CEQA Response

Analysis of Safety Issues
For the
Proposed Commuter Rail Service
On the
Riverside County Transportation Commission's Perris Valley Line
in the Vicinity of the Highland and Hyatt Schools

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by

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Introduction

The San Jacinto Branch Line Commuter Rail (Perris Valley Line) Project is a 24 mile extension of the Metrolink 91 Line, currently providing service from Riverside to Fullerton and downtown Los Angeles.

The extension would begin at a junction with the Burlington Northern Santa Fe line, north of the City of Riverside and turn southeast along the San Jacinto Branch Line. The terminus of the line is in the City of Perris at Route 74 and Ethanac Road in Perris.

The San Jacinto Branch Line, purchased by the Riverside County Transportation Commission (RCTC) in 1993, runs parallel to I-215, one of the most heavily traveled and congested freeways in the region.

Upon start up, the Perris Valley Line Project will have four new stations. It will operate through three cities (Riverside, Moreno Valley, and Perris), bringing commuter rail service to major employment centers. The project will also provide communities such as Hemet, San Jacinto, Murrieta, Lake Elsinore, Menifee, Wildomar and Temecula closer access to the Southern California commuter rail network.

The Perris Valley Line will operate primarily on track used as a freight rail line for more than 120 years. Establishing Metrolink service on this track will transfer the responsibility of track maintenance, repair and the upkeep of rail right of way away from privately-owned railroad to the Southern California Regional Rail Authority (SCRRA), the public agency that operates Metrolink. The existing freight line will be rehabilitated and upgraded with new track, to include, rail, ties, and ballast.

Concerns have been raised regarding the potential for hazard and safety impacts caused by adding commuter trains to the existing rail line which sits no less than 25' from an existing 6" jet fuel pipeline, owned and operated by Kinder Morgan and which runs parallel to track in the vicinity of the Highland Elementary School. The jet fuel pipeline has been in place since 1972 and in one location is approximately 50' west of the Highland Elementary School.

Concerns have also been raised about whether there is an increased risk of derailment with the addition of commuter trains, especially in the area where the trains will pass by another existing school, the Hyatt Elementary School, and a residential neighborhood.

This report examines and analyzes the following questions.

1. Will the addition of commuter rail to the existing line significantly increase the safety risks in the vicinity of the Highland Elementary School and the Kinder-Morgan pipeline near that school?
2. Will the addition of commuter rail to the existing line significantly increase the safety risks in the vicinity of the Hyatt Elementary School?

Background and Line Characteristics

The Perris Valley Line currently is used by BNSF to serve its shippers. The current operations consist of a daily local going upgrade and an empty return coming down the 2% grade. BNSF currently moves approximately 116 car loads a week, which is approximately 0.8 MGT traffic a year. The line is a single track line with 2% ruling grade and contains a series of 2 to 11 degree curve as shown in Figure 1. The right of way changes from 100 feet (total width) in some sections to 200 feet in many areas.

The current track varies from fair to poor condition, with areas of rail spalling on the gauge corner of the rail in the sharp curves and poor tie, fastener and ballast condition. There are several different sections of rails in place to include 90 lbs/yd., 115 lbs/yd., 119 lbs/yd. and 136 lbs/yd. These are scheduled to be completely replaced as part of the upgrade for commuter rail operations. Observation of the right of way indicated potentially unstable side slopes including some of sandstone. On several curves, silt was washed down during heavy rains and covered sections of 136 lbs. rail.

The current track condition is FRA Class 2. As a result, the general operating speed ranges up to a maximum speed of 20 mph.

The proposed commuter operation consists of approximately 12 trains per day, each train of approximately 640 tons in weight (see Table 1). This will increase the total traffic from the current 0.8 MGT per year of freight traffic to approximately 1.8 MGT per year of mixed passenger and freight traffic. Of these 1.8 MGT, 0.8 MGT will be the existing freight and 1 MGT will be commuter (passenger) traffic.

The proposed track upgrade includes replacing the existing rail with 136 RE Continuously Welded Rail (CWR), installation of new concrete ties with elastic fasteners, and new ballast. In addition, sixteen new crossings will be added together with a new signaling system and other upgrades to the right of way.

Figure 1: Track Chart Showing Curvature and Grade

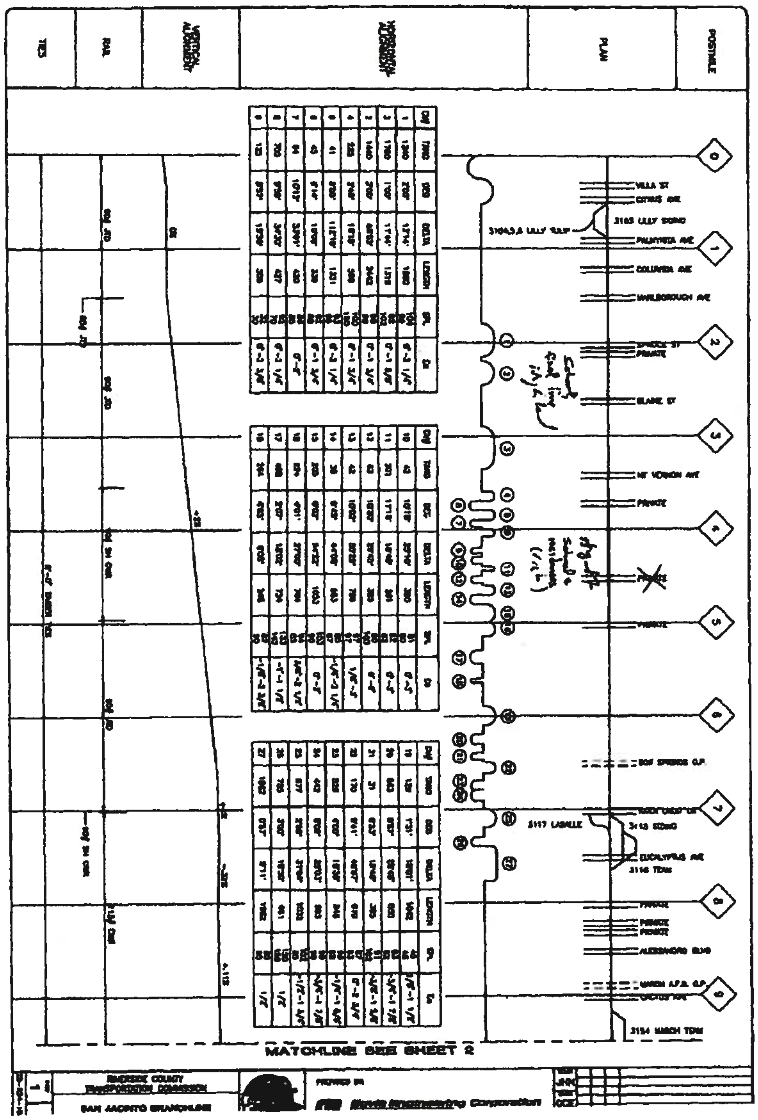

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Table 1: Passenger Equipment Characteristics

Average weight of proposed passenger train	640 tons
Passenger Car Dimensions	
Length	85'0"
Width	9'10"
Height	15'11"

Question:

Will the addition of commuter rail to the existing railway line significantly increase the safety risks in the vicinity of the Highland Elementary School and the Kinder-Morgan pipeline near that school?

It is our opinion that the addition of commuter rail to the existing railway line does not significantly increase the safety risks in the vicinity of the Highland Elementary School and the Kinder-Morgan pipeline near that school.

Discussion:

The Highland School is located in the vicinity of M.P. 2.5 in an area where the Kinder Morgan Jet Fuel Line high pressure pipeline is located between 25 and 75 feet from the track. Approximately 0.8 mgt of freight traffic currently operates on the existing line. The track in that area is on a 2% grade but is relatively straight with a one degree curve in the vicinity of the school and two degree curves approximately 0.5 miles away from the school in each direction. As noted before, as part of the addition of the commuter rail traffic, the track structure will be upgraded to new 136 RE CWR on concrete ties, elastic fasteners, and a new ballast section. Likewise, turnouts, grade crossings, and signal system will all be upgraded.

In order to address the question of increased risk associated with the addition of the passenger train operations, ZETA-TECH performed a derailment[1] risk analysis using all derailment classes in the FRA accident database for the years 2007 - 2009. Since the existing track is part of the BNSF railroad, data was restricted to Class 1 railroad

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[1] The Federal Railroad Administration , Office of Railroad Safety, defines derailment as follows: "A derailment occurs when on-track equipment leaves the rails for a reason other than a collision, explosion, highway-rail grade crossing impact, etc." FRA Guide for Preparing Accident/Incident Reports, November 9, 2010.

operations and particularly to the four major US Class 1 railroads[2] using the most recent three full years of available data for these railroads. Table 1 shows total million gross ton-miles, total derailment and total derailments per million gross ton-miles.

Table 1: Big Four Class I Railroad (BN, CSX, NS, UP) Derailment Data

	2007	2008	2009	Average
MGTM[3] (Revenue)	1,660,525	1,670,478	1,440,530	1,590,511
Total Derailments	1,517	1,430	1,059	1,335
Total Derailments/MGTM	0.00091357	0.00085604	0.00073515	0.00083956

As can be seen from the above table average derailment probability per million gross ton miles is a very low number, 0.00084 derailments per million gross ton miles per year. Looking at the global risk of derailment in the vicinity of each school using this data, for a distance of one half mile in each direction, the total risk of derailment under current operations is 0.000672 or 1 derailment every 1500 years.

In order to compare the level of risk associated with the added passenger service to the base (existing) freight service, ZETA-TECH also performed a passenger train derailment risk analysis using all derailment classes in the FRA accident database for the years 2007 - 2009. Table 2 shows corresponding passenger train total million gross ton-miles, total derailment and total derailments per million gross ton-miles.

Table 2: FRA Reported Passenger Derailment Data

	2007	2008	2009	Average
MGTM (Revenue)	90,237	100,643	112,074	100,985
Total Derailments	33	32	33	33
Total Derailments/MGTM	0.00036570	0.00031796	0.00029445	0.00032348

As can be seen from the above table passenger train average derailment probability per million gross ton miles is an extremely low number of 0.00032 derailments per million gross ton miles per year. Using this data, the increased risk of derailment in the vicinity of each school, for a distance of one half mile in each direction, associated with the introduction of passenger service is 0.00032 or 1 derailment every 3000 years.

Thus, it can be seen that the incremental risk associated with the addition of the passenger traffic is very small.

However, since both a school and a pipeline are adjacent to the railroad right of way[4], there is a very small risk of derailment associated with the rail operation. In order to assess the risk associated with the added passenger train operations in the event of a derailment, a derailment energy analysis was performed comparing the maximum

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[2] BNSF is one of the four major US Class 1 railroads.

[3] 1 MGTM corresponds to 1 Million Gross Tons of traffic (MGT) moving 1 mile.

[4] The pipeline is between 25 and 75 feet from the track and the school is a further 50+ feet west of the pipeline.

available energy at the time of derailment of a freight train to that of a passenger train on this line.

The analysis is based on a 2300 ton freight train[5] traveling at 20 mph[6] compared to a 640 ton passenger train[7] operating at 30 mph[8].

a. Freight train Energy Calculation

$$E = 1/2MV^2$$

Where: E^f = Energy of the freight system
M = Mass of the train (W/g = 2300 tons/g)
V = Maximum Velocity of the train (20mph)

b. Passenger train Energy calculation

$$E^p = 1/2MV^2$$

Where: E^p = Energy of the passenger system
M = Mass of the passenger train (W/g = 640 tons/g)
V = Maximum Velocity of the passenger train (30mph)

c. Ratio of passenger energy to freight energy

$$E^p/E^f = 0.626 = 62.6\%$$

From the energy ratios it can be seen that the passenger train will develop 63% of the energy developed by a freight train at this location should a derailment occur. This more than compensates for the small increase in derailment risk associated with the addition of the passenger trains, with a resulting combined risk of the order of 90% of the current freight operations[9].

Thus, the addition of commuter rail to the existing railway line does not significantly increase the safety risks in the vicinity of the Highland Elementary School and the Kinder-Morgan pipeline near that school.

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[5] A representative 16 car freight train with locomotive will weigh approximately 2300 tons.
[6] Current maximum freight train operating speed.
[7] The expected passenger consist of one locomotive, one cab car and four coach cars will weigh approximately 640 tons.
[8] The actual speed of operation is not finalized, however based on the curvature of the track, as shown in the track chart in Figure 1, it is expected that the passenger trains will be operating at 30 mph in this area.
[9] Based on the risk analysis presented here, it is recommended that passenger train speed be limited to 30 mph in the vicinity of the Highland School.

Question:

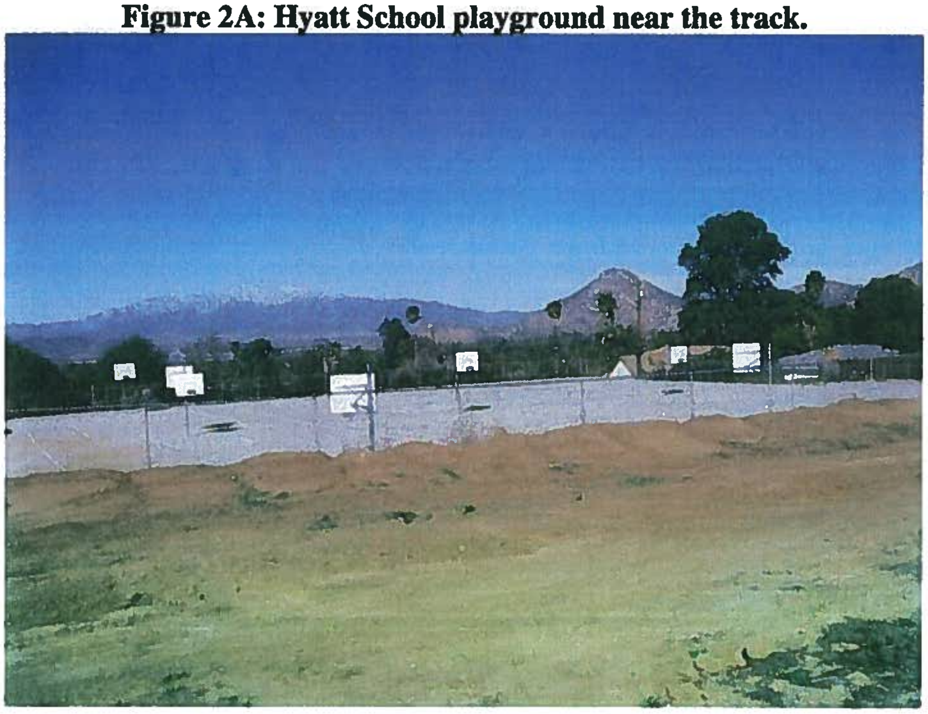
Will the addition of commuter rail to the existing railway line significantly increase the safety risks in the vicinity of the Hyatt Elementary School?

It is our opinion that the addition of commuter rail to the existing railway line does not significantly increase the safety risks in the vicinity of the Hyatt Elementary School.

Discussion

The Hyatt School is located in the vicinity of M.P. 4.6 on an 11 deg. curve and 2% grade, as shown in Figure 1. It is furthermore located in a zone of high curvature and heavy grade which includes several 10 and 11 degree curves in the vicinity of the school. The school playground is located at a lower elevation than the track elevation (see Figures 2A-C). The school board is concerned about derailment[10] risk which could result in railway vehicles encroaching on or near school property. There was a previous incident in the nearby residential area which resulted in some 45 gallon drums rolling down the hill into a home owner's pool.

Figure 2A: Hyatt School playground near the track.



[10] The Federal Railroad Administration , Office of Railroad Safety, defines derailment as follows: "A derailment occurs when on-track equipment leaves the rails for a reason other than a collision, explosion, highway-rail grade crossing impact, etc." FRA Guide for Preparing Accident/Incident Reports, November 9, 2010.

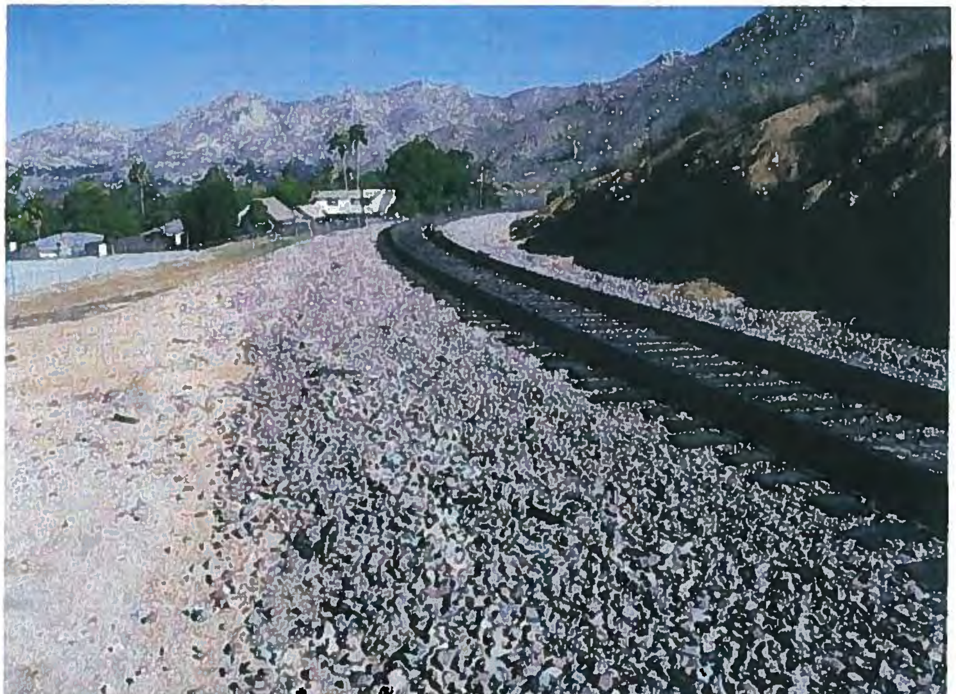


Figure 2B: Curve near Hyatt School

Figure 2C: Residential area near Hyatt School

The key issue to be addressed here is the level of increased risk associated with the addition of passenger train operations. As noted before, as part of this addition of traffic, the track structure will be upgraded to new 136 RE CWR on concrete ties, elastic fasteners, and a new ballast section. Likewise, turnouts, grade crossings, and signal system will all be upgraded.

Therefore the issue is the increase in derailment risk associated with the new traffic.

In general, accidents and derailments can be divided into several major categories:

Track related derailments

Mechanical equipment related derailments

Human Factors related accidents and derailments

Signal System related derailments

Grade Crossing Accidents

Since both the signal system and the grade crossings will be upgraded to a higher overall standard and level of sophistication, the expectation is that the overall level of accident or derailment risk associated with these categories will be reduced because of the improved systems. This is consistent with experience on other passenger rail systems with the introduction of improved signal systems and grade crossing warning systems.

In the case of human factor related accidents and derailments; likewise, an improved signaling system will reduce the level of risk associated with this class of accidents as compared to the existing operations. This will be further enhanced by the improved braking capability of the passenger equipment with significantly shorter braking distances as compared to the existing freight operations. This will be discussed later in this report under Human Factors Risk.

Thus, the focus of this report will be on Track and Equipment related derailments.

As discussed previously, ZETA-TECH performed a baseline derailment risk analysis using all derailment classes in the FRA accident database for the years 2007 – 2009 for Class 1 freight railroad operations (Table 1) and for passenger rail operations (Table 2).

However, because of the severe nature of the track alignment in the vicinity of the Hyatt School, with severe grade and curvature conditions, a more detailed derailment analysis was performed focusing on the key potential high severity types of derailments for track with these conditions of severe curvature and grade. The associated derailment risks were analyzed and evaluated based on the upgrade of the line and introduction of passenger train service.

Table 3 summarizes the highest risk classes of derailments by derailment category[11] for freight railroad operations. The first group of five is mechanical equipment related, the next group of three is track related and the last group of three is human factors related. Table 3 summarizes the number of derailments and the average derailments per MGTM by the different cause category for four largest Class I railroads, to include BNSF.

Table 3: Big Four Class I Railroad (BN, CSX, NS, UP) Derailments by Category

	2007	2008	2009	Average	Avg. Derailments/ MGTM
Mechanical					
Axles & Journal Bearings	42	33	27	34	0.0000214
Truck Components	48	57	37	47	0.0000298
Wheels	44	48	39	44	0.0000275
Brake	16	23	18	19	0.0000119
Coupler & Draft system	11	18	15	15	0.0000092
Track					
Track Geometry	249	232	176	219	0.0001377
Rail, Joint bar, Rail anchoring	244	224	145	204	0.0001285
Roadbed	32	29	18	26	0.0000166
Human Factors					
Use of Brake	28	25	22	25	0.0000157
Speed	45	29	34	36	0.0000226
Train Handling, make-up	85	64	56	68	0.0000430
Total	**844**	**782**	**587**	**738**	0.0004638

In reviewing these specific derailment risk areas, it can be seen that the track geometry and rail joint bar/rail anchoring category have the highest derailment rate value. These will be addressed in detail under Track Caused Derailments.

Table 4 summarizes these same derailment categories for passenger train derailments.

Table 4: Passenger Derailments by Category

	2007	2008	2009	Average	Avg Derail./ MGTM
Axles & Journal Bearings	1	0	0	0.33	0.0000033
Truck Components	0	0	0	0.00	0.0000000
Wheels	0	0	2	0.67	0.0000066
Brake	0	0	0	0.00	0.0000000
Coupler & Draft system	0	0	0	0.00	0.0000000

[11] It should be noted that Frog and Switch associated derailments are another high derailment category, however, there are no turnouts, frogs or switches in the vicinity of the Hyatt School and as such this category was omitted from consideration here.

Track Geo.	9	5	8	7.33	0.0000726
Rail Joint bar Rail anchoring	1	2	3	2.00	0.0000198
Roadbed	0	0	0	0.00	0.0000000
Use of Brake	1	0	1	0.67	0.0000066
Speed	3	2	0	1.67	0.0000165
Train Handling, make-up	0	0	0	0.00	0.0000000
Total	**15**	**9**	**14**	**12.67**	0.0001255

In all cases the derailment risk associated with passenger train operation is less than for freight operations, with most of the cases being 5 to 10 times lower risk levels.

In order to better understand the risks of passenger derailments, the key potential high severity types of derailments were analyzed and evaluated based on the upgrade of the line and introduction of passenger train service. Note, this analysis refers specifically to the track in the vicinity of the Hyatt School which is a severe curvature, severe grade environment with existing freight train operations.

The following sections address each of the three major areas.

Mechanical Caused Derailments

Mechanical caused derailments refer to derailments caused by railway vehicles to include locomotives, freight cars and passenger cars.

As can be seen in Table 3, wheels, axles and trucks are the largest individual risk areas. However, these risk areas are for the heavily loaded freight cars with individual car weights of the order of 130 to 140 tons and axle loads of the order of 33 to 36 tons. Passenger cars have significantly lower weights and axle loads with the proposed cars to be used for this service to be of the order of 80 to 100 tons weight and 20 to 25 ton axle loads.

Furthermore, most wheel and brake problems occur on severe grades for heavy freight trains with train weights of the order of several thousand tons as opposed to the proposed passenger train weight of 640 tons. Thus the major braking and wheel overheating problems most commonly associated with freight operations do not carry over into the lighter passenger train operations, and even more specifically the proposed passenger train operations on this line. This can be clearly seen in the significantly reduced passenger train derailment risk (Table 4) for axles and bearing (passenger risk is 15% of freight risk), wheels (passenger risk is 24% of freight risk) as well as for the truck and brake categories which show no passenger train reported derailments in the data set.

This is consistent with the design of the passenger car trucks, suspension systems, and braking systems, which are designed to provide a level of risk significantly below that of the freight car systems.

Human Factor Caused Accidents and Derailments

Human factor caused accidents and derailments include both operator related and train make up related accidents and derailments. These include the three categories shown in Tables 3 and 4 which include two operator related categories; speed and use of brake, and one train makeup category. The latter category is primarily associated with freight rail operations, as can be seen in total lack of accidents or derailments associated with passenger train operations in Table 4.

For the two operator related categories presented; it is again noted that significant reduction in accident/derailment rate is observed in the passenger related operations, with the passenger related risk of the order of 40% of the freight train related risk for use of brake related incident and 70% for speed related incidents. It should be further noted that since this is a high curvature area, train speeds are reduced to 25 mph for passenger trains (and 20 mph and less for freight), thus further reducing the speed associated derailment risks.

Here again, improved signal systems, to be installed as part of the overall system upgrade for the passenger operations will significantly reduce any derailment risk.

Track Caused Derailments

In the case of the track caused derailments, the overall condition of the line will be improved significantly because of a full track upgrade replacing all rail with new 136 RE CWR and all ties and fasteners with new concrete ties and elastic fasteners.

As can be seen in Table 3, rail, and track geometry cause categories are the largest individual risk areas[12]. However, as noted previously, these risk areas are for the heavily loaded freight cars with individual car weights of the order of 130 to 140 tons and axle loads of the order of 33 to 36 tons. Passenger cars have significantly lower weights and axle loads with the proposed cars to be used for this service to be of the order of 80 to 100 tons weight and 20 to 25 ton axle loads. Thus, the risks associated with the new passenger service are well below that of existing rail operations; i.e. 15% of the freight rail risk for rail related derailments, and 50% for track geometry.

Focusing on the key derailment risk areas associated with the track in the vicinity of the Hyatt School, the increase in derailment associated with the addition of passenger trains on to the existing route is 0.0001255 derailments per year or one derailment every 8000 years.

Thus, the addition of commuter rail to the existing railway line does not significantly increase the safety risks in the vicinity of the Hyatt Elementary School.

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[12] As noted previously, turnout related derailments are also a major derailment category but are not relevant here since there are no turnouts in the vicinity of the Hyatt School.

Respectfully Submitted

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ALLAN M. ZAREMBSKI Ph.D., P.E., F.A.S.M.E.
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Summary of Qualifications:
Over thirty years of professional engineering responsibility. Extensive experience in all areas of rail operations to include freight operations, transit, commuter and inter-urban. Internationally recognized expertise in the area of railway track and structures, vehicle-track dynamics, failure and failure analysis, safety, railway operations, and maintenance. Consulting services provided to virtually all major rail operations in North America together with numerous operations worldwide.

PROFESSIONAL HISTORY:

September 2007 to present	**ZETA-TECH, an Independent Business Unit of Harsco Rail** Vice President and General Manager Directed activities in track maintenance planning and planning software, vehicle-track dynamics and interaction, rail and track analyses, economic analyses of railroad operations, and railway costing. Special areas of activity include rail maintenance, rail grinding, railroad track structure, vehicle-track dynamics, fatigue and failure analysis, safety, and risk management.
1984 to 2007	**ZETA-TECH Associates, Inc., Cherry Hill, New Jersey** President Directed activities in track maintenance planning and planning software, vehicle-track dynamics and interaction, rail and track analyses, economic analyses of railroad operations, and railway costing. Special areas of activity include railroad track structure, vehicle-track dynamics, fatigue and failure analysis, safety, and risk management.
1981 - 1984	**Pandrol Inc./Speno Rail Services Co.** Director Research & Development Dual responsibility for both companies in directing all research and development activities for new products, new systems, and future corporate activities. Reported directly to the President. Responsible for all railroad technology activities including product application, advertising, and technical support.
1976 - 1981	**Association of American Railroads** Manager - Track Research Division December 1978 to September 1981 Directed Division Responsible for conducting major research programs on railroad track. Directed AAR Track Laboratory. Conducted extensive field and laboratory tests as well as analytical research programs.

	Assistant Manager - Track Research Division August 1978 to December 1978 Initiated major research programs in Track Strength, Rail Fatigue, Ballast Failure Mechanisms, etc.
	Senior Research Engineer August 1976 to August 1978 Responsible for research programs on freight car fatigue design, rail overturning, and track gage widening. Developed industry standard methodology for fatigue design of freight cars. Developed test plans and procedures for AAR Track Laboratory.
1975 - 1976	**Princeton University** Research Associate - Dept. of Civil Engineering Conducted research activities in the area of lateral (railroad) track deformation and track buckling. Conducted laboratory tests at civil engineering laboratory.
1971 - 1973	**Grumman Aerospace Corp.** Engineer Responsibility for design and analysis of military aircraft structural components. Also conducted dynamic analyses of aircraft structures.

EDUCATION:

Sept. 1975	Ph.D. Civil Engineering; Princeton University
June 1974	M. A. Civil Engineering; Princeton University
Jan. 1973	M. S. Engineering Mechanics; New York University
Jan. 1971	B. S. (Magna Cum Laude) Aeronautics and Astronautics; New York University

PROFESSIONAL AFFILIATIONS:

Registered Professional Engineer: NJ, NY, PA, IL, MD

MEMBER:

American Railway Engineering and Maintenance of Way Association (Honorary Member)
American Society of Mechanical Engineers (Fellow)
American Society of Civil Engineers

HONORS AND AWARDS:

Elected Honorary Member of American Railway Engineering and Maintenance of Way Association (AREMA) in 2010

Received Federal Railroad Administration's SPECIAL ACT AWARD, February 2001

Elected Fellow of the American Society of Mechanical Engineers in 2000

1992 Rail Transportation Award, American Society of Mechanical Engineers

Associate Editor, Railway Track and Structures Magazine, January 1985 to 1996. Author of monthly column; "Tracking R&D"

Adjunct Assistant Professor, Department of Civil Engineering, Illinois Institute of Technology 1980 - 1981

Instructor: Railroad Engineering Continuing Education Courses
Institute for Railroad Engineering; 1984 – 2004
George Washington University; 1980 - 1981
University of Wisconsin at Madison; 1978 -1981

Member: National Academy of Sciences, National Materials Advisory Board; Committee on Nondestructive Testing of Longitudinal Force in Rails

Member: Office for Research and Experiments of the International Union of Railway; Committee D150

Delegate: American Railway Engineering Association Railroad Delegation to the Peoples Republic of China, 1983

Deputy Director - International Government Industry Research Program on Track Train Dynamics

Patent (Pending): Automated Turnout Inspection

Author of over 160 papers on railroad track analysis and behavior, rail fatigue, and freight car design and analysis

Author of over 130 articles on railway operations and maintenance, published in all of the major U.S. and international (English speaking) industry publications

Author of the book Tracking R&D; Research and Development, Simmons Boardman, Omaha, NE, 1993
Author of the book The Art and Science of Rail Grinding, Simmons Boardman, Omaha, NE, 2005

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BOOKS

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1. The Railroad: What It Is, What It Does, Chapter 3: The Track: Alignment and Structure, **Simmons Boardman Books, Inc. 2008**

2. Guidelines to Best Practices for Heavy Haul Railway Operations, Chapter 6.7 Maintenance Management Analysis Tools, **International Heavy Haul Association, 2009**

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