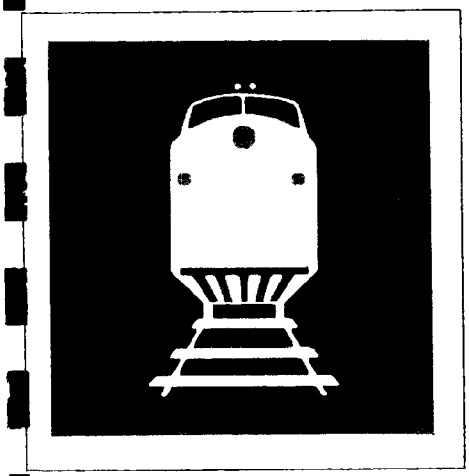

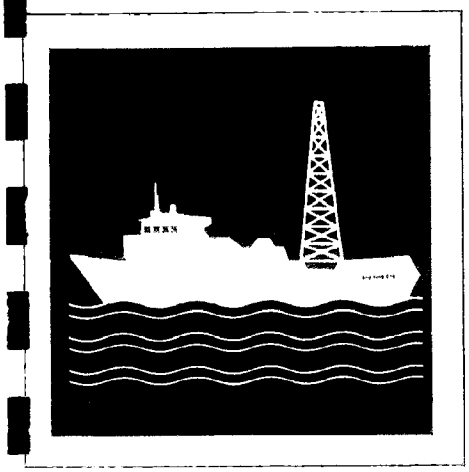

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Coastal Energy Transportation Study
Phase II, Volume 2

An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone

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Office of Coastal Management
North Carolina Department of Natural Resources
and Community Development

CEIP REPORT NO. 3
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COASTAL ENERGY TRANSPORTATION STUDY
PHASE II, VOLUME 2

AN ASSESSMENT OF POTENTIAL IMPACTS OF ENERGY-RELATED TRANSPORTATION DEVELOPMENTS ON NORTH CAROLINA'S COASTAL ZONE

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PREFACE

This report summarizes work on the second phase of a three-phase study funded by the Coastal Energy Impact Program and conducted by the UNC Institute for Transportation Research, and Education. Phase I of this study, conducted in 1980, identified and documented the transportation needs necessary to support a group of energy projects proposed for the coastal area of North Carolina.

Following a series of interviews with industry representatives, key officials in coastal counties, and various State agencies in mid-1980, major facilities were identified, energy use scenarious were developed, and transportation needs were assessed. Concurrent with these tasks, an impact assessment methodology was developed for conducting certain Phase II tasks.

The results of Phase I were documented in three reports:

1. A technical report entitled, "Coastal Energy Transportation Study: An analysis of Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone," Phase I Report, December 1980 (180 pages);

2. A summary report entitled, "Coastal Energy Transportation Study: An Analysis of Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone," March 1981 (30 pages); and

3. An executive summary report issued by the Office of Coastal Management entitled, "Special Report: First Inventory of Coastal Energy Facilities Reported," April 1981 (2 pages).

All of these reports are available from the UNC Institute for Transportation Research and Education or the Office of Coastal Management in the North Carolina Department of Natural Resources and Community Development.

Phase II (September 1980 - August 1981) is divided into two distinct parts:

1. An assessment of impacts of the Outer Continental Shelf (OCS) oil and gas exploration and production activity with emphasis on the transportation requirements and alternative locations for on-shore support base(s) in North Carolina, and

2. An assessment of impacts of coal exports from North Carolina with emphasis on the transportation requirements of alternative locations and capacities of coal terminals.

Phase III (September 1981 - August 1982) is an assessment of impacts of transport, and storage of all other energy feedstocks and products, including crude oil, refinery products, liquified petroleum gas, peat, wood, and biomass material. A more detailed analysis of coal transportation to North Carolina's ports will also be undertaken during Phase III. Other energy-related projects may be added at a later date.

This report is one of three volumes documenting the results of Phase II as described above. These three volumes are entitled:

1. Coastal Energy Transportation Study: Volume 1, A Study of OCS Onshore Support Bases and Coal Export Terminals;

2. Coastal Energy Transportation Study: Volume 2, An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone; and

3. Coastal Energy Transportation Study: Volume 3, An Analysis of State and Federal Policies Affecting Major Energy Projects in North Carolina's Coastal Zone.

Scheduling of tasks was designed to permit the study team to complete key activities in advance of certain critical dates. For example, many of the tasks related to OCS activity in Phase II have been completed so that state, regional, and local decisionmakers involved in the OCS program will have output prior to August 1981, the scheduled date for OCS Lease Sale #56 by the Bureau of Land Management.

The movement of export coal shipments through North Carolina is now underway. The contract with Alla-Ohio Coal Company to ship three million tons annually through the State Ports Authority (SPA) facilities in Morehead City was announced in October 1980; and the first shipment of export steam coal left Morehead City for Holland on May 13, 1981. Although the situation regarding the development of energy projects is constantly changing, this report is based on the most up-to-date information available at the time of printing.

An additional, parallel task of this study has been the monitoring of the situation regarding all types of energy projects in the coastal zone. The dynamics of the other projects that will be included in Phase III, as well as those of the coal exports and OCS lease sale, are of interest.

Since this research project began in January 1980, a significant amount of activity has taken place in the North Carolina coastal zone with respect to proposals for new or exchanged energy projects. These project proposals have been in response to changing economic conditions, and dynamic corporate and private investment strategies. For example, since the Phase I report was written, the following captions from Raleigh and Wilmington

newspapers reveal the "shifting attitudes" surrounding the development of the Brunswick Energy Company (BECO) refinery in Brunswick County, across the Cape Fear from Wilmington:

11/18/80	"Building Refinery"
1/04/81	"Refinery, Smelter Debated"
1/28/81	"U.S., Agency Not Taking Stand on Refinery"
2/22/81	"BECO, Environmentalists at Odds"
3/08/81	"Low Demand (for petroleum products) Closing Refineries"
4/28/81	"BECO to 'Re-evaluate' Brunswick Co. Refinery"
4/29/81	"BECO May Consider Selling Refinery Project"
5/15/81	"BECO Drops Plans to Build Oil Refinery"

Continued monitoring of the local, state, national, and international situations that affect the potential of energy developments in North Carolina will be continued throughout this study.

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ABSTRACT

In an earlier study (Phase I) potential methodologies were identified to assess the possible impacts of the transportation facilities necessary to support the development of major energy projects for the coastal area of North Carolina. This study concentrates on two projects: (1) on-shore support bases for Outer Continental Shelf (OCS) oil and gas exploration and (2) coal export terminals.

In order to examine the impacts of the proposed development, three OCS-coal exporting siting counties (Brunswick, Carteret, and New Hanover) and eight transportation counties (Beaufort, Bladen, Columbus, Craven, Duplin, Lenoir, Pender, and Pitt) were identified. Baseline data describing the economic, social-demographic are provided. Additional baseline data are provided for five peat counties (Dare, Hyde, Pamlico, Tyrrell, and Washington).

The examination of the potential impacts of locating temporary OCS support bases assumes two alternative scenarios - a low resource estimate and a high resource estimate. Given these scenarios, economic, social-demographic, recreational, environmental, and fiscal impacts for Brunswick, Carteret, and New Hanover Counties are developed.

The examination of potential impacts of locating coal exporting terminals assumes the development scenarios announced by the respective coal companies for the Morehead City area and the New Hanover-Brunswick County area. Given the proposed coal tonnage, estimates of rail and ship traffic are used to identify economic, social-demographic, recreational, environmental, and fiscal impacts for terminal siting counties and the rail transportation corridor counties.

SUMMARY AND CONCLUSIONS

"Volume 2, An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone," addresses two major projects:

1. Impacts of Outer Continental Shelf (OCS) oil and gas exploration activity; and

2. Impacts of coal export movement from North Carolina.

Following an assessment of baseline economic, social-demographic, recreational, environmental, and fiscal conditions in three OCS-coal exporting siting counties, eight transportation corridor counties, and five peat counties, separate assessments were made for potential impacts from Temporary OCS support bases and coal exporting terminals respectively.

Impacts of Temporary OCS Support Bases

Potential locations for temporary OCS support bases were identified for Carteret and New Hanover Counties which will be required for the 1984 through 1988 time period. Two development scenarios based on low resource estimates and high resource estimates of OCS oil and gas exploration are used to identify potential impacts.

Economic impacts will result from direct, indirect, and induced employment related to exploration. An estimated 1,100 jobs will be created between 1984 and 1988. Estimates indicate that between 45 percent and 75 percent of the jobs will be filled locally. Given the present employment patterns in Carteret and New Hanover Counties, the potential for new local employment may be mitigated by workers who presently are employed in other counties taking jobs in their home counties. Additionally the latter fact would lessen the potential for in-migration and population growth due to development. That jobs in OCS related activity pay higher than prevailing wages in the siting counties will improve economic conditions in Carteret and New Hanover Counties.

Initial estimates indicate that because the recommended sites for OCS temporary support bases make use of existing facilities, recreational, environmental, land use, and fiscal impacts will be minimal during the exploratory phase of OCS development.

Impacts of Coal Exporting Terminals

Seven corporations have proposed the development of coal exporting facilities for coastal North Carolina. The range of possible coal exports extends from the three million tons at the currently operating Alla-Ohio Valley facility to approximately 80 million tons if all proposed facilities became operational. The impact analyses used projected coal-export figures

from the respective corporations to estimate the railroad and ship traffic demand associated with the proposed sites (Table 34).

Coal export facilities tend to be capital intensive. Although there presently is little empirical evidence about the magnitude of new direct and indirect employment related to the operation of a coal port,income generated will be significant. The major impact will be from the railroad activity to the port and ship traffic from the port. If all Carteret County projects were fully developed, an estimated 24 trains per day and 500 ships per year would be needed to move the coal. Figures for the Brunswick-New Hanover County area would be approximately 40 trains per day and 800 ships per year.

The impacts on the transportation infrastructures of the respective communities are directly related to the historical development of those transportation systems. The pace of development and community reaction to that development will be directly related to attempts to deal with transportation problems of coal exporting. The solution of these transportation problems will have important implications for the future growth of the communities' employment sectors.

Given the preceeding, a list of recommendations relevant to the development of coal exporting facilities would include:

Morehead City Sites

1. No additional coal terminals should be approved in the Morehead City harbor until major changes are implemented in the land transportation link for coal inbound to the port. A rail bypass around Morehead City, a conveyor system, or barge service should be investigated for this purpose.

2. If increases in throughput tonnage at the currently operating or planned sites (Alla-Ohio C-16) and (Gulf Interstate C-12) are to increase significantly, an off-loading/ground storage terminal should be developed at the junction of US 70 and NC 24 (Site C-14), with either an overhead conveyor system, pneumatic pipeline system or similar technology (not a slurry pipeline) being used to move the coal to the harbor to eliminate at-grade rail crossing conflicts.

Cape Fear River Sites

3. No coal terminals should be sited on the east side of the Cape Fear River because of the railroad grade crossing problems in Wilmington.

4. Site C-5 should be given priority in consideration for the development of a coal terminal on the west side of the Cape Fear River, this being the least environmentally damaging site.

Other Considerations

5. All sites developed should use enclosed storage of stockpiled coal (silos, bins, etc.) to minimize the particulate and coal dust emissions, and to minimize coal-water interactions from precipitation and runoff.

6. All transport operations should use enclosed systems (conveyors, tubes, chutes) with suitable dust suppression technology, such as water or chemical sprays, used at all transfer points.

7. A separate stormwater collection system for the entire terminal site should be provided, with sufficient capacity to handle all runoff and waste streams (dust suppression and wash down). This collected wastewater should be adequately treated to remove pollutants prior to discharge. Reuse and recycling of this wastewater for non-potable usage is recommended.

8. Sufficient land should be available to allow for on-site treatment facilities (air and/or water) and adequate buffer space to minimize noise and aesthetic interference in the surrounding communities.

9. Identify and monitor alternative technologies for the operation of coal export facilities with emphasis on their economic and environmental impacts. The immediate emphasis should be placed on the employment patterns at the Alla-Ohio Valley project in Morehead City.

10. Identify alternative technologies and routes for transporting coal to terminal sites. The immediate emphasis should be on monitoring the impacts of coal trains operating through New Bern and Morehead City.

11. Identify the environmental impacts of increased ship traffic at proposed site and its effects on commercial fishing and recreational activity.

12. Identify more clearly the elements of the recreational sector of local economies to provide a more complete knowledge base for predicting the recreational impacts of development.

13. Monitor community response to the development of proposed development of coal export facilities. One method of doing this would include a community survey.

1.0 INTRODUCTION

In Phase II of the Coastal Energy Transportation Study, the impacts of alternative transportation modes for Outer Continental Shelf (OCS) oil and gas activity and coal exporting are examined. OCS oil and gas exploration and coal exporting are defined in terms of their respective transportation requirements and the effects those transportation needs will have on the present and future coastal transportation systems. A detailed discussion of the coastal transportation systems can be found in the Phase I Report of the Coastal Energy Transportation Study (ITRE, 1980). Discussion of the site and transportation requirements required for temporary support bases for OCS oil and gas exploration and coal export terminals can be found in CEIP Report 2, Report of the Coastal Energy Transportation Study: "An Analysis of Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone" (ITRE, 1981a).

In this report, transportation requirements for the respective energy activities are examined for their economic, social-demographic, environmental, recreational, fiscal, and land use impacts. Impacts are defined as consequences of the development of temporary OCS support bases and coal export terminals. Both primary and secondary development are addressed.

Primary (or direct) development refers to activity specific to the construction and operation of an OCS support base and coal export terminal. Secondary development refers to demands created by the primary activity and includes indirect development and induced development. Secondary indirect development includes industrial projects that serve and support the primary activity. Secondary induced development refers to the expansion of community services and facilities to serve the population attracted through primary and indirect secondary development.

There are four remaining chapters in this report: (1) the identification of the geographical area affected by OCS oil and gas support bases and coal export terminals; (2) the description of the context of development within the impact area; (3) the impacts of alternative sites for temporary support bases of OCS exploration; and (4) the impacts of alternative sites for coal export terminals.

2.0 IDENTIFICATION OF IMPACT AREA

2.1 Criteria for Defining the Impact Area

The Impact area for OCS activity and coal exporting is geographically defined. Criteria used for defining the affected area include: (1) the specific sites for temporary OCS support bases and coal export terminals; (2) the nature of the transportation activity associated with OCS and coal facilities; and (3) the geographical unit of analysis to be used in assessing the impacts of the respective activities.

When OCS oil and gas activity and coal exporting are viewed in terms of their transportation requirements, there exists a key facility which represents the primary node in the respective transportation systems. For OCS activity the site of the temporary support base is that primary node. For coal exporting, the port terminal represents the primary node. These activity nodes serve to define the center of the primary geographical impact area.

The nature of the transportation activity associated with OCS activity and coal exporting serves to define the extent of the geographical area of impact. Although both transportation activities extend inland and seaward, there are qualitative differences in the transportation activity for OCS exploration and for coal export. The primary transportation emphasis in OCS oil and gas exploration is the movement between the onshore support base and drilling sites. In contrast, for coal activity, there is an equal emphasis between the inland transportation of coal to the port and the movement from the port seaward.

The geographical area of impact for the proposed OCS support bases will extend from the specific site seaward. The geographical area of impact for the coal export terminals will include the transportation corridors that move the coal to the port and the transportation corridors that move the coal seaward.

The principal geographical unit of analysis used to assess impacts is the county. The county is the reporting unit for relevant data which is generally available. Data for municipalities within impacted counties will be used when available, especially for municipalities which are directly affected by OCS or coal transportation activity.

2.2 Definition of the Geographical Impact Areas

Although the coastal study area includes the 27 counties identified in CEIP Report 1 (ITRE, 1980:6), the data presented in this report are limited to 16 counties.[1] Using criteria discussed in Section 2.1, the

---

[1]Counties in the study area not included in this report are Bertie, Camden, Chowan, Currituck, Gates, Hertford, Jones, Martin, Onslow, Pasquotank, and Perquimans.

16 counties are included because: (1) they contain a proposed temporary OCS support base site, and/or coal export terminal site, (2) they are part of a transportation corridor for moving coal to a terminal site, or (3) they contain peat mining and use sites.

As seen in Table 1, there is considerable overlap between counties for the proposed OCS support bases and coal export terminals in the siting areas of Brunswick and New Hanover Counties and in Carteret County.

The transportation corridors for the shipment of coal to the port are delimited by existing rail services. There are two rail corridors for each siting area. Pender and Duplin Counties represent the first rail corridor for coal exporting sites in Brunswick and New Hanover Counties, and Columbus and Bladen Counties represent the second.

Two rail corridors serve the Carteret County coal export terminal sites. They follow the same rail route through Carteret and Craven Counties, and split into two routes extending northwest from Craven County. One route moves west through Lenoir County while the second moves north and west through Beaufort and Pitt Counties.

For the purposes of analysis, a distinction will be made between OCS support base and coal export terminal siting counties, transportation corridor counties, and peat mining counties.

TABLE 1. COASTAL STUDY AREA COUNTIES IMPACTED BY OCS SUPPORT BASES, RAIL TRANSPORTATION AND PEAT MINING

OCS-Coal Export Counties	Peat Mining Counties
Brunswick	Dare
Carteret	Hyde
New Hanover	Pamlico
	Tyrrell
Transportation Corridor Counties	Washington
Beaufort	Duplin
Bladen	Lenoir
Columbus	Pender
Craven	Pitt

3.0 THE CONTEXT OF DEVELOPMENT

3.1 Introduction

Impact assessment of the development of temporary OCS support bases and coal export terminals must take into account the context of development. Specifically, trends and present conditions are identified for each of the 11 counties which may be impacted by siting and/or rail transportation. This section provides an overview of the economic, social-demographic, environmental, recreational, fiscal, and land use conditions. A distinction is made between the three OCS-coal export siting counties and the seven rail transportation counties. The main emphasis will be on Brunswick, Carteret, and New Hanover Counties which contain the proposed sites identified in CEIP Report 2 (ITRE, 1981a) for the temporary OCS support base and coal export terminals. Data for the five peat mining counties are included for comparative purposes.

The characterization of the context of development depends on the most recent data for each of the variables identified in Part B of the Phase I Report, Coastal Energy Transportation Study (ITRE, 1980). The extent to which the characterization of the economic and social-demographic context of the study area is limited by the unavailability of the 1980 U.S. Census data will be discussed in the appropriate sections.

3.2 The Economic Context

3.2.1 General

The economic context of development is described. The focus of the economic development is placed on the size and composition of the labor force, how employment and income are changing, and the geographical patterns of employment. The economic sectors of commercial fishing and agriculture are described in some detail. The economic dimensions of recreation are discussed in Section 3.5.

Although employment in fishing and agriculture remains economically significant, particularly in terms of income, the composition of the labor force in the 11 county study area is shifting toward employment in the industrial and service sectors. The shift toward industrial and service employment has been coupled with increased commuting to work in adjacent counties. The income levels in the 16 counties, with the exception of New Hanover County, are below the income levels of the state. The lower income levels for the 16 counties are related to the types of available jobs.

3.2.2 Labor Force Composition

An important indicator of a local economy is the composition of the labor force. As seen in Table 2, the composition of the employed labor

force underwent dramatic changes between 1960 and 1980. The shift away from the agriculture, forestry, and fisheries category to other industrial categories was significant. The shift was dramatic in terms of both absolute numbers and relative proportions of the labor force.

The most consistent gains in employment were in the area of government. The growth in government employment reflects increases in county and municipal employment. The other occupational category which showed consistent gains in all counties was manufacturing employment. Generally, two types of counties showed the greatest gains in manufacturing employment: counties with large or medium sized cities and counties immediately adjacent to urbanized counties.

An important qualification must be placed on the interpretation of growth in employment in specific industrial categories. The data in Table 2 reports industrial categories for residents of the respective counties and does not imply that workers actually have jobs in their county of residence. Although the journey to work will be dealt with specifically later in this section, it must be noted that this pattern of working outside the county of residence has important consequences in assessing the impact of economic development on local communities.

Although the availability of the 1980 census data will provide information on whether labor force trends in the 1970's were similar to those for the 1960's, data on the patterns of economic development during the 1970's are available through the North Carolina Employment Securities Commission's estimates of total employment and nonagricultural wage and salary employment by county of residence and industrial employment by county of work. Industrial employment is broken down into manufacturing and nonmanufacturing employment.

The data provide several points of information: (1) the change in the total labor force of the residents of respective counties, (2) the change in the total nonagricultural wage and salary labor force of residents in the respective counties, (3) the change in industrial employment located in the respective counties, (4) the change in the relative importance of manufacturing and nonmanufacturing employment within the respective counties, and (5) an estimate of whether the respective counties are net importers or exporters of workers. Although the discussion focuses on the primary impact counties, data is provided for all 11 counties.

All counties experienced growth in total employment and total nonagricultural wage and salary employment during the 1970's, as well as increased industrial jobs located in each county. There were changes in the relative amount of employment in the manufacturing and nonmanufacturing segments of the industrial sector. The proportion of manufacturing jobs declined from 23 percent in 1970 to 19 percent in 1979 in Carteret County. In New Hanover County, the proportion of manufacturing jobs declined from 30 percent in 1970 to 24 percent in 1979. In Brunswick County the pattern

TABLE 2. EMPLOYMENT SUMMARY BY INDUSTRY GROUPS BY COUNTY, 1960, 1970

	Brunswick		Carteret		New Hanover		Beaufort	
	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %
Total Employed	5,417	7,828	8,068	11,225	25,935	32,750	11,061	13,183
Agriculture, Forestry, Fisheries	22.1	6.4	11.7	6.5	3.1	1.6	26.9	12.6
Construction	11.7	14.7	8.9	6.9	7.2	8.3	6.4	8.3
Manufacturing	21.2	25.9	10.3	14.4	20.2	25.6	16.7	24.0
Transportation Communication Utilities	6.6	9.7	4.6	5.0	12.3	8.9	4.0	8.9
Wholesale Trade/ Retail Trade	14.9	17.7	23.0	23.2	22.1	21.3	19.2	20.5
Services	---	6.1	---	9.0	---	10.6	---	8.4
Education	2.8	5.9	4.2	5.8	4.5	6.0	4.5	6.1
Government	4.8	16.6	17.1	29.4	4.3	12.8	2.9	13.6

Source: U.S. Census of Population, 1960 General Social and Economic Characteristics, North Carolina Table 85, 1960. U.S. Census of Population, 1970, General Social and Economic Characteristics, Table 123.

Table 2
Continued

	Bladen		Columbus		Craven		Duplin	
	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %
Total Employed	8,073	9,069	15,570	16,205	14,999	17,395	13,259	14,290
Agriculture, Forestry, Fisheries	30.5	13.7	40.6	18.9	15.9	6.0	44.6	20.6
Construction	5.8	10.4	4.8	7.5	6.4	6.8	6.7	7.9
Manufacturing	27.1	32.8	17.3	27.9	16.2	17.9	12.1	26.7
Transportation, Communication, Utilities	2.3	3.0	2.6	3.0	4.6	6.2	1.4	2.8
Wholesale Trade/ Retail Trade	14.5	16.8	14.4	17.0	19.3	21.6	13.7	16.7
Services	---	7.9	---	7.9	---	8.2	---	7.6
Education	4.4	6.0	4.5	7.3	3.8	7.9	4.5	6.3
Government	2.6	13.5	2.0	12.7	13.0	28.9	3.2	14.3

Table 2
Continued

	Lenoir		Pender		Pitt		Dare	
	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %
Total Employed	18,016	20,459	5,850	6,354	22,353	27,079	1,772	2,333
Agriculture, Forestry, Fisheries	21.6	11.0	36.1	14.0	29.1	15.0	15.8	7.8
Construction	7.6	10.2	6.3	9.5	5.6	7.4	13.2	13.5
Manufacturing	17.9	23.6	17.6	27.9	13.9	17.8	5.6	5.7
Transportation, Communication, Utilities	2.9	5.9	2.3	4.2	2.8	3.9	9.7	6.8
Wholesale Trade/ Retail Trade	18.9	18.9	13.3	16.2	18.6	21.9	17.8	29.0
Services	---	9.2	---	7.8	---	8.4	---	13.9
Education	6.6	7.9	4.7	5.0	8.0	12.1	3.8	3.6
Government	3.3	16.9	5.4	19.2	2.2	19.2	9.4	22.1

Table 2
Continued

	Hyde		Pamlico		Tyrrell		Washington	
	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %	1960 %	1970 %
Total Employed	1,686	1,699	2,881	2,963	1,354	1,220	4,088	4,679
Agriculture, Forestry, Fisheries	44.7	26.0	30.3	13.2	27.7	18.4	16.9	9.8
Construction	5.3	10.0	4.8	7.3	6.7	11.7	3.8	5.9
Manufacturing	10.3	17.4	15.8	20.5	20.0	19.9	17.2	42.4
Transportation, Communication, Utilities	3.3	4.5	4.2	5.6	3.1	1.9	2.2	2.2
Wholesale Trade/ Retail Trade	13.0	13.5	18.6	18.0	16.5	16.7	15.8	13.9
Services	---	6.8	---	6.4	---	8.0	---	8.5
Education	5.1	10.1	4.5	6.0	7.0	10.3	3.1	5.8
Government	4.4	25.1	10.7	24.5	2.0	18.4	3.4	13.0

TABLE 3. TOTAL EMPLOYMENT, NONAGRICULTURAL WAGE, AND SALARY EMPLOYMENT AND INDUSTRIAL EMPLOYMENT BY COUNTY 1970, 1975, 1979

	Brunswick			Carteret			New Hanover		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Total employment[a]	10,810	12,740	14,630	11,610	12,490	13,940	32,220	38,080	43,690
Nonagric. wage/salary[b] employment	9,150	10,690	12,400	9,610	10,350	11,490	26,580	32,310	37,190
Industrial employment[c]	5,130	8,830	10,970	7,020	8,440	10,710	32,350	36,520	43,580
Manufacturing	1,690	3,320	3,320	1,610	1,740	2,070	9,830	9,710	10,480
Non-manufacturing	3,440	5,510	7,650	5,410	6,700	8,640	22,520	26,810	33,100

a. Total employment is by "county of residence."
b. Nonagricultural wage/salary employment is by "county of residence."
c. Industrial employment is by "county of work."

	Beaufort			Bladen			Columbus		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Total employment[a]	14,640	16,940	18,100	9,630	10,170	11,890	18,500	19,600	19,830
Nonagric. wage/salary[b] employment	10,400	12,750	14,050	7,020	7,680	9,560	12,130	13,510	14,560
Industrial employment[c]	10,460	12,860	14,820	5,250	5,790	7,510	11,210	12,610	14,170
Manufacturing	3,750	3,920	5,200	2,390	2,430	3,540	4,820	4,460	5,670
Non-manufacturing	6,710	8,940	9,620	2,860	3,360	3,970	6,390	8,150	8,500

Table 3
Continued

	Craven			Duplin			Lenoir		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Total employment[a]	19,180	22,780	25,430	15,750	16,010	16,270	22,890	25,980	26,710
Nonagric. wage/salary[b] employment	15,580	19,170	21,810	9,900	10,530	11,570	16,610	19,650	20,890
Industrial employment[c]	17,260	19,700	22,870	8,320	8,900	10,310	19,350	23,030	25,740
Manufacturing	2,800	3,060	4,290	3,720	3,820	4,320	7,280	8,670	9,090
Non-manufacturing	14,460	16,640	18,580	4,600	5,080	5,990	12,070	14,360	16,650

	Pender			Pitt			Dare		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Total employment[a]	6,500	6,230	8,380	30,690	35,910	40,690	2,790	4,260	6,020
Nonagric. wage/salary[b] employment	4,960	4,840	7,110	21,310	26,390	31,540	2,020	3,150	4,450
Industrial employment[c]	1,590	2,450	3,640	20,430	25,350	32,580	2,000	3,170	4,700
Manufacturing	580	290	710	5,150	6,520	7,450	50	140	140
Non-manufacturing	1,010	2,160	2,930	15,280	18,830	25,130	1,950	3,030	4,560

Table 3
Continued

	Hyde			Pamlico			Tyrrell		
	1970	1975	1979	1970	1975	1979	1970	1975	1979
Total employment[a]	1,820	2,120	2,520	2,760	3,380	3,770	1,260	1,640	1,230
Nonagric. wage/salary[b] employment	1,090	1,370	1,750	2,160	2,740	3,170	880	1,250	870
Industrial employment[c]	750	950	1,280	1,160	1,510	1,850	590	840	630
Manufacturing	170	140	180	400	270	420	170	200	200
Non-manufacturing	580	810	1,100	760	1,240	1,430	420	640	430

	Washington		
	1970	1975	1979
Total employment[a]	5,150	6,270	6,290
Nonagric. wage/salary[b] employment	4,130	5,250	5,300
Industrial employment[c]	2,090	2,590	3,160
Manufacturing	400	500	560
Non-manufacturing	1,690	2,090	2,600

Source: N.C. Department of Commerce, Employment Security Commission, North Carolina Labor Force Estimates by County, Area and State.

showed an increase in manufacturing jobs from 30 percent in 1970 to 38 percent in 1975 and then declined to 30 percent in 1979.

The data also allow an estimate of whether the respective counties are net importers or exporters of workers by comparing the number of county residents employed in nonagricultural wage and salary jobs and the total number of industrial jobs. If the number of industrial employees in a county is less than the number of county residents in wage and salary employment then the county is a net exporter of workers. Of the OCS-coal exporting counties, Brunswick and Carteret are net exporters of workers. If the number of industrial jobs is greater than wage and salary employment of residents then the county is a net importer of workers. Of the OCS-coal exporting counties, New Hanover is a net importer of workers. The implications of a county's being a net importer or exporter of workers and additional data on workers' commuting patterns are provided in Section 3.2.3.

Additional information on the changes in one sector of the economy, manufacturing industries, is provided by the North Carolina Department of Commerce's data on investments, payroll and number of employees in new, proposed, and expanded manufacturing industries. The data for 1971 through 1977 are shown in Table 4. The figures must be interpreted carefully because proposed development is included and such projects may or may not actually be developed. Examples exemplifying this caution are the BECO refinery in Brunswick County and the aluminum smelter operation in Columbus County.

In the OCS-coal exporting counties, the balance between investment, payroll, expansion, and new employment is roughly proportionate, with the exception of Brunswick County which had proposed far greater investment in new manufacturing industry. This figure represents the BECO refinery for which plans have recently been dropped. In total the figures represent a continuing trend of expansion of manufacturing industry in coastal North Carolina in general and the 16 county study area in particular.

3.2.3 Journey To Work

An important element in understanding the local economy, especially in nonmetropolitan areas, is the journey to work, i.e., the relationship between the place of work and the place of residence. Empirical research has revealed the phenomenon of "economic leakage" in nonmetropolitan areas (Scott and Summers, 1974). A community trying to attract industry assumes that the economic benefits of growth will stay within the community. However, a community is not a closed, self-sustaining unit. Workers may commute from adjoining areas and spend their earnings in their home communities.

To assess the possibility of economic leakage, census data is used to provide information on workers who are employed outside their county of residence. As seen in Table 5, counties with medium-sized or large cities are least likely to have workers employed outside their county of residence. Additionally, the least urbanized counties are most likely

TABLE 4. INVESTMENTS, PAYROLL, AND NUMBER OF EMPLOYEES IN NEW AND PROPOSED, AND EXPANDED MANUFACTURING INDUSTRIES BY COUNTY, CUMULATIVE TOTALS 1971 THROUGH 1977.

	Investment (000's)		Payroll (000's)		Employees	
	New	Expanded	New	Expanded	New	Expanded
Siting Counties						
Brunswick	$144,515	$ 450	$ 3,787	$ 4,663	393	567
Carteret	3,570	2,935	3,342	2,617	495	490
New Hanover	79,198	62,043	7,707	8,610	926	964
Transportation Counties						
Beaufort	4,343	168,102	4,143	6,175	846	797
Bladen	4,247	2,721	3,484	2,113	753	405
Columbus	20,099	246,216	6,250	5,964	1,066	671
Craven	34,450	17,768	4,212	1,162	744	164
Duplin	12,388	12,570	3,963	499	715	79
Lenoir	12,243	88,674	8,160	11,852	1,397	1,438
Pender	490	390	1,011	159	165	27
Pitt	53,866	17,881	10,061	5,174	1,636	902
Peat Counties						
Dare	---	215	---	109	---	15
Hyde	400	---	154	---	27	---
Pamlico	40	230	116	314	35	73
Tyrrell	---	---	---	---	---	---
Washington	---	380	---	680	---	120

Source: N.C. Department of Commerce, Industrial Development Division.

TABLE 5. PERCENTAGE OF WORKERS EMPLOYED OUTSIDE COUNTY OF RESIDENCE, 1960, 1970.

	1960	1970
OCS-Coal Exporting Counties		
Brunswick	24.9	29.6
Carteret	17.2	26.2
New Hanover	5.7	6.7
Transportation Counties		
Beaufort	8.0	9.2
Bladen	14.3	25.4
Columbus	5.7	14.4
Craven	5.4	8.3
Duplin	11.5	17.9
Lenoir	7.0	9.2
Pender	26.8	40.3
Pitt	8.1	9.8
Peat Counties		
Dare	4.0	3.2
Hyde	5.6	12.8
Pamlico	35.7	45.6
Tyrrell	8.9	19.7
Washington	25.3	36.1
North Carolina	10.5	14.3

Sources: U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1972, Table 2.

U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1962, Table 2.

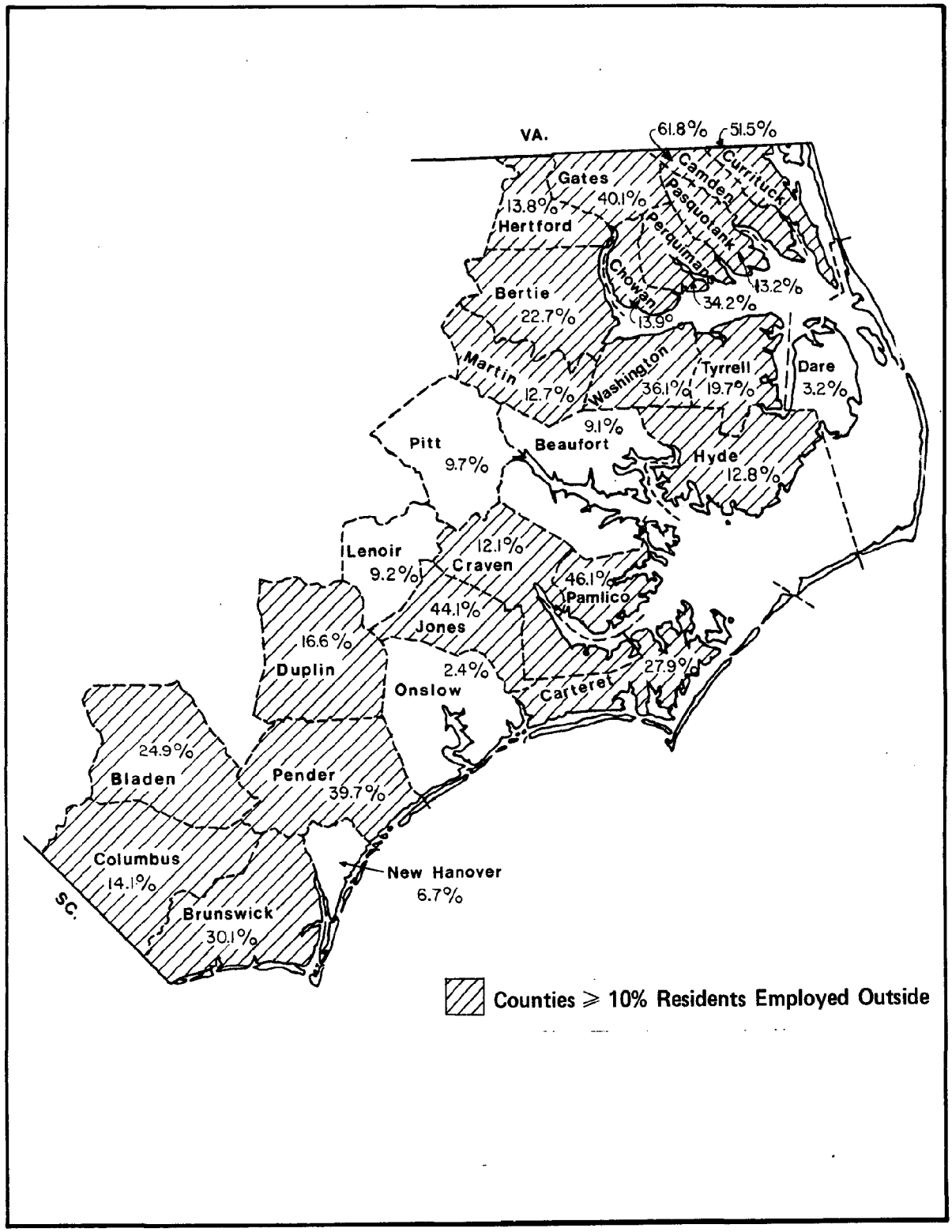

Figure 1. Percentage of Employed Working Outside County of Residence, 1970.

to have experienced an increase during the 1960's in the percentage of workers who were employed outside their county of residence.

Data on the journey to work helps explain the changes in the labor force composition of the respective counties during the 1960's (See Table 2). The shift away from agriculture is explained by increased commuting to adjacent counties for jobs. For example, Brunswick, Bladen, and Columbus Counties, which are adjacent to the Wilmington metropolitan area, all showed increases in workers going to another county for employment, while the proportion of workers in New Hanover County going to another county for a job stayed relatively constant for the decade.

The availability of 1980 census data will indicate whether the commuting patterns have decreased, increased, or remained stable. The important implication of this data on journey to work is that new jobs created may not be filled by the unemployed but rather employed workers who leave jobs away from their home community and take the new jobs.

3.2.4 Income and Poverty

Measures of income are important indices of the economic well being of a community. The income variables used are median family income data from the decennial census and per capita personal income estimates from the U.S. Department of Commerce's (USDOC) Bureau of Economic Analysis.

Data on median family income and the percentage of families with incomes below the poverty line is shown in Table 6. Median income shows a positive correlation to the level of urbanization in each county. Only the median income value for New Hanover County is above the North Carolina median income figure. The median income figures are reflected in proportion of families with incomes below the poverty line in 1970. All of the counties except New Hanover were above the state mean percentage of families below the poverty line.

Trends in median family income observed in the 1960's reflect the changing composition of the labor force in the counties during this time period. The counties with the largest shifts away from agricultural employment showed the largest gains in median family income as measured by the ratio of the county average to the state average. For example, the median family income for Brunswick County was 67 percent of the state figure in 1960 and 82 percent of the state figure for 1970. With the availability of the 1980 figures, the trends in median income for the 1970's can be compared with those for the 1960's.

Per capita personal income estimates developed by the Bureau of Economic Analysis provide an estimate of income trends during the 1970's. As seen in Table 7, the per capita income figures are below the state values with the exception of New Hanover County. Again, per capita income is positively related to urbanization and the labor force composition.

TABLE 6. MEDIAN FAMILY INCOME AND PERCENT OF FAMILIES BELOW POVERTY LINE BY COUNTY 1960, 1970

	1960		1970	
	Median Family Income	% of Families Below Poverty Line	Median Family Income	% of Families Below Poverty Line
OCS-Coal Exporting Counties				
Brunswick	$2,678	N.A.	$6,409	23.0
Carteret	4,058	N.A.	7,155	16.6
New Hanover	4,336	N.A.	8,269	14.4
Transportation Counties				
Beaufort	$2,409	N.A.	$6,434	25.0
Bladen	2,446	N.A.	5,546	30.7
Columbus	2,572	N.A.	5,845	28.0
Craven	3,708	N.A.	7,033	19.1
Duplin	2,151	N.A.	5,706	29.0
Lenoir	3,248	N.A.	6,985	23.8
Pender	2,376	N.A.	5,390	28.8
Pitt	2,675	N.A.	6,447	27.1
Peat Counties				
Dare	$3,226	N.A.	$6,536	13.3
Hyde	1,979	N.A.	4,430	33.5
Pamlico	2,851	N.A.	5,761	27.6
Tyrrell	1,927	N.A.	4,307	37.9
Washington	3,495	N.A.	7,152	23.7
North Carolina	$3,956	N.A.	$7,770	16.5

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

TABLE 7. PER CAPITA PERSONAL INCOME, 1970, 1975, 1977

	1970	1975	1977
OCS-Coal Exporting Counties			
Brunswick	$2,358	$3,483	$4,259
Carteret	2,624	4,292	5,030
New Hanover	3,363	5,030	6,074
Transportation Counties			
Beaufort	$2,693	$4,421	$5,268
Bladen	2,276	3,619	4,051
Columbus	2,412	3,879	4,349
Craven	3,048	4,685	4,806
Duplin	2,611	4,662	4,801
Lenoir	3,897	4,791	5,618
Pender	2,376	3,714	4,113
Pitt	2,786	4,570	5,428
Peat Counties			
Dare	$2,730	$4,685	$5,387
Hyde	2,204	3,612	3,901
Pamlico	2,176	4,005	4,588
Tyrrell	2,046	3,589	4,358
Washington	2,710	4,096	4,946
North Carolina	$3,200	$4,940	$5,916

Source: Local Area Personal Income, South East Region, U.S. Department of Commerce, Bureau of Economic Analysis.

TABLE 8. AVERAGE PERCENTAGE UNEMPLOYED, 1970, 1975, 1979

	1970	1975	1979
OCS-Coal Exporting Counties			
Brunswick	3.9	9.8	7.3
Carteret	5.1	7.8	6.6
New Hanover	4.1	8.4	6.0
Transportation Counties			
Beaufort	4.5	6.4	4.8
Bladen	6.4	14.1	6.2
Columbus	5.5	11.1	6.6
Craven	5.5	6.5	4.3
Duplin	4.5	9.2	5.4
Lenoir	4.5	6.9	5.1
Pender	6.6	13.2	6.3
Pitt	5.8	6.9	5.4
Peat Counties			
Dare	4.8	5.5	5.3
Hyde	8.1	6.2	6.0
Pamlico	8.9	9.9	5.3
Tyrrell	9.4	10.9	11.5
Washington	6.0	7.5	5.0
North Carolina	4.3	8.6	4.8

Source: N.C. Department of Commerce, Employment Security Commission, Labor Force Estimates.

3.2.5 Unemployment

The standard measure of a community's economic well being is it's unemployment rate. As seen in Table 8, unemployment varied considerably over the decade with 1975 being the peak year for unemployment in North Carolina. The variance in the unemployment rate among the 11 counties was greatest in 1975. Interestingly, counties with small cities, i.e., Beaufort, Craven, Lenoir, and Pitt, had the lowest unemployment rates for 1975. The explanation for lower unemployment rates depends on the industry mix within a county and how recession proof those industries are.

3.2.6 Commercial Fishing

3.2.6.1 Magnitude and Economic Value of Commercial Fisheries

A key economic activity in coastal North Carolina is commercial fishing. In 1980 the dockside ("exvessel") value of commercial fish landings was over $61 million dollars, and the dockside value of landings in the six impact counties in 1980 was $29 million. In addition to direct activity in fishing, secondary economic activities (fish processing and boat construction, supply, and maintenance) are significant elements of the respective local economies resulting from commercial fishing.

Data on commercial fishing vessel licenses, pounds landed, and dockside value of landings are shown in Table 9. Between 1975 and 1979 there were tremendous increases in pounds landed and dockside value for each of the counties, while the number of commercial vessel licenses changed much less dramatically. Essentially, there was a 100 percent increase in landings and over a 200 percent increase in the dockside value.

Several factors contributed to the tremendous increases in landings. During the 1975-1980 period the fisheries landings of sea scallops, hard clams, sciaenid fisheries (spot, croaker, trout, etc.), and crabs increased dramatically. The increases in these fisheries were due to: (1) the use of new technologies such as clam kicking and dredging; (2) tremendous increases in the use of existing technologies such as crab pots; (3) the intensified efforts of part-time commercial fishermen; and (4) the improvement in statistical reporting in North Carolina commercial fisheries.

Differences in landings between counties depend on the number of commercial vessels operating out of county ports and the relative proportion of full-time, part-time, and pleasure vessels. Thirty percent of the commercial licenses were for full-time vessels in Carteret County, 17 percent in Brunswick and Beaufort Counties, but only seven percent of the commercial vessel licenses were full-time in New Hanover, Craven, and Pender Counties. In all counties there is a pool of part-time commercial vessels from which fishing activity could be increased.

TABLE 9. COMMERCIAL FISHING VESSEL LICENSES, POUNDS LANDED, AND DOCKSIDE VALUE BY COUNTY 1975-1980.[1]

	Pounds			Dockside Value			Commercial Vessel Licenses		
	1975 (000s)	1980 (000s)	% Change (75-80)	1975 (000s)	1980 (000s)	% Change (75-80)	1975 (000s)	1980 (000s)	% Change (75-80)
OCS-Coal Exporting Counties									
Brunswick	1,500	3,086	105.7	905	3,702	310.2	1,954	1,933	-1.1
Carteret	25,739	48,189	87.2	5,440	18,717	244.1	3,690	4,033	9.3
New Hanover	750	3,141	318.8	322	2,771	760.6	2,635	2,692	2.2
Transportation Counties									
Beaufort	3,802	6,868	99.5	917	2,733	198.0	1,079	1,116	3.4
Bladen	---	---	---	---	---	---	---	---	---
Columbus	---	---	---	---	---	---	---	---	---
Craven	14	206	137.7	4	44	1000.0	1,866	1,713	-8.3
Duplin	---	---	---	---	---	---	---	---	---
Lenoir	---	---	---	---	---	---	---	---	---
Pender	108	1,144	959.3	60	961	1501.7	775	893	15.2
Pitt	---	---	---	---	---	---	---	---	---
Peat Counties									
Dare	16,372	41,585	154.0	3,707	13,731	270.4	1,075	992	-7.9
Hyde	3,204	13,056	307.5	770	4,182	443.1	448	415	-7.4
Pamlico	10,014	21,381	113.5	2,553	9,737	281.4	1,042	928	-10.9
Tyrrell	766	976	27.4	143	228	59.4	143	113	-21.0
Washington	604	532	-11.9	88	100	13.6	254	263	3.5
North Carolina	72,326	153,805	112.7	16,409	61,390	274.1	17,776	18,268	2.8

[1]The figures do not include menhaden landings.

Source: N.C. Department of Natural Resources and Community Development, Division of Marine Fisheries, "Annual Statistics on Fish Landings."

The tremendous increases in the dockside value of commercial landings are due to three factors: (1) the increases due to larger harvests in the respective fisheries, (2) the "real" increases in the prices paid in the respective fisheries, and (3) "inflationary" increases in the prices paid in the respective fisheries.

3.2.6.2 Commercial Fisheries and Development

An important component in the commercial fisheries is the shell - fish industry in the estuarine waters of coastal North Carolina. Of particular interest is the closure of estuarine waters acreage to taking clams and oysters. The Division of Health Services of the North Carolina Department of Human Resources is responsible for determining which areas are safe or unsafe. The primary reason for closures is coliform bacterial pollution. The major sources of pollution are discharges from sewage treatment systems, land disturbances during construction, urban runoff, and recreational boating and beach use. In short, pollution is positively correlated to development in general.

Data have been gathered for Carteret and New Hanover Counties on water acreage closed to taking clams and oysters. As seen in Table 10, about 2 percent of the acreage in Carteret County and at least 50 percent of the acreage in New Hanover County has been closed to taking clams and oysters during the past twenty years. Research has shown that development as measured by population growth is directly related to acreage closures which is in turn related to landings and value (Maiolo and Tschetter, 1981). For example, in Carteret County, the estimated economic impact is that for every 1,000 person increase in population and value lost in clams is $31,459 and the total value lost (using a multiplier effect) is $78,648.

TABLE 10. ESTUARINE WATERS CLOSED FOR SHELLFISHING

	Carteret			New Hanover		
	Open Acres	Closed Acres	% Closed	Open Acres	Closed Acres	% Closed
1960	298,480	6,520	2.1	6,865	9,185	57.2
1965	297,971	7,029	2.3	6,865	9,185	57.2
1970	297,379	7,621	2.5	6,865	9,195	57.2
1975	299,437	5,563	1.8	2,190	13,860	86.4
1980	299,613	5,387	1.8	8,468	7,583	47.2

Source: Compiled by Robert Davis and David Prewett, East Carolina University, from data of N.C. Division of Health Services.

As part of another research project, data are being compiled for the other coastal counties and an analysis of the relationship between development and closures to shellfishing will be extended to those counties. This research will be incorporated in Phase III, of this project.

3.2.7 Agriculture

Reflecting the rural character of the coastal counties, agricultural income is an important component of the local economies of the respective counties. The North Carolina Crop and Livestock Reporting Service provides annual estimates of the value of crops, livestock and livestock products, and government payments. To measure the economic impact of agricultural activity, total cash receipts by county are presented in Table 11.

As seen in Table 11, gross income from agriculture is higher for the transportation counties than the OCS-coal exporting counties. In 1979 cash receipts for Brunswick County were $24 million, for Carteret County they were $10 million, and for New Hanover County they were $2 million. In the primary counties receipts were predominantly from crops rather than livestock or livestock products.

Although the absolute value of agricultural receipts is important, the impact depends on the size of the farm population and the number and size of farms. These data are discussed in Section 3.3.6.

3.3 The Social-Demographic Context

3.3.1 General

The social-demographic characteristics of a population describe the change and stability in a social system, be it community or county. Important variables are the size and the composition of the population and how those numbers are changing. Change is measured in terms of the population processes, i.e., natural increase and net migration.

With the exception of New Hanover County, the counties of the study area are nonmetropolitan and predominantly rural. Preliminary estimates indicate that all counties grew during the past decade. The primary reason for this growth was the reversal of historical trends of out-migration to a consistent pattern of in-migration. This pattern of growth caused by in-migration is significantly changing the population composition of the coastal area.

3.3.2 Population Size and Change

Although all the counties in the study area grew in population during the 1970's, there was considerable variation between the counties. Generally, the OCS-coal exporting counties grew faster than North Carolina's 15 percent growth rate for the past decade, while with the exception of Pender County for the transportation counties and Dare County for the Peat Counties, the remaining counties grew more slowly than the state as a whole.

The OCS-coal exporting counties were among the twenty fastest growing counties in the state. As seen in Table 12, Brunswick County, which grew

TABLE 11. TOTAL CASH RECEIPTS FROM FARM MARKETING AND GOVERNMENT PAYMENTS BY COUNTY 1970, 1976, 1979

	1970 (000s)	1976 (000s)	1979 (000s)
OCS-Coal Exporting Counties			
Brunswick	$ 8,514	$ 15,803	$ 24,076
Carteret	3,201	5,568	10,612
New Hanover	2,445	1,823	2,074
Transportation Counties			
Beaufort	$27,742	$ 52,123	$ 54,841
Bladen	19,782	34,277	41,502
Columbus	38,024	68,914	72,670
Craven	18,275	32,302	36,426
Duplin	75,899	144,593	172,305
Lenoir	32,578	60,636	66,143
Pender	16,878	22,450	30,593
Pitt	55,927	96,644	101,289
Peat Counties			
Dare	$ 76	$ 225	$ 355
Hyde	7,219	14,876	18,113
Pamlico	5,188	9,517	12,475
Tyrrell	3,522	9,628	15,501
Washington	8,066	17,998	32,074
North Carolina	1,585,419	2,829,396	3,405,674

Source: N.C. Department of Agriculture, Crop and Livestock Reporting Service, Farm Income, North Carolina.

by 48 percent in the 1970's, was the third fastest growing county in the state. Additionally, the OCS-coal exporting counties showed dramatic increases in their respective growth rates for the 1970's over the 1960's. The growth rates for Brunswick and Carteret Counties roughly doubled while the growth rate for New Hanover County increased by over half.

With the exceptions of Craven and Pitt Counties, the transportation counties experienced population declines during the 1960's. During the 1970's all the transportation counties showed population growth. Although they grew slower than the rate for the state during the 1970's, the transportation counties all experienced 100 percent increases in their respective growth rates for the 1970's over the 1960's.

For the peat counties, Dare and Washington Counties showed population growth during the 1960's and 1970's with Dare County being among the fastest growing counties in the state during the 1970's. Hyde, Pamlico, and Tyrrell Counties experienced a reversal with a trend of population decline for the 1960's and population growth during the 1970's.

An essential consideration in interpreting these changes is knowledge of the relative importance of net migration for the counties. As seen in Table 13, the OCS-coal exporting counties had small net in-migration rates in the 1960's followed by large increases in net migration during the 1970's. For all the transportation counties the 1960's were years of net out-migration, while for the 1970's, the net migration rates became positive for all counties except Craven. With the exception of Dare County, all the peat counties had net out-migration during the 1960's. For the 1970's all counties except Washington had net in-migration. The estimates for Pender County show in-migration on a magnitude equal to that for the OCS-coal exporting counties.

These figures for the 1970's indicate that the counties are not only keeping residents who previously would have been candidates to leave, but also are attracting new, additional residents. The characteristics of these new residents, determinable from 1980 census data, will have important implications for the composition of the labor force and demand for products and services.

Equally important to the overall growth patterns of the respective counties is the geographical distribution of that growth within the counties. Townships represent a unit of analysis which had permanent boundaries during the 1970's and for which preliminary 1980 census data are available for comparisons with the 1970 population figures (See Table 14). Focusing on the OCS-coal exporting counties because they contain the proposed sites for the temporary OCS support bases and coal export terminals, townships directly adjacent to the coastline grew the most. These townships represent areas where recreational and retirement homes were developed during the 1970's. Interestingly, the preliminary 1980 census figures indicate Wilmington lost population during the decade while the rest of New Hanover County grew. In Carteret County,

TABLE 12. TOTAL POPULATION BY COUNTY 1960
1970, 1980, AND PERCENT CHANGE

	1960	1970	% Change 60-70	1980	% Change 70-80
OCS-Coal Exporting Counties					
Brunswick	20,278	24,223	19.5	35,767	47.7
Carteret	30,940	31,603	15.2	41,092	30.0
New Hanover	71,742	82,996	15.7	103,471	24.7
Transportation Counties					
Beaufort	36,014	35,980	-.1	40,266	11.9
Bladen	28,881	26,477	-8.3	30,448	15.0
Columbus	48,973	46,937	-4.2	51,037	8.7
Craven	58,773	62,554	6.4	71,043	13.6
Duplin	40,270	38,015	-5.6	40,952	7.7
Lenoir	55,276	55,204	-.1	59,819	8.4
Pender	18,508	18,149	-1.9	22,215	22.4
Pitt	69,942	73,900	5.7	83,651	13.2
Peat Counties					
Dare	5,935	6,995	17.9	13,377	91.2
Hyde	5,765	5,571	-3.4	5,873	5.4
Pamlico	9,850	9,467	-3.9	10,398	9.8
Tyrrell	4,520	3,806	-15.8	3,975	4.4
Washington	13,488	14,308	4.1	14,801	5.4
North Carolina	4,556,155	5,084,411	11.5	5,874,429	15.5

Sources: Bureau of the Census, U.S. Department of Commerce, City and County Book, 1972, Table 2.

Census of Population, Bureau of the Census, U.S. Department of Commerce (Preliminary Counts),Table 1.

U.S. Department of Commerce, Bureau of the Census, Census of Population, North Carolina, 1980 (Preliminary Counts), Table 1.

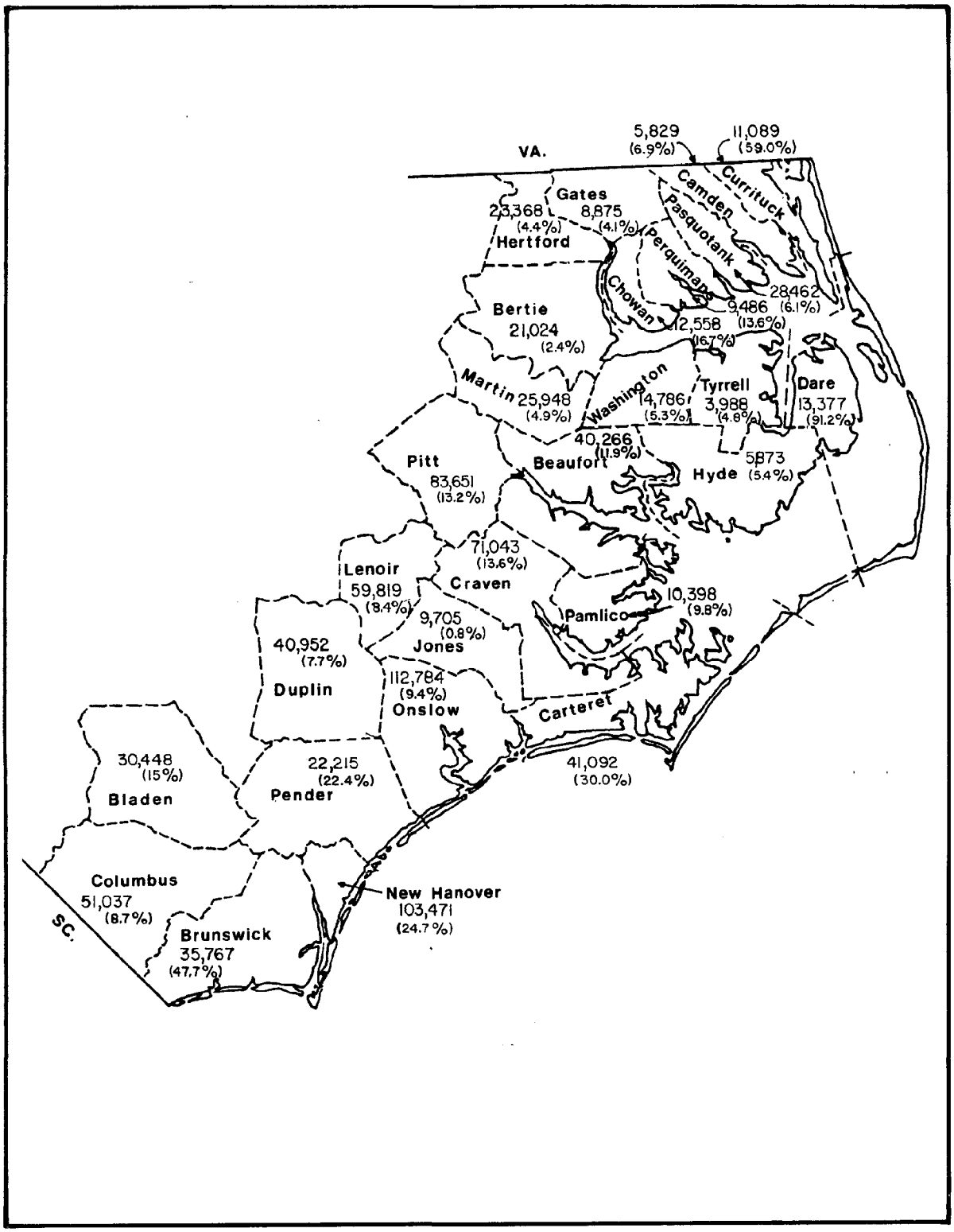

Figure 2. Total Population, 1980, and Percentage Change in Total Population, 1970-1980.

TABLE 13. NET MIGRATION BY COUNTY
1960-1970 and 1970-1980

	1960-1970		1970-1980	
	% Change	% Migration	% Change	% Migration
OCS-Coal Exporting Counties				
Brunswick	19.5	6.9	47.7	35.8
Carteret	15.2	3.4	30.0	21.9
New Hanover	15.7	5.6	24.7	17.1
Transportation Counties				
Beaufort	-.1	-9.5	11.9	6.4
Bladen	-8.3	-18.6	15.0	8.6
Columbus	-4.2	-17.4	8.7	1.1
Craven	6.4	-14.9	13.6	-2.2
Duplin	-5.6	-16.6	7.7	1.4
Lenoir	-.1	-12.7	8.4	1.0
Pender	-1.9	-11.7	22.4	16.2
Pitt	5.7	-8.4	13.2	5.2
Peat Counties				
Dare	17.9	10.6	91.2	86.1
Hyde	-3.4	-8.5	5.4	14.7
Pamlico	-3.9	-10.5	9.8	6.3
Tyrrell	-15.8	-21.3	4.4	2.9
Washington	4.1	-10.3	5.4	-2.9
North Carolina	11.6	-1.5	15.5	7.7

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

U.S. Department of Commerce, Bureau of the Census, Current Population Reports, (P-25 Series) "Estimates of the Population of Counties," Table 1.

TABLE 14. TOTAL POPULATION BY COUNTY AND TOWNSHIPS, 1970, 1980

	1970	1980	% Change 70-80
Brunswick County	24,223	35,394	46.1
Lockwoods Folly Township	4,748	7,259	52.9
Northwest Township	3,356	4,638	38.2
Shallotte Township	4,877	6,492	33.1
Smithville Township	4,346	6,675	53.6
Town Creek Township	5,215	8,357	60.2
Waccamaw Township	1,681	1,973	17.4
Carteret County	31,603	40,794	29.1
Atlantic Township	814	814	0.0
Beaufort Township	6,147	6,950	13.1
Cedar Island Township	290	325	12.1
Davis Township	456	491	7.7
Harkers Island Township	1,639	1,903	16.1
Harlowe Township	762	940	23.4
Marshallberg Township	525	572	9.0
Merriman Township	330	428	29.7
Morehead Township	11,929	15,743	32.0
Newport Township	3,926	5,383	37.1
Portsmouth Township	2		
Sea Level Township	347	546	57.3
Smyrna Township	517	636	23.0
Stacy Township	257	321	24.9
Straits Township	1,166	1,514	29.8
White Oak Township	2,496	4,228	69.4
New Hanover County	82,996	103,304	24.5
Cape Fear Township	6,734	10,152	50.8
Federal Point Township	5,113	8,507	66.4
Harnett Township	17,427	26,899	48.8
Masonboro Township	7,553	13,646	80.7
Wilmington Township	46,169	44,100	-4.5

Source: U. S. Department of Commerce, Bureau of the Census, Census of Population, North Carolina, 1980 (Preliminary Counts) Table 1.

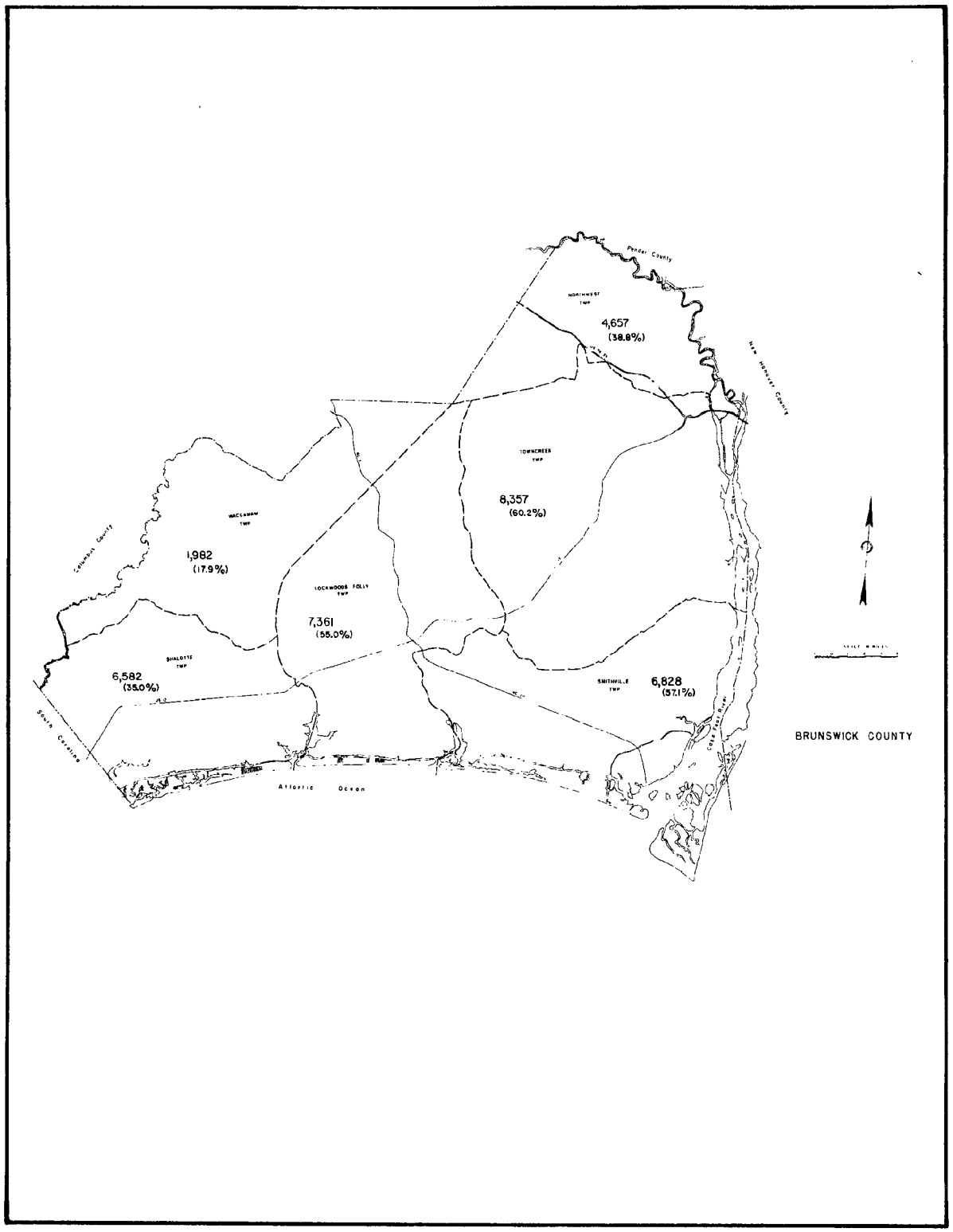

Figure 3. Total Population by Township, 1980, and Percentage Change 1970-1980, Brunswick County.

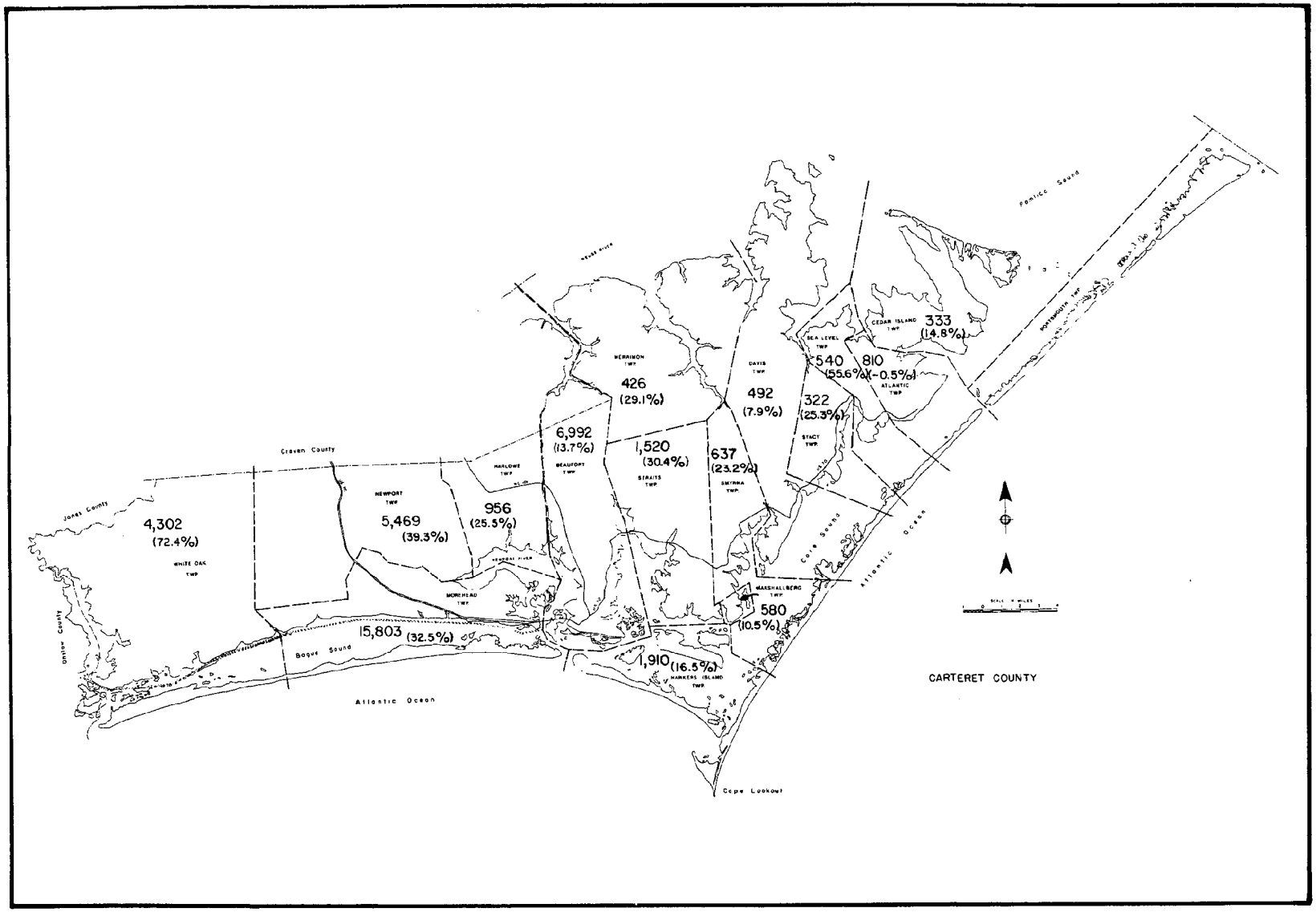

Figure 4. Total Population by Township, 1980, and Percentage Change 1970-1980, Carteret County.

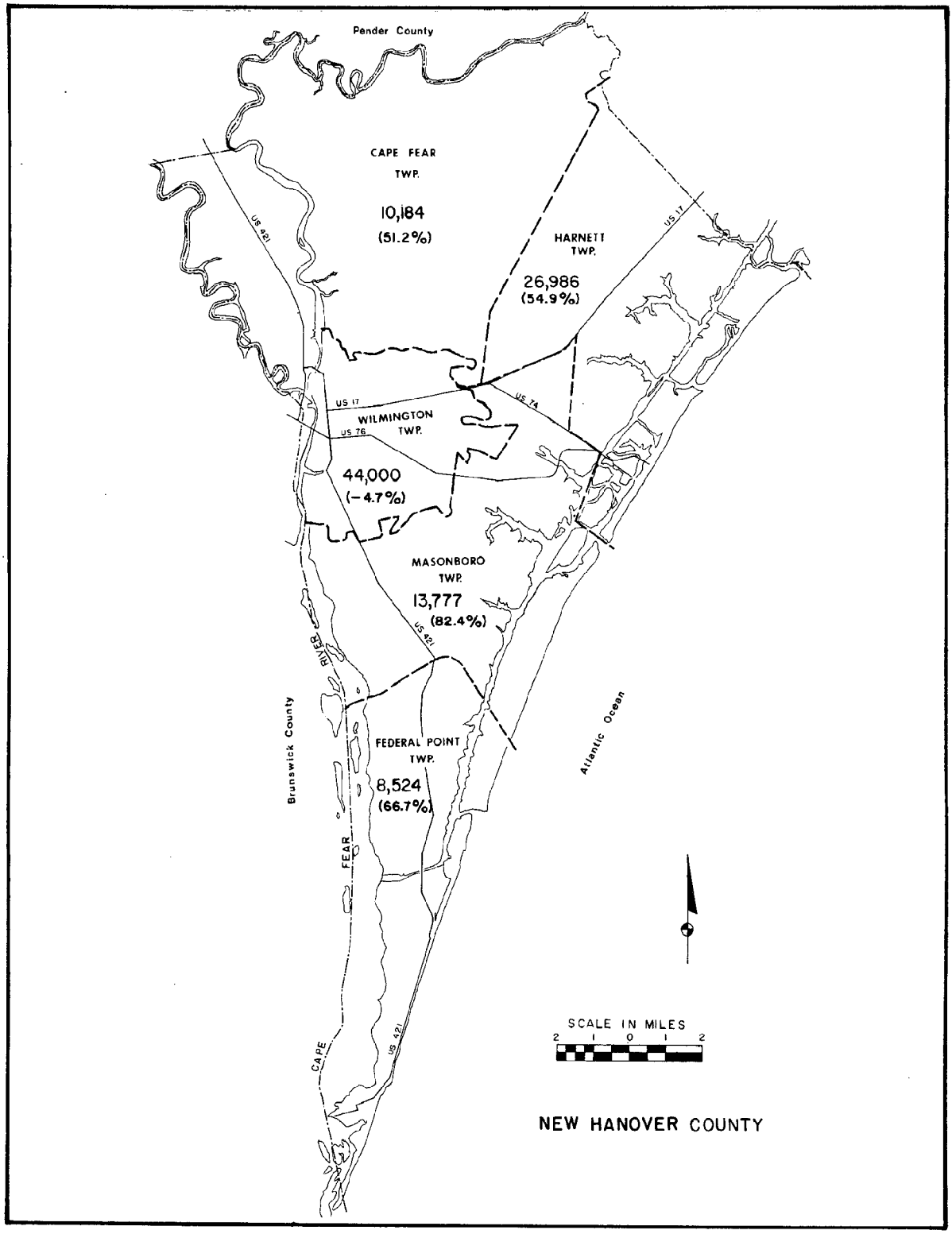

Figure 5. Total Population by Township, 1980, and Percentage Change 1970-1980, New Hanover County.

Morehead City declined in population while the rest of Morehead Township, including Atlantic Beach and Pine Knoll Shores grew dramatically.

3.3.3 Urbanization

With the exception of New Hanover County, the counties are non-metropolitan in character. As seen in Table 15, only in New Hanover, Craven, and Pitt Counties do a majority of the population live in urbanized areas. As of 1970 three counties, Brunswick, Bladen, and Pender, were entirely rural. Preliminary estimates from the 1980 census indicate that figures on percent urban will not change dramatically. In Brunswick County, the town of Southport has met the census criteria for urban places by 1980.

The pattern of population settlement for the counties is a series of small, nonurban places (less than 2,500 people), a series of small towns (2,500 to 5,000 people), a few small cities (10,000 to 35,000 people), and one metropolitan area. In the OCS-coal exporting counties, apart from the Wilmington metropolitan area, there is no urban place of more than 5,000 people. In the transportation counties, there are a series of medium size towns, i.e., New Bern (Craven County), Washington (Beaufort County), Greenville (Pitt County), and Kinston (Lenoir County). The peat counties include only the small town of Plymouth (Washington County).

There is an important exception to this pattern of settlement that should be noted and is related to the recreational population that moves in and out of the OCS-coal exporting counties on a regular, predictable basis. Although this population will be discussed more specifically in Section 5.0, it is important to realize that on any given day during the recreational season specific locations in the respective counties change from sparsely settled rural areas to congested, quasi-urban areas. For example, the populations of Carteret and Brunswick Counties more than double during the height of the summer recreational season.

3.3.4 Age, Sex, and Racial Composition

Examination of the age, sex, and social composition trends of the 11 counties in the impact area indicates that the respective populations are becoming older and contain a decreasing proportion of males and nonwhites. The age trends for the respective counties show little variation with the exception of Craven and Pitt Counties which have significantly younger populations than the remaining counties (See Tables 16, 17, 18). The sex ratio (the number of males per 100 females) trends indicate a declining proportion of males. The counties with the lowest sex ratios, New Hanover, Lenoir, and Pitt are among the most urban counties of the group. The proportion of the population which is nonwhite is declining for all counties. The counties with the smallest proportions of nonwhites are Carteret and New Hanover.

TABLE 15. PERCENT URBAN BY COUNTY, 1960, 1970, 1980

	1960	1970	1980
OCS-Coal Exporting Counties			
Brunswick	0.0	0.0	12.3
Carteret	27.5	27.2	19.9
New Hanover	69.0	69.5	86.7
Transportation Counties			
Beaufort	27.6	24.9	20.8
Bladen	0.0	0.0	11.6
Columbus	9.6	8.9	16.2
Craven	26.7	55.2	49.6
Duplin	0.1	14.9	14.1
Lenoir	44.9	46.6	47.4
Pender	0.0	0.0	0.1
Pitt	42.8	50.0	49.7
Peat Counties			
Dare	0.0	0.0	0.0
Hyde	0.0	0.0	0.0
Pamlico	0.0	0.0	0.0
Tyrrell	0.0	0.0	0.0
Washington	34.6	34.0	30.9

Sources: U. S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U. S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

U. S. Department of Commerce, Bureau of the Census, Census of Population, Number of Inhabitants North Carolina, 1980, Table 3.

TABLE 16. MEDIAN AGE BY COUNTY 1960, 1970

	1960	1970
OCS-Coal Exporting Counties		
Brunswick	23.9	26.4
Carteret	25.6	28.3
New Hanover	28.6	27.8
Transportation Counties		
Beaufort	26.2	29.0
Bladen	20.6	25.9
Columbus	22.3	26.3
Craven	22.8	23.2
Duplin	23.8	27.5
Lenoir	23.8	26.5
Pender	23.5	27.4
Pitt	22.5	23.9
Peat Counties		
Dare	32.4	33.6
Hyde	28.8	29.8
Pamlico	24.9	29.4
Tyrrell	25.7	31.8
Washington	22.8	24.8

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

TABLE 17. SEX RATIO BY COUNTY 1960, 1970
(Number of Males Per 100 Females)

	1960	1970
OCS-Coal Exporting Counties		
Brunswick	101.7	99.0
Carteret	137.8	97.1
New Hanover	98.8	91.5
Transportation Counties		
Beaufort	97.5	91.6
Bladen	98.4	95.8
Columbus	96.9	94.5
Craven	112.0	108.4
Duplin	97.0	94.0
Lenoir	99.1	90.4
Pender	97.6	97.7
Pitt	98.4	91.5
Peat Counties		
Dare	97.2	94.7
Hyde	98.2	95.0
Pamlico	97.8	93.6
Tyrrell	99.5	93.4
Washington	102.7	98.7

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

TABLE 18. PERCENT NONWHITE POPULATION BY COUNTY 1960, 1970, 1980

	1960	1970	1980
OCS-Coal Exporting Counties			
Brunswick	35.4	30.7	23.7
Carteret	12.4	11.5	10.3
New Hanover	27.9	22.9	22.3
Transportation Counties			
Beaufort	36.9	33.3	31.9
Bladen	42.3	39.5	40.1
Columbus	34.9	31.8	32.6
Craven	28.9	26.0	29.0
Duplin	37.6	34.3	34.5
Lenoir	39.6	36.9	38.5
Pender	48.1	43.9	39.1
Pitt	43.6	34.8	34.7
Peat Counties			
Dare	6.8	7.3	6.8
Hyde	42.2	41.3	35.7
Pamlico	36.7	33.2	31.7
Tyrrell	43.7	43.4	39.2
Washington	45.1	41.5	43.6

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

Data from the 1980 census on the racial composition are available. Brunswick County showed a continuing decline in the percentage of the population that is nonwhite, a trend which reflects the increased in-migration during the 1970's. Other counties which showed a significant drop in the percentage of the population that is nonwhite are Hyde and Tyrrell Counties. For the remaining counties, the proportion of the population that was nonwhite remained relatively constant between 1970 and 1980.

Census data for the sex and age composition of the counties in 1980 are not yet available. However, given the general pattern of lower birth rates and high in-migration rates during the 1970's, the respective county populations should be older and have a larger proportion of females.

3.3.5 Education

3.3.5.1 Educational Attainment

Educational attainment serves as an indicator of the potential skill level of the adult population. The measure of educational attainment used is the percentage of the population 25 years of age and older that has graduated from high school. As seen in Table 19, the proportion of adults that have graduated from high school has increased, mirroring state and national trends. Variations between counties are related to migration patterns and levels of urbanization. Migrants are more likely to be better educated and more likely to move to urban areas. New Hanover County, followed by Craven and Carteret Counties has the largest proportion of high school graduates. The most rural counties, Brunswick, Bladen, Columbus, and Pender, have the smallest proportion of high school graduates.

Although the 1980 census data is not yet available, the trend toward higher educational attainment should continue. This conclusion is based in part on the estimated migration patterns for the 1970's and the general characteristics of migrants, and in part on the trends for local school districts.

3.3.5.2 Educational Enrollments

Other important considerations are educational enrollments and school expenditures for local populations. Development, particularly as it attracts new residents, places demands on educational institutions and local expenditures. Examination of average daily attendance statistics for the public school systems of the counties reveals some interesting facts. While enrollments tended to increase during the 1960's, the pattern for the 1970's shows a decline in enrollments with a few exceptions. The pattern for the 1970's shows declines in average daily attendance despite the population growth experienced by all counties.

TABLE 19. PERCENT OF POPULATION 25 YEARS OF AGE AND OLDER WHO ARE HIGH SCHOOL GRADUATES 1960, 1970

	1960	1970
OCS-Coal Exporting Counties		
Brunswick	20.8	29.5
Carteret	36.7	40.3
New Hanover	38.0	50.0
Transportation Counties		
Beaufort	25.8	34.8
Bladen	21.2	27.7
Columbus	23.9	29.7
Craven	36.7	47.4
Duplin	24.4	33.6
Lenoir	30.0	35.6
Pender	23.7	29.2
Pitt	29.2	38.3
Peat Counties		
Dare	28.4	33.5
Hyde	23.3	22.7
Pamlico	25.7	27.4
Tyrrell	21.0	18.6
Washington	24.0	36.5
North Carolina	32.2	38.5

Sources: U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1962, Table 2.

U.S. Department of Commerce, Bureau of the Census, City and County Data Book, 1972, Table 2.

TABLE 20. PUBLIC SCHOOL AVERAGE ATTENDANCE
SCHOOL YEARS ENDING 1960, 1970, 1979

	1960	1970	1979
OCS-Coal Exporting Counties			
Brunswick	5,187	5,507	7,116
Carteret	5,969	7,105	7,008
New Hanover	15,542	17,739	19,056
Transportation Counties			
Beaufort	8,819	8,155	8,171
Bladen	8,103	6,926	6,517
Columbus	13,672	12,097	11,488
Craven	11,423	13,710	12,587
Duplin	10,199	9,198	8,544
Lenoir	13,311	13,300	11,493
Pender	4,862	4,431	4,680
Pitt	16,612	17,095	15,734
Peat Counties			
Dare	1,180	1,371	1,964
Hyde	1,316	1,269	1,146
Pamlico	2,454	2,372	2,053
Tyrrell	1,127	1,003	804
Washington	3,437	3,619	3,268
North Carolina	1,003,455	1,104,295	1,095,412

Source: N.C. Department of Education, Division of Statistical Services. Statistical Profile North Carolina Public Schools.

Two factors help to explain the decline in enrollments. One consideration is the general decline in the birth rate which affects the size of the pool for enrollment. A second factor is that population growth is disproportionately related to net migration, and migrants are likely to have fewer children. More importantly the trends in enrollment are likely to continue with increased net in-migration likely to help schools hold current enrollment levels rather than dramatically increase enrollment levels. Forecasts of future likely enrollments are dependent on the final 1980 census data on the age structure and the characteristics of migrants in the 1970's.

3.3.6 Farm Population

As seen in Section 3.2.7, farm income is an important part of the respective counties' economic structures. However, the farm population is declining in absolute and relative terms. Figures from the 1970 U.S. Census indicate that during the 1960's, the farm population declined by over 50 percent in all of the counties except New Hanover (U.S. Department of Commerce, 1970). Although data for the 1970's are not available, the trend of declining farm population should have continued through the 1970's.

The trends on farm population do not provide information on the acreage in farms and the average size of farms during this same time period. Data for these variables from the U.S. Census of Agriculture in 1969, 1974, and 1978 are presented in Table 21. As indicated from the data in Table 21, the 1970's were a volatile time in coastal agriculture. While value per acre and the average size of farms increased throughout the decade, the amount of land in farms fluctuated dramatically.

For the OCS-coal exporting counties, Brunswick County showed a consistent decrease in farm acreage. Carteret County showed an initial decline in farm acreage and then a dramatic increase in farm acreage between 1974 and 1978. New Hanover County first showed a slight increase in farm acreage and then a sharp decline in acreage between 1974 and 1978.

Among the transportation counties, Columbus, Duplin, and Pender Counties showed consistent decreases in farm acreage throughout the decade. Although, Beaufort, Bladen, Craven, Lenoir, and Pitt showed overall loses in total farm acreage for the decade, the actual pattern saw a decline between 1969 and 1974 followed by an increase between 1974 and 1978.

For the Peat Counties, Hyde, Tyrrell, and Washington Counties showed consistent increases in total farm acreage during the decade. Only Pamlico County showed a decrease in total farm acreage during the 1970's.

TABLE 21. TOTAL FARM ACREAGE, VALUE PER ACRE, AND AVERAGE SIZE OF FARMS BY COUNTY 1969, 1974, and 1978

OCS-Coal Exporting Counties	1969	1974	1978	% Change 74-78	1969	1974	1978	% Change 74-78	1969	1974	1978	% Change 74-78
Brunswick	86,968	71,631	67,368	-6.0	286	591	995	68.4	90	96	100	4.2
Carteret	31,028	25,330	68,663	171.1	352	764	746	-2.4	105	103	375	264.1
New Hanover	18,091	20,166	12,943	-35.8	347	512	1,058	106.6	148	232	156	-32.8
Transportation Counties												
Beaufort	195,996	159,565	169,958	6.5	309	670	1,081	61.3	134	134	162	20.9
Bladen	195,884	159,750	177,167	10.9	244	468	893	90.8	106	113	139	23.0
Columbus	241,382	207,744	197,036	-5.2	380	655	1,159	76.9	76	82	91	11.0
Craven	111,032	103,459	106,664	3.1	328	605	1,200	98.3	110	129	152	17.8
Duplin	283,867	271,215	261,718	-3.5	321	519	1,116	115.0	91	105	117	11.4
Lenoir	163,182	168,966	157,306	-6.9	512	717	1,491	107.9	112	151	155	2.6
Pender	112,483	102,162	98,323	-3.8	234	504	942	86.9	115	130	151	16.2
Pitt	248,688	228,802	241,478	5.5	512	815	1,553	90.6	114	145	180	24.1
Peat Counties												
Dare	---	---	---	---	---	---	---	---	---	---	---	---
Hyde	79,473	91,636	92,881	1.4	280	435	939	115.9	270	409	436	6.6
Pamlico	45,466	46,130	42,597	-7.7	235	434	870	100.5	159	205	245	19.5
Tyrrell	33,603	37,979	56,492	48.7	321	486	899	85.0	158	220	327	48.6
Washington	90,870	97,633	110,699	13.4	333	576	1,213	110.6	190	256	288	12.5

Sources: U.S. Department of Commerce, Bureau of Census, Census of Agriculture, North Carolina, 1969, Table 1.

U.S. Department of Commerce, Bureau of Census, Census of Agriculture, North Carolina, 1974, Table 1.

U.S. Department of Commerce, Bureau of Census, Census of Agriculture, North Carolina, 1978, Table 1.

3.4 Environmental Context for Proposed Projects

The protection of environmental quality has become a major factor associated with increased development. Coal export operations and outer continental shelf oil and gas exploration will produce onshore development. Such development must be managed to promote the optimum benefits from the marine and coastal resources, while ensuring the adequate protection of these resources.

The coast is an attractive yet fragile environment. The rivers, bays, and sounds provide for a well developed, protected water transportation network including two major ports and the Atlantic Intracoastal Waterway. The long, narrow barrier islands, the coastal sounds, and wide shallow estuaries magnify the impacts from the development of transportation facilities.

No single methodology or guideline has been accepted as "the" correct approach for determining the impacts on the environment from all levels of development activity. Many federal agencies (Council on Environmental Quality, 1974), consulting organizations (Weston, 1978; Conservation Foundation), and academic institutions have developed different guidelines and techniques, usually adapted for specific projects under consideration at the time the methodologies were formulated. However, no single approach has been adopted over other methods as offering superior advantages in all cases. Impact assessment is still a subjective art requiring significant judgement and experience.

The objective of an environmental impact assessment is to identify and describe the changes in the environmental systems of an area as a result of some development or activity. Two recurring realities must be recognized by those performing the analysis of environmental impacts: (1) a proposed project (and alternatives) may cause dozens of potential impacts--not all of them harmful; and (2) how may one single out the "significant impacts" of an activity or development? The emphasis of an environmental analysis is on the physical environment or on man's use of that environment. The analysis focuses on projects, activities associated with the project, the disturbances or alterations to the physical environment, and the effects that these alterations have (Conservation Foundation, 1978: Volume II).

The environment, for purposes of an environmental impact assessment, may be broken into two subdivisions: the physical environment and the social environment. Components of the physical environment which are often considered in an impact assessment include (Camougis, 1981: 98):

bedrock geology
surficial geology
water quality
water quantity
aquatic flora
aquatic fauna
terrestrial flora
terrestrial fauna
terrestrial habitat
aquatic habitat
wetland habitat
air quality
precipitation
temperature
wind conditions

The components to be considered in the assessment of the social environment include (Camougis, 1981: 99).

demography
economics (including agriculture)
transportation
utilities
sociology
public safety and health
educational resources
historical resources
archeology
cultural resources
recreational resources
conservation
preservation
aesthetics

The social environment, for the most part, is examined elsewhere in this report. This section will consider the components of the physical environment.

An environmental assessment begins with the compilation of data to form a baseline--the reference point from which to measure changes resulting from development activities. Forecasts are then made of the effects of a "normal growth" (i.e., the economic and social development of a region without the proposed project) on the environment. The proposed project and the development associated with the project is then added to the growth projection to determine the best estimate of the impacts on the environmental systems of the area.

Appendix A lists major environmental impact statements, studies, and references pertaining to the Coastal Study Zone, estuaries of proposed projects and developments within the region. While all references do not specifically deal with either energy projects or transportation facilities required for those projects, the Appendix will serve as the environmental data baseline for the assessment of coal export and OCS support base projects included in this report.

The environmental systems to be evaluated under the Weston Methodology include: biology, geology, land use, air, and water quality, recreation, and aesthetics (Weston, 1978, Vol. II). A description and analysis of the requirements and limitations of this methodology is found in Chapter 7 of the Phase I report. The Final Environmental Impact Statement (FEIS) of the OCS Lease Sale No. 56, discusses the following nine issues which it considers as major impact issues: air quality, West Indian Manatee, commercial fisheries, live bottoms and reefs, community services and facilities, recreational fishing, shoreline recreation, tourism, and water quality (U.S. Department of Interior, 1981: 65).

This section will describe the factors to be considered in general in the assessment of impacts on the physical environment. These factors are: water quality, air quality, land resources usage, solid and hazardous wastes, noise control, and biological activity. Subsequent sections in Chapters 4 and 5 will deal with specific considerations for analysis in assessment of impacts from the development of OCS support bases and coal export operations, respectively.

3.4.1 Water Quantity and Quality

North Carolina has been fortunate in maintaining, for the most part, the inherent quality of its coastal waters. Except for domestic sewage pollution, which tends to impact more on a localized basis rather than coastwide, relatively little toxic material contamination has been documented. Fish kills have occurred periodically and several large areas of estuarine shellfishing waters have been closed because of excessive bacterial contamination. Eutrophication, the enrichment of nutrient levels in a body of water caused by agricultural runoff or point-source pollution (sewage discharges), can result in significant and perhaps irreversible deterioration of water quality.

One of the major concerns of developmental activity is the effect of such development on water tables and groundwater recharge. Most drainage systems in the coastal study area are surface draining rather than subsurface draining networks. Water tables are quite shallow, fluctuating with precipitation and evapo-transpiration rates. Differences in water table depths between developed and undeveloped

sites are often less than one foot, causing only slight effects on groundwater recharge in the different areas (N.C. Marine Science Council, 1980: 31). The lowering of the water table to provide water supplies for increased economic and industrial development may lead to salt water intrusion of the major aquifers of the coastal area, effectively rendering the groundwater supply permanently unfit as a source of fresh water.

Many factors must be included in any analysis of impacts upon the water resources of an area. These factors, including both biotic and abiotic factors, will require close scrutiny to determine "significant impacts" of the proposed projects. Many of the impacts will be very project and/or site specific in nature, and will often overlap into other areas of analysis, such as land resources or biological activity. The following list contains many of the factors which need to be addressed in the analysis of impacts on the water resources of the area (Camougis, 1981: 129):

effects on water quality (general)
erosion/sedimentation/turbidity
oxygen depletion
temperature effects
hydrologic changes
loss of aquatic habitat
loss of terrestrial habitat
loss of unique or critical habitat
effects on wetlands
threatened and endangered species (plant and animal, aquatic and terrestrial)
impingement of fish
entrainment of fish eggs and larvae
effects on fish migration
public health matters
toxic substances

3.4.2 Air Quality

The North Carolina coastal region is divided into two Air Quality Control Regions (AQCR) by the Environmental Protection Agency, in accordance with the Clean Air Act (See Figure 6). This act also establishes National Ambient Air Quality Standards. There are two maximum acceptable levels for each of a number of pollutants: particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen dioxide. The primary standard is for the protection of public health, with the secondary standards to protect values other than human health, such as vegetation and visibility. Table 22 lists the current standards. Table 23 gives the EPA estimate of pollutants emissions for the two AQCRs and 18 counties in the coastal study area.

TABLE 22

FEDERAL AMBIENT AIR QUALITY STANDARDS

PARAMETER	STANDARD	
	Primary	Secondary
PARTICULATE MATTER:		
Annual Geometric mean	75 ug/m^3 1/	60 ug/m^3
24-hour maximum	260 ug/m^3	150 ug/m^3
SULFUR OXIDES (Measured as SO_2):		
Annual arithmetic mean	80 ug/m^3	---
24-hour maximum	365 ug/m^3	---
3-hour maximum	---	1300 ug/m^3 2/
CARBON MONOXIDE:		
8-hour maximum	10 mg/m^3 3/	10 mg/m^3
1-hour maximum	40 mg/m^3	40 mg/m^3
HYDROCARBONS:		
3-hour maximum	160 ug/m^3	160 ug/m^3
NITROGEN DIOXIDE 4/:		
Annual arithmetic mean	100 ug/m^3	100 ug/m^3
OZONE:		
1-hour maximum	235 ug/m^3	235 ug/m^3
LEAD:		
Quarterly maximum	1.5 mg/m^3	1.5 mg/m^3

1/ ug/m^3 = micrograms per cubic meter

2/ not to be exceeded more than once per year

3/ mg/m^3 = milligrams per cubic meter

4/ in addition to Federal restrictions, North Carolina also has a 24-hour maximum limit of NO_2 of 250 ug/m^3

Source: Final Environmental Impact Statement, OCS Lease Sale No. 56. USDI, BLM, 1981; and Final Environmental Impact Statement, OCS Lease Sale No. 43, USDI, BLM, 1977.

TABLE 23

AIR POLLUTION EMISSION ESTIMATES

Emissions in Tons/Year

AQCR or County	Parti-culates	Sulfur Oxides	Nitrogen Oxides	Hydro-carbons	Carbon Monoxides
168	24,492	26,495	30,020	41,859	151,615
170	84,626	70,165	69,077	66,588	324,756
Beaufort	2,781	9,602	3,417	3,429	15,721
Bertie	3,418	268	1,580	2,409	11,511
Brunswick	2,915	2,066	5,320	5,442	20,812
Camden	440	130	927	1,073	4,102
Carteret	1,100	960	3,734	4,586	18,179
Chowan	325	520	589	1,177	5,051
Craven	3,071	5,107	5,720	6,281	34,562
Currituck	490	337	2,434	1,672	5,685
Dare	201	249	1,321	2,549	8,922
Hyde	1,010	403	2,982	3,027	9,367
New Hanover	13,377	25,728	16,033	10,836	27,534
Onslow	5,162	921	6,541	11,267	55,050
Pamlico	367	325	2,229	1,538	5,208
Pasquotank	5,454	568	1,144	1,682	7,070
Pender	1,220	349	2,628	3,280	13,035
Perquimans	309	102	523	958	4,542
Tyrrell	3,037	67,157	44,008	2,097	6,280
Washington	1,202	149	832	1,825	7,458

Source: Final Environmental Impact Statement, OCS Lease Sale No. 43. Dept. of Interior, BLM, 1977.

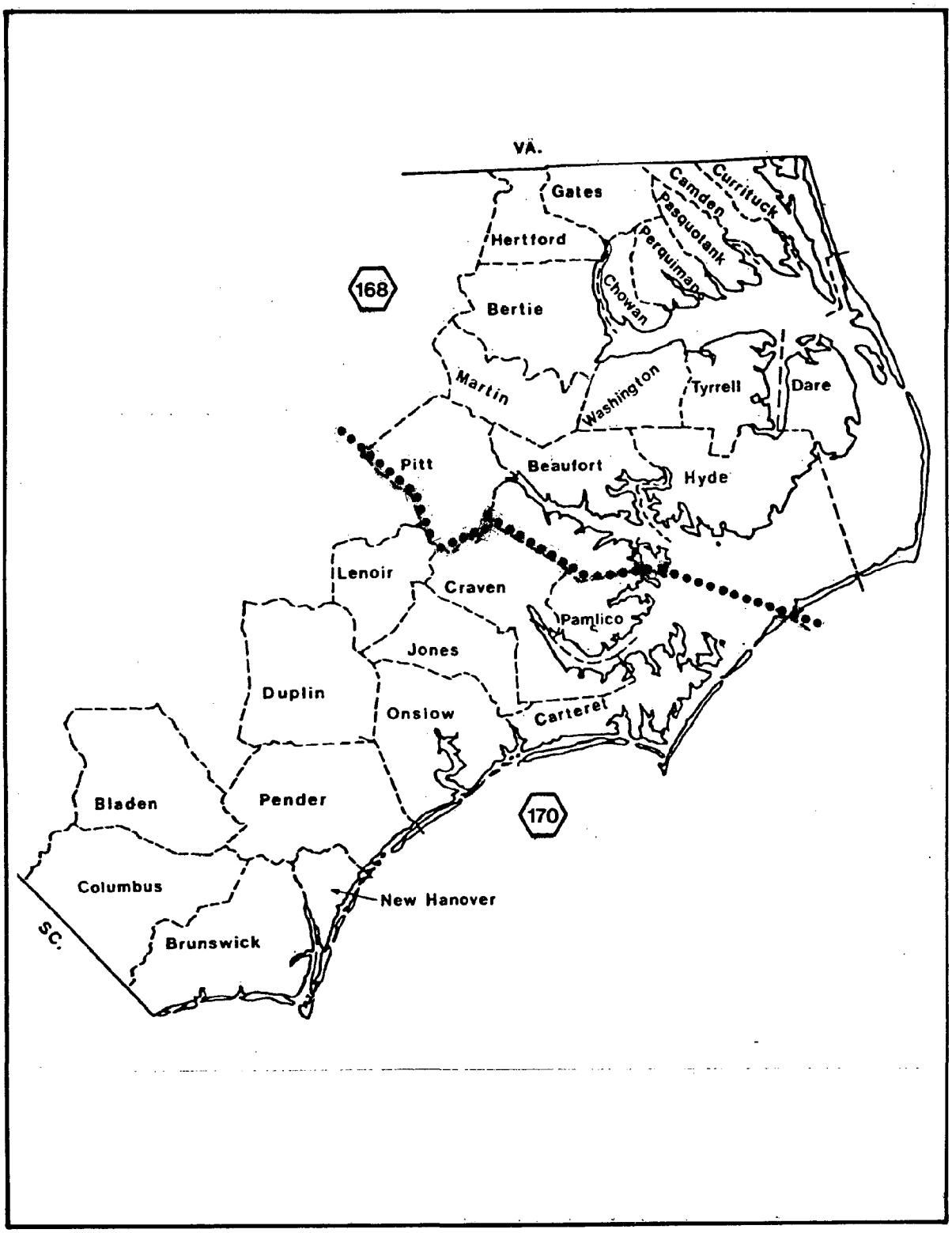

Figure 6. Air Quality Control Regions for Coastal North Carolina.

Air quality in the study area is generally good. The counties with major urban areas - Carteret, New Hanover, and Brunswick - in which most of the proposed projects will occur, have higher concentrations of pollutants than the other counties in the coastal study area. This indicates a direct correlation between pollutant concentrations and population. Thus, any major development activities which cause an influx in population, and specifically the associated increase in automobile usage, will contribute to the deterioration of air quality in that location.

The pollutant produced in the largest volume is carbon monoxide. Over 90 percent of this emission is from automobile exhaust, the balance coming from miscellaneous industrial operations such as process heath generation. Particulate emissions result from industrial processes such as mineral and wood products, area burning, fugitive dust, and roads. Sulfur oxides (SO_X) and nitrogen oxides (NO_X) result from fuel combustion of coal, oil, or natural gas. Hydrocarbons have various sources, depending on the specific location (U.S. Department of Interior, 1977).

The influence of particulate and sulfate concentrations on increased mortality has been demonstrated. Over the past 30 years, there has been an increase in death rates due to respiratory and cardiovascular ailments that have been strongly correlated with the increase in particulate and sulfate pollutant concentrations (U.S. Department of Interior, 1977).

The impacts of the proposed projects on the air quality of the coastal area appear to be minimal. The specific impacts of the OCS support bases and coal export activities are discussed in sections 4.4 and 5.4 respectively. The permitting requirements and procedures for development of these activities are described in section 2.3.4, Air Quality, in CEIP Report 4 (ITRE, 1981).

3.4.3 Land Resources Usage

The North Carolina coastal area has developed a water oriented tourist industry as a major component of its economic activity, a result of the protected waterways and water transportation facilities (Intracoastal Waterway, marinas, and the two state ports). The beaches and Outer Banks areas are a vital part of the tourist recreational industry. Private development, whether industrial or for personal recreational use (vacation homes), will restrict the availability of land for other uses. While not actually a consumption or degradation of a resource, as is water usage or pollution, land development is an impact on natural resource which must be considered in any evaluation of assessment of activities in the coastal area.

The Federal Coastal Zone Management Act (CZMA) and the North Carolina Coastal Area Management Act (CAMA) are the major regulations

governing the development of facilities within the coastal area. Any development activities which occur in a designated area of environmental concern (AECs) require a CAMA permit. The AECs include coastal wetlands, estuarine waters and shorelines, ocean hazard areas, public trust areas, and natural and cultural resource areas. Section 2.3.6, CAMA Regulations, of CEIP Report No. 4 (ITRE, 1981) discusses the permitting process and regulations for development under these two acts.

There are three major activities associated with most development within the coastal area which could have adverse environmental consequences: dredging and fill operations, construction of piers, bulkheads and other marine structures, and erosion which may result from these or other activities, either during or following construction of the facilities. Engineering activities related to dredging and the construction and operation of marine facilities must receive careful analysis of potential impacts on the biotic and abiotic environmental systems.

Dredging is the primary method used for improving and maintaining navigation channels and harbors. It is estimated that the U.S. Army Corps of Engineers dredges about 10 million cubic yards of material annually for navigation purposes (Camougis, 1981: 130). The Corps of Engineers and the U.S. Environmental Protection Agency specifically address the disposal of dredged material. Dredging and the associated disposal of the dredge spoil may release toxic materials from the disturbed sediments, including heavy metals, hydrocarbons, and organic and inorganic compounds. Dredging may also release or resuspend settled nutrients such as nitrates and phosphates which could cause an increase in the primary productivity of the area. Dredging will also increase short term turbidity on a localized basis. The effects on aquatic life of this increase are in general, temporary.

An additional consideration for any dredging operation is the problem of where to dispose of the dredge spoil. Wilmington and Morehead City both have high ground sites for spoil disposal which preclude the need to dump the dredged materials into water areas. However, these sites will become less available as the demand for land for development increases. North Carolina may experience pressure to use the ocean or wetlands for disposal of dredge spoil, a practice that has not been used in the past and which is unlikely under CAMA. Section 2.3.1 and Table 2-2 of CEIP Report No. 4 (ITRE, 1981) discuss the requirements and regulations pertaining to dredging and filling activities.

The construction of piers, wharves, dams, dikes, bulkheads, pipelines, cables, and any other type of construction activity within, across, or adjacent to navigable waters is controlled by permit requirements through the Army Corps of Engineers (See Section 2.3.5, CEIP Report No. 4, ITRE, 1981). This construction will usually have localized effects on the environment, including increased turbidity of the water, changes in

solar radiation on various sections of the area, changes in the hydrodynamics of the area, and the loss of some habitats, such as shellfish beds. A positive impact that often results from the construction of piers is the increase in algae and other organisms, thus improving the productivity of the waters around the pier.

Any such structure or development will have increased industrial and human activities. This increased activity may lead to secondary effects on the environment, due, for example, to discharges of chemicals, oils, or wastes from the ships, equipment, and human activity at the facility.

Sedimentation from the actual sites of construction is regulated at the state level, through the Division of Land Resources, and often at the local level also by ordinances. The majority of sediment at the sites of potential development as an OCS base or coal port are due to sources upstream, either agricultural or nonagricultural in origin. These sediments, transported to the coast via the major rivers, are responsible for the silting of the navigable waterways and harbors, which must be dredged occasionally. The environmental impacts of dredging and disposal of dredge spoil have been previously discussed. Control methods have been developed which will effectively eliminate any discharge of sediments from a site during construction. These methods include silt fence, sedimentation basins, and protective linings for drainage and runoff channels. It is anticipated that any major construction activity, especially one involving large areas of vegetation stripping and earthwork, will be required to develop an approved erosion control plan prior to receiving the required permits for construction, effectively minimizing the environmental impacts of such activities.

3.4.4 Solid and Hazardous Waste Disposal

The disposal of solid and hazardous wastes has become of crucial concern to the public in the last 10 years or so. While there is no direct threat of hazardous waste generation from either the coal export operations or OCS support bases, the associated development, such as increased population and related economic activity, will contribute to the amount of solid waste that must be managed by the local community.

Coal and coal slurries, and "Drilling fluids, produced waters and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy" (40 C.F.R. S261.4(b) (5)) are specifically excluded from the requirements of the Resources Conservation and Recovery Act (See Section 2.4.2., CEIP Report No. 4 (ITRE, 1981). Most drilling muds and wastes will be returned to the sea immediately, except for those muds and fluids which contain oil, which must first be treated prior to disposal. Drilling muds and fluids have been found to have a negligible effect on open ocean water quality (U.S. Department of Interior, 1981: 117).

Sanitary landfills are the predominant method of disposal of solid waste throughout the coastal area. Increased growth in the area, not necessarily related to the proposed projects, may cause existing landfills to become inadequate within the near future. Thus, the municipalities and/or county governments must plan for the development of facilities required, with or without the development of an OCS support base or a coal export terminal. Hazardous wastes may not be disposed of in a sanitary landfill; rather they must be disposed of in approved facilities or methods under the Resources Conservation and Recovery Act guidelines. To date, there is no approved hazardous waste disposal site in North Carolina. New legislation has recently passed in the North Carolina General Assembly dealing with the siting and operation of these facilities.

3.4.5 Noise Control

Information on effects of noise is best documented for hearing loss due to noise at work (industrial situations). Other effects of occupational noise are less certain. These are changes in psychological and physiological states, including annoyance and sleep interruptions. Property damage by actual vibrational destruction or depreciation because noise paths and patterns impinge on the property has been documented, and is to some degree measurable and predictable. Noise effects are examined as hearing changes and losses, interference with speech communication, annoyance and sleep interruption, other physiological or psychological responses, and the impairment of property values in the work place, the community, and on wildlife (Chanlett, 1979: 540).

Noise is an objectionable sound. It is in the wrong place at the wrong time. By defining noise as "unwanted sound", noise thus becomes subjective, since different segments of the population have differing levels of tolerance for noise. The majority of research on the effects of noise on communities has primarily dealt with noise levels surrounding jet aircraft operations (take offs and landings) at airports. These studies, often based on questionnaire surveys of area residents, produce data which is not "scientific" enough to develop strong conclusions. Biases may result from the researchers, the participants, the questionnaire itself, or as a result of the length of the survey: over time, noise which is at first regarded as "tolerable" will become "unacceptable" (Chanlett, 1979: 545). Community reaction to noise resulting from coal port operations (including coal train movements) and OCS support bases are expected to be similar to airport noise responses--subjective and wide ranging. Noise originating from or surrounding the operation of a particular piece of equipment (air compressor, crusher, etc.) would be governed by the laws and regulations concerning exposure to occupational noise, as administered by the Occupational Safety and Health Administration (OSHA), Department of Labor.

The Federal Noise Control Act of 1972 (42 U.S.C. S4901) sets federal noise emission standards for rail and motor carriers, but not specifically noise from transfer (loading, unloading) operations. The EPA is developing standards limiting the noise arising from railroad yard activities (switching, humping, and loading/unloading), and not just from the equipment itself (Michigan Department of Natural Resources, 1980).

The effects of noise on animals have not been extensively researched. The effects would, however, be similar to the effects on man. There is hearing loss which deprives the animal of signals of danger or the presence of prey. Animals depend on hearing for territorial stakeouts, courtship, and mating. Noise which makes natural sounds can be detrimental to animal survival. Noise around construction, airports, or factories can disrupt habitats. Impulse noises can startle, panic, or produce violent behaviors in animal population. Animals migrate from such conditions if alternate habitats can be found. Noise may therefore have detectable impacts on area wildlife (Chanlett, 1979: 551).

The potential for noise, pollution problems, and mitigating actions for coal terminals and OCS support base activities are discussed in Section 4.4 and 5.4, respectively.

3.4.6 Biological Productivity and Diversity

Wetlands comprise unique habitats which combine many features of both aquatic and terrestrial ecosystems with some unique features. National interest in conservation and environmental protection has lead to the enactment of various laws whose provisions include the protection of such wetlands as the habitat for waterfowl, wildlife, and many of the endangered species.

Wetlands are highly productive systems. Coastal marshes are among the most productive of all ecosystems. Primary producers in the marshes supply energy to nearby estuaries and marine environments. Detritus forms an energy source for the entire estuarine food chain, including the marshes used as nursery grounds for menhaden and other species.

Physical changes of the wetlands and estuarine environments, such as those caused by dredging, filling and other development activities, can have major impacts on the biotic systems of the area by changing the habitats and food chains of the organisms in these areas. Dredging, filling, bulkheading, and channelization projects will increase turbidity, change hydrodynamic patterns, destroy or inhibit growth of aquatic and terrestrial plants, and eliminate areas of productivity such as shellfish beds and breeding grounds. Increased commercial activity at ports and waterways could lead to increased concentrations of chemical substances or compounds in the waters which may be detrimental to aquatic biota, in spite of the stringent relations or controls governing the

use and discharge of such substances. The effects of coal port and OCS support base operations on the biota of the coastal area will be discussed in Sections 4.4 and 5.4 respectively.

An estuary is a semi-isolated body of water near the coast separated from the open sea by a partial barrier (Camougis, 1981: 56). The estuary has a free connection to the sea, with the water in the estuary being of medium salinity (5 - 18 parts per thousand) a result of the dilution of seawater by the freshwater from land drainage (river systems). Water temperatures vary seasonally, ranging from near freezing to 30°. Dissolved oxygen concentrations range from zero to saturation levels. The estuaries are highly nutritious, the rivers contributing nitrogen and phosphorus compounds. Biochemical oxygen demand (BOD) is quite high due to large amounts of decaying organic materials in the bottom sediments. Turbidity is often high, resulting from the suspended sediments brought in from the river and the constant mixing action in the estuary caused by tides, wind, and thermal currents. Flooding of the estuary, resulting from tides and/or excessive upland runoff causes most of the above parameters to be constantly changing.

North Carolina's sounds constitute the largest estuarine system along the Atlantic Coast, larger than the Chesapeake Bay system. This system, of the plankton-based type, functions as a nursery or temporary home for migrating nekton, including striped bass, menhaden, and shrimp.

Two documents provide the baseline data for the evaluation of development activities on the biota of the North Carolina coastal area. The Final Environmental Impact Statement, OCS Lease Sale No. 43 (U.S. Dept. of Interior, 1977) is included by reference in the Final Environmental Impact Statement, OCS Lease Sale No. 56 (U.S. Dept. of Interior, 1981) for much of the description of the aquatic and terrestrial biota of the region. The Atlantic Coast Ecological Inventory, prepared in 1980 by the U.S. Dept. of Interior, Fish and Wildlife Service, is of particular significance to this report. The accompanying maps (1:250,000 scale) show locations of gamelands, wildlife refuges and natural areas, and aquatic and terrestrial flora and fauna, including locations of species of special status, within the coastal study area. While the map scale prevents use in identifying specific sites, the inventory does serve as an excellent baseline for identifying areas which should be avoided to minimize potential conflicts between development and environmental concerns. Many other Environmental Impact Statements also provide abundant baseline data but of uneven quality.

3.5 The Recreation Context

3.5.1 General

Geography and climate combine to make the 16 counties an important part of the recreational resources of the coastal area of North Carolina. The public recreational resources of the area can be stated in terms of the number and acres of parks, beaches, marinas, piers, and boat launching sites. Additionally, the private sector has large investments in the recreational resources of the area in the form of motels and hotels, restaurants and nightclubs, retail stores, and private vacation homes and condominiums.

An important point is that the population using these resources can be analytically separated into two broad categories. First, there is the permanent resident population. This group represents the year-round residents and was discussed in detail in Section 3.2. Second, there is the temporary population which is comprised of two subgroups, i.e., the temporary overnight population and the temporary day population. In this section only the temporary populations will be discussed.

3.5.2 Geography of Recreation

An inventory of the recreational sites in the 16 impact counties indicates that the extensiveness of recreational areas varies directly with inclusion in the Coastal Zone Management Area. A measure of the extensiveness of recreational areas is provided by the "North Carolina Recreational Areas Inventory" (N.C. Department of Natural Resources and Community Development, 1976), which identifies public and private lands primarily used for outdoor recreation. Types of areal classification include high density recreational areas, general outdoor recreational areas, natural environment, areas, natural areas, wilderness areas, and historical or cultural areas.

Using this classification the counties with the largest proportions of land classified as recreational are Dare (82.7 percent), Pender (53.3 percent), Tyrrell (51.4 percent), Brunswick (36.1 percent), Hyde (33.8 percent), Carteret (25.8 percent), Washington (21.5 percent) and Craven (19.4 percent). Although counties with the smallest proportion of land classified as recreational are among the secondary impact counties, New Hanover County has only 3.9 percent of its land classified as recreational.

Another indicator of the possible extent of recreation is the area of the county that is covered by water. The figures in Table 24 include only inland water. Dare and Hyde Counties, with Pamlico Sound and Albermarle Sound, have the largest intracoastal recreational area (564,600 and 471,000 acres, respectively). Carteret County, with Core Sound, Bogue Sound, and Pamlico Sound, has the next largest intracoastal water recreational area (342,300 acres). The remaining coastal counties have relatively small, but significant water acreages comprised mainly of the area between the barrier islands and the mainland.

In addition to the total recreational acreage it is important to

locate recreational sites within the respective counties. Figure 7 provides a map of national, state, and private recreational areas. State parks within the primary impact counties area include Fort Macon (Carteret) and Carolina Beach (New Hanover). State natural areas include Roosevelt Natural Area (Carteret) and Masonboro Island (New Hanover). These major recreational sites are in the immediate coastal area.

3.5.3 Recreational Populations

As mentioned previously, the recreational populations may be analytically separated into two categories, i.e., the temporary overnight population and the temporary day population. The temporary overnight population stays one or more nights in the local county. The temporary day population enters and leaves the county in the same twenty-four hour period.

The recreational populations are important because of the pressure they put on recreational resources and the economic advantages (disadvantages) they provide to the respective counties. Although both types of temporary populations put pressure on recreational resources, the overnight population is considered to be economically more important than the day population because the latter are likely to spend more money on a per capita basis.

An immediate methodological problem is measuring the size of the recreational population and breaking that population into the two subcategories. Although a few limited counts of the recreational population and activities exist most cover an entire region rather than specific localities. Additionally, such counts that do exist rarely make the distinction between the temporary overnight and day populations.

Thus, the characterization of recreational populations is based on estimates from a variety of sources. Used as estimates, the intent is to indicate the relative magnitude of recreation within specific counties and the trends in those estimates.

3.5.4 Economic Measures of Tourism

One method of estimating the magnitude of recreational activity is to use estimates of travel and tourism expenditures. Although such estimates do not provide actual numbers of recreationists, they do give an estimate of the dollars generated and the relative importance of travel and tourism to the local economy.

Although the Travel and Tourism Division of the North Carolina Department of Commerce has made estimates of expenditures, their estimates for individual counties during the 1970's contain inconsistencies that make intra-county comparisons for selected years impossible. The reason for these inconsistencies are changes in the methodology for attributing expenditures to counties. One methodology (Rulison, 1980) was

TABLE 24. RECREATIONAL LAND AND WATER ACREAGE BY COUNTY

	Total Acres Recreational Land	% of Total Land Area	Total Acres of Water
OCS-Coal Exporting Counties			
Brunswick	200,559	36.1	23,200
Carteret	87,904	25.8	342,300
New Hanover	4,811	3.9	22,200
Transportation Counties			
Beaufort	29,549	5.6	88,800
Bladen	44,221	7.9	7,700
Columbus	14,767	2.5	10,400
Craven	89,209	19.4	42,400
Duplin	14,448	2.8	1,300
Lenoir	2,036	.8	3,300
Pender	288,541	53.3	6,900
Pitt	1,411	.3	2,000
Peat Counties			
Dare	204,365	82.7	564,600
Hyde	136,985	33.8	471,000
Pamlico	5,549	2.6	151,000
Tyrrell	130,837	51.4	109,200
Washington	46,245	21.5	55,000

Sources: N.C. Department of Natural Resources and Community Development, Division of Parks and Recreation, "N.C. Outdoor Recreation Areas Inventory."

N.C. Department of Administration Division of State Budget and Management, Profile: North Carolina Counties, Fifth Edition, 1977.

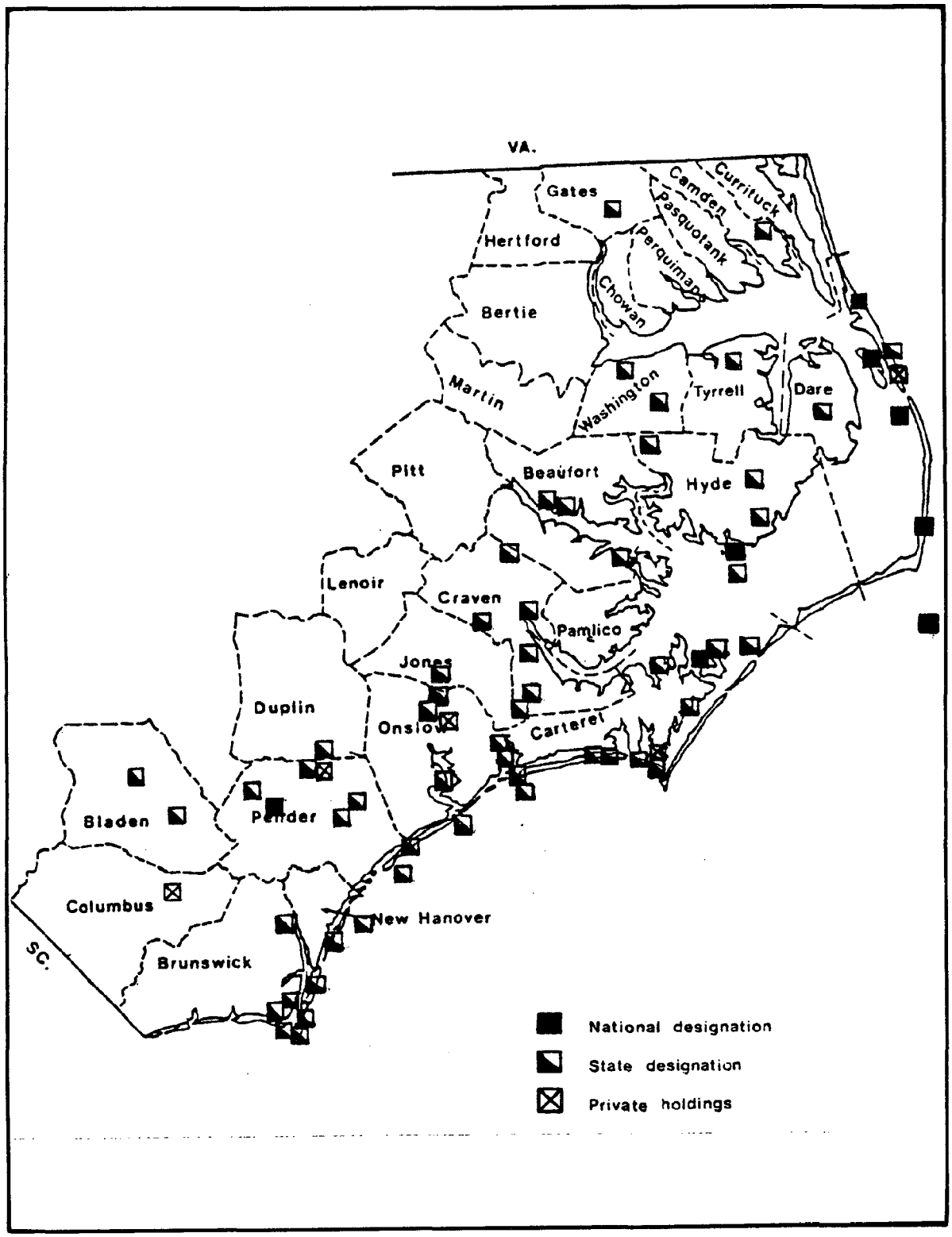

Figure 7. Natural and Recreational Areas.

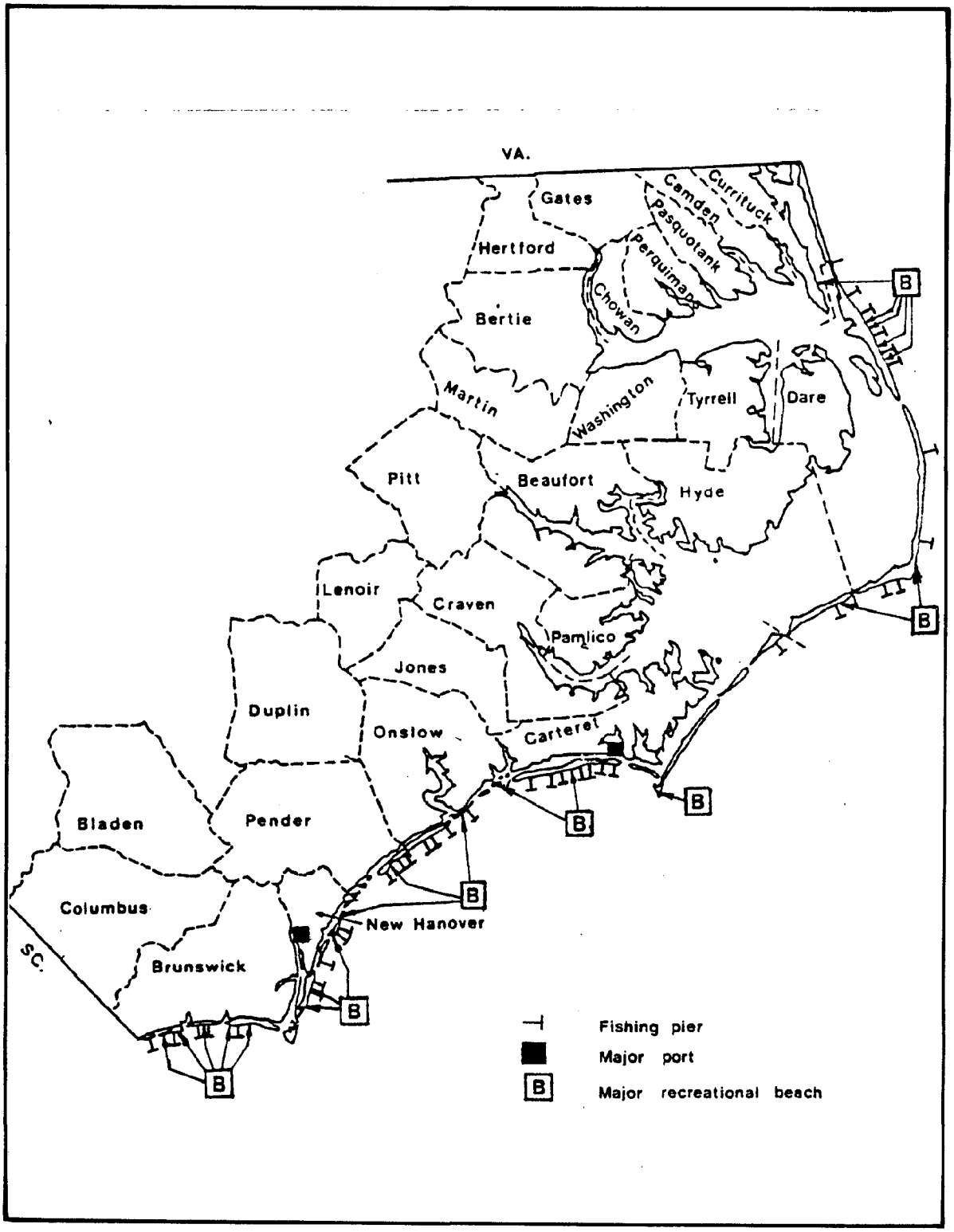

Figure 8. Beachfront Recreational Facilities.

TABLE 25. ESTIMATES OF TRAVEL AND TOURISM EXPENDITURES BY COUNTY (RULISON METHODOLOGY) 1973 and 1979

	1973			1979		
	Estimated Expenditures ($1,000)	% County Retail Sales	% State Travel Expenditures	Estimated Expenditures ($1,000)	% County Retail Sales	% State Travel Expenditures
Siting Counties						
Brunswick	6,112	10.7	.66	16,740	16.9	.79
Carteret	25,964	29.5	2.81	61,563	35.4	2.93
New Hanover	44,293	19.4	4.80	86,033	13.1	4.08
Transportation Counties						
Beaufort	5,488	5.1	.59	8,447	3.8	.40
Bladen	1,827	3.7	.20	2,922	3.5	.14
Columbus	1,876	1.7	.20	4,836	2.3	.23
Craven	8,464	4.9	.92	14,213	4.8	.68
Duplin	562	.6	.06	1,498	1.0	.07
Lenoir	6,210	3.5	.67	10,055	3.0	.48
Pender	3,223	11.7	.35	5,264	10.8	.25
Pitt	5,194	2.6	.56	22,853	5.4	1.08
Peat Counties						
Dare	50,627	133.6	5.48	120,788	124.0	5.70
Hyde	2,252	32.8	.24	7,705	50.4	.36
Pamlico	136	1.4	.01	98	.5	.01
Tyrrell	20	.3	.00	153	1.3	.01
Washington	391	1.3	.01	614	1.0	.03

a. These estimates were prepared by Dr. Michael Rulison, Center for Population and Urban Rural Studies, Research Triangle Institute, Research Triangle Park, North Carolina.

Source: N.C. Department of Commerce, Division of Travel and Toursim, "Travel Survey for North Carolina."

TABLE 26. ESTIMATES OF TRAVEL AND TOURISM EXPENDITURES BY COUNTY (COPELAND METHODOLOGY) 1975 and 1978

	1975			1978		
	Estimated Expenditures ($1,000)	% County Retail Sales	% State Travel Expenditures	Estimated Expenditures ($1,000)	% County Retail Sales	% State Travel Expenditures
Siting Counties						
Brunswick	4,354	7.7	.40	7,084	7.2	.36
Carteret	9,714	9.3	.89	16,937	9.7	.86
New Hanover	33,270	8.6	3.05	59,745	9.1	3.03
Transportation Counties						
Beaufort	5,343	4.6	.49	8,846	4.0	.45
Bladen	2,573	4.9	.24	4,253	5.1	.22
Columbus	5,095	4.1	.47	8,447	4.1	.43
Craven	8,615	5.0	.79	14,355	4.8	.73
Duplin	2,776	3.7	.25	4,615	3.0	.23
Lenoir	8,892	4.5	.82	14,644	4.4	.74
Pender	1,622	5.6	.15	2,677	5.6	.14
Pitt	10,177	4.4	.93	16,709	3.9	.85
Peat Counties						
Dare	17,961	36.3	1.65	27,522	33.9	1.40
Hyde	1,119	18.3	.10	1,831	13.1	.01
Pamlico	588	5.7	.05	970	5.7	.00
Tyrrell	231	4.1	.02	383	3.8	.00
Washington	879	2.9	.08	1,479	2.6	.01

a. These estimates were prepared by Dr. Lewis Copeland, University of Tennessee, Knoxville, Tennessee.

Source: N.C. Department of Commerce, Division of Travel and Tourism, "Travel Survey for North Carolina."

employed for 1973, 1979, and is being used for the 1980 estimates currently being prepared. A second methodology (Copeland, 1975) was used for the county estimates for 1975, 1976, 1977, and 1978. There is consistency between methods for comparisons across years for total state travel and tourism expenditures. Since expenditures for specific counties using different methodologies cannot be compared across years, the estimates for the study areas using the different methodologies are presented separately in Tables 25 and 26.

A brief comparison between the tables shows that, as expected, travel and tourism is more important for the primary impact counties than the secondary impact counties. However, there is a tremendous difference between the two methodologies in the county expenditures especially for the primary impact counties. For the most recent years (1978 and 1979) the difference for Brunswick County is over 9 million dollars, for Carteret County the difference is over 44 million dollars, and for New Hanover County the difference is over 25 million dollars.

Although the estimates of total expenditures for the state are calculated in the same manner using either methodology, the procedures for allocating expenditures to counties differs between methodologies. In the Rulison approach (Rulison, 1980) the county's proportion of the state's total hotel and motel receipts is used to calculate the county's share of the estimate of the state's travel and tourism expenditures. The Copeland Approach provides a conservative estimate of travel and tourism expenditures using hotel and motel receipts, food receipts, transportation receipts, and auto service transactions.

The conclusion is that both methodologies are inadequate when dealing with counties with large ratios of recreationists to permanent residents such as found in Carteret County. For these particular counties the Copeland methodology underestimates expenditures and the Rulison methodology overestimates expenditures. Further research on allocating travel and tourism expenditures to counties is suggested, especially since any assessment of impacts from development may affect this important segment of a local economy. The Brunswick County CEIP Project on oilspill impacts will be useful in assessing the economic significance of travel and tourism.

3.5.5 Noneconomic Measures of Tourism

Noneconomic indicators of recreational activity are also useful. Collectively these estimates help to geographically locate recreational activity and identify the types of recreational activity. The measures include visits to state parks and historic sites and the location and number of charter recreational fishing boats.

Table 27 provides information on visits to state parks and historic sites in the primary impact counties. Measured in terms of total visitors, Fort Macon is the second largest state park in North Carolina. In any of the three years shown nearly 20 percent

TABLE 27. ANNUAL VISITS TO CAROLINA BEACH STATE PARK FORT MACON STATE PARK AND FORT FISHER 1970, 1975, 1980.

	1970	1975	1980
State Parks			
Carolina Beach-New Hanover	N.A.	186,616	135,240
Fort Macon-Carteret	756,653	778,945	879,426
Historic Sites			
Fort Fisher-New Hanover	122,911	112,322	106,942

Sources: N.C. Department of Natural Resources and Community Development, Division of Parks and Recreation.

N.C. Department of Cultural Resources, Division of Archives and History.

TABLE 28. MAJOR CHARTER AND HEAD BOAT PORTS BY PORT AND COUNTY

	Number of Charter Boats	Number of Head Boats
Brunswick		
Holden Beach	3	
Shallote	3	
Southport	5	1
Carteret		
Atlantic Beach	10	1
Beaufort	2	
Harkers Island	3	
Marshallberg	3	
Morehead City	20	1
New Hanover		
Carolina Beach	11	
Kure Beach	2	
Wilmington	3	4
Wrightsville Beach	1	1

Source: U.S. Department of the Interior, Bureau of Land Management, Final Environmental Impact Statement, OCS Lease Sale No. 56.

of all state park visitations are to the Fort Macon site with 879,426 visitors during 1980. Attendance at Carolina Beach State Park declined in the last five years of the decade, but there were still 135,240 visitors during 1980. In terms of numbers of visitors, Fort Fisher is the most attractive historic site in North Carolina. For any given year over 20 percent of all visitations to state historic sites were to Fort Fisher with 106,942 visitors in 1980.

Taken together the data indicate the magnitude of recreational activity in the respective counties. Using North Carolina Division Parks and Recreation estimates, approximately 140,000 people visited Fort Macon during July, 1980, this in a county of approximately 40,000 permanent residents. It should be noted that the visitation figures for state parks, in particular, are biased in the direction of the temporary, day population since temporary overnight visitors have access to beaches and other recreational activities.

Another indicator of recreational activity is recreational fishing. A study by Centaur Management Consultants (1977) indicates that for the South Atlantic region in 1975 total sales related to marine recreational activity were approximately $288 million. Although information on recreational fishing are not broken down by state or county, data on the location and number of charter fishing boats are available.

As shown in Table 28, there is extensive charter boat activity in the three primary impact counties. There were 38 charter boats and two head boats in Carteret County with activity centered in Morehead City and Atlantic Beach. There were 17 charter boats and 5 head boats in New Hanover County with activity centered at Carolina Beach. There were 11 charter boats and one head boat in Brunswick County with activity centered in Southport. It is assumed that private fishing boats also operate through these ports and that the extensiveness of recreational fisheries in these counties is underestimated by the figures shown.

3.6 Fiscal Context of Development

The fiscal base on which the potentially impacted areas rest is intrinsic to an understanding of the extent and nature of the growth process. The types and quantity of services currently required by particular counties allows an insight into available resources and future needs.

Information is presented in Table 29 pertaining to assessed valuation and total property taxes levied by the counties in the study area. It should be noted that the generally massive percentage changes in assessed valuation between 1972 and 1980 (96 percent for Brunswick County, 500 percent for Carteret County, etc.) are due largely to reassessments rather than additional investments.

TABLE 29. ASSESSED VALUATION AND TOTAL PROPERTY TAXES LEVIED BY COUNTY 1972, 1977, 1980

	Assessed Valuation (000s)	Total Property Tax For All Purposes (000s)	Percent Total Levies Are Of Assessed Valuation	Assessed Valuation (000s)	Total Property Tax For All Purposes (000s)	Percent Total Levies Are Of Assessed Valuation	Assessed Valuation (000s)	Total Property Tax For All Purposes (000s)	Percent Total Levies Are Of Assessed Valuation
OCS-Coal Exporting Counties									
Brunswick	85,899	1,922	2.24	1,418,269	6,762	.48	1,683,456	9,449	.56
Carteret	91,609	2,182	2.38	461,373	3,555	.77	555,026	5,455	.98
New Hanover	696,195	8,973	1.29	1,610,280	17,480	1.09	1,860,258	20,860	1.12
Transportation Counties									
Beaufort	118,583	2,433	2.05	425,595	3,414	.80	793,456	4,138	.52
Bladen	72,709	1,428	1.96	296,759	2,518	1.19	364,469	3,786	1.04
Columbus	141,924	3,123	2.20	348,458	5,068	1.45	406,391	5,942	1.46
Craven	167,746	3,693	2.20	482,170	5,099	1.06	756,349	6,537	.86
Duplin	116,537	2,380	2.04	319,073	3,842	1.20	585,991	4,821	.82
Lenoir	174,509	4,039	2.31	554,298	5,835	1.05	707,135	8,401	1.19
Pender	53,530	959	1.79	194,852	1,938	.99	401,871	2,627	.65
Pitt	228,224	5,936	2.58	870,536	10,654	1.22	1,067,178	13,822	1.30
Peat Counties									
Dare	56,932	1,230	2.16	317,012	2,555	.93	376,436	3,931	1.04
Hyde	18,448	308	1.67	63,369	651	1.03	176,910	1,073	.61
Pamlico	37,634	463	1.23	63,250	847	1.34	80,098	1,073	1.34
Tyrrell	16,909	258	1.52	43,028	500	1.16	50,137	683	1.36
Washington	32,169	802	2.49	124,868	1,446	.78	158,646	1,821	1.15

Source: N.C. Department of Commerce, Tax Research Division, Statistics of Taxation.

TABLE 30. COUNTY TAX COLLECTIONS BY TYPE 1977, 1980

	FY1977					FY1980				
	Total County Taxes (000s)	County Share of State Taxes (000s)	County Share of Sales Tax (000s)	County-wide Property Taxes[a] (000s)	Other Taxes[b] (000s)	Total County Taxes (000s)	County Share of State Taxes (000s)	County Share of Sales Tax (000s)	County-wide Property Taxes[a] (000s)	Other Taxes[b] (000s)
Primary Counties										
Brunswick	$ 6,788	$113	$ 642	$ 5,957	$ 76	$ 9,068	$134	$ 983	$ 7,912	$ 39
Carteret	3,228	157	713	2,307	51	5,050	214	1,032	3,719	85
New Hanover	13,863	494	2,157	11,111	101	17,781	654	3,211	13,766	150
Secondary Counties										
Beaufort	$ 3,682	$220	$ 784	$ 2,639	$ 40	$ 4,508	$291	$ 999	$ 3,174	$ 44
Bladen	2,648	67	378	2,166	37	3,734	114	499	3,098	23
Columbus	5,151	126	826	4,181	17	6,121	166	1,055	4,877	23
Craven	5,540	323	1,207	3,954	56	7,181	383	1,577	5,143	78
Duplin	3,799	86	542	3,159	12	4,825	117	703	3,985	20
Lenoir	5,831	310	1,319	4,157	45	8,487	379	1,678	6,364	66
Pender	1,858	92	194	1,559	13	2,665	128	296	2,210	32
Pitt	9,796	331	1,392	8,009	64	12,686	485	1,954	10,138	108

a. Does not include school district levies.
b. License tax and excise tax on conveyances.

Source: N.C. Department of Commerce, Tax Research Division, Statistics of Taxation.

A significant difference exists in the percent that total levies are of assessed valuation between the OCS-coal exporting and transportation counties. For the OCS-coal exporting counties of Brunswick, Carteret, and New Hanover, the downward trend appearing between 1972 and 1977 has begun to reverse itself by 1980 while the trend for the transportation counties is a continuing reduction in the percent of the total valuation on which levies are assessed.

In terms of ranking the OCS-coal exporting counties in a continuum consisting of percentages of the assessed valuation, Brunswick County assessed the next to the lowest rate, while Carteret and New Hanover have rates that place them at the higher end of the continuum. Table 30 presents the tax sources of revenues for both OCS-coal exporting and transportation counties for 1977 and 1980. All counties experienced an increase in total county taxes received over this period as well as in virtually all categories within counties.

For 1980 the table shows that property taxes are the main source of tax revenue, followed by the counties' share of local government sales taxes, their share of state taxes and lastly "other taxes." New Hanover and Brunswick Counties rank one and three respectively in total amount of county taxes, for OCS-coal exporting and transportation counties, while Carteret ranks seventh out of the 11 counties.

3.7 The Land Use Policy Context

3.7.1 General

Potential development in the OCS-coal exporting and transportation counties will not occur in a land use policy vacuum. In 1974 the North Carolina General Assembly passed the North Carolina Coastal Area Management Act (CAMA) for the purpose of requiring committees and regions to plan for the management and long-term use of North Carolina lands and resources. While many of the resulting land use plans and their accompanying land classification maps are currently undergoing revision, a community or Council of Government's (COG) perception about its future can be gleaned from its most current maps and plans.

3.7.2 CAMA Land Use Definitions

The classification system for the following graphics generally corresponds to the North Carolina State Land Use Classification System and includes the following categories (Cape Fear Council of Governments, 1978).

DEVELOPED - Lands currently in urban use with an overall density of 2,000 persons/square mile or greater.

TRANSITION - Lands being developed with urban services to accomodate

future population growth at an average density of at least 2,000 persons per square mile by the year indicated, according to the following priorities:

1) Areas not presently serviced with water and sewer with a minimum population density of 2,000 persons per square mile.

2) Areas experiencing septic tank problems and/or facing potential public health threats by contamination of on-site wells or pollution of estuarine waters to which existing residential development is adjacent.

3) Areas where future development is expected and can be clustered for the provision of services.

4) Lands located along existing or proposed service corridors where higher density development is to be encouraged.

COMMUNITY - Lands characterized by a cluster of residential and commercial land uses in rural areas, limited municipal type services. May have public water but no public sewer unless necessary to correct existing or projected public health hazards. Overall density not to exceed 640 persons per square mile.

CONSERVATION - Lands that contain major wetlands are unique, fragile or hazardous for development, and are appropriate for natural resources management; or lands with one or more limitations that would make development costly or hazardous.

RURAL - To provide for agricultural, forest management, mineral extraction, and various other low-intensity uses on land sites, including residences where urban services are not required and natural resources will not be unduly impaired.

CONSERVATION - INDUSTRIAL - To provide for planned industrial access and simultaneously provide protection to estuarine wetland areas by the elevation of industrial access corridors.

3.7.3 Brunswick County

Although the Cape Fear Planning Region had the largest percentage population growth rate of the North Carolina Planning Regions between 1970 and 1975, the increase is primarily a consequence of growth in New Hanover rather than Brunswick County. Figure 9 shows that moderate change is expected in this largely agricultural/rural/conservation county with much of the predicted change occurring as a consequence of the construction of transportation corridors and recreation development. Figure 10 illustrates the pattern of present land use in Southport, an important urban center in Brunswick County which was classified as an urban place with the 1980 U.S. Census.

3.7.4 New Hanover County

Figures 11 and 12 reveal the current pattern of land use in New Hanover County as well as predictions for future growth, given the continuation of present trends.

Development in this county centers around the port of Wilmington, and over the past twenty-five years this development is a "fan-like pattern extending from the northeastern to the southeastern parts of the county. . .development to north and northwest part of the city (being) primarily industrial sites accompanied by a scattering of relatively compact subdivisions. In the northern part of the county agriculture is still a significant land use" (Wilmington, New Hanover County Planning Commission, 1976).

While long-range future development is expected to occur primarily in the south and northeast sections of the present urban area, along the intercoastal waterway, short-term growth is expected to occur in a pattern similar to that of the past twenty-five years, i.e., along proposed transportation routes.

Figure 12 illustrates the present pattern of land use in New Hanover County revealing it to be dominated by single family residential housing with industrial areas adjacent to the river and railroad on the western side of Wilmington.

It should be noted that not all of New Hanover County is included in this planning process - Wrightsville Beach and Carolina Beach have opted to prepare their own plans.

3.7.5 Carteret County

As indicated by Figure 13 current development as well as predicted growth in Carteret County, an area with considerable conservation and rural lands, is expected to occur around the developed communities of Newport, Beaufort, and Morehead City. In addition, Bogue Banks is expected to grow significantly as a consequence of the increasing importance of the recreational sector. For a more detailed view of the present pattern of land use in Beaufort and Morehead City (See Figures 14 and 15, See Section 5.7).

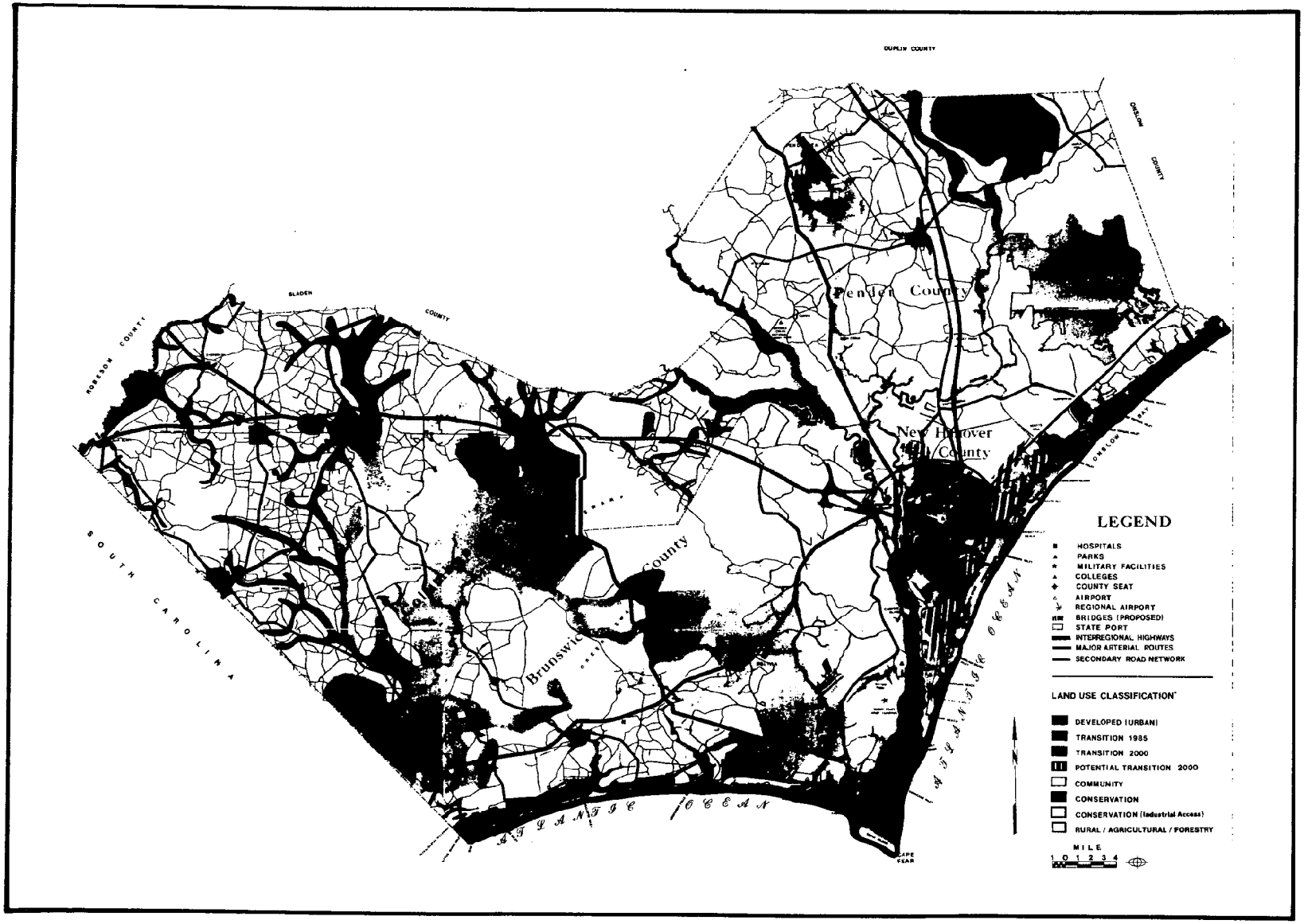

Figure 9. Land Use Plan, Cape Fear Council of Governments.

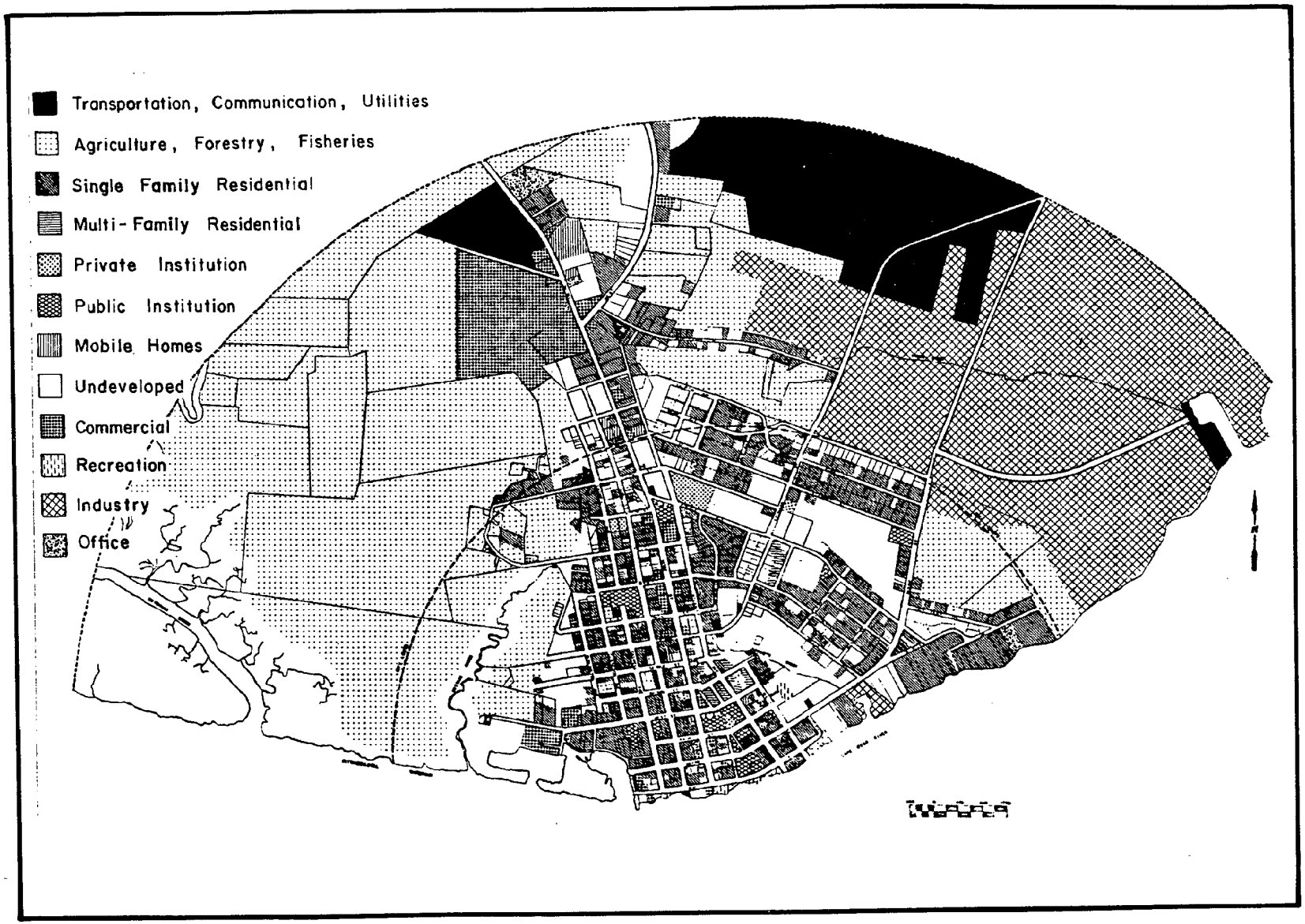

Figure 10. Land Use Plan, Southport City.

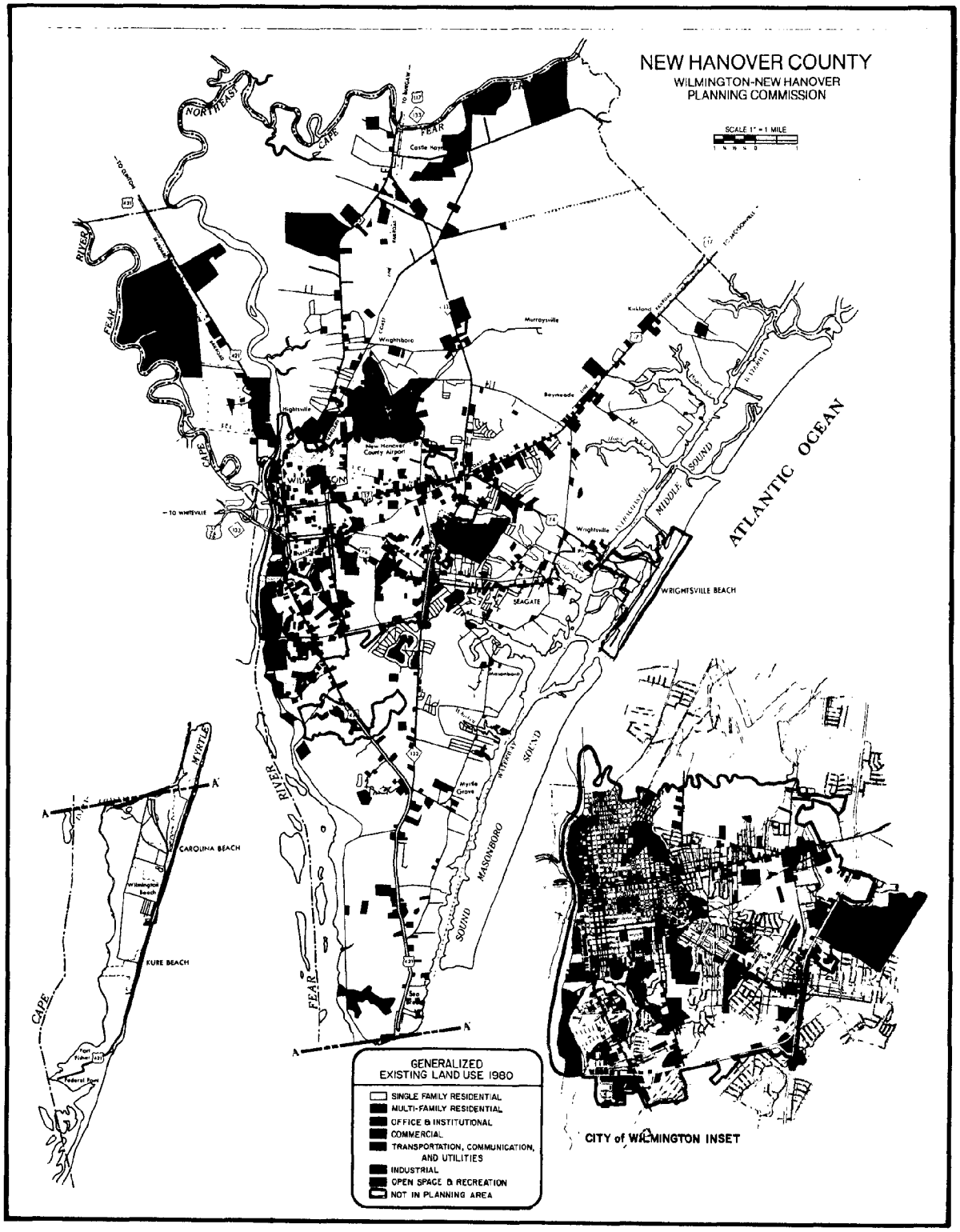

Figure 11. CAMA Land Use Plan, New Hanover County.

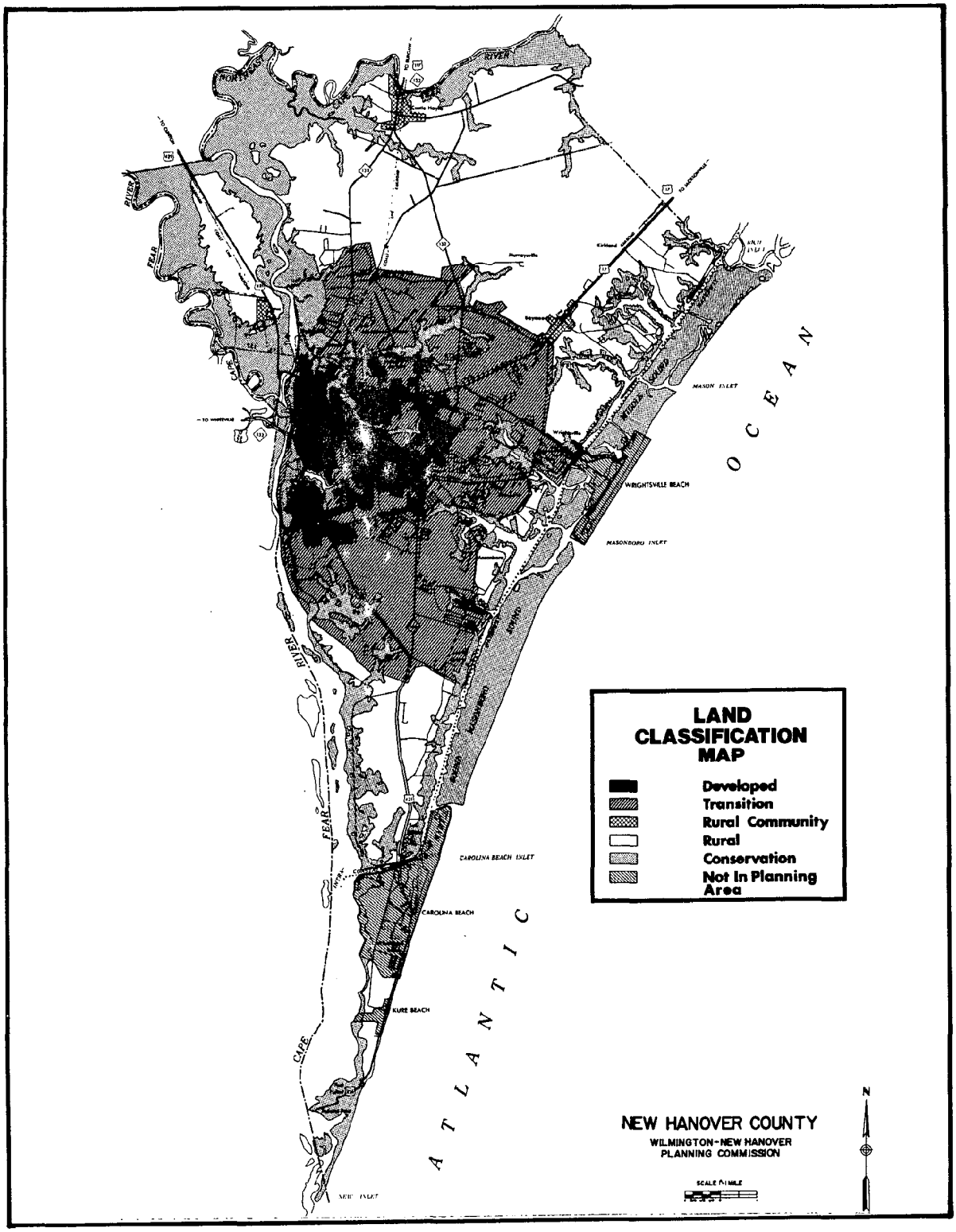

Figure 12. Land Use Classification, New Hanover County.

Figure 13. CAMA Land Use Plan, Carteret County.

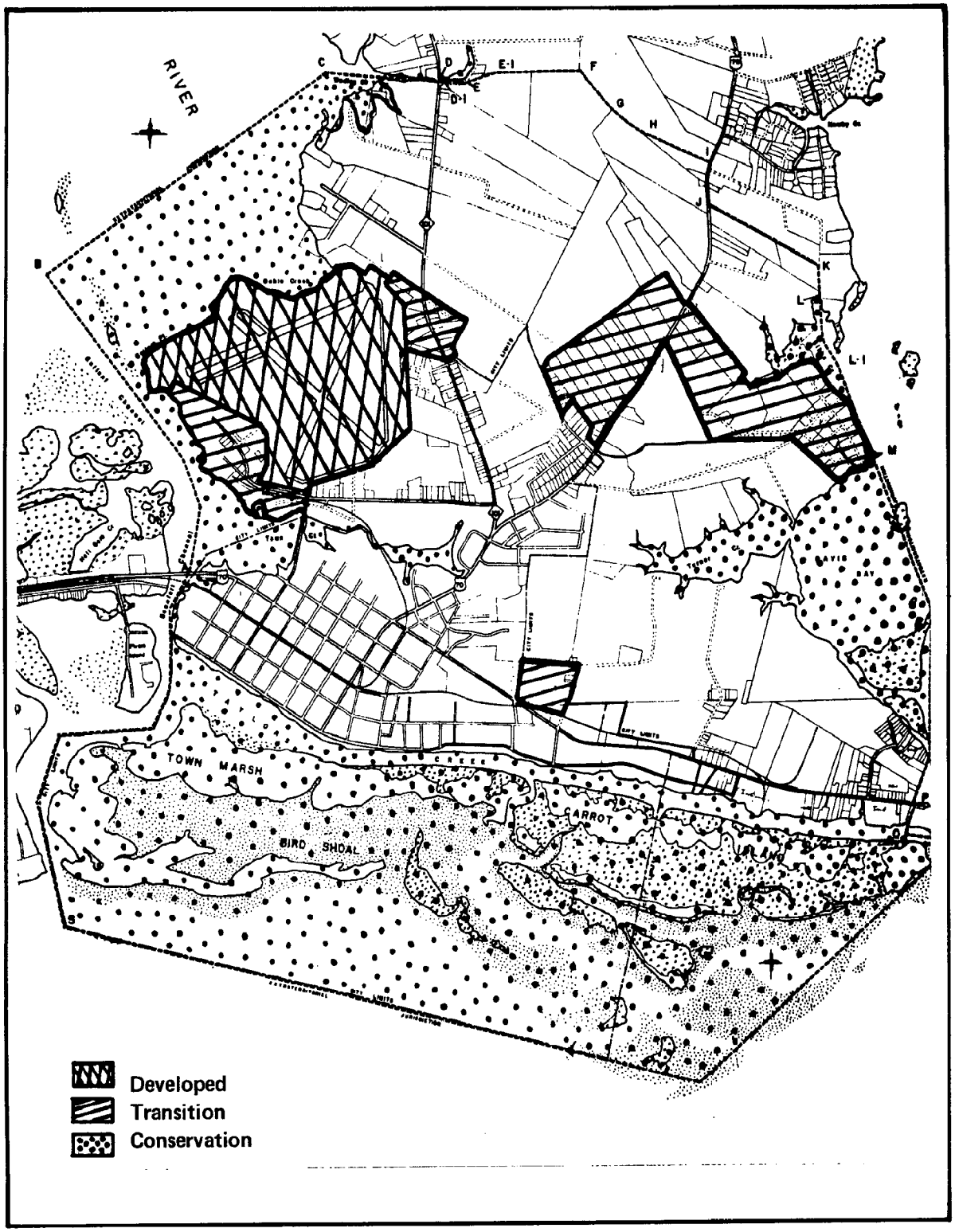

Figure 14. Land Use Classification, Beaufort City.

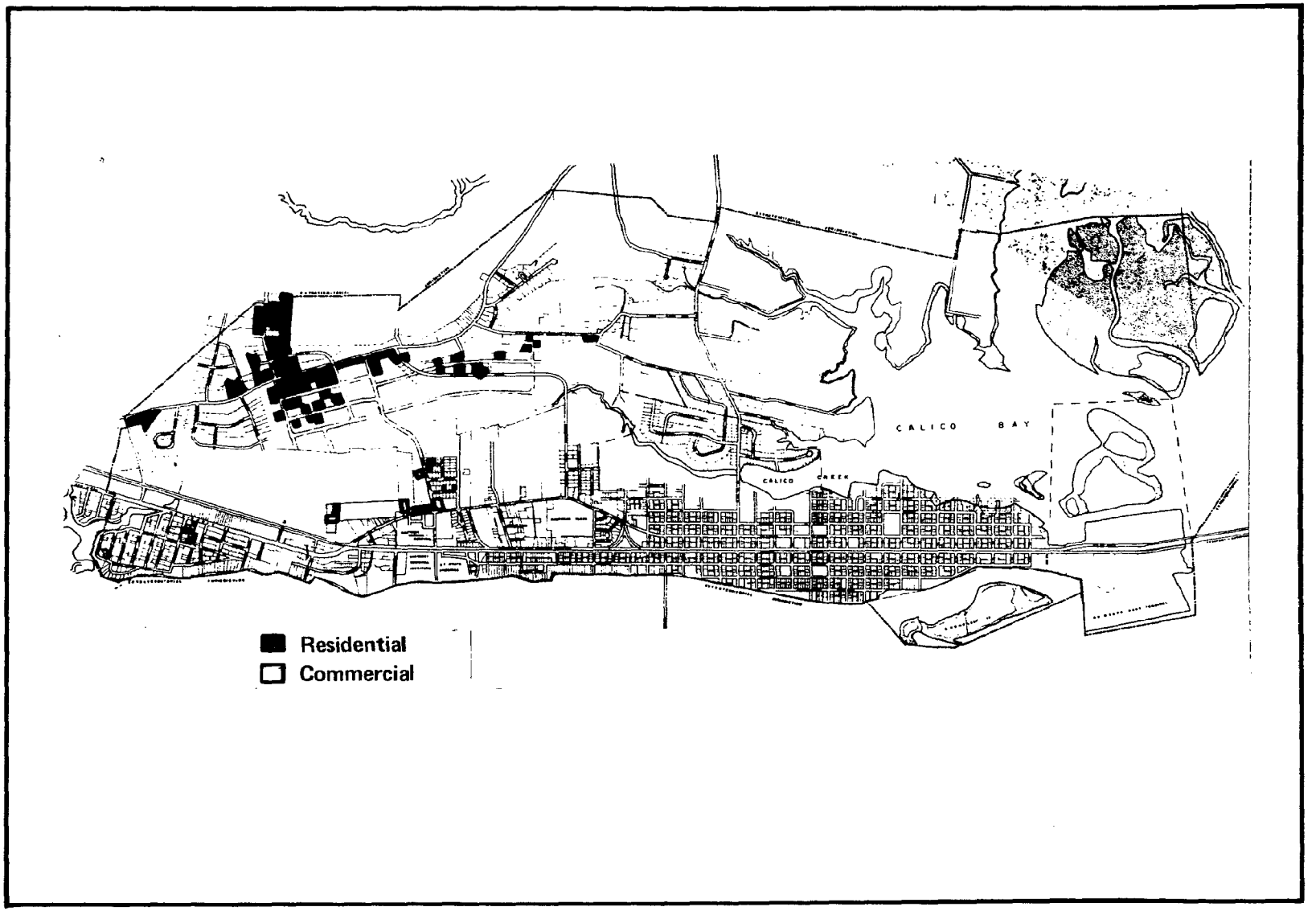

Figure 15. Land Use Classification, Morehead City.

4.0 POTENTIAL IMPACTS OF TEMPORARY OCS SUPPORT BASES

4.1 Introduction

OCS oil and gas exploration and development activities have the potential for creating various impacts on the surrounding communities and counties. Economic, socio-demographic, environmental, recreational, fiscal and land-use patterns, and processes may be involved. This section relates the above-mentioned concerns to a discussion of the impacts of temporary OCS support bases, focusing primarily on those sites recommended in the CEIP Report 2 -- site 17 in Wilmington and site 23 in Morehead City. (ITRE, 1981a)

4.2 Economic Assessment

Based on the Final Environment Impact Statement for Sale 56 (U.S. Department of Interior, 1981) between one and three temporary services bases will be required for the northern tract group for the 1984 through 1988 period. The range in the number of support bases is due to uncertainty about the amount and location of oil and gas in the area, as well as uncertainty about the willingness of particular companies to share a support base. While economies of scale do exist in regard to the material and personnel requirements for a temporary base, other factors are important. For example, it is generally the case that major oil companies prefer to operate their own service bases while smaller companies tend to operate out of service company operated bases that pool resources (future discussion of land use impacts appears in Section 4.7).

Direct, indirect and induced employment will be a consequence of the exploration stage of development. Jobs directly connected with the oil and gas activity as well as opportunities created due to an increase in population (i.e., more retail jobs, a need for more teachers, etc., will be created). The U.S. Department of Interior (1981) reports that approximately 1100 jobs will be created between 1984 and 1988, 83 percent of which will be related directly or indirectly to the oil and gas industry. Estimates of the proportion of these positions that will be filled by the local population vary from 45 percent (U.S. Department of Interior,1981) to 75 percent (NERBC-RALI,1976) with actual percentage dependent on the nature of the local employment situation and applicable skills of the local populace. Four main job categories exist at a service base: (1) wharf and warehouse crew (six per rig); (2) helicopter crew (three per helicopter); (3) crew boat crew (six per boat) and (4) supply boat crew (ten-twelve per boat) along with auxiliary and indirectly employed personnel. The average salary per individual was $17,000 in 1976 amounting to approximately $734,000 per rig year. Consequently, annual salaries for a base supporting three rigs would be in excess of $1,900,000, much of which would be paid to local inhabitants (See Section 4.3). In addition,

depending on the leasing arrangement (i.e., from a municipal port or private owner) and the amount of construction necessary, the literature suggests that capital investment for a temporary base can range from $150,000 to $250,000 (NERBC-RALI, 1976). As the two recommended sites are on existing N.C. State Ports Authority property, the necessary capital investment would be towards the lower end of this scale.

4.3 Social Demographic Assessment

4.3.1 Population Growth

Changes in the socio-demographic characteristics of a population or region (i.e., migration rates, population size, urbanization rates, etc.) reflect changing needs in services (Section 4.6) as well as changing aspects of social life. While too rapid rate of population growth (estimated to be 10 percent per year) can overburden service delivery systems, cause a deterioration in the quality of community life, a no growth situation may reflect stagnation, out-migration, etc. (HUD, 1976). Since forces for population growth exist whether or not the proposed development is approved, it is useful to determine the extent to which the proposed activity will cnange the host communities (See Section 4.7). Although the data presented in Table 31 are concerned primarily with the OCS production development rather than the OCS exploratory stage, they given an indication of the impact the OCS exploratory stage will have on the demographic structure. Overlap between exploration and development periods is minimal since development is not slated to begin prior to 1989 (U.S. Department of Interior, 1981).

As shown in the Table 33, even the maximum case scenario under the OCS generated growth does not result in a growth rate approaching HUD's critical growth level. Using population figures from Section 3.3.2 for the Wilmington area the added growth accounts for a maximum of 14 percent of the base case growth prediction. However, it should be noted that while the combined OCS-generated plus base case maximum scenario for the Morehead City and Brunswick areas indicates moderate growth levels, in these areas OCS generated growth may account for a greater proportion of the increase in population.

4.3.2 Urbanization

That the community could be radically transformed due to OCS exploration activity has been a concern from Alaska to the Gulf of Mexico. However, the moderate manpower needs for this stage of activity (See Table 31) coupled with the already urban nature of the Wilmington metropolitan area and increasingly urban nature of the Morehead City area, indicate moderate impacts in this regard.

4.3.3 Migration

Migration can be expected to affect the host areas by drawing

TABLE 31. EMPLOYMENT ESTIMATES (NONCONSTRUCTION) NORTHERN AND SOUTHERN TRACT GROUP DEVELOPMENT SCENARIOS

Northern Tract Group

Year	Direct & Indirect LRE - HRE	Induced LRE - HRE	Total LRE - HRE
1984	159 - 159	32 - 32	192 - 192
1986	464 - 464	96 - 96	560 - 560
1988	348 - 348	71 - 71	419 - 419

Source: U.S. Department of Interior, Bureau of Land Management, FEIS Lease Sale No. 56, 1980.

into the area new populations (See Table 32) that will generate increased demand for services, and by changing commuting/employment patterns of local residents who take OCS related positions.

As shown in Table 32, both adult and school-age populations can be expected to rise. It should be noted that the ratio of school-age children to adults is generally lower for migrant oil and gas workers due to their usual work pattern which involves several weeks at the job site followed by a return to their families in the Southwest.

The counties in which the two potential sites are located have different geographical employment patterns. New Hanover County is a net importer of labor from Brunswick and Pender Counties. Carteret County is a net exporter of labor to Craven County. Locating jobs in New Hanover County (site 17) would further accelerate this process adding population and revenues. Locating positions in Carteret County (site 23) would tend to reduce the outmigration of labor and revenues.

4.4 Environmental Assessment

CEIP Report No. 2 (ITRE, 1981a) describes the requirements for a support base, and describes 16 prospective sites for the location of a base in North Carolina. As explained in that report, several of the sites are all but eliminated from consideration by the lack of sufficient transportation infrastructure: rail service, roads, air facilities, or channel depth are inadequate without major capital expenditures or large-scale development which would have adverse environmental impacts. A brief description of each of the 16 sites, with potential environment effects associated with each, follows.

4.4.1 Morehead City

The four prospective sites in the Morehead City area are located in an industrial area surrounding the existing State Ports Authority terminal. Site C-13 (Marsh Island) and Site 22, the northwest corner of the existing SPA Terminal, have limited water depths and would require extensive dredging to meet the needs of the work support boats; the boats would also have bridge clearance problems with the highway and railway bridges connecting Morehead City with Beaufort. Site C-13 has no rail or highway access. The expenditures required to develop these two sites are most likely greater than the oil exploration companies would like to spend, especially for a temporary base. Site C-13 is currently used as a dredge spoil dumping ground. The use of this site for a base would reduce the land available for spoil disposal which is already quite limited in the Morehead City area.

TABLE 32. POPULATION IMPACT--ESTIMATED NEW RESIDENT POPULATION AND SCHOOL ENROLLMENT

Northern Tract Group Development Scenario

Year	New Resident Population LRE - HRE	School Enrollment LRE - HRE
1982	0 - 0	0 - 0
1983	0 - 0	0 - 0
1984	51 - 51	18 - 0
1986	146 - 146	52 - 52
1988	197 - 107	38 - 38

Sources: BLM, 1980.

U.S. Department of Interior, Bureau of Land Management, FEIS Lease Sale No. 56, 1980.

Site 21 (Radio Island) has good rail and highway access, and is adjacent to the 40-foot channel. However, the site contains only ten acres which may prove too small for expanded use in the future. Also, rail traffic may become congested if a proposed coal terminal (Site C-12) is built on Radio Island. A dock, pier, or bulkhead structure must be built to accommodate the service boats at this site. The environmental impacts of such a structure were discussed in Section 3.4.3, Land Resources Usage.

Site 23 (west side of the existing SPA terminal) is the best of the four Morehead City sites with respect to minimizing environmental impacts. No additional dredging or wharf/dock construction would be required. There would be little or no erosion or sedimentation during the construction of any facilities required. The terminal provides the necessary rail, highway, and utility and communication facilities. Reducing the amount of additional construction required, thus minimizing any adverse environmental impact, is another reason for Site 23 being the recommended alternatives for the Morehead City area (Section 2.6, Volume 1).

4.4.2 Wanchese

The lack of rail and highway facilities and the large amount of dredging that would be required to provide adequate depth channels for service boats almost exclude Site 15 from further consideration. The several miles of dredging required to deepen the existing 8 1/2 foot deep channel to 20 feet would generate enormous volumes of dredge spoil. The construction of a rail spur could not be justified if it were used only to serve the support base. Obtaining permits for construction of the magnitude required for a base at this site would be a major undertaking in itself. Site 15 is thus not recommended, primarily because of adverse environmental impacts resulting from the required levels of development.

4.4.3 Southport

Site C-6 has been determined to be unavailable for development, either as a support base or as a coal terminal, and therefore warrants no further discussion (Section 2.6.3 of CEIP Report 2). Site C-5 (North of Pfizer Chemical Company) is a high ground site, surrounded by tidal flats and marshland. The use of a T-headed pier would minimize the effects associated with bulkheading and/or dredging and filling associated with other types of wharf construction. The five-mile long rail spur required to join the site with the existing U.S. government-owned rail line would require careful planning and construction, (possibly involving large amounts of trestle) to avoid deterioration of the surrounding wetlands. Erosion and sedimentation from the site during construction would require careful controlling to prevent damage to fishing areas and the disruption of benthic activity.

A positive aspect of locating the support base at Site C-5 is the minimization of ship traffic congestion on the Cape Fear River since Site C-5 is only five miles from the mouth of the river.

4.4.4 Wilmington

Site 1 (Eagle Island) is strategically one of the best locations in the Wilmington area. Environmentally, however, the site has several problems. Since the island is primarily built up from dredge spoil, almost any heavy structural construction would require substantial foundation work, possibly causing sedimentation or erosion of the island into the river. Construction of a pier or wharf would be required, with the accompanying environmental impacts: disruption of hydrodynamics, destruction of fish nursery areas, wildlife areas, and others.

Site 2 (south of Barnard's Creek) would require (extensive dredging to connect a channel with the ship channel (approximately 3,000 feet). Since the site is surrounded by a farm and a country club, there may be more noticeable noise and/or air quality impacts at this site than one in an industrial land use classification. At least one mile of rail spur would have to be constructed to serve the site.

Sites 3 and 4 (north of Snow's Cut) would require seven miles of railroad track, at least a mile of dredging an existing channel to a sufficient depth, and construction of wharf facilities. The impacts from such construction would be substantial.

Site C-8 (north of Town Creek) has no rail or highway access, is 3,000 feet from the deepwater channel, and bordered on the north and south by marsh and tidal flats. This site would require a substantial amount of development, similar to Sites 3 and 4, with the associated adverse impacts. Site 9 (south of NC 133 on Brunswick River) would be similar in scope for rail and dredging requirements and thus is not recommended.

Sites 10 and 11 (on the Northwest Cape Fear River) are above Wilmington and would require substantial amounts of dredging to serve the sites, along with wharf construction required at each site. In addition, Site 11 would require two miles of road and three miles of raid to adequately serve the site. Any such construction could have significant impacts on the wetlands and marshes that must be crossed.

Site C-17 (north end of existing SPA terminal) is one location currently under serious consideration as a coal terminal site. Complete facilities -- rail, highway, and wharf space -- are currently available. This site would have the least impact environmentally of the nine sites in the Wilmington area.

4.4.5 Recommendations

The sites recommended in Section 2.7 of CEIP Report No. 2 (ITRE, 1981a), Site 17 and 23, require the least development of all those evaluated. Thus, these two locations would also have the least environmental impacts from use as support bases. The environmental considerations were taken into account in the parametric analysis (Table 7, CEIP Report No. 2), thus there should be little, if any, conflict surrounding the use of either site as a support base.

4.5 Recreational Assessment

"The Atlantic Ocean, its beaches, associated historical features, national seashores and resorts are tourist destination areas contributing significantly to the economy of the coastal region" (U.S. Department of Interior, 1981), as well as providing recreation and supplementary income for local residents. Adverse impacts on these sectors of the economy could lead to a severe damaging of the economic variability of many small coastal communities dependent on tourist and recreational trade.

Since the two sites recommended for the location of the temporary OCS supply base are situated on already existing State Ports Authority industrial oriented installations, activity at the two sites is least likely to create severe competition or impacts on the recreational/tourist industry. Such impacts as would exist would be the consequences of increased boat and helicopter activity around the base and the possible aesthetic deterioration of the night horizon due to lights on exploratory rigs.

4.6 Fiscal Assessment

4.6.1 General

As stated in Section 4.2 the areas chosen for a support base stands to benefit from the construction and operation of the facility. Such economic assistance would be welcome insofar as the Wilmington SMSA was third from last with regard to per capita income of all North Carolina SMSAs while Brunswick and Carteret Counties totaled 76 and 87 percent of the North Carolina average of $7,382 for 1979 (U.S. Dept. of Commerce, 1981).

However, as the HUD study (HUD, 1976) indicates, while revenues from energy development are generally sufficient (in the long run and at the regional level) to defray expenses, problems related to timing and geographic distribution of revenues, exist for local communities. Revenues may lag behind the costs of expanded government services, as taxes, leases, etc. imposed on the project usually come in after the project is completed and complicate the issue of payment for the amelioration of present problems. Revenues may be distributed

inappropriately, revenues may be paid to state or county level agencies while ". . .impacts are absorbed by a city or community. . . It should be recognized that while benefits are long-range and regional the negative impacts are immediate and local" (HUD, 1976). The severity of these impacts depend on a variety of social factors such as original population size and composition, size of project, composition of facilities needed, and available facilities.

4.6.2 Housing

In many cases the first impact on a community is on housing. Should a greater demand for housing appear than can be filled, workers and their families turn to mobile homes, a prospect not generally welcomed in planned growth counties. Given the size of the proposed work force, attendant population increase, and nature of the proposed site communities, Site 17 seems to be more able to accommodate the housing increase with less adjustments being necessary than Site 23 and 24.

4.6.3 Service

As indicated by Table 33, additions to the schools' populations are projected to be modest and possibly short-run. For most projects, the growth of school age populations during the exploration phase can be adequately serviced by existing community structures (i.e., sanitation, police, fire, entertainment), with Site 1 providing a larger, more diversified population base and so fewer adjustments (See Table 33). Requirements for the installation itself appear in Section 2.4 and indicate that the State Ports Authority facilities can provide sufficient resources for the temporary OCS service base.

4.7 Land Use Impact Assessment

The proposed exploration and development of oil and gas resources in or near the proposed sites (17 and 23) must be considered in the context of an ongoing development scenario. Regional planning councils as well as city officials had predicted growth before the possibility of oil and gas development arose. It is therefore important not only to discuss the potential development as a growth stimulus, but also to discuss its relative impact within the broader context of regional growth.

Both areas proposed as sites for the temporary OCS supply base are involved in seeking, as well as planning for, future population and economic growth with their attendant changes in land use patterns (Cape Fear Council of Governments, 1978; Carteret County Planning Dept., 1978). Given this non-hostile stance plus the placement of the sites on industrial rather than rural, residential, or conservation areas, conflicts with such interests should be minimal. Conflicts that do occur may arise from the competition among different industries (i.e., coal vs. oil) for limited space.

TABLE 33. POTENTIAL ONSHORE DEVELOPMENT AREA IMPACT INDICATORS FOR COMMUNITY SERVICES/FACILITIES

Potential Onshore Development Area	Maximum % Share of Onshore Impacts	Projected Population[c] 1985	1990	Average % Annual Increase 1985-1990	OCS-Generated Population (Peak) Total (avg. Annual Inc.) LRE	HRE	% Annual Inc.[d] LRE	HRE	Proj. Pop. Average % Annual Inc.[e] (Base Case)	Combined Average % Annual Inc. (OCS generated + Base Case) LRE	HRE
Morehead City Area	100[a]	44,000	48,600	2.1	925 (308)	3,083 (1,028)	0.6	2.2	1.9	2.5	4.1
Wilmington Area	75[a]	170,000	197,100	3.2	694 (231)	2,312 (771)	0.1	0.4	2.8	2.9	3.2
Brunswick Area	75[b]	62,300[b]	68,100	1.9	875 (292)	2,761 (1,381)	0.5	2.1	1.8	2.3	3.9

a. Percent of Northern Tract Group development scenario impacts.
b. Percent of Southern Tract Group development scenario impacts.
c. Considered as base case projections without OCS development.
d. Average annual increase to peak population as a percent of estimated development area population at beginning of increase.
e. Average annual increase of projected population (base case) during period of OCS-generated population growth.

Source: North Carolina Division of State Budget and Management. Update; North Carolina population projections. Raleigh, N.C.

4.8 Summary

The two proposed sites strike a balance between regional, state, and community goals while at the same time not contributing to a boom-town accelerated growth pattern with its concomitant social and economic problems.

In conclusion it might be added that the planning process will be useful whether or not the project is completed. If the project is cancelled or transformed into something radically different, the plans themselves may be useless; however, the identification of goals, means of attaining these goals, and various options will be of lasting value. Sites suitable for one type of energy development are usually suitable for many other types of water-dependent energy or industrial development. Part of this process involves a monitoring or survey mechanism that will provide constant feedback from the host community or region. Studies in the West (Gilmore, 1976; Kresge, 1977) have shown that such mechanisms forestall future problems. At present such a mechanism is not in place, as evidenced by a lack of awareness in coastal communities of OCS activity.

5.0 POTENTIAL IMPACTS OF COAL EXPORTING FACILITIES

5.1 Introduction

5.1.1 General

The development and operation of a system for transporting to, and exporting coal from, sites in coastal North Carolina has the potential for creating various impacts on the counties and communities that will form the transportation corridors. In this section the possible economic, social-demographic, environmental, recreational, fiscal, and land-use impacts of the coal export terminal sites identified in CEIP Report 2 (ITRE, 1981a) and the railroad and ship transportation corridors (See Section 2.0) which would serve those sites will be discussed.

This analysis presents an initial assessment of potential impacts in an ongoing monitoring process in the development of coal exporting facilities in North Carolina. Several qualifications related to the process of development and the relative lack of recent historical experience in coal exporting serve to limit the data for specific elements of the present analysis and the conclusions of this study.

The proposals for the development of coal exporting facilities have and are occuring rapidly (ITRE, 1981a). Responding to new economic markets with new facilities, investors have many technological options to choose from, e.g., high capacity terminals, coal slurry systems, midstream transfer, pneumatic pipelines, conveyor belts, extra-wide-beam ships, and barge carrying ships (Office of Technology Assessment, 1981: 58-62). The significant fact for the present study is there is little historical data for judging the economic costs, employment, or environmental consequences of the alternative technologies.

Additionally, since most of the facilities are still in the planning stages, investors' figures on costs and employment are as yet unavailable, or those figures that are available are very tentative.

Given the number of coal exporting facilities that are being proposed, one must remember that whether an individual project becomes operational is not independent of the other proposals. Generally each proposed coal export facility is in competition with all other United States' coal ports (Office of Technology Assessment, 1981), a competition which will be decided by the markets for steam coal and the economics of particular ports and technologies.

Additionally, each of the proposed coal facilities must compete locally for scarce resources such as rail, land, and water access.

For example, given the existing rail system serving Morehead City, there will be competition between the Alla-Ohio Valley Project and the Gulf Interstate Project for access to the rail system.

While it is outside the purview of this study to determine which projects will compete successfully in the steam coal export market, this impact assessment will identify limitations respective projects might face in this competition.

5.1.2 Assumptions for Impact Assessment

A series of assumptions that form the basis for this initial assessment of the impacts of the coal export facilities and the transportation systems to serve them can be identified.

1. The proposed sites for coal export facilities are those identified in Volume 1: C-12, C-16 (Carteret County); C-7, C-17, C-20, C-21 (Brunswick-New Hanover County) (ITRE, 1981a: 47).

2. The infrastructure requirements for the coal exporting facilities are those identified in Volume 1 (ITRE, 1981a: 46).

3. The transporting of coal feedstocks to the coal exporting facilities will use existing rail services (See Section 2.0).
   a. Sites C-12 and C-16 are served by the Southern Railroad operating through Carteret, Craven, Beaufort, Pitt, and Lenoir Counties.
   b. Sites C-7, C-20, and C-21 are served by the Seaboard Coast Line Railroad operating through Brunswick, New Hanover, Pender, Duplin, Columbus, and Bladen Counties.

4. The transporting of coal from the ports will use 60,000 dwt ships.

5.2 Economic Assessment

5.2.1 General

There are presently six companies which have identified sites for coal exporting terminals and the available data for these proposals are presented in Table 34. Given that most of the projects are in the initial planning stages, the data on the scope of the respective operations are tentative and incomplete. While data on the amount of coal to be exported and capital investment are the most complete, estimates of new direct and indirect employment are essentially non-existent. The only employment figures which exist are those for the Alla-Ohio Valley Coal Company operation which has already begun at

TABLE 34. PROPOSED COAL TERMINAL SITES, STARTUP DATES, CAPACITIES, CAPITAL INVESTMENT, EMPLOYMENT, PAYROLL, AND RAIL AND SHIP TRAFFIC.

	Startup Date	Effective Capacity	Capital Investment ($ Millions)	Estimated New Employment	Estimated Payroll ($ Millions)	Estimated Number of Units Trains/ Day[b]	Estimated Coal Ships/Year[c]
Carteret County							
1. State Ports Authority Terminal (Alla Ohio Valley Coal Co.)							
a. Existing SPA facilities (C-16)	1981	3	4.5	65	1.3	2	50
b. Radio Island	N.A.[a]	10-15	N.A.	N.A.	N.A.	8-12	167-250
2. Radio Island (Gulf-Interstage Engineering Co.) (C-12)	1984	15	60-70	85	3.0	12	250
Brunswick County							
1. Northeast Cape Fear River (American Coal Co.) (C-20)	1982	3-7	15	40	.75	2-5	50-117
2. Pleasant Oak PLantation (Utah International Coal Co.) (C-7)	1984	5-7	N.A.	N.A.	N.A.	4-6	83-117
New Hanover County							
1. Northeast Cape Fear (Clean Coal Terminals) (C-21)	1982	3	10	24	.5	2	50
2. Northeast Cape Fear (Williams Terminals)	1984	10-20	70	60	N.A.	8-16	167-333
Pender County							
1. Scotts-Hill (Wheelbrater-Frye)(C-18)	1985	12-14	150	100	N.A.	10-12	200-233

a. Not available.
b. Unit train are assumed to be 100 ton cars - 75 cars per train.
c. Ships are assumed to be 60,000 dwt.

Source: N.C. Department of Natural Resources and Community Development, Office of Regulatory Relations, "Coal Export in North Carolina: A Review of the Issues" (October, 1981).

Morehead City. The reasons for the incompleteness of the employment data were discussed in the previous section (5.1.1).

Estimates of the number of unit trains per day necessary to move the coal to the respective ports shown in Table 33 are based on the lowest and highest companies' forecasted annual coal tonnage. An important consideration of these estimates is the potential total number of trains moving in and out of each service area. For the Carteret County rail system the minimum number of trains, if both facilities were operational, would be 22 unit trains per day while the maximum number would be 38 unit trains per day. Corresponding figures for the Brunswick-New Hanover County rail system the minimum number is 20 unit trains per day while the maximum number is 30 unit trains per day.

Estimates of the number of ships per year which would be needed to export the coal shown in Table 34 are also based on the companies' forecasts of total annual tonnage. Considering the potential total number of ships using the channels and port facilities of the two service areas, the figures are dramatic. For Carteret County, the minimum number is 310 ships per year and the maximum number of ships is 533 ships per year. For the Brunswick-New Hanover County the minimum figure is 265 ships per year and the maximum figure is 390 ships per year.

These estimates for unit trains and ships for the respective rail and port systems serving Carteret County and Brunswick-New Hanover support the argument that the various coal port projects will be in competition locally for limited rail service and docking facilities in addition to being in competition with all other coal export facilities for existing steam coal markets (See Section 5.1.1). Although the following discussion focuses on individual projects, the data in Table 34 can be viewed as a means of multiplying the magnitude of impacts if all proposed facilities were to come on line.

5.2.2 Economic Benefits and Employment

The economic impacts of coal exporting include the primary and secondary development tied to the operation of coal terminals. Impacts from primary development include the employment and income generated by the industrial projects that serve and support the coal exporting facility. Examples of secondary indirect development projects include rail services, ship repair, vessel supply, freight forwarders, shipping agents, storage facilities, and repair operations. Secondary induced development includes the employment and income created by the expansion of community services and facilities to serve primary and indirect secondary development, e.g., banks, restaurants, and schools.

Given the paucity of data for existing coal port proposals, the best approach for estimating the economic benefits of coal

exporting is to start with a case study of the Alla-Ohio Valley project at the State Ports Authority Terminal in Morehead City. A North Carolina Department of Transportation (1981) study provides estimates of the economic benefit stream resulting from the Alla-Ohio Valley project. The focus is only on those benefits occuring solely to North Carolina.

An analysis of the economic benefits is shown in Table 35. An initial fifty new jobs at the terminal site have been estimated as a result of the Alla-Ohio Valley project. These jobs provide a $1 million payroll increase for the Morehead City-Carteret County area. This payroll is circulated through the local economy several times providing a "multiplier effect." The multiplier effect developed by the State Ports Authority is 1.9 (N.C. Department of Transportation, 1981), thus the associated income is $1.9 million. The total income figure for Morehead City is $2.9 million per year or $8.7 million over the three year period.

The Alla-Ohio Valley project will generate additional railroad employment and State Ports Authority revenue. The estimate of income produced over the three year period by the additional railroad employment is $1.02 million. Net revenues generated for the State Ports Authority are $4.9 million.

Given the fact that the Alla-Ohio Valley project does not necessarily end after the three year contract, but actually may expand from 3 mta to 10-12 mta there are longer range economic and financial benefits. The North Carolina Department of Transportation's (1981) analysis of the economic and financial benefits is shown in Table 36. Alla-Ohio Valley's estimates indicate that an additional 50 new jobs would be created by 1986. Projected over a 20 year period, payroll benefits are estimated to be over $87 million, while net revenues for the State Ports Authority are forecast to be approximately $50 million.

The forecasts of economic benefits have focused on one project, and forecasts for other projects would be parallel with a few notable exceptions. There is no basis to argue that there is a one to one increase between tonnage exported and the number of new jobs. For example, Alla-Ohio Valley has hired 50 workers to move 3 mta but expects to add only 50 more workers to move an additional 7-9 mta by 1986. It will be important to monitor the job opportunities realized by the actual development of coal export facilities.

An important consideration in assessing the new employment is who will fill those jobs (See Section 3.2). An important question, suggested by the OCS experience, is what proportion of the new jobs are filled by local residents as opposed to new residents. The best current evidence is that 40 jobs will be filled by local residents (Carteret County News-

TABLE 35. PAYROLL AND PORTS AUTHORITY BENEFIT STREAM RESULTING FROM PORTS AUTHORITY (MOREHEAD CITY) THREE-YEAR COAL CONTRACT*

		Payroll Benefits			Financial Benefits
Tons[1]	Year[2]	Morehead City[3]	R.R. Employment (N.C.)[4]	Total (N.C.)	Ports Authority Net Rev.[5]
1.75 Million	1981	$ 2.9 M	$ .18 M	$3.08 M	$1.375 M
3	1982	2.9	.42	3.31	1.75
3	1983	2.9	.42	3.31	1.75
		$8.7 M	$1.02 M	$9.73 M	$4.875 M

*Only benefits accuring solely to North Carolina are included. Railroad and coal company financial returns have thus been excluded from analysis. All values are in constant 1981 dollars and no discounting of 1982 and 1983 values to reflect present (1981) values has been done.

[1]Tonnage projections from State Ports Authority.

[2]Reflects three-year coal contract.

[3]Components of this benefit stream include direct and indirect employment gains at Morehead City, as well as a "multiplier" of 1.9 times the employment (payroll) increase.

[4]This benefit stream results from simplified calculations of crew-time required for the North Carolina portion of the coal-haul. Train crew-consists were assumed to be four employees and N.C. coal-haul travel time (most probable route) was roughly calculated at a current 8 hours. Train trips varied with coal volume (assuming unit trains of 70 tons, 75 cars) from about 1.75 to 3 per day (one round-trip equalling two trips). Payroll increases were based on Southern Railway's N.C. average employee wage in 1979, factored up 10% per year to 1981 and then held constant.

[5]Net revenue projections from State Ports Authority.

Source: N.C. Department of Transportation, Transportation Planning Division, "Coal Train Movements Through the City of New Bern."

TABLE 36. ECONOMIC AND FINANCIAL BENEFIT STREAM FROM UNIT-TRAIN COAL MOVEMENT THROUGH N.C. TO MOREHEAD CITY*

Term: 20 years[1]

Discount Rate: 5%

Tons[2]	Year[3]	Payroll Benefits[4] Morehead City[5]	R.R. Employment (N.C.)[6]	Total (N.C.)	Financial Benefits[4] Ports Authority Net Rev.[7]
3Millions	1983	$ 2.75 M	$ .40 M	$ 3.16 M	$ 1.67 M
3	1984	2.63	.38	3.01	1.59
8	1985	4.29	.97	5.26	2.59
10	1986	4.77	1.38	6.15	2.88
12	1987	4.55	1.43	5.98	3.13
13	1988	4.34	1.46	5.80	3.17
14	1989	4.12	1.49	5.61	3.20
15	1990	3.92	1.42	5.34	3.21
15	1991	3.74	1.35	5.09	3.06
15	1992	3.56	1.29	4.85	2.92
15	1993	3.39	1.23	4.62	2.78
15	1994	3.23	1.17	4.40	2.64
15	1995	3.07	1.11	4.18	2.52
15	1996	2.93	1.06	3.99	2.40
15	1997	2.79	1.01	3.80	2.23
15	1998	2.66	.96	3.62	2.18
15	1999	2.53	.92	3.45	2.07
15	2000	2.41	.87	3.28	1.97
15	2001	2.29	.83	3.12	1.88
15	2002	2.18	.79	2.97	1.79
		$66.1 M	$21.5 M	$87.6 M	$49.9 M

*Only benefits solely accruing to North Carolina included. Railroad and coal company financial returns have thus been excluded from analysis.

[1]This period was selected to correspond to the reasonable project life of any major investment (e.g., rail by-pass which might be required as a result of the coal movement.)

[2]Tonnage projections from State Ports Authority. SPA projection of 15 million tons for 1990 has been extended to 2002 unchanged.

[3]1983 was selected as the initial year for calculation of the benefit streams in order to allow for comparisons with the cost of major investments which might be required as a result of the coal movement. It has been assumed that such investments would not be completed until the beginning of 1983.

[4]The benefit streams have been discounted back to 1982 present-value to allow comparisons to any major project investments required by the coal movement. These investments, it has been assumed, could be completed no earlier than 1983.

[5]Components of this benefit stream include direct and indirect employment gains at Morehead City, as well as a "multiplier" of 1.9 times the employment (payroll) increase.

[6]This benefit stream results from simplified calculations of crew-time required for the North Carolina portion of the coal-haul. Train crew-consists were assumed to be four employees and N.C. coal-haul travel time (most probable route) was roughly calculated at a current 8 hours. Train trips varied with coal volume (assuming unit-trains of 70 tons, 75 cars) from 3 to 15 per day (one round-trip equalling two trips). Payroll increases were based on Southern RAilway's N.C. average employee wage in 1979, factored up 10% per year to 1983 and then held constant.

[7]Data from Ports Authority. Contract renumeration per ton was held constant at the 1981-84 rates.

Source: N.C. Department of Transportation, Transportation Planning Division, "Coal Train Movements Through the City of New Bern."

Times, 1981a). Given the high proportion of Carteret County workers who are employed outside the county (See Section 3.2.3), it is questionable whether the new jobs will reduce unemployment in the county. A similar pattern can be expected for Brunswick County which is also a net exporter of workers (See Section 3.2.2).

5.2.3 Commercial Fishing

As established in Section 3.2.6, commercial fisheries is an important element of the respective counties' economies, and the development of coal export facilities may impact this livelihood. While it is documented that development, in general, particularly affects the estuarine shellfish industry (Maiolo and Tschetter, 1981), nothing is known about the effects of increased ship traffic on the ecology of the estuarine system. As previously mentioned (See Section 5.2.1) the increased volume of ship traffic will be dramatic. Additionally, the impact of dredging the channels to accommodate larger ships, an alternative for decreasing the absolute number of ships to move the forecasted tonnage (Carteret County News-Times, 1981b), must be studied for its impact on commercial fishing.

5.3 Social-Demographic Assessment

5.3.1 General

Relevant social demographic changes due to the development of coal exporting facilities includes changes in population growth and changes in the social structure of the local communities. Potential changes in population growth patterns due to development are likely to concentrate in the communities/counties in which the terminal facilities are located because this is where the new jobs associated with coal exporting are located. Changes in population size and composition will affect the demand for community services.

Potential changes in the social structure will be located in both the community which is the site of the terminal facilities and in communities which are part of the transportation corridors serving the ports. Of particular interest are the social impacts of the increased volume of rail traffic moving the coal to the terminal facilities.

5.3.2 Population Growth

As mentioned in Section 4.3.1, a too rapid rate of population growth can overburden community service systems and cause a deterioration in the quality of community life. The HUD indicator for too rapid growth is a population growth rate in excess of 10 percent per year (HUD, 1976). As noted in Section 3.3.2, preliminary 1980 census data indicate that while the three primary impact counties grew significantly during the 1970's, the growth figures did not approach the HUD estimate of too fast a growth rate.

A question remains if the coal export facilities will significantly increase the population growth rate. Since coal export facilities tend to be capital intensive rather than labor intensive, the relatively low gains in new direct and indirect employment would not effectively spur population growth. Additionally, since most new jobs will be filled by local residents there should be little, if any, increased new migration due to coal export.

In fact there is the possibility that the development of the coal export terminals using existing transportation facilities may detract from the positive in-migration the counties have recently experienced. This argument focuses on the aesthetics of local communities as a factor in attracting new residents and tourists. Specifically, assuming the continuance of the existing transportation infrastructure, the large increases in rail and ship traffic estimated from the forecasted tonnages of coal (See Section 5.2.1) may negatively alter potential residents and tourists perceptions of the coastline in the primary impact counties. Empirical support for this argument will be made in subsequent sections.

5.3.3 Social Impacts of Railroad Traffic

The most significant impacts of the development of the coal export terminals result from the traffic necessary to move the coal on the existing transportation systems. Although there are potential impacts all along the rail systems, the potential effects are most significant in urban areas. Three cities can be singled out for consideration, i.e., New Bern, Morehead City, and Wilmington. In New Bern the railroad tracks pass through the central business and historic districts using the center of Hancock Street. In Morehead City the railroad tracks pass through the central business district using the center of Arendell Street. Although the railroad tracks in Wilmington are not in the middle of a street, they do pass through important business areas. In all three cities all the railroad tracks have grade crossings that intersect traffic.

To gauge the impact of the traffic delays due to unit coal trains, estimates of railroad crossing delays per intersection are shown in Table 37. The number of train movements per day are related to the number of tons of coal to be shipped. The two estimates of delay times are based on the usual train speed for New Bern (5 mph) (N.C. Department of Transportation, 1981) and Morehead City (10 mph) (Carteret County News-Times, 1981a). Although the delay time for moving low volumes of coal are initially minimal, the times become dramatic when the volume of coal increases. For example, the minimum number of trains for the Alla-Ohio Valley and Gulf Interstate projects is 22 trains (See Section 5.2.1), a figure which would cause a total delay per day of 2.5 hours for New Bern and over 1 hour for Morehead City. For the maximum number of 37 trains, the total delay time would be over 3 hours for New Bern and almost 3 hours for Morehead City. Delay times for Wilmington would not be as significant because with the locations of the projects, most of the trains would not have to pass through the city.

TABLE 37. ESTIMATED RAILROAD CROSSING DELAYS BE SPEED OF TRAINS

Tons (Millions)	Estimated Train Movements Per Day[1]	Total Crossing Delay/Intersection/Day 5 MPH[2]	10 MPH[3]
1.75	2	15.4 min.	7.7 min.
5	6	46.2	23.1
10	12	92.4	46.2
15	18	138.6	69.3
20	24	184.8	92.4
25	30	231.0	115.5
30	36	277.2	138.6
35	42	323.4	161.7
40	48	369.6	184.8

1. Unit trains are assumed to be 70 ton-cars-75 cars/per train.

2. Crossing delay based on 7.7 minutes crossing blockage resulting from one train movement/day.

3. Crossing delay based on 3.85 minutes crossing blockage resulting from one train movement/day.

Source: Adapted from Table 3, N.C. Department of Transportation, Transportation Planning Division, "Coal Train Movements Through the City of New Bern," 1981.

TABLE 38. ESTIMATED POTENTIAL ECONOMIC IMPACTS ON CENTRAL BUSINESS DISTRICT AND HISTORIC DISTRICT

Number of Trains in Either Direction During Time Period	Time Period	Approximate Number of Shopper-Tourist Trips Not Made During Train Movements	Potential Annual Revenue Losses
1	10:00am-12:00noon	115	325,100
1	12:00noon-02:00pm	139	394,600
1	02:00pm-04:00pm	49	139,400
1	04:00pm-06:00pm	106	301,800
2	10:00am-12:00noon	230	650,200
2	12:00noon-02:00pm	278	789,300
2	01:00pm-04:00pm	98	278,800
2	04:00pm-06:00pm	213	603,600
3	10:00am-12:00noon	344	975,300
3	12:00noon-02:00pm	417	1,183,900
3	01:00pm-04:00pm	147	418,200
3	04:00pm-06:00pm	319	905,400
4	10:00am-12:00noon	458	1,300,400
4	12:00noon-02:00pm	556	1,578,600
4	01:00pm-04:00pm	196	557,600
4	04:00pm-06:00pm	425	1,207,200

Source: N.C. Department of Transportation, Travel Planning Division, "Coal Train Movements Through the City of New Bern," 1981.

Important impacts of this rail traffic are its effects on retail sales, emergency vehicle operation, recreation, noise, dust and vibration levels. While recreational impacts will be discussed in the Section 5.5 and noise, dust, and vibration levels will be discussed in Section 5.4, the present discussion will focus on retail sales and emergency vehicle operation.

The North Carolina Department of Transportation (1981) has made estimates of the number of shopper-tourist trips not made during train movements which are shown in Table 37. Although the estimates are judgemental, the data show there is a strong positive relationship between the number of trains and the total dollars lost to the central business district. Although similar figures do not exist for Morehead City, it is safe to assume that the increases in train traffic would have significant impacts on the Morehead City central business district and less so on the Wilmington Central business district.

Another important element of community service is the provision of emergency vehicle service. The North Carolina Department of Transportation study (1981) of New Bern indicates that available alternative emergency routes exist that would not significantly alter emergency response times due to traffic blockage. A similar situation also exists for the Wilmington area. However, the emergency vehicle situation in Morehead City will have significant problems as rail traffic increases.

The Carteret County Hospital is north of the railroad tracks and when trains are using the Arendell Street tracks all populations south of the tracks may be prevented from access to the west bound lanes of Arendell Street. This population includes the south side of Morehead City and the Bogue Banks area. This latter problem will not be solved with the proposed new bridge from the mainland to Atlantic Beach (See Section 5.5), since even with the new bridge the emergency vehicles would have to cross the railroad tracks going east to the hospital.

5.3.4 Social Impacts of Ship Traffic

As discussed in Section 5.1.1, there will be a significant increase in ship traffic. Apart from the demands on port infrastructures, there is a potential social impact from the ships which should be investigated. The number and characteristics of crews working the ships may be important given the minimum number of ships estimated for Morehead City at over 300 ships and the maximum at over 500 ships, and corresponding figures of over a 250 ship minimum and over a 350 ship maximum for the Brunswick-New Hanover area. Since ship crews tend to be younger, single males, there is a potential for new establishments to serve such a population. Additional impacts of shipping will be discussed in Sections 5.4 and 5.5

5.4 Environmental Assessment of Coal Terminal Operation

5.4.1 General

The major environmental problems associated with the transportation and terminal operations of coal for export include dust, water quality, traffic congestion from unit trains, and noise from both trains and loading/unloading operations. These impacts can be effectively controlled or minimized using currently available technology.

Three adverse impacts of coal train movement are increased noise levels, vibrational damage to structure and traffic disruption and delays. Noise depends upon train volume, type of train, train speed, and condition of the roadbed. Trains can cause increases in noise levels to 200 times that of a quiet urban day (Stone, 1981: 7). Regulations governing locomotive and train operation noise were discussed in Section 3.4.5. At the 3-5 miles per hour speeds required for the trains moving through the New Bern and Morehead City city limits, the primary source of noise will be from the engines.

Vibrations from the increased occurrence of train movements may cause damage to existing structures, especially older buildings located in the historical district along Hancock Street in New Bern. Factors to be evaluated in an assessment of the impacts of rail vibrations include: distance to structure, condition of structure, frequency of induced vibrations, soil types and rail and bed conditions (N.C. Department of Transportation, 1981). Geological and engineering analyses, including seismic recordings of train-induced vibrations, are required before a more definite statement can be made regarding the effects of such vibrations.

Coal dust will result from the unloading of trains, stock-piling, loading of ships, and the fugitive dust originating from the coal cars in transit. Most unloading operations for the sites proposed for North Carolina will be bottom dump unloading rather than rotating car dumpers. Any coal unloading operation will result in the release of coal dust and particulates. The quantity of dust emissions is dependent upon coal size, moisture content, type of installation, and rate of throughput (operating capacity). Estimates of dust emissions during unloading operations are on the order of 0.4 pounds per ton unloaded for uncontrolled unloading (Szabo, 1978: 76).

Coal storage is divided into two types: storage and stock-piling. Storage refers to quantities of coal held in reserve for times when the quantity of coal available in stockpiles is unable to meet demand. Electric utilities and industrial operations will often have storage piles of 30 to 120 times the daily operating demand. Stockpiles are often referred to as "active" storage or "short-term" storage. Closed storage, in silos or other enclosed structures, is considered to be the best available control technology in many parts of the county, and may be required in the future at all locations. Since all coal terminals involve short-term storage, methods sometimes used to prevent windborne particulate emissions from storage piles, such as the use of asphaltic sealants, is infeasible for these applications (Pelham, 1980: 16-17). The level of

particulate emissions from open coal storage piles is dependent upon:

Pile geometry
Surface area of the pile
Moisture content and bulk density of the coal
Coal size and erodibility
Local lopographical conditions
Local meterological conditions
Regional precipitation
Length of storage and condition of crust formation
Mitigation measured employed

The particulate emission factor for a coal storage pile has been estimated at 12.5 pounds of particulates per ton-year of storage (Pelham, 1980: 27).

Due to the high humidity and wind conditions in the coastal areas where the coal terminals are proposed, it is recommended that enclosed storage (silos, bins, etc.) be required at any terminal site.

Loading the coal from stockpiles to the colliers will most likely be by means of enclosed conveyors and loadout chutes to reduce the particulate loss. The use of water sprays on chemical sprays at transfer points will also help reduce the particulate emission load. The permitting process, described in Section 2.3.4 of Volume 3, will require the use of control technology to prevent any significant deterioration of the surrounding air quality.

Fugitive dust, escaping from coal cars in transit, can be controlled by use of wind screens or tarpaulins on the cars, or the use of water, oil, or chemical sprays on the exposed coal surface in the cars. Estimates of the fugitive emission factor for coal in transit vary from 0.05 percent to 10 percent by weight (Szabo, 1978: 77).

Water quality surrounding a coal terminal may be adversely affected by several means: runoff of storm water from the site itself, precipitation which contacts airborne coal dust, and coal spills into waters from accidents or careless handling practices. Water contacting the dust, spilled coal or open storage piles may be degraded by taking on dissolved or suspended solids and fines, including sediment, solid mineral debris, colloidal and dissolved materials.

All coal terminal sites will probably be required to treat all surface runoff and waste streams (such as those from dust suppression spraying operations) before discharge into either a publicly owned waste treatment system or a receiving body of water. The discharge of untreated runoff may result in the following potential adverse environmental impacts (Pelham, 1980: 22):

1. The alteration of the pH of receiving waters.

2. The precipitation of metallic hydroxides in larger or higher buffered receiving streams, resulting in flocculent coatings that cover stream bottoms and destroy benthic organisms.

3. Significantly increase the concentration of trace metals in receiving waters. Metals can be biomagnified in the food chain and may affect humans as well as animals.

4. Increased turbidity of receiving waters.

5. Reduce oxygen concentrations in receiving waters through chemical oxygen demand.

6. Percolation through soils and contamination of groundwater with heavy metals, organics and groundwater with heavy metals, organics and depressed pH.

In general, control technology available for reducing the impacts of wastewater can be classified as follows: (1) techniques that reduce runoff/leachate flow and characteristics (source control); and (2) techniques that remove pollutants from the runoff/leachate wastes (collection and treatment). Various source control techniques have been developed to reduce coalwater interaction. Table 39 provides a summary of some source control techniques and their advantages and disadvantages.

The collection and treatment of wastewater is currently practiced at many terminal operations. Treatment usually includes removal of suspended solids and pH control. The use of storage ponds or detention basins exclusively is only effective in the removal of suspended solids. These basins, if carefully designed and constructed, are effective in meeting suspended solids effluent limits. Runoff from some coal, especially the higher sulfur eastern coals may require neutralization prior to discharge. The basic methodology for treatment of runoff would consist of:

1. Collection of runoff from the entire site.

2. Providing sufficient capacity for storage prior to treatment.

3. Removal of suspended solids and heavy metals,

4. Sufficient storage capacity to provide for polishing of the effluent.

5. Utilization of treated wastewater for dust suppression sprays and other non-potable uses, if possible.

6. Recovery of coal fines from settling and precipitation facilities.

Table 40 summarizes typical treatment systems currently in use for runoff/leachate pollution control.

TABLE 39. SUMMARY OF SOURCE WATER CONTROL TECHNOLOGY

Control Technology	Advantages/Disadvantages
Open-sided shed storage with perimeter containment	Low capital cost
Tarpaulin	Can promote spontaneous combustion
	Suitable only for small storage piles
Sealing coal pile with asphaltic spray*	Provides control against water contact as well as dust emission
	Can promote localized combustion unless sealant cover is applied on top as well as on side slopes to prevent "chimney" effect
Sealing coal pile side slopes with earth	Effective in reducing water-coal contact as well as wind erosion
Application of chemical binders runback and polymers (e.g., acrylics)	Effective in controlling wind erosion
	Coal-water contact is only minimized by formation of a crust on coal particles
	Less expensive than asphalt spray
	Easy to handle and spray
	2 to 3 applications over the area where effective in preventing contact with coal (90%) of rainfall
Prevent oxidation of pyritic and marcasite coal by preventing air circulation through the coal pile	Will reduce leaching of sulfur and iron compounds
	Will reduce acidity in leachate/runoff
-Increase coal size or reduce surface area	Will reduce treatment requirements for leachate/runoff
-Coating coal with oil	
-Store aged or weathered coal	

*Sealant requirements depends upon coal pile permeability, coal size; may be minimized by covering the pile with fines up to 0.3 (ft) deep.

Source: Pelham, p. 37.

TABLE 40. TYPICAL TREATMENT SYSTEMS

Collection and Treatment	Advantages/Disadvantages
Catch basin with provisions to monitor overflow	Effective only in reducing suspended impurities
	Not suitable for reducing acidity and 'yellow boy' problems or for heavy metals
Collection and reuse of runoff/ leachate for spray systems	Treatment required only for reducing suspended particles to protect against nozzle clogging
Pit and berm storage of coal	Provides positive containment of runoff/leachate
	Improves aesthetic appearance; visible height of coal pile is reduced

Source: Pelham, p. 39.

Chapter 3 of Volume 1 of this report describes the requirements for a coal terminal (Table 12, Volume 1), and describes the 11 prospective sites for the location of a terminal in North Carolina. Four of the sites (C-5, C-8, C-13, and C-17), which were identified both as potential support base and coal terminal sites, have already been described in Chapter 4. The remaining seven coal terminal sites will be described in the following section.

5.4.2 Morehead City

Site C-12: Gulf Interstate Engineering Company Site on Radio Island: As discussed in Section 3.4.1 of Volume 1 the development of this site would require the construction of a T-head pier; the impacts of marine construction were discussed in Section 3.4.3 of this volume. The site is smaller than the recommended acreage for a terminal (Table 12, Volume 1), but should be sufficient for the volume of coal exports predicted. The use of this site will involve the movement of unit trains through Morehead City and across the low level bridge across the Newport River.

Site C-16: Alla-Ohio Valley Coal Company Site in Existing SPA Terminal: There have been no serious complaints of environmental degradation at this site since it began operation in April 1981. Since the site is using the existing terminal facilities, the impacts should be minimal. (An actual on-site investigation of the environmental controls has not been performed at this time. This is expected to be done within the next several weeks).

Site C-19: Brant Island: As stated in Volume 1, this site would have severe environmental problems if a coal site were to be developed there, due to the amount of construction required for providing rail and/or highway access. No further consideration of this site will be given at this time.

Site C-14: Near Junction of US 70 and NC 24: The development of this site would eliminate the movement of unit trains through downtown Morehead City. The available land would allow for sufficient buffer areas and space for runoff treatment facilities. Also, since this site is more inland than others, it would minimize the effects on the wetlands from coal dust or spillage. In addition to an offshore loading facility, consideration should be given to the feasibility of an overhead enclosed conveyor system to the existing port, thus eliminating the need for the coal trains in the city. This should relieve the primary complaint against such a facility in the Morehead City area.

5.4.3 Wilmington

Site C-7: Utah International Site South of Sand Hill Creek: This site, on the west bank of the Cape Fear River, will eliminate the necessity for coal trains to enter Wilmington, which has major grade crossing conflicts.

Either extensive dredging or a T-head pier must be constructed for access to the shipping channel from this site. The site development would also have to minimize the impacts on surrounding wetlands.

Site C-20: American Coal Export Company Site on Northeast Cape Fear River: This site, on the west side of the Northeast Cape Fear River, would allow for operations without movement of trains through Wilmington. However, the channel and upper turning basin must be dredged significantly deeper than its present 22 feet. Bridge clearances, and a narrow channel and the additional distance to be traveled could add to congestion and potential conflicts in river traffic. Dredging and dock/wharf construction will have the major adverse effects in the development of the site.

Site C-18: Hampstead/Scotts Hill: This particular site is selected for use as a terminal for an offshore loading point using a slurry pipeline as the transfer mechanism. While much research has been and is being conducted on slurry technology, its use in the coastal zone may present additional problems not previously considered. A pipeline must be laid across the Intracoastal Waterway, wetlands, and at least six miles out into the ocean. A water return pipeline will probably be required, to bring the slurry water back to the site for treatment prior to discharge or reuse in the system. A slurry pipeline system requires large quantities of water, even with reuse and recycling techniques. The slurry water will carry dissolved organics and other pollutants after contact with the coal. In addition, the preparation of the coal into a suitable size and condition will require crushers or grinders/pulverizers possibly causing an increase in the amount of coal dust released from the onshore operations. Excellent discussions of the environmental impacts and the technologies required for coal slurry operation are found in Pelham (1980) and Szabo (1978). Any slurry development in the coastal area will require a more complete environmental assessment than the time frame of this study allows.

Site C-17: North End of Existing SPA Terminal: As discussed in Section 3.4 of Volume 1, this site would cause the fewest adverse environmental impacts from dredging, construction or land use. The impacts from the movement of unit coal trains through Wilmington to the port facilities include noise, traffic disruption, and potential emergency service interruption, as discussed in Section 5.1. These impacts must be given serious consideration in relation to the advantages offered by the use of the existing facilities at the SPA Terminal.

5.5 Recreational Assessment

5.5.1 General

Given the import of recreational activity to the local economies of the primary counties (See Section 3.5), it is important to assess the impacts from the development of coal exporting facilities. Although

the specific sites proposed for the terminal facilities do not specifically affect recreational areas or activity, the transportation infrastructure necessary to serve the terminals may in fact affect recreation activity and the revenues generated.

5.5.2 Recreational Impacts of Rail Traffic

The increase in rail traffic will most directly affect recreational activity in Carteret County because of the locations of the automobile traffic patterns in the Morehead City - Bogue Banks area and the location of the primary recreational intrastructure in the Bogue Banks area. Evidence that the current relationship between recreation, auto traffic, and the Bogue Banks area is unsatisfactory comes from the current proposal to build a third bridge between Morehead City and Atlantic Beach (U.S. Department of Transportation, 1981). The average daily traffic count for the year 2000 are shown in Figure 16. The important point is that all traffic crossing the existing Morehead City - Atlantic Beach bridge must cross the railroad tracks to go west from Morehead City on U.S. 70. With drawbridge openings and the signalized intersection at U.S. 70, the typical backup in the peak summer traffic is often one mile.

The addition of railroad caused delays due to increased coal related railroad activity will only increase the time needed to exit from the Bogue Banks area. Thus, the potential impact of coal train movement by increasing congestion is objectively negative. This objective congestion is easily translatable into negative perceptions of tourists who will have another reason to avoid the Morehead City - Atlantic Beach area. Although the proposed third bridge will generally alleviate the congestion related to recreational activity on Bogue Banks, the negative impacts on tourist related sales in Morehead City caused by coal train movements will remain (See Section 5.2.3).

5.5.3 Recreational Impacts of Ship Traffic

The potential recreational impacts from the increased ship traffic projected from the coal terminal proposals are related to increased harbor and channel congestion. The increased congestion would directly affect recreational boating and fishing. Apart from the possible environmental consequences of increased harbor congestion (See Section 5.4), there is the possibility of negative perceptions of the area among recreational boaters. However, the recreational boating sites most directly affected are those marinas and launching areas closest to the terminal sites. Additional monitoring of the impact of development on marinas will be important.

5.6 Fiscal Assessment

The areas chosen for a coal exporting terminal stand to benefit from the construction and operation of the facility. The property tax base

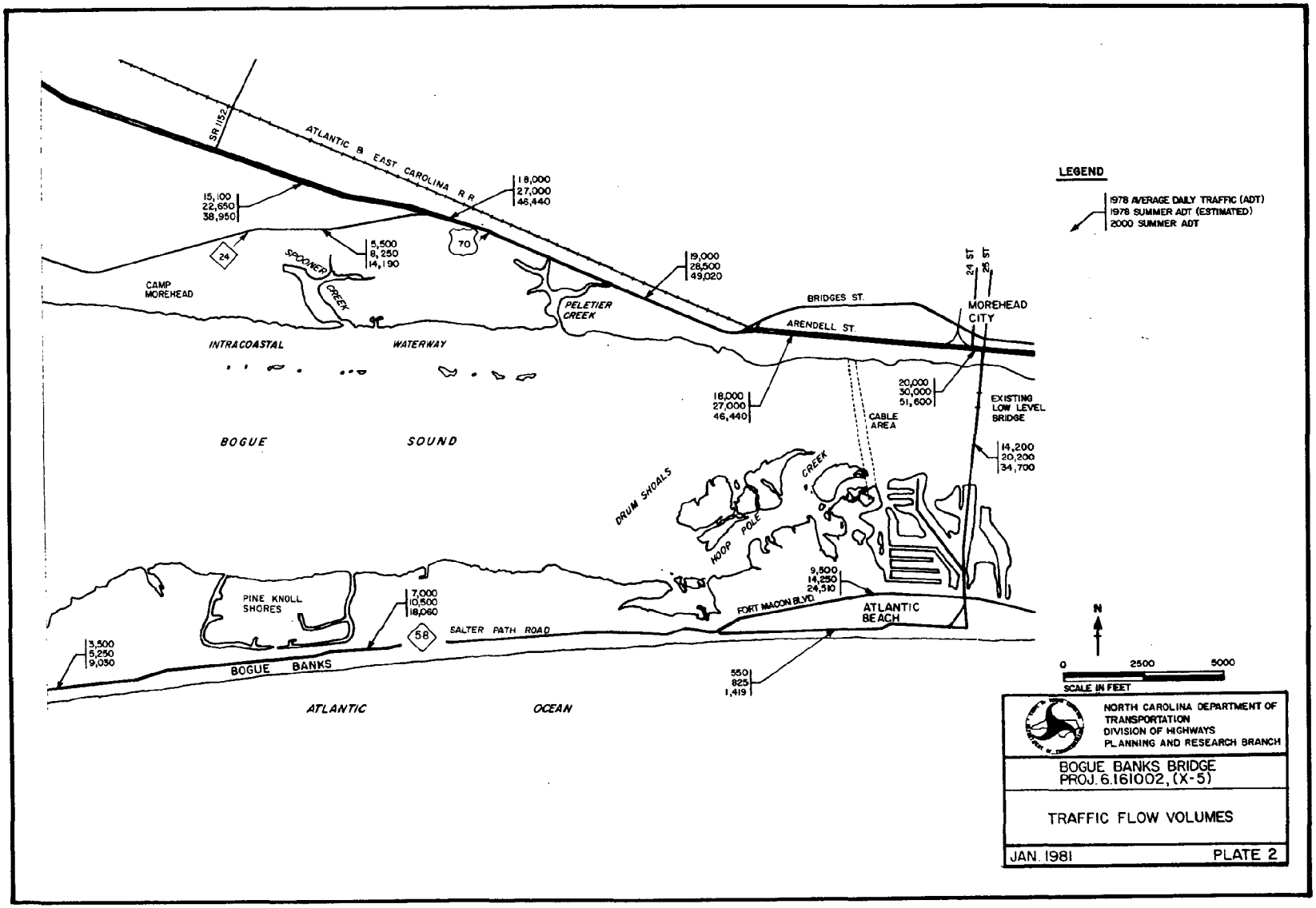

Figure 16. Traffic Patterns for Morehead City (Figure courtesy of NCDOT).

will increase dramatically with construction. For example, the Morehead City government has already collected a $7,000 inspection fee from the Alla-Ohio Valley project (Carteret County News-Times, 1981c). Due to the relatively low population growth rate expected to be induced by the respective projects, there will not be a significant demand for increases in community services.

Although there will be little direct impact on demand for services at the local level, the development of the coal exporting facilities will provide an impetus for significant demands on state expenditures for infrastructure improvements. Needed infrastructure improvements identified for the study area include a rail bypasses for New Bern and Morehead City and grade improvements for Wilmington, and dredging of the channel and harbor for Carteret County. The cost of the New Bern railroad bypass has been estimated at $15.2 millions (N.C. Department of Transportation, 1981). Since feasibility studies have not been done, there are no corresponding cost figures for the other infrastructure improvements.

Another infrastructure improvement that will receive impetus from the coal trains through Morehead City is the construction of a third bridge to Bogue Banks. The costs of that project is estimated at between $24.9 and 34.9 million.

The impacts of all the above infrastructure investment will extend beyond the coal exporting activity. The improvement in rail service and harbor facilities will provide a magnet for attracting other industries to the respective counties.

5.7 Land Use Assessment

The development of the coal exporting facilities and the transportation systems to serve them will take place within the policy context of local zoning ordinances and the CAMA Plans that presently exist. With one exception, all the proposed land sites are acceptable in terms of both applicable zoning ordinances and CAMA Plans. The one exception is the Gulf Interstate facility on Radio Island (C-21).

The Radio Island site is classified as port-industrial in the Carteret County zoning ordinance but is classified as rural in the Carteret County CAMA Plan (Carteret County News-Times, 1981d). As the result of action taken by the Coastal Resources Commission, a CAMA reclassification of Radio Island from rural to rural-port will take place in July, 1982, provided problems with railroad traffic in New Bern and Morehead City are alleviated and a comprehensive port development plan is developed for the Morehead City - Beaufort area.

5.8 Summary

In the process of making this initial assessment of the possible impacts from the proposed development of coal exporting facilities in

Brunswick, Carteret, and New Hanover Counties several issues have been identified which constitute a research agenda for future monitoring. Although possible impacts will be related to the pace of development, the major point is the potential magnitude of development if all proposed facilities become operational. Given the fact that coal export facilities tend to be capital intensive rather than labor intensive, the major impacts on the host communities will be in terms of the railroad activity to the port and ship traffic from the port.

These impacts on the transportation infrastructures of the respective communities are directly related to the historical development of those transportation systems. Ironically, the existing rail systems are a major source of contention in groups questioning the development of coal exporting, i.e., Craven County Crossroads and Carteret County Crossroads (Raleigh News and Observer, 1981a&b). The pace of development and community reaction to that development will be directly related to attempts to deal with the transportation problems of coal exporting. The solution of these transportation problems will have important implications for the future growth of the communities' employment sectors.

REFERENCES

Camougis, George, 1981. Environmental Biology for Engineers: A Guide to Environmental Assessment. McGraw-Hill, Inc. New York.

Cape Fear Council of Governments, 1978. Region 'O' Comprehensive Development Plan.

Carteret County News-Times, January 12, 1981. Officials Review Coal Plans for State Port.

Carteret County News-Times, February 16, 1981. Coal Facility Word Continues.

Carteret County News-Times, February 19, 1981. Gulf Interstate to Build Coal Exporting Facility.

Carteret County News-Times, June 4, 1981. What to do with Radio Island.

Centaur Management Consultants, Inc. 1977. Economic Activity Associated With Marine Recreational Fishing, Washington, D.C.

Chanlett, Emil T. Environmental Protection. New York: McGraw-Hill, Inc., 1979.

Cribbins, P.D., 1981. Coastal Energy Transportation Study: An Analysis of Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone (Phase II). Coastal Energy Impact Program Report No. 2 and Institute for Transportation Research and Education Report No. 23254-3. Raleigh: Department of Natural Resources and Community Development, pp.

Cribbins, P.S., 1981. Coastal Energy Transportation Study: An Analysis of State and Federal Policies Affecting Major Energy Projects in North Carolina's Coastal Zone. Coastal Energy Impact Program Report No. 4 and Institute for Transportation Research and Education Report No. 23254-5. Raleigh: Department of Natural Resources and Community Development, pp.

Gilmore, John S. Boom Towns May Hinder Energy Resource Development Science. Vol. 191, February 13, 1976.

Hauser, E.W., Cribbins, P.D., Tschetter, P.D. and Latta, R.D., 1980. Coastal Energy Transportation Study: An Analysis of Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone. (Phase I). Coastal Energy Impact Program Report No. 1 and Institute for Transportation Research and Education No. 23254-1. Raleigh: Department of Natural Resources and Community Development, 180+ pp.

ITRE, 1980. See Hauser, E.W. et. al., 1980. (Phase I Report).

ITRE, 1981a. See Cribbins, P.D., 1981. (Phase II Vol. 1 Report).

ITRE, 1981c. See Cribbins, P.S., 1981. (Phase II Vol. 3 Report).

Kresge, David T., Thomas A. Morehouse, and George W. Rogers. Issues In Alaska Development. Seattle: University of Washington Press, 1977.

Maiolo, John R. and P.D.Tschetter, 1981. Relating Population Growth to Shellfish Bed Closures: A Cast Study from North Carolina. Coastal Zone Management Journal, Vol. 9, No. 1., pp. 1-18.

Michigan Department of Natural Resources, 1980. Coastal Effects of Coal Transhipments in Michigan: An Evaluation Strategy. Great Lakes Basin Commission for the Michigan Department of Natural Resources.

New England River Basin Commission, Volume 1, Department of the Interior, Onshore Facilities Related to Offshore Oil and Gas Development, 1976.

N.C. Department of Natural Resources and Community Development, North Carolina Recreational Areas Inventory, Raleigh, 1976.

N.C. Department of Transportation, Transportation Planning Division, Coal Train Movements Through the City of New Bern, 1981.

North Carolina Marine Science Council. North Carolina and the Sea. Office of Marine Affairs, N.C. Dept. of Administration, June 1980.

Office of Technology Assessment. Coal Exports and Port Development., Washington, D.C.: U.S. Government Printing Office, April, 1981.

Pelham, L. The Environmental Impact of Coal Transfer and Terminal Operations, (EPA 600/7-80-169), October 1980.

Roy F. Weston, Inc., for National Science Foundation, Bureau of Land Management,Methodology for Assessing Onshore Impacts of Offshore. Outer Continental Shelf Oil and Gas Development, 1978.

Scott, John T. and Gene F. Summers, "Problems in Rural America after Industry Arrives," in Rural Industrialization: Problems and Potentials. Larry Whiting, Editor, Ames Iowa, Iowa State University Press, 1974.

Stone, John P. The Impacts of Coal Movements Through North Carolina. Paper presented at N.C. Urban Affairs Conference, April 2, 1981, Charlotte, N.C.

Szabo, M.F. Environmental Assessment of Coal Transportation. (EPA -600/7-78-081), May 1978.

The Conservation Foundation for the U.S. Fish and Wildlife Service, Department of the Interior, Environmental Planning for Offshore Oil, 1978.

The Final Environmental Impact Statement, OCS Lease Sale No. 43, U.S. Department of Interior, 1977.

The Final Environmental Impact Statement, OCS Lease Sale No. 56, U.S. Department of Interior, 1981.

U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income, South East Region. Washington, D.C., 1978.

U.S. Department of Commerce, Bureau of Economic Analysis, Local Area Personal Income, South East Region, Washington, D.C., 1981.

U.S. Department of Commerce, Bureau of the Census, Census of Population, Washington, D.C., 1970.

U.S. Department of Housing and Urban Development, Rapid Growth From Energy Projects, Ideas for State and Local Action, 1976.

Wilmington - New Hanover County Planning Commission, 1976. Summary of the Wilmington - New Hanover Country Land Use Plan.

APPENDIX A

ENVIRONMENTAL IMPACT STATEMENTS

North Carolina Department of Natural Resources, North Carolina Sedimentation Control Commission. Rules and Regulations for Erosion and Sediment Control. Promulgated Pursuant to Provisions contained in Sedimentation Pollution Control Act of 1973. (GS Chapter 113A, Article 4).

North Carolina Department of Transportation, Environmental Unit. Memo to Project Engineers, "Coastal Area Management Act," December 6, 1979.

North Carolina Department of Transportation, Environmental Unit. Memo to Project Engineers,"Executive Order 11990-Protection of Wetlands - Revised Guidance and Procedures." December 21, 1978.

North Carolina Department of Transportation, Environmental Unit. Memo to Project Engineers, "Procedures to follow to Comply with the Endangered Species Act-1978 Amendments." February 18, 1980.

North Carolina Department of Transportation, Environmental Unit. Final Environmental Statement: Marine Maintenance Facility, Manns Harbor, Dare County. July, 1978.

"Procedures for Considering Environmental Impacts: Policies and Procedures." Federal Register. Vol. 44, No. 191. Monday, October 1, 1979.

Proposed Primary Highway Extension from I-40 Terminus (at I-95) near Benson to Wilmington, Johnston, Sampson, Duplin, Pender, and New Hanover Counties. Administrative Action Final Environmental Impact Statement. United States Department of Transportation, Federal Highway Administration and North Carolina Department of Transportation. July 12, 1979.

Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. Council on Environmental Quality, Executive Office of the President. November 29, 1978.

Replacement Bridge and Approach Roadways, NC 32 over Albemarle Sound, Washington and Chowan Counties. Administrative Action, Draft, Negative Declaration. USDOT, FHWA, NCDOT. February 4, 1980.

United States Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, and North Carolina Department of Natural Resources and Community Development, North Carolina Coastal Management Program. Final Environmental Impact Statement: Proposed Coastal Management Program for the State of North Carolina.

United States Department of Commerce, National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, and North Carolina Department of Natural Resources and Community Development, North Carolina Coastal Management Program. Final Environmental Impact Statement: Proposed Coastal Management Program for the State of North Carolina. Appendices.

United States Department of the Interior, Bureau of Land Management. Final Environmental Impact Statement, OCS Lease Sale No. 43. 1977.

United States Department of the Interior, Bureau of Land Management. Final Environmental Impact Statement, OCS Lease Sale No. 56. 1981.

ENVIRONMENTAL ASSESSMENT

Camougis, George. Environmental Biology for Engineers: A Guide to Environmental Assessment. McGraw-Hill, Inc. New York, 1981.

Chanlett, Emil T. Environmental Protection. New York: McGraw-Hill, Inc., 1979.

Conservation Foundation. Coastal Ecosystem Management. John R. Clark, Ed. John Wiley & Sons, Inc. New York. 1977.

Great Lakes Basin Commission. Coastal Effects of Coal Transhipments in Michigan: An Evaluation Survey. Prepared for the Michigan Department of Natural Resources. 1980.

Neal, Leon. Impact of Continental Shelf Development. North Carolina Science and Technology Research. March 18, 1976.

North Carolina Department of Administration, Office of Marine Affairs, North Carolina and the Sea. 1980.

North Carolina Department of Transportation, Transportation Planning Division, "Coal Train Movements Through the City of New Bern." Working paper. 1981.

Robert R. Nathan Associates. The Coastal Plains Deepwater Terminal Study. Prepared for the Coastal Plains Regional Commission. 1975.

Schoenbaum, Thomas J. and Silliman, Kenneth G. Coastal Planning: The Designation and Management of Areas of Critical Environmental Concern. Raleigh, North Carolina: UNC Sea Grant Program. November, 1976.

Shuldiner, P.W.; Cope, D.F.; and Newton, R.B. National Cooperative Highway Research Program Report 218 B: Ecological Effects of Highway Fills on Wetlands, User's Manual. Washington, D.C.: Transportation Research Board. December, 1979.

Stone, John R. "The Impacts of Coal Movements Through North Carolina." Paper presented at NC Urban Affairs Conference, Charlotte, NC. April 2, 1981.

United States Army Corps of Engineers, Wilmington District. Scoping Report: Brunswick Energy Company, Brunswick County, North Carolina. Wilmington. September, 1979.

United States Department of the Interior, Fish and Wildlife Service. Atlantic Coast Ecological Inventory. 1980.

United States Army Corps of Engineers, Wilmington District. Scoping Report: Carolina Refining and Distributing Company, Carteret County, North Carolina. Wilmington. September, 1979.

United States Environmental Protection Agency. Environmental Assessment of Coal Transportation. 1978.

United States Environmental Protection Agency. Environmental Impact of Coal Transfer and Terminal Operations. 1980.

WATER RESOURCES

Bond, Sharon; Grover; and Howells, David H. The Chowan River Project: Summary Report. Raleigh, North Carolina: Water Resources Research Institute of the University of North Carolina.

Howells, David H. Water Resource Problems and Research Needs of North Carolina. Raleigh, North Carolina: Water Resources Research Institute of the University of North Carolina. July 1, 1976.

McJenkin, Frederick Eugene; Coe, Mary Jordan; and Knarr, Bruce Allen. Water Resources of North Carolina: An Inventory of Information and Data. Report #22. Raleigh, North Carolina: Water Resources Research Institute, 1968.

National Association of Conservation Districts. The Role of Conservation Districts in the Coastal Zone Management Program. Written and compiled under contract from the Office of Coastal Zone Management National Oceanic and Atmospheric Administration, United States Department of Commerce. December, 1979.

North Carolina Department of Natural Resources and Community Development. Public Water Supplies of North Carolina. North Coastal Region. South Coastal Region. July, 1977.

Pardue, Garland B.; Huish, Melvin T.; and Perry, H. Randolph, Jr. Ecological Studies of Two Swamp Watersheds in Northeastern North Carolina: A Prechannelization Study. Report #105. Raleigh, North Carolina: Water Resources Research Institute of the University of North Carolina. April, 1975.

Workshop on Stream Channelization and Wetland Drainage: Proceedings. Sponsored by North Carolina Department of Water and Air Resources, and Water Resources Research Institute. Held at Quail Roost Conference Center, Rougemont, North Carolina, November 18, 1970. Raleigh, North Carolina. Report #45.

CEIP Publications

1. Hauser, E. W., P. D. Cribbins, P. D. Tschetter, and R. D. Latta. Coastal Energy Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #1. September 1981. $10.

2. P. D. Cribbins. A Study of OCS Onshore Support Bases and Coal Export Terminals. CEIP Report #2. September 1981. $10.

3. Tschetter, P. D., M. Fisch, and R. D. Latta. An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone. CEIP Report #3. July 1981. $10.

4. Cribbins, P. S. An Analysis of State and Federal Policies Affecting Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #4. September 1981. $10.

5. Brower, David, W. D. McElyea, D. R. Godschalk, and N. D. Lofaro. Outer Continental Shelf Development and the North Carolina Coast: A Guide for Local Planners. CEIP Report #5. August 1981. $10.

6. Rogers, Golden and Halpern, Inc., and Engineers for Energy and the Environment, Inc. Mitigating the Impacts of Energy Facilities: A Local Air Quality Program for the Wilmington, N.C. Area. CEIP Report #6. September 1981. $10.

7. Richardson, C. J. (editor). Pocosin Wetlands: an Integrated Analysis of Coastal Plain Freshwater Bogs in North Carolina. Stroudsburg (Pa): Hutchinson Ross. 364 pp. $25. Available from School of Forestry, Duke University, Durham, N. C. 27709. (This proceedings volume is for a conference partially funded by N. C. CEIP. It replaces the N. C. Peat Sourcebook in this publication list.)

8. McDonald, C. B., and A. M. Ash. Natural Areas Inventory of Tyrrell County, N. C. CEIP Report #8. October 1981. $10 for all requests.

9. Fussell, J., and E. J. Wilson. Natural Areas Inventory of Carteret County, N. C. CEIP Report #9. October 1981. $10 for all requests.

10. Nyfong, T. D. Natural Areas Inventory of Brunswick County, N. C. CEIP Report #10. October 1981. $10 for all requests.

11. Leonard, S. W., and R. J. Davis. Natural Areas Inventory for Pender County, N. C. CEIP Report #11. October 1981. $10 for all requests.

12. Cribbins, Paul D., and Latta, R. Daniel. Coastal Energy Transportation Study: Alternative Technologies for Transporting and Handling Export Coal. CEIP Report #12. January 1982. $10 for all requests.

19. Pate, Preston P., and Jones, Robert. Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina, N. C. CEIP Report #19. December, 1981. $1.00.

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