PRELIMINARY STANDARDS, CLASSIFICATION, AND DESIGNATION OF LINES OF CLASS I RAILROADS IN THE UNITED STATES

A REPORT
BY
THE SECRETARY OF TRANSPORTATION

VOLUME I

Submitted in Accordance with Section 503 of the Railroad Revitalization and Regulatory Reform Act of 1976 (P.L. 94-210)

U.S. DEPARTMENT OF TRANSPORTATION

AUGUST 3, 1976

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Executive Summary

This report commences a series of studies mandated by Congress under various sections of the Railroad Revitalization and Regulatory Reform Act of 1976 to determine the best means to rehabilitate and revitalize the nation's railroads. It is produced in accordance with section 503(b) of the Act and is intended both to provide a means for classifying the lines of the Class I railroads of the United States into categories and to designate the individual rail lines into those categories. This classification and designation process is intended to serve a number of purposes under the Act, but its prime purpose is to categorize the rail lines of the nation according to reasonable measures of priority so that investments in track can be directed where they will do the most good.

Volume I of this report establishes a preliminary set of categories and designations of Class I rail lines which will then be subjected to public review and comment prior to the establishment of final categories and designations by January 30, 1977. In establishing these preliminary categories the Department has used four appropriate standards: (1) density, (2) service to major markets, (3) appropriate levels of capacity, and (4) national defense. These standards were then applied to classify the rail system into six distinct categories encompassing both mainlines and branchlines. All rail lines were then designated into these categories. Thus, a prioritizing of rail lines is initiated which will serve as a guideline for future investment in track and, in a general sense, begin to depict those portions of the rail system most important to the flow of interstate commerce. This process should assist railroad management with future decisions regarding investment, operations, and facilities rationalization, lead to safer operations and provide both federal and state regulatory and planning agencies with a useful tool to better accomplish their missions.

The need to develop a hierarchy among rail lines becomes increasingly important when viewed in the context that one-third of the network carries only one percent of total traffic and one-fifth of the same system carries nearly two-thirds of the traffic. By careful rehabilitation of the most important links, scarce capital resources will be prudently invested.

The report develops the following six preliminary categories shown below and then describes an orderly designation process for each line comprising the approximately 193,500-mile Class I rail system.

Category Title	*Category Description*	*Percent of Designated Route-Miles of Class I Rail Network*
1. A Mainline	• 20 million or more gross ton-miles per mile per year ("gross tons")	15.5
	• Three or more daily passenger operations in each direction	0.8
	• Major Transportation Zone connectivity	0.8
2. Potential A Mainline	• A temporary status for through lines located in Corridors of Excess Capacity. They will be designated to another category upon resolution of the redundancy.	11.6
3. B Mainline	• Less than 20 million gross tons but at least 5 million	21.7
4. A Branchline	• Less than 5 million gross tons but at least 1 million	21.9
5. B Branchline	• Less than 1 million gross tons	25.6
6. Defense-Essential Branchline	• Required for access of oversized military shipments	2.1

A national map of the rail lines designated by category is contained, along with maps of individual line designations by state, in Volume II of the Report. Technical appendices are contained in Volume I.

These preliminary classifications and designations are subject to public hearings and review which will be conducted by the Rail Services Planning Office of the Interstate Commerce Commission commencing within 30 days after publication of this Report. The Department will issue its final classification and designation report on or before January 30, 1977, after considering all comments of this Report.

CHAPTER 1
Introduction

One year ago, railroad companies comprising more than 15 percent of the route miles of the Class I rail system in the United States were in bankruptcy, and, for the first time since industry-wide data have been collected, the entire rail industry experienced a net operating loss in the first quarter of 1975. For calendar year 1975, the industry's return on investment was a meager 1.2 percent.

Since the mid-1950s earnings of the rail industry have been less than adequate. This earnings shortfall has undermined the industry's ability to replace worn out assets and advance technologically and has resulted in lowered standards of efficiency and service to the public. At the same time, the railroads remain the number one mode in terms of freight ton miles (see Table 1), although this amount is one-half of the market share enjoyed by the railroads in 1930.

Table 1.—Volume of U.S. Intercity Freight—1975

	Ton Miles	*Percent of Freight Moved*
Railroads	761 billion	37.0
Trucks (common carriers)	441 billion	21.4
Great Lakes	108 billion	5.2
Inland Waterways	235 billion	11.4
Oil Pipelines	510 billion	24.8
Air	4 billion	.2
TOTAL		100.0

SOURCE: Association of American Railroads.

Allowing the railroads to continue to deteriorate financially and physically would result in more serious safety and service problems, with some railroads being unable to continue operations. The Railroad Revitalization and Regulatory Reform Act of 1976 ("the Act") was enacted to avert such problems by revitalizing the industry within a private sector framework.

Title V of the Railroad Revitalization and Regulatory Reform Act of 1976

A key mechanism for railroad revitalization is the rehabilitation and improvement financing provision in Title V of the Act. Congress authorized $600 million in redeemable preference share financing, which cannot be used for facilities rehabilitation and improvement until the final classification and designation of rail lines under Section 503 of the Act. Section 503(a) requires each Class I railroad (other than railroads subject to reorganization under the Regional Rail Reorganization Act of 1973) to submit within 90 days of enactment an analysis of its rail system to the Secretary of Transportation ("Secretary"). The Act then requires in Section 503(b):

"Preliminary Standards and Designations. Within 180 days after the date of enactment of this Act, the Secretary shall develop and publish—

(1) the preliminary standards for classification, in at least 3 categories, of main and branch rail lines according to the degree to which they are essential to the rail transportation system; and

(2) the preliminary designations with respect to each main and branch rail line, in accordance with such standards for classification.

The classification of rail lines for purposes of this subsection shall be based on the level of usage measured in gross-ton-miles, the contribution to the economic viability of the railroad which controls such lines, and the contribution of such lines to the probable economic viability of any other railroads which participate in the traffic originating on such lines. In determining level of usage and probable economic viability, for purposes of such classification, the Secretary shall take into account operational service and other appropriate factors, and he may make reasonable allowance for differences in operation among individual railroads or groups of railroads."

Thirty days after publication of the preliminary report the Rail Services Planning Office ("RSPO") of the Interstate Commerce Commission shall conduct public hearings on the report and within 120 days submit to the Secretary a report containing its conclusions and recommendations. Within 60 days of receipt of the RSPO report the Secretary shall publish final standards and designations. One purpose of the Section 503 report is to create some logical basis for future private or public investments in track that would produce maximum benefits for both the public and the railroads.

Key Problem: Deterioration of Fixed Plant

One of the key problems that Title V addresses is a dilemma faced by all but the most financially healthy roads—deterioration of fixed plant. A deficient track structure plays havoc with road and switching operations and undermines both the quality and cost of service.

Many elements—including equipment utilization, labor agreements and operating practices—contribute to determining rail efficiency, service quality, and profitability. Among such factors, the costs and utility of the track structure are of vital, although not necessarily of dominant, importance.[1] But the quality and utilization of the track

[1] Maintenance-of-way expense represents about 20 percent of operating costs.

structure have a pervasive impact on all other service and cost elements. Good track is essential to the operation of safe, high-quality, and efficient railroad service. Many railroads have been unable to maintain their track adequately, and therefore have suffered declining levels of efficiency and loss of traffic with major—often devastating—effects on profitability.

Of the major, multi-commodity transportation modes, only railroads own essentially all the fixed facilities needed to conduct their transportation business. In fact, railroads are usually known as much for their specific facilities and routes as they are for the trains that the particular carrier operates. The full ownership of the plant causes the cost of operation of that plant to be highly fixed relative to their competitors who pay either a user charge that is not necessarily compensatory, as in trucking, or no user charge at all, as in inland water transport.

The present railway mainline structure has changed relatively little since the 1920's when the railroads moved fully three-fourths of all common carrier intercity freight and passenger traffic. It makes little sense from an investment standpoint for the railroads or the Government to sponsor rehabilitation projects which do not recognize the changes in the market that the railroad industry has experienced.

Estimates of the costs to rebuild mainline tracks alone have been substantial—far in excess of the financial authorizations under the Act.[2] With investment requirements running at anticipated high levels, the critical problem for the Federal Government and railroad industry is to determine where to invest in fixed plant to allow sufficient earnings generation to cover the cost of the capital expended. Without sufficient traffic volumes, earnings will not be sufficient to pay back the investment.

[2] The Secretary will make recommendations as to the amounts needed to rebuild or rehabilitate facilities, including track, under Section 504, the Capital Needs Study.

Explanation of Terms

Before proceeding further, it is necessary to define and explain some words and phrases. The following list is limited and excludes terminology which has been repeatedly defined in other documents, such as the Regional Rail Reorganization Act of 1973, and especially reports produced therefrom, such as the *Preliminary System Plan* and *Final System Plan* of the United States Railway Association ("USRA"):

(1) *Standard* means a criterion utilized to determine the classification of rail lines.

(2) *Classification* means the process of establishing categories of rail lines.

(3) *Category* means a division within a system of classification of rail lines.

(4) *Designation* means the process of evaluating the characteristics of rail lines and of assigning them, based on that evaluation, into a specific group or category.

(5) *Mainline* means a rail line which incurs a relatively high density of freight or passenger usage or which is essential, or potentially essential, for providing rail service to major markets. (See sidebar for further explanation of terms (5) and (6).)

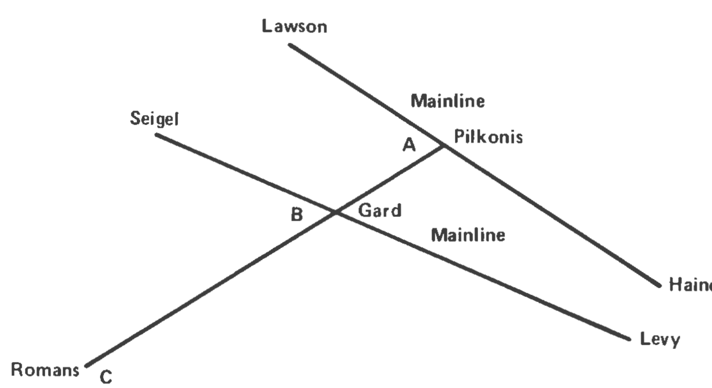
(6) *Branchline* means all rail lines other than mainlines.

The Distinction Between Mainlines and Branchlines

While Section 503 of the Act requires branchline as well as mainline categories, the definitions of those terms have historically been left to the discretion of each railroad and inconsistently applied. Consequently, there is no generally accepted definition of either term. What one carrier designates as a branchline may display the traffic character of a line designated as a mainline on another railroad. Further, many railroad designations are rooted in history, reflecting the merger of companies of varying system profile. For example, one of the most heavily used lines in the nation—the former Penn Central (now ConRail) through route between Perryville, Md., and Enola Yard at Harrisburg, Pa.—is known as the Columbia and Port Deposit *Branch*.

The Department considered denoting stub-ended lines as branches and through lines connecting at both ends as mainlines. This method, however, posed a number of both practical and theoretical dilemmas. First, it is difficult if not fruitless, to attempt to define rigorously the bounds of a branchline. For example, in an instance where a stub-end branchline intersects two mainlines (see illustration), would the branchline be defined as A to C, or B to C with A to B being a through and therefore a mainline?

Second, it would appear that a stub-end line that originated or terminated large amounts of rail commerce for the nation (e.g., a line serving a mine) would be classified unrealistically as a branchline. In these circumstances, the only rational method to create meaningful categories for mainlines and branchlines is to classify them, as the statute directs, in terms of their level of usage as measured in gross tons, and taking into account the other appropriate factors described in Chapter 2. Therefore, for purposes of this Report, branchlines are those lines which carry lighter density traffic, whether they are stub-ended lines, low density through lines, or lines which connect two through routes.



Development of Preliminary Standards

In setting standards for classification to be used in designating rail lines, the Department believes that two characteristics are essential. First, each standard must be objective. Each of the standards proposed by the Department is based upon historical data, which can be verified by interested parties. For this reason, standards cannot be developed meaningfully on the basis of traffic forecasts, since such projections are subjective and based on assumptions.

In addition to meeting the test of objectivity, the standards must be capable of uniform application. Any interested party should be able to apply the standards and arrive at substantially the same answer. The Department believes that it has produced standards that meet the test of uniformity of application.

These standards, each of which will be more fully explained in the next chapter, are:

(1) *Density*. The density of traffic on a line, or level of usage measured in gross tons moved on the line or in number of passenger trains, is a measurable indicator of activity of that line.

(2) *Service to Major Markets*. Analysis of the origin and termination of rail traffic shows those markets with the greatest demand for rail freight service and shows movement of freight between markets. Lines which are important to connect major markets can be clearly identified.

(3) *Appropriate Levels of Capacity*. For healthy competition to occur among railroads in particular market areas, rail traffic should be sufficient to require relatively high use of the fixed plant capacity in those areas. Historical changes have often meant that carriers which were in the past in healthy competition in various markets have now lost traffic, and thus have more capacity in those markets than they can economically support. This standard will identify traffic corridors served by more than two carriers on mainline through routes where the level of rail activity does not justify the existing level of mainline facilities.

(4) *Defense Essentiality*. Certain lines are essential to our national defense. Consideration of these lines or alternative routes is implicit in the Act.

For the purposes of this Report, the Department carefully considered two other standards—namely, the importance of each rail line (a) to the economic viability of the owning carrier, and (b) to the probable economic viability of connecting carriers. The language of Section 503(b) indicates that these standards should be considered along with the level of usage.

Accordingly, the Department requested the carriers to comment both on lines in which traffic density does not fairly reflect their economic viability and on lines of other carriers that have significant impact on the viability of their company.[3] Roughly half of the carriers thought that density itself produced a good measure of economic viability or importance of lines to their railroad. Others concluded that exceptions existed and a few thought that all their lines, regardless of density, were important to their economic viability. Little was submitted that documented the contribution of individual lines to economic viability and that which was submitted showed little consistency among carriers. Because the resulting information lacked uniformity and no other methodology is available to gather uniform data on these factors,[4] the Department determined that is was infeasible to use these standards as part of any system for classifying and designating rail lines. In reaching this decision, it was noted that the industry maintains neither a revenue and cost accounting system nor a cost allocation system based upon route segments. In fact, the deficiency of the accounting system is specifically addressed in Section 307 of the Act, which directs the Interstate Commerce Commission to revise the uniform cost and accounting system by June 30, 1977.

The Preliminary Classification and Designation Process

To classify the rail system into categories as mandated under Section 503(b), the Department utilized the four standards listed above. This classification process produced the following categories: (1) A mainlines, (2) Potential A mainlines, (3) B mainlines, (4) A branchlines, (5) B branchlines, and (6) Defense-Essential branchlines. Categories (1), (3), (4), and (5) resulted from the application of the density standard, with category (1) also reflecting application of the service to major market standard. Category (2) was formulated from the standard addressing appropriate levels of capacity, and category (6) from the defense-essential lines standard. A detailed explanation of the categories is found in Chapter 3.

Each rail line in the data submitted by the carriers is designated into one of the six categories. Designated lines are identified on state maps in Volume II and coded according to railroad, category, and density. The designation process is described more fully in Chapter 3.

One matter regarding designations deserves special comment. The classification and designation procedure deals with railroad data and conditions current as of December 31, 1975.[5] The dynamic nature of American industry which transportation serves must be taken into consideration; consequently, future contingencies which cannot now

[3] In its uniform data guide order of March 11, 1976, authorized under Section 503(a), the Department requested density data and sought additional information on economic viability directly from the carriers.

[4] It might be recalled that USRA was charged with a similar responsibility in developing the *Preliminary System Plan*. In carrying it out, USRA analyzed approximately 10,000 miles of light density lines in the 17 state Northeast and Midwest Region, spending more than $2 million in a two-year effort. During the same period, USRA analyzed the economic viability of certain mainlines in the Region for railroads which accounted for only 15 percent of the industry's freight revenue. The nation's current Class I railroad network, the subject of this report, approximates 193,500 miles.

[5] It should be pointed out, however, that density data for ConRail's lines do not represent actual traffic patterns on ConRail's predecessor railroads, but rather the line densities projected to result from USRA's adjustment of the patterns of those traffic flows.

be foreseen could impact designations made in this report. For example:

(1) The opening or closing of industries or mines furnishing the bulk of a rail line's traffic. An obvious example is the likelihood, confirmed by several rail companies, that lines in the emerging low-sulphur coal-originating areas of the eastern Rocky Mountain slope currently rated low in traffic density will, within a decade, require upgrading to heavy-duty capability in order to handle the production of new mines.

(2) The impact on significant segments of rail traffic of new competitors—such as coal slurry pipelines—of as yet untested economic viability and market strength. There is no economic experience from which to forecast the effect on rail line densities of long-distance pipelines serving multiple producers and consumers, such as are being proposed for construction between the northwest-central coal-producing area and the Midwest.

To meet such future contingencies the Department will consider provisions for correcting its Final Report under Section 503 and an appropriate process for updating designations when necessary.

Anticipated Use of the Report

The Section 503 Final Report will serve several purposes. As indicated earlier it will serve as a general, but not absolute, guideline for making investments in track. It must also be considered under Section 504, the Capital Needs Study, under which the Secretary is required to make legislative recommendations to the Congress as to the amount and form of financial assistance, if any, which the Federal Government should provide to the rail industry. Further, although not directly linked in the Act, the Report will provide invaluable aid in conducting the comprehensive multipart study of the American rail system assigned to the Secretary under Section 901 of the Act. Specifically, it should dovetail closely with those studies examining physical restructuring and corporate realignment of the industry. Its content should be most helpful to that study in estimating the potential savings in the cost of rehabilitating the United States railway system where rehabilitation is limited to those portions which are critical to interstate commerce or national defense. This Report also should aid railroad management in reaching future decisions regarding investment, operations, and facilities rationalization, should lead to safer operations, and should provide both federal and state regulatory and planning agencies with a useful tool to better accomplish their missions.

CHAPTER 2

The Development of Preliminary Standards for the Classification of Rail Lines

The process for the classification of the rail system into categories of lines used in this Report is based upon the "level of usage measured in gross-ton-miles" and "operational service and other appropriate factors" as required in Section 503(b) of the Act.

The development process resulted in the creation of four standards. The first of these—density—is the principal standard. The other three—service to major markets, appropriate levels of capacity, and defense essentiality—represent other factors which in most cases should be considered supplemental to the standard of density.

The First Standard: Density

The first standard for the classification of rail lines is both the simplest to apply and the one that serves as the basis for the categories into which the great preponderance of the mileage of rail lines is designated. Since, in this Report, density is applied to freight and passenger operations in a different manner, each will be discussed separately.

Freight Density

The freight density of rail lines, for purposes of this Report, is measured by the number of ton-miles of movement passing over each mile of railroad line annually, and will be referred to as "gross tons". Freight density thus includes the combined weights of the freight hauled, the rolling stock carrying it, the motive power pulling it, and also any nonrevenue or empty equipment moving on the line.

The curve plotted in Figure 1 depicts the degree of concentration of rail freight on the approximately 193,500 route-miles comprising the Nation's Class I railroad system. Many thousands of miles of rail line in the Nation's system carry an almost imperceptible level of traffic. Point 1 on the curve illustrates that approximately 33 percent of the rail network (60,000 route miles), for example, produces only one percent of the traffic, or the equivalent of about one average-sized train per week. At the other extreme, as indicated by Point 2 on the curve, two-thirds of the rail industry's total ton-miles are produced on approximately one-fifth, or about 40,000 miles, of the system. In terms of freight density, these 40,000 miles of route are essentially comprised of lines with densities of 20 million gross tons or higher. The principal purpose of the classification and designation process is to determine which portions of the rail right-of-way should have priority for rehabilitation or improvement. The distribution of traffic noted above clearly indicates the importance of density information in determining the relative importance of various segments of the rail system.

Because density constitutes such an accurate indicator of rail activity, it also has important relationships with two other significant factors: economic viability and maintenance-of-way costs.

As discussed in Chapter 1, a number of carriers referred in their commentaries to the general relationship between economic viability and density. Yet freight density, while an indicator of viability, is not on its own a complete determinant. For example, a line with low density may handle only a few cars of a relatively low-value, bulk commodity such as gravel that yields a low revenue, or an equivalent weight of a more valuable and service-sensitive commodity earning a high revenue. Other variables being equal, the movement of a low volume of gravel may well incur a loss while the higher-revenue commodity may be profitable.[1] Therefore, a number of factors, many of which are unique to individual lines and not susceptible to objective and uniform measurement, may affect viability. However, when considering two lines with densities that are measureably different, the line with higher density will, in the great majority of cases, also be more viable economically, and density is the only objective and uniform standard which exhibits this characteristic.

Density also has a close relationship to maintenance costs. From a practical standpoint, the cost of maintaining track can be roughly divided between a fixed cost and a variable cost based on the movement of traffic.[2] This cost relationship reflects the fact that unit maintenance costs decrease as tonnage increases, and leads to the conclusion that it is generally desirable to operate heavy traffic levels over fewer lines rather than light traffic levels over a more dispersed system. This conclusion is supported in recent work on track maintenance costs completed for USRA and the Federal Railroad Administration ("FRA"), which is the source for the comparison illustrated in Figure 2. Figure 2 indictates that, between 5 and 20 million gross tons, maintenance costs per unit of traffic are high but that they decrease rapidly with increasing density. Below 5 million gross tons maintenance costs per unit of traffic are very high leading to costly and less economically efficient operations. This is not to say that traffic at lower density levels may not be profitable, but rather that the probability of profitability increases with density. At densities above 20 million tons, unit maintenance costs are the lowest and they

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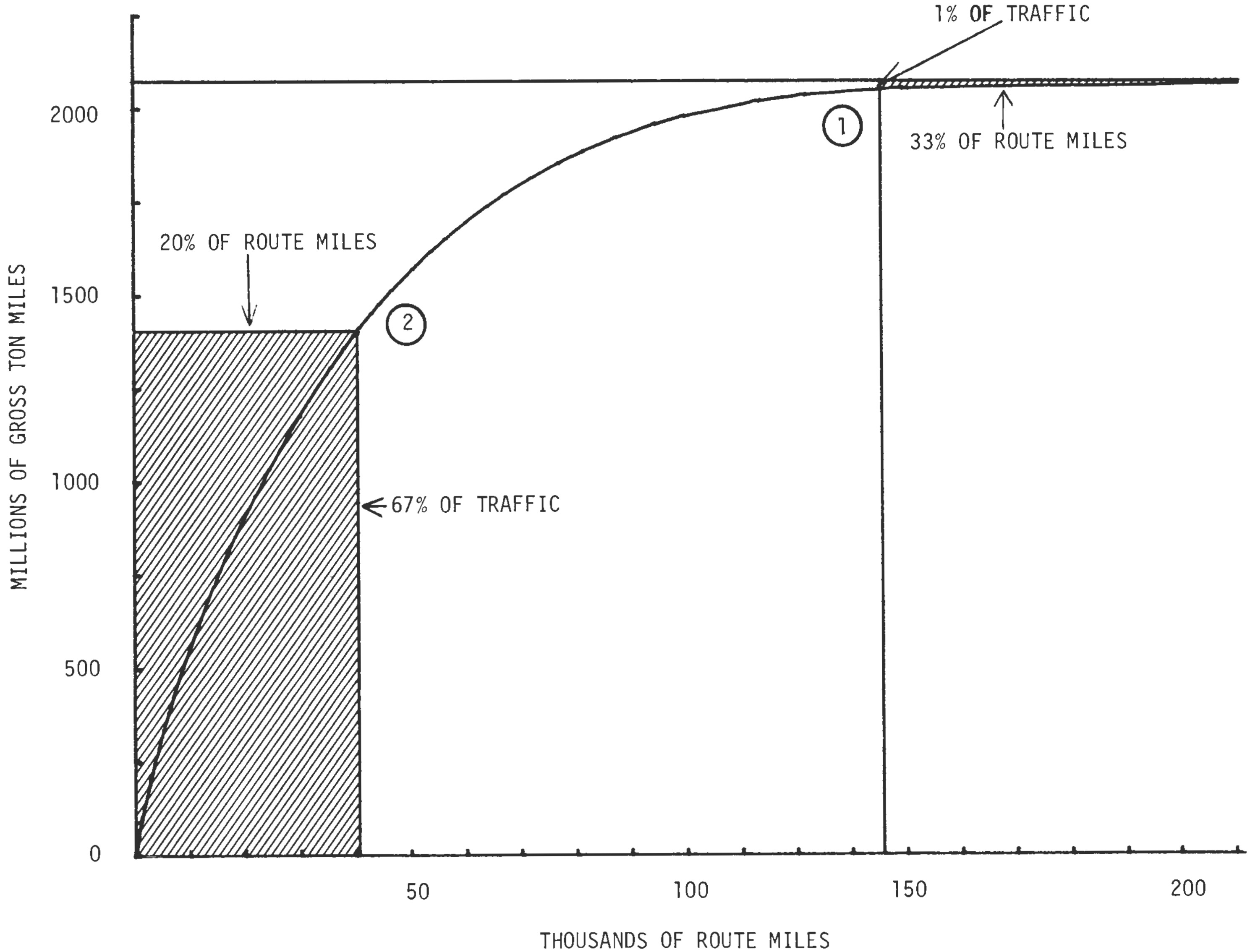
[1] It should be noted, however, that low-rated commodities, if they contribute to overhead, help lower unit costs.

[2] For average track, the median maintenance costs incurred are associated with subgrade stability, ballast, ties, track inspection, rail wear, lining, and surfacing. Track is maintained on a normalized basis when one-half of the useful life of the track components remains.

FIGURE 1

A CORRELATION OF RAIL FREIGHT CARRIED AND ROUTE MILES FOR CLASS I RAILROAD LINES IN THE UNITED STATES



continue to decrease as density increases, but at a slower rate.[3]

A final aspect of density as a standard for classifying rail lines is the insight it provides into the type of rail operations being carried out on the line. At the lower end of the density range, for example, a line is likely to support only local freight trains, operating on a frequency of no more than one train per day, and performing all of their own switching chores. As densities increase, they indicate lines which will support increasingly greater specialization in freight car classification and higher throughputs.

In summary, from this discussion of the density standard there can be developed five basic conclusions:

(1) Traffic density is an effective measure of the level of activity on the rail system.

(2) A thorough look at the rail system on the basis of traffic density reveals that a large amount of total rail traffic moves on a rather small portion of the total rail plant and, conversely, that a rather large portion of the rail plant carries an almost imperceptible level of traffic.

(3) Since it is not feasible to calculate directly and with accuracy the economic viability of individual rail lines, traffic density—though it is not always completely accurate—is the best available indicator.

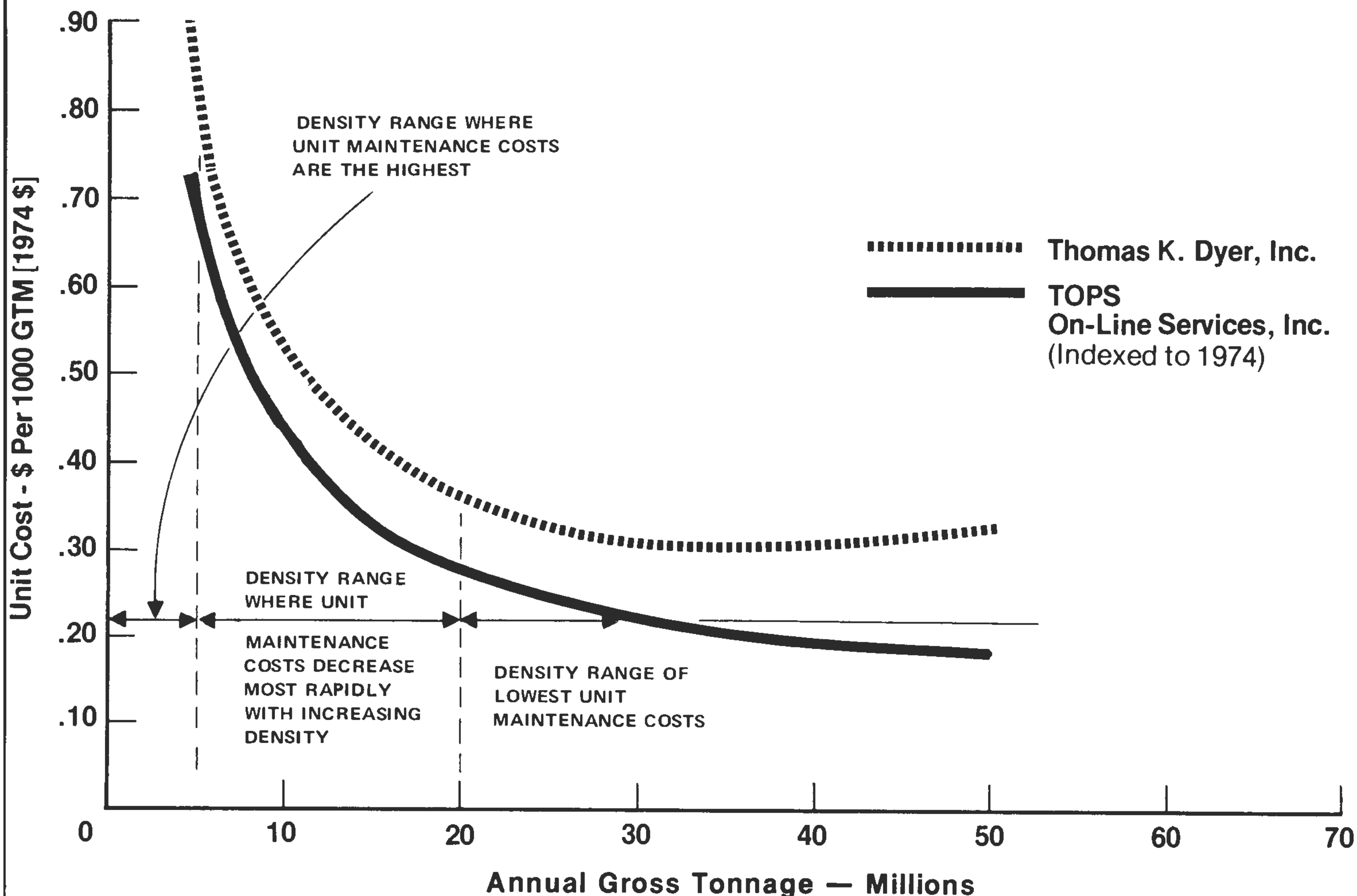
(4) The fact that unit maintenance costs tend to decrease per carload as traffic density increases means that financial benefits can accrue to the railroads from concentrating traffic onto lines of higher densities.

(5) There is generally a direct correlation between the type of operations and the density of traffic on a rail line.

Taken together, the insights inherent in these conclusions make it clear why density should be, and is, the principal standard to be used in the classification of the rail system for both mainlines and branchlines.

[3] For more data on the relationship between maintenance costs and density, see Appendix 1.

FIGURE 2
Comparison of Unit Track Maintenance Costs - Dyer and Roadway Study



Passenger Density

Although the railroad industry's overriding contribution to the Nation is from freight transportation, rail passenger service also makes a significant and vital contribution to the transportation system in several areas of the country. Unlike the density of freight operations, which is measured in gross tons, however, the density of passenger operations is most reasonably and accurately measured in terms of frequency of service, or the number of trains per day.

This stems from the fact that roadway requirements for passenger services depend upon their frequency and service level, not on their weight.[4] For example, many carriers move 20–25 freight trains daily over a single-track line. Even though opposing trains require numerous slowdowns, this kind of delay in carrying freight is seldom a problem for even the most service-sensitive shipper, since it accounts for a very small part of the total transit time. This kind of delay, in contrast, in the operation of a similar number of passenger trains running at 80–100 miles per hour over a single track, would cause a considerable loss of *average* speed, with a significant negative impact on the quality, and thus on the market attractiveness, of the passenger service provided. Studies conducted by FRA during the Metroliner demonstration between Washington, D.C., and New York City, indicated conclusively that only a small delay in a passenger train's schedule is tolerable if rail is to be viewed as an attractive travel option. This higher sensitivity to delay, along with the need to maintain a relatively high average speed, means that, at high passenger service frequencies, there is likely to be a requirement for some degree of separation or segregation of freight and passenger service. Based on the current pattern of rail passenger service in this country, the only area where passenger train frequencies are high enough to raise the issue of segregation or separation of facilities is in the Northeast Corridor between Washington, D.C., and Boston, Mass.

In other geographic areas the frequency of daily passenger train service is relatively low, and passenger services can easily be routed on freight mainlines, since operating patterns on such lines can generally be adjusted to ensure that the passenger trains are not delayed. Combining freight and passenger operations where passenger frequencies are low is also economical because a low level of passenger usage cannot justify the expense of maintaining the roadway to a level which permits comfortable, high-speed passenger train performance. Indeed, given the usual close correla-

[4] Compared to the average freight train weight of 4,300 tons, an eight-car, locomotive-hauled passenger train weighs from 550–600 tons.

tion between level of maintenance and density of freight traffic, management should, whenever feasible, seek to operate passenger trains on high-density freight mainlines—especially when only one or two passenger trains are operated daily in each direction.

The Second Standard: Service to Major Markets

The first standard of classification—density—might, at first glance, seem adequate to cover all segments of the rail network. But while density is a good measure of the level of usage of individual lines, it fails to take full account of the impact of individual markets for freight traffic or of the flow between them. Hence, in order to ensure that the system of classification for the rail system is as sound as possible, the Department analyzed all segments of the rail network in regard to the origins and destinations of traffic to assist in developing a standard that would ensure that major traffic centers are served by the highest priority category of mainline.

The analysis was conducted using analytical tools and data developed by the Department for general use in rail system analysis. In connection with previous studies, the Department developed, as a tool for analysis, a system for dividing the continental United States into a total of 486 Transportation Zones. For purposes of this Report it is sufficient to characterize the basis for establishing the respective zones as the optimum means yet found of identifying various groupings of undivided counties with similar transportation requirements. These Transportation Zones were used as a basic unit of analysis in the Department's 1974 report *Rail Service In the Midwest and Northeast Region* and in USRA's *Preliminary System Plan* and *Final System Plan.* The zones are an integral part of the railroad network planning computer model utilized by FRA.

The basic data used in the market service analysis were provided from annual surveys by the Department of the flow of rail freight within the United States. These surveys are carried out by sampling the waybills covering rail carload freight movements. Assessing the relation between the origins and destinations of traffic, as determined by waybill data for 1973, and the Transportation Zones provides the statistical basis for application of the standard for service to major markets in the line-designation process.

According to the 1973 waybill sample, approximately 45 million cars originated, terminated or moved within the 486 traffic centers. The largest zone, Chicago, Ill. accounted for 1.4 million cars; the smallest, Caliente, Nev., accounted for 200 cars. Table 2 gives a breakdown of car activity in Transportation Zones by ranges.

Table 2.—Loaded Cars Originated and Terminated

Range of Loaded Cars	*No. of Zones*	*No. of Cars (millions)*	*Percent of cars*	*Cumulative Cars (millions)*
greater than 150,000	74	25.1	56	25.1
100,000–150,000	49	5.8	13	30.9
75,000–100,000	46	4.0	9	34.9
50,000–75,000	77	4.7	10	39.6
25,000–50,000	101	3.7	8	43.3
10,000–25,000	87	1.5	3	44.8
less than 10,000	52	0.3	1	45.1

SOURCE: FRA Waybill Data, 1973

To determine an appropriate basis for the service to major markets standard, the Transportation Zone analysis was made as follows:

(1) Every zone was checked in order to determine whether its major traffic generating points are served by at least one high-density mainline. If so, the zone was eliminated from further analysis.

(2) The remaining zones were divided into two groups: zones generating more than a threshold number of freight carloads per year, in terms of either originations or terminations—identified as "major" zones, and zones of lesser traffic activity.

(3) Zones below the carload threshold were eliminated from further consideration as potential candidates for the requirement of highest category mainline service. For such zones, access lines of a lower priority category are considered adequate.

(4) Zones remaining in the study universe were then subjected to a detailed traffic analysis to determine if they required service by a highest category mainline for intra-zonal access or connectivity between zones.

The Third Standard: Appropriate Levels of Capacity

For healthy competition to take place among railroads serving a particular market area, there must be a sufficient level of traffic to absorb a relatively high proportion of the railroad mainline capacity used to provide service. When this relationship is distorted, the resulting cost impact damages all competitors and the Nation as a whole. In an effort to quantify the extent of this problem, FRA has undertaken an analysis of markets in which there appears to be the potential for such excess capacity. In performing this analysis it has become apparent that such markets are best described as corridors, that is, as sets of through rail routes between major traffic centers.[5]

In determining whether a rail freight market or corridor has an imbalance between capacity and traffic, two criteria are used. These are:

- *Number of competing routes.* The corridor has to include *more than* two competing through routes, each operated by a different company.
- *Relation between capacity and density.* The corridor has to demonstrate significant excess capacity in comparison to annual density. It should be recognized that a certain level of excess capacity is necessary,

[5] Since a very large number of through routes could conceivably be structured between the major traffic centers which serve as the ends of a corridor, it was necessary to establish a criterion for defining those routes which comprise a corridor. The criterion selected was that any route less than 50 percent longer than the shortest through route between the traffic centers defining the corridor would be included in the analysis of capacity.

given daily and seasonal peaking of traffic and the need to cope with service interruptions, such as derailments and natural disasters. Above a certain level, however, the costs of maintaining excess capacity exceed any potential benefits; in the Department's judgment 50 percent excess capacity represents a conservative standard for defining that level.

To measure capacity, the Department utilized the Parametric Line Capacity Analyzer, a tool developed for the FRA in 1973. The model allows rigorous examination of route capacity—it separates each route into a number of discrete sections on the basis of crew change points, major junctions, changes from single to double track (or vice-versa), and points of change in major physical characteristics. Consequently, the model produces a separate capacity for each segment of the route. The Department, on the other hand, assessed the capacity for each segment of the entire route by seeking the most constraining segment and designating the line capacity on that basis. Therefore, in every instance the capacity of a particular line and corridor is stated in this Report in the most conservative fashion, which consequently understates the degree to which various rights-of-way are underutilized.

The Chicago-Minneapolis corridor, whose characteristics are described in Table 3 and depicted in Figure 3, is representative of the industry's problem of underutilized facilities.

Table 3.—Through Routes in the Chicago-Minneapolis Corridor: Mileages, Densities and Capacities

Rail Routes	*Route Miles*	*Average Density (MGT)*	*Line Capacity (MGT)*
Rock Island	485	15	48
Burlington Northern	435	38	49
Soo Line	435	19	24
Chicago & North Western	412	19	51
Milwaukee Road	404	20	100
TOTALS:	2,171	111	272

The two cities are served by five railroads offering multi-access competition. The shortest route is owned by the Milwaukee Road (404 miles); the longest is owned by the Rock Island (485 miles); together, the five roads account for 2,171 route-miles. In the past few years, the total density of the five lines was about 111 million gross tons, whereas the capacity model indicates that the overall capacity of the corridor is 272 million gross tons—substantially more than twice the density. This density can be handled by two or three routes of the five, with substantial savings from concentration of rehabilitation investment. Other such Corridors of Excess Capacity, identified in Chapter 3, were identified utilizing the same criteria.[6]

Railroads situated in Corridors of Excess Capacity should consider three approaches for tailoring capacity to fit use. First, consolidations and mergers might be entertained. Second, they might enter into joint trackage agreements so that maintenance and rehabilitation funds can be concentrated on fewer lines. And third, they might downgrade one or more routes.

In order for the carriers in Corridors of Excess Capacity to have the greatest flexibility in resolving route redundancy, all through routes in a given corridor are given equal status in the designation process. Thus, in addressing this problem, the carriers can take into account such variables as traffic flows, line condition, line capacity, yard location, curves, grades, financial consideration, and corporate relationships when selecting lines. The Department is cognizant of the importance of the traffic in these corridors, and urges the carriers to move promptly to resolve the excess capacity problem. The railroads may, pursuant to Section 401 of the Act, meet collectively with the Secretary to discuss and reach agreements regarding this problem.

The Fourth Standard: Essential for Defense

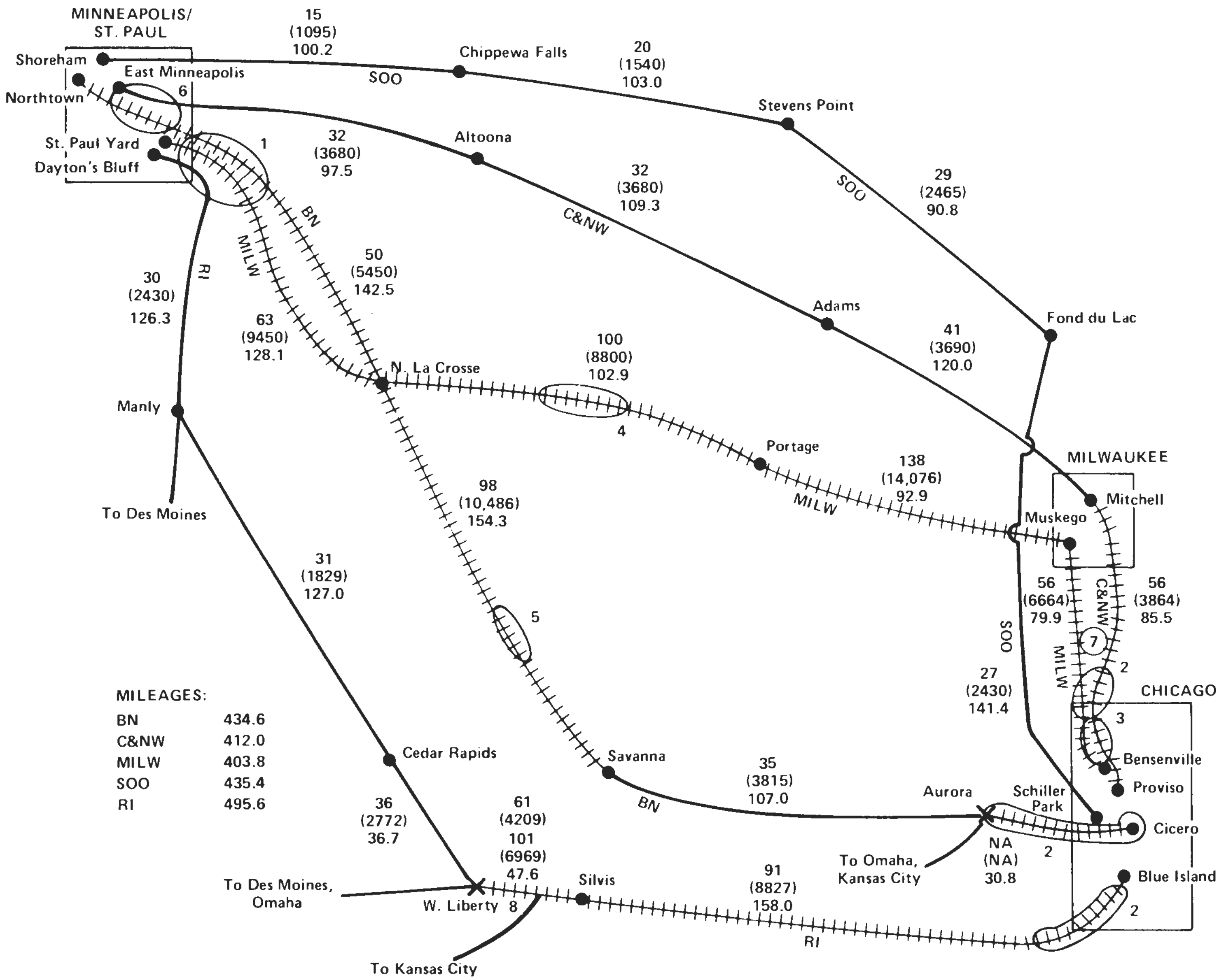
The specific needs of the national defense constitute the basis for a fourth standard. This standard is predicated on considerations apart from, or supplementary to, line density. The focus of concern here is to identify those branchlines which are essential to provide rail service for oversized military shipments. The designation of defense-essential lines in this Report is appropriately limited to branchlines, since those lines are critical to providing access from the mainline system to the various defense installations requiring access for oversize loads. Defense requirements applying to the mainline portions of the network will be addressed by the Department in its study under Section 901(3) of the Act, which addresses those portions of the overall rail system that are "essential to interstate commerce or national defense." Thus, in this Report, the defense standard will identify those segments of the branchline system which serve unique defense requirements.[7]

[6] For a more detailed discussion of the individual Corridors of Excess Capacity, see Appendix 2.

[7] The Department of Defense provided the information used to make the designations of defense essential branchlines.

FIGURE 3

CHICAGO – MINNEAPOLIS CORRIDOR



LEGEND:

┼┼┼┼┼┼┼┼	Section or subsection primarily double track
———	Section or subsection primarily single track
●	Crew change point (analysis section boundary)
✕	Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
63	Section or subsection line capacity, trains per day
(9450)	Section or subsection line capacity, cars per day
142.2	Section or subsection length, miles

NOTES: (oval)

1. Joint trackage, BN and MILW, 19.2 miles, each single track, RI trackage rights, 5.8 miles
2. Commuter traffic
3. MILW trackage rights on C&NW, 10.1 miles, double track
4. C&NW trackage rights on MILW, 13.0 miles, 2.7 miles single track, 10.3 miles double track
5. BN trackage rights on ICG, 12.5 miles, double track
6. C&NW operates over BN to East Minneapolis, 10.5 miles, double track
7. Crew assumed to make round trip in 12 hours
8. Capacity constrained by Silvis-Des Moines crew district

CHAPTER 3

The Preliminary Classification of the Rail System and Designation of Rail Lines

The Department is of the opinion that any process for the classification of the Nation's rail system into categories into which rail lines can be designated should seek to promote the following objectives:

- Provide a mainline rail network adequate for the commercial shipping, passenger and defense needs of the Nation.
- Emphasize the necessity of concentrating available resources into those segments of the fixed plant which handle the preponderance of the Nation's rail freight. Any degradation of maintenance standards on these lines will have the greatest impact on safety and system efficiency because of the traffic involved.
- Define a rail system with sufficient capacity to absorb potential growth and meet reasonable short term traffic surges (such as export grain movement).

To meet these objectives, it is the judgment of the Department that the following set of categories for rail lines should be established:

(1) A Mainlines	• 20 million or more gross tons • three or more daily passenger operations in each direction • major Transportation Zone connectivity
(2) Potential A Mainlines	• Corridors of Excess Capacity
(3) B Mainlines	• at least five, but less than 20 million gross tons
(4) A Branchlines	• at least one, but less than five million gross tons
(5) B Branchlines	• less than one million gross tons
(6) Defense-Essential Branchlines	• A or B Branchlines required for the shipment of oversized military loads

Explanation of Categories

Mainline Categories

In establishing categories, the basic standard used is density. Based upon the considerations discussed in Chapter 2, two categories of mainline—Categories A and B—were established using density as the essential determinant.

Category A Mainline. A line is classified into this category if it meets any of these three tests:

1. *High Freight Density Test*—Does a line carry at least 20 million gross tons per year?

Based on a review of the traffic density data submitted by the carriers and the factors discussed in Chapter 2, the Department established a minimum route density of 20 million gross tons as the first threshold for designation of a Category A Mainline. An analysis of the relation of unit maintenance cost to line density (See Figure 2 in Chapter 2) supports the selection of 20 million gross tons as a major threshold, as does the fact that lines with densities of 20 million gross tons or more comprise about one-fifth of the rail system and produce two-thirds of the ton-miles. Further, if the Category A Mainline threshold were higher than 20 million gross tons, it would eliminate lines serving a significant number of major traffic centers and thereby erode the integrity of the mainline network. Thus, Category A Mainlines generally carry most of the traffic, exhibit the most efficient use of rail route capacity in terms of the unit cost of operation, maintenance, and return on invested capital, and serve—with few exceptions—the major traffic centers. This categorization of primary mainlines does not, of course, represent an absolute criterion for requiring any specified level of track rehabilitation. Need for rehabilitation is dependent upon a number of other variables, such as existing condition, service levels, and alternatives available. Such considerations will be addressed fully in the Department's Capital Needs Report, which is required under section 504 of the Act and is due, in preliminary form, on January 30, 1977.

2. *High Passenger Train Frequency Test*—Does a line handling less than the Category A Mainline density threshold of 20 million gross tons, and not in a Corridor of Excess Capacity, carry three or more intercity passenger trains in each direction on a daily, year-round basis?

As the discussion in Chapter 2 points out, passenger density is measured not in gross tons but in frequency of service. Because of the relatively low market share of rail passenger service in markets served by a small number of passenger trains daily, it is the judgment of the Department that in order for a rail line that does not meet the Category A Mainline freight density test of 20 million gross tons to merit upgrading to that highest category on the basis of frequency of service, it should carry a minimum of three intercity passenger trains daily in each direction. That number of trains was felt to be the minimum to justify the level of investment which would ordinarily be required to maintain a line of highest priority.

3. *Service to Major Markets Test*—Is a route with a density of less than 20 million gross tons required to provide rail route linkage for Transportation Planning Zones generating at least 75,000 carloads of freight annually?

As pointed out in Chapter 2, where the density standard does not provide for the designation of a highest category mainline to serve a market generating more than a certain threshold level of traffic, an adjustment to the classification standards should take place. The Department's analysis indicated that a reasonable traffic generation threshold for an individual Transportation Zone is 75,000 freight carloads per year. The application of this threshold covers more than three-quarters—78 percent—of the carloads generated on the rail system and approximately one-third—35 percent—of the Transportation Zones. This minimum, in the Department's judgment, provides a reasonable standard for connecting major markets to the mainline system if they are not served, for some reason, by a line meeting either the freight or passenger density test.

Category Potential A Mainlines (Corridors of Excess Capacity.) As discussed fully in Chapter 2 under the standard "Appropriate Levels of Capacity," this category is provided for lines making up all through rail routes located in geographic areas of the country defined as "Corridors of Excess Capacity." A Corridor of Excess Capacity is defined as one in which three or more parallel through routes, operated by three or more carriers, serve the corridor and the practical traffic-handling capacity of the combined routes exceeds the actual traffic density (in gross tons of the combined lines) by 50 percent or more.[1] In such a corridor, all through rail lines between major markets, without regard to their actual densities, are designated as Category Potential A Mainlines.[2]

The purpose of providing equal status for each of these lines is to avoid pre-judgment by the Department of the relative treatment of the competing routes in any rationalization plan by the railroads operating in a Corridor of Excess Capacity. Mergers or coordination agreements designed to reduce excess route capacity may result in shifts of traffic from one line to another for the purpose of concentrating traffic. An existing line that may currently be low-rated in relation to competing routes may be chosen by cooperating rail carriers as a key route in the future due to other considerations. Competing railroads in the corridor have equal opportunity to demonstrate the respective essentiality of their routes and facilities.

Category B Mainlines. The Category B Mainline is a through or feeder rail route which carries less than 20 million gross tons but at least 5 million gross tons annually. It qualifies neither for Category A Mainline status on the basis of passenger train usage or the need to provide service to major markets, nor, since it is not a through route in a Corridor of Excess Capacity, can it be a Category Potential A Mainline. The lower threshold for this Category was established based upon the judgment that it represents the lower bound of the density range in which a line can reasonably be classified as a mainline.

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[1] Since a very large number of through routes could conceivably be structured between the major traffic centers which serve as the ends of a corridor it was necessary to establish a criterion for defining those routes which comprise a corridor. The criterion selected was that any route less than 50 percent longer than the shortest through route between the traffic centers defining the corridor would be included in the analysis of capacity.

[2] A major market serving as the end of a Corridor of Excess Capacity is either a Transportation Zone generating 75,000 or more carloads of freight per year or a gateway.

Branchline Categories

As discussed previously, there is no consistent historic means of determining which rail lines are branchlines. Consequently, for purposes of this Report, the term "mainline" refers to all rail routes carrying at least 5 million gross tons and the term "branchline" refers to all other rail routes. Three categories of branchlines have been established for designation of routes under 5 million gross tons:

Category A Branchline. A rail route handling at least 1.0 but less than 5.0 million gross tons.

Category B Branchline. A rail route carrying less than 1.0 million gross tons.

Category Defense-Essential Branchline. A branchline which would otherwise be a Category A or B branchline, but which is required to provide rail service for oversized military shipments.

The Designation of Rail Lines

With the categories established, each of the line segments found on the approximately 193,500 route-mile system of Class I railroad lines in the continental United States can be designated by category. In the designation process, each link in the national rail network was subjected to individual analysis, and the results of that analysis are to be found in Volume II. There, the railroad network structure of each State (except Alaska and Hawaii) is graphically displayed. In cases where structural complexity requires considerable detail, the State network structures are divided.

Coding of Categories

On each of the state and district maps appropriate information is provided for each link in the rail network.

Each route segment is accorded an identification code comprising the initials of the owning railroad company and the link number. The full corporate titles of the owning rail companies to which the initials refer are listed in Volume II.

After being coded, each line was analyzed and assigned a category.

The category of designation is indicated by color coding the individual route links as follows:

Red—Category A Mainlines

Green—Category Potential A Mainlines

Blue—Category B Mainlines

Solid Black—Category A Branchlines

Dashed Black—Category B Branchlines

Dotted Black—Defense-Essential Branchlines

Gray—Routes operated by Class II railroads (companies earning less than $10 million gross revenues annually) are shown on the maps but not identified by carrier. Under the provisions of Section 503, data are not required to be submitted by Class II railroads.

Density Identification

In addition to company and link references and designation of category by color on the maps, there is listed in Section II of Volume II an illustrative range of density for each line segment as follows:

Key No.	*Density Range (in millions of gross tons)*
1	less than 1
2	at least 1 but less than 5
3	at least 5 but less than 10
4	at least 10 but less than 20
5	at least 20 but less than 30
6	30 or more

Discussion of National Network Graphics

In order that the user of the report may acquire a comprehensive overview of the relation to the national network of the rail routes in which he is interested, Volume II of the report supplements the state and congested-area maps with national network graphics. This is an enlarged national network map displaying the mainline designations by category with all categories of branchlines displayed in a single color.

Line Analysis Process

The step-by-step process of designating each of the route segments in the rail network into a specific category was based on the application of the criteria for each category as they were developed from the classification standards in Chapter 2.

The process of designating line segments was carried forward by applying a uniform progression of what are, in effect, inquiries and responses based on the four standards described. That process is illustrated graphically in Figure 4.

It is noted that the initial inquiry—"Is line in a Corridor of Excess Capacity?"—is applied to each line segment prior to the more pervasive density standard. The reason is that, contrary to the other standards, the standard relating to the levels of capacity requires the designation of Corridors of Excess Capacity prior to any other measurement of the essentiality of rail routes within corridors so designated. Once these corridors have been determined, all through mainline routes therein are automatically designated Category Potential A Mainlines.

Selection of Density in Five-Year Range

Included in the process of designating individual rail lines by category is the selection of the base to be used for determination of the density level. As set forth in earlier chapters, the major standard for classification of rail lines—density—is the only standard of evaluation in this Report which is influenced by the requirement to take into account trends over a period of time. All other standards are measured against data produced for a single year.

In mandating a full and complete analysis of Class I carriers, Section 503(a) requires the respondent railroads to "indicate the traffic density for the preceding five calendar years on each of the main and branch rail lines of the railroad submitting such analysis." This time span for measuring the level of usage enables the Department to apply density standards more realistically than by using density data only for 1975, the most recent year available.

Provision by the carriers of five-year data provides the means of identifying upward and downward trends in line utilization as factors in the appraisal. At the same time, the need for uniform application of quantifiable standards requires that a single density rating be assigned to every candidate rail line.

This Report's preliminary designation of rail lines on the basis of density of use reflects the following procedure in evaluating five-year traffic trends, using as an example a rail line in the upper range of density levels:

(1) If density in 1975 (or in the latest year reported by the railroad) is 20 million gross tons or more, the line is summarily designated as a Category A Mainline, the highest status, unless it is in a Corridor of Excess Capacity.

(2) Since calendar year 1975 was a period of relatively depressed rail traffic, routes which would normally qualify for Category A Mainline may fail to have done so in that year. In such instances, a careful examination of density trends in the preceding four years is made—taking into account the fact that rail traffic was also depressed in 1971. In instances where density shows an upward trend over the preceding four years, or annual density therein averages higher than the 1975 level, the higher figure is selected as the indicated annual density for initial classification of the line.

(3) Where 1975 density fails to attain the Category A Mainline minimum, and the five-year data show a declining trend, the appropriate lower category is used for designation.

(4) In instances where no dominant trend can be discerned, the highest annual density in the five-year span is used to designate the category for the line.

Sample results of the application of the foregoing evaluation procedure in determining designation of individual lines are illustrated in Table 4. Italicized figures therein show the dominant trend on which density determination is based. This method of determining the indicated annual density for lines from a five-year period is used also in dealing with lines down to the lowest levels of usage reflected in the categories.

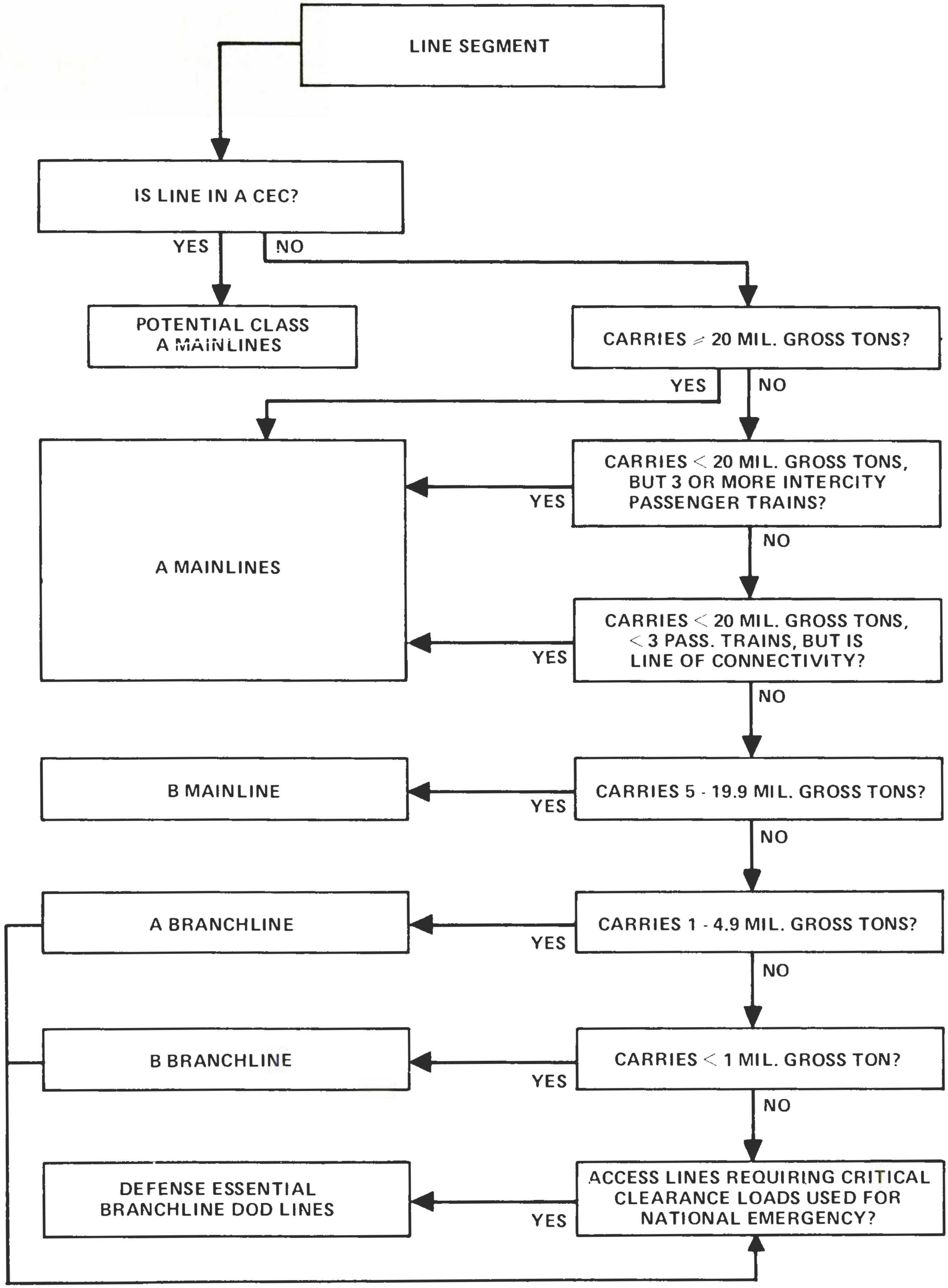
Table 4.—Examples of Line Density Determination For Designation Purposes Using Five-Year Data

(Millions of Gross Ton-Miles Per Mile Per Year)

		1971	*1972*	*1973*	*1974*	*1975*	*Category of Designation*
Line A	Increasing Trend	*18*	*21*	*22*	*24*	18	A Mainline
Line B	Decreasing Trend	19	22	*21*	*17*	*15*	B Mainline
Line C	New Traffic in 1975	15	16	16	17	*25*	A Mainline
Line D	Increasing Trend	*4*	*6*	*8*	*9*	4	B Mainline
Line E	Decreasing Trend	6	*7*	*5*	*3*	*3*	A Branchline

FIGURE 4

THE RAIL LINE SEGMENT DESIGNATION PROCESS



Summary of Designations

In addition to the application of freight density criteria in the designation process, there were—as mentioned above—three other tests applied which reflected passenger frequency, service to major markets, and excess capacity in selected corridors. Before describing the results of the freight density designations, it is appropriate to review the results of these other three tests:

1. *Passenger Frequency:* Most passenger service provided in this country is operated on lines which satisfy the Category A Mainline test on the basis of density alone. However, approximately 8,700 miles of line in the 28,000 mile intercity passenger system (including services provided by Amtrak, Auto-Train, Southern, the Rock Island, and the Rio Grande) use routings which do not meet the Category A mainline freight density level. Of these 8,700 miles, 1,586—of which more than half are in the Potential A Mainline category or the Northeast Corridor—carry three or more daily, year-round passenger trains in each direction. These lines are located in the following four regions or areas of the country:

(1) The Northeast Corridor Region	
a. Harrisburg-Philadelphia via Lancaster	103 miles
b. Newark-Boston	242 miles
c. New Haven-Springfield	62 miles
d. New York City (Grand Central Terminal)-Schenectady, N.Y.	160 miles
(2) The Chicago Hub	
a. Chicago-St. Louis via Bloomington and Alton	282 miles
b. Porter, (Ind.)-Jackson, (Mich.) via Niles	161 miles
(3) Los Angeles-San Diego	103 miles
(4) Florida Services	
a. St. Petersburg-Tampa	47 miles
b. Jacksonville-Miami via Orlando (includes Auburndale-Lakeland)	426 miles
Total	1,586 miles

The net impact of this test upon the Category A Mainline system added 1,586 route miles and is indicated on the National Network Map.

2. *Service to Major Markets:* The 75,000-carloads-a-year screening process identified as "major" a total of 169 Transportation Zones. Of the total of 169 major zones, only 11 were not served by Category A Mainlines and, therefore, required further analysis.

The zones subjected to detailed analysis are:

1. Bangor, ME (Zone 1)
2. Augusta, ME (Zone 2)
3. Panama City, FL (Zone 259)
4. Ft. Myers, FL (Zone 255)
5. Parkersburg, WV (Zone 198)
6. Escanaba, MI (Zone 166)
7. Marquette, MI (Zone 167)
8. Bemidji, MN (Zone 297)
9. Baton Rouge, LA (Zone 278)
10. Corpus Christi, TX (Zone 370)
11. Two Harbors, MI (Zone 295)

Each of these zones was analyzed in terms of commodities originated or terminated and of the basic traffic flow pattern. A discussion of the detailed results of the analysis of each of the total 11 zones is set forth in Appendix 3. The net impact of the application of this test on the Category A Mainline System added approximately 1,500 route miles and is indicated on the National Network Map.

3. *Corridors of Excess Capacity:* Table 5 below summarizes the designation impact of the application of the excess capacity standard in corridors with more than two competing routes. The criteria inherent in this category resulted in the creation of 11 Corridors of Excess Capacity, involving the designation of 22,500 miles of rail line as Category Potential A Mainlines. The lines so designated are indicated in green on National Network Map.

Table 5.—Corridors of Excess Capacity

Corridor	*Rail Routes*	*Route Miles* [1]	*Average Line Density (MGT)*	*Line Capacity (MGT)* [2]
Chicago to Pittsburgh	Baltimore & Ohio	464	35	91
	Norfolk & Western	451	32	54
	ConRail (via Cleveland)	449	70	150
	ConRail (via Ft. Wayne)	438	26	126
	TOTALS:	1,802	163	427
Chicago to Buffalo	Chesapeake & Ohio	530	7	21
	ConRail (via Detroit)	530	15	43
	Norfolk & Western	511	33	61
	ConRail (via Cleveland)	506	74	109
	TOTALS	2,077	129	234
Chicago to Southern Gateways	Baltimore & Ohio (to Cincinnati)	364	37	26
	Milwaukee Rd (to Louisville)	343	5	27
	Louisville & Nashville (to Evansville)	308	17	37
	Louisville & Nashville (to Louisville)	308	8	24
	ConRail (to Louisville)	304	13	26
	ConRail (to Cincinnati)	284	4	45
	Chesapeake & Ohio (to Cincinnati)	282	7	42
	TOTALS:	2,193	91	227
Chicago to Kansas City	Missouri Pacific	551	18	45
	Chicago & North Western	544	33	6
	Norfolk & Western	508	19	14
	Rock Island	493	18	43
	Milwaukee Road	483	11	40
	Burlington Northern	455	22	51
	Santa Fe	450	40	139
	Illinois Central Gulf	450	6	24
	TOTALS:	3,934	167	362
Kansas City to Dallas/Ft. Worth	Kansas City Southern	760	12	26
	Rock Island	588	17	32
	Missouri Pacific	586	19	26
	Santa Fe	584	44	45
	St. Louis-San Francisco	549	16	26
	Missouri-Kansas-Texas	506	12	34
	TOTALS:	3,573	120	189

[1, 2] See footnotes at end of table.

Table 5.—Corridors of Excess Capacity—Continued

Corridor	*Rail Routes*	*Route Miles*[1]	*Average Line Density (MGT)*	*Line Capacity (MGT)*[2]
Dallas/Ft. Worth to Houston	Santa Fe	338	27	48
	Missouri-Kansas-Texas	322	11	22
	Rock Island	289	7	29
	Missouri Pacific	279	16	37
	Southern Pacific	266	20	21
	TOTALS:	1,494	81	157
Chicago to Omaha	Burlington Northern	485	35	46
	Illinois Central Gulf	478	12	24
	Rock Island	472	19	37
	Milwaukee Road	467	12	32
	Chicago & North Western	463	45	69
	TOTALS:	2,365	123	208
Kansas City/ Omaha to Colorado	Missouri Pacific	622	13	62
	Santa Fe	718	24	34
	Union Pacific (from Kansas City)	635	9	30
	Burlington Northern	630	18	57
	Rock Island	586	8	40
	Union Pacific (from Omaha)	561	55	57
	TOTALS:	3,752	127	280
Chicago to Minneapolis	Rock Island	485	15	48
	Burlington Northern	435	38	49
	Soo Line	435	19	24
	Chicago & North Western	412	19	51
	Milwaukee Rd	404	20	100
	TOTALS:	2,171	111	272
Chicago to St. Louis	Chicago & North Western	318	33	27
	Illinois Central Gulf (ex GMO)	272	10	43
	Missouri Pacific	272	18	53
	Norfolk & Western	271	13	65
	Illinois Central Gulf (ex IC)	269	21	26
	TOTALS:	1,402	95	214
Chicago to Detroit	Chesapeake & Ohio	314	24	21
	Grand Trunk Western	301	22	70
	Norfolk & Western	279	9	37
	ConRail	264	30	43
	TOTALS:	1,158	85	171

[1] Because some of the line segments comprising the through routes in Corridors of Excess Capacity serve as parts of through routes for more than one corridor, the "TOTALS" for each of the individual corridors are not additive.

[2] Due to the methodologies employed for calculating line density and line capacity, there are five instances where density exceeds capacity. Density was computed as a weighted (by mileage) average for the entire line, whereas capacity was defined by the constraining link. As a result, the lowest capacity link serves as the throughput capacity without modification, but the lowest density segment is simply one factor in the overall line density.

The results of these three tests, when added to the designations made on the basis of freight density alone, are presented in Table 6 below. In addition, the total mainline and branchline system is depicted on the National Network Map which is found in Volume II of the Report.

Table 6.—Summary of Rail Mileage Designations by Category

		Route-Miles (in thousands)		*Percent of Total Route-Miles*
CATEGORY A MAINLINES		33.0		17.1
High Freight Density Test	30.0		15.5	
High Passenger Frequency Test	1.5		0.8	
Service to Major Markets Test	1.5		0.8	
CATEGORY POTENTIAL A MAINLINES		22.5		11.6
CATEGORY B MAINLINES		42.0		21.7
CATEGORY A BRANCHLINES		42.5		21.9
CATEGORY B BRANCHLINES		49.5		25.6
CATEGORY DEFENSE-ESSENTIAL BRANCHLINES		4.0		2.1
TOTAL		193.5		100.0

APPENDIX 1

Density

This appendix examines several key factors which were considered by the Department in establishing the density standards. The initial section explains the present density structure of the Nation's railroad system. The second section discusses the critical relationship between density and maintenance-of-way costs. Next, theoretical examples are developed which show that substantial cost savings can be achieved through the aggregation of scattered flows. Finally, several actual railroad examples are examined to test the practical application of the theories developed.

Functional Definition of Density

Density is measured in gross ton-miles per mile of line per year—referred to as "gross tons". It includes the net tons of freight combined with the cars to carry it, the locomotives to pull it, nonrevenue equipment and empty car movements.

Present Density Structure

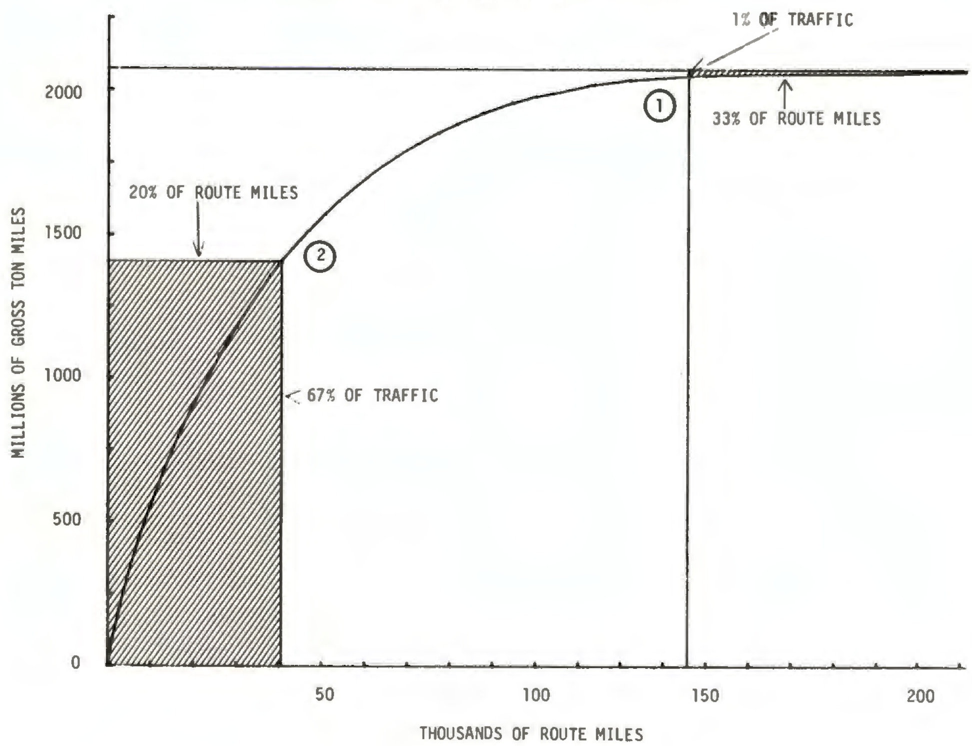
In 1974 the railroads generated approximately two trillion gross ton miles on a national Class I rail system encompassing approximately 193,500 route miles. The "average" mile of track in the United States therefore produced 10 million gross tons. This equates to about five average-size trains per day. These averages, however, are very misleading when viewed by themselves.

If the actual distribution of total gross ton miles versus the mileage upon which it is generated is examined (see Figure 1), it becomes readily apparent that large segments of the system on the low density end carry an almost imperceptible level of traffic. Almost one-third of the rail mileage carries only one percent of the total gross ton miles. At the other end of the scale, about 20 percent of the rail mileage carries fully two-thirds of the total rail traffic of the Nation. When one considers the declining financial condition of the industry together with the continuing deterioration of track, it becomes very apparent that limited resources are being stretched too far.

In terms of rail operations, when traffic density is less than 1 million gross tons, it generally signifies a line which can only support a local peddler freight with once-per-day service or even less. The train provides the slowest service to customers, since it must do all switching chores at both ends of the route as well as in between.

FIGURE 1

A CORRELATION OF RAIL FREIGHT CARRIED AND ROUTE MILES FOR CLASS I RAILROAD LINES IN THE UNITED STATES



As traffic builds, specialization of trains is possible. At the next level of density, up to 5 million gross tons, enough traffic exists to run higher frequency with some trains stopping only at intermediate yards and major shippers. Building traffic further justifies yards with greater classification specialization and higher throughput. Classifications can be made for more distant destinations, thus allowing many intermediate yards to be completely bypassed.

Cost of Maintenance as Related to Density

For average track, the cost of maintenance is roughly divided between a fixed cost and a variable cost based on the movement of traffic.[1] This cost equation recognizes decreasing unit costs as tonnage increases and therefore makes it attractive to operate heavy traffic levels over few lines rather than light traffic levels on a dispersed system.

In discussing the relationship of traffic density and maintenance costs, two key facts have been identified:

1. The unit cost of maintaining a rail line on a normalized basis increases as the density falls.[2] The low maintenance costs cited for some low-density lines reflect the fact that maintenance is being deferred and the lines will ultimately become inoperable.

2. Considerable maintenance expense can be saved by combining traffic flows over parallel lines into a more limited route structure.

These conclusions are drawn from recent work on track maintenance costs completed for the Federal Railroad Administration.

Since the industry's costs are heavily tied to its facilities, its performance is more closely associated with the cyclical ups and downs in the economy than other modes whose costs are more variable. Because profits, even in the best of times, were not adequate, many railroads have not been able to survive economic downturns. At one point in the 1930's, one-third of all rail mileage was owned by carriers in reorganization. Then World War II brought traffic levels that produced profits that not only pulled most carriers out of bankruptcy, but also allowed significant investment to be put into plant and equipment rehabilitation and improvement.

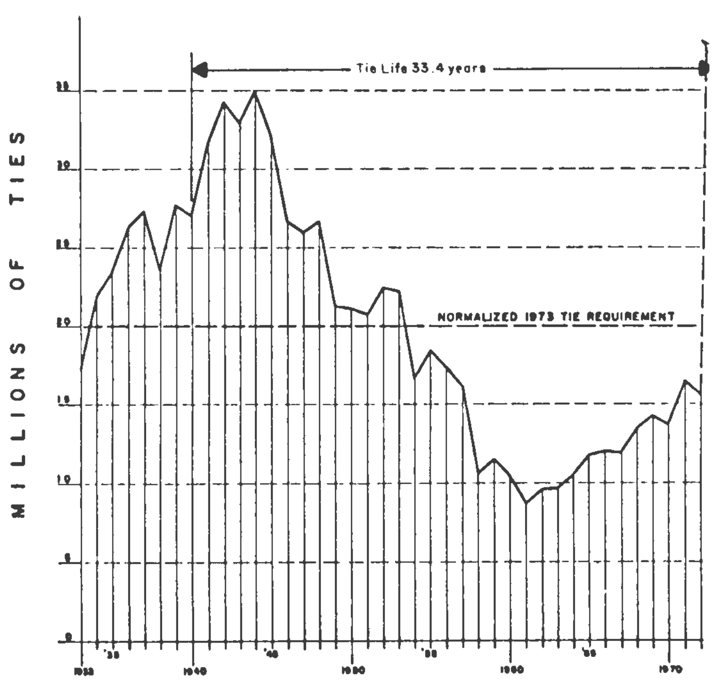
Increasing competition and the downturns in the economic cycle brought the post-war rehabilitation surge to an end by the early 1950's. Much of today's problem of deteriorated right-of-way facilities began at this point since subsequent earnings were inadequate to provide the necessary funding for facility improvements except for a few of the strongest carriers.

Figures 2 and 3 illustrate the tie and rail shortfalls for Class I railroads which have generally coincided with the economic ups and downs. Since 1953, however, tie and new rail replacements have failed to keep pace with normal requirements, even during the better years for the industry. This phenomenon was not restricted to the Eastern bankrupts, and can be found in the Western and Southern regions also.

This problem of deferred maintenance and the resulting decline in the quality of the track structure reached a critical stage on many of the bankrupt carriers in the Northeast and Midwest region. The impact on service quality and efficiency was so great that only the provision of substantial Federal financial assistance could reverse the trend. The problem is also reaching an acute stage on many of the Midwestern granger railroads. Even some lines of "strong" solvent carriers suffer from maintenance deferrals, although the impact on their service quality and efficiency is not serious at this time. The trends, however, indicate that the problem is growing and could reach a critical point in the not too distant future.

The deferral of maintenance on many lines represents a necessary economic response to declining levels of demand. Not all (perhaps not even a majority) of those lines with serious maintenance deficiencies should be rebuilt. The challenge to both private sector and government-assisted financing is to identify those lines which still provide potentially economic or socially necessary services and to concentrate available funding, material, and manpower on rehabilitating them.

FIGURE 2



TIE INSTALLATIONS AND
TIE REQUIREMENTS

Thomas K. Dyer, Inc.
Lexington, Mass.

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[1] For average track, median costs are associated with subgrade stability, ballast, ties, track inspection, rail wear, lining, and surfacing.

[2] Track is maintained on a normalized basis when one-half of the useful life of the track components remain.

FIGURE 3

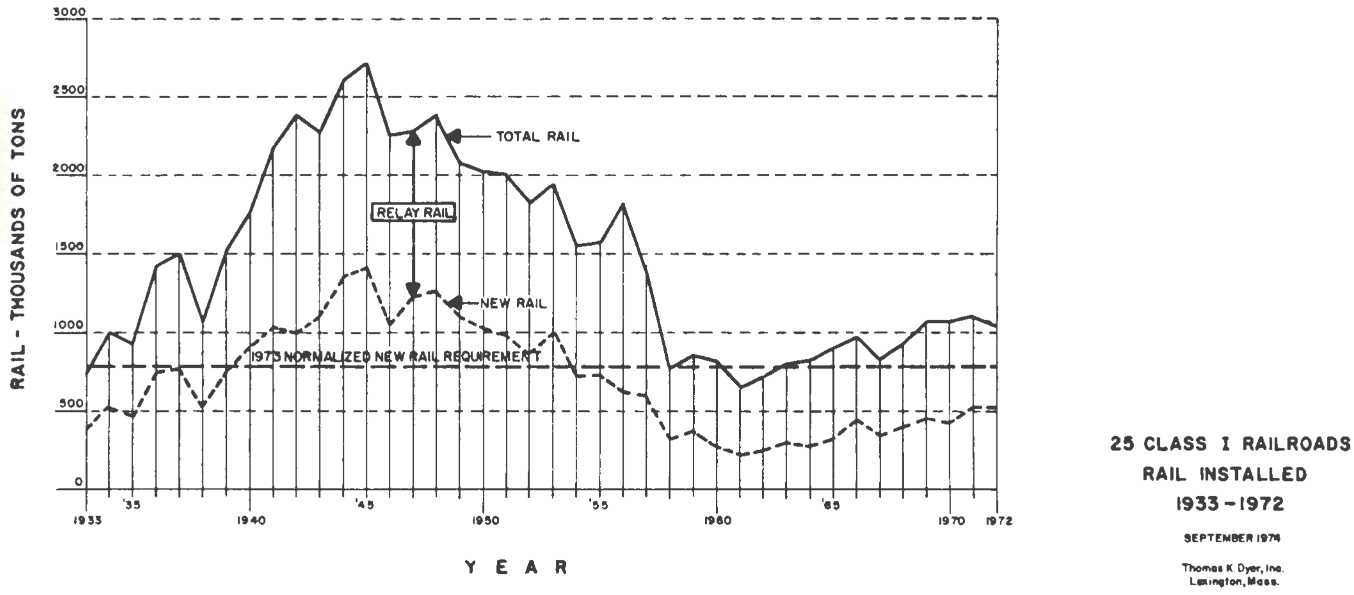
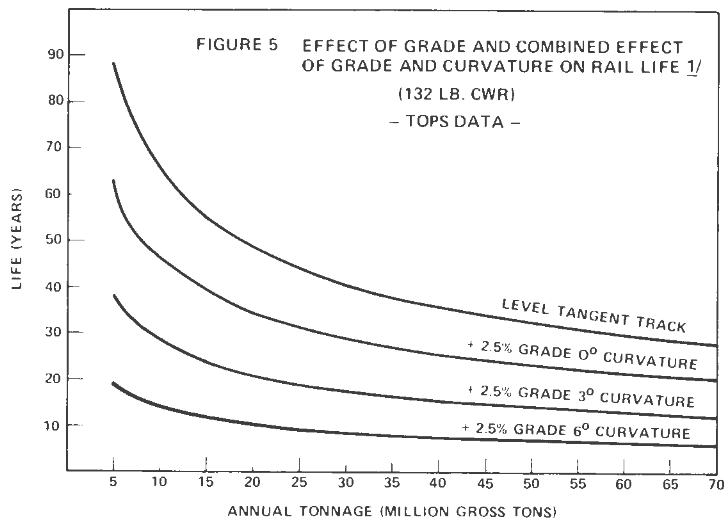


Figure 4 illustrates the major track components and the variables which affect the cost of maintaining the track. It is subjected to an extremely wide range of natural and traffic-imposed forces and exhibits a cost pattern based on these variants. Rail, for example, may last 20–30 years in a straight and level stretch where traffic is not too heavy. But with sharp curves, steep grades and heavy traffic, it could require renewal in less than two years (Figure 5). Furthermore, new rail laid upon poor ties and ballast can be ruined in a matter of days by moderate traffic levels due to poor support.



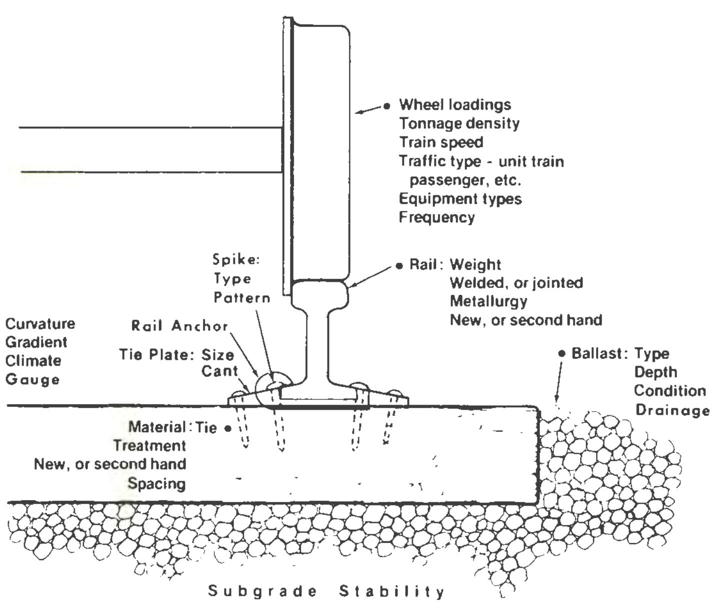


FIGURE 4 Factors Affecting Roadway.

The previous overview is confirmed by empirical studies on the subject and their applications. Two studies on the matter are considered here. One was conducted by TOPS On-line Services, Inc. for the Federal Railroad Administration, while the other was done by Thomas K. Dyer, Inc. for the United States Railway Association.[4] The TOPS study is based largely on Southern Pacific's experience, while the Dyer work examined the Northeastern railroads.[5] Each study has demonstrated the same general trend, although in varying absolute values. The Dyer work was done in what has been traditionally a high-cost region of the country. Taken together the analysis begins to bracket the question of the importance of density to maintenance-of-way expenses. Both illustrate that the cost of maintenance increases as the tonnage over the track increases (assuming

[4] Procedures for Analyzing the Economic Costs of Railroad Roadway for Pricing Purposes, Final Report, January 1976.

[5] Trackage Rights Study, Thomas K. Dyer, June 1975.

other variables remain about equal), but at a decreasing rate. This is illustrated in Figure 6.

An examination of the data summarized in Figure 7 reveals that two breakpoints are important in terms of the effects of density on maintenance costs. First, on the high side of the density scale, although unit economies continue to increase, the *rate* of increase begins to flatten out at 20 million gross tons. At the lower end of the scale, some taper begins at 10 million gross tons, while a severe change occurs at around 5 million tons. The unit costs of maintenance decline rapidly with density until the 20-million-gross-ton level is reached. Beyond that, unit costs flatten out with some diseconomies over 40 million gross tons by Dyer and increasing economies by the TOPS report. The outcome appears to be dependent upon the effects of congestion. Dyer viewed density as a linear function with the number of trains operated. However, TOPS found on the Southern Pacific that train frequency increased only slightly over the range of densities from 30–60 million gross tons (Figure 8).

This categorization of primary mainline does not, of course, represent an absolute criterion for requiring any specified level of track rehabilitation. Need for rehabilitation is dependent upon a number of other variables, such as existing condition, service levels, and available alternatives. Such considerations will be fully addressed in the Department's Capital Needs Report required under Section 504 of the Act and due January 30, 1977.

FIGURE 6
Comparison of Annual M of W and S Costs as a Function of Annual Tonnage - AAR and Roadway Study "Average Routes"

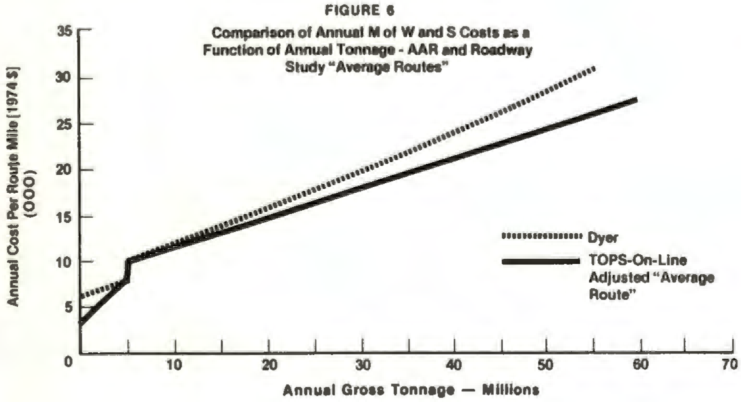


FIGURE 7
Comparison of Unit Track Maintenance Costs - Dyer and Roadway Study

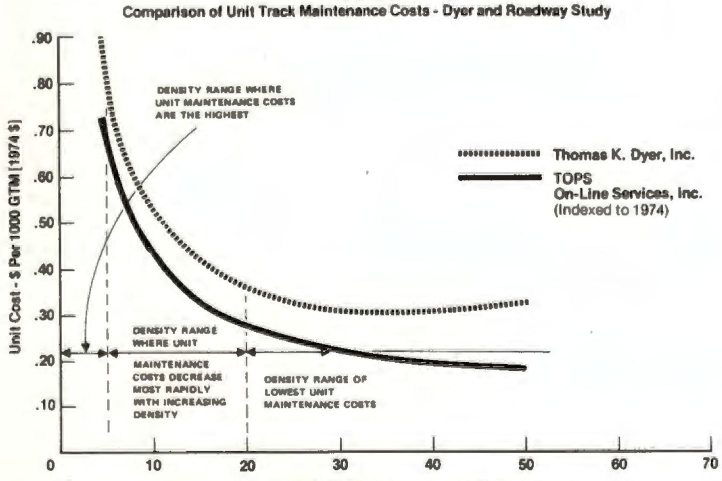
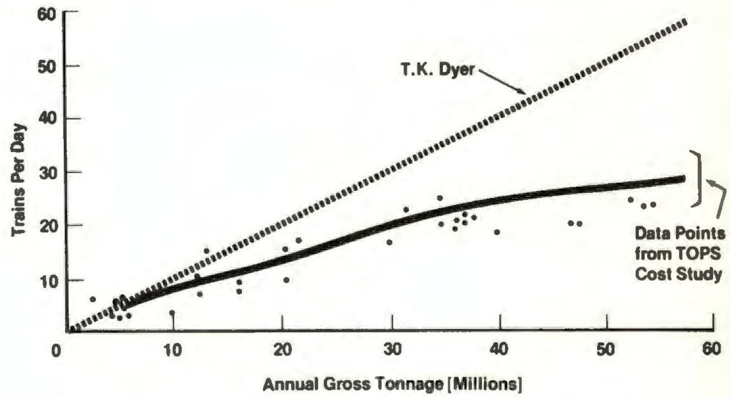


FIGURE 8
Trains Per Day as a Function of Annual Tonnage

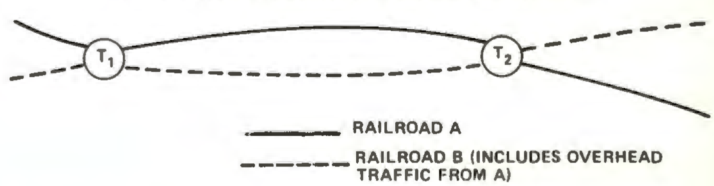


The implications of both studies can be applied to specific operating situations. The following illustrates several hypothetical examples and then applies the formulas to some specific examples of rail consolidations—Southern Pacific and Western Pacific in Nevada and the Western Maryland and Baltimore and Ohio in Maryland and Pennsylvania.

Theoretical Example of Analytical Results

The following expanded example illustrates the available options. To illustrate the analytical results, assume two essentially parallel lines with equal density. Two decisions are possible. Downgrading one for only local service requirements, or if no local service is needed, abandon one line. All traffic would then be moved over the surviving line between the common junction points.

SINGLE TRACK MAINLINE RATIONALIZATION SCHEME



Example A. Current Density (Base Case)

Maintenance-of-Way Costs per mile (000) and Traffic Density (Millions of Gross Tons)—Single Track, Signalled Lines.

	Cost	*Density*	*Cost*	*Density*	*Cost*	*Density*	*Cost*	*Density*
Railroad A	$10	5	$12	10	$15	20	$18	30
Railroad B	10	5	12	10	15	20	18	30
Totals	$20	10	$24	20	$30	40	$36	60

Example B. Downgrade one parallel line

Maintenance-of-Way Costs per mile (000) and Traffic Density (Millions of Gross Tons)—Single Track, Signalled Lines.

	Cost	*Density*	*Cost*	*Density*	*Cost*	*Density*	*Cost*	*Density*
Railroad A	$ 5	1	$ 5	1	$ 5	1	$ 5	1
Railroad B	11.5	9	15	19	21	39	28	59
Totals	$16.5	10	$20	20	$26	40	$33	60
Savings made from Base Case	$ 3.5		$ 4		$ 4		$ 3	

Example C. Abandon one parallel line

Maintenance-of-Way Costs per mile (000) and Traffic Density (Millions of Gross Tons)—Single Track, Signalled Lines.

	Cost	Density	Cost	Density	Cost	Density	Cost	Density
Railroad A	$ 0	0	$ 0	0	$ 0	0	$ 0	0
Railroad B	12	10	15	20	22	40	29	60
Totals	$12	10	$15	20	$22	40	$29	60
Savings made from a Basic Case	$ 8		$ 9		$ 8		$ 7	

This typifies many cases found today throughout the railroad industry. Most of these situations involve parallel routes where the average densities are at the lower end of the spectrum, making traffic transfers less difficult to implement.

On the other hand, downgrading or eliminating parallel routes each with 20 million or more gross tons would likely be counterproductive since additional track capacity would probably need to be constructed. In this instance, the investment could not be justified on maintenance savings, and total maintenance costs would probably increase.

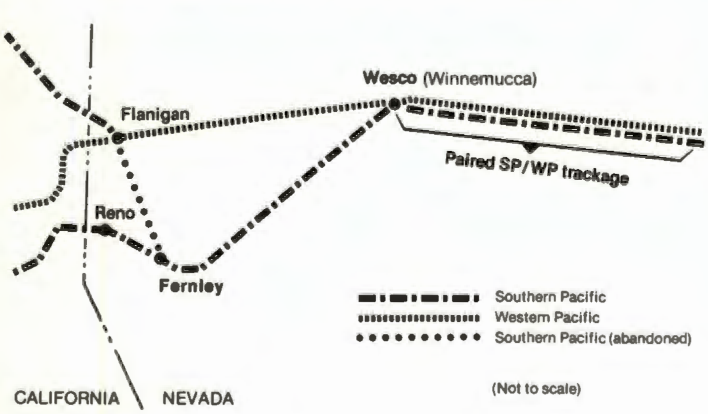
Practical Application of Line Consolidation

1. Southern Pacific between Flanigan and Winnemucca, Nevada.

Several years ago, the Southern Pacific abandoned its own line between Flanigan and Fernly, Nevada, and gained use of the Western Pacific line between Flanigan and Weso (Winnemucca). This consolidation not only allowed the SP to drop 58 miles of line extending through the Nevada desert, but shortened the circuity for SP trains between Flanigan and Weso by 50 miles, or 24 percent. The projected savings[6] in the first year of joint operation were over $700,000, shared equally between the SP and WP.

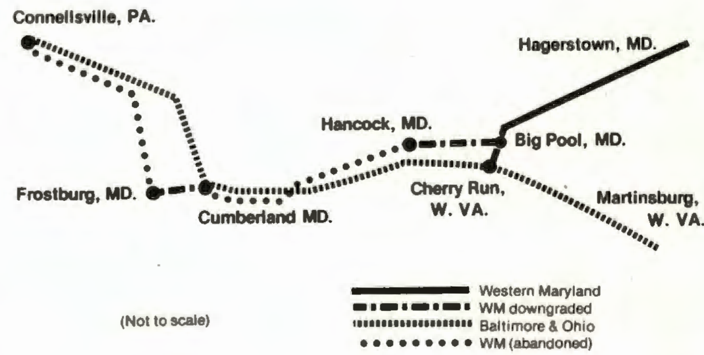
Current savings from maintenance-of-way expenses are estimated to be $0.6 million annually when the SP cost decreases are offset against the increased costs on the WP route. Savings in operating costs for the shorter routing as well as the elimination of rehabilitation cost for the abandoned segment have not been updated to account for the inflationary impact of the post-abandonment years. One-time capital costs were incurred to improve the connection at Flanigan; however, the abandoned line was in poor condition and would have required rehabilitation costs considerably higher than the connection.

[6] Based upon the Trackage Rights Study methodology.



2. Western Maryland between Big Pool, Maryland, and Connellsville, Pennsylvania.

As part of the consolidation of the Western Maryland into the Chessie System, approximately 150 miles of closely parallel lines, often separated only by a river, between Big Pool (Cherry Run, West Virginia) and Connellsville, Pennsylvania—have been either abandoned or downgraded by shifting former WM traffic to the Baltimore and Ohio route.



Estimated net annual savings in maintenance (1974 dollars) are over $0.9 million when compared to independent operation of each line.[7]

Saving by WM	$1,431,000
Additional B&O Expenses	512,000
	$ 919,000

Paired Trackage

The previous discussion has concerned itself with the consolidation of underutilized lines. However, a few lines are now at capacity or could be with a relatively modest increase in traffic. Capacity constraints are generally found on single track segments with centralized traffic control signal systems. Additional capacity can be built into these lines, but not without constructing additional track, a relatively costly investment, given the financial resources of most railroads.

However, through cooperative ventures, two or more railroads can share parallel lines to create a multiple track operation. Two notable examples are the paired trackage agreements between Winnemucca and Wells, Nevada, and Denver and Pueblo, Colorado.

Between Winnemucca and Wells, the Southern Pacific and Western Pacific each own a single track, but all eastbound traffic uses the Western Pacific line, while trains heading west use the Southern Pacific. If these railroads did not share the other's facilities, the WP line would be considerably underutilized, and the SP line would be at capacity. As it is, the paired trackage operation allows considerable train operating flexibility, a reasonable level of utilization and a future growth capability for both roads.

The case in Colorado is similar to the SP/WP arrangement, except that three carriers (the Rio Grande, Santa Fe,

[7] Based upon the Trackage Rights Study methodology.

and Colorado and Southern) use a mostly double track route. One track is owned by the Santa Fe and the other by the Rio Grande, while the C&S has trackage rights. At the current traffic levels, no one carrier has enough traffic to generate adequate utilization of even a single track, CTC line. However, the combination of three carriers' traffic greatly enhances the density over this segment.

The opportunities for paired trackage do not exist everywhere, but where they do, they represent the lowest cost method to expand capacity and increase operating flexibility.

SUMMARY

To summarize the preceeding discussion, several points relating to line density are pertinent:

1. Large amounts of traffic move on a rather small amount of the total rail plant.
2. Increasing line density leads to a decrease in unit costs for track maintenance.
3. Additional concentration of traffic on major mainlines to gain both cost and service benefits appears both feasible and desirable.

APPENDIX 2

Corridors of Excess Capacity

Throughout the northeastern and granger regions of the country a critical problem confronting the rail industry is underutilization of facilities. The bankruptcy of the northeastern roads brought the light density branch line side of the issue into clearer focus. but. because of the higher costs associated with the mainline facilities. a thorough investigation must now be undertaken of this area.

As discussed in the previous Appendix. railroad costs are of a highly fixed nature due to the private ownership of roadway. Since railroad costs are directly related to capacity. which must accommodate traffic peaking, while revenues are associated with density. it is essential that an appropriate equilibrium between capacity and density is maintained. Consequently. quantification of the disparity between capacity and density is crucial to an assessment of the degree to which mainline facilities are underutilized and some costs needlessly incurred. Socially and economically unjustified investments in mainline facilities exist most frequently in freight corridors where available traffic does not require more than two mainline routes. However. in many areas excess capacity develops, with the result that realizable benefits are not provided. and in fact service deterioration sets in.

In the Department's judgment the following criteria define a corridor of excess capacity:

(1) The corridor is served by three or more mainline through routes providing through service.

(2) The total capacity of the mainline through routes exceeds their annual density by at least 50 percent.

(3) A mainline through route is included when it is less than 50 percent longer than the shortest through route.

The Parametric Line Capacity Analyzer

To handle the capacity side of the analysis. the FRA utilized the Parametric Line Capacity Analyzer, a tool developed for the FRA in 1973. which is based upon a minimum-level-of-service (MLS) concept of capacity. USRA also used the Analyzer during development of the *Final System Plan*.

The MLS capacity has been defined for analysis as: the volume of trains at which a statistically significant (less than 5 percent) number of "critical" trains will exceed some maximum acceptable trip time over the line. "Critical" trains are those which have been determined. by examination of the lines being analyzed. as most likely to constrain capacity. These will vary somewhat from line to line, depending upon the characteristics of the line being analyzed. How critical trains are determined and what a maximum acceptable trip time is will be discussed later.

Determination of the capacity of a line. once a "maximum acceptable trip time for critical trains" has been defined, is done using a parametric analysis of physical and operating characteristics of the line. The parametric analysis was prepared using a train dispatching simulation, to analyze a wide range of rail line physical and operating characteristics. Both the train dispatching simulation and the parametric analysis have been validated on a number of actual rail line operations and found to be quite accurate at their relative levels of capabilities. The parametric analysis can be considered to be accurate within 20 percent.

Determining Critical Trains and Defining Maximum Acceptable Trip Time

The MLS determination of capacity requires that critical trains be identified and a maximum acceptable trip time for these trains be defined in order to identify line capacity. Using the MLS concept. it is possible that several capacities can be determined for the same line and operation depending upon which trains are thought to be critical. It is also possible to change the capacity by changing the maximum acceptable trip time. For most lines the constraints are obvious. For some lines it is necessary to analyze the line with several sets of constraints to determine which is most reasonable. Conditions creating these problems can be categorized.

For most lines the overriding constraint is getting the lowest priority through trains over the line without "outlawing" (exceeding the hours of service limitation). The critical trains are generally the through freights which make set-outs and pick-ups at intermediate yards (leaving cars or picking up cars for local switching or for other through trains). Such trains are usually given lower priority than major freights and are usually heavier and slower than others (except unit trains which do not usually stop between crew changes). These critical trains usually require the most time to cover a subdivision (between two crew changes). The maximum acceptable trip time then becomes 12 hours minus the terminal time for the crew.

Terminal time consists of the time for the crew to pick up its train. to make a brake test. if necessary, and to tie up the train when arriving at the terminating yard. It also includes the time lost by a crew between its calling time and the time the train is ready for the crew. Crews are called to go on duty at a time the crew clerk estimates will be optimum overall. He attempts to minimize crew waiting time, but he also does not want to have the train waiting for the crew to arrive. Analysis of actual data indicates that total terminal time is about 2 hours in most cases, except where one or both crew change points are at major yards, in which case two and one-half hours are consumed in the terminals. The remaining time (9.5 to 10 hours) then becomes the maximum acceptable trip time.

Freight crews are paid on a combination mileage and time basis. The crews receive a full day's pay for anything up to 100 miles or eight hours. If either limit is exceeded, the additional time or mileage is prorated, so that a crew running either 150 miles or 12 hours, or both, would receive one and one-half day's pay. A crew running only 100 miles, but requiring 12 hours, would receive one and one-half day's pay, although only producing one day's mileage. Thus, it is more economical, between 100 and 150 miles, to prorate the maximum acceptable trip time by the length of the run, such that the trip time plus terminal time is proportional to the mileage.

For crew runs less than 100 miles, crews will still receive at least 8 hours pay. Most main line operations with crew runs which are substantially less than 100 miles can expect to turn most crews within the 12-hour limit, i.e., have them make a round trip to reduce crew costs. In these cases, the critical trains are not necessarily those which make set-outs and pick-ups, since they can consume 8 hours in one direction without incurring any additional crew costs. The critical trains are those which must make it over the line in less than 6 hours (including crew terminal time) so that crews can be returned without outlawing. Analysis indicates that capacity is substantially lower with the round-trip criteria, even with higher priority trains, than with the working through freights.

The above factors are critical for defining capacity. In some cases it is still possible for them to be invalid. A few lines have been observed to be operating above their calculated capacity. In virtually every case, the railroad was accepting a substantial number of recrew operations. It has not been determined if the railroads involved have made an economic decision to operate this way. On other lines the capacity indicated by this analysis is considerably greater than could probably be realized under the railroads' existing operations. The reason is not that the railroad is operating the line poorly, but that the level of service implied by the high capacity operation would be so much lower than that now provided, that trip times of important high priority freights would be severely degraded. In addition, because the constraining link is used to determine route capacity over the full corridor length, there are a few cases where actual annual density exceeds the analyzer line capacity calculation. In these cases, apparently the carrier has applied operating techniques in other portions of the route to overcome congestion in the constraining link. This approach is consistent with the Department's attempt to be conservative on all line capacity analysis.

Parametric Analysis Characteristics and Assumptions

The parametric analysis is a simplified procedure for estimating line capacity. Its primary purpose is to make preliminary estimates of line capacity for analysis such as these, for examinations of a wide range of options for line changes before more detailed studies are performed, or for similar purposes. It cannot be as accurate as other more detailed (but time consuming techniques) especially when pushed beyond its design limits. Therefore, the following section describes the characteristics of the parametric analysis: the parameters for which it is designed, the ranges of parameters, and the assumptions about the parameters used in this analysis.

General Response Characteristics

The parametric analysis consists of two basic relationships. The first relates average delay per train to line characteristics and traffic volume. The second determines capacity as a function of maximum acceptable delay, and average delay per train. These two relationships are used together to determine capacity of any particular line segment.

Two characteristics of the first relationship should be appreciated to understand the nature of the parametric analysis and its limitations. First, the average dispatching delay (as distinct from planned work stops) a train can expect to receive when traversing a line is assumed to increase in direct proportion to the number of trains per day over the line. This has been found to be true over a wide range of values; however, some obvious limitations occur. If the line is so short and traffic levels so low that each train can get over the line before another starts, no interference occurs. If traffic levels are so high that a breakdown of flow occurs, delays will be much higher than estimated. The latter will only occur, however, when physical capacity is less than capacity constrained by other causes as discussed before. Thus, the proportional delay assumption is fairly accurate for almost all lines.

The second characteristic which applies to the average delay relationship is that capacity-affecting factors are approximately additive rather than multiplicative. However, it should be noted that the amount of capacity added by a given factor is not necessarily uniform over the range of values for that factor. For example, an addition of 10 percent double track is far more important on a line that is almost all double track than it is on a line that is almost all single track.

The relationship between maximum trip time and average dispatching delay, which determines MLS capacity, is a squared relationship; maximum trip time increases as the square of the average delay (above some minimum trip time). Since maximum trip time is given when trying to estimate capacity, the average delay at capacity (i.e., maximum acceptable average delay) becomes a square root function of maximum acceptable trip time. The relationship used to calculate capacity is:

$$C = \frac{A_c}{K} \quad x \quad \frac{100}{L}$$

where:

C = capacity of a line segment in trains per day,
A_c = average delay per train at capacity,
K = the delay characteristic of the line, and
L = the length of the line.

The value for A_c is determined from the maximum acceptable trip time and other factors such as speed, and scheduled delays. The K value is the average amount of dispatching delay each train can expect to receive for each additional train on the line. For example, if K=0.05, and 20 trains are operated each day, then each train will average 0.05 x 20 or 1.00 hours of dispatching delay. If 21 trains are operated, then each train will be delayed about 1.05 hours. Note that total delay increases as the square of the number of trains, from 20 hours (20 x 1.00) to 22.05 hours (21 x 1.05). The K values are normalized for a 100 mile line; thus the 100/L is an adjustment for the specific length of line.

Assumptions for Corridor Analyses

Two sets of assumptions will be described; those affecting K and those affecting A_c. The K value is specific to a line and the way it is operated and, in effect, represents the rate at which service deteriorates with increasing traffic. The characteristics which determine K are:

Average running speed;
Siding or crossover spacing;
Signal spacing;
Train length;
Uniformity of train speeds;
Directional imbalance of traffic;
Proportion of multiple track;
Train priorities;
Uniformity of siding spacing;
Peaking of traffic; and
Occurrence of incidents (interlocking delays, signal & equipment failures, pull aparts, detector readings, etc.).

Characteristics which affect A_c are:

Crew districts (length of run);
Scheduled stops (work, brake cooling, helpers);
Interlocking delays, other incidents;
Average running speed;
Terminal delays (crew call, wait for train, signoff times); and
Single or double track.

Some factors are important to both values, and are only discussed once below.

Primary Assumptions

Since the purpose of this analysis is to examine the potential for reducing the number of main lines, several basic assumptions were guided by this purpose. No major improvements in line facilities (additional trackage, curve straightening, grade crossing elimination, etc.) were anticipated, although it was assumed that substandard track would be brought up to timetable speeds. Train departures would be adjusted to maximize the use of the line. Trains would be powered adequately, again to maximize use of the line.

Average Running Speed and Uniformity of Speeds

Average running speed was computed from timetable speed limits, with specific allowances for permanent slow orders and a general allowance for grades, except where specific heavy grades (greater than 1.0%) were identified. With potential consolidations of lines, it was assumed that all trains would be powered sufficiently to minimize the impact of slow speeds. Trains were assumed to be powered to maintain a reasonably uniform mix of train speeds. A power-to-weight ratio of 1.5 horsepower per ton was assumed, except for mountainous areas, where 2.0 horsepower per ton was assumed. Even where higher speeds are permitted by timetable, a maximum of 50 mph was assumed for critical trains.

Train Priorities

Trains were assumed to have a reasonable mix of priorities, however, since train speeds were reasonably uniform, no specific provisions were made for passenger trains. Other studies have shown that giving passenger trains absolute priority may consume a capacity equivalent to four freight trains for each passenger train. Where significant speed differences occur, passenger trains may consume even greater quantities of capacity.

Train Lengths

Train lengths were assumed to be constrained such that all trains could fit into 90 percent of the sidings. Trains longer than most sidings have a severe effect on line capacity. Throughput, in terms of cars per day, was then limited to the number of trains per day times the maximum train length. Increasing train length would reduce car throughput since the number of trains which could be handled would decrease faster than the length of trains would increase. Longer trains also have a higher rate of incidents which also further reduces capacity.

Peaking and Directional Imbalance of Traffic

It was assumed that no significant imbalances or peaks in traffic occurred. Since the purpose of the analysis is to examine potential reduction in duplicate lines, rescheduling some trains would be necessary to maximize use of the line. This does not imply completely uniform dispatching only that no major imbalances occur.

Physical Characteristics of Lines

Average siding spacing and proportions of single and double track were explicitly taken into account in the analysis. Signal spacing was assumed to average about two miles, except on certain high speed lines. Signal spacing is primarily a capacity constraint on high-speed double-track lines. When timetable speed limits for freight trains were greater than 55 mph, with few speed restrictions, signal spacing was increased to four miles to account for the much greater stopping distance of high speed freight trains.

Occurrence of Incidents

"Incidents" includes a large number of types of occurrences which delay trains. Any type of unplanned delay on a line other than that due to traffic on the line falls into this category. These include:

- Cross traffic at interlockings;
- Signal failures;
- Air brake failures;
- Pull aparts (coupling failures);
- Locomotive failures;
- Hot boxes (axle bearing failures);
- Dragging equipment;
- Hot box and dragging equipment detector failures;
- Accidents; and
- Train stallings on grades.

The rate at which these occur and their duration are important factors in delay to not only the trains affected, but also other trains which may be impacted by the delay of the affected trains. The rate described in the "Parametric Analysis of Railway Line Capacity" was used. This is typical for many actual rail lines observed and constitutes one failure of an average duration of about 30 minutes per 540 train miles. Interlocking delays were included separately in the determination of A_c. Ten minutes were added to the time of the critical train for each interlocking up to 20 minutes.

Crew Districts

Crew districts were determined by FRA, which consulted the railroads when necessary. For those cases where several length crew runs were involved, the most common one was used. Where junctions of two routes are involved, and through crews operated both ways, two capacities might result. The lower of the two was used in determining controlling capacity.

Scheduled Stops

The critical trains were defined as those doing work along the way. Working freights were assumed to do set-outs and pick-ups of 45 minute duration each at half the yards on a line. No more than 90 minutes of work would be performed by any through train, it was assumed. Additional time for helpers and brake cooling on steep grades was allowed if necessary.

Terminal delays were based upon actual observations of several railroads. Terminal delay consists of crew call time, train assembly and brake test time (if necessary) and signoff time. Crew call time is due to the fact that when road crews are called, it may not be clear when the train will be ready to depart. Two hours notification of the crew are usually required before they must be at work. If the train is originating, the crew often must pick up its locomotives, couple to the train, and make a brake test before departing the yard. If the train is a relay train (continuing through with only a crew change), the crew must be ready well before the train arrives at the crew change point. When leaving the train, a crew may have to remove the locomotive and run to the engine house, or be shuttled by highway to the crew quarters. On the average, this non-running time consumes two hours if both terminals of the crew run are at small yards, and two-and-a-half hours if a major yard is involved at either end.

Availability of Capacity

The capacity calculated in this analysis must be allocated to all the uses which must be made of the line. In addition to through freights, a number of other uses compete for the limited capacity. The list of uses includes:

- Through freights;
- Way (local) freights which service industries along the line;
- Passengers (which may consume four or more units of capacity each);
- Switchers operating near yards along the line;
- Work trains and equipment for maintaining the line; and
- Hi-rail or other on-rail inspection vehicles.

In addition, major disruptions of services such as washouts or major accidents can remove a line from service for several days. Recovery from such catastrophes can usually be made within the physical capabilities of a line if a MLS concept is used to define capacity.

The model allows rigorous examination of route capacity by separating each route into a number of discrete sections on the basis of crew change points, major junctions, changes from single to double track (or vice-versa) and points of major physical characteristic changes. Consequently, the model submits a separate capacity for each segment of the route. FRA, on the other hand, assessed the capacity for each segment of the entire route by seeking the bottleneck link and designating the line capacity on that basis. Therefore, in every instance the capacity of a particular line and corridor is stated by the FRA in the most conservative fashion, which subsequently understates the degree to which various rights-of-way are underutilized.

Typical Example of a Corridor of Express Capacity

The railroad route between Chicago and Omaha/Council Bluffs is marked by redundant service provided by five Class I railroads. (See map.) The shortest of the lines, 463 miles, is run by the Chicago and North Western (CNW), and the longest, 485 miles, belongs to the Burlington Northern. Between those extreme lengths are the Chicago, Milwaukee, St. Paul and Pacific (MILW), Chicago, Rock Island and Pacific (CRIP), and the Illinois Central Gulf (ICG).

Assessing the five lines between Chicago and Omaha/Council Bluffs is easily done by an examination of three categories. First, physical plant, track and signal systems, indicate the railroad's degree of modernization. Second, factors such as line length and transit time suggest the service level for shippers. Finally, density indicates the tonnage presently handled by the road. With these elements in mind, a short analysis of the five lines follows.

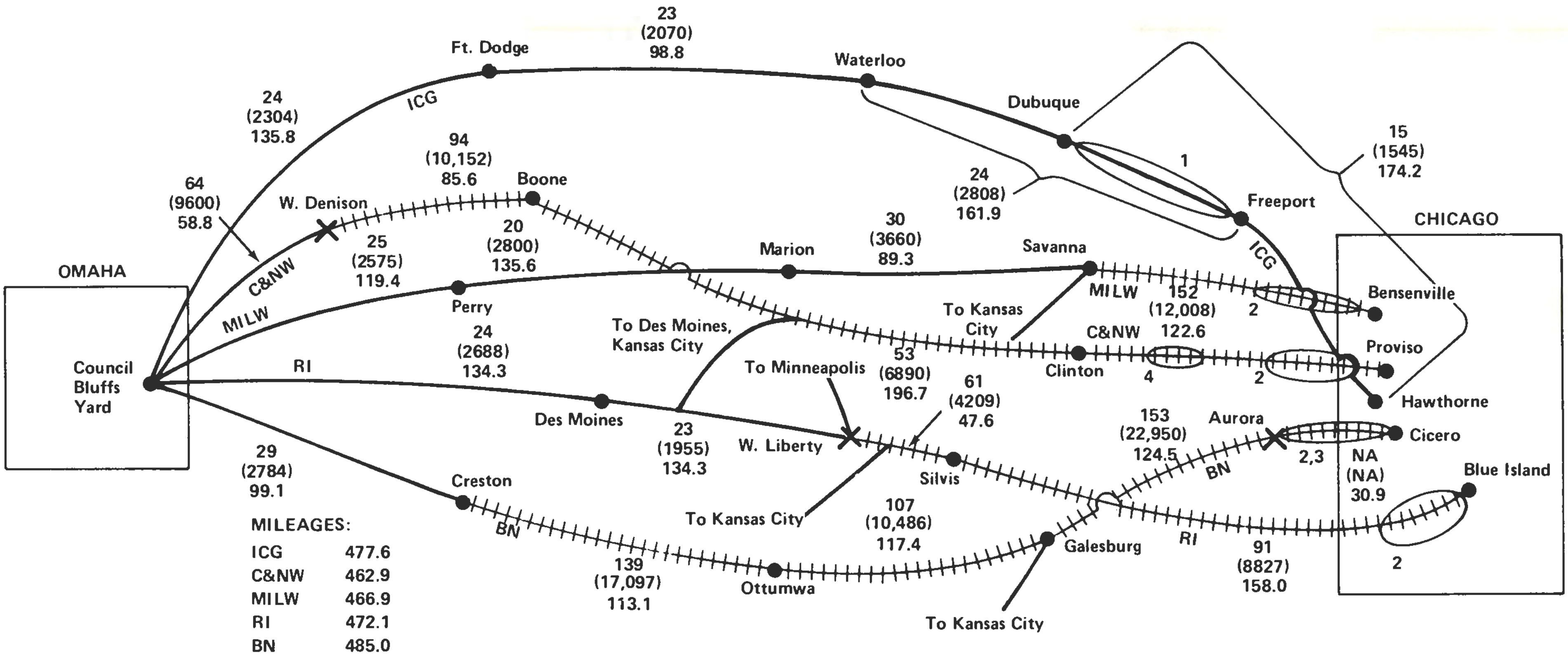
The Burlington Northern with 83 percent double track and 62 percent centralized traffic control (CTC), has the highest capacity of the railroads in question. On the average the five routes have 42 percent CTC and 43 percent double track, but there is a great disparity between these averages and the individual railroad's statistics. Obviously, the BN is considerably above both averages but it is the only railroad in that category. The Milwaukee, CNW, and CRIP are above average in only one category, while only the ICG is below average in both.

Table 1.—The Chicago-Omaha Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Burlington Northern	485	35	46
Illinois Central Gulf	478	12	24
Rock Island	472	19	37
Milwaukee Road	467	12	32
Chicago & North Western	463	45	69
TOTALS:	2,365	123	208

[1] Due to the methodologies employed for calculating line density and line capacity, there are five instances where density exceeds capacity. Density was computed as a weighted (by mileage) average for the entire line, whereas capacity was defined by the constraining link. As a result, the lowest capacity link serves as the throughput capacity without modification, but the lowest density segment is simply one factor in the overall line density.

CHICAGO—OMAHA CORRIDOR



LEGEND:

- ++++++++ Section or subsection primarily double track
- ——— Section or subsection primarily single track
- ● Crew change point (analysis section boundary)
- ✕ Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
- 63 Section or subsection line capacity, trains per day
- (9450) Section or subsection line capacity, cars per day
- 142.2 Section or subsection length, miles

NOTES: ⬭

1. ICG train crews run Hawthorne-Dubuque, Dubuque-Waterloo engine crews run Hawthorne-Freeport, Freeport-Waterloo; data for critical links (Hawthorne-Dubuque, Freeport-Waterloo) are shown; overlap is 93.1 miles
2. Commuter traffic
3. >3 tracks, 30.9 miles
4. 4 tracks, 2.1 miles

Density statistics are perhaps the most significant figures cited in this report (Table 1). Among these lines, the highest density line is the CNW, with over 40 million gross tons per route mile and the lowest is the MILW and ICG with 12 million GTM. These statistics suggest that there is unused capacity on all of these lines.

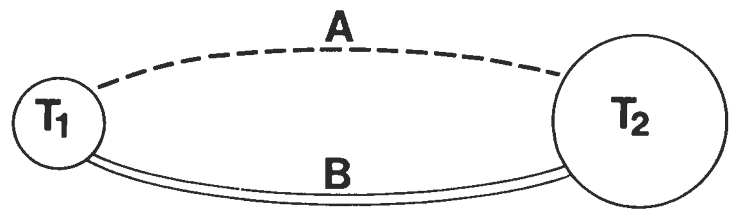
Cost of Rebuilding

A cursory examination of the rebuilding requirements was made for the Chicago-Omaha Corridor. These results show that while rationalization of the rail system will reduce maintenance costs per ton mile, the reduction in rehabilitation costs for a rationalized network will have a far greater impact on the railroad industry's finances. Without rationalization, a substantial amount of deteriorated track will have to be rebuilt. In cases of multiple lines with excess capacity, there is often one or more lines in good condition competing with one or more in bad condition. By transferring through traffic to the better line(s), the ones in poor condition, but is gradually accumulating deferred mainte-habilitation costs of 10 percent or less of that required for a high-density mainline.

This applies also in regard to the case where two (or more) competing lines between traffic centers are in bad condition. Moving all but local service to one upgraded route could make the capital expenditure economically sound. A hypothetical example is illustrated in Figure 1.

Railroad A is single track and carries 10 million gross tons, while Railroad B is double track and carries 30 million gross tons, far below the capacity of either line. Twenty years ago Railroad A was a 60-mile-per-hour railroad, but now has many 10-mile-per-hour slow orders due to earnings inadequate to maintain its plant. Railroad B is in good condition, but is gradually accumulating deferred maintenance. The average cost to rehabilitate the lines back into top condition is $250,000 per route mile for A and $100,000 per route-mile for B. Since it is 200 miles between terminals, total cost would be $50 million for A and $20 million for B.

FIGURE 1



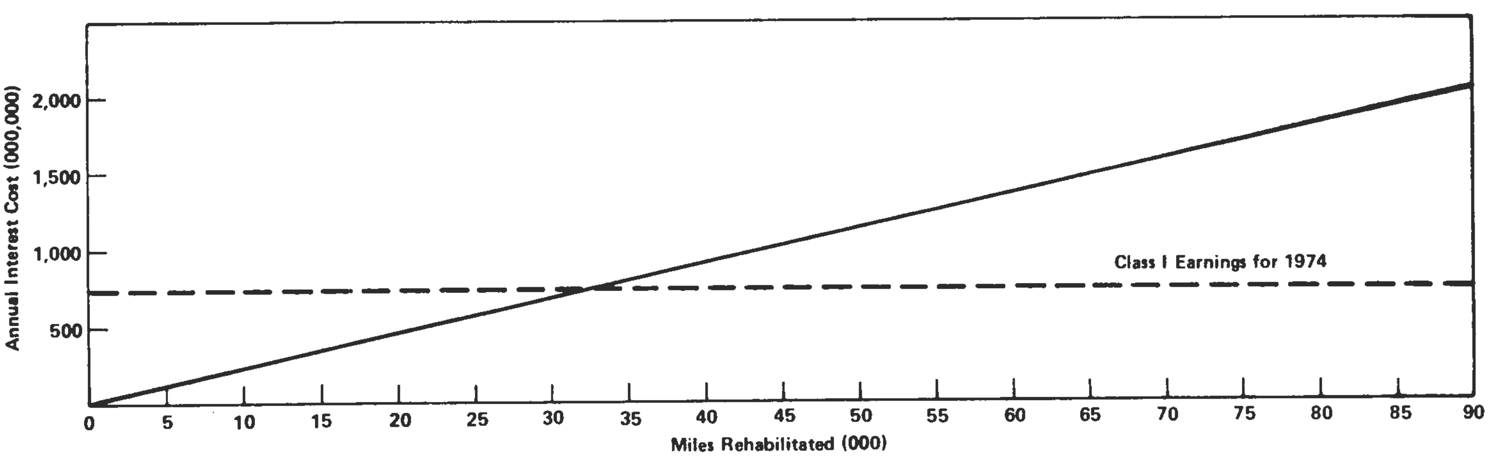
Concentrating A's through trains onto B would cut total rehabilitation costs from $70 million to $28 million, assuming A was put in good condition for a light-density line. This would increase B's traffic by 30 percent and add additional revenues from the trackage rights agreement to allow a higher maintenance budget. Moving the through traffic off of A would cut maintenance costs on A by two-thirds, producing a savings that would outweigh the incremental maintenance required on B by about $600,000 annually.

The FRA has estimated that on the average $250,000 is required to rebuild a mile of very poor track into a 60 mph, heavy duty line. The interest expense alone, assuming the approximate current rate of 8½ percent, would be higher than the maintenance expense per mile for any line with a traffic density of less than 35 million gross tons (Figure 2). Since most lighter density lines generally have an accumulation of deferred maintenance, itself an indicator of inadequate earnings, it is highly unlikely that any additional financial burden, such as debt service incurred for rehabilitation, could be met from operations.

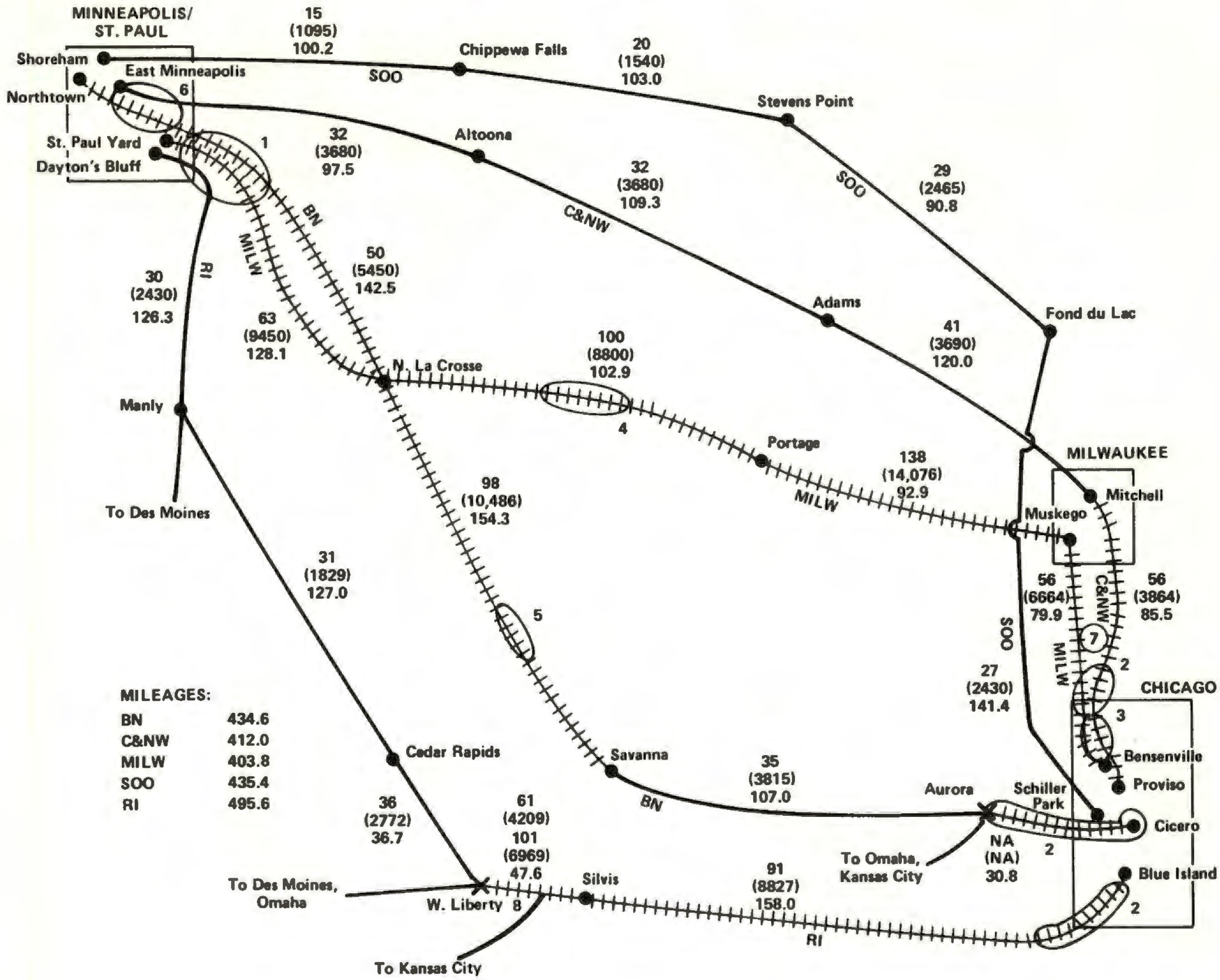
The other Corridors of Excess Capacity are defined and discussed in the remainder of this appendix.

FIGURE 2

INTEREST COST OF REHABILITATION
INTEREST = 8.5%
REHABILITATION = $250,000/MILE



CHICAGO—MINNEAPOLIS CORRIDOR



LEGEND:

- Section or subsection primarily double track
- Section or subsection primarily single track
- ● Crew change point (analysis section boundary)
- ✕ Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
- 63 Section or subsection line capacity, trains per day
- (9450) Section or subsection line capacity, cars per day
- 142.2 Section or subsection length, miles

NOTES: (oval)

1. Joint trackage, BN and MILW, 19.2 miles, each single track, RI trackage rights, 5.8 miles
2. Commuter traffic
3. MILW trackage rights on C&NW, 10.1 miles, double track
4. C&NW trackage rights on MILW, 13.0 miles, 2.7 miles single track, 10.3 miles double track
5. BN trackage rights on ICG, 12.5 miles, double track
6. C&NW operates over BN to East Minneapolis, 10.5 miles, double track
7. Crew assumed to make round trip in 12 hours
8. Capacity constrained by Silvis-Des Moines crew district

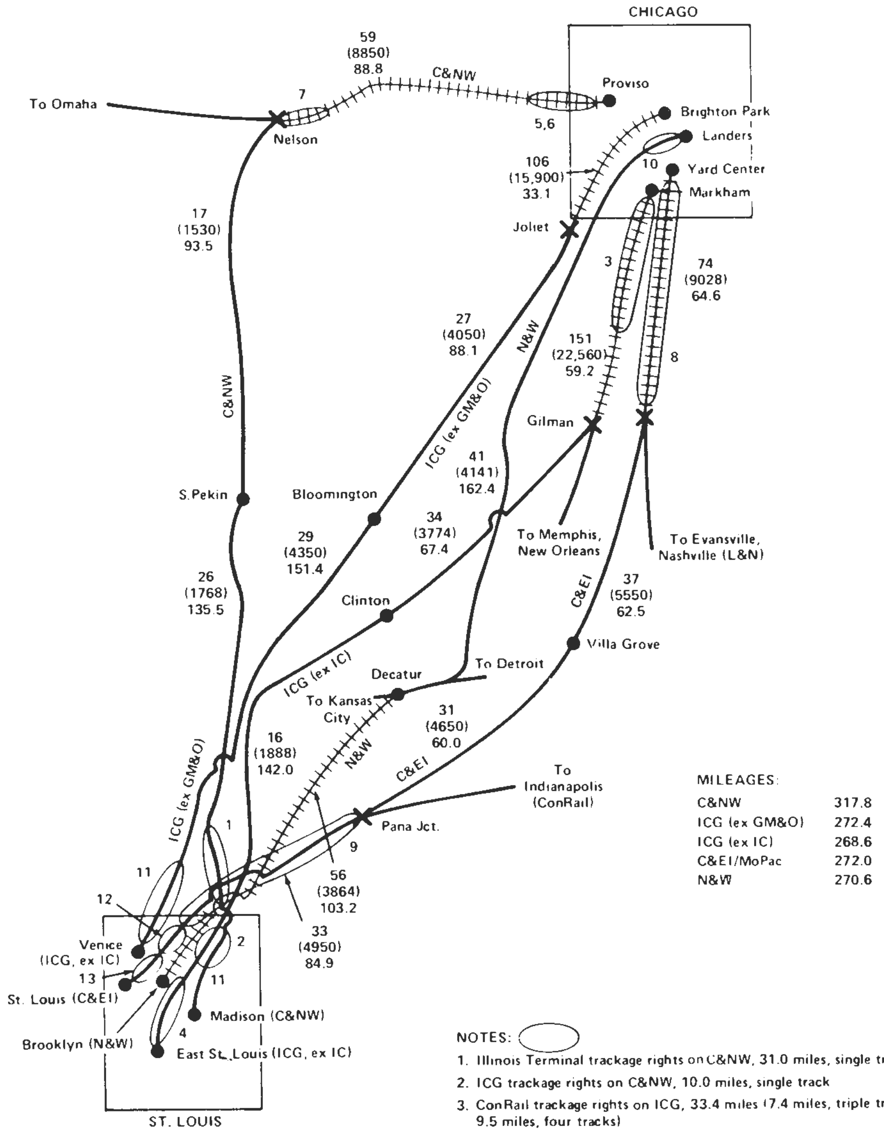
The Chicago to Minneapolis corridor is served by five through routes operated by five Class I railroads. The shortest route is offered by the Milwaukee Road (404 miles), the longest by the Rock Island (485 miles), and altogether the five routes account for 2,171 route miles. Total density on the five lines is about 110 MGT's, whereas capacity is at least 2.5 times that amount. Assuming all the traffic is through freight, it could be handled by two roads.

Table 2.—The Chicago-Minneapolis Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Rock Island	485	15	48
Burlington Northern	435	38	49
Soo Line	435	19	24
Chicago & North Western	412	19	51
Milwaukee Road	404	20	100
TOTALS:	2171	111	272

[1] See footnote, Table 1.

CHICAGO-ST. LOUIS CORRIDOR



LEGEND:

- Section or subsection primarily double track
- Section or subsection primarily single track
- ● Crew change point (analysis section boundary)
- X Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
- 63 Section or subsection line capacity, trains per day
- (9450) Section or subsection line capacity, cars per day
- 142.2 Section or subsection length, miles

NOTES:

1. Illinois Terminal trackage rights on C&NW, 31.0 miles, single track
2. ICG trackage rights on C&NW, 10.0 miles, single track
3. ConRail trackage rights on ICG, 33.4 miles (7.4 miles, triple track; 9.5 miles, four tracks)
4. ICG operates over joint trackage of Illinois Terminal and Terminal Railroad Association of St. Louis, 4.2 miles, double track
5. Commuter traffic
6. Triple track, 16.6 miles
7. Four tracks, 1.3 miles
8. Joint trackage, C&EI and L&N, 64.6 miles, double track
9. C&EI trackage rights on Con Rail, 70.0 miles, single track
10. N&W trackage rights on Chicago and Western Indiana, 3.6 miles, double track
11. Joint trackage, ICG and ConRail, BN trackage rights, 15.9 miles
12. C&EI trackage rights on ConRail/ICG joint trackage, 5.7 miles, double track
13. C&EI trackage rights on TRRA, 9.2 miles, double track

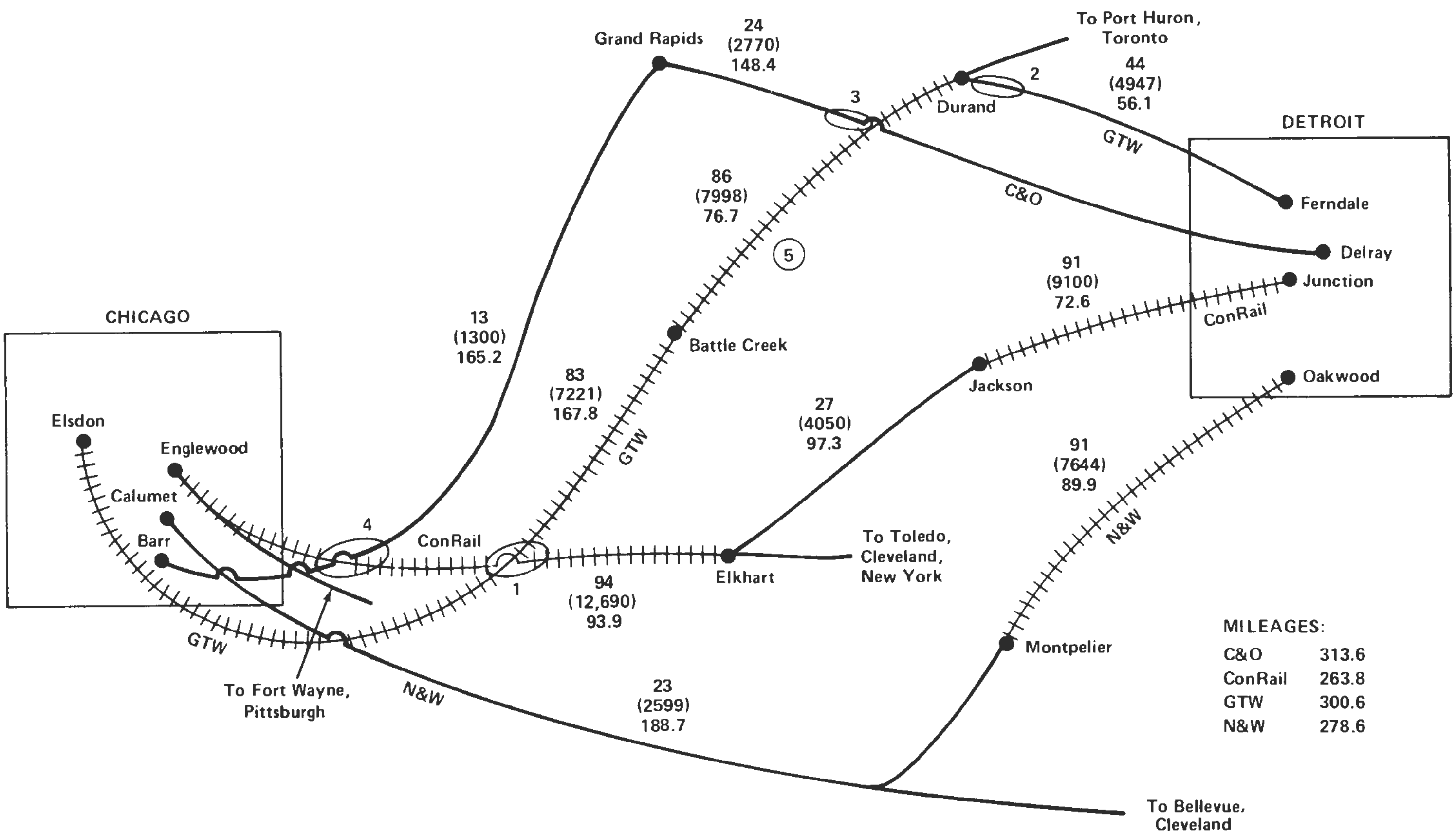
The Chicago to St. Louis corridor is served by five through routes, two of which are operated by the Illinois Central Gulf Railroad. The old Illinois Central route is the shortest (269 miles), whereas the Chicago and North Western line is the longest (318 miles). The capacity of the lines is over 200 MGT, which is about two times the total density.

Table 3.—The Chicago-St. Louis Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Chicago & North Western	318	33	27
Illinois Central Gulf (ex GMO)	272	10	43
Missouri Pacific	272	18	53
Norfolk & Western	271	13	65
Illinois Central Gulf (ex IC)	269	21	26
TOTALS:	1402	95	214

[1] See footnote, Table 1.

CHICAGO—DETROIT CORRIDOR



LEGEND:

++++++++	Section or subsection primarily double track
———	Section or subsection primarily single track
●	Crew change point (analysis section boundary)
X	Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
63	Section or subsection line capacity, trains per day
(9450)	Section or subsection line capacity, cars per day
142.2	Section or subsection length, miles

NOTES: (oval)

1. Joint trackage, ConRail and GTW, 1.6 miles, single track
2. Joint trackage, Ann Arbor and GTW, 1.5 miles, single track
3. C&O trackage rights on ConRail, 0.9 miles, double track
4. C&O trackage rights on ConRail, 17.9 miles, double track
5. Crew assumed to make round trip in 12 hours

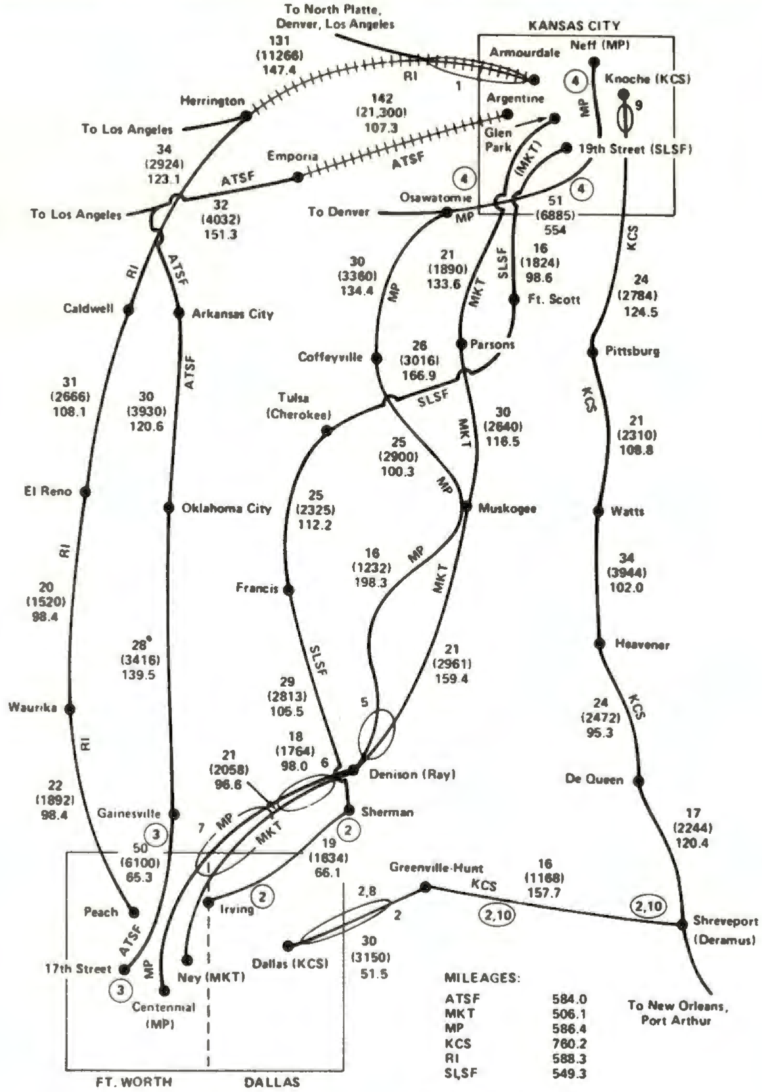
Although the shortest route between Chicago and Detroit is 264 miles (ConRail), there is a total of almost 1200 through route mileage in the corridor. The Norfolk and Western line is the only route handling less than 20 MGT. but even the ConRail and Grand Trunk Western routes, which handle greater than 20 MGT, have considerable excess capacity. Altogether the density of the four routes is 85 MGT, as compared to a capacity of about 170 MGT.

Table 4.—The Chicago-Detroit Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)*[1]
Chesapeake & Ohio	314	24	21
Grand Trunk Western	301	22	70
Norfolk & Western	279	9	37
ConRail	264	30	43
TOTALS:	1158	85	171

[1] See footnote, Table 1.

KANSAS CITY—DALLAS/FT. WORTH CORRIDOR



LEGEND:

- +++++++ Section or subsection primarily double track
- ——— Section or subsection primarily single track
- ● Crew change point (analysis section boundary)
- × Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
- 63 Section or subsection line capacity, trains per day
- (9450) Section or subsection line capacity, cars per day
- 142.2 Section or subsection length, miles

NOTES:

1. Trackage rights on UP, 66.5 miles, double track
2. Capacity may be overestimated because of timetable/train order operation
3. Portion of Gainesville-Cleburne crew district
4. Crew assumed to make round trip in 12 hours
5. MP trackage rights on MKT, 20.9 miles, single track
6. MP trackage rights on MKT, 23.9 miles, single track; note MP capacity over section is more critical than MKT capacity
7. Trackage rights on MP, 23.9 miles, single track
8. Trackage rights on ATSF, 37.8 miles, single track
9. MILW trackage rights, 1.3 miles, single track
10. Assumes track upgraded to accommodate 50 mph max. speed

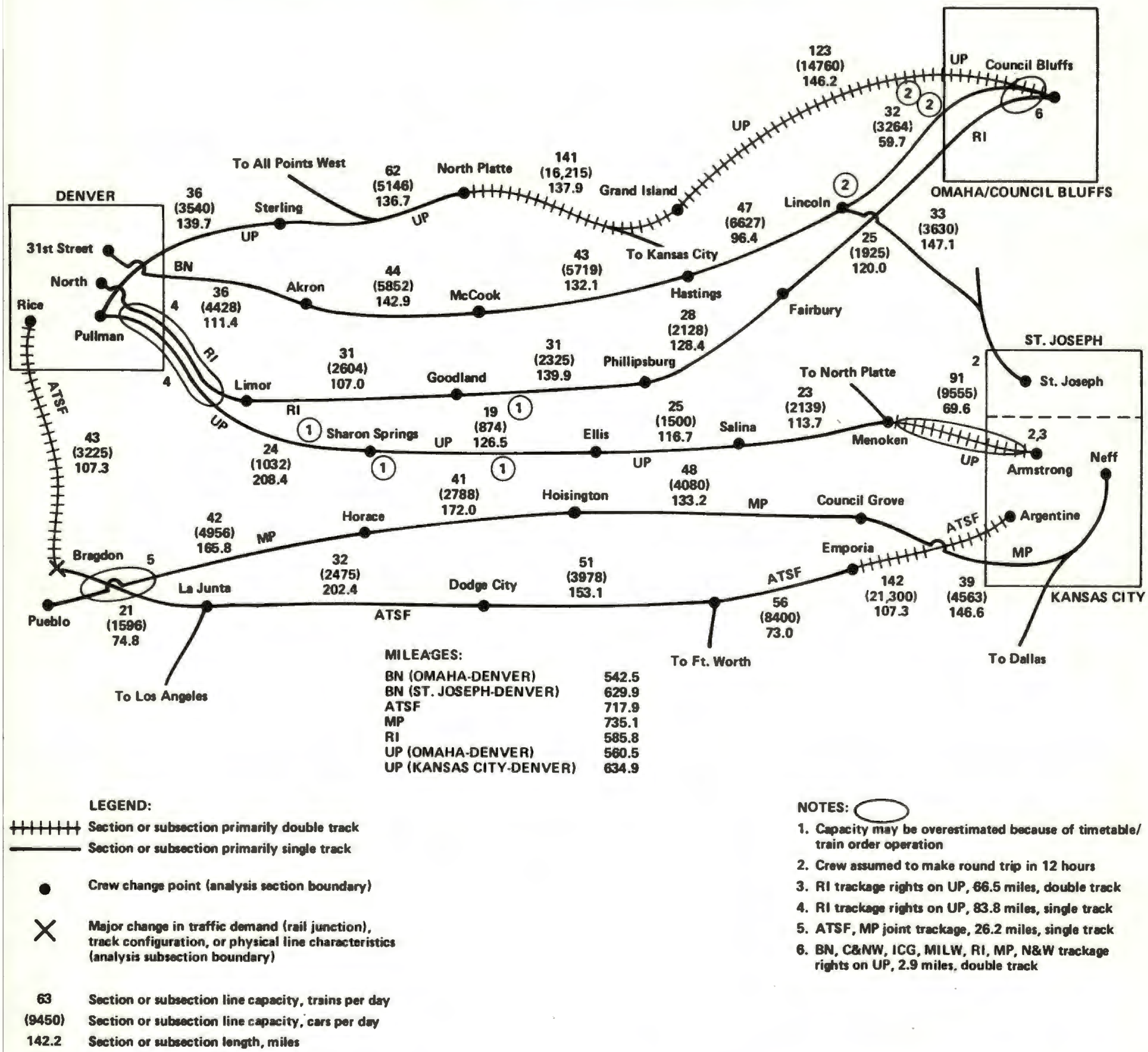
This corridor is a major shipping artery in the Central States, handling agricultural products for export, imported automobiles and petroleum products, as well as a variety of other commodities. The shortest route is operated by the Missouri-Kansas-Texas (506 miles), while the longest is owned by the Kansas City Southern (760 miles). Altogether the 3,600 route miles handled 120 MGT of traffic with only the Santa Fe topping the 20 MGT figure. The capacity in the corridor is just over 50 percent more than the density.

Table 5.—The Kansas City-Dallas/Ft. Worth Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Kansas City Southern	760	12	26
Rock Island	588	17	32
Missouri Pacific	586	19	26
Santa Fe	584	44	45
St. Louis-San Francisco	549	16	26
Missouri-Kansas-Texas	506	12	34
TOTALS:	3573	120	189

[1] See footnote, Table 1.

KANSAS CITY/OMAHA—COLORADO CORRIDOR



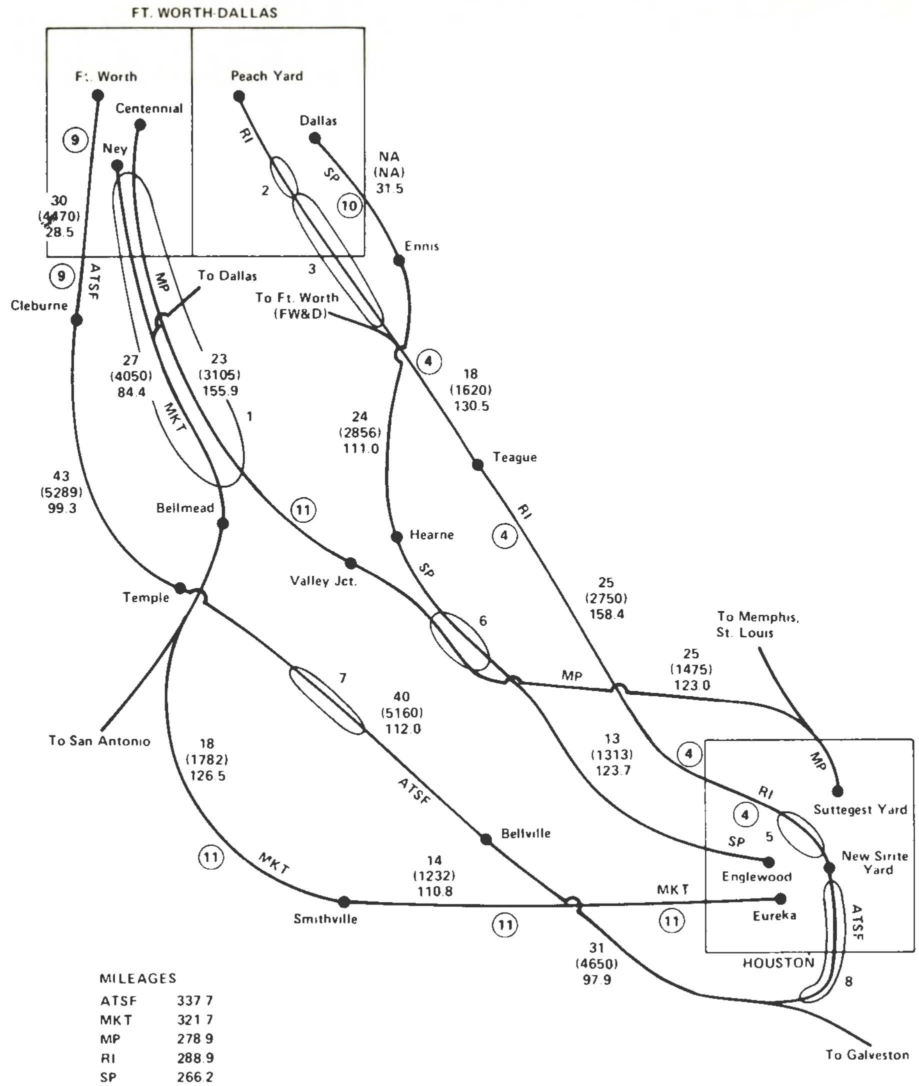
This corridor is the eastern link in the central transcontinental rail corridor, and is not easily defined by one city pair. The Union Pacific route from Omaha is one of the highest density lines in the nation and handles, at some points, over 100 MGT. Moreover, that line is the shortest route (561 miles), and contrasts sharply with the Missouri Pacific line that is 735 miles and carries only 13 MGT. The corridor's total density is 127 MGT, which is less than one-half of the estimated capacity. The total route mileage of the six lines is seven times the distance of the shortest route available.

Table 6.—The Kansas City/Omaha-Colorado Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Missouri Pacific	622	13	62
Santa Fe	718	24	34
Union Pacific (from Kansas City)	635	9	30
Burlington Northern	630	18	57
Rock Island	586	8	40
Union Pacific (from Omaha)	561	55	57
TOTALS:	3,752	127	280

[1] See footnote, Table 1.

DALLAS/FT. WORTH—HOUSTON CORRIDOR



LEGEND:

- ++++++++ Section or subsection primarily double track
- ———— Section or subsection primarily single track
- ● Crew change point (analysis section boundary)
- ✕ Major change in traffic demand (rail junction), track configuration, or physical line characteristics (analysis subsection boundary)
- 63 Section or subsection line capacity, trains per day
- (9450) Section or subsection line capacity, cars per day
- 142.2 Section or subsection length, miles

NOTES: ⬭

1. MP trackage rights on MKT, 85.5 miles, (84.0 miles single track, 1.5 miles, double track); note MP has the more critical capacity constraint
2. Trackage rights on Dallas UT, 1.5 miles, single track
3. RI and FW&D trackage rights on MKT, 28.2 miles, double track
4. RI and FW&D joint trackage, 214.2 miles, single track
5. RI and FW&D trackage rights on Houston B&T, 11.5 miles, single track
6. MP trackage rights on SP, 26.9 miles, single track
7. SP trackage rights, 46.6 miles, single track
8. RI, FW&D, MP trackage rights, 20.3 miles, single track
9. Portion of Gainesville-Cleburne crew district
10. Local switching, Dallas-Ennis
11. Capacity may be overestimated, timetable/train order operation

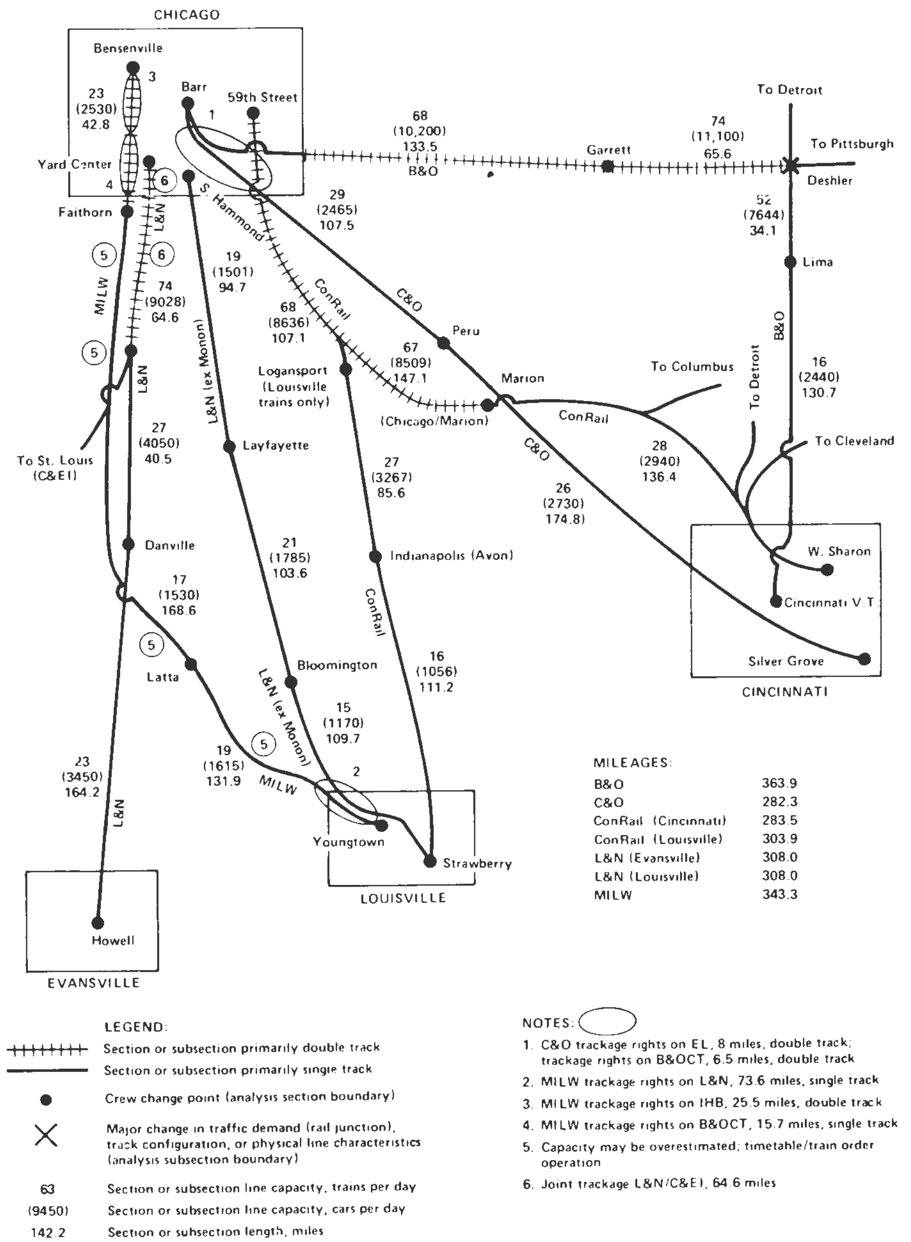
This corridor to the Gulf is served by five routes with a density of about 80 MGT total. The shortest line is operated by the Southern Pacific (266 miles), and the longest by the Santa Fe (338 miles). The Santa Fe line has the highest density (27 MGT) and the highest capacity (48 MGT). Altogether there are about 1500 route miles, which taken together have almost double the capacity required to haul the current traffic levels.

Table 7.—The Dallas/Ft. Worth-Houston Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)*[1]
Santa Fe	338	27	48
Missouri-Kansas-Texas	322	11	22
Rock Island	289	7	29
Missouri Pacific	279	16	37
Southern Pacific	266	20	21
TOTALS:	1494	81	157

[1] See footnote, Table 1.

CHICAGO—SOUTHERN GATEWAYS



Traffic which radiates from Chicago towards the Ohio River is generally destined for the Southern Region through three gateway cities, Evansville, Louisville and Cincinnati. However, while the largest portion of the North/South traffic is carried by only two railroads (Southern and Louisville and Nashville), five railroads operate between Chicago and these gateways.

The L&N provides one carrier service to Evansville and Louisville, while the Chessie (B&O and C&O), Milwaukee Road and ConRail interchange at Louisville and Cincinnati with Southern and L&N. The railroads north of these gateways have considerable excess capacity—about two and one-half times greater than the traffic handled.

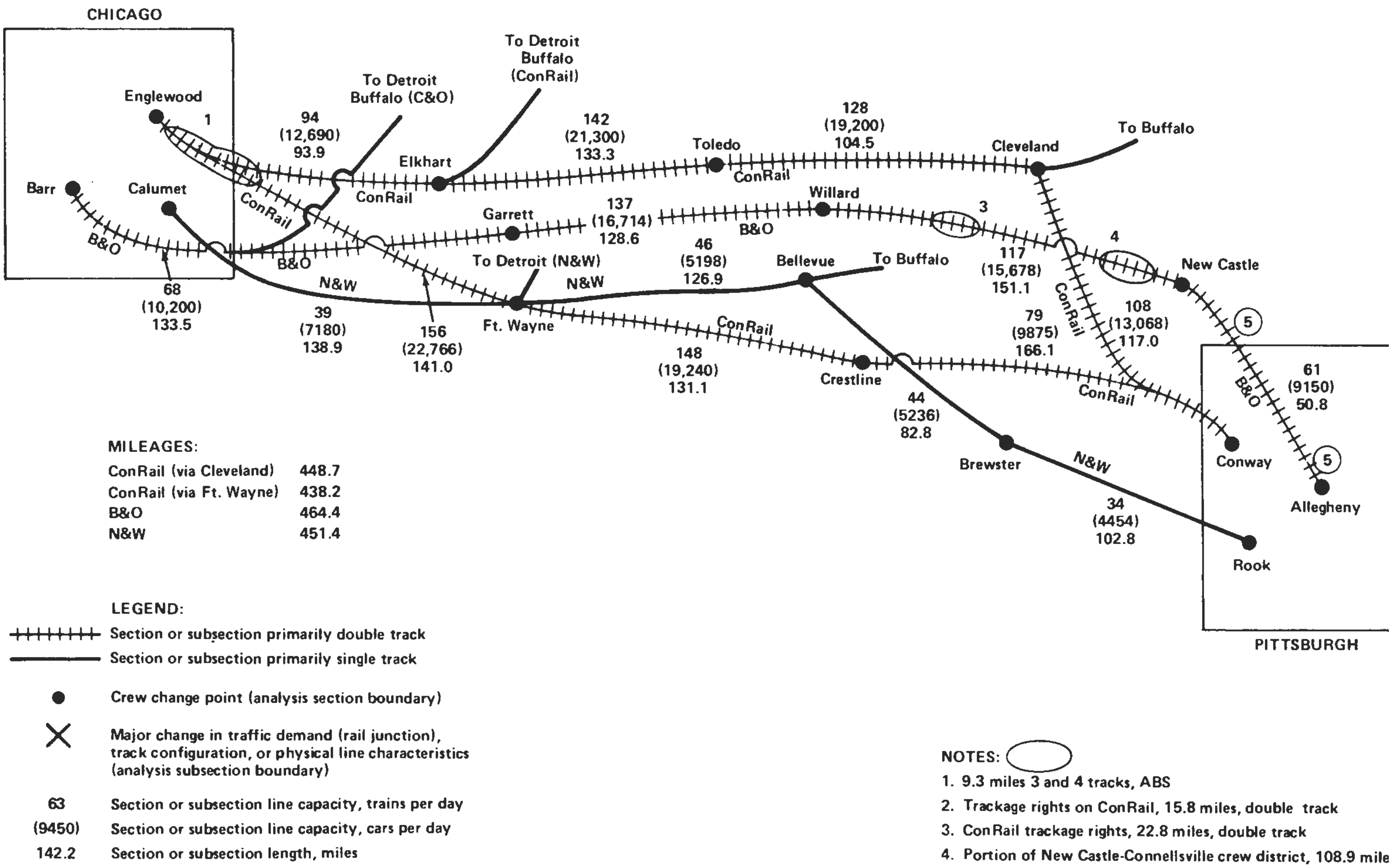
The two carriers operating south of these Southern Gateways have an additional advantage in that they can aggregate additional traffic to and from other Midwestern industrial centers such as St. Louis, Detroit, and Toledo. This enhances density considerably more than if they had to rely exclusively on the Chicago traffic.

Table 8.—The Chicago-Southern Gateways Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Baltimore & Ohio (to Cincinnati)	364	37	26
Milwaukee Road (to Louisville)	343	5	27
Louisville & Nashville (to Evansville)	308	17	37
Louisville & Nashville (to Louisville)	308	8	24
ConRail (to Louisville)	304	13	26
ConRail (to Cincinnati)	284	4	45
Chesapeake & Ohio (to Cincinnati)	282	7	42
TOTALS:	2193	91	227

[1] See footnote, Table 1.

CHICAGO—PITTSBURGH CORRIDOR



Although USRA conducted a thorough planning effort for the Northeast and Midwest Region, that effort concentrated more heavily on the railroads in reorganization rather than on the two key solvents in the region—the Chessie and the Norfolk and Western. When the remaining through routes of ConRail, along with the Chessie (B&O and C&O) and N&W lines, are considered in aggregate, there is capacity considerably in excess of the current traffic levels.

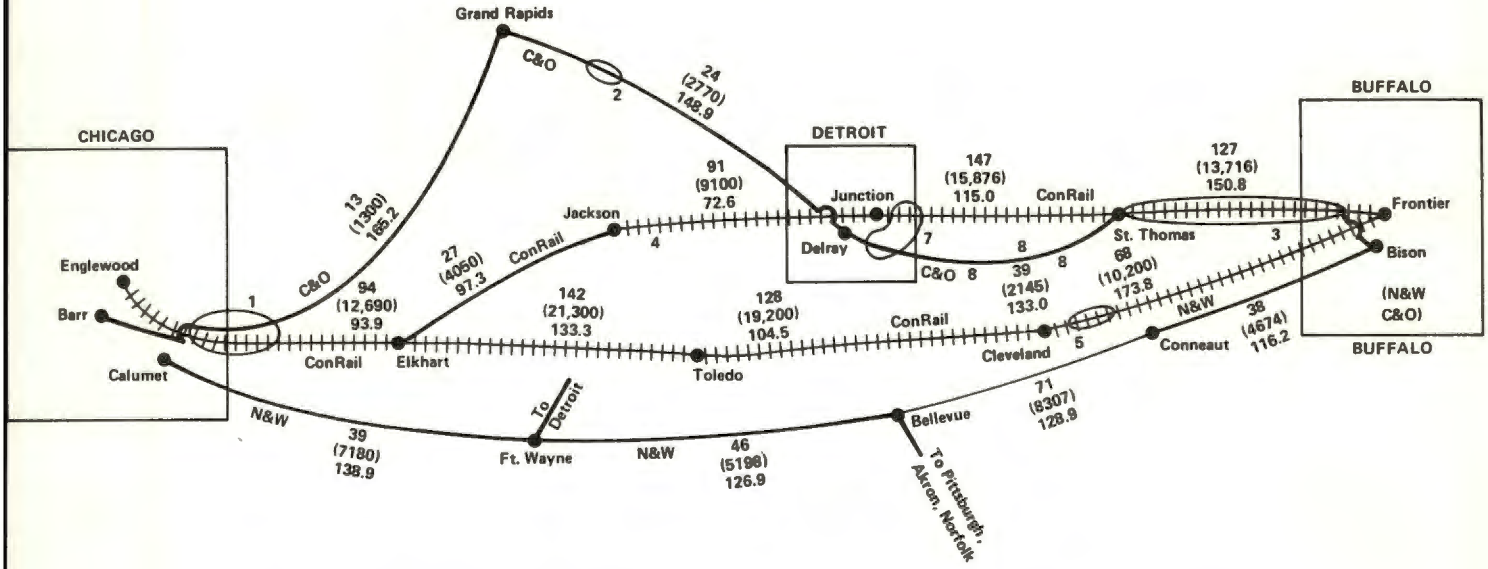
An initial examination looked at the through lines between Chicago and the Mid-Atlantic coastal region. This analysis found the entire corridor to have excessive capacity. However, when several subsets of the corridor were considered, it was discovered that a significant decrease in capacity, along with an increase in line density, occurred East of the Buffalo and Pittsburgh gateways. This examination allowed a better definition of the corridor which was determined to be Chicago to Pittsburgh and Chicago to Buffalo.

Table 9.—The Chicago-Pittsburgh and Chicago-Buffalo Corridors

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
CHICAGO to PITTSBURGH			
Baltimore & Ohio	464	35	91
Norfolk & Western	451	32	54
ConRail (via Cleveland)	449	70	150
ConRail (via Ft. Wayne)	438	26	126
TOTALS:	1802	163	427
CHICAGO to BUFFALO			
Chesapeake & Ohio	530	7	21
ConRail (via Detroit)	530	15	43
Norfolk & Western	511	33	61
ConRail (via Cleveland)	506	74	109
TOTALS:	2077	129	234

[1] See footnote, Table 1.

CHICAGO - BUFFALO CORRIDOR



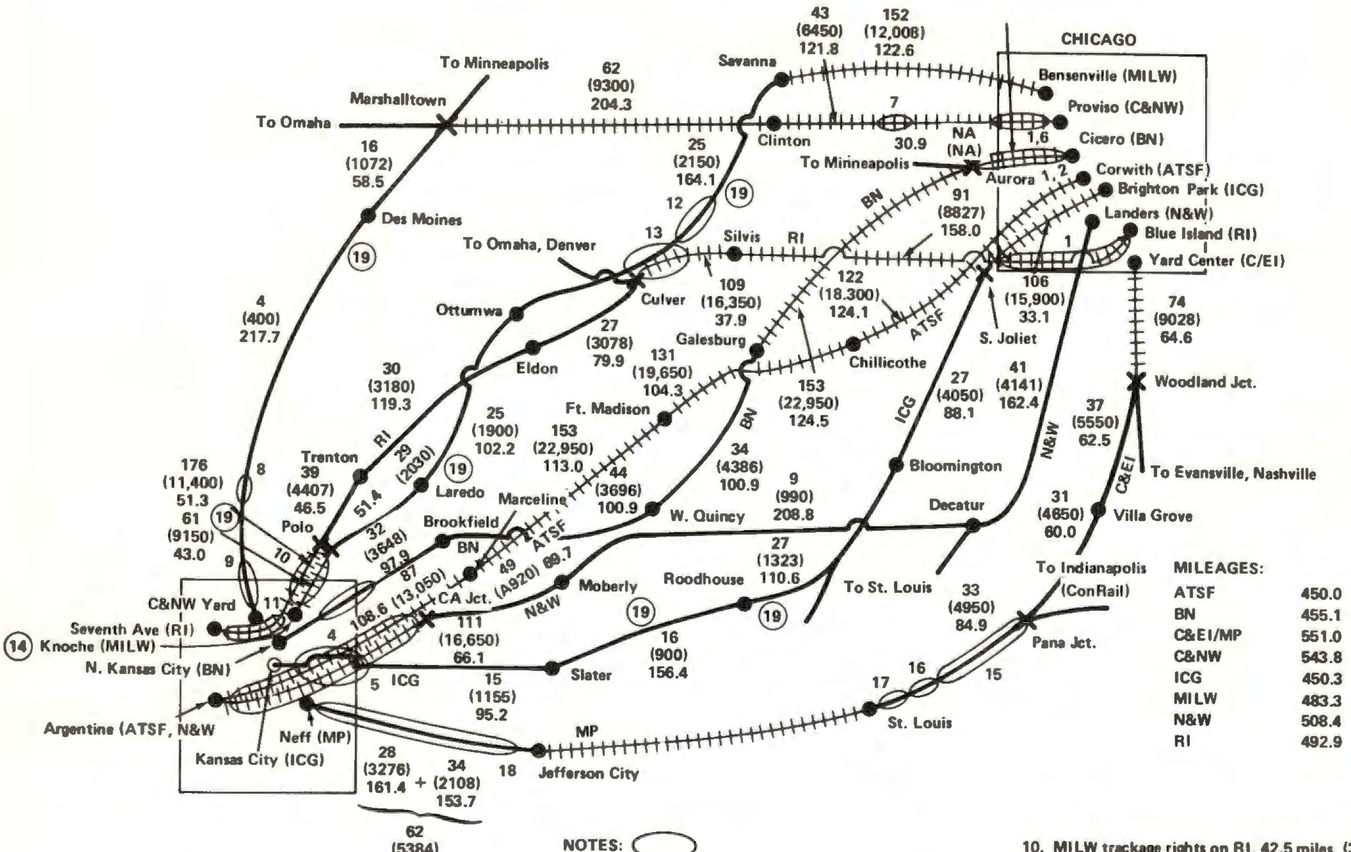
NOTES: (oval symbol)

1. C&O trackage rights on ConRail, 17.9 miles, double track
2. C&O trackage rights on ConRail, 0.9 miles, double track
3. C&O trackage rights on ConRail, miles, double track
4. Crew assumed to make round trip
5. 19 miles, 3 tracks
6. C&O trackage rights on ConRail 13.7 miles, (3.0 miles single track, 107 miles double track)
8. Capacity may be overestimated because of timetable / train order operation

MILEAGES:

C&O	597.4
ConRail (via Detroit)	529.6
ConRail (via Cleveland)	505.5
N&W	510.9

CHICAGO—KANSAS CITY CORRIDOR



NOTES: (oval symbol)

1. Commuter traffic
2. Triple track, 30.9 miles
3. BN trackage rights on N&W, 16.0 miles (15.1 miles, single track, 0.9 miles, double track)
4. N&W trackage rights on ATSF, KCT, 36.5 miles (34.4 miles, double track, 2.1 miles, single track) ATSF trackage rights on KCT, 6.2 miles, double track
5. ICG trackage rights on KCT, 6.8 miles, double track
6. 3 tracks, 16.6 miles
7. 4 tracks, 2.1 miles
8. C&NW trackage rights on BN, St. Joseph Terminal, ATSF, 8.9 miles, (0.8 miles, double track, 8.1 miles, single track)
9. C&NW trackage rights on MP, 24.3 miles, single track
10. MILW trackage rights on RI, 42.5 miles, (38.5 miles, double track, 4.0 miles, single track)
11. RI trackage rights on KCS, KCT, 8.8 miles, double track
12. MILW trackage rights on DRI, C&NW, 37.3 miles, single track
13. MILW trackage rights on RI, 26.5 miles, double track
14. MILW trackage rights on KCS, 1.3 miles, double track
15. C&EI trackage rights on ConRail, 70.0 miles, single track
16. C&EI trackage rights on joint ConRail/ICG trackage, 5.7 miles, double track
17. C&EI trackage rights on TRRA, 9.2 miles, double track
18. MP has two routes, Jefferson City-Neff Yard, both primarily single track
19. Capacity may be overestimated; timetable/train order operation not explicitly evaluated by analysis

LEGEND:

++++++++	Section or subsection primarily double track
———	Section or subsection primarily single track
●	Crew change point (analysis section boundary)
X	Major change in traffic demand (rail junction), track configuration, or phsical line characteristics (analysis subsection boundary)
63	Section or subsection line capacity, trains per day
(9450)	Section or subsection line capacity, cars per day
142.2	Section or subsection length, miles

The Chicago to Kansas City corridor is served by more rail routes (8) than any other corridor identified. The most dense line is operated by the Chicago and Northwestern (33 MGT), whereas the Illinois Central Gulf route, although the shortest (450 miles) handles only 6 MGT. Altogether the nearly 4,000 miles of rail routes carries about 150 MGT, which is considerably less than the 360 MGT capacity. The rationalization process in this corridor is complicated because it exists in the heart of the Granger area, and most of the routes are key arteries in the individual roads' networks.

Table 10.—The Chicago-Kansas City Corridor

Rail Routes	*Route Miles*	*Average Line Density (MGT)*	*Line Capacity (MGT)* [1]
Missouri Pacific	551	18	45
Chicago & North Western	544	33	6
Norfolk & Western	508	19	14
Rock Island	493	18	43
Milwaukee Road	483	11	40
Burlington Northern	455	22	51
Santa Fe	450	40	139
Illinois Central Gulf	450	6	24
TOTALS:	3934	167	362

[1] See footnote, Table 1.

APPENDIX 3

Individual Analyses of Major Transportation Zones

The following summaries of the findings of analyses of the total of 11 Major Transportation Zones requiring Category A Mainline internal or external access or both are based upon 1973 carload traffic data.

Zone 1: Bangor, ME

Total traffic attributable to the Bangor Zone is about 116,000 cars. Major commodity groups are lumber and wood products, petroleum and coal products, and pulp and paper products. Major traffic flows involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
1	1	36,300	31	31
1	2	15,500	13	44
2	1	12,000	10	54
1	74	2,800	2	56
1	58	2,600	2	58
1	4	2,100	2	60

Data indicates that 54 percent of Bangor's traffic moves within the Bangor Zone or between Zones 1 and 2. The remaining 46 percent requires a Category A connecting mainline between the Bangor area and the mainline system in Massachusetts. It is necessary to designate as Category A Mainline a joint interline route composed of lines of the Bangor and Aroostook (BAR), Maine Central (MEC) and Boston & Maine (BM) railroads. From Oakfield to Northern Maine Jct, a BAR line of 5.5 MGT density is designated; from Bangor to Portland a MEC line of about 7 MGT; and from Portland to Ayer a BM line of 12 MGT.

Zone 2: Augusta, ME

The Augusta zone generates 83,000 cars of which the major commodities are lumber and wood products, pulp and paper products, and petroleum or coal products. The major traffic movements involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
1	2	15,500	19	19
2	1	12,000	15	34
2	14	8,900	11	45
5	2	3,600	4	49
2	2	3,000	4	53

Augusta requires connectivity to Bangor, as well as the national mainline network; the joint route designated between Bangor and Ayer should satisfy that need.

Zone 166: Escanaba, MI

Escanaba accounts for 148,000 cars; major originating commodities are lumber and wood products and pulp and paper products; major received commodities are metallic ores. The largest flows attributable to the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
167	166	124,200	84	84
166	166	3,700	3	87
166	171	3,400	2	89

Since 84 percent of Escanaba Zone traffic moves from Marquette (Zone 167), the two zones require connectivity. Accordingly, the Chicago and North Western line between Ishpeming and Escanaba is designated Category A Mainline. Escanaba Zone traffic moving to or from other zones does not justify line upgrading to provide connectivity beyond.

Zone 167: Marquette, MI

Metallic ores constitute about 60 percent of the total of 221,000 carloads generated by Marquette. Major freight moves involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
167	166	124,200	56	56
167	167	57,800	26	82
167	155	4,900	2	84

Since 82 percent of Marquette traffic moves internally or to Escanaba, the zone is sufficiently served by the CNW line designated to provide connectivity for Zone 166 above.

Zone 198: Parkersburg, WV

Parkersburg accounts for 99,000 cars, of which the major incoming commodity is coal (58,500 cars) and the major originating commodities are chemicals and nonmetallic minerals. Major traffic movements involving Parkersburg are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
195	198	43,900	44	44
197	198	8,000	8	52
200	198	3,900	4	56
198	197	3,300	3	59

To provide the connectivity required by this level of traffic generation, the Baltimore and Ohio (BO) between Grafton, WV, and Chillicothe, OH, via Parkersburg, now a Category B Mainline, is redesignated "A". The BO between Grafton and Cumberland (MD), is Category A on the basis of density.

Zone 255: Ft. Myers, FL

Ft. Myers generates 117,000 cars; major traffic flows are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
258	255	39,200	34	34
254	255	24,300	21	55
256	255	19,200	16	71
255	254	8,200	7	78
255	255	5,400	5	83

Since the majority of freight traffic attributable to Ft. Myers originates in the eastern half of the zone, the Florida East Coast Line between Marcy (crossing of the Seaboard Coast Line A Mainline) and Lake Harbor (around Lake Okeechobee) is designated a Category A Mainline for service within the zones as well as to connect the zone with the national mainline network.

Zone 259: Panama City, FL

The Panama City zone accounts for 85,000 cars; major commodities are lumber and wood products and pulp and paper products. Largest freight flows involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
261	259	15,700	19	19
259	259	8,400	10	29
264	259	6,700	8	37
247	259	5,400	6	43
209	259	4,200	5	48
266	259	3,700	4	52
259	260	3,000	4	56

The highest concentration of freight generated in the zone moves between Bay, Washington and Jackson counties and Transportation Zones in the States of Alabama and Tennessee. The volume of the movement requires that Panama City be provided direct access to the mainline system. The Atlanta and Saint Andrews Bay (ASAB), a Class II railroad company, is the sole rail route serving Bay County and linking it with the above-cited two counties in the zone and also linking Bay County with the mainline network. Designation as Category A Mainlines of the ASAB line between Panama City and Cottondale and of the Louisville and Nashville line between Cottondale and Flomaton, via Pensacola, provides the required access for Zone 259 to Alabama and Tennessee. As a Class II railroad company, the ASAB is not required to report its density levels. Its Class II status, which is based solely on the level of annual gross operating revenue, should not be assumed to reflect its traffic density level, however.

Zone 278: Baton Rouge, LA

Baton Rouge accounts for 96,000 cars. Inter-Zonal traffic flows are relatively fragmented—only five involving more than 2,000 carloads. Major moves are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
146	278	8,100	9	9
278	276	5,400	6	15
277	278	4,300	5	20
296	278	3,000	3	23
278	277	2,300	2	25

Flow fragmentation complicates selection of an interacting zone justifying connectivity. However, a high percentage of Baton Rouge Zone traffic moves via major north-south grain routes. The Illinois Central Gulf line between Baton Rouge and the high density mainline at Hammond is designated Category A Mainline.

Zone 295: Two Harbors, MN

The Two Harbors Zone generates 117,000 cars of which metallic ore is the predominant commodity. Largest freight flows involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
296	295	112,300	96	96
295	170	800	1	97
297	295	600	1	98

Since 112,000 cars move between Zone 295 and Zone 296 (Duluth), Two Harbors requires connectivity with the Duluth Area. The highest density line available in the area, the Duluth, Missabe and Iron Range, is designated Category A Mainline from Two Harbors via Allen Junction to Iron Junction, at which point it connects with a high density mainline in the Duluth zone which is currently of Category A Mainline status.

Zone 297: Bemidji, MN

The Bemidji zone accounts for 255,000 cars, of which 65 percent is iron ore. Major traffic flows involving Zone 297 are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
297	296	172,200	68	68
118	297	17,100	7	75
297	297	10,500	4	79
297	300	8,900	3	82

Since 68 percent of Bemidji's traffic moves to Duluth, the Burlington Northern line between Grand Rapids, MN, and Brookston in the Duluth zone is designated as Category A Mainline.

Zone 370: Corpus Christi, TX

The Corpus Christi zone accounts for 96,000 cars; the most important commodities are metallic ores, nonmetallic minerals and chemical products. The largest flows involving the zone are:

Zone Numbers				
Origin	*Destination*	*No. of Cars*	*Percent of Total*	*Cumulative Percentage*
390	370	5,800	6	6
349	370	4,300	4	10
378	370	4,300	4	14
370	268	4,000	4	18
376	370	3,700	4	22
371	370	3,500	4	26
381	370	3,100	3	29
370	374	2,300	2	31
346	370	2,300	2	33
370	367	2,200	2	35
345	370	2,200	2	37
340	370	2,100	2	39
375	370	2,000	2	41

Freight flows associated with Corpus Christi are fragmented. The primary need, therefore, is for connectivity to the mainline network in the Houston area, which provides direct access to the largest selection of routes beyond. The highest density route available for the purpose, the Missouri Pacific between Robstown and Alvin, is designated a Category A Mainline.