NEW CASTLE COUNTY

WATER RESOURCE PROTECTION AREA PROGRAM REVISION

WATER RESOURCES AGENCY

FOR

NEW CASTLE COUNTY

November 1987

ACKNOWLEDGEMENTS

This report was accomplished with the guidance of representatives of the Delaware Geological Survey, Ken Woodruff and John Talley; the Delaware Department of Natural Resources & Environmental Control, Phil Cherry and Mike Apgar; New Castle County Department of Planning, Frank Bonifacino and Robert Chartowich; and New Castle County Department of Public Works, Warren O'Sullivan and David Biloon. Additional review and comment was provided by the Water Resources Agency's Technical Coordinating and Advisory Committees. The contributions of all are greatly appreciated.

TABLE OF CONTENTS

LIST OF FIGURES

PREFACE

The Water Resources Agency is a cooperative program by the City of Newark, City of Wilmington, and New Castle County governments in water resources planning and management. It carries out two interrelated functions: water quality planning and management and water supply planning and management. The Agency has recently completed and received approval of WATER 2000, a comprehensive water plan for New Castle County. The objective of WATER 2000 is to establish a long term strategy for the conservation, management, protection and development of water resources in New Castle County.

Volume VIII of WATER 2000, "Future Water Supply for Southern New Castle County," recommended additional land management measures as a means to protect water resources, particularly groundwater. Improved land management has also been identified by the federal and state government as a means to achieve water resources goals. The recent passage of the Safe Drinking Water Act Amendments of 1986, for instance, include provisions focusing on land use management in areas of proximity to public water supply wells. Additionally, the State of Delaware Department of Natural Resources & Environmental Control (DNREC) is revising the work of the Comprehensive Water Resources Management Committee and recasting it into a comprehensive groundwater protection strategy. As a first step toward the development of the strategy, the WRA participated in a U. S. Environmental Protection Agency and National Water Well Association demonstration program with funding provided by the EPA through DNREC. Using its computerized geographic mapping systems, WRA produced a map of New Castle County indicating areas potentially vulnerable to groundwater contamination. This indicated the need for a detailed investigation into land management approaches to water resource protection for New Castle County and the State.

The purpose of this report is to present the results of the first phase of this investigation. The report proposes improved land management measures to protect water resources through expanded use of the Resource Protection Area program currently in New Castle County Code. The rationale and criteria used to define the resource areas to be protected, the proposed land use restrictions appropriate to each resource area, and maps indicating the areas of New Castle County involved are presented. Additionally, a three panel series of maps (scale: 1 inch equals 2000 feet) have been developed and are available at the Water Resources Agency office.

I. INTRODUCTION

A. THE NEED FOR ADDITIONAL WATER RESOURCE PROTECTION

There currently exists an array of federal, state, and locally managed programs which protect water resources. The Federal Clean Water Act controls surface water discharges through the NPDES permit system for municipal and industrial wastewater treatment plants. The Safe Drinking Water Act requires the U.S. EPA to set contaminant levels and monitoring requirements for public drinking water supplies. The 1986 amendments to this act require states to develop wellhead protection programs. Other programs exist to control hazardous materials and wastes, waste disposal and the application of herbicides and pesticides. Although the responsibility for enforcing these programs lies with the Federal government, the U.S. EPA has delegated its authority in most instances to the states, including Delaware. The Delaware state agencies overseeing these programs are the Department of Natural Resources and Environmental Control, the Division of Public Health and the Department of Agriculture. Delaware has in turn, through memoranda of understanding, delegated authority to enforce some provisions of state programs to local governments in New Castle County. An example of this is the on-site waste management program incorporated into the New Castle County Septic Code administered by the Department of Public Works. Although these programs provide a background level of protection, there are areas in New Castle County where additional land use management measures are warranted to assure the quality and quantity of existing and planned water supplies.

New Castle County relies on a combination of ground and surface water resources for public water supply. These existing, as well as future water sources, are vulnerable to pollution. This situation can be traced primarily to continued intensive and extensive land development and certain threatening land use

activities. These range from on-lot waste disposal to use of hazardous substances to underground storage of petroleum products. Because water resources, particularly drinking water supplies, are valuable, their protection from pollution associated with land use is growing in importance. This is especially true of groundwater, which once polluted is often expensive and difficult to clean up. Much of this report focuses on the protection of groundwater; however, interrelationships between ground and surface water require that both be considered as parts of the same system. The protection of groundwater protects surface water and vice versa. Local land management measures can be used to effectively compliment federal and state environmental regulations in achieving water resource protection.

Recent water shortages and isolated pollution problems such as landfill contamination and fuel oil spills have emphasized the need to increase the protection of water supplies we currently use and to plan for the development of new sources of supply for the future. The Water Resources Agency (WRA) has long been involved in efforts aimed at both of these goals.

Following completion of WATER 2000, a work program was prepared for developing additional land management measures to protect water resources. Working with a technical committee of representatives from the Delaware Geological Survey (DGS), State Department of Natural Resources & Environmental Control (DNREC), New Castle County Department of Planning, and New Castle County Department of Public Works, WRA staff identified several specific work tasks. The work focuses on a review of land management measures for protecting water resources in other states, presents examples of criteria to be used to define the water resource areas to be protected, maps these areas in New Castle County, and proposes land management measures for each of these areas.

B. THE BASIS FOR ADDITIONAL WATER RESOURCE PROTECTION

The basis for additional water resource protection in New Castle County is: 1) the federal and state groundwater protection programs including the Safe Drinking Water Act Amendments of 1986, 2) Water Resources Agency program activities, and 3) the existing Resource Protection Area designation in the New Castle County Septic Code. These are discussed further below.

- Federal and State Groundwater Protection Activities

  - The Federal Safe Drinking Water Act Amendments of 1986

As part of the 1986 amendments to the Federal Safe Drinking Water Act, the U. S. Environmental Protection Agency requires that "each state establish wellhead protection areas." The purpose of the program is to develop measures for protecting areas around wells supplying public drinking water systems from contamination that could harm health.

  - Federal and State Groundwater Protection Strategy

Additionally, the U. S. Environmental Protection Agency delegated primary responsibility to each state to develop its own groundwater protection strategy. The states have been given considerable flexibility in developing this strategy. This approach recognizes the fact that land use management, which has traditionally been under local government control, is an effective means to protect groundwater. WRA's role in the development of Delaware's groundwater strategy has been to recommend modification of local land management codes to emphasize ground and surface water protection. It is expected that any code amendments or management plans that result from this effort would be evaluated by the state for their applicability to Delaware's Statewide Groundwater Protection Strategy.

- Water Resources Agency Program Activities

- DRASTIC Mapping Project

WRA recently cooperated with the U. S. Environmental Protection Agency, DNREC, and the National Water Well Association (NWWA) in a nationwide demonstration project to evaluate a methodology for assessing the vulnerability of groundwater to pollution. This system, called DRASTIC, utilizes the major hydrogeologic factors that affect and control groundwater movement. Numerical values are assigned to these factors and applied to an area based on existing hydrogeologic data. WRA participated in this project by providing to the NWWA computer-generated hydrogeologic data for New Castle County. Using the DRASTIC methodology, NWWA developed a map which indicates most of the groundwater in New Castle County is vulnerable to pollution. This evaluation reconfirms previous assessments of groundwater vulnerability.

- WATER 2000: A Water Plan for New Castle County

A major component of the WATER 2000 Plan focuses on resource management. Resource management considered both the protection of water resources and the development of new water supplies. Water resource management was discussed in length in Volume VIII of WATER 2000, entitled "Future Water Supply for Southern New Castle County." Although Volume VIII targeted southern New Castle County's water conditions, the recommendations for additional land management measures to provide greater protection of our water resources are applicable to all of New Castle County.

Additionally, current and anticipated growth and development in sensitive areas of the County (i.e., steep slopes, floodplains, groundwater recharge areas) have emphasized the need to establish measures to better protect our water resources. There is a heightened concern about the continued availability and quality of the County's water supply.

- Existing Resource Protection Area Designation

A land management measure already in New Castle County Code that is targeted at protecting groundwater is the Resource Protection Area (RPA). Currently, this designation in the County's Septic Code protects areas of highly permeable geology by requiring a two acre minimum lot size for each dwelling unit. The RPA is an "already in place" land management mechanism which can be used for broader purposes. It provides the basis for identifying sensitive areas, formulating technical criteria to define these areas, the mapping of these areas, and stipulating appropriate land use controls.

C. SUMMARY

The need to protect water resources in New Castle County are reflected in federal, state, and local water management programs. These include federal and state groundwater protection strategies, the Federal Safe Drinking Water Act, WRA activities, and the Resource Protection Area designation in the New Castle County Septic Code. These established programs provide the basis for further action to protect water resources. At each of these levels, the local control of land use is identified or implied as an effective means to protect water resources.

The Resource Protection Area program, which currently protects groundwater in recharge areas by limiting septic system density, can be redefined and broadened to include other sensitive geologic areas, wellheads, and surface water supplies from other pollutants. The Resource Protection Area concept can also be adapted to other jurisdictions in New Castle County and used as a prototype for consideration statewide and as compliance with federally mandated programs.

II. THREATS TO WATER RESOURCES

Land use activities in sensitive areas can pose a wide range of threats to the water resources of New Castle County. These include pollution from residential, commercial, office, and manufacturing land uses and the reduction of groundwater recharge. Specific activities such as the use of hazardous substances, underground storage of petroleum products, municipal and industrial waste disposal, agricultural waste disposal and storage of deicing salts are of particular concern. This section describes land uses and specific activities which pose significant threats to water resources and suggests approaches to mitigate these threats.

A. LAND USE POLLUTION THREATS

Threats to water resources from residential, commercial, office, and manufacturing land uses include effluent from septic systems, pollutants in stormwater runoff, increased erosion, and reduced groundwater recharge caused by the creation of impervious surfaces.

- Septic Systems

The effluent from residential septic systems contains nitrogen, bacteria, and viruses which can pollute ground and surface water. A properly sited, designed, and functioning septic system will treat most of these pollutants. A problem arises, however, when septic systems are located in areas of highly permeable geology. In these areas, the effluent can move rapidly through the soil and geologic material and enter the groundwater or discharge to surface water before natural treatment can occur. In these instances, larger lot sizes are necessary to ensure maintenance of groundwater quality.

- Stormwater Runoff

Stormwater runoff from parking lots, driveways, and streets can contain significant amounts of pollutants including oil and grease, deicing salt, and heavy metals. The threat of these pollutants grows with the density of residential development and the size of the commercial, office, and manufacturing uses. These pollutants can pose a significant threat to surface and groundwater resources. This threat could be diminished by density restrictions in residential developments, and size limits and impervious surface restrictions on commercial, office, and manufacturing uses.

- Erosion

Erosion from construction or channelized runoff from paved surfaces can pollute surface water with sediment, silt and other pollutants, increase the cost of drinking water treatment, and shorten the life expectancy of impoundments. The threat is most significant in the watersheds of drinking water reservoirs and on steep slopes near streams above surface water intakes. This makes it important to minimize erosion. Density restrictions, reforestation requirements, and prohibition of construction on steep slopes upstream from surface public water supply intakes can aid in addressing these problems.

- Recharge Reduction

With residential, commercial, office, or manufacturing development, the amount of impervious surface increases. Impervious surfaces prevent precipitation from percolating into the earth and recharging groundwater. The result is a reduction in the amount of water available to wells and stream base flow. The threat is most significant where recharge areas are of limited extent and where surficial geologic deposits are highly permeable. This can be addressed through increasing the lot size of residential

developments, clustering where appropriate, limiting the amount of impervious surface of commercial, office, and manufacturing land uses, and requiring that the rate and quality of runoff and volume and quality of groundwater recharge from a developed site equal predevelopment levels.

B. SPECIFIC ACTIVITIES

In addition to these general land uses, specific activities have been identified that require special attention to protect water resources. These are: 1) use of hazardous substances, 2) underground storage of petroleum products, 3) municipal and industrial waste disposal, 4) agricultural waste disposal, and 5) storage of deicing salts.

- Use of Hazardous Substances

The release into the environment of even small quantities of hazardous substances through spills or leaks can pollute a large volume of water and pose a significant threat to public health. Activities involving the use, storage, treatment or transfer of hazardous substances pose a serious threat to surface and groundwater resources.

The use of hazardous substances includes any land use activity associated with any material which when discharged on land, into the air, or into or upon waters or groundwater, presents an imminent and substantial danger to public health or welfare, aquatic organisms including but not limited to fish and shellfish, terrestrial life, birds and other wildlife. Examples of hazardous substances and reportable quantities are found in Appendix A.

- Underground Storage of Petroleum Products

The underground storage of petroleum products includes any underground storage vessel, including the underground pipes connected thereto which is used to contain petroleum products including heating oil and diesel fuel, and the volume of which, including the volume of the underground pipes connected thereto, is buried ten percent or more beneath the surface of the ground. Spills or undetected leaks from these vessels can pollute a large volume of water. This threat is especially significant in areas of highly permeable geology and near public water supplies.

- Municipal and Industrial Waste Disposal

Municipal and industrial waste disposal includes any land use associated with the disposal, storage, treatment, or transfer of municipal solid waste, industrial solid waste, sewage treatment plant sludge, industrial residual wastes, and other special solid wastes. These activities can create long term pollution sources and permanently pollute water resources.

- Agricultural Waste Disposal

Agricultural waste disposal includes the storage or disposal of agricultural waste materials including but not limited to manure, animal carcasses, and spent compost. These are usually localized threats which can be addressed with proper management.

- Storage of Deicing Salts

The storage of deicing salts, especially when it is done without protection from precipitation and runoff and without means to control brine can cause serious, long term contamination of ground and surface water.

C. SUMMARY

Land use activities can pose threats to water resources from a variety of sources. These can range from the reduction in the amount of precipitation recharging groundwater to hazardous substances. All of these threats are more significant in areas of highly permeable geologic deposits or near existing or potential public drinking water supplies. In these areas, additional land management measures are necessary to protect water resources. In the next section, four areas which are both vulnerable and important to our public water supply are identified. For each area, land management measures are recommended to minimize the threats posed by the land activities identified in Chapter II.

III. THE WATER RESOURCE PROTECTION AREAS

The four Water Resource Protection Areas (RPA's) proposed for additional land management practices in New Castle County are: 1) the land area directly above and draining to the Cockeysville Formation outcrop, 2) the areas around public water supply wells, 3) areas in the watersheds of Hoopes Reservoir, and the proposed Thompson Station Reservoir, and the floodplains and steep slopes upstream of surface public water supply intakes including the planned Churchmans Reservoir, and 4) recharge areas. This section provides a general description and technical definition of RPA's. Land management measures are also proposed for protecting each RPA.

A. COCKEYSVILLE FORMATION RESOURCE PROTECTION AREA

- General Description

The Cockeysville Formation is a carbonate geologic formation that outcrops in the Piedmont area of New Castle County. It currently supports public water supply wells producing on an average over 1.9 million gallons per day (MGD) and has a proven capability to produce an additional 0.7 MGD. It also supports numerous private water supply wells. It is an area of extreme sensitivity due to its geology. Rocks in this formation are highly fractured and soluble in water. Fractures, places where the rock has been dissolved, and highly permeable weathered marble provide for rapid infiltration of surface water and potential pollutants. The extent of the recharge area to the formation is limited. The water that drains to this formation, either from streams or precipitation, is its sole source of recharge.

These conditions make the groundwater in this area very vulnerable to pollution, therefore, the Cockeysville Resource Protection Area requires special land management techniques. Land use activities associated with hazardous substances should be prohibited. Certain other land uses with pollution potential should be permitted only if they conform with performance standards or density limits. It is also important to maintain the existing groundwater recharge and manage withdrawals from the aquifer. Reduction in groundwater recharge may reduce the water available to wells and stream base flow. It is also important not to channelize runoff directly over the marble. This can promote the formation of solution channels and sink holes which can provide direct pathways for pollutants to groundwater. An effective means of providing recharge without channelization is to permit development only on large lots. This also helps to protect the quality of recharge water by preventing the concentration of runoff and related pollutants.

- Technical Definition

The Cockeysville Formation Resource Protection Area (Fig. 1) is defined as constituting the following locations:

1. The land surface underlain by the Cockeysville Formation outcrop; and,

2. The land surface which drains to the Cockeysville Formation outcrop.

- Land Management Measures

  - Land directly overlying the Cockeysville Formation outcrop

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at predevelopment levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels.

   a) Residential Land Use
      1) Each dwelling unit will be required to be on a minimum two acre lot.
      2) The amount of impervious surface will not exceed ten percent of the gross area.

   b) Commercial, Office, and Manufacturing Land Use
      1) The amount of impervious surface will not exceed ten percent of the gross area.

3. No more than 20 percent of the woodland on a site will be removed. The remaining woodland will be protected by deed restrictions. Any woodland that is removed will be replaced on an acre for acre basis. When it is proven that additional land for woodland replacement is not available, alternative mitigation procedures may be considered.

4. Use of Hazardous Substances
   Restricted

5. Underground Storage of Petroleum Products
   Restricted

6. Municipal and Industrial Waste Disposal
   Restricted

7. Agricultural Waste Disposal
   Restricted

8. Storage of Deicing Salts
   Restricted

- Land Draining to the Cockeysville Formation outcrop

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at predevelopment levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels. This standard can be met with the following measures.

   a. Residential Land Use
      1) Developments served by public sanitary sewers will have a one dwelling unit per acre maximum average density.
      2) The amount of impervious surface will not exceed 10 percent of the gross area.

   b. Commercial, Office and Manufacturing Land Use
      1) The amount of impervious surface will not exceed 50 percent of the gross area.

   c. All Sewered Urban Land Uses
      Alternative, engineered techniques can be used to achieve this performance standard if the following deed restrictions are applied to the property:
      1) The parcel can not be subdivided;

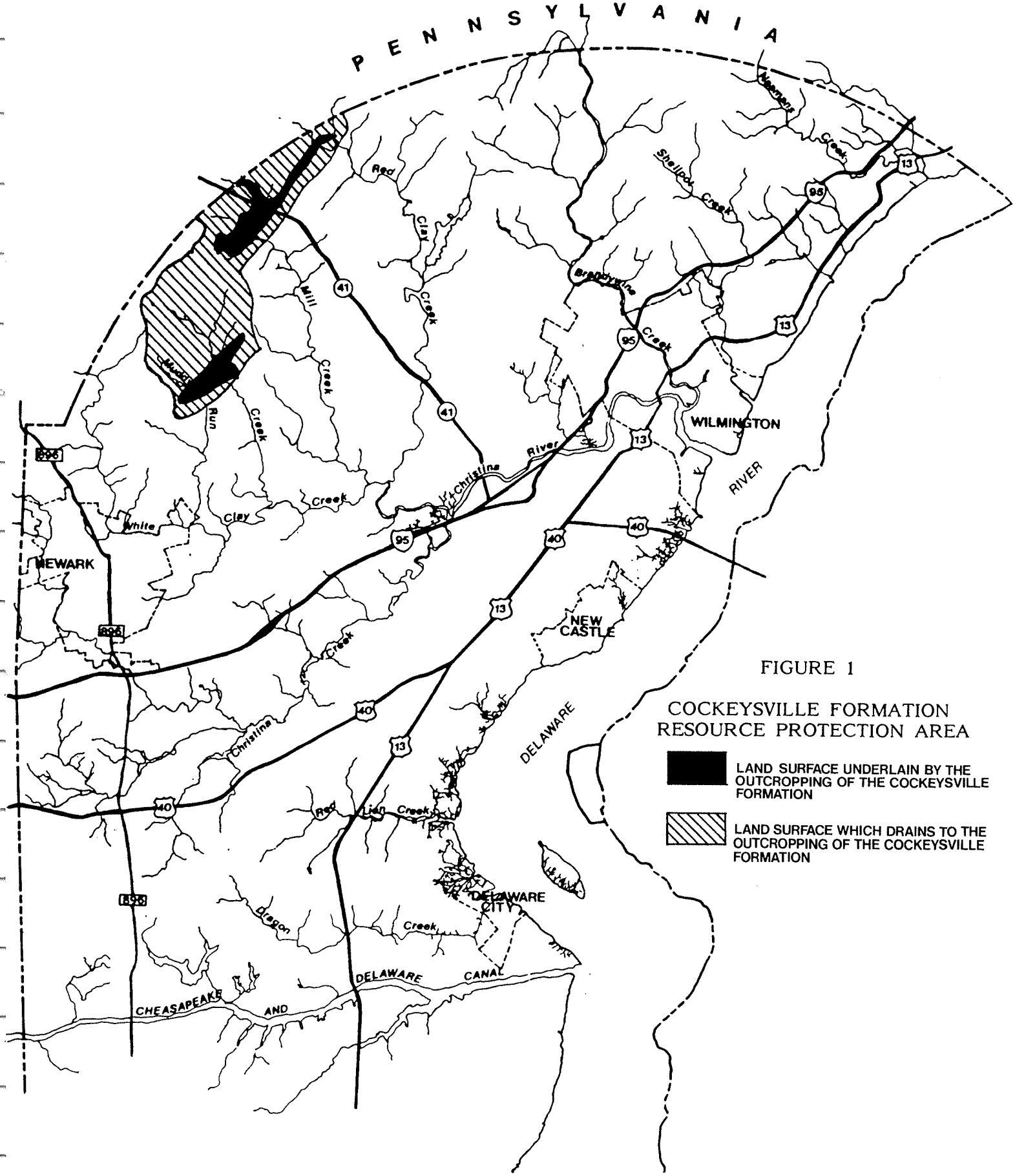

FIGURE 1

COCKEYSVILLE FORMATION
RESOURCE PROTECTION AREA

2) The stormwater management and recharge facilities would be operated by the landowner;
3) Water quality monitoring of groundwater underlying and down gradient from any recharge facilities would be required of the landowner;
4) Financial guarantees sufficient for continued operation and maintenance of water management facilities and continued water quality monitoring would be provided by the landowner.

3. Each residential dwelling unit served by a septic system will be on a minimum two acre lot.

4. No more than 20 percent of the woodland on a site will be removed. The remaining woodland will be protected by deed restrictions. Any woodland that is removed will be replaced on an acre for acre basis. When it is proven that additional land for woodland replacement is not available, alternative mitigation procedures may be considered.

5. Use of Hazardous Substances
   Restricted

6. Underground Storage of Petroleum Products
   Underground petroleum storage tanks will be required to be installed with secondary containment capability and spill and leak detection alarms.

7. Municipal and Industrial Waste Disposal
   Restricted

8. Agricultural Waste Disposal

Agricultural waste disposal will be required to be done according to a conservation plan approved by the USDA Soil Conservation Service.

9. Storage of Deicing Salts

Restricted

B. WELLHEAD RESOURCE PROTECTION AREA

- General Description

The Wellhead Resource Protection Area is the land around public water supply wells capable of yielding over 100 gallons per minute under which groundwater is drawn directly into the wells. As a result of pumping, the water table level is lowered and the threat of polluting the well from the surface may be significant. Also, most of the recharge of water to a well comes directly from the land surface often in the vicinity of the wells; therefore, the permeability of the surface should be maintained. Public water supply production wells in these areas currently produce approximately 11.2 MGD of water. This is approximately 70 percent of the total public groundwater supply in northern New Castle County.

Because the water table is affected by pumping, pollutants which reach the water table are likely to pollute production wells. This makes the wells highly vulnerable to contamination from surface spills or leaks.

- Technical Definition

The Wellhead Resource Protection Area (Figure 2) is defined as the land surface expression around a public water supply well(s) capable of yielding over 100 gallons per minute where the water

table is significantly influenced by pumping and where pollutants are reasonably likely to move toward and reach such wells.

- Land Management Measures

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at predevelopment levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels. This standard can be met with the following measures:

   a. Residential Land Use
      1) Developments served by public sanitary sewers will have a one dwelling unit per two acres maximum average density.

      2) The amount of impervious surface will not exceed 10 percent of the gross area.

   b. Commercial, Office and Manufacturing Land Use
      1) The amount of impervious surface will not exceed 50 percent of the gross area.

   c. All sewered Urban Land Uses
      Alternative, engineered techniques can be used to achieve this performance standard if the following deed restrictions are applied to the property.

      1) The parcel can not be subdivided;
      2) The stormwater management and recharge facilities would be operated by the landowner;

3) Water quality monitoring of groundwater underlying and down gradient from any recharge facilities would be required of the landowner;
4) Financial guarantees sufficient for continued operation and maintenance of water management facilities and continued water quality monitoring would be provided by the landowner.

3. Each residential dwelling unit served by a septic system will be on a minimum two acre lot.

4. Use of Hazardous Substances
   Restricted

5. Underground Storage of Petroleum Products
   Restricted

6. Municipal and Industrial Waste Disposal
   Restricted

7. Agricultural Waste Disposal
   Agricultural waste disposal will be required to be done according to a conservation plan approved by the USDA Soil Conservation Service.

8. Storage of deicing salts
   Restricted

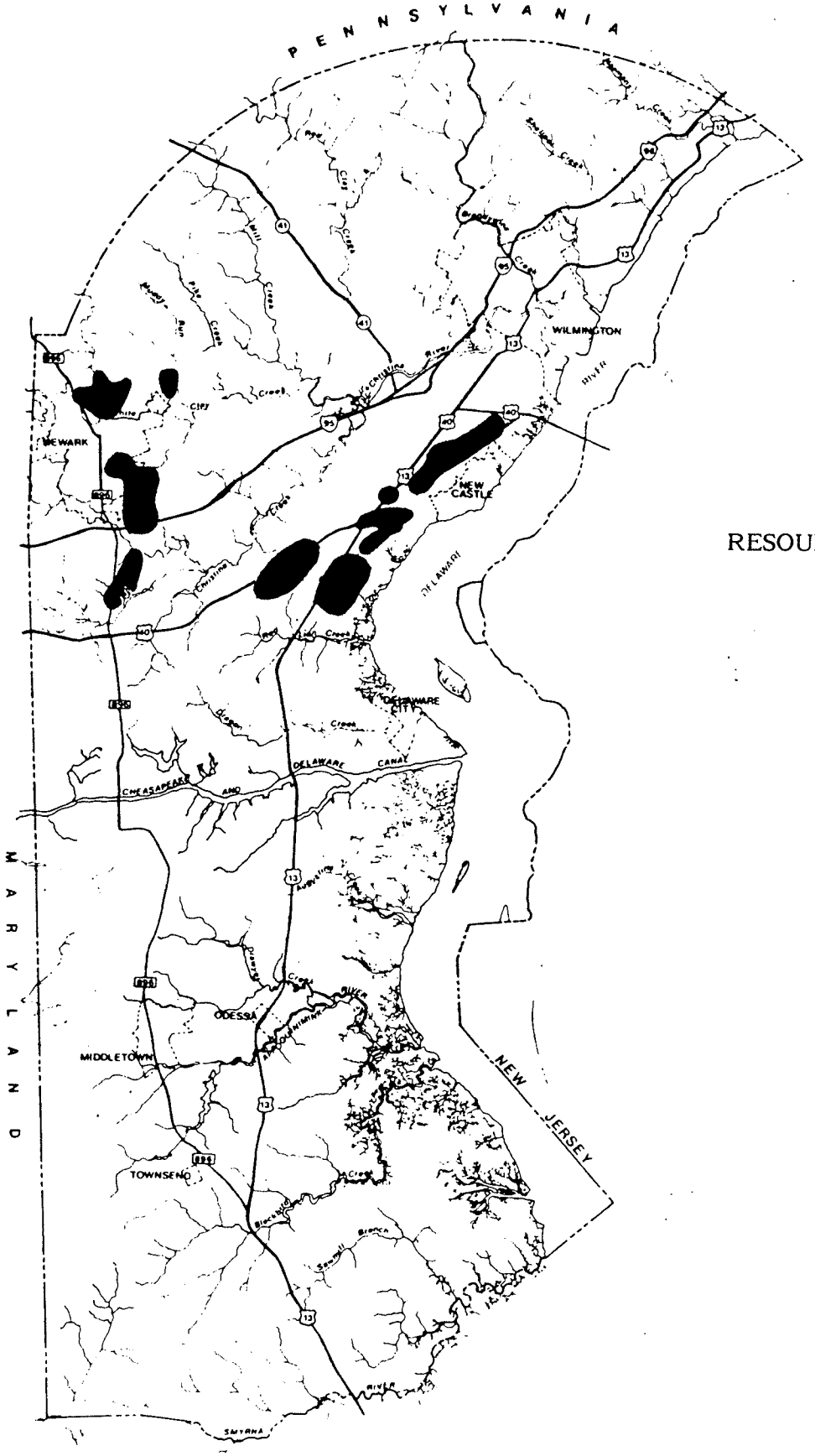

FIGURE 2

WELLHEAD
RESOURCE PROTECTION AREA

C. SURFACE WATER RESOURCE PROTECTION AREA

- General Description

The Surface Water Resource Protection Area constitutes the land area surrounding Hoopes and the planned Thompson Station Reservoirs, and protective corridors upstream of surface public water supply intakes on the Brandywine Creek, Red Clay Creek, White Clay Creek, and Christina River and the proposed Churchmans Reservoir. Any pollutants released upstream or in the vicinity of these locations will reach public water supplies. The protective corridors should include the 100-year floodplain upstream and steep slopes contiguous to floodplains or water courses upstream of surface water supply intakes. This would reduce risks to these water supplies.

Surface water is used to provide the majority of our drinking water, accounting for over 70 percent of the total public water supply in New Castle County. Last year, surface water withdraws averaged about 47 MGD, with peaks of up to 59 MGD during periods of high demand. This resource is critical not only to meet daily demands, but is the key for providing additional supplies when needed. In recognition of the value and vulnerability of these surface waters, land management measures are proposed to improve their protection.

- Technical Definition

The Surface Water Resource Protection Area (Figure 3) is defined as constituting three distinct locations:

1. The entire area which drains on the surface or underground to the existing Edgar M. Hoopes Reservoir and the land surface which drains on the surface or underground to the proposed Thompson Station Reservoir;

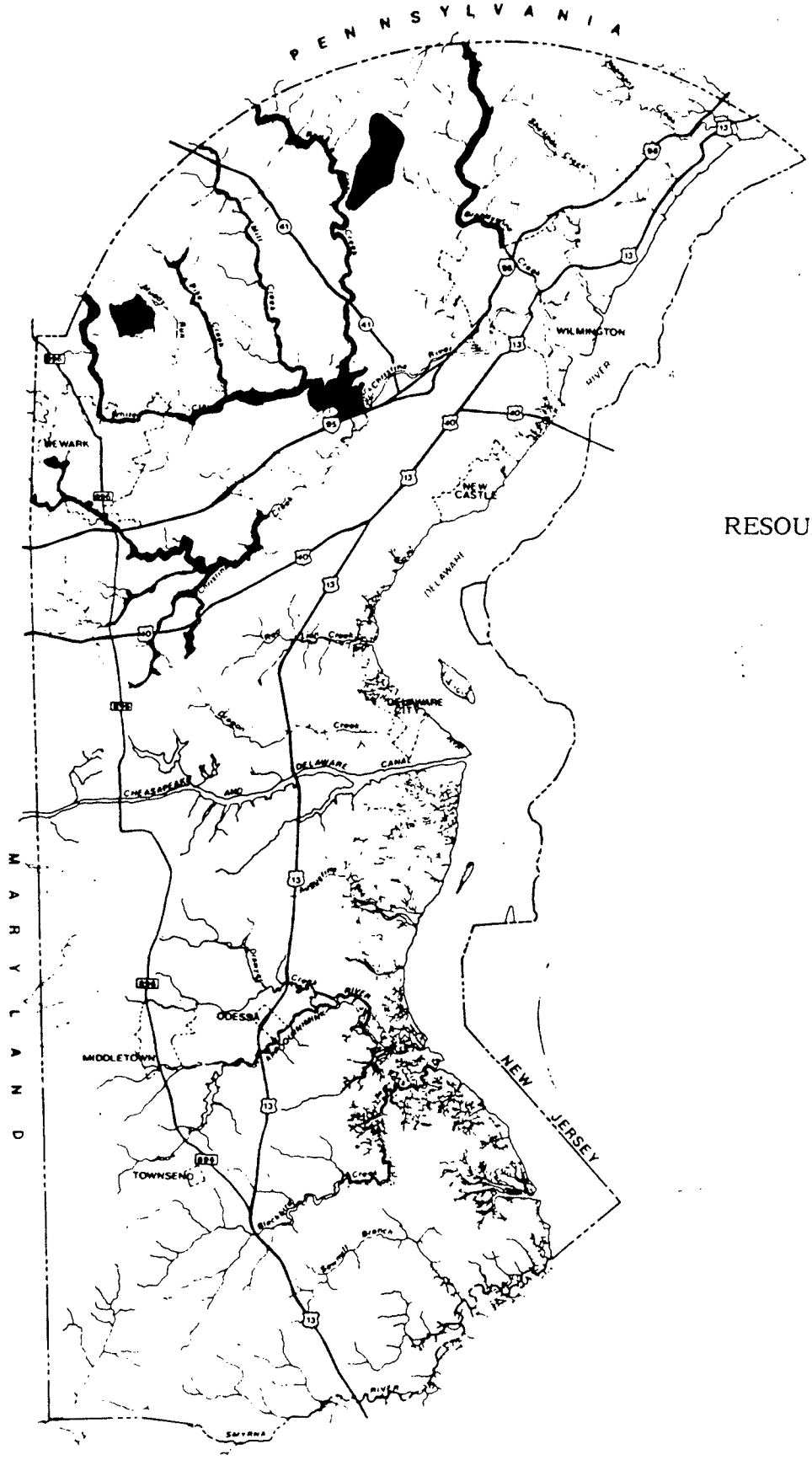

FIGURE 3

SURFACE WATER
RESOURCE PROTECTION AREA

2. The land surface within the 100-year floodplain upstream from Smalley's Pond, the proposed Churchmans Reservoir, or any existing public water supply intake; and,

3. The land with soils of USDA Soil Conservation Service Class IVe or greater contiguous to a water course or 100-year flood plain upstream from Smalley's Pond, the proposed Churchmans Reservoir, or any existing public water supply intake.

- Land Management Measures

The entire land surface draining to the Hoopes Reservoir and to the proposed Thompson Station Reservoir

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at predevelopment levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels.

   a) Residential Land Use
      1) Each dwelling unit will be required to be on a minimum ten acre lot.

   b) Commercial, Office and Manufacturing Land Use
      Restricted

3. No more than 5 percent of the woodland on a site will be removed. The remaining woodland will be protected by deed restrictions. Any woodland that is removed will be replaced on an acre for acre

basis. When it is proven that additional land for woodland replacement is not available, alternative mitigation procedures may be considered.

4. Use of Hazardous Substances
   Restricted

5. Underground Storage of Petroleum Products
   Restricted

6. Municipal and Industrial Waste Disposal
   Restricted

7. Agricultural Waste Disposal
   Restricted

8. Storage of Deicing Salts
   Restricted

- The 100-Year floodplain upstream from surface public water supply intakes

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at pre-development levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels.

   a) Residential Land Use
      Residential land use in the floodplain will be restricted. Only under extreme circumstances of hardship will a variance be

granted, and only if equivalent upstream flood storage is created.

b) Commercial, Office, and Manufacturing Land Use
Commercial, office, and manufacturing land use in the floodplain will be restricted. Only under extreme circumstances of hardship will a variance be granted, and only if equivalent upstream flood storage is created.

3. No more than 10 percent of the woodland on a site will be removed. The remaining woodland will be protected by deed restrictions. Any woodland that is removed will be replaced on an acre for acre basis. When it is proven that additional land for woodland replacement is not available, alternative mitigation procedures may be considered.

4. Use of Hazardous Substances
Restricted

5. Underground Storage of Petroleum Products
Restricted

6. Municipal and Industrial Waste Disposal
Restricted

7. Agricultural Waste Disposal
Restricted

8. Storage of Deicing Salts
Restricted

- The land with soils of USDA Soil Conservation Service Class IVe or greater contiguous to a water course or 100-year floodplain upstream of Smalley's Pond, the

proposed Churchmans Reservoir, or any existing public water supply intake.

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at pre-development levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels.

   a) Residential Land Use
      1) Developments served by sanitary sewers will have a one dwelling unit per two acres maximum average density.
      2) Land clearing will be minimized.
      3) The amount of impervious surface will not exceed 10 percent of the gross area.

   b) Commercial, Office and Manufacturing Land Use
      1) Land clearing will be minimized.
      2) The amount of impervious surface will not exceed 10 percent of the gross area.

3. Each residential dwelling unit served by a septic system will be on a minimum 2 acre lot.

4. No more than 10 percent of the woodland on a site will be removed. Any woodland that is removed will be replaced on an acre for acre basis. When it is proven that additional land for woodland replacement is not available, alternative mitigation procedures may be considered.

5. Use of Hazardous Substances
   Restricted

6. Underground Storage of Petroleum Products
   Restricted

7. Municipal and Industrial Waste Disposal
   Restricted

8. Agricultural Waste Disposal
   Restricted

9. Storage of Deicing Salts
   Restricted

D. RECHARGE RESOURCE PROTECTION AREA

- General Description

Recharge Resource Protection Areas are areas underlain by highly permeable geologic deposits located in the Coastal Plain of New Castle County. Because of the high permeability, pollutants released in these areas are likely to enter the groundwater. In addition, because these areas enable recharge to the groundwater, the rate of runoff and volume of groundwater recharge should be maintained at predevelopment levels. Land use controls in these areas protect the overall quality and quantity of groundwater in the County.

- Technical Definition

The Recharge Resource Protection Area (Figure 4) is defined as areas where surficial geologic deposits generally consist of coarse sand and gravel beds, silty gravels, coarse sand, or coarse to medium sand, and have a hydraulic conductivity of 100 feet per day or greater. These areas are delineated by the Delaware Geologic Survey in the document entitled, Map Showing

the Potential for Ground Water Recharge in New Castle County, Delaware, (February, 1976).

- Land Management Measures

1. The rate of stormwater runoff and volume of groundwater recharge will be maintained at predevelopment levels.

2. The quality of stormwater runoff and groundwater recharge will be maintained at predevelopment levels.

   a) All Sewered Urban Land Uses
      Engineered techniques can be used to achieve this performance standard if the following deed restrictions are applied to the property:

      1) The stormwater management and recharge facility would be owned and operated by a single legal entity.
      2) Water quality monitoring of groundwater underlying and down gradient from any recharge facility would be required by the owner of the facility.
      3) Financial guarantees sufficient for continued operation and maintenance of water management facilities and groundwater quality monitoring would be provided by the landowners.

4. Each residential dwelling unit served by a septic system will be on a minimum 2 acre lot.

5. Use of Hazardous Substances

Deed restrictions will be required that safeguards will be installed to prevent the release of hazardous substances into the environment.

6. Underground Storage of Petroleum Products

Underground petroleum storage tanks will be required to be installed with secondary containment and spill and leak detection alarms.

7. Municipal and Industrial Waste Disposal

Restricted

8. Agricultural Waste Disposal

Agricultural waste disposal will be required to be done according to a conservation plan approved by the USDA Soil Conservation Service.

9. Storage of Deicing Salts

The storage of deicing salts will be required to be in a permanent, weather proof structure with a curbed, impervious floor. Runoff water will be diverted around the structure and storage tanks will be installed to collect brine.

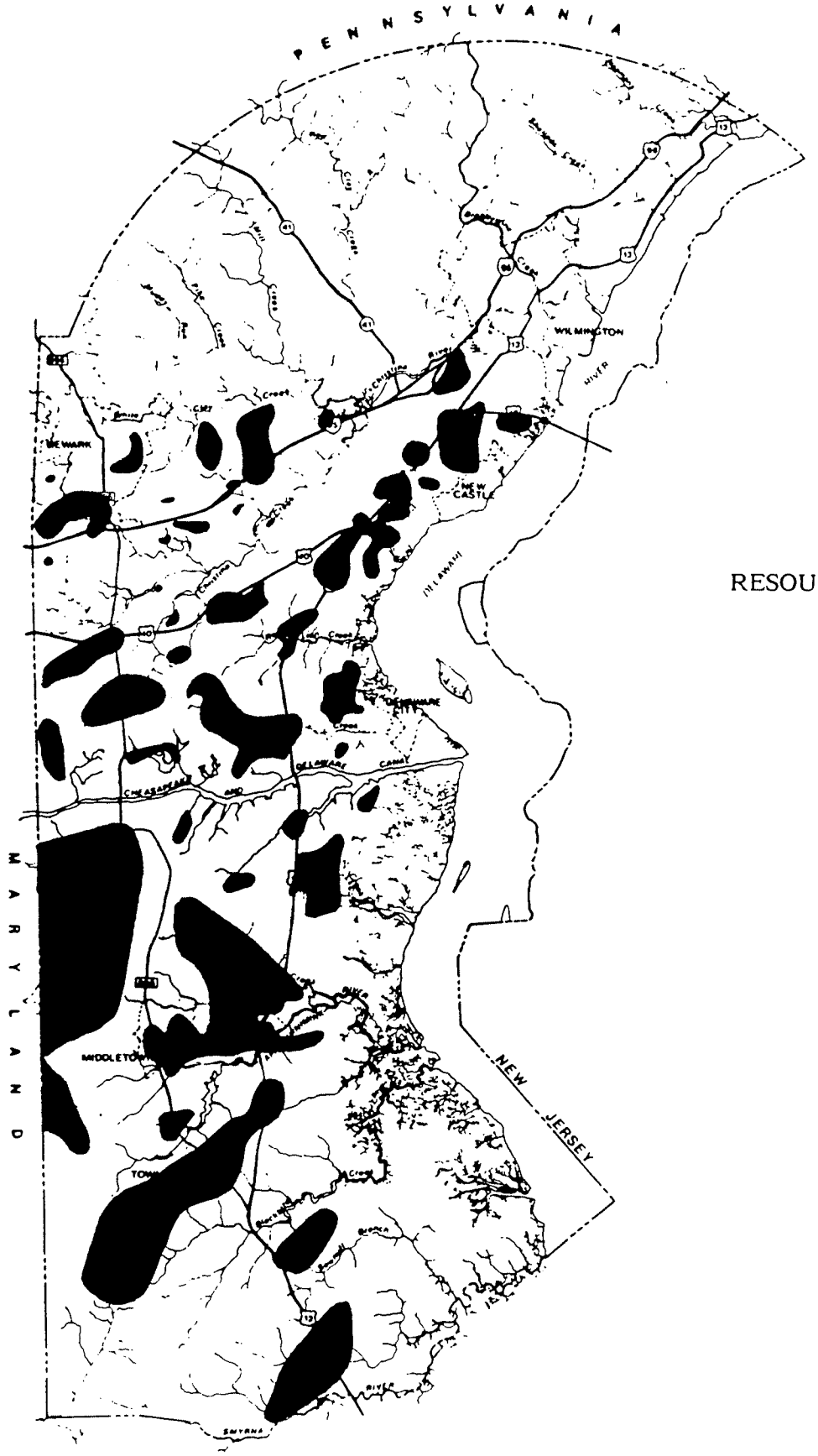

FIGURE 4

RECHARGE
RESOURCE PROTECTION AREA

IV. ADMINISTRATION

A. THE WATER RESOURCE PROTECTION AREA

The need to better protect water resources in New Castle County is well established. Important water sources such as the Cockeysville Formation, wells used for public water supply, streams or impoundments used as surface water sources, and locations conducive to aquifer recharge have been identified. Using a land management technique, the overlay zone, that has been successful in protecting water resources in other jurisdictions, the Water Resources Agency proposes redefining and expanding the Resource Protection Area concept currently designated in the New Castle County Septic Code. Four overlay zones, the Cockeysville Formation Resource Protection Area, the Wellhead Resource Protection Area, the Surface Water Resource Protection Area and the Recharge Resource Protection Area, would be created. Each RPA, or zone, has specific land management measures designed to protect the particular resource. Existing local government zoning classification would not be affected EXCEPT where it conflicts with provisions of the designated overlay RPA.

Figure 5 illustrates the general location and boundary of the four RPA's. Portions of the jurisdictions of the City of Wilmington, the City of Newark, the City of New Castle, the Town of Middletown, the Town of Odessa, and the Town of Townsend as well as New Castle County are within the proposed RPA's.

Table 1 summarizes the land management measures recommended for each RPA. The provisions include specific restrictions, performance standards, and minimum density requirements appropriate to the RPA.

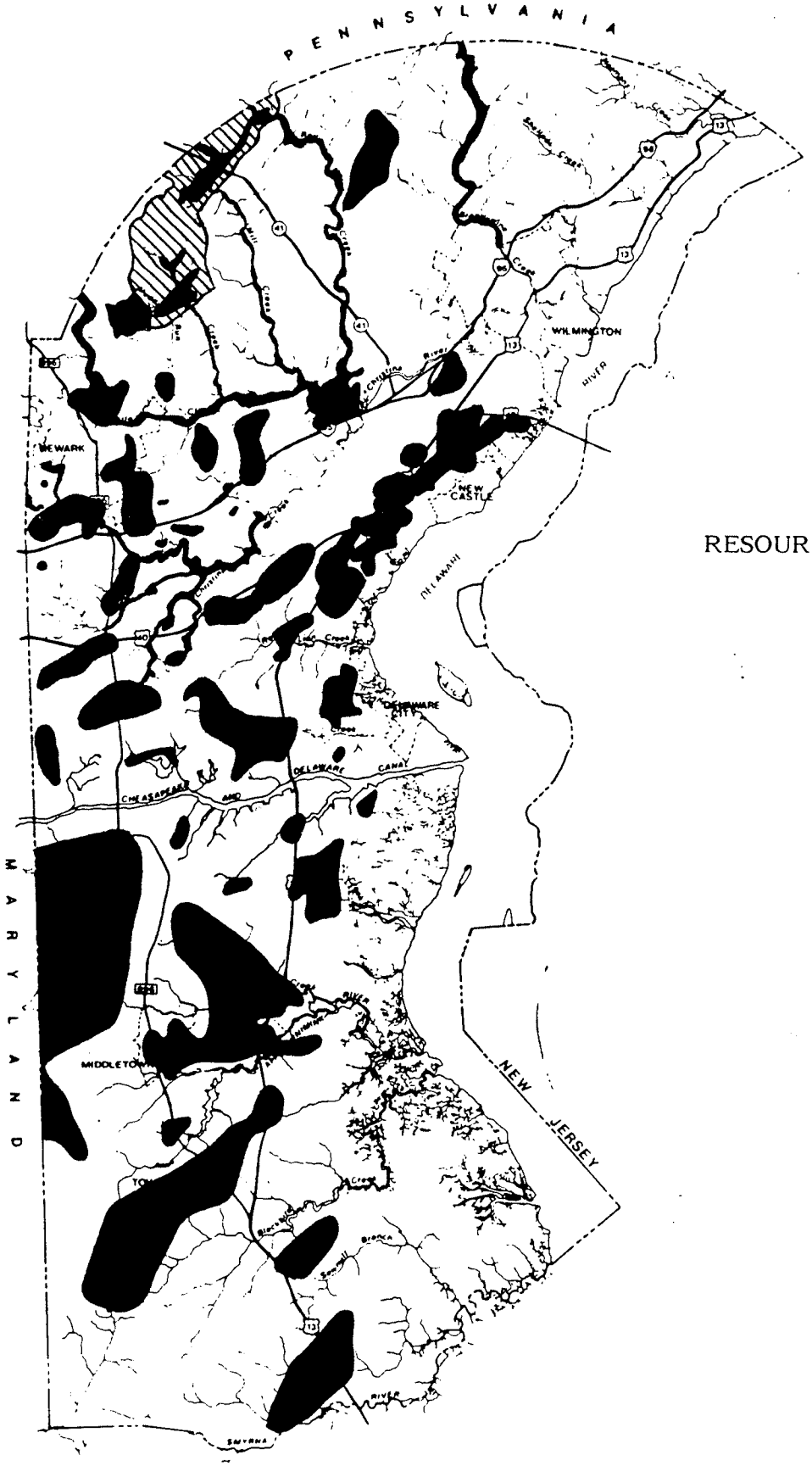

FIGURE 5

RESOURCE PROTECTION AREAS

B. TECHNICAL REVIEW

The Resource Protection Area Program would be administered as a Department of Planning function through a technical advisory committee process organized for this purpose.

In New Castle County, a Resource Protection Area Technical Advisory Committee would be formally established for purposes of:

1. interpretating the technical definition and criteria of Resource Protection Areas;
2. advising on performance standards, mitigation procedures, requests for variances, and nonconforming uses;
3. advising on RPA ordinances and regulations; and
4. assisting the Department of Planning as may be necessary.

The Resource Protection Area Technical Advisory Committee (RPATAC) would consist of representatives of the Delaware Geological Survey, Delaware Department of Natural Resources & Environmental Control, USDA Soil Conservation Service, New Castle County Department of Public Works and Department of Planning, the University of Delaware Department of Civil Engineering, the chemical industry, the Delaware Division of Public Health, a professional engineering society, and the Water Resources Agency. Meetings of the RPATAC would be convened by the Department of Planning on an as needed basis.

In other jurisdictions in New Castle County such as the Cities of Wilmington and Newark, the Water Resources Agency would coordinate with appropriate administrative departments for consideration of establishing a comparable Water Resource Protection Area Program.

C. IMPLEMENTATION

The proposed Water Resource Protection Area Program is presented as a series of actions. The initial phase is a review of the redefined Resource Protection Area as outlined in this report and its incorporation in New Castle County Code. This has involved the preparation of a draft ordinance, detailed maps and provisions as part of a planned phase-in of the Resource Protection Area Program. The second phase will be development of a program of work to continually refine the RPA designation by updating and expanding the data base supporting each RPA.

In accordance with the above, the proposed Water Resource Protection Area Program has been presented to the Policy Board of the Water Resources Agency and New Castle County government. Detailed maps of the Water Resource Protection Areas have been printed and are available at WRA offices. The proposed Resource Protection Area program has also been submitted to legal counsel and drafted into an ordinance for consideration as amendments of appropriate codes of the jurisdictions in New Castle County. Concurrently, technical provisions will continue to be reviewed and modified with input from government agencies, committees and governing bodies through workshops. Subsequent to favorable consideration and enactment, the Water Resources Agency will assist the jurisdictions to prepare materials needed to administer the RPA program.

The Water Resources Agency will prepare a data base program of work in conjunction with the RPATAC, and has submitted the New Castle County RPA program for inclusion as a component of the State of Delaware Groundwater Management Strategy. WRA will continue to work with County jurisdictions to establish comparable resource protection programs.

TABLE 1

WATER RESOURCE PROTECTION AREA
LAND MANAGEMENT MEASURES

	Restricted Land Uses	Conditional Land Uses
COCKEYSVILLE FORMATION RPA		
- Land Directly Over Outcrop:	a) Use of Hazardous Substances b) Underground Storage of Petroleum Products c) Municipal/Industrial Waste Disposal d) Agricultural Waste Disposal e) Storage of Deicing Salt	a) All Land Uses - Runoff to equal predevelopment rate & quality; groundwater recharge to equal predevelopment volume & quality. b) Residential - Minimum 2 acre lot size/dwelling unit. - 10% maximum impervious surface. c) Commercial/Office/ Manufacturing - 10% maximum impervious surface d) Woodland Removal - 20% with replacement.
- Land Draining to Outcrop:	a) Use of Hazardous Substances b) Municipal/Industrial Waste Disposal c) Storage of Deicing Salt	a) All Land Uses - Runoff to equal predevelopment rate & quality; groundwater recharge to equal predevelopment volume & quality. b) Residential - One dwelling unit/ acre maximum average density on sewers. - Minimum 2 acre lot size/dwelling unit on septics. - 10% maximum impervious surface. c) Commercial/Office/ Manufacturing - 50% maximum impervious surface.

Table 1 Continued:	Restricted Land Uses	Conditional Land Uses
		c) Underground Storage of Petroleum Products - Secondary containment required. d) Agricultural Waste Disposal - Conservation plan required. e) Woodland Removal - 20% maximum with replacement.
WELLHEAD RPA:	a) Use of Hazard-Substances b) Underground Storage of Petroleum Products c) Municipal/ Industrial Waste Disposal d) Storage of Deicing Salt	a) All Land Uses - Runoff to equal predevelopment rate and quality; groundwater recharge to equal predevelopment volume & quality. b) Residential - 1 dwelling unit/2 acres maximum average density on sewers. - Minimum 2 acre lot/dwelling unit on septics. - 10% maximum impervious surface. c) Commercial/Office/ Manufacturing - 50% maximum impervious surface
SURFACE WATER RPA: - Land in Reservoir Watersheds	a) Use of Hazardous Substances b) Underground Storage of Petroleum Products c) Municipal/Industrial Waste Disposal d) Agricultural Waste Disposal e) All Commercial/ Office/Manufacturing	a) Residential - Runoff to equal predevelopment rate & quality; groundwater recharge to equal predevelopment volume & quality - Minimum 10 acre lot size/dwelling unit. b) Woodland Removal - 5% maximum with replacement.

Table 1 Continued:	Restricted Land Uses	Conditional Land Uses
	f) Storage of Deicing Salt	
- 100-Year Floodplain Upstream of Intakes	a) Use of Hazardous Substances b) Underground Storage of Petroleum Products c) Municipal/Industrial Waste Disposal d) Agricultural Waste Disposal e) Residential Variance Only Under Extreme Circumstances and After Creation of Upstream Flood Storage f) Commercial/Office/Manufacturing Variance Only Under Extreme Circumstances and After Creation of Upstream Flood Storage g) Storage of Deicing Salt.	a) Woodland Removal - 10% maximum with replacement.
- 15% Slopes Contiguous with Floodplain and Water Course, Upstream of Intakes	a) Use of Hazardous Substances b) Underground Storage of Petroleum Products c) Municipal/Industrial Waste Disposal d) Agricultural Waste Disposal e) Storage of Deicing Salt	a) All Land Uses - Runoff to equal predevelopment rate & quality; groundwater recharge to equal predevelopment volume & quality. b) Residential - 1 dwelling unit/2 acres maximum average density on sewers.

Table 1 Continued:	Prohibited Land Uses	Conditional Land Uses
		- 10% maximum impervious surface - Minimum 2 acre lot size/dwelling unit on septics - Land clearing minimized. c) Commercial/Office/ Manufacturing - Land clearing minimized. - 10% maximum impervious surface. d) Woodland Removal - 10% maximum with replacement.
RECHARGE RPA:	a) Municipal/Industrial Waste Disposal	a) All Land Uses - Runoff to equal predevelopment rate & quality; groundwater recharge to equal predevelopment volume & quality. b) Residential - Minimum 2 acre lot size/dwelling unit on septics. c) Use of Hazardous Substances - Performance standards required. d) Underground Storage of Petroleum Products - Secondary containment required. e) Agricultural Waste Disposal - Conservation plan required. f) Storage of Deicing Salt - Weather proof storage structure required.

APPENDIX A

List of Hazardous Substances (from 40 CFR, §300)

Chemical name	CAS No.	Ambient physical state
Acetone cyanohydrin	75-86-5	Liquid
Acetone thiosemicarbazide	1752-30-3	Solid
Acrolein	107-02-8	Liquid
Acrylamide	79-06-1	Solid
Acrylonitrile	107-13-1	Liquid
Acrylyl chloride	814-68-6	Liquid
Adiponitrile	111-69-3	Liquid
Aldicarb	116-06-3	Solid
Aldrin	309-00-2	Solid
Allyl alcohol	107-18-6	Liquid
Allylamine	107-11-9	Liquid
Aluminum phosphide	20859-73-8	Solid
Aminopterin	54-62-6	Solid
Amiton	78-53-5	Liquid
Amiton oxalate	3734-97-2	Solid
Ammonia	7664-41-7	Gas
Ammonium chloroplatinate	* 16919-58-7	Solid
Amphetamine	300-62-9	Liquid
Aniline	62-53-3	Liquid
Aniline, 2,4,6-trimethyl-	88-05-1	Liquid
Antimony pentafluoride	7783-70-2	Liquid
Antimycin A	1397-94-0	Solid
Antu	86-88-4	Solid
Arsenic pentoxide	1303-28-2	Solid
Arsenous oxide	1327-53-3	Solid
Arsenous trichloride	7784-34-1	Liquid
Arsine	7784-42-1	Gas
Azinphos-ethyl	2642-71-9	Solid
Azinphos-methyl	86-50-0	Solid
Bacitracin	* 1405-87-4(a)	Solid
Benzal chloride	98-87-3	Liquid
Benzenamine, 3-(trifluoromethyl)-	98-16-8	Liquid
Benzene, 1-(chloromethyl)-4-Nitro-	100-14-1	Solid
Benzenearsonic acid	98-05-5	Solid
Benzenesulfonyl chloride	* 98-09-9	Liquid
Benzotrichloride	98-07-7	Liquid
Benzyl chloride	100-44-7	Liquid
Benzyl cyanide	140-29-4	Liquid
Bicyclo[2.2.1]heptane-2-carbonitrile, 5-chloro-6-((((methylamino)Carbonyl)oxy)Im	15271-41-7	Solid
Bis(chloromethyl) ketone	534-07-6	Solid
Bitoscanate	4044-65-9	Solid
Boron trichloride	10294-34-5	Liquid
Boron trifluoride	7637-07-2	Gas
Boron trifluoride compound with methyl ether (1:1)	353-42-4	Liquid
Bromadiolone	28772-56-7	Solid
Bromine	7726-95-6	Liquid
Butadiene	* 106-99-0	Gas
Butyl isovalerate	* 109-19-3	Liquid
Butyl vinyl ether	* 111-34-2	Liquid
C.I. basic green 1	* 633-03-4	Solid
Cadmium oxide	1306-19-0	Solid
Cadmium stearate	2223-93-0	Solid
Calcium arsenate	7778-44-1	Solid
Camphechlor	8001-35-2	Solid
Cantharidin	56-25-7	Solid
Carbachol chloride	51-83-2	Solid
Carbamic acid, methyl-, 0-(((2,4-Dimethyl-1, 3-Orthiolan-2-yl)Methylene)Amino)-	26419-73-8	Solid
Carbofuran	1563-66-2	Solid
Carbon disulfide	75-15-0	Liquid
Carbophenothion	786-19-6	Liquid
Carvone	* 2244-16-8	Liquid
Chlordane	57-74-9	Liquid
Chlorfenvinfos	470-90-6	Liquid
Chlorine	7782-50-5	Gas
Chlormephos	24934-91-6	Liquid
Chlormequat chloride	999-81-5	Solid
Chloroacetaldehyde	* 107-20-0	Liquid
Chloroacetic acid	79-11-8	Solid
Chloroethanol	107-07-3	Liquid
Chloroethyl chloroformate	627-11-2	Liquid
Chloroform	67-66-3	Liquid
Chloromethyl ether	542-88-1	Liquid
Chloromethyl methyl ether	107-30-2	Liquid
Chlorophacinone	3691-35-8	Solid
Chloroxuron	1982-47-4	Solid
Chlorthiophos	21923-23-9	Liquid
Chromic chloride	10025-73-7	Solid
Cobalt	* 7440-48-4	Solid
Cobalt carbonyl	10210-68-1	Solid
Cobalt, ((2,2'-(1,2-ethanediylbis (nitrilomethylidyne))bis(6-fluorophenolato))(2)	62207-76-5	Solid
Colchicine	64-86-8	Solid
Coumafuryl	* 117-52-2	Solid
Coumaphos	56-72-4	Solid
Coumatetralyl	5836-29-3	Solid
Cresol, o-	95-48-7	Solid
Crimidine	535-89-7	Solid
Crotonaldehyde	4170-30-3	Liquid
Crotonaldehyde, (E)-	123-73-9	Liquid
Cyanogen bromide	506-68-3	Solid
Cyanogen iodide	506-78-5	Solid
Cyanophos	2636-26-2	Liquid
Cyanuric fluoride	675-14-9	Liquid
Cyclohexamide	66-81-9	Solid
Cyclohexylamine	108-91-8	Liquid
Cyclopentane	* 287-92-3	Liquid
Decaborane (14)	17702-41-9	Solid
Demeton	8065-48-3	Liquid
Demeton-s-methyl	919-86-8	Liquid
Dialifos	10311-84-9	Solid
Diborane	19287-45-7	Gas

Chemical name	CAS No.	Ambient physical state
Dibutyl phthalate	[b] 84-74-2	Liquid
Dichlorobenzalkonium chloride	[b] 8023-53-8	Solid
Dichloroethyl ether	111-44-4	Liquid
Dichloromethylphenylsilane	149-74-6	Liquid
Dichlorvos	62-73-7	Liquid
Dicrotophos	141-66-2	Liquid
Diepoxybutane	1464-53-5	Liquid
Diethyl chlorophosphate	814-49-3	Liquid
Diethyl-p-phenylenediamine	[b] 93-05-0	Liquid
Diethylcarbamazine citrate	1642-54-2	Solid
Digitoxin	71-63-6	Solid
Diglycidyl ether	2238-07-5	Liquid
Digoxin	20830-75-5	Solid
Dimefox	115-26-4	Liquid
Dimethoate	60-51-5	Solid
Dimethyl phosphorochlondothioate	2524-03-0	Liquid
Dimethyl phthalate	[b] 131-11-3	Liquid
Dimethyl sulfate	77-78-1	Liquid
Dimethyl sulfide	75-18-3	Liquid
Dimethyl-p-phenylenediamine	99-98-9	Solid
Dimethyldichlorosilane	75-78-5	Liquid
Dimethylhydrazine	57-14-7	Liquid
Dimetilan	644-64-4	Solid
Dinitrocresol	534-52-1	Solid
Dinoseb	88-85-7	Solid
Dinoterb	1420-07-1	Solid
Dioctyl phthalate	[b] 117-84-0	Liquid
Dioxathion	78-34-2	Liquid
Dioxolane	[b] 646-06-0	Liquid
Diphacinone	82-66-6	Solid
Diphosphoramide, octamethyl-	152-16-9	Liquid
Disulfoton	298-04-4	Liquid
Dithiazanine iodide	514-73-8	Solid
Dithiobiuret	541-53-7	Solid
Emetine, dihydrochloride	316-42-7	Solid
Endosulfan	115-29-7	Solid
Endothion	2778-04-3	Solid
Endrin	72-20-8	Solid
Epichlorohydrin	106-89-8	Liquid
EPN	2104-64-5	Solid
Ergocalciferol	50-14-6	Solid
Ergotamine tartrate	379-79-3	Solid
Ethanesulfonyl chloride, 2-chloro-	1622-32-8	Liquid
Ethanol, 1,2-dichloro-, acetate	10140-87-1	Liquid
Ethion	563-12-2	Liquid
Ethoprophos	13194-48-4	Liquid
Ethyl thiocyanate	542-90-5	Liquid
Ethylbis(2-chloroethyl)amine	538-07-8	Liquid
Ethylene fluorohydrin	371-62-0	Liquid
Ethylene oxide	75-21-8	Gas
Ethylenediamine	107-15-3	Liquid
Ethylenimine	151-56-4	Liquid
Ethylmercuric phosphate	[b] 2235-25-8	Solid
Fenamiphos	22224-92-6	Solid
Fenitrothion	122-14-5	Liquid
Fensulfothion	115-90-2	Liquid
Fluenetil	4301-50-2	Solid
Fluorine	7782-41-4	Gas
Fluoroacetamide	640-19-7	Solid
Fluoroacetic acid	144-49-0	Solid
Fluoroacetyl chloride	359-06-8	Liquid
Fluorouracil	51-21-8	Solid
Fonofos	944-22-9	Liquid
Formaldehyde	[c] 50-00-0	Gas
Formaldehyde cyanohydrin	107-16-4	Liquid
Formetanate	23422-53-9	Solid
Formothion	2540-82-1	Liquid
Formparanate	17702-57-7	Solid
Fosthietan	21548-32-3	Liquid
Fuberidazole	3878-19-1	Solid
Furan	110-00-9	Liquid
Gallium trichloride	13450-90-3	Solid
Hexachlorocyclopentadiene	77-47-4	Liquid
Hexachloronaphthalene	[b] 1335-87-1	Solid
Hexamethylenediamine, N,N'-dibutyl-	4835-11-4	Liquid
Hydrazine	302-01-2	Liquid
Hydrocyanic acid	74-90-8	Gas
Hydrogen chloride	7647-01-0	Gas
Hydrogen fluoride	7664-39-3	Gas
Hydrogen peroxide (concentration greater than 52%)	7722-84-1	Liquid
Hydrogen selenide	7783-07-5	Gas
Hydrogen sulfide	7783-06-4	Gas
Hydroquinone	123-31-9	Solid
Indomethacin	[b] 53-86-1	Solid
Indium trichloride	[b] 10025-97-5	Solid
Iron, Pentacarbonyl-	[b] 13463-40-6	Liquid
Isobenzan	297-78-9	Solid
Isobutyronitrile	78-82-0	Liquid
Isocyanic acid, 3,4-dichlorophenyl ester	102-36-3	Solid
Isodrin	465-73-6	Solid
Isofluorphate	55-91-4	Liquid
Isophorone diisocyanate	4098-71-9	Solid
Isopropyl chloroformate	108-23-6	Liquid
Isopropyl formate	625-55-8	Liquid
Isopropylmethylpyrazolyl dimethylcarbamate	119-38-0	Liquid
Lactonitrile	78-97-7	Liquid
Leptophos	21609-90-5	Solid

Chemical name	CAS No.	Ambient physical state
Lewisite	541-25-3	Liquid
Lindane	58-89-9	Solid
Lithium hydride	7580-67-8	Solid
Malononitrile	109-77-3	Solid
Manganese, tricarbonyl methylcyclopentadienyl	12108-13-3	Liquid
Mechlorethamine	51-75-2	Liquid
Mephosfolan	950-10-7	Liquid
Mercuric acetate	1600-27-7	Solid
Mercuric chloride	7487-94-7	Solid
Mercuric oxide	21908-53-2	Solid
Mesitylene	[8] 108-67-8	Liquid
Methacrolein diacetate	10476-95-6	Liquid
Methacrylic anhydride	760-93-0	Liquid
Methacrylonitrile	126-98-7	Liquid
Methacryloyl chloride	920-46-7	Liquid
Methacryloyloxyethyl isocyanate	30674-80-7	Liquid
Methamidophos	10265-92-6	Solid
Methanesulfonyl fluoride	558-25-8	Liquid
Methidathion	950-37-8	Solid
Methiocarb	2032-65-7	Solid
Methomyl	16752-77-5	Solid
Methoxyethylmercuric acetate	151-38-2	Solid
Methyl 2-chloroacrylate	80-63-7	Liquid
Methyl bromide	74-83-9	Gas
Methyl chloroformate	79-22-1	Liquid
Methyl disulfide	624-92-0	Liquid
Methyl isocyanate	624-83-9	Liquid
Methyl isothiocyanate	556-61-6	Solid
Methyl mercaptan	74-93-1	Gas
Methyl phenkapton	3735-23-7	Liquid
Methyl phosphonic dichloride	676-97-1	Solid
Methyl thiocyanate	556-64-9	Liquid
Methyl vinyl ketone	78-94-4	Liquid
Methylhydrazine	60-34-4	Liquid
Methylmercuric dicyanamide	502-39-6	Solid
Methyltrichlorosilane	75-79-6	Liquid
Metolcarb	1129-41-5	Solid
Mevinphos	7786-34-7	Liquid
Mexacarbate	315-18-4	Solid
Mitomycin C	50-07-7	Solid
Monocrotophos	6923-22-4	Solid
Muscimol	2763-96-4	Solid
Mustard gas	505-60-2	Liquid
Nickel	[8] 7440-02-0	Solid
Nickel carbonyl	13463-39-3	Liquid
Nicotine	54-11-5	Liquid
Nicotine sulfate	65-30-5	Solid
Nitric acid	7697-37-2	Liquid
Nitric oxide	10102-43-9	Gas
Nitrobenzene	98-95-3	Liquid
Nitrocyclohexane	1122-60-7	Liquid
Nitrogen dioxide	10102-44-0	Gas
Nitrosodimethylamine	62-75-9	Liquid
Norbormide	991-42-4	Solid
Organorhodium complex (PMN-82-147)	0	Solid
Orotic acid	[8] 65-86-1	Solid
Osmium tetroxide	[8] 20816-12-0	Solid
Ouabain	630-60-4	Solid
Oxamyl	23135-22-0	Solid
Oxetane, 3,3-bis(chloromethyl)-	78-71-7	Liquid
Oxydisulfoton	2497-07-6	Liquid
Ozone	10028-15-6	Gas
Paraquat	1910-42-5	Solid
Paraquat methosulfate	2074-50-2	Solid
Parathion	56-38-2	Liquid
Parathion-methyl	298-00-0	Solid
Paris green	12002-03-8	Solid
Pentaborane	19624-22-7	Liquid
Pentachloroethane	[8] 76-01-7	Liquid
Pentachlorophenol	[8] 87-86-5	Solid
Pentadecylamine	2570-26-5	Solid
Peracetic acid	79-21-0	Liquid
Perchloromethylmercaptan	594-42-3	Liquid
Phenol	108-95-2	Solid
Phenol, 2,2'-thiobis(4,6-dichloro-	97-18-7	Solid
Phenol, 2,2'-thiobis[4-chloro-6-methyl-	4418-66-0	Solid
Phenol, 3-(1-methylethyl)-, methylcarbamate	64-00-6	Solid
Phenoxarsine, 10,10'-oxydi-	58-36-6	Solid
Phenyl dichloroarsine	696-28-6	Liquid
Phenylhydrazine hydrochloride	59-88-1	Solid
Phenylmercury acetate	62-38-4	Solid
Phenylsilatrane	2097-19-0	Solid
Phenylthiourea	103-85-5	Solid
Phorate	298-02-2	Liquid
Phosacetim	4104-14-7	Solid
Phosfolan	947-02-4	Solid
Phosgene	75-44-5	Gas
Phosmet	732-11-6	Solid
Phosphamidon	13171-21-6	Liquid

TYPES OF LAND MANAGEMENT MEASURES

	COCKEYSVILLE		WELLHEAD	SURFACE WATER			RECHARGE
	Geology	Drainage		Floodplain	Steep Slopes	Reservoirs	
Residential Use	Conditional	Conditional	Conditional	Restricted	Conditional	Conditional	Conditional
Lot Size(min)	2 Acre Septic	2 Acre Septic	2 Acre Septic	N/A	2 Acre Septic	10 Acre Septic	2 Acre Septic
Density (Max Avg)	N/A	1 Acre Sewer	2 Acre Sewer	N/A	2 Acre Sewer	N/A	None
Runoff Rate & Recharge Volume & Quality	Equal Pre-developed	Equal Pre-developed	Equal Pre-developed	N/A	Equal Pre-developed	Equal Pre-developed	Equal Pre-developed
Impervious Surface(max)	10 %	10 %	10 %	N/A	10%		None
Woodland Replacement	Yes	Yes	No	Yes	Yes	Yes	No
Commercial, Office, & Manufacturing Use	Conditional	Conditional	Conditional	Restricted	Conditional	Restricted	Conditional
Runoff Rate & Recharge Volume & Quality	Equal Pre-developed	Equal Pre-developed	Equal Pre-developed	N/A	Equal Pre-Developed	N/A	Equal Pre-developed
Impervious Surface(max)	10 %	50 %	50 %	N/A	N/A	N/A	None
Woodland Replacement	Yes	Yes	No	Yes	Yes	Yes	No
Use of Hazardous Substances	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Conditional
Underground Storage of Petroleum Products	Restricted	Conditional	Restricted	Restricted	Restricted	Restricted	Conditional
Municipal/Industrial Waste Disposal	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted
Agricultural Waste Disposal	Restricted	Conditional	Conditional	Restricted	Restricted	Restricted	Conditional