

## **APPENDIX D**

# **Grade-Crossing Safety and Delay Analysis**



# Contents

---

List of Tables ..... ii

List of Acronyms and Abbreviations ..... iii

**Appendix D Grade-Crossing Safety and Delay Analysis..... D-1**

    D.1 Grade-Crossing Safety Analysis Methods..... D-1

        D.1.1 Assumptions and Data Sources for Calculations ..... D-1

        D.1.2 Calculation of Accident Frequency ..... D-2

    D.2 Grade-Crossing Delay Analysis Methods..... D-17

        D.2.1 Assumptions and Data Sources for Calculations ..... D-17

        D.2.2 Calculations for Proposed Rail Line Analysis..... D-18

    D.3 References ..... D-31

        D.3.1 Personal Communications ..... D-32

# Tables

---

Table D-1. New and Existing Road/Rail At-Grade Crossings by Alternative .....	D-3
Table D-2. FRA Accident Prediction Formula Constants.....	D-5
Table D-3. Grade-Crossing Safety, Northern and Southern Alternatives, Low Production – 7.4 trains per day (Year 2037).....	D-6
Table D-4. Grade-Crossing Safety, Northern (Year 2037) and Southern (Year 2030) Alternatives, Medium Production – 11.9 trains per day .....	D-9
Table D-5. Grade-Crossing Safety, Northern (18.6 trains per day) and Southern (26.7 trains per day) Alternatives, High Production – (Year 2037).....	D-12
Table D-6. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, Low Production – 10.4 trains per day (Year 2037) .....	D-15
Table D-7. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, Medium Production – 14.9 trains per day (Year 2037).....	D-16
Table D-8. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, High Production – 21.6 trains per day (Year 2037) .....	D-16
Table D-9. Level of Service Designations.....	D-18
Table D-10. Grade-Crossing Delay, Northern and Southern Alternatives, Low Production – 7.4 trains per day (Year 2037).....	D-20
Table D-11. Grade-Crossing Delay, Northern (Year 2037) and Southern (Year 2030) Alternatives, Medium Production – 11.9 trains per day .....	D-22
Table D-12. Grade-Crossing Delay, Northern (18.6 trains per day) and Southern (26.7 trains per day) Alternatives, High Production – (Year 2037) .....	D-25
Table D-13. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, Low Production – 10.4 trains per day (Year 2037) .....	D-28
Table D-14. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, Medium Production – 14.9 trains per day (Year 2037).....	D-29
Table D-15. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, High Production – 21.6 trains per day (Year 2037) .....	D-30

## Acronyms and Abbreviations

---

AADT	annual average daily traffic
BNSF	BNSF Railway Company
FRA	Federal Railroad Administration
LOS	level of service
mph	miles per hour
OEA	Office of Environmental Analysis
STB	Surface Transportation Board



Appendix D

# Grade-Crossing Safety and Delay Analysis

---

## D.1 Grade-Crossing Safety Analysis Methods

The following sections address the methods for analyzing the impact of the proposed rail line on grade-crossing and delay.<sup>1</sup>

### D.1.1 Assumptions and Data Sources for Calculations

The Surface Transportation Board's (Board) Office of Environmental Analysis (OEA) used several data sources and assumptions to characterize grade-crossing safety conditions.

- OEA used information on projected future rail traffic for the proposed rail line from TRRC (Chapter 2, *Proposed Action and Alternatives*) and information on projected future rail traffic under the No-Action Alternative (Appendix C, *Coal Production and Markets*).
- OEA used information from the Federal Railroad Administration (FRA) on road and train traffic characteristics at rail/roadway crossings within the transportation study area and downline, including the number of tracks, number of road lanes, warning devices, daily vehicle traffic volume, road paving, road classifications, and the most recent 5 years of accident history (Federal Railroad Administration 2013a).
- OEA used information on annual average daily traffic (AADT) from state transportation department traffic maps and reports (Montana Department of Transportation 2014, Wyoming Department of Transportation 2012, North Dakota Department of Transportation 2011, Wisconsin Department of Transportation 2012, Illinois Department of Transportation 2010 and 2011, Iowa Department of Transportation 2012, South Dakota Department of Transportation 2012, Minnesota Department of Transportation 2012, Nebraska Department of Roads 2012). Where current AADT values were not available from state agency traffic maps, OEA used AADT values from FRA (2013a).
- OEA applied a historic vehicle-miles traveled growth rate to AADT data from 1970 to 1995 (3.1 percent growth rate) and from 1996 to 2011 (2 percent growth rate) to estimate 2012 AADT (U.S. Energy Information Administration 2013).
- OEA estimated AADT values for analysis years 2018, 2023, 2030, and 2037 using the available data and an annual growth rate of 1.5 percent (U.S. Energy Information Administration 2014). These analysis years are consistent with those analyzed in

---

<sup>1</sup> This appendix provides supporting information for Section 3.3, *Grade-Crossing Delay*, and Section 3.4, *Grade-Crossing Safety*, of this *Draft Environmental Impact Statement for the Tongue River Railroad*. This information should not be interpreted as stand-alone information and must be read in combination with the sections.

Appendix C, *Coal Production and Markets*, and represent the 20-year analysis period of this EIS.

- For any grade crossing for which an AADT value could not be located using state data sources or the FRA data, OEA applied an average AADT value based on collected AADT values for the same road type in that state.
- OEA used the FRA GradeDec.Net Model to calculate predicted accident frequencies at existing grade crossings (Federal Railroad Administration 2014a).
- OEA assumed an average freight train length of 6,925 feet (four 75-foot locomotives and one hundred twenty-five 53-foot rail cars) for proposed action trains and 6,154 feet for existing BNSF trains. TRRC has stated that the rail line would be designed to meet FRA Class 3 track standards and that the anticipated average operating speed would be 40 miles per hour (mph), except at crossing 060524A on Wimer Road along the Colstrip Subdivision, which would be restricted to 25 mph per state regulations (Montana Department of Transportation 2010).
- OEA assumed an average passenger train length (AMTRAK Empire Builder) of 1,245 feet (two 70-foot locomotives and thirteen 85-foot rail cars (McClure pers.comm.).
- OEA calculated the predicted accident frequency assuming a 5-year analysis period (2012 to 2008) and an assumption of zero previous accidents within this 5-year period.

## **D.1.2 Calculation of Accident Frequency**

### **D.1.2.1 Proposed Rail Line Analysis**

For all new grade crossings proposed by TRRC (referred to as the *new grade crossings* to distinguish them from the existing grade crossings on the Colstrip Subdivision), OEA used the FRA accident prediction formula to calculate a total predicted annual accident rate. Table D-1 presents the new and existing grade crossings by build alternative. Because grade-separated crossings do not pose a collision safety hazard, they are not included in the analysis.

**Table D-1. New and Existing Road/Rail At-Grade Crossings by Alternative**

Road Name	Estimated AADT in 2037 (vehicles/ day)	Tongue River	Tongue River East	Colstrip <sup>a</sup>	Colstrip East <sup>a</sup>	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Decker	Decker East
Cow Creek Road	60			X	X						
Rosebud Creek Road	60			X	X						
Tongue River Road <sup>b</sup>	50	X	X	X	X	X	X	X	X	X	X
East Tongue River Road	50	X		X		X		X			
Moon Creek Road	120	X	X					X	X		
Snider Creek Road	60	X	X					X	X		
Liscom Creek Road	70					X	X				
Beaver Creek Road	50					X	X				
Foster Creek Road	97					X	X				
Highway 314	802									X	X
Four-Mile Creek Road	20									X	X
W Fork Armells Creek (FRA ID: 060514U)	32			X	X						
Old Highway 10 (FRA ID: 060499U)	498			X	X						
Wimer Road (FRA ID: 060524A)	16			X	X						
Pine Butte Dr (FRA ID: 086276D)	948			X	X						
Willow St (FRA ID: 099063F)	1,177			X	X						
Total Number of Crossings by Build Alternative		4	3	9	8	5	4	4	3	5	5

Notes:

<sup>a</sup> The Colstrip Alternatives include existing rail crossings along the Colstrip Subdivision

<sup>b</sup> Tongue River Road has multiple crossing points that vary by build alternative

OEA did not use the FRA GradeDec.Net model for the crossings listed in Table D-1 because the model does not have the capabilities to calculate safety ratings for new grade crossings, only existing public, at-grade crossings. OEA used surface types to distinguish between paved and unpaved roads (Montana Department of Transportation 2014). For calculation purposes, OEA assumed that all road at-grade crossings would have passive crossing devices. Below is the accident prediction formula. The remaining values are summarized in Table D-2.

$$a = K * EI * DT * MS * MT * HP * HL$$

Where:

K = the basic accident prediction constant

EI = the exposure index factor based on the product of the number of roadway vehicles and trains per day

DT = the factor for the number of through trains per day during daylight

MS = the factor for maximum timetable speed

MT = the factor for number of main tracks

HP = the factor for paved roadway

HL = the factor for number of roadway lanes

The exposure index factor (EI) is calculated using:

$$((c*t)+0.2/0.2)^{0.37}$$

Where:

c=number of vehicles (AADT)

t=number of trains per day

**Table D-2. FRA Accident Prediction Formula Constants**

Formula Constant	Equation or Description	Formula Value
K =	Basic accident prediction constant	0.0006938
DT =	$((d+0.2)/0.2)^{0.178}$	
	7.4 trains per day =	1.89
	11.9 trains per day =	2.16
	18.6 trains per day =	2.16
	26.7 trains per day =	2.37
MS =		$e^{0.0077ms}$
	40 mph	1.36
MT=	Number of main tracks	1
HP =	Paved/Unpaved	1/0.55
HL =	2 roadway lanes	1.15

Source: Federal Railroad Administration 1987

OEA used the FRA GradeDec.Net model to calculate the total annual predicted accident frequency for existing grade crossings along Segment 3, Colstrip, MT to Nichols, MT (Chapter 3, *Transportation*). See Appendix V, *Downline Analysis*, for a detailed description of the GradeDec.Net model.

The analysis of this segment accounted for accident history and frequency of trains at grade crossings, volume of vehicle traffic, existing safety devices at grade crossings, and other factors to determine the potential impacts of an increase in rail traffic. All existing public, at-grade highway/railroad crossings located along the Colstrip Subdivision have had zero accidents from 2008 to 2012 (Federal Railway Administration 2014b).

Tables D-3 through D-8 show the results of the grade-crossing safety analysis for each build alternative under three coal production scenarios: low, medium, and high. These production scenarios reflect potential coal production at proposed and potentially induced mines in the study area. Increasing train traffic is associated with increasing production. Not all of the build alternatives would access all of the potentially induced mines. In the context of these scenarios, the build alternatives are referred to as the northern alternatives (Tongue River Alternatives, Colstrip Alternatives, Tongue River Road Alternatives, and Moon Creek Alternatives) and the southern alternatives (Decker Alternatives). The scenarios are described in detail in Appendix C, *Coal Production and Markets*.

**Table D-3. Grade-Crossing Safety, Northern and Southern Alternatives, Low Production – 7.4 trains per day (Year 2037)**

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency (per year)	Predicted Intervals Between Accidents (years)
<b>Northern Alternatives</b>										
<b>Colstrip</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	7.4	0.01131	88
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	7.4	0.01131	88
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	7.4	0.01557	64
East Tongue River Road	At-Grade	Passive	Gravel	2	63	40	6,925	7.4	0.00951	105
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01192</b>	<b>84</b>
<b>Colstrip East</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	7.4	0.01131	88
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	7.4	0.01131	88
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	7.4	0.01557	64
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01273</b>	<b>79</b>
<b>Tongue River</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	7.4	0.01272	79
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	7.4	0.00951	105
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01064</b>	<b>94</b>
<b>Tongue River East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	7.4	0.01272	79
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01102</b>	<b>91</b>
<b>Tongue River Road</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	7.4	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency (per year)	Predicted Intervals Between Accidents (years)
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	7.4	0.01797	56
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	7.4	0.00951	105
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	7.4	0.01353	74
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01227</b>	<b>82</b>
<b>Tongue River Road East</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	7.4	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	7.4	0.01797	56
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	7.4	0.01353	74
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01296</b>	<b>77</b>
<b>Moon Creek</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	7.4	0.01272	79
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
East Tongue River Road	At-Grade	Passive	Paved	2	63	40	6,925	7.4	0.01729	58
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	7.4	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01259</b>	<b>79</b>
<b>Moon Creek East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	7.4	0.01272	79
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	7.4	0.01017	98
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	7.4	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	7.4	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01102</b>	<b>91</b>
<b>Southern Alternatives</b>										
<b>Decker Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	788	40	6,925	7.4	0.04411	23
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	25	40	6,925	7.4	0.00678	147

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency (per year)	Predicted Intervals Between Accidents (years)
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	7.4	0.01910	52
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	7.4	0.01910	52
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	7.4	0.01076	93
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01997</b>	<b>50</b>
<b>Decker East Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	788	40	6,925	7.4	0.04411	23
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	25	40	6,925	7.4	0.00678	147
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	7.4	0.01910	52
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	7.4	0.01076	93
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	7.4	0.01076	93
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01830</b>	<b>55</b>

<sup>1</sup> Rail traffic would not result in vehicle accidents at crossings that are grade-separated

**Table D-4. Grade-Crossing Safety, Northern (Year 2037) and Southern (Year 2030) Alternatives, Medium Production – 11.9 trains per day**

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
<b>Northern Alternatives</b>										
<b>Colstrip</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	11.9	0.01541	65
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	11.9	0.01541	65
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	11.9	0.02121	47
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	11.9	0.01295	77
US212	Grade-Separated	--	Paved	2	1988	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01624</b>	<b>62</b>
<b>Colstrip East</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	11.9	0.01541	65
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	11.9	0.01541	65
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	11.9	0.02121	47
US212	Grade-Separated	--	Paved	2	63	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01734</b>	<b>58</b>
<b>Tongue River</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	11.9	0.01733	58
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	11.9	0.01295	77
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01450</b>	<b>69</b>
<b>Tongue River East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	11.9	0.01733	58
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
I-94	Grade-Separated	--	Paved	2	63	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01501</b>	<b>67</b>
<b>Tongue River Road</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	11.9	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	11.9	--	--
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	11.9	0.02448	41

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	11.9	0.01295	77
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	11.9	0.01843	54
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01671</b>	<b>60</b>
<b>Tongue River Road East</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	11.9	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	11.9	--	--
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	11.9	0.02448	41
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	11.9	0.01843	54
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01766</b>	<b>57</b>
<b>Moon Creek</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	11.9	0.01733	58
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
East Tongue River Road	At-Grade	Passive	Paved	2	63	40	6,925	11.9	0.02354	42
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	11.9	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01714</b>	<b>58</b>
<b>Moon Creek East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	11.9	0.01733	58
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	11.9	0.01385	72
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	11.9	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	11.9	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01501</b>	<b>67</b>
<b>Southern Alternatives</b>										
<b>Decker Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	743	40	6,925	11.9	0.05882	17
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	24	40	6,925	11.9	0.00904	111

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
Tongue River Road	At-Grade	Passive	Unpaved	2	389	40	6,925	11.9	0.02547	39
Tongue River Road	At-Grade	Passive	Unpaved	2	389	40	6,925	11.9	0.02547	39
Tongue River Road	At-Grade	Passive	Unpaved	2	83	40	6,925	11.9	0.01435	70
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.02663</b>	<b>38</b>
<b>Decker East Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	743	40	6,925	11.9	0.05882	17
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	24	40	6,925	11.9	0.00904	111
Tongue River Road	At-Grade	Passive	Unpaved	2	389	40	6,925	11.9	0.02547	39
Tongue River Road	At-Grade	Passive	Unpaved	2	83	40	6,925	11.9	0.01435	70
Tongue River Road	At-Grade	Passive	Unpaved	2	83	40	6,925	11.9	0.01435	70
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.02441</b>	<b>41</b>

<sup>1</sup> Rail traffic would not result in vehicle accidents at crossings that are grade-separated

**Table D-5. Grade-Crossing Safety, Northern (18.6 trains per day) and Southern (26.7 trains per day) Alternatives, High Production – (Year 2037)**

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
<b>Northern Alternatives</b>										
<b>Colstrip</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	18.6	0.01817	55
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	18.6	0.01817	55
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	18.6	0.02502	40
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	18.6	0.01527	65
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01916</b>	<b>52</b>
<b>Colstrip East</b>										
Cow Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	18.6	0.01817	55
Rosebud Creek Road	At-Grade	Passive	Unpaved	2	100	40	6,925	18.6	0.01817	55
Tongue River Road	At-Grade	Passive	Unpaved	2	238	40	6,925	18.6	0.02502	40
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.02046</b>	<b>49</b>
<b>Tongue River</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	18.6	0.02044	49
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	18.6	0.01527	65
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01710</b>	<b>58</b>
<b>Tongue River East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	18.6	0.02044	49
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01771</b>	<b>56</b>
<b>Tongue River Road</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	18.6	--	--

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	18.6	0.02888	35
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
East Tongue River Road	At-Grade	Passive	Unpaved	2	63	40	6,925	18.6	0.01527	65
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	18.6	0.02175	46
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01972</b>	<b>51</b>
<b>Tongue River Road East</b>										
I-94	Grade-Separated	--	Paved	2	6388	40	6,925	18.6	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
Tongue River Road	At-Grade	Passive	Unpaved	2	350	40	6,925	18.6	0.02888	35
Liscom Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Beaver Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Foster Creek Road	At-Grade	Passive	Unpaved	2	163	40	6,925	18.6	0.02175	46
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.02083</b>	<b>48</b>
<b>Moon Creek</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	18.6	0.02044	49
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
East Tongue River Road	At-Grade	Passive	Paved	2	63	40	6,925	18.6	0.02777	36
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	18.6	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.02022</b>	<b>49</b>
<b>Moon Creek East</b>										
Moon Creek Road	At-Grade	Passive	Unpaved	2	138	40	6,925	18.6	0.02044	49
Snider Creek Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
Tongue River Road	At-Grade	Passive	Unpaved	2	75	40	6,925	18.6	0.01634	61
I-94	Grade-Separated	--	Paved	2	6625	40	6,925	18.6	--	--
US212	Grade-Separated	--	Paved	2	1988	40	6,925	18.6	--	--
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.01771</b>	<b>56</b>

Crossing	Type of Crossing <sup>1</sup>	Type of Protection	Road Type	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Predicted Accident Frequency	Predicted Intervals Between Accidents (years)
<b>Southern Alternatives</b>										
<b>Decker Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	788	40	6,925	26.7	0.08891	11
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	25	40	6,925	26.7	0.01244	80
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	26.7	0.03508	29
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	26.7	0.03508	29
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	26.7	0.01977	51
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.03826</b>	<b>26</b>
<b>Decker East Alternative</b>										
Highway 314	At-Grade	Passive	Paved	2	788	40	6,925	26.7	0.08891	11
Four-Mile Creek Road	At-Grade	Passive	Unpaved	2	25	40	6,925	26.7	0.01244	80
Tongue River Road	At-Grade	Passive	Unpaved	2	413	40	6,925	26.7	0.03508	29
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	26.7	0.01977	51
Tongue River Road	At-Grade	Passive	Unpaved	2	88	40	6,925	26.7	0.01977	51
<b>Average Predicted Accident Frequency and Interval</b>									<b>0.03520</b>	<b>28</b>

<sup>1</sup> Rail traffic would not result in vehicle accidents at crossings that are grade-separated

**Table D-6. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, Low Production – 10.4 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	No Action - Annual Predicted Accident Frequency				Post-Construction - Annual Predicted Accident Frequency					
					Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)	Train Speed (mph)	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)
W Fork Armells Creek Rd	060514U	001185	2	44	40	6154	3	0.00396	252	40	6925	10.4	0.007499	133
Old Highway 10	060499U	000050	2	1200	40	6154	3	0.00678	147	40	6925	10.4	0.010609	94
WIMER ROAD	060524A	002251	2	30	25	6154	3	0.00249	402	25	6925	10.4	0.004759	210
PINE BUTTE DR	086276D	002667	2	1100	40	6154	3	0.00842	119	40	6925	10.4	0.014137	71
WILLOW ST	099063F	002940	2	1100	40	6154	3	0.00909	110	40	6925	10.4	0.014954	67
<b>Average Predicted Accident Frequency and Interval (No Action)</b>								0.00615	163	<b>Average Predicted Accident Frequency and Interval (Proposed Action)</b>				
										0.010392	96			

<sup>1</sup> The City of Colstrip has train speed restrictions. Source: Montana Department of Transportation. 2010. Montana State Rail Plan. Available at: <http://www.mdt.mt.gov/pubinvolve/railplan/>.

**Table D-7. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, Medium Production – 14.9 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	No Action - Annual Predicted Accident Frequency				Post-Construction - Annual Predicted Accident Frequency						
					Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)	Train Speed (mph)	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)	
W Fork Armells Creek Rd	060514U	001185	2	44	40	6154	3	0.00396	252	40	6925	14.9	0.008992	111	
Old Highway 10	060499U	000050	2	1200	40	6154	3	0.00678	147	40	6925	14.9	0.012004	83	
WIMER ROAD	060524A	2251	2	30	25	6154	3	0.00249	402	25	6925	14.9	0.005736	174	
PINE BUTTE DR	086276D	002667	2	1100	40	6154	3	0.00842	119	40	6925	14.9	0.016340	61	
WILLOW ST	099063F	002940	2	1100	40	6154	3	0.00909	110	40	6925	14.9	0.017576	57	
<b>Average Predicted Accident Frequency and Interval (No Action)</b>								0.00615	163	<b>Average Predicted Accident Frequency and Interval (Proposed Action)</b>				0.012130	82

**Table D-8. Grade-Crossing Safety, Segment 3 from Colstrip, MT - Nichols, MT, High Production – 21.6 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	No Action - Annual Predicted Accident Frequency				Post-Construction - Annual Predicted Accident Frequency						
					Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)	Train Speed (mph)	Train Length (feet)	Trains per Day	Rate	Predicted Intervals Between Accidents (years)	
W Fork Armells Creek Rd	060514U	001185	2	44	40	6154	3	0.00396	252	40	6925	21.6	0.011534	87	
Old Highway 10	060499U	000050	2	1200	40	6154	3	0.00678	147	40	6925	21.6	0.014186	70	
WIMER ROAD	060524A	2251	2	30	25	6154	3	0.00249	402	25	6925	21.6	0.007421	135	
PINE BUTTE DR	086276D	002667	2	1100	40	6154	3	0.00842	119	40	6925	21.6	0.019883	50	
WILLOW ST	099063F	002940	2	1100	40	6154	3	0.00909	110	40	6925	21.6	0.021400	47	
<b>Average Predicted Accident Frequency and Interval (No Action)</b>								0.00615	163	<b>Average Predicted Accident Frequency and Interval (Proposed Action)</b>				0.014885	67

<sup>1</sup> The City of Colstrip has train speed restrictions. Source: Montana Department of Transportation 2010. Montana State Rail Plan. Available at: <http://www.mdt.mt.gov/pubinvolve/railplan/>.

## D.2 Grade-Crossing Delay Analysis Methods

### D.2.1 Assumptions and Data Sources for Calculations

OEA used several data sources and assumptions to estimate potential delay at new grade crossings and changes in vehicle delay at existing grade crossings.

- OEA used information on projected future rail traffic for the proposed rail line from TRRC (Chapter 2, *Proposed Action and Alternatives*) and information on projected future train rail traffic under the No-Action Alternative (Appendix C, *Coal Production and Markets*).
- OEA used information on road and train traffic characteristics at rail/roadway crossings, including the number of tracks, number of road lanes, warning devices, daily vehicle traffic volume, road paving, road classifications, and the most recent 5 years of accident history (Federal Railroad Administration 2013a).
- OEA used information on annual average daily traffic (AADT) from state transportation department traffic maps and reports (Montana Department of Transportation 2014, Wyoming Department of Transportation 2012, North Dakota Department of Transportation 2011, Wisconsin Department of Transportation 2012, Illinois Department of Transportation 2010 and 2011, Iowa Department of Transportation 2012, South Dakota Department of Transportation 2012, Minnesota Department of Transportation 2012, Nebraska Department of Roads 2012). Where current AADT values were not available from state agency traffic maps, OEA used AADT values from the Federal Railroad Administration (FRA) (2013a).
- OEA applied a historic vehicle-miles traveled growth rate to AADT data from 1970 to 1995 (3.1 percent growth rate) and from 1996 to 2011 (2 percent growth rate) to estimate AADT in 2012 (U.S. Energy Information Administration 2013).
- OEA estimated AADT values for analysis years 2018, 2023, 2030, and 2037 using the available data and an annual growth rate of 1.5 percent based on vehicle-miles traveled (U.S. Energy Information Administration 2014).
- For any grade crossing for which an AADT value could not be located using state data sources or the FRA data, OEA applied an average AADT value based on collected AADT values for the same road type in that state.
- OEA assumed an average freight train length of 6,925 feet (four 75-foot locomotives and one hundred twenty-five 53-foot rail cars) for proposed action trains and 6,154 feet for existing BNSF trains. TRRC has stated that the rail line would be designed to meet FRA Class 3 track standards and that the anticipated average operating speed would be 40 miles per hour (mph), except at crossing 060524A on Wimer Road along the Colstrip

Subdivision, which would be restricted to 25 mph per the state regulations (Montana Department of Transportation 2010).

- OEA assumed an average passenger train length (AMTRAK Empire Builder) of 1,245 feet (two 70-foot locomotives and thirteen 85-foot rail cars (McClure pers.comm.).

## D.2.2 Calculations for Proposed Rail Line Analysis

For each at-grade crossing analyzed, OEA estimated the time that each passing train would block a particular crossing and estimated the average delay per vehicle at that crossing in a 24-hour period. OEA used the average delay per vehicle at signalized intersections to determine the level of service (LOS) and to provide a conservative estimate of potential delay impacts. LOS designations provide a qualitative measure of traffic flow. While a designation of A indicates free-flowing traffic, a designation of F indicates that traffic is constantly slowed at that location (Table D-9). OEA also estimated the average traffic delays for all vehicles over a 24-hour period and used the average delay per vehicle to determine LOS for each grade crossing.

**Table D-9. Level of Service Designations**

LOS	Average Delay for All Vehicles (seconds/vehicle)
A	<=10
B	>10 and <=20
C	>20 and <=35
D	>35 and <=55
E	>55 and <=80
F	>80

Source: Transportation Research Board 2010

OEA used the following calculations to estimate traffic delay for public, at-grade crossings. The traffic delay at a crossing includes the time for the train to pass, and the time for any warning device to engage and disengage. For simplification purposes, it is assumed that both rail and road traffic would be uniform throughout the day.

The first step includes the calculation of gate-down time per train event (T).

$$T = T_w + \frac{L}{V}$$

Where:

$T_w$  = Gate warning time

L = Average train length

V = Average train speed

The number of stopped vehicles delayed per day ( $N_v$ ) can be calculated as follows:

$$N_v = \frac{T}{24} * N * ADT$$

Where:

N = Number of trains per day

AADT = Average daily traffic

24 = Hours per day

The average delay per vehicle in a 24-hour period ( $D_v$ ) is:

$$D_v = \frac{N_v}{AADT} * \frac{T * \frac{R_D}{R_D - R_A}}{2}$$

Where:

$R_D$  = Departure rate (vehicles/lane/hour)<sup>2</sup>

$R_A$  = Arrival rate, average daily traffic converted to vehicles/lane-hour

2 = Denominator to reflect that vehicles do not experience the entire time the train is blocking the grade crossing. They are assumed to arrive on average at the midpoint of the train crossing period.

Total vehicle delay (D) is the product of average delay per vehicle ( $D_v$ ) and the average daily traffic (ADT).

$$D = D_v * ADT$$

Tables D-10 through D-15 show the results of the grade-crossing delay analysis for the build alternatives.

---

<sup>2</sup> The vehicle departure rate depends on a wide range of factors such as the presence or absence of signals, number, and type of lanes, lane width, grade, sight distances, type, and peak of vehicle traffic, and curve radius. Data on these factors are not readily available for the grade crossings included in this analysis and, thus, calculation of crossing-specific departure rates is not feasible. Based on the *Highway Capacity Manual* (Transportation Research Board 2000), departure rates (in vehicles/lane-hour) are the following: highways (1,800), arterials (1,400), collectors (900), and local roads (700).

**Table D-10. Grade-Crossing Delay, Northern and Southern Alternatives, Low Production – 7.4 trains per day (Year 2037)**

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
<b>Northern Alternatives</b>												
<b>Colstrip</b>												
Cow Creek Road	At-Grade	2	100	40	6925	7.4	2.47	1.24	1.3	0.94	A	1.57
Rosebud Creek Road	At-Grade	2	100	40	6925	7.4	2.47	1.24	1.3	0.94	A	1.57
Tongue River Road	At-Grade	2	238	40	6925	7.4	2.47	1.24	3.0	0.95	A	3.74
East Tongue River Road	At-Grade	2	63	40	6925	7.4	2.47	1.24	0.8	0.94	A	0.98
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
<b>Colstrip East</b>												
Cow Creek Road	At-Grade	2	100	40	6925	7.4	2.47	1.24	1.3	0.94	A	1.57
Rosebud Creek Road	At-Grade	2	100	40	6925	7.4	2.47	1.24	1.3	0.94	A	1.57
Tongue River Road	At-Grade	2	238	40	6925	7.4	2.47	1.24	3.0	0.95	A	3.74
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
<b>Tongue River</b>												
I-94	Grade-Separated	2	6388	40	6925	7.4	--	--	--	--	--	--
Moon Creek Road	At-Grade	2	138	40	6925	7.4	2.47	1.24	1.7	0.94	A	2.16
Snider Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Tongue River Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
East Tongue River Road	At-Grade	2	63	40	6925	7.4	2.47	1.24	0.8	0.94	A	0.98
<b>Tongue River East</b>												
I-94	Grade-Separated	2	6388	40	6925	7.4	--	--	--	--	--	--
Moon Creek Road	At-Grade	2	138	40	6925	7.4	2.47	1.24	1.7	0.94	A	2.16
Snider Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Tongue River Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
<b>Tongue River Road</b>												
I-94	Grade-Separated	2	6388	40	6925	7.4	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
Tongue River Road	At-Grade	2	350	40	6925	7.4	2.47	1.24	4.4	0.95	A	5.53
Liscom Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Beaver Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
East Tongue River Road	At-Grade	2	63	40	6925	7.4	2.47	1.24	0.8	0.94	A	0.98
Foster Creek Road	At-Grade	2	163	40	6925	7.4	2.47	1.24	2.1	0.94	A	2.55

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
<b>Tongue River Road East</b>												
I-94	Grade-Separated	2	6388	40	6925	7.4	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
Tongue River Road	At-Grade	2	350	40	6925	7.4	2.47	1.24	4.4	0.95	A	5.53
Liscom Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Beaver Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Foster Creek Road	At-Grade	2	163	40	6925	7.4	2.47	1.24	2.1	0.94	A	2.55
<b>Moon Creek</b>												
Moon Creek Road	At-Grade	2	138	40	6925	7.4	2.47	1.24	1.7	0.94	A	2.16
Snider Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Tongue River Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
East Tongue River Road	At-Grade	2	63	40	6925	7.4	2.47	1.24	0.8	0.94	A	0.98
I-94	Grade-Separated	2	6625	40	6925	7.4	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
<b>Moon Creek East</b>												
Moon Creek Road	At-Grade	2	138	40	6925	7.4	2.47	1.24	1.7	0.94	A	2.16
Snider Creek Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
Tongue River Road	At-Grade	2	75	40	6925	7.4	2.47	1.24	1.0	0.94	A	1.18
I-94	Grade-Separated	2	6625	40	6925	7.4	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	7.4	--	--	--	--	--	--
<b>Southern Alternatives</b>												
<b>Decker Alternative</b>												
Highway 314	At-Grade	2	788	40	6925	7.4	2.47	1.26	10.0	0.96	A	12.61
Four-Mile Creek Road	At-Grade	2	25	40	6925	7.4	2.47	1.23	0.3	0.94	A	0.39
Tongue River Road	At-Grade	2	413	40	6925	7.4	2.47	1.25	5.2	0.95	A	6.53
Tongue River Road	At-Grade	2	413	40	6925	7.4	2.47	1.25	5.2	0.95	A	6.53
Tongue River Road	At-Grade	2	88	40	6925	7.4	2.47	1.24	1.1	0.94	A	1.37
<b>Decker East Alternative</b>												
Highway 314	At-Grade	2	788	40	6925	7.4	2.47	1.26	10.0	0.96	A	12.61
Four-Mile Creek Road	At-Grade	2	25	40	6925	7.4	2.47	1.23	0.3	0.94	A	0.39
Tongue River Road	At-Grade	2	413	40	6925	7.4	2.47	1.25	5.2	0.95	A	6.53
Tongue River Road	At-Grade	2	88	40	6925	7.4	2.47	1.24	1.1	0.94	A	1.37
Tongue River Road	At-Grade	2	88	40	6925	7.4	2.47	1.24	1.1	0.94	A	1.37

<sup>1</sup> Rail traffic would not result in vehicle delay at crossings that are grade separated.

**Table D-11. Grade-Crossing Delay, Northern (Year 2037) and Southern (Year 2030) Alternatives, Medium Production – 11.9 trains per day**

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
<b>Northern Alternatives</b>												
<b>Colstrip</b>												
Cow Creek Road	At-Grade	2	100	40	6925	11.9	2.47	1.24	2	1.51	A	2.52
Rosebud Creek Road	At-Grade	2	100	40	6925	11.9	2.47	1.24	2	1.51	A	2.52
Tongue River Road	At-Grade	2	238	40	6925	11.9	2.47	1.24	5	1.52	A	6.02
East Tongue River Road	At-Grade	2	63	40	6925	11.9	2.47	1.24	1	1.51	A	1.58
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
<b>Colstrip East</b>												
Cow Creek Road	At-Grade	2	100	40	6925	11.9	2.47	1.24	2	1.51	A	2.52
Rosebud Creek Road	At-Grade	2	100	40	6925	11.9	2.47	1.24	2	1.51	A	2.52
Tongue River Road	At-Grade	2	238	40	6925	11.9	2.47	1.24	5	1.52	A	6.02
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
<b>Tongue River</b>												
I-94	Grade-Separated	2	6388	40	6925	11.9	--	--	--	--	--	--
Moon Creek Road	At-Grade	2	138	40	6925	11.9	2.47	1.24	3	1.52	A	3.47
Snider Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Tongue River Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
East Tongue River Road	At-Grade	2	63	40	6925	11.9	2.47	1.24	1	1.51	A	1.58
<b>Tongue River East</b>												
I-94	Grade-Separated	2	6388	40	6925	11.9	--	--	--	--	--	--
Moon Creek Road	At-Grade	2	138	40	6925	11.9	2.47	1.24	3	1.52	A	3.47

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
										1.52		
Snider Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Tongue River Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
<b>Tongue River Road</b>												
I-94	Grade-Separated	2	6388	40	6925	11.9	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
Tongue River Road	At-Grade	2	350	40	6925	11.9	2.47	1.24	7	1.53	A	8.90
Liscom Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Beaver Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
East Tongue River Road	At-Grade	2	63	40	6925	11.9	2.47	1.24	1	1.51	A	1.58
Foster Creek Road	At-Grade	2	163	40	6925	11.9	2.47	1.24	3	1.52	A	4.11
<b>Tongue River Road East</b>												
I-94	Grade-Separated	2	6388	40	6925	11.9	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
Tongue River Road	At-Grade	2	350	40	6925	11.9	2.47	1.24	7	1.53	A	8.90
Liscom Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Beaver Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Foster Creek Road	At-Grade	2	163	40	6925	11.9	2.47	1.24	3	1.52	A	4.11
<b>Moon Creek</b>												
Moon Creek Road	At-Grade	2	138	40	6925	11.9	2.47	1.24	3	1.52	A	3.47
Snider Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Tongue River Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
East Tongue River Road	At-Grade	2	63	40	6925	11.9	2.47	1.24	1		A	1.58

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
										1.51		
I-94	Grade-Separated	2	6625	40	6925	11.9	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
<b>Moon Creek East</b>												
Moon Creek Road	At-Grade	2	138	40	6925	11.9	2.47	1.24	3	1.52	A	3.47
Snider Creek Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
Tongue River Road	At-Grade	2	75	40	6925	11.9	2.47	1.24	2	1.51	A	1.89
I-94	Grade-Separated	2	6625	40	6925	11.9	--	--	--	--	--	--
US212	Grade-Separated	2	1988	40	6925	11.9	--	--	--	--	--	--
<b>Southern Alternatives</b>												
<b>Decker Alternative</b>												
Highway 314	At-Grade	2	743	40	6925	11.9	2.47	1.26	15	1.54	A	19.12
Four-Mile Creek Road	At-Grade	2	24	40	6925	11.9	2.47	1.23	0	1.51	A	0.59
Tongue River Road	At-Grade	2	389	40	6925	11.9	2.47	1.24	8	1.53	A	9.91
Tongue River Road	At-Grade	2	389	40	6925	11.9	2.47	1.24	8	1.53	A	9.91
Tongue River Road	At-Grade	2	83	40	6925	11.9	2.47	1.24	2	1.51	A	2.08
<b>Decker East Alternative</b>												
Highway 314	At-Grade	2	743	40	6925	11.9	2.47	1.26	15	1.54	A	19.12
Four-Mile Creek Road	At-Grade	2	24	40	6925	11.9	2.47	1.23	0	1.51	A	0.59
Tongue River Road	At-Grade	2	389	40	6925	11.9	2.47	1.24	8	1.53	A	9.91
Tongue River Road	At-Grade	2	83	40	6925	11.9	2.47	1.24	2	1.51	A	2.08
Tongue River Road	At-Grade	2	83	40	6925	11.9	2.47	1.24	2	1.51	A	2.08

<sup>1</sup> Rail traffic would not result in vehicle delay at crossings that are grade separated.

**Table D-12. Grade-Crossing Delay, Northern (18.6 trains per day) and Southern (26.7 trains per day) Alternatives, High Production – (Year 2037)**

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
<b>Northern Alternatives</b>												
<b>Colstrip</b>												
Cow Creek Road	At-Grade	2	100	40	6925	18.6	2.47	1.24	3	2.36	A	3.15
Rosebud Creek Road	At-Grade	2	100	40	6925	18.6	2.47	1.24	3	2.36	A	3.15
Tongue River Road	At-Grade	2	238	40	6925	18.6	2.47	1.24	6	2.37	A	7.51
East Tongue River Road	At-Grade	2	63	40	6925	18.6	2.47	1.24	2	2.36	A	1.97
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
<b>Colstrip East</b>												
Cow Creek Road	At-Grade	2	100	40	6925	18.6	2.47	1.24	3	2.36	A	3.15
Rosebud Creek Road	At-Grade	2	100	40	6925	18.6	2.47	1.24	3	2.36	A	3.15
Tongue River Road	At-Grade	2	238	40	6925	18.6	2.47	1.24	6	2.37	A	7.51
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
<b>Tongue River</b>												
I-94	Grade-Separated	2	6388	40	6925	18.6	--	--	--	--		--
Moon Creek Road	At-Grade	2	138	40	6925	18.6	2.47	1.24	4	2.37	A	5.43
Snider Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Tongue River Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
East Tongue River Road	At-Grade	2	63	40	6925	18.6	2.47	1.24	2	2.36	A	2.46
<b>Tongue River East</b>												
I-94	Grade-Separated	2	6388	40	6925	18.6	--	--	--	--		--
Moon Creek Road	At-Grade	2	138	40	6925	18.6	2.47	1.24	4	2.37	A	5.43
Snider Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
					6925					2.36		
Tongue River Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
<b>Tongue River Road</b>												
I-94	Grade-Separated	2	6388	40	6925	18.6	--	--	--	--		--
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
Tongue River Road	At-Grade	2	350	40	6925	18.6	2.47	1.24	11	2.38	A	13.91
Liscom Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Beaver Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
East Tongue River Road	At-Grade	2	63	40	6925	18.6	2.47	1.24	2	2.36	A	2.46
Foster Creek Road	At-Grade	2	163	40	6925	18.6	2.47	1.24	5	2.37	A	6.42
<b>Tongue River Road East</b>												
I-94	Grade-Separated	2	6388	40	6925	18.6	--	--	--	--		--
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
Tongue River Road	At-Grade	2	350	40	6925	18.6	2.47	1.24	11	2.38	A	13.91
Liscom Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Beaver Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Foster Creek Road	At-Grade	2	163	40	6925	18.6	2.47	1.24	5	2.37	A	6.42
<b>Moon Creek</b>												
Moon Creek Road	At-Grade	2	138	40	6925	18.6	2.47	1.24	4	2.37	A	5.43
Snider Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Tongue River Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
East Tongue River Road	At-Grade	2	63	40	6925	18.6	2.47	1.24	2	2.36	A	2.46
I-94	Grade-Separated	2	6625	40	6925	18.6	--	--	--	--		--

Crossing	Type of Crossing <sup>1</sup>	Number of Roadway Lanes	AADT	Train Speed (mph)	Train Length (feet)	Trains Per Day	Total Blocked Time/Train (min)	Average Delay/Veh. (min)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service (LOS)	Total Delay in a 24-hour period (min)
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
<b>Moon Creek East</b>												
Moon Creek Road	At-Grade	2	138	40	6925	18.6	2.47	1.24	4	2.37	A	5.43
Snider Creek Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
Tongue River Road	At-Grade	2	75	40	6925	18.6	2.47	1.24	2	2.36	A	2.96
I-94	Grade-Separated	2	6625	40	6925	18.6	--	--	--	--		--
US212	Grade-Separated	2	1988	40	6925	18.6	--	--	--	--		--
<b>Southern Alternatives</b>												
<b>Decker Alternative</b>												
Highway 314	At-Grade	2	788	40	6925	26.7	2.47	1.26	36	3.47	A	45.51
Four-Mile Creek Road	At-Grade	2	25	40	6925	26.7	2.47	1.23	1	3.39	A	1.41
Tongue River Road	At-Grade	2	413	40	6925	26.7	2.47	1.24	19	3.43	A	23.57
Tongue River Road	At-Grade	2	413	40	6925	26.7	2.47	1.24	19	3.43	A	23.57
Tongue River Road	At-Grade	2	88	40	6925	26.7	2.47	1.24	4	3.40	A	4.95
<b>Decker East Alternative</b>												
Highway 314	At-Grade	2	788	40	6925	26.7	2.47	1.26	36	3.47	A	45.51
Four-Mile Creek Road	At-Grade	2	25	40	6925	26.7	2.47	1.23	1	3.39	A	1.41
Tongue River Road	At-Grade	2	413	40	6925	26.7	2.47	1.24	19	3.43	A	23.57
Tongue River Road	At-Grade	2	88	40	6925	26.7	2.47	1.24	4	3.40	A	4.95
Tongue River Road	At-Grade	2	88	40	6925	26.7	2.47	1.24	4	3.40	A	4.95

<sup>1</sup> Rail traffic would not result in vehicle delay at crossings that are grade separated.

**Table D-13. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, Low Production – 10.4 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Total Blocked Time/Train (min)	Average Delay/Stopped Vehicle (min/Veh)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/Veh)	Level of Service	Total Delay in a 24-hr Period (min).	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/Veh)
<b>No Action</b>																
W Fork Armells Creek Rd	060514U	001185	2	44	40	6154	3	2.25	1.13	0	0.32	A	0.23	--	--	--
Old Highway 10	060499U	000050	2	1,200	40	6154	3	2.25	1.16	6	0.32	A	6.50	--	--	--
Wimer Rd	060524A	2251	2	30	25	6154	3	3.30	1.65	0	0.68	A	0.33	--	--	--
PINE BUTTE DR	086276D	002667	2	1,100	40	6154	3	2.25	1.15	5	0.32	A	5.94	--	--	--
WILLOW ST	099063F	002940	2	1,100	40	6154	3	2.25	1.16	5	0.33	A	5.99	--	--	--
<b>Post-Construction</b>																
W Fork Armells Creek Rd	060514U	001185	2	44	40	6925	10.4	4.61	2.31	1	1.17	A	0.87	0.54	1	0.86
Old Highway 10	060499U	000050	2	1,200	40	6925	10.4	4.61	2.37	20	1.21	A	24.13	14.54	1	0.88
Wimer Rd	060524A	2251	2	30	25	6925	10.4	6.77	3.39	1	2.54	A	1.25	0.53	2	1.86
PINE BUTTE DR	086276D	002667	2	1,100	40	6925	10.4	4.61	2.36	18	1.20	A	22.07	13.33	1	0.88
WILLOW ST	099063F	002940	2	1,100	40	6925	10.4	4.61	2.38	18	1.21	A	22.23	13.33	1	0.89

<sup>1</sup> The City of Colstrip has train speed restrictions. Source: Montana Department of Transportation 2010. Montana State Rail Plan. Available at: <http://www.mdt.mt.gov/pubinvolve/railplan/>.

**Table D-14. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, Medium Production – 14.9 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Total Blocked Time/Train (min)	Average Delay/Stopped Vehicle (min/veh)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service	Total Delay in a 24-hr Period (min).	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
<b>No Action</b>																
W Fork Armells Creek Rd	060514U	001185	2	44	40	6154	3	2.25	1.13	0	0.32	A	0.23	--	--	--
Old Highway 10	060499U	000050	2	1,200	40	6154	3	2.25	1.16	6	0.32	A	6.50	--	--	--
Wimer Rd	060524A	225100266	2	30	25	6154	3	3.30	1.65	0	0.68	A	0.33	--	--	--
PINE BUTTE DR	086276D	700294	2	1,100	40	6154	3	2.25	1.15	5	0.32	A	5.94	--	--	--
WILLOW ST	099063F	0	2	1,100	40	6154	3	2.25	1.16	5	0.33	A	5.99	--	--	--
<b>Post-Construction</b>																
W Fork Armells Creek Rd	060514U	001185	2	44	40	6925	14.9	4.61	2.31	1	1.70	A	1.25	0.86	2	1.38
Old Highway 10	060499U	000050	2	1,200	40	6925	14.9	4.61	2.37	29	1.74	A	34.85	23.38	2	1.42
Wimer Rd	060524A	225100266	2	30	25	6925	14.9	6.77	3.39	1	3.67	A	1.81	0.85	3	2.99
PINE BUTTE DR	086276D	700294	2	1,100	40	6925	14.9	4.61	2.36	27	1.74	A	31.87	21.43	2	1.41
WILLOW ST	099063F	0	2	1,100	40	6925	14.9	4.61	2.38	27	1.75	A	32.11	21.43	2	1.43

<sup>1</sup> The City of Colstrip has train speed restrictions. Source: Montana Department of Transportation 2010. Montana State Rail Plan. Available at: <http://www.mdt.mt.gov/pubinvolve/railplan/>.

**Table D-15. Grade-Crossing Delay, Segment 3 from Colstrip, MT - Nichols, MT, High Production – 21.6 trains per day (Year 2037)**

STREET	FRA Crossing ID	Milepost	Number of Roadway Lanes	AADT	Train Speed (mph) <sup>1</sup>	Train Length (feet)	Trains per Day	Total Blocked Time/Train (min)	Average Delay/Stopped Vehicle (min/veh)	Number of Vehicles Delayed Per Day	Average Delay for all Vehicles (sec/veh)	Level of Service	Total Delay in a 24-hr Period (min).	Change in the Number of Stopped Vehicle	Change in Trips Affected (%)	Change in Average Delay per Vehicle (sec/veh)
<b>No Action</b>																
W Fork Armells Creek Rd	060514U	00118 5	2	44	40	6154	3	2.25	1.13	0	0.32	A	0.23	--	--	--
Old Highway 10	060499U	00005 0	2	1,200	40	6154	3	2.25	1.16	6	0.32	A	6.50	--	--	--
Wimer Rd	060524A	2251 00266	2	30	25	6154	3	3.30	1.65	0	0.68	A	0.33	--	--	--
PINE BUTTE DR	086276D	7 00294	2	1,100	40	6154	3	2.25	1.15	5	0.32	A	5.94	--	--	--
WILLOW ST	099063F	0	2	1,100	40	6154	3	2.25	1.16	5	0.33	A	5.99	--	--	--
<b>Post-Construction</b>																
W Fork Armells Creek Rd	060514U	00118 5	2	44	40	6925	21.6	4.61	2.31	2	2.47	A	1.82	1.35	3	2.16
Old Highway 10	060499U	00005 0	2	1,200	40	6925	21.6	4.61	2.37	42	2.54	A	50.82	36.55	3	2.22
Wimer Rd	060524A	2251 00266	2	30	25	6925	21.6	6.77	3.39	2	5.36	A	2.63	1.32	4	4.68
PINE BUTTE DR	086276D	7 00294	2	1,100	40	6925	21.6	4.61	2.36	39	2.53	A	46.47	33.50	3	2.21
WILLOW ST	099063F	0	2	1,100	40	6925	21.6	4.61	2.38	39	2.55	A	46.82	33.50	3	2.23

<sup>1</sup> The City of Colstrip has train speed restrictions. Source: Montana Department of Transportation 2010. Montana State Rail Plan. Available at: <http://www.mdt.mt.gov/pubinvolve/railplan/>.

## D.3 References

- Federal Railroad Administration. 1987. *Rail-Highway Crossing Resource Allocation Procedure User's Guide*. Third Edition. Available: <https://www.fra.dot.gov/eLib/Details/L02900>. Accessed: March 21, 2014.
- Federal Railroad Administration. 2013a. *Highway-Rail Crossing Inventory Data*. Available: <http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Downloaddbf.aspx>. Accessed: May 17, 2013.
- Federal Railroad Administration. 2013b. *GradeDec.Net Reference Manual*. Available: <http://gradedec.fra.dot.gov/default.aspx>. Accessed: May 17, 2013.
- Federal Railroad Administration. 2014a. *GradeDec.Net Model*. Available: <http://gradedec.fra.dot.gov/default.aspx>. Accessed: May 17, 2013.
- Federal Railroad Administration. 2014b. *Web Accident Prediction System (WBAPS): Colstrip Subdivision*. Available: <http://safetydata.fra.dot.gov/webaps/default.aspx>. Accessed: April 30, 2014.
- Illinois Department of Transportation. 2010. *IDOT Average Annual Daily Traffic*. Available: <https://data.illinois.gov/Transportation/IDOT-Average-Annual-Daily-Traffic-2010/iw7a-edsn>. Accessed: December 11, 2013.
- Illinois Department of Transportation. 2011. *Average Daily Total Traffic Map*. Available: <http://www.dot.il.gov/trafficmaps/table.htm>. Accessed: December 11, 2013.
- Iowa Department of Transportation. 2012. *Traffic Counts*. Available: <http://www.iowadot.gov/maps/>. Accessed: December 11, 2013.
- Minnesota Department of Transportation. 2012. *Traffic Volumes*. Available: <http://www.dot.state.mn.us/traffic/data/>. Accessed: December 11, 2013.
- Montana Department of Transportation. 2010. *Rail Plan*. Available: <http://www.mdt.mt.gov/pubinvolve/railplan/>. Accessed: March 5, 2014.
- Montana Department of Transportation. 2014. *Traffic Data Annual Reports*. Available: <http://www.mdt.mt.gov/publications/datastats/traffic.shtml>. Accessed: March 9, 2015.
- Montana Department of Transportation. 2014. *Montana Fuel Tax Interactive Map*. Available: <https://www.mdt.mt.gov/business/fueltax/allocations.shtml>. Accessed: March 9, 2015.
- Nebraska Department of Roads. 2012. *Traffic Flow Map of the State Highways*. Available: <http://www.transportation.nebraska.gov/maps/>. Accessed: December 11, 2013.

- North Dakota Department of Transportation. 2011. *Traffic Volume Map*. Available: <http://www.dot.nd.gov/road-map/traffic/>. Accessed: December 11, 2013.
- South Dakota Department of Transportation. 2012. *South Dakota Traffic Flow Map*. Available: <http://www.sddot.com/transportation/highways/traffic/>. Accessed: December 11, 2013.
- Transportation Research Board. 2010. *Highway Capacity Manual*. Available: [http://www.co.monterey.ca.us/planning/major/Pebble%20Beach%20Company/Pebble\\_Beach\\_DEIR\\_Nov\\_2011/Pebble\\_Beach\\_DEIR\\_Admin\\_Records\\_Nov\\_2011/TRB/TRB\\_2000HghwyCapMan\\_IntersectionLOSCriteria.pdf](http://www.co.monterey.ca.us/planning/major/Pebble%20Beach%20Company/Pebble_Beach_DEIR_Nov_2011/Pebble_Beach_DEIR_Admin_Records_Nov_2011/TRB/TRB_2000HghwyCapMan_IntersectionLOSCriteria.pdf). Accessed: March 5, 2014.
- Wisconsin Department of Transportation. 2012. *Historical Traffic Count Maps by County*. Available: <http://www.dot.wisconsin.gov/travel/counts/maps.htm>. Accessed: December 11, 2013.
- Wyoming Department of Transportation. 2012. *Automatic Traffic Recorder Report: 2012*. Available: [https://www.dot.state.wy.us/home/planning\\_projects/Traffic\\_Data.default.html](https://www.dot.state.wy.us/home/planning_projects/Traffic_Data.default.html). Accessed: December 11, 2013.
- U.S. Energy Information Administration. 2013. *Annual Energy Outlook 2013 with Projection to 2040*. Vehicle Miles Traveled. Page 35. Available: [http://www.eia.gov/forecasts/archive/aeo13/pdf/0383\(2013\).pdf](http://www.eia.gov/forecasts/archive/aeo13/pdf/0383(2013).pdf). Accessed: February 28, 2014.
- U.S. Energy Information Administration. 2014. *Annual Energy Outlook*. Table A7. Transportation Sector Key Indicators and Delivered Energy Consumption. Available: <http://www.eia.gov/forecasts/aeo/er/pdf/tbla7.pdf>. Accessed: March 5, 2014.

### **D.3.1 Personal Communications**

McClure, Karen. Rail Transportation Expert. Department of Transportation, Federal Railroad Administration, Washington, D.C. February 21, 2014 —Email Correspondence.