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THE TRANSPO GROUP

RAILROAD CROSSING CLOSURES for Otis Orchards Area

Prepared for:

Spokane County
Purchasing Department

July 15, 1999

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Prepared by:

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EXECUTIVE SUMMARY

The purpose of this project is to analyze the potential impacts of closing four at-grade highway-railroad grade crossings in Spokane County, Washington. This report provides a detailed analysis of the expected impacts on traffic operations, benefits and costs of the proposed closures, and a discussion of potential community impacts. This report provides objective documentation of the projects expected impacts on existing transportation operations and future 2010 transportation operations.

The project is located in the Otis Orchards area, 14 miles east of Spokane, Washington. The study area is in a rural location, between State Route 290 and Interstate 90. The Union Pacific Railroad (UPRR) owns and operates rail service through the core of the Otis Orchards community, dividing the land between Wellesely and Euclid Roads. As a result of a report provided to the Washington Utilities and Transportation Commission (WUTC) provided by Richards & Associates, four railroad crossings are being considered for consolidation and closure. The Richards & Associate Report proposes: 1) the complete closure of Ashton, Corrigan, Arden, and Lynden; 2) relocate the crossing gates from Corrigan to Kenney and install new gates at Garry; and 3) provide emergency access roads between Campbell/Ashton, Corrigan/Harvard, and Arden/Lynden. This report evaluates two potential scenarios, 1) the impacts and benefit-cost associated with closing the four crossings and constructing cul-de-sacs at each end of the roadways in lieu of emergency access roads, and 2) the benefit-cost of gating all crossings except for Ashton Road.

As part of the project, traffic operations were analyzed for existing conditions without and with the closures, and 2010 traffic operations were analyzed for without and with the closures. To calculate traffic operations for the closure scenarios, estimations were developed for travel diversions. To estimate travel diversions, trip distributions were developed for each roadway based on exiting travel patterns. Trips were then assigned to the network based on the distributions and the estimated path for the shortest travel time. The without- and with-closure volumes were used to estimate levels of service during the PM peak hour for all 14 intersections during existing and 2010 conditions. Under the existing conditions scenario, only the intersection at Wellesley Road/Harvard road is noticeably impacted. This intersection is expected to degrade from LOS D during exiting conditions without closure to LOS E with closure during the PM peak hour. The intersection Wellesley Road/Harvard Road is expected to degrade from an existing without closure LOS D to a future 2010 without closure LOS E. The future 2010 without closure LOS E is expected to further degrade to a future with closure LOS F. Trip diversions will have an impact on the Wellesley Road/Harvard Road intersection.

The next step in the analysis was to estimate the future expected number of accidents without the closures and with the closures. This analysis was performed with the U.S. DOT Accident Prediction Model. The accident prediction formula combines two independent calculations to produce an accident prediction value. The first formula provides an initial prediction value of the number of the number of accidents at a crossing based on the characteristics of the site. The second formula utilizes the results of the first calculation as well as the accident history of the site to produce a final accident prediction value. The results of the analysis are shown in Table I.

As shown in Table I, approximately 3.3 accidents are estimated over the next 10 years if the crossings operate as they currently do. The expected number of accidents drops to 2.2 accidents and 1.7 accidents over a 10 year period under the "all gated" and "proposed closure" scenarios, respectively. The number of accidents in the study area are low because this is a single track with low train traffic volumes interacting with local rural roads with low vehicular traffic. These factors result in relatively infrequent train-vehicle conflicts. As Table I shows, the expected reduction in the number of accidents is relatively insignificant. As is demonstrated in the benefit-cost analysis section.

Table I. Estimated Number of Accidents Over 10 Year Period

	Scenario		
Location	**Current Conditions**	**All Crossing Gated**	**Proposed Closures & Gates**
Ashton	0.2080	0.0165	0.0000
Kenney	0.9240	0.6390	0.6480
Corrigan	0.1600	0.1600	0.0000
Harvard	0.3760	0.3760	0.3800
Arden	0.3270	0.1650	0.0000
Lynden	0.3600	0.1850	0.0000
Garry	0.9340	0.6410	0.6667
Total	**3.2890**	**2.1825**	**1.6950**

A sensitivity analysis was performed on the accident prediction model. This was done to better understand the degree of impact changes of traffic volume or train volume would have on the expected number of future accidents. What the analysis showed was that there is not a linear relationship between train/vehicle traffic and the predicted number of accidents at a crossing. In this instance (using Kenney Road for the analysis site), a 100 percent increase in traffic volumes yielded a 9 to 11 percent increase in predicted number of accidents. Since the predicted number of accidents was relatively low at most of the crossings, a shift in travel diversions, other than what TRANSPO estimated, will have a limited effect on the out come of the number of predicted accidents. Similar results yielded for increased train traffic. This section also helped to show the number of variables that are eliminated from the equation when a crossing is gated verses passive.

Based on data provide by Spokane County, cost estimates were developed for providing the closure and consolidation improvements, and for gating all of the crossings except for Ashton. It was estimated that the capital costs for closing the crossings and constructing the cul-de-sacs is $487,056. The cost for gating all the crossings, except for Ashton, was estimated at $406,000. Based on discussions with UPRR, operating and maintenance costs for the gated crossings was estimated at $2,000 per year per crossing.

Based on the expected reduction of accidents over the 10-year period, potential benefits were developed. The costs used for the benefit analysis are from the FHWA's Technical Advisory Report on "Motor Vehicle Accident Costs", report number T7570.2 of October 31, 1994. The report is based on guidance furnished by the Office of the Secretary of Transportation (OST). The costs presented by the FHWA are comprehensive costs that people are willing to pay (WTP) to avoid pain and the lost quality of life due to vehicle accidents. The expected economic-safety benefit of the proposed closures is $395,856, with a present worth of $321,075 at 4 percent for 10 years. The resulting benefit-cost is 0.67 for the proposed closure and consolidation scenario.

The expected economic-safety benefit of gating the crossings is $217,184, with a present worth of $176,156 at 4 percent for 10 years. The resulting benefit-cost for this scenario is 0.37. Based on this analysis, neither project would yield a positive economic return.

Local agencies and businesses were contacted and visited, to further document community impacts. Most of the groups were opposed to the closings. The emergency and medical service providers were primarily against the closures due to expected increases in response times, which can significantly impact the survivability of some victims. Businesses and agencies in the area with fixed deliver/pick up routes (i.e., Postal Service, Valley Garbage) would incur slightly increased operating expenses. Yet, other businesses, such at AT&T and TCI cable would experience no impacts due to random routes and response locations. The East Valley School District #361 voiced no concerns, stating they would simply adjust there routes appropriately.

Unfortunately, there was very little literature summarizing the issues regarding the impacts of trespassers in rural railroad locations. Trespassing is primarily an urban problem. Almost a third of the trespass victims are sitting or lying in the right of way at the time of impact, which indicates a clear negligence on the trespassers behalf or possible suicidal intentions. Most literature indicates that there is very little the railroad can do to discourage trespassers. There is strong legal precedence that trespassers, and not the owners of the land, bear the burden of taking appropriate care.

Previously, consideration was given to establishing "emergency access" roads between the closed crossings, as proposed by Richards & Associates. However, these "emergency access" roads would need to be to County Standards to provide circulation alternatives to county traffic. It was assumed that the roads would be rural residential access streets. The necessary right of way to construct this street would be 30 feet. Analysis of the construction of the eight "emergency access" roads would prove to be much more expensive than the cul-de-sac approach. There would be additional costs for right of way, signing, pavement, base material, construction, etc. These additional costs would significantly increase the capital expenditure costs as well as maintenance costs. If the access roads were used the b/c ratio would be significantly worse.

INTRODUCTION

The highway-railroad at-grade crossing is a unique traffic operational situation because it constitutes the intersection of two transportation modes, which differ significantly in their physical and operational characteristics. It is the responsibility of the railway operators and the highway authorities to provide crossings that provide an adequate level of operational efficiency as well as safety.

The purpose of this report is to review the proposed closure of four at-grade highway-railroad crossings in the Otis Orchards area of Spokane County, Washington. The proposed closures are a result of recommendations provided to the Washington Utilities and Transportation Commission performed by Richards & Associates. This report provides an objective analysis of the impacts to the surrounding community as well as potential alternatives to closing the crossings. To remain objective, this report will not attempt to make recommendations, but to only present relevant facts.

Project Description

The study location is known as the Otis Orchards area, which is approximately 14 miles east of Spokane. The study area is in a rural area of Spokane County, Washington between State Route 290 and Interstate 90. As shown in Figure 1, the study area is bound by Wellesley Avenue to the north, Garry Road to the east, Euclid Avenue to the south, and Ashton Road to the west.

The Union Pacific Railroad owns and operates rail service through the core of the Otis Orchards area, dividing the land between Wellesely and Euclid. The railroad connection in this area serves as a freight connector to the Canadian rail system from major ports in Seattle and Portland. There are multiple at-grade highway-railroad crossings in this region. From Campbell Road to Garry Road there are eight crossings over a little more than 1.5 miles. Each crossing is approximately ¼ of a mile apart.

The study crossings in this area consist of Ashton Road, Kenney Road, Corrigan Road, Harvard Road, Arden Road, Lynden Road, and Garry Road. Within this study group four of the crossings are being considered for closure to vehicle traffic, while two would receive improved traffic control devices. The proposed improvements, provided by Richards & Associates, are: 1) the complete closure of Ashton, Corrigan, Arden, and Lynden; 2) relocate the crossing gates from Corrigan to Kenney and install new gates at Garry; and 3) provide emergency access roads between Campbell/Ashton, Corrigan/Harvard, and Arden/Lynden.

This report also reviews one additional scenario, which is providing active warning devices at all study area crossings. This is done to provide the cost effectiveness of an additional alternative. This report provides a benefit/cost analysis of the proposed improvements, as well as documenting the impacts to the community and emergency services.

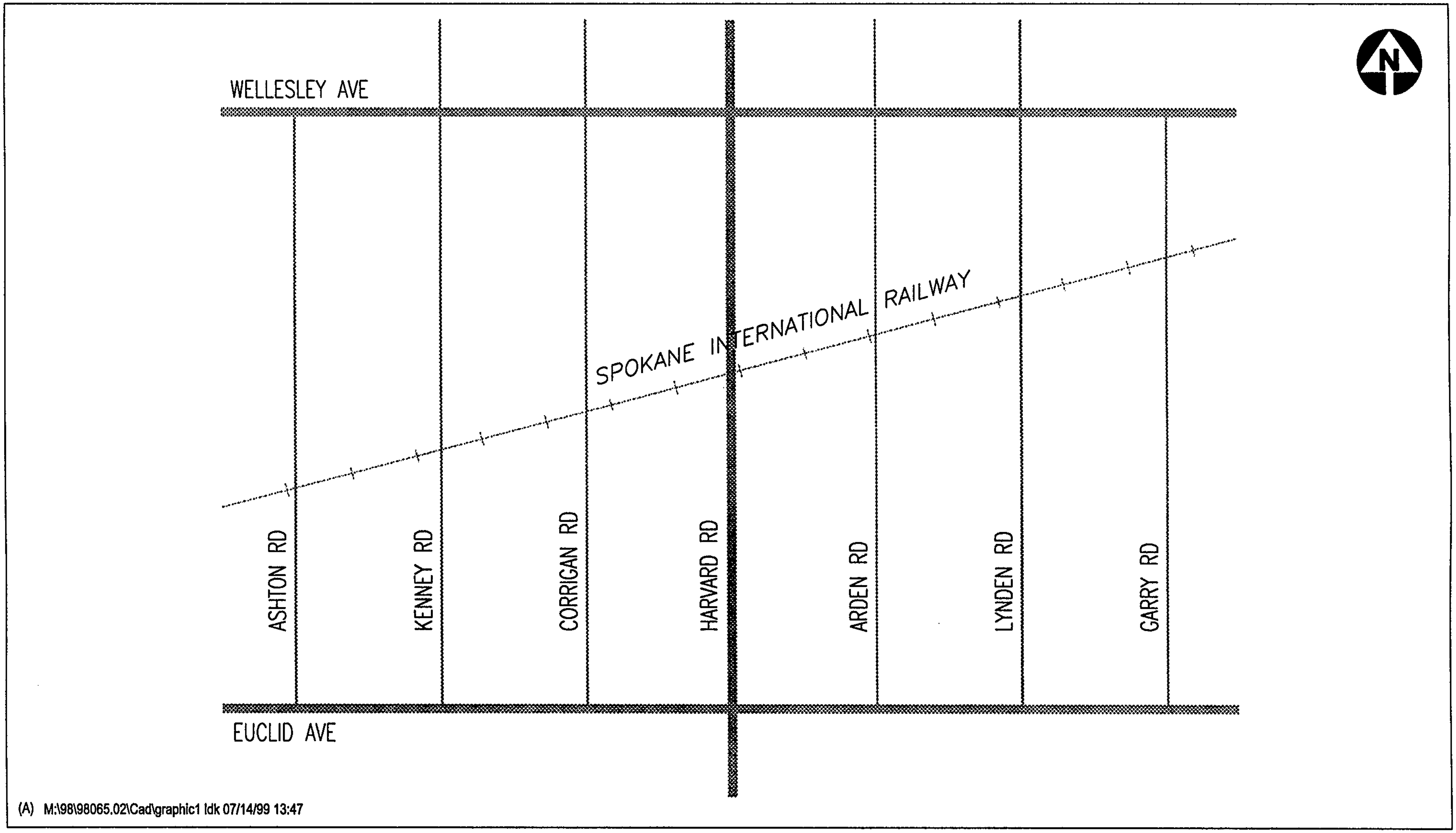

Figure 1
Study Area

EXISTING CONDITIONS

The purpose of this section is to document the existing transportation system conditions and operations. This section will summarize existing traffic volumes, roadway characteristics, traffic control devices, estimated levels of service, existing train activity, and accident history.

Roadway Characteristics

This section of the report documents the existing roadway characteristics within the study area. The description of the roadways is consistent only with the section of roadway within the project study area.

Wellesley Avenue is an east-west rural principal arterial. Wellesley is a two-lane roadway with four-way stop control at Harvard Road. There are sidewalks along both sides. Wellesley provides the main north access for all of the north/south roadways in the study area. All intersecting roadways are stop controlled.

Euclid Avenue is an east-west rural minor arterial with stop control at Harvard. Euclid is a two-lane roadway, which begins at Baker Road to the west and continues east to River Road. Euclid is the main south access for most of the north-south study roadways in this study. All intersecting roadways are stop controlled.

Ashton Road is a north-south local gravel roadway that provides access to residential neighborhoods. Aston provides access between Euclid and Wellesely Avenue. The at-grade railroad crossing is passive with two reflectorized crossbucks and stop signs.

Kenney Road is a north-south local roadway that provides access to residential neighborhoods. It is a paved two-lane roadway. Kenney provides access from Euclid to Gilbert Road, just north of Wellesely Avenue. The at-grade railroad grade crossing is passive on Kenney Road with two reflectorized crossbucks and stop signs.

Corrigan Road is a north-south local roadway that provides access to residential neighborhoods. It is a paved two-lane roadway that provides access from Euclid to Gilbert Road. The at-grade railroad crossing has active warning gates.

Harvard Road is a north-south principal arterial. It provides access from I-90 to SR 290 and communities further north. The roadway is a paved two-lane roadway. The at-grade railroad crossing has active warning gates. Intersecting side roads are stop controlled.

Arden Road is a north-south local roadway. Arden is a paved two-lane roadway. It provides access to residential neighborhoods as well as a junior high school and church on the north end. The roadway can only be accessed from Euclid or Wellesley Avenue. The at-grade railroad crossing is passive on Arden Road with two reflectorized cross bucks and stop signs.

Lynden Road is a north-south local roadway. It provides access to mainly residential neighborhoods. Lynden provides access from Euclid to Wellesley, continuing north, ending just north of SR 290. Lynden is a two-lane paved roadway. The at-grade railroad crossing is passive with two reflectorized cross bucks and stop signs.

Garry Road is a north-south local roadway. It mainly provides access between Euclid Avenue and Wellesely Avenue, as well as the residential neighborhoods in between. The roadway is a paved two-lane roadway. The at-grade railroad crossing is passive with two reflectorized cross bucks and stop signs.

Existing Traffic Volumes

Existing daily and PM peak hour traffic volumes were only available for the intersections of Harvard/Euclid and Harvard/Wellesley. Consequently, PM peak hour volumes for Ashton, Corrigan, Arden, and Gary had to be derived. The methodology used to derive the counts is adequate for the analysis purposes of this report (i.e. estimated level of service).

To determine these volumes, an aerial photograph of the area was examined to estimate the number and use of the structures located on the study arterials without daily counts. With the exception of the school located on Arden, most of the structures were determined to be single family dwelling units. The Institute of Transportation Engineers (ITE) *Trip Generation*, 6th Edition was used to determine the number of trips generated by these developments, and the vehicles were assigned to the road based upon estimated travel times.

PM peak hour volumes were determined by applying a 9.15 reduction factor to the daily observed and estimated counts on the north south arterials. This 9.15 reduction factor was derived by comparing the daily at Harvard, Euclid, and Wellesley to the PM peak hour intersection counts at Harvard/Euclid and Harvard/Wellesley. Inbound and outbound trip percentages to and from the structures on the north-south arterials were determined with the use of the ITE trip generation rates. Directional percentages were determined from counts at Harvard/Euclid and Harvard/Wellesley. Through movements on Wellesley and Euclid were estimated by extrapolating the counts from Harvard to the adjacent intersection to the east or west and the estimated turning movements would be added and/or subtracted. The process was repeated at the corresponding adjacent intersections for the rest of the study area. The resulting estimated PM peak hour trips are shown in Figure 2.

Existing Volumes With-Crossing Closure

Existing PM peak hour intersection volumes with the crossing closures were estimated similar to the process described above. Daily counts were determined for each north-south arterial based upon Spokane County counts and estimates from ITE rates. The anticipated cut-through traffic on the impacted arterials was re-routed to the next to open arterials based upon estimated travel times. The PM peak hour traffic volumes on the north-south arterials were factored down by 9.15, and the actual PM peak hour counts from Harvard/Euclid and Harvard/Wellesley were extrapolated through the adjacent intersections while accounting for the estimated turning movements. The resulting estimated PM peak hour trips are shown Figure 3.

Existing Levels of Service

After the PM peak hour volumes were determined for the study area, LOS determination was made to estimate operating condition of the existing study area intersections. Level of service (LOS) is a qualitative measure of traffic flow and congestion for

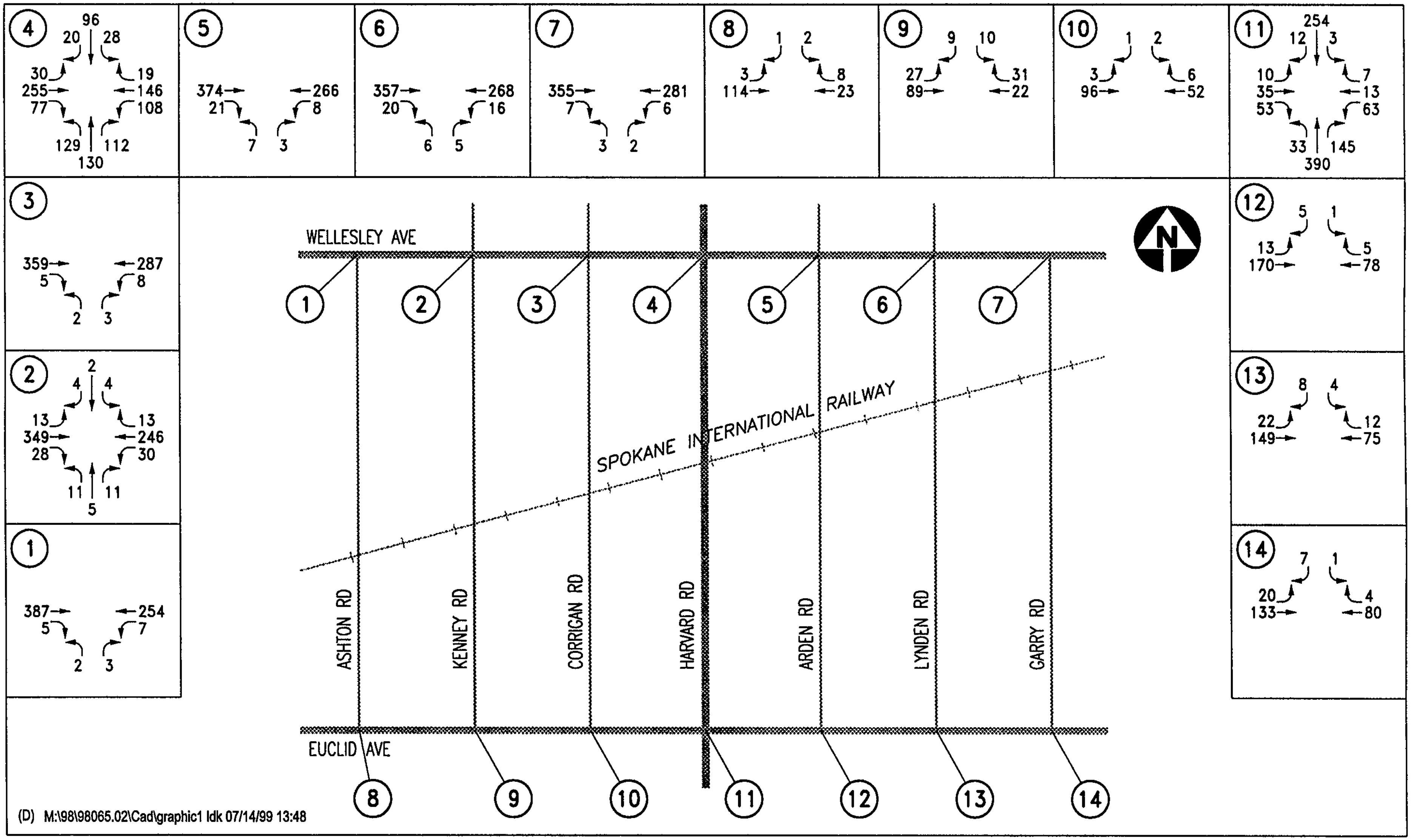

Figure 2
Existing Estimated PM Peak Hour Volumes
Before Closure

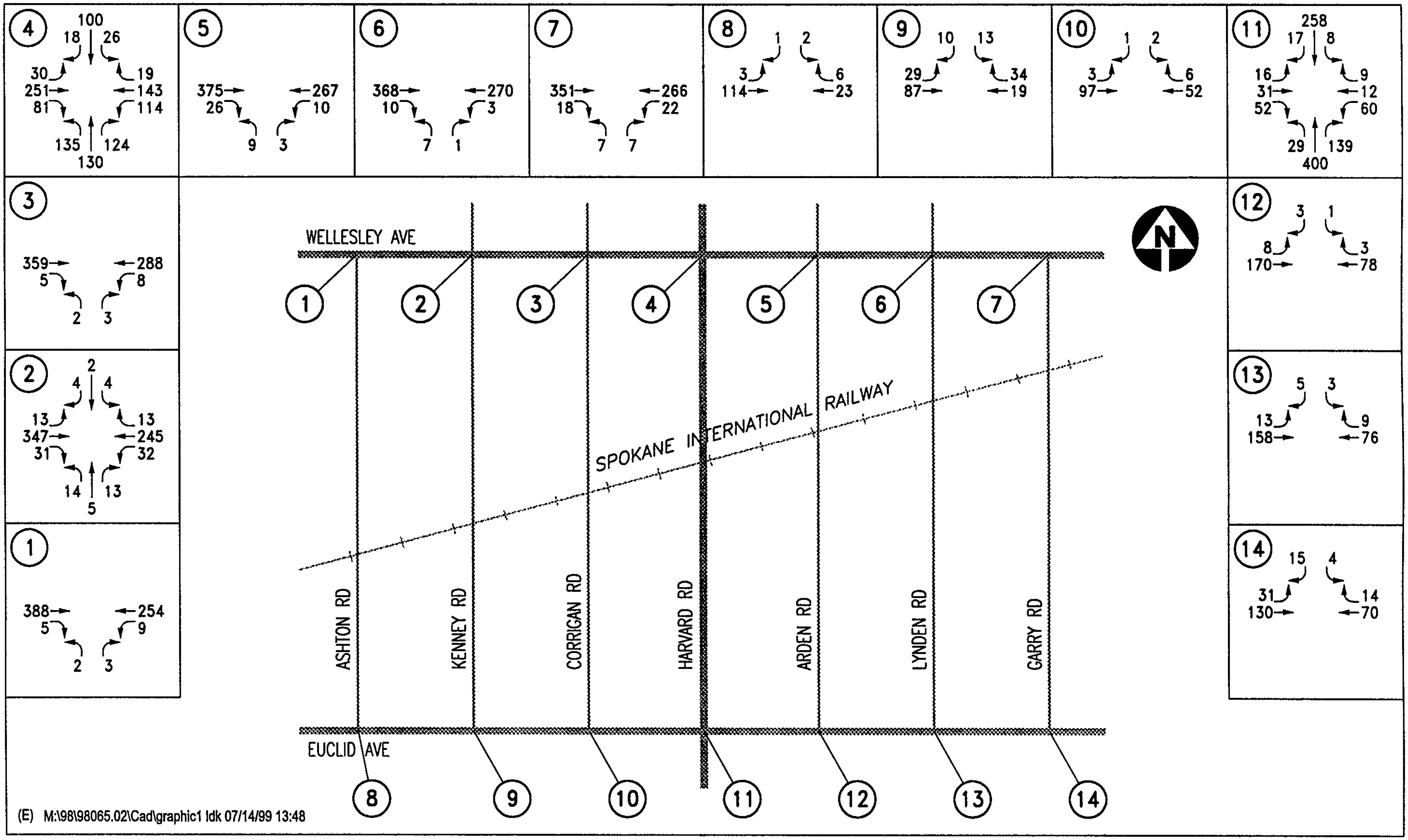

Figure 3
Existing Estimated PM Peak Hour Volumes
After Closure

stop-controlled intersections and is defined in terms of vehicle delay per approach (all-way stop) or approach movement (two-way-stop). Levels of service values range from LOS A, indicating free-flow traffic conditions, to LOS F, representing extreme congestion and long vehicle delays. The LOS analyses used in this analysis follows the guidelines and procedures outlined in the *Highway Capacity Manual* (TRB Special Report 209, 1994). The LOS determinations were made with *Highway Capacity Software*, Version 2.1f.

By determining LOS, relative transportation impacts can be assessed by comparing different project conditions. In this case, the existing with and without crossing closure conditions were estimated and compared to assess the impacts of the proposed project. The results of the analysis are shown on Table 1.

Table 1. Estimated Existing LOS With- and Without- Crossing Closures

		Exisitng Without-Closure		Exisitng With-Closure	
Intersection	Worst Approach	LOS	Delay	LOS	Delay
Wellesley &					
Ashton	NB Approach	B	6.2	B	6.3
Kenney	NB Approach	B	7.7	B	8.0
Corrigan	NB Approach	B	6.2	B	6.2
Harvard	NB Approach	D	29.8	E	33.4
Arden	NB Approach	B	8.1	B	8.5
Lynden	NB Approach	B	7.0	B	8.6
Garry	NB Approach	B	7.1	B	6.9
Euclid &					
Ashton	SB Approach	A	3.7	A	3.7
Kenney	SB Approach	A	3.7	A	3.7
Corrigan	SB Approach	A	3.8	A	3.8
Harvard	WB Approach	C	18.8	C	18.5
Arden	SB Approach	A	3.2	A	3.4
Lynden	SB Approach	A	3.5	A	3.6
Garry	SB Approach	A	3.1	A	3.3

Table 1 is organized to show the study area intersection, the worst approach upon which LOS is based, the LOS, and the approach delay. The table compares the without- and with-closure conditions during the PM peak hour to estimate closure impacts. Spokane County standards indicate that unsignalized intersections operate acceptably at LOS E, or better. As shown, none of the study area intersections operate below LOS E.

A comparison of the without- and with- closure conditions indicates that many of the intersections experience more delay with crossing closures. Harvard/Wellesley actually drops from LOS D to LOS E. A comparison of the approach delays shown, indicates that there is a 5 percent increase in delay throughout the system with crossing closures indicating that there is a definite, but minimal impact. Level of service analysis worksheets are provided in Appendix A.

IMPACTS OF PROPOSED CLOSURES

The purpose of this section is to estimate future 2010 conditions both without- and with-crossing closures. The impact of the crossing closure on the 2010 transportation network can be estimated by comparing future traffic volumes, estimated levels of service, train activity, and estimated accidents to a future no-change condition. Additionally, the 2010 analysis can be compared to the existing analysis to determine if impacts increase with time.

Roadway Characteristics

The Spokane County did not identify any improvements that would change the capacity of the study area intersections and arterials. Thus no changes were made to the 2010 transportation network for the level of service analysis.

Future 2010 Traffic Volumes

The future 2010 traffic volumes were forecast according to information found in the Spokane Regional Transportation Council's forecast travel demand model. This model simulates traffic utilization on roadways by assigning traffic from occupied "zones" to a computer generated transportation network. For this model to work, the zones must be coded with the perceived type and number of land uses for the existing and/or future transportation networks.

The study area for this project lies within Transportation Analysis Zones (TAZ's) 253, 254, and 423. These zones were examined to determine the land use allocations and trips for the existing, and projected 2010 and 2020 transportation networks. The results were compared to determine a growth rate. The resulting one percent annual growth rate was applied to the existing counts used in the analysis to determine the forecast 2010 daily and PM peak hour volumes. The results for both the 2010 without and 2010 with the closures are shown in Figures 4 and 5 respectively.

Future 2010 Levels of Service

Future 2010 LOS for the without- and with-closure condition were determined to estimate the long range impacts of the project upon the transportation network. Table 2 shows the results. The existing LOS results were included for the purposes of comparison.

As shown in Table 2, all of the study area intersection operate at LOS E or better with the exception of Harvard and Wellesley, which operates at an unacceptable LOS F. The total delay of the without-closure condition is 8.7 percent less than the total delay of the with-closure condition. This again indicates that the crossing closure impacts the transportation network. Finally, it can be noted that there is a 23 to 27 percent increase in total delay between the two existing and two 2010 conditions. The detailed level of service work sheets are provided in Appendix B.

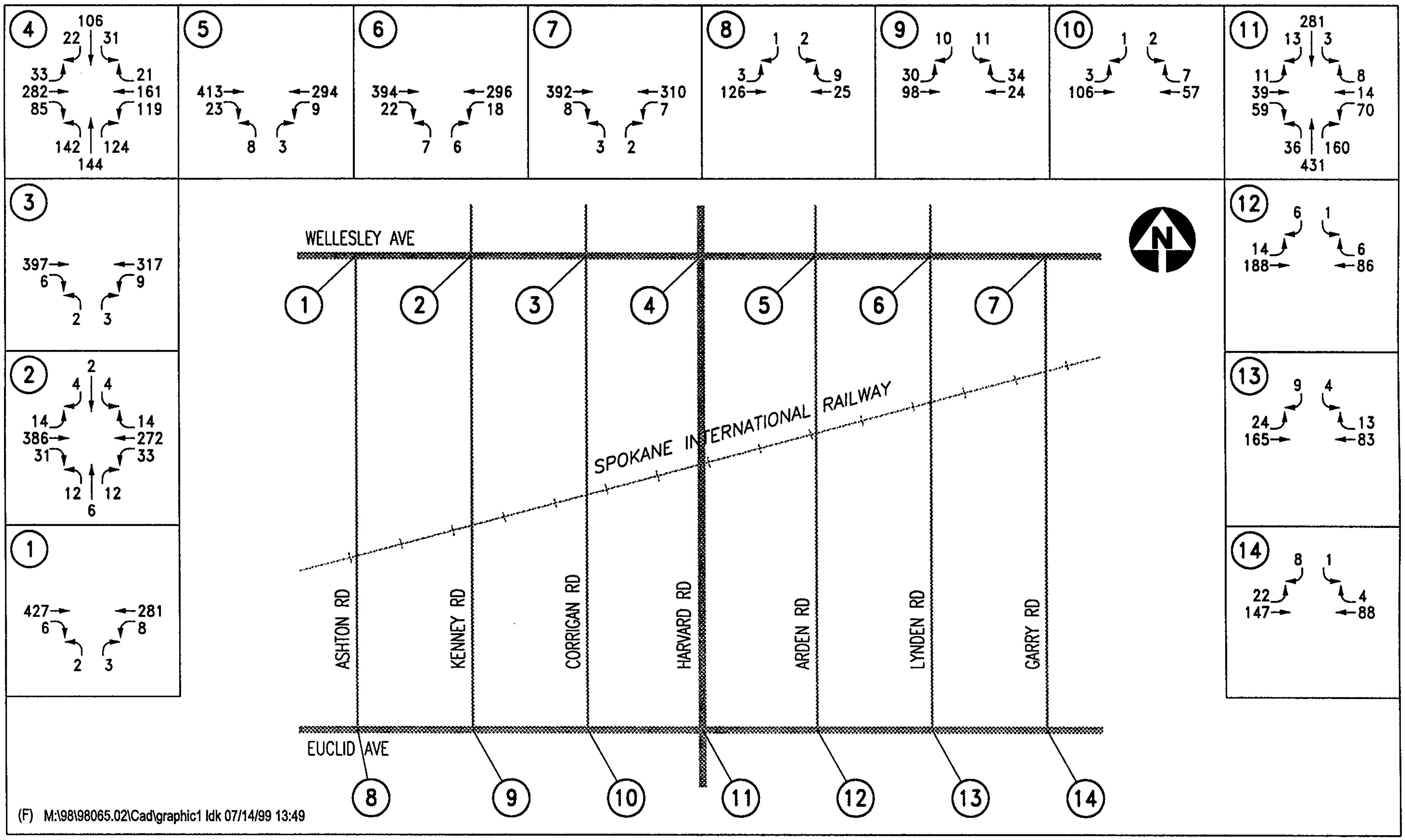

Figure 4
2010 Estimated PM Peak Hour Volumes
Before Closure

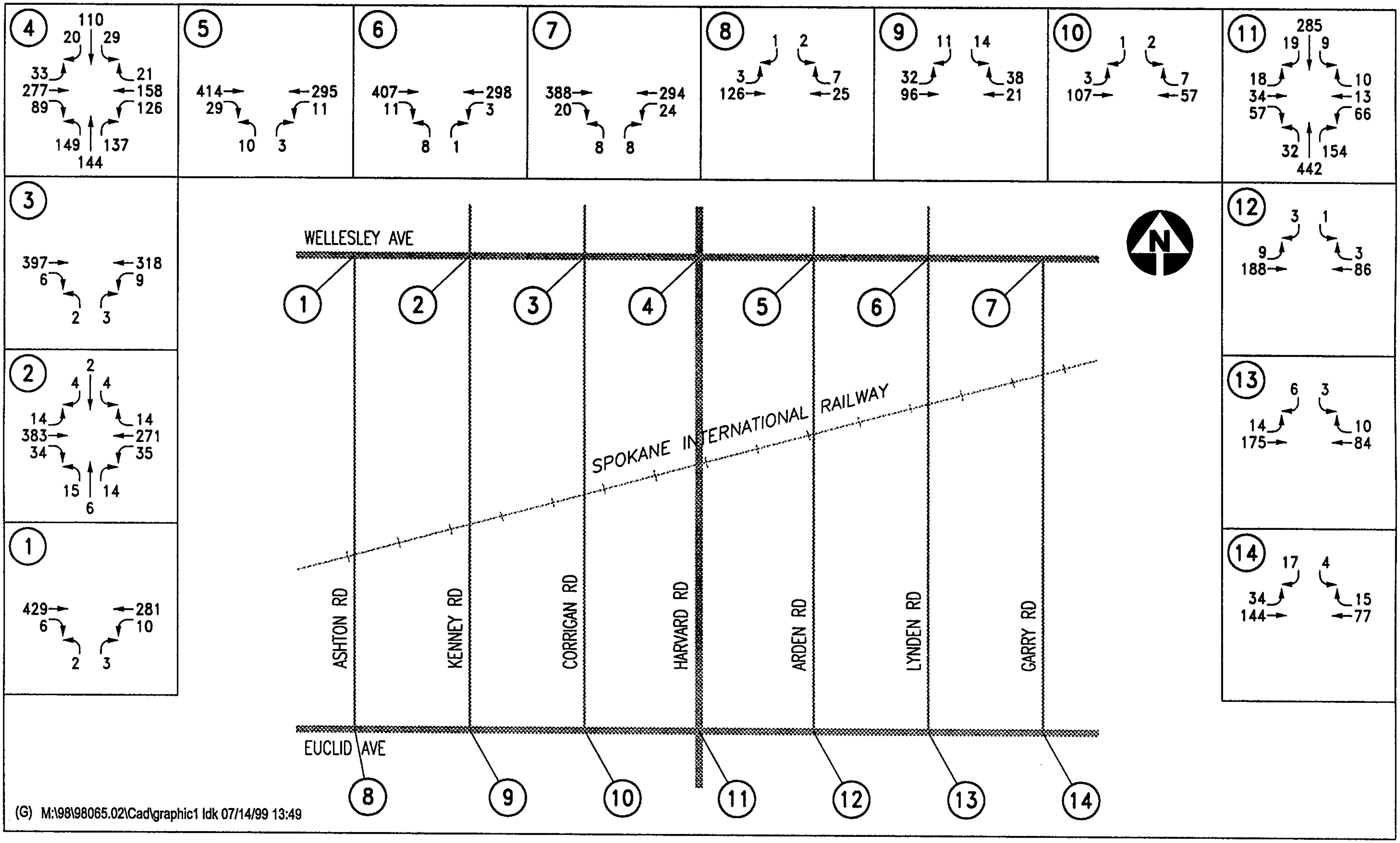

Figure 5
2010 Estimated PM Peak Hour Volumes
After Closure

Spokane Railroad Closures

The TRANSPO Group, Inc.

Table 2. LOS Comparisons Existing With- and Without- Closure and 2010 With- and Without- Closure

		Exisitng Without-Closure		Exisitng With-Closure		2010 Without-Closure		2010 With-Closure	
Intersection	Worst Approach	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Wellesley &									
Ashton	NB Approach	B	6.2	B	6.3	B	6.8	B	6.8
Kenney	NB Approach	B	7.7	B	8.0	B	8.6	B	8.8
Corrigan	NB Approach	B	6.2	B	6.2	B	6.7	B	6.7
Harvard	NB Approach	D	29.8	E	33.4	E	43.2	F	48.5
Arden	NB Approach	B	8.1	B	8.5	B	9.1	B	14.4
Lynden	NB Approach	B	7.0	B	8.6	B	7.7	B	9.5
Garry	NB Approach	B	7.1	B	6.9	B	7.8	B	7.6
Euclid &									
Ashton	SB Approach	A	3.7	A	3.7	A	3.8	A	3.8
Kenney	SB Approach	A	3.7	A	3.7	A	3.7	A	3.9
Corrigan	SB Approach	A	3.8	A	3.8	A	3.9	A	3.9
Harvard	WB Approach	C	18.8	C	18.5	D	26.5	D	25.4
Arden	SB Approach	A	3.2	A	3.4	A	3.2	A	3.5
Lynden	SB Approach	A	3.5	A	3.6	A	3.6	A	3.6
Garry	SB Approach	A	3.1	A	3.3	A	3.1	A	3.3

Train Activity

Currently, the Union Pacific Railroad (UPRR) operates 10 through trains per day, 6 trains are during daylight hours and 4 trains during night hours. This is equivalent to approximately 1 train every 2.5 hours. There are also two switching trains that operate on the tracks.

National initiatives, such as the Canada-United States Free Trade Agreement (CFTA), the General Agreement of Tariffs and Trade (GATT), the North American Free Trade Agreement (NAFTA), have encouraged increased trade activities between Canada, the United States and Mexico. Due to the probability of increased trade it is expected train traffic will increase in the corridor over the next several years. Currently, UPRR has limited estimates on the expected increase of train traffic in this particular corridor. They estimate the train traffic could increase by 4-to-6 trains within the next 10 years.

At-grade Crossings Accident History

A 10-year (1988-1998 for a full 10 years) accident history review revealed there were two recorded accidents within this corridor between Arden Road and Garry Road. There was one accident at the Kenney crossing in 1991 and one accident at the Garry crossing in 1988.

The Kenney crossing accident occurred on February 15, 1991 at 4:00 p.m. The accident resulted in three highway user fatalities. Accident records indicate the driver proceeded through the crossing and was struck by the rail equipment.

The Garry crossing accident occurred on March 14, 1988 at 10:20 p.m. The accident resulted in the injury of one highway user.

Accident Prediction Model

There are various hazard indices and accident prediction formulae that are used to rank highway-railroad crossings level of safety. Some of the most common ones used are the Peabody Dimmick Formula, the New Hampshire Index, the National Cooperative Highway Research Report 50 Formula (NCHRP 50), and the U.S. DOT Accident prediction Formula.

Most of these formulae have been developed by studying historical accidents at highway-railroad grade crossings and analyzing the various variables that may influence accident patterns. Multiple regression analysis is typically performed on all the variables to determine the level of influence each factor has in contributing to an accident. Equations are then developed that provide each variable with a factor of influence depending on the characteristic of the variable.

For consistency and comparison with the Richards & Associates Report, this study utilized the U.S. DOT Accident Prediction Formula. The U.S. DOT combines two independent calculations to produce an accident prediction value. The first formula provides an initial prediction value of the number of accidents at a crossing based on the characteristics of the site. The second formula utilizes the results of the first calculation as well as the accident history of the site to produce a final accident prediction value. The second formula assumes that the future accidents per year at the crossing will be similar to the average historical accident rate over the time period used in the calculation. The accident prediction is adjusted as characteristics of the crossing are adjusted, such as improving from passive to active warning devices. The main variables involved in the calculation are: 1) an exposure index accounting for vehicular and train volumes, 2) a factor for the number of main tracks, 3) a factor for the number of trains through the area during the day, 4) a highway paved factor, 5) a speed factor, 6) a highway type factor, and 7) a factor for the number of highway lanes. The equations and factors are provided in Appendix C.

The U.S. DOT Accident Prediction Formulae was used to estimate the potential number of accident over a 10-year time frame for three scenarios: 1) existing conditions with the crossings remaining as they are currently, 2) with all of the crossings gated (see Figure 6), and 3) with the proposed closures of Ashton, Corrigan, Arden, and Lynden; and gates installed at Corrigan and Garry (see Figure 7). The results of the analysis are shown in Table 3. It is important to note that this table shows the raw number of expected accidents based on crossing characteristics and not the expected number of fatalities or injuries. Estimates for expected number of fatalities and injuries are provided later.

The current conditions analysis assumes all highway-railroad crossings operate with the existing traffic control devices. The ADT at the crossings was provided by Spokane County. To provide a conservative analysis the ADTs were projected for 10 years with a growth rate of one percent per year, as provided from the regional model. The analysis also assumes 10 total trains, 6 day and 4 night. As Table 3 shows, if the crossings were left alone there is an estimate of 3.3 accidents over the next 10 years.

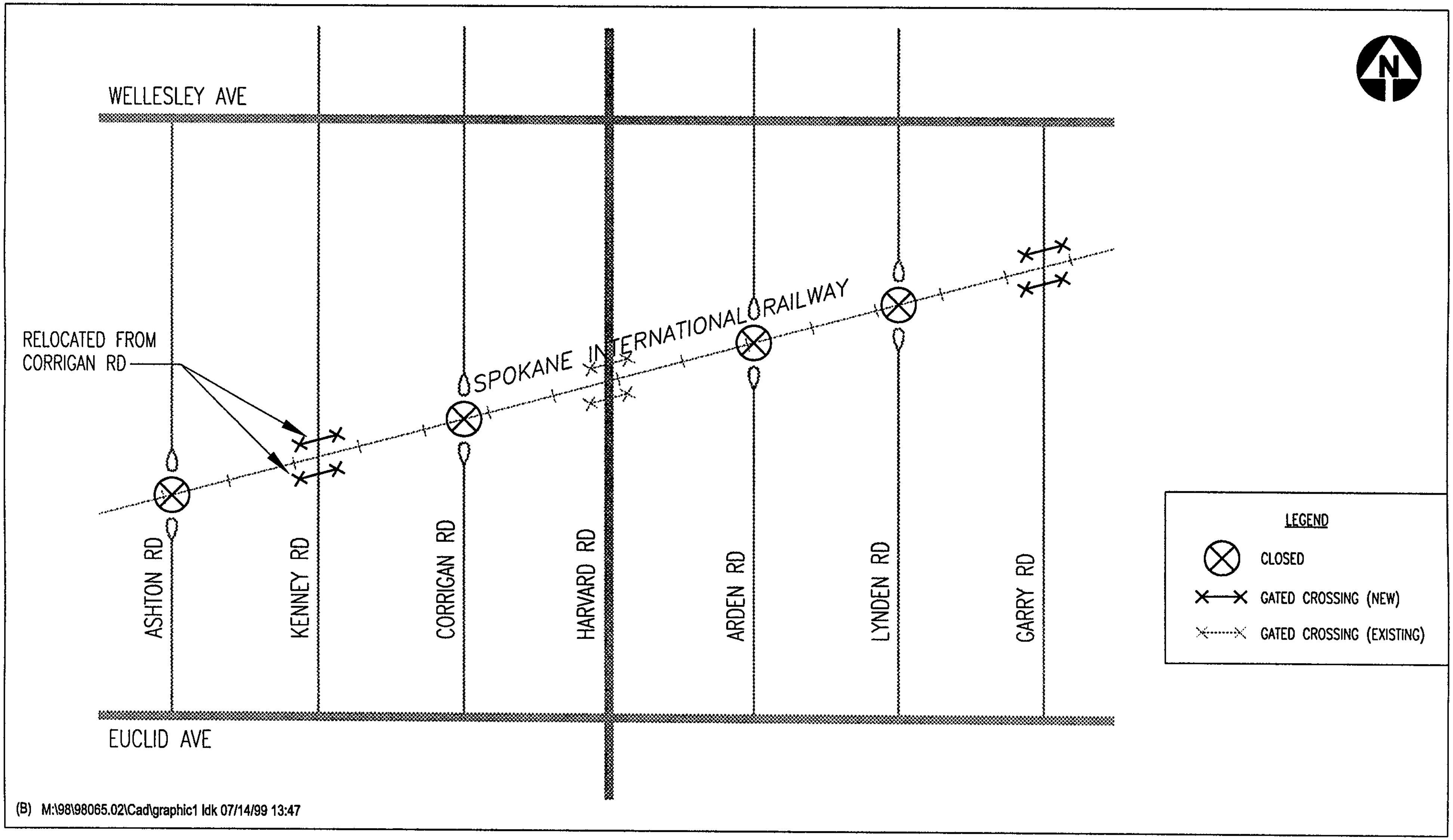

Figure 6
Scenario 1
Proposed Grade Crossing Closures

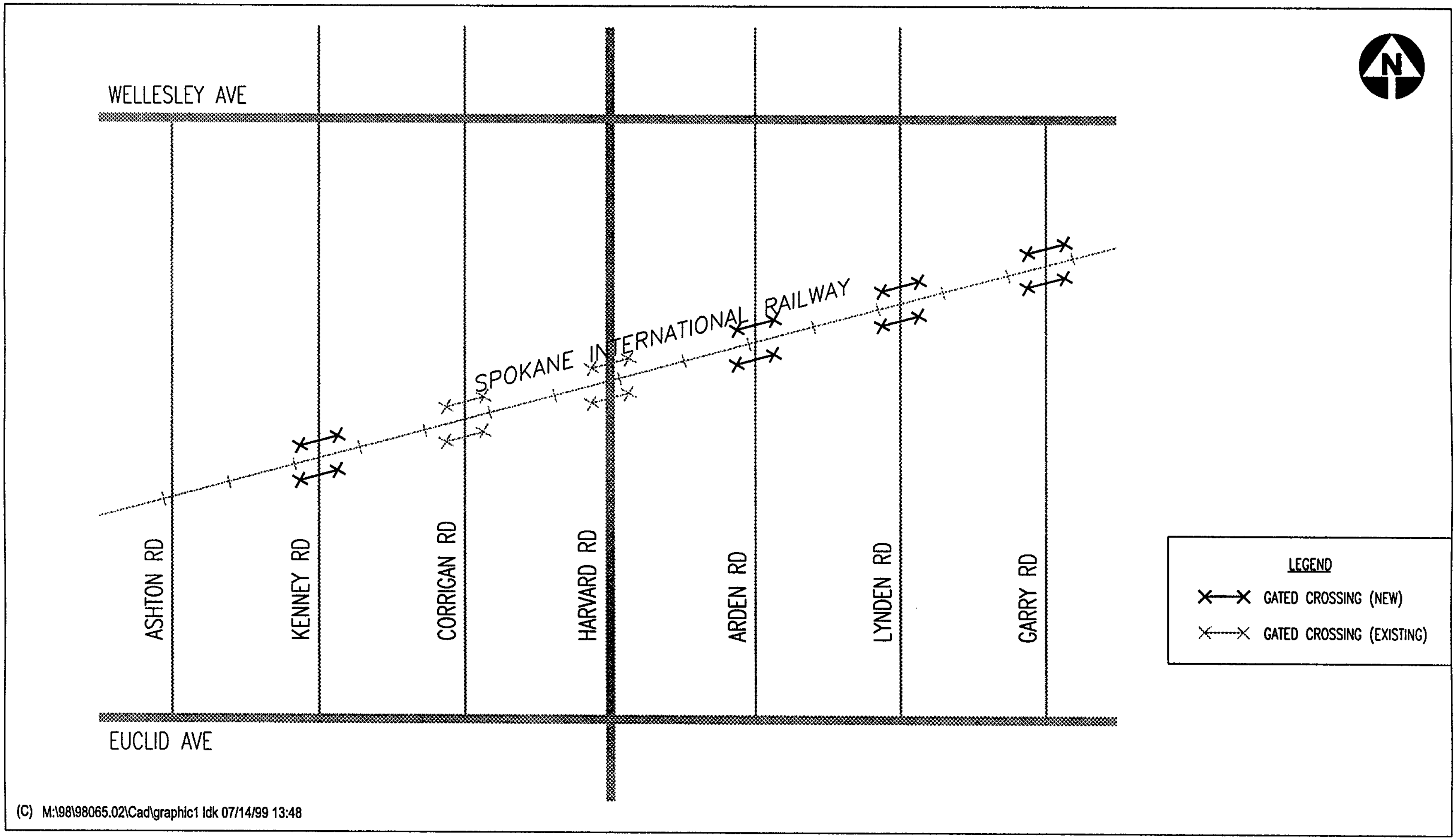

Figure 7
Scenario 2
All Crossings Gated Except Ashton Rd

Table 3. Estimated Number of Accidents Over 10 Year Period

	Scenario		
Location	**Current Conditions**	**All Crossing Gated**	**Proposed Closures & Gates**
Ashton	0.2080	0.0165	0.0000
Kenney	0.9240	0.6390	0.6480
Corrigan	0.1600	0.1600	0.0000
Harvard	0.3760	0.3760	0.3800
Arden	0.3270	0.1650	0.0000
Lynden	0.3600	0.1850	0.0000
Garry	0.9340	0.6410	0.6667
Total	**3.2890**	**2.1825**	**1.6950**

The "all crossings gated" scenario assumes all the crossings have gates and each was analyzed with the 10-year ADT forecasts. The accident prediction model estimates that there will be approximately 2.2 accidents over the next 10 years. This is approximately 1.1 accidents or 34 percent less than under the existing condition scenario. The "proposed closures and gates" scenario analyzes the crossings based on the proposal set forth in the Richards & Associates Report. It is assumed that the closed crossings would provide no accidents, as they would be adequately barricaded from vehicular trespass traffic. The gated crossings have a slightly higher predicted accident factor than the "all gated" scenario, because it is assumed that under closure conditions more traffic will be diverted to the open crossings. The accident prediction model estimates the potential for 1.7 accidents over the 10-year period. This is a potential reduction of 1.6 accidents or 48 percent fewer expected accidents than the "existing conditions" scenario and a potential expected accident reduction of 0.49 accidents or 22 percent fewer accidents than under the "all gated" scenario.

Part of the reason there is not a large reduction in the expected number of accidents between the "all gated" scenario and the "proposed closure" scenario is because the crossings proposed to remain open are the crossings with an accident history. Since these crossings (Kenney and Garry) have an accident history, it is assumed that they have a higher probability of a future accident in the next 10 years. Thus, if they remain open the reduction in the number of predicted accidents for the "proposed closure" scenario is negligible. Furthermore, the overall accident reductions are relatively insignificant. The number of accidents in the study area are low because this is a single track with low train traffic volumes interacting with local rural roads with low vehicular traffic. These factors result in relatively infrequent train-vehicle conflict.

As shown in Table 3, the only crossing that achieves marginal benefit from having active warning gates installed is the Ashton crossing. Due to the relatively low traffic volumes on this roadway, and the fact that Ashton is a gravel roadway, it is expected that active warning devices would yield a negligible benefit. For the purpose of the benefit-cost analysis it will be assumed that Ashton will not have active warning gates installed.

Formula Sensitivity Analyses

A sensitivity analysis was performed to determine the degree to which variables would effect the results of predicted accidents for this corridor. Due to the difficulty in estimating travel diversions and future train traffic volumes, it was determined that the effects of these two variable on the accident prediction equation should be understood.

As discussed earlier, the prime variables in the accident prediction equation are based on: the crossing category, the total daily train traffic, annual average daily traffic, number of main tracks, number of trains traveling during the daylight, highway paved (yes/no), maximum speed, highway type, and highway number of lanes. It is assumed that the only variables that will potential change in the future is the train volume, vehicle volume, or crossing category. These variables were adjusted to measure the relative impact of each.

Kenney Road was used for the analysis. Currently, this crossing averages about 340 vehicles per day (vpd). The vehicular volume was doubled to 680 vpd and evaluated in the accident prediction equation for a passive crossing. This resulted in an accident prediction value of 1.025 accidents over a 10-year period, 11 percent increase. Then the train traffic activity was doubled, from 10 to 20 train trips per day, estimating that 12 would be day trips. This resulted in an accident prediction value of 1.074 accidents over a 10-year period, a 16 percent increase. As this analysis indicates, at a passive crossing the volume of trains has a greater effect on the potential for increased accidents than increased vehicular volume, assuming all other variables remain constant. At a passive crossing, the other variable that has a strong degree of influence on the predicted results is the number of main line tracks. However, in this case it is doubtful this value will change.

The same analysis was performed using variable factor values and the equation for a gated crossing. The vehicle traffic was doubled to 680 vpd. The resulting accident prediction value was 0.697 accidents over a 10-year period, an increase of approximately 9 percent. Doubling the train activity only results in the same value. This is because at a gated crossing the variable factors related to day through trains, highway paved, maximum speed, and highway type are all 1.00. Installing gates removes the influence these factors have. When a crossing is gated the only factors that influence the predicted accident values are: volume of daily vehicle traffic, volume of train traffic, number of mainline tracks, and number of highway lanes.

As shown above, an increase in vehicular traffic is only slightly more influential on the predicted number of accidents at a passive crossing verses a gated crossing. With these volumes there is only a two percent difference between the results of doubling the traffic at a passive crossing verses a gated crossing.

What this analysis also helps to show is that there is not a linear relationship between train/vehicle traffic and the predicted number of accidents at a crossing. In this instance, a 100 percent increase in traffic volumes yielded a 9 to 11 percent increase in predicted number of accidents. Since the predicted number of accidents is relatively low at most of the crossings, a shift in travel diversions, other than what TRANSPO estimated, will have a limited effect on the out come of the number of predicted accidents. Similar results yielded for the increased train traffic. This section also helps to show the number of variables that are eliminated from the equation when a crossing is gated verses passive.

Accident Severity

A variable needed for benefit-cost analysis is the severity of an accident, which typically range from the most catastrophic (fatal) to the least catastrophic (property damage only). There is also a range of injury accidents that are typically incapacitating, evident, and possible. The U.S. DOT has also developed a formula for predicting the severity of a crossing accident. For estimating the probability of a fatal accident given an accident, the contributing variables are: 1) number of through trains per day, 2) number of switching trains per day, and 3) urban or rural crossing. For estimating the probability of an injury accident given an accident, the contributing variables are the same as they were for the fatal accident probability equation, with the addition of the results from the fatal accident probability equation. The equations are presented in Appendix D.

For all of the crossings, regardless of traffic control, the probability of a fatality given an accident has occurred is 0.0795 or approximately eight percent of the accidents. Once again, for all of the crossings, the probability of an injury given an accident has occurred is 0.3033 or approximately 30 percent of the accidents. These values are relatively low due to the low train traffic.

BENEFIT/COST ANALSYIS

Benefit/cost analysis is a monetary valuation of the impact of deploying projects. This technique is used by many public and private sector organizations to justify a project or to rank projects. In transportation engineering, benefit-cost analysis involves analyzing the advantages, benefits and cost reductions associated with a proposed transportation system enhancement as they apply to the system providers and users. The costs associated with the benefits of the enhancement are then directly compared to the capital expenditures, as well as operational and maintenance costs required for providing the proposed transportation enhancement. Enhancements are generally safety-related and/or capacity-related with the goal of saving lives and/or increasing levels of service (LOS).

This project reviewed the cost of two alternatives known as scenario 1) "proposed closures" and 2) "all gated". For the "all gated" scenario, it was assumed that gates would be installed at Kenney, Arden, Lynden, and Garry. Ashton was not gated because of the low predicted number of accidents. The number of accidents that would be reduced by installing active warning gates at Ashton would be negligible. This is due to the low traffic volumes on Ashton.

This section of the report estimates the costs and the associated benefits resulting from installing scenario (1) and (2). Information used in developing the costs estimates were provided by Spokane County and UPRR.

All money values used in the analyses are present worth values developed from the present worth factor equation at four percent for 10 years. It was agreed with Spokane County Staff that 4 percent was an appropriate rate since this is what WSDOT uses for these types of evaluations.

Cost Estimate Methodology

Scenario (1) – Closure of Four Crossings and Adding Active Warning Gates

An engineering cost estimate for the Otis Orchards railroad crossing closings was prepared to calculate a benefit/cost ratio for the proposed project. As previously described, four at-grade crossings would be removed and replaced with eight cul-de-sacs; crossing gates with flashing beacons would be constructed at Kenney and Garry.

The cost estimate was based on information provided by Spokane County engineering staff and it reflects the average rates for time and materials in and around Spokane. Line items for mobilization, clearing and grubbing are estimates made by TRANSPO based on estimates for the time and effort required for each task. Quantities for excavation, fill, and pavement are based on Spokane County's standard plans for a public street cul-de-sac, with an assumed 100-ft diameter pavement section. The estimates assume that the existing pavement (or gravel) will be used for the center section of the cul-de-sac, and that additional pavement and curbing will be added. The estimate also assumes that additional right-of-way purchase will be required to build full, 100-ft diameter cul-de-sacs.

Spokane County's recently submitted estimates for at-grade crossing treatments (sent to WSDOT funding via FHWA) assumed that each crossing in the Otis Orchards area would cost approximately $101,500. The cost estimate assumes that the two new crossing treatments at Kenney and Garry would cost $101,500. An existing crossing at Corrigan would be closed and the equipment would be used at the new Kenny crossing. The cost estimate assumes that the cost to move the existing equipment from Corrigan to Kenny would be offset by the savings of not buying new equipment for the Kenny crossing. Therefore, the $101,500 estimate was considered valid. The worksheet for the cost estimate development is provided in Appendix E.

Scenario (2) Gate all Crossings (except Ashton)

Based on the cost estimates Spokane County received from WSDOT, with an estimate of approximately $101,500 per crossing, cost estimates were developed for crossings at Kenney, Arden, Lynden, and Euclid. The estimated cost to gate the four crossings is $406,000.

Operation and Maintenance Costs

Operation and maintenance costs are developed for specific line items that are an additional expense from existing conditions. The only significant additional operational and maintenance expenses are for the active warning gates. UPRR provided an estimated range of $1,000 to $3,000 per crossing per year. It was agreed with UPRR that $2,000 would be used in the benefit-cost analysis, which would account for operational and maintenance expenses.

Benefits of Improvements

This section of the report addresses the treatment of the value of life and injury in economic analysis as recommended by the Federal Highway Administration (FHWA). The costs used for the benefit-cost analysis are from the FHWA's Technical Advisory Report on "Motor Vehicle Accident Costs", report number T7570.2 of October 31, 1994. The report is based on guidance furnished by the Office of the Secretary of Transportation (OST). The costs presented by the FHWA are comprehensive costs that people are willing to pay (WTP) to avoid pain and the lost quality of life due to vehicle accidents.

WTP is theoretically the correct approach to valuing all benefits arising from public investments or regulatory actions including fatalities and injuries avoided as a result of accident risk reduction projects. FHWA recommends that state, local highway, and safety agencies use these costs when developing benefit-cost criterion. This is because WTP represents the maximum amount of value yielded by other goods and services individuals would be willing to forgo and still be as well off after the introduction of an accident risk reduction as they were before it. Table 4 shows the FHWA recommended values.

These values will be attached to the expected number of reduced accidents for the two scenarios. The probability of a fatality and injury factors will be multiplied by the total number of expected reduction in accidents to determine the appropriate amount from each cost category. Since the expected number of fatalities and injuries will not account for the total number of expected accidents the remaining accidents will be assumed to be property damage only. An average value will be used for the three levels of injury accidents ($84,000).

Table 4. Society Willingness-to-pay to Avoid Injury Comprehensive Costs

Descriptor	Cost per Injury (1999)[1]
Fatal	$2,787,200
Incapacitating	$ 193,032
Evident	$ 38,606
Possible	$ 20,376
Property Damage Only	$ 2,145

1. 1999 values derived from FHWA 1994 values with GDP implicit price deflator

Scenario (1) – Closure of Four Crossings and Adding Active Warning Gates

It is expected that this improvement will reduce the number of accidents over the next 10 years from 3.289 to 1.695, resulting in 1.5494 fewer accidents. When the appropriate FHWA cost factors are applied; this improvement results in a benefit of $395,856 over the 10-year period, resulting in a present worth of $321,075. The calculations are shown in the appendix.

Scenario (2) Gate all Crossings (except Ashton)

It is expected that this improvement will reduce the number of accidents over the next 10 years from 3.289 to 2.390, resulting in 0.899 fewer accidents. When the appropriate FHWA cost factors are applied; this improvement results in a benefit of $217,184 over the 10-year period, resulting in a present worth of $176,156. The calculations are shown in the appendix.

Expected Benefit/Cost

This section of the report presents the final expected benefit/cost ratio. Often values greater than one are expected to provide societal economic value and are consider for installation. Values less than one indicate that the money invested into the project will not provide for any positive return in the future.

Scenario (1) – Closure of Four Crossings and Adding Active Warning Gates

The total present worth for this project, including operation and maintenance costs is approximately $503,278. From the results provided above, the total economic benefit is expected to by approximately $321,075. These two values result in an economic benefit/cost of 0.64. Based on this analysis, the project would not yield a positive economic return.

Scenario (2) Gate all Crossings (except Ashton)

The total present worth for this project, including operation and maintenance costs is approximately $470,888. From the benefit results provided above, the total economic benefit is expected to be approximately $176,156. The two values result in an economic benefit/cost of 0.37. Based on this analysis, the project would not yield a positive economic return.

POTENTIAL COMMUNITY IMPACTS

TRANSPO Staff called and visited local agencies to try and quantify and qualify any potential community impacts that would be created by closing four of the crossings. This section of the report will provide the general results of each of the meetings.

The first primary group of contacts was the emergency and medical service providers. This group consisted of the American Medical Response (AMR) Group and the Spokane County Fire District #1, each was met with separately. However, the two responses were similar. The AMR is opposed to the crossing closures due to the possibility of increased response times. This data is not quantifiable because of the randomness of response calls. However, response times do have significant effect on some medical emergencies. The longer it takes to respond to some types of medical emergencies the greater the chances are of the victim not surviving. An example provided by the AMR; if a cardiac arrest victim has not been shocked with VF within 10 minutes of collapse, the probability of survival approaches zero.

Similarly, the Spokane Fire District opposes closing the crossings. They have two additional concerns: 1) increased exposure on local roadways, and 2) limited access to fire hydrants. The fire district said that the greatest risk their response people encounter is typically enroute on local streets. Their liability risks tend to increase when traveling on local streets verses larger volume roadways such as arterials. Also closing some of the crossings would limit their access to some of the fire hydrants (see Appendix F). For example, Corrigan Road does not have hydrants on the south side of the railroad tracks. Access to this particular hydrant would become more difficult if vehicular access is restricted. Lt. Charley Schreck of the Washington State Patrol said they would support the fire district and the AMR.

Milly Krop, Post Master for the U.S. Postal Service was contacted to determine potential impacts to the postal service mail deliver routes. She concluded that it would take a driver an additional 15-20 minutes per day to do the route and increase the total mileage an additional 6-7 miles per day. She said that the routes operate 210 days out of the year. This works out to be an additional 1,470 miles per year. These additional miles are created because drivers would have to double back on routes. Ms. Krop also said that a branch of the U.S. Postal Service in Washington D.C. would probably redevelop the routes if the crossings were closed.

Contact was made with Douglas Sanders, Transportation Supervisor of the East Valley School District #361, to determine if the closures would impact their operations. Douglas stated that the closures would have negligible impacts on the school bus operations. They would simply modify the routes or have the students walk to Euclid or Wellesely. The school district was not concerned with the closures.

Jerry Camyn of Valley Garbage was contacted to determine if there would be any impacts to their business. Similar to the postal service, routes would have to double back, possibly increasing operating costs. However, Valley Garbage never provided any quantifiable data.

US West and TCI Cable were also contacted. It was determined that the closures would have negligible impact on their businesses because of the randomness of their routes and response locations.

TRESPASSERS

By definition, a trespasser is anyone whose presence on railroad property-track, bridges, equipment, and yards is not authorized by the railroad. 1997 data revealed that trespassing deaths were the leading source of railroad related fatalities, surpassing grade-crossing fatalities. Unfortunately, there is very little literature summarizing trespasser issues on rural railroad locations.

Most trespassers can be characterized as single white males, typically under the influence of alcohol. Trespassing is primarily an urban problem. Almost a third of the trespass victims are sitting or lying in the right of way at the time of impact, which indicates a clear negligence on the trespassers behalf or possible suicidal intentions. Most literature indicates that there is very little the railroad can do to discourage trespassers.

There is strong legal precedence that trespassers, and not the owners of the land, bear the burden of taking appropriate care. Trespassers bear the entire risk of any natural hazards that they encounter and can only claim damages if they are injured by an artificial hazard (manmade), if the owner has not used reasonable care to post a "warning". However, the courts have held that the mere existence of a railroad track is sufficient warning of the potential dangers. This implies that law assumes that the public is well aware of the inherent dangers of trespassing the railroad property.

EMERGENCY ACCESS ROADS

Previously, consideration was given to establishing "emergency access" roads between the closed crossings. However, these "emergency access" roads would need to be to County Standards to provide circulation alternatives to county traffic. It was assumed that the roads would be rural residential access streets. The necessary right of way to construct this street would be 30 feet.

The UPRR has 100 feet of right of way. Based on the parcels map, there appears to be approximately 40 feet to the north of the tracks and 60 feet south of the tracks. Based on sign placement criteria provided in the MUTCD, there would need to be at least 12 feet of clearance on either side of the centerline of the railroad tracks. Based on these measurements, there would not be enough right of way on the north to build an access road to County Standards. An access road to the north of the tracks would require the purchase of additional right of way.

The construction of the eight "emergency access" roads would prove to be much more expensive than the cul-de-sac approach. There would be additional costs for right of way, signing, pavement, base material, construction, etc. These additional costs would significantly increase the capital expenditure costs as well as maintenance costs. If the access roads were used the b/c ratio would be significantly worse.

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