NBP-91-70

Land Use Map of the Hunt-Potowomut River Watershed 56pp

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Narragansett Bay Estuary Program

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#NBP-91-70

FOREWORD

The United States Congress created the National Estuary Program in 1984, citing its concern for the "health and ecological integrity" of the nation's estuaries and estuarine resources. Narragansett Bay was selected for inclusion in the National Estuary Program in 1984 , and the Narragansett Bay Project (NBP) was established in 1985. Narragansett Bay was designated an "estuary of national significance" in 1988. Under the joint sponsorship of the U.S. Environmental Protection Agency and the Rhode Island Department of Environmental Management, the NBP's mandate is to direct a program of research and planning focussed on managing Narragansett Bay and its resources for future generations.

The NBP will develop a draft Comprehensive Conservation and Management Plan (CCMP) by December, 1991, which will recommend actions to improve and protect the Bay and its natural resources.

The NBP has established the following seven priority issues for Narragansett Bay:

- management of fisheries
- nutrients and potential for eutrophication
- impacts of toxic contaminants
- health and abundance of living resources
- health risk to consumers of contaminated seafood
- land-based impacts on water quality
- recreational uses

The NBP is taking an ecosystem/watershed approach to address these problems and has funded research that will help to improve our understanding of various aspects of these priority problems. The Project is also working to expand and coordinate existing programs among federal, state and local agencies, as well as with academic researchers, in order to apply research findings to the practical needs of managing the Bay and improving the environmental quality of its watershed.

This report represents the technical results of an investigation performed for the Narragansett Bay Project. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency through Cooperative Agreement #CX812768 to the Rhode Island Department of Environmental Management. It has been subject to the Agency's and the Narragansett Bay Project's peer and administrative review and has been accepted for publication as a technical report by the Management Committee of the Narragansett Bay Project. The results and conclusions contained herein are those of the author(s), and do not necessarily represent the views or recommendations of the NBP.

Acknowledgments

The writer deeply appreciates the cooperation and assistance from a number of individuals who made the results of this project well prepared, documented and supportive of the Narragansett Bay Project water quality management goals.

Dr. Peter August, Director URI, Environmental Data Center; Steven Hale, URI Graduate School of Oceanography; Eric Sheffer and Elizabeth Bishop, URI, Environmental Data Center; Elizabeth Flynn, IEP, Inc., Manager GIS Operations; Robert Benoit, IEP, Inc., GIS Specialist, Nancy Palmstrom, IEP, Inc., Aquatic ecologist and Dr. William W. Walker, private consultant to IEP.

It has been a pleasure to work with Caroline Karp, Dr. Charles Roman and the staff of the Narragansett Bay Project. Within a short period of 12 months we have worked together to produce effective management tools for enhancing water quality in Narragansett Bay.

Lester Garvin
Senior Associate
Project Manager

EXECUTIVE SUMMARY

Over a two year period (1989-1990) IEP, Inc. developed an integrated dataset to support current and future Narragansett Bay Project water quality research projects. The dataset consisted of ten geographic information system (GIS) ARC/INFO coverages ready for installation on the University of Rhode Island (URI), Environmental Data Center's (EDC) system. Seven of these coverages were provided by the URI/EDC as a foundation for ensuring dataset integration; 1) watershed boundary, 2) Hunt sole source aquifer boundary, 3) municipal boundaries, 4) United States Geological Survey map boundaries and corner tics, 5) transportation network, 6) hydrography and shoreline boundaries, and 7) soils.

IEP developed land use/land cover for 1985 and 1988, sub-basin boundaries and zoning. The 1985 land use was interpreted from 1" = 800' scale aerial photographs and the 1988 land use from 1" = 2000' scale aerial photographs.

Seven sub-basins were delineated and digitized so that land use data on a sub-basin basis could be developed for correlation with water quality data from major tributaries.

A coding scheme was used to normalize differences between municipal zoning districts in individual communities which made use of land use categories within the Land Use classification system. By using this approach, 60 zoning districts were condensed into 10 districts having similar characteristics.

The utility of the database was demonstrated by the following analyses:

1. Land use/land cover changes in the Hunt-Potowomut watershed between 1985 and 1988.

2. Areas for the seven sub-basins.

3. Areas for each of the condensed zoning districts for the watershed and areas for potential development within each district.

4. Areas for 78 soil types within the watershed.

5. Areas of hydric (wetlands) soils. (Approximately 19% of the watershed area falls into this category).

6. Percentage of land covered by impervious surfaces for 17 types of urbanized land use.

7. Incremental changes in impervious surfaces for a watershed over a three year period.

8. Areas and percent impervious fraction for the Hunt-Potowomut Watershed, the Mawny-Frenchtown brook watershed and a 100 meter corridor each side of the Mawny-Frenchtown Brook and/or contiguous wetlands. These figures were produced for input to the P-8 Land Based Water Quality Model.

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1.0 INTRODUCTION

1.1 Background and Project Objectives

The Narragansett Bay Project (NBP), a member of the National Estuary Program is jointly sponsored by the Rhode Island Department of Environmental Management (DEM) and the U.S. Environmental Protection Agency (EPA) with appropriations provided under the Clean Water Act. The NBP's specific mandate is to develop a comprehensive water quality management plan for Narragansett Bay which is premised on a thorough evaluation of the Bay's water quality related problems and available pollution control and use management strategies. A key section of the management plan will address the impact of nonpoint source pollution entering ground and surface water tributaries to Narragansett Bay.

In December 1988 IEP, Inc. initiated three projects in direct support of the NBP's objectives:

#1. An investigation into multiple uses of vegetated buffer strips,

#2. Development of a land-based, water quality model for use by state and local land use planners and

#3. Land use map of the Hunt-Potowomut River Watershed.

This report presents the results of project #3, the primary purpose of which is to develop a geographic information system (GIS) database to support the investigative needs of projects #1 and #2 and the long term goals of the NBP Land Management Project.

The specific objectives of this project are:

1. Digitize and interpret land uses within some geographically distinct portion of the Hunt-Potowomut River Watershed using the 1988 aerial photographic survey of the State of Rhode Island,

2. Provide the land use data compiled above in ARC/INFO readable files for inclusion in the Rhode Island Geographic Information System operated and maintained by the Environmental Data Center at the University of Rhode Island,

3. Digitize the zoning maps/or some geographically distinct portions of the Hunt-Potowomut River Watershed and overlay a complete build-out of approved uses and

4. Demonstrate the application of the RIGIS ARC/INFO to the study of changing land use or physiography by comparing some geographically distinct portion of the Hunt-Potowomut River Watershed over time.

1.2 Project Study Area

The Hunt-Potowomut Watershed is centrally located in Rhode Island on the westerly side of Narragansett Bay (Figure 1). Geographically it covers approximately 25 square miles (15,852 acres*) and includes parts of seven Rhode Island communities (Figure 2); East Greenwich, North Kingstown, Exeter, West Greenwich, Coventry, West Warwick and Warwick. The study area was selected because of the mixed land uses within the watershed, the present high water quality in the Hunt River, development pressure for change and its tributary relationship to Narragansett Bay. Its relationship to the boundary of the USEPA designated Hunt Sole Source Aquifer is shown in Figure 3. The study area is characterized by undeveloped or lightly developed rolling countryside in the western half and more highly developed with commercial, high density residential, industrial and major travel routes in the eastern half (Figure 4).

*Note: After the draft report was submitted in 1990, additional work was undertaken to map the land area draining into the Potowomut estuary contiguous to Narragansett Bay. Throughout the report this additional area is referred to as the Hunt-Potowomut extension. It adds approximately 1,156 acres to the initial study area of 14,696 acres and brings the total study area to 15,852 acres or approximately 25 square miles.

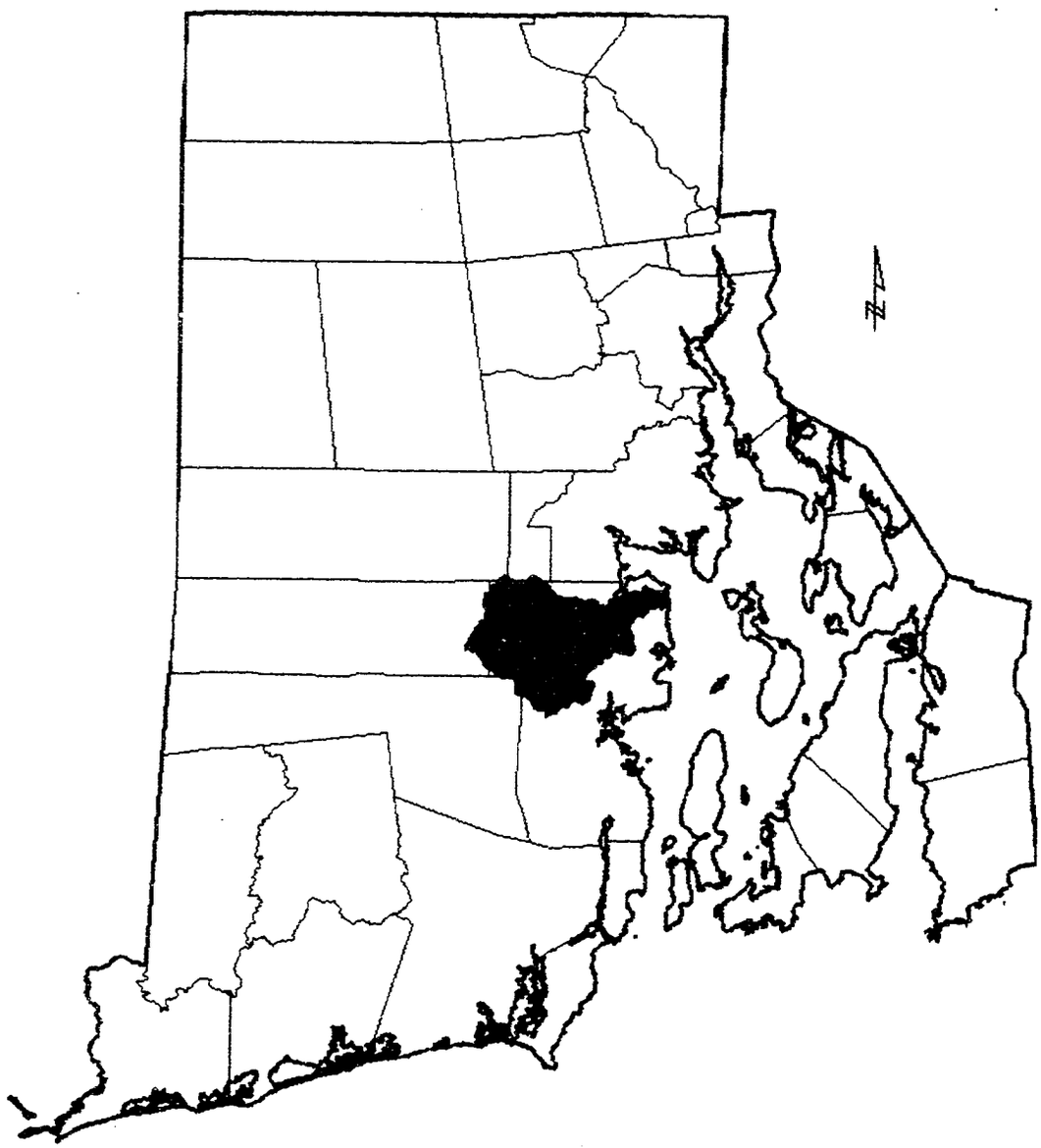

Figure 1. Location of the Hunt-Potowomut Watershed in Rhode Island

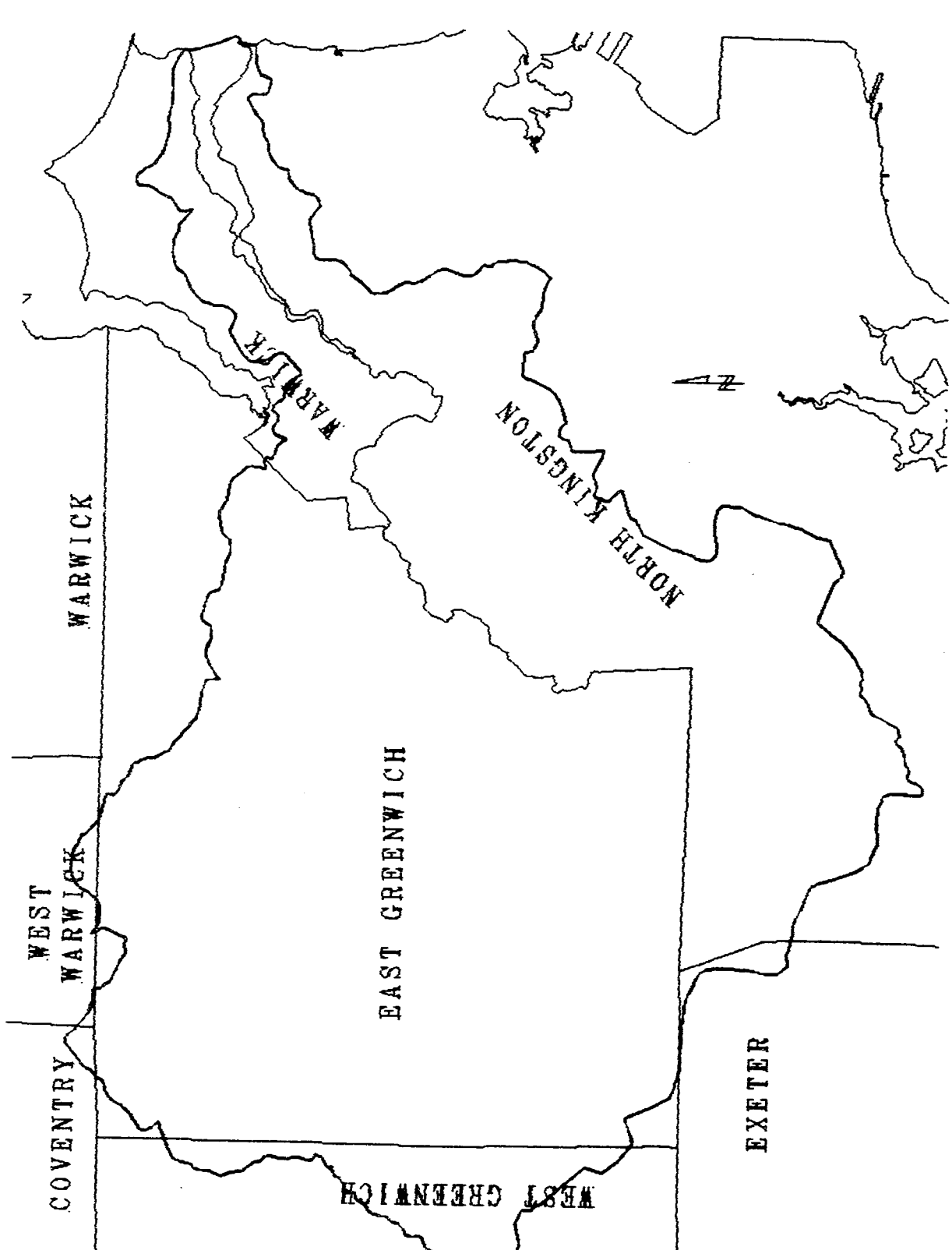

Figure 2. Rhode Island Communities within the Hunt-Potowomut Watershed

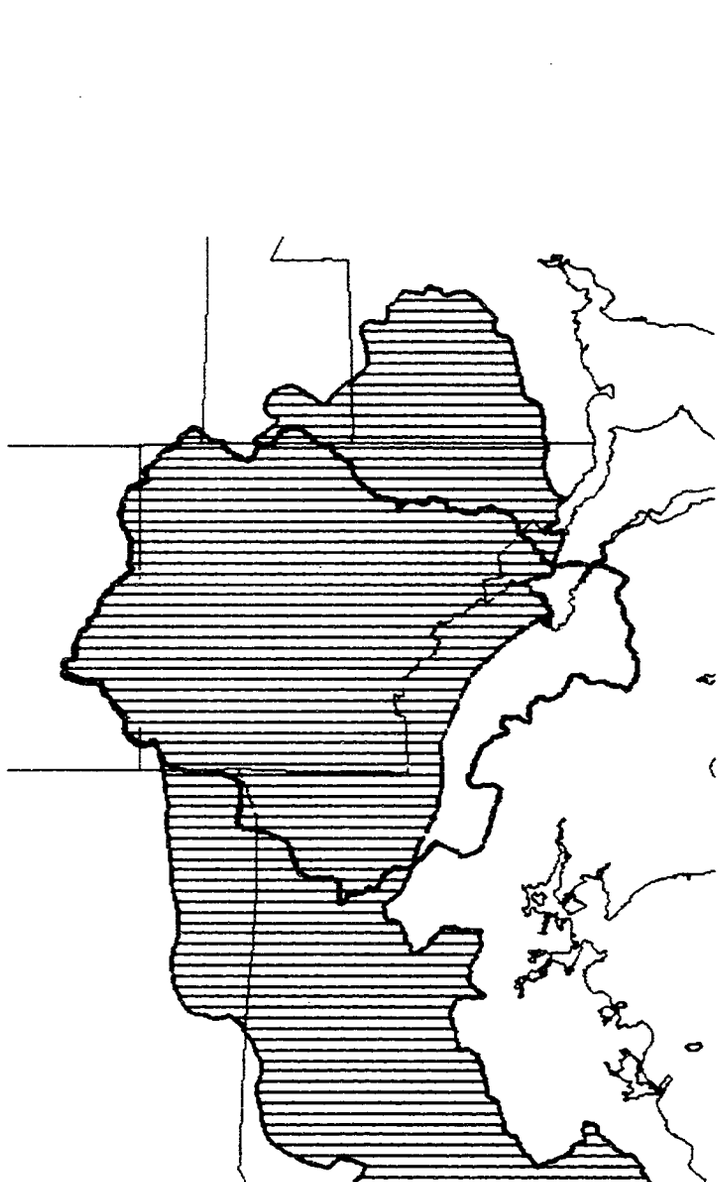

Figure 3. Relationship of the Hunt-Potowomut Watershed to the Hunt Sole Source Aquifer

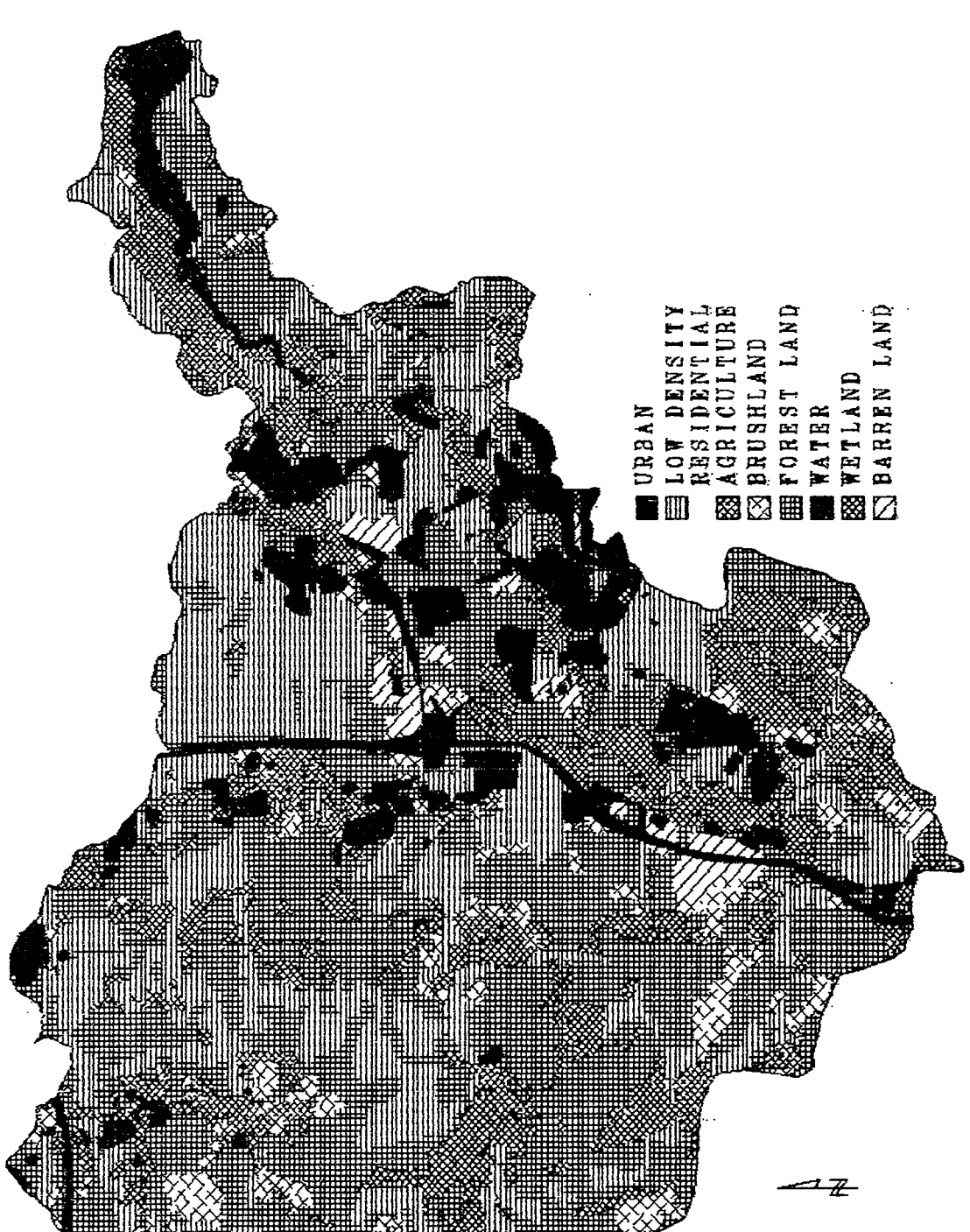

Figure 4. General Land Development in the Hunt-Potowomut Watershed, 1988

2.0 DATA BASE DEVELOPMENT METHODS

The digital database was developed over a period of nearly 12 months and includes data imported from the University of Rhode Island, Environmental Data Center (Rhode Island Geographic Information System) RIGIS and data developed by IEP.

2.1 Data from URI/EDC

Digital data for the following coverages were imported to IEP's ARC/INFO based system using floppy disk media;

- Watershed boundary
- Hunt aquifer boundary
- Municipal boundaries
- USGS boundaries and tic ID's
- Transportation network
- Hydrography and shoreline boundaries
- Soils

2.2 Land Use

IEP developed the land use data set for 1985 and 1988 using aerial photograph interpretation, stereo viewing and the classification system shown in Table 1. The land use units are the same as used on the Scituate Reservoir Watershed data base and essentially the same as used by the Rhode Island Office of State Planning for support of comprehensive planning efforts. The classification system was developed in 1986-87 for use in water quality monitoring studies for the Scituate Reservoir. It is based on the Anderson, et al. system originally published in 1972 by the USGS for use with remote sensing systems and augmented with inputs from the "Ideal List of Land Use and Cover Classes for Water Runoff Studies" as published by Trolier and Phillipson in 1986.

Land use types were delineated, to the 1/2 acre size level, directly on the aerial photographs. These were field verified extensively before continuing with the cartographic process. Map manuscripts were produced by using the following coverages from the URI Environmental Data Center; Hunt-Potowomut Watershed boundary, transportation, hydrography, municipal boundaries and USGS tics. Base manuscripts were plotted at a scale of 1" = 800' and land use units and codes were transferred using a Bausch and Lomb Zoom Transfer Scope (ZTS). Land use units were digitized, edited and labeled to produce the 1985 data set and plots.

The 1988 land use data was interpreted from aerial photographs (taken on 4/26/88) using stereoscopic viewing and change analysis methods. Changes in land use were delineated and coded prior to digitizing the revised land use.

Table 1. **RHODE ISLAND LAND USE AND COVER CLASSIFICATION** (A Heirarchical System Based on DOP 1975 Land Use Categories with Modifications for Surface & Ground Water Management)

LEVEL I	LEVEL II/III	NOTES:	ANDERSON ETAL. CATEGORY	1975 RI-OSP EQUIVALENT
1. Urban or Built-up Land	11. Residential		Residential	
	111 High Density	Greater than 8 units/acre	—	UA, UT
	112 Medium Density	4 to 7.9 units/acre	—	URH
	113 Medium Density	1 to 3.9 units/acre	—	URM
	114 Medium Low Density	.5 to .9 units/acre	—	URL
	115 Low Density	.2 to .49 units/acre	—	URO, UCR
	116 Rural Density	Less than .2 units/acre	—	URF, UE
	12. Commercial & Services	Used primarily for sale of Products & Services	Commercial & Services	UC, UH, US
	13. Industrial	Manufacturing	Industrial	
	131 Heavy Industrial	Raw Material Associations Products & Waste	—	UI
	132 Medium Industrial	Design, Assembly, Finishing, Processing & Packaging	—	UL
	14. Transportation, Communications & Utilities (including R-O-Ws)		Transportation, Communications & Utilities	
	141 Roads	R-O-Ws, Interchanges, Service Areas, & Terminals	—	UIT, HW
	142 Airports	Runways, Terminals, Parking & Fuel Storage	—	UTA
	143 Railroads	Stations, Parking, Repair, Roundhouses & Switching	—	UTR
	144 Water Treatment Facilities		—	FB
	145 Sewerage Treatment Facilities		—	FB
	146 Waste Disposal Site		—	D, DA
	147 Other		—	UTW, RM, PL

LEVEL I	LEVEL II/III	NOTES:	ANDERSON ETAL. CATEGORY	1975 RI-OSP EQUIVALENT
	15. Industrial & Commercial Complexes	Industrial Parks, Warehousing, Wholesaling	Industrial & Commerical Complexes	UL
	16. Mixed Urban or Built-Up Land	Separate Commercial and Residential Land Uses Cannot Be Mapped Individually	Mixed Urban or Built-Up Land	UI/UG MIX
	17. Other Urban or Built-Up Land	Zoos, Urban Parks, Cemetaries, Golf Courses, Playgrounds, etc.	Other Urban or	+Symbol, RS, RG, RD, RPG, RSK, RT, RA, RAP, RFG, RI, RP
	18. Institutional	Educational, Health, Correctional, Religious, Military, etc.	Classified Under 12 (Commercial & Services)	UP
	19. (not used at this time)		Not Used	
2. Agricultural Land	21. Cropland & Pasture		Cropland & Pasture	T, TU, P
	22. Orchards, Groves & Nurseries		Orchards, Groves & Nurseries	O, N
	23. Confined Feeding Operations		Confined Feeding Operations	Not Classified
	231 Dairy Confined		—	Not Classified
	232 Poultry Confined		—	Not Classified
	233 Other Confined Animals		—	Not Classified
	24. Other Agricultural Uses		—	CB
3. Brushland	31. Abandoned Fields		Herbaceous Rangeland (31)	AF, AO
	32. Brush & Open Forests	Includes Regently Cut-Over Areas	Shrub & Brush Rangeland (32) or Mixed Rangeland	H

LEVEL I	LEVEL II/III	NOTES:	ANDERSON ETAL. CATEGORY	1975 RI-OSP EQUIVALENT
4. Forest Land	41. Deciduous Forest	80% or Greater Deciduous Species	Deciduous Forest Land	H
	42. Evergreen Forest	80% or Greater Evergreen Species	Evergreen Forest Land	S
	43. Mixed-Deciduous Species Dominant	50-80% Deciduous Dominance	Mixed Forest Land	HS
	44. Mixed-Evergreen Species	50-80% Evergreen Dominance	Mixed Forest Land	SH
5. Water	51. Streams & Waterways		Streams & Canals	W
	52. Lakes & Ponds		Lakes	W
	53. Reservoirs		Reservoirs	W
	54. Bays & Estuaries		Bay & Estuaries	Not Classified
6. Wetland	61. Forested Wetland		Forested Wetland	SS
	62. Non-Forested Wetland		Non-Forested Wtlnd	BP, TSM, ISM, DSM, SF, B, M SM, DM
7. Barren Land	71. Salt Flats		Dry Salt Flats	Not Classified
	72. Beaches		Beaches	RFB, RSB
	73. Sandy Areas other than Beaches		Sandy Areas other than Beaches	S
	74. Bare Exposed Rock		Bare Exposed Rock	Not Classified
	75. Strip Mines, Quarries, & Gravel Pits		Strip Mines, Quarries, & Gravel Pits	SG, OM
	76. Transitional Areas		Transitional Areas	UO
	77. Mixed Barren Land		Mixed Barren Land	Not Classified

The above approach produced a high quality (accurate and current) data set with the added perspective of two time periods. The detail available in the 1" = 800' scale photos allowed accurate interpretation and the 1988 photographs (1" = 2000' scale) provided current information. The acreages of all land uses in the watershed for 1985 and 1988 are shown in Table 2.

2.3 Sub-basins

Seven sub-basins within the Hunt-Potowomut watershed were digitized and coded so that land use data on a sub-basin basis could be developed for correlation with water quality data from major tributaries. The sub-basins are shown in Figure 5 and the area for each is shown in Table 3. The Hunt-Potowomut extension is included as a drainage area to the Hunt-Potowomut estuary, but not in the same context as a sub-basin to the Hunt-Potowomut River.

2.4 Municipal Zoning Districts

In a previous project IEP derived a coding scheme which normalized differences between districts in individual communities and made use of categories of land use within the Land Use Classification System. IEP used a similar approach on this project. As a result 60 zoning districts were condensed into 10 districts, thus simplifying the coding and representing areas within the watershed with similar zoning characteristics. The coding scheme is shown in Table 4, Zoning Districts for the Hunt-Potowomut Watershed. Table 4-1 provides a brief description of the zoning districts for the seven municipalities in the Hunt-Potowomut Watershed. Table 5 provides an area tabulation for condensed zoning districts for the total watershed (less the Hunt-Potowomut extension area) and Figure 6 graphically shows their distribution.

2.5 Soils

IEP imported the soils data from the RIGIS database on January 1991. The watershed occurs at the junction of four 7 1/2" U.S. Geological Survey Quadrangles. The four "clipped out" portions of the soils occurring in each watershed were edge matched and made into a seamless coverage for the total watershed plus the Hunt-Potowomut Extension. The soils coverage is shown in Figure 5A and the hydric or "wetland" soils are highlighted as solid polygons. The area of each soil type is shown in Table 5A. Soils included in the hydric or wetland category are noted by asteriks and account for approximately 17% of the watershed area.

Table 2. Land Use and Land Cover for 1985 and 1988

UNIT	Area in Acres 1985	1988	Difference
100 Urban or Built-Up Land			
111	19.873	19.873	0
112	12.301	12.301	0
113	657.208	657.208	0
114	1924.100	2110.602	+186.502
115	842.623	904.482	+61.859
116	60.289	60.289	0
120	199.610	199.394	-.216
131	51.278	51.278	0
132	75.409	75.409	0
140	11.353	11.353	0
141	214.384	260.774	+46.39
145	12.051	12.051	0
146	91.841	83.651	-8.19
150	38.656	38.656	0
170	188.142	188.142	0
180	424.249	424.249	0
200 Agricultural Land			
210	1169.692	1117.233	+52.459
220	3.405	3.405	0
232	1.907	1.907	0

Table 2. Land Use and Land Cover for 1985 and 1988 (Continued)

300 Brushland			
310	385.236	384.720	-.516
320	368.779	368.779	0
400 Forest Land			
410	5355.133	5169.712	-185.421
420	694.725	677.796	-16.929
430	381.146	373.627	-7.519
440	501.572	494.349	-7.233
500 Water			
520	87.997	87.997	0
540	203.719	203.719	0
600 Wetland			
610	1437.541	1437.541	0
620	93.455	933.455	0
700 Barren Land			
750	199.970	199.970	0
760	142.013	125.729	-16.284
TOTAL AREA (ACRES)	15,851.6	15,851.6	

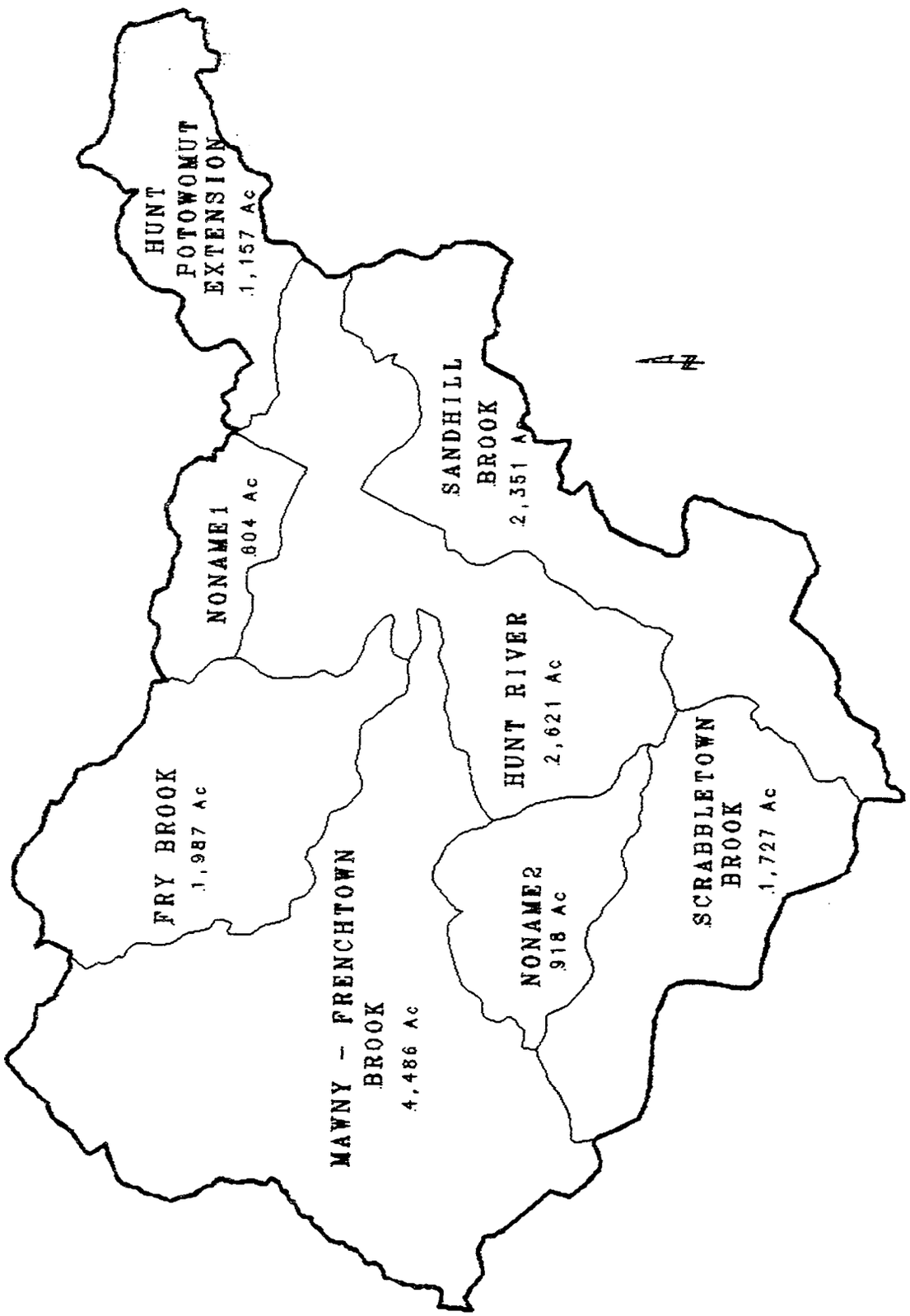

Figure 5. Sub-basins for the Hunt-Potowomut Watershed

Table 3. Area Measurements for Hunt-Potowomut Sub-basins

Sub basin	Area (acres)
Mawny-Frenchtown Brook	4,486.96
Hunt River	2,621.55
Sandhill Brook	2,351.66
Fry Brook	1,986.86
Scrabbletown Brook	1,727.64
No Name 1	603.59
No Name 2	918.04
Hunt-Potowomut extension	1,156.00
TOTAL AREA:	15,851.6 acres

Table 4. Zoning Districts Matrix

LANDUSE	CLASSIFI-CATIONS	EAST GREENWICH	NORTH KINGSTOWN	WARWICK	WEST GREENWICH	COVENTRY	WEST WARWICK	EXETER
RESIDENTIAL	112	R6, R10	PVD	A7, A10		PD	AA,A,B,C	
	113	R20,R30, F, F-1,	MFR,VR,NR	A15,A40		R20		
	114	F-2	RR		R-F-R	RR2		RE2
	115					RR5		RU3, RU4, CR-5
	116							
COMMERCIAL	120	CD,CL, CH,W	WB,NB,GB, HB,PBD	GB,O,WB	NB,HB	NB,GB	D	B
INDUSTRIAL	130	M					E	I
	131		ID	GI	IB	I2		
	132		DD	LI	IA	I1		
OPEN SPACE/ PUBLIC SPACE			OS/OL	OS				

Table 4-1. A Description of Zoning Districts for Communities in the Hunt-Potowomut Watershed

West Greenwich
Zoning District Use Regulations

The town is divided into five zones designated as follows:

Rural, Farming, Residential, R-F-R. The purpose of this zone is to provide adequate land suitable for medium density development to establish unified neighborhoods for more efficient, economical, community services and facilities and a more pleasant and diversified environment. Minimum lot size is two acres. The lot size can be reduced to one acre by the zoning Board of Review as Special Exception if the lot is served by a public water system and a sewage disposal system approved by the Rhode Island Department of Health.

Neighborhood Business Zone, NB. The purpose of this zone is to provide areas for business use to serve the day-to-day needs of the residential population of the community.

Highway Business Zone, HB. The purpose of this zone is to provide areas for commercial activities to serve the needs of the entire community and contiguous regions.

Industrial A Zone, IA. The purpose of this zone is to provide areas for the future development of industrial and allied uses and to provide for existing uses of this nature. Uses include manufacturing, storing, processing, fabricating, packaging and assembling of materials.

Industrial B Zone, IB. The purpose of this zone is to provide areas for future development of industrial and allied uses which due to the peculiar nature of their activities require locations remote from other classes of use. Areas so designated are primarily undeveloped or are very sparsely developed to minimize adverse effect upon neighborhood properties and activities.

East Greenwich

The town is divided into thirteen zones designated as follows:

Residential Zones

R-6. This zone is composed of high density areas with unique dimensional regulations predominant in this area. Single-family minimum lot size is 6000 sq. ft., two-family minimum lot size is 10,000 sq. ft.

R-10. This district is composed of certain residential areas of medium density. Minimum lot size is 10,000 sq. ft.

R-20. This district is composed of certain residential areas of moderate density. Minimum lot size is 20,000 sq. ft.

R-30. This district is composed of certain residential areas of low density. Minimum lot size is 30,000 sq. ft.

Farming Zones

F. This district is composed of agricultural uses, certain low density residential areas, plus certain open areas where similar residential development appears likely to occur. Minimum lot size for farming and single family residential use is 43,500 sq. ft.

F-1. A special zone for agricultural uses interspersed with open land and residential uses. Minimum lot size is 43,500 sq. ft.

F-2. This district is composed of sparsely populated areas and agricultural uses. Minimum lot size is 87,120 sq. ft.

Commercial Zones

Commercial downtown zone, CD. This district contains commercial development in the central business district.

Commercial limited zone, CL. This district is composed of certain land and structures used primarily for professional and personal services, certain low intensity businesses and high density residential development. Restart and wholesale establishments are specifically prohibited.

Commercial highway zone, CH. This district is for commercial sites which include places of amusement and high density businesses, requiring easy vehicular access, adequate customer parking and considerable trucking and unloading operations.

The CD zone requires 5,000 sq. ft. while the CL and CH zones require 30,000 sq. ft. minimum lot size.

Waterfront zone, W. A special zone to enhance the utilization and beauty of the waterfront by special restrictions and uses, with emphasis on the use of certain areas for all residents. Two acres are required for marinas, yacht clubs and other permitted uses.

Industrial zones, M. This district is composed of certain industrial areas and open land suitable for industrial development. The minimum lot size is three acres.

Warwick

The City is divided into ten zoning districts designated as follows:

Residence, A-7. Used for high density residential use comprising not more than one single family dwelling per lot area measuring a minimum of 7000 square feet.

Residence, A-10. Used for medium density residential use, comprising not more than one single family dwelling unit per lot area measuring a minimum of 10,000 square feet.

Residence, A-15. Used for low density residential use comprising not more than one single family dwelling unit per lot area measuring a minimum of 15,000 square feet.

Residence, A-40. Used for very low density residential use comprising not more than one single family dwelling unit per lot area measuring a minimum of 40,000 square feet.

Open Space, OS. For purposes of maintaining open space, recreation, agriculture, conservation of natural resources, or other environmental conditions.

Office District, O. used primarily for professional and personal service offices, and low density businesses, which generally serve as a transition between residential and other non-residential districts.

Waterfront business district, WB. Used primarily for businesses catering to marine activities.

General business district, GB. Used for a wide diversity of commercial establishments including retail, service, office and automation related uses.

Light industrial district, LI. Used for limited or light industrial purposes generally of a less intensive nature than those allowed in the General Industrial district.

General industrial district, GI. Used for general industrial and manufacturing operations and enterprises, including assembly of durable goods, bulk storage, and general storage of trucks and construction equipment.

North Kingstown

The town is divided into 13 zoning districts designated as follows:

Rural, RR. The rural residential district is established to protect the rural landscape and to conserve natural resources. The minimum lot size is 80,000 square feet.

Neighborhood Residential, NR. This district is established to promote low density neighborhood growth in areas with natural limitations for development. The minimum lot size is 40,000 square feet.

Village Residential, VR. The village residential district is established to protect and promote the convenience and character of compact village settlements designed to complement the natural features of the land. The minimum lot size is 20,000 square feet.

Multi-family Residential, MFR. This district is intended to promote the orderly development of multifamily dwellings in appropriate locations and to promote suitable placement of buildings and related facilities in relation to the site and surrounding areas. The maximum density for multi-family dwellings shall not exceed one dwelling unit for each 15,000 square feet of land area.

Planned Village District, PVD. This district is established to encourage development of harmonious efficient and environmentally sound neighborhoods by promoting variety in land use, residential density and site design through the grouping of buildings and preservation of unique features of the site; it may include compatible residential and recreation uses. It shall be serviced by an approved central sewerage facility and public water.

Waterfront Business, WB. This district is established for business catering to marine activities and for small business operations.

Neighborhood Business, NB. This district is intended to provide areas within and adjacent to residential neighborhoods where groups of small businesses may be located to: (1) serve frequent commercial and service needs of residents within convenient traveling distances; (2) serve as a transitional zone between more intensive business areas and residential neighborhoods; and (3) provide a district for nonintensive business activities which do not generate the traffic, noise, glare or large parking areas associated with intensive business uses.

General Business, GB. This district is created to provide areas for commercial establishments that primarily depend upon a great volume of vehicular traffic and serve community and town-wide shopping needs.

Heavy Business, HB. This district is established to provide areas for intensive business activities, the merchandise and operations of which generally require outdoor storage or activity.

Planned Business Development, PBD. This district is established to provide controlled development in areas where commercial activities are likely to concentrate and to ensure that business center development complements the site and the surrounding development by means of design standards.

Industrial Districts, ID. Property and buildings to be used for industrial purposes shall be so designed and laid out as to minimize disturbance to adjacent property by such features as buffer fences, planting, suitably located points of traffic ingress and egress, and areas for loading and parking.

Development District, DD. The development district is established to allow the greatest potential use of specified areas within the town, up to limits compatible with the community development plan. Such areas have all the major public utilities, good access and the physical conditions needed for intensive development.

Open Space and Public Lands District, OS/PL. This district is designed for all lands which shall be permanently dedicated to open space, recreation, conservation, or public uses. The intent is to show on the zoning map the relationship of the other use districts to the open space plan for the town.

Exeter

The town is divided into six zones designated as follows:

Residential District, RE-2. The purpose of this zone is to provide adequate land suitable for medium density development and to establish unified neighborhoods for a more efficient, economical environment. More importantly, the density permitted in this district would maintain an adequate water supply and suitable soil for individual septic systems.

Rural District, RU-3. The main purpose in the establishment of this zone is to provide land suitable for low density residential rural development blended with forestry, farming and recreational activities.

Rural District, RU-4. The main purpose of this zone is to protect land now used for forestry, farming and related activities and the natural habitat of wildlife and to preserve the area's rural character. This zone provides land suitable for low density residential development and reserves land for future farming, forestry, conservation practices, and recreational uses.

Conservation-Recreation District, CR-5. This zone is established as a separate district to preserve and protect an area abundant with natural resources, landscapes and sensitive soils having severe limitations and to provide for a natural mixture of residential and recreational uses.

Business District, B. The purpose of this zone is to provide areas for business which unused serve the day-to-day needs of the residential population of the community. Also its' purpose is to provide areas for commercial activities to serve the needs of the entire community and the contiguous regions.

Industrial District, I. The purpose of this zone is to provide areas for the future development of industrial and allied uses and to provide for existing uses of this nature. Areas so designated are considered to be geographically and topographically suitable for the future economic growth of the community.

Coventry

The town is divided into eight zones designated as follows:

Rural Residential District, RR-2. These are rural areas which are not served by public facilities and in which intensive development should not occur. These are characterized by low-density residential development, large estates, agriculture and contain low density non-residential activities incidental to a rural environment.

Rural Residential District, RR-5. These are rural areas which are not served by public facilities, and in which intensive development should not occur. This district is designed to preserve the rural character of the town and to preserve and protect environmentally sensitive land.

Residence District, R-20. This district is composed of certain quiet low density residential areas of the town, plus certain open areas where similar residential development will likely occur in the future.

Neighborhood Business District, NB. This district is composed of certain land and structures to provide for the retailing of commodities classified by merchants as "convenience goods" such as groceries, milk and drugs, and the furnishing of certain personal services.

General Business District, GB. This district is composed of certain land and structures to provide for the retailing of commodities and the furnishing of services which depend primarily on vehicular traffic.

Planned District, PD. These are floating zones composed of a variety of land uses that are created in conformance with article 14 of this ordinance. Planned districts are intended to create multi-family residential and mixed use communities, to promote attractive, convenient, efficient development through careful site planning and to preserve open space historic sites and valuable natural features of the land.

Industrial, I1. These are primarily large tracts of land suitable for industrial development in conformance with development standards.

Industrial, I2. These are older industrial mill complexes in existence prior to the enactment of zoning legislation in the town which have existing buildings over thirty-five feet in height.

West Warwick

The town is divided into six zones designated as follows:

Residence Districts, AA. In this district the minimum lot area for a dwelling is 10,000 square feet.

Residence District, A. In this district the minimum lot area for a single family dwelling is 8,000 square feet.

Residence District, B. In this district the minimum lot area for a single family dwelling is 7,500 square feet.

Residence District, C. In this district the minimum lot area for a single family dwelling is 6,000 square feet.

Business District, D. This is a general business district which accommodates a range of business from neighborhood to heavy vehicular.

Industrial District, E. This is a general industrial zone which allows a broad range of commercial user and a large number of heavy impact uses by special permit.

Table 5. Area Tabulation for Condensed Zoning Districts for the Hunt-Potowomut Watershed

ZONING DISTRICT	ACRES	ACRES OF UNDEVELOPED AND NON-WETLAND AREAS
112	298.214	10.336
113	3180.729	1513.123
114	5169.155	2977.709
115	4027.931	2833.754
120	437.168	168.615
130	400.222	191.623
131	400.709	204.369
132	551.940	305.620
OPEN SPACE	223.618	0
TOTALS	14,690.000	8,205.000

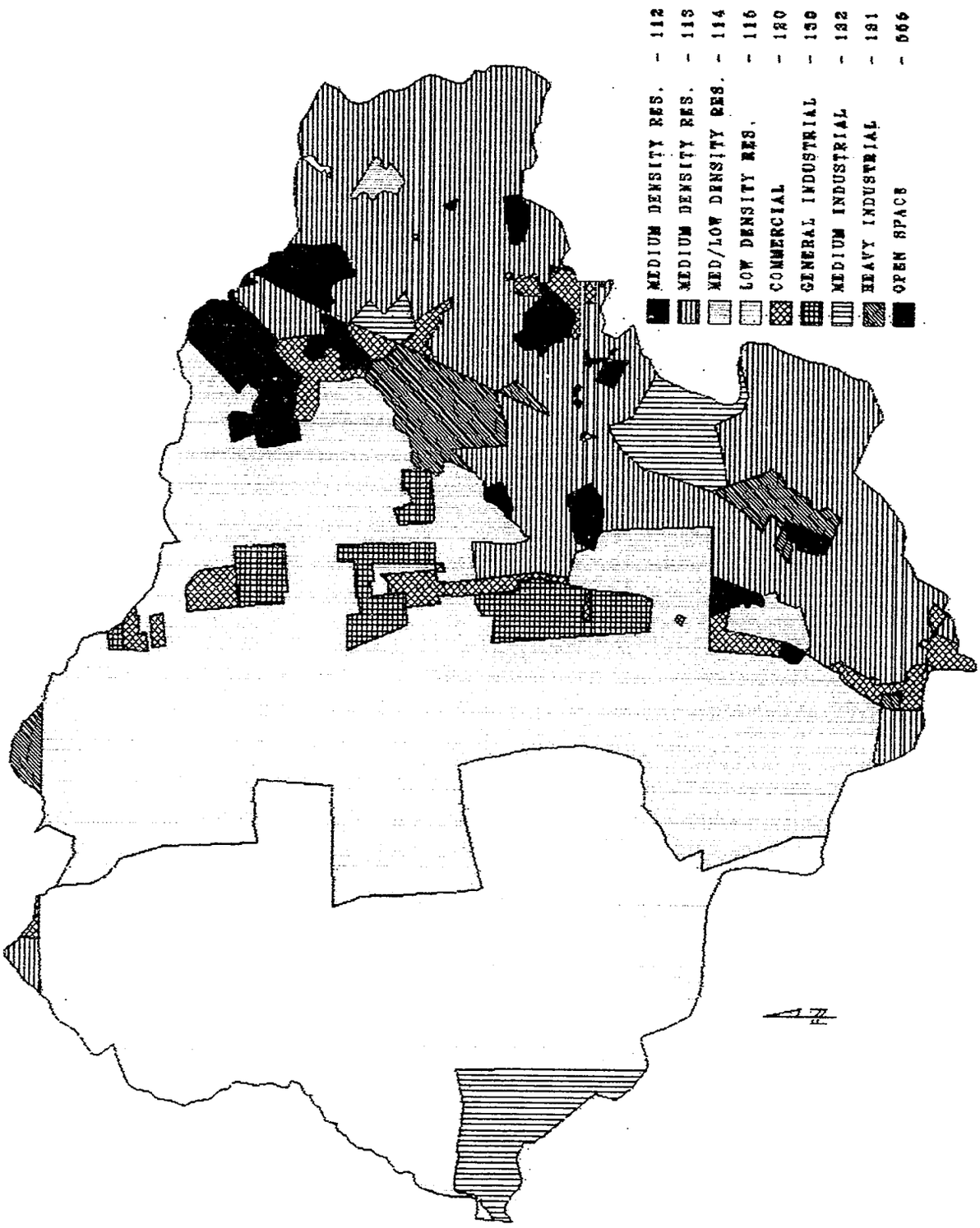

Figure 6. Condensed Zoning Districts

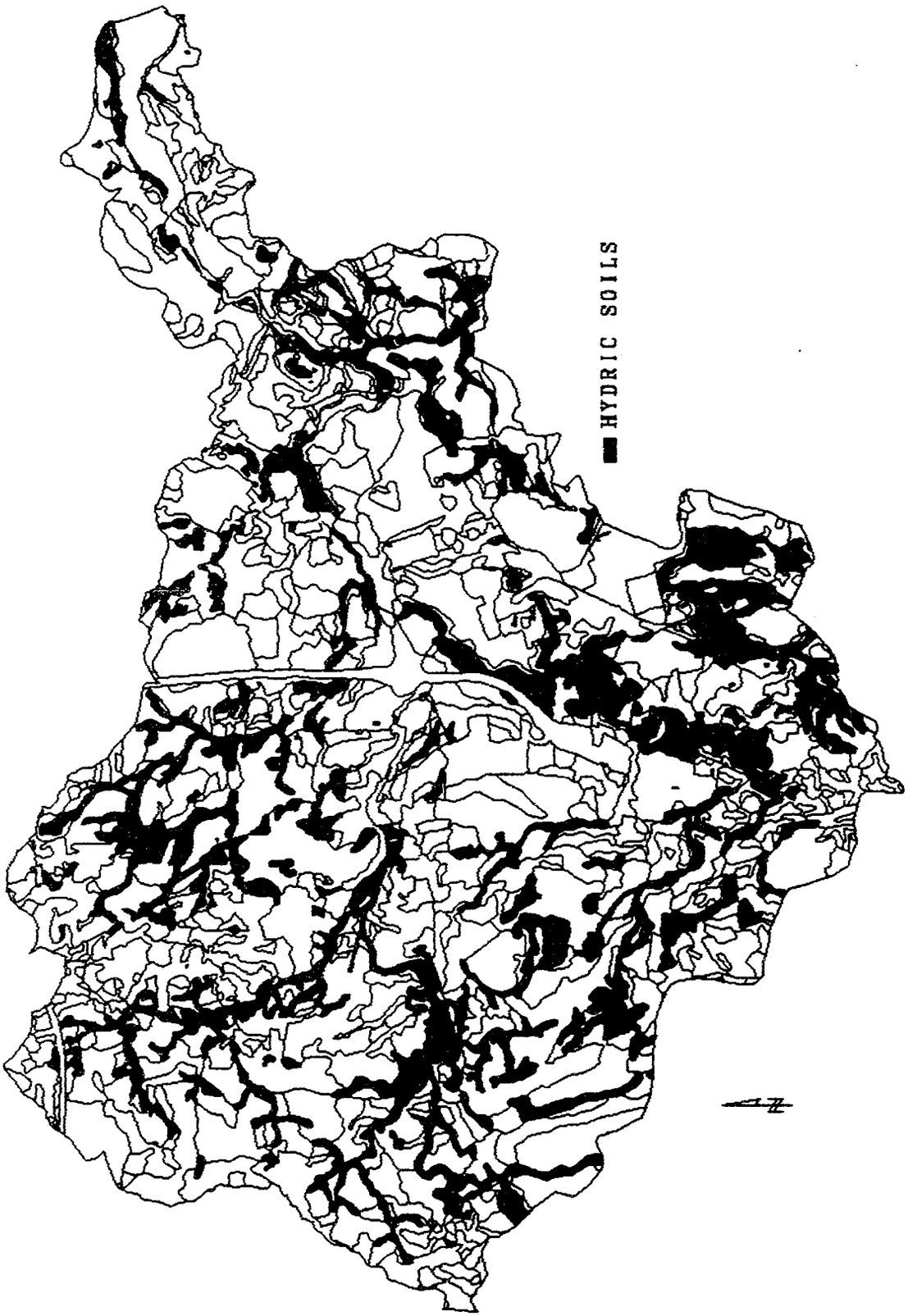

Figure 6A. Hydric Soils within the Hunt-Potowomut Watershed

Table 5A. Soil Types and Areas in the Hunt-Potowomut Watershed

SOIL TYPE**	AREA (ACRES)
Aa	393.518*
Ba	12.521
Bc	26.520
BhA	164.794
BhB	169.104
BmA	237.374
BmB	444.042
BnB	1,481.616
BnC	413.069
BoC	636.970
CB	71.840
CaC	9.671
CaD	10.838
CdA	21.448
CdB	61.630
CdC	12.578
CeC	266.175
ChB	356.985
ChC	68.884
ChD	87.017
CkC	62.063
Co	675.410*
Dc	10.809
Du	9.636
EfA	83.325
EfB	207.362
GhC	5.951
HkA	40.723
HkC	493.125
HkD	176.975
HnC	458.248
MU	798.303
Mk	48.081*
MmA	850.658
MmB	518.184
NP	15.563
NaA	20.658
NaB	161.228
NbB	884.342
NbC	32.415
NcC	443.396
NeA	31.037
NeB	6.221
NeC	2.896
NfB	3.096
NoC	18.000

Table 5A. Soil Types and Areas in the Hunt-Potowomut Watershed (Cont.)

SOIL TYPE**	AREA (ACRES)
PaA	0.023
Pg	191.582
PnB	0.046
Pp	40.635
PsA	10.050
PsB	49.539
QoA	91.471
QoC	650.583
Rc	72.446*
Re	8.819
Rf	1,083.172*
Ru	63.302*
Sb	206.223*
ScA	33.843
SdB	4.172
Ss	191.343
StA	4.194
StB	8.272
SuB	36.014
SvB	8.527
Tb	31.322
UD	811.394
Ur	247.254
W	306.235*
Wa	136.224*
WbA	39.449
WbB	71.265
WcB	279.668
WdB	37.608
WgA	88.317
WgB	35.783
WoB	8.777
TOTAL	15,851.235

*Hydric soils

**Map symbols for USDA Soil Conservation Service Soil Series

3.0 DATA BASE APPLICATIONS

3.1 Zoning Build-Out Analyses

Zoning build-out analyses are based on current zoning and are useful as planning tools for projecting environmental impacts to the infrastructure and natural environments. They can be undertaken using a broad range of methods and approaches. Analyses can be based on land use as defined by tax assessment codes and ground surveys or land use/land cover based on a remote sensing or overhead aerial photograph interpretation perspective. While there are preferences or biases concerning each approach, either one is appropriate, depending on the application, providing the overall methods are consistent and logical. In this study land use/land cover was used as the basis for the analyses. The primary thrust of the Bay Project is enhanced water quality management. The use of land use/land cover data relates very well to the process of projecting present and future impacts of non-point source pollution to receiving waters.

The methodology for zoning build-out analyses is premised on the following six assumptions:

1. Zoning districts are a blueprint for future development. Any future development in those areas will be consistent with what is allowed in the zoning ordinances.

2. Zoning districts can be aggregated for multiple communities in a region based on similar characteristics in the ordinances and regulations.

3. Zoning district descriptions can be linked to land use/land cover descriptions in the classification units. For example, if a community requires a minimum lot size of 10,000 square feet, future development will allow approximately 4.3 dwelling units per acre. This translates into a medium density development with a descriptor of 112 and a range of 4 to 7.9 units per acre.

4. Aerial photograph interpreters are capable of analyzing photographs and delineating homogeneous units consistent with the land use/land cover descriptors.

5. Impervious surfaces can be measured and correlated with land use descriptors. See Table 6 for percentages of impervious surfaces relative to land use units used in the study area.

6. Percent of impervious cover can be readily attached to the polygon attribute file (PAT) for each land use type or descriptor so that impervious area determinations can be made for existing land uses and projected for varying degrees of future change based on allowable zoning.

Table 6. Impervious Area Percentage vs. Land Uses

LAND USE CATEGORY	USE CODES	% IMPERVIOUS	(n)	(SCS MEASUREMENTS) % IMPERVIOUS
Residential	111	44	(3)	65
Residential	112	35	Estimate	--
Residential	113	27	(5)	20-38
Residential	114	25	(10	12-20
Residential	115	14	(10)	12
Residential	116	5	(2)	<12
Commercial	120	62	(10)	85
Industrial	131	81	(4)	72
Industrial	132	77	(3)	72
Transportation	141	41	(10)	--
Transportation	143	40	Estimate	--
Waste Disposal	146	42	(10)	--
Industrial/ Commerical Complexes	150	44	(2)	72-85
Mixed Urban	160	50	Estimate	--
Other Urban	170	2	(2)	--
Institutional	180	47	(7)	--
Gravel Pits	750	46	(9)	--

(n) = number of land use areas measured to determine percentage of impervious area. Measurements were made from 1"=800' scale aerial photographs using such features as roof area, driveways, sidewalks, tennis courts and roads/highways.

[1]Source: 210-VI-TR-55, Second Edition, June 1986, p. 2-5.

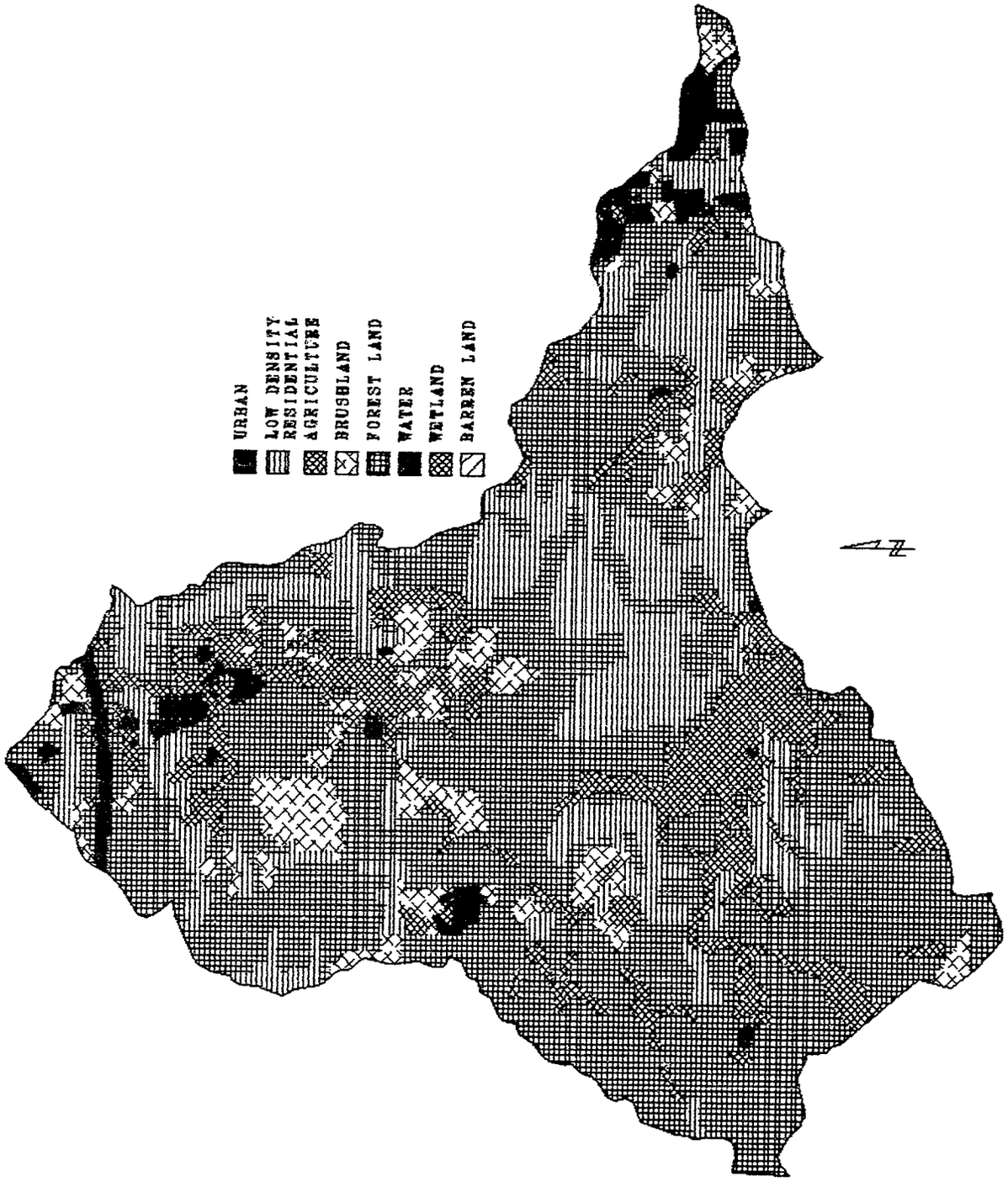

Figure 7. Land Use in the Mawny-Frenchtown Brook Watershed

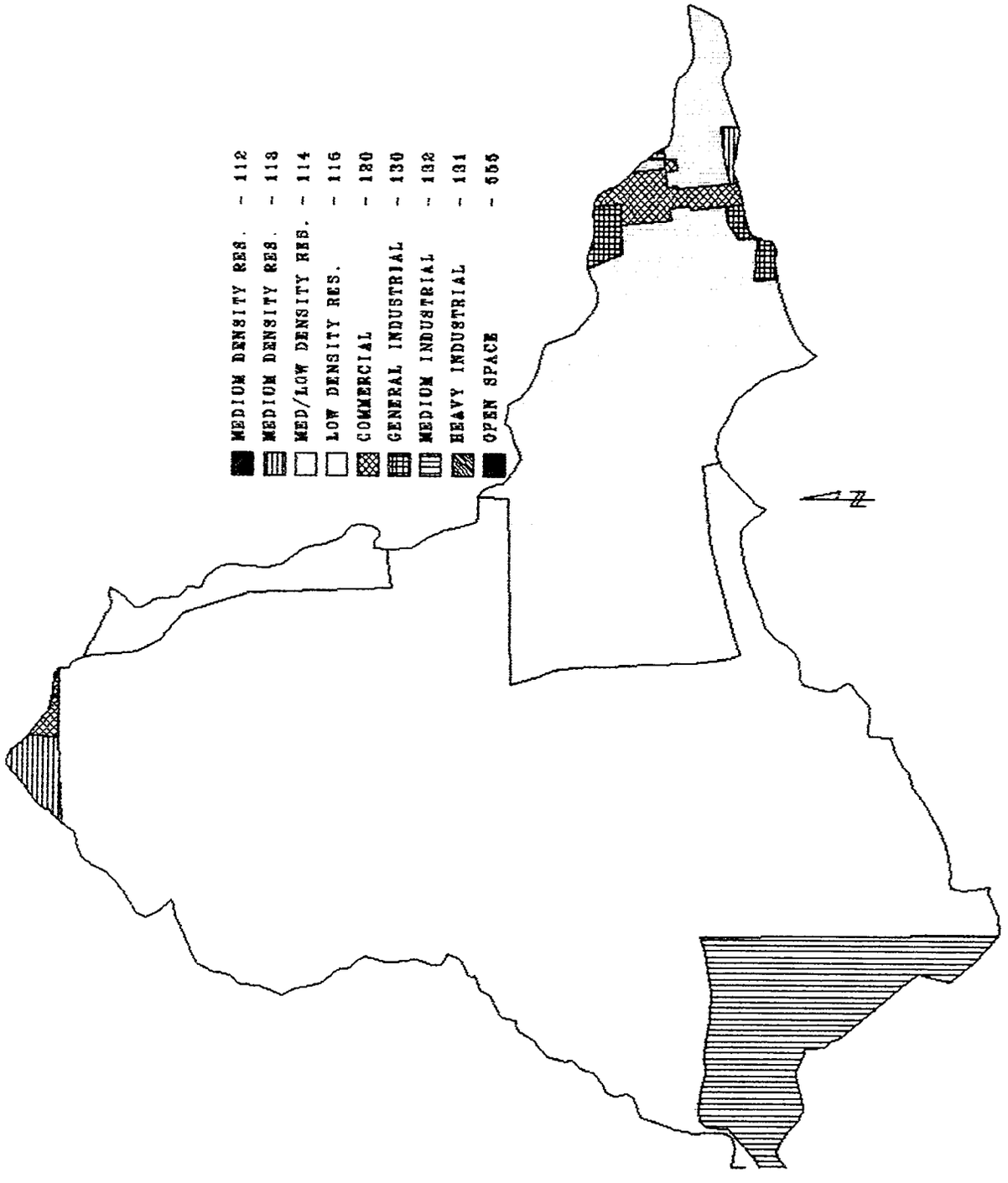

Figure 8. Zoning Districts within the Mawny-Frenchtown Brook Watershed

Build-out analyses were conducted for two geographic areas; the Mawny-Frenchtown Brook watershed and the total Hunt-Potowomut watershed.

The following methodology was applied to both areas:

1. Determine the limits or boundary for the study area and the total acreage. For the Mawny-Frenchtown Brook watershed the total area is 4,487 acres and for the Hunt-Potowomut watershed it is 14,696 acres.

2. Aggregate land use units for all developed areas plus those considered undevelopable such as wetlands and open water.

3. Intersect the aggregated units (#2 above) with zoning districts to determine developable area in each zoning district.

4. Determine area of impervious surfaces as now exists in the study area and the area if full build-out should occur.

The results of the above methodology provide a current level and worst case level of impervious surfaces measurements for input into the land based water quality model. The approach can be refined considerably by providing information on current and planned water and sewer systems in the region, soils not acceptable for individual septic systems or slopes greater than 15 percent.

The actual results of the two levels of watershed scale applications of the model are summarized in the following maps and tables.

1. Figure 7 shows the distribution of land uses within the Mawny-Frenchtown brook watershed.

2. Figure 8 shows the zoning districts within the Mawny-Frenchtown brook watershed.

3. Table 7 is a summary of the developable area for each zoning district in the Mawny-Frenchtown Brook the incremental addition of impervious surface for each one. The total for all districts is included. The incremental addition of impervious surfaces from 1985 to 1988 is shown in Table 8.

4. Figures 4 and 6 show the land use and zoning districts for the whole Hunt-Potowomut watershed.

5. Table 5 includes developable areas in each condensed zoning district for the complete Hunt-Potowomut watershed.

6. Table 6 relates percent of impervious surfaces to the area of seventeen land use categories based on measurements from 87 land use polygons. The number of land use areas measured for each land use category is listed in the "n" column.

Table 7. Developable Areas by Zoning Districts for the Mawny-Frenchtown Brook Watershed

ZONING DISTRICT	AREA (acres)	DEVELOPABLE AREA (acres)
113	34.121	19.600
114	1,091.144	613.068
115	2,975.121	2,075.345
120	50.675	21.304
130	29.870	9.968
132	305.470	250.265
TOTALS:	4,486.	2,990. (67%)

Table 8. Incremental Addition of Impervious Surfaces from 1985 to 1988 for the Mawny-Frenchtown Watershed

LAND USE	1985 IMPERVIOUS AREA (acres)	1988 IMPERVIOUS AREA (acres)	CHANGE (acres)
113	2.94	2.94	0
114	100.37	126.52	+26.15
115	52.32	57.12	+4.80
116	0.59	0.59	0
120	11.67	11.67	0
131	7.71	7.71	0
141	20.23	20.23	0
146	23.42	19.98	-3.44
150	1.50	1.50	0
180	9.40	9.40	0
750	4.69	4.69	0
	234.84	262.35	+27.51

3.2 Watershed Scale Model Inputs

The methodology described in the previous section provides inputs to the land based water quality model for watershed scale determinations. These determinations are predicated on the extent of surfaces impervious to water and hence surface water runoff and associated water quality degradation from suspended particles. The geographic information system can provide tabular data output for a watershed scale application of P8, including watershed acreage, percent impervious (based on land use type) and pervious curve number (SCS) based on soils data. The approach allows projection of impacts as build-out proceeds in residential, commercial and industrial zones. Table 9 provides examples of model inputs for three watershed scale applications.

3.3 Vegetated Buffer Strip Research Support

While the data base land use resolution cannot provide much assistance on individual sites, the use of stream corridors for identifying vulnerable portions of tributaries has considerable merit. The same methodology as developed for the build-out analyses has equal applicability to stream corridors. Determination of land uses at varying distances from stream centerlines such as 50', 100' and 300' may be more valuable for evaluating water quality impacts than on a sub-basin or total watershed basis.

Urban land uses within these narrow corridor widths would tend to have drainage systems which carry surface waters directly into stream tributaries and hence into the bay, while urban land uses further away from the streams would have their drainage impacts mitigated by flow over undeveloped areas and by engineered devices such as leaching catchbasins.

Figure 9 shows a 100 meter corridor each side of Mawny-Frenchtown brook and its tributaries. Table 10 shows a tabulation of impervious surfaces at two corridor widths.

The 100 meter corridor is defined as 100 meters from the center of the stream and/or 100 meters beyond wetlands contiguous to the stream. This approach allows more upland land uses to be included in the sample.

Table 9. Examples of Land Based Water Quality Model Inputs for Watershed Scale Application

Description of Area	Acreage	Percent Impervious Fraction
(1) Mawny-Frenchtown Brook Watershed	4,486.96	262.35/4,486.96 = 5.8%
(2) 100 Meter Buffer each side of Mawny-Frenchtown Brook Tributaries	1,711.16	73.72/1,711.16 = 4.3%
(3) Hunt-Potowomut Watershed	15,852.	1508.55/15,852 = 9.52%

Table 10. Impervious Surfaces for Two Corridors Widths (15 Meters and 100 Meters) Along the Mawny-Frenchtown Brook Tributaries

LAND USE	15 METER (acres)	100 METER (acres)
113	.008	.806
114	1.796	24.744
115	1.771	18.436
116	0.035	.342
120	.582	4.643
131	--	--
141	.973	7.332
146	.971	10.162
150	--	.302
180	--	2.090
750	1.420	4.862
TOTALS	7.556 acres	73.719 acres

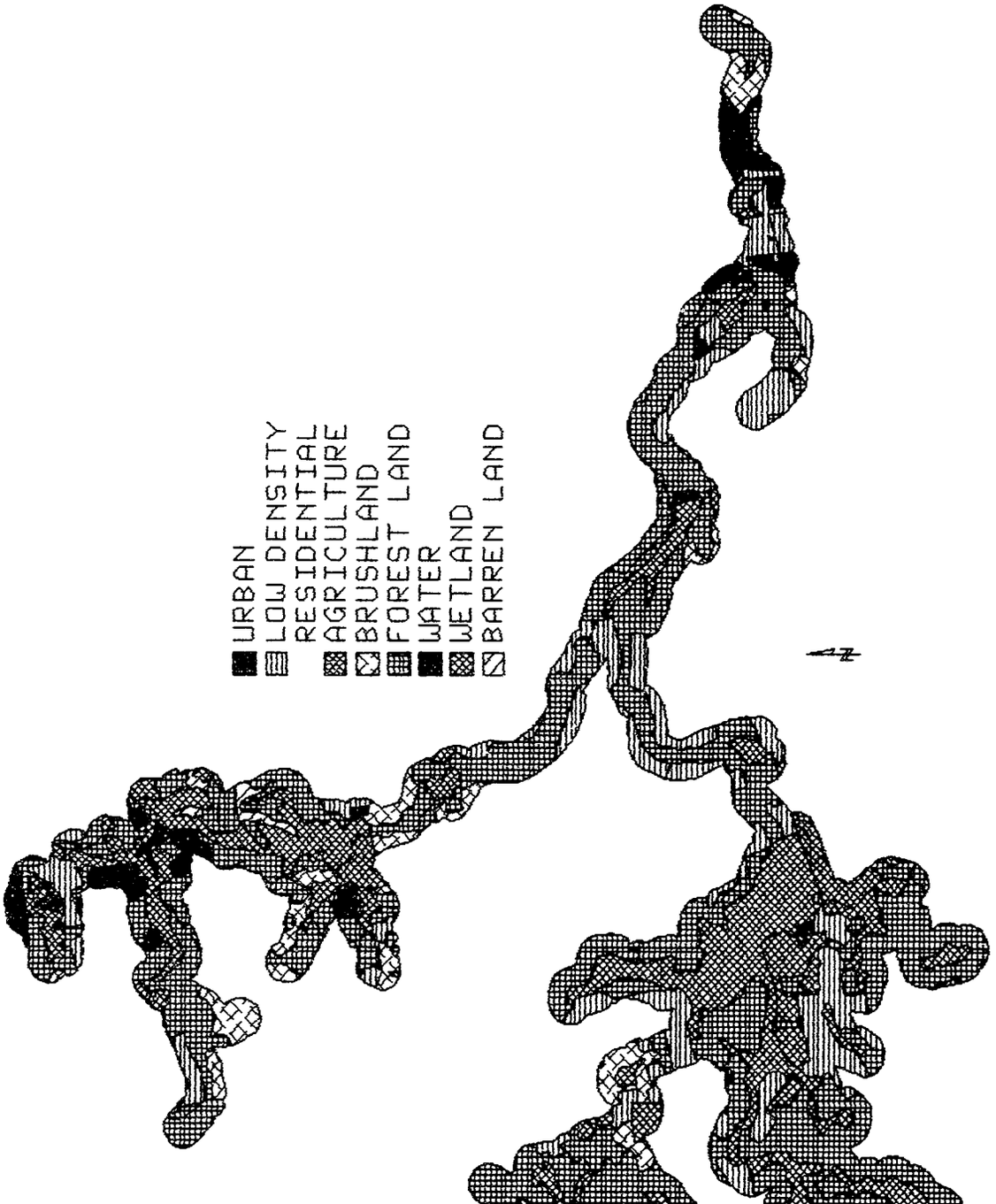

Figure 9. 100 Meter Corridor Along Each Side of Mawny-Frenchtown Brook

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

1. An ARC/INFO based geographic information system has the basic functionality to support water quality planning.

2. Land use/land cover data can be linked to the land based water quality model through use of approximations of impervious cover for various land uses.

3. Zoning is a "blueprint" or "program" for a community's future development. Zoning districts can be mapped and described in terms of minimum lot size, building to land area ratios, building height, signage, allowed material storage and screening requirements. These characteristics relate to aerial photograph image signatures and provide a basis for aggregating zoning districts on a regional level and linking these groups to various types of land use/land cover units.

4. The linkage of zoning districts to land use/land cover allows projection of future water quality impacts through increased fractions of impervious cover and higher levels of surface water runoff. This linkage allows projection of land use impacts in specified corridors adjacent to streams or over multi-community watershed areas.

5. The overall methodology described above is somewhat simplistic, however, as a tool for comparative analysis of watersheds and for generalizing future impacts from development, it appears to exhibit high merit.

4.2 Recommendations

1. Using the 1988 land use/land cover data being developed for the Office of State Planning, fund a research effort to design and implement a statistically sound project to measure impervious surfaces for the urban and residential land use classes. While the measurements we made matched well with SCS measurements, our sampling was very modest and represents the most tenuous link in the overall methodology.

2. Generate comparative levels of impervious surfaces for watersheds emptying into Narragansett Bay. Using the 1988 land use/land cover data.

3. Use the information in #3 above to emphasize the need for use of the water quality model and vegetated buffer strips for individual site developments in undeveloped areas and also use the information to consider redesigning stormwater management systems in heavily urbanized areas.

5.0 REFERENCES

Anderson, James R., Ernest E. Hardy and John T. Roach, 1972. A Land-Use Classification System for Use with Remote-Sensor Data, U.S.G.S. Circular 671.

Trolier, Laurie J. and Warren R. Phillipson, 1986. Visual Analysis of Landsart Thematic Mapper Images for Hydrologic Land Use and Cover, Photogrammetric Engineering and Remote Sensing, Vol. 52, No. 9.

U.S.D.A. Soil Conservation Service, 210-VI-TR-55, Second Edition, June 1986.

APPENDIX 6.0

6.1 Residential Densities for RI Cities and Town in 1970

RESIDENTIAL DENSITIES FOR 1978

1"=6000' Statewide Zoning Map

High – 8 or more D.U./Acre
Med/High – 4-7.9 D.U./Acre
Med – 1-3.9 D.U./Acre
Med/Low – .5-.9 D.U./Acre
Low – up to .49 D.U./Acre

City/Town	Local Symbol	Residential Zones: Lot Size (sq. ft.)	Residential Zones: Density (D.U./Acre)	State Map Classification
Barrington	AA	40,000	1.1	Med
	A	25,000	1.7	Med
Bristol	SRR	40,000	1.1	Med
	SR	20,000	2.2	Med
	LR	10,000	4.3	Med/High
	GR	6,000	7.2	Med/High
Burrillville	F2	2 acre	.5	Med/Low
	R40	1 acre	1	Med
	R20	20,000	2.2	Med
	R10	10,000	4.3	Med/High
Central Falls	R1	6,000	7.25	Med/High
	R2	5,000	8.7	High
	R3	5,000	8.7	High
Charlestown	R80	2 acre	.54	Med/Low
	R40	40,000	1.1	Med
	R20	20,000	2.2	Med
Coventry	RR	87,000	.5	Med/Low
	R20	20,000	2.2	Med
	R10	10,000	4.3	Med/High
Cranston	A80	80,000	.5	Med/Low
	A20	20,000	2.2	Med
	A12	12,000	3.6	Med
	A8	8,000	5.4	Med/High
	B1	6,000	7.25	Med/High
	B2	6,000	7.25	Med/High
Cumberland	AA	12,000	3.6	Med
	A	9,000	4.8	Med/High
	B	7,200	6	Med/High
	C	5,000	8.7	High

City/Town	Local Symbol	Residential Zones: Lot Size (sq. ft.)	Residential Zones: Density (D.U./Acre)	State Map Classification
East Greenwich	R80	87,000	.5	Med/Low
	R40	44,000	.98	Med/Low
	R30	30,000	1.4	Med
	R20	20,000	2.2	Med
	R10	10,000	4.3	Med/High
	R6	6,000	7.25	Med/High
	F1	1 Acre	1	Med
	F2	2 Acre	.5	Med/Low
East Providence	R1	18,750	2.3	Med
	R2	10,000	4.3	Med/High
	R3	7,500	5.8	Med/High
	R4	5,000	8.7	High
	R5	7,500	5.8	Med/High
	R6	5,000	8.7	High
Exeter	RU4	4 Acres	.25	Low
	RU3	3 Acres	.3	Low
	RE2	2 Acres	.5	Med/Low
Foster	RA	200,000	.21	Low
Glocester	F3	3 Acres	.3	Low
	R2	2 Acres	.5	Med/Low
Hopkinton	R	30,000	1.45	Med
Jamestown	RR	80,000	.5	Med/Low
	R40	40,000	1.1	Med
	R20	20,000	2.2	Med
	R8	8,000	5.4	Med/High
Johnston	A	10,000	4.35	Med/High
	B	7,000	6.2	Med/High
	C	5,000	8.7	High
Lincoln	RA40	40,000	1.1	Med
	RS20	20,000	2.2	Med
	RL9	9,000	4.8	Med/High
	RG7	7,000	6.2	Med/High
Little Compton	RL87	2 Acres	.5	Med/Low
Middletown	R40	40,000	1.1	Med
	R20	20,000	2.2	Med
	R10	10,000	4.35	Med/High
Narragansett	R40	40,000	1.1	Med
	R15	15,000	2.9	Med
	R10	10,000	4.35	Med/High

City/Town	Local Symbol	Residential Zones: Lot Size (sq. ft.)	Residential Zones: Density (D.U./Acre)	State Map Classification
New Shoreham	RA	80,000	.54	Med/Low
	RB	40,000	1.1	Med
	RC	20,000	2.2	Med
Newport	R160	160,000	.27	Low
	R80	80,000	.5	Med/Low
	R40	40,000	1.1	Med
	R20	20,000	2.2	Med
	R10	10,000	4.35	Med/High
	R3	3,000	14.5	High
North Kingstown	Rural	80,000	.5	Med/Low
	Res.	40,000	1.1	Med
	Village	20,000	2.2	Med
North Providence	RS	8,000	5.4	Med/High
	RL	7,000	6.2	Med/High
	RG	6,000	7.25	Med/High
North Smithfield	REA120	120,000	.36	Low
	RA65	65,000	.67	Med/Low
	RS40	40,000	1	Med
	RU20	20,000	2.2	Med
Pawtucket	RL	9,000	4.8	Med/High
	RS	5,000	8.7	High
	RT	5,000	8.7	High
	RM	5,000	8.7	High
Portsmouth	R1	16,000	2.7	Med
	R2	25,000	1.7	Med
Providence	R1	6,000	7.25	Med/High
	R2	5,000	8.7	High
	R3	5,000	8.7	High
Richmond	R80	2 Acres	.5	Med/Low
	R40	40,000	1.1	Med
Scituate	RR60	60,000	.73	Med/Low
	RS60	60,000	.73	Med/Low
Smithfield	RR	80,000	.54	Med/Low
	R30	30,000	1.4	Med
	R20	20,000	2.2	Med

City/Town	Local Symbol	Residential Zones: Lot Size (sq. ft.)	Residential Zones: Density (D.U./Acre)	State Map Classification
South Kingstown	RR80	80,000	.54	Med/Low
	R40	40,000	1.1	Med
	R30	30,000	1.4	Med
	R20	20,000	2.2	Med
	R10	10,000	4.3	Med/High
	RM	10,000	4.3	Med/High
Tiverton	R80	80,000	.54	Med/Low
	R60	60,000	.725	Med/Low
	R40	40,000	1.1	Med
	R30	30,000	1.4	Med
	R15	15,000	2.9	Med
Warren	R40	40,000	1.1	Med
	R20	20,000	2.2	Med
	R10	10,000	4.3	Med/High
	R6	6,000	7.25	Med/High
Warwick	A40	40,000	1.1	Med
	A15	15,000	2.9	Med
	A10	10,000	4.35	Med/High
	A7	7,000	6.2	Med/High
Westerly	R1WH	1 Acre	1	Med
	A1	20,000	2.2	Med
	R1	20,000	1	Med
	R2	10,000	4.35	Med/High
	R3	10,000	4.35	Med/High
West Greenwich	R2	2 Acres	.5	Med/Low
	R1	1 Acre	1	Med
West Warwick	AA	10,000	4.35	Med/High
	A	8,000	5.4	Med/High
	B	7,500	5.8	Med/High
	C	6,000	7.2	Med/High
Woonsocket	R1	10,000	4.35	Med/High
	R2	8,000	5.2	Med/High
	R3	7,000	6.2	Med/High
	R4	6,000	7.2	Med/High

6.2 Data Documentation Forms For Hunt-Potovomut

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: BASINS

Source of Data and Description of Dataset:
RECEIVED FROM URI/EDC; WATERSHED BOUNDARY

Scale of Original Dataset:
CONTACT URI/EDC

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
DR. PETER AUGUST
URI/EDC
(401)792-4794

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE_____ POLYGON__X____

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

BASINCODE - 4,4,I
ACRES - 4,12,F

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
BASINCODE	1301	URI/EDC CODE FOR HUNT-POTOWMUT BASIN
ACRES	14,696	TOTAL ACREAGE OF WATERSHED

Misc. Comments:
IEP OBTAINED HUNT-POTOWOMUT WATERSHED BOUNDARY FROM
URI/EDC IN LATE 1988.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: HLINES

Source of Data and Description of Dataset:
URI/EDC; RIVERS AND STREAMS OF HUNT-POTOWOMUT WATERSHED

Scale of Original Dataset:
CONTACT URI/EDC

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
DR. PETER AUGUST
URI/EDC
(401)792-4794

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE___X___ POLYGON_____

New Items In .PAT_____ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

Code Values for New Items:

ITEM	VALUE	DESCRIPTION

Misc. Comments:
DATA RECEIVED FROM URI/EDC.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: HPOLYS

Source of Data and Description of Dataset:
URI/EDC; WATERBODIES OF WATERSHED

Scale of Original Dataset:
CONTACT URI/EDC

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
DR. PETER AUGUST
URI/EDC
(401)792-4794

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT_____ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)
NONE

Code Values for New Items:

ITEM	VALUE	DESCRIPTION

Misc. Comments:
LAKES AND PONDS WITHIN WATERSHED SUPPLIED BY URI/EDC.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: LUSE85

Source of Data and Description of Dataset:
AERIAL PHOTOGRAPHS(3/27/85); 1985 LAND USE DATA

Scale of Original Dataset:
1 : 9,600

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
LESTER GARVIN
IEP, INC.
(508)393-8558

Contact Person for Questions on Data Automation:
ROBERT BENOIT (same as above)

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

OSP - 4,5,B,0
ACRES - 4,12,F,3
IMPCOEF - 4,5,B,2
IMPACRES - 4,12,F,3

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
OSP	varies	LAND USE CATEGORIES USING OFFIC OF STATE PLANNING CODES
ACRES	varies	TOTAL AREA OF EACH LAND USE POLYGON
IMPCOEF	varies	IMPERVIOUS SURFACE COEFFICIENTS PER LAND USE CATEGORY
IMPACRES	varies	TOTAL ACREAGE OF IMPERVIOUS SURFACE PER LAND USE POLYGON

Misc. Comments:

IMPERVIOUS SURFACE COEFFICIENTS WERE DEVELOPED FROM AREA MEASUREMENTS TAKEN FROM AERIAL PHOTOGRAPHS. THE NUMBER OF MEASUREMENTS FOR EACH LAND USE TYPE CAN BE FOUND IN THE NARRAGANSETT BAY PROJECT BY IEP ON THE HUNT-POTOWOMUT DATA BASE.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: LUSE88

Source of Data and Description of Dataset:
AERIAL PHOTOGRAPHS(4/13/88); 1988 LAND USE DATA

Scale of Original Dataset:
1 : 24,000

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
LESTER GARVIN
IEP, INC.
(508)393-8558

Contact Person for Questions on Data Automation:
ROBERT BENOIT (same as above)

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

OSP - 4,5,B,0
ACRES - 4,12,F,3
IMPCOEF - 4,5,B,2
IMPACRES - 4,12,F,3

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
OSP	varies	LAND USE CATEGORIES USING OFFIC OF STATE PLANNING CODES
ACRES	varies	TOTAL AREA OF EACH LAND USE POLYGON
IMPCOEF	varies	IMPERVIOUS SURFACE COEFFICIENTS PER LAND USE CATEGORY
IMPACRES	varies	TOTAL ACREAGE OF IMPERVIOUS SURFACE PER LAND USE POLYGON

Misc. Comments:

IMPERVIOUS SURFACE COEFFICIENTS WERE DEVELOPED FROM AREA MEASUREMENTS TAKEN FROM AERIAL PHOTOGRAPHS. THE NUMBER OF MEASUREMENTS FOR EACH LAND USE TYPE CAN BE FOUND IN THE NARRAGANSETT BAY PROJECT BY IEP ON THE HUNT-POTOWOMUT DATA BASE.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: ROADS

Source of Data and Description of Dataset:
URI/EDC; ROAD DATA FOR HUNT-POTOWOMUT WATERSHED

Scale of Original Dataset:
CONTACT URI/EDC

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
DR. PETER AUGUST
URI/EDC
(401)792-4794

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE__X____ POLYGON_____

New Items In .PAT_____ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

Code Values for New Items:

ITEM	VALUE	DESCRIPTION

Misc. Comments:
DATA RECEIVED FROM URI/EDC.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: SUB-BASINS

Source of Data and Description of Dataset:
USGS QUADRANGLES; SUB-BASIN DELINEATIONS OF HUNT-POTOWOMUT WATERSHED

Scale of Original Dataset:
1 : 24,000

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
LESTER GARVIN
IEP, INC.
(508)393-8558

Contact Person for Questions on Data Automation:
ROBERT BENOIT (same as above)

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

ACRES - 4,12,F
NAME - 12,12,C

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
ACRES	14,696(total)	SUB-BASINS ARE TOTALED INDIVIDUALLY
NAME		SUB-BASINS ARE NAMED INDIVIDUALLY

Misc. Comments:

SUB-BASIN-ID	NAME
10	MAUNY-FRENCHTOWN BROOK
15	FRY BROOK
20	NO NAME1
25	HUNT RIVER
30	SAND HILL BROOK
35	NO NAME2
40	SCRABBLETOWN BROOK

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: TOWNS

Source of Data and Description of Dataset:
URI/EDC; ROAD DATA FOR HUNT-POTOWOMUT WATERSHED

Scale of Original Dataset:
CONTACT URI/EDC

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
DR. PETER AUGUST
URI/EDC
(401)792-4794

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)
TOWN - 12,12,C

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
TOWN		TOWN NAME IN .PAT

Misc. Comments:
DATA RECEIVED FROM URI/EDC. ITEM TOWN ADDED BY IEP.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: WETLANDS

Source of Data and Description of Dataset:
AERIAL PHOTOGRAPHS(4/13/88); WETLANDS DATA

Scale of Original Dataset:
1 : 24,000

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
LESTER GARVIN
IEP, INC.
(508)393-8558

Contact Person for Questions on Data Automation:
URI/EDC

Topography: POINT_____ LINE__X____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

CODE - 3,3,I

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
CODE	1-16	WETLANDS CLASSIFICATION

Misc. Comments:

WETLAND CLASSIFICATIONS WERE SET BY URI/EDC.

DOCUMENTATION FORM FOR HUNT-POTOWOMUT WATERSHED,
RHODE ISLAND

Geographic Area: HUNT-POTOWOMUT WATERSHED

Coverage Name: ZONING

Source of Data and Description of Dataset:
ZONING DISTRICT MAPS FOR THE MUNICIPALITIES WITHIN THE WATERSHED; ZONING DATA

Scale of Original Dataset:
1 : 9,600

Contact Person for Questions on Dataset (Name, Institution, Telephone #):
LESTER GARVIN
IEP, INC.
(508)393-8558

Contact Person for Questions on Data Automation:
ROBERT BENOIT (same as above)

Topography: POINT_____ LINE_____ POLYGON___X___

New Items In .PAT___X___ .AAT_____
(give ITEM definition, e.g., USE=8,8,N,2)

ZONE - 4,5 B,0

Code Values for New Items:

ITEM	VALUE	DESCRIPTION
ZONE	varies	GENERALIZED ZONING DISTRICTS

Misc. Comments:

ZONING DISTRICTS ARE NORMALIZED BY RELATING THEIR CHARACTERISTICS TO THE O.S.P. LAND USE CATEGORIES. THIS APPROACH ELIMINATES CODING DIFFERENCES AMONG COMMUNITIES.