ARIZONA DEPARTMENT OF TRANSPORTATION

REPORT NUMBER: FHWA-AZ93-285

COMPARATIVE RISKS OF TRANSPORTING HAZARDOUS MATERIALS ON THE STATE HIGHWAY SYSTEM IN ARIZONA

Final Report

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February 1993

Prepared for:
Arizona Department of Transportation
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in cooperation with
U.S. Department of Transportation
Federal Highway Administration

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-AZ93-285		

4. Title and Subtitle	5. Report Date / 6. Performing Organization Code
COMPARATIVE RISKS OF TRANSPORTING HAZARDOUS MATERIALS ON THE STATE HIGHWAY SYSTEM IN ARIZONA	5. Report Date: February 1993 6. Performing Organization Code
7. Author(s) Charles D. Anders and James C. Olsten	8. Performing Organization Report No.
9. Performing Organization Name and Address Dames & Moore 7500 N. Dreamy Draw Drive, Suite 145 Phoenix, Arizona 85020	10. Work Unit No. 11. Contact or Grant No. HPR-PL-1-43(285)
12. Sponsoring Agency Name and Address ARIZONA DEPARTMENT OF TRANSPORTATION 206 S. 17TH AVENUE PHOENIX, ARIZONA 85007	13. Type of Report & Period Covered Final 9/88 - 3/92 14. Sponsoring Agency Code

15. Supplementary Notes

Prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration

16. Abstract

The purpose of this research study was to assess the risks associated with the transportation of hazardous materials and hazardous waste on the Arizona state highway system. Another objective of the study was to evaluate the use of a Geographic Information System, GIS, to model the risks to the public.

A statewide GIS model was developed which included over 600 individual segments on the State highway system. Volumes of different categories of hazardous materials were estimated for each segment based on data collected in a previous statewide survey. Truck accident rates were assigned to each segment based on the past accident experience for that segment. Population data from the 1980 census were spatially distributed throughout the state. In addition, the location of emergency response units was also integrated into the model.

For each highway segment, the model estimated the relative probability that a hazardous material incident would occur, the potential population that would be impacted and the emergency response time from the nearest response unit. The results are presented through a series of color maps which depict the relative risk for each category of hazardous material evaluated. The use of the GIS system proved very useful and allowed the integration of highway segment information such as traffic volumes and truck accident rate with spatial data such as population. Emergency response time was easily calculated by the GIS model based on the response unit's proximity to each highway segment. Use of the GIS model also resulted in a more detailed evaluation that has the capability to easily consider additional spatial data such as land use, location of schools and hospitals, weather patterns, etc.

23. Registrant's Seal

17. Key Words	18. Distribution Statement
Hazardous Materials, Hazardous Waste, Risk Assessment, Geographic Information System, GIS	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	226	

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

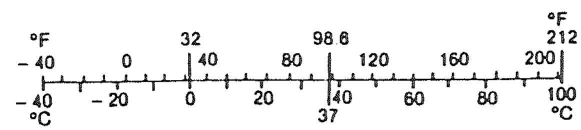
Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimetres	mm
ft	feet	0.305	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
	AREA			
in^2	square inches	645.2	millimetres squared	mm^2
ft^2	square feet	0.093	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometres squared	km^2
	VOLUME			
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.028	metres cubed	m^3
yd^3	cubic yards	0.765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

Symbol	When You Know	Multiply By	To Find	Symbol
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9	Celcius temperature	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
	AREA			
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
ha	hectares	2.47	acres	ac
km^2	kilometres squared	0.386	square miles	mi^2
	VOLUME			
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
	TEMPERATURE (exact)			
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F



* SI is the symbol for the International System of Measurement

(Revised April 1989)

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1.0 INTRODUCTION

The transportation of hazardous materials and wastes has become a routine part of our society. Past studies have shown that one in ten trucks traveling on our highway system is transporting some type of material that is classified as hazardous. This fact presents a challenge to those government officials and professionals in the private sector that are responsible for the safety of the public.

In January of 1986, a study was published which estimated the magnitude, chemical types and hazard class of hazardous material shipments being transported on the Arizona highway system. This study was conducted by the Center for Environmental Studies and School of Public Affairs and Center for Advanced Research in Transportation at Arizona State University in Tempe, Arizona. The study was funded by the Arizona Department of Transportation and the Federal Highway Administration and administered by the Arizona Transportation Research Center.

The 1986 study entitled "Transportation of Hazardous Materials in Arizona" utilized a number of surveys to estimate the type and volume of hazardous materials being transported on over 80 highway segments throughout Arizona. These include: 1) hazardous waste shipment manifest data; 2) two one-week surveys of placarded trucks at Arizona's major ports of entry; 3) an intrastate survey at nine locations; and 4) interviews with distributors of gasoline, acids, and propane.

This follow-on study is designed to utilize the data developed in the 1986 study and evaluate the risks associated with the movement of these hazardous materials. In addition, this study assesses the vulnerability of populations in geographic areas by integrating the emergency response times into the analysis. The evaluation of the risks associated with the transportation of radioactive materials was not within the scope of this analysis.

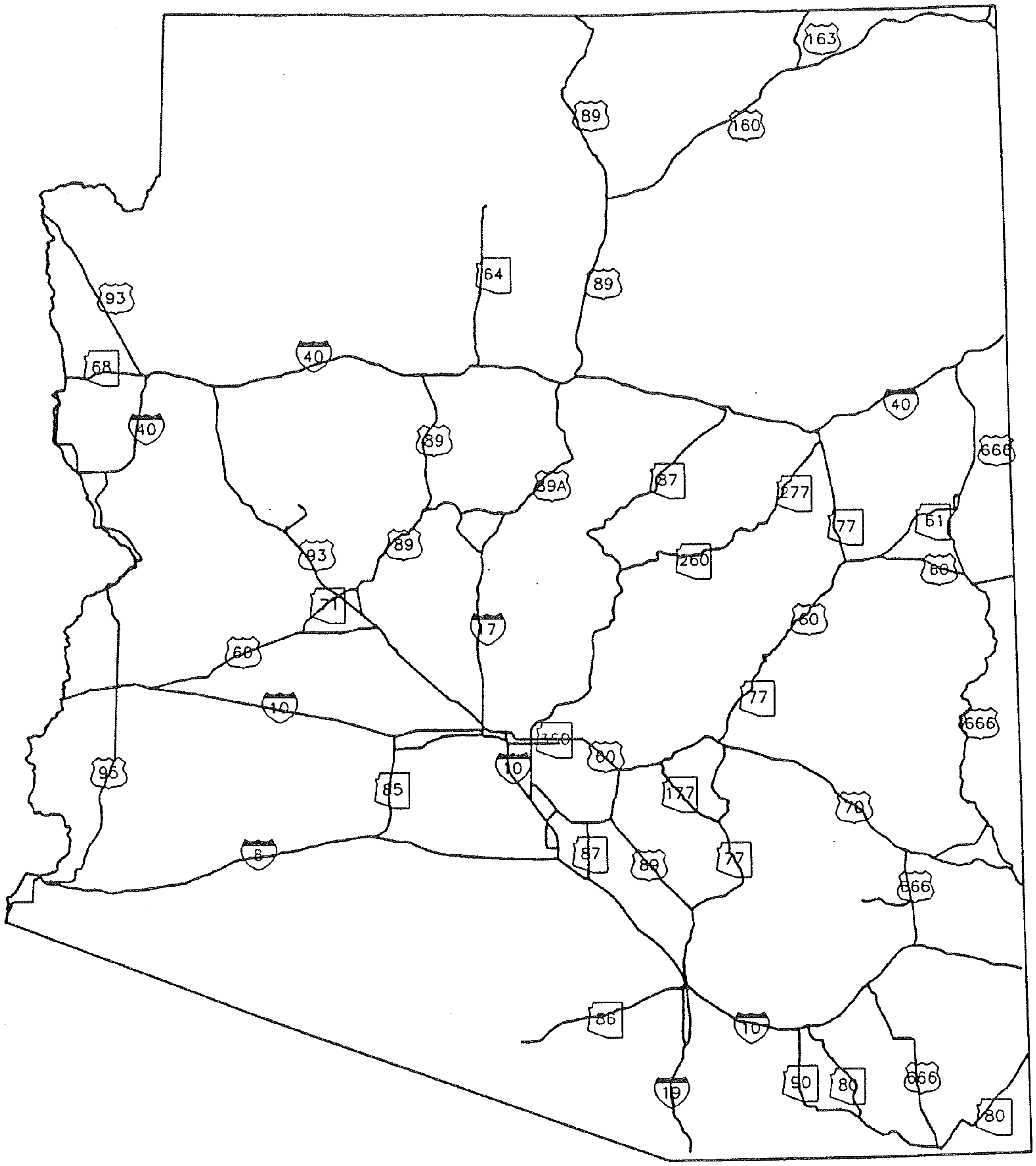
This study was conducted using a geographic information system which is a new approach to risk analysis. Use of the geographic information system provides for a more detailed evaluation of how the transportation system interacts with a wide variety of demographic factors, such as population and land use. Additionally, a geographic information system easily allows consideration of specific sites such as locations of emergency response units, hospitals and schools.

This report is organized into three major categories: 1) the original data; 2) the hazard, risk and vulnerability analysis; and 3) programmatic implications and recommendations. For the purpose of this study, the term hazardous materials will include hazardous wastes.

2.0 STATE HIGHWAY NETWORK

The highway network that was used for this study included the federally aided system of state highways. This system is presented in Figure 2.1 A detailed system map is also provided which identifies each segment designation. The numerical designations of the segments were taken from the original designations in the 1986 hazardous material study. The original 80 segments are identified as the first two digits of a three-digit number. The last digit represents a more detailed breakdown of each segment.

The original data did not encompass the complete federally aided state highway system. Therefore, additional segments were added until the complete system was represented. For numerous segments, hazardous material volume data were not available.



State Highway Network Included
In The Study

Figure 2.1
ATRC/Dames & Moore

3.0 1986 SURVEY DATA

The 1986 survey data for the volumes of hazardous materials and hazardous waste form the basis of the risk assessment. These data were obtained from a study conducted by the Center for Environmental Studies and the Center for Advanced Research and Transportation at Arizona State University. Data on the estimated volumes of hazardous waste were taken from an analysis of hazardous waste manifest for the year 1984. The estimated volumes of hazardous materials transported on the highway system in Arizona were developed from two week-long surveys of inbound trucks at Arizona ports of entry, an internal survey of trucks traveling within the state of Arizona and a telephone survey of transporters of hazardous materials within Arizona.

These data were provided to Dames & Moore on a series of 5¼-inch floppy disks. The following discussion addresses how these data were utilized in the risk analysis.

3.1 HAZARDOUS MATERIAL TRANSPORT

The estimates of the volumes of hazardous materials and the routes they are shipped over were developed through the use of a number of different surveys. Two surveys were conducted at Arizona port of entry stations. These week-long surveys were conducted in March and July of 1984. This survey was designed to estimate the number of incoming and drive-through trips. The estimated number and amounts of hazardous materials entering Arizona at selected ports of entry are shown in Table 3.1.

Table 3.1

TOTAL NUMBER OF ANNUAL SHIPMENTS AND TRUCKLOADS BY PORT OF ENTRY

Port of Entry	Shipments	Truckloads	Tons	Gallons	Total Equivalent Tons
Ehrenberg	46,800	43,368	176,532	149,000,000	799,571
Sanders	99.580	47,840	239,255	117,000,000	730,524
Topock	6,136	5,772	40,437	17,900,000	115,407
Yuma	11,856	11,024	20,740	76,200,000	340,080
San Simon	17,368	11,856	124,225	71,800,000	425,148

In addition to the interstate trips, a 14-day survey was conducted on various routes throughout the state to assess the number and amount of hazardous materials being transported internally. The number of responses to this survey was relatively small and therefore the information obtained was not considered statistically adequate. However, the survey did indicate that the primary types of hazardous materials being transported within the state were gasoline, propane, and acids.

Additional research was conducted to assess the extent of intrastate transportation of these three materials. Interviews with transportation companies and shippers were conducted. In addition, data available on gasoline usage by county was also evaluated. Estimates of the total annual volume of propane, gasoline, and acids were developed for selected routes throughout Arizona.

The estimated volumes of hazardous materials by hazard class were developed and presented in the written report entitled Transportation of Hazardous Materials in Arizona dated January 1986. However, the electronic data provided on the 5¼-inch floppy disks did not contain these annualized estimates. Rather these data only contained the results of the March port of entry survey and hazardous waste manifests. Efforts to obtain more detailed electronic data and backup information used to develop the estimates from the principal researchers was unsuccessful. Therefore, Dames & Moore utilized the data presented in the written report to conduct the risk analysis. These data were obtained from the various figures and tables in the written report which provided generalized information regarding the volumes of hazardous materials being transported by hazard type by route.

The data presented in the figures of the 1986 report are broken into three levels with each level representing a range of shipments, see Appendix A. For example, the flammable category, Figure 39, identified a lower range of 1 to 11,000 shipments, a mid range of 11,001 to 22,000 shipments, and a high range of 22,001 to 33,000 shipments. Since more detailed data were not available, Dames & Moore utilized the mean of each of these three categories for assigning traffic to individual routes for the risk analysis.

Our interpretation of these data are presented in Figures 3.1 through 3.5. The volumes of hazardous materials by route are presented in three categories: 0-25th percentile, 26th-75th percentile, and 76th-100th percentile.

3.2 HAZARDOUS WASTE TRANSPORT

The database provided to Dames & Moore identified shipments of hazardous waste by hazard class and also identified the route and individual segments of a route over which the hazardous waste was transported. The study estimated that 2,933 shipments of hazardous waste were made in 1984. These shipments were transported in 2,521 truck loads, which indicates that a number of shipments were mixed waste where multiple hazardous wastes were transported in one trip. The 1986 study also broke down the hazardous waste by the following classes:

Hazard Class	Definition
Corrosive	Any liquid or solid that causes destruction of human skin tissue or a liquid that has a severe corrosion rate on steel.
Flammable liquid	Any liquid having a flash point less than 100°F with the following exceptions: (i) A flammable liquid with a vapor pressure greater than 40 psia at 100°F; (ii) Any mixture having one component or more with a flash point of 100°F or higher that makes up at least 99 percent of the total volume of the mixture; and (iii) A water-alcohol solution containing 24 percent or less alcohol by volume if the remainder of the solution does not meet the definition of a hazardous material contained in this subchapter.
Solid	Any solid material, other than an explosive, which is liable to cause fires through friction, absorption of moisture, spontaneous chemical changes, retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious transportation hazard.
Poison A	Extremely Dangerous Poisons - Poisonous gases or liquids of such nature that a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life.
Poison B	Less Dangerous Poisons - Substances, liquids, or solids (including pastes and semi-solid), other than Class A or Irritating materials, which are know to be so toxic to man as to afford a hazard to health during transportation; or which in the absence of adequate data on human toxicity, are presumed to be toxic to man.
Combustible	Any liquid with a flash point from 100°F except any mixture having one component or more with a flash point at 200°F or higher, that makes up at least 99 percent of the total volume of the mixture.
Oxidizer	A substance such as chlorate, permanganate, inorganic peroxide, nitrocarbo nitrate, or a nitrate, that yields oxygen readily to simulate the combustion of organic matter.
Organic	Any organic compound containing the bivalent -0-0 structure and which may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals must be classified as an organic peroxide.

ORM-A	A material which has an anesthetic, irritating, noxious, toxic, or other similar property and which can cause extreme annoyance or discomfort to passengers and crew in the event of leakage during transportation.
ORM-B	A material (including a solid when wet with water) capable of causing significant damage to a transport vehicle or vessel from leakage during transportation. Materials meeting one or both of the following criteria are ORM-B materials: (i) A liquid substance that has a corrosion rate exceeding 0.250 inch per year (IPY) on aluminum (nonclad 7075-T6) at a test temperature of 130°F.
ORM-C	A material which has other inherent characteristics not described as an ORM-A or ORM-B but which make it unsuitable for shipment, unless properly identified and prepared for transportation.
ORM-D/E	A material such as a consumer commodity which, though otherwise subject to the regulations presents a limited hazard during transportation due to its form, quantity and packaging.
Source:	Transportation of Hazardous Materials in Arizona, Volume 1: Comprehensive Study Approach, Analyses and Findings; 1986.

The 1986 study evaluated all hazardous waste manifests for the year 1984. These data are presented in Table 3.2.

Table 3.2

DISTRIBUTION OF SHIPMENTS OF HAZARDOUS WASTE BY HAZARD CLASS AND VOLUME 1984

Hazard Class	Number of Shipments	Percent of Total	Lbs.	Gallons	Total Weight in Ton[1]	Percent of Total
Flammable	1,009	34.4	3,749,834	784,014	5,158	26.7
Corrosive	434	14.8	1,364,334	706,458	3,641	18.8
Poison	67	2.3	174,498	16,398	156	0.8
Combustible	40	1.4	83,180	15,458	106	0.5
Oxidizer	35	1.2	20,024	11,132	57	0.2
Organic	1	--	0	1	--	--
ORM-A	325	11.1	427,268	128,532	752	4.0
ORM-B	4	0.1	0	12,532	52	.3
ORM-C	15	0.5	130,990	996	70	.4
ORM-E	1,003	34.2	12,764,983	707,088	9,344	48.3
Total	2,933	100	18,715,111	2,382,577	19,336	100.0

[1] A unit conversion factor of 8.377 lbs/gal. was used.

Source: The Transportation of Hazardous Materials in Arizona, Volume I, Comprehensive Study Approach, Analysis and Findings.

As can be seen, the largest number of shipments was in the flammable and ORM-E categories which accounted for 34.4 percent and 34.2 percent of the total shipments of hazardous waste, respectively. The next highest class was corrosives which accounted for less than 15 percent of all shipments.

The volume of hazardous wastes being transported is small compared to the amount and number of trips of hazardous materials. Therefore, for the purpose of this analysis, only hazardous materials were used. The origin and destination information on the manifest provided insight into the routes over which these materials were transported. This information is presented in Appendix A.

3.3 MATERIALS WHICH POSE THE GREATEST THREAT TO THE PUBLIC

State emergency response personnel were interviewed to identify materials that they believed posed the greatest threat to the public from their transportation in commerce by motor carriers. These rankings are presented below by hazardous class:

Ranking	Hazard Class	Specific Product
1	Flammable liquid	Gasoline
2	Corrosive	Sulfuric acid
3	Flammable gas	Propane
4	Combustibles	General
5	Poisons	General
6	Explosives	General
7	Oxidizers	General
8	Nonflammable gas	General

The above ranking of threat to the public from the transportation of specific products/categories is amazingly in line with the frequency and quantity of products/categories being transported (see Table 3.1). The variances in categories ranked five through eight compared to the frequency and quantity of materials in transportation, is minor and much less than expected in this subjective ranking process.

The 1984 surveys (January 1986 report) identified the following materials as the most frequently transported into/through Arizona. The "predominant" hazard class is added to assist in correlating these data with that provided elsewhere in this section.

Product	ID#	Predominant Hazard Class
Gasoline	1203	Flammable liquid
Paint related	1263	Flammable liquid
Resin	1866	Flammable liquid
Adhesive	1133	Flammable liquid
Propane	1979	Flammable gas
Sulfuric acid	1830	Corrosive
Cleaning compound	1760	Corrosive

Note: "Predominant" is used with hazard class to indicate that not all material in the categories listed fall within the specific class shown, i.e., some adhesives are in the combustible class and some cleaning compounds are in the flammable/combustible classes.

There are several factors influencing the level of threat to the public resulting from the transportation of hazardous materials. These factors include: (1) the specific material involved; (2) the frequency at which it is transported; (3) the average load size (volume); (4) point of origin and destination of individual shipments; and (5) population density along the transport route.

The top three specific materials identified by the emergency response community and supported by the data from the 1984 study as posing the greatest threat to the public are discussed below.

Flammable Liquid (gasoline) - The points of origin for gasoline shipments in Arizona are diverse. There are specific areas served exclusively from a given point of origin; however, the following assumes that all extraneous factors are equal and that the point of origin for shipments serving specific areas include:

1. Tank Farm, Phoenix, Arizona - serving central Arizona.
2. Tank Farm, Tucson, Arizona - serving southeastern Arizona.
3. Points in northwestern New Mexico - serving northeastern Arizona.
4. Points in southeastern Nevada - serving northwestern Arizona.
5. Points in southeastern California - serving southwestern Arizona.
6. Points in southern Utah - serving north-central Arizona.

The public threat from the transportation of hazardous materials is greatest at/near the point of origin or port of entry and diminishes significantly with distance (route dispersion based on destination).

Figure 3.1 presents the relative volume of shipments of explosives. Based on these data the following routes from each point of origin are listed in descending order of concern for further study:

1. From the tank farm in Phoenix - The Phoenix metropolitan area for both intra-area/intrastate movement of gasoline is of major concern. As discussed earlier, as distances increase from the point of origin, the threat is diminished. However, the length and frequency of transport in some arterial routes out of (originating in) the metro area should receive special attention. They include I-10 west to S.R. 85, I-10 south (east) to S.R. 387, I-17 north to Flagstaff and S.R. 89 from Cordes Junction to Prescott.

2. From the tank farm in Tucson - The Tucson metropolitan area for both intra-area and interstate movement of gasoline is of considerable concern. Specific intrastate concerns include I-10 east to Benson, I-19 south, S.R. 86 west and S.R. 89 north.

3. All other routes in Arizona are weighted almost equally with minor exceptions. In this case, areas of increased concern include I-40 from Sanders POE to Holbrook, from Topok POE to S.R. 95, and I-10 from Yuma POE to and including all of the Yuma area.

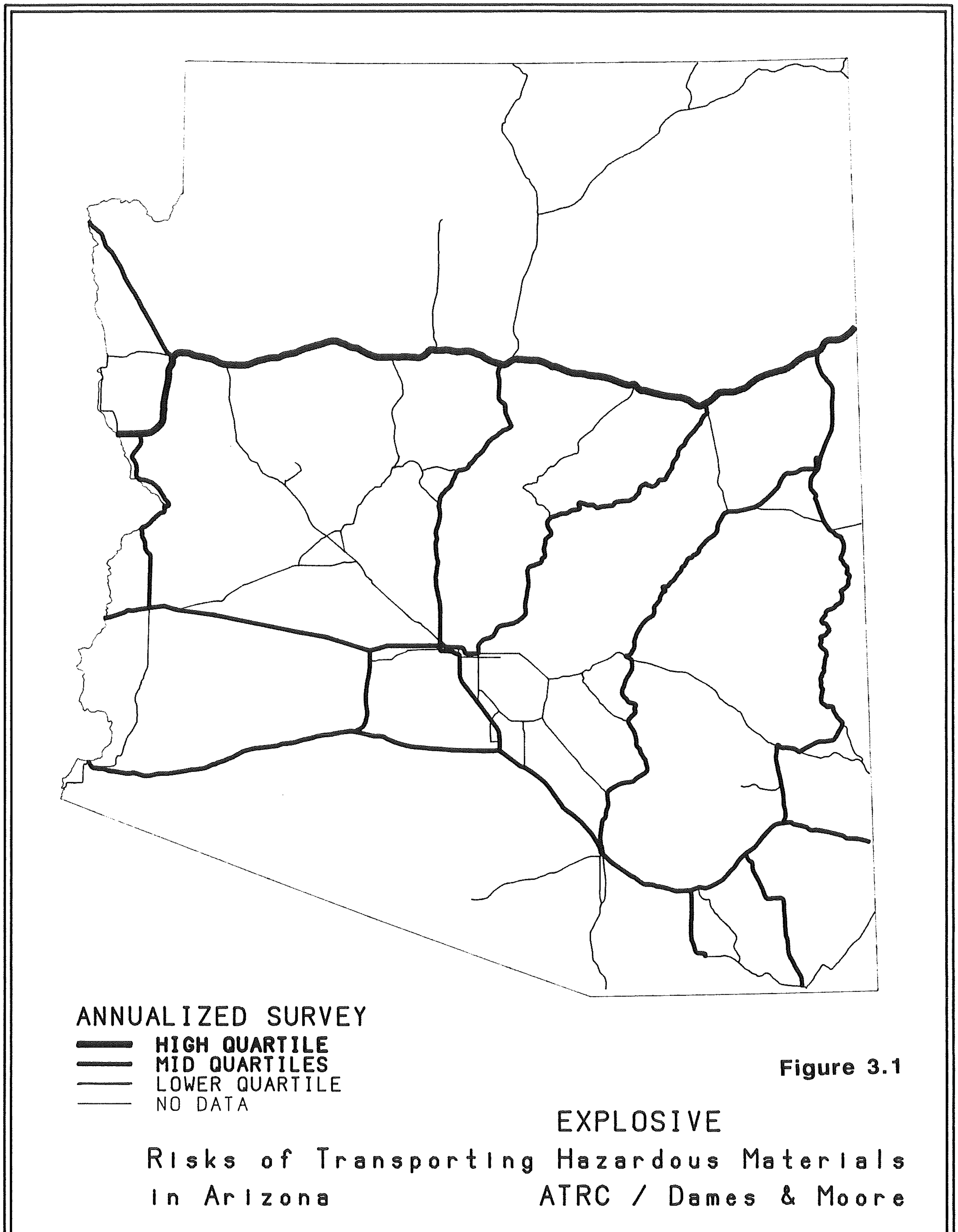
<u>Corrosives</u> - The 1984 study of the movement of acids by motor carrier suggests that a much more comprehensive study of the movement of sulfuric acid (corrosive of principal concern) is needed. The report recognized forthcoming mine closures and other operational changes that would cause "substantial" shift in the shipment patterns of sulfuric acid. When such changes were to occur is not evident and/or if they have or to what degree they have occurred is unknown.

With the limitations indicated above, specific routes of concern are: (1) all intrastate routes identified in Table 29 of the 1986 report (1984 study); and (2) all routes connecting Arizona mining operations, particularly in southeastern Arizona.

<u>Flammable Gas</u> (propane) - The 1986 report acknowledges a lack of data specificity regarding intrastate origin-destination movements of this product. This is considered a significant shortfall in that all areas of the state are vulnerable to the movement of this product

and it is the primary energy source for those out of reach of the natural gas pipelines. The entire intrastate distribution system for propane is a major concern and an in-depth study is needed.

As one might expect, the movement of propane during the winter months is estimated to be 3-4 times that occurring during the summer months. This increased vulnerability period is further estimated to be 7-8 months in duration (September - April). For this reason, the March data on which the 1984 study is based is representative of the annual winter season flow of propane and valid to that extent for the purpose of this study.


ANNUALIZED SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
Figure 3.1
EXPLOSIVE
Risks of Transporting Hazardous Materials
in Arizona
ATRC / Dames & Moore

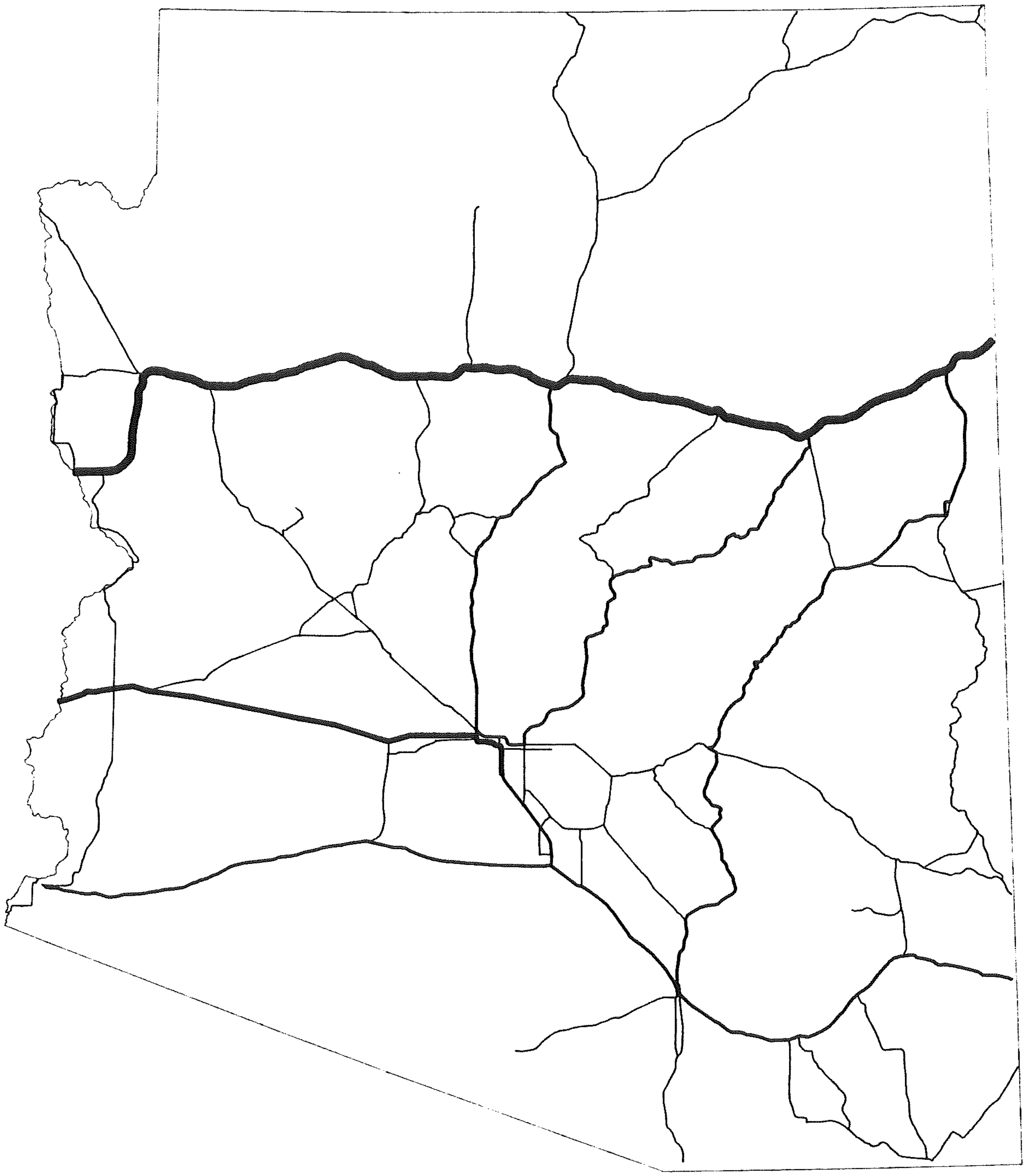
ANNUALIZED SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA

Figure 3.2

CORROSIVE

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore



ANNUALIZED SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA

Figure 3.3

POISON

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

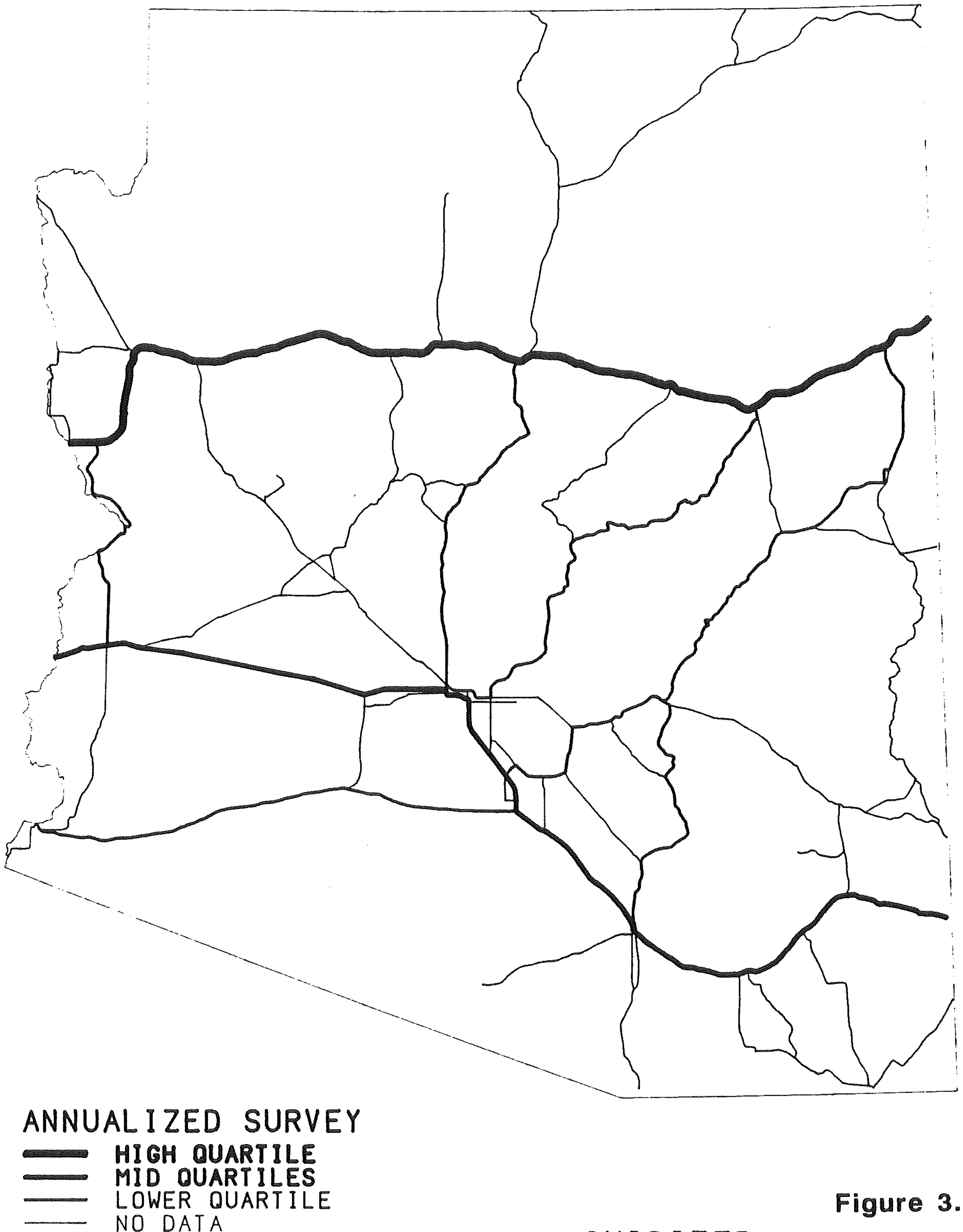
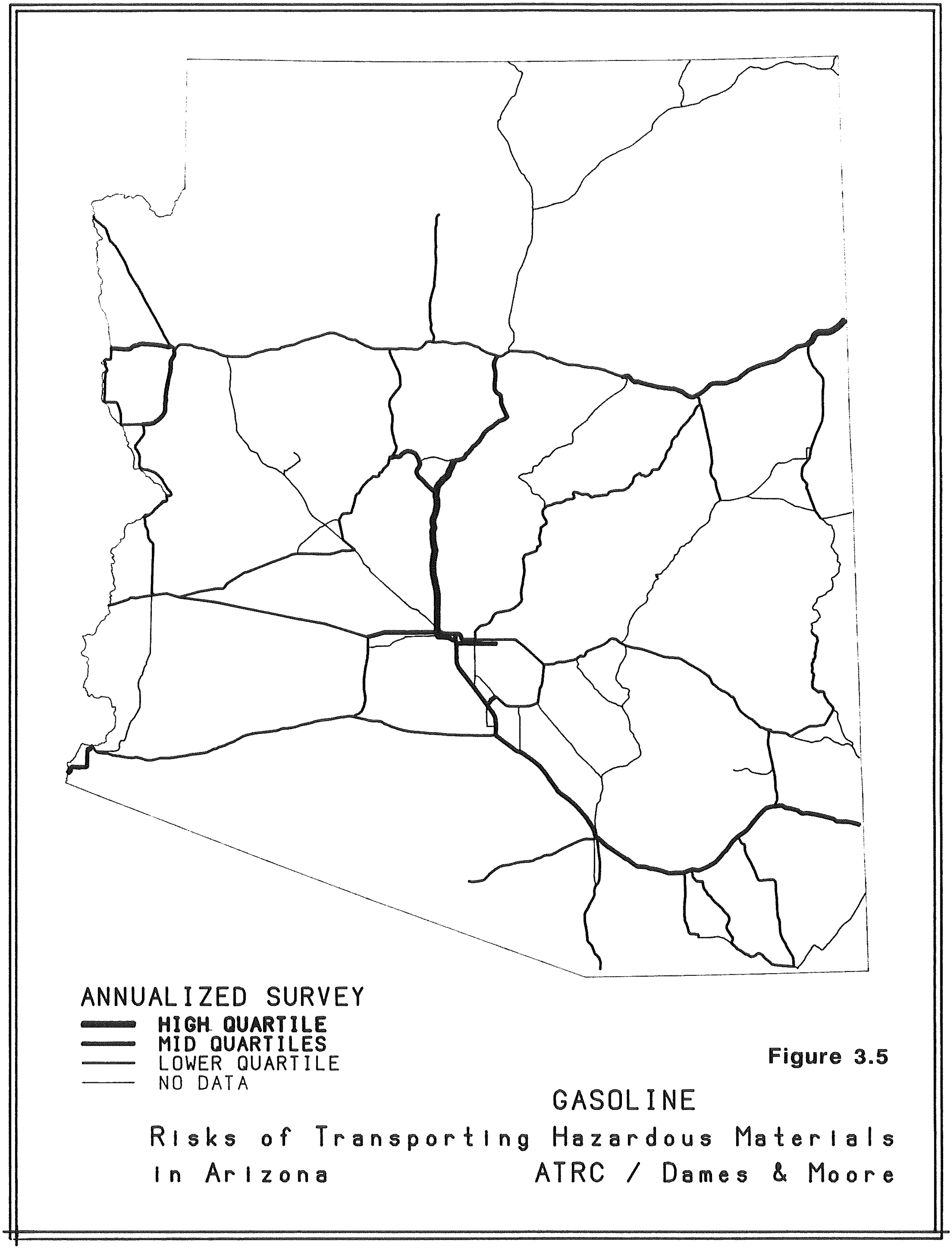


Figure 3.4

OXIDIZER

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore


ANNUALIZED SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
Figure 3.5
GASOLINE
Risks of Transporting Hazardous Materials
in Arizona
ATRC / Dames & Moore

4.0 ARIZONA'S TRUCK ACCIDENT RATE

The truck accident rate for various segments of the state highway system was obtained from the Arizona Department of Transportation. Data for the years 1975, 1976, and 1977 were analyzed and averaged to obtain the rates used in this study. These average accident rates are shown in Figures 4.1 and 4.2.

Over 600 roadway segments are included in the truck accident rate data. These segments were based on the following criteria:

Intersections with major highways
Significant changes in accident rates
Jurisdictional boundaries

The average accident rates ranged from 0 to 17.31 accidents per million vehicle miles traveled. A listing of the accident rates for each segment is presented in Appendix B. These data are identified by highway route number and milepost.

ANNUAL SURVEY

HIGH QUARTILE

MID QUARTILES

LOWER QUARTILE

NO DATA

Figure 4.1

'85-'87 AVERAGE ACCIDENT RATES

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

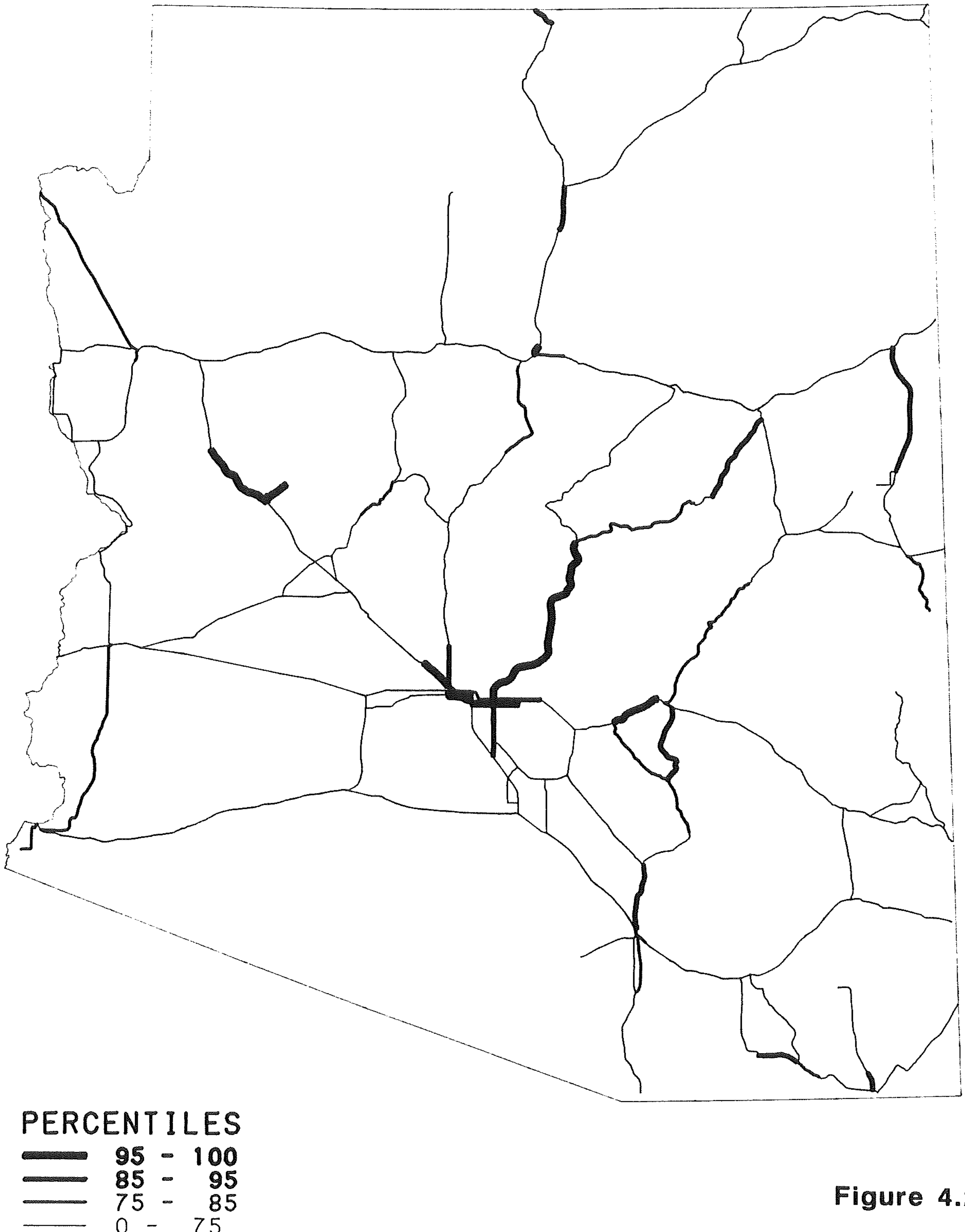


Figure 4.2

'85-'87 AVERAGE ACCIDENT RATES

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

5.0 DEMOGRAPHIC DATA

5.1 POPULATION

Population data were taken from the 1980 census summary tapes. While these data have limited geographic information, they were the best available when this analysis was conducted. The new 1990 census files will provide greater geographic resolution. Two summary levels in the 1980 summary files contain geographic centroids, these were read into the GIS and aggregated on a square mile basis. Inspection of the maximum values indicated that normalizing was required to achieve actual density.

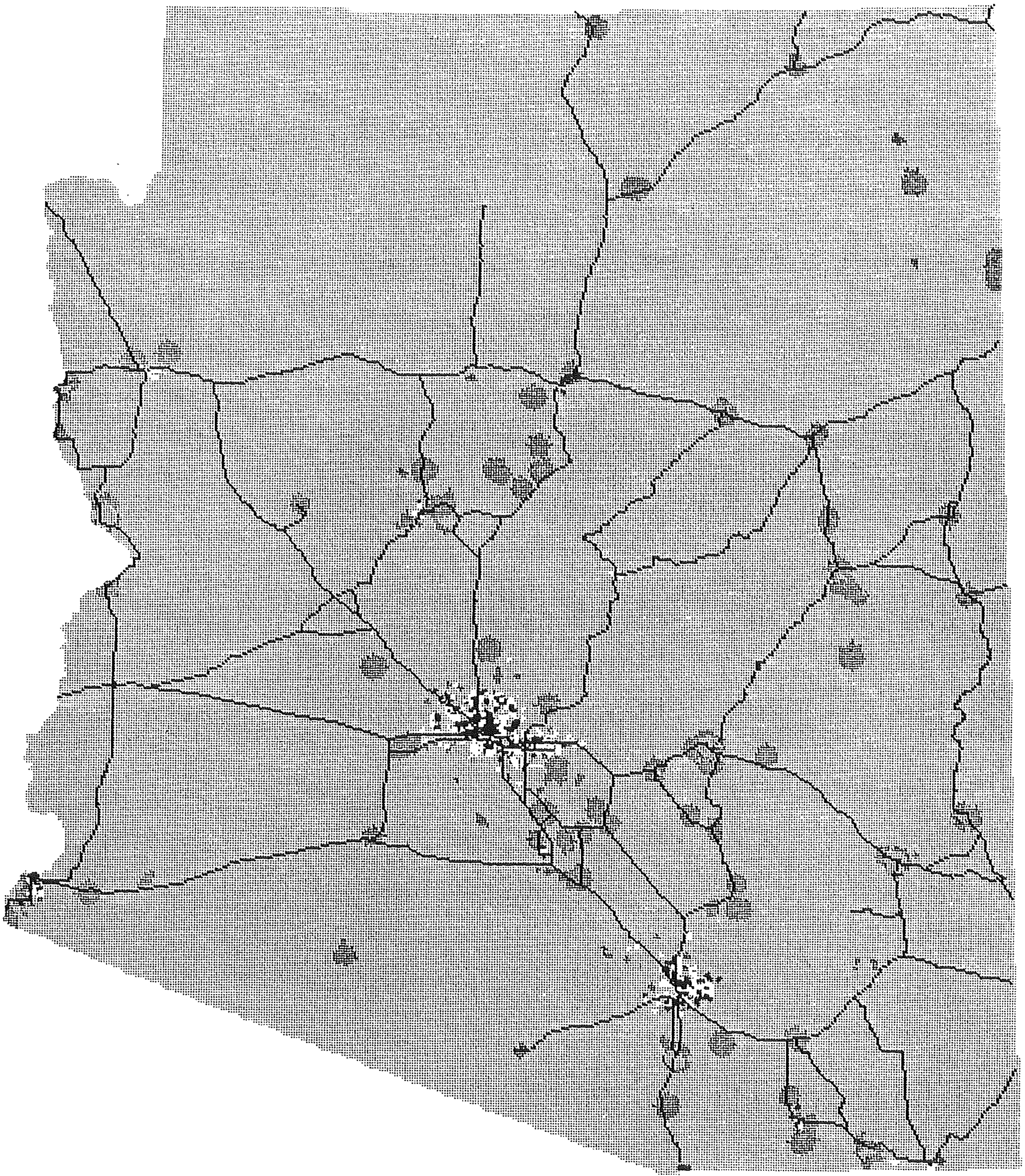
The GIS was requested to distribute the population from its inherent "point" location equally across a 5-square-mile area thereby smoothing the data and reaching a calibrated persons per square mile density matching the observed development density. In rural areas when the enumeration districts are well over 5 square miles, this population model was conservative in its overestimation of population density. The results of this process are shown in Figure 5.1.

5.2 EMERGENCY RESPONSE LOCATIONS

The primary emergency response organizations that respond to hazardous materials incidents are fire departments. A listing of fire department units was compiled from information provided from the State Fire Marshal's Office and individual fire departments. This information is illustrated on Figure 5.2.

Individual fire departments may have specific response areas and may not be authorized to respond to an incident that is near to their location. For the purposes of this analysis, it was assumed that the closest emergency response unit would respond to a hazardous materials incident regardless of jurisdictional boundaries that may prohibit them from responding.

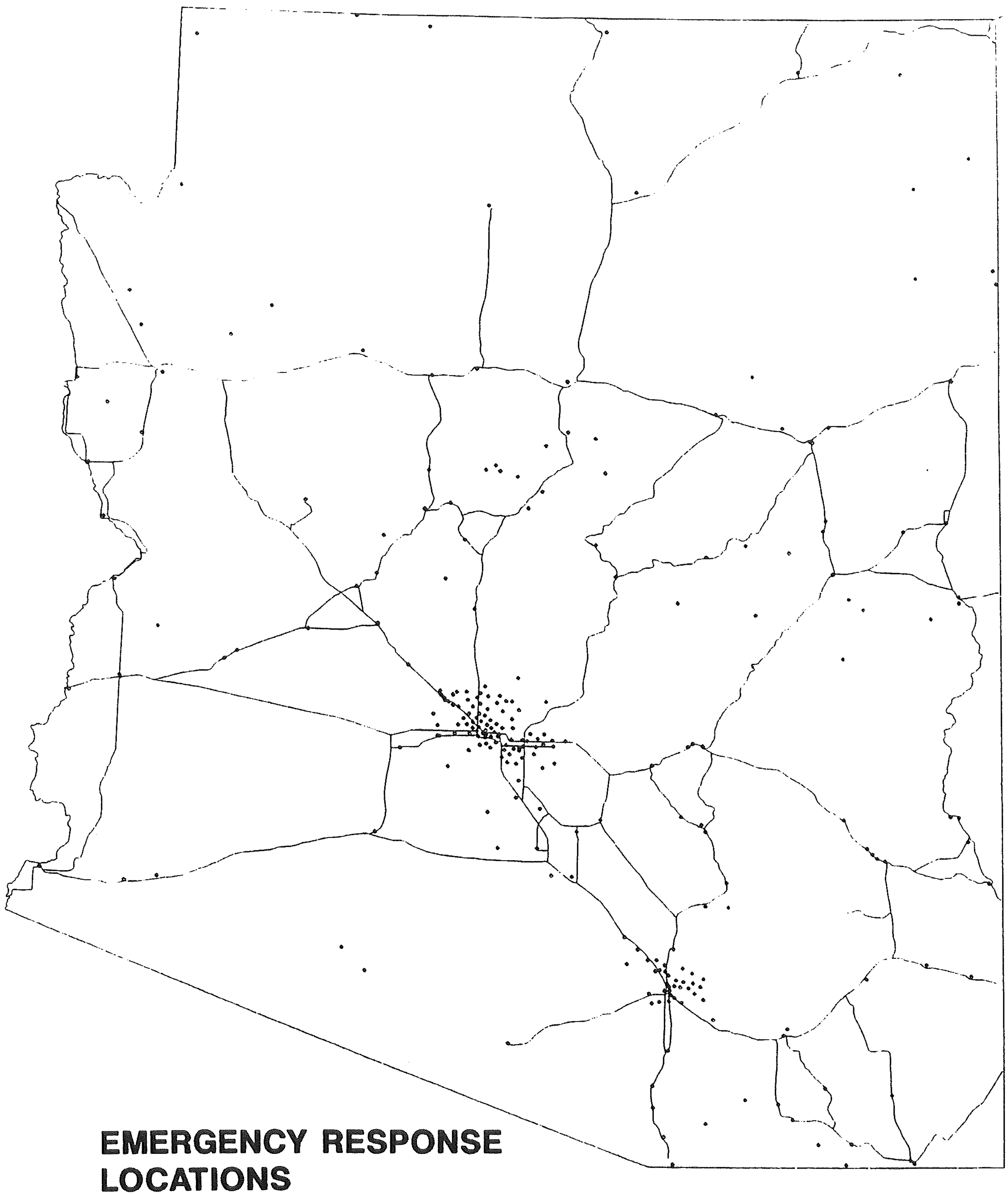
There are significant differences in the training and capability of a fire department unit to respond to hazardous material emergencies. The cities of Phoenix and Tucson have units specifically trained to respond to hazardous materials incidents. Consistent information regarding the size and training of each unit and their capability to respond to different types of hazardous materials incidents was not available at the time this analysis was conducted. Therefore, for the purposes of this analysis, it was assumed that all fire department units were capable of responding to any type of hazardous material emergency. In any case, some level of response will be obtained for a nearby emergency response unit if only to identify and characterize the incident as one requiring additional 'specialist' attention.



POPULATION DENSITY

Transporting Hazardous Materials In Arizona

Figure 5.1
ATRC/Dames & Moore



EMERGENCY RESPONSE LOCATIONS

Transporting Hazardous Materials In Arizona

Figure 5.2

ATRC/Dames & Moore

6.0 MODELING METHODOLOGY

The objective of modeling for this study is to obtain a comparative analysis of the risks for the entire state highway system. The spatial relationships are considered more important than the specific values obtained, that is the relative risks across the network are the principal objective.

Models can be used for varying purposes. For this study, the risk model is used as an analysis tool for understanding the data and allows for planning activities on the network. As such, the entire network is modeled. Alternative models can be described as fixed specific location models and real time event models. Specific location models can typically be calibrated with annual meteorological data incorporating the probability of wind direction and speed. Event models require actual meteorological data and are used in predicting the consequence of an actual event in emergency response functions.

The basic risk model is described in Federal document FHWA-IP-80-15, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials. In consists of:

The frequency of hazardous material shipments

The probability of an event at a location

The nature of dispersion based on the material characteristics

The density of population in the area

The nature of the incident consequences

For this study it was impractical to incorporate meteorological conditions for over 100,000 square miles of Arizona. Since the severity of the event is also relative, we chose to externalize this factor from the model itself. The severity consequence is not a spatial factor, while all other components of the model are. The ability to externally weight the final model results allows for varying the consequences based on medical, chemical and public perception of the event type.

6.1 DATABASE STRUCTURE

Spatial analysis requires locational diversity. For this project the road network provides the framework for analysis. The federally aided highways in Arizona were digitized based on the USGS state series maps which are in a LAMBERT projection. The state boundaries were obtained from digital data prepared for the 1980 census.

The major data integration occurred in a combination of tabular traffic data from state surveys with the geographic network. The digitized network consisted of the unique segments between intersections/interchanges making up the state highway system. The tabular data typically referred to only the estimated volumes of hazardous materials by route segment for each major category of hazardous material. The database model was specified for each origin/destination which allocated the surveyed trip to the constituent segments in the network. Essentially each survey shipment was projected into unique segment records in the detailed tabular database.

Accident data from the state records were available in more detail than were the hazardous material transport data. Within the GIS, the segments were coded in a hierarchy. This hierarchy allowed flexibility to analyze segments as a whole when using the tabular data on materials shipments and also to assess the more detailed accident data on such segments. Typically the accident data were available with subsegments defined by major state and county road intersections/interchanges. Most of the highway data segments were classified into three to five subsegments with corresponding historic accident rates for truck traffic for each subsegment.

6.2 MODEL STRUCTURE

The data were entered into the Geographic Information Management System (GIMS), developed by Dames & Moore. GIMS is a comprehensive vector and raster based system which allows the integration of cell based data and point data and linear data.

Five models, representing five typical exposure pathways, were constructed based on the generic evaluation equation of four spatially varying components:

Component	Evaluation
Accident rate	Incident probability
Shipment frequency	Hazard
Population affected	Risk
Response time	Vulnerability

The generic formula for evaluation consisted of the following:

Absolute Hazard	= (R) (F)
Population at Risk	= (R) (F) (P)
Vulnerability	= (R) (F) (P) (T)

Where

R Accident rate by subsegment. These data are drawn directly from the accident rate table.

F Shipment frequency by highway segment and type of hazardous material. These data are drawn from the previous survey data.

P Population affected. Determined by the local population density and modified by the material specific effects radius.

T Response time. Determined by nearness of fire stations as modeled over the state highway network.

Documentation on the Model and its operation is presented in Appendix D, Risk Assessment.

6.3 HAZARD ANALYSIS

The initial component of the model provides a comparison of the absolute hazard by route segment which is calculated by multiplying the truck accident rate by the volume of hazardous material transported. This information is presented in Figures 6.1 through 6.5 for the five scenarios analyzed.

6.4 RISK ANALYSIS

The population affected by a hazardous materials incident is calculated by evaluating the population within an impact area. The impact area varies depending on the type of hazardous material being transported and the exposure pathway. The impact radius was obtained from report FHWA-IP-80-15, Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials. The following pathway models were utilized using the GIMS command structure.

Model	Representative Material	Impact Radius In Miles
Inhale	Nonflammable Gas	2.0
Blast	Explosives	0.5
Toxic	Poisons	0.3
Contact	Corrosives	0.7
Combust	Gasoline (flammable)	0.5

The population at risk index is then calculated by multiplying the truck accident rate by the frequency of hazardous material by the population affected. The outputs of the population at risk analyses are presented in Figures 6.6 through 6.10.

6.5 VULNERABILITY ANALYSIS

The geographic locations of fire stations were included in the map database. Utilizing the federally aided highway network as the principal access from the fire stations to potential incidents, both the network and the intervening space were modeled for probable response time. The highway network was set to support a 50-mph effectiveness speed; urban and rural areas off the principal network were set to an effective 25-mph speed. A base mobilization of 5 minutes was also assumed. The model allows the user to set any of these values for alternative assessments. Based on the above parameters, a maximum of 76 minutes for any segment of the network was obtained and a maximum of 136 minutes for any point in the state.

Figure 6.11 presents the results of the response time analysis. With this information, the model can calculate the relative vulnerability for each route segment by multiplying the truck accident rate by the volume of hazardous material by the population affected by the response time index. A response time index which ranged from 1 to 5 was used instead of the actual response time in minutes because using actual response time gave too much weight to response time vis a vis population at risk. The response time index was calculated as follows:

Response Time Index	Actual Response Time
1	Less than 15 minutes
2	16 to 30 minutes
3	31 to 45 minutes
4	46 to 60 minutes
5	> 60 minutes

The results of the vulnerability analysis of the five different categories of exposure are shown on Figures 6.12 through 6.16.

6.6 COMPOSITE ANALYSIS

The results from the analysis of the different types of hazardous materials can be combined to obtain a combined or composite risk. The model has the ability to weight the outputs of the analysis of different types of hazardous materials depending on their relative hazard to one another. Other variables, such as the sensitivity of the vulnerability index, can also be easily changed to calibrate the model to specific situations. Figures 6.17 through 6.19 present the composite hazard, composite risk and composite vulnerability of the five models assuming each model is of equal weight.

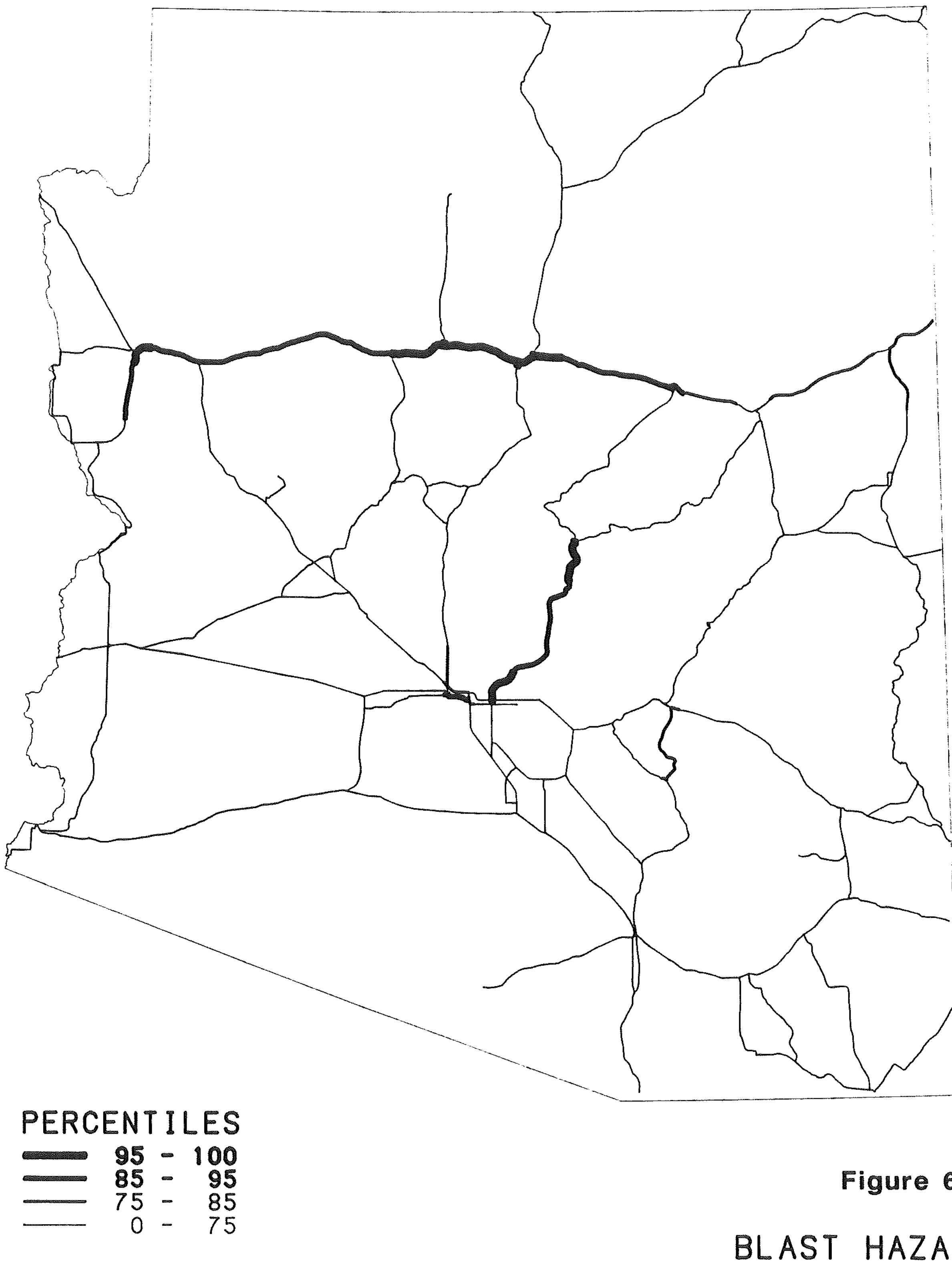


Figure 6.1

BLAST HAZARD

Risks of Transporting Hazardous Materials in Arizona ATRC / Dames & Moore

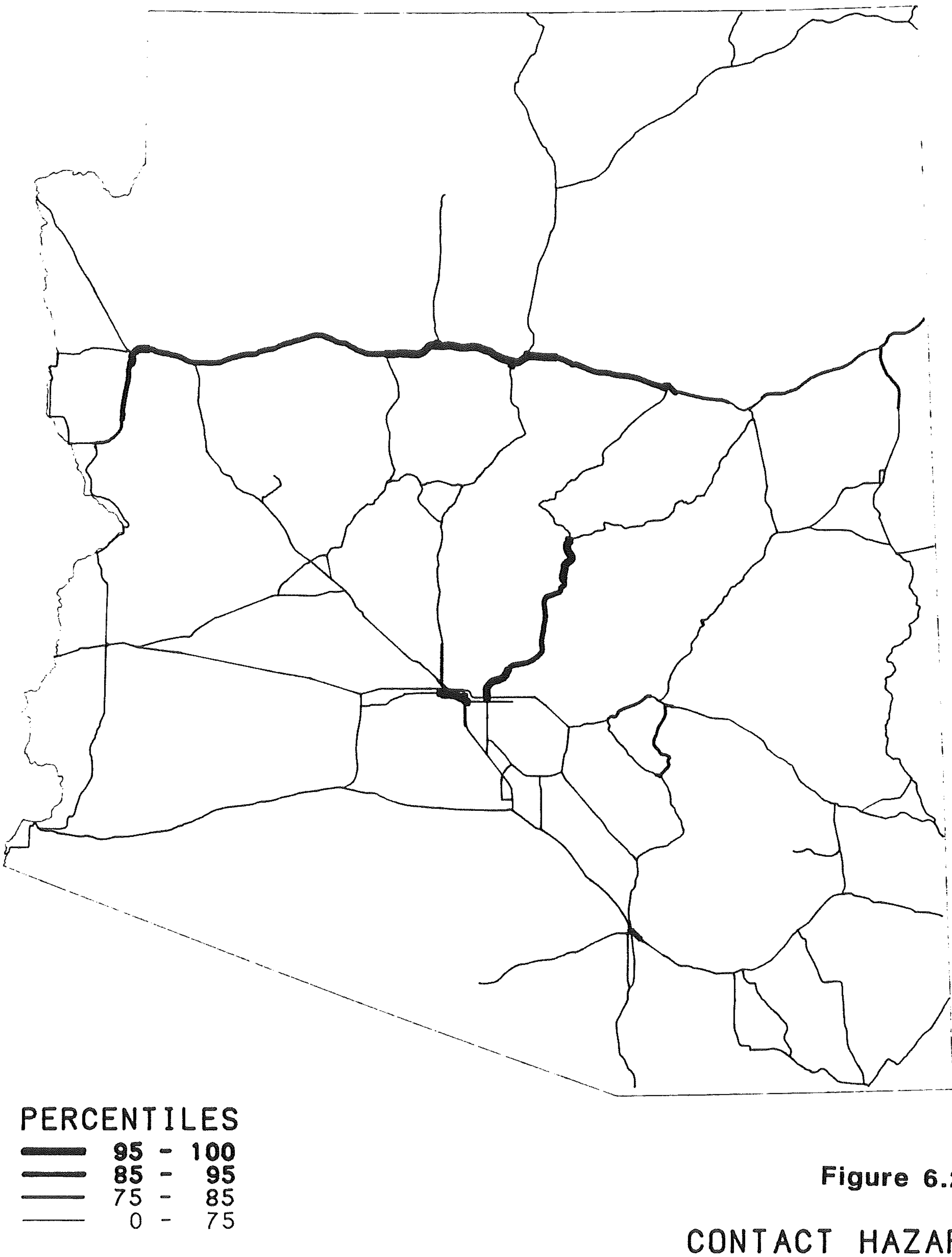


Figure 6.2

CONTACT HAZARD

Risks of Transporting Hazardous Materials in Arizona ATRC / Dames & Moore

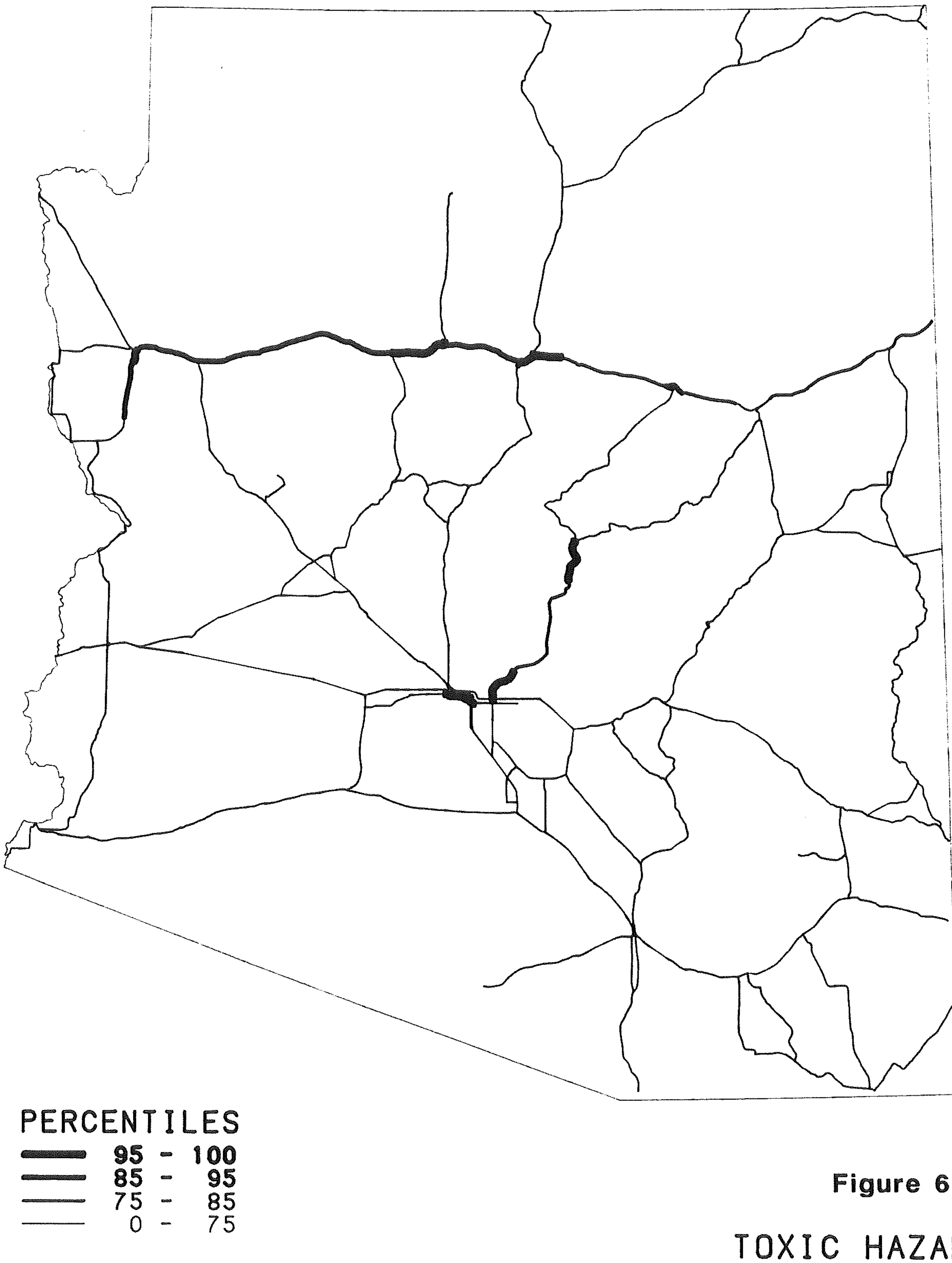
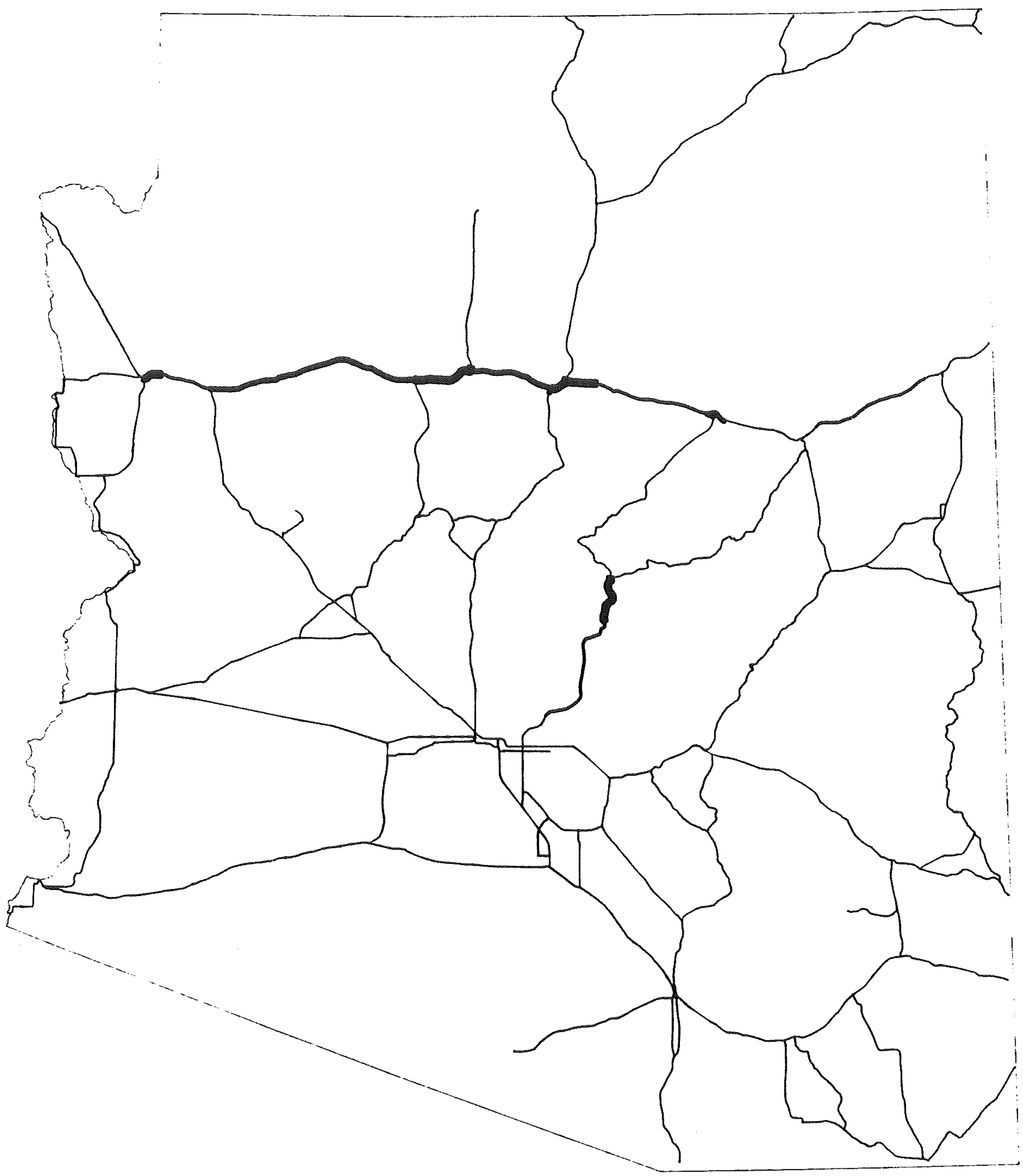


Figure 6.3

TOXIC HAZARD
Risks of Transporting Hazardous Materials in Arizona
ATRC / Dames & Moore



PERCENTILES
95 - 100
85 - 95
75 - 85
0 - 75

Figure 6.4

INHALATION HAZARD

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

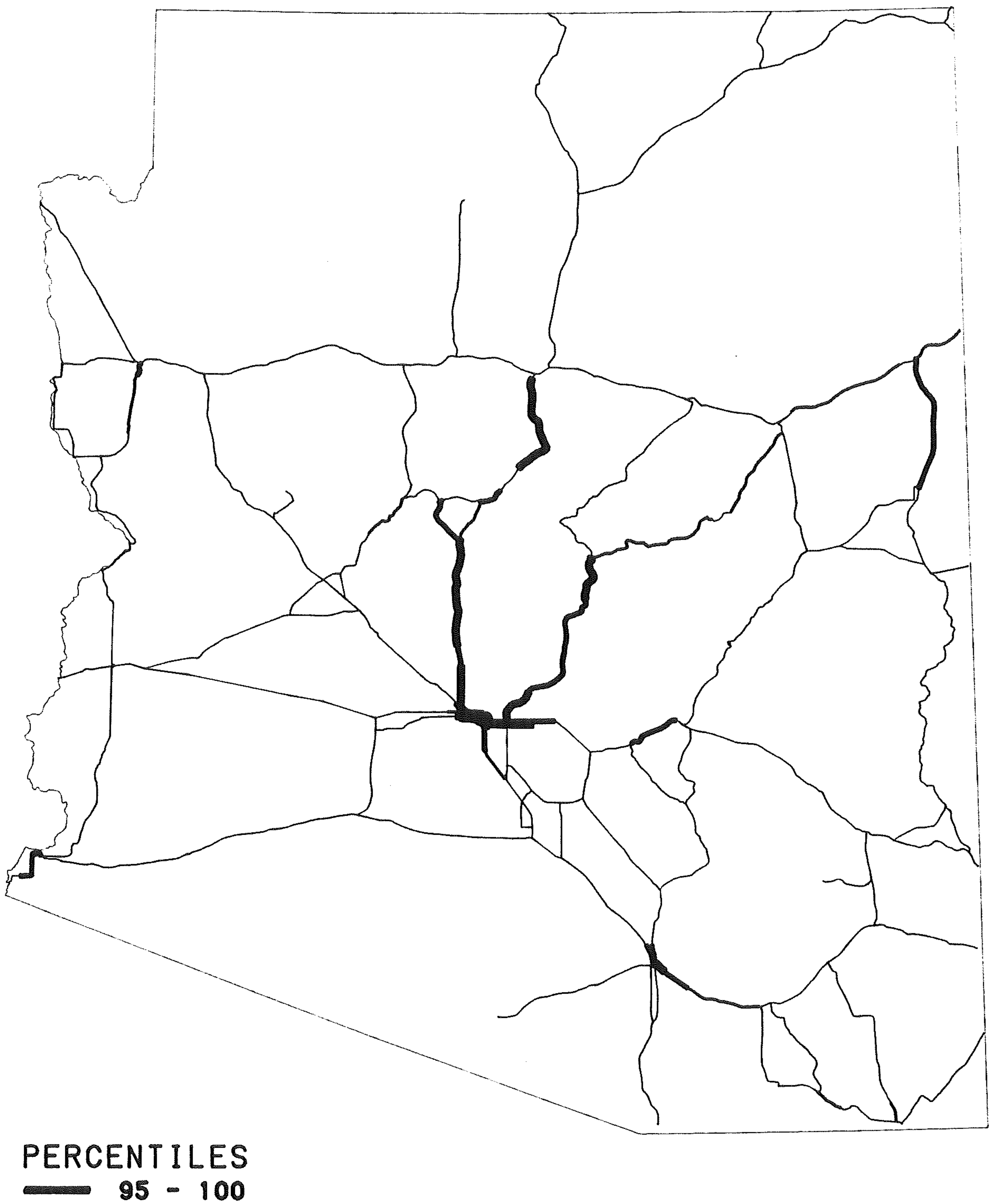


Figure 6.5

COMBUSTION HAZARD

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

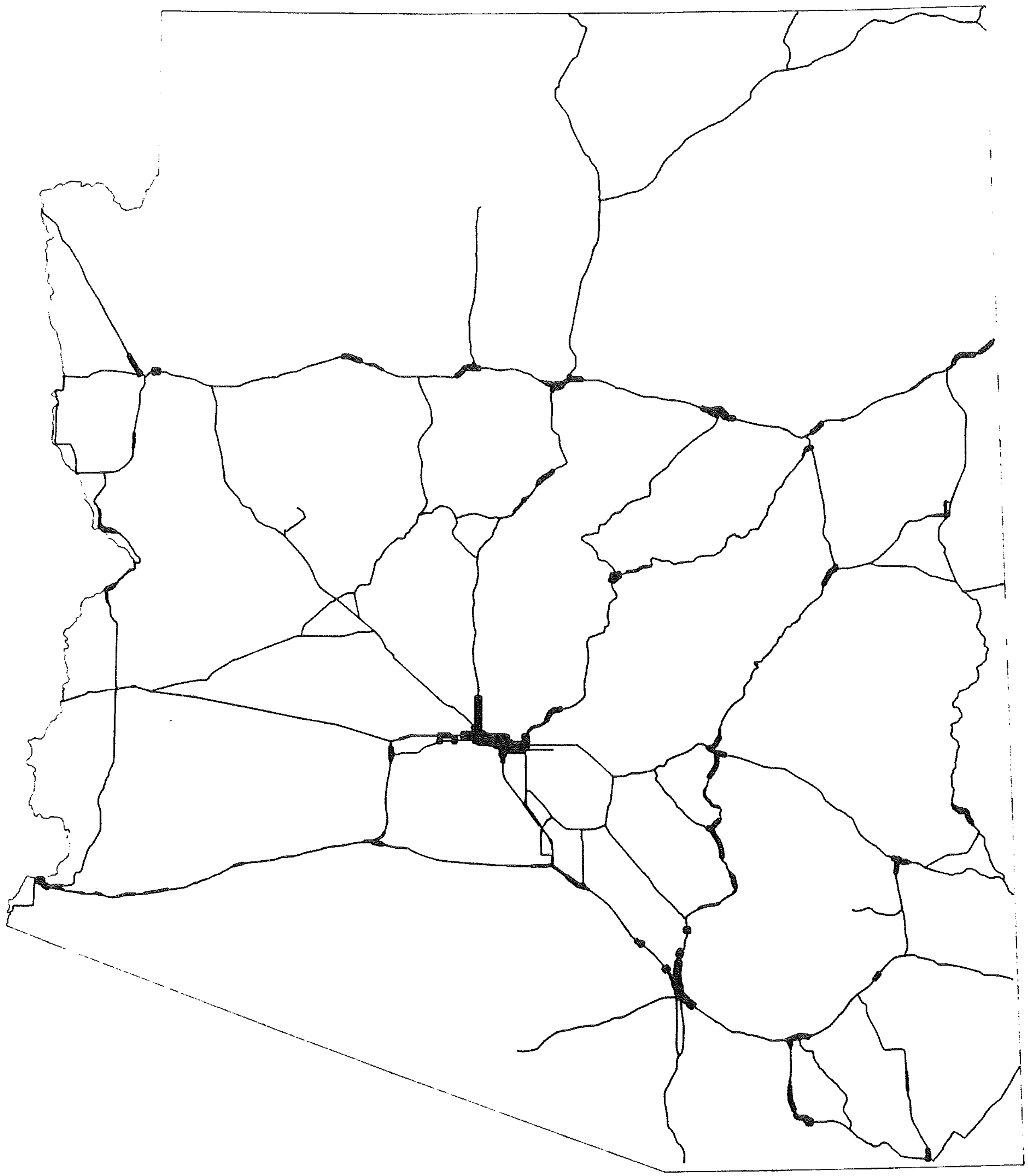


Figure 6.6

BLAST RISK

Risks of Transporting Hazardous Materials in Arizona
ATRC / Dames & Moore

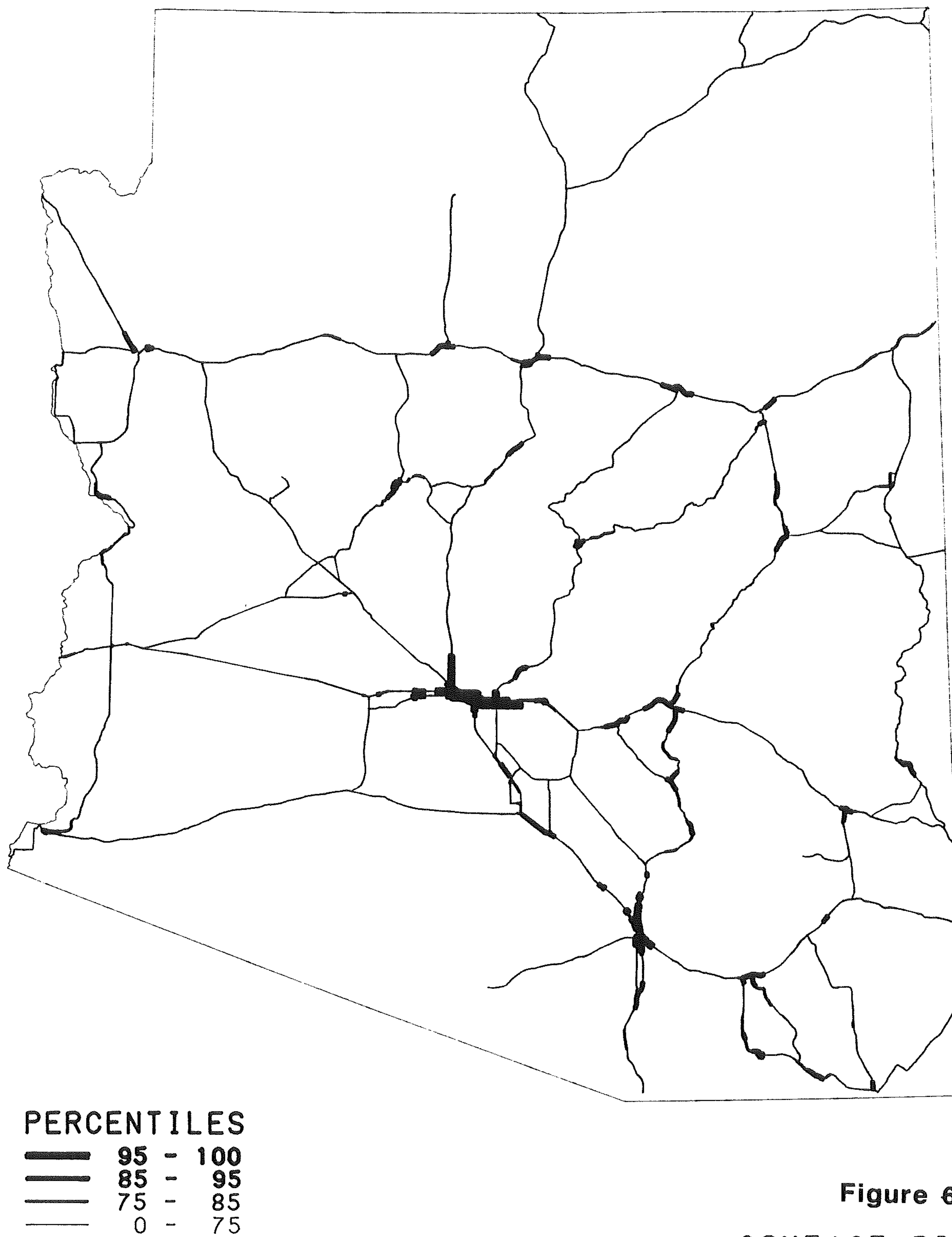


Figure 6.7

CONTACT RISK

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

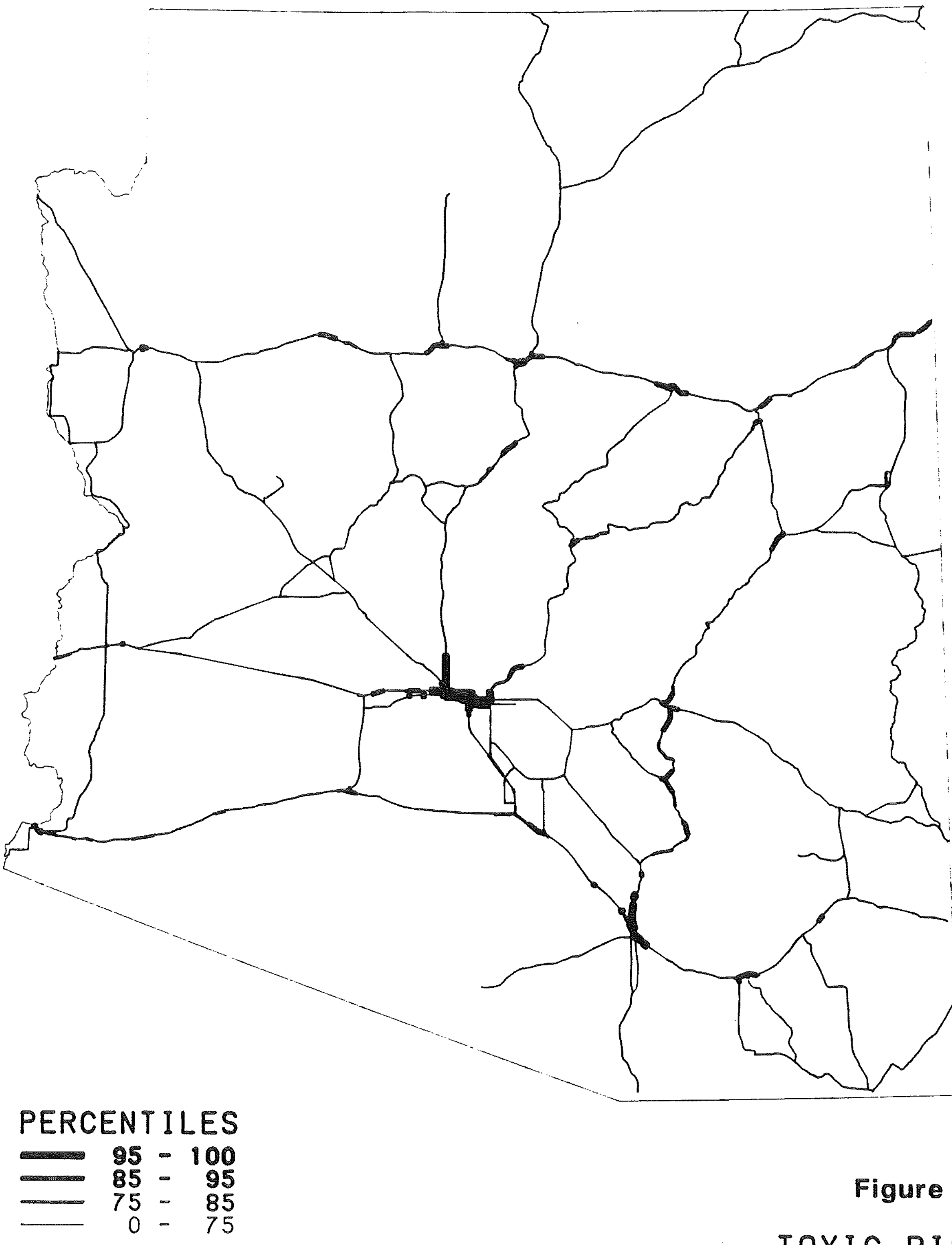


Figure 6.8

TOXIC RISK

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

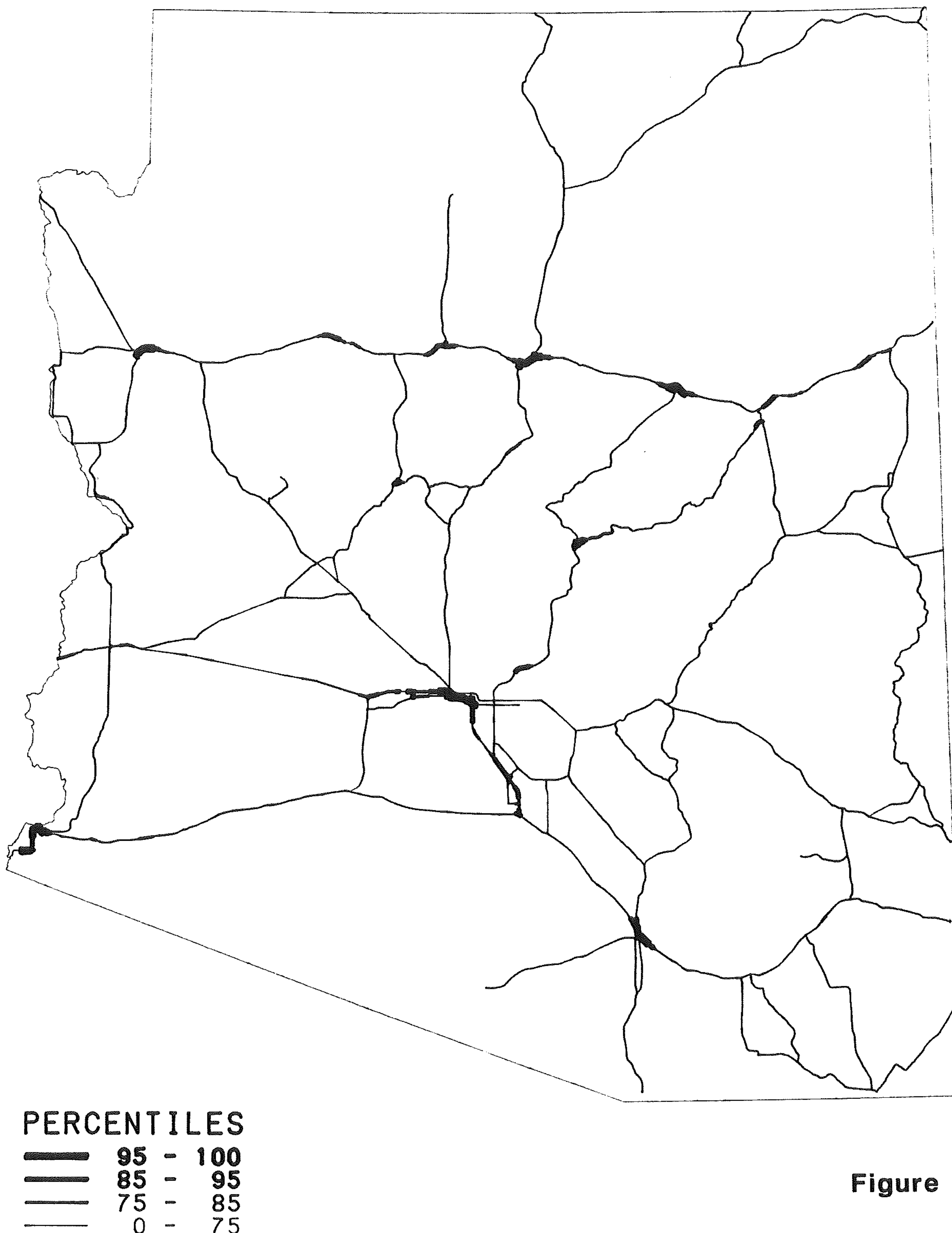


Figure 6.9

INHALATION RISK

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

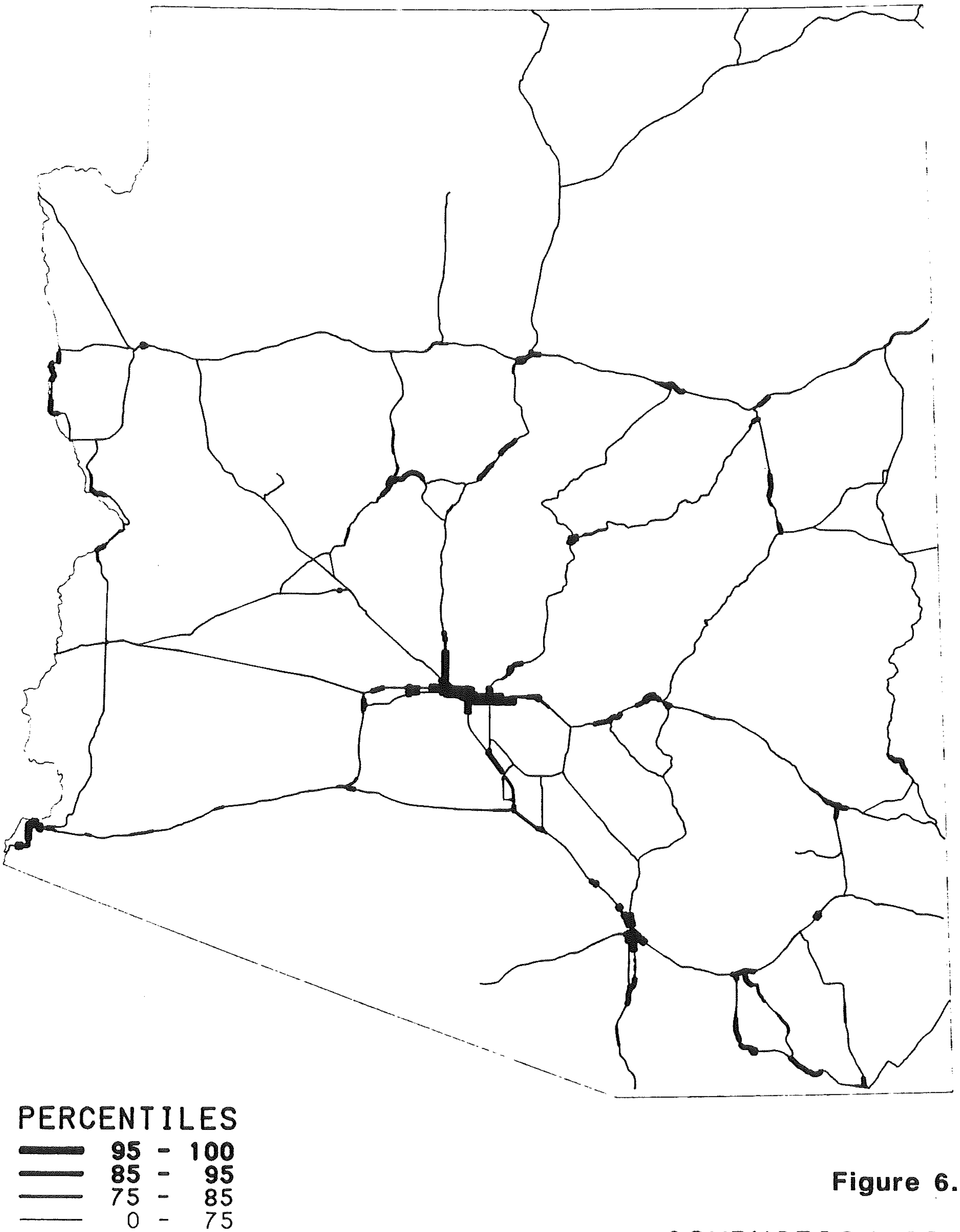
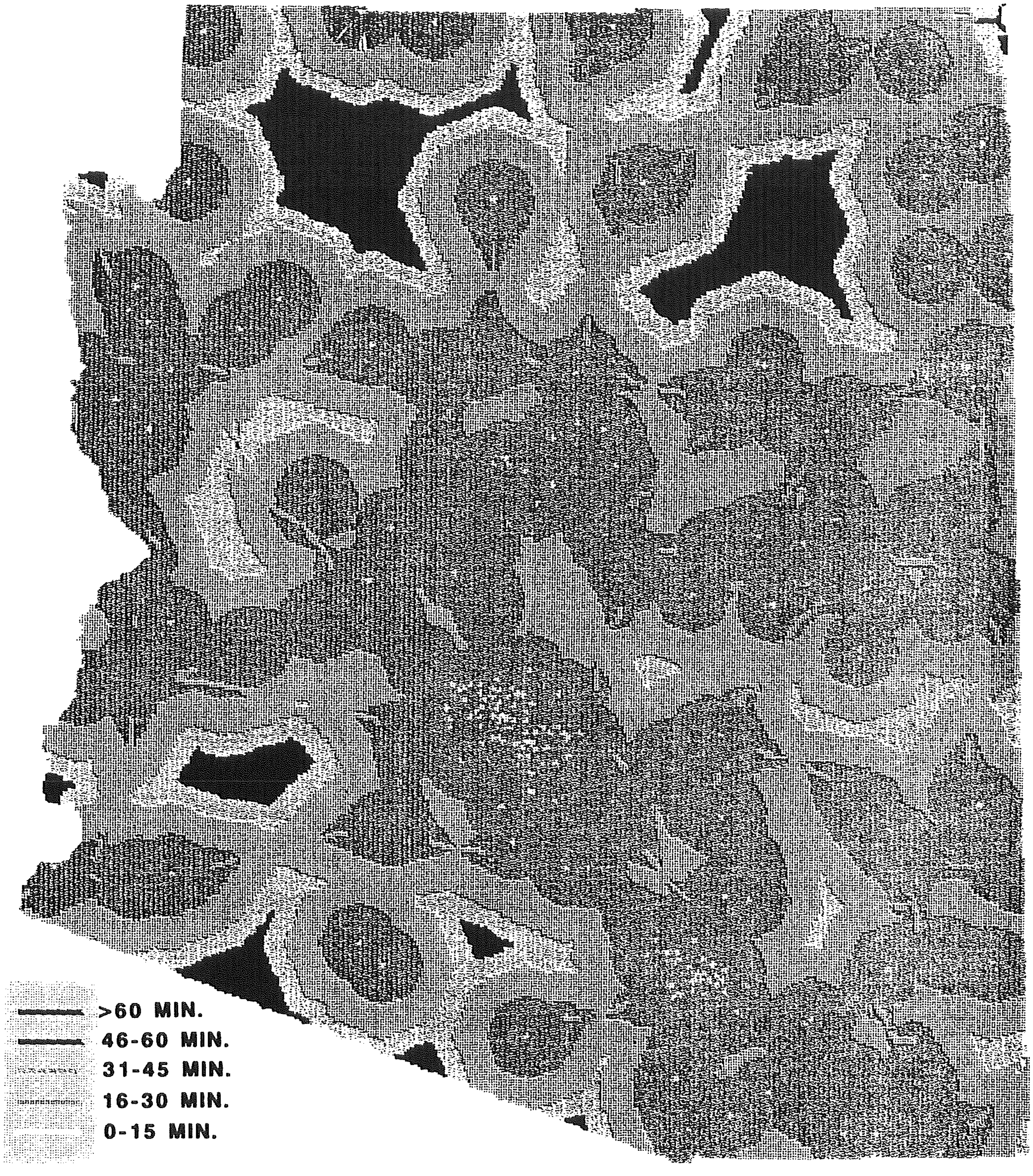


Figure 6.10

COMBUSTION RISK

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore



EMERGENCY RESPONSE TIMES
Transporting Hazardous Materials In Arizona

Figure 6.11
ATRC/Dames & Moore

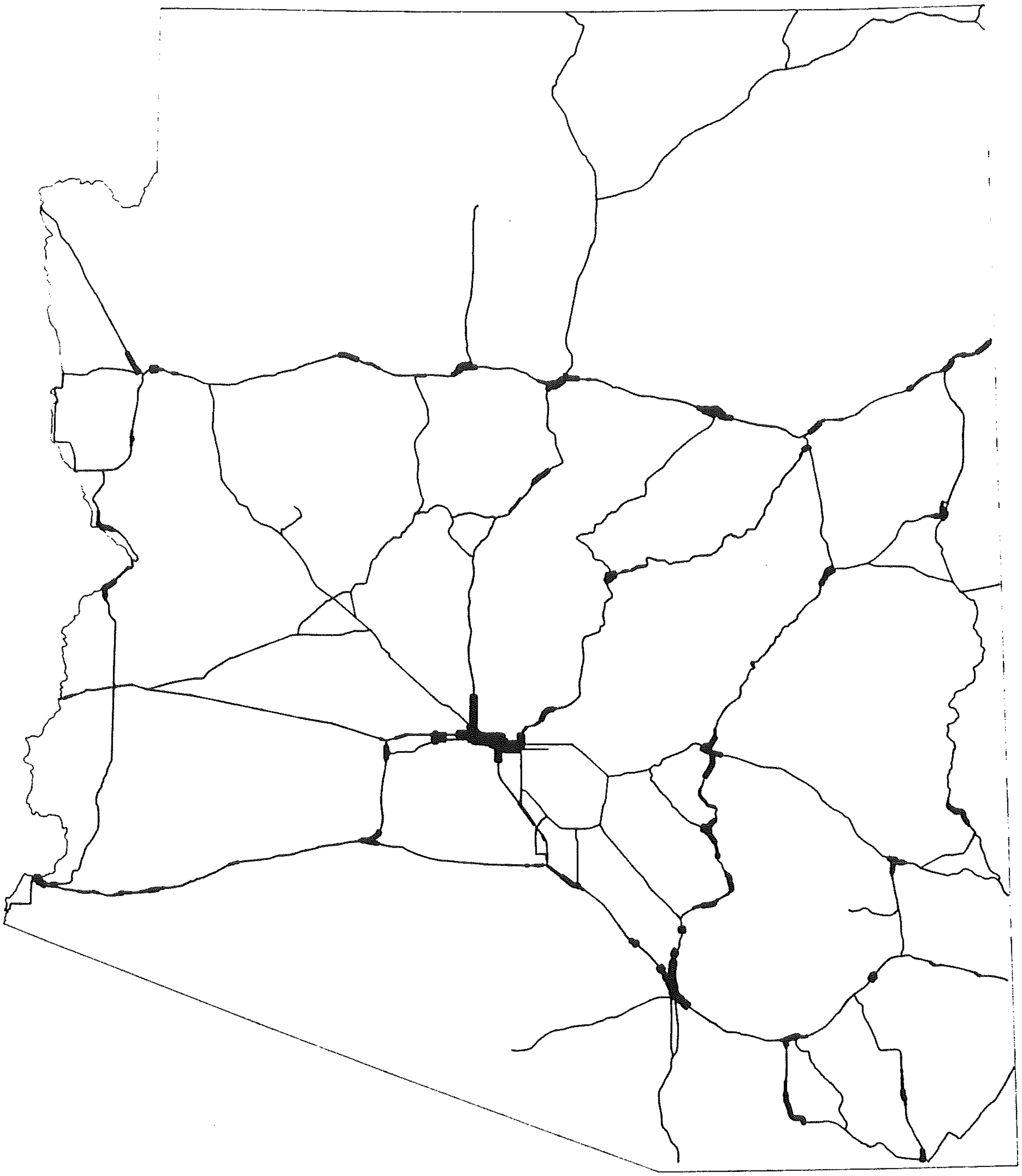


Figure 6.12

BLAST VULNERABILITY

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

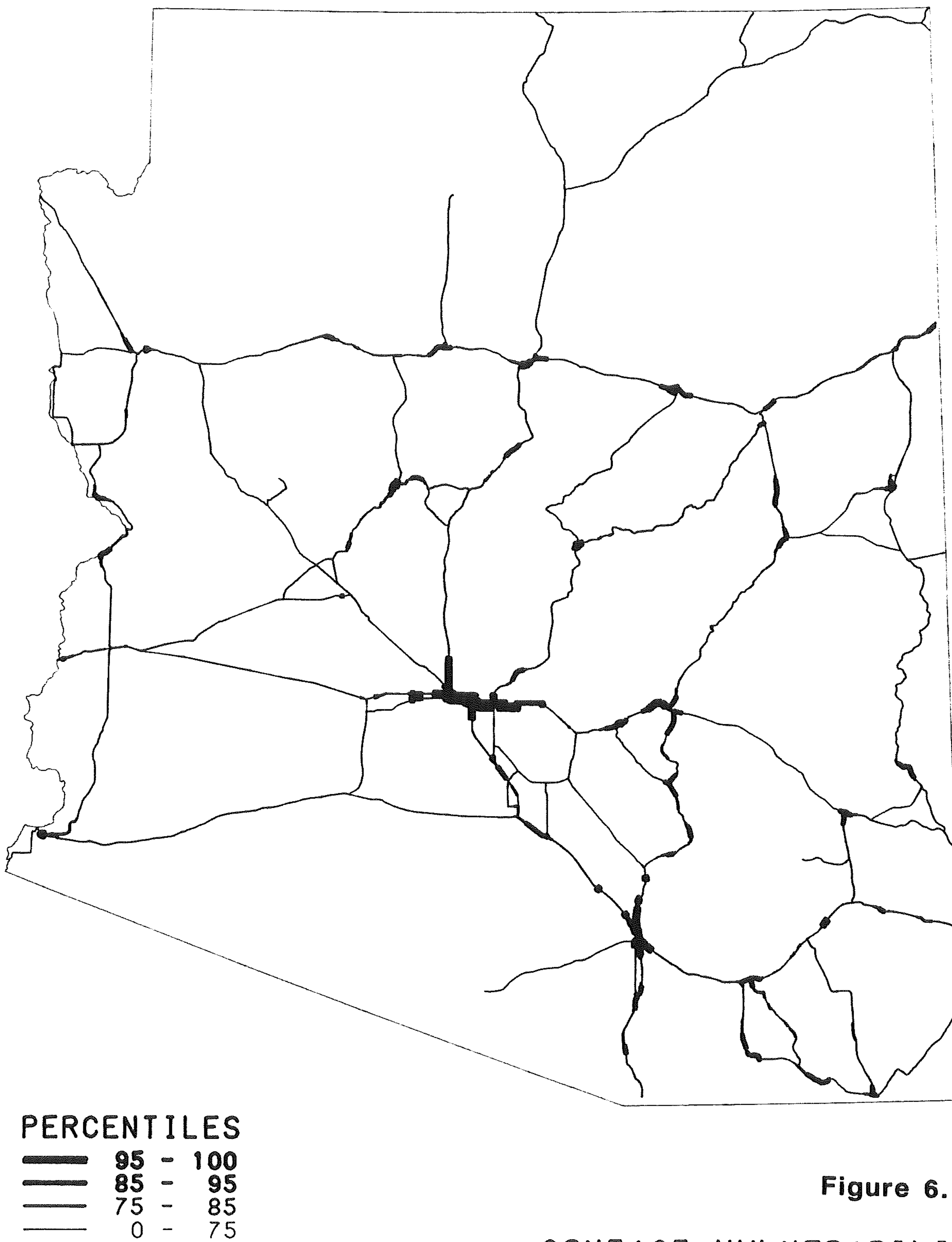


Figure 6.13

CONTACT VULNERABILITY

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

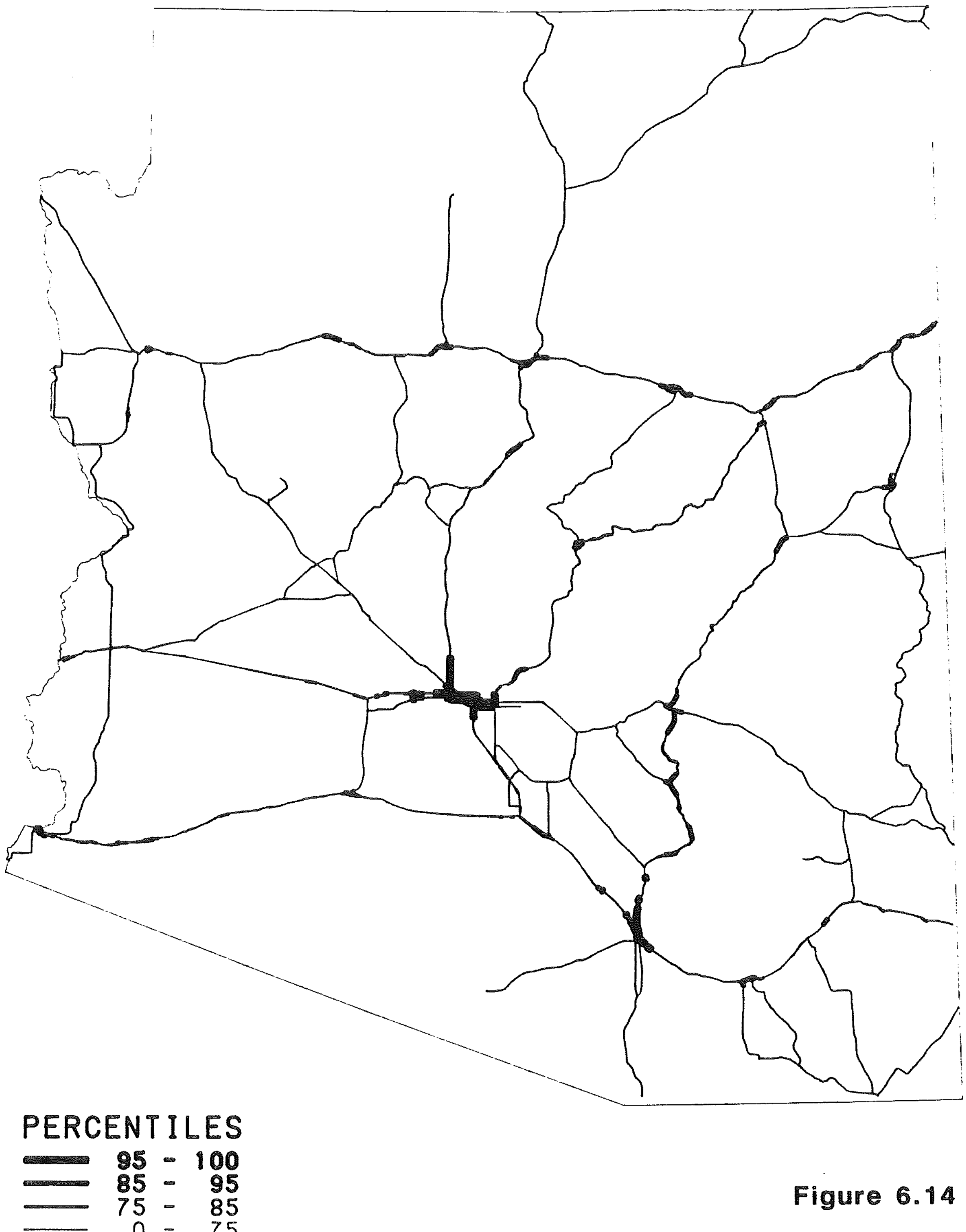


Figure 6.14

TOXIC VULNERABILITY
Risks of Transporting Hazardous Materials in Arizona
ATRC / Dames & Moore

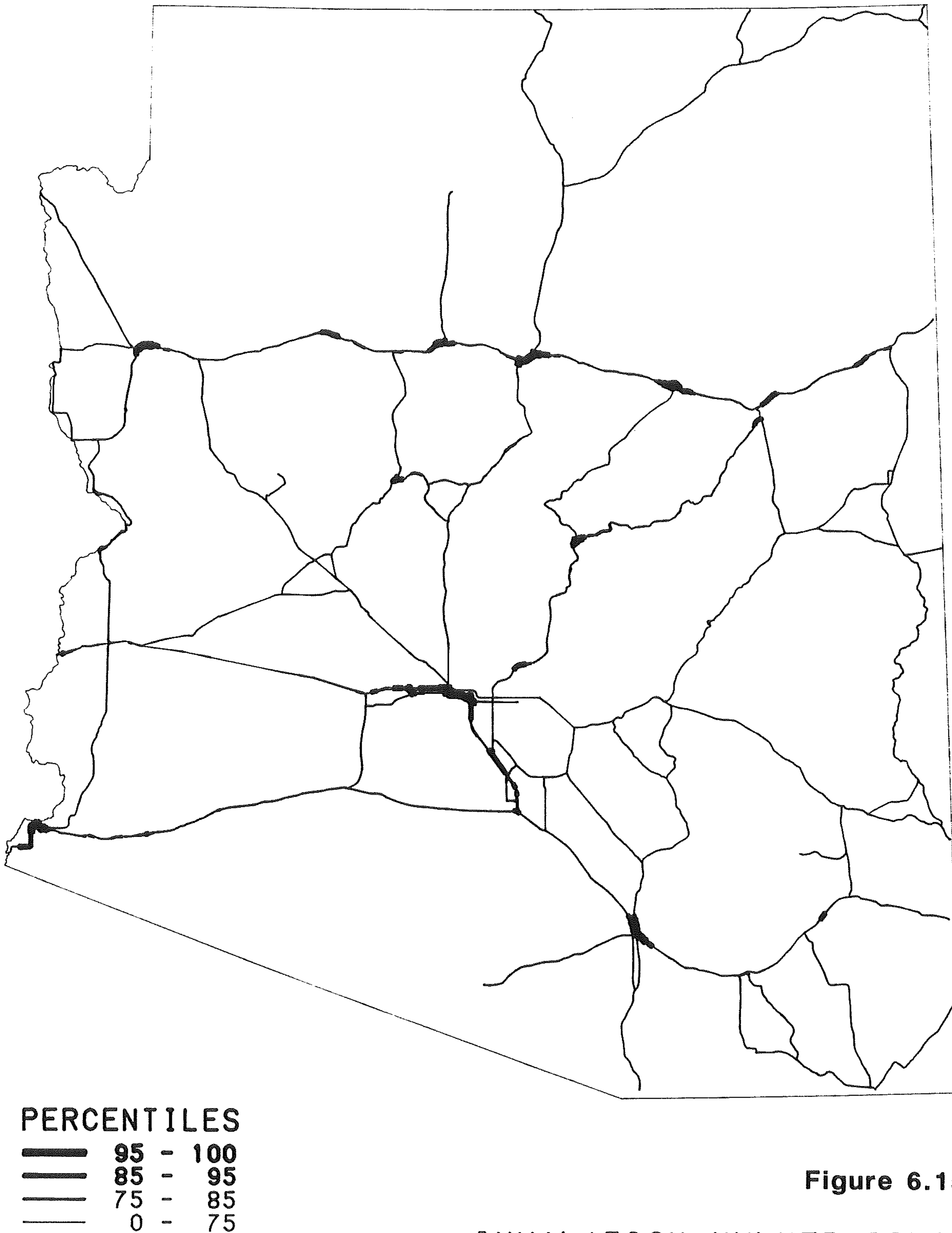


Figure 6.15

INHALATION VULNERABILITY

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

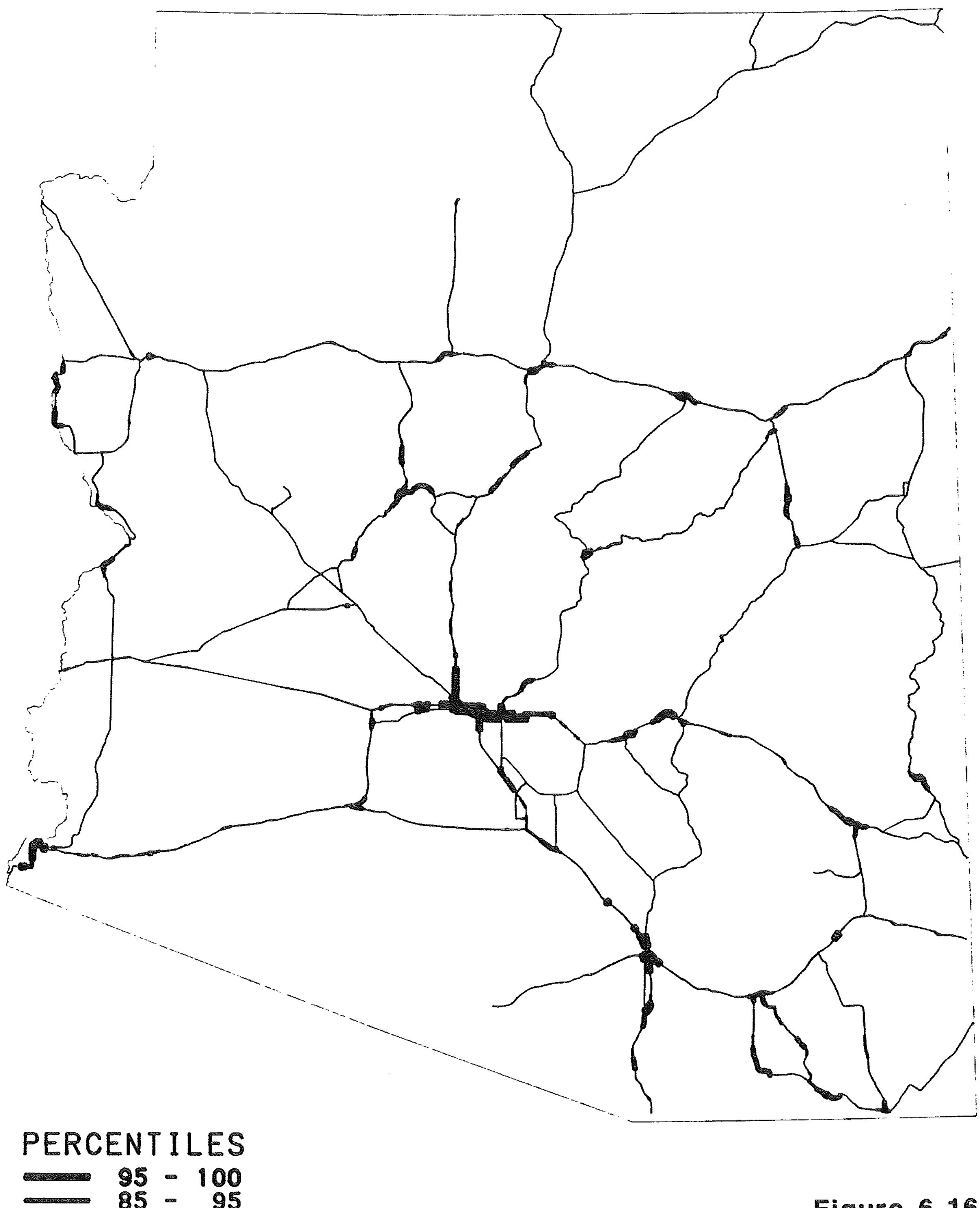


Figure 6.16

COMBUSTION VULNERABILITY

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

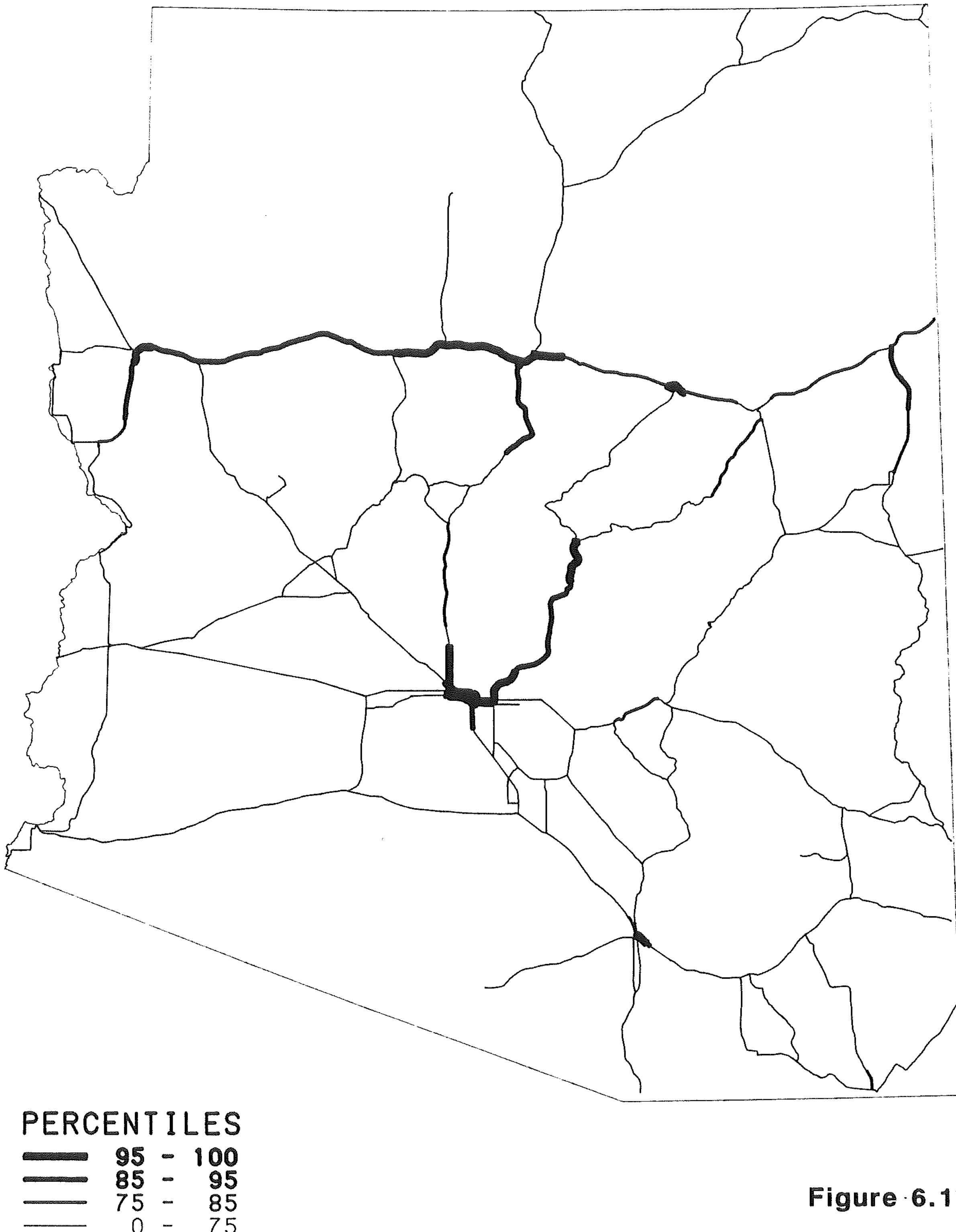


Figure 6.17

COMPOSITE HAZARD

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

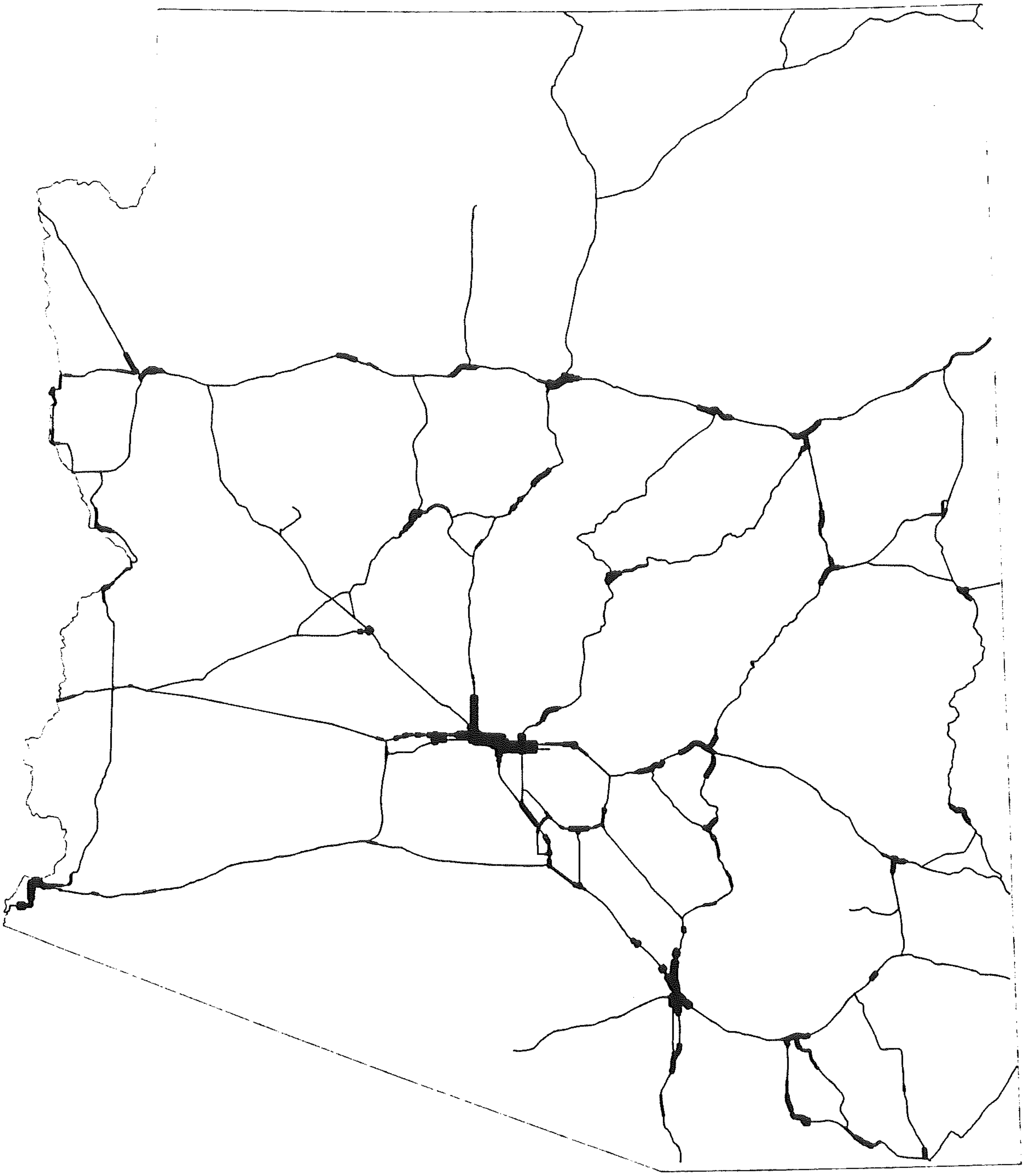


Figure 6.18

COMPOSITE RISK

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

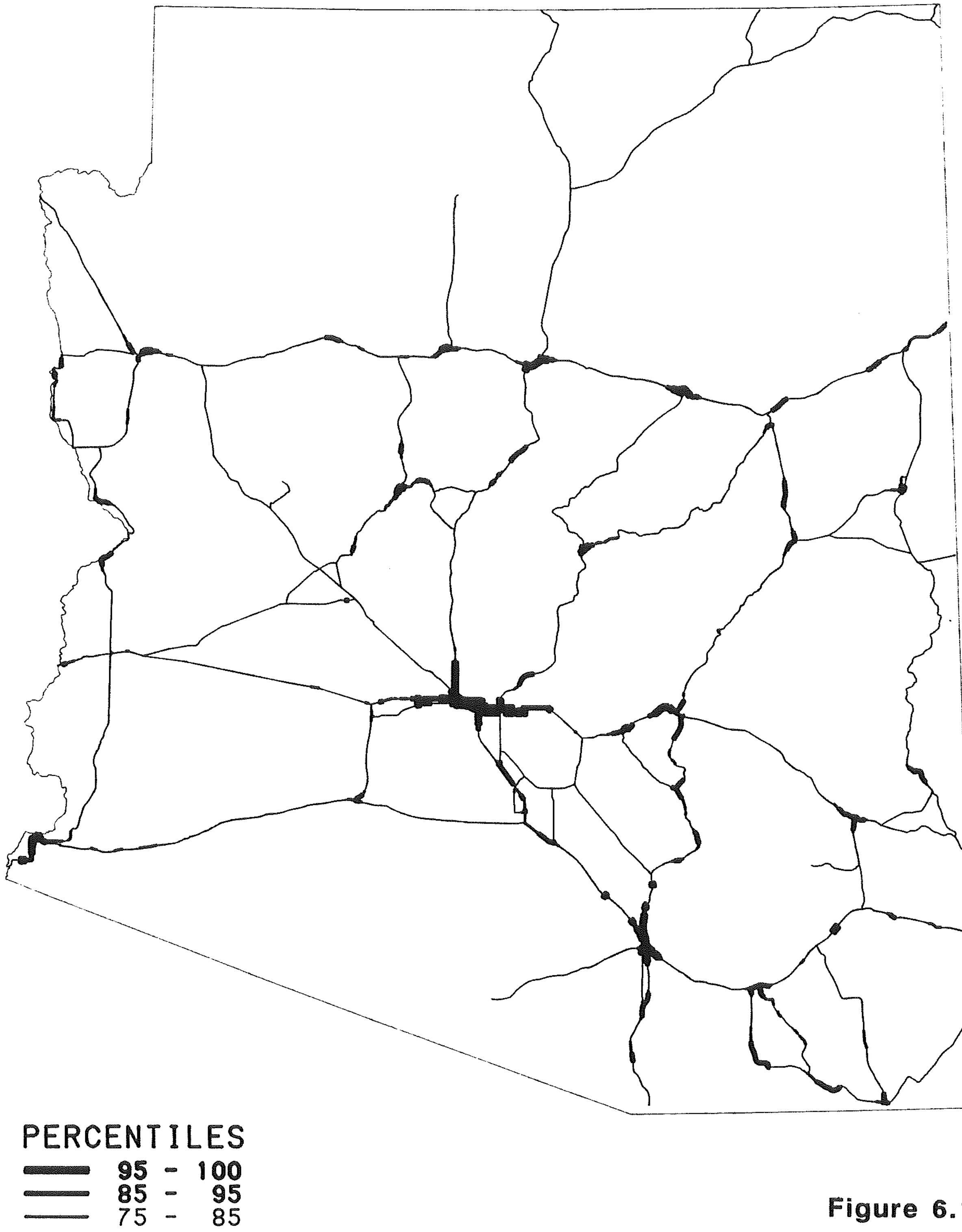


Figure 6.19

COMPOSITE VULNERABILITY

Risks of Transporting Hazardous Materials in Arizona

ATRC / Dames & Moore

7.0 IMPLICATIONS OF RISK ANALYSIS

This risk analysis has demonstrated a number of different techniques to assess risk of transporting hazardous materials. These include:

the absolute hazard or the probability that an accident will take place that involves a hazardous material without regard to the consequences,

assessing the consequences of hazardous materials incident by evaluating the number of people at risk, and

assessing what impact mitigation of a hazardous materials accident through prompt emergency response will have on the number of people affected.

One must be very cautious about drawing conclusions from this analysis. The hazardous materials data are 5 to 6 years old and may not be characteristic of the current patterns of hazardous material transport. The actual estimated volumes of hazardous materials by route segment were not available. Therefore, the volumes of hazardous materials by class were estimated from figures in the 1986 report. However, these figures appear to represent only interstate movements and therefore are incomplete. In addition, only 1980 population data were available at the time of the analysis.

This analysis demonstrated the successful application of the geographic information system to address the risk analysis problem. Unlike the traditional risk analysis techniques, the GIS analysis allows for the consideration of numerous spatial considerations. Currently, GIS data are relatively limited. However, the 1990 census data will be available in a GIS format and can be easily utilized in future analysis. National highway files are also available.

The GIS analysis can be applied on a large-scale basis, such as a state-level analysis. It can also be used to conduct regional or local evaluations. The GIS risk analysis also has the capability to zoom in on specific areas of concern so that the information can be seen in greater detail.

The potential applications of the GIS analysis is very broad. Because of its flexibility, the extensive GIS databases that are being developed and the tremendous increase in computing power, it is likely that the GIS will be the primary risk analysis tool of the future. Potential applications and uses of the risk analysis might include:

- Highway construction and maintenance prioritization
- Routing of hazardous materials and waste
- Transportation mode alternative analysis
- Siting emergency response units
- Assessing and prioritizing training for emergency response units
- Evaluating risks to sensitive population centers
- Evaluating risks to sensitive ecological areas

There are also a number of private sector applications of the GIS risk analysis model:

- Minimum time and mileage routing
- Improved utilization of equipment and personnel
- Minimum population exposed routes
- Time of day risk analysis routing alternatives

Considerations of the risks to sensitive activities and land uses, such as hospitals, retirement homes and schools, may also be useful. These data could be easily integrated into the GIS database and evaluated.

8.0 RECOMMENDATIONS

As previously stated, the data available for this risk assessment were very limited. Complete and up to date data are necessary to draw meaningful route specific conclusions from the analysis. Therefore, we would recommend that a more comprehensive survey be conducted to assess the amount and routing of hazardous materials traveling throughout the state. Perhaps more permanent survey programs could be implemented at all ports of entry. Additionally, information concerning the volumes and routing of hazardous materials and wastes being transported on the rail systems throughout the state should be included in the risk analysis to obtain a complete understanding of the risks to the public.

The new 1990 census data should be utilized when it becomes available. A more detailed analysis should also take into consideration the population changes during a typical work day and on weekends. The population density in the urban areas shifts significantly during the work day. Shipments of particular hazardous materials might be controlled not only by the routes they can travel, but also by the time of day they may be transported. In addition, seasonal variations in traffic patterns should also be taken into consideration. Significant shifts in truck traffic from I-40 to I-10 during the winter months have been observed.

More detailed information regarding the staffing and response capabilities of the fire department units is essential if the risk analysis is to be used to optimize the locations and training of the emergency response units. Jurisdictional considerations should also be integrated into the model to more accurately reflect the actual areas that the emergency response units are authorized to serve.

Consideration of the risk to sensitive activities and land uses, such as hospitals, retirement homes and schools, may also be useful. These data could be easily integrated into the GIS database and evaluated.

APPENDIX A

ESTIMATED HAZARDOUS MATERIAL TRANSPORTATION ON THE ARIZONA STATE HIGHWAY SYSTEM BY CLASS - 1984

Source: Transportation of Hazardous Materials in Arizona, Report Number FHWA/AZ 86/223-1.

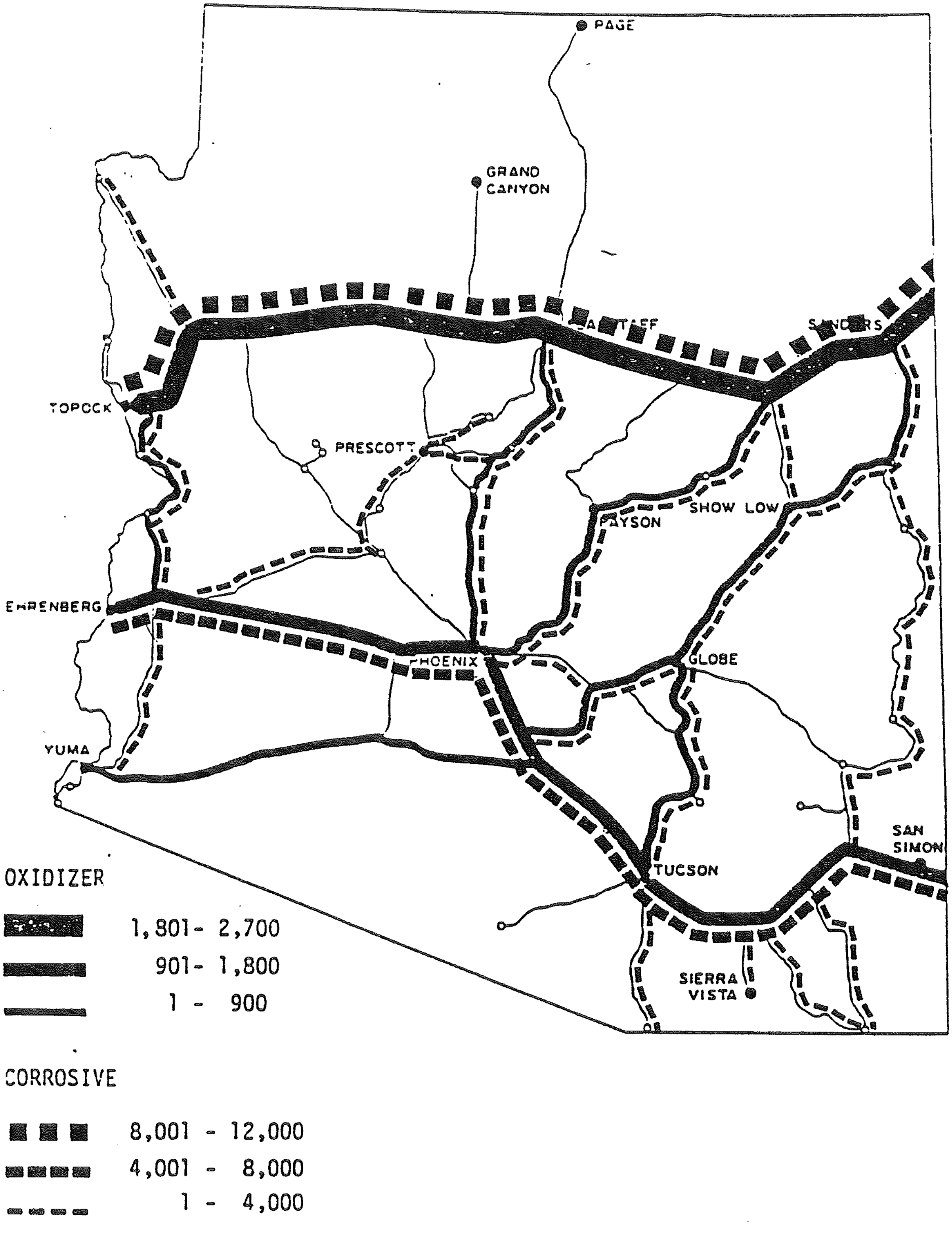


FIGURE 36. Annual Oxidizer and Corrosive Shipments as Estimated from the Port of Entry Survey.

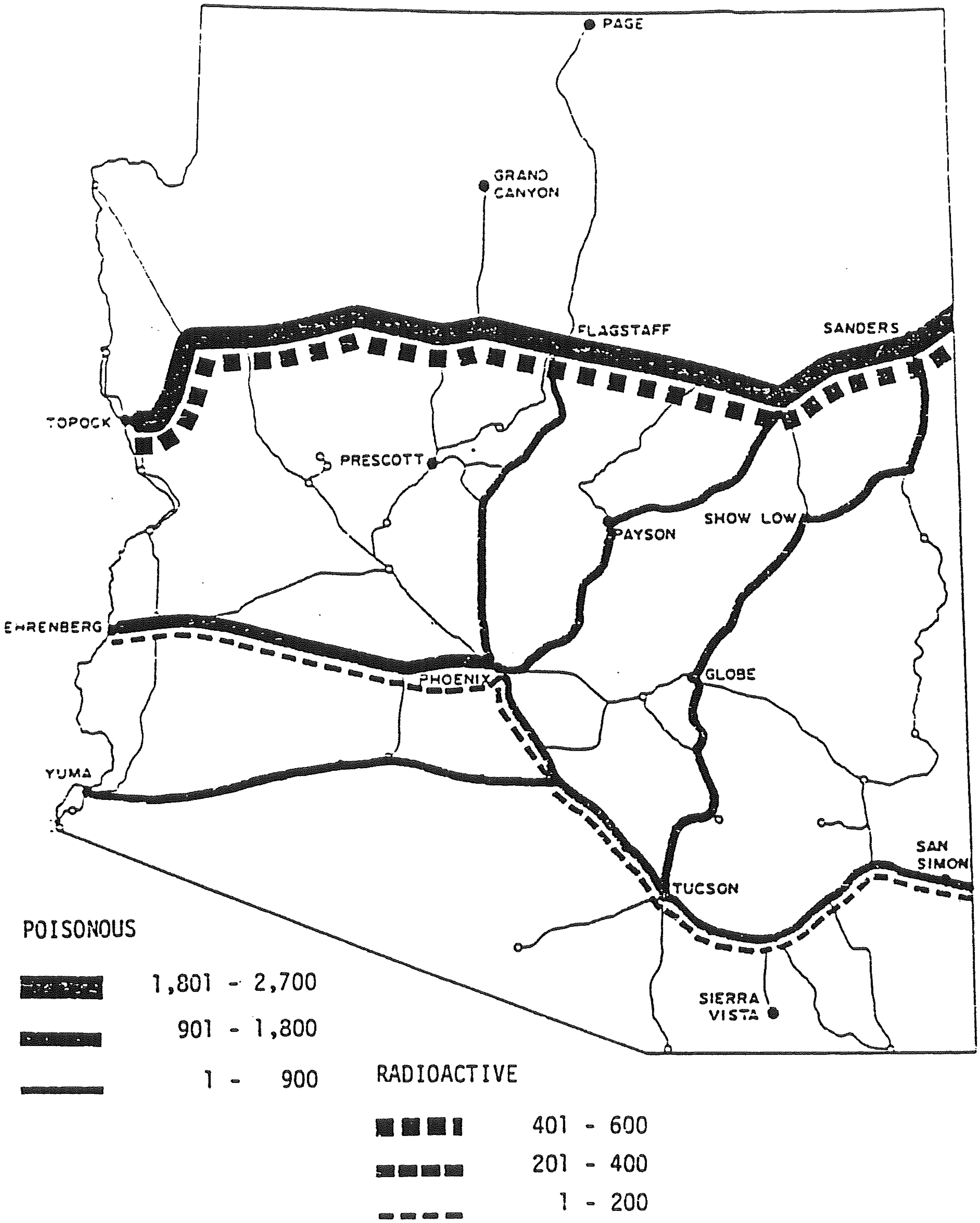


FIGURE 37. Annual Poisonous and Radioactive Shipments as Estimated from the Hazardous Material Port of Entry Survey.

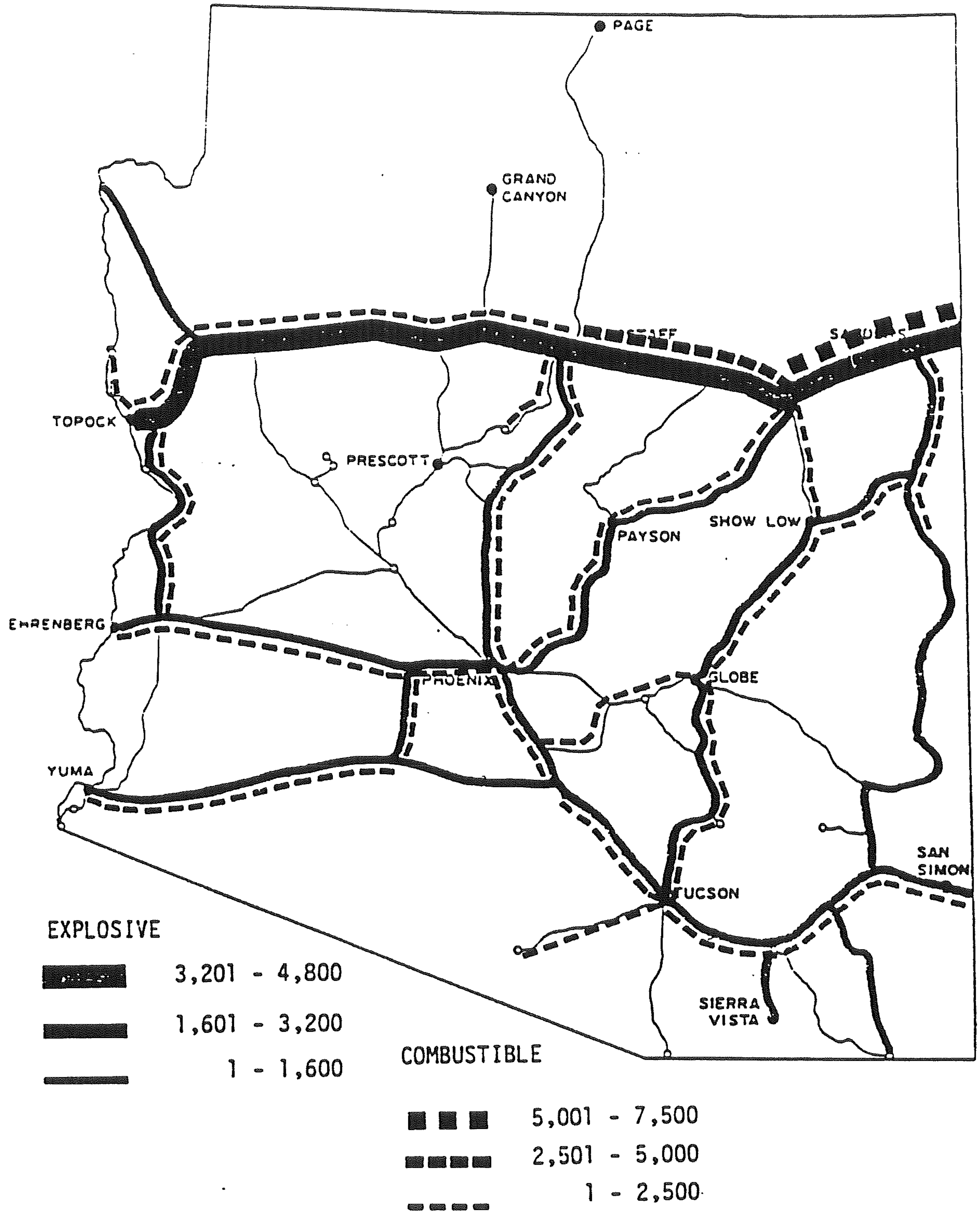


FIGURE 38. Annual Explosive and Combustible Shipments as Estimated from the Hazardous Material Port of Entry Survey.

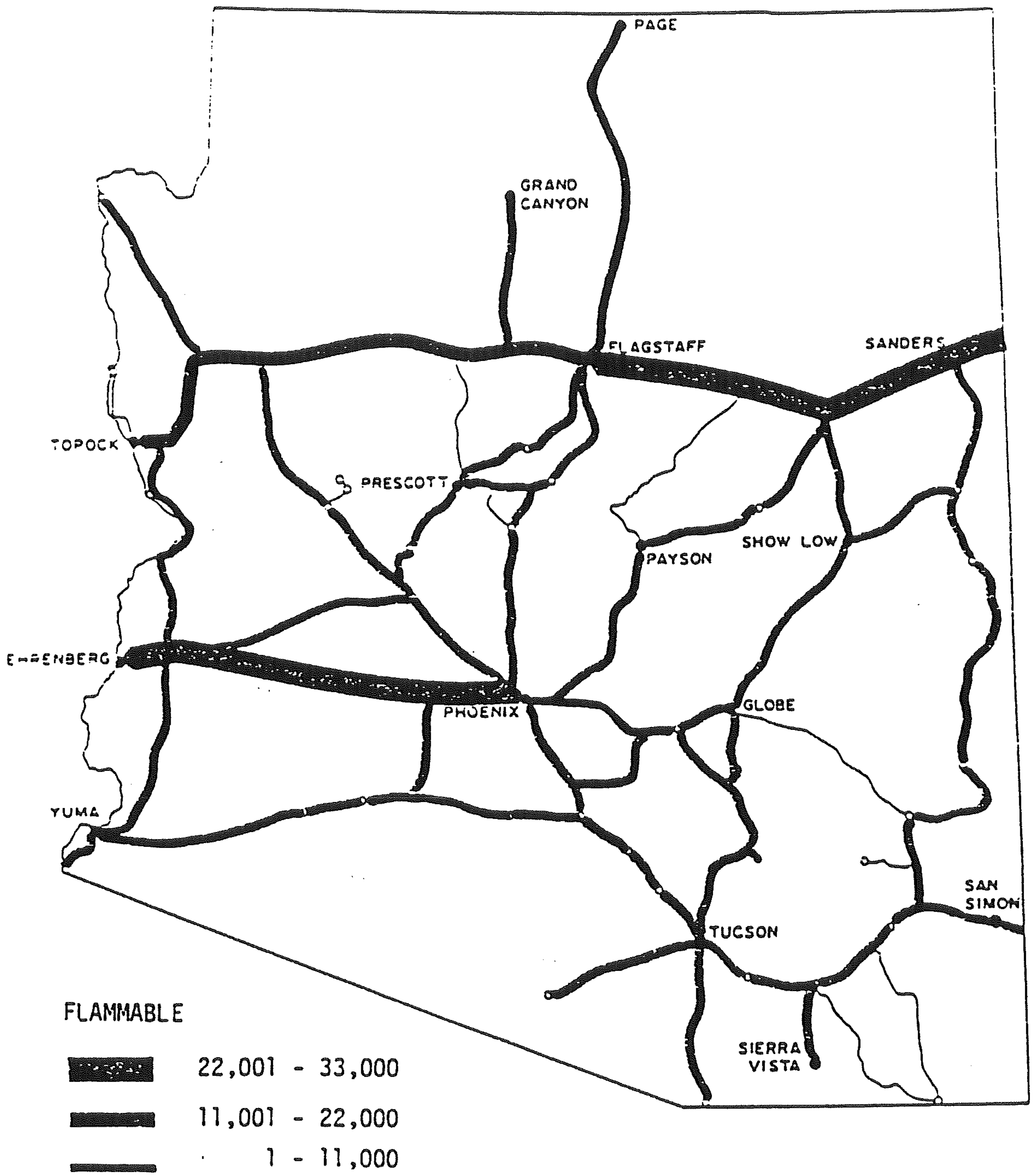


FIGURE 39. Annual Flammable Shipments as Estimated from the Hazardous Material Port of Entry Survey.

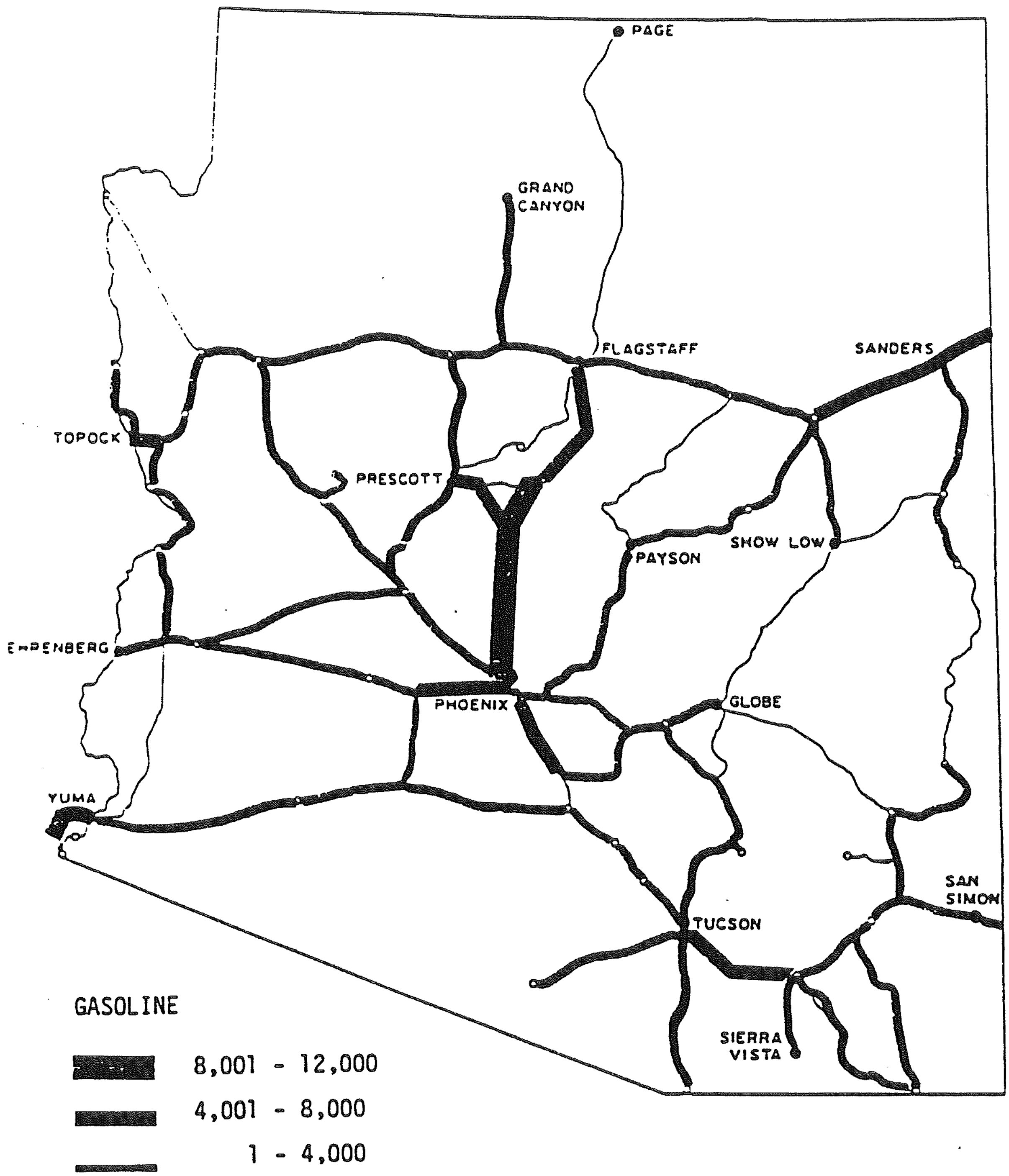
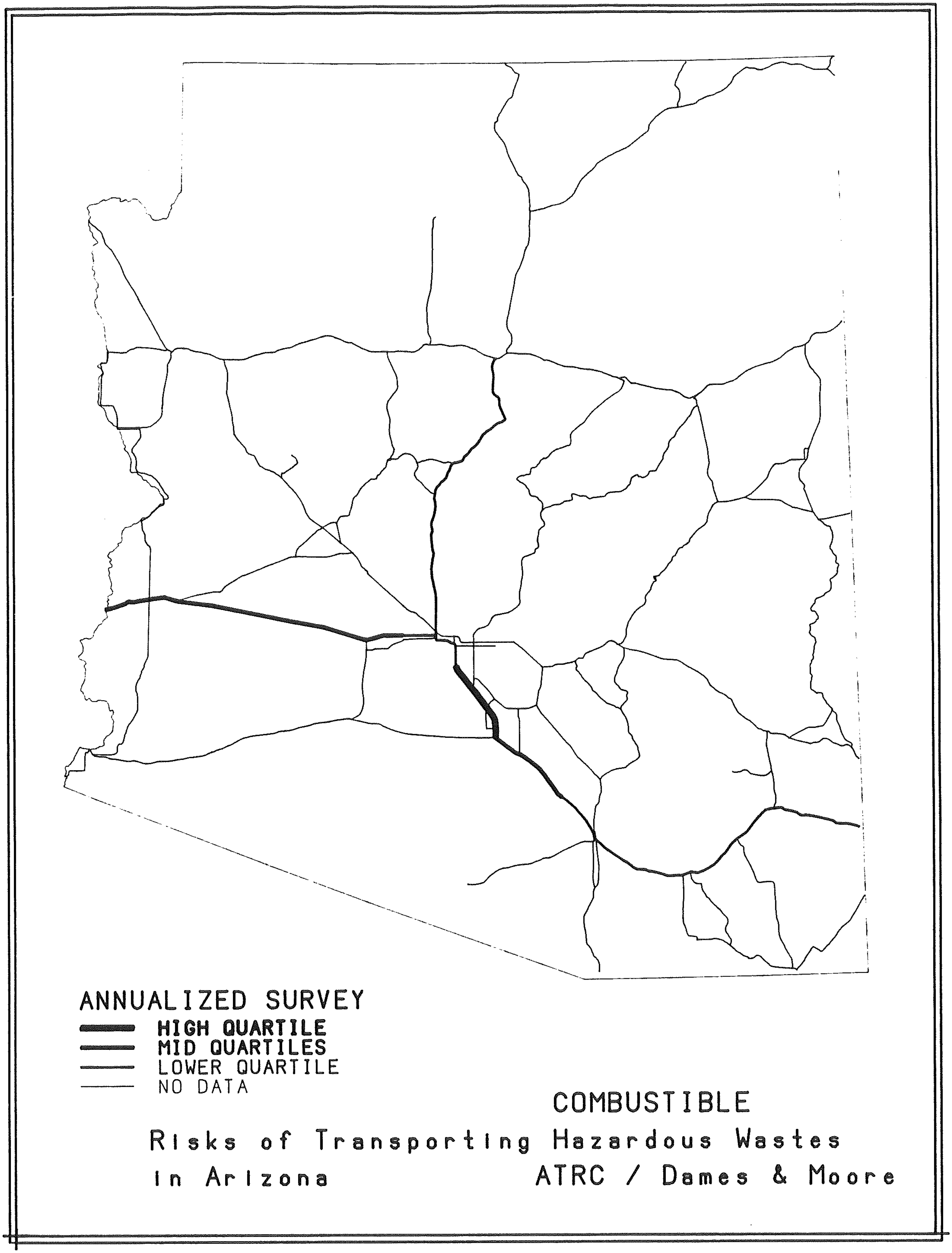
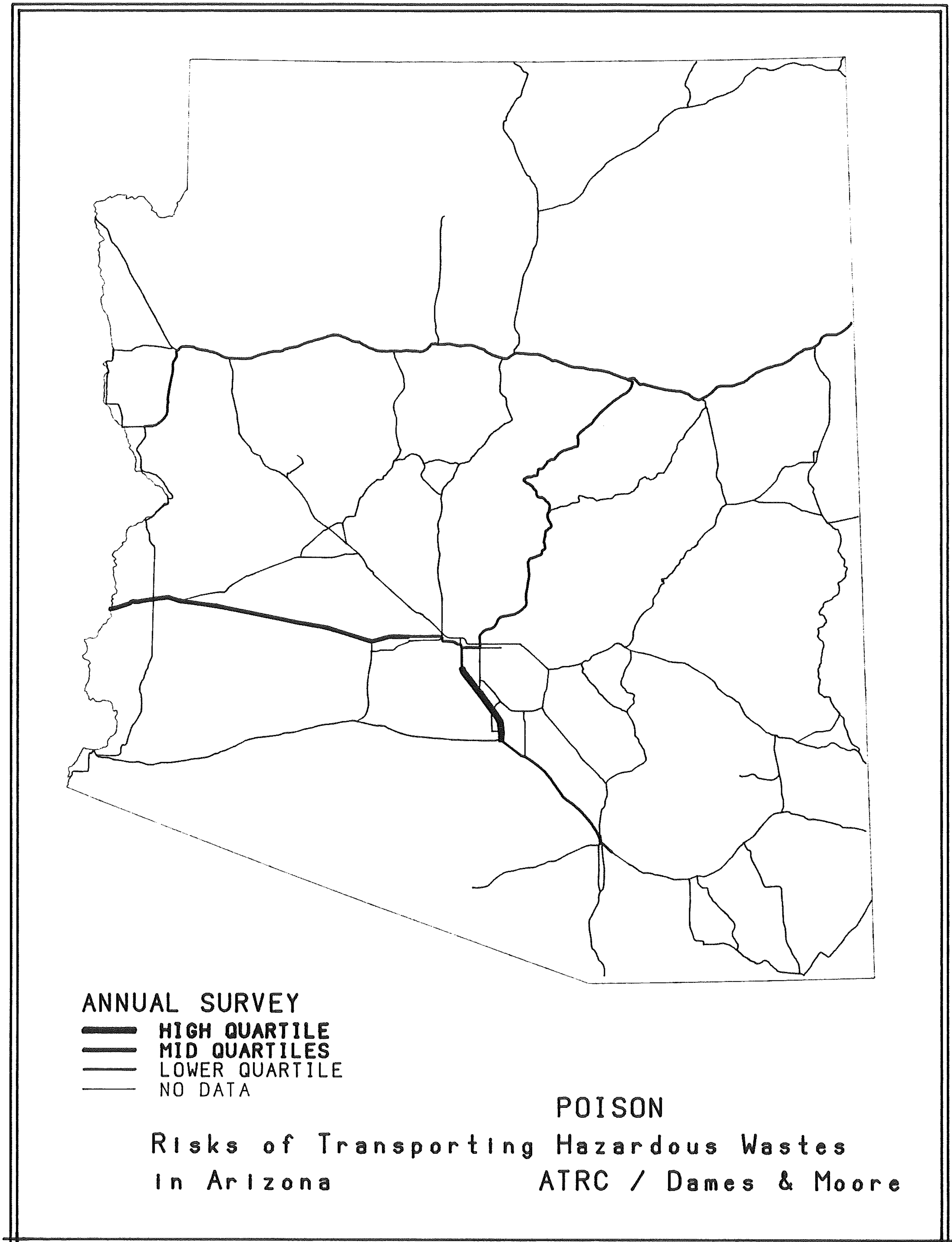


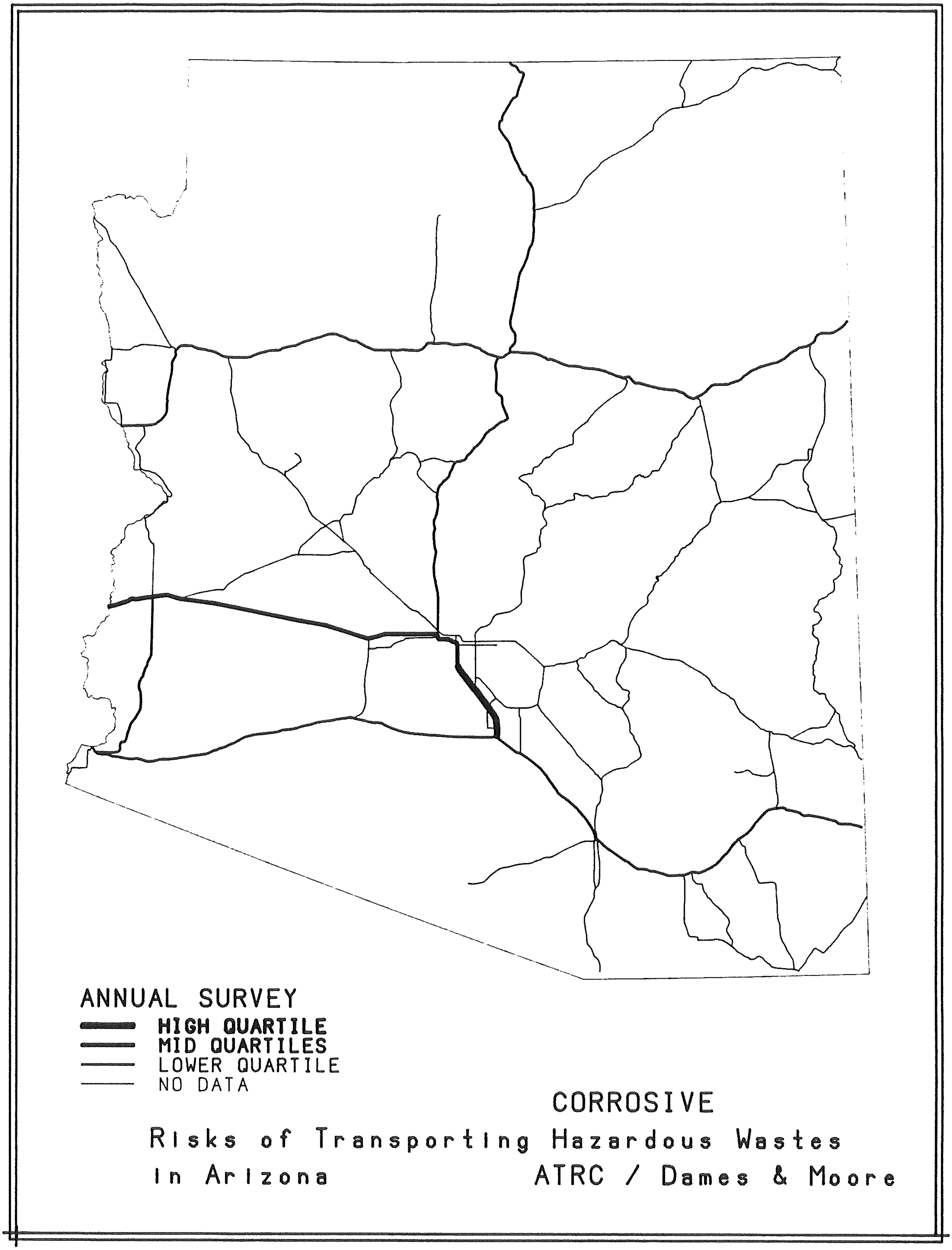
FIGURE 40. Annual Total Gasoline Shipments as Estimated from the Gasoline Sales Tax Data.

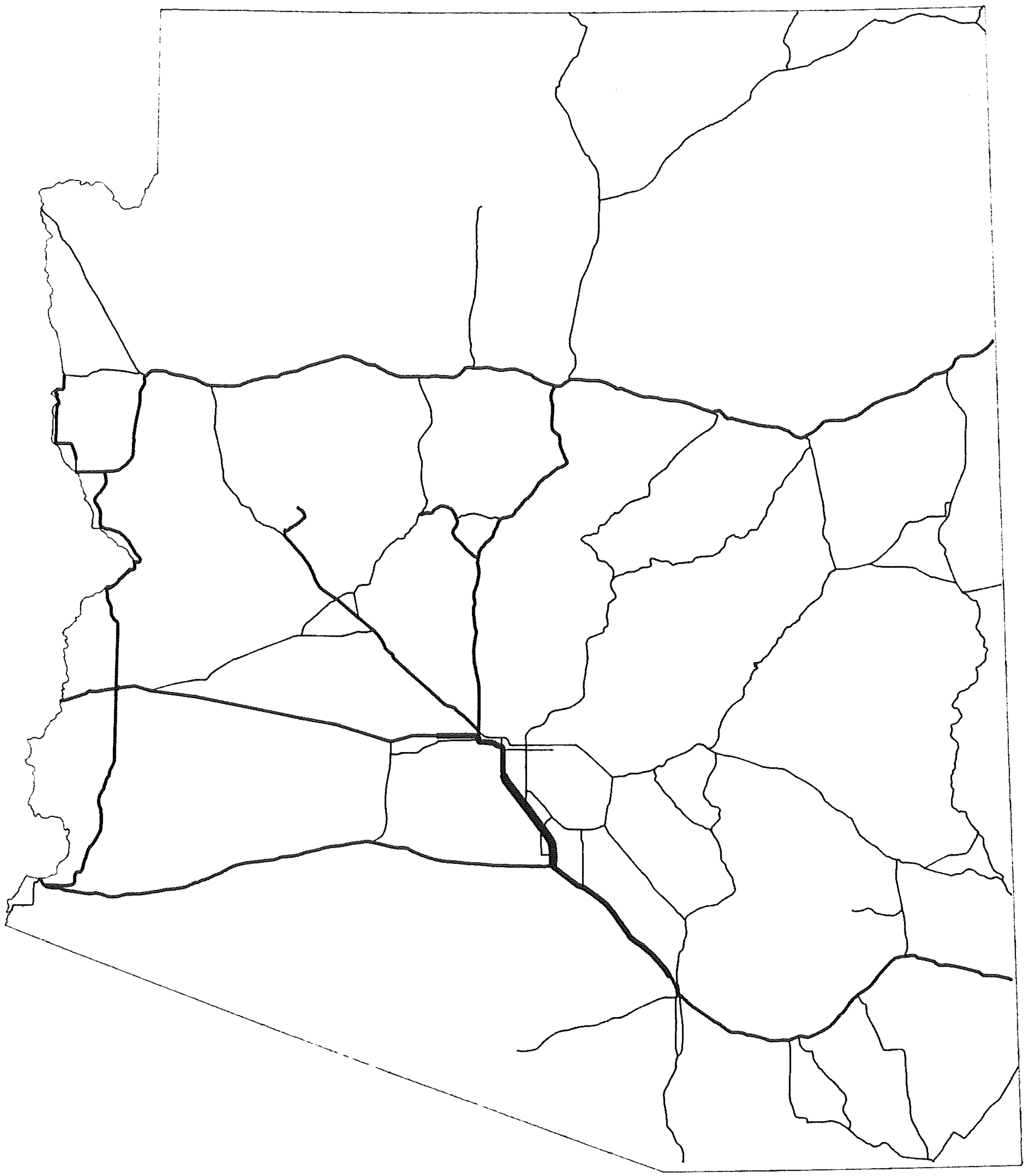
APPENDIX B

HAZARDOUS WASTE TRANSPORTATION ON THE ARIZONA STATE HIGHWAY SYSTEM BY CLASS - 1984


ANNUALIZED SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
COMBUSTIBLE
Risks of Transporting Hazardous Wastes in Arizona
ATRC / Dames & Moore


ANNUAL SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
POISON
Risks of Transporting Hazardous Wastes
in Arizona
ATRC / Dames & Moore


ANNUAL SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
CORROSIVE
Risks of Transporting Hazardous Wastes
in Arizona
ATRC / Dames & Moore



ANNUAL SURVEY

- HIGH QUARTILE
- MID QUARTILES
- LOWER QUARTILE
- NO DATA

FLAMABLE

Risks of Transporting Hazardous Wastes in Arizona

ATRC / Dames & Moore

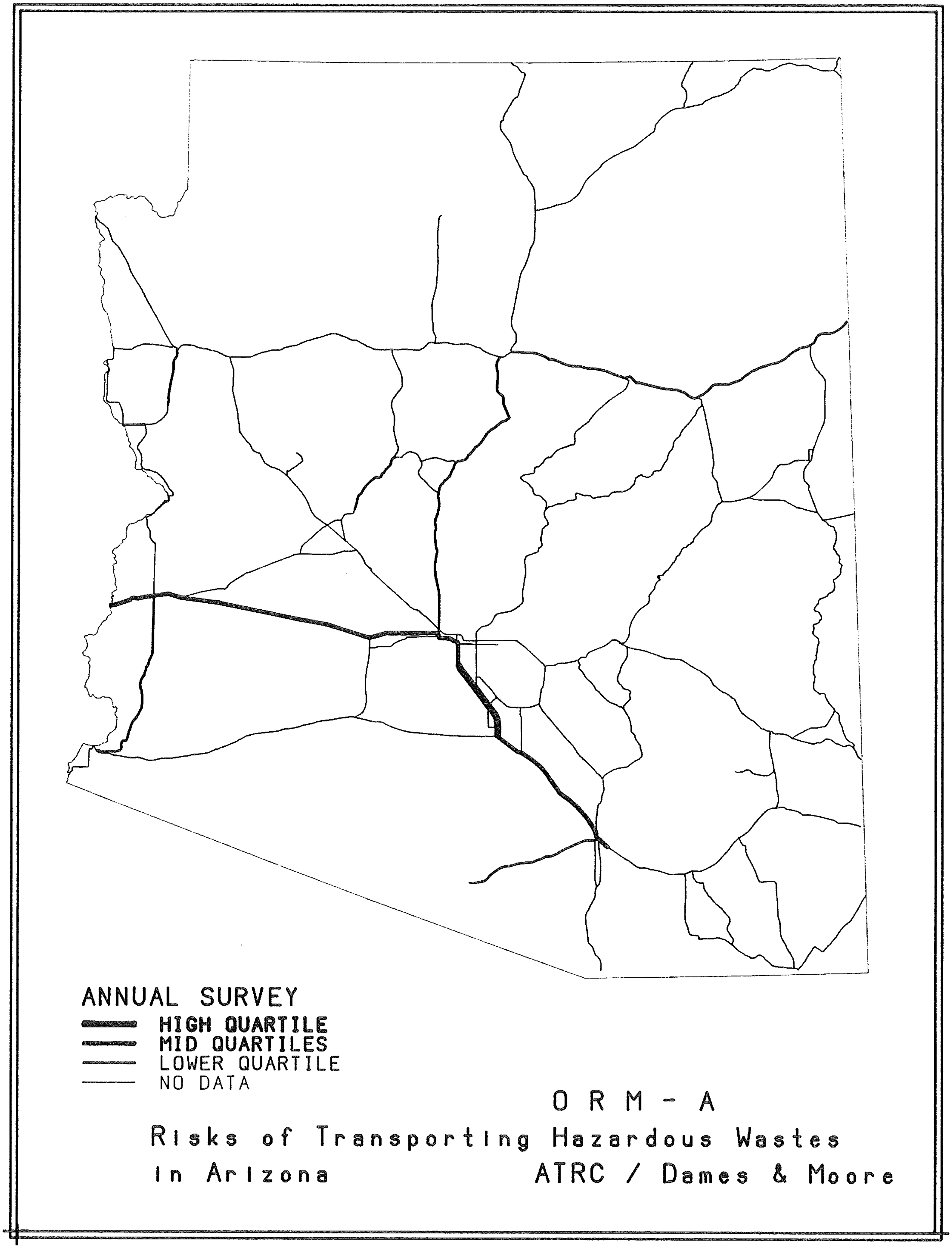
ANNUAL SURVEY

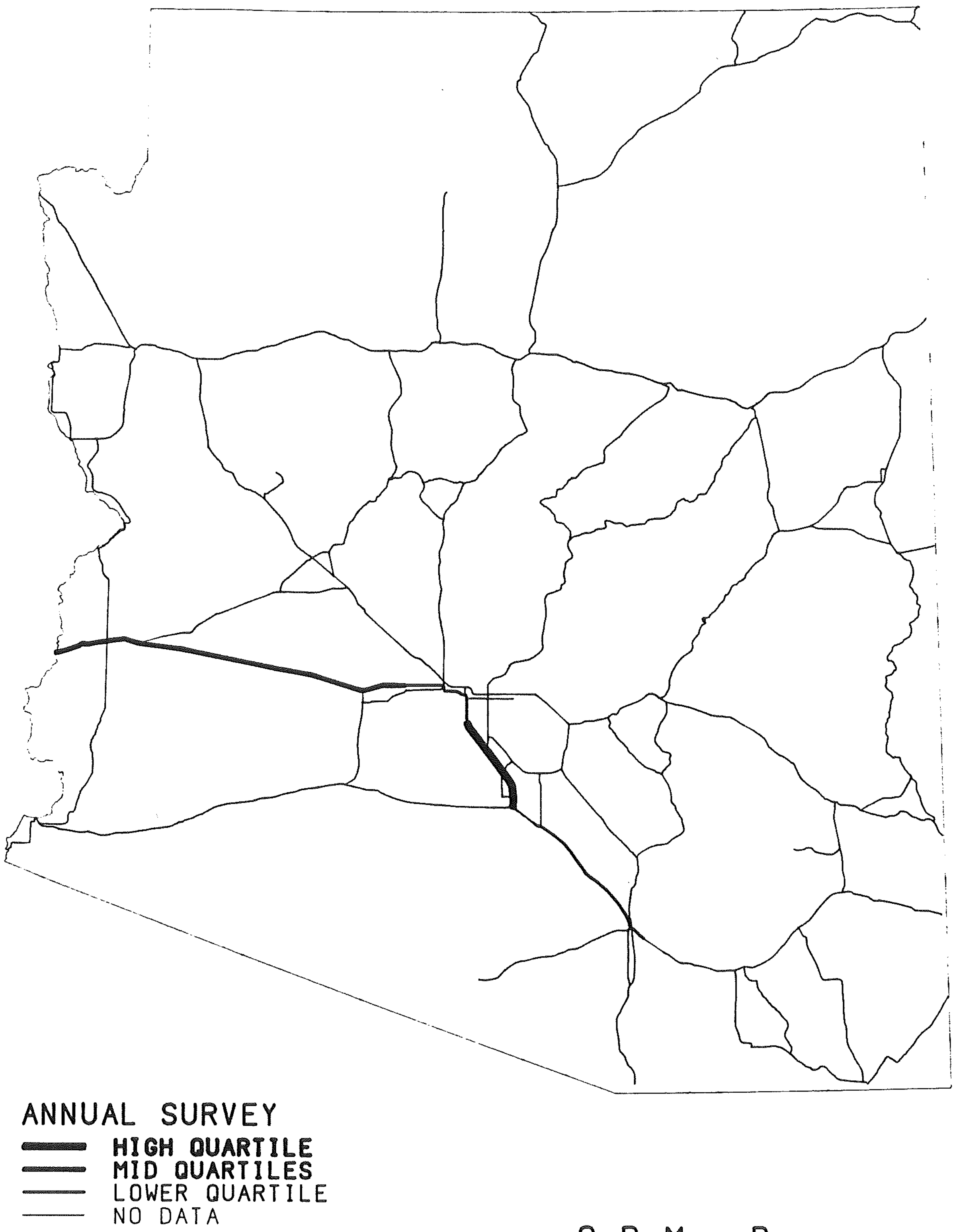
- HIGH QUARTILE
- MID QUARTILES
- LOWER QUARTILE
- NO DATA

OXIDIZER

Risks of Transporting Hazardous Wastes in Arizona

ATRC / Dames & Moore

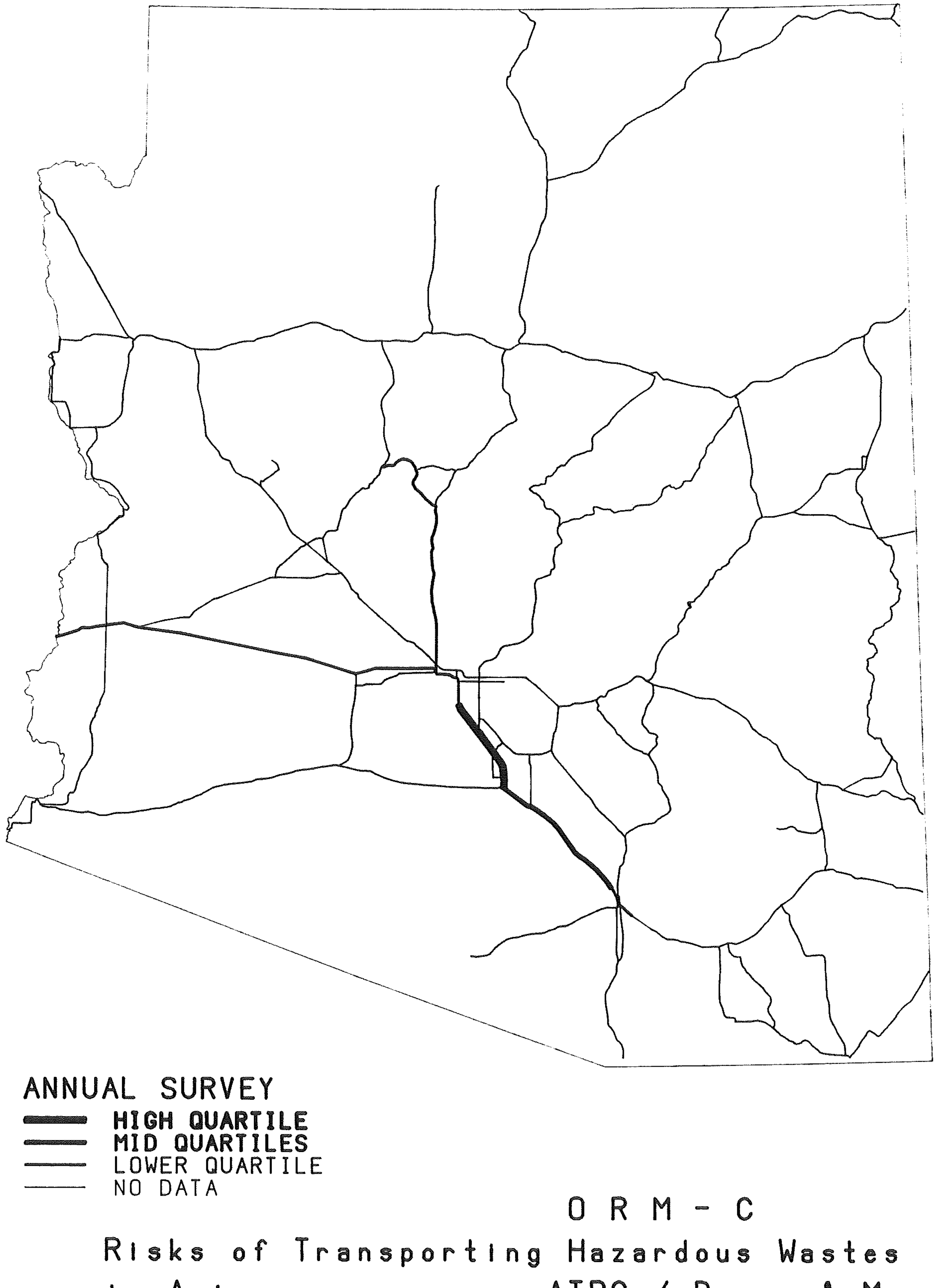

ANNUAL SURVEY
HIGH QUARTILE
MID QUARTILES
LOWER QUARTILE
NO DATA
O R M - A
Risks of Transporting Hazardous Wastes
in Arizona
ATRC / Dames & Moore



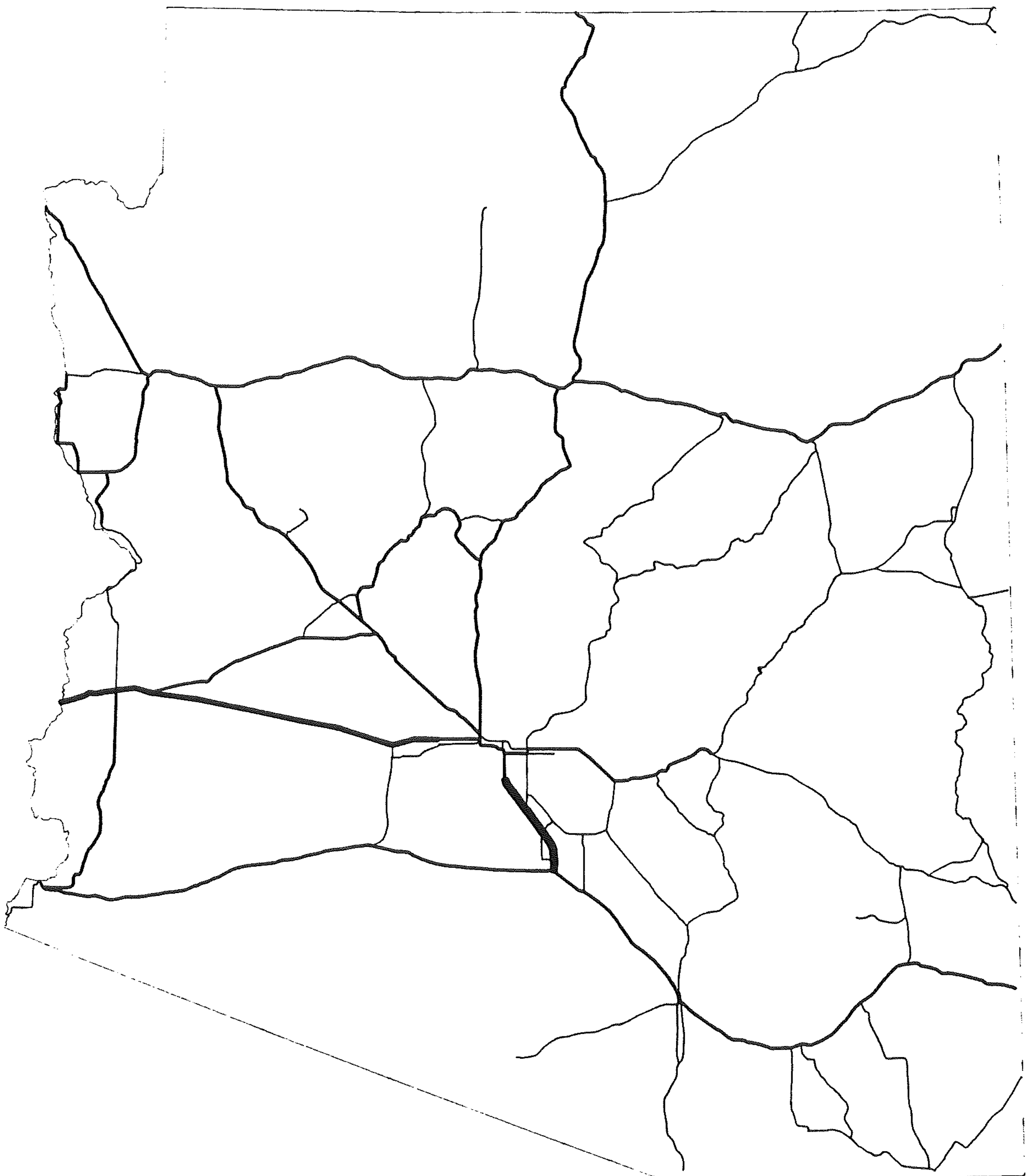
O R M - B

Risks of Transporting Hazardous Wastes in Arizona

ATRC / Dames & Moore



Risks of Transporting Hazardous Wastes in Arizona ATRC / Dames & Moore



ORM - E

Risks of Transporting Hazardous Wastes in Arizona

ATRC / Dames & Moore

APPENDIX C

ADOT TRUCK ACCIDENT RATES, YEARS 1985 THROUGH 1987

ADOT Truck Accident Rates
Years 1985 through 1987

	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
I	10	1.1	167.47	5.09	9	24000	5040	0.07	0.32	21
I	10	1.1	175.81	8.34	27	22000	4620	0.13	0.64	21
I	10	1.2	185.26	9.45	21	21667	4550	0.09	0.45	21
I	10	1.3	190.65	5.39	8	19000	4560	0.07	0.30	24
I	10	1.3	194.90	4.25	7	18667	4480	0.08	0.34	24
I	10	1.4	198.05	3.15	7	20000	4800	0.10	0.42	24
I	10	1.4	199.08	1.03	3	20667	4960	0.13	0.54	24
I	10	2.0	200.12	1.04	6	23000	5290	0.23	1.00	23
I	10	2.0	203.84	3.72	11	23667	5443	0.11	0.50	23
I	10	2.0	208.79	4.95	19	23333	5367	0.15	0.65	23
I	10	3.0	210.97	2.18	5	24333	5597	0.09	0.37	23
I	10	3.0	212.21	1.24	9	23000	6440	0.29	1.03	28
I	10	3.0	219.83	7.62	27	23000	6440	0.14	0.50	28
I	10	3.0	226.44	6.61	22	23333	6533	0.13	0.47	28
I	10	3.0	232.02	5.58	18	25000	7000	0.12	0.42	28
I	10	3.0	236.42	4.40	11	24667	6907	0.09	0.33	28
I	10	4.0	240.42	4.00	9	23000	6440	0.09	0.32	28
I	10	4.0	242.95	2.53	9	26000	7280	0.12	0.45	28
I	10	4.0	246.73	3.78	25	28000	7840	0.22	0.77	28
I	10	4.0	248.72	1.99	4	30667	8587	0.06	0.21	28
I	10	4.0	250.04	1.32	10	40333	11293	0.17	0.61	28
I	10	4.0	251.18	1.14	11	43000	12040	0.20	0.73	28
I	10	4.0	252.43	1.25	5	44333	12413	0.08	0.29	28
I	10	4.0	254.30	1.87	12	50000	14000	0.12	0.42	28
I	10	5.1	255.26	0.96	15	56667	15867	0.25	0.90	28
I	10	5.1	256.18	0.92	10	67000	15410	0.15	0.64	23
I	10	5.1	257.28	1.10	14	72667	16713	0.16	0.70	23
I	10	5.1	257.75	0.47	2	67000	15410	0.06	0.25	23
I	10	5.1	258.36	0.61	11	80000	18400	0.21	0.90	23
I	10	5.2	259.33	0.97	14	74667	17173	0.18	0.77	23
I	10	5.2	260.36	1.03	18	75000	17250	0.21	0.93	23
I	10	5.3	260.99	0.63	9	63333	14567	0.21	0.90	23
I	10	5.4	261.24	0.25	13	46333	10657	1.02	4.46	23
I	10	5.4	261.74	0.50	6	46333	10657	0.24	1.03	23
I	10	5.4	262.57	0.83	10	34000	7820	0.32	1.41	23
I	10	5.4	264.43	1.86	13	32000	7360	0.20	0.87	23
I	10	5.5	267.10	2.67	17	28667	6593	0.20	0.88	23
I	10	6.1	129.70	1.01	4	17333	7280	0.21	0.50	42
I	10	6.1	131.68	1.98	7	20667	8680	0.16	0.37	42
I	10	6.1	133.68	2.00	7	22000	9240	0.15	0.35	42
I	10	6.1	134.67	0.99	2	35000	14700	0.05	0.13	42
I	10	6.2	135.66	0.99	2	38000	15960	0.05	0.12	42
I	10	6.2	136.68	1.02	2	33333	3000	0.05	0.60	9
I	10	6.2	137.65	0.97	5	40000	3600	0.12	1.31	9
I	10	6.2	138.66	1.01	1	39667	3570	0.02	0.25	9
I	10	6.3	139.66	1.00	3	50000	4500	0.05	0.61	9
I	10	6.3	140.65	0.99	1	50500	4545	0.02	0.20	9

ADOT Truck Accident Rates
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Rte No		Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
I	10	6.3	141.68	1.03	2	48500	4365	0.04	0.41	9
I	10	6.3	142.65	0.97	4	40000	3600	0.09	1.05	9
I	17	6.4	195.05	1.03	37	121667	10950	0.27	3.00	9
I	17	6.4	196.00	0.95	53	125000	11250	0.41	4.53	9
I	17	6.4	196.94	0.94	21	124667	11220	0.16	1.82	9
I	17	6.4	197.94	1.00	33	123333	11100	0.24	2.72	9
I	17	6.4	199.14	1.20	51	121333	10920	0.32	3.55	9
I	17	6.4	199.69	0.55	12	121333	10920	0.16	1.82	9
I	17	6.4	199.82	0.13	6	121333	10920	0.35	3.86	9
I	10	6.5	149.62	0.41	8	123667	11130	0.14	1.60	9
I	10	6.5	152.10	2.48	130	124333	11190	0.39	4.28	9
I	10	6.5	153.10	1.00	37	123667	11130	0.27	3.04	9
I	10	6.6	153.47	0.37	9	124667	11220	0.18	1.98	9
I	10	6.6	154.90	1.43	50	124667	11220	0.26	2.85	9
I	10	6.7	155.64	0.74	19	65333	5880	0.36	3.99	9
I	10	6.7	157.74	2.10	13	60667	5460	0.09	1.04	9
I	10	6.7	158.69	0.95	5	60000	12600	0.08	0.38	21
I	10	6.7	159.70	1.01	5	50000	10500	0.09	0.43	21
I	10	6.7	160.89	1.19	3	34333	7210	0.07	0.32	21
I	10	6.7	162.38	1.49	3	24667	5180	0.07	0.35	21
I	10	7.0	126.69	1.99	4	16000	6720	0.11	0.27	42
I	10	7.0	128.69	2.00	3	16333	6860	0.08	0.20	42
I	10	8.0	114.85	2.10	5	14333	6020	0.15	0.36	42
I	10	8.0	121.68	6.83	10	14667	6160	0.09	0.22	42
I	10	8.0	124.70	3.02	7	16667	7000	0.13	0.30	42
I	10	9.0	98.29	4.14	12	10133	4256	0.26	0.62	42
I	10	9.0	103.45	5.16	15	12667	5320	0.21	0.50	42
I	10	9.0	109.68	6.23	14	14333	6020	0.14	0.34	42
I	10	9.0	112.75	3.07	10	13667	5740	0.22	0.52	42
I	10	10.1	26.65	6.86	14	11000	4620	0.17	0.40	42
I	10	10.1	31.17	4.52	17	11000	4620	0.31	0.74	42
I	10	10.2	45.36	14.19	31	10533	4424	0.19	0.45	42
I	10	10.3	53.96	8.60	25	11533	4844	0.23	0.55	42
I	10	10.3	69.66	15.70	47	10867	4564	0.25	0.60	42
I	10	10.3	81.22	11.56	48	10100	4242	0.38	0.89	42
I	10	10.4	94.15	12.93	34	10200	4284	0.24	0.56	42
I	10	11.1	0.70	0.70	1	17667	5830	0.07	0.22	33
I	10	11.2	5.84	5.14	10	16333	5390	0.11	0.33	33
I	10	11.2	11.91	6.07	11	15000	4950	0.11	0.33	33
I	10	11.2	17.47	5.56	8	15000	4950	0.09	0.27	33
I	10	11.2	19.79	2.32	6	12333	5180	0.19	0.46	42
I	8	12.1	0.57	0.57	0	7133	1213	0.00	0.00	17
I	8	12.1	2.23	1.66	2	9133	1553	0.12	0.71	17
I	8	12.2	3.98	1.75	2	9933	1689	0.11	0.62	17
I	8	12.2	7.63	3.65	4	9167	1558	0.11	0.64	17
I	8	12.2	9.40	1.77	1	8567	1456	0.06	0.35	17
I	8	12.3	12.21	2.81	2	11667	1517	0.06	0.43	13

ADOT Truck Accident Rates
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	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
I	10	20.2	362.88	6.91	13	10267	3183	0.17	0.54	31
I	10	20.2	366.82	3.94	7	10067	3121	0.16	0.52	31
I	10	20.3	378.95	12.13	15	10233	3172	0.11	0.36	31
I	10	20.3	382.35	3.40	7	9900	3069	0.19	0.61	31
I	10	20.3	390.75	8.40	10	8633	2676	0.13	0.41	31
I	10	20.3	391.23	0.48	0	9200	2852	0.00	0.00	31
S	69	21.1	269.61	6.76	4	4567	457	0.12	1.18	10
S	69	21.1	272.03	2.42	1	4433	443	0.09	0.85	10
S	69	21.1	281.05	9.02	2	5600	560	0.04	0.36	10
S	69	21.2	283.60	2.55	0	8233	576	0.00	0.00	7
S	69	21.2	286.80	3.20	0	9733	681	0.00	0.00	7
S	69	21.2	289.50	2.70	1	12667	887	0.03	0.38	7
S	69	21.2	292.10	2.60	0	12667	887	0.00	0.00	7
S	69	21.2	296.34	4.24	3	14000	980	0.05	0.66	7
I	17	22.1	218.01	0.91	1	24333	2433	0.04	0.41	10
I	17	22.1	223.99	5.98	7	25000	2500	0.04	0.43	10
I	17	22.2	225.52	1.53	1	21667	2167	0.03	0.28	10
I	17	22.2	229.09	3.57	2	21000	2100	0.02	0.24	10
I	17	22.2	232.00	2.91	5	19667	1967	0.08	0.80	10
I	17	22.2	236.00	4.00	6	18667	1867	0.07	0.73	10
I	17	22.2	242.10	6.10	7	18333	1833	0.06	0.57	10
I	17	22.2	244.94	2.84	3	18000	1800	0.05	0.54	10
I	17	22.2	248.40	3.06	9	17333	1733	0.15	1.55	10
I	17	22.2	252.52	4.12	9	17333	1733	0.12	1.15	10
I	17	22.2	256.05	3.53	7	17333	1733	0.10	1.04	10
I	17	22.2	259.43	3.38	2	17667	1767	0.03	0.31	10
I	17	22.2	262.65	3.22	3	16000	1600	0.05	0.53	10
I	40	23.0	13.16	3.37	3	6033	2232	0.13	0.36	37
I	40	23.0	20.13	6.97	9	6167	2282	0.19	0.52	37
I	40	23.0	25.18	5.05	5	6300	2331	0.14	0.39	37
S	95	24.0	182.36	3.37	1	4633	602	0.06	0.45	13
S	95	24.0	182.50	0.14	0	5300	689	0.00	0.00	13
S	95	24.0	183.09	0.59	0	9700	1261	0.00	0.00	13
S	95	24.0	183.84	0.75	0	9600	1248	0.00	0.00	13
S	95	24.0	185.50	1.66	0	7533	979	0.00	0.00	13
S	95	24.0	187.51	2.01	0	5833	758	0.00	0.00	13
S	95	24.0	202.01	14.20	0	3467	451	0.00	0.00	13
S	95	25.0	144.49	0.58	0	10800	1836	0.00	0.00	17
S	95	25.0	158.75	14.20	10	5800	986	0.11	0.65	17
S	95	25.0	167.67	8.92	2	3333	567	0.06	0.36	17
S	95	25.0	178.99	11.36	1	3300	429	0.02	0.19	13
S	95	26.1	110.60	1.50	1	3800	646	0.16	0.94	17
S	95	26.1	131.69	21.09	0	2200	374	0.00	0.00	17
S	95	26.2	142.90	11.21	2	2900	493	0.06	0.33	17
S	95	26.2	143.91	1.01	0	6367	1082	0.00	0.00	17
U	93	28.1	182.88	27.61	13	3633	618	0.12	0.70	17
U	93	28.2	193.73	10.85	4	3467	589	0.10	0.57	17

ADOT Truck Accident Rates
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U	93	29.0	155.21	30.46	32	3633	327	0.26	2.93	9
U	93	30.1	41.82	41.23	32	5567	557	0.13	1.27	10
U	93	30.2	52.76	10.94	14	5467	547	0.21	2.14	10
U	93	30.2	67.11	14.35	10	5167	517	0.12	1.23	10
U	93	30.3	71.04	3.93	7	12000	1200	0.14	1.36	10
I	17	31.1	285.53	7.13	11	14000	1960	0.10	0.72	14
I	17	31.1	287.29	1.76	4	13667	1913	0.15	1.08	14
I	17	31.2	289.98	2.69	2	14000	1960	0.05	0.35	14
I	17	31.2	293.26	3.28	3	14333	2007	0.06	0.42	14
I	17	31.2	298.99	5.73	6	12667	1773	0.08	0.54	14
I	17	31.3	306.30	7.31	14	10300	1442	0.17	1.21	14
I	17	31.3	315.58	9.28	21	10200	1428	0.20	1.45	14
I	17	31.3	317.87	2.29	12	9900	1386	0.48	3.45	14
I	17	31.3	320.50	2.63	10	9833	1377	0.35	2.52	14
I	17	31.3	322.72	2.22	8	10267	1437	0.32	2.29	14
I	17	31.3	326.20	3.48	2	10367	1451	0.05	0.36	14
I	17	31.3	328.76	2.56	3	10467	1465	0.10	0.73	14
I	17	31.3	331.10	2.34	6	11633	1629	0.20	1.44	14
I	17	31.3	333.85	2.75	6	11067	1549	0.18	1.29	14
I	17	31.3	337.39	3.54	6	15000	2100	0.10	0.74	14
I	17	31.3	339.76	2.37	6	17667	2473	0.13	0.93	14
I	17	31.3	340.02	0.26	0	18000	2520	0.00	0.00	14
I	17	32.0	268.94	6.29	3	13333	1867	0.03	0.23	14
I	17	32.0	278.40	9.46	9	13667	1913	0.06	0.45	14
I	40	33.1	253.62	1.50	8	11667	3967	0.42	1.23	34
I	40	33.1	255.75	2.13	7	10033	3512	0.30	0.85	35
I	40	33.1	257.82	2.07	5	11333	3967	0.19	0.56	35
I	40	33.2	264.77	6.95	22	11667	4083	0.25	0.71	35
I	40	33.2	269.97	5.20	11	11667	4083	0.17	0.47	35
I	40	33.2	274.74	4.77	8	11333	3967	0.14	0.39	35
I	40	33.2	277.08	2.34	3	10667	3733	0.11	0.31	35
S	87	34.1	254.53	1.95	0	14333	4013	0.00	0.00	28
S	87	34.1	267.63	13.10	6	3433	961	0.12	0.44	28
S	87	34.1	270.70	3.07	0	2900	812	0.00	0.00	28
S	87	34.1	278.50	7.80	0	1200	336	0.00	0.00	28
S	87	34.2	290.45	11.95	1	1033	289	0.07	0.26	28
S	87	34.2	340.84	50.39	2	727	204	0.05	0.18	28
S	87	34.2	342.17	1.33	1	1533	429	0.45	1.60	28
S	87	35.1	190.90	2.07	0	6800	136	0.00	0.00	2
S	87	35.1	199.14	8.24	2	6100	122	0.04	1.82	2
S	87	35.1	218.45	19.31	9	5067	101	0.08	4.21	2
S	87	35.1	235.76	17.31	7	6367	127	0.06	2.91	2
S	87	35.2	239.45	3.69	3	6033	121	0.12	6.14	2
S	87	35.2	250.80	10.57	9	6700	134	0.12	5.80	2
S	87	35.2	251.75	0.95	0	7833	157	0.00	0.00	2
S	87	35.2	252.58	0.83	3	20667	413	0.16	7.99	2
I	40	36.1	51.68	2.83	13	14000	3640	0.30	1.15	26

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I	40	36.1	53.08	1.40	3	12667	3293	0.15	0.59	26
I	40	36.2	59.65	6.12	18	12000	3240	0.22	0.83	27
I	40	36.2	66.47	6.82	8	11667	3150	0.09	0.34	27
I	40	36.2	71.96	5.49	15	11667	3150	0.21	0.79	27
I	40	37.1	204.85	3.73	19	12000	4080	0.39	1.14	34
I	40	37.1	207.24	2.39	12	9200	3128	0.50	1.47	34
I	40	37.1	211.16	3.92	21	10167	3457	0.48	1.42	34
I	40	37.2	219.55	8.39	26	10667	3627	0.27	0.78	34
I	40	37.2	225.05	5.50	16	11333	3853	0.23	0.69	34
I	40	37.2	230.43	5.38	9	12000	4080	0.13	0.37	34
I	40	37.2	233.88	3.45	6	10667	3627	0.15	0.44	34
I	40	37.2	239.67	5.79	14	10667	3627	0.21	0.61	34
I	40	37.2	245.39	5.72	11	10667	3627	0.16	0.48	34
I	40	37.2	252.12	6.73	17	11667	3967	0.20	0.58	34
I	40	38.1	280.62	3.54	13	12000	4200	0.28	0.80	35
I	40	38.1	283.64	3.02	9	11333	3967	0.24	0.69	35
I	40	38.1	285.17	1.53	4	12333	4317	0.19	0.55	35
I	40	38.1	286.87	1.70	4	10667	3733	0.20	0.58	35
I	40	38.2	289.49	2.62	1	10567	3698	0.03	0.09	35
I	40	38.2	292.82	3.33	6	11667	4083	0.14	0.40	35
I	40	38.3	294.53	1.71	2	10667	3520	0.10	0.30	33
I	40	38.3	303.60	9.07	19	10567	3487	0.18	0.55	33
I	40	38.3	311.56	7.96	14	10100	3333	0.16	0.48	33
I	40	38.3	320.00	8.44	15	9633	3179	0.17	0.51	33
I	40	38.3	325.92	5.92	10	9533	3146	0.16	0.49	33
I	40	38.3	330.00	4.08	6	9433	3113	0.14	0.43	33
I	40	38.3	333.41	3.41	3	10967	3619	0.07	0.22	33
I	40	38.4	339.52	6.11	8	9600	3168	0.12	0.38	33
U	60	39.0	212.17	16.35	9	7133	499	0.07	1.01	7
U	60	40.1	214.25	2.08	1	6867	481	0.06	0.91	7
U	60	40.1	225.70	11.45	6	6067	425	0.08	1.13	7
U	60	40.1	226.85	1.15	1	7000	490	0.11	1.62	7
U	60	40.2	242.82	15.66	26	5500	440	0.28	3.45	8
U	60	40.2	243.67	0.85	0	6033	483	0.00	0.00	8
U	60	40.2	244.37	0.70	0	7433	595	0.00	0.00	8
U	60	40.2	245.04	0.67	1	13667	1093	0.10	1.25	8
U	60	40.2	247.06	2.02	5	13000	1040	0.17	2.17	8
U	60	40.3	249.50	2.44	1	17000	1360	0.02	0.28	8
U	60	40.3	250.05	0.55	1	19667	1573	0.08	1.06	8
U	60	40.3	250.47	0.42	3	15333	1227	0.43	5.32	8
U	60	40.3	251.11	0.64	0	10033	803	0.00	0.00	8
U	60	40.3	252.23	1.12	3	15333	1227	0.16	1.99	8
S	95	41.1	216.32	4.98	0	1400	98	0.00	0.00	7
S	95	41.2	227.28	10.96	0	2000	140	0.00	0.00	7
S	95	41.2	231.33	4.05	2	7000	490	0.06	0.92	7
S	95	41.2	236.20	4.87	5	6700	469	0.14	2.00	7
S	95	41.2	242.78	6.58	2	12033	842	0.02	0.33	7

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S	95	41.2	243.43	0.65	0	13667	957	0.00	0.00	7
S	95	41.2	244.50	1.07	0	16333	1143	0.00	0.00	7
S	95	41.2	246.10	1.60	6	20667	1447	0.17	2.37	7
S	95	41.2	248.48	2.38	2	23333	1633	0.03	0.47	7
S	95	41.2	251.34	2.86	0	9967	698	0.00	0.00	7
U	89	42.1	277.33	9.54	2	1533	92	0.12	2.08	6
U	89	42.1	289.02	11.69	0	1500	90	0.00	0.00	6
U	89	42.2	308.95	19.93	4	1100	66	0.17	2.78	6
U	89	42.2	310.67	1.72	0	5600	336	0.00	0.00	6
U	89	42.2	311.63	0.96	1	13667	820	0.07	1.16	6
U	89	42.2	312.70	1.18	2	16000	960	0.10	1.61	6
U	89	43.1	267.79	9.56	1	1533	92	0.06	1.04	6
U	89	43.2	252.78	0.74	0	5767	807	0.00	0.00	14
U	89	43.2	257.99	5.21	4	5167	723	0.14	0.97	14
U	60	44.1	49.56	18.30	3	1067	448	0.14	0.33	42
U	60	44.2	56.40	6.84	0	1933	812	0.00	0.00	42
U	60	44.2	61.51	5.11	0	1833	770	0.00	0.00	42
U	60	44.2	85.81	24.33	3	1500	630	0.08	0.18	42
I	40	45.0	0.54	0.54	0	5933	1780	0.00	0.00	30
I	40	45.0	2.99	2.45	2	6633	1990	0.11	0.37	30
I	40	45.0	9.79	6.80	5	6667	2000	0.10	0.34	30
S	97	46.0	166.97	11.70	6	360	61	1.30	7.68	17
S	96	47.0	4.02	4.02	0	827	141	0.00	0.00	17
U	89	48.1	420.70	2.11	12	13333	1333	0.39	3.90	10
U	89	48.2	457.11	36.41	33	7800	780	0.11	1.06	10
U	89	48.2	465.21	8.10	7	4300	430	0.18	1.84	10
U	89	48.3	480.80	15.57	11	3633	327	0.18	1.97	9
U	89	48.4	498.02	16.81	2	2500	250	0.04	0.43	10
U	89	48.4	524.03	26.01	11	2400	240	0.16	1.61	10
U	89	48.5	547.18	23.15	4	2200	242	0.07	0.65	11
U	89	48.6	548.55	1.37	0	2133	235	0.00	0.00	11
U	89	48.6	549.84	1.29	1	4667	513	0.15	1.38	11
U	89	48.6	556.99	7.15	8	2600	286	0.39	3.57	11
U	95	49.0	29.85	5.69	21	7667	920	0.44	3.66	12
U	95	49.0	40.50	10.65	9	4167	542	0.19	1.42	13
U	95	49.0	44.10	3.60	1	4067	529	0.06	0.48	13
U	95	49.0	54.90	10.80	0	1133	147	0.00	0.00	13
U	95	49.0	98.57	43.67	3	1033	134	0.06	0.47	13
U	95	49.0	104.51	5.94	0	1867	243	0.00	0.00	13
I	40	50.1	26.17	0.99	0	6100	2257	0.00	0.00	37
I	40	50.1	28.75	2.58	7	5633	2084	0.44	1.19	37
I	40	50.1	37.03	8.28	16	5633	2084	0.31	0.85	37
I	40	50.1	44.31	7.28	10	5600	2072	0.22	0.61	37
I	40	50.2	48.85	4.54	12	6933	1803	0.35	1.34	26
I	40	51.1	148.26	2.01	1	9000	1620	0.05	0.28	18
I	40	51.1	149.15	0.89	2	9200	1656	0.22	1.24	18
I	40	51.1	151.82	2.67	16	9533	1716	0.57	3.19	18

ADOT Truck Accident Rates
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Rte No		Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
I	40	51.1	157.77	5.95	22	10200	3876	0.33	0.87	38
I	40	51.1	161.96	4.19	13	9433	3585	0.30	0.79	38
I	40	51.1	163.54	1.58	8	8267	3141	0.56	1.47	38
I	40	51.1	166.00	2.46	6	8333	3167	0.27	0.70	38
I	40	51.2	167.52	1.68	5	9300	3534	0.29	0.77	38
I	40	51.2	171.65	4.13	10	9967	3787	0.22	0.58	38
I	40	51.2	178.18	6.53	14	9933	3775	0.20	0.52	38
I	40	51.2	185.11	6.93	20	9600	3648	0.27	0.72	38
I	40	51.2	190.54	5.43	27	11000	4180	0.41	1.09	38
I	40	51.2	191.67	1.13	6	11000	4180	0.44	1.16	38
I	40	51.2	195.42	3.75	27	11333	4307	0.58	1.53	38
I	40	51.3	198.33	2.91	25	14667	4987	0.53	1.57	34
I	40	51.3	201.12	2.79	13	17667	6007	0.24	0.71	34
I	40	52.1	79.47	7.39	10	8267	2232	0.15	0.55	27
I	40	52.1	87.58	8.11	23	8000	2160	0.32	1.20	27
I	40	52.1	91.70	4.12	19	8067	2178	0.52	1.93	27
I	40	52.1	96.02	4.32	4	8400	2268	0.10	0.37	27
I	40	52.1	103.58	7.56	16	8400	2268	0.23	0.85	27
I	40	52.1	109.65	6.07	7	8400	2268	0.13	0.46	27
I	40	52.1	121.08	11.43	10	8500	2295	0.09	0.35	27
I	40	52.1	123.32	2.24	5	6767	1827	0.30	1.12	27
I	40	52.2	139.85	16.53	30	8267	2232	0.20	0.74	27
I	40	52.2	144.94	5.09	17	8300	3320	0.37	0.92	40
I	40	52.2	146.25	1.31	1	8300	3320	0.08	0.21	40
S	64	53.0	234.61	21.03	2	2900	261	0.03	0.33	9
S	64	53.0	241.70	7.09	1	4533	408	0.03	0.32	9
U	89	54.1	317.53	4.83	4	5933	1068	0.13	0.71	18
U	89	54.2	320.02	2.49	0	5500	990	0.00	0.00	18
U	89	54.2	327.25	7.23	3	4867	876	0.08	0.43	18
U	89	54.2	329.20	1.95	0	5467	984	0.00	0.00	18
U	89	54.2	363.84	33.42	7	1300	234	0.15	0.82	18
UA	89	55.1	324.90	7.05	0	2233	201	0.00	0.00	9
UA	89	55.1	344.33	19.43	4	1133	102	0.17	1.84	9
UA	89	55.1	346.50	2.17	0	2300	207	0.00	0.00	9
UA	89	55.1	348.40	1.90	0	2300	207	0.00	0.00	9
UA	89	55.2	353.08	4.68	4	4333	347	0.18	2.25	8
UA	89	55.2	355.07	0.51	0	18667	1493	0.00	0.00	8
UA	89	55.2	355.21	0.14	0	8667	693	0.00	0.00	8
UA	89	56.1	362.68	7.47	0	6967	906	0.00	0.00	13
UA	89	56.1	372.21	9.53	4	5333	693	0.07	0.55	13
UA	89	56.1	374.14	1.93	1	11267	1465	0.04	0.32	13
UA	89	56.2	375.67	1.53	2	7300	949	0.16	1.26	13
UA	89	56.2	398.55	22.88	2	4800	624	0.02	0.13	13
UA	89	56.2	401.57	3.02	4	3933	511	0.31	2.37	13
UA	89	56.2	402.24	0.67	1	8767	1052	0.16	1.30	12
UA	89	56.2	403.33	1.09	6	23667	2840	0.21	1.77	12
S	169	57.0	15.12	15.12	0	1400	98	0.00	0.00	7

ADOT Truck Accident Rates
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	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
U	95	58.0	19.88	7.83	1	6600	792	0.02	0.15	12
U	95	58.0	21.86	1.98	5	16667	2000	0.14	1.15	12
U	95	58.0	22.26	0.40	1	17667	2120	0.13	1.08	12
U	95	58.0	23.36	1.10	5	21667	2600	0.19	1.60	12
U	95	58.0	24.16	0.80	10	22000	2640	0.52	4.32	12
U	95	59.0	11.46	6.76	0	5633	676	0.00	0.00	12
U	95	59.0	12.05	0.59	0	6533	784	0.00	0.00	12
S	85	60.0	150.48	30.16	48	7933	2777	0.18	0.52	35
S	86	61.1	134.35	20.29	0	1153	58	0.00	0.00	5
S	86	61.1	150.43	16.08	0	1267	63	0.00	0.00	5
S	86	61.2	159.50	9.07	2	2600	130	0.08	1.55	5
S	86	61.2	163.43	3.59	0	3400	170	0.00	0.00	5
S	86	61.2	166.30	2.87	0	4667	233	0.00	0.00	5
S	86	61.2	169.86	3.56	0	16667	833	0.00	0.00	5
S	86	61.2	170.34	0.48	1	18667	933	0.10	2.04	5
S	86	61.2	171.37	1.03	2	34000	1700	0.05	1.04	5
S	86	61.2	171.86	0.49	0	29000	1450	0.00	0.00	5
S	86	61.2	172.39	0.53	0	28333	1417	0.00	0.00	5
I	19	62.1	1.16	1.16	0	4867	389	0.00	0.00	8
I	19	62.1	2.95	1.79	1	6267	501	0.08	1.02	8
I	19	62.1	5.30	2.35	1	4633	371	0.08	1.05	8
I	19	62.1	7.71	2.41	3	9900	792	0.11	1.44	8
I	19	62.1	10.88	3.17	2	9367	749	0.06	0.77	8
I	19	62.1	13.96	3.08	0	7100	568	0.00	0.00	8
I	19	62.1	15.63	1.67	0	6833	547	0.00	0.00	8
I	19	62.1	18.13	2.57	3	6633	531	0.16	2.01	8
I	19	62.1	21.62	3.49	0	6233	499	0.00	0.00	8
I	19	62.1	24.82	3.20	3	6233	499	0.14	1.72	8
I	19	62.1	26.54	1.72	0	7200	576	0.00	0.00	8
I	19	62.1	29.98	3.44	0	6967	557	0.00	0.00	8
I	19	62.1	34.87	4.89	0	7533	603	0.00	0.00	8
I	19	62.1	39.44	4.57	1	8800	704	0.02	0.28	8
I	19	62.1	40.74	1.30	0	11167	893	0.00	0.00	8
I	19	62.1	43.24	2.50	1	12000	960	0.03	0.38	8
U	89	62.2	46.11	2.23	0	4200	294	0.00	0.00	7
U	89	62.2	48.15	2.04	0	4700	329	0.00	0.00	7
U	89	62.2	51.13	2.98	0	4700	329	0.00	0.00	7
U	89	62.2	56.45	5.32	4	4700	329	0.15	2.09	7
U	89	62.2	58.42	1.97	3	7133	499	0.19	2.79	7
U	89	62.2	60.41	1.99	2	16667	1167	0.06	0.79	7
U	89	62.2	62.50	2.09	3	18333	1283	0.07	1.02	7
U	89	62.2	63.50	1.00	0	20000	1400	0.00	0.00	7
U	89	62.2	64.12	0.62	5	24000	1680	0.31	4.38	7
S	90	63.0	311.93	3.53	1	7733	541	0.03	0.48	7
S	90	63.0	313.60	1.89	1	8700	609	0.06	0.79	7
S	90	63.0	317.18	3.69	1	10567	740	0.02	0.33	7
S	90	63.0	319.00	1.82	4	13333	933	0.15	2.15	7

ADOT Truck Accident Rates
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	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
S	90	63.0	321.50	2.50	0	8833	618	0.00	0.00	7
U	80	64.1	294.66	1.39	0	4067	285	0.00	0.00	7
U	80	64.1	298.34	3.68	0	4200	294	0.00	0.00	7
U	80	64.1	299.78	1.39	0	4033	282	0.00	0.00	7
U	80	64.1	300.70	0.92	0	4067	285	0.00	0.00	7
U	80	64.1	301.70	1.00	2	2267	159	0.81	11.49	7
U	80	64.1	313.88	12.18	1	2133	149	0.04	0.50	7
U	80	64.2	316.54	2.66	0	2400	168	0.00	0.00	7
U	80	64.2	318.02	1.15	1	4100	287	0.19	2.77	7
U	80	64.2	332.85	14.83	0	1433	100	0.00	0.00	7
U	80	64.3	339.81	6.96	3	3567	250	0.11	1.57	7
U	80	64.3	341.49	1.68	1	2933	205	0.19	2.65	7
U	80	64.3	343.72	1.58	2	8833	618	0.13	1.87	7
U	80	64.4	344.25	0.53	0	3567	642	0.00	0.00	18
U	80	64.4	348.03	3.85	1	3533	636	0.07	0.37	18
U	80	64.4	356.50	8.47	2	3233	582	0.07	0.37	18
U	80	64.4	364.66	8.16	1	3333	600	0.03	0.19	18
U	80	64.4	365.64	0.98	0	7900	1422	0.00	0.00	18
U	80	64.4	366.50	0.86	3	11133	2004	0.29	1.59	18
U	666	65.1	24.66	17.27	2	1080	194	0.10	0.55	18
U	666	65.1	38.12	13.46	3	1200	216	0.17	0.94	18
U	666	65.1	45.69	7.57	1	1133	170	0.11	0.71	15
U	666	65.2	53.50	7.81	0	1400	210	0.00	0.00	15
U	666	65.2	66.84	13.34	0	1733	260	0.00	0.00	15
S	260	66.0	252.85	0.91	1	10500	1050	0.10	0.96	10
S	260	66.0	255.90	3.05	4	7500	750	0.16	1.60	10
S	260	66.0	268.47	12.57	10	3667	367	0.20	1.98	10
S	260	66.0	281.97	13.50	7	3000	300	0.16	1.58	10
S	260	66.0	305.67	23.70	7	2700	270	0.10	1.00	10
S	377	67.0	33.83	33.83	4	653	59	0.17	1.83	9
S	77	68.1	349.65	6.38	4	4467	715	0.13	0.80	16
S	77	68.1	357.25	7.80	6	4100	656	0.17	1.07	16
S	77	68.1	357.87	0.62	0	5700	912	0.00	0.00	16
S	77	68.1	359.55	1.68	2	8000	1280	0.14	0.85	16
S	77	68.1	361.07	1.52	1	9833	1573	0.06	0.38	16
S	77	68.2	364.51	3.44	0	2600	416	0.00	0.00	16
S	77	68.2	386.21	21.70	6	2200	352	0.11	0.72	16
S	77	68.3	387.80	1.59	1	4200	672	0.14	0.85	16
S	77	68.3	388.67	0.87	0	8167	1307	0.00	0.00	16
U	60	69.1	255.94	3.86	0	3267	523	0.00	0.00	16
U	60	69.1	293.09	34.23	32	2567	411	0.33	2.08	16
U	60	69.1	318.15	24.35	18	2700	432	0.25	1.56	16
U	60	69.2	338.68	20.53	9	2433	389	0.16	1.03	16
U	60	69.2	339.71	1.03	0	3133	501	0.00	0.00	16
U	60	69.3	340.83	1.12	2	11000	1760	0.15	0.93	16
U	60	69.3	341.64	0.81	3	19333	3093	0.17	1.09	16
U	60	69.3	342.42	0.78	2	10667	1707	0.22	1.37	16

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Rte	No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
S	61	70.1	381.86	9.57	0	1567	251	0.00	0.00	16
U	180	70.2	366.45	2.49	0	2200	352	0.00	0.00	16
U	180	70.2	368.27	1.82	0	3000	480	0.00	0.00	16
U	180	70.2	368.93	0.66	1	5967	955	0.23	1.45	16
U	666	71.1	344.62	24.04	5	590	94	0.32	2.02	16
U	666	71.2	368.47	23.85	5	540	86	0.35	2.23	16
S	77	72.1	115.33	1.71	1	4533	680	0.12	0.79	15
S	77	72.1	134.81	19.48	11	2467	370	0.21	1.39	15
S	77	72.2	170.93	32.79	21	1433	258	0.41	2.27	18
U	89	73.1	65.76	1.64	5	18000	1620	0.15	1.72	9
U	89	73.1	66.47	0.71	0	16667	1500	0.00	0.00	9
U	89	73.1	67.72	1.25	13	20000	1800	0.47	5.28	9
U	89	73.1	68.10	0.56	2	16667	1500	0.20	2.17	9
U	89	73.1	69.55	1.45	6	31333	2820	0.12	1.34	9
U	89	73.2	70.79	1.24	5	34000	3060	0.11	1.20	9
U	89	73.2	72.09	1.30	2	32000	2880	0.04	0.49	9
U	89	73.2	74.84	2.75	4	36333	3270	0.04	0.41	9
U	89	73.2	77.40	2.56	9	26000	2340	0.12	1.37	9
U	89	73.2	79.00	1.60	0	20667	1860	0.00	0.00	9
U	89	73.2	88.05	9.05	4	16667	1500	0.02	0.27	9
U	89	73.2	91.14	2.95	0	6433	579	0.00	0.00	9
S	177	74.0	137.50	1.19	0	4900	490	0.00	0.00	10
S	177	74.0	139.59	2.09	0	2400	240	0.00	0.00	10
S	177	74.0	145.80	6.21	0	2300	230	0.00	0.00	10
S	177	74.0	152.18	6.38	1	2233	223	0.06	0.64	10
S	177	74.0	167.10	14.92	7	1033	103	0.41	4.16	10
S	177	74.0	167.61	0.51	0	3067	307	0.00	0.00	10
U	666	75.1	90.13	2.65	0	1333	213	0.00	0.00	16
U	666	75.1	104.37	14.24	4	1433	229	0.18	1.12	16
U	666	75.2	113.69	9.32	1	1600	256	0.06	0.38	16
U	666	75.2	118.90	5.21	2	3133	501	0.11	0.70	16
U	666	75.2	120.07	1.17	0	6100	976	0.00	0.00	16
U	666	75.2	121.02	0.95	0	6533	1045	0.00	0.00	16
U	666	76.0	162.95	8.43	1	2433	389	0.04	0.28	16
U	666	76.0	163.95	1.00	0	3567	571	0.00	0.00	16
UX	666	76.0	164.90	0.95	0	7033	1125	0.00	0.00	16
UX	666	76.0	167.35	2.45	1	4867	779	0.08	0.48	16
UX	666	76.0	169.07	1.72	1	4333	693	0.12	0.77	16
UX	666	76.0	170.90	1.83	0	1103	176	0.00	0.00	16
UX	666	76.0	179.57	8.67	0	217	35	0.00	0.00	16
U	666	76.0	207.44	33.35	2	150	24	0.37	2.28	16
U	666	77.1	253.74	46.30	0	133	21	0.00	0.00	16
U	70	78.1	252.85	0.71	1	7867	629	0.16	2.04	8
U	70	78.1	254.11	1.26	3	4433	355	0.49	6.13	8
U	60	78.1	387.84	3.39	1	3567	642	0.08	0.42	18
U	70	78.2	258.86	4.75	4	3233	323	0.24	2.38	10
U	70	78.2	271.06	12.14	3	1800	180	0.13	1.25	10

ADOT Truck Accident Rates
Years 1985 through 1987

	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
U	70	78.2	272.55	1.49	1	3767	377	0.16	1.63	10
U	70	78.2	293.38	20.83	0	2167	217	0.00	0.00	10
U	70	78.2	301.54	8.16	1	2433	243	0.05	0.46	10
U	70	78.2	313.45	11.91	0	2500	250	0.00	0.00	10
U	70	78.2	330.20	5.65	1	2833	283	0.06	0.57	10
U	70	78.2	330.70	0.50	0	3467	347	0.00	0.00	10
U	70	78.2	332.00	1.30	0	4933	493	0.00	0.00	10
U	70	78.2	335.52	3.52	0	5367	537	0.00	0.00	10
U	70	78.2	336.60	1.08	0	9267	927	0.00	0.00	10
U	70	78.2	337.78	1.18	0	10100	1010	0.00	0.00	10
U	70	78.2	338.97	1.19	0	12000	1200	0.00	0.00	10
U	70	78.2	339.46	0.49	0	10967	1097	0.00	0.00	10
U	180	78.2	369.41	0.48	0	2367	379	0.00	0.00	16
U	180	78.2	380.28	10.87	0	1700	272	0.00	0.00	16
U	180	78.2	394.36	14.08	3	2500	400	0.08	0.49	16
U	666	78.3	320.58	5.03	0	2000	320	0.00	0.00	16
S	266	81.0	123.78	19.18	0	203	32	0.00	0.00	16
U	60	84.0	105.64	19.83	2	1367	574	0.07	0.16	42
U	60	84.0	107.79	2.15	0	2100	882	0.00	0.00	42
U	60	84.0	108.39	0.60	1	6300	2646	0.24	0.58	42
U	60	84.0	110.33	1.84	1	9533	4004	0.05	0.12	42
U	60	85.0	110.76	0.43	1	14333	1290	0.15	1.65	9
U	60	85.0	111.30	0.54	0	12333	1110	0.00	0.00	9
U	60	85.0	120.11	8.81	4	7667	690	0.05	0.60	9
U	60	86.0	142.78	22.67	14	7467	672	0.08	0.84	9
U	60	86.0	143.40	0.62	5	7033	633	1.05	11.63	9
U	60	87.0	144.30	0.90	1	9533	858	0.11	1.18	9
U	60	87.0	145.79	1.49	0	14667	1320	0.00	0.00	9
U	60	87.0	147.12	1.33	2	16667	1500	0.08	0.92	9
U	60	87.0	149.25	2.13	4	24667	2220	0.07	0.77	9
U	60	88.0	150.56	1.31	8	23667	2130	0.24	2.62	9
U	60	88.0	151.95	1.39	8	27333	2460	0.19	2.14	9
U	60	88.0	153.35	1.40	3	20667	1860	0.09	1.05	9
U	60	88.0	154.75	1.40	9	20667	1860	0.28	3.16	9
U	60	88.0	157.60	2.85	15	28333	2550	0.17	1.88	9
U	60	88.0	160.72	3.12	40	29333	2640	0.40	4.43	9
U	60	88.0	161.83	1.11	10	26333	2107	0.31	3.90	8
U	60	88.0	163.23	1.39	4	19333	1547	0.14	1.70	8
U	60	89.0	164.23	1.00	6	25667	2053	0.21	2.67	8
U	60	89.0	166.23	2.00	13	23000	1840	0.26	3.23	8
U	60	89.0	168.25	2.02	8	27667	2213	0.13	1.63	8
U	60	90.0	171.22	2.97	7	26000	2080	0.08	1.03	8
U	60	90.0	173.31	2.09	9	39667	3173	0.10	1.24	8
U	60	90.0	175.09	1.78	7	26333	1053	0.14	3.41	4
U	60	90.0	176.03	0.94	1	22000	880	0.04	1.10	4
U	60	90.0	177.05	1.02	3	20667	827	0.13	3.25	4
U	60	90.0	179.03	1.98	5	22333	893	0.10	2.58	4

ADOT Truck Accident Rates
Years 1985 through 1987

	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
U	60	91.0	179.52	0.49	2	22333	893	0.17	4.17	4
U	60	91.0	180.01	0.49	2	22333	893	0.17	4.17	4
U	60	91.0	188.00	7.99	27	22000	1540	0.14	2.00	7
U	60	91.0	195.82	7.82	25	24333	1703	0.12	1.71	7
S	87	94.0	175.61	1.38	12	32667	653	0.24	12.16	2
S	87	94.0	176.74	1.13	10	23333	467	0.35	17.31	2
S	87	94.0	177.79	1.05	4	36667	733	0.09	4.75	2
S	87	94.0	179.66	1.81	5	9833	197	0.26	12.81	2
S	87	94.0	188.83	9.38	3	8967	179	0.03	1.63	2
I	17	100.1	200.80	1.06	25	122000	10980	0.18	1.96	9
I	17	100.1	201.67	0.79	26	122000	10980	0.25	2.74	9
I	17	100.2	201.93	0.26	23	122000	12200	0.66	6.62	10
I	17	100.2	202.90	0.97	19	122000	12200	0.15	1.47	10
I	17	100.2	203.90	1.00	19	125000	12500	0.14	1.39	10
I	17	100.2	204.91	1.01	17	125000	12500	0.12	1.23	10
I	17	100.2	205.91	1.00	13	125000	12500	0.09	0.95	10
I	17	100.2	206.90	0.99	14	125000	12500	0.10	1.03	10
I	17	100.2	207.96	1.06	14	122000	12200	0.10	0.99	10
I	17	100.2	208.93	0.97	14	117000	11700	0.11	1.13	10
I	17	100.2	209.94	1.01	9	112000	11200	0.07	0.73	10
I	17	100.2	210.94	1.00	24	107000	10700	0.20	2.05	10
I	17	100.2	211.93	0.99	11	99000	9900	0.10	1.02	10
I	17	100.2	212.94	1.01	12	85000	8500	0.13	1.28	10
I	17	100.2	213.96	1.02	5	57667	5767	0.08	0.78	10
I	17	100.2	215.96	2.00	4	36333	3633	0.05	0.50	10
I	17	100.2	217.10	1.14	1	27667	2767	0.03	0.29	10
S	77	110.0	100.26	9.12	4	5100	765	0.08	0.52	15
S	77	110.0	103.32	3.06	1	4000	600	0.07	0.50	15
S	77	110.0	109.15	4.97	1	5133	770	0.04	0.24	15
S	77	110.0	113.62	4.47	1	3767	565	0.05	0.36	15
U	70	112.0	340.06	0.60	0	6367	637	0.00	0.00	10
U	70	112.0	341.85	1.79	1	5100	510	0.10	1.00	10
U	70	112.0	344.35	2.50	0	4167	417	0.00	0.00	10
U	70	112.0	349.49	5.14	0	2633	263	0.00	0.00	10
U	666	113.0	154.52	23.88	2	1567	251	0.05	0.30	16
S	277	117.0	312.53	6.86	1	1767	159	0.08	0.84	9
U	93	122.0	123.66	32.46	9	3767	339	0.07	0.75	9
S	64	123.0	213.58	27.84	2	2433	365	0.03	0.18	15
I	40	131.0	341.81	2.29	5	10333	3410	0.19	0.58	33
I	40	131.0	343.83	2.02	3	10233	3377	0.13	0.40	33
I	40	131.0	346.55	2.72	6	10200	3366	0.20	0.60	33
I	40	131.0	348.16	1.61	4	10300	3399	0.22	0.67	33
I	40	131.0	351.35	3.19	5	10567	3487	0.14	0.41	33
I	40	131.0	354.61	3.26	5	10233	3377	0.14	0.41	33
I	40	131.0	357.53	2.92	4	9967	3289	0.13	0.38	33
I	40	131.0	359.18	1.65	3	10300	3399	0.16	0.49	33
I	40	131.0	359.63	0.45	0	9433	3113	0.00	0.00	33

ADOT Truck Accident Rates
Years 1985 through 1987

	Rte No	Road Link Number	End Mile Post	Length in Miles	Total Truck Accidents (85-87)	Average Vehicle Daily Traffic	Average Truck Daily Traffic	Vehicle Accident Rate per MVM	Truck Accident Rate per MVM Trucks	Percent Commercial Vehicles
I	15	132.0	8.61	8.61	6	7267	1889	0.09	0.34	26
I	15	132.0	18.33	9.72	14	7267	1889	0.18	0.70	26
I	15	132.0	27.47	9.14	7	7167	1863	0.10	0.38	26
I	15	132.0	29.40	1.93	0	7200	1872	0.00	0.00	26
S	90	134.0	306.80	17.21	1	4733	331	0.01	0.16	7
S	90	134.0	308.40	1.60	4	5033	352	0.45	6.49	7
U	666	136.0	7.39	7.39	4	1467	264	0.34	1.87	18
SS	85	138.0	154.52	4.04	4	6133	2269	0.15	0.40	37
*** Total ***				3394.1	4149					

APPENDIX D

RISK ASSESSMENT COMPUTER MODEL DOCUMENTATION

The Arizona Hazardous Materials Risk Assessment Model (AZHAZ) is comprised of three modules, GIMS1, GIMS2, and GETPLOT. Each module has a series of menus. Specific options may be chosen from individual menus.

Individual menus for each of the modules are presented in the remainder of this Appendix. Primary menus are designated with a letter, i.e., I, W, etc. Submenus have alpha-numeric designations, i.e, I1, I2, etc.

AZHAZ MENU

W E L C O M E T O A Z H A Z

This system consists of three major modules:

GIMS1 for plotting shipment volumes (enter AZPLOT after header appears)

GIMS2 for modeling hazard, risk and vlnerability (enter AZMODEL after header appears)

GETPLOT for displaying, printing and plotting

enter one of the above at the prompt to execute

AZPLOT MENU

W E L C O M E   T O   A Z P L O T

The following operations are available and are generally executed in the order presented

I - INTRODUCTION

W - WINDOW GEOGRAPHIC AREA

P - PLOT INFORMATION

N - NETWORK ANALYSIS

<enter> END SESSION Enter menu selection

I MENU

INTRODUCTION

The following general information is available:

I0 - LICENSE AGREEMENT

I1 - PROJECT DESCRIPTION

I2 - GEOGRAPHIC SYSTEM

I3 - DATA FILE NAME CONVENTION

I4 - USER FILE NAME CONVENTION

<enter> END INTRODUCTION Enter a selection

IO MENU

LICENSE AGREEMENT

Dames & Moore is the owner of the trademark GIMS and the associtated software modules provided to ADOT under Engineering Consultants Services Contract #88-07. As contract modification #7 to Section IVB, ADOT is granted a non-exclusive license to use the software, but no ownership is transferred to ADOT.

To return to the introduction menu, press <ENTER>

I1 MENU

PROJECT DESCRIPTION

The AZHAZ is a highway transport model which assesses the hazard, risk, and vulnerability of hazardous materials shipments in Arizona. The materials and associated traffic tables were obtained by surveys; the accident rates for commercial vehicles are derived from the State historic records. The models presented implement assessments outlined in the U.S. Department of Transportation, Federal Highway Administration document FHWA-IP-80-15.

The model is implemented on Dames & Moore's GIMS, the Geographic Information Management System.

To return to the introduction menu, press <ENTER>

I2 MENU

GEOGRAPHIC SYSTEM

The geographic system to support the analysis divides the state of Arizona into square miles. Each square mile is then analyzed for the relative hazard, risk and vulnerability from selected hazardous materials.

Included in the geographic data are:

Federal aided highway network segments
Population density
Fire station response locations

Included in the tabular data are:

Tables of hazardous shipments
Table of accident rates

Menus and command files implement the models which draw on the above data.

To return to the introduction menu, press <ENTER>

I3 MENU

DATA FILE NAME CONVENTION

The basic data files fall into four classes:

TABULAR:	ASCII text tables of link shipment rates (class)(type).TX
class:	shipment designation
type:	M material or W waste
DIGITIZED:	ASCII coordinate files for GIMS1 (entity).G1
entity:	point, link or boundry data
SAMPLED:	BINARY square mile grid samples (entity).G2
entity:	point, link or boundry data
COMMAND:	ASCII text files of GIMS1 or GIMS2 commands (operation).C1 GIMS1 or .C2 GIMS2

To return to the introduction menu, press <ENTER>

I4 MENU

USER FILE NAME CONVENTION

The user data files fall into two classes:

MODEL:	BINARY square mile grid samples from models pathway)(measure).G2
pathway:	model designation (ex BLAS = blast)
measure:	assessment level (ex R = risk)
DISPLAY:	ASCII neutral plot file for GETPLOT processing PLTDAT. The default temporary neutral file OR (window)(class)(palette).NP The user renamed file
window:	Wn window number used (ex W1 = state)
class:	type or theme of data (ex ROAD = road)
pallette:	C color or B black/white

To return to the introduction menu, press <ENTER>

W MENU

WINDOW GEOGRAPHIC AREA

The following windows are available:

W1 - STATEWIDE

W2 - PHOENIX - TUSCON

W3 - PHOENIX

W4 - USER SPECIFIED

<enter> END WINDOW Enter a selection

P MENU

PLOT INFORMATION

The following plot runs are available:

PTARQ.C1 accident quartiles

PTARH.C1 accident high level

PCORW.C1 corrosive waste

PCORM.C1 corrosive material

PCOMW.C1 combustable waste

PEXPM.C1 explosive material

PFDPT.C1 fire departments

PFLMW.C1 flamable waste

PGASM.C1 gasoline PLINK.C1 network links

PNFLM.C1 non-flamable

POXIM.C1 oxidizer material

POXIW.C1 oxidizer waste

POREW.C1 o r e waste

PORCW.C1 o r e c waste

PORBW.C1 o r e b waste

PORAW.C1 o r e a waste

PPOIM.C1 poison material

PPOIW.C1 poison waste

PROAD.C1 road

<enter> END PLOT MENU Enter a selection

A neutral plotfile has been created called PLTDAT. it may be displayed with the GETPLOT process.

Press <ENTER> to return to the AZPLOT menu

N MENU

NETWORK ANALYSIS

The following network operations allow specification of an origin and destination node. The network can be analyzed by actual distance, or by realtive (percent) distance.

N1 - Orig/Dest network distance in miles

N2 - Orig/Dest relative network percent

<enter> END NETWORK Enter a selection

AZMODEL MENU

W E L C O M E   T O   A Z M O D E L

The following operations are available and are generally executed in the order presented

I - INTRODUCTION

R - REVIEW DATA RESOURCES

W - WINDOW GEOGRAPHIC AREA

M - MODEL ANALYSIS

D - DISPLAY RESULTS

<enter> END SESSION Enter menu selection

I MENU

INTRODUCTION

The following general information is available:

I0 - LICENSE AGREEMENT

I1 - PROJECT DESCRIPTION

I2 - GEOGRAPHIC SYSTEM

I3 - DATA FILE NAME CONVENTION

I4 - USER FILE NAME CONVENTION

<enter> END INTRODUCTION Enter a selection

R MENU

REVIEW DATA RESOURCES

The following are available:

R1 - DATA TABLE DIRECTORY

R2 - DIGITIZED MAP DIRECTORY

R3 - SAMPLED MAP DIRECTORY

<enter> END REVIEW Enter a selection

R1 MENU

GASM TX 7355 01-03-90 9:32a

COMW TX 11708 01-04-90 3:48p

CORM TX 4429 01-03-90 9:11a

EXPM TX 4459 01-25-90 11:01a

FLMW TX 11707 01-05-90 10:07a

NFLM TX 6894 09-13-89 8:30a

ORAW TX 11707 01-04-90 3:57p

ORBW TX 11714 01-04-90 9:57a

ORCW TX 11708 01-04-90 3:58p

OREW TX 11707 01-05-90 10:21a

OXIM TX 4429 01-03-90 9:12a

OXIW TX 11707 01-04-90 4:05p

POIM TX 4429 01-03-90 9:34a

POIW TX 11707 01-04-90 4:08p

TAR TX 18152 03-29-92 5:44p

CORW TX 11580 03-27-92 12:20p

16 file(s) 155392 bytes

R2 MENU

DIGITIZED DATA DIRECTORY

The following digitized maps are available.

ROAD.G1 Federal Aided Highways

CNTY.G1 Arizona County Boundries

FDPT.G1 Fire Department

Locations digitized directory complete press <Enter> for REVIEW menu

R3 MENU

SAMPLED MAP DIRECTORY

The following square mile sample maps are available through GIMS2.

ROAD.G2 Federal Aided Highway
ERT.G2 Emergency Response Time
POP03.G2 Persons within 0.3 miles
POP05.G2 Persons within 0.5 miles
POP07.G2 Persons within 0.7 miles
POP20.G2 Persons within 2.0 miles

additionally the following pathway maps can be produced

BLA[H/R/V].G2 Blast where
COM[H/R/V].G2 Combustion H: Hazard
CON[H/R/V].G2 Contact R: Risk
INH[H/R/V].G2 Inhalation V: Vulnerability
TOX[H/R/V].G2 Toxic

sample map directory complete, press <enter> for REVIEW menu.

W MENU

WINDOW GEOGRAPHIC AREA

The following windows are available:

W1 - STATEWIDE

W2 - PHOENIX - TUSCON

W3 - PHOENIX

W4 - USER SPECIFIED

<enter> END WINDOW Enter a selection

M MENU

MODEL ANALYSIS

The following models are available:

M1 - BLAST M2 - COMBUST

M3 - CONTACT

M4 - INHALE M5 - TOXIC

<enter> END MODELS Enter a selection

D MENU

DISPLAY RESULTS

The following displays are available:

D1 - SCREEN QUICK CHARACTER MAP

D2 - SCREEN QUICK SHADING MAP

D3 - PLOT DATA LINEAR RANGE 5 COLORS

D4 - PLOT POPULATION FIXED RANGE COLOR

D5 - PLOT POPULATION FIXED RANGE B/W

D6 - PLOT TIME FIXED RANGE COLOR

D7 - PLOT TIME FIXED RANGE B/W

D8 - PLOT DATA LOG RANGE 5 COLORS

<enter> END DISPLAY MENU Enter a selection

GETPLOT

1 Toshiba 3-in-one double

2 Toshiba 3-in-one quad

3 HP LaserJet 75 dpi

4 HP LaserJet 150 dpi

5 HP LaserJet 300 dpi

6 EGA 16 Color Graphics

7 VGA 16 Color Graphics

8 VGA 256 Color Graphics

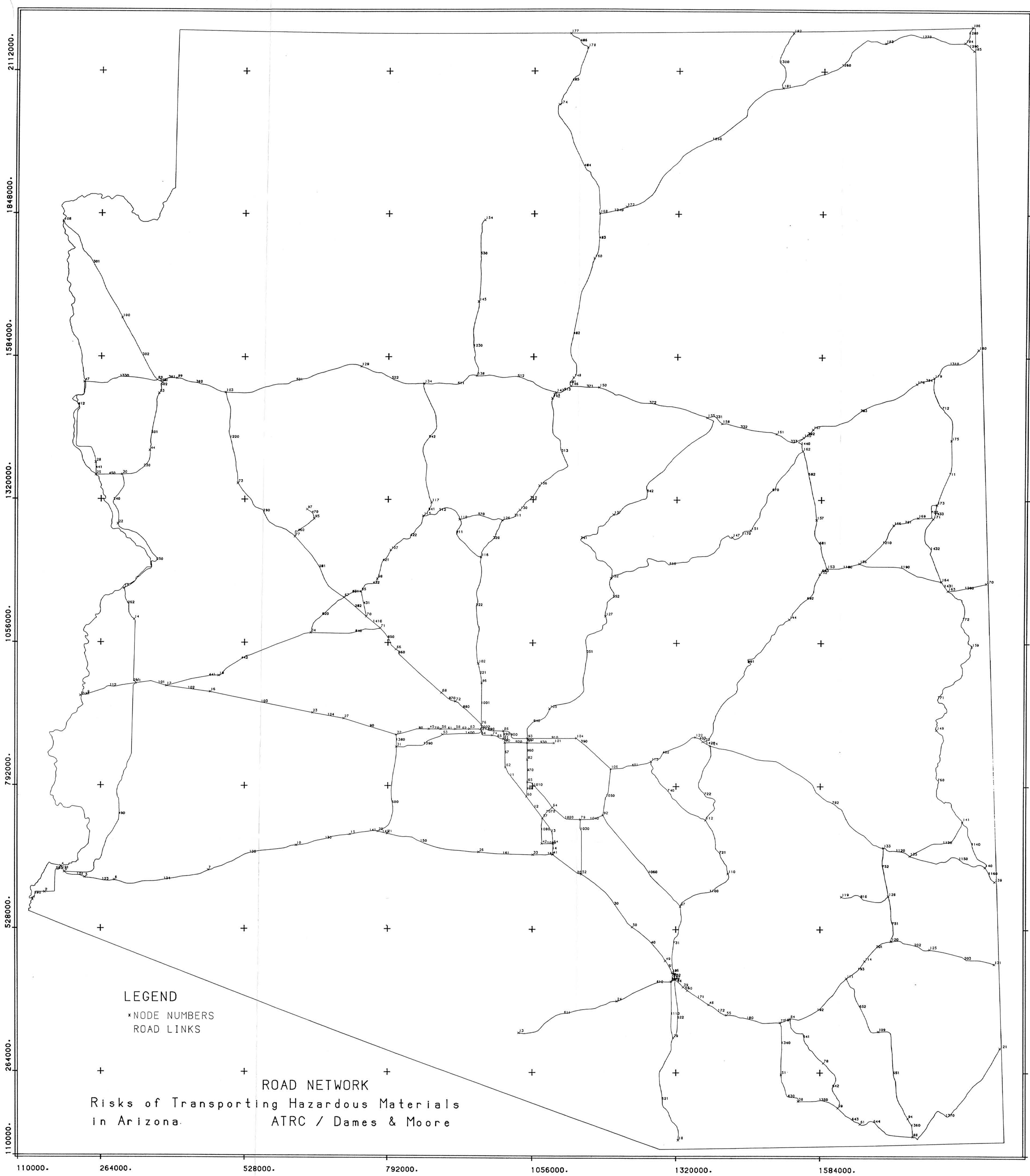
9 AutoCAD DXF file

10 HIDDEN COMMAND

10 Enter Dos Command

EXIT APPEARS AS 0 0 Exit Plot Utility

SELECT DEVICE


LEGEND
x NODE NUMBERS
ROAD LINKS
ROAD NETWORK
Risks of Transporting Hazardous Materials
in Arizona
ATRC / Dames & Moore
2112000.
1848000.
1584000.
1320000.
1056000.
792000.
528000.
264000.
110000.
110000.
264000.
528000.
792000.
1056000.
1320000.
1584000.