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HIGHLIGHTS

This paper examines the desirability, feasibility, and cost of incorporating a detailed community impact assessment process in the existing railroad benefit-cost procedure. The North Dakota DOT utilizes this procedure to evaluate the net benefits of investing federal or state money in rail lines, usually in the form of rehabilitation loans or grants. The existing procedure evaluates the statewide economic and highway-related impacts of railroad abandonment. However, it does not address the economic, social, or environmental impacts on specific communities. In this study, a range of community impact assessment techniques and procedures are reviewed, and their relevance to North Dakota circumstances is assessed. From this review of techniques, a basic set of community impact assessment variables, data sources, and estimating techniques is synthesized. This synthesis produces an integrated set of techniques which can be applied to a rail-line analysis in North Dakota. However, as the study concludes, the resource costs and the degree of difficulty in performing a full-blown community impact assessment are usually high. Furthermore, some aspects of community impacts are already captured in the existing statewide methodology which utilizes the North Dakota input/output model. So, the study recommends that a detailed community impact assessment be undertaken only in certain instances, e.g. where large manufacturing or processing plants are located on the line.

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I. INTRODUCTION

Rail abandonment has been and continues to be a major concern in the Northern Plains region, especially in North Dakota. Since 1980, over 750 miles of North Dakota track have been abandoned (Table 1). Even after these abandonments, there are still 4,372 miles of track in North Dakota, including 2,809 miles of branch lines. A good portion of the 2,809 miles of remaining branch line track could be in danger of abandonment in the future (Table 2). In a recent analysis, the North Dakota Department of Transportation projected that 1,800 miles of track could be abandoned by the year 2020 (Evans).

TABLE 1. RAIL LINE ABANDONMENTS (BY YEAR AND RAILROAD)[1]

Year	BN (miles)	SOO (miles)	MILW (miles)	Total (miles)
1980	46.8	0	106.4	153.2
1981	33.5	0	0	33.5
1982	36.7	9.3	123.8	169.8
1983	56	0	0	56
1984	105.7	19.6	0	125.3
1985	23.5	0	0	23.5
1986	99.4	22.1	0	121.5
1987	0	16.3	0	16.3
1988	15.8	0	0	15.8
1989	0	0	0	0
1990	0	0	0	0
1991[2]	0	42.4	0	42.4
Total	417.4	109.7	230.2	757.3

[1]Source: North Dakota Public Service Commission

[2]Through May 1991

TABLE 2. STATE RAIL SYSTEM 1991 (BY RAILROAD AND CLASSIFICATION)[3]

Railroad	Mainline (miles)	Branch line (miles)	Total (miles)
Burlington Northern	1,048	1,341	2,389
Soo Line	353	562	915
Dakota, Minnesota & Eastern	0	14	14
Red River Valley and Western	59	594	653
Dakota, Missouri Valley & Western	0	298	298
South Dakota Rail	103	0	103
Total	1,563	2,809	4,372

Rail line abandonment has led to a loss of rail service in more than 50 communities and 3 counties in North Dakota. Although some of the abandoned branch lines no longer originated any traffic, some served grain elevators and a limited number of manufacturing or processing plants. While service to one, two, or three plants may seem insignificant, many small towns in sparsely populated states such as North Dakota depend upon rail service for their economic survival.

Line abandonment is one method of rail restructuring or "rationalization." Rail carriers feel that they must rationalize their systems in order to realize cost savings. The U.S. Department of Transportation favors adopting policies which ease procedures for abandoning light density lines. The justification for the policy is:

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[3]Source: *North Dakota in Perspective, A Comparative Report*, A Joint Publication of the Census Data Center and the Department of Agricultural Economics, North Dakota Agricultural Experiment Station, NDSU, Fargo, 1991.

Competitive building of railroads in the last century resulted in a vast network of multiple railroad and companies. Many lines are no longer needed, and many others could be downgraded or abandoned if existing traffic were consolidated onto the parallel or connecting lines of other rail companies. Consolidation or coordination of parallel services holds the potential for savings in operating costs and avoidance of rehabilitation that otherwise would be needed (U.S. DOT).

Findings from a preliminary report submitted to the Transportation Research Board intensify concerns over the possibilities of wide-spread abandonment. Grimm, Phillips, and Selzer found that "elimination of a large number of light density lines does not dramatically reduce main line densities" (p. 2). It was further concluded that "from a pure cost perspective it is clear that large scale abandonment programs of unprofitable light density lines will serve to reduce system average cost" (Grimm, Phillips, and Selzer, p. 11).[4]

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[4]Rail carriers may follow several strategies in rationalizing their networks. First, they may attempt large-scale abandonment programs. However, this approach is politically unpopular, and railroads fear that extensive abandonments could lead to re-regulation of the industry. In addition, abandonments require the lengthy and expensive legal process involved with Interstate Commerce Commission approval. A second option for Class I railroads is to sell light density branch lines to regional or short line railroads. Since 1980, over 200 short lines, operating over 17,500 miles of track, have been created (Murphy). Concurrent with the increase in short lines has been a decrease in abandonments. In many cases, the strategy of the Class I carrier is to create short lines which will originate traffic before turning it over to the Class I carrier. Operating costs are reduced on branch lines under short line ownership as a result of smaller crew consists, more flexible work rules, and lower crew wage rates. Short line railroads have begun to surface in North Dakota. To date, the Red River Valley and Western Railroad (RRV&W) is the only extensive short line system in the state. The RRV&W operates 653 miles of track previously owned by Burlington Northern. The line began operation in July 1987 under the ownership of several Minnesota investors. The line has been extremely successful, hauling 24,996 cars of freight during its first year and grossing $8 million in revenues ("Short-line"). In addition to its financial success, the RRV&W has been hailed from both a railroad and public perspective as a "giant success." Service to shippers on the lines has improved, shipments have increased over previous levels, and track is being upgraded to improve service even more. Overall, the affected communities and their shippers hold the new railroad in high regard (Evans). When the profitability of the RRV&W as a short line was analyzed, it was found that " . . . the network showed a simulated cost savings of 26% in on-line operating, maintenance, and capital cost" over ownership by Burlington Northern (BN) (UGPTI Staff Paper No. 85, p. 3). Under BN's ownership the regional system showed a loss of $452,051 as compared to a profit of

Although some line abandonments are inevitable, many light-density lines can be preserved through intervention by state and federal agencies. The North Dakota Department of Transportation makes low interest loans available to carriers for the rehabilitation of rail lines, or for the provision of substitute rail services. Federal grants are also available on a competitive basis from the Federal Railroad Administration for line rehabilitation and related purposes. Historically, both sources of funds have been used to save deteriorating branch lines in North Dakota, and thus maintain rail services to small communities and cities.

The use of state and federal funding in rail preservation has a history that dates back to 1976, when the Railroad Revitalization and Regulatory Reform Act (4R Act) was passed. The Railroad Revitalization and Regulatory Reform Act of 1976 included a subsidy program which provided 600 million dollars in grants and 1 billion dollars in loans to rehabilitate main lines of financially weak carriers (Keeler). In addition, the act subsidized unprofitable branch lines by providing 360 million dollars over five years. The federal

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$2,246,856 as realized under simulated short line ownership. Short line sales have almost ceased since April 1988 when the 3rd Circuit Court of Appeals held that a railroad must negotiate with its unions before the railroad is sold. The result of this decision, which has been appealed to the United States Supreme Court, would be to substantially increase labor costs for new short lines. Without labor cost savings, it is unlikely that many short line sales will be completed and there will be more abandonments. Third, if a railroad cannot obtain permission to abandon or sell unprofitable lines, they may pursue an alternative course of de facto abandonment. Traffic levels may be eroded through differential pricing by setting unit train rates for mainline stations much lower than single-car rates. The rate increases may eventually drive present shippers out of business or just force them to stop using rail as their mode of transportation. Most track subject to abandonment has deteriorated because of deferred maintenance. In many cases, the track on light-density branch lines is less than 90 pound rail and cannot accommodate modern 100-ton cars. For example, 30% of Burlington Northern's system-wide track is less than 100 pound rail. Similarly, 57% of Soo Line's track is less than 100 pound rail system-wide. Given the uncertainty over the future of short line sales, abandonment becomes more likely. However, abandonment is not the only answer for failing branch lines. Railroads may also seek to rehabilitate branch lines using federal loans programs.

government subsidized 100 percent of branch line deficits in the first year, 90 percent in the second year, 80 percent in the third year, and 70 percent in the fourth and fifth years. This policy was aimed at a gradual transfer of the burden of operating deficits to state and local governments in order to give them time to assess future needs (Lieb).

Two years after the passage of the 4R Act, the Local Rail Services Assistance Act of 1978 was passed. This act was passed with the objectives of "improving the rail service assistance program and providing increased flexibility to the states to deal with branch rail line problems" (Local Rail Service Assistance Act of 1978). Specifically, the Local Rail Services Act: (1) expanded the categories of assistance for which Federal funds could be used and (2) granted states greater flexibility in administering funds as grant or loan moneys. The Local Rail Service Assistance Act was recently extended by Congress, and renamed the Local Rail Freight Assistance (LRFA) Act of 1990. LRFA authorized federal funds for grants and loans at least through 1992, with the possibility of reauthorization.

While these acts have made public funds available for line preservation, there are some specific guidelines which must be met in order to receive federal funding. To qualify for federal loans, it must be demonstrated through benefit/cost analysis that a particular branch line is a worthwhile recipient of rehabilitation funding. In addition to demonstrating that a line is a worthwhile recipient, the state must demonstrate that its methodology for analyzing costs and benefits of a project is adequate (Mittleider, Tolliver, Vreugdenhil). In recent years, benefit/cost studies of branch lines in North Dakota have been performed at the Upper Great Plains Transportation Institute (UGPTI) using standard economic principles and guidelines. The analyses have generally been based on the FRA's 1980 Guidelines for Benefit/Cost Analysis, and subsequent revisions. These guidelines have been refined for use in North Dakota and are included in a model called

NOLAM.[5]

The present North Dakota rail planning model is designed to analyze the viability of individual line segments and to simultaneously estimate both the primary efficiency and secondary efficiency benefits which accrue from rehabilitation. Primary benefits are those which are derived directly from rehabilitation of the line. The secondary benefits are those which are an indirect result of rehabilitation. The primary benefits resulting from rehabilitation (as measured by NOLAM) include: (1) the reduction in cost on existing traffic, (2) the consumers' surplus on new rail traffic, and (3) the producers' surplus on new rail traffic. The secondary benefits from rehabilitation (as measured by NOLAM) include: (1) state and regional impacts resulting from an increase in consumers' surplus, and (2) the avoidance of incremental pavement damage from increased truck use. The secondary benefits of state and regional impacts are estimated through input/output (I/O) analysis, and consider only changes in gross business volume and personal income. At present, NOLAM does not estimate specific impacts to any community, and does not directly consider some secondary impacts resulting from abandonment (e.g. job losses, and tax effects). The philosophy of previous North Dakota studies has been that the effects which should be measured are statewide impacts, and that this can best be accomplished through a state input-output analysis. However, since the distributional impacts of abandonment can weigh heavily on individual cities and towns, it is appropriate that the merits of including a community impact assessment procedure in the state benefit-cost analysis be considered.

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[5]See Mittleider, Tolliver, and Vreugdenhil. *North Dakota Line Segment Analytical Model (NOLAM) -- A Technical Description*. UGPTI Publication No. 50.

Abandonment decisions can impact the economic, social, and environmental fabric of community life. Economic-related community impacts include items such as: increased transportation and capital costs for shippers, increased unemployment compensation, public assistance payments, losses in income tax revenue, changes in local land values, and changes in the local tax base.[6] Social impacts include losses in primary and secondary job markets, movement of people due to business closures or transfers, and increased safety problems due to increased truck traffic through towns. The energy impacts of abandonment are measured by increases in energy consumption caused by a shift in the transportation mode. Environmental community impacts include increases or decreases in air, noise, and water pollution.

Ideally, the North Dakota rail benefit/cost model should provide a means of determining the full range of economic, social, energy, and environmental impacts of branch line abandonment on communities. However, the benefits derived from knowing some of these secondary community impacts must be weighed against the costs of compiling and analyzing the data.

The goal of this report is to evaluate the role of community impact assessment in benefit/cost analysis. Specifically, the objectives of this paper are to:

1) briefly review the UGPTI benefit/cost model,

2) provide an overview of community impact analysis (CIA), determining which elements may be relevant to benefit/cost analysis

3) review possible sources of data (primary and secondary), determining what data source should be used, and

4) ascertain the desirability and feasibility of including a detailed community impact assessment procedure in the North Dakota benefit-cost process.

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[6]Changes in shippers' transportation costs and personal income effects are currently considered in NOLAM.

If the benefit/cost analysis is modified to consider community impacts, the following objectives must be attained at a later date:

5) construction of questionnaires designed to gather the information required for CIA,

6) completion of a North Dakota case study to determine the reliability of data sources,

7) illustration of the CIA costing methodologies, and

8) judgment on the performance of the model, including recommendations as to its implementation as part of the UGPTI benefit/cost model.

Two important factors must be considered in any evaluation. Given the limited rail planning funds available, the resource cost of performing an in-depth CIA study is an important consideration. The cost to perform a single line-analysis may be quite high due to extensive surveying and data collection requirements. Another factor which must be considered is the scope of the analysis. Under the revised (1990) benefit-cost guidelines of the FRA, the scope of a rail project analysis must be statewide. Many impacts such as job losses and relocation may actually be transfers instead of impacts. Displaced workers may be re-hired elsewhere in the state within a limited period of time.

The remainder of the paper is organized in the following manner. Part II is a brief description of the present UGPTI benefit/cost model (NOLAM). Part III is a literature review citing past studies and papers involving CIA and/or rail line abandonment. Part IV describes the variables, as well as the methods for estimating each. Part V covers the data requirements which should be included in surveys of shippers, rail carriers, and motor carriers. Finally, a summary and conclusion follow in Part VI of the report.

II. UGPTI BENEFIT/COST MODEL

NOLAM was originally developed in response to the demand for a methodology which would consider a range of simultaneous changes in the grain handling and merchandising system of North Dakota. "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" (Mittleider, Tolliver, Vreugdenhil).

Major Features

At the time of its development, NOLAM incorporated several new features and advantages over previous rail models. First, NOLAM included procedures for estimating both on-branch and off-branch costs without relying on data provided by the railroads (Mittleider, Tolliver, Vreugdenhil). This is an important feature since railroads often do not provide on-branch and off-branch cost data in a timely manner. These data are generally not made available until a line is in category 3.[7] Second, NOLAM "has the capability to estimate avoidable costs for a variety of traffic scenarios" (Mittleider, Tolliver, Vreugenhil). This is a major advantage over the use of historic railroad data which only allow the estimation of costs for the baseline traffic scenario. 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" (Mittleider, Tolliver, Vreugenhil). By utilizing these adjustments both the on-branch and off-branch efficiencies of multiple carload traffic can be reflected.

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[7]When a line is classified under category 3, it means that an abandonment application on the line is pending.

Theory and Methods

Because the objective of the model is to estimate the benefits and costs which would result from rehabilitation, the essential part of the methodology is based on the demand for transportation. This includes an estimation of how costs and revenues to producers of transport services (rail and motor carriers) and consumers of transport services (shippers) change with different levels of modal use.

Primary efficiency benefits are the direct benefits from line rehabilitation. The most important input in the calculation of PEB is the estimation of avoidable costs associated with operating and maintaining the line segment. "The [primary] benefits which would accrue from rehabilitation comprise three categories: 1) the reduction in cost on existing traffic, 2) consumers' surplus on new rail traffic, and 3) producers' surplus on new rail traffic" (Mittleider, Tolliver, Vreugdenhil).

"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" (Mittleider, Tolliver, Vreugenhil). A secondary efficiency benefit is not realized in situations where a change in the economy is compensated by an opposite change in another section of the economy. Secondary efficiency benefits (SEB) in NOLAM are estimated on the basis of input-output analysis. "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" (Mittleider, Tolliver, Vreugenhil). Secondary efficiency benefits are realized through rehabilitation in the form of increased consumers' surplus as projected throughout the local economy. Additionally, SEBs also arise from the avoidance of adverse highway impacts which would occur due to abandonment. For example, increased truck traffic, absorbing the slack if branch lines are abandoned, may cause additional deterioration of highways. The additional deterioration of highways would then reduce the life expectancy of roadbeds, necessitating an increase in maintenance and resurfacing costs (Mittleider, Tolliver, Vreugdenhil).

There are two major items which the current methodology does not address. First, the SEB are not traced to any specific community. Instead, they are aggregated at a state or regional level. Second, only changes in gross business volume and personal income are estimated by NOLAM. Other social, energy, or environmental effects are not presently considered.

The next section of the paper will review literature pertaining to community impact analysis and describe how CIA variables are chosen.

III. LITERATURE REVIEW

Much of the general background information on community impact analysis (CIA) presented in this section comes from Chapter 2 of the Federal Railroad Administration's *Rail Planning Manual, Volume II: Guide for Planners*. An entire section of Chapter 2 of the manual is devoted to CIA. It gives an overview of CIA and describes what a community impact analysis entails. The FRA formulated its manual and requirements based on several other pieces of rail planning literature as well as other community impact analyses.[8] The results of these studies are incorporated directly and indirectly into the discussion which follows.

A study design is discussed in this chapter of the paper, as are methods of data collection. The main portion of the section is concerned with the actual estimation of community impacts such as increased transportation costs to shippers and loss of primary jobs due to rail abandonment. Each of the variables is described, followed by a precise explanation of how collected data are used to estimate the various impacts of abandonment on a community.

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[8]The following documents are some of the more frequently cited sources in Chapter 2 of the FRA *Rail Planning Manual:*

Creighton, Hamburg Inc., *Manual For Pennrail Community Impact Study*, (Harrisburg: 1975).

CONSAD Research Corporation, *Analysis of Community Impacts Resulting From the Loss of Rail Service*, U.S. Railway Association, Washington, D.C.; 1974.

Federal Rail Administration, U.S.D.O.T., *Rail Planning Procedures Report*, prepared by States of Wisconsin and Michigan; Harbridge House, Inc.; and CONSAD Research Corporation (Springfield, Va.: NTIS, 1975).

Additional sources can be found in the manual.

In Chapter 2 of the Rail Planning Manual, the Federal Railroad Administration mentions several important issues in study design. These issues involve: (1) the development of criteria and goals, (2) data acquisition costs, (3) compliance with federal guidelines, (4) the time horizon of impact analysis, and (5) consistent application of the guidelines.

First, impact analysis can vary substantially depending on the goals and criteria used by the state. "A number of different 'orientations' could be adopted by a state, such as (1) minimize state expenditures for rail service, (2) minimize the economic impact of light-density line abandonments, (3) save jobs, (4) protect or enhance the environment, and (5) promote commerce and economic development" (FRA).

Second, as discussed earlier, a tradeoff exists between greater detail in data and prohibitively high data collection costs. "A decision to use a more detailed analysis requires a concomitant decision to seek out and develop the required inputs. This may necessitate a very thorough shipper survey, or detailed information on commodities shipped or received by LDL customers, or even information on track gradients and curvatures. Data acquisition costs can be significantly greater than the staff time required to complete an analysis of a particular light-density line" (FRA).

Also, there are certain federal guidelines with which community impact analysis must comply. These guidelines "require that each line or project be evaluated with respect to 'relative economic, social, environmental, and energy costs and benefits involved in the use of alternative rail services or alternative rail modes.'[9] This means that the assessment process must be comprehensive and not limited to economic objectives which may be of paramount interest to the state" (FRA).

[9]49 C.F.R. Part 266.15(3) (4) (vi).

The time horizon is also an important consideration in designing a community impact analysis. "Impacts of LDL abandonment vary substantially depending upon whether they are estimated for the short run (one year after service discontinuation) or for the long run... Thus, it becomes important to calculate impacts for at least two time periods" (FRA). The North Dakota Department of Transportation's current planning horizon is 10 years.

Finally, consistent measurement of community impacts is necessary once a design has been settled upon, and the design's applicability to a variety of situations should be considered in design choice. "Impacts calculated a year hence should be comparable with similar calculations done today" (FRA).

Additional information on community impact analysis has been obtained from a North Dakota State University graduate thesis, *The Economic, Social and Energy Impacts of North Dakota Rail Branch Line Abandonment*, by Rebecca Gudrun Kraft Janski. In her study, Janski considered the economic, social, and energy related impacts of abandonment on communities located along the Sherwood branch line in North Dakota.

Janski used questionnaires of shippers, community members, and grain producers to estimate the economic, social, and energy benefits of continued branch-line service to communities and shippers. The social benefits of continued rail service (as estimated by Janski) include higher community population, greater church attendance[10], higher school enrollment, more community activities and organizations, and greater highway safety. The economic benefits of continued rail service (as estimated by Janski) include higher community income, increased property tax revenues, a higher level of employment, lower

[10]Church attendance would appear to be solely a function of population. However, Janski includes this as a separate benefit. It appears that Janski made some assumptions about the relationship between rail service, attitude, and church attendance in including this benefit.

cost household goods, lower cost farm inputs, a greater variety of goods and services, greater opportunities for economic growth, a greater ability to attract new industries, lower highway maintenance costs, and higher residential, commercial, and agricultural land values. The energy benefit of continued rail service (as estimated by Janski) is the lower fuel consumption in rail service as compared to truck service.

Finally, additional insight into the choice of variables to be considered in a community impact analysis is obtained from a report by Michael F. Trentacoste of the Federal Railroad Administration and John K. Lussi of the New York State DOT. Their report, *Analysis of Rail Line Abandonment Priorities,* explains the process which NYSDOT followed in choosing the variables for their CIA. The authors explain how NYSDOT's initial list of community impact analysis factors was reduced through research and investigative reports. This reduction process eliminated marginally significant factors, as well as those which explained the same effect that was explained better by a different factor. Table 3 shows the proposed criteria, impacts, and available measures used by the NYSDOT as identified through the screening process. Impacts and measures are the same in this table since the affected items are also measurable.

TABLE 3. PROPOSED VARIABLES FOR CIA, NYSDOT - 1977

Criterion	Impacts and Measures
Employment	Railroad employees Shipper employees Related service employees
Consumer costs	Transportation costs Competition effects
Taxes and community economics	Income tax Sales tax Property tax Corporate tax
Pollution	Energy use Air quality Aesthetics Traffic congestion
Community cohesiveness	Population shifts Urban and rural composition Land use or zoning disruption Public investment

SOURCE: Trentacoste and Lussi, 1973

A set of impact assessment procedures and variables have been synthesized from the FRA Rail Planning Manual and the other sources listed in this section. The selection of variables (or relevant factors) is an important step in the formulation of a valid CIA procedure. In the next section of the paper, a set of CIA variables is presented, and the potential sources of data for each item are discussed.

IV. VARIABLES AND METHODS OF ESTIMATION

"The general purpose of community impact analyses is to identify and evaluate the total impacts of discontinuing rail service on light density rail lines, including social, economic, environmental, energy, and other contributing factors" (FRA). In CIA, the social and economic costs to the community of line abandonment are compared to the financial cost of rehabilitation or related actions.

The most significant costs of abandonment include: personal income loss, tax receipt loss, transport cost increase, and unemployment and welfare payments (FRA). If a line is abandoned, the rail users usually have three choices: (1) use an alternate means of transportation for commodities previously carried by rail, (2) relocate operations to another site having rail service, or (3) abandon at least that portion of the business utilizing rail service (Trentacoste and Lussi). All of these choices will impose costs on the community.

Alternatively, the cost of continuing service is comprised of both capital and annual costs. Capital costs consist of expenditures for accelerated maintenance of way, rail line rehabilitation, or acquisition. Annual costs include expenditures for maintenance of equipment, traffic and transportation, taxes, leasing the right-of-way, management fees, and miscellaneous and off-branch operating costs (FRA).

The selection of CIA variables can affect the projected benefits and costs, and is thus a very important step in the process. Based on the review of literature presented previously, the CIA variables shown in Table 4 have been selected as the major factors to be considered in abandonment impact analysis. Table 4 shows the CIA criterion, the variable used to measure community impacts, and whether the data are derived from primary or secondary sources. Primary data are those derived directly from surveys or interviews, while secondary data are derived from published or other existing sources.

TABLE 4. CIA VARIABLES--PRIMARY OR SECONDARY SOURCES

Criterion	Variable	Source
Consumer costs	Increased capital costs	Primary/Secondary
	Changes in transportation costs*	Primary/Secondary
Employment	Primary job loss	Primary
	Secondary job loss	Primary/Secondary
Taxes and community economics	Wage and salary losses	Primary/Secondary
	Increased unemployment compensation and public assistance payments	Primary/Secondary
	Personal income losses*	Primary/Secondary
	Income tax losses	Primary/Secondary
	Property tax losses	Primary/Secondary
Safety	Safety	Primary/Secondary
Pollution	Energy consumption	Primary/Secondary
	Noise pollution	Primary/Secondary
	Water pollution	Secondary

*Currently measured in NOLAM.

As Table 4 illustrates, CIA requires a vast amount of primary and secondary data. In order to obtain primary data, several surveys would be required, including a survey of rail carriers. Detailed information is available on North Dakota grain movements. However, the same information is limited and confidential for non-grain shipments. If a North Dakota CIA is performed, one of the main objectives of the rail carrier survey will be to create a list of non-grain shippers along specified branch lines. The secondary data sources in Table 4 are derived from *Freight Data Requirements for Statewide Transportation Systems Planning: User's Manual* (Creighton, Banks, and Associates, No. 178).

The following section of the report provides a description of the variables which could be used in a community impact analysis, and provides an overview of the methods which could be employed in analyzing the data for a community impact analysis[11].

Increased Capital Costs

An increase in capital costs can occur for some shippers if they are forced to switch transportation modes due to rail abandonment (FRA). Capital costs may increase as a result of leasing, rental, or purchase of equipment required to modify a plant so as to accommodate alternative transportation modes. The changes in plant may include (1) construction of loading docks, driveways, or similar structures at the plant, (2) the purchase or rental of trucks, (3) the purchase of materials handling equipment such as forklifts and cranes, (4) conversion of rail handling facilities to truck handling facilities, (5) construction of storage facilities, grain elevators, sheds, or bins at the plant, and/or (6) construction of a materials transfer facility at a team track, or at a siding retaining rail service.

Because many shippers are not likely to have good estimates of the increased capital costs required in the event of an abandonment, additions to existing shipper surveys may be necessary to estimate these costs. One way of approaching the problem would be to design an economic-engineering model based on the present plant configuration (as a starting point). The necessary improvements required to upgrade the plant could be synthesized by using economic-engineering techniques. The synthetic method is preferred because it provides a uniform estimate of equipment. "The synthesized function may reflect standardized conditions not found in any particular plant, and comparison with

[11]Much of the methodology in this section follows procedures outlined in the FRA's *Rail Planning Manual, Volume II: Guide for Planners*.

actual input-output observations can provide a type of 'ball park' check plus an indication of the level of performance being modeled" (French).

An analysis of increased capital cost may be appropriate only if a large plant or industry is located on a line. This is due to the large resource costs involved in an economic-engineering analysis. The magnitude of the impacts may not justify the cost of the analysis for elevators and other small businesses, where increased capital costs may be small and difficult to quantify.

Changes in Transportation Costs

Another consequence of rail abandonment is that shippers who previously relied on rail service are forced to use alternative modes of transport. Thus, abandonment may lead to a transportation cost increase.

Increases in transportation costs can have several negative effects on firms and consumers. A cost increase could cause firms to transfer operations elsewhere or to close plants. Firms may also reduce profits, increase prices, and/or reduce production or employment due to changes in transportation costs. The effects of increased transport costs on a firm are dependent upon the type of business or industry experiencing the increase, the internal economics of the particular firm, the absolute and relative amounts of the increase, and the ease or difficulty of transferring operations to a new location. The effects of increased transportation costs are accounted for in the present North Dakota line analysis procedure by examining changes in consumer and producer surpluses which would occur if a line is rehabilitated instead of abandoned.

The method for estimating changes in transportation costs due to abandonment is highlighted next, but the exact procedure and calculations are detailed in Appendix A. First, a shipper survey should be designed to identify shippers and consignees currently using rail service on the specific line segment as well as the annual carloads and tons of each commodity shipped and/or received by each shipper. The shipper survey should ascertain whether a firm is served by a private siding, a team track, or a leased siding. A combination of the shipper and carrier surveys can be used to estimate transshipment (loading and unloading) rates for the county or region under study.[12] Next, system maps, track charts, and freight routings should be used to determinate increases (or decreases) in rail distances from the affected shippers' locations to the nearest alternative railhead or terminal markets. Changes in rates can be developed from tariffs and surveys. Finally, the motor carrier survey could be used to determine trucking costs (average operating speed, vehicle operating costs, and wage rates) for the county or region under study.[13]

Primary Job Loss

Primary job losses are those incurred by employees who work for firms directly impacted by the abandonment. They include shippers and consignees who are unable to pass on the increased transport costs, and railroad workers involved in serving the line. Employees of retail and wholesale shippers are not likely to be greatly affected. However, employees of certain kinds of manufacturing and extractive industries probably will be impacted (FRA). Rail workers are not likely to be greatly affected by abandonment, since many are protected by merger agreements and union contracts. Many rail workers will be

[12]Transshipment rates for North Dakota will be affected by the amount of agricultural commodities which are moved in unit trainloads.

[13]Several UGPTI papers address these truck costs (e.g. Dooley and Bertram, *An Economic-Engineering Model for Estimating Motor Carrier Costs*, UGPTI Report No. 68). The publications *Wage and Benefit Surveys* and *North Dakota Employment and Wages* provide information on wage rates for truckers in North Dakota.

absorbed elsewhere in the system rather than displaced.

In contrast to these effects, the number of employees in trucking firms may increase. This is due to the shift from rail to truck.

There are two methods for estimating the primary job losses resulting from abandonment. The first method adds railroad and shipper job losses, and subtracts trucking job gains from these losses in order to estimate the net job loss from rail abandonment. Trucking job gains are estimated by multiplying the increased transportation costs by the percentage of truck costs which are the result of labor costs. The average trucking wage is then divided into this total to estimate the gain in trucking jobs.[14] The second method uses the ratio of increased transportation costs to total annual sales in order to estimate the loss of primary jobs by firms.[15]

Secondary Job Losses

Secondary job losses are those job losses which occur as a result of decreases in community income due to income losses in the directly affected industries. Secondary job loss involves a drop in the number of employees working in service and service-related industries such as local government, retail trade, insurance, and public utilities. This category of impacts includes the additional job, wage, and income losses due to the loss of

[14]Extreme caution must be exercised in estimating the gain in trucking jobs. Some "gains" in trucking jobs (particularly owner-operator trucking jobs) may be transfers. Individuals may leave jobs in other sectors of the state's economy (e.g., agriculture) to start a trucking firm. This type of shift is really a re-deployment of labor, rather than a structural gain in new jobs.

[15]Both of these estimation methods are shown in detail in Appendix B. All of the data items needed for primary job loss estimation can be obtained from shipper and carrier surveys.

railroad service.[16]

There are two primary methods of estimating secondary job losses. The first assumes that secondary job losses will occur as a multiplier of the income lost in basic industries, while second assumes that the amount of secondary income lost will occur as a multiplier of the amount of primary income lost.

In the first method of secondary job loss estimation, the multiplier is calculated as the ratio of employment in non-basic industries to employment in basic industries in the area of study. The ratio usually varies substantially between labor markets within a state, covering a range between 0.5 and 3.0 (FRA). The basic industry sector usually includes agriculture, mining, metal industries, machinery, textile industries, chemical industries, lumber industries, food and kindred products, various other manufacturing, and federal government. Non-basic industries include contract construction, printing, publishing, and allied industries; transportation, communication, and public utilities; wholesale and retail trade; finance, insurance, and real estate; various other services; and state and local government (FRA).[17] Appendix C gives a detailed description of this procedure.

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[16]When community impact analysis is aimed at estimating state wide effects of rail abandonment, caution must be used in estimating primary and secondary job losses. This is necessary since jobs may simply be transferred within the state.

[17]A categorization of the basic and non-basic industries in the affected area can be obtained through the State Office of Planning, the State Department of Transportation, and/or the State Public Service Commission. Other possible sources of information on employment and salaries in the impacted area include: *Directory of Labor Market and Occupational Information*, *North Dakota Employment and Wages*, state industrial census data, and county economic profiles.

In the second method of secondary job loss estimation, the income multiplier is calculated as a function of the population of the largest incorporated place in the community, the population of some incorporated place or township not in the community but within 50 miles of it, and the distance between the place not in the community and the center of the community. Secondary jobs lost are then estimated as a function of the losses in secondary income (FRA).[18] A detailed description of this estimation procedure is included in Appendix C.

Wage and Salary Losses

Along with the primary and secondary job losses, rail abandonment can cause wage and salary losses. In order to estimate these losses, several steps are necessary. First, the primary wage and salary losses are estimated from a shipper survey. Second, the ratio of non-basic to basic employment is used as a multiplier in estimating secondary wage and salary losses. Third, the wage and salary gains of trucking firm employees are estimated by multiplying the percentage of trucking costs due to wages by the increase in transportation costs to shippers from switching to truck. Fourth, the wage and salary losses resulting from transport cost increases absorbed by the community are estimated as a function of the affected firms' market size, the increased transportation costs of the affected firms, the portion of production retained by the affected firms, and the ratio of non-basic to basic employment. Finally, the total wage and salary loss realized in the community is estimated as the sum of all of the estimated losses less the estimated gains

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[18]System maps and track charts are used to identify communities and municipalities utilizing rail service. Census publications such as *Economic Characteristics*, and *Census Tracts* provide information on population of municipalities, community residents employed in the secondary sector, and total income of those employed in the secondary sector.

by trucking firm employees.[19] [20] A more precise description of the procedure and calculations is found in Appendix D.

Increased Unemployment Compensation/Public Assistance Payments

Because of the job losses resulting from rail abandonments, there is likely to be an increase in the amount of unemployment compensation and public assistance payments paid out by state government. There are two possible ways to estimate these increased payments. The first method estimates unemployment compensation increases, as well as public assistance payment increases, while the second only estimates unemployment compensation increases.

The first method uses detailed estimates of unemployment compensation and public assistance payments for individual firms. It consists of separate estimates of primary compensation increases for firms in basic and non-basic industries, and estimates secondary compensation increases from secondary job losses. Primary unemployment compensation increases are estimated from the firm's average annual wage[21] and the number of job losses by the firm due to rail abandonment. Secondary unemployment compensation increases are estimated from the average annual wage for the county and

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[19]When the community impact analysis is performed with the purpose of estimating state-wide effects, caution must be used in performing salary and wage loss estimates. This is due to the fact that wages and salaries may be transferred within the state.

[20]Information on employment in the impacted area can be obtained from state industrial census data, county economic profiles, the *Directory of Labor Market and Occupational Information*, and the *North Dakota Business Directory*. Other data necessary in this analysis can be obtained from the shipper and carrier surveys.

[21]Using the average annual wage can be somewhat misleading, since the affected jobs may have salaries which vary substantially from the average. However, in the absence of information on the salaries of those that will be affected, this is a reasonable approximation.

the amount of secondary job losses due to rail abandonment. Public assistance payments are estimated by the difference between the maximum public assistance allowed per household in the county and the unemployment compensation.[22] A more detailed description of the procedure and calculations can be found in Appendix E.

The second method consists of a simple average unemployment compensation calculation. The total unemployment compensation paid out by the state during the prior year is divided by the number of people claiming unemployment during the prior year. This number is multiplied by the number of primary and secondary job losses and then by 1.5. The reason that the total is multiplied by 1.5, is that this method assumes that the length of unemployment caused by a rail abandonment will be 50 percent longer than the length of unemployment occurring in normal circumstances.[23] This method is much less precise than the previous method. A detailed description of the procedure and calculations can be found in Appendix E.

Personal Income Losses

Because the increased unemployment compensation and public assistance payments are lower than the wages and salaries lost by individuals, a decrease in personal income is realized in the community in the event of a rail abandonment. Thus, the decrease in personal income realized by a community is the difference between the loss in wages and

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[22]The type of business, the average annual wage, and the initial job losses for primary industries can be obtained from the shipper survey. Weekly unemployment payments by average wage, the average period of unemployment, and the allowance for dependents can be obtained from the state department of labor. The maximum public assistance allowed per household can be obtained from county social services, and the average county wages can be obtained from the state department of commerce.

[23]The total amount of unemployment compensation and the total number of unemployment claims filed during the previous year can be obtained from the state department of labor.

salaries and the increase in unemployment and public assistance.

There is one method for estimating this personal income loss. This method merely subtracts the increased unemployment compensation and public assistance from the loss in wages and salaries.[24] [25] [26]

Income Tax Losses

Due to the personal income losses that may take place in the event of a rail abandonment, income tax receipts can decrease as well. These decreases occur at the state level[27], and are influenced by the length of unemployment, the tax rates of those unemployed, and their previous earnings.

Estimation of income tax losses consists of a few simple calculations. First, in firms which have primary job losses, the average firm income (for a time equal to the estimated amount of time unemployed) is multiplied by the applicable tax rate and the estimated number of employees laid off. Next, the estimated secondary job losses are multiplied by average county income (for a time equal to the estimated amount of time unemployed) and the applicable tax rate. Finally, these totals are added together to estimate the

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[24]For a detailed description of the procedure and calculations, see Appendix F.

[25]All of the data items necessary for this estimation have been previously estimated.

[26]A note of caution must be added here. Care must be taken to ensure that allowances are made for persons returning to work (in the same region) after a period of unemployment.

[27]Although this decrease may also occur at the federal level, it is much more doubtful. This is due to the fact that decreased business in one firm that loses rail service may result in increased business by a competing firm in another part of the country. This may lead to the hiring of unemployed workers in that state. This could also occur within the state.

reduction in state tax receipts.[28] [29] Again, income tax losses may be temporary in nature, or may be transfers instead of impacts.

Property Tax Losses

When a rail line abandonment occurs, property tax losses may be realized. This occurs as the value of the land bordering the rail line decreases, due to the fact that its attractiveness for commercial use is diminished. The rail abandonment may be accompanied by plant closings further diminishing the value of the land. In extreme cases, large plant closings on the rail line can lead to secondary plant closings (FRA).

However, studies performed in North Dakota have found this effect to be small.[30] In a study by Charles E. Herman, David C. Nelson, and Thomas K. Ostenson, the following conclusion was drawn:

> *Railroad branch lines are relatively unimportant as a tax revenue source for the support of public services provided by political subdivisions in North Dakota. Branch line taxable valuations tend to remain relatively constant while business activity and agricultural technology continue to increase the value of other real estate. Accordingly, the branch lines' property taxes as a percent of total property tax revenues have declined. Future trends in school consolidation and the eventual modernization of local government could further reduce the importance of rail branch lines as a source of local property tax revenues. . . .Rail branch line property as a source of tax revenues to support local government services appears to be a minor consideration.*

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[28]This procedure is outlined in detail in Appendix G.

[29]The only data requirement for this estimation which has not been previously estimated or obtained from the shipper survey, is the state income tax rates. This can be obtained from the state department of revenue.

[30]These studies conflict with complaints made by county officials, who argue that branch line abandonment has significantly reduced property tax revenues.

Additionally, Janski concluded from her study of the Sherwood branch line abandonment in North Dakota, that "Rail and country elevator property tax payments represent a small percentage of total community and school budgets."

Only one method for annual property tax loss estimation has been identified. First, a survey is used to estimate which firms will close or transfer if an abandonment occurs. Next, the annual amount of property taxes paid by these firms is obtained from county tax assessors. In addition, the total annual amount of property taxes paid in the county is obtained from the county auditor. Based on the assumption that these firms will no longer pay significant amounts of property taxes, the total amount they pay annually is assumed to be the annual property tax loss. This loss divided by total county property taxes represents the percentage decline in assessments.[31] [32]

Safety

Two opposing effects can alter highway safety in the event of a rail line abandonment. First, a rail line abandonment will eliminate the possibility of accidents at rail-highway grade crossings. In contrast, a rail line abandonment can increase the possibility of traffic accidents due to the increased use of heavy trucks.

However, these two effects are not likely to have a great impact on highway safety. There are two reasons why. First, the incidence of accidents at rail-highway grade crossings on light-density lines is so low (due to the low traffic density) that elimination of these accidents will not represent a significant number. The second reason is that the increased truck mileage resulting from a light-density line abandonment is likely to be

[31]In addition to the shipper survey, information from county and local tax assessors is necessary for this estimation.

[32]A detailed description of this estimation method is shown in Appendix H.

small, since the traffic hauled on the light-density line was low. Without a large increase in truck mileage, there won't be much of an impact on highway driving. Although these effects are unlikely to be large, they still should be examined in a community impact analysis.

Energy Consumption

When a light-density rail line is abandoned there are two opposing effects on energy consumption. First, energy savings will be realized due to the discontinuance of the low volume rail shipments associated with the light-density lines. However, increased energy consumption will occur as more local and intercity traffic is necessary to transport the freight by an alternate mode. The second effect should dominate the first, since trucks are less fuel efficient than locomotives in general.

Most of the literature supports the hypothesis that the second effect will dominate the first, and that energy consumption will increase as a result of light-density line abandonment. In Janski's study of the Sherwood branch line in North Dakota it was stated that:

> *Consumption of fuel would be 259,249 gallons per year less with rail service than it would be if grain was transported by truck. With rail and country elevator service the quantity of fuel required would be 576,940 gallons per year more than it would be if grain producers deliver their grain directly to main line rail service.*

The net change in fuel consumption resulting from a rail abandonment will be influenced by several factors. The factors influencing the reduction in rail fuel use are changes in distance traveled, running speed, "dead head" time, load size, train size, type of traction power, switching time, and the physical geometry of the line (primary grade and curvature) (FRA). The factors influencing the truck fuel consumption are the size of the load, the type of terrain, the distance traveled, the type of equipment used, and the speed of travel (FRA).

There are two existing methods for estimating the change in energy consumption resulting from a rail line abandonment. These two methods differ greatly in the amount of detail in the estimate produced. The first method, which produces very detailed estimates, uses detailed information on rail line and highway route alignments and on operating characteristics.[33] The second method is based on system averages and approximations.[34]

Noise Pollution

Rail line abandonment will likely change both the magnitude and the distribution of noise pollution. Noise pollution will decrease along the abandoned rail line, while it will increase along highway routes. This is the case as rail traffic is diverted to truck. Thus, the relative populations living along the rail line and the highway routes should be considered. If there is an insignificant number of people living along a highway route in comparison to the number living near the rail line, then the rail line abandonment may actually improve noise pollution.

Because the estimation procedure for increased noise pollution is very complex[35] and requires a lot of data, some general guidelines are suggested (FRA)[36]. The first guideline

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[33]This method is outlined in detail in Appendix I. It requires the following data sources: the shipper survey, annual R-1 reports, the waybill sample, highway and system maps, and contour maps.

[34]This method is also outlined in Appendix I. It requires the use of the shipper survey, and highway and system maps.

[35]The method for estimating noise pollution is detailed in Appendix J. Data needed for this analysis includes survey data, highway and system maps, state department of transportation highway capacity data, and aerial photographs.

[36]Creighton, Hamburg Inc., *Manual For Pennrail Community Impact Study*, (Harrisburg: 1975).

states that "if existing peak period truck traffic is greater than 40 trucks per hour and rail abandonment generates fewer than 40 trucks in the peak period, impact will be negligible"(FRA). The second guideline for less than 40 trucks per hour during peak periods states that if: (1) the ratio of generated to existing truck traffic is below .15 then the noise impact is negligible; (2) the ratio of generated to existing truck traffic is between .15 and .5 then the noise impact is slight; and (3) the ratio of generated to existing truck traffic is between .5 and 1 then further analysis is required. In addition to these guidelines suggested by FRA, one more guideline should be applied. This guideline states that the noise pollution estimation should not be performed when a significant population along the highway route is non-existent.

In order to use the above guidelines two steps could be taken. First, a simple model could be developed to convert current rail car loadings along a line into anticipated truck loadings, based on the assumption that businesses along the line maintain current levels. This in conjunction with an estimation of current truck traffic could be used for the FRA guidelines. Second, aerial photographs can be obtained from the State Department of Transportation. These photos could be used in conjunction with highway maps to determine whether a significant number of residents live near highway routes.

Water Pollution

The effects of rail abandonment on water pollution levels are difficult to measure. Several effects of rail abandonment on water quality may be positive. First, there may be a small positive effect on the water quality of an area after rail abandonment due to the elimination of herbicide use in controlling right-of-way vegetation growth. Thus, leaching and runoff of these chemicals from right-of-ways will be eliminated. Additionally, the risk of chemical pollution from derailments will be eliminated . Finally, railroad causeways can be eliminated, putting an end to much of the artificial impoundment of water. There could also be a negative impact on water quality due to rail abandonment. Trucks use de-icing compounds, which can damage water quality. However, it is rare that transportation alterations produce measurable changes in the local water quality.

The purpose of this chapter has been to define a set of variables appropriate for use in community impact assessment, and to describe at least one method of estimating each variable. It is not recommended that each item be evaluated in every case. In fact, as discussed earlier, some of the environmental effects of abandonment may be so negligible in North Dakota that it is difficult to warrant their evaluation (in any case).

V. COMMUNITY IMPACT ANALYSIS DATA SOURCES

The following section will detail the types of information which can be obtained from the shipper, rail carrier, and motor carrier surveys. A portion of the data required for CIA and the NOLAM model is available through secondary research, but a large amount must be collected through primary sources.

Shipper Survey Requirements

The data requirements for the shipper survey are shown in Table 5. The general guidelines for data requirements are taken from Chapter 2 of the FRA's *Rail Planning Manual*. However, numbers 19 through 22 are added to the list to make the model more comprehensive for analysis of North Dakota rail lines.

Rail Carrier Survey Requirements

The data requirements for the rail carrier survey are shown in Tables 6, 7, and 8. Table 6 shows data requirements for all rail carriers, while Tables 7 and 8 show the additional data requirements for Class I and short line carriers, respectively. The general guidelines for data requirements are found in Chapter 2 of the FRA's *Rail Planning Manual*. The additional items are added in order to gain more information about rail carriers in North Dakota. Fortunately, much of the traffic data, particularly grain traffic, are available in public files. Some of the other data items could be developed from the waybill sample, or other sources.

Motor Carrier Survey Requirements

The data requirements for the motor carrier survey are shown in Table 9. Additionally, questions may need to be addressed in the motor carrier survey regarding the numbers of new employees needed in the case of rail abandonment. New employees would include not only truck drivers, but also mechanics, secretaries, and bookkeepers. A model has been developed which determines the estimated number of new employees hired by trucking firms after rail abandonment. The current model does not include estimates of increases in the number of mechanics, secretaries, and bookkeepers, but that information would not be difficult to incorporate into the existing model.

Community Impact Analysis Secondary Data Requirements

The analysis of the community impact caused by rail abandonment requires several types of information which must be gathered from secondary sources including federal, state, and local government, social services, local trucking firms, and affected community officials. The data items in Table 10 will be required for completion of a community impact analysis. Table 11 lists the publications required in CIA secondary research, while Table 12 lists the federal and state offices used for data in CIA research.

TABLE 5. SHIPPER SURVEY REQUIREMENTS

1. Identification
   a. Name
   b. Address
   c. Phone no.
   d. Name and title of respondent
2. Private siding/team track
3. Distance to nearest alternate team track facility at which service will be continued
4. Estimated job losses due to:
   a. Plant closing
   b. Transfer of operations
   c. Reduced production
5. Type of business
6. Annual sales volume in dollars
7. Total present employment of firm
8. Annual property tax; tax jurisdictions
9. Anticipated capital investment due to abandonment
10. Radius of firm's market (selling area)
11. Mode to be used in the event of abandonment
12. Annual no. of carloads per commodity
13. Annual tonnage per commodity
14. Shipment origin of each commodity
15. Shipment destination of each commodity
16. Average weight per carload by commodity
17. Revenue/car-mile by commodity
18. Station
19. Type - originating or terminating
20. Shipment type:
    a. Type 1 = Single (1-2) car shipment
    b. Type 2 = Small multiple (3-15) car shipment
    c. Type 3 = Large multiple (16-48) car shipment
    d. Type 4 = Unit train (48+) shipment
21. Car type(s)
22. Liquid or bulk

TABLE 6. RAIL CARRIER SURVEY REQUIREMENTS

1. Identification
   a. Name
   b. Address
   c. Phone no.
   d. Name and title of respondent
2. Length of rail line
3. Annual one-way locomotive trips
4. Average grade per mile segment
5. Average curve per mile segment
6. Average running speed
7. Terrain type
8. System and branch revenue
9. System and branch operating statistics
   a. Train-miles
   b. Locomotive-miles
   c. Car-miles
10. Railroad crew size
11. Railroad wage rates
12. Transshipment (loading & unloading) cost by region
13. Service frequency
14. Number of locomotives per train
15. Average number of cars per train
16. Round trip way train miles
17. Maintenance of way per mile
18. Net liquidation value per mile
19. Property taxes per mile
20. Trains per year

TABLE 7. CLASS I RAIL CARRIER SURVEY REQUIREMENTS

1. Cost of capital
   a. Road
   b. Equipment
2. Loss and damage (line related)
3. Derailment costs

TABLE 8. SHORT LINE CARRIER SURVEY REQUIREMENTS

1. Cost of capital
   a. Road
   b. Equipment
2. Crew size
3. Derailment costs
4. Loss and damage (line related)

TABLE 9. MOTOR CARRIER SURVEY REQUIREMENTS

1. Identification
   a. Name
   b. Address
   c. Phone no.
   d. Name and title of respondent
2. Levels
   a. Origin
   b. Destination
   c. Commodity
3. Data items
   a. Rates
   b. Mileages (highway)
   c. Truck-trailer type (ie: dry van, hopper, tanker, refrigerator van)

TABLE 10. SECONDARY DATA REQUIREMENTS OF CIA

1. Number of employees by industry type for each impact area
2. Average wage by county (basic and non-basic)
3. Average wage of secondary sector employees
4. Per capita income from sources other than wages, salaries, and proprietor's income
5. Population by MCD (Minor Civil Division)
6. Average household size
7. Weekly and total unemployment payments by wage class
8. Average period of unemployment
9. Public assistance payments by household size
10. Total new unemployment claimants-previous year
11. Federal and state income tax rates by salary level
12. Ambient pollutant levels
13. Environmentally sensitive areas
14. Local highway condition ratings
15. Trucking costs per ton by region
    a. Trucking wage rates
    b. Highway license, fuel, and use taxes

TABLE 11. PUBLICATIONS USED IN COMMUNITY IMPACT ANALYSIS

1. UGPTI Report No. 67
2. UGPTI Report No. 68
3. UGPTI Rail Database
4. ND System maps
5. ND Track charts
6. Highway maps
7. Contour maps
8. *Wage and Benefit Surveys*
9. *North Dakota Employment and Wages*
10. *Directory of Labor Market and Occupational Information*
11. *Economic Characteristics*
12. *Census Tracks*
13. *U.S. Census of Population*
14. *Transport Statistics in the U.S.*
15. *North Dakota Business Directory*

TABLE 12. GOVERNMENT OFFICES USED IN COMMUNITY IMPACT ANALYSIS

1. State Department of Labor
2. State Highway Department
3. Public Service Commission
4. Economic Development Commission
5. County Department of Social Services
6. State Department of Commerce
7. U.S. Treasury Department
8. Internal Revenue Service
9. Bureau of Statistics
10. State Income Tax Bureau
11. County Tax Assessor's Office
12. County Auditor's Office

VI. SUMMARY AND CONCLUSIONS

Since 1980, over 750 miles of branch line have been abandoned in North Dakota. More than 50 communities and 3 counties have lost rail service as a result of abandonment. The North Dakota Department of Transportation predicts that an additional 1800 miles of track could be abandoned by the year 2020. Due to the potential consequences of branch line abandonment, communities, carriers, shippers, and governments have begun to explore new alternatives to discontinuing service.

One option (which preserves local rail service) is rehabilitation of the rail line using federal funds. In order to qualify for federal loans under the Local Rail Freight Assistance Act, it must be demonstrated through benefit/cost analysis that a branch line is a worthwhile recipient of rehabilitation funds. In past years, benefit/cost analyses have been performed at the Upper Great Plains Transportation Institute (UGPTI) using NOLAM (North Dakota Line Segment Analytical Model). NOLAM is designed to analyze the viability of individual line segments and to simultaneously determine both the primary and secondary efficiency benefits which accrue from rehabilitation.

One possible shortcoming of the existing North Dakota benefit-cost procedure is that it does not consider the impact of abandonment on the economic, social, and environmental health of a community. The FRA rail planning manual suggests that community impact analysis be conducted along with benefit/cost analysis for line segments prior to abandonment. "The general purpose of community impact analyses is to identify and evaluate the total impacts of discontinuing rail service on light density rail lines, including social, economic, environmental, energy, and other contributing factors" (FRA).

Due to the magnitude of the choices available to rail carriers, shippers, and communities, and their associated costs and impacts, the selection of CIA variables is extremely important. Based on the literature review presented in Section 2 of this report, the following thirteen variables have been selected as major CIA factors: (1) increased capital costs, (2) changes in transportation costs, (3) primary job loss, (4) secondary job loss, (5) wage and salary losses, (6) increased unemployment compensation/public assistance payments, (7) personal income losses, (8) income tax losses, (9) property tax losses, (10) safety, (11) energy consumption, (12) noise pollution, and (13) water pollution. This set of variables should be considered in any detailed CIA study.

Changes in transportation costs are captured by the present North Dakota methodology. Environmental effects (increased energy consumption, noise, and water pollution) are typically not a major concern in rural North Dakota, as the incremental truck traffic from a given light-density line is usually not sufficient in scale to generate major impacts. However, in the event of major feeder line or mainline abandonments, environmental impacts may warrant evaluation. According to the revised (1990) FRA benefit-cost guidelines, primary and secondary job losses (and resultant unemployment compensation) must be statewide in scope before they can be considered impacts in a state-funded rehabilitation project. Many displaced employees in the local community are typically re-employed elsewhere within the state within a one year time-frame. When this occurs, job losses cannot be considered as impacts for federal or state-funded projects. Furthermore, a study of grain elevators in Iowa after abandonment showed little impact in this sector of the economy, either in terms of business losses or job losses. Most elevators have substitute truck service available. So, business failures and primary job losses on grain branch lines have historically been insignificant factors in rail abandonment impact analysis.

Overall, the study has revealed a potential need for community impact analysis *in certain instances.* Some situations which might warrant a detailed community impact assessment are:

1. When many non-grain shippers are located on a branch line;
2. When some or all of the shippers have substantial investments in facilities designed exclusively for rail transport;
3. When truck transportation is not a viable option due to commodity characteristics;
4. When some or all of the shippers would have to construct new facilities to allow truck handling of commodities;
5. When one industry or plant on the line employs a relatively large number of people.

In general, light-density lines which handle grain exclusively (or predominantly) are not likely to generate substantial community impacts. The potential for major community impacts is typically present when substantial non-grain shippers are located on a line, and one or more of the remaining four items noted above holds true. So, the process which we propose to follow in federal/state line analysis is: first, evaluate the five general indicators listed above; second, if some of the general indicators are true, assess the scope of the CIA needed; third, project the approximate resource cost of the analysis; and fourth, evaluate the trade-off between increased information and cost.

Because of the localized nature of many of the impacts of abandonments, one or more communities may be interested in the specific effects on their cities and towns. In such instances, they may wish to commission a comprehensive community impact study, and use the results of the study to determine if they wish to subsidize or purchase the line. In this case, community impacts are examined from a local perspective, rather than a state perspective.

In conclusion, the existing North Dakota benefit-cost procedure captures many of the statewide secondary impacts of rail-line abandonment through input-output analysis. Job and wage losses that accrue to elevators, manufacturers, and other shippers are not accounted for in the current procedure. Nor are environmental, energy, and other community impacts. Some of the impacts are difficult to quantify, and would eventually be classified as transfers (using a statewide scope). Thus, this study finds that the existing state benefit-cost procedure is adequate for most foreseeable cases, and that an extensive CIA analysis should be undertaken only in special cases. If and when a detailed CIA analysis is warranted, the criteria, variables, and procedures presented in this paper will serve as a framework or set of guidelines for the study.

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The methodology outlined in the following appendices for estimating the community impacts of rail abandonment follows the methodology outlined in the FRA's *Rail Planning Manual, Volume II: Guide for Planners*. The objective of the appendices is to introduce some of the methods used to estimate community impacts. When unit costs are included in a methodology, they are done so for illustrative purposes only. The unit costs used are applicable to 1978 standards and these costs would be very different today. Caution must be exercised in using these methods, as the appearance of an impact may simply be a transfer within the state.

APPENDIX A

INCREASED TRANSPORTATION COSTS

The following steps are used to estimate the increase in transportation costs resulting from rail abandonment

1. Use the shipper survey to find the following: (1) the amount (in tons) of bulk commodities and non-bulk commodities shipped or received by rail for each shipper (consignee) which uses a private rail siding, (2) the amount (in tons) of total commodities shipped or received by rail for each shipper (consignee) which uses team tracks, and (3) the distance of all shippers from the nearest team track facility where service will be continued.

2. The information obtained in step 1 is used in conjunction with unit costs which were developed by the New York Department of Transportation[1] in order to estimate the increased transportation cost. The following calculations are performed in this estimation.

   a. For each firm with private siding:

   NYDOT estimates that transportation costs increase 8 cents per ton per mile from the team track facility with rail abandonment. They also estimate that for firms with private sidings transportation costs increase $4.15 per ton of bulk commodities shipped and $6.15 per ton of non-bulk commodities shipped. Thus the following calculations are used:

   Increased transportation cost for firms on private siding =
   (bulk tons shipped or received) * ($4.15) +
   (non-bulk tons shipped or received) * ($6.15) +
   ($.08 * distance from team track) * (bulk and non-bulk tons shipped or received)

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[1]The unit cost estimates are included for illustrative purposes only. The estimates were done in 1976, and would appear very different today. These cost estimates might be adjusted to current levels through the following steps : (1) by relate their estimates to the difference between rail and truck costs in 1976, (2) adjust rail and truck costs to current levels with the AAR Railroad Cost Indexes and the Fruit and Vegetable Truck Rate and Cost Summary, (3) if the relationship between rail and truck costs has changed, adjust the estimates accordingly. However, a new estimate of the changes in transportation costs due to rail abandonment for specific commodities and distances in North Dakota would be preferred.

b. For each firm using team track:

NYDOT estimates that for firms using team track transportation costs increase $2.15 per ton for bulk and non-bulk commodities. Thus the following calculations are used:

Increased transportation cost for firms using team track =
(total tons shipped or received) * ($2.15) +
($.08 * distance from team track) * (total tons shipped or received)

3. Total increased transportation cost[2] =
Increased transportation cost for firms on private siding +
Increased transportation cost for firms using team track

<u>References as shown in *Rail Planning Manual, Volume II: Guide For Planners*</u>

1. New York State Department of Transportation, *New York State Rail Plan*, (Albany, New York; January, 1976).

2. CONSAD Research Corporation, *Analysis of Community Impacts Resulting From the Loss of Rail Service*, United States Railway Association, Washington, D.C.; 1974.

3. *Comparative Costs Analysis*, United State Railway Association, Technical memorandum; January, 1975.

4. *Freight Commodity Statistics for Motor Carriers*, Interstate Commerce Commission, Washington, D.C.; 1971.

5. *Cost of Storing and Handling Grain in Commercial Elevators*, Economic Research Service, United States Department of Agriculture, FDS-252; February, 1974.

[2]These increased transportation costs should not include firms closing or moving. Also for firms that are reducing production, the expected fraction of reduction should be multiplied by the increased transportation costs for that firm and the ensuing total should be subtracted from increased transportation costs.

APPENDIX B

PRIMARY JOB LOSSES

Two procedures are used to estimate primary job losses[3] resulting from rail abandonment. These two procedures are outlined below.

Procedure #1

1. Use the shipper survey to estimate the amount of jobs lost to transfers out of the state, to closings, and to reduced production.

2. Use the rail carrier survey to estimate the amount of railroad jobs lost.

3. Use the motor carrier survey to estimate the percentage of local incremental trucking costs due to wages, and to estimate the average salary of the local trucking employee.

4. Use Appendix A to estimate the increase in transportation costs.

5. Estimate the increase in trucking jobs as follows: (a) multiply the increase in transportation costs of shippers in basic industries switching to truck by the percentage of local incremental trucking costs due to wages, and (b) divide the total in '(a)' by the average salary of the local trucking employee.

6. Add jobs lost in industry to jobs lost by rail workers and subtract jobs gained in trucking.[4]

Procedure #2

1. Use the shipper survey to find the total sales of the firms, the total employment of firms, and the estimated losses in business volume.

2. Use the rail carrier survey to estimate rail worker losses.

3. Estimate the increase in transportation costs as in Appendix A.

4. The ratio of the increase in transportation costs to total annual sales is used to estimate job losses. This ratio will produce different estimates of job losses for different types of firms.

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[3]As noted previously, extreme caution must be taken in estimating primary and secondary job losses, since they may actually be transferred within the state.

[4]As noted in the text, jobs lost by rail workers and truckers should probably not be included as primary losses since rail and truck shipments don't create wealth. However, they are included as in the *Rail Planning Manual, Volume II: Guide For Planners*.

<u>References as shown in *Rail Planning Manual, Volume II: Guide For Planners*</u>

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

2. CONSAD Research Corporation, *Analysis of Community Impacts Resulting from the Loss of Rail Service*, Volume I - Documentation, prepared for U.S. Railway Association (Washington: February, 1975).

APPENDIX C

SECONDARY JOB LOSSES

Two procedures are used to estimate secondary job losses resulting from rail abandonment. These two procedures are outlined below.

Procedure #1

1. Use shipper survey to estimate wage and salary losses in basic industries.

2. Estimate multiplier by dividing county non-basic employment by basic employment.

3. Estimate the amount of transport cost increases that are absorbed by basic industries with the following equation:

(increased transport cost) * (portion of production maintained after rail abandonment) * (market area factor)

where:

market area factor = 1.0 when market area is 0-25 miles
0.5 when market area is 25-50 miles
0.1 when market area is greater than 50 miles

4. Total basic industry wage, salary, and income losses equal wage and salary losses plus the amount of transport increases absorbed by the industry.

5. In order to estimate secondary employment losses, multiply total basic wage, salary, and income losses by the non-basic to basic multiplier, and divide the ensuing total by the average county salary.

Procedure #2

1. Use the shipper survey to estimate primary income losses.

2. Use census publications to estimate the number of secondary sector employees in the community, and the secondary sector income.

3. This procedure assumes that the loss in secondary sector income is a multiple of primary sector income, and uses the following income multiplier.

$$My = 0.5 + \frac{Pc/50}{\max(P_m/D_m)} \quad \text{(not to exceed 1.5)}$$

Where Pc = population of the largest incorporated place or township in the community,

P_m = population of some incorporated place or township not in the community but within 50 miles of it,

D_m = distance (in road miles) between the latter place and the center of the community, and the second community is chosen so as to maximize the ratio P_m/D_m

4. Use this multiplier in conjunction with primary income losses to estimate secondary income losses.

5. In order to obtain secondary sector job losses, take the following steps. First, divide secondary income losses by the total wage and salary income of secondary sector employees. Next, square the result, and multiply it by the number of employees in the secondary sector. The total equals secondary sector job losses.

References as shown in *Rail Planning Manual, Volume II: Guide For Planners*

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

2. CONSAD Research Corporation, *Analysis of Community Impacts Resulting from the Loss of Rail Service*, Volume I - Documentation, prepared for U.S. Railway Association (Washington: February, 1975).

3. States of Wisconsin and Michigan, Harbridge House, Inc., and CONSAD Research Corporation, *Rail Planning Procedures Report*, prepared for Federal Railroad Administration, U.S. Department of Transportation, (Springfield, VA: NTIS, 1975)

APPENDIX D

WAGE AND SALARY LOSSES

The following steps are used to estimate the wage and salary losses[5] resulting from rail abandonment.

1. Use the shipper survey to estimate primary wage and salary losses.

2. Use the motor carrier survey to estimate the percentage of local incremental trucking costs due to wages.

3. Estimate the multiplier by dividing non-basic employment by basic employment for the community.

4. Multiply basic sector wage and salary losses by the non-basic to basic multiplier in order to estimate secondary wage and salary losses.

5. Estimate the amount of transport cost increases that are absorbed by basic industries with the following equation:

   (increased transport cost) * (portion of production maintained after rail abandonment) * (market area factor)

where:

market area factor =	1.0 when market area is 0-25 miles
	0.5 when market area is 25-50 miles
	0.1 when market area is greater than 50 miles

6. Multiply the transport cost increases absorbed by basic industries by the non-basic to basic multiplier. The ensuing total equals the wage and salary losses that result from absorbed transport cost increases.

7. Estimate the increase in trucking wages and salaries by multiplying the increase in transportation costs of shippers in basic industries switching to truck by the percentage of local incremental trucking costs due to wages.

8. The total wage and salary losses equal primary wage and salary losses plus secondary wage and salary losses plus the wage and salary losses resulting from absorbed transport cost increases minus trucking wage and salary gains.

[5]Again, extreme caution must be exercised in estimating wage and salary losses, as wages and salaries may simply be transferred within the state.

References as shown in *Rail Planning Manual, Volume II: Guide For Planners*

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

2. U.S. Railway Association, *Analysis of Community Impact Resulting from the Loss of Rail Service*, prepared by CONSAD Research Corporation (Washington: 1974) Vol. III.

3. Office of Public Counsel, Rail Services Planning Office, Interstate Commerce Commission, *Guide for Evaluation the Community Impact of Rail Service Discontinuance*, (Washington: 1975).

APPENDIX E

INCREASED UNEMPLOYMENT COMPENSATION AND PUBLIC ASSISTANCE PAYMENTS

Two procedures are used to estimate increased unemployment compensation and public assistance payments resulting[6] from rail abandonment. These two procedures are outlined below.

Procedure #1

1. In order to estimate the increased unemployment compensation and public assistance payments due to primary job losses the following steps are taken:

(1) Use the shipper survey to obtain the average annual wage for each primary firm, and the number of expected layoffs due to rail abandonment.

(2) Obtain unemployment compensation estimates for the average period of unemployment in the state for each firm's average annual wage from the state department of labor.

(3) Multiply the applicable unemployment compensation estimate by the total number of expected layoffs for each firm. The sum of the totals of each firm will represent the primary increase in unemployment compensation due to rail abandonment.

(4) Find the maximum public assistance allowance per household from the department of social services.

(5) If the maximum public assistance allowance is greater than the unemployment compensation estimate for a particular firm's wage, then the difference between the two is multiplied by the number of layoffs for that firm. This will equal the primary increase in public assistance payments due to rail abandonment.

2. In order to estimate the increase in unemployment compensation and public assistance payments due to secondary job losses the following steps are taken:

(1) Obtain an unemployment compensation estimate for the average county wage for the average period of unemployment in the state from the state department of labor.

(2) Multiply secondary layoffs (as estimated in Appendix C) by the unemployment compensation estimate. This will equal the secondary increase in unemployment compensation due to rail abandonment.

(3) If the maximum public assistance allowance is greater than the unemployment compensation at the average county wage, then multiply the

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[6]Since jobs may be transferred within the state, extreme caution must be used in estimating increases in unemployment compensation and public assistance.

difference between the two by the amount of secondary layoffs. This will equal the secondary increase in public assistance payments due to rail abandonment.

Procedure #2

1. Calculate the average unemployment compensation in the state by dividing the total amount of unemployment compensation paid by the state in the previous year by the total number of unemployment recipients in the previous year.

2. Multiply the total number of primary and secondary job losses (Appendices B and C) by the average unemployment compensation.

3. Under the assumption that the period of unemployment that will take place due to a rail abandonment will be 50 percent longer than the average length of unemployment due to normal circumstances[7], the above total is multiplied by 1.5. This equals the increase in unemployment compensation due to rail abandonment.

<u>References as shown in *Rail Planning Manual, Volume II: Guide For Planners*</u>

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

2. CONSAD Research Corporation, *Analysis of Community Impacts Resulting from the Loss of Rail Service*, Volume I - Documentation, prepared for U.S. Railway Association (Washington: February, 1975).

[7]The *Rail Planning Manual: Volume II: Guide For Planners* does not give a reason for the 50 percent longer duration of unemployment. However, there are two possible reasons for using this figure. First, those laid off due to a rail abandonment are likely to have highly specialized skills (due to the nature of the affected firms, e.g. manufacturing). These workers will have more difficulty finding a job in the state to meet those skills. Second, workers who are laid off as a result of rail abandonment are more likely to receive displaced worker settlements from the company. This is a windfall income, which acts to supplement the unemployment compensation that the workers receive. Under such circumstances workers are more likely to exert less effort in finding another job until the settlement money is gone.

APPENDIX F

PERSONAL INCOME LOSSES

The following procedure is used to estimate personal income losses resulting from rail abandonment.

1. Subtract the increase in unemployment compensation and public assistance payments (Appendix E) from the loss in wages and salaries (Appendix D). This will equal the total decrease in personal income.

References as shown in *Rail Planning Manual, Volume II: Guide For Planners*

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

APPENDIX G

INCOME TAX LOSSES

The following procedure is used to estimate the income tax losses resulting from rail abandonment.[8]

1. For primary firms, multiply the average salary of the firm by the applicable state tax rate and then by the expected number of job losses for that firm. This will provide an estimate of primary state income taxes lost due to abandonment.

2. For secondary firms, multiply the average county salary by the applicable state tax rate and then by the expected number of job losses in the secondary sector (Appendix C). This will provide an estimate of secondary state income taxes lost due to abandonment.

<u>References as shown in *Rail Planning Manual, Volume II: Guide For Planners*</u>

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

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[8]Caution must be used in estimating state income tax losses from rail abandonment since a job loss in one part of the state may create a job gain in another part of the state.

APPENDIX H

PROPERTY TAX LOSSES

The following procedure is used to estimate the local property tax losses resulting from rail abandonment.

1. Use the shipper survey to estimate which firms would close or transfer with abandonment.

2. Obtain estimates of the property taxes paid annually by the closing firms from local tax assessors. In addition obtain an estimate of the total amount of property taxes collected by the jurisdiction annually.

3. Assume that the closing firms will not pay significant amounts of taxes after they close. The loss of property taxes is then equal to the sum of the taxes paid annually by those firms which would close.

4. The estimated percentage decline in property taxes collected is the estimated decline in annual property taxes divided by the total collected in the jurisdiction annually.

References as shown in *Rail Planning Manual, Volume II: Guide For Planners*

1. T. J. Humphrey, *Framework for Predicting External Impacts of Railroad Abandonment*, prepared for Office of University Research, Department of Transportation/OST (Springfield, Va: National Technical Information Service, 1975).

2. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

APPENDIX I

ENERGY CONSUMPTION

Two procedures are used to estimate changes in energy consumption resulting from rail abandonment.[9] These two procedures are outlined below.

Procedure #1

1. For all shippers or consignees shipping or receiving freight on the line do the following:

   a. Estimate the number of carloads per train (total carloads per year divided by trains per year).
   b. Compile the number of carloads per year for each commodity and the weight by shipper location.
   c. Estimate the average weight of the cargo at each pick-up and delivery location
   d. Estimate the total train weight at each shipper location.
   e. Estimate the total cars switched at each destination or shipper location by dividing total annual cars shipped/received by the number of trains per year, and multiply the two.

2. Tractive effort is defined as train energy plus energy losses. Tractive effort will change when there is train acceleration and deceleration, and when grade, curve, or train weight changes.

   a. First the tractive effort required for acceleration on the segment must be estimated:

$$\text{Tractive effort (lb/ton)} = \frac{\pm 70(Vi^2 - Vf^2)}{\text{Segment length (ft.)}}$$

Where:

$$\text{Segment length (ft.)} = \frac{5280(Vi - Vf)^2}{2a}$$

And:

Vi = initial train speed in MPH
Vf = final train speed in MPH
a = acceleration in MPH/hour

[9] Both of these procedures use unit values for fuel consumption. The actual values may not be appropriate, and should be reviewed for the impact analysis performed.

b. Next, the tractive effort required to overcome rolling resistance of the train is estimated:

Tractive effort (16/ton) = R + 20 G + 0.8 D

Where:

$$R = \frac{W_L}{W_t} * R_L * \frac{W_c}{W_t} * R_c$$

G = Grade (percent)
D = Average curve (degrees)

And:

R = Total unit train resistance (lbs/ton)
W_t= Weight of train (tons)
W_L= Weight of locomotive (tons)
W_c= Weight of cars and commodities (tons)
R_L= Resistance of locomotive (lbs/ton) =
2.6 lbs/ton @ 5MPH; 2.9 lbs/ton @ 10 MPH
3.3 lbs/ton @ 15 MPH; 4.0 lbs/ton @ 20 MPH

R_c= Resistance of cars = 2.2 lbs/ton + $\frac{121.6C}{W_t}$

C = Total number of cars in train

c. Total tractive effort is equal to the sum of tractive effort required to supply train energy for acceleration and tractive effort required to overcome rolling resistance of the train.

3. Estimate the horsepower-hours required for each segment of the line:

$$\text{Hp-hr} = \frac{\text{Total tractive effort (lb/ton) * Total train weight (tons) * Segment length (miles)}}{375}$$

4. Estimate pre-abandonment annual locomotive branch line fuel consumption.

a. Annual fuel consumption (running operation) =
Trains/year * Round trip horsepower hours
* Fuel consumption (0.06 gallons/hphr.)

b. Annual fuel consumption (switching) =
Cars switched per round trip * Number of round trips
* Time per car (0.25 hours) * Fuel consumption (3 gallons/hour)

c. Annual locomotive branch line fuel consumption before abandonment =
Annual fuel consumption (running operation) +
Annual fuel consumption (switching)

5. Estimate the increase in annual truck fuel consumption after branch line abandonment:

a. Use *ICC Statistics* to convert annual rail carloads shipped/received for each firm that remains in operation after abandonment to truckloads, by commodity type

b. For each firm and community use county highway maps to estimate the highway distances for each portion of the route to the nearest alternate team track.

c. Using the following fuel consumption rates, estimate the amount of fuel consumed over each route:

Loaded fuel consumption rate (miles/gallon)
= 8.0 - 0.12w (level terrain)
= 7.0 - 0.11w (rolling terrain)
= 5.6 - 0.085w (hilly terrain)

Where:
w = commodity weight (tons); (w = 0 for empty consumption rate)

Fuel consumption (gallons) =

$$\frac{\text{estimated truckloads * highway distance to nearest team track}}{\text{fuel consumption rate (loaded)}} +$$

$$\frac{\text{estimated truckloads * highway distance to nearest team track}}{\text{fuel consumption rate (empty)}}$$

d. Sum the fuel consumption for all routes in order to estimate the annual truck branchline fuel consumption after abandonment.

6. Use the following equation to estimate the locomotive mainline fuel consumption, before and after abandonment:

Locomotive mainline fuel consumption =
distance (miles) * commodity wt. (tons) * 0.0043 (gal./ton-mile)

7. Use the following equation to estimate the truck mainline fuel consumption after abandonment:

Fuel consumption (gallons) =

$$\frac{\text{Mainline Truck-Miles}}{6.5 \text{ mi./gal.} - (0.10 \text{ mi./gal./ton} * \text{commodity wt.})} + 0.25 \frac{\text{Mainline Truck-Miles}}{6.5 \text{ mi./gal.}}$$

8. The net change in fuel consumed equals the increase in truck fuel consumption on the branchline plus the increase in truck fuel consumption on the mainline less the reduction in locomotive fuel consumed on the branchline and mainline after abandonment.

Procedure #2

1. Annual rail and truck fuel consumption is estimated as follows:

   a. Truck Fuel = # of carloads per year * d * 2.4 trucks per carload * .2 gallons per mile

   b. Rail Fuel = # of hours per trip * # of trips per year * 12 gallons per hour

   where: d is the round trip distance between the rail user and the proposed team track facility.

References as shown in *Rail Planning Manual, Volume II: Guide For Planners*

1. Creighton, Hamburg, Inc. and R. L. Banks & Associates, *Manual for Pennrail Community Impact Study*, prepared for Office of Planning, Pennsylvania D.O.T. (February, 1975)

2. New York State Department of Transportation, *New York State Rail Plan*, (Albany, NY: 1969).

APPENDIX J

NOISE POLLUTION

The following procedure is used to estimate the local property tax losses resulting from rail abandonment.

1. With a knowledge of traffic volumes on anticipated truck routes before and after abandonment, and utilizing procedures described in NCHRPR #117, Highway Noise, A Design Guide for Engineers and in NCHRPR #144, Highway Noise, A Field Evaluation of Traffic Noise Reduction Measures, estimate the L_{10} highway noise levels at 100 feet, before and after abandonment.

2. Use the following table in conjunction with the estimated noise levels to establish significance levels for highway noise before (S_B) and after abandonment (S_A):

S_B, S_A	Highway L_{10} Noise Level at 100 Feet	Significance of Noise Pollution Impacts
0	Less than 45 dBA	of no importance
1	45 dBA to 54 dBA	of some importance
2	55 dBA to 69 dBA	significant
3	70 dBA and above	highly significant

3. With a knowledge of the average number of daytime and nighttime train operations before and after abandonment, use the following equation and table to establish significance levels for rail noise before (N_B) and after abandonment (N_A):

N = Average Daily Equivalent Number of Operations = $N_d + 10N_n$

where:

N_d = the average number of daytime train operations
N_n = the average number of nighttime train operations

Nighttime operations are given 10 times the weight of daytime operations which on a decibel scale (logarithmic) is equivalent to adding 10 dBA to the nighttime noise level.

N_B, N_A	Average Daily Equivalent Number of Train Operations (N)	Significance of Noise Pollution Impacts
0	$0 \leq N \leq 1$	of no importance
1	$1 < N \leq 2$	of some importance
2	$2 < N \leq 40$	significant
3	$40 < N$	highly significant

4. Calculate the number of residences located within 800 feet of the highway (P_H) and within 800 feet of the railroad (P_R) using truck route and rail line data:

$P_H = M_{UH} * F_{UH} + M_{NH} * F_{NH}$ and $P_R = M_{UR} * F_{UR} + M_{NR} * F^{N}_{R}$

where

M_{UH} = length of the portion of such highway routes in urban areas parallelling the branch
F_{UH} = average number of residences per mile within 800 feet of parallel highways in urban areas
M_{NH} = length of the portion of such highway routes in rural areas parallelling the branch
F_{NH} = average number of residences per mile within 800 feet of parallel highways in rural areas
M_{UR} = length of the portion of the line located in urban areas
F_{UR} = average number of residences per mile located within 800 feet of the portions of rail branch lines lying in urban areas
M_{NR} = length of the portion of the line located in rural areas
F_{NR} = average number of residences per mile located within 800 feet of the portions of rail branch lines lying in rural areas

5. Estimate the index used to evaluate the noise impacts of abandoning the line as follows:

Noise Pollution Index = $(S_A - S_B)P_H + (N_A - N_B)P_R$

<u>References as shown in *Rail Planning Manual, Volume II: Guide For Planners*</u>

1. Wisconsin Department of Transportation, *The Wisconsin State Rail Plan* (Madison: 1976).