Exhibit __ LFL-1

Docket No. TR-090121 BNSF's First Data Requests to Intervener Lynn Logen Page 3

BNSF DATA REQUEST NO. 3:

What is the maximum speed at which the farm equipment referenced in your response to Data Request No. 1 can and does travel on a paved roadway surface?

ANSWER TO DATA REQUEST NO. 3:

The Kubota B21 has a maximum speed of 18 km (11.2 MPH). The Ford 9N has an estimated maximum speed of 15 to 20 MPH (though it does not feel safe at those speeds).

Date prepared: 3/13/09 Preparers: Lynn Logen

Witness with knowledge about this response: Lynn Logen

AMES MADISON UNIVERSITY.

Comprehensive Safety Plan

Ratio of Speed to Stopping Distance

Contents

§ 46.2-880. Tables of speed and stopping distances.

Overview

All courts shall take notice of the following tables of speed and stopping distances of motor vehicles, which shall not raise a presumption, in actions in which inquiry Fire Safety

thereon is pertinent to the issues:

Facilities Management Safety

Emergency Response

Lab Safety

Hazardous **Materials**

Bloodborne **Pathogens**

Radiological Safety

Threats, Violence, Terrorism

Continuity of **Operations Plans**

Office Safety

Theater Safety

Campus Crime Report

Field Trip Plan

Student Handbook

Vehicle Safety

Lighting and Safety The courts shall further take notice that such tables are the result of experiments made with motor vehicles, unloaded except for the driver, equipped with fourwheel brakes, in good condition, on dry, hard, approximately level stretches of highway free from loose material.

(Code 1950, § 46-212.2; 1956, c. 600; 1958, c. 541, § 46.1-195; 1989, c. 727.)

Weapons

Aviation Safety

Flood

Bicycle Safety

Media Releases

SPEED	IN	AVERAGE ST	OPPING D	ISTANCES	TOTAL STOP DISTANCES	PING
Miles per Hour	Feet per Second	Automobile Brakes (In Feet)	Truck Brakes (Brakes on All Wheels (In Feet)	Average Driver Reaction Time (3/4 seconds) (In Feet)	Automobiles (In Feet)	Trucks (In Feet)
10	14.67	5	7	11	16	18
15	22.0	12	17	16	28	33
20	29.34	21	30	22	43	52
25	36.62	32	47	27	59	74
30	44.0	47	67	33	80	100
35	51.3	63	92	38	101	130
40	58.7	82	120	44	126	164
45	66.0	104	152	50	154	202
50	73.3	128	187	55	183	242
55	80.7	155	227	61	216	288
60	88.0	185	270	66	251	336
65	95.3	217	316	71	288	387
70	102.6	252	367	77	329	444
75	109.9	289	422	82	371	504
80	117.2	328	480	88	416	568
90	132.0	425	607	99	524	706
100	146.6	514	750	109	623	859

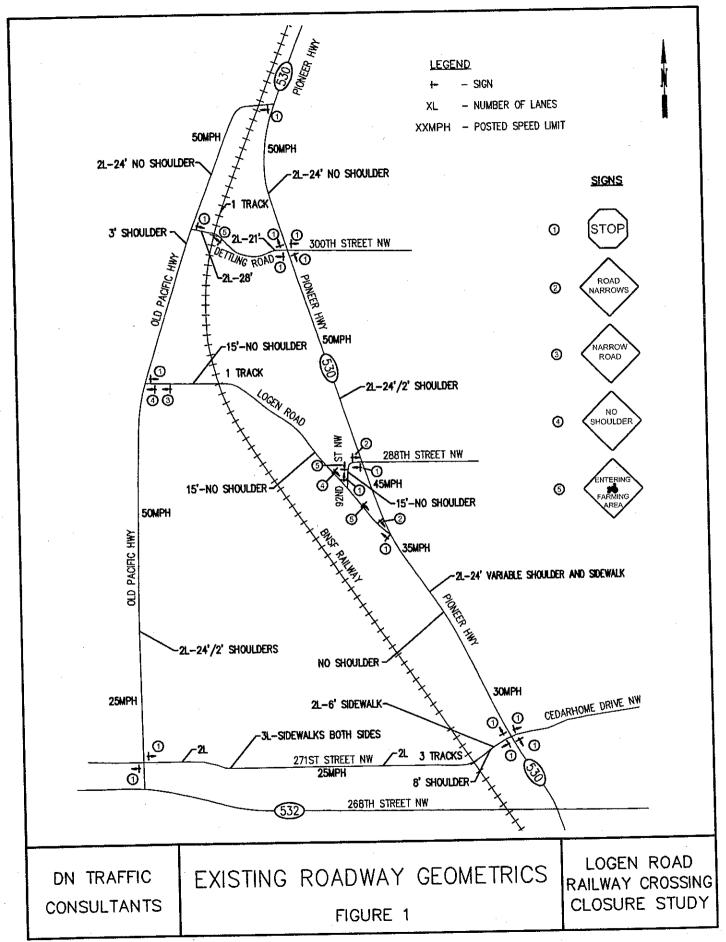
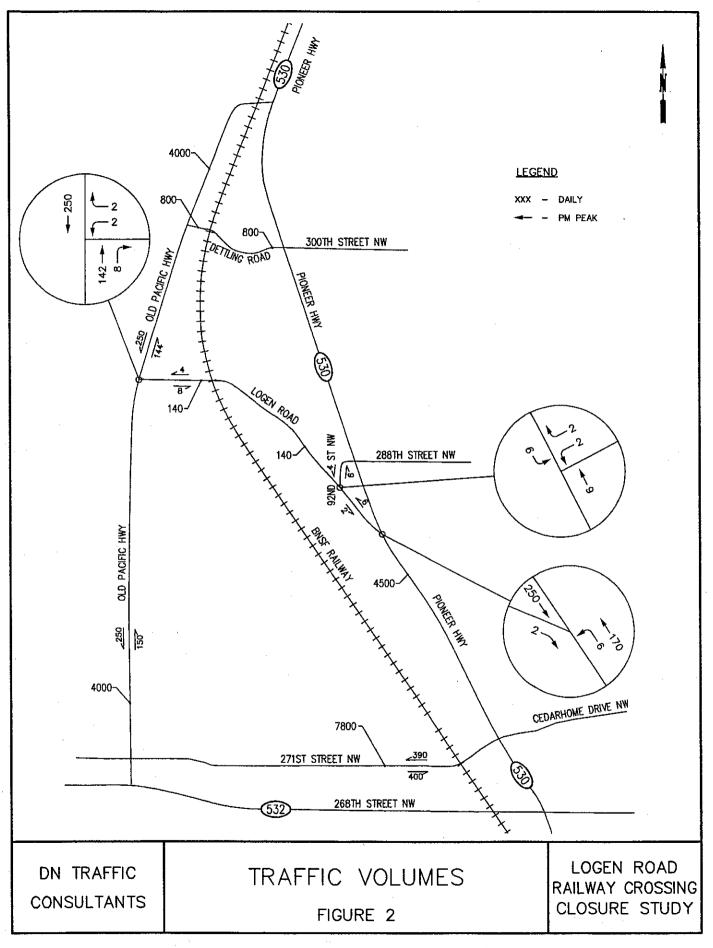


Exhibit No. __ LFL-4



_	IONEER HWY @ O		G FILE NUMBER 06111		SA A
CLASSIFICATION SUBMITTED BY	D. WISEHART	CTOR (7); BOTH ROADS	REQUESTED BY: AN		
	D. WISEHART			DATE _ 08/17	7/06
-					
<u>NDICATOR</u>		<u>DATA VALUE</u>	INDICATOR VALUE WEIGHT	<u>PARTIAL</u> INDEX	COMMENTS
NUMBER OF ACCIE	DENTS	1.33 ACC/YR	27 X 0.150 =	= 4.05	
ACCIDENT RATE	•	0.42 ACC/MEV	10 X 0.150 =	1.50	· _ ·
ACCIDENT SEVERI	TY	\$7,400 \$/ACC	36 X 0.100 =	3.60	
VOLUME/CAPACIT	Y RATIO	0.33	50 X 0.100 =	5.00	
SIGHT DISTANCE R	OITA	0.38	100 X 0.100 =	10.00	
PEDESTRIAN/BICY	CLE FACILITIES	9	90 X 0.100 =	9.00	
TRAFFIC CONFLICT	Γ	1 CONF/HR	6 X .0.150 =	0.90	
ORIVER EXPECTAN	ICY	2	34 X 0.150 =	5.10	
			'''	*	Oo not include weights for indicators
OTALS:			1.000 *	39.15 us	ed at this location.
OTAL INDEX = SU	JM OF PARTIAL INDEX	ES /SUM OF APPLICABLE WEIGHT	S = 39.15 / 1.000 =	39.15	
RELATIVE STRENG	FI'H OF EVALUATION =	SUM OF APPLICABLE WEIGHTS X	100% =	100%	
				100%	NI LOCATION AND
NOTE: A TOTAL IN	DEX GREATER THAN 4	O CLASSIFIES THE LOCATION AS A	A POSSIBLE INADEQUATE R	OAD CONDITIO	ON LOCATION AND ORKS (IF APPROPRIATE).
NOTE: A TOTAL IN	DEX GREATER THAN 4		A POSSIBLE INADEQUATE R	OAD CONDITIO	ON LOCATION AND ORKS (IF APPROPRIATE).
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From Miscollaneous section
of Snolowich Co Exhibit Z

Exhibit ____LFL-6

MEMORANDUM

November 21, 2007

Т	O	•
_	_	•

Brent Mattila, Traffic Programs Engineer

Program Planning

FROM

Don Wisehart, Traffic Analysis & Data Management Technician

SUBJECT:

Preferred option for signalization of Pioneer Hwy. @ Old Pacific Hwy. IRC's: 0611FR00R96, Pioneer Hwy. @ Old Pacific Hwy.; 0612FR98R93,

Pioneer Hwy. @ Dettling Rd. / 300 St. NW

Originally, a request was made to Program Planning for prioritization of the following and three options were given:

1) Signalization of Pioneer Highway @ Old Pacific Highway or

2) Closure of Old Pacific Highway and signalization of Pioneer Highway @ Dettling Road or

3) Install Roundabout at Pioneer Highway @ Dettling Road (after closure of Old

Pacific Highway).

Old Pacific -part officient route i comnot be closed.

Truck turning radius not avail @ old Pacific/Dattling Rd & Closed. Option Number 1 (Signalization of Pioneer Highway @ Old Pacific Highway) is now the preferred option based on our meeting today with Jim Bloodgood, County Traffic Engineer. The process required for the closure of Old Pacific Highway would be cumbersome, and Dettling Road is not currently built to handle the extra vehicular and truck traffic without significant improvements.

. Buttling Rd need to be virdened and curves improved for trule traff In attendance at the meeting with Jim Bloodgood were Theam Ong, TADM Supervisor; Brent Mattila, Traffic Programs Engineer; and Don Wisehart, TADM Tech III.

· Council approval rue deal to close old Pauli - a long techous process

dw

Attachments

Cc: Theam Ong, TADM Supervisor

Harold Wirch, P.E., Engineer IV, Traffic Signal Operations Engineer

From Snohowith County Response habded Exhibit AA

Exhibit __ LFL-7

SITE LOCATION P	IONEER HWY @ D	ETTLING RD/300	ST NW-	FILE NUMB	ER06121	FR98R93	TSA _	A
CLASSIFICATION	R - MAJ. COLLECTO	OR (7); MIN. COLL	ECTOR (8)	REQUESTE	эву: <u>AN</u>	DY SMITH	. TDR	
SUBMITTED BY	D. WISEHART					DATE <u>08</u>	/17/06	
INDICATOR		DATA VALUE		INDICATOR VALUE	<u>WEIGHT</u>	PARTIAL INDEX		<u>COMMENTS</u>
NUMBER OF ACCID	DENTS	1.00	ACC/YR	23	X 0.150 =	3.45		
ACCIDENT RATE		0.46	ACC/MEV	11	X 0.150 =	1.65		
ACCIDENT SEVERIT	TY .	\$11,233	\$/ACC	43	X 0.100 =	4.30		
VOLUME/CAPACITY	Y RATIO	0.21		39	X 0.100 =	3.90		
SIGHT DISTANCE R	ATIO	1.21		23	X 0.100 =	2.30		
PEDESTRIAN/BICYO	CLE FACILITIES .	9		90	X 0.100 =	9.00		
TRAFFIC CONFLICT	ť	0	CONF/HR	0	X 0.150 =	0.00		
DRIVER EXPECTAN	ICY	1		17	X 0.150 =	2.55		
TOTALS:					1.000 *	27.15	*Do not in	clude weights for indicato
TOTAL INDEX = SU	JM OF PARTIAL INDEX	ES /SUM OF APPLIC	'ARI E WEIGHTS:	= 27.15		27.15		
- •			TIDE TIME TO A COLUMN		1.000	47.14		
ner tenen ordinale						1000/		
	TH OF EVALUATION =	SUM OF APPLICABL	LE WEIGHTS X 100			100%		
NOTE: A TOTAL IN	TH OF EVALUATION =	SUM OF APPLICABL	E WEIGHTS X 100	OSSIBLE INAL		DAD CONDIT		
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__LFL-8 Pagelof8 Exhibit

SNSF RAILWAY COMPANY Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex Stanwood, WA - Snohomish County Rail Incidents Incidents

NEAREST STATION: SUB DIVISION:

COUNTY:

ACCT. NO.:

TRACK TYPE:

TRACK MTCE:

TRACK COST:

TYPE INCIDENT:

STANWOOD WA MILE POST:

BELLINGHAM

SNOHOMISH

PA-1194-200 DATE:

MAIN

TRACK NUMBER:

HGX XING COLL

D-CODE: EQUIPMENT COST:

4NL200

TIME: 22 50

PRIMARY CAUSE: CONTRIBUTING CAUSE:

\$0 OTHER HWY/RAIL CROSSING ACCT CAUSE (PROVIDE DETAILS) M399

\$0

00057.9

1994/11/13

NON-REPORTABLE

TRACK NAME: MAIN

NO CONTRIBUTING CAUSE

CONSIST: F-L001 1-01

CONSIST TYPE: TRAIN (UNITS PULLING)

TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1994-11-15

FREIGHT TRAIN BN TRAIN F-L001 1-01

CREW INFO:

ROAD ENGINEER MJ MERCERI

ROAD CONDUCTOR

HE TONY

ROAD BRAKEMAN

UNKNOWN

DESCRIPTION:

TRAIN 53626 NORTHBOUND ON MAIN TRACK STANWOOD, WA. MP

57.93 STRUCK VEHICLE STOPPED ON GRADE CROSSING.

CROSSING GATES AND SIGNALS WORKING. OCCUPANT SUSTAINED

FATAL INJURIES AND WAS TRANSPORTED TO HARBOR VIEW

HOSPITAL SEATTLE.

LFL-8 248

BNSF RAILWAY COMPANY Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex Stanwood, WA - Snohomish County Rail Incidents Incidents

NEAREST STATION: SUB DIVISION:

STANWOOD WA MILE POST:

BELLINGHAM

COUNTY:

ACCT. NO.:

SNOHOMISH

PA-0399-200 DATE: 1999/03/07

TRACK NAME: MAIN

TRACK TYPE:

MAIN

TRACK NUMBER: HGX XING COLL

MAIN

00057.9

TIME: 02 15

TYPE INCIDENT: TRACK MTCE:

BNSF

D-CODE:

93L200 \$0 NON-REPORTABLE

TRACK COST: PRIMARY CAUSE: \$3,000

EQUIPMENT COST: M302 HIGHWAY USER INATTENTIVENESS

CONTRIBUTING CAUSE:

NO CONTRIBUTING CAUSE

CONSIST: M-EVEVBC1-06

CONSIST TYPE: TRAIN (UNITS PULLING)

TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1999-03-08

FREIGHT TRAIN BNSF TRAIN M-EVEVBC1-06

CREW INFO:

ROAD ENGINEER

SG MCARTHUR

ROAD CONDUCTOR

JP OCONNOR

ROAD HEAD BRAKEM CD TAYLOR

DESCRIPTION:

PER NOC REPORT: FOLLOW UP REQUIRED BY PACIFIC DIV.

M-EVEVBC1-06 REPORTS STRIKING AUTOMOBILE AT MP

57.93 BETWEEN STANWOOD AND MT VERNON.

SIGNAL DAMAGES INCLUDE REPLACING OF SIGNAL MAST, BASE,

GATE, AND LIGHTS.

ANSF RAILWAY COMPANY Prepared 03/11/09 Using /data/bnsf/sf/b804216/reidet2.fex Stanwood, WA - Snohomish County Rail Incidents Incidents

hFL-8
Page 3 of 8

NEAREST STATION:

STANWOOD WA MILE POST:

0.0000.0

TRACK NAME: WOLKIL LD

SUB DIVISION:

COUNTY:

BELLINGHAM

SNOHOMISH

PA-1291-204 DATE: TRACK NUMBER: 1991/12/11

TIME: 07 28

ACCT. NO.: TRACK TYPE: TYPE INCIDENT:

INDUSTRY

HGX XING COLL

INDUSTRY D-CODE: 1DL204

NON-REPORTABLE

TRACK MTCE: TRACK COST:

\$0

EQUIPMENT COST:

\$0

PRIMARY CAUSE:

M399 OTHER HWY/RAIL CROSSING ACCT CAUSE (PROVIDE DETAILS)

CONTRIBUTING CAUSE:

NO CONTRIBUTING CAUSE

CONSIST: F-L001 1-01

CONSIST TYPE: TRAIN (UNITS PUSHING)
TYPE EQUIPMENT: FREIGHT TRAIN

ORIGINAL ENTRY ON 1991-12-11

FREIGHT TRAIN BN TRAIN F-LOO1 1-01

CREW INFO:

ROAD ENGINEER

JE TASCHE

ROAD CONDUCTOR

AB COY

DESCRIPTION:

TRAIN 01-53818-11 PUSHING CARS AT INDUSTRY OF WOLFKILL AT STANWOOD, WASHINGTON STRUCK 91 CHEVY CAPRICE DRIVEN BY R C CLEARY OF 27820 83RD NW, STANWOOD, WA AT 271ST NW CROSSING. NO INJURIES. PAGE 4 OF 15012 NOT RECEIVED

SRS TILL 1-15-92.



DEPARTMENT OF TRANSPORTATIONFEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

LFL-8 Page 4098

OMB Approval No. 2130-0500

Name Of					Alphabetic Code	RR Accident/Incid	ient No.
Reporting Railroad	Burl	ington Northe	ern RR Co. [BN]		1a. BN	1b. CA0146	
2. Other Railroad Involved in Train Acc					2a.	2b.	
3. Railroad Responsible for Track Mair	nance Burl	ington Northe	rn RR Co. [BN]		3a. BN	3b. CA0146	
4. U.S. DOT-AAR Grade Crossing ID I			ate of Accident/Incident	1 07/05/04		ent/incident 01:15	AM
	0047		·	1	o. Time of Acoide	1	
7. Nearest Railroad Station STANWOOD		8. Division		9. County SNOHO	OMISH	10. State Abbr. 53	Code WA_
11. City (if in a city)		12. Highway	Name or No. 102ND	AVENUE	61 & Parth	Public F	Private
Highway Us	Involved			Rail Equip	ment Involved		
13. Type C. Truck-trailer F. Bus	J. Other Motor	Vehicle Code	17. Equipment 1. Train (units pul	4. Car(s)	(moving) 8. C	Other (specify)	Code
A. Auto D. Pick-up truck G. Schoo		1	Train (units pul. Train (units pus. Train (units pus.	lling) 5. Car(s)	(standing) A. 1	Frain pulling- RCL	
B. Truck E. Van H. Motoro		ecify) A	3. Train (standing			Train pushing- RCL Train standing- RCL	1
14. Vehicle Speed 15. Direct	n (geographica	al) Code		'	ood(o) (oranganig)		
(est. mph at impact) 0 1. North	2. South 3. East	4. West 1			1		
Position 1. Stalled on crossing Stopped on Crossing	Moving over cross Trapped	sing Code			nt struck highway user t struck by highway us	er	Code 1
20a. Was the highway user and/or rail		Code	2 2 2 2 2 2			<u> </u>	Code
in the impact transporting hazard		1			•		
1. Highway User 2. Rail Equip			1. Highway	User 2. Rail	Equipment 3. Both	4. Neither	L
20c. State the name and quantity of th	nazardous materials	released, if any					Ī
21. Temperature 22. Visi	ity (single entry)	Code	e 23. Weather (singi	le entry)			Code
(specify if minus) 55 °F 1. Day	2. Day 3. Dusk	4. Dark 4	1. Clear 2. Clou	ıdy 3. Rain 4. f	Fog 5. Sleet 6. Snov	v	2
24. Type of Equipment		Spec. MoW	25. Track Type Use	ed by Rail	Code	26. Track Number or	Name
	k train 7. Yard/Swit		Equipment Invo	•			
(single entry) 2. Passenger train 5, S 3. Commuter train 6, C				rd 3 Sidina	4. Industry 1	SINGLE MAIN TRACK	
27. FRA Track 28. Number of	29. Number of		peed (Recorded if avail		31. Time Table Direct		Code
Class Locomotive	Cars	R. Record		nable) Code	31. THIS TADIS DIESE	1011	, Code
3 Units	3 41	E. Estima	ted 40	mph E	1. North 2. South 3	. East 4. West	1
	wags 7. C	Crossbucks 10.	Flagged by crew	33. Signal	ed Crossing 3	34. Whistle Ban	Code
Crossing 2. Cantilever FLS 5. H	_		Other (specify)	Warni	ng	1. Yes	
Warning 3. Standard FLS 6. A		Vatchman 12.	None		. (1)	2. No	ı İ
Code(s) 01 03	06		<u> </u>		arn min (1);	3. Unknown	
35. Location of Warning 1. Both Sides	Code		g Warning Jhway Signals	Code	 Crossing Illumin Lights or Specia 	•	Code
2. Side of Vehicle Approach	1	Wild in a	iriway olgilala	2	Lights of Opecia	ii Ligitto	
3. Opposite Side of Vehicle Appro	h 1	1. Yes	2. No 3. Unknown		1, Yes 2, No	3. Unknown	1
38. Driver's 39. Driver's Code 40	Driver Drove Behind	or in Front of Tra	ain Code 41. [Oriver			Code
Age Gender	and Struck or was S				or thru the gate 4. S		
1. Male 2. Female	1. Yes 2. No	3. Unknown		 Stopped and Did not stop 	then proceeded 5. C	Other (specify)	4
42. Driver Passed Standing	ode 43. View of Tr	rack Obscured b					Code
Highway Vehicle	1. Perman	ent Structure	3. Passing Train 5	5. Vegetation	7. Other (spec		
1. Yes 2. No 3. Unknown	2. Standin	g railroad equipr	nent 4. Topography		icles 8. Not Obstructe	ed	8
Casualties to: K	ed Injured	14. Driver was		Code	45. Was Driver in the	Vehicle?	Code
Casuames to.	injured	1. Killed 2. I	njured 3. Uninjured	3	1. Yes 2. No		2
46. Highway-Rail Crossing Users	0	17. Highway Veh (est. dollar da	icle Property Damage	\$5,000	48. Total Number of I	Highway-Rail Crossin	· .
49. Railroad Employees	0 5		of People on Train	1 42,000	51. Is a Rail Equipme		Code
52. Passengers on Train	0		engers and crew)	.	Incident Report B 1. Yes 2. No	eing Filed	2
53a. Special Study Block	<u> </u>		53b. Special Study I	LBlock			
54. Narrative Description		, , , , , , , , , , , , , , , , , , , ,				<u> </u>	
C. (Garage Description							
•							
55 Tuned Neme and Title	56 6:					57 Det-	
55. Typed Name and Title	56. Signature					57. Date	

24-25 DEPARTMENT OF TRANSPORTATION

HIGHWAY-RAIL GRADE CROSSING ACCIDENT/INCIDENT REPORT

FEDERAL RAILROAD ADMINISTRA	TION (FR	A)							OMB A	Approval No. 2	130-0500
Name Of								Alphabetic C	ode RF	R Accident/Inci	dent No.
Reporting Railroad		В	urlington N	orther	n RR Co. [BN]			1a. BN	1b	PA745	
2. Other Railroad Involved in Train	Accident/I	ncident						2a.	2b).	
3. Railroad Responsible for Track N	laintenand	ce						3a.	3b).	
4. U.S. DOT-AAR Grade Crossing I	D No.	084	716K	5. Dat	e of Accident/Incid	ent (6/10/76	6. Time of Acc	ident/Inci	dent 07:50	AM
7. Nearest Railroad Station STANWOOD WASH			8. Div	/ision			9. County SNOH	OMISH	10.	State Abbr. 53	Code WA
11. City (if in a city)			12. Hiç	jhway N	lame or No. OL	D PAC			V	Public	Private
Highway	User Invo	lved	l				······	oment Involved			
	nool Bus torcycle	K. Pedestr M. Other	(specify)	Code	1. Train (units	pushini	g) 6. Light	oco(s) (moving) 1	B. Train p	(specify) ulling- RCL ushing- RCL tanding- RCL	Code 8
1 ' '	irection	geograp) outh 3. Eas	•	Code	18. Position of Ca	r Unit	in Train	1			
16. Position 1. Stalled on crossing		oving over c		4 Code	10 Circumotonea	1 00	::	nt struck highway us			Code
2. Stopped on Crossi		-	iossing	3	19. Circumstance			nt struck nignway us nt struck by highway			l 1
20a. Was the highway user and/or	rail equipr	nent involve	ed	Code	20b. Was there a						Code
in the impact transporting haz 1. Highway User 2. Rail Eq			4. Neither	4	1. Highw	av Hse	ar 2 Rail	Equipment 3. Bot	th 4 Ne	ither	1
20c. State the name and quantity o					1. 1 1191144	ay 030	2. I\aii	Equipment 3. 50	4,146		
21. Temperature 22.	Vicibility	(single entr	4		02 144-45 (-)		.4.1				
70.0 5	-	Day 3. Du	•	Code I 2	23. Weather (si	-		.			Code I 2
24. Type of Equipment	Dawii Z.	Day 3. DI		<u> </u>			·· · · · · ·	Fog 5. Sleet 6. S	1		
	. Work tra	in 7. Yard/	A. Spec. MoV Switching	·V	25. Track Type t Equipment I		-	Code	26. Tra	ack Number or	Name
(single entry) 2. Passenger train 5 3. Commuter train 6	. Single ca	ar 8. Light	oco(s)	Code 8	1. Main 2.			4. Industry 1	1	GLE MAIN ACK	
27. FRA Track 28. Number of		29. Numbe	r of 30. Cor	nsist Sp	eed (Recorded if a	vailabl	e) Code	31. Time Table Din	ection		Code
Class Locomot	ive 0	Cars	• I	Recorde			, E				4
	. Wig wag:		<u> </u>	Estimate	lagged by crew	mph	<u></u>	1. North 2. South led Crossing		4. west istle Ban	Code
Crossing 2. Cantilever FLS 5.	. Hwy. traf	fic signals	8. Stop signs	11. 0	ther (specify)		Warn	-	1. Y		Code
Warning 3. Standard FLS 6.	Audible		9. Watchman	12. N	one ,				2. N		. 1
Code(s) 03								o warn (4);		Inknown	J
35. Location of Warning 1. Both Sides		(-	Warning way Signals		Code	37. Crossing Illur Lights or Spe			Code
Side of Vehicle Approach		1	1	-	• •		3	Lights of Spe	Ciai Ligins	3	1 2
3. Opposite Side of Vehicle Ap					2. No 3. Unknown	1	<u> </u>	1. Yes 2. N	o 3. Unk	known	4
38. Driver's 39. Driver's Code Age Gender	1					1. Drive					Code
Age Gender 1. Male [as Struck by S No. 3. Unknow		i l			d or thru the gate 4 then proceeded 5		l on crossing (specify)	1
2, Female	<u> </u>	,			2		id not stop	their proceeded C	. Onioi	(эрсону)	3
42. Driver Passed Standing	Code		of Track Obscu		(primary obst		•				Code
Highway Vehicle 1. Yes 2. No 3. Unknown	2		nanent Structi iding railroad i		3. Passing Trai ent 4. Topography	n 5. V 6. H	egetation ighway Vel	7. Other (s) nicles 8. Not Obstru	oecify) icted		8
			44. Driver v						•	·- O	
Casuaities to:	Killed	Injured			ured 3. Uninjured		ode	45. Was Driver in t	ine venici	e?	Code
		 			 	.,	·		- C (!!- }		1
46. Highway-Rail Crossing Users	0	0	_	ıy venic İlar dan	le Property Damag aaae)		200	48. Total Number ((include driver)		ıy-Rail Crossin 1	
49. Railroad Employees	0	0			of People on Train	1 4	200	51. Is a Rail Equip			Code
52. Passengers on Train	0	0			ngers and crew)	1		Incident Repor 1. Yes 2. No	_	iled	2
53a. Special Study Block		.			53b. Special Stud	ty Plac		1. 1es 2. No			J
54. Narrative Description					33b. Special Stuc	IY BIOC	,x		· · · · · · · · · · · · · · · · · · ·		
5 realisante degoniphion											
55. Typed Name and Title		56. Signatu	re							57. Date	

24-25

DEPARTMENT OF TRANSPORTATION

FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING LFL-8 Page 6 of 8

ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of								Alphabetic Co	de F	RR Accident/II	ncident No.
Reporting Railroad		В	urlington No	rther	n RR Co. [BN]		,	1a. BN	1	lb. CA0240	
2. Other Railroad Involved in Train	Accident/I							2a.	2	∑b.	
3. Railroad Responsible for Track N	Jaintenan	ce B	urlington No	rther	n RR Co. [BN]			3a. BN	3	3b. CA0240	
4. U.S. DOT-AAR Grade Crossing I	iD No.				e of Accident/Incide	ent 1	1/13/94	6. Time of Acci	dent/In	cident 10:5	0 PM
7. Nearest Railroad Station STANWOOD			8. Divis	sion			9. County SNOH	OMISH	11	0. State Abbr.	Code 53 WA
11. City (if in a city)			12. High	hway N	lame or No. 102N	VD ST		Pacific fust		Public	Private
Highway	User Invo	ived			Josh	1		pment involved			
13. Type C. Truck-trailer F. Bus	š	J. Other M	otor Vehicle	Code	17. Equipment 1. Train (units p	<u>.</u>			. Other) Code
A. Auto D. Pick-up truck G. Sch					Train (units page 2. Train (units page 2.)	oulling) oushine) 5. Car(s) α\6. Light∣) (standing) — A loco(s) (moving) — B		pulling- RCL pushing- RCI	
		M. Other		A	3. Train (standir	ing)	7. Light			standing- RC	
	irection Iorth 2. Sc	<i>(geograp</i> outh 3.Eas	•	Code	18. Position of Car	r Unit i	in Train	1			
16. Position 1. Stalled on crossing	3. Mo	oving over co		Code 2	1			nt struck highway use			Code
Stopped on Crossi Was the highway user and/or	ng 4. Ha	nent involve	<u></u>	رخ Code	20b. Was there a h			nt struck by highway i	user		1 Code
in the impact transporting haz	ardous ma	aterials?	1		ZVD. Was there a.	lidzaro	Jous mater	ials release by			Code
1. Highway User 2. Rail Eq				4	1. Highwa	ay Use	r 2. Rail	Equipment 3. Both	1 4.1	Neither	
20c. State the name and quantity o	f the hazar	rdous mater	rials released, i	f any							
21. Temperature 22. V	Visibility	(single entry	/1	Code	23. Weather (sin	cala or	~t=1				Codo
		Day 3. Du	•	4				Fog 5. Sleet 6. Sn	O/W		Code
24. Type of Equipment			A. Spec. MoW		25. Track Type U		-	Code		rack Number	or Name
Consist 1. Freight train 4 (single entry) 2. Passenger train 5	. Work trai	in 7. Yard/S	Switching		Equipment In		•				
(single entry) 2. Passenger train 5 3. Commuter train 6	. Single ca i. Cut of ca	ır 8. Ligni i ırs 9. Ma in./	oco(s) inspect.	Code 1	1. Main 2. Y	Yard :	3. Siding	4. Industry 1		NGLE MAI RACK	N
27. FRA Track 28. Number of		29. Number	r of 30. Cons	ist Spe	eed (Recorded if av	vailable	e) Code	31. Time Table Dire	ction		Code
Class Locomoti 4 Units	ive 3	Cars ,	R. Re	ecorde	d		1		_		
Cinto	. Wig wags			stimate		mph		1. North 2. South			1
Crossing 2. Cantilever FLS 5. Warning 3. Standard FLS 6.	. Hwy. traff	fic signals	8. Stop signs	11. 0	agged by crew ther (specify)		33. Signal Warn	led Crossing ing	1.	histle Ban Yes	Code
Code(s) 01 03	. Audible		9. Watchman	72. N	one	\dashv	20 sec w	arn min (1);		No Unknown	
35. Location of Warning			Cogte 36. Cro	ssing \	Warning		Code	37. Crossing Illum	L		Code
1. Both Sides		(1)	4		way Signals			Lights or Spec			0044
Side of Vehicle Approach Opposite Side of Vehicle Approach	p <u>roach</u>		1 / 1.\	Yes 2	. No 3. Unknown		2	1. Yes 2. No	3. Ui	nknown	2
	40. Driver	Drove Beh	ind or in Front	of Train	n Code 41.	. Drive	er				Code
Age Gender 1. Male	L.		s Struck by Sec		rain I			d or thru the gate 4.			,
2. Female		l. Yes ∠. ıv	lo 3. Unknow	П	2		topped and id not stop	then proceeded 5.	Other	(specity)	4
42. Driver Passed Standing	Code		of Track Obscur		(primary obstru			· · · · · · · · · · · · · · · · · · ·		- 10	Code
Highway Vehicle 1. Yes 2. No 3. Unknown	2		nanent Structur iding railroad ed		3. Passing Train ant 4. Topography	n 5. Ve	egetation	7. Other (spenicles 8. Not Obstruc	ecify)		8
Ti 100 Zi 110 Oi Oilaireini			44. Driver wa		NIC -1 (AKADI-AKI)			45. Was Driver in th		-1-0	
Casualties to:	Killed	Injured		`	ured 3. Uninjured		yde)	45. was Driver in tr	ie vein	cie :	Code 2
	<u> </u>	 			le Property Damage		/	48. Total Number o	f Hiabw	vav-Rail Cross	
46. Highway-Rail Crossing Users	1	0	(est. dolla			1	3,000	(include driver)	1119,,,,	ray itali orco.	1
49. Railroad Employees	0	0	1		f People on Train	<u> </u>		51. Is a Rail Equipn			Code
52. Passengers on Train	0	0	(include p	passen	ngers and crew)			Incident Report 1. Yes 2. No	Being i	Filed	2
53a. Special Study Block					53b. Special Study	y Block	k				
54. Narrative Description					-						
·											
							· · · · · ·		····	ī	- · · · · · · · · -
55. Typed Name and Title	ľ	56. Signatu	re							57. Date	I

24.25

DEPARTMENT OF TRANSPORTATION FEDERAL RAILROAD ADMINISTRATION (FRA)

HIGHWAY-RAIL GRADE CROSSING LFL - 8 Page 7 of 8 ACCIDENT/INCIDENT REPORT

OMB Approval No. 2130-0500

Name Of						Alphabetic Code	RR Accident/Inci	dent No.
1. Reporting Railroad		hicago, Milv	vauke	e, St. Paul & Pacifi	e RR MILW	V] 1a. MILW	1b. 916401	
2. Other Railroad Involved in Train Accider	/Incident					2a.	2b.	
3. Raifroad Responsible for Track Mainten	nce B	urlington No	orther	n RR Co. [BN]		3a. BN	3b. XXX	
4. U.S. DOT-AAR Grade Crossing ID No.	0847	714 W	5. Dat	te of Accident/Incident	07/13/78	6. Time of Accider	nt/Incident 05:57	AM
7. Nearest Railroad Station STANWOOD		8. Divi	ision		9. County	QMISH	10. State Abbr. 53	Code WA
11. City (if in a city) STANWOOD		12. Hig	hway N	Name or No. DETTI	LING ROAD		Public	Private
Highway User Ir	volved	:		1	Rail Equir	oment Involved		
13. Type C. Truck-trailer F. Bus	J. Other Mc	otor Vehicle	Code			(moving) 8. O		Code
A. Auto D. Pick-up truck G. School Bu	K. Pedestria	ian	В	Train (units pulli Train (units pusi	hing) 6. Light l	(standing) A. i oco(s) (moving) B. T	rain pulling-RCL rain pushing-RCL	1
B. Truck E. Van H. Motorcycle 14. Vehicle Speed 15. Direction	M. Other (: (geograp)		<u> </u>	3. Train (standing)) 7. Light le		rain standing-RCL	
	<i>(geograpi</i> South 3. East	•	Code 4	18. Position of Car U	nitin irain	1		
16. Position 1. Stalled on crossing 3.	Moving over cr		Code	19. Circumstance 1.	Rail equipmer	nt struck highway user		Code
Stopped on Crossing 4. 20a. Was the highway user and/or rail equ	<u> </u>		3			t struck by highway use	F	2
in the impact transporting hazardous		a	Code	20b. Was there a haz	zardous materi	als release by		Code
Highway User 2. Rail Equipment			3	1. Highway l	User 2. Rail	Equipment 3. Both	4. Neither	
20c. State the name and quantity of the ha	:ardous mater	ials released,	if any					
21. Temperature 22. Visibility	(single entry)	<i>y</i>)	Code	23. Weather (single	o antru)			Code
	2. Day 3. Dus	•	l 1			Fog 5. Sleet 6. Snow		l 1
24. Type of Equipment		A. Spec. MoW	<u> </u>					110000
Consist 1. Freight train 4. Work	rain 7. Yard/S	Switching	•	25. Track Type Used Equipment Invol	•	Code 2	6. Track Number or	Name
(single entry) 2. Passenger train 5. Single 3. Commuter train 6. Cut of			Code 1	1. Main 2. Yan		4. Industry 1	SINGLE MAIN	LINE
27. FRA Track 28. Number of	29. Number	[•	eed (Recorded if availa	lable) Code	31. Time Table Direction	on	Code
Class Locomotive 4 Units	Cars 2	27	Recorde stimate		mph E	1. North 2. South 3.	East / West	4
32. Type of 1. Gates 4. Wig w				lagged by crew	· · · · · · · · · · · · · · · · · · ·		£ast 4. west 4. Whistle Ban	Code
Crossing 2. Cantilever FLS 5. Hwy. t	affic signals 8	8. Stop signs	11. 0	Other (specify)	Warni	- 1	1. Yes	
Warning 3. Standard FLS 6. Audibl Code(s) 07 11		9. Watchman	12. N	lone	_		2. No	ļ.
Code(s) 07 11 35. Location of Warning		Code 36. Cro	ina	Warning	Code	C7. Crassing Illumina	3. Unknown	Code
1. Both Sides	•			vvarning iway Signals	Code	37. Crossing Illumina Lights or Special	•	Code
2. Side of Vehicle Approach	1	1 1	Ves :	2. No 3. Unknown	2	1. Yes 2. No	2 Unknown	3
3. Opposite Side of Vehicle Approach 38. Driver's 39. Driver's Code 40. Dri	er Drove Beh	nind or in Front			<u> </u>	1, 103 2, 140	3. Officiowii	Code
1 . 1		as Struck by Se				d or thru the gate 4. St	opped on crossing	Code
1. Male	1. Yes 2. N	No 3. Unknow	vn	2 2	2. Stopped and	then proceeded 5. Of		3
2. Female 42. Driver Passed Standing Coo	e 43. View o	of Track Obscu	red by		3. Did not stop			Code
Highway Vehicle	1. Perm	nanent Structu	ıre	3. Passing Train 5	. Vegetation	7. Other (speci	fy)	1
1. Yes 2. No 3. Unknown 2	2. Stand	ding railroad e	equipme	ent 4. Topography 6	i. Highway Veh	nicles 8. Not Obstructed	<u> </u>	8
Casualties to: Killed	injured	44. Driver w			Code	45. Was Driver in the	Vehicle?	Code
	1,,,,,,,,			jured 3. Uninjured	2	1. Yes 2. No		1
46. Highway-Rail Crossing Users 0	1		-	le Property Damage		48. Total Number of H	lighway-Rail Crossir	ng Users
		(est. dol.			\$2,500	(include driver) 51. Is a Rail Equipmer	Assidant /	Code
49. Railroad Employees 0	0			of People on Train ngers and crew)		Incident Report Be		Code ,
52. Passengers on Train 0	0	1	puoce.	igere and cross,		1. Yes 2. No		2
53a. Special Study Block				53b. Special Study B	Block			
54. Narrative Description								
55. Typed Name and Title	56. Signatur	 ;					57. Date	
55. Typed Haine and Tige	50. Signator	ie					or. Date	

2 1-25 DEPARTMENT OF TRANSPORTATION

HIGHWAY-RAIL GRADE CROSSING LFL-8

LFL-8 Page &

FEDERAL RAILROAD ADMINISTRATION (FRA) RR Accident/Incident No. Name Of Alphabetic Code 1. Reporting Railroad 1b. PA1550 Burlington Northern RR Co. [BN] 1a. BN 2. Other Railroad Involved in Train Accident/Incident 2a. 2b. 3. Railroad Responsible for Track Maintenance 3b. PA1550 3a. BN Burlington Northern RR Co. [BN 4. U.S. DOT-AAR Grade Crossing ID No. 084714W 5. Date of Accident/Incident 11/03/80 6. Time of Accident/Incident 7. Nearest Railroad Station 8. Division 9. County 10. State Code WA Abbr. 53 STANWOOD SNOHOMISH 11. City (if in a city) 12. Highway Name or No. | BETTLING RD ✓ Public Private Highway User Involved Rail Equipment Involved 13. Type Code 17. Equipment 4. Car(s) (moving) 5. Car(s) (standing) 8. Other Code C. Truck-trailer F. Bus J. Other Motor Vehicle 1. Train (units pulling) A. Train pulling- RCL D. Pick-up truck G. School Bus A. Auto K. Pedestrian 2. Train (units pushing) 6. Light loco(s) (moving) B. Train pushing- RCL R 1 B. Truck E. Van H. Motorcycle M. Other (specify) 3. Train (standing) C. Train standing- RCL 7. Light loco(s) (standing) 14. Vehicle Speed 15. Direction (geographical) Code 18. Position of Car Unit in Train (est. mph at impact) 8 1. North 2. South 3. East 4. West 4 16. Position 1. Stalled on crossing Code 3. Moving over crossing Code 19. Circumstance 1. Rail equipment struck highway user 3 2. Stopped on Crossing 4. Trapped 2. Rail equipment struck by highway user 20a. Was the highway user and/or rail equipment involved 20b. Was there a hazardous materials release by Code Code in the impact transporting hazardous materials? 1. Highway User 2. Rail Equipment 3. Both 4. Neither 1. Highway User 2. Rail Equipment 3. Both 4. Neither 20c. State the name and quantity of the hazardous materials released, if any 21. Temperature 22. Visibility (single entry) Code 23. Weather (single entry) Code 55 °F 2 (specify if minus) 1. Dawn 2. Day 3. Dusk 4. Dark 1. Clear 2. Cloudy 3. Rain 4. Fog 5. Sleet 6. Snow 24. Type of Equipment A. Spec. MoW 25. Track Type Used by Rail Code 26. Track Number or Name Consist 1. Freight train 4. Work train 7, Yard/Switching Equipment Involved SINGLE MAIN (single entry) 2. Passenger train 5. Single car 8. Light loco(s) Code 3. Commuter train 6. Cut of cars 9. Main./inspect. TRACK 1. Main 2. Yard 3. Siding 4. Industry 1 27. FRA Track 28. Number of 29. Number of 30. Consist Speed (Recorded if available) Code 31. Time Table Direction Code Class Locomotive R. Recorded 13 E 3 Units 32 F. Estimated mph 1. North 2. South 3. East 4. West 7. Crossbucks 10. Flagged by crew 32. Type of 1. Gates 4. Wig wags 33. Signaled Crossing Code 34. Whistle Ban 2. Cantilever FLS 5. Hwy. traffic signals 8. Stop signs 11. Other (specify) Warning 1 Yes Warning 3. Standard FLS 6. Audible 9. Watchman 12. None 2 No. Code(s) 3. Unknown 35. Location of Warning 37. Crossing Illuminated by Street 36. Crossing Warning Code Code Code 1. Both Sides with Highway Signals Lights or Special Lights 2. Side of Vehicle Approach 1 3 3 1. Yes 2. No 3. Unknown 1. Yes 2. No 3. Unknown 3. Opposite Side of Vehicle Approach 38. Driver's 39. Driver's Code 40. Driver Drove Behind or in Front of Train 41. Driver Code Code Gender Aae and Struck or was Struck by Second Train 1. Drove around or thru the gate 4. Stopped on crossing 1. Male 1. Yes 2. No 3. Unknown 2. Stopped and then proceeded 5. Other (specify) 3 2. Female 3. Did not stop 42. Driver Passed Standing Code 43. View of Track Obscured by (primary obstruction) Code Highway Vehicle 1. Permanent Structure 7. Other (specify) 3. Passing Train 5, Vegetation 2. Standing railroad equipment 4. Topography 6. Highway Vehicles 8. Not Obstructed 8 1. Yes 2. No 3. Unknown 44 Driver was 45. Was Driver in the Vehicle? Code Casualties to: Killed Injured 1. Killed 2. Injured 3. Uninjured 1. Yes 2. No 1 47. Highway Vehicle Property Damage 48. Total Number of Highway-Rail Crossing Users 46. Highway-Rail Crossing Users 0 1 (est. dollar damage) (include driver) \$1,500 51. Is a Rail Equipment Accident / Code 49. Railroad Employees 0 0 50. Total Number of People on Train Incident Report Being Filed (include passengers and crew) 0 0 2 52. Passengers on Train. 1. Yes 2. No 53a. Special Study Block 53b. Special Study Block 54. Narrative Description 55. Typed Name and Title 57. Date 56. Signature

Exhibit ____ LFL-9
Page 1 of 2

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

HIGHWAY/RAIL GRADE CROSSING TECHNICAL WORKING GROUP (TWG)

NOVEMBER 2002

GUIDANCE ON TRAFFIC CONTROL DEVICES AT HIGHWAY-RAIL GRADE CROSSINGS

EXECUTIVE SUMMARY

The Technical Working Group (TWG) established by the U.S. Department of Transportation, is led by representatives from the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), and the National Highway Traffic Safety Administration (NHTSA). The cooperation among the various representatives of the TWG represents a landmark effort to enhance communication between highway agencies, railroad companies and authorities, and governmental agencies involved with developing and implementing policies, rules and regulations.

The report is intended to provide guidance to assist engineers in selection of traffic control devices or other measures at highway-rail grade crossings. It is not to be interpreted as policy or standards. Any requirements that may be noted in this guidance are taken from the Manual on Uniform Traffic Control Devices (MUTCD) or other document identified by footnotes. These authorities should be followed. This guide merely tries to incorporate some of the requirements found in those documents. A number of measures are included which may not have been supported by quantitative research, but are being used by States and local agencies. These are included to inform practitioners of an array of tools used or being explored.

The goal is to provide a guidance document for users who understand general engineering and operational concepts of highway-rail grade crossings. The Guide serves as a reference to aid in decisions to install traffic control devices or otherwise improve such crossings. Additional references are provided as resource for further information.

The Guide discusses a number of existing laws, regulations and policies of the FHWA and FRA concerning highway-rail grade crossings and railroad operations, driver needs concerning various sight distance, and highway and rail system operational requirements and functional classification. There is an extensive description of passive and active traffic control devices, including supplemental devices used in conjunction with active controls. Traffic control devices in the 2000 edition of the MUTCD are listed, together with a few experimental devices. An appendix provides limited discussion on the complex topic of interconnection and preemption of traffic signals near highway-rail grade crossings. There is also discussion concerning closure, grade separation and consideration for installing new grade crossings. A glossary defines a few less familiar and technical terms. (Please note that the term grade crossings is synonymous with both the terms "highway-rail grade crossings" and "highway-rail intersections" in this document.)

A traffic control device selection procedure and extensive list of quantitative guidance are the specific products of this document. However, due to the unique characteristics of each individual crossing, these procedures and practices should not be considered as warrants or standards. Therefore, selection decisions must be made based on engineering studies.

safety. fhwa. dot. gov/media/twgrepart. Ltm

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FOUR-QUADRANT TRAFFIC GATE SYSTEMS

Four-quadrant gate systems consist of a series of automatic flashing-light signals and gates where the gates extend across both the approach and departure side of roadway lanes. Unlike two-quadrant gate systems, four-quadrant gates provide additional visual constraint and inhibit nearly all traffic movements over the crossing after the gates have been lowered. At this time, only a small number of four-quadrant gate systems have been installed in the U.S., and incorporate different types of designs to prevent vehicles from being trapped between the gates.

Table 2, prepared by members of the TWG, relates the typical minimal clearing sight distances for various train speeds and vehicle types. (It should be noted the column for 65 foot double trucks generally corresponds to the distances listed in table 36 on page 133 of the *RHGCH*, under the column for vehicle speed of "0 MPH." Vehicle acceleration data has been interpreted from the *Traffic Engineering Handbook*. (61) The person or agency evaluating the crossing should determine the specific design vehicle, pedestrian, bicyclist, or other non-motorized conveyance and compute clearing sight distance if it is not represented in the table. Also note the table values are for a level, 90-degree crossing of a single track. If other circumstances are encountered, the values **must** be **re-computed**.

TABLE 2
CLEARING SIGHT DISTANCE (in feet) *

Train Speed	Car	Single Unit-Truck	Bus	WB-50 Semi-Truck	65-ft Double Truck	Pedestrian **
10	105	185	200	225	240	180
20	205	365	400	450	485	355
25	255	455	500	560	605	440
30	310	550	600	675	725	530
40	410	730	795	895	965	705
50	515	910	995	1,120	1,205	880
60	615	1,095	1,195	1,345	1,445	1,060
70	715	1,275	1,395	1,570	1,680	1,235
80	820	1,460	1,590	1,790	1,925	1,410
90	920	1,640	1,790	2,015	2,165	1,585

Federal Transit Administration - Reports & Publications

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Lesson 38: Four-Quadrant Gated Crossing

September 13, 2000

1. Executive Summary

On September 29, 1997, the Massachusetts Bay Transportation Authority (MBTA) successfully completed the rehabilitation of the Old Colony Railroad Rehabilitation (OCRR) Lines. This commuter line restored rail service to 32 South Shore communities between Braintree and Plymouth/Middleborough areas. The OCRR services an area covering nearly 450 square miles and is comprised of approximately 70 miles of track, 44 signalized grade crossings and 15 stations. Today, the local roads, which accommodate more automobiles, have trains traveling at speeds up to 70 miles per hour passing through the highway-rail grade crossings nearly every hour throughout the day.

Aware of concerns for public safety, the Commonwealth of Massachusetts passed legislation in 1996 in an effort to attain a higher level of safety at the newly activated crossings along the OCRR. Prior to instituting the changes called for in the legislature, the MBTA applied for and received a grant from the Federal Transit Administration (FTA). The grant was awarded to demonstrate four-quadrant gate operations on the OCRR and then evaluate its effect on on or enhancements to sysystem safety. The MBTA commissioned a private consulting firm (SYSTRA) to establish, implement and evaluate design methods for four-quadrant gated grade crossings with Vehicle Intrusion Detection System (VDS).

2. Background

The project involved participation from various Federal and State agencies including: the FTA, Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), MBTA, Department of Energy and Telecommunications (DTE), and the American Association of Railroads (AAR) as well as Amtrak and the Town of Abington. Early involvement by all the referenced parties resulted in the successful implementation of this demonstration project.

In order to develop a safety optimizing four-quadrant gate design that optimizes the safety offor a highway-rail grade crossing, the operating characteristics of both modes of transportation were thoroughly studied. MBTA's design consultant conducted a detailed corridor analysis of each of the newly constructed 44 signalized highway-rail grade crossings along the OCRR before installing the four-quadrant gate system. This analysis focused on enhancing warning systems at each crossing. The existing arrangement of the warning devices were documented and evaluated specifically for this investigation. This systematic approach ultimately helped to determine where the four-quadrant gates could be installed for the greatest public benefit.

The final design step was to select one of the existing highway-rail grade crossings on the OCRR for the demonstration project. Wales Street in Abington met all the parameters of the design methodology. Additionally, baselines of motorists' behavior could be established, as well as the associated costs for the four-quadrant gate system could be estimated for other applications of highway-rail crossings in the Commonwealth of Massachusetts.

Prior to the construction of the four-quadrant gate system at Abington, cameras were installed at the Wales Street crossing to observe its current operation and driver behavior patterns. The camera recorded each event until the warning system was no longer activated. The MBTA reviewed the recorded videotapes every few days and any incidents or right-of-way violations were identified and logged. For purposes of this study an "incident" was defined as any automotive vehicle, pedestrian, or bicyclist that violated the existing warning devices and proceeded through the crossing after the initial bells, flashers and gate arms were activated. The base line survey was conducted for an eight-week observation period

from May 26, 1998 to July 15, 1998. During this time period the MBTA documented thirteen incidents.

Following the baseline observation period the MBTA proceeded with the installation of the four-quadrant gate design elements. The design elements were comprised of the following components:

- 1. Raised Concrete Median Islands
- 2. Gate Offsets
- 3. Emergency Exit Zones
- 4. Signage and Striping
- 5. Exit Gates
- 6. Vehicle Intrusion Detection System (VDS)
- 7. In-service testing
- 8. Public Awareness

The concrete median islands (7 inches in height) provided channelized traffic control for vehicles entering and exiting the crossing area. With a target distance of 25 feet from the gage of the rail, this offset gate allowed the motorist who managed to pass the entrance gate just before it descended to leave the crossing area. The off set gates provided strong visibility relative to the no crossing zone once the system was activated. Emergency exit zones were created to provide for an emergency pull off area should the motorist panic during the system activation process and become restrained between the entrance gate and the off set gate once the system responded to a train approach. Signage and striping was implemented to warn both pedestrians and motorists of the different types of railroad crossings. The exit gates themselves provided the basis of the four-quadrant gate system to prevent motorist from intentionally circumventing the standard gate warning devices. The Vehicle Intrusion Detection System was designed and installed as a non-vital element of the railroad grade crossing signal system and was to have minimal interface with the vital signal system. The VDS was outlined in each vehicular travel lane and designated as the Zone of Detection (ZOD). The ZOD was effectively located between the entrance and exit gate for each lane of traffic and was comprised of fluxgate magnetic sensor (magnetometers) elements placed strategically within the designated ZOD and connected to the exit gates via electronic signals. The magnetometers measured a change in the magnetic field of the earth detected by the presence of a vehicle located within the ZOD. The VDS was designed to not be ignored or shut off by the vital circuits controlling the exit gates signal system as the train passed through the crossing. Once the system was installed and tested an in-service observation period was conducted for approximately 26 weeks from June 18, 1999 to December 18, 1999 and then extended to mid March 2000 to provide further evaluation during inclement winter weather conditions.

During the entire process public awareness and "Operation Lifesaver" played a crucial role in the overall effectiveness and success of the program. The MBTA extended the "Operation Lifesaver" program to local schools and heightened public awareness about the four-quad gate program. Through educating and communicating with the public officials in the Town of Abington, the MBTA was able to develop a strong partnership that provided support for the demonstration project. In addition, the MBTA worked with a local television station and developed two special video programs regarding the four-quadrant gate system for educating the public.

3. Lessons Learned

During the demonstration project there were two events recorded that indicated a problem with the operation of the crossing. Both of these events were minor in scope and required only slight adjustments to the elements of the four-quadrant gate system. Based on the evolution of the project the following lessons were learned for possible future applications.

- Exit gates that require to be powered down and remain under power to stay down will require a
 dedicated 12VDC vital battery source. Future applications should investigate gate manufactures
 prior to design for requirements regarding the power down and stay option of the gates once the
 system would be activated.
- 2. The location of the magnetic sensors is critical to the overall performance and reliability of the

VDS. It is recommended that a detailed site survey at any future crossings be performed in order to establish a thorough understanding of the normal magnetic field that exists when a train is passing through the crossing.

3. During the preliminary testing, it was determined that two sensors should be installed in the track bed approximately fifteen feet outside of the crossing area. This would greatly reduce the complexity of the algorithms the controller would have to analyze, especially with slow moving trains or equipment movements through the crossing.

4. It is recommended that if an emergency exit zone is provided, an additional sensor should be located at approximately eight feet back from the existing sensor located in the street. The purpose of this is to provide positive directional identification of a vehicle that enters the area, either as an escape route during a train event or as an unauthorized entry.

5. Sensor cables should be constructed flush and plumb with the track bed in accordance with the installation drawings for maximum effectiveness and reliability.

6. Sensor cables should never be spliced in wet weather or unsuitable soil conditions as this may result in system failure and erratic behavior. Also, sensor cabling should be comprised of double-jacketed railroad burial grade, as it is far more durable and effective for use in the critical nature of grade crossings.

7. Should four-quadrant grade crossings be installed and placed into extended service, a maintenance plan and schedule needs to be developed and implemented consistent with current AREMA standards and CFR 49 requirements.

8. Large induced currents, such as those caused by the Sperry Track Inspection Car, used to test weld integrity in the track, caused a residual magnetic effect in the reinforcing bars of the concrete ties. This dramatic change to the magnetic ambient conditions along the track will necessitate a need to re-baseline the sensor array to compensate for such an altered condition.

 A four Quadrant Gate system cannot be applied or "forced" at all crossing locations. Each location has its own merits and concerns and a detailed systematic review is required to determine the best way to address the crossing.

4. Applicability

The four-quadrant gate system demonstrated that new technology combined with traditional grade crossing applications and enhanced feature elements could be effective and reliable to control motorist movement at an activated highway-rail intersection. However, this project demonstrated that a four-quadrant gate system cannot be applied or "forced" at all crossing locations. Each highway-rail grade crossing under consideration for a four-quadrant gate system must be thoroughly evaluated by a team of experts who can assess the unique site characteristics and specific configuration of the proposed crossing and highway geometry. This demonstration has shown that a four-quadrant gate system can be added to an existing operating system. Further, this project has demonstrated the need for additional testing of the new VDS technology utilizing magnetometers as well as industry evaluation. Other viable alternatives, such as the extension of gate arms and the use of roadway medians should be considered during the preliminary engineering phase of the project.

5. Contact

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Email: hhaywood@mbta.com

6. Resources

• Four-quadrant Gate Demonstration Project on the Old Colony Railroad

- (Draft final report Rev. 1 June 2000) Design Methodology Report
- Corridor Analysis Report- April 1998
- Manual for Uniform Traffic Control Devices (MUTCD)
- Operation Lifesaver
- Specialized Pamphlets for Public Education "Operation Lifesaver
- Video Programs Developed for Televised Education in the Local Community



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Title:

FIELD EVALUATION OF A FOUR-QUADRANT GATE SYSTEM FOR USE AT RAILROAD-

HIGHWAY GRADE CROSSINGS

Accession Number:

00495482

Record Type:

Abstract:

Component

As part of research to identify and evaluate innovative active warning devices with the potential for improving safety at railroad-highway grade crossings, candidate devices were identified and developed, and the most promising devices were evaluated in detailed laboratory studies. Based on the results of the laboratory evaluation, three devices were evaluated in the field at actual crossings. One of the innovative active warning devices evaluated in the field was a fourquadrant gate and flashing light signal system with skirts. A before-and-after study approach was used to evaluate the four-quadrant gate system. Data were collected on measures of effectiveness (MOEs) at the existing crossing with the standard two-quadrant gate system and then again at the same crossing after the four-quadrant gate system had been installed to allow a direct comparison of the impact on the MOEs. With the installation of the four-quadrant gate system, MOEs such as speeds, perception-brake reaction times, and deceleration levels did not indicate a change in driver behavior. There were no measurable safety disadvantages to the four-quadrant gate system as measured by these MOEs. The four-quadrant gate system had no effect on the level of service at the crossing but had a positive effect on driver behavior at the crossing by eliminating risky and illegal behavior as well as violations at the crossing, thus producing superb improvements in safety MOEs. Such benefits are especially important at crossings with limited sight distance, high-speed trains, and multiple tracks.

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Highways

Operations and Traffic Management

Railroads

Safety and Human Factors Security and Emergencies

I73: Traffic Control

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Exhibit LFL-13 3/25/2009

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Create New Zone Manage Existing Zones

Change Scenario: LOGEN ROAD_28433 Cancel

Gates

9

084713P 292ND ST NW Crossing Street Log Off

Continue

SSM Risk Pre-SSM Traffic|Warning Device

New 24-hour QZ \$100,000.00 17610.00 4924.4 Logen Road III LOGEN ROAD_28433 MODIFY 1,478.50 Proposed Quiet Zone: Scenario: **Estimated Total Cost:** Nationwide Significant Risk Threshold: Risk Index with Horns: Type: 0 Summary

1478.5

Select

Quiet Zone Risk Index:

* Note: The use of ASMs requires an application to and approval from the FRA.

Click for ASM spreadsheet: ASM

Step by Step Instructions:

ALERT: Quiet Zone qualifies because SSM has

been applied in each crossing.

* Only Public At Grade Crossings are listed.

Click for Supplementary Safety Measures

Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the MODIFY Button

[SSM]

Step 2: Select proposed warning device or SSM. Then click the <u>UPDATE</u> button. To generate a spreadsheet of the values on this spreadsheet can then be used for page, click on ASM button—This ASM calculations.

Risk Index falls below the NSRT or the Risk Index with Horn. shown ONLY when the Quiet Zone Step 3: Repeat Step (2) until the SELECT button is shown at the bottom right side of this page. Note that the SELECT button is

continue, click the SELECT button

Step 1: To specify New Warning

file://C:\DOCUME~1\Ilogen\LOCALS~1\Temp\ZKKBKYQA.htm

3/25/2009

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Crossing **Create New Zone** Manage Existing Zones

Change Scenario: Logen Road_28434

Cancel

Continue

Pre-SSM SSM Risk ----

MODIFY

2,141.40

12

0

084713P 292ND ST NW Street

Traffic Warning Device Gates 09

5135.24 New 24-hour QZ Logen Road_28434 \$13,000.00 2141.4 Logen Road II 17610 .00 Select Quiet Zone Risk Index: Proposed Quiet Zone: Nationwide Significant Risk Threshold: Risk Index with Horns: Type: Scenario: Estimated Total Cost: Summary

Step by Step Instructions:

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the

[SSM]

* Note: The use of ASMs requires an application to

and approval from the FRA.

Click for ASM spreadsheet: ASM

<u>UPDATE</u> button,To generate a spreadsheet of the values on this page, click on <u>ASM</u> button—This spreadsheet can then be used for Step 2: Select proposed warning device or SSM. Then click the **ASM** calculations.

bottom right side of this page.
Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or Step 3: Repeat Step (2) until the SELECT button is shown at the he Risk Index with Horn. Step 4: To save the scenario and

ALERT: Quiet Zone qualifies because SSM has

been applied in each crossing.

Only Public At Grade Crossings are listed.

Log Off

Click for Supplementary Safety Measures

MODIFY Button

Exhibit ____ LFL-14
Page 1 of 2

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084713P 292ND ST NW Crossing Street Create New Zone Manage Existing Zones

Change Scenario: Logen Road_28434

Cancel

Continue

Traffic Warning Device Gates 9

MODIFY 13 1,713.12 Pre-SSM SSM Risk 0

> * Only Public At Grade Crossings are listed. Log Off

ALERT: Quiet Zone qualifies because SSM has been applied in each crossing,

Click for Supplementary Safety Measures [SSM]

Step 1: To specify New Warning Device (For Pre-Rule Quiet Zone Only) and/or SSM, click the

MODIFY Button

Step by Step Instructions:

Step 2: Select proposed warning device or SSM. Then click the

Click for ASM spreadsheet: ASM

* Note: The use of ASMs requires an application to and approval from the FRA.

A HACK COMMITTEE TO THE	Select
1713.12	Quiet Zone Risk Index:
5135.24	Risk Index with Horns:
17610 .00	Nationwide Significant Risk Threshold:
\$15,000.00	Estimated Total Cost:
Logen Road_28434	Scenario:
New 24-hour QZ	Type:
Logen Road II	Proposed Quiet Zone:
	Summary

UPDATE button. To generate a spreadsheet of the values on this Step 3: Repeat Step (2) until the spreadsheet can then be used for page, click on ASM button—This ASM calculations.

bottom right side of this page. Note that the SELECT button is shown ONLY when the Quiet Zone Risk Index falls below the NSRT or SELECT button is shown at the the Risk Index with Horn. Step 4: To save the scenario and continue, click the SELECT button

Exhibit

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