Appendix

Environmentally Sensitive Areas

The sensitive areas mapped for purposes of this report were prepared with some limitations on both the information available and the level of effort associated with preparing the computerized Geographic Information System (GIS) coverages. The sensitive areas mapped in Figures 12-17 and reported in Tables 3 and 4 consist of the combination of several types of areas, many of which overlap (see Table A-1). Sensitive areas are defined by the State Planning Act of 1992, which includes areas considered sensitive by the local government. For purposes of this report, wetlands and wetland buffers are added to the list defined by the legislation of 100-year floodplains, streams and their buffers, steep slopes, and habitats of rare, threatened, or endangered species. Since a comprehensive understanding of the locations of habitats of rare, threatened or endangered species is not mapped, this information was not included in the tables or maps.

The range of acreage and percentages used for stream buffers represent the highs and lows for buffer width applied consistently along the entire stream length. Slopes were not used directly to determine the buffer width as they would be when looking at individual sites. Steep slope acreages and percentages are based on a computerized analysis of the topography to determine areas with slopes greater than 25 percent. Floodplains were mapped in two different ways: a) existing M-NCPPC maps of floodplains, based on ultimate development for most mainstems and some tributary streams were used for the Subregion floodplain map where the M-NCPPC maps were available; and b) where stream areas were not covered by the existing M-NCPPC floodplain maps, such as in headwater areas and along smaller tributaries, maps of floodplain soils were used. The soils maps are less accurate than the M-NCPPC floodplain maps, but they provide floodplain information in areas not covered by the M-NCPPC maps. Wetlands coverage includes a combination information from DNR wetlands guidance maps, National Wetlands Inventory maps and hydric soils from the 1995 *Soil Survey of Montgomery County*.

All these coverages were overlaid to obtain a single map (used in Figures 12-17) of sensitive areas that includes the outside boundaries of all the areas covered by a 150-foot stream buffer and the steep slopes, floodplains, wetlands, and wetland buffers as established in the *Environmental Guidelines*. This coverage is approximate and only to be used for master planning purposes. Detailed planning for specific areas or for site planning requires more refined mapping and field investigation.

Wetlands Functional Assessment Methodology

For the Potomac Subregion Wetland Functional Assessment Study, M-NCPPC staff and EA Engineering, Science & Technology collected information in the field about the location, quality and function of wetlands in six watersheds. The protection of wetlands is an important goal for Montgomery County, as stated in the General Plan Refinement (1993). By identifying and assessing wetlands early in the master planning process these sensitive areas may be considered when designating land uses.

A wetlands functional assessment protocol was developed by M-NCPPC and approved by the Maryland Department of the Environment to allow analysis of wetlands functions based on information obtained from field observations. This modified method incorporates field-based wetlands functional indicators from *A Method for the Assessment of Wetland Function* (1995), prepared by Fugro East, Inc. for the MDE and indicators drawn from the Biohabitats *Wetland Functional Assessment Protocol,* (1996). The functional assessment method is a tool to evaluate and compare groups of wetlands.

For the purpose of the study, wetlands were grouped into assessment groups. The groups are designated by stream and numbered from the headwaters downstream (e.g., WB1, Watts Branch; PB3, Piney Branch). Each group contains wetlands which have a high degree of hydrologic interaction. Typical boundaries for each group include: road crossings with extensive embankments and culverts, significant inflows from tributary streams or other factors which influence hydrologic interaction (e.g., dams and reservoirs.)

The assessment method uses indicators to evaluate wetlands function. These indicators include: presence of seeps, springs or standing water, wetland size, topographic position of wetland, diversity of vegetation types, physical evidence of overbank flows, etc. In the absence of long-term research to quantify wetlands functions within the study area, the indicators allow the assessor to evaluate the functional capacity of wetlands.

Sensitive Resources

Table A-1

	Water-shed	Parkland[1]		Wetlands[2]				Steep Slopes[3]				Floodplain[4]				Floodplain Soils[5]				100-ft Stream Buffer[6]				150-ft Stream Buffer[6]			
				In Watershed		In Parkland		In Watershed		In Parkland		In Watershed		In Parkland		In Watershed		In Parkland		In Watershed		In Parkland		In Watershed		In Parkland	
	Acres	Acres	%[7]	Acres	%[7]	Acres	%[8]	Acres	%[7]	Acres	%[8]	Acres	%[7]	Acres	%[8]	Acres	%[7]	Acres	%[8]	Acres	%[7]	Acres	%[8]	Acres	%[7]	Acres	%[8]
Potomac Subregion																											
Potomac River[9]	3,394	346	10	3,145	93	346	11	58	2	11	19	3,394	100	346	10	813	24	319	39	309	9	176	57	492	14	182	37
Lower Seneca	5,776	1,493	26	843	15	457	54	358	6	150	42	507	9	404	80	592	10	381	64	915	16	400	44	1,338	23	586	44
Rock Run	3,210	273	9	424	13	128	30	125	4	55	44	166	5	78	47	173	5	81	47	440	14	120	27	607	19	149	24
Direct Tributaries	5,283	1,972	37	1,071	20	835	78	776	15	382	49	657	12	572	87	371	7	350	94	975	18	576	59	1,392	26	783	56
Cabin John Creek	7,654	1,030	13	761	10	297	39	471	6	182	39	373	5	254	68	352	5	245	70	1,076	14	383	36	1,553	20	517	33
Muddy Branch	7,732	1,297	17	719	9	401	56	506	7	214	42	359	5	337	94	439	6	355	81	1,140	15	444	39	1,638	21	602	37
Watts Branch	10,332	680	7	1,075	10	303	28	532	5	85	16	658	6	309	47	474	5	246	52	1,649	16	325	20	2,364	23	422	18
Headwaters																											
Cabin John Creek	4,138	199	5	248	6	40	16	NA	NA	NA	NA	104	3	58	56	125	3	45	36	NA	NA	NA	NA	NA	NA	NA	NA
Muddy Branch	4,899	167	3	654	13	59	9	NA	NA	NA	NA	126	3	49	39	205	4	42	21	NA	NA	NA	NA	NA	NA	NA	NA
Watts Branch	3,961	271	7	402	10	120	30	NA	NA	NA	NA	156	4	100	64	147	4	84	57	NA	NA	NA	NA	NA	NA	NA	NA

(1) GIS coverage of existing Parkland, M-NCPPC 1997.

(2) GIS coverage of Wetlands, EA 1997. Includes data from NWI wetlands maps, DNR wetlands guidance maps, M-NCPPC planimetric GIS coverage of streams, riparian areas within 15 feet of a stream, and hydric soils from 1995 *Soil Survey of Montgomery County*.

(3) GIS coverage of Slopes interpreted from 1993-1995 aerial topography, M-NCPPC 1997. Steep slopes defined as slopes greater than 25% per 1997 M-NCPPC *Environmental Guidelines*.

(4) GIS coverage of M-NCPPC 100-year floodplain maps (ultimate land use), EA 1997. Coverage for Muddy Branch and Seneca Creek limited to main stem. Potomac River based on FEMA data. River floodplain extends beyond CSPS subshed and is accounted for under in the appropriate watersheds.

(5) GIS coverage of floodplain soils from 1995 *Soil Survey of Montgomery County*, EA 1997.

(6) Stream buffer size ranges from a minimum of 100 feet to a maximum of 150 feet for Use I streams, depending on adjacent slopes, as set forth in 1997 M-NCPPC *Environmental Guidelines*.

(7) Percent of watershed area.

(8) Percent of sensitive resource.

(9) Area defined by CSPS subwatershed, includes the Potomac River and islands in the river. See Figure 9 for subwatershed boundaries.

- Groundwater Discharge was a function driven by wetland size, since most of the wetland assessment groups exhibited wetland hydrology and were associated with streams.

- Floodflow Attenuation functional value was determined in large measure by the presence or absence of overbank flooding. Most of the wetland assessment groups in the developed watersheds exhibited a high frequency of overbanking (presumably due to stormwater flows), while less developed areas exhibited less evidence of frequent overbanking.

- Nutrient Removal/Sediment Retention scores were not largely determined by a single indicator, instead these scores were based upon the predominance of steep slopes, the wetland water regime, and the shape of the wetland outlet.

- The Aquatic Habitat function was determined by wetland size, land use, and the degree of fragmentation of the wetland assessment group. Large wetlands with little fragmentation scored higher than small wetlands adjacent to residential areas. However, these small wetlands are often important vernal pool reproductive sites for locally rare species.

- Wildlife Habitat scores were higher for large wetlands with a broad and uninterrupted character. Smaller wetlands adjacent to developed lands scored lower.

The wetland assessment group scores for the wetlands of the Potomac Subregion ranged widely. The ranges for each wetland function are presented in Table A-2.

Fish Species of the Potomac Subregion

The *Countywide Stream Protection Strategy* (MCDEP, 1997) lists fish collected in each watershed in Montgomery that were identified during the monitoring program (see Table A-3). While this information is based on a limited number of samples, it indicates the diversity of species for each watershed. The information will be updated through the *CSPS* as additional data is collected. Consult the most current copy of the *CSPS* for updated information.

Countywide Stream Protection Strategy Management Categories

The CSPS developed five categories that were based first on the existing stream quality and imperviousness combined with predominant land use. The Special Protection Area and Regular Protection Area were included as management approaches (along with a remedial protection approach) under a more general Watershed Protection category. Two management categories were added to deal with the special conditions in agricultural and urban areas. The categories in the CSPS include:

Watershed Preservation Areas

- Stream condition is EXCELLENT.

- Projected land use is not expected to put significant stress on resource and projected imperviousness is generally less than 10 percent of the subwatershed area.

- Areas are generally protected by very low density zoning or parkland.

Watershed Protection Areas

- Stream condition is EXCELLENT or GOOD

- Existing and/or planned land use results in development patterns with imperviousness above 10 percent and protection of the resources from development impacts is necessary.

- Different management levels are applied based on the level and type of protection deemed necessary to protect the resource:

  Special level — Due to the sensitivity of the resource and the magnitude of change between existing and planned development, some level of enhanced watershed management is necessary beyond typical environmental guidelines and sediment control and stormwater permitting requirements.

  Regular level — Standard existing protection measures are expected to adequately protect the resource from existing and/or projected land use. Development activity is not expected to significantly increase impervious area over what already exists and accompanying Development Review requirements and stormwater controls would provide adequate mitigation.

  Remedial level — Stream condition is good or excellent but problems are observed, usually in the habitat condition, that are attributable to previous land use impacts. Habitat conditions may be on the verge of or in the process of deteriorating, but stream biological integrity has not yet deteriorated to fair or poor conditions requiring more comprehensive restoration efforts. The remedial level may be used in conjunction with a special level of protection, where existing habitat problems exist and projected land uses

Wetland Assessment Group Functional Scores

Table A-2

WAG Number*	Groundwater Discharge (3.33 Max.)	Floodflow Attenuation (3.00 Max.)	Nutrient Removal/ Sediment Retention (3.40 Max.)	Aquatic Habitat (3.30 Max)	Wildlife Habitat (3.20 Max.)
Muddy Branch					
MB 1	3.33	2.25	2.60	2.00	2.80
MB 2	2.33	2.00	2.60	1.50	1.40
MB 3	3.33	2.25	2.60	2.00	3.20
MB 5	3.33	2.25	2.40	2.00	2.40
MB 6	3.33	2.25	2.60	2.00	2.60
MB 7	2.33	2.00	2.40	1.50	2.20
MB 8	2.33	1.50	2.20	1.66	1.60
MB 9	3.33	2.25	2.60	2.16	2.40
MB 10	3.33	1.75	2.20	2.33	2.80
MB 11	2.33	1.50	2.20	1.80	1.20
Cabin John					
CJ1	3.33	2.50	2.40	2.33	2.00
CJ2	3.33	2.50	2.40	2.33	2.60
CJ3	3.33	2.50	2.20	2.00	2.80
CJ4	3.33	2.50	2.40	2.00	2.60
CJ5	3.33	2.25	2.60	2.33	2.00
CJ6	3.33	2.50	2.60	2.33	2.60
CJ7	3.33	2.50	2.40	2.33	2.60
BB1	2.33	2.25	2.40	1.83	2.00
Rock Run					
RR1	3.33	2.50	2.60	2.33	2.00
RR2	3.33	2.25	2.40	2.33	2.60
Watts Branch					
WB1	2.33	2.50	2.20	2.00	1.80
WB2	2.33	2.75	2.20	2.00	1.80

Wetland Assessment Group Functional Scores

Table A-2

WAG Number*	Groundwater Discharge (3.33 Max.)	Floodflow Attenuation (3.00 Max.)	Nutrient Removal/ Sediment Retention (3.40 Max.)	Aquatic Habitat (3.30 Max)	Wildlife Habitat (3.20 Max.)
WB2A	2.33	2.25	2.20	2.30	1.60
WB3	1.33	2.25	2.00	1.83	1.90
WB4	2.66	2.25	2.00	2.16	1.60
PB1	2.33	0.00	2.00	2.60	2.10
PB2	2.33	2.25	2.00	2.00	1.40
PB2A	2.66	2.75	2.20	1.60	1.60
PB3	2.66	2.66	2.00	2.33	1.80
PB4	2.33	2.75	2.40	2.16	1.60
SB1	1.00	2.25	2.40	2.00	1.80
SC1	1.33	1.75	2.20	2.08	1.50
GB1	2.33	2.50	2.40	2.00	1.60
GB2	2.33	2.75	1.40	2.60	2.60
GB3	2.33	0.00	2.40	2.60	2.60
KB1	2.33	2.75	1.40	1.20	0.20
KB2	2.33	2.75	2.40	2.00	2.10
Seneca Creek					
HB1	2.66	1.75	1.40	2.50	2.60
HB3	2.66	2.50	1.40	2.16	2.20
Potomac-Direct					
P1	2.33	2.75	2.75	2.16	2.40

***Watersheds:**

MB	Muddy Branch
CJ	Cabin John
BB	Bucks Branch
RR	Rock Run
WB	Watts Branch
PB	Piney Branch
SB	Sandy Branch
SC	Stony Creek
GB	Greenbriar Branch
KB	Kilgour Branch
HB	Hookers Branch
P	Potomac-Direct

Fish Species Collected in Various Watersheds[1]

Table A-3

Species [2]		Great Seneca Creek	Muddy Branch	Watts Branch	Cabin John Creek	Rock Run	Potomac Direct
American Eel	*Anguilla rostrata*	X	X	X	X		
Banded Killifish	*Fundulus diaphanus*		X				
Black Crappie	*Pomoxis nigromaculatus*			X			
Blacknose Dace	*Rhinichthys atratulus*	X	X	X	X	X	X
Bluegill Sunfish	*Lepomis macrochirus*	X	X	X	X		
Bluntnose Minnow	*Pimephales notatus*	X	X	X			
Brown Bullhead	*Ameiurus nebulosus*			X			
Central Stoneroller	*Campostoma anamalum*	X	X	X	X		
Common Carp	*Cyprinus carpio*				X		
Common Shiner	*Notropis cornutus*	X		X	X		
Creek Chub	*Semotilus atromaculatus*	X	X	X	X	X	X
Creek Chub Sucker	*Erimyzon oblongus*	X					
Cutlips Minnow	*Exoglossum maxillingua*	X		X	X	X	X
Eastern Mudminnow	*Umbra pygmaea*	X					
Eastern Silvery Minnow	*Hybognathus regius*	X					
Fallfish	*Semotilus corporalis*	X	X		X		
Fantail Darter	*Etheostoma flabellare*	X	X	X		X	X
Golden Redhorse	*Moxostoma erythrurum*		X		X		
Golden Shiner	*Notropis chrysoleucas*	X		X	X		
Goldfish	*Carassius auratus*				X		
Green Sunfish	*Lepomis cyanellus*	X	X		X	X	X
Greenside Darter	*Etheostoma biennioides*	X	X	X			
Northern Hogsucker	*Hypentelium nigricans*	X	X	X			
Largemouth Bass	*Micropterus salmoides*	X		X	X		
Longear Sunfish	*Lepomis megalotis*		X				
Longnose Dace	*Rhinichthys cataractae*	X	X	X	X	X	X
Margined Madtom	*Noturus insignis*	X				X	X

Fish Species Collected in Various Watersheds[1] (Continued) Table A-3

Species [2]		Great Seneca Creek	Muddy Branch	Watts Branch	Cabin John Creek	Rock Run	Potomac Direct
Mosquito Fish	*Gambusia holbrooki*		X				
Mottled Sculpin	*Cottus bairdi*	X	X				
Potomac Sculpin	*Cottus girardi*	X	X	X	X		
Pumpkinseed Sunfish	*Lepomis gibbosus*	X	X	X	X		
Rainbow trout	*Oncorhynchus mykiss*			X			
Redbreast Sunfish	*Lepomis auritus*	X	X	X	X		
River Chub	*Nocomis micropogon*	X					
Rock Bass	*Ambloplites rupestris*	X					
Rosyside Dace	*Clinostomus funduloides*	X	X	X	X	X	
Satinfin Shiner	*Notropis analostanus*		X	X			
Silverjaw Minnow	*Ericymba buccata*	X	X	X	X		
Smallmouth Bass	*Micropterus dolomieu*	X	X	X	X		
Spotfin Shiner	*Notropis spilopterus*	X	X	X			
Spottail Shiner	*Notropis hudsonius*	X					
Swallowtail Shiner	*Notropis procne*	X	X	X	X		
Tessellated Darter	*Etheostoma olmstedi*	X	X	X	X	X	X
Warmouth	*Lepomis gulosus*		X				
White Sucker	*Catostomus commersoni*	X	X	X	X	X	X
White Crappie	*Pomoxis annularis*	X					
Yellow Bullhead	*Ameiurus natalis*	X	X			X	X

(1) **Source:** CSPS. 1997. Montgomery County's Countywide Stream Protection Strategy (Draft). Montgomery County Department of Environmental Protection and Maryland-National Capital Parks and Planning Commission. 21 April 1997.

(2) Contact MCDEP for detailed information on the sampling results.

are expected to increase imperviousness significantly. In these areas it is particularly important to address existing channel instability so that stream reaches will be able to withstand small incremental impacts associated with change in land use. The remedial level under Watershed Protection Areas differs from Watershed Restoration areas by being applied as limited spot improvements to areas with good or excellent stream condition. Watershed Restoration areas have fair or poor stream condition and require more comprehensive restoration efforts.

Watershed Restoration Areas

- Stream condition FAIR or POOR.
- Contributing drainage generally has less than 55 percent ultimate impervious area.
- Significant areas of natural stream channel still exist.
- Most land abutting the stream is in conservation easements or public ownership.

Urban Watershed Management Areas

- Designation based on recognition that certain existing and planned land uses have a detrimental and unavoidable effect on subwatershed hydrology, stream habitat, water quality, and aquatic life that limits the potential for restoration.
- Stream condition is POOR.
- Land use generally consists of intense development (e.g. Central Business Districts, major commercial areas).
- Contributing drainage generally has 55 percent or greater ultimate impervious area and system presently does not support viable biological community.
- Significant portion of the drainage area is piped or channelized and habitat restoration is generally infeasible.

Agricultural Watershed Management Areas

- Stream condition is GOOD, FAIR, or POOR.
- Agriculture is the predominant land use.
- Some level of impairment is reflected in the monitoring data, as indicated by a resource condition of good, fair, or poor. (Excellent agricultural subwatersheds would fall into the Watershed Preservation Area management category).
- The Montgomery Soil Conservation District would be the lead agency for developing management approaches and tools for Agricultural Watershed Management Areas.

Calculating Existing Subwatershed Imperviousness

Existing imperviousness was obtained from the *Countywide Stream Protection Strategy*. The CSPS used the information from the County's geographic information system (GIS). The information was entered into digital format from aerial photos by the Research and Technology Center of the M-NCPPC Montgomery County Department of Park and Planning.

The GIS information that represented current conditions reflected those conditions present in the study area in the period 1993-1995 (different parts of the study area were photographed at different times, see Figure A-1). There has been a relatively small amount of development in the study area since 1990 due to sewer limitations, so that land use conditions reflected by the planimetric data were assumed to closely represent present existing conditions. That is, existing planimetric data were used to characterize existing conditions with respect to land uses and land cover.

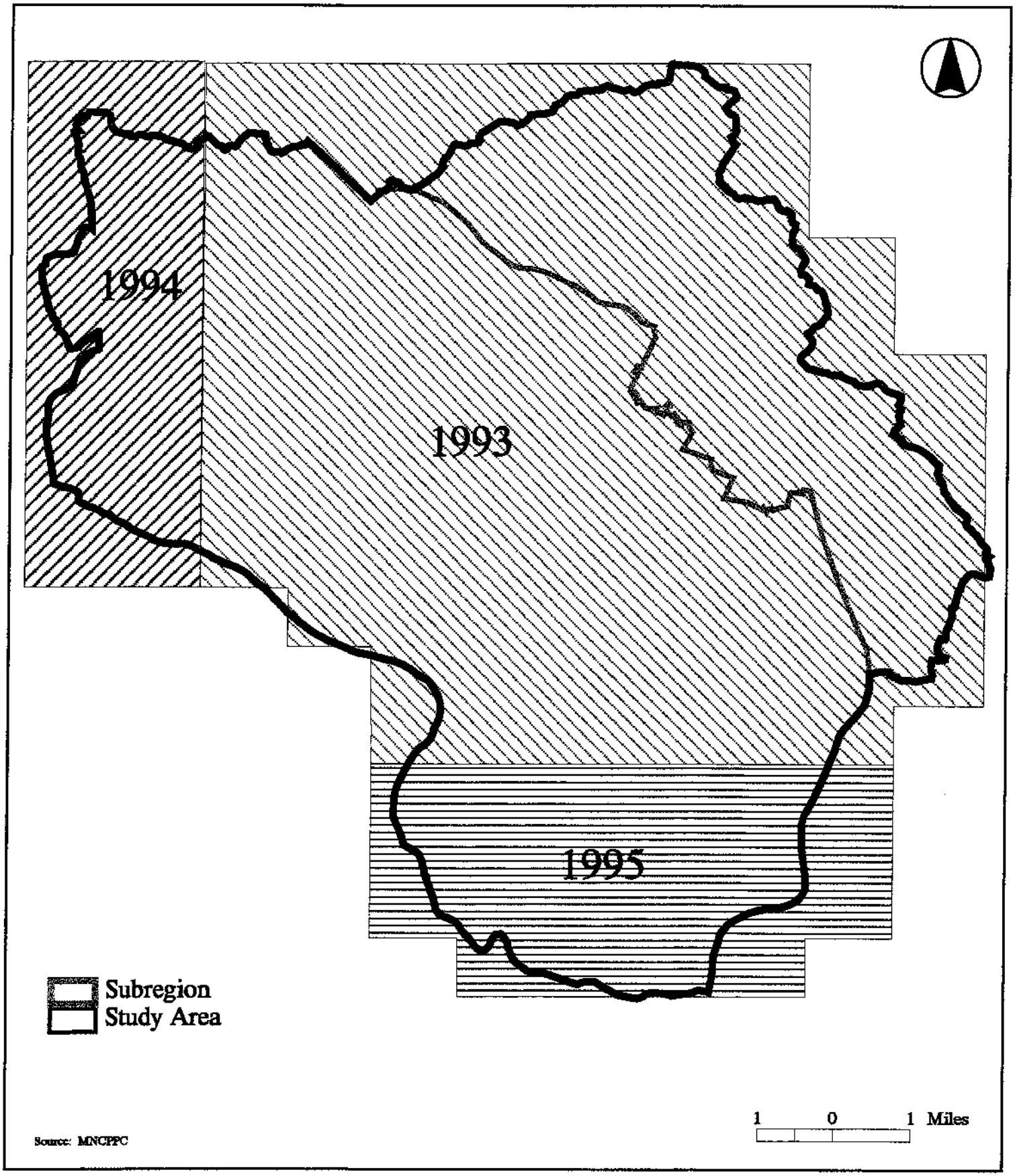
GIS was used to measure all paved surfaces and building rooftops that are shown in the planimetric layers for each subwatershed. These layers include all features that are considered to be impervious surfaces except for sidewalks and driveways for single-family detached houses. (See below for the estimated impervious surface area attributable to sidewalks and residential driveways.)

In order to calculate the area of driveways not already accounted for, the building, road/street, and parking layers were evaluated and an approximate count obtained of the number of buildings (primarily residential single-family detached in subdivisions; rear yard structures assumed to be sheds and the like were not counted) for which a driveway existed but did not appear in the planimetric layer. This number was then multiplied by the average area for a driveway in each subwatershed, which was obtained from the required front-yard setback for the predominant residential zones within the watershed multiplied by an assumed width of 15 feet.

Sidewalks are a feature in the GIS data that are shown as lines and not as polygons. The area of sidewalks was determined by multiplying the length (taken from the planimetric layer) by an assumed width of 4 feet.

Potomac Study Area Aerial Photograph Acquisition Dates

Figure A-1



Potomac Study Area Subwatersheds

Figure A-2

Source: Montgomery County Dept. of Environmental Protection

Summary of Percent Impervious Area[1]

Table A-4

Sub-watershed Number	Sub-watershed Name	Watershed Name	Percent Existing Impervious Area
6	South Germantown	Great Seneca Creek	11[+]
7	Lower Great Seneca	Great Seneca Creek	4 [+]
8	Upper Muddy and Decoverly Tributary	Muddy Branch	36/27 [#]
9	Route 28 Tributary	Muddy Branch	19
10	Lakes Tributary	Muddy Branch	33
11	Quince Orchard Knolls	Muddy Branch	20
12	Potomac Grove Tributary	Muddy Branch	23
13	Mainstem Above Turkey Foot	Muddy Branch	10
14	Dufief Tributary	Muddy Branch	19
15	North Potomac	Muddy Branch	8
16	Query Mill Tributary	Muddy Branch	7
17	Darnestown Tributary	Muddy Branch	8
18	Farmlands Tributary	Muddy Branch	9
19	Mainstem Above River Road	Muddy Branch	5
20	Esworthy Area	Muddy Branch	9
21	Riverwood Area	Muddy Branch	5
22	Pennyfield Tributary	Muddy Branch	22
23	Upper Watts and Research Boulevard	Watts Branch	33/26 [#]
24	Rockville - Lakewood	Watts Branch	22
25	Upper Piney Branch	Watts Branch	10
26	Middle Piney Branch	Watts Branch	6
27	Middle Watts Branch	Watts Branch	16
28	West Piney Branch	Watts Branch	8
29	Lower Piney Branch	Watts Branch	7
30	Lower Watts Branch	Watts Branch	11
31	Greenbriar Branch	Watts Branch	6
32	Upper Sandy Branch	Watts Branch	8
33	Lower Sandy Branch	Watts Branch	9

Summary of Percent Impervious Area[1] (Continued)

Table A-4

Sub-watershed Number	Sub-watershed Name	Watershed Name	Percent Existing Impervious Area
34	Upper Mainstem	Cabin John Creek	27
35	Old Farm Branch and Lower Old Farm	Cabin John Creek	27
36	Bogley Branch	Cabin John Creek	20
37	Mainstem	Cabin John Creek	19
38	Snake Den Branch	Cabin John Creek	20
39	Buck Branch including Buck Branch A	Cabin John Creek	18
40	Middle Mainstem	Cabin John Creek	27
41	Ken Branch including Ken Branch A	Cabin John Creek	12/13
42	Congressional Country Club Tributary	Cabin John Creek	11
43	Beltway Branch	Cabin John Creek	Incomplete
85	Lower Mainstem	Cabin John Creek	Incomplete
44	Upper Rock Run	Rock Run	25 - 30%*
45	Lower Rock Run	Rock Run	25 - 30%*
46	Avenel North	Rock Run	25 - 30%*
47	Avenel South	Rock Run	25 - 30%*
48	Direct 6	Potomac Direct	2
49	Direct 5	Potomac Direct	No Data
50	Direct 4	Potomac Direct	15 - 25%*

(1) Source: *Montgomery County's Countywide Stream Protection Strategy (Draft)*. Montgomery County Department of Environmental Protection and Maryland-National Capital Park and Planning Commission. April 1997. Percentages are based on actual ground cover from aerial photography.

(+) Sub-watershed boundaries are not exactly as in *Montgomery County's Countywide Stream Protection Strategy (Draft)*.

(#) Sub-watershed divided into two smaller sub-watersheds by *Montgomery County's Countywide Stream Protection Strategy (Draft)*.

* Ranges as provided by *Montgomery County's Countywide Stream Protection Strategy (Draft)*.

In addition to the GIS layers for paved features (buildings, driveways, roads, streets and parking, cultural, and sidewalks) the impervious contribution of nonpaved land cover was calculated, based on the assumption that these surfaces also contribute to surface water runoff for some precipitation events. Remaining nonpaved land was categorized as either forested or nonforest-nonpaved. Nonforest-nonpaved land includes lawn, pasture, and crop fields and is referred to as meadow. Forest cover is assigned an imperviousness factor of one percent; nonforest green cover is assigned a factor of three percent. A one percent imperviousness factor for forest cover has been used in other studies that focus on land use imperviousness (Northern Virginia Planning District Commission, 1980; Galli, 1983; CH2M Hill, 1982). For nonforested green cover, a wider range of imperviousness factors have been used (i.e., 0 to 7 percent). The CSPS uses three percent imperviousness factor for nonforested green cover because it is roughly the middle of the range of values that have been used in other studies and it reflects the greater benefits of forest cover compared to meadow or grass cover on streams.

Determination of Significant Forest Blocks

Identification of significant forest blocks in the Potomac Subregion is based on criteria established by the Chesapeake Bay Critical Area Commission (1986). These criteria were developed in response to concerns about the declining populations of many native breeding birds which are associated with large, relatively undisturbed blocks of mature forest. The Chesapeake Bay Critical Area Commission's report suggests that upland forest blocks of 100 acres or more and riparian (streamside) forests which are 300 feet wide or wider may serve as habitat for forest interior dwelling birds. The report goes on to note that these criteria should serve as a general guideline; forest interior birds may be found in some smaller forest areas.

Based on these recommendations, staff measured forest blocks and riparian corridors on the GIS forest layer created for the Potomac Subregion Environmental Report. Upland blocks in excess of 100 acres and riparian corridors 300 feet wide or more were delineated and identified as "significant forest blocks." These areas have the greatest potential to provide habitat for forest interior bird species.

Confirmation that these areas are serving as forest interior areas for birds can only be accomplished by conducting breeding bird surveys. The Chesapeake Bay Critical Area Commission suggests that breeding bird surveys, which identify at least four forest interior bird species or at least one sensitive species as "probable" or "confirmed" breeders in a given forest area, should confirm that area as a forest interior (see Table A-5).

List of Forest Interior Dwelling Bird Species Table A-5

Common Name	Scientific Name
Flycatcher, Acadian	*Empidonax virescens*
*Hawk, red-shouldered	*Buteo lineatus*
Ovenbird	*Seiurus aurocapillus*
*Owl, barred	*Strix varia*
Parula, northern	*Parula americana*
*Redstart, American	*Setophaga ruticilla*
Tanager, scarlet	*Piranga olivacea*
Vireo, red-eyed	*Vireo olivacea*
Vireo, yellow-throated	*Vireo flavifrons*
Warbler, black-and-white	*Mniotilta varia*
*Warbler, hooded	*Wilsonia citrina*
*Warbler, Kentucky	*Oporornis formosus*
Warbler, prothonotary	*Prothonotaria citrea*
*Warbler, Swainson's	*Limnothlypis swainsonii*
*Warbler, worm-eating	*Helmitheros vermivorus*
*Waterthrush, Louisiana	*Seiurus motacilla*
Whip-poor-will	*Caprimulgus vociferus*
Woodpecker, hairy	*Picoides villosus*
Woodpecker, pileated	*Dryocopus pileatus*

* Denotes species especially sensitive to disturbance

Sources: Chesapeake Bay Critical Area Commission (1986). A Guide to the Conservation of Forest Interior Dwelling Birds in the Critical Area. Guidance Paper No. 1; 15pp. Maryland Ornithological Society. 1982.

Maryland and D.C. Breeding Bird Atlas Project Handbook, 1983-1987. Supplement to Maryland Birdlife, Vol. 38, 1982; 20pp.

Note: Determination of breeding status should be according to the criteria set forth by the Maryland Ornithological Society (1982).

Potomac Subregion Sewer and Water Status Report

Prepared by M-NCPPC with the Assistance of:

Montgomery County Department of Environmental Protection
Washington Suburban Sanitary Commission
Montgomery County Department of Permitting Services

Overview

Community sewer service in the Potomac Subregion is provided via one of four sewer trunk lines: Muddy Branch, Watts Branch, Rock Run, and Cabin John. These trunk lines direct flows from the Potomac Subregion and other planning areas south into the Potomac (Dulles) Interceptor. The Potomac Interceptor is a very large diameter main that

captures sewage flows from much of Montgomery County and parts of Loudoun and Fairfax Counties in Virginia. The Dulles Interceptor discharges to the Blue Plains treatment plant in the District of Columbia where much of the region's treatment needs are met. Various regional agreements detail the average and peak flow limits each jurisdiction is allowed to discharge into this system.

The *Approved and Adopted Master Plan for the Potomac Subregion, May 1980* envisions sewer service within the master plan area to be expanded based on a staging sequence. As with all master plans, the extension of community water and sewer service to achieve the desired zoning densities are implemented through the *Comprehensive Water Supply and Sewerage Systems Plan.* The water and sewer plan is administered by the Montgomery County Department of Environmental Protection. It sets the policies upon which community water and sewer service is extended. The master plan recommendations and the water and sewer plan are coordinated to avoid conflicts in policy.

Presently, most of the master plan area designated as sewer stages I, II and III have or are approved to receive community sewer service. This generally includes areas with zoning densities R-200 and greater, as well as RE-1, RE-2C and RE-2. The intent of the master plan was to allow stages I, II, and III to develop first and use available capacity within the conveyance system and at the Blue Plains treatment plant. The remainder of the Potomac Subregion was designated as sewer stage IV, the last stage to be opened to development. The master plan anticipated that stage IV would use any remaining capacity within the system if it could be served by logical and economical extensions from existing sewers. The Potomac Subregion is one of two planning areas[7] in the county that recommends community sewer service to the RE-2 Zone.

County Council Actions on Sewer Service

In the Potomac Subregion, properties included in the fourth and final sewer stage were opened to the consideration of development using community sewer service on a case-by-case basis by action of the Planning Board in July 1987. That action included recommendations to exclude certain stage IV areas in the western part of the master plan area from receiving sewer service. In addition, the County Council has placed further restrictions on the availability of sewer within stage IV. For areas designated as stage IV, the master plan recommends extending service to only those areas that can be served by logical, economical and environmentally acceptable extensions from the sewerage system constructed to serve stages I, II and III. Under this guidance and limitations imposed by the County Council, only a portion of the entire stage IV area has developed on sewer which will be discussed later in this document. Development with septic systems generally cannot occur at the zoned density due to poor hydraulic conductivity and shallow soils, resulting in failed percolation tests.

Sewer Service in the Sandy Branch/Greenbriar Branch Basins

The County Council's approval of sewer service for the Palatine of Potomac project in March 1988 opened the possibility of development within the upper portions of these watersheds (upstream of Glen Road) using community sewer service. The County subsequently received many requests for water and sewer category changes, accounting for as much as fifty percent of the land in the upper portions of these basins. At MCDEP's request, WSSC initiated a sewer facility study to examine service alternatives for this area. The Council endorsed an option in the 1991-1996 WSSC Capital Improvement Program (CIP) that served the Greenbriar Branch basin by a grinder pump and low-pressure sewer system; the Sandy Branch basin would be served by a gravity system feeding into the proposed Glen Road pumping station and force main.

However, the County Council raised concerns about the amount of traffic that would be generated in the area should development supported by community sewer service occur. Of concern was the network of small roads that do not meet current County codes for safety and that were also part of the ongoing Rural/Rustic Roads Task Force. In 1988, the Council decided to defer all category change requests within these basins except for those areas zoned R-200/TDR-3, pending the results of a traffic study.

The traffic study brought about a number of conflicts with County transportation and land use policy. Mainly, the study found that development within this basin could be accommodated with safety improvements to the area roads with minor intersection improvements. At the same time, the County was considering adopting the recommendations of the Rural/Rustic Road Task Force which included a proposed designation for Glen Road. Road improvements recommended in the study were in conflict with the recommendations of the Rustic Roads Task Force. The Council Transportation and Environment Committee (T&E Committee) recommended denial of all category change applications within the basins, except again for those areas zoned R-200/TDR-3, until this conflict could be resolved.

Subsequently, the Council chose to delete the previously approved CIP projects necessary to support development in the basin from the 1992-1997 WSSC CIP. The Council

[7]The approved and adopted *Fairland Master Plan* designates a portion of Fairland Recreation Park that is zoned RE-2 for sewer service in order to serve park facilities.

further directed the Planning Board to examine the land use, infrastructure, environmental and fiscal impacts of providing sewer service to this area as part of a master plan amendment process. With the exception of the Palatine property, which was already approved for service, and a number of smaller properties immediately abutting the Palatine project sewerage system, which were considered to have a minimal effect on traffic, the Council chose not to act on all other water and sewer category change requests in the RE-2 Zone of these basins effectively denying those requests. The Department of Park and Planning staff is now in the initial stages of the master plan process, and these considerations, among others will be part of that process.

Sewer Service in the Piney Branch Basin

In the upper portions of the Piney Branch watershed, the extension of the community sewerage systems was required in order to achieve the land use recommendations in the master plan and the adopted zoning densities. Sewer service presented a problem because of the long extension up the Piney Branch from the Watts Branch trunk sewer. The Piney Branch is a Use I-P stream with unusually good water quality. The trunk sewer traverses sewer stage IV areas zoned RE-1 and RE-2. In 1991, the Council chose to maintain the trunk sewer in the WSSC CIP, but also chose to adopt a restricted access policy for the Piney Branch sewerage system in the Water and Sewer Plan, citing the following concerns:

- potential environmental degradation resulting from build out at the maximum zoned density,
- disagreement with regard to the master plan recommendations for sewer service to stage IV areas zoned RE-1 and RE-2,
- category changes previously approved in the lower part of the basin, and
- the need to serve the upper portions of the basin.

This policy effectively limits service in the stage IV areas of the Piney Branch basin to those properties that immediately abut the Piney Branch Trunk Sewer. The policy has been tested many times by property owners' category change requests and has been upheld by the Council. The restricted access policy also restricts sewer service from some R-200 and RE-1 zoned property designated as sewer stages I and II. This issue has been brought to the attention of the Council who will likely review this as part of the master plan revision. Within the Piney Branch basin, properties not eligible for connection to the sewer must rely on septic systems.

Sewer Service in Other Stage IV Areas

Outside the areas identified in the preceding discussions on the Sandy Branch, Greenbriar Branch, and Piney Branch basins, the County Council has generally upheld the concept of community sewer service for stage IV areas where such service is consistent with master plan recommendations.

Soils Constraints

Generally, soils west of Interstate 270 have moderate to severe limitations for septic percolation tests. The entire Potomac Subregion is constrained due to a number of factors including high clay content, shallow bedrock, and high water table. This results in lower housing yields than would be expected to occur if community sewer service were available. In parts of the Sandy Branch, Greenbriar Branch, and Piney Branch basins, extremely shallow bedrock can result in little to no development potential.

The Department of Park and Planning is anticipating close coordination with WSSC, MCDEP and the MCDPS, Wells and Septic Unit, to better understand the limitations of the soils and any existing or potential health concerns associated with failing septic systems. This effort will identify the development yields that could be realized using septic systems given soil types, topography and other environmental features to the extent possible with existing data. Should the provision of sewer service to a particular area warrant investigation, these meetings may provide the master planning process with a preliminary determination of potential environmental impact to streams and water quality due to construction impacts and the potential for long-term cumulative impacts of development. Discussion will also occur regarding the success of mitigation of these impacts on water resources.

Sewer System Capacity

The *Montgomery County Future Sewer Capacity Constraints Report*, April 1996, by WSSC, identifies those sewer systems that will be over capacity given current population forecasts. Within the Potomac Subregion, the Muddy Branch and Cabin John trunk sewers can be expected to exceed design capacities in portions of their length by the year 2010; certainly within the lifetime of the upcoming master plan revision. The need for their replacement and/or relief should be acknowledged in the master plan revision. Additionally, the Watts Branch may need relief beyond 2020. Given the public concern toward environmental and economic impacts during the recent city of Rockville wastewater conveyance study for the King Farm, facility planning may be required in this basin. The actual timing and techniques used to address these sewer capacity concerns will be dependent on the actions of the County Council through the Water and Sewer Plan and the

WSSC capital improvement program, as well as the master planning process.

The WSSC is currently undertaking a major facility plan to address capacity constraints within the Rock Creek sewerage basin. A possible option under consideration is pumping excess flows from Rock Creek over to the Cabin John sewerage basin. If selected, this option will impact on the extent and timing of relief sewer construction required in the Cabin John basin.

The master plan may consider County policy regarding the decisions made about the Rock Run wastewater treatment plant. The WSSC Strategic Sewerage Study (Greeley and Hansen, 1993) identifies this facility as a critical element for the regions treatment needs in all the alternatives considered in the study. Although a site for the treatment plant has been designated and documented in the current master plan, a consultant study is underway to conduct a preliminary investigation of influent/effluent alternatives and environmental issues, develop planting and screening schemes, a long-term implementation schedule, and establish a WSSC presence on the site. The master plan will need to recognize the proposed location of the plant.

Water Treatment Issues

The WSSC Potomac water filtration plant is located on River Road with water intakes located downstream of the Potomac River's confluence with Watts Branch. The plant provides ninety percent of the bi-county's community water supply needs. The plant will continue to supply future water supply needs of the sanitary district for most of future anticipated growth.

In recent years the Maryland Department of the Environment (MDE) has expressed concerns about the release of sedimentation basin solids into the Potomac River. Earlier this year, the WSSC and the MDE signed a consent agreement that includes provisions for separating the filter backwash and discharging it directly back to the Potomac River. The agreement also has provisions for pumping, thickening , dewatering, and disposal of the sedimentation solids under certain river conditions. The agreement includes a compliance schedule which requires the WSSC to complete the facilities necessary to comply with the conditions of the new permit within 4.5 years from the date of issuance. The release permit is pending.

Detailed Discussion of Analysis Areas

Analysis Area 1 - The Darnestown Triangle

This area is located in the Muddy Branch watershed bounded by MD 28 to the north, Turkey Foot Road to the west, and Jones Lane to the east. The 1980 master plan recommended that this portion of the Potomac Subregion remain in the R-200 Zone without community sewer service. Development of lots at full density, i.e. half acre lots, is unrealistic using on-site septic systems. This was understood when the 1980 master plan was prepared. The purpose of this recommendation was to maintain a variety of lot sizes, larger than typically realized in R-200 developments using sewer, in order to preserve the large lot character of the existing developed areas. In this area, the requirement to provide an adequate septic absorption trench area on each lot was used as a tool to lower densities.

This particular policy has been problematic for development in this area. In the R-200 Zone there is an expectation by the development community that sewer service will be provided. Sewer service to R-200 Zones is supported in the policies of the *Comprehensive Water Supply and Sewerage Systems Plan* (the Water and Sewer plan) and the Executive Regulation for on-site wastewater disposal systems. The Water and Sewer plan has a general policy to place zones of one-half acre and more dense in a service area category for community water and sewer. It does recognize that a local master plan has the ability to modify this general policy as has been done in the Potomac Subregion. Outside the Potomac Subregion, incidences of non-sewered R-200 zones are limited and usually associated with rural villages within the rural zone or agricultural preserve.

The Montgomery County Department of Permitting Services, Well and Septic Section has expressed concerns about this portion of the Potomac Subregion. The basis of their concern is that there is an expectation from developers to develop on lots closer to a half acre in size within the R-200 Zone. County well and septic officials cite the attempts of developers to "squeeze" approved septic systems onto the smallest lots possible leaving little or no room for house amenities such as decks or pools and limiting the space available to construct utilities. Typically, it is the Permitting Services and Environmental Protection departments that receives the complaints when a septic system limits the ability of a homeowner to make reasonable modifications to a house. Although the master plan is clear that the use of septic is being used to maintain large lots, pressure to get the maximum yield under the zone using septic continues to create problems for County agencies. The Council has asked that the master plan process review the policies for this area.

Analysis Area 2 - Sandy Branch Pump Station (WWPS) and Rich Branch Trunk Sewer

The Sandy Branch pump station collects sewage flow from the area zoned R-200/TDR-3 on the north and south side of Travilah Road at the intersection with Dufief Mill Road. Capacity at this pumping station and the Rich Branch trunk sewer to which it feeds are approaching capacity. In reviewing two recent map amendments to the Water and

Sewer Plan located within the pump station sewershed, the Council requested an analysis of the capacity problem. The MCDEP and WSSC are looking closely at the remaining capacity left in these two sewerage systems to allow the TDR area to continue developing. Should there be a need to enlarge the existing Sandy Branch WWPS or provide relief for the Rich Branch trunk sewer, there will be environmental and community impacts associated with these projects.

The Sandy Branch pump station is located in the headwaters of the Sandy Branch watershed. In the late 1980s, it was anticipated that the Sandy Branch watershed would be served by the Glen Road pump station (deleted from the CIP as previously noted). The Glen Road pump station could have also served the area presently served by the Sandy Branch pump station, precluding the need for the pump station and the need to relieve the Rich Branch Trunk Sewer.

Upgrades to either the existing Sandy Branch pump station or the Rich Branch trunk sewer would serve existing development and also allow the TDR zones to develop to their fullest potential. The upgrade alternatives will be the subject of a facility plan that will be used by WSSC to recommend appropriate CIP projects to address the identified sewage transmission problems.

Analysis Area 3 - Sandy Branch and Greenbriar Branch

This area is generally defined as being bounded by Travilah Road to the north, Glen Road to the south, and Piney Meetinghouse to the east. It includes the Rockwell Crushed Stone Quarry site and properties to the south and west of the quarry. This basin was to be served by the Glen Road pump station. A limited number of category changes were approved for development on grinder pumps and a pressure sewer. It was anticipated that portions of the Palatine development that drain by gravity to the Sandy Branch would ultimately connect to the Glen Road WWPS. However, the Council deleted the pumping station and force main from the WSSC CIP. The category change approved for the Palatine project allowed the development to move forward using grinder pump systems in the event an area-wide sewerage system is not provided. The remainder of the basin has been slow to develop due to severe septic system limitations.

The approved Potomac Master Plan currently recommends service to the RE-2 Zone in stage IV if it can be logically and economically extended from the existing sewer system. Service to this basin would require program size lines and would need County Council approval. A sewer facility plan was developed in the late 1980s by WSSC. If sewer service to this area is to be evaluated, it will be desirable to update this earlier study.

Although the current RE-2 Zone supports sewer service, a decision to increase density could have potential water quality impacts to both Use I-P streams. As determined by the preliminary results of the County's stream monitoring efforts, streams in this area of the County have fair to good water quality and will need to be evaluated for the impacts expected from any increased development in this basin. The present water quality of Sandy Branch should be taken into consideration prior to decisions about changes in zoning densities and sewerage system extensions.

Analysis Area 4 -Piney Branch Basin

After considerable debate over environmental impact, the County Council in the late 1980s chose to extend a gravity sewer line up the Piney Branch stream system to serve the sewer stages I and II properties located in the upper reaches of the basin between Boswell Lane and MD 28. These included properties zoned R-200/TDR-3, R-200, and RE-1. These same environmental issues were raised again in the early 1990s when the Council considered replacing the gravity trunk sewer with a pumping station and force main. The trunk sewer was retained in the WSSC CIP, but to minimize the effects of development on the stream system, the Council restricted the ability of properties in the basin to connect to the sewer. County Council Resolution 12-486 details the Piney Branch Sewer Agreement which includes the Piney Branch Restricted Access Policy. This policy was crafted to restrict connections to the line based on the following:

Properties with Right of Connection to the Piney Branch

1. Properties with sewer approval prior to December 3, 1991.
2. Transferable development rights (TDR) receiving areas without approval prior to December 3, 1991.
3. Connections requested for public health reasons.
4. Properties directly abutting the Piney Branch sewer main or sewer right-of-way.

Properties Restricted from Access to the Piney Branch Sewer

1. Properties that do not directly abut, but could drain by gravity to the sewer with a new tributary non-program size main to make the connection.

This policy, enacted in 1991, has been successfully upheld throughout the previous six years of amendments to

the Water and Sewer Plan. Recently, however, the Executive brought to the Council a number of category change requests for properties in the Piney Branch watershed and within stages I and II of the master plan. Service to these properties is consistent with the master plan but not consistent with the restricted access policy and therefore, went to the Council with a recommendation to deny by reviewing agencies. An argument was made that these properties should have been allowed to connect to the Piney Branch sewer at the inception of the policy since they were included in sewer stages I and II in the master plan, the difference being that these properties were not zoned as TDR receiving areas as were the larger tracts: Traville, Piney Glen, Willows of Potomac and Conklin/Ward properties. At the request of the Council, MCDEP prepared an evaluation of the restricted access policy on development in the Piney Branch basin for the T&E Committee. The T&E Committee recommended maintaining the existing policy pending a review of the basin as part of the master plan update.

The Councils action in March 1997 essentially upheld the restricted access policy, with one exception. Citing special circumstances the Council approved a narrowly-focused amendment to the restricted access policy to allow sewer service for the RE-1-zoned Cavanaugh Property. The Council acted to deny all the other sewer stage I and II area category change requests. To date this is the only amendment to the restricted access policy. The Council feels that other properties in the Piney Branch basin may warrant further consideration and have instructed the Planning Board to examine this as part of the master plan revision.

Water Quality Monitoring Summary Tables

The following tables (Tables A-6 through A-10) summarize the results of historical and current water quality monitoring for the streams within the Potomac Subregion. The results are necessarily simplified, and more detail about the results of some of the studies appear in the text of Chapter 1. These tables convey the basic information about the type, time, source, methodology and generalized results for various sections of streams arranged in chronological order by type of monitoring.

Summary of Lower Seneca Stream Monitoring

Table A-6

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Seneca Creek Mainstem
Macro-invertebrates	1989-1991	MDE July 1993	surber or kicknet[4]	MD RBP[5]	unimpaired, moderately impaired, impaired; narrative[6]	generally moderately impaired, showing little WQ impact; good
	1991-1993	MDE 1994	surber or kicknet	MD RBP	unimpaired, moderately impaired, impaired; narrative	moderately impaired community; good
Fish	1972-1974	Ragan & Dietemann 1976	seine & electro-shock[7]	compare to historical data	narrative	no change from earlier survey, good condition, diverse habitat
Chemical and Physical Water Quality	pre-1972	MNCPPC 1976	not specified[8]	compare to MD standards[9]	excellent/good/fair/poor	overall good; good for DO, pH, turbidity, temperature, nutrients or BOD; all streams failed the fecal coliform standard at times
	1969-1973	MCDEP 1973	Not specified; data summary	9 parameters	excellent/good/fair/poor	good
	1970-1973	MCDEP 1974	standard	compare to MD standards, reference stream, prof. judgement	excellent/good/fair/poor	good/good
	1974-1975	MCDEP 1976	standards	see MCDEP 1974	excellent/good/fair/poor	good/good
	1976	MCDEP 1977	standards	WQI Rating	bad/poor/permissible/good/ excellent	permissible (intermediate)
	1977	MCDEP 1978	standards	WQI Rating	bad/poor/permissible/good/ excellent	permissible (intermediate)
	1978	MCDEP 1979	standards	WQI Rating	bad/poor/permissible/good/ excellent	permissible (intermediate)
	1979	MCDEP 1980	standards	WQI Rating	bad/poor/permissible/good/ excellent	permissible (intermediate)

Summary of Lower Seneca Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Seneca Creek Mainstem
Chemical and Physical Water Quality	1980	MCDEP 1981	standards	WQI Rating	bad/poor/permissible/good/ excellent	permissible (intermediate)
	1969-1973	MDE 1974	not specified	compare to MD standards, 9 parameters	excellent/good/fair/poor	consistently good
	1974-1975	MDE 1976	not specified	compare to MD standards, 9 parameters	excellent/good/fair/poor	consistently good
	1976	MDE 1977	not specified	compare to MD standards, 9 parameters	bad/poor/permissible/good/ excellent	consistently good
	1977	MDE 1978	not specified	compare to MD standards, 10 parameters	bad/poor/permissible/good/ excellent	permissible, improved over previous year
	1978	MDE 1979	not specified	compare to MD standards, 10 parameters	bad/poor/permissible/good/ excellent	permissible, improved over previous year
	1979	MDE 1980	not specified	compare to MD standards, 10 parameters	bad/poor/permissible/good/ excellent	permissible
	1980	MDE 1981	not specified	compare to MD standards, 10 parameters	bad/poor/permissible/good/ excellent	permissible, degraded relative to previous year
	1977-1985	MDE 1988	trend data	compare to MD standards	increasing trend, no trend, decreasing trend	decreasing quality based on total suspended sediment and fecal coliform

Summary of Lower Seneca Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Seneca Creek Mainstem
Chemical and Physical Water Quality	1989-1991	MDE 1993	trend data	compare to MD standards; macro-invertebrate community indicates good water quality	excellent/good/fair/poor	good; elevated bacterial nutrient, and suspended sediment levels
	1972	Ragan & Dietemann 1976		9 parameters	excellent/good/fair/poor	good
	1985	MWCOG 1987	various	modified ICPRB 1979 [10]	excellent/good/fair/poor	good; fecal coliform exceed standards
	1985-1987	MDE April 1988	trend data	compare to MD standards	narrative	good, meets Class I standards, fecal coliform levels decreasing
	1989-1991	MDE July 1991	trend data	compare to MD standards	excellent/good/fair/poor	generally good, bacteria, nutrients and TSS are slightly elevated due to runoff; clearly impacted by development & agriculture
	1991-1993	MDE 1994	trend data	compare to MD standards	excellent/good/fair/poor	good; slightly elevated bacteria, nutrient and TSS

Notes:

1. Method or equipment used to collect the referenced sample information in the field.
2. Approach to analyze collected information following a standard or identified methodology.
3. Stream condition characterization attempts to provide the range of possible characterizations included in the methodology used. In some instances, no standard terminology is used.
4. Surber and kicknet samplers are devices used to quantitatively and qualitatively, respectively, collect macro invertebrates in shallow riffle areas of streams.

Summary of Lower Seneca Stream Monitoring (Continued)

5. Maryland Rapid Bioassessment Protocol (Primrose 1991) is a quick and cost-effective standardized methodology for evaluating aquatic resources based on the EPA's methodology (Plafkin et al. 1988).
6. Narrative descriptions are often provided in the referenced sources. In some cases, they are a broad summary of the results of other methods, while in other cases, the basis for the characterization is not clear.
7. Seine and electro-fishing are two common methods used for fish sampling.
8. No information on sampling method provided in referenced source.
9. Comparison of measured water quality parameter values to published standards for Maryland Use I designated waters.
10. Modified method used by the Interstate Commission on the Potomac River Basin.

Summary of Muddy Branch Stream Monitoring

Table A-7

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Muddy Branch Mainstem
Macro-invertebrates	1991	Rivers 1996	various[4]	HBI[5]	narrative[6]	excellent to good at three locations
	1993	MDE 1993	various	not specified	narrative	moderately impacted
	1994	Garrison/ MDE 1994	various	not specified	narrative	moderately impacted
	1991-1993	MDE 1994	surber[7]	Md. RBP	narrative; unimpaired/moderately impaired/impaired	good-fair; moderately impacted community
	1996-1997	MCDEP	Mont. Co. Protocols kicknet[11]	IBI	good-fair	good-fair
Fish	1972-1974	Ragan & Dietemann 1976	seine & electro-fishing[8]	compare to historical data	narrative	good condition, diverse habitat, excellent species diversity
	1996-1997	MCDEP	Mont. Co. Protocols [11]	IBI	fair-poor	good-fair
Chemical and Physical Water Quality	pre-1972	MNCPPC 1976	various	compare to MD standards[9]		good for DO, pH, turbidity, temperature, nutrients or BOD; all streams failed the fecal coliform standard at times
	1969-1973	MCDEP 1973	Not specified; data summary	9 parameters	excellent/good/fair/poor	poor
	1970-1973	MCDEP 1974	standard	compare to MD standards, reference stream, prof. judgement	poor/good	poor/good

Summary of Muddy Branch Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Muddy Branch Mainstem
Chemical and Physical Water Quality	1974-1975	MCDEP 1976	standards	see MCDEP 1974	excellent/good/fair/poor	good/good
	1976	MCDEP 1977	standards	WQI Rating		permissible (intermediate)
	1977	MCDEP 1978	standards	WQI Rating	excellent/good/permissible/ poor/bad	permissible (intermediate)
	1978	MCDEP 1979	standards	WQI Rating	excellent/good/permissible/ poor/bad	good
	1979	MCDEP 1980	standards	WQI Rating	excellent/good/permissible/ poor/bad	permissible (intermediate)
	1980	MCDEP 1981	standards	WQI Rating	excellent/good/permissible/ poor/bad	permissible (intermediate)
	1969-1973	MDE 1974	not specified	compare to MD standards, 9 parameters	excellent/good/fair/poor	poor
	1974-1975	MDE 1976	not specified	compare to MD standards, 9 parameters	excellent/good/permissible/ poor/bad	poor to good
	1976	MDE 1977	not specified	compare to MD standards, 9 parameters	excellent/good/permissible/ poor/bad	good
	1977	MDE 1978	not specified	compare to MD standards, 10 parameters	excellent/good/permissible/ poor/bad	permissible

Summary of Muddy Branch Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Muddy Branch Mainstem
Chemical and Physical Water Quality	1978	MDE 1979	not specified	compare to MD standards, 10 parameters	excellent/good/permissible/poor/bad	good
	1979	MDE 1980	not specified	compare to MD standards, 10 parameters	excellent/good/permissible/poor/bad	permissible
	1980	MDE 1981	not specified	compare to MD standards, 10 parameters	excellent/good/permissible/poor/bad	permissible, improved relative to previous year
	1991-1993	MDE 1994	trend data	compare to MD standards	excellent/good/fair/poor	good; high nutrient and TSS
	1972	Ragan & Dietemann 1976	grabs	9 parameters	excellent/good/fair/poor	good
	1996-1997	MCDEP	Mont. Co. Protocols[11]	DO, pH, Cond, Water Temp, TSS, Air Temp	Narrative	met Use I criteria
Stream Habitat Quantitative and Qualitative	1993	MDE 1993	various	Md RBP	unimpaired, moderately impaired, impaired, narrative	good

Summary of Muddy Branch Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Muddy Branch Mainstem
Stream Habitat Quantitative and Qualitative	1994	Garrison /MDE 1994	various		unimpaired, moderately impaired, impaired, narrative	good
	1996	EQR 1996	various	Modified RSAT[10]	excellent/good/fair/poor	10 stations in Gaithersburg, 2 scored good, 6 scored fair and 2 scored poor
	1997	DEP and MNCPPC 1997	Mont. Co. Protocol[11]	Rapid Habitat Assessment	excellent/good/fair/poor	fair (headwaters) to good (mainstem and tributaries)

Notes:

1. Method or equipment used to collect the referenced sample information in the field.
2. Approach to analyze collected information following a standard or identified methodology.
3. Stream condition characterization attempts to provide the range of possible characterizations included in the methodology used. In some instances, no standard terminology is used.
4. Various unspecified standard methods used to collect information, depending on date of survey work.
5. Index of Biotic Integrity, as outlined in the CSPS (1997), pg 16.
6. Narrative descriptions are often provided in the referenced sources. In some cases, they are a broad summary of the results of other methods, while in other cases, the basis for the characterization is not clear.
7. Surber and kicknet samplers are devices used to quantitatively and qualitatively, respectively, collect macro invertebrates in shallow riffle areas of streams.
8. Seine and electro-fishing are two common methods used for fish sampling.
9. Comparison of measured water quality parameter values to published standards for Maryland Use I designated waters.
10. Modified Rapid Stream Assessment Technique is a method developed by Washington Council of Governments (1992).
11. Montgomery County Water Quality Monitoring Program Stream Monitoring Protocols. 1997.

Summary of Watts Branch Stream Monitoring

Table A-8

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Macro-invertebrates	1991 (Spring/ Summer)	MD DNR	D-net, 90 sec.[4]	Modified RBP III[5]	Excellent/good/fair /poor	Taxa Richness: 8-12 Total EPT: 30-32 Total Dipteran: 1-64 (Fair to Good)	Taxa Richness: 7-15 Total EPT: 20-46 Total Dipteran: 0-82 (Fair to Good)		
	1991	M-NCPPC Parks	D-Net	Modified RBP III	Excellent to fair				
	1991-1993	MDE 1994	surber[6]	not specified	narrative; unimpaired moderately impaired; impaired				fair-poor; severely impacted community, habitat unimpaired
	1993 (Spring/ Summer/ Fall)	Audubon Naturalist Society	Not given in source[7]	Modified RBP II[8]	excellent/good/fair/ poor		Taxa Richness: 5-14 Total EPT: 1-6 Total Dipteran: 4-26 (Fair to Good)	Taxa Richness: 6-11 Total EPT: 3-4 Total Dipteran: 1-68 (Fair)	
	1994 (Spring/ Summer/ Fall)	Audubon Naturalist Society	Not given in source	Modified RBP II	excellent/good/fair/ good		Taxa Richness: 7-14 Total EPT: 2-3 Total Dipteran: 17-34 (Fair)	Taxa Richness: 7-11 Total EPT: 2-3 Total Dipteran: 15-25 (Fair)	
	1995 (Winter/ Spring/ Summer/ Fall)	Audubon Naturalist Society	Not given in source	Modified RBP II	excellent/good/fair/ poor		Taxa Richness: 17-18 Total EPT: 5 Total Dipteran: 17-47 (Fair)	Taxa Richness: 11-14 Total EPT: 4-9 Total Dipteran: 4-38 (Fair)	

Summary of Watts Branch Stream Monitoring (Continued)

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Macro-invertebrates	1996 (Winter/ Spring/ Fall)	Audubon Naturalist Society	Not given in source	Modified RBP II	excellent/good/fair/ poor	Taxa Richness: 2-16 Total EPT: 0-6 Total Dipteran: 6-47 (Fair)	Taxa Richness: 1-6 Total EPT: 0-12 Total Dipteran: 5-26 (Poor)	Taxa Richness: 3 Total EPT: 5 Total Dipteran: 1 (Poor)	
	1996-1997	Loiderman	Rapid Bioassess-ment; kicknet	HBI[9]	excellent/good/fair/ poor	Fair; Characterize d as pollution tolerant community			
	1997	EA	Kicknet	RBP[10]	excellent/good/fair/ poor	poor invertebrate community at 6 stations			
	1997 (Winter)	Audubon Naturalist Society	Not given in source	Modified RBP II	excellent/good/fair/ poor	Taxa Richness: 2 (Fair) Total EPT: 0 Total Dipteran: 26 (Poor)			
	1996 (Spring)	MCDEP	Mont. Co. Protocol	IBI	mostly good 3 subsheds in fair	Fair	Lower Sandy fair-good, rest fair	West Piney & Upper Piney good, rest fair	Fair
Habitat, Qualitative	1993 (Spring/ Summer/ Fall)	Audubon Naturalist Society	Visual	RBP	excellent/good/fair/ poor		Embedded-ness: Good Stream Cover: Good Habitat Assessment : (Good)	Embedded-ness: Good Stream Cover: Good Habitat Assessment: (Good)	

Summary of Watts Branch Stream Monitoring (Continued)

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Habitat, Qualitative	1994 (Spring/ Summer/ Fall)	Audubon Naturalist Society	Visual	RBP	excellent/good/fair/ poor		Embedded-ness: Fair to Excellent Stream Cover: Good Habitat Assessment : 36-42 (Good)	Embedded-ness: Poor to Excellent Stream Cover: Good Habitat Assessment: 26-44 (Fair to Good)	
	1995 (Winter/ Spring/ Summer/ Fall)	Audubon Naturalist Society	Visual	RBP	excellent/good/fair/ poor		Embedded-ness: Fair Stream Cover: Good Habitat Assessment : 35-39 (Fair to Good)	Embedded-ness: Fair to Excellent Stream Cover: Good Habitat Assessment: 27-40 (Good)	
	1996 (Winter/ Spring/ Summer/ Fall)	Audubon Naturalist Society	Visual	RBP	excellent/good/fair/ poor	Embedded-ness: Good Stream Cover: Fair Habitat Assessment: 42 (Fair to Good)	Embedded-ness: Good to Excellent Stream Cover: Fair Habitat Assessment : 39-41 (Fair)		
	1994-1996	MCDEP	Mont. Co. Stream Protocols	Rapid Habitat Assess-ment; also, see Protocols	good/with some fair habitat areas	Fair	Fair	Good	Fair
	1996-1997	Loiderman	not specified	not specified	excellent/good/fair/ poor	fair			
	1997	Biohabitats	Stream Survey	RSAT[11]	excellent/good/fair/ poor	good to fair	good to fair	good to fair	good to fair

Summary of Watts Branch Stream Monitoring (Continued)

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Habitat, Qualitative	1997	EA	Visual	RBP	optional/suboptimal/marginal/poor	6 stations ranging from marginal to suboptimal			
	1997 (Winter)	Audubon Naturalist Society	Visual	RBP	excellent/good/fair/good	Embedded-ness: Fair to Good Stream Cover: Fair Habitat Assessment: 41 (Fair)			
Fish	1972-1974	Ragan & Dietemann 1976	seine & electro-fishing[12]	species diversity[13]	narrative				overall good diversity, eastern portions in urban area have reduced diversity
	1990 (Fall)	MD DNR	Not given in source	Not given in source	excellent/good/fair/poor	Taxa Richness: 6 (Fair)	Taxa Richness: 16-17 (Good to Excellent)	Taxa Richness: 9 (Fair)	
	1990	MD DNR	Electo-fishing	Not specified	excellent to good	Taxa Richness: 7	Taxa Richness: 16	Taxa Richness: 9-17	
	1993 (Spring/ Summer/ Fall)	Audubon Naturalist Society	Dipnet	Not given in source	excellent/good/fair/poor		Taxa Richness: 1-2 (Poor to Fair)		
	1995 (Spring)	Audubon Naturalist Society	Dipnet	Not given in source	excellent/good/fair/poor		Taxa Richness: 1 (Poor)		
	1994-1997	MCDEP	Protocols	IBI	excellent/good/fair/poor	Fair to Good	Good	Fair to Good	Fair to Good
	1997 (Spring)	EA	Electro-fishing		Fair	6 stations, fair for fish			

Summary of Watts Branch Stream Monitoring (Continued)

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Chemical and Physical Water Quality	1972	MCDEP (1974)	Grab[14] samples	9 parameters	excellent/good/fair/ poor			good	Good (Location unknown)
	1972-1973	MCDEP (1974)	Grab samples	9 parameters	excellent/good/fair/ poor				Good/ Excellent
	1969-1973	MCDEP (1973)	Not specified	9 parameters	excellent/good/fair/ poor			good	Good
	1972-1974	Ragan & Dieteman (1976)		9 parameters	excellent/good/fair/ poor				Excellent
	1974	MCDEP (1975)	Grab samples	9 parameters	excellent/good/fair/ poor				Excellent (Location unknown)
	1975	MCDEP (1976)	Grab samples	9 parameters	excellent/good/fair/ poor				Excellent (Location unknown)
	1976	MCDEP (1976)	Grab samples	9 parameters	excellent/good/fair/ poor	permissible	permissible	permissible	Excellent (Location unknown)
	1977	MCDEP (1978)	Grab samples	9 parameters	excellent/good/ permissible/fair/ poor			permissible	permissible
	1977	MCDEP (1976)	Grab samples	9 parameters	excellent/good/fair/ poor	permissible	permissible	permissible	Permissible (Location unknown)
	1978	MCDEP (1976)	Grab samples	9 parameters	excellent/good/fair/ poor	permissible, improved relative to previous year	permissible	good	Permissible (Location unknown)
	1979	MCDEP (1976)	Grab samples	9 parameters	excellent/good/fair/ poor	permissible	permissible	permissible	Permissible (Location unknown)

Summary of Watts Branch Stream Monitoring (Continued)

Parameter Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Watts Branch Subwatersheds			
						Upper Watts	Lower Watts	Piney Branch	Mainstem
Chemical and Physical Water Quality	1979	MCDEP (1980)	Grab samples	9 parameters	excellent/good/ permissible/fair/ poor			permissible	permissible
	1980	MCDEP (1981)	Grab samples	9 parameters	excellent/good/ permissible/poor			permissible	permissible
	1991-1993	MDE 1994	trend data	compare to MD standards	excellent/good/fair/ poor	permissible, degraded relative to previous year	permissible, degraded relative to previous year	permissible, improved relative to previous year	good
	1993	Audubon Naturalist Society	Temp/pH meter[15]	2 parameters	excellent/good/fair/ poor				
	1994	Audubon Naturalist Society	Temp/pH meter	2 parameters	excellent/good/fair/ poor				
	1995	Audubon Naturalist Society	Temp/pH meter	2 parameters	excellent/good/fair/ poor				
	1996	Audubon Naturalist Society	Temp/pH meter	2 parameters	excellent/good/fair/ poor				
	1996-1997	Loiderman	Grab samples	6 parameters	narrative	consistent with Use I designation			
	1996-1997	Biohabitats	various standard equipment	6 parameters	generally consistent with Use I designation	good	good	good	good
	1997	EA	+Hydrolab	5 parameters	narrative	consistent with Use I designation			
	1997	Audubon Naturalist Society	Temp/pH meter	2 parameters	excellent/good/fair/ poor	fair	good	good	fair
	1994-1997	MCDEP	Mont. Co. Protocols[16]	See protocols	within Use I criteria	consistent with Use I designation			

Summary of Watts Branch Stream Monitoring (Continued)

Notes:

1. Method or equipment used to collect the referenced sample information in the field.
2. Approach to analyze collected information following a standard or identified methodology.
3. Stream condition characterization attempts to provide the range of possible characterizations included in the methodology used. In some instances, no standard terminology is used.
4. D-net for 90 seconds, refers to the collection of invertebrates using a D-frame dip net for a period of 90 seconds. The effort (90 seconds of sampling) standardizes this qualitative sampling technique.
5. Modified RBP III refers to EPA's Rapid Bioassessment Protocol, level III (Plafkin et al. 1988), which uses genus level invertebrate analysis.
6. Surber and kicknet samplers are devices used to quantitatively and qualitatively, respectively, collect macro invertebrates in shallow riffle areas of streams.
7. Information on sampling methodology not provided in source document.
8. Modified RBP II refers to EPA's Rapid Bioassessment Protocol, level II (Plafkin et al. 1988), which uses family level analysis of the invertebrate community.
9. Index of Biotic Integrity, as per Montgomery County Stream Monitoring Protocols (Van Ness, et al, 1997).
10. Maryland Rapid Bioassessment Protocol (Primrose 1991) is a quick and cost-effective standardized methodology for evaluating aquatic resources based on the EPA's methodology (Plafkin et al. 1988).
11. Modified Rapid Stream Assessment Technique is a method developed by Washington Council of Governments (1992).
12. Seine and electro-fishing are two common methods used for fish sampling.
13. Species diversity evaluates the relationship between the number of species present and the number of individuals present.
14. Grab samples consist of a sample (s) collected at a specific point in time.
15. Meters used to measure one or more water quality characteristics, including temperature, dissolved oxygen pH, conductivity, etc.
16. Montgomery County Stream Monitoring Protocols (Van Ness, et al, 1997).

Summary of Cabin John Stream Monitoring

Table A-9

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Cabin John Subwatersheds			
						Old Farm Creek	Booze Creek	Thomas Branch	Cabin John Mainstem
Macro-invertebrates	1989-1991	MDE July 1991	surber[4]	Md RBP	unimpaired; moderately impaired; impaired; narrative				good
	1991-1993	MDE 1994	surber		unimpaired; moderately impaired; impaired; narrative				fair; habitat unimpaired; biological community severely impaired
	1992-1995	Galli et al 1996	not given	RSAT[5]; verbal rating[6]	excellent/good/fair/poor	3.9-fair	1.2-poor	3.6-fair	one minor trib was rated 7-excellent, generally good to fair condition
	1996	MCDEP	Mont. Co. protocols	IBI as per protocols	excellent/good/fair/poor	fair to poor	poor	poor	fair to poor
Fish	1899-1944	multiple, *in:* Dietemann 1975	not listed	diversity & abundance	narrative				good; 23 sp., minimal diff. among studies over time
	1974	Dietemann 1975	seine, electro-fishing[8]	diversity & abundance, compared to historic data	narrative				fair to good; 18 sp., most in upper reaches, only pollution tolerant species collected in lower reaches
	1972-1974	Ragan & Dietemann 1976[9]	seine & electro-shock	species diversity compared to historic conditions	narrative				species diversity has been reduced to fair to good; most species collected were found in the headwaters, diversity is very low in lower reaches

Summary of Cabin John Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Cabin John Subwatersheds			
						Old Farm Creek	Booze Creek	Thomas Branch	Cabin John Mainstem
Fish	1996	MCDEP	Mont. Co. protocols	IBI as per protocols	excellent/good/fair/ poor	fair	poor	poor	good
	1993	Galli and Trieu 1994	field survey	RSAT	excellent/good/fair/ poor	good			fair, with a few areas classified as good
Chemical and Physical Water Quality	1969-1973	MDE 1974	not specified	compare to MD standards, 9 parameters	excellent/good/fair/ poor		poor		
	1969-1973	MCDEP 1973	not specified; data summary	9 parameters	excellent/good/ fair/poor		poor		poor
	1970-1973	MCDEP 1974	standard	compare to MD standards, reference stream, prof. judgement	excellent/good/fair/ poor				poor due to public sewer overflow
	1974-1975	MCDEP 1976	standards	see MCDEP 1974	excellent/good/fair/ poor				fair/poor
	1976	MCDEP 1977	standards	WQI Rating	excellent/good/ permissible/poor/bad				permissible
	1977	MCDEP 1978	standards	WQI Rating	excellent/good/ permissible/poor/bad				permissible
	1978	MCDEP 1979	standards	WQI Rating	excellent/good/ permissible/poor/bad				permissible
	1979	MCDEP 1980	standards	WQI Rating	excellent/good/ permissible/poor/bad				permissible
	1980	MCDEP 1981	standards	WQI Rating	excellent/good/ permissible/poor/bad				permissible

Summary of Cabin John Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Cabin John Subwatersheds			
						Old Farm Creek	Booze Creek	Thomas Branch	Cabin John Mainstem
Chemical and Physical Water Quality	1974-1975	MDE 1976	not specified	compare to MD standards, 9 parameters	excellent/good/ permissible/poor/bad		poor		
	1976	MDE 1977	not specified	compare to MD standards, 9 parameters	excellent/good/ permissible/poor/bad		fair to poor		
	1977	MDE 1978	not specified	compare to MD standards, 10 parameters	excellent/good/ permissible/poor/bad		permissible		permissible
	1978	MDE 1979	not specified	compare to MD standards, 10 parameters	excellent/good/ permissible/poor/bad		permissible, improved relative to previous year		permissible
	1979	MDE 1980	not specified	compare to MD standards, 10 parameters	excellent/good/ permissible/poor/bad		good		good
	1980	MDE 1981	not specified	compare to MD standards, 10 parameters	excellent/good/ permissible/poor/bad		good		permissible, degraded relative to previous year
	1971-1979	CH2M Hill 1982	standard	meet MD Class I water standards[10]	narrative		meets standards except fecal/pH		fair to good, except for fecal coliform, pH
	1977-1985	MDE 1988	not specified	compare to MD standards	increasing trend, no trend, decreasing trend				trend of degrading water quality based on TSS

Summary of Cabin John Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Cabin John Subwatersheds			
						Old Farm Creek	Booze Creek	Thomas Branch	Cabin John Mainstem
Chemical and Physical Water Quality	1985-1987	MDE April 1988	not specified	compare to MD standards	narrative				good, meets Class I standards
	1989-1991	MDE July 1991	trend data	compare to MD standards	excellent/good/fair/ poor				fair; high bacteria, nutrient and TSS
	1989-1991	MDE 1993	trend data	compare to MD standards	excellent/good/fair/ poor				high bacterial, nutrient, and suspended sediment levels; benthic macro inverte-brate community indicate good water quality
	1991-1993	MDE 1994	trend data	compare to MD standards	excellent/good/fair/ poor				fair; high bacteria, nutrient and TSS
	1993	Galli and Trieu 1994	field survey	RSAT	excellent/good/fair/ poor	fair			good-fair
	1992-1995	Galli et al 1996	TDS, substrate fouling	RSAT; verbal rating	excellent/good/fair/ poor	good/ poor	poor/poor	fair/poor	fair/poor
	1996	MCDEP	Mont. Co. protocols		met Use I standards				
Habitat Condition Qualitative and Quantitative	1993	Galli and Trieu 1994	field survey	RSAT	excellent/good/fair/ poor	fair to good			fair
	1994-1995	Audubon Naturalist Society	field survey	Mont. Co. Monitorin g Methods[11]	excellent/good/fair/ poor				marginal to suboptimal
Habitat Condition Qualitative and Quantitative	1992-1995	Galli et al 1996	TDS, substrate fouling	RSAT; verbal rating	excellent/good/fair/ poor	fair	fair	fair	fair

Summary of Cabin John Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Cabin John Subwatersheds			
						Old Farm Creek	Booze Creek	Thomas Branch	Cabin John Mainstem
	1996	DEP and MNCPPC 1997	Mont. Co. protocols	Mont. Co. protocols	optional - poor	good	good	fair	good to poor

Notes:

1. Method or equipment used to collect the referenced sample information in the field.
2. Approach to analyze collected information following a standard or identified methodology.
3. Stream condition characterization attempts to provide the range of possible characterizations included in the methodology used. In some instances, no standard terminology is used.
4. Surber samplers are devices used to quantitatively collect macro invertebrates in shallow riffle areas of streams.
5. Modified Rapid Stream Assessment Technique is a method developed by Washington Council of Governments (1992).
6. Verbal rating is a subjective summary of a number of objective indices for a particular stream.
7. Species diversity evaluates the relationship between the number of species present and the number of individuals present.
8. Seine and electro-fishing are two common methods used for fish sampling.
9. It appears that the same data were presented in Dietemann 1975 and Ragan & Dietemann 1976. No specific confirmation was found.
10. Comparison of collected water quality to water quality standards established for the State of Maryland's Use I designated surface waters.

Summary of Rock Run Stream Monitoring

Table A-10

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Rock Run Mainstem
Macro-invertebrates	1991-1992	Dewberry and Davis	Surber and Seine, 4 stations	Diversity and Abundance	narrative	good condition, pollution-tolerant invertebrates dominate
	1996	MCDEP	Mont. Co. Protocols	Mont. Co. IBI	excellent/good/fair/ poor	poor; invertebrates impaired by water quality
Fish	1912	McAtee & Weed 1915, in Dietemann 1975	Not listed	Diversity and abundance[5]	narrative	excellent; 21 species collected
	1974	Dietemann 1975	seine, electro-fishing[6]	Diversity and abundance, comparison to historic data	narrative	excellent; 21 species (some different from 1912); minimal land use change from 1912 sample
	1996	MCDEP	Mont. Co. Protocols	IBI as in protocols	excellent/good/fair/ poor	Upper - Poor Lower - Fair
	1972-1974	Ragan & Dietemann 1976	seine & electro-shock	species diversity compared to historic conditions	narrative	excellent species diversity
Chemical and Physical Water Quality	1971-1979	CH2M Hill 1982	standard	comparison with MD Class I water standards[7]	narrative	pH violations were 6 of 122 readings, none after 1972; fecal coliform exceeded standards in more than 50% of readings
	1970-1973	MCDEP 1974	standard	compare to MD standards, reference stream, prof. judgement	excellent/good/fair/ poor	good/excellent
	1974-1975	MCDEP 1976	standards	see MCDEP 1974	excellent/good/fair/ poor	good/excellent
	1976	MCDEP 1977	standards	WQI Rating	excellent/good/ permissible/poor/bad	good
	1977	MCDEP 1978	standards	WQI Rating	excellent/good/ permissible/poor/bad	permissible (intermediate)

Summary of Rock Run Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Rock Run Mainstem
Chemical and Physical Water Quality	1978	MCDEP 1979	standards	WQI Rating	excellent/good/ permissible/poor/bad	good
	1979	MCDEP 1980	standards	WQI Rating	excellent/good/ permissible/poor/bad	permissible (intermediate)
	1980	MCDEP 1981	standards	WQI Rating	excellent/good/ permissible/poor/bad	good
	1969-1973	MDE 1974	not specified	compare to MD standards, 9 parameters	excellent/good/fair/ poor	good
	1974-1975	MDE 1976	not specified	compare to MD standards, 9 parameters	excellent/good/fair/ poor	good to excellent
	1976	MDE 1977	not specified	compare to MD standards, 9 parameters	excellent/good/fair/ poor	good to excellent
	1977	MDE 1978	not specified	compare to MD standards, 10 parameters	excellent/good/fair/ poor	good
	1978	MDE 1979	not specified	compare to MD standards, 10 parameters	excellent/good/fair/ poor	permissible, degraded relative to previous year
	1979	MDE 1980	not specified	compare to MD standards, 10 parameters	excellent/good/fair/ poor	good
	1975	MNCPPC	not specified; data summary	5 parameters	excellent/good/fair/ poor	excellent
	1972	Ragan & Dietemann 1976	grabs	9 parameters	excellent/good/fair/ poor	excellent
	1980	MDE 1981	not specified	compare to MD standards, 10 parameters	excellent/good/ permissible/poor/bad	permissible

Summary of Rock Run Stream Monitoring (Continued)

Parameters Studied	Year of Data Collection	Source	Sampling Method[1]	Analysis Method[2]	Stream Condition Characterization[3]	Rock Run Mainstem
Habitat Conditions Qualitative	1991-1992	Dewberry and Davis	grab samples, 4 stations	comparison to upstream and downstream reference stations	narrative	good condition
	MCDEP	Mont. Co. protocols	as in protocols	met Use I criteria		
	1995	Audubon Naturalist Society	visual	Mont. Co. protocols	optimal to poor	good to excellent
	1997	MCDEP	rapid habitat assessment	Mont. Co. protocols	optimal to poor	generally good

Notes:

1. Method or equipment used to collect the referenced sample information in the field.
2. Approach to analyze collected information following a standard or identified methodology.
3. Stream condition characterization attempts to provide the range of possible characterizations included in the methodology used. In some instances, no standard terminology is used.
4. Montgomery County Water Quality Monitoring Program Stream Monitoring Protocols. 1997.
5. Species diversity evaluates the relationship between the number of species present and the number of individuals present. Abundance refers strictly to the number of organisms sampled or the number extrapolated to an area (e.g., number per square meter)
6. Seine and electro-fishing are two common methods used for fish sampling.
7. Comparison of measured water quality parameter values to published standards for Maryland Use I designated waters.