 per acre-foot, to be implemented in FY 97; **Potomac Woods:** Construct an off-line extended detention marsh to provide water quality and partial quantity control at a cost of \$51,600 per acre-foot, to be implemented in FY 96, plus a second wet extended detention pond to provide water quality and quantity control for smaller storms at a cost of \$47,800 per acre-foot, to be implemented in FY 99; **Locks Pond Court:** Convert an existing dry pond to an extended shallow marsh for water quality control at a cost of \$31,000 per acre-foot, to be implemented in FY 95; **North Farm:** Convert an existing dry pond into a shallow extended detention marsh to provide quality control for smaller storms and reduce stream channel erosion at a cost of \$39,500 per acre-foot, to be implemented in FY 99; **Woodmont Country Club:** Enlarge the existing golf course pond by six times to provide water quality and quantity control at a cost of \$59,500 per acre-foot, to be implemented at the time of redevelopment of the golf course; and **Montrose Park:** Prepare a detailed base survey of the existing conditions in FY 97 to develop alternative measures. These projects are summarized in Appendix A, page A-1.

I. History of Development in the Watershed

Watershed History

A watershed is an area of land from which all the water drains to the same stream, river, lake, estuary. The city of Rockville contains three watersheds that are part of the larger Potomac River Watershed (see Figure 1). The Cabin John watershed, located in the southern section of Rockville, drains 3.6 square miles of a heavily urbanized area. There are approximately 42,000 linear feet (8 miles) of stream with 25 percent located on public property and 75 percent located on private property. The Cabin John watershed is further divided into three tributaries within the city: the main branch and two smaller tributaries, Bogley Branch and Old Farm Branch. Both of these smaller tributaries enter the main stem of Cabin John Branch downstream of the corporate limits of Rockville. Although the Cabin John watershed is very small, it affects both the Potomac River and the Chesapeake Bay. All of the headwaters of Cabin John are located in the city of Rockville (see Figure 2 for location).

The City of Rockville was incorporated in 1860 and at that time encompassed 133 acres with a population of 365. Through annexations and improved access to major cities by transportation advancements, Rockville increased in size and population to 7,890 acres (12.3 square miles) and 47,136 population. The most dramatic growth occurred in the 1940s and 1950s. The development of houses, roadways, and retail centers rapidly increased the impervious areas,

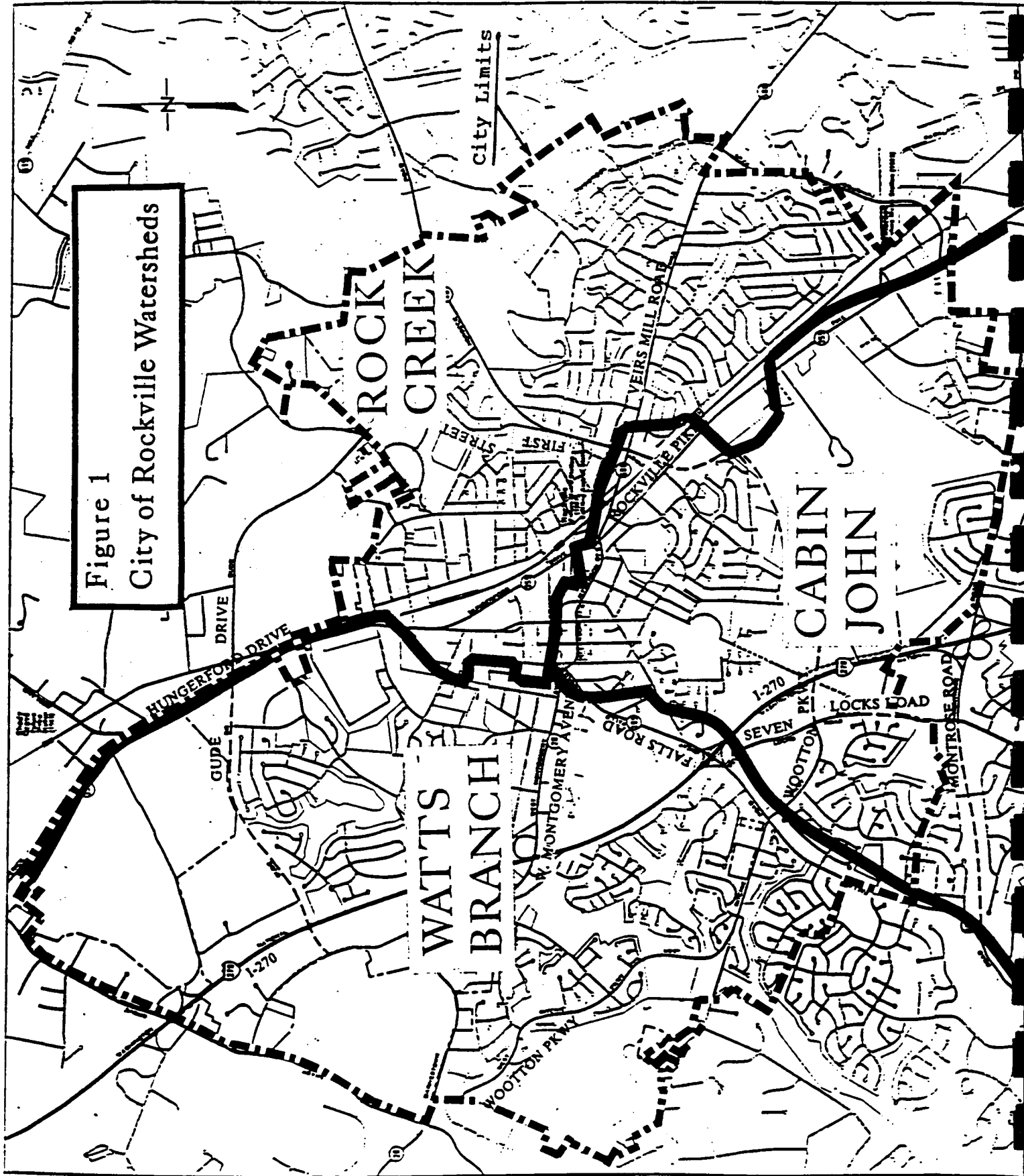
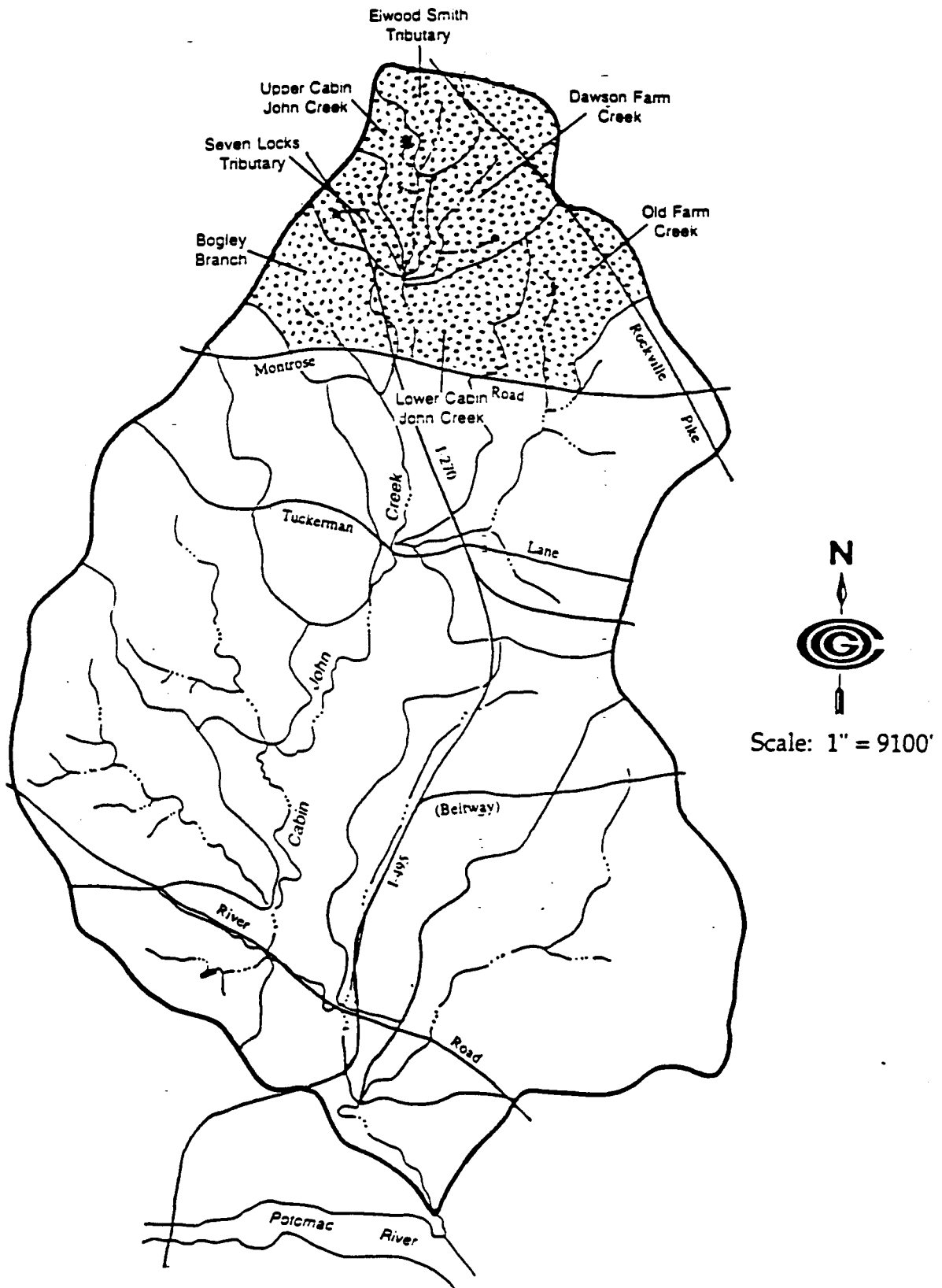


Figure 1
City of Rockville Watersheds

Figure 2
Cabin John Creek Watershed Management Study Area



resulting in uncontrolled storm water runoff. During this post-war development boom, the land rapidly underwent a change. Forests and meadows were removed and replaced with pavement and roofs. The runoff from these impervious areas was quickly transported away from the new development by storm drain pipes and discharged into streams. The inability of the ground to absorb the rainfall compounded with the discharging of runoff directly into the streams resulted in severely eroded streambanks, sediment deposition, and an increase in pollutant loadings.

In response to this degradation and subsequent flooding, the City adopted regulations and established its Stormwater Management (SWM) program in 1978. At that time over 75 percent of the City was developed, and the Cabin John Watershed was approximately 80 percent developed. The City, recognizing the need to adopt a very stringent water quantity control policy to reduce flooding and erosion, determined that the discharge resulting from a 10-year post-development storm should be released at a rate equivalent to a 2-year pre-development storm assuming the site was in meadow condition, based on hydrologic modeling.

This policy was aimed at controlling the quantity of the water flow after a storm to prevent localized flooding and stream channel erosion, without addressing the quality of the water in the stream. However, since 1986, due to the increased awareness of water quality concerns, the City has required that any development required to provide SWM must provide both quality and quantity control.

This watershed management plan is being developed to reconcile the competing interests of an urbanized area and the streams that exist within it. Because the streams are currently degraded, they cannot support a diversified and healthy habitat. Eroding stream banks, sediment deposits, elevated temperatures, and the absence of diverse macro-invertebrates are all indicators of stressed urbanized streams as evidenced in the Cabin John watershed.

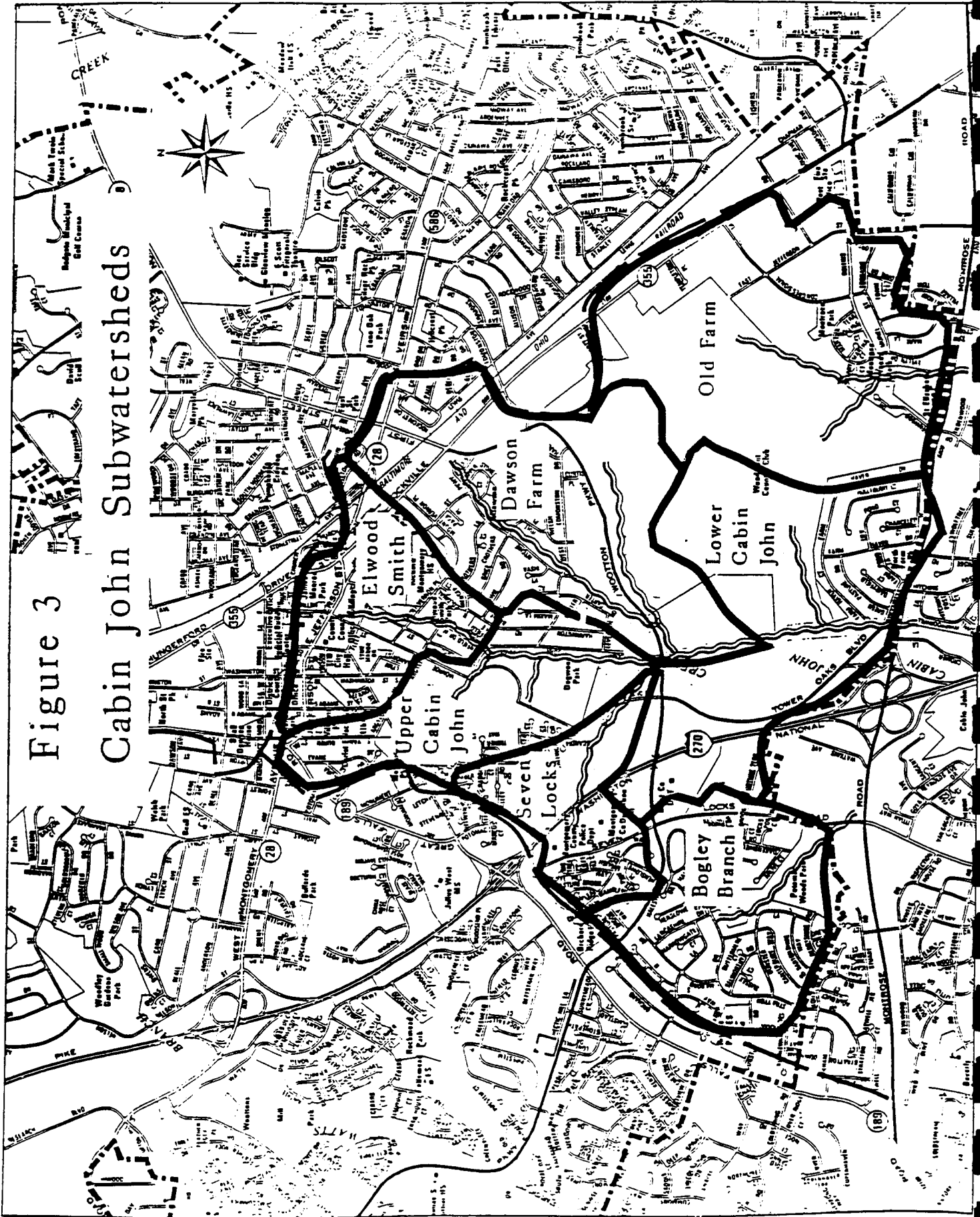
Physical Description

The Cabin John watershed is divided into seven subwatersheds (see Figure 3). Existing ponds and existing SWM facilities have been identified in each subwatershed. The existing ponds are being listed because they provide some water quality control by allowing pollutants to settle out in their permanent pools. The seven subwatersheds are as follows:

1. The Elwood Smith subwatershed is located in the northernmost section in the Cabin John watershed and includes a drainage area of 221 acres. This stream flows from Fleet Street to Cabin John Parkway where it enters the main stem of Cabin John Creek. The watershed consists of a portion of Rockville Pike with approximately 35 percent of the subwatershed zoned commercial, and 65 percent zoned residential. This subwatershed is about 48 percent impervious and contains two existing SWM facilities, Rockville Heights and Mount Vernon dry ponds.
2. The Upper Cabin John subwatershed located in the northwest section of the watershed drains an area of 247 acres, and is considered the main tributary of the Cabin John Creek. It begins at

Figure 3

Cabin John Subwatersheds



the New Mark Commons Lake outfall, also known as the Lynfield tributary, and ends at the triple culverts at Wootton Parkway. It also includes the Dogwood Park tributary, which flows from Monroe Street to its confluence with the main stem of Cabin John. Approximately 90 percent of the subwatershed is zoned residential and 10 percent zoned commercial. The subwatershed is about 30 percent impervious and contains no public SWM facilities. However, the privately-owned New Mark Commons Lake is located in this subwatershed.

3. Dawson Farm subwatershed is located in the northeast section of the Cabin John watershed and includes a drainage area of 430 acres. The stream, Dawson Farm Creek, flows from Fleet Street to the end of the gabion-lined channel at Wootton Parkway and includes the Hungerford tributary located on the Woodmont Country Club property. Approximately 30 percent of the subwatershed is zoned commercial, 45 percent zoned residential, and the remaining 25 percent consists of the Woodmont Country Club. Although the Woodmont Country Club is currently zoned Residential Estate, it is not anticipated to be developed soon. This subwatershed is approximately 43 percent impervious and contains one existing SWM facility, Dawson Farm dry pond, and two privately-owned golf course ponds.

4. The Seven Locks subwatershed is located in the western section of the watershed and drains 170 acres from I-270 to the north side of Wootton Parkway. The stream, Seven Locks tributary, is zoned approximately 30 percent commercial/office and 70 percent residential. It is approximately 35 percent impervious, with one SWM facility, the Detention Center wet pond.

5. The lower Cabin John subwatershed is at the southern portion of the watershed and drains 472 acres. The stream is the continuation of the main stem of Cabin John Creek from the triple culverts at Wootton Parkway to Montrose Road. Approximately 20 percent of the subwatershed is zoned industrial, 30 percent zoned commercial/office, 25 percent zoned residential, and 25 percent zoned Residential Estates, which is the Woodmont Country Club. This subwatershed is approximately 41 percent impervious and contains one SWM facility, the North Farm dry pond, and one privately-owned golf course pond.

6. The Bogley Branch subwatershed drains 316 acres and is located at the southwestern portion of the watershed. The stream, Bogley Branch, flows from Stratton Drive to Seven Locks Road. Approximately 5 percent of the subwatershed is zoned industrial with the remaining 95 percent zoned residential, resulting in 27 percent imperviousness. Two existing SWM facilities are located in this subwatershed, Arlive Court and Locks Pond Court dry ponds.

7. The largest subwatershed, Old Farm Creek, drains 532 acres. Approximately 20 percent is zoned commercial, 5 percent is zoned high-density residential, 30 percent is zoned residential, 40 percent is Woodmont Country Club, and the remaining 5 percent is wooded. This subwatershed is 37 percent impervious and contains two privately-owned golf course ponds but no public storm water facilities.

II. Evaluating Existing Stream Conditions

The Metropolitan Washington Council of Governments (COG) developed a methodology, the Rapid Stream Assessment Technique (RSAT), for the Montgomery County Department of Environmental Protection to evaluate the condition of streams. COG prepared the Upper Cabin John Creek Watershed Management Study for the City of Rockville in which were noted an explanation of the RSAT methodology, results of the field work, and recommendations by COG to improve the watershed.

III. Land Use and the Cabin John Watershed

Cabin John watershed land use consists of the following:

- 20 percent low density residential (fewer than 10 dwelling units per acre)
- 20 percent high density residential (more than 10 dwelling units per acre)
- 30 percent office/industrial/commercial
- 30 percent open space (including parks and Woodmont Country Club)

Cabin John specifically includes five neighborhood areas identified in the City's Approved and Adopted Master Plan dated October 25, 1993:

Residential Neighborhood Areas:

- Planning Area 3 - Hungerford-Stoneridge and New Mark Commons
- Planning Area 10 - Montrose
- Planning Area 11 - North Farm
- Planning Area 13 - Orchard Ridge, Potomac Woods, and Falls Ridge

Non-residential Neighborhood Area:

- Planning Area 12 - Westmont/Tower Oaks

It also includes a small portion of Planning Area 1, Town Center; and Planning Area 9, Rockville Pike.

Planning Area 3:

This planning area consists of 426 acres of residential neighborhoods and is comprised of three subareas: Monroe-Lynfield, Hungerford-Stoneridge, and New Mark Commons (see Figure 4).

The Master Plan states that "there is little land in this area that is undeveloped or not committed to some specific use, such as parkland." The Master Plan also recommends that any remaining vacant parcels should be used for residences. Remaining vacant parcels include the following:

- The former Oak Ridge school site, which is approximately 10 acres, is a vacant parcel located between the New Mark Commons subdivision and I-270.
- Two vacant parcels, which contain approximately 10 acres, are located north of Wootton Parkway and east of the former Hungerford Elementary School.
- The final vacant parcel, which contains approximately 11 acres, is located north of Dogwood Park between Monroe Street and Cabin John Parkway and currently has a development plan being processed for 44 residential townhouses.

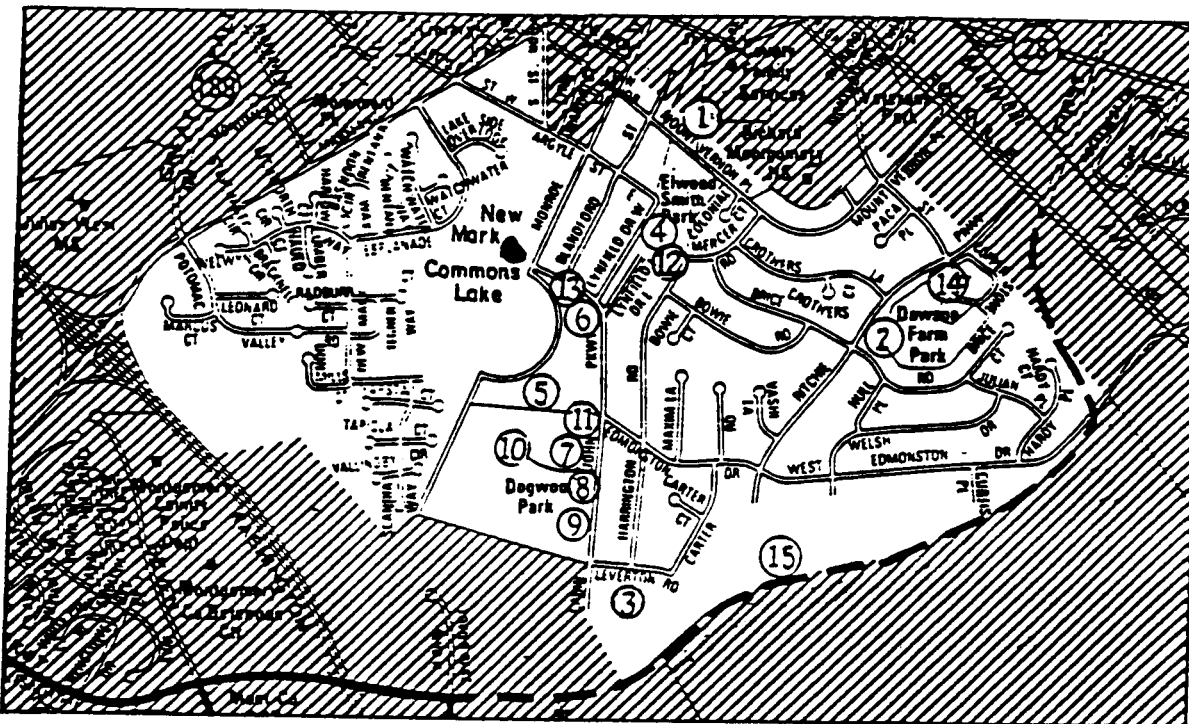
Each of these sites will be evaluated carefully at the time of development to determine how they will directly impact the watershed and the goals established in this report.

Planning Area 3 is located in the Elwood Smith and Upper Cabin John subdrainage areas as identified in the technical portion of the COG report. The proposed watershed improvements and their impact to Planning Area 3 are shown in Figure 4.

Figure 4

PLANNING AREA 3

Hungerford, Stoneridge and New Mark Commons Neighborhoods



Facility Number	Type of Facility	Name of Facility	Cost of Construction	FY to be designed
1	SWM Retrofit	Mount Vernon Place	\$60,000	FY 1996
2	SWM Retrofit	Dawson Farm Park	\$170,000	FY 2000
3	SWM facility	Hungerford Swim Center	\$605,000	FY 1996
4	Stream Restoration	Elwood Smith Tributary - 250 LF of channel restoration	\$40,000	FY 1995
5	Stream Restoration	Dogwood Park Tributary	\$120,000	FY 1998
6	Fish Barrier Removal	Cabin John Parkway Culvert	\$7,500	FY 1998
7-9	Creation of Non-SWM Wetland Sites	Dogwood Park #1, #2, and #3	\$15,000 \$ 4,500 \$ 5,300	FY 2000
10-15	Riparian Reforestation	<ul style="list-style-type: none"> ● Upper Cabin John - Edmonston to Levection ● Dogwood Park ● Elwood Smith Park ● Elwood Smith & Upper Cabin John Confluence ● Upper Dawson Farm Crk ● Dawson Farm Creek - near Wootton Parkway 	N/A	In conjunction with stream restoration, volunteer projects and forest mitigation for future City and developer projects.

Planning Areas 9 and 10:

Planning Area 9 is located along Rockville Pike and is primarily a retail center with some office and residential development. Only a portion of this planning area drains to the Cabin John watershed (see Figure 5).

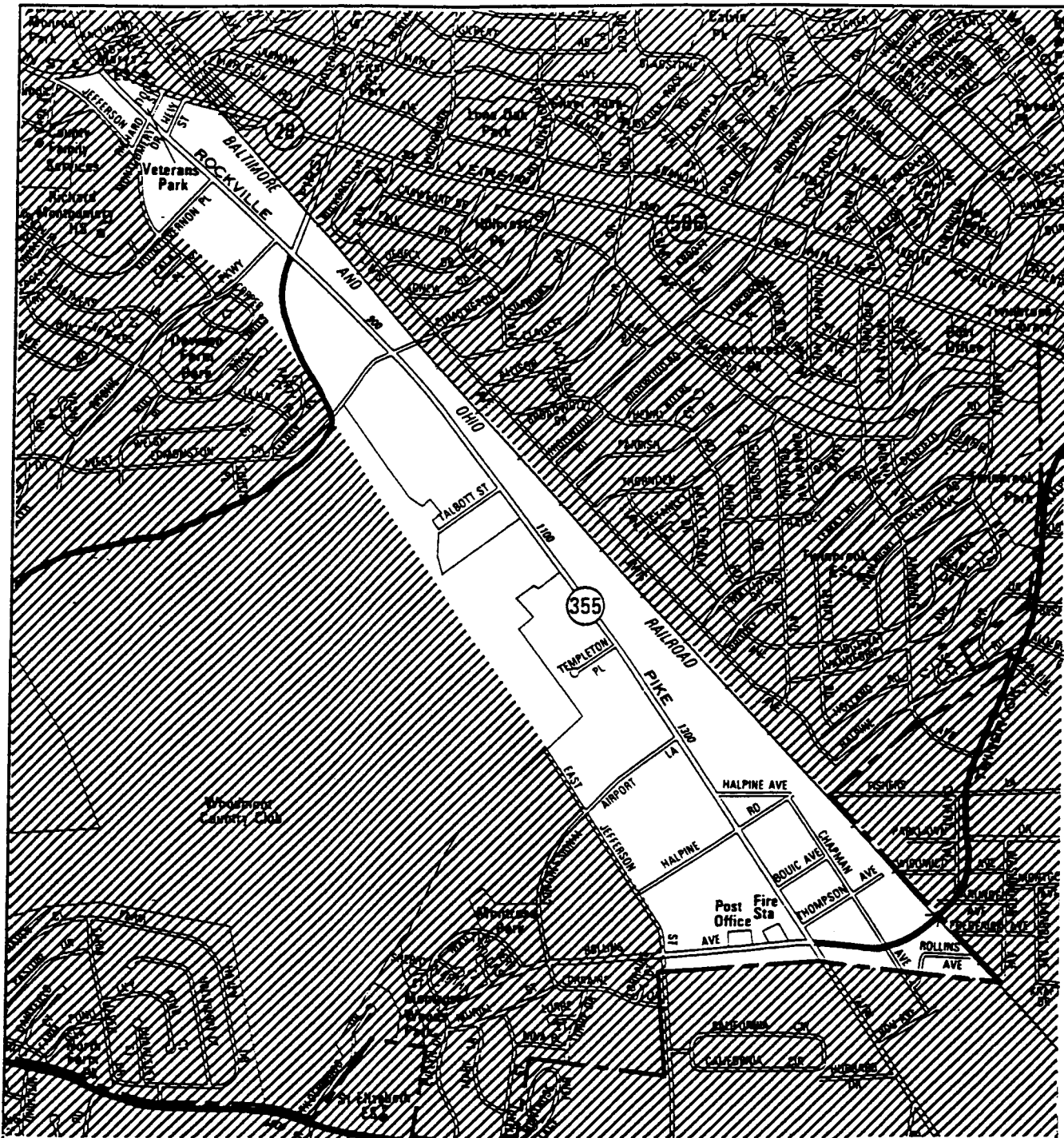
Planning Area 10 of 170 acres is one of the smallest planning areas in the city and is all zoned residential. According to the Master Plan, it includes "a mix of single-family houses, townhouses, garden apartments, and apartment towers which, at seven to eight stories, are among the tallest residential buildings in the city outside of Town Center." Although no commercial centers are within this planning area, it is adjacent to the Rockville Pike corridor.

Although few vacant parcels exist within this planning area, redevelopment of areas constructed prior to the City's SWM regulations will require SWM and thus will impact the Cabin John watershed. Since redevelopment usually involves smaller impervious areas, participation in the City's regional program becomes a viable solution to providing SWM for the redeveloped site. This area is located in the Old Farm Branch tributary of the Cabin John watershed. Figure 6 identifies the proposed recommendations to the watershed.

Planning Area 11:

This planning area consists of the North Farm subdivision, the Woodmont Country Club, and no commercial centers. The Master Plan states that "the development of Woodmont Country Club is

Figure 5



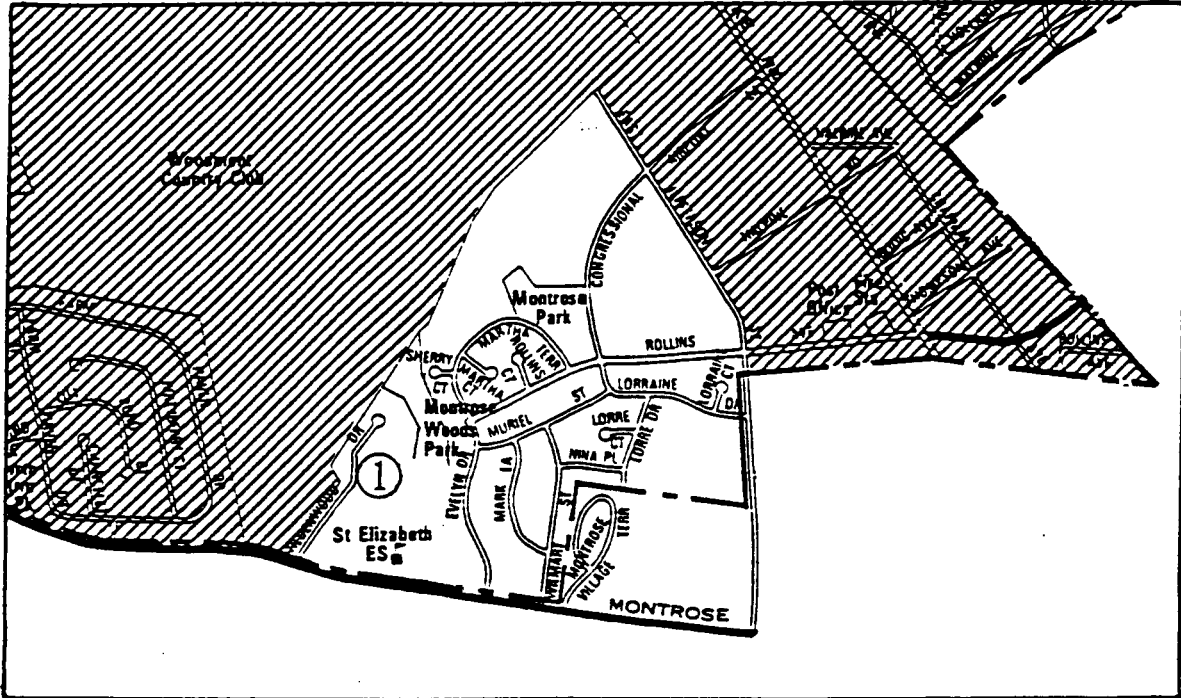
PLANNING AREA 9
Rockville Pike Corridor



Figure 6

PLANNING AREA 10

Montrose Neighborhood



Facility Number	Type of Facility	Name of Facility	FY To Be Designed
1	Alternative Review	Montrose Park	FY 1997

unlikely" and is therefore not anticipated to affect the watershed at this time. No vacant parcels exist in this planning area.

Planning Area 11 is located in three subwatersheds of the Cabin John watershed and includes the Dawson Farm Creek and Woodmont Country Club Tributary No.1, Lower Cabin John Creek and Old Farm Creek. The watershed recommendations that directly affect this planning area are shown in Figure 7.

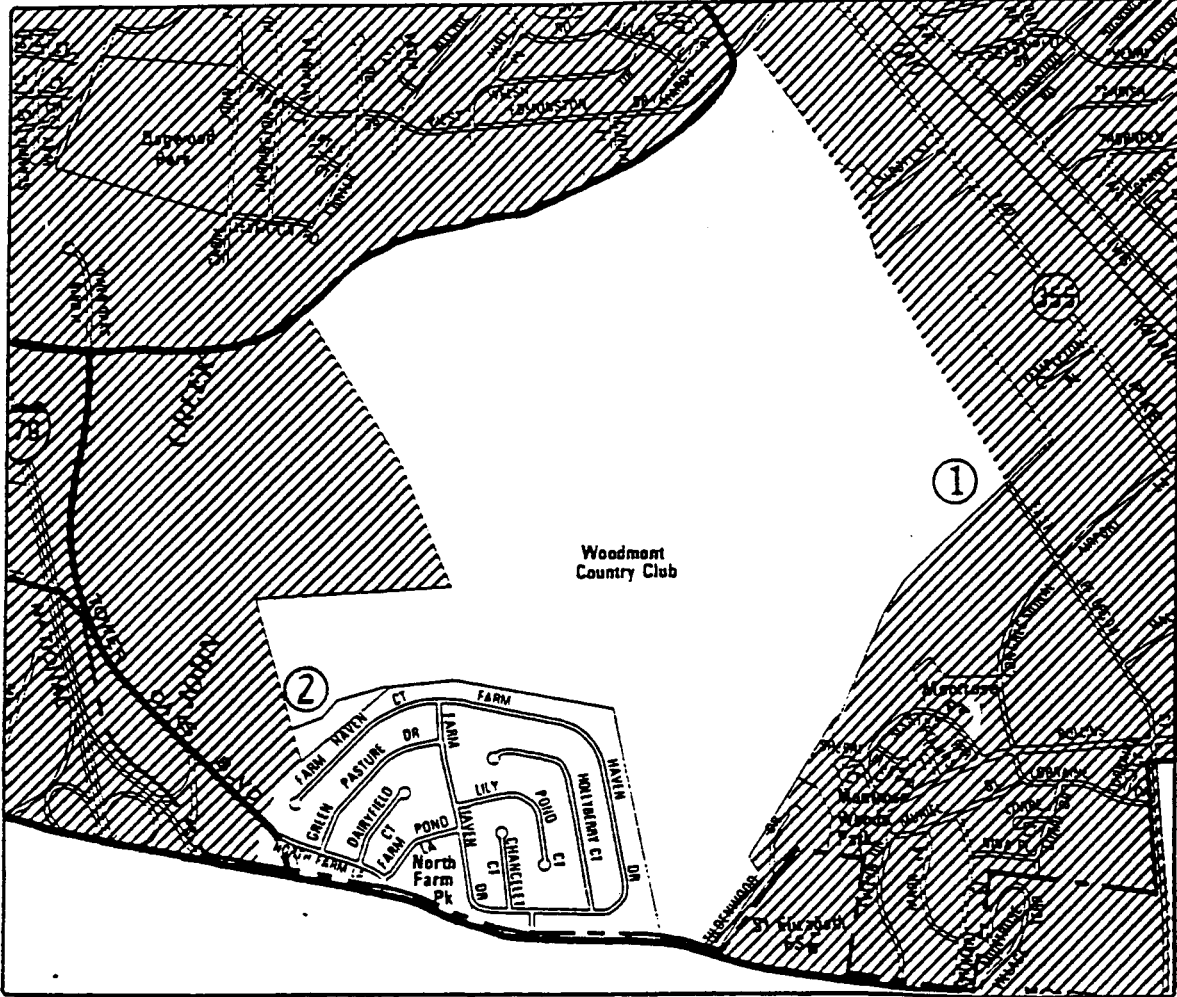
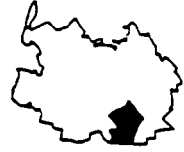
Planning Area 13:

This planning area is located between Falls Road and I-270. It consists of the following residential subdivisions: Falls Orchard, Potomac Woods, Falls Ridge, Potomac Woods East, and Orchard Ridge. It also includes Montgomery County's Seven Locks Technical Center, the County Detention Center, and a County police sub-station. Commercial property includes Seven Locks Plaza and several office buildings east of Seven Locks Road. Few vacant parcels exist within this planning area and proposed development is anticipated to be only future expansion of County facilities. A 50-acre parcel, known as Fortune Parc and located immediately to the south of the planning area, is within the City's Urban Growth Areas and will likely be annexed to the city and developed with a mix of residential and office uses. Timing for this development is currently unknown.

Figure 7

PLANNING AREA 11

North Farm Neighborhood

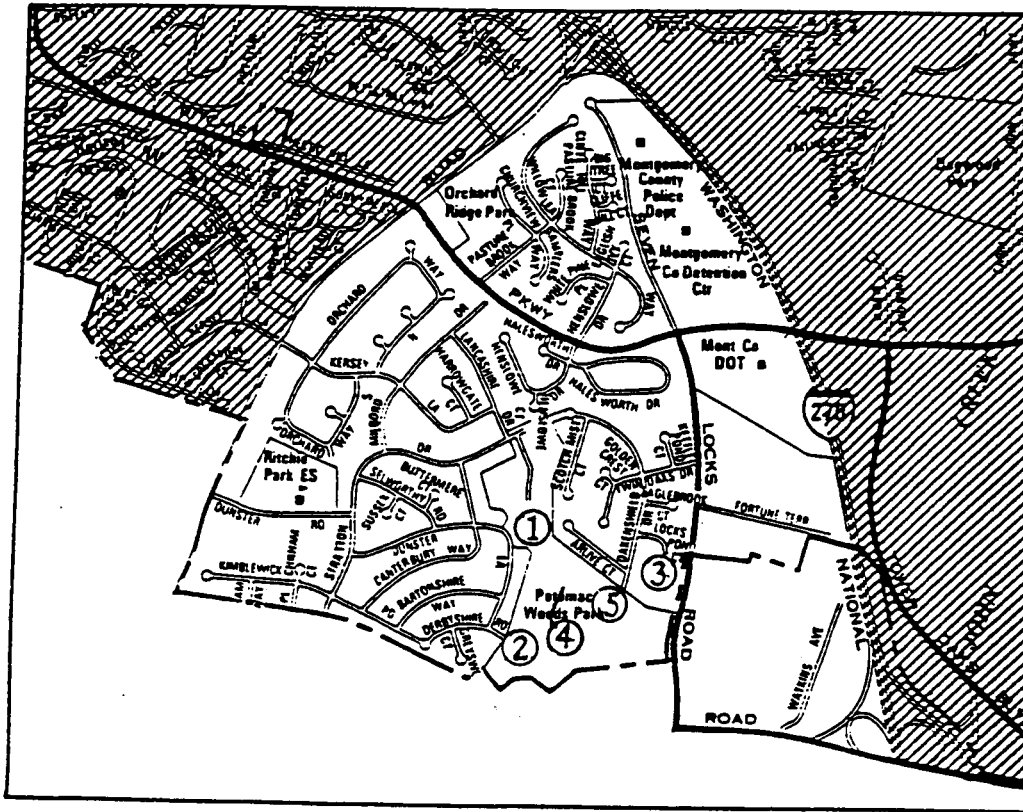


Facility Number	Type of Facility	Name of Facility	Cost of Construction	FY to be designed
1	SWM Facility	Woodmont Country Club	\$508,370	FY 2003
2	SWM Retrofit	North Farm	\$48,000	FY 1999

Figure 8

PLANNING AREA 13

Orchard Ridge, Falls Ridge and Potomac Woods Neighborhoods



Facility Number	Type of Facility	Name of Facility	Cost of Construction	FY to be designed
1	SWM Facility	Potomac Woods East	\$100,000	FY 1996
2	SWM Facility	Potomac Woods West	\$67,000	FY 1999
3	Retrofit SWM Facility	Locks Pond Court	\$84,000	FY 1995
4	Stream Restoration	Potomac Woods Park - from ballfield to Seven Locks Rd	\$90,000	FY 1996
5	Fish Barrier Removal	Maintenance Road in Potomac Woods Park	Incorporated in redesign of maint. road.	FY 1995

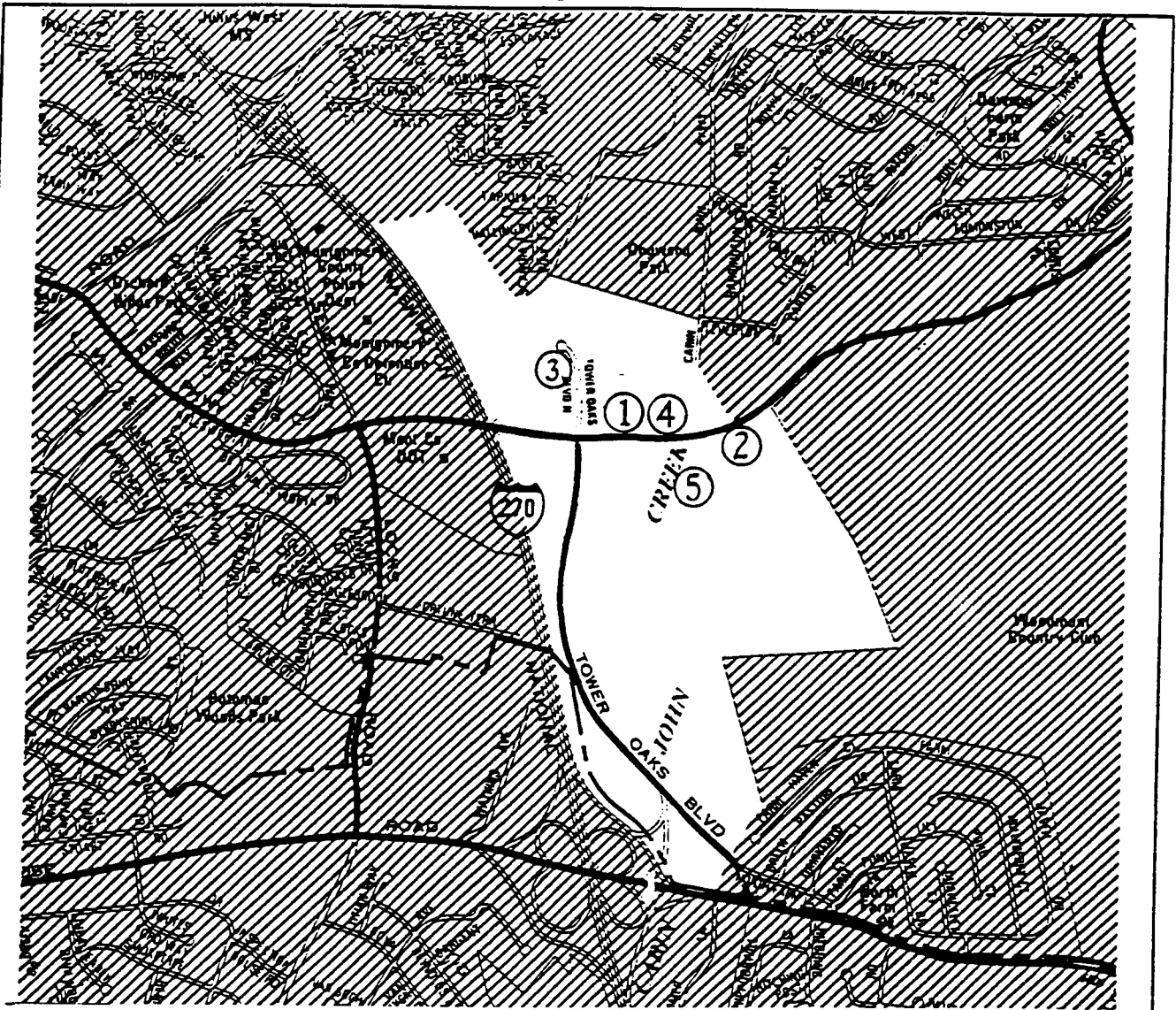
Planning Area 13 is located in the Bogley Branch and Seven Locks subwatershed areas of the Cabin John watershed. The proposed watershed improvements and their impact on this planning area are identified in Figure 8.

Planning Area 12:

This planning area is a non-residential neighborhood area and includes the Westmont (Tower Oaks) property. It also includes two existing developed office and light industrial uses along Tower Oaks Boulevard. A comprehensive Neighborhood Plan was adopted for the Tower Oaks site in March 1985. SWM for the entire site was not approved at the time of the Master Plan. A residential section of the site is currently under design and proposes a regional SWM facility to be located in a portion of the rip-rap lined Seven Locks tributary. As development is proposed, SWM and its effect on the watershed will be evaluated to ensure that it is consistent with the goals of this watershed study.

Planning Area 12 is located in the Seven Locks/Detention Center tributary and the Lower Cabin John Creek tributary as identified in the watershed plan. The proposed watershed improvements are listed in Figure 9.

Figure 9



Facility Number	Type of Facility	Name of Facility	Cost of Construction	FY to be designed
1	SWM Facility	Villages at Tower Oaks	By developer	FY 1995
2	SWM Facility	Wootton Parkway Weirs	\$70,000	FY 1997
3	Fish Barrier Removal	Tower Oaks culvert	\$7,500	FY 1998
4-5	Riparian Reforestation	Near Wootton Parkway Lower Cabin John Creek near Wootton Parkway		In conjunction with stream restoration.

PLANNING AREA 12
Westmont (Tower Oaks)



IV. Goals of the Watershed Management Plan

The RSAT methodology, which provided an overall assessment of the existing conditions of the Cabin John watershed, resulted in the establishment of the following goals to improve and maintain the existing system of streams:

1. Reduce pollutants and improve the water quality through:
 - A. Construction of new SWM facilities
 - B. Retrofitting existing facilities.
2. Restore, to the extent possible, the habitat and biodiversity of the watershed by:
 - A. Improving degraded streambanks
 - B. Removing fish barriers
 - C. Creating and protecting wetlands
 - D. Expanding the forest cover and creating a contiguous corridor of forest along streams.
 - E. Increasing public awareness of the impact that all citizens have on water quality

Relationship of RSAT Goals to the SWM Task Force Goals and Recommendations:

A SWM task force was formed in January 1992 to assist the Mayor and Council in assessing Rockville's SWM program. The Task Force, made up of 15 Rockville citizens, met biweekly to study all aspects of SWM as it relates to the city. The Task Force provided the Mayor and

Council with a final report on September 10, 1992. Below is a summary of the recommendations and how they relate to the Cabin John watershed. These recommendations were grouped into five categories:

1. Laws and Regulations
2. Funding
3. Maintenance
4. Public Education
5. Watershed Planning

1. Laws and Regulations.

As a result of this watershed study and proposed changes to storm water regulations being pursued by the state, we are proposing some significant changes to our regulations.

- Eliminate 10/2 control and replace with one year extended detention (ED) control.
- Expand storm water program to include a variety of water resource protection and enhancement projects.
- Expand storm water program as needed to comply with National Pollution Discharge Elimination System (NPDES).

Other procedural changes include requiring concept SWM approval early in the development phase to ensure adequate protection of our water resources; amending the SWM maintenance agreement and easement to require annual certification by the property owner that their SWM facility is in operation; and developing a memorandum of understanding or guidelines for

cooperation between Montgomery County and Rockville to cover such items as compliance, water quality stream monitoring, and enforcement of water quality violations.

2. Funding

Funding remains a critical issue. Although expanding the program provides the best opportunity to restore Rockville's water resources, it also necessitates a review of the funding mechanism. Currently, all funding is by developer contribution for participation in the Regional SWM Program. It may be necessary to augment this funding in the future. Allocation of part of the General Fund tax revenue for SWM, creation of a separate utility fee or SW tax are typical methods of ensuring long-term success for this type of program. Another possible source of revenue is to increase the required contribution rate for developer participation in the Regional SWM Program. Although detailed funding analysis was beyond the scope of this watershed study, the cost estimates included for the various projects will be used to determine future funding needs.

3. Maintenance

A comprehensive maintenance program is critical to the success of improving our water resources. Rockville has a proactive maintenance approach which includes inspection and maintenance of both private and public SWM facilities; stream bank repair; erosion prevention; habitat improvement, and maintaining water quality structures installed along some of our roadways. This watershed study has proposed locations where stream restoration is needed as emphasized by the SWM Task Force.

4. Public Education

Public education provides opportunities to implement fundamental changes in the way individuals live and interact with our environment. Involving the public with our SWM program is one of the best methods for teaching individuals about the consequences of their actions. During the course of this watershed study we held many public meetings. Some focused on educating people about the problems, others involved site visits to look at and learn about our streams, and still others focused on solutions to restoring our streams, as well as the Chesapeake Bay. Other examples of public education include articles in the ROCKVILLE REPORTS, segments on Cable TV53, community projects such as stenciling storm drain inlets with pollution warnings, and pamphlets.

5. Watershed Planning

This watershed study addresses the many concerns expressed by the SWM Task Force including upgrading existing facilities, proposing new facilities, creating opportunities for wetlands, and stabilizing and rehabilitating streams. Because the process for implementing the watershed recommendations was a concern of the Task Force, the City has taken every opportunity to inform and encourage the participation of its citizens and the public agencies who will eventually review the recommended proposals. The final recommendations will be presented to the Mayor and Council, who will then decide which watershed improvements to pursue, with implementation beginning immediately. Design of existing and proposed SWM facilities, stream restoration sites, wetland creation sites, and removal of fish barriers have been included in the City's Capital Improvements Program (CIP), which will be reviewed and approved by the Mayor and Council.

V. Implementing Final Recommendations of the Cabin John Watershed Plan

The Upper Cabin John Watershed Management Study prepared by COG provides the detailed field survey of streams located within the city. This information provides an assessment of current physical, chemical, and biological conditions of the watershed. This technical report further develops the information obtained in the field into recommendations for a comprehensive watershed management plan. The recommendations include creating and retrofitting SWM facilities, stream restoration, wetland creation, and reforestation opportunities.

City staff, using the results of the COG report, further evaluated the proposed and retrofitted SWM facilities by performing preliminary hydrologic-hydraulic analysis of the COG SWM recommendations. The hydrologic-hydraulic analysis incorporated the COG recommendations for water quality and quantity control and modeled each facility within the existing physical constraints. The modeling was done using TR-55, TR-20, and HEC-2.

Staff recommendations on whether or not to pursue a more detailed design of the proposed facilities are based on the physical constraints, the benefits of each facility, and the results of the preliminary hydrologic-hydraulic modeling. This preliminary modeling illustrated how much quantity and/or quality control could actually be obtained at the proposed facilities. A unit cost, based on the amount of storage each facility could provide, was also factored into staff recommendations. The SWM facilities are in the conceptual design phase to determine their approximate size and limits. The type of facility will not change; however, specific concerns such

as landscaping, fencing, tree loss, bike paths, and safety issues will be addressed throughout the design process and will be coordinated closely with concerned residents. The staff recommendations based on the hydrologic-hydraulic modeling, unit costs, constraints, and benefits to the watershed are as follows:

I-A. Fleet Street

This proposed facility is an excavated basin with an extended detention shallow marsh. The permanent pool will have a depth of two feet with extended detention being provided for the first 1.1" of runoff. It received a low priority rating by COG due to the small drainage area and high land acquisition costs. City staff concurs with COG's concerns and, based on a cost of \$172,300 per ac-ft of storage for water quality and quantity control, recommends delaying pursuit of this facility until the later years of the SWM program.

I-B. Mount Vernon Place

This existing dry pond, constructed in 1980, was one of the first regional SWM facilities built by the City. This proposed retrofit facility received a high priority rating by COG, with which City staff concurs. COG's suggested retrofit of this existing SWM facility will provide water quality for approximately 0.25" of the first runoff in this highly urbanized 65.5-acre drainage area. COG recommends excavating a permanent pool that will provide water quality and regrading the facility to increase the storage for quantity control, possibly including an area north of the existing bike

path. City staff concurs that these modifications would enhance the water quality in addition to increasing the amount of quantity control for the drainage area. The estimated cost is \$23,300 per ac-ft of total storage. City staff recommends pursuing the retrofit design to the Mount Vernon Place facility in FY 1996.

2. Elwood Smith

This facility was proposed originally by the City as a dry detention storm water management facility in 1978. COG has further evaluated it and believes that it could provide some water quality and quantity control benefit as a dry extended detention pond and has given this facility a low priority rating. Because preliminary hydrologic-hydraulic analysis shows that this type of facility could reduce the impact of smaller storms on the stream through Elwood Smith Park in addition to providing a reduction in the runoff from the 2- and 10-year storms, City staff has given this facility a moderate priority rating.

City staff has considered the environmental benefits compared to the loss of an active recreational ball field, and the high cost of constructing the facility and relocating the existing sanitary sewer system. Although the estimated cost for this facility is high at \$96,800 per ac-ft of storage, the benefits directly downstream of the facility are enough to recommend further analysis only if an acceptable alternative can be found to replace the ball field within the Hungerford-Stoneridge community. Design will be pursued only after the affected associations (Hungerford-Stoneridge

Homeowners Association, Elwood Smith Park Council, Rockville Baseball Association, Recreation and Park Advisory Board) have concurred with an alternative ball field location.

3. Rockville Heights

This existing dry pond SWM facility was constructed in 1987 to eliminate the frequent flooding at the Maryland Avenue and South Washington Street intersection. COG recommends this facility be retrofitted to provide for water quality by excavating a permanent pool two feet in depth and providing extended detention for the first 0.5" of runoff. This retrofit received a moderate priority rating from COG. Preliminary hydrologic-hydraulic analysis has shown that the proposed retrofit will decrease the runoff from the smaller storms. However, since the downstream receiving system consists of over 2,000 feet of enclosed storm drain pipe, City staff believes the water quality and channel erosion benefits obtained by controlling the smaller storms would only decrease the flows in the existing storm drain pipe system and would not provide enough benefit to the stream channel to warrant a major modification to this facility. The City therefore recommends that this facility not be retrofitted.

4. Hungerford Swim Center

Field

COG recommends the construction of an off-line excavated extended detention marsh on this property in combination with a levee system running parallel to Cabin John Parkway. A pipe will be located in the stream to divert the first half-inch of runoff to the proposed facility. The levee

system will provide flood control for the houses along Cabin John Parkway. This facility is expected to provide a moderate level of channel erosion protection for the stream and received a high priority rating from COG, with which City staff concurs. Preliminary hydrologic-hydraulic analysis determined that diverting the runoff will provide control for the first half-inch of runoff and will also decrease the 2-year storm by approximately one-third. The estimated cost per ac-ft of storage is \$37,800. City staff recommends pursuing this project in FY 1996.

5. New Mark Commons

COG's proposal recommends retrofitting this existing privately-owned lake by lowering the permanent water surface elevation and replacing the four-foot-square concrete control structure. This retrofit facility received a moderate priority rating from COG. Preliminary hydrologic-hydraulic analysis has revealed that the permanent water surface must be lowered 1.5 to 2.0 feet to provide extended detention for 0.5" of runoff and meet current design pond standards. City staff agrees with COG's recommendations on the benefits that this facility will provide to the watershed; however, we do not recommend retrofitting this facility because the homeowners association is not agreeable to the impacts that this facility will have to their private lake.

6. Dogwood Park

COG recommends the construction of an off-line extended detention marsh. A low overall priority rating was given to this facility by COG because of its small drainage area, active practice

field, and high construction costs. The estimated cost is \$108,000 per ac-ft of storage. The preliminary hydrologic-hydraulic analysis determined that this facility would control the first half-inch of runoff, the 2-year storm, and approximately one-third of the 10-year storm. City staff does not recommend constructing this facility because of its conflict with the existing ball field. City staff concurs with COG that the alternative parallel pipe system be further investigated to determine what benefits it may provide to the Dogwood tributary without adversely impacting the main branch of Cabin John Creek. The parallel pipe alternative will benefit only the smaller tributary from New Mark Commons (Farsta Court) to the main branch of Cabin John Creek along Cabin John Parkway near Edmonston Drive.

7. Seven Locks/Detention Center Tributary

COG's proposal suggests the construction of an extended detention wet pond on the Tower-Dawson property. COG gave this facility a moderate rating. The estimated cost is \$128,000 per ac-ft of storage. This facility is located on an intermittent stream on the Detention Center/Seven Locks tributary, above the site of the intersection of the main Detention Center tributary with this stream. Of the 48 acres draining to this proposed facility, about half the area has water quality provided by the recently constructed Don Mills Court underground infiltration facility. The remaining drainage area is mostly undeveloped. The 2,500 feet of receiving system downstream of this facility is 50 percent piped, gabion-lined, or rip-rap-lined channel. In addition, the Detention Center tributary that combines with the intermittent stream has 100 percent of both

water quality and 10/2 quantity control provided by the existing City-owned Detention Center SWM facility.

City staff notes that Tower-Dawson proposed a regional SWM facility to be built in the existing rip-rap-lined channel in conjunction with their planned townhouse development. Staff recommends that the Tower-Dawson location, which is 2,500 feet downstream of the proposed COG location, should replace the COG site. This alternative facility, located between Tower Oaks Boulevard North and Wootton Parkway, will be of greater benefit to the watershed because it is located farther downstream, thus providing control for a larger drainage area, which includes direct treatment of the townhouse development, and will protect more than just piped and rip rap-lined stream channel. City staff recommends having Tower-Dawson provide this facility as part of their townhouse development, which is scheduled to begin in 1995. On February 27, 1995, the Mayor and Council approved the concept plan and location of this SWM facility.

8. Dawson Farm

COG recommends converting this existing dry detention facility into a two-cell extended detention shallow marsh system, and anticipates moderate water quality and downstream channel erosion benefits. This project received a high priority rating from COG. The estimated cost is \$26,700 per ac-ft of storage. Although the preliminary hydrologic-hydraulic analysis indicates that retrofitting this facility is not feasible due to many existing physical constraints (i.e., the height of the existing road, impact to historic sites, downstream flooding effects, and the

possibility of adverse dam breach flooding effects on downstream properties), City staff recommends this facility with a low priority rating. Further design analysis to determine its feasibility should be pursued in FY 2000.

9. Wootton Parkway

COG recommends two weirs, four to six feet high, be constructed within the existing rip-rap-lined stream channel along Wootton Parkway to provide additional water quality benefits in this stream through extended detention of approximately 6 to 12 hours. Preliminary hydrologic-hydraulic analysis has determined that less than one ac-ft of storage could be contained within the channel without adversely impacting the hydraulics of the culverts under Wootton Parkway. The estimated cost is \$108,800 per ac-ft of storage. City staff concurs with COG's moderate priority rating and recommends these weirs be pursued in FY 1997.

10. Potomac Woods #1 (Potomac Woods East)

Three facilities are proposed at various locations throughout Potomac Woods Park. The stream in this park, Bogley Branch, is experiencing severe erosion. City staff recommends pursuing two facilities #10 and #12, as explained in the following text. The construction of these two facilities would provide storm water management for 117.5 acres of previously developed area which is currently without any control and is contributing to the severe erosion of Bogley Branch.

COG recommends an off-line extended detention marsh behind Dunster Lane near the existing tot lot. This facility is designated by COG as Potomac Woods #1. It is designed to provide water quality for a 90-acre drainage area. Preliminary hydrologic-hydraulic analysis indicates this facility will provide water quality control and partial quantity control for the smaller storms. The cost is \$51,600 per ac-ft of storage. COG gave Potomac Woods #1 a low priority rating due to the amount of trees to be removed and the possibility of constructing Potomac Woods #2 as an alternative. However, Potomac Woods #2 eliminates an active ball field without a reasonable possibility of replacing it in the same neighborhood; therefore, City staff recommends Potomac Woods #1 with a high priority rating and pursuing it in FY 1996.

11. Potomac Woods #2

COG recommends an off-line extended detention marsh to provide water quality for a 152-acre drainage area. Preliminary hydrologic-hydraulic analysis indicates this facility will provide water quality control and quantity control for the smaller storms. COG gave this facility a high priority rating. Although this facility would provide a high level of water quality control and moderate stream channel protection, City staff recommends not pursuing this facility because of the loss of the frequently used ball field and the estimated cost of \$145,100 per ac-ft of storage. City staff believes a replacement ball field cannot be located within the same neighborhood, thus Potomac Woods #2 is not recommended for further investigation.

12. Potomac Woods #3 (Potomac Woods West)

COG's proposal suggests constructing a wet extended detention pond downstream of Derbyshire Road to provide water quality and quantity control for the 27.5-acre drainage area. Preliminary hydrologic-hydraulic analysis indicates this facility can provide water quality and quantity control for the smaller storms, and minimal control for the 10-year storm. While COG anticipates this facility will provide a high level of water quality and stream channel erosion control benefit, due to the loss of trees it received a moderate priority rating. City staff also gave this facility a moderate rating. The loss of trees will be incorporated in the design and mitigated as necessary. The estimated cost is \$47,800 per ac-ft of storage. City staff recommends pursuing this facility in FY 1999.

13. Locks Pond Court

COG recommends this existing dry pond be retrofitted to an extended detention shallow marsh. The estimated cost is \$31,000 per ac-ft of storage. Because of structural problems associated with the existing riser, design and reconstruction of the facility has already begun. The redesigned facility will provide water quality control for the 1" rainfall event and partial 2-year quantity control. The facility will be constructed beginning in July 1995. City staff concurs with COG's high priority rating.

14. North Farm

COG recommends converting this existing dry pond into a shallow extended detention marsh. This will be accomplished by excavating approximately three feet below the existing pond bottom. The estimated cost is \$39,500 per ac-ft of storage. Preliminary hydrologic-hydraulic analysis indicates this facility will be able to provide control for the smaller storms, however the discharge from the 10-year storm will increase. City staff concurs with COG's moderate priority rating and agrees that the modifications to this dry pond will enhance the water quality and provide stream channel erosion control benefits where it was previously lacking. City staff recommends pursuing this facility in FY 1999.

15. Woodmont Country Club

COG recommends enlarging this existing golf course pond by six times its original size. This retrofit facility will provide water quality and quantity control for the 2-year storm. The estimated cost is \$59,500 per ac-ft of storage. Preliminary hydrologic-hydraulic analysis shows that the water quality and control of the smaller storms may be accomplished. City staff concurs with COG's low priority rating based on its cost and downstream presence of 1,000 feet of piped stream. This facility should be pursued only in conjunction with the redevelopment of Woodmont Country Club.

16. Montrose Park

This proposed dry pond located at the end of Rollins Avenue, originally identified by the City in 1978, also is recommended by COG with some modifications. COG recommends a dry extended detention pond with a micropool to minimize clogging. This facility has an estimated cost of \$9,200 per ac-ft of storage. This facility will reduce existing channel erosion/sediment bedload problems and enhance water quality. An alternative analysis based on an updated topographic survey of the stream in this area will be conducted in FY 97.

VI. Impacts and Recommendations to City's SWM Laws and Regulations

A. CURRENT LAWS AND REGULATIONS

There are many State, County and City laws and regulations that affect the watershed and the goals proposed in this comprehensive watershed management plan. The City's Zoning Ordinance, Storm Water Management Laws and Regulations, Forest and Tree Preservation Ordinance, Master Plan, Floodplain Ordinance, and Federal and State Wetlands Regulations are a few of the laws and regulations that affect development. The type of development has a direct and lasting effect on the watershed.

COMPARISON OF CITY AND STATE SWM LAWS

Appendix B contains a comparison of City laws, current State laws and proposed State laws for SWM. The following list highlights the differences between the current City and State laws:

- The City requires SWM when 2,500 square feet of impervious area is created. The State requires SWM for development that disturbs 5,000 square feet or more.
- The City provides control of the 10-year post-developed storm to the 2-year pre-developed rate. The State requires that the 2-year post-developed storm be controlled to the 2-year existing developed storm and the 10-year post-developed storm be controlled to the 10-year existing developed storm. Here, the City requires a larger reduction in the

amount of runoff from a site than does the State. The City requirements also include larger storage structure (pond, underground pipes) than is required by State standards.

- The City assumes that the site being developed is in pre-development condition (meadow) prior to development. The State allows the use of existing site conditions for comparison to the proposed conditions. The difference in the City's and State's approaches is that the City's goal is to provide management for the increased runoff that resulted from development that existed prior to the adoption of our SWM law, while the State considers only increased runoff resulting from development after the State law was first adopted (1984). By not requiring a site to be managed to pre-developed conditions (meadow), the State allows the effects of development on a watershed to remain at its status quo. Because the City's portion of Cabin John was 80 percent developed before the advent of SWM, there would be little improvement to our streams without the provision to manage to meadow conditions.
- Another aspect of the City's pre-development control requirements is the stipulation that if development disturbs more than 50 percent of the site or doubles the existing imperviousness, then SWM must be provided for the entire site. The State does not require SWM to be provided for existing imperviousness even if it is to be removed and replaced. Additionally, the State requires SWM only for portions of the site that actually are disturbed.
- In the past the City used the term "waiver" to represent a fee-in-lieu when it was not possible or practical to provide SWM on-site. The State, on a case-by-case review,

allows provisions for counties and municipalities to approve exemptions where no fee is required.

CITY'S ZONING ORDINANCE

The City's Zoning Ordinance guides physical development in the city with regard to the height, number of stories, and size of buildings and other structures; the percentage of lots that may be occupied; off-street parking; size of yards; the density of population; and the location and use of buildings, signs, and other structures. The Ordinance implements the recommendations of the Master Plan by defining regulations for orderly development and the most appropriate use of land throughout the city.

CITY'S FOREST AND TREE PRESERVATION ORDINANCE

The Maryland Forest Conservation Act became effective on July 1, 1991. Regulations for implementation of the law were finalized by the Department of Natural Resources in January 1992. In accordance with the Maryland Forest Conservation Act, the City of Rockville enacted its own Forest and Tree Preservation Ordinance to meet the requirements of the State law. The City's law became effective January 1, 1993.

The City recognizes the importance of trees including their ability to reduce energy costs by providing windbreaks and shade, clean the air, reduce storm water runoff, protect the soil and watershed, and provide shelter for wildlife. The loss of forest cover is believed to be a major

reason for the decline of water quality in the Chesapeake Bay. Protecting trees is critical to the environmental stability of the city.

The creation and implementation of this Ordinance has a direct effect on the city's watersheds. The City's Ordinance is more stringent than the State's requirements and tries to protect smaller forested areas and save significant trees that would otherwise have been lost under the State regulations.

As part of the requirements for this Ordinance the developer is first required to prepare a forest stand delineation (FSD) plan that identifies "all intermittent and perennial streams and steep slopes over twenty-five percent, all soils with structural limitations, hydric soils,... or slopes of fifteen percent or more, and forested nontidal wetlands." Once this has been established a forest conservation plan is required that "shall give priority to and provide for, the protection and maintenance of any existing forest and significant trees within the FSD area which may be adversely affected by the proposed development activity for the tract." A forest conservation threshold was established for all land use categories. The threshold percentage is used to determine the reforestation ratio. For example, either a quarter of an acre of planting is required for each acre removed or two acres of planting are required for each acre removed. Afforestation (planting trees) is required on sites which do not meet the minimum thresholds for forest cover.

In addition, the Ordinance requires "(b) Afforestation and reforestation are to be primarily employed to:

- (1) Establish or enhance stream buffer areas;
- (2) Establish or enhance forested areas on 100-year floodplains;....
- (5) Stabilize certain slopes;..."

The restrictions and requirements imposed by the City's Forest and Tree Preservation Ordinance help protect the city's watershed by protecting the streams from depositing sediment from steep slopes and protecting and enhancing forested areas located directly adjacent to the streams that stop stream bank erosion and provide water quality runoff.

The Ordinance further enforces its goals by requiring afforestation and reforestation where tree removal cannot be avoided. The Ordinance states: "The primary objective is to accomplish reforestation and afforestation on-site." Where this cannot be done it is recommended that afforestation and reforestation be done within the same watershed. This statement recognizes the importance of trees in the watershed.

The Cabin John Watershed Study's recommendations include having areas where reforestation will enhance the watershed through protecting streams and improving wildlife habitat. The eight sites which were recommended for riparian and reforestation sites are listed in Appendix B.

CITY'S FLOODPLAIN MANAGEMENT ORDINANCE

The City of Rockville adopted the Floodplain Management Ordinance in 1977 to regulate development within the floodplain. The Ordinance was enacted to protect development from floods and to satisfy the requirements of the National Flood Insurance Program so that property owners within the city would qualify for flood insurance. The City also recognized that, "Floodplains perform vital natural functions such as temporary storage of floodwaters, moderation of peak flood flows, maintenance of water quality, groundwater recharge, erosion prevention and the provision of wildlife habitat... These functions are best served if floodplains are kept in their natural state...."

In summary, floodplains protect the city's watersheds by providing both water quantity and quality control. The City's Floodplain Management Ordinance imposes greater restrictions than the State requirements. To ensure safety and protect the floodplains, the City does not allow new development within the floodplain unless a variance is granted for reasons determined in the Ordinance.

By limiting development within the floodplain the City protects and preserves the natural vegetation that shades the streams, and provides water quality. In addition, flood plains control peak flows by allowing the stormwater to be temporarily detained within the flood plain area.

FEDERAL AND STATE WETLAND REGULATIONS

In the state of Maryland the protection of nontidal wetlands is regulated by both Federal and State agencies. Through a joint application to the U.S. Army Corps of Engineers, the Maryland Department of the Environment, and the Maryland Department of Natural Resources, development is regulated within the wetlands and its 25' buffer. The impacts are evaluated under the federal/state avoidance guidelines listed below:

- 1) Avoiding the wetland impact altogether by not taking a certain action or parts of an action.
- 2) Minimizing impacts by limiting the degree of magnitude of the action and its implementation.
- 3) Rectifying the impacts by repairing, rehabilitating or restoring the affected environment.
- 4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
- 5) Compensating for the impact by replacing or providing substitute resources or environments.

In reviewing the impacts to the wetlands and their buffers, the Federal and State agencies attempt to maintain the wetlands in their natural conditions unless the proposed disturbance is for a project determined to be necessary and unavoidable for the public good. Examples of these are road crossings, sewer lines, and storm drain outfalls for which no alternative exists; stream restoration projects; and maintenance projects involving existing utilities.

The City requires that all necessary permits from State and Federal agencies have been issued before allowing development in the wetlands; however, the City has no jurisdiction over the review and enforcement of any wetlands regulations.

B. PROPOSED CHANGES TO CITY SWM LAWS AND REGULATIONS

The State of Maryland is in the process of changing its SWM laws and regulations. The State has changed the emphasis for the goals of SWM from one of solely controlling runoff to prevent flooding to include providing water quality to protect and enhance our streams and natural resources. This evolving philosophy places more of an emphasis on treating the smaller, more frequent storms where the first flush of pollutants is most prevalent and where the most erosion occurs along the streambanks. The State is therefore considering that 24-hour extended detention be provided for the 1-year storm. In addition, the State is considering that the 10-year storm be controlled to the existing conditions.

As a result of this watershed study and the anticipated proposed changes to the State law, the following changes to City laws and regulations will be investigated:

- A. Adopt stricter water quality control measures (1-year, 24-hour extended detention) for larger developments. Apply this standard to our Regional Facilities, where practicable.

B. Maintain current practice of using Best Management Practices (BMPs) for smaller developments, or if not feasible, then encourage participation in our regional SWM program.

C. Adopt 10-year post-development to 10-year pre-development control for all development. Apply this standard to our Regional Facilities, where practicable.

D. Adopt stricter measures for ensuring safety associated with wet ponds. This may result in requiring fencing at all permanent wet ponds. An alternative may be to use gentle side slopes in combination with a level 10-foot wide bench around the pool's perimeter.

E. Maintain policy which requires SWM for redevelopment sites.

VII. Monitoring Goals

To evaluate the effectiveness of our program and to assist in future program goals, a monitoring program will be implemented. Various approaches will be investigated to determine those most appropriate for Rockville's urban streams. These may include: chemical, toxicity testing, biological surveys, RSAT, or modified RSAT. Whenever practicable Rockville will participate with Montgomery County's monitoring program to promote overall watershed improvements and coordination.

The initial stream assessment was made using RSAT. This base-line assessment provided a one-time overall look at the Cabin John streams in the City of Rockville. RSAT (or a modified RSAT rating based only on urban streams) may be used to assess the streams every three years in the future.

COST-BENEFIT

Most of the benefits of a SWM program are not easily quantified. The benefits that can be attributed to the improvements recommended in this watershed study include:

- less stream bank erosion, resulting in less sediment being deposited in the Potomac River and the Chesapeake Bay;
- improved water quality resulting in less chemical treatment of our drinking water;
- additional wetlands created for better wildlife habitat and improved flood control;

- expanded forests that both improve wildlife habitat and water quality;
- removing fish barriers to allow an increase in the diversity of fish; and
- increasing public awareness which can result in fewer pollutants dumped in the streams.

All of these benefits can result from implementing the recommendations of this watershed study. However, attributing an actual cost to the amount of sediment that will no longer be required to be dredged from the Chesapeake Bay; or the reduced amount of chemicals that will be needed to treat our drinking water because of the reforested areas, new wetlands, etc., is an unattainable figure. Despite this, it is recommended that monitoring these watersheds continue now that the baseline information has been obtained. The improvements to the watershed will not be seen all at once, but as recommendations are implemented the quality of the stream should improve and be observed through the monitoring process.

GOALS

The following goals for long-term monitoring should be pursued:

- Determine the effectiveness of our SWM program.
- Protect, maintain, and restore water quality in the city's watersheds.

How to obtain these goals:

- Keep abreast of current technology and trends to determine the best type of SWM for our watersheds.

- Monitor recent Montgomery County legislation that requires developers to monitor BMPs in critical areas of the county. This should yield information to assess the effectiveness of SWM practices.
- Modify the RSAT rating scale to more closely reflect and compare the types of streams that are attainable in an urban environment. For example, when studying the Watts Branch and Rock Creek watersheds, a rating system will be designed that sets a realistic goal for the watershed through recommendations made in the studies. The methodology may be similar to RSAT but the results will relate more specifically to Rockville's urban watersheds.
- Investigate the benefits of biological monitoring in urban streams. The City will continue to work closely with Montgomery County. If this additional monitoring can help in attaining our goals, the City could pursue this through the County's monitoring program or institute a similar one of our own.
- Require RSAT or a similar type of monitoring every three years to determine the status of our streams and to evaluate specifically the impacts in the areas where the recommendations have been implemented.

GLOSSARY OF TERMS

AFFORESTATION - The establishment of a tree cover on an area from which it has always or very long been absent , or the planting of open areas which are not presently in forest cover.

BEST MANAGEMENT PRACTICES (BMP) - Structural devices that temporarily store or treat urban stormwater runoff to reduce flooding, remove pollutants, and provide other amenities.

EXTENDED DETENTION - A storm water design feature that provides for the gradual release of a volume of water (0.25 - 1.0 inches per impervious acre) over a 12- to 48-hour interval to increase settling of urban pollutants, and protect channel from frequent flooding.

FIRST FLUSH - The delivery of a disproportionately large load of pollutants during the early part of storms due to the rapid runoff of accumulated pollutants.

FISH BARRIERS - An impediment in a stream, such as a sudden vertical drop, or a structure such as a culvert, which inhibits the ability of fish to swim.

HEC-2 - U. S. Army Corps of Engineers Water Surface profiles computer program used to determine the water surface elevation in natural or man-made channels.

HYDRAULIC ANALYSIS - Determining through the use of computer models the behavior of water including the planning and construction of facilities for prevention of excessive damage by water.

HYDROLOGIC- Determining the occurrence and distribution of the waters of the earth.

MACRO-INVERTEBRATE - Organisms living in or on bottom substrates that provide an indication of the water quality of the stream.

MICROPOOL - A smaller permanent pool used in a storm water pond due to extenuating circumstances, i.e. concern over the thermal impacts of larger ponds, impacts on existing wetlands, or lack of topographic relief.

RIPARIAN REFORESTATION - The replanting of the banks and floodplain of a stream with native forest and shrub species to stabilize soils, improve both surface and ground water quality, increase stream shading, and enhance wildlife habitat.

STORMWATER MANAGEMENT RETROFIT - Modify an existing stormwater management structure to change the focus of the flow control. Typically, the focus is shifted to managing the smaller, more frequent storms.

GLOSSARY OF TERMS

TEN-YEAR FREQUENCY STORM - A rainfall event which occurs, on average, approximately every 10 years. In Rockville, a ten-year storm event is associated with 5.1 inches of rainfall over a 24-hour period.

TR-20 - Technical Release 20 developed by the Soil Conservation Service, entitled Project Formulation - Hydrology. A computer program which provides for hydrologic analyses of a watershed under present conditions and various combinations of land use/cover and structural or channel modifications using single event storm rainfall-frequency data.

TR-55 - Technical Release 55 developed by the Soil Conservation Service entitled, Urban Hydrology for Small Watersheds. It is a simplified procedure to calculate storm runoff volume, peak rate of discharge, hydrographs, and storage volumes required for detention structures.

TWO -YEAR FREQUENCY STORM - A rainfall event which occurs, on average, approximately every two years. In Rockville, a two-year storm event is 3.2 inches of rainfall over a 24-hour period.

WEIR - A structure that extends across the width of a channel and is intended to impound, delay or in some way alter the flow of water through the channel.

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Appendix A
Cabin John Watershed Management Plan Recommendations
May 1995

SWM Project Recommendations					
Facility Number	Name of Facility	Cost to City per Ac-Ft of Storage	Rockville Priority Ranking	Total Cost - Design and Construction	FY to be designed
1-A	Fleet Street	\$172,300	Low	\$400,000	FY 2003
1-B	Mount Vernon Place	\$23,300	High	\$90,000	FY 1996
2	Elwood Smith *	\$96,800	Moderate*	\$785,000	FY 1998
3	Rockville Heights	\$8,100	Not Recommended	----	----
4	Hungerford Swim Center	\$37,800	High	\$783,000	FY 1996
5	New Mark Commons	\$14,000	Not Recommended	----	----
6	Dogwood Park	\$108,000	Not Recommended	----	----
7	Seven Locks/Detention Center	\$128,000	Alternative Recommended	----	----
7A	Villages at Tower Oaks	N/A	High	----	By devel. (1995)
8	Dawson Farm	\$26,700	Low	\$230,000	FY 2000
9	Wootton Parkway	\$108,800	Moderate	\$100,000	FY 1997
10	Potomac Woods #1(East)	\$51,600	High	\$190,000	FY 1996
11	Potomac Woods #2	\$145,100	Not Recommended	----	----
12	Potomac Woods #3 (West)	\$47,800	Moderate	\$97,000	FY 1999
13	Locks Pond Court	\$31,000	High	\$78,000	FY 1995
14	North Farm	\$39,500	Moderate	\$78,000	FY 1999
15	Woodmont Country Club	\$59,500	Low	\$550,000	FY 2003
16	Montrose Park-Alternatives	Unknown	High	\$75,000	FY 1997

* Contingencies per City staff recommendations

Appendix A
Cabin John Watershed Study Recommendations
May 1995

Stream Restoration Areas				
Facility Number	Name of Facility	Linear Feet of Channel	Construction Cost	FY to be designed
1	Upper/Middle Cabin John Creek Maintstem Leverton Rd to Wootton Parkway	1130	\$100,000	FY 1998
2	Elwood Smith Tributary E. Lynfield Dr. & Elwood Smith Branch	250	\$40,000	FY 1995
3	Bogley Branch Baseball field to Seven Locks Road	1030	\$90,000	FY 1996
4	Dogwood Park Tributary	400	\$120,000	FY 1998

Removal of Fish Barriers				
Location Number	Location	Upstream Length for Fish Habitat	Construction Cost	FY to be designed
1	Upper/Middle Cabin John Creek - Wootton Parkway Culvert	> 2000'	\$7,500	FY 1998
2	Dawson Farm Creek - Wootton Parkway Culvert	1300'	\$7,500	FY 1998
3	Seven Locks Tributary - Tower Oaks Culvert	1000'	\$7,500	FY 1998
4	Seven Locks Tributary - Above Monroe Street Tower Oaks Development	300'	-	Stream Restoration Work Approved by MDE
5	Bogley Branch - Maintenance Road access via hiker/biker trail; below Potomac Woods Park baseball field	700'	-	FY 1995
6	Elwood Smith Tributary - Cabin John Parkway Culvert	>1800'	\$7,500	FY 1998

Appendix A
Cabin John Watershed Study Recommendations
May 1995

Creation of Non-SWM Wetland Sites				
Location Number	Location	Wet Pool Area (Acres)	Construction Cost	FY to be designed
1	Cabin John Creek - Dogwood Park #1	0.1	\$15,000	FY 2000
2	Cabin John Creek - Dogwood Park #2	0.05	\$ 4,500	FY 2000
3	Cabin John Creek - Dogwood Park #3	0.16	\$ 5, 300	FY 2000
4	Seven Locks Tributary - Tower Oaks #1	0.82	-	Completed by developer
5	Seven Locks Tributary - Tower Oaks #2	0.12	\$3,900	Private Ownership

Riparian Reforestation Sites				
Location Number	Location	Reforestation Acreage	Stream Length (Ft)	Land Ownership
1	Upper/Middle Cabin John Creek Mainstem - Edmonston to Leverton	0.86	1,500	Public
2	Upper/Middle Cabin John Creek Mainstem - Dogwood Park	0.91	200	Public
3	Upper Cabin John Creek - Elwood Smith Park	0.29	500	Public
4	Elwood Park Tributary & Cabin John Creek - Confluence Area	0.17	200	Public
5	Upper Dawson Farm Creek - Jefferson St. Area	0.10	200	Public
6	Dawson Farm Creek - Wootton Parkway Area	0.36	800	Private
7	Middle Cabin John Creek - Wootton Parkway Area	0.50	200	Private
8	Seven Locks Tributary - Wootton Parkway Area	0.28	400	Private

Appendix B
Comparison of City, State and Draft State regulations
August, 1994

	CITY	CURRENT STATE LAWS	PROPOSED STATE LAWS
When is SWM required	Residential zones: land disturbing activity greater than 5000 sq ft or creation of 2500 sq ft impervious area Non-residential zones: all land disturbing activity resulting in 2500 sq ft or more of impervious area since November 1, 1978	Developments that disturb over 5,000 square feet of land area.	Developments that disturb over 5,000 square feet of land area.
Enforcement Authority	Department of Public Works Chapter 19, Laws of Rockville Stormwater Management and Sediment Control Regulations	Department of the Environment Environment Article 4-201 - 4-215, Annotated Code of Maryland Dept. of the Environment, Title 26, Subtitle 09 Chapter 02	Department of the Environment Environment Article 4-201 - 4-215, Annotated Code of Maryland Dept. of the Environment, Title 26, Subtitle 09 Chapter 02
Requirements and Methods:			
Quantity Control	Manage the increase in peak discharge from 10 year post-developed to the 2-year pre-developed discharge (10/2) Priority of Methods: Infiltration Flow attenuation Retention (wet ponds) Detention (dry ponds)	In the City of Rockville and Montgomery County the State requires that the post-developed peak discharge for a 2- and 10- year frequency storm event to or less than the respective 2- and 10- year pre-developed peak discharge rates. Alternate minimum control requirements may be adopted subject to Administration approval. Priority of Methods: Infiltration Flow attenuation Retention (wet ponds) Detention (dry ponds)	Post-development 10-year storm to predeveloped conditions. 24 hour extended detention for the post-development 1-year storm event

Appendix B
Comparison of City, State and Draft State regulations
August, 1994

	CITY	CURRENT STATE LAWS	PROPOSED STATE LAWS
Quality Control	<p>Requirements and Methods By Priority</p> <p>Infiltration - one inch rainfall event</p> <p>Retention - Permanent pool must be at least 1/2 inch runoff from the drainage area</p> <p>Detention - 24 hour detention and release of total volume for one year event for central facilities</p> <p>Detention - 24 hour detention and release of total volume for one inch rainfall event for on-site facilities</p> <p>Other Water Quality Measures Acceptable to the Dept.</p>	<p>Infiltration</p> <p>Retention and Detention shall provide for a permanent pool of water or provide for a 24-hour detention and releasing the volume of runoff from a 1-year frequency storm.</p>	<p>Infiltration of the first one-half inch of runoff volume of impervious area.</p> <p>Shallow marsh with the first 0.4 inch runoff of volume.</p> <p>Retention practices per the following: Volume in inches Impervious area in acres 0.5 < 50 0.59 50-60 0.68 60-70 0.86 70 +</p> <p>Alternate minimum control requirements may be adopted subject to MDE approval.</p>
Predevelopment Definition	Assumes the land is a meadow in good hydrologic condition	All lands in the site to be developed shall be assumed to be in good hydrologic condition through methods approved by the Administration	All lands in the site to be developed shall be assumed to be in good hydrologic condition through methods approved by the Administration
Retrofitting	SWM for the entire site is required when land disturbing activity is more than 50% the of site SWM for entire site is required when impervious area more than doubles	Not required	Not required
Legal Requirements for On-Site Facilities	Require a written and recorded inspection and maintenance agreement	Requires an operation and maintenance plan	Requires an operation and maintenance plan
SWM Requirements for Roadways	Require SWM be provided for one-half contiguous rights-of-way up to 30 feet maximum		

Appendix B
Comparison of City, State and Draft State regulations
August, 1994

	CITY	CURRENT STATE LAWS	PROPOSED STATE LAWS
<p>SWM Waiver Categories</p> <p>City's Waiver is actually a fee-in-lieu</p> <p>State's waiver requires no SWM</p>	<p>1) The hydraulic characteristics of the receiving stream are such that on-site management is contrary to obtaining the objective of erosion prevention and water quality</p> <p>2) The proposed development will not generate more than a 10% increase in the 2 year predevelopment peak discharge rate</p> <p>3) The site is surrounded by existing developed areas which are served by an existing network of improved storm drain systems of adequate capacity to accommodate the runoff from the additional development</p> <p>4) There exists an adequate SWM alternative acceptable to the Mayor and Council</p> <p>a) construction and conveyance of a SWM facility to the City together with as-built drawings</p> <p>b) dedication and conveyance of land or granting of an easement to the City to be used for a public SWM facility.</p> <p>c) monetary contribution to City for use in connection with a public SWM facility.</p> <p>d) arrangement whereby the subject property is served by a private off-site SWM facility.</p>	<p>Based on a case by case review provided that the provisions for waivers contained in county municipal ordinances are approved by the Administration</p> <p>The Administration will approve provisions for waivers if they ensure that a development will not adversely impact stream quality due to channel erosion, pollution, siltation and sedimentation and local flooding.</p>	<p>Water Quantity:</p> <ol style="list-style-type: none"> The proposed development will not generate an increase in the 1-year pre-development discharge rate; The proposed development is completely surrounded by existing developed areas which are served by a network of enclosed public storm drainage systems capable of discharging the additional runoff from the proposed development at non-erosive velocities; or Direct discharges to tidewater are provided. <p>Water Quality:</p> <p>In no case will the minimum control requirements for stormwater quality specified in Regulation .06C of this chapter be waived.</p>
<p>SWM Fee-In-Lieu Contribution</p>	<p>Quality: \$6,000/imp. acre Quantity: \$40,000/imp. acre</p>		

Appendix B
 Comparison of City, State and Draft State regulations
 August, 1994

	CITY	CURRENT STATE LAWS	PROPOSED STATE LAWS
Exemptions	<ol style="list-style-type: none"> 1. Clearing or grading activities that are subject exclusively to State approval and enforcement under State law or regulations. 2. Agricultural land management activities. 3. Land development activities which the MDE determines will be regulated under specific State laws which provide for managing stormwater runoff. 	<ol style="list-style-type: none"> 1. Agricultural land management activities 2. Additions or modifications to existing single family detached residential structures 3. Land development activities which WRA determines will be regulated under specific State laws. 4. Residential development consisting of single family structures each on a lot of 2 acres or greater. 5. Development that does not disturb over 5000 sq ft of land area are exempt from providing on-site. 	<ol style="list-style-type: none"> 1. Agricultural land management activities 2. Additions or modifications to existing single family detached residential structures 3. Land development activities which WRA determines will be regulated under specific State laws. 4. Development that does not disturb over 5000 sq ft of land area are exempt from providing on-site