NORTH DAKOTA LINE SEGMENT ANALYTICAL MODEL (NOLAM) -- A TECHNICAL DESCRIPTION

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John F. Mittleider
Denver D. Tolliver
Harvey G. Vreugdenhil

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JOHN F. MITTLEIDER
DENVER D. TOLLIVER
HARVEY G. VREUGDENHIL

DEPARTMENT OF AGRICULTURAL ECONOMICS
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

and

UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA STATE UNIVERSITY
P. O. BOX 5074
FARGO, NORTH DAKOTA 58105

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<u>Highlights</u>

This report presents a technical description of the North Dakota Line-Segment Analytical Model (NOLAM) -- a model developed to analyze the benefits and costs associated with rehabilitation of line-segments within the state. Primary efficiency benefits associated with rehabilitation of a potentially abandonable line segment are calculated within NOLAM by comparing revenues and costs in the base case (that situation which will occur if the line-segment is not rehabilitated) to revenues and costs under a rehabilitation scenario. From this comparison, a producer's surplus, a consumers' surplus, and a cost savings on existing traffic are calculated. These primary efficiency benefits, discounted to present value, are compared against net rehabilitation costs to estimate the net present value of a particular project. Secondary efficiency benefits associated with line-segment rehabilitation also are estimated. Changes in personal income and gross business volume are calculated by means of input-output analysis, and changes in highway resurfacing and maintenance are calculated based on estimated changes in truck traffic between the base case and the rehabilitation scenario.

Some specialized features of NOLAM which distinguish it from more generalized models of this nature include: (1) an exempt carrier truck cost model, (2) railroad specific cost coefficients, (3) capabilities of estimating multiple-car costs for a wide range of service options, (4) potential user specification of key operational and cost inputs, and (5) an overall flexibility which allows the analysis of line-segments under a variety of circumstances.

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Introduction

North Dakota's rail transportation system continues to be one of the most important components of the infrastructure supporting the state's economy. Rail transportation is considered the most feasible mode of exporting the huge quantities of bulky and weight intensive grain and mineral products. Rail shipments accounted for 79 percent of all grains and oilseeds exported from North Dakota in 1974-75, but only 63 percent in 1980-81 (Table 1).

TABLE 1. PERCENTAGE OF GRAIN AND OILSEED SHIPMENTS FROM NORTH DAKOTA, BY MODE, CROP PRODUCTION YEAR 1974-75 TO 1980-81

Crop Production Year	Rail	Truck
	-----------percent-----------	
1974-75	79	21
1975-76	74	26
1976-77	67	33
1977-78	66	34
1978-79	59	41
1979-80	62	38
1980-81	63	37

SOURCE: Griffin, 1982.

Three railroads currently operate in North Dakota--Burlington Northern, Soo Line, and Chicago and Northwestern (Figure 1). Burlington Northern accounts for over 77 percent of the main line trackage and over 70 percent of branch line traffic in the state (Table 2).

Over 510 miles of branch line have been abandoned in North Dakota since 1936 with 95 percent of this trackage being abandoned since 1970 and 64 percent since 1980 (Table 3). Currently, 421 miles of branch line are subject to abandonment, constituting 14 percent of the branch line network in North Dakota (Table 4).

*Mittleider and Vreugdenhil are Research Associates, Department of Agricultural Econonmics and Tolliver is Research Associate, Upper Great Plains Transportation Institute, North Dakota State University, Fargo.

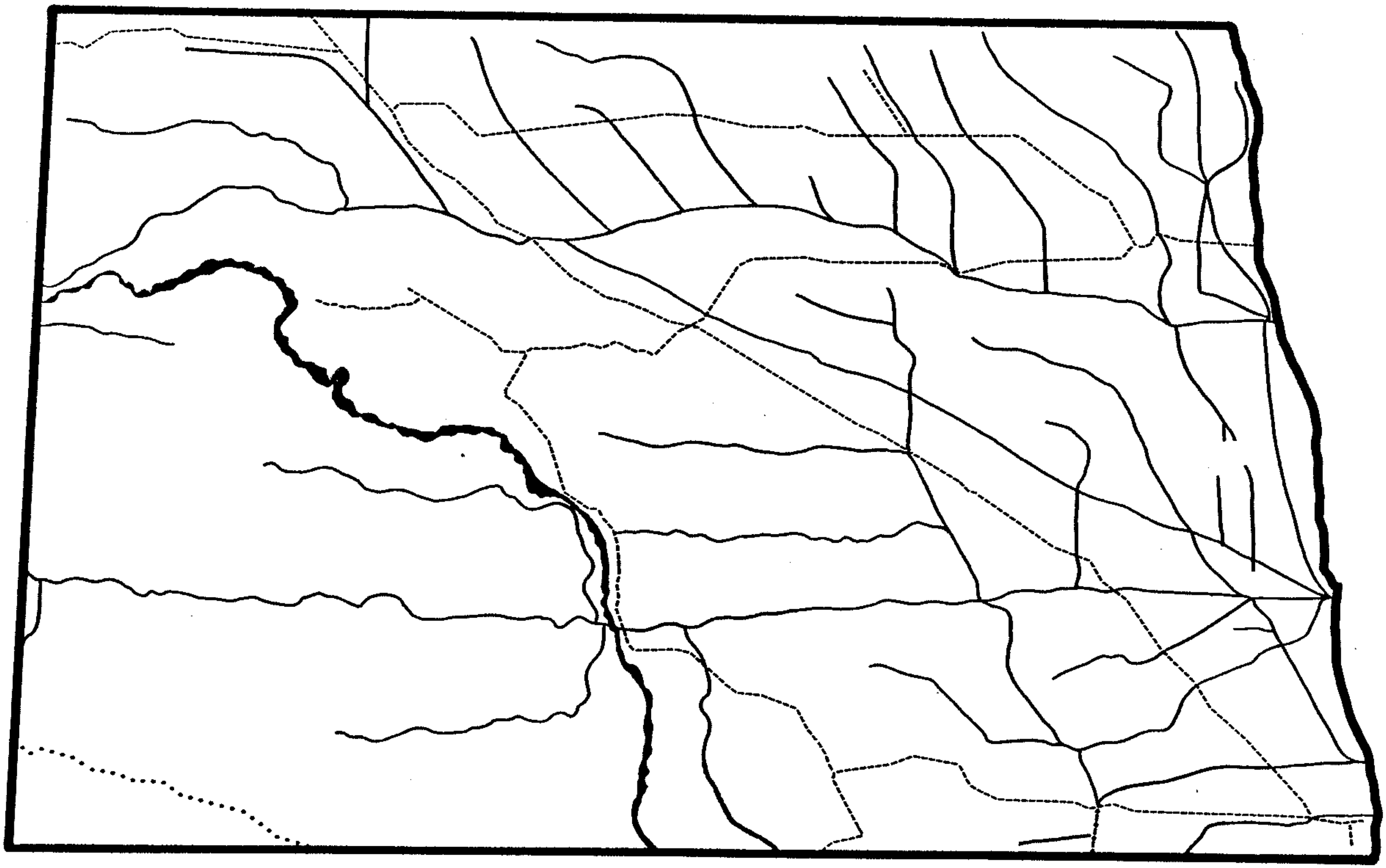

Figure 1. North Dakota Rail System, 1982

BURLINGTON NORTHERN
SOO LINE
STATE OF SOUTH DAKOTA
CHICAGO & NORTHWESTERN

TABLE 2. MAIN AND BRANCH LINE TRACKAGES IN NORTH DAKOTA, BY RAILROAD, 1982

Railroad	Main Line	Branch Line	Total
	---------miles---------		
Burlington Northern	1,212[a]	2,164	3,376[a]
Soo Line	352	895	1,247
Chicago and Northwestern	0	15	15
Total	1,564	3,074	4,638

[a]Includes 103 miles of trackage owned by the state of South Dakota and operated by Burlington Northern.

SOURCE: Planning Division and Office of Rail, 1982.

Historically, specified federal and state governmental agencies have had the flexibility to mitigate the effects of branch line abandonment or provide assistance and funding for rehabilitation. As a prelude, each state was required by Congressional action to develop a methodology to estimate the costs and benefits of rail branch line abandonment and rehabilitation.

The Department of Agricultural Economics, sponsored by a grant from the Upper Great Plains Transportation Institute, began evaluating the economic viability of branch lines in North Dakota in 1979. A methodology was defined to compare the costs and benefits of branch line abandonment with those of rehabilitation for a 25-year period. The methodology utilized both a net present value and a benefit/cost approach in determining branch line viability. Primary efficiency benefits (benefits directly attributable to improved rail service) and secondary efficiency benefits (those indirectly attributable to improved rail service) were estimated on an annual basis, based on expected changes in the transportation system. This methodology was adapted into various computer programs, each capable of analyzing only one line because of the different shipping rates, shipping costs, mileage to destination, etc. This modeling technique was quite time consuming and cumbersome but suited its intended purpose as few branch lines were subject to abandonment. However, by 1980 a situation had developed whereby numerous branch lines were subject to abandonment, and by July 1, 1981, nearly 1,500 miles of branch line were categorized as potentials for abandonment. During this time railroads also introduced multiple-car and trainload rates for selected commodities to certain destinations. These factors created a need to develop an interactive (user personal) computer model which could accurately determine the economic viability of rehabilitating a branch line. This rendition of the model was completed in 1982 and utilized to analyze several branch lines in the state.

The purpose of this report is to provide a description of the model's structure, capabilities, data base, and user-procedures. The remainder of this report is organized into six sections. First, rail planning and a general

TABLE 3. RAIL ABANDONMENTS IN NORTH DAKOTA, 1936 TO 1982

Line Segment	Date of Abandonment	Mileage
Brampton to Cogswell	1936	7.5
Walhalla to Canadian Border	1936	5.3
St. John to Canadian Border	1936	3.6
Portland to Clifford	1962	10.2
Wimbledon to Edgeley	1970	67.7
Maxbass to Dunning	1972	4.5
Rutland to Ludden	1974	30.2
Brinsmade to Minnewaukan	1976	7.5
Mayville to Blanchard	1976	10.1
Neche to Canadian Border	1976	1.0
Leeds to Brinsmade	1977	9.9
Jamestown to Klose	1979	5.9
Devils Lake to Warwick	1979	21.0
Fargo to Ortonville, MN[a]	1980	69.5
Edgeley to Aberdeen, SD[a]	1980	31.5
Forbes to Ellendale	1980	13.5
Brampton to Andover, SD[a]	1980	4.2
Joliette to Pembina	1980	12.2
McHenry to Binford	1981	11.7
Newburg to Dunning	1981	5.6
Great Bend to Fairview Junction	1981	8.8
Golva to Carlisle	1981	4.4
Walford to Dunseith	1981	27.7
Casselton to Amenia	1982	6.1
Rolla to St. John	1982	7.2
New England to McLaughlin, SD[a]	1982	123.61
Total		510.41

[a]Includes only North Dakota trackage.

SOURCE: Planning Division and Office of Rail, 1982.

overview of transportation modeling are introduced. Second, cost coefficient estimation procedures which are utilized to determine specific cost components within the North Dakota Line Segment Analytical Model (NOLAM) are defined. Third, a detailed description of NOLAM is provided. Calculations of primary and secondary benefits are described in the fourth section. Fifth, user-procedures are defined. Finally, the adaptability and transferability of other states utilizing NOLAM and its supporting software are discussed.

Introduction to Rail Planning

Since the passage of the Railroad Revitalization and Regulatory Reform Act of 1976, state governments have assumed an interest in maintaining and

TABLE 4. NORTH DAKOTA BRANCH LINES SUBJECT TO ABANDONMENT, JULY 1982

Line Segment	Railroad	Category[a]	Mileage
Wimbledon to Clementsville	Soo	1	9.30
Wishek to Pollock, SD	Soo	2	35.93
Ellendale to Oakes	Burlington Northern	1	27.82[c]
Hunter to Blanchard	Burlington Northern	1	10.42
Edgeley to Streeter	Burlington Northern	1	39.83
Tuttle to Wilton	Burlington Northern	1	37.77
Hazen to Truax	Burlington Northern	1	6.37
Zap to Killdeer	Burlington Northern	1	40.86
Beach to Golva	Burlington Northern	1	12.86
Grand Forks to Honeyford	Burlington Northern	1	22.10
Linton to Eureka, SD	Burlington Northern	1	37.67
Mandan to Mott	Burlington Northern	1	99.10
Walford to Dunseith	Burlington Northern	3	27.39
Rolla to St. John	Burlington Northern	3	7.24
Amenia to Casselton	Burlington Northern	b	6.08
Total			420.74

[a]Category 1--railroad intends to file abandonment application within three years, Category 2--railroad is considering line for future abandonment, Category 3--railroad has filed abandonment application with ICC and a decision is pending.
[b]Modified procedure (pending).
[c]Includes 7.83 miles of trackage rights on Chicago and Northwestern from Oakes to Ludden.

SOURCE: Planning Division and Office of Rail, 1982.

promoting adequate rail service within their boundaries. These activities, consisting of providing technical assistance to shippers, carriers, and communities, as well as providing financial assistance for the rehabilitation of deteriorated rail lines, are known collectively as state-wide rail planning.

The rail planning process itself is quite broad and policy-oriented. The analytical aspects of rail planning, however, are quite specific and technical in nature. The following section presents an overview of the rail planning process in agricultural states and describes the analytical procedures which underlie the planning process.

During the decades following World War II, the railroad industry entered a phase of long-term decline. As the nation shifted to a service-oriented economy, demand for the transportation of bulk commodities, the railroads' bread-and-butter, declined relative to previous levels. At the same time, intermodal competition, fueled in part by large capital expenditures for through or interstate highways, eroded the railroad's traffic base in the area of time-sensitive commodities, such as high-valued manufactured products. The result was an eroding revenue base, a declining market share, and, consequently, poor internal cash flow and a weakened position in external capital markets. In the 1970s, the railroad industry was operating essentially the same number of miles of road as it had in the 1950s, with fewer ton-miles of traffic, and with a troublesome cash flow situation.

Until recently, railroads were restricted by regulation from abandoning a large portion of trackage which no longer had the necessary densities to support traffic. The logical alternative to abandonment, under these circumstances, was to defer maintenance on line segments of lesser density. This was particularly true in grain producing areas, where a proliferation of branch line trackage had occurred during the railroad-building era.

Impetus for Rail Planning

The railroads' poor financial posture and deteriorating physical plant forced Congress to act in order to prevent large-scale collapse within the transportation system. The Regional Rail Reorganization Act, passed in 1973, established CONRAIL and provided federal assistance for upgrading the rail network in the Northeast Corridor. The Railroad Revitalization and Regulatory Reform Act (4R Act) of 1976 extended to midwestern and western states the federal assistance which had been allocated earlier to CONRAIL. The act appropriated monies for the rehabilitation of light-density tracks and for the preparation of state rail plans.

The 4R Act was followed by the Local Rail Services Assistance Act of 1978. Each state was appropriated monies for the rehabilitation of rail branch lines and for the development of comprehensive state-wide rail plans. In order to spend the appropriated funds, states had to have an acceptable methodology for analyzing the potential benefits and costs of each particular project, as well as an overall planning methodology.

Rail planning in agricultural states has been complicated by the many and far-reaching changes which are simultaneously occuring in the grain handling and merchandising system. Branch line abandonment, trainload rate structures, and light-density surcharges have been paralleled by movements toward more centralized loading and marketing of grains and oilseeds. This dynamic environment has resulted in a planning process that is flexible and has created the need for analytical methodologies which are futuristic and adaptive.

In agricultural states, the planning process and its underlying methodologies is one which must consider a range of simultaneous changes and must be able to analyze the operating and cost efficiencies of a variety of transportation systems. It was in response to the demands for such a methodology that NOLAM was developed.

The objectives of NOLAM are to analyze the viability of individual line segments and simultaneously to determine both the primary efficiency benefits (PEB) and the secondary efficiency benefits (SEB) resulting from rehabilitation. Given the necessary expenditures for rehabilitation, the methodology will forecast costs and revenues under several traffic assumptions.

Rail Cost Model

One of the critical inputs in the determination of PEB is the estimation of avoidable costs associated with operating and maintaining the line segment. In certain instances, estimation of both on-branch and off-branch cost elements can be obtained from the railroad, particularly if the line has already been placed in Interstate Commerce Commission (ICC) category 3 (abandonment application is pending). However, this information is not always available in a timely fashion, or for line segments in other than category 3 groupings. There also may be disagreements in calculating procedures between the railroad's data and Federal Railroad Administration (FRA) or state standards.

NOLAM consists of a rail model which estimates both on-branch and off-branch cost elements without relying on data provided by the railroads. Operating, maintenance, and capital costs are developed for the on-branch portion including a return on net liquidation value. Adjusted Rail Form A cost coefficients are used for the off-branch portion of the movements.

One of the major differences between NOLAM and other state methodologies (and one of its major advantages over the use of historic railroad data) is that the model has the capability to estimate avoidable costs for a variety of traffic scenarios. Even if rehabilitated, for example, a branch line may not appear to be viable if the traffic is costed as single-car movements, which may be unrealistic in the majority of cases.

NOLAM has built-in adjustments for multiple-car movements in (1) switching times, (2) car times at origin and destination, (3) train running time, (4) station and billing costs, (5) train weights and locomotive statistics, and (6) off-branch switching events. These adjustments reflect both the on-branch and off-branch efficiencies of multiple carload traffic.

Start —

Theory of Primary Efficiency Benefits

The objective of the model is to determine the benefits and costs which would accrue from rehabilitation. The crux of the methodology is based on the demand for transportation and how costs and revenues to producers of transport services (railroads and truckers) and consumers of transport services (shippers) change with different levels of modal use. For example, D is the demand function for transportation (Figure 2). Consumers are willing to pay P_0 for Q_0 units of output. The economic cost for Q_0 units of output is C_0. Area A is defined as the consumers' surplus while area B is defined as the producers' surplus at Q_0 units of output. When the price of the good is reduced from P_0 to P_1, consumers will purchase Q_1 units. The consumers' surplus for Q_1 units of output at a price of P_1 is areas A + B + E + F. The cost of producing Q_1 units of output is C_1; the producers' surplus is areas G + H. The change in benefits as a result of the change in quantity demanded from Q_0 to Q_1 and price from P_0 to P_1 is (A + B + E + F + G + H) - (A + B) or areas E + F + G + H. The benefits which would accrue from rehabilitation comprise three categories: 1) the reduction in cost on existing traffic (E + G), 2) consumers' surplus on new rail traffic (F), and 3) producers' surplus on new rail traffic (H).

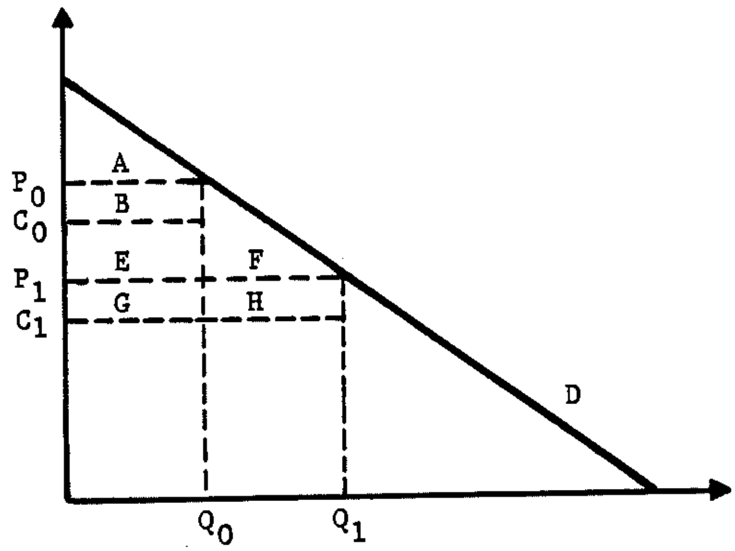

Figure 2. Demand for Transportation

A reduction in operating cost will occur on the existing traffic base due to rehabilitation, irrespective of the addition of new traffic. More efficient operating conditions will prevail because of rehabilitated track. Trains will move at greater speeds and consequently, crew costs will be reduced. This is particularly true if a multiple-car or trainload scenario is considered under the rehabilitation case. Cost reduction on existing traffic is computed as:

$$S_c = Q_o(C_o - C_1)$$

where: S_c = Shipping cost reduction on existing traffic

Q_o = Quantity shipped--base (original) case

C_o = Shipping cost, base case

C_1 = Shipping cost, rehabilitation alternative

In addition to cost savings on existing traffic, rehabilitation of a branch line, in theory, will result in an increased rail share. A proportion of the traffic which was moving by truck under the base (original) case will now move by rail because of more efficient service and the probability of multiple-car or trainload rates. This incremental traffic results in additional consumers' surplus, or the difference between what a consumer is willing to pay for some amount of service and what he has to pay, which is calculated as:

$$C_s = 1/2\ [(P_o - P_1)\ (Q_1 - Q_o)]$$

where: C_s = Consumers' surplus on new traffic

P_0 = Shipping rate, base case

P_1 = Shipping rate, rehabilitation alternative

Q_1 = Quantity shipped, rehabilitation alternative

Q_0 = Quantity shipped, base case

The incremental traffic also results in additional producer's surplus, or the difference between the producer's price and the cost of providing service, and is calculated as:

$$P_s = (P_1 - C_1)\ (Q_1 - Q_0)$$

where: P_s = Producer's surplus on new traffic

P_1 = Shipping rate, rehabilitation alternative

C_1 = Shippping cost, rehabilitation alternative

Q_1 = Quantity shipped, rehabilitation alternative

Q_0 = Quantity shipped, base case

These three components describe the change in benefits which occur from rehabilitating the line segment rather than letting the line continue as it has under the base case, which will eventually result in the cessation of service and the forcing of rail traffic to trucks.

In order to calculate the primary efficiency benefits (PEB), net rehabilitation cost also must be calculated. Net rehabilitation cost is defined as the cost of rehabilitating the line segment minus the net present salvage value of the rehabilitated line segment (discounted from the end of the project life to present year value) and the net present value of reusable or resaleable fixed capital items removed from the original branch line.

The net cost of rehabilitation is subtracted from the net present value of the PEB to determine the net present value of the project. Whenever the net present value of the PEB exceeds the net rehabilitation cost, the project is considered viable. A benefit/cost ratio also is calculated from these two values as the ratio of the PEB to net rehabilitation cost. A benefit/cost ratio of 1.00 or greater indicates project viability.

Theory of Secondary Efficiency Benefits

Secondary efficiency benefits are defined as the changes in the value of goods and services produced which are an indirect result of the rehabilitation alternative. For example, farmers may receive a higher price and hence a higher return for their product under the rehabilitation alternative without a corresponding decrease in profit to the elevators. This would be classified as a secondary efficiency benefit of the rehabilitation alternative. A secondary efficiency benefit would not be realized in a situation where a change in the economy is compensated by an opposite change elsewhere in the economy.

NOLAM estimates secondary efficiency benefits (SEB) on the basis of input-output analysis (I-O). Input-output analysis relates changes which occur in a basic sector of the economy to the level of activities in other sectors through a matrix of interdependency coefficients. Through this procedure, the effects of the benefits realized through rehabilitation in the form of increased consumers' surplus are projected throughout the economy.

In addition to the multiplicative effects of increased consumers' surplus throughout the economy, SEB also arise from the avoidance of adverse highway impacts which would occur due to abandonment. Firms relying on rail service preceding abandonment will be required to truck their product to or from the nearest railhead or truck the entire distance from origin to destination after abandonment, assuming they remain in business and do not relocate. This increased truck traffic may cause additional deterioration of highways, reducing the life expectancy of roadbeds and necessitating increased maintenance and resurfacing costs.

However, increases in truck traffic also will generate additional revenues in the form of license fees and fuel tax collections. These increased revenues are calculated and subtracted from increased highway costs to determine the net cost of additional truck traffic. A thorough description of the methodology will be discussed later.

Rail Costing Procedures

The determination of primary efficiency benefits depends, to a large degree, on the underlying revenue and cost calculations in the base case and under the rehabilitation alternative. The rail costing methodology generates both on-branch and off-branch cost estimations which are of particular importance for use in the NOLAM. This section of the study will present an overview of the rail costing procedures utilized, and provide a summary of the cost elements derived for various classes of traffic.

General Approach and Methodology

The analysis of line segment viability in areas of bulk commodity transportation requires a different approach to cost estimation than in situations where traffic patterns are largely stable. In grain producing regions, in particular, the transportation system is evolving from a single-car system to a multiple carload and/or trainload gathering system, necessitating a methodology which is dynamic in nature.

Techniques have been developed (United States Railway Association, 1976, for example) which went to great depths in specifying on-branch cost components. These techniques were based on single car assumptions and could not be transferred to evolving transportation scenarios. In addition, such techniques utilized regional Rail Form A off-branch costs (average costs for numerous railroads) which may not be reflective of the individual carriers involved.

The methodology developed in this study entails improvements over previous and existing approaches in both of the above areas. Individual carrier costs are used to develop both on-branch and off-branch cost elements. In addition, costs are adjusted to account for the effects of multiple-car shipments.

Cost Estimation Procedures

The cost coefficients used in this study have been developed using Rail Form A (RFA), a statistical cost-finding formula developed by the Interstate Commerce Commission (ICC). Rail Form A is essentially a statistical software package which is used to generate unit costs for a variety of output measures (Table 5) for individual railroads or groups of railroads.

TABLE 5. RAIL FORM A UNIT COSTS AND OUTPUT MEASURES

Expense Item	Output Measure
Gross Ton Mile	Gross Ton Miles of Cars, Contents, & Caboose
Locomotive Unit Mile	Locomotive Unit Miles
Crew Wages	Train Miles
Other Train Mile	Train Miles
Station Clerical Cost	Carload Shipments Originated/Terminated
TOFC Clerical	TOFC Shipments Originated/Terminated
Intraterminal Clerical	Cars Switched Intraterminal
Interterminal Clerical	Cars Switched Interterminal
Station Employee Special Services	Carload Shipments Originated/Terminated
TOFC Special Services	TOFC Shipments Originated/Terminated
Train Supplies, Running	Revenue Car Miles, Including Mileage Cars, Loaded & Empty
Train Supplies, Terminal	Carload Shipments Originated/Terminated
Loss & Damage	Carload Tons Originated/Terminated
Carload Claims Clerical	Carload Tons Originated/Terminated
TOFC Claims Clerical	TOFC Tons Originated/Terminated
Interterminal Claims Clerical	Cars Switched Interterminal
Intraterminal Claims Clerical	Cars Switched Intraterminal
Mileage Cars Inspection	Car Miles, Mileage Cars, Loaded & Empty
Car Mile Costs	Car Miles, Less Mileage Cars, Loaded & Empty
Car Day Costs	Car Days, Total
Engine Minute Expense	Total Switching Minutes, Yard & Way Switching
Heating and Refrigeration	Refrigerator Car Miles, Loaded & Empty

RFA utilizes source input data, both accounting and operating, to derive estimates of variable costs. A series of allocation formulas and distribution ratios for allocating common and/or joint costs to various activities are contained within the formula. The results of the ICC regression studies also are included in a separate file.

The manner in which the various data flow through the formula is depicted in Figure 3. As illustrated, several independent but interrelated

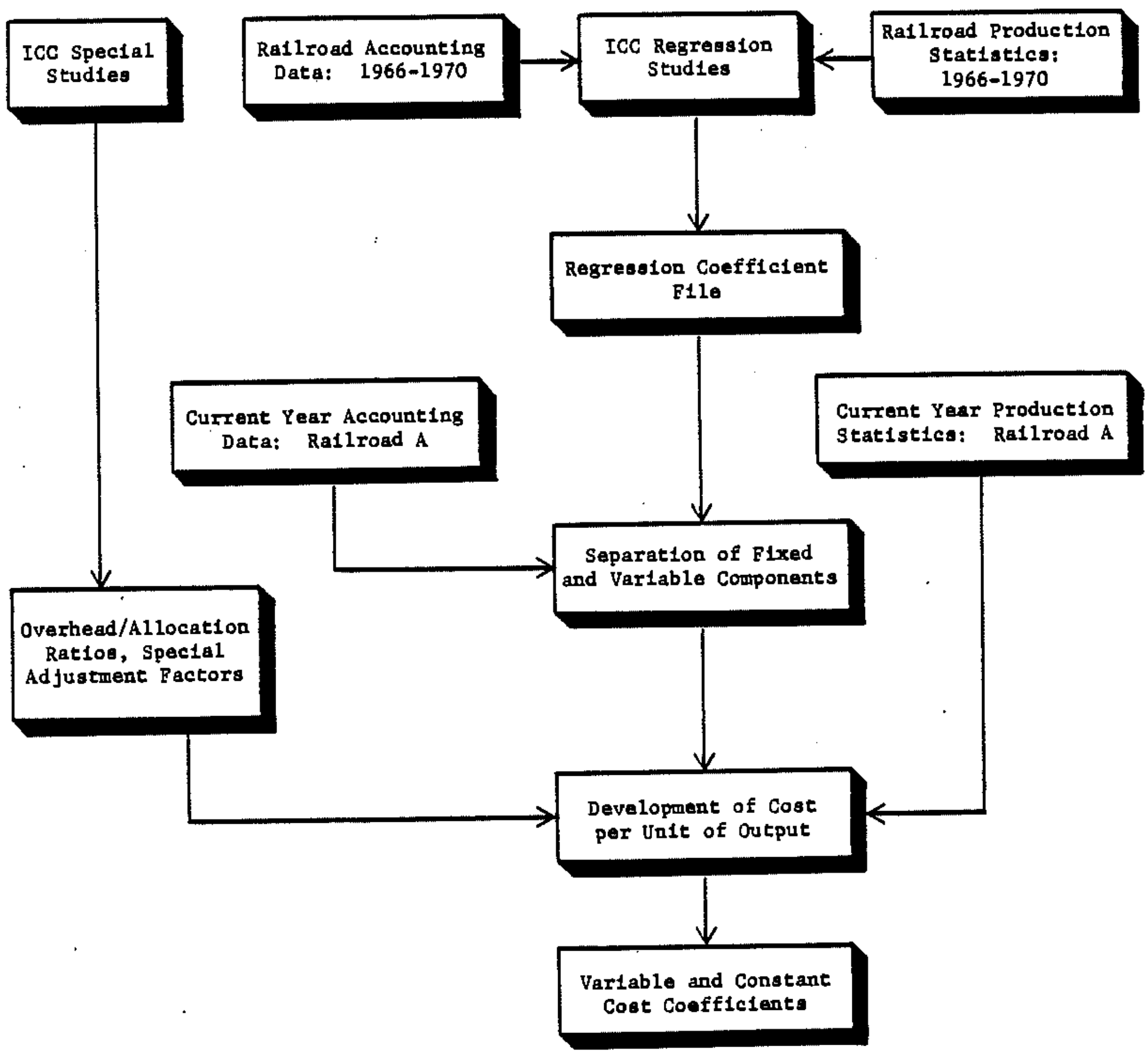

Figure 3. Rail Form A: Basic Inputs and Data Flow

steps are involved in the process. Determination of cost variability is not performed within the formula, but is developed external to Rail Form A. The coefficient file containing regression results is read into the formula for use in later application.

Within the cost-finding formula, accounting expenses and production data are transformed into unit costs via a multi-stage process. Each grouping of accounts (for example, maintenance of roadbed and structures) is separated into fixed and variable components on the basis of the variability ratios developed through regression analysis. If the accounting expenses must be allocated to more than one output measure, this allocation is performed in a related step.[1] The total expenses are divided by the number of productive units consumed during the year to produce a cost per unit of output or "unit cost" for each of the categories depicted in Table 5. Using the gross ton mile service unit as an example, this process is illustrated below:

$$UC = (AC \times APV) \div TGM$$

where: UC = Unit cost per gross ton mile

AC = Total expenses for groups of accounts

APV = Annual percent variable of the account or group

TGM = Total system gross ton miles

Application of Cost Coefficients

The coefficients then must be applied to specific situations to obtain cost estimates for various levels of service, commodities, and origin-destination scenarios once the unit costs are derived from the application of Rail Form A. The manner in which these raw coefficients are applied to produce useful estimates of rail costs is the subject of the following discussion.

Development of Baseline Car Costs

The costs for any equation, either off-branch or on-branch, are determined as:

$$C_{ij} = UC * SU_{ij}$$

where: C_{ij} = Cost of movement from elevator i to destination j

UC = Unit cost per measure of output, derived from RFA applications

SU_{ij} = Number of service units consumed in moving from elevator i to destination j

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[1] For example, maintenance of roadway expenditures are primarily allocated between gross ton mile and train mile service units, with a small residual allocated to locomotive unit mile.

The movement cost, C_{ij}, is actually an aggregation of cost equations for a variety of output measures (i.e., gross ton mile, locomotive unit mile, train mile, etc.). These individual cost equations are summed to derive total movement costs for particular origin-destination combinations.

Not all of the service units and unit costs shown in Table 5 are utilized for either on-branch or off-branch cost equations. Off-branch and on-branch equations utilize those cost elements which are specific to the type of activities which occur during either phase of the movement. On-branch costs, in addition, include cost estimation procedures which utilize individual branch line statistics for investment costs, maintenance of way, and crew wages rather than relying on system-average Rail Form A factors. Some estimating procedures will vary from the base case to the rehabilitation case.

On-Branch Cost Elements

On-branch costs consist of those cost elements which relate to train running activities and the time spent on-branch by locomotives and train crews. The number of hours spent on-branch are developed on the basis of service frequency and the length and operating condition of the line. Annual crew wages are estimated for each individual line from these data. Maintenance of way (MOW) and net investment costs, or the net liquidation value of railway assets (NLV), are developed directly rather than relying on Rail Form A averages. The remainder of the on-branch costs are developed using individual-carrier Rail Form A unit costs.

Train Costs

On-branch train-related costs include the following RFA cost elements: (1) gross ton mile costs, (2) locomotive unit mile costs, and (3) train mile expenses. Gross ton mile costs include the on-branch costs (other than MOW) which are attributable to the weight of the consignment and the weight of the freight car, including some allocations for train fuel, locomotive and freight car repairs, and transportation and overhead expenses. Locomotive unit mile (LUM) costs include expenses for maintenance and repair of equipment, depreciation, and fuel.[2] Train mile (OTM) expenses include traffic and overhead expenses such as train dispatching costs and caboose-related costs, including ownership, maintenance, and repair.

Crew Wages On-Branch

Crew wages on-branch are computed separately for the base case while included in OTM under the rehabilitation alternative. Crew wages on-branch

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[2]The alternative to a locomotive unit mile (LUM) allocation would be to develop costs on a locomotive hour basis, as was done by USRA. Locomotive depreciation, however, is more attributable to useage rather than time. Repairs and fuel also are more related to useage or miles run than to time. For these reasons, a LUM allocation is felt to be more appropriate than a locomotive hour allocation.

under the base case generally will be higher than the system-wide average due to reduced train speed caused by deferred maintenance. Crew wages are expected to correspond with system-wide averages under the rehabilitation alternative and are included with OTM using RFA procedures. Crew wages will be discussed in further detail in a later section of the report.

MOW and Road Capital Adjustments

Rail Form A variable costs normally include maintenance of roadway expenditures and road capital costs. Maintenance of way expenditures (costs for ties, ballast, rail, etc.) are primarily allocated to gross ton mile and train mile service units, with some residual to locomotive unit mile. The same is true of capital costs for roadway assets.

These costs represent historic investment costs under average operating characteristics. Many branch lines have been the subject of deferred maintenance for many years. There may be differences between line segments in the value of land as well. For both reasons, maintenance of roadway and road capital costs have been removed from the Rail Form A base during the calculation of on-branch costs and estimated directly for the base case. Normalized maintenance has been assumed for the rehabilitation scenario. As a result, system-average Rail Form A factors are felt to be more reflective of actual maintenance expenditures than they were in the base case and have been retained in the Rail Form A cost calculations. Off-branch costs, as will be discussed later, have been treated differently than on-branch costs in the estimation of MOW and road capital costs. Off-branch costs are the result of system operations as a whole.

The other principal on-branch cost elements are car ownership expenses (car day and car mile). Rail Form A provides a system-average car day and car mile cost, as depicted in Table 5. The costs represent composites for all car types in a carrier's fleet. Such averages are acceptable where data are not available at an individual car level. The preferred approach, and the one utilized where possible in this study, is to develop car day and car mile costs at a disaggregate car-type level.

The ICC has prescribed a set of procedures for developing per diem and mileage rentals for a broad range of car types.[3] These procedures use data collected annually by the carriers and car-use data published by the Association of American Railroads. These inputs are processed through Rail Form H to derive car ownership costs by car type (ICC, 1979).

These car day and car mile costs contain the same basic cost elements as the car day and car mile costs developed from a Rail Form A application:

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[3]ICC car classifications follow broad, functional car-type categories and include the following types, among others: 1) 40-foot boxcar, 2) 50-foot boxcar, 3) equipped boxcars, 4) plain gondolas, 5) equipped gondolas, 6) open-top hoppers, general service, 7) open-top hoppers, special service, 8) covered hoppers, 9) mechanized refrigerator cars, 10) standard reefers, 11) trailers on flatcars (TOFC), 12) general service flatcars, 13) other flatcars, and 14) two classifications of tank cars.

1) freight car repairs, 2) depreciation and retirements, 3) net car-hire rentals, and 4) departmental overheads (superintendence, insurance, payroll, etc.). The difference is that in lieu of net car-hire rentals, Rail Form H allows a return on investment equal to the cost of capital. Rail Form H costs, in addition, are developed at the individual car-type level while RFA unit costs are generic in nature.

The car mile and car day costs developed using Rail Form H do not include overhead or indirect maintenance. When developed from this source, the costs have been increased by the Rail Form A multiplier for general overhead. This is designed to account for common or overhead expenses which cannot be assigned directly to individual car-types (i.e., joint maintenance of repair shops and facilities). These costs must be allocated on a prorata basis among car types.

Off-Branch Cost Elements

The off-branch cost equations include the same train-running activities as on-branch, plus terminal and intermediate yard activities. The following description of off-branch costs makes reference to a number of terminal and line-haul cost elements depicted in Table 5. These elements are restated and summarized according to types of activity in Table 6.

TABLE 6. OFF-BRANCH SERVICE UNITS AND COST CATEGORIES

Service Unit	Terminal	Line-Haul
Engine Minute	X	X
Car Day	X	X
Car Mile	X	X
Tons Originating/Terminating	X	
Carloads Originating/Terminating	X	
Gross Ton Mile		X
Locomotive Mile		X
Train Mile		X

Terminal Switching Costs

Terminal switching costs are treated exclusively as an off-branch expense. The engine minutes consumed in terminal switching at origin and destination are estimated using Rail Form A averages per car. The average number of minutes consumed per switch is multiplied by the number of cars switched, doubled to account for the spotting of the empty and pulling of the load, and doubled again to account for the minutes consumed at both origin and destination. The minutes developed in this manner are multiplied by the RFA expense per switch engine minute to produce estimates of terminal switching expenses for each origin-destination scenario.

Car Days: Origin-Destination

Rail Form A provides estimates of the number of car days spent loading and unloading at origin and destination plus the number of days spent switching (the time consumed in getting the loaded and empty car to and from the industry siding at both the originating and terminating freight yards). Rail Form A allows two days loading or unloading per shipment. This is consistent with most single-car tariffs which allow 48 hours free time at origin and destination. Rail Form A also allows four days switching at origin and destination (assuming a spotted-to-pulled ratio of 1.0). There is some overlap in the Rail Form A terminal cost attributable to origin car days because of the manner in which on-branch costs are calculated.

On-branch car day costs account for total time spent on the branch line, including the car days spent loading plus the time required to move the car from the branch line junction point to and from the originating elevator. To eliminate any double counting, the two car days that were allowed switching at origin have been removed from the Rail Form A terminal costs. These have been retained at destination to account for car days switching beyond the terminating yard.

Technically, anything beyond the junction point is considered off-branch, and off-branch car days would begin to accrue from the junction point. This presents no problems regarding the cost categories so long as the classification yard is located exactly at the junction of the branch line and main line. However, this happens infrequently in areas of dense branch line trackage. A regional classification yard may service several branch lines in areas of dense trackage, with the yard being centrally located on the main line, although not necessarily at the junction of any branch line. What occurs between the junction point and the classification yard is a somewhat gray area between on-branch and off-branch categories, and must be dealt with on a cost-element basis.

It is reasonable to assume that off-branch car days do not begin accruing until the car reaches the originating classification yard. One car day is allowed in the on-branch calculation for spotting the car and one day for pulling the load. Whether the car is being spotted or pulled, the one day allocation is relevant to the time the car is in way-train transit, not just the branch line portion of the movement. So, while off-branch car miles begin accruing from the time the car is past the branch line junction point (regardless of whether the junction point and the classification yard are one and the same), off-branch car days do not begin accruing until the car reaches the classification yard.

Other Terminal Costs

All other terminal costs are treated exclusively as off-branch. These include carload-related costs (station clerical costs, employee special services, train supplies and terminal expenses, as well as the terminal switching portion of car mile expenses) and those expenses developed on a per-ton basis (loss and damage, carload claims clerical).

Adjustments for Loss and Damage Claims

The system-average loss and damage claims depicted in Table 5 do not distinguish between commodity classifications. Such figures vary substantially between bulk and manufactured commodities. To account for this difference, the system-average cost listed in Table 6 has been replaced by estimates of loss and damage claims on a commodity-specific basis, derived from an ICC special study (Bureau of Accounts, 1977).

In summary, off-branch terminal costs include: switching minute costs, car ownership, station clerical, other carload-related costs, and ton-related costs including loss and damage. The remainder of off-branch costs are comprised of running costs and intermediate yard switching.

Development of Engine Switching and Car Ownership Costs at Intermediate Yards

When a shipment moves off-branch, it goes through a process of classification and declassification enroute to its final destination. The shipment may pass through several intermediate yards, where it is switched from train to train or even from carrier to carrier. At these points, costs are incurred for engine switching and car ownership which must be approximated in estimating off-branch costs.

Intermediate yard switching consists of two types: (1) intertrain and intratrain, and (2) interchange. Intertrain or intratrain switching (I & I) occurs on the lines of a single carrier, while interchange switching entails the exchange of freight cars between carriers. Both must be estimated in order to approximate intermediate car ownership and engine switching expenses.

The frequency of interchange switching for the single carload has been determined on the basis of a mileage interval. In recent rate structure investigations, the ICC (ICC, 1976) stated that interchange switching, on the average, occurred every 800 miles. The reciprocal of the distance interval (1/800) has been used to approximate off-branch costs on a per car mile basis, multiplied by the applicable empty return ratio and circuity factors. Once the number of interchange events has been determined, the number of line-haul engine minutes and car hours at intermediate points are developed using engineering estimates of the time consumed for each switch, as well as the engine switching minutes involved.[4]

The estimation of intertrain/intratrain switching events is more complex than that of interchange switching. I & I events are not totally a function of distance as interchange events are thought to be. For the majority of shipments originated or terminated outside of metropolitan switching districts, two I & I switches are required--one at the originating classification yard

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[4]RFA averages, based on ICC special studies, allow 12 hours per each intertrain or intratrain switch, and 12 hours per each interchange. The engine minutes consumed will vary from region to region and from carrier to carrier. These are developed using RFA factors for the number of equated handlings per car developed in ICC 29556 and contained in ICC, 1963.

(OCY) which serves the originating station, and one at the destination yard (DCY) which services the consignee. When the empty return is accounted for, four I & I switches are involved. These switches are not a function of distance but are a function of the shipment itself and are incurred on all shipments consigned outside of the yard switching limits regardless of distance. As the purpose of NOLAM is to analyze line segment viability, the large majority of stations analyzed will be situated on branch lines or connection line segments lying outside of switching limits of the classification yard. The shipments, as a consequence, will incur the two loaded I & I switches at a minimum.

In addition to the two loaded I & I switches, each train incurs some caboose switching as well as switching of bad order cars at intermediate points. These are likewise not related to distance, but are a function of originating and terminating shipments. In testimony submitted before the Interstate Commerce Commission (ICC, 1978), railroad cost analysts have stated that 5 percent of the cost of one system-average intertrain switch is incurred even on trainload or unit train movements, which require no further intermediate yard switching for the remainder of the movement. Rail Form A does not make an explicit allocation of this cost even for the single-car, thus perhaps understating the responsibility for line-haul switching. To allow for such occurences, the cost coefficients utilized in NOLAM have been adjusted to account for bad-order and caboose switching in addition to the standard intertrain/intratrain switching developed on a per shipment basis. This treatment of bad-order and caboose switching treats each cost element (car day costs and engine switching expenses) as a fixed cost per shipment.

Some portion of I & I switching activity is related to distance. Such switching occurs between OCY and DCY and is a result of the sorting and reclassification as the freight car moves between the originating and destination yards. This type of intermediate yard activity is a function of distance, increasing with the mileage between OCY and DCY.

USRA (USRA, 1976) used a distance interval of 200 miles, which was based on previous ICC studies and is a widely accepted interval for use in RFA. Using this interval, distance-related I & I switches per car mile are calculated as follows:

$$I \,\&\, I = (1/200) * ERR * CIRC$$

where: I & I = Intertrain/intratrain switching events

ERR = Ratio of total to loaded car miles

CIRC = Circuitous routing factor

Once the distance-related I & I switches are determined they are multiplied by the estimated number of car hours and engine minutes per switch to develop movement service units (see footnote 4).

Running Costs

Off-branch running costs include car mile costs, train mile costs, locomotive mile costs, and the portion of car day costs related to running as opposed to yard activities.

The off-branch train mile cost equations are structured in a similar manner to on-branch train mile equations. The difference is that the off-branch equations include Rail Form A crew wages per train mile (both way train and through train wages) where on-branch equations utilized an hourly allocation of crew wages. Locomotive unit mile expenses and crew wages are developed utilizing RFA statistics for way and through trains separately.

An adjusted gross ton mile expense is developed for off-branch operations from the locomotive unit mile and train mile equations. This cost reflects the differences in cost among types of trains due to train weight, the number of locomotive units per train, and crew wages. The statistical definitions of train class used in Rail Form A (i.e., way train versus through train) are very analogous to operational definitions. Way trains are defined as those trains which operate primarily to gather and distribute cars among way stations and way points and classification yards, although occasionally a way train will shuttle cars from a smaller to a larger destination point. Through trains, on the other hand, are those trains which operate solely between major concentration or distribution points. Through trains do not engage in the type of train switching and related activities which characterize a way train.

The gross ton mile expense per train mile in each class of train is a function of three factors (Table 7): (1) the weight of the train, (2) the number of locomotive units required, and (3) crew wage differentials. Generally speaking, the larger the train, the lower the gross ton mile expense per train mile (GTMTM) will be. This occurs because common train-mile expenses, both wage and non-wage, are fixed for the train journey. The greater the number of production units to spread these costs over, the lower the per unit cost (GTMTM) becomes.

There also is some inherent slack in locomotive capacity on smaller trains. As the size of the train increases, the number of locomotive units also increases, but not necessarily in direct proportion. Building of longer and heavier trains has a direct effect on the utilization of locomotive capacity, which is simulated through the adjusted GTMTM unit cost.

The gross weight of a 24- or a 26-car consignment may, on certain occasions, be greater than the weight of the system-average way train. The effect of greater train weights and locomotive capacity on-branch are factored directly into the service unit calculation, as will be explained later. Off-branch, the cost difference between through and way train simulates the effect of long-haul, line-haul efficiencies on cost.

Car mile and car day coefficients used in the off-branch equations are the same as described earlier for use in on-branch equations. The number of service units consumed in off-branch running activities was developed using an average train speed for car days running, in conjunction with Rail Form A estimates for intermediate switching events. (The development of intermediate

TABLE 7. RAIL FORM A GROSS TON MILE ADJUSTMENT BY TYPE OF TRAIN

Item	Rail Form A Core Number Way Train	Rail Form A Core Number Through Train	Data Source
1. Average Trailing Weight of Train	---	---	Schedule 755, R-1 Report
2. Raw Gross Ton Mile Expense	B(3261)	B(3261)	Schedule B, RFA
3. Gross Ton Mile Cost Per Train Mile	---	---	Line 1 x Line 2
4. Locomotive Units Per Train	---	---	Schedule 755, R-1 Report
5. Cost Per LUM	B(3262)	B(3262)	Schedule B, RFA
6. Locomotive Cost Per Train Mile	---	---	Line 4 x Line 5
7. Crew Wages Per Train Mile	B(3316)	B(3317)	Schedule B, RFA
8. Other Train Mile Expenses	B(3263)	B(3263)	Schedule B, RFA
9. Cost Per Train Mile	---	---	Line 3 + Line 6 + Line 7 + Line 8
10. Cost Per Gross Ton Mile Per Train Mile	B(3325)	B(3326)	Line 9 Line 1

yard switching events for the single carload was discussed earlier.) The service units, once developed for the total trip, are multiplied by the unit cost to produce cost estimates for individual car-type categories.

MOW and Road Capital Costs

While maintenance of running tracks and road capital costs have been removed from the Rail Form A base in developing on-branch cost coefficients, this is not the case for off-branch cost coefficients. Off-branch costs reflect a variety of traffic and operating conditions. System average maintenance of way and road capital costs off-branch can be expected to more closely reflect actual expenditure and valuation levels than in the case of on-branch traffic. Rail Form A allocations for roadway expenditures have been retained in the off-branch cost coefficients.

Return on Investment and Fixed Cost Allocation

Returns on carrier investment, both road and equipment, are included in the Rail Form A variable cost base. Return on locomotive investment is included in the locomotive unit mile cost, while return on freight cars is included in the car day and car mile cost. Return on road property is included in the off-branch terminal and line-haul unit costs, primarily in the gross ton mile, train mile other than crew wages, and station clerical costs.

The return allowed is set equal to the current cost of capital. For 1982, the ICC determined the railroads' replacement cost of capital to be 16.5 percent. This rate of return is reflected in all of the off-branch costs to which cost of capital is allocated, as well as to equipment costs on-branch.

Development of Off-Branch Multiple-Car Costs

An essential component of the cost estimation process is the development of multiple-car costs. An overview of multiple-car costing procedures and a description of the nature of the cost adjustments involved are provided in the following section.

The consignment of shipments in multiple carload blocks generates both terminal and line-haul efficiencies. Terminal efficiencies are achieved because of (1) reduced engine switching time, (2) fewer car hours at origin and destination, and (3) station/billing efficiencies. Line-haul efficiencies are gained because of (1) reduced frequency of in-route switching, (2) reduced interchange frequency, and (3) fewer line-haul car days.

Engine Minutes Terminal Switching

Adjustments in switching times at origin and destination have been developed using factors originally estimated by the ICC (ICC, 1976) and later refined by the Office of Rail Public Council (RPC).[5] RPC estimated a linear regression equation of switching minutes based on block size by refining the ICC's switching time adjustments. Adjustments for any size carload block may be developed by reading from the slope of the regression line.

Car Days: Origin-Destination

Rail Form A single-car terminal costs include an allowance of 48 hours loading or unloading for a total of 96 hours at origin and destination. Most multiple-car tariffs restrict shippers to 24 hours at either origin or destination. Multiple-car costs developed in this study reflect the 24-hour loading and unloading restriction at origin and destination. This has the effect of cutting the allowance for loading and unloading in half.

Station Clerical Costs

Station clerical costs at origin and destination also have been adjusted using ICC factors (ICC, 1980). This adjustment factors station clerical costs

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[5]See: ICC, 1980 and ICC, 1978.

into those costs which are attributable to the shipment (25 percent) and those which are attributable to the carload (75 percent). The cost per carload is less for multiple-car blocks as the fixed shipment expense is spread over a greater number of carloads.

Line-Haul Switching

As noted earlier, interchange switching costs are allocated on a per mile basis for the single carload. This is an appropriate allocation under single-car parameters, where cars simply follow the path of least resistance. For larger multiple carload blocks, however, the consignments do not follow the normal routing patterns of the carrier. Most multiple-car rates are published as local rates between known origin and destination points (i.e., Fargo, North Dakota to Minneapolis). For this reason multiple-car movements of 10 cars and above normally occur on the lines of a single carrier. As a consequence, interchange costs have been eliminated for carload blocks of 10 cars or greater in the estimation of line-haul costs.

For multiple-car movements of nine cars or less, the mileage allocation developed earlier has been retained. These blocks resemble more closely a single-car consignment with regard to operating circumstances. The assumption followed here is that single-car parameters will prevail in the transportation of these consignments and the system-average frequency of interchange switching will occur.

The frequency of I & I switching also will vary between single-car and multiple-car scenarios. For large multiple carload blocks, the distance-related activities are not normally incurred. When the block is classified at OCY, it will normally be included in a direct through train to the DCY, along with similar shipments bound for the same general destination. Such trains known as "grain drags" are common to grain transportation in the western United States. These trains, because they are made wholly at OCY, do not need to be broken apart, re-sorted, and reassembled at intermediate points enroute to DCY.[6] For this reason, distance-related I & I switching events have been eliminated in the calculation of line-haul costs for large multiple carload blocks of 23 cars or greater. The shipment-related I & I switching events, however, have been retained in the line-haul cost calculation. With the exception of trainload shipments, which will be discussed later, these consignments must still undergo classification and declassification at OCY and DCY, respectively.

Trainload Costs

In addition to multiple-car costs, NOLAM entails the capability to estimate costs for 52-car trainload movements. Trainload movements, as the name implies, consist of a solid train of cars moving between origin and

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[6]Based on conversations with Burlington Northern trainmasters. This operating description fits the class of train called a "fast" or "direct" through freight. These are priority trains which are largely blocked together for a similar destination at the originating yard.

destination as an integrated unit in a one-time movement pattern. Trainloads are thus distinct from unit trains, which entail a cyclical, continuous pattern of movement, a dedicated train set, and normally an annual contractual volume agreement.

The adjustments for trainload service are built on the adjustments which were described earlier for multiple carloads. Engine switching minute reductions are based on the RPC factors which provide specific adjustment for various carload blocks. Station clerical costs are adjusted by allocating 75 percent of the cost to the carload, as before, and 25 percent to the shipment. There are additional differences between multiple carload and trainload consignments, however, which require further adjustments for 52-car trains. These include: (1) intertrain/intratrain switching, (2) car days switching at origin and destination, and (3) road train characteristics.

Trainload consignments are assumed to run uninterrupted from origin to destination, without the necessity for blocking and classification of cars. Because of the integrated nature of the unit, intermediate yard activities are by-passed. No intertrain or intratrain switching is required. Rail Form A expenses for I & I switching, consequently, have been eliminated during the estimation of 52-car costs, with the exception of bad-order and caboose switching.

Road Train Characteristics

Under a Rail Form A application, the characteristics of the train are normally assumed to be system-average for the type of train service being used. For through train shipments, for example, the consignment is "forced into" a system-average through train, with a set number of locomotive units and a specific train weight. The individual consignment then shares in the common train mile expenses (i.e., crew wages, locomotive unit mile cost, and other train mile costs) on the basis of the ratio of the gross tons of the shipment to the average trailing weight of the train. Under a trainload consignment, however, the characteristics of the road train do not reflect the system-average through train, but rather reflect the specific characteristics of the trainload unit. The number of gross trailing tons of cars and contents will be equal to the average trailing weight of the consignment (i.e., 4,191 tons for a covered-hopper train), while the number of locomotive units will reflect the specific capacity necessary to pull the train rather than the system-average number of units. For 52-car consignments, the number of locomotive units has been based on specific engineering estimates or on conversations with regional trainmasters.

In addition to train weights and power requirements, the trainload shipments differ from standard train operations with regard to the speed of the train. Under normal costing procedures, the speed of the road-haul train reflects the system-average as developed from the carrier's annual report. The system-average, however, entails some element of train switching time. For single-car shipments, the system-average is appropriate for describing the speed of the various types of train service. Under a trainload scenario, however, no train switching occurs at origin, destination, or intermediate points. The only switching which occurs is the road train-to-industry switching, or so-called "terminal switch." In calculating the train running speed, therefore, any way and intermediate yard switching time has been eliminated from the road train hours in calculating train speed. The train speed for 52-car trains, as a result, reflects only the actual train running time required.

Car Days Switching: Origin and Destination

For single-car and multiple-car shipments, two car days were allowed at destination for spotting and pulling the freight car. This is necessary because the consignment is broken out of the road train at the destination classification yard and delivered by a local train (spotting). After the car is unloaded, it is then pulled back to the classification yard, consuming two car days. Under a trainload scenario, these car days are not incurred. The consignment is delivered directly to the customer's siding by the road train, unloaded, and then pulled by a set of road locomotives for the return trip to the origin territory. The back-and-forth activities between the consignee's siding and the classification yard are therefore eliminated. As a consequence, the two car days normally included in the Rail Form A calculation for off-branch costs are eliminated in the case of 52-car trains.

Summary of Cost Coefficients

The preceding discussion has described the manner in which off-branch and on-branch cost elements are developed and the manner in which multiple-car costs are derived. The individual cost elements are incorporated directly into the equations for on-branch costs, condensing the large number of cost elements described earlier into four summary cost coefficients for off-branch costs.

Off-branch coefficients are calculated for the following service units: 1) carloads originated, 2) freight tons consigned, 3) car miles, and 4) ton miles. All terminal cost elements are condensed to a carload and freight ton basis, while all line-haul costs are summarized on a ton mile or car mile basis. The relationship between the disaggregate cost elements described earlier and the four summary off-branch cost measures are depicted in Table 8. This aggregation is done primarily for purposes of simplifying model calculations.

Methodology and Procedures for Determining the Economic Impact of Branch Line Abandonment/Rehabilitation

The impacts of rail branch line abandonment/rehabilitation may be estimated for a 1- to 25-year time span. Costs and revenues for grain movements by rail may be estimated for single, 3, 10, 24, 26, or 52-car movements, depending on the operating railroad and commodity. Fertilizer and machinery movements also may be included along with up to two additional miscellaneous commodities.[7] Grain movements (outbound) may have up to 10

[7]Grain, oilseed, coal, fertilizer, and machinery are the principal products originating or terminating on railroads in North Dakota.

TABLE 8. DEVELOPMENT OF SUMMARY OFF-BRANCH UNIT COSTS

Cost Category	Unit Cost	Cost Elements	Activity
Terminal	Carload	Engine Minute Cost	Terminal Switching
		Car Ownership Cost	Car Days Switching, Loading, and Unloading
		Station Clerical	Billing and Station Functions
		Train Supplies	Shipment Related
		Station Employee Special Services	Shipment Related
	Freight Tons	Loss and Damage	Shipment Liability
		Claims Clerical	Shipment Liability
Line-Haul	Car Mile	Car Ownership Running	Train Movement
		Car Ownership Switching	Yard Switching
		Engine Minute Cost	Yard Switching
		Train Supplies Running	Train Movement
		Tare Weight Cost	Car Movement, Gross Ton Miles
	Ton Mile	Net Ton Miles	Movement of Lading, Gross Ton Miles

origins and 4 destinations while fertilizer and machinery (inbound) may have 1 origin and up to 10 destinations. Other miscellaneous movements may have only 1 origin and 1 destination. The following computations are used to estimate the changes in shipping rates and costs which will occur if a branch line is abandoned versus if that line is rehabilitated. Shipping rates and costs are computed for two cases--base and rehabilitation. The base case is the situation which is likely to occur if the branch line is not rehabilitated. The likely occurrence in the base case is that a branch line will cease to exist at some time in the future, generally from one to five years, unless major rehabilitation of the line is undertaken. This condition generally occurs due to the deferred maintenance schedule administered by the owning railroad (i.e., the branch line has deteriorated to a point of marginal or sub-marginal serviceability). The rehabilitation situation is simply the shipping costs and returns associated with the rehabilitated line. Shipments by mode may shift, at least to some degree, from truck to rail service under this scenario.

Base Case

The branch line is expected to remain in service for only a few years in the base case. This requires numerous computational considerations. For purposes of simplicity, preabandonment modeling techniques will be described first, followed by postabandonment modeling techniques.

Traffic Shipments

A three-year historic average shipment (the last three crop years) is used to project future grain traffic patterns by mode, origin, commodity, and destination. This period is used so as to reduce the volatility in shipments due to climatic or price conditions which may occur in a given year, but yet not overstate the railroad's portion of traffic due to deteriorating branch line trackage conditions. Historic grain traffic patterns, in bushels, are obtained from the North Dakota Public Service Commission and include shipments by commodity, origin, destination, mode, and type of rail car. Shippers on the branch line are surveyed to determine quantities of product and mode of shipment for commodities other than grain, such as lumber, machinery, fertilizer, coal, etc., which are shipped either into or out of the study area for the latest crop year.

It is anticipated that total grain shipments will increase over time due to increases in productivity and changes in technology. Future production increases in grain and oilseed crops were estimated on a regional basis for North Dakota for selected years (Cobia, 1980). These production increases were interpolated and extrapolated to estimate future annual increases in commodity shipments for each region (Figure 4). Annual percentage increases were computed for six commodities--wheat, barley, oats, sunflower, soybean, and "other" (Tables 9 through 14). "Other" includes grains such as corn, rye, and flaxseed which are grown in North Dakota but constitute a relatively low proportion of total grain shipments. The projected production increase is multiplied by the historic shipment to obtain annual grain shipments by commodity in the base case for the specified time period:

$$Shipbr_{(Y,O,G,D)} = AH_{(O,G,D)} * PI_{(G,Y)} * CF_{(G)} * PR_{h(O,G,D)}$$

where: Shipbr = Number of hundredweights (cwts.) shipped by rail, base case

Y = Year (1983 to 2007)

O = Origin (1 to 10)

G = Type of grain

D = Destination (Minneapolis, Duluth, Omaha, or Pacific Northwest)

AH = Average historic shipment, in bushels, all modes (last three crop years)

PI = Percentage increase (from Tables 9 through 14)

CF = Conversion factor for bushels to cwt. (wheat, .6; barley, .48; oats, .32; sunflower, .3; soybean, .6)[8]

PR_h = Percent shipped by rail, historic (last three crop years)

[8]The conversion factor for "other" grains is based on the weighted average weight per bushel for those commodities shipped.

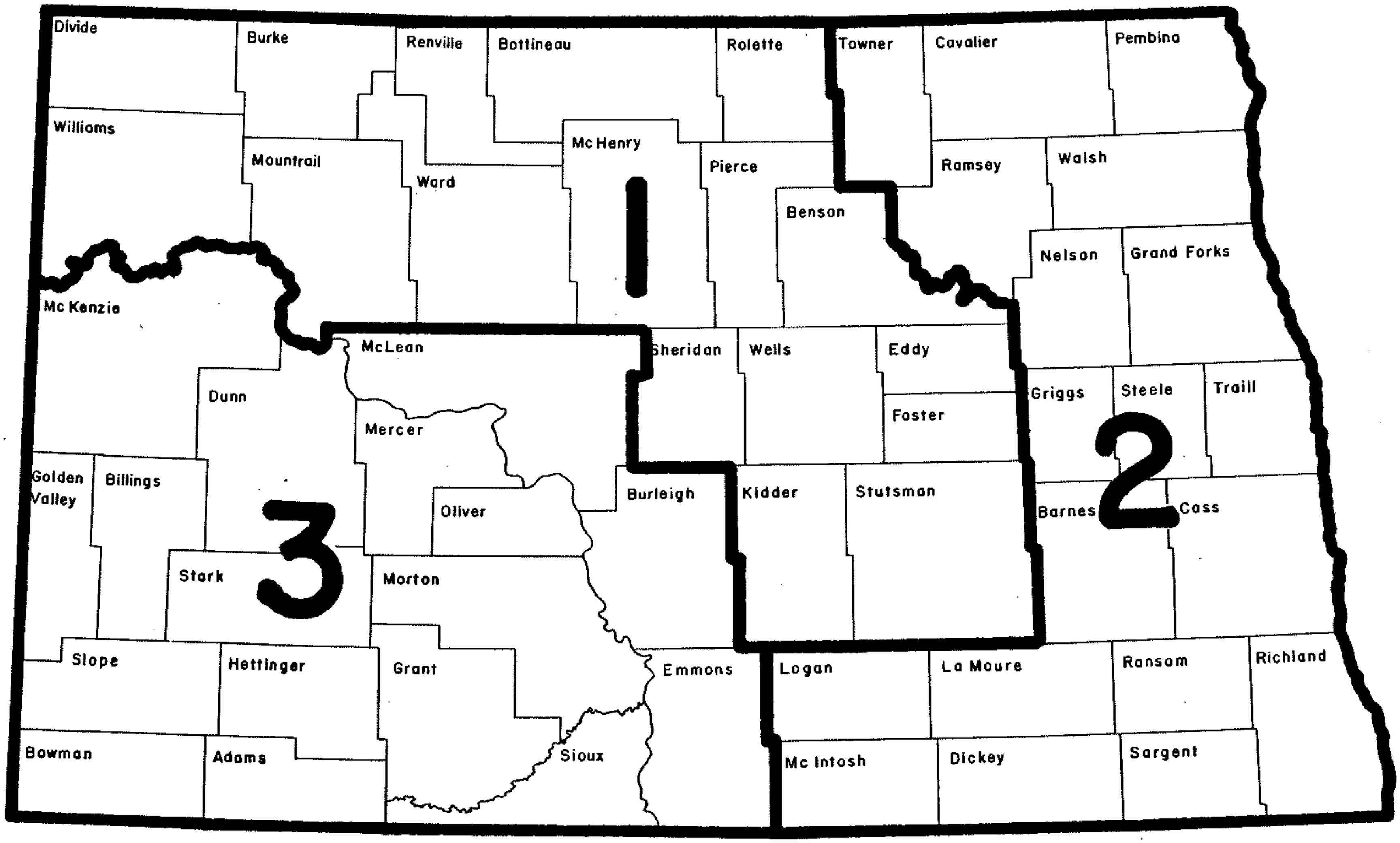

Figure 4. North Dakota Transportation Regions

TABLE 9. PROJECTED PRODUCTION OF WHEAT, BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[a]

Year	Region 1		Region 2		Region 3	
	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	104,471	1.00000	118,503	1.00000	59,051	1.00000
1983	106,507	1.01949	120,561	1.01737	59,601	1.00931
1984	108,898	1.04238	123,013	1.03806	60,091	1.01761
1985	110,741	1.06002	124,857	1.05362	60,673	1.02747
1986	112,583	1.07765	126,701	1.06918	61,254	1.03731
1987	114,426	1.09529	128,546	1.08475	61,836	1.04716
1988	116,268	1.11292	130,390	1.10031	62,417	1.05700
1989	118,111	1.13056	132,234	1.11587	62,999	1.06686
1990	120,807	1.15637	135,023	1.13941	63,439	1.07431
1991	123,503	1.18217	137,812	1.16294	63,879	1.08176
1992	126,199	1.20798	140,612	1.18657	64,318	1.08919
1993	128,895	1.23379	143,390	1.21001	64,758	1.09665
1994	131,591	1.25959	146,179	1.23355	65,198	1.10410
1995	134,287	1.28540	148,968	1.25708	65,638	1.11155
1996	136,983	1.31121	151,757	1.28062	66,078	1.11900
1997	139,679	1.33701	154,546	1.30415	66,517	1.12643
1998	142,375	1.36282	157,335	1.32769	66,957	1.13388
1999	145,071	1.38862	160,124	1.35122	67,397	1.14134
2000	147,767	1.41443	162,913	1.37476	67,837	1.14879
2001	150,463	1.44024	165,702	1.39829	68,277	1.15624
2002	153,159	1.46604	168,491	1.42183	68,716	1.16367
2003	155,855	1.49185	171,280	1.44536	69,156	1.17112
2004	158,551	1.51766	174,069	1.46890	69,596	1.17857
2005	161,247	1.54346	176,858	1.49243	70,036	1.18603
2006	163,943	1.56927	179,647	1.51597	70,476	1.19348
2007	166,639	1.59507	182,436	1.53951	70,916	1.20093

[a]Adapted from Cobia, 1980.

TABLE 10. PROJECTED PRODUCTION OF BARLEY, BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[a]

Year	Region 1		Region 2		Region 3	
	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	20,768	1.00000	54,991	1.00000	8,072	1.00000
1983	20,769	1.00005	55,697	1.01284	8,256	1.02279
1984	20,777	1.00043	56,508	1.02759	8,452	1.04708
1985	20,775	1.00034	57,157	1.03939	8,630	1.06913
1986	20,773	1.00024	57,807	1.05121	8,807	1.09106
1987	20,771	1.00014	58,456	1.06301	8,985	1.11311
1988	20,769	1.00005	59,106	1.07483	9,162	1.13503
1989	20,767	0.99995	59,755	1.08663	9,340	1.15709
1990	20,780	1.00058	60,655	1.10300	9,546	1.18261
1991	20,794	1.00125	61,556	1.11938	9,752	1.20813
1992	20,807	1.00188	62,456	1.13575	9,959	1.23377
1993	20,821	1.00255	63,357	1.15213	10,165	1.25929
1994	20,834	1.00318	64,257	1.16850	10,371	1.28481
1995	20,847	1.00380	65,157	1.18487	10,577	1.31033
1996	20,861	1.00448	66,058	1.20125	10,783	1.33585
1997	20,874	1.00510	66,958	1.21762	10,990	1.36150
1998	20,888	1.00578	67,859	1.23400	11,196	1.38702
1999	20,901	1.00640	68,759	1.25037	11,402	1.41254
2000	20,914	1.00703	69,659	1.26673	11,608	1.43806
2001	20,928	1.00770	70,560	1.28312	11,814	1.46358
2002	20,941	1.00833	71,460	1.29949	12,021	1.48922
2003	20,955	1.00900	72,361	1.31587	12,227	1.51474
2004	20,968	1.00963	73,261	1.33224	12,433	1.54026
2005	20,981	1.01026	74,161	1.34860	12,639	1.56578
2006	20,995	1.01093	75,061	1.36497	12,844	1.59118
2007	21,008	1.01156	75,961	1.38134	13,050	1.61670

[a]Adapted from Cobia, 1980.

TABLE 11. PROJECTED PRODUCTION OF OATS, BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[a]

	Region 1		Region 2		Region 3	
Year	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	16,611	1.00000	23,169	1.00000	22,022	1.00000
1983	16,240	0.97763	22,559	0.97371	22,221	1.00901
1984	15,859	0.95473	21,988	0.94903	22,419	1.01802
1985	15,422	0.92843	21,404	0.92383	22,618	1.02703
1986	15,024	0.90445	20,961	0.90472	22,816	1.03604
1987	14,617	0.87994	20,457	0.88297	23,014	1.04505
1988	14,152	0.85196	19,943	0.86078	23,213	1.05405
1989	13,727	0.82636	19,471	0.84039	23,411	1.06306
1990	13,243	0.79725	19,041	0.82185	23,610	1.07207
1991	12,800	0.77056	18,603	0.80294	23,808	1.08108
1992	12,348	0.74335	18,156	0.78365	24,006	1.09009
1993	11,887	0.71561	17,754	0.76630	24,205	1.09910
1994	11,366	0.68426	17,344	0.74860	24,403	1.10811
1995	10,898	0.65604	16,981	0.73291	24,602	1.11712
1996	10,400	0.62608	16,610	0.71692	24,800	1.12613
1997	9,851	0.59305	16,288	0.70300	24,998	1.13514
1998	9,346	0.56261	15,903	0.68640	25,197	1.14414
1999	8,831	0.53164	15,567	0.67192	25,395	1.15315
2000	8,254	0.49692	15,390	0.66426	25,594	1.16216
2001	7,722	0.46487	14,934	0.64458	25,792	1.17117
2002	7,181	0.43229	14,637	0.63176	25,990	1.18018
2003	6,576	0.39588	14,334	0.61870	26,189	1.18919
2004	6,017	0.36221	14,084	0.60791	26,387	1.19820
2005	5,449	0.32802	13,771	0.59438	26,586	1.20721
2006	4,873	0.29333	13,480	0.58182	26,784	1.21623
2007	4,296	0.25865	13,187	0.56928	26,983	1.22525

[a]Adapted from Cobia, 1980.

TABLE 12. PROJECTED PRODUCTION OF SUNFLOWER, BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[a]

	Region 1		Region 2		Region 3	
Year	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	52,662	1.00000	88,200	1.00000	21,859	1.00000
1983	55,539	1.05463	90,714	1.02850	23,064	1.05513
1984	58,415	1.10924	93,228	1.05701	24,269	1.11025
1985	61,291	1.16386	95,742	1.08551	25,474	1.16538
1986	64,168	1.21849	98,256	1.11401	26,679	1.22050
1987	67,044	1.27310	100,770	1.14252	27,883	1.27558
1988	69,921	1.32773	103,284	1.17102	29,088	1.33071
1989	72,797	1.38234	105,798	1.19952	30,293	1.38584
1990	74,246	1.40986	106,882	1.21181	30,816	1.40976
1991	75,695	1.43737	107,966	1.22410	31,338	1.43364
1992	77,144	1.46489	109,050	1.23639	31,861	1.45757
1993	78,593	1.49240	110,134	1.24868	32,384	1.48150
1994	80,042	1.51992	111,218	1.26098	32,907	1.50542
1995	81,490	1.54742	112,302	1.27327	33,429	1.52930
1996	82,939	1.57493	113,386	1.28556	33,952	1.55323
1997	84,388	1.60245	114,470	1.29785	34,475	1.57715
1998	85,837	1.62996	115,554	1.31014	34,997	1.60103
1999	87,286	1.65748	116,638	1.32243	35,520	1.62496
2000	88,735	1.68499	117,722	1.33472	36,043	1.64889
2001	90,184	1.71251	118,806	1.34701	36,565	1.67277
2002	91,633	1.74002	119,890	1.35930	37,088	1.69669
2003	93,082	1.76754	120,974	1.37159	37,611	1.72062
2004	94,531	1.79505	122,058	1.38388	38,134	1.74454
2005	95,979	1.82255	123,142	1.39617	38,656	1.76842
2006	97,428	1.85006	124,226	1.40846	39,179	1.79235
2007	98,877	1.87758	125,310	1.42075	39,702	1.81628

[a]Adapted from Cobia, 1980, and personal communication with Dr. David Cobia, Department of Agricultural Economics, North Dakota State University, Fargo.

TABLE 13. PROJECTED PRODUCTION OF SOYBEANS, BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[a]

Year	Region 1[b]		Region 2		Region 3[b]	
	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	--	1.00	3,690	1.00000	--	1.00
1983	--	1.00	3,733	1.01165	--	1.00
1984	--	1.00	3,777	1.02358	--	1.00
1985	--	1.00	3,819	1.03496	--	1.00
1986	--	1.00	3,861	1.04634	--	1.00
1987	--	1.00	3,903	1.05772	--	1.00
1988	--	1.00	3,945	1.06911	--	1.00
1989	--	1.00	3,987	1.08049	--	1.00
1990	--	1.00	4,033	1.09295	--	1.00
1991	--	1.00	4,078	1.10515	--	1.00
1992	--	1.00	4,124	1.11762	--	1.00
1993	--	1.00	4,169	1.12981	--	1.00
1994	--	1.00	4,215	1.14228	--	1.00
1995	--	1.00	4,261	1.15474	--	1.00
1996	--	1.00	4,306	1.16694	--	1.00
1997	--	1.00	4,352	1.17940	--	1.00
1998	--	1.00	4,397	1.19160	--	1.00
1999	--	1.00	4,443	1.20407	--	1.00
2000	--	1.00	4,489	1.21653	--	1.00
2001	--	1.00	4,534	1.22873	--	1.00
2002	--	1.00	4,580	1.24119	--	1.00
2003	--	1.00	4,625	1.25339	--	1.00
2004	--	1.00	4,671	1.26585	--	1.00
2005	--	1.00	4,717	1.27832	--	1.00
2006	--	1.00	4,763	1.29079	--	1.00
2007	--	1.00	4,809	1.30325	--	1.00

[a]Adapted from Cobia, 1980.
[b]No production estimates were available; therefore, the projected increase was held constant at 1.00.

TABLE 14. PROJECTED PRODUCTION OF "OTHER" GRAINS,[a] BY TRANSPORTATION REGION, NORTH DAKOTA, 1982-2007[b]

Year	Region 1		Region 2		Region 3	
	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)	Projected Production	Projected Change (1982=Base)
	000 bushels		000 bushels		000 bushels	
1982	3,194	1.00000	14,207	1.00000	285,213	1.00000
1983	3,154	0.98727	14,212	1.00034	289,117	1.01369
1984	3,107	0.97273	14,236	1.00206	293,099	1.02765
1985	3,080	0.96433	14,273	1.00462	296,999	1.04132
1986	3,065	0.95959	14,305	1.00691	300,980	1.05528
1987	3,039	0.95128	14,364	1.01107	304,881	1.06896
1988	3,033	0.94944	14,409	1.01422	308,790	1.08266
1989	3,025	0.94695	14,482	1.01938	312,694	1.09635
1990	2,984	0.93433	14,541	1.02354	316,680	1.11033
1991	2,944	0.92153	14,617	1.02888	320,589	1.12403
1992	2,901	0.90813	14,684	1.03361	324,496	1.13773
1993	2,870	0.89840	14,781	1.04043	328,485	1.15172
1994	2,837	0.88814	14,893	1.04832	332,394	1.16542
1995	2,817	0.88193	14,968	1.05354	336,304	1.17913
1996	2,783	0.87140	15,066	1.06047	340,214	1.19284
1997	2,762	0.86457	15,166	1.06750	344,205	1.20683
1998	2,739	0.85762	15,277	1.07532	348,117	1.22055
1999	2,716	0.85023	15,383	1.08276	352,109	1.23455
2000	2,701	0.84551	15,495	1.09069	356,022	1.24827
2001	2,683	0.83998	15,613	1.09898	359,934	1.26198
2002	2,666	0.83478	15,728	1.10707	363,927	1.27598
2003	2,652	0.83011	15,851	1.11573	367,842	1.28971
2004	2,638	0.82582	15,973	1.12433	371,755	1.30343
2005	2,625	0.82193	16,100	1.13327	375,750	1.31744
2006	2,613	0.81805	16,227	1.14221	379,705	1.33130
2007	2,601	0.81417	16,354	1.15115	383,660	1.34517

[a]"Other" grains include flax, corn, and rye.
[b]Adapted from Cobia, 1980.

These shipments are estimated annually for up to 25 years, even after abandonment. The reasoning behind this will be discussed later on pages 50 and 51.

Future shipments of commodities other than grain are held constant at the latest crop year level due to the unavailability of reliable historic data to estimate future shipments. Rail shipments of commodities such as fertilizer, machinery, lumber, coal, etc. are computed as:

$$Shipbr_{(Y,O,C,D)} = Mh_{(O,C,D)} * PR_{h(O,C,D)}$$

where: C = Commodity

Mh = Total shipment in latest crop year, in cwts

Rail shipments then are summed for all origins on a commodity, year, and destination basis:

$$SShipbr_{(Y,C,D)} = Shipbr_{(Y,O1,C,D)} + Shipbr_{(Y,O2,C,D)} + \ldots + Shipbr_{(Y,On,C,D)}$$

where: SShipbr = Summed rail shipments in base case (cwts.)

C = Commodity

01 = Origin 1

02 = Origin 2

On = Origin n

Truck shipments are calculated as:

$$Shipbt_{(Y,O,C,D)} = (AH_{(O,C,D)} * PI_{(C,Y)} * CF_{(G)}) - Shipbr_{(Y,O,C,D)}$$

where: Shipbt = Number of cwts. shipped by truck, base case

Traffic Revenues

The most recent rates available are used to calculate revenues. Grain rail rates are developed directly from rail tariffs or from rate books published by the Minneapolis Grain Exchange which summarize some of these tariffs.[9] While grain truck rates are obtained from shippers, rail and truck

[9] Rates developed from tariffs are verified by the Traffic Department of the Public Service Commission before using.

rates for other commodities are obtained from shippers on the line, rate clerks, or tariffs. Revenues by mode are calculated as follows:

Revbr(Y,O,C,D) = Shipbr(Y,O,C,D) * Rater(O,C,D)

Revbt(Y,O,C,D) = Shipbt(Y,O,C,D) * Ratet(O,C,D)

where: Revbr = Rail revenue, base case

Rater = Rail rate

Revbt = Truck revenue, base case

Ratet = Truck rate

Rail Costs

Rail costs are classified into two categories--on-branch and off-branch. On-branch costs include all costs associated with the movements on the branch line while off-branch include all costs after the movements have left the branch line. On-branch costs include gross ton mile cost, locomotive unit mile cost, crew cost, car mile cost, car day cost, train mile cost, maintenance of way cost, property taxes, and opportunity cost on fixed assets. Line-haul and terminal costs are considered off-branch costs and are broken down into car mile and ton mile line-haul costs and carload and ton terminal costs. These costs are based on the number and weight of movements and length of haul. Gross ton mile, locomotive unit mile, and other train mile expenses are included in ton mile cost.

On-branch rail costs include both fixed and variable costs, while either variable or total rail costs may be computed for the off-branch position of the movement. Only two rail costs (ton terminal and ton mile line-haul) are affected when including fixed rail costs within NOLAM.

On-Branch Rail Costs

Box and hopper car capacities in hundredweights (cwts.) were computed on the basis of system-wide averages for the railroads by commodity (Table 15). Capacities for other types of rail cars were estimated at 57 tons for mechanical refrigeration, 88 tons for open top hopper, and 100 tons for gondola and tanker cars.

Not all branch lines have the capacity to carry fully loaded cars, especially jumbo hopper cars. Therefore, if the carrying capacity (less tare weight) of the branch line is less than the car carrying capacity, the car capacity is set equal to the carrying capacity of the branch line in the base case:

TABLE 15. BOX AND HOPPER CAR CAPACITIES, BY COMMODITY

Commodity	Type of Car	
	Box	Hopper
	------cwts.-------	
Wheat	1,234	1,970
Barley	1,106	1,756
Oats	989	1,457
Sunflower	761	1,159
Soybean	1,319	1,820
Other Grain	1,247	1,906
Fertilizer	--	1,960

SOURCE: ICC, 1982 and Office of Policy, 1982.

If CBLb < CRCb, then CRCb = CBLb

where: CBLb = Carrying capacity of branch line (less tare weight), base case

CRCb = Rail car capacity, base case

Covered hopper cars have comprised an increasing share of the total grain traffic in recent years while the number and utilization of box cars for grain has declined dramatically. This trend is expected to continue to the point where box cars will no longer be used to transport grain. Therefore, the historic number of box cars was projected into the future using trend analysis to determine the expected decline in the number of box cars (Table 16). The decline, computed annually using 1982 as a base of 1.00, was used to determine the number of box cars available for future traffic shipments:

$$Boxb_{(Y,G,D)} = Shipbr_{(Y,O,G,D)} * PBox_{(Y,O,G,D)} * PDBox_{(Y)}$$

$$NBoxb_{(Y,G,D)} = Boxb_{(Y,G,D)}/CBox_{(G)}$$

where: Boxb = Shipments (in cwt.) by box car, base case

PBox = Percent of shipments by box car

PDBox = Percent decline in the number of box cars

NBoxb = Number of box cars, base case

CBox = Box car capacity

The number of covered hopper cars is computed similarly:

TABLE 16. PROJECTED DECLINE IN THE NUMBER OF BOX CARS, 1966-2007

Year	Actual[a]	Projected	Decline (1982 = 1.00)
1966	464,761		
1967	436,103		
1968	411,565		
1969	394,005		
1970	375,668		
1971	357,850		
1972	340,163		
1973	333,607		
1974	328,028		
1975	321,480		
1976	302,889		
1977	280,367		
1978	262,986		
1979	274,002		
1980	251,420		
1981		228,993	
1982		214,827	1.00
1983		200,660	.93
1984		186,494	.87
1985		172,327	.80
1986		158,160	.74
1987		143,994	.67
1988		129,827	.60
1989		115,660	.54
1990		101,494	.47
1991		89,327	.42
1992		73,161	.34
1993		58,994	.27
1994		44,827	.21
1995		30,661	.14
1996		16,494	.08
1997		2,328	.01
1998		0	.00
1999		0	.00
2000		0	.00
2001		0	.00
2002		0	.00
2003		0	.00
2004		0	.00
2005		0	.00
2006		0	.00
2007		0	.00

[a]SOURCE: Personal conversation with Association of American Railroad personnel, Washington, D.C., January 12, 1981; and Economic and Finance Department, 1980 and 1981.

$$Hopb_{(Y,G,D)} = Shipbr_{(Y,O,G,D)} - Boxb_{(Y,O,G,D)}$$

$$NHopb_{(Y,G,D)} = Hopb_{(Y,O,G,D)}/CHop_{(G)}$$

where: Hopb = Shipments by covered hopper car, base case

NHopb = Number of covered hopper cars, base case

CHop = Hopper car capacity

For commodities other than grain, the number of cars is computed as follows:

$$NMISCbn_{(O,D)} = Shipbr_{(N,O,D)}/CCar_{(n)}$$

where: NMISCbn = Number of miscellaneous cars n, base case

CCar = Car capacity

The total number of cars shipped in the base case before abandonment is summed to determine the number of cars shipped per service:

$$NTOTb_{(Y)} = NBoxb_{(Y)} + NHopb_{(Y)} + NMISCbn_{(Y)}$$

$$NSb_{(Y)} = NTOTb_{(Y)}/(52 * SW)$$

where: NTOTb = Total number of rail cars, base case

NSb = Number of cars per service, base case

SW = Number of times branch line is serviced per week

<u>Gross Ton Mile Cost</u>. Gross ton mile (GTM) costs include the on-branch costs, other than maintenance of way (MOW), attributable to the weight of the consignment and the weight of the freight car including some allocation for train fuel, locomotive and freight car repairs, and tranportation and overhead expenses. Gross ton mile cost by railroad is calculated as:

$$TGTMb_{(Y)} = [(Tob_{(Y)} * WMBLb) + (Tar_{(CT)} * NC_{(CT,Y)} * 2WMBLb)]GTM$$

where: TGTMb = Total gross ton mile cost, base case

Tob = Number of tons originating or terminating on branch line, base case

WMBLb = Weighted midpoint of branch line, base case (in miles)

Tar = Tare weight of car in tons (from Table 17)

CT = Car type

NC = Number of cars originating or terminating on branch line

GTM = Gross ton mile cost (from Table 18)

TABLE 17. AVERAGE CAR TARE WEIGHTS

Car Type	Average Tare Weight (Tons)
Covered Hopper	30.60
Box	23.54
Flat-General Service	28.58
Gondola-Plain	30.55
Open Top Hopper	27.75
Tank	34.95
Refrigeration	44.01

SOURCE: Association of American Railroads, 1982.

The car cost component of GTM is multiplied by two to account for both the loaded and empty movement of cars on the branch line. (The weighted midpoint of the branch line is calculated exogenous to the model.)

Locomotive Unit Mile Cost. Locomotive unit mile (LUM) costs include expenses for maintenance and repair, depreciation, and fuel for the locomotive. Locomotive unit mile costs are computed as:

$$TLUMb_{(Y)} = 2LBL * SU_{(Y)} * LUM$$

where: TLUMb = Total locomotive unit mile cost, base case

LBL = Length of branch line

SU = Number of service units annually

LUM = Locomotive unit mile cost (from Table 18)

The length of the branch line is multiplied by two to account for both the movement from the junction point to the end of the branch line and the return trip to the junction point. The number of service units annually is computed as:

TABLE 18. GROSS TON MILE, LOCOMOTIVE UNIT MILE, CREW, TRAIN MILE, CAR DAY, AND CAR MILE COSTS, ON-BRANCH, BASE CASE, BY RAILROAD SERVING NORTH DAKOTA, JANUARY 1983

Cost Component	Burlington Northern	Soo Line
	---dollars---	
Gross Ton Mile	.001524	.001473
Locomotive Unit Mile	2.044673	2.410586
Crew Per Hour[a]		
2-Man	45.05	55.26
3-Man	62.86	76.74
4-Man	80.67	97.88
5-Man	100.38	118.97
Train Mile	1.349627	1.656826
Car Day		
Covered Hopper Car	17.3832	18.8294
Box Car	11.2668	12.2041
Flat-General Service Car	15.3705	16.6492
Gondola-Plain Car	18.3585	19.8858
Open Top Hopper Car	18.8590	20.4279
Refrigerator-Mechanical Car	22.1264	23.9672
Car Mile		
Tank Car	.097983	.100424
All Other	.067507	.057259

[a]Developed using USRA procedures (USRA, 1976).

$$SU_{(Y)} = SW * LOC * 52$$

where: SW = Number of service cycles per week

LOC = Number of locomotives per service (obtained from train master)

Crew Cost. Crew costs generally are included under train mile costs and are system-wide averages. Crew costs under the base case for deteriorated branch lines will undoubtedly be higher than system-wide averages because of reduced speeds caused by deferred maintenance. Therefore, crew wages were removed from train mile expenses and computed separately under the base case. Crew costs were computed for four different crew sizes by railroad (Table 18) and estimated from the railroad's annual operating report. On-branch annual crew wages in the base case are computed as:

$$TWCb_{(Y)} = HCC_{(CS)} * [(2LBL/Pb) + (2NCTb_{(Y)} * SEH)] * SW * 52$$

where: TWCb = Total crew cost, base case

HCC = Hourly crew cost (from Table 18)

CS = Crew size

Pb = Maximum allowable operating speed on the branch line, base case

NCTb = Number of cars per train, base case

SEH = Switching engine hours per car (from Table 19)

TABLE 19. SWITCHING ENGINE HOURS PER CAR FOR RAILROADS OPERATING IN NORTH DAKOTA, 1982

Railroad	Switching Engine Hours Per Car
Burlington Northern	0.182355
Soo Line	0.199719

SOURCE: Derived through Rail Form A using Burlington Northern and Soo Line Railroads' Annual Reports.

The maximum allowable operating speed on the branch line is obtained from the North Dakota State Highway Department. Total crew costs include the amount of time spent during switching on the branch line which was obtained using RFA procedures.

Train Mile Expense. Train mile expenses include traffic and overhead expenses such as train dispatching costs (less crew costs) and caboose related costs, including ownership, maintenance, and repair. Train mile expenses are computed as:

$$TOTMb_{(Y)} = 2LBL * SW_{(Y)} * 52 * OTM$$

where: TOTMb = Total train mile costs, base case

OTM = Train mile cost (from Table 18)

Car Day Cost. On-branch car costs are composed of two components--car day and car mile. Car day costs are based on the number of days a car spends on the branch line per service cycle and are dependent on the number of times the branch line receives service per week. Car day costs are computed as:

$$TCDCb_{(Y)} = [DBL * CDC_{(CT)} * NBoxb_{(Y)}] + [DBL * CDC_{(CT)} * Nhopb_{(Y)}] + [DBL * CDC_{(CT)} * MISCb_{(CT,Y)}]$$

where: TCDCb = Total car day cost, base case

DBL = Car days on branch line

CDC = Car day cost (from Table 18)

Car days on branch line per service are based on the frequency of service (Table 20).

TABLE 20. CAR DAYS ON-BRANCH

Item	Service Per Week							
	.5	1	2	3	4	5	6	7
Days traveling from junction to shipping point	1	1	1	1	1	1	1	1
Days loading or unloading at branch line point	2	2	2	2	2	2	2	2
Days waiting at branch line point	11	4	3	1.67	1.25	1.2	0.5	0
Days traveling from branch line point to junction	1	1	1	1	1	1	1	1
Total Car Days	15	8	7	5.67	5.25	5.2	4.5	4

SOURCE: Adapted from USRA, 1976.

Car Mile Cost. Car-mile costs are a function of the length of haul on-branch and the type of car used for shipment. Annual car mile costs are calculated as:

$$TCMCb_{(Y)} = [NBoxb_{(Y)} * 2WMBLb * CMC_{(CT)}] + [NHopb_{(Y)} * 2WMBLb * CMC_{(CT)}] + [NMISCb_{(CT,Y)} * 2WMBLb * CMC_{(CT)}]$$

where: TCMCb = Total car mile cost, base case

CMC = Car mile cost (from Table 18)

Twice the weighted midpoint of the branch line is used to compute total car mile costs so as to include both the movement from the junction point to a point on the branch line and final movement off the branch line.

Maintenance of Way Cost. As previously stated, maintenance of way costs (costs for ties, ballast, rail, etc.) are allocated to gross ton mile and train mile expenses using Rail Form A cost accounting. These expenditures would result in average system-wide operating characteristics. Since many branch lines have had deferred maintenance, it would be inappropriate to allocate average MOW expenditures to these branch lines. Therefore, MOW on-branch costs have been removed from RFA cost coefficients. On-branch MOW costs are obtained directly from the operating railroad's trainmasters on a cost per mile basis.

Property Tax. Railroads are required to pay property tax on branch line rights of way. Property tax collections accrue to county governmental agencies and taxations on each branch line can be identified. Therefore, county tax assessment agencies are contacted to obtain historic branch line taxation levels.

Opportunity Cost of Capital. The potential return on net liquidation value of a branch line is considered an opportunity cost to the owning railroad.[10] The opportunity cost of net liquidation value is computed as the salvage value of rail, ties, miscellaneous materials (tie plates, spikes, etc.), and land minus the recovery cost of these capital items:

$$TSVRb = [LBL * (1{,}760 \text{ yds/mile}) * 2 \text{ rails} * WTRb]/(2{,}000 \text{ pounds/ton}) * SVRb$$

$$TSVTb = (3{,}250 \text{ ties/mile}) * LBL * PRTb * SVTb$$

$$TSVLb = 2RW * CFac * LBL * LV$$

$$TSVMb = MTM * LBL * SVM$$

$$TRCb = CR * LBL$$

$$NLVb = TSVRb + TSVTb + TSVLb + TSVMb - TRCb$$

$$OCNLVb = NLVb * CC$$

where: *TSVRb = Total salvage value of rail, base case

WTRb = Weight of rail, base case

SVRb = Net salvage value of rail per ton, base case

*TSVTb = Total salvage value of reusable ties, base case

PRTb = Percent reusable ties, base case

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[10]For a discussion of opportunity cost, see Ferguson and Maurice, 1974, or Mansfield, 1970.

SVTb = Net salvage value per tie, base case

* TSVLb = Total salvage value of land, base case

RW = Width of right of way (if feet)

CFac = Conversion factor of feet to acres (.1212)

LV = Average per acre value of land surrounding branch line

* TSVMb = Total salvage value of miscellaneous materials, base case

MTM = Weight of miscellaneous track materials per mile (43.53 tons)

SVM = Net salvage value of miscellaneous materials per ton ($337.50)

* TRCb = Total recovery cost, base case

CR = Recovery cost per mile (default value of $11,800)

* NLVb = Net liquidation value, base case

* OCNLVb = Opportunity cost of capital, base case

CC = Railroad cost of capital (default value of 16.5)

Net salvage values are defined as salvage value minus applicable shipping costs.

Rate of Return. An appropriate rate of return on NLV is a rate which fully compensates the carrier for the capital assets invested. In analyzing branch line investment, a carrier has the opportunity to liquidate the branch line assets, resulting in capital available for use elsewhere. The alternative is to raise additional capital either through the issuance of debt instruments (i.e, bonds or equipment trust certificates), the development of financial lease arrangements, or entry into capital markets. The opportunity cost of capital or the rate of return on NLV is synonymous with the railroad's overall cost of capital for the current year.

Each year the ICC is required by law to determine the current cost of capital to the industry. The cost is a weighted average of the current cost of debt and the current cost of equity weighted in accordance with the capital structure of the railroad industry. The figure for 1981 was 16.5 percent.

Off-Branch Rail Costs

Off-branch rail costs are based on the type and number of cars originating or terminating on the branch line and comprise two categories, line-haul and terminal. Line-haul costs are further defined as car mile and ton mile costs, while terminal costs include carload and ton costs.

<u>Car Mile Line-Haul Cost</u>. Car mile line-haul costs are a function of the length of haul off-branch, the type of train, and the type of car used. Car mile line-haul costs differ significantly between way and through trains and must be computed separately, then aggregated:

$$TWTCMLHb_{(Y)} = [NBoxb_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}] + [NHopb_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}] + [NMISCb_{(CT,Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}]$$

$$TTTCMLHb_{(Y)} = [NBoxb_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(CT)}] + [NHopb_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(CT)}] + [NMISCb_{(CT,Y,D)} * LH_{(CY,D)} * TTCMLH_{(CT)}]$$

$$TCMLHb_{(Y)} = TWTCMLHb_{(Y)} + TTTCMLHb_{(Y)}$$

where: TWTCMLHb = Total way train car mile line-haul cost, base case

LH = Length of haul

J = Junction point

CY = Classification yard

WTCMLH = Way train car mile line-haul cost (from Table 21)

TTTCMLH = Total through train car mile line-haul cost, base case

TTTMLH = Through train car mile line-haul cost (from Table 21)

TCMLHb = Total car mile line-haul cost, base case

<u>Ton Mile Line-Haul Cost</u>. Ton mile line-haul costs are a function of the weight and length of haul, off-branch, of the shipment. Ton mile line-haul costs differ significantly between way and through trains. The way train portion of ton mile line-haul costs is calculated as:

$$TWTTMLHb_{(Y)} = [NBoxb_{(Y,D)} * (CRCb_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NHopb_{(Y,D)} * (CRCb_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NMISCb_{(CT,Y,D)} * (CRCb_{(C)}/20) * LH_{(J,CY)} * WTTMLH]$$

where: TWTTMLHb = Total way train ton mile line-haul cost, base case

WTTMLH = Way train ton mile line-haul cost (from Table 22)

TABLE 21. CAR MILE LINE-HAUL COST, SINGLE CARS, BY TYPE OF CAR, TYPE OF TRAIN, AND RAILROAD, JANUARY 1983

Car Type	Type of Train	Railroad Burlington Northern	Soo Line
		---dollars---	
Covered Hopper	Way	1.07410	.80634
	Through	.84108	.79576
Box	Way	.86693	.49637
	Through	.68292	.48676
Flat-General Service	Way	.93734	.74089
	Through	.73359	.72866
Gondola-Plain	Way	1.05810	.72658
	Through	.83454	.72201
Tank	Way	1.28050	.82248
	Through	.87742	.69381
Open-Hopper	Way	1.03470	.78396
	Through	.83619	.79422
Refrigerator-Mechanical	Way	1.35780	1.01530
	Through	1.03170	.98438

TABLE 22. VARIABLE AND TOTAL TON MILE LINE-HAUL COST, BY TYPE OF TRAIN AND RAILROAD, JANUARY 1983

Type of Train	Type of Cost	Railroad Burlington Northern	Soo Line
		---dollars---	
Way	Variable	.01361267	.00953613
	Total	.02078188	.01706588
Through	Variable	.00775072	.00730153
	Total	.01491993	.01484505

The through train portion of ton mile line-haul costs is computed as:

$$TTTTMLHb_{(Y)} = [NBoxb_{(Y,D)} * (CRCb_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NHopb_{(Y,D)} * (CRCb_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NMISCb_{(CT,Y,D)} * (CRCb_{(C)}/20) * LH_{(CY,D)} * TTTMLH]$$

where: TTTTMLHb = Total through train ton mile line-haul cost, base case

TTTMLH = Through train ton mile cost (from Table 22)

Way and through train ton mile line-haul costs are then aggregated:

$$TTMLHb_{(Y)} = TWTTMLHb_{(Y)} + TTTTMLHb_{(Y)}$$

where: TTMLHb = Total ton mile line-haul cost, base case

Carload Terminal Cost. Carload terminal costs are a function of the number of cars shipped and the type of car used:

$$TCLTb_{(Y)} = [NBoxb_{(Y)} * CLT_{(CT)}] + [NHopb_{(Y)} * CLT_{(CT)}] + [NMISCb_{(CT,Y)} * CLT_{(CT)}]$$

where: TCLTb = Total carload terminal cost, base case

CLT = Carload terminal cost (from Table 23)

TABLE 23. CARLOAD TERMINAL COST, SINGLE CAR, BY CAR TYPE AND RAILROAD, JANUARY 1983

Car Type	Railroad: Burlington Northern	Railroad: Soo Line
	----dollars----	
Covered Hopper	273.081	271.392
Box	228.619	223.958
Flat-General Service	260.899	258.225
Gondola-Plain	278.906	277.772
Tank	169.174	157.673
Hopper-Open	281.979	281.047
Refrigerator-Mechanical	301.517	302.422

Ton Terminal Cost. Ton terminal costs, a function of the quantity shipped, are computed as:

$$TTTb(Y) = \langle [NBoxb_{(Y)} * (CRCb_{(C)}/20)] + [NHopb_{(Y)} * (CRCb_{(C)}/20)] + [NMISCb_{(CT,Y)} * (CRCb_{(C)}/20)] \rangle * TT$$

where: TTTb = Total ton terminal cost, base case

TT = Ton terminal cost (from Table 24)

TABLE 24. TON TERMINAL COST, BY RAILROAD, JANUARY 1983

Railroad	Type of Cost	Ton Terminal Cost
		-----dollars-----
Burlington Northern	Variable	.04567820
	Total	.69036467
Soo Line	Variable	.01922668
	Total	.91463756

Loss and Damage Cost. Loss and damage claims are a function of the type of commodity and quantity shipped:

$$TLDb_{(Y)} = Tob_{(Y,C)} * LD_{(C)}$$

where: TLDb = Total loss and damage cost, base case

LD = Loss and damage cost (from Table 25)

TABLE 25. LOSS AND DAMAGE COST PER TON,[a] NOVEMBER 1982

Commodity	Loss and Damage
	dollars per ton
Soybeans	.188670
Other Grains	.080761
Fertilizer	.129673
Lumber	.117945
Machinery	2.200579
Petroleum	.071347
Coal	.027136
Potatoes	1.978443

[a]Obtained from Bureau of Accounts, 1977 and inflated by Producer Price Index of 1.2436231 from 1977 to November 1982 levels.

Total Rail Cost

Rail costs are computed by individual component, as previously defined, and aggregated on an annual basis for as long as the branch line is expected to remain in service:

$$TRCb_{(Y)} = TGTMb_{(Y)} + TLUMb_{(Y)} + TWCb_{(Y)} + TOTMb_{(Y)} + TCDCb_{(Y)} + TCMCb_{(Y)} + MOW_{(Y)} + \text{Property Tax}_{(Y)} + OCNLVb_{(Y)} + TCMLHb_{(Y)} + TTMLHb_{(Y)} + TCLTb_{(Y)} + TTTb_{(Y)} + TLDb_{(Y)}$$

where: TRCb = Total rail cost, base case

Truck Cost

Truck costs before abandonment will have no effect on cost savings, producer's surplus, and consumers' surplus. Since it is the objective of these modeling procedures to estimate PEB and SEB attributable to rehabilitation of a branch line, these costs are not estimated. Truck costs are estimated after abandonment and are described in the following section.

Postabandonment Modeling Techniques

Numerous adjustments are required to accurately model the transportation system after abandonment in order to estimate efficiency benefits. This section describes those computational considerations.

Traffic Movements

The proportion of traffic which would have moved by rail will by necessity move by truck after abandonment, as well as the original share moved by truck. Truck shipments are computed as:

$$Shipbt_{(Y,O,C,D)} = AH_{(O,C,D)} * PI_{(C,Y)} * CF_{(C)}.$$

Traffic Revenues

Revenues after abandonment are calculated as:

$$Revbt_{(Y,O,C,D)} = Shipbr_{(Y,O,C,D)} * Ratet_{(O,C,D)}$$

Note that in the years after abandonment the shipments which would have moved by rail but now are moving by truck are used to compute revenue. Shipments which would move by truck regardless of whether the branch line remains in service will not change the producer's or consumers' surplus as previously defined, and no changes in cost savings will occur for that traffic. Therefore, these shipments were not included in the cost and revenue analysis.

Traffic Costs

Grain shipments by truck in North Dakota are completed almost exclusively by exempt carriers. Operating costs for exempt motor carriers have been estimated for the industry (Wilson et al., 1982). A variable and total cost of $.52 and $.92 per running mile respectively (1980 price levels) were estimated, assuming no backhaul (Appendix A). The cost per running mile varied substantially as backhaul potential increased.

North Dakota truckers were surveyed to obtain the frequency of backhaul from Minneapolis, Duluth, and the Pacific Northwest on a commodity basis (Table 26). Total truck costs per mile were adjusted to account for the frequency of backhaul and inflated to 1982 price levels (Table 26).[11] Omaha is used as a surrogate destination for shipments to other than the three major destinations and backhauls were difficult to estimate for other than the three major destinations. Therefore, a backhaul of zero is assumed with a corresponding total truck cost of $1.096 per running mile for Omaha movements. Fertilizer and machinery are considered backhauls for truckers and, therefore, a total cost applicable to 100 percent backhaul ($.548 per mile) is used. Other commodities shipped by truck are considered on a case by case basis.

Variable costs were inflated from $.52 per running mile (1980 price levels) to $.619 per running mile (November 1982 price levels). Variable costs are unadjusted for backhaul so as to be representative of the long run situation. Adjusting variable costs for backhaul would misconstrue the economic environment in which the trucking industry operates. A variable truck cost of $.619 per running mile is used for all commodities, origins, and destinations (Table 26).

It is assumed that trucks will be used to haul the traffic (from origin to destination) which would have been moved by rail had the branch line remained in service. Currently, the most cost-effective approach to moving grain from a point of origin not on a main line to a point of destination without branch line rail service may be to long-haul the commodity by truck rather than through a truck-rail transshipment situation.[12] Therefore, truck shipping costs are multiplied by the portion of traffic which would have moved by rail had the branch line remained in service:

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[11]Either variable or total truck costs may be computed within NOLAM depending on the user's specifications. Rail and truck costs are computed so that variable truck costs will be computed if the user requests variable rail costs. A similar situation occurs when the user requests total rail cost estimation.

[12]For a discussion of transshipment costs, see Appendix B.

TABLE 26. PERCENT BACKHAULED AND TRUCK COST PER MILE, BY COMMODITY AND DESTINATION, NORTH DAKOTA EXEMPT TRUCKERS, NOVEMBER 1982

Commodity	Minneapolis			Duluth			Omaha			Pacific Northwest		
	Percent Back-hauled	Cost Per Mile[a] Variable	Total[b]	Percent Back-hauled	Cost Per Mile[a] Variable	Total[b]	Percent Back-hauled	Cost Per Mile[a] Variable	Total[b]	Percent Back-hauled	Cost Per Mile[a] Variable	Total[b]
Wheat	66	$.619	$.661	46	$.619	$.744	--	$.619	$1.096	72	$.619	$.643
Barley	66	.619	.661	46	.619	.744	--	.619	1.096	47	.619	.738
Sunflower	60	.619	.685	30	.619	.846	--	.619	1.096	43	.619	.762
Other Grain	65	.619	.667	46	.619	.744	--	.619	1.096	47	.619	.738

[a]Based on Wesley Wilson et al., 1982, and inflated from 1980 to November 1982 level using a Consumer Price Index inflator of 1.1910292.
[b]Adjusted for backhaul.

$$TTCb_{(Y)} = (Shipbr_{(Y,O,C,D)}/TCAP_{(C)}) * DM_{(O,D)} * 2TCM_{(C,D)}$$

where: TTCb = Total truck shipping cost, base case

TCAP = Truck capacity (from Table 27)

DM = Distance in miles

TCM = Truck cost per mile factored for percent of backhaul (from Table 26)

TABLE 27. AVERAGE TRUCK CAPACITIES, BY COMMODITY

Commodity	Capacity
	--cwt.--
Wheat	497
Barley	556
Oats	470
Sunflower	557
Soybean	493
Other Grain	496
Dry Fertilizer	500
Liquid Fertilizer	524
Petroleum	540
Potatoes	553

SOURCE: North Dakota Public Service Commission, 1982

Truck costs are doubled to account for both the movement from origin to destination and the return trip.

Rehabilitation Alternative

Numerous computational differences exist in the revenue and cost calculations between the base case and rehabilitation alternative. Poor track conditions and branch line service may have prompted shippers to switch from rail to truck service, although shippers may prefer rail for shipping their product. This may lead to increased rail shipments under the rehabilitation alternative. Costs, such as total crew wages, maintenance cost, etc., of operating the branch line will likely decline after rehabilitation due to increased allowable operating speeds.

Railroads recently have introduced multiple-car and trainload rates based on consignment sizes of 3, 10, 24, 26, and 52 cars, among others. Multiple-car movements effectively reduce the railroad's per unit operating costs. NOLAM has the capability to determine the impact of multiple-car and trainload (52 car) rates and costs on branch line efficiencies. Single-car computations will be discussed first, followed by multiple-car and trainload adjustments.

Traffic Shipments

As previously indicated, rehabilitation of a branch line will likely result in an increased proportion of rail shipments. Shippers on the affected branch line are surveyed to obtain information on how their shipping strategies will change (in percentage) with rehabilitation. Shipments by rail under the rehabilitation alternative are computed similar to those under the base case except that the anticipated changes in shipping patterns are accounted for:

$$Shiprr_{(Y,O,G,D)} = AH_{(O,G,D)} * PI_{(G,Y)} * CF_{(G)} * PRp$$

where: Shiprr = Number of cwts. shipped by rail, rehabilitation alternative

PRp = Percent shipped by rail, projected (from shippers survey)

The projected percentage shipped by rail must equal or exceed the historic shipment.

Again, future shipments of commodities other than grain are held constant at the latest crop year level. Rail shipments for the rehabilitation alternative are summed for all origins by commodity, year, and destination:

$$SShiprr_{(Y,C,D)} = Shiprr_{(Y,01,C,D)} + Shiprr_{(Y,02,C,D)} + \ldots + Shiprr_{(Y,On,C,D)}$$

where: SShiprr = Summed rail shipments, rehabilitation alternative

Truck shipments under the rehabilitation alternative are computed as the residual value:

$$Shiprt_{(Y,O,C,D)} = (AH_{(O,C,D)} * PI_{(C,Y)} * CF_{(C)}) - Shiprr_{(Y,O,C,D)}$$

$$SShiprt_{(Y,C,D)} = Shiprt_{(Y,01,C,D)} + Shiprt_{(Y,02,C,D)} + \ldots + Shiprt_{(Y,On,C,D)}$$

where: Shiprt = Number of cwts. shipped by truck, rehabilitation alternative

SShiprt = Summed truck shipments, rehabilitation alternative

Traffic Revenues

Rail revenues are computed the same as in the base case except to allow for changes in shipments by mode:

$$Revrr(Y,O,C,D) = Shiprr(Y,O,C,D) * Rater(O,C,D)$$

where: Revrr = Rail revenue, rehabilitation alternative

Truck revenues are not computed under the rehabilitation alternative. Generally, a reduction in truck traffic will occur which will reduce the original consumers' plus producer's surplus provided by truckers. It would be inappropriate to subtract this loss from efficiency benefits accrued due to branch line investment as the reduction in truck traffic is merely a means whereby shippers take advantage of changes in rates. Some losses may be realized by truckers if a branch line is rehabilitated, but these truckers will either move into another shipping area or be re-employed elsewhere in the economy.

Rail Costs

Rail costs under the rehabilitation alternative are categorized the same as under the base case. The number of cars must be computed in order to accurately estimate on- and off-branch costs:

$$Boxr(Y,G,D) = Shiprr(Y,O,G,D) * PBox(Y,O,G,D) * PDBox(Y)$$

$$NBoxr(Y,G,D) = Boxr(Y,G,D)/CBox(C)$$

$$Hopr(Y,G,D) = Shiprr(Y,O,G,D) - Boxr(Y,O,G,D)$$

$$NHopr(Y,G,D) = Hopr(Y,G,D)/CHop(C)$$

$$NMISCrn(O,D) = Shiprr(O,N,D)/CCar(n)$$

where: Boxr = Shipments by box car, rehabilitation alternative

NBoxr = Number of box cars, rehabilitation alternative

Hopr = Shipments by hopper car, rehabilitation alternative

NHopr = Number of hopper cars, rehabilitation alternative

NMISCrn = Number of miscellaneous cars n, rehabilitation alternative

On-Branch Rail Costs

The total number of cars shipped in the rehabilitation alternative is summed to determine the number of locomotive service units required annually:

$$NTOTr_{(Y)} = NBoxr_{(Y)} + NHopr_{(Y)} + NMISCrn_{(Y)}$$

$$NLSUr_{(Y)} = (NTOTr_{(Y)}/NCP) * NLPTr$$

where: NTOTr = Total number of rail cars, rehabilitation alternative

NLSUr = Number of locomotive service units required annually, rehabilitation alternative

NCP = Average number of cars pulled per service

NLPTr = Number of locomotives per train, rehabilitation alternative

The number of locomotives per train, obtained from the operating railroad's annual reports, was 1.884 for Burlington Northern and 1.740 for the Soo Line. NCP is calculated from Schedule 755 of the railroads' annual report (R-1) and was 21 for Burlington Northern and 41 for Soo Line in 1982.

Gross Ton Mile Cost. On-branch gross ton mile (GTM) costs under the rehabilitation alternative comprise the same cost components as under the base case except an allowance for maintenance of way also is included in GTM. GTM costs are calculated as:

$$TGTMr_{(Y)} = [(Tor_{(Y)} * WMBLr) + (Tar_{(CT)} * NC_{(CT,Y)} * 2WMBLr)]GTM$$

where: TGTMr = Total gross ton mile cost, rehabilitation alternative

Tor = Tons originated or terminated on branch line, rehabilitation alternative

WMBLr = Weighted midpoint on branch line (in miles) rehabilitation alternative

Tar = Tare weight of car (from Table 17)

CT = Car type

NC = Number of cars originated or terminated on branch line

GTM = Gross ton mile cost (from Table 28)

Locomotive Unit Mile Cost. Locomotive unit mile (LUM) cost under the rehabilitation alternative is based on the length of the branch line and number of locomotive service units required annually:

$$TLUMr_{(Y)} = 2LBL * NLSUr_{(Y)} * LUM$$

TABLE 28. GROSS TON MILE, LOCOMOTIVE UNIT MILE, TRAIN MILE, CAR DAY, AND CAR MILE COSTS, ON-BRANCH, REHABILITATION ALTERNATIVE, BY RAILROAD OPERATING IN NORTH DAKOTA, 1982

Cost Component	Railroad Burlington Northern	 Soo Line
	----dollars----	
Gross Ton Mile	.002913	.003249
Locomotive Unit Mile	2.048211	2.413400
Train Mile[a]	8.391958	8.833817
Car Day		
Covered Hopper Car	17.3832	18.8294
Box Car	11.2668	12.2041
Flat-General Service Car	15.3705	16.6492
Open Top Hopper Car	18.3590	20.4279
Gondola-Plain Car	18.3585	19.8858
Refrigerator-Mechanical Car	22.1264	23.9672
Car Mile		
Tank Car	.097983	.100424
All Other	.067507	.057259

[a]Includes crew wages.

where: TLUMr = Total locomotive unit mile cost, rehabilitation alternative

LBL = Length of branch line

LUM = Locomotive unit mile cost (from Table 28)

Train Mile Expense. Train mile (OTM) expenses for the rehabilitation alternative include the same expenses as under the base case plus crew wages based on RFA computations of railroad's system-wide branch line operations:

$$TOTMr_{(\gamma)} = 2LBL * (NTOTr_{(\gamma)}/NCP) * OTM$$

where: TOTMr = Total train mile expenses, rehabilitation alternative

OTM = Train mile expenses (from Table 28)

Car Day Cost. Car day costs under the rehabilitation alternative differ from those under the base case in that they are based on the system-wide average branch line pull rather than a set service cycle. Branch lines with deferred maintenance generally receive a set service cycle (i.e., service a given number of times per week). With the potential for major increases in rail traffic resulting from improved track and service conditions under the rehabilitation alternative, it is more appropriate to define the service cycle based on the system-wide average branch line pull. This will result in a modification of on-branch car days:

$$DBL_{(Y)} = [365/(NCTr_{(Y)}/NCPr)] + 2$$

where: DBL = Car days on branch line per car

NCTr = Total number of rail cars, rehabilitation alternative

NCP = Average number of cars pulled per service, rehabilitation alternative

Car day costs are calculated as:

$$TCDCr_{(Y)} = [NBoxr_{(Y)} * DBL_{(Y)} * CDC_{(CT)}] + [NHopr_{(Y)} * DBL_{(Y)} * CDC_{(CT)}] + [NMISCr_{(CT,Y)} * DBL_{(Y)} * CDC_{(CT)}]$$

where: TCDCr = Total car day cost, rehabilitation alternative

CDC = Car day cost (from Table 28)

Car Mile Cost. Car mile costs under the rehabitation alternative are computed the same as those under the base case:

$$TCMCr_{(Y)} = [NBoxr_{(Y)} * 2WMBLr * CMC_{(CT)}] + [NHopr_{(Y)} * 2WMBLr * CMC_{(CT)}] + [NMISCr_{(CT,Y)} * 2WMBLr * CMC_{(CT)}]$$

where: TCMCr = Total car mile cost, rehabilitation alternative

CMC = Car mile cost (from Table 28)

Maintenance of Way Cost. Maintenance of way costs under the rehabilitation alternative are allocated to gross ton mile and train mile expenses using Rail Form A cost accounting. These expenditures are based on system-wide average operating characteristics.

Property Tax. Property tax on the branch line right of way will not change as a result of branch line rehabilitation. Therefore, the property tax estimate used in the base case also is used for the rehabilitation alternative.

Opportunity Cost of Capital. Rehabilitation of a branch line generally will result in the use of heavier rail and a higher proportion of reuseable ties than were available on the original line. This would result in a higher net liquidation value as well as a higher opportunity cost. The calculation of opportunity cost for the rehabilitation alternative is the same as that for the base case except that the increased weights, values, and percentage of reuseable materials (if any) are accounted for.

Off-Branch Rail Costs

The same off-branch rail costs are computed under the rehabilitation alternative as were under the base case. Rehabilitation of the branch line generally will result in additional rail traffic and, therefore, possibly higher total off-branch costs. (Revenue will increase concomitantly, however.) Car mile, ton mile, carload, and ton cost coefficients will not change between the two alternatives; that is, those coefficients used in the base case will apply to the rehabilitation alternative.

Car Mile Line-Haul Cost. Car mile line-haul costs are computed separately for way and through trains by type of car:

$$TWTCMLHr_{(Y)} = [NBoxr_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}] + [NHopr_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}] + [NMISCr_{(CT,Y,D)} * LH_{(J,CY)} * WTCMLH_{(CT)}]$$

$$TTTCMLHr(Y) = [NBoxr_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(CT)}] + [NHopr_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(CT)}] + [NMISCr_{(CT,Y,D)} * LH_{(J,CY)} * TTCMLH_{(CT)}]$$

$$TCMLHr_{(Y)} = TWTCMLHr_{(Y)} + TTTCMLHr_{(Y)}$$

where: TWTCMLHr = Total way train car mile line-haul cost, rehabilitation alternative

WTCMLH = Way train car mile line-haul cost (from Table 21)

TTTCMLHr = Total through train car mile line-haul cost, rehabilitation alternative

TTCMLH = Through train car mile line-haul cost (from Table 21)

TCMLHr = Total car mile line-haul cost, rehabilitation alternative

Ton Mile Line-Haul Cost. Ton mile line-haul costs are computed separately for the way and through train portion of haul, then aggregated:

$$TWTTMLHr_{(Y)} = [NBoxr_{(Y,D)} * (CBox_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NHopr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NMISCr_{(CT,Y,D)} * (CMISC_{(CT,C)}/20) * LH_{(J,CY)} * WTTMLH]$$

$$TTTTMLHr_{(Y)} = [NBoxr_{(Y,D)} * (CBox_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NHopr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NMISCr_{(CT,Y,D)} * (CMISC_{(CT,C)}/20)\ LH_{(CY,D)} * TTTMLH]$$

$$TTMLHr_{(Y)} = TWTTMLHr_{(Y)} + TTTTMLHr_{(Y)}$$

where: TWTTMLHr = Total way train ton mile line-haul cost, rehabilitation alternative

CBox = Capacity of box car

CHop = Capacity of covered hopper car

CMISC = Capacity of miscellaneous car

WTTMLH = Way train ton mile line-haul cost (from Table 22)

TTTTMLHr = Total through train ton mile line-haul cost, rehabilitation alternative

TTTMLH = Through train ton mile cost (from Table 22)

TTMLHr = Total ton mile line-haul cost, rehabilitation alternative

<u>Carload Terminal Cost</u>. Carload terminal costs are computed as:

$$TCLTr_{(Y)} = [NBoxr_{(Y)} * CLT_{(CT)}] + [NHopr_{(Y)} * CLT_{(CT)}] + [NMISCr_{(CT,Y)} * CLT_{(CT)}]$$

where: TCLTr = Total carload terminal cost, rehabilitation alternative

CLT = Carload terminal cost (from Table 23)

<u>Ton Terminal Cost</u>. Ton terminal costs are calculated as:

$$TTTr_{(Y)} = \left\langle [NBoxr_{(Y)} * (CBox_{(C)}/20)] + [NHopr_{(Y)} * (CHop_{(C)}/20)] + [NMISCr_{(CT,Y)} * (CMISC_{(C)}/20)] \right\rangle * TT_{(CT)}]$$

where: TTTr = Total ton terminal cost, rehabilitation alternative

TT = Ton terminal cost (from Table 24)

Loss and Damage Costs. Loss and damage claims are computed in the same manner as under the base case:

$$TLDr_{(\gamma)} = Tor_{(\gamma,C)} * LD_{(C)}$$

where: TLDr = Total loss and damage costs, rehabilitation alternative

LD = Loss and damage cost (from Table 25)

Total Rail Cost

Rail costs are aggregated from individual components on an annual basis:

$$TRCr_{(\gamma)} = TGTMr_{(\gamma)} + TLUMr_{(\gamma)} + TOTMr_{(\gamma)} + TCDCr_{(\gamma)} + TCMCr_{(\gamma)} + \text{Property Tax} + OCNLVr_{(\gamma)} + TCMLHr_{(\gamma)} + TTMLHr_{(\gamma)} + TCLTr_{(\gamma)} + TTTr_{(\gamma)} + TLDr_{(\gamma)}$$

where: TRCr = Total rail cost, rehabilitation alternative

Multiple-Car Adjustments

Railroads have recently introduced multiple-car and trainload rates for specific commodities, origins, and destinations (Table 29). These rates can offer substantial transportation cost savings to shippers. Railroads realize cost savings because of the increased loading, transporting, and unloading efficiencies associated with larger, single-block consignments.

When multiple-car movements are considered within NOLAM, the largest consignment for which a rate is available (i.e., 26 car wheat rate to Minneapolis via Burlington Northern) is used in cost and revenue generation. Only single-origin multiple-car lots are considered within NOLAM for purposes of modeling simplicity. Multiple-car movements to the Gulf Ports are not estimated because of the limited amount of product moving in that direction. When multiple-car movements are considered within NOLAM, shipments of commodites must be disaggregated by type of shipment to determine the associated revenues.

Multiple-car shipments are handled differently than single-car shipments by railroads. Multiple-car consignments have "on-demand" service; that is, cars are positioned at the shipper's loading area on day one, day two is allowed for loading or unloading, and the cars are pulled from the shipper's

TABLE 29. AVAILABLE MULTIPLE-CAR AND TRAINLOAD RATES, BY COMMODITY, DESTINATION, AND RAILROAD, NORTH DAKOTA, 1983

Destination	Size of Car Consignment	Number of Origins	Burlington Northern	Soo Line
	No. of Cars		----Commodity----	
Minneapolis, St. Paul	3	1	Wheat, Oats, Sunflower, Soybeans, Corn, Flax, Rye	Wheat, Sunflower, Soybeans, Corn, Flax
	10	1	Barley	
	24	1[a]		Wheat, Sunflower, Soybeans, Corn, Flax
	26	1	Wheat, Oats, Sunflower, Soybeans, Corn, Flax, Rye	
	52	1	Wheat, Oats, Sunflower, Soybeans, Corn, Flax, Rye	
Duluth, Superior	3	1	Wheat, Barley, Oats, Sunflower, Soybeans, Corn, Flax, Rye	Wheat, Barley, Sunflower, Soybeans, Corn, Flax
	24	1[a]		Wheat, Barley, Sunflower, Soybeans, Corn, Flax
	26	1	Wheat, Barley, Oats, Sunflower, Soybeans, Corn, Flax, Rye	
	52	1	Wheat, Barley, Oats, Sunflower, Soybeans, Corn, Flax, Rye	

- continued -

TABLE 29. AVAILABLE MULTIPLE-CAR AND TRAINLOAD RATES, BY COMMODITY, DESTINATION, AND RAILROAD, NORTH DAKOTA, 1983 (CONTINUED)

Destination	Size of Car Consignment	Number of Origins	Burlington Northern	Soo Line
	No. of Cars		Commodity	
Pacific Northwest	25	1[a]		Wheat, Sunflower, Soybeans, Corn
	25	2-4[a]		Wheat, Sunflower, Soybeans, Corn
	26	1[a]	Wheat, Barley, Sunflower	Barley
	26	2-4[a]	Wheat, Barley, Sunflower	Barley
	27	1	Soybeans, Corn	
	50	1[a]		Wheat, Sunflower
	52	1[a]	Wheat, Barley, Sunflower	Barley
	54	1[a]	Soybeans, Corn	Soybeans, Corn
	54	2	Soybeans, Corn	
	54	3-5	Soybeans, Corn	
Gulf Ports	25	1		Sunflower
		2-4		Sunflower
	26	1 1	Sunflower	
	50	1		Sunflower
	52	1	Sunflower	

[a]Applies only to selected origins.

SOURCE: Transportation Department, 1983.

site to the classification yard on the third day.[13] On-demand service results in potentially fewer days on branch line, and one locomotive per multiple-car consignment. (It is assumed that one empty multiple-car consignment will be taken from the classification yard to a shipper's site, while a loaded multiple-car consignment will be returned, although not necessarily from the same shipping site.) Only covered hopper cars are utilized for multiple-car grain shipments, increasing the railroad's on-branch efficiency.

Numerous off-branch efficiencies also are realized because of multiple-car shipments. Reduced engine switching time, fewer car hours at classification yards, and station/billing efficiencies are realized at the terminals. Line-haul efficiencies are gained because of reduced in-route and interchange switching and fewer line-haul car days.

These changes resulting from multiple-car shipments require recalculation of numerous items when compared to single-car movements. In essence, the model computes multiple-car costs first, followed by single-car shipment costs. The following discussion addresses the changes in computations required because of multiple-car movements.

Rail Shipments and Revenues

As previously indicated, multiple-car rates apply to specific commodities and destinations. An inherent assumption within NOLAM is that if a multiple-car rate applies for a given commodity and destination, then all of that commodity will be shipped to that destination by multiple-car consignments. Rail shipments of those commodites which can be shipped in multiple-car consignments to given destinations are removed from shipments only allowed in single-car consignments. The corresponding rail rate applicable to the commodity, origin, destination, and type of movement (single or multiple) is multiplied by the quantity shipped to determine rail revenue.

Rail Costs

Multiple-car shipments are moved only in covered hopper cars, necessitating a reallocation of box and covered hopper car mix. The following computations are used to calculate the number of covered hopper and box cars:

$$\mathrm{NMHopr}(Y,O,MC,MD) = \mathrm{MShiprr}(Y,O,MC,MD)/\mathrm{CHop}(C)$$

$$\mathrm{SBoxr}(Y,O,C,D) = \mathrm{Shipsrr}(Y,O,C,D) * \mathrm{PBox}(Y,O,C,D) * \mathrm{PDBox}(Y)$$

$$\mathrm{NSBoxr}(Y,C,D) = \mathrm{SBoxr}(Y,O,C,D)/\mathrm{CBox}(C)$$

$$\mathrm{SHopr}(Y,O,C,D) = \mathrm{Shipsrr}(Y,O,C,D) - \mathrm{SBoxr}(Y,O,C,D)$$

---

[13]Burlington Northern and Soo Line Railroads' three-car multiple shipments receive the same type of service as their single-car consignments; rail costs, therefore, are calculated similar to single-car movements.

$$NSHopr(Y,C,D) = SHopr(Y,O,C,D)/CHop(C)$$

where: NMHopr = Number of covered hopper cars, multiple shipments, rehabilitation alternative

MC = Commodity shipped by multiple car

MD = Destination which has multiple-car rates

MShiprr = Shipments by rail multiple car, rehabilitation alternative

SBoxr = Shipments by single box car, rehabilitation alternative

Shipsrr = Quantity shipped by rail, single car, rehabilitation alternative

NSBoxr = Number of single box cars, rehabilitation alternative

SHopr = Shipments by rail, single covered hopper car, rehabilitation alternative

NSHopr = Number of single covered hopper cars, rehabilitation alternative

On-Branch Rail Costs. The total number of rail cars by type of movement is summed to determine the number of locomotive service units annually:

$$NMTOTr(Y) = NMHopr(Y,O,MC1,MD1) + NMHopr(Y,O,MC1,MD2) + \cdots + NMHopr(Y,O,MCn,MDn)$$

$$NMLSUr(Y) = NMTOTr(Y)/SM$$

$$NSTOTr(Y) = NSBoxr(Y,C,D) + NSHopr(Y,C,D) + NMISCr(Y,C,D)$$

$$NSLSUr(Y) = NSTOTr(Y)/NCP$$

where: NMTOTr = Total number of multiple, covered hopper cars, rehabilitation alternative

NMLSUr = Total number of locomotive service units required for multiple-car movements, rehabilitation alternative

SM = Size of multiple movement

NSTOTr = Total number of single cars, rehabilitation alternative

NSLSUr = Total number of locomotive service units required for single-car movements, rehabilitation alternative

Although the individual on-branch cost coefficients (i.e., GTM, LUM, etc.) do not change for single- versus multiple-car movements, annualized costs will differ between the two scenarios because of the potential efficiencies realized by the increased weight of trains, decline in locomotive unit miles, fewer car days, etc. This necessitates calculation of each cost component by type of movement as follows.

$$TMGTMr_{(Y)} = [(Tom_{(Y)} * MWMBLr) + (Tar_{(CT)} * NC_{(CT,Y)} * 2MWMBLr)]GTM$$

$$TSGTMr_{(Y)} = [(Tos_{(Y)} * SWMBLr) + (Tar_{(CT)} * NC_{(CT,Y)} * 2SWMBLr)]GTM$$

$$TMLUMr_{(Y)} = 2MWMBLr * NMLSUr_{(Y)} * LUM$$

$$TSLUMr_{(Y)} = 2LBL * NSLSUr_{(Y)} * LUM$$

$$TMOTMr_{(Y)} = 2MWMBLr * (NMTOTr_{(Y)}/SM) * OTM$$

$$TSOTMr_{(Y)} = 2LBL * (NSTOTr_{(Y)}/NCP) * OTM$$

$$SDBLr_{(Y)} = [365/(NCTr_{(Y)}/NCP)] + 2$$

$$TMCDCr_{(Y)} = NMTOTr_{(Y)} * 3 * CDC_{(CT)}$$

$$TSCDCr_{(Y)} = [NSBoxr_{(Y)} * SDBLr_{(Y)} * CDC_{(CT)}] + [NSHopr_{(Y)} * SDBLr_{(Y)} * CDC_{(CT)}] + [NMISCr_{(CT,Y)} * SDBL_{(Y)} * CDC_{(CT)}]$$

$$TMCMCr_{(Y)} = NMTOTr_{(Y)} * 2MWMBLr * CMC_{(CT)}$$

$$TSCMCr_{(Y)} = [NSBoxr_{(Y)} * 2SWMBLr * CMC_{(CT)}] + [NSHopr_{(Y)} * 2SWMBLr * CMC_{(CT)}] + [NMISCr_{(CT,Y)} * 2SWMBLr * CMC_{(CT)}]$$

where: TMGTMr = Total gross ton mile cost for multiple-car movements, rehabilitation alternative

Tom = Tons originated or terminated on branch line, multiple-car movements

MWMBL = Weighted midpoint of branch line for multiple-car movements, rehabilitation alternative

TSGTMr = Total gross ton mile cost for single-car movements, rehabilitation alternative

Tos = Tons originated or terminated on branch line, single-car movements

SWMBLr = Weighted midpoint of branch line for single-car movements, rehabilitation alternative

TMLUMr = Total locomotive unit mile cost for multiple-car movements, rehabilitation alternative

TSLUMr = Total locomotive unit mile cost for single-car movements, rehabilitation alternative

TMOTMr = Total train mile cost for multiple-car movements, rehabilitation alternative

TSOTMr = Total train mile cost for single-car movements, rehabilitation alternative

SDBLr = Car days on branch line, per car, single cars, rehabilitation alternative

TMCDCr = Total car day cost, multiple cars, rehabilitation alternative

TSCDCr = Total car day cost, single cars, rehabilitation alternative

TMCMCr = Total car mile cost, multiple cars, rehabilitation alternative

TSCMCr = Total car mile cost, single cars, rehabilitation alternative

Property tax and opportunity cost of capital will not change as a result of multiple-car movements.

Off-Branch Rail Costs. Off-branch efficiencies are realized by the railroads when transporting multiple cars, including carload terminal and car mile line-haul efficiencies. Car mile and carload costs have been adjusted to reflect those efficiencies gained through multiple-car movements (Tables 30 and 31).

TABLE 30. CAR MILE LINE-HAUL COST FOR COVERED HOPPER CARS, MULTIPLE CAR SHIPMENTS, BY TYPE OF TRAIN AND RAILROAD, JANUARY 1983

Type of Train	Number of Multiple Cars	Railroad Burlington Northern	Railroad Soo Line
		------dollars------	
Way	3	1.07410	.80634
	10	1.03700	
	24		.76745
	26	1.03700	
Through	3	.84108	.79576
	10	.80391	
	24		.75687
	26	.68246	

Annual costs, therefore, must be computed seperately for multiple and single cars:

TABLE 31. CARLOAD TERMINAL COST, FOR COVERED HOPPER CARS, BY TYPE OF MOVEMENT AND RAILROAD, JANUARY 1983

Number of Multiple Cars	Railroad: Burlington Northern	Railroad: Soo Line
	------dollars------	
3	268.473	267.009
10	228.920	
24		210.653
26	214.621	

$$TMWTCMLHr_{(Y)} = NMTOTr_{(Y)} * LH_{(J,CY)} * WTCMLH_{(MC)}$$

$$TMTTCMLHr_{(Y)} = NMTOTr_{(Y)} * LH_{(CY,D)} * TTCMLH_{(MC)}$$

$$TMCMLHr_{(Y)} = TMWTCMLHr_{(Y)} + TMTTCMLHr_{(Y)}$$

$$TSWTCMLHr_{(Y)} = [NSBoxr_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(SC,CT)}] + [NSHopr_{(Y,D)} * LH_{(J,CY)} * WTCMLH_{(SC,CT)}] + [NMISCr_{(CT,Y,D)} * LH_{(J,CY)} * WTCMLH_{(SC,CT)}]$$

$$TSTTCMLHr_{(Y)} = [NSBoxr_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(SC,CT)}] + [NSHopr_{(Y,D)} * LH_{(CY,D)} * TTCMLH_{(SC,CT)}] + [NSMISCr_{(CT,Y,D)} * LH_{(CY,D)} * TTCMLH_{(SC,CT)}]$$

$$TSCMLHr_{(Y)} = TSWTCMLHr_{(Y)} + TSTTCMLHr_{(Y)}$$

$$TMWTTMLHr_{(Y)} = NMTOTr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(J,CY)} * WTTMLH$$

$$TSWTTMLHr_{(Y)} = [NSBoxr_{(Y,D)} * (CBox_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NSHopr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(J,CY)} * WTTMLH] + [NMISCr_{(CT,Y,D)} * (CMISC_{(C)}/20) * LH_{(J,CY)} * WTTMLH]$$

$$TMTTTMLHr_{(Y)} = NMTOTr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(CY,D)} * TTTMLH$$

$$TSTTTMLHr_{(Y)} = [NSBoxr_{(Y,D)} * (CBox_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NSHopr_{(Y,D)} * (CHop_{(C)}/20) * LH_{(CY,D)} * TTTMLH] + [NMISCr_{(CT,Y,D)} * (CMISC_{(C)}/20) * LH_{(CY,D)} * TTTMLH]$$

$$TMTMLHr_{(Y)} = TMWTTMLHr_{(Y)} + TMTTTMLHr_{(Y)}$$

$$TSTMLHr_{(Y)} = TSWTTMLHr_{(Y)} + TSTTTMLHr_{(Y)}$$

$$TMCLTr_{(Y)} = NMTOTr_{(Y)} * CLT_{(MC)}$$

$$TSCLTr_{(Y)} = [NSBoxr_{(Y)} * CLT_{(SC,CT)}] + [NSHopr_{(Y)} * CLT_{(SC,CT)}] + [NMISCr_{(CT,Y)} * CLT_{(SC,CT)}]$$

$$TMTTr_{(Y)} = NMTOTr_{(Y)} * (CHop_{(C)}/20) * TT$$

$$TSTTr_{(Y)} = \left\langle [NSBoxr_{(Y)} * (CBox_{(C)}/20)] + [NSHopr_{(Y)} * (CHop_{(C)}/20)] + [NMISCr_{(CT,Y)} * (CMISC_{(C)}/20)] \right\rangle * TT$$

$$TMLDr_{(Y)} = Tom_{(Y,C)} * LD_{(C)}$$

$$TSLDr_{(Y)} = Tos_{(Y,C)} * LD_{(C)}$$

where: TMWTCMLHr = Total way train car mile line-haul cost, multiple cars, rehabilitation alternative

MC = Size of multiple-carload lot

TMTTCMLHr = Total through train car mile line-haul cost, multiple cars, rehabilitation alternative

TMCMLHr = Total car mile line-haul cost, multiple cars, rehabilitation alternative

TSWTCMLHr = Total way train car mile line-haul cost, single cars, rehabilitation alternative

SC = Single car

TSTTCMLHr = Total through train car mile line-haul cost, single cars, rehabilitation alternative

TSCMLHr = Total car mile line-haul cost, single cars, rehabilitation alternative

TMWTTMLHr = Total way train ton mile line-haul cost, multiple cars, rehabilitation alternative

TSWTTMLHr = Total way train ton mile line-haul cost, single cars, rehabilitation alternative

TMTTTMLHr = Total through train ton mile line-haul cost, multiple cars, rehabilitation alternative

TSTTTMLHr = Total through train ton mile line-haul cost, single cars, rehabilitation alternative

TMTMLHr = Total ton mile line-haul cost, multiple car, rehabilitation alternative

TSTMLHr = Total ton mile line-haul cost, single car, rehabilitation alternative

TMCLTr = Total carload terminal cost, multiple cars, rehabilitation alternative

TSCLTr = Total carload terminal cost, single cars, rehabilitation alternative

TMTTr = Total ton terminal cost, multiple cars, rehabilitation alternative

TSTTr = Total ton terminal cost, single cars, rehabilitation alternative

TMLDr = Total loss and damage cost, multiple cars, rehabilitation alternative

TSLDr = Total loss and damage cost, single cars, rehabilitation alternative

Total rail costs are aggregated on an annual basis:

$$\begin{aligned} TRCr_{(\gamma)} = {} & TMGTMr_{(\gamma)} + TSGTMr_{(\gamma)} + TMLUMr_{(\gamma)} + TSLUMr_{(\gamma)} + TMOTMr_{(\gamma)} + \\ & TSOTMr_{(\gamma)} + TMCDCr_{(\gamma)} + TSCDCr_{(\gamma)} + TMCMCr_{(\gamma)} + TSCMCr_{(\gamma)} + \\ & \text{Property Tax} + OCNLVr_{(\gamma)} + TMCMLHr_{(\gamma)} + TSCMLHr_{(\gamma)} + \\ & TMTMLHr_{(\gamma)} + TSTMLHr_{(\gamma)} + TMCLTr_{(\gamma)} + TSCLTr_{(\gamma)} + TMTTr_{(\gamma)} + \\ & TSTTr_{(\gamma)} + TMLDr_{(\gamma)} + TSLDr_{(\gamma)} \end{aligned}$$

where: TRCr = Total rail cost, rehabilitation alternative

Trainload Movements

Trainload movements differ from single- or multiple-car movements in that a train is "assigned" to a given movement rather than cars. The normal procedure for assigning these trains follows the accompanying example. A train of hopper cars constituting the required size (50, 52, or 54 cars) is assembled at the originating station's regional classification yard. The cars are pulled to the shipper's loading site, generally with a single engine. (Twenty-four hours are allowed for loading.) "Pull" engines are sent to the shipper's site after the required loading time has expired to pull the cars to their final destination. Upon arrival, the cars are spotted at the termination site, uncoupled from the engines, and the engines are returned to the destination's regional classification yard. Twenty-four hours are allowed for unloading, at which time a "spot" engine will pull the cars to the regional classification yard. The cars then will be returned to the originating classification yard, either with the "pull" engines or in a new train consist.

The trainload cost coefficients and equations within NOLAM have been adjusted from their original RFA format to account for these anomalies. Rail revenue calculations are derived similar to the multiple-car scenario; that is, revenue for a trainload movement will be generated whenever a trainload (50-, 52-, or 54-car) rate applies for a given origin, commodity, and destination.

Trainload rail cost estimation is disaggregated into two categories--"spot" and "pull" costs. Spot costs include all costs associated with moving the cars from the originating station's regional classification yard to the shipper's site, while pull costs include the costs associated with moving the train from the shipper's site to destination, and the return trip to the originating classification yard. Only hopper cars are used in trainload movements.

Spot Costs

Spot costs are comprised of on-branch costs and way train car mile line-haul costs. The following equations are used to calculate spot costs for trainload movements:

$$TUGTMr_{(Y)} = Tar_{(CT)} * NC_{(Y)} * UWMBLr * GTM$$

$$TULUMr_{(Y)} = 2UWMBLr * NULLSUr_{(Y)} * (NC/UTS) * LUM$$

$$TUOTMr_{(Y)} = 2UWMBLr * (NC_{(Y)}/UTS) * OTM$$

$$TUCDCr_{(Y)} = 2 * NC_{(Y)} * CDC$$

$$TUCMCr_{(Y)} = NC_{(Y)} * UWMBLr * CMC$$

$$TUWTCMLHr_{(Y)} = NC_{(Y)} * LH_{(O,CY)} * UWTCMLH_{(U)}$$

where: TUGTMr = Total gross ton mile cost for trainload movements, rehabilitation alternative

UWMBLr = Weighted midpoint of branch line for trainload movements, rehabilitation alternative

TULUMr = Total locomotive unit mile cost for trainload movements, rehabilitation alternative

NULLSUr = Number of light locomotive service units, rehabilitation alternative

UTS = Number of cars per trainload

TUOTMr = Total train mile cost for trainload movements, rehabilitation alternative

TUCDCr = Total car day cost for trainload movements, rehabilitation alternative

TUCMCr = Total car mile cost for trainload movements, rehabilitation alternative

TUWTCMLHr = Total way train car mile line-haul cost for trainload movements, rehabilitation alternative

UWTCMLH = Way train car mile line-haul cost for trainload (Table 32)

TABLE 32. TRAINLOAD COST COEFFICIENTS, BY RAILROAD, JANUARY 1983

Cost Component	Burlington Northern	Soo Line
	---dollars---	
Spot:		
Way train car mile line-haul	.26955	.25299
Pull:		
Car mile line-haul	.53270	.49997
Ton mile line-haul	.00806848	.00806503
Carload terminal	108.727	97.083
Ton terminal	.0456782	.01922668

Pull Costs

Pull costs are comprised of four cost components: 1) car mile, 2) ton mile, 3) carload terminal, and 4) ton terminal. Pull costs are computed on the length of haul from origin to destination:

$$TUCMLHr_{(Y)} = NC_{(Y)} * LH_{(O,D)} * UCMC$$

$$TUTMLHr_{(Y)} = NC_{(Y,D)} * (CHop_{(C)}/20) * LH_{(O,D)} * UTMLH$$

$$TUCLTr_{(Y)} = NC_{(Y)} * UCLT$$

$$TUTTr_{(Y)} = NC_{(Y)} * (CHop_{(C)}/20) * UTT$$

where: TUCMLHr = Total car mile line-haul costs for trainload, rehabilitation alternative

UCMC = Trainload car mile cost (Table 32)

TUTMLHr = Total ton mile line-haul costs for trainload, rehabilitation alternative

UTMLH = Trainload ton mile line-haul cost (Table 32)

TUCLTr = Total trainload carload terminal cost, rehabilitation alternative

UCLT = Trainload carload terminal cost (Table 32)

TUTTr = Total trainload ton terminal cost, rehabilitation alternative

UTT = Trainload ton terminal cost (Table 32)

Loss and damage and on-branch fixed costs (e.g., opportunity cost of capital and property tax) are computed as previously defined. These cost coefficients do not change with the size of the multiple car or trainload shipments although total costs will change.

With each progressive increase in the size of the multiple shipments (e.g., 26 to 52), those commodities, origins, and destinations for which a rate applies (e.g., 52 car rate) are costed at that level. The next lowest rate level (e.g., 26-car rate) is costed next, and so on until all shipments have been accounted for.

The Special Case of Miscellaneous Shipments

NOLAM has the capability to estimate costs and revenues associated with shipments of miscellaneous commodities, as indicated throughout this publication. Specifically, machinery, dry fertilizer, and liquid product are handled similarly to grain shipments. In addition, up to another two commodities can be included in the analysis. Since types of commodities shipped (other than grain, fertilizer, machinery, and liquid product) vary by branch line, it would be inappropriate to "lock" other specific commodity coefficients into the model due to time and space requirements. The user is thus given the option of selecting other commodities for analysis and has additional flexibility in selecting origin/destination sites.

Shipments of miscellaneous commodities other than fertilizer, machinery, and liquid product may occur only in single cars. Only one origin and one destination is permitted for these commodities, and one rail and one truck rate is required. Costs and revenues are computed in the same manner as described throughout the text, using the appropriate rates, car day, car mile, etc., costs.[14]

Estimation of Efficiency Benefits

The direct (primary efficiency) and indirect (secondary efficiency) benefits of rehabilitation are estimated through NOLAM once costs and revenues for the base case and rehabilitation alternative have been computed. The following discussion describes the development of efficiency benefits.

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[14]Specific cost coefficients are developed for each commodity by type of car used, etc., using Rail Form A costing procedures.

Primary Efficiency Benefits

Primary efficiency benefits (PEB) are those which are directly attributable to rehabilitation of a branch line, such as cost savings to railroads and shippers, rate savings to shippers, and additional producer's surplus to the railroad (see description of PEB on pages 7-9). References will be made to computations developed in the previous section for purposes of simplicity.

Cost reduction on existing traffic accrues because of increased efficiency of branch line operations to the railroad and rate reductions to shippers. Although a specific branch line may remain in service for only a few years rather than the entire term of analysis, only that portion of traffic which will/would have moved by rail is used to estimate cost savings. Shipping costs in the base case ($TRCb_{(Y)}$ previous to abandonment and $TTCb_{(Y)}$ postabandonment) and rehabilitation alternative ($TRCr_{(Y)}$) are converted to a cwt. basis using $SShipbr_{(Y)}$ and $SShiprr_{(Y)}$ to determine the cost per hundredweight (cwt.) of shipments. The shipping cost under the rehabilitation alternative is subtracted from the base case shipping cost to determine the change in shipping costs between the two alternatives. The change in shipping cost is multiplied by the annual quantity of commodities which will/would have been shipped by rail in the base case, $SShipbr_{(Y)}$, to determine cost savings on existing traffic.

Consumers' surplus on new traffic accrues as a result of rate changes which occur due to lower rates charged to shippers and is based on changes in modal traffic splits between the base case and rehabilitation alternative. Shipping revenues ($Revbr_{(Y)}$ prior to abandonment, $Revbt_{(Y)}$ postabandonment, and $Revrr_{(Y)}$ under the rehabilitation alternative) are converted to a cwt. basis to determine the shipping rate per cwt. The shipping rate under the rehabilitation alternative is subtracted from the base case shipping rate to determine the change in rates between the two alternatives. The change in quantity shipped between the two alternatives is computed as the difference between $SShiprr_{(Y)}$ and $SShipbr_{(Y)}$. Multiplication of one-half the change in shipping rates by the change in quantity shipped yields consumer surplus on new traffic.

Producer's (railroad's) surplus on new traffic accrues because of increased traffic levels and efficiencies incurred under the rehabilitation alternative. The producer's surplus is computed as the shipping rate minus the shipping cost under the rehabilitation alternative times the change in quantity shipped.

Primary efficiency benefits of branch line rehabilitation are the summation of cost savings, consumers' surplus, and producer's surplus. Primary efficiency benefits must be discounted from future years to current year and summed in order to determine net present value or benefit/cost ratios. The appropriate discount factor for a given year, based on the specified interest rate (inputted by the user), is multiplied by that year's primary efficiency benefits to determine the discounted value. A cummulative discounted total is computed.

Net Present Value and Benefit/Cost

Rehabilitation costs of branch lines are an integral part of determining the economics of continued, long-run service. Rehabilitation costs specific to a branch line are obtained from North Dakota State Highway Department in conjunction with the owning railroad on a cost per mile basis.

Rehabilitation of a branch line generally includes replacement of at least a portion of ties, rail, ballast, tie plates, spikes, etc. Some of these materials which are removed from the original branch line will be resold to other users. Similarly, at least a portion of the new rails, ties, etc. will have a resale value when removed from the rehabilitated branch line at the end of its life. The revenues and costs associated with the removal and resale of these items are used to estimate net rehabilitation cost of the branch line:

$$NRC = RC * LBL - [(NSUTo + NSVRo + NSVMo) + NLVr]$$

where: NRC = Net rehabilitation cost in present year

RC = Rehabilitation cost (per mile) in present year

LBL = Length of branch line, in miles

NSVTo = Total net salvage value of ties on original branch line

NSVRo = Total net salvage value of rail on original branch line

NSVMo = Total net salvage value of miscellaneous track materials on original branch line

NLVr = Net liquidation value of the rehabilitated branch line discounted from last year of project life (1 to 25) to current year

Net salvage values are defined as the salvage value less shipping costs to market. Removal costs are not included in the value estimates for ties, track, and miscellaneous materials for the original line since these are already accounted for in the rehabilitation cost estimates.

Net present value, one measure of viability, of branch line rehabilitation is calculated within NOLAM as:

$$NPV = CDPEB - NRC$$

where: NPV = Net present value of branch line rehabilitation

CDPEB = Cummulative discounted primary efficiency benefits

A NPV greater than zero indicates project viability.

A benefit/cost ratio also is computed as follows:

B/C = CDPEB/NRC

where: B/C = Benefit/cost ratio

A benefit/cost ratio greater than one indicates project viability.

Secondary Efficiency Benefits

Secondary benefits, in addition to primary benefits, accrue as a result of branch line rehabilitation. Farmers may receive a higher price for their products as a result of lower transportation rates to shippers. Highway construction and maintenance costs may increase in the absence of a given branch line. This section of the report will define and explain the procedures used to estimate secondary benefits.

Personal Income and Gross Business Volume

Changes in personal income and gross business volume as a result of branch line rehabilitation are estimated by the use of multipliers developed through previous research (Appendix C). Only consumers' surplus on new traffic is used to estimate changes in personal income and gross business volume as the remainder (cost savings and producer's surplus) likely will be transferred out of the study area. The proximity of elevators in North Dakota and their competitive nature suggests that the consumers' surplus ultimately will accrue to farmers either in the form of higher prices for their grain or patronage refunds paid by cooperative elevators. Changes in personal income as a result of rehabilitating a branch line are calculated as 1.55 (from row 12, column 12, Appendix Table C2) times consumers' surplus on new traffic.

Gross business volume is the total business activity in an area, measured in dollars, as the result of spending and respending within the economy. Consumers' surplus on new traffic is used to estimate changes in gross business volumes. Gross business volume is computed at a rate of 3.08 (from row 18, column 12, Appendix Table C2) times consumers' surplus.

Changes in personal incomes and gross business volumes are discounted, based on the specified interest rate (user inputted), and cumulatively totaled. These calculations are computed for each rehabilitation scenario (single-car, multiple-car, and trainload) as consumers' surplus will change under each scenario.

Highway Resurfacing and Maintenance Costs

Abandonment of a branch line will require those firms who previously relied on rail service to ship their products by truck from origin to destination, assuming they remain in business and do not relocate. This increased truck traffic may cause additional deterioration of highway structures, reducing the life expectancy of roadbeds and necessitating increased maintenance costs. These may be offset, at least in part, by increased fuel tax and license fee collections. If rehabilitation were to occur, truck shipments may decline, resulting in lower levels of roadbed deterioration and tax collections. The estimates provided are for the entire length of haul rather than just North Dakota impacts.

Types of trucks used, weight per load, routing of traffic, absolute and relative volumes of increased traffic, and the type and condition of pavement are factors which will dictate changes in highway construction and maintenance costs. FRA methodology (FRA, 1978) is used to estimate changes in highway construction and maintenance costs.

Movement of commodities on or off the branch line by truck is converted to a tandem-axle truck-trailer basis and multiplied by the corresponding origin to destination mileage for both the base case and rehabilitation alternative.

Changes in construction and maintenance costs are based on the number of 18-KIP loads[15] each route can withstand. The 18-KIP load factors are not available on a roadbed basis; therefore, a surrogate of 1,629,000 and 5,112,000 18-KIP loads was used for flexible (asphalt) and rigid (concrete) pavement, respectively (FRA, 1978). The number of passes each route can withstand is calculated as:

$$P_N = \frac{L_{KIP}}{EL}$$

where: P_N = Number of passes each route an withstand

L_{KIP} = Number of 18-KIP loads each route can withstand

EL = 18-KIP load equivalents (.955 for flexible pavement and 1.583 for rigid pavement)

Resurfacing and maintenance costs are based on averages for all paved roads in North Dakota. Average resurfacing costs are estimated at $59,202 and $177,606 per mile for flexible and rigid pavement, respectively.[16] Maintenance costs per mile are estimated at $2,358 and $4,473 for flexible and rigid pavement, respectively.[17]

The change in resurfacing and maintenance costs for each route due to the change in truck traffic is calculated as:

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[15]An 18-KIP load is an engineering term used to express the weight of a vehicle and the stress it places on a surface.

[16]Based on communication with North Dakota State Highway Department personnel.

[17]Ibid.

$$\Delta RM_{(Y)} = \left[\frac{C_R + C_M}{P_N}\right] MT_{(Y)}$$

where: ΔRM = Change in resurfacing and maintenance costs

C_R = Resurfacing cost per mile

C_M = Maintenance cost per mile

MT = Change in truck mileage

The change in resurfacing and maintenance cost by route is aggregated to estimate the total change.

Revenues from license fees and fuel taxes may change due to changing levels of truck traffic. Revenues from fuel taxes as a result of the change in truck shipments are computed on an annual basis by route and aggregated as follows:

$$\Delta FT_{(Y)} = [(Shipbt_{(Y,O,C,D)}/TC_{(C)}) - (Shiprt_{(Y,O,C,D)}/TC_{(C)})] * 2(M_{(O,D)}/3.4172 \text{ MPG}) * Tg$$

where: ΔFT = Change in fuel tax revenues

TC = Truck capacity

M = Mileage

Tg = Tax per gallon (17¢)[18]

The change in license fee collections as a result of abandonment are calculated as:

$$\Delta LF_{(Y)} = LV \; [(Shipbt_{(Y,O,C,D)}/TC_{(C)}) - (Shiprt_{(Y,O,C,D)}/TC_{(C)})]/T$$

where: ΔLF = Change in license vehicle fees

LV = Annual license fee ($1,500)[19]

T = Number of trips per year (Minneapolis--150, Duluth--150, Omaha--65, West Coast--52)[20]

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[18]Includes federal fuel tax of 9¢ per gallon and state fuel tax of 8¢ per gallon.

[19]Wilson et al., 1982.

[20]The number of trips per year for miscellaneous movements are estimated extraneous to NOLAM.

The net change per year in resurfacing and maintenance costs is calculated as resurfacing and maintenance cost minus the sum of fuel tax and license fee collections. The net change is discounted, based on the specified interest rate, and cumulatively totaled to determine the discounted net change in resurfacing and maintenance costs.

Job losses, changes in fuel consumption, and changes in personal income, corporate income, and sales and use tax collections could be estimated using procedures developed through previous research (Coon et al., 1983; and Mittleider et al., 1981). Previous research has shown that changes in these values would be rather insignificant for the state of North Dakota and, therefore, are not calculated within NOLAM.

User Procedures

NOLAM is intended to be applicable for a wide range of users and user requirements dealing with branch line abandonment. The model is interactive, providing flexibility for the user by varying certain inputs for any given branch line and also for examining different branch lines.

The software for NOLAM was programmed in interactive FORTRAN. Running the model requires no knowledge of how the model is programmed but only requires the user to answer a set of questions. The model contains three types of files: User-defined, Quasi-user-defined, and Nonuser-defined.

User-Defined Files

User-defined files contain the responses to questions that will vary from branch line to branch line or that may be varied for different scenarios for a given branch line. These files are created during model execution. The User-defined files include the following:

1. Beginning and ending point of branch line--used to provide headings for the output.

2. Years model to run--allows the user to specify a time span from 1 to 25 years for which the model calculates primary and secondary efficiency benefits.

3. Length of the branch line--is used to estimate some on-branch rail costs.

4. Number of originating stations--the number of origins can change from branch line to branch line. The number of origins is used to read the Quasi-user-defined files.

5. Years of service--the user specifies the time span that the branch line would be in service before it will be abandoned.

6. Production region--is used to increase the annual hundredweights shipped by region by the expected increase in productivity. This is stored in a Nonuser-defined file.

7. Railroad--cost coefficients for two railroads are included in the model. The user selects the appropriate railroad which is used to select railroad-specific costs from Nonuser-defined files.

8. Variable or fixed cost allocator--is used to select either variable or fixed cost coefficients from Nonuser-defined files according to the user's specifications.

9. Weighted midpoint of the branch line for the base case; single-car movements under the single-car rehabilitation alternative; single-car movements under the multiple-car and trainload scenarios, rehabilitation alternative; multiple-car movements under the multiple-car scenario, rehabilitation alternative; multiple-car movements under the trainload scenario, rehabilitation alternative; and trainload movements under the trainload scenario, rehabilitation alternative--these six values are used to calculate rail costs based on on-branch mileages for each respective scenario. These values are based on the proximity of shippers to the junction point and the amount of grain shipped by elevator.

10. Distance from junction point to classification yard--is used to calculate way train costs.

11. Distance from classification yard to Minneapolis, Duluth, Omaha, and Pacific Northwest--is used to estimate through train costs for grain.

12. Distance from origin to Minneapolis, Duluth, Omaha, and Pacific Northwest for 52-car trainloads--is used to estimate pull costs for trainload movements.

13. Number of light locomotive units to spot 52-car trains--used to estimate locomotive costs associated with the spotting of trains.

14. Distance from origin to classification yard for dry fertilizer, machinery, and liquid product--is used to calculate through train costs for these three products.

15. Average weight, in pounds, for "other" grains shipped--is used to convert shipments from bushels to cwts.

16. Enter 1 for liquid fertilizer movements in tanker cars, 2 for petroleum, or 3 for no tanker movements--is used to select the corresponding cost coefficients from Nonuser-defined files.

17. Hundredweight capacity of rail car and truck trailer for machinery--the user enters the hundredweight capacity of the flat car and truck used to move machinery. The material that can be carried on a flat car can vary substantially in weight by commodity. Therefore, the hundredweight in rail cars and trucks for machinery must be entered by the user.

18. Number of trips a truck can make hauling dry fertilizer, machinery, and liquid product in 260 working days per year from the specified origins--is used to estimate secondary efficiency benefits of this traffic.

19. Maximum load carrying capacity of the branch line under the base case--is used to allocate shipments into cars.

20. Current crew size--size of the crew is used to obtain the respective cost from a Nonuser-defined file under the base case.

21. Number of locomotives per trip under the base case--is used to derive the appropriate on-branch annual locomotive costs.

22. Number of times the branch line receives service per week under the base case--is used to develop the number of trains per week and associated train costs.

23. Average speed on the branch line in the base case--the speed on the branch line will determine how long a train spends on a given branch line, thereby affecting some of the associated on-branch costs.

24. Maintenance and inspection cost per mile on-branch under the base case--cost of maintenance under the base case is included in this User-defined file. No deferred maintenance costs should be included.

25. Total property tax on the branch line--this User-defined file contains the property taxes applicable to the branch line.

26. Width of the right of way in feet--this User-defined file contains the width of the right of way, in feet, from the center of the branch line and is used to determine the number of acres of land utilized by the branch line in estimating salvage values and opportunity costs.

27. Average land value per acre--the user-entered value represents the average land value per acre surrounding the branch line.

28. Weight and salvage value of rail--these two User-defined files contain the weight and value of the rail under the base case and rehabilitation alternative. If more than one rail weight or salvage value is included on the branch line, the values should be weighted.

29. Ties--percent reuseable and salvage value. Percent reuseable ties and the corresponding salvage values (base case and rehabilitation alternative) are used to estimate salvage values and opportunity costs.

30. Removal cost of salvageable items per mile--the user may accept the default value of $11,800 per mile or enter another value. This is used to determine net liquidation value of the branch line.

31. Value of salvagable ties, rail, and miscellaneous track materials removed from the original branch line--these three values are applied as a credit to rehabilitation cost of the branch line.

32. Percent of grain shipments by rail under the rehabilitation alternative. It is expected that rehabilitation of a branch line will result in increased rail shipments and decreased truck shipments. These values are obtained from a survey of the shippers and a weighted average for all grains are entered. Shipment by rail under the rehabilitation alternative is increased to this level on a commodity basis. However, if the User-defined value is lower for a given commodity than what was shipped by rail under the base case, the percentage shipped by rail is held at the original level.

33. Percent of machinery, dry fertilizer, and liquid product shipments by rail under the rehabilitation alternative--this allows the user to increase rail shipments for these commodities to coincide with projected increases in rail usage.

34. Rehabilitation cost--this User-defined file contains the cost per mile for rehabilitating the branch line.

35. Rail cost of capital--the user may accept the default value of 16.5 percent or input another value. This is used to estimate railroad opportunity costs.

36. Cost of capital for discounting public benefits--this is used to discount future benefits to present year dollars.

Additional User-defined files are included for miscellaneous shipments. The program asks if any miscellaneous shipments are included. If there are none, the miscellaneous shipment questions are not used. Two miscellaneous shipments may be included. The following data must be entered for each miscellaneous shipment:

1. Total cwts. shipped and percent shipped by rail;

2. Rail and truck rate;

3. Capacity of rail and truck in cwts.;

4. Rail miles on branch line and rail miles from origin to destination less on-branch and way train miles (through train miles);

5. Tare weight of rail car;

6. Car day and car mile costs;

7. Carload terminal cost;

8. Way and through train car mile line-haul costs;

9. Loss and damage cost per ton, rail;

10. Percent of shipment by rail, rehabilitation alternative;

11. Truck mileage from origin to destination;

12. Truck cost per mile factored for backhaul;

13. Percent of truck miles on flexible pavement; and

14. Total number of trips a truck can make in 260 working days per year.

Quasi-User-Defined Files

There are four types of Quasi-user-defined files. Quasi-user-defined files are files that include branch line specific data on shipments, rates, and mileages. These files are different from User-defined files since they must be created before the model is executed.

Six grain shipment files are created, one for each grain: wheat, barley, oats, sunflower, soybeans, and "other". Shipments of each of the grain commodities are obtained from North Dakota Public Service Commission commodity tapes. Three numbers are included for each line of data in the grain shipment files: total commodity shipped, percent of total shipped by rail, and percent of rail shipment by box car. The first line of data is for shipments from origin one to Minneapolis; the second line for shipments from origin one to Duluth; third, from origin one to Omaha; and fourth, from origin one to the Pacific Northwest. These four lines of data are repeated for each origin on the branch line.

Three Quasi-user-defined files are created which contain dry fertilizer, machinery, and liquid product shipments. These files have the same format construction as the grain shipment files except that only two values are entered on each line of data--total shipment and percent of shipment by rail. Data for the files are obtained from a survey of shippers.

Quasi-user-defined files are developed which contain shipping rates. A rate file is created for each of the six grain crops with one line of data for each origin-to-destination. Each line of data consists (in order) of a single-car; three-car; 10-, 24-, 25-, or 26-car; a trainload; and a truck rate. As not all commodity-origin-destination combinations have applicable rail rates for these types of movements, the next lowest rate is used. For example, a 26-car rail rate is used in place of a trainload rate if that rate is nonexistant. This will not affect cost calculations as other Quasi-user-defined files are created to "read" these rates at the appropriate level (e.g., 26-car rate). Dry fertilizer, machinery, and liquid product rate files are created which contain only a single car rate and a truck rate.

Three User-defined files which contain the available rate classification structure are created for each of the six grains (18 files). These files are used to cost the grain shipments according to the type of movement. For example, origin A may have a 26-car wheat rate to destination B, but only a three-car wheat rate to destination C. These files essentially cause the rail cost calculations for the wheat movement from origin A to destination B to be costed at the 26-car level, while the wheat movement from origin A to destination C would be costed at the three-car level. These matrices are created for the 3-car; 10-, 24-, 25-, and 26-car; and 50-52-54-car levels. One line of data is constructed for each origin containing the appropriate rail rate classification structure to each of the four destinations for that particular grain.

Files are developed which contain truck mileages which are used to calculate truck costs. One file is developed which contains truck mileages from the shipping origins to the four market destinations for grain movements (Minneapolis, Duluth, Omaha, and the Pacific Northwest) with a line of data created for each origin. Dry fertilizer, machinery, and liquid product shipments each account for an additional file (constructed similarly) with each line of data having one value: mileage from origin to destination.

Additional files are created which contain the percentage of flexible pavement over which trucks will travel when shipping products on or off the branch line. These four files are set up in the same manner as those for truck mileages.

Nonuser-Defined Files

Nonuser-defined files contain components of the model that are not branch line specific. These files are required to calculate costs or influence how shipments are allocated. (Components of these files are shown in the methodology section of this report.) Files include the following:

1. Estimated projected change in grain shipments over the 25-year time period (one file per grain commodity)--these are used to project changes in shipments of grain by commodity over time.

2. Projected decline in the number of box cars--the projected decline in box car file is used to decrease the number of hundredweights shipped by box car and increase shipments by hopper cars over time as a result of the projected decline in the number of box cars.

3. Gross ton mile cost--two files are used for gross ton mile cost--one for the base case and one for the rehabilitation alternative. These files contain the costs for both railroads.

4. Locomotive unit mile cost--one file is created for the base case costs and another for the rehabilitation alternative costs. Both railroads' costs are included.

5. Switching engine hours per car--the file contains switching time factors for each railroad and is used to account for the time the train spends in switching on the branch line under the base case. No switching time is included under the rehabilitation alternative since this is accounted for in the appropriate on-branch cost coefficients.

6. Crew wages--the cost of labor for crew sizes of two, three, four, or five persons, by railroad, is stored in this Nonuser-defined file. This is used to develop on-branch costs in the base case. The User-defined files--size of crew and name of railroad--are used to select the correct cost from this file.

7. Train mile costs--two files are created which contain the costs by railroad. One file is created for the base case costs and another for rehabilitation alternative costs.

8. Car day cost--this file contains the cost per car day by railroad and car type.

9. Car days on branch line--this file contains the estimated number of car days on the branch line as a result of the service cycle and is used to calculate total car day costs in the base case.

10. On-branch car mile cost--this file contains the cost per car mile for the respective railroads by car type.

11. Car mile line-haul costs--six files are created for car mile line-haul costs with each file containing the appropriate costs for each railroad. Two files are created for way train costs, one which contains the single- and multiple-car costs for covered hopper cars and the second which contains the costs for each of the other car types. Two other files are created for through train costs and are set up the same as for the way train. Trainload car-mile costs are included in two additional files--one which contains spot costs and the other which contains pull costs for each respective railroad.

12. Ton mile costs--three files are created which contain costs per ton mile. One file is created for way train costs, the second for through train costs, and the third for trainload movements. Costs for the respective railroads are included in each file.

13. Ton terminal cost--these two files contain the terminal cost per ton for each respective railroad. One file contains the terminal cost per ton for trainload movements, while the other file contains the cost for all other types of movements.

14. Carload terminal cost--three files are created which contain the carload terminal cost. The first file contains the carload terminal cost by railroad for single- and multiple-car movements by covered hopper cars. The second file contains the carload terminal cost by railroad and type of car for single-car movements. Trainload movement costs are contained in the third file.

15. Number of cars per pull--this file contains the system-wide average number of cars pulled per service for the respective railroads as well as the number of cars pulled per service for the multiple-car shipments. These values are used to calculate the number of times the branch line will be served under the rehabilitation alternative.

16. Number of locomotives per service--this file contains the system-wide average number of locomotives per service for the respective railroads in addition to the number of locomotives used for the multiple-car shipments. These values are used to estimate the number of locomotives used annually on-branch under the rehabilitation alternative.

17. Truck cost--these two files contain the truck cost per mile based on the commodity hauled, destination, and the estimated backhaul. One file contains variable costs and one contains total costs.

User-defined files are shown in Appendix D along with an example of the resulting output.

Special Capabilities of NOLAM

NOLAM has numerous features which enhance its capability for use as a rail modeling tool and which make it dynamic in nature. First, cost coefficients used in NOLAM are railroad specific rather than regionalized rail coefficients as are used in numerous other rail models. This allows for a more precise measurement of actual costs incurred by the operating railroad.

Second, NOLAM has built-in parameters which compute anticipated changes in grain traffic levels. The vast majority of rail shipments in North Dakota are out-of-state grain shipments. Changes in technology and productivity have resulted in increased crop yields and production, and corresponding increases in grain shipments. Anticipated changes in grain shipments may dramatically affect the viability of rehabilitating potential branch lines.

Third, projected rail costs for future years typically are predicated on historic movements by car type. Originally, grain was shipped in box cars. Technology has resulted in the decline of the size of the box car fleet and a corresponding increase in utilization of more cost-effective covered hopper cars. It appears reasonable to assume that, over time, the box car fleet will not be utilized to ship grain. This change in car type will result in lower per unit costs to the railroads. Again, NOLAM has built-in parameters to account for these anticipated changes in the box car fleet.

NOLAM's capability to simultaneously estimate "what will be" and "what could be" merits attention. Rail costing in the base case allows the user to model a particular branch line's operational procedures. Branch lines which have had deferred maintenance typically produce relatively few gross ton miles. This may have a dramatic effect on crew wages, locomotive costs, car day costs, etc. By allowing the user the flexibility allotted in NOLAM, current branch line operations which are atypical of the system may be accounted for. Conversely, dramatic changes may be noted in the railroad's operating costs and operational procedures under the rehabilitation alternative. Branch line operations after rehabilitation may be more "typical" of the railroad's entire system. The parameters within NOLAM allow for the normative branch line operations under the rehabilitation scenario.

Fourth, NOLAM may be utilized to analyze any branch line in the state with a minimum of inputs. Its dynamic nature allows for a changing number of origins and types of commodities shipped as one analyzes various branch lines. Additionally, branch line segments may be analyzed individually as the user becomes familiar with NOLAM.

Special features within NOLAM allow for estimation of costs and revenues associated with multiple-car and trainload movements. Because multiple-car and trainload movements are a more cost-effective approach to moving grain and other products, these effects on branch line viability may be measured. Additionally, one may require cost and revenue information for a specific movement. For example, the costs associated with moving a trainload of product from point A to point B may be required. These costs may readily be obtained through the model.

Finally, probably the most important attribute of NOLAM may be its ease of use. Utilization of the model requires no knowledge of computer programming; the user only is required to input certain parameters into the model before a branch line or line segment can be analyzed. Generally, the majority of this information is readily available and would have to be obtained when analyzing a particular branch line, regardless of the procedures used.

Adaptability and Transferability of NOLAM To Other States and Regions

While NOLAM is specific to the agricultural marketing and transportation system of North Dakota, the procedures developed have broader applicability to other states and situations. The same modeling capabilities which are built into NOLAM may be developed for any state or region facing similar problems.

The orientation of the model may be adapted to the economic base of the region being analyzed. NOLAM currently entails the capacity to analyze several basic or core commodities, with other movements treated as miscellaneous. For other areas where the traffic base may be considerably different than in North Dakota, these same basic commodities may not be the ones which need to be analyzed. A different set of commodity matrices, therefore, may have to be developed. Once the basic commodities are specified, however, the costing and revenue equations, using commodity specific inputs, will read data in the same manner and produce similar types of output.

Different carriers may be encountered when building similar capabilities for other regions. The cost coefficients developed in NOLAM will hold true only so long as the carriers do not change. Different Rail Form A coefficients will have to be derived when a change of carriers is encountered. Individual carrier RFA costs may be developed for the railroad being analyzed if the analyst(s) have a facility with ICC cost-finding formulas. Regional ICC costs may be used in lieu of carrier-specific data if the analysts do not possess cost-finding capabilities. Regional railroad costs may be obtained for any of seven geographical/operational regions upon request from the ICC.

The series of equations in NOLAM would produce rail cost output for any carrier or region once the rail cost coefficients are developed. However, several other considerations must be addressed in developing the single-car costs. First, the equipment type must be specified as railroad costs will vary considerably by type of car. Second, train and operating characteristics such as those entailed in NOLAM must be developed for each railroad being analyzed (i.e., locomotive units per train, train weights, crew cost per hour). Third, off-branch summary coefficients must be aggregated from the disaggregate RFA series of equations. And fourth, specific car-type factors such as empty return ratios and circuity multipliers must be developed.

Adjustments for multiple carload and trainload traffic must still be made once single-car costs have been developed. This is particularly critical to the calculation of carrier costs under the rehabilitation scenario. Adjustments to single-car costs are depicted for specific carload sizes in NOLAM. If trainload and/or different sizes of multiple carload blocks are considered, a different set of coefficients will have to be developed on the basis of the adjustment factors outlined in NOLAM.

Costs for the alternative mode (exempt agricultural carrier) have been specified for NOLAM. These may or may not be appropriate for analysis in other areas, depending on the alternative mode of transportation. Cost coefficients will have to be specified by the analysts where the alternative mode is not exempt agricultural carriers. Even where exempt carriers are the mode, coefficients based on North Dakota operating characteristics and industry economics still may be unsuitable for analysis of exempt agricultural carriers in other regions. Truck cost coefficients, in short, will have to be user-justified and defendable as inputs to the modeling process.

Where waterways are the competing mode, costs per mile or ton mile will have to be developed. Costing methodologies normally are not as well-developed for this mode as for rail or truck. Waterway rates, therefore, may have to be used in order to proxy costs.

Secondary Efficiencies

The framework used to derive secondary efficiency benefits for NOLAM will serve as a good starting point for measurement when developing capabilities for other states or regions. Input-output analysis can be used to project the spending effects of increased consumers' surplus on any given economy, provided that interdependence coefficients are calibrated on the basis of the economy being analyzed. Many states, and regions for that matter, have calibrated I-O coefficients for use in economic forecasting. Once the analyst has been satisfied that the coefficients yield reasonable estimates of true economic linkages, the dollars produced in terms of consumers' surplus, which are attributable to line segment rehabilitation, may be used to generate secondary efficiency benefits for the line or lines being analyzed in a similar manner to that produced by NOLAM.

NOLAM, in short, while specific to the circumstances and economic base of North Dakota, incorporates certain central capabilities which may be duplicated for any state or region. Some recalibration of cost coefficients and/or input parameters will probably be necessary regardless of the area analyzed given the site-specific nature of many of NOLAM's inputs. For states with agricultural economies, these alterations may be less substantial than in areas with a diversified economic base. But regardless of the nature of the traffic mix or the configuration of the transportation system, NOLAM may be adapted to other states or regions and used to produce similar analyses to those being produced in North Dakota.

Adaptability of NOLAM to Newer Generations of Cost Coefficients

The rail costs developed for use in this model have been predicated on the basis of Rail Form A cost coefficients. At the time of writing, RFA constitutes the state-of-the-art in rail cost analysis. Presently, however, the ICC is involved in the finalization of a new cost-finding methodology--the Uniform Rail Costing System (URCS).

URCS has been in various stages of development for the past five years. When finalized, URCS will supposedly produce cost coefficients superior to those generated by RFA. Whether URCS produces markedly different results than Rail Form A remains to be seen. However, NOLAM may be adjusted quickly to incorporate URCS coefficients if they are adopted by the ICC.

Cost coefficients generated under an URCS application would essentially be the same as those estimated under RFA. The same basic service units (gross ton mile, locomotive unit mile, train mile, car mile, car day, carload, ton and switch engine minutes) used in RFA costing also will serve as the basis for a URCS cost application. The principal difference, for utilization purposes, is that URCS will produce car specific coefficients (car day and car mile) as opposed to the system-average developed under RFA. Impact of this change on NOLAM will be limited, as car specific coefficients are already developed outside of RFA for the car-day portion of ownership expense. Effects of this change on model structure and application will be minimal.

The four summary off-branch costs (ton mile, car mile, carload and ton) will have to be respecified using disaggregate URCS coefficients. Procedures for doing this will be essentially the same as those used for aggregating Rail Form A coefficients.

In summary, the change from a RFA to a URCS costing format would present only minor changes for the modeling capabilities and procedures developed in NOLAM. With some reworking of the cost coefficients, which would occur largely extraneous to the model, NOLAM can be recalibrated to function using the newest generation of rail cost coefficients.

APPENDIX A

TRUCK COSTS

Exempt Trucking Costs

Long-haul exempt carrier costs have been estimated primarily from information developed in a series of studies performed at the Upper Great Plains Transportation Institute. Cost functions were estimated for exempt agricultural haulers, utilizing an extensive survey of the industry, in conjunction with factor prices (Wilson et al., 1982). Exempt carrier costs had previously been estimated on an economic-engineering basis only (Cosgriff, 1978). The results of the Wilson study are discussed below.

Methods of Estimation

Wilson et al. estimated a cost per running mile on two separate bases. First, total cost and average total cost (ATC) functions were estimated for the industry, using the results of a survey of 145 North Dakota truckers. Four different output measures were posited: (1) total miles, (2) gross ton miles, (3) net ton miles, and (4) hundredweight miles. The coefficients of determination for each of the ATC models were identical (.53), and the industry cost per unit of output varied less than $.15. The industry cost per mile derived in this manner was estimated at $.91 per loaded or empty mile.

Econometrically derived estimates per running mile were compared to estimates developed using an economic-engineering approach to cost estimation. The cost of various inputs (i.e., labor, equipment, parts, fuel, and lubricants) was used to synthesize the costs of operation for a composite or "typical" firm. Costs developed via this approach were for a three-tractor, four-trailer firm (the average of all firms responding to the North Dakota survey).

When economic-engineering estimates were set at the average level of industry output (annual miles), the cost estimates derived were almost identical to those derived using econometric techniques. The two cost estimates thus tend to be mutually supportive as an industry average.

Adjustments for Backhaul

The raw statistical or economic-engineering costs developed do not necessarily reflect the backhaul characteristics of any given class of traffic, as the backhaul patterns are known to vary significantly. To account for this, backhaul adjustment factors have been developed and used to adjust the raw truck cost per running mile.

Wilson et al. estimated a cost of $.92 per running mile (economic-engineering estimate) which reflected no backhaul possibility. While 100 percent empty return is possible in certain cases, it is not likely to be the norm for the North Dakota industry. Backhaul possibilities, furthermore, will vary among destinations as well as perhaps among locations within the state. North Dakota truckers were surveyed to determine the proportion or frequency of backhauls between North Dakota stations and various destinations to account for this variance in the cost. Having determined these proportions, truck costs per running mile were adjusted to fit the circumstances of current grain traffic.

The adjustment factors are depicted in Appendix Table A1. When even limited backhaul possibilities are considered, the cost per running mile drops considerably as the fixed movement costs which must be borne totally by the fronthaul traffic in Case 1 are spread out over the backhaul mileage, as depicted in Cases 2-5.

APPENDIX TABLE A1. BACKHAUL ADJUSTMENT FACTORS FOR DECEMBER 1980 TRUCK COST ESTIMATE

Case	Percent Backhaul	Cost Per Running Mile	Percent Reduction in Cost
1	0	$.92	--
2	25	.74	19.56
3	50	.61	33.69
4	75	.53	42.39
5	100	.46	50.00

SOURCE: Wilson et al., 1982.

APPENDIX B

TRANSSHIPMENT COSTS

Transshipment Costs

It has been suggested that shippers may use a transshipment alternative to move their product from origin to destination in the absence of rail service. The purpose of this analysis is to give the reader insight into the costs associated with transshipment versus long-haul truck movements for selected North Dakota sites.

Several short-haul truckers were contacted in 1982 to determine rates for short-haul truck movements. Truckers indicated that short-haul rates were quoted on a mileage basis rather than a set rate such as those for long-haul movements, and generally were obtained from a Minnesota Public Utilities Commission rate case (Minnesota Public Utilities Commission, 1981).

Four origins were randomly selected in North Dakota and used to estimate long-haul and transshipment costs (Appendix Table B1). Long-haul truck rates were collected from shippers at each origin to four destinations. Mileages were estimated from origins to the nearest possible transshipment point and short-haul truck rates were based on these mileages. The total transshipment costs also include elevation costs ($.20 per cwt.) at the transshipment point. A 26-car rail rate from the transshipment point to the destinations was used so as to take advantage of the most appropriate multiple-car rates. Total transshipment costs were higher than the alternative of truck shipment from origin to destination in all instances considered, except one.

APPENDIX TABLE B1. COMPARISON OF LONG-HAUL TRUCK AND TRANSSHIPMENT FROM SELECTED SITES IN NORTH DAKOTA TO FOUR DESTINATIONS, 1982[a]

Origin	Destination	Long-Haul Truck Rate	Transshipment Point	Transshipment: Short-Haul Mileage	Transshipment: Short-Haul Truck Rate[b]	Transshipment: Elevation Costs[c]	Transshipment: Rail Rate From Transshipment Point[d]	Transshipment: Total Transshipment Cost	Difference[e]
		$/cwt.			----	----	$/cwt.	----	----
Portland	Minneapolis	.70	Hillsboro	20	.185	.20	.59	.975	.275
	Duluth	.70	Buxton	20	.185	.20	.61	.995	.295
	Omaha	1.23	Hillsboro	20	.185	.20	1.76	2.145	.915
	West Coast	2.15	Clifford	12	.175	.20	2.18	2.555	.405
Maddock	Minneapolis	1.30	Hamberg	14	.175	.20	.91	1.285	- .015
	Duluth	1.30	Harlow	14	.175	.20	.96	1.335	.035
	Omaha	1.99	Hamberg	14	.175	.20	2.10	2.475	.485
	West Coast	1.80	Hamberg	14	.175	.20	1.97	2.345	.545
Mott	Minneapolis	.75	Richardton	35	.20	.20	1.13	1.53	.78
	Duluth	1.40	Richardton	35	.20	.20	1.13	1.53	.13
	Omaha	1.55	Richardton	35	.20	.20	2.34	2.74	1.19
	West Coast	2.08	Richardton	35	.20	.20	1.97	2.37	.29
Woodworth	Minneapolis	.90	Medina	22	.19	.20	.76	1.15	.25
	Duluth	.95	Medina	22	.19	.20	.76	1.15	.20
	Omaha	f	Medina	22	.19	.20	1.94	2.33	--
	West Coast	f	Medina	22	.19	.20	1.85	2.24	--

[a]Rates are based on wheat movements.
[b]SOURCE: Minnesota Public Utilities Commission, 1981.
[c]Adapted from Chase, et al., in print.
[d]Rail rate is for 26-car, single origin movements, except to Omaha which is single car rate.
[e]Transshipment costs minus long-haul truck rate.
[f]Shipper does not ship grain to these destinations, and truck rates are unknown.

APPENDIX C

INPUT-OUTPUT MODEL

Input-Output Model

Input-output analysis is a technique for tabulating and describing the linkages or interdependencies between various industrial groups within an economy. The economy considered may be the national economy or an economy as small as that of a multicounty area served by one of the state's major retail trade centers. The North Dakota economy is divided into 17 industrial groups referred to as sectors of the economy. The sector delineation and corresponding standard industrial classification (SIC) codes are presented in Appendix Table C1.

The input-output analysis used in this model assumes that economic activity in a region is dependent upon the basic industries (referred to as its economic base) that exist in an area. The economic base is largely a region's export base, i.e., those industries (or "basic" sectors) that earn income from outside the area. These activities in North Dakota consist of livestock and crop production, manufacturing, mining, tourism in the area, and federal government outlays in the area. The remaining economic activities are the trade and service sectors, which exist to provide the inputs required by other sectors in the area.

The North Dakota input-output model has three features which merit special comment. First, the model is closed with respect to households. In other words, households are included in the model as a producing and a consuming sector. Second, the total gross business volume of trade sectors was used (both for expenditures and receipts in the transactions table) rather than value added by those sectors. This procedure results in larger activity levels for those sectors than would be obtained by conventional techniques, but this is offset by correspondingly larger levels of expenditures outside the region by those sectors for goods purchased for resale. The advantage of this procedure is that the results of the analysis are expressed in terms of gross business volumes of the respective sectors, which is usually more meaningful to most users. The third feature is that all elements in the column of interdependence coefficients for the local government sector were assigned values of zero, except for a one (1.00) in the main diagonal. This was intended to reflect the fact that expenditures of local units of government are determined by the budgeting process of those units, rather than endogenously within the economic system.

Production by any sector requires the use of production inputs, such as materials, equipment, fuel, services, labor, etc., by that sector. These inputs are referred to as the direct requirements of that sector. Some of these inputs will be obtained from outside the region (imported), but many will be produced by and purchased from other sectors in the area economy. If so, these other sectors will require their own inputs from still other sectors, which in turn will require inputs from yet other sectors, and so on. These additional rounds of input requirements that are generated by production of the direct input requirements (of the initial sector) are known as the indirect requirements.

The total of the direct and indirect input requirements of each sector in an economy is measured by a set of coefficients that is known as the input-output interdependence coefficients. Each coefficient indicates the total (direct and indirect) input requirement that must be produced by the row

APPENDIX TABLE C1. ECONOMIC SECTORS OF THE NORTH DAKOTA INPUT-OUTPUT MODEL AND STANDARD INDUSTRIAL CLASSIFICATION CODE OF EACH

Economic Sector	SIC Code[a]
1. Ag., Livestock	Group 013 - Livestock
2. Ag., Crops	All of major group 01 - agricultural production, except group 013 - livestock
3. Sand & Gravel Mining	Major group 14 - mining and quarrying of nonmetallic minerals, except fuels
4. Construction	Division C - contract construction (major groups 15, 16, and 17)
5. Transportation	All division E - transportation, communications, electric, gas, and sanitary services, except major groups 48 and 49
6. Communications & Public Utilities	Major group 48 - communications and major group 49 - electric, gas, and sanitary services, except industry no. 4911
7. Ag. Processing & Miscellaneous Manufacturing	Major group 50 - wholesale trade, and major group 20 - food and kindred products manufacturing
8. Retail Trade	All of division F - wholesale and retail trade, except major group 50 - wholesale trade
9. Finance, Insurance, and Real Estate	Division G - finance, insurance, and real estate
10. Business and Personal Service	All of division H - services, except major groups 80, 81, 82, 86, and 89
11. Professional and Social Services	Major group 80 - medical and other health services, major group 8, legal services, major group 82 - educational services, major group 86 - nonprofit membership organizations, and major group 89 - miscellaneous services
12. Households	Not applicable
13. Government	Division I - government
14. Coal Mining	Major group 12 - bituminous coal and lignite mining
15. Electric Generating	Industry number 4911 - electric companies and systems
16. Petroleum and Natural Gas Exploration and Extraction	Major group 13 - crude petroleum and natural gas
17. Petroleum Refining	Major group 29 - petroleum refining and related industries

[a]Executive Office of the President/Bureau of the Budget, 1967.

sector per dollar of output for final demand by the column sector. Final demand is defined as output by a basic sector that is sold to purchasers from outside the region. Final demand consists of receipts from sales of livestock (receipts of Sector 1); receipts by Sector 2 from sales of crops; Sector 4 from federal government outlays for construction, processed agricultural products and other manufacturing (Sector 7); Sectors 8 and 10, tourist expenditures; Sector 14, exports of mine product; Sector 15, electricity exported; Sector 16, crude oil exported; and Sector 17, exported refined petroleum products. For any of these basic sectors which produce for final demand, the sum of the values for that column indicates the multiplier effect in the region's economy resulting from a dollar's worth of sales outside the region by that sector. For example, if the column total of interdependence coefficients for the livestock producing sector is 4.49, $4.49 worth of output is required by all sectors in the economy in order that $1.00 worth of livestock be produced for final demand. Thus, it can be said that the output multiplier for the livestock producing sector is 4.49, or that the original dollar "turns over" about 4.5 times in the region.

If the level of output of any of the basic sectors were to increase, the level of output of other sectors also would be expected to increase. The amount of the increase in other sectors would be equal to the dollar amount of the increase in the basic sector's output times the respective interdependence coefficients in the column for the basic sector. For example, the effect of a $1 million increase in federal government outlays for construction in the region could be estimated from Column 4, Appendix Table C2. Livestock production in the region could be expected to increase by $30,000 (0.03 times $1 million); crop production by $10,000 (0.01 times $1 million); retail trade volume by $410,000 (0.41 times $1 million); personal income (the income of households, Sector 12) by $610,000 (0.61 times $1 million); and the total for all sectors in the economy by $2,440,000 (2.44 times $1 million). These increases in the respective sectors represent both the direct and the indirect effects of expanded final demand that is injected into the region via the contract construction sector because of increased federal expenditures to it.

Given these basic procedures, the gross business volumes of each sector in the area economy can be estimated by multiplying the output of the "basic" sectors (payments received from outside the area) by the interdependence coefficients for those sectors.

The multiplier effect for a sector (which is measured by the sum of the sector's column of interdependence coefficients) results from the spending and respending within the region's economy of income that is received from sale of its exports. For example, the establishment of a new manufacturing plant in a region would result in expenditures by the plant for some locally supplied inputs, such as materials, labor, etc. These expenditures will generate additional rounds of spending in the region because the firms providing materials to the plant will now purchase some additional inputs in the region and employees of the plant will spend a part of their income in the region. These expenditures, in turn, will generate another round of spending and so on.

Multiplication of the interdependence coefficients by the sales of the basic sectors (income received from outside the region or sales for final demand) yields estimates of the gross business volumes of each of the sectors

APPENDIX TABLE C2. INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS, BASED ON TECHNICAL COEFFICIENTS FOR 17-SECTOR MODEL FOR NORTH DAKOTA

Sector	Lvstk. (1)	Crops (2)	S&G (3)	Const. (4)	Trans. (5)	C&U (6)	W&AP (7)	Ret. (8)	FIRE (9)
1. Ag. Livestock	1.2072	0.0774	0.0445	0.0343	0.0455	0.0379	0.1911	0.0889	0.0617
2. Ag. Crops	0.3938	1.0921	0.0174	0.0134	0.0178	0.0151	0.6488	0.0317	0.0368
3. Sand & Gravel	0.0083	0.0068	1.0395	0.0302	0.0092	0.0043	0.0063	0.0024	0.0049
4. Construction	0.0722	0.0794	0.0521	1.0501	0.0496	0.0653	0.0618	0.0347	0.0740
5. Transportation	0.0151	0.0113	0.0284	0.0105	1.0079	0.0135	0.0128	0.0104	0.0120
6. Comm. & Util.	0.0921	0.0836	0.1556	0.0604	0.0839	1.1006	0.0766	0.0529	0.1321
7. Wholesale & Ag. Proc.	0.5730	0.1612	0.0272	0.0207	0.0277	0.0239	1.7401	0.0452	0.0704
8. Retail	0.7071	0.8130	0.5232	0.4100	0.5475	0.4317	0.6113	1.2734	0.6764
9. Fin., Ins., Real Estate	0.1526	0.1677	0.1139	0.0837	0.1204	0.1128	0.1322	0.0577	1.1424
10. Bus. & Pers. Services	0.0562	0.0684	0.0430	0.0287	0.0461	0.0374	0.0514	0.0194	0.0766
11. Prof. & Soc. Services	0.0710	0.0643	0.0559	0.0402	0.0519	0.0526	0.0530	0.0276	0.0816
12. Households	1.0458	0.9642	0.8424	0.6089	0.7876	0.7951	0.7859	0.4034	1.2018
13. Government	0.0987	0.0957	0.0853	0.0519	0.2583	0.0999	0.0796	0.0394	0.1071
14. Coal Mining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15. Electric Generating	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
16. Pet. Exp./Ext.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17. Pet. Refining	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gross Receipts Multiplier	4.4931	3.6851	3.0284	2.4430	3.0534	2.7901	4.4509	2.0871	3.6778

- Continued -

APPENDIX TABLE C2. INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS, BASED ON TECHNICAL COEFFICIENTS FOR 17-SECTOR MODEL FOR NORTH DAKOTA (CONTINUED)

Sector	B&PS (10)	P&SS (11)	HH (12)	Govt. (13)	Coal (14)	E. Gen. (15)	Pet. Exp./Ext. (16)	Pet. Ref. (17)
1. Ag. Livestock	0.0384	0.0571	0.0674	0.0000	0.0376	0.0251	0.0159	0.0145
2. Ag. Crops	0.0152	0.0229	0.0266	0.0000	0.0285	0.0321	0.0062	0.0057
3. Sand & Gravel	0.0043	0.0050	0.0057	0.0000	0.0032	0.0019	0.0045	0.0037
4. Construction	0.0546	0.0787	0.0902	0.0000	0.0526	0.0328	0.1148	0.0929
5. Transportation	0.0118	0.0100	0.0093	0.0000	0.0084	0.0048	0.0180	0.0172
6. Comm. & Util.	0.1104	0.1192	0.1055	0.0000	0.0712	0.0378	0.0510	0.0444
7. Wholesale & Ag. Proc.	0.0237	0.0362	0.0417	0.0000	0.0618	0.0782	0.0097	0.0089
8. Retail	0.4525	0.6668	0.7447	0.0000	0.3995	0.2266	0.1838	0.1675
9. Fin., Ins., Real Estate	0.1084	0.1401	0.1681	0.0000	0.0771	0.0977	0.0388	0.0358
10. Bus. & Pers. Services	1.0509	0.0455	0.0605	0.0000	0.0289	0.0201	0.0139	0.0127
11. Prof. & Soc. Services	0.0497	1.1026	0.0982	0.0000	0.0493	0.0301	0.0210	0.0195
12. Households	0.7160	1.0437	1.5524	0.0000	0.6666	0.3973	0.3205	0.2951
13. Government	0.0774	0.0881	0.1080	1.0000	0.0511	0.0444	0.0280	0.0285
14. Coal Mining	0.0000	0.0000	0.0000	0.0000	1.0000	0.1582	0.0003	0.0002
15. Electric Generating	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000
16. Pet. Exp./Ext.	0.0000	0.0000	0.0000	0.0000	0.0138	0.0084	1.0981	0.8227
17. Pet. Refining	0.0000	0.0000	0.0000	0.0000	0.0168	0.0102	0.0000	1.0000
Gross Receipts Multiplier	2.7133	3.4159	3.0783	1.0000	2.5664	2.2057	1.9245	2.5693

in the region. Sales of the basic sectors can be baseline or project/industry specific (which are appropriate in the case of impact analysis). The resulting product for the household sector (Sector 12) is personal income received from the respective business sectors in the form of wages and salaries, profits, rents, and interest income of individuals.

Interdependence Coefficients

The input-output technical and interdependence coefficients for the North Dakota economy were derived from actual expenditure data collected in 1965 for business firms, households, and units of government in southwestern North Dakota (Sand, 1968; Bartch, 1968; and Senechal, 1971). The North Dakota input-output interdependence coefficients were calculated originally for a 13-sector model.

The original coefficients were derived when energy production (coal, electricity, crude petroleum, and refined petroleum products) was not a very large component of the North Dakota economic base. Increasing importance of North Dakota energy exports made expansion of the model necessary. Survey expenditure data of the energy-related industries were collected in 1975 (Hertsgaard et al., 1977). These expenditures data yielded technical coefficients (direct requirements) for four additional economic sectors. These coefficients were simply appended to the 13-sector direct requirements matrix to form an augmented 17-sector direct requirements matrix. The technical coefficients for the four energy sectors were included as columns 14-17. Rows 14 to 17 for columns 1-13 were assigned a value of zero. This was appropriate because the original 13 sectors have insignificant amounts of expenditures to the energy sectors, but the energy sectors had a considerable amount of expenditures to the original 13 sectors. Inverting the 17 X 17 technical coefficients matrix yielded the 17-sector interdependence coefficients. Interdependence coefficients for the 17-sector model are presented in Appendix Table C2.

Gross Business Volumes

Application of the input-output multipliers to the final demand vectors provides estimates of gross business volume of all sectors of the economy. Final demand vectors can be baseline or project/industry and historic or projected. Multipliers applied to the historic final demand vectors yield estimates of historic gross business volumes. Gross business volume of the household sector (Sector 12) is personal income. Applying the household sector's gross receipts and household row multipliers to consumers' surplus will give estimates of the gross business volumes and personal incomes, respectively, that are directly or indirectly attributable to the additional income received as a result of branch line rehabilitation for the specified time period.

The accuracy of the input-output model has been tested by comparing personal income from the model with personal income reported by the Bureau of Economic Analysis, U.S. Department of Commerce. For the time period 1958 to 1980, estimates of North Dakota personal income from the input-output model had an average deviation of 5.13 percent from Department of Commerce estimates

(Appendix Table C3). The Theil's coefficient of .031 also indicates the model is quite accurate for predictive purposes.[1]

APPENDIX TABLE C3. ESTIMATES OF PERSONAL INCOME AND DIFFERENCES IN ESTIMATES, STATE OF NORTH DAKOTA, 1958-1980

Year	Estimates by Input-Output Techniques ($000)	Estimate by U.S. Department of Commerce ($000)[a]	Percent Difference
1958	$1,022,412	$1,027,000	- 0.5
1959	978,420	956,000	2.3
1960	942,488	1,066,000	-11.6
1961	1,011,460	995,000	1.7
1962	1,285,790	1,353,000	- 5.0
1963	1,353,864	1,280,000	5.8
1964	1,521,191	1,277,000	19.1
1965	1,470,128	1,508,000	- 2.5
1966	1,662,393	1,553,000	7.0
1967	1,573,010	1,592,000	- 1.2
1968	1,684,451	1,645,000	2.4
1969	1,890,973	1,830,000	3.3
1970	2,117,318	1,904,000	11.2
1971	2,156,642	2,158,000	- 0.1
1972	2,601,416	2,676,000	- 2.8
1973	3,674,738	3,875,000	- 5.2
1974	4,104,667	3,740,000	9.8
1975	4,009,826	3,755,000	6.8
1976	3,860,970	3,728,000	3.6
1977	3,829,503	3,833,000	- 0.1
1978	4,481,330	4,984,000	-10.1
1979	4,763,620	5,047,000	- 5.6
1980	5,430,915	5,415,000	0.3
Average Error =			5.13

Theil's Coefficient = .031429843

[a] _Survey of Current Business_, August 1979, pp. 28-31 (1958-1976), _Survey of Current Business_, April 1980, p. 25 (1977) and _Survey of Current Business_, April 1981, p. 38 (1978-1979).

[1] The Theil U_1 coefficient is a summary measure, bounded to the interval 0 and 1. A value of 0 for U_1 indicates perfect prediction, while a value of 1 corresponds to perfect inequality (i.e., between the actual and predicted values). For further discussion on the Theil coefficient, see Leuthold, 1975 and Pindyck, Robert S. and Daniel L. Rubinfeld, 1981.

APPENDIX D

USER SPECIFIED FILES AND
GENERATED OUTPUT

```
**************************************************************************
*                                                                        *
*     THIS PROGRAM CALCULATES THE PRIMARY [illegible]                   *
* [illegible]                                                            *
* [illegible]                                                            *
* [illegible]                                                            *
* [illegible]                                                            *
* [illegible] DEPARTMENT                                                 *
* OF AGRICULTURAL ECONOMICS, NORTH DAKOTA STATE UNIVERSITY.             *
* PHONE (701) 237-7441                                                   *
*                                                                        *
*                                                        HGV             *
*                                                                        *
**************************************************************************

UP TO TEN ORIGINS CAN BE ENTERED INTO THE MODEL.  THE MODEL AUTOMATICALLY
ASSUMES SHIPMENTS OF GRAIN TO FOUR DESTINATIONS:  MINNEAPOLIS, DULUTH, OMAHA
AND PACIFIC NORTHWEST.  MISCELLANEOUS GRAIN SHIPMENTS TO MINNESOTA DESTINATIONS SHOULD BE
ENTERED INTO EITHER THE MINNEAPOLIS OR DULUTH MARKET.  THE OMAHA DESTINATION
MAY BE USED AS A SURROGATE MARKET FOR OTHER GRAIN SHIPMENTS THROUGHOUT
THE UNITED STATES


 ENTER THE BEGINNING POINT ON THE BRANCH LINE
?ABC


 ENTER THE ENDING POINT ON THE BRANCH LINE
?XYZ


 ENTER NUMBER OF YEARS THAT YOU WANT TO RUN THE MODEL (1 TO 25)
?25


 ENTER THE LENGTH OF THE BRANCH LINE (IN MILES)
?53.4


 HOW MANY ORIGINS ARE TO BE INCLUDED ON THE BRANCH LINE
?5


 ENTER 1 IF BURLINGTON NORTHERN OR 2 IF SOO LINE
?1


 ENTER 1 FOR VARIABLE RAIL AND TRUCK COSTS OR 2 FOR FULLY ALLOCATED COSTS
?2


 ENTER THE NUMBER OF YEARS IN WHICH THERE WILL BE SERVICE ON THE CURRENT BRANCH LINE
?5


 ENTER REGION OF PRODUCTION (1,2,OR 3)
?[illegible]


 ENTER WEIGHTED MIDPOINT ON THE BRANCH LINE FOR BASE CASE, AND SINGLE, MULTIPLE
 CAR, AND TRAINLOAD SHIPMENTS UNDER REHABILITATION ALTERNATIVE (6 VALUES)
?[illegible],4,30.5,30.3,6.6,31.1


 ENTER NUMBER OF MILES FROM JUNCTION POINT OF BRANCH LINE TO CLASSIFICATION YARD (IN MILES)
?56.3


 ENTER DISTANCE FROM THE CLASSIFICATION YARD TO MINNEAPOLIS, DULUTH, OMAHA AND PACIFIC NORTHWEST (IN MILES)
?[illegible],265,406,1518


 ENTER DISTANCE FROM ORIGIN TO MINNEAPOLIS, DULUTH,
 OMAHA AND PACIFIC NORTHWEST (IN MILES) FOR 52 CAR TRAINLOAD
?325,332,493,1605


 ENTER THE NUMBER OF LIGHT LOCOMOTIVE UNITS USED TO SPOT THE
 52 CAR TRAINLOAD UNDER REHABILITATION ALTERNATIVE
?1


 ENTER DISTANCE FROM ORIGIN TO CLASSIFICATION YARD FOR DRY FERTILIZER,
 MACHINERY AND TANKER CARS (3 VALUES)
?1721,0,0


 ENTER AVERAGE WEIGHT IN POUNDS FOR THE OTHER GRAINS SHIPPED
?55.5


 ENTER 1 FOR LIQUID FERTILIZER MOVEMENTS, 2 FOR
 PETROLEUM OR 3 FOR NO LIQUID PRODUCT MOVEMENTS
?3
```

```
ENTER THE HUNDREDWEIGHT CAPACITY OF RAIL CAR AND TRUCK FOR MACHINERY
?0,0

ENTER NUMBER OF TRIPS A TRUCK CAN MAKE HAULING DRY FERTILIZER, MACHINERY
AND LIQUID PRODUCT IN 260 WORKING DAYS FROM THE SELECTED ORIGINS (3 VALUES)
?52,0,0

ENTER MAXIMUM NET LOAD CARRYING CAPACITY (IN TONS) OF CARS THAT CAN BE
TRANSPORTATED ON THE BRANCH LINE UNDER THE BASE CASE
?100

ENTER CURRENT CREW SIZE ON BRANCH LINE
?4

ENTER THE NUMBER OF LOCOMOTIVES USED PER TRIP UNDER BASE CASE
?2.5

ENTER NUMBER OF TIMES A WEEK THE BRANCH LINE RECEIVES SERVICE UNDER THE BASE CASE
?1

ENTER AVERAGE SPEED ON THE BRANCH LINE UNDER BASE CASE
?20

ENTER MAINTAINENCE COST PER MILE ON THE BRANCH LINE UNDER BASE CASE
?7000

ENTER TOTAL PROPERTY TAX ON THE BRANCH LINE
?5727

ENTER THE WIDTH OF THE RIGHT OF WAY (IN FEET)
?50

ENTER THE AVERAGE PER ACRE VALUE OF LAND SURROUNDING THE BRANCH LINE
?600

ENTER WEIGHT OF RAIL ON THE BRANCH LINE UNDER BASE CASE AND REHABILITATION ALTERNATIVE (2 VALUES)
?72,90

ENTER NET SALVAGE VALUE OF RAIL ON THE BRANCH LINE UNDER BASE CASE AND REHABILITATION ALTERNATIVE (2 VALUES)
?40,50

ENTER PERCENT OF REUSABLE TIES ON THE BRANCH LINE UNDER BASE CASE AND REHABILITATION ALTERNATIVE (2 VALUES)
?70,95

ENTER NET SALVAGE VALUE OF REUSABLE TIES ON THE BRANCH LINE UNDER BASE CASE AND REHABILITATION ALTERNATIVE (2 VALUES)
?4,4

ENTER THE RECOVERY COST OF SALVAGABLE ITEMS ON THE ABANDONED BRANCH LINE
OR ENTER 0 TO ACCEPT THE DEFAULT VALUE OF $11,800 PER MILE
?0

ENTER VALUE OF SALVAGABLE TIES, RAIL AND MISCELLANEOUS MATERIAL REMOVED FROM THE ORIGINAL BRANCH LINE
?19200,277360,2800

ENTER PERCENT OF GRAIN SHIPMENTS BY RAIL UNDER REHABILITATION
?95

ENTER PERCENT OF MACHINERY, DRY FERTILIZER AND LIQUID PRODUCT
SHIPMENTS BY RAIL UNDER REHABILITATION ALTERNATIVE (3 VALUES)
?0,75,0

ENTER REHABILITATION COST PER MILE
?132000

THE MODEL ALSO INCLUDES THE OPTION OF SHIPPING TWO MISCELLANEOUS
COMMODITIES OTHER THAN GRAIN, MACHINERY AND FERTILIZER.  ONLY ONE ORIGIN AND ONE
DESTINATION IS PERMITTED FOR EACH MISCELLANEOUS COMMODITY.  DO YOU WANT TO INCLUDE
ANY SHIPMENTS IN ADDITION TO GRAIN, MACHINERY AND FERTILIZER (1=YES, 2=NO)
?1

ENTER THE RAIL COST OF CAPITAL OR ENTER 0 TO ACCEPT THE DEFAULT VALUE OF 16.5 PERCENT
?0
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ENTER THE COST OF CAPITAL FOR DISCOUNTING PUBLIC BENEFITS
?11.7

ENTER NUMBER OF MISCELLANEOUS SHIPMENTS (1 OR 2)
?1

ENTER TOTAL HUNDREDWEIGHTS SHIPPED AND PERCENT BY RAIL FOR MISCELLANEOUS COMMODITY 1
?14000,60

ENTER RAIL RATE FOR SINGLE CAR SHIPMENTS AND TRUCK RATE FOR MISCELLANEOUS COMMODITY 1
?2.50,3.00

ENTER CAPACITY OF RAIL CAR AND TRUCK FOR MISCELLANEOUS COMMODITY 1
?1000,500

ENTER RAIL MILES FROM WEIGHTED MIDPOINT TO JUNCTION POINT
AND FROM CLASSIFICATION YARD TO DESTINATION FOR MISCELLANEOUS COMMODITY 1
?14,610

ENTER TARE WEIGHT OF RAIL CAR FOR MISCELLANEOUS COMMODITY 1
?28.58

ENTER CAR DAY COST FOR MISCELLANEOUS COMMODITY 1
?15.37

ENTER CAR MILE COST FOR MISCELLANEOUS COMMODITY 1
?.0675

ENTER CARLOAD TERMINAL COST FOR SINGLE CAR FOR MISCELLANEOUS COMMODITY 1
?237.71

ENTER WAY TRAIN CAR MILE LINE-HAUL FOR SINGLE CAR FOR MISCELLANEOUS COMMODITY 1
?1.09

ENTER THROUGH TRAIN CAR MILE LINE-HAUL FOR SINGLE CAR FOR MISCELLANEOUS COMMODITY 1
?.79

ENTER LOSS AND DAMAGE PER TON FOR MISCELLANEOUS COMMODITY 1
?.12

ENTER PERCENT SHIPPED BY RAIL UNDER REHABILITATION FOR MISCELLANEOUS COMMODITY 1
?70

ENTER NUMBER OF TRUCK MILES FROM ORIGIN TO DESTINATION FOR MISCELLANEOUS COMMODITY 1
?390

ENTER TRUCK COST PER MILE FACTORED FOR BACKHAUL FOR MISCELLANEOUS COMMODITY 1
?1.10

ENTER PERCENT FLEXIBLE HIGHWAY AND NUMBER OF TRIPS A TRUCK CAN MAKE
IN 260 DAYS FOR MISCELLANEOUS COMMODITY 1
?9,150
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ESTIMATION OF THE ECONOMIC VIABILITY OF REHABILITATING THE ABC TO XYZ
BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

LENGTH OF BRANCH LINE (IN MILES): 53.40

NUMBER OF SHIPPING POINTS ON THE BRANCH LINE : 5.00
YEAR OF SERVICE REMAINING PRIOR TO ABANDOMENT: 5.0

WEIGHTED MIDPOINTS OF THE BRANCH LINE (IN MILES):
CURRENT: 30.70

REHABILITATION:
SINGLE CARS ONLY: 30.40
SINGLE CARS UNDER MULTIPLE CAR SCENARIO: 30.80
MULTIPLE CARS UNDER MULTIPLE CAR SCENARIO: 30.30

LENGTH OF WAY TRAIN MOVEMENTS (IN MILES): 56.30

LENGTH OF THROUGH TRAIN MOVEMENTS FOR GRAIN (IN MILES):
MINNEAPOLIS: 238.00 DULUTH: 265.00
OMAHA: 406.00 PACIFIC NORTHWEST: 1518.00

AVERAGE WEIGHT OF OTHER GRAIN SHIPMENTS (LBS): 55.50
CURRENT CREW SIZE: 4.00
CURRENT AVERAGE TRAIN SPEED: 20.00
PROPERTY TAX ON BRANCH LINE: 8727.00

CURRENT CARRYING CAPACITY OF BRANCH LINE (TONS): 100.00
NUMBER OF TIMES/WEEK BRANCH LINE IS CURRENTLY SERVED: 1.00
CURRENT ANNUAL MAINTENANCE COST PER MILE: 7000.00
WIDTH OF RIGHT OF WAY (IN FEET): 50.00

AVERAGE LAND VALUE ADJACENT TO BRANCH LINE (PER ACRE): 600.00

WEIGHT OF RAIL (IN POUNDS):	CURRENT:	72.00	REHABILITATION:	90.00
NET SALVAGE VALUE OF RAIL (IN DOLLARS PER TON):	CURRENT:	40.00	REHABILITATION:	50.00
PERCENT RESUABLE TIES:	CURRENT:	70.00	REHABILITATION:	95.00
NET VALUE OF REUSABLE TIES (IN DOLLARS PER TIE):	CURRENT:	4.00	REHABILITATION:	4.00

RECOVERY COST (DOLLARS PER MILE): 11800.00
PERCENT OF GRAIN SHIPMENTS BY RAIL, REHABILITATION: 0.95
REHABILITATION COST PER MILE: 132000.00
RAIL COST OF CAPITAL (PERCENT): 16.50
COST OF CAPITAL FOR DISCOUNTING PUBLIC BENEFITS (PERCENT): 11.70

SINGLE CAR SHIPMENTS UNDER BOTH BASE CASE AND REHABILITATION ALTERNATIVE
FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

	TOTAL COMMODITY SHIPMENTS, BY CARRIER (IN CWTS.)						TOTAL RAIL REVENUE AND COSTS (IN 1983 DOLLARS)					
	BASE			REHABILITATION			BASE			REHABILITATION		
YEAR	TRUCK	RAIL	TOTAL	TRUCK	RAIL	TOTAL	REVENUE	COST	DIFFERENCE	REVENUE	COST	DIFFERENCE
1983	771768.	2295029.	3066797.	142545.	2924252.	3066797.	2187522.	2675540.	-488018.	2780259.	2888783.	-108524.
1984	785350.	2336804.	3122154.	145072.	2977082.	3122154.	2225385.	2705135.	-479750.	[illegible]	[illegible]	[illegible]
1985	798117.	2370754.	3168871.	147226.	3021645.	3168871.	2256982.	2728370.	-471388.	2867710.	2955064.	-87354.
1986	811025.	2405027.	3216052.	149387.	3066665.	3216052.	2288865.	2752393.	-463528.	2908591.	2985895.	-77304.
1987	824102.	2439429.	3263531.	151569.	3111962.	3263531.	2320966.	2775870.	-454904.	2949322.	3016002.	[illegible]
1988	3310678.	0.	3310678.	153739.	3156939.	3310678.	0.	0.	0.	2990700.	3045536.	[illegible]
1989	3358521.	0.	3358521.	155927.	3202594.	3358521.	0.	0.	0.	3032339.	3076508.	[illegible]
1990	3408137.	0.	3408137.	158112.	3250025.	3408137.	0.	0.	0.	3072683.	3104431.	-31748.
1991	3458021.	0.	3458021.	160295.	3297726.	3458021.	0.	0.	0.	3113340.	[illegible]	-21048.
1992	3507875.	0.	3507875.	162489.	3345386.	3507875.	0.	0.	0.	3153904.	3161142.	-7238.
1993	3558153.	0.	3558153.	164693.	3393460.	3558153.	0.	0.	0.	3195036.	3189207.	5829.
1994	3608857.	0.	3608857.	166910.	3441947.	3608857.	0.	0.	0.	3236602.	3218467.	18135.
1995	3659003.	0.	3659003.	169111.	3489892.	3659003.	0.	0.	0.	3277510.	3245866.	31644.
1996	3709591.	0.	3709591.	171329.	3538262.	3709591.	0.	0.	0.	3318921.	3274576.	44345.
1997	3760377.	0.	3760377.	173544.	3586833.	3760377.	0.	0.	0.	3360540.	3302224.	58316.
1998	3811155.	0.	3811155.	175772.	3635383.	3811155.	0.	0.	0.	3402177.	3336080.	66097.
1999	3861999.	0.	3861999.	177994.	3684005.	3861999.	0.	0.	0.	3443868.	[illegible]	[illegible]
2000	3913603.	0.	3913603.	180244.	3733359.	3913603.	0.	0.	0.	3486322.	3408585.	77737.
2001	3964215.	0.	3964215.	182462.	3781753.	3964215.	0.	0.	0.	3527811.	3441392.	86419.
2002	4015406.	0.	4015406.	184698.	3830708.	4015406.	0.	0.	0.	3569859.	3476644.	93215.
2003	4066710.	0.	4066710.	186938.	3879772.	4066710.	0.	0.	0.	3612049.	3512033.	[illegible]
2004	4118214.	0.	4118214.	189189.	3929025.	4118214.	0.	0.	0.	3654427.	3547576.	[illegible]
2005	4169550.	0.	4169550.	191429.	3978121.	4169550.	0.	0.	0.	3696667.	3583014.	[illegible]
2006	4220989.	0.	4220989.	193668.	4027321.	4220989.	0.	0.	0.	3738998.	[illegible]	[illegible]
2007	4272419.	0.	4272419.	195915.	4076504.	4272419.	0.	0.	0.	3781316.	3654043.	127273.

PRIMARY EFFICIENCY BENEFITS FOR SINGLE CAR SHIPMENTS UNDER BOTH BASE CASE AND REHABILITATION ALTERNATIVE FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	ANNUAL QUANTITY SHIPPED, BASE CASE	SHIPPING COST BASE	SHIPPING COST REHAB.	SHIPPING COST DIFF.	COST SAVINGS	SHIPPING RATE BASE	SHIPPING RATE REHAB.	SHIPPING RATE DIFF.	CHANGE IN QUANTITY SHIPPED	CONSUMER SURPLUS	RATE-COST REHAB.	PRODUCERS SURPLUS	PRIMARY EFFICIENCY BENEFITS	CUMULATIVE DISCOUNTED PRIMARY EFFICIENCY BENEFITS
	(CWTS.)	($/CWTS)			($)	($/CWTS)			(CWTS.)	($)	($/CWTS)	($)	($)	($)
1983	2295029.	1.17	0.99	0.18	408347.	0.95	0.95	0.00	629223.	754.	-0.04	-23352.	385749.	345544.
1984	2336804.	1.16	0.98	0.18	409003.	0.95	0.95	0.00	640278.	844.	-0.03	-21073.	388775.	[illegible]
1985	2370754.	1.15	0.98	0.17	409854.	0.95	0.95	0.00	650891.	961.	-0.03	-18817.	391999.	[illegible]
1986	2405027.	1.14	0.97	0.17	410709.	0.95	0.95	0.00	661638.	1074.	-0.03	-16679.	395105.	[illegible]
1987	2439429.	1.14	0.97	0.17	411662.	0.95	0.95	0.00	672533.	1191.	-0.02	-14302.	398350.	[illegible]
1988	2473642.	1.29	0.96	0.33	804397.	1.03	0.95	0.08	683297.	28330.	-0.02	-11869.	820658.	[illegible]
1989	2508247.	1.29	0.96	0.33	826182.	1.03	0.95	0.08	694347.	28658.	-0.01	-9576.	845264.	[illegible]
1990	2549104.	1.29	0.96	0.33	849581.	1.03	0.95	0.08	700921.	28645.	-0.01	-6847.	871379.	[illegible]
1991	2590101.	1.29	0.95	0.34	871976.	1.03	0.94	0.08	707625.	28657.	-0.01	-4516.	896116.	[illegible]
1992	2631123.	1.29	0.94	0.34	896726.	1.02	0.94	0.08	714263.	28664.	-0.00	-1545.	923844.	[illegible]
1993	2672296.	1.28	0.94	0.34	921400.	1.02	0.94	0.08	721164.	28704.	0.00	1239.	951343.	[illegible]
1994	2713744.	1.28	0.94	0.35	945835.	1.02	0.94	0.08	728203.	28765.	0.01	3887.	978437.	[illegible]
1995	2754915.	1.28	0.93	0.35	970570.	1.02	0.94	0.08	734977.	28788.	0.01	6664.	1006022.	[illegible]
1996	2796323.	1.28	0.93	0.36	995139.	1.02	0.94	0.08	741939.	28840.	0.01	9299.	1033278.	[illegible]
1997	2837860.	1.28	0.92	0.36	1020792.	1.01	0.94	0.08	748973.	28894.	0.02	12177.	1061862.	[illegible]
1998	2879364.	1.28	0.92	0.36	1041740.	1.01	0.94	0.08	756019.	28965.	0.02	13746.	1084450.	[illegible]
1999	2920924.	1.28	0.92	0.36	1061821.	1.01	0.93	0.08	763081.	29031.	0.02	15091.	1105942.	[illegible]
2000	2962976.	1.28	0.91	0.37	1082224.	1.01	0.93	0.08	770383.	29101.	0.02	16454.	1127779.	[illegible]
2001	3004346.	1.28	0.91	0.37	1102441.	1.01	0.93	0.08	777407.	29192.	0.02	17765.	1149396.	[illegible]
2002	3046115.	1.28	0.91	0.37	1122787.	1.01	0.93	0.07	784593.	29274.	0.02	19092.	1171152.	[illegible]
2003	3087938.	1.28	0.91	0.37	1143287.	1.01	0.93	0.07	791834.	29367.	0.03	20413.	1193065.	[illegible]
2004	3129896.	1.27	0.90	0.37	1163848.	1.00	0.93	0.07	799129.	29460.	0.03	21733.	1215039.	[illegible]
2005	3171728.	1.27	0.90	0.37	1184439.	1.00	0.93	0.07	806393.	29560.	0.03	23036.	1237036.	[illegible]
2006	3213640.	1.27	0.90	0.37	1205064.	1.00	0.93	0.07	813681.	29663.	0.03	24339.	1259064.	[illegible]
2007	3255537.	1.27	0.90	0.38	1225708.	1.00	0.93	0.07	820967.	29768.	0.03	25632.	1281107.	[illegible]

NET PRESENT VALUE = CUMM: DISCOUNTED PRIMARY EFFICIENCY BENEFITS - NET REHABILITATION COST = -1015749.
BENEFIT/COST RATIO = 0.85

SECONDARY IMPACT ON HOUSEHOLD INCOME AND GROSS BUSINESS VOLUME DUE TO REHABILITATION OF
ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007 .
(SINGLE CAR SHIPMENTS UNDER BOTH BASE CASE AND REHABILITATION ALTERNATIVE)

		CHANGE IN HOUSEHOLD INCOME		CHANGE IN GROSS BUSINESS VOLUME	
YEAR	CONSUMER SURPLUS	HOUSEHOLD INCOME	CUMMULATIVE DISCOUNTED INCREASE	GROSS BUSINESS VOLUME	CUMMULATIVE DISCOUNTED INCREASE
1983	754.	1169.	1047.	2323.	2080.
1984	844.	1309.	2096.	2600.	4164.
1985	961.	1490.	3165.	2961.	6289.
1986	1074.	1665.	4234.	3308.	8414.
1987	1191.	1845.	5295.	3667.	10522.
1988	28330.	43911.	27903.	87256.	55446.
1989	28658.	44420.	48378.	88267.	96131.
1990	28645.	44399.	66699.	88226.	132537.
1991	28657.	44418.	83108.	88263.	165143.
1992	28664.	44429.	97802.	88285.	194342.
1993	28704.	44492.	110975.	88410.	220519.
1994	28765.	44586.	122794.	88598.	244003.
1995	28788.	44621.	133383.	88667.	265045.
1996	28840.	44702.	142880.	88827.	283916.
1997	28894.	44785.	151398.	88993.	300842.
1998	28965.	44896.	159043.	89212.	316033.
1999	29031.	44999.	165902.	89417.	329664.
2000	29101.	45107.	172058.	89631.	341896.
2001	29192.	45247.	177586.	89910.	352881.
2002	29274.	45375.	182549.	90164.	362743.
2003	29367.	45518.	187007.	90449.	371600.
2004	29460.	45662.	191010.	90735.	379555.
2005	29560.	45818.	194606.	91045.	386700.
2006	29663.	45977.	197836.	91361.	393120.
2007	29768.	46141.	200738.	91686.	398887.

SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 3 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE
FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

	TOTAL COMMODITY SHIPMENTS, BY CARRIER (IN CWTS.)						TOTAL RAIL REVENUE AND COSTS (IN 1983 DOLLARS)					
	BASE			REHABILITATION			BASE			REHABILITATION		
YEAR	TRUCK	RAIL	TOTAL	TRUCK	RAIL	TOTAL	REVENUE	COST	DIFFERENCE	REVENUE	COST	DIFFERENCE
1983	771768.	2295029.	3066797.	142545.	2924252.	3066797.	2187522.	2675540.	-488018.	2707158.	[illegible]	[illegible]
1984	785350.	2336804.	3122154.	145072.	2977082.	3122154.	2225385.	2705135.	-479750.	2752780.	[illegible]	[illegible]
1985	798117.	2370754.	3168871.	147226.	3021645.	3168871.	2256982.	2728370.	-471388.	2792042.	2949727.	[illegible]
1986	811025.	2405027.	3216052.	149387.	3066665.	3216052.	2288865.	2752393.	-463528.	2831752.	[illegible]	[illegible]
1987	824102.	2439429.	3263531.	151569.	3111962.	3263531.	2320966.	2775870.	-454904.	2871608.	[illegible]	[illegible]
1988	3310678.	0.	3310678.	153739.	3156939.	3310678.	0.	0.	0.	2911510.	[illegible]	[illegible]
1989	3358521.	0.	3358521.	155927.	3202594.	3358521.	0.	0.	0.	2951966.	[illegible]	[illegible]
1990	3408137.	0.	3408137.	158112.	3250025.	3408137.	0.	0.	0.	2991008.	[illegible]	[illegible]
1991	3458021.	0.	3458021.	160295.	3297726.	3458021.	0.	0.	0.	3030342.	[illegible]	[illegible]
1992	3507875.	0.	3507875.	162489.	3345386.	3507875.	0.	0.	0.	3069593.	[illegible]	[illegible]
1993	3558153.	0.	3558153.	164693.	3393460.	3558153.	0.	0.	0.	3109405.	3181975.	-72570.
1994	3608857.	0.	3608857.	166910.	3441947.	3608857.	0.	0.	0.	3149636.	[illegible]	[illegible]
1995	3659003.	0.	3659003.	169111.	3489892.	3659003.	0.	0.	0.	3189224.	3238122.	[illegible]
1996	3709591.	0.	3709591.	171329.	3538262.	3709591.	0.	0.	0.	3229311.	3266581.	[illegible]
1997	3760377.	0.	3760377.	173544.	3586833.	3760377.	0.	0.	0.	3269595.	[illegible]	[illegible]
1998	3811155.	0.	3811155.	175772.	3635383.	3811155.	0.	0.	0.	3309658.	[illegible]	[illegible]
1999	3861999.	0.	3861999.	177994.	3684005.	3861999.	0.	0.	0.	[illegible]	[illegible]	[illegible]
2000	3913603.	0.	3913603.	180244.	3733359.	3913603.	0.	0.	0.	3391364.	[illegible]	[illegible]
2001	3964215.	0.	3964215.	182462.	3781753.	3964215.	0.	0.	0.	3431524.	[illegible]	-1111.
2002	4015406.	0.	4015406.	184698.	3830708.	4015406.	0.	0.	0.	3472233.	[illegible]	[illegible]
2003	4066710.	0.	4066710.	186938.	3879772.	4066710.	0.	0.	0.	3513083.	[illegible]	[illegible]
2004	4118214.	0.	4118214.	189189.	3929025.	4118214.	0.	0.	0.	3554121.	[illegible]	[illegible]
2005	4169550.	0.	4169550.	191429.	3978121.	4169550.	0.	0.	0.	3595017.	[illegible]	[illegible]
2006	4220989.	0.	4220989.	193668.	4027321.	4220989.	0.	0.	0.	3636002.	[illegible]	[illegible]
2007	4272419.	0.	4272419.	195915.	4076504.	4272419.	0.	0.	0.	3676977.	[illegible]	[illegible]

PRIMARY EFFICIENCY BENEFITS FOR SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 3 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	ANNUAL QUANTITY SHIPPED, BASE CASE	SHIPPING COST BASE	SHIPPING COST REHAB.	SHIPPING COST DIFF.	COST SAVINGS	SHIPPING RATE BASE	SHIPPING RATE REHAB.	SHIPPING RATE DIFF.	CHANGE IN QUANTITY SHIPPED	CONSUMER SURPLUS	RATE-COST REHAB.	PRODUCERS SURPLUS	PRIMARY EFFICIENCY BENEFITS	CUMMULATIVE DISCOUNTED PRIMARY EFFICIENCY BENEFITS
	(CWTS.)	($/CWTS)	($/CWTS)	($/CWTS)	($)	($/CWTS)	($/CWTS)	($/CWTS)	(CWTS.)	($)	($/CWTS)	($)	($)	($)
1983	2295029.	1.17	0.99	0.18	412192.	0.95	0.93	0.03	629223.	8619.	-0.06	-38027.	382784.	342670.
1984	2336804.	1.16	0.98	0.18	413018.	0.95	0.92	0.03	640278.	8856.	-0.06	-35996.	385878.	651564.
1985	2370754.	1.15	0.98	0.17	414042.	0.95	0.92	0.03	650891.	9111.	-0.05	-33967.	389186.	951217.
1986	2405027.	1.14	0.97	0.17	415059.	0.95	0.92	0.03	661638.	9363.	-0.05	-32060.	392362.	[illegible]
1987	2439429.	1.14	0.97	0.17	416194.	0.95	0.92	0.03	672533.	9620.	-0.04	-29913.	395901.	[illegible]
1988	2473642.	1.29	0.96	0.33	809111.	1.03	0.92	0.11	683297.	36900.	-0.04	-27707.	818305.	[illegible]
1989	2508247.	1.29	0.96	0.33	831069.	1.03	0.92	0.11	694347.	37371.	-0.04	-25649.	842791.	[illegible]
1990	2549104.	1.29	0.95	0.34	854669.	1.03	0.92	0.11	700921.	37453.	-0.03	-23064.	869058.	[illegible]
1991	2590101.	1.29	0.95	0.34	877233.	1.03	0.92	0.11	707625.	37562.	-0.03	-20890.	893905.	[illegible]
1992	2631123.	1.29	0.94	0.34	902210.	1.02	0.92	0.11	714263.	37664.	-0.03	-18058.	921817.	3214419.
1993	2672296.	1.28	0.94	0.35	927095.	1.02	0.92	0.10	721164.	37803.	-0.02	-15422.	949476.	[illegible]
1994	2713744.	1.28	0.93	0.35	951728.	1.02	0.92	0.10	728203.	37965.	-0.02	-12981.	976712.	[illegible]
1995	2754915.	1.28	0.93	0.35	976683.	1.02	0.91	0.10	734977.	38085.	-0.01	-10298.	1004469.	[illegible]
1996	2796323.	1.28	0.92	0.36	1001458.	1.02	0.91	0.10	741939.	38235.	-0.01	-7815.	1031878.	[illegible]
1997	2837860.	1.28	0.92	0.36	1027338.	1.01	0.91	0.10	748973.	38389.	-0.01	-5086.	1060640.	[illegible]
1998	2879364.	1.28	0.92	0.36	1048403.	1.01	0.91	0.10	756019.	38560.	-0.00	-3695.	1083267.	[illegible]
1999	2920924.	1.28	0.91	0.37	1068581.	1.01	0.91	0.10	763081.	38727.	-0.00	-2534.	1104773.	[illegible]
2000	2962976.	1.28	0.91	0.37	1089084.	1.01	0.91	0.10	770383.	38898.	-0.00	-1357.	1126625.	[illegible]
2001	3004346.	1.28	0.91	0.37	1109398.	1.01	0.91	0.10	777407.	39088.	-0.00	-228.	1148257.	[illegible]
2002	3046115.	1.28	0.91	0.37	1129841.	1.01	0.91	0.10	784593.	39272.	0.00	913.	1170025.	[illegible]
2003	3087938.	1.28	0.90	0.37	1150440.	1.01	0.91	0.10	791834.	39466.	0.00	2048.	1191953.	[illegible]
2004	3129896.	1.27	0.90	0.37	1171099.	1.00	0.90	0.10	799129.	39660.	0.00	3182.	1213941.	[illegible]
2005	3171728.	1.27	0.90	0.38	1191788.	1.00	0.90	0.10	806393.	39863.	0.01	4302.	1235951.	[illegible]
2006	3213640.	1.27	0.90	0.38	1212512.	1.00	0.90	0.10	813681.	40067.	0.01	5415.	1257994.	5597196.
2007	3255537.	1.27	0.89	0.38	1233254.	1.00	0.90	0.10	820967.	40275.	0.01	6522.	1280049.	5677716.

NET PRESENT VALUE = CUMM. DISCOUNTED PRIMARY EFFICIENCY BENEFITS - NET REHABILITATION COST = -1034066.
BENEFIT/COST RATIO = 0.85

SECONDARY IMPACT ON HOUSEHOLD INCOME AND GROSS BUSINESS VOLUME DUE TO REHABILITATION OF
ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007
(SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 3 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE)

		CHANGE IN HOUSEHOLD INCOME		CHANGE IN GROSS BUSINESS VOLUME	
YEAR	CONSUMER SURPLUS	HOUSEHOLD INCOME	CUMMULATIVE DISCOUNTED INCREASE	GROSS BUSINESS VOLUME	CUMMULATIVE DISCOUNTED INCREASE
1983	8619.	13359.	11960.	26547.	23766.
1984	8856.	13727.	22962.	27276.	45627.
1985	9111.	14122.	33095.	28063.	65763.
1986	9363.	14513.	42418.	28838.	84288.
1987	9620.	14912.	50993.	29631.	101329.
1988	36900.	57195.	80440.	113652.	159842.
1989	37371.	57925.	107139.	115102.	212896.
1990	37453.	58051.	131094.	115354.	260496.
1991	37562.	58221.	152602.	115690.	303235.
1992	37664.	58380.	171910.	116006.	341601.
1993	37803.	58595.	189259.	116434.	376076.
1994	37965.	58846.	204857.	116932.	407071.
1995	38085.	59031.	218866.	117301.	434908.
1996	38235.	59264.	231457.	117764.	459927.
1997	38389.	59503.	242774.	118238.	482416.
1998	38560.	59768.	252951.	118765.	502638.
1999	38727.	60027.	262102.	119278.	520821.
2000	38898.	60292.	270330.	119807.	537172.
2001	39088.	60587.	277732.	120392.	551881.
2002	39272.	60871.	284390.	120957.	565111.
2003	39466.	61172.	290381.	121555.	577015.
2004	39660.	61473.	295770.	122153.	587723.
2005	39863.	61787.	300619.	122777.	597359.
2006	40067.	62104.	304983.	123407.	606030.
2007	40275.	62426.	308910.	124046.	613833.

SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 26 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE
FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

	TOTAL COMMODITY SHIPMENTS, BY CARRIER (IN CWTS.)						TOTAL RAIL REVENUE AND COSTS (IN 1983 DOLLARS)					
	BASE			REHABILITATION			BASE			REHABILITATION		
YEAR	TRUCK	RAIL	TOTAL	TRUCK	RAIL	TOTAL	REVENUE	COST	DIFFERENCE	REVENUE	COST	DIFFERENCE
1983	771768.	2295029.	3066797.	142545.	2924252.	3066797.	2187522.	2675540.	-488018.	2486085.	2516566.	-30481.
1984	785350.	2336804.	3122154.	145072.	2977082.	3122154.	2225385.	2705135.	-479750.	2527657.	2552368.	[illegible]
1985	798117.	2370754.	3168871.	147226.	3021645.	3168871.	2256982	2728370.	-471388.	2563555.	[illegible]	[illegible]
1986	811025.	2405027.	3216052.	149387.	3066665.	3216052.	2288865	2752393.	-463528.	2599871.	[illegible]	[illegible]
1987	824102.	2439429.	3263531.	151569.	3111962.	3263531.	2320966.	2775870.	-454904.	2636505.	2645481.	[illegible]
1988	3310678.	0.	3310678.	153739.	3156939.	3310678.	0.	0.	0.	2672810.	2676398.	[illegible]
1989	3358521.	0.	3358521.	155927.	3202594.	3358521.	0.	0.	0.	2709813.	2708111.	[illegible]
1990	3408137.	0.	3408137.	158112.	3250025.	3408137.	0.	0.	0.	2745081.	[illegible]	[illegible]
1991	3458021.	0.	3458021.	160295.	3297726.	3458021.	0.	0.	0.	2780524.	2768036.	[illegible]
1992	3507875.	0.	3507875.	162489.	3345386.	3507875.	0.	0.	0.	2815936.	2797624.	[illegible]
1993	3558153.	0.	3558153.	164693.	3393460.	3558153.	0.	0.	0.	2851875.	2827879.	[illegible]
1994	3608857.	0.	3608857.	166910.	3441947.	3608857.	0.	0.	0.	2888199.	2858659.	29540.
1995	3659003.	0.	3659003.	169111.	3489892.	3659003.	0.	0.	0.	2923928.	2888608.	35320.
1996	3709591.	0.	3709591.	171329.	3538262.	3709591.	0.	0.	0.	2960117.	2919177.	40940.
1997	3760377.	0.	3760377.	173544.	3586833.	3760377.	0.	0.	0.	2996492.	[illegible]	[illegible]
1998	3811155.	0.	3811155.	175772.	3635383.	3811155.	0.	0.	0.	3032879.	[illegible]	[illegible]
1999	3861999.	0.	3861999.	177994.	3684005.	3861999.	0.	0.	0.	3069318.	3013332.	[illegible]
2000	3913603.	0.	3913603.	180244.	3733359.	3913603.	0.	0.	0.	3106465.	3045874.	60571.
2001	3964215.	0.	3964215.	182462.	3781753.	3964215.	0.	0.	0.	3142722.	3077703.	65019.
2002	4015406.	0.	4015406.	184698.	3830708.	4015406.	0.	0.	0.	3179489.	3109947.	[illegible]
2003	4066710.	0.	4066710.	186938.	3879772.	4066710.	0.	0.	0.	3216380.	3142313.	[illegible]
2004	4118214.	0.	4118214.	189189.	3929025.	4118214.	0.	0.	0.	3253458.	3174834.	78624.
2005	4169550.	0.	4169550.	191429.	3978121.	4169550.	0.	0.	0.	3290393.	3207249.	83144.
2006	4220989.	0.	4220989.	193668.	4027321.	4220989.	0.	0.	0.	3327421.	[illegible]	[illegible]
2007	4272419.	0.	4272419.	195915.	4076504.	4272419.	0.	0.	0.	3364435.	[illegible]	[illegible]

PRIMARY EFFICIENCY BENEFITS FOR SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 26 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	ANNUAL QUANTITY SHIPPED, BASE CASE	SHIPPING COST BASE	SHIPPING COST REHAB.	SHIPPING COST DIFF.	COST SAVINGS	SHIPPING RATE BASE	SHIPPING RATE REHAB.	SHIPPING RATE DIFF.	CHANGE IN QUANTITY SHIPPED	CONSUMER SURPLUS	RATE-COST REHAB.	PRODUCERS SURPLUS	PRIMARY EFFICIENCY BENEFITS	CUMMULATIVE DISCOUNTED PRIMARY EFFICIENCY BENEFITS
	(CWTS.)	- - -($/CWTS)		- - -	($)	- - -($/CWTS)-		- -	(CWTS.)	($)	($/CWTS)	($)	($)	($)
1983	2295029.	1.17	0.86	0.31	700472.	0.95	0.85	0.10	629223.	32404.	-0.01	-6559.	726317.	[illegible]
1984	2336804.	1.16	0.86	0.30	701702.	0.95	0.85	0.10	640278.	33064.	-0.01	-5315.	729451.	[illegible]
1985	2370754.	1.15	0.85	0.30	701728.	0.95	0.85	0.10	650891.	33720.	-0.01	-4201.	731246.	[illegible]
1986	2405027.	1.14	0.85	0.29	702209.	0.95	0.85	0.10	661638.	34377.	-0.00	-3092.	733494.	[illegible]
1987	2439429.	1.14	0.85	0.29	702109.	0.95	0.85	0.10	672533.	35046.	-0.00	-1940.	735215.	[illegible]
1988	2473642.	1.29	0.85	0.44	1093637.	1.03	0.85	0.18	683297.	62732.	-0.00	-777.	1155592.	[illegible]
1989	2508247.	1.29	0.85	0.44	1114707.	1.03	0.85	0.18	694347.	63621.	0.00	369.	1178697.	[illegible]
1990	2549104.	1.29	0.84	0.45	1137171.	1.03	0.84	0.18	700921.	63977.	0.00	1567.	1202714.	[illegible]
1991	2590101.	1.29	0.84	0.45	1159716.	1.03	0.84	0.18	707625.	64365.	0.00	2680.	1226759.	[illegible]
1992	2631123.	1.29	0.84	0.45	1182630.	1.02	0.84	0.18	714263.	64743.	0.01	3910.	1251282.	[illegible]
1993	2672296.	1.28	0.83	0.45	1205940.	1.02	0.84	0.18	721164.	65168.	0.01	5100.	1276207.	[illegible]
1994	2713744.	1.28	0.83	0.45	1229519.	1.02	0.84	0.18	728203.	65621.	0.01	6250.	1301388.	[illegible]
1995	2754915.	1.28	0.83	0.45	1252588.	1.02	0.84	0.18	734977.	66020.	0.01	7438.	1324046.	[illegible]
1996	2796323.	1.28	0.83	0.46	1276014.	1.02	0.84	0.18	741939.	66459.	0.01	8585.	1351056.	[illegible]
1997	2837860.	1.28	0.82	0.46	1299731.	1.01	0.84	0.18	748973.	66903.	0.01	9778.	1376410.	[illegible]
1998	2879364.	1.28	0.82	0.46	1322672.	1.01	0.83	0.18	756019.	67365.	0.01	10709.	1400744.	[illegible]
1999	2920924.	1.28	0.82	0.46	1345414.	1.01	0.83	0.18	763081.	67822.	0.02	11597.	1424832.	[illegible]
2000	2962976.	1.28	0.82	0.46	1368500.	1.01	0.83	0.18	770383.	68293.	0.02	12503.	1449296.	[illegible]
2001	3004346.	1.28	0.81	0.46	1391367.	1.01	0.83	0.18	777407.	68773.	0.02	13366.	1473504.	[illegible]
2002	3046115.	1.28	0.81	0.46	1414379.	1.01	0.83	0.18	784593.	69251.	0.02	14243.	1497873.	[illegible]
2003	3087938.	1.28	0.81	0.47	1437546.	1.01	0.83	0.18	791834.	69743.	0.02	15116.	1522404.	[illegible]
2004	3129896.	1.27	0.81	0.47	1460778.	1.00	0.83	0.18	799129.	70236.	0.02	15991.	1547005.	[illegible]
2005	3171728.	1.27	0.81	0.47	1484033.	1.00	0.83	0.18	806393.	70737.	0.02	16854.	1571623.	[illegible]
2006	3213640.	1.27	0.80	0.47	1507325.	1.00	0.83	0.18	813681.	71240.	0.02	17715.	1596280.	[illegible]
2007	3255537.	1.27	0.80	0.47	1530633.	1.00	0.83	0.17	820967.	71746.	0.02	18571.	1620949.	[illegible]

NET PRESENT VALUE = CUMM. DISCOUNTED PRIMARY EFFICIENCY BENEFITS - NET REHABILITATION COST = 1649235.
BENEFIT/COST RATIO = 1.25

SECONDARY IMPACT ON HOUSEHOLD INCOME AND GROSS BUSINESS VOLUME DUE TO REHABILITATION OF
ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007
(SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 26 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE)

		CHANGE IN HOUSEHOLD INCOME		CHANGE IN GROSS BUSINESS VOLUME	
YEAR	CONSUMER SURPLUS	HOUSEHOLD INCOME	CUMMULATIVE DISCOUNTED INCREASE	GROSS BUSINESS VOLUME	CUMMULATIVE DISCOUNTED INCREASE
1983	32404.	50226.	44965.	99803.	89349.
1984	33064.	51250.	86041.	101838.	170971.
1985	33720.	52267.	123544.	103859.	245493.
1986	34377.	53285.	157772.	105882.	313509.
1987	35046.	54322.	189012.	107943.	375586.
1988	62732.	97235.	239074.	193216.	475063.
1989	63621.	98613.	284527.	195953.	565363.
1990	63977.	99164.	325446.	197048.	646694.
1991	64365.	99765.	362302.	198243.	719929.
1992	64743.	100352.	395491.	199409.	785879.
1993	65168.	101010.	425399.	200718.	845309.
1994	65621.	101712.	452360.	202112.	898883.
1995	66020.	102332.	476644.	203343.	947138.
1996	66459.	103011.	498529.	204693.	990626.
1997	66903.	103699.	518252.	206060.	1029818.
1998	67365.	104415.	536032.	207483.	1065147.
1999	67822.	105125.	552057.	208893.	1096990.
2000	68293.	105854.	566503.	210342.	1125696.
2001	68773.	106598.	579527.	211820.	1151575.
2002	69251.	107339.	591268.	213293.	1174905.
2003	69743.	108102.	601854.	214809.	1195940.
2004	70236.	108866.	611398.	216328.	1214904.
2005	70737.	109643.	620003.	217871.	1232003.
2006	71240.	110422.	627762.	219420.	1247420.
2007	71746.	111206.	634757.	220978.	1261320.

SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 52 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE
FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

	TOTAL COMMODITY SHIPMENTS, BY CARRIER (IN CWTS.)						TOTAL RAIL REVENUE AND COSTS (IN 1983 DOLLARS)					
	BASE			REHABILITATION			BASE			REHABILITATION		
YEAR	TRUCK	RAIL	TOTAL	TRUCK	RAIL	TOTAL	REVENUE	COST	DIFFERENCE	REVENUE	COST	DIFFERENCE
1983	771768.	2295029.	3066797.	142545.	2924252.	3066797.	2187522.	2675540.	-488018.	2345526.	2324005.	21521.
1984	785350.	2336804.	3122154.	145072.	2977082.	3122154.	2225385.	2705135.	-479750.	2384500.	2354268.	30232.
1985	798117.	2370754.	3168871.	147226.	3021645.	3168871.	2256982.	2728370.	-471388.	2418236.	2380182.	38054.
1986	811025.	2405027.	3216052.	149387.	3066665.	3216052.	2288865.	2752393.	-463528.	2452380.	2403509.	48871.
1987	824102.	2439429.	3263531.	151569.	3111962.	3263531.	2320966.	2775870.	-454904.	2486824.	2432957.	53867.
1988	3310678.	0.	3310678.	153739.	3156939.	3310678.	0.	0.	0.	2520952.	2459037.	61915.
1989	3358521.	0.	3358521.	155927.	3202594.	3358521.	0.	0.	0.	2555747.	2485864.	69883.
1990	3408137.	0.	3408137.	158112.	3250025.	3408137.	0.	0.	0.	2588521.	2510828.	77693.
1991	3458021.	0.	3458021.	160295.	3297726.	3458021.	0.	0.	0.	2621559.	2536386.	85173.
1992	3507875.	0.	3507875.	162489.	3345386.	3507875.	0.	0.	0.	2654511.	2561263.	93248.
1993	3558153.	0.	3558153.	164693.	3393460.	3558153.	0.	0.	0.	2687966.	2586761.	101205.
1994	3608857.	0.	3608857.	166910.	3441947.	3608857.	0.	0.	0.	2721790.	2612743.	109047.
1995	3659003.	0.	3659003.	169111.	3489892.	3659003.	0.	0.	0.	2755054.	2637951.	117103.
1996	3709591.	0.	3709591.	171329.	3538262.	3709591.	0.	0.	0.	2788750.	2663733.	125017.
1997	3760377.	0.	3760377.	173544.	3586833.	3760377.	0.	0.	0.	2822624.	2689517.	133107.
1998	3811155.	0.	3811155.	175772.	3635383.	3811155.	0.	0.	0.	2856510.	2714328.	142182.
1999	3861999.	0.	3861999.	177994.	3684005.	3861999.	0.	0.	0.	2890451.	2743464.	146987.
2000	3913603.	0.	3913603.	180244.	3733359.	3913603.	0.	0.	0.	2925058.	2771174.	153884.
2001	3964215.	0.	3964215.	182462.	3781753.	3964215.	0.	0.	0.	2958616.	2798153.	160463.
2002	4015406.	0.	4015406.	184698.	3830708.	4015406.	0.	0.	0.	2993062.	2825556.	167506.
2003	4066710.	0.	4066710.	186938.	3879772.	4066710.	0.	0.	0.	3027468.	2853069.	174399.
2004	4118214.	0.	4118214.	189189.	3929025.	4118214.	0.	0.	0.	3061980.	2880707.	181273.
2005	4169550.	0.	4169550.	191429.	3978121.	4169550.	0.	0.	0.	3096389.	2908261.	188128.
2006	4220989.	0.	4220989.	193668.	4027321.	4220989.	0.	0.	0.	3130884.	2935879.	195005.
2007	4272419.	0.	4272419.	195915.	4076504.	4272419.	0.	0.	0.	3165371.	2963491.	201880.

PRIMARY EFFICIENCY BENEFITS FOR SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 52 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	ANNUAL QUANTITY SHIPPED, BASE CASE	SHIPPING COST BASE	SHIPPING COST REHAB.	SHIPPING COST DIFF.	COST SAVINGS	SHIPPING RATE BASE	SHIPPING RATE REHAB.	SHIPPING RATE DIFF.	CHANGE IN QUANTITY SHIPPED	CONSUMER SURPLUS	RATE-COST REHAB.	PRODUCERS SURPLUS	PRIMARY EFFICIENCY BENEFITS	CUMULATIVE DISCOUNTED PRIMARY EFFICIENCY BENEFITS
	(CWTS.)	- - -($/CWTS)		- - -	($)	- - -($/CWTS)		- -	(CWTS.)	($)	($/CWTS)	($)	($)	($)
1983	2295029.	1.17	0.79	0.37	851599.	0.95	0.80	0.15	629228.	47526.	0.01	4631.	903756.	[illegible]
1984	2336804.	1.16	0.79	0.37	857196.	0.95	0.80	0.15	640278.	48459.	0.01	6502.	912157.	1540170.
1985	2370754.	1.15	0.79	0.36	850901.	0.95	0.80	0.15	650891.	49372.	0.01	8197.	918470.	[illegible]
1986	2405027.	1.14	0.78	0.36	845092.	0.95	0.80	0.15	661635.	50288.	0.01	9897.	925276.	[illegible]
1987	2439429.	1.14	0.78	0.36	848719.	0.95	0.80	0.15	672533.	51220.	0.02	11646.	931585.	[illegible]
1988	2473642.	1.29	0.78	0.51	1263952.	1.03	0.80	0.23	683297.	79167.	0.02	13401.	1356517.	4027727.
1989	2508247.	1.29	0.78	0.51	1288769.	1.03	0.80	0.23	694347.	80323.	0.02	15151.	1384242.	4665737.
1990	2549104.	1.29	0.77	0.52	1315164.	1.03	0.80	0.23	700921.	80853.	0.02	16756.	1412772.	[illegible]
1991	2590101.	1.29	0.77	0.52	1341658.	1.03	0.79	0.23	707625.	81420.	0.03	18276.	1441354.	[illegible]
1992	2631123.	1.29	0.77	0.52	1368526.	1.02	0.79	0.23	714263.	81976.	0.03	19909.	1470410.	[illegible]
1993	2672296.	1.28	0.76	0.52	1395816.	1.02	0.79	0.23	721164.	82585.	0.03	21508.	1499907.	[illegible]
1994	2713744.	1.28	0.76	0.52	1423407.	1.02	0.79	0.23	728203.	83224.	0.03	23071.	1529701.	[illegible]
1995	2754915.	1.28	0.76	0.53	1450456.	1.02	0.79	0.23	734977.	83805.	0.03	24652.	1558521.	[illegible]
1996	2796323.	1.28	0.75	0.53	1477894.	1.02	0.79	0.23	741939.	84426.	0.04	26215.	1588553.	[illegible]
1997	2837860.	1.28	0.75	0.53	1505637.	1.01	0.79	0.23	748973.	85055.	0.04	27815.	1618507.	[illegible]
1998	2879364.	1.28	0.75	0.53	1532607.	1.01	0.79	0.23	756019.	85704.	0.04	29152.	1647462.	[illegible]
1999	2920924.	1.28	0.74	0.53	1559383.	1.01	0.78	0.23	763081.	86347.	0.04	30446.	1676175.	[illegible]
2000	2962976.	1.28	0.74	0.54	1586557.	1.01	0.78	0.23	770383.	87010.	0.04	31765.	1705330.	[illegible]
2001	3004346.	1.28	0.74	0.54	1613447.	1.01	0.78	0.23	777407.	87675.	0.04	33026.	1734148.	9113003.
2002	3046115.	1.28	0.74	0.54	1640522.	1.01	0.78	0.23	784593.	88343.	0.04	34308.	1763172.	[illegible]
2003	3087938.	1.28	0.74	0.54	1667761.	1.01	0.78	0.22	791834.	89024.	0.04	35588.	1792372.	9451878.
2004	3129896.	1.27	0.73	0.54	1695082.	1.00	0.78	0.22	799129.	89709.	0.05	36869.	1821659.	9641075.
2005	3171728.	1.27	0.73	0.54	1722414.	1.00	0.78	0.22	806393.	90400.	0.05	38135.	1850948.	[illegible]
2006	3213640.	1.27	0.73	0.54	1749794.	1.00	0.78	0.22	813681.	91094.	0.05	39599.	1880256.	[illegible]
2007	3255537.	1.27	0.73	0.55	1777189.	1.00	0.78	0.22	820967.	91791.	0.05	40657.	1909635.	10038563.

NET PRESENT VALUE = CUMM. DISCOUNTED PRIMARY EFFICIENCY BENEFITS - NET REHABILITATION COST = 3326801.
BENEFIT/COST RATIO = 1.50.

SECONDARY IMPACT ON HOUSEHOLD INCOME AND GROSS BUSINESS VOLUME DUE TO REHABILITATION OF
ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007
(SINGLE CAR SHIPMENTS UNDER BASE CASE, A MAXIMUM OF 52 CAR MULTIPLE SHIPMENTS UNDER REHABILITATION ALTERNATIVE)

		CHANGE IN HOUSEHOLD INCOME		CHANGE IN GROSS BUSINESS VOLUME	
YEAR	CONSUMER SURPLUS	HOUSEHOLD INCOME	CUMMULATIVE DISCOUNTED INCREASE	GROSS BUSINESS VOLUME	CUMMULATIVE DISCOUNTED INCREASE
1983	47526.	73665.	65949.	146380.	131047.
1984	48459.	75111.	126149.	149253.	250671.
1985	49372.	76527.	181059.	152066.	359783.
1986	50288.	77946.	231130.	154887.	459278.
1987	51220.	79391.	276787.	157758.	550004.
1988	79167.	122708.	339964.	243833.	675542.
1989	80323.	124500.	397349.	247393.	789571.
1990	80853.	125323.	449063.	249029.	892332.
1991	81420.	126201.	495655.	250774.	984973.
1992	81976.	127062.	537708.	252485.	1068477.
1993	82585.	128006.	575608.	254361.	1143789.
1994	83224.	128997.	609802.	256330.	1211735.
1995	83803.	129895.	640627.	258113.	1272987.
1996	84426.	130860.	668429.	260031.	1328231.
1997	85055.	131836.	693504.	261970.	1378057.
1998	85704.	132841.	716123.	263968.	1423004.
1999	86347.	133838.	736525.	265949.	1463545.
2000	87010.	134865.	754931.	267990.	1500118.
2001	87675.	135897.	771535.	270040.	1533111.
2002	88343.	136931.	786512.	272096.	1562873.
2003	89024.	137987.	800025.	274194.	1589723.
2004	89709.	139049.	812214.	276303.	1613945.
2005	90400.	140120.	823212.	278433.	1635797.
2006	91094.	141196.	833133.	280571.	1655510.
2007	91791.	142276.	842082.	282716.	1673293.

1 / ((1+.08)**.[illegible])

NET SAVINGS IN HIGHWAY IMPACTS AS A RESULT OF REHABILITATING VERSUS ABANDONING THE
ABC TO XYZ
BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	REDUCTION IN RESURFACING AND MAINTENANCE	REDUCTION IN FUEL TAX	REDUCTION IN LICENSE FEES	NET CHANGE	CUMMULATIVE DISCOUNTED NET CHANGE
1983	56101.	51088.	14339.	-9325.	-8349.
1984	56877.	51799.	14555.	-9477.	-15944.
1985	57620.	52480.	14762.	-9623.	-22849.
1986	58379.	53177.	14974.	-9772.	-29126.
1987	59150.	53883.	15190.	-9923.	-34833.
1988	309705.	280544.	76109.	-46948.	-59004.
1989	313556.	284042.	77136.	-47622.	-80954.
1990	317546.	287672.	78164.	-48290.	-100880.
1991	321582.	291344.	79201.	-48963.	-118968.
1992	325602.	295001.	80236.	-49634.	-135384.
1993	329703.	298730.	81288.	-50315.	-150281.
1994	333860.	302511.	82353.	-51004.	-163801.
1995	337918.	306202.	83397.	-51682.	-176065.
1996	342048.	309958.	84457.	-52368.	-187191.
1997	346198.	313732.	85523.	-53058.	-197285.
1998	350361.	317518.	86590.	-53748.	-206435.
1999	354523.	321304.	87659.	-54439.	-214733.
2000	358764.	325161.	88749.	-55145.	-222259.
2001	362921.	328941.	89812.	-55832.	-229081.
2002	367127.	332765.	90891.	-56529.	-235264.
2003	371353.	336609.	91974.	-57230.	-240868.
2004	375597.	340468.	93062.	-57934.	-245947.
2005	379832.	344319.	94147.	-58634.	-250549.
2006	384076.	348178.	95234.	-59336.	-254718.
2007	388320.	352037.	96322.	-60039.	-258494.

(A POSITIVE VALUE INDICATES HIGHWAY COSTS WILL BE REDUCED AT A GRATER RATE THAN TAX AND LICENSE FEE COLLECTIONS, WHILE A NEGATIVE VALUE INDICATES THE CONVERSE.)

NUMBER OF CARS, CAR DAYS AND LOCOMOTIVE UNITS ON-BRANCH, BASE CASE AND REHABILITATION ALTERNATIVE
FOR ABC TO XYZ BURLINGTON NORTHERN BRANCH LINE, 1983 TO 2007

YEAR	BASE CASE-SINGLE CARS ONLY: NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES	REHABILITATION ALTERNATIVE-SINGLE CARS ONLY: NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES
1983	28.93	1504.26	12034.08	2.50	130.00	21.00	2029.74	11724.47	1.88	182.10
1984	29.25	1521.05	12168.39	2.50	130.00	21.00	2051.93	11768.66	1.88	184.09
1985	29.44	1530.88	12247.07	2.50	130.00	21.00	2065.81	11796.62	1.88	185.33
1986	29.66	1542.52	12340.14	2.50	130.00	21.00	2082.21	11829.42	1.88	[illegible]
1987	29.84	1551.80	12414.37	2.50	130.00	21.00	2095.23	11855.47	1.88	187.97
1988	0.	0.	0.	2.50	0.	21.00	2107.38	11879.75	1.88	[illegible]
1989	0.	0.	0.	2.50	0.	21.00	2122.26	11909.52	1.88	[illegible]
1990	0.	0.	0.	2.50	0.	21.00	2130.28	11925.56	1.88	191.12
1991	0.	0.	0.	2.50	0.	21.00	2144.03	11953.07	1.88	[illegible]
1992	0.	0.	0.	2.50	0.	21.00	2147.82	11960.64	1.88	[illegible]
1993	0.	0.	0.	2.50	0.	21.00	2154.33	11973.66	1.88	193.27
1994	0.	0.	0.	2.50	0.	21.00	2163.67	11992.34	1.88	194.11
1995	0.	0.	0.	2.50	0.	21.00	2168.89	12002.78	1.88	194.53
1996	0.	0.	0.	2.50	0.	21.00	2177.04	12019.07	1.88	195.31
1997	0.	0.	0.	2.50	0.	21.00	2181.37	12027.73	1.88	195.70
1998	0.	0.	0.	2.50	0.	21.00	2205.64	12076.27	1.88	197.38
1999	0.	0.	0.	2.50	0.	21.00	2233.36	12131.72	1.88	[illegible]
2000	0.	0.	0.	2.50	0.	21.00	2261.57	12188.13	1.88	[illegible]
2001	0.	0.	0.	2.50	0.	21.00	2289.10	12243.20	1.88	[illegible]
2002	0.	0.	0.	2.50	0.	21.00	2317.02	12299.04	1.88	207.87
2003	0.	0.	0.	2.50	0.	21.00	2345.00	12355.00	1.88	[illegible]
2004	0.	0.	0.	2.50	0.	21.00	2373.11	12411.22	1.88	[illegible]
2005	0.	0.	0.	2.50	0.	21.00	2401.10	12467.19	1.88	215.41
2006	0.	0.	0.	2.50	0.	21.00	2429.15	12523.30	1.88	[illegible]
2007	0.	0.	0.	2.50	0.	21.00	2457.20	12579.39	1.88	220.45

SINGLE AND THREE CAR MOVEMENTS UNDER REHABILITATION ALTERNATIVE

	SINGLE CARS					THREE CARS				
YEAR	NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES	NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES
1983	21.00	361.38	2087.48	1.88	32.42	21.00	1668.35	9637.00	1.88	[illegible]
1984	21.00	364.66	2091.53	1.88	32.72	21.00	1687.27	9677.33	1.88	151.37
1985	21.00	367.30	2097.45	1.88	32.95	21.00	1698.51	9699.17	1.88	[illegible]
1986	21.00	370.31	2103.80	1.88	33.22	21.00	1711.90	9725.62	1.88	[illegible]
1987	21.00	372.91	2110.01	1.88	33.45	21.00	1722.33	9745.45	1.88	154.32
1988	21.00	375.32	2115.75	1.88	33.67	21.00	1732.06	9764.00	1.88	155.39
1989	21.00	378.20	2122.36	1.88	33.93	21.00	1744.06	9787.16	1.88	156.47
1990	21.00	378.13	2116.79	1.88	33.92	21.00	1752.15	9808.77	1.88	[illegible]
1991	21.00	378.91	2112.43	1.88	33.99	21.00	1765.13	9840.64	1.88	[illegible]
1992	21.00	378.29	2106.59	1.88	33.94	21.00	1769.53	9854.04	1.88	[illegible]
1993	21.00	378.19	2101.94	1.88	33.93	21.00	1776.15	9871.73	1.88	[illegible]
1994	21.00	378.52	2097.98	1.88	33.96	21.00	1785.15	9894.36	1.88	160.15
1995	21.00	378.20	2092.99	1.88	33.93	21.00	1790.69	9909.80	1.88	[illegible]
1996	21.00	378.37	2088.90	1.88	33.94	21.00	1798.67	9930.18	1.88	161.37
1997	21.00	378.04	2084.48	1.88	33.92	21.00	1803.32	9943.25	1.88	161.75
1998	21.00	380.46	2083.09	1.88	34.13	21.00	1825.18	9993.18	1.88	163.74
1999	21.00	383.35	2082.35	1.88	34.39	21.00	1850.02	10049.37	1.88	[illegible]
2000	21.00	386.37	2082.22	1.88	34.66	21.00	1875.20	10105.91	1.88	[illegible]
2001	21.00	389.23	2081.77	1.88	34.92	21.00	1899.87	10161.43	1.88	170.45
2002	21.00	392.18	2081.73	1.88	35.18	21.00	1924.84	10217.31	1.88	[illegible]
2003	21.00	395.16	2081.98	1.88	35.45	21.00	1949.84	10273.62	1.88	[illegible]
2004	21.00	398.18	2082.44	1.88	35.72	21.00	1974.93	10328.78	1.88	177.18
2005	21.00	401.17	2083.00	1.88	35.99	21.00	1999.93	10384.20	1.88	179.42
2006	21.00	404.18	2083.72	1.88	36.26	21.00	2024.97	10439.57	1.88	181.67
2007	21.00	407.19	2084.56	1.88	36.53	21.00	2050.01	10494.83	1.88	183.92

SINGLE, 10, 24 AND/OR 26 CAR MULTIPLE MOVEMENTS UNDER REHABILITATION ALTERNATIVE

YEAR	SINGLE AND THREE CARS: NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES	10, 24 AND/OR 26 CARS: NUMBER OF CARS /SERVICE CYCLE	TOTAL NUMBER OF CARS	TOTAL CAR DAYS OF BRANCH	NUMBER OF LOCO MOTIVES /SERVICE CYCLE	TOTAL NUMBER OF LOCOMO-TIVES
1983	21.00	312.82	1251.27	1.88	28.06	24.83	1496.37	4489.09	1.00	60.25
1984	21.00	316.05	1264.20	1.88	28.35	24.84	1525.37	4576.11	1.00	61.41
1985	21.00	318.65	1274.60	1.88	28.59	24.85	1550.27	4650.80	1.00	62.40
1986	21.00	321.61	1286.43	1.88	28.85	24.85	1575.40	4726.21	1.00	63.40
1987	21.00	324.10	1296.40	1.88	29.08	24.86	1600.65	4801.94	1.00	64.40
1988	21.00	326.46	1305.82	1.88	29.29	24.86	1625.75	4877.24	1.00	65.39
1989	21.00	329.17	1316.70	1.88	29.53	24.87	1651.16	4953.46	1.00	66.40
1990	21.00	329.00	1316.00	1.88	29.52	24.87	1675.84	5027.51	1.00	67.40
1991	21.00	329.59	1318.35	1.88	29.57	24.87	1700.63	5101.88	1.00	68.39
1992	21.00	328.88	1315.52	1.88	29.51	24.87	1725.41	5176.23	1.00	69.39
1993	21.00	328.58	1314.31	1.88	29.46	24.87	1750.37	5251.12	1.00	70.39
1994	21.00	328.65	1314.56	1.88	29.48	24.87	1775.53	5326.58	1.00	71.40
1995	21.00	328.20	1312.82	1.88	29.44	24.87	1800.45	5401.34	1.00	72.41
1996	21.00	328.15	1312.62	1.88	29.44	24.87	1825.56	5476.68	1.00	73.42
1997	21.00	327.64	1310.57	1.88	29.39	24.87	1850.77	5552.30	1.00	74.43
1998	21.00	329.68	1318.72	1.88	29.58	24.87	1875.96	5627.87	1.00	75.44
1999	21.00	332.17	1328.70	1.88	29.80	24.87	1901.19	5703.56	1.00	76.46
2000	21.00	334.78	1339.13	1.88	30.03	24.87	1926.78	5780.35	1.00	77.48
2001	21.00	337.22	1348.87	1.88	30.25	24.87	1951.88	5855.65	1.00	78.49
2002	21.00	339.75	1359.01	1.88	30.48	24.87	1977.27	5931.81	1.00	79.51
2003	21.00	342.29	1369.16	1.88	30.71	24.87	2002.70	6008.11	1.00	80.54
2004	21.00	344.87	1379.48	1.88	30.94	24.87	2028.24	6084.72	1.00	81.56
2005	21.00	347.41	1389.64	1.88	31.17	24.87	2053.69	6161.06	1.00	82.58
2006	21.00	349.97	1399.86	1.88	31.40	24.87	2079.18	6237.55	1.00	83.61
2007	21.00	352.52	1410.08	1.88	31.63	24.87	2104.68	6314.03	1.00	84.63

SINGLE, 10, 24, 26 AND/OR 52 CAR MULTIPLE MOVEMENTS UNDER REHABILITATION ALTERNATIVE

SINGLE AND THREE CARS

YEAR	NUMBER OF CARS /SERV-ICE CYCLE	TOTAL NUMBER OF CARS	TOTAL NUMBER OF BRANCH	NUMBER OF LO-COMO-TIVES /SERV-ICE CYCLE	TOTAL NUMBER OF LO-COMO-TIVES
1983	21.00	312.82	1251.27	1.88	28.06
1984	21.00	316.05	1264.20	1.88	28.35
1985	21.00	318.65	1274.60	1.88	28.59
1986	21.00	321.61	1286.43	1.88	28.85
1987	21.00	324.10	1296.40	1.88	29.08
1988	21.00	326.46	1305.82	1.88	29.29
1989	21.00	329.17	1316.70	1.88	29.53
1990	21.00	329.00	1316.00	1.88	29.52
1991	21.00	329.59	1318.35	1.88	29.57
1992	21.00	328.88	1315.52	1.88	29.51
1993	21.00	328.58	1314.31	1.88	29.48
1994	21.00	328.65	1314.58	1.88	29.48
1995	21.00	328.20	1312.82	1.88	29.44
1996	21.00	328.15	1312.62	1.88	29.44
1997	21.00	327.64	1310.57	1.88	29.39
1998	21.00	329.68	1318.72	1.88	29.58
1999	21.00	332.17	1328.70	1.88	29.80
2000	21.00	334.78	1339.13	1.88	30.03
2001	21.00	337.22	1348.87	1.88	30.25
2002	21.00	339.75	1359.01	1.88	30.48
2003	21.00	342.29	1369.18	1.88	30.71
2004	21.00	344.87	1379.48	1.88	30.94
2005	21.00	347.41	1389.64	1.88	31.17
2006	21.00	349.97	1399.86	1.88	31.40
2007	21.00	352.52	1410.08	1.88	31.63

10, 24 AND/OR 26 CARS

YEAR	NUMBER OF CARS /SERV-ICE CYCLE	TOTAL NUMBER OF CARS	TOTAL NUMBER OF BRANCH	NUMBER OF LO-COMO-TIVES /SERV-ICE CYCLE	TOTAL NUMBER OF LO-COMO-TIVES
1983	10.00	43.88	131.64	1.00	4.39
1984	10.00	44.52	133.56	1.00	4.45
1985	10.00	45.03	135.09	1.00	4.50
1986	10.00	45.54	136.63	1.00	4.55
1987	10.00	46.05	138.16	1.00	4.61
1988	10.00	46.57	139.70	1.00	4.66
1989	10.00	47.08	141.23	1.00	4.71
1990	10.00	47.79	143.36	1.00	4.78
1991	10.00	48.50	145.49	1.00	4.85
1992	10.00	49.21	147.62	1.00	4.92
1993	10.00	49.91	149.74	1.00	4.99
1994	10.00	50.62	151.87	1.00	5.06
1995	10.00	51.33	154.00	1.00	5.13
1996	10.00	52.04	156.13	1.00	5.20
1997	10.00	52.75	158.26	1.00	5.28
1998	10.00	53.46	160.39	1.00	5.35
1999	10.00	54.17	162.51	1.00	5.42
2000	10.00	54.88	164.64	1.00	5.49
2001	10.00	55.59	166.77	1.00	5.56
2002	10.00	56.30	168.90	1.00	5.63
2003	10.00	57.01	171.03	1.00	5.70
2004	10.00	57.72	173.15	1.00	5.77
2005	10.00	58.43	175.28	1.00	5.84
2006	10.00	59.14	177.41	1.00	5.91
2007	10.00	59.85	179.54	1.00	5.98

52 CARS

YEAR	NUMBER OF CARS /SERV-ICE CYCLE	TOTAL NUMBER OF CARS	TOTAL NUMBER OF BRANCH	NUMBER OF LO-COMO-TIVES /SERV-ICE CYCLE	TOTAL NUMBER OF LO-COMO-TIVES
1983	52.00	1452.49	2904.97	1.00	[illegible]
1984	52.00	1480.85	2961.71	1.00	[illegible]
1985	52.00	1505.24	3010.48	1.00	[illegible]
1986	52.00	1529.86	3059.72	1.00	[illegible]
1987	52.00	1554.59	3109.19	1.00	[illegible]
1988	52.00	1579.18	3158.36	1.00	[illegible]
1989	52.00	1604.08	3208.16	1.00	[illegible]
1990	52.00	1628.05	3256.10	1.00	31.31
1991	52.00	1652.13	3304.26	1.00	31.77
1992	52.00	1676.20	3352.41	1.00	[illegible]
1993	52.00	1700.46	3400.92	1.00	[illegible]
1994	52.00	1724.90	3449.80	1.00	[illegible]
1995	52.00	1749.11	3498.23	1.00	[illegible]
1996	52.00	1773.52	3547.03	1.00	34.11
1997	52.00	1798.02	3596.03	1.00	34.58
1998	52.00	1822.50	3644.99	1.00	[illegible]
1999	52.00	1847.02	3694.04	1.00	[illegible]
2000	52.00	1871.90	3743.81	1.00	[illegible]
2001	52.00	1896.29	3792.59	1.00	36.47
2002	52.00	1920.97	3841.94	1.00	[illegible]
2003	52.00	1945.70	3891.39	1.00	[illegible]
2004	52.00	1970.52	3941.05	1.00	[illegible]
2005	52.00	1995.26	3990.52	1.00	[illegible]
2006	52.00	2020.05	4040.10	1.00	[illegible]
2007	52.00	2044.83	4089.67	1.00	[illegible]

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