

**OAKES TO INDEPENDENCE
BENEFIT COST ANALYSIS**

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Abstract

The Oakes to Independence line segment (the *Independence Line*) has been analyzed using North Dakota's rail-line benefit-cost model which has been employed in previous studies. The methodology has been reviewed and accepted by the FRA. It was updated in 1992 so that the analysis period, discount rate, and treatment of project costs were consistent with the new FRA benefit-cost procedures. The benefit-cost methodology is described in Appendix C. Only the major assumptions, costing techniques, and results are included in this report.

The analysis was performed by the Upper Great Plains Transportation Institute using Data provided by the Red River Valley and Western Railroad and transportation statistics maintained by the UGPTI. Using a discount rate of four percent, the overall benefit cost ratio for the project is 0.34. The analysis has shown that the project cost outlay will not be recovered in the next ten years.

Introduction

The Oakes to Independence rail line (*the Independence Line*) consists of 15.4 miles of track in south-central North Dakota (Figure 1). Though the line segment does not serve any shippers directly, it acts as a link between Red River Valley and Western's (RRVW) Third Subdivision and twenty-one shippers located on the Fourth and Sixth Subdivisions. During 1992, 2284 carloads were moved over the line. Some of the major project aspects are summarized in Table 1.

Train speed over the segment is ten miles per hour, and is not expected to increase after rehabilitation. The project includes replacing 6900 cross ties and 6000 tons of ballast. No further rehabilitation is planned for this line segment. If the line is not rehabilitated, the line will eventually be abandoned and the overhead traffic will be rerouted over the Fourth Subdivision to Davenport.

Table 1: Project Description

Mile Posts	0.0 to 15.4; 3rd Subdivision
Cost Estimate	\$313,841
Project Type	Tie/Ballast Replacement
Traffic Volume (1992)	2284 Car Loads

Track Condition

The line in question is currently rated as FRA Class I, suitable for 10 mph operation. The Section Foreman indicated that the line has been upgraded to 25 mph several times in the past. However, the increased traffic speeds had caused severe maintenance problems with the rail.

The line is laid with primarily 72# rail dating from 1909 to 1913. All but three curves have been re-laid with 112# ribbon rail. The rail currently in place, though old, seems to be handling the current traffic demand. Several broken rails were noted, along with some broken angle bars. The Section Foreman stated that rail problems were not frequent with traffic moving at 10 mph, but quite common at 25 mph. Most of the defects were located in spots where the subgrade was in poor condition, suggesting that the defects may be associated with undue deflection from lack of support.

The design of 72# pound rail is one which has been long out-dated. Modern car weights are simply far too stressful for rail of this size. However, it seems that the 72# section is rather resilient when care is taken. It is not known when or if rail replacement can be justified in the future, so every effort should be made to maintain what is currently in place. This means that trains should not be operated over ten miles per hour regardless of sub-grade conditions. The increased stresses associated with the speed increase have been shown to be too great both mathematically and empirically.

Tie condition is fair to good. Tie counts consistently showed between 400 and 500 defective ties per mile. This is better than what was expected. However, many of the ties currently in-place appear to be rather old and nearing the end of their expected serviceable life. During an earlier project in 1988, the RRVW inserted three thousand ties. Other ties have been inserted as needed since then. It would seem that most of failed ties are in locations of severely fouled ballast. Many of these failing ties are much younger than their counterparts found in well drained areas. Most have been broken or crushed as a result of moving trains and attempts to raise the track with mud jacks.

The ballast condition varies from place to place. Where the track is well drained, the ballast condition and line is quite good, benefiting from the 1988 project. There are several spots where the ballast was spread thin in 1988 which need some attention. However, where the ballast is in good shape, the alignment of the track is excellent.

Drainage along the line is very poor. Nearly every section of track which suffers from poor line, ballast, or ties is in a location where water is prohibited from draining freely from the track. The only way to insure the long-term serviceability of this line is to solve the drainage problems.

There are no specific switches in place along the line as there are no shippers between Oakes and Independence. There is only one bridge structure. There is no indication that the structure suffers from any deterioration.

Operations

Operating statistics for the year 1991 indicated that 168 trips were made between Wahpeton and Edgeley. Trains leave Breckenridge with traffic destined between Wahpeton and Oakes as well as traffic for Englevale to Edgeley. When the Sixth Subdivision between Montpelier and La Moure is to be served, that traffic is also included in the train. Stations between Wahpeton and Oakes are served en-route to Independence.

Once trains reach Independence, traffic destined for Englevale is left on a siding as necessary. The train then continues to Edgeley. If the Independence to Englevale segment is to be served, the train then returns and distributes cars to Verona and Englevale. Traffic from these two stations only constitutes 16 percent of the total traffic on this segment. In the event that the line from La Moure to Montpelier is to be served, trains are run in a similar fashion. This line produced nine revenue carloads of traffic in 1991.

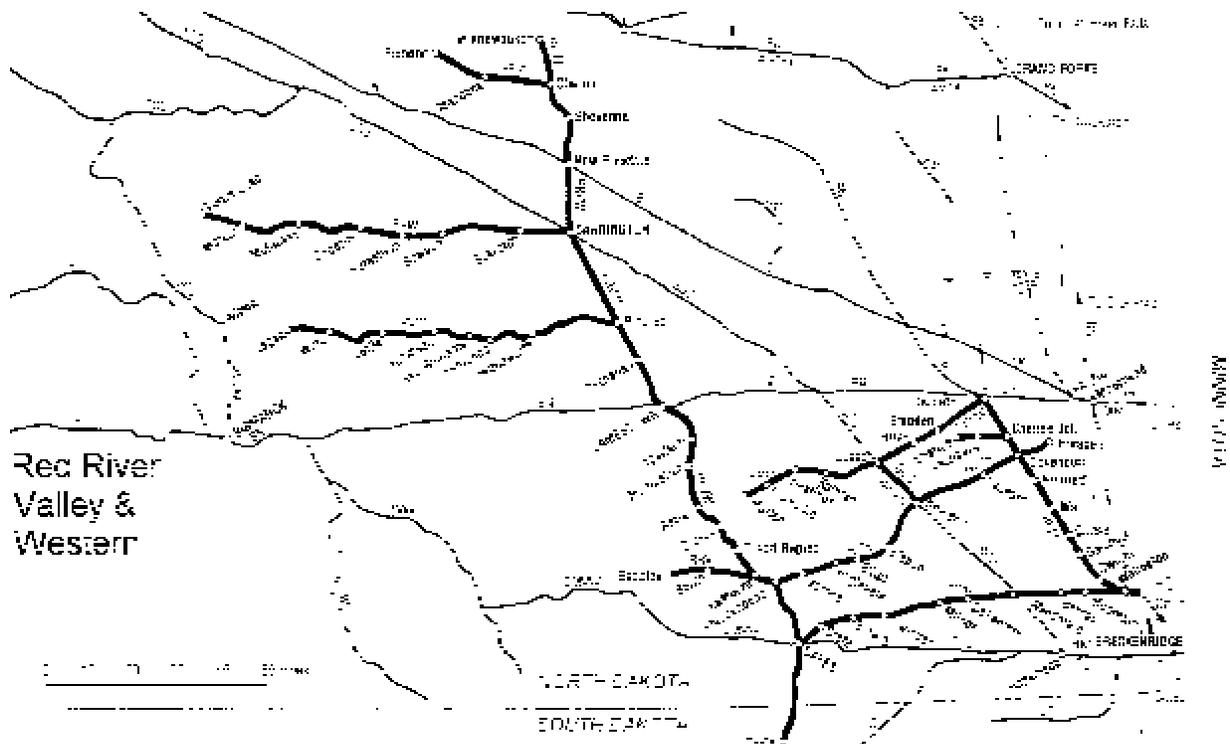


Figure 1: RRVW Regional Map

Base Case Scenario

If the line is not rehabilitated, the RRVW has indicated that the line could possibly be abandoned within five years. Thus, the base case analysis reflects abandonment in year five. After abandonment, the Englevale to Edgeley line would be served via the Wahpeton-Davenport-Edgeley route, rather than through Oakes. Therefore, it was assumed that no traffic would be diverted to highways as the shippers should see little change in service.

The analysis assumes that 168 trips per year are made to Independence. At this point the train either goes to Englevale (64 trips per year) or to Edgeley (104 trips per year). Although both stations are sometimes served during the same trip, other operating circumstances will counter-balance any efficiencies in operating costs resulting from common train service. Each train does not traverse the entire line to Edgeley or Englevale on every trip, but merely stops at the last station to be served. This accumulated difference in distance should nearly equal the cost to serve both lines during the same trip.

The line between La Moure and Montpelier is also served in this fashion. However, 1991 operating statistics show that only nine cars were moved off this segment in 1991. Operations over this branch would not be significant enough to include in the analysis.

Traffic statistics for 1992 indicate that 2284 cars were originated or terminated from Englevale to Edgeley during 1992. Two locomotives were used in all cases due to the additional traffic handle from Wahpeton to Oakes. Red River Valley and Western data shows that 6968 cars were moved between Wahpeton and Edgeley in 1991, and 360 between Englevale and Independence. This means that 5044 cars were distributed between Oakes and Wahpeton. Furthermore, an additional 176 cars were moved from Wahpeton to Oakes destined for the Hecla branch. Therefore, the attributable off-branch costs are 30.43 percent of the operating budget between Oakes and Independence.

After abandonment, traffic would move via Davenport. During 1991, the Davenport to Sheldon portion of the Fourth Subdivision was serviced 96 times. The Sheldon to Elliott Segment was serviced 36 times. The logical method of operation after abandonment would be to service the Davenport to Elliott portion of the line as part of the Edgeley turn. Horace traffic was excluded from the post-abandonment analysis as it produces only around 100 revenue carloads per year.

After abandonment in the base case, there would be 144 trips per year to Edgeley. No switching service would be performed by the Edgeley local between Wahpeton and Davenport. Local service between Davenport and Sheldon would be provided as part of the train operation to Edgeley as well as the trips to the Lucca to Marion line. The Marion line generated 404 carloads during 1991, constituting

approximately 21 percent of the traffic volume moving between Ransom Junction and Davenport for the abandonment scenario. It was assumed that 21 percent of the traffic generated between Sheldon and Davenport would be handled by this train rather than the Edgeley train.

During 1991, 1525 cars were generated between Horace and Lisbon. This would increase to 3809 after abandonment. Therefore, the off-branch operational costs were computed to as 59.96 percent of the train costs between Englevale and Wahpeton.

Only the operating expenses were used in the comparison of base and project case costs. The net change in Cost of Capital of track assets, Normalized Maintenance of Way, and Maintenance Overhead should remain fixed as the total assets held by the RRVW will not change. Only in the case where the Oakes to Independence segment is abandoned is this cost included as a separate avoidable cost in the benefit-cost equation.

Project Scenario

Due to the concerns outlined in the Track Condition section, no change in maintenance-of-way or operating savings were computed. The only change in cost is the Cost of Capital of track assets, which changes from zero, to \$3,242. The rehabilitation cost estimate is shown in table two.

Table 2: Red River Valley & Western R.R. Co. Oakes to Independence Tie Replacement Cost Estimate			
Cost Item	Quantity (Units)	Unit Cost	Cash Cost
Installation:			
Work Train Service, Scatter Ties	18 days	\$220/day	\$ 3,960
Labor	48 man-days	140/ man-day	6,720
Backhoe	14 weeks	670/week	9,380
Tie Installation, Labor	397.5 man-days	140/ man-day	55,650
Surfacing Costs, Labor	81,300 lf	0.131/lf	10,650
Material:			
Ties	6930	16.22 each	112,405
Spikes	86 kegs	70/keg	6,020
Ballast	6000 tons	5.75/ton	34,500
Surfacing Costs, Equipment	81,300 lf	0.139	11,301
Work Train, Ballast	12 days	280/day	3,360
Other:			
Administration & Overhead		5%	12,697
Project Contingencies		6%	15,999
Freight-Ballast	60 cars	\$520/car	31,200
Total Project Cost			\$ 313,841

Operational Costs

Both the on and off-branch costs used in computing the operational expenses were derived from RRVW's accounting and operational data. Most of the unit costs are averages for the entire RRVW system. The unit costs were separated into fixed and variable components using data from previous analyses of short line and regional carriers operating in the mid-west.

Only the operational expenses were computed for all but the Oakes to Independence segment. No maintenance or operational savings could be computed for the rehabilitation case. Furthermore, if the line were to be abandoned, the only difference in maintenance expenditures would be the savings from maintaining 15 fewer miles of track.

Table 3: Base Case On-Branch Costs		
Independence to Elliott:		
Train Crew	64 trips * 5 man-hours/trip * \$16.8134/man hour	\$ 5,380.29
Locomotive Costs	64 trips * 2 locomotives * (2.5 hours * \$2.9167/hour + 18 miles * \$0.2419/mile)	1,490.68
Fuel Costs	8117.76 gallons * \$0.62/gallon	5,033.01
Overhead (90% fixed)	64 trips * 18 miles * \$0.45607/mile	525.39
Independence to Edgeley:		
Train Crew	104 trips * 5.52 hours * 2 crew * \$16.8134/hour	19,318.66
Locomotive Costs	104 trips * 2 locomotives * (5.52 hours * \$2.9167/hour + 52.6 miles * \$0.2419/mile)	5,995.28
Fuel Costs	104 trips * 5.52 hours * 28.94 gallons per hour * \$0.62/gallon	10,301.28
Overhead	104 trips * 52.6 miles * \$0.45607/mile	2,494.89

Table 4: Base Case Off-Branch Costs Wahpeton to Oakes		
Train Crew	168 trips * 15.4 hours * 2 crew * \$16.8134/hour * 30.43%	\$ 26,473.87
Locomotive Costs	168 trips * 2 locomotives * (15.4 hours * \$2.9167/hour + 146.8 miles * \$0.2419/mile) * 30.43%	8,223.35
Fuel Cost	168 trips * 15.4 hours * 28.94 gallons per hour * \$0.62/gallon * 30.48%	14,126.10
Overhead Cost	168 trips * 146.8 miles * \$0.45607/mile * 30.48%	3,418.04
Total Off-Branch Costs, Base Case		\$ 52,241.36

Table 5: Maintenance Costs Oakes to Independence		
Before Rehabilitation:		
Normalized Maintenance of Way	15.4 miles * 80 ties/year/mile * \$25/tie + 25 days per year additional maintenance * \$384/day	\$ 40,400
Maintenance Overhead	15.4 miles * \$500.37/mile	\$7,705.70
Cost of Capital	Negative-N/A	\$0.00
Maintenance Costs Before Rehabilitation (Avoidable)		\$ 48,105.70
After Rehabilitation:		
Cost of Capital	\$32,420 * 10%	\$ 3,242
Maintenance Costs After Rehabilitation		\$ 51,347.70

**Table 6: Davenport to Elliott
Base Case Operational Costs**

Elliott to Sheldon:		
Crew Costs	36 trips * 5.42 hours * 2 crew * \$16.8134/hour	\$ 6,561.26
Locomotive Costs	36 trips * 2 locomotives * (5.42 hours * \$2.9167/hour + 45 miles * \$0.2419/mile)	1,921.97
Fuel Costs	36 trips * 5.42 hours * 30 gallons/hour * \$0.62/gallon	3,629.23
Overhead	36 trips * 45 miles * \$0.45607/mile	738.83
Sheldon to Davenport:		
Crew Costs	96 trips * 5.32 hours * 2 crew * \$16.8134/hour * 79.06%	13,577.67
Locomotive Costs	96 trips * 2 locomotives * (5.32 hours * \$2.9167/hour + 44.2 miles * \$0.2419/mile) * 79.06%	3,978.37
Fuel Costs	96 trips * 6.32 hours * 30 gallons/hour * \$0.62/gallon * 79.06%	7,510.22
Overhead	96 trips * 44.2 miles * \$0.45607/mile * 79.06%	1,529.97
Davenport to Wahpeton:		
Crew Costs	96 trips * 4.4 hours * 2 crew * \$16.8134/hour * 79.06%	11,229.65
Locomotive Costs	96 trips * 2 locomotives * (4.4 hours * \$2.9167/hour + 110 miles * \$0.2419/mile) * 79.06%	25,917.97
Fuel Costs	96 trips * 4.4 hours * 30 gallons/hour * \$0.62/gallon * 79.06%	6,211.96
Overhead	96 trips * 110 miles * \$0.45607/mile * 79.06%	3,807.61
Total Davenport to Elliott Operational Costs, Base Case:		\$ 86,614.21

Table 7: Abandonment Scenario: Rerouting Edgeley Traffic Via Davenport		
On-Branch Costs (Edgeley to Elliott):		
Crew Costs	144 trips * 10.9 hours * 2 crew * \$16.8134	\$ 52,780.63
Locomotive Costs	144 trips * 2 locomotives * (5.45 hours * \$2.9167/hour + 90.1 miles * \$0.2419/mile)	15,440.09
Fuel Costs	144 trips * 10.9 hours * 30 gallons/hour * \$0.62/hour	29,194.56
Overhead	144 trips * 90.1 miles * \$0.45607/mile	5,923.80
Off-Branch Costs (Elliott to Wahpeton):		
Crew Costs	144 trips * 15.14 hours * 2 crew * \$16.8134 * 59.95%	43,957.76
Locomotive Costs	144 trips * 2 locomotives * (15.14 hours * \$2.9167/hour + 199.2 miles * \$0.2419/mile) * 59.96%	15,946.63
Fuel Costs	144 trips * 15.14 hours * \$0.62/trip * 59.96%	3,211.94
Overhead	144 trips * 199.2 miles * \$0.5607/mile * 59.96%	7,844.13
Total Operational Cost, Abandonment Case		\$ 174,299.54

A cost of capital of ten percent has been used to compute the opportunity cost of rail-line assets over the Oakes to Independence segment. This is analogous to computing a return on investment (ROI) of the net liquidation value. The cost of capital should not be confused with the discount rate, which is used to convert future benefits to present value. The prescribed FRA discount rate of four percent has been used in the benefit-cost analysis.

Off-branch operating costs were calculated as a percentage of the total Elliott to Edgeley traffic compared to the total traffic moved off-branch. This allows for cost allocation to be made to the traffic which is handled en-route to the stations included in the analysis. It has been assumed that 21 percent of the Sheldon to Davenport traffic would be handled by the train that serves the Lucca to Marion line, as it also serves the Davenport to Ransom Junction line segment as well.

Project Benefits

North Dakota utilizes a detailed benefit-cost methodology which computes the change in producers' and consumers' surpluses resulting from rehabilitation. Five major classes of non-duplicative benefits are usually computed: (1) cost savings on existing traffic due to efficiency gains, (2) shipper profits on new traffic, (3) railroad profits on new traffic, (4) avoidable highway costs, and (5) secondary economic benefits (i.e. business volume and income effects) resulting from shipper profits on new traffic. The computational approach yields conservative estimates of benefits since only the consumers' surplus on new traffic is considered in estimating secondary benefits. Furthermore, the process guards against double-counting of benefits.

In this analysis, it is unlikely that any new traffic will be generated from rehabilitation. Furthermore, abandonment will result in traffic being rerouted over the carrier's system. Thus, no additional highway traffic can be projected. As mentioned before, no savings in maintenance expenditures would result from rehabilitation. Therefore, the only change in operating expense after rehabilitation would be a change in the cost of capital of track materials.

Base case off-branch traffic would suffer as the result of abandonment because the on-branch traffic helps defray some of the operating costs to Oakes. Yet the traffic on the new route would benefit in an analogous fashion. The abandonment of track between Oakes and Independence would actually become a benefit as it represents 15.4 miles less track that must be maintained to move the same amount of traffic. There would also be a savings in serving the Davenport to Elliott segment with the train to Edgeley. All discounted benefits and costs have been provided in Appendix A.

Benefit Cost Analysis

The benefit-cost equation for this project is slightly different than most due to the unusual nature of the base case. The net present value of the project is **-623,298**. All benefits and costs are in present value. The benefit-cost equation is as follows:

<i>Benefits:</i>	Increased Operational Costs via Davenport Additional Operational Costs to the 3rd Subdivision
<i>Costs:</i>	Project Cost Absorbed Cost of Operating Between Davenport and Elliott as a Separate Train Avoided Maintenance between Oakes and Independence as a Result of Abandonment Additional Cost of Capital as a Result of the Project

Many of the avoidable costs could be treated either as benefits or costs. Some of the individual avoidable cost elements have been added to the project total, rather than being considered as benefits. However, this treatment has no impact upon the net present value of the project.

This results in the equation:

$$\frac{\$165,585 + \$154,890}{313,814 + 388,118 + \$215,562 + \$26,279} = 0.3397$$

Appendix A: Annual Benefits and Costs

Year	Present Value	Additional Re-Route Cost	Additional Cost to 3rd Sub	Additional Cost of Capital	Avoided Maint. Costs	Absorbed Sheldon Op. Costs
Annual		36952.69	34565.87	3240	48105.7	86614.21
1	0.961538	0	0	3115.385	0	0
2	0.924556	0	0	2995.562	0	0
3	0.888996	0	0	2880.348	0	0
4	0.854804	0	0	2769.566	0	0
5	0.821927	30372.42	28410.63	2663.044	39539.38	71190.57
6	0.790315	29204.25	27317.91	2560.619	38018.63	68452.47
7	0.759918	28081.01	26267.22	2462.134	36556.38	65819.68
8	0.73069	27000.97	25256.94	2367.436	35150.36	63288.15
9	0.702587	25962.47	24285.52	2276.381	33798.43	60854
10	0.675564	24963.91	23351.46	2188.828	32498.49	58513.46
Total		\$ 165585	\$ 154890	\$ 26279	\$ 215561	\$ 388118