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Rev. 3

Public Information Circular for Shipments of Irradiated Reactor Fuel

**U.S. Nuclear Regulatory
Commission**

Office of Nuclear Material Safety and Safeguards



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**Division of Safeguards
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555**



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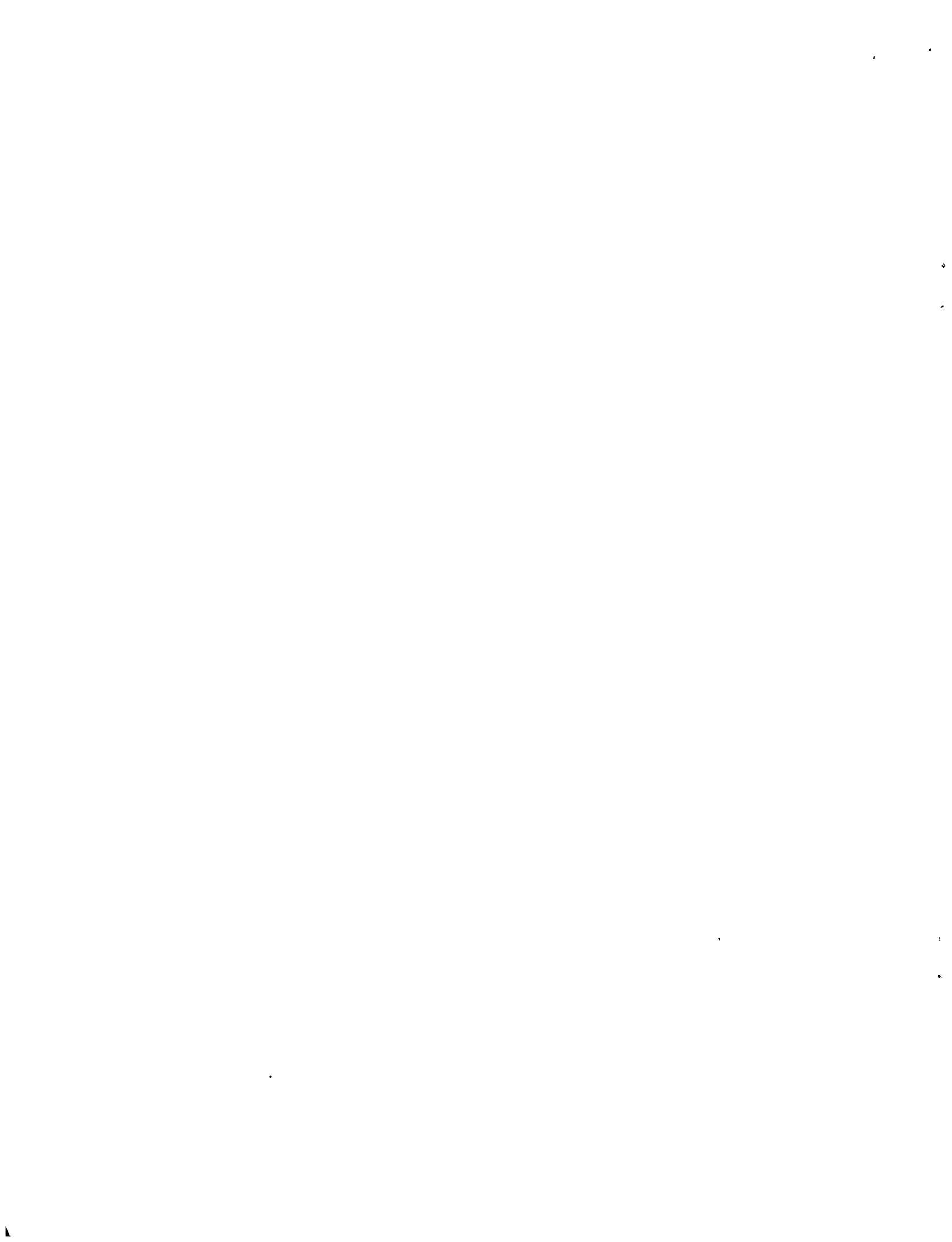
PREFACE

This circular has been prepared in response to numerous requests for information regarding routes for the shipment of irradiated reactor (spent) fuel subject to regulation by the Nuclear Regulatory Commission (NRC) and to meet the requirements of Public Law 96-295. The NRC staff approves such routes prior to their first use, in accordance with the regulatory provisions of 10 CFR Part 73.37. The design and construction of the casks used to ship the spent fuel provide adequate radiological protection of the public health and safety against accidents. Therefore, transporting appropriately packaged spent fuel over existing rail systems and via any highway system is radiologically safe without specific NRC approval of the route. However, to assure adequate planning for protection against actual or attempted acts of sabotage, the NRC requires advance route approval. Thus, the additional safeguards regulations contained in 10 CFR Part 73.37 were aimed exclusively at protection against radioactive dispersal caused by malevolent acts by persons.

Spent-fuel shipment routes, primarily for road transportation, but also including two rail routes, are indicated on reproductions of road maps. Also included are the amounts of material shipped during the approximate 4-year period that safeguards regulations have been effective. This information is current as of June 1, 1983.

Section 147 of Public Law 96-295 provides that "...the public disclosure of information pertaining to the routes and quantities of shipments of... irradiated nuclear reactor fuel" shall not be prohibited. The maps and tables dealing with the spent fuel shipment routes and quantities included in this document are responsive to these requirements for public disclosure of spent fuel shipment information. In addition, the Commission has chosen to provide information in this document regarding the NRC's safety and safeguards regulations for spent fuel shipments as well as safeguards incidents regarding spent fuel shipments (of which none have been reported to date). This additional information is furnished by the Commission in order to convey to the public a more complete picture of NRC regulatory practices concerning the shipment of spent fuel than could be obtained by the publication of the shipment routes and quantities alone.

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1 INTRODUCTION

1.1 About This Publication

This publication is the fourth in a proposed series of annual publications issued by the Nuclear Regulatory Commission in response to public information requests regarding the Commission's regulation of shipments of irradiated reactor fuel. Subsequent issues in this series will update the information contained herein.

This publication contains basically three kinds of information.

- (1) Routes approved by the Commission for the shipment of irradiated reactor fuel,
- (2) Information regarding any safeguards-significant incidents which have been reported to occur during shipments along such routes, and
- (3) Cumulative amounts of material shipped.

1.2 NRC Regulatory Objectives

The Nuclear Regulatory Commission is authorized under the Atomic Energy Act of 1954, as amended, to regulate the private nuclear industry for purposes of protecting the public health and safety and the common defense and security of the United States. The Commission is concerned with the transportation of all nuclear materials in the nuclear fuel cycle, which includes the transportation of irradiated reactor fuel (spent fuel).

Protection of the public, insofar as the transportation of spent fuel is concerned, depends on maintaining the integrity of the shipping casks in which the spent fuel is transported. As long as the radioactive material is kept within the casks, significant radiation doses to the public will not occur. The design of the cask is intended to provide reasonable assurance that transportation accidents, even severe ones, will not cause leakage. The NRC believes that the package design provides adequate protection so that it is safe to transport appropriately packaged spent fuel over existing rail and highway systems without specific NRC approval of the route.

Although the design of the shipping cask makes difficult the release of a significant amount of radioactive material as a result of sabotage, the NRC believes that until the possible consequences of sabotage can be evaluated more fully, protective measures in addition to reliance upon cask design are prudent. Hence, exercising prudence, the Commission approved in May 1979, for issuance in effective form, new interim regulations for strengthening the protection of shipments of spent fuel against sabotage. In May 1980, these regulations were revised in response to public comments and were issued in effective form as an interim final rule. These regulations are expected to remain in effect until the completion of an ongoing research program concerning the response of shipping casks to certain forms of sabotage, at which time the regulations may

be rescinded, modified or made permanent, as appropriate. In particular, these regulations require NRC approval of routes for the transportation of spent fuel. This requirement for advance route approval is not based on accident prevention, but is intended to assure adequate planning for protection against actual or attempted acts of sabotage. Further discussion of the safety of spent fuel shipments is provided herein.

Furthermore, the routes approved by the Commission reflect the U.S. Department of Transportation (DOT) requirements of 49 CFR Part 177.825(b), which designate the use of the Interstate System of highways as being the primary roadways over which radioactive material shipments under a route plan are to be carried. The general designation as preferred highways is given to these roadways based upon an overall performance rating with respect to the lower accident rates and their capacity for reducing transit times.

Appropriate state routing agencies, following prescribed criteria, may designate an alternative route for the preferred interstate system.

1.3 Safety of Spent Fuel Shipments

The NRC distinguishes between safety regulation of shipments and safeguards regulation of shipments. Safety deals with protection against adverse consequences from accidents, or natural causes, while safeguards deals with the protection of shipments against deliberate, malevolent acts by persons.

The NRC ensures the safety of spent fuel shipments mainly through stringent packaging requirements. Spent fuel is shipped only in massive, durable casks designed to withstand severe accidents without release of the radioactive contents.

Of the thousands of shipments that have been made during the past 30 years, none has resulted in an identifiable injury to the public through release of radioactive material.

General standards and requirements for spent fuel casks are set forth in NRC regulations. A cask must be designed to withstand a series of specified impact, puncture, and fire environments, thereby providing reasonable assurance that the package will withstand serious transportation accidents. The cask design is initially reviewed by the NRC staff to verify its resistance to accidents. A certificate must be issued by the NRC before a cask fabricated from that design can be used to transport spent fuel.

The standards that have been established in the regulations provide that a cask shall prevent the loss or dispersion of the radioactive contents, provide adequate shielding and heat dissipation, and prevent nuclear criticality under both normal and accident conditions of transportation. The normal conditions of transportation which must be considered are specified in the regulations in terms of hot and cold environments, pressure differential, vibration, water spray, impact, puncture, and compression tests. Accident conditions which must be considered are specified in terms of impact, puncture and fire conditions.

Thus far, success of the packaging strategy has been demonstrated despite an occasional traffic accident. For example, one such accident occurred on December 8, 1970, on a major highway near Oak Ridge, Tennessee. In this accident, the driver of a vehicle carrying a spent fuel cask swerved to avoid colliding with an oncoming vehicle, lost control, and overturned off the roadway. The cask assembly was thrown into a ditch, traveling more than 100 feet before coming to rest. No release of contents or release of radiation occurred. The outer surface of the cask suffered minor damage. The spent fuel cask was placed on another trailer and taken to its destination. The cask was returned to service following repair of the minor damage and inspection.

The durability of casks has also been demonstrated in controlled tests. In one DOE test, a truck bearing a cask was deliberately placed in the path of and struck by a 120-ton locomotive traveling about 80 miles per hour. In another DOE test, a cask aboard a truck moving at about 80 miles per hour was deliberately crashed into an immovable concrete structure. Subsequent examination confirmed in both of these tests that no radioactive material would have been released from the casks had they been loaded with spent fuel. Thus, both field experience and controlled tests have substantiated the NRC strategy of depending upon packaging design for safety in transit.

2 SAFEGUARDS FOR SPENT FUEL SHIPMENT

2.1 Safeguards Incident Reporting Requirements

Safeguards incidents for spent fuel shipments are those which involve attempts at sabotage of spent fuel, or purposeful acts which threaten or result in significant degradation of the safeguards system used to protect the shipment. Licensees are required to record such events in a written log. In addition, licensees are required to promptly report safeguards incidents to the NRC by telephone, followed by a written report. Licensees are also required under existing regulations to immediately notify local law enforcement authorities upon the occurrence or discovery of a safeguards incident for the purpose of initiating an appropriate response.

2.2 Safeguards Incidents Reported

To date no safeguards incidents involving the shipment of spent fuel have occurred. Also, no NRC licensee has been cited for noncompliance with spent fuel transportation safeguards regulations.

3 APPROVED ROUTES FOR SPENT FUEL SHIPMENTS

3.1 Routes Described

NRC licensees planning to ship spent fuel are required to submit proposed routes for such shipments to the NRC staff for approval prior to the first use of a given route. Once approved, the same route may be utilized for additional shipments in a proposed series of shipments without further approval of the route, provided that the NRC is notified in advance of each shipment. From time to time, the NRC may authorize alternate routes or detours as circumstances

dictate at the time of shipment. Also, detours may be taken without prior approval in response to unforeseen circumstances which arise during a shipment. Criteria for determining when and how such detours may be taken are provided in published regulatory guidance (NUREG-0561, Rev. 1).

The spent fuel shipment routes shown in Appendix A of this document are those which were approved as of June 1, 1983. Some of these routes have been used for shipments which have already been completed, others for shipments which have yet to be completed, while some have been approved but have yet to be utilized. The routes shown do not include proposed routes.

3.2 Route Display Format

The routes are shown in the form of maps acquired from the U.S. Department of Transportation, Federal Highway Authority. Each state containing one or more approved spent fuel shipment routes is included. In some cases, to achieve the best clarity, only the portions of the state including the routes are shown. The routes are indicated by widened shaded lines drawn along the routes. The route numbers have been left unshaded to assure maximum clarity.

3.3 States Containing Approved Routes

The states containing portions of approved spent fuel shipment routes are listed in Table 1. In total, there are 35 states containing portions of such routes.

4 AMOUNTS OF SPENT FUEL SHIPPED

The amounts of spent fuel shipped from one facility to another are presented in Table 2. Each entry corresponding to a given combination of origin and destination for which a spent fuel shipment route is approved describes the number of shipments completed between July 16, 1979 and June 1, 1983, and the total number of kilograms of spent fuel included in such shipments (exclusive of structural and packaging material). Since some nuclear facilities both send and receive spent fuel shipments, shipments may proceed in either direction along a given route. Accordingly, each location listed in Table 2 is considered to be alternately a point of origin or destination. Combinations of origins and destinations between which no spent fuel shipment routes are approved are indicated by the entry "NR."

TABLE 1

STATES CONTAINING APPROVED SPENT FUEL SHIPMENTS ROUTES

- | | |
|-------------------|--------------------|
| 1. Arizona | 19. New Mexico |
| 2. California | 20. New York |
| 3. Colorado | 21. North Carolina |
| 4. Connecticut | 22. North Dakota |
| 5. Idaho | 23. Ohio |
| 6. Illinois | 24. Oregon |
| 7. Indiana | 25. Pennsylvania |
| 8. Iowa | 26. Rhode Island |
| 9. Kentucky | 27. South Carolina |
| 10. Maryland | 28. Tennessee |
| 11. Massachusetts | 29. Utah |
| 12. Michigan | 30. Vermont |
| 13. Minnesota | 31. Virginia |
| 14. Missouri | 32. Washington |
| 15. Montana | 33. Wisconsin |
| 16. Nebraska | 34. West Virginia |
| 17. Nevada | 35. Wyoming |
| 18. New Jersey | |

TABLE 2

NUMBER/QUANTITY OF SHIPMENTS (NUMBER/KILOGRAMS)

Key

NR = No Approved Route
 * = New End-Point

ORIGIN	DESTINATION													
	A. Aiken, SC	B. Cornelius, NC	C. Lynchburg, VA	D. Morris, IL	E. Oakland, CA	F. Pleasanton, CA	G. Port Chicago, CA	H. Scoville, ID	I. Southport, NC	J. West Jefferson, OH	K. Argonne, IL	L. Portsmouth, VA	M. North Anna, VA*	
1. Alexandria Bay, NY	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
2. Ann Arbor, MI	5/7.791	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
*3. Brownville, NE	NR	NR	NR	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	
4. Calvert Cliffs, MD	NR	NR	NR	NR	NR	NR	NR	NR	NR	3/31.136	NR	NR	NR	
5. Champlain, NY	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
6. Charlevoix, MI	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0/0	1/7.757	NR	
7. Columbia, MO	8/41.71	NR	NR	NR	NR	NR	NR	2/10.760	NR	NR	NR	NR	NR	
8. Cordova, IL	NR	NR	NR	NR	NR	2/26.1767	NR	NR	NR	1/17.679	NR	NR	NR	
9. Derby Line, VT	8/20.376	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
10. Fort Calhoun, NE	NR	NR	NR	NR	NR	NR	NR	NR	NR	1/0.544	NR	NR	NR	
11. Ft. St. Vrain, CO	NR	NR	NR	NR	NR	NR	NR	78/3157.986	NR	NR	NR	NR	NR	
12. Genoa, WI	NR	NR	NR	4/938.904	NR	NR	NR	NR	NR	NR	NR	NR	NR	
13. Haddam Neck, CT	NR	NR	NR	NR	NR	NR	NR	NR	NR	3/1500	NR	NR	NR	
14. Hartsville, SC	NR	NR	NR	NR	NR	NR	NR	NR	17/59500	NR	NR	NR	NR	
15. Lynchburg, VA	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
16. Monticello, MN	NR	NR	NR	NR	NR	3/52.8238	NR	NR	NR	1/33.338	NR	NR	NR	
17. Narrangansett, RI	1/2.756	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
18. Oakland/Bay Area, CA	NR	NR	NR	NR	9/111.881	NR	18/70.898	NR	NR	NR	NR	NR	NR	
19. Ogdensburg, NY	14/69.384	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
20. Oyster Creek, NJ	NR	NR	NR	NR	NR	NR	NR	NR	NR	1/49.311	NR	NR	NR	
*21. Pembina, ND	NR	NR	NR	NR	NR	NR	1/3.298	NR	NR	NR	NR	NR	NR	
22. Pleasanton, CA	NR	NR	NR	9/111.881	NR	NR	0/0	4/26.96	NR	2/27.625	NR	NR	NR	
23. Port Huron, MI	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
24. Portland, OR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0/0	NR	NR	NR	
25. Portsmouth, VA	108/608.387	NR	NR	NR	NR	NR	NR	11/74.004	NR	NR	NR	NR	NR	
26. Richland, WA	NR	NR	0/0	NR	NR	0/0	NR	NR	NR	0/0	NR	NR	NR	
27. San Onofre, CA	NR	NR	NR	16/8000	NR	NR	NR	NR	NR	NR	NR	NR	NR	
28. Sault Ste. Marie, MI	0/0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
29. Seneca, SC	NR	27/12511.8	3/1500	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
30. Southport, NC	NR	NR	NR	NR	NR	NR	NR	NR	NR	1/30.118	NR	NR	NR	
*31. Surry, VA	NR	NR	NR	NR	NR	NR	NR	NR	NR	1/19.789	NR	NR	0/0	
32. Tuxedo, NY	4/11.721	NR	NR	NR	NR	NR	NR	1/3.052	NR	NR	NR	NR	NR	
33. Waterford, CT	NR	NR	NR	NR	NR	3/36.224	NR	NR	NR	NR	NR	NR	NR	
34. Zion, IL	NR	NR	NR	NR	NR	NR	NR	NR	NR	1/490.7	NR	NR	NR	

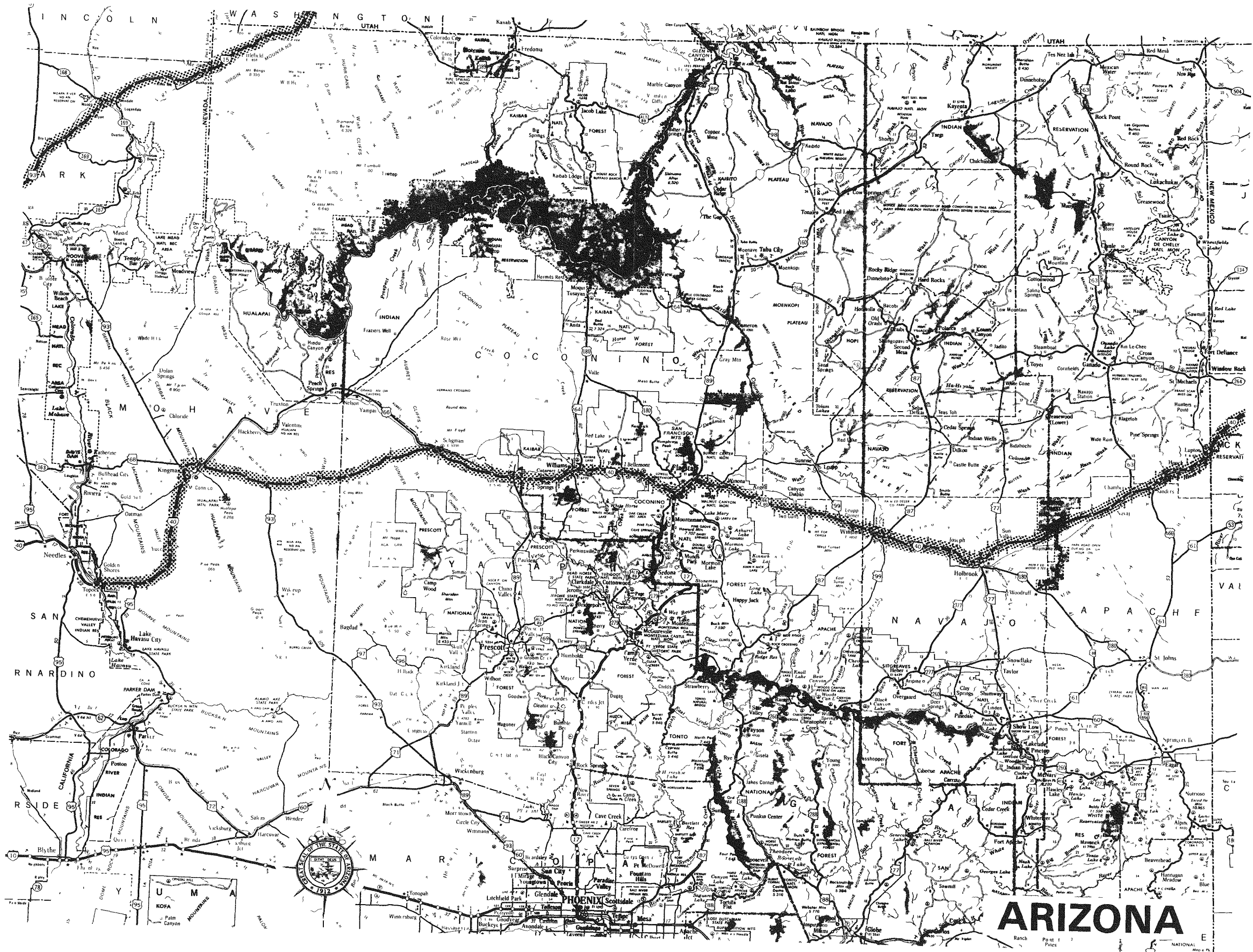
APPENDIX A

SPENT FUEL SHIPMENTS ROUTES UNITED STATES (CONTIGUOUS)

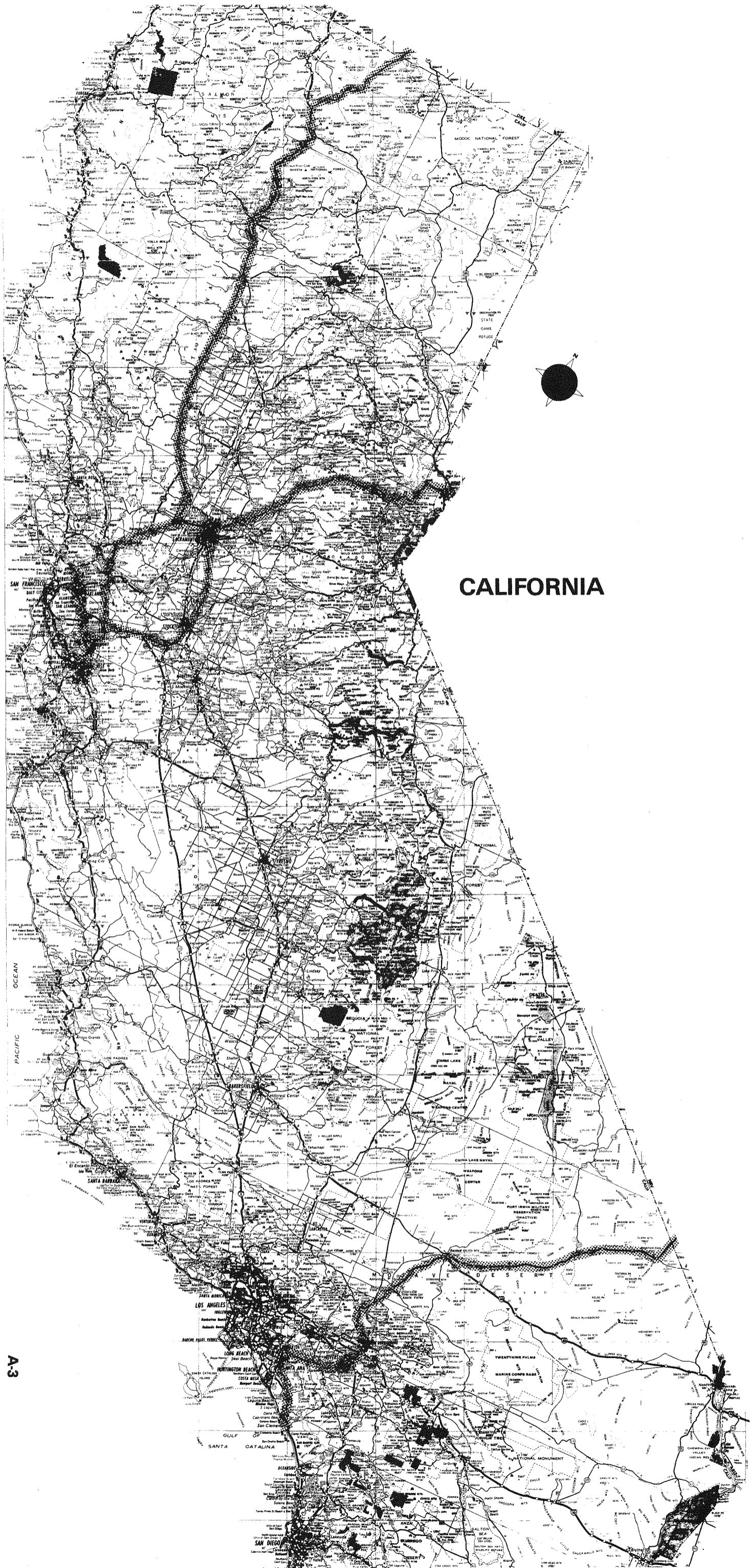


☉ REFERENCE POINTS

● SPENT FUEL ROUTE
END-POINTS

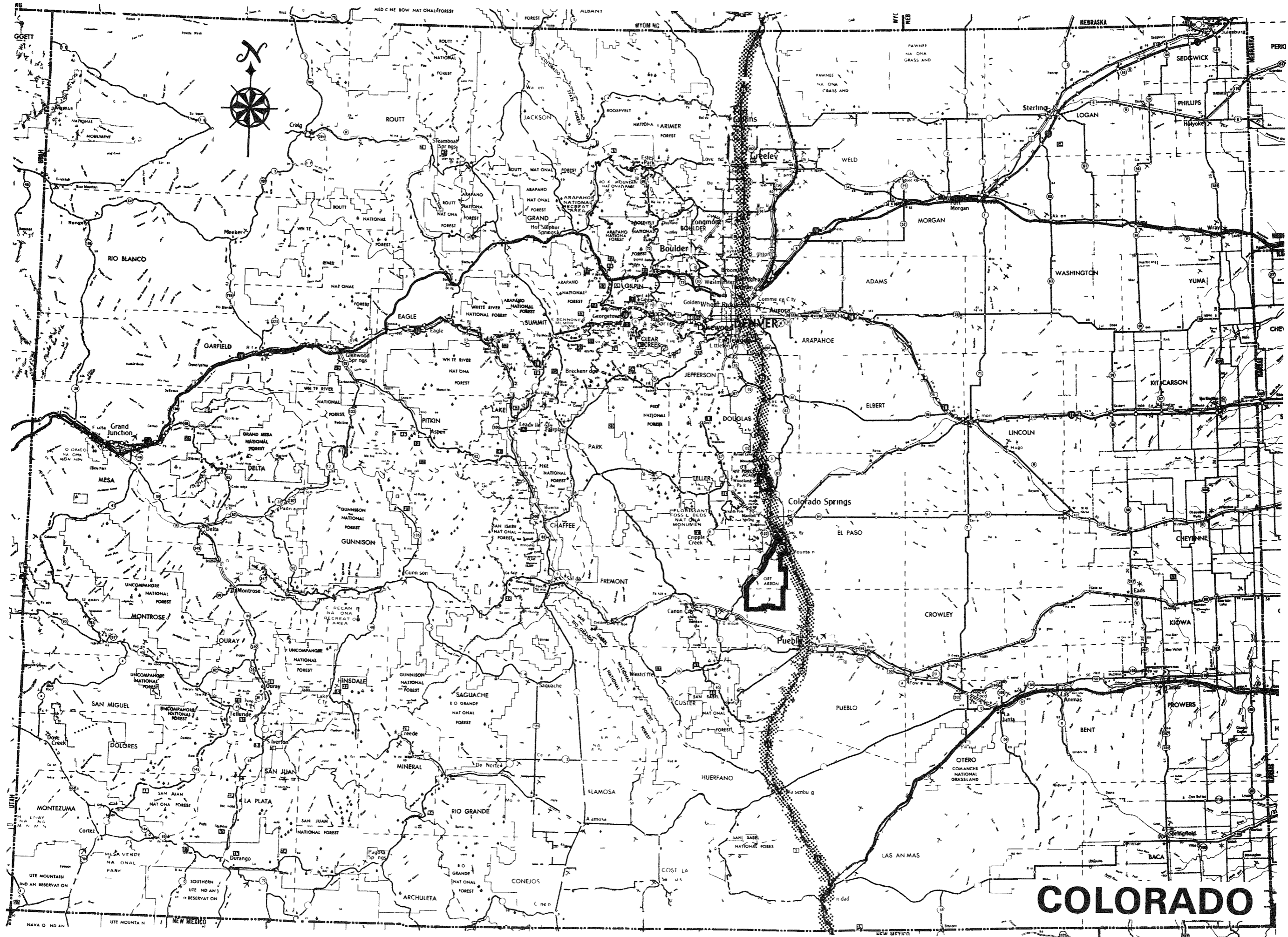


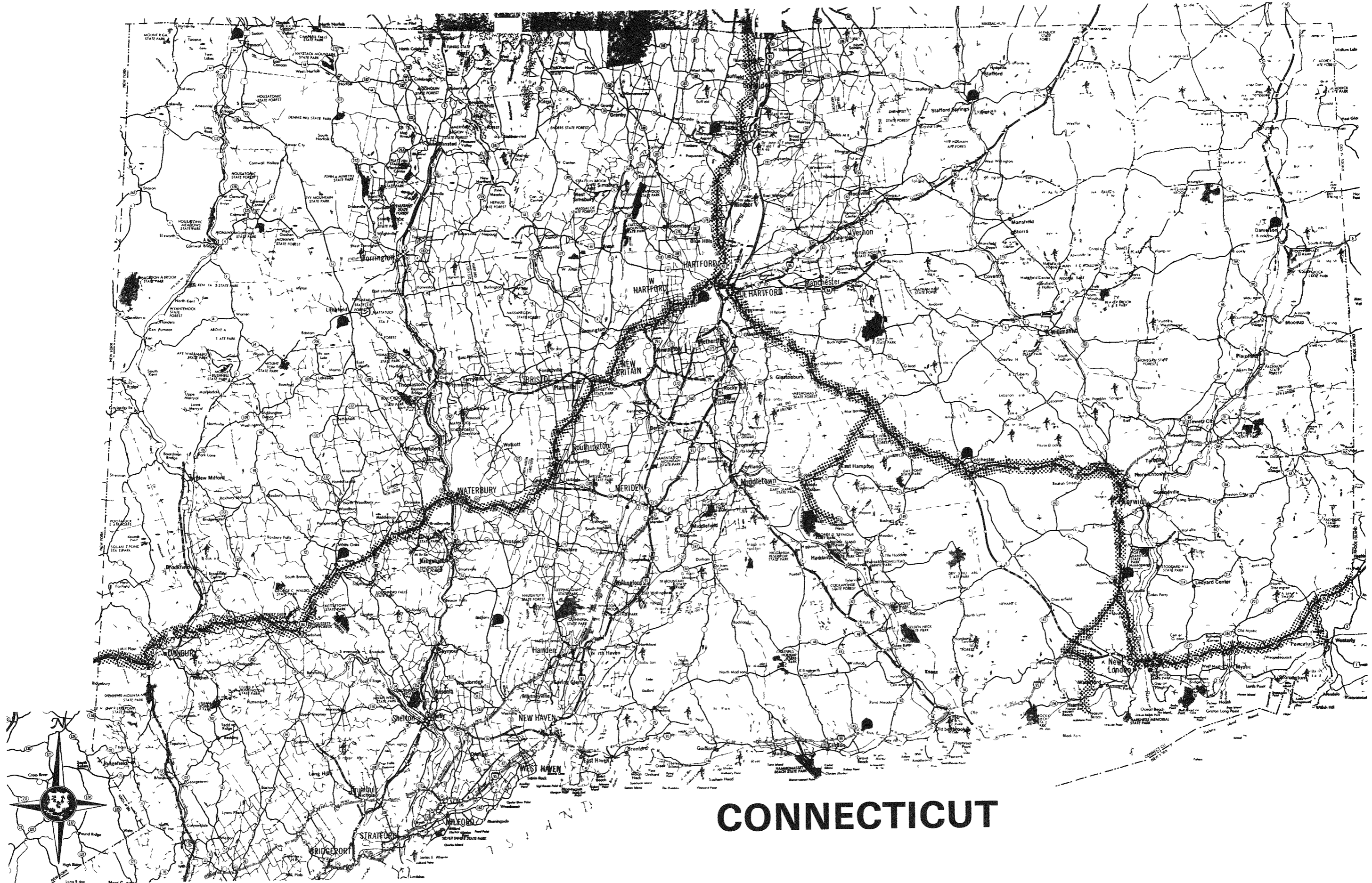
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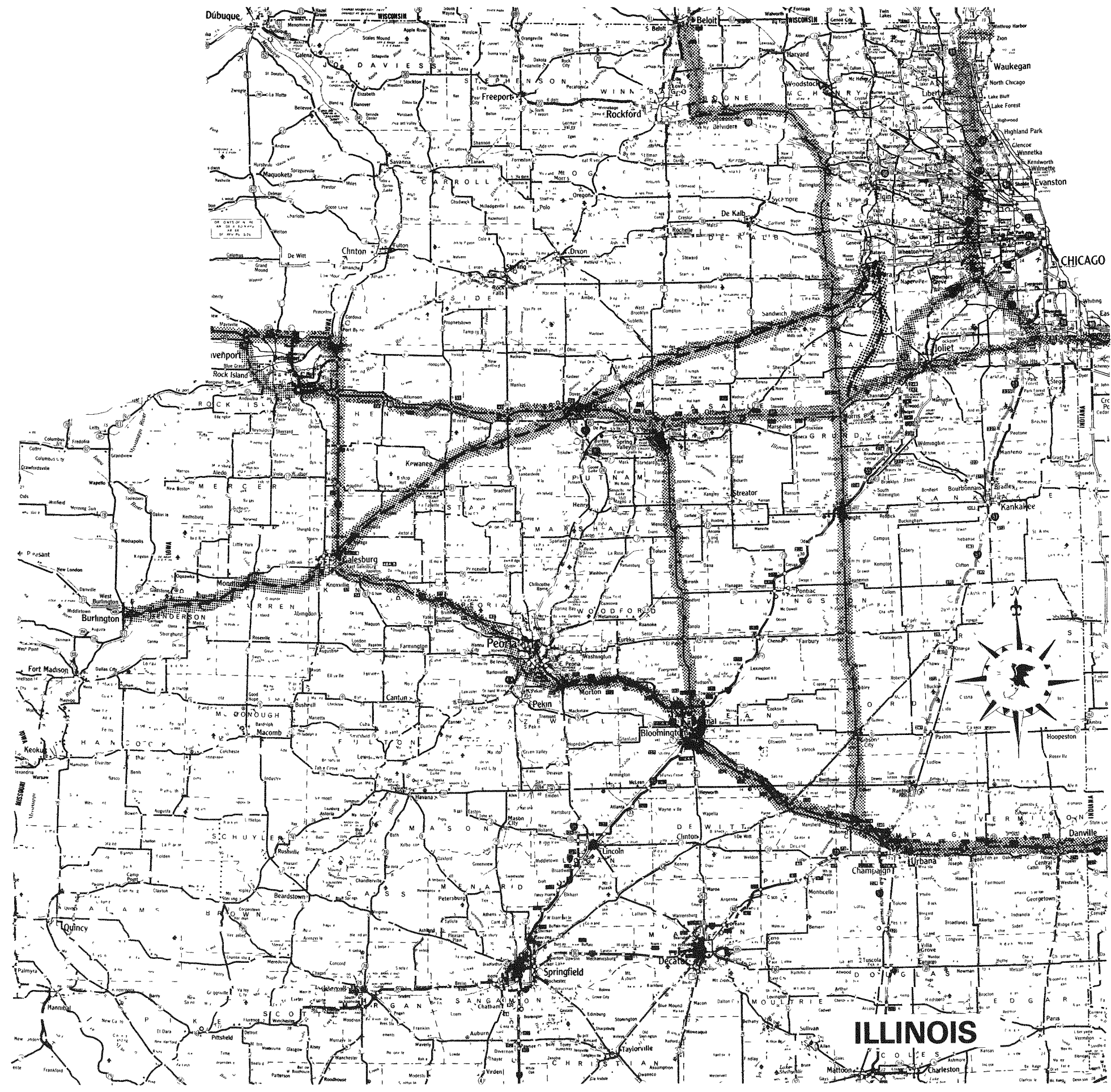
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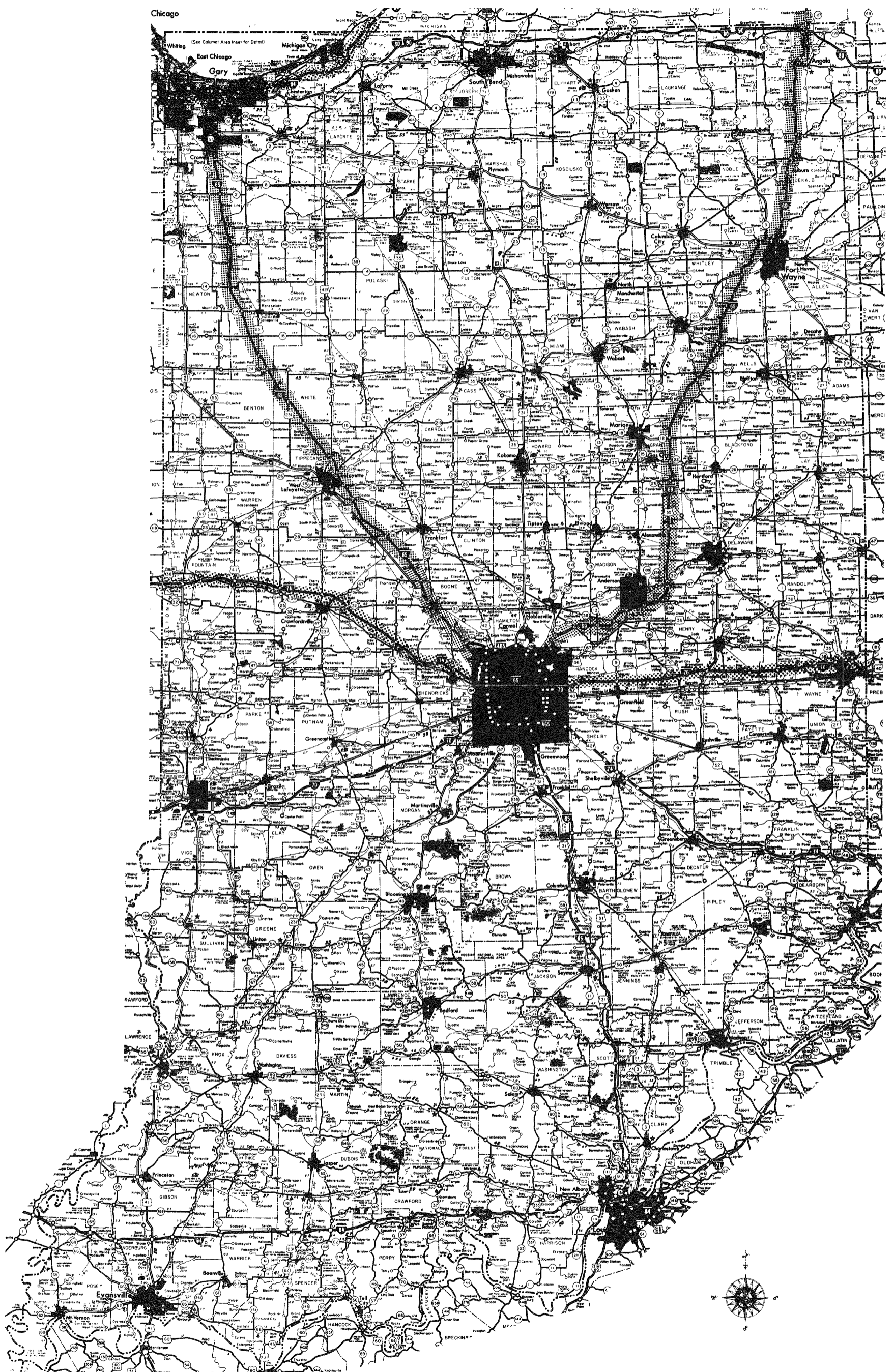




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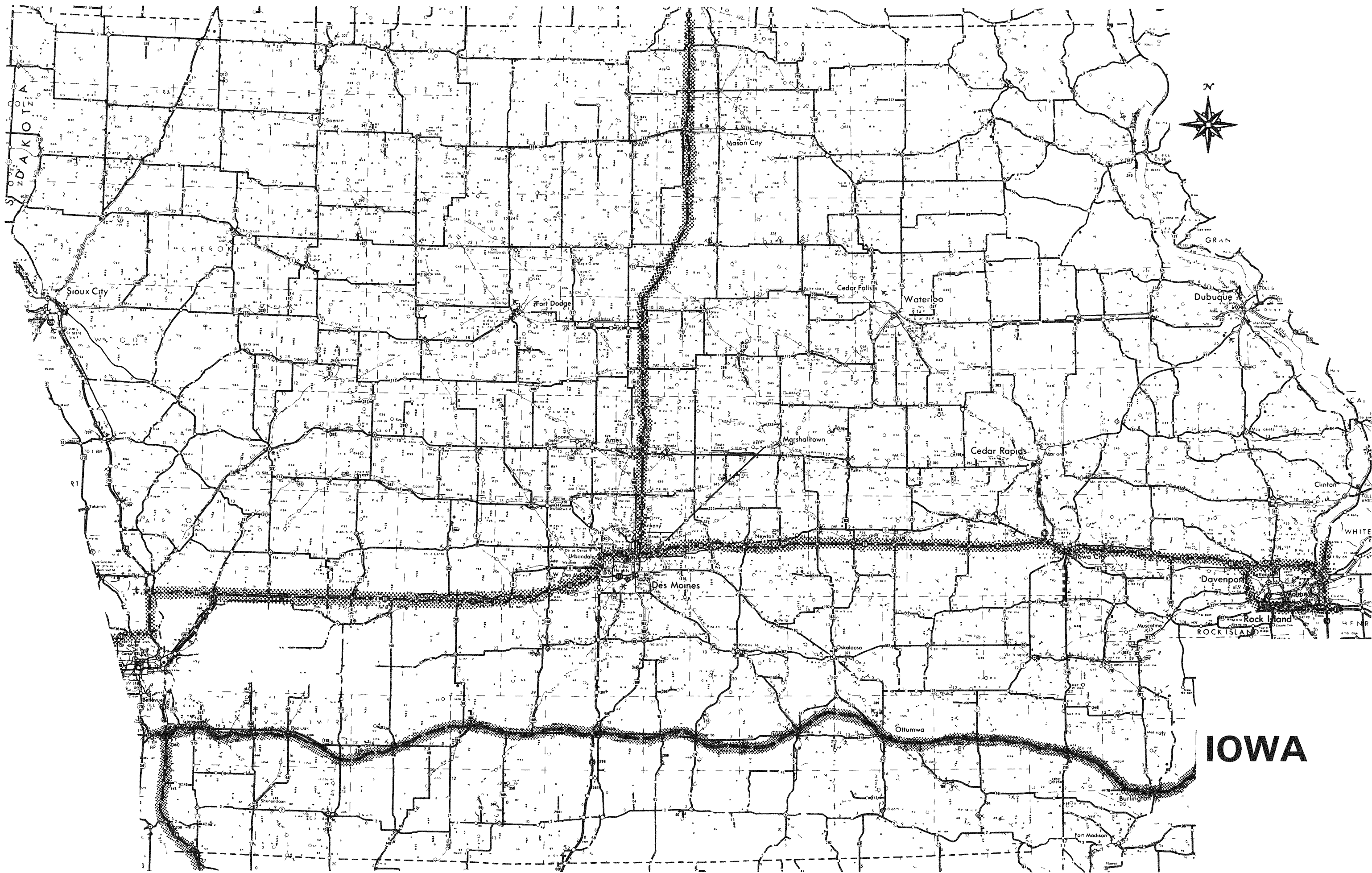


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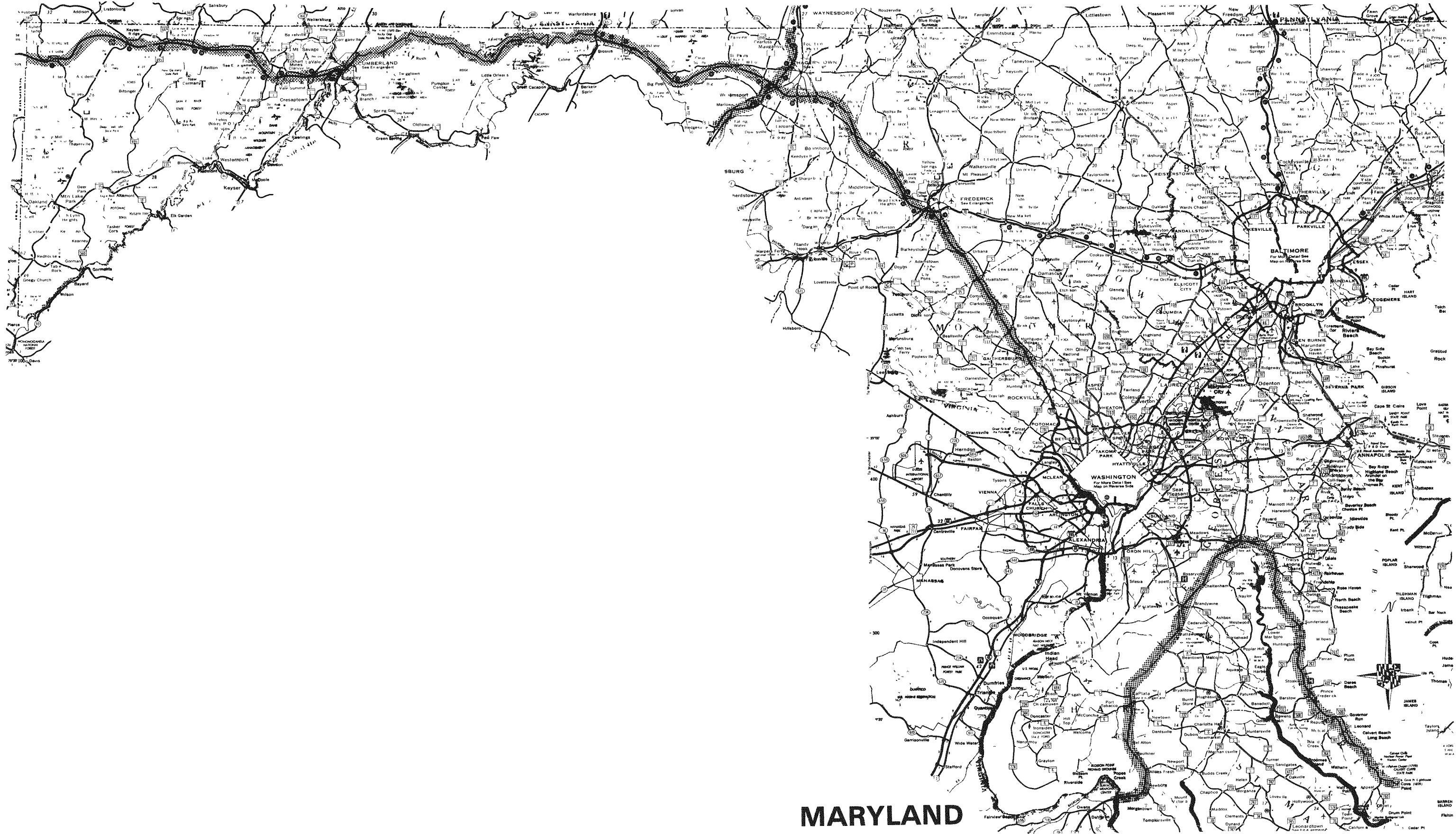
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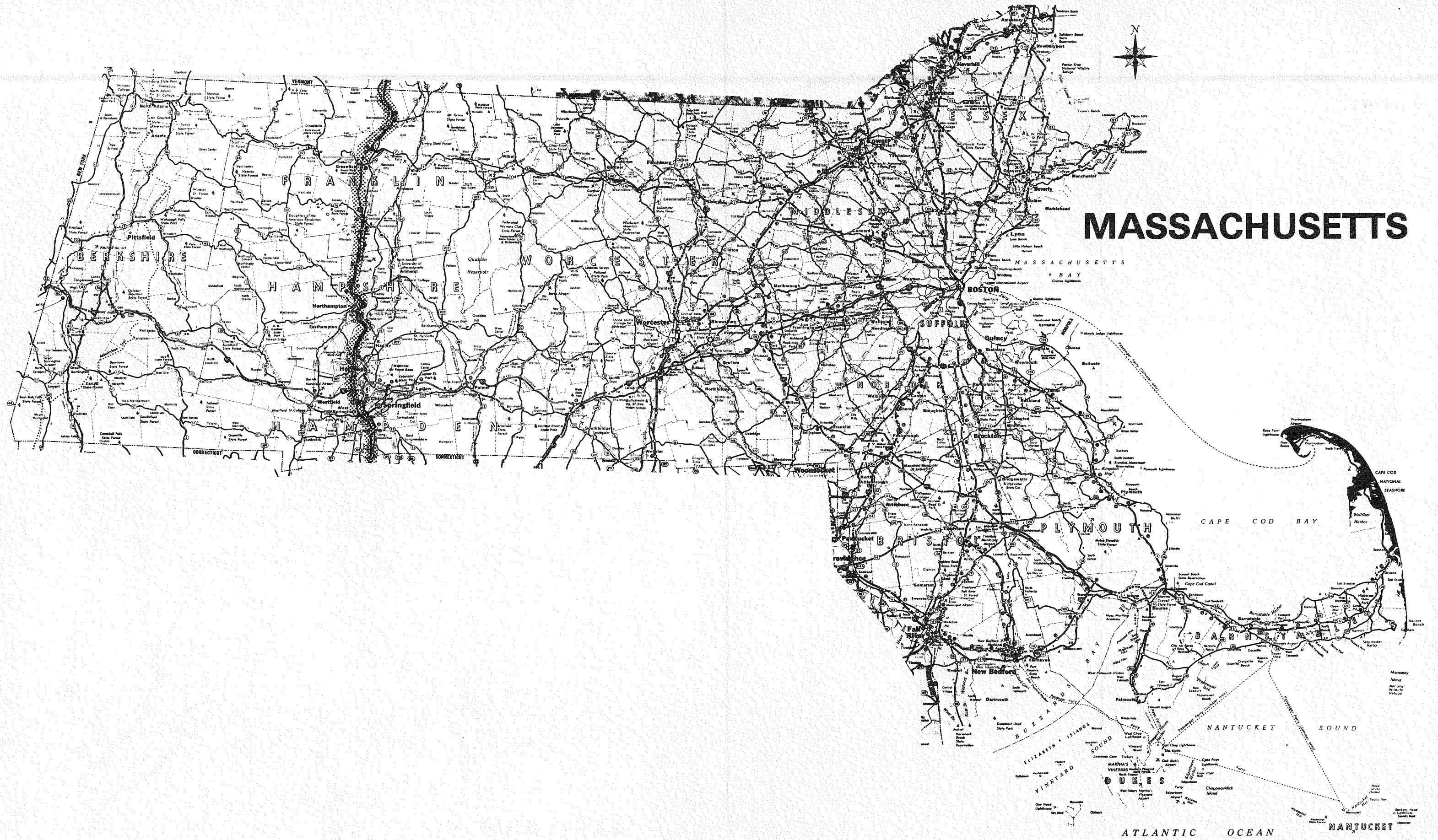
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KENTUCKY

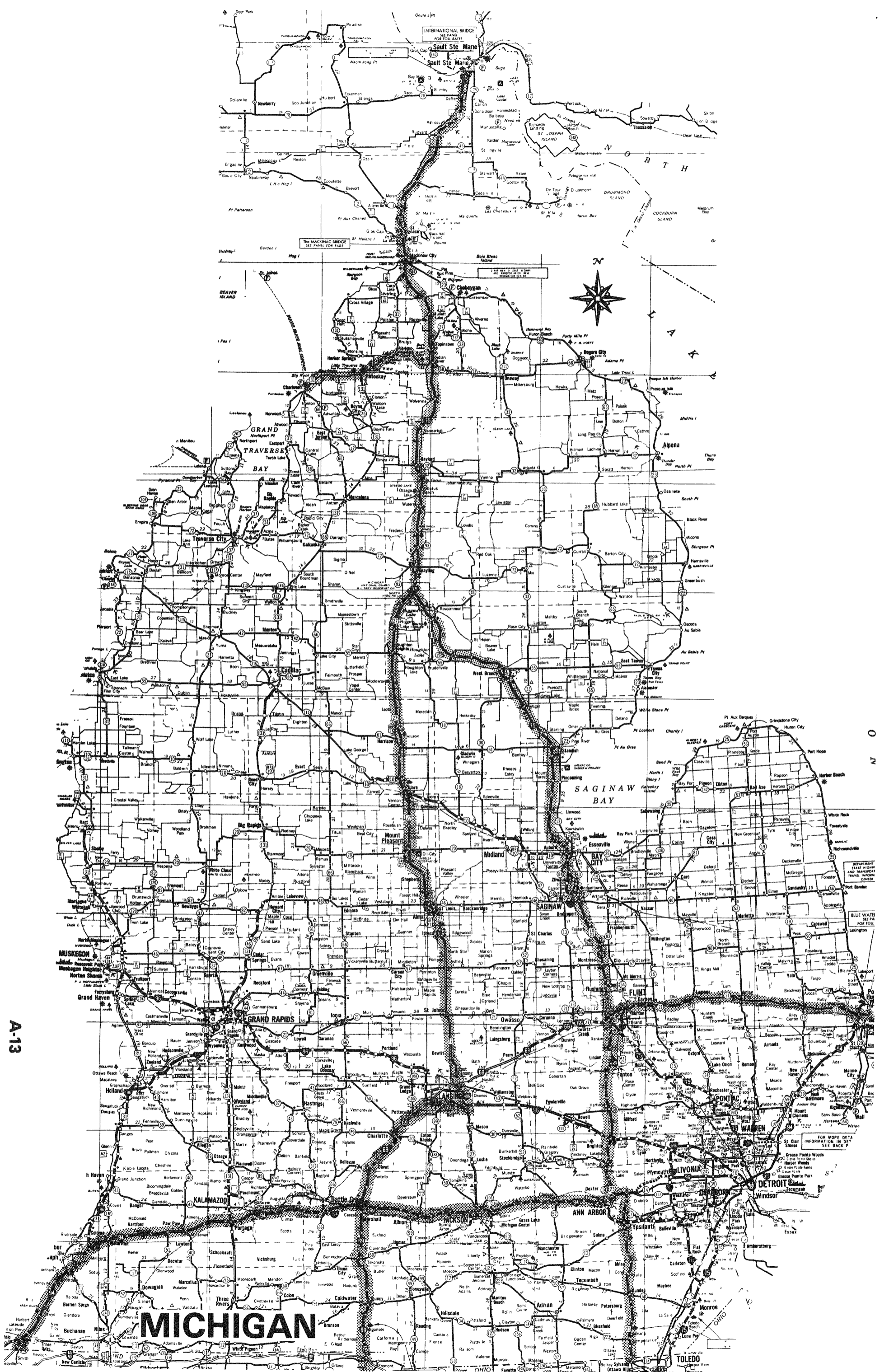


MARYLAND



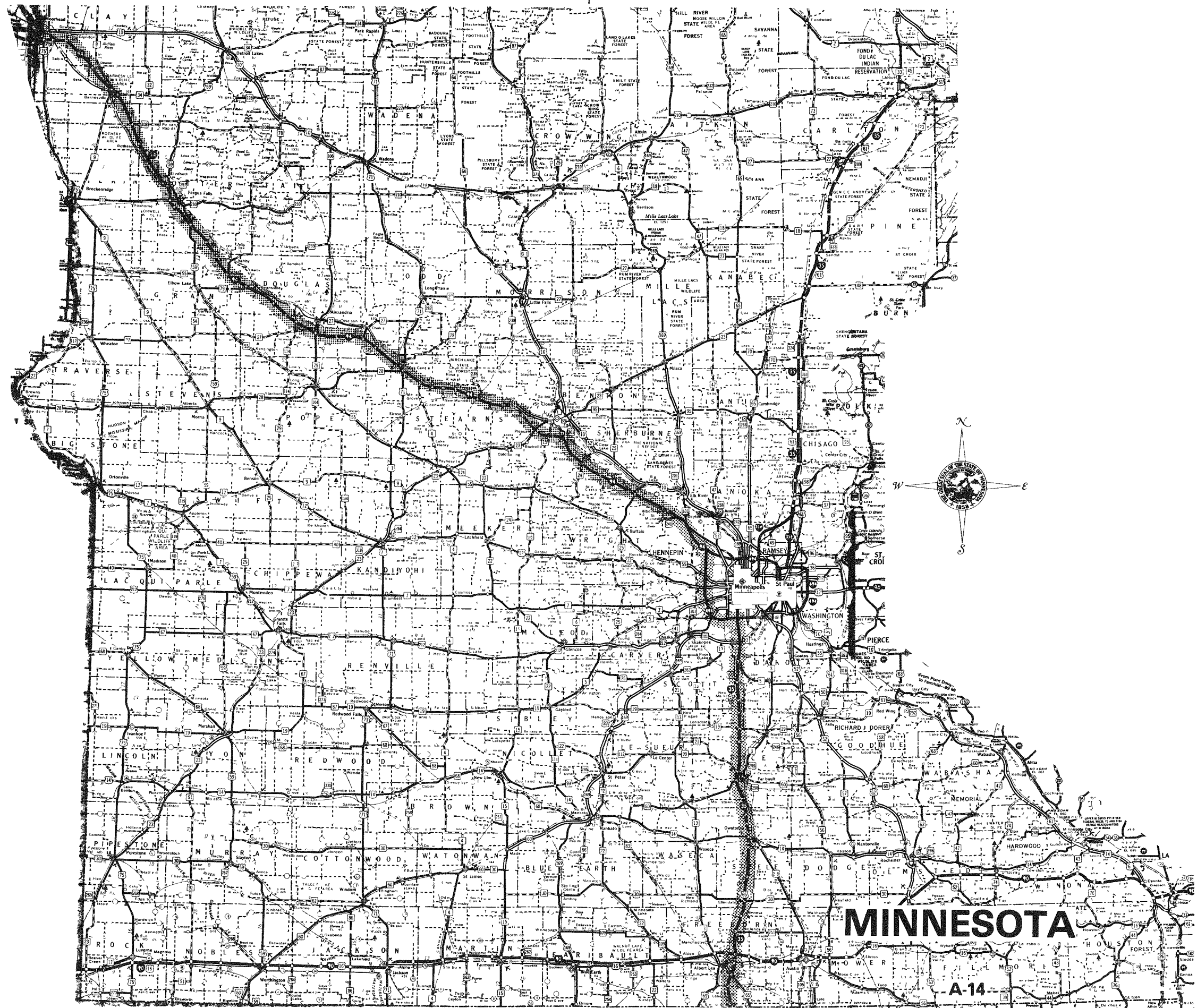
MASSACHUSETTS

A-13



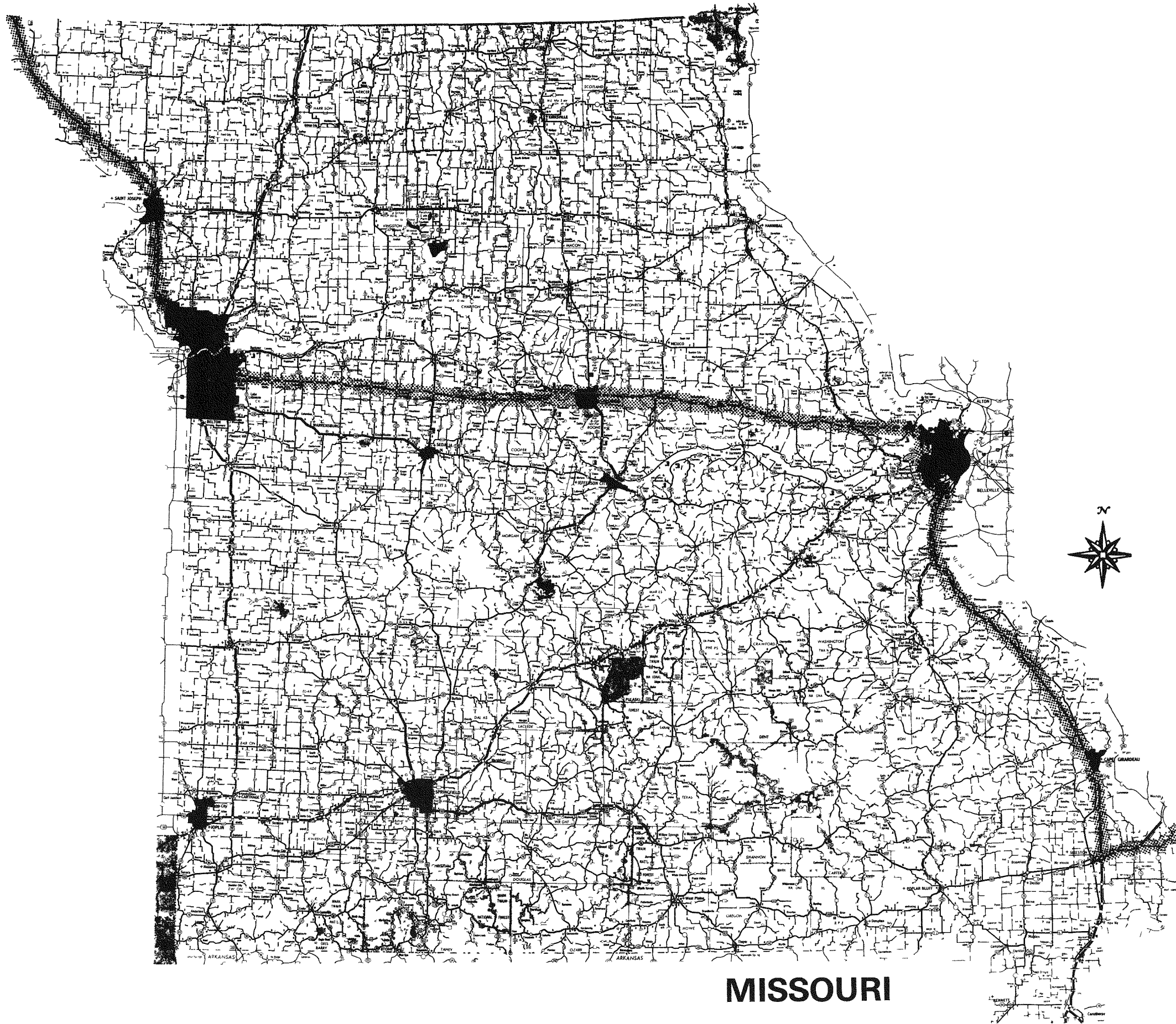
MICHIGAN

TOLEDO

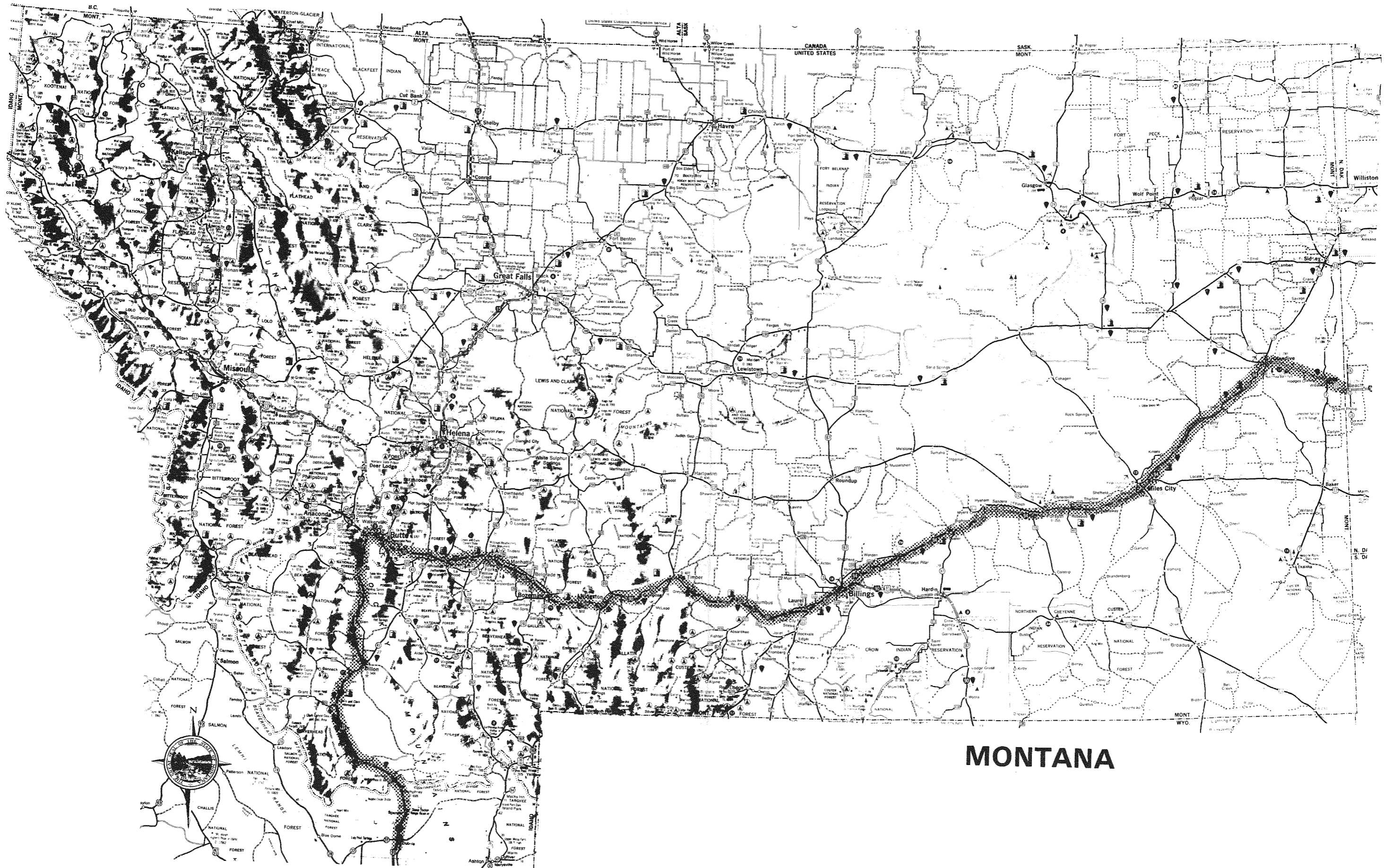


MINNESOTA

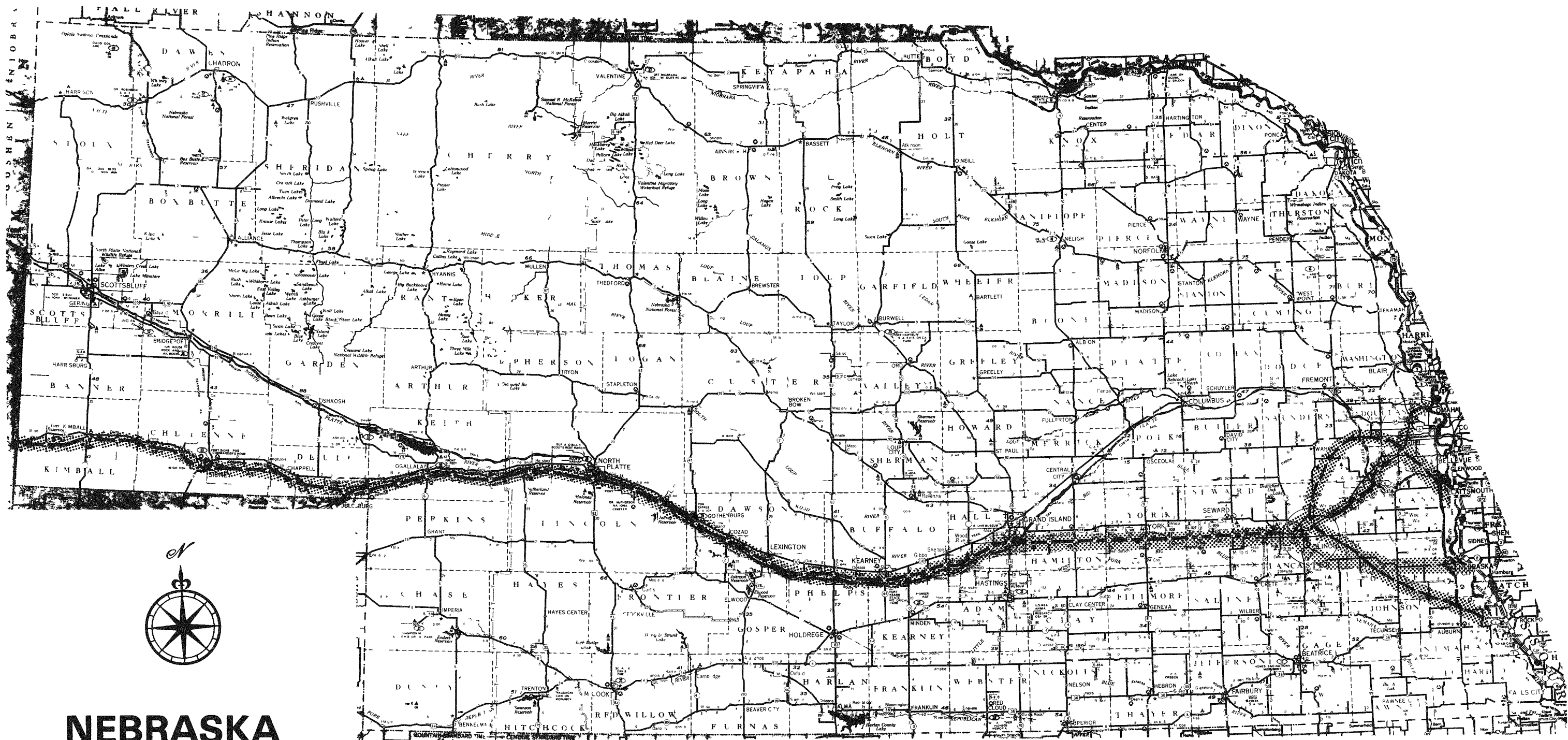
A-14



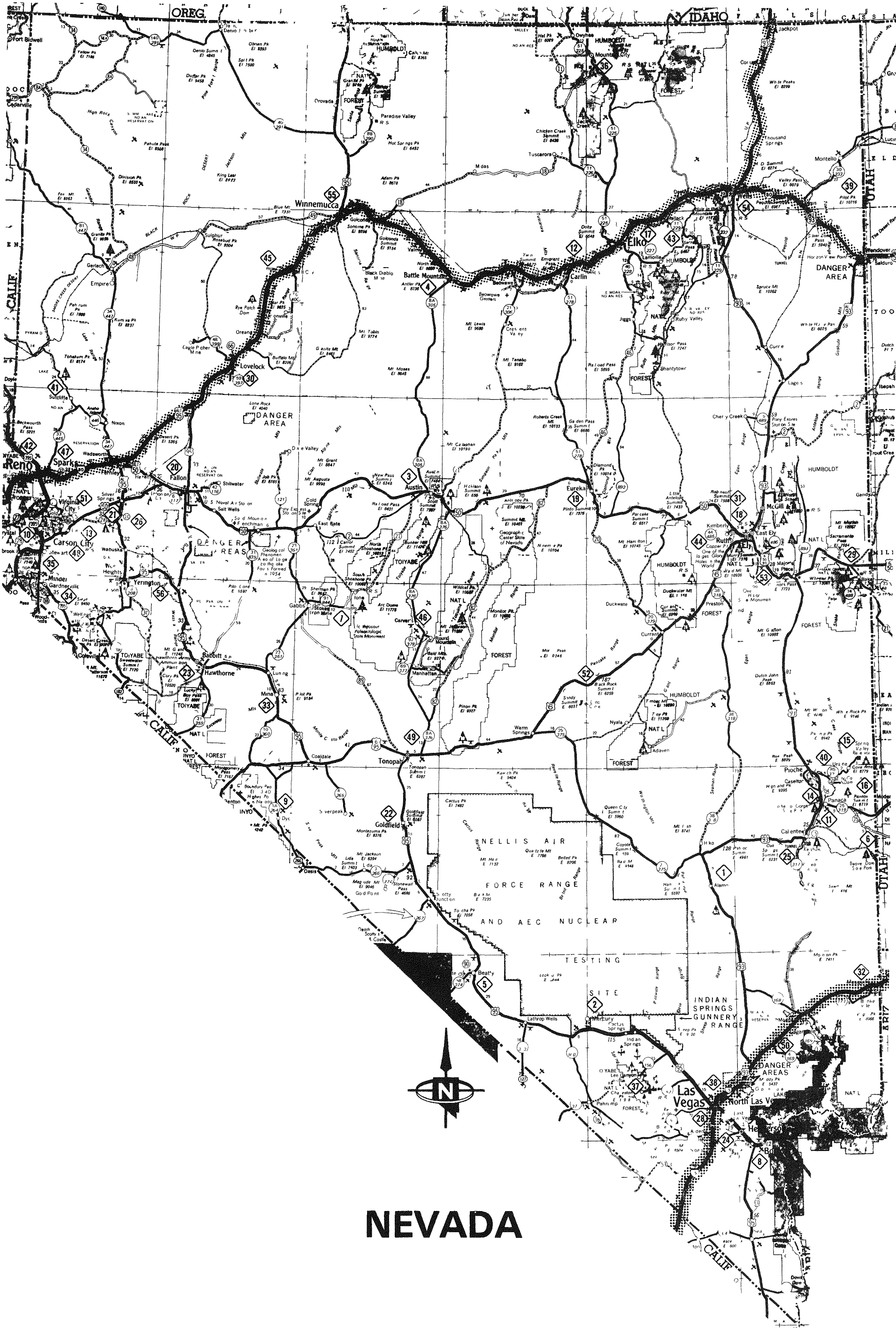
MISSOURI



MONTANA

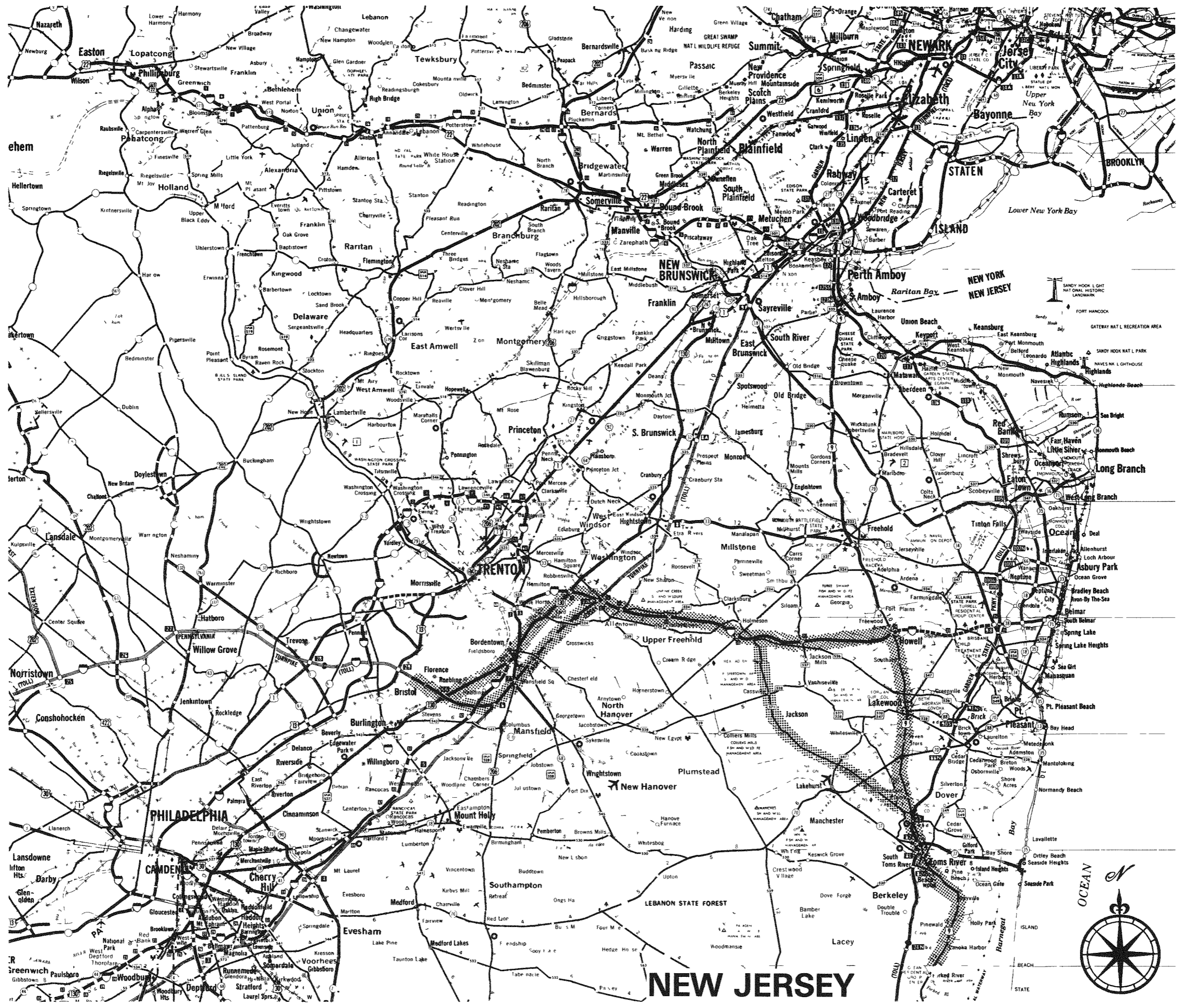


NEBRASKA



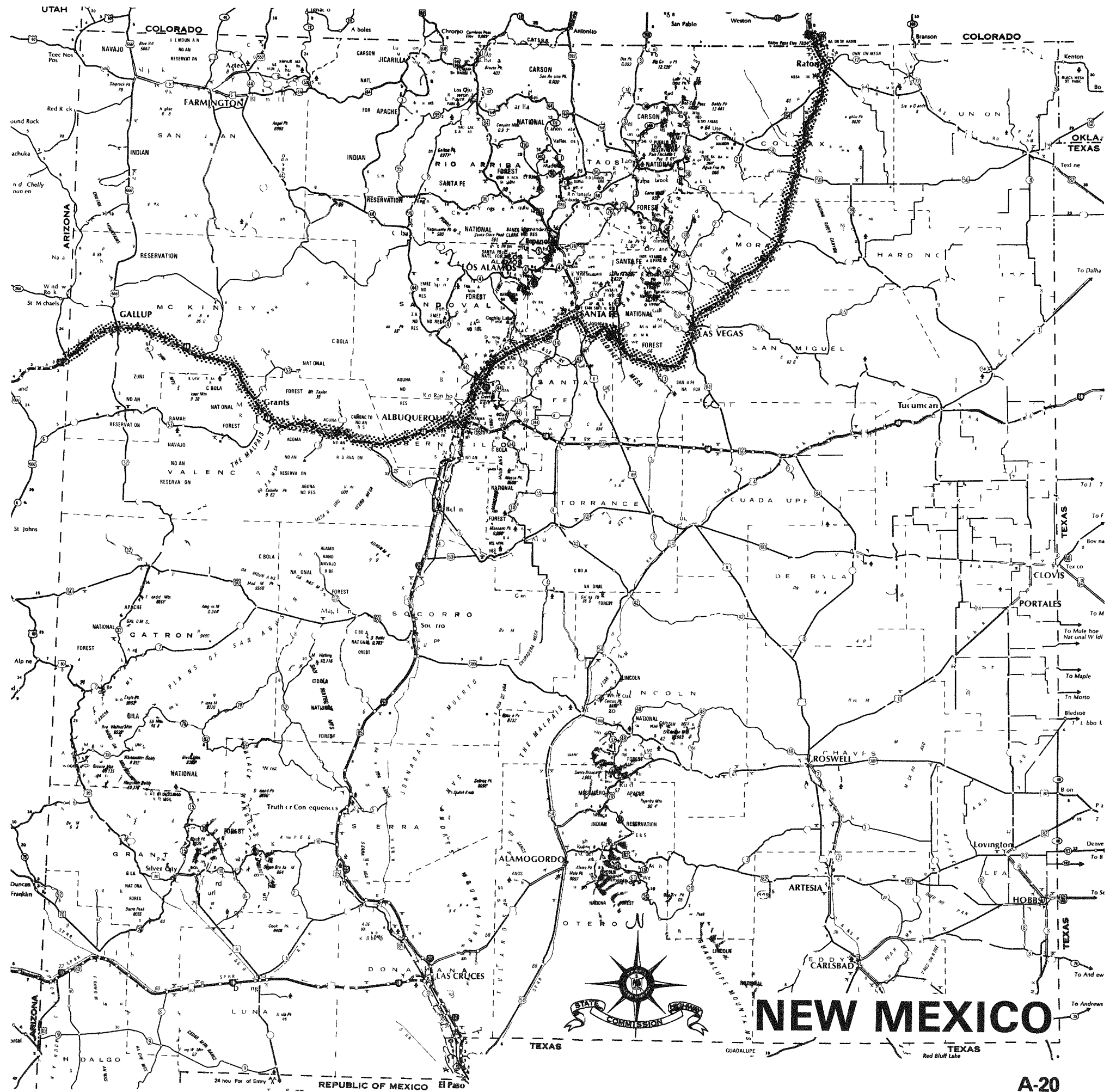
A-18

NEVADA



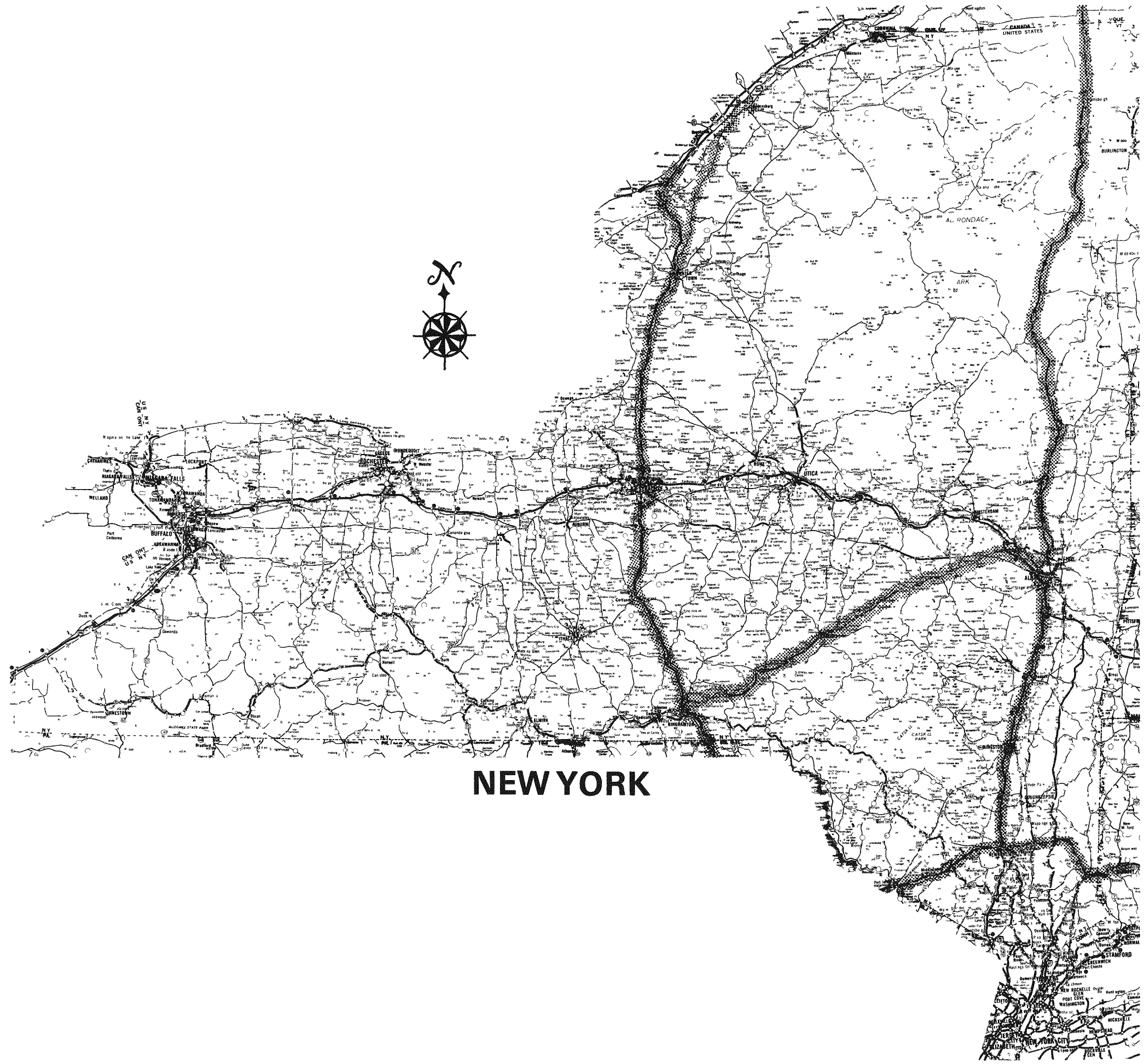
NEW JERSEY



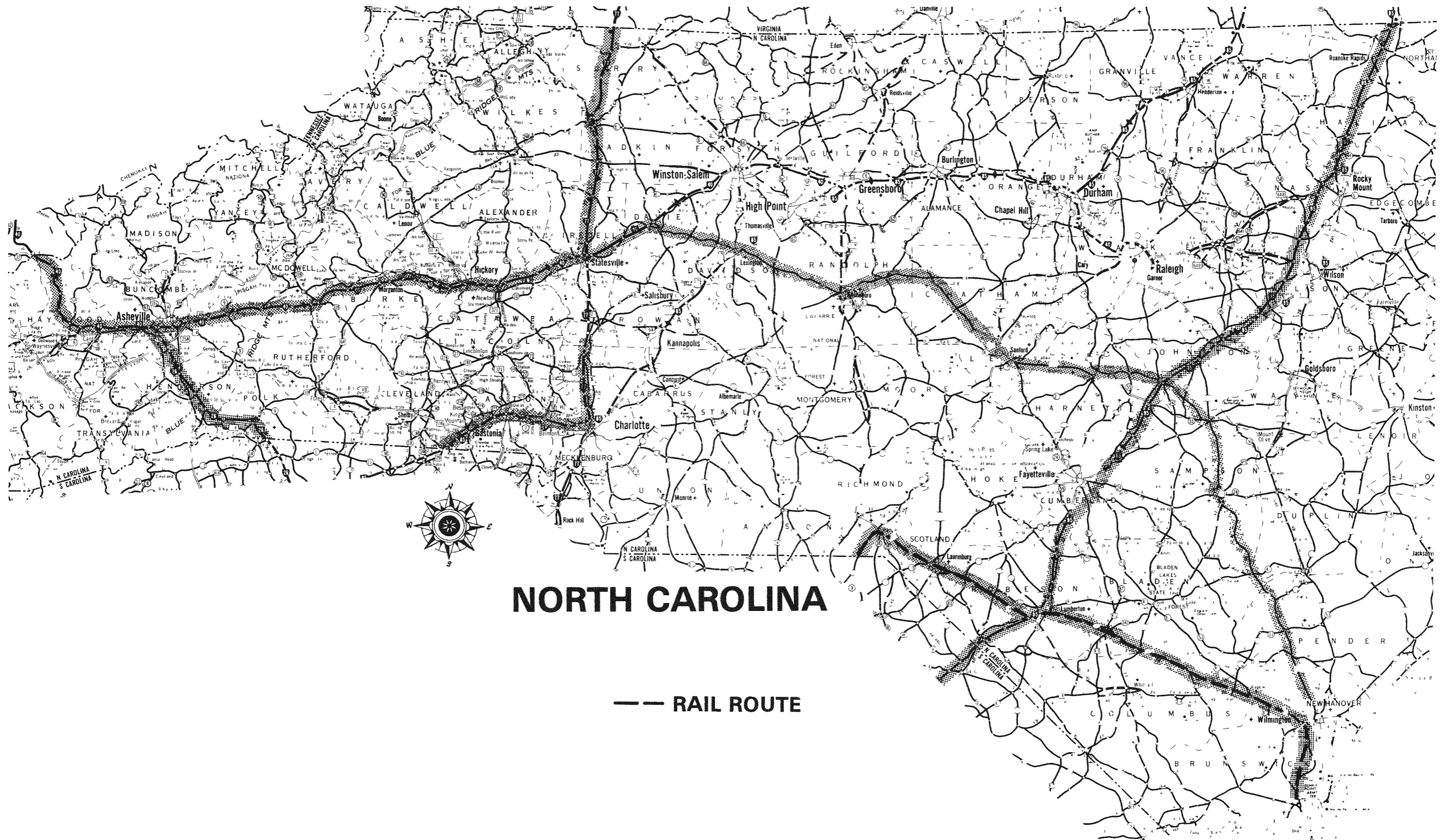


NEW MEXICO



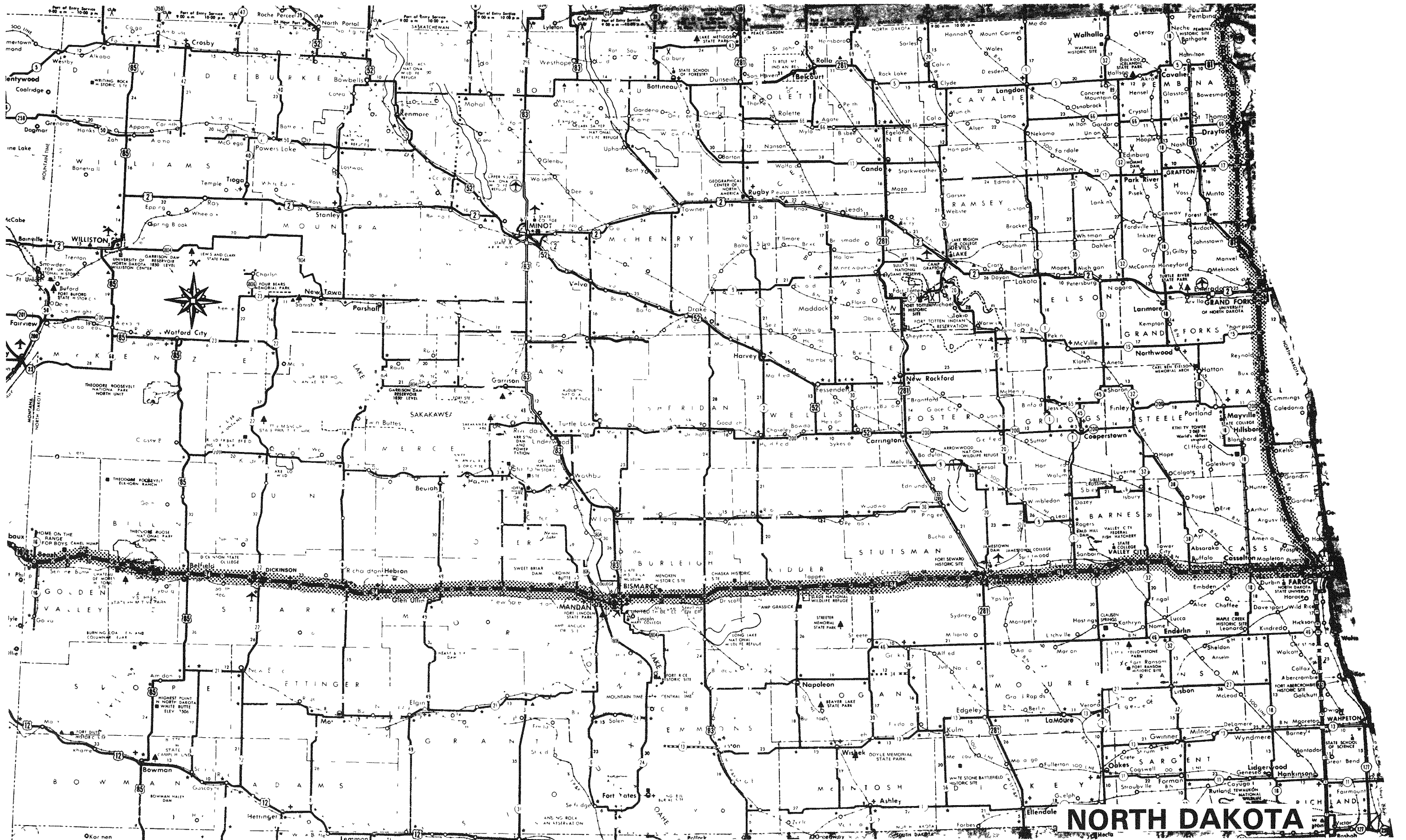


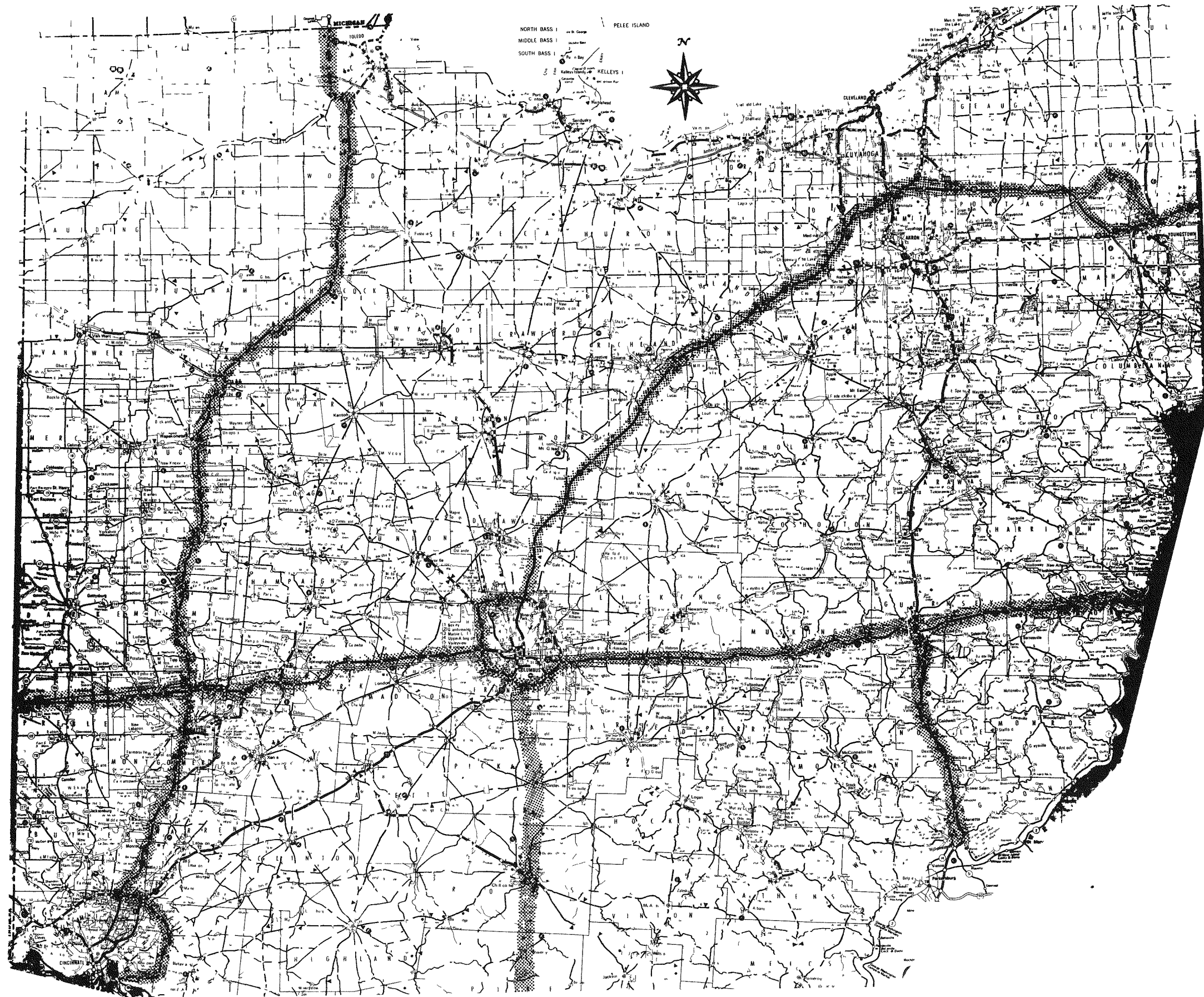
NEW YORK



NORTH CAROLINA

— — RAIL ROUTE

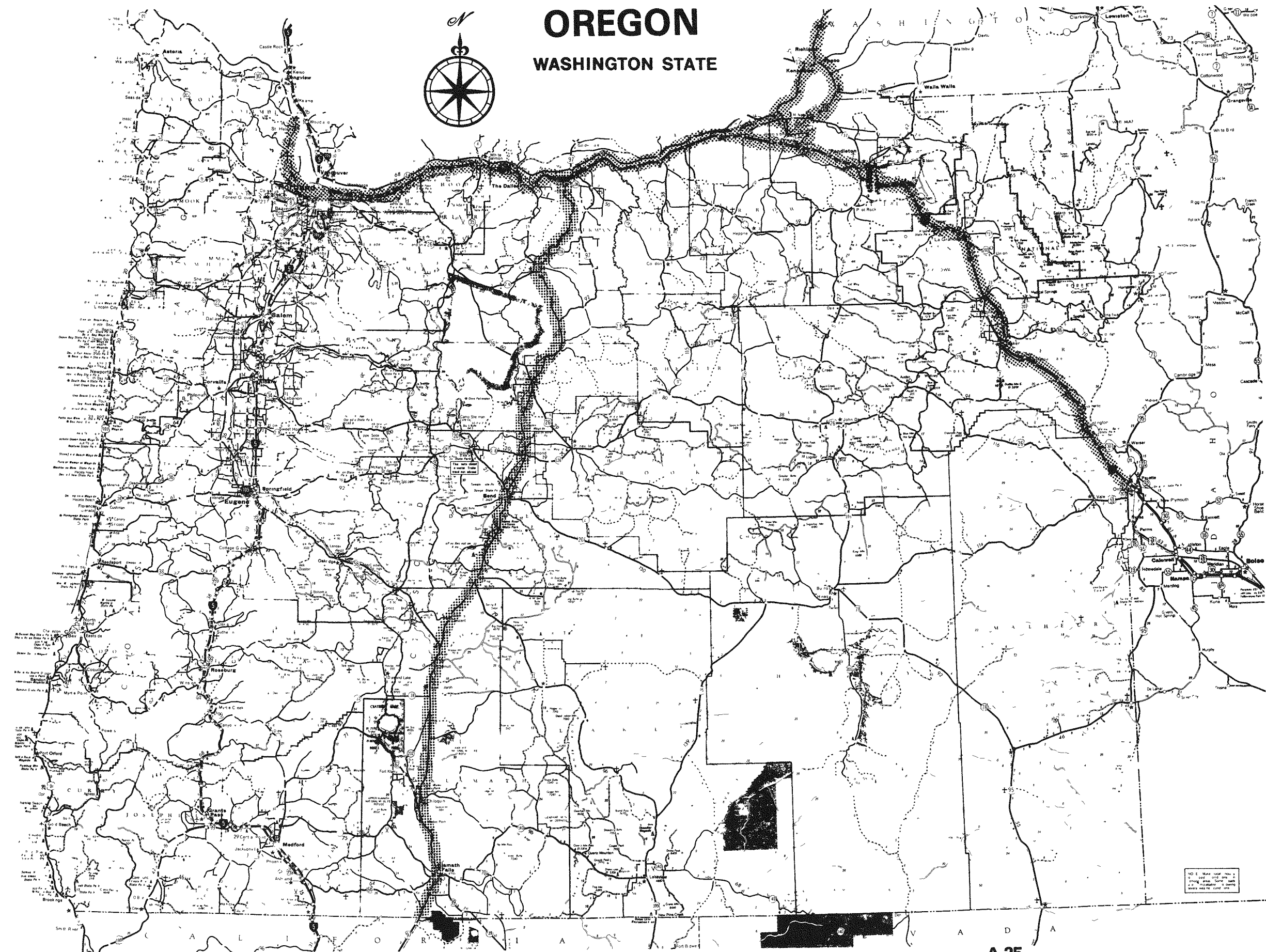




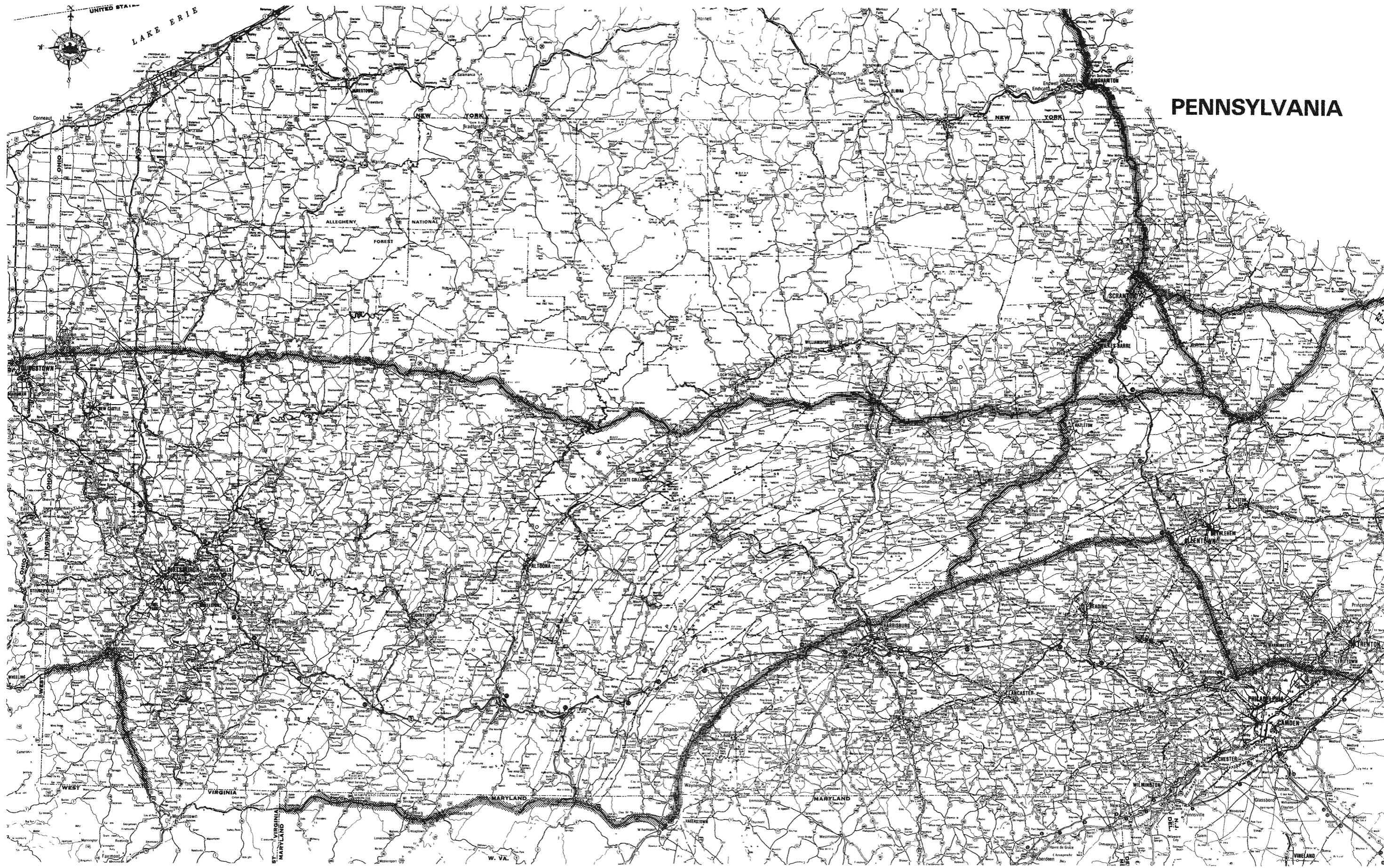
OHIO

OREGON

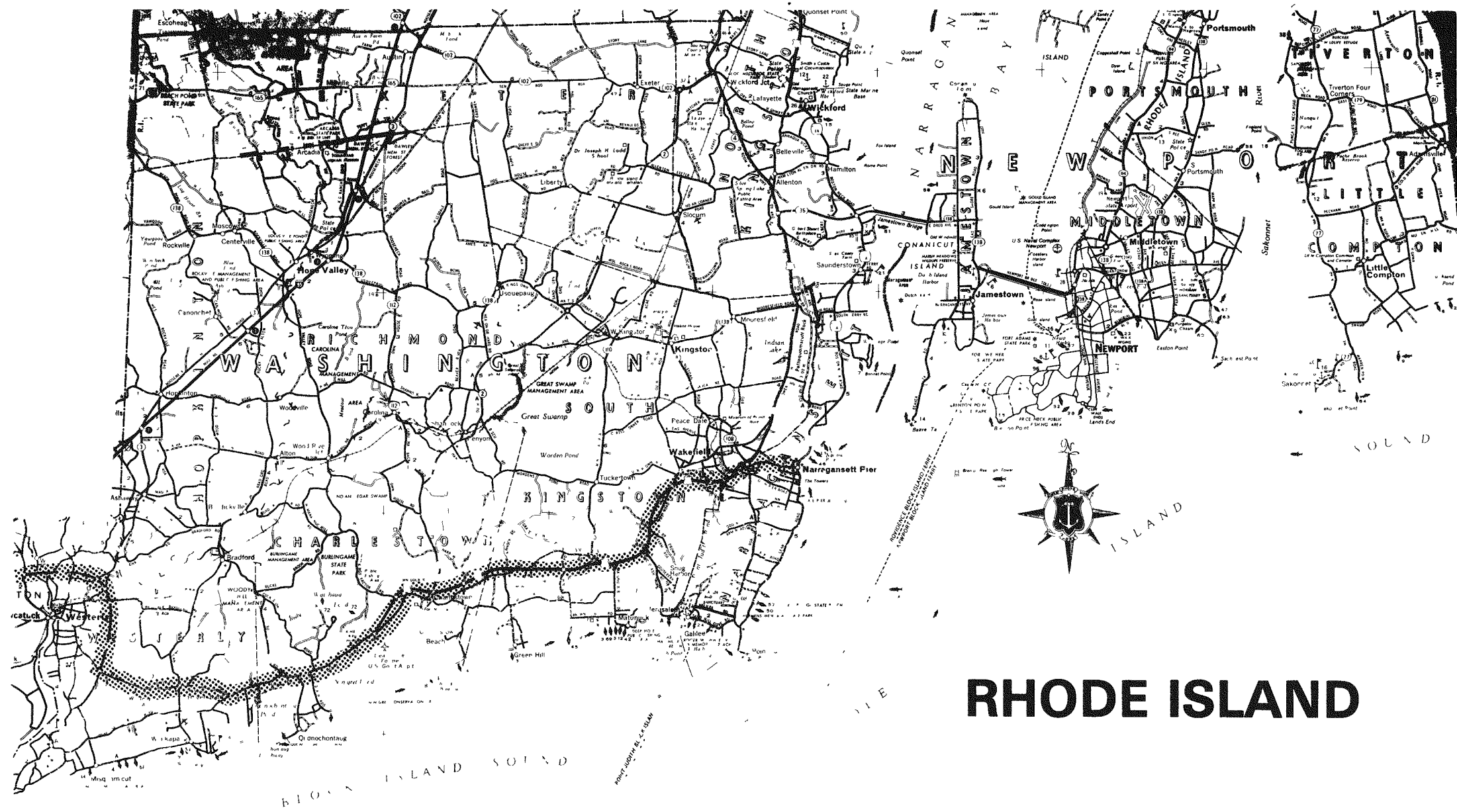
WASHINGTON STATE



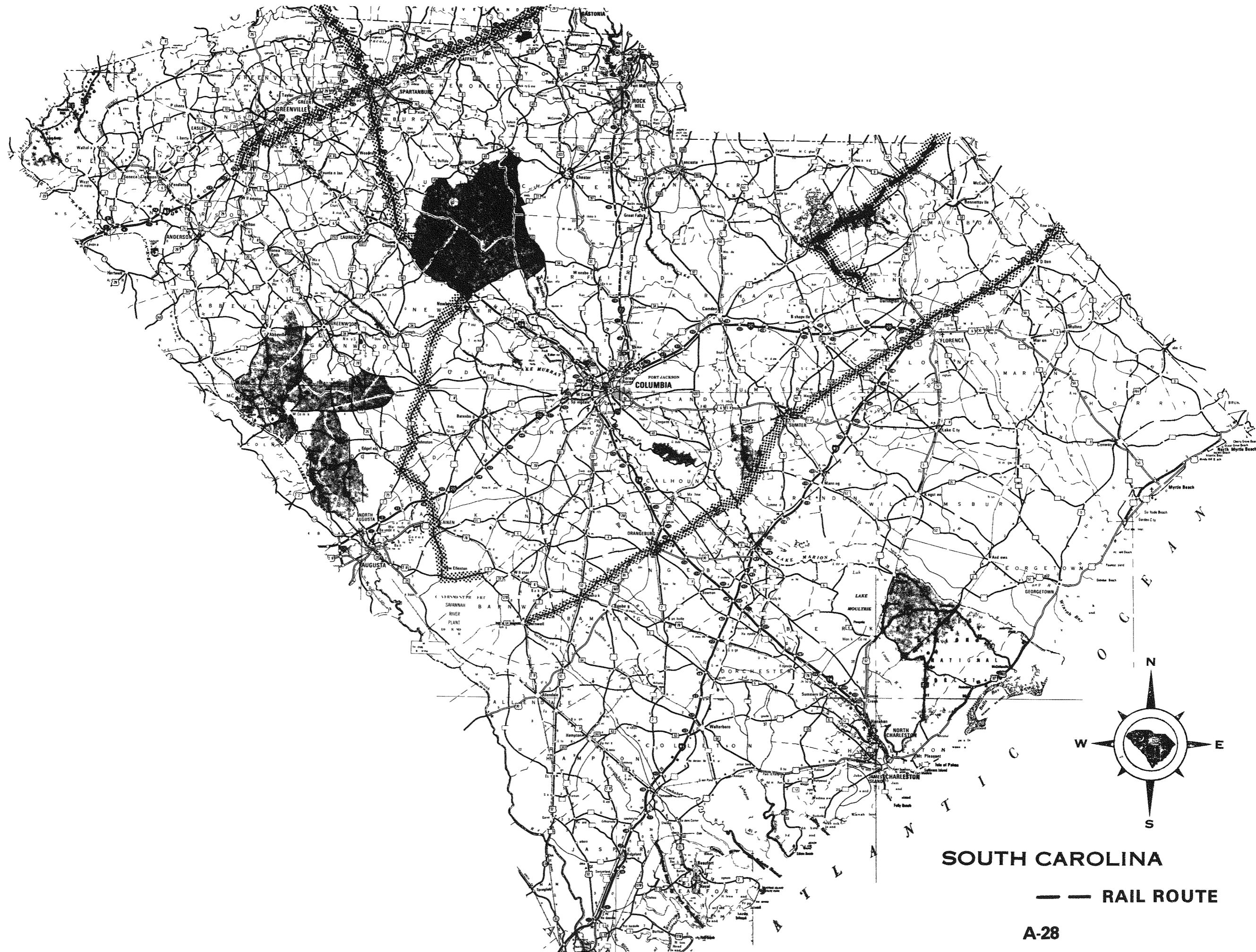
NO. 1 Map of Oregon
Scale 1:500,000
Copyright 1960
Revised 1965



PENNSYLVANIA

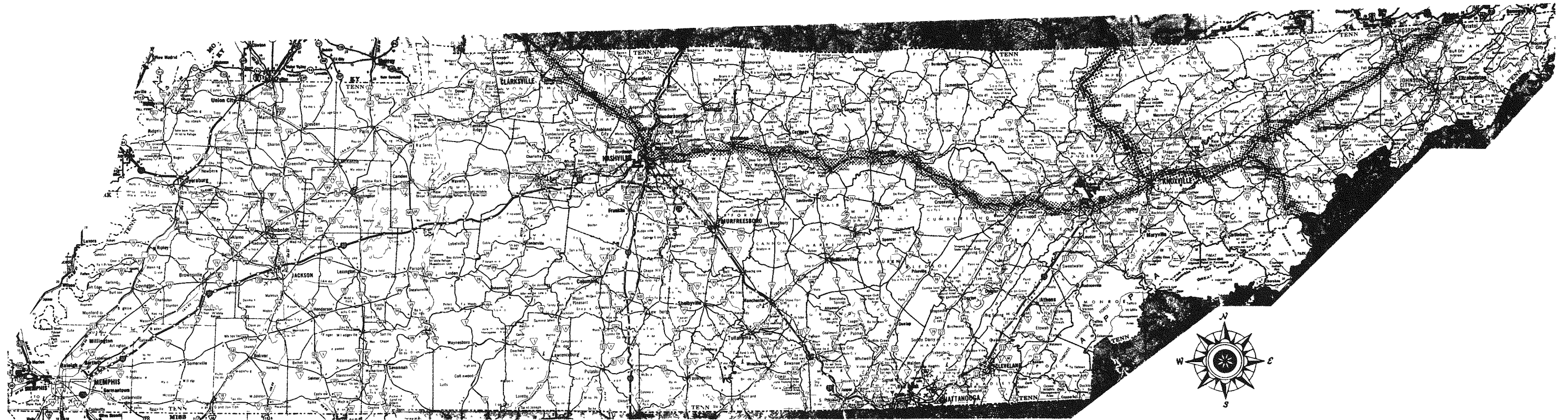


RHODE ISLAND

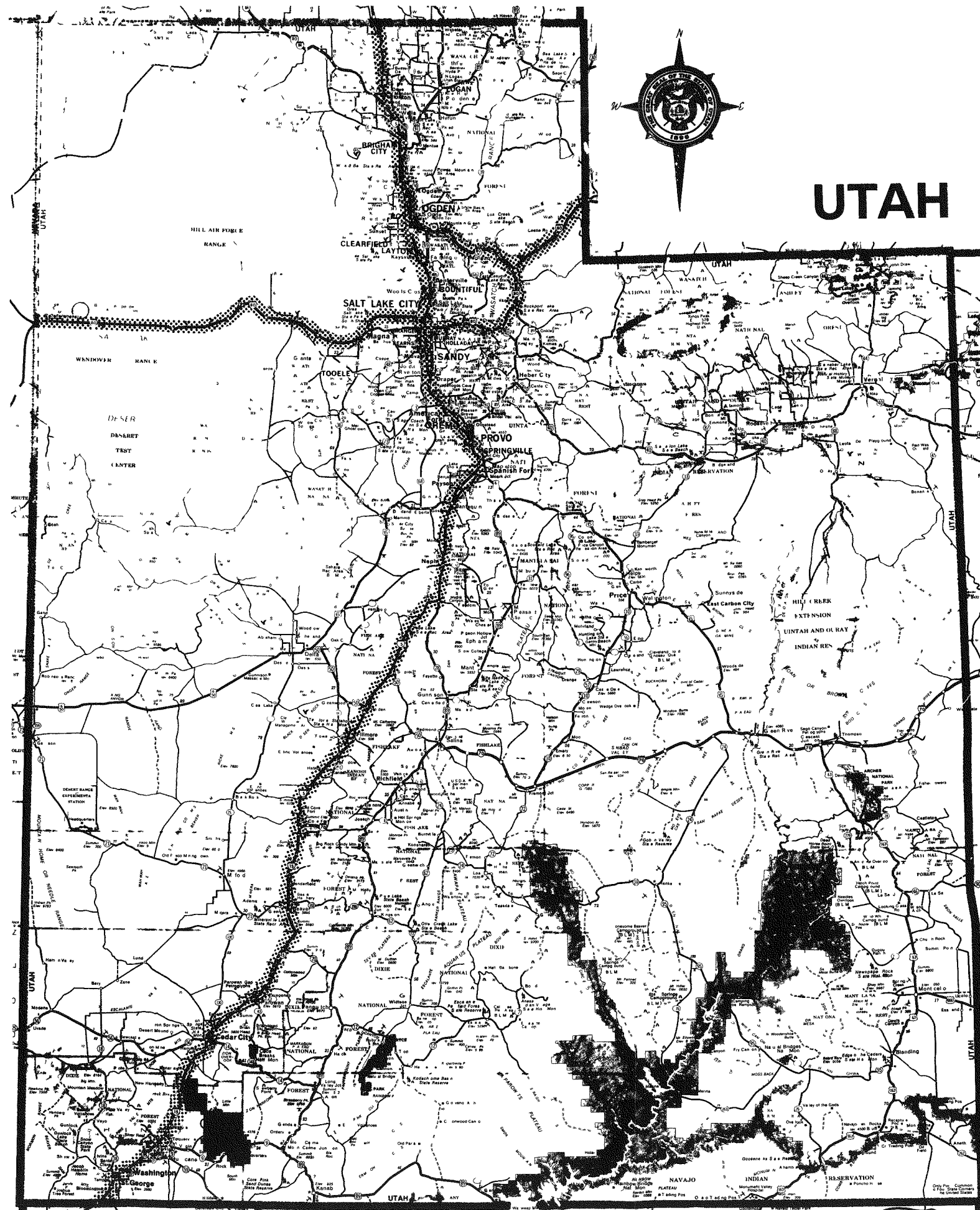


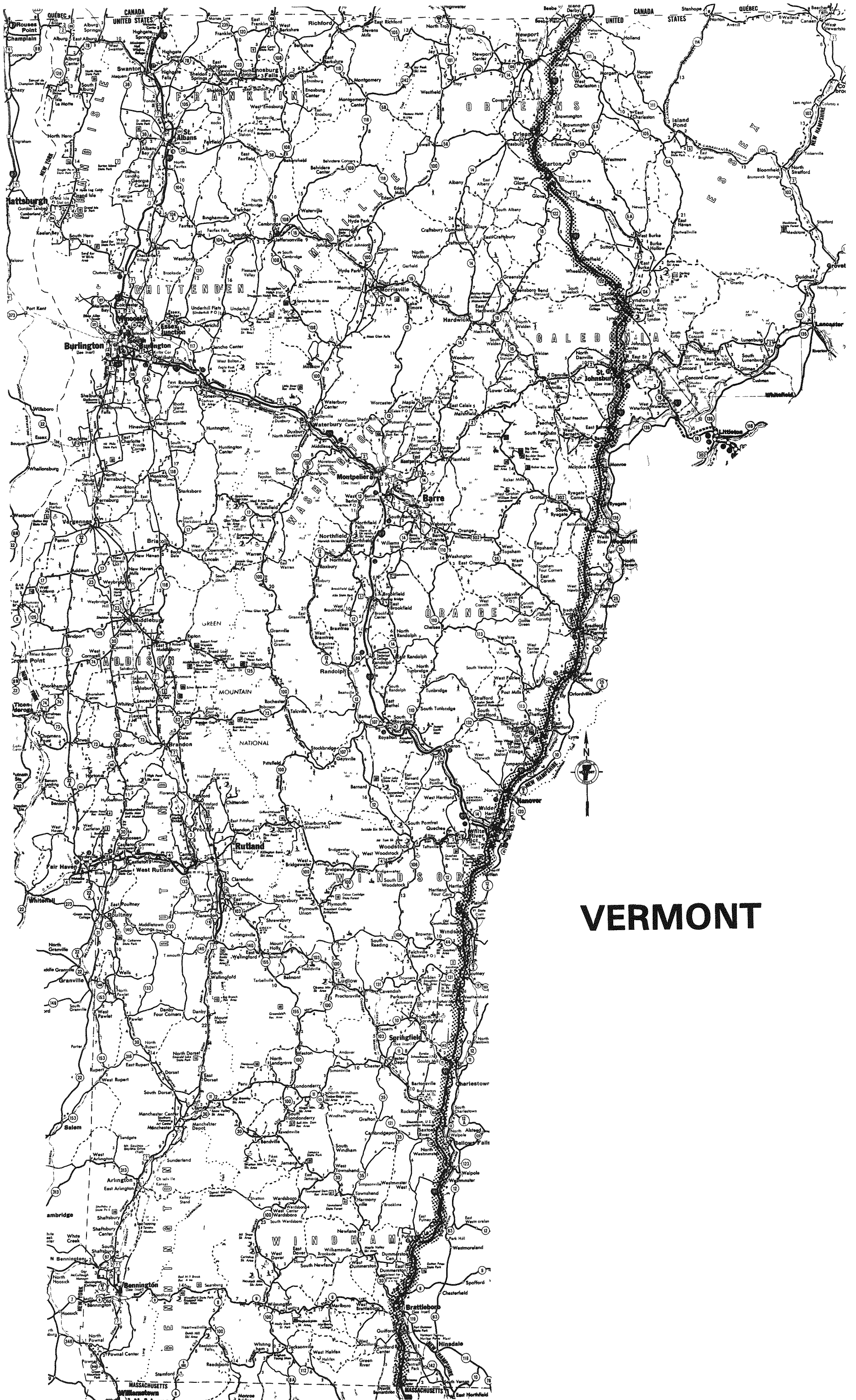
SOUTH CAROLINA

— — RAIL ROUTE



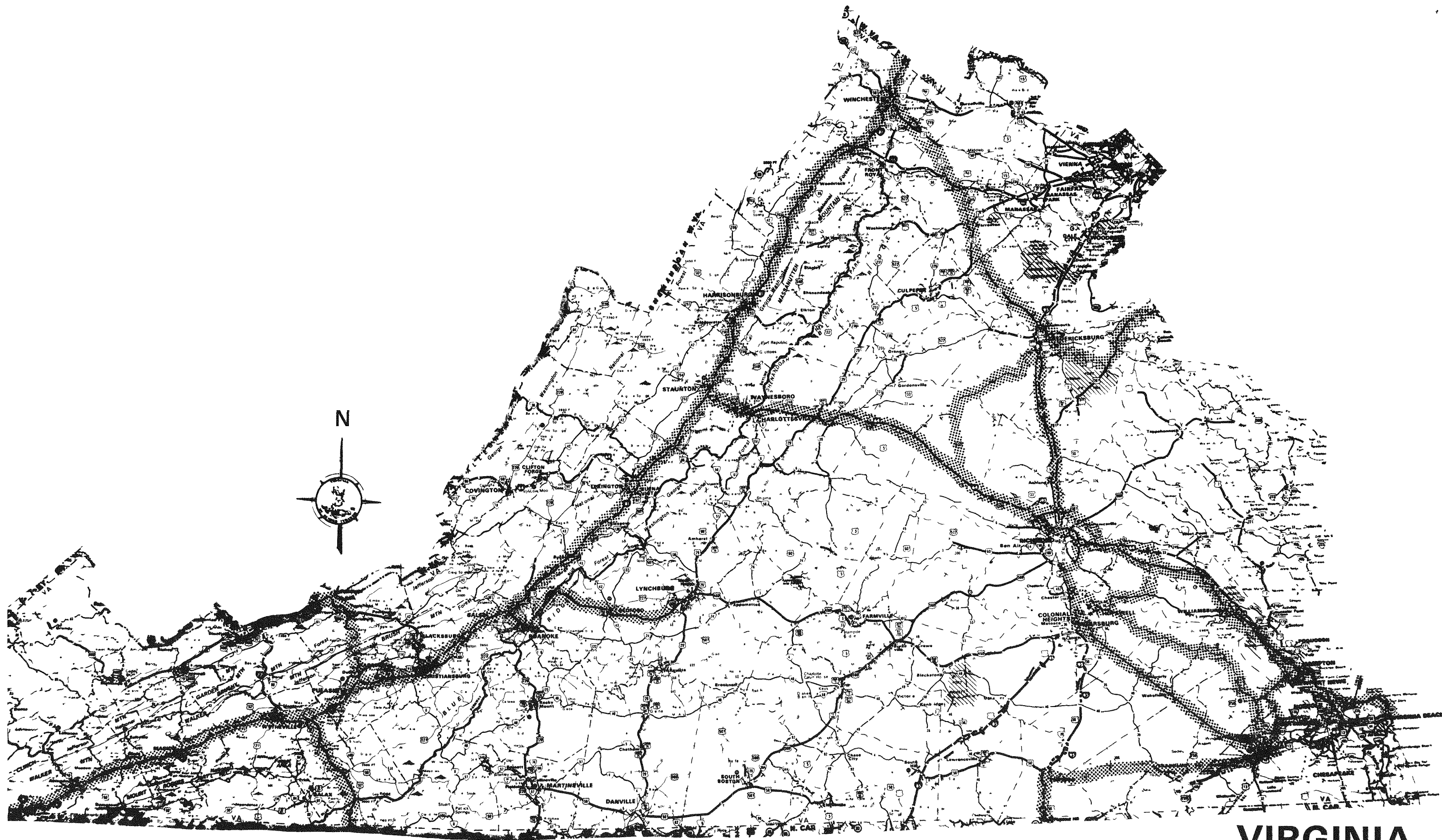
TENNESSEE



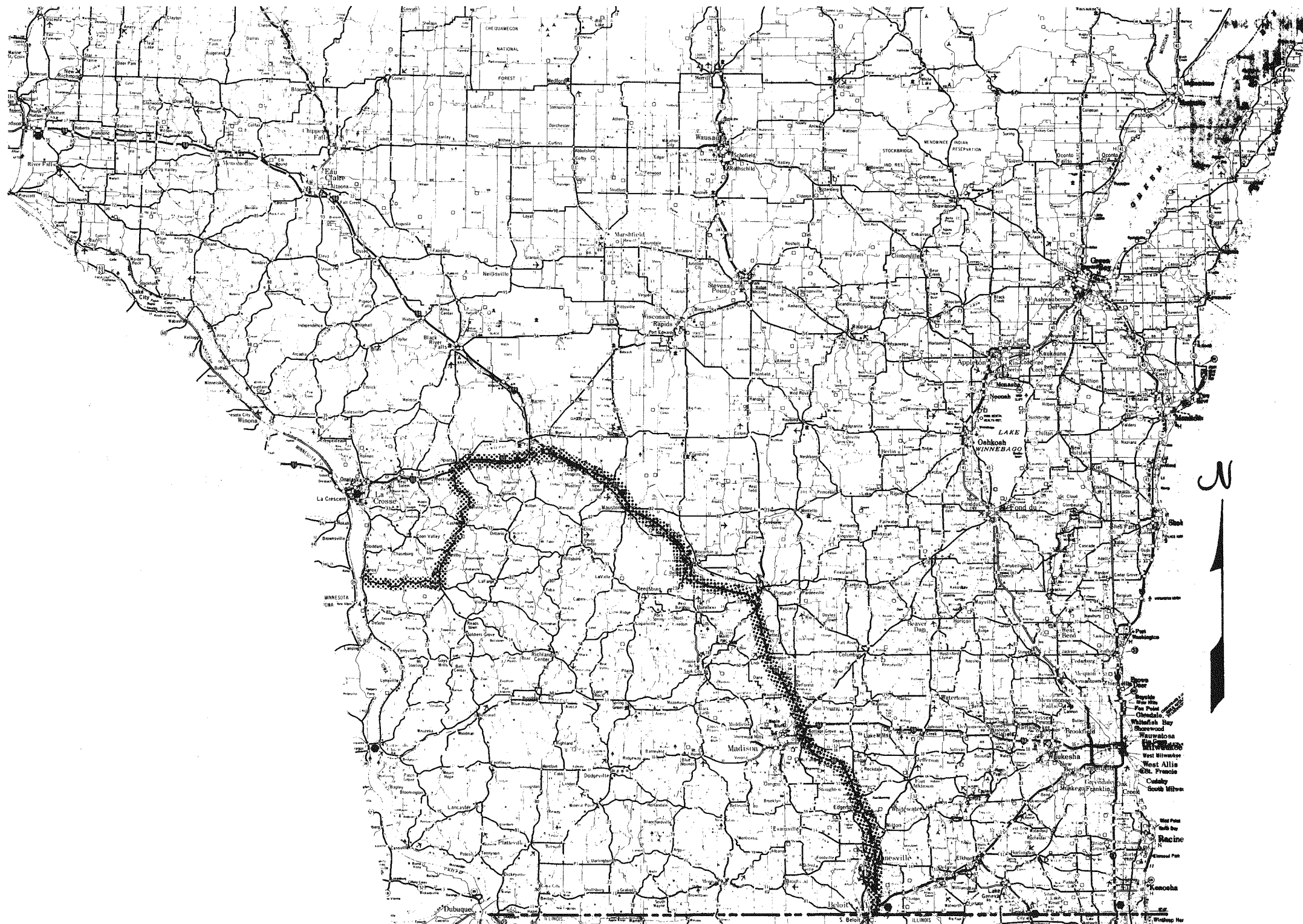


VERMONT

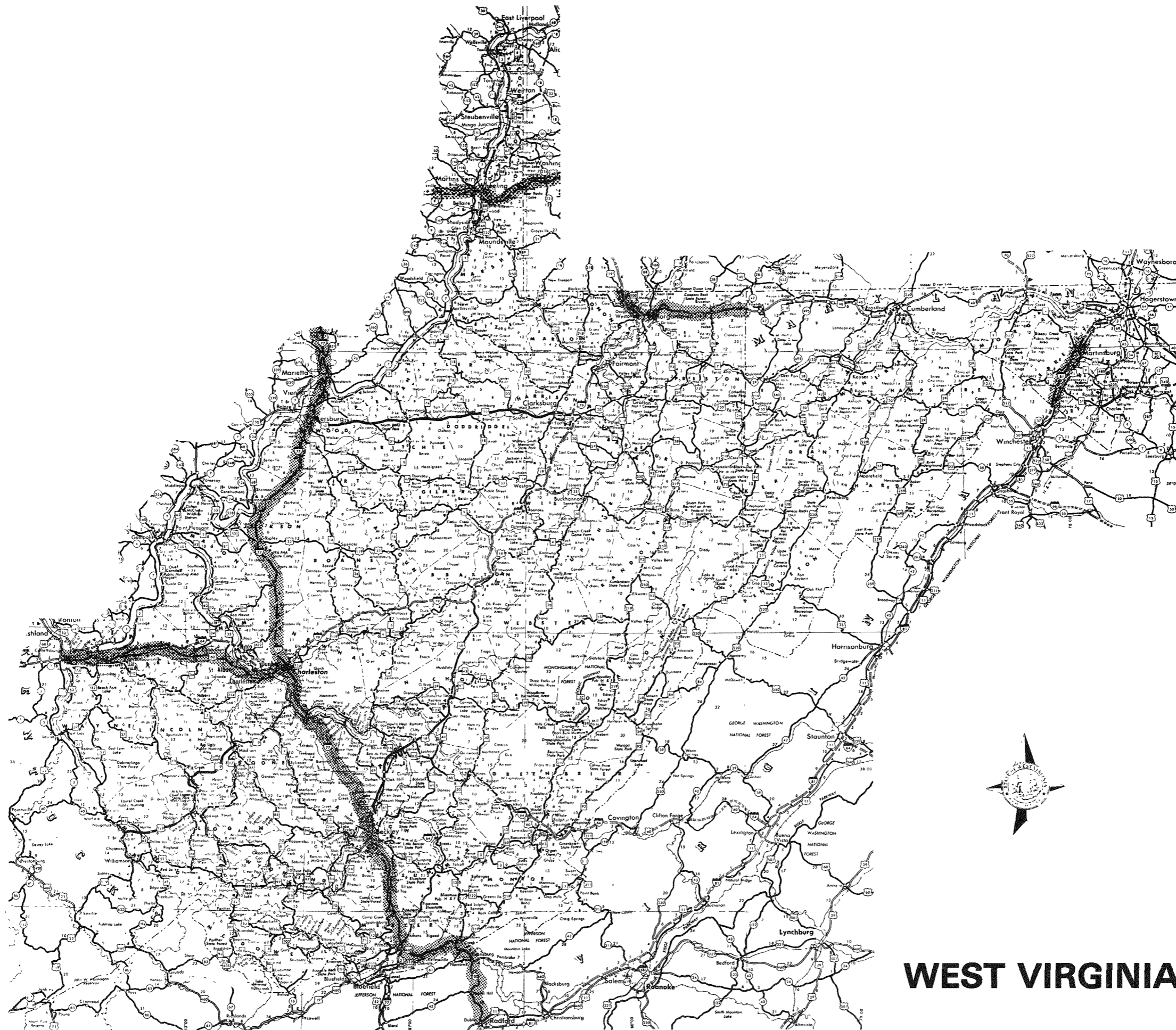
A-31



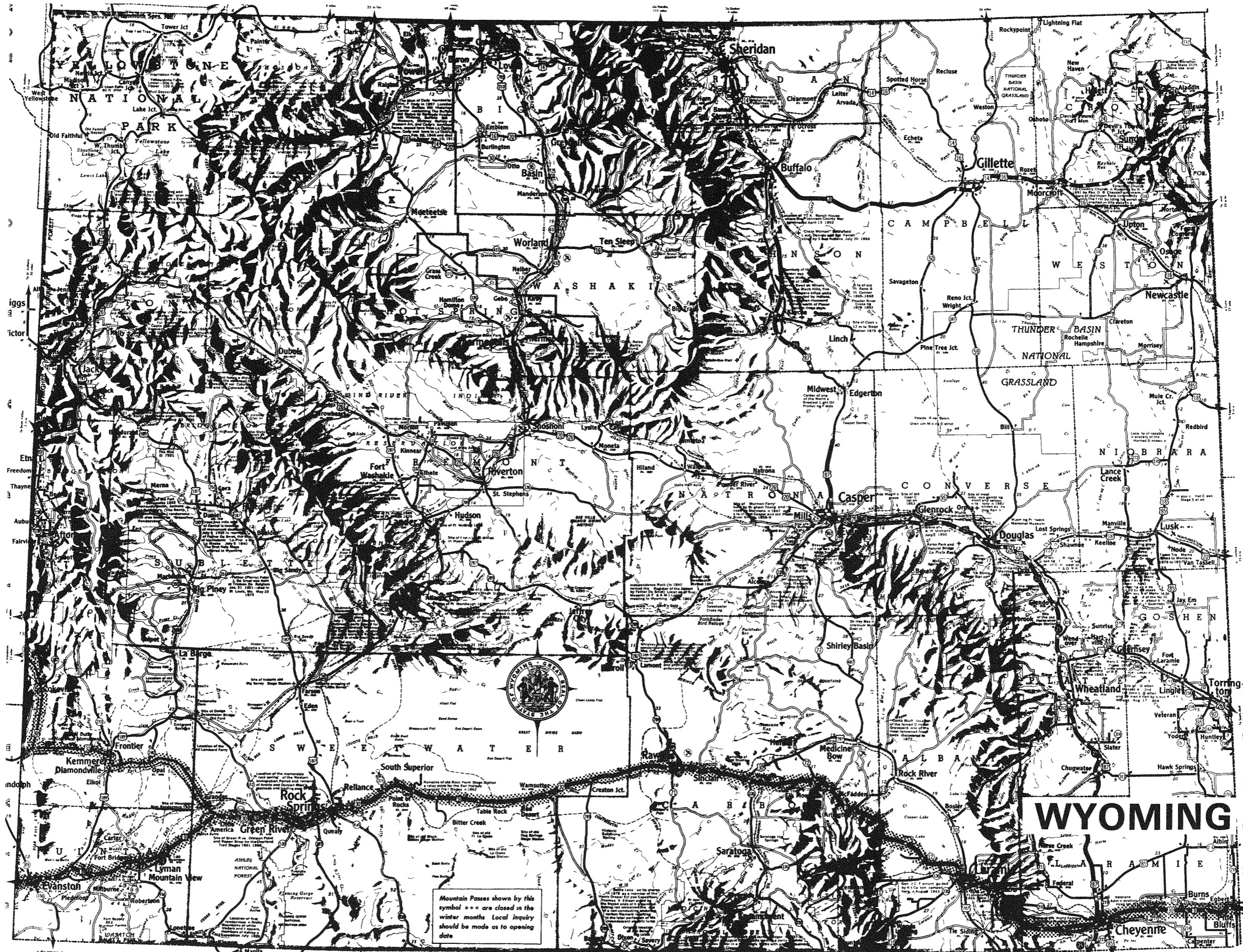
VIRGINIA



WISCONSIN



WEST VIRGINIA



Mountain Passes shown by this symbol *** are closed in the winter months. Local inquiry should be made as to opening date.

WYOMING