october 1995

TECHNICAL REPORT

Upper Paint Branch

WATERSHED PLANNING STUDY

The Maryland-National Capital Park & Planning Commission
Montgomery County Planning Department

8787 Georgia Avenue ✦ Silver Spring, Maryland 20910-3760

Abstract

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Abstract	This report documents the current conditions of the upper Paint Branch stream system, projecting future conditions through analysis of current and potential recommendations formulated by an interagency work group for employing various watershed management measures within each major subwatershed within this area.

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2. The acquisition, development, operation, and maintenance of a public park system; and

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Executive Summary

This study examines the body of knowledge on the urbanization impacts on the water resources of Paint Branch, estimates future impacts, and formulates a land use and regulatory strategy to preserve these resources. It is intended to be used to help develop land use recommendations in the current updates to the *1981 Eastern Montgomery County Master Plan* and to help guide modifications to current environmental regulations, guidelines, and programs to ensure the continuing protection of the Paint Branch system.

The Paint Branch supports a naturally-reproducing brown trout population, which has been recognized and monitored since the early 1970's. This long-term presence of a self-sustaining trout fishery makes Paint Branch a unique, high quality resource for Montgomery County. The *1981 Eastern Montgomery County Master Plan* recognizes the fishery as being so valuable for the County that special measures to protect the resource were adopted as part of the Plan. In addition, in July, 1995, the Montgomery County Council designated the upper Paint Branch as a Special Protection Area to enable the application of more rigorous water quality protection measures for new development.

Extensive monitoring of the stream system for over 20 years, primarily by the Maryland Department of Natural Resources, indicate that the critical part of the system, namely the stream system north of Fairland Road (i.e., upper Paint Branch), is experiencing increasing stress within roughly the past 5 to 10 years. This study's examination of land use and land cover changes within the watershed, represented in part by impervious cover, shows that the upper watershed has experienced some development since the adoption of the *1981 Master Plan*. Even with the limited amount of development, the small streams that make up the Paint Branch system only have limited and finite abilities to absorb and withstand adverse conditions imposed on them before the system irreversibly degrades and the unique resource is lost.

The increased stress documented in upper Paint Branch is attributed to many factors. Generally, these include: cumulative adverse impacts of uncontrolled stormwater runoff from individual, small developments that add to uncontrolled runoff from larger subdivisions predating stormwater management regulations; continuing loss of forest cover in the watershed; increasing impervious cover in the watershed; and limited effectiveness of engineered best management practices.

From the information and analysis presented in this study, it is concluded that **degradation to the Paint Branch system and irreversible damage to its natural resources, including the brown trout fishery, will occur if significant modifications are not made to the 1981 Master Plan land uses and to existing environmental regulations and guidelines governing new and existing development within the watershed.**

This study presents recommendations to protect the brown trout fishery and other natural resources of Paint Branch over the long term. These recommendations have been formulated by a technical work group consisting of representatives of State and County environmental regulatory and resource management agencies. These agencies include the Maryland Department of Natural Resources (DNR), the Maryland Department of the Environment, Metropolitan Washington Council of Governments, Interstate Commission on the Potomac River Basin, M-NCPPC Montgomery County Planning

Department and Department of Parks, Montgomery County Department of Environmental Protection (DEP), and Montgomery County Office of Planning Implementation.

The recommendations to protect Paint Branch follows a comprehensive watershed-based, stream system approach and include the following components:

- **The highest level of preservation and protection of natural areas within the most critical and fragile areas of the Paint Branch watershed. This involves park acquisition of much of the remaining developable land in Good Hope and Gum Springs tributaries, the two most important trout-spawning and nursery streams in the system. It also involves park acquisition of key properties or parts of properties in the Left Fork and Right Fork tributaries in order to preserve the high quality, cold baseflow features of these streams and to minimize the ability of existing and future land development activities to degrade the streams.**

- **More stringent control and management of the location and amount of future impervious cover and the associated land disturbance and land cover changes in the less critical and less fragile parts of the watershed through a combination of an environmental overlay zone and the application of the Special Protection Area (SPA) Law and the 1981 Master Plan Performance Criteria for new development.**

- **Increased efforts for identification and implementation of solutions to current problem areas and stressed conditions in the stream system.**

- **Development of an upper Paint Branch watershed management plan that integrates the various programs, policies, and regulatory and implementation tools into a comprehensive plan for long-term protection of the stream system. Such a plan could be part of an SPA Conservation Plan that DEP is proposing to develop for the watershed.**

Introduction

The *1981 Eastern Montgomery County Master Plan* recognized the importance of land use planning in maintaining water quality in watersheds and established watershed protection as a major goal. It states that "to protect the water quality and quantity of the Anacostia and Patuxent River basins, sound watershed management needs to be practiced to improve existing conditions and control future development" (M-NCPPC, 1981). Recommendations are set forth in the 1981 master plan to reduce negative impacts of human activities on watersheds and help protect stream systems.

The 1981 master plan recognized the importance of the Paint Branch, in particular, as a critical resource for the County, and more specifically, the brown trout fishery in Paint Branch as a feature so valuable as a water quality indicator and unique as a natural resource for the County that special measures were required to protect it. The *Plan* recommended certain amounts of development activity in the watershed, but also recommended special measures, including downzoning in the upper Paint Branch watershed, to achieve a low ultimate impervious land cover. These measures included limiting land disturbance and forest cover loss, recommending additional park acquisition, and the incorporation of extraordinary best management practices in land development projects. It was thought that recommendations of the *Master Plan* would help provide the necessary environmental protection to ensure the continued integrity of the cold water resource.

A. Purpose and Scope of Study

This study comprehensively examines the body of knowledge gained since the adoption of the 1981 master plan on urbanization impacts on the water resources of Paint Branch, estimates future impacts, and formulates a land use and regulatory strategy to ensure continuing protection of these resources. This study is intended to be used in two ways: to help develop land use recommendations in the Paint Branch watershed as part of the work for the Cloverly, White Oak, and Fairland Master Plans and to help guide modifications to current County environmental regulations, guidelines, and programs, as they apply to Paint Branch.

To identify what watershed management measures are needed in Paint Branch, the study looks at the following questions:

- What are the past and current conditions of the streams in Paint Branch?
- What changes in the health and conditions of the streams have been documented over time and how are these changes related to changes in the land uses within the subwatersheds of Paint Branch?
- What are the projected changes in the health and conditions of the various streams if the subwatersheds are developed according to the 1981 master plan, as amended in 1990, land use recommendations?

- Are the projected changes in the streams under the 1981 master plan, as amended, within limits that are acceptable for protection of Paint Branch?

- If the recommendations in the 1981 master plan, as amended, are not adequate to protect the natural resources of Paint Branch, what watershed management measures should be implemented to provide the appropriate level of protection?

B. Description of the Upper Paint Branch Stream System

The Paint Branch is a moderate-sized, fourth order stream. The upper Paint Branch, defined as being roughly upstream of Fairland Road, exhibits high water and habitat quality. These high quality conditions can be seen in the various animal and plant life that live in the stream. One indication of high quality conditions is the presence of large numbers of individuals and variety of different species. This includes species sensitive to pollution such as certain macro-invertebrates. Another, more well-known indicator of a high quality stream system, is the presence of a naturally-reproducing brown trout population.

The presence of brown trout in Paint Branch makes this stream system a unique resource for the County because it is the only stream system in Montgomery County with a *proven, consistent, long-term self-sustaining* trout population. (The other Use III streams are also important and valuable but they have been stocked with juvenile trout in the recent past to supplement low numbers of trout or to establish self-sustaining populations). A self-sustaining trout population had been documented in 1973 and possibly as far back as the late 1930's (Gougeon, 1985). The Paint Branch's ability to support continuously this fishery resource reflects its long history of high quality conditions and its importance in the County's "collection" of unique and valuable natural resources. An excellent and more detailed characterization of Paint Branch can be found in a compendium put together in the early 1980's (Galli, 1983).

The brown trout fishery in Paint Branch extends from the upper reaches of the stream system near Spencerville Road (MD 198) down to the mainstem at I-495 (the Capital Beltway). The individual streams in Paint Branch form a network and have inter-related roles and functions in supporting a naturally-reproducing trout fishery. For Paint Branch to remain in a condition that can maintain the trout fishery, the entire stream system must be managed to ensure that high quality conditions are preserved; it is not sufficient to protect only some of the streams in the system.

Paint Branch downstream of Fairland Road supports limited numbers of juvenile (known as young-of-year) and adult trout down to US 29, and only adult trout down to I-495. The numbers of adult trout decline downstream because the quality of the water and habitat become less suitable for the trout. Much of the lower Paint Branch has been developed at fairly high densities with associated high impervious cover; this pattern of land use has significantly degraded the downstream sections of the stream system, as compared to the upper sections. Although the lower Paint Branch's quality is not as high as the upper Paint Branch, it is still important to maintain ***and improve*** the conditions in lower Paint Branch to ensure that the stream quality remains high enough to sustain a viable adult trout population in this part of the stream system.

The highest quality conditions and most critical part of the stream system occur in the upper Paint Branch, defined as that part of the system roughly north of Fairland Road. The majority of high quality trout habitat exists here, as does a large part of the watershed's seeps, springs, and wetlands that contribute to the cold, steady, high quality stream baseflow of the system. Many of the streams in upper Paint Branch, especially those tributaries that are critical to the brown trout population, historically share several common characteristics: cold steady stream baseflow; relatively low pollutant, sand, silt, and sediment loads; stream channel and bank erosion changes that are near natural levels; abundance of clean riffle/pool/run segments; high abundance and diversity of aquatic macroinvertebrates; and near stream vegetation largely composed of forest cover.

In addition to the mainstem above Fairland Road, there are four trout spawning/nursery tributaries that support the brown trout fishery located in upper Paint Branch:

Good Hope Tributary

Good Hope Tributary is responsible for the greatest, most consistent natural reproduction of brown trout in Paint Branch. Unlike any other portion of Paint Branch, it has been successful in recruiting young-of-the-year trout each year for the past 16 years (1979 to 1994) (Gougeon, 1994). Roughly 75 percent of trout young-of-year are produced in Good Hope Tributary each year.

Gum Springs Tributary

Gum Springs Tributary is the second most important trout spawning and nursery stream in Paint Branch. It has historically supported significantly more trout reproduction than it currently does. The upper Gum Springs (upstream of the Oak Springs tributary) is of very high quality, both from a habitat and water quality perspective. The lower Gum Springs has been significantly degraded due to subdivisions that were constructed between 1980 and 1987; heavy sediment input during the construction phases has severely degraded trout spawning habitat in lower Gum Springs. In addition, the Oak Springs stormwater management (SWM) facility is a continuing source of high volumes of warm water to the stream during the summer months, when warm water temperatures can become a limiting factor for the survival of trout in Paint Branch.

Right Fork Tributary

The Right Fork has the highest water quality of all the streams in Paint Branch. It is important to the stream system as a source of high quality water for the downstream sections of the system. This high quality water is important in providing suitable conditions for adult trout to live in the mainstem. It supports limited trout spawning, but not as much as in Good Hope or Gum Springs Tributaries because it does not naturally have as much adult trout habitat (e.g., at baseflow conditions, streamflow is low and there are few quality deep pools with overhead cover created at undercut stream banks) (Gougeon, 1995).

Left Fork Tributary and Mainstem

In addition to the three tributaries that provide the majority of the trout spawning and nursery areas, there are other parts of the stream system that play an important role in the maintenance of the trout fishery. The Left Fork Tributary and the mainstem above Fairland Road help maintain high quality conditions in upper Paint Branch. Left Fork Tributary is not consistently used as a trout spawning and nursery area. However, it is of high enough quality to provide limited young-of-year and adult trout habitat. The mainstem above Fairland Road, which is fed by the above four major tributaries and some smaller, minor tributary streams, also provides high quality conditions for adult trout; and in the past, it has been documented by DNR to provide some limited trout spawning and nursery areas.

The inter-related and sometime overlapping functions that these streams provide for the brown trout gives the trout the resiliency and redundancy it needs to maintain a healthy population. This network of high quality streams also provides other aquatic life with a similar ability to be resilient and maintain healthy and diverse populations.

Watershed Planning

A. The Importance of a Healthy Stream Ecosystem[1]

Today, it is generally recognized that clean water is essential for the health and functioning of an ecosystem, including that in which the human population is a part of. That is, the quality of water affects the health and well-being of plant and animal life, including people. Historically, the restoration and protection of water quality has grown in importance as our understanding of the complex processes involved in both the maintenance of healthy, functioning ecosystems and the mechanisms of degradation has improved.

1. Legislative Efforts to Protect Water Quality and Water Resources

a. Federal

The need for protecting our water resources is reflected in both federal, state, and local laws and regulations. At the national level, the Federal Water Pollution Control Act of 1948 (which regulates dumping and disposal into navigable waters), the Water Quality Act of 1965 (which created ambient water quality standards for interstate waters), and the Federal Clean Water Act (1972 and amended in 1987; this act deals with point and non-point source water pollution, wetlands, and protection of aquatic life) form the basis for efforts to protect water quality and water resources.

[1] An ecosystem is a complex of the plants and animals and the physical environment of an area and their interactions.

b. State

State and local laws and programs have been formulated to address issues of protecting regional and local water resources. The restoration of water quality and plant and animal communities in the regional resources of the Chesapeake Bay and its tributary waters, such as the Anacostia River, have been the focus of many state and local laws and programs. These regional waters provide significant economic and recreational resources.

Initiatives to protect and restore the Chesapeake Bay, the nation's largest and most productive estuary, began in the early 1980's. As a result of extensive data documenting the decline of the Bay's health, the Chesapeake Bay Agreement of 1983 was formulated. This agreement is a commitment by the states of Pennsylvania, Maryland, and Virginia, the District of Columbia, and the U.S. Environmental Protection Agency to restore and protect the Bay through correcting existing pollution problems and avoiding new ones that affect the Bay. This regional commitment to clean up the Bay is an important framework on which other regional, state, and local water resource legislation and programs rest.

c. Local

(1) Anacostia Restoration

Locally, the Anacostia River has also been the focus of extensive restoration and protection efforts. In the 1970's, the Anacostia River was designated a scenic river under the Maryland Scenic and Wild Rivers Act (Md. DNR, undated). In 1984, the first Anacostia Watershed Restoration Agreement was signed by the State of Maryland and the District of Columbia. It outlined the initial steps to restore the Anacostia. In 1987, Prince George's and Montgomery Counties were added in a new partnership created by the second Anacostia Watershed Restoration Agreement. This second agreement formalized a cooperative partnership and resulted in significant progress. The agreement called for the formation of an Anacostia Watershed Restoration Committee (AWRC) to develop a restoration plan and coordinate the efforts of the various local, state, and federal agencies to ensure the plan's rapid implementation. The restoration plan, entitled *A Commitment to Restore Our Home River: A Six-Point Action Plan to Restore the Anacostia River* (Anacostia Restoration Team, November 1991), was adopted by the four jurisdictions involved in the agreement in 1991; the action plan provides specific goals and detailed strategies for restoring the river by the turn of the 21st century.

More recently, in 1994, the Anacostia River was listed as a threatened river by the American Rivers, a national conservation organization dedicated to protecting and improving American rivers. The designation is an upgrade over its 1993 status of endangered and reflects the extensive efforts of many jurisdictions to restore the river system. In addition, the Clinton Administration has designated the Anacostia River a priority ecosystem and the U.S. Environmental Protection Agency has a established a Five-Point Action Plan to restore the watershed.

(2) Paint Branch

As a tributary of the Anacostia River, Paint Branch is subjected to the same regional and local efforts for protection and restoration as the other parts of the River under the Anacostia River watershed restoration plan. Because of the high quality conditions of its headwater streams and the presence of a naturalized, self-sustaining, brown trout fishery, Paint Branch within Montgomery County has been afforded additional protection through a number of State and County actions.

In 1974, Paint Branch and all of its tributaries upstream of the Capital Beltway were classified by the Maryland Department of Natural Resources Water Resources Administration as Use III Waters.[2] Paint Branch was the first stream system in Montgomery County to be identified as Use III. In 1980, Maryland DNR designated the Paint Branch watershed upstream of Fairland Road as a "Special Native Trout Management Area." This designation was the first of its kind in Maryland and was intentionally designed to give the streams special status and maximum protection afforded by state regulations.

The *1981 Eastern Montgomery County Master Plan* singles out the brown trout fishery in Paint Branch as a feature so valuable as a water quality indicator and unique as a natural resource for the County that special measures are required to preserve it. These special measures include rezoning to achieve a low ultimate impervious land cover and associated lower land disturbance and forest cover loss, larger park acquisition, and recommendations to incorporate extraordinary best management practices in land development projects.

The policy established in the *1981 Eastern Montgomery County Master Plan* of protecting a high quality feature of a part of the upper Anacostia River system, such as Paint Branch, is in keeping with the County's commitment to protect the Anacostia River by helping avoid degradation and possibly improving conditions in downstream sections.

In addition to the recommendations of the 1981 master plan, the County provides protection to the streams of Paint Branch under a variety of laws, regulations, and guidelines which apply to all County streams. The Planning Board applies stream buffer guidelines (Montgomery County Planning Department, 1993) for new development in the County. County requirements for stormwater management and sediment and erosion control are designed to reduce the impacts of land-disturbance activities and land development on streams and other water bodies. Under the County Forest Conservation Law, forest stands that are associated with streams are given the highest priority for protection, in recognition of the importance of forest cover in the health and function of stream systems. In addition, the County has on-going capital improvement programs to identify and improve streams that have been degraded by existing land uses.

[2] Use III waters are also identified as "Natural Trout Waters." This designation indicates that the stream system possesses the overall high quality conditions and other natural features that are able to support natural trout populations, including propagation and their associated food organisms. "Propagation" is the continuance of a species by generation of successive reproduction in the natural environment as opposed to the maintenance of the species by artificial culture and stocking.

More recently, Montgomery County has established a process to apply more rigorous water quality protection measures for new development in specific areas of the County. Effective on March 3, 1995, the County Council can designate certain areas as Special Protection Areas. Such areas are defined as containing existing water resources or other environmental features directly relating to those water resources that are of high quality or unusually sensitive, and where proposed land uses would threaten the quality or preservation of the resources in the absence of special water quality protection measures.

On July 11, 1995, the County Council designated the Upper Paint Branch as a special protection area. As part of this designation, the Council established that new development would be subject to combined application of the SPA legislation and performance criteria set forth in the *1981 Eastern County Master Plan.*

2. Characteristics of a Healthy Stream Ecosystem

A stream system includes not only the stream channel itself, but is also defined by the freshwater wetlands, floodplains, near-stream area, seeps, and springs that are linked to the stream. A healthy stream has high water quality and supports a diverse plant and animal life. It has a fairly even and regular flow of water which is derived mostly from groundwater.[3] (This groundwater-derived flow of water in a stream is known as baseflow). Some of this groundwater enters the stream by way of wetlands, springs, and seeps.

Ideally, the stream carries relatively low sand, silt, and sediment loads. There should be relatively low occurrences of in-stream channel erosion. The stream channel and banks are relatively stable, although some stream bank undercutting does occur as a part of the dynamic nature of stream flows. Undercut stream banks, if not excessive, are part of a stream's natural morphology and are frequently used by fish for cover.

The stream is usually made of segments with different water flow characteristics. There should be shallow, fast-moving runs, areas with fast moving water with cobbles and rocks known as riffles, and deep, slow-moving pools. Riffles provide habitat for a variety of aquatic insect larvae and other macroinvertebrates.[4] (Macroinvertebrates are an important source of food for fish.) These riffle areas also allow oxygen to be mixed into the water, which contributes to a high level of stream productivity. Pools are used by fish for cover and protection and may provide cooler water temperatures in the warmer months.

In the Piedmont region,[5] in which almost all of Montgomery County lies, the water in a healthy stream is clear, cool (below 68°F. in the summer), and odorless. A large part of the cool water may originate from groundwater sources. Cool or cold water is important in a Piedmont stream because many stream-dwelling organisms that are intolerant to pollution are also sensitive to temperature fluctuations, especially temperature increases.

Another important component of a healthy stream system is the near-stream, or riparian, vegetation cover, especially forest. Near-stream vegetation provides stability to stream banks, reduces and filters surface stormwater runoff, and aids in maintaining recharge areas for groundwater. Forest cover along and near the stream is necessary to provide shade to the stream channel to aid in water temperature moderation. In addition, for small streams, which includes most of the streams in Montgomery County, leaf litter and woody

[3] Groundwater in the Piedmont region is derived from precipitation that infiltrates through the regolith. Regolith is a mantle of unconsolidated material beneath the ground surface that is created by rocks that have weathered in place over geologic time. This layer of regolith can be as thick as 200 feet in the Piedmont region and is made up of saprolite, soils, and alluvium. Saprolite is clay-rich residual material derived from weathering of bedrock.

Movement of water from precipitation moves downward through the regolith until it reaches the water table, which is the area of regolith and fractured bedrock that is saturated with water. Once water reaches the water table, it flows laterally to a point of discharge, which may include: seeps along steep slopes, bank and channel seepage into streams and ponds, seeps where bedrock is near the surface or where impermeable soils exist, and springs where fractures or geologic structures intersect the land surface or stream bank. Depending on the hydrology of the area, wetlands may or may not exist in these discharge areas. (Hau, 1995)

[4] Macroinvertebrates are animals without a spinal column and can be seen without the use of a microscope. Examples include insects, mollusks, worms and crayfish.

[5] The Piedmont region in Maryland is a physiographic area which is characterized by undulating topography with low knobs and ridges and numerous stream valleys. Almost the entirety of Montgomery County lies within the Piedmont region. The eastern edge of the Piedmont area in Montgomery County can be roughly marked by US 29. The remaining County land lying approximately between US 29 and the eastern County line is known as the fall line, which is a transitional area between the Piedmont and the Coastal Plain physiographic areas. Streams within the fall line are typically fast-flowing and are associated with steep-sided and narrow gorges.

debris supply the chemical energy for the stream ecosystem. Various aquatic insect larvae and crustaceans[6] feed on leaf material. These organisms are, in turn, fed upon by predatory organisms, including other macroinvertebrates (e.g., stoneflies, some caddisflies, and hellgrammites) and fish. Without an abundant and constant supply of leaf material and woody debris, the stream ecosystem changes in the mix and diversity of organisms found in the stream.

The biological communities found in a healthy stream are abundant and diverse. There is a diverse population of microbes (fungi and bacteria), aquatic insect larvae, crustaceans, and fish which make up these communities. Many of the species found in a healthy Maryland Piedmont stream can live only in cold, relatively silt-free, clean streams with steady baseflow and some variation in stream channel structure to provide habitat for different stages and functions of the species' life cycles; that is, these species can usually live and reproduce in stream systems where there are no wide fluctuations in chemical and physical conditions from those defined for a healthy stream.

B. Factors that Contribute to the Degradation of a Stream System

The cover and uses of the land that drains to a stream greatly influences the quality and health of that stream. Uses that involve extensive land disturbance, the elimination of vegetative cover, especially forest cover, and the replacement of pervious surfaces with impervious surfaces result in the degradation of the receiving stream system.

1. Change in Land Use

When a piece of land is cleared of trees, graded, and developed, several features of the land change. The natural surface water runoff storage capacity is lost by removing the protective canopy of trees, grading of natural depressions, and removal of spongy topsoil and leaf litter. With the compaction of soil and placement of impervious materials on the land (e.g., buildings, roads, sidewalks, driveways, parking lots), the natural feature of the land that enables rainfall to percolate into the soil is lost. Essentially all of the water from rainfall and other precipitation events become surface runoff that travels directly to receiving streams.

If the development of land covers a significant portion of a watershed, the receiving stream system will be adversely affected. Clearing and grading of land can generate sediment that enter the stream even with sediment and erosion control measures in place. Loss of forest cover within and around the stream valley increases the potential for unstable and eroding soils, exposes the stream to sunlight and raises water temperatures in the summer months, and eliminates the main energy source for the stream system. With the loss of forest material as an energy source, the stream system must rely on other sources, such as sunlight and algae, and the aquatic organisms that depend on leaf litter and woody material disappear.

2. Impervious Surfaces

The placement of extensive impervious surfaces in the watershed eliminates recharge areas for groundwater that feeds stream baseflow. Since impervious surfaces cover up the natural recharge areas for groundwater, more water from precipitation events (e.g., rainfall and snowfall) enters the stream as surface stormwater runoff and less as groundwater-derived baseflow. Stream baseflow becomes irregular and can be very small or eliminated during dry weather periods. Decreased baseflow reduces the ability of small streams to dilute and "neutralize" the effects of pollutants.

During warm weather (e.g., summer), extensive impervious surfaces can elevate the temperature of stormwater that travels over these surfaces prior to entering the stream, even with the use of stormwater management controls; this is because impervious surfaces absorb and reflect heat, and water travelling over these surfaces will pick up this heat. Warm stormwater runoff can adversely increase the temperatures of the receiving stream waters.

3. Stormwater Runoff

Stormwater runoff entering the streams may also be erosive and carry adverse levels of pollu-

[6] Crustaceans are a scientifically-defined group of animals with specific characteristics, including an exoskeleton (i.e., an external supportive covering), a segmented body, and the absence of a spinal column. Examples of crustaceans include lobsters, shrimp, crabs and crayfish.

tants and trash, even with stormwater management controls in place. The runoff from a developed area tends to enter a stream as a point source rather than as dispersed flow that is filtered through vegetative cover.

Increased land development and urbanization in a watershed usually results in increased pollutant-generating activities, such as motor vehicle uses (which generate oils and greases, metals, salts, sand, etc.), care and maintenance of lawns and other landscaped areas (which generate pesticides, fertilizers, etc.), use and disposal of various material (which generates trash), and care of pets (which generates animal waste). The higher pollutant loads often lead to lower water quality in the receiving streams; many times, this lower quality is in violation of state water quality standards that are designed to protect the streams. Some of these pollutants can also cause lower dissolved oxygen levels in the receiving streams, which can be detrimental to many aquatic species.

4. Sediment Loads

To adjust to increases in stormflows due to increased impervious surfaces in the watershed, a stream will widen its channel, creating higher sediment loads and severely disturbing the stream bank area through undercutting, treefall, and slumping. Much of the sediment forms sandbars and silt deposits in the channel. These bars and deposits are constantly shifting and adds to the streambank erosion process by deflecting stream flows into erodible bank areas.

Increased sediment loads can reduce a stream channel's capacity to carry water; this causes lateral channel erosion to make up for this "lost" volume. In addition, increased sediment load in the stream can severely degrade or eliminate the natural runs, riffles, and pools that are present in healthy streams. This change in the stream morphology greatly reduces the diversity and availability of habitat for aquatic organisms.

The sediment may also be deposited within the small spaces between cobbles and gravels in riffle areas. This is known as embedding. Embedding greatly limits the quality and availability of spawning areas for fish, especially trout. It also reduces the circulation of water, organic matter, and oxygen to the filter-feeding aquatic insect larvae that live among and under the riffle areas.

C. Effects of Urbanization on Species Diversity and Composition of the Stream Community

The significant changes in the stream's morphology, hydrology, and water quality that occur when land development increases in a watershed degrades the health and viability of the biological community in the stream. The number and variety of species found in the stream community typically drops when the physical and chemical features of the stream degrade. Species that need steady, cold, clean, relatively silt-free stream flow often cannot go through parts or all of their life cycles in degraded streams; these species, which have relatively narrow ranges of tolerances of stream conditions, may be greatly reduced in numbers or disappear altogether in a degraded stream.

Species that have narrow tolerances for degraded stream conditions are often used as indicators, or "markers," for the overall good health of a stream. Examples of these indicator species include certain aquatic insect larvae such as stoneflies (Plecoptera order[7]) and certain species of mayflies (Ephemeroptera order) and caddis flies (Trichoptera order). Fish have also been used as indicators of long-term (i.e., several years) stream health because they are relatively long-lived and mobile. In Maryland Piedmont streams, trout are often used as indicators of a healthy stream.

D. Assessing Urbanization Impacts on a Stream System

1. Stream Monitoring

The health of a stream system can be documented in various ways. The ideal way is to methodically and consistently quantify the physical, chemical, and biological conditions within the streams over time. Such a monitoring program

[7] This and other scientific names referenced in this study are part of a standardized scientific classification system for plants and animals. This classification system categorizes plants and animals into a hierarchy of groups. The major types of taxonomic categories are as follows, listed in order of decreasing inclusiveness (e.g., a phylum includes a wider range of organisms than a species): kingdom, phylum, class, order, suborder, family, subfamily, genus, species.

would be able to document the water chemistry; physical features of the stream channel's shape, size, and stream bottom characteristics; and the size, composition, and diversity of the entire biological community in the stream. If the stream system degrades, the ideal monitoring program would be able to document the declining changes within the streams' physical, chemical, and biological conditions. In addition, the ideal monitoring program would also be able to track specific changes to the land uses in the watershed and pinpoint the causes of degradation to the streams.

In reality, stream systems within Montgomery County rarely have been or can be monitored in a truly comprehensive manner. This is because monitoring resources are always limited, compared to the numerous streams that should be monitored because of their potential for declining quality. Often, only certain components of the stream system are monitored, such as limited water chemistry parameters or certain groups of organisms (e.g., fish or aquatic macroinvertebrates). And the monitoring program usually is set up so that only a very limited number of widely-spaced monitoring stations can be put in place, with very limited time periods available for collecting data. Because of limited resources, monitoring programs usually include methods to identify the presence or absence of species or groups of species that have small tolerance ranges for "unhealthy" stream conditions (i.e., indicator species); these methods enable the health of a stream to be documented fairly accurately without having to implement an extensive monitoring program. However, such monitoring programs usually do not include methods to track or identify the specific causes of degradation of the streams.

If stream monitoring resources are limited, one way of assessing the health or changing conditions of a stream system and the factors that affect its health is to examine all available data on the streams' conditions, in conjunction with characterizing the watershed's impervious cover.

2. Level of Watershed Imperviousness

Impervious cover in a watershed can be viewed as an easily quantified, planning-level (i.e., general) measure of human impact on the aquatic resources in the watershed, including the stream system. The proportion of a watershed covered in impervious surfaces can indicate the degree to which stream and wetlands baseflows, water temperatures, water quality, and stream morphology are adversely altered. It can also signify the susceptibility of the watershed to unstable and erodible soil conditions, and loss of vegetative cover (e.g., due to grading and construction activities).

In general, the greater the proportion of a watershed covered in impervious surfaces, the lower the quality and health of the stream system found in the watershed. The absolute imperviousness levels tolerated by different stream systems vary. This is because many variables affect how well a stream is buffered from the negative effects of urbanization. These variables include the characteristics of the soils, geology, and topography in the watershed; the size and configuration of the stream; the extent, location, and type of vegetation cover in the watershed; the importance of baseflow in the stream's overall flow patterns; the amount and type of stormwater management serving existing development and the extent and location of urban land uses with respect to the stream.

A study of 27 small watersheds in the Maryland Piedmont region found a direct relationship between stream quality and watershed imperviousness (Klein, 1979). The study concluded that generally, stream quality impairment is observed when watershed imperviousness reaches between 12 and 15 percent. Severe degradation occurs when watershed imperviousness is at about 30 percent. For more sensitive stream systems, such as those supporting naturally-reproducing trout populations, the study recommends that watershed imperviousness should not exceed 10 percent to maintain the quality and integrity of these streams. It should be noted that most of the development in the watersheds that were studied did not have stormwater management controls to help offset adverse impacts.

Since the Klein study, other studies have been conducted to determine the relationship of stream quality and watershed imperviousness and urbanization. These studies cover a variety of physiographic areas in the United States and one area in Canada; their findings and conclusions are clearly summarized in a research article on impervious cover (Schueler, 1994).

Although these studies cover a wide range of stream systems (for example, ranging from the Jones and Clark study [1987], which looked at several streams draining to the Potomac River in northern Virginia, to streams in the state of

Washington [Booth and Reinelt, 1993]), they lead to the same general conclusion: few, if any, streams with moderate to high levels of watershed imperviousness (25 percent or more) can support diverse, healthy insect communities. With respect to a stream's ability to support pollution-sensitive fish such as trout and salmon, the Schueler article found that the general upper limits of trout or salmon streams are in the range of 10 to 15 percent watershed imperviousness.

The Interstate Commission on the Potomac River Basin (ICPRB) has noted that in general, stream quality is impaired when urbanization (developed areas) reaches 10 percent of a watershed. Normally, a stream is "severely impaired" when at least 25 percent of the area it drains is impervious. (ICPRB, 1992).

A Metropolitan Washington Council of Governments (MWCOG) study of water temperature impacts of urbanization and stormwater management (SWM) facilities on small headwater streams in the Eastern Montgomery County area revealed that summer stream temperatures increase linearly with increasing watershed imperviousness. The study showed that watershed imperviousness has a negative effect on stream temperatures under both baseflow and stormflow conditions, regardless of whether SWM controls are present or absent in the watershed. Stream temperature regime changes occur when watershed imperviousness exceeds about 12 percent. The results of the study strongly suggest that coldwater organisms, such as trout, will most likely be lost when watershed imperviousness exceeds 12 percent to 15 percent (Galli, 1990).

The Anacostia Watershed Restoration Committee's (AWRC) Upper Paint Branch Work Group recognized the lack of specific watershed imperviousness "thresholds" to establish limits in which stream degradation will definitely occur. The work group references a range of upper limits for watershed imperviousness (between 10 and 15 percent) beyond which coldwater stream systems in Maryland become severely degraded or are destroyed (AWRC, 1994).

In addition to the *amount* of impervious cover, the location of the impervious surfaces in the watershed is important in determining the degree with which such land cover will adversely impact the stream system. For example, paved surfaces located adjacent to or within a stream buffer, as defined by the Montgomery County Planning Board's environmental guidelines (M-NCPPC, 1993), will have a greater adverse affect on the stream than the same paved areas located 200 feet uphill of the stream buffer. As another example, paved surfaces located in the extreme headwaters of a stream system will create greater adverse impacts on the system than paved surfaces located further down in the watershed; this is because smaller streams have less flow and channel resiliency to counter the effects of impervious cover than larger streams.

E. Techniques for Reducing Urbanization Impacts on Streams

1. Land Use Controls

The control or management of land uses placed in a watershed is generally considered the most effective tool in influencing the health of a stream system. Management of land uses that maximizes retention of vegetation cover, especially forest, and minimizes disturbance and modification of soils and topography is the most effective method to protect the high quality conditions of a stream system. Preservation of a watershed's vegetation cover is especially important in that part of a watershed that drains to small streams (i.e., commonly defined as first to third order streams) because of the limited ability of these streams to withstand and counter adverse impacts. Retention of vegetation cover, especially forest, is also crucial in the area surrounding a stream channel.

The tools to manage land cover and uses in a watershed include zoning, overlay zoning, performance criteria for land development, and the use of legally-protected conservation areas in and around sensitive natural features. If urbanization or suburbanization is to take place in a watershed, and the preservation of the stream system is a goal, land use tools that greatly limit the overall impervious cover should be implemented in those areas of the watershed that drain to small streams. Ideally, urban and suburban uses that result in high impervious cover should be located in areas that drain to larger streams and rivers (fourth order streams or larger), although the overall watershed imperviousness should still be relatively small. In addition, areas immediately in and around streams should be placed in protected conservation areas throughout the watershed.

2. Best Management Practices

When a land use will result in significant clearing of vegetation, disturbance of soils, modification of the natural topography, and/or creation of impervious surfaces, stormwater management and sediment and erosion control measures are usually required by State and County laws to be put in place. Such measures are termed best management practices (BMP) and are designed to reduce the adverse impacts of land disturbance and land development on aquatic resources. A best management practice is a method or measure considered to be the most effective and practicable means available to prevent or reduce the amount of pollutants or other detrimental water resource impacts generated from non-point sources.[8]

BMPs include many types of measures. They can range from engineered structures such as stormwater management ponds or sediment traps to vegetated buffer areas that are preserved or enhanced on either side of a stream to design and layout features of a development project that are sensitive to protecting water resources.

BMPs vary in their effectiveness in protecting water resources. Although the performance of engineered BMP's have improved over the years due to better design, their effectiveness is generally limited by the following factors: inherent limitations of engineering designs to completely replicate natural conditions and features, limitations of performance efficiencies of the control measures, poor construction of these measures, and/or poor maintenance of these measures after they are put in place and are operational.

In a research article on impervious cover, Schueler (1994) notes that many types of water quality pollutants generated from urban land uses can be lowered by the use of a variety of stormwater management practices. However, he also points out that "even when effective practices are widely applied, we eventually cross a threshold of imperviousness, beyond which we cannot maintain predevelopment water quality" (Schueler, 1994).

A study of sediment control measures in Maryland showed that the sediment traps and basins used at the time of the study were not very effective (Schueler and Lugbill, 1990). The study found that only a 46 percent sediment removal rate could be considered to be a representative estimate of the effectiveness of existing sediment control designs in Maryland. No sediment control measures were found to be 100 percent effective over the entire length of time they were in operation. In addition, it was found that small-sized sediments (i.e., extremely fine clays and colloids) may be very difficult, if at all possible, to trap within the control measures. It should be noted that the Maryland and Montgomery County sediment and erosion control design standards have been revised to increase sediment-trapping efficiencies, because of the results of the study; it is not known how much improvement has occurred on land development sites with these changes in design standards. Even with improved designs, however, the success of sediment control measures are highly dependent on proper construction, inspection, and maintenance of these measures on the site.

Some characteristics of healthy stream systems that are typically diminished or eliminated by extensive land development in the watershed may not be fully mitigated by engineered measures. Reduced stream baseflow due to impervious surfaces covering groundwater recharge areas may not be fully brought back to pre-development flow patterns with current engineered best management practices. Several types of stormwater management facilities can generate warm water discharges, including those that previously were thought to be thermally neutral (e.g., infiltration-dry ponds) (Galli, 1990).

Some engineered best management practices are effective at mitigating some of the impacts resulting from urbanization, but may exacerbate or create other adverse conditions. A well-known example of this is the SWM retention facility (i.e., wet pond). This type of facility can be effective at trapping many water quality pollutants, but it introduces warm water discharges into the stream, which can only be partially mitigated.

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[8] Non-point source pollution is pollution that originates from diffuse sources and not from discernible, confined, or discrete sources. For example, fertilizers or pesticides on a lawn that are carried in surface water runoff to a stream are non-point source pollutants. In contrast, nitrogen and phosphorus compounds discharged into a stream from a wastewater treatment plan are point source pollutants.

Methodology and Technical Approach of Study

To answer the questions posed in Chapter 1, this study has taken the following steps: compiled stream quality data from various sources, conducted limited baseline stream quality and stream habitat sampling, and estimated and evaluated impervious cover and land uses for the Paint Branch watershed within Eastern Montgomery County.

The assumption underlying the approach of looking at watershed imperviousness is that the higher the level of land development in a watershed, the greater the degradation in stream quality. As has been summarized in Chapter 2, this inverse relationship between stream quality and watershed imperviousness has been well-documented in several studies and is widely accepted in the water resources field. Factors such as stormwater management measures, improved sediment and erosion controls, and best management practices do help reduce the frequency and severity of impacts, but their effectiveness is limited. And in watersheds where stream systems are healthy and the biological communities in the streams contain pollution-intolerant, indicator species, the limited effectiveness of engineered measures may not be enough to maintain and protect the high quality and healthy conditions of these streams. The watershed's land cover and use, in and of itself, is still the overriding factor in predicting impacts to a stream system at the master planning level.

A. Defining Subwatersheds of Paint Branch

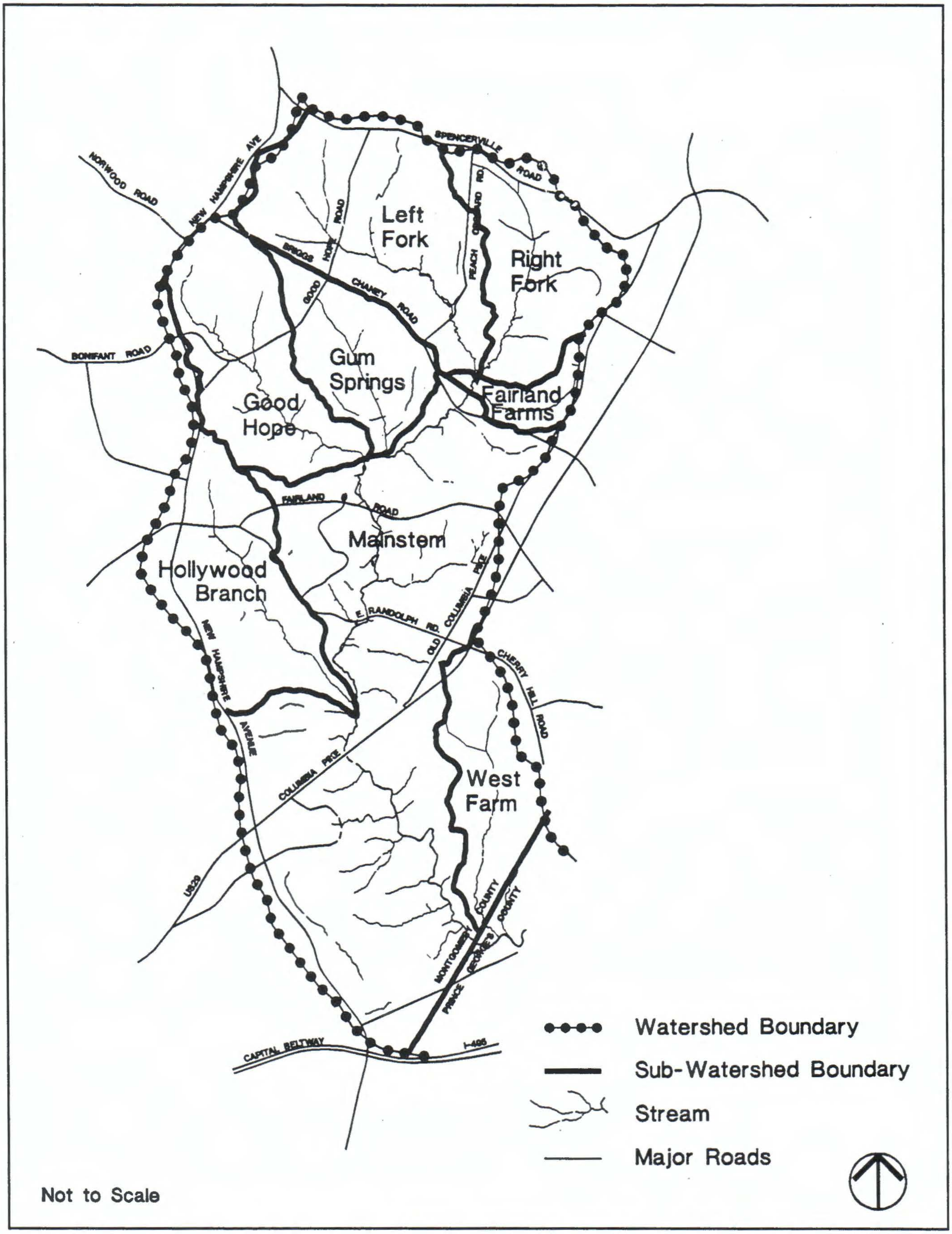
For the purposes of this study, Paint Branch within Eastern Montgomery County is divided up into eight subwatersheds. (See Figure 1, page 14.) A subwatershed is defined in such a way so that, in most cases, it contains at least one first- or second-order stream[9] and the land uses and/or potential for change in land use throughout the subwatershed are relatively similar.

The Paint Branch mainstem in the area around Briggs Chaney Road downstream to the County line is defined as one large subwatershed with at least a third-order stream because there is very little potential for additional development or change in land use in this area.

[9] The size of a stream can be characterized in a relative manner according to where it fits in within the larger system of streams. A first-order stream is one in which no other stream drains to it. A second-order stream is a stream which is formed by the joining of at least two first-order streams.

Paint Branch Subwatersheds Defined for the Study

Figure 1



B. Compiling Stream Quality Data

Within the subwatersheds, the study has collected limited information on aquatic macroinvertebrate communities and stream habitat conditions in areas where no consistent monitoring has been done in the past in order to better characterize existing conditions. M-NCPPC Environmental Planning Division staff collected data on macroinvertebrates and stream habitat conditions at two stations using the Rapid Bioassessment Protocol II developed by the U.S. Environmental Protection Agency (Plafkin et al., 1989). A modified and more rigorous version of this methodology for assessing stream quality is being used by DEP in their stream monitoring program.

The original intent of this stream monitoring effort was to collect data for at least three seasons and, ideally, for a longer time period. However, because of staff time limitations, only one season, the 1993 summer season, could be sampled; therefore, the macroinvertebrate and stream habitat data collected by M-NCPPC staff is limited in nature and must be used with caution in characterizing existing stream quality conditions.

The stream sampling stations set up by the M-NCPPC Environmental Planning Division for the 1993 summer monitoring is shown in Figure 2, page 16. Stream sampling stations within the Eastern Montgomery County portion of Paint Branch that have been set up as part of past or present monitoring programs by other agencies are also shown in Figure 2.

Data on stream quality collected by other agencies have also been compiled to comprehensively characterize as well as possible the past and present conditions of the various streams and any changes in the quality and health of these streams since the adoption of the *1981 Eastern Montgomery County Master Plan.*

C. Calculating Existing Subwatershed Imperviousness

This study estimates subwatershed imperviousness for current conditions and projects the impervious cover assuming buildout conditions under the 1981 master plan zoning. The methodology in this study used Geographic Information System (GIS) data to estimate impervious cover for current conditions and added on estimated impervious cover by zoning category to project subwatershed imperviousness for future conditions.

The first step in estimating impervious cover was to define subwatershed boundaries. These boundaries were drawn on 1" = 200' topographic maps and clipped to each of the GIS planimetric layers (i.e, files) for buildings, roads, streets and parking lots, cultural features, and sidewalks. These planimetric layers form the foundation of the County's geographic information system. The information was entered into digital format from aerial photos by the Research and Information Systems Division of the M-NCPPC Montgomery County Planning Department.

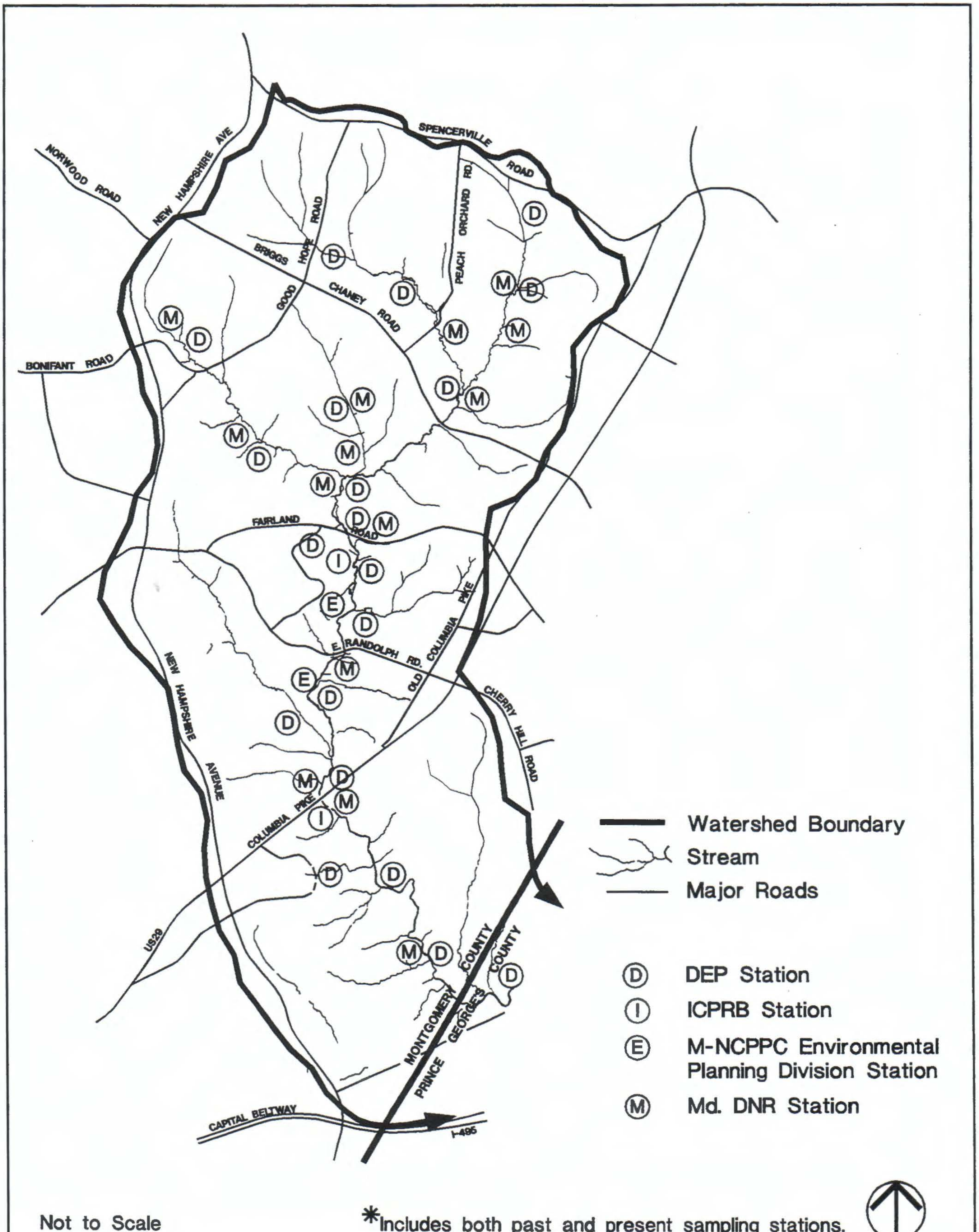
For the study, the layers that represented current conditions reflected 1990 conditions. There has been a relatively small amount of development in the Eastern Montgomery County area since 1990 due to traffic moratorium conditions, so that land use conditions reflected by the 1990 planimetric data were assumed to closely represent present existing conditions. That is, 1990 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 method used in estimating impervious surface area attributable to sidewalks and residential driveways). This method of measuring impervious surfaces differs from past studies (i.e., M-NCPPC staff analysis of imperviousness in upper Paint Branch for the *1981 Eastern Montgomery County Master Plan* [M-NCPPC 1981] work, staff analysis of imperviousness in Paint Branch due to proposed development in 1979 (Gresh, 1979), and the "Anacostia: Technical Watershed Study" [CH2M Hill, 1982]) in that previous methods relied largely on imperviousness factors by land use or development category to estimate subwatershed imperviousness under "current" or "existing" conditions; to calculate imperviousness within a given subwatershed, the factor would be multiplied by the amount of corresponding land use or development category occurring in the subwatershed, and the estimated impervious surfaces for the various land use or development categories would be summed.

The actual measure of impervious surface on the land, which has only recently become possible due to the development of GIS technology, pro-

Paint Branch Stream Sampling Stations

Figure 2



Not to Scale

*Includes both past and present sampling stations.

vides a more accurate measure of imperviousness for "current" or "existing" conditions. It can also provide a reference against which to evaluate past and present methods of estimating imperviousness by land use category.

As part of this study, the GIS layers were compared to 1993 aerial photographs to check and verify the accuracy of the data. This comparison revealed that substantial paved area exists in the form of driveways on single-family detached residential lots which are not included in the planimetric database. 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 units 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 an estimated 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.

In addition to the GIS layers for paved features (buildings, driveways, roads, streets and parking, cultural, and sidewalks) the "impervious" contribution of non-paved land cover was calculated, based on the assumption that these surfaces also contribute to surface water runoff for some precipitation events. Remaining non-paved land was categorized as either forested or nonforest-nonpaved. Non-forest, non-paved land includes lawn, pasture, and crop fields and is referred to as meadow. Forest cover is assigned an imperviousness factor of 1 percent; non-forest green cover is assigned a factor of 3 percent. A 1 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 non-forested green cover, a wider range of imperviousness factors have been used (i.e., 0 to 7 percent). This study uses 3 percent imperviousness factor for non-forested green cover because it is roughly the middle of the range of values that have been used in other studies, it is the factor used in the Paint Branch compendium (Galli, 1983), and it reflects the greater benefits of forest cover compared to meadow or grass cover on streams.

The study's methodology may underestimate imperviousness at some development sites because it does not account for compacted urban soils. However, there are currently no imperviousness factors that are generally accepted to accurately represent the "impervious" nature of such soils.

Figure 3 summarizes the study's assumptions in calculating subwatershed imperviousness under 1990 conditions.

D. Projecting Subwatershed Imperviousness

To estimate the effects of the 1981 master plan zoning recommendations on the ultimate subwatershed imperviousness levels, the study projected imperviousness by zoning.

For each subwatershed, properties were identified according to their development status as of 1990: already developed, developable, committed or pipeline (i.e., properties that have an approved development plan, preliminary plan, or site plan, or are recorded lots, but were not constructed as of 1990). Developable and committed/pipeline properties were further characterized by zoning. For land in each category of zoning and development status, the amounts of forest and non-forest cover and associated impervious surfaces under 1990 conditions were calculated through the use of M-NCPPC Montgomery County Planning Department Arc/Info layers and databases. The projected impervious cover on a category of land if or when it develops under either the master plan zoning or an approved plan was calculated using imperviousness factors by zones. To estimate the total subwatershed impervious cover assuming 1981 master plan buildout, the projected impervious covers for all categories of land were added to the 1990 calculated impervious coverage and 1990 impervious surfaces for developable and committed/pipeline land were subtracted out (as shown in box below):

$$\text{Projected subwatershed imperviousness for given land use scenario} = \left(\text{1990 subwatershed imperviousness}\right) - \Sigma\left(\text{1990 calculated imperviousness for developable or committed/pipeline property}\right) + \Sigma\left[\left(\text{size of developable or committed/pipeline property}\right) \times \left(\text{imperviousness factor of the zone proposed or existing for the property}\right)\right]$$

Assumptions Used in Calculating Subwatershed Imperviousness for Existing Conditions

Figure 3

1. Use 1990 planimetric data (most current data available on GIS at this time) to represent existing conditions.

2. Driveways for single-family detached lots are not included in the GIS data bases. Assume the following average dimension for a driveway:

   30 ft. x 15 ft. in Paint Branch

3. Imperviousness due to forest cover = 1%

4. Imperviousness due to non-forest, non-paved cover = 3% (i.e., meadow, pasture, lawn, field, shrub-shrub)

5. Imperviousness due to buildings and pavement = 100%

6. Sidewalks appear in the GIS data as linear features, not polygons. Assume sidewalks have an average width of 4 feet.

7. Percent subwatershed imperviousness in 1990 =

$$100\% \text{ X } \frac{\left(\text{Acres of roads + buildings}\right) + \left(\text{Estimated acres of driveways}\right) + \left(\text{Estimated acres of sidewalks}\right) + \left[(.01)\left(\text{Acres of forest cover}\right)\right] + \left[(.03)\left(\text{Acres of non-forest, non-paved cover}\right)\right]}{\text{Subwatershed size in acres}}$$

Imperviousness Factors by Zone

Table 1

Zoning Category	Imperviousness Factor (percent)
RC	6
RE-2	9
RE-2C	9
RE-1	11
R-200	19
R-90	20
R-200/TDR5	35
R-150/TDR5	35
R-90/TDR 5 to 8	37
R-60/TDR 8 to 9	40
R-20	60
PD-2	20
C-1, C-2, C-3	90
O-M	90
I-1	60
I-2	80
I-3	60
I-4 in West Farm	60

Imperviousness factors by zone were primarily derived from and are comparable to estimates of percent impervious cover by land use type that were compiled as part of a study of nonpoint pollution from uncontrolled urban and rural-agricultural land uses in northern Virginia (Northern Virginia Planning District Commission, 1980). These land use types are comparable to the zones found in Montgomery County. In addition, the Eastern Montgomery County watershed study calculated impervious cover for selected residential subdivisions that have been constructed in Eastern Montgomery County using data on the GIS system.

Table 1 presents the imperviousness factors by zones that have been used to project the total subwatershed imperviousness under the 1981 master plan buildout. These imperviousness factors by zone have also been used to project subwatershed imperviousness under various buildout scenarios that deviate from the 1981 master plan zoning recommendations for specific subwatersheds to determine how changes to the 1981 master plan may affect impervious cover.

Analysis and Results

The analysis of the Paint Branch watershed has involved the input of the Paint Branch Technical Work Group consisting of representatives of State and county environmental regulatory and resource management agencies. These agencies include the Maryland Department of Natural Resources (DNR), Maryland Department of the Environment (MDE), Metropolitan Washington Council of Governments (MWCOG), Interstate Commission on the Potomac River Basin (ICPRB), M-NCPPC Montgomery County Planning Department and Department of Parks, Montgomery County Department of Environmental Protection (DEP), and Montgomery County Office of Planning and Implementation.

A. Past and Present Conditions

1. Conditions of the Natural Resources in Paint Branch

Data on past and present conditions in various parts of Paint Branch are summarized in Table 2. Figure 4 shows the general location of seeps and springs in Paint Branch which were largely characterized through field observations by members of the Potomac-Patuxent Chapter of Trout Unlimited in May, 1979; the information in Figure 4 has also been supplemented by the extensive field knowledge of John Galli of MWCOG and Charles Gougeon of the DNR Freshwater Fisheries Division, as well as field observations through regulatory review work by the M-NCPPC Environmental Planning Division. Additional information documenting Paint Branch's health has been extensively collected in the form of data on the fish community, in particular, the brown trout population. This data has been collected for over 20 years by the DNR Freshwater Fisheries Division and are summarized in Tables 3 and 4.

Other data that have been collected and documented on the condition of the natural resources in Paint Branch, but that have not been summarized in the above tables and figures include:

- Some limited field surveys of the streams in upper Paint Branch were conducted by CH2M Hill as part of their April 1980 study to characterize the physical features of these streams. The report also references some limited macroinvertebrate studies in Good Hope and Gum Springs Tributary that were conducted in the 1970's outside of DNR's monitoring program.

- A limited field survey of Good Hope Tributary was conducted in November, 1979 to estimate stream baseflows (Galli, 1983).

- M-NCPPC Department of Parks 1980 and 1993 stream channel cross-section analysis for upper Good Hope Tributary (AWRC, 1994).

- Inventory and assessment of the Paint Branch as part of an assessment of possible effects of the Intercounty Connector (Aquatic Resource Consulting, 1986).

- MWCOG Rapid Stream Assessment Technique survey for the Good Hope Tributary (AWRC, 1994).

- Monitoring program initiated by DEP in 1994 for fish, macroinvertebrates, and physical and habitat conditions in Paint Branch. This is part of a County-wide baseline monitoring program to assess the biological, physical/chemical, and habitat conditions in all County streams.

- MWCOG Rapid Stream Assessment Technique survey for the Right Fork Tributary on June 16, 1995 (Galli, 1995).

- A cursory assessment of specific spring and seep areas in upper Paint Branch by a hydrogeologic consultant for the M-NCPPC Environmental Planning Division (Hau, 1995).

As can be seen from these sources summarized and referenced above, the data include a wide range of parameters and vary in coverage over time and geographic location , depending on the monitoring program. These data show the generally high quality conditions in upper Paint Branch over time. In contrast, stream conditions within the mainstem are more variable, and stream quality tends to be lower in the lower sections than in the upper sections.

From the various data sources, other points can be made regarding the conditions of the various Paint Branch streams:

- The large concentration of seeps and springs in upper Paint Branch, compared to the lower Paint Branch, highlights the importance of cold, clean groundwater flow contribution to the quality of upper Paint Branch.

- Good Hope Tributary —

  The upper headwaters of the stream just south of Briggs Chaney Road and east of New Hampshire Avenue appear to derive their baseflow from a bedrock fracture that lies directly under the stream channel.

  A large spring, which contributes significant cold baseflow to the upper stream reaches, exists at the rear of Parcel 471, south of Good Hope Road. Cursory evaluation of the geology of the area by Hau (1995) indicates that the groundwater feeding the spring may be recharging from land in three general areas: land between Good Hope Road and Piping Rock Drive between the two branches of Good Hope Tributary, land to the west of the left branch, and land to the east of the right branch.

  The stream has undergone some degradation since the early 1980's:
    - There is a general trend towards channel widening in upper Good Hope Tributary.
    - Existing embeddedness (sand-silt deposition in riffle areas) are very high throughout the stream.
    - The number of larger adult trout (defined as adult trout at least 26 cm., or approximately 10 inches, in length) has, since about 1989, significantly declined.

- Gum Springs Tributary —

  The stream appears to derive much of its baseflow from a bedrock fracture that lies directly under the stream channel. It is also likely that several fractures lying perpendicular and oblique to the Gum Springs channel are also providing groundwater recharge to the stream.

  The stream varies in quality. The upper section, roughly northeast of Twig Road, exhibits very good conditions. This section, with the exception of years when human activities have caused recruitment failure, is consistently successful in producing young-of-year trout; it also continues to provide limited habitat for adult trout. In contrast, the lower section is currently more degraded because of greater subdivision-related impacts. However, both sections of the stream serve as potential holding areas for young-of-year and adult trout.

- Right Fork Tributary —

  The very abundant and diverse macroinvertebrate community consistently shows this stream to be of very high water quality. The stream has the highest water quality of all the streams in the Paint Branch system.

(Continued on page 30)

Summary of Studies Characterizing Stream Conditions in the Paint Branch Watershed in Eastern Mont. County

Table 2

Parameters Studied	Year of Data Collection	Agency (Source)	Sampling Method	Analysis Method	Stream Condition Characterization	Paint Branch Subwatersheds					
						Left Fork Trib.	Right Fork Trib.	Good Hope Trib.	Gum Springs Trib.	Hollywood Branch	Mainstem
Macro-invertebrates	1979-1980	MD. DNR (Hughes, 1980)	Not given in source.	Macro-invertebrate Diversity Index	3.00 - 4.00 = Excellent 2.00 - 3.00 = Good 1.00 - 2.00 = Fair 0.00 - 1.00 = Poor	Range = 1.88 - 2.16 (FAIR TO GOOD) Mean = 2.00	Range = 2.27 - 3.77 (GOOD TO EXCEL) Mean = 3.14	Range = 2.42 - 3.01 (GOOD TO EXCEL) Mean = 2.80			•Briggs Chaney Rd: Range= 2.00 - 2.43 (GOOD) Mean = 2.16 •Fairland Rd: Range= 1.65 - 2.65 (FAIR TO GOOD) Mean = 2.21 •Rt. 29: Range= 1.38 - 2.25 (FAIR TO GOOD) Mean = 1.90
	1980-1984	MD. DNR (Gougeon, 1985)	Not given in source.	Macro-invertebrate Diversity Index	3.00 - 4.00 Excellent 2.00 - 3.00 = Good 1.00 - 2.00 = Fair 0.00 - 1.00 = Poor	Range = 1.83 - 2.83 (FAIR TO GOOD)	Range = 1.69 - 3.56 (FAIR TO EXCEL)	•Upper: Range = 1.83 - 3.56 (FAIR TO EXCEL) •Lower: Range = 1.41 - 3.13 (FAIR TO EXCEL)	Range = 1.61 - 3.62 (FAIR TO EXCEL)		•Briggs Chaney Rd: Range= 1.36- 3.03, for 1980 to 3/82 only (FAIR TO EXCEL) •Fairland Rd: Range= 1.17 - 2.86 (FAIR TO GOOD) •Rt. 29: Range= 0.71 - 2.40 (FAIR TO GOOD)
	1989	MWCOG (Kumble, 1990)	Surber, 2 sq. ft.	Modified RBP III; 6 metrics[1]	Good/Fair/Poor						•Fairland Rd (GOOD) •Rt. 29 (GOOD)
	1989	ICPRB (Stribling et.al., 1990)	Surber, 2 sq. ft.	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor						•Fairland Rd (EXCEL) •Rt. 29 (GOOD)
	1990	ICPRB (Cummins et.al., 1991)	Surber, 2 sq. ft.	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor						•Randolph Rd (EXCEL)
	1990	MD. DNR (1990)	D-net, 90 seconds	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor	•Lower (GOOD)	•Upper (EXCEL)	•Upper (GOOD) •Lower (GOOD)	•Lower (FAIR)		•Fairland Rd (GOOD) •Rt. 29 (FAIR)
	1991	MD. DNR (1991)	D-net, 90 seconds	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor	•Lower (EXCEL)	•Upper (EXCEL)	•Upper (EXCEL) •Lower (EXCEL)	•Lower (GOOD)		•Fairland Rd (EXCEL) •Rt. 29 (FAIR)
	1992	MD. DNR (1992)	D-net, 90 seconds	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor	•Lower (EXCEL)	•Upper (EXCEL)	•Upper (EXCEL) •Lower (EXCEL)	•Lower (GOOD)		•Fairland Rd (EXCEL) •Rt. 29 (GOOD)

Summary of Studies Characterizing Stream Conditions (cont.)

Parameters Studied	Year of Data Collection	Agency (Source)	Sampling Method	Analysis Method	Stream Condition Characterization	Paint Branch Subwatersheds					
						Left Fork Trib.	Right Fork Trib.	Good Hope Trib.	Gum Springs Trib.	Hollywood Branch	Mainstem
	1993	MD. DNR (1993)	D-net, 90 seconds	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor	•Lower (FAIR)	•Upper (EXCEL)	•Upper (GOOD) •Lower (GOOD)	•Lower (FAIR)		•Fairland Rd (GOOD) •Rt. 29 (POOR)
	1993	M-NCPPC EPD (1993)	D-net, 300 seconds	RBP II; 7 metrics. EPD analysis[2]	Excellent/Good/ Fair/Poor						•Above Randolph Rd (FAIR) •Below Randolph Rd (FAIR)
Fish - (excludes MD. DNR data)	1988	MWCOG (Herson et.al, 1989) ICPRB (Cummins, 1989)	Seine hauls	Fish diversity comparisons. MWCOG ratings[3]	Excellent=15-25 species Good=10-15 species Fair = 5-10 species Poor = 0-5 species						•Rt. 29: 5-10 species (FAIR)
	1983, 1986, 1988	MWCOG (Kumble et.al., 1990)	Not given in source	Abundance of sensitive species	No rating provided			7 sensitive species out of 12 species collected, at 10% impervious-ness		1 sensitive species out of 6 sps. collected at 25% imperv.	
	1990	ICPRB (Cummins et.al., 1991)	Electro-shock	RBP V; IBI, 8 metrics[4]	Excellent/Good/ Fair/Poor						•Below Randolph Rd (GOOD)
Chemical and Physical Water Quality	1972	MCDEP (1974)	Grab samples	9 parameters[5]	Excellent/Good/ Fair/Poor						•Fairland Rd (EXCEL) •Powdermill Rd (EXCEL)
	1973	MCDEP (1974)	Grab samples	9 parameters[5]	Excellent/Good/ Fair/Poor						•Fairland Rd (GOOD) •Powdermill Rd (GOOD)
	1974-1975	MCDEP (1976)	Grab samples	9 parameters[5]	Excellent/Good/ Fair/Poor						•Fairland Rd (EXCEL) •Powdermill Rd (EXCEL)
	1976	MCDEP (1977)	Grab samples	9 parameters[6]	Excellent/Good/ Fair/Poor						•Fairland Rd (GOOD) •White Oak NSWC (GOOD) •Powdermill Rd (GOOD)

Summary of Studies Characterizing Stream Conditions (cont.)

Parameters Studied	Year of Data Collection	Agency (Source)	Sampling Method	Analysis Method	Stream Condition Characterization	Paint Branch Subwatersheds					
						Left Fork Trib.	Right Fork Trib.	Good Hope Trib.	Gum Springs Trib.	Hollywood Branch	Mainstem
	1977	MCDEP (1978)	Grab samples	9 parameters[6]	Excellent/Good/ Fair/Poor						•Fairland Rd (FAIR) •White Oak NSWC (FAIR) •Powdermill Rd (FAIR)
	1978	MCDEP (1979)	Grab samples	9 parameters[6]	Excellent/Good/ Fair/Poor						•Fairland Rd (FAIR) •White Oak NSWC (FAIR) •Powdermill Rd (FAIR)
	1979	MCDEP (1980)	Grab samples	9 parameters[6]	Excellent/Good/ Fair/Poor						•Fairland Rd (FAIR) •White Oak NSWC (FAIR) •Powdermill Rd (FAIR)
	1980	MCDEP (1981)	Grab samples	9 parameters[6]	Excellent/Good/ Fair/Poor						•Fairland Rd (FAIR) •White Oak NSWC (FAIR) •Powdermill Rd (FAIR)
	1985	MWCOG (1987)	Grab samples	4 parameters[7]	Good/Fair/Poor						•Powdermill Rd (GOOD)
	1988	ICPRB (Cummins, 1989)	Grab samples	4 parameters[8]	No rating provided						•Rt. 29[8]
	1989	ICPRB (Stribling et.al., 1990)	Grab samples	10 parameters[9]	Good/Fair/Poor						•Fairland Rd (GOOD) •Rt. 29 (FAIR)
	1990	ICPRB (Cummins et.al., 1991)	Grab samples	6 parameters[10]	No rating provided						•Randolph Rd[10]

Summary of Studies Characterizing Stream Conditions (cont.)

1. RBP III (EPA's Rapid Bioassessment Protocol, level III) is a genus level study on the benthic macroinvertebrate (aquatic insect) community, which entails scoring 6 different macroinvertebrate community attributes (metrics) at each site and comparing those scores to a reference (best condition) site to get a consistent assessment of all sites in the study. MWCOG examined the RBP III data collected and analyzed by ICPRB in 1989 and then developed the stream condition characterization breakdown.

2. RBP II (EPA's Rapid Bioassessment Protocol, level II) is a family level study on the benthic macroinvertebrate (aquatic insect) community. The Environmental Planning Division analyzed data from the source indicated, which involved transposing a mix of genus and family level macroinvertebrate data into a consistent set of family level data for all the sites and then performing a RBP II (family level) analysis. The RBP II analysis entails scoring 7 different macroinvertebrate community attributes (metrics) at each site and comparing those scores to a reference (best condition) site to get a consistent assessment of all sites throughout the study.

3. Fish diversity comparisons involved comparing the diversity of fish communities from different stream sites throughout the Anacostia River basin. Ratings are based on a MWCOG breakdown: 0 - 5 fish species = POOR, 5 - 10 species = FAIR, 10 - 15 species = GOOD, 15 - 25 species = EXCELLENT.

4. RBP V is a species level analysis on the fish community. An Index of Biological Integrity (IBI) is an analysis procedure, similar to RBP II & III, which involves assigning values for 8 different fish community attributes (metrics) for each site, and then comparing those values to a reference (best condition) site to get a consistent and standardized assessment for all sites throughout the study.

5. The 9 parameters assessed by MCDEP in the years 1972 through 1975 included; mean water temperature, mean dissolved oxygen, mean pH, mean biochemical oxygen demand (BOD), mean turbidity, mean total coliform, mean fecal coliform, mean total nitrate/nitrite, and mean total phosphates. Stream condition characterization for 1972 through 1975 was based on a combination of assessments and comparisons of the average values of the 9 water quality parameters for all the sites on each stream, which included; assessing violations of State water quality criteria, assessing sites which exhibited poor water quality, comparisons of the various parameters between streams, and professional judgement of DEP staff.

6. The 9 parameters assessed by MCDEP in the years 1976 through 1980 included; mean water temperatures, mean dissolved oxygen, mean pH, mean BOD, mean total phosphates, mean nitrate/nitrite, mean turbidity, mean total suspended solids, and mean fecal coliform bacteria concentrations. Stream condition characterization for 1976 through 1980 was based on a Water Quality Index (for further information and explanation see the MCDEP Environmental Reports for those years or see the EPA publication: EPA-907/9-74-001, Feb 1974).

7. The 4 parameters assessed by MWCOG in 1985 included; mean total suspended solids, mean fecal coliforms, mean nitrate, mean total phosphorous concentrations. Stream condition characterization was based on professional judgement.

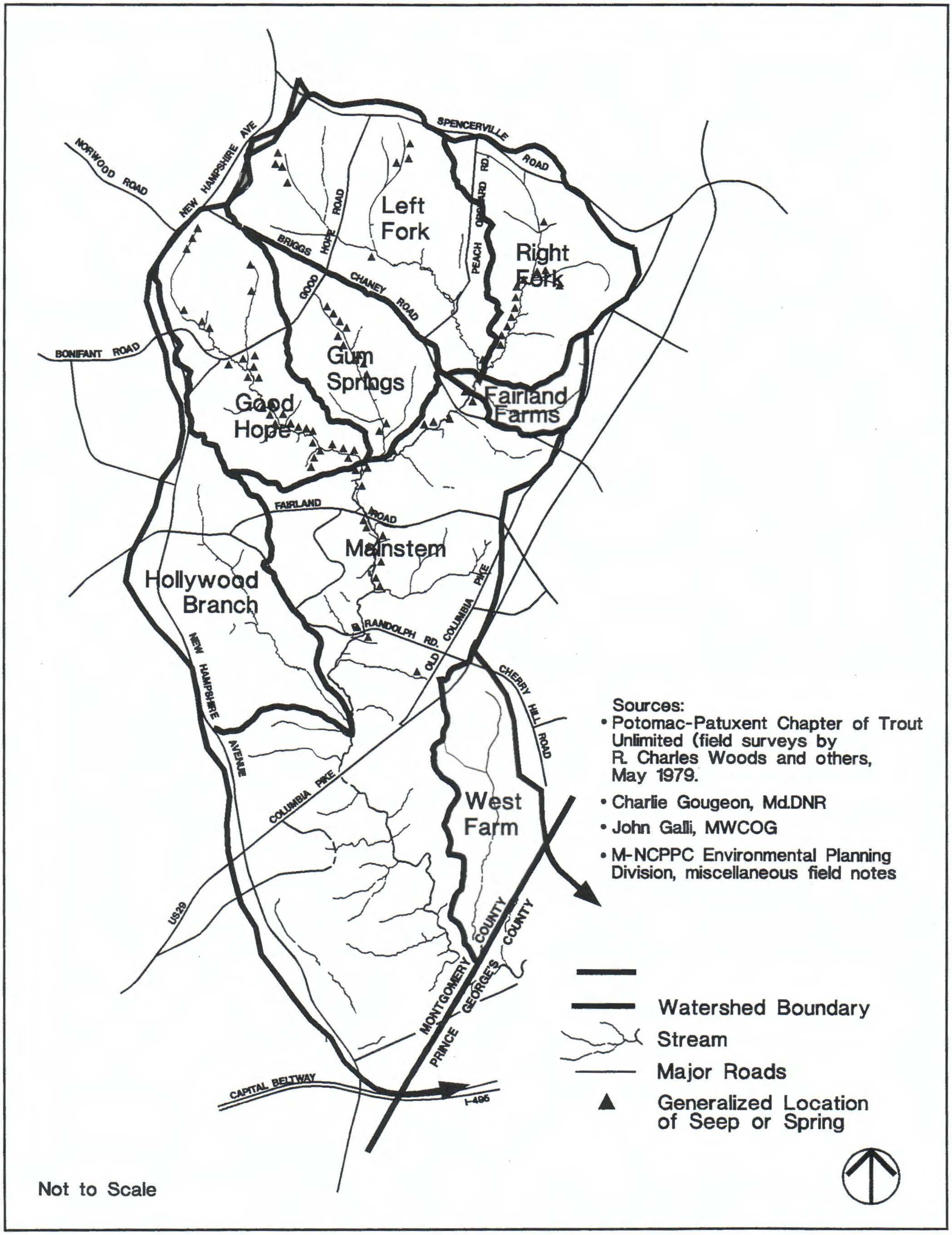
8. The 4 parameters collected by ICPRB in 1988 included; water temperatures, pH, dissolved oxygen, and conductivity. No stream rating or characterization was furnished in the study report, however a discussion of the relative significance of the values of the 4 parameters was provided in the report and is summarized in the following: the Rt 29 site had temperatures, pH, and conductivity levels which were normal in spring, summer, and fall, but the dissolved oxygen level was low in summer while normal in spring and fall.

9. The 10 parameters assessed by ICPRB in 1989 included; mean water temperature, mean dissolved oxygen, mean pH, mean turbidity, mean total suspended solids, mean total dissolved solids, mean ammonia, mean conductivity, mean total coliforms, and mean fecal coliform. Stream condition characterization was based on professional judgement.

10. The 6 parameters assessed by ICPRB in 1990 included; water temperature, pH, total dissolved solids, turbidity, dissolved oxygen, and coliform bacteria concentrations. No stream rating or characterization was furnished as part of the study report, however a discussion of the relative significance of the values was provided in the report and is summarized in the following; the Randolph Rd site had pH levels which were mostly normal throughout the year but high in July, the Total Dissolved Solid levels were normal all year, the turbidity levels were normal all year, the dissolved oxygen levels were normal all year, the temperature levels were normal all year, the coliform concentrations chronically met or exceeded the recommended limit set in State water quality standards.

Generalized Locations of Large Seeps and Springs

Figure 4



Fish Species Collected by Maryland DNR in Paint Branch, Montgomery and Prince George's Counties, 1974-1994

Table 3

Salmonidae	
Brown trout	*Salmo trutta* Linnaeus
Cyprinidae	
Blacknose Dace	*Rhinichthys atratulus* (Hermann)
Longnose dace	*Rhinichthys cataractae* (Valenciennes)
Cutlips minnow	*Exoglossum maxillingua* (Lesueur)
Creek chub	*Semotilus atromaculatus* (Mitchill)
Fallfish	*Semotilus corporalis* (Mitchill)
Rosyside dace	*Clinostomus funduloides* Girard
Common shiner	*Notropis cornutus* (Mitchill)
Bluntnose minnow	*Pimephales notatus* (Rafinesque)
Carp	*Cyprinus carpio* Linnaeus
Satinfin shiner	*Notropis analostanus* (Girard)
Spottail shiner	*Notropis hudsonius* (Clinton)
Swallowtail shiner	*Notropis procne* (Cope)
Spotfin shiner	*Notropis spilopterus* (Cope)
Goldfish	*Carassius auratus* (Mitchill)
Golden shiner	*Notemigonus crysoleucae* (Mitchill)
Catostomidae	
Northern hogsucker	*Hypentelium nigricans* (Lesueur)
White sucker	*Catostomus commersoni* (Lacepede)
Ictaluridae	
Margined madtom	*Noturus insignis* (Richardson)
Brown bullhead	*Ictalurus nebulosus* (Lesueur)
Cottidae	
Mottled sculpin	*Cottus bairdi* Girard
Percidae	
Tessellated darter	*Etheostoma olmstedi* Storer
Shield darter	*Percina peltata* (Stauffer)
Centrarchidae	
Bluegill sunfish	*Lepomis macrochirus* (Rafinesque)
Largemouth bass	*Micropterus salmoides* (Lacepede)
Redbreast sunfish	*Lepomis auritus* (Linnaeus)
Green sunfish	*Lepomis cyanellus* Rafinesque
Pumpkinseed sunfish	*Lepomis gibbosus* (Linnaeus)
Anguillidae	
American eel	*Anguilla rostrata* (Lesueur)

Source: Gougeon, 1985 and 1995

Note: DEP's monitoring of fish species initiated in 1994 included many of the above species. In addition, lamprey (*Lampetra* species) was also collected.

TABLE 4. RELATIVE ABUNDANCE OF BROWN TROUT (ADULT AND YOUNG-OF-YEAR) IN PAINT BRANCH

Stream Section	1974	1978	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Above Capital Beltway (Rt. 495) to lower boundary of Naval Surface Warfare Center (NSWC)	O	NS	NS	NS	NS	NS	VS	NS	NS	NS	NS	NS	VS	NS	VS	NS	VS	
Within NSWC boundaries	O	NS	NS	VS	NS	VS	NS	NS	NS	NS	NS	NS	S	NS	NS	NS	S	
Upper boundary of NSWC to U.S. 29	S-C	O	VS	S	S	S	S	S	S	VS	VS	S	S	NS	VS	S	S	
U.S. 29 to Randolph Road	C	VS	S	S	S	S	S	S	VS	NS	VS	NS	NS	NS	VS	NS	VS	
Randolph Road to Fairland Road	NS	NS	NS	NS	S	S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fairland Road to Briggs Chaney Road	C	S	S-C	C	S-C	S-C	C	S	S	S	S-C	S	S	A	C	S-C	S-C	S
Mainstem Above Briggs Chaney Road and Right Fork Tributary	C-A	C	VS	S	S	S-C	S-C	NS	S	S	S-C	S	S	NS	S	S	S	
Left Fork Tributary	S-C	VS	O	NS	NS	VS	NS	C	VS	NS	S-C	C	S	NS	NS	NS	NS	
Good Hope Tributary	C-A	C	A	C-A	C	C	A	A	A	C	C-A	C	C-A	C	C	A	A	A
Gum Springs Tributary	C-A	C	A	C-A	NS	NS	C	S	S	NS	S	S-C	A	C	C	S-C	A	VS[1] O[2]

NS - Not Sampled
A - Abundant
C-A - Common/Abundant
C - Common
S-C - Scarce/Common
S - Scarce
VS - Very Scarce
O - None Collected

Sources: Gougeon, 1985.
Maryland Department of Natural Resources, Freshwater Fisheries Division, 1995.

[1]Station from confluence with mainstem upstream to horse trail crossing.

[2]Bart Dr. Station - The absence of trout at this station is most likely a result of WSSC sewer overflow in spring 1995.

(Continued from page 22)

Bedrock fractures may be a source of some of the stream baseflow. However, it appears that the more significant source of stream baseflow is from shallow ground-water flows through soils on adjacent upland recharge areas.

A recent stream assessment conducted by MWCOG and DEP shows that the stream is in very good condition. The upstream section, roughly northeast of Locustwood Lane and draining land with less impervious cover, is of higher quality than the downstream section. Stream channel erosion greatly increases within the downstream section, compared to the upstream section.

- Left Fork Tributary —

This stream is not a consistent reproduction area for trout. It continues to provide habitat for adult trout and seasonal refuge for young-of-year trout.

- Hollywood Branch —

This is a small stream that drains to the mainstem below Fairland Rd. It is severely degraded. The unstable stream flow pattern has resulted in a less diverse and abundant fish community.

- Mainstem —

Between 1982 and 1984, the mainstem between Fairland Road and Briggs Chaney Road was found to be used as a successful trout spawning and nursery area. This represented an improvement in the mainstem because prior to 1982, no evidence of successful trout reproduction existed for the same section of the mainstem (Gougeon, 1985).

However, in recent DNR surveys, young-of-year trout have declined in density in the mainstem above Fairland Road since about 1985. There are currently very good numbers of young-of-year trout in this part of the mainstem; DNR believes these young-of-year are migrants from the nursery areas of Good Hope and Gum Springs tributaries (Gougeon, 1995).

DNR has observed increases in sediment loads and silting over the years in the mainstem above Randolph Road. This section of the mainstem had supported limited trout spawning in the past (see above), but trout spawning in the mainstem has become very inconsistent (Gougeon, 1995).

In July 1982, the Naval Surface Weapons Center discontinued the discharge of chlorinated water into the mainstem south of US 29. Trout, as well as other fish species, were able to repopulate the section of the mainstem below the discharge point after termination of the chlorine input.

2. Subwatershed Imperviousness

Table 5 shows the impervious cover for each of the subwatersheds in Paint Branch for 1990. It also shows the proportion of each subwatershed in forest and wetland cover. Table 6 compares impervious cover within the four main subwatersheds in upper Paint Branch between the early 1980's and early 1990's. It should be noted that the imperviousness estimates vary among the different sources for the same time period because different imperviousness factors were applied for some land use categories. From Table 6, it can be seen that impervious cover within the four main subwatersheds of upper Paint Branch has significantly increased since the early 1980's.

3. Relating Land Use Activities with Stream Conditions

The increases in impervious cover over time *is a general indicator* of a greater degree of stressful conditions placed on the streams due to increasing land-cover changes and more land disturbance activities within the drainage basins. These increases in stress are reflected in changing conditions of some of the streams and changing characteristics of part of the brown trout population that have been documented over time. Significant land use activities and land-cover changes and their effects on the receiving stream systems in upper Paint Branch are summarized below. Many of these changes have occurred since the adoption of the 1981 master plan:

- Good Hope Tributary —

  About 1980-present — Increased stormwater runoff into the Good Hope Tributary. This is due to land development occurring without SWM facilities in about three-fourths of the developed area in Good Hope Tributary (such development predated stormwater management requirements) and the relatively large number of individual single-family lots being constructed over about the last 10 years (no SWM controls are required for such individual lots). These land cover changes have resulted in channel widening and high sand-silt deposition in riffle areas caused by increased stream bank erosion. These changes translate to a degradation and loss of adult trout habitat, a decline in the general water quality and habitat conditions of the stream, and a stressed trout population in Good Hope Tributary, as exhibited in the dramatic decline in the number of larger-sized adult trout (AWRC, 1994).

  February and March 1981 — Logging operation in the upper third of Good Hope basin (on the Lanigan Property) created high sediment loads to the stream due to heavy equipment crossing and resulting stream bank erosion. About 0.5 km. of stream length was adversely affected. Poor trout hatch in Good Hope Tributary was documented in 1982 (Gougeon, 1985).

  July 1981 — Subdivision construction site (Landfare/Fairland Ridge subdivision) adjacent to Good Hope Tributary generated large sediment loads to about a 1.5 km. segment via an unnamed tributary. Trout fry hatch for 1982 was very poor. Macroinvertebrate numbers and diversity severely reduced (Gougeon, 1985).

  1986 to present — On-site stormwater management facility at the Fairland Ridge subdivision was designed and constructed to include redundant quality control measures and to prevent warm water discharges to the stream (i.e., state-of-the-art). However, because of lack of maintenance and localized soil conditions, some of the infiltration control features are not working as designed. In addition, as part of a study on thermal impacts of stormwater management facilities, MWCOG has documented that warm water discharges can occur from this type of facility (Galli, 1990); this conclusion is contrary to the long-held assumption that stormwater management facilities that include infiltration measures and that do not retain water on a permanent basis are thermally neutral.

- Gum Springs Tributary —

  Current conditions, as noted in the previous section, indicate that the lower section is more degraded than the upper section. Upper Gum Springs Tributary drains an area with about 12 percent imperviousness, in contrast to the 19 percent imperviousness of the land that drains to lower Gum Springs Tributary. The higher imperviousness of lower Gum Springs Tributary is a general indicator of the adverse impacts associated with the greater degree of land disturbance activities and land cover changes. The specific impacts on lower Gum Springs Tributary are summarized in the three events listed below:

  1980-1984 — Sediment originating from poorly maintained sediment traps at the Oak Springs subdivision construction site (near Good Hope Road) generated high sediment load that affected the entire Gum Springs Tributary. Sediment input occurred in fall of 1982; trout hatch of spring 1983 was very poor (Gougeon, 1985).

  August 10, 1986 — Heavy sediment inputs during construction of Oak Springs and Gum Springs Farm subdivisions have severely degraded the lower Gum Springs Tributary, including the loss of trout spawning habitat.

  The Oak Springs SWM facility, which contains a wet pool area, has degraded the lower Gum Springs Tributary. The initial

Summary of 1990 Subwatershed Impervious and Other Land Cover in Paint Branch

Table 5

Subwatershed	Size of Sub-watershed (Acres)	1990 % Imperviousness	% Imperviousness from Pipeline	1990 Existing + Pipeline % Imperviousness	% Imperviousness from Developable Land Under 1981 Zoning	Existing + Pipeline + Developable % Imperviousness Under 1981 Master Planned Zoning	% Imperviousness from Master Planned Roads[1]	1981 Master Plan Build-out % Imperviousness	Percent of Subwatershed in:		
									Developable Land	Forest Cover	Wetland Cover[2]
Left Fork	1,400	12.1	0.4	12.4	2.2	14.6	N/A	14.6	25.2	19.9	2.6
Right Fork	941	9.6	0.8	10.4	4.4	14.8	N/A	14.8	46.9	21.7	3.0
Good Hope	986	9.8	0.6	10.4	2.4	12.8	1.7	14.5	30.6	54.4	1.8
Gum Springs	624	15.6	1.9	17.5	0.2	17.7	0.6	18.3	3.8	24.6	0.4
Fairland Farms	198	11.8	0.8	12.6	2.5	15.1	N/A	15.1	15.0	15.2	1.3
Hollywood Branch	996	24.1	0.2	24.3	0.0	24.3	N/A	24.3	0.0	13.6	0.2
West Farm	727	17.9	17.7	35.6	16.9	52.5	N/A	52.5	23.8	20.5	0.3
Mainstem	3,828	21.0	0.5	21.5	1.1	22.6	0.3	22.9	3.5	29.2	2.3

Source: Data based on GIS analysis of 1990 conditions
N/A - Not applicable N/C - Not calculated

1. Master planned roads include only Briggs Chaney Road realignment at MD 650, MD 28-MD 198 connector, and a 6-lane ICC.

2. Wetlands coverage is based on MD DNR non-tidal wetlands data for 1988.

Estimated Impervious Cover Within the Major Subwatersheds of Upper Paint Branch

Table 6

Subwatershed	Estimated Percent Subwatershed Imperviousness	
	In Early 1980s	In Early 1990s
Good Hope Tributary	9.21% (Source: M-NCPPC, 1981) 5.81% (Source: CH_2M Hill, 1982) 7.28% (Source: Galli, 1983) 5.7% (Source: AWRC, 1994)	9.0% (Source: AWRC, 1994) 9.8% (Source: Table 4 of this study)
Gum Springs Tributary	10.75% (Source: M-NCPPC, 1981) 7.7% (Source: CH_2M Hill, 1982) 8.78% (Source: Galli, 1983)	15.6% (Source: Table 4 of this study)
Right Fork Tributary	8.90% (Source: M-NCPPC, 1981) 4.7% (Source: CH_2M Hill, 1982) 6.36% (Source: Galli, 1983)	9.6% (Source: Table 4 of this study)
Left Fork Tributary	7.2% (Source: CH_2M Hill, 1982)	12.1% (Source: Table 4 of this study)

construction of the facility resulted in stream bank erosion because of excessive stormwater discharges from the facility. This problem has since been corrected, but the facility continues to discharge warm waters to the stream during the warm summer months. Because of this degradation, the stream has suffered in its function as a major trout spawning and nursery area.

1993 — Construction of the WSSC water line along Briggs Chaney Road resulted in large sediment inputs via existing storm drain networks into Gum Springs Tributary. This severely reduced the young-of-year trout that had been produced in Gum Springs Tributary for that year (Gougeon, 1995).

- Right Fork Tributary —

  The stream's high water quality is most likely due to the subwatershed's currently low impervious cover, especially in its upper reaches. In the lower part of the subwatershed, where more subdivision activity has occurred, the stream is of slightly lower quality.

- Left Fork Tributary —

  This stream is not consistently successful in recruiting young-of-year trout. This is likely because the stream receives high storm flows from existing R-200 subdivisions. These storm flows create erosive conditions which result in a siltier stream. In addition, the stream receives periodic warm water discharges from old existing ponds (e.g., Twin Ponds near Rainbow Drive and ponds at the former Maydale Nature Center) which further reduce the suitability of the stream as a trout nursery area.

- Hollywood Branch —

  This stream, as noted in the previous section, is degraded. This is because its drainage basin has fairly high impervious cover (about 24 percent). Much of the development is composed of R-200 subdivisions which predate stormwater management control requirements.

- Mainstem —

  April 1980 — An extensive fish kill (all fish species) occurred in Left and Right Forks and the mainstem to about 183 km. below Briggs Chaney Road (total stream lengths affected about 4.8 km.). The fish kill was due to intentional dumping of swimming pool chlorine. The trout fishery was able to recover from this man-made "disaster." This is because there were other stream refugia in the system (Good Hope and Gum Springs tributaries) which were healthy and could provide enough young-of-year trout to repopulate the affected area. That is, the stream system had enough healthy areas to counter unforseen "disaster" events. If the healthy areas of the stream system were more confined or restricted, the system may not have responded as well to the "disaster" (Gougeon, 1985). **This event illustrates the importance of preserving healthy conditions in a system of streams, rather than just a limited number of streams, so that the aquatic system has redundancy and resiliency and can effectively counter significant stresses.**

  The mainstem downstream of Briggs Chaney Road (at least to about 300 feet downstream) was heavily silted due to inadequate erosion and sediment controls during a bridge and roadway improvement project at Briggs Chaney Road in the 1970's. This project resulted in a long-term loss of young-of-year and adult trout habitat and trout-spawning areas, as well as aquatic macroinvertebrate habitat.

- Of the 901.5 acres in stream valley park in the Paint Branch watershed, 370.8 acres were acquired or dedicated since the adoption of the 1981 master plan (Gries, 1995). Park ownership of near-stream areas per the 1981 master plan is a good tool for protecting and managing these areas, and it helps preserve wide, natural buffers for the stream. However, it cannot prevent in-stream problems (as illustrated in the example cited above), such as high water temperatures, erosive storm flows, reduced stream baseflows, and sediment input that are due to large impervious surfaces, land disturbance, or poor or inadequate BMP's that occur outside of parkland but drain to the stream.

B. Projected Conditions

Although the Paint Branch system continues to exhibit high quality conditions in general, especially above Fairland Road, it has been stressed by past and present development activities. The relatively small size of the streams that make up the system, especially above Fairland Road, and the incremental land use changes in the watershed make it difficult for the system to continue to "neutralize" the stressful conditions (i.e., to reach an equilibrium and stabilize). The stream system only has a limited and finite ability to absorb and withstand adverse conditions imposed on it before it irreversibly degrades and its unique trout resource, along with the high water quality conditions and other aquatic life, are lost.

As can be seen in Table 5, impervious cover is projected to increase significantly in most parts of the Paint Branch watershed, except for the subwatersheds of Hollywood Branch and the mainstem, given the 1981 master plan zoning. These increases are indicators of a large potential for adverse impacts to the streams that drain the land, if the subwatersheds develop according to the 1981 master plan.

The potential for significant adverse impacts is greatest to the streams in upper Paint Branch (i.e., north of Fairland Road). Stressed conditions have already been observed and documented in these streams, even with headwater subwatershed imperviousness falling within the generally accepted range of 10 to 15 percent (see Chapter 2, C. 2.) for preserving healthy streams.

Conclusions and Recommendations

A. Conclusions and Recommended Approach to Protecting Paint Branch

It is evident that the Paint Branch system is exhibiting a trend of overall increased stress in many of its streams within roughly the past five to ten years. If land uses and development continues to follow the 1981 master plan and comply with current regulatory standards and guidelines, significant degradation of the stream system and irreversible damage to its natural resources, including the brown trout fishery will most likely occur.

Therefore, given the goal of protection and preservation of the Paint Branch system, this study recommends a comprehensive, watershed-based, stream system approach for protecting the brown trout and other natural resources of Paint Branch over the long term. Such an approach includes four main components:

- *The highest level of preservation and protection of natural areas* within the most critical and fragile areas of the Paint Branch watershed. This would require modifications to the 1981 master plan land use plan.

- *More stringent control and management of the location and amount of future impervious cover and the associated land disturbance and land cover changes in the less critical and less fragile parts of the watershed through a combination of an overlay zone and the application of the Special Protection Area Law.* This would require modifications to the 1981 master plan land use plan and to current regulations, guidelines, and policies that apply to new development.

- *Increased efforts of identification and implementation of solutions to current problem areas and stressed conditions* in the system. This would require increased County resources and efforts allocated to existing County programs and projects that deal with stormwater management retrofits and stream restoration work in Paint Branch.

- *Development of an integrated Upper Paint Branch watershed management plan* which, at a minimum, brings together the following elements: resource monitoring, stormwater management retrofitting, stream restoration, terrestrial and aquatic habitat management, inspection and maintenance of parkland and stormwater management facilities, and public education.

1. Protecting and Preserving the Watershed's Most Critical and Fragile Areas

The highest level of protection for natural areas is provided through the designation of natural conservation areas within public parkland. Park acquisition of near-stream areas in Paint Branch was initiated by M-NCPPC before the 1981 master plan and was expanded by the Plan. However, the preservation of natural areas immediately surrounding the streams is not sufficient to protect the most fragile and most critical streams in the system. Therefore, the 1981 master plan park acquisition program needs to be greatly expanded.

Where environmentally-sensitive natural features exist, but are located in the less fragile areas of Paint Branch, protection of these features is also very important. Although adding these features to public parkland would be the ideal protection measure, protection through the creation of conservation easements on private land could be sufficient to provide an acceptable level of protection for these features and for the entire stream system.

The critical area for Paint Branch and its natural resources has been established as the part of the watershed north of Fairland Road. Within this critical area, the streams that are the most fragile and are currently most at risk for irreversible degradation of their high quality conditions are the Good Hope and Gum Springs tributaries. It is within these two subwatersheds that preservation of natural areas over the greatest proportions of the respective subwatersheds is necessary to help stop the current trend of declining quality of the two streams.

The Right and Left Fork tributaries are also very important to the health of Paint Branch. There are highly critical areas within these two subwatersheds which should become protected natural areas, if the streams' roles in supporting the brown trout fishery are to continue.

Within the mainstem north of Fairland Road, opportunities to provide a high level of protection to fragile natural areas are very limited beyond what has already been acquired as parkland. Much of its subwatershed is already developed.

Recognizing the need to provide a higher level of protection for the most fragile and most at-risk streams in upper Paint Branch, the Montgomery County Planning Board set in motion the process to designate park acquisition beyond the 1981 master plan through the approval of the Public Hearing Draft of the "Limited Amendment to the Master Plan for the Eastern Montgomery County Planning Area" in May 1995. The draft limited master plan amendment recommended that essentially all remaining developable land and unbuilt lots in Good Hope and Gum Springs subwatersheds be acquired for parkland. Since the Montgomery County Planning Board action, the Paint Branch Technical Work Group has evaluated the properties recommended for park acquisition in the draft limited master plan amendment. The group has refined the list of properties within the Good Hope and Gum Springs subwatersheds based on natural resource protection and land use criteria. These criteria are listed in Figure 5.

Based on the criteria in Figure 5, the Technical Work Group has also identified properties in the subwatersheds of the Right and Left Fork tributaries to be added to the recommended park acquisition list.

2. Controlling and Managing the Watershed's Future Impervious Cover

Controlling and managing future impervious cover can be accomplished in various ways:

- In the most critical and fragile areas of upper Paint Branch, park acquisition is the most effective method to limit the amount and location of future impervious cover and the associated negative impacts of land cover changes.

- Remaining developable land within upper Paint Branch must develop only under very stringent criteria and standards. By designating the upper Paint Branch as a Special Protection Area, the Montgomery County Council set in place a process to apply strict criteria and standards for incorporating water quality protection measures into new development. As part of its action, the Council established that the performance criteria for new development set forth in the 1981 master plan would be applied within the Paint Branch SPA. With the combination of SPA guidelines and executive regulations and the 1981 master plan performance criteria, new development would be subject to certain requirements including, but not limited to, the following:

  Limitation of site impervious cover to no more than 10 percent through the application of both an environmental overlay zone and the SPA law.

  Protection and preservation of natural

stream buffer areas which are expanded beyond the current regulatory stream buffers to protect streams, springs, seeps, and wetlands.

Application of best available BMP's for stormwater management and sediment and erosion control to reduce the negative impacts, within the inherent limits of BMP's, of development to receiving streams.

Required design and employment of BMP systems with back-up features to provide a higher likelihood of long-term BMP system integrity.

Monitoring of the development's BMPs and the receiving streams to document and quantify the effectiveness of these measures.

- In conjunction with the SPA law, the limitation on the amount and location of future impervious cover on developable land not recommended for park acquisition in upper Paint Branch should be achieved through the use of an environmental overlay zone.

- Outside the critical area of Paint Branch (i.e., downstream of Fairland Road), the management of future impervious cover should be geared towards locating impervious surfaces away from a site's environmentally-sensitive features and implementing BMPs that mitigate negative impacts as much as possible. This management approach would be accomplished through the standard regulatory requirements and guidelines for new development.

  The more stringent measures of SPA and/or expanded park acquisition are not recommended for this part of Paint Branch because of the essentially built-out character of the area and the generally lower quality of the streams. By virtue of its Use III designation, Paint Branch is afforded a higher level of protection through the standard regulatory requirements and guidelines than streams that are designated Use I or IV. These standard requirements and guidelines include wider stream buffers for Use III streams under the Planning Board's environmental guidelines and more stringent stormwater management and sediment and erosion control requirements applied through DEP's regulatory review program.

3. Identifying and Implementing Solutions to Current Problem Areas and Stressed Conditions

This component of the recommended approach includes measures that have already been initiated under the regional Anacostia River restoration effort. As part of the stormwater retrofit inventory for the part of the Anacostia River watershed within Montgomery County, MWCOG identified 29 potential stormwater management facility retrofit and stream restoration projects within the Montgomery County portion of Paint Branch (Galli and Herson, 1988). Some of these projects have been or are currently in the process of being implemented through the County capital improvements program (CIP) and DEP's stormwater management regulatory review program.

However, many of the inventory's retrofit and restoration projects that are still recommended remain to be implemented. And other projects of this type need to be identified and put in place in a timely manner for current stresses in the Paint Branch system to be effectively reduced or eliminated. (One example of retrofit projects identified since the 1988 MWCOG inventory is a group of possible stormwater retrofit projects that have been identified for the Good Hope tributary by the AWRC Upper Paint Branch Work Group (AWRC, 1994).

Evaluation and prioritization of potential retrofit and restoration projects, identification of specific new projects and programs, and recommendations for how the County can implement such projects and programs in a high priority manner are outside of the scope of this study and the charge of the Technical Work Group. The County has an on-going stormwater management retrofit and stream restoration program that addresses these issues through the development of watershed conservation and action plans, which includes citizen participation. The Technical Work Group supports the County's efforts in this program.

Criteria to Identify Properties for Expanded Park Acquisition in Upper Paint Branch

Figure 5

1. Existence of environmentally-sensitive areas on the property — streams, floodplains, wetlands, springs, or seeps.

2. Existence of a stream buffer on the property.

3. Existence of large forest stand on the property.

4. Location in the headwater area of the stream of interest.

5. Location within the primary trout spawning and nursery streams (i.e., most fragile streams) and most at-risk streams of upper Paint Branch (i.e., Good Hope and Gum Springs tributaries).

6. Adjacent to areas which contain a concentration of several seeps and springs or to individual seeps and springs which exhibit large or significant flows (relative to stream baseflow) for sustained periods.

7. Relatively large size of property (at least 20 acres in size).

8. Land use-related criteria used to aid in identifying expanded park acquisition for a property are:

   a. Property is contiguous to existing or recommended parkland or other publicly-owned land.

   b. Property is vacant.

For each property considered by the Work Group, an assessment was made of the potential for significant adverse impacts on the receiving stream if development occurs on the property. Such an assessment was based on which of the above criteria were met. Significant impacts include severe degradation to trout spawning and nursery areas, degradation of water quality through large increases in sediment and other pollutant loads, large reductions and fluctuations of cold stream baseflows, large increases in stream water temperatures, and erosive stormwater flows on land and within the stream.

In **Good Hope and Gum Springs subwatersheds**, because of the streams' highly fragile and critical nature, all of the criteria are equally weighted in the determination of whether a property should be acquired. It should also be noted that the vacant lots in the Oak Springs, Section 10 subdivision were evaluated as a single piece of land rather than as individual lots.

In **Right Fork and Left Fork subwatersheds**, the large size (i.e., about 20 acres or greater) of a property, the existence of forest stands, or the property's adjacency to or inclusion of high-flowing seeps/springs or to large numbers of seeps/springs was weighted more heavily than the existence of streams, wetlands, stream buffers in determining whether a property should be recommended for park acquisition.

For properties that are recommended for expanded park acquisition by the work group, it has been determined that development could potentially create significant adverse impacts on the receiving streams. These properties encompass land within upper Paint Branch that require the highest level of protection in order to preserve the high quality conditions of the stream system.

4. Developing an Integrated Upper Paint Branch Watershed Management Plan

DEP is proposing to develop an SPA conservation plan for managing the upper Paint Branch watershed, in coordination with M-NCPPC and other agencies. Such a plan is needed to ensure that the various programs, standards, and guidelines that are implemented to protect upper Paint Branch function in a comprehensive, stream system-wide manner over time. The plan could include resource monitoring, stormwater management retrofitting, terrestrial and aquatic habitat management, stream restoration, inspection and maintenance of parkland and stormwater management facilities, and public education.

B. Recommendations by Subwatershed

1. All Subwatersheds in Upper Paint Branch

The *general strategy* for protecting the upper Paint Branch subwatersheds is to provide the highest level of protection for the most fragile and critical parts within upper Paint Branch, protect sensitive natural features within the less critical parts, apply the most stringent regulatory standards and guidelines for development within the less critical parts of the subwatersheds, and correct existing water resource problems through the strategic and timely implementation of watershed and aquatic habitat management measures and SWM retrofit/stream restoration projects.

Recommendations that follow this strategy are given below for the individual subwatersheds in upper Paint Branch. In addition, there are some recommendations that apply to all the subwatersheds in upper Paint Branch. These are as follows:

- Amend the 1981 master plan performance criteria for new development so that it is consistent with current standards, guidelines, and programs. In addition, include a discussion of how these criteria are employed within this regulatory framework. The criteria should keep intact the requirement for new development to not exceed a 10 percent imperviousness cap and a provision for an expanded stream buffer. Recommended modifications to the criteria are found in Appendix A, page 47. Components of these criteria may be covered in SPA regulations and guidelines.

- Ideally, new SWM facilities should be publicly owned and maintained. Historically, privately-owned SWM facilities in the County generally have been less intensively maintained than publicly-owned structures. A publicly-owned facility affords a greater chance of being properly monitored and maintained than a privately-owned facility.

- To document how effective the master plan, SPA program, and various related regulatory processes are at controlling the amount and location of future imperviousness in the various subwatersheds, a system should be set up to track increases in impervious surfaces in these subwatersheds. This recommendation had been previously made by the AWRC Upper Paint Branch Technical Work Group (AWRC, 1994).

- Stringent inspection and enforcement programs for development sites and stringent inspection and maintenance programs for stormwater management facilities should be implemented by the County to ensure that measures and facilities to minimize impacts of new development are functioning properly and efficiently over time.

- For any land that can be developed in these subwatersheds, the requirements and guidelines of the SPA and the 1981 master plan performance criteria, as modified, should be strictly applied.

- An environmental overlay zone should be created for the upper Paint Branch watershed. Such a zone should be set up to meet the following objectives:

    Minimize additional imperviousness and adverse impacts of new development.

    Protect streams, wetlands, springs, and seeps that are not part of the land proposed for park acquisition.

Protect and enhance forest stands at the headwaters of streams not proposed for park acquisition.

- An overlay zone should include, at a minimum, the following components:

  Maximum site imperviousness of 10 percent for all new development (exception noted below for ridgeline properties).

  In residential zones, eliminate development standards for lot sizes and development envelopes (i.e., setback requirements for lots). Retain existing standards for density and unit types of the base zone.

  Prohibit or place conditions on permitted and specific special exception uses that create unacceptable adverse impacts to the resources of Paint Branch.

  No site imperviousness cap for existing single-family residential uses.

  A property that lies within more than one watershed (i.e., ridgeline property) can develop if it either:

  a) meets the 10 percent site imperviousness cap within the Paint Branch portion of the site; or

  b) it conforms to all three provisions listed below without a site imperviousness cap:

     i) all stormwater runoff from existing and proposed impervious surfaces on the site can be artificially diverted into the adjoining watershed (out of the Paint Branch watershed);

     ii) stormwater runoff is treated to the standards required in the Special Protection Area Law; and

     iii) groundwater recharge is maximized within the upper Paint Branch watershed.

  An existing non-residential use may add more impervious surfaces on the property if: the additional paved or built area is no more than 10 percent of the existing impervious surface on the site, stormwater controls meet the requirements of the Special Protection Area Law, and the maximum total site imperviousness does not exceed a threshold that is set to reflect the range of imperviousness levels currently occurring on non-residential uses within upper Paint Branch.

- Designate existing and proposed parkland, except for neighborhood parks, as the "Upper Paint Branch Conservation Park," and plan park uses accordingly.

2. Good Hope Tributary

Good Hope Tributary is one of the most fragile and critical streams in Paint Branch because of its role as the primary trout spawning and nursery area for the system. It is currently under stress, even with the limited amount of additional development that has occurred since the early 1980's; this is one of the streams that is most at-risk in losing its high quality conditions.

Therefore, the *strategy* for protecting this stream is to provide the highest level of protection to its natural features, which include not only its wetlands, seeps, and springs, but also its forest cover and natural recharge areas, and to greatly minimize negative impacts from existing and any future development. Such a protection strategy would require impervious cover within the subwatershed to remain as close to existing levels as possible and to maximize the preservation of natural areas as public parkland. In addition, solutions to existing stormwater-related problems should be identified and implemented in a timely manner to stop the trend of declining quality in the stream.

Recommendations that follow this strategy are:

- Establish a park acquisition program that significantly expands upon the 1981 master plan. Table 7 lists the properties or parts of properties recommended for park acquisition beyond the 1981 master plan. Appendix B shows the properties' locations in the subwatersheds.

Recommended Properties for Park Acquisition in the Good Hope Tributary Subwatershed

Table 7

Property Description: Legal Description	Block	Lot	Parcel#	Streams/Flood Plain	Wetlands/Springs/Seeps	Stream Buffer	Forest	Location in Headwaters	Drains to Primary Trout Spawning/Nursery Streams (Good Hope/Gum Springs)	Adjacency to High Flowing or Large Number of Springs/Seeps	Adjacent to Parkland or Other Publicly Owned Land	Vacant	Twenty Acres or More in Size
Colesville Park	4	2	0	✓	✓	✓	✓	✓	✓		✓	✓	
Colesville Park	4	5	0			✓	✓	✓	✓		✓	✓	
Parcel F Peachwood	K		0	✓	✓	✓		✓	✓		✓	✓	
Peachwood	K	olA	0			✓		✓	✓		✓	✓	
Snowdens Manor Enlarged			70	✓	✓	✓	✓		✓	✓	✓	✓	
Snowdens Manor Enlarged			73	✓	✓	✓	✓		✓		✓	✓	
Parcel A Cloverly**	A		117					✓	✓		✓	✓	
Snowdens Manor Enlarged			330	✓	✓	✓	✓		✓	✓	✓	✓	✓
Part Snowdens Manor			353	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Colesville			408				✓		✓		✓	✓	✓
Part Snowdens Manor			427	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Snowdens Manor Enlarged*			471		✓				✓	✓	✓		
Snowdens Manor Enlarged*			474		✓				✓	✓	✓		
Bealls Manor			475	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Friend in Need			678				✓		✓		✓	✓	
Bealls Manor			850	✓	✓	✓	✓		✓	✓	✓	✓	✓
Snowdens Manor			880	✓	✓	✓	✓		✓		✓	✓	
Snowdens Manor Enlarged**			82				✓		✓			✓	

* Only a portion of the entire property is being recommended for acquisition.

** Impervious reserve for community/public interest projects.

- The park acquisition program should include some property for use as an "impervious area reserve for community and public interest projects." It is envisioned that the impervious reserve could be drawn upon to assist in the development of projects having longstanding, strong ties to communities in the watershed that have difficulty meeting SPA criteria. Projects that might be appropriate for drawing upon this reserve could include the Good Hope Union United Methodist Church who described in compelling testimony to the Council and Board how the church they seek to expand has for decades served as a vital community focal point. In may also be appropriate to use these areas to perform retrofitting of deficient SWM systems or construction of new facilities. Since modest amounts of acreage are being proposed for acquisition as reserve, it is not envisioned that any major public infrastructure projects would be able to draw upon these reserves.

- The County should examine and implement in a timely manner stormwater retrofit projects that have been identified to aid in reducing current stresses to the stream. These projects include, but would not be limited to:

  Projects to address uncontrolled stormwater runoff from existing development located north of Good Hope Road along the left branch of Good Hope Tributary, as recommended by the AWRC Upper Paint Branch Work Group (AWRC, 1994).

Retrofits currently being considered by DEP and the Department of Transportation (MCDOT) for the DOT Colesville Maintenance Facility.

A project to rehabilitate and/or replace the existing Fairland Ridge SWM infiltration trenches by M-NCPPC and/or DEP.

3. Gum Springs Tributary

Gum Springs Tributary is another extremely fragile and critical stream of Paint Branch, along with Good Hope Tributary. The high quality conditions that enable the stream to function as the second most important spawning and nursery area for the brown trout fishery must be preserved. If this stream, particularly its upper headwater reaches, degrades to the point that it loses its ability to provide trout spawning and nursery areas, the trout fishery's ability to be self-sustaining will be severely impaired. Good Hope Tributary most likely cannot function alone in the long run to maintain the trout fishery's naturally-reproducing characteristic.

In addition, it has been documented that the lower section of the stream has been degraded by impacts from subdivisions placed in the subwatershed. Thus, like Good Hope Tributary, it is at-risk for losing its high quality conditions.

The *strategy* for protecting this stream follows that for Good Hope Tributary. The highest level of protection, through acquisition of parkland, must be placed on the subwatershed's environmentally-sensitive features, forest cover, and natural recharge areas, and to greatly minimize negative impacts from existing and any future development. Measures to maintain the subwatershed imperviousness as close to existing levels as possible and to maximize the preservation of natural areas as parkland should be implemented.

Recommendations are as follows:

- Establish a park acquisition program beyond the 1981 master plan (see Table 8, page 43). Appendix B shows the properties' locations in the subwatershed.

- Identify and implement SWM retrofit and stream restoration projects in an expeditious manner to restore the lower section of Gum Springs as a significant trout spawning and nursery area. One of these projects involves the construction of a flow diversion structure and parallel pipe system to carry storm flows from the lower Oak Springs SWM facility (a wet pond located at the end of Twig Road) around Gum Springs Tributary to the mainstem of Paint Branch; this project is currently funded through the County CIP and the U.S. Army Corps of Engineers, with an estimated construction start date of 1997, depending on the progress of design and other factors.

4. Right Fork Tributary

As previously discussed, the Right Fork Tributary has the highest water quality of all the streams in Paint Branch. This stream not only provides habitat for a diverse and abundant macroinvertebrate community (which is a food source for the brown trout, as well as other fish), but it also supports some limited trout spawning. It is important for the brown trout because it provides the following: excellent habitat for food organisms for the trout; redundancy in the Paint Branch system as a trout spawning and nursery area; suitable habitat for adult trout; high water quality conditions to help maintain suitable trout habitat, as well as habitat for the trout's food organisms, in the mainstem of Paint Branch.

It is, therefore, very important to maintain the high water quality within the Right Fork Tributary, preserve the very good habitat structure in the upper section, and improve the stream channel conditions in the lower stream section. The strategy for protecting this stream is to protect environmentally-sensitive features (e.g., streams, stream buffers, wetlands, seeps, springs, floodplains) within the subwatershed, provide the highest level of protection to those areas which play significant roles in supplying the stream with the steady, high quality, coldwater baseflow, and minimize the ability of existing and future land development activities to degrade the stream. An area which plays a significant role in supplying the high quality stream baseflow includes: any area which has a large concentration of springs and seeps or a relatively constant- and large-flowing spring or seep; or any area which is approximated to contribute significant groundwater recharge to these concentrations of springs and seeps or large spring or seep.

This protection strategy would involve park acquisition within the subwatershed which extends

Recommended Properties for Park Acquisition in the Gum Springs Tributary Subwatershed

Table 8

Property Description: Legal Description	Block	Lot	Parcel#	Streams/Flood Plain	Wetlands/Springs/Seeps	Stream Buffer	Forest	Location in Headwaters	Drains to Primary Trout Spawning/Nursery Streams (Good Hope/Gum Springs)	Adjacency to High Flowing or Large Number of Springs/Seeps	Adjacent to Parkland or Other Publicly Owned Land	Vacant	Twenty Acres or More in Size
Plat 18881 Outlot A Oak Springs	D		0	✓	✓	✓	✓	✓	✓		✓	✓	✓
Oak Springs	9	1	0	✓	✓	✓	✓		✓	✓	✓	✓	
Oak Springs	9	2	0	✓	✓	✓	✓		✓	✓	✓	✓	
Oak Springs	9	3	0	✓	✓	✓	✓		✓	✓	✓	✓	
Oak Springs	9	4	0	✓	✓	✓	✓		✓	✓	✓	✓	
Oak Springs	9	5	0	✓	✓	✓	✓		✓	✓	✓	✓	
Oak Springs	9	6	0				✓		✓	✓	✓	✓	
Oak Springs	9	7	0				✓		✓	✓	✓	✓	
Oak Springs	9	8	0		✓		✓		✓	✓	✓	✓	
Oak Springs	9	9	0				✓		✓	✓	✓	✓	
Oak Springs	9	10	0				✓		✓	✓	✓	✓	
Oak Springs	9	11	0				✓		✓	✓	✓	✓	
Oak Springs	9	12	0				✓		✓	✓	✓	✓	
Oak Springs	9	13	0				✓		✓	✓	✓	✓	
Oak Springs	9	14	0				✓		✓	✓	✓	✓	
Oak Springs	9	15	0				✓		✓	✓	✓	✓	
Oak Springs	9	16	0				✓		✓	✓	✓	✓	
Oak Springs	9	17	0				✓		✓	✓	✓	✓	
Oak Springs	9	18	0				✓		✓	✓	✓	✓	
Oak Springs	9	19	0				✓		✓	✓	✓	✓	
Oak Springs	9	20	0				✓		✓	✓	✓	✓	
Oak Springs	9	21	0				✓		✓	✓	✓	✓	
Oak Springs	9	22	0		✓		✓		✓	✓	✓	✓	
Oak Springs Outlot A	10		0				✓		✓	✓	✓	✓	
Oak Springs	10	1	0				✓		✓	✓	✓	✓	
Oak Springs	10	2	0				✓		✓	✓	✓	✓	
Oak Springs	10	3	0		✓		✓		✓	✓	✓	✓	
Oak Springs	10	4	0				✓		✓	✓	✓	✓	
Oak Springs	11	1	0				✓		✓	✓	✓	✓	
Oak Springs	11	2	0				✓		✓	✓	✓	✓	
Oak Springs	11	3	0				✓		✓	✓	✓	✓	
Oak Springs	11	4	0				✓		✓	✓	✓	✓	
Oak Springs	11	5	0				✓		✓	✓	✓	✓	
Oak Springs	11	6	0				✓		✓	✓	✓	✓	
Oak Springs	11	7	0				✓		✓	✓	✓	✓	
Oak Springs	11	8	0				✓		✓	✓	✓	✓	
Oak Springs	11	9	0				✓		✓	✓	✓	✓	
Oak Springs	11	10	0				✓		✓	✓	✓	✓	
Oak Springs	11	11	0				✓		✓	✓	✓	✓	
Law 36258 Snowdens Manor Enlarged			712		✓		✓	✓	✓		✓	✓	

beyond the 1981 master plan acquisition program. In addition, it involves limiting the amount and location of future impervious surfaces, although the amount of land that would be able to develop is greater in this subwatershed than in the subwatersheds of Good Hope and Gum Springs tributaries. Recommendations which follow this strategy are:

- Expand the 1981 master plan park acquisition program to include the properties listed in Table 9 and shown in Appendix B.
- Where environmentally-sensitive features are not part of a recommended park acquisition area, such features should be protected

Recommended Properties for Park Acquisition in the Right Fork Tributary Subwatershed

Table 9

Property Description: Legal Description	Block	Lot	Parcel#	Streams/Flood Plain	Wetlands/Springs/Seeps	Stream Buffer	Forest	Location in Headwaters	Drains to Primary Trout Spawning/Nursery Streams (Good Hope/Gum Springs)	Adjacency to High Flowing or Large Number of Springs/Seeps	Adjacent to Parkland or Other Publicly Owned Land	Vacant	Twenty Acres or More in Size
Layhill*			230	✓	✓	✓	✓	✓		✓		✓	✓
Layhill*			525	✓	✓	✓		✓		✓	✓	✓	✓
Snowdens Manor Enlarged			830	✓	✓	✓	✓			✓	✓	✓	✓

* Only a portion of the entire property is being recommended for acquisition.

through the creation of conservation easements on private property.

- Identify and implement SWM retrofit and/or stream restoration projects to improve habitat conditions for the lower section of Right Fork Tributary.

5. Left Fork Tributary

Left Fork Tributary provides habitat for adult trout and their food organisms. It provides the redundancy for the trout fishery, as well as for other animal and plant communities of Paint Branch, that is necessary to maintain a healthy and functioning population. Preservation of this redundancy is especially important in the upper Paint Branch because the ability of lower Paint Branch to provide suitable habitat for trout and their food organisms is very limited due to the highly developed nature of that part of the watershed. It is, therefore, important to maintain those features of the stream and its subwatershed that allow stream quality conditions to continue to be high enough to support adult trout and to reduce or eliminate stresses on the stream that currently exist.

The protection *strategy* for this stream is similar to that for Right Fork Tributary: to protect environmentally-sensitive features (e.g., streams, stream buffers, wetlands, seeps, springs, floodplains) within the subwatershed, provide the highest level of protection to those areas which play significant roles in supplying the stream with the steady, high quality, coldwater baseflow, and minimize the ability of existing and future land development activities to degrade the stream. As in Right Fork Tributary, an area which plays a significant role in supplying the high quality stream baseflow includes: any area which has a large concentration of springs and seeps or a relatively constant- and large-flowing spring or seep; or any area which is approximated to contribute significant groundwater recharge to these concentrations of springs and seeps or large spring or seep.

Recommendations that follow this strategy are also similar to Right Fork Tributary:

- Expand the 1981 master plan park acquisition program to include the properties listed in Table 10 and shown in Appendix B.

- Where environmentally-sensitive features are not part of a recommended park acquisition area, such features should be protected through the creation of conservation easements on private property.

- Identify and implement SWM retrofit and/or stream restoration projects to improve water quality and habitat conditions in Left Fork Tributary. Some of these projects have been identified in the past by various agencies and include the coldwater, baseflow bypass around Twin Ponds to be constructed by the Montgomery County Public Schools as part of the stormwater management concept for the Briggs Chaney Middle School and retrofits

Recommended Properties for Park Acquisition in the Left Fork Tributary Subwatershed

Table 10

Property Description: Legal Description	Block	Lot	Parcel#	Streams/Flood Plain	Wetlands/Springs/Seeps	Stream Buffer	Forest	Location in Headwaters	Drains to Primary Trout Spawning/Nursery Streams (Good Hope/Gum Springs)	Adjacency to High Flowing or Large Number of Springs/Seeps	Adjacent to Parkland or Other Publicly Owned Land	Vacant	Twenty Acres or More in Size
Edgewood			330		✓		✓	✓				✓	✓
Holmes Tract			500	✓	✓	✓	✓	✓		✓			✓
Holmes Tract			600	✓	✓	✓	✓	✓			✓	✓	
Bealls Christie			653	✓	✓	✓	✓	✓		✓			
Snowdens Manor Enlarged			677		✓		✓	✓		✓	✓	✓	✓
Holmes Tract			710	✓	✓	✓	✓	✓		✓	✓	✓	
Holmes Tract*			770		✓	✓	✓	✓		✓		✓	
Snowdens Manor Enlarged*			866		✓	✓	✓	✓		✓	✓		

* Only a portion of the entire property is being recommended for acquisition.

being considered by DEP and others for wet ponds at and above the former Maydale Nature Center.

6. Mainstem of Paint Branch Upstream of Fairland Road

The mainstem provides suitable conditions for adult trout use. As with Left Fork Tributary, it provides necessary and redundant habitat for the trout population, as well as other aquatic species in the stream system. In addition, documentation shows that in the past, it has been used by trout as a spawning and nursery area. It is important to maintain the conditions that enable the trout to live in this part of the mainstem. It is also important to restore the mainstem to allow it to regain both adult trout carrying capacity and potential as a trout spawning and nursery area.

The high quality, cold baseflow that flows through this section of the mainstem is due partly from baseflow contributions from Right and Left Fork tributaries. Any large, significant seeps and springs along the mainstem which also contribute to this baseflow already are protected within existing parkland; and some of their associated groundwater recharge areas may be largely within already subdivided land. So opportunities to provide a higher level of protection than what already exists for areas that play significant roles in the high quality, cold baseflow in this part of Paint Branch are limited. The protection strategy is, therefore, narrower than in Right and Left Fork tributaries.

The *strategy* is to protect environmentally-sensitive features, where possible, and to minimize adverse impacts of existing and future land development activities on the stream. Recommendations that follow this strategy are:

- Environmentally-sensitive features, such as streams, stream buffers, wetlands, seeps, springs, and floodplains, that are not already protected within parkland or conservation easements should be protected through the creation of conservation easements on private property, where possible.
- Identify and implement SWM retrofit and/or stream restoration projects to improve water quality and habitat conditions in the mainstem.

7. Paint Branch Downstream of Fairland Road (Lower Paint Branch)

As has been previously discussed, lower Paint Branch has been degraded by past and existing land development activities within that part of the watershed. Although it provides habitat for adult trout and their food organisms, the quality of the water and habitat is not as high as that found in upper Paint Branch. It is important to keep the lower Paint Branch from degrading any further and to reduce or remove existing stresses to this part of the stream system as much as possible.

The protection *strategy* for this part of Paint Branch is to protect environmentally-sensitive features as much as possible, given the limited amount of remaining developable land, minimize adverse impacts to the stream system from existing and future development, and improve and restore stream water quality and habitat conditions where possible. Recommendations are as follows:

- Environmentally-sensitive features, such as streams, stream buffers, wetlands, seeps, springs, and floodplains, that are not already protected within parkland or conservation easements should be protected through the creation of conservation easements on private property, where possible.

- Identify and implement SWM retrofit and/or stream restoration projects to improve water quality and habitat conditions in lower Paint Branch.

Performance Criteria for Proposed Development in the Upper Paint Branch Watershed

Background

In 1973, the Maryland Department of Natural Resources (Md. DNR) identified two self-propagating populations of brown trout inhabiting Paint Branch and its tributaries. To protect the Paint Branch watershed and the trout fishery, special land and water resource management is needed. The two primary methods of land and water resource management are:

- land use controls; and
- best management practices (BMP's)[1] for land development.

The *1981 Eastern Montgomery County Master Plan* recommends RE-1 and RE-2C zoning for most of the undeveloped land in the Paint Branch watershed upstream of Fairland Road. This zoning replaced R-200 zoning, which is two to four times as dense. This rezoning reduces the possibility of adverse impacts to the watershed from development. Within the areas designated for the RE-1 and some of the areas designated for the RE-2C zones, there is a PD-2 option. The master plan states that the PD-2 option would be considered only if an applicant could demonstrate that development at a PD-2 density could provide better protection for the environment. Only a few small properties in the upper Paint Branch watershed have been rezoned to PD-2 since the 1981 Master Plan. In the 1990 Trip Reduction Amendment to the *Eastern Montgomery County Master Plan*, the PD-2 option is removed on all properties except those zoned PD; this action was done to help reduce ultimate vehicular traffic in residential zones.

Since the adoption of the *1981 Eastern Montgomery County Master Plan*, monitoring of the stream system, primarily by Md. DNR and more recently by MCDEP, has shown that the upper Paint Branch has been subjected to increasing stressed conditions. Therefore, a strategy that focuses more strongly on conservation and protection of natural areas and vegetation cover, especially forest, in upper Paint Branch is needed to prevent the irreversible degradation of Paint Branch's high quality conditions and unique natural resource. This strategy involves a park acquisition program that greatly expands upon the 1981 Master Plan program, and the application of stringent performance criteria for new development in the upper watershed. The park acquisition program is covered in the *1995 Limited Amendment to the Eastern Montgomery County Master Plan* for Expanded Park Acquisition for Resource

[1] A best management practice is a method considered to be the most effective and practicable means available to prevent or reduce the amount of pollutants or other detrimental water resource impacts generated from non-point sources. Non-point source pollution is pollution that originates from diffuse sources and not from descernible, confined, or discrete sources. For example, fertilizers or pesticides on lawns that are carried in surface water runoff to a stream are non-point source pollutants. In contrast, nitrogen and phosphorus compounds discharged into a stream from a wastewater treatment plant are point-source pollutants.

Management and Protection of the Paint Branch Watershed. The performance criteria are based upon BMP's that would protect the Paint Branch watershed and its trout resource. They also respond to the Maryland Department of Environment (MDE) standard criteria for Use III Waters (Natural Trout Waters).[2]

Assuring that BMP's are incorporated into development design is the responsibiity of various county and state agencies during a coordinated review process for new development projects. Within this development framework, lead agency responsibility has been designated so that final authority over which BMP's or other methods of development should be employed is left to the appropriate agency with the others acting in an advisory capacity. The reviewing agencies act under current laws, regulations and guidelines that are in place in the County and State. Among those which apply to Paint Branch are: the Zoning Ordinance of Montgomery County, the Subdivision Regulations, the Stormwater Management and Sediment Control Laws and Regulations, the Forest Conservation law, and the Planning Board's Environmental Guidelines. In addition, on July 11, 1995, the Montgomery County Council designated the upper Paint Branch watershed (i.e., upstream of Fairland Road) as a Special Protection Area (SPA), thus making it subject to the SPA law and regulations. The Council also authorized the continued application of the 1981 Master Plan Performance Criteria to new development within the Paint Branch SPA.

Since 1981, a significant portion of the Paint Branch performance criteria have been incorporated into the county laws, regulations and guidelines mentioned above. As such, the application of the criteria falls under the responsibility of various reviewing agencies acting in their "lead" capacity. This plan endorses this approach for the continued application of the performance criteria. The criteria have been updated and modified and are presented in a manner which reflects this approach. Application of these criteria shall occur at the time a project is subject to regulatory review by the Planning Board or MCDEP. This includes review of preliminary subdivision and site plans, special exceptions cases, mandatory referrals, and water quality review. In addition, for any property undergoing rezoning, the Performance Criteria should be considered as part of the judgement to grant or deny the requested zoning. Where development plans or site plans are required, the Performance Criteria also provide guidance to developing and evaluating these plans. Any criteria which are not covered by current laws or regulations, or are insufficiently covered by future changes to laws and regulations, should still be required as part of all proposed development within Paint Branch.

Environmental Analysis

To ensure that water quality standards are maintained in Paint Branch and its tributaries (especially Good Hope, Gum Springs, Left Fork, Right Fork, and the Mainstem north of Fairland Road), an environmental analysis of any proposed development in this area is necessary. The environmental analysis is to be produced by the applicant for a development project and should provide the site- specific information necessary to assess the development plan to determine if the standards and requirements set forth for the watershed are met. The environmental analysis shall include an analysis of natural features and an analysis of the proposed development. The information required under these analyses may be submitted to either MNCPPC and/or MCDEP, as appropriate, under most current county laws and regulations and agency review authority. Items which are not covered by existing processes should be included in the submission to MNCPPC.

The following site parameters would need to

[2] The Md. Department of the Environment Water Resources Administration has established four water use classes, each with a corresponding set of standards:

- **I** Water Contact Recreation and Aquatic Life
- **II** Shellfish Harvesting
- **III** Natural Trout Waters
- **IV** Recreational Trout Waters

Use III, or "Natural Trout Waters" are waters that are capable of supporting natural trout populations, including propagation, and their associated food organisms. "Propagation" means that continuance of species by generation of successive production in the natural environment, as opposed to the maintenance of species by artificial culture and stocking.

[3] A Special Protection Area is defined as a watershed or part of a watershed in Montgomery County that contains existing water resources or other environmental features directly relating to those water resources, that are of high quality or unusually sensitive, and where proposed land uses would threaten the quality or preservation of the resources in the absence of special water quality protection measures. A Special Protection Area is created through action by the Montgomery County Council or adoption in a master plan.

be considered as part of an environmental analysis:

I. Analysis of Natural Features

A. Site information currently required as part of a natural resources inventory/forest stand delineation (NRI-FSD) per the Environmental Guidelines and Forest Conservation Law:

- Topography:
  - existing terrain of the site; and
  - identification of slopes between 15 and 25%, and 25% and greater.

- Soils/Geology:
  - soil types including drainage characteristics, susceptibility to erosion, and areas of moderate and severe erosion;

- Vegetation:
  - **inventory of forest and trees.**

- Physical Habitat (Stream Environment):
  - location of perennial/intermittent streams **and associated buffers;**
  - **location of wetlands, seeps and springs and associated buffers; and,**
  - **location of major drainage courses (i.e., ephemeral streams).**

- Hydraulics:
  - existing drainage of the site;
  - ultimate 100-year floodplain;

B. Additional site information which would currently be submitted for properties within Upper Paint Branch per Special Protection Area law:

- Vegetation:
  - inventory of the different vegetation types and areas of the site with emphasis on streamside vegetation, wetland areas, mature woods and areas under stress due to erosion, poor soils, steep slopes, etc.

- Soils/Geology:
  - depth of seasonal high water table; and
  - geologic condtitions.

- Physical Habitat (Stream Environment):
  - Stream characteristics:
    - stream gradient;
    - substrate suitability;
    - areas of channel or streambed erosion;
    - habitat suitability for trout and their support organisms.

- Hydrology:
  - Surface Water:
    - base flow of receiving stream.
  - Groundwater:
    - groundwater characteristics (depth, yield, storage, etc.);
    - ocation and character of springs **and seeps**; and
    - recharge areas **for stream baseflow, seeps, and springs**.

- Hydraulics:
  - existing and future channel velocities.

- Water Quality:
  - existing water quality conditions **as provided to the applicant by MCDEP through compilation of documented stream quality data.**

II. Analysis of Proposed Development

A. Current Standard Submission Requirements per the Montgomery County Zoning Ordinance:

- Size and Location of Development:
  - proximity of physical development to stream channels, wetlands, floodplains, and appropriate buffers; and
  - area of physical development (ground coverage including buildings, roads, parking areas, walks, and other transportation ways).
  - ~~proximity to headwaters (for any given perennial/intermittent stream)~~

- Proposed Drainage Plan:
  - stormwater management concept plan including the types of storm water conveyance and impervious area ~~and measures to augment ground water recharge to~~

~~maintain sufficient base flows of streams.~~

- Sewerage and Water Systems:
  - proximity of water and sewer lines to stream channels, **wetlands, springs, seeps and buffers,**
  - location of septic fields, and
  - location of primary and alternative well locations.

- **Forest Conservation Plan per the Forest Conservation Law:**
  - **plans and worksheet showing proposed forest/tree loss, limits of disturbance and tree protection devices, forest/tree conser- vation areas (size and location), reforestation and/or afforesta- tion areas (size and location), and conservation easements (size and location); stream buffer areas, by law, have the highest priority for forest retention, forest plantings, and protection, at a minimum, through conservation easements.**

B. Additional requirements currently requried per the Special Protection Area Law:

- Proposed Drainage Plan:
  - **stormwater management concept plan that, in addition to meeting standard requirements, would include extraordinary measures, such as linked BMP's to progressively minimize sediment and stormwater impacts;**
  - **engineered stormwater management measures that avoid environmentally-sensitive areas such as streams and buffers, wetlands, floodplains, where feasible;**
  - proposed impervious area; and
  - proposed measures to augment groundwater recharge to maintain sufficient base flows of streams.

- Impact on Water Quality:
  - **Water quality parameters that would be of concern and should be monitored may include, but are not limited to:**
  - water temperature;
  - dissolved oxygen concentration;
  - total suspended solids;
  - **total dissolved solids;**
  - turbidity;
  - BOD5;
  - pH;
  - **total organic carbon;**
  - **total phosphorous;**
  - **nitrate;**
  - **copper;**
  - toxics; and
  - total residual chlorine.
  - ~~fecal coliform density (increased nutrient load — both soluble and insoluble);~~
  - ~~nutrients.~~

- Impact on Aquatic Habitat:
  - **Aquatic habitat impact parameters that are of concern and should be monitored may include, but are not limited to:**
  - sediment deposition;
  - channel velocities;
  - streambed scouring/channel erosion;
  - **substrate fouling;**
  - **riffle embeddedness; and**
  - **stream baseflow.**

- Site Maintenance:
  - erosion and sediment control (during and after construction); and
  - land application of substances (fertilizer, pesticides, etc.) or potential for deposition of residuals (refuse, vegetable debris, etc.).

In a watershed environment, all of these factors and more will interact in a cumulative way to establish the water quantity and quality of the stream and the associated impact on the stream habitat and biota. Therefore, it is difficult to set specific individual site standards for most of the parameters listed above. For the purposes of monitoring and administering development, especially cluster and planned development, the following performance criteria, updated and modified from the 1981 Eastern Montgomery County Master Plan, should be adhered to.

Performance Criteria

A. Location and Size of Development

1. Low density development **that results in low site imperviousness (10 percent or less) is preferred in the upper Paint Branch watershed (i.e., north of Fairland Road).** ~~(two acre lots or larger) is preferred in the headwaters of Paint Branch~~.

2. Any physical development[4] should be located as far away from the stream and its headwaters area as possible to provide the maximum protective buffer.

3. The cluster development is **normally** preferred to minimize the area of the site that is actually physically changed.

4. Physical development should not occur within 150 feet of **streams, wetlands, seeps and springs or within the regulatory stream buffer, whichever is greater**. ~~the 100 year ultimate floodplain~~

5. Development of areas with steep slopes (**25** ~~15~~ percent or more), **stream buffers**, ~~poorly drained soils~~, **documented** groundwater recharge areas, wetlands, and other environmentally sensitive areas should be avoided.

6. **A combination of structural and** non-structural Best Management Practices (BMP's), urban and agricultural, should be utilized to reduce pollutant loading—especially sediment—in receiving streams. ~~These BMP's should be incorporated into an erosion and sediment control plan.~~

7. Sewer lines and septic fields should be sited and constructed in such a manner as to maximally reduce the potential for ground and surface water contamination.

8. Water and sewer line stream crossings should be minimized. Where crossings do occur, they should be placed away from **trout**-spawning areas.

9. Stream buffers should be designed and established to accomplish the following:

   a. complement on-site erosion/sediment control measures by serving as a back-up natural filter/trap;
   b. maintain or improve the water temperature regimen of the stream(s);
   c. provide groundwater storage/recharge for the stream(s); and
   d. prevent the siting of structures within the 100-year ultimate floodplain.

Stream buffer width should be based upon: ~~Characteristics to be examined to be examined to determine stream buffer width should include:~~

   a. soil type and infiltration rate;
   b. types and density of vegetative cover and soil holding ability, and
   c. slope of the land adjacent to the steam.

Stream buffers must remain undisturbed except for unavoidable and necessary development infrastructure.
Note: Stream buffers are currently defined in Planning Board guidelines and Section A.4. of these Performance Criteria.

B. Soil and Slope Conditions

1. **Highly pervious soils or documented groundwater recharge areas should be maintained as open space, parkland, or for stormwater management facilities that promote infiltration.** ~~Structural development should be located on soils with a low infiltration capacity as opposed to soils with a high infiltration capacity. Pervious soils should be maintained as open space and parkland.~~

2. Physical development should not occur in areas where the slope equals or exceeds **25** ~~15~~ percent **or in stream buffer areas**.

~~2. Poor soils — eroded or poorly drained — should be treated with vegetative cover, as~~

[4] Physical development refers to the structure installed improvements, roads, driveways, parking areas, paths, etc.

~~recommended by Montgomery County Soil Conservation District (MSCD).~~

3. Steep slope areas (**25** ~~15~~ percent or more) **and stream buffer areas** should be incorporated into the site's open space.

~~4. Additional erosion control measures (as recommended by MSCD) should be utilized where moderately or severely eroded soils exist.~~

C. Vegetation and Tree Cover

~~1. Trees and other natural vegetation should not be disturbed except at the specific site of structural development.~~

1. Vegetation along the channel banks should not be disturbed ~~under any conditions.~~ **except for necessary and unavoidable development infrastructure such as some types of stormwater management facilities, roads for access, and sewer lines.**

2. Wetland areas should not be disturbed ~~under any conditions.~~ **except for necessary and unavoidable development infrastructure.**

3. When a development site consists of both cropland and forestland, it is preferable to develop the area of cropland. Where that is not possible, and development occurs on the forestland, the residual cropland should be reforested.

4. Areas adjacent to streams **and within stream buffer areas** should be stabilized with appropriate vegetation.

D. Imperviousness

1. Development should not result in more than 10 percent of the total site area in impervious surface (including structures, roadways, parking areas, paths, etc.).

2. Stormwater conveyance systems which enhance infiltration and decrease runoff volumes and velocities should be used.

3. Porous materials should be used in the construction of pathways, driveways, parking areas, etc., to limit **effective** impervious surfaces.

E. Hydrologic Criteria

1. The stormwater management concept plan **should** ~~must~~ account for the following:

   a. Drainage for the development site should limit runoff to maintain the base flow and channel velocity of the receiving stream.

   b. Where possible, natural drainage should be utilized instead of structural drainage. No modification of existing natural drainageways should occur.

   c. **Where possible, drainage systems that reduce stormwater runoff velocities, such as grass-lined drainage swales or vegetated swales with check dams, should be utilized in development projects. These systems should be shaded where possible**. ~~The velocities of stormwater runoff should be reduced by including alternative drainage systems instead of traditional drainage systems. These systems may include: dutch drains, drainage swales, stone filled ditches, or grass lined ditches. These systems should be shaded.~~

   d. Wet ponds are prohibited in the Paint Branch watershed. If structural measures are required, **stormwater control measures that avoid or minimize thermal impacts. Above ground structures should be designed with shading.** ~~infiltration devices, underground storage, and/or dry ponds should be considered (for water quality reasons, dry ponds should be designed to detain "first flush" stormwater). These should be designed with shading~~.

   ~~e. Flows should be diverted from poten-~~

~~tially erosive areas through the use of standard diversion techniques such as interceptor berms or diversion dikes during and after construction.~~

2. The base flow of springs and streams should be ~~maintained.~~ **monitored and protected through the combined stringent application of low-density residential land uses and existing laws, regulations and guidelines.**

3. Groundwater recharge areas should be **identified** and protected **through the combined stringent application of low-density residential land uses and existing laws, regulations and guidelines.**

4. The installation of any in-stream structures which will prevent or inhibit the natural movement of aquatic life, or the conversion of any stream or spring into a hydraulically efficient storm sewer system, ~~should be discouraged~~ **should not be allowed unless unavoidable.**

F. Hydraulic Criteria

1. As a minimum, ~~no landscape modification~~ **no clearing or grading** may occur within ~~100 feet of any stream or within 25 feet of the ultimate 100 year floodplain — whichever distance is greater.~~ **the stream buffer area, except for unavoidable and necessary development infrastructure.**

2. Effective energy dissipation techniques should be employed at all storm drainage outfalls to reduce upland and channel erosion.

3. No bridge support or pilings should be located within the stream.

4. Storm **drain** ~~sewer~~ outfalls should be sited as hydrologically remote from waterways as possible **while maintaining sufficient channel stability and erosion control.**

~~G. Water Quality Critieria~~ ***Items in this area are struck out (as shown below) or have been moved to either Section A or the new Section G.***

~~Maryland's Water Quality Standards for Class III Waters (Natural Trout Waters) must be maintained. Therefore, the following measures are recommended:~~

~~7. Site drainage ways should be shaded when necessary to prevent high temperature storm water from being discharged into the receiving streams.~~

G. Construction and Maintenance Measures

~~1. Erosion and Sediment Control Plans must be strictly implemented.~~

1. **Stream** ~~Floodplain~~ buffer around natural waterways should be protected with appropriate measures during and after construction activities.

2. Prior to and during construction, the following measures should be taken:

   a. **phase grading and clearing operations, where necessary;** ~~plan and phase grading and clearing operations to expose only the smallest practicable area of land at any one time during development (the period of exposure should be as short as possible);~~
   ~~b. avoid unnecessary clearing;~~
   b. maintain natural vegetation to the greatest extent possible;
   c. minimize time that unstabilized areas are exposed to erosive forces.
   ~~d. cover spoil piles with plastic or other protective materials; and~~
   ~~e. mulch and tamp areas which will remain exposed to erosive forces for a period greater than 15 days (if the exposure period is going to exceed 30 days, these areas should be mulched and seeded in accordance with approved MSCD practices).~~

3. Deposition of materials in the **stream buffer should be prohibited unless approved on**

appropriate development plans (i.e., sediment control or site plans). ~~100 year floodplain should be discouraged.~~

4. Top soil should be stored and redistributed on-site according to approved **MCDEP** ~~MSCD~~ practice.

5. Vegetative debris such as leaves and grass clippings **should not be disposed of in or near the stream.** ~~should be bagged or bundled. These clippings should not be put out for collection more than one day prior to pick up.~~

6. Conveyance system cleaning should be conducted at frequent intervals to remove silt and debris from catch basins and ditches.

7. **Where stormwater management facilities are not normally required (e.g., RE-2 or less dense development), there should be some provisions for trapping and removal of litter and debris from storm drainage systems in new developments**. ~~Litter traps should be installed in and along drainage ditches, culverts, roadways, parking lots, etc.~~

8. Urban and agricultural BMP's should be employed to protect water quality from:

   a. misapplication of fertilizer and pesticide;
   b. improper refuse pickup;
   c. vegetative debris; and
   d. animal waste.

9. The discharge of untreated swimming pool effluent into any stream or storm **drainage** ~~sewer~~ system is prohibited. Treated effluent must meet **Use** ~~Class~~ III water quality standards.

Criteria for Use III Waters (Natural Trout Waters)[5]

(a) Bacteriological. There may not be any sources of pathogenic or harmful organisms in sufficient quantities to constitute a public health hazard. A public health hazard will be presumed if the fecal coliform density exceeds a log mean of 200 per 100 ml. based on a minimum of not less than five samples taken over any 30 day period, or if 10 percent of the total number of samples taken during any 30-day period exceed a log mean of 400 per 100 ml. unless a sanitary survey approved by the Department of Health and Mental Hygiene discloses no significant health hazard.

(b) Dissolved Oxygen. The dissolved oxygen concentration may not be less than 5.0 mg. per liter at any time, with a minimum daily average of not less than 6.0 mg. per liter.

(c) Temperature. The maximum temperature outside the mixing zone determined in accordance with COMAR Regulation may not exceed 68F (20C) or ambient temperature of the receiving waters, whichever is greater. In addition, thermal barriers that adversely affects aquatic life may not be established.

(d) pH. Normal pH values may not be less than 6.5 nor greater than 8.5.

(e) Turbidity. Turbidity may not exceed levels detrimental to aquatic life. Turbidity in the receiving water resulting from any discharge may not exceed 150 NTU (Nephelometer Turbidity Units) at any time or 50 NTU as monthly average. Note that NTUs are equivalent measures to FTUs (Formazin Turbidity Units) and JTUs (Jackson Turbidity Units).

(f) Total Residual Chlorine. Except as provided in COMAR Regulations, MDE may not issue a permit allowing the use of chlorine or chlorine containing compounds in the treatment of wastewaters discharging to Use III waters.

(g) Toxic Materials. All toxic substance criteria to protect fresh water aquatic organisms and the wholesomeness of fish for human consumption apply.

[5] Code of Maryland Regulations (COMAR) 26.08.02 Water Quality.

Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 1

Good Hope Sub-Watershed

Proposed Park Acquisition 1995

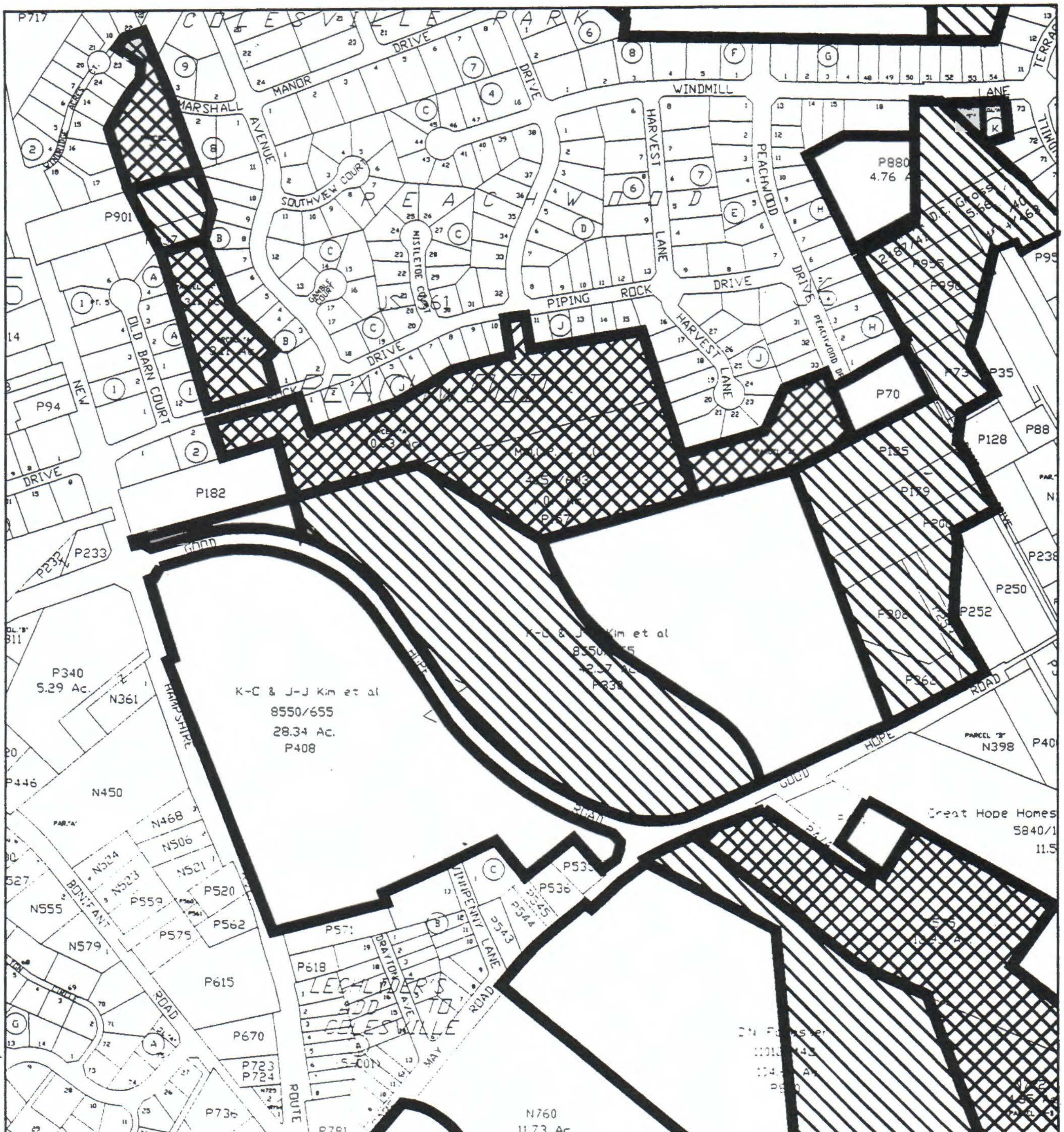
Proposed Park Acquisition 1981

Existing Park

Not to Scale

Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 2



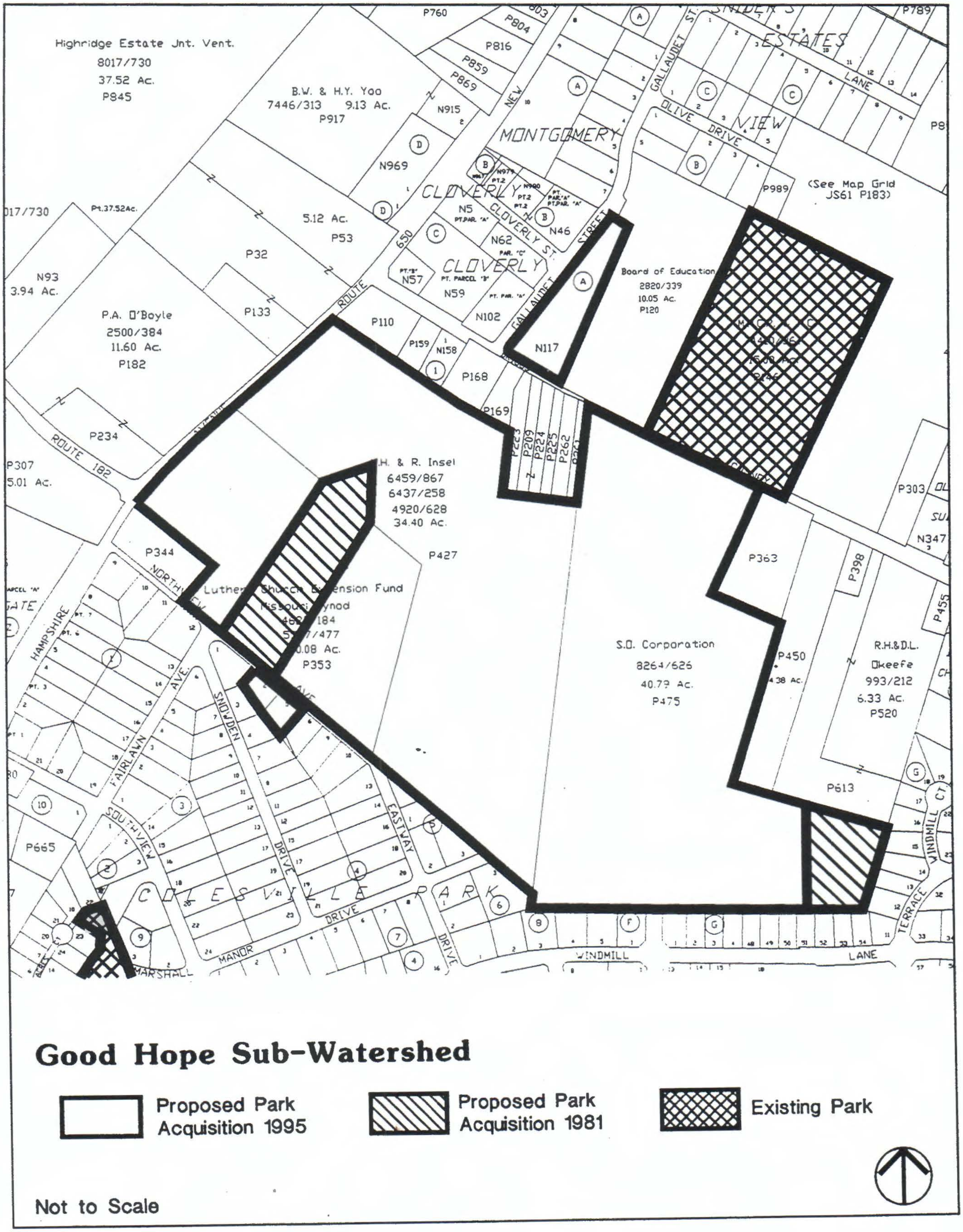
Good Hope Sub-Watershed

- Proposed Park Acquisition 1995
- Proposed Park Acquisition 1981
- Existing Park

Not to Scale

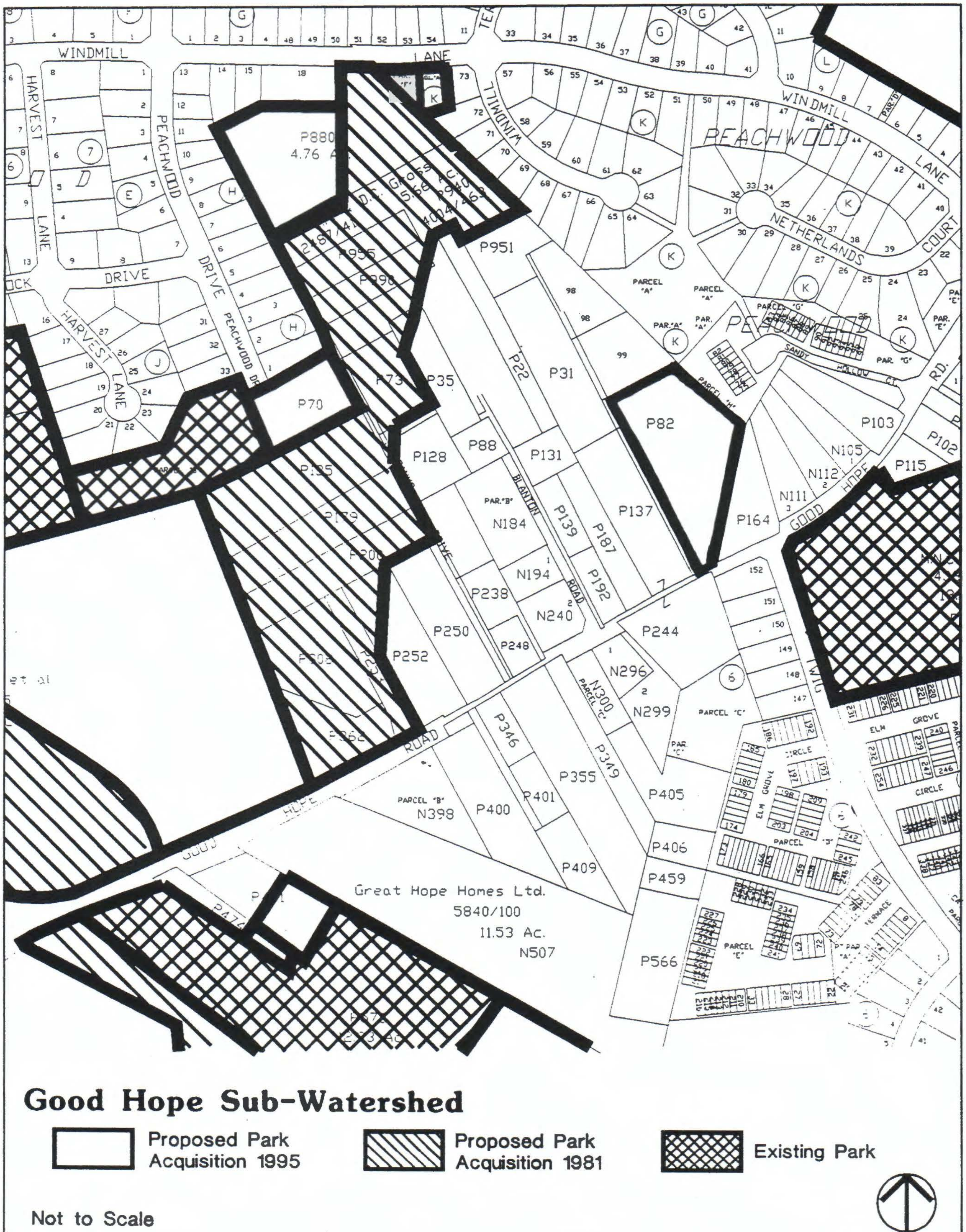
Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 3



Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 4



Good Hope Sub-Watershed

Proposed Park Acquisition 1995

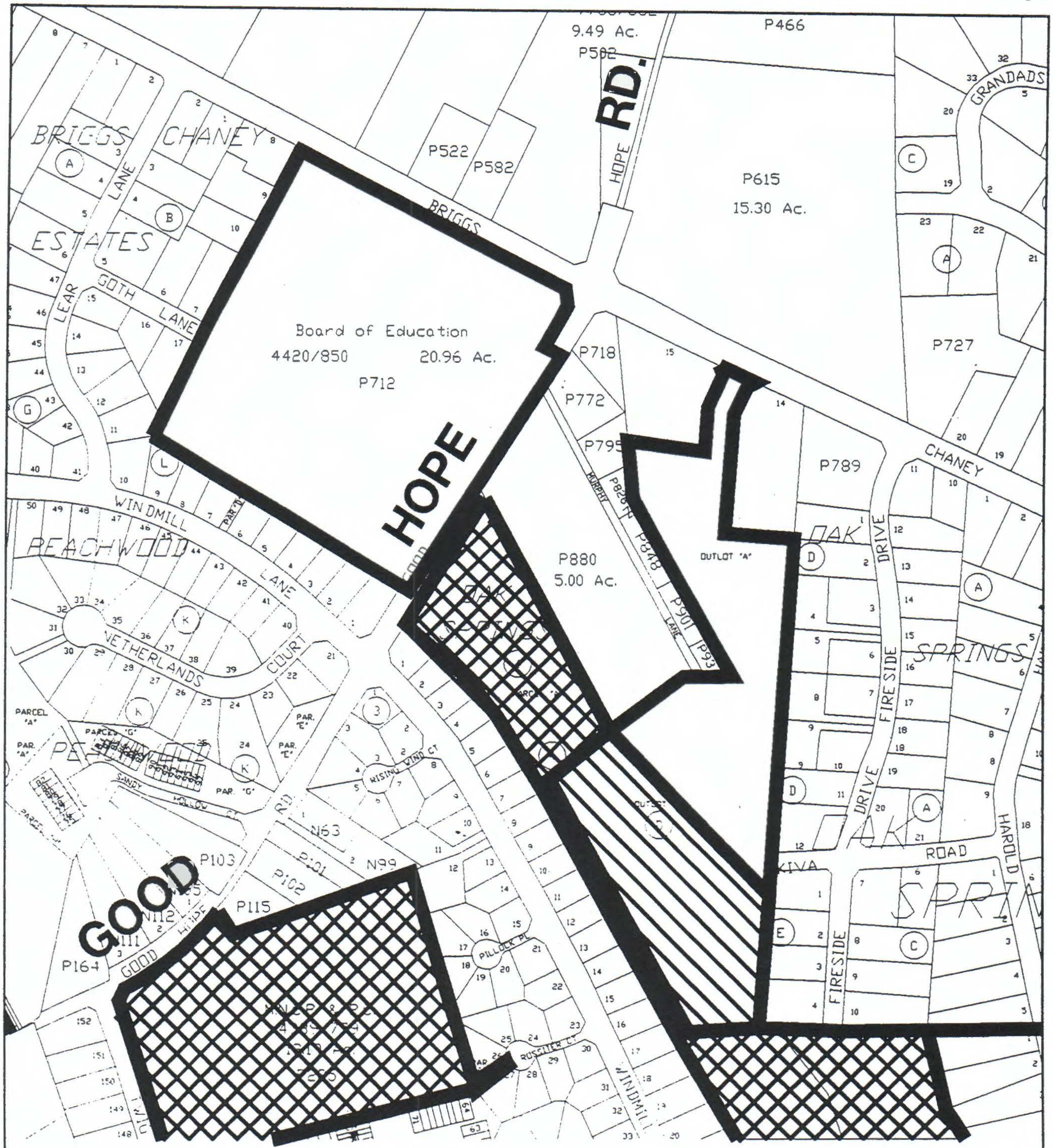
Proposed Park Acquisition 1981

Existing Park

Not to Scale

Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 5



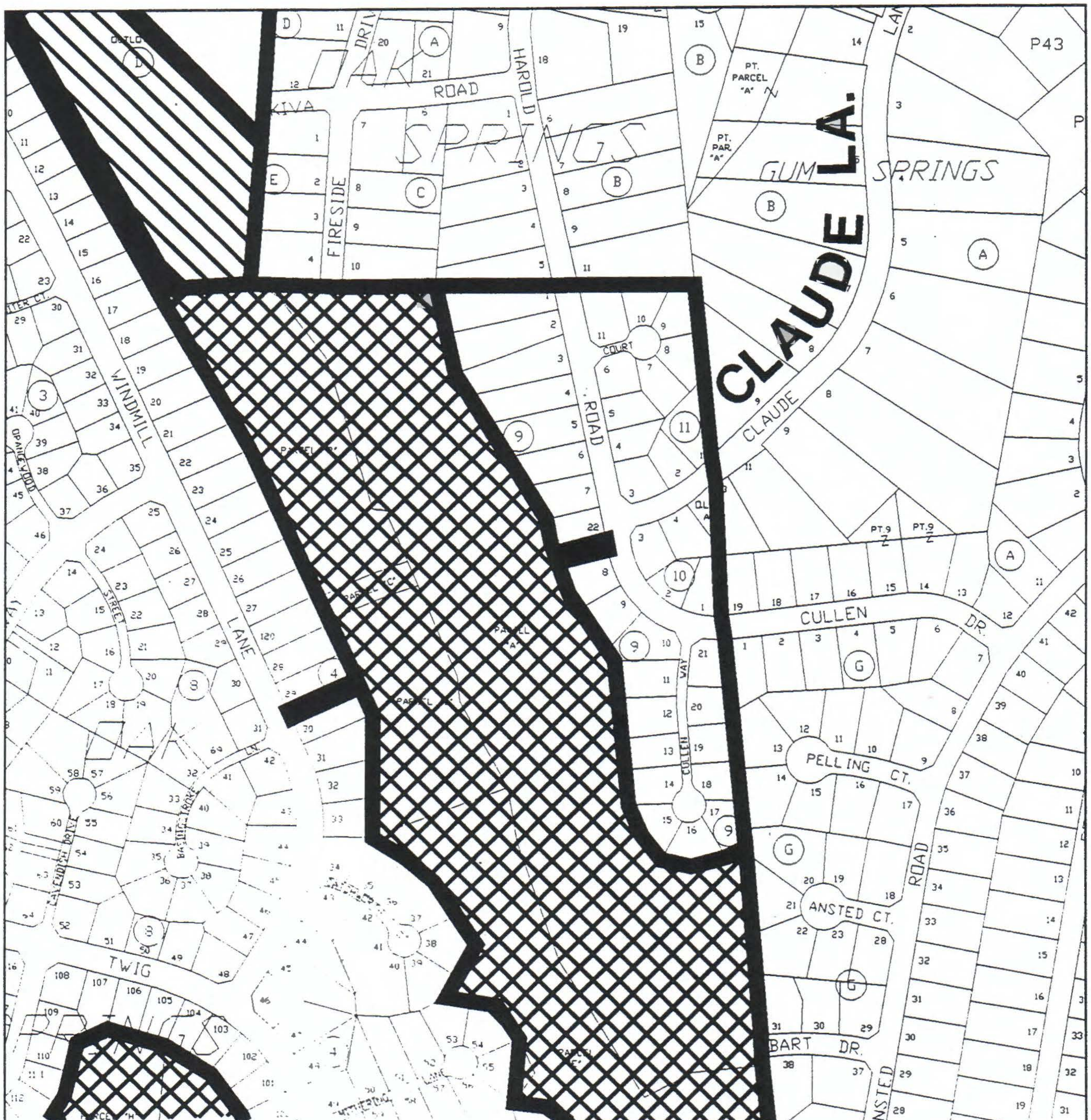
Upper Gum Springs Sub-Watershed

- Proposed Park Acquition 1995
- Proposed Park Acquition 1981
- Existing Park

Not to Scale

Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 6



Upper Gum Springs Sub-Watershed

Proposed Park Acquisition 1995

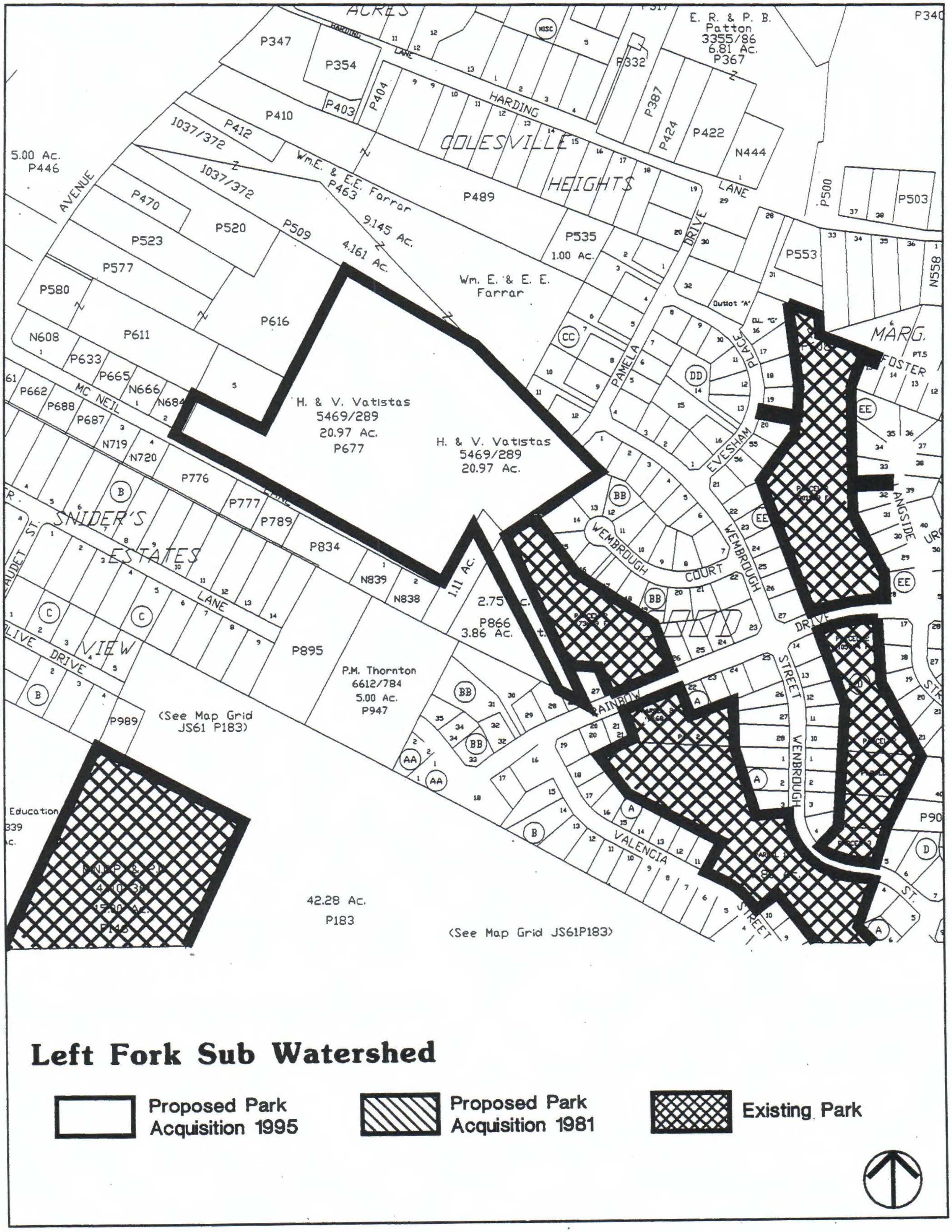
Proposed Park Acquisition 1981

Existing Park

Not to Scale

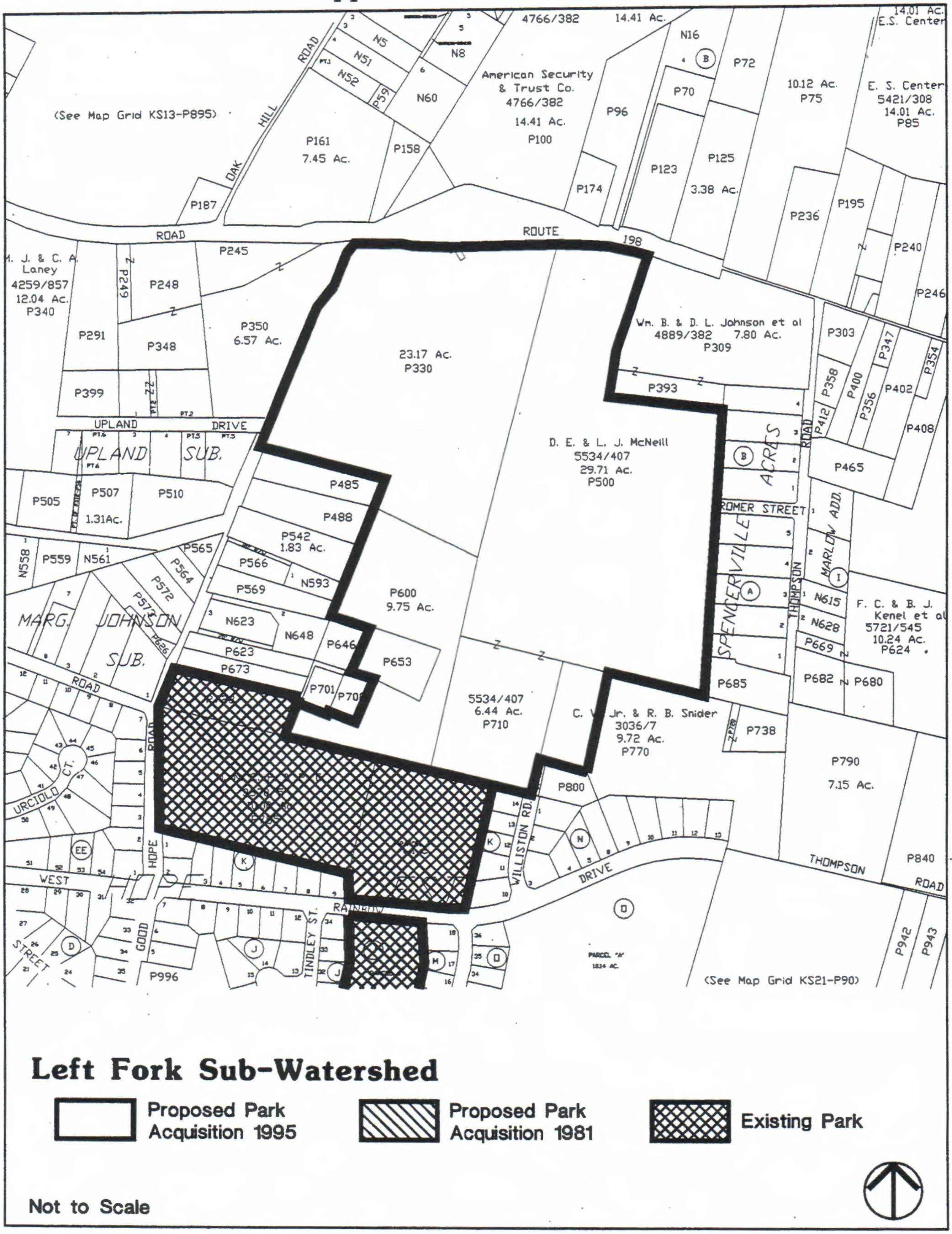
Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 7



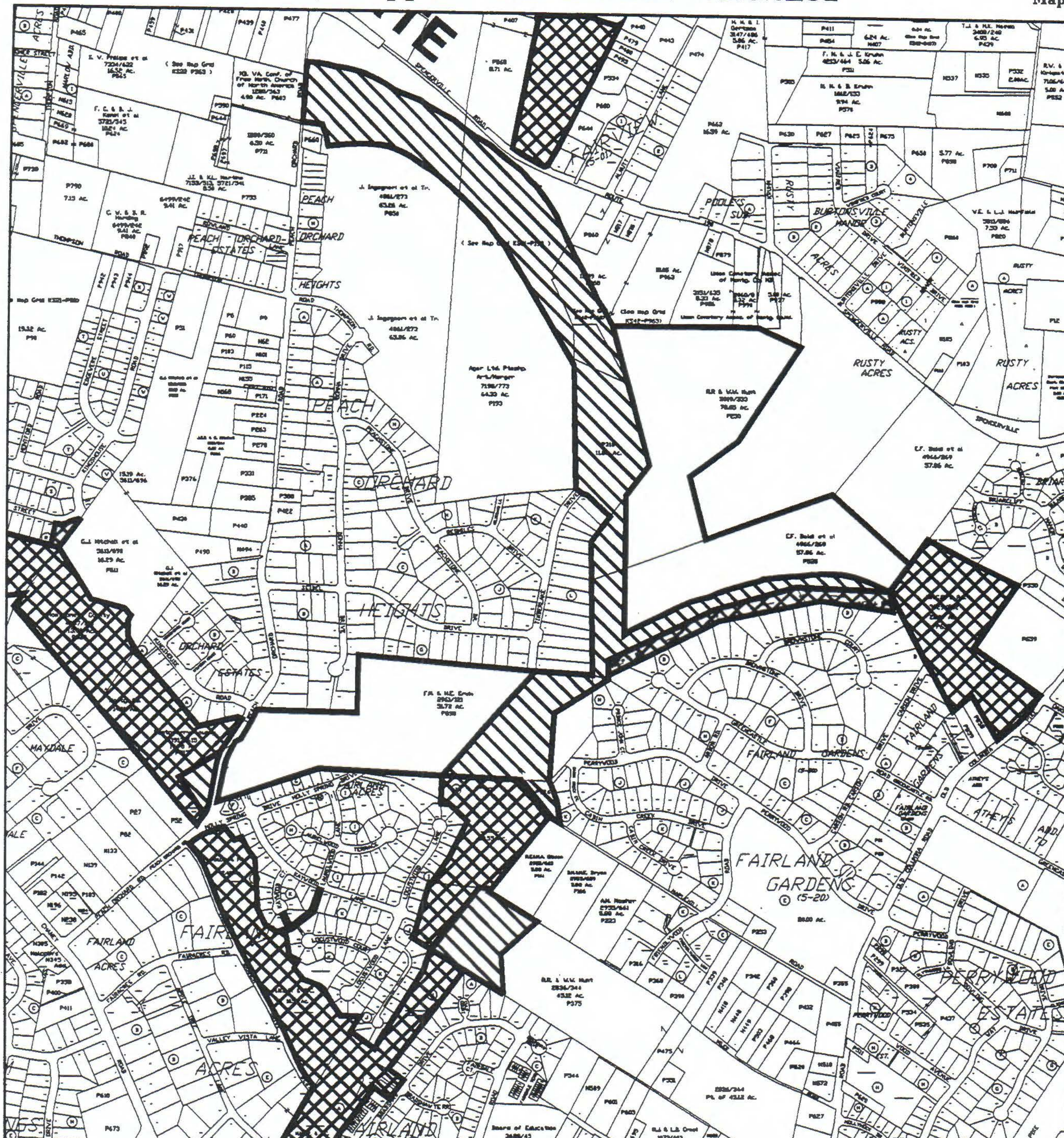
Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 8



Limited Amendment: Expanded Park Acquisition in the Upper Paint Branch Watershed

Map 9



Right Fork Sub-Watershed

Proposed Park Acquisition 1995

Proposed Park Acquisition 1981

Existing Park

Not to Scale

Anacostia Restoration Team, Department of Environmental Programs, Metropolitan Washington Council of Governments. A Commitment to Restore Our Home River: A Six-Point Action Plan to Restore the Anacostia River. November 1991.

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