VALERO BENICIA CRUDE BY RAIL PROJECT

Revised Draft Environmental Impact Report
SCH # 2013052074
Use Permit Application 12PLN-00063

Prepared for
City of Benicia

August 2015

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TABLE OF CONTENTS

Valero Benicia Crude by Rail Project
Revised Draft Environmental Impact Report

Page

1. Introduction **1-1**
1.1 Purpose of this Document 1-1
1.2 Recirculation and Public Comment 1-5

2. Revisions to the Draft EIR **2-1**
2.1 DEIR Executive Summary 2-1
2.2 DEIR Chapter 1, Introduction 2-16
2.3 DEIR Chapter 2, Summary of Environmental Impacts 2-19
2.4 DEIR Chapter 3, Project Description 2-19
2.5 DEIR Chapter 4, Approach to the Analysis of Impacts 2-23
2.6 DEIR Section 4.1, Air Quality 2-25
2.7 DEIR Section 4.2, Biological Resources 2-42
2.8 DEIR Section 4.3, Cultural Resources 2-46
2.9 DEIR Section 4.4, Energy Conservation 2-48
2.10 DEIR Section 4.5, Geology and Soils 2-52
2.11 DEIR Section 4.6, Greenhouse Gas Emissions 2-53
2.12 DEIR Section 4.7, Hazards and Hazardous Materials 2-62
2.13 DEIR Section 4.8, Hydrology and Water Quality 2-124
2.14 DEIR Section 4.9, Land Use and Planning 2-126
2.15 DEIR Section 4.10, Noise 2-127
2.16 DEIR Section 4.11, Transportation and Traffic 2-137
2.17 DEIR Chapter 5, CEQA Statutory Sections 2-141
2.18 DEIR Chapter 6, Analysis of Alternatives 2-167
2.19 DEIR Chapter 7, Report Preparation 2-168
2.20 DEIR Chapter 8, Glossary and Acronyms 2-170
2.21 Chapter 9, References 2-170

Appendices

A. Air Quality and GHG Emissions Supplement A-1
B. Updated Methodology for Assessment of Health Risk and PM2.5 Concentrations at the Refinery near Locomotive Tracks in Fairfield, CA B-1
C. Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations Between Roseville, CA and the Oregon and Nevada Borders C-1
D. Qualitative Assessment of Cumulative Contribution of Health Impacts near Rail Lines in Auburn, Chico, Marysville, Redding, and Truckee, California D-1
E. Sensitive Biological Resources within 300 Feet of Rail Routes E-1
F. Quantitative Risk Analysis of the Valero Benicia Crude by Rail Project F-1
G. Preemption of CEQA by the ICCTA G-1
H. Valero Benicia Refinery Statement re: Preemption H-1

Page

List of Figures

1-1 North American Freight Railroads 1-2
1-2 Union Pacific Crude Network 1-3
1-3 Uprail Routes 1-4
1-4 California Class I Rail System 1-6
ES-1 Regional Location 2-4
ES-2 Valero Refinery Boundary 2-5
ES-3 Site Plan 2-7
4.7-1 Santa Barbara County Injury and Fatality Risk Thresholds ~~Evolution of Rail Industry Tank Car Standards for Crude Oil~~ 2-88
4.7-2 Risk Associated with CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 50 Car Unit Train to California Border 2-96
4.7-3 Risk Associated with CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 100 Car Unit Train to California Border 2-97
4.7-4 Risk Associated with DOT-117 Tank Car Mainline Crude Oil Unit Train Transportation – 50 Car Unit Train to California Border 2-99
4.7-5 Risk Associated with DOT-117 Tank Car Mainline Crude Oil Unit Train Transportation – 100 Car Unit Train to California Border 2-100
4.7-6 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 50 Car Unit Train to California Border 2-101
4.7-7 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 100 Car Unit Train to California Border 2-102
4.7-8 Worst Case Facility Thermal Radiation Hazards 2-109
4.7-9 Risk Associated with Valero Unloading Facility Crude Oil Spills and Fires 2-110
4.10-3 Typical Levels of Ground-borne Vibration 2-131
4.10-4 Noise Impact Criteria for Rail Projects and Allowable Increases in Cumulative Noise Levels 2-134
5-1 Cumulative Mainline Crude Oil Unit Train Transportation Risk – CPC-1232 Tank Cars to the California Border 2-161
5-2 Cumulative Mainline Crude Oil Unit Train Transportation Risk – DOT-117 Tank Cars to the California Border 2-162
5-3 Cumulative Mainline Crude Oil Unit Train Transportation Risk – DOT-117R Tank Cars to the California Border 2-163

List of Tables

ES-1 Proposed Project vs. Alternatives, Summary of Environmental Impact Conclusions 2-10
ES-2 Summary of Impacts and Mitigation Measures for the Valero Crude by Rail Project 2-16
4.0-1 Potential Rail Routes to Refinery 2-25
4.1-9 Maximum Cancer and Noncancer Risks in the Bay Area Basin 2-29
4.1-10 Maximum Cancer and Noncancer Risks in the Sacramento Basin 2-30
4.1-11 Miles Traveled Within Air Districts from Roseville to State Line 2-31
4.1-12 Project-Related Criteria Pollutant Emissions – Oregon to Roseville Route 2-33
4.1-13 Project-Related Criteria Pollutant Emissions – Nevada to Roseville (Northern) Route 2-34
4.1-14 Project-Related Criteria Pollutant Emissions – Nevada to Roseville (Southern) Route 2-35
4.1-15 Locomotive and Marine Vessel Emissions Factors Comparison for 1,000,000 Barrels Delivered per 1,000 Miles Travelled 2-36
4.1-16 Examples of Total Net Emissions, Including Outside of California 2-37

Page

List of Tables (continued)

4.1-17 Maximum Cancer Risk, Chronic Hazard, and PM2.5 Concentrations Along the Three Train Routes Uprail of the Roseville Yard 2-40
4.4-1 UPRR Energy Consumption 2-49
4.6-3 Project Construction Greenhouse Gas Emissions 2-57
4.6-4 Baseline Marine Vessel GHG Emissions Within California 2-57
4.6-5 Project Annual Net GHG Emissions Generated Within California 2-58
4.6-6 Emission Factors Comparison for 1,000,000 Barrels Delivered per 1,000 Miles Travelled Outside of California 2-60
4.6-7 Examples of GHG Emissions Outside of California 2-60
4.7-1 Rail Incidents – Initiating and Contributing Causes 2-64
4.7-2 Summary of National and California Train Accident Data 2-65
4.7-3 Local Safety Hazard Sites in California 2-66
4.7-4 Final Regulatory Requirements for HHFT 2-80
4.7-5 Final Safety Features by Tank Car Option 2-81
4.7-6 Probability of Crude Oil Release from Project Trains 2-93
4.7-7 Worst Case Thermal Radiation Hazard Zones – Mainline Rail 2-94
4.7-8 Worst Case Thermal Radiation Hazard Zones – Unloading Facility 2-108
4.7-9 Schools Within 1/4 Mile of the UPRR Mainline 2-117
4.10-5 Ground-borne Vibration (GBV) and Ground-borne Noise (GBN) Impact Criteria for General Assessment 2-132
4.10-6 Noise Levels Defining Impact for Transit Projects 2-136
4.11-3 Intersection Delay Time as a Function of Train Speed 2-139
5-1 Potential Projects for Cumulative Effects Evaluation 2-145
5-2 Cumulative Health Risk At or Near the Refinery 2-153
5-3 Cumulative Health Risk At the Maximum Exposed Individual Receptor 2-155

CHAPTER 1
Introduction

1.1 Purpose of this Document

This Revised Draft Environmental Impact Report (Revised DEIR) has been prepared by the City of Benicia (City), as the lead agency with primary responsibility for analyzing potential effects of the Crude by Rail Project (Project) proposed by the Valero Benicia Refinery (Refinery) under the California Environmental Quality Act (CEQA)[1] and as the agency with primary authority for Project approval under state and local law.[2]

A Draft Environmental Impact Report (DEIR) was issued for the Project in June 2014 that analyzes the direct, indirect, and cumulative impacts of the Refinery's proposed receipt of up to 70,000 barrels per day of North American crude oil by railroad tank cars (up to 100 railcars per day) and the construction, operation, and maintenance of a new railcar unloading rack where crude oil would be unloaded from the railcars and pumped into existing crude oil storage tanks. The amount of crude oil delivered by railcar would be offset by a corresponding decrease in crude oil that currently is delivered by marine vessels (ERM, 2012; ERM, 2013). The Project would not increase the Refinery's total crude oil throughput or result in an increase in the production of existing products or byproducts. The DEIR analyzes potential impacts of the Project primarily between two points: Roseville, California, where the Union Pacific Railroad (UPRR) would dispatch tank cars received via existing rail lines from a number of potential points of origination across the nation for shipment into the Refinery, and the Refinery itself.[3]

In response to requests made in comments on the DEIR, the City is issuing this Revised DEIR for public input to consider potential impacts that could occur "uprail" of Roseville, California (i.e., between a crude oil train's point of origin and the California State border, and from the border to Roseville) and to supplement the DEIR's evaluation of the potential consequences of upsets or accidents involving crude oil trains based on new information that has become available since the DEIR was published. In order to allow the public and interested agencies the opportunity to review this information, the City has elected to recirculate certain portions of the DEIR. The City has prepared this Revised DEIR in compliance with Section 15088.5 of the CEQA Guidelines (14 Cal. Code Regs. §15088.5) and will use it in conjunction with other information developed in the City's formal record when considering the Project.

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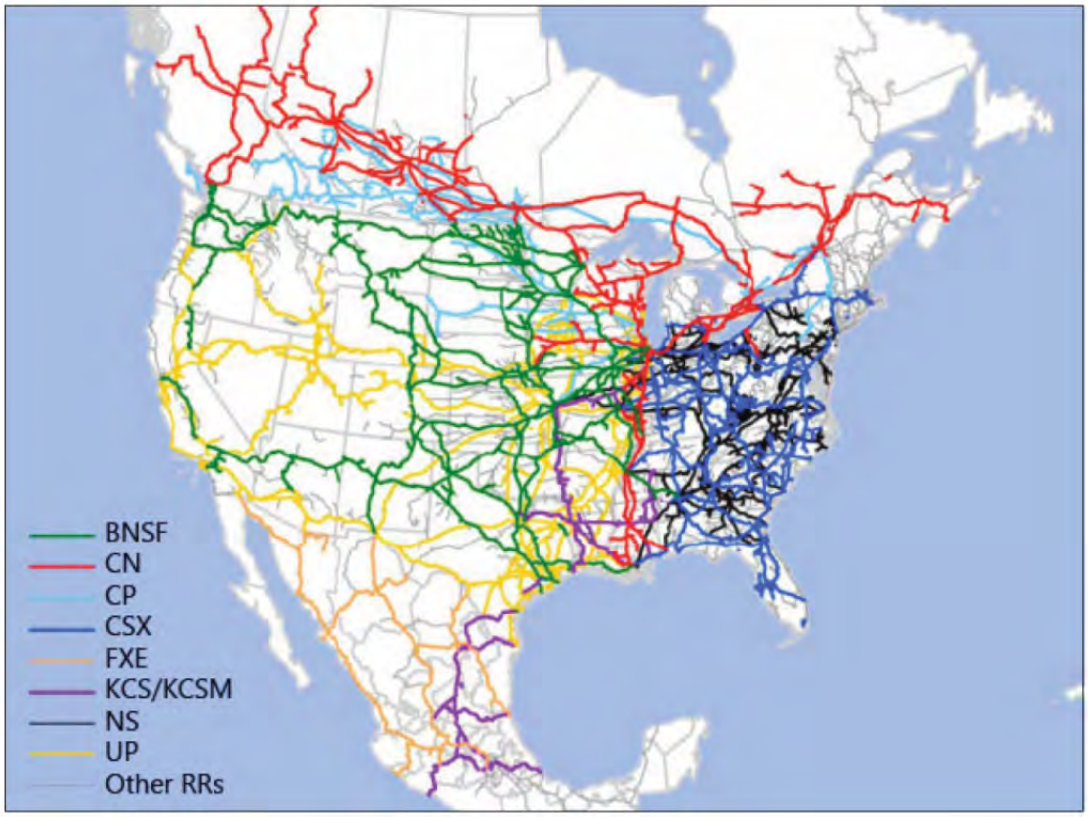
1 Pub. Res. Code §21000 et seq. Implementing regulations, the "CEQA Guidelines," are found in Title 14 of the California Code of Regulations beginning with section 15000.

2 See, e.g., Gov't Code §65000 et seq.

3 Roseville is home to one of UPRR's two California system classification yards, where freight trains that consist of isolated cars and unit trains are divided according to their destinations; UPRR's other system classification yard is in West Colton (Southern California) (Caltrans, 2013).

It is theoretically possible, due to track sharing agreements (also called "trackage rights"), for crude to be provided to the Refinery via any of the North American freight railroad tracks, which are shown in Figure 1-1, *North American Freight Railroads*. However, it is more likely that UPRR's existing crude network (Figure 1-2, *Union Pacific Crude Network*) would be used to transport Project-related crude because the UPRR rail line already provides rail access for the Refinery and because Refinery personnel have indicated that the UPRR would serve the Project (see, e.g., ERM, 2013). Further, based on information provided in application materials submitted by Refinery personnel (ERM, 2013), the DEIR and this Revised DEIR assume for purposes of analysis that all Project-related crude would be routed through Roseville.[4] Accordingly, this analysis focuses on the lines leading from Roseville toward the California border and points beyond from the north (Oregon to Roseville), northeast (Nevada to Roseville, Northern), and east (Nevada to Roseville, Southern). See Figure 1-3, *Uprail Routes*.



BNSF= BNSF Railway; CN= Canadian National Railway; CP= Canadian Pacific Railway; CSX= CSX Transportation; FXE= Ferromex (a contraction of Ferrocarril Mexicano or "Mexican Railway"); KCS/KCSM= Kansas City Southern Railway; NS= Norfolk Southern Railway; and UP= Union Pacific Railroad.

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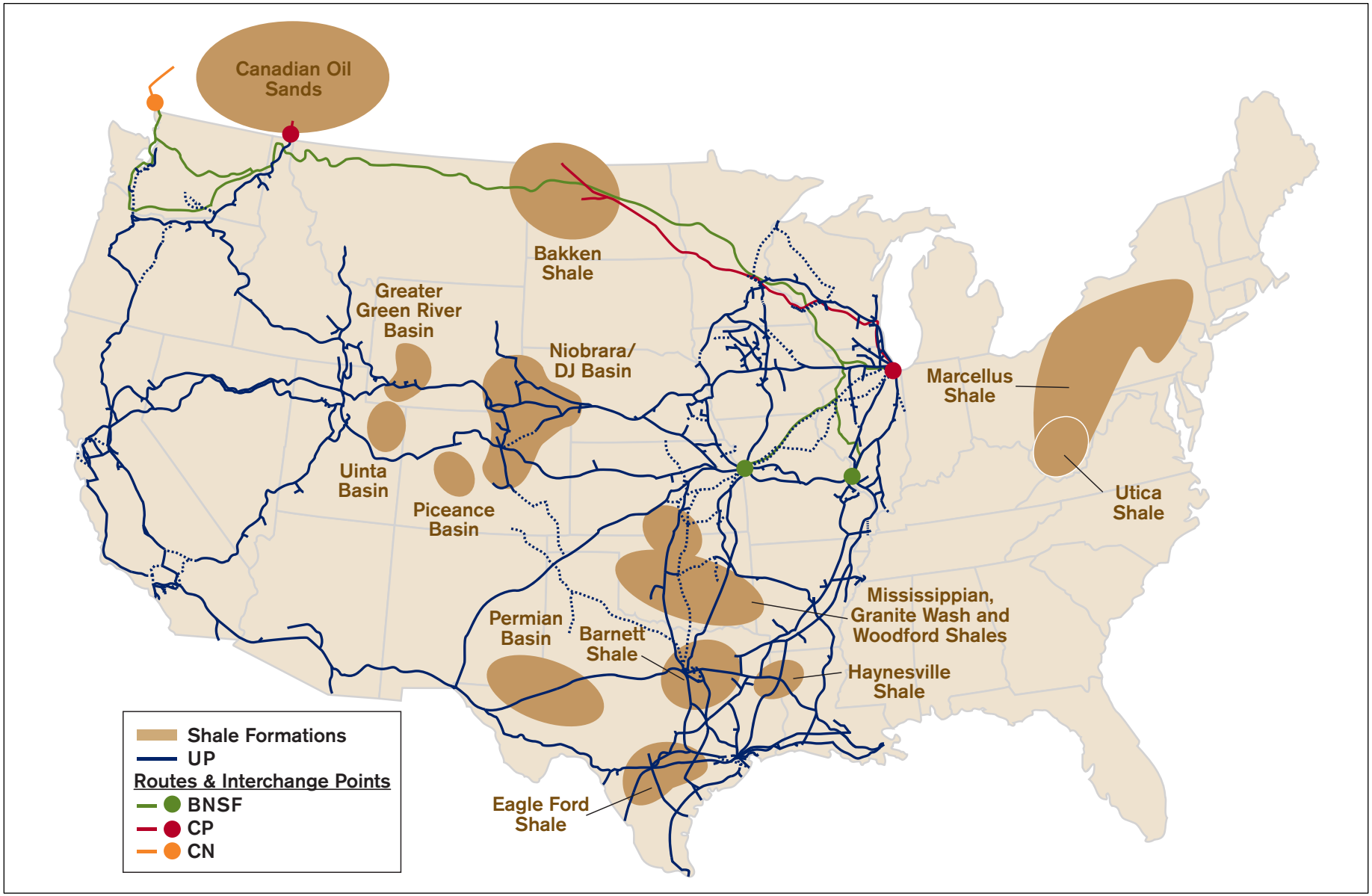
SOURCE: Association of American Railroads, 2014

Figure 1-1
North American Freight Railroads

4 UPRR confirmed in November 2014, "There are currently no plans for any other service unit [besides Roseville] to provide crude trains to the Valero Benicia refinery." (Valero, 2014)



SOURCE: Union Pacific, 2015

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Figure 1-2
Union Pacific Crude Network

SOURCE: ESA

Benicia Valero CTR . 202115.01

Figure 1-3

Uprail Routes

Acknowledging that, on the basis of federal preemption, neither the Refinery nor the City has authority to dictate or limit routes selected by UPRR (see DEIR Section 3.7, *Federal Preemption of Railroad Regulation*, DEIR Appendix L, and Revised DEIR Appendices G and H), it is possible that Project-related crude oil could reach the Refinery through Roseville using routes from southern California (see Figure 1-4, *California Class I Rail System*). However, based upon Valero's statement that trains would be dispatched from Roseville to the Refinery in 50 tank car unit trains (Valero, 2014), it is less likely that Project trains would use the southern route because they first would have to travel through Sacramento to Roseville, and then back through Sacramento to reach the Refinery. For the reasons explained on a resource-by-resource basis in Chapter 2 of this Revised DEIR, potential direct, indirect, and cumulative impacts of crude oil transport by rail approaching the Refinery from the south are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes. The potential impacts that could occur as a result of delivery of crude oil to the Refinery via a southern route are analyzed in Chapter 2 of this Revised DEIR.

The analysis in this Revised DEIR analyzes reasonable worst case scenarios as appropriate on a resource-by-resource basis. See, for example, Section 2.6.2 regarding uprail air quality-related impacts, Section 2.11.1 regarding greenhouse gas emissions, and 2.12.6 regarding hazards and hazardous materials. In this way, the analysis is appropriately conservative in its impact determinations.

1.2 Recirculation and Public Comment

Because the proposed revisions are limited to a few portions of the DEIR, *the City is recirculating only the affected portions of the analysis* (14 Cal. Code Regs. §15088.5(c)). For example, for most resources two new sections are being added: one captioned "Uprail Impacts and Mitigation Measures" and the other captioned "Summary of Impacts." By contrast, for Hazards and Hazardous Materials, revisions proposed in this Revised DEIR affect other portions of the DEIR as noted. Pursuant to CEQA Guidelines Section 15088.5(f)(2), anyone wishing to submit written comments on the Revised DEIR should limit those comments to the revised portions shown in Chapter 2 of this Revised DEIR. New text that has been added is shown as <u>underlined</u> text. Text that has been deleted is shown as ~~strikethrough~~ text. Consistent with CEQA and the CEQA Guidelines, the City's Final EIR for the Project will include written responses to all substantive comments received on the DEIR and this Revised DEIR.

This Revised DEIR will be available for public comment for 45 days beginning on August 31, 2015, when the Notice of Completion and Notice of Availability of the Revised DEIR will be submitted to the State Clearinghouse and the Notice of Availability will be published in the Benicia Herald and Vallejo Times Herald. Written comments on the revisions to the DEIR shown in Chapter 2 of this Revised DEIR should be sent to the City of Benicia Community Development Department, Attention: Amy Million, 250 East L Street, Benicia, CA 94510.

SOURCE: ESRI, 2012; Caltrans, 2013

Benicia Valero CBR . 202115.01

Figure 1-4

California Class I Rail System

References

Association of American Railroads, 2014. Moving Crude Oil by Rail. [https://www.aar.org/BackgroundPapers/Moving%20Crude%20Oil%20by%20Rail.pdf] September.

California Department of Transportation (Caltrans), 2013. Freight Planning Fact Sheet, California freight Rail. [http://www.dot.ca.gov/hq/tpp/offices/ogm/fact_sheets/Freight_Railroad_Fact_Sheet_122413_jhm.docx]. December 24.

ERM, 2012. Land Use Permit Application Crude by Rail Project, Valero Benicia Refinery, Benicia, California. December.

ERM, 2013. Valero Crude by Rail Project Description, Benicia Refinery, Benicia, California. March.

Valero, 2014. *Response to City of Benicia Information Request dated November 5, 2014.*

CHAPTER 2
Revisions to the Draft EIR

This chapter presents the City's revisions to the DEIR relating to impacts that could occur uprail of Roseville, California (i.e., between a crude oil train's point of origin and the California State border, and from the border to Roseville) and a supplemental quantitative evaluation of potential consequences of upsets or accidents. Direct, indirect, and cumulative effects of uprail impacts assume normal operating conditions and are analyzed on a resource-by-resource basis. Potential indirect effects (sometimes called "secondary effects") that could occur as a consequence of a train car-related upset or accident (including, but not limited to, potential secondary impacts to Biological Resources, Cultural Resources, Geology and Soils, and Hydrology and Water Quality) are analyzed in Revised DEIR Section 4.7, *Hazards and Hazardous Materials*. New text added to the DEIR is shown as <u>underlined</u> text. Text that has been deleted from the DEIR is shown as ~~strikethrough~~ text. Introductory, explanatory, and contextual material is provided in *italics* to assist the reader. Italicized text does not denote a change to the DEIR. This Revised DEIR proposes no revisions to subjects, sections, or portions of the DEIR other than as noted below in ~~strikethrough~~ and <u>underlined</u> text.

2.1 DEIR Executive Summary

The DEIR's Executive Summary (p. ES-1 et seq.) includes Section ES-1, Introduction (p. ES-1); Section ES-2, Project Objectives (p. ES-1 et seq.); Section ES-3, Project Setting and Location (p. ES-2 et seq.); Section ES-4, Project Description (p. ES-3 et seq.); Section ES-5, Alternatives (p. ES-4 et seq.); Section ES-6, Environmentally Superior Alternative(p. ES-7); Section ES-7, Areas of Controversy and Issues to be Resolved (p. ES-7 et seq.); and Section ES-8, Summary of Impacts (p. ES-6 et seq.). The DEIR's Executive Summary has been further developed and refined to clarify the geographic scope of the whole of the Project as extending between the various potential North American points of origin of Project-related crude oil and the Refinery; to clarify the temporal context of the Project in terms of the rapidly evolving regulatory regime that governs the transport of crude by rail; and to reflect conclusions reached in the Revised DEIR regarding the potential uprail effects of transporting Project-related crude by rail.

The Executive Summary, as set forth below in this Revised DEIR, replaces the DEIR Executive Summary in its entirety.

2.1.1 DEIR ES-1, Introduction

This Environmental Impact Report (EIR) is an informational document that does three things: discloses to the public and to decision-makers the environmental effects of the Crude by Rail project (Project) proposed by Valero at the oil refinery it owns and operates in Benicia, California (Refinery); lists ways that potential significant effects of the Project might be minimized; and identifies and analyzed alternatives to the Project.

Valero filed a Land Use Application with the City of Benicia Community Development Department's Planning Division (the City) in December 2012 seeking Use Permit authorization for the Refinery to receive a proportion of its existing crude oil deliveries by railcar, i.e., up to 70,000 barrels[1] per day of North American crude (ERM, 2012). The amount of crude oil delivered by railcar would be offset by a corresponding decrease in crude oil delivered by marine vessels (ERM, 2012). The Project would not increase the Refinery's total crude oil throughput or result in an increase in the production of existing products or byproducts. The City is the CEQA lead agency.

This Executive Summary includes the following sections:

- Introduction (ES-1)
- Project Objectives (ES-2)
- Project Setting and Location (ES-3)
- Project Description (ES-4)
- Alternatives (ES-5)
- Environmentally Superior Alternative (ES-6)
- Areas of Controversy and Issues to be Resolved (ES-7)
- Summary of Impacts (ES-8)

This EIR assesses the direct, indirect, and cumulative environmental impacts that could occur as a result of the construction, operation, and maintenance of the Project and alternatives to the Project. Based on this analysis, this EIR preliminarily identifies Alternative 1 – Limiting Project to One 50-Car Train Delivery per Day as the Environmentally Superior Alternative.

2.1.2 DEIR ES-2, Project Objectives

The Refinery converts crude oil into finished products, including gasoline, jet fuel, liquefied petroleum gas, heating oil, fuel oil, asphalt, petroleum coke, and sulfur. Valero has proposed the Project for the purpose of receiving a larger proportion of its crude oil by railcar, up to 70,000 barrels per day of North American crude (ERM, 2012, ERM, 2013). The Project has the following objectives:

1. Allow for the delivery of up to 70,000 barrels per day of North American-sourced crude oil by rail.

2. Replace marine vessel delivery with rail delivery of up to 70,000 barrels per day of crude oil.

[1] One barrel is equivalent to 42 gallons of crude oil.

3. Mitigate project-related impacts.

4. Implement the Project without changing existing Refinery process equipment or Refinery process operations, other than operation of the Project components.

5. Continue to meet requirements of existing rules and regulations pertaining to oil refining including the State of California Global Warming Solutions Act of 2006 (AB 32).

2.1.3 DEIR ES-3, Project Setting and Location

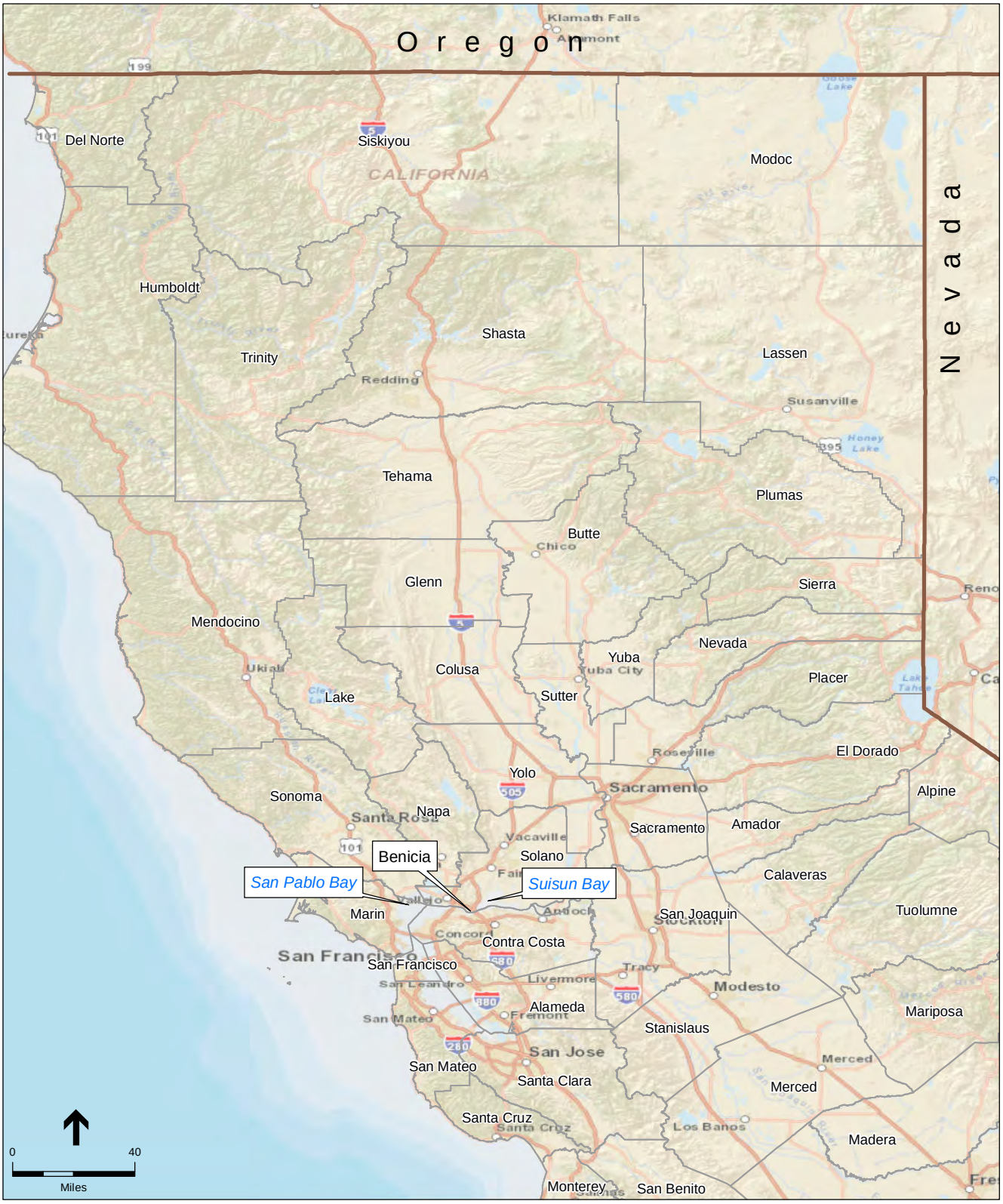
The Refinery is located at 3400 East Second Street, an industrial area in the eastern portion of the City of Benicia, in Solano County. The Refinery lies in a general north-south orientation near and west of Interstate 680. The Refinery is located along the northern edge of the Suisun Bay below a low range of coastal hills. See Figure ES-1, *Regional Location.* To the west of East Second Street is open space, and the closest residential areas are approximately 3,000 feet to the south and west of the Refinery, and approximately 2,100 feet to the northwest. Refinery operations occupy approximately 330 acres of Valero's 880 acre property.

The Refinery dock is located on the Carquinez Strait between the Benicia-Martinez Bridge and the Port of Benicia wharf. The Refinery's marine terminal and pipeline to the Refinery provide access for receiving and shipping bulk cargoes (including crude) by marine vessel. The existing Union Pacific Railroad (UPRR) rail line provides rail access for the Refinery and for the Benicia Industrial Park, which is located east and north of the Refinery. See Figure ES-2, *Valero Refinery Boundary*. Presently, the Refinery uses tank cars to receive chemicals used in refining and to ship refined products from the Refinery.

The Project site is located in the northeastern portion of the Refinery property, between the eastern side of the lower tank farm and the fence adjacent to Sulphur Springs Creek. See Figure ES-3, *Site Plan*. Existing facilities within the Project site include siding track and a liquid spill containment area (including an associated containment berm).

2.1.4 DEIR ES-4, Project Description

Valero proposes to install, operate, and maintain new equipment, pipelines, and associated infrastructure as well as new and realigned segments of existing railroad track within the Refinery boundary to allow the Refinery to receive a portion of its crude oil feedstock deliveries by tank car. More specifically, the Project would allow Valero to accept up to 100 tank cars of crude oil a day in two 50-car trains. The trains would enter the Refinery on an existing rail spur that crosses Park Road. Crude oil unloaded from the tank cars would be pumped to an existing storage tank in the Refinery via a new crude offloading pipeline. The amount of crude oil delivered by railcar would offset the amount of crude oil delivered by marine vessels. See generally ERM, 2012, ERM, 2013, Valero, 2013a, and Valero, 2013b.

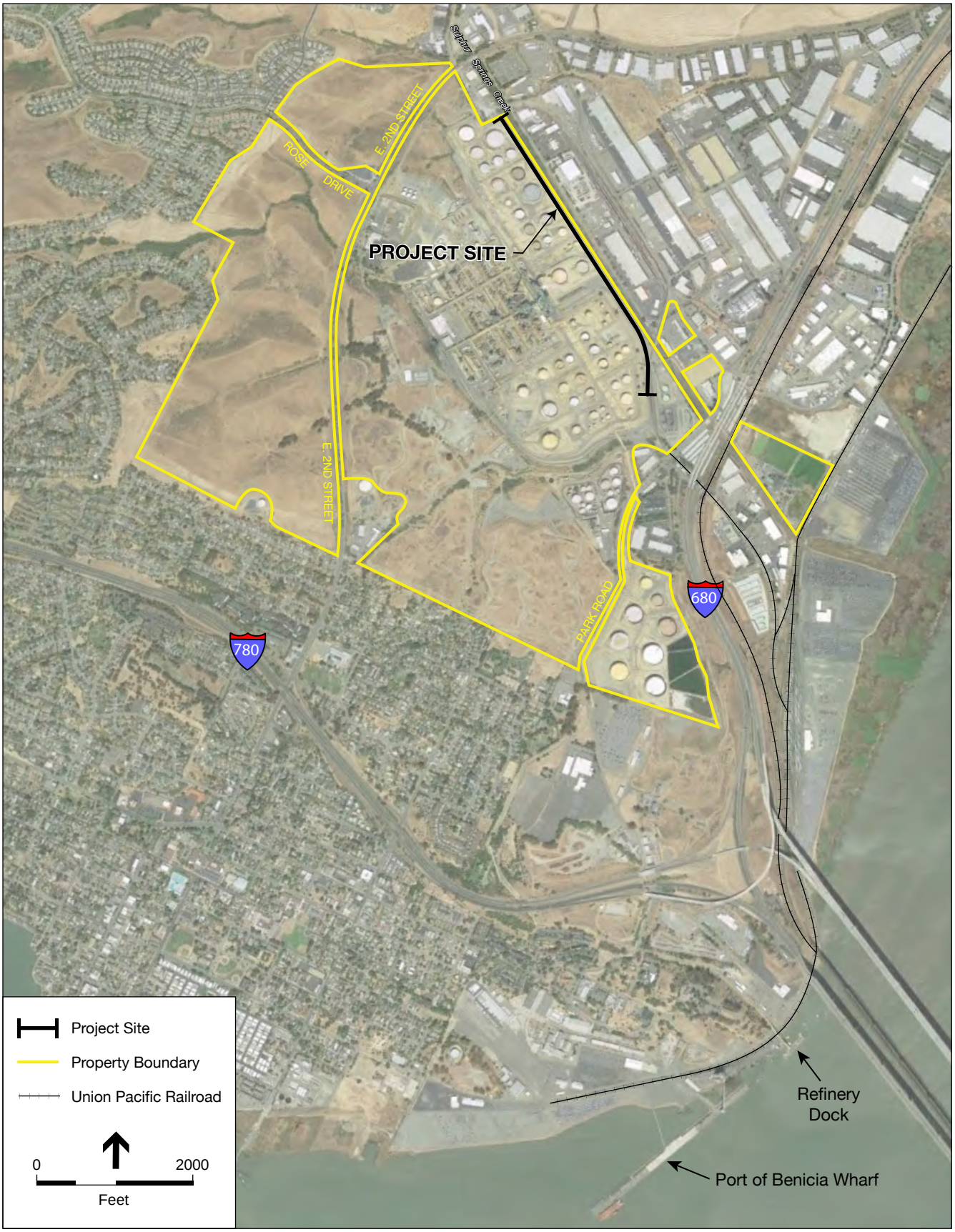


SOURCE: ESA

Benicia Valero CTR . 202115.01

Figure ES-1

Regional Location



SOURCE: Google Earth; ERM

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Figure ES-2
Valero Refinery Boundary

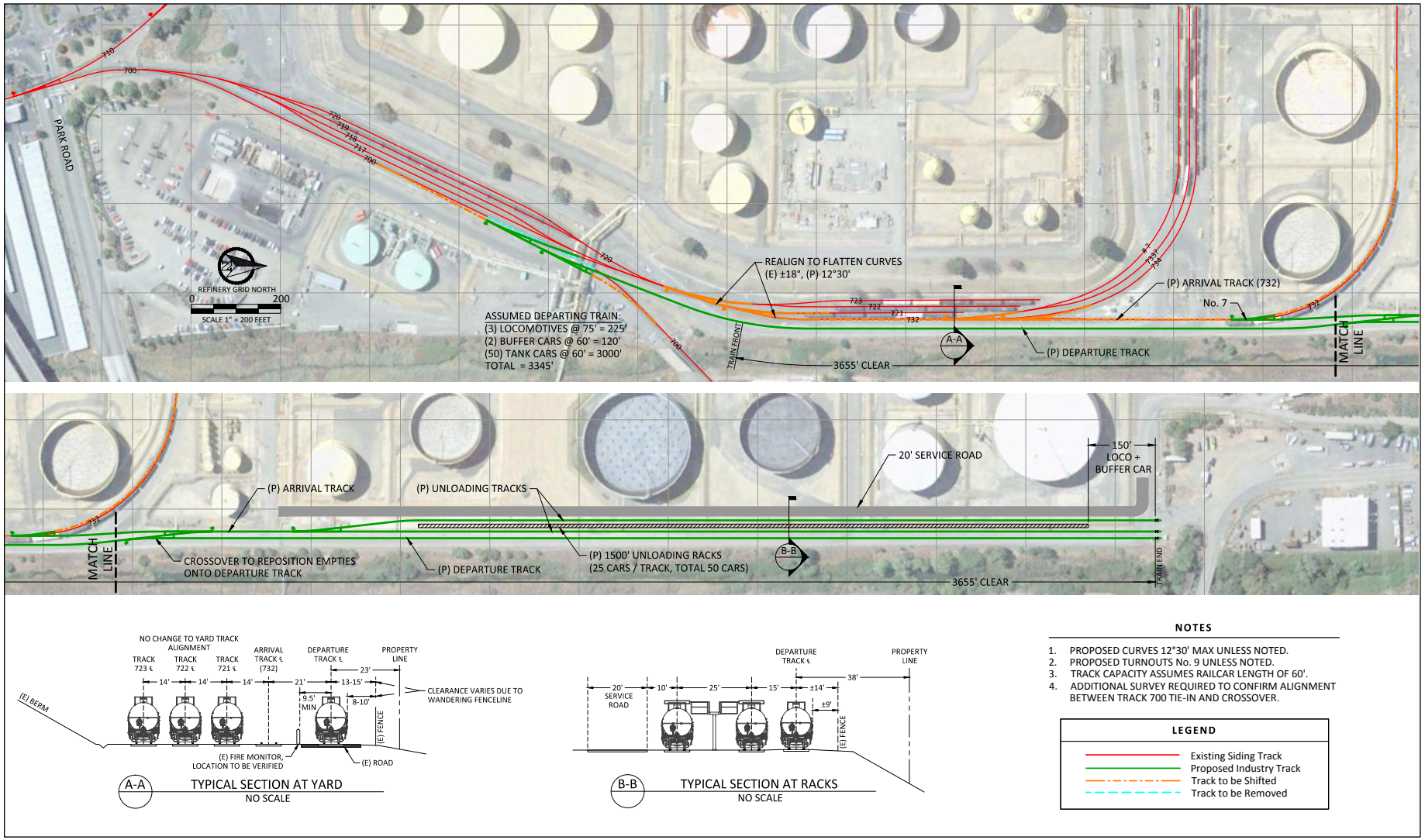
Key components of the Project are shown in Figure ES-3, *Site Plan*, and include:

- Installation of a new offloading rack capable of offloading two parallel rows of 25 crude oil rail cars (50 total cars per train). The rail unloading rack and track would be located on the west side of Sulphur Springs Creek.
- Removal of approximately 1,800 feet of the existing earthen liquid spill containment berm for the tanks abutting the tank car unloading facilities and constructing a new concrete berm approximately 12 feet west of the existing berm.
- Installation of one new 20-foot service road to be located adjacent to the western side of the proposed unloading rail spurs.
- Installation of approximately 4,000 feet of new 16-inch diameter aboveground crude oil pipeline and associated components and infrastructure to be installed between the proposed offloading racks and existing crude supply piping.
- Installation of approximately 8,880 track-feet of new track on Refinery property, including: 614 track-feet approaching the proposed unloading area, two offloading rail spurs (the western side of the unloading rack would include 2,216 track-feet; the eastern side of the unloading rack would include 2,275 track-feet), a parallel engine runaround track (2,262 track-feet), and a departure track on Refinery property to allow receipt of rail cars at the proposed offloading racks. The rail spurs and parallel engine runaround track would be constructed between the east side of the lower tank farm and Sulphur Springs Creek.
- Realignment of approximately 3,560 track-feet currently located on Refinery property.
- Relocation of an existing firewater pipeline, compressor station, and existing underground infrastructure to accommodate the new rail tracks.
- Relocation of existing groundwater monitoring wells from along Avenue "A" to a location between Sulphur Springs Creek and the proposed offloading rack.

The Project would not increase the amount of crude oil or the amounts of petroleum products that could be processed at the Refinery. The Project would not involve any changes to existing Refinery operations or process equipment, other than those summarized above and described in more detail in Chapter 3, *Project Description*. The Project would require no change to the Bay Area Air Quality Management District (BAAQMD) operating permit regarding the Refinery's crude oil processing rate and would not result in any change to the emissions limits set forth in the Refinery's current BAAQMD permits. See DEIR Section 1.10, *Permits and Approvals*, regarding the authorizations expected to be necessary in addition to a Use Permit from the City before the Project could proceed.

If the Project is approved as proposed, up to 70,000 barrels of crude oil would arrive at the Refinery each day by rail. The UPRR would transport the crude oil from a variety of potential North American sources to UPRR's J.R. Davis Yard in Roseville, California (the "Roseville Yard") in unit trains[2]

[2] Unit trains carry just one commodity, such as grain or crude oil. All of the cars in a unit train are shipped together from the same origin to the same destination.



SOURCE: Valero

Benicia Valero CBR . 202115.01

Figure ES-3

Site Plan

using existing rail lines. Unit trains would consist of 50 or up to 100 tank cars (Valero, 2013c). 100-tank car trains would be transported with four locomotives and two buffer cars;[3]50-tank car trains would be transported with two locomotives and two buffer cars. Two 50-car trains would be dispatched from the Roseville Yard to the Refinery each day. UPRR would own and operate the locomotive engines. Valero would own or lease the tank cars. Valero proposes to use non-jacketed Casualty Prevention Circular (CPC)-1232-compliant tank cars. See DEIR Section 3.4.1.3, *Tank Cars*, for more information.

2.1.5 DEIR ES-5, Alternatives

This EIR considers one No Project Alternative and three project alternatives. Each is summarized below.

2.1.5.1 No Project Alternative

Under the No Project alternative, the Project would not be constructed, which would prevent crude oil from being transported to the Refinery via tank car and have no effect on the Refinery's existing ability to process crude oil received via other existing, approved mechanisms such as by marine vessel or pipeline. The Refinery's existing facilities at the site of the proposed unloading racks and spurs would remain. Air emissions (both criteria pollutants and greenhouse gases) from marine vessels that transport crude oil into the Bay Area Air Basin would remain unchanged, because there would be no reduction in marine vessel trips to the Refinery. Valero would not be able to achieve most of its Project objectives.

2.1.5.2 Alternative 1: Limiting Project to One 50-Car Train Delivery per Day

Under this alternative the Project would operate with a 50% reduction in the proposed number of train deliveries to the Refinery per day. Deliveries would be limited to a maximum of one[4] 50-car train each day, containing a daily total of 35,000 barrels. This single train would be delivered during nighttime hours (between 8:00 p.m. and 5:00 a.m.) and once emptied, would depart the Refinery during nighttime hours and be returned to its origination point. All other aspects of this alternative would be the same as the Project. This alternative would not allow Valero to fully achieve the primary Project objectives 1 and 2, but would still fulfill Project objectives 3 through 5.

Any limitation on the volume of product shipped or the frequency, route, or configuration of such shipments is preempted under federal law. See Revised DEIR Appendix G. See also Valero's statement regarding preemption in Revised DEIR Appendix H. Thus, Alternative 1 is legally infeasible.

[3] Railroads use "buffer" cars primarily to comply with U.S. Department of Transportation (USDOT) regulations regarding separation of occupied equipment (i.e., locomotives) from hazardous materials cars. Buffer cars provide no transportation function.

[4] This means that one 50-car train would be delivered for unloading each day and after unloading the 50-car train would return to its origination point.

2.1.5.3 Alternative 2: Two 50-Car Trains Delivered during Nighttime Hours

Under this alternative, the Project would be required to schedule all Park Road train crossings during nighttime hours only (between 8:00 p.m. and 6:00 a.m.). As described in the DEIR, this could be accomplished through either a single 100-car train or sequencing two 50-car trains such that they are delivered and subsequently depart only during nighttime hours; however, it since has been determined that Valero cannot accept 100-cars at a time due to the constraints placed by UPRR and insufficient on-site capacity at the Refinery to handle 100 cars at once. All other aspects of this alternative would be the same as the Project. This alternative would allow Valero to achieve most of its Project objectives.

Any limitation on the timing of deliveries by train (independent of whether such trains would consist of 50 or 100 cars) is preempted under federal law. See Revised DEIR Appendix G. Thus, Alternative 2 is legally infeasible.

2.1.5.4 Alternative 3: Offsite Unloading Terminal

This alternative would consist of a separate, offsite facility where crude oil could be shipped by either marine vessel or rail, and then transferred to the Refinery by a new pipeline or truck. There are two variations to this alternative: 1) an offsite terminal would be developed and operated by Valero, and 2) an offsite terminal would be independently developed and operated by a third party.

The construction of new or modification of existing infrastructure could be required to receive crude oil at the offsite facility, transfer it to the Refinery, and/or integrate the new delivery method into the Refinery's existing infrastructure. Once a location and other necessary details about the offsite facility have been identified, subsequent site-specific CEQA review would be required for the facility and the pipeline or other method of conveyance necessary to receive it within the Refinery. This alternative would meet all objectives of the Project.

2.1.6 DEIR ES-6, Environmentally Superior Alternative

CEQA Guidelines Section 15126.6(e)(2) requires an EIR to identify an environmentally superior alternative. If the environmentally superior alternative is the No Project Alternative, the EIR also must identify an environmentally superior alternative from among the other alternatives. In general, the environmentally superior alternative is defined as that alternative with the least adverse impacts to the Project area and its surrounding environment. A comparison of potential impacts of the Project and alternatives is provided in Table ES-1, *Proposed Project v. Alternatives: Summary of Environmental Impact Conclusions.*

TABLE ES-1
PROPOSED PROJECT VS. ALTERNATIVES
SUMMARY OF ENVIRONMENTAL IMPACT CONCLUSIONS

Resource Area	Proposed Project	Limiting Project to One 50-Car Train Delivery per Day (Alternative 1)	Two 50-Car Trains Delivered during Nighttime Hours (Alternative 2)	Offsite Unloading Terminal (Alternative 3)	No Project Alternative
Air Quality	Impacts to air quality would be significant and unavoidable because the Project would contribute to an existing or projected air quality violation and result in a cumulatively considerable increase in ozone precursor emissions. **No Preference.**	Impacts to air quality would be greater than the Project because the decrease in emissions associated with 50% reduction in train trips would not offset marine vessel emissions. **Not Preferred.**	Impacts to air quality would be the same as the Project. **No Preference.**	Impacts to air quality would likely be similar to the Project, as emissions from train trips would be similar. **No Preference.**	Although criteria pollutant emissions would be greater than the Project, overall impacts to air quality would be less than the Project because significant and unavoidable impacts associated with train trips would not occur. **Most Preferred.**
Biological Resources	Impacts to biological resources would be less than significant or less than significant with mitigation, but could have secondary effects due to train derailment. **No Preference.**	Impacts to biological resources would be less than the Project due to reduced potential for a train derailment. **Slight Preference.**	Impacts to biological resources would slightly greater than the Project due to increased noise effects during nighttime hours. **Least Preference.**	Impacts to biological resources would likely be greater than the Project due to construction of additional Project infrastructure. **Not Preferred.**	Impacts to biological resources would be less than the Project because no construction would occur and no crude oil would be delivered by train. **Most Preferred.**
Cultural Resources	The Project would have no impact to cultural resources, but could have secondary effects due to train derailment. **No Preference.**	Impacts to cultural resources would be less than the Project due to reduced potential for train derailment. **Slight Preference.**	Impacts to cultural resources would be the same as the Project. **No Preference.**	Impacts to cultural resources would be the same as the Project. **No Preference.**	Secondary effects to cultural resources would be less than the Project because no crude oil would be delivered by train. **Most Preferred.**
Energy Conservation	Impacts to energy conservation would be less than significant or less than significant with mitigation. **No Preference.**	Impacts to energy conservation would be less due to the 50% reduction in train trips. **Most Preferred.**	Impacts to energy conservation would be the same as the Project. **No Preference.**	Impacts to energy conservation would likely be similar to the Project, depending on the distance between the terminal and Refinery. **No Preference.**	Although transport of crude by rail is less efficient than by marine vessel, the distances travelled by marine vessel may result in greater energy use. **No Preference.**

TABLE ES-1 (Continued)
PROPOSED PROJECT VS. ALTERNATIVES
SUMMARY OF ENVIRONMENTAL IMPACT CONCLUSIONS

Resource Area	Proposed Project	Limiting Project to One 50-Car Train Delivery per Day (Alternative 1)	Two 50-Car Trains Delivered during Nighttime Hours (Alternative 2)	Offsite Unloading Terminal (Alternative 3)	No Project Alternative
Geology and Soils	Impacts to geology and soils would be less than significant or less than significant with mitigation, but could have secondary effects from a seismic event resulting in a derailment and subsequent adverse effects to people and structures. **No Preference.**	Impacts to geology and soils would be less than the Project due to reduced potential for a train derailment. **Slight Preference.**	Impacts to geology and soils would be the same as the Project. **No Preference.**	Impacts to geology and soils would be the same as the Project. **No Preference.**	Impacts to geology and soils would be less than the Project because no construction would occur and no crude oil would be delivered by train. **Most Preferred.**
Greenhouse Gas Emissions	Impacts to greenhouse gas emissions would be significant and unavoidable because the Project would generate significant levels of GHG and conflict with plans adopted for reducing GHG emissions. **No Preference.**	Impacts to greenhouse gas emissions would be greater than the Project because the decrease in emissions associated with 50% reduction in train trips would not offset marine vessel emissions. **Not Preferred.**	Impacts to greenhouse gas emissions would be the same as the Project. **No Preference.**	Impacts to greenhouse gas emissions would likely be similar to the Project, as emissions from train trips would be similar. **No Preference.**	Impacts to greenhouse gas emissions would be greater than the Project because there would be no reduction associated with elimination of up to 82% of annual marine vessel trips. **Least Preferred.**
Hazards and Hazardous Materials	Most impacts regarding hazards would be less than significant or less than significant with mitigation. Potential train derailment would result in significant and unavoidable adverse effects to people and secondary effects to biological, cultural, and hydrological resources, and geology. **No Preference.**	Impacts regarding hazards would be less than the Project due to reduced potential for a train derailment. **Slight Preference.**	Impacts regarding hazards would be the same as the Project. **No Preference.**	Impacts regarding hazards would be the same as the Project. **No Preference.**	Impacts regarding hazards would be less than the project because no crude oil would be delivered by train. **Most Preferred.**
Hydrology and Water Quality	Impacts to hydrology would be less than significant or less than significant with mitigation, but could have secondary effects due to train derailment. **No Preference**	Impacts to hydrology would be less than the Project due to reduced potential for a train derailment. **Slight Preference.**	Impacts to hydrology would be the same as the Project. **No Preference**	Impacts to hydrology would likely be greater than the Project due to construction of additional Project infrastructure. **Not Preferred.**	Impacts to hydrology would be less than the Project because no construction would occur and no crude oil would be delivered by train. **Most Preferred.**

TABLE ES-1 (Continued)
PROPOSED PROJECT VS. ALTERNATIVES
SUMMARY OF ENVIRONMENTAL IMPACT CONCLUSIONS

Resource Area	Proposed Project	Limiting Project to One 50-Car Train Delivery per Day (Alternative 1)	Two 50-Car Trains Delivered during Nighttime Hours (Alternative 2)	Offsite Unloading Terminal (Alternative 3)	No Project Alternative
Land Use and Planning	Impacts to land use and planning would be less than significant. **No Preference.**	Impacts to land use and planning would be the same as the Project. **No Preference.**	Impacts to land use and planning would be the same as the Project. **No Preference.**	Impacts to land use and planning would be the same as the Project. **No Preference.**	Impacts to land use and planning would be the same as the Project. **No Preference.**
Noise	Impacts to noise would be less than significant. **No Preference.**	Impacts to noise would be less than the Project due to the 50% reduction in train trips. **Slight Preference.**	Impacts to noise would be greater than the Project due to increased train movement during nighttime hours. **Least Preferred.**	Impacts to noise could be greater than the Project, depending on the terminal location. **Not Preferred.**	Impacts to noise would be less than the Project because no construction would occur and no crude oil would be delivered by train. **Most Preferred.**
Transportation and Traffic	Impacts to transportation and traffic would be less than significant or less than significant with mitigation. **No Preference.**	Impacts to transportation and traffic would be less than the Project due to the 50% reduction in train trips and subsequent reduction in train crossings at Park Road. **Slight Preference.**	Impacts to transportation and traffic would be less than the Project because fewer vehicles would be affected by train crossings at Park Road. **Slight Preference.**	Impacts to transportation and traffic could be less than the Project, depending on the terminal location. **No Preference.**	Impacts to transportation and traffic would be less than the Project because no crude would be delivered by train. **Most Preferred.**

As explained in DEIR Section 6.4.2, Alternative 1 (reducing the Project to single 50-car train per day) is environmentally superior to the Project in a few respects. Alternative 1 would reduce the emission of criteria pollutants, toxic air emissions, and greenhouse gases from trains as compared with the Project, and avoid the Project's significant NO_x impact in the Sacramento Metropolitan Air Quality Management District (Sacramento Metro AQMD). As under the Project, Alternative 1 would have a significant NO_x impact within the Yolo-Solano, Tehama County, Butte County, Siskiyou County, Shasta County, Lassen County, Northern Sierra, Feather River, and Placer County air districts. Significant impacts to biological resources and hazards (including secondary effects related to biological resources, cultural resources, geology and soils, and hydrology) would be reduced compared to the Project because 50% fewer trains would deliver crude oil to the Refinery. This would reduce the probability that derailment of a Project-related train could occur. The potential adverse effects resulting from a subsequent spill and/or fire would remain significant. However, for the reasons described above, this alternative is legally infeasible because of federal preemption. See Revised DEIR Appendix G. Alternative 1 would also reduce the impacts of train crossings on traffic. Since the Project would not have a significant effect on traffic, however, Alternative 1 would not avoid any significant traffic effects.

The Project, however, is environmentally superior to Alternative 1 with respect to overall air quality. Alternative 1 would result in greater emissions of criteria pollutants, toxic air emissions, and greenhouse gases than the Project overall, because the decrease in emissions associated with a 50% reduction in train trips would not offset emissions of these same pollutants from marine vessels.

2.1.7 DEIR ES-7, Areas of Controversy and Issues to be Resolved

Areas of controversy known to lead agencies, including issues raised by agencies and the public, must be identified in the Executive Summary of an EIR (CEQA Guidelines §15123). Areas of controversy known to the City about this Project include the topics listed below. See also, for example, the Scoping Report provided as DEIR Appendix B.

- The geographic area of study considered for impact analysis of the Project and potential indirect impacts of the Project.
- The source of the Project's crude feedstocks, potential changes in the quality of the feedstocks, and potential impact on Refinery operations and/or emissions.
- Relationships between the Valero Improvement Project, a previous project at the Refinery, and the Project.
- Railroad hazardous material operational safety and tank car specification information.
- Cumulative impacts of the Project and other similar refinery or oil terminal projects within the State of California.

Issues to be resolved, including a choice among alternatives, and whether and how to mitigate potential significant impacts, also must be identified in an Executive Summary (CEQA

Guidelines §15123). The main issue to be resolved in this EIR is which among the alternatives would meet most of the basic Project objectives with the least environmental impact. Balancing sometimes competing environmental values can be challenging because it rests on assumptions of relative value. Decision-makers may elect to balance relative values of environmental resources and, thereby, resolve the issues considered in this EIR with a different conclusion than the one summarized in Section ES-6 and discussed in Section 6.4.4, *Environmentally Superior Alternative*.

2.1.8 DEIR ES-8, Summary of Impacts

2.1.8.1 Resource Areas Evaluated

This section summarizes the potential impacts of the Project or alternatives. The affected environment and the potential direct and indirect effects of the Project are described and evaluated in Chapter 4 of this EIR for the resource areas listed below. Other CEQA considerations, including the cumulative impact analysis, are in Chapter 5, and the alternatives analysis is in Chapter 6. Chapter 4 is organized into the following 11 environmental resource or issue areas:

4.1 Air Quality
4.2 Biological Resources
4.3 Cultural Resources
4.4 Energy Conservation
4.5 Geology and Soils
4.6 Greenhouse Gas Emissions
4.7 Hazards and Hazardous Materials
4.8 Hydrology and Water Quality
4.9 Land Use and Planning
4.10 Noise
4.11 Transportation and Traffic

A detailed analysis of each environmental topic, each potential impact and the mitigation measure(s) needed, if any, is contained in Chapter 4.

2.1.8.2 Summary of Impacts

Table ES-2, *Summary of Impacts and Mitigation Measures for the Valero Benicia Crude by Rail Project*, summarizes the impacts of the Project for each of the resource areas assessed in this EIR. As noted above, detailed analyses of direct and indirect effects are described in DEIR Chapter 4, *Environmental Setting, Impacts, and Mitigation Measures*; cumulative effects are analyzed and described in DEIR Section 5.4, *Cumulative Impacts*. No impacts were identified for:

- Cultural Resources

Where potentially significant impacts are identified, mitigation measures are proposed that could, if implemented, avoid or reduce the severity of the impact below established thresholds. Impacts were found to be less than significant or less than significant with mitigation implemented for:

- Energy Conservation
- Geology and Soils
- Hydrology and Water Quality
- Land Use and Planning
- Noise
- Transportation and Traffic

Implementing the Project would result in significant and unavoidable impacts for:

- Air Quality
- Biological Resources
- Greenhouse Gas Emissions
- Hazards and Hazardous Materials

Table ES-2 provides an overview of each impact identified in this Revised DEIR.

2.2 DEIR Chapter 1, Introduction

DEIR Chapter 1 (p. 1-1 et seq.), Introduction, includes Section 1.1, Purpose of this Document (p. 1-1); Section 1.2, Project Overview (p. 1-1 et seq.); Section 1.3, Project Background (p. 1-2 et seq.); Section 1.4, Key Areas of Environmental Concern (p. 1-3 et seq.); Section 1.5, Public Comment on the Draft EIR (p. 1-4); Section 1.6, Areas of Controversy (p. 1-4); Section 1.7, Confidential Business Information (p. 1-4 et seq.); Section 1.8, Organization of the Document (p. 1-6 et seq.), Section 1.9, Use of this Document by Agencies (p. 1-7); and Section 1.10, Permits and Approvals (p. 1-7). No changes to DEIR Chapter 1 are proposed except (as noted below) to Section 1.5 to reflect the existence of this Revised DEIR. Sections where no revisions are proposed are not repeated in this Revised DEIR.

2.2.1 DEIR Section 1.5, Public Comment on the DEIR and Revised DEIR ~~Draft EIR~~

The Draft EIR was ~~is being~~ circulated to state and local agencies and interested individuals for their ~~who may wish to~~ review and comments on the report~~. Written comments may be submitted to the City of Benicia~~ during an initial ~~the~~ 45-day public review period that began on June 17, 2014 and concluded on August 1, 2014. The City of Benicia Planning Commission decided at its July 10, 2014 public meeting to extend the public review period by 45 days to September 15, 2014. Written comments on the ~~this~~ Draft EIR were ~~will be~~ accepted via regular mail, fax, and e-mail and at ~~a~~ public meetings that were held before the City Planning Commission on July 10, August 14, and September 11, 2014 ~~will be noticed under separate cover~~.

The Revised DEIR is being circulated to government agencies and members of the public for a 45-day public review period that will begin as of the date a notice of its availability is filed with the State Clearinghouse. Notice also will be sent to the distribution list that the City has established for the Project and the document itself will be posted on the City's website. Written comments may be submitted to the City of Benicia during this period via regular mail, fax, and e-mail and at one or more public meetings that will be noticed under separate cover.

All comments received will be addressed in a Response to Comments document, which, together with the ~~this~~ Draft EIR and Revised DEIR, will constitute the Final EIR for the Project.

TABLE ES-2
SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR THE VALERO BENICIA CRUDE BY RAIL PROJECT

Environmental Impact	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Air Quality			
Impact 4.1-1: The Project could conflict with implementation of applicable air quality plans.	Potentially Significant	None available	Significant and Unavoidable
Impact 4.1-5: Operation of the Project could contribute to an existing or projected air quality violation uprail from the Roseville Yard.	Potentially Significant	None available	Significant and Unavoidable
Impact 4.1-6: The Project could expose sensitive receptors uprail from the Roseville Yard to substantial pollutant concentrations associated with locomotive emissions.	Less than Significant	None required	Less than Significant
Impact 4.1-7: The Project could result in cumulatively considerable net increases in ozone precursor emissions in uprail air districts.	Potentially Significant	None available	Significant and Unavoidable
Impact 4.1-8: The Project could generate objectionable odors affecting a substantial number of people along uprail routes	Less than Significant	None required	Less than Significant
Biological Resources			
Impact 4.2-10: The Project could have a substantial adverse effect on candidate, sensitive or special-status wildlife species or migratory birds, including injury or mortality resulting from collisions with trains along the North American freight rail lines as a result of increased frequency (high traffic volumes) of railcars.	Potentially Significant	None available	Significant and Unavoidable
Energy Conservation			
Impact 4.4-1a: Operation of the Project would result in the consumption of diesel fuel but the necessary amount would not be considered significant.	Less than Significant	None required	Less than Significant
Impact 4.4-1b: The Project could increase local or regional energy demand to move crude oil between the point(s) or origination and the Roseville Yard, but would not require additional energy supply capacity**.**	Less than Significant	None required	Less than Significant

TABLE ES-2 (Continued)
SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR THE VALERO BENICIA CRUDE BY RAIL PROJECT

Environmental Impact	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Greenhouse Gas Emissions			
Impact 4.6-1: The Project would generate direct and indirect GHG emissions.	Potentially ~~Less than~~ Significant	None available	Significant and Unavoidable
Impact 4.6-2: The Project would conflict with Executive Order S-3-05.	Potentially Significant	None available	Significant and Unavoidable
Hazards and Hazardous Materials			
Impact 4.7-2: The Project could pose significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.	Potentially ~~Less than~~ Significant	None ~~required~~ available	~~Less than~~ Significant and Unavoidable
Impact 4.7-6: Train derailments and unloading accidents that lead to hazardous materials spills, fires, and explosions could result in substantial adverse secondary effects, including to Biological Resources, Cultural Resources, Geology and Soils, and Hydrology and Water Quality.	Potentially Significant	None available	Significant and Unavoidable
Impact 4.7-~~8~~9: Operation of the Project could expose people or structures to significant risk, injury, or loss from wildland fires.	Potentially ~~Less than~~ Significant	None ~~required~~ available	~~Less than~~ Significant and Unavoidable
Noise			
Impact 4.10-1a: Operation of the Project could result in exposure of persons to noise levels in uprail communities, but such levels would not exceed applicable standards.	Less than Significant	None required	Less than Significant
Impact 4.10-2a: The transportation of Project-related crude uprail from the Roseville Yard would result in the generation of ground borne vibration or ground borne noise, but this vibration or noise would not be excessive.	No Impact	None required	No Impact

TABLE ES-2 (Continued)
SUMMARY OF IMPACTS AND MITIGATION MEASURES FOR THE VALERO BENICIA CRUDE BY RAIL PROJECT

Environmental Impact	Significance before Mitigation	Mitigation Measures	Significance after Mitigation
Noise (cont.)			
Impact 4.10-3a: The transportation of Project-related crude uprail from the Roseville Yard would result in an increase of the frequency of noise events in the vicinity of the train tracks above the frequency of such events existing without the project, but addition of one train per day would cause neither a substantial nor a permanent increase in ambient noise levels.	Less than Significant	None required	Less than Significant
Impact 4.10-4a: Operation of the Project would not result in a substantial temporary or periodic increase in ambient noise levels.	Less than Significant	None required	Less than Significant
Impact 4.10-5: Project-related transport of crude via the existing freight rail network would not expose people working within an airport land use plan area or within 2 miles of a public airport, public use airport, or a private airstrip to excessive noise levels.	Less than Significant	None required	Less than Significant
Transportation and Traffic			
Impact 4.11-6: The Project would not cause a substantial increase in average vehicle delay at train crossings uprail from Roseville.	Less than Significant	None required	Less than Significant
Impact 4.11-7: The Project would not decrease the performance of passenger trains.	Less than Significant	None required	Less than Significant

2.3 DEIR Chapter 2, Summary of Environmental Impacts

DEIR Chapter 2 (p. 2-1 et seq.), Summary of Environmental Impacts, includes a single introductory paragraph and Table 2-1, Summary of Impacts and Mitigation Measures for the Valero Benicia Crude by Rail Project. Although the table number is different, the title and substance of Table 2-1 is exactly the same as Table ES-2, Summary of Impacts and Mitigation Measures for the Valero Benicia Crude by Rail Project, which is provided above in Revised DEIR Section 2.3.1. No changes to DEIR Chapter 2 are proposed in addition to those identified in Table ES-2, above.

2.4 DEIR Chapter 3, Project Description

DEIR Chapter 3 (p. 3.1-1 et seq.), Project Description, includes Section 3.1, Project Overview and Location (p. 3-1 et seq.); Section 3.2, Project Objectives and Components (p. 3-5 et seq.); Section 3.3, the Existing Refinery (p. 3-7 et seq.); Section 3.4, Components of the Proposed Project (p. 3-17 et seq.); Section 3.5, Future Crude Oil Feedstock (p. 3-22 et seq.); Section 3.6, Project Construction (p. 3-25 et seq.); and Section 3.7, Federal Preemption (p. 3-26 et seq.). No changes to DEIR Chapter 3 are proposed except as noted below. Sections where no revisions are proposed are not repeated in this Revised DEIR.

2.4.1 DEIR Section 3.1.1.2, The Proposed Project

DEIR Section 3.1 (p. 3.1-1 et seq.), Project Overview and Location, includes Section 3.1, Introduction, and Section 3.2, Location. Section 3.1.1 introduces the Refinery (Section 3.1.1.1, p. 3-1) and the Project (Section 3.1.1.2, pp. 3-1, 3-2). Section 3.2 (p. 3-2) describes the location. Section 3.1.1.2 is revised to clarify how railcars would be received at the Refinery. No other changes to DEIR Section 3.1 are proposed in this Revised DEIR.

The Valero Crude by Rail project (Project) would enable the Refinery to receive up to 70,000 barrels per day of crude oil by tank car. The Project involves the installation of rail spur tracks, a tank car unloading rack, pumps, connecting pipelines, and infrastructure.

If the Project is approved, Valero will accept up to 100 tank cars of crude oil a day in two 50-car trains. The trains would enter the Refinery on an existing rail spur crossing Park Road. The crude oil unloaded from the tank cars would be pumped to the existing crude oil storage tanks in the Refinery via a new crude offloading pipeline, connected to existing piping located within the Refinery. The Project would require twenty additional employees or contractors. The trains would not be scheduled to arrive or depart between the hours of 6:00 AM – 9:00 AM or 4:00 PM – 6:00 PM weekdays. Valero would operate the Project components 24 hours per day, 7 days per week, and 365 days per year.

The crude oil delivered by rail would displace up to 70,000 barrels per day of the crude oil that is presently delivered by marine vessels. Crude oil delivered to the Refinery by tank car would not displace crude oil delivered to the Refinery by pipeline.

The crude oil to arrive by tank car would originate at sites in North America and be shipped by Union Pacific Railroad (UPRR). UPRR would transport tank cars from the points of origin in unit trains consisting of up to 100 tank cars (Valero, 2013c), four locomotives, and two buffer cars on a daily basis using existing rail lines from sources in North America to Roseville, California, from where the cars would be dispatched ~~assembled into a train for shipment in~~to the Refinery. Unit trains carry just one commodity, such as grain or crude oil. All of the cars in a unit train are shipped together from the same origin to the same destination. Alternatively, two trains per day of up to 50 tank cars each, with two locomotives and two buffer cars per train, would transport the crude to Roseville. Valero would own or lease the tank cars that would be used to transport crude oil. UPRR owns and operates the locomotive engines that would be used.

Implementing the proposed Project could reduce marine vessel delivery of crude oil by as much as 25,550,000 barrels in a 365 day year. Based on the three-year baseline period from December 10, 2009 to December 9, 2012 annual marine vessel deliveries could be reduced by as much as 82 percent.

The Project would not involve any changes to the existing Refinery operations or process equipment, other than the construction and operation of the Project components. The Project would not increase the amount of crude oil that can be processed at the refinery, or the amounts of petroleum products that can be produced. The Refinery's crude oil processing rate is limited to an annual average of 165,000 barrels per day (daily maximum of 180,000 barrels per day) by its Bay Area Air Quality Management District (BAAQMD) operating permit. The Project does not propose any change to this limit. The Project does not propose changes to the emissions limits in the current BAAQMD permits, although the Project does require approval of an Authority to Construct from the BAAQMD. In connection with this approval, the BAAQMD will consider ~~locomotive emissions and~~ tank car unloading emissions that would ~~as may~~ be caused by the Project.

2.4.2 Section 3.4.2.1, Tank Car Transport and Unloading

The description of Project operation, specifically the transport and unloading of tank cars, described in DEIR Section 3.4.2.1 (p. 3-20 et seq.) is supplemented to clarify potential train routes and the timing of deliveries. Exclusive federal jurisdiction over the regulation of some relevant railroad operations is noted.

The tank car unloading rack would accommodate up to 25 tank cars on each side at one time (up to two, 50 tank car "switches" per day would be transported to the rack by train). The tank cars would be emptied into a single pipeline located between the two rail spurs at slightly below ground level (see Figure 3-3). Each side of the rack would have 25 unloading stations, which would "bottom-unload" closed-dome tank cars using 4-inch-diameter hose, with dry disconnect couplings that would connect to a common header between the two sides of the rack (a check valve, connected to the top of each tank car via 2-inch-diameter hose would open to allow ambient air to enter during unloading and immediately close when unloading is finished). Three new pumps would be located on the western side of a new service road between Tanks 1720 and

1716. Two pumps operating in parallel would pump the crude oil from the unloading rack header via a new 16-inch pipeline. The third pump will be installed as a spare pump. This will facilitate periodic maintenance on the primary pumps. Once emptied, the 50 tank cars would be disconnected from the rack, moved to an on-site departure spur, and then replaced by another 50-rail-car switch.

A typical tank car handling scenario is described below:

1. Tank cars carrying crude oil destined for the Refinery arrive at ~~the~~ UPRR's J.R. Davis Yard in Roseville, California (the "Roseville Yard") ~~railyard~~ from a variety of potential North American crude sources including, but not limited to, locations in Texas, North Dakota, Oklahoma, New Mexico, or Canada (U.S. Energy Information Administration, 2015a, 2015b; see also, DEIR Appendix K).

2. UPRR-operated locomotives would move up to a 50 car unit train directly from the Roseville Yard ~~railyard~~ via UPRR mainlines to Benicia and then onto the Refinery unloading tracks on Refinery property, traveling at up to 50 miles per hour (mph) on the main line. When crossing Park Road at the Refinery property entrance, the trains would travel at approximately 5 mph.

3. Up to 25 tank cars would be positioned on the unloading tracks located on each side of the unloading rack. UPRR would leave its locomotives attached to each 25 tank car train.

4. UPRR would turn over operation of the trains to Valero for offloading.

5. A check valve would be installed onto each vent valve on the top of each tank car. The vent valve on the top of each tank car would be opened and the accompanying check valve would only allow fresh air into each tank car, and would prevent release of hydrocarbon fugitive emissions to the atmosphere. At each end car and on approximately every 8 tank cars in the 25 tank car string, a hose would be connected from the tank car's vent connection to a separate "equalization header." The equalization header would ensure the vapor spaces above the stored liquid crude in the tank cars is equalized between the tank cars. Individual drain hoses would be manually connected to the bottom of each tank car by on-site workers.

6. Valero would drain the contents of each tank car by gravity into a collection pipe (collection header) and then pump the contents directly into storage tankage located in the Refinery's crude oil storage tank field.

7. After the tank cars are emptied, the empty tank cars would be moved onto the departure spur on Refinery property adjacent to the unloading rack, where a train of up to 50 empty tank cars would be reassembled in preparation for transport off-site. Prior to departure, UPRR and Valero would conduct a safety inspection and ready the train for departure.

8. UPRR would transfer the empty 50 tank car train across Park Road and then east on the UPRR mainlines returning to the ~~UPRR's~~ Roseville Yard ~~railyard~~. UPRR would assemble up to a 100 empty tank car train and transfer it to accept new loads from the North American crude source.

UPRR owns and maintains a network of rail lines throughout California and the United States for the transport of crude (see Figure 1-2, *Union Pacific Crude Network*). This network includes the

main line between the Roseville Yard ~~railyard~~ and the Bay Area. ~~The~~ This main line is part of the Martinez subdivision.[5] UPRR operates freight trains on the line, and allows Capitol Corridor Joint Powers Authority (Capitol Corridor) and Amtrak passenger trains to operate on the line. ~~[¶]~~ Freight trains on the line include unit, manifest, and local trains. Unit trains carry just one commodity, such as grain or crude oil. All of the cars in a unit train are shipped together from the same origin to the same destination. Manifest trains are express trains that carry a variety of different commodities in cars with different origins and different destinations. Local trains make multiple stops at terminals along the line. All of the trains carrying crude oil to the Refinery would be unit trains travelling from an oil producing region to the Refinery. ~~[¶]~~ The passenger trains are scheduled to the minute. UPRR dispatches the passenger trains so as to meet these precise schedules. Freight trains do not typically run on regular schedules. In its normal course of operation, however, UPRR dispatches freight trains so as to avoid congestion that results in delayed deliveries.

If the Project were approved, Valero would ask UPRR to schedule Valero's unit trains so that none of them cross Park Road during the commute hours of 6:00 AM to 9:00 AM and 4:00 PM to 6:00 PM. UPRR has agreed to make all reasonable effort to comply with this request and, therefore, it is expected that Valero's unit trains will avoid crossing Park Road during the commute hours. UPRR ~~has demonstrated the ability to~~ regularly meets passenger train schedules -- the Capitol Corridor trains dispatched by UPRR are on time between 94% and 97% of the time (RailPAC, 2014; Amtrak 2015a; Amtrak 2015b). On the basis of past performance, ~~O~~ one can assume that UPRR could ~~will have little difficulty~~ schedule ~~ing~~ Project-related crude oil trains around a three hour window and a two hour window~~, given their success in meeting the much more precise one-minute schedules required by Capitol Corridor~~. Moreover, UPRR currently avoids dispatching freight trains during the commute hours in order to ensure that freight trains do not delay the Capitol Corridor passenger trains. Valero's requested schedule, therefore, is consistent with UPRR's existing practice for dispatching freight trains.

Valero would schedule delivery of one train between the nighttime hours 8:00 PM and 5:00 AM, and a second train in the daytime hours (except during the commute hours). It would take Valero approximately 12 hours to unload each train and prepare the empty train for the return trip to Roseville. Thus, two trains would cross Park Road during the evening hours, and two would cross Park Road during the daytime hours other than the hours of 6:00 AM to 9:00 AM and 4:00 PM to 6:00 PM. Acknowledging that, on the basis of federal preemption, neither Valero nor the City has authority to dictate or limit the frequency, route, or configuration of shipments selected by UPRR (see DEIR Section 3.7, Federal Preemption of Railroad Regulation, DEIR Appendix L, and Revised DEIR Appendix G), it is possible that Project-related crude oil could be delivered outside scheduled hours. The ~~[¶]~~ ~~O~~ operations noted in Steps 1 through 8 could occur at any time of day/7 days per week/365 days per year. ~~These operations would be dynamic and subject to change based on changing business conditions.~~

[5] Subdivisions are major components of regional and national rail networks, connecting major population centers and rail terminals (Caltrans, 2013a).

The proposed Project could result in the addition of approximately 20 new permanent refinery personnel (four crews of five), spread among different work shifts (two shifts per day) and on different days (four crews per week).

2.5 DEIR Section 4.0, Approach to the Analysis of Impacts

DEIR Section 4.0 (p. 4.0-1 et seq.), Approach to the Analysis of Impacts, provides an overview of relevant CEQA requirements (Section 4.0.1, p. 4.0-1 et seq.), identifies the contents of each of the resource sections and defines key terms (Section 4.0.2, p. 4.0-2 et seq.), directs reviewers to where in the document the analysis of cumulative effects and the analysis of effects of the alternatives may be found (Section 4.0.3, p. 4.0-3 et seq.), and describes the geographic scope of analysis (Section 4.0.4, p. 4.0-3 et seq.). In response to comments received on the DEIR, Section 4.0.4 is being revised as set forth below. No changes to DEIR Section 4 are proposed except as noted for Section 4.0.4.

2.5.1 DEIR Section 4.0.4, Geographic Scope of Analysis

CEQA requires the City to consider and discuss the Project's impacts on the environment, including any impacts of the Project that might be felt outside the Project area. Impacts felt outside the Project area, however, may be discussed in less detail if they are indirect and/or difficult to predict. The City is not required to speculate, and may limit its analysis to impacts that are reasonably foreseeable.

~~Some of the Project's potential impacts would be felt only within the Refinery complex, such as any geological impacts. Other impacts might, at least potentially, extend into the Refinery's immediate vicinity. Examples include impacts in the areas of aesthetics, biological resources, hydrology and water quality, land use and planning. Other Project impacts could, at least potentially, be felt beyond the Refinery's immediate vicinity. Examples include impacts in the areas of air quality, greenhouse gas emissions, hazards, and transportation.~~

As noted in Chapter 1, *Introduction*, and Chapter 3, *Project Description*, crude oil that would be delivered to the Refinery by the Project would be extracted from various sites within North America and transported in unit trains by UPRR on existing rail lines to UPRR's J.R. Davis Yard in Roseville, California (the "Roseville Yard").

As indicated in Section 1.7, *Confidential Business Information*, and Appendix D, *Discussion of Confidential Business Information*, Valero considers the specific North American crudes that would be shipped to the Refinery to be confidential under Public Resources Code §21160. Further, as indicated in DEIR Appendix L, *Union Pacific Railroad Statement re: Preemption*, and Revised DEIR Appendix G, *Preemption of CEQA by the ICCTA*, UPRR retains unfettered flexibility in selecting the routes that trains could travel from the crude oil origination sites to Roseville. As described in Revised DEIR Section 1.1, *Purpose of this Document*, it is theoretically possible, due to track sharing agreements (Caltrans, 2013a) for Project-related crude to be provided to the

Refinery via any of the North American freight railroad tracks, which are shown in Figure 1-1, *North American Freight Railroads*. However, it is more likely that UPRR's existing crude network (Figure 1-2, *Union Pacific Crude Network*) would be used to transport Project-related crude because the UPRR rail line already provides rail access for the Refinery and because Refinery personnel have indicated that UPRR would serve the Project (see, e.g., ERM, 2013).

Although UPRR has declined to describe the routes the tank cars would take before arriving at Roseville (Valero, 2014), the DEIR and this Revised DEIR assume based on information provided in application materials submitted by Refinery personnel (ERM, 2013) that all Project-related crude would be routed through Roseville using any or all of three routes along the existing UPRR rail system to the north and northeast of Roseville.[6] One of these potential routes approaches Roseville from the north via Oregon; two enter California northeast of Roseville from Nevada. See Figure 1-3, *Uprail Routes*, and Table 4.0-1, which summarizes distances between the Refinery and the California state line using these three routes.

- The route labeled "Oregon to Roseville" in Figure 1-3 enters California from Oregon approximately 15 miles southwest of Klamath Falls, Oregon and uses UPRR's Black Butte and Valley subdivisions. This route extends approximately 297 miles to the Roseville Yard and passes through Siskiyou, Shasta, Tehama, Butte, Sutter, Yuba, and Placer counties.
- The route labeled "Nevada to Roseville (northern)" in Figure 1-3 enters California approximately 50 miles north of where the Roseville subdivision crosses the state line, on the Winnemucca subdivision near Herlong. Trains using this route travel along the Canyon, Sacramento, and Valley subdivisions before reaching Roseville, approximately 229 miles from the Nevada border. This route passes through Lassen, Plumas, Butte, Yuba, and Placer counties.
- The route labeled "Nevada to Roseville (southern)" in Figure 1-3 uses UPRR's Roseville subdivision that crosses into California approximately 20 miles east of Truckee and extends approximately 119 miles from the state line to the Roseville Yard while passing through Sierra, Nevada, and Placer counties.

UPRR would transport tank cars to Roseville on a daily basis in unit trains consisting of up to 100 tank cars, four locomotives, and two buffer cars.[7] Alternatively, two trains per day of up to 50 tank cars each, with two locomotives and two buffer cars per train, could transport the crude to Roseville. From the Roseville Yard, UPRR would dispatch trains for shipment to the Refinery. The 50 tank car trains traveling from Roseville would continue approximately 69 miles to Benicia, passing through Placer, Sacramento, Yolo, and Solano counties. Trains would travel approximately 3 miles on a siding track from the main line in order to reach the Refinery, resulting in a total distance of 72 miles between Roseville and the Refinery.

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6 Acknowledging that, on the basis of federal preemption, neither the Refinery nor the City has authority to dictate or limit routes selected by UPRR (see Draft EIR Section 3.7, *Federal Preemption of Railroad Regulation*, Draft EIR Appendix L, and Revised DEIR Appendix G), it is possible that Project-related crude oil could reach the Refinery through Roseville using routes from southern California. However, based upon Valero's statement that trains would be dispatched to the Refinery in 50 tank car unit trains from Roseville, it is less likely that Project trains would use such an approach because they first would have to travel through Sacramento to Roseville, and then back through Sacramento to reach the Refinery.

7 Response to data request, November 26, 2013.

TABLE 4.0-1
POTENTIAL RAIL ROUTES TO REFINERY

Uprail Segment	Distance (miles)	Roseville to Benicia via UPRR Mainline	Siding Track to Refinery	Total Distance from State Line to Refinery
Oregon to Roseville, from the Oregon state line via the I-5 corridor	297	69	3	369
Nevada to Roseville (northern), from the Nevada state line to Roseville via Feather River Canyon	229	69	3	301
Nevada to Roseville (southern), from the Nevada state line to Roseville via Truckee	119	69	3	191

The analysis in this EIR considers the potential effects of the Project regardless of whether they could occur within the Refinery boundary, between the Refinery and the Roseville Yard, between the Roseville Yard and the State border via the three routes described above, via a southern route within California, or beyond the State line to the Project-related crude oil's point of origin. Potential effects of the Project within the Refinery boundary and from the Refinery to the Roseville Yard are addressed in the DEIR except as noted below. Uprail impacts, i.e., those potential impacts that may occur between the Roseville Yard to the State border and points beyond, are addressed in a new subsection within each resource discussion called "Uprail Impacts and Mitigation Measures." ~~in each environmental resource area below includes a discussion of any Project impacts that might be felt outside the Project area and/or outside the Project's immediate vicinity. Project impacts that are indirect and/or difficult to predict are discussed in less detail than direct impacts that can be predicted with reasonable certainty.~~

2.6 DEIR Section 4.1, Air Quality

DEIR Section 4.1 (p. 4.1-1 et seq.), Air Quality, identifies and evaluates issues related to the baseline balance between the rate and location of pollutant emissions and the meteorological conditions and topographic features that disperse those pollutants, and how such conditions could be affected by the Project. It describes the physical and regulatory setting in Section 4.1.2 (p. 4.1-1 et seq.), and the criteria used to evaluate the significance of potential impacts in Section 4.1.3 (p. 4.1-12). The evaluation of potential impacts is presented in Section 4.1.4 (p. 4.1-13 et seq.) and Section 4.1.5 (p. 4.1-14 et seq.). No changes are being made to DEIR Section 4.1 except as noted below.

In response to comments received on the DEIR, Section 4.1 is being supplemented to include a new Section 4.1.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues related to Air Quality uprail from the Roseville Yard to the State border and beyond and a new Section 4.1.7, Summary of Air Quality Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere. The description of the analytical methodology provided in DEIR Section 4.1.3.1 has been supplemented to explain

the approach taken in the analysis of potential uprail impacts. No changes to DEIR Section 4.1 are proposed in addition to those noted below.

2.6.1 DEIR Section 4.1.3.1, Analysis Methodology

Emission estimates for the Project presented in this section were prepared by Environmental Resource Management (ERM), a consultant of the Applicant, and independently reviewed by the City's consultant, Environmental Science Associates (ESA). Project-related construction and operation emissions within the BAAQMD were estimated and compared to significance thresholds recommended in the BAAQMD's *Revised Draft Options and Justification Report* (2009b). The justification report provides substantial evidence to support the recommended thresholds and, therefore, the City of Benicia has determined they are appropriate for use in this analysis. To analyze the long-term operational impact of the Project, the estimated operational emissions for the Project that would be generated within the Bay Area Basin were evaluated relative to the annual average Project baseline emissions (see Section 4.1.2.6, *Project Baseline*). The total Project-related net change in emissions within the Bay Area Basin is then compared to the BAAQMD significance thresholds to determine the significance of the impacts. The details of data, calculations, and assumptions used to determine Project-related emissions and associated public health risks that would be caused by the Project are included in Appendix E of the DEIR and Appendices A through D of the Revised DEIR.

The analysis herein focuses on air quality impacts of Refinery-specific and rail emissions within the Bay Area Basin ~~jurisdiction of the BAAQMD~~ and ~~to a lesser extent~~ within the ~~jurisdictions of air districts in the~~ following air basins, which ~~that~~ would be affected by rail emissions: Sacramento Valley ~~Air Basin~~(Sacramento Basin), Mountain Counties, and Northeast Plateau. ~~that would be effected by rail emissions, including the Yolo-Solano Air Quality Management District (YSAQMD), the Sacramento Metropolitan Air Quality Management District (SMAQMD), and the Placer County Air Pollution Control District (PCAPCD). While the Project may have some air quality impacts outside these air district jurisdiction boundaries, these impacts are indirect and difficult to predict given the speculative nature of the exact rail routes that would be used to transport the crude oil to the Union Pacific's J.R. Davis Yard in Roseville (Roseville Yard), and are discussed in more general terms.~~

For impacts within the BAAQMD, the analysis follows the BAAQMD's 2012 "California Environmental Quality Act Air Quality Guidelines."

Project-related air quality impacts within ~~the Sacramento~~ California, but outside of the Bay Area Basin, are addressed by air district boundary based on guidance provided by Yolo-Solano ~~YS~~ Air Quality Management District (AQMD) in "Handbook for Assessing and Mitigating Air Quality Impacts" (YSAQMD, 2007), Sacramento Metropolitan ~~SM~~AQMD in "CEQA Guide December 2009" (SMAQMD, 2014), ~~and~~Placer County ~~PC~~ Air Pollution Control District (APCD) in "CEQA Air Quality Handbook" (PCAPCD, 2012), Tehama County APCD in "Air Quality Planning & Permitting Handbook: Guidelines for Assessing Air Quality Impacts" (TCAPCD, 2015), Butte County APCD in "CEQA Air Quality Handbook: Guidelines for Assessing Air

Quality and Greenhouse Gas Impacts for Project Subject to CEQA Review" (BCAQMD, 2014), and Feather River AQMD in "Indirect Source Review Guidelines: A Technical Guide to Assess the Air Quality Impact of Land Use Project" (FRAQMD, 2010).

2.6.2 DEIR Section 4.1.6, Uprail Impacts and Mitigation Measures

Together with the DEIR, this Revised DEIR analyzes emissions from Project-related locomotives traveling along the established rail network between the Refinery, the Roseville Yard, the State border, and (more generally) to the point(s) of the crude oil's origination. Within the State, emissions would be generated in the Bay Area Basin, the Sacramento Basin, and basins under the jurisdiction of the Placer County APCD, Yolo-Solano AQMD, Tehama County APCD, Butte County APCD, Feather River AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, and Northern Sierra AQMD.[8]

Impact 4.1-1: The Project could conflict with implementation of applicable air quality plans. (*Significant and Unavoidable*)

[As noted in the DEIR Section 4.1.4, the Project would not conflict with the air quality plan for the San Francisco Bay Area. The revisions provided below pertain to air quality plans in other air districts that Project-related trains would travel through between the Refinery and the State line.]

Because the crude by rail trains would cross other air districts between Benicia and the ~~Roseville rail yards~~ California border, indirect emissions from Project-related locomotives were analyzed in the Yolo-Solano ~~YS~~AQMD, Sacramento Metropolitan ~~SM~~AQMD, ~~and~~ Placer County APCD, Tehama County APCD, Butte County APCD, Feather River AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, and Northern Sierra AQMD. As is discussed in Section 4.1.5 b), significant impacts for NO_x emissions from these locomotives were identified for ~~both the YSAQMD and SMAQMD~~ each of these air districts. Consequently, the Project would conflict with each of these air districts' applicable air quality plans. See Impacts 4.1-1b and 4.1-5 for additional information.

Impact 4.1-3: The Project could expose sensitive receptors to substantial pollutant concentrations. (*Less than Significant*)

The BAAQMD recommends that lead agencies assess the incremental toxic air contaminant (TAC) exposure risk to all sensitive receptors within 1,000 feet of a project. Construction of the Project would generate diesel particulate matter (DPM), which is considered to be a TAC, from the use of diesel off-road equipment. For short-term construction emissions, the BAAQMD recommends that construction health risks be evaluated if there are sensitive receptors located within 1,000 feet of the construction site. All project-related construction sources would be temporary (i.e., 25 weeks) and

[8] The northeastern part of Roseville Yard is in western Placer County and the southwestern part of the yard is in northern Sacramento County.

would be over 2,000 feet from the nearest sensitive land uses, which are residences off Lansing Circle. Therefore, Project construction would not result in a significant health risk.

Long-term operations associated with the Project would generate TAC emissions including benzene, ethylbenzene, toluene, xylenes, hexane, and hydrogen sulfide from fugitive equipment leaks (rectangular area sources), DPM from locomotive idling (point sources), locomotive transit (line ~~of~~ or volume sources), and locomotive switching (line ~~of~~ or volume sources). The Applicant-provided detailed health risk assessment analysis for these TAC emissions and sources is summarized in Table 4.1-9. In addition to the assessment of health risks from toxics, $PM_{2.5}$, which comprises the majority of DPM, was modeled to evaluate the potential for elevated concentrations from the locomotives.

Locomotive emissions during transit were modeled over a track length of 4 miles out from the proposed unloading rack. The modeling domain around the Refinery was extended out to approximately 4 miles because this is the distance beyond where there would be minimal impacts from equipment fugitive emissions and train idling emissions. There are no residences in the immediate vicinity of the 4 miles of modeled train route, as residences in Benicia are located more than 1,000 feet away from the locomotive activity; however, in the City of Fairfield there are residences as close as approximately 50 feet from the train route. Additional modeling was conducted to evaluate the exposure from train travel to these residential receptors. In addition, Armijo High School is adjacent to the train tracks in Fairfield; a receptor was modeled there as well. The results of the modeling (Table 4.1-9 below) show that one of these residences, just ~~south~~ northwest of the railroad tracks and ~~of~~ Railroad Avenue, is the Maximum Exposed Individual Residential (MEIR).

Locomotive switching emissions were modeled over a distance equivalent to approximately two train lengths (i.e., 3,300 feet) from the unloading rack. Because the portion of the track within the Refinery would be used for both switching and transit, emissions from the two activities were added and assigned to the common volume sources. Five years of BAAQMD meteorological data from the “Valero Admin” meteorological site and digital elevation model files were reviewed to identify elevations for sources, receptors, and buildings/structures were used for the analysis in Benicia. The modeling analysis conducted to model the locomotives that would travel through Fairfield incorporated a string of volume sources the length of a 50-car train. Residences in Benicia near the Refinery are much farther away from the railroad compared to the residences in Fairfield; therefore, the MEIR was modeled in Fairfield using a five-year meteorological dataset from ~~the Suisun Sewage Treatment Plant, adjacent to Fairfield~~ former Nut Tree Restaurant located in Vacaville. Risk was directly modeled using the ~~ISCST3~~ AERMOD dispersion model and Office of Environmental Health Hazard Assessment unit risk factors for cancer risk and reference exposure levels for non-cancer health effects, as the exposure pathway for all the toxic air contaminants emitted from the sources is inhalation only (ERM, 2015a). The above methodology is described in detail in Appendix E.6.

TABLE 4.1-9
MAXIMUM CANCER AND NONCANCER RISK IN THE BAY AREA BASIN

Receptor Type	Cancer Risk per Million (Receptor Location)	Chronic Hazard Index (Receptor Location)	Acute Hazard Index (Receptor Location)	$PM_{2.5}$ Concentration (µg/m^3) (Receptor Location)
Maximum Exposed Individual Receptor (MEIR)	4.0 ~~7.99~~ Worst case risk at 90 ~~160~~ feet southeast ~~northwest~~ of train tracks in Fairfield (585145E, 4234384N) ~~(585058E, 4234218N)~~	0.004 ~~0.0003~~ Worst case risk at 90 ~~160~~ feet southeast ~~northwest~~ of train tracks in Fairfield (585145E, 4234384N) ~~(585058E, 4234218N)~~)	0.0024 ~~0.0030~~ Near E. 6th ~~5th~~ Street, Benicia (575444E,4212595N) ~~(575694E, 4212345N)~~	0.004 ~~0.0157~~ Worst case risk at 90 ~~160~~ feet southeast ~~northwest~~ of train tracks in Fairfield (585145E, 4234384N) ~~(585058E, 4234218N)~~))
Maximum Exposed Individual Worker (MEIW)	7.4 (576144E, 4213045N) ~~4.45~~ ~~(576144E, 4214145N)~~	0.014 (576044E, 4214195N) ~~(576144E, 4214145N)~~	0.048 (576144E, 4213045N) ~~0.0113~~ ~~(576094E, 4212895N)~~	0.075 (576144E, 4213045N) ~~N/A~~
Maximum Sensitive Receptor (MSR)	0.25 ~~0.28~~ Day Care Center (574594E, 4212895N)	0.0003 ~~0.0005~~ Elementary School (574900E, 4212500N) ~~Day Care Center~~ ~~(574594E, 4212895N)~~	0.001 ~~0.0004~~ Elementary School (574900E, 4212500N)	0.001 ~~0.00244~~ Elementary School (574900E, 4212500N) ~~Day Care Center~~ ~~(574594E, 4212895N)~~
Significance Threshold	10	1	1	0.3 ug/m^3
Significant Impact?	No	No	No	No

SOURCE: ERM. 2015a.

The dose to which receptors are exposed is the primary factor affecting health risk from exposure to TACs. Dose is a function of the concentration of a substance or substances in the environment and the duration of exposure to the substance. MEIR cancer risk was calculated ~~is modeled for~~ using a 70-year exposure period and the OEHHA guidelines (OEHHA, 2015) ~~multiplied by the BAAQMD recommended age specific factor of 1.7~~. The maximum exposed individual worker (MEIW) was modeled using a 70~~40~~-year exposure at 250 days per year ~~residential cancer risk multiplied by an adjustment factor of 0.2199 to convert from residential risk to worker cancer risk. The maximum sensitive receptor (MSR) risk is the modeled 70 year residential risk multiplied by 9 years times the age specific factor of 3 and divided by 70 years~~. As shown in Table 4.1-9, the cancer risks at the MEIR, MEIW, and MSR are below 10 in a million. The chronic hazard index and the acute hazard index at the MEIR, MEIW, and MSR are also well below 1.0. In addition, the modeled $PM_{2.5}$ concentrations at the MEIR and MSR are well below 0.3 ug/m^3. Therefore, the impact related to exposing sensitive receptors in the Bay Area Basin to substantial pollutant concentrations would be less than significant.

A modeling assessment of risk and $PM_{2.5}$ concentrations in the Sacramento Basin near tracks along the route to and from Roseville was also conducted for residential receptors in the YSAQMD, SMAQMD, and PCAPCD. The results of the analysis are shown in Table 4.1-10, below. The analysis methodology is identical to that described for the Fairfield receptors above,

except different meteorological data sets were used. For Dixon, meteorological data from Davis was used. Data from the Sacramento Executive Airport was used for the modeling ~~analysis~~ in Sacramento and Roseville. ~~Data from this station are more representative of the Sacramento Basin than that used for Benicia or Fairfield.~~ As indicated in Table 4.1-10, the impacts associated with Project-related incremental risk and $PM_{2.5}$ concentrations relative to locomotive emissions at residences in these air districts would less than significant.

TABLE 4.1-10
MAXIMUM CANCER AND NONCANCER RISK IN THE SACRAMENTO BASIN

Location of Estimated Health Impact	Cancer Risk (per million)	Chronic Hazard Index	Acute Hazard Index[1]	$PM_{2.5}$ Concentration ($\mu g/m^3$)
Yolo-Solano Air Quality Management District (Dixon) (602805E, 4256360N) ~~603050 E, 4256574 N~~	2.2 ~~3.9~~	0.0004 ~~0.002~~	N/A	0.002 ~~0.008~~
Sacramento Metropolitan Air Quality Management District (Sacramento) (642944E, 4283022N) ~~643028 E, 4283130 N~~	3.2 ~~4.4~~	0.0006 ~~0.002~~	N/A	0.0031 ~~0.009~~
Placer County Air Pollution Control District (Roseville) (648208E, 4289991N) ~~648387 E, 4290123 N~~	3.2 ~~4.6~~	0.0006 ~~0.002~~	N/A	0.0031 ~~0.008~~
Significance Threshold	10	1	N/A	0.3 ug/m^3
Significant Impact?	No	No	N/A	No

[1] For locomotive travel, the only TAC of concern is diesel particulate matter, which does not have an acute health effect.

SOURCE: ERM. 2015a.

Impact 4.1-5: Operation of the Project could contribute to an existing or projected air quality violation uprail from the Roseville Yard. (*Significant and Unavoidable*)

This air quality assessment evaluates the potential air quality impacts of transporting crude oil along each of the three rail routes from the California border to the Roseville Yard, as described in Section 4.0.4, *Geographic Scope of Analysis*. The three routes include: Oregon to Roseville, Nevada to Roseville (northern), and Nevada to Roseville (southern) (see Figure 1-3 for an illustration of the routes). Each of the three routes cross multiple air districts that would be affected by the proposed rail transport of crude oil. The affected air districts include:

- Siskiyou County APCD
- Shasta County AQMD
- Tehama County APCD
- Butte County AQMD
- Feather River AQMD
- Lassen County APCD
- Northern Sierra AQMD
- Placer County APCD
- Sacramento Metropolitan AQMD

Unlike the BAAQMD, there are no marine vessel baseline emissions within these air district jurisdictions that would be displaced by the locomotive emissions. Therefore, Project-related

increases in locomotive exhaust emissions and fugitive emissions from tank cars would result in a net increase of air pollutant emissions within the air districts along the three routes.

The methodology used to estimate uprail air pollutant emissions that would be generated by the Project is similar to the methodology used to estimate emissions disclosed in Appendix E of the DEIR. Locomotive exhaust and fugitive emissions from tank cars were estimated using pounds of pollutant per mile travelled emissions factors (see Appendix A of the Revised DEIR). Therefore, the daily distance travelled within each of the air districts is directly proportional to the daily emissions that would be generated within each of the applicable air districts. Because train routing is under the control of UPRR and can vary from day to day, it is not possible to identify a sole railroad route that would be used by Project-related trains. Given the uncertainty of the actual rail route or routes that would be used to transport Project-related crude, this analysis conservatively evaluates emissions relative to three scenarios whereby Project-related trains would travel exclusively along one of the three routes to the California state line. Therefore, the maximum level of emissions that could be generated by Project-related trains within any air district along any of the three routes is calculated.

Project-related rail traffic is assumed to consist of 100 tank cars, four locomotives, and two buffer cars per train. The assumed train schedule used in this analysis consists of one train traveling to and from the Roseville Yard each day. Table 4.1-11 provides the estimated distances traveled within each air district jurisdiction along each rail route. For a conservative analysis, the distances travelled in Placer County APCD and Sacramento Metropolitan AQMD reflect the total distances that would be travelled within those jurisdictions, not just the distances travelled within and uprail of the Roseville Yard. Following the table are emissions summary estimates and associated impact discussions for each of the three route scenarios.

TABLE 4.1-11
MILES TRAVELED WITHIN AIR DISTRICTS FROM ROSEVILLE TO STATE LINE

Air District	Oregon to Roseville	Nevada to Roseville (northern)	Nevada to Roseville (southern)
Siskiyou County APCD	89	N/A	N/A
Shasta County AQMD	78	N/A	N/A
Tehama County APCD	40	N/A	N/A
Butte County AQMD	44	53	N/A
Feather River AQMD	26	25	N/A
Placer County APCD*	25	25	93
Sacramento Metropolitan AQMD*	16	16	16
Lassen County APCD	N/A	36	N/A
Northern Sierra AQMD	N/A	95	31
Total Distance	**318**	**250**	**140**

* The distances for Placer County APCD and Sacramento Metropolitan AQMD include total mileage within those jurisdictions.

N/A – Not applicable because Project-related trains would not travel through this air district on this route.

SOURCE: ESA, 2015

Oregon to Roseville Route

Project-related trains travelling along the Oregon to Roseville route would result in the generation of emissions in seven air districts: Siskiyou County, Shasta County, Tehama County, Butte County, Feather River, Placer County, and Sacramento Metropolitan. With the exception of Siskiyou County and Shasta County, these air districts have developed CEQA significance thresholds to identify air pollutant emission levels generated within their jurisdictions that could result in, or contribute to, an exceedance of an air quality standard (TCAPCD, 2015; BCAQMD, 2014; FRAQMD, 2010; PCAPCD, 2012; and SMAQMD, 2014). To evaluate the significance of emissions that would be generated within Siskiyou County and Shasta County, the most stringent thresholds adopted by other air districts along the route (i.e., Tehama County, Butte County, and Feather River) were used. Table 4.1-12 presents the estimated maximum air pollutant emissions for ROG, NO_x, CO, SO_x, PM_{10}, and $PM_{2.5}$ that would be generated within each air district under this route scenario and compares those emissions to the applicable significance thresholds.

As shown in Table 4.1-12, emissions of criteria pollutants associated with Project-related trains travelling along the Oregon to Roseville route would not exceed significance thresholds, with the exception of NO_x. NO_x emissions generated by Project-related rail traffic along this route would exceed the significance thresholds in each of the seven air districts. Consequently, Project-related train traffic along this route would result in a significant impact related to the generation of ozone precursor (i.e., NO_x) emissions.

Nevada to Roseville (northern) Route

Project-related trains travelling along the Nevada to Roseville (northern) route would result in the generation of emissions in six air districts: Butte County, Feather River, Lassen County, Northern Sierra, Placer County, and Sacramento Metropolitan. With the exception of Lassen County and Northern Sierra, these air districts have developed CEQA significance thresholds to identify air pollutant emission levels generated within their jurisdictions that could result in, or contribute to, an exceedance of an air quality standard (BCAQMD, 2014; FRAQMD, 2010; PCAPCD, 2012, and SMAQMD, 2014). To evaluate the significance of emissions that would be generated within Lassen County and Northern Sierra, the most stringent thresholds adopted by other air districts along the route (i.e., Butte County and Feather River) were used. Table 4.1-13 presents the estimated maximum air pollutant emissions that would be generated within each air district and compares those emissions to the applicable significance thresholds.

As shown in Table 4.1-13, emissions of criteria pollutants associated with Project-related trains travelling along the Nevada to Roseville (northern) route would not exceed significance thresholds, with the exception of for NO_x. NO_x emissions generated by Project-related rail traffic along this route would exceed the significance thresholds in each of the six air districts. Consequently, train traffic along this route would result in a significant impact related to the generation of ozone precursor (i.e., NO_x) emissions.

TABLE 4.1-12
PROJECT-RELATED CRITERIA POLLUTANT EMISSIONS – OREGON TO ROSEVILLE ROUTE

	Emissions (pounds/day)					
	ROG	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$
Siskiyou County APCD						
Train Emissions	23.5	474.8	93.5	0.3	12.7	12.3
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Shasta County AQMD						
Train Emissions	20.6	416.1	82.0	0.3	11.1	10.8
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Tehama County APCD						
Train Emissions	10.5	213.4	42.0	0.2	5.7	5.5
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Butte County AQMD						
Train Emissions	11.6	234.7	46.2	0.2	6.3	6.1
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Feather River AQMD						
Train Emissions	6.9	138.7	27.3	0.1	3.7	3.6
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Placer County APCD						
Train Emissions*	8.7	164.6	29.4	0.1	4.2	4.1
Threshold of Significance	82	82	None	None	82	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Sacramento Metropolitan AQMD						
Train Emissions**	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance	65	65	None	None	None	None
Exceed Threshold?	No	**Yes**	---	---	--	---

* Emissions identified within Placer County APCD include locomotive exhaust and tank car fugitive emissions uprail of the Roseville Yard and emissions from switching activities at the yard.

** Although only a portion of the Roseville Yard (i.e., approximately 1 mile) is within the Sacramento Metropolitan AQMD, the emissions estimates include locomotive exhaust and tank car fugitive emissions that would be generated within the entire jurisdiction of the Sacramento Metropolitan AQMD.

SOURCE: ESA, 2015.

TABLE 4.1-13
PROJECT-RELATED CRITERIA POLLUTANT EMISSIONS
NEVADA TO ROSEVILLE (NORTHERN) ROUTE

	Emissions (pounds/day)					
	ROG	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$
Butte County AQMD						
Train Emissions	14.0	282.8	55.7	0.2	7.5	7.3
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Feather River AQMD						
Train Emissions	6.6	133.4	26.3	0.1	3.6	3.5
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Lassen County APCD						
Train Emissions	9.5	192.1	37.8	0.1	5.1	5.0
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Northern Sierra AQMD						
Train Emissions	25.0	506.8	99.8	0.4	13.5	13.1
Threshold of Significance	25	25	None	None	80	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Placer County APCD						
Train Emissions*	8.7	164.6	29.4	0.1	4.2	4.1
Threshold of Significance	82	82	None	None	82	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Sacramento Metropolitan AQMD						
Train Emissions**	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance	65	65	None	None	None	None
Exceed Threshold?	No	**Yes**	---	---	---	---

* Emissions identified within Placer County APCD include locomotive exhaust and tank car fugitive emissions uprail of the Roseville Yard and emissions from switching activities at the yard.
** Although only a portion of the Roseville Yard (i.e., approximately 1 mile) is within the Sacramento Metropolitan AQMD, the emissions estimates include locomotive exhaust and tank car fugitive emissions that would be generated within the entire jurisdiction of the Sacramento Metropolitan AQMD.

SOURCE: ESA, 2015.

Nevada to Roseville (southern) Route

Project-related trains travelling along the Nevada to Roseville (southern) route would result in the generation of emissions in three air districts: Northern Sierra, Placer County, and Sacramento Metropolitan. Placer County and Sacramento Metropolitan have adopted CEQA significance thresholds to identify air pollutant emission levels generated within their jurisdictions that could result in, or contribute to, an exceedance of an air quality standard (PCAPCD, 2012 and SMAQMD, 2014). Northern Sierra does not have adopted significance thresholds; therefore, to

assess the significance of emissions generated within this jurisdiction, the emissions are compared to the Placer County APCD significance thresholds, which are the most stringent thresholds of the other two districts along the route. Table 4.1-14 presents the estimated maximum air pollutant emissions that would be generated within each of the air districts and compares those emissions to the applicable significance thresholds.

TABLE 4.1-14
PROJECT-RELATED CRITERIA POLLUTANT EMISSIONS
NEVADA TO ROSEVILLE (SOUTHERN) ROUTE

	Emissions (pounds/day)					
	ROG	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Northern Sierra AQMD						
Train Emissions	8.2	165.4	32.6	0.1	4.4	4.3
Threshold of Significance	65	65	None	None	82	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Placer County APCD						
Train Emissions*	26.6	527.4	100.8	0.4	13.9	13.5
Threshold of Significance	82	82	None	None	82	None
Exceed Threshold?	No	**Yes**	---	---	No	---
Sacramento Metropolitan AQMD						
Train Emissions**	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance	65	65	None	None	None	None
Exceed Threshold?	No	**Yes**	---	---	---	---

* Emissions identified within Placer County APCD include locomotive exhaust and tank car fugitive emissions uprail of the Roseville Yard and emissions from switching activities at the yard.
** Although only a portion of the Roseville Yard (i.e., approximately 1 mile) is within the Sacramento Metropolitan AQMD, the emissions estimates include locomotive exhaust and tank car fugitive emissions that would be generated within the entire jurisdiction of the Sacramento Metropolitan AQMD.

SOURCE: ESA, 2015

As shown in Table 4.1-14, emissions of criteria pollutants associated with Project-related trains travelling along the Nevada to Roseville (southern) route would not exceed significance thresholds, with the exception of for NO_x. NO_x emissions generated by Project-related rail traffic along this route would exceed the significance thresholds in all three jurisdictions. Consequently, Project-related train traffic along this route would result in a significant impact related to the generation of ozone precursor (i.e., NO_x) emissions.

Total Net Emissions, including Operations Outside ~~the San Francisco Bay and Sacramento Basinsof~~ California

As explained above, if the Project were approved and constructed, Project-related trains would travel between oil field locations in North America and the ~~Roseville Yard. These~~ Refinery. In addition to pollutant emissions that would be generated within California air basins, these trains also would cause an increase in locomotive emissions outside of California. These impacts can be described only in general terms, however, because ~~it is impossible to predict the routes that Project-~~

~~related trains would take across North America with any degree of certainty. In both the short and the long term, Valero~~ UPRR could ~~obtain crude oil from oil fields in Louisiana, Texas, Oklahoma, North Dakota, and/or parts of western Canada. Any~~ choose any route for any delivery. Accordingly, any attempt to identify and quantify the impact of locomotive emissions associated with the Project on air quality ~~in this vast region, without even knowing where the trains will come from,~~ outside of California would be ~~highly~~ speculative. The Project also would ~~also~~ eliminate maritime emissions from ships traveling between the Refinery and oil field locations in Alaska, South America, the Middle East, and other parts of the world. ~~Similarly~~ For the reasons described above, these emissions can be described only in general terms ~~because it is impossible to identify and quantify emissions across the vast range of possible routes~~.

This analysis generally describes the net impact of the Project ~~on~~ in terms of overall generation of air ~~quality~~ pollutant emissions, including outside ~~the boundaries of the Bay Area and Sacramento Basins~~ of California, by comparing locomotive emissions with emissions from marine vessels. First, the analysis identifies the relative rate of emissions for ships and trains, for each pollutant, based on a specified distance (1,000 miles) and a specified load (1 million barrels). The results are set forth in Table 4.1-~~7~~15. For both locomotives and vessels, the emissions estimates are based on average emissions factors. Second, this analysis applies these emissions factors to a few scenarios that take into account the length of specified trips.

TABLE 4.1-15 ~~7~~
LOCOMOTIVE AND MARINE VESSEL EMISSIONS FACTORS COMPARISON
FOR 1,000,000 BARRELS DELIVERED PER 1,000 MILES TRAVELLED
~~OUTSIDE OF THE BAY AREA AND SACRAMENTO BASINS~~

Sources	tons per thousand miles hauled per million barrels delivered					
	ROG	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$
Locomotives – large line haul	0.91	19.1	3.75	0.01	0.51	0.49
Marine Vessel Main Engines	0.65	11.7	0.97	1.62	0.32	0.32

SOURCE: ESA 2014; See Appendix E.5

As Table 4.1-~~7~~15 shows, locomotives generate more emissions than marine vessels per mile, per 1,000,000 barrels of crude oil delivered each year, of ROG, NO_x, CO, PM_{10}, and $PM_{2.5}$. The reverse is true, however, for SO_x. Even with these emissions factors, there is no way to estimate with any certainty the net effect of the Project on areas outside of ~~the Bay Area and Sacramento Basins~~ California because ~~there is no way to predict~~ the length of locomotive ~~trips that could occur if the Project were approved,~~ or ~~the length of~~ marine vessel trips ~~that would occur if the Project were not approved~~ cannot be predicted with reasonable accuracy.

For purposes of a general analysis, it is useful to consider several examples. Currently, vessels carrying crude oil from Alaska to the Refinery travel approximately 2,000 miles (from the terminus of the TransAlaska pipeline), vessels carrying crude oil from South America to the Refinery travel roughly 4,000 miles, and vessels carrying crude oil from the Middle East to the Refinery travel roughly 8,500 miles. Using a weighted-average composite distance for crude oil

delivered to the Refinery from source countries-of-origin during the baseline period, Valero has estimated that the average maritime distance travelled from source to the Refinery was 7,305 miles. By comparison, a train carrying North American crude oil to the Refinery could travel roughly 1,500 miles. Based on these distances, Table 4.1-~~8~~16 generally compares baseline emissions from marine vessels traveling outside of the Bay Area and Sacramento Basins with locomotive emissions from trains traveling outside of the Bay Area and Sacramento Basins.

TABLE 4.1-~~8~~16
EXAMPLES OF TOTAL NET EMISSIONS, INCLUDING OUTSIDE OF ~~THE BAY AREA AND SACRAMENTO BASINS~~CALIFORNIA

Emission Sources for Example Crude Oil Origins	Example One-Way Distance (miles)	Tons per 25,550,000 Barrels Delivered per Year					
		ROG	NO_x	CO	SO_x	PM_{10}	$PM_{2.5}$
Baseline Marine Vessel Main Engines - Alaskan Origin*	2,000	66.4	1,194.6	99.6	165.9	33.2	33.2
Baseline Marine Vessel Main Engines - South American Origin	4,000	132.7	2,389.2	199.1	331.8	66.4	66.4
Baseline Marine Vessel Main Engines - Middle East Origin	8,500	282.1	5,077.0	423.1	705.1	141.0	141.0
Baseline Marine Vessel Main Engines - Composite Origin	7,305	242.4	4,363.2	363.6	606.0	121.2	121.2
Project Locomotives - large line haul from North American Origin	1,500	69.6	1,460.5	287.7	1.0	38.9	37.8
Net Emissions with Alaskan Origin Baseline	---	3.2	265.9	188.2	-164.9	5.8	~~-4.6~~ 4.6
Net Emissions with South American Origin Baseline	---	-63.19	-928.71	88.63	-330.81	-27.43	-28.59
Net Emissions with Middle East Origin Baseline	---	-212.51	-3,616.52	-135.35	-704.11	-102.10	-103.25
Net Emissions with Composite Baseline Origin Baseline	---	-172.86	-2,902.76	-75.87	-604.98	-82.27	-83.43

* This estimate excludes emissions from operation of the pipeline from the North Slope to the marine terminal.

SOURCE: ESA, 2014; See Appendix E.5

As indicated in Table 4.1-~~8~~16, net emissions ~~that would be generated outside of the Bay Area and Sacramento Basins~~ are highly dependent on the origin of the crude oil source. However, due to the uncertainty of the origins of the crude oil that would be delivered by rail as well as the origins of the crude oil that would be displaced, the Project emissions data presented in Table 4.1-~~8~~16 are disclosed for comparison purposes only and cannot be relied upon with assurance as the basis for any significance determinations. The comparison indicates that the Project would reduce total net emissions from the crude oil's points of origin, unless all marine vessels came from Alaska (although SO_x would still be higher under this scenario).

As disclosed in Tables 4.1-12 through 4.1-14, Project-related train traffic along the three routes within California uprail of the Roseville Yard would result in the generation of ozone precursor

(i.e., NO_x) emissions that could result in, or contribute to, an exceedance of an air quality standard in each of the air districts along the routes, which would be a significant impact.

Mitigation Discussion

As a general rule, CEQA requires an EIR to describe mitigation measures that could, if implemented, minimize significant environmental effects (14 Cal. Code Regs. §§15126(c), 15126.1(a)). Under CEQA Guidelines Section 15370, "mitigation" includes, among other things, minimization of an impact (by limiting the degree or magnitude of the action and its implementation) and compensation for an impact (by replacing or providing substitute resources).

There are several existing technologies available to reduce locomotive emissions, including the use of ultra low-emitting switch locomotives and use of new Tier 4 interstate line haul locomotives (CARB, 2009).[9] If UPRR were required not only to ensure that all switch locomotives used to direct Project-related rail cars are ultra low-emitting switch locomotives but also to use exclusively Tier 4 interstate haul Project-related rail cars, then Project-related locomotive emissions would be reduced substantially in all air districts that the locomotives would travel and could reduce locomotive NO_x emissions generated within the Placer County APCD along the Oregon to Roseville and Nevada to Roseville (northern) routes, as well as within the Sacramento Metropolitan AQMD along all three uprail routes, to levels that would be considered less than significant. NO_x emissions impacts within all of the other subject air districts would remain at levels that would be considered significant (ESA, 2015).

Compensation also could reduce the significance of Project-related locomotive emissions. Two uprail air districts, Placer County and Sacramento Metropolitan, have off-site mitigation programs that include payment of fees to fund emission reduction activities within their respective air basins. However, the Placer County APCD recommends that the fee be paid at the time of recordation of the Final Map (for residential projects) or issuance of a Building Permit (for non-residential projects) (PCAPCD, 2012). Neither trigger would be met by UPRR's operation of its locomotives along existing routes; therefore, this off-site mitigation fee program would not apply to the Project. Sacramento Metropolitan's off-site mitigation fee program appears to be geared toward construction emissions; however, there is no reason based on the plain language of the program why it could not apply to locomotive emissions or require the payment of a fee. If UPRR were required to enter into a voluntary emission reduction agreement (VERA) with the Sacramento Metropolitan AQMD to pay an annual off-site mitigation fee for Project-related locomotive emissions of NO_x generated within the air district in excess of 65 pounds per day in an amount equal to $17,720 per ton of emissions per year, the fee could be used to fund

[9] In March 2008, USEPA established federal emission standards for NOx, hydrocarbons (HC), CO, particulate matter, and smoke for newly manufactured and remanufactured locomotives. These standards, which are referred to as the "2008 Locomotive Rule" are codified at 40 Code of Federal Regulation (CFR) Part 1033. They include several sets of emission standards with applicability dependent on the date a locomotive is/was first manufactured. The standards also apply to existing locomotives when they are remanufactured, which typically is required every 7 to 10 years. The first set of standards (Tier 0) applies to most locomotives originally manufactured before 2001. The most stringent set of standards (Tier 4) applies to locomotives originally manufactured in 2015 and later. The requirements also reduce idling for new and remanufactured locomotives. This year (2015), newly manufactured line haul locomotives are required to meet Tier 4 emission standards; however, CARB estimates that the national Tier 4 locomotive fleet turnover will occur gradually over 30 years from 2015 to 2045. (CARB, 2009).

diesel emission reduction projects in Sacramento County. Although this would not directly reduce Project-related locomotive emissions, it would effectively reduce the significant impact in Sacramento County to a less-than-significant level because the air district would use the mitigation fee to fund diesel emission reduction projects in Sacramento County that would offset Project-related locomotive emissions that would exceed the air district's significance threshold for NO_x.

However, "If the lead agency determines that a mitigation measure cannot be legally imposed, the measure need not be proposed or analyzed. Instead, the EIR may simply reference that fact and briefly explain the reasons underlying the lead agency's determination." (14 Cal. Code Regs. §15126.4(a)(5)). CEQA Guidelines Section 15364 defines "feasible" as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account several factors, including legal, social, and policy ones. Mitigation measures that are beyond a lead agency's powers to impose or enforce are legally infeasible. *Kenneth Mebane Ranches v. Superior Court* (1992) 10 Cal.App.4th 276.

As explained in Revised DEIR Appendix G, the City cannot regulate UPRR's rail operations either directly, by dictating routing or choice of locomotives, or indirectly, by requiring Valero to pay a mitigation fee or purchase emissions offsets. Any such attempt would be preempted by federal law, which proscribes any mitigation measure that would have the effect of managing or governing rail operations.

For these reasons, mitigation measures requiring the use of ultra low-emitting switch locomotives, use of new Tier 4 interstate line haul locomotives, or compensation to reduce the significance of Project-related locomotive emissions in specific air districts are infeasible. Accordingly, Impact 4.1-5, regarding the Project's contribution to an existing or projected air quality violation uprail from the Roseville Yard would remain significant and unavoidable.

Mitigation Measures: None available.

Impact 4.1-6: The Project could expose sensitive receptors uprail from the Roseville Yard to substantial pollutant concentrations associated with locomotive emissions. (*Less than Significant*)

Health risks and $PM_{2.5}$ concentrations were estimated for the three potential train routes between the Roseville Yard and the California border. Locomotive emissions, meteorological data, and sensitive receptor locations for each route were entered into the AERMOD dispersion model. PM_{10} emissions from locomotives were used to represent diesel particulate matter (DPM). For the Oregon to Roseville route, the analysis used meteorological data from the Redding Municipal Airport for Redding and from the Yuba County Municipal Airport for Marysville. For the Nevada to Roseville (northern) route, the analysis used meteorological data from the Chico Municipal Airport for Chico, and from the Yuba County Municipal Airport for Marysville. For the Nevada to Roseville (southern) route, the analysis used meteorological data from the Auburn Municipal Airport for Auburn and from the Truckee – Tahoe Airport for Truckee. Table 4.1-17 shows the results of the health risk

analysis. The results are conservative in that they assume that all Project-related train traffic would travel exclusively on each route. Actual train traffic and the resulting emissions would likely be split among the three routes. The Project would not result in a significant health risk because, for each route, the worst-case cancer risks would be less than 10 in a million and the maximum chronic hazard index would be less than one. In addition, the Project's maximum estimated $PM_{2.5}$ annual concentrations would be less than 0.8 micrograms per cubic meter ($\mu g/m^3$) on all three routes, which is less than the significance threshold for specific projects used by the BAAQMD.

TABLE 4.1-17
MAXIMUM CANCER RISK, CHRONIC HAZARD, AND PM2.5 CONCENTRATIONS ALONG THE THREE TRAIN ROUTES UPRAIL OF THE ROSEVILLE YARD

Train Route	Location of Maximum Estimated Health Impact	Cancer (per million)[1]	Chronic Hazard Index	$PM_{2.5}$ Annual Concentration ($\mu g/m^3$)
Roseville to Oregon	Marysville – eastern	5.5	0.0011	0.0052
	Marysville – western	4.9	0.0009	0.0047
	Redding	6.3	0.0012	0.0060
Roseville to Nevada (northern)	Marysville – eastern	5.5	0.0011	0.0052
	Marysville – western	4.9	0.0009	0.0047
	Chico	5.5	0.0011	0.0052
Roseville to Nevada (southern)	Auburn – eastern	4.6	0.0009	0.0043
	Auburn – western	5.2	0.0010	0.0050
	Truckee	4.5	0.0009	0.0043
Significance Threshold		10	1	0.8

[1] Cancer risk calculation includes age sensitivity factors and breathing rates representative of the 95th percentile for all ages, as recommended in the Updated OEHHA Guidelines (OEHHA, 2015). For locomotive travel, the only TAC of concern is diesel particulate matter, which does not have an acute health effect.

SOURCE: ERM, 2015b.

Impact 4.1-7: The Project could result in cumulatively considerable net increases in ozone precursor emissions in uprail air districts. (*Significant and Unavoidable*)

With the exception of Siskiyou County APCD, which is attainment or unclassified for all federal and state ambient air quality standards (AAQSs), each of the uprail air districts are non-attainment of an ozone, PM_{10}, and/or $PM_{2.5}$ federal and/or state AAQS.

Based on guidance from Tehama County APCD, Butte County AQMD, Sacramento Metropolitan AQMD, and Feather River AQMD, if a project within their respective jurisdictions would result in an increase in criteria pollutants of more than their respective average daily mass significance thresholds, then it also would be considered to contribute considerably to a significant cumulative impact (TCAPCD, 2015; BCAQMD, 2014; and FRAQMD, 2010). For projects in Placer County, the Placer County APCD recommends the use of a ROG and NO_x cumulative impact threshold of 10 pounds per day (PCAPCD, 2012). As discussed under Impact 4.1-5 above, Project-related emissions that would be generated with the jurisdictions of Tehama County APCD, Butte County AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, Northern Sierra AQMD, and Feather River AQMD would exceed the incremental project significance thresholds

for NO_x under each of the route scenarios. In addition, NO_x emissions generated in Placer County would exceed the cumulative 10 pounds per day significance threshold under each route scenario and ROG emissions generated in Placer County under the Nevada to Roseville (southern) scenario would exceed the 10 pound per significance threshold. Therefore, implementation of the Project would result in a cumulatively considerable increase of NO_x emissions in Yolo-Solano AQMD, Sacramento Metropolitan AQMD, Tehama County APCD, Butte County AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, Northern Sierra AQMD, Feather River AQMD, and Placer County APCD, and a cumulatively considerable increase in ROG emissions in Placer County APCD related to the Nevada to Roseville (southern) route, and the associated cumulative impact would be significant and unavoidable.

Mitigation: None available.

Impact 4.1-8: The Project could generate objectionable odors affecting a substantial number of people along uprail routes. (*Less than Significant*)

Project uprail operations would include the generation of diesel exhaust from train locomotives that could result in the creation of objectionable odors. However, these emissions would be temporary and/or intermittent in nature and the closest sensitive receptors to the railroad are residences that are set back from the railroad, thus odor impacts associated with diesel combustion during Project operations would be less than significant. This impact would be less than significant.

Mitigation: No mitigation required.

2.6.3 Summary of Air Quality Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.1 (p. 4.1-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.1 (p. 5-5; 5-12 to 5-14). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.6; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Acknowledging that neither Valero nor the City has authority to dictate or limit routes selected by UPRR (see DEIR Section 3.7, *Federal Preemption of Railroad Regulation*, DEIR Appendix L, and Revised DEIR Appendix G), it is possible that Project-related crude oil could reach the Refinery from the south rather than by way of Roseville. Potential air quality-related direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes. For example, the locomotives' internal combustion engines would emit criteria pollutants and toxic air emissions that would or could exceed air pollution control district thresholds and, thereby, result in a significant and unavoidable impact related to significance criteria a) regarding conflicts with air quality plans,

b) regarding violation of air quality standards, and c) regarding the cumulatively considerable net increase of criteria pollutants. These determinations are consistent with the analysis documented by San Luis Obispo County in its October 2014 CEQA evaluation of the *Phillips 66 Company Rail Spur Extension and Crude Unloading Project Revised EIR* (San Luis Obispo County, 2014) (the "Phillips 66 Revised EIR"). In the Phillips 66 Revised EIR, see Section 4.3, Air Quality and Greenhouse Gases, pp. 4.3-50 through 4.3-56; 4.3-66 through 4.3-71.

Integrating the data and other information in these sections, the Project as a whole would result in less-than-significant impacts related to criterion d), regarding exposure to pollutant concentrations and criterion e), regarding exposure to objectionable odors; and significant and unavoidable impacts related to significance criteria a) regarding conflicts with air quality plans, b) regarding violation of air quality standards, and c) regarding the cumulatively considerable net increase of criteria pollutants.

2.7 DEIR Section 4.2, Biological Resources

DEIR Section 4.2 (p. 4.2-1 et seq.), Biological Resources, identifies issues related to vegetation and wildlife species and related habitat, including federally-protected wetlands, and evaluates how such resources could be affected by the Project. It describes the physical and regulatory setting in Section 4.2.2 (p. 4.2-1 et seq.), identifies the criteria used to evaluate the significance of potential impacts in Section 4.2.3 (p. 4.2-26 et seq.), and documents the analysis of potential impacts in Section 4.2.4 (p. 4.2-27 et seq.). No changes are being made to DEIR Section 4.2 except as noted below.

In response to comments received on the DEIR, Section 4.2 is being supplemented to include a new Section 4.2.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues related to Biological Resources uprail from the Roseville Yard to the State border and beyond and a new Section 4.2.7, Summary of Biological Resources Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.7.1 DEIR Section 4.2.6, Uprail Impacts and Mitigation Measures

Project-related crude could travel to the Roseville Yard via existing tracks along any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*, and from there on into the Refinery. No new or replacement track would be required to transport Project-related crude from the point(s) of origination to the Roseville Yard, and no physical changes to existing rail routes would occur on the mainline between Benicia and Roseville, from Roseville to the State border, or beyond. Given the substantial length of the main line routes, the diversity of sensitive biological resources in proximity to rail routes, and the inability to predict which routes would be traversed for Project purposes, a focused biological survey or delineation of these resources was not conducted as part of this evaluation.

Biological resources along the main line routes were evaluated based on database queries, aerial photo interpretation, and existing literature pertinent to crude rail transportation. A California Natural Diversity Database (CNDDB) query was conducted that includes a review of all sensitive biological resources within 300 feet of the rail line routes to develop a general list of potential plant and wildlife species that may be affected by the Project (see Revised DEIR Appendix E). Documented plant and wildlife occurrences are intended to serve as a minimum baseline for describing potential impacts that could occur under normal operating conditions and, as analyzed in Revised DEIR Section 4.7 regarding hazards and hazardous materials, under upset or accident conditions potentially including an oil spill. Additional sensitive biological resources that are not documented in the CNDDB and not specifically discussed in this impact analysis could occur in close proximity to the tracks. This analysis of potential uprail impacts focuses primarily on the three routes between the State border and the Refinery that are shown in Figure 1-3 and also (more generally) evaluates potential effects between the State border and the crude oil's points of origination. The three routes, including biological resources of particular consideration in this analysis, are summarized below.

- The "Oregon to Roseville" route enters California from Oregon approximately 15 miles southwest of Klamath Falls, Oregon and uses UPRR's Black Butte and Valley subdivisions (Figure 1-3). This route extends approximately 297 miles to the Roseville Yard and passes through Siskiyou, Shasta, Tehama, Butte, Sutter, Yuba, and Placer counties. Important upland and aquatic habitat on this route occurs within the Sacramento Valley, Cascade Mountains, Shasta National Forest, and Klamath National Forest, among other areas, and includes the Sacramento River, Shasta Lake, and numerous tributary streams.

- The "Nevada to Roseville (northern)" route enters California approximately 50 miles north of where the Roseville subdivision crosses the State line, on the Winnemucca subdivision near Herlong (Figure 1-3). Trains using this route travel along the Canyon, Sacramento, and Valley subdivisions before reaching Roseville, approximately 229 miles from the Nevada border. This route passes through Lassen, Plumas, Butte, Yuba, and Placer counties. Important biological habitats occur in association with the Feather River, Lassen National Forest, Plumas National Forest, and Lake Oroville, among other areas.

- The "Nevada to Roseville (southern)" route uses UPRR's Roseville subdivision that crosses into California approximately 20 miles east of Truckee and extends approximately 119 miles from the State line to the Roseville Yard while passing through Sierra, Nevada, and Placer counties (Figure 1-3). Important biological habitats occur at the Truckee River, Tahoe National Forest, Toiyabe National Forest, and other areas.

The potential effects that could occur during normal operating conditions are analyzed in this section. The potential secondary effects to wildlife, vegetation, and other biological resources in the event of an upset or accident, including an oil spill, fire, or explosion, are addressed in Revised DEIR Section 2.12 regarding hazards and hazardous materials.

Under normal operating conditions, trains transporting Project-related crude oil would not have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service and would not interfere substantially with the

movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites because the presence of any such habitat or community located within or along the tracks under baseline conditions demonstrates tolerance with trains passing via the tracks. Under normal operating conditions, Project trains also would not have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act because no wetland removal, fill, hydrological interruption, or other effect on such resources would occur, and would not conflict with local policies or ordinances protecting biological resources, or with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan because the passage of Project trains along existing tracks would result in no change to existing conditions relative to such plans. For these reasons, the transportation of crude by rail for the Project would cause no impact related to criteria b), c), d), e), or f) as set forth in DEIR Section 4.2.3 (DEIR, p. 4.2-26 et seq.).

Impact 4.2-10: The Project could have a substantial adverse effect on candidate, sensitive, or special-status wildlife species or migratory birds, including injury or mortality resulting from collisions with trains along the North American freight rail lines as a result of increased frequency (high traffic volumes) of railcars. (*Significant and Unavoidable*)

Although there are numerous special status plants documented within 300 feet of the three uprail routes the existing operations of train transportation and track maintenance limits the potential for special-status plants to occur along rail routes. The addition of trains transporting Project-related crude on established rail corridors would not impact special-status plants.

As discussed in DEIR Section 4.2.4.2 for Suisun Marsh, the Project would not increase the lateral area of disturbance that extends approximately 200 meters from the railroad alignment, relative to baseline conditions, since the area of disturbance is determined by physical laws of sound attenuation. Wildlife species are expected to soon habituate to the more frequent noise. The increased frequency of trains per day would not substantially increase noise impacts to special-status wildlife within the uprail study area beyond existing operations. Trains can cause mortality or injury of wildlife through direct impacts. With increased frequency of trains per day as a result of Project transportation needs, there is a directly related increase in potential for wildlife collisions along all the route lines. This threat is highest in sensitive habitats such as riparian corridors, wetlands, and marshes where a higher number of wildlife species are supported. Mortality or injury of special status wildlife or migratory birds would constitute a significant impact. The Project could have a significant adverse effect on candidate, sensitive, or special-status wildlife species or migratory birds, including injury or mortality resulting from collisions with trains along the North American freight rail lines as a result of increased frequency (high traffic volumes) of railcars.

Mitigation Discussion

As a general rule, CEQA requires an EIR to describe mitigation measures that could, if implemented, minimize significant environmental effects (14 Cal. Code Regs. §§15126(c), 15126.1(a)). Under CEQA Guidelines Section 15370(b), “mitigation” includes “[m]inimizing impacts by limiting the degree or magnitude of the action and its implementation.” For example,

reducing train speeds in zones within designated critical habitat areas, national wildlife refuges, national parks, CDFW sensitive natural communities, or within 0.25 mile of any body of water to reduce the risk of train-strikes could, if implemented, reduce the severity of Impact 4.2-10 by allowing additional time for wildlife species to avoid being struck by oncoming allowing additional time for wildlife species to avoid being struck by oncoming trains.

However, "If the lead agency determines that a mitigation measure cannot be legally imposed, the measure need not be proposed or analyzed. Instead, the EIR may simply reference that fact and briefly explain the reasons underlying the lead agency's determination." (14 Cal. Code Regs. §15126.4(a)(5)). CEQA Guidelines Section 15364 defines "feasible" as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account several factors, including legal ones. Mitigation measures that are beyond a lead agency's powers to impose or enforce are legally infeasible. *Kenneth Mebane Ranches v. Superior Court* (1992) 10 Cal.App.4th 276. As explained in Revised DEIR Appendix G to this Revised DEIR, the City cannot regulate UPRR's rail operations by requiring UPRR to reduce train speeds to minimize the risk of train-strikes to wildlife. Any such attempt would be preempted by federal law, which proscribes any mitigation measure that would have the effect of managing or governing rail operations. For this reason, a mitigation measure that required reduced speeds in certain areas would be infeasible, and so is not recommended. Accordingly, Impact 4.2-10, regarding potential injury and mortality of candidate, sensitive, or special-status wildlife species or migratory birds resulting from collisions with trains, would remain significant and unavoidable.

Mitigation Measures: None available.

2.7.2 Summary of Biological Resources Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.2 (p. 4.2-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.2 (pp. 5-15 and 5-16). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.7; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Acknowledging that neither Valero nor the City has authority to dictate or limit routes selected by UPRR (see DEIR Section 3.7, *Federal Preemption of Railroad Regulation*, DEIR Appendix L, and Revised DEIR Appendix G), it is possible that Project-related crude oil could reach the Refinery from the south rather than by way of Roseville. Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes. For example, potential impacts to biological resources along any southern route could include collision-related injury and mortality to protected wildlife and migratory bird species.

Integrating the data and other information in these sections, the Project as a whole would result in no impact to criterion f), regarding conflicts with habitat conservation plans, and less-than-significant impacts or impacts reduced to less-than-significant with implementation of mitigation measures, relating to criteria b) through e). The Project would have a significant and unavoidable impact to criterion a), regarding adverse effects to candidate, sensitive, or special-status species.

2.8 DEIR Section 4.3, Cultural Resources

DEIR Section 4.3 (p. 4.3-1 et seq.), Cultural Resources, identifies and evaluates issues related to Cultural and Paleontological Resources. It describes the physical and regulatory setting in Section 4.3.2 (p. 4.3-1 et seq.), including paleontological potential; the geoarcheological and prehistoric, ethnographic, and historical setting; and laws and regulations, such as CEQA Guidelines Section 15064.5, that govern the analysis and protection of cultural and paleontological resources. The criteria used to evaluate the significance of potential impacts are identified in Section 4.3.3 (p. 4.3-7). The evaluation of potential impacts is presented in Section 4.3.4 (p. 4.3-7 et seq.) and Section 4.3.5 (p. 4.3-89). No changes are being made to DEIR Section 4.3 except as noted below.

In response to comments received on the DEIR, Section 4.3 is being supplemented to include a new Section 4.3.6, Uprail Impacts and Mitigation Measures. As set forth below, this new section identifies and evaluates issues related to Cultural and Paleontological Resources uprail from the Roseville Yard to the State border and beyond. In Section 4.3.6, the meaning of key terms (including "historical resource," "unique archaeological resource," and "unique paleontological resource or site or unique geological feature") is the same as in the DEIR. A new Section 4.3.7, Summary of Cultural Resources Impacts, also is being added; it considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.8.1 DEIR Section 4.3.6, Uprail Impacts and Mitigation Measures

Project-related crude could travel to the Roseville Yard via existing tracks along any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*, and from there on into the Refinery. No new or replacement track would be required to transport Project-related crude from the point(s) of origination to the Roseville Yard, and no physical changes to existing rail routes would occur on the mainline between Benicia and Roseville, from Roseville to the State border, or beyond. Because no ground disturbance would occur, the Project would cause no impact to a unique archaeological resource; no impact to a unique paleontological resource or site or unique geological feature; and no impact related to the disturbance of human remains, including those interred outside of formal cemeteries.

Several historical resources are located on or along the rail lines within California including, but not limited to, the Fort Jones House in Fort Jones (National Park Service, 1976) and the McCloud Historic District in McCloud (National Park Service, 1990), both in Siskiyou County; Cottonwood Historic District in Cottonwood, Shasta County (California State Parks, 2015a);

Southern Pacific Depot in Chico, Butte County (California State Parks, 2015b); Colfax Freight Depot in Colfax and the Mountain Quarries Bridge over the North Fork of the American River in Auburn, both in Placer County (California State Parks, 2015c); Susanville Railroad Depot in Susanville, Lassen County (California State Parks, 2015d); and Plumas-Eureka State Park District in Blairsden, Plumas County (California State Parks, 2015e). See generally, 14 Cal. Code Regs. §15064.5(a); (California State Parks, 2015f). Many other historical resources could be located nearby.

The proximity of rail-related and other historical resources to existing railroad tracks is not unique to California. Several such resources exist, for example, in some of the states that rank among the highest crude oil producers in the nation (US EIA, 2015a). For example, the Fort Sumner Railroad Bridge crosses the Pecos River in Texas (National Park Service, 2015) and a variety of historic bridges are used in North Dakota (National Park Service, 1997). Given the total length of the three routes shown in Figure 1-3, *Uprail Routes*, (approximately 717 miles), it is likely that historical resources occur in the vicinity of these rail lines. Because the rail lines pass through multiple rural and urban communities, potential cultural resources near the rail lines are anticipated to be mainly historical buildings and other structures. Under normal railroad operations, Project-related crude oil trains traveling on the existing rail system would result in no impact to these potential resources. Regarding the potential for an upset or accident condition (such as a train derailment and a resulting oil spill, explosion, fire, or cleanup and restoration activities) to disturb or destroy historical resources, see Revised DEIR Section 2.12.

2.8.2 Summary of Cultural Resources Impacts

Potential direct and indirect effects of Project components within the Refinery are analyzed in DEIR Section 4.3 (p. 4.3-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.3 (p. 5-16). Potential direct and indirect effects of Project-related transport of crude by rail are analyzed in Revised DEIR Section 2.8; potential cumulative effects of this rail travel are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: no impact to cultural or paleontological resources is expected to result from the transport of crude by rail under normal operating conditions. This determination is consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 4.5, p. 4.5-8 et seq.); see also Section 4.5.6, p. 4.5-15 et seq.). The potential secondary effects to cultural resources of an upset or accident condition are addressed in Revised DEIR Section 2.12, regarding Hazards and Hazardous Materials.

Integrating the data and other information in these sections, the Project as a whole would result in no impact related to criterion a), regarding historical resources, criterion b), regarding unique archaeological resources, criterion c), regarding unique paleontological resources or sites and unique geological features, and criterion d), regarding the disturbance of human remains.

2.9 DEIR Section 4.4, Energy Conservation

DEIR Section 4.4 (p. 4.4-1 et seq.), Energy Conservation, analyzes the Project's relationship to energy conservation goals as described in Appendix F of the CEQA Guidelines. It describes the physical and regulatory setting in Section 4.4.2 (p. 4.4-1 et seq.), identifies the criteria used to evaluate the significance of potential impacts in Section 4.4.3 (p. 4.4-5), and evaluates potential impacts in Section 4.4.4 (p. 4.4-5 et seq.) and Section 4.4.5 (p. 4.4-7). No changes are being made to DEIR Section 4.4 except as noted below.

In response to comments received on the DEIR, Section 4.4 is being supplemented to include a new Section 4.4.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues related to energy conservation goals based on Project-related use of existing railroad facilities uprail from the Roseville Yard to the State border and beyond, and a new Section 4.4.7, Summary of Energy Conservation Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.9.1 DEIR Section 4.4.6, Uprail Impacts and Mitigation Measures

Project-related crude could travel to the Roseville Yard via existing tracks along any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*, and from there on into the Refinery. Transportation-related energy use is proportional to the number of locomotives required. As described in Revised DEIR Section 2.1.4, UPRR would transport the crude oil in unit trains consisting of up to 100 tank cars, likely using four locomotives and two buffer cars. Additional locomotives would be required in some instances. Track gradient (i.e., the number of feet of rise per 100 feet of horizontal distance) affects how many locomotives would be required to haul a train.[10] Grades are generally 1 percent or less on main lines, grades steeper than about 2.2 percent are rare, and, at 3.3 percent, BNSF's Raton Pass grade in New Mexico is reported to be the steepest main-line grade in North America (McGonigal, 2006). Trains Magazine published a map of the steepest grades on America's railroads in 2012 (Metzger and Lester, 2012) that shows two in Northern California: a 2.2 percent grade for Western Pacific's Greenville-Almanor route and a 3.1 percent grade for Southern Pacific's Tunnel 13 at Siskiyou Summit. Because UPRR could select any route to transport Project-related crude from the source to the Refinery, this analysis assumes that one locomotive would be required per 25 train cars of crude for all but the steepest grades and, for the steepest grades, up to six locomotives could be required.

Union Pacific's fleet includes approximately 8,000 locomotives (UPRR, 2015a), consisting primarily of conventional diesel locomotives built by General Motors Electro-Motive Division (EMD) and GE (Trains, 2015) as well as a few steam locomotives (Strack, 2015, 2014). Any combination of these locomotives could be used to haul Project-related crude. UPRR's

[10] See, for example, McGonigal 2006 ("For each percent of ascending grade, there is an additional resistance to constant-speed movement of 20 lbs. per ton of train. This compares with a resistance on level, straight track of about 5 lbs. per ton of train. A given locomotive, then, can haul only half the tonnage up a .25-percent grade that it can on the level.").

locomotive fuel efficiency has improved by 18 percent since 2000 (UPRR, 2015b). In 2000, the company moved a ton of freight 375 miles on 1 gallon of diesel fuel (UPRR, 2013); it now can move a ton of freight 475 miles using 1 gallon of diesel fuel (UPRR, 2015b). The company's fuel efficiency is expected to continue to improve, as indicated by purchase in 2013 of 100 new, more fuel-efficient locomotives (UPRR, 2013). UPRR's energy consumption, including diesel fuel, is shown in Table 4.4.-1, *UPRR Energy Consumption*.

TABLE 4.4.-1
UPRR ENERGY CONSUMPTION

	2012	2013
Diesel	1,103.8 gallons	1,103.5 gallons
Gasoline	12.1 gallons	12.9 gallons
Other fuel	8.6 gallons	13.8 gallons
Electricity	603.5 kilowatt hours	652.9 kilowatt hours
Natural gas	1,000.8 standard cubic feet	761.8 standard cubic feet

NOTE: Measurements estimated in millions

SOURCE: UPRR 2013, p. 39

a) Would the Project's energy requirements by amount and fuel type for each stage of the Project, including construction, operation, maintenance and/or removal, be considered significant?

The Project would not require construction or decommissioning uprail of the Roseville Yard, and so would not require energy for those stages of the Project in uprail locations. No construction- or decommissioning-related energy requirements would result uprail from Roseville. Operation of the Project would require energy (diesel fuel) for the transport of crude oil from the point(s) of origination to the Roseville Yard.

Impact 4.4-1a: Operation of the Project would result in the consumption of diesel fuel but the necessary amount would not be considered significant. (*Less than Significant*)

The Project's energy requirements for the uprail transport of crude oil would require diesel fuel to power the locomotives. The Project would result in the rail travel of one additional unit train per day into the Roseville Yard, and two 50-car trains per day from Roseville into the Refinery. As noted in Revised DEIR Section 2.4.1, a unit train consists of up to 100 tank cars, four locomotives, and two buffer cars. Because an average loaded tank car weighs 132 tons, an average buffer car weighs 143 tons, and an average locomotive weighs 187 tons, each unit train would weigh an average total of 14,234 tons. UPRR can move a ton of freight 475 miles using 1 gallon of diesel fuel (UPRR, 2015b). Of the three routes shown in Figure 1-3, *Uprail Routes*, the longest total distance from the State line to the Roseville Yard (297 miles) would use the Oregon to Roseville route. Accordingly, Project-related train travel between the State line and the Roseville Yard would require up to 8,900 gallons of diesel fuel per day. The return trip with unloaded tank cars (weighing 37 tons) would require approximately 2,960 gallons. (The 72-mile trip to be traveled by the two 50-car trains from the Roseville Yard to the Refinery would be the

same no matter which uprail route was selected and would require approximately 2,876 gallons per total round trip). A Project-related train could travel roughly 1,500 miles from the crude oil's point of origin to the Refinery (see discussion under Impact 4.1-5 in Section 4.1.6, above). This round trip journey would require approximately 59,900 gallons.

Argonne National Laboratory reported in 2002 that locomotives use approximately 4 billion gallons of diesel fuel annually, and that this volume was about 10 percent of the total diesel fuel used in transportation and 2.3 percent of all the fuel used in transportation nationwide (Argonne National Laboratory, 2002). The Project's increased diesel fuel demand would represent a mere fraction of the total demand. This would be a less than significant impact.

b) Would the Project have a significant adverse effect on local and regional energy supplies and on requirements for additional capacity?

Impact 4.4-1b: The Project could increase local or regional energy demand to move crude oil between the point(s) or origination and the Roseville Yard, but would not require additional energy supply capacity. (*Less than Significant)*

As noted in the analysis of Impact 4.4-1a, the Project would increase the annual demand for diesel fuel by 4.3 million gallons. Meeting this increase in demand would not require the further development or expansion of diesel supply capacity, the provision of which could adversely affect established energy conservation goals. However, it could have a marginal effect on regionally or locally available diesel supplies. UPRR locomotives use No. 2-D diesel fuel (UPRR, 2015c). Many refineries, including Valero and others, manufacture No. 2-D diesel fuel (see, e.g., Valero, 2013d; Shell, 2012; Chevron, 2007). UPRR currently uses a variety of methods to source its locomotive fuel, including receiving fuel shipments by transport truck, pipeline, barge, rail tank car, and other methods (UPRR, 2015d). Commodity pricing likely drives procurement decisions (UPRR, 2015e). Scarcity drives up price. Should one supplier's supply diminish, its price is likely to increase and thereby motivate UPRR to select a different source with a lower-cost supply available. There is no evidence that Project-related locomotive fuel needs would increase local or regional energy demand sufficient to cause the development of additional energy supply capacity. A less than significant impact would result.

c) What effect would the Project have on peak and base period demands for electricity and other forms of energy?

The U.S. Energy Information Administration with the U.S. Department of Energy (U.S. DOE) defines "peak demand" as the maximum load during a specified time period and "base period" as the period of time for which data used as the base of an index number or other ratio have been collected (U.S. EIA, 2015a; U.S. EIA, 2015b). The Project's transport of crude oil via the existing national rail network, including along the three routes identified in Figure 1-3, *Uprail Routes*, would have no effect on peak and base period demands for electricity or diesel fuel, and no other forms of energy would be required to transport Project-related crude from the point(s) of origination to the Roseville Yard. Accordingly, the movement of Project-related crude oil on tracks uprail from the Roseville Yard would cause no impact related to peak and base period energy demands.

d) To what degree would the Project comply with existing energy standards?

The U.S. Environmental Protection Agency (U.S. EPA) has promulgated strict emission standards associated with diesel fuel combustion. See, for example, 40 CFR Part 1033, which provides emission standards and certification requirements; 40 CFR Part 1065 and 40 CFR §1033.501 regarding exhaust emission test procedures and how to apply them to locomotives; and 40 CFR Part 1068 and 40 CFR §1033.601 regarding the general compliance provisions and how to apply them to locomotives. See also, U.S. EPA, 2012b (Emission Standards Reference Guide) and, more generally, Argonne National Laboratory 2002 (explaining the emission regulations, and methods to achieve future reductions safely and economically). The regulation of locomotive emissions, including the preemption of state and local governments from adopting or enforcing "any standard or other requirement relating to the control of emissions from ...new locomotives or new engines used in locomotives" (U.S. EPA, 1997), is discussed in greater detail in Revised DEIR Section 4.1, *Air Quality*. Operation of the railroad, including locomotives, to transport Project-related crude oil would be consistent with existing, independently enforceable emissions and other energy standards. Accordingly, the movement of Project-related crude oil on tracks uprail from the Roseville Yard would cause no impact related to compliance with existing energy standards.

e) What effects would the Project have on energy resources?

The only energy resource affected by the movement of Project-related crude oil between Roseville and the State border and beyond would be diesel fuel. Potential energy conservation-related impacts of diesel fuel use for the Project are analyzed in the discussion of Impact 4.4-1a and Impact 4.4-1b.

f) Would the Project's projected transportation energy use requirements be significant, and would the Project's overall use of transportation alternatives be efficient?

As analyzed in Impact 4.4-1a, there would be a less than significant impact associated with the transportation energy required to move Project-related crude oil by rail from the point(s) of origin outside of California to the State border and from there into the Roseville Yard. Accordingly, the Project's projected transportation energy use requirements would not be significant.

A comparison of the efficiency of the Project's proposed use of rail transportation relative to other transportation alternatives reveals that locomotives routinely are reported to be four times (or 400 percent) more fuel efficient than trucks (U.S. Department of Transportation Federal Railroad Administration [USDOT], 2014; Association of American Railroads, 2014; UPRR, 2011) and 8 percent less efficient per ton of freight per gallon of fuel than marine transport. One study suggests that marine vessels in domestic waters typically travel 514 miles per gallon of fuel while transporting one ton of cargo (Tennessee-Tombigbee Waterway, 2015). By comparison, UPRR can travel 475 miles per gallon of fuel while transporting one ton of freight (UPRR, 2015b).[11] Although

[11] As reported by Congressional Research Service, however, the limited availability of Jones Act-qualified tankers has been identified as a current constraint on marine transport of crude oil (Congressional Research Service 2014). The Jones Act requires that vessels transporting cargo between two U.S. points be built in the United States, and be crewed and owned at least 75 percent by U.S. citizens (Id.).

fuel efficiency may slightly favor marine transport, the difference would not be substantial, and there is no evidence that the Project's proposed use of rail transportation would be inefficient.

2.9.2 Summary of Energy Conservation Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.4 (p. 4.4-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.4 (p. 5-16). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.9; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential energy conservation-related direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: the transportation of crude by rail, including along rail lines that could be used to transport Project-related crude to the Refinery, would have a less than significant impact on energy conservation because the consumption of diesel fuel would not be considered significant; it would not require additional energy supply capacity; it would comply with diesel locomotive emissions standards; and transport of crude oil by train along this route would not be inefficient relative to other modes of crude oil transport. These determinations are consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 6.2, Energy Conservation, pp. 6-2 through 6-4). Integrating the data and other information in these sections, the Project as a whole would result in less-than-significant impacts for all significance criteria relating to Energy Conservation.

2.10 DEIR Section 4.5, Geology and Soils

DEIR Section 4.5 (p. 4.5-1 et seq.), Geology and Soils, identifies and evaluates issues related to geology, soil conditions, and seismicity in the Project area, including geologic and seismic hazards that could affect structures associated with the Project. It describes the physical and regulatory setting in Section 4.5.2 (p. 4.5-1 et seq.), and the criteria used to evaluate the significance of potential impacts in Section 4.5.3 (p. 4.5-14). The evaluation of potential impacts is presented in Section 4.5.4 (p. 4.4-14 et seq.) and Section 4.5.5 (p. 4.5-15 et seq.). No changes are being made to DEIR Section 4.5 except as noted below.

In response to comments received on the DEIR, Section 4.5 is being supplemented to include a new Section 4.5.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues related to Soils and Seismicity uprail from the Roseville Yard to the State border and beyond, and a new Section 4.5.7, Summary of Geology and Soils Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.10.1 DEIR Section 4.5.6, Uprail Impacts and Mitigation Measures

Project-related crude could travel to the Roseville Yard via existing tracks along any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*, and from there on into the Refinery. See Figure 1-3, *Uprail Routes*, and Figure 1-1, *North American Freight Railroads*. The Project would not result in any physical changes to these rail routes and would not involve or result in any action that could affect earthquake potential, seismic ground shaking, seismic-related ground failure (including liquefaction), landslides, lateral spreading, subsidence, or the expansiveness of soils beneath the tracks. For these reasons, the Project would have no impact related to significance criteria a) through d) as set forth in DEIR Section 4.5.3. Further, the Project would require no septic tanks, alternative waste disposal systems, or sewer connections along the rail routes, and so would have no impact related to significance criterion e) as set forth in DEIR Section 4.5.3. Under normal railroad operations, Project-related crude oil trains traveling on the existing rail system would result in no impact regarding seismic hazards. However, a seismic event could result in the derailment of a Project train and thereby potentially expose people and or structures to adverse effects, including risk of loss, injury, or death. The potential secondary effects to people and structures in the event of an upset or accident, including an oil spill, fire, or explosion that may result from a seismic event, are addressed in Revised DEIR Section 2.12 regarding hazards and hazardous materials.

2.10.2 Summary of Geology and Soils Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery are analyzed in DEIR Section 4.5 (p. 4.5-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.5 (pp. 5-16 to 5-17). Potential direct and indirect effects of Project-related transport of crude by rail are analyzed in Revised DEIR Section 2.10; potential cumulative effects of this rail travel are analyzed in Revised DEIR Section 2.17.4. Potential geology and soils-related direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: no impact related to geology or soils resources is expected to result from the transport of crude by rail under normal operating conditions. The potential secondary effect of an upset or accident condition is addressed in Revised DEIR Section 2.12, regarding Hazards and Hazardous Materials. In summary, the Project as a whole would result in no impact related to significance criterion e) and less than significant impacts, or reduced to less than significant with implementation of mitigation measures, for criteria a) through d).

2.11 DEIR Section 4.6, Greenhouse Gas Emissions

DEIR Section 4.6 (p. 4.6-1 et seq.), Greenhouse Gas Emissions, identifies and evaluates issues related to greenhouse gas emissions, an inherently global and cumulative effect. It describes the physical and regulatory setting in Section 4.6.2 (p. 4.6-1 et seq.), and the criteria used to evaluate the significance of potential impacts in Section 4.6.3 (p. 4.6-8). The evaluation of potential

impacts is presented in Section 4.6.4 (p. 4.6-10) and Section 4.6.5 (p. 4.6-11 et seq.). No changes are being made to DEIR Section 4.6 except as noted below.

In response to comments received on the DEIR, Section 4.6 is being supplemented to reflect greater focus on issues related to GHG emissions uprail from the Roseville Yard to the State border and beyond within the overall discussion of GHG emissions-related effects. As set forth below, revisions are being proposed to DEIR Section 4.6.3's discussion of Analysis Methodology and to DEIR Section 4.6.5's Discussion of Impacts and Mitigation Measures. DEIR Section 4.6 also is being supplemented to add a new Section 4.6.7, Summary of Greenhouse Gas Emissions Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.11.1 DEIR Section 4.6.3, Significance Criteria

Based on CEQA Guidelines Sections 15064.4 and 15064.7(c), as well as Appendix G, a project would cause adverse impacts associated with GHG emissions if it would:

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment; or

b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

Analysis Methodology

GHG emission estimates for the Project presented in this section were prepared by Environmental Resource Management (ERM), a consultant of the Applicant, and independently reviewed by the City's consultant, Environmental Science Associates (ESA). ESA determined that the emission estimates were acceptable for incorporation in this analysis. GHG emissions from locomotives were estimated for the small line haul round trip and switching operations within the Refinery and for the large line haul round trip between the crude oil's point of origin to ~~inland~~ California state boundary and the Refinery. [¶]

This analysis evaluates the effects of transporting crude oil by rail from its point of origin into California along the three specific rail routes between the Roseville Yard and the California border (as described in Section 4.0.4, Geographic Scope of Analysis) and from there into the Refinery. The three routes include the Oregon to Roseville route, the Nevada to Roseville (northern) route, and the Nevada to Roseville (southern) route. See Figure 1-3, which shows the routes. The roundtrip mileage that would be associated with these routes varies between 238 miles for the Nevada to Roseville (southern) route and 594 miles for the Oregon to Roseville route. The average mileage for all three of these routes is 430 miles. Because locomotive routing is under the control of UPRR, it is not possible to rule out that any one of the three railroad routes would be used exclusively by Project-related trains. Therefore, for a worst-case analysis, the Project-related GHG emissions that would be generated within the State have been revised to reflect a round-trip mileage between the California border and Roseville Yard of 594 miles. Based on these estimates, GHG emissions can be extrapolated to accommodate the myriad

permutations of potential routes from the crude oil's point of origin to the State border. ~~Because there is uncertainty regarding the exact route(s) that the crude by rail trains would use to enter the state and arrive at the Roseville rail yard, an average of the track length between the Roseville rail yard and the Nevada state line and the track length between the Roseville rail yard and the Oregon state line (approximately 195 miles of mainline track) was used, to estimate in-state GHG emissions from large line haul.~~ For details of data, calculations, and assumptions used to determine Project-related GHG emissions ~~that would be associated with the Project~~, refer to Appendix E of the DEIR and Appendix A of the Revised DEIR.

As explained in Section 4.1.3, the BAAQMD adopted Thresholds of Significance in 2010, including certain thresholds for GHG emissions. Due to pending litigation the BAAQMD is no longer recommending that the Thresholds be used as a "generally applicable measure" of a project's significant air quality impacts. Lead agencies remain free, however, to apply any significance thresholds that are based on substantial evidence in the record including, but not limited to, the same thresholds that the BAAQMD adopted in 2010.

The BAAQMD's *Revised Draft Options and Justification Report (2009)* recommended an operational significance threshold of 10,000 metric tons per year of CO_2e for projects involving stationary sources within the jurisdiction of the BAAQMD. The threshold level of 10,000 metric tons of CO_2e per year represents a capture rate of approximately 95% of all GHG emissions from stationary sources in the San Francisco Bay Area Air Basin. This threshold level was calculated as an average of the combined CO_2 emissions from all stationary source permit applications submitted to the BAAQMD during a three year analysis period (BAAQMD, 2009). This threshold is consistent with the Executive Order S-3-05 GHG emissions reductions goal of 80% below 1990 levels by 2050, which is roughly equivalent to 90% below current levels by 2050. This emissions reduction goal goes beyond the AB 32 emissions reduction goal established for 2020. The BAAQMD recommended that the stationary source threshold be used for land use projects that would accommodate processes and equipment that would emit GHG emissions and would require a BAAQMD permit.

The Project would require a BAAQMD permit and would result in emissions of GHG within the Bay Area and within other parts of California. Because the effects of GHG emissions are not local and have no relevance to the individual air basins where the emissions are generated, the City of Benicia has determined, based on the 2009 Report and the evidence cited therein, that the 10,000 metric ton threshold is conservative and appropriate to assess the significance of Project-related emissions that would be generated within California. Therefore, the Project-related net annual operational GHG emissions generated within the State would be considered to result in a significant impact on the environment if the net emissions would be more than 10,000 metric tons CO_2e per year. No GHG emissions standard has been adopted as a threshold to determine whether the Project-specific incremental addition to national GHG emission levels would be significant from a CEQA perspective. Accordingly, this analysis uses the 10,000 metric tons CO_2e per year threshold for GHG emissions resulting from Project-related rail transport from points of origin in North America to the California border.

The BAAQMD's 2009 Report did not identify a significance threshold for construction-related GHG emissions. However, the City has elected to use an approach to the determination of significance of GHG construction emissions based on guidance developed by the South Coast Air Quality Management District (SCAQMD). For construction related GHGs, SCAQMD recommends that total emissions from construction be amortized over 30 years and added to operational emissions and then compared to the operations significance threshold (SCAQMD, 2008). Similar to the SCAQMD's recommended approach for construction emissions, this analysis amortizes the construction emissions over a 30-year project lifetime then compares those emissions to the significance threshold of 10,000 metric tons CO_2e per year.

CEQA requires the City to consider whether the Project might conflict with the implementation of any applicable plan, policy, or regulation designed to address climate change. The analysis below considers potential conflicts between the Project and the following ~~three such plans:~~ 1) Executive Order S-3-05 GHG emissions reductions goal of 80% below 1990 levels by 2050; 2) CARB's 2008 Climate Change Scoping Plan in 2008, as updated on May 22, 2014 (CARB, 2014a); ~~2~~ 3) the 2010 CAP (BAAQMD, 2010); and ~~3~~ 4) the City of Benicia Climate Action Plan (City of Benicia, 2009).

2.11.2 DEIR Section 4.6.5, Discussion of Impacts and Mitigation Measures

[Because the "No Impact" determination regarding significance criterion b) has changed as a result of uprail analysis in this Revised DEIR, a new impact (Impact 4.6-2) has been added following discussion of Impact 4.6-1.]

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment.

Impact 4.6-1: The Project would generate direct and indirect GHG emissions. (*~~Less than~~ Significant and Unavoidable*)

Construction Emissions

The majority of Project-related GHG construction emissions would be generated onsite due to the use of heavy-duty off-road equipment that would include excavators, graders, front loaders, dump trucks, cranes, paving equipment, etc., to relocate a portion of an existing spill containment berm, and to construct the proposed rail car unloading rack, unloading rail spurs, and ancillary facilities, such as an aboveground crude oil pipeline, spill containment structures, a firewater pipeline, groundwater wells, and a service road. The equipment operation hours per day and number of required work-days would vary depending on the specific type of equipment and on the construction activity; however, for the purposes of this analysis, it is assumed that construction activities at the site would occur during two shifts each day for an average of 10 hours per shift, 7 days a week, for 25 weeks. GHG emissions would also be generated by construction worker daily commutes and by heavy-duty diesel tractor trailer trucks that would be required to haul materials (e.g., concrete, asphalt, rails) and debris to/from the Project site.

Table 4.6-3 sets forth a summary of the GHG construction emissions that the Project would generate. As indicated in the table, total GHG construction emissions that would be generated over the 6-month construction period in the form of CO_2e would be approximately 601 metric tons. These emissions amortized over a 30-year period equal approximately 20 metric tons per year. As described in the analysis methodology, the total emissions from construction are added to operational emissions and then compared to the operations significance threshold (see Table 4.6-5, below). For details of the GHG construction emissions calculations and assumptions, refer to Appendix E.

TABLE 4.6-3
PROJECT CONSTRUCTION GREENHOUSE GAS EMISSIONS

Sources	CO_2e Emissions (metric tons)
Equipment Exhaust	474
Onsite Vehicle Exhaust	24
Off site Vehicle Exhaust	103
Total Emissions	**601**
Amortized Emissions	20 per year

SOURCE: ERM, 2013a, see Appendix E.1

Operational Emissions in California

Table 4.6-4 identifies (1) the Refinery's total maritime emissions of GHGs over the three-year baseline period; (2) the three-year average to be used as the baseline for maritime emissions (14,260 metric tons of CO_2e); and (3) the portion of those baseline maritime emissions that the Project would eliminate (11,707 metric tons of CO_2e). For additional information about the GHG baseline associated with the Project, refer to Section 4.6.2.3, *Project Baseline*, and Appendix E.2.

TABLE 4.6-4
BASELINE MARINE VESSEL GHG EMISSIONS WITHIN CALIFORNIA

Marine Vessel Baseline Emissions	CO_2e (metric tons)
Total Emissions over Baseline Period	42,780
Annual Average Emissions over Baseline Period	14,260
Estimated Baseline Emissions Displaced by Project	11,707

NOTES: Total crude delivered by marine vessel during the 3-year baseline period was 93,361,985 barrels, which equals an annual average of approximately 31,120,662 barrels. It is estimated that the Project would displace approximately 25,550,000 barrels per year of crude oil delivered by marine vessel.

SOURCES: ERM, 2014 and ESA, 2014, see Appendix Sections E.2 and E.5.

As Table 4.6-5 shows, Project operations would result in a net increase of approximately ~~6,726~~ 13,609 metric tons of CO_2e per year for the state compared to the existing baseline emissions. This increase in emissions is more ~~less~~ than the conservative significance threshold of 10,000 metric tons of CO_2e per year. Therefore, the emissions of GHG that would be generated by the Project within California would ~~not~~ be cumulatively considerable and would represent a

~~less-than-~~significant impact. It seems unlikely that the trains carrying Project-related crude exclusively would use a single route; nonetheless, its exclusive use of the Oregon to Roseville route would result in a significant impact while its exclusive use of either of the other two routes would result in annual net GHG emissions that would be less than the significance threshold and would result in a less-than-significant impact. Total net emissions would be 9,021 and 1,598 metric tons of CO_2e per year for the Nevada to Roseville northern and southern routes, respectively. Given the uncertainty of the actual rail route or routes that would be used to transport Project-related crude oil, this analysis conservatively assumes that exclusive use of the Oregon to Roseville route would occur, resulting in a significant impact.

TABLE 4.6-5
PROJECT ANNUAL NET GHG EMISSIONS GENERATED WITHIN CALIFORNIA

Sources	California CO_2e Emissions (metric tons/year)
Trains - Long Line Haul from California State Line to Roseville[a]	20,041 ~~13,158~~
Trains – Long Line Haul from Roseville to Refinery	4,589
Trains – Short Line Haul at Refinery	135
Trains – Switching at Refinery	351
Electricity Consumption[b]	180
Amortized Construction Emissions	20
Total Project Emissions	25,316 ~~18,433~~
Marine Vessel Emissions Displaced (Baseline)	-11,707
Total Net Emissions	13,609 ~~6,726~~
Significance Threshold	10,000
Significant Impact?	Yes ~~No~~

[a] Train emissions from the state line to Roseville were estimated by ESA based on ERM, 2013b. The estimates assume all train travel on the longest route (Oregon to Roseville), a round-trip distance of 594 miles per day.
[b] Indirect GHG emissions associated with electricity consumption were provided by Valero (2013).

SOURCES: ERM, 2013b and 2014, and ESA 2014 and 2015, see Appendix Sections E.2, E.3, ~~and~~ E.5, and Appendix A of the Revised DEIR.

As disclosed in the discussion of Impact 4.6-1, Project-related train traffic would generate direct and indirect GHG emissions that may have a significant impact on the environment.

Mitigation Discussion

As a general rule, CEQA requires an EIR to describe mitigation measures that could, if implemented, minimize significant environmental effects (14 Cal. Code Regs. §§15126(c), 15126.1(a)). Under CEQA Guidelines Section 15370(e), "mitigation" includes compensating for an impact by replacing or providing substitute resources. For example, the implementation of a Carbon Footprint Reporting and Offsets Plan could, if implemented, reduce the severity of Impact 4.6-1 below established thresholds by requiring Valero to purchase carbon credits from the Climate Action Reserve or another approved source to offset all Project locomotive-related CO_2e emissions generated in excess of 10,000 metric tons.

However, "If the lead agency determines that a mitigation measure cannot be legally imposed, the measure need not be proposed or analyzed. Instead, the EIR may simply reference that fact and briefly explain the reasons underlying the lead agency's determination." (14 Cal. Code Regs. §15126.4(a)(5)). CEQA Guidelines Section 15364 defines "feasible" as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account several factors, including legal, social, and policy ones. Mitigation measures that are beyond a lead agency's powers to impose or enforce are legally infeasible. *Kenneth Mebane Ranches v. Superior Court* (1992) 10 Cal.App.4th 276. As explained in Appendix G of this Revised DEIR, the City cannot regulate UPRR's rail operations either directly or indirectly. Any such attempt would be preempted by federal law, which proscribes any mitigation measure that would have the effect of managing or governing rail operations. For these reasons, a mitigation measure that required the payment of carbon emission offset fees would be infeasible, and so is not recommended. Accordingly, Impact 4.6-1, regarding Project locomotive-related generation of direct and indirect GHG emissions, would remain significant and unavoidable.

Mitigation: None available.

Operational Emissions Outside of California

As explained in Section 4.1, trains travelling between the Refinery and North American oil fields would generate locomotive emissions outside of the State. In order to understand the Project's net impact on climate change, however, one must consider the maritime emissions that the Project would eliminate. The baseline includes emissions from marine vessels travelling between the Refinery and shipping ports throughout the world, including ports in Alaska, South America, and the Middle East.

In order to compare the Project's increase in locomotive emissions with the Project's decrease in baseline maritime emissions, ESA developed emissions factors for GHG emissions from locomotives hauling 100-car trains and marine vessels based on calculations provided by Valero. The emission factors, set forth in Table 4.6-6, are stated in metric tons of CO_2e emitted for delivery of one million barrels of crude oil for each thousand miles of distance traveled[12] between the source and the Refinery.

Table 4.6-7 presents estimates of GHG emissions that would be generated outside of California due to transport of the Project maximum quantity of crude oil by marine vessels and trains. Emissions from marine vessel operation outside California have been estimated using a composite nautical distance for crude oil delivered from source countries of origin during the baseline period. Due to the uncertainty of the origins of the crude oil that would be delivered by rail, the total Project-related GHG emissions that would be generated outside of State cannot be precisely calculated. GHG emissions have been estimated using average estimated distance from two potential North American sources.

[12] The mileage is the one-way distance from the terminal to the Refinery; the emissions are doubled to include the trip to return to the terminal.

TABLE 4.6-6[13]
EMISSIONS FACTORS COMPARISON FOR 1,000,000 BARRELS DELIVERED PER 1,000 MILES TRAVELLED OUTSIDE OF CALIFORNIA

Sources	Metric tons CO_2e per thousand miles hauled per million barrels delivered
Locomotives – large line haul	1,321
Marine Vessel Main & Aux Engines, Open Ocean	876

SOURCE: ESA, 2014; See Appendix E.5

TABLE 4.6-7
EXAMPLES OF GHG EMISSIONS OUTSIDE OF CALIFORNIA

Emission Sources for Example Crude Oil Origins	Example One-Way Distance (miles)	Metric tons CO_2e per 25,550,000 Barrels Delivered per Year (round trip)
Project Locomotives – large line haul from composite North American Origin	1,500	101,219
Baseline Marine Vessel Engines - Alaskan Origin	2,000	89,540
Baseline Marine Vessel Engines – South American Origin	4,000	179,080
Baseline Marine Vessel Engines –Middle East Origin	8,500	380,554
Baseline Marine Vessel Engines – Composite Baseline Origin	7,305	327,044
Net Emissions with Alaskan Origin Baseline	--	11,679
Net Emissions with South American Origin Baseline	--	-77,861
Net Emissions with Middle East Origin Baseline	---	-279,325
Net Emissions with Composite Baseline Origin Baseline	---	-225,825

* This estimate excludes emissions from operation of any pipeline to terminal of origin. The weighted average of sea distances between various ports form which crude oil was imported during the baseline period and the Refinery terminal.

SOURCE: ESA, 2014; See Appendix E.5

As indicated in Table 4.6-~~6~~7, delivery of crude oil by large line haul tank cars would result in lower overall emissions outside of the State than delivery of crude oil by marine vessel from the composite baseline origin. Net GHG emissions that would be generated outside of the State are highly dependent on the origin of the crude oil source and due to the uncertainty in the origins of the crudes that would be delivered by rail as well as the origins of the crudes that would be displaced, the net Project emissions estimates presented in Table 4.6-7 are disclosed for comparison purposes only.

[13] The estimates provided in Table 4.6-7 do not include the following emissions, which occur in California: locomotive emissions associated with small-line (25-rail car trains) hauling or switching that would occur at or in the vicinity of the Refinery, and the marine vessel emissions do not include emissions from main and auxiliary engines and auxiliary boiler operation associated with slow cruise in reduced speed zone, vessel maneuvering, or hoteling at the Refinery dock (i.e., operation of main and auxiliary engines and boilers at/near the dock) or emissions associated with tugboat escorts and berthing, because it would be overly speculative to attempt to estimate such emissions.

Mitigation: None required.

b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases.

Impact 4.6-2: The Project would conflict with Executive Order S-3-05. (*Significant and Unavoidable*)

As discussed under Impact 4.6-1, above, total net GHG emissions associated with the Project would exceed the emissions significance threshold of 10,000 metric tons CO_2e per year, which represents a capture rate of approximately 95% of all GHG emissions from stationary sources in the San Francisco Bay Area Air Basin and is consistent with the Executive Order S-3-05 GHG emissions reductions goal of 80% below 1990 levels by 2050, which is roughly equivalent to 90% below current levels by 2050. Exceedance of this threshold indicates that implementation of the Project would not be consistent with the GHG emission reduction goals for year 2050 identified in Executive Order S-3-05. Therefore, it can be concluded that the Project would conflict with the intent of Executive Order S-3-05, and would result in a potentially significant impact.

The City of Benicia Climate Action Plan Objective IC-4 is to *Encourage the Refinery to Continue to Reduce Emissions* applies to the Refinery (City of Benicia, 2009). Although the Project may result in an increase in GHG emissions (see Impact 4.6-1 discussion, below), the Project would not directly conflict with the City's established strategies to support Objective IC-4; including Strategy IC-4.1, *Continue Implementing Capital Improvement Programs*, and Strategy IC4.2, *Investigate Onsite Energy Production* (City of Benicia, 2009). Therefore, the Project would not conflict with the Climate Action Plan.

In addition, the Project would not conflict with any of the 39 Recommended Actions identified by CARB in its Climate Change Scoping Plan, including the five Recommended Actions that may be relevant to the overall operations of the Refinery (see Table 4.6-2), because none of the recommended actions are directly applicable to the Project. Also, pursuant to State law the Refinery currently participates in the AB 32 emissions reporting and cap-and-trade programs. Any change in GHG emissions generated at the Refinery due to implementation of the Project would be accounted for in these programs. Furthermore, the Project would not result in any potential conflicts related to implementation of measures identified in the BAAQMD's 2010 CAP. ~~There would be no impact.~~

Mitigation Measures: None available. See *Mitigation Discussion*, under Impact 4.6-1.

2.11.3 DEIR Section 4.6.6, Uprail Impacts and Mitigation Measures

The analysis of impacts associated with GHG emissions and related issues of climate change are inherently global concerns. Accordingly, GHG emissions of rail transport of Project-related crude oil are considered in Revised DEIR Section 2.11.2, which supplements and clarifies the focus on DEIR Section 4.6.5, *Discussion of Impacts and Mitigation Measures*.

2.11.4 Summary of Greenhouse Gas Emissions Impacts

Potential direct and indirect effects of Project-related GHG emissions, including the transport of crude by rail from North American point(s) of origination, are analyzed in Revised DEIR Section 2.11.2, which updates the analysis presented in DEIR Section 4.6.5 (p. 4.6-11 et seq.). Potential cumulative effects of GHG emissions are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes, including a potential significant impact regarding GHG emissions from locomotives. This impact determination is consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 4.3, Air Quality and Greenhouse Gases, pp. 4.3-69 through 4.3-71).

Integrating the data and other information in these sections, the Project as a whole would result in significant and unavoidable impacts related to significance criterion a) regarding the generation of GHGs and criterion b) regarding a conflict with plans, policies, or regulations adopted for the purpose of reducing GHG emissions.

2.12 DEIR Section 4.7, Hazards and Hazardous Materials

DEIR Section 4.7 (p. 4.7-1 et seq.), Hazards and Hazardous Materials, identifies and evaluates potential hazards to the public or the environment through the routine transport, use, and disposal of hazardous materials or through reasonably foreseeable upset and accident conditions involving a release of hazardous materials; wildland fire risks; and other hazards-related issues. It describes the physical and regulatory setting in Section 4.7.2 (p. 4.7-1 et seq.) and the criteria used to evaluate the significance of potential impacts in Section 4.7.3 (p. 4.7-13). The evaluation of potential impacts is presented in Section 4.7.4 (p. 4.7-13 et seq.) and Section 4.7.5 (p. 4.7-14 et seq.).

Substantial revisions are proposed to DEIR Section 4.7 in response to comments received on the DEIR that requested supplementation to further develop and refine the quantification of potential risks (including potential health risks) and to address potential consequences of upset or accident conditions in more detail. Given the extent of the changes (shown in underscore and ~~strike-out~~ format), the complete outline of Section 4.7 is reproduced in this section for reviewers' ease and convenience and to provide context for the proposed revisions. Where no changes are proposed, this fact is noted in bracketed italics. In addition to revisions relating to the prior analysis of potential risks and consequences, the DEIR is supplemented to include a new Section 4.7.6, Uprail Impacts and Mitigation Measures, and a new Section 4.7.7, Summary of Hazards and Hazardous Materials Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.12.1 DEIR Section 4.7.1, Introduction

[No revisions are proposed to DEIR Section 4.7.1.]

2.12.2 DEIR Section 4.7.2, Setting

DEIR Section 4.7.2, Setting, describes the Regional Setting (see Section 4.7.2.1, which is found on DEIR page 4.7-1), Local Setting (see Section 4.7.2.2, which begins on DEIR page 4.7-1), Regulatory Setting (see Section 4.7.2.3, which begins on DEIR page 4.7-2), and Project Baseline (see Section 4.7.2.4, which is found on DEIR page 4.7-12). Proposed revisions to these sections (including the addition of a new Section 4.7.2.2 to describe the mainline rail setting) are as noted below.

2.12.2.1 DEIR Section 4.7.2.1, Regional Setting

[No change is proposed to DEIR Section 4.2.7.1.]

2.12.2.2 [*New*] DEIR Section 4.7.2.2, Mainline Rail Setting

This section discusses the existing rail operations along the mainline routes that could be used by crude oil trains serving the Refinery. The UPRR mainline routes that could be used to move crude oil to the Refinery currently are used for both freight and passenger trains. The City of Benicia serves as the terminus for what commonly is referred to as the Overland Route for UPRR.

Rail Track Type

Rail track is classified into six categories (Class 1 – 6) with Class 6 having the most stringent track tolerances/standards[14] and maintenance schedules. With the advent of higher speed trains, additional classifications have been defined for Classes 7 and 8. Main line tracks are generally Class 4 or 5 and typically have lower accident rates per million miles. Class 6 track is used for high speed trains up to 110 miles per hour, and is found in the Northeast Corridor between Washington, D.C. and New York. Class 4 track is the dominant class for main line track used in passenger and long-haul freight service. The Class of a track determines the maximum speed that freight and passenger trains can travel. Higher class tracks have higher allowable speeds.

The Federal Railroad Administration (FRA) establishes minimum design standards for each of the various track classes. Each railroad establishes its own design standards for its tracks that meet or exceed the FRA standards. FRA standards cover the track roadbed, track geometry, track structure (ballast, cross-ties, joints, switches, etc.). These minimum track safety standards are specified in Title 49 of the Code of Federal Regulations (CFR) Part 213 (49 CFR 213).

For the route from the Roseville Yard to the Refinery, 80.8 percent of the track is Class 4 and 5. For the route from Roseville to Oregon, 98.1 percent of the track is Class 4 and 5. For the route from Roseville to Nevada (northern), 100 percent of the track is Class 4 and 5. For the route from Roseville to Nevada (southern), only 3.5 percent of the track is Class 4 and 5. Attachment 1 of

[14] Track tolerances/standards refer to the consistency of the track rail spacing and track gage consistency. 49 CFR 213 contains a detailed explanation of how the track inspection data is used to determine the quality of the rail, in terms of spacing and gage consistency, and how that affects track loading and speed limits.

Revised DEIR Appendix F (Quantitative Risk Analysis of the Valero Benicia Crude by Rail Project) provides more information on the track class these main line rail routes to the Refinery. The main line track along these three routes has an allowable gross weight rating of 315,000 pounds per car.

Rail Accident Rates

Train accidents are required to be reported to the FRA. Such reports typically identify the causes and contributing factors as shown in Table 4.7-1.

TABLE 4.7-1
RAIL INCIDENTS – INITIATING AND CONTRIBUTING CAUSES

Human Errors	Equipment Failures	System or Procedural Failures	External Events
Humping	Non-dedicated car	Routing	Vandalism/sabotage
Switching	Crossing guard failure	Control	At-grade crossing
Coupling	Overpressure	-yards	Flood/washout
Transloading	Leaking valve	-mainline	Earthquake
Inerting	Roller bearing failure	-in-plant	Rockslide/landslide
Contamination	Coupling failure	Interim storage at	Avalanche
Heating and cooling	Broken rail	holding track	Fire on rail siding
Overfilling	Brake failure	Car tracking	Fog/blizzard
Speeding	Roadbed failure	Container specification	Bridge failure
Ignoring closed	Protective coating/ insulation/ thermal protection failure	Emergency response training	
Block signals	Relief device failure	Maintenance	
Driver impairment	Track sensor failure	Inspection	
	Switchgear failure	Circuitous routing	
	Signal failure		
	Communications		
	system failure		
	Broken wheel		
	Suspension failure		
	Fitting defect		
	Corrosion		
	Material defect		
	Bad weld		

SOURCE: MRS, 2015 (Revised DEIR Appendix F), citing Center for Chemical Process Safety (CCPS), 1995.

The transportation of hazardous substances poses a potential for fires, explosions, and hazardous materials releases. In general, the greater the miles traveled the greater the potential for an accident. The size of a potential release is related to the maximum volume of a hazardous substance that can be released in a single accident, should an accident occur, and the type of failure of the containment structure, e.g., rupture or leak. The potential consequences of the accident are related to the size of the release, the population density at the location of the accident, the specific release scenario, the physical and chemical properties of the hazardous material, and local meteorological conditions.

The FRA regulations on reporting railroad accidents/incidents are found primarily in 49 CFR Part 225. The purpose of the regulations is to provide FRA with accurate information concerning the hazards and risks that exist on the nation's railroads. The FRA uses this information for regulatory and enforcement purposes, and for determining comparative trends of railroad safety. These regulations preempt states from prescribing accident/incident reporting requirements.

The FRA compiles data on railroad-related accidents, injuries, and fatalities to depict the nature and cause of rail-related accidents and improve safety. Train accident data reported in the United States, in California, and accidents reported by UPRR between 2005 and 2014 are summarized in Table 4.7-2. Based on the train accident data for the United States, the train accident rate varied from 2.3 accidents per million miles traveled in 2014 to 4.1 accidents per million miles traveled in 2005. The train accident rate for 2014 was 2.3 train accidents per million miles traveled. Of the train accidents reported during the 10-year period (a total of 123,877), less than 1 percent of the train accidents resulted in a release of hazardous materials (259/123,877 = 0.0021 or 0.21%).

TABLE 4.7-2
SUMMARY OF NATIONAL AND CALIFORNIA TRAIN ACCIDENT DATA

Category	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Train Accident Data for United States										
Total Accidents/ Incidents	14,311	13,803	13,936	12,958	11,246	11,630	11,502	11,048	11,588	11,855
Accident Rate	18.14	16.97	17.56	16.74	16.84	16.50	16.03	15.10	15.48	15.48
Train Accidents	3,266	2,998	2,693	2,481	1,912	1,902	2,022	1,760	1,822	1,755
Train Accident Rate	4.139	3.685	3.393	3.205	2.863	2.699	2.818	2.406	2.433	2.292
Train Accidents on Main Line	1,021	981	854	767	619	617	621	504	571	517
Accident Rate on Main Line	1	1	1	1	1	1	1	1	1	1
Hazmat Releases	39	30	46	21	22	21	21	26	18	15
Cars Carrying Hazmat	8,034	9,000	8,562	8,430	6,440	7,567	7,582	6,877	7,188	7,531
Damaged/Derailed	915	1,047	1,056	750	749	722	666	672	822	784
Cars Releasing	52	71	76	37	44	40	66	50	78	26
Total Train Miles (millions)	789	814	794	774	668	705	718	732	749	766
Train Accident Data for UPRR										
Total Accidents/ Incidents	2,747	2,749	2,597	2,287	1,696	1,710	1,744	1,731	1,721	1,774
Train Accidents	955	891	723	637	444	447	546	506	501	501
Hazmat Releases	12	5	6	5	3	4	4	6	1	5
Train Accident Data for California										
Total Accidents/ Incidents	965	944	950	843	728	724	708	828	805	788
Train Accidents	199	191	155	120	101	87	87	86	99	77
Hazmat Releases	2	3	4	1	1	1	0	0	0	0

SOURCE: MRS, 2015 (Revised DEIR Appendix F), citing U.S. Department of Transportation (USDOT), 2015a.

Local Safety Hazard Sites in California

The California Public Utilities Commission (CPUC) has identified a number of local safety hazard sites (LSHS) within California along the mainline rail routes and adopted rules governing operations at some of these sites. Table 4.7-3 provides a list of these LSHS. These sites consist of steep grades and tight curves, and also have historically high frequencies of derailments. As described in Public Utilities Code §7711, factors that the CPUC considers in determining a LSHS include at a minimum the following:

1. The severity of grade and curve of track.
2. The value of special skills of train operators in negotiating the particular segment of railroad line.
3. The value of special railroad equipment in negotiating the particular segment of railroad line.
4. The types of commodities transported on or near the particular segment of railroad line.
5. The hazard posed by the release of the commodity into the environment.
6. The value of special railroad equipment in the process of safely loading, transporting, storing, or unloading potentially hazardous commodities.
7. The proximity of railroad activity to human activity or sensitive environmental areas.

TABLE 4.7-3
LOCAL SAFETY HAZARD SITES IN CALIFORNIA

Generic Name	County	Track Length (miles)	Number of Derailments 2009-13
UPRR Yuma Line	San Bernardino/Riverside	56.4	32
UPRR Bakersfield Line	Kern	24.9	10
UPRR Shasta Line	Siskiyou	26.9	4
UPRR Bakersfield Line	San Bernardino	23.0	4
UPRR Roseville District	Placer	10.0	3
UPRR Feather River Division	Butte and Plumas	93.1	2
UPRR Yuma Line	Riverside	6.0	1
BSNF Gateway	Plumas	10.0	1
BNSF San Diego	San Diego	4.0	1
UPRR Coast Line (Cuesta Grade)	San Luis Obispo	14.0	0
Central Oregon and Pacific Railroad	Siskiyou	9.7	0
UPRR Feather River Division	Plumas	29.0	0
UPRR Cima Grade	San Bernardino	18.1	0
BNSF Cajon	San Bernardino	15.0	0
BNSF Cajon	San Bernardino	0.5	0
BNSF Cajon	San Bernardino	25.6	0

NOTE: Sites highlighted in gray are located along one or more of the three routes most likely to be used by Project-related crude oil trains to transport materials between the State border and the Roseville Yard.

SOURCE: MRS, 2015 (Revised DEIR Appendix F), Adapted from CPUC Annual Railroad Local Safety Hazard Site Report 2014.

Depending upon the route that is taken to get from the California border to the Refinery, each crude oil train would have to traverse one or two LSHS. LSHS account for a disproportionate share of derailments occurring in California. Within the previous five calendar years, California has experienced 342 derailments. Of those, 58 derailments, or 17 percent have occurred at or near LSHS (this includes the LSHS track plus the distance of track 1 mile on each side of the local safety hazard site) (MRS, 2015 [Revised DEIR Appendix F, CPUC, 2014]).

There are four LSHSs along the routes most likely to be used to deliver crude oil to the Refinery; one along the route from the Roseville to the Oregon state line, two along the Feather River route to Nevada (northern), and one along the Truckee route to Nevada (southern). There were nine derailments on these LSHS between 2009 and 2013 (see Table 4.7-3).

2.12.2.3 DEIR Section 4.7.2.3 ~~2~~, Local Setting

The existing Refinery routinely receives, processes, and transports various hazardous materials. These materials exhibit one or more hazardous characteristics, such as combustibility, flammability, or toxicity. Flammable materials can ignite, causing significant fires, explosions, or the release of toxic hazardous materials. Operations at the Refinery are subject to strict safety protocols and process safety management programs that are intended to minimize the possibility of accidental releases.

Existing Refinery Operations

The Refinery converts crude oil into finished products, including gasoline, jet fuel, liquefied petroleum gas (LPG), heating oil, fuel oil, asphalt, petroleum coke, and sulfur. The Refinery produces 10 percent of the clean-burning California Air Resources Board (CARB) gasoline used in California, and 25 percent of the CARB gasoline used in the San Francisco Bay Area.

The Refinery contains a variety of equipment, including distillation columns, storage tanks, reactors, vessels, heaters, boilers, and other ancillary equipment. The Refinery also operates its own asphalt plant, wastewater treatment plant, and a marine terminal at the Port of Benicia. The marine terminal receives crude oil, refinery products, and feedstock deliveries and exports via marine vessels and barges. The Refinery uses rail transport to import chemicals used in refining and to export refinery products such as asphalt, petroleum coke, and LPG.

Crude oils delivered to the Refinery are transferred into storage tanks located in the crude oil tank farm north of the marine terminal. The crude oils are stored in external floating roof tanks, which are configured and operated to comply with the stipulations of BAAQMD Regulation 8-5. Valero combines crude oils from these storage tanks into blends that are then pumped to the Refinery process units located north of the tank farm.

Existing Refinery Rail Traffic

The Refinery is served by a spur off the UPRR Overland Route mainline that runs between the industrial port area along the southeastern edge of the City of Benicia and the Refinery itself, terminating north of Park Road. This spur features an at-grade crossing at Park Road, east of

Bayshore Road. The spur also serves the industrial areas northeast of the Refinery. Switching activity between tracks typically occurs just south of the Park Road at-grade railroad crossing. The Park Road crossing is controlled by two gates and mast-mounted flashing lights.

The Refinery currently exports petroleum coke and LPG from the Refinery via rail to off-site customers. Once a day, during the daytime hours, up to 12 railcars loaded with petroleum coke leave the Refinery via Track 700, and cross Park Road toward the marine terminal and AMPORTS Benicia Port Terminal Company facility directly to the south. The product then is off-loaded into storage silos near the dock for eventual loading onto marine vessels for export. The empty coke railcars are brought back onto the Refinery for reloading for the next day's transfer operations. These railcars remain on the rail spur that serves the Refinery and do not transit on the UPRR main line.

Similar export operations take place with railcars transporting LPG destined for customers. The quantity of these export operations vary with season and production volume. On an annual basis it averages approximately two railcars per day. These railcars are transported on the UPRR main line to their ultimate destinations. The Refinery also occasionally imports LPG. ~~For this analysis, the study area includes the rail corridor between Roseville and Benicia, the unloading facility, and those portions of San Francisco Bay that could be affected by a maritime oil spill. The analysis does not attempt to consider any impacts that might occur along train routes on the way to Roseville. Any such analysis would be speculative, because crude oil shipments heading to the Refinery could come from oil producing regions all over North America. The study area includes:~~

- ~~Residences and businesses near the Rail Unloading facility;~~
- ~~Residences and businesses located along the transportation route; and~~
- ~~Environmental sensitive areas, including the Suisun Marsh along the train route from Roseville to Benicia.~~

~~The analysis also considers the San Francisco Bay, to the extent that the Project would reduce the risk of a crude oil spill from a ship traveling to the port in Benicia.~~

Airports and Air Hazards

[No change is proposed regarding the discussion of airports and air hazards.]

Wildland Fire

[No change is proposed regarding the discussion of wildland fire.]

2.12.2.4 DEIR Section 4.7.2.4 ~~3~~ Regulatory Setting

[No change is proposed to introductory language about the Regulatory Setting.]

Federal and State

Hazardous Materials Management

Under the Federal Emergency Planning & Community Right-To-Know Act (EPCRA), businesses must retain ~~manufacturers'~~ a Material Safety Data Sheet~~s~~ (MSDS) for each hazardous chemical product. Each MSDS sets forth information about the chemical in question, including its hazards, guidelines for handling and storage, and accidental release response measures. EPCRA also requires businesses to submit hazardous chemical inventory forms to the State Emergency Response Commission, Local Emergency Planning Committee, and local fire department annually on March 1st. In 1990, Congress passed the Pollution Prevention Act, which requires facilities to report additional data on waste management and source reduction activities to U.S. Environmental Protection Agency (EPA) under the Toxics Release Inventory Program. The goal of the Toxics Release Inventory is to provide communities with information about toxic chemical releases and waste management activities and to support informed decision making at all levels by industry, government, non-governmental organizations, and the public. [¶]

In California, businesses meet the federal requirements by complying with the California Hazardous Materials Business Plan program (CA Health and Safety Code §25504 [a-c]). The Hazardous Materials Business Plans describe hazardous materials inventories, storage container types and locations, emergency response and evacuation procedures, and employee hazardous materials training program. The Solano County Department of Resource Management, Environmental Health Services Division Enforcement (SCDRM) enforces the hazardous materials the Hazardous Materials Business Plan requirements as they apply to the Refinery. SCDRM is the Certified Unified Program Agency (CUPA) for Solano County under state law.

Hazardous Waste Management

The Federal Resource Conservation and Recovery Act of 1976 (RCRA) sets forth a "cradle-to-grave" regulatory program governing the generation, transportation, treatment, storage, and disposal of hazardous waste. Under RCRA, individual states may implement their own hazardous waste programs in lieu of RCRA as long as the state program is at least as stringent as federal RCRA requirements.

In California, the Department of Toxic Substances Control (DTSC) implements the federal RCRA requirements under the California Hazardous Waste Control Law. DTSC's hazardous waste regulations establish criteria for identifying, packaging, labeling, and managing of hazardous wastes. The requirements are implemented through a permit program governing treatment, storage, disposal, and transportation of hazardous waste. The regulations require hazardous waste generators to prepare a Hazardous Waste Contingency Plan describing hazardous waste storage and secondary containment facilities, emergency response and evacuation procedures, and employee hazardous waste training program. While DTSC generally retains authority to implement and enforce its hazardous waste management regulations, much of the day-to-day regulation is delegated to the SCDRM as the local CUPA.

Risk Management Programs

The EPA requires each facility that handles listed regulated substances to develop Risk Management Programs (RMP) to prevent accidental releases of these substances. RMP materials are submitted to both local agencies (generally the fire department) and the EPA. Stationary sources with more than a threshold quantity of a regulated substance shall be evaluated to determine the potential for, and impacts of, accidental releases of that substance. Under certain conditions, the owner or operator of a stationary source may be required to develop and submit a RMP. A RMP consists of three main elements: a hazard assessment that includes off-site consequences analyses and a five-year accident history; a prevention program; and an emergency response program.

Federal Regulation of Oil Transport by Rail

The Federal Railroad Administration (FRA) is a department within the U.S. Department of Transportation (USDOT). The FRA operates through a number of regional offices. The Region 7 office, headquartered in Sacramento, governs rail activities in Arizona, California, Nevada, and Utah. FRA adopts and enforces railroad safety regulations, including regulations relating to track safety, grade crossings, rail equipment, operating practices, and the transport of hazardous materials by rail. FRA promulgates railroad safety regulations (49 CFR subtitle B, chapter II (parts 200-299)) and orders, enforces those regulations and orders as well as the Hazardous Materials Regulations at 49 CFR Parts 171-180, and the Federal railroad safety laws, and conducts a comprehensive railroad safety program.

FRA's regulations promulgated for the safety of railroad operations involving the movement of freight address: 1) railroad track; 2) signal and train control systems; 3) operating practices; 4) railroad communications; 5) rolling stock; 6) rear-end marking devices; 7) safety glazing; 8) railroad accident/incident reporting; 9) locational requirements for the dispatch of U.S. rail operations; 10) safety integration plans governing railroad consolidations, mergers, and acquisitions of control; 11) alcohol and drug testing; 12) locomotive engineer and conductor certification; 13) workplace safety; 14) highway-rail grade crossing safety; and other subjects. The FRA inspects rail facilities throughout the country in order to ensure compliance with its own regulations, and those adopted by the Pipeline and Hazardous Materials Safety Administration (PHMSA).

The FRA also is responsible for conducting inspections of rail lines and bridges throughout the United States, for example, with the railroad bridge safety standards (49 CFR Parts 213 and 237). The bridge safety standards final rule requires the railroad companies that own the bridges to:

- Implement bridge management programs that include at minimum annual inspections of railroad bridges;
- Conduct special inspections if the weather or other conditions warrant such inspections;
- Maintain an inventory of all railroad bridges and know their safe load capacities;
- Maintain design documents and to document all repairs, modifications, and inspections of each bridge;
- Ensure bridge engineers, inspectors, and supervisors must meet minimum qualifications;

- Make sure bridge inspections are conducted under the direct supervision of a designated railroad bridge inspector; and
- Conduct internal audits of bridge management programs and inspections.

PHMSA is another department within the USDOT. Pursuant to the Hazardous Materials Transportation Act, PHMSA adopts regulations governing the transport of hazardous materials by rail, highway, air, and water. The PHMSA regulations are set forth in Chapter I of Subtitle B of Title 49 of the Code of Federal Regulations (49 CFR 100 et seq.). The FRA enforces the requirements set forth in PHMSA regulations.

The National Transportation Safety Board (NTSB) is an independent federal agency. The NTSB reviews transportation accidents, including rail accidents, and makes recommendations to FRA and PHMSA for regulatory changes.

The American Association of Railroads (AAR) is an industry trade association that represents railroads, including the major freight railroads in the United States, Canada, and Mexico. AAR adopts standards for the design and construction of tank cars carried by its members. In some cases, these standards are more stringent than the requirements set forth in FRA or PHMSA regulations. In addition, USDOT's predecessor delegated to AAR regulatory authority to approve the construction, alteration, repair, and conversion of tank cars and to certify facilities engaged in these activities.

The PHMSA regulations classify hazardous materials based on each material's hazardous characteristics. Crude oil is assigned to hazard Class 3, based on specified characteristics of flammability and combustibility (49 CFR 173.120)[15]. The pertinent PHMSA regulations governing rail transport are summarized as follows:

- 49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans*, addresses numerous aspects of safe rail transport, including requirements pertaining to the hazardous materials classification of crude oil.
- 49 CFR 173, *General Requirements for Shipments and Packages*, specifies requirements for bulk packaging including the type of tank car a hazardous material must be transported in based on its assigned Packing Group.
- 49 CFR 174, *Carriage by Rail*, specifies handling, loading, and unloading requirements for the safe transport and shipping of hazardous materials, which must be performed by qualified personnel. This part also addresses correct placarding of rail cars to indicate the hazard classifications of the materials, and segregation of incompatible materials.
- 49 CFR 176, *Carriage by Vessel*, provides further details on vessel carriage requirements for different classes of hazardous materials.

[15] A flammable liquid (Class 3) means a liquid having a flash point of not more than 60°C (140°F), or any material in a liquid phase with a flash point at or above 37.8°C (100°F) that is intentionally heated and offered for transportation or transported at or above its flash point in a bulk packaging.

- 49 CFR 179, *Specifications for Tank Cars*, provides design standards and construction requirements for rail tank cars including tank wall thickness, tank mounting, welding certification, pressure relief devices, protection of fittings, loading/unloading valve requirements, coupler vertical restraints systems, tank-head puncture-resistance systems, and thermal protection systems.

Under PMHSA regulations, all crude oil must be shipped in a tank car built to the "DOT-111" specification. DOT-111 tank cars are non pressure tank cars. The cars have a minimum shell thickness of 7/16 inch and a design pressure of up to 500 pounds per square inch gage (psig). DOT-111 tank cars are used to transport a variety of hazardous materials, including crude oil and ethanol. The DOT-111 design has been in use since the 1960's.

Different "packaging" requirements apply to different crude oils transported by rail. PHMSA regulations assign hazardous materials to "Packing Groups" based on the risks posed by the transport of each hazardous material. Packing Group I indicates great danger; Packing Group II indicates medium danger; and Packing Group III indicates minor danger (49 CFR 171.8). Materials assigned to Packing Group I are subject to the most stringent packaging requirements, while crude oils assigned to Packing Group III are subject to the least stringent requirements.

Individual crude oils can be classified as Packing Group I, II, or III materials depending on their boiling points and flash points. Any crude oil with a boiling point below 95° Fahrenheit is assigned to Packing Group I. Packing Group II includes any crude oil with a boiling point above 95° and a flash point below 73° Fahrenheit. Packing Group II crude oils are less volatile than Packing Group I, although more volatile than Packing Group III crude oils. Packing Group III includes any crude oil with a boiling point above 95° and a flash point between 73° and 140° Fahrenheit.

Recent and Ongoing Developments in the Regulation of Crude Transport by Rail

In response to recent rail accidents involving crude oil and ethanol, federal regulatory agencies and AAR have taken a variety of actions designed to reduce the risk of accidental releases from DOT-111 tank cars. The effort to reduce risk is ongoing, and further regulatory changes are expected in the relatively near future.

The first of these rail accidents occurred at a highway/rail grade crossing in Cherry Valley, Illinois on June 19, 2009. A freight train carrying ethanol in DOT-111 tank cars derailed, causing the release of ethanol from thirteen tank cars. The ethanol caught fire. At the time of the derailment, several motor vehicles were stopped on either side of the grade crossing waiting for the train to pass. The fire fatally injured an occupant in one of the motor vehicles, and seriously injured two other occupants. Five occupants of other vehicles were also injured. The accident prompted a mandatory evacuation of approximately 600 residences within a ½ mile radius of the grade crossing (NTSB, 2012a).

In its 2012 Accident Report, the NTSB identified a number of causes of the Cherry Valley accident and the ensuing release, including the fact that the track structure was washed out by a flash flood. The NTSB also concluded that design of the DOT-111tank cars was "inadequate,"

making the cars "subject to damage and catastrophic loss of hazardous materials during derailment" (NTSB, 2012a).

In 2012, NTSB issued a safety recommendation urging PHMSA to adopt more stringent specifications for DOT-111 tank cars that carry ethanol or crude oil and are assigned to Packing Groups I or II (NTSB, 2012b). The recommendations included making the tank head and shell more puncture resistant and requiring that bottom outlet valves are designed to remain closed during accidents when the valve and operating handle are subjected to impact forces.

Also in response to the Cherry Valley accident, AAR's North American Tank Car Committee began to consider possible changes to the DOT-111 design that would help prevent releases. In March 2011, the AAR filed Petition P-1577 with the PHMSA, asking PHMSA to adopt more stringent standards for DOT-111 tank cars (AAR, 2011a). ~~PHMSA has not yet acted on the AAR Petition.~~ PHMSA ~~has, however,~~ instituted a rulemaking to address the AAR Petition along with seven other petitions and four NTSB recommendations relating to transportation of hazardous materials by rail (PHMSA, 2013). PHMSA reviewed the public comments on the proposed rulemaking and used the information gathered to aid in the development of a Notice of Proposed Rulemaking issued by USDOT on July 23, 2014. The Final Rule was issued on May 1, 2015 (see below). ~~The rulemaking will address, among other issues, the adequacy of the DOT-111 tank cars. The PHMSA rulemaking may well result in more stringent regulations governing the design of tank cars that carry crude oil and other hazardous materials.~~

Rather than wait for action on its PHMSA Petition, on August 31, 2011, AAR voluntarily imposed more stringent standards for the design of DOT-111 tank cars. AAR issued the new standards through Casualty Prevention Circular 1232 (CPC-1232) (AAR, 2011b). CPC-1232 established the following requirements for DOT-111 tank cars:

- Thicker, tank shell and heads;
- Higher tensile strength, normalized steel to improve the ability of tank cars to survive an accident;
- Protective, steel head shields at both ends of tank car;
- Consolidated top fittings located beneath a robust steel protective housing; and
- A reclosing pressure relief device to reduce the likelihood of over-pressure if the car is involved in an accident and pool fire.

DOT-111 tank cars that meet these standards are often referred to by the number "1232," and shall be referred to here as "1232 Tank Cars" ~~(see Figure 4.7-1)~~. DOT-111 tank cars that do not comply with CPC 1232 are often referred to as "legacy" DOT-111 tank cars, and are referred to here as "DOT-111 Legacy Tank Cars." As a result of CPC-1232, all DOT-111 tank cars ordered after October 1, 2011 must meet the standards for 1232 Tank Cars. As of April, 2013, approximately one third of the DOT-111 tank cars used to transport crude oil in North America ~~are~~ were 1232 Tank Cars, while the rest are DOT-111 Legacy Tank Cars (AAR, 2014). More

recent information indicates that nearly 25 percent of the DOT-111 fleet carrying crude today meets the higher design standards outlined above (MRS 2015, [Revised DEIR Appendix F], p. 21).

In addition, ~~in just the last year~~ beginning in 2013, PHMSA, FRA, NTSB, and AAR have taken a number of actions in response to certain accidents involving the rail transportation of crude oil ~~from the Bakken Shale formation in North Dakota~~. These incidents are summarized as follows:

- On March 27, 2013, a train derailed in Parkers Prairies, Minnesota. Fourteen cars on a Canadian Pacific Railway (CP) train caring Canadian crude derailed, and one car was heavily damaged. An estimated 30,000 gallons of crude spilled; there was no fire or explosion.

- On May 21, 2013, a train derailed near Jansen, Saskatchewan, Canada. A CP mixed freight train jumped the tracks and five cars derailed, with one leaking its content. An estimated 24,000 gallons spilled; there was no fire or explosion.

- On July 6, 2013, a train carrying Bakken crude oil in 72 DOT-111 Legacy Tank Cars derailed in the downtown area of Lac-Mégantic, Canada. The waybills described the Bakken crude oil as a Class 3 hazardous material, assigned to Packing Group III. The engineer stopped the train at a designated crew change point, left the lead locomotive engine idling, and departed the area leaving the train unattended on the mainline track. A fire was later reported on one of the train's unattended locomotive engines and local emergency personnel responded. An employee of the rail line also arrived on scene. After the responders departed, the unattended train began to move and gather speed, travelling uncontrolled for 7.4 miles down a descending 1.2% grade into the town of Lac-Mégantic. The train reached a top speed of 60-70 miles per hour. Sixty-three of the tank cars derailed and, of these, at least 60 released a total of 1.6 million gallons of crude oil. The spilled oil ignited immediately, and the resulting fire engulfed the tank cars and the surrounding area. A total of 47 people died in the accident. Thirty buildings were destroyed and 2,000 people were evacuated. Approximately 26,000 gallons of crude oil was discharged into the Chaudière River (NTSB, 2014a).

- On October 19, 2013, a 134-car mixed freight train transporting nine tank cars of liquefied petroleum gas and four tank cars of crude oil derailed and caught fire outside Gainford, Alberta, Canada. Gainford residents were evacuated. None of the tank cars carrying oil leaked or burned. No one was injured or killed.

- On November 8, 2013, a train derailed in Aliceville, Alabama. The train was carrying 90 DOT-111 Legacy Tank Cars with Bakken crude oil from North Dakota to a refinery in the Gulf Coast. Approximately 12 of the tank cars released crude oil and caught fire. There were no reported injuries.

- On December 30, 2013, a train carrying 106 DOT-111 Legacy Tank Cars with Bakken crude oil collided with a grain train in Casselton, North Dakota. A total of 34 cars from both trains derailed, including 20 that were carrying Bakken crude oil. These cars released their contents, exploded and burned for over 24 hours. There were no reported injuries. Over 1,400 residents were evacuated from the scene.

- On April 30, 2014 in Lynchburg, Virginia, a train carrying crude oil tank cars derailed. Some of the cars that derailed were Legacy DOT-111 Tank Cars, while some were 1232 Tank Cars. One of the 1232 Tank Cars ruptured and released crude oil that ignited (Oil Daily, 2014). In addition, over 33,000 gallons of Bakken crude oil was released into the James River. There were no reported injuries.

- On February 14, 2015, a Canadian National (CN) crude oil unit train was proceeding eastward on CN's Ruel Subdivision near Gogama, Ontario. The train was hauling 100 DOT-111 tank cars loaded with crude oil and petroleum distillates. While travelling at 38 mph, the train crew felt a heavy tug on the train and a train-initiated emergency brake application occurred. Subsequently, the crew observed a fire about 10 cars behind the locomotives, so they detached the locomotives from the train. Twenty-nine cars derailed and several were breached, released product, and ignited a large fire that initially involved 7 of the derailed cars. Additional product was subsequently released, and a total of 21 cars sustained fire damage ranging from minor to severe. About 900 feet of track was destroyed.

- On February 16, 2015, a CSX train carrying Bakken crude derailed in the Mount Carbon area of Fayette County West Virginia. Twenty-six cars of a 109-car train derailed; 19 cars were involved in the fire and explosion. Some of the spilled oil entered the Kanawha River. There were no reported injuries.

- On March 5, 2015, a Burlington Northern Santa Fe (BNSF) unit train carrying crude oil derailed in Jo Daviess County, Illinois near the City of Galena. Twenty-one tank cars (each containing about 30,000 gallons) derailed. Of the 21 derailed cars, originally 5 were on fire and/or ruptured spilling oil onto the embankment and in a seasonal wetland (currently not flooded) adjacent to the Galena and Mississippi Rivers. The fire burned for three days. BNSF successfully uncoupled approximately 84 railroad tank cars containing crude oil, thus removing the risk of crude oil releasing from these tanks. According to the FRA, the train was traveling at 23 miles per hour (mph) when it derailed, well below the maximum speed allowed. The damaged tank cars were newer CPC-1232 tank cars.

- On March 7, 2015 a CN crude oil unit train was proceeding eastward on CN's Ruel Subdivision near Gogama, Ontario. The train was hauling 94 DOT-111 tank cars. While travelling at about 43 mph, a train-initiated emergency brake application occurred and the crew observed a fireball about 700 feet behind the locomotives. They detached the locomotives and first five cars behind the locomotives and pulled clear. Thirty-nine cars derailed. One of the derailed cars struck the bridge structure, rolled down an embankment, and released product. Two derailed cars were submerged in the river, three were partially submerged, and the rest were in a pile on the river bank. Several cars breached, released product, and a large pool fire ignited that destroyed the steel rail bridge. Most of the remaining cars sustained fire damage. About 700 feet of track was destroyed.

- On May 6, 2015, a BNSF train derailed near Heimdal, North Dakota, about 100 miles northeast of Bismarck, resulting in a large fire that involved six tank cars. There were no injuries, and about 40 people were evacuated from Heimdal. The train's event recorder showed it was traveling at about 24 mph at the time of the derailment, which was slower than the 35 mph limit.

- On July 16, 2015, a BNSF train hauling 106 tank cars derailed near Culbertson, Montana. Approximately 22 cars derailed and 4 were breached, spilling about 35,000 gallons of crude oil. About a dozen homes and an oil field worker camp were evacuated; no injuries were reported. No explosions or fires occurred as a result of the accident.

~~These a~~ Accidents have triggered the following responses from federal regulators and the AAR:

- On August 2, 2013, FRA issued Emergency Order No. 28 establishing additional requirements for unattended trains. The requirements are designed to ensure that unattended trains, locomotives, and tenders on the mainline track or siding are properly secured against

unintended movement. The Order was prompted by the Lac-Mégantic accident, which involved an unattended train (FRA, 2013a). On July 29, 2015, FRA issued a final rule (FRA-2014-0032) that codifies many of the requirements included in the Emergency Order, which will sunset on the effective date of the final rule (October 5, 2015) (FRA, 2015a).

- Also on August 2, 2013, PHMSA and FRA issued joint Safety Advisory 2013-06. The advisory recommended eight specific actions that railroads and shippers should take relating to unattended trains, procedures for securing trains, safety and security plans, and proper classification of hazardous materials for shipment (FRA/PHMSA, 2013b).

- On September 6, 2013 PHMSA published an Advanced Notice of Proposed Rulemaking. As noted previously, information gathered for this proposed rulemaking was used in the development of a Notice of Proposed Rulemaking issued by USDOT on July 23, 2014. The Final Rule was issued on May 1, 2015 (see below). This rulemaking ~~will~~ proposed to address, among other topics, the need to enhance the standards for DOT-111 tank cars used to transport Packing Group I and II hazardous materials, including crude oil (78 FR 54849; PMHSA, 2013).

- On November 14, 2013, AAR submitted comments in response PHMSA's advance notice of rulemaking. In the comments, AAR recommended that PHMSA adopt tank car standards that are even more stringent than those adopted by AAR in CPC-1232. AAR recommended that PHMSA adopt standards for new cars, and require retrofit of existing cars, to include:

  - an outer steel jacket around the tank car and thermal protection,
  - full-height head shields, and
  - high-flow capacity pressure relief valves.

  AAR also recommended that PHMSA require additional safety upgrades for 1232 Tank Cars, including:

  - installation of high-flow-capacity relief valves, and
  - design modifications to prevent bottom outlets from opening in the case of an accident.

  AAR also recommended that PHMSA aggressively phase out older-model tank cars used to move flammable liquids that cannot be retrofitted to meet new federal requirements, and eliminate the option for rail shippers to classify a flammable liquid with a flash point between 100 and 140 degrees Fahrenheit as a combustible liquid. ~~The tank standards that AAR is currently recommending are displayed in Figure 4.7-1.~~

- On November 20, 2013, PHMSA and FRA issued joint Safety Advisory 2013-07 relating to the proper classification of crude oil for purposes of the packing group requirements. (FRA/PHMSA 2013c). The Advisory expressed the concern that, based on its low flash point, the Bakken crude involved in the Lac-Mégantic incident should not have been classified as a Packing Group III material. The Advisory stressed the importance of proper classification based on flash point and other hazardous characteristics. The Advisory also announced a joint FRA/PHMSA compliance initiative called "Operation Classification." The initiative involves unannounced inspections at oil producing sites to ensure that crude oil has been properly tested and classified before it is loaded onto a tank car. The initiative has informally been referred to as the "Bakken Blitz."

- On January 2, 2014, PHMSA issued a Safety Alert reinforcing the need to properly characterize crude oil offered for shipment (PHMSA, 2014a). The Alert specifically noted

that, because of its low flash point and/or low boiling point, light sweet crude such as Bakken should typically be assigned to Packing Group I or II.

- On January 21, 2014, NTSB issued Safety Recommendations R-14-4, 14-5, and 14-6 to PHMSA relating to the Lac-Mégantic incident (NTSB, 2014a). NTSB reported its finding that, based on its flash point, the Bakken crude oil released in the Lac-Mégantic incident was improperly characterized as a Packing Group III material, and should have been assigned to Packing Group II. NTSB recommended, among other things, that PHMSA and FRA work together to require shippers to accurately characterize hazardous materials offered for shipment to ensure that they are assigned to the correct packing group.

- On January 23, 2014, NTSB issued Safety Recommendations R-14-1, 14-2, and 14-3 to FRA relating to the Lac-Mégantic incident (NTSB, 2014b). NTSB repeated its findings relating to mischaracterization of Bakken crude oil and recommended that FRA, among other things, audit shippers and railroads to ensure that they are using the correct shipping classifications.

- On February 21, 2014, DOT and AAR announced an agreement relating to the transport of crude oil by rail (USDOT/AAR, 2014). AAR and its individual members (including Union Pacific Railroad) agreed to take the following eight specific actions designed to reduce the risk of transporting crude by rail:

  - Increase track inspections~~;~~: Effective March 25, 2014, railroads are required to perform at least one additional internal-rail inspection each year above those required by FRA regulations on main line routes over which trains moving 20 or more carloads of crude oil travel. Railroads also must conduct at least two high-tech track geometry inspections each year on main line routes over which trains with 20 or more loaded cars of crude oil are moving. Current federal regulations do not require comprehensive track geometry inspections.

  - Upgrade braking systems~~;~~: No later than April 1, 2014, railroads were required to equip all trains with 20 or more carloads of crude oil with either distributed power or two-way telemetry end-of-train devices. These technologies allow train crews to apply emergency brakes from both ends of the train in order to stop the train faster.

  - Use of Rail Traffic Routing Technology: Apply the route planning and route selection requirements set forth in 49 CFR 172.820[16] to the routing of crude oil trains (the requirements do not currently apply to trains transporting crude oil~~);~~). No later than July 1, 2014 railroads were required to use the Rail Corridor Risk Management System (RCRMS) to aid in the determination of the safest and most secure rail routes for trains with 20 or more cars of crude oil. RCRMS is a sophisticated analytical tool, developed in coordination with the federal government, including the U.S. Department of Homeland Security, PHMSA, and FRA.

  - Lower Speeds: No later than July 1, 2014 railroads were required to operate trains with 20 or more tank cars carrying crude oil that include at least one older DOT-111 car no

[16] Section 172.820 requires rail carriers to analyze the safety and security risks for each transportation route. The analysis must take into account a variety of relevant factors including, among others, the volume of hazardous materials transported, the density of rail traffic, trip length, track type, class and maintenance schedule, track grade and curvature, signals and train control system, environmentally sensitive or significant areas, and venues along the route (49 CFR 172 app. D). The analysis must also identify and analyze practicable alternative routes.

faster than 40 miles-per-hour in the federally designated high-threat-urban areas[17] (HTUA) as established by Federal regulations. ~~Establish a maximum speed limit of 40 miles per hour for DOT-111 Legacy Tank Cars carrying crude oil through federally designated "high threat urban areas."~~ (These areas include some cities along the route from Roseville to Benicia)~~;~~

- Continue to work with local communities to address their concerns about crude-by-rail transport in their areas;

- No later than July 1, 2014, railroads were required to begin i~~I~~nstalling wayside wheel bearing detectors[18] ~~on tracks~~ at 40-mile intervals (if not already in place) along tracks with trains carrying 20 or more crude oil cars. These devices monitor train wheels and can detect potential defects before they cause an accident;

- Increase emergency response training~~;~~. Railroads committed to provide $5 million to develop specialized crude by rail training (by July 1, 2014) and fund a tuition assistance program for local first responders. One part of the curriculum was designed to be provided to local emergency responders in the field, as well as comprehensive training that was conducted at the Transportation Technology Center, Inc. (TTCI) facility in Pueblo, Colorado. The funding provided program development as well as tuition assistance for an estimated 1,500 first responders in 2014.

- Conduct planning for emergency response capability. Railroads developed an inventory of emergency response resources for responding to the release of large amounts of crude oil along routes over which trains with 20 or more cars of crude oil operate. This inventory included locations for the staging of emergency response equipment and, where appropriate, contacts for the notification of communities, and to provide USDOT (and other emergency responders upon request) with information on the deployment of the resources.

- On March 6, 2014, USDOT issued Emergency Order DOT-OST-2014-0025. (USDOT, 2014a). Among other things, the Order requires shippers to assign crude oil to Packing Groups I or II, thereby assuring that Bakken and other highly volatile crude oils cannot be mischaracterized and assigned to Packing Group III.

- On May 7, 2014, USDOT issued Emergency Order DOT-OST-2014-0067. (USDOT, 2014b). The Order requires railroads to notify the State Emergency Response Commission for each state in which the railroad transports Bakken crude oil. The notice must contain certain prescribed information, including the number of trains, the train routes, and the characteristics of the crude oil. Absent the required notice, railroads are prohibited from transporting Bakken crude oil. The Order allows states to effectively plan emergency response procedures for an accident involving Bakken crude oil.

[17] A HTUA is defined by the Federal government as an area comprising one or more cities and surrounding areas including a 10-mile buffer zone. A list of the HTUA, as determined by the Federal government, is provided in Attachment 6 of Revised DEIR Appendix F.

[18] Wayside wheel bearing detectors are devices that are placed along railroad tracks that detect heat or acoustic signatures, which would indicate that a bearing may fail in the near future. This allows railroad operators to detect defects before they cause accidents or damage track.

- On May 7, 2014, FRA and PHMSA issued a joint Safety Advisory relating to the transport of Bakken crude by rail. (FRA/PHMSA, 2014). The Advisory recommended that shippers and railroads use the rail tank car designs with the "highest level of integrity reasonably available within their fleet" for the shipment of Bakken crude oil. The Advisory also specifically advised shippers and railroads to avoid the use of DOT-111 Legacy Tank Cars for shipping Bakken crude oil, to the extent reasonably practicable.

- On July 23, 2014 PHMSA issued an Advanced Notice of Proposed Rulemaking regarding Oil Spill Response Plans for "high-hazard flammable trains" (HHFT) that seeks to expand oil spill planning requirements for shipments of flammable materials (PHMSA, 2014b). The proposed rulemaking would set a lower threshold for preparation of a comprehensive oil spill response plan for crude oil trains.

- On April 17, 2015 PHMSA and FRA issued two Safety Advisories and an Emergency Order to further enhance the safe shipment of Class 3 flammable liquids (USDOT, 2015a). PHMSA issued a Safety Advisory to remind hazardous materials shippers and carriers of their responsibility to ensure that current, accurate, and timely emergency response information is immediately available to first responders. PHMSA and FRA issued a Safety Advisory to remind railroads operating a HHFT train that certain information may be required by PHMSA and/or FRA personnel during the course of an investigation immediately following an accident. FRA issued an Emergency Order to require that trains transporting large amounts of Class 3 flammable liquid through certain highly populated areas adhere to a maximum authorized operating speed of 40 mph. FRA issued a Safety Advisory recommending that railroads use highly qualified individuals to conduct brake and mechanical inspections and recommends a reduction to the impact threshold levels the industry currently uses for wayside detectors that measure wheel impacts to ensure the wheel integrity of tank cars in those trains. FRA issued a Notice and comment request seeking to gather additional data concerning rail cars carrying petroleum crude oil in any train involved in an FRA reportable accident. FRA Acting Administrator also sent a letter to the president of the Association of American Railroads asking continued commitment of its member railroads to address the safety issues presented.

USDOT Final Rule: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains

On May 1, 2015, USDOT issued its final rule covering enhanced tank car standards and operational controls for high-hazard flammable trains (USDOT, 2015b). The final rule defines certain trains transporting large volumes of flammable liquids as "high-hazard flammable trains" (HHFT) and regulates their operation in terms of speed restrictions, braking systems, and routing. The final rule also adopts safety improvements in tank car design standards, a sampling and classification program for unrefined petroleum-based products, and notification requirements. Table 4.7-4 provides a summary of the elements of the final rule. Table 4.7-5 further summarizes the design specifications for tank cars allowed under the final rule. New tank cars built after October 1, 2015 would be required to meet the new DOT-117 standard. All existing Non-Jacketed CPC-1232 tank cars in Packing Group I service (tank cars proposed for use by Valero) would have to meet the DOT-117R standard by April 1, 2020.

TABLE 4.7-4
FINAL REGULATORY REQUIREMENTS FOR HHFT

Adopted Requirement	Affected Entity
Enhanced Standards for Both New and Existing Tank Cars Used in HHFTs • New tank cars constructed after October 1, 2015 are required to meet enhanced DOT Specification 117 design or performance criteria. • Existing tank cars must be retrofitted in accordance with the DOT-prescribed retrofit design or performance standard. • Retrofits must be completed based on a prescriptive retrofit schedule and a retrofit reporting requirement is triggered if initial milestone is not achieved.	Tank Car Manufacturers, Tank Car Owners, Shippers / Offerors and Rail Carriers
More Accurate Classification of Unrefined Petroleum-Based Products • Develop and carry out sampling and testing program for all unrefined petroleum-based products, such as crude oil, to address: (1) Frequency of sampling and testing that accounts for any appreciable variability of the material (2) Sampling prior to the initial offering of the material for transportation and when changes that may affect the properties of the material occur; (3) Sampling methods that ensures a representative sample of the entire mixture, as offered, is collected; (4) Testing methods that enable classification of the material under the HMR; (5) Quality control measures for sample frequencies; (6) Duplicate samples or equivalent measures for quality assurance; (7) Criteria for modifying the sampling and testing program; (8) Testing or other appropriate methods used to identify properties of the mixture relevant to packaging requirements • Certify that program is in place, document the testing and sampling program outcomes, and make information available to DOT personnel upon request.	Offerors / Shippers of unrefined petroleum-based products
Rail Routing - Risk Assessment • Perform a routing analysis that considers, at a minimum, 27 safety and security factors and select a route based on its findings. These planning requirements are prescribed in 49 CFR § 172.820. ***Rail Routing - Notification*** • Ensures that railroads notify State and/or regional fusion centers and State, local, and tribal officials who contact a railroad to discuss routing decisions are provided appropriate contact information for the railroad in order to request information related to the routing of hazardous materials through their jurisdictions. This replaces the proposed requirements to notify State Emergency Response Commissions (SERCs) or other appropriate state delegated entity about the operation of these trains through their States. ***Reduced Operating Speeds*** • Restrict all HHFTs to 50-mph in all areas. • Require HHFTs that contain any tank cars not meeting the enhanced tank car standards required by this rule operate at a 40-mph speed restriction in high-threat urban areas.	Rail Carriers
Enhanced Braking • Require HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributed power (DP) braking system. • Require trains meeting the definition of a "high-hazard flammable unit train" (HHFUT) be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021, when transporting one or more tank cars loaded with a Packing Group I flammable liquid. • Require trains meeting the definition of a HHFUT be operated with an ECP braking system by May 1, 2023, when transporting one or more tank cars loaded with a Packing Group II or III flammable liquid.	Rail Carriers

NOTES:

HHFT-High-Hazard Flammable Trains are trains comprised of 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or 35 or more loaded tank cars of a Class 3 flammable liquid across the entire train.

HHFUT-High-Hazard Flammable Unit Trains are trains comprised of 70 or more loaded tank cars containing Class 3 flammable liquids traveling at speeds greater than 30 mph.

SOURCE: MRS, 2015 (Revised DEIR Appendix F), citing USDOT, 2015b.

TABLE 4.7-5
FINAL SAFETY FEATURES BY TANK CAR OPTION

Tank Car	Bottom Outlet Handle	GRL (lbs)	Head Shield Type	Pressure Relief Valve	Shell Thickness	Jacket	Tank Material	Top Fittings Protection	Thermal Protection System	Braking
DOT-117	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full- height, 1/2 inch thick head shield	Reclosing pressure relief device	9/16 inch – Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
DOT-117R for Unjacketed CPC-1232	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full Height 1/2 inch thick head shield	Reclosing pressure relief device	7/16 inch – Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
CPC-1232[1]	Bottom Outlets are Optional	263K	Optional; Bare Tanks half height; Jacket Tanks full height	Reclosing pressure relief valve	7/16 inch - Minimum	Jackets are optional	TC-128 Grade B, normalized steel	Not required, but when Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Optional	Not required

NOTES:

[1] This is referred to as a post October 1, 2011 tank car and is the tank car design proposed for use by Valero.

ECP-Electronically controlled pneumatic; DP-Distributed power; EOT-End of Train

HHFUTs transporting at least one car of Packing Group I flammable liquid to operate with ECP breaking system by January 1, 2021. Required all other HHFUTs to operate with ECP braking system by May 1, 2013 or operate at a maximum speed of 30 miles per hour.

Non –Jacketed CPC-1232 tank cars in Packing Group I (tank cars proposed for the Project) must meet DOT-117R standard by April 1, 2020.

SOURCE: MRS, 2015 (Revised DEIR Appendix F), Adapted from USDOT, 2015b.

California Public Utilities Commission

The CPUC is the State agency charged with ensuring the safety of freight railroads, inter-city and commuter railroads, and highway-railroad crossings in the State of California. The CPUC performs these railroad safety responsibilities through the Railroad Operations and Safety Branch (ROSB) of the Safety and Enforcement Division.

The ROSB's mission is to ensure that California communities and railroad employees are protected from unsafe practices on freight and passenger railroads by enforcing rail safety rules, regulations, and inspection efforts; and by carrying out proactive assessments of potential risks before they create dangerous conditions. ROSB personnel investigate rail accidents and safety related complaints, and recommend safety improvements to the CPUC, railroads, and the federal government as appropriate. A more detailed listing of the CPUC regulations for railroad is provided in Attachment 5 of Revised DEIR Appendix F.

The CPUC is responsible for enforcing federal and state railroad safety requirements, including those governing railroad tracks, facilities, bridges, rail crossings, motive power and equipment, operating practices, and hazardous material shipping requirements. The Project would require review and approval by the CPUC as it relates to the new track and operations that would occur at the Refinery.

The ROSB currently has 38 certified rail inspectors and has funding to hire seven more. Inspections are divided into five railroad disciplines:

1. Operating Practices – oversight of main, branch, and yard train operations, including hours of service, carrier operating rules, employee qualification guidelines, and carrier training and testing programs to determine compliance with railroad occupational safety and health standards, accident and personal injury reporting requirements, and other requirements.
2. Track – oversight of track construction, maintenance and inspection activities.
3. Signal & Train Control – oversight of signal system construction, maintenance and inspection activities.
4. Motive Power & Equipment – oversight of locomotives, freight and passenger rail cars, air brakes, and other safety appliances maintenance and inspection activities.
5. Hazardous Materials – oversight of the rail movements of hazardous materials, such as petroleum and chemical products; and inspection of hazardous materials shippers.

At a minimum, main line track within California is inspected annually by ROSB inspectors. Any identified track deficiencies are reported to the FRA and the track operator, and repairs are required to be made. (MRS, 2015 [Revised DEIR Appendix F], citing Roger Clugston, CPUC ROSB Manager, 2014).

Governor's Office of Emergency Services

The Office of Emergency Services (OES), in support of local government, coordinates overall state agency response to major disasters. The office is responsible for assuring the State's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for

assisting local governments in their emergency preparedness, response, and recovery efforts. During major emergencies, OES may call upon all State agencies to help provide support. Due to their expertise, the California National Guard, California Highway Patrol, Department of Forestry and Fire Protection, Conservation Corps, Department of Social Services, and the Department of Transportation are the agencies most often asked to respond and assist in emergency response activities.

In January 2014, the California Governor's Office convened an Interagency Rail Safety Working Group (CA IRSWG, or "Working Group") to examine safety concerns and recommend actions the State of California and others should take in response to the emerging risk posed by increased shipments of crude oil by rail into California. The Working Group includes representatives from the CPUC, OES, California EPA, DTSC, California Energy Commission, California Natural Resources Agency, California Office of the State Fire Marshal, Department of Oil, Gas and Geothermal Resources, and Office of Spill Prevention and Response.

The Working Group published a report on June 10, 2014 that provides preliminary findings and recommendations to improve emergency response for crude oil trains in California (CA IRSWG, 2014). Some of the key recommendations in the report included increasing the number of CPUC rail inspectors, improving emergency preparedness and response programs at both the state and local level, and requiring railroads to provide better information to emergency responders and affected communities about crude by rail shipments and accident/incident data. Some of these recommendations were addressed with the passage of SB 861, which was signed into law in June 2014 (see below). Also, the most recent California budget allotted funds for additional CPUC rail inspectors, and the CPUC is currently in the process of hiring two railroad bridge inspectors.

In March 2015, OES published "Updated Gap Analysis for Rail in California" (OES, 2015). This report assessed the rail systems in California and the transport of hazardous materials in correlation to critical infrastructure, environmentally sensitive areas, and areas of population density; identified "Key Threat Zones;" located existing public and private hazardous materials resources; identified emergency response time challenges for acceptable areas of coverage; noted gaps in required and reliable hazardous materials response capabilities; and suggested resource and training gaps that exist to ensure for a comprehensive, reliable, and sustainable hazardous materials emergency response capability.

Senate Bill (SB) 861 (Oil Spill Prevention and Response)

SB 861 (signed into law in June 2014) expanded the regulatory oversight of the Office of Spill Prevention and Response to cover all state surface waters at risk of oil spills from any source, including pipelines and oil shipped by rail. The expansion provided funding for industry preparedness, spill response, and continued coordination between government agencies, industry, and non-governmental organizations. Some of the key program objectives include targeting critical locations to stage spill responders and equipment and creating inland response plans that are comparable to the existing marine response plans. Facilities such as railroads, pipelines, and oil production facilities will now be required to have oil spill contingency plans. SB 861 implemented a $0.065 per barrel tax on crude oil received at refineries from all sources to fund the new programs.

Liquid Pipelines and Oil Facilities

Hazardous liquid pipelines are under the jurisdiction of USDOT and must follow the regulations in 49 CFR Part 195, Transportation of Hazardous Liquids by Pipeline, as authorized by the Hazardous Liquid Pipeline Safety Act of 1979 (49 USC §60101 et seq.). Other applicable Federal requirements are contained in 40 CFR Parts 109, 110, 112, 113, and 114, pertaining to the need for Oil Spill Prevention Control & Countermeasures (SPCC) Plans. The SPCCs covered in these regulatory programs apply to oil storage and transportation facilities and terminals, tank farms, bulk plants, oil refineries, and production facilities, as well as bulk oil consumers, such as apartment houses, office buildings, schools, hospitals, farms, and state and federal facilities as follows:

- Part 109 establishes the minimum criteria for developing oil-removal contingency plans for certain inland navigable waters by state, local, and regional agencies in consultation with the regulated community (i.e., oil facilities).

- Part 110 prohibits discharge of oil such that applicable water quality standards would be violated, or that would cause a film or sheen upon or in the water. These regulations were updated in 1987 to adequately reflect the intent of Congress in Section 311(b) (3) and (4) of the Clean Water Act, specifically incorporating the provision "in such quantities as may be harmful."

- Part 112 deals with oil spill prevention and preparation of Spill Prevention Control and Countermeasure Plans. These regulations establish procedures, methods, and equipment requirements to prevent the discharge of oil from onshore and offshore facilities into or upon the navigable waters of the United States. These regulations apply only to non-transportation-related facilities.

- Part 113 establishes financial liability limits; however, these limits were preempted by the Oil Pollution Act of 1990.

- Part 114 provides civil penalties for violations of the oil spill regulations.

Accidental Release Prevention

Under federal and state laws, certain facilities must assess the potential for accidental releases of toxic, reactive, flammable, or explosive chemicals, and establish programs to minimize the frequency and extent of accidental releases. These laws include the U.S. Environmental Protection Agency Risk Management Plan (RMP) Rule (see above); the California Accidental Release Programs (CalARP); and the California Occupational Safety and Health (Cal/OSHA) Process Safety Management (PSM) standard. The PSM standard addresses workplace and employee safety on-site. The RMP and CalARP regulations address on-site incidents that might have offsite consequences for the general public.

Fire Protection-Flammable Liquid and Compressed Gas Storage

The Refinery is required to comply with the California Fire Code and National Fire Protection Association (NFPA) codes that address requirements for flammable and combustible liquid and compressed gas storage including pressure vessel installation, water mains, foam fire protection

systems, and water supply reliability requirements. The Benicia Fire Department has local jurisdiction over proper implementation of fire code requirements.

Worker Safety

Occupational safety standards exist in federal and State laws to minimize worker safety risks from both physical and chemical hazards in the work place. The Cal/OSHA and the federal Occupational Safety and Health Administration are the agencies responsible for assuring worker safety in the workplace.

Cal/OSHA assumes primary responsibility for developing and enforcing standards for safe workplaces and work practices within the State. The Cal/OSHA PSM rule is discussed above under Accidental Release Prevention. Worker entry into confined spaces, such as bulk storage tanks, must be performed in accordance with OSHA confined space procedures, including training for participants, planning, provisions for access/egress, monitoring, and supervision. Work requiring welding, grinding, demolition, repair, and installation require hot work (cutting torches, welding, grinding, etc.). Hot work within the Refinery environment must be performed under the facility hot work program that is designed in accordance with OSHA requirements and industry guidelines. At sites known to have hazardous materials present (hydrocarbons, lead based paint, asbestos, contaminated soil, etc.), a site safety plan must be prepared to protect workers. The site safety plan establishes policies and procedures to protect workers and the public from exposure to known and potential hazards at the site. Additional information on Valero's Process Safety Management programs are discussed in Chapter 3, *Project Description*, and in this section, see Impact 4.7-7 below.

In addition, regulations protecting worker safety during crude oil unloading from tank cars are under the supervision of Cal/OSHA. The State requirements under California Code of Regulations, Title 8 are designed to protect workers and the public from health and safety hazards during crude oil handling related to rail transport. Cal/OSHA requires that employers provide employees with information and training on hazardous chemicals that may be encountered in their work area and instructions on ways to protect themselves in the event of a spill or release of hazardous substances.

Emergency Response

California has developed an emergency response plan to coordinate emergency services provided by federal, State, and local government and private agencies. Responding to hazardous materials incidents is one part of this plan, as is responding to intentional acts of destruction. Another part of the plan involves development of a downstream evacuation plan for areas within the potential inundation area. For Solano County, the plan is administered by the ~~California~~ Governor's Office of Emergency ~~Management Agency~~ Services, which coordinates the responses of other agencies, including the California Environmental Protection Agency, California Highway Patrol, California Department of Fish and Wildlife, Regional Water Quality Control Board, and local fire departments.

Crude Oil Tank Car Movements

Union Pacific Railroad (UPRR) is a common carrier, which is a company that transports goods for any person or company and that is responsible for the loss of goods during transport. Federal law requires common carriers like UPRR to transport hazardous materials, such as crude oil, for its

customers. If a customer delivers the hazardous material in conformity with applicable USDOT requirements, UPRR must transport the material. UPRR transports all materials (hazardous or otherwise) in accordance with applicable federal law, industry standards, and other operating rules to safely and efficiently move freight. Specifically, 49 CFR 130 - Oil Spill Prevention and Response Plans, requires transporters of oil (both non-hazardous and hazardous) to have a written emergency response plan. UPRR's Hazardous Material Emergency Response Plan (HMERP) meets this requirement. Additionally, UPRR's Hazmat Team is trained to respond and manage incidents involving the release, or potential release, of hazardous materials during an incident.

Local

[No change is proposed to the discussion of the local regulatory setting.]

2.12.2.5 DEIR Section 4.7.2.5 ~~4,~~ Project Baseline

[No change is proposed to the statement of baseline conditions.]

2.12.3 DEIR Section 4.7.3, Significance Criteria

Based on California Environmental Quality Act (CEQA) Guidelines Appendix G, a project would cause adverse impacts related to hazards and hazardous materials if it would:

a) Create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials;

b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances or waste within one-quarter mile of an existing or proposed school;

d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would create a significant hazard to the public or the environment;

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would result in a safety hazard for people residing or working in the project area;

f) For a project within the vicinity of a private airstrip, would result in a safety hazard for people residing or working in the project area;

g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan; or

h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

2.12.3.1 DEIR Section 4.7.3.1, Approach to Analysis

Within each impact area, this analysis compares existing conditions with existing-plus-project conditions, and applies an appropriate qualitative or quantitative significance threshold. An increased cancer risk, for example, is considered significant if the risk exceeds 10 in 1 million.

A CEQA lead agency may exercise its own judgment in determining an appropriate standard of significance (*Sierra Club v. City of Orange* (2008) 163 Cal. App. 4th 523, 541), and may choose to use applicable thresholds of another state or and local agency. Santa Barbara County adopted Public Safety Thresholds in August 1999, which established quantitative risk-based criteria that have been utilized by various state and local agencies, including the California Coastal Commission, the California State Lands Commission, the County of San Luis Obispo, Los Angeles County, City of Carpentaria, City of Whittier, City of Huntington Beach, and others as a basis to evaluate significance criteria a) and b). The City of Benicia elects also to use Santa Barbara County's thresholds to evaluate the significance of potential Project impacts.

In general, risk is a compound measure of the probability and consequences of an adverse effect. Common expressions of risk include individual risk and societal risk. Individual risk is somewhat restricted in its ability to reflect actual risk; it only expresses the risk to a single individual without consideration of the total vulnerable population in a hazardous zone. Societal risk, illustrated as a risk spectrum, expresses a continuous variation in risk as a relationship of probability and consequence, the latter measuring the number of estimated fatalities and serious injuries.

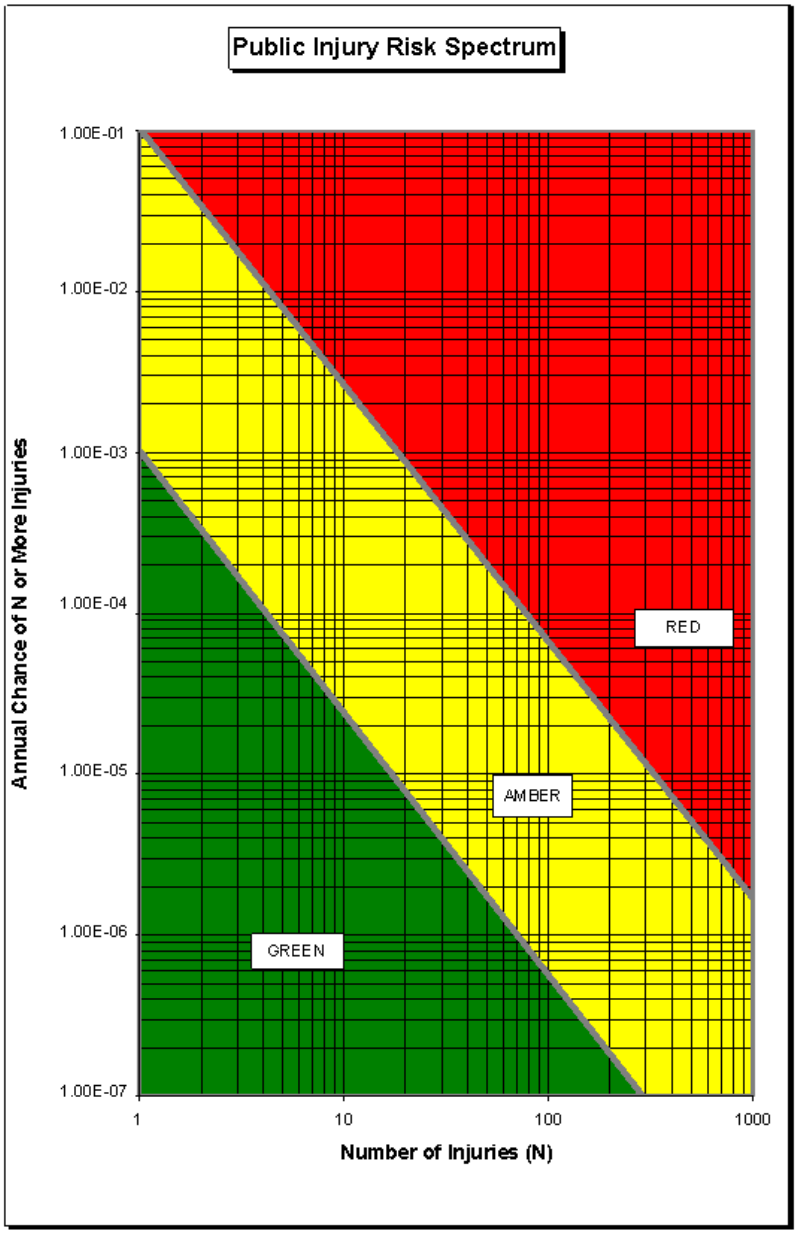
The thresholds established by Santa Barbara County's Safety Criteria provide specific zones (i.e., green, amber, and red) on a risk profile curve to guide the determination of significance or insignificance based on the estimated probability and consequence of an accident. In general, risk levels in the green area would be less than significant, while risk levels in the amber and red zones would be potentially significant. Risk profiles plot the frequency of an event against the consequence in terms of fatalities or injuries: frequent events with high consequence have the highest risk level (see Figure 4.7-1).

The criteria used in this analysis are based on the potential risk associated with the crude by rail operations (at both the Refinery and along the UPRR main line routes). An impact would be considered significant if either of the following were to occur:

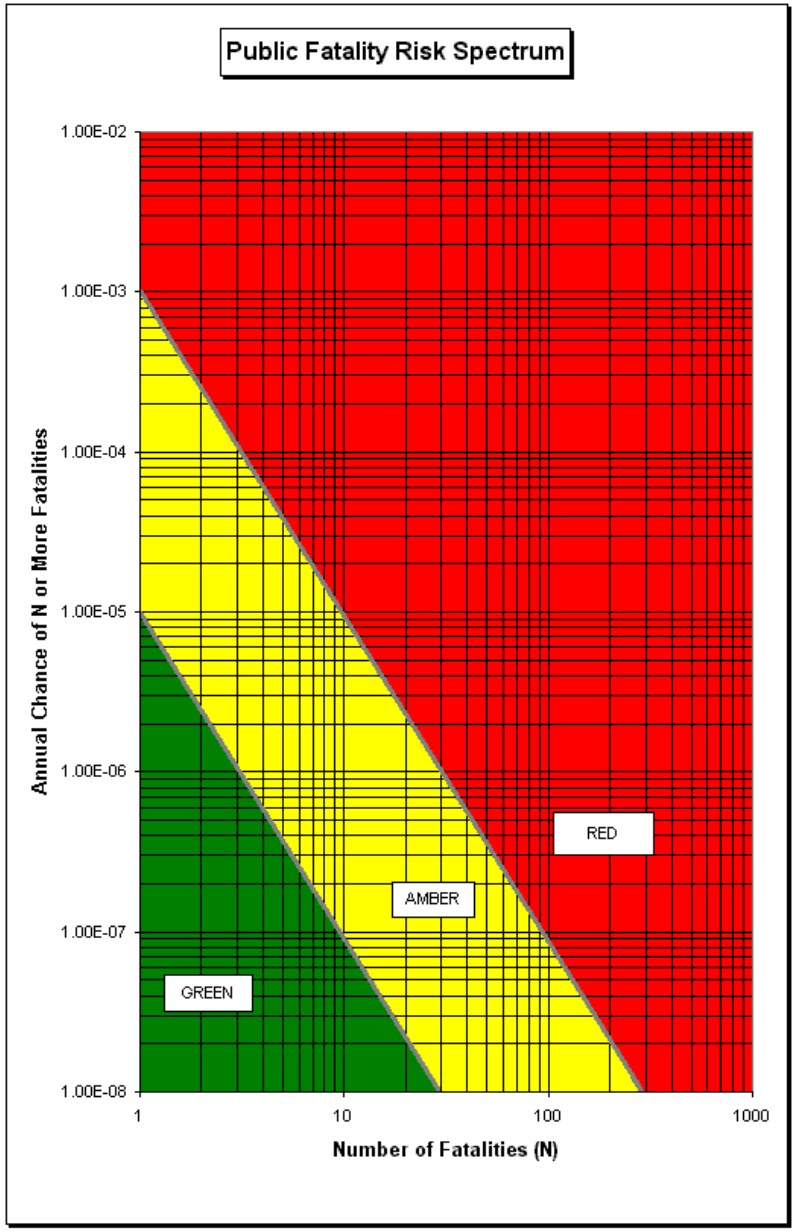
1) A risk profile plot is located within the amber or red region of the Santa Barbara County Safety Criteria, or

2) The Project is determined to be in a state of non-compliance with any applicable design code, regulation, NFPA standard, or generally acceptable industry practice.

The foregoing thresholds do not address risk of environmental damage. The thresholds applied to evaluate the significance of potential effects to Biological Resources, Cultural Resources, and Hydrology and Water Quality that could result from an upset or accident condition (including a train derailment or unloading accident that leads to a hazardous materials spill, fire, or explosion) are discussed below. ~~The risk of an accidental release of hazardous materials is subject to a qualitative evaluation, taking into account the applicable regulatory framework, the probability that an accident will occur, and the potential consequences of an accident.~~



Santa Barbara Injury Risk Thresholds



Santa Barbara Fatality Risk Thresholds

SOURCE: Santa Barbara County Environmental Thresholds and Guidance Manual

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Figure 4.7-1
Santa Barbara County Injury and Fatality Risk Thresholds

2.12.4 DEIR Section 4.7.4, Hazardous Properties of Crude Oil to be Shipped by Rail

[No change is proposed to this discussion.]

2.12.5 DEIR Section 4.7.5, Discussion of No Hazards and Hazardous Materials Impacts

[No change is proposed to this analysis of significance criteria d), e), and f).]

2.12.6 DEIR Section 4.7.6, Discussion of Impacts and Mitigation Measures

a) Create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials.

General Railroad Safety

UPRR is a common carrier by rail and would be responsible for transporting crude oil to the Refinery if the Project were approved. Federal law requires common carriers like UPRR, to transport hazardous materials, such as ethanol or crude oil, for its customers. If a customer delivers the hazardous material in conformity with applicable DOT requirements, UPRR must transport the hazardous material.

UPRR transports all commodities in accordance with applicable federal laws and industry standards. To maximize safety and security when moving hazardous materials, UPRR has implemented additional voluntary rules to secure trains operating on their 23-state network. UPRR invests substantially in efforts to improve hazardous materials transportation safety, funding an array of security and hazardous materials-related initiatives that exceed mandatory compliance measures. UPRR has indicated that it is continuously improving safety when it comes to transporting crude oil and other hazardous materials. Every day, as part of this effort, UPRR inspects tracks, locomotives, and cars carrying crude oil and other hazardous liquids. UPRR conducts extensive training and preparedness programs involving specialized safety training for rail personnel, as well as local first responders (UPRR, 2013).

It should be noted that UPRR does not produce hazardous materials, own the tank cars that move the hazardous materials, load or unload those tank cars, or select the origin point or destination where the hazardous materials are shipped. In addition, UPRR has procedures in place to ensure that equipment is properly secured, including several checks and balances to control the risk of an uncontrolled movement. Project trains are expected to move directly from Roseville to Benicia, and will be attended at all times. To maximize safety and security, UPRR has implemented additional procedures to secure an unattended train or locomotives (UPRR, 2013). These include:

- Designate trains carrying loads of hazardous materials that will not be left unattended on main line tracks or sidings outside of yards or terminals unless specifically authorized.

- Develop a written plan that specifies locations and circumstances under which it is safe to leave unattended trains or vehicles transporting hazardous material loads.
- Develop a process for employees securing unattended trains or vehicles that include specific communications with the train dispatchers.
- Review, verify and adjust as necessary protocols related to securing unattended trains or vehicles.
- Implement operating rules and instructions regarding job briefings that include appropriate securement protocols.
- Implement procedures for inspecting equipment for proper securement in cases where an emergency responder has been on, under or between equipment.

In addition, UPRR has implemented the measures set forth in the context of Impact 4.7-2 to maximize safety and security when transporting crude oil. That discussion is incorporated here by this reference.

Impact 4.7-1: The Project could pose a significant hazard to the public or environment during operation of the Project or routine transport or disposal of hazardous materials. (*Less than Significant*)

The operation of the Project and transportation of crude oil by rail would increase the frequency of emissions of toxic air contaminants (TACs) from locomotive emissions, and from equipment fugitive emissions. Crude oil delivered by tank car would be stored in existing crude storage tanks and the crude brought in by rail will displace crude brought in by marine vessel. Therefore, there would be no increase in fugitive emissions from storage tanks. A health risk assessment performed for the Project (see Appendix E.6) including operations at the new unloading facility and along the UPRR mainline between the Refinery and the Roseville rail yards, shows that the cancer risk from the increase in exposure to TACs ranges from 0.3 to 7.4 ~~8~~ in one million, which is less than the significance threshold of 10 in one million. Also, the maximum chronic and acute hazard indices of 0.014 and 0.048 ~~0.0113~~, respectively, are less than the significance threshold of 1.0. Thus, the potential risk to the public and environment for the routine transport of crude oil by rail for the Project is considered to be less than significant.

Mitigation: None required.

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b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.

Impact 4.7-2: The Project could pose significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. (~~*Less than*~~ *Significant and Unavoidable*)

If the Project were approved and constructed, trains would transport crude oil on UPRR's mainline tracks from the Roseville Yard to the Refinery's unloading facility. Each train, carrying up to

50 cars of crude oil, would pass through the cities of Roseville, Sacramento, Davis, Dixon, Vacaville, Fairfield, Suisun City, and Benicia. The Refinery would receive two trains per day, 7 days per week (730 train visits per year). As noted in Revised DEIR Section 2.5.1, it is unknown what route(s) beyond Roseville that UPRR would use to deliver Project-related trains to the Refinery. This Revised DEIR assumes that all such trains would be routed through Roseville using any or all of three routes along the existing UPRR rail system to the north and northeast of Roseville. One route approaches Roseville from the north via Oregon and two enter California northeast of Roseville from Nevada. See Figure 1-3, *Uprail Routes*, and Table 4.0-1, which summarizes distances between the Refinery and the California state line using these three routes. [¶]

If a train carrying crude oil ~~from the Roseville Yard~~ to the Refinery were to derail~~,~~ and one or more tank cars were to rupture, crude oil could be released into the environment.[19] If an ignition source is present, the released crude oil could ignite and/or explode. ~~This section b) performs a qualitative analysis of this risk. The analysis takes into account the following factors: (1) the probability of an accidental release of crude oil from a train; (2) the consequences of a release; (3) the reduction in the risk of accidental releases from a marine vessel, based on the reduction in marine trips that would be caused by the Project; (4) the recent history of accidents involving DOT-111 tank cars carrying crude oil; and (5) the regulatory requirements designed to prevent releases and/or mitigate the consequences in the event of a release from trains.~~

~~If a release were to occur, the consequences depend largely on the amount and location of release. A release in any area could, depending on the specific circumstances, require a significant hazardous materials cleanup. A release of a relatively small amount of crude may not have significant consequences if it were to occur along the line in a rural area other than the Suisun Marsh. If a release in an urban area were to ignite and/or explode, depending on the specific circumstances, the release could result in property damage and/or injury and/or loss of life. As explained in Section 4.2, *Biological Resources*, a release into the Suisun Marsh could result in significant damage to biological resources. [¶]~~ As explained above, there is a variety of federal regulations designed to prevent the accidental release of crude oil from trains, and minimize the consequences of any such release. FRA and PHMSA closely regulate the rail transport of crude oil and other hazardous materials. Crude oil must be ~~classified,~~ assigned to a packing group subject to packaging requirements, and transported in rail cars that meet certain specifications. The transport of crude oil by rail is subject to requirements for handling, loading and unloading, and the placement of placards to alert emergency response teams as to the contents of each car. FRA routinely inspects the facilities of shippers and railroads to ensure that all regulatory requirements are being met. In addition, UPRR has implemented the following measures to maximize safety and security when transporting crude oil:

- Using the Rail Corridor Risk Management System (RCRMS) routing protocol for trains carrying 20 or more crude oil cars to determine the safest and most secure routes. The RCRMS is an analytical tool developed in conjunction with the Department of Homeland Security and the FRA. This tool takes into account 27 risk factors to assess rail route safety and security.

[19] Not every tank car derailment results in a spill, fire, or explosion. This analysis focuses on derailments that result in a release of crude oil.

- Requiring trains carrying 20 or more crude oil cars that include at least one older DOT-111 tank car not to exceed 40 miles per hour in the 46 designated HTUAs[20] established by Federal regulations. This reduces by 10 miles per hour UPRR's current self-imposed speed limit. This reduced train speed reduces the kinetic energy that has been determined to contribute to tank car breeches in an accident.
- Evaluating where the railroad may need to install additional advanced track-side detectors.
- Increased emergency response training and tuition assistance to include a specialized crude by rail curriculum at the industry's Transportation Technology Center, Inc. (TTCI) facility in Pueblo, Colorado.
- Creating a comprehensive emergency response resources inventory.
- Use of distributed power or two-way telemetry end-of-train devices for enhanced braking on trains that carry 20 or more carloads of crude oil (MRS, 2015 [Revised DEIR Appendix F], citing UPRR, 2014a).

UPRR also has a capital track maintenance project in California that covers the replacement and upgrading of track. In the last five years, UPRR has replaced over two million railroad ties and 452 miles of rail line in California (MRS, 2015 [Revised DEIR Appendix F], citing UPRR, 2014b).

UPRR also has a bridge inspection program that complies with 49 CFR Part 237-Bridge Safety Standards. This program is used to ensure the structural integrity of bridges, culverts, and tunnels. All bridges are inspected between one and three times per year. In the last five years, UPRR has upgraded 70 bridges in California (MRS, 2015 [Revised DEIR Appendix F], citing UPRR, 2014b).

As required by Federal law, UPRR has been installing Positive Train Control (PTC) on their main rail lines in California. Most of the main line routes between the Refinery and the stateline that would be used for the proposed project have been upgraded to include PTC. PTC is used to prevent train to train collisions, over-speed derailments, switch misalignment, and unauthorized entry into work zones (MRS, 2015 [Revised DEIR Appendix F], citing UPRR, 2014b).

In order to evaluate potential Project-related risks to the public, the City's consultant, MRS, prepared a quantitative risk assessment (QRA) consistent with the guidelines of the American Institute of Chemical Engineers, Center for Chemical Process Safety (See Revised DEIR Appendix F). The main objective of the QRA is to assess the risk of generating serious injuries or fatalities to members of the public, to assess the risk of spill events, and to develop mitigation measures that could reduce these risks. Attachment 2 of Revised DEIR Appendix F provides a detailed description of the QRA methodology and the parameters that were used for various QRA inputs. This attachment describes each of the steps used in the QRA as well as the various consequence models and impact thresholds that were used in the QRA. The QRA was used to determine the significance of an accident associated with crude oil transportation along each of the three mainline routes that Project-related trains could take to reach the Refinery, as well as for the rail operations that would occur at the Refinery.

[20] A list of the HTUAs is provided in Attachment 6 of Appendix F. Within California, the crude oil trains could pass through two HTUAs (the Bay Area and Sacramento). Outside of California, a crude oil train could pass through one or more HTUAs depending upon the route taken (e.g., via Las Vegas, Denver, Seattle, etc.).

Probability (Frequency) of a Derailment and Associated Crude Oil Spill

In order to identify the probability of an accident (i.e., accident rate or derailment rate) and oil spill (i.e., spill rate) from a crude oil train on each of the possible routes, the City retained Dr. Christopher Barkan, a Professor and the Executive Director of the Rail Transportation and Engineering Center at the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign, to determine route specific accident rates and spill rates based on Valero's proposed tank car design (see Attachment 1 of Revised DEIR Appendix F). The analysis took into account major risk factors (including route specific FRA track class, method of operation, tank car safety design, the proposed volume of crude oil trains over the route, and the estimated spill size) to develop a conditional cumulative probability distribution of spill sizes in the event of a release along various FRA track classes. These conditional cumulative probability distributions assume non-jacketed CPC-1232 tank cars (which are the tank cars Valero would use for the Project) on routes with annual traffic density of more than 20 million gross tons and considers various spill sizes that could result from a derailment that leads to loss of oil from a tank car puncture or fitting failure. The spill sizes evaluated in the analysis included the following:

- Small Spill (100 gallons) - represents approximately the 100 percent cumulative probability spill size given that a release has occurred.[21]
- Median Spill (30,000 gallons) - represents approximately the 50 percent cumulative probability spill size given that a release has occurred. This represents the volume of about one tank car.
- Large Spill (180,000 gallons) - represents approximately the 3 percent cumulative probability spill size given that a release has occurred. This represents the volume of about six tank cars.
- Very Large Spill (240,000 gallons) - represents approximately the 1 percent cumulative probability spill size given that a release has occurred. This represents the volume of about eight tank cars.

These are oil spill volumes resulting from a derailment that leads to loss of oil from a tank car puncture or fitting failure, and do not include secondary release due to fire and associated thermal tears in a railcar's steel shell. The hazards zones associated with the fires and secondary thermal tears resulting in fireballs were incorporated into the QRA.

The probability of a crude oil release incident from Project trains, depending upon the rail route used to get to the Refinery, is shown in Table 4.7-6.

TABLE 4.7-6
PROBABILITY OF CRUDE OIL RELEASE FROM PROJECT TRAINS

100 gallons+	One release every 20 to 27 years
30,0000 gallons+	One release every 38 to 80 years
180,000 gallons+	One release every 200 to 4,000 years
240,000 gallons+	One release every 308 to 10,000 years

[21] For example, for a small spill (100 gallons) there is a 100 percent cumulative probability that 100 gallons or more would be released assuming that the tank car has failed and that a release has occurred. For the median spill size (30,000 gallons), half/50 percent of potential spills would be 30,000 gallons or more. Thus, there is a 50 percent chance that an accident involving the breach of a single or multiple tank cars would result in a spill of 30,000 gallons or more. The cumulative probabilities of very large spills involving multiple tank cars is much lower at three percent for a spill of 180,000 gallons or more, and one percent for a spill of 240,000 gallons or more.

These probabilities of a release are only for the portion of the routes between the Refinery and California/Oregon and California/Nevada state lines. As discussed below, the probability of a release of crude oil would be greater for the full length of the train route (from the crude oil's point(s) of origin to Refinery).

In conducting the QRA, the routes were divided into distinct segments based on rail characteristics and population density along the railroad. Segments based on the population density adjacent to the railroad are shown in Figure 2-1 of Revised DEIR Appendix F. Crude oil spill probabilities for each of the routes and segments are shown in Tables 5.3 through 5.5 of Revised DEIR Appendix F.

Consequence Modeling Results

Several crude oil spill scenarios were modeled to evaluate worst-case thermal radiation hazards associated with a large crude oil fire. Modeled scenarios ranged from small releases from a tank car, to the complete loss of multiple tank cars. The worst case spill was assumed to be 240,000 gallons (about eight tanker cars). An explosion of tank cars, referred to as a thermal tear and simulated as a Boiling Liquid Expanding Vapor Explosion (BLEVE), also was evaluated. The worst-case thermal radiation and explosion hazard distances are provided in Table 4.7-7. The modeling input data and results for these hazards are provided in Attachment 3 of Revised DEIR Appendix F. A 100-gallon spill was used as the cut off for the hazards analysis since below that level the hazard zones would likely be contained to the railroad right-of-way, and explosions would be unlikely since a 100-gallon spill fire would not generate enough thermal radiation for a long enough period of time to produce a thermal tear.

TABLE 4.7-7
WORST CASE THERMAL RADIATION HAZARD ZONES – MAINLINE RAIL

Thermal Radiation Hazard Zones (feet)		
Wind Speed (meters/second)	**5 kW/m^2**	**10 kW/m^2**
1	846	466
2	912	509
3	948	535
4	974	554
5	994	571
10	1,053	620
20	1,585	1,109
BLEVE Hazard Zones (feet)		
40 kJ/m^2	2,339	
150 kJ/m^2	1,158	
250 kJ/m^2	846	

NOTES:
kW/m^2=kilowatts per square meter
kJ/m^2=kilojoules per square meter
See Attachment 3 of Revised DEIR Appendix F for the detailed consequence modeling results.
See Attachment 2 of Revised DEIR Appendix F for a description of the consequences associated with these hazards.

The consequence modeling results then were used along with the spill probability and population densities to estimate the overall risk of injury and fatality for each of the routes. These hazard zones would be the same for the entire rail route within California and all the way back to the source of the crude oil.

Quantitative Risk Assessment Results

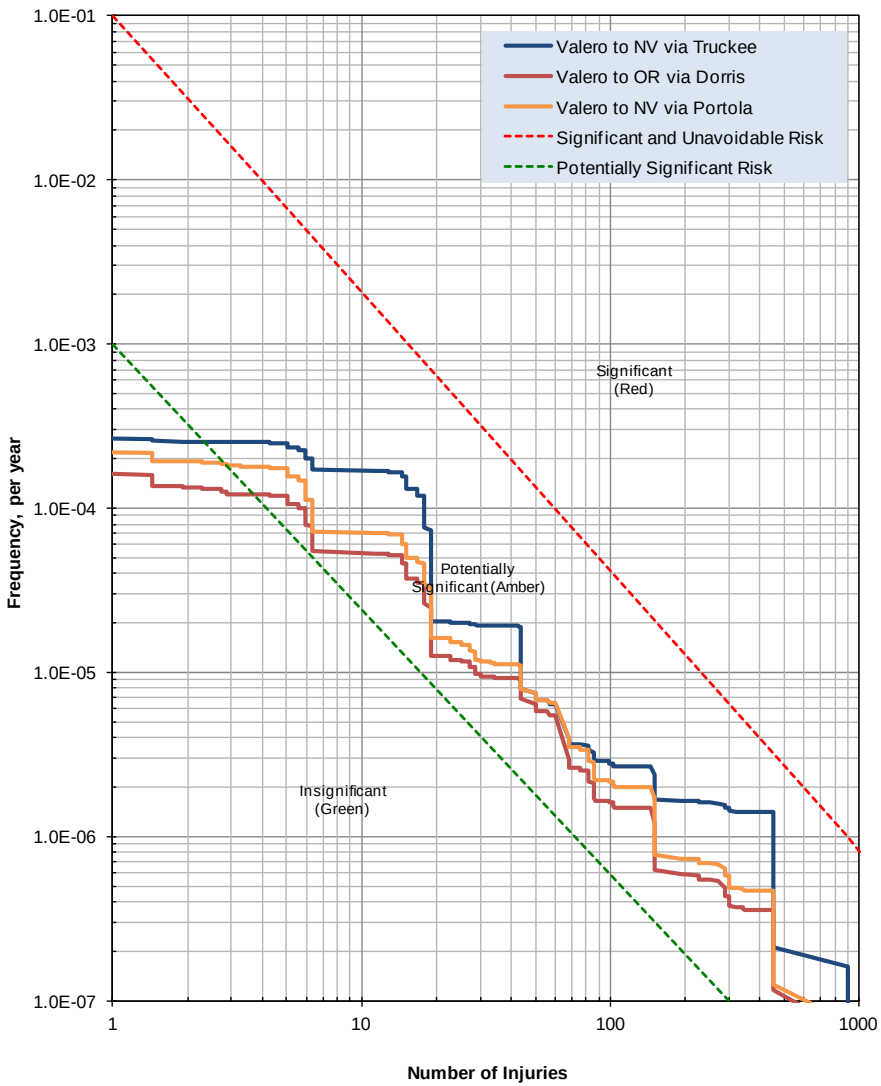
The results of the QRA for the Project are presented in Figures 4.7-2 and 4.7-3 as risk profiles. The risk profiles in Figure 4.7-2 assume that two 50-car unit trains travel between the Roseville Yard and Refinery every day for a total of 730 trains per year, and assume that all 730 trains per year use the same route between Roseville and Oregon or Nevada. The risk profiles in Figure 4.7-3 also assume that two 50-car unit trains travel between the Roseville Yard and Refinery every day for a total of 730 trains per year, and assume that all 365 of the 100-car unit trains per year use the same route between Roseville and Oregon or Nevada. The risk profile curves shown on these figures (and others below) correspond to the following Project routes:

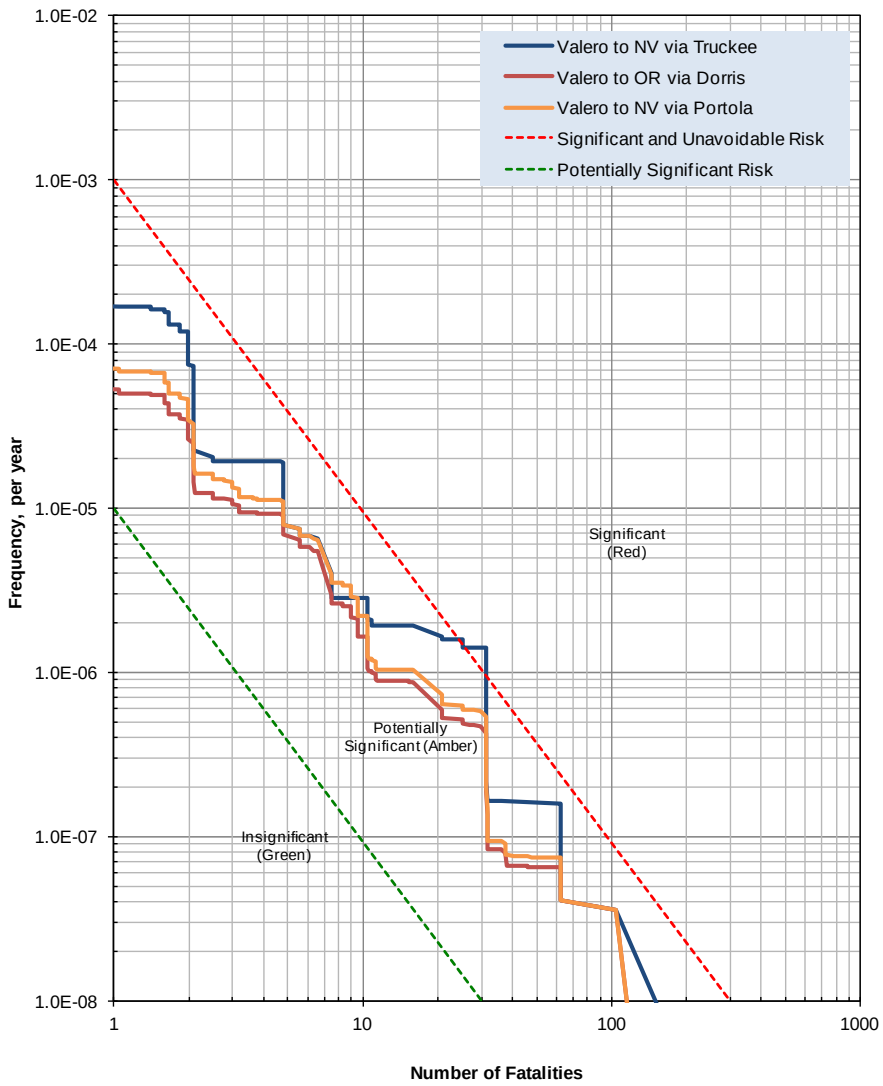
- Valero to NV via Truckee (Nevada to Roseville, Southern)
- Valero to OR via Dorris (Oregon to Roseville)
- Valero to NV via Portola (Nevada to Roseville, Northern)

The level of risk for the Project along the three potential main line rail routes is represented by the solid orange, red, and blue lines in these two figures. The graph on the left shows the risk for potential injuries, while the graph on the right shows the risk for potential fatalities. The diagonal dashed green and red lines represent the significant risk threshold for insignificant (green) and significant and unavoidable (red) risk. If the risk falls between the dashed green and red lines, the impact remains potentially significant with the ultimate CEQA conclusion ("less than significant with mitigation incorporated" or "significant and unavoidable") depending on whether mitigation measures have been identified that could be implemented to avoid or reduce the severity of the impact below established thresholds.

Because maximum risks from proposed transport of Project-related crude oil are above the significant risk threshold (dashed green line), impacts would be considered significant for both the 50- and 100-unit car trains. These risk profiles represent the collective risk along the entire route. The risk within any individual city or county would be considerably less. The risk is primarily driven by the HTUA (Bay Area and Sacramento) since these are the locations where fairly long stretches of track are in close proximity to heavily populated areas.

As discussed in Revised DEIR Section 1.1, it is possible that Project-related crude could be transported to the Refinery via any of the North American freight railroad tracks shown in Figure 1-1. Therefore, the routes used by UPRR to transport crude from source locations to the California border cannot be determined with certainty. While determination of the exact routes used by Project-related trains would be speculative, many of the routes outside of California also would traverse populated areas (including HTUA) that could be affected in the event of a release that results in a fire or explosion. Train accident rates typically are determined based on the number of accidents per million miles traveled. As the miles a train travels increase, the probability of an accident also increases. Therefore, the additional miles Project-related trains





SOURCE: MRS, 2015

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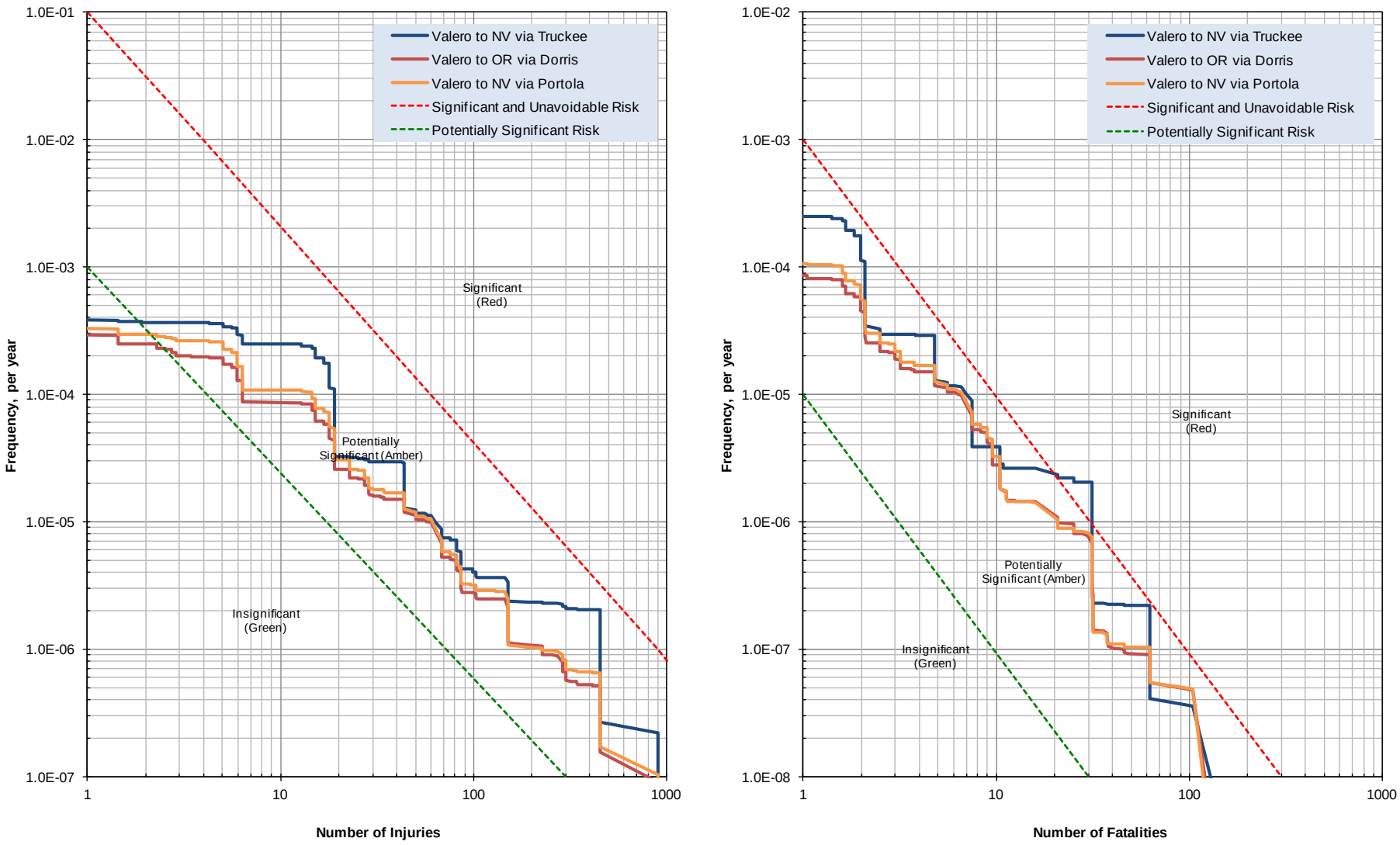
Figure 4.7-2

Risk Associated with CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 50 Car Unit Train to California Border



SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-3

Risk Associated with CPC-1232 Tank Car Mainline Crude Oil Unit Train Transportation – 100 Car Unit Train to California Border

would travel from the source locations to the California border would increase the overall probability of an accident resulting in injuries and fatalities; the impact would remain significant.

As described in the USDOT Final Rule: Enhanced Tank Car Standards and Operational Controls for High-Hazard Flammable Trains (USDOT, 2015b), new tank cars constructed after October 1, 2015 are required to meet the new USDOT Specification 117 design or performance criteria. The prescribed car has a 9/16-inch tank shell, 11-gauge jacket, 0.5-inch full-height head shield, thermal protection, and improved pressure relief valves and bottom outlet valves. Existing tank cars must be retrofitted with the same key components based on a prescriptive, risk-based retrofit schedule. As a result, the final rule will require replacing the entire fleet of DOT-111 tank cars for Packing Group I, which covers most crude shipped by rail, within 3 years and all non-jacketed CPC-1232s, in the same service, within approximately 5 years.

The rule requires HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributed power (DP) braking system. Trains meeting the definition of a “high-hazard flammable unit train,” or HHFUT (a single train with 70 or more tank cars loaded with Class 3 flammable liquids), with at least one tank car with Packing Group I materials, must be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021. All other HHFUTs must have ECP braking systems installed after 2023.

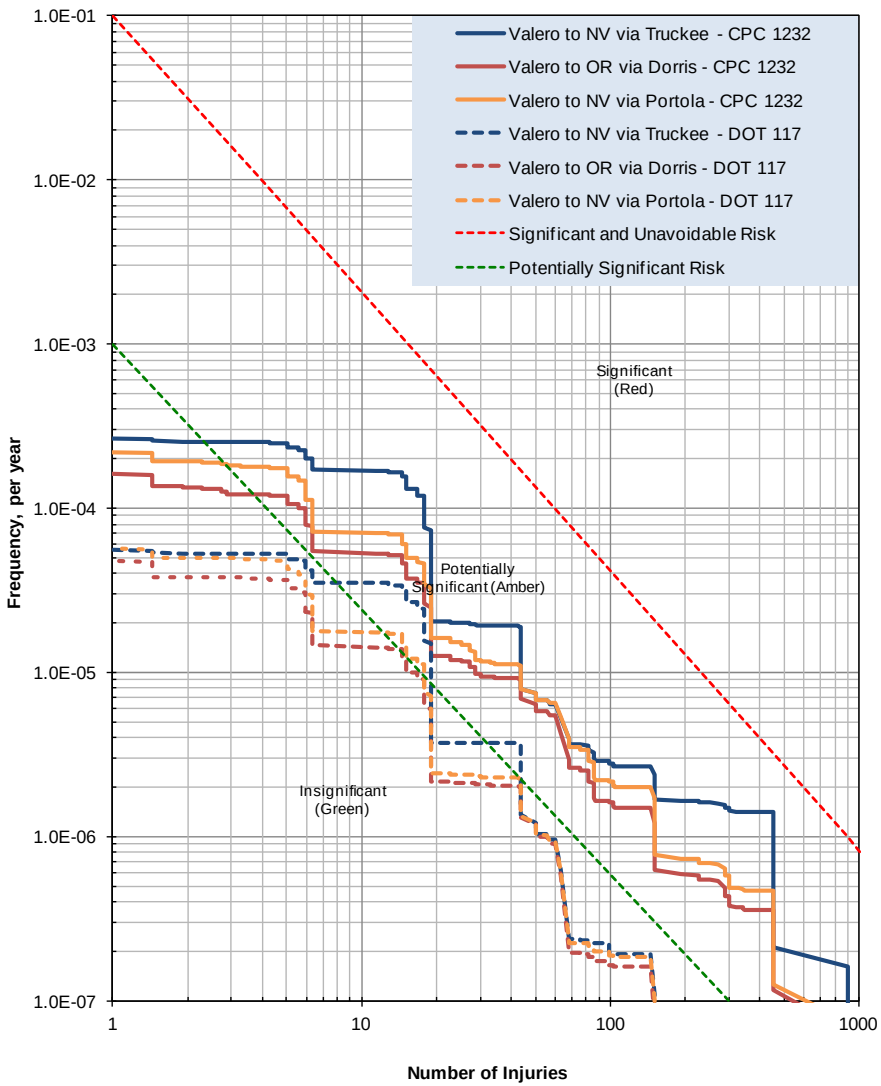
The rule restricts all HHFTs to 50 mph in all areas and HHFTs containing any tank cars not meeting the enhanced tank car standards required by this rule are restricted to operating at a 40 mph speed restriction in HTUA. The 40 mph restriction for HHFTs without new or retrofitted tank cars is also currently required under FRA’s Emergency Order No. 30.

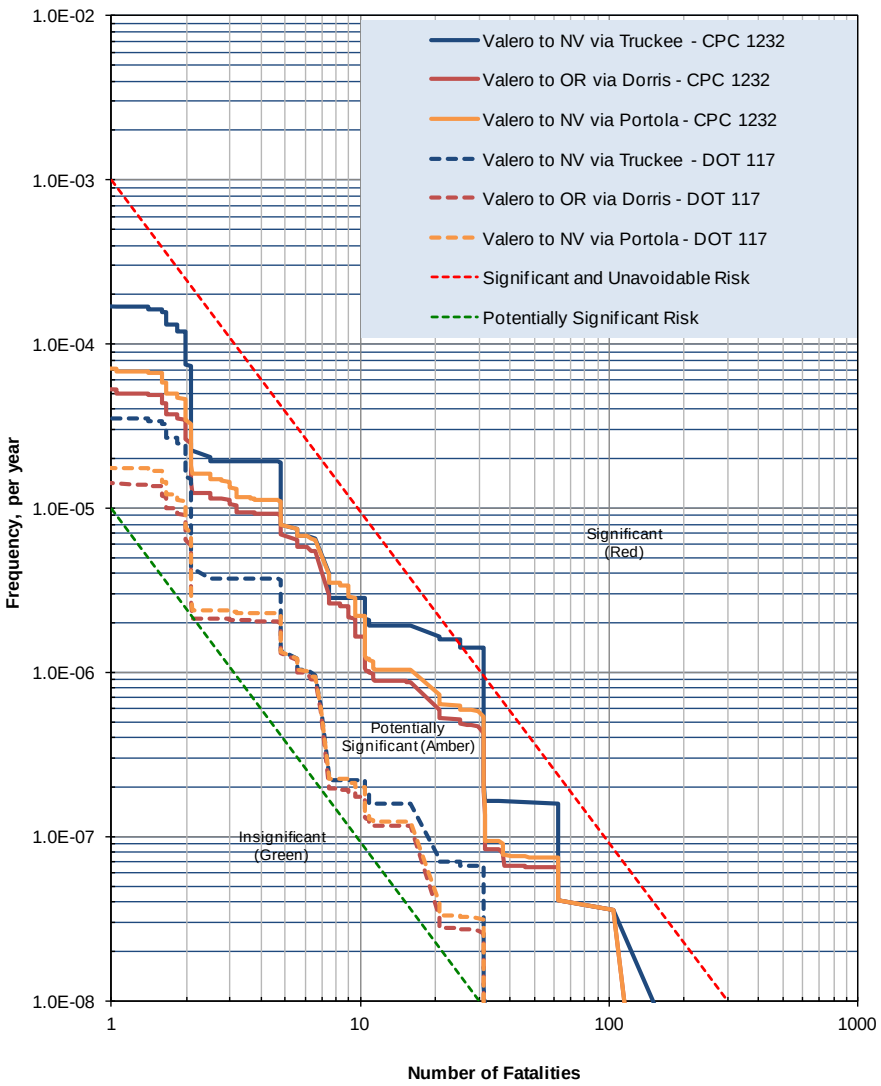
Railroads operating HHFTs must perform a routing analysis that considers, at a minimum, 27 safety and security factors, including “track type, class, and maintenance schedule” and “track grade and curvature,” and select a route based on its findings. These planning requirements are prescribed in 49 CFR §172.820.

Improved information sharing ensures that railroads provide State and/or regional fusion centers, and State, local, and tribal officials with a railroad point of contact for information related to the routing of hazardous materials through their jurisdictions. This replaces the proposed requirement for railroads to notify State Emergency Response Commissions (SERCs) or other appropriate state-designated entities about the operation of these trains through their states.

Shippers must develop and carry out sampling and testing programs for all unrefined petroleum-based products, such as crude oil, to address the criteria and frequency of sampling to improve and ensure accuracy. Offerors must certify that hazardous materials subject to the program are packaged in accordance with the test results, document the testing and sampling program outcomes, and make that information available to USDOT personnel upon request.

The QRA provided in Revised DEIR Appendix F also evaluates the new tank car design standards (DOT-117 and DOT-117R) and safety requirements relative to the Project. The results of the QRA are presented in Figures 4.7-4 through 4.7-7. Risk profiles are presented for both the



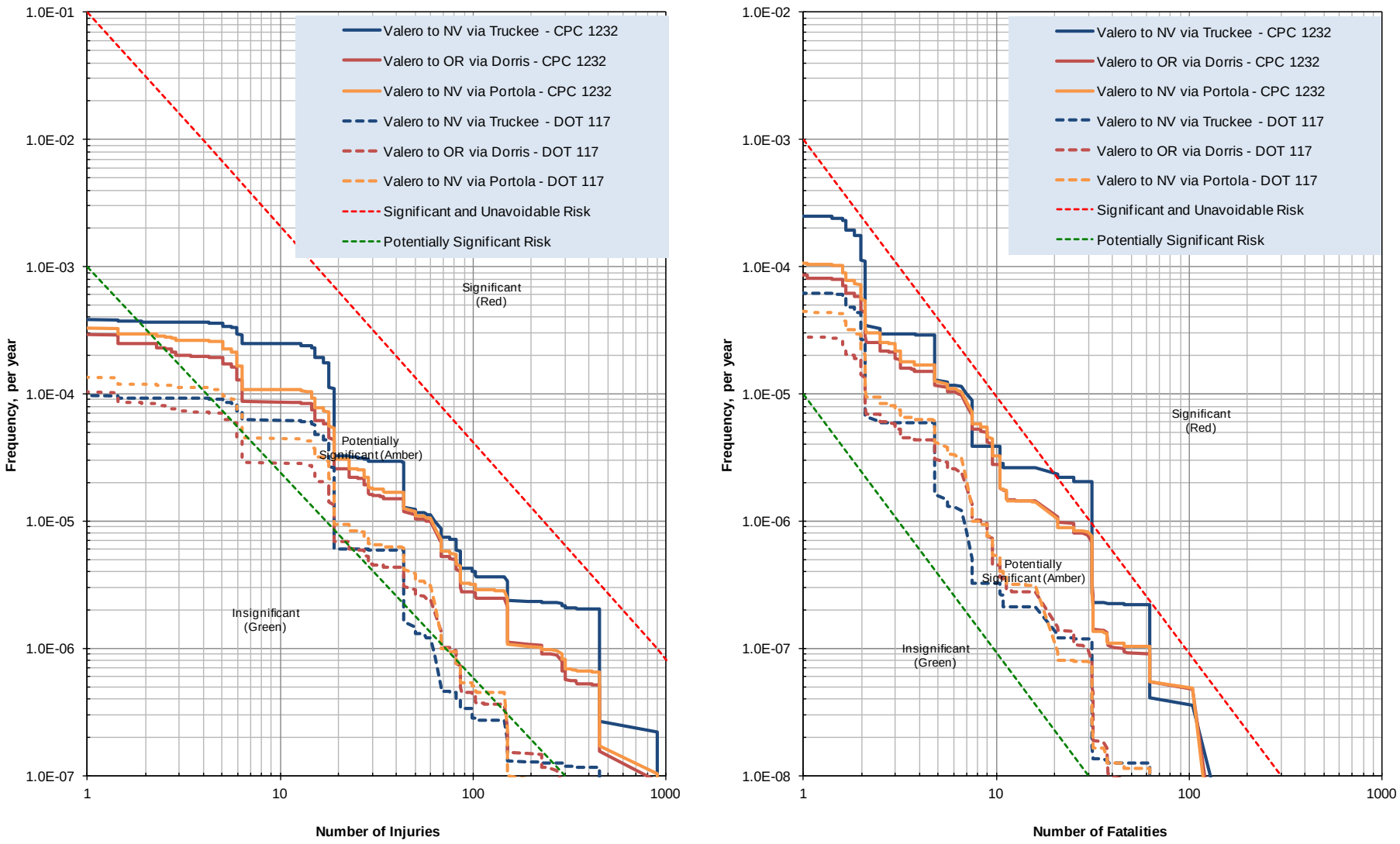


SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-4

Risk Associated with DOT-117 Tank Car
Mainline Crude Oil Unit Train Transportation –
50 Car Unit Train to California Border

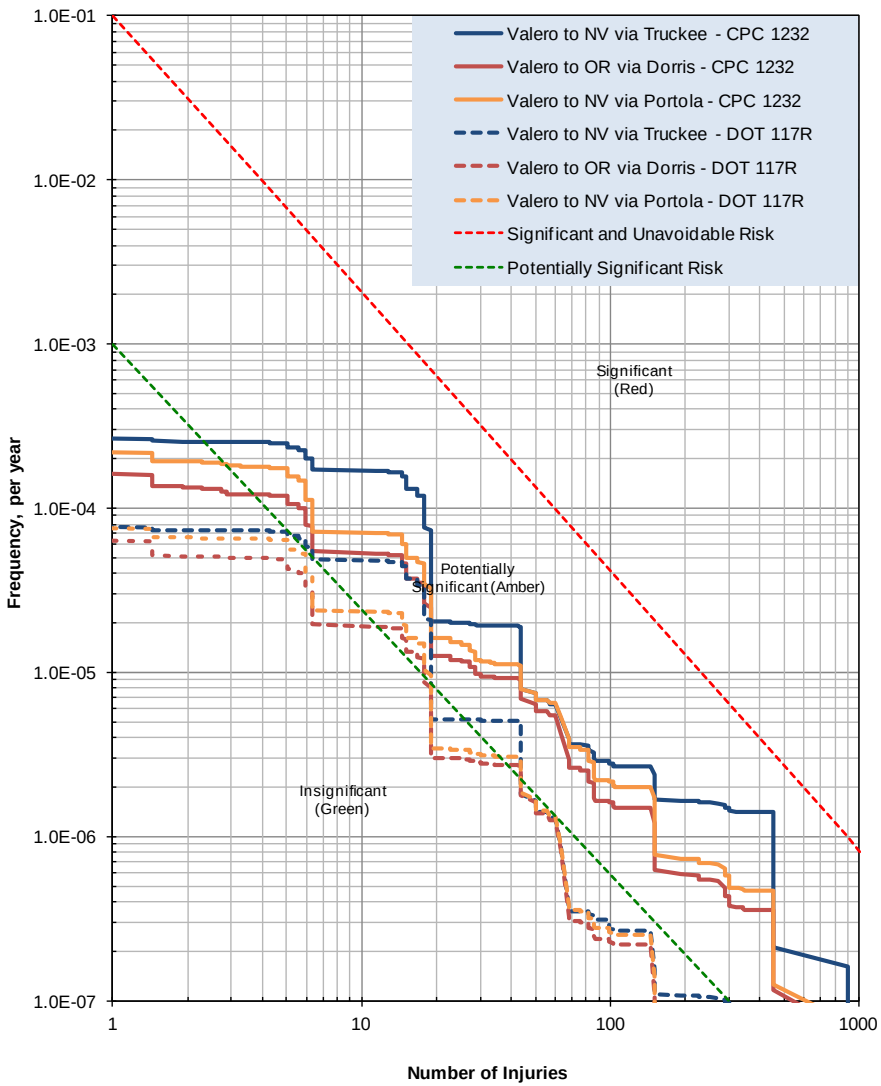


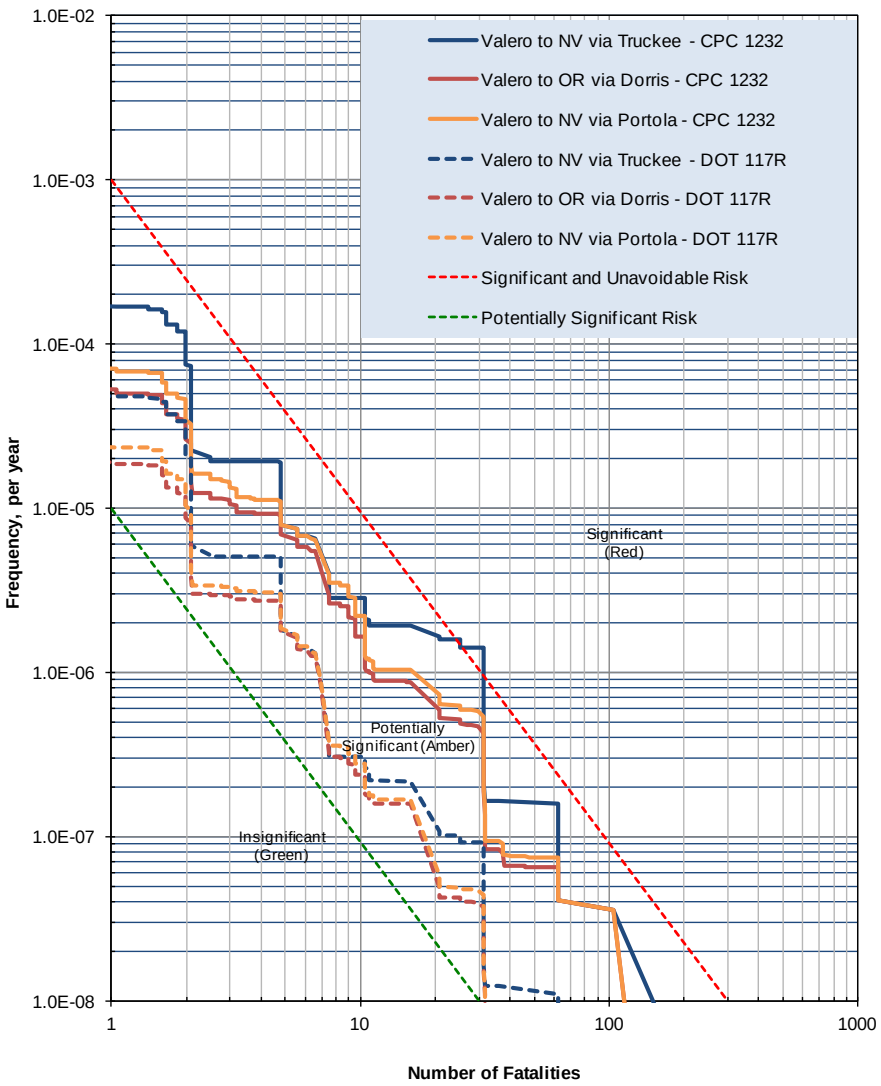
SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-5

Risk Associated with DOT-117 Tank Car Mainline Crude Oil Unit Train Transportation – 100 Car Unit Train to California Border



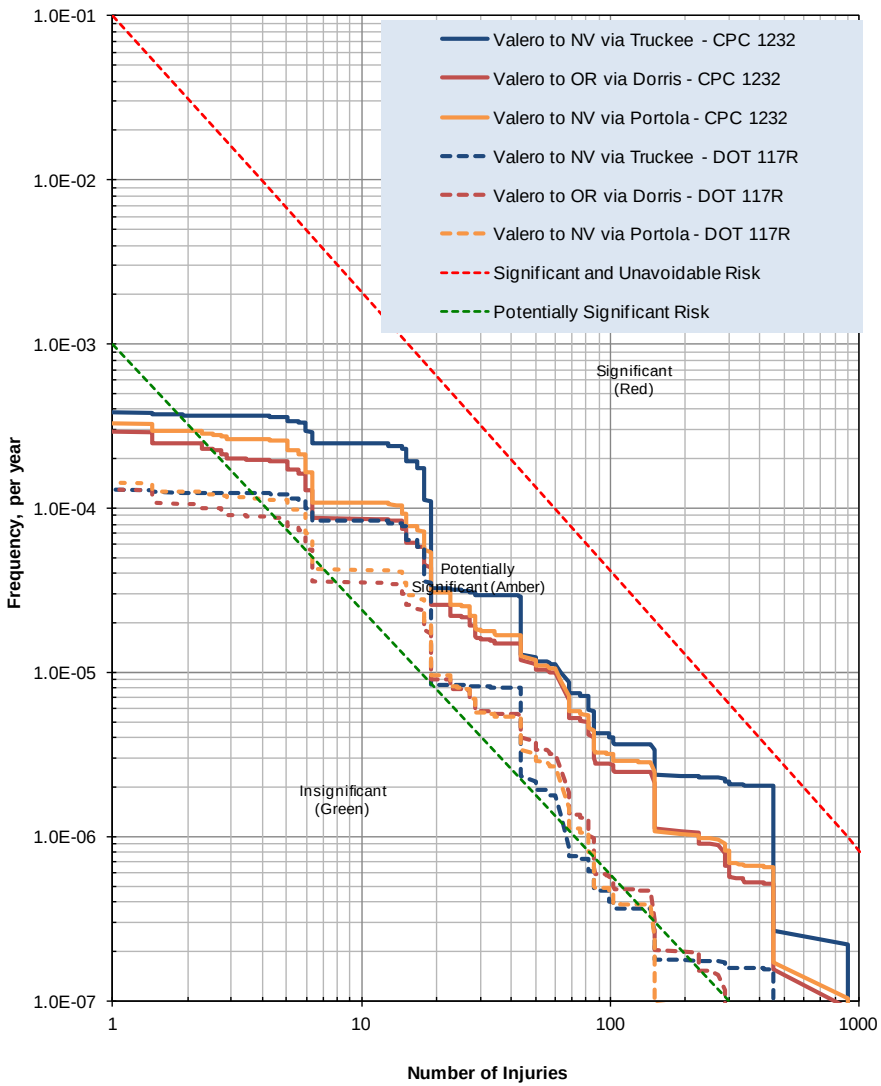


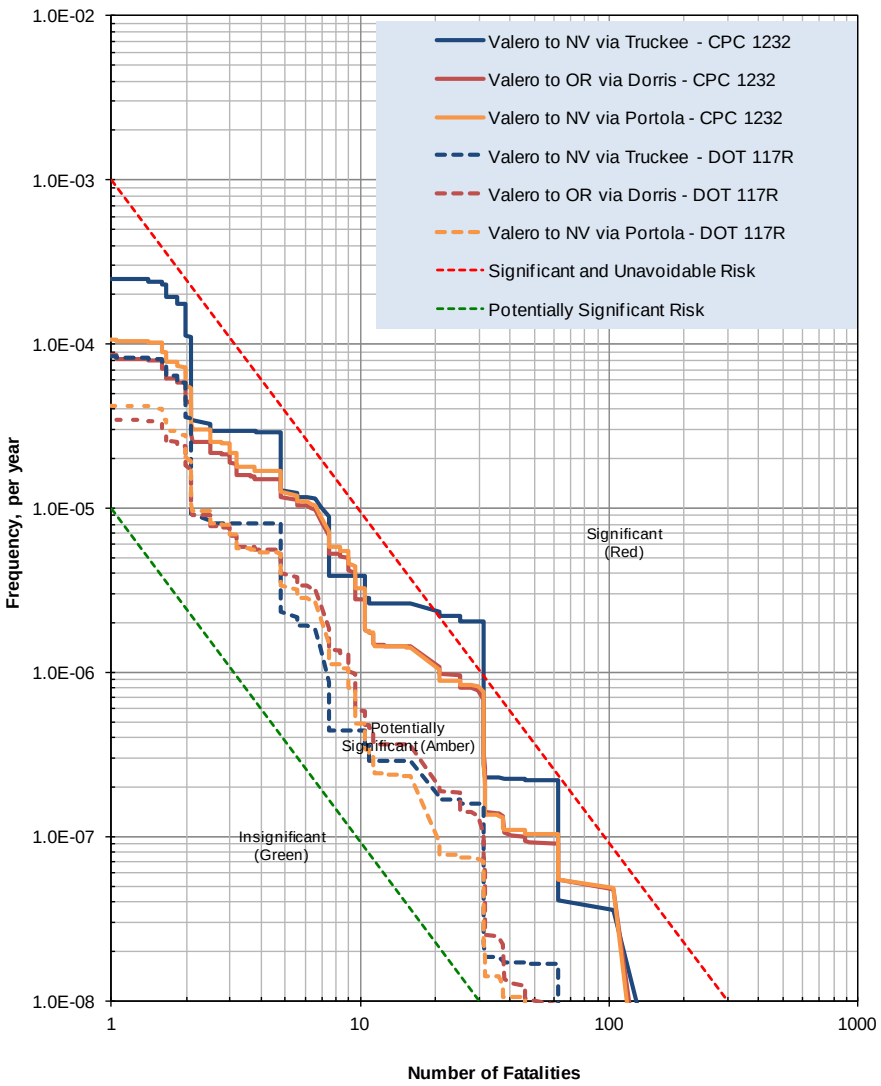
SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-6

Risk Associated with DOT-117R for CPC-1232 Tank Car
Mainline Crude Oil Unit Train Transportation –
50 Car Unit Train to California Border





SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-7

Risk Associated with DOT-117R for CPC-1232 Tank Car
Mainline Crude Oil Unit Train Transportation –
100 Car Unit Train to California Border

Project as proposed, and under the new USDOT requirements. As shown in these figures, while the updated tank car designs reduce the overall risk, the impact would remain significant.[22]

~~In order to identify the probability of an accidental release of crude oil from a Valero train, the City retained Dr. Christopher Barkan to conduct a quantitative assessment. Dr. Barkan is Professor and Executive Director of the Rail Transportation and Engineering Center at the Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign. He and his colleagues prepared a report that is attached hereto as Appendix F.~~

~~The annual rate of crude oil release accidents on the route between Roseville and Benicia was estimated. Consistent with recent industry practice a release event in which a tank car loses more than 100 gallons of crude oil was considered significant. It was assumed that the Refinery would use 1232 Tank Cars for all shipments, based on Valero's commitment to do so. The risk analysis took into account major risk factors, including the route's FRA track class, method of operation, tank car safety design and the proposed volume of petroleum crude oil traffic over the route.~~

~~The estimated risk of an accident resulting in a release of more than 100 gallons is approximately 0.009 per year, which corresponds to an estimated frequency of occurrence of once per 111 years. The risk of a release along the portion of the route traversing the Suisun wetland area has an even lower annual risk of 0.00381, which corresponds to an estimated frequency of once per 262 years.~~

~~According to the report, these risk estimates are probably conservative, meaning that they probably overstate the actual risk. This is because the rate of hazardous materials releases from trains has declined since the rate estimates were developed; the accident rate has been declining for decades, and this trend will likely continue based on continued investment in infrastructure and new safety technologies; the analysis does not take into account the safety practices adopted by AAR earlier this year. In addition, the pending PHMSA rulemaking could result in new tank car standards that are even more stringent than those for 1232 Tank Cars.~~

~~The report also compared the likelihood of an accident involving a Valero train travelling from Roseville to Benicia with the likelihood of automobile accidents, based on recent US federal data on highway safety in terms of incidents per million vehicle miles traveled. The risk of a motor vehicle accident is 22 times higher than the risk of a Valero train release. Considered on an annual basis, the average US driver is 6.3 times more likely to be involved in a motor vehicle accident, and 1.9 times more likely to be involved in an accident involving injuries or fatalities, than the occurrence of a release incident on the Roseville to Benicia route.~~

Although the Project involves a risk of an accidental release from tank cars ~~(albeit very low at 0.009)~~, the Project also involves a corresponding reduction in the risk of an accidental maritime release from vessels carrying crude oil to the Refinery. For harbor and mooring accidents, the probability of an accident as reported by FEMA is 0.001 accidents per transit, and about 0.15 of these accidents would result in a spill (FEMA, 1989). Assuming current baseline transits for marine terminal (approximately 89 ships per year), the estimated baseline probability of an accidental

[22] The probabilities labeled on the vertical axis of these graphs as "Frequency, per year" are expressed using scientific notation. For example, 1.0E-04 = 0.0001 = 1/10,000.

release resulting in a spill would be 0.0267 releases per year (or once every 37.5 years). With operation of the Project, marine vessel deliveries would be reduced by up to 82% per year and the probability of a maritime release in San Francisco Bay would be lowered to 0.0048 releases per year (once in 208 years).

~~As also explained above, in the past year there have been several significant accidents involving the release of Bakken crude oil from rail cars, including the incidents in Lac-Mégantic, Aliceville, Casselton, and Lynchburg. All of these incidents involved a significant fire and/or explosion. The Lac-Mégantic was the only incident involving injuries or loss of life, although the loss in that event can only be described as catastrophic. The Lac-Mégantic and Lynchburg events both resulted in a significant discharge of crude oil into a waterway.~~

~~These incidents raise the concern that a release of Bakken crude is more likely to result in a fire or explosion because of its low flash point and/or low boiling point than other crude oils. Since Bakken is one of the available North American crudes that Valero might purchase and transport by rail to Benicia, it is important to consider those incidents, and the regulatory requirements adopted in their aftermath. It is also important to consider how the circumstances in those incidents compare to the Project's train trips.~~

~~The accident in Lac-Mégantic was caused by human error – the decision to leave an idling train unattended at the top of a steep grade. DOT's Emergency Order No. 28 substantially reduces the risk of such an occurrence in the United States by imposing a variety of requirements relating to unattended trains and the securing thereof.~~

~~The accidents in Lac-Mégantic, Aliceville, and Casselton all involved DOT-111 Legacy Tank Cars. If the Project were approved, Valero here would use only 1232 Tank Cars to transport oil from Roseville to Benicia. This substantially reduces the risk of release in the event of derailment as compared with the use DOT-111 Legacy Tank Cars because, as explained above, 1232 Tank Cars are designed according to more stringent requirements. Had the trains in Aliceville or Casselton been using 1232 Tank Cars, it is possible that crude oil might not have been released. (Since the train in the Lac-Mégantic incident was travelling at a rate of 63 miles per hour when it derailed, it is unlikely that the use of 1232 Tank Cars would have prevented a release, although it might have reduced the severity somewhat).~~

~~At the same time, it is important to recognize that, in the Lynchburg incident, one of the 1232 Tank Cars ruptured (Oil Daily, 2014).~~

~~As explained above, in the past year the following actions by FRA, PHMSA, and AAR will significantly reduce the risk of further incidents involving Bakken crude oil:~~

- ~~DOT and AAR agreed to a program involving more track inspections, better braking systems, maximum speed limits, installation of wayside wheel bearing detectors every 40 miles, additional training and planning for emergency response, and application of route planning and selection requirements to crude by rail.~~
- ~~FRA Emergency Order No. 28 established additional requirements to ensure that unattended trains, locomotives, and tenders on the mainline track or siding are properly secured against unintended movement.~~

- ~~DOT Emergency Order 2014-25 mandated that all crude oil be transported according to the requirements for Packing Groups I or II, even if the material in question might otherwise meet the requirements for Packing Group III. This will ensure a higher level of protection for all shipments of crude oil, including Bakken.~~
- ~~As part of the "Bakken Blitz" compliance initiative, the FRA began unannounced inspections at oil producing sites to ensure that crude oil has been properly tested and classified before it is loaded onto a tank car.~~
- ~~DOT Emergency Order 2014-0067 required railroads to notify the State Emergency Response Commission for each state in which the railroad transports Bakken crude oil so that adequate emergency response procedures are in place in the event of an incident.~~

~~In addition, PHMSA is currently considering more stringent regulations for the transportation of crude by rail, including requirements for tank car design that are even more stringent than those set forth in CPC-1232. AAR has already advocated such an approach in its rulemaking comments. PHMSA's review will benefit from the lessons learned from all recent incidents, and the input of FRA and NTSB. Union Pacific and Valero will comply with any revised regulations, thereby reducing the risk of an accident, and the potential consequences of an accident, even further.~~

~~In conclusion, the risk of an accidental release of crude oil from a train travelling from Roseville to Benicia is considered insignificant based on the following:~~

- ~~Although the consequences of a release are potentially severe, the likelihood of such a release is very low. The probability of an accidental release of crude oil from a tank car traveling to the Refinery involving more than 100 gallons of crude oil is just 0.009 per year.~~
- ~~An extensive body of rules and regulations adopted by FRA, PHMSA, and AAR are designed to minimize the risk of an accidental release of crude oil from tank cars.~~
- ~~Although there have been a number of recent fires involving Bakken crude oil, the DOT, FRA, PHMSA, NTSB, and AAR have moved aggressively to identify the causes of those incidents and reduce the risk of similar incidents. The transport of Bakken crude to the Refinery, if any, will be subject to the new, more stringent requirements.~~
- ~~The Project would significantly reduce the risk of an accidental release of crude oil from a vessel in San Francisco Bay. If the Project were approved and constructed, the risk of maritime spill would be reduced from 0.0267 (once every 37.5 years) to 0.0048 (once every 208 years).~~

Mitigation: None ~~required~~ available.

~~Finally, it bears noting that~~ No reasonable, feasible mitigation measures have been identified that would, if implemented, reduce below established thresholds the potential significant hazard to the public or the environment that may result through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. Further, as discussed in DEIR Section 3.7, DEIR Appendix L, and Revised DEIR Appendix G, the City cannot regulate UPRR's rail operations either directly or indirectly. Any such attempt would be preempted by federal law, which proscribes any mitigation measure that would have the effect of managing or governing rail operations ~~federal law preempts the ability of state and local governments to regulate rail activity and/or impose any requirements that burden the unrestricted movement of trains in interstate commerce~~. While the City can identify and disclose the risks posed by rail transport of

crude oil, it must rely on the federal authorities to ensure that any such risks are mitigated as appropriate. Therefore, Impact 4.7-2 is considered significant and unavoidable.

Impact 4.7-3: The Project could create a hazard to the public or environment through reasonably foreseeable upset or accident conditions during train maneuver at the rail unloading facility. (*Less than Significant*)

There is also a potential that a tank car could derail while being maneuvered onto the side-track unloading area at the Refinery. FRA has published ten-year accident statistics for UPRR on side track maneuvers (FRA, 2013d). The average accident rate for these maneuvers was reported to be about 15 accidents per million yard switching miles. Assuming that the travel distance during these maneuvers is about one mile per train visit, the probability of a derailment or other accident at this location on an annual basis is estimated to be 0.01, or once in one hundred years. Given the low speed the trains would be moving (3 mph), tank cars would not be impacted enough to result in a spill because the estimated shell and head puncture velocity of the tank car design proposed for use by Valero are 8.3 mph and 10.3 mph, respectively (MRS, 2015 [Revised DEIR Appendix F, USDOT, 2014]). In addition, assuming a reasonable worst case scenario where one entire tank car contents spilled, from such an accident (30,000 gallons), the Project's spill containment system is designed to hold the entire contents of a spill plus any firefighting water and firefighting foam fire suppression system that might be used to prevent a fire. Thus, the impact would be less than significant.

Mitigation: None required.

Impact 4.7-4: The Project could create a hazard to the public or the environment through reasonably foreseeable upset or accident conditions during the line hookup and crude oil transfer from a tank car at the unloading facility. (*Less than Significant*)

An accident may occur at the rail unloading facility when a rail car is coupled to the manifold during unloading operations. This process could result in spills due to mechanical failure, structural failure, corrosion, or human error. The most likely spill related event would be a release during the unloading process due to a loading line failure.

For this operation a hard-piped elbow would be connected to the bottom drain at the tank car to be unloaded. Then one end of a flexible hose would be connected to the elbow and the other end connected to the manifold. It is possible that the hose connection could leak and crude oil would drain and be contained in to the sump below the tank car. Although such an event may have a higher probability of occurring than a derailment at the unloading facility, the amount of crude oil that could be released would be much smaller before remedial action could take place, such as closing the valve at the bottom of the tank car. To minimize the likelihood and the volume in the event of an oil spill at the unloading rack, hardware design on the rack includes a sight/flow glass for each tank car to verify that the contents have been emptied prior to decoupling the hose, a check valve between the offloading header and each tank car to prevent backflow from the offloading

header, and manually operated block valves on both ends of the offloading hose. ~~Since the volume released would be relatively small, contained on site, and under controlled conditions, the impact would be less than significant. Even so, t~~ The sump under the unloading facility has the capacity to receive and contain a volume almost nine times greater than the capacity of one tank car. This containment volume is significantly larger than the EPA 40 CFR 112.9 SPCC, which requires 100% of a single storage container and sufficient freeboard to contain precipitation. Given this, even if the contents of one entire tank car were released during an unloading operation, the impact would remain contained and less than significant.

The loading area also would be equipped with a fire protection system that complies with code requirements at the time of construction. System components could include, for example, fire detection equipment hydrants, controls, and piping. The unloading rack would be equipped with a foam sprinkler deluge system and firewater monitors with foam generators at the unloading rack periphery. In the event of a spill that led to a fire, the sprinkler deluge system would activate and douse the area with foam. Any spilled oil would be directed away from the unloading area to the spill containment tanks, which would serve to keep any fire away from the tank cars.

Downstream of the two unloading facility meter assemblies, a new 16-inch above ground pipeline would be routed along an existing internal road on the Valero property between the unloading facility and the Refinery. This pipeline would connect with the existing Refinery crude oil storage tanks. This road accommodates periodic on-site traffic only associated with Refinery personnel traveling at low-speeds. The pipeline would be approximately 4,000 feet in length. The unloaded crude oil would be stored in the existing Refinery storage tanks. Therefore, crude oil storage would not result in any increase in fire and explosion risk at the Refinery.

The proposed unloading facility would have a maximum crude oil pumping rate of 4,000 gallons per minute. The unloading facility and 16-inch pipeline would be monitored using multiple Programmable Logic Controllers and controlled using the existing Refinery's Supervisory Control and Data Acquisition (SCADA) system. The SCADA would detect a catastrophic failure of the 16-inch pipeline within 1 minute, thus limiting pumping losses. However, the drainage of the pipeline would occur, and potentially result in a worst-case spill of about 73,000 gallons of crude oil. This worst case spill would occur where the pipeline connects with unloading pumps since this is the lowest elevation of the pipeline. Further up the pipeline toward the storage tanks, the maximum spill volumes decrease, with the smallest spill volumes being near the storage tanks. In the event of a release from the pipeline, the oil would drain into the area around the pipeline and unloading racks, which could result in a pool fire.

Several crude oil spill scenarios were modeled to evaluate worst-case thermal radiation hazards associated with a large crude oil fire. Modeled scenarios ranged from small releases from a tank car, full release of tank car contents, and full release of the pipeline volume. (See Attachment 3 in Revised DEIR Appendix F for consequence modeling input data and results). The worst-case thermal radiation hazard distances are provided in Table 4.7-8.

As shown below in Figure 4.7-8, none of these flammable hazard zones have the potential for offsite impacts associated with the worst-case unloading facility crude oil spill and fire in residential areas. The worst case spill would occur just north of the unloading facility where nearly the entire

TABLE 4.7-8
WORST CASE THERMAL RADIATION HAZARD ZONES – UNLOADING FACILITY

Wind Speed (meters/second)	Distance in feet to	
	5 kW/m^2	10 kW/m^2
1	518	282
2	558	308
3	581	324
4	974	554
5	994	571
10	1,053	620
20	1,585	1,109

NOTES:
kW/m^2=kilowatts per square meter
See Attachment 3 of Revised DEIR Appendix F for the detailed consequence modeling results.
See Attachment 2 of Revised DEIR Appendix F for a description of the consequences associated with these hazards.

pipeline would drain onto the ground due to the slope of the area between the unloading facility and Refinery storage tanks. Spills closer to the Refinery storage tanks would be smaller, thus resulting in smaller hazard zones and less offsite exposure. Since the worst case hazard zones extend beyond the Refinery boundaries, the QRA provided in Revised DEIR Appendix F evaluates the risk to adjacent workers in the commercial/industrial area east of the Refinery.

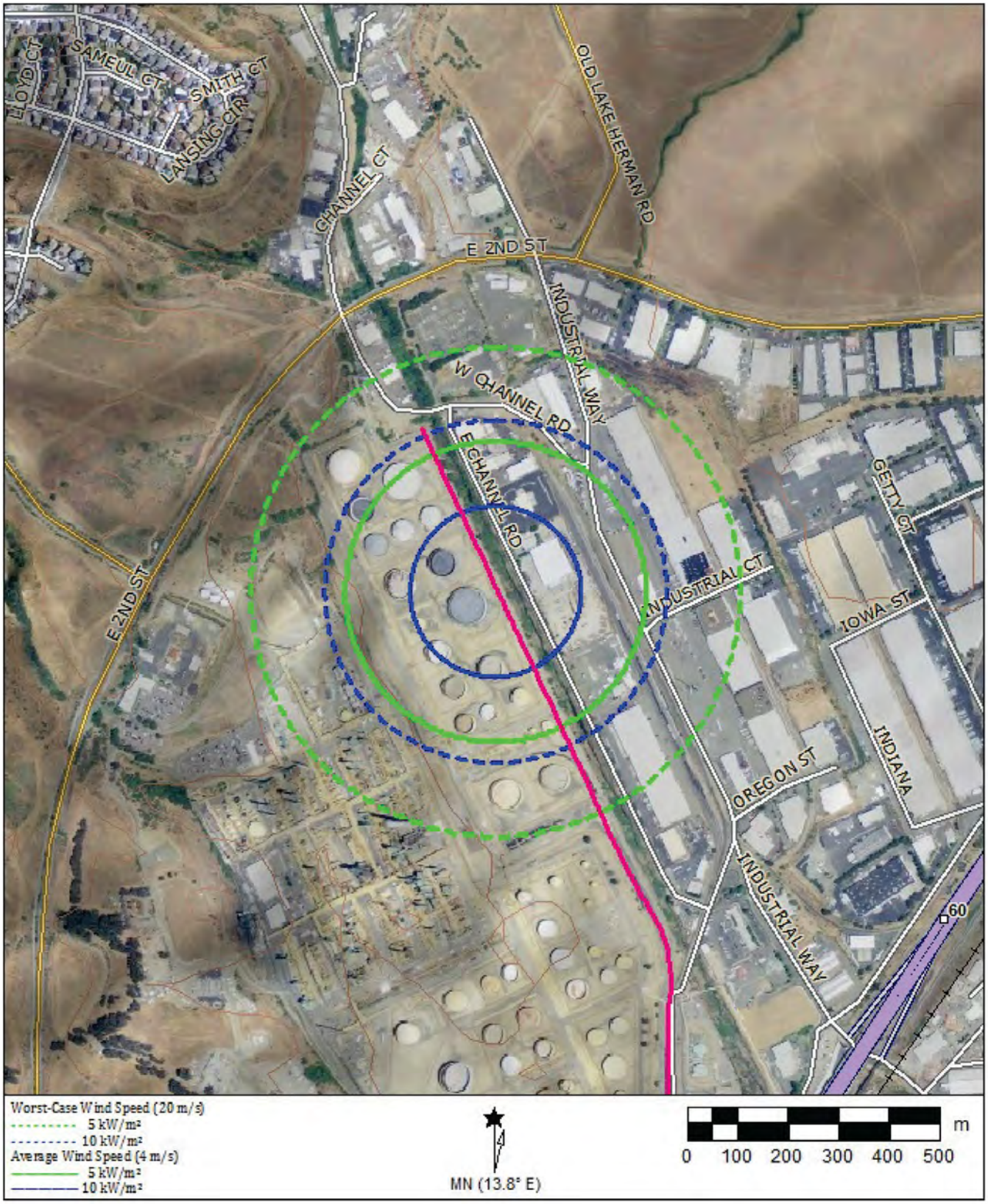
The QRA also considers the potential for a tank car thermal tear to result in the event that a pipeline spill exceeds the volume of the spill containment sump and the crude oil ignites. The results of the QRA for the Project are presented in Figure 4.7-9 as risk profiles, which show that the risk of injuries or fatalities associated with unloading facility accidents would be less than significant.

Mitigation: None required.

Impact 4.7-6: Train derailments and unloading accidents that lead to hazardous materials spills, fires, and explosions could result in substantial adverse secondary effects, including to Biological Resources, Cultural Resources, Geology and Soils, and Hydrology and Water Quality. (*Significant and Unavoidable*)

Secondary Effects to Biological Resources

Train derailments and unloading accidents that lead to spills, fires, explosions, and ensuing emergency response activities could result in substantial adverse impacts to biological resources, including species identified as a candidate, sensitive, or special-status, riparian habitats or other sensitive natural communities or federally protected wetlands; and may interfere substantially with the movement of native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, may impede the use of native wildlife nursery sites. Although the probability of derailment and related risks would be low, the consequences to biological resources could be high. Numerous factors affect the severity of impacts to biological

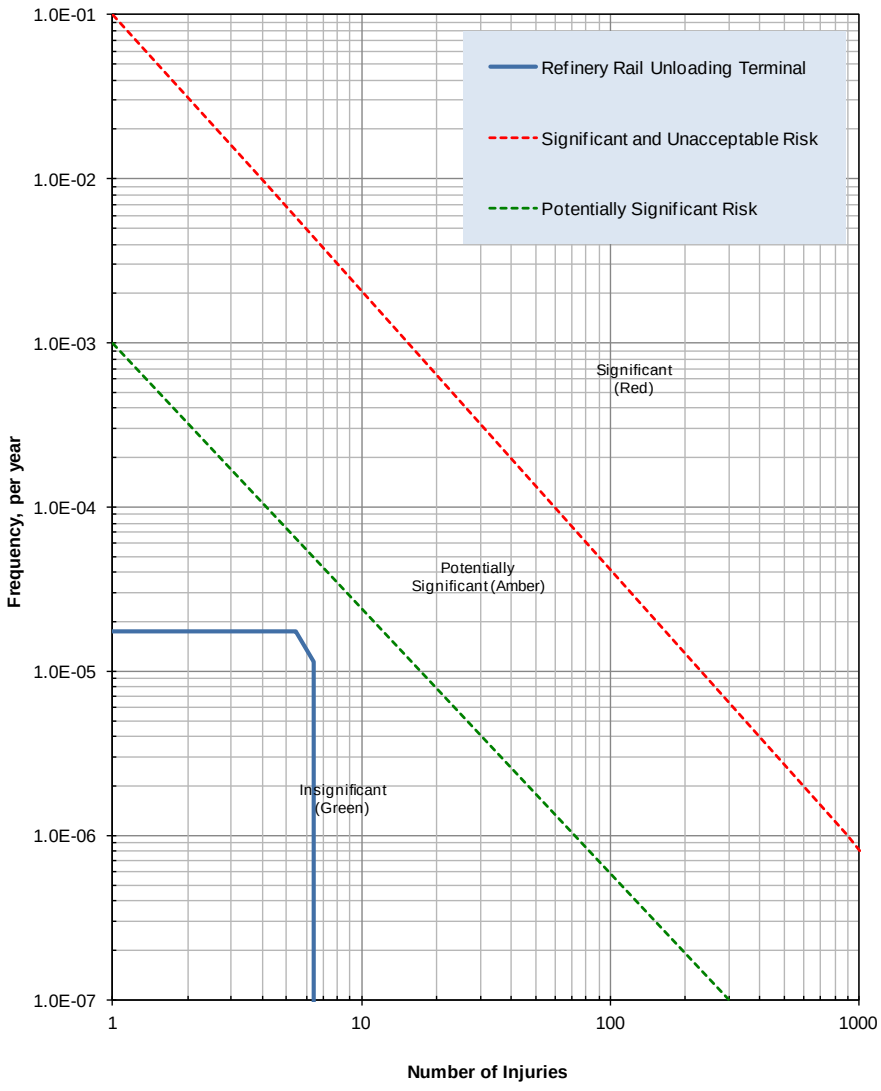


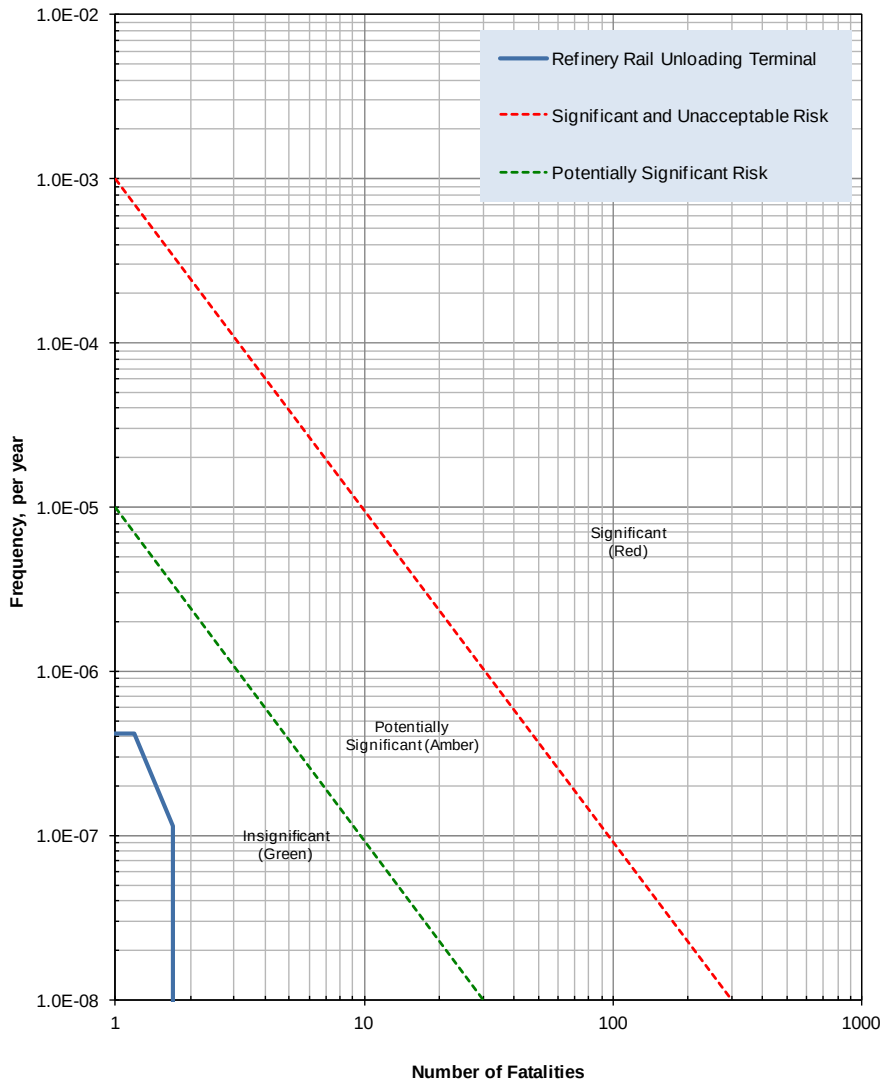
SOURCE: City of Benicia

Benicia Valero CBR . 202115.01

Figure 4.7-8

Worst-Case Facility Thermal Radiation Hazards





SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 4.7-9

Risk Associated with Valero Unloading Facility Crude Oil Spills and Fires

resources in the event of an accidental oil spill. For instance, full train derailment and spill occurring within a remote and steep canyon section of Feather River where slope and water flow could accelerate the rate of oil spread would pose a greater risk to biological resources than a spill occurring in disturbed flatland habitats such as agricultural fields in the Sacramento Valley. In addition, depending upon the location of an oil spill along the UPRR mainline tracks, availability of oil spill containment or cleanup equipment and access to accident sites could prolong emergency response agencies and impair cleanup efforts. Although the QRA finds a minimal likelihood of train derailment and oil spill, the possibility still exists.

Special Status Plant Species

Based on the database query along the UPRR mainline (Revised DEIR Appendix E), there are a minimum of 96 sensitive plant species occurrences documented within 300 feet on each side of the rail. The Oregon to Roseville route has approximately 40 special status plants documented within 300 feet of the rail line, the Nevada to Roseville (northern) has 44 and the Nevada to Roseville (southern) has 11 special status plants.

For most sensitive plant species, it is unlikely that a train derailment or spill would eliminate the entire population of the species, as most sensitive plant species populations occur at multiple locations. However, some special-status plants occupy very limited ranges and a substantial spill or related fire could potentially impact localized populations and impair the survival of the species. Direct impacts or secondary impacts to sensitive plants as a result of any trail derailment crude oil spill would be considered a significant and unavoidable impact.

Special Status Wildlife

Based on the database query (Revised DEIR Appendix E), there are currently a minimum of 83 special-status wildlife occurrences documented within 300 feet of the mainline rail routes. The Oregon to Roseville route has approximately 48 special-status wildlife documented within 300 feet of the rail line, the Nevada to Roseville (northern) has 34 and the Nevada to Roseville (southern) has 17. The majority of these species are associated with natural, continuous habitats running along the uprail routes. These include the Sacramento and Feather River riparian corridors, the Sierra and Cascade Mountain Ranges with associated forests, and the numerous wetlands and creeks traversed by the rail routes.

In the event of a train derailment or oil spill, the potential for impacts may be greater to aquatic and semi-aquatic species due to the sensitivity of aquatic environments and the probability of greater spread through gravity and water transportation. Oil contamination into water increases the chance of direct contact with wildlife species than if a spill were to occur on flat terrestrial habitats. Contact with oil can damage waterproofing ability of aquatic birds, poisoning through ingestion of contaminated water or vegetation, deterioration of water quality, destruction of habitat, long-term reproductive or health problems, and contamination up food chains. Even an oil spill on terrestrial habitats could affect sensitive species and natural communities through soil contamination, loss of habitat, fire spread due to explosion and derailment, and disturbances from emergency response and cleanup efforts. Irrespective of whether a crude oil train accident were to occur within aquatic or terrestrial habitats, any such incident would have the potential to impact

special-status wildlife species and their habitats. Therefore, oil spills along the main line rail routes could be significant and unavoidable depending upon the location and severity of the spill.

Critical Habitat

The routes uprail from Roseville Yard to the State border bisect nine critical habitat units: Delta smelt, chinook salmon, steelhead, vernal pool tadpole shrimp, vernal pool fairy shrimp, Sierra Nevada yellow-legged frog, yellow-billed cuckoo (proposed critical habitat), Contra Costa goldfields, and Suisun thistle. An oil spill within critical habitat would have adverse impacts either directly through habitat loss or through habitat degradation of essential habitat features of special status species. This would constitute a significant and unavoidable impact.

Sensitive Habitats

Based on the database query (Revised DEIR Appendix E), a total of 10 sensitive habitats are documented within 300 feet of the mainline rail routes. Examples of sensitive habitat include: Northern Claypan Vernal Pool, Great Valley Mixed Riparian Forest, Coastal Brackish Marsh, Great Valley Valley Oak Riparian Forest, Central Valley Drainage Valley Floor River, and Elderberry Savanna. Most of the sensitive communities documented within 300 feet the routes occur along the Oregon to Roseville route. Overall, the database query of only 10 sensitive habitats is considered to be low and is likely underestimated since the main line rail transects numerous properties and habitat types that may have not been mapped and/or documented within the CNDDB. An oil spill within sensitive habitat would have adverse impacts either directly through habitat loss or through habitat degradation of essential habitat features of special status species. This would constitute a significant and unavoidable impact.

Streams, Rivers, Wetlands and Other Waterbodies

Based on database queries and map and aerial photo interpretation, the uprail routes bisect or run parallel of numerous wetland features. Larger features include the Feather, Sacramento, American, and Truckee Rivers; Shasta Lake, Lake Oroville, Suisun Bay, Suisun Marsh, and Yolo Bypass. In addition, there are numerous creeks, drainages, vernal pools, seeps, marsh complexes, and other wetland features within the vicinity of the mailing rail routes that could be adversely impacted by an oil release. Due to the sensitive nature of water habitats, the greater risk of oil spread through flow and gravity, and the difficulty of remediation to water features impacts resulting from accidental oil release could have significant and unavoidable impacts.

Mitigation Discussion

As a general rule, CEQA requires an EIR to describe mitigation measures that could, if implemented, minimize significant environmental effects (14 Cal. Code Regs. §§15126(c), 15126.1(a)). Under CEQA Guidelines Section 15370(b), “mitigation” includes “[m]inimizing impacts by limiting the degree or magnitude of the action and its implementation.” Requiring a project to comply with specific legal obligations may be a proper mitigation measure when it is reasonable to expect compliance. *Oakland Heritage Alliance v. City of Oakland* (2011) 195 Cal. App. 4th 884, 906. Recent California legislation addresses the protection of surface waters, wetlands, and environmentally sensitive areas in the event of an oil spill. For example, Senate Bill (SB) 861, *Oil Spill Prevention and Response*, was signed into law on June 20, 2014 after issuance

of the DEIR. SB 861 authorizes the Office of Spill Prevention and Response with the statewide expansion and regulatory oversight to cover all statewide surface waters at risk of oil spills. In the event of an oil spill on the mainline tracks within California, SB 861 requires implementation of an approved California Oil Spill Contingency Plan (Gov't Code §8574.1). In the event of an oil spill, the implementation of an approved California Oil Spill Contingency Plan could reduce impacts to marshes or other sensitive habitats within the State to less than significant. However, under a worst case scenario, significant direct and indirect impacts to special-status species and their habitats could occur. If Valero were required to document (subject to verification) that all required provisions of an SB 861 Oil Spill Contingency Plan were in place for all mainline rail routes in California that could be used to transport crude oil to the Refinery and that all first response agencies along such routes had been provided a copy of the plan, the significance of Impact 4.7-6 could be reduced relative to streams, rivers, wetlands and other waterbodies.

"If the lead agency determines that a mitigation measure cannot be legally imposed, the measure need not be proposed or analyzed. Instead, the EIR may simply reference that fact and briefly explain the reasons underlying the lead agency's determination." (14 Cal. Code Regs. §15126.4(a)(5)). CEQA Guidelines Section 15364 defines "feasible" as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account several factors, including legal ones. Mitigation measures that are beyond a lead agency's powers to impose or enforce are legally infeasible. *Kenneth Mebane Ranches v. Superior Court* (1992) 10 Cal.App.4th 276.

As explained in Revised DEIR Appendix G, the City cannot regulate UPRR's rail operations. Any such attempt would be preempted by federal law, which proscribes any mitigation measure that would have the effect of managing or governing rail operations. For this reason, a mitigation measure that required compliance with SB 861, as supplemented to require verification and provision of plans to all first response agencies, would be infeasible, and so is not recommended. Accordingly, Impact 4.7-6, regarding potential secondary hazard-related effects to biological resources, including special status species, sensitive habitats, and wetlands, following a train derailment or other upset or accident, would remain significant and unavoidable.

UPRR would remain obligated to comply with independently enforceable federal requirements, including emergency planning requirements. However, even with a plan in place, potential impacts to special status species, sensitive natural communities, or wetlands affected by a substantial spill would remain significant and unavoidable.

Mitigation Measures: None available.

Secondary Effects to Cultural Resources

Train derailments and unloading accidents that lead to fires, explosions, and ensuing emergency response activities could result in substantial adverse impacts to the significance of a historical resource as defined in CEQA Guidelines §15064.5. As noted in Revised DEIR Section 2.8 (regarding cultural resources), several historical resources are located along and near the rail lines within and beyond the State border. In the event of a train derailment and a resulting explosion, fire, or cleanup and restoration activities at any point along the rail route from the point of origin

to the Refinery where historical buildings, structures, or other resources are present, such resources or their immediate surroundings could be damaged, destroyed, or otherwise altered such that their significance would be materially impaired. Although the risk of such an occurrence is quite low,[23] any substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines §15064.5 would be a significant impact. Because no reasonable, feasible mitigation measures have been identified that would, if implemented, reduce the significance below established thresholds, this secondary hazards and hazardous materials related impact to cultural resources would be significant and unavoidable.

Secondary Effects Relating to Geology and Soils

Seismic hazards may pose a safety concern for the State's railroad system infrastructure because railroad tracks and bridges cross active faults (California Interagency Rail Safety Working Group, 2014) and because the potential for earthquake-induced damage to railroad system infrastructure is high (CPUC, 2013). Railroad tracks located within a fault zone could be severed directly by fault rupture and displaced or buried by landslides, rock falls, liquefaction and embankment settlement (USGS, 2008; Jones et al., 2008; Byers, 2008). Railroad damage was reported in approximately 100 earthquakes that occurred between 1859 and 2008 (Byers, 2008) and can be expected to occur in future events. See, for example, the California Geological Survey's analysis of a hypothetical magnitude 7.8 earthquake on the San Andreas Fault in Southern California (USGS, 2008; Jones et al., 2008). The report discloses that railroads cross the San Andreas Fault rupture zone a total of 21 times in the Palmdale area, Cajon Pass, San Gorgonio Pass, and near the Salton Sea; that earthquake-induced landslides could bury railroad tracks beneath millions of cubic meters of debris; and that liquefaction-induced lateral spreading could cause substantial track displacement (Jones et al., 2008). Earthquake-induced track damage could result in an accident involving a train carrying Project-related crude oil in any seismically active area along any of the routes shown in Figure 1-1, North American Freight Railroads. See Revised DEIR Section 2.12, which analyzes the risks and potential direct and indirect consequences of rail-related accidents and other upsets. Because a seismic event could expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death and because no reasonable, feasible mitigation measures are available that would, if implemented, reduce the significance below established thresholds, this rail-transport related impact would be significant and unavoidable.

Secondary Effects Relating to Hydrology and Water Quality

Train derailments and other accident conditions (including tank car punctures and fitting failures) could result in substantial adverse impacts to Hydrology and Water Quality by violating water quality standards or waste discharge requirements, creating or contributing runoff water that

[23] As analyzed in the QRA provided in Appendix F to this Revised DEIR, "…the probability of a crude oil release incident exceeding 100 gallons or more would range between one every 20 years to once every 27 years depending upon the rail route used to get to the Refinery. The probability of a crude oil release incident exceeding 30,000 gallons or more would range between one every 38 years to once every 80 years; the probability of a crude oil release incident exceeding 180,000 gallons or more would range between one every 200 years to once every 4,000 years; and the probability of a crude oil release incident exceeding 240,000 gallons or more would range between one every 308 years to once every 10,000 years. These probabilities of a release are only for the portion of the routes between the Refinery and Oregon/Nevada state lines…. the probability of a release of crude oil would be greater for the full length of the train route (crude source location to Refinery)."

would exceed the capacity of stormwater drainage systems or providing substantial additional sources of polluted runoff, or otherwise substantially degrading water quality. Such incidents and accidents also could expose people or structures to a significant risk of loss, injury or death involving flooding or inundation by seiche, tsunami, or mudflow if the derailment also causes levee or dam failure.

The risk that these secondary effects of train-related incidents and accidents to Hydrology and Water Quality could occur would be lower than the risk described in the QRA prepared of the Project (see Revised DEIR Appendix F, Section 5.2.1) because, in order for there to be an impact to surface water and water quality, the incident would need to occur in the vicinity of a water body such as a stream, river, marsh, or bay. In order for groundwater quality to be affected by a train-related incident or accident, there would have to be hydrologic connection to an affected surface water body or else a spill would have to occur in a groundwater recharge area. In the event of a derailment or other accident resulting in the release of crude oil from rail cars, substantial degradation to surface water and/or groundwater quality could occur depending upon the volume of the materials released and the location of the spill.

The topography or terrain in the area of an oil spill would affect the extent of the potential impacts. Hills, valleys, low areas, and other land features can affect how a release is contained or migrates over the ground surface. For example, a release in an area with a steep slope could accelerate the rate of oil migration and cause the spill to cover a greater area. Releases near low areas or confined valleys could pool and contain the oil and reduce aerial coverage of the release. Spills that flow into a drainage ditch or channel might flow greater distances from the release site due to the funneling of the oil in the channel. Smaller drainage channels generally flow into larger channels, which potentially could empty to a surface water feature, thus increasing the impacts of the spill. A spill released to level, flat ground would generally not migrate as far from the release site.

If released to water, crude oil typically floats on the water’s surface. If crude oil is left on the water’s surface over an extended period of time, some constituents within the oil will evaporate, other fractions will dissolve, and eventually, some material may descend to the bottom. Oil can sink in the water column as it degrades and mixes with particulates in water. In flowing waters, the spreading of the oil in three dimensions creates many challenges for responders to minimize the impacts of the release. Consideration of submerged oil in a flowing water environment would require different response action planning and response equipment to contain and recover the submerged oil. Spills into water ways and infiltration into groundwater could impact sources of drinking water, threatening water supplies for local populations. Oiling could occur on vegetation and soil along the banks or shore of surface waterbodies. Wetlands and other natural areas along with their inhabitants (e.g., amphibians, reptiles, fish, and aquatic plants; see the subsection above for detailed discussion of secondary hazards-related impacts to Biological Resources) could be impacted if an oil spill entered these ecological systems. However, compared to flowing surface water systems, an oil plume within a wetlands-like environment typically would migrate slowly, oiling surface vegetation and wildlife. Additionally, secondary impacts also could occur from the cleanup and response activities.

In the event of a crude oil spill, UPRR would rely first upon the emergency response agencies and responsibilities described above. See also regional spill response plans such as the Truckee River Geographic Response Plan for the Truckee River Corridor, which is implemented in Placer, Nevada, and Sierra counties in California and Washoe, Storey, and Lyon counties in Nevada (Truckee River Area Committee, 2005). Compliance with applicable rules and response plans would reduce train derailments and improve emergency response in the event of an accident involving a release of oil. UPRR maintains spill response contracts with companies throughout their rail network in California. All of the UPRR response firms are rated Oil Spill Response Organization (OSRO) by the State of California and classified Oil Spill Removal Organization by the United States Coast Guard. Depending upon the location, and extent of a spill local response teams, UPRR response personnel and State and Federal response agencies would be involved in the containment and cleanup operations. However, depending upon the location of an oil spill along the UPRR main line tracks, there may be no oil spill containment or cleanup equipment immediately available, and it could take some time for emergency response teams to mobilize adequate spill response equipment. Depending upon the location of the spill, this could allow enough time for the spill to affect water resources. For example, as summarized in Section 3.1 of Revised DEIR Appendix F, approximately 26,000 gallons of crude oil were discharged into the Chaudière River as a result of the July 6, 2013, derailment in Lac-Mégantic, Canada; more than 33,000 gallons of crude oil were released into the James River as a result of the April 30, 2014 derailment in Lynchburg, Virginia; and oil also entered waterways as a result of the February 16, 2015 derailment in Fayette County, West Virginia and the March 7, 2015 derailment near Gogama, Ontario. Consistent with these occurrences, it is clear that oil spills along mainline tracks (whether they occur within the State or elsewhere in North America) could result in a significant impact to water resources and water quality (including sources of drinking water) depending upon the location of the spill. Although the risk of such an occurrence is quite low, any violation of water quality standards or waste discharge requirements, or exceedance of another of the thresholds identified in DEIR Section 4.8.3 (p. 4.8-13 et seq.) would be a significant and unavoidable impact.

Mitigation Discussion

Requiring compliance with SB 861 (with or without assuring that all first response agencies along main line routes that could be used to transport Project-related crude oil have been provided a copy of the Oil Spill Contingency Plan) could lessen the potential significance of secondary effects to hydrology and water quality during a train derailment and subsequent oil spill. However, for the reasons discussed above, it would be infeasible for the City to require this as a mitigation measure. Therefore, this secondary hazards and hazardous materials impact would remain significant and unavoidable.

Mitigation Measures: None available.

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances or waste within one-quarter mile of an existing or proposed school.

Impact 4.7-7 ~~6~~: Operation of the Project could emit hazardous emissions or handle hazardous or acutely hazardous materials, substances or waste within one-quarter mile of an existing or proposed school. (*Less than Significant*)

There are no schools within a 1/4 mile radius of the Refinery and the Project facilities (unloading racks and rail spurs) within the Refinery. No direct impact would result from operation of the proposed facilities within the Refinery.

Along the three UPRR mainline routes between the Refinery and the ~~yards in Roseville,~~ California border, some portion of ~~27~~ over 100 school properties are located within an approximately 1/4 mile radius of the UPRR mainline. Table 4.7-~~1~~ 9 lists these schools.

TABLE 4.7-~~1~~9
SCHOOLS WITHIN 1/4 MILE OF THE UPRR MAINLINE

School Name	City	County
Crystal Middle School	Suisun City	Solano
Our Christian Scholastic Academy	Suisun City	Solano
Children's World Learning Center	Suisun City	Solano
Armijo High School	Fairfield	Solano
Holy Spirit School	Fairfield	Solano
Grange Middle School	Fairfield	Solano
Vanden High School	n/a	Solano
Travis Community Day	n/a	Solano
Dixon High School	Dixon	Solano
Maine Prairie High School	Dixon	Solano
Linford L Anderson Elementary School	Dixon	Solano
Dixon Community Day	Dixon	Solano
University of California Davis	Davis	Yolo
Families First NPS	Davis	Yolo
River City Christian Academy	West Sacramento	Yolo
Westfield Village Elementary	West Sacramento	Yolo
Washington Elementary	Sacramento	Sacramento
Sacramento Montessori School	Sacramento	Sacramento
Mustard Seed School	Sacramento	Sacramento
Woodlake Elementary	Sacramento	Sacramento
Martins' Achievement School	n/a	Sacramento
Aero Haven Elementary	n/a	Sacramento
Kohler Elementary	n/a	Sacramento
Northwood Elementary	Sacramento	Sacramento
Miles P. Richmond School	n/a	Sacramento
Hillsdale Elementary	n/a	Sacramento
Highlands High School	n/a	Sacramento
Berean Christian School	Sacramento	Sacramento
Elverta Elementary School	Elverta	Sacramento
Heritage Peak Charter	Rio Linda	Sacramento

TABLE 4.7-~~1~~9 (Continued)
SCHOOLS WITHIN 1/4 MILE OF THE UPRR MAINLINE

School Name	City	County
Community Collaborative Charter	McClellan	Sacramento
Elwood J. Keema High	McClellan	Sacramento
Placer Christian Academy	Roseville	Placer
Phoenix High	Lincoln	Placer
Lincoln High	Lincoln	Placer
Sheridan	Sheridan	Placer
Bradford Woodbridge Fundamental Elementary	Roseville	Placer
Placer County Court Schools	Auburn	Placer
Placer County Community Schools	Auburn	Placer
Placer County Special Education	Auburn	Placer
Bowman Charter	Auburn	Placer
Alta-Dutch Flat Elementary	Alta	Placer
Emigrant Gap Elementary	Emigrant Gap	Placer
Loomis Elementary	Loomis	Placer
Weimar Hills	Weimar	Placer
Del Oro High	Loomis	Placer
Sierra Foothills Academy	Loomis	Placer
Placer High	Auburn	Placer
Independence High	Roseville	Placer
Adelante High	Roseville	Placer
Roseville High	Roseville	Placer
Forty-Niner ROP	Auburn	Placer
Roseville Community	Roseville	Placer
Nord Country	Chico	Butte
Rosedale Elementary	Chico	Butte
Notre Dame School	Chico	Butte
Mission High	Durham	Butte
Durham High	Durham	Butte
Durham Elementary	Durham	Butte
Durham Intermediate	Durham	Butte
Gridley Unified Community Day	Gridley	Butte
Esperanza High	Gridley	Butte
McKinley Elementary	Gridley	Butte
Wilson Elementary	Gridley	Butte
Gridley Unified Community Day	Gridley	Butte
Learning Community Charter	Oroville	Butte
Butte County Special Education	Oroville	Butte
Spring Valley Elementary	Oroville	Butte
Oroville High	Oroville	Butte
Sierra School of Butte County	Oroville	Butte
Phoenix Program	Redding	Shasta
Oasis Community	Redding	Shasta
Shasta County Special Education	Redding	Shasta
Anderson New Technology High	Anderson	Shasta

TABLE 4.7-~~1~~9 (Continued)
SCHOOLS WITHIN 1/4 MILE OF THE UPRR MAINLINE

School Name	City	County
Castle Rock Elementary	Castella	Shasta
Cottonwood Community Day	Cottonwood	Shasta
West Cottonwood Junior High	Cottonwood	Shasta
Monarch Learning Center	Redding	Shasta
Shasta Charter Academy	Redding	Shasta
Shasta-Trinity ROP	Redding	Shasta
Shasta Baptist Schools	Redding	Shasta
Central Valley High	Shasta Lake	Shasta
North Woods Discovery	Redding	Shasta
Golden Eagle Charter	Mount Shasta	Siskiyou
Mt. Shasta Elementary	Mount Shasta	Siskiyou
I AM School	Mount Shasta	Siskiyou
Butte Valley Middle	Macdoel	Siskiyou
Picard Community Day Elementary	Dorris	Siskiyou
Tehama County Special Education	Red Bluff	Tehama
Lincoln Street	Red Bluff	Tehama
Los Molinos High	Los Molinos	Tehama
Vina Elementary	Vina	Tehama
Tehama County ROP	Red Bluff	Tehama
New Day Charter	Marysville	Yuba
Lindhurst High	Olivehurst	Yuba
Lincoln (Abraham)	Marysville	Yuba
North Marysville Continuation High	Marysville	Yuba
South Lindhurst Continuation High	Olivehurst	Yuba
Marysville Charter Academy for the Arts	Marysville	Yuba
Marysville High	Marysville	Yuba
Wheatland Elementary	Wheatland	Yuba
Academy for Career Education Charter	Wheatland	Yuba
Quincy Junior/Senior High	Quincy	Plumas

SOURCE: ESRI, Tele Atlas North America, 2010, ESA, 2014, 2015

The intent of this criteria per CEQA §21151.4 is to ensure that construction or alteration of a facility within 1/4 mile of a school is disclosed and potential impacts from hazardous emissions or the handling of hazardous or acutely hazardous materials. Given that the schools identified along the existing UPRR mainline are already in place as is the UPRR mainline that there are no alternations or proposed construction for this Project within any school, the proximity of these schools to the indirect Project impacts from railroad emissions transporting the crude by rail would likely represent a less than significant impact per the intent of CEQA §21151.4. In addition, the health risk assessment (see DEIR Appendix E.6 and Appendix C of the Revised DEIR) discussed above for Impact 4.7-1, considered TAC emissions from the operation of Project trains along the UPRR mainline. The health risk assessment found a less than significant impact for the nearest receptors along the mainline and in all cases these receptors were much

closer to the mainline than the school properties listed in Table 4.7-~~1~~9, also see Section 4.1.5, for a full discussion of this analysis. Consequently, given the intent of CEQA §21151.4 and the results of the health risk assessment (see DEIR Appendix E.6 and Appendix C of the Revised DEIR); this impact is considered less than significant.

Mitigation: None required.

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g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.

Valero Emergency Response

The Refinery's emergency notification procedures, including notification to City of Benicia Dispatch and the public, are contained in Section 203 of Valero's Emergency Procedures Manual (EPM) see Appendix G. In the event of an emergency, courtesy notification may also be provided to the ~~California~~ Governor's Office of Emergency Services (~~Cal~~ OES). If a release of a hazardous substance exceeds regulatory reportable quantities, Valero would also contact the appropriate state or federal agencies.

The Valero Fire Department maintains its own equipment to respond to emergencies within the Refinery. Under agreement with the City of Benicia, equipment and resources to operate the equipment, may also be dispatched at the request of the City of Benicia Fire Department. A copy of Valero's EPM is on file with the City of Benicia Fire Department. A list of Apparatus and Equipment available on Valero property is listed in Section 206 of Valero's EPM see Appendix G.

Refinery operators are qualified and trained annually on fire response, hazmat and rescue. Certified Emergency Medical Technicians (EMT's), fire truck operators, and personnel trained in oil spill response are on site at all times. Valero currently has approximately 30 certified EMT's on staff. There is at least one EMT on site at all times. The Refinery is also staffed with a Registered Nurse during weekday business hours and has access to an off-site medical clinic staffed and available 24 hours a day.

Valero's Oil Spill Contingency Plan contains a list of oil spill response equipment available on site. Annual refresher training is conducted for refinery personnel trained in oil spill response. Periodic tabletop and equipment deployment drills are conducted with various federal, state, county, and local agencies.

The City of Benicia Fire Department has access to Valero property through three gates. These include two gates from East Second Street, and one gate on Park Road. To expedite access of City of Benicia Fire Department personnel to the Valero facility, a list of all Benicia Fire Department members is on file with Valero security personnel.

The Refinery also has a separate agreement for emergency mutual aid with other refineries in the Bay area. Per the agreement with all members of the Bay Area Petrochemical Mutual Aid Organization (PMAO), members provide mutual aid to other member facilities in case of an

emergency, contingent upon the availability of responders or equipment at the time of the event. The PMAO Manual outlines the response for different types of events.

An example of a recent response was the August 6, 2012 fire at the Chevron Richmond Refinery. All responding members of the PMAO were on site during that event. Valero provided one fire engine with three firefighters along with the Valero Fire Chief to assist in the emergency response. Valero's fire engine connected to the Chevron refinery fire water system and provided 1,250 gpm of firewater flow to the base of the fire. Valero was on site a total of 6 hours until the fire was extinguished.

Valero Spill Response

The Refinery utilizes a multi-level organization based on the Incident Command System to provide immediate, efficient and flexible response to spills associated with the operation of its facilities. The initial level of response is provided by trained operating personnel, the Refinery Process Team-Spill Response Team, who are on-duty 24 hours per day. If the demands of the incident require capabilities beyond those of this team, the Spill Management Team (SMT) is activated. The SMT is initially staffed using on-call Benicia Refinery personnel. In general, the SMT should be capable of managing a response to any of the planning scenarios described in the Oil Spill Contingency Plan.

The structure of the Refinery SMT is based on the National Interagency Incident Management System Incident Command System. The organization permits immediate scale-up to meet the requirements of any size incident. Coordination with state and federal Incident Commanders is maintained using the Unified Command approach, regardless of the level of activation of Valero resources.

In the event of an incident that results in the accidental spill or release of oil outside the Refinery, the Incident Command System would be immediately activated. As representatives of various agencies are deployed in the response, a Unified Command would be established and populated by Federal, State and Local agency personnel including but not limited to the following agencies:

- U.S. Coast Guard
- California Office of Spill Prevention and Response
- California Department of Fish and Wildlife
- U.S. EPA
- Solano County Department of Environmental Management
- Local Police and Fire Departments

Additional agency representatives would be integrated into the incident command organization as required by the extent of the event and scope of the response. In addition, Valero has standing agreements with experts in the field of oil spill containment and recovery, such as NRC Environmental Services. These firms also maintain an inventory of containment boom and other specialized materials that can be deployed immediately upon discovery of an accidental release.

Any release of oil in an environmentally sensitive area, whether from a pipeline, marine vessel or train cargo, would activate the Incident Command organization described above. Together with the regulatory agencies, Valero would participate in the incident to:

- Ensure the safety of the public and response personnel
- Control the source of the spill
- Maximize protection of environmentally sensitive areas
- Manage coordinated response efforts
- Contain, recover and dispose of material in accordance with an established Waste Plan
- Recover and rehabilitate injured wildlife
- Remove oil from impacted areas
- Minimize economic impacts from business interruptions, and
- Keep stakeholders and the public informed of response activities.

UPRR Hazardous Material Emergency Response

Details of UPRR emergency response are provided in their HMERP (see Appendix H). In general, should an incident happen involving hazardous materials (such as crude oil), UPRR would contact the appropriate agencies / first responders to contain the incident and stay on scene until control/clean up is finished. UPRR personnel from their Roseville, California office would be responsible for incidents that may happen between ~~Roseville~~ the California border and the Refinery. Available UPRR equipment includes firefighting trailers consisting of alcohol resistant-aqueous form filming foam, midland capping kits, magnetic patches, a 10,000 gallon portable water tank, and equipment to remediate tank car valves and fittings. Two boom trailers are stored in Chico and Dunsmuir, and another in Reno, Nevada (OES, 2015). In addition, UPRR currently has three (3) emergency response contractors in northern California that cover Benicia. Two of the contractors are US Coast Guard approved Oil Spill Response Organizations (OSROs). One of the OSRO certified contractors is located in the Benicia area.

Impact 4.7-8 ~~7~~: The Project could impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. (*Less than Significant with Mitigation*)

Along with resources from the City of Benicia, Valero personnel respond to emergencies at the Refinery; however, ~~while~~ the City of Benicia retains jurisdiction/responsibility for the Refinery. ~~has overall responsibility for emergency response and evacuation plans within the City.~~ The main feature of the Project that could interfere with evacuation plans is the amount of time during which project-related rail traffic would block Park Road outside the Refinery's southern border. As discussed in Section 14, *Public Services*, of the IS/MND (see Appendix A) and Section 4.11.5, *Transportation/Traffic*, the Project with implementation of Mitigation Measure 4.11-4, would not pose a potentially significant new delay on this road and thus, is considered to be a less than significant impact on emergency/evacuation response plans.

Mitigation: Implement Mitigation Measure 4.11-4.

Significance after Mitigation: Less than significant.

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h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

Impact 4.7-9 ~~8~~: Operation of the Project could expose people or structures to significant risk, injury, or loss from wildland fires. (~~*Less than*~~ *Significant and Unavoidable*)

Construction of the Project (loading racks and railroad spurs) would occur within the Refinery property within the unzoned CAL FIRE local FHSZ and would not pose and risk to starting wildland fires or being affected by wildland fires. Similarly, operation of the loading racks and railroad spurs pose no risk to or from potential wildland fires. Furthermore, along with the Benicia Fire Department, ~~the~~ Valero Fire Department personnel would respond to all emergencies within the Refinery and would address any such fire risks as needed. No impact would result.

As discussed in Section 4.7.2.2 above, an area just south of the main Refinery and Park Road containing Valero's main crude tank farm (see Figure 3-2) located on a small hill, is surrounded by a CAL FIRE Local Responsibility Area of FHSZ of moderate to high severity (CAL FIRE, 2008). These moderate and high FHSZ areas extend to the east from this small hill and cover a portion of the ~~likely~~ railroad spur proposed for ~~used by~~ UPRR's use to deliver and remove tank cars from the Refinery. Given that the existing crude tank farm is between 1,000 to 1,300 feet separated by local roads and other railroad tracks from this railroad spur and that the existing conditions already includes routine movements of rail cars and locomotives, the addition of the Project's railroad operations is expected to be a less than significant impact to potential wildland fires in the vicinity of this Local Responsibility Area.

Transportation of crude by Project-related trains on UPRR's main line routes in California would traverse fire hazard severity zones as shown on statewide CAL FIRE maps for State Responsibility Areas and Local Responsibility Areas (CAL FIRE, 2007a and b, respectively). Rough mountainous or other wildland terrain could have a very high danger of wildfire due its virtual inaccessibility, dense vegetation and/or tree cover, drought conditions, or myriad other factors regardless of whether it has been identified on a map as a high fire danger area. Project-related trains would travel through such areas within and beyond the California border. If a Project-related train derails in such an area, a fire or explosion could result in a wildland fire. Depending on the location of a potential accident and subsequent fire, emergency response personnel may be not available to contain the fire before people and/or structures are exposed to injury, loss of life, or damage to property. Because no reasonable, feasible mitigation measures are available that would, if implemented, reduce the significance below the established threshold, this secondary hazards and hazardous materials related impact would be significant and unavoidable.

Mitigation: None ~~required~~ available.

2.12.7 Summary of Hazards and Hazardous Materials Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.7 (p. 4.7-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.7 (p. 5-17). Potential direct and indirect effects of Project-related transport of crude by rail from the Refinery to the State border and beyond are analyzed in Revised DEIR Section 2.12; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative hazards and hazardous materials-related impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes. The transportation of crude by rail would have a significant and unavoidable impact if train cars derailed and an associated rupture, leak, spill, explosion, or fire resulted in substantial adverse effects to people or structures (including the risk of loss, injury, or death). Secondary effects of an upset or accident condition to biological resources (including sensitive habitats, wetlands, or vegetation and wildlife species), cultural resources (including historical), geology and soils (including as a result of seismically-induced ground-shaking), and hydrology and water quality (including degradation of surface and groundwater quality) also would be significant and unavoidable. These impact determinations are consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see, e.g., Section 4.7, Hazards and Hazardous Materials, pp. 4.7-45 through 4.7-63).

Integrating the data and other information in these sections, the Project as a whole would result in no impact related to criterion d), regarding inclusion on a list of hazardous materials sites or criteria e) or f), regarding inclusion within an airport land use plan or in the vicinity of a private airstrip, respectively; less-than-significant impacts related to criterion c), regarding emissions of hazardous materials within one-quarter mile of schools and criterion g), regarding impairment of emergency response plans; and significant and unavoidable impacts related to significance criterion b), regarding reasonably foreseeable upset and accident conditions involving the release of hazardous materials and criterion h), regarding the exposure of people or structures to wildland fires.

2.13 DEIR Section 4.8, Hydrology and Water Quality

DEIR Section 4.8 (p. 4.8-1 et seq.), Hydrology and Water Quality, identifies and evaluates issues related to potential changes in hydrology, water quality, groundwater, and flooding conditions that could result from implementation of the Project. It describes the physical and regulatory setting in Section 4.8.2 (p. 4.8-1 et seq.), and the criteria used to evaluate the significance of potential impacts in Section 4.8.3 (p. 4.8-13 et seq.). The evaluation of potential impacts is presented in Section 4.8.4 (p. 4.8-14) and Section 4.8.5 (p. 4.8-15 et seq.).

In response to comments received on the DEIR, Section 4.8 is being supplemented to include a new Section 4.8.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues

related to Hydrology and Water Quality uprail from the Roseville Yard to the State border and beyond, and a new Section 4.8.7, Summary of Hydrology and Water Quality Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.13.1 DEIR Section 4.8.6, Uprail Impacts and Mitigation Measures

Trains transporting crude oil could arrive at the Refinery via the Roseville Yard and any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*. The UPRR mainline routes shown in Figure 1-3 and Figure 1-2 would traverse numerous creeks, rivers, wetlands, aqueducts, canals, and sloughs. In addition, the routes are in proximity to numerous lakes and marine waters. Beneficial uses (described in DEIR Section 4.8.2.3) of these water bodies are variable, and it is likely that almost all designated beneficial uses are represented across the wide variety of water bodies intersecting the mainline rail routes. Under normal operating conditions, Project-related crude oil would be transported from North American points of origin to the Refinery in enclosed trains over existing tracks, and so would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade water quality; would not affect groundwater supplies or groundwater recharge; would not substantially alter existing drainage patterns in a manner that would result in substantial erosion or siltation, increase the rate or amount of surface runoff in a manner that would result in flooding, or create or contribute runoff water that would exceed the capacity of stormwater drainage systems or provide substantial additional sources of polluted runoff; and would not place housing or other structures within a 100-year flood hazard area. Under normal operating conditions, Project-related rail transport also would not expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding, inundation by seiche, tsunami, or mudflow. For these reasons, the routine rail transport of the Project-related crude would contribute no impact regarding any of the criteria described in DEIR Section 4.8.3, *Significance Criteria*. Potential secondary impacts to Hydrology and Water Quality as a result of upset or accident conditions, including train derailments and unloading accidents that lead to hazardous materials spills, fires, explosions, and ensuing emergency response activities, are analyzed in Revised DEIR Section 2.12.1 (regarding DEIR Section 4.7's evaluation of Hazards and Hazardous Materials).

2.13.2 Summary of Hydrology and Water Quality Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.8 (p. 4.8-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.8 (pp. 5-17 through 5-18). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.13; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could

result between the Refinery and the State border via any of the northern routes: no impact to hydrology and water quality is expected to result from the transport of crude by rail under normal operating conditions. This determination is consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014). Potential secondary effects to hydrology and water quality resulting from an upset or accident condition are addressed in Revised DEIR Section 2.12, regarding Hazards and Hazardous Materials.

Integrating the data and other information in these sections, the Project as a whole would result in no impact related to criterion j), regarding inundation by seiche, tsunami, or mudflow; and less-than-significant impacts or impacts reduced to less-than-significant with implementation of mitigation measures, related to all other significance criteria.

2.14 DEIR Section 4.9, Land Use and Planning

DEIR Section 4.9 (p. 4.9-1 et seq.), Land Use and Planning, identifies and evaluates issues related to Land Use and Planning. It describes the physical and regulatory setting in Section 4.9.2 (p. 49-1 et seq.), identifies the criteria used to evaluate the significance of potential impacts in Section 4.9.3 (p. 4.9-9), and evaluates the significance of potential impacts in Section 4.9.4 (p. 4.9-9 et seq.) and Section 4.9.5 (p. 4.9-10 et seq.). No changes are being made to DEIR Section 4.9 except as noted below.

In response to comments received on the DEIR, Section 4.9 is being supplemented to include a new Section 4.9.6, Uprail Impacts and Mitigation Measures, that identifies and evaluates issues related to Land Use and Planning uprail from the Roseville Yard to the State border and beyond, and a new Section 4.9.7, Summary of Land Use and Planning Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.14.1 DEIR Section 4.9.6 Uprail Impacts and Mitigation Measures

Trains carrying Project-related crude could travel through any of the established communities and any area subject to a habitat conservation plan (HCP) or natural community conservation plan (NCCP) that has been approved along the existing railroad tracks between the Roseville Yard and the State border (as shown in Figure 1-3, *Uprail Routes*) or beyond (as shown in Figure 1-1, *North American Freight Railroads*). The Project would not require or result in the construction of new tracks anywhere outside the Refinery boundary and would result in no change of use. Accordingly, the Project would cause no change to the existing uprail track network or the use of that network and would not cause or affect any physical division of an established community or conflict with any HCP or NCCP. No impact would result relative to significance criteria a) or c) as set forth in DEIR Section 4.9.3.

No city, county, or state outside the City of Benicia has land use jurisdiction over the Project. Accordingly, none of the land use plans or policies of such entities would apply to the Project. As indicated in DEIR Section 1.10 (p. 1-7), the Bay Area Air Quality Management District has jurisdiction to issue or deny an Authority to Construct for the unloading rack proposed within the

Refinery boundary and to regulate Refinery-related air emissions as part of the Clean Air Act Title V program. No local or regional air quality agencies have jurisdiction to regulate locomotive emissions. Therefore, the Project would not conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project. No impact would result relative to significance criterion b) as set forth in DEIR Section 4.9.3.

2.14.2 Summary of Land Use and Planning Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.9 (p. 4.9-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.9 (p. 5-19). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.14; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: no impact would result related to the physical division of an established community or conflict with a land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect or with a habitat conservation plan or natural community conservation plan. These determinations are consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 4.8, Land Use and Recreation, pp. 4.8-15, 4.8-21).

Integrating the data and other information in these sections, the Project as a whole would result in a less-than-significant impact related to criteria a) and b), and no impact related to criterion c) as set forth in DEIR Section 4.9.3 (p. 4.9-9).

2.15 DEIR Section 4.10, Noise

DEIR Section 4.10 (p. 4.10-1 et seq.), Noise, identifies and evaluates issues related to acoustics. It describes the physical and regulatory setting in Section 4.10.2 (p. 410-1 et seq.), identifies the criteria used to evaluate the significance of potential impacts in Section 4.10.3 (p. 4.10-10), and evaluates the significance of potential impacts in Section 4.10.4 (p. 4.10-12 et seq.) and Section 4.10.5 (p. 4.10-13 et seq.). No changes are being made to DEIR Section 4.10 except as noted below.

In response to comments received on the DEIR, Section 4.10 is being supplemented to include a new Section 4.10.6, Uprail Impacts and Mitigation Measure, that identifies and evaluates Noise issues uprail from the Roseville Yard to the State border and beyond, and a new Section 4.10.7, Summary of Noise Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.15.1 DEIR Section 4.10.6 Uprail Impacts and Mitigation Measures

UPRR would transport Project-related crude oil tank cars daily in unit trains (with four locomotives per train) via existing tracks along any of the routes described in Section 4.0.4, *Geographic Scope of Analysis*. Alternatively, two trains per day of up to 50 tank cars each (with two locomotives per train) would transport the crude to Roseville, and then to the Refinery. No new or replacement track (the construction of which could generate noise separate from the sound emitted by moving rail cars and locomotives) would be required to transport Project-related crude from the point(s) of origination to the Roseville Yard. Valero would own or lease the tank cars that would be used to transport crude oil. UPRR owns and operates the locomotive engines that would be used.

According to the *2013 California State Rail Plan* (Caltrans, 2013a), between 11-25 passenger and freight trains per day use the route between Roseville and the Oregon border (Caltrans 2013,a). In addition to the daily round trip by Amtrak's California Zephyr, up to 32 freight trains per day travel on the route between Roseville through Truckee to Reno, Nevada. The potential route through the Feather River Canyon has a daily volume of 11 to 25 freight trains. It is unknown if 50-car unit trains or 100-car trains would be used to transport crude oil by UPRR to Roseville, or what route or combination of routes would be used. Under the most conservative scenario, two 50-car trains per day would travel along only one of the three possible routes to Roseville, which could result in four additional daily train trips along portions of this route. These additional rail trips would represent an increase of between 12 percent and 36 percent of existing rail operations, depending on the route taken.

The U.S. EPA describes noise pollution as "unwanted or disturbing sound" (U.S. EPA, 2012a). Noise pollution can contribute to significant public health impacts, including hearing loss, high blood pressure, stress related illnesses, speech interference, sleep disruption, and lost productivity, among others (U.S. EPA, 2012a; Caltrans, 2013b). Noise pollution associated with railroad activities can occur at a single source (such as rail yard) or from the exhaust, braking, acceleration or movement of trains along the tracks and the use of train whistles and horns. For example, the interaction of steel wheels and rails generates rolling noise due to continuous rolling contact, impact noise when a wheel encounters a discontinuity in the running surface, and squeal generated by friction on tight curves (FTA, 2006). At low speeds, locomotive exhaust noise dominates; at higher speeds, wheel-rail noise becomes the dominant noise source (FTA, 2006). Noise associated with Project-related rail transport could be experienced by noise sensitive receptors in proximity to the tracks, potentially including but not limited to: residential uses, hospitals, rest homes, long term care facilities, mental care facilities, schools, libraries, places of worship, and passive recreation areas. Vibration associated with Project-related rail transport also could affect individuals and structures in proximity to the tracks. Noise and vibration from Project-related rail transport also could affect wildlife.

a) Would the Project expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Impact 4.10-1a: Operation of the Project could result in exposure of persons to noise levels in uprail communities, but such levels would not exceed applicable standards. (*No Impact*)

Federal law preempts local governments from regulating railroad noise. Therefore, local general plans or noise ordinances are not applicable. For example, the Federal Railroad Administration's Train Horn Rule (49 CFR Parts 222, 229.129; 71 Fed Reg. 47614) requires locomotive horns be sounded, in furtherance of public safety, for 15-20 seconds before entering all public grade crossings. The maximum volume level for the train horn is 110 decibels; the minimum sound level is 96 decibels (Federal Railroad Administration, 2015b). This range has been described as from "about the same sound level as an electric drill in your hand" to "the threshold of discomfort" (Helling, 2011). Federal regulations also prescribe other railroad-generated noise and related questions of compliance in 49 CFR Parts 201 and 210. See, for example, 49 CFR §210.7 (any railroad that uses railroad equipment that is noise defective or engages in a car coupling operation that results in excessive noise is responsible for correcting the defect, removing the defective equipment from service, or modifying the equipment to bring it into compliance) and 49 CFR §210.9 (a noise defective train "may be moved no farther than the nearest forward facility where the noise defective conditions can be eliminated"). Because Project-related trains would be subject to compliance with existing federal regulations governing noise emissions, the Project would not expose people to or generate noise levels in excess of applicable standards. Therefore, no impact would result relative to significance criterion a) as set forth in DEIR Section 4.10.3.

b) Would the Project expose persons to or generate excessive ground borne vibration or ground borne noise levels?

Impact 4.10-2a: The transportation of Project-related crude uprail from the Roseville Yard would result in the generation of ground borne vibration or ground borne noise, but this vibration or noise would not be excessive. (*No Impact*)

Transportation by rail of unit trains carrying Project-related crude from the point(s) of origin to the Roseville Yard would increase by one the daily number of trains into Roseville from the State border and points beyond. Because trains are a common source of ground borne vibration and related noise (see, e.g., FTA, 2006),[24] this Project-related increase of one 100-car train per day in North America would increase ground borne vibration and related noise along the routes into the Roseville Yard that are selected by UPRR.

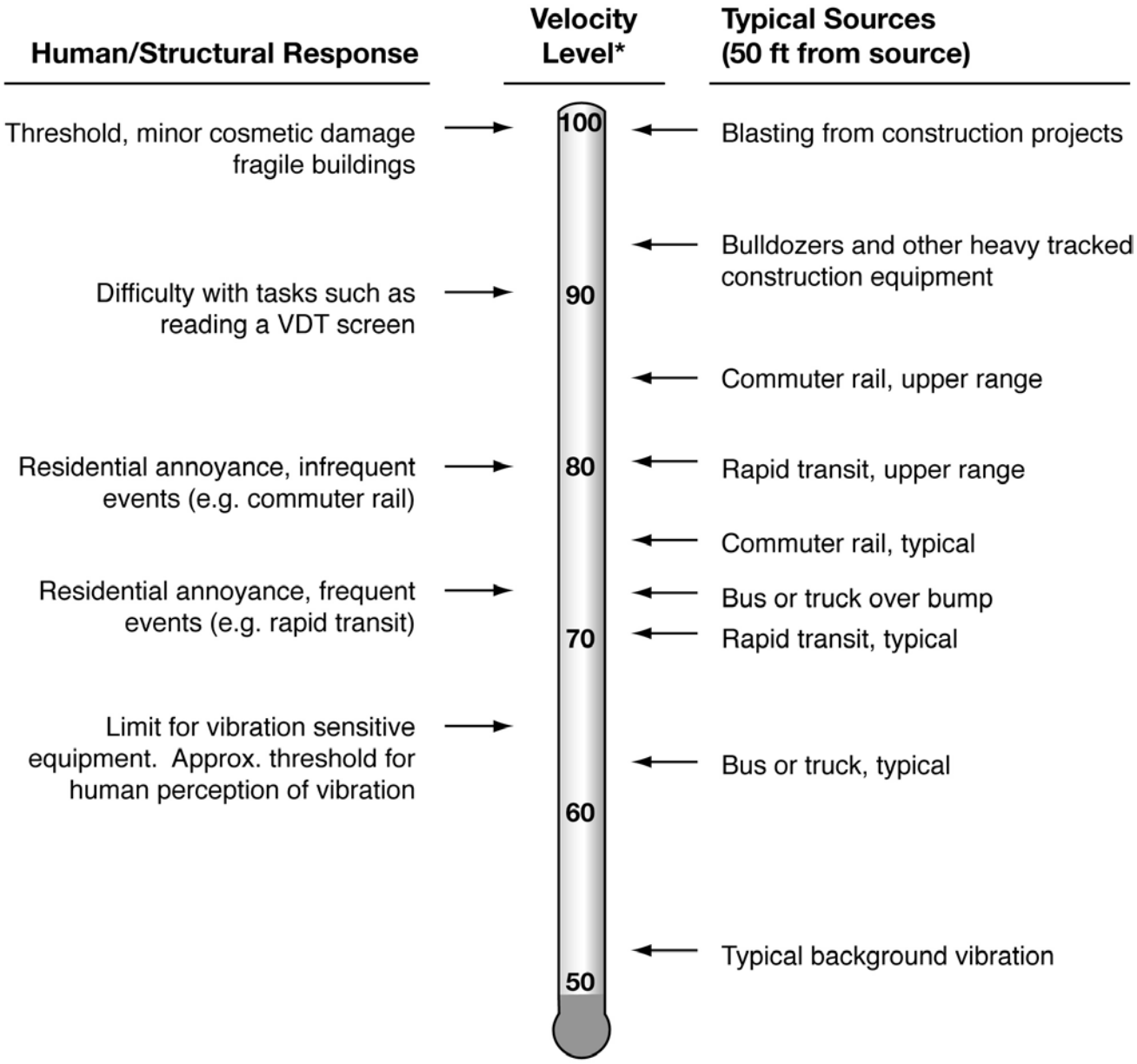
[24] As explained by the Federal Transit Administration (FTA) in its Transit Noise and Vibration Impact Assessment, Manual (FTA 2006), "The train wheels rolling on the rails create vibration energy that is transmitted through the track support system into the transit structure. The amount of energy that is transmitted into the transit structure is strongly dependent on factors such as how smooth the wheels and rails are and the resonance frequencies of the vehicle suspension system and the track support system. These systems, like all mechanical systems, have resonances which result in increased vibration response at certain frequencies, called natural frequencies. [¶] The vibration of the transit structure excites the adjacent ground, creating vibration waves that propagate through the various soil and rock strata to the foundations of nearby buildings. The vibration propagates from the foundation throughout the remainder of the building structure. The maximum vibration amplitudes of the floors and walls of a building often will be at the resonance frequencies of various components of the building."

Ground-borne vibration can cause buildings to shake (including perceptible movement of floors, rattling of windows, and shaking of items on shelves or hanging on walls) and rumbling sounds to be heard. In extreme cases, the vibration can cause damage to buildings. Ground-borne vibration rarely annoys people who are outdoors, and the rumble noise that can accompany building vibration is perceptible only inside buildings (FTA, 2006). Visual effects (e.g., movement of hanging objects) and the time of day when vibration and related noise occurs (e.g., late at night) can affect individuals' perception of these phenomena. The criteria for acceptable ground-borne vibration are expressed in terms of vibration velocity levels in decibels (VdB) and the criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound levels (dBA). Background vibration velocity level in residential areas is usually 50 VdB or lower, which is well below the threshold of human perception of approximately 65 VdB (FTA, 2006). When diesel locomotives are used, the upper range for vibration is 85 VdB at 50 feet. At this level within a residence, most people would be strongly annoyed by the vibration (FTA, 2006).[25] Figure 4.10-3, *Typical Levels of Ground-borne Vibration*, illustrates common vibration sources and the human and structural response to ground-borne vibration.

The FTA establishes vibration limits for three categories of land uses (FTA, 2006). Vibration Category 1 (High Sensitivity) includes buildings where vibration would interfere with operations within the building such as hospitals with vibration-sensitive equipment, university research operations, and facilities where vibration-sensitive research and manufacturing occurs (e.g., computer chip manufacturing facilities). Vibration Category 2 (Residential) includes all residential land uses and any buildings where people sleep, such as hospitals and hotels. Vibration Category 3 (Institutional) includes churches, schools, other institutions, and quiet offices with primarily daytime use that do not have vibration-sensitive equipment, but still have the potential for activity interference. FTA-recommended ground-borne vibration and ground-borne noise impact criteria intended for the general assessment of potential impacts are provided in Table 4.10-5, *Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria for General Assessment*. For a typical line-haul freight train (such as the ones that would be used to transport Project-related crude) where the rail car vibration would last for several minutes, FTA recommends that the frequent-event limits should be applied (FTA, 2006).

Vibration exists within existing rail corridors between the Roseville Yard and the State border and beyond as part of the baseline condition. Under this scenario, the FTA recommends that the criteria provided in Table 4.10-5 be relied upon to evaluate the significance of vibration for infrequently-used rail corridors (i.e., those that experience fewer than 5 trains per day). For moderately-used rail corridors (i.e., 5 to 12 trains per day), Project-related trains would cause no impact if the existing (pre-Project) vibration exceeds the criteria in Table 4.10-5; alternatively, the FTA recommends that the criteria provided in Table 4.10-5 be relied upon to evaluate the significance of vibration. For heavily-used rail corridors (i.e., more than 12 trains per day) where existing train vibration exceeds the impact criteria, Project-related trains would cause no impact unless they approximately double the number of existing events or would increase existing vibration by 3 VdB or more. (FTA, 2006)

[25] The City acknowledges, as does the FTA, that "[m]ost railroad tracks used for freight lines were in existence for many years before the affected residential areas were developed" (FTA, 2006).



** RMS Vibration Velocity Level in VdB relative to 10^{-6} inches/second*

SOURCE: FTA 2006

Benicia Valero CBR . 202115.01

Figure 4.10-3

Typical Levels of Ground-borne Vibration

TABLE 4.10-5
GROUND-BORNE VIBRATION (GBV) AND GROUND-BORNE NOISE (GBN)
IMPACT CRITERIA FOR GENERAL ASSESSMENT

	GBV Impact Levels (VdB re 1 micro-inch /sec)			GBN Impact Levels (dB re 20 micro Pascals)		
Land Use Category	**Frequent Events[1]**	**Occasional Events[2]**	**Infrequent Events[3]**	**Frequent Events[1]**	**Occasional Events[2]**	**Infrequent Events[3]**
Category 1	65 VdB[4]	65 VdB[4]	65 VdB[4]	NA[4]	NA[4]	NA[4]
Category 2	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

NOTES:
1 "Frequent Events" is defined as more than 70 vibration events of the same source per day.
2 "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.
3 "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day.
4 This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes.
5 Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

SOURCE: FTA, 2006 (Table 8-1)

Conservatively assuming that UPRR would use diesel locomotives to transport Project trains using the company's existing crude network (see Figure 1-2), the upper range of vibration for transport would be 85 VdB at 50 feet. This is above the "frequent events" limits for all use categories. Based on freight train trips reported in the *2013 California State Rail Plan* (Caltrans 2013,a), this analysis assumes that UPRR's routes into Roseville would be "moderately-used" or "heavily-used."

For moderately-used rail corridors (i.e., 5 to 12 trains per day), Project-related trains would cause no impact if the existing (pre-Project) vibration exceeds the criteria in Table 4.10-5. Because freight trains using diesel locomotives already pass along UPRR's crude network routes, peak vibration levels would not be increased by trains carrying Project-related crude. Therefore, the Project would cause no vibration impact if the route is considered a moderately-used rail corridor.

For heavily-used rail corridors (i.e., more than 12 trains per day) where existing train vibration exceeds the impact criteria, Project-related trains would cause no impact unless they approximately double the number of existing events or would increase existing vibration by 3 VdB or more. Existing train vibration along heavily-used rail corridors on UPRR's crude network is caused by freight trains using diesel locomotives. Because diesel locomotives are assumed to cause vibration that exceeds the impact criteria and because there is no evidence that Project-related locomotives would increase existing vibration by 3 VdB or more relative to any other diesel locomotives in UPRR's fleet, the question becomes one of the number of freight trains that would travel along the route with and without the Project (and thereby would cause a vibration "event"). The Association of American Railroads reports that 1,403,044 carloads traveled on U.S. freight rail lines in April 2015 and that total traffic for the first four months of 2015 was 4,770,126 carloads (Association of American Railroads, 2015b). In this context, a "carload" is quantity of freight required to fill a railcar (Intermodal Association of North America, 2015). Within California, UPRR reports that it delivered 1,695,157 carloads to California in 2014, for an average of 141,263 carloads terminated in the State per month (UPRR, 2015f). The Project's addition of

100 carloads per day for a total of approximately 3,000 additional cars per month would not double the number of existing vibration events.

For these reasons, Project-related transport of crude by rail would not expose people to or generate excessive ground borne vibration or ground borne noise levels. No impact would result relative to the CEQA Guidelines Appendix G significance criterion b) for Noise.

c) Would the Project cause a substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?

Impact 4.10-3a: The transportation of Project-related crude uprail from the Roseville Yard would result in an increase of the frequency of noise events in the vicinity of the train tracks above the frequency of such events existing without the project, but addition of one train per day would cause neither a substantial nor a permanent increase in ambient noise levels. (*Less than Significant*)

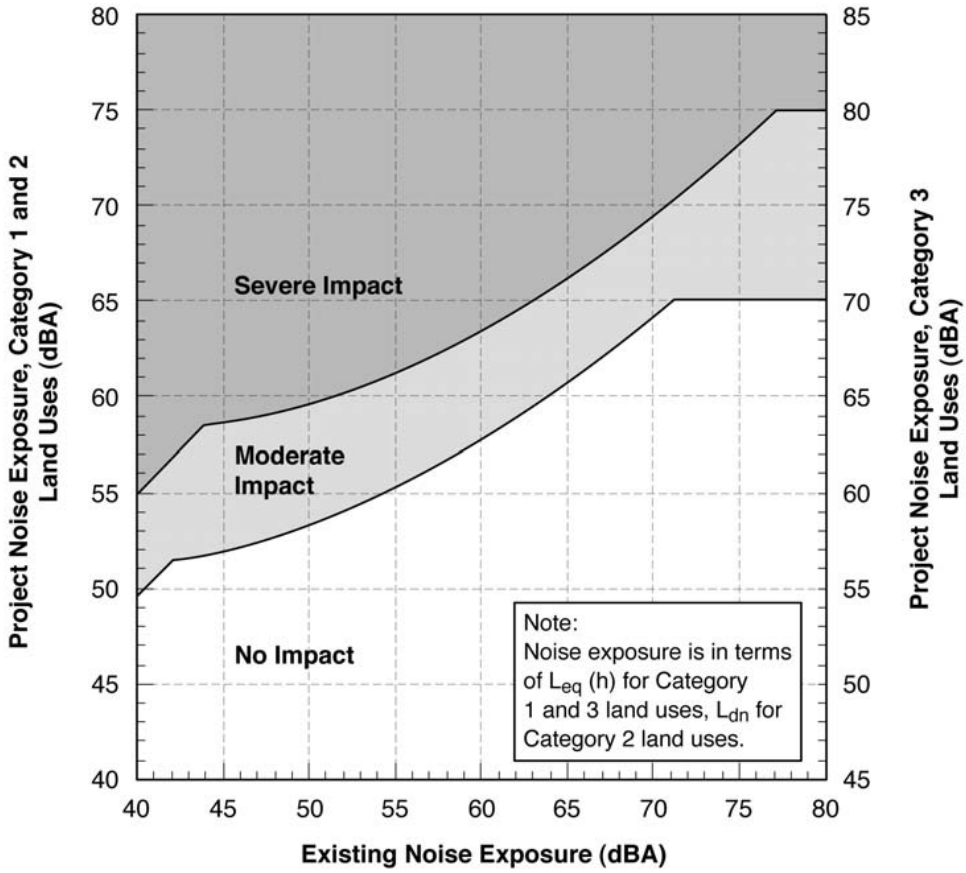
Based on information presented in the *2013 California State Rail Plan* (Caltrans, 2013a), Project-related freight rail trips would result in a 12 percent to 36 percent increase in train trips along the routes shown in Figure 1-3, *Uprail Routes*, depending on the route taken. This would contribute less than a doubling of sound energy. A doubling of sound energy corresponds to a 3 dBA increase in long-term noise levels, which Caltrans recognizes as a barely perceptible increase in noise (Caltrans, 2013b). This would be a less than significant increase in ambient noise levels.

d) Would the Project cause a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?

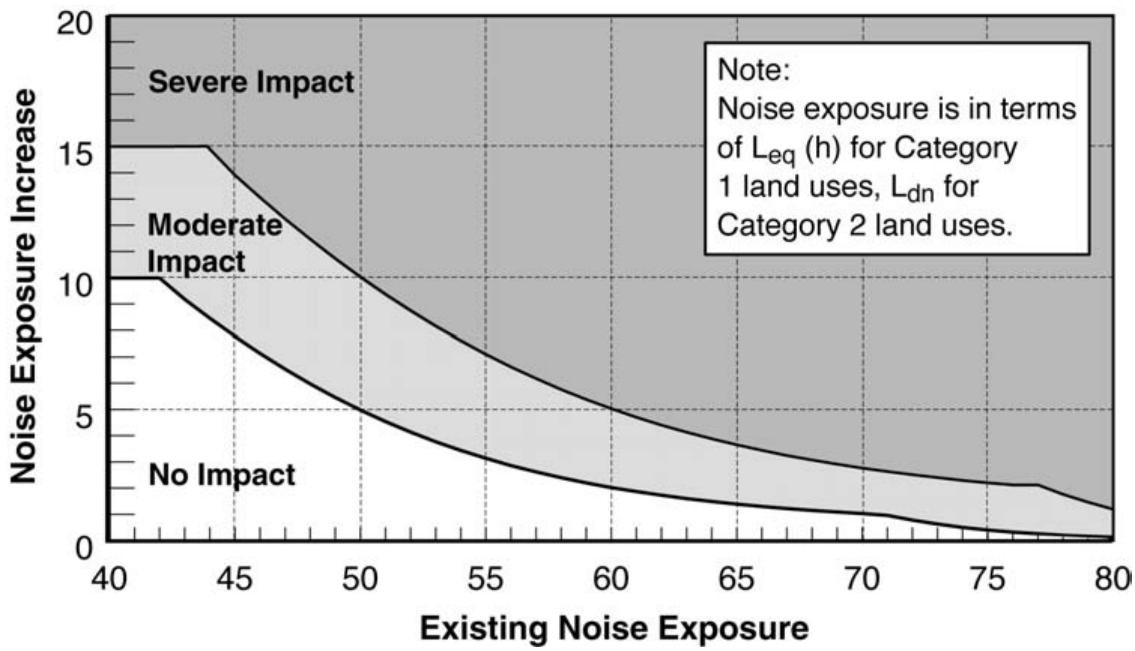
Impact 4.10-4a: Operation of the Project would not result in a substantial temporary or periodic increase in ambient noise levels. (*Less than Significant*)

Recognizing that different approaches may be taken to analyze noise impacts, this analysis relies on the criteria recommended by FTA for the evaluation of noise impacts from rail projects (including fixed facilities such as storage and maintenance yards) because these criteria "were developed specifically for transit noise sources operating on fixed guideways or at fixed facilities in urban areas" (FTA, 2006).

The noise impact criteria for rail projects shown in the top graph in Figure 4.10-4, *Noise Impact Criteria for Rail Projects and Allowable Increases in Cumulative Noise Levels*, vary among three land use categories. Land Use Category 1 is measured using Outdoor Leq(h) for the noisiest hour of transit-related activity during hours of noise sensitivity. Category 1 applies to lands where quiet is an essential element of the land's intended use, such as for a recording studio, concert hall or pavilion, and outdoor amphitheaters. Land Use Category 2 is measured using Outdoor Ldn. Category 2 applies to residences and other buildings where people normally sleep (such as homes, hospitals, and hotels) where a nighttime sensitivity to noise is assumed to be very important. Land Use Category 3 is measured using Outdoor Leq(h) for the noisiest hour of transit-related activity during hours of noise sensitivity. Category 3 applies to institutional land uses with primarily daytime and evening use (such as schools, libraries, theaters, and structures



Noise Impact Criteria for Rail Projects



Allowable Increases in Cumulative Noise Levels

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SOURCE: FTA 2006

Figure 4.10-4

Noise Impact Criteria for Rail Projects and Allowable Increases in Cumulative Noise Levels

used for religious worship) where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. (FTA, 2006).

Table 4.10-6, *Noise Levels Defining Impact for Rail Projects*, identifies the noise levels at which the Project's rail travel would result in no impact, moderate impact, and severe direct or indirect effects to Land Use Category 1, 2, and 3 sites. Regarding cumulative effects, the lower graph in Figure 4.10-4shows noise impact criteria for Category 1 and 2 land uses in terms of the allowable increase in the cumulative noise exposure. Given that Category 3 land uses are less sensitive to noise than those classified as Category 1 or 2, the criteria allow the project noise for Category 3 sites to be 5 decibels greater than for Category 1 and 2 sites (FTA, 2006). The incremental additional noise that would be generated by Project-related trains along existing mainline rail routes would be substantially similar to existing temporary/periodic train noise experienced as part of baseline ambient conditions. Therefore, the Project would result in a less than significant impact.

e), f) Would the project expose people residing or working within an airport land use plan area or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport to excessive noise levels? Would the project expose people residing or working in the vicinity of a private airstrip to excessive noise levels?

There are public and/or private airports in each of the uprail counties identified in Revised DEIR Section 2.5.1 as between the Roseville Yard and the State border. Public airports, public use airports, and private airstrips also could be located along out-of-state segments of the route selected by UPRR to transport Project related crude by rail to and across the California state border. Regardless, Project-related rail travel would not result in the location of any new residents within an airport land use plan area or within 2 miles of a public airport, public use airport, or a private airstrip who could be exposed to aviation noise associated with proximity to one or more of these types of aviation uses. Therefore, Project-related transport of crude via the existing freight rail network would result in no impact relating to the exposure of residents to excessive noise levels within an airport land use plan area or within 2 miles of a public airport, public use airport, or a private airstrip.

Impact 4.10-5: Project-related transport of crude via the existing freight rail network would not expose people working within an airport land use plan area or within 2 miles of a public airport, public use airport, or a private airstrip to excessive noise levels. *(Less than Significant)*

Project-related rail travel could result in occupational exposure of railroad conductors and engineers to aviation noise as their trains pass within airport land use plan areas or within 2 miles of a public airport, public use airport, or a private airstrip. However, freight train crews are limited[26]; crew members would be exposed to loud, more proximate sounds caused by the trains; and crew members' hearing would be protected from occupational exposures by OSHA (29 CFR §1910.95.) and the Federal Railroad Administration (FRA). For example, Title 49 of the Code of

[26] Freight train crews used to consist of five people (a conductor, two trainmen or brakemen, an engineer, and a fireman), and now operate with just two (a conductor and an engineer) (Dokoupil 2015; Sperandeo and Keefe 2006).

TABLE 4.10-6
NOISE LEVELS DEFINING IMPACT FOR TRANSIT PROJECTS

Existing Noise Exposure* L_{eq} (h) or L_{dn} (dBA)	Project Noise Impact Exposure, * L_{eq} (h) or L_{dn} (dBA)					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient+10	Ambient + 10 to 15	> Ambient+10	< Ambient+15	Ambient + 15 to 20	> Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

* L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.

Federal Regulations Part 227 regulates occupational noise exposure for railroad operating employees whose predominant noise exposure occurs in the locomotive cab (49CFR §227.1). It requires railroads to conduct noise monitoring and implement a hearing conservation program for employees whose exposure to cab noise equals or exceeds an 8-hour time-weighted-average sound level of 85 dBA (49 CFR §227.103). Noise caused by a combination of internal and external sources (potentially including the sounds of aviators' take-offs and landings) would be captured by the monitoring required as part of these occupational protections for railroad workers. For these reasons, Project-related transport of crude via the existing freight rail network would not expose people working within an airport land use plan area or within 2 miles of a public airport, public use airport, or a private airstrip to excessive noise levels. A less than significant impact would result.

2.15.2 Summary of Noise Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.10 (p. 4.10-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.10 (p. 5-19). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.15; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: transportation of Project-related crude by rail could generate noise and/or expose people to or produce vibration levels that would exceed local agencies' thresholds of significance; however, the addition of Project-related trains is not expected to result in a significant change to existing conditions in these respects. These determinations are consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 4.9, Noise and Vibration, pp. 4.9-28 through 4.9-30).

Integrating the data and other information in these sections, the Project as a whole would result in less-than-significant impacts related to all significance criteria.

2.16 DEIR Section 4.11, Transportation and Traffic

DEIR Section 4.11 (p. 4.11-1 et seq.), Transportation and Traffic, identifies and evaluates issues related to the circulation system, including all applicable modes of transportation, emergency access, and related issues. It describes the physical and regulatory setting in Section 4.11.2 (p. 4.11-1 et seq.), identifies the criteria used to evaluate the significance of potential impacts in Section 4.11.3 (p. 4.11-4), and evaluates the significance of potential impacts in Section 4.11.4 (p. 4.11-5) and Section 4.11.5 (p. 4.11-6 et seq.). No changes are being made to DEIR Section 4.11 except as noted below.

In response to comments received on the DEIR, Section 4.11 is being supplemented to include a new Section 4.11.6, Uprail Impacts and Mitigation Measure, that identifies and evaluates Transportation and Traffic issues uprail from the Roseville Yard to the State border and beyond, and a new Section 4.11.7, Summary of Transportation and Traffic Impacts, that considers the impacts of the whole of the Project, whether initially analyzed in the DEIR, this Revised DEIR, or elsewhere.

2.16.1 DEIR Section 4.11.6 Uprail Impacts and Mitigation Measures

Transportation of Project-related crude oil via the existing North American rail network would not conflict with any roadway or highway congestion management program (indeed no such plan applies to rail transport); result in a change in air traffic patterns (which already accommodate rail traffic along all of the routes that could be used to transport Project-related crude); substantially increase hazards due to a design feature or incompatible uses (because no design or use changes would occur); result in inadequate emergency access (the configuration of which already accommodates rail travel routes); or conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities (none of which apply to rail travel). Accordingly, the transportation of crude by rail would have no effect relating to significance criteria b) through f) as identified in DEIR Section 4.11.3. The analysis below analyzes whether Project-related use of the existing rail network could conflict with adopted measures of effectiveness for the performance of the circulation system including mass transit, non-motorized travel, and relevant components of the circulation system.

Impact 4.11-6: The Project would not cause a substantial increase in average vehicle delay at train crossings uprail from Roseville. (*Less than Significant*)

As described under Impact 4.11-1, there would be less than significant indirect Project impacts at the at-grade crossings along the mainline between the Refinery and the Roseville Yard. Similarly, there would be impacts at the at-grade crossings on the three routes from the Roseville Yard to the State line, as described in Section 4.0.4, *Geographic Scope of Analysis*.

Project trains arriving at Roseville along these three routes would likely consist of either a single 100-tank car unit train or two 50-tank car unit trains on a daily basis. A 100-tank car train would include four locomotives (and two buffer cars) and would be approximately 6,500 feet long; a 50-car train would include two locomotives and two buffer cars and would be about 3,300 feet long.

The duration it would take a train to pass through an at-grade crossing, and thus create a corresponding vehicular delay, would be a function of the train length and speed. The crossing times shown in Table 4.11-3 include a 30-second buffer for opening/closing of crossing gates and assume an average roadway width of 100 feet.

Because it would take Valero approximately 12 hours to unload each train and prepare the empty train for the return trip, any single train is likely to only pass through any given at-grade crossing once per day (at most) during the AM or PM peak hours. Therefore, assuming four peak period hours per day (two AM and two PM), any one train would have about an 8 percent chance of traveling through an at-grade intersection during the AM or PM peak period. Average vehicle delay

would not substantially increase at any given intersection over the peak two-hour period. The impact would be less than significant.

TABLE 4.11-3
INTERSECTION DELAY TIME AS A FUNCTION OF TRAIN SPEED

Train Speed (miles per hour)	At-grade Crossing Time (minutes)	
	50-Unit Car Train	100-Unit Car Train
10	4.4	8.0
20	2.4	4.2
30	1.8	3.0
40	1.5	2.4
50	1.3	2.0

Impact 4.11-7: The Project would not decrease the performance of passenger trains. (*Less than Significant*)

Project trains would use various UPRR tracks that are shared with three intercity passenger rail lines that operate wholly or partially within California: the Capitol Corridor, California Zephyr, and Coast Starlight.

The Capitol Corridor Joint Powers Authority contracts with Amtrak to operate the Capitol Corridor rail service, which extends 169 rail miles from Auburn to San Jose. Project trains would share some of the same track as the Capitol Corridor between Benicia and Auburn, a distance of approximately 87 miles. The Capitol Corridor currently has 15 weekday round trips between Sacramento and Oakland or San Jose (11 on weekends), including one daily round trip that extends through Sacramento to Auburn (CCJPA, 2015a). Including freight trains, there is an average of 42 trains traveling daily between Benicia and Roseville (Valero, 2013e).

The endpoint on-time performance (OTP) of the Capitol Corridor in February 2015 and June 2015 was 95 percent and 94 percent, respectively, which is well above the target goal of 80 percent established by the Federal Railroad Administration (FRA). The OTP was 94 percent in the 12 months preceding February 2015 (Amtrak, 2015a; Amtrak, 2015b). The endpoint OTP measures how a train actually performs compared to the published schedule at the last station on the run. It uses the actual departure time at the origin point of the train and the actual arrival time at the last stop, within a tolerance of 10-30 minutes, depending on the route length. The OTP on the Capitol Corridor has been over 90 percent since 2008-2009 (Caltrans, 2013a) and it had the best OTP in the entire Amtrak system for the fifth year in a row as of 2014 (CCJPA, 2015b).

The California Zephyr is an Amtrak train that operates one round-trip per day between San Francisco (Emeryville) and Chicago. Project trains would share tracks with the California Zephyr between Benicia and the Nevada state line near Truckee, a distance of approximately 188 miles. Up to 32 freight trains per day travel on the portion of this route between Roseville and Reno, Nevada (Caltrans, 2013a). The OTP of the California Zephyr in February 2015 was

73 percent, which has an FRA goal of 80 percent. The OTP was 73 percent in the 12 months preceding February 2015 (Amtrak, 2015c). The California Zephyr had an average OTP of 52 percent from 2011 to mid-2014 (FRA, 2014).

The Coast Starlight is an Amtrak train that operates one round-trip per day between Los Angeles and Seattle. Project trains would share tracks with the Coast Starlight between Benicia and Sacramento at which point the Coast Starlight proceeds north instead of continuing onward to Roseville. Project trains also would share tracks with the Coast Starlight from Yuba City to the Oregon border. The total distance of shared tracks would be approximately 322 miles. According to the State Rail Plan, between 11-25 passenger and freight trains per day use the route between Yuba City and the Oregon state line. The OTP of the Coast Starlight in February 2015 was 87 percent, which also has an FRA goal of 80 percent. The OTP was 91 percent in the 12 months preceding February 2015 (Amtrak, 2015d). The Coast Starlight had an average OTP of 79 percent from 2011 to mid-2014 (FRA, 2014).

As noted in Chapter 3, *Project Description*, UPRR currently avoids dispatching freight trains during the commute hours to avoid delaying Capitol Corridor trains. In addition, the majority of this route consists of a double track that facilitates the movement of trains in both directions (Caltrans, 2013a). Based upon UPRR's past performance in dispatching 30 daily Capitol Corridor trains to meet precise schedules (see Revised DEIR Section 2.4.2), the addition of two round-trip Project trains along this corridor would not likely result in a significant effect on passenger trains operating between Benicia and Roseville.

The Coast Starlight and California Zephyr routes that would be shared by Project trains within California can experience delays anywhere along their respective routes, with the majority of the California Zephyr route located outside California. The California Zephyr route between Roseville and the Nevada state line also consists of mostly double track, which increases operational reliability. Given the very low frequency of these trains (one round-trip/day on each route), Project trains would not result in a significant effect on the OTP of the Coast Starlight and California Zephyr.

2.16.2 Summary of Transportation and Traffic Impacts

Potential direct and indirect effects of Project components in the vicinity of the Refinery and between the Refinery and the Roseville Yard are analyzed in DEIR Section 4.11 (p. 4.11-1 et seq.); potential cumulative effects of these components are analyzed in DEIR Section 5.4.3.11 (p. 5-20). Potential direct and indirect effects of Project-related transport of crude by rail uprail from the Roseville Yard to the State border and beyond are analyzed in Revised DEIR Section 2.16; potential cumulative effects of travel along these routes are analyzed in Revised DEIR Section 2.17.4.

Potential transportation and traffic-related direct, indirect, and cumulative impacts of crude oil transport via a southern California rail route are expected to be substantially similar to the type and severity of impacts that could result between the Refinery and the State border via any of the northern routes: Project-related rail transport could delay traffic on roadways in the vicinity of at-

grade crossings or the performance of public rail transit that shares the rails along routes selected to transport Project-related crude; however, such impacts are not expected to be significant. These determinations are consistent with the analysis documented by San Luis Obispo County in the Phillips 66 Revised EIR (San Luis Obispo County, 2014) (see Section 4.12, Transportation and Circulation, pp. 4.12-25 through 4.12-36).

Integrating the data and other information in these sections, the Project as a whole would result in no impact related to criterion c), regarding change in air traffic patterns and less-than-significant impacts or impacts reduced to less-than-significant with implementation of mitigation measures, for all other significance criteria.

2.17 DEIR Chapter 5, CEQA Statutory Sections

DEIR Chapter 5 (p. 5-1 et seq.), CEQA Statutory Sections, considers significant and unavoidable impacts in Section 5.1 (DEIR p. 5-1), significant irreversible environmental effects in Section 5.2 (DEIR p. 5-1 et seq.), growth-inducing impacts in Section 5.3 (DEIR p. 5-2 et seq.), cumulative impacts in Section 5.4 (DEIR p. 5-3 et seq.), and effects found to not be significant in Section 5.5 (DEIR p. 5-20 et seq.). DEIR Chapter 5 is being revised to reflect the impact conclusions reached and other changes reflected in this Revised DEIR. No other changes to DEIR Chapter 5 are proposed.

2.17.1 DEIR Section 5.1, Significant Unavoidable Environmental Impacts

Section 15126.2(b) of the CEQA Guidelines requires an EIR to identify any significant environmental effects of a project that cannot be avoided through feasible mitigation and/or alternatives. As analyzed in Chapter 4 of the DEIR and in Revised DEIR Sections 2.6.2, 2.7.1, 2.11.2, and 2.12.6, significant unavoidable impacts would result to the following resources: ~~As described in this DEIR Section 4.1, Air Quality, there would be two significant unavoidable air quality environmental impacts as an indirect result of the Project (See Impacts 4.1-1b and 4.1-2).~~

- ***Air Quality***: See Impact 4.1-1 (Operation of the Project would conflict with applicable air quality plans), Impacts 4.1-1b and 4.1-5 (Operation of the Project would contribute to an existing or projected air quality violation), and Impacts 4.1-2 and 4.1-7 (The Project could result in a cumulatively considerable net increase in criteria pollutant and ozone precursor emissions). (DEIR p. 4.1-16 et seq. and Revised DEIR Section 2.6.2.)

- ***Biological Resources***: See Impact 4.2-10 (Operation of the Project would result in adverse effects on candidate, sensitive, or special-status wildlife species resulting from collisions with trains). (Revised DEIR Section 2.7.1.)

- ***Greenhouse Gas Emissions***: See Impact 4.6-1 (Operation of the Project would generate significant levels of GHG) and Impact 4.6-2 (Operation of the Project would conflict with applicable plans adopted for reducing GHG emissions). (Revised DEIR Section 2.11.2)

- ***Hazards and Hazardous Materials***: See Impact 4.7-2 (Operation of the Project would result in a significant hazard to the public during accident conditions), Impact 4.7-6

(Operation of the Project would result in adverse secondary effects to the public or environment), and Impact 4.7-9 (Operation of the Project would expose people or structures to wildland fires during accident conditions). (Revised DEIR Section 2.12.6.)

2.17.2 DEIR Section 5.2, Significant Irreversible Environmental Effects

Under Section 21100(b)(2)(B) of CEQA, an EIR must identify any significant irreversible effects of the project. Section 15126.2(c) of the CEQA Guidelines describes irreversible environmental changes as follows:

> *Uses of nonrenewable resources during the initial and continued phases of the project may be irreversible since a large commitment of such resources makes removal or nonuse thereafter unlikely. Primary impacts and, particularly, secondary impacts (such as highway improvement which provides access to a previously inaccessible area) generally commit future generations to similar uses. Also irreversible damage can result from environmental accidents associated with the project.*

Construction ~~and operation~~ of the Project's proposed tank car unloading rack would require use of some non-renewable resources, including diesel and gasoline for construction vehicles and equipment. However, this use would be limited to the approximate 25-week construction period. Operation and maintenance of the unloading rack would require minor amounts of gasoline or diesel to fuel maintenance vehicles or other fossil fuel products to assure safe operation of the equipment (such as lubricants for moving parts). These needs ~~temporary construction-related increases~~ would not result in significant use of non-renewable resources and would not commit future generations to similar uses.

The Project would involve the continued use of nonrenewable crude oil supplies by the existing Refinery. At some point in the future, the supply of crude oil available by railcar would presumably become exhausted. This would ~~will~~ occur, however, with or without the Project. The Project would not involve any increase in the use of crude oil by the Refinery. Rather, the Project would merely assure that an equivalent of up to 70,000 barrels of crude oil per day arriving at the Refinery would come from a North American source ~~substitute North American crude oils for other crude oils from around the world~~.

During Project operations, diesel fuel would be used by trains bringing crude oil to the Refinery and returning empty tank cars to North American source locations for refilling. This Project-related diesel fuel consumption, however, would be offset in part by the reduced consumption of lower-grade fuels used by marine vessels that currently deliver crude oil to the Refinery. Given that distances to potential crude feedstock sources over the life of the Project for both marine vessel and rail transport are likely to vary and depend on future market forces,[27] it would be

[27] Currently, vessels carrying crude from Alaska to the Refinery travel 2,000 miles (from the terminus of the TransAlaska pipeline). Vessels carrying crude from South America to the Refinery travel roughly 4,000-miles. Vessels carrying crude from the Middle East to the Refinery travel roughly 8,500 miles. ~~By comparison, a train~~ Trains carrying North American crude oil to the Refinery could travel any number of miles along the North American freight rail routes shown in Figure 1-1. ~~roughly 1,500 miles to locations in the mid-west.~~

speculative to estimate or compare exact fuel usage differences between the two modes of transport. ~~Although exact distances to potential crude feedstocks are not known for either marine vessel or rail transport, it is likely that rail transport of North American sourced crude would tend to be much shorter than crude brought from more distant global sources by marine vessels.~~

As explained in ~~sections~~ DEIR Sections 4.2, *Biological Resources*, ~~and~~ 4.7, *Hazards and Hazards Materials*, and 4.8, *Hydrology and Water Quality*, and in Revised DEIR Section 2.12, a release of crude oil from a railcar during upset or accident conditions could potentially affect nearby residents, sensitive habitat, cultural resources, and the quality of surface water and groundwater. ~~The~~ Although the probability of such an occurrence~~, however,~~ is quite low, the consequences of such an event should it occur could be quite high and potentially result in a significant irreversible effect to affected resources. ~~In addition, as explained in Section 4.7, *Hazards and Hazardous Materials*, there are a variety of state and federal regulations designed to ensure that any releases are contained and remediated, and any resulting damage is mitigated. Therefore, the risk of irreversible damage from accidental releases is not considered significant.~~

2.17.3 DEIR Section 5.3, Growth-Inducing Impacts

Section 15126.2(d) of the CEQA Guidelines states that an EIR should discuss "the ways in which the Project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment." Growth can be induced in a number of ways, including through the elimination of obstacles to growth, through the stimulation of economic activity within the region, or through precedent-setting action. CEQA requires a discussion of how a project could increase population, employment, or housing in the areas surrounding the project as well as an analysis of the infrastructure and planning changes that would be necessary to implement the project.

The temporary increase in the local labor force of approximately 121 construction workers at its peak over the approximate 25-week construction period would not contribute to any significant increase in the local population as there is a well-established worker base in the area that serves the five Bay Area refineries for projects similar to the Project. Operation of the Project would require approximately 20 new permanent employees at the Refinery. Operation of the Project also would require UPRR personnel to operate the locomotives - likely to be one conductor and one engineer per train (Dokoupil, 2015; Sperandeo and Keefe, 2006). It is possible that these employees would be new residents of the area. However, the potential number of new residents would be insignificant given the total population of the area and the housing vacancy rate. Therefore, construction and operations associated with the Project would not encourage new development or induce population growth and the Project would neither directly nor indirectly induce short-term or long-term population growth.

2.17.4 DEIR Section 5.4, Cumulative Impacts

2.17.4.1 DEIR Section 5.4.1, General and Regional Plans Considered in the Cumulative Analysis

No changes to this subsection, which is found on DEIR page 5-4, are proposed.

2.17.4.2 DEIR Section 5.4.2, Specific Projects Considered in the Cumulative Analysis

This subsection begins on DEIR page 5-4. It identifies other recent Valero Benicia Refinery projects in subsection 5.4.2.1, other crude by rail projects in California in subsection 5.4.2.2, other relevant local projects in subsection 5.4.2.3, and other City of Benicia projects in subsection 5.4.2.4. Cumulative projects are summarized in DEIR Table 5-1, Potential Projects for Cumulative Effects Evaluation, which begins on DEIR page 5-6. Of these, revisions are proposed only to subsection 5.4.2.2 and Table 5-1. No other revisions to DEIR Section 5.4.2 are proposed.

As is evident in the above analysis, this Revised DEIR expands the geographic area of consideration to include at appropriate levels of detail the North American freight rail routes that could be used to transport Project-related crude oil. DEIR Section 5.4.3's analysis of cumulative effects, revised as indicated in Section 2.17.4.3, considers the potential for the full range of the Project's potential direct and indirect effects to cause or contribute to significant cumulative effects. However, for reasons of practicality, reasonableness, and the lack of availability of useful data for the broader area, this cumulative effects analysis focuses on the Project's potential to cause or contribute to cumulative effects within the State or as noted on a resource-by-resource basis below.

2.17.4.2.1 DEIR Subsection 5.4.2.2, Other Crude by Rail Projects in California

Table 5-1 includes other crude-by-rail projects that have been undertaken, ~~or~~ permitted, or proposed within the State in the last several ~~five~~ years. Briefly, such projects include:

- Phillips 66 Santa Maria Refinery Rail Spur Project (San Luis Obispo County): New unloading facility at existing refinery that could accept up to five, 80-tank car unit trains per week.
- Alon Bakersfield Refinery Crude Flexibility Project: New unloading facility at existing refinery that could accept up to two, 104-tank car unit trains per day.
- Plains All American Pipeline Bakersfield Crude Terminal: New unloading facility in which crude oil delivered in tank cars is transferred to outbound pipelines.
- Kinder Morgan (City of Richmond): Repurposed ethanol transloading facility in which crude oil is loaded onto trucks for delivery to refineries.
- Tesoro Refinery (Contra Costa County): Existing refinery accepting crude oil from third-party operated unloading facility.

2.17.4.2.2 DEIR Table 5-1, Potential Projects for Cumulative Effects Evaluation

TABLE 5-1
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Recent Valero Benicia Refinery Projects (2008-2015 ~~2013~~)				
Maintenance Dredging at Valero Refinery Crude Dock	Valero Benicia Refinery	Periodic maintenance dredging of a maximum of 80,000 cubic yards of sediment per year through 2023	Originally approved in 2008. Permit has been renewed through 2023.	Project location is on the northeast side of the Valero Benicia Refinery
Valero Refining Company - California, Valero Benicia Refinery NPDES Permit Reissuance	Valero Benicia Refinery	National Pollutant Discharge Elimination System (NPDES) permit reissuance. An on-site wastewater treatment plant treats process wastewater and stormwater prior to discharge to Suisun Bay. The refinery also discharges stormwater to Carquinez Strait and Suisun Bay through several additional outfalls. The reissued permit regulates both treated wastewater and stormwater discharges.	NPDES NO. CA0005550: Adopted November 18, 2009, Effective Jan 1, 2010 Expired Dec. 31st, 2014 Currently undergoing renewal.	Project location is on the northeast side of the Valero Benicia Refinery
Valero Improvement Project	Valero Benicia Refinery	The project made changes and installed new equipment at the Valero Refinery to: allow the refinery to process lower grade of crude oil and gas oil; allow the refinery to switch between crude and gas oil, as desired; and optimize operations for efficient production. The project included an increase in crude processing capacity, while significantly reducing emissions, which mitigated project-related impacts to avoid detrimental effects on the Community.	Approved in 2003, amended in 2008 then completed construction in 2011 except for the construction of the hydrogen plant. The Refinery currently has sufficient hydrogen to process the wide range crudes it now uses and consequently Valero is in the process of determining whether to implement the VIP-proposed replacement hydrogen plant as it is not essential to refinery operations or to this Project.	Project location is on the northeast side of the Valero Benicia Refinery
Other Crude by Rail Projects in California				
WesPac Pittsburg Energy Infrastructure Project [This proposed project no longer includes a rail component; therefore, it is now discussed in "Relevant Local Projects," below]	~~City of Pittsburg~~	~~WesPac Energy-Pittsburg LLC (WesPac) proposes to reactivate the existing oil storage and transfer facilities located at the NRG Energy, Inc. Pittsburg Generating Station. The WesPac Terminal would be designed to receive crude oil and partially refined crude oil from trains, marine vessels, and pipelines, store the oil in existing or new storage tanks, and then transfer oil to nearby refineries. The WesPac Terminal would connect to two third-party common-carrier pipelines, including the KLM (Kettleman-Los Medanos) Pipeline (currently owned and operated by Chevron Pipeline Company) that currently provides crude oil to the Valero Benicia Refinery and other Bay Area refineries. The project would allow for an average throughput of 242,000 barrels of crude oil or partially refined crude oil per day, with a maximum of 375,000 barrels per day. The proposed rail transload facility would be capable of receiving and transloading up to one 104-car unit train per day.~~	~~Recirculated Draft EIR in July, 2013. According to the City of Pittsburg website, as of March 2014 the project is undergoing additional review. The City does not currently have a timeframe available for this additional review.~~	~~14 miles~~

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Other Crude by Rail Projects in California (cont.)				
Phillips 66 Company Rail Spur Extension Project	San Luis Obispo County	Phillips 66 is proposing to modify the existing rail spur currently on the southwest side of the Santa Maria Refinery (SMR). The rail spur extension is proposed entirely on the SMR property and would be located east of the Union Pacific Railroad and the existing refinery facilities. The project would include an eastward extension of the existing rail spur by approximately 7,000 feet as well as a railcar unloading facility. Trains would deliver crude oil to the SMR for processing. The unloaded material would be transferred from the proposed unloading facility to existing crude-oil storage tanks via a new on-site above-ground pipeline.	Public review period for Draft EIR ended on January 27, 2014. ~~County will be recirculating the DEIR – no date set.~~ A Revised Draft EIR was published on October 10, 2014; the FEIR is pending.	265 miles
Alon Bakersfield Refinery Crude Flexibility Project	Kern County	This project is a modification of a Precise Development Plan that would allow greater flexibility for the Refinery to utilize a variety of crude oils that can be processed onsite. The project proponent is requesting: 1) expansion of rail, transfer and storage facilities including an addition of up to three boilers; 2) process unit upgrades and/or modifications; 3) repurposing of existing tankage; and 4) relocation and modernization of existing Liquefied Propane Gas (LPG) truck rack and upgrades to sales rack. The rail expansion would consist of the construction of a double rail loop from a new spur connection off of the existing Burlington Northern and Santa Fe Railway (BNSF) and would be fully contained onsite. Most of the proposed process unit changes are minor in scope. The Refinery's 70,000 barrels per day (BPD) maximum crude processing capacity would not be increased.	Kern County approved the project on September 9, 2014. ~~NOP certified September 2013, to prepare Draft EIR.~~	270 miles
Plains All American Pipeline Bakersfield Crude Terminal	Kern County	An unloading facility in which crude oil delivered in tank cars is transferred to outbound pipelines.	Operating	270 miles
Tesoro Refinery	Contra Costa County	The existing refinery currently is accepting up to approximately 350,000 barrels per month of crude oil delivered via unit trains.	Operating	5 miles
Kinder Morgan	City of Richmond	This is a repurposed ethanol transloading facility in which crude oil delivered in tank cars is transloaded onto trucks for delivery to the Tesoro Refinery in the City of Martinez.	Operating	16 miles
InterState Oil Co.	Sacramento County	A transloading facility in which crude oil delivered in tank cars is transloaded onto trucks for delivery to Bay Area refineries.	Currently not operating due to court imposed shutdown.	58 miles
Targa Stockton	Port of Stockton	Proposed marine oil terminal that would receive up to approximately 70,000 barrels per day of crude delivered by rail that would be transloaded onto barges or trucks and/or pipeline for delivery to Bay Area refineries.	Project is still in planning phase.	45 miles
NuStar Energy Selby	Contra Costa County	Existing marine terminal capable of receiving manifest crude by rail shipments.	Operating	6 miles

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Relevant Local Projects (refinery related pipelines, infrastructure, or marine oil terminals)				
WesPac Pittsburg Energy Infrastructure Project	City of Pittsburg	WesPac Energy-Pittsburg LLC (WesPac) proposes to reactivate the existing oil storage and transfer facilities located at the NRG Energy, Inc. Pittsburg Generating Station. The WesPac Terminal would be designed to receive crude oil and partially refined crude oil from ~~trains,~~ marine vessels~~,~~ and pipelines, store the oil in existing or new storage tanks, and then transfer oil to nearby refineries. The WesPac Terminal would connect to two third-party common-carrier pipelines, including the KLM (Kettleman-Los Medanos) Pipeline (currently owned and operated by Chevron Pipeline Company) that currently provides crude oil to the Valero Benicia Refinery and other Bay Area refineries. The project would allow for an average throughput of 242,000 barrels of crude oil or partially refined crude oil per day, with a maximum of 375,000 barrels per day. ~~The proposed rail transload facility would be capable of receiving and transloading up to one 104-car unit train per day.~~	Recirculated Draft EIR in July, 2013. According to the City of Pittsburg website, as of March 2015 ~~2014~~ the project is undergoing additional review. The City does not currently have a timeframe available for this additional review.	14 miles
Chevron Richmond Revised Renewal Project	City of Richmond	This project is a reduced scope of the Hydrogen and Energy Renewal Project Proposed in 2005. In 2008, the City of Richmond certified the EIR and issued permits for the project. In 2010, a court ordered that the EIR be set aside. Chevron has reduced the overall scope of the original project. The Revised Project would complete construction and make operational the Hydrogen Plant Replacement and Hydrogen Purity (sulfur removal) Improvement of the Original Project. The Revised Project would not include the Catalytic Reformer Replacement, Power Plant Replacement, and Other New and Replacement Facilities (storage tanks, control building and central maintenance building) that were part of the original project.	The NOD was filed in July 2014. ~~City is currently preparing a revised EIR.~~	16.8 miles
Chevron Tank Replacement Project	City of Richmond	The project would replace five existing petroleum storage tanks with five newly constructed tanks, and construct a new firewater tank in its quarry tank field. The five petroleum storage tanks will be field-fabricated within existing refinery tank fields. Total capacity of new petroleum tanks will be 541,000 barrels. Total capacity of petroleum tanks removed from service is 366,000 barrels. The petroleum tanks will be provided with secondary containment in accordance with state and federal law, and will be covered to minimize air emissions. The firewater storage tank will store recycled water from plant operations to increase the fire management capabilities at the refinery.	MND Approved March 2011. Tanks are being permitted and constructed individually: Tank 1 constructed, Tank 2 under construction, Tanks 3-5 to be permitted and constructed.	16.8 miles
Phillips 66 Propane Recovery Project	Contra Costa County	Phillips 66, proposes modify existing facilities at their Rodeo, California Refinery and add new facilities to recover propane and butane from refinery fuel gas (RFG) and then ship it by rail for sale. The Project involves hydrotreating a portion of the RFG and would reduce the amount of sulfur in the fuel gas, reducing the Refinery's sulfur dioxide (SO2) emissions to the atmosphere.	The Draft EIR was published in June 2013, and the Final EIR in November 2013. A Recirculated Draft EIR was published in October 2014 and the project was approved in February 2015.	7 miles

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Relevant Local Projects (refinery related pipelines, infrastructure, or marine oil terminals) (cont.)				
Shell Crude Tank Replacement Project	City of Martinez	This project would increase crude oil storage capacity at the refinery to facilitate future operations at current production levels despite anticipated changes in the source of crude oil feed stocks with no increases in crude oil throughput at the Refinery. The project would maintain current operation and production levels of California Air Resources Board mandated cleaner-burning gasoline and ultra-low sulfur diesel fuels at the Refinery substituting imported crude oil by vessel for diminishing San Joaquin Valley crude by pipeline.	Approved October, 2011. Complete.	5.6 miles
California State Lands Commission Marine Terminal Lease – for Shell Martinez Refinery	City of Martinez	The California State Lands Commission (CSLC) recently granted the Shell Martinez Refinery a new 30-year lease for its marine terminal operations. The CSLC certified the EIR prepared for the consideration of the new 30-year lease describes the marine terminal operations and evaluates the impacts of the new lease, including evaluation of future vessel traffic impacts. The assumptions and basis for the proposed Project are aligned with the forecasted activity of the marine terminal lease operations.	The new lease was granted by the CSLC on June 23, 2011.	5.6 miles
California State Lands Commission Marine Terminal Lease – for NuStar Selby Marine Terminal	Contra Costa County	The California State Lands Commission (CSLC) recently granted the NuStar Selby Marine Terminal a new 30-year lease for its marine terminal operations. The CSLC certified the EIR prepared for the consideration of the new 30-year lease describes the marine terminal operations and evaluates the impacts of the new lease, including evaluation of future vessel traffic impacts. The assumptions and basis for the proposed Project are aligned with the forecasted activity of the marine terminal lease operations.	The new lease was granted by the CSLC in 2012.	7 miles
Selby Slag Site Remediation	Contra Costa County	The Selby Slag Site is the location of a former smelting facility. Smelting is the process of extracting metals, such as lead or copper, from a mineral or rock through high-temperature melting or fusing. Asarco operated a smelting facility at the Selby Slag Site from 1872 to 1971. During the smelting operations, slag (a waste product from the smelting process containing metals) was produced and used to fill the adjacent tideland areas. Most of the area of the Site was created from this historical filling of tideland areas with slag. Department of Toxics Substances Control (DTSC) is the lead government agency overseeing the investigation and cleanup at the Selby Slag Site. The Selby Group, comprised of Asarco LLC, the California State Lands Commission, and C.S. Land, Inc., has been undertaking investigation and cleanup actions at the Site under the oversight of DTSC.	A CEQA document is currently being prepared by DTSC.	7 miles

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Relevant Local Projects (refinery related pipelines, infrastructure, or marine oil terminals) (cont.)				
Tesoro Amorco and Avon Marine Oil Terminals	Contra Costa County	The Tesoro Refining and Marketing Company (Tesoro), a wholly owned subsidiary of Tesoro Petroleum Corporation, leases 16.6 acres of sovereign public land from the CA State Lands Commission for the Tesoro Amorco Marine Oil Terminal (Amorco MOT) and 11.2 acres for the Avon MOT (PRC 3453.1 and 3454.1). The Applicant is seeking approval from the CSLC for a new 30-year lease at both sites. The Amorco MOT exists and is currently operating, and no changes to the facilities or operations are proposed; however, issuance of a new 30-year lease will require the preparation of an EIR because, among other potentially significant impacts, there is an inherent risk of spills at any facility where petroleum product is routinely transferred over water. Proposed changes at the Avon MOT include removal of one berth and construction of a new berthing area.	The CSLC ~~is currently preparing two~~ published the Amorco MOT EIR in February 2014 and the Avon MOT EIR in January 2015. ~~s for the new leases.~~	3 miles
Plains All American Pipeline Martinez Marine Terminal 20-year Lease Consideration	City of Martinez	Proposed new 20-year lease of 5.04 acres of California sovereign lands would allow Plains All American Pipeline to continue its marine oil terminal operations for vessel transfers of crude oil and petroleum products. The terminal enables transfers to on-land storage facilities approximately two miles east of the City of Martinez, south shore of Carquinez Strait, and approximately one mile east of the Benicia Bridge.	NOD filed August 2005	3 miles
Air Products Local Area Pipeline Network Project	City of Martinez	Air Products and Chemicals Inc. (Air Products) owns and operates a hydrogen plant located within the Shell Martinez Refinery. In September 2009, a Draft EIR was published describing a local area pipeline network project proposed by Air Products. The proposed pipelines would originate at another existing Air Products hydrogen plant at the Tesoro Golden Eagle Refinery and travel westward about 2.6 miles in an unpopulated area along Waterfront Road, where they would connect with the existing Air Products Hydrogen Plant at the Shell Martinez Refinery. The two pipelines, one for hydrogen and the other for fuel gas, would be installed in the same trench to minimize impacts. The primary objective of this project is to maintain adequate, available, and efficient supply of hydrogen for the two refineries (Tesoro and Shell) by allowing the	The EIR for the project was certified in May 2011 by the County. Construction of the Air Products pipeline is proposed over a 3-month period was scheduled for 2012. This did not occur. The current construction schedule is to be determined.	3 miles
Air Products Local Area Pipeline Network Project (cont.)		transfer of hydrogen and fuel gas (hydrogen plant feed and fuel) and connecting the existing Air Products hydrogen plants at both refineries. The project would provide for hydrogen supply at the Martinez Refinery for the processing of products to meet the cleaner-burning fuel standards. The CTRP does not involve changes to the process units that would affect hydrogen demand.		

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Relevant Local Projects (refinery related pipelines, infrastructure, or marine oil terminals) (cont.)				
Praxair Contra Costa Pipeline Project	Contra Costa County and the Cities of Richmond, Martinez, Hercules, and potential San Pablo	Praxair is proposing to develop an approximately 21.3-mile hydrogen pipeline from the Chevron Richmond Refinery to the Shell Martinez Refinery. This pipeline would include a 1.1-mile lateral pipeline extension to the Phillips66 Refinery in Rodeo, California. The pipeline would transport hydrogen that is produced at the Chevron Refinery and not required for Chevron's own operations. The Praxair Contra Costa Pipeline Project would consist of construction of approximately 13.5 miles of new pipeline and the reuse of approximately 7.8 miles of an existing Chevron pipeline previously used to transport natural gas. The project would also include the construction of approximately 2.2 miles of natural gas pipeline. Although the hydrogen pipeline is proposed to terminate at the Shell Martinez Refinery, Shell currently has no agreement in place with Praxair for future hydrogen supply. As stated previously, the CTRP does not involve changes to the process units that would affect hydrogen demand.	A Draft EIR was released in 2010 and Contra Costa County is currently preparing a Final EIR for the project.	5 to7miles
Other City of Benicia Projects and Projects that Include Benicia Subject to CEQA Review (as of May, 2014)				
Solano County Draft General Plan Update	County of Solano	The proposed project is the 2008 update of the Solano County General Plan.	Adopted August, 2008.	Encompasses City of Benicia and Project location.
Lower Arsenal Mixed Use Specific Plan - Recirculation	City of Benicia	Recirculation of Noise and Global Climate Change, Energy Use and Sustainability Sections. Recirculated the proposed project includes implementation of a Specific Plan for the Lower Arsenal site, which is designated for mixed use in the Benicia General Plan. The Specific Plan covers four distinct zones, each of which exhibits a unique physical character. The Specific Plan would implement a form based code to shape future development on the project site, with primary emphasis on the physical form and character of the new development. After build-out of the Specific Plan, the area would contain approximately 741,865 square feet of mixed uses, 22 residential units, and 6.39 acres of open space. The Specific Plan area currently contains approximately 525,000 square feet of mixed uses.	Draft EIR originally circulated in 2007. Draft EIR recirculated August, 2009. This project is currently on hold and the EIR will be revised again by the City.	Between 1 to 2 miles-Project is not within planning area.
Housing Element, 2015-2023	City of Benicia	This project updated the Housing Element of the City of Benicia General Plan as required by Government Code Section 65580 - 65589.8. The Housing Element is a comprehensive statement by the City describing the housing needs of Benicia and how the City's plans, policies, programs and regulations facilitate the development, improvement and preservation of housing for all economic segments of the community.	Deadline for adoption / certification is January 31, 2015.	Project is within City limits.

TABLE 5-1 (Continued)
POTENTIAL PROJECTS FOR CUMULATIVE EFFECTS EVALUATION

Project Name	Location	Description	Status/Schedule	Approximate Distance From Project
Other City of Benicia Projects and Projects that Include Benicia Subject to CEQA Review (as of May, 2014) (cont.)				
Tannery Bay Trail	City of Benicia	The proposed project is to construct a shoreline public pathway with amenities as part of San Francisco Bay Trail System. The project would include approximately 350 cubic yards of solid fill over a 2,260 sf area; Construction of an 8 foot wide, 275 foot long path way; Construction of approximately 3,199 sf of landscaping area; Construction of approximately 3,310 sf of shoreline protection (rip rap system); Installation of four public benches; A series of concrete walkways from the existing building to the new pathway and decomposed granite (DG) along the west side of the new pathway, adjacent to the new shoreline revetment.	Initial Study/Mitigated Negative Declaration adopted 2013.	2 miles
New Harbor Church	City of Benicia	The proposed project would consist of constructing a new 20,244 sq. ft., multi-use, two-story church at the terminus of Blake Court, east of Rose Drive. Pursuant to a prior agreement with the City in June 2001, the land was dedicated to a church to be selected by the Benicia Council of Churches. New Harbor Community Church was the selected recipient of this land. However, the Church will still needs to get Use Permit approval from the Planning Commission since the location is in the City's Single Family Zone District.	EIR certified in 2001. Project under review and EIR Addendum certification pending.	3 miles
Jefferson Ridge LLC Assisted Living Care Complex	City of Benicia	Project proposes to build a two-building, 273-unit assisted-living and memory-care complex that may be built on a vacant lot on Jefferson Street near Park Road and Adams Street Benicia's industrial port, within the lower arsenal.	Submitted to the City in August 2012, project is currently under review for General Plan/zoning compliance. CEQA documentation TDB.	1 mile-adjacent to the Project.
Water States Agreement for Annual Transfers of a Quality of Solano ID Annual Allotment	Solano County, City of Benicia and City of Fairfield	The Project includes proposed agreements to accomplish annual transfers of a quantity of Solano Irrigation District's (District) annual allotment of Solano Project water to the city of Benicia (Benicia) is the amount of 2,000 acre feet per year and the city of Fairfield (Fairfield) in the amount of 2,000 acre feet a year, for a total of 4,000 acres feet per year. The cities will pay consideration to District for the transfer. If one of the cities does not execute the agreement, the District may proceed with the remaining city. The water quantities transferred will be delivered in Lake Berryessa (Berryessa) and transferred through the Putah South Canal and will be utilized by each city primarily to assure yield through drought periods for the existing city water service area compared to the quantity of water delivered from the State Water Project (SWP) to enhance water quality to city customers within the existing city water service area, to reduce water treatment by each city, and to provide supplies for replacement of reduced sources of SWP water die to SWP operating conditions.	Agreement approved in 2009.	Project is within City limits

2.17.4.3 DEIR Section 5.4.3, Areas of Potential Cumulative Impacts

2.17.4.3.1 DEIR Subsection 5.4.3.1, Air Quality

This subsection begins on DEIR page 5-5. It documents the analysis of cumulative impacts associated with construction, operation, and health risk. Of these, revisions are proposed as noted below to the discussion of operation-phase cumulative effects and health risk. No other revisions to DEIR Section 5.4.3.1 are proposed.

Operation

As described in Impacts 4.1-1b and 4.1-2, after mitigation measures are applied, Project operational emissions generated within the Bay Area Basin would not exceed the BAAQMD regional mass emissions thresholds. Consequently, operation of the Project would not be considered to make a cumulatively considerable contribution to regional cumulative air quality impacts in the Bay Area Basin.

With regard to emissions of the Project generated within the ~~Sacramento Basin~~ California air districts outside of the BAAQMD, as discussed in Section 4.1.5 under Impact 4.1-2 and Impact 4.1-7, Project-related emissions in the ~~YSAQMD~~ Yolo-Solano AQMD, ~~and SMAQMD~~ Sacramento Metropolitan AQMD, Siskiyou County APCD, Shasta County AQMD, Tehama County APCD, Butte County AQMD, and Feather River AQMD would exceed the incremental project significance thresholds for NO_x ~~and~~, NO_x emissions generated in Placer County would exceed the PCAPCD cumulative 10 pounds per day significance threshold, and emissions of ROG along the Nevada to Roseville (southern) route also would exceed the cumulative threshold for Placer County. Therefore, implementation of the Project would result in a cumulatively considerable increase of ~~NO_x~~ emissions in ~~YSAQMD~~ Yolo-Solano AQMD, ~~SMAQMD~~ Sacramento Metropolitan AQMD, ~~and PCAPCD~~ Placer County APCD, Tehama County APCD, Butte County AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, Northern Sierra AQMD, Feather River AQMD and the associated cumulative impact within ~~the Sacramento~~ these air districts would be significant.

Health Risk

As noted above, the project health risk assessment modeling found the Maximum Exposed Individual Residence (MEIR) to be at a residence in Fairfield adjacent to the rail tracks primarily as a result of the increase in train traffic for the ~~Benicia Refinery p~~ Project. Cumulative risk has been evaluated for sources within 1,000 feet of that location (see below). ~~Similarly, an~~An additional cumulative assessment was performed to evaluate the combined risks at residences near the Refinery from DPM sources from the Project, I-680, and existing rail traffic on the tracks near the Refinery. As part of this cumulative assessment, the health risk ~~assessed~~ for the Valero Improvement Project (VIP) (City of Benicia, 2002) and VIP Amendments (City of Benicia, 2008) were ~~also~~ combined with the above sources to estimate the risk contribution ~~to risk~~ from existing sources at the Refinery. Finally, cumulative risks were also evaluated for locations outside of the BAAQMD between Fairfield and Roseville and in uprail locations from Roseville to the Oregon and Nevada borders.

~~Screening-level c~~Cumulative health risks ~~was~~ were evaluated in the vicinity of residences near the Refinery where the maximum risk and $PM_{2.5}$ concentration was modeled. This modeled residence is located to the southwest of the Refinery (UTM 575,694 East [meters], 4,212,345 North [meters]). The BAAQMD provides a Google Earth tool that displays the ~~screening-level~~ health risks and $PM_{2.5}$ concentrations from freeways and rail sources in each county (BAAQMD, 2014). The results of the near-Refinery residential cumulative risk from the Project, the recent VIP/VIP Amendments Project, the I-680 freeway, and rail sources obtained from the BAAQMD Google Earth tool are presented below in Table 5-2.

TABLE 5-2
CUMULATIVE HEALTH RISK AT OR NEAR THE REFINERY

Type of Estimated Health Impact	Source of Contribution to Risk, Chronic Hazards, and $PM_{2.5}$ Concentration				Total	Total with ASF*[1]
	Crude by Rail Project	I-~~160~~ 680 (at 1,000 feet)	UPRR Tracks (at 1,000 feet)	VIP Project		
Cancer Risk (per million)	~~0.99~~ 2.2	3.47	1.65	2.38	~~8.49~~ 9.7	~~14.4~~ 11.4
Chronic Hazard[2]	0.0003	0.003	0.000	0.0113	0.015	0.015
$PM_{2.5}$ Annual Concentration (ug/m^3)	~~0.003~~ 0.002	0.024	0.002	~~0.002~~ N/A	~~0.029~~ 0.028	~~0.029~~ 0.028

*[1] Cancer risk for the VIP project does not account for the Age Sensitivity Factor (ASF) required by recent guidance issued by the Office of Environmental Health Hazard Assessment (OEHHA, 2015). The Total with ASF column adjusts the VIP Project cancer risk by multiplying by 1.7 to account for the ASF.~~includes the Age Sensitivity Factor (ASF)~~

[2] Crude by Rail Project chronic hazard based on maximum sensitive receptor value. VIP project chronic hazard value represents the VIP chronic risk from VIP Draft EIR, Table 4.7-9 (maximum nonresidential location) plus the maximum off-site chronic hazard index value for the VIP amendments stationary sources (Table 3.1.8-2) and mobile sources (Table 3.1.8-3).

SOURCE: ERM, 2015 ~~2014~~; see Revised DEIR Appendix B ~~E.6~~

With respect to cumulative health risk impacts associated with localized air emissions, the VIP, which was essentially completed in 2011, is considered to be a past cumulative project. The only component of the VIP that has not been constructed is a replacement hydrogen plant. The Refinery has sufficient hydrogen now to process the wide range of crudes that it now uses and Valero is in the process of determining whether or not to replace the hydrogen plant. The Permit-to-Construct the replacement hydrogen plant ~~would~~ expired in December 2014. Since the proposed replacement hydrogen plant would be a replacement project, this element would not likely result in an increase in emissions and would have no cumulative impact.

The VIP proposed a series of modifications and additions to the Refinery, including modification to existing equipment and installation of new refining equipment, such as piping, heat exchangers, instrumentation, catalytic reactors, fractionation equipment, pumps, compressors, furnaces, tanks, and flue gas scrubber. Health risk analyses were conducted for the VIP (City of Benicia, 2002 and 2008) that estimated health risks for all components of this cumulative project. The VIP health risk analysis concluded that the maximum incremental cancer risk at the nearest residential receptor would be 1.47 in a million and a maximum non-residential cancer risk would be 2.38 in a million. The non-cancer chronic hazard was found to be 0.007 for the maximally exposed resident and 0.018

for the maximally exposed worker. It should be noted that predominate wind direction in the vicinity of the Refinery is from the west, towards the east. There are no residences or other sensitive receptors immediately east of the Refinery. This predominant wind direction tends to limit exposure of the residences to the north, east, and south of the Refinery.

Combining the risks of the Project with the existing risks associated with I-~~160~~ 680, the UPRR, and the VIP results in a cumulative combined cancer risk of ~~14.4~~11.4 in one million to the maximally exposed residential receptor near the Refinery. This value is well below the cumulative threshold of 100 in one million for cancer risk. Combining the chronic hazards of the Project plus the existing concentrations associated with 1-680, the UPRR, and the VIP, results in a cumulative combined chronic hazard of 0.015. This value is well below the BAAQMD cumulative chronic hazard significance threshold of 10.0. Combining the $PM_{2.5}$ concentrations of the Project with the existing concentrations associated with I-~~160~~ 680, the UPRR, and the VIP results in a cumulative combined $PM_{2.5}$ concentration of 0.0~~29~~ 028 ug/m^3 to the maximally exposed residential receptor near the Refinery. This value is well below the cumulative threshold of 0.8 ug/m^3. Therefore, the combined risk, hazard index, and $PM_{2.5}$ concentrations would result in a less than significant cumulative impact and the incremental increases in the vicinity of the Refinery that would be associated with the Project would not be cumulatively considerable.

A ~~screening-level~~ cumulative risk analysis was prepared for sensitive receptors ~~also evaluated~~ in the vicinity of the MEIR in Fairfield to estimate the combined exposure from the Project locomotives, existing locomotives using ~~these tracks~~, I-680, and stationary sources of TACs within 1,000 feet of the MEIR. The BAAQMD Google Earth tool ~~that~~ displays the ~~screening-level~~ health risks, chronic hazards, and $PM_{2.5}$ concentrations from TACs. This tool ~~sources in each county~~ was used to obtain existing risk and concentrations data for TAC sources in the vicinity of the MEIR (BAAQMD 2014). The stationary sources within 1,000 feet of the MEIR are described below:

- Commercial Business, 744 N. Texas Street;
- Commercial Business, 106 Railroad Avenue;
- Commercial Business, 110 Railroad Avenue;
- Commercial Business, 1350 N. Texas Street;
- Commercial Business, 890 E. Travis Boulevard; and
- Commercial Business, 409 Railroad Avenue, Suite B.

~~Though conservatively developed, the screening-level~~ The risk values from BAAQMD's Google Earth tool can be ~~compared~~ combined with ~~to~~ the modeled health risk, chronic hazard, and $PM_{2.5}$ concentrations from the locomotives to determine whether cumulative risk may be significant. The values shown in Table 5-3 below represent the modeled health risk with conservative ~~screening~~ risk levels imposed at that MEIR. The combined cumulative risks would be below 100 in one million for cancer, below the chronic hazard index of 10.0, and below the 0.8 ug/m^3 $PM_{2.5}$ concentration. Therefore, the incremental increase in risk, chronic hazards, and $PM_{2.5}$ concentrations ~~that would be~~ associated with the Project would not be cumulatively considerable at the MEIR. The cumulative impact would be less than significant.

TABLE 5-3
CUMULATIVE HEALTH RISK AT THE MAXIMUM EXPOSED INDIVIDUAL RECEPTOR

Type of Estimated Health Impact	~~Screening-level~~ Cancer Risk per million (Location)	Chronic Hazard Index (Location	~~Screening-~~ PM2.5 Concentration (ug/m^3) (Location)
Maximum Exposed Individual Residential (MEIR) – Fairfield residential receptor	~~88.1~~ 69.7 (Existing risk at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)	0.078 (Existing hazard index at 90 feet northwest of train tracks)	0.10 (Existing worst case Conc. at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)
	~~8~~4.0 (Project incremental risk at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)	0.004 (Project incremental hazard index at 90 feet northwest of train tracks)	0.~~02~~004 (Project worst case Conc. at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)
	~~88.0~~ 73.7 (Cumulative risk at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)	0.082 (Cumulative hazard index at 90 feet northwest of train tracks)	0.~~12~~10 (Cumulative worst case conc. at ~~160~~ 90 feet ~~southeast~~ northwest of train tracks)
Significance Threshold	100	10.0	0.8 ug/m^3
Significant Impact?	No	No	No

SOURCE: ERM, 2015 ~~2014~~; see Revised DEIR Appendix B ~~E.6~~

Health Risks from the BAAQMD Border to Roseville and from Roseville to the Oregon and Nevada Borders

This section focuses on the cumulative health risks from the BAAQMD border to Roseville and along the three potential train routes between Roseville, California and the California border. Cumulative health risks must address TACs from all relevant sources. For the Project, this includes the Project locomotives, existing locomotives, stationary sources, and major roadways. Rail traffic primarily generates DPM emissions from diesel fuel combustion. Motor vehicles emit an assortment of TACs and particulate matter from the combustion of gasoline, diesel fuel, and tire and brake wear. Stationary sources have the potential to emit a variety of TACs. The U.S. EPA federal reporting system contains the location and identification numbers for facilities that handle toxic compounds. This system was used to identify stationary sources within 1,000 feet of the rail lines in each of the three towns.

Three towns were evaluated for cumulative health impacts along the train route from the BAAQMD border to the Roseville Yard. These included Dixon (within the Yolo-Solano Air District), Sacramento (within the Sacramento Air District), and Roseville (within the Placer County Air District). Each town has sensitive land uses located near the rail line and close to existing TAC sources.

Five towns along the three uprail train routes have the highest potential for significant cumulative health impacts: Auburn, Chico, Marysville, Redding, and Truckee. Each town has sensitive land uses located near rail lines and close to existing sources of TACs. Sensitive land uses are locations where individuals susceptible to air pollution are frequently found. These include residences, schools, daycares, and hospitals.

The U.S. EPA federal reporting system contains the location and identification numbers for facilities that handle toxic compounds. This system was used to identify stationary sources within 1,000 feet of the rail lines in each of the three towns between the BAAQMD border and Roseville (shown in Revised DEIR Appendix A.9) and in the five uprail towns (shown in Revised DEIR Appendix D).

The cumulative health risks in three cities from the BAAQMD border to Roseville and in the five uprail cities cannot be quantified because the information needed to do so is unavailable. Emission rates for many of the minor and larger sources are unavailable and the local air districts have not attempted to quantify health risks from most of the existing TAC sources. Consequently, cumulative TAC concentrations and resulting health risks cannot be estimated.

The Project's rail activity would increase cancer risks by less than 10 in one million and chronic hazards by less than 1.0 in the eight communities analyzed in this assessment. Since the Project would not result in significant Project-specific health impacts, it is assumed that the Project would not contribute to cumulatively considerable health risk impacts. However, since the data is unavailable to analyze the health risk contribution from other TAC sources, a significance determination of the cumulative health risks of the project combined with other sources cannot be quantified. Consequently, this analysis conservatively assumes that the project plus other TAC sources could result in potentially significant and unavoidable cumulative health risks.

2.17.4.3.2 DEIR Subsection 5.4.3.2, Biological Resources

The Project would result in less than significant ~~has~~ potential impacts on biological resources within and near the Refinery. ~~the Project area the City of Roseville. None of the impacts are significant in themselves.~~

As explained in Section 4.2 (DEIR p. 4.2-1 et seq.), the Project would increase activity and nighttime lighting along a 0.7-mile (3,839 linear feet) stretch of Sulphur Springs Creek. A significant increase in activity and lighting in this area could potentially cause wildlife to avoid the corridor, travel on roads, and be harmed by traffic. The Project impact would not be significant because the Project lighting within the Refinery would be directed downward and away from the riparian corridor. ~~[¶]~~ The incremental light-related impacts of past projects to biological resources is reflected in the baseline conditions. Other ~~past,~~ present~~,~~ and reasonably foreseeable future projects would result in ~~have and will~~ increased activity and nighttime lighting along the riparian corridor, and could combine to create ~~thus creating~~ a cumulative impact. The Project's contribution to this impact, however, would not be cumulatively considerable. Even with a backdrop of heavy industrialization, the riparian corridor offers safe passage across Interstate 680 for animals moving between grasslands north of Second Street and shoreline

marshes south/east of the Interstate. This is not expected to change even if activity and lighting were to increase as a result of projects identified in Table 5-1.

Along the railroad system within and beyond the State line, an ~~state-wide~~ increase in railcar traffic (frequency and/or duration) could result in a cumulatively considerable impact on biological resources during normal operating conditions as a result of increased noise, light, and risk of train/wildlife collisions. For example, the noise from a cumulatively significant increase in night traffic could drown out the nocturnal mating calls of migratory and other ~~marsh~~ birds, increased nighttime lighting could affect mating or nesting success, ~~or~~ the noise and visual disturbance from a cumulatively significant increase in daytime traffic could discourage use of adjacent marshes or other sensitive habitat by burrowing owls and other species, and also result in increased risk of collisions with wildlife. A review of Table 5-1 suggests that other crude by rail projects in the State (~~WesPac Pittsburg Energy Infrastructure Project,~~ including the Phillips 66 Company Rail Spur Extension Project and the~~,~~ Alon Bakersfield Refinery Crude Flexibility Project) would increase railcar traffic along the same rail segments that could be used by trains carrying crude bound for the Refinery ~~transportation systems serving those project areas~~, which may or may not overlap with the Project. Other relevant local projects (such as the Shell Crude Tank Replacement Project, Shell Martinez Refinery Marine Terminal Lease, and NuStar Selby Marine Terminal Lease) could ~~have the potential to~~ increase railcar traffic in the future, and these may overlap geographically with the rail segments that could be used by trains carrying crude bound for the Refinery ~~UPRR railroad mainline and spurs that UPRR could potentially use for the Project~~. The cumulative increase in railcar usage, however, would occur on existing mainline track where baseline usage is already the routine. Thus, the addition of Project-related railcars to the state-wide network and beyond would not involve a cumulatively considerable contribution to the impact on biological resources.

Lastly, regarding the cumulative potential for an oil spill during transport of crude oil, a region-wide increase in all types of vessel traffic (frequency and/or duration of ships, railcars, etc.), along with an increased number of conveyance pipelines planned under regional projects such as the Air Products Local Area Pipeline Network Project and the Praxair Contra Costa Pipeline Project, would increase the overall likelihood of a spill in the region. This could occur anywhere along a marine vessel route, a pipeline route, or a rail line route, though aquatic environments such as Suisun Marsh and San Francisco Bay are especially vulnerable locations for a spill. A spill would only occur under circumstances of an upset or accident, and the probability of occurrence of any single event is small (see Section 4.7, *Hazards and Hazardous Materials*, for additional information); the probability of two or more events occurring at the same time (from the Project and another cumulative project) is even smaller. As noted in Revised DEIR Section 2.12, an oil spill along mainline tracks could result in a significant and unavoidable impact regarding sensitive plant and wildlife species, and wetlands, because resources in proximity of a train derailment and accompanying oil spill and/or explosion would likely be damaged and/or destroyed. While non-Project crude oil trains would use some of the same routes as the Project trains, the likelihood that two or more trains would derail in the same area is remote. Therefore, because a spill would be unlikely to occur during cumulative conditions, the cumulative impact would be less than significant. ~~This potential is even further reduced by the~~

~~fact that the current Project, and other similar projects, would switch modes of transportation from ship to railcar; thus, there wouldn't be an increase in traffic, just a switch in mode of transport. The switch from ship transport through the aquatic environment to railroad transport through the terrestrial environment may arguably reduce the likelihood for a spill, and/or reduce the environmental impacts resulting from a spill by being easier to contain and clean up in a terrestrial or diked, semi-vegetated marshland.~~

2.17.4.3.3 DEIR Subsection 5.4.3.3, Cultural Resources

The construction and operation of the Project would result in no impacts to cultural resources or to lands designated for such use. Thus, the Project could not contribute to cumulative impacts to cultural resources that could be caused by implementation of other Refinery and non-Refinery projects. There would be no cumulative impacts to cultural resources as a result of the Project.

2.17.4.3.4 DEIR Subsection 5.4.3.4, Energy Conservation

The construction and the operation of the Project, in addition to other cumulative Refinery projects and other non-Refinery cumulative development in the Project area (including other crude by rail projects using the railroad system between the Refinery and the Project-related crude oil's points of origin), would not result in any cumulative impacts to energy resources. The energy required for the construction and operation of the Project would be a less-than-significant portion of the regional energy supplies, and would not place significant demands on the regional energy infrastructure. The Project does not involve construction of major new energy facilities off-site, or of facilities that would stimulate the Bay Area's economy, resulting in a cumulative increase in energy use. The construction and the operation of the Project, in addition to other cumulative refinery projects and other non-refinery cumulative development, would not result in any known cumulative impacts to energy.

2.17.4.3.5 DEIR Subsection 5.4.3.5, Geology and Soils

The San Francisco Bay Area is within a seismically active region with a wide range of geologic and soil conditions. Impacts associated with geology and soils tend to be limited to individual project sites and the areas immediately adjacent. Projects from the cumulative projects table relevant to the cumulative analysis relating to geology and soils (Table 5-1) include the Valero Improvement Project, ~~and~~ those projects immediately adjacent to the Project site, as well other crude by rail projects using the railroad system between the Refinery and the Project-related crude oil's points of origin. The combination of the Project and ~~these~~ projects on site, ~~and~~ those projects immediately adjacent to the Refinery, and other crude by rail projects constitutes the list of cumulative projects for Geology and Soils.

The Project, combined with the above-referenced cumulative projects, would not result in an increased population in an area subject to seismic risks and hazards. Additionally, any new project, including the Project, would be required to meet building code requirements that address the various seismic and geologic hazards present in the Bay Area region, which would reduce cumulative impacts related to geology, soils, and seismicity immediately adjacent to the Refinery. Development projects are required to meet the most recent geologic and seismic standards.

Generally, compliance with applicable building and other codes, as would be required for all present and future cumulative projects, would reduce the potential for cumulative impacts immediately adjacent to the Refinery.

Construction and operation of the various Project components, combined with past, present, and other foreseeable improvements within the Refinery property and development in the area, would adhere to current building code and other regulatory requirements and would not therefore result in a cumulatively significant impact related to exposing people or structures to risk related to geologic hazards, soils, and/or seismic conditions. No mitigation is required.

As noted in Revised DEIR Section 2.12, a seismic event along the railroad system between the Refinery and the Project-related crude oil's points of origin could expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death. While non-Project crude oil trains would use some of the same routes as the Project trains, the likelihood that two or more trains would be in the same area during a seismic event is remote. Therefore, because adverse effects to people or structures is unlikely to occur during cumulative conditions, the cumulative impact would be less than significant.

2.17.4.3.6 DEIR Subsection 5.4.3.6, Greenhouse Gas Emissions

Both the BAAQMD and the California Air Pollution Control Officers Association (CAPCOA) consider greenhouse gas (GHG) emissions impacts to be exclusively cumulative impacts (BAAQMD, 2012; CAPCOA, 2008); as such, assessment of significance is based on a determination of whether the GHG emissions from a project represent a cumulatively considerable contribution to the global atmosphere. The Project would result in a net increase of ~~6,726~~ 13,609 metric tons carbon dioxide equivalents (CO_2e) per year within the State of California (see Section 4.6.5). Therefore, when compared to the City's significance threshold of 10,000 metric tons CO_2e, the Project's contribution to GHG impacts would ~~not~~ be cumulatively considerable, and there would ~~not~~ be a significant cumulative impact associated with the Project.

2.17.4.3.7 DEIR Subsection 5.4.3.7, Hazards and Hazardous Materials

As discussed in Section 4.7.6, routine operations of the Project, potential upsets, or accidents during transport of crude by rail would not result in any significant impacts associated with hazards or hazardous materials due to regulatory measures and the low probability of potential accidents (see Section 4.7, *Hazards and Hazardous Materials*, for additional information). For the Project to make a cumulatively considerable contribution to the impact of hazards, two or more events (from the Project and another cumulative project) would have to occur at the same time and affect the same places. ~~The likelihood of such a cumulative accident event would be even smaller than the estimated low probability of a Project-related accident and spill. The impact of such a cumulative event would be less-than-significant.~~ A number of other crude by rail projects have been proposed or undertaken within California. There is the potential for cumulative impacts associated with other crude by rail projects that would use some of the same UPRR mainline routes as the Project. Using the QRA conducted for the Project, cumulative risk profiles were developed for the three mainline routes to the State border that could be used by the

Project. The QRA assumed that all the cumulative projects would use the same tank car design and transport similar crude oil as the Project. Figures 5-1 through 5-3 show the cumulative risk profiles for the proposed tank cars, as well as the DOT-117 and DOT-117R tank car designs. Because maximum risks from proposed transport of crude oil are above the significant risk threshold (dashed green line), impacts would be considered cumulatively significant. As shown in these figures, while the updated tank car designs reduce the overall risk, the impact would remain significant.

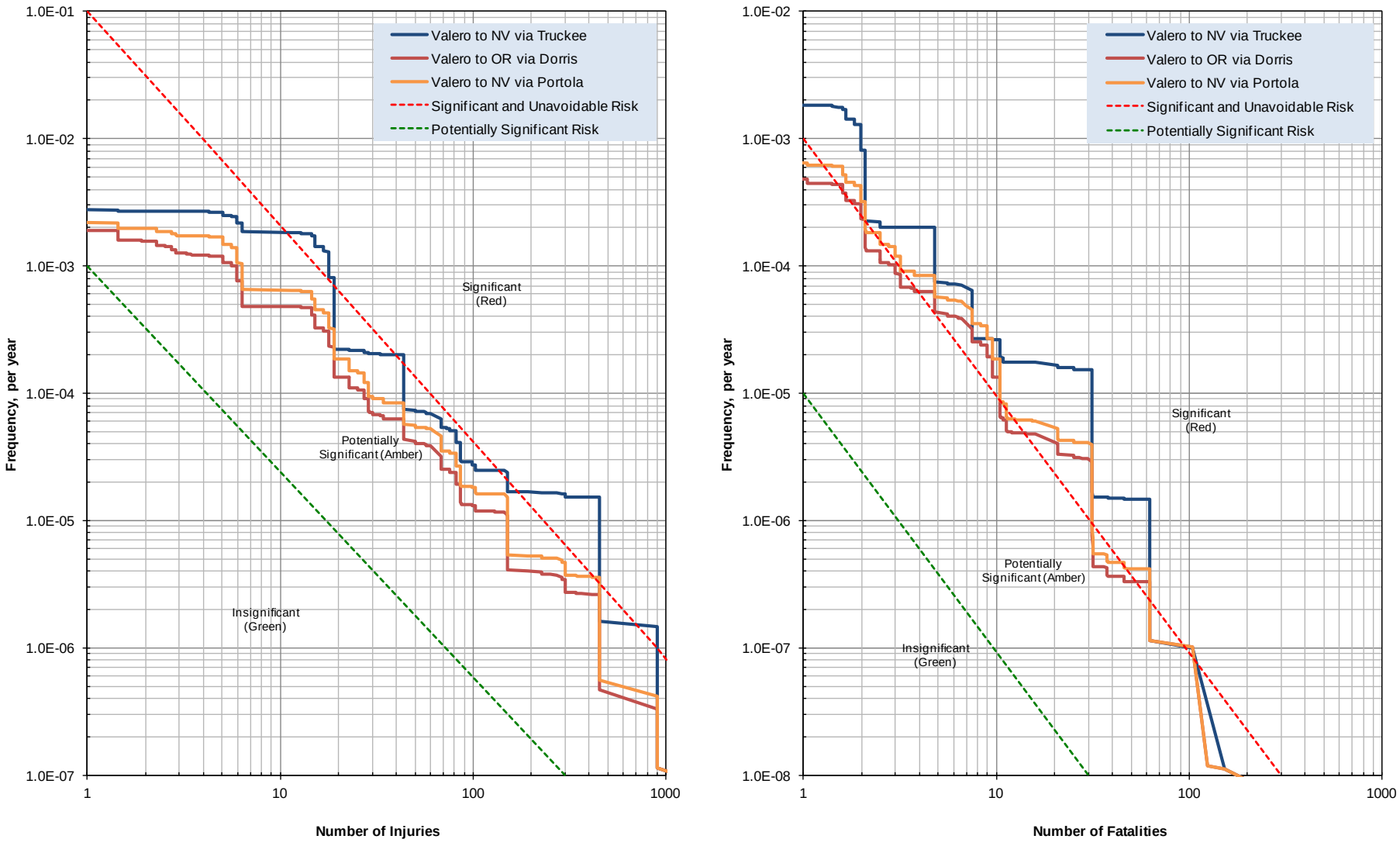
See also Section 5.4.3.1, *Air Quality*, above for additional discussion of cumulative health risk.

2.17.4.3.8 DEIR Subsection 5.4.3.8, Hydrology and Water Quality

The geographic area for the analysis of cumulative hydrology and water quality and water quality impacts is the Lake Herman/Sulphur Springs Creek watershed, particularly the urbanized southern portion of the watershed in the vicinity of the Project, which drains into Suisun Bay, as well as surface water and groundwater resources traversed by the railroad system between the Refinery and the Project-related crude oil's points of origin. The cumulative analysis considers the relevant past, present, and probable future projects listed in Table 5-1 with regards to the cumulative geographic area.

Several other recent, current, and foreseeable future projects are located within the Refinery site, in the urbanized portion of the watershed, and along the margin of Suisun Bay and Carquinez Straits. The watershed in the vicinity of the Project outside of Refinery property has been urbanized and no longer reflects historic conditions in terms of stormwater quality, volume, and drainage. The majority of the surfaces within the Refinery, including most locations affected by the Project, are covered with impervious surfaces and as a result, stormwater runoff is generally rapid and surface infiltration rates are very low. Stormwater flows in the portion of the watershed adjacent to the Project are generated as runoff from paved surfaces and drain down gradient into stormwater conveyance systems and can contain pollutants typical of urbanized watersheds. Sulphur Springs Creek in the vicinity of the Project has been channelized to provide flood protection and convey stormflows to Suisun Bay.

Concurrent construction of the Project and other projects in the cumulative geographic area surrounding the Refinery could result in increased erosion of exposed soils during land disturbing activities and subsequent sedimentation, which could have a cumulative effect on the water quality of receiving waters. Also, any inadvertent release of fuels or other hazardous materials during concurrent construction of projects could affect the water quality in the stream channels or storm drains that eventually flow into Suisun Bay and Carquinez Straits. As described under Impact 4.8-1 in Section 4.8.5, the applicant would minimize Project impacts relating to construction water quality by complying with the Valero SWPPP (RWQCB, 2013) for the Refinery property, applicable water quality regulations, and implementing a stormwater management plan employing best management practices (BMPs), and practicing control measures to manage and reduce erosion, stormwater runoff, and sedimentation downstream (Mitigation Measure 4.8-1). Adherence to these requirements would reduce potential cumulative impacts associated with stormwater runoff and water quality associated with construction of the Project.

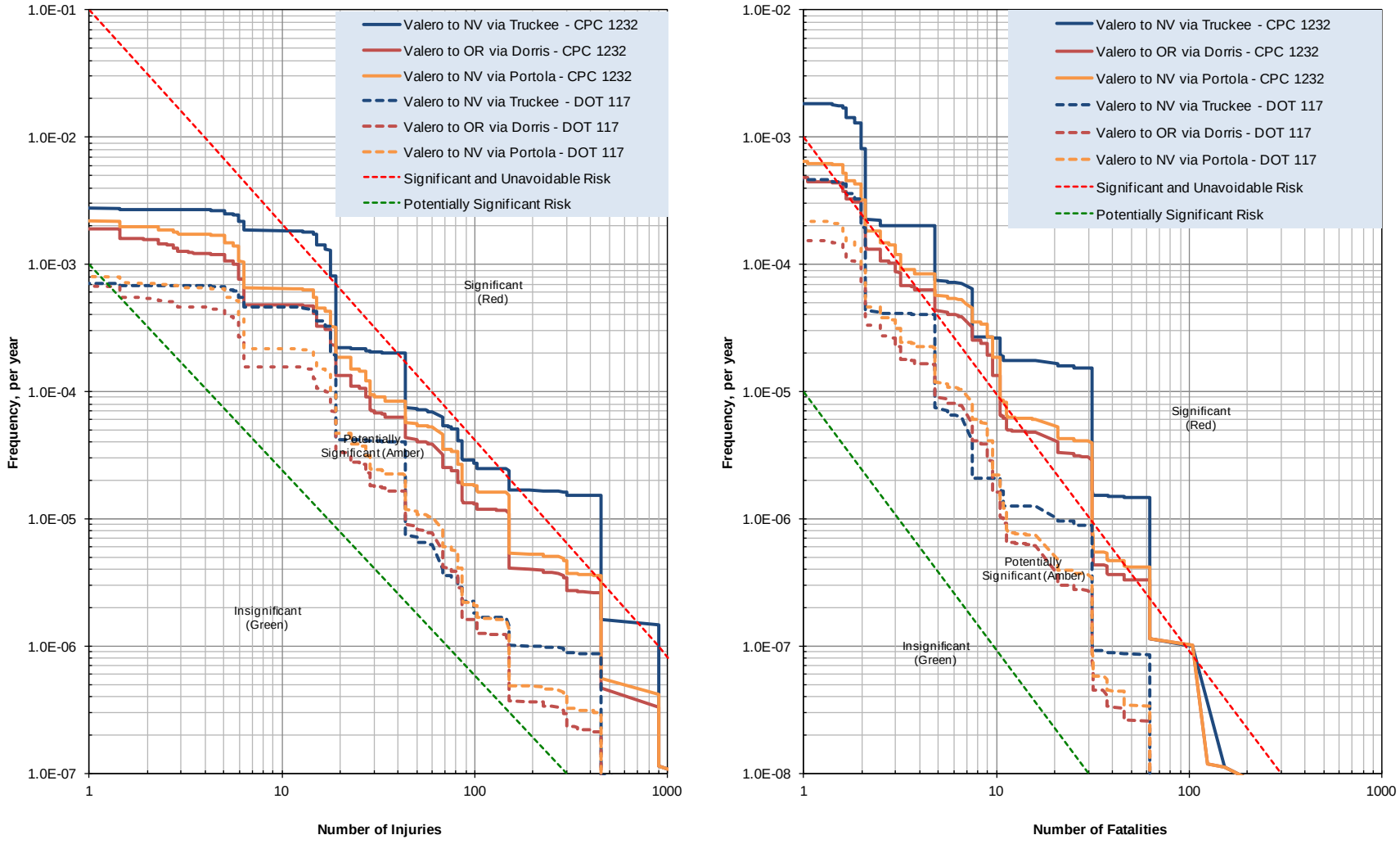


SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 5-1

Cumulative Mainline Crude Oil Unit Train Transportation Risk – CPC-1232 Tank Cars to the California Border

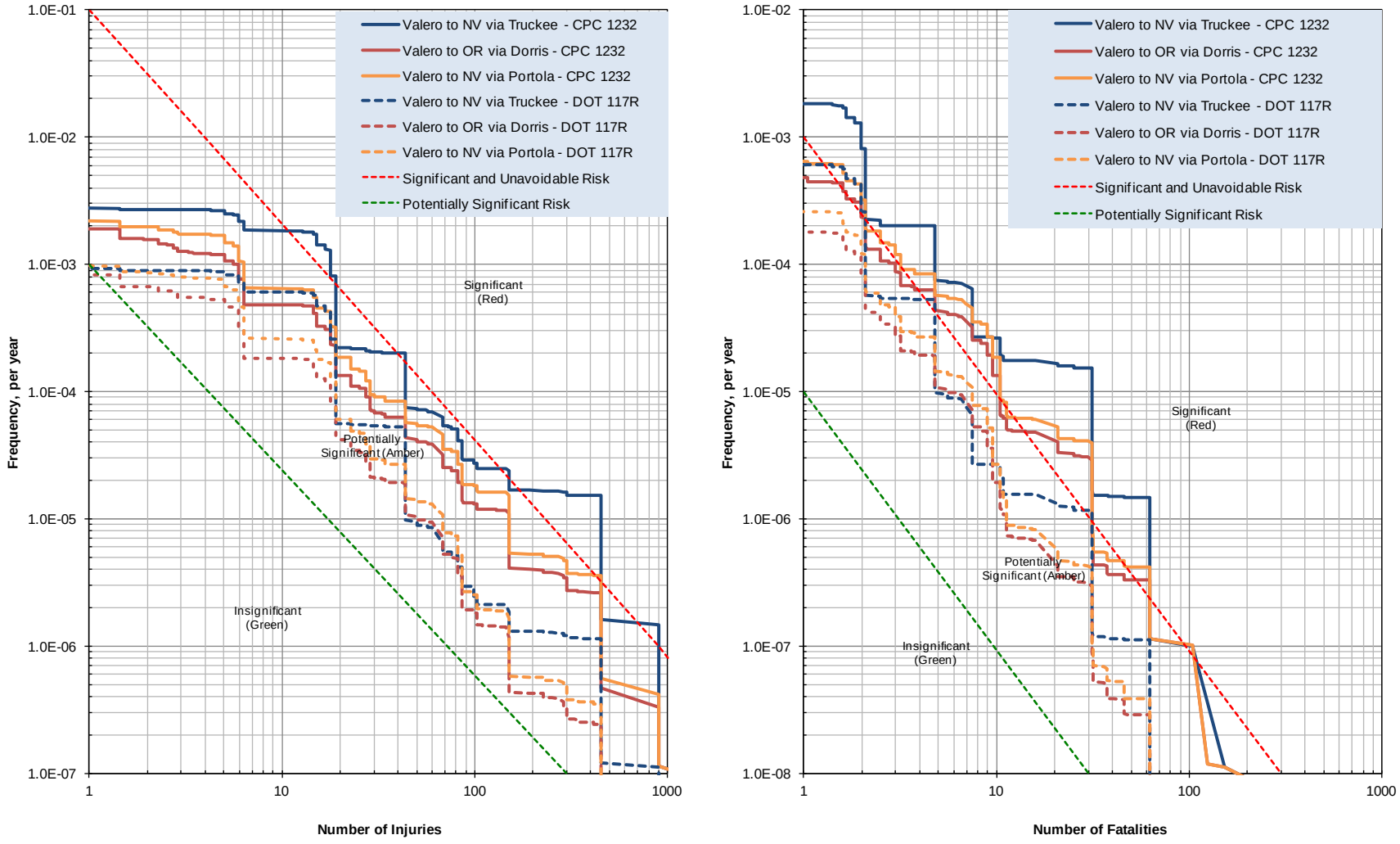


SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 5-2

Cumulative Mainline Crude Oil Unit Train Transportation Risk – DOT-117 Tank Cars to the California Border



SOURCE: MRS, 2015

Benicia Valero CBR . 202115.01

Figure 5-3

Cumulative Mainline Crude Oil Unit Train Transportation Risk – DOT-117R Tank Cars to the California Border

Operation of the Project would not represent a substantial land use change within the watershed compared to current conditions at the site and in the surrounding area. The Project site is currently paved with impervious surfaces and storm runoff generated at the Project site would be similar to the existing runoff on-site. Stormwater runoff would continue to be managed as required by the Refinery NPDES Permit. The stormwater outfalls are permitted under the Refinery NPDES permit, which sets stormwater outfall discharge limits. The NPDES discharge requirements, established by the RWQCB, are themselves measures based on consideration of cumulative effect. The Project in combination with other projects at neighboring refineries and the non-refinery projects in the geographic area for the analysis of cumulative impacts have effluent discharges that contribute pollutants to Suisun Bay and the Carquinez Straits. Although other projects listed in Table 5-1 that are located along the waterfront could also involve similar activities that could affect water quality in Suisun Bay or Carquinez Straits, the Project's contribution to this cumulative impact would not be cumulatively considerable with compliance with existing regulations.

As noted in Revised DEIR Section 2.12, an oil spill along mainline tracks could result in a significant impact to water resources and water quality, depending upon the location of the spill. While non-Project crude oil trains would use some of the same routes as the Project trains, the likelihood that two or more trains would derail and spill crude oil into the same water body is remote. Therefore, because a spill would be unlikely to occur during cumulative conditions, the cumulative impact would be less than significant.

The Project would not result in adverse effects related to stormwater drainage and erosion, flooding, tsunami inundation, and would therefore not contribute to cumulative impacts related to these topics. Given the measures taken to reduce and avoid hydrologic and water quality impacts related to construction and operation of the Project, the Project would not be expected to make a considerable contribution toward any cumulative water quality or hydrology related impacts and there would be no cumulative impact associated with the Project. No mitigation is required.

2.17.4.3.9 DEIR Subsection 5.4.3.9, Land Use and Planning

The construction and operation of the Project, in addition to other Refinery projects and other non-refinery development, would not result in cumulative impacts to land use. Development and its cumulative effects are considered in the *City of Benicia General Plan* (1999). As discussed in Impact 4.9-1, the Project would be consistent with the adopted General Plan and its applicable land use designations and policies adopted for the purpose of avoiding or mitigating environmental effects. The Project would not contribute to cumulative land use changes in the City of Benicia (or anywhere along the railroad system between the Refinery and the Project-related crude oil's points of origin) because the Project would not result in any change to existing land use or conflict with adopted plans at the Project site, ~~or~~ surrounding area, or elsewhere.

Cumulative impacts related to conflicts with BAAQMD and RWQCB regional plans for air quality and water quality are analyzed in Sections 5.4.3.1 and 5.4.3.8, respectively, above. The Project's contribution to those impacts would not be cumulatively considerable. No mitigation is required.

2.17.4.3.10 DEIR Subsection 5.4.3.10, Noise

As described above, the VIP was completed in 2011 except for construction and operation of a replacement hydrogen plant. However, the Refinery has sufficient hydrogen now to process the wide range of crudes that it now uses and Valero is in the process of determining whether or not to implement this approved project. If implemented, this hydrogen plant could result in noise levels that could combine with those of the Project to result in a cumulative noise impact. According to the Draft EIR for the VIP, noise producing equipment that would be associated with the alkylation unit modifications and the selective hydrogeneration facilities would produce steady equipment noise levels of less than 30 dBA at the nearest residential receptors (City of Benicia, 2002). When combined with the loudest noise levels that would be associated with the Project (train horn soundings), the hourly L_{eq} associated with the hydrogen plant would not incrementally add to the train horn hourly L_{eq} of approximately 40 dBA, and would not exceed the City's nighttime hourly L_{eq} limit of 50 dBA. The existing average hourly L_{eq} noise levels for day, evening, and nighttime hours at the nearest residences to the Project site range between 51 dBA and 56 dBA, so the combined noise levels should not contribute to an adverse cumulative impact.

Other cumulative projects at the Refinery, including the Maintenance Dredging at Valero Refinery Crude Dock project, and the Refinery NPDES Permit Reissuance project are ongoing and part of the baseline for the Project. The other cumulative projects listed in Table 5-1 would occur more than a mile away from the Refinery and would not be a concern for cumulative noise impacts. There are no other approved or Projects at the Refinery or in the vicinity of the Refinery that would lead to cumulative noise impacts along with the Project.

Therefore, the Project's less-than-significant individual noise impacts would not be cumulatively considerable, and would result in a less-than-significant cumulative impact.

<u>For uprail impacts, the Project would have no impact regarding exceeding noise standards of uprail communities or generation of ground borne vibration or ground borne noise; therefore, the Project would not contribute to these potential cumulative impacts. The Project's incremental additional noise generated along mainline rail routes would be similar to baseline conditions. Thus, the Project's contribution of one or two trains per day to cumulative ambient noise impacts would not be considered significant.</u>

2.17.4.3.11 DEIR Subsection 5.4.3.11, Transportation and Traffic

A 1.5 percent per year growth rate was applied to existing traffic volumes, which is similar to the 1.6 percent per year rate used in the *Benicia Business Park EIR* for the period between 2006 and 2030. It is noted that according to 2006 and 2013 count data collected at the intersection of Park Road / Bayshore Road, traffic volumes have not increased during the seven-year period, potentially due to the recent economic downturn.

Under cumulative volume conditions, vehicle queues associated with the 50-railcar crossing again would extend back onto the northbound I-680 off-ramp, but not onto the I-680 mainline. Queues also would extend back to the Park Road / Refinery Driveway, but would not reach Industrial

Way. Traffic volumes in the evenings and late nights are much lower within the study area compared to the peak traffic periods. During the 9:00 – 10:00 PM hour, the resulting queues during a train crossing would be no longer than five vehicles. Although the proposed 50-railcar train crossing would block Park Road for over 8 minutes, the resulting queues would be contained within the provided intersection storage capacity at Park Road / Bayshore Road during the 9:00 – 10:00 PM hour. The 9:00-10:00 PM hour was used in this analysis to represent the off-peak period of 7:00 PM-6:00 AM as stated in the traffic analysis for the DEIR. If the proposed train crossings occur during the 7:00 PM – 6:00 AM period, resulting queues on the west side and east side of the tracks would not exceed the provided storage capacity, and would not extend back and affect the operations of other study intersections.

Project train crossings occurring during the 9:00 AM – 7:00 PM period would generate queues on the west side of the tracks that would extend back onto Bayshore Road and affect the operations of the I-680 ramp-terminal intersections, but would not extend back onto the I-680 mainline. Queues on the east side of the tracks would generally be contained within the Park Road segment between the tracks and Industrial Way, affecting access to and from Refinery driveways and the U-Store-It driveway. The segment of Park Road between the at-grade railroad crossing and Industrial Way provides a two-way left-turn lane (TWLTL), and because the great majority of westbound traffic approaching Bayshore Road on Park Road turns left, those drivers would be expected to use the TWLTL as a queue storage lane, and other westbound drivers would use the through lane as a means to turn right into the Refinery (or as a queue storage lane if they intend to go straight on Park Road or to turn right onto Bayshore Road).

~~If the proposed train crossings occur during the 7:00 PM – 6:00 AM period, resulting queues on the west side and east side of the tracks would not exceed the provided storage capacity, and would not extend back and affect the operations of other study intersections.~~

The change in average vehicle delay at the Park Road crossing associated with the 8.3-minute duration when the Project's trains could block traffic at that crossing would increase the average vehicle delay in an hour by about 0.8 second, which is less than the one-second threshold of significance when the train crossing currently operates at LOS F. The Project impacts would be less than cumulatively significant.

Other crude by rail projects listed in Table 5-1 could travel on the same UPRR routes used by the Project within California, and beyond. Two of these projects, Alon Bakersfield and Plains All American, would use tracks leading south from Sacramento so they would not combine with Project trains between the Refinery and Sacramento. In addition, these two projects, as well as some of the other crude by rail projects, would use BNSF tracks for portions of their trips, thus they would not combine with the Project to affect passenger train performance when traveling on non-UPRR tracks. The additional crude by rail trains listed in Table 5-1 are not anticipated to substantially reduce the on-time performance of passenger trains on these routes. Therefore, the Project's less-than-significant impact would not be cumulatively considerable, and the impact would be less than significant.

2.18 DEIR Chapter 6, Analysis of Alternatives

DEIR Chapter 6 (p. 6-1 et seq.), Analysis of Alternatives, explains the CEQA context for the EIR's analysis of alternatives in Section 6.1, General Considerations (DEIR p. 6-1 et seq.); identifies the potentially significant impacts of the Project in Section 6.2 (DEIR p. 6-4); describes potential alternatives that were considered but dismissed from further consideration in Section 6.3 (DEIR p. 6-4 et seq.) and, in Section 6.4 (DEIR p. 6-6 et seq.), describes the potential alternatives that were carried forward for detailed analysis. DEIR Section 6.2 (DEIR p. 6-4) and 6.4.2.1 (DEIR p.6-7 et seq.) are being revised to reflect the impact conclusions reached in this Revised DEIR. No other changes to DEIR Chapter 6 are proposed.

2.18.1 DEIR Section 6.2, Potentially Significant Impacts of the Project

As explained above, CEQA requires the lead agency to identify and evaluate a reasonable range of alternatives that could avoid or substantially lessen any of the significant adverse environmental impacts of the Project. This EIR evaluates the potential impacts of implementing the Project. As discussed in detail in DEIR Chapters 4 and 5 and this Revised DEIR, after the implementation of the mitigation measures proposed in this EIR, there would still remain ~~a~~ significant and unavoidable impacts to the following resources: [¶]

- Air Quality (see Impacts 4.1-1, 4.1-1b, ~~and~~ 4.1-2, 4.1-5, and 4.1-7) from indirect NO_x emissions along the Union Pacific Railroad mainline.
- Biological Resources (see Impact 4.2-10) from adverse effects on candidate, sensitive, or special-status wildlife species resulting from collisions with trains.
- Greenhouse Gas Emissions (See Impacts 4.6-1 and 4.6-2) from generation of GHG.
- Hazards and Hazardous Materials (see Impacts 4.7-2, 4.7-6, and 4.7-9) from adverse effects resulting from upset of tank cars during accident conditions. [¶]

All other environmental impacts associated with the Project were determined to be insignificant.

2.18.2 DEIR Section 6.4.2.1, Alternative 1 – Limiting Project to One 50-Car Train Delivery per Day

Under this alternative, the Project would operate with a 50% reduction in the proposed number of train deliveries to the Refinery per day.[28] Deliveries would be limited to a maximum of one 50-car train each day, containing a daily total of 35,000 barrels. This single train would be delivered during nighttime hours (between 8:00 p.m. and 6:00 a.m.) and once emptied, would depart the Refinery during nighttime hours and be returned to its origination point. All other aspects of this alternative would be the same as the Project.

[28] The Refinery has limited space in proximity to the proposed unloading rack. Therefore, it is capable of accepting delivery of only 50 railcars at a time.

Analysis

Alternative 1 would have essentially the same impacts as the Project except in the areas of air quality and climate change. Alternative 1 would reduce the emission of criteria pollutants, toxic air emissions, and greenhouse gases from trains as compared with the Project. At the same time, however, Alternative 1 would result in smaller reductions in the same pollutants from marine vessels. Overall, Alternative 1 would result in greater emissions of criteria pollutants, toxic air emissions, and greenhouse gases.

As with the Project, under Alternative 1 locomotive emissions would have a significant NO_x impact within the Yolo-Solano Air Quality Management District (AQMD), Tehama County APCD, Butte County AQMD, Siskiyou County APCD, Shasta County AQMD, Lassen County APCD, Northern Sierra AQMD, Feather River AQMD, and Placer County APCD. Alternative 1, however, would avoid the Project's significant NO_x impact in the Sacramento Metro AQMD.

Significant impacts to biological resources and hazards and hazardous materials (including secondary effects) would be reduced compared to the Project because 50% fewer trains would deliver crude oil to the Refinery. This would reduce the probability that derailment of a Project-related train could occur. However, the potential adverse effects resulting from a subsequent spill and/or fire would remain significant. By eliminating two rail crossings per day, Alternative 1 would reduce local traffic impacts.

Alternative 1 would not allow Valero to fully achieve the primary Project objectives 1 and 2, which includes receiving as much as 70,000 barrels of North American crude oil by rail and achieving reductions in maritime deliveries and emissions (see Section 6.1.2, above), but would still fulfill Project objectives 3 through 5.

As explained in Section 3.7, Union Pacific has taken the position that any limitation on the volume of product it ships or the frequency, route, or configuration of such shipments is clearly preempted by federal law (See Appendix L). Thus, Alternative 1 may be legally infeasible.

2.19 DEIR Chapter 7, Report Preparation

DEIR Chapter 7 (pp. 7-1, 7-2), Report Preparation, identifies Lead Agency authors of the DEIR in Section 7.1.1, consultant and subconsultant authors of the DEIR in Section 7.1.2, and the agencies and organizations contacted in Section 7.2. Section 7.1.2 is supplemented as noted below. No other changes to DEIR Chapter 7 are proposed.

2.19.1 DEIR Section 7.1.2, Consultants

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Matt Fagundes	Air Quality; Greenhouse Gas Emissions; Noise
Tim Rimpo	Air Quality; Greenhouse Gas Emissions
Chris Sanchez	Noise
Jack Hutchison	Transportation and Traffic
Pete Hudson and Justin Taplin	Geology and Soils; Hydrology and Water Quality
Julie Remp and Natasha Dvorak	Biological Resources
Heidi Koenig	Cultural Resources
Kristina Tierney	Air Quality; Greenhouse Gas Emissions; Noise
Michelle Williams	Cumulative Impacts

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Project Description

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Hazards and Hazardous Materials; Air Quality

2.20 DEIR Chapter 8, Glossary and Acronyms

DEIR Chapter 8 (p. 8-1 et seq.), Glossary and Acronyms, defines technical terms in Section 8.1 (DEIR p. 8-1 et seq.) and relevant acronyms and abbreviations in Section 8.2 (DEIR p. 8-5 et seq.). No changes to DEIR Chapter 8 are proposed.

2.21 DEIR Chapter 9, References

DEIR Chapter 9 (p. 9-1 et seq.), References, identifies on a section-by-section basis the scientific studies and other source materials relied upon in drafting the DEIR. DEIR Chapter 9 is being supplemented to include the materials identified below, which are relied upon in this Revised DEIR. No other changes to DEIR Chapter 9 are proposed.

2.21.1 DEIR Executive Summary

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2.21.2 DEIR Chapter 1, Introduction

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2.21.3 DEIR Chapter 2, Summary of Environmental Impacts

U.S. Energy Information Administration, 2015a. Rankings: Crude Oil Production, January 2015 (thousand barrels) [http://www.eia.gov/state/rankings/#/series/46] March 30. Accessed April 22.

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2.21.4 DEIR Chapter 3, Project Description

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2.21.5 DEIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures

2.21.5.1 DEIR Section 4.0, Approach to the Analysis of Impacts

Caltrans, 2013a. *Final 2013 California State Rail Plan*. May.

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2.21.5.2 DEIR Section 4.1, Air Quality

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ERM, 2015a. Updated Methodology for Assessment of Health Risk and PM2.5 Concentrations at the Refinery and at Receptors near Locomotive Tracks in Fairfield, CA (11 June 2014) Amended 15 June 2015. June 15, 2015 Memorandum from Cheri Velzy, ERM to Lynn McGuire, ERM. (Revised DEIR Appendix B)

ERM, 2015b. Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations between Roseville, California and the Oregon and Nevada Borders. June

22, 2015 Memorandum from Cheri Velzy, ERM to Lynn McGuire, ERM. (Revised DEIR Appendix C)

ERM, 2015c. Qualitative Assessment of Cumulative Contribution of Health Impacts near Rail Lines in Auburn, Chico, Marysville, Redding, and Truckee, California. (Revised DEIR Appendix D)

2.21.5.3 DEIR Section 4.2, Biological Resources

DEIR Section 4.2, Biological Resources, is not supplemented in this Revised DEIR. Sensitive Biological Resources within 300 Feet of Rail Routes is included as Revised DEIR Appendix E.

2.21.5.4 DEIR Section 4.3, Cultural Resources

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APPENDIX A

Air Quality and GHG Emissions Supplement

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A.1 Emission Factors

Locomotive Exhaust

Emissions within other Air Districts	Roundtrip Distance (miles)	Emissions (lbs/day)					
		ROG	NOx	CO	Sox	PM10	PM2.5
Locomotives - large line haul in Yolo-Solano AQMD	64	8.13	170.72	33.63	0.12	4.55	4.42
Locomotives - large line haul in Sacramento Metro AQMD	31	3.94	82.69	16.29	0.06	2.2	2.14

Emissions within other Air Districts	Roundtrip Distance (miles)	Emission Factor (lbs/(mile-day))					
		ROG	NOx	CO	Sox	PM10	PM2.5
Locomotives - large line haul in Yolo-Solano AQMD	64	0.127	2.668	0.525	0.002	0.071	0.069
Locomotives - large line haul in Sacramento Metro AQMD	31	0.127	2.667	0.525	0.002	0.071	0.069

Source: Pounds/day emissions are from Benica Valero CBR Draft EIR, Appendix E.5

Fugitive ROG Emissions from Railcars (see VALERO's FUGITIVE EMISSION ESTIMATES SHEET)

Railcar Evaporative Emissions	One-way Distance (miles)	(lbs/day)*	lbs/ (mile - day)
VOC emissions - YSAQMD	32	0.152	0.0048
VOC emissions - SMAQMD	15.5	0.073	0.0047
VOC emissions - PCAPCD	84.5	0.4	0.0047
VOC emissions - SFNA	132	0.623	0.0047
			0.0047

A.2 Criteria Pollutant Locomotive Exhaust and Rail Car Fugitive ROG Emission Estimates

Placerville Rail Yard Emissions

Source	ROG	NOx	CO	SOx	PM10	PM2.5
Locomotives (lbs/day)	3.38	57.91	8.34	0.03	1.34	1.33

Source: Benica Valero CBR EIR, 2014

Oregon to Roseville Alternative

District	Round Trip Distance (miles)	Emissions (lbs/day)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Siskiyou County APCD	178	23.5	474.8	93.5	0.3	12.7	12.3
Shasta County AQMD	156	20.6	416.1	82.0	0.3	11.1	10.8
Tehama County APCD	80	10.5	213.4	42.0	0.2	5.7	5.5
Butte County AQMD	88	11.6	234.7	46.2	0.2	6.3	6.1
Feather River AQMD	52	6.9	138.7	27.3	0.1	3.7	3.6
Placer County APCD	40	5.3	106.7	21.0	0.1	2.8	2.8
Sacramento Metro AQMD	31	4.1	82.7	16.3	0.1	2.2	2.1
Total	594						

District	Round Trip Distance (miles)	Emissions (lbs/day)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Siskiyou County APCD	178	23.5	474.8	93.5	0.3	12.7	12.3
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Shasta County AQMD	156	20.6	416.1	82.0	0.3	11.1	10.8
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Tehama County APCD	80	10.5	213.4	42.0	0.2	5.7	5.5
Threshold of Significance		25	25	-	-	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Butte County AQMD	88	11.6	234.7	46.2	0.2	6.3	6.1
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Feather River AQMD	52	6.9	138.7	27.3	0.1	3.7	3.6
Threshold of Significance		25	25	-	-	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Placer County APCD	40	8.7	164.6	29.4	0.1	4.2	4.1
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No
Sacramento Metro AQMD	31	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No

Navada to Roseville (Feather River Canyon) Alternative

District	Round Trip Distance (miles)	Emissions (lbs/year)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Butte County AQMD	106	14.0	282.8	55.7	0.2	7.5	7.3
Feather River AQMD	50	6.6	133.4	26.3	0.1	3.6	3.5
Placer County APCD	40	5.3	106.7	21.0	0.1	2.8	2.8
Sacramento Metro AQMD	31	4.1	82.7	16.3	0.1	2.2	2.1
Lassen County APCD	72	9.5	192.1	37.8	0.1	5.1	5.0
Northern Sierra AQMD	190	25.0	506.8	99.8	0.4	13.5	13.1
	458						

District	Round Trip Distance (miles)	Emissions (lbs/day)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Butte County AQMD	106	14.0	282.8	55.7	0.2	7.5	7.3
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Feather River AQMD	50	6.6	133.4	26.3	0.1	3.6	3.5
Threshold of Significance		25	25	-	-	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Placer County APCD	40	8.7	164.6	29.4	0.1	4.2	4.1
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No
Sacramento Metro AQMD	31	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No
Lassen County APCD	72	9.5	192.1	37.8	0.1	5.1	5.0
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Northern Sierra AQMD	190	25.0	506.8	99.8	0.4	13.5	13.1
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No

Navada to Roseville (Truckee) Alternative

District	Round Trip Distance (miles)	Emissions (lbs/year)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Placer County APCD	176	23.19	469.48	92.48	0.33	12.51	12.16
Northern Sierra County AQMD	62	8.17	165.39	32.58	0.12	4.41	4.28
Sacramento Metro AQMD	31	4.08	82.69	16.29	0.06	2.20	2.14
	238						

District	Round Trip Distance (miles)	Emissions (lbs/day)					
		ROG	NOx	CO	SOx	PM10	PM2.5
Placer County APCD	176	26.6	527.4	100.8	0.4	13.9	13.5
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No
Northern Sierra AQMD	62	8.2	165.4	32.6	0.1	4.4	4.3
Threshold of Significance		25	25	500	80	80	-
Exceed Threshold?		No	Yes	No	No	No	No
Sacramento Metro AQMD	31	4.1	82.7	16.3	0.1	2.2	2.1
Threshold of Significance		82	82	-	-	82	-
Exceed Threshold?		No	Yes	No	No	No	No

A.3 GHG Emissions Estimate

Sources	Worst Case California CO_2e Emissions (metric tons/year)[a]	Average (of all three routes) California CO_2e Emissions (metric tons/year)[b]
Trains - Long Line Haul from California State Line to Roseville	20,041	14,508
Trains - Long Line Haul from Roseville to Refinery	4,589	4,589
Trains - Short Line Haul to Refinery	135	135
Trains - Switching at Refinery	351	351
Electricity Consumption[b]	180	180
Amortized Construction Emissions	20	20
Total Project Emissions	**25,316**	**19,783**
Marine Vessel Emissions Displaced (Baseline)	-11,707	-11,707
Total Net Emissions	**13,609**	**8,076**
Significance Threshold	10,000	10,000
Significant Impact?	Yes	No

[a] Train emissions from the state line to Roseville were estimated by ESA based on ERM, 2013b. The estimates assume all train travel on the longest route (California/Oregon border) to the Roseville Rail Yard, a round-trip distance of 594 miles per day.

[b] Train emissions from the state line to Roseville were estimated by ESA based on ERM, 2013b. The estimates assume the average round trip travel distance for all three routes from California border to the Roseville Railyard, a round-trip distance of 430 miles per day.

Sources	Worst case	Average	north	south
Average CO2e for Long Line Haul from State Line to Roseville (round trip miles; from Valero DEIR, Appendix E-5)	390	390		
CO2e (metric tons per year), Valero DEIR, Appendix E-5	13158.45	13158.45		
CO2e (metric tons per mile)	0.09	0.09	0.09	0.09
Long Line Haul Distance from CA state line to Roseville (round trip miles)	594	430	458	238
CO2e (metric tons per year) for Worst Case Line Haul	20041.33	14508.03	15452.74	8030.03

Sources	CO2e (metric tons/year)
North	15,453
Trains - Long Line Haul from Roseville to Refinery	4,589
Trains - Short Line Haul to Refinery	135
Trains - Switching at Refinery	351
Electricity Consumption[b]	180
Amortized Construction Emissions	20
Total Project Emissions	**20,728**
Marine Vessel Emissions Displaced (Baseline)	-11,707
Total Net Emissions	**9,021**
Significance Threshold	10,000
Significant Impact?	No

South	8,030
Trains - Long Line Haul from Roseville to Refinery	4,589
Trains - Short Line Haul to Refinery	135
Trains - Switching at Refinery	351
Electricity Consumption[b]	180
Amortized Construction Emissions	20
Total Project Emissions	**13,305**
Marine Vessel Emissions Displaced (Baseline)	-11,707
Total Net Emissions	**1,598**
Significance Threshold	10,000
Significant Impact?	No

A.4 Rail Mileage for Uprail Routes

Air District	Miles from Oregon Border to Roseville Yard	Miles from Nevada Border to Roseville Yard (Feather River Canyon)	Miles from Nevada Border to Roseville Yard (Truckee)
Siskiyou County APCD	89	N/A	N/A
Shasta County AQMD	78	N/A	N/A
Tehama County APCD	40	N/A	N/A
Butte County AQMD	44	53	N/A
Feather River AQMD	26	25	N/A
Placer County APCD*	20	20	87
Lassen County APCD	N/A	36	N/A
Northern Sierra County AQMD	N/A	95	31
Total Distance (miles)	297	229	118
Round Trips	594	458	236

Average 429

A.5 Mitigated Uprail NOx Emissions

(Assumes a mitigation reduction rate of 76 percent for Tier 4 locomotives and 20 percent for switching locomotives compared to unmitigated emissions, per CARB, 2009)

California Air Resources Board (CARB), 2009. *Technical Options to Achieve Additional Emissions and Risk Reductions from California Locomotives and Railyards* . August.

Oregon to Roseville Alternative

District/Threshold	NOx
Siskiyou County APCD	114
Threshold of Significance	25
Exceed Threshold?	Yes
Shasta County AQMD	100
Threshold of Significance	25
Exceed Threshold?	Yes
Tehama County APCD	51
Threshold of Significance	25
Exceed Threshold?	Yes
Butte County AQMD	56
Threshold of Significance	25
Exceed Threshold?	Yes
Feather River AQMD	33
Threshold of Significance	25
Exceed Threshold?	Yes
Placer County APCD	72
Threshold of Significance	82
Exceed Threshold?	No
Sacramento Metro AQMD	20
Threshold of Significance	82
Exceed Threshold?	No

Navada to Roseville (Feather River Canyon) Alternative

District/Threshold	NOx
Butte County AQMD	68
Threshold of Significance	25
Exceed Threshold?	Yes
Feather River AQMD	32
Threshold of Significance	25
Exceed Threshold?	Yes
Placer County APCD	72
Threshold of Significance	82
Exceed Threshold?	No
Sacramento Metro AQMD	20
Threshold of Significance	82
Exceed Threshold?	No
Lassen County APCD	46
Threshold of Significance	25
Exceed Threshold?	Yes
Northern Sierra AQMD	122
Threshold of Significance	25
Exceed Threshold?	Yes

Navada to Roseville (Truckee) Alternative

District/Threshold	NOx
Placer County APCD	159
Threshold of Significance	82
Exceed Threshold?	Yes
Northern Sierra AQMD	40
Threshold of Significance	25
Exceed Threshold?	Yes
Sacramento Metro AQMD	20
Threshold of Significance	82
Exceed Threshold?	No

A.6 Valero's Fugitive ROG Railcar Emissions

Modified by ESA on 6/30/2015 to include consistent and conservative equipment counts per railcar for empty and full rail cars; Valero's total VOC content equation shown for tons per year was C6*F6*G6*H6*(1-I6)/1000/1.10231, but was changed to: =C6*F6*G6*H6*(1-I6)/1000*1.10231.

Assuming EPA Average Marketing Terminal Factors (Table IV-1b)

Full Rail Cars

Yolo Solano AQMD	t Count Per	Average mph	Traveled (one	Traveling /Railcar/y	Rail Cars	Factor (kg/hr/so	Methane Content	content (tons/yr)	content (lbs/day)
Pressure Relief Valves (Gas)	2	35	32	333.7	100	0.00012	0	0.009	0.048
Valves (light liquid)	1	35	32	333.7	100	0.000043	0	0.002	0.009
Valves (gas)	3	35	32	333.7	100	0.000013	0	0.001	0.008
Connectors (gas)	9	35	32	333.7	100	0.000042	0	0.014	0.076
Connectors (light liquid)	2	35	32	333.7	100	0.000008	0	0.001	0.003
Total								**0.026**	**0.144**

Sacramento Metro District	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Total VOC content (tons/yr)	Total VOC content (lbs/day)
Pressure Relief Valves (Gas)	2	35	15.5	161.6	100	0.00012	0	0.004	0.023
Valves (light liquid)	1	35	15.5	161.6	100	0.000043	0	0.001	0.004
Valves (gas)	3	35	15.5	161.6	100	0.000013	0	0.001	0.004
Connectors (gas)	9	35	15.5	161.6	100	0.000042	0	0.007	0.037
Connectors (light liquid)	2	35	15.5	161.6	100	0.000008	0	0.000	0.002
Total								**0.0128**	**0.070**

Placer County APCD	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Total VOC content (tons/yr)	Total VOC content (lbs/day)
Pressure Relief Valves (Gas)	2	35	84.5	881.2	100	0.00012	0	0.023	0.128
Valves (light liquid)	1	35	84.5	881.2	100	0.000043	0	0.004	0.023
Valves (gas)	3	35	84.5	881.2	100	0.000013	0	0.004	0.021
Connectors (gas)	9	35	84.5	881.2	100	0.000042	0	0.037	0.201
Connectors (light liquid)	2	35	84.5	881.2	100	0.000008	0	0.002	0.009
Total								**0.0696**	**0.381**

SFNA	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Total VOC content (tons/yr)	Total VOC content (lbs/day)
Pressure Relief Valves (Gas)	2	35	132	1376.6	100	0.00012	0	0.036	0.200
Valves (light liquid)	1	35	132	1376.6	100	0.000043	0	0.007	0.036
Valves (gas)	3	35	132	1376.6	100	0.000013	0	0.006	0.032
Connectors (gas)	9	35	132	1376.6	100	0.000042	0	0.057	0.314
Connectors (light liquid)	2	35	132	1376.6	100	0.000008	0	0.002	0.013
Total								**0.1086**	**0.595**

* Emission Factors based from CAPCOA , 1999. CALIFORNIA IMPLEMENTATION GUIDELINES FOR ESTIMATING MASS EMISSIONS OF FUGITIVE HYDROCARBON LEAKS AT PETROLEUM FACILITIES http://www.arb.ca.gov/fugitive/impl_doc.pdf

** Travels one way with crude, then loads rail cars with air.

*** travel from the eastern border.

Assuming EPA Average Marketing Terminal Factors (Table IV-1b)

Yolo Solano AQMD	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Dilution factor	Total VOC content (tons/yr)	Total VOC content (lbs/day)	Total VOC content Full + Empty (lbs/day)
Pressure Relief Valves (Gas)	2	35	32	333.7	100	0.00012	0	5%	0.000	0.002	
Valves (light liquid)	1	35	32	333.7	100	0.000043	0	5%	0.000	0.000	
Valves (gas)	3	35	32	333.7	100	0.000013	0	5%	0.000	0.000	
Connectors (gas)	9	35	32	333.7	100	0.000042	0	5%	0.001	0.004	
Connectors (light liquid)	2	35	32	333.7	100	0.000008	0	5%	0.000	0.000	
Total									**0.001**	**0.007**	**0.007**

Sacramento Metro District	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Dilution factor	Total VOC content (tons/yr)	Total VOC content (lbs/day)	Total VOC content Full + Empty (lbs/day)
Pressure Relief Valves (Gas)	2	35	15.5	161.6	100	0.00012	0	5%	0.000	0.001	
Valves (light liquid)	1	35	15.5	161.6	100	0.000043	0	5%	0.000	0.000	
Valves (gas)	3	35	15.5	161.6	100	0.000013	0	5%	0.000	0.000	
Connectors (gas)	9	35	15.5	161.6	100	0.000042	0	5%	0.000	0.002	
Connectors (light liquid)	2	35	15.5	161.6	100	0.000008	0	5%	0.000	0.000	
Total									**0.0006**	**0.003**	**0.003**

Placer County APCD	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Dilution factor	Total VOC content (tons/yr)	Total VOC content (lbs/day)	Total VOC content Full + Empty (lbs/day)
Pressure Relief Valves (Gas)	2	35	84.5	881.2	100	0.00012	0	5%	0.001	0.006	
Valves (light liquid)	1	35	84.5	881.2	100	0.000043	0	5%	0.000	0.001	
Valves (gas)	3	35	84.5	881.2	100	0.000013	0	5%	0.000	0.001	
Connectors (gas)	9	35	84.5	881.2	100	0.000042	0	5%	0.002	0.010	
Connectors (light liquid)	2	35	84.5	881.2	100	0.000008	0	5%	0.000	0.000	
Total									**0.0035**	**0.019**	**0.019**

SFNA	Equipment Count Per Railcar	Average mph	Miles Traveled (one way)**	Hours Traveling /Railcar/yr	Rail Cars	Emission Factor (kg/hr/source)*	Methane Content	Dilution factor	Total VOC content (tons/yr)	Total VOC content (lbs/day)	Total VOC content Full + Empty (lbs/day)
Pressure Relief Valves (Gas)	2	35	132	1376.6	100	0.00012	0	5%	0.002	0.010	
Valves (light liquid)	0	35	132	1376.6	100	0.000043	0	5%	0.000	0.000	
Valves (gas)	3	35	132	1376.6	100	0.000013	0	5%	0.000	0.002	
Connectors (gas)	9	35	132	1376.6	100	0.000042	0	5%	0.003	0.016	
Connectors (light liquid)	0	35	132	1376.6	100	0.000008	0	5%	0.000	0.000	
Total									**0.0050**	**0.027**	**0.027**

* MASS EMISSIONS OF FUGITIVE HYDROCARBON LEAKS AT PETROLEUM FACILITIES
http://www.arb.ca.gov/fugitive/impl_doc.pdf

** Travels one way with crude, then loads rail cars with air. Assume returning railcar remaining vapor concentration is diluted 95% with air.

*** the eastern border.

RDEIR APPENDIX A (HEALTH RISK ASSESSMENT PORTION)

A.7. Cumulative Chronic Hazard Index Calculations - Fairfield

This section evaluates the cumulative chronic hazard index in Fairfield resulting from the Project plus existing sources. The Project's maximum chronic hazard index value would occur at a residence (maximum exposed individual residence or MEIR) 90 feet northwest of the train tracks in Fairfield (at UTM coordinates 585145 East, 4234384 North) (ERM, 2015a). This cumulative assessment evaluates the total cumulative chronic index at the MEIR from the Project and from existing stationary and mobile sources located within 1,000 feet of the MEIR.

Table HRA-1 shows stationary sources located within 1,000 feet of MEIR. These sources were obtained from BAAQMD's Google Earth stationary source database for Solano County. The six businesses within 1,000 feet of the MEIR have a combined hazard index of 0.071.

Table HRA-2 shows the risk from existing locomotives. The chronic hazard for existing locomotives equals 0.007 at 100 feet from the railroad. The combined stationary source and locomotive chronic hazard index at the MEIR equals 0.078.

The chronic hazard index from the Project equals 0.004 (ERM, 2015a). The combined chronic hazard index from the Project (0.004) plus from existing sources (0.078) equals 0.082. This value is substantially less than the BAAQMD's cumulative chronic threshold of 10.0.

Table HRA-1. Chronic Hazard Index Values from Stationary Sources within 1,000 Feet of the Maximum Exposed Individual Residence in Fairfield Obtained from BAAQMD Google Earth Data

	Commercial Business	Commercial Business	Commercial Business	Commercial Business	Commercial Business	Commercial Business
Address	744 N Texas St., Fairfield	1350 N Texas St., Fairfield	110 Railroad Ave, Suite G, Suisun City	106 Railroad Ave, Suisun City	890 E. Travis Blvd., Fairfield	409 Railroad Ave., Suite B, Suisun City
East UTM Coordinate	584489	584598.388	584768	585018.981	585723	585870
North UTM Coordinate	4234104	4234294.921	4233988	4234204.101	4234917	4233770
Chronic Hazard Index Value	0	6.60E-05	0	0.005749	0.025561	0.04

Table HRA-2. Chronic Hazard Index from Existing Locomotives Traveling on Railways in Fairfield (includes age sensitivity factor)

Link 564 (6ft elevation)

	PM2.5	Risk	Chron.HI	Acute.HI
10 ft N	0.082	47.298	0.017	0
25 ft N	0.065	37.371	0.013	0
50 ft N	0.050	28.810	0.010	0
75 ft N	0.041	23.755	0.008	0
100 ft N	0.035	20.381	0.007	0
200 ft N	0.023	13.456	0.004	0
300 ft N	0.017	10.285	0.003	0
400 ft N	0.014	8.430	0.003	0
500 ft N	0.012	7.157	0.002	0
750 ft N	0.009	5.247	0.001	0
1000 ft N	0.007	4.160	0.001	0
10 ft S	0.139	80.176	0.029	0
25 ft S	0.114	66.021	0.024	0
50 ft S	0.091	52.724	0.019	0
75 ft S	0.077	44.487	0.016	0
100 ft S	0.067	38.830	0.014	0
200 ft S	0.046	26.877	0.009	0
300 ft S	0.036	21.141	0.007	0
400 ft S	0.030	17.675	0.006	0
500 ft S	0.026	15.303	0.005	0
750 ft S	0.020	11.568	0.004	0
1000 ft S	0.016	9.305	0.003	0

A.8 Cumulative Chronic Hazard Index Calculations – Near Refinery

This section evaluates the cumulative chronic hazard index near the refinery from the Project and existing sources. Table HRA-3 shows that the highest chronic hazard index resulting from the Project equals 0.0003 at the maximum sensitive receptor [MSR], an elementary school located at UTM coordinates 574900 East, 4212500 North) (ERM, 2015a).

For existing sources, the highest chronic index value from I-680 at 1,000 feet equals 0.003, based on BAAQMD's Google Earth mobile source (freeway) database. The chronic risk from existing locomotives operating on the UPRR track at 1,000 feet equals 0.000 using BAAQMD's Google Earth railroad database. Finally, the chronic hazard from the VIP project equals 0.011246. This value represents the sum of the chronic index values from:

- Table 4.7-9 of the VIP Draft EIR (chronic hazard value of 0.00962 for the maximum nonresidential location),
- Table 3.1.8-2 of the VIP Amendments – Environmental Analysis (chronic hazard index value of 0.00161 for maximum stationary source off-site) and
- Table 3.1.8-3 of the VIP Amendments – Environmental Analysis (chronic hazard index value of 0.000016 for maximum mobile source).

The resulting total cumulative chronic hazard index of 0.014546 is less than the BAAQMD's chronic hazard index threshold of 10.0.

Table HRA-3. Risk from Existing Locomotives Traveling on Railways in Fairfield (includes age sensitivity factor)

	Crude by Rail	I-680 at 1,000 ft	Rail Tracks at 1,000 ft	VIP Project	Total
Chronic Risk	0.0003	0.003	0.000	0.011246	0.014546

A.9 Qualitative Assessment of Cumulative Health Impacts near Dixon, Sacramento, and Roseville, California

The RDEIR summarizes the Project's cumulative health risks within the Bay Area Air Quality Management District (BAAQMD). Those risks are based on a separate report prepared for the Project (ERM, 2015a). RDEIR also summarizes the Project's cumulative health risks between Roseville and the Oregon and Nevada borders (uprail). Those risks are also based on a separate report prepared for the Project (ERM, 2015c).

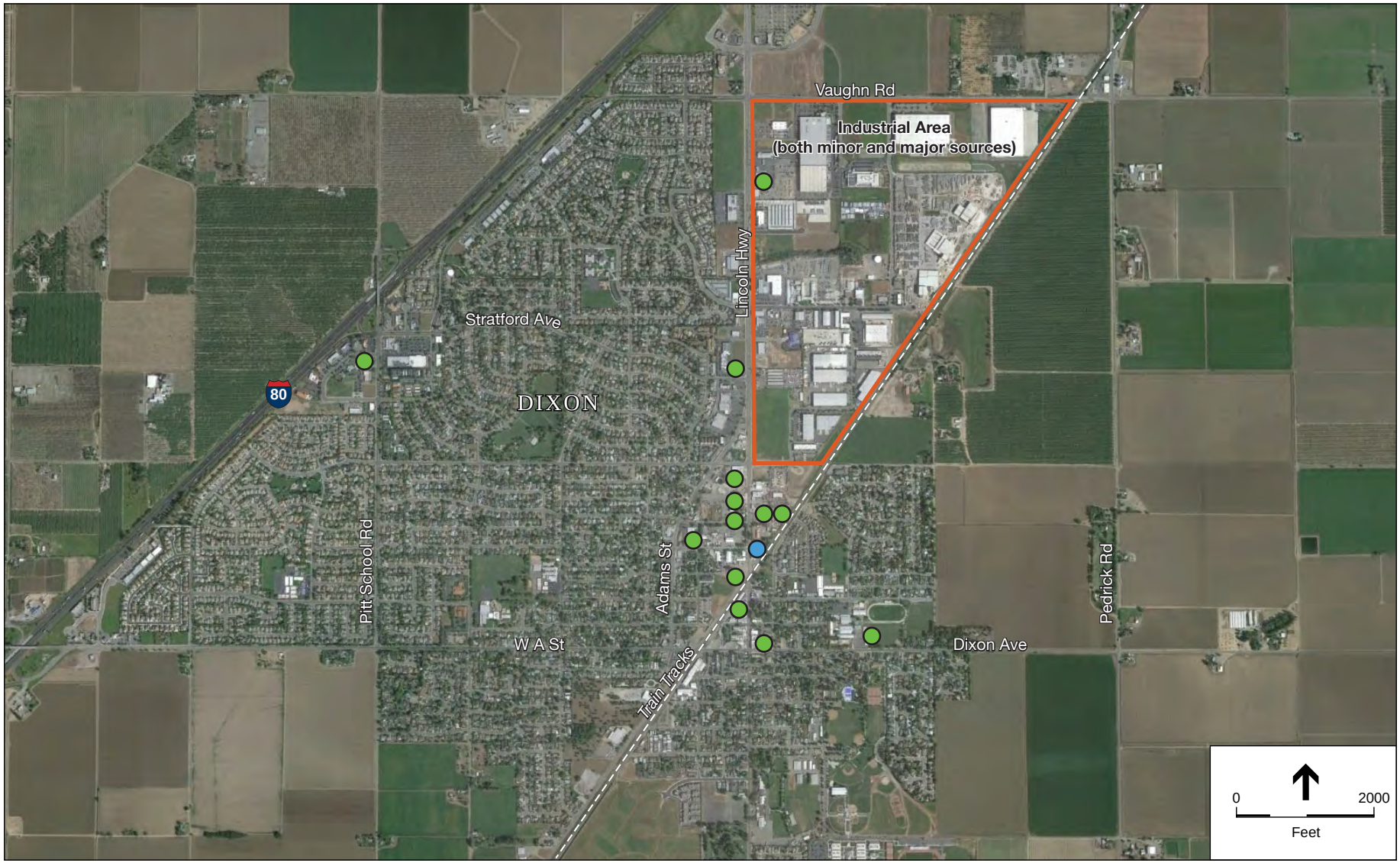
This analysis focuses on the Project's cumulative health risks from trains traveling between the Bay Area Air Quality Management District (BAAQMD)/Yolo-Solano County Air Quality Management District (YSAQMD) border and Roseville. This HRA focuses on Dixon, Sacramento, and Roseville. These represent populated areas that have sensitive receptors located close to the rail lines and for which Project specific health risk modeling was conducted (ERM, 2015a). Table 4.1-10 of the DEIR summarizes Project specific health risks for Dixon, Sacramento, and Roseville. The Project's incremental increase in locomotive emissions would not result in significant cancer risks, chronic or acute health hazards, or PM2.5 concentrations.

The cumulative evaluation of health risk must consider other sources of TACs. These include stationary sources, roadways, and existing rail traffic. The U.S. EPA Federal Report System contains the location and facility identification numbers of facilities that could potentially pose health risks. The EPA system was queried to identify sources within 1,000 feet of the rail lines in locations near the Dixon, Sacramento, and Roseville maximum exposed individual residences (MEIR).

In addition to stationary sources, existing rail traffic and major roadways contribute to cumulative impacts for sensitive receptors. Rail traffic generates diesel particulate matter emissions from diesel fuel combustion. Motor vehicles emit a variety of TACs from the combustion of gasoline and diesel fuel. The level of health risks pose by rail traffic and roadways depends on the volume of traffic and the distance to sensitive receptors.

Figures HRA-1 through HRA-3 show emission sources that could contribute to cumulative health risks near the Dixon, Sacramento, and Roseville MEIRs. In Dixon, the point of maximum exposed individual residential (MEIR) impact from the Project is located north of the railroad tracks and just east of the Lincoln Highway (State Route 113). Several minor stationary sources are shown in the immediate vicinity of the MEIR. In addition, several minor and major sources are located due north of the project in an industrially zoned area. In addition, emissions from the existing railroad and from vehicles traveling on SR 113 would contribute to cumulative health risks.

In Sacramento, the MEIR is located in the North Highlands area of Sacramento County. As shown in Figure HRA-2, only two minor sources plus the existing railroad track are located near the MEIR.



Minor Sources

Point of Maximum Residential Cancer and Non-Cancer Health Risk

SOURCE: Google Earth; ESA

Benicia Valero CBR . 202115.01

Figure HRA-1

Point of Maximum Residential Health Risks and Surrounding Sources in Dixon, California

Minor Sources

Point of Maximum Residential Cancer and Non-Cancer Health Risk

SOURCE: Google Earth; ESA

Benicia Valero CBR . 202115.01

Figure HRA-2

Point of Maximum Residential Health Risks and Surrounding Sources in Sacramento County, California

Major Source Minor Source Point of Maximum Residential Cancer and Non-Cancer Health Risk

SOURCE: Google Earth; ESA

Benicia Valero CBR . 202115.01

Figure HRA-3

Point of Maximum Residential Health Risks and Surrounding Sources in Roseville, California

In Roseville, the MEIR is located just north of the Roseville Railyards. Figure HRA-3 shows a few minor sources near the MEIR. The Roseville Railyards represents the major source of emissions that would contribute to cumulative health risks at the MEIR.

Project emissions plus emissions from existing point sources, roadways, and locomotives would all contribute to cumulative health risks. However, unlike the BAAQMD, information needed to quantify cumulative risk from existing sources is not currently available within the YSAQMD, SMAQMD, or PCAPCD. In addition, none of these agencies have developed cumulative health risk thresholds.

As shown in Table 4.1-10 of the RDEIR, the Project's proposed increase in rail activity in Dixon, Sacramento, and Roseville would contribute less than 10 in one million to any cumulative cancer risk, and less than 1.0 to chronic risks at sensitive receptors near the rail lines. Therefore, the Project would not make a significant contribute to a cumulatively considerable health risk impact. However, an assessment of the cumulative impacts of the Project plus other sources is not possible due to a lack of relevant data on existing emission sources. This analysis assumes that the combined effects of the Project with other existing sources described above and shown in Figures HRA-1, HRA-2, and HRA-3 could have a potentially significant and unavoidable cumulative health risk.

APPENDIX B

Updated Methodology for Assessment of Health Risk and PM2.5 Concentrations at the Refinery near Locomotive Tracks in Fairfield, CA

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Memorandum

Environmental Resources Management

1277 Treat Boulevard
Suite 500
Walnut Creek, CA 94597
(925) 946-0455
(925) 946-9968 (fax)

Re: Valero Crude by Rail Project

From: Cheri Velzy, ERM

cc: Lynn McGuire, ERM

Date: 15 June 2015

Subject: Updated Methodology for Assessment of Health Risk and $PM_{2.5}$ Concentrations at the Refinery and at Receptors near Locomotive Tracks in Fairfield, CA (11 June 2014)
Amended 15 June 2015

This memo provides updated health risk assessment (HRA) results for those presented previously in Appendix E.6 of the Valero Benicia Crude by Rail Project Draft Environmental Impact Report (DEIR). The original HRA dated 11 June 2014 has been amended as follows:

- Risk calculations reflect use of updated Office of Environmental Health Hazard Assessment (OEHHA) risk assessment guidelines, and
- Dispersion modeling utilizes AERMOD in place of the ISCST3 model.

All other HRA parameters, including source setup, emission factors and emission rates are unchanged from the analysis provided in the DEIR Appendix E.6.

APPROACH

OEHHA, the state agency that establishes procedures for calculating health risk from toxic air contaminants, updated its guidelines on 6 March 2015 for estimating health risks. The update requires explicit consideration of the effect of toxic air contaminant concentrations on infants, children, and adults. The updated OEHHA guidelines have different values to account for varied breathing rates in different age groups. This results in an overall increase in breathing volume over a 70-year period. The updated OEHHA guidelines were incorporated into the original HRA, and are discussed in Attachment 1.

Both the ISCST3 and AERMOD are approved EPA dispersion models. AERMOD is the new standard dispersion model recommended for use by the EPA and many local air quality agencies, including the Bay Area Air Quality Management District (BAAQMD). The ISCST3 model was used in the original HRA analysis due to the lack of a processed meteorological data set for AERMOD for Benicia, CA. While use of ISCST3 continues to be allowed by BAAQMD for use in HRA dispersion modeling, it is not as easily

incorporated with the tools available for implementing the updated OEHHA guideline HRA methodology. Therefore, dispersion modeling for the amended HRA was performed with AERMOD. The following meteorological data were utilized to create the appropriate meteorological data set for AERMOD:

- Refinery - Valero Admin
- Fairfield – Nut Tree Restaurant
- Dixon - Davis
- Sacramento – Sacramento Executive Airport
- Roseville – Sacramento Executive Airport

The updated OEHHA guidelines require calculation of health risk using a methodology that is more complex than that used in the original HRA. In this amended HRA, cancer, chronic and acute health risks were calculated using the concentration predicted by the AERMOD dispersion model. The resulting concentrations at each receptor are referred to as "χ/Q" (ground-level concentrations per emission rate). Detailed equations and calculation methodologies are presented in Attachment 1. The modeling data assumptions and emission factors are shown in Attachment 2.

SOURCES MODELED

This HRA amends the original HRA provided with the project's DEIR Appendix E.6, and includes on-site sources from the project's November 2013 BAAQMD permit application and California Environmental Quality Act (CEQA) sources. The CEQA sources include off-site project locomotives operating near the refinery and traveling between the refinery and the eastern boundary of the BAAQMD (Fairfield). The modeling assessment of risk and $PM_{2.5}$ (particulate matter less than 2.5 microns in diameter) concentrations near railroad tracks along the route between Fairfield and Roseville was also amended utilizing AERMOD and the updated OEHHA guidelines.

Results of the amended HRA for the area near the refinery and locomotive travel within the BAAQMD are provided in Table 1. Results of the amended HRA at locations near rail tracks in air districts between the BAAQMD and Roseville are shown in Table 2. Amended values are shown in **bold underline**. As shown in Tables 1 and 2, the cancer risk at the maximum exposed individual residential (MEIR) receptor, maximum exposed individual worker (MEIW) receptor, and maximum sensitive receptor (MSR) are all less than 10 in one million. The non-cancer chronic hazard index and the acute hazard index at the MEIR, MEIW, and MSR, are less than 1.0. $PM_{2.5}$ concentrations are less than 0.3 microgram per cubic meter ($\mu g/m^3$).

Table 1 Maximum Cancer and Non-Cancer Risk

Type of Estimated Health Impact	Cancer Risk per million (Receptor Location)	Chronic Hazard Index (Receptor Location)	Acute Hazard Index (Receptor Location)	$PM_{2.5}$ Annual Concentration ($\mu g/m^3$) (Receptor Location)
Maximum Exposed Individual Residential (MEIR)	**4.0 Worst case risk at 90 feet northwest of train tracks in Fairfield (585145E, 4234384N)**	**0.004 Worst case risk at 90 feet northwest of train tracks in Fairfield (585145E, 4234384N)**	**0.0024 Near E. 5th Street, Benicia (575444E, 4212595N)**	**0.004 Worst case risk at 90 feet northwest of train tracks in Fairfield (585145E, 4234384N)**
Maximum Exposed Individual Worker (MEIW)	**7.4** (576044E, 4214195N)	0.014 (576044E, 4214195N)	**0.048** (576144E, 4213045N)	**0.075** (576044E, 4214195N)
Maximum Sensitive Receptor (MSR)	**0.25** Day-Care Center (574594E, 4212895N)	**0.0003 Elementary School (574900E, 4212500N)**	**0.001** Elementary School (574900E, 4212500N)	**0.001 Elementary School (574900E, 4212500N)**

Table 2 Maximum Cancer and Non-Cancer Risk at Locations near Rail Tracks in Other Air Districts

Location of Estimated Health Impact	Cancer (per million)	Chronic Hazard Index	Acute Hazard Index[1]	$PM_{2.5}$ Annual Concentration ($\mu g/m^3$)
Yolo-Solano Air District (Dixon) (602806 E, 4256360 N)	**2.2**	**0.0004**	**N/A**	**0.002**
Sacramento Air District (Sacramento) (642944 E, 4283022 N)	**3.2**	**0.0006**	**N/A**	**0.0031**
Placer Air District (Roseville) (648208 E, 4289991 N)	**3.2**	**0.0006**	**N/A**	**0.0031**

[1]For locomotive travel, the only TAC of concern is diesel particulate matter, which does not have an acute health effect.

Figure 1 in Attachment 3 shows the location of modeled sources, facility boundary, and locations of maximum exposed receptors near the refinery, using the updated OEHHA guidelines and AERMOD. These locations are slightly different, but in the same vicinity, than the locations originally modeled and presented in the original HRA dated 11 June 2014. The original model utilized ISCST3 and OEHHA factors that were current at that time.

Figures 2 through 7 in Attachment 3 show the source locations and maximum exposed receptors near Fairfield, Dixon, Sacramento, and Roseville, and the wind roses for the meteorological data used in the modeling.

CUMULATIVE CANCER RISK AND $PM_{2.5}$ ANALYSIS

Fairfield MEIR

The data from non-project, cumulative risk sources near the Fairfield MEIR for the screening-level cumulative risk analysis in DEIR Appendix E.6 has not changed. Table 3 shows the cancer risk and $PM_{2.5}$ contribution to the cumulative risk from sources near the Fairfield MEIR. The revised modeling results performed for this amended HRA are included in the Fairfield cumulative risk and $PM_{2.5}$ sources, and are also shown in Table 3.

Table 3 Cancer Risk and $PM_{2.5}$ Concentration from Stationary Sources within 1,000 Feet of the Maximum Exposed Individual Residence in Fairfield Obtained from BAAQMD Google Earth Data (includes ASF)

	Commercial Business	Commercial Business	Commercial Business	Commercial Business	Commercial Business	Commercial Business
Address	744 N Texas Street, Fairfield	1350 N Texas Street, Fairfield	110 Railroad Ave, Ste G, Suisun City	106 Railroad Ave, Suisun City	890 E Travis Boulevard, Fairfield	409 Railroad Ave, Ste B, Suisun City
East UTM Coordinate	584489	584598.388	584768	585018.981	585723	585870
North UTM Coordinate	4234104	4234294.921	4233988	4234204.101	4234917	4234770
Cancer Risk (per million)	0	0	0	16.236956	23.902249	9.18
$PM_{2.5}$ Annual Concentration ($\mu g/m^3$)	N/A	0	0	0.029	N/A	0

Risk from Existing Locomotives Traveling on Railroad in Fairfield (includes ASF)[1]		
	$PM_{2.5}$	Risk
10 ft N	0.082	47.298
25 ft N	0.065	37.371
50 ft N	0.05	28.81
75 ft N	0.041	23.755
100 ft N	0.035	20.381
200 ft N	0.023	13.456
300 ft N	0.017	10.285
400 ft N	0.014	8.43
500 ft N	0.012	7.157
750 ft N	0.009	5.247
1000 ft N	0.007	4.16
10 ft S	0.139	80.176
25 ft S	0.114	66.021
50 ft S	0.091	52.724
75 ft S	0.077	44.487
100 ft S	0.067	38.83
200 ft S	0.046	26.877
300 ft S	0.036	21.141
400 ft S	0.03	17.675
500 ft S	0.026	15.303
750 ft S	0.02	11.568
1000 ft S	0.016	9.305

	Cancer Risk (in one million)	$PM_{2.5}$ Annual Concentration ($\mu g/m^3$)
Total Contribution from Nearby Sources, near the Fairfield MEIR	**69.7**	0.10
Total Cumulative Risk Including Project, near the Fairfield MEIR	**73.7**	**0.10**

[1]Source: http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Tools-and-Methodology.aspx

Near-Refinery Cumulative Analysis

Table 4 presents the amended risk values presented in DEIR Appendix E.6 in the vicinity of residences near the refinery. The values included in the "Crude by Rail Project" column reflect the updated OEHHA guidelines using concentrations predicted by AERMOD. The values shown were modeled at a residence southwest of the refinery.

The "Total with ASF" column sums the risks from I-680, rail traffic, and the previously approved and completed Valero Improvement Project (VIP), applying the ASF to the VIP Project risk value. The ASF is already incorporated in the risk values for I-680 and the rail tracks. The amended Crude by Rail risk values also incorporate the ASFs in the revised modeling.

Table 4 Combined Risk Values at Maximum Exposed Residence near the Valero Refinery UTM 575,694 E (meters), 4,212,345 N (meters)

Type of Estimated Health Impact	Source of Contribution to Risk and $PM_{2.5}$ Concentration				TOTAL	TOTAL with ASF[4]
	Crude by Rail Project	I-680 (at 1,000 feet W)[1]	Rail Tracks (at 1,000 feet W)	VIP Project[2]		
Cancer Risk (per million)	**2.2**	3.47	1.65	2.38[2]	**9.7**	**11.4**[3]
$PM_{2.5}$ Annual Concentration ($\mu g/m^3$)	**0.002**	0.024	0.002	N/A	**0.028**	**0.028**

[1]Values for I-680 and rail tracks are obtained from Table 5 (bold bordered).
[2]VIP Draft Environmental Impact Report, Table 4.7-9, Maximum Nonresidential Location, and the Valero Improvement Project Amendments – Environmental Analysis, Table 3.1.8-2 and Table 3.1.8-3.
[3]Includes Age Sensitivity Factor (ASF).
[4]The ASF was applied to the historical VIP.

Table 5 displays the I-680 and rail risk values obtained from the BAAQMD Google Earth tool. Values in Table 5 have not changed from the original HRA.

Table 5 Freeway and Rail Risk and $PM_{2.5}$ Values from BAAQMD Google Earth Tool

I-680		
	$PM_{2.5}$	**Risk**
10 ft W	0.273	37.642
25 ft W	0.222	30.791
50 ft W	0.172	23.917
75 ft W	0.142	19.764
100 ft W	0.121	16.981
200 ft W	0.079	11.189
300 ft W	0.061	8.563
400 ft W	0.049	7.019
500 ft W	0.042	5.96
750 ft W	0.031	4.377
1000 ft W	0.024	3.467
10 ft E	0.456	62.905
25 ft E	0.37	51.191
50 ft E	0.285	39.577
75 ft E	0.235	32.682
100 ft E	0.202	28.048
200 ft E	0.131	18.313
300 ft E	0.099	13.858
400 ft E	0.08	11.199
500 ft E	0.067	9.402
750 ft E	0.047	6.675
1000 ft E	0.035	5.001

Rail		
	$PM_{2.5}$	**Risk**
10 ft W	0.032	18.608
25 ft W	0.027	15.612
50 ft W	0.021	12.417
75 ft W	0.018	10.372
100 ft W	0.015	8.919
200 ft W	0.01	5.802
300 ft W	0.007	4.276
400 ft W	0.005	3.389
500 ft W	0.004	2.822
750 ft W	0.003	2.061
1000 ft W	0.002	1.647
10 ft E	0.077	44.529
25 ft E	0.069	39.968
50 ft E	0.058	33.357
75 ft E	0.049	28.636
100 ft E	0.043	25.161
200 ft E	0.03	17.603
300 ft E	0.024	13.833
400 ft E	0.02	11.539
500 ft E	0.017	9.954
750 ft E	0.013	7.574
1000 ft E	0.01	6.187

Source: http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES/Tools-and-Methodology.aspx.
The values in the bold border are used in Table 4 above for the contribution to cumulative risk near the refinery.

Attachment 1

Health Risk Calculation Methodology using the Updated OEHHA Guidelines

ATTACHMENT 1

HEALTH RISK CALCULATIONS

This attachment describes the health risk calculations using the March 2015 updated OEHHA guidelines. The approach makes use of the concentrations predicted by dispersion modeling using AERMOD. The resulting concentrations at each receptor are referred to as "χ/Q," or the ground-level concentrations per emission rate.

The OEHHA, which is the state agency that establishes procedures for calculating health risk from toxic air contaminants, updated its guidelines on 6 March 2015 for estimating health risks. These updates require explicit consideration of the effect of these toxic air contaminant concentrations on infants and children as well as adults. The updated OEHHA guidelines now have different values to account for varied breathing rates in different age groups, and results in an overall increase in breathing volume over a 70-year period.

Equation [1] is the approach used to calculate cancer risk per the updated OEHHA guidelines. The updated OEHHA guidelines also require age sensitivity factors (ASFs) to reflect increased cancer risk susceptibility in younger age groups, which are applied to cancer risks calculated over the exposure duration of each age bin. These age-specific breathing rates and ASFs were used in this current analysis, and are shown in Table A1-1.

Equation [1]

$$\text{Cancer Risk} = {}_j\sum ER_j \times SF_j \times ({}_i\sum \chi/Q \times (ED_i/AT) \times ASF_i \times BR_i \times EF \times [1/1000]$$

where:

χ/Q = Concentration modeled for unit emission rate [($\mu g/m^3$) / (g/s)]
ER = Emission rate of DPM
SF = cancer slope factor for DPM [(mg/kg BW-day) $^{-1}$]
ED_i = exposure duration in age bin i [years]
AT =averaging period (70 years for lifetime cancer risk)
ASF_i = Age sensitivity factor in age bin i
BR_i = Breathing rate in age bin i [liters (L) of air per kg of body weight per day]
EF = exposure frequency (days per 365 days)
[1/1000] = Conversion factor: mg/1000 μg

Chronic health hazard index is simply the modeled pollutant concentration divided by the OEHHA Reference Exposure Level (REL) for that pollutant, then summed over all pollutants.

Table A1-1. Factors Applied to Amended HRA Based on Updated OEHHA Guidelines

Age Bin	Exposure Duration (ED) (Years)	Breathing Rate (BR) (L/kg BW-day)	ASF
Third Trimester	0.25	361	10
0 < 2 Years	2	1,090	10
2 < 16 Years	14	745	3
16 < 70 Years (residential)	54	290	1
16 < 70 Years (offsite worker)	40[2]	230	1

[1]These represent the 95th percentile breathing rates. Draft risk management guidance from CARB and CAPCOA suggests that 95th percentile can be used for the age of 2, while 80th percentile can be used for over the age of 2. Due to potential differences in implementation of this guidance by individual air districts, use of 95th percentile for all ages is considered conservative.

[2] Draft risk management guidance from CARB and CAPCOA suggests use of a 25-year exposure period for offsite workers. Again, there could be potential differences in implementation of this guidance by individual air districts, so use of 40 years from the previous OEHHA guidelines would be conservative.

Residential Locations

In the DEIR analysis, Equation [1] would still represent the basic calculation methodology that was used, however, without the use of age bins. "ASF" is set to 1 over one single exposure duration (ED) of 70 years and one breathing rate (BR) of 302 L/kg BW-day, as explained above. Therefore, there is no "inside" summation with the previous approach. As noted above, the BAAQMD had adopted ASFs at that time, but there is no need for the summation approach with the use of one BR and a single ED (i.e., 70 years). The ASFs over a 70-year period were incorporated by a single multiplier of 1.7, representing a weighted average. In the DEIR calculation, the exposure frequency was set to 1 (i.e., 365 days out of 365 days).

In the updated analysis using the updated OEHHA Guidelines, the overall exposure duration was kept at 70 years, but broken into age bins. The "inside summation" in Equation {1} consisted of the ED_is, ASF_is, and BR_is in the first four rows of Table 1. In addition, per the updated OEHHA guidelines, the exposure frequency (EF) was revised to 350 days out of 365 days, a factor of 0.96.

Offsite Workers

In the DEIR analysis, cancer risk at the MEIW was estimated by modeling as a residential receptor and then multiplying by 0.2199, as recommended in the previous OEHHA guidelines to convert inhalation cancer risk estimates calculated for a residential receptor to a worker receptor based on the differences in the exposure duration and the daily exposure frequencies.

Under the updated OEHHA guidelines, this scalar multiplier approach is not possible given how residential exposures are now calculated. Equation [1] is now used directly for an offsite worker receptor, with the following factors used in the calculation:

- Age bins are not necessary under the assumption that full-time work begins at the age of 18 or beyond, thus only one age bin (16<70) is needed and the ASF is set to 1. The breathing rate (BR) used is shown in the fifth row of Table 1.
- The exposure duration was kept at 40 years to be conservative.

Per the updated OEHHA guidelines, the exposure frequency (EF) was revised to 250 days out of 365 days, a factor of 0.685 for an offsite worker.

Sensitive Receptors

In the DEIR analysis, the sensitive receptor with the highest cancer risk modeled as a residential receptor was a day-care center in Benicia, and that result was multiplied by a factor of 9/70 to adjust the 70-year residential exposure assumption to 9 years for a day-care center (or school) site, as provided in the previous OEHHA guidelines. Per 2010 BAAQMD guidance where the BAAQMD had adopted ASFs at that time, this was then multiplied by an ASF of 3 to represent cancer sensitivity of the 2<16 age group.

Under the updated OEHHA guidelines, this scalar multiplier approach is not possible given how residential exposures are now calculated. Equation [1] is now used directly for a day-care center or school site, with the following factors used in the calculation:

- Age bins are not necessary under the assumption the age of children at the receptor are between 2 and 16 years old. Thus only one age bin (2<16) is needed and the ASF is set to 3. The breathing rate (BR) used is shown in the third row of Table 1.
- The exposure duration was kept at 9 years, per the updated OEHHA guidelines.

Attachment 2

Modeling Data, Assumptions, and Emission Factors

Crude by Rail Project
Locomotive DPM Emissions for CEQA Modeling

Year 2015 Annual Locomotive DPM Emissions - 100 Railcars per Day

Parameter	Value	Unit	Reference
Additional Annual Tank Cars due to Project	36,500	Cars/year	Based on Project Description assume 2 (50 tank cars each) per day
Maximum Net Freight Weight	106	short tons/car	TRN Spec Sheet-1
Annual Freight Transported due to Project	3,861,700	short tons/year	Based on Project Description (multiplication of cars * freight weight) excludes weight of empty car
Weight of Empty Tank Car	37	short tons/car	TRN Spec Sheet-1
Total Annual Weight of Empty Tank Cars	1,357,800	short tons/year	
Annual Gross Weight Hauled	5,219,500	short tons/year	Freight Weight + Empty Railcar Weight
Number of Railcars per Train	50	Cars/train	
Length of Line Source	Varies	feet	Model Source Dependent
Average Fuel Efficiency[1]	1005	ton-mi/gal	EPA-420-R-92-009 with fuel and ton-mile information for UP.
Average Train Size	50	cars/train	Project Description
Length of Railcars	60	ft	Spec Sheet
Number of Trains per Day	2	trains/per day	

[1]Based on data collected by the Association of American Railroads for revenue ton-miles and fuel consumption.
Thus dividing g/gal emission rates by average fuel efficiency gives approximate g/ton-mile emission rates.
This factor in all emission estimates has been corrected to 1005 ton-mile per gallon based on a comment from BAAQMD in September 2014.

Source Type - Mode	**2015 PM10 Locomotive Emissions Factor**	
	Value	**Unit**
Line Source - Running Full[1]	3.4	g/gal fuel
Line Source - Running Empty[1]	3.4	g/gal fuel
Total		
1. Emission Factors for large line haul Locomotives in calendar year 2015. Source: EPA-420-F-09-025, April 2009		

Locomotive Small Line Haul - Line Source (As Separated Volume Source)					
Track Length Considered for Modeling	3,000	feet		0.6	miles
Length of the Line Source, L_{RS}	3,000	ft		0.6	miles
Width of the Line Source, W (Width of one track + 3 m on each side)*	30	ft		9.1	m
Source Type	Line source represented by separated volume sources, Elevated source not on or adjacent to a building				
Length of the Side of the Line/Volume Source = W	30	ft		9.1	m
Spacing of Separated Volume Source Along Line (c/c)	59	ft		18.1	m
Starting Location	Offset Half Volume Width				
Release Height (stack height of 15 ft + avg. vertical plume rise)*	45.8	ft		13.95	m
Initial Lateral Dimension (SYINIT) = 2W/2.15	27.62			8.42	m
Initial Vertical Dimension (SZINIT) = Release Height/4.3	10.64			3.24	m
Number of Volume Sources Generated by BEEST Model	51	volume sources/line		51	volume sources/line

*Appendix C3, Health Risk Assessment for the Southern, California Intermodal Gateway (SCIG), Pg 23/89, http://www.portoflosangeles.org/EIR/SCIG/DEIR/APPENDIX_C3.pdf

Release parameters obtained from Railyard studies such as

http://www.arb.ca.gov/railyard/hra/env_sheila_admrpt.pdf

http://www.arb.ca.gov/railyard/hra/sr_oak_rpt.pdf

* Average of day time and night time release height for arriving and departing line haul in Table 4-1. http://www.arb.ca.gov/railyard/hra/env_richmond_admrpt.pdf

Attachment 3

Figures 1-7

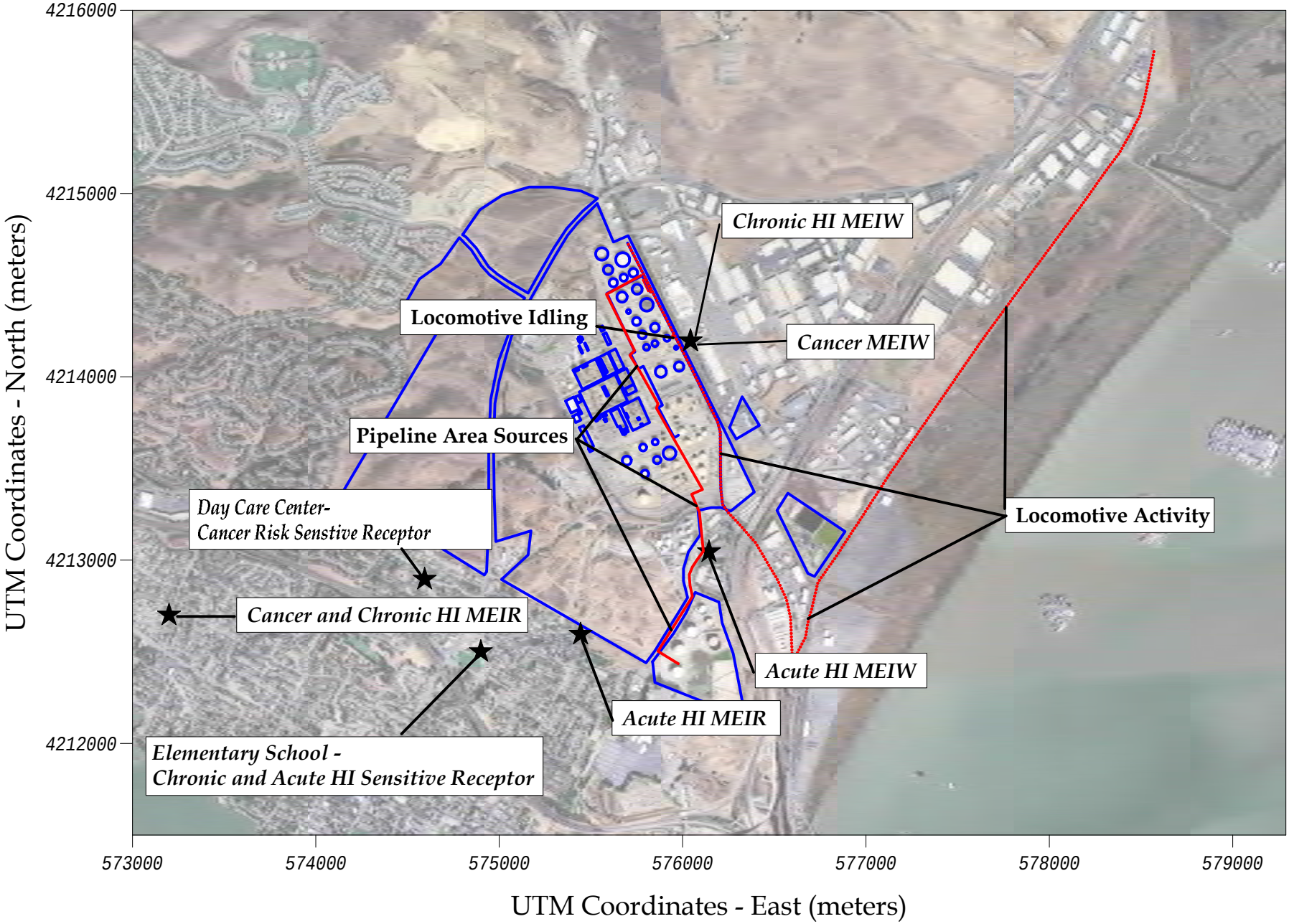


Figure 1

Source and Health Risk Assessment Result Locations
Valero - Crude by Rail Project
Benicia, California

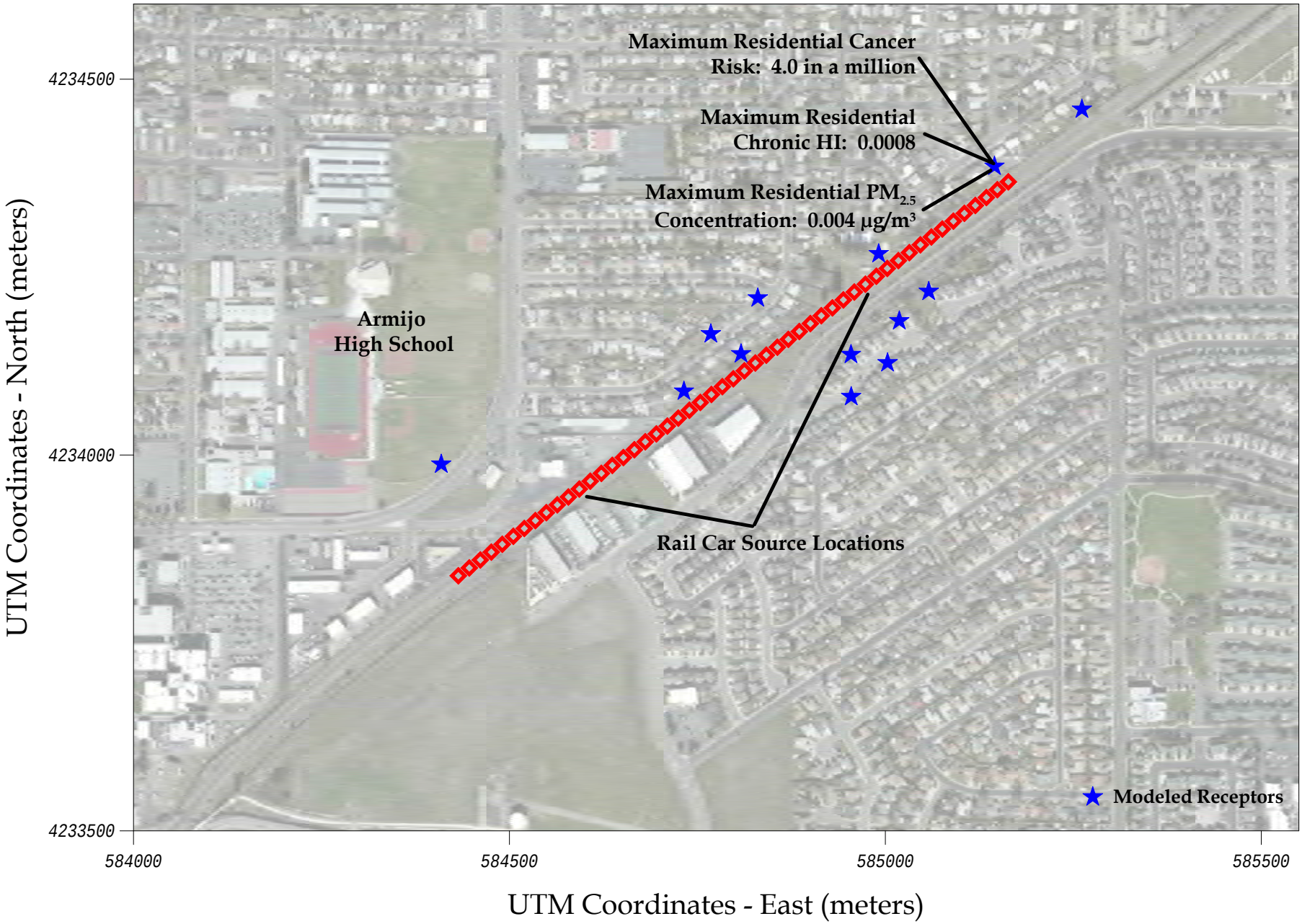


Figure 2

Fairfield Rail Source Locations and Modeling Health Risk Results
Valero Crude by Rail Project
Benicia, California

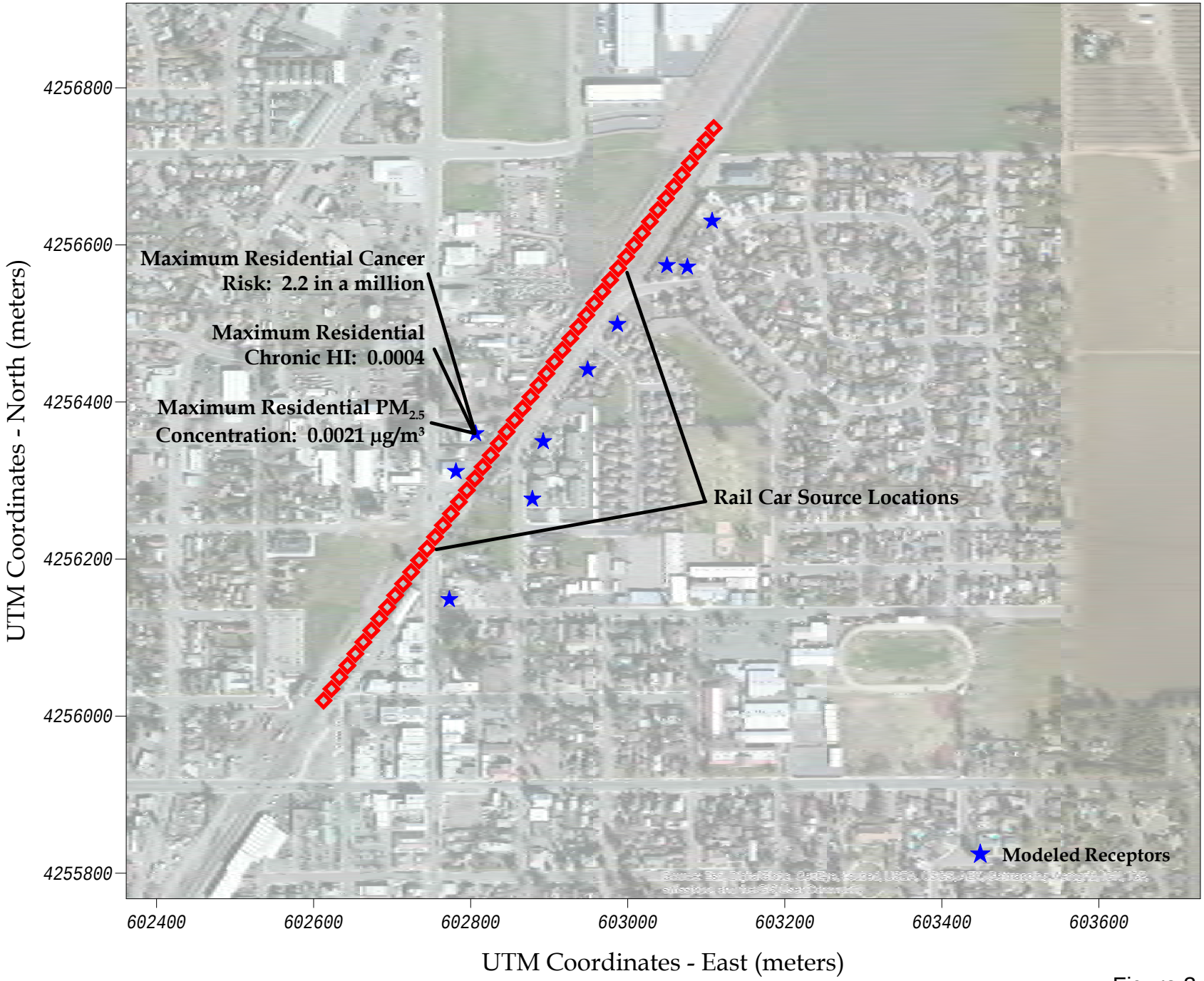


Figure 3

Yolo Solono County Rail Source Locations and Modeling Health Risk Results
Valero Crude by Rail Project
Benicia, California

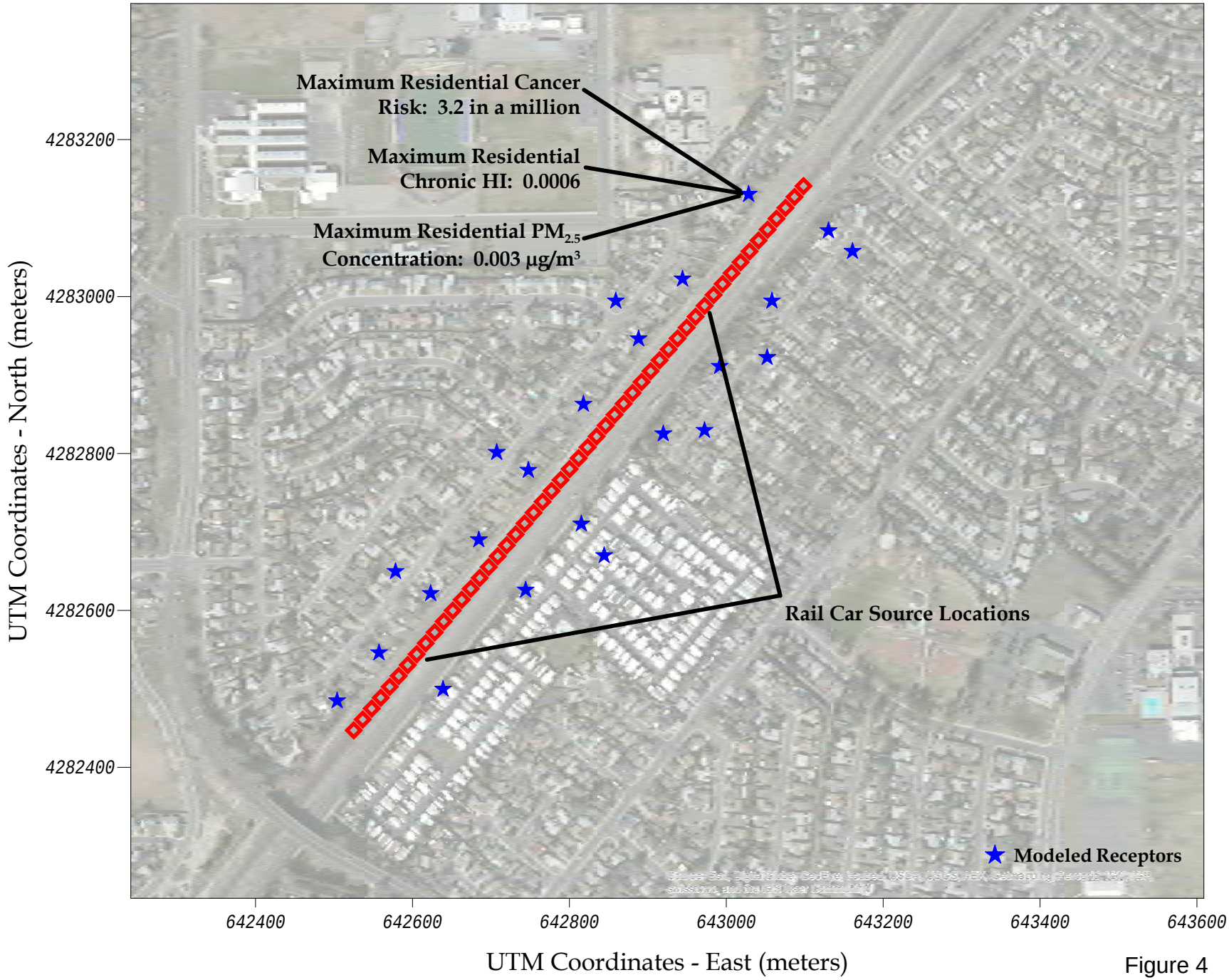


Figure 4

Sacramento County Rail Source Locations and Modeling Health Risk Results
Valero Crude by Rail Project
Benicia, California

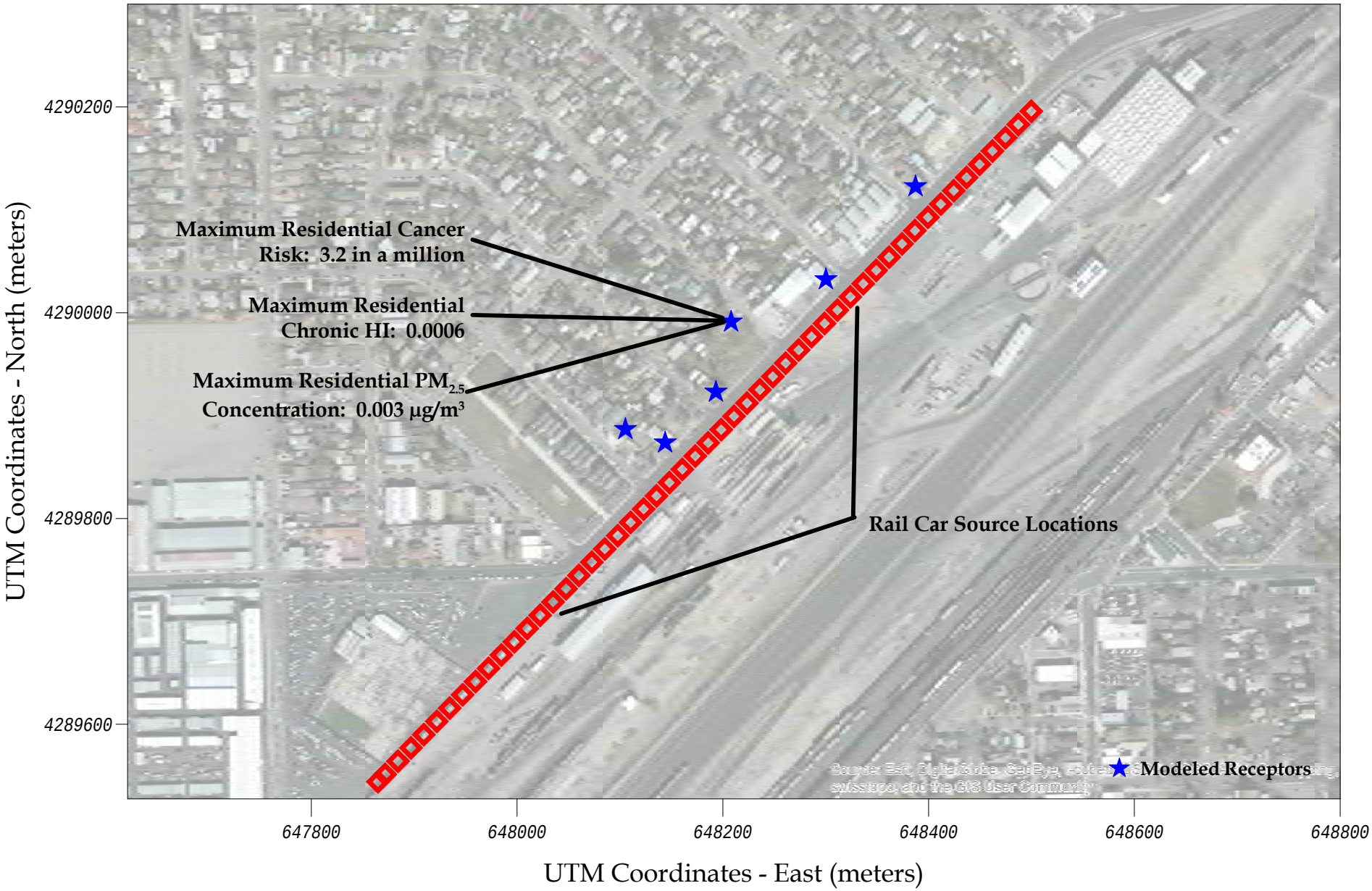


Figure 5

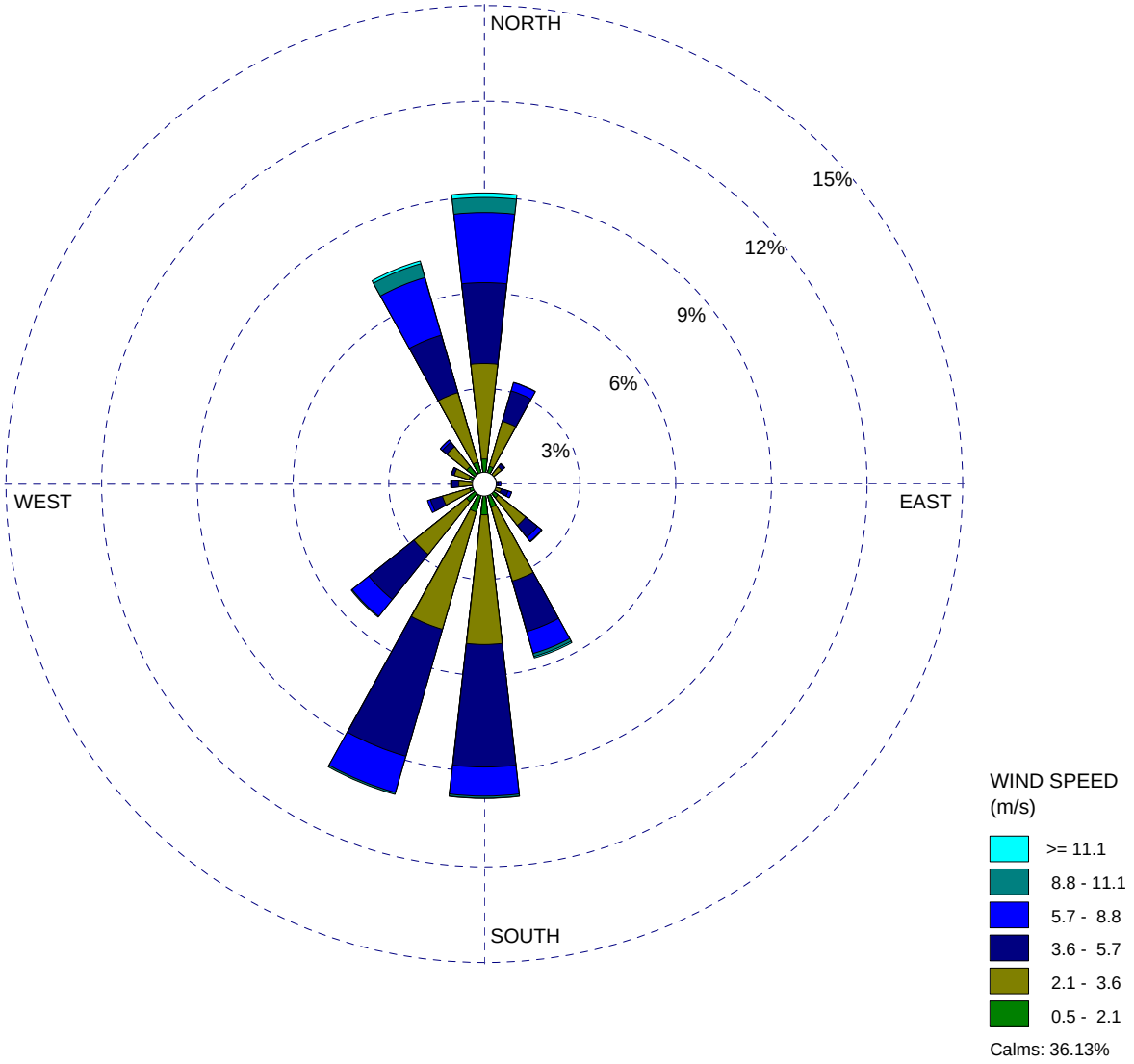
Placer County Rail Source Locations and Modeling Health Risk Results
Valero Crude by Rail Project
Benicia, California

WIND ROSE PLOT:

Davis, CA

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
2011 - 2013	**Start Date: 1/1/2011 - 00:00** **End Date: 12/31/2013 - 23:00**	MODELER:	
	CALM WINDS: **36.13%**	TOTAL COUNT: **24562 hrs.**	
	AVG. WIND SPEED: **2.25 m/s**	DATE: **6/4/2015**	PROJECT NO.:

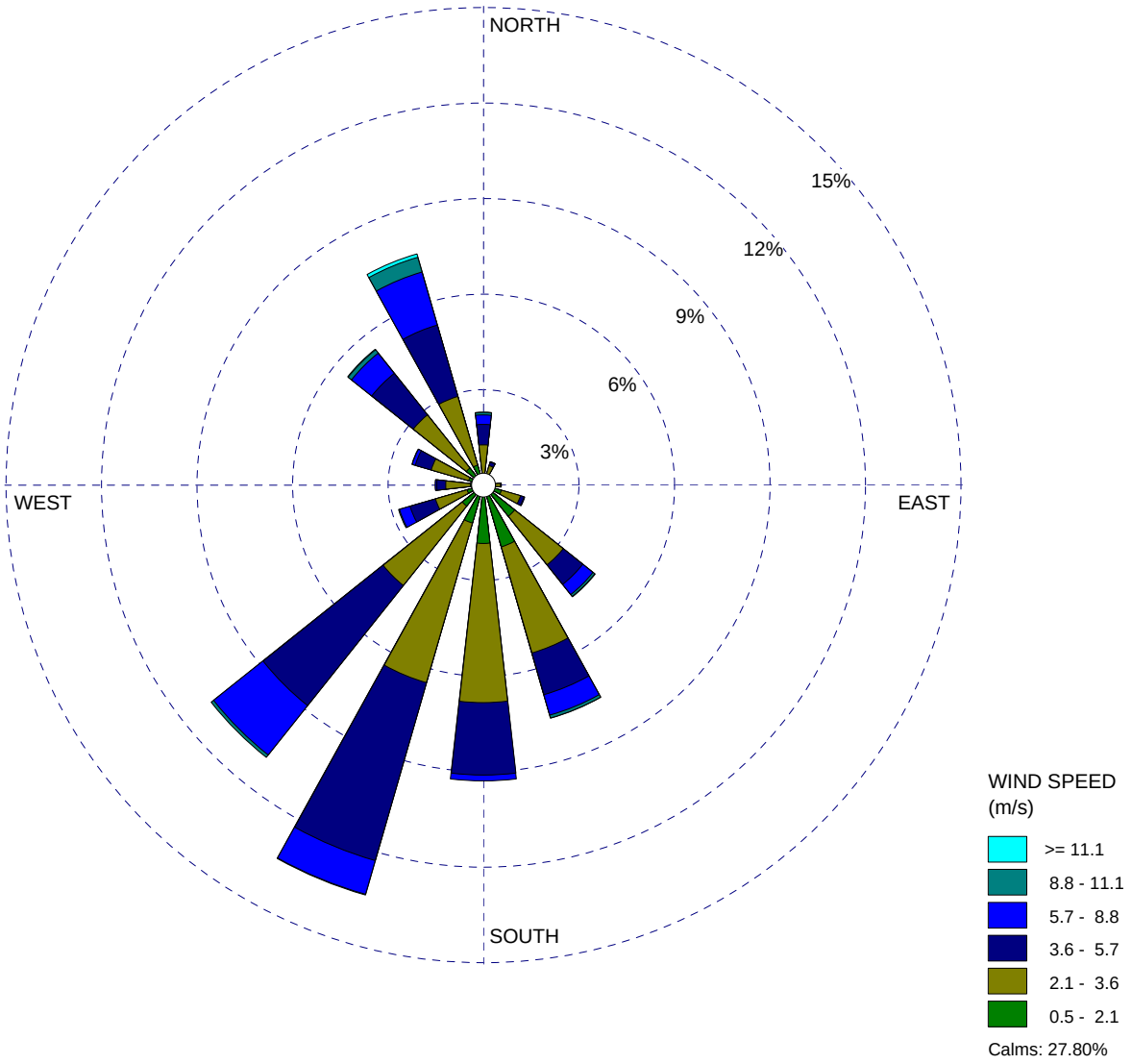
WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Sacramento Executive Airport

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
2009 - 2013	**Start Date: 1/1/2009 - 00:00** **End Date: 12/31/2013 - 23:00**	MODELER:	
	CALM WINDS: **27.80%**	TOTAL COUNT: **41721 hrs.**	
	AVG. WIND SPEED: **2.61 m/s**	DATE: **6/4/2015**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

APPENDIX C

Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations Between Roseville, CA and the Oregon and Nevada Borders

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Memorandum

Environmental Resources Management

1277 Treat Boulevard
Suite 500
Walnut Creek, CA 94597
(925) 946-0455
(925) 946-9968 (fax)

Re: Valero Crude By Rail Project

From: Cheri Velzy, ERM

cc: Lynn McGuire, ERM

Date: 22 June 2015

Subject: Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations between Roseville, California, and the Oregon and Nevada Borders

---

At the request of the City of Benicia (City), ERM performed a health risk assessment to evaluate cancer and chronic non-cancer risks of locomotive emissions from project crude trains traveling between Roseville, California, and the Oregon and Nevada borders. The City requested modeling using the ISC model with available meteorological data near these routes. However, meteorological data for ISC are not available for all the routes. The California Air Resources Board has compiled meteorological data for use with the latest United States Environmental Protection Agency (EPA) dispersion model, AERMOD, which is an update to the ISC model. Since AERMOD-ready processed meteorological data are available for all the selected uprail route locations, ERM used AERMOD to perform the health risk assessment. In addition, updated Office of Environmental Health Hazard Assessment (OEHHA) health risk guidelines, which were released in March 2015, were used in this health risk assessment, and those guidelines recommend the use of AERMOD.

The health risk assessment modeled five locations along the three Union Pacific Railroad lines that run from the Roseville Rail Yard to the Oregon and Nevada borders. These lines, with the locations modeled, include:

- Roseville North Route through Redding to the Oregon border
  - Chico
  - Redding
- Feather River Canyon Route
  - Marysville
- Truckee Route to the Nevada border
  - Auburn
  - Truckee

Attachment 1 includes the train-specific data and calculations for the emissions used in the health risk assessment, and the modeling assumptions.

AERMOD

The EPA AERMOD dispersion model was used to estimate diesel particulate matter (DPM) pollutant concentrations for the health risk assessment. Processed meteorological data for AERMOD were available for all the selected uprail locations. The locomotive emissions were modeled as a series of volume sources to represent a line source. A grid was established around the track area modeled, and additional discrete receptors were placed on residences near the tracks not coinciding with a grid point.

Meteorological Data

The following meteorological data sets were used with the modeled track areas:

- Chico – Chico Municipal Airport
- Redding – Redding Municipal Airport
- Marysville – Yuba County Municipal Airport
- Auburn – Auburn Municipal Airport
- Truckee – Truckee-Tahoe Airport

RISK CALCULATIONS

Cancer and chronic health risks are calculated for DPM, the pollutant of concern in locomotive emissions. The approach makes use of the concentrations predicted by dispersion modeling using AERMOD. The resulting concentrations at each receptor are referred to as "χ/Q", (ground-level concentrations per emission rate). Detailed risk calculation methodologies are presented in Attachment 2.

RISK ASSESSMENT RESULTS

The results of the analysis are shown in Table 1. This table presents the results at the point of maximum impact (PMI), which in some cases does not coincide with a residential location. However, the risk at all residential locations would be less than that at the PMI. The modeling grid used in the health risk assessment provided sufficient

coverage to capture the risks at nearby residential locations. Figures showing the cancer and chronic hazard index results at the PMI are included in Attachment 3, Figures 1 through 5.

Table 1 includes reference to risk thresholds of 10 in one million for cancer risk and 1.0 for chronic hazard index (per Assembly Bill 2588 air toxic "hot spots" public notification thresholds). Two of the subject air districts between Roseville and the California border (Feather River and Shasta) have not published risk thresholds for cancer risk and chronic hazard impacts for CEQA purposes. Butte County has proposed these risk thresholds, but they have not been adopted yet. Placer County has included these risk thresholds in its health risk assessment methodology in its CEQA Handbook. However, the State's AB2588 stationary source notification thresholds are applicable in these jurisdictions and correspond to levels below which public notification of risk is deemed unnecessary. There are no similar thresholds for mobile sources. Therefore, many districts have utilized the stationary source notification thresholds for non-stationary sources for comparison purposes. The risk threshold values listed in AB2588 are also equivalent to the Bay Air Air Quality Management District's CEQA thresholds of 10 in one million (cancer risk) and 1.0 (chronic hazard index), and have been used for both stationary and mobile sources. These thresholds are referenced in the HRA impact analysis presented in the 2014 Crude by Rail Project DEIR. Thus, they are shown here for comparison of the health risk impacts from the emissions in uprail locations from the project rail activity. All values are less than their comparative risk thresholds.

Table 1 Maximum Cancer Risk and Chronic Hazard Index near Rail Tracks from Locomotive DPM Emissions at Uprail Locations in California

Location of Estimated Health Impact	Cancer Risk (per million)	Chronic Hazard Index	DPM Annual Average Concentration ($\mu g/m^3$)
Marysville - eastern	5.5	0.0011	0.0052
Marysville - western	4.9	0.0009	0.0047
Chico	5.5	0.0011	0.0052
Redding	6.3	0.0012	0.0060
Auburn – eastern	4.6	0.0009	0.0043
Auburn - western	5.2	0.0010	0.0050
Truckee	4.5	0.0009	0.0043
AB2588 Risk Threshold	10	1	N/A

Attachment 1

Modeling Data, Assumptions, and Emission Factors

Crude by Rail Project
Locomotive DPM Emissions for CEQA Modeling

Year 2015 Annual Locomotive DPM Emissions - 100 Railcars per Day

Parameter	Value	Unit	Reference
Additional Annual Tank Cars due to Project	36,500	Cars/year	Based on Project Description assume 2 (50 tank cars each) per day
Maximum Net Freight Weight	106	short tons/car	TRN Spec Sheet-1
Annual Freight Transported due to Project	3,861,700	short tons/year	Based on Project Description (multiplication of cars * freight weight) excludes weight of empty car
Weight of Empty Tank Car	37	short tons/car	TRN Spec Sheet-1
Total Annual Weight of Empty Tank Cars	1,357,800	short tons/year	
Annual Gross Weight Hauled	5,219,500	short tons/year	Freight Weight + Empty Railcar Weight
Number of Railcars per Train	50	Cars/train	
Length of Line Source	Varies	feet	Model Source Dependent
Average Fuel Efficiency[1]	1005	ton-mi/gal	EPA-420-R-92-009 with fuel and ton-mile information for UP.
Average Train Size	50	cars/train	Project Description
Length of Railcars	60	ft	Spec Sheet
Number of Trains per Day	2	trains/per day	

[1]Based on data collected by the Association of American Railroads for revenue ton-miles and fuel consumption.
Thus dividing g/gal emission rates by average fuel efficiency gives approximate g/ton-mile emission rates.
This factor in all emission estimates has been corrected to 1005 ton-mile per gallon based on a comment from BAAQMD in September 2014.

Source Type - Mode	**2015 PM10 Locomotive Emissions Factor**	
	Value	**Unit**
Line Source - Running Full[1]	3.4	g/gal fuel
Line Source - Running Empty[1]	3.4	g/gal fuel
Total		
1. Emission Factors for large line haul Locomotives in calendar year 2015. Source: EPA-420-F-09-025, April 2009		

Locomotive Line Haul - Line Source (As Separated Volume Source)					
Track Length Considered for Modeling		20,640	feet	3.9	miles
Length of the Line Source, L_{RS}		20,640	ft	3.9	miles
Width of the Line Source, W (Width of one track + 3 m on each side)*		30	ft	9.1	m
Source Type		Line source represented by separated volume sources, Elevated source not on or adjacent to a building			
Length of the Side of the Line/Volume Source = W		30	ft	9.1	m
Spacing of Separated Volume Source Along Line (c/c)	Fairfield, Dixon, Sacramento, and Placer	59	ft	18.1	m
	Auburn, Chico, Marysville, Redding and Truckee	60	ft	18.3	m
Starting Location		Offset Half Volume Width			
Release Height (stack height of 15 ft + avg. vertical plume rise)*		45.8	ft	13.95	m
Initial Lateral Dimension (SYINIT) = 2W/2.15		27.62		8.42	m
Initial Vertical Dimension (SZINIT) = Release Height/4.3		10.64		3.24	m
Number of Volume Sources Modeled:					
	Fairfield	51	volume sources/line	51	volume sources/line
	Dixon	50	volume sources/line	50	volume sources/line
	Sacramento	51	volume sources/line	51	volume sources/line
	Placer	52	volume sources/line	52	volume sources/line
	Auburn	376 351	volume sources/line	376 351	volume sources/line
	Chico	384	volume sources/line	384	volume sources/line
	Marysville	201 160	volume sources/line	201 160	volume sources/line
	Redding	478	volume sources/line	478	volume sources/line
	Truckee	344	volume sources/line	344	volume sources/line

*Appendix C3, Health Risk Assessment for the Southern, California Intermodal Gateway (SCIG), Pg 23/89, http://www.portoflosangeles.org/EIR/SCIG/DEIR/APPENDIX_C3.pdf

Release parameters obtained from Railyard studies such as

http://www.arb.ca.gov/railyard/hra/env_sheila_admrpt.pdf

http://www.arb.ca.gov/railyard/hra/sr_oak_rpt.pdf

* Average of day time and night time release height for arriving and departing line haul in Table 4-1. http://www.arb.ca.gov/railyard/hra/env_richmond_admrpt.pdf

Attachment 2

Health Risk Calculation Methodology using the Updated OEHHA Guidelines

ATTACHMENT 2

HEALTH RISK CALCULATIONS

OEHHA, the state agency that establishes procedures for calculating health risk from toxic air contaminants, updated its guidelines on 6 March 2015 for estimating health risks. This update requires explicit consideration of the effect of toxic air contaminant concentrations on infants, children, and adults. The updated OEHHA guidelines have different values to account for varied breathing rates in different age groups. This results in an overall increase in breathing volume over a 70-year period.

Equation [1] is the approach used to calculate cancer risk per the updated OEHHA guidelines. The updated OEHHA guidelines also require age sensitivity factors (ASFs) to reflect increased cancer risk susceptibility in younger age groups, which are applied to cancer risks calculated over the exposure duration of each age bin. These age-specific breathing rates and ASFs were used in this current analysis, and are shown in Table A1-1.

Equation [1]:

$$\text{Cancer Risk} = ER \times SF \times \left({}_i\sum \chi/Q \times (ED_i/AT) \times ASF_i \times BR_i \times EF \times [1/1000]\right)$$

where:

χ/Q = Concentration modeled for unit emission rate [$(\mu g/m^3)/(g/s)$]
ER = Emission rate of DPM
SF = cancer slope factor for DPM [$(mg/kg\ BW\text{-}day)^{-1}$]
ED_i = exposure duration in age bin i [years]
AT =averaging period (70 years for lifetime cancer risk)
ASF_i = Age sensitivity factor in age bin i
BR_i = Breathing rate in age bin i [liters (L) of air per kg of body weight per day]
EF = exposure frequency (days per 365 days)
[1/1000] = Conversion factor: mg/1000 μg

Table A1-1 Factors Applied to HRA Based on Updated OEHHA Guidelines

Age Bins (i)	Exposure Duration[1] (years)	Age Sensitivity Factor[1]	Breathing Rates[2] (L/kg BW-day)
3rd Trimester	0.25	10	361
0 < 2 Years	2	10	1,090
2 < 16 Years	14	3	745
16 < 70 Years	54	1	290

[1]Use of a 70-year exposure duration and ASFs listed here is consistent with the methodology used in the HRA analysis prepared for the initial DEIR.
[2]The 2014 Crude by Rail Project DEIR HRA analysis used a recommended breathing rate of 302 liters/kilogram of bodyweight per day (L/kg BW-day). These age-specific breathing rates represent the 95th percentile rates for each age bin. Due to potential differences in implementation of the guidance on breathing rates by individual air districts, use of 95th percentile for all ages is considered conservative.

Chronic health hazard index is simply the modeled DPM concentration divided by the OEHHA Reference Exposure Level (REL) for DPM, which is 5 $\mu g/m^3$.

Attachment 3

(Figure 1 through Figure 5)

Created By: Date: 6/1/2015 Project: 0274904

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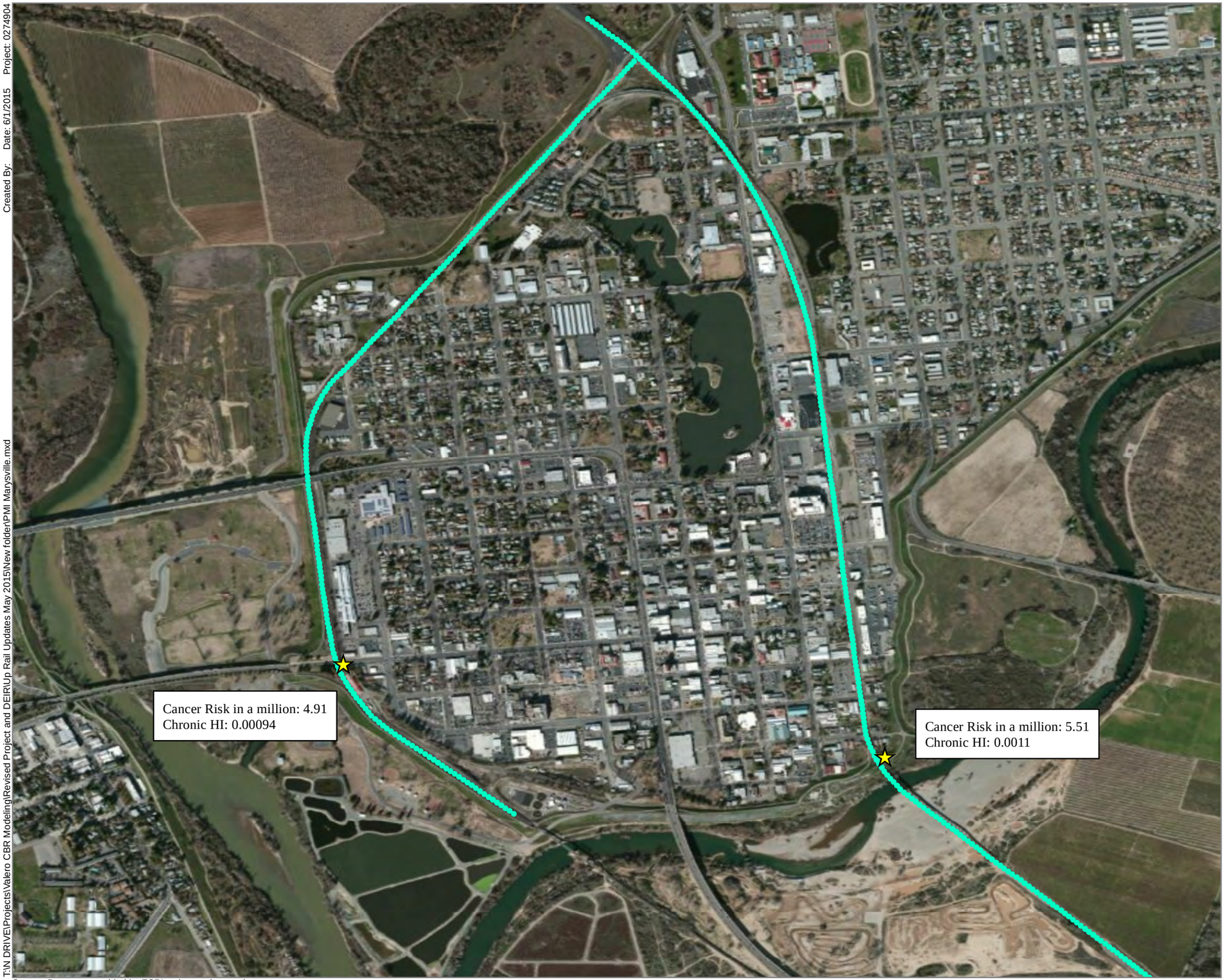


Legend

PMI

Marysville Rail Sources

0 500 1,000 2,000 Feet

Source: Basemap provided by ESRI web mapping services

Figure 1
Marysville Rail Segments: Point of Maximum Impact (PMI) Cancer Risk and Chronic HI

ERM

Project: 0274904
Date: 6/1/2015
Created By:
T:\N DR\VE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI Chico.mxd

Legend

PMI

Chico Rail Sources

N

0 1,100 2,200 4,400 Feet

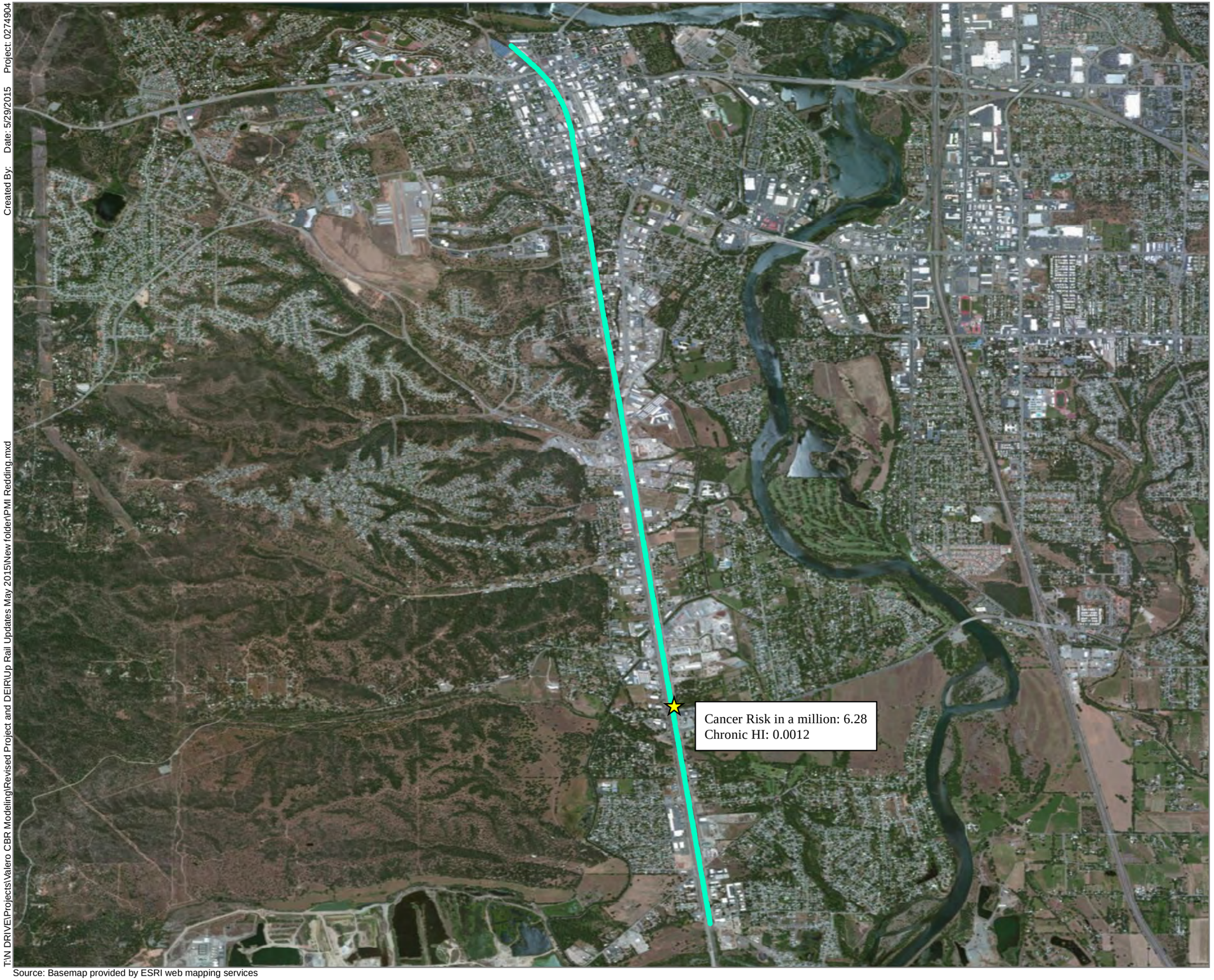
Source: Basemap provided by ESRI web mapping services

ERM

Figure 2
Chico Rail Segments:
Point of Maximum Impact (PMI)
Cancer Risk and Chronic HI

Created By: Date: 5/29/2015 Project: 0274904

T:\N DRIVE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI Redding.mxd



Legend

- Redding Rail Sources

N

0 1,550 3,100 6,200 Feet

Source: Basemap provided by ESRI web mapping services

ERM

Figure 3
Redding Rail Segments:
Point of Maximum Impact (PMI)
Cancer Risk and Chronic HI

Project: 0274904

Date: 5/29/2015

Created By:

T:\N DRIVE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI Auburn.mxd

Legend

- Auburn Rail Sources

N

0 1,100 2,200 4,400 Feet

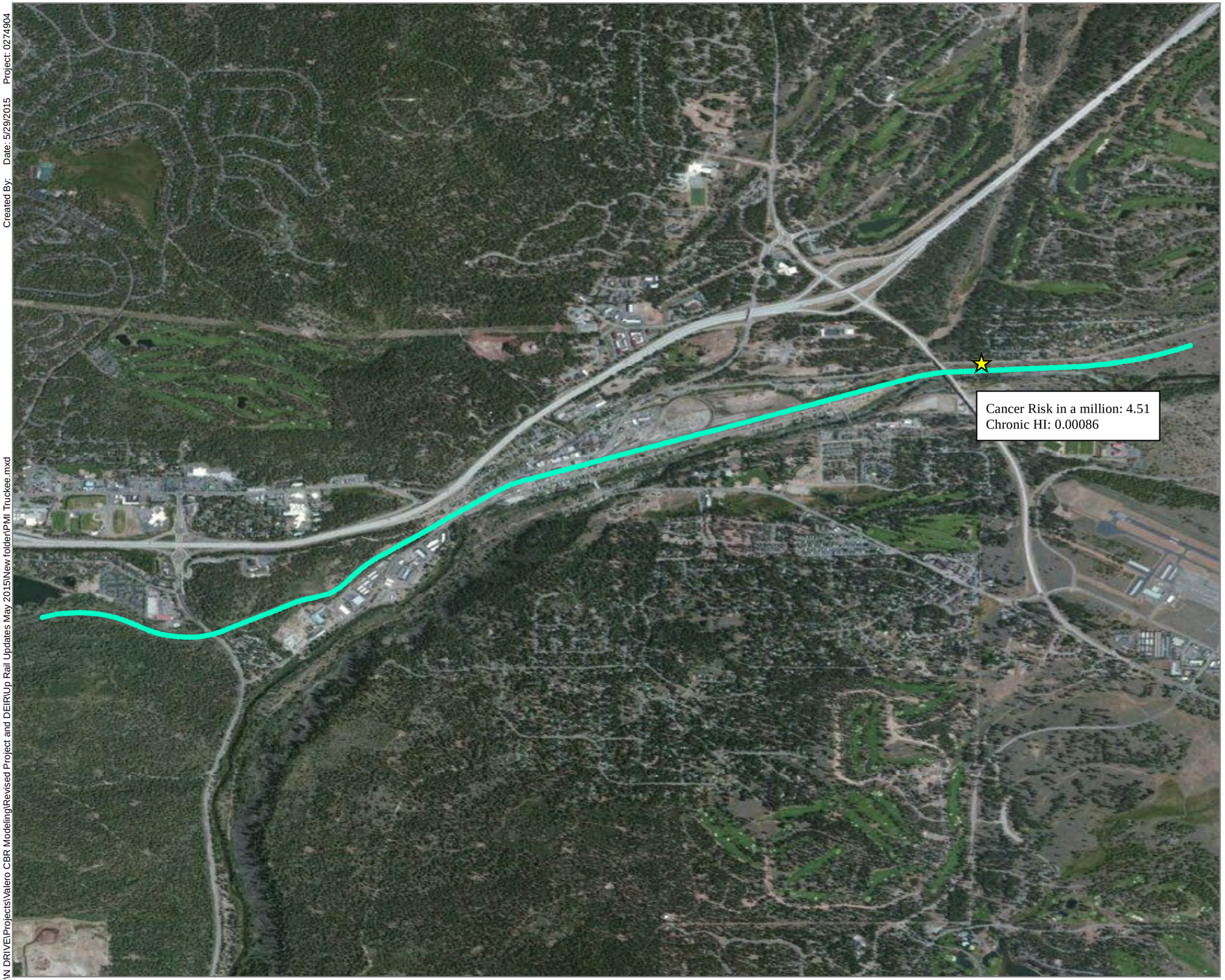
Source: Basemap provided by ESRI web mapping services

ERM

Figure 4
Auburn Rail Segments:
Point of Maximum Impact (PMI)
Cancer Risk and Chronic HI

Created By: Date: 5/29/2015 Project: 0274904

T:\N DRIVE\Projects\Valero CBR Modeling\Revised Project and DEIR\Up Rail Updates May 2015\New folder\PMI_Truckee.mxd



Legend

- Truckee Rail Sources

N

0 1,050 2,100 4,200 Feet

Source: Basemap provided by ESRI web mapping services

ERM

Figure 5
Truckee Rail Segments:
Point of Maximum Impact (PMI)
Cancer Risk and Chronic HI

APPENDIX D

Qualitative Assessment of Cumulative Contribution of Health Impacts near Rail Lines in Auburn, Chico, Marysville, Redding, and Truckee, California

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Memorandum

Environmental Resources Management

1277 Treat Boulevard
Suite 500
Walnut Creek, CA 94597
(925) 946-0455
(925) 946-9968 (fax)

Re: Valero Crude by Rail Project

From: Jennifer Schulte, ERM
Cheri Velzy, ERM

cc: Lynn McGuire, ERM

Date: 19 June 2015

Subject: Qualitative Assessment of Cumulative Contribution of Health Impacts near Rail Lines in Auburn, Chico, Marysville, Redding, and Truckee, California

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This memorandum presents a qualitative analysis of potential cumulative health risk impacts from projected locomotive emissions from the Valero Crude by Rail project traveling between Roseville, California, and the Oregon and Nevada borders, and considers other sources of toxic air contaminants (TACs) near these rail lines. The California Environmental Quality Act (CEQA) Guidelines authorize qualitative as well as quantitative analyses of project impacts for the project alone, and for the impacts of the project combined with the impacts of projects having similar impacts. In this case, because of the lack of sufficient quantitative data for sources of TACs, this analysis employs a qualitative assessment of the project's combined health risk impacts.

BACKGROUND

A health risk assessment was provided in the 2014 Draft Environmental Impact Report (DEIR) for locations between the refinery and Roseville, California. This assessment included analysis of mobile source emissions (offsite locomotives) traveling between Benicia and Roseville, California. At the request of the City of Benicia, additional analysis of locomotive emissions impacts in five uprail locations between Roseville and the northern and eastern California borders are considered. The California locations selected are those along the rail route where the greater potential for cumulative impacts would be expected. They include Auburn, Chico, Marysville, Redding, and Truckee. These represent populated areas that may have sensitive receptors located in proximity to the rail lines between Roseville and the northern and eastern California borders where meterological data was available. The results of project-related locomotive emissions impacts on sensitive receptors in these locations are discussed in a separate memorandum entitled: *Methodology and Results for Project Health Risk Assessment at Project-Specific Uprail Locations between Roseville, California, and the Oregon and Nevada Borders.*

This memorandum discusses other sources near sensitive receptors at the five selected locations that could contribute to cumulative air quality impacts and health effects.

METHODOLOGY

Stationary Sources

The United States Environmental Protection Agency Federal Reporting System contains location and facility identification numbers for facilities that handle toxic compounds. This system includes those sources with reporting requirements based on the federal reporting threshold. This information system was queried to identify sources within 1,000 feet of the rail lines in locations subject to this cumulative qualitative risk assessment[1]. This list was further limited to exclude facilities that only reported solid and waterborne wastes since this analysis was focused on air emissions impacts. The North American Industry Classification System (NAICS) codes for these facilities provide a general idea of the facility type.

Roadways and Existing Rail Traffic

In addition to the project-related rail traffic, nearby major roadways and existing rail traffic contribute to the overall cumulative impact for nearby sensitive receptors. Rail traffic primarily generates diesel particulate matter (DPM) emissions from the combuston of diesel fuel. Motor vehicles emit an assortment of TACs and particulate matter associated with combustion of gasoline, diesel motor fuels, and tire and brake wear. Major roadways are present near the rail lines that would contribute to the overall health impacts of a sensitive receptor located near the rail lines. The level of contribution depends on the volume of traffic and the distance from the roadway to the sensitive receptor.

ANALYSIS

Source-specific TAC emission information is not consistently available for sources (nearby facilities, roadways, existing rail traffic) in the less populated California air districts. The subsections below summarize the types of nearby facilities and roadways

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[1] Identification of sources within 1,000 foot radius of a source is consistent with the approach used in the previous DEIR and methodology used in the BAAQMD's Updated CEQA Air Quality Guidelines, May 2012.

in the five locations, to give a general perspective of nearby emissions sources and types. The sources in each uprail area that would contribute to a cumulative impact are shown on Figures 1 through 5.

Marysville

The Marysville area has several minor sources of localized emissions that are commonly found in populated areas. These primarily include gas stations. Larger sources of emissions in Marysville include an electroplating facility, a ready-mix concrete facility, a rendering and meat processing facility, and a shelving unit and display case manufacturing facility. Stationary sources within 1,000 feet of the rail lines in Marysville are shown on Figure 1. The larger sources are labeled. In addition, State Route (SR)-20 and SR-70 are primary thoroughfares through Marysville and are likely substantial contributors to the cumulative risk at a sensitive receptor near the rail lines.

Chico

The Chico area has several minor sources of localized emissions that are commonly found in populated areas. These include auto body shops, gas stations, dry-cleaners, and telecommunications facilities housing standby generators, which are intermittent sources of DPM. Slightly larger sources of localized emissions include California State University-Chico (CSU-Chico), breweries, machinery repair and maintenance, motor vehicle manufacturing, pump and pump equipment manufacturing, a ready-mix concrete facility, wood cabinet manufacturing, and rail support activities. Stationary sources within 1,000 feet of Chico rail lines are shown on Figure 2. CSU-Chico is approximately 1,100 feet northeast of the rail line. The primary sources of cumulative risk in Chico would be diesel standby generators and roadway traffic. SR-32 runs parallel to the rail line, and is shown on Figure 2. SR-32 is a primary thoroughfare near Chico and is likely a substantial contributor to the cumulative risk at nearby receptors near the rail line.

Redding

The Redding area has several minor sources of localized emissions that are commonly found in populated areas. These primarily include auto body shops. Larger sources of emissions in Redding include a bulk terminal, engineered wood, fabricated structural steel, millwork, a ready-mix concrete facility, and sawmills. Stationary sources within 1,000 feet of the rail line in Redding are shown on Figure 3. SR-273 is immediately adjacent to the rail line, is a primary thoroughfare through Redding, and is likely a substantial contributor to the cumulative risk at nearby receptors. Interstate (I)-5 is more than 9,000 feet from the rail line. Based on information provided by the Bay Area Air

Quality Management District (BAAQMD) for I-80 near Fairfield, a major roadway that is far removed from a sensitive receptor would contribute a very minor, if any amount, to the cumulative risk at a sensitive receptor near that rail line.

Auburn

The Auburn area has several minor sources of localized emissions that are commonly found in populated areas. These include auto body shops, gas stations, and telecommunications facilities housing standby generators, which are intermittent sources of DPM. Slightly larger sources of localized emissions include electrical power generation, wood cabinet manufacturing, and a construction company. Stationary sources within 1,000 feet of the Auburn rail lines are shown on Figure 4. Two major roadways, I-80, a major truck route with high traffic volume, and SR-49, are also shown on Figure 4. These roadways and existing rail line traffic are substantial contributors to the cumulative risk at receptors near the rail lines.

Truckee

There were no stationary source facilities located within 1,000 feet of the rail line in Truckee. I-80 is a major truck route with high traffic volume that runs parallel to the rail line. SR-89 and SR-267 intersect the rail line in Truckee. The rail line and major roadways in Truckee are shown on Figure 5. These major roadways (I-80, SR-89 and SR-267) and existing rail traffic would contribute to a cumulative impact at a sensitive receptor near the rail line.

Emission Types

The NAICS code can give a general indication of the types of emissions that may occur for a given facility. Table 1 summarizes some of the major NAICS categories identified and typical emission types.

Table 1 NAICS Categories for Emission Profiles

Facility Type	Type of Emissions
Gasoline Dispensing Facilitiy	TACs (benzene, toluene, xylenes) associated with gasoline and diesel fuel emissions
Autobody Shop	PM[1] and TACs associated with paints and surface coating
Ready-Mix Concrete	PM and TACs (i.e., metals) from aggregate processing
Airport Operations	PM and TACs (combustion exhaust) from equipment used to operate the facility
Landfill	PM and various organic compounds from breakdown of material and equipment used to manage waste
Wastewater Treatment Plant	Various organic compounds from volatilization of compounds at liquid surface
Telecommunications	PM associated with intermittant operation of emergency diesel generators
Other Electric Power Generation	PM and various TACs in natural gas combustion associated with generation of power
Manufacturing	PM and various TACs used in the manufacturing process
Funeral Home	PM, formaldehyde, and metals
Rendering Facility	Ammonia
Postharvest Crop Activities	DPM from agricultural equpment
Freight Transportation Arrangement	DPM from trucks
Newspaper Facilities	PM and TACs from printing components
Brewery	PM
Coffee Roasting	PM

1. PM is used generically to represent DPM, respirable particulate matter less than 10 microns in diameter (PM_{10}), and inhalable particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), as all may be emitted to varying degrees.

SUMMARY

Point source and fugitive emissions from adjacent existing facilities, and emissions from nearby roadways and railroad locomotives contribute to a cumulative amount of particulate matter and TACs for sensitive receptors near these facilities, roadways, and rail lines. Because information for quantifying existing health risk conditions in these cities is limited, an accurate quantitative analysis that provides a quantitative magnitude or significance level is not feasible. Cumulative risk thresholds have not been established by the air quality management agencies in these uprail areas, nor has the quantitative contribution to cumulative impact from a majority of the existing sources been determined.

However, this qualitative analysis can present the project's contribution to the cumulative impact and evaluate whether or not that contribution is considerable. The considerable contributions of a project to a potential cumulative impact are determined by looking at the project's impact relative to the project-level thresholds. If a project's impact is less than the project-level significance threshold, then the project's contribution to combined effects in the relevant geographical area is not considerable.

Assembly Bill (AB) 2588 air toxics "hot spots" public notification thresholds of 10 in one million for cancer risk and 1.0 for chronic hazard index, which are applicable in these uprail counties (Butte, Feather River, Placer, and Shasta), provide a level below which public notification of risk is deemed unnecessary. Some of the subject air districts between Roseville and the California border have proposed project-specific risk thresholds of 10 in one million for cancer risk and 1.0 for chronic hazard index for CEQA purposes. The risk threshold values listed in AB 2588 are also equivalent to the BAAQMD's CEQA threshold level of 10 in one million for cancer risk and 1.0 for chronic hazard index, and have been used for both stationary and mobile sources. The same risk thresholds were used in the 2014 DEIR, and may be used for evaluating whether the project's contribution to the cumulative impact is considerable in these uprail locations. For reference, the BAAQMD's proposed cumulative threshold for combined cancer risk is 100 in one million, and for combined chronic hazard index is 10.0.[2]

The proposed increased rail activity from the project in these locations would contribute less than 10 in one million to any cumulative cancer risk and a chronic hazard index of less than 1.0 at sensitive receptors near subject rail lines in the selected uprail communities analyzed in this report. Therefore, the project would not itself have a cumulatively considerable health risk impact. As for the impacts of the project combined with those of other sources, an assessment of those cumulative impacts, given the lack of relevant and meaningful data, would be speculative. CEQA does not require speculation. Nevertheless, it is conservatively assumed for the purpose of this analysis that the combined effects of the project with the other sources identified above could have a potential significant and unavoidable (given federal preemption) cumulative (i.e., combined) health risk.

[2] The thresholds proposed in BAAQMD's 2010 CEQA Guidelines, though currently superseded by court order, are used by the City of Benicia in the 2014 DEIR, for the reasons stated therein. Moreover, BAAQMD's methodology for cumulative risk assessment is finalized and included in its 2012 CEQA Guidelines.

Figures

Project: 0274904
Date: 6/16/2015
Created By:
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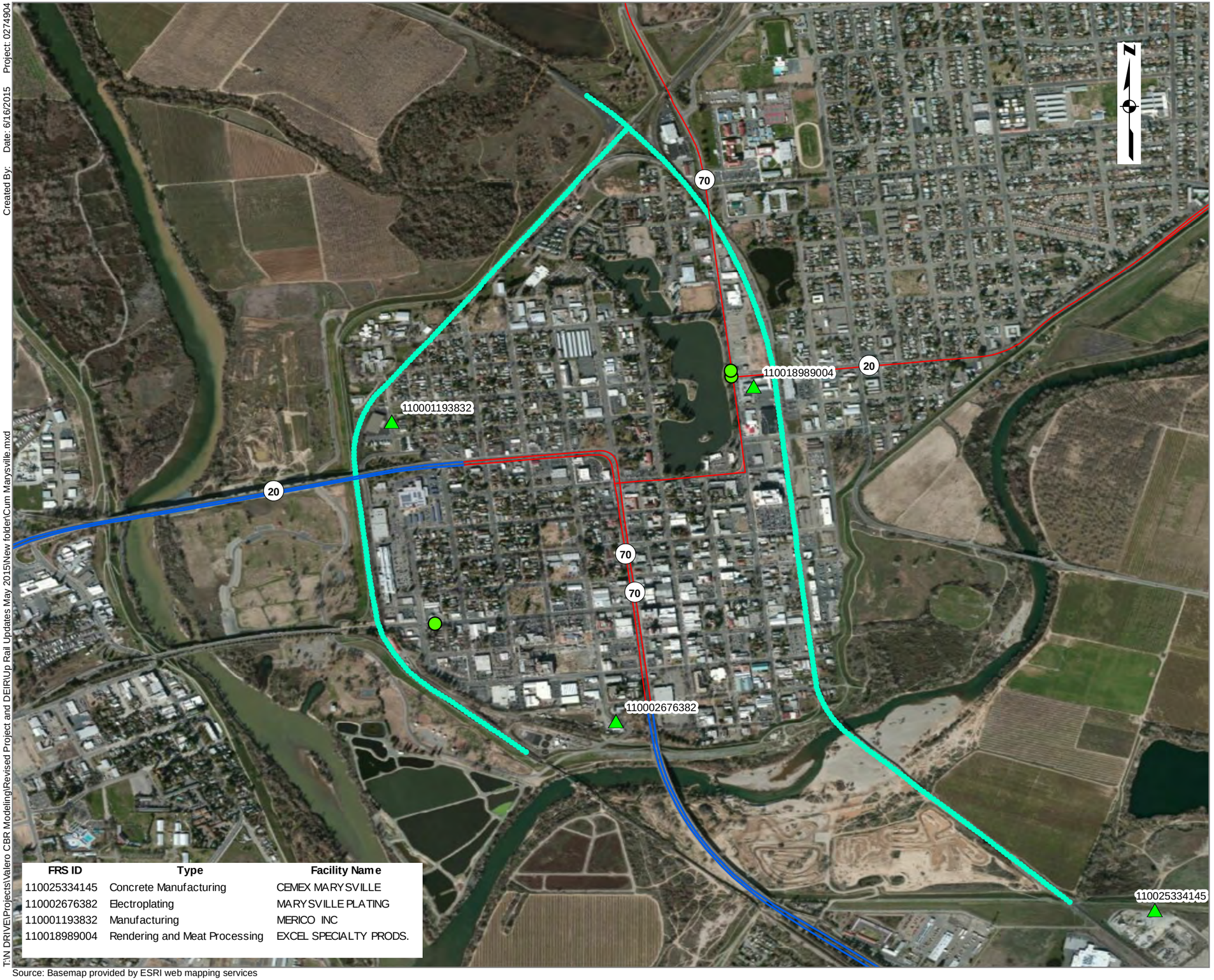


FRS ID	Type	Facility Name
110025334145	Concrete Manufacturing	CEMEX MARYSVILLE
110002676382	Electroplating	MARYSVILLE PLATING
110001193832	Manufacturing	MERICO INC
110018989004	Rendering and Meat Processing	EXCEL SPECIALTY PRODS.

Source: Basemap provided by ESRI web mapping services

0 625 1,250 2,500 Feet

Legend

Small Facility Type

- Gas Stations
- Large Facilities
- Marysville Rail Lines

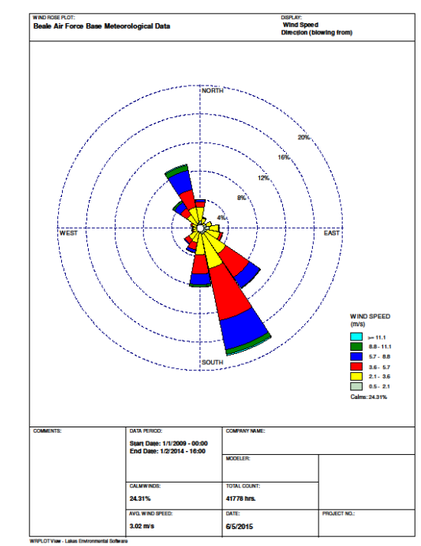
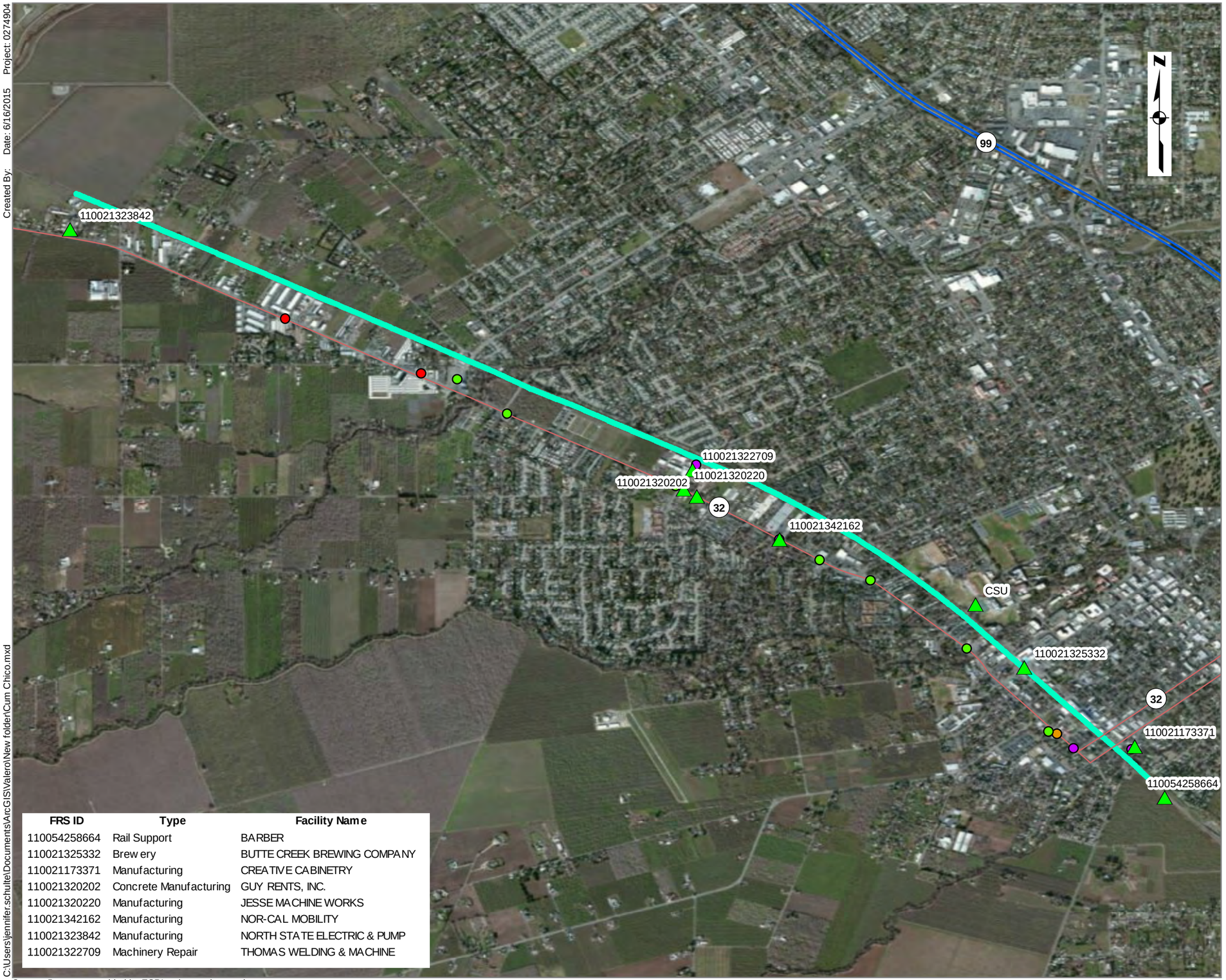


Figure 1
Marysville Rail Segments: Cumulative Stationary Sources

Created By: Date: 6/16/2015 Project: 0274904



FRS ID	Type	Facility Name
110054258664	Rail Support	BARBER
110021325332	Brewery	BUTTE CREEK BREWING COMPANY
110021173371	Manufacturing	CREATIVE CABINETRY
110021320202	Concrete Manufacturing	GUY RENTS, INC.
110021320220	Manufacturing	JESSE MACHINE WORKS
110021342162	Manufacturing	NOR-CAL MOBILITY
110021323842	Manufacturing	NORTH STATE ELECTRIC & PUMP
110021322709	Machinery Repair	THOMAS WELDING & MACHINE

Source: Basemap provided by ESRI web mapping services

0 1,100 2,200 4,400 Feet

Legend

Small Facility Type

- Auto Body
- Drycleaning
- Gas Stations
- Telecommunications
- Large Facilities
- Chico Rail Line

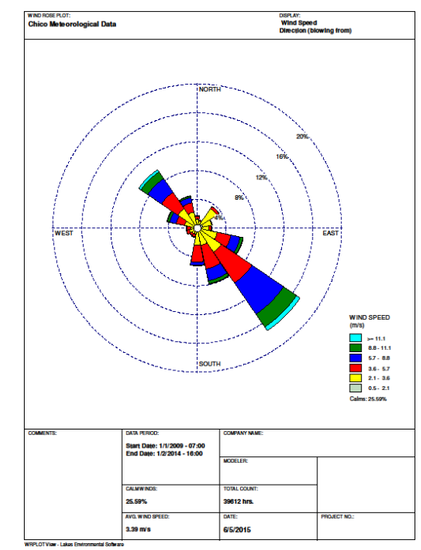


Figure 2
Chico Rail Segments: Cumulative Stationary SourcesI

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Project: 0274904
Date: 6/17/2015
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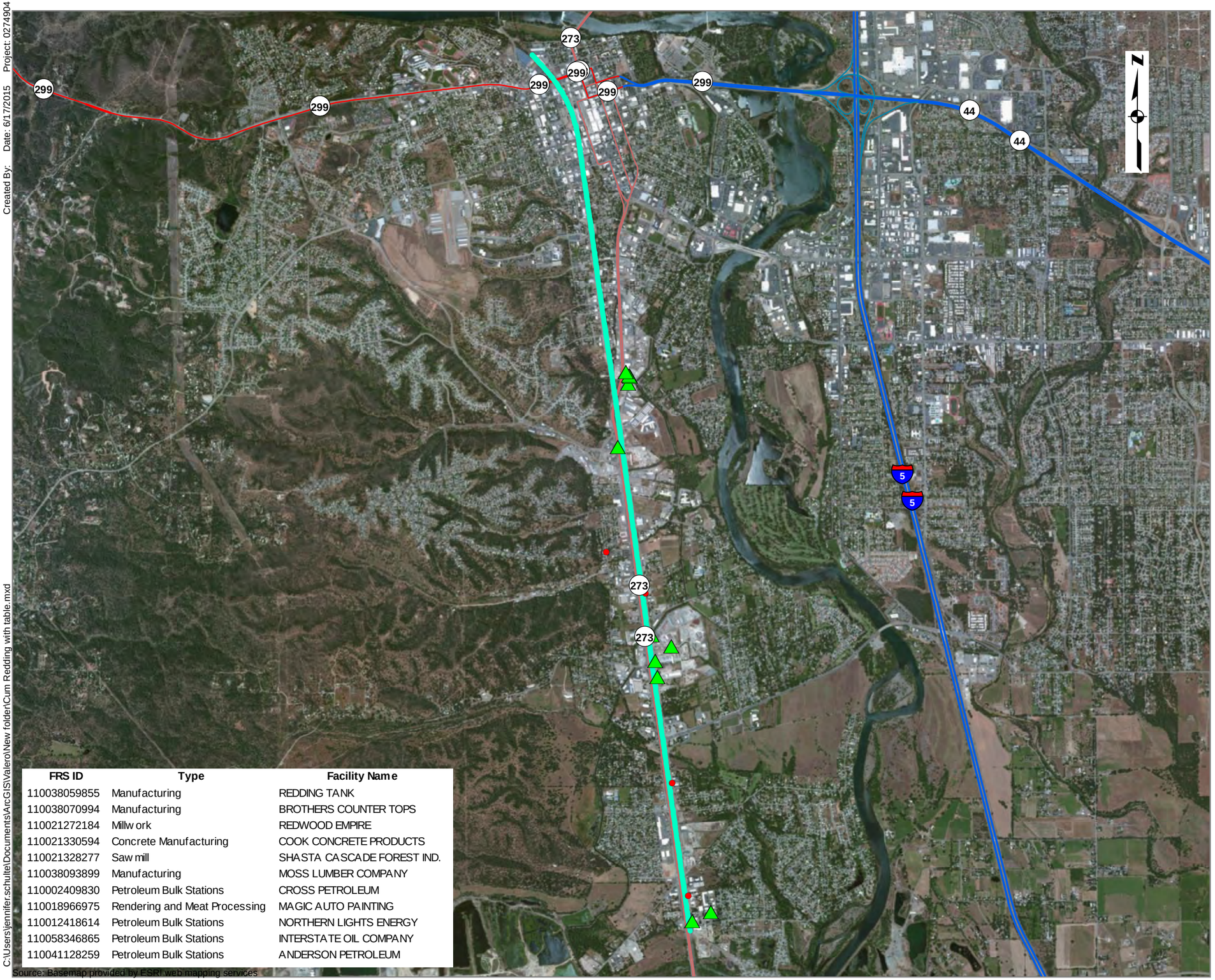
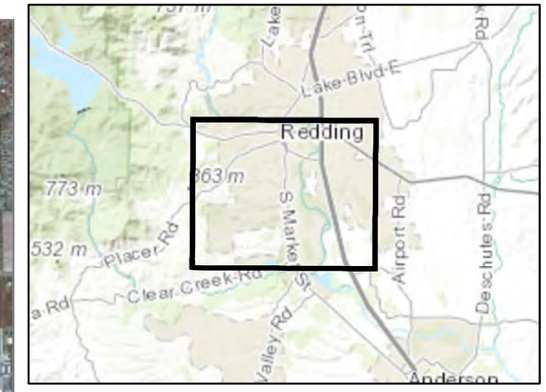


FRS ID	Type	Facility Name
110038059855	Manufacturing	REDDING TANK
110038070994	Manufacturing	BROTHERS COUNTER TOPS
110021272184	Millw ork	REDWOOD EMPIRE
110021330594	Concrete Manufacturing	COOK CONCRETE PRODUCTS
110021328277	Saw mill	SHASTA CASCADE FOREST IND.
110038093899	Manufacturing	MOSS LUMBER COMPANY
110002409830	Petroleum Bulk Stations	CROSS PETROLEUM
110018966975	Rendering and Meat Processing	MAGIC AUTO PAINTING
110012418614	Petroleum Bulk Stations	NORTHERN LIGHTS ENERGY
110058346865	Petroleum Bulk Stations	INTERSTATE OIL COMPANY
110041128259	Petroleum Bulk Stations	ANDERSON PETROLEUM

Source: Basemap provided by ESRI web mapping services

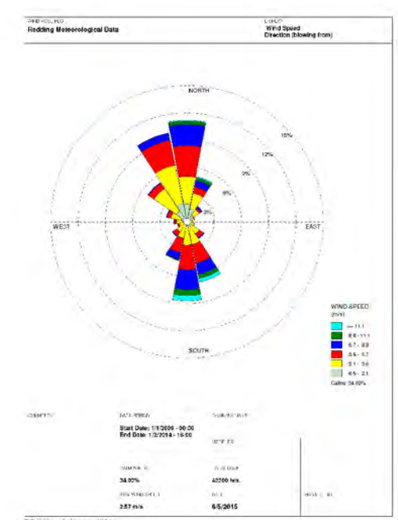


0 1,600 3,200 6,400 Feet

Legend

Small Facility Type

- Auto Body
- Large Facilities
- Redding Rail Line



ERM

Figure 3
Redding Rail Segments: Cumulative Stationary Sources

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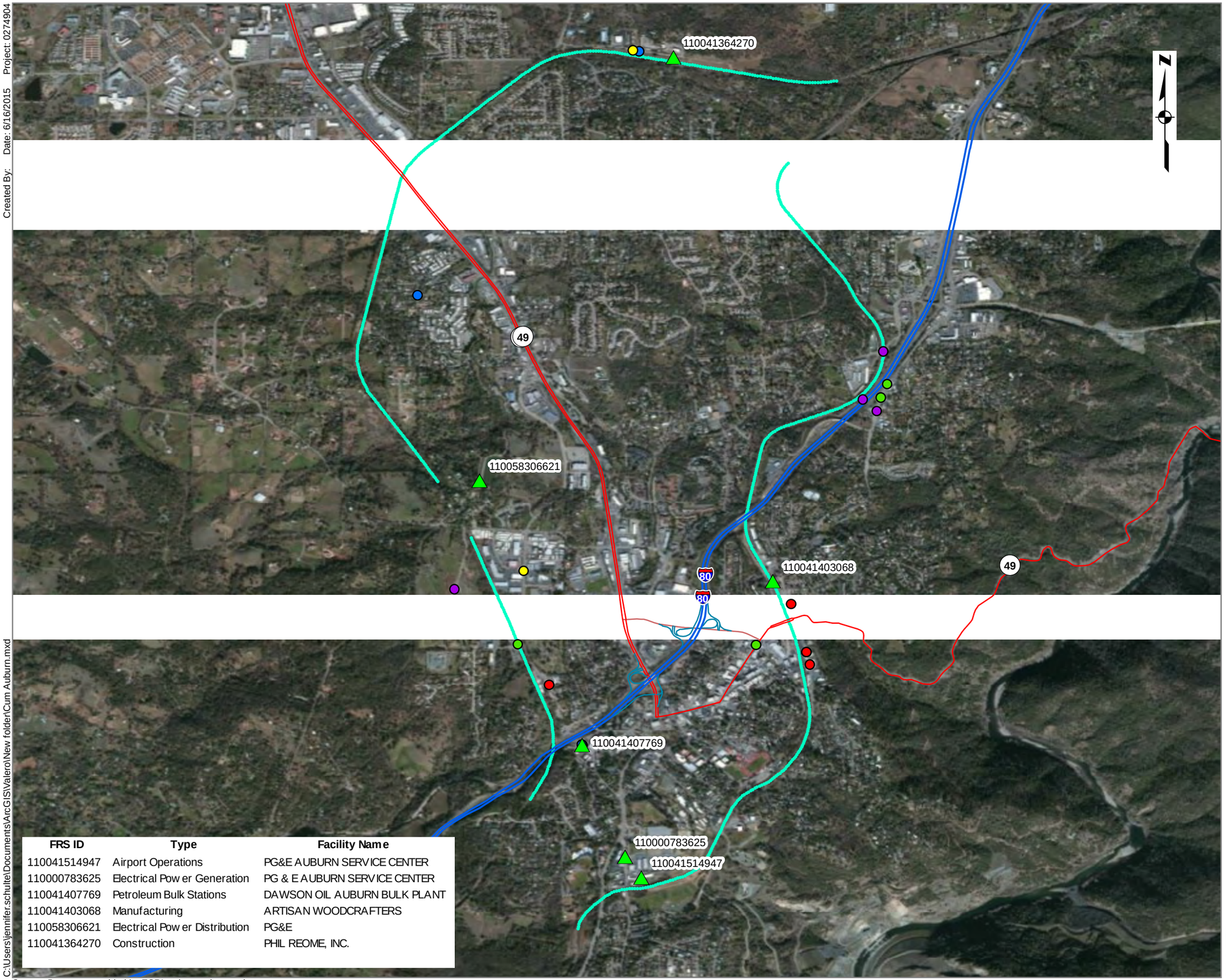
Date: 6/16/2015
Created By:



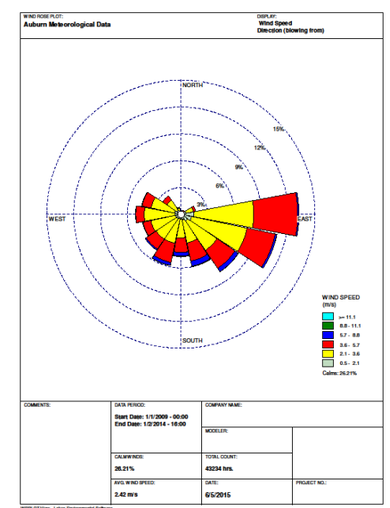
FRS ID	Type	Facility Name
110041514947	Airport Operations	PG&E AUBURN SERVICE CENTER
110000783625	Electrical Pow er Generation	PG & E AUBURN SERVICE CENTER
110041407769	Petroleum Bulk Stations	DAWSON OIL AUBURN BULK PLANT
110041403068	Manufacturing	ARTISAN WOODCRAFTERS
110058306621	Electrical Pow er Distribution	PG&E
110041364270	Construction	PHIL REOME, INC.

0 1,100 2,200 4,400 Feet

Legend

Small Facility Type

- Auto Body
- Educational Support
- Gas Stations
- Other Government Support
- Telecommunications
- Large Facilities
- Auburn Rail Lines



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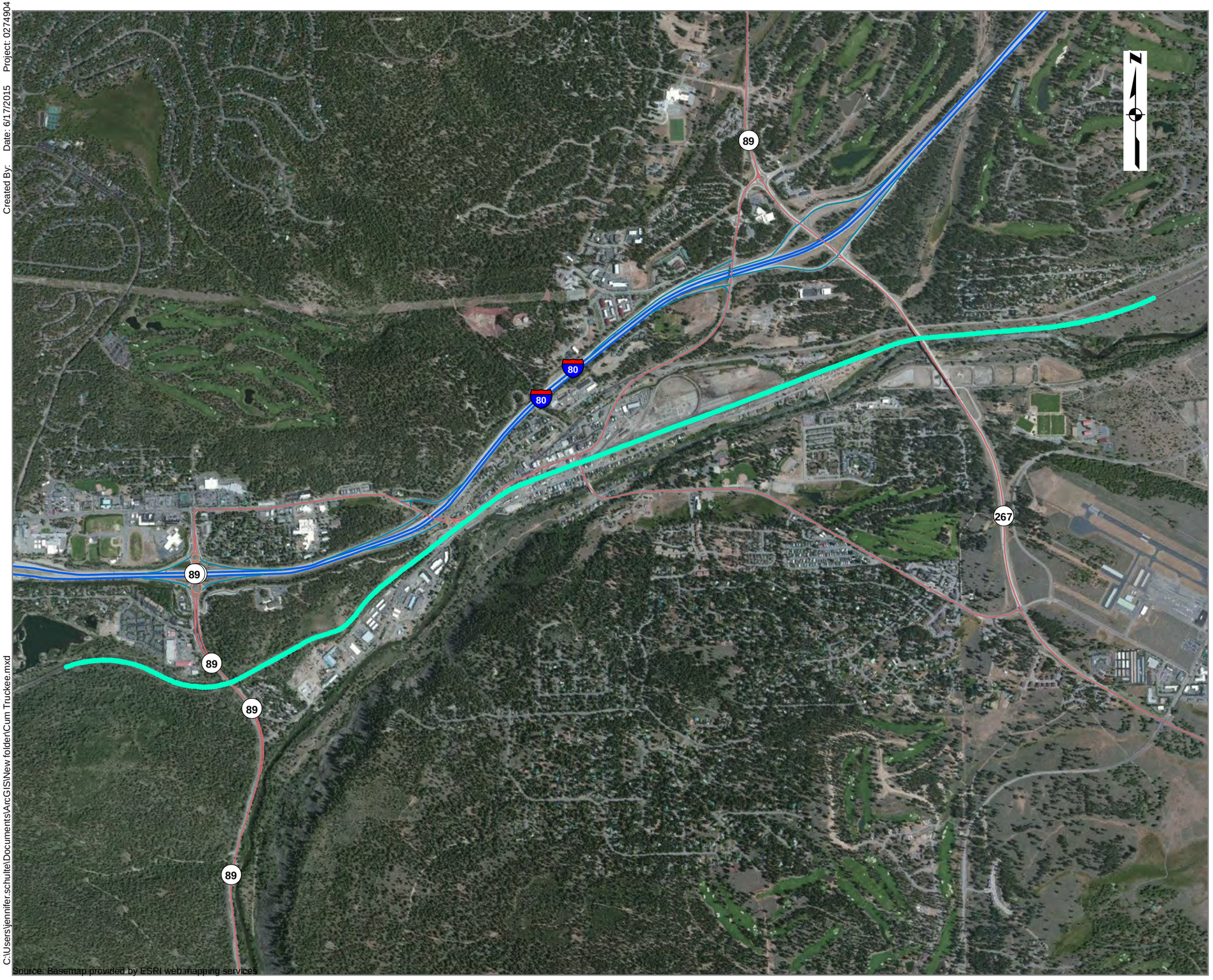
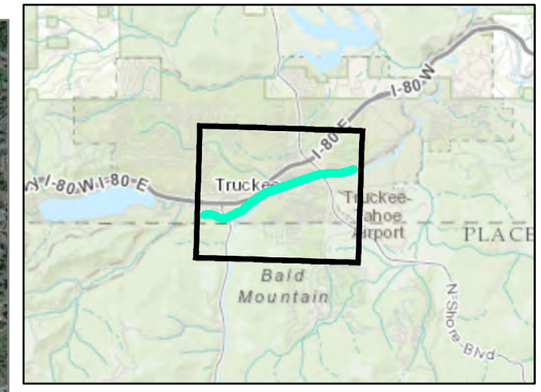
Source: Basemap provided by ESRI web mapping services

ERM

Figure 4
Auburn Rail Segments: Cumulative Stationary Sources

Created By: Date: 6/17/2015 Project: 0274904

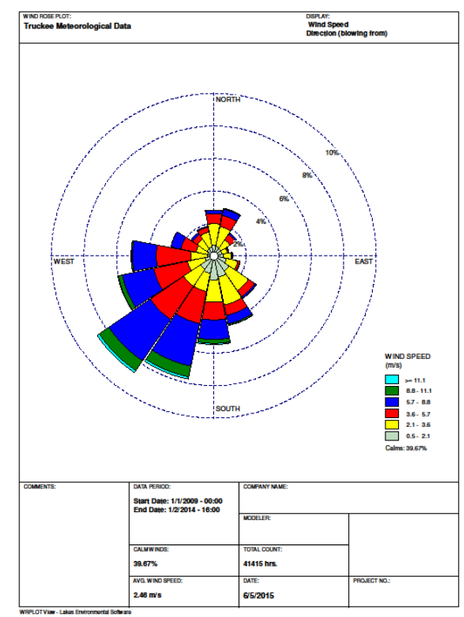




0 875 1,750 3,500 Feet

Legend

- Truckee Rail Line



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Source: Basemap provided by ESRI web mapping services

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Figure 5
Truckee Rail Segments: Cumulative Stationary Sources

APPENDIX E

Sensitive Biological Resources within 300 Feet of Rail Routes

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SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES

Scientific Name	Federal/State/CNPS Status
Benicia to Roseville	
Special Status Wildlife	
California tiger salamander *Ambystoma californiense*	FE/ST
white-tailed kite *Elanus leucurus*	--/FP
Swainson's hawk *Buteo swainsoni*	--/ST
American peregrine falcon *Falco peregrinus anatum*	Delisted/FP
California black rail *Laterallus jamaicensis coturniculus*	--/ST
Ridgeway's (California clapper) rail *Rallus obsoletus*	FE/SE
burrowing owl *Athene cunicularia*	--/SSC
purple martin *Progne subis*	--/SSC
least Bell's vireo *Vireo bellii pusillus*	FE/SE
saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--/SSC
song sparrow ("Modesto" population) *Melospiza melodia*	--/SSC
Suisun song sparrow *Melospiza melodia maxillaris*	--/SSC
steelhead - Central Valley DPS *Oncorhynchus mykiss irideus*	FT/--
longfin smelt *Spirinchus thaleichthys*	FC/ST
Sacramento splittail *Pogonichthys macrolepidotus*	--/SSC
Suisun shrew *Sorex ornatus sinuosus*	--/SSC
silver-haired bat *Lasionycteris noctivagans*	--/--
hoary bat *Lasiurus cinereus*	--/--
pallid bat *Antrozous pallidus*	--/SSC
salt-marsh harvest mouse *Reithrodontomys raviventris*	FE/SE
American badger *Taxidea taxus*	--/SSC
western pond turtle *Actinemys marmorata*	--/SSC
Alameda whipsnake *Masticophis lateralis euryxanthus*	FT/ST
giant garter snake *Thamnophis gigas*	FT/ST

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Benicia to Roseville (cont.)	
Special Status Wildlife (cont.)	
vernal pool fairy shrimp *Branchinecta lynchi*	FT/--
vernal pool tadpole shrimp *Lepidurus packardi*	FE/--
callippe silverspot butterfly *Speyeria callippe callippe*	FE/--
Special Status Plants	
Bolander's water-hemlock *Cicuta maculata var. bolanderi*	--/--/2B.1
Mason's lilaeopsis *Lilaeopsis masonii*	--/--/1B.1
Carquinez goldenbush *Isocoma arguta*	--/--/1B.1
Contra Costa goldfields *Lasthenia conjugens*	FE/--/1B.1
Suisun Marsh aster *Symphyotrichum lentum*	--/--/1B.2
dwarf downingia *Downingia pusilla*	--/--/2B.2
legenere *Legenere limosa*	--/--/1B.1
San Joaquin spearscale *Extriplex joaquinana*	--/--/1B.2
alkali milk-vetch *Astragalus tener var. tener*	--/--/1B.2
Delta tule pea *Lathyrus jepsonii var. jepsonii*	--/--/1B.2
showy rancheria clover *Trifolium amoenum*	FE/--/1B.1
round-leaved filaree *California macrophylla*	--/--/1B.1
Mt. Diablo buckwheat *Eriogonum truncatum*	--/--/1B.1
Baker's navarretia *Navarretia leucocephala ssp. bakeri*	--/--/1B.1
soft salty bird's-beak *Chloropyron molle ssp. molle*	FE/Rare/1B.2
Sanford's arrowhead *Sagittaria sanfordii*	--/--/1B.2
adobe-lily *Fritillaria pluriflora*	--/--/1B.2
Sensitive Communities	
Northern Claypan Vernal Pool	
Coastal Brackish Marsh	
Elderberry Savanna	

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Oregon	
Special Status Wildlife	
Pacific tailed frog *Ascaphus truei*	--/SSC
foothill yellow-legged frog *Rana boylii*	--/SSC
Cascades frog *Rana cascadae*	--/SSC
osprey *Pandion haliaetus*	--/WL
bald eagle *Haliaeetus leucocephalus*	Delisted/SE
Swainson's hawk *Buteo swainsoni*	--/ST
ferruginous hawk *Buteo regalis*	--/WL
American peregrine falcon *Falco peregrinus anatum*	Delisted/FP
prairie falcon *Falco mexicanus*	--/WL
greater sandhill crane *Grus canadensis tabida*	--/ST
western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT/SE
burrowing owl *Athene cunicularia*	--/SSC
black swift *Cypseloides niger*	--/SSC
bank swallow *Riparia riparia*	--/ST
least Bell's vireo *Vireo bellii pusillus*	FE/SE
song sparrow ("Modesto" population) *Melospiza melodia*	--/SSC
chinook salmon - Central Valley spring-run ESU *Oncorhynchus tshawytscha*	FT/ST
steelhead - Central Valley DPS *Oncorhynchus mykiss irideus*	FT/--
western red bat *Lasiurus blossevillii*	--/SSC
spotted bat *Euderma maculatum*	--/SSC
Townsend's big-eared bat *Corynorhinus townsendii*	--/SCT
pallid bat *Antrozous pallidus*	--/SSC
western mastiff bat *Eumops perotis californicus*	--/SSC
gray wolf *Canis lupus*	FE/SE

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Oregon (cont.)	
Special Status Wildlife (cont.)	
fisher - West Coast DPS *Pekania pennanti*	FPT/SCT
California wolverine *Gulo gulo*	--/ST
western pond turtle *Actinemys marmorata*	--/SSC
giant garter snake *Thamnophis gigas*	FT/ST
vernal pool fairy shrimp *Branchinecta lynchi*	FT/--
vernal pool tadpole shrimp *Lepidurus packardi*	FE/--
Special Status Plants	
broad-nerved hump moss *Meesia uliginosa*	--/--/2B.2
marbled wild-ginger *Asarum marmoratum*	--/--/2B.3
woolly balsamroot *Balsamorhiza lanata*	--/--/1B.2
big-scale balsamroot *Balsamorhiza macrolepis*	--/--/1B.2
Shasta chaenactis *Chaenactis suffrutescens*	--/--/1B.3
alkali hymenoxys *Hymenoxys lemmonii*	--/--/2B.2
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE/SE/1B.1
subalpine aster *Eurybia merita*	--/--/2B.3
silky cryptantha *Cryptantha crinita*	--/--/1B.2
seaside bittercress *Cardamine angulata*	--/--/2B.1
Mt. Eddy draba *Draba carnosula*	--/--/1B.3
Columbia yellow cress *Rorippa columbiae*	--/--/1B.2
dwarf downingia *Downingia pusilla*	--/--/2B.2
legenere *Legenere limosa*	--/--/1B.1
Hoover's spurge *Euphorbia hooveri*	FT/--/1B.2
Ferris' milk-vetch *Astragalus tener var. ferrisiae*	--/--/1B.1
Siskiyou clover *Trifolium siskiyouense*	--/--/1B.1

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Oregon (cont.)	
Special Status Plants (cont.)	
round-leaved filaree *California macrophylla*	--/--/1B.1
Cooke's phacelia *Phacelia cookei*	--/--/1B.1
veiny monardella *Monardella venosa*	--/--/1B.1
marsh skullcap *Scutellaria galericulata*	--/--/2B.2
Butte County checkerbloom *Sidalcea robusta*	--/--/1B.2
northern clarkia *Clarkia borealis ssp. borealis*	--/--/1B.3
Oregon fireweed *Epilobium oreganum*	--/--/1B.2
pincushion navarretia *Navarretia myersii ssp. myersii*	--/--/1B.1
Cantelow's lewisia *Lewisia cantelovii*	--/--/1B.2
woodnymph *Moneses uniflora*	--/--/2B.2
recurved larkspur *Delphinium recurvatum*	--/--/1B.2
Newberry's cinquefoil *Potentilla newberryi*	--/--/2B.3
pallid bird's-beak *Cordylanthus tenuis ssp. pallescens*	--/--/1B.2
Shasta orthocarpus *Orthocarpus pachystachyus*	--/--/1B.1
grass alisma *Alisma gramineum*	--/--/2B.2
pointed broom sedge *Carex scoparia var. scoparia*	--/--/2B.2
Red Bluff dwarf rush *Juncus leiospermus var. leiospermus*	--/--/1B.1
Indian Valley brodiaea *Brodiaea rosea*	--/SE/1B.1
adobe-lily *Fritillaria pluriflora*	--/--/1B.2
slender Orcutt grass *Orcuttia tenuis*	FT/SE/1B.1
northern adder's-tongue *Ophioglossum pusillum*	--/--/2B.2
Sensitive Communities	
Central Valley Drainage Valley Floor River	
Central Valley Drainage Fall Run Chinook Stream	
Northern Hardpan Vernal Pool	
Great Valley Cottonwood Riparian Forest	

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Oregon (cont.)	
Sensitive Communities (cont.)	
Great Valley Mixed Riparian Forest	
Great Valley Valley Oak Riparian Forest	
Roseville to Nevada (northern)	
Special Status Wildlife	
foothill yellow-legged frog *Rana boylii*	--/SSC
northern goshawk *Accipiter gentilis*	--/SSC
Swainson's hawk *Buteo swainsoni*	--/ST
prairie falcon *Falco mexicanus*	--/WL
California black rail *Laterallus jamaicensis coturniculus*	--/ST
western yellow-billed cuckoo *Coccyzus americanus occidentalis*	FT/SE
burrowing owl *Athene cunicularia*	--/SSC
long-eared owl *Asio otus*	--/SSC
willow flycatcher *Empidonax traillii*	--/SE
least Bell's vireo *Vireo bellii pusillus*	FE/SE
song sparrow ("Modesto" population) *Melospiza melodia*	--/SSC
chinook salmon - Central Valley spring-run ESU *Oncorhynchus tshawytscha*	FT/ST
steelhead - Central Valley DPS *Oncorhynchus mykiss irideus*	FT/--
hardhead *Mylopharodon conocephalus*	--/SSC
Townsend's big-eared bat *Corynorhinus townsendii*	--/SCT
pallid bat *Antrozous pallidus*	--/SSC
western mastiff bat *Eumops perotis californicus*	--/SSC
western white-tailed jackrabbit *Lepus townsendii townsendii*	--/SSC
Sierra Nevada mountain beaver *Aplodontia rufa californica*	--/SSC
gray wolf *Canis lupus*	FE/SE
Sierra Nevada red fox *Vulpes vulpes necator*	--/ST

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Nevada (northern) (cont.)	
Special Status Wildlife (cont.)	
American badger *Taxidea taxus*	--/SSC
western pond turtle *Actinemys marmorata*	--/SSC
vernal pool fairy shrimp *Branchinecta lynchi*	FT/--
vernal pool tadpole shrimp *Lepidurus packardi*	FE/--
valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT/--
Carson wandering skipper *Pseudocopaeodes eunus obscurus*	FE/--
Special Status Plants	
big-scale balsamroot *Balsamorhiza macrolepis*	--/--/1B.2
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE/SE/1B.1
Lewis Rose's ragwort *Packera eurycephala var. lewisrosei*	--/--/1B.2
sticky pyrrocoma *Pyrrocoma lucida*	--/--/1B.2
Constance's rockcress *Boechera constancei*	--/--/1B.1
dissected-leaved toothwort *Cardamine pachystigma var. dissectifolia*	--/--/1B.2
many-flowered thelypodium *Thelypodium milleflorum*	--/--/2B.2
dwarf downingia *Downingia pusilla*	--/--/2B.2
Clifton's eremogone *Eremogone cliftonii*	--/--/1B.3
western seablite *Suaeda occidentalis*	--/--/2B.3
Hillman's cleomella *Cleomella hillmanii var. hillmanii*	--/--/2B.2
Feather River stonecrop *Sedum albomarginatum*	--/--/1B.2
Geyer's milk-vetch *Astragalus geyeri var. geyeri*	--/--/2B.2
Lemmon's milk-vetch *Astragalus lemmonii*	--/--/1B.2
lens-pod milk-vetch *Astragalus lentiformis*	--/--/1B.2
Pulsifer's milk-vetch *Astragalus pulsiferae var. pulsiferae*	--/--/1B.2
Webber's milk-vetch *Astragalus webberi*	--/--/1B.2

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Nevada (northern) (cont.)	
Special Status Plants (cont.)	
intermontane lupine *Lupinus pusillus var. intermontanus*	--/--/2B.3
lance-leaved scurf-pea *Ladeania lanceolata*	--/--/2B.3
veiny monardella *Monardella venosa*	--/--/1B.1
Stebbins' monardella *Monardella stebbinsii*	--/--/1B.2
marsh skullcap *Scutellaria galericulata*	--/--/2B.2
flat-leaved bladderwort *Utricularia intermedia*	--/--/2B.2
currant-leaved desert mallow *Sphaeralcea grossulariifolia*	--/--/2B.3
white-stemmed clarkia *Clarkia gracilis ssp. albicaulis*	--/--/1B.2
Mildred's clarkia *Clarkia mildrediae ssp. mildrediae*	--/--/1B.3
Schoolcraft's wild buckwheat *Eriogonum microthecum var. schoolcraftii*	--/--/1B.2
Dugway wild buckwheat *Eriogonum nutans var. nutans*	--/--/2B.3
Ahart's buckwheat *Eriogonum umbellatum var. ahartii*	--/--/1B.2
winged dock *Rumex venosus*	--/--/2B.3
pincushion navarretia *Navarretia myersii ssp. myersii*	--/--/1B.1
Cantelow's lewisia *Lewisia cantelovii*	--/--/1B.2
Sierra Valley ivesia *Ivesia aperta var. aperta*	--/--/1B.2
Plumas ivesia *Ivesia sericoleuca*	--/--/1B.2
Webber's ivesia *Ivesia webberi*	FT/--/1B.1
pink creamsacs *Castilleja rubicundula var. rubicundula*	--/--/1B.2
Sheldon's sedge *Carex sheldonii*	--/--/2B.2
Red Bluff dwarf rush *Juncus leiospermus var. leiospermus*	--/--/1B.1
Santa Lucia dwarf rush *Juncus luciensis*	--/--/1B.2
Sierra blue grass *Poa sierrae*	--/--/1B.3

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Nevada (northern) (cont.)	
Sensitive Communities	
Northern Hardpan Vernal Pool	
Darlingtonia Seep	
Great Valley Valley Oak Riparian Forest	
Great Valley Willow Scrub	
Roseville to Nevada (southern)	
Special Status Wildlife	
western spadefoot *Spea hammondii*	--/SSC
Sierra Nevada yellow-legged frog *Rana sierrae*	FE/ST
northern goshawk *Accipiter gentilis*	--/SSC
black swift *Cypseloides niger*	--/SSC
willow flycatcher *Empidonax traillii*	--/SE
purple martin *Progne subis*	--/SSC
Townsend's big-eared bat *Corynorhinus townsendii*	--/SCT
Sierra Nevada snowshoe hare *Lepus americanus tahoensis*	--/SSC
Sierra Nevada mountain beaver *Aplodontia rufa californica*	--/SSC
Sierra Nevada red fox *Vulpes vulpes necator*	--/ST
western pond turtle *Actinemys marmorata*	--/SSC
coast horned lizard *Phrynosoma blainvillii*	--/SSC
starved daisy *Erigeron miser*	--/--/1B.3
Tahoe yellow cress *Rorippa subumbellata*	FC/SE/1B.1
dubious pea *Lathyrus sulphureus var. argillaceus*	--/--/3
marsh skullcap *Scutellaria galericulata*	--/--/2B.2
Scadden Flat checkerbloom *Sidalcea stipularis*	--/SE/--
Brandegee's clarkia *Clarkia biloba ssp. brandegeeae*	--/--/4.2
Donner Pass buckwheat *Eriogonum umbellatum var. torreyanum*	--/--/1B.2
western androsace *Androsace occidentalis*	--/--/2B.3

SENSITIVE BIOLOGICAL RESOURCES WITHIN 300 FEET OF RAIL ROUTES (Continued)

Scientific Name	Federal/State/CNPS Status
Roseville to Nevada (southern) (cont.)	
Special Status Wildlife (cont.)	
alder buckthorn *Rhamnus alnifolia*	--/--/2B.2
Plumas ivesia *Ivesia sericoleuca*	--/--/1B.2
Sierra blue grass *Poa sierrae*	--/--/1B.3

STATUS CODES:

FEDERAL: (U.S. Fish and Wildlife Service)
FE = Listed as Endangered (in danger of extinction) by the Federal Government.
FT = Listed as Threatened (likely to become Endangered within the foreseeable future) by the Federal Government.
FC = Candidate to become a *proposed* species.

STATE: (California Department of Fish and Game
SE = Listed as Endangered by the State of California
ST = Listed as Threatened by the State of California
SCT = Candidate to become Threatened by the State of California
SSC = California Species of Special Concern
Rare = California Rare
WL = California Watch List

California Native Plant Society Rare Plant Inventory
Rank 1A: Plants Presumed Extinct in California
Rank 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere
Rank 2: Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
Rank 3: Plants About Which We Need More Information - A Review List
Rank 4: Plants of Limited Distribution - A Watch List

SOURCE: CDFW, 2015; USFWS, 2015.

APPENDIX F

Quantitative Risk Analysis of the Valero Benicia Crude by Rail Project

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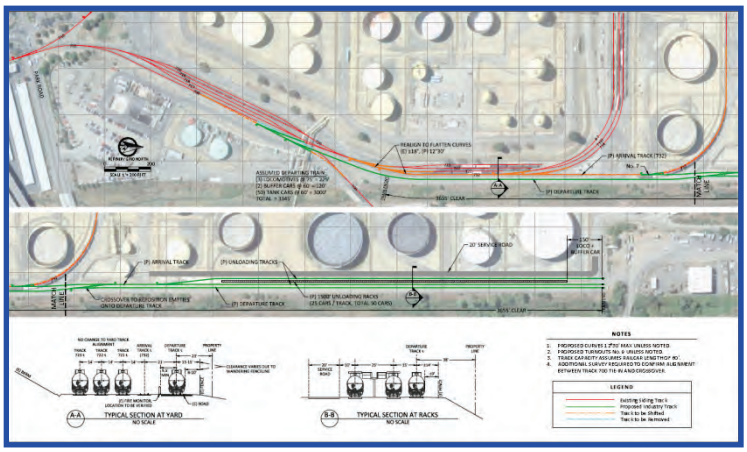
Quantitative Risk Analysis of the Valero Benicia Crude by Rail Project

Final Draft



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July, 2015

1.0 Introduction ... 1

2.0 Environmental Setting ... 6

2.1 Mainline Rail ... 6
2.2 Existing Rail Traffic ... 6
2.3 Rail Track Type ... 7
2.4 Rail Accident Rates ... 7
2.5 Local Safety Hazard Sites in California ... 10
2.6 Existing Refinery Operations ... 11
2.7 Population Density ... 12

3.0 Regulatory Setting ... 14

3.1 Federal Laws and Regulations ... 14
3.2 California Laws and Regulations ... 30
3.3 Other Applicable Guidelines, National Codes, and Standards ... 35

4.0 Significance Criteria ... 38

5.0 Risk Analysis ... 39

5.1 Unloading Facility Risk ... 41
5.2 Mainline Rail Accident Risk ... 46
5.2.1 Probability (e.g., Frequency) of a Derailment and Associated Crude Oil Spill ... 48
5.2.2 Consequence Modeling Results ... 50
5.2.3 Quantitative Risk Assessment Results ... 58
5.2.3.1 Proposed Project ... 58
5.2.3.2 Upgraded DOT 117 and 117R Tank Cars ... 61
5.3 Cumulative Risk Analysis ... 66

6.0 References ... 72

List of Tables

Table 2.1 Rail Incidents - Initiating and Contributing Causes ... 8
Table 2.2 Summary of National and California Train Accident Data ... 9
Table 2.3 List of Local Safety Hazard Sites in California ... 10
Table 2.4 Representative Default Population Densities ... 12
Table 2.5 Final Regulatory Requirements for HHFT (USDOT May 1, 2015) ... 24
Table 2.6 Final Safety Features by Tank Car Option (USDOT May 1, 2015) ... 26
Table 5.1 Properties of Crude Oil Used for Consequence Modeling ... 41
Table 5.2 Worst Case Refinery Unloading Facility Thermal Radiation Hazard Zones ... 43
Table 5.3 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route ... 51

Table 5.4 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route 52
Table 5.5 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route 55
Table 5.6 Worst Case Mainline Rail Hazard Zones 58
Table 5.7 Cumulative Rail Projects 67
Table 5.8 Cumulative Crude by Rail Traffic 68

List of Figures

Figure 1-1 Rail Unloading Facility Site Plan 2
Figure 2-1 UPRR Route and Population Densities 13
Figure 5-1 Steps Involved in Developing a Quantitative Risk Assessment 40
Figure 5-2 Worst-Case Facility Thermal Radiation Hazards 44
Figure 5-3 Risk Associated Valero Unloading Facility Crude Oil Spills and Fires 45
Figure 5-4 Mainline Rail Routes Evaluated in the Quantitative Risk Assessment 49
Figure 5-5 Risk Associated with CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border 59
Figure 5-6 Risk Associated with CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border 60
Figure 5-7 Risk Associated with DOT-117 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border 62
Figure 5-8 Risk Associated with DOT-117 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border 63
Figure 5-9 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border 64
Figure 5-10 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border 65
Figure 5-11 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – CPC-1232 Tank Cars to the California Border 69
Figure 5-12 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – DOT-117 Tank Cars to the California Border 70
Figure 5-13 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – DOT-117R Tank Cars to the California Border 71

List of Attachments

Attachment 1 **Crude Oil Release Report**

Attachment 2 **Risk Assessment Methodology**

Attachment 3 **Oil Spill Consequence Modeling Results**

Attachment 4 **Risk Assessment Modeling Results**

Attachment 5 **Summary of California Public Utilities Commission Railroad Regulations**

Attachment 6 **List of High Threat Urban Areas (HTUAs) (CFR 49 Appendix A to Part 1580)**

1.0 Introduction

This report evaluates potential public safety and hazard impacts associated with upset and accident conditions that could occur with the Valero Benicia Refinery Crude by Rail Project. Potential impacts include train derailments and unloading accidents that could lead to fires and explosions, which could impact the public. The information in this report outlines the environmental setting, regulatory setting, significance criteria, potential risk scenarios and their significance, and the levels of risk to the public associated with these scenarios.

The Valero Crude by Rail project (Project) would enable the Valero Benicia Refinery (Refinery) to receive up to 70,000 barrels per day of crude oil by tank car. The Project involves the installation of rail spur tracks, a tank car unloading rack, pumps, connecting pipelines, and infrastructure, and the receipt of crude oil by rail from North American points of origin.

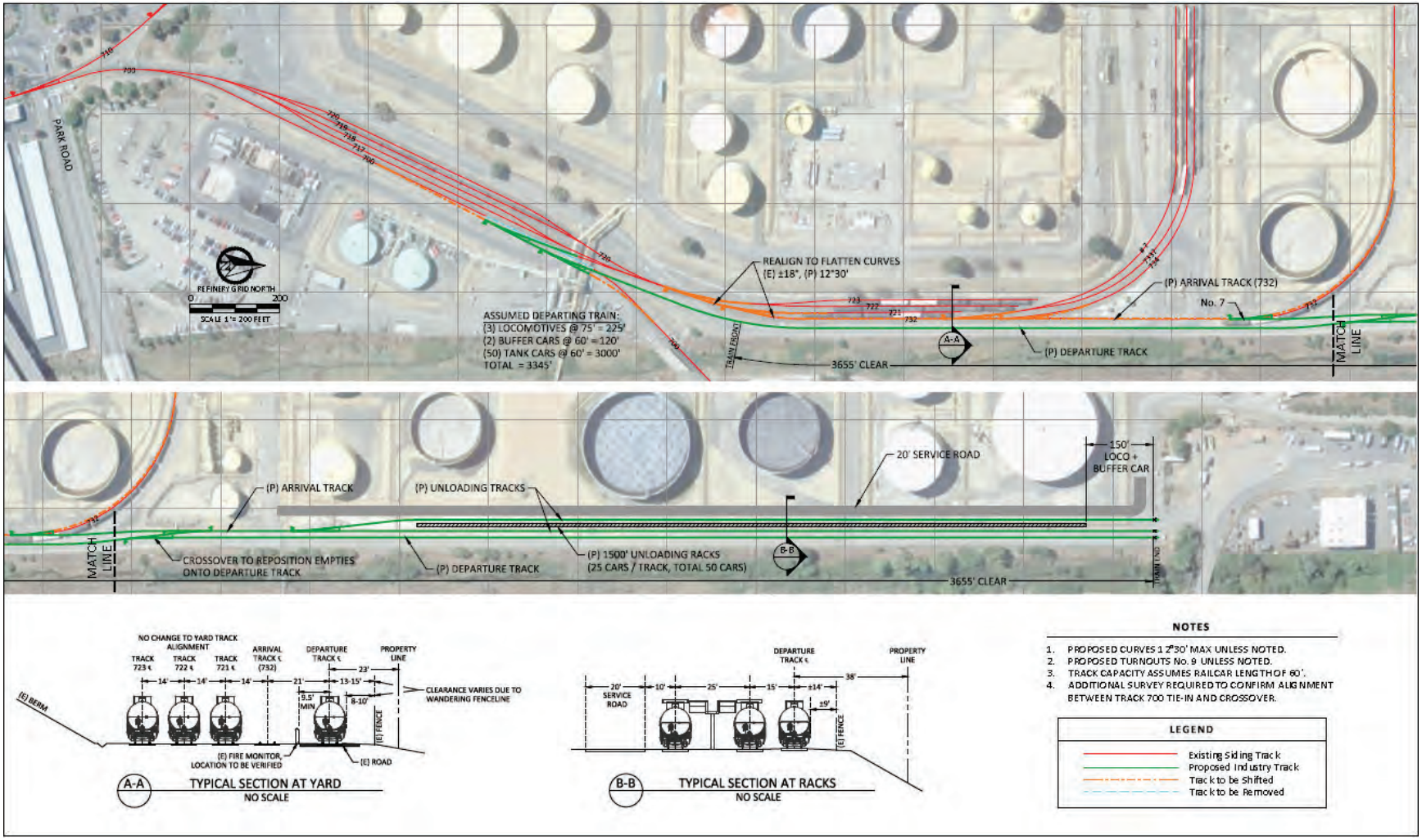
If the Project is approved, Valero would accept up to 100 tank cars of crude oil a day in two 50-car trains. The trains would enter the Refinery on an existing rail spur crossing Park Road. The crude oil unloaded from the tank cars would be pumped to the existing crude oil storage tanks in the Refinery via a new crude offloading pipeline, connected to existing piping located within the Refinery. The Project would require twenty additional employees or contractors. The trains would not be scheduled to arrive or depart between the hours of 6:00 AM – 9:00 AM or 4:00 PM – 6:00 PM weekdays. Valero would operate the Project components 24 hours per day, 7 days per week, and 365 days per year.

Based on Valero's plans, the crude oil delivered by rail would displace up to 70,000 barrels per day of the crude oil that is presently delivered by marine vessels. Crude oil delivered to the Refinery by tank car would not displace crude oil delivered to the Refinery by pipeline. The crude oil to arrive by tank car would originate at sites in North America and be shipped by Union Pacific Railroad (UPRR). UPRR would transport tank cars on existing rail lines from sources in North America to UPRR's J.R. Davis Yard in Roseville, California (the "Roseville Yard"), where the cars would be to the Refinery. Valero would own or lease the tank cars that would be used to transport crude oil. UPRR owns and operates the locomotive engines that would be used.

The proposed equipment layout for the crude by rail facilities at the Refinery is shown in Figure 1-1, and would consist of the following primary components:

- Installation of a single tank car unloading rack capable of offloading two parallel rows of 25 crude oil tank cars.

Figure 1-1 Rail Unloading Facility Site Plan



- Construction of two parallel, offloading rail spurs to access the tank car unloading rack along with a parallel departure track to store tank cars in preparation for departure, for a total of 8,880 track-feet of new track on Refinery property.
- Realignment of approximately 3,560 track-feet currently located on Refinery property.
- Installation of approximately 4,000 feet of 16-inch diameter crude oil pipeline and associated components and pump infrastructure between the offloading rack and the existing crude supply piping.
- Replacement and relocation of approximately 1,800 feet of existing tank farm dikes.
- Relocation of an existing firewater pipeline, compressor station, and underground infrastructure.
- Relocation of groundwater wells along Avenue "A."
- Construction of a service road adjacent to the proposed unloading rack.

The tank car unloading rack would accommodate up to 25 tank cars on each side at one time (up to two, 50 tank car "switches" per day would be transported to the rack by train). The tank cars would be emptied into a single pipeline located between the two rail spurs at slightly below ground level. Each side of the rack would have 25 unloading stations, which would "bottom-unload" closed-dome tank cars using 4-inch-diameter hose, with dry disconnect couplings that would connect to a common header between the two sides of the rack (a check valve, connected to the top of each tank car via 2-inch-diameter hose would open to allow ambient air to enter during unloading and immediately close when unloading is finished). Three new pumps would be located on the western side of a new service road between Tanks 1720 and 1716. Two pumps operating in parallel would pump the crude oil from the unloading rack header via a new 16-inch pipeline. The third pump will be installed as a spare pump. This will facilitate periodic maintenance on the primary pumps. Once emptied, the 50 tank cars would be disconnected from the rack, moved to an on-site departure spur, and then replaced by another 50- rail-car switch.

A typical tank car handling scenario is described below:

1. Tank cars carrying crude oil destined for the Refinery arrive at the Roseville Yard.
2. UPRR-operated locomotives would move up to a 50 car unit train directly from the Roseville Yard via UPRR mainlines to Benicia and then onto the Refinery unloading tracks on Refinery property, traveling at up to 50 miles per hour (mph) on the Main line. When crossing Park Road at the Refinery property entrance, the trains would travel at approximately 5 mph.
3. Up to 25 tank cars would be positioned on the unloading tracks located on each side of the

unloading rack. UPRR would leave its locomotives attached to each 25 tank car train.

4. UPRR would turn over operation of the trains to Valero for offloading.

5. A check valve would be installed onto each vent valve on the top of each tank car. The vent valve on the top of each tank car would be opened and the accompanying check valve would only allow fresh air into each tank car, and would prevent release of hydrocarbon fugitive emissions to the atmosphere. At each end car and on approximately every 8 tank cars in the 25 tank car string, a hose would be connected from the tank car's vent connection to a separate "equalization header." The equalization header would ensure the vapor spaces above the stored liquid crude in the tank cars is equalized between the tank cars. Individual drain hoses would be manually connected to the bottom of each tank car by on-site workers.

6. Valero would drain the contents of each tank car by gravity into a collection pipe (collection header) and then pump the contents directly into storage tankage located in the Refinery's crude oil storage tank field.

7. After the tank cars are emptied, the empty tank cars would be moved onto the departure spur on Refinery property adjacent to the unloading rack, where a train of up to 50 empty tank cars would be reassembled in preparation for transport off-site. Prior to departure, UPRR and Valero would conduct a safety inspection and ready the train for departure.

8. UPRR would transfer the empty 50 tank car train across Park Road and then east on the UPRR mainlines returning to the Roseville Yard. UPRR would assemble up to a 100 empty tank car train and transfer it to accept new loads from the North American crude source.

UPRR owns and maintains the main line between the Roseville Yard and the Bay Area. The line is part of the Martinez subdivision. UPRR operates freight trains on the line, and allows Capitol Corridor Joint Powers Authority (Capitol Corridor) passenger trains to operate on the line.

Freight trains on the line include unit, manifest, and local trains. Unit trains carry just one commodity, such as grain or crude oil. All of the cars in a unit train are shipped together from the same origin to the same destination. Manifest trains are trains that carry a variety of different commodities in cars with different origins and different destinations. Local trains make multiple stops at terminals along the line. All of the trains carrying crude oil to the Refinery would be unit trains travelling from an oil producing region to the Refinery.

UPRR dispatches the passenger trains so as to meet these precise schedules. Freight trains do not typically run on regular schedules. In its normal course of operation, however, UPRR dispatches freight trains so as to avoid congestion that results in delayed deliveries.

If the Project were approved, Valero would ask UPRR to schedule Valero's unit trains so that none of them cross Park Road during the commute hours of 6:00 AM to 9:00 AM and 4:00 PM

to 6:00 PM. UPRR has agreed to make all reasonable effort to comply with this request and, therefore, it is expected that Valero's unit trains will avoid crossing Park Road during the commute hours. UPRR has demonstrated the ability to regularly meet passenger train schedules -- the Capitol Corridor trains dispatched by UPRR are on time 97% of the time. One can assume that UPRR will have little difficulty scheduling trains around a three hour window and a two hour window, given their success in meeting the much more precise one-minute schedules required by Capitol Corridor. Moreover, UPRR currently avoids dispatching freight trains during the commute hours in order to ensure that freight trains do not delay the Capitol Corridor passenger trains. Valero's requested schedule, therefore, is consistent with UPRR's existing practice for dispatching freight trains.

Valero would schedule delivery of one train between the nighttime hours 8:00 PM and 5:00 AM, and a second train in the daytime hours (except during the commute hours). It would take Valero approximately 12 hours to unload each train and prepare the empty train for the return trip to the Roseville Yard. Thus, two trains would cross Park Road during the evening hours, and two would cross Park Road during the daytime hours other than the hours of 6:00 AM to 9:00 AM and 4:00 PM to 6:00 PM.

Operations noted in Steps 1 through 8 could occur at any time of day/7 days per week/365 days per year. These operations would be dynamic and subject to change based on changing business conditions.

2.0 Environmental Setting

For the Crude by Rail Project, environmental setting or baseline conditions reflect the baseline risks of upset associated with the existing refinery and rail operations. For the public safety analysis, the study area includes the mainline rail corridors, the rail spur at the Refinery, and the rail unloading facilities and associated pipelines.

An accidental release of crude oil at the Refinery or along transportation routes could have an adverse impact to the public and environmental resources in the study area. The study area that would be affected in terms of public safety by an upset condition includes any population located in the vicinity of the Refinery and along the mainline rail routes. This would include residences, businesses, educational institutions, etc.

2.1 Mainline Rail

This section discusses the existing rail operations along the mainline routes that could be used by crude oil trains servicing the Refinery.

2.2 Existing Rail Traffic

The UPRR mainline routes that could be used to move crude oil to the Refinery are currently used for both freight and passenger trains. The City of Benicia serves as the terminus for what is commonly referred to as the Overland Route for UPRR. The Refinery is served by a spur off the Overland Route mainline that runs between the industrial port area along the southeastern edge of the City of Benicia and the Refinery itself, terminating north of Park Road. This spur features an at-grade crossing at Park Road, east of Bayshore Road. The spur also serves the industrial areas northeast of the Refinery. Switching activity between tracks typically occurs just south of the Park Road at-grade railroad crossing. The Park Road crossing is controlled by two gates and mast-mounted flashing lights.

The Refinery currently exports petroleum coke and liquefied petroleum gas (LPG) from the Refinery via rail to off-site customers. Once a day, during the daytime hours, up to 12 railcars loaded with petroleum coke leave the Refinery via Track 700, and cross Park Road towards the AMPORTS Benicia Port Terminal Company facility directly to the south. The product is then off-loaded into storage silos near the dock for eventual loading onto marine vessels for export. The empty coke railcars are brought back onto the Refinery for reloading for the next day's transfer operations. These railcars remain on the rail spur that serves the refinery and do not transit on the UPRR mainline.

Similar export operations take place with railcars transporting LPG destined for customers. The

quantity of these export operations vary with season and production volume. On an annual basis it averages approximately two railcars per day. These railcars are transported on the UPRR mainline to their ultimate destinations.The Refinery also occasionally imports LPG.

2.3 Rail Track Type

Rail track is classified into six categories (Class 1 – 6) with Class 6 having the most stringent track tolerances/standards and maintenance schedules allowing for higher track speed limits and a lower probability of a train derailment. With the advent of higher speed trains additional classifications have been defined for Classes 7 and 8. Mainline tracks are generally Class 4 or 5 and typically have lower accident rates per million miles. Class 6 track is used for high speed trains up to 110 mph, and is found in the Northeast Corridor between Washington D.C. and New York. Class 4 track is the dominant class for mainline track used in passenger and long-haul freight service. The Class of a track determines the maximum speed that freight and passenger trains can travel. Higher class tracks have higher allowable speeds.

The Federal Railroad Administration (FRA) establishes minimum design standards for each of the various track classes. Each railroad establishes their own design standards for their tracks that meet or exceed the FRA standards. The FRA standards cover the track roadbed, track geometry, track structure (ballast, cross-ties, joints, switches, etc.). These minimum track safety standards are specified in Title 49 of the Code of Federal Regulations (CFR) Part 213 (49 CFR 213).

For the route from the Roseville Yard to the Refinery 80.8% of the track is Class 4 and 5. For the route from Roseville to Oregon via Dorris (Dunsmuir) 98.1% of the track is Class 4 and 5. For the route from Roseville to Nevada via Portola (Feather River Canyon) 100% of the track is Class 4 and 5. For the route from Roseville to Nevada via Truckee only 3.5% of the track is Class 4 and 5, with the remaining track Class 3. Attachment 1 provides more information on the track class for each of the possible mainline rail routes to the Refinery. The mainline track along the three routes has an allowable gross weight rating of 315,000 lbs per car.

2.4 Rail Accident Rates

Train accidents are required to be reported to the FRA and typically identify the causes and contributing factors as shown in Table 2.1.

The transportation of hazardous substances poses a potential for fires, explosions, and hazardous materials releases. In general, the greater the miles traveled the greater the potential for an accident. The size of a potential release is related to the maximum volume of a hazardous substance that can be released in a single accident, should an accident occur, and the type of failure of the containment structure, e.g., rupture or leak. The potential consequences of the accident are related to the size of the release, the population density at the location of the accident, the specific release scenario, the physical and chemical properties of the hazardous

material, and the local meteorological conditions.

The FRA regulations on reporting railroad accidents/incidents are found primarily in 49 CFR Part 225. The purpose of the regulations is to provide FRA with accurate information concerning the hazards and risks that exist on the nation's railroads. The FRA uses this information for regulatory and enforcement purposes, and for determining comparative trends of railroad safety. These regulations preempt states from prescribing accident/incident reporting requirements.

Table 2.1 Rail Incidents - Initiating and Contributing Causes

Human Errors	Equipment Failures	System or Procedural Failures	External Events
Humping Switching Coupling Transloading lnerting Contamination Heating and cooling Overfilling Speeding Ignoring closed Block signals Driver impairment	Non-dedicated car Crossing guard failure Overpressure Leaking valve Roller bearing failure Coupling failure Broken rail Brake failure Roadbed failure Protective coating/ insulation/thermal protection failure Relief device failure Track sensor failure Switchgear failure Signal failure Communications system failure Broken wheel Suspension failure Fitting defect Corrosion Material defect Bad weld	Routing Control -yards -mainline -in-plant Interim storage at holding track Car tracking Container specification Emergency response training Maintenance Inspection Circuitous routing	Vandalism/sabotage At-grade crossing Flood/washout Earthquake Rockslide/landslide Avalanche Fire on rail siding Fog/blizzard Bridge failure

Source: Center for Chemical Process Safety (CCPS), 1995.

The FRA compiles data on railroad-related accidents, injuries and fatalities to depict the nature and cause of rail-related accidents and improve safety. Train accident data reported in the United States, in California, and accidents reported by UPRR between 2005 and 2014 are summarized in Table 2.2. Based on the train accident data for the United States, the train accident rate varied from 2.3 accidents per million miles traveled to 4.1 accidents per million miles traveled over the 10-year period from January 2005 to December 2014. The train accident rate for 2014 was 2.3 train accidents per million miles traveled.

Table 2.2 Summary of National and California Train Accident Data

Category	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Train Accident Data for United States										
Total Accidents/ Incidents	14,311	13,803	13,936	12,958	11,246	11,630	11,502	11,048	11,588	11,855
Accident Rate	18.14	16.97	17.56	16.74	16.84	16.50	16.03	15.10	15.48	15.48
Train Accidents	3,266	2,998	2,693	2,481	1,912	1,902	2,022	1,760	1,822	1,755
Train Accident Rate	4.139	3.685	3.393	3.205	2.863	2.699	2.818	2.406	2.433	2.292
Train Accidents on Main Line	1,021	981	854	767	619	617	621	504	571	517
Accident Rate on Main Line	1	1	1	1	1	1	1	1	1	1
Hazmat Releases	39	30	46	21	22	21	21	26	18	15
Cars Carrying Hazmat	8,034	9,000	8,562	8,430	6,440	7,567	7,582	6,877	7,188	7,531
Damaged/Derailed	915	1,047	1,056	750	749	722	666	672	822	784
Cars Releasing	52	71	76	37	44	40	66	50	78	26
Total Train Miles (millions)	789	814	794	774	668	705	718	732	749	766
Train Accident Data for UPRR										
Total Accidents/ Incidents	2,747	2,749	2,597	2,287	1,696	1,710	1,744	1,731	1,721	1,774
Train Accidents	955	891	723	637	444	447	546	506	501	501
Hazmat Releases	12	5	6	5	3	4	4	6	1	5
Train Accident Data for California										
Total Accidents/ Incidents	965	944	950	843	728	724	708	828	805	788
Train Accidents	199	191	155	120	101	87	87	86	99	77
Hazmat Releases	2	3	4	1	1	1	0	0	0	0
Source: U.S. Department of Transportation (USDOT), 2015b.										

Of the train accidents reported during the 10-year period (a total of 123,877), less than one percent of the train accidents resulted in a release of hazardous materials (259/123,877 = 0.0021 or 0.21%).

2.5 Local Safety Hazard Sites in California

The California Publc Utilities Commission (CPUC) has identified a number of local safety hazard sites (LSHS) within California along the mainline rail routes and adopted rules governing operations at some of these sites. Table 2.3 provides a list of these LSHS. These sites consist of steep grades and tight curves, and also have historically high frequencies of derailments. As described in California Public Utilities Code §7711, factors that the CPUC considers in determining a LSHS includes at a minimum the following:

1. The severity of grade and curve of track.
2. The value of special skills of train operators in negotiating the particular segment of railroad line.
3. The value of special railroad equipment in negotiating the particular segment of railroad line.
4. The types of commodities transported on or near the particular segment of railroad line.
5. The hazard posed by the release of the commodity into the environment.
6. The value of special railroad equipment in the process of safely loading, transporting, storing, or unloading potentially hazardous commodities.
7. The proximity of railroad activity to human activity or sensitive environmental areas.

Table 2.3 List of Local Safety Hazard Sites in California

Generic Name	County	Track Length (miles)	Number of Derailments 2009-13
UPRR Yuma Line	San Bernardino/Riverside	56.4	32
UPRR Bakersfield Line	Kern	24.9	10
UPRR Shasta Line	Siskiyou	26.9	4
UPRR Bakersfield Line	San Bernardino	23.0	4
UPRR Roseville District	Placer	10.0	3
UPRR Feather River Division	Butte and Plumas	93.1	2
UPRR Yuma Line	Riverside	6.0	1
BSNF Gateway	Plumas	10.0	1
BNSF San Diego	San Diego	4.0	1
UPRR Coast Line (Cuesta Grade)	San Luis Obispo	14.0	0
Central Oregon and Pacific Railroad	Siskiyou	9.7	0
UPRR Feather River Division	Plumas	29.0	0
UPRR Cima Grade	San Bernardino	18.1	0
BNSF Cajon	San Bernardino	15.0	0
BNSF Cajon	San Bernardino	0.5	0
BNSF Cajon	San Bernardino	25.6	0

Source: Adapted from CPUC Annual Railroad Local Safety Hazard Site Report 2014.
Sites highlighted in blue could be used by crude trains servicing the Refinery.

Depending upon the route that is taken to get from the California border to the Refinery, the crude oil train would have to traverse a number of LSHS. LSHS account for a disproportionate share of derailments occurring in California. Within the previous five calendar years, California has experienced 342 derailments. Of that amount, 58 derailments, or 17 percent, have occurred at or near local safety hazard sites (includes the LSHS track plus the distance of track one mile on each side of the local safety hazard site) (CPUC 2014).

There are four LSHS along the routes that could be used to deliver crude oil to the Refinery; one along the route from the Roseville Yard to the Oregon state line, two along the Feather River route to Nevada, and one along the Truckee route to Nevada. There were nine derailments on these LSHS during the five year period of 2009 to 2013 (see Table 2.3)

2.6 Existing Refinery Operations

The Refinery converts crude oil into finished products, including gasoline, jet fuel, LPG, heating oil, fuel oil, asphalt, petroleum coke, and sulfur. The Refinery produces 10 percent of the clean-burning California Air Resources Board (CARB) gasoline used in California, and 25 percent of the CARB gasoline used in the San Francisco Bay Area.

The Refinery contains a variety of equipment, including distillation columns, storage tanks, reactors, vessels, heaters, boilers, and other ancillary equipment. The Refinery also operates its own asphalt plant, wastewater treatment plant, and a marine terminal at the Port of Benicia. The marine terminal receives crude oil, refinery products, and feedstock deliveries and exports via marine vessels and barges. The Refinery uses rail transport to import chemicals used in refining and to export refinery products such as asphalt, petroleum coke, and LPG.

Crude oils delivered to the Refinery are transferred into storage tanks located in the crude oil tank farm north of the marine terminal. The crude oils are stored in external floating roof tanks, which are configured and operated to comply with the stipulations of Bay Area Air Quality Management Distirct (BAAQMD) Regulation 8-5. Valero combines crude oils from these storage tanks into blends that are then pumped to the Refinery process units located north of the tank farm.

The Refinery currently exports petroleum coke and LPG from the Refinery to off-site customers. Once a day, during the daytime hours, up to 12 railcars loaded with petroleum coke leave the Refinery via Track 700, and cross Park Road towards the AMPORTS Benicia Port Terminal Company facility directly to the south. The product is then off-loaded into storage silos near the dock for eventual loading onto marine vessels for export. The empty coke railcars are brought back onto the Refinery for reloading for the next day's transfer operations. These railcars remain on the rail spur that serves the refinery and do not transit on the UPRR mainline.

Similar export operations take place with railcars transporting LPG destined for customers. The quantity of these export operations vary with season and production volume. On an annual basis it averages approximately two railcars per day. The Refinery also occasionally imports LPG. These railcars are transported on the UPRR mainline to their ultimate destinations.

2.7 Population Density

Figure 2-1 shows the population densities along the mainline rail routes that could be used by the crude oil trains between the Refinery and the Oregon and Nevada state lines. Each of the rail routes were divided into numerous segments based on population density using the categories listed in Table 2.4

Table 2.4 Representative Default Population Densities

Designation	Density	Description
Remote	20 people/sq mile	Non-metropolitan area with scattered housing; farms
Rural	100 people/sq mile	Small village or town; recreation areas
Suburban	1,000 people/sq mile	Typical suburbs; mixed use areas
Urban	3,000 people/sq mile	Small city; densely populated suburbs; congested commercial areas
High	10,000+ people/sq mile	Very dense city area

Source: CCPS, 1995.

Figure 2-1 UPRR Route and Population Densities

3.0 Regulatory Setting

Many regulations and standards exist to ensure the safe operation of oil facilities, pipelines, rail transportation, and hazardous materials. This section provides an overview of the federal, state, and local regulations.

3.1 Federal Laws and Regulations

Federal Regulation of Oil Transportation by Rail

The FRA, which is part of the USDOT, is responsible for regulating the safety of the nation's railroad system. FRA promulgates railroad safety regulations (49 CFR subtitle B, chapter II (parts 200-299)) and orders, enforces those regulations and orders as well as the Hazardous Materials Regulations at 49 CFR Parts 171-180, and the Federal railroad safety laws, and conducts a comprehensive railroad safety program.

FRA's regulations promulgated for the safety of railroad operations involving the movement of freight address: (1) railroad track; (2) signal and train control systems; (3) operating practices; (4) railroad communications; (5) rolling stock; (6) rear-end marking devices; (7) safety glazing; (8) railroad accident/incident reporting; (9) locational requirements for the dispatch of U.S. rail operations; (10) safety integration plans governing railroad consolidations, mergers, and acquisitions of control; (11) alcohol and drug testing; (12) locomotive engineer and conductor certification; (13) workplace safety; (14) highway-rail grade crossing safety; and other subjects. The FRA inspects rail facilities throughout the country in order to ensure compliance with its own regulations, and those adopted by the Pipeline and Hazardous Materials Safety Administration (PHMSA).

The FRA is also responsible for conducting inspections of rail lines and bridges throughout the United States. In July 2010, new federal rules on railroad bridge safety standards were issued (49 CFR Parts 213 and 237). The bridge safety standards final rule requires the railroad companies that own the bridges to:

- Implement bridge management programs that include at minimum annual inspections of railroad bridges,
- Conduct special inspections if the weather or other conditions warrant such inspections,
- Maintain an inventory of all railroad bridges and know their safe load capacities,
- Maintain design documents and to document all repairs, modifications, and inspections of each bridge,
- Ensure bridge engineers, inspectors and supervisors must meet minimum qualifications,
- Make sure bridge inspections are conducted under the direct supervision of a designated railroad bridge inspector, and

- Conduct internal audits of bridge management programs and inspections.

PHMSA is another department within the USDOT. Pursuant to the Hazardous Materials Transportation Act, PHMSA adopts regulations governing the transport of hazardous materials by rail, highway, air, and water. The PHMSA regulations are set forth in Chapter I of Subtitle B of Title 49 of the Code of Federal Regulations (49 CFR 100 et seq.). The FRA enforces the requirements set forth in PHMSA regulations.

The National Transportation Safety Board (NTSB) is an independent federal agency. The NTSB reviews transportation accidents, including rail accidents, and makes recommendations to FRA and PHMSA for regulatory changes.

The American Association of Railroads (AAR) is an industry trade association that represents railroads, including the major freight railroads in the United States, Canada, and Mexico. AAR adopts standards for the design and construction of tank cars used by its members. In some cases, these standards are more stringent than the requirements set forth in FRA or PHMSA regulations.

The PHMSA regulations classify hazardous materials based on each material's hazardous characteristics. Crude oil is assigned to hazard Class 3, based on specified characteristics of flammability and combustibility (49 CFR 173.120). The key PHMSA regulations governing rail transport are summarized below:

- 49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans*, addresses numerous aspects of safe rail transport, including requirements pertaining to the hazardous materials classification of crude oil.

- 49 CFR 173, *General Requirements for Shipments and Packages*, specifies requirements for bulk packaging including the type of tank car a hazardous material must be transported in based on its assigned Packing Group.

- 49 CFR 174, *Carriage by Rail*, specifies handling, loading, and unloading requirements for the safe transport and shipping of hazardous materials, which must be performed by qualified personnel. This part also addresses correct placarding of rail cars to indicate the hazard classifications of the materials, and segregation of incompatible materials.

- 49 CFR 176, *Carriage by Vessel*, provides further details on vessel carriage requirements for different classes of hazardous materials.

- 49 CFR 179, *Specifications for Tank Cars*, provides design standards and construction requirements for rail tank cars including tank wall thickness, tank mounting, welding certification, pressure relief devices, protection of fittings, loading/unloading valve requirements, coupler vertical restraints systems, tank-head puncture-resistance systems, and thermal protection systems.

Under PMHSA regulations, all crude oil must be shipped in a tank car built to the "DOT-111" specification. DOT-111 tank cars are non pressure tank cars. The cars have a minimum shell thickness of 7/16 inch and a design pressure of up to 500 pounds per square inch gage (psig).

DOT-111 tank cars are used to transport a variety of hazardous materials, including crude oil and ethanol. The DOT-111 design has been in use since the 1960's. Different "packaging" requirements apply to different crude oils transported by rail. PHMSA regulations assign hazardous materials to "Packing Groups" based on the risks posed by the transport of each hazardous material. Packing Group I indicates great danger; Packing Group II indicates medium danger; and Packing Group III indicates minor danger (49 CFR 171.8).

Materials assigned to Packing Group I are subject to the most stringent packaging requirements, while materials assigned to Packing Group III are subject to the least stringent requirements. Individual crude oils can be classified as Packing Group I, II, or III materials depending on their boiling points and flash points. Any crude oil with a boiling point below 95° Fahrenheit is assigned to Packing Group I. Packing Group II includes any crude oil with a boiling point above 95° and a flash point below 73° Fahrenheit. Packing Group II crude oils are less volatile than Packing Group I, although more volatile than Packing Group III crude oils. Packing Group III includes any crude oil with a boiling point above 95° and a flash point between 73° and 140° Fahrenheit.

Recent and Ongoing Development in the Regulation of Crude Transportation by Rail

As a result of recent train accidents involving the derailment of crude oil trains a number of recent regulatory actions by the Federal government and voluntary actions by the railroads have taken place.

A summary of some of the recent crude oil rail accidents are listed below.

- On March 27, 2013, a train derailed in Parkers Prairies Minnesota. Fourteen cars on a Canadian Pacific Railway train caring Canadian crude derailed, and one car was heavily damaged. An estimated 30,000 gallons of crude spilled; there was no fire or explosion.
- On May 21, 2013, a train derailed near Jansen Saskatchewan Canada. A Canadian Pacific Railway mixed freight train jumped the tracks and five cars derailed, with one leaking its content. An estimated 24,000 gallons spilled; there was no fire or explosion.
- On July 6, 2013, a train carrying Bakken crude oil in 72 DOT-111 Legacy Tank Cars (cars that do not meet the CPC-1232 standard) derailed in the downtown area of Lac-Mégantic, Canada. The waybills described the Bakken crude oil as a Class 3 hazardous material, assigned to Packing Group III. The engineer stopped the train at a designated crew change point, left the lead locomotive engine idling, and departed the area leaving the train unattended on the mainline track. A fire was later reported on one of the train's unattended locomotive engines and local emergency personnel responded. An employee of the rail line also arrived on scene. After the responders departed, the unattended train began to move and

gather speed, travelling uncontrolled for 7.4 miles down a descending 1.2% grade into the town of Lac-Mégantic. The train reached a top speed of 60-70 miles per hour. Sixty-three of the tank cars derailed and, of these, at least 60 released a total of 1.6 million gallons of crude oil. The spilled oil ignited immediately, and the resulting fire engulfed the tank cars and the surrounding area. A total of 47 people died in the accident. Thirty buildings were destroyed and 2,000 people were evacuated. Approximately 26,000 gallons of crude oil was discharged into the Chaudière River.

- On November 8, 2013, a train derailed in Aliceville, Alabama. The train was carrying 90 DOT-111 Legacy Tank Cars with Bakken crude oil from North Dakota to a refinery in the Gulf Coast. Approximately 12 of the tank cars released crude oil and caught fire. There were no reported injuries.
- On December 30, 2013, a train carrying 106 DOT-111 Legacy Tank Cars with Bakken crude oil collided with a grain train in Casselton, North Dakota. A total of 34 cars from both trains derailed, including 20 that were carrying Bakken crude oil. These cars released their contents, exploded and burned for over 24 hours. There were no reported injuries. Over 1,400 residents were evacuated from the scene.
- On April 30, 2014 in Lynchburg, Virginia, a train carrying crude oil tank cars derailed. Some of the cars that derailed were Legacy DOT-111 Tank Cars, while some were Casualty Prevention Circular (CPC)-1232 Tank Cars (please refer to Table 2-6 for a description of CPC-1232 tank cars). One of the CPC-1232 Tank Cars ruptured and released crude oil that ignited. In addition, over 33,000 gallons of Bakken crude oil were released into the James River. There were no reported injuries.
- On February 14, 2015, near Gogama, Ontario a Canadian National (CN) crude oil unit train was proceeding eastward on CN's Ruel Subdivision near Gogama, Ontario. The train crew was composed of a locomotive engineer and a conductor. The train was equipped with 2 head-end locomotives hauling 100 Class 111 tank cars, 68 loaded with Petroleum Crude Oil (UN 1267) and 32 loaded with Petroleum Distillates (UN 1268). The train was 6089 feet long and weighed 14 355 tons. While travelling at 38 mph, the train crew felt a heavy tug on the train and a train-initiated emergency brake application occurred. Subsequently, the crew observed a fire about 10 cars behind the locomotives, so they detached the locomotives from the train. The temperature at the time was -31°C and a slow order (speed restriction) of 40 mph was in place.
- On February 16, 2015, a CSX train carrying Bakken crude derailed in the Mount Carbon area of Fayette County West Virginia. Twenty-six cars of a 109- car train derailed, and 19 of the cars were involved in the fire and explosion. Some of the spilled oil entered the Kanawha River. There were no reported injuries.
- On March 5, 2015, a Burlington Northern Santa Fe (BNSF) unit train carrying crude oil derailed at Mile Post 171.6 in Jo Daviess County, Illinois near the city of Galena, Illinois. BNSF reported the incident to the National Response Center at 2:52 pm CST, 88 minutes after the train derailed. 21 railroad tanker cars (each containing about 30,000 gallons) derailed. Of the 21 derailed cars, originally 5 were on fire and/or ruptured spilling oil onto the embankment and in a seasonal wetland (currently not flooded) adjacent to the Galena and Mississippi Rivers. The fire was ongoing from March 5, 2015 to March 8, 2015. BNSF

successfully uncoupled approximately 84 railroad tank cars containing crude oil, thus removing the risk of crude oil releasing from these tanks. According to the FRA, the train south of Galena was traveling at 23 mph when it derailed, well below the maximum speed allowed. The damaged tank cars were newer CPC-1232 tank cars.

- On March 7, 2015 Canadian National (CN) crude oil unit train was proceeding eastward on CN's Ruel Subdivision near Gogama, Ontario. The train crew was composed of a locomotive engineer, a trainee and a conductor. The train was equipped with 2 head-end locomotives hauling 94 Class 111 tank cars loaded with Petroleum Crude Oil. Around 02:42, while travelling at about 43 mph, a train-initiated emergency brake application occurred near Mile 88.70. Looking back, the crew observed a fireball about 700 feet behind the locomotives. They detached the locomotives and first 5 cars behind the locomotives from the derailed cars, and pulled clear. The 6th to the 44th cars behind the locomotives (39 cars in total) had derailed. The 6th and 7th cars derailed to the south, but made it across the bridge to the east side of the river. The derailed trailing end of the 7th car struck the south side of the bridge structure as it crossed, the car rolled down the east embankment and its bottom outlet valve was compromised and released product. The last 2 cars (43rd and 44th) derailed but remained upright and came to rest near mile 88.75 on the west side of the river. The remaining cars derailed near the west end of the bridge. Two of the cars were submerged in the river, 3 cars were partially submerged in the river and the rest were in a pile on the west river bank (see Photo 1). A number of the cars were breached, released product and ignited a large pool fire which destroyed the steel rail bridge. Most of the remaining cars sustained fire damage ranging from minor to severe. About 700 feet of track was destroyed.

- On May 6, 2015, a BNSF-operated train derailed near Heimdal, North Dakota, about 100 miles northeast of Bismarck, derailed resulting in a large fire that involved six tank cars. There were no injuries, and about 40 people were evacuated from Heimdal. The train’s event recorder showed it was traveling at about 24 mph at the time of the derailment, which was slower than the 35 mph limit, possibly to allow for compaction of an area to the east where BNSF had been working on the track. The cars involved in the crash were all built after 2011, known as CPC-1232s, have more safety features than earlier types.

- On July 17, 2015, a BNSF-operated train derailed in rural northeastern Montana, prompting the evacuation of some homes and leaving at least two of the cars leaking crude. There were no immediate reports of injury or fire, but of the 21 cars that derailed only two remained upright. The train was pulling 106 loaded crude oil cars when it derailed near Culbertson near the North Dakota border just after 6 p.m. MDT.

As a result of accidents a number of actions have been taken by the Federal government and the railroads to address the safety issues associated with moving crude oil by rail. These actions include the following:

- On August 2, 2013, FRA issued Emergency Order No. 28 establishing additional requirements for unattended trains. The requirements are designed to ensure that unattended trains, locomotives, and tenders on the mainline track or siding are properly secured against

unintended movement. The Order was prompted by the Lac-Mégantic accident, which involved an unattended train.

- Also on August 2, 2013, PHMSA and FRA issued joint Safety Advisory 2013-06. The advisory recommended eight specific actions that railroads and shippers should take relating to unattended trains, procedures for securing trains, safety and security plans, and proper classification of hazardous materials for shipment.

- On September 6, 2013 PHMSA published an Advanced Notice of Proposed Rulemaking. This rulemaking will address, among other topics, the need to enhance the standards for DOT-111 tank cars used to transport Packing Group I and II hazardous materials, including crude oil.

- On November 20, 2013, PHMSA and FRA issued joint Safety Advisory 2013-07 relating to the proper classification of crude oil for purposes of the packing group requirements. The Advisory expressed the concern that, based on its low flash point, the Bakken crude involved in the Lac-Mégantic incident should not have been classified as a Packing Group III material. The Advisory stressed the importance of proper classification based on flash point and other hazardous characteristics. The Advisory also announced a joint FRA/PHMSA compliance initiative called "Operation Classification." The initiative involves unannounced inspections at oil producing sites to ensure that crude oil has been properly tested and classified before it is loaded onto a tank car. The initiative has informally been referred to as the "Bakken Blitz."

- On January 2, 2014, PHMSA issued a Safety Alert reinforcing the need to properly characterize crude oil offered for shipment. The Alert specifically noted that, because of its low flash point and/or low boiling point, light sweet crude such as Bakken should typically be assigned to Packing Group I or II.

- On January 21, 2014, NTSB issued Safety Recommendations R-14-4, 14-5, and 14-6 to PHMSA relating to the Lac-Mégantic incident. NTSB reported its finding that based on its flash point, the Bakken crude oil released in the Lac-Mégantic incident was improperly characterized as a Packing Group III material, and should have been assigned to Packing Group II. NTSB recommended, among other things, that PHMSA and FRA work together to require shippers to accurately characterize hazardous materials offered for shipment to ensure that they are assigned to the correct packing group.

- On January 23, 2014, NTSB issued Safety Recommendations R-14-1, 14-2, and 14-3 to FRA relating to the Lac-Mégantic incident. NTSB repeated its findings relating to mischaracterization of Bakken crude oil and recommended that FRA, among other things, audit shippers and railroads to ensure that they are using the correct shipping classifications.

- On February 21, 2014, DOT and AAR announced an agreement relating to the transport of crude oil by rail. AAR and its individual members (including UPRR) agreed to take the following eight specific actions designed to reduce the risk of transporting crude by rail:

  - **Increased Track Inspections** – Effective March 25, 2014, railroads will perform at least one additional internal-rail inspection each year above those required by new FRA

regulations on main line routes over which trains moving 20 or more carloads of crude oil travel. Railroads will also conduct at least two high-tech track geometry inspections each year on main line routes over which trains with 20 or more loaded cars of crude oil are moving. Current federal regulations do not require comprehensive track geometry inspections.

- **Braking Systems** – No later than April 1, 2014, railroads will equip all trains with 20 or more carloads of crude oil with either distributed power or two-way telemetry end-of-train devices. These technologies allow train crews to apply emergency brakes from both ends of the train in order to stop the train faster.
- **Use of Rail Traffic Routing Technology** – No later than July 1, 2014 railroads will begin using the Rail Corridor Risk Management System (RCRMS) to aid in the determination of the safest and most secure rail routes for trains with 20 or more cars of crude oil. RCRMS is a sophisticated analytical tool, developed in coordination with the federal government, including the U.S. Department of Homeland Security, PHMSA and FRA. Railroads currently use RCRMS in the routing of security sensitive materials, but it currently does not apply to trains carrying crude oil. This tool takes into account 27 risk factors – including volume of commodity, trip length, population density along the route, local emergency response capability, track quality and signal systems – to assess the safety and security of rail routes.
- **Lower Speeds** – No later than July 1, 2014 railroads will operate trains with 20 or more tank cars carrying crude oil that include at least one older DOT-111 car no faster than 40 miles-per-hour in the federally designated high-threat-urban areas[1] (HTUA) as established by Federal regulations. In the meantime, railroads will continue to operate trains with 20 or more carloads of hazardous materials, including crude oil, at the industry self-imposed speed limit of 50 miles per hour.
- **Community Relations** - Railroads will continue to work with communities through which crude oil trains move to address location-specific concerns that communities may have.
- **Increased Trackside Safety Technology** – No later than July 1, 2014 railroads will begin installing additional wayside wheel bearing detectors[2] if they are not already in place every 40 miles along tracks with trains carrying 20 or more crude oil cars, as other safety factors allow.
- **Increased Emergency Response Training and Tuition Assistance** – Railroads have committed by July 1, 2014 to provide $5 million to develop specialized crude by rail training and tuition assistance program for local first responders. One part of the curriculum will be designed to be provided to local emergency responders in the field, as well as comprehensive training that will be designed to be conducted at the Transportation Technology Center, Inc. (TTCI) facility in Pueblo, Colorado. The funding

[1] High-Threat-Urban Areas are defined by the Federal Government as an area comprising one or more cities and surrounding areas including a 10-mile buffer zone. A list of the HTUA, as determined by the Federal Government, is provided in Appendix H.6.

[2] Wayside wheel bearing detectors are devices that are placed along railroad tracks that detect heat or acoustic signatures, which would indicate that a bearing may fail in the near future. This allows railroad operators to detect defects before they damage track or cause accidents.

will provide program development as well as tuition assistance for an estimated 1,500 first responders in 2014.

- **Emergency Response Capability Planning** – No later than July 1, 2014, railroads will develop an inventory of emergency response resources for responding to the release of large amounts of crude oil along routes over which trains with 20 or more cars of crude oil operate. This inventory will include locations for the staging of emergency response equipment and, where appropriate, contacts for the notification of communities. When the inventory is completed, railroads will provide USDOT with information on the deployment of the resources and make the information available upon request to appropriate emergency responders.

- On March 6, 2014, USDOT issued Emergency Order DOT-OST-2014-0025. Among other things, the Order requires shippers to assign crude oil to Packing Groups I or II, thereby assuring that Bakken and other highly volatile crude oils cannot be mischaracterized and assigned to Packing Group III.

- On May 7, 2014, USDOT issued Emergency Order DOT-OST-2014-0067. The Order requires railroads to notify the State Emergency Response Commission for each state in which the railroad transports Bakken crude oil. The notice must contain certain prescribed information, including the number of trains, the train routes, and the characteristics of the crude oil. Absent the required notice, railroads are prohibited from transporting Bakken crude oil. The Order allows states to effectively plan emergency response procedures for an accident involving Bakken crude oil.

- On May 7, 2014, FRA and PHMSA issued a joint Safety Advisory relating to the transport of Bakken crude by rail. The Advisory recommended that shippers and railroads use the rail tank car designs with the "highest level of integrity reasonably available within their fleet" for the shipment of Bakken crude oil. The Advisory also specifically advised shippers and railroads to avoid the use of DOT-111 Legacy Tank Cars for shipping Bakken crude oil, to the extent reasonably practicable.

- On July 23, 2014 USDOT issued a Notice of Proposed Rulemaking covering enhanced tank car standards and operations controls for high-hazard flammable trains. PHMSA in coordination with the FRA, are proposing: (1) new operational requirements for certain trains transporting a large volume of Class 3 flammable liquids; (2) improvements in tank car standards; and (3) revision of the general requirements to ensure proper classification and characterization of mined gases and liquids. These proposed requirements are designed to lessen the frequency and consequences of train accidents/incidents involving certain trains transporting a large volume of flammable liquids, including trains carrying crude oil. This proposed rule is discussed further in the section below.

- July 23, 2014 Advanced Notice of Proposed Rulemaking re: Oil Spill Response Plans for high-hazard flammable trains (HHFT) USDOT releases comprehensive rulemaking proposal to improve the safe transportation of large quantities of flammable materials by rail, including a Notice of Proposed Rulemaking for enhanced tank car standards, an Advanced Notice of Proposed Rulemaking seeking to expand oil spill response planning requirements

for shipments of flammable materials, and a report summarizing the analysis of Bakken crude oil data gathered by PHMSA and FRA. This proposed rule is discussed further in the section below.

- April 17, 2015 PHMSA issued a Safety Advisory to remind hazardous materials shippers and carriers of their responsibility to ensure that current, accurate and timely emergency response information is immediately available to first responders. PHMSA and FRA issued a Safety Advisory to remind railroads operating a high-hazard flammable train that certain information may be required by PHMSA and/or FRA personnel during the course of an investigation immediately following an accident. FRA issued an Emergency Order to require that trains transporting large amounts of Class 3 flammable liquid through certain highly populated areas adhere to a maximum authorized operating speed of 40 mph. FRA issued a Safety Advisory recommending that railroads use highly qualified individuals to conduct the brake and mechanical inspections and recommends a reduction to the impact threshold levels the industry currently uses for wayside detectors that measure wheel impacts to ensure the wheel integrity of tank cars in those trains. FRA issued a Notice and comment request seeking to gather additional data concerning rail cars carrying petroleum crude oil in any train involved in an FRA reportable accident. FRA Acting Administrator sent a letter to the Honorable Edward Hamberger, president of the Association of American Railroads, asking continued commitment of its member railroads to address the safety issues presented.

- On May 1, 2015 USDOT announced a Final Rule to strengthen the safe transportation of flammable liquids by rail. The Final Rule applies to trains transporting large volumes of flammable liquids and will make significant and extensive changes to improve accident prevention, mitigation, and emergency response. A summary of the key provisions contained in the Final Rule is provided below.

USDOT Rulemaking for High-Hazard Flammable Trains (HHFT)

USDOT regulates the design standards for rail cars. The rail car type for crude oil are DOT-111 non-pressurized tank cars (DOT 111A60W1). DOT-111 tank cars for crude oil service have a maximum capacity of 30,000 gallons. Following an accident in Illinois in 2009, the NTSB made a number of safety recommendations to both the AAR and the PHMSA regarding DOT-111 tank cars. The NTSB recommended to PHMSA that it require modifications be made on all existing and new DOT-111s. PHMSA did not mandate a fleet retrofit, nor has it published new standard designs for crude and ethanol tank cars. The AAR-North American Tank Car Committee, independent of a federal mandate, implemented nearly all of the recommendations made to PHMSA in its design standards for new crude oil and ethanol tank cars ordered after October 2011. Specifically, all new DOT-111 tank cars for ethanol and crude oil service beginning October 1, 2011 were required to have:

- Increased head and shell thickness;
- Normalized steel;
- ½-inch thick ½-height head shields; and
- Top fitting protection.

The NTSB also recommended the AAR review the design requirements for attaching center sills or draft sills for all tank cars. The AAR-North American Tank Car Committee has studied the stub sill issue and will revise those standards as recommended. Nearly 25 percent of the DOT-111 fleet carrying crude today meets the higher design standards, as outlined above.

On July 23, 2014 the USDOT issued a notice of proposed rulemaking covering enhanced tank car standards and operational controls for high-hazard flammable trains, which include crude oil trains. As part of the proposed USDOT rulemaking, the PHMSA, in coordination with the FRA, is proposing: (1) new operational requirements for certain trains transporting a large volume of Class 3 flammable liquids[3]; (2) improvements in tank car standards; and (3) revision of the general requirements for offerors to ensure proper classification and characterization of mined gases and liquids. These proposed requirements are designed to lessen the frequency and consequences of train accidents/incidents (train accidents) involving certain trains transporting a large volume of flammable liquids.

On May 1, 2015 the USDOT issued its final rule covering enhanced tank car standards (the "DOT-117 standard") and operational controls for high-hazard flammable trains. The final rule defines certain trains transporting large volumes of flammable liquids as "high-hazard flammable trains" (HHFT) and regulates their operation in terms of speed restrictions, braking systems, and routing. The final rule also adopts safety improvements in tank car design standards, a sampling and classification program for unrefined petroleum-based products, and notification requirements. Table 2.5 provides a summary of the elements of the final rule. Table 2.6 further summarizes the design specifications for tank cars allowed under the final rule. New tank cars built after October 1, 2015 would be required to meet the new DOT-117 standard. All existing Non-Jacketed CPC-1232 tank cars in Packing Group I service (tank cars proposed for use by Valero) would have to meet the DOT-117R standard by April 1, 2020 (a tank car that is retrofitted to the DOT-117 standard; please see Table 2.6 for more detail).

Liquid Pipelines and Oil Facilities

Hazardous liquid pipelines are under the jurisdiction of the USDOT and must follow the regulations in 49 CFR Part 195, Transportation of Hazardous Liquids by Pipeline, as authorized by the Hazardous Liquid Pipeline Safety Act of 1979 (49 USC §60101et seq.). Other applicable Federal requirements are contained in 40 CFR Parts 109, 110, 112, 113, and 114, pertaining to the need for Oil Spill Prevention Control & Countermeasures Plans; and 40 CFR Parts 109–114 promulgated in response to the Oil Pollution Act of 1990.

[3] A flammable liquid having a flash point of not more than 141°F, or any material in a liquid phase with a flash point at or above 100°F, and would include crude oil.

Table 2.5 Final Regulatory Requirements for HHFT (USDOT May 1, 2015)

Proposed Requirement	Effected Entity
Enhanced Standards for Both New and Existing Tank Cars Used in HHFTs • New tank cars constructed after October 1, 2015 are required to meet enhanced USDOT Specification 117 design or performance criteria. • Existing tank cars must be retrofitted in accordance with the USDOT-prescribed retrofit design or performance standard. • Retrofits must be completed based on a prescriptive retrofit schedule and a retrofit reporting requirement is triggered if initial milestone is not achieved.	Tank Car Manufacturers, Tank Car Owners, Shippers / Offerors and Rail Carriers
More Accurate Classification of Unrefined Petroleum-Based Products • Develop and carry out sampling and testing program for all unrefined petroleum-based products, such as crude oil, to address: (1) Frequency of sampling and testing that accounts for any appreciable variability of the material (2) Sampling prior to the initial offering of the material for transportation and when changes that may affect the properties of the material occur; (3) Sampling methods that ensures a representative sample of the entire mixture, as offered, is collected; (4) Testing methods that enable classification of the material under the HMR; (5) Quality control measures for sample frequencies; (6) Duplicate samples or equivalent measures for quality assurance; (7) Criteria for modifying the sampling and testing program; (8) Testing or other appropriate methods used to identify properties of the mixture relevant to packaging requirements • Certify that program is in place, document the testing and sampling program outcomes, and make information available to USDOT personnel upon request.	Offerors / Shippers of unrefined petroleum-based products
Rail Routing - Risk Assessment • Perform a routing analysis that considers, at a minimum, 27 safety and security factors and select a route based on its findings. These planning requirements are prescribed in 49 CFR § 172.820. ***Rail Routing - Notification*** • Ensures that railroads notify State and/or regional fusion centers and State, local, and tribal officials who contact a railroad to discuss routing decisions are provided appropriate contact information for the railroad in order to request information related to the routing of hazardous materials through their jurisdictions. This replaces the proposed requirements to notify State Emergency Response Commissions (SERCs) or other appropriate state delegated entity about the operation of these trains through their States. ***Reduced Operating Speeds*** • Restrict all HHFTs to 50-mph in all areas. • Require HHFTs that contain any tank cars not meeting the enhanced tank car standards required by this rule operate at a 40-mph speed restriction in high-threat urban areas.	Rail Carriers
Enhanced Braking • Require HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributed power (DP) braking system.	Rail Carriers

Table 2.5 Final Regulatory Requirements for HHFT (USDOT May 1, 2015)

Proposed Requirement	Effected Entity
• Require trains meeting the definition of a "high-hazard flammable unit train" (HHFUT) be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021, when transporting one or more tank cars loaded with a Packing Group I flammable liquid. • Require trains meeting the definition of a HHFUT be operated with an ECP braking system by May 1, 2023, when transporting one or more tank cars loaded with a Packing Group II or III flammable liquid.	

HHFT-High-Hazard Flammable Trains (A train comprised of 20 or more loaded tank cars of a Class 3 flammable liquid in a continuous block or 35 or more loaded tank cars of a Class 3 flammable liquid across the entire train.

HHFUT-High-Hazard Flammable Unit Train (a train comprised of 70 or more loaded tank cars containing Class 3 flammable liquids traveling at speeds greater than 30 mph.)
Source: USDOT, 2015a.

Table 2.6 Final Safety Features by Tank Car Option (USDOT May 1, 2015)

Tank Car	Bottom Outlet Handle	GRL (lbs)	Head Shield Type	Pressure Relief Valve	Shell Thickness	Jacket	Tank Material	Top Fittings Protection	Thermal Protection System	Braking
DOT-117	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full- height, 1/2 inch thick head shield	Reclosing pressure relief device	9/16 inch Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
DOT-117R for Unjacketed CPC-1232	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full Height 1/2 inch thick head shield	Reclosing pressure relief device	7/16 inch-Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
CPC-1232[1]	Bottom Outlets are Optional	263K	Optional; Bare Tanks half height; Jacket Tanks full height	Reclosing pressure relief valve	7/16 inch-Minimum	Jackets are optional	TC-128 Grade B, normalized steel	Not required, but when Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Optional	Not required

1. This is referred to as a post October 1, 2011 tank car and is the tank car design proposed for use by Valero.
ECP-Electronically controlled pneumatic; DP-Distributed power; EOT-End of Train
HHFUTs transporting at least one car of Packing Group I flammable liquid to operate with ECP breaking system by January 1, 2021. Requires all other HHFUTs to operate with ECP braking system by May 1, 2013 or operate at a maximum speed of 30 miles per hour.
Non –Jacketed CPC-1232 tank cars in Packing Group I (tank cars proposed for the Project) must meet DOT-117R standard by April 1, 2020.
Source: Adapted from USDOT 2015a.

Overview of the 49 CFR 195 Requirements.

Part 195.30 incorporates many of the applicable national safety standards of the:

- American Petroleum Institute (API);
- American Society of Mechanical Engineers (ASME);
- American National Standards Institute (ANSI); and
- American Society for Testing and Materials (ASTM).

Part 195.50 requires reporting of accidents by telephone and in writing for:

- Explosion or fire not intentionally set by the operator;
- Spills of 5 gallons or more or 5 barrels if confined to company property and cleaned up promptly;
- Daily loss of 5 barrels a day to the atmosphere;
- Death or injury necessitating hospitalization; or
- Estimated property damage, including cleanup costs, greater than $50,000.

The Part 195.100 series includes design requirements for the temperature environment, variations in pressure, internal design pressure for pipe specifications, external pressure and external loads, new and used pipe, valves, fittings, and flanges.

The Part 195.200 series provides construction requirements for standards such as compliance, inspections, welding, siting and routing, bending, welding and welders, inspection and nondestructive testing of welds, external corrosion and cathodic protection, installing in-ditch and covering, clearances and crossings, valves, pumping, breakout tanks, and construction records.

The Part 195.300 series prescribes minimum requirements for hydrostatic testing, compliance dates, test pressures and duration, test medium, and records.

The Part 195.400 series specifies minimum requirements for operating and maintaining steel pipeline systems, including:

- Correction of unsafe conditions within a reasonable time;
- Procedural manual for operations, maintenance, and emergencies;
- Training;
- Maps;
- Maximum operating pressure;
- Communication system;
- Cathodic protection system;
- External and internal corrosion control;
- Valve maintenance;
- Pipeline repairs;

- Overpressure safety devices;
- Firefighting equipment; and
- Public education program for hazardous liquid pipeline emergencies and reporting.

Overview of 40 CFR Parts 109, 110, 112, 113, and 114

The Spill Prevention, Control and Countermeasure Plans (SPCCs) covered in these regulatory programs apply to oil storage and transportation facilities and terminals, tank farms, bulk plants, oil refineries, and production facilities, as well as bulk oil consumers, such as apartment houses, office buildings, schools, hospitals, farms, and state and federal facilities as follows:

- Part 109 establishes the minimum criteria for developing oil-removal contingency plans for certain inland navigable waters by state, local, and regional agencies in consultation with the regulated community (i.e., oil facilities).
- Part 110 prohibits discharge of oil such that applicable water quality standards would be violated, or that would cause a film or sheen upon or in the water. These regulations were updated in 1987 to adequately reflect the intent of Congress in Section 311(b) (3) and (4) of the Clean Water Act, specifically incorporating the provision "in such quantities as may be harmful."
- Part 112 deals with oil spill prevention and preparation of Spill Prevention Control and Countermeasure Plans. These regulations establish procedures, methods, and equipment requirements to prevent the discharge of oil from onshore and offshore facilities into or upon the navigable waters of the United States. These regulations apply only to non-transportation-related facilities.
- Part 113 establishes financial liability limits; however, these limits were preempted by the Oil Pollution Act of 1990.
- Part 114 provides civil penalties for violations of the oil spill regulations.

Overview of 6 CFR Part 27

Chemical Facility Anti-Terrorism Standards, 6 CFR 27. The Department of Homeland Security established the chemical facility anti-terrorism standards of 2007. This 2007 rule established risk-based performance standards for the security of chemical facilities. It requires covered chemical facilities to prepare Security Vulnerability Assessments, which identify facility security vulnerabilities, and to develop and implement Site Security Plans, which include measures that satisfy the identified risk-based performance standards.

Emergency Planning and Community Right-to-Know Act

Under the Emergency Planning and Community Right-to-Know Act, or Title III of the Superfund Amendments and Reauthorization Act of 1986, the U.S. Environmental Protection Agency (EPA) requires local agencies to regulate the storage and handling of hazardous materials and requires development of a plan to mitigate the release of hazardous materials.

Businesses that handle any of the specified hazardous materials must submit to government agencies (i.e., fire departments or public health departments), an inventory of the hazardous materials, an emergency response plan, and an employee training program. The business plans must provide a description of the types of hazardous materials/waste onsite and the location of these materials. The information in the business plan can then be used in the event of an emergency to determine the appropriate response action, the need for public notification, and the need for evacuation.

In 1990, Congress passed the Pollution Prevention Act which requires facilities to report additional data on waste management and source reduction activities to EPA under Toxics Release Inventory Program. The goal of the Toxics Release Inventory is to provide communities with information about toxic chemical releases and waste management activities and to support informed decision making at all levels by industry, government, non-governmental organizations, and the public.

Section 112(r) of the Clean Air Act Amendments of 1990, 40 CFR 68 (Hazardous Materials Management Planning)

The EPA requires facilities that handle listed regulated substances to develop Risk Management Programs (RMP) to prevent accidental releases of these substances. RMP materials are submitted to both local agencies (generally the fire department) and the EPA. Stationary sources with more than a threshold quantity of a regulated substance shall be evaluated to determine the potential for, and impacts of, accidental releases of that substance. Under certain conditions, the owner or operator of a stationary source may be required to develop and submit a RMP. A RMP consists of three main elements: a hazard assessment that includes off site consequences analyses and a five-year accident history; a prevention program; and an emergency response program.

Spill Prevention Control and Countermeasures Plans, 40 CFR 112.3 and 112.7 (National Contingency Plan Requirements)

Facilities that store large volumes of hazardous materials are required to have a Spill Prevention Control and Countermeasures Plans (SPCCP) per the requirements of 40 CFR 112 submitted to the EPA. The SPCCP is designed to prevent spills from onsite facilities and includes requirements for secondary containment, provides emergency response procedures, and establishes training requirements.

Worker Health and Safety

Occupational Safety and Health Act, 29 CFR et seq.

Under the authority of the Occupational Safety and Health Act of 1970, the U.S Department of Labor's Occupational Safety & Health Administration (OSHA) has adopted numerous regulations pertaining to worker safety (29 CFR) and provides oversight and enforcement (along with the California Occupational Safety and Health Administration (Cal/OSHA)). These regulations set standards for safe workplaces and work practices, including the reporting of

accidents and occupational injuries. Some OSHA regulations contain standards relating to hazardous materials handling, including workplace conditions, employee protection requirements, first aid, and fire protection, as well as material handling and storage.

Hazard Communication, 29 CFR 1910.1200

The purpose of the OSHA Hazard Communication law is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning any potential hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets, and employee training.

Process Safety Management, 29 CFR 1910.119

Under this section, facilities that use, store, manufacture, handle, process, or move hazardous materials are required to:

- Conduct employee safety training;
- Have an inventory of safety equipment relevant to potential hazards;
- Have knowledge on use of the safety equipment;
- Prepare an illness prevention program;
- Provide hazardous substance exposure warnings;
- Prepare an emergency response plan; and
- Prepare a fire prevention plan.

In addition, 29 CFR 1910.119, Process Safety Management of Highly Hazardous Chemicals, OSHA specifically requires prevention program elements to protect workers at facilities that have toxic, flammable, reactive or explosive materials. Prevention program elements are aimed at preventing or minimizing the consequences of catastrophic releases of chemicals and include process hazard analyses, formal training programs for employees and contractors, investigation of equipment mechanical integrity, and an emergency response plan.

3.2 California Laws and Regulations

State laws address gas and liquid pipelines, oil and gas facilities, and hazardous materials and waste. The following sections discuss each of these.

California Public Utilities Commission (CPUC)

CPUC is the State agency charged with ensuring the safety of freight railroads, inter-city and commuter railroads, and highway-railroad crossings in the State of California. CPUC performs these railroad safety responsibilities through the Railroad Operations and Safety Branch (ROSB) of the Safety & Enforcement Division.

ROSB's mission is to ensure that California communities and railroad employees are protected from unsafe practices on freight and passenger railroads by enforcing rail safety rules, regulations, and inspection efforts; and by carrying out proactive assessments of potential risks before they create dangerous conditions. ROSB personnel investigate rail accidents and safety related complaints, and recommend safety improvements to the Commission, railroads, and the federal government as appropriate. A more detailed listing of the CPUC regulations for railroad is provided in Attachment 5.

The CPUC is responsible for enforcing federal and state railroad safety requirements, including those governing railroad tracks, facilities, bridges, rail crossings, motive power and equipment, operating practices, and hazardous material shipping requirements. TheProject would require review and approval by the CPUC as it relates to the new track and operations that would occur at the Refinery.

ROSB currently has 38 certified rail inspectors and has funding to hire seven more. Inspections are divided into five railroad disciplines:

1. Operating Practices – oversight of main, branch and yard train operations, including hours of service, carrier operating rules, employee qualification guidelines, and carrier training and testing programs to determine compliance with railroad occupational safety and health standards, accident and personal injury reporting requirements, and other requirements.
2. Track – oversight of track construction, maintenance and inspection activities.
3. Signal & Train Control – oversight of signal system construction, maintenance and inspection activities.
4. Motive Power & Equipment – oversight of locomotives, freight and passenger rail cars, air brakes, and other safety appliances maintenance and inspection activities.
5. Hazardous Materials – oversight of the rail movements of hazardous materials, such as petroleum and chemical products; and inspection of hazardous materials shippers.

At a minimum mainline track within California is inspected by ROSB inspectors on an annual basis. Any identified track deficiencies are reported to the FRA and the track operator, and repairs are required to be made. (Roger Clugston, CPUC ROSB Manager, 2014).

Gas and Liquid Pipelines and Oil Facilities

Overview of California Pipeline Safety Regulations

State of California regulations Part 51010 through 51018 of the Government Code provide specific safety requirements that are more stringent than the Federal rules. These include:

- Periodic hydrostatic testing of pipelines, with specific accuracy requirements on leak rate determination;
- Hydrostatic testing by state-certified independent pipeline testing firms;

- Pipeline leak detection; and
- Reporting of all leaks required.

Recent amendments require pipelines to include means of leak prevention and cathodic protection, with acceptability to be determined by the California State Fire Marshall (CSFM). All new pipelines must also be designed to accommodate passage of instrumented inspection devices (smart pigs) through the pipeline.

California Pipeline Safety Act of 1981

The California Pipeline Safety Act gives regulatory jurisdiction for the safety of all intrastate hazardous liquid pipelines and all interstate pipelines used for the transportation of hazardous or highly volatile liquid substances to the CSFM. The law establishes the governing rules for interstate pipelines to be the Federal Hazardous Liquid Pipeline Safety Act and Federal pipeline safety regulations.

Oil Pipeline Environmental Responsibility Act (Assembly Bill 1868)

This Act requires every pipeline corporation qualifying as a public utility and transporting crude oil in a public utility oil pipeline system to be held strictly liable for any damages incurred by "any injured party which arise out of, or are caused by, the discharge or leaking of crude oil or any fraction thereof ...." The law applies only to public utility pipelines for which construction would be completed after January 1, 1996, or that part of an existing utility pipeline that is being relocated after the above date and is more than three miles in length. The major features signed into law in October 1995 include:

- Each pipeline corporation that qualifies as a public utility that transports any crude oil in a public utility oil pipeline system shall be absolutely liable, without regard to fault, for any damages incurred by any injured party that arise out of, or are caused by, the discharge or leaking of crude oil.
- Damages for which a pipeline corporation is liable under this law are: all costs of response, containment, cleanup, removal, and treatment, including monitoring and administration cost; injury or economic losses resulting from destruction of, or injury to, real or personal property; injury to, destruction of, or loss of natural resources, including but not limited to, the reasonable cost of rehabilitating wildlife habitat, and other resources and the reasonable cost of assessing that injury, destruction, or loss, in any action brought by the State, County, city, or district; loss of taxes, royalties, rents, use, or profit shares caused by the injury, destruction, loss, or impairment of use of real property, personal property, or natural resources; and loss of use and enjoyment of natural resources and other public resources or facilities in any action brought by the State, County, city, or district;
- A pipeline corporation shall immediately clean up all crude oil that leaks or is discharged from a pipeline.

- No pipeline system subject to this law shall be permitted to operate unless the State Fire Marshal certifies that the pipeline corporation demonstrates sufficient financial responsibility to respond to the liability imposed by this section. The minimum financial responsibility required by the State Fire Marshal shall be seven hundred fifty dollars ($750) times the maximum capacity of the pipeline in the number of barrels per day up to a maximum of one hundred million dollars ($100,000,000) per pipeline system, or a maximum of two hundred million dollars ($200,000,000) per multiple pipeline system. For the Pacific Pipeline, the Bill specifically requires $100,000,000 for the financial responsibility (Section l.h.(l)).
- Financial responsibility shall be demonstrated by evidence that is substantially equivalent to that required by regulations issued under Section 8670.37.54 of the Government Code, including insurance, surety bond, letter of credit, guaranty, qualification as a self-insurer, or combination thereof or any other evidence of financial responsibility. The State Fire Marshal shall require that the documentation evidencing financial responsibility be placed on file with that office.
- The State Fire Marshal shall require evidence of financial responsibility to fund post-closure cleanup spots. The evidence of financial responsibility shall be 15 percent of the amount of financial responsibility stated above.

California Accident Release Prevention

The California Accident Release Prevention program mirrors the Federal Risk Management program, except that it adds external events and seismic analysis to the requirements and includes facilities with lower inventories of materials. A California Accident Release Prevention or Risk Management Plan, as administered by the Fire Departments and the EPA, if applicable, is a document prepared by the owner or operator of a stationary source containing detailed information including:

- Regulated substances held onsite at the stationary source;
- Offsite consequences of an accidental release of a regulated substance;
- The accident history at the stationary source;
- The emergency response program for the stationary source;
- Coordination with local emergency responders;
- Hazard review or process hazard analysis;
- Operating procedures at the stationary source;
- Training of the stationary source’s personnel;
- Maintenance and mechanical integrity of the stationary source’s physical plant; and
- Incident investigation.

Hazardous Materials and Hazardous Waste

Hazardous Waste Control Law

The Hazardous Waste Control Law is administered by the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC). DTSC has adopted extensive

regulations governing the generation, transportation, and disposal of hazardous wastes. These regulations impose cradle-to-grave requirements for handling hazardous wastes in a manner that protects human health and the environment. The Hazardous Waste Control Law regulations establish requirements for identifying, packaging, and labeling hazardous wastes. They prescribe management practices for hazardous wastes; establish permit requirements for hazardous waste treatment, storage, disposal, and transportation; and identify hazardous wastes that cannot be disposed of in landfills. Hazardous waste is tracked from the point of generation to the point of disposal or treatment using hazardous waste manifests. The manifests list a description of the waste, its intended destination, and regulatory information about the waste.

Hazardous Materials Management Planning

The Office of Emergency Services (OES), in support of local government, coordinates overall state agency response to major disasters. The office is responsible for assuring the State's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response, and recovery efforts. During major emergencies, OES may call upon all State agencies to help provide support. Due to their expertise, the California National Guard, California Highway Patrol (CHP), Department of Forestry and Fire Protection, Conservation Corps, Department of Social Services, and the California Department of Transportation (Caltrans) are the agencies most often asked to respond and assist in emergency response activities.

In January 2014, the Governor's Office convened a Rail Safety Working Group to examine safety concerns and recommend actions the State of California and others should take in response to the emerging risk posed by increased shipments of crude oil by rail into California.

The Working Group includes representatives from the CPUC, California OES, California EPA, DTSC, California Energy Commission, California Natural Resources Agency, California Office of the State Fire Marshal, Department of Oil, Gas and Geothermal Resources, and Office of Spill Prevention and Response.

The Working Group published their report on June 10, 2014. The report provides preliminary findings and recommendations to improve emergency response for crude oil trains in California. Some of the key recommendations in the report covered increasing the number of CPUC rail inspectors, improve emergency preparedness and response programs at both the state and local level, require railroad to provide better information to emergency responders and affected communities about crude by rail shipments and accident/incident data. Some of these recommendations were addressed with the passage of SB 861, which was signed into law in June 2014. Also, the most recent California budget allotted funds for additional CPUC rail inspectors, and the CPUC is currently in the process of hiring two railroad bridge inspectors.

Hazardous Materials Transportation in California

California regulates the transportation of hazardous waste originating or passing through the State in Title 13 of the California Code of Regulations. The CHP and Caltrans have primary responsibility for enforcing Federal and State regulations and responding to hazardous materials transportation emergencies. The CHP enforces materials and hazardous waste labeling and packing regulations that prevent leakage and spills of material in transit and provide detailed information to cleanup crews in the event of an incident. Vehicle and equipment inspection, shipment preparation, container identification, and shipping documentation are all part of the responsibility of the CHP. The CHP conducts regular inspections of licensed transporters to ensure regulatory compliance. Caltrans has emergency chemical spill identification teams at locations throughout the State.

Hazardous waste must be regularly removed from generating sites by licensed hazardous waste transporters. Transported materials must be accompanied by hazardous waste manifests.

Hazardous Material Worker Safety, California Occupational Safety and Health Act

Cal/OSHA is responsible for assuring worker safety in the handling and use of chemicals in the workplace. Cal/OSHA assumes primary responsibility for developing and enforcing workplace safety regulations in Title 8 of the California Code of Regulations (CCR). Cal/OSHA hazardous materials regulations include requirements for safety training, availability of safety equipment, hazardous substance exposure warnings, and emergency action and fire prevention plan preparation.

Cal/OSHA also enforces hazard communication program regulations, which contain training and information requirements, including procedures for identifying and labeling hazardous substances. The hazard communication program also requires that Material Safety Data Sheets be available to employees and that employee information and training programs be documented.

3.3 Other Applicable Guidelines, National Codes, and Standards

Safety and Corrosion Prevention Requirements — American Society of Mechanical Engineers, National Association of Corrosion Engineers, American National Standards Institute, API

The following design requirements are generally enforced by local building departments, fire departments and public health departments during plan review and permit issuance. The code requirements address a range of issues that would reduce impacts, including equipment design, material selection, and use of safety valves.

- ASME & ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings;
- ASME & ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings;
- ASME & ANSI B31.1a, Power Piping;

- ASME & ANSI B31.4a, addenda to ASME B31.4a, Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols;
- NACE Standard RP0190, Item No. 53071. Standard Recommended Practice External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems;
- NACE Standard RP0169, Item No. 53002. Standard Recommended Practice Control of External Corrosion on Underground or Submerged Metallic Piping Systems;
- API 510 Pressure Vessel inspection Code;
- API 570 Piping Inspection Code, applies to in-service metallic piping systems used for the transport of petroleum products;
- API 572 Inspection of Pressure Vessels;
- API 574 Inspection Practices for Pipe System Components;
- API 575 API Guidelines and Methods for Inspection of Existing Atmospheric and Low-pressure Storage Tanks;
- API 576 Inspection of Pressure Relieving Devices;
- API 650 Welded Steel Tanks for Oil Storage;
- API 651 Cathodic Protection of Aboveground Storage Tanks;
- API 653 Tank Inspection, Repair, Alteration, and Reconstruction;
- API 2610, Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities; and
- API Spec 12B - Bolted Tanks for Storage of Production Liquids.

API 653, atmospheric tank inspection and repair, is particularly applicable to the Crude by Rail Project and addresses the following issues:

- Tank suitability for service;
- Brittle fracture considerations;
- Inspections;
- Materials;
- Design considerations;
- Tank repair and alteration;
- Dismantling and reconstruction;
- Welding;
- Examination and testing;
- Marking and recordkeeping;
- Pertinent issues related to tank inspections in API 653;
- External inspections by an authorized inspector every 5 years;

- Ultrasonic inspections of shell thickness every 5 years (when corrosion rate not known); and
- Internal bottom inspection every 10 years, if corrosion rates not known.

Fire and Explosion Prevention and Control, National Fire Protection Agency

The following design requirements are generally enforced by fire departments during plan review and permit issuance. The code requirements address a range of issues that would reduce impacts, including fire fighting system design, and water supply requirements.

- NFPA 30 Flammable and Combustible Liquids Code and Handbook;
- NFPA 11 Foam Extinguishing Systems;
- NFPA 12 A&B Halogenated Extinguishing Agent Systems;
- NFPA 15 Water Spray Fixed Systems;
- NFPA 20 Centrifugal Fire Pumps; and
- NFPA 70 National Electrical Code.

4.0 Significance Criteria

As defined in California Environmental Quality Act (CEQA) Guidelines Appendix G (the Environmental Checklist Form), a project could result in a significant safety effect if it "create[s] a potential health hazard or involve[s] the use, production or disposal of materials which pose a hazard to people, animal or plant populations in the area affected." The purpose of this study is to address the first two items in the CEQA Guidelines checklist for hazards and hazardous materials. These two items are:

a) Create a significant hazard to the public or the environment through the routine transport, use or disposal of hazardous materials;

b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;

California does not have a defined process to address these two items from the CEQA checklist. Santa Barbara County adopted Public Safety Thresholds in August 1999 which established quantitative risk-based criteria that have been utilized by various state and local agencies, including the California Coastal Commission, the California State Lands Commission, the County of San Luis Obispo, Los Angeles County, City of Carpentaria, City of Whittier, City of Huntington Beach, etc. Therefore, the Santa Barbara County thresholds have been applied. The thresholds provide specific zones (i.e., green, amber, and red) on a risk profile curve to guide the determination of significance or insignificance based on the estimated probability and consequence of an accident. In general, risk levels in the green area would be less than significant and therefore acceptable, while risk levels in the amber and red zones would be significant. Risk profiles plot the frequency of an event against the consequence in terms of fatalities or injuries; frequent events with high consequence have the highest risk level.

The criteria used in this analysis are based on the potential risk associated with the crude by rail operations (operations at Refinery and along the UPRR mainline routes). Therefore, an impact would be considered significant if any of the following were to occur:

- Be within the amber or red regions of the Santa Barbara County Safety Criteria; or
- Non-compliance with any applicable design code, regulation, NFPA standard, or generally acceptable industry practice.

The foregoing thresholds do not address risk of environmental damage. The thresholds applied for risk of significant environmental impact due to accidental spills are discussed in the appropriate issue areas of the EIR for the Valero Crude by Rail Project. In addition, the thresholds do not apply to occupational safety. Occupational risk is governed by OSHA and Cal/OSHA.

5.0 Risk Analysis

The Project would result in the construction of new facilities that could lead to increased fire and explosion hazards at the Refinery and along the railroad routes to the Refinery. In assessing the level of public risk associated with these hazards a quantitative risk assessment (QRA) was conducted for both the new rail facilities at the Refinery as well as for the various mainline rail routes to the Refinery.

A QRA involves evaluating risks presented to the public by a facility or transportation operation in the form of hazardous materials releases resulting in explosions, flammable vapors, or toxic material impacts. A QRA was used to evaluate the risks associated with the transport of crude by rail along the main rail lines between the Refinery and the Roseville Yard and the three mainline routes to Oregon (1 route) and Nevada (2 routes), and for the rail operations that would occur at the Refinery.

The QRA analyzes the risks of immediate human safety impacts presented by these operations on nearby populations. The assessment follows commonly accepted industry standards including the recommendations of the Center for Chemical Process Safety (CCPS), and the Health and Safety Executive of the United Kingdom.

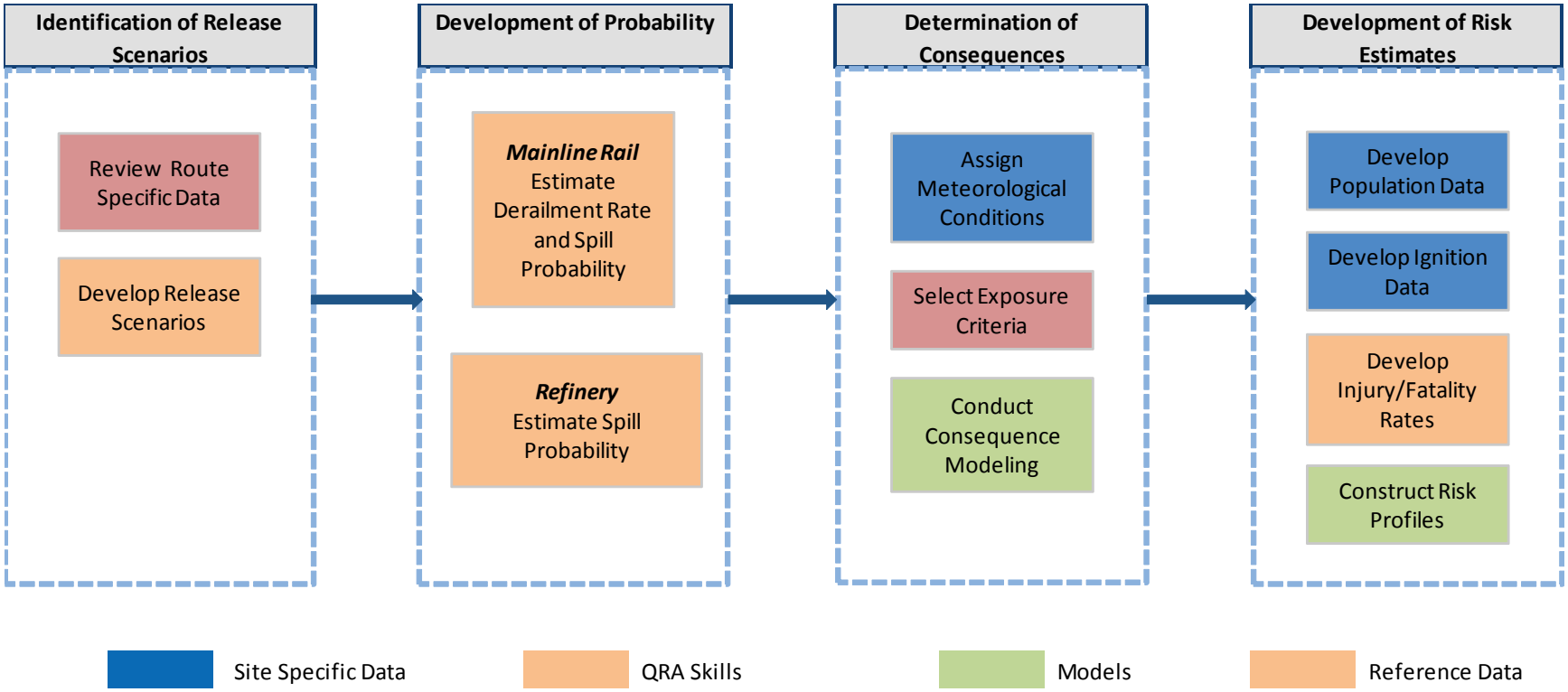
The main objective of the QRA is to assess the risk of generating serious injuries or fatalities to members of the public, to assess the risks of spill events, and to develop mitigation measures that could reduce these risks. The development of the serious injury and fatality aspects of the QRA involves five major tasks:

- Identifying release scenarios;
- Developing frequencies of occurrence for each release scenario;
- Determining consequences of each release scenario;
- Developing estimates of risk, including risk profiles;
- Compare the risk level to the significance criteria; and
- Developing risk-reducing mitigation measures.

Figure 5-1 shows the steps in developing a QRA. A QRA computer model, developed by Marine Research Specialists, is used to calculate the risk profiles[4] and, in conjunction with Geographic Information System software, to manage the data in accordance with CCPS guidelines for hazard assessments (CCPS, 1989). A detailed description of the QRA methodology is provided in Attachment 2. This attachment describes each of the steps used in the QRA as well as the various consequence models and impact thresholds that were used in the QRA.

[4] A risk profile is a plot of the frequency (i.e., probability) of various levels of fatalities or injuries that could result from a set of hazardous events.

Figure 5-1 Steps Involved in Developing a Quantitative Risk Assessment



The spill modeling was done using a multi-component crude with the properties provided below in Table 5.1. These crude properties were based upon a Bakken type crude due to its lighter properties and relatively higher volatility.

Table 5.1 Properties of Crude Oil Used for Consequence Modeling

Gravity (API)	50
Flash Point (C)	10
Vapor Pressure (kPa)	90
Light Ends (<C10; Vol %)	39
Burn Rate (meters/second)	0.00025
Flame Temperature (K)	1,000
Flame Emissive Power (kw/m^2)	56.7

Combined, these values are extremely conservative, and represent crude that is likely lighter than the average crudes that would be received at the Refinery. Ultimately, the modeling is sensitive to the initial percent of light ends, flame temperature, and emissive power values, which for the modeling are very conservative for the types of crudes that would be delivered to the Refinery.

5.1 Unloading Facility Risk

The new unloading facility would include an access platform and a system of pumps and meters, suction lines from the railcars, carbon beds for vapor treatment, and a common pipeline leading to the Refinery's existing tank farm. The unloading facility would be equipped with two 25-car unloading systems. This would allow 50 rail cars to be unloaded at one time.

All of the rail track extensions built as part of the Project would have to comply with applicable CPUC general orders including:

- GO 26-D: Clearances on railroads and street railroads as to side and overhead structures, parallel tracks and crossings,
- GO 72-B: Construction & Maintenance - Standard types of pavement construction at railroad grade crossings,
- GO 75-D: Warning Devices for at-grade railroad crossings, and
- GO 118: Construction, reconstruction and maintenance of walkways and control, of vegetation adjacent to railroad tracks.

Implementation of the Project could result in spills at the Project site due to mechanical failure, structural failure, corrosion, or human error during pipeline use and oil transportation to and from the facility. Given the low speed the trains would be moving at the site (3 mph) it is unlikely that a tank car could be impacted enough to result in a spill. The estimated shell and

head puncture velocity of the tank car design proposed for use by Valero are 8.3 and 10.3 miles per hour respectively (USDOT 2014).

The most likely spill related event would be a release during the unloading process due to a loading line failure. The new tank car unloading facilities would include a liquid spill containment sump with the capacity to contain the contents of at least one tank car (30,000 gallons). The loss of a loading hose could result in a maximum spill of about 30,000 gallons of crude oil (the capacity of one rail car). This system would effectively control spills that would result from the loading operations.

The loading area would also be equipped with a fire protection system that would consist of fire detection equipment hydrants, controls and piping. The unloading rack would be equipped with a foam sprinkler deluge system and firewater monitors with foam generators at the unloading rack periphery. In the event of a spill that led to a fire, the sprinkler deluge system would activate and douse the area with foam. Any spilled oil would be directed away from the unloading area to the spill containment tanks, which would serve to keep any fire away from the rail cars.

Downstream of the two unloading facility meter assemblies, a new 16-inch above ground pipeline would be routed along an existing internal road on the Valero property between the unloading facility and the refinery. This pipeline would connect with the existing refinery crude oil storage tanks. This road accommodates periodic on-site traffic only associated with refinery personnel traveling at low-speeds.

The pipeline would be approximately 4,000 feet in length. The unloaded crude oil would be stored in the existing refinery storage tanks. Therefore, crude oil storage would not result in any increase in fire and explosion risk at the refinery.

The proposed unloading facility would have a maximum crude oil pumping rate of 4,000 gpm. The unloading facility and 16-inch pipeline would be monitored using multiple Programmable Logic Controllers (PLCs) and controlled using the existing refinery Supervisory Control and Data Acquisition (SCADA) system. The SCADA would detect a catastrophic failure of the 16-inch pipeline within one minute, thus limiting pumping losses. However, the drainage of the pipeline would occur, and potentially result in a worst-case spill of about 73,000 gallons of crude oil. This worst case spill would occur where the pipeline connects with unloading pumps since this is the lowest elevation of the pipeline. As one moves up the pipeline toward the storage tanks, the maximum spill volumes decrease, with the smallest spill volumes being near the storage tanks. In the event of a release from the pipeline the oil would drain into the area around the pipeline and unloading racks, which could result in a pool fire.

Several crude oil spill scenarios were modeled to evaluate worst-case thermal radiation hazards associated with a large crude oil fire. Modeled scenarios ranged from small releases from a tank car, full release of rail car contents, and full release of the pipeline volume. (Attachment 3 for

consequence modeling input data and results). The worst-case thermal radiation hazard distance are provided in Table 5.2

Table 5.2 Worst Case Refinery Unloading Facility Thermal Radiation Hazard Zones

Wind Speed (meters/second)	Distance in feet to	
	5 kw/m^2	10 kw/m^2
1	518	282
2	558	308
3	581	324
4	974	554
5	994	571
10	1,053	620
20	1,585	1,109

See Attachment 3 for the detailed consequence modeling results.
See Attachment 2 for a description of the consequences associated with these hazards.

As shown in Figure 5-2, none of these flammable hazard zones have the potential for offsite impacts associated with the worst-case unloading facility crude oil spill and fire in residential areas. The worst case spill occurs just north of the unloading facility where nearly the entire pipeline would drain onto the ground due to the slope of the area between the unloading facility and refinery storage tanks. Spills closer to the refinery storage tanks would be smaller, thus resulting in smaller hazard zones and less offsite exposure. Since the worst case hazard zones extend beyond the Refinery boundaries, a QRA was prepared to evaluate the risk to adjacent workers in the commercial/industrial area east of the Refinery.

The QRA also considered the potential for a rail car thermal tear in the event that the pipeline spill exceeded the volume of the spill containment sump and the crude oil ignited. The results of the QRA for the proposed Project are presented in Figure 5-3 as risk profiles and show that the societal risk of injuries or fatalities associated with unloading facility accidents would be considered less than significant.

Figure 5-2 Worst-Case Facility Thermal Radiation Hazards

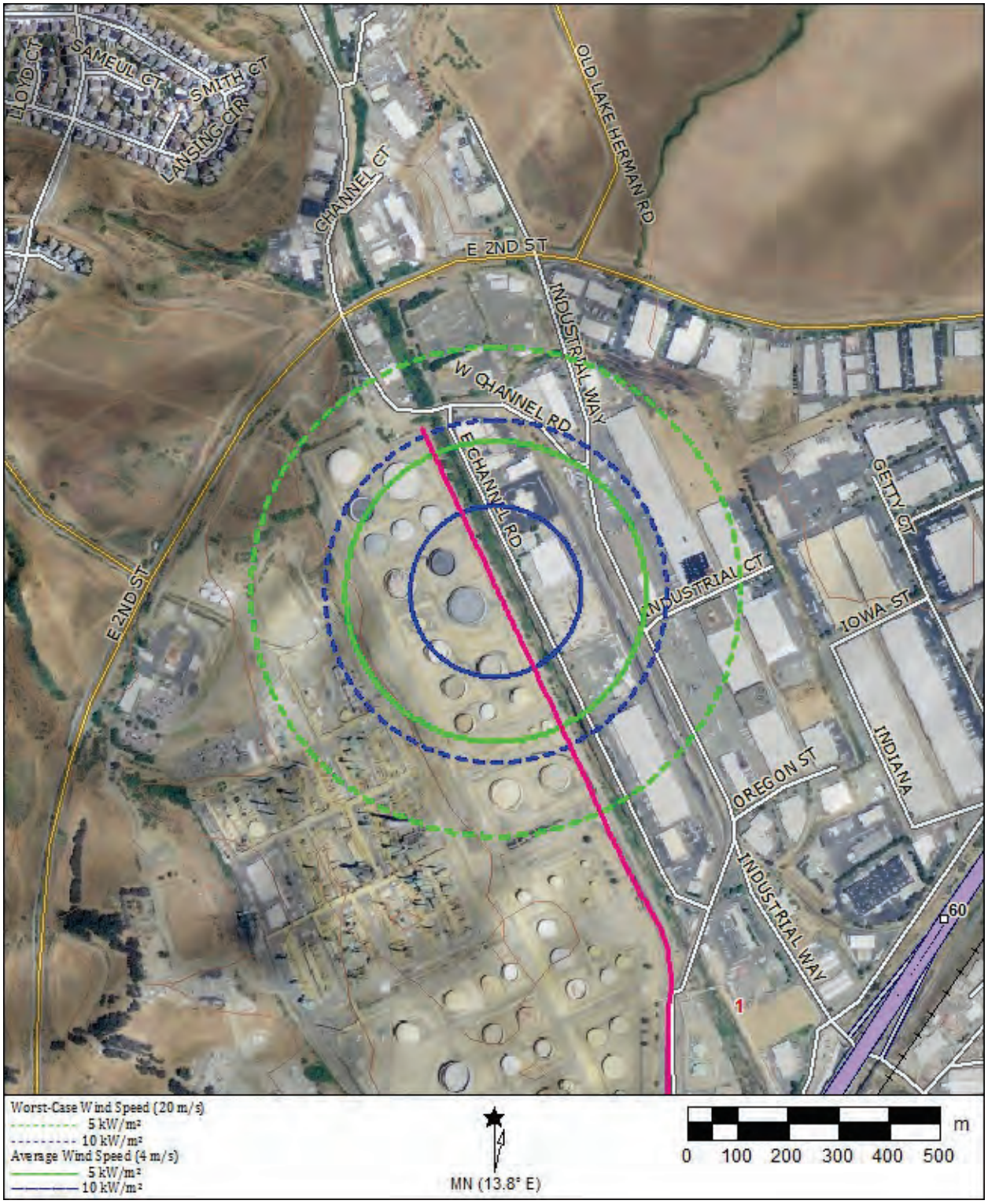
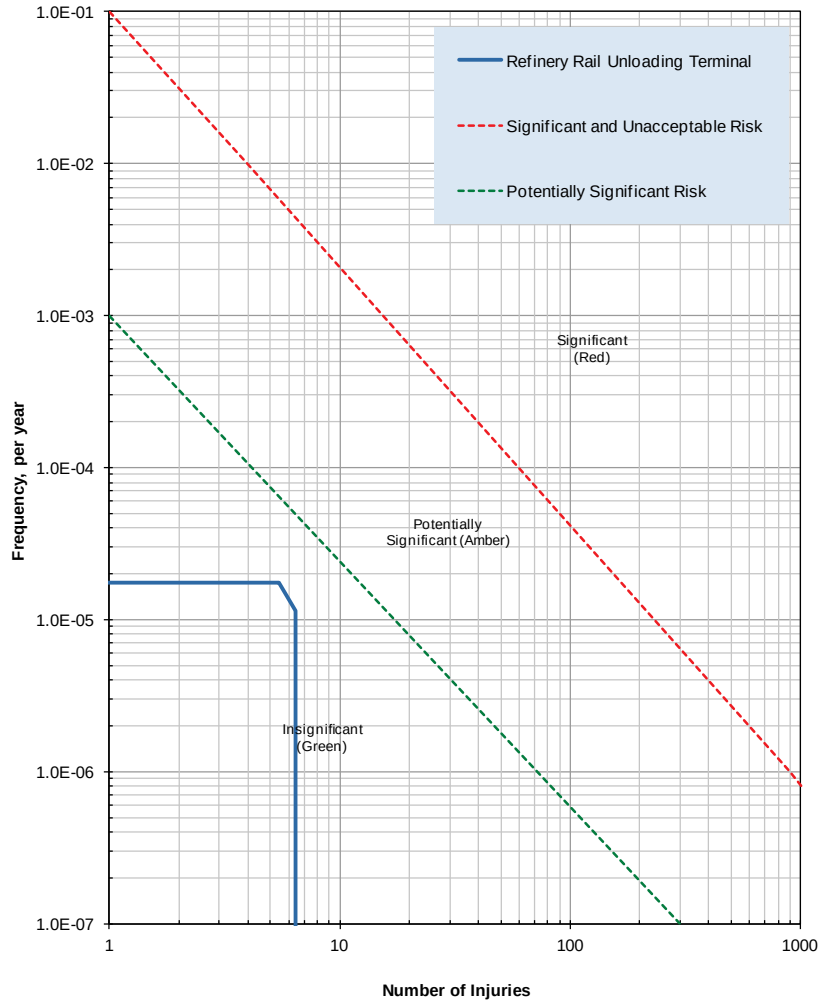
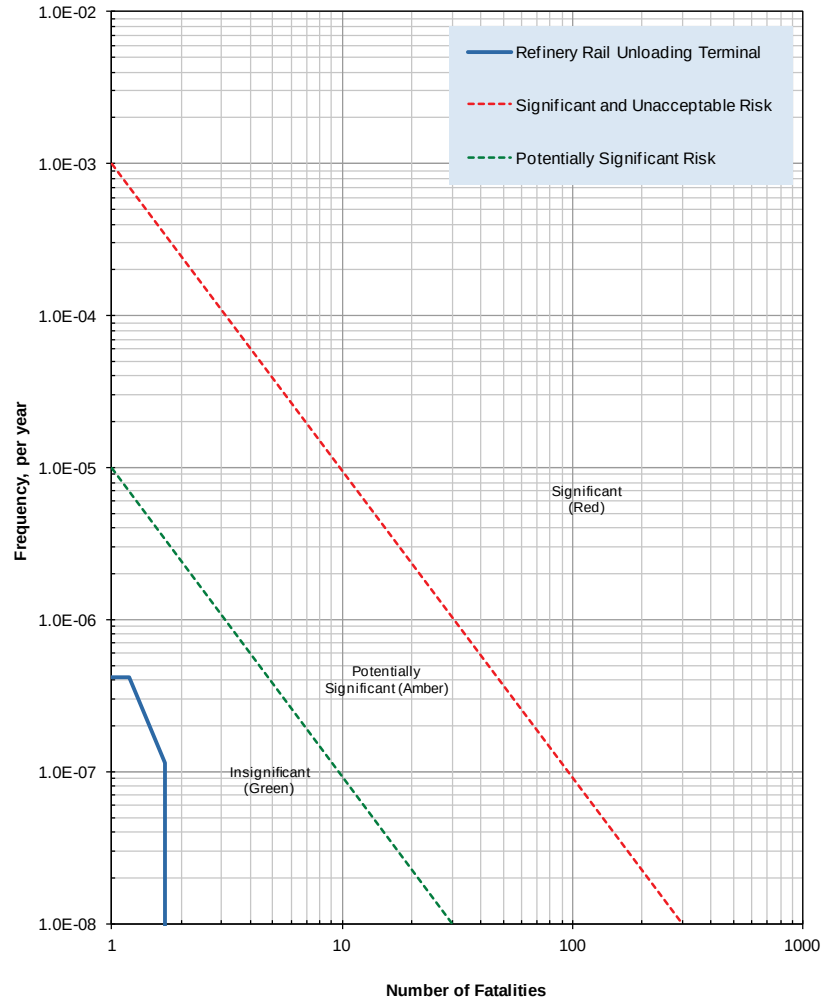


Figure 5-3 Risk Associated Valero Unloading Facility Crude Oil Spills and Fires





5.2 Mainline Rail Accident Risk

It is unknown what route UPRR would use to deliver the trains to the Refinery. Coming from the north the routes merge at the Roseville Yard. This risk analysis evaluates the risk for all three mainline routes from the Roseville Yard to the California stateline that could be used to transport crude oil to the Refinery.

The route distances were developed using a graphical information systems (GIS). The GIS estimated the distances for the three routes are:

- 69 miles Valero Benicia Refinery to the Roseville Yard
- 297 miles Roseville to Oregon via Dorris (Dunsmuir)
- 229 miles Roseville to Nevada via Portola (Feather River Canyon)
- 119 miles Roseville to Nevada via Truckee (I80 corridor)

UPRR would be responsible for transporting the crude oil to the Refinery if the Project were approved. Federal law requires common carriers like UPRR, to transport hazardous materials, such as crude oil, for its customers. If a customer delivers the hazardous material in conformity with applicable USDOT requirements, UPRR must transport the material. UPRR is required to transport all commodities in accordance with applicable federal laws.

To maximize safety and security when moving crude oil, UPRR has implemented additional measures that include:

- Using the Rail Corridor Risk Management System (RCRMS) routing protocol for trains carrying 20 or more crude oil cars to determine the safest and most secure routes. The RCRMS is an analytical tool developed in conjunction with the Department of Homeland Security and the FRA. This tool takes into account 27 risk factors to assess rail route safety and security.

- Requiring trains carrying 20 or more crude oil cars that include at least one older DOT-111 tank car not to exceed 40 miles per hour in the 46[5] designated high-threat-urban areas (HTUA) established by Federal regulations. This reduces by 10 miles per hour UPRR's current self-imposed speed limit. This reduced train speed reduces the kinetic energy that contributes to tank car breeches in accident.

- Evaluating where the railroad may need to install additional advanced track-side detectors.

[5] A list of the HTUA is provided in Attachment 6. Within California the crude oil trains could pass through three HTUA (the Bay Area and Sacramento). Outside of California, a crude oil train could pass through a number of HTUA depending upon the route taken to get to California (i.e., Las Vegas, Denver, Seattle, etc.)

- Increased emergency response training and tuition assistance to include a specialized crude by rail curriculum at the industry's Transportation Technology Center, Inc. (TTCI) facility in Pueblo, Colorado.
- Creating a comprehensive emergency response resources inventory.
- Use of distributed power or two-way telemetry end-of-train devices for enhanced braking on trains that carry 20 or more carloads of crude oil (UPRR, 2014a).

In addition, UPRR has a track inspection program for its rail lines in California that exceed the current Federal requirements. The UPRR inspection program includes the following:

- Tracks in California are visually inspected twice a week with "hi-rail" pickup trucks to identify any broken rails or issues with track surface condition.
- Special inspections are performed during and after storm events and earthquakes.
- UPRR conducted track geometry tests of their mainline tracks at least twice per year. These tests provide information on the condition of the track, track alignment, curve wear, clearance in tunnels and bridges, track profile, etc. These inspections also include collecting video of the track, which can be used to further assess track conditions.
- UPRR also tests their mainline rails in California every three to six months using a rail detector system, which uses ultrasonic sound waves to search the tracks for any internal issues. This is a key technology that helps to prevent broken rail derailments.

UPRR also has a capital track maintenance project in California that covers the replacement and upgrading of track. In the last five years UPRR has replaced over two million railroad ties and 452 miles of rail line in California (UPRR, 2014b).

UPRR also has a bridge inspection program that complies with 49 CFR Part 237-Bridge Safety Standards. This program is used to ensure the structural integrity of bridges, culverts, and tunnels. All bridges are inspected between one and three times per year. In the last five years, UPRR has upgraded 70 bridges in California (UPRR, 2014b).

As required by Federal law, UPRR has been installing Positive Train Control (PTC) on their main rail lines in California. The three mainline routes between the Refinery and the stateline that would be used for the proposed project have been almost completely upgraded to include PTC, with only a portion of the Feather Canyon route not fully upgraded. PTC is used to prevent train to train collisions, over-speed derailments, switch misalignment, and unauthorized entry into work zones (UPRR, 2014b).

A QRA was prepared following the guidelines of the American Institute of Chemical Engineers, Center for Chemical Process Safety (CCPS, 1995). Attachment 2 provides a detailed description

of the QRA methodology and the parameters that were used for various QRA inputs. The three rail routes evaluated are shown in Figure 5-4.

The QRA was used to determine the significance of an accident associated with crude oil transportation along each of the routes, assuming that all of the annual trains servicing the Refinery used that specific route. Each of the major inputs to the QRA is discussed below.

5.2.1 Probability (e.g., Frequency) of a Derailment and Associated Crude Oil Spill

In order to identify the probability of an accident (i.e., accident rate or derailment rate) and oil spill (i.e., spill rate) from a crude oil train on each of the possible routes, Dr. Christopher Barkan was retained to conduct a quantitative assessment. Dr. Barkan is Professor and Executive Director of the Rail Transportation and Engineering Center at the Department of Civil and Environmental Engineering at the University of Illinois at Urbana- Champaign. He and his colleagues prepared a report (see Attachment 1) that looked at route specific accident rates and spill rates based upon the tank car design proposed by Valero. The analysis took into account major risk factors, including route specific FRA track class, method of operation, tank car safety design, and the proposed volume of crude oil trains over the route and the estimated spill size.

Dr. Barkan and his team developed conditional cumulative probability distribution of spill sizes given that a release has occurred for various FRA track classes. These conditional cumulative probability distributions assume non-jacketed CPC-1232 tank cars with traffic density of more than 20 million gross tons (MGT) per year[6]. The conditional cumulative probability distribution of spill sizes are for spills that result from a derailment that leads to loss of oil from a tank car puncture or fitting failure, and do not include secondary release due to fire and associated thermal tears. The spill sizes evaluated in the analysis included the following:

- **Small Spill (100 gallons)** - represents approximately the 100% cumulative probability spill size given that a release has occurred.
- **Median Spill (30,000 gallons)** - represents approximately the 50% cumulative probability spill size given that a release has occurred. This represents the volume of about one tank car.
- **Large Spill (180,000 gallons)** - represents approximately the 3% cumulative probability spill size given that a release has occurred. This represents the volume of about six tank cars.
- **Very Large Spill (240,000 gallons)** - represents approximately the 1% cumulative probability spill size given that a release has occurred. This represents the volume of about eight tank cars.

[6] University of Illinois at Urbana-Champaign Rail Transportation and Engineering Center (RAILTEC), Petroleum Crude Oil Unit Train Transportation Risk Analysis: Benicia Project, Kuly 2015.

Figure 5-4 Mainline Rail Routes Evaluated in the Quantitative Risk Assessment

As discussed above, these are oil spill volumes resulting from a derailment that leads to loss of oil from a tank car puncture or fitting failure, and do not include secondary release due to fire and associated thermal tears. The hazards zones associated with the fires and secondary thermal tears resulting in fireballs will be estimated as part of the hazards analysis and incorporated into the quantitative risk assessment (QRA).

The results of analysis showed that the probability of a crude oil release incident exceeding 100 gallons or more would range between one every 20 years to once every 27 years depending upon the rail route used to get to the Refinery. The probability of a crude oil release incident exceeding 30,000 gallons or more would range between one every 38 years to once every 80 years; the probability of a crude oil release incident exceeding 180,000 gallons or more would range between one every 200 years to once every 4,000 years; and the probability of a crude oil release incident exceeding 240,000 gallons or more would range between one every 308 years to once every 10,000 years. These probabilities of a release are only for the portion of the routes between the Refinery and California/Oregon and California/Nevada state lines. As discussed below, the probability of a release of crude oil would be greater for the full length of the train route (crude source location to Refinery).

In conducting the QRA the routes were divided into distinct segments based on rail characteristics and population density along the railroad. Segments are shown based on the population density adjacent to the railroad. Crude oil spill probabilities for each of routes and segments are shown in Tables 5.3 through 5.5.

5.2.2 Consequence Modeling Results

As with the Refinery spill analysis, several crude oil spill scenarios were modeled to evaluate worst-case thermal radiation hazards associated with a large crude oil fire. Modeled scenarios ranged from small releases from a tank car, to the complete loss of multiple tank cars. The worst case spill was assumed to be 240,000 gallons (about eight tanker cars). An explosion of tank cars, referred to as a thermal tear and simulated as a Boiling Liquid Expanding Vapor Explosion (BLEVE), was also evaluated. The worst-case thermal radiation and explosion hazard distance are provided in Table 5.6. The modeling input data and results for these hazards are provided in Attachment 3. A 100-gallon spill was used as the cut off from the hazards analysis since below that level the hazard zones would likely be contained to the railroad right-of-way, and explosions would be unlikely since 100-gallon spill fire would not generate enough thermal radiation for a long enough period of time to produce a thermal tear.

The consequence modeling results were then used along with the spill probability and population densities to estimate the overall risk of injury and fatality for each of the routes. These hazard zones would be the same for the entire rail route within California and all the way back to the source of the crude oil.

Table 5.3 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	9.10E-07	1,000	730	9.49E-06	2.48E-06	6.35E-09	4.18E-10	3.16E-04	8.26E-05	2.12E-07	1.39E-08
19	Roseville	1.4	1.12E-06	3,000	730	1.16E-05	3.04E-06	7.78E-09	5.12E-10	3.88E-04	1.01E-04	2.59E-07	1.71E-08
20	Roseville	1.1	8.71E-07	3,000	730	9.08E-06	2.37E-06	6.07E-09	3.99E-10	3.03E-04	7.90E-05	2.02E-07	1.33E-08
21	Roseville	2.5	1.94E-06	1,000	730	2.02E-05	5.28E-06	1.35E-08	8.90E-10	6.74E-04	1.76E-04	4.51E-07	2.97E-08
22	Roseville	0.5	3.58E-07	100	730	3.74E-06	9.75E-07	2.50E-09	1.64E-10	1.25E-04	3.25E-05	8.33E-08	5.48E-09
23	Rocklin	2.5	1.99E-06	1,000	730	2.07E-05	5.42E-06	1.39E-08	9.13E-10	6.91E-04	1.81E-04	4.63E-07	3.04E-08
24	Placer Co	8.0	6.31E-06	100	730	6.58E-05	1.72E-05	4.40E-08	2.90E-09	2.19E-03	5.73E-04	1.47E-06	9.65E-08
25	Newcastle	0.5	3.57E-07	3,000	730	3.72E-06	9.72E-07	2.49E-09	1.64E-10	1.24E-04	3.24E-05	8.30E-08	5.46E-09
26	Placer Co	2.5	1.98E-06	100	730	2.07E-05	5.40E-06	1.38E-08	9.10E-10	6.89E-04	1.80E-04	4.61E-07	3.03E-08
27	Auburn	5.3	4.22E-06	1,000	730	4.40E-05	1.15E-05	2.95E-08	1.94E-09	1.47E-03	3.83E-04	9.82E-07	6.46E-08
28	Placer Co	13.6	1.08E-05	100	730	1.12E-04	2.93E-05	7.50E-08	4.94E-09	3.74E-03	9.76E-04	2.50E-06	1.65E-07
29	Colfax	0.7	5.34E-07	1,000	730	5.56E-06	1.45E-06	3.72E-09	2.45E-10	1.85E-04	4.84E-05	1.24E-07	8.16E-09

Table 5.3 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
30	Placer Co	57.4	4.54E-05	3,000	730	4.74E-04	1.24E-04	3.17E-07	2.08E-08	1.58E-02	4.12E-03	1.06E-05	6.95E-07
31	Truckee	2.1	1.68E-06	100	730	1.75E-05	4.57E-06	1.17E-08	7.70E-10	5.84E-04	1.52E-04	3.90E-07	2.57E-08
32	Nevada Co	13.9	1.10E-05	1,000	730	1.15E-04	2.99E-05	7.66E-08	5.04E-09	3.82E-03	9.97E-04	2.55E-06	1.68E-07
33	Floriston	0.2	1.83E-07	100	730	1.91E-06	4.99E-07	1.28E-09	8.41E-11	6.37E-05	1.66E-05	4.26E-08	2.80E-09
34	Sierra Co	5.8	4.58E-06	1,000	730	4.78E-05	1.25E-05	3.20E-08	2.10E-09	1.59E-03	4.16E-04	1.07E-06	7.01E-08

Table 5.4 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06

Table 5.4 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	3.63E-07	1,000	730	4.43E-06	1.83E-06	1.08E-07	3.81E-08	1.48E-04	6.11E-05	3.58E-06	1.27E-06
19	Roseville	1.4	4.45E-07	3,000	730	5.44E-06	2.25E-06	1.32E-07	4.67E-08	1.81E-04	7.50E-05	4.39E-06	1.56E-06
20	Roseville	2.3	7.20E-07	3,000	730	8.79E-06	3.64E-06	2.13E-07	7.55E-08	2.93E-04	1.21E-04	7.10E-06	2.52E-06
21	Placer Co	1.3	4.04E-07	1,000	730	4.94E-06	2.04E-06	1.20E-07	4.24E-08	1.65E-04	6.81E-05	3.99E-06	1.41E-06
22	Placer Co	0.1	4.68E-08	100	730	5.71E-07	2.36E-07	1.39E-08	4.90E-09	1.90E-05	7.88E-06	4.62E-07	1.63E-07
23	Placer Co	2.9	9.23E-07	1,000	730	1.13E-05	4.66E-06	2.73E-07	9.68E-08	3.76E-04	1.55E-04	9.11E-06	3.23E-06
24	Lincoln	1.2	3.77E-07	100	730	4.60E-06	1.90E-06	1.12E-07	3.95E-08	1.53E-04	6.35E-05	3.72E-06	1.32E-06
25	Lincoln	2.9	9.05E-07	3,000	730	1.11E-05	4.57E-06	2.68E-07	9.49E-08	3.69E-04	1.52E-04	8.93E-06	3.16E-06
26	Sheridan	10.7	3.37E-06	100	730	4.11E-05	1.70E-05	9.97E-07	3.53E-07	1.37E-03	5.67E-04	3.32E-05	1.18E-05
27	Wheatland	0.9	2.94E-07	1,000	730	3.59E-06	1.48E-06	8.70E-08	3.08E-08	1.20E-04	4.95E-05	2.90E-06	1.03E-06
28	Yuba County	9.2	2.92E-06	100	730	3.56E-05	1.47E-05	8.64E-07	3.06E-07	1.19E-03	4.91E-04	2.88E-05	1.02E-05
29	Olivehurst	4.3	1.35E-06	1,000	730	1.64E-05	6.80E-06	3.98E-07	1.41E-07	5.48E-04	2.27E-04	1.33E-05	4.70E-06
30	Marysville	1.3	4.20E-07	3,000	730	5.13E-06	2.12E-06	1.24E-07	4.40E-08	1.71E-04	7.07E-05	4.14E-06	1.47E-06
31	Marysville	0.3	9.49E-08	100	730	1.16E-06	4.80E-07	2.81E-08	9.95E-09	3.87E-05	1.60E-05	9.37E-07	3.32E-07
32	Marysville	0.4	1.18E-07	1,000	730	1.44E-06	5.94E-07	3.48E-08	1.23E-08	4.79E-05	1.98E-05	1.16E-06	4.11E-07
33	Yuba County	0.7	2.37E-07	100	730	2.89E-06	1.20E-06	7.01E-08	2.48E-08	9.64E-05	3.99E-05	2.34E-06	8.27E-07
34	Yuba County	0.2	4.85E-08	1,000	730	5.92E-07	2.45E-07	1.43E-08	5.08E-09	1.97E-05	8.16E-06	4.78E-07	1.69E-07
35	Yuba County	0.8	2.39E-07	3,000	730	2.91E-06	1.20E-06	7.06E-08	2.50E-08	9.71E-05	4.02E-05	2.35E-06	8.33E-07
36	Yuba County	0.3	9.41E-08	100	730	1.15E-06	4.75E-07	2.79E-08	9.86E-09	3.83E-05	1.58E-05	9.28E-07	3.29E-07
37	Yuba/Butte County	16.3	5.16E-06	1,000	730	6.30E-05	2.61E-05	1.53E-06	5.41E-07	2.10E-03	8.69E-04	5.09E-05	1.80E-05
38	Palermo	4.2	1.33E-06	3,000	730	1.62E-05	6.70E-06	3.93E-07	1.39E-07	5.40E-04	2.23E-04	1.31E-05	4.63E-06
39	Butte County	1.1	3.35E-07	100	730	4.09E-06	1.69E-06	9.91E-08	3.51E-08	1.36E-04	5.64E-05	3.30E-06	1.17E-06
40	South Oroville	2.4	7.61E-07	3,000	730	9.29E-06	3.84E-06	2.25E-07	7.98E-08	3.10E-04	1.28E-04	7.51E-06	2.66E-06
41	Oroville	0.9	2.68E-07	100	730	3.28E-06	1.36E-06	7.95E-08	2.81E-08	1.09E-04	4.52E-05	2.65E-06	9.38E-07
42	Oroville	1.3	4.20E-07	1,000	730	5.13E-06	2.12E-06	1.24E-07	4.40E-08	1.71E-04	7.07E-05	4.14E-06	1.47E-06
43	Thermolito Div.	0.1	2.97E-08	100	730	3.62E-07	1.50E-07	8.78E-09	3.11E-09	1.21E-05	4.99E-06	2.93E-07	1.04E-07
44	Butte County	1.4	4.52E-07	1,000	730	5.51E-06	2.28E-06	1.34E-07	4.73E-08	1.84E-04	7.60E-05	4.46E-06	1.58E-06
45	Feather Canyon	53.9	1.70E-05	100	730	2.08E-04	8.59E-05	5.04E-06	1.78E-06	6.92E-03	2.86E-03	1.68E-04	5.94E-05

Table 5.4 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
46	Hallsted	1.5	4.77E-07	1,000	730	5.82E-06	2.41E-06	1.41E-07	5.00E-08	1.94E-04	8.03E-05	4.71E-06	1.67E-06
47	Plumas County	12.5	3.95E-06	100	730	4.82E-05	1.99E-05	1.17E-06	4.14E-07	1.61E-03	6.65E-04	3.90E-05	1.38E-05
48	Spanish Creek	0.5	1.52E-07	1,000	730	1.86E-06	7.69E-07	4.51E-08	1.60E-08	6.20E-05	2.56E-05	1.50E-06	5.32E-07
49	Plumas County	1.6	5.15E-07	100	730	6.29E-06	2.60E-06	1.52E-07	5.40E-08	2.10E-04	8.67E-05	5.08E-06	1.80E-06
50	Quincy	3.6	1.15E-06	1,000	730	1.40E-05	5.81E-06	3.40E-07	1.20E-07	4.68E-04	1.94E-04	1.13E-05	4.02E-06
51	Plumas County	4.6	1.44E-06	100	730	1.76E-05	7.29E-06	4.27E-07	1.51E-07	5.87E-04	2.43E-04	1.42E-05	5.04E-06
52	Spring Garden	0.3	9.96E-08	1,000	730	1.22E-06	5.03E-07	2.95E-08	1.04E-08	4.06E-05	1.68E-05	9.83E-07	3.48E-07
53	Plumas County	5.9	1.87E-06	100	730	2.28E-05	9.44E-06	5.53E-07	1.96E-07	7.61E-04	3.15E-04	1.84E-05	6.53E-06
54	Twentymile House	2.3	7.39E-07	1,000	730	9.02E-06	3.73E-06	2.19E-07	7.75E-08	3.01E-04	1.24E-04	7.29E-06	2.58E-06
55	Plumas County	2.4	7.70E-07	100	730	9.41E-06	3.89E-06	2.28E-07	8.08E-08	3.14E-04	1.30E-04	7.60E-06	2.69E-06
56	Blairsden	6.7	2.13E-06	1,000	730	2.60E-05	1.07E-05	6.30E-07	2.23E-07	8.66E-04	3.58E-04	2.10E-05	7.44E-06
57	Plumas County	1.8	5.65E-07	100	730	6.90E-06	2.85E-06	1.67E-07	5.93E-08	2.30E-04	9.52E-05	5.58E-06	1.98E-06
58	Plumas Golf	1.1	3.60E-07	1,000	730	4.40E-06	1.82E-06	1.07E-07	3.77E-08	1.47E-04	6.06E-05	3.55E-06	1.26E-06
59	Plumas County	1.8	5.78E-07	100	730	7.06E-06	2.92E-06	1.71E-07	6.06E-08	2.35E-04	9.73E-05	5.70E-06	2.02E-06
60	Portola	3.5	1.11E-06	1,000	730	1.36E-05	5.63E-06	3.30E-07	1.17E-07	4.54E-04	1.88E-04	1.10E-05	3.89E-06
61	Plumas County	14.9	4.69E-06	100	730	5.73E-05	2.37E-05	1.39E-06	4.92E-07	1.91E-03	7.89E-04	4.63E-05	1.64E-05
62	Chilcoot	1.8	5.81E-07	1,000	730	7.10E-06	2.93E-06	1.72E-07	6.09E-08	2.37E-04	9.78E-05	5.73E-06	2.03E-06
63	Lassen County	19.2	6.05E-06	100	730	7.39E-05	3.06E-05	1.79E-06	6.34E-07	2.46E-03	1.02E-03	5.97E-05	2.11E-05
64	Doyle	1.2	3.82E-07	1,000	730	4.67E-06	1.93E-06	1.13E-07	4.01E-08	1.56E-04	6.43E-05	3.77E-06	1.34E-06
65	Lassen County	8.0	2.52E-06	100	730	3.07E-05	1.27E-05	7.45E-07	2.64E-07	1.02E-03	4.24E-04	2.48E-05	8.79E-06
66	Herlong	4.5	1.41E-06	1,000	730	1.72E-05	7.13E-06	4.18E-07	1.48E-07	5.75E-04	2.38E-04	1.39E-05	4.93E-06
67	Lassen County	5.2	1.64E-06	1,000	730	2.01E-05	8.29E-06	4.86E-07	1.72E-07	6.68E-04	2.76E-04	1.62E-05	5.74E-06

Table 5.5 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	3.25E-07	1,000	730	3.22E-06	1.33E-06	7.80E-08	2.76E-08	1.07E-04	4.43E-05	2.60E-06	9.20E-07
19	Roseville	1.4	3.98E-07	3,000	730	3.94E-06	1.63E-06	9.56E-08	3.38E-08	1.31E-04	5.44E-05	3.19E-06	1.13E-06
20	Roseville	2.3	6.44E-07	3,000	730	6.37E-06	2.64E-06	1.55E-07	5.47E-08	2.12E-04	8.79E-05	5.15E-06	1.82E-06
21	Placer Co	1.3	3.62E-07	1,000	730	3.58E-06	1.48E-06	8.68E-08	3.07E-08	1.19E-04	4.93E-05	2.89E-06	1.02E-06
22	Placer Co	0.1	4.19E-08	100	730	4.14E-07	1.71E-07	1.00E-08	3.56E-09	1.38E-05	5.71E-06	3.35E-07	1.19E-07
23	Placer Co	2.9	8.26E-07	1,000	730	8.17E-06	3.38E-06	1.98E-07	7.02E-08	2.72E-04	1.13E-04	6.60E-06	2.34E-06
24	Lincoln	1.2	3.37E-07	100	730	3.34E-06	1.38E-06	8.09E-08	2.87E-08	1.11E-04	4.60E-05	2.70E-06	9.55E-07
25	Lincoln	2.9	8.10E-07	3,000	730	8.02E-06	3.32E-06	1.94E-07	6.88E-08	2.67E-04	1.11E-04	6.48E-06	2.29E-06
26	Sheridan	10.7	3.01E-06	100	730	2.98E-05	1.23E-05	7.23E-07	2.56E-07	9.94E-04	4.11E-04	2.41E-05	8.53E-06
27	Wheatland	0.9	2.63E-07	1,000	730	2.60E-06	1.08E-06	6.31E-08	2.23E-08	8.68E-05	3.59E-05	2.10E-06	7.45E-07
28	Yuba County	9.2	2.61E-06	100	730	2.58E-05	1.07E-05	6.26E-07	2.22E-07	8.61E-04	3.56E-04	2.09E-05	7.39E-06
29	Olivehurst	4.3	1.20E-06	1,000	730	1.19E-05	4.93E-06	2.89E-07	1.02E-07	3.97E-04	1.64E-04	9.63E-06	3.41E-06

Table 5.5 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
30	Marysville	1.3	3.76E-07	3,000	730	3.72E-06	1.54E-06	9.02E-08	3.19E-08	1.24E-04	5.13E-05	3.01E-06	1.06E-06
31	Marysville	2.3	6.56E-07	100	730	6.49E-06	2.68E-06	1.57E-07	5.57E-08	2.16E-04	8.95E-05	5.24E-06	1.86E-06
32	Live Oak	0.3	9.29E-08	1,000	730	9.19E-07	3.80E-07	2.23E-08	7.89E-09	3.06E-05	1.27E-05	7.43E-07	2.63E-07
33	Live Oak	6.4	1.81E-06	100	730	1.80E-05	7.42E-06	4.35E-07	1.54E-07	5.98E-04	2.47E-04	1.45E-05	5.14E-06
34	Live Oak	0.4	1.03E-07	1,000	730	1.02E-06	4.23E-07	2.48E-08	8.79E-09	3.41E-05	1.41E-05	8.27E-07	2.93E-07
35	Live Oak	1.0	2.86E-07	3,000	730	2.83E-06	1.17E-06	6.87E-08	2.43E-08	9.45E-05	3.91E-05	2.29E-06	8.11E-07
36	Butte Co	5.2	1.48E-06	100	730	1.46E-05	6.04E-06	3.54E-07	1.25E-07	4.87E-04	2.01E-04	1.18E-05	4.18E-06
37	Gridley	0.5	1.29E-07	1,000	730	1.27E-06	5.26E-07	3.08E-08	1.09E-08	4.24E-05	1.75E-05	1.03E-06	3.64E-07
38	Gridley	0.8	2.34E-07	3,000	730	2.32E-06	9.58E-07	5.62E-08	1.99E-08	7.72E-05	3.19E-05	1.87E-06	6.63E-07
39	Gridley	2.5	7.08E-07	100	730	7.01E-06	2.90E-06	1.70E-07	6.02E-08	2.34E-04	9.67E-05	5.67E-06	2.01E-06
40	Biggs	0.6	1.62E-07	3,000	730	1.60E-06	6.62E-07	3.88E-08	1.37E-08	5.34E-05	2.21E-05	1.29E-06	4.58E-07
41	Butte Co	5.1	1.45E-06	100	730	1.43E-05	5.93E-06	3.48E-07	1.23E-07	4.78E-04	1.98E-04	1.16E-05	4.11E-06
42	Richvale	0.8	2.36E-07	1,000	730	2.34E-06	9.66E-07	5.66E-08	2.01E-08	7.79E-05	3.22E-05	1.89E-06	6.69E-07
43	Nelson	9.3	2.62E-06	100	730	2.59E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.42E-06
44	Durham	2.4	6.89E-07	1,000	730	6.82E-06	2.82E-06	1.65E-07	5.85E-08	2.27E-04	9.40E-05	5.51E-06	1.95E-06
45	Chico	4.3	1.22E-06	100	730	1.21E-05	5.00E-06	2.93E-07	1.04E-07	4.03E-04	1.67E-04	9.76E-06	3.46E-06
46	Chico	4.5	1.27E-06	1,000	730	1.26E-05	5.22E-06	3.06E-07	1.08E-07	4.21E-04	1.74E-04	1.02E-05	3.61E-06
47	Chico	2.8	7.91E-07	100	730	7.83E-06	3.24E-06	1.90E-07	6.72E-08	2.61E-04	1.08E-04	6.33E-06	2.24E-06
48	Nord	0.6	1.65E-07	1,000	730	1.63E-06	6.74E-07	3.95E-08	1.40E-08	5.44E-05	2.25E-05	1.32E-06	4.67E-07
49	Butte Co	11.3	3.20E-06	100	730	3.17E-05	1.31E-05	7.69E-07	2.72E-07	1.06E-03	4.37E-04	2.56E-05	9.07E-06
50	Vina	0.4	1.26E-07	1,000	730	1.25E-06	5.16E-07	3.02E-08	1.07E-08	4.16E-05	1.72E-05	1.01E-06	3.57E-07
51	Copeland	6.3	1.78E-06	100	730	1.76E-05	7.30E-06	4.28E-07	1.51E-07	5.88E-04	2.43E-04	1.43E-05	5.05E-06
52	Los Molinos	0.5	1.47E-07	1,000	730	1.45E-06	6.01E-07	3.52E-08	1.25E-08	4.84E-05	2.00E-05	1.17E-06	4.16E-07
53	Los Molinos	1.0	2.81E-07	100	730	2.78E-06	1.15E-06	6.73E-08	2.38E-08	9.26E-05	3.83E-05	2.24E-06	7.94E-07
54	Tehema	0.3	9.39E-08	1,000	730	9.30E-07	3.84E-07	2.25E-08	7.98E-09	3.10E-05	1.28E-05	7.51E-07	2.66E-07
55	Tehema	2.2	6.32E-07	100	730	6.25E-06	2.59E-06	1.52E-07	5.37E-08	2.08E-04	8.62E-05	5.05E-06	1.79E-06
56	Gerber	2.3	6.54E-07	1,000	730	6.47E-06	2.68E-06	1.57E-07	5.56E-08	2.16E-04	8.92E-05	5.23E-06	1.85E-06
57	Tehema Co	1.8	5.05E-07	100	730	5.00E-06	2.07E-06	1.21E-07	4.29E-08	1.67E-04	6.89E-05	4.04E-06	1.43E-06
58	Red Bluff	0.8	2.18E-07	1,000	730	2.16E-06	8.92E-07	5.23E-08	1.85E-08	7.19E-05	2.97E-05	1.74E-06	6.17E-07

Table 5.5 Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
59	Red Bluff	4.6	1.31E-06	100	730	1.29E-05	5.35E-06	3.14E-07	1.11E-07	4.31E-04	1.78E-04	1.05E-05	3.70E-06
60	Red Bluff	3.3	9.27E-07	1,000	730	9.18E-06	3.80E-06	2.23E-07	7.88E-08	3.06E-04	1.27E-04	7.42E-06	2.63E-06
61	Tehema Co	15.3	4.32E-06	100	730	4.27E-05	1.77E-05	1.04E-06	3.67E-07	1.42E-03	5.89E-04	3.45E-05	1.22E-05
62	Cottonwood	0.6	1.72E-07	1,000	730	1.70E-06	7.05E-07	4.13E-08	1.46E-08	5.68E-05	2.35E-05	1.38E-06	4.88E-07
63	Anderson	5.4	1.51E-06	100	730	1.50E-05	6.20E-06	3.63E-07	1.29E-07	4.99E-04	2.07E-04	1.21E-05	4.29E-06
64	Anderson	3.5	1.00E-06	1,000	730	9.92E-06	4.10E-06	2.40E-07	8.51E-08	3.31E-04	1.37E-04	8.01E-06	2.84E-06
65	Anderson	4.1	1.15E-06	100	730	1.14E-05	4.72E-06	2.77E-07	9.80E-08	3.81E-04	1.57E-04	9.23E-06	3.27E-06
66	Redding	6.0	1.71E-06	1,000	730	1.69E-05	6.99E-06	4.09E-07	1.45E-07	5.63E-04	2.33E-04	1.36E-05	4.83E-06
67	Redding	0.8	2.15E-07	1,000	730	2.13E-06	8.81E-07	5.17E-08	1.83E-08	7.10E-05	2.94E-05	1.72E-06	6.10E-07
68	Redding	1.1	3.19E-07	100	730	3.16E-06	1.31E-06	7.66E-08	2.71E-08	1.05E-04	4.35E-05	2.55E-06	9.04E-07
69	Redding	0.4	1.10E-07	1,000	730	1.09E-06	4.52E-07	2.65E-08	9.37E-09	3.64E-05	1.51E-05	8.83E-07	3.12E-07
70	Redding	2.6	7.29E-07	100	730	7.22E-06	2.98E-06	1.75E-07	6.19E-08	2.41E-04	9.95E-05	5.83E-06	2.06E-06
71	Shasta Co	0.5	1.48E-07	1,000	730	1.46E-06	6.05E-07	3.54E-08	1.25E-08	4.87E-05	2.02E-05	1.18E-06	4.18E-07
72	Shasta Lake	1.7	4.66E-07	100	730	4.61E-06	1.91E-06	1.12E-07	3.96E-08	1.54E-04	6.36E-05	3.73E-06	1.32E-06
73	Shasta Lake	0.8	2.12E-07	1,000	730	2.10E-06	8.68E-07	5.09E-08	1.80E-08	7.00E-05	2.89E-05	1.70E-06	6.01E-07
74	Shasta Co	16.4	4.64E-06	100	730	4.60E-05	1.90E-05	1.11E-06	3.95E-07	1.53E-03	6.34E-04	3.72E-05	1.32E-05
75	Lakeshore	0.6	1.71E-07	1,000	730	1.70E-06	7.02E-07	4.11E-08	1.46E-08	5.66E-05	2.34E-05	1.37E-06	4.85E-07
76	Shasta Co	28.7	8.10E-06	100	730	8.02E-05	3.32E-05	1.94E-06	6.88E-07	2.67E-03	1.11E-03	6.48E-05	2.29E-05
77	Dunsmuir	1.3	3.68E-07	1,000	730	3.64E-06	1.51E-06	8.83E-08	3.13E-08	1.21E-04	5.02E-05	2.94E-06	1.04E-06
78	Siskiyou Co	12.8	3.61E-06	100	730	3.57E-05	1.48E-05	8.65E-07	3.06E-07	1.19E-03	4.92E-04	2.88E-05	1.02E-05
79	Mount Shasta	1.1	3.19E-07	1,000	730	3.16E-06	1.31E-06	7.67E-08	2.71E-08	1.05E-04	4.36E-05	2.56E-06	9.05E-07
80	Siskiyou Co	64.5	1.82E-05	100	730	1.80E-04	7.46E-05	4.37E-06	1.55E-06	6.01E-03	2.49E-03	1.46E-04	5.16E-05
81	Dorris	0.9	2.49E-07	100	730	2.47E-06	1.02E-06	5.98E-08	2.12E-08	8.22E-05	3.40E-05	1.99E-06	7.06E-07
82	Siskiyou Co	3.4	9.64E-07	1,000	730	9.54E-06	3.95E-06	2.31E-07	8.19E-08	3.18E-04	1.32E-04	7.71E-06	2.73E-06

Table 5.6 Worst Case Mainline Rail Hazard Zones

Thermal Radiation Hazard Zones (feet)		
Wind Speed (meters/second)	**5 kw/m^2**	**10 kw/m^2**
1	846	466
2	912	509
3	948	535
4	974	554
5	994	571
10	1,053	620
20	1,585	1,109
BLEVE Hazard Zones (feet)		
40 kj/m^2	2,339	
150 kj/m^2	1,158	
250 kj/m^2	846	

See Attachment 3 for the detailed consequence modeling results.
See Attachment 2 for a description of the consequences associated with these hazards.

5.2.3 Quantitative Risk Assessment Results

5.2.3.1 Proposed Project

The results of the QRA for the Project are presented in Figures 5-5 and 5-6 as risk profiles. The risk profiles in Figure 5-5 assume that two 50-car unit trains travel between the Roseville Yard and Refinery every day for a total of 730 trains per year, and assumes that all 730 trains per year use the same route between Roseville and Oregon or Nevada. The risk profiles in Figure 5-6 also assume that two 50-car unit trains travel between the Roseville Yard and Refinery every day for a total of 730 trains per year, and assumes that all 365 100-car unit trains per year use the same route between Roseville and Oregon or Nevada.

The level of risk for the Project along the three potential mainline rail routes is represented by the solid orange, red, and blue lines in Figures 5-5 and 5-6. The graph on the left shows the risk for potential injuries, while the graph on the right shows the risk for potential fatalities. Because maximum risks from proposed transport of crude oil are above the significant risk threshold (dashed green line), impacts would be considered potentially significant. These risk profiles represent the cumulative risk along the entire route. The risk within any individual City or County would be considerably less. The risk is primarily driven by the HTUA (Bay Area and Sacramento) since these are the locations where fairly long stretches of track are in close proximity to heavily populated areas.

Figure 5-5 Risk Associated with CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border

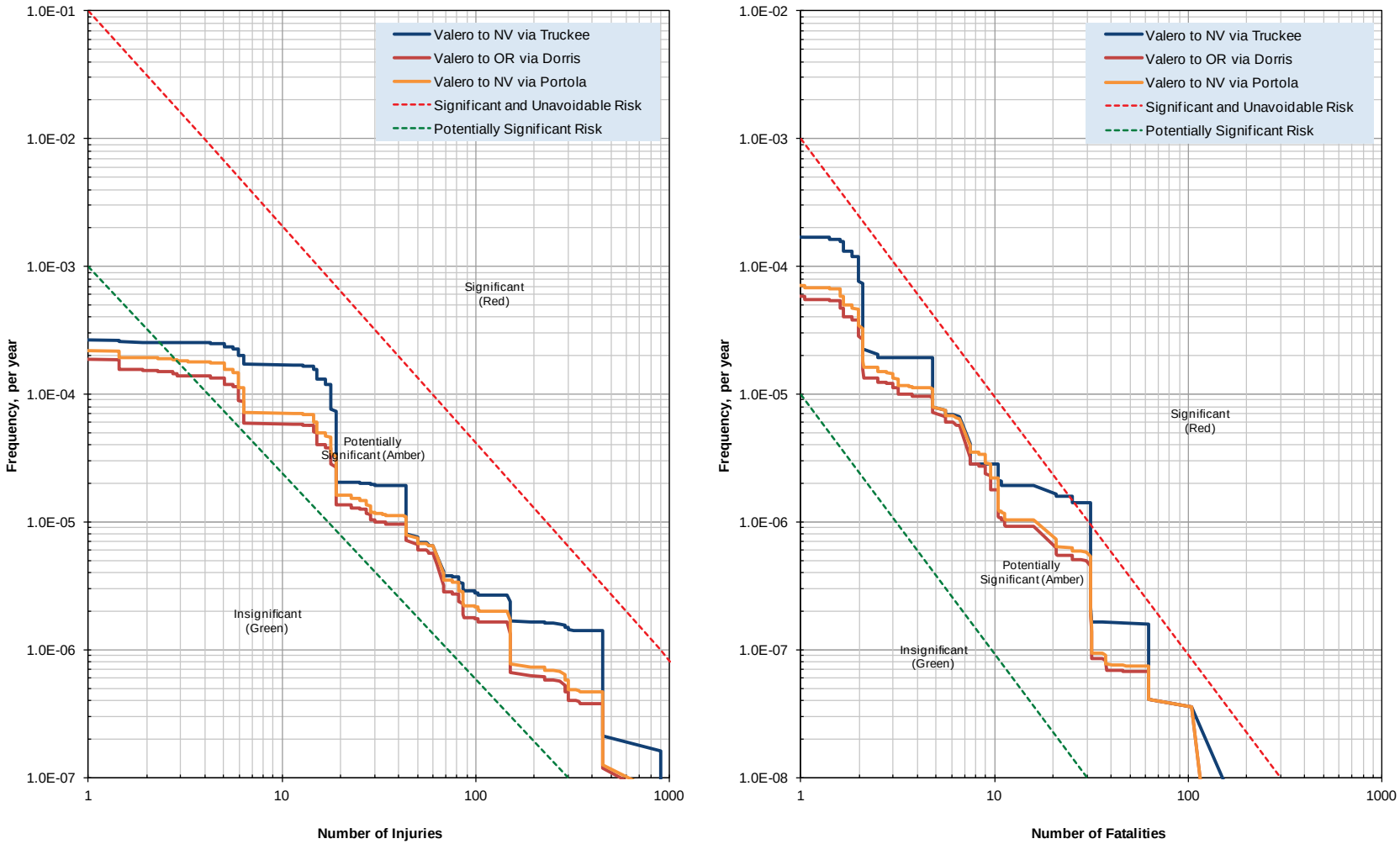
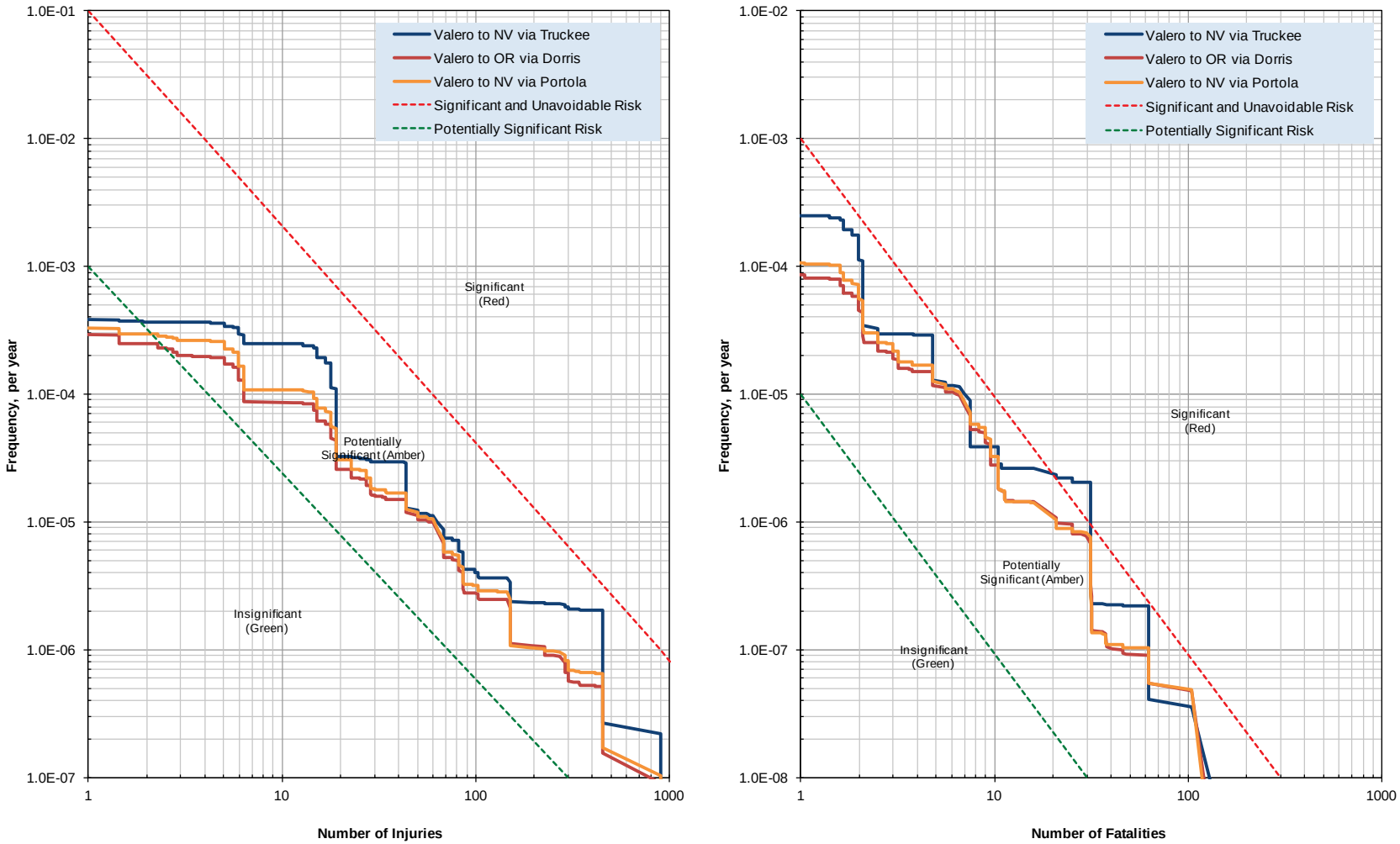


Figure 5-6 Risk Associated with CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border



The diagonal dashed green and red lines in Figures 5-5 and 5-6 represent the significant risk threshold for insignificant (green) and significant and unavoidable (red) risk. If the risk falls between the dashed green and red lines, the impact remains significant, but risk may be viewed as acceptable (according to the Santa Barabara methodology described in Section 4, *Significance Criteria*) if all feasible mitigation has been identified and implemented. For both the 50 and 100 unit car train the risk would remain significant.

5.2.3.2 Upgraded DOT 117 and 117R Tank Cars

New tank cars constructed after October 1, 2015, are required to meet the new USDOT Specification 117 design or performance criteria. The prescribed car has a 9/16 inch tank shell, 11 gauge jacket, 1/2 inch full-height head shield, thermal protection, and improved pressure relief valves and bottom outlet valves. Existing tank cars must be retrofitted with the same key components based on a prescriptive, risk-based retrofit schedule, and are designated as DOT 117R tank cars. As a result the final rule will require replacing the entire fleet of DOT-111 tank cars for Packing Group I, which covers most crude shipped by rail, within three years and all non-jacketed CPC-1232s, in the same service, within approximately five years.

The rule requires HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributed power (DP) braking system. Trains meeting the definition of a "high-hazard flammable unit train," or HHFUT (a single train with 70 or more tank cars loaded with Class 3 flammable liquids), with at least one tank car with Packing Group I materials, must be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021. All other HHFUTs must have ECP braking systems installed after 2023.

The rule restricts all HHFTs to 50 mph in all areas and HHFTs containing any tank cars not meeting the enhanced tank car standards required by this rule are restricted to operating at a 40 mph speed restriction in high-threat urban areas. The 40 mph restriction for HHFTs without new or retrofitted tank cars is also currently required under FRA's Emergency Order No. 30.

Railroads operating HHFTs must perform a routing analysis that considers, at a minimum, 27 safety and security factors, including "track type, class, and maintenance schedule" and "track grade and curvature," and select a route based on its findings. These planning requirements are prescribed in 49 CFR §172.820.

Improved information sharing ensures that railroads provide State and/or regional fusion centers, and State, local, and tribal officials with a railroad point of contact for information related to the routing of hazardous materials through their jurisdictions. This replaces the proposed requirement for railroads to notify State Emergency Response Commissions (SERCs) or other appropriate state-designated entities about the operation of these trains through their States.

Figure 5-7 Risk Associated with DOT-117 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border

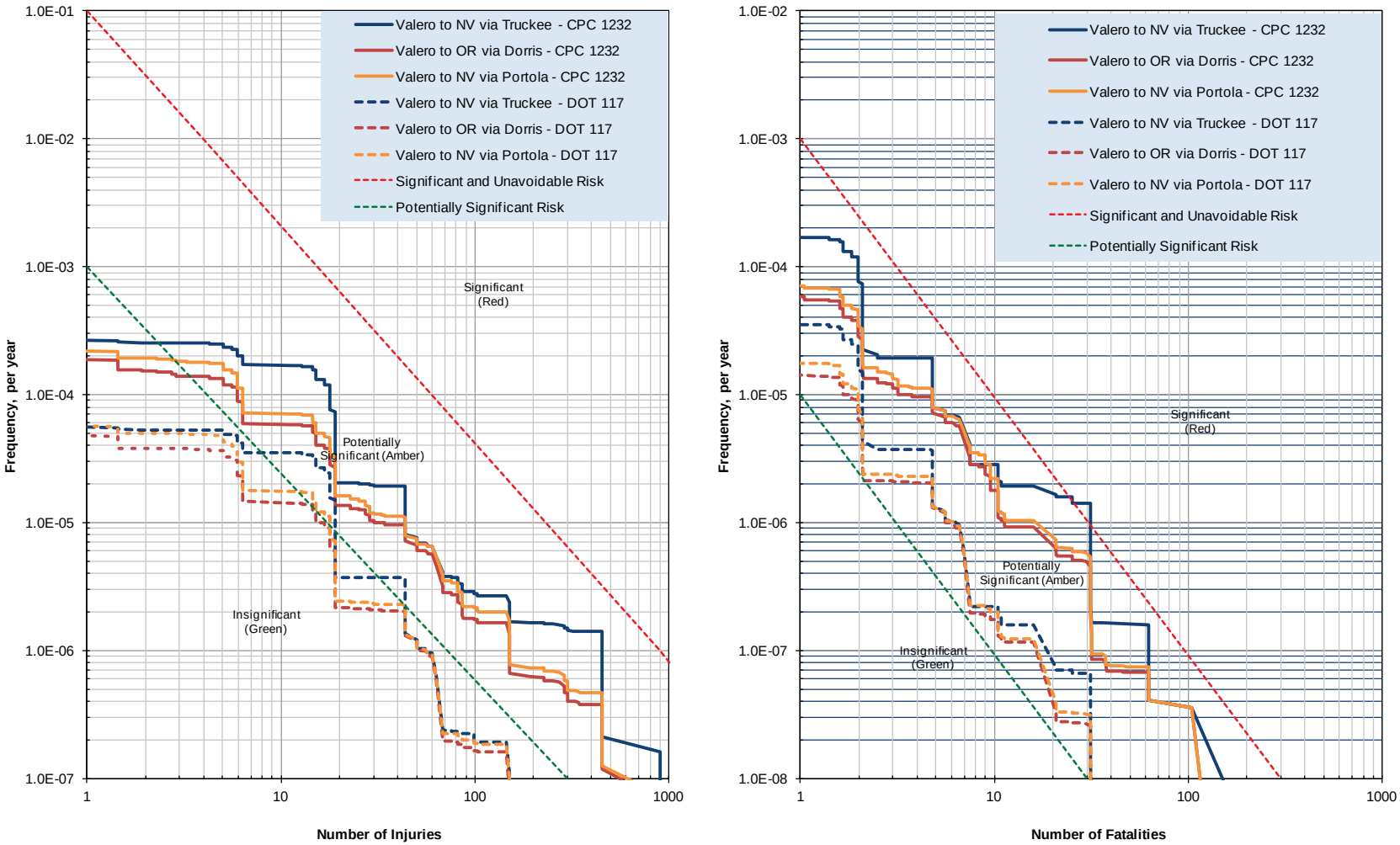


Figure 5-8 Risk Associated with DOT-117 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border

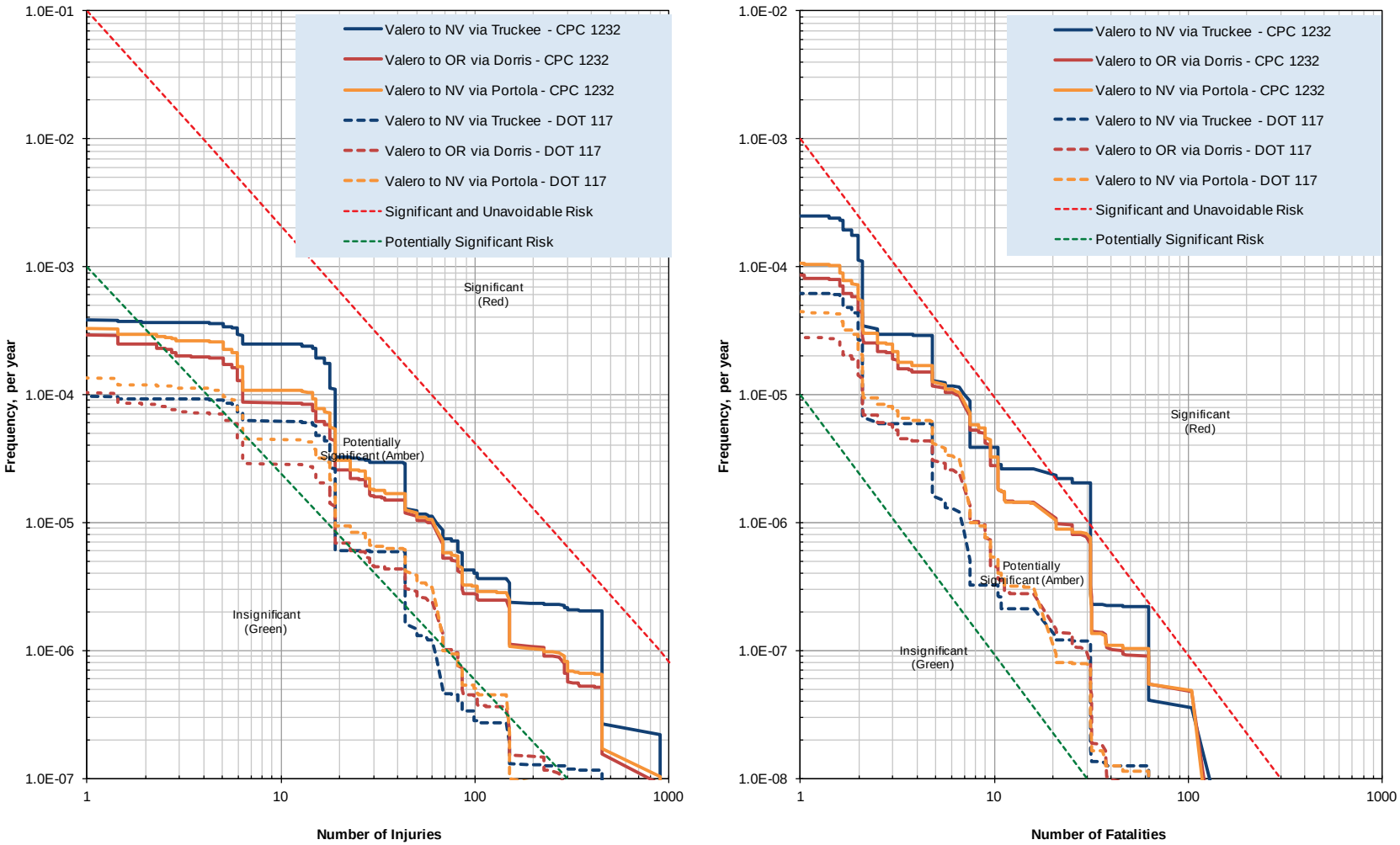


Figure 5-9 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 50 Car Unit Trains to California Border

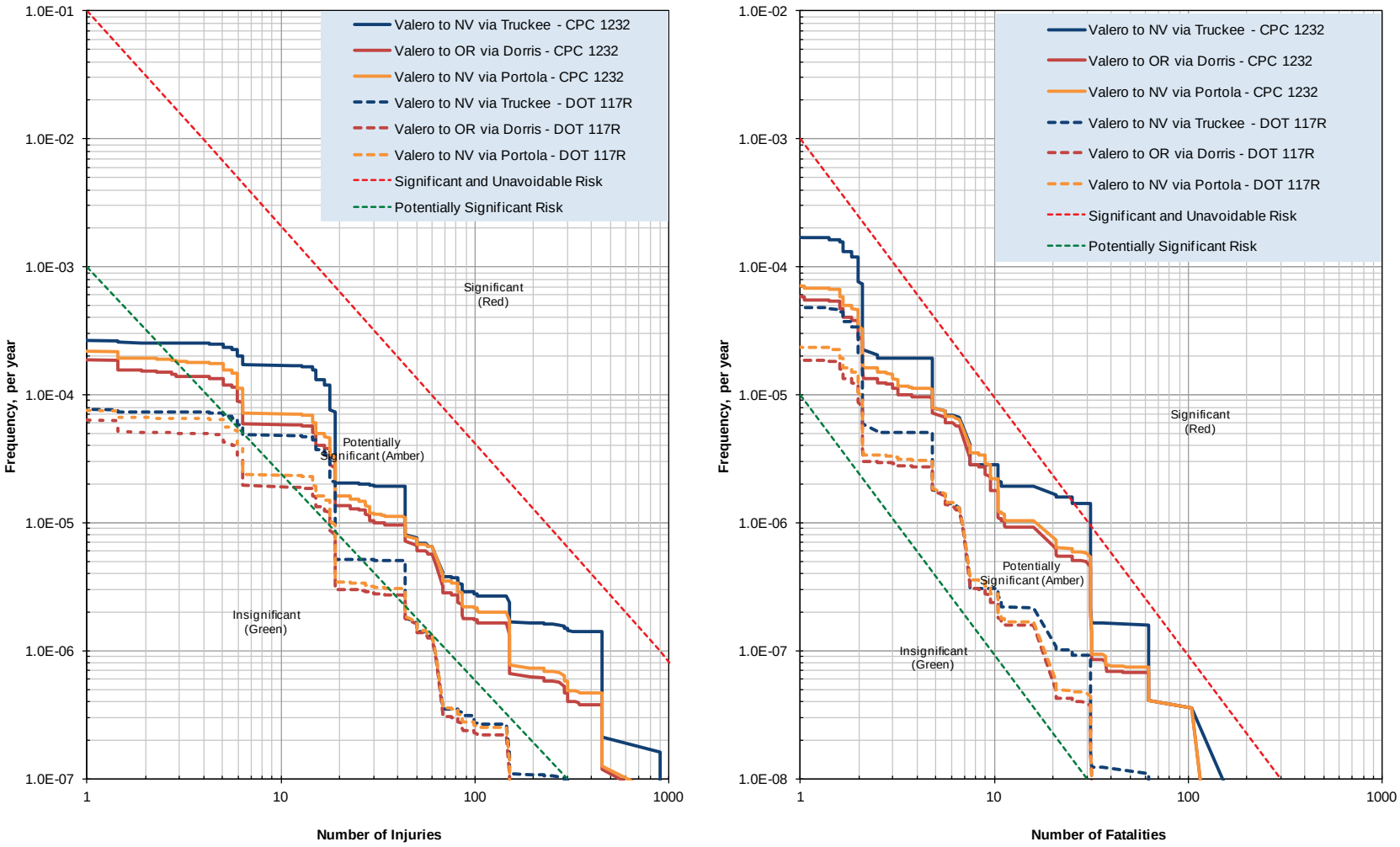
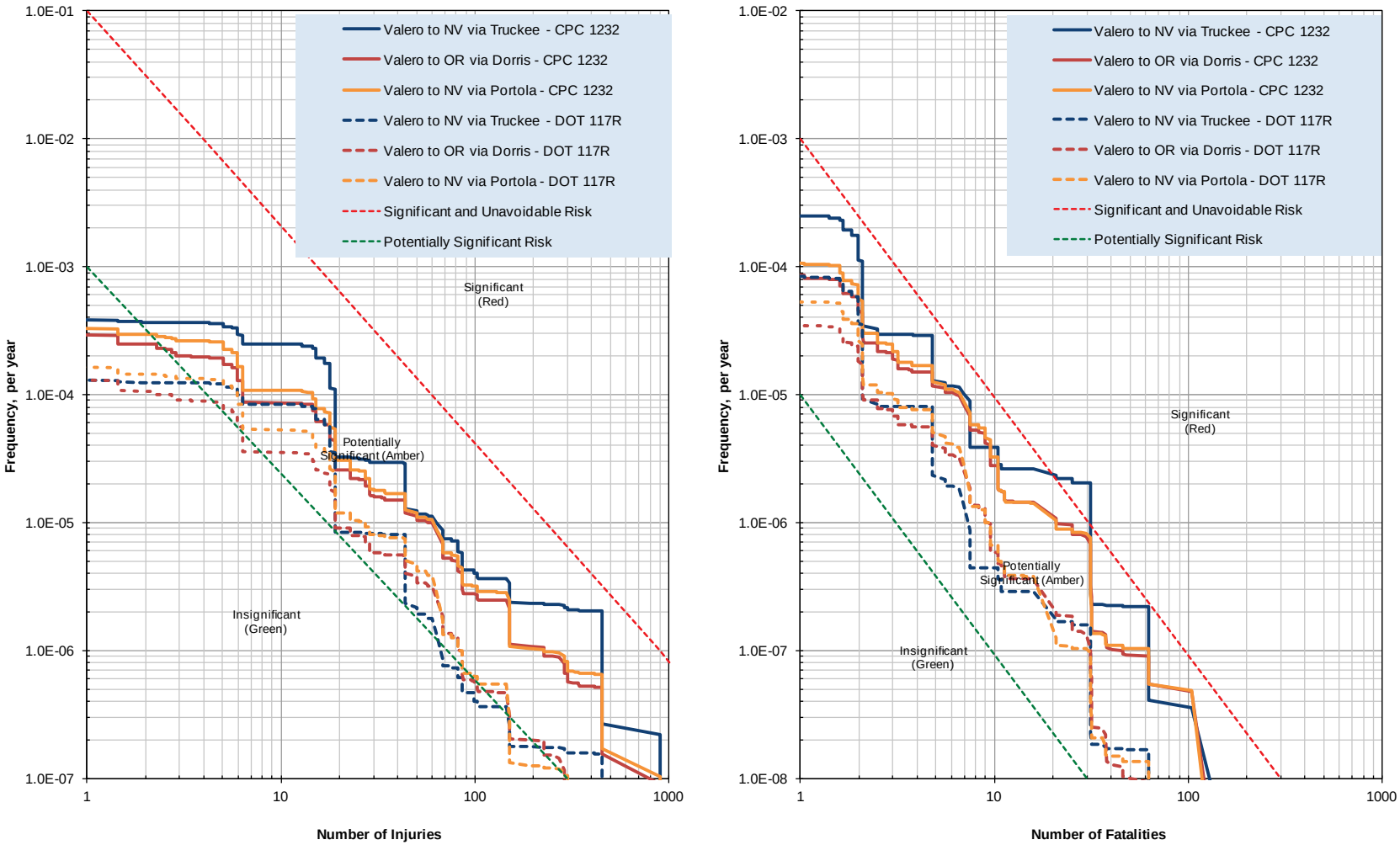


Figure 5-10 Risk Associated with DOT-117R for CPC-1232 Tank Car Mainline Rail Crude Oil Unit Train Transportation – 100 Car Unit Trains to California Border



USDOT's May 2014 Emergency Order ensures that such information is provided to SERCs on a routine basis related to any train carrying one million gallons or more of Bakken crude oil. To address the concerns raised by stakeholders, the May 2014 Emergency Order will remain in full force and effect until further notice while the agency considers options for codifying the May 2014 disclosure requirement on a permanent basis.

Shippers must develop and carry out sampling and testing programs for all unrefined petroleum-based products, such as crude oil, to address the criteria and frequency of sampling to improve and ensure accuracy. Offerors must certify that hazardous materials subject to the program are packaged in accordance with the test results, document the testing and sampling program outcomes, and make that information available to USDOT personnel upon request.

Based on the new tank car design and safety requirements, the QRA was updated to reflect the improvements in risk associated with the DOT 117 and DOT-117R for CPC-1232 tank cars for the Project. The results of the QRA are presented in Figures 5-7 through 5-10. Risk profiles are presented for both the Project, as proposed, and under the new USDOT requirements. While the updated tank car designs reduce the overall risk, the impact remains significant.

5.3 Cumulative Risk Analysis

A number of other crude by rail projects have been proposed or undertaken within California. These projects are summarized in Table 5.7. There is the potential for cumulative impacts associated with other crude by rail projects that would use some of the same UPRR mainline routes. In conducting the cumulative analysis for crude by rail it has been assumed that all the cumulative projects would use the same tank design and transport similar crude as the Project. Table 5.8 provides the cumulative rail traffic volumes for each relevant UPRR mainline route segment.

Using the QRA conducted for the Project a cumulative risk profiles were developed for these stretches of mainline track. Figures 5-11 through 5-13 show the cumulative risk profiles for the proposed tank cars, as well as the DOT 117 and 117R tank car designs. These figures show that the cumulative risk would be significant for all of the tank car designs.

Table 5.7 Cumulative Rail Projects

Project	Location	Description
Tesoro Refinery	City of Martinez	Existing refinery; third-party offloading facility.
Kinder Morgan	City of Richmond	Repurposed ethanol transloading facility; currently operating; crude is loaded onto trucks bound for Tesoro refinery in City of Martinez.
Targa Stockton	Port of Stockton	Proposed marine oil terminal to receive CBR and load onto barges; up to 70,000 bpd; allow CBR to be transferred to barges or tankers as well as to be delivered to Bay area refineries via Kinder Morgan Partners (KMP) pipeline.
NuStar Energy Selby	Contra Costa County (near Rodeo)	Existing marine terminal able to redeliver crude to refineries by barge; handles other liquids and has been adapted to receive crude; only handles manifest rail shipments and is primarily a refined products distribution facility; up to 34 cars/day.
Alon Bakersfield Refinery Crude Flexibility Project	Kern County	This project would allow for greater flexibility for the refinery to utilize a variety of crude oils. The proposed project would involve: (1) expansion of existing and construction of new rail, transfer and storage facilities; to include construction of a double rail loop from a new on-site spur connection off of the existing BNSF Railway and the addition of up to three boilers; (2) construction of process unit upgrades and/ or modifications; (3) repurposing of existing tankage; and (4) relocation and modernization of existing Liquefied Propane Gas (LPG) truck rack and upgrades to sales rack. The rail component of the project would allow for the delivery and unloading of two 104-car unit trains per day.
Phillips 66 Santa Maria Refinery Rail Spur Project	San Luis Obispo County	This project would allow the Philips 66 Santa Maria Refinery to receive crude by rail. The Project involves the installation of a new tank car unloading rack, rail track spurs, pumps, pipeline, and associated infrastructure at the Refinery. The project would allow the Refinery to accept 80 tank car unit trains. The project would allow Phillips 66 to receive up to up 80 tank car unit trains per week.
Plains All American Pipeline LP	Kern County	Plains All American Pipeline LP is building a rail unloading facility in Kern County with a capacity of about 65,000 to 70,000 bpd that would handle up to two unit trains per day.

Table 5.8 Cumulative Crude by Rail Traffic

Cumulative Rail Project	Frequency of train movements		# of Unit Trains per Year				
			Benicia to Sacramento	Sacramento to Roseville	Roseville to Oregon	Roseville to Nevada (northern route)	Roseville to Nevada (southern route)
Valero	2	per day	730	730	730	730	730
Plains All American Pipeline	2	per day	0	730	730	730	730
Alon	2	per day	0	730	730	730	730
Phillips 66	5	per week	250	250	250	250	250
Tesoro Refinery	3	per month	36	36	36	36	36
Kinder Morgan	1	every two weeks	26	26	26	26	26
Inter State Oil Co.	1	per day	0	365	365	365	365
Targa Stockton	1	per day	0	365	365	365	365
Total			**1,042**	**3,232**	**3,232**	**3,232**	**3,232**

1. For the cumulative analysis will assume that all CBR trains use the same route, which would represent a worst case.
2. Phillip 66 limited to a maximum of 250 unit trains per year.

Figure 5-11 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – CPC-1232 Tank Cars to the California Border

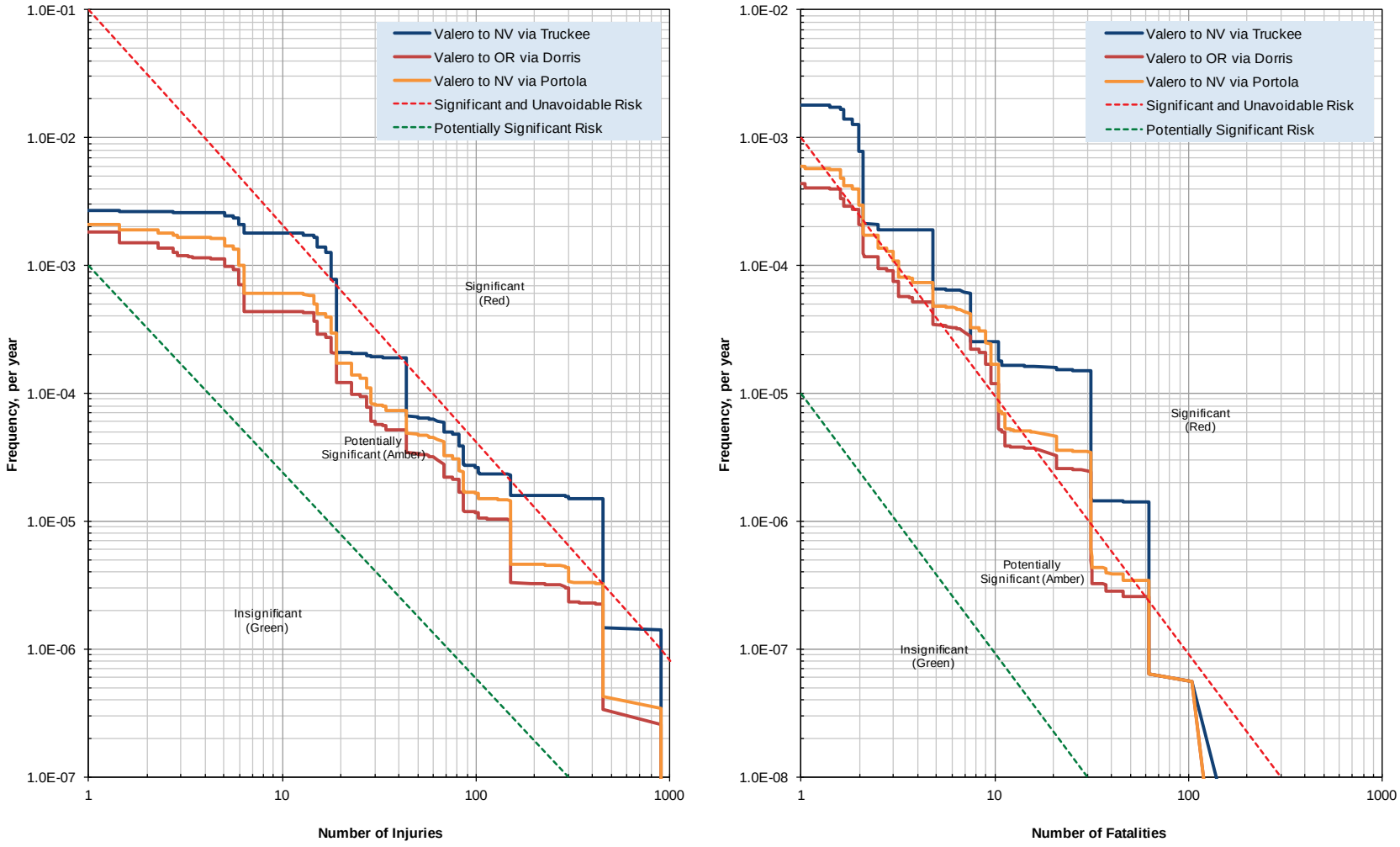


Figure 5-12 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – DOT-117 Tank Cars to the California Border

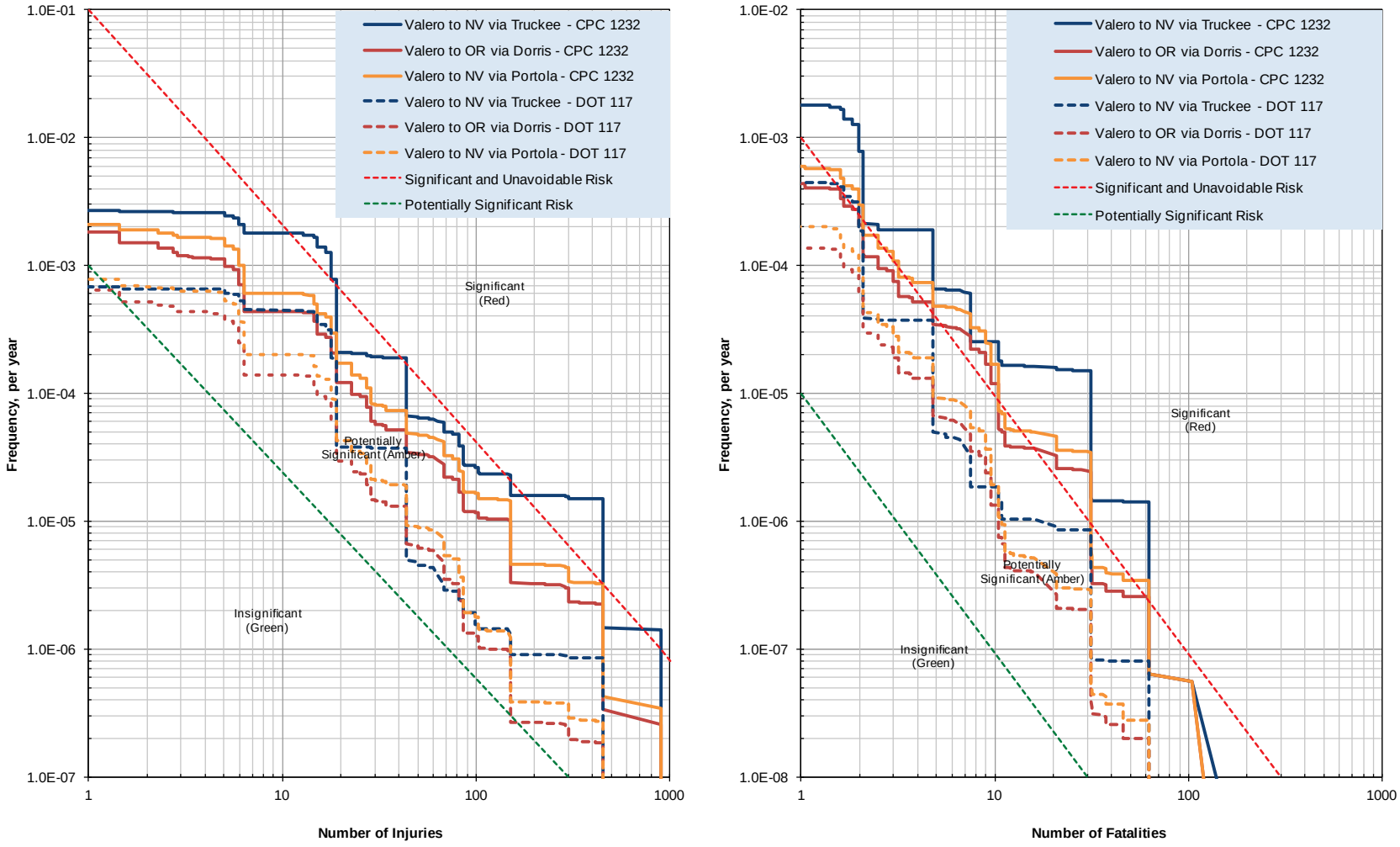
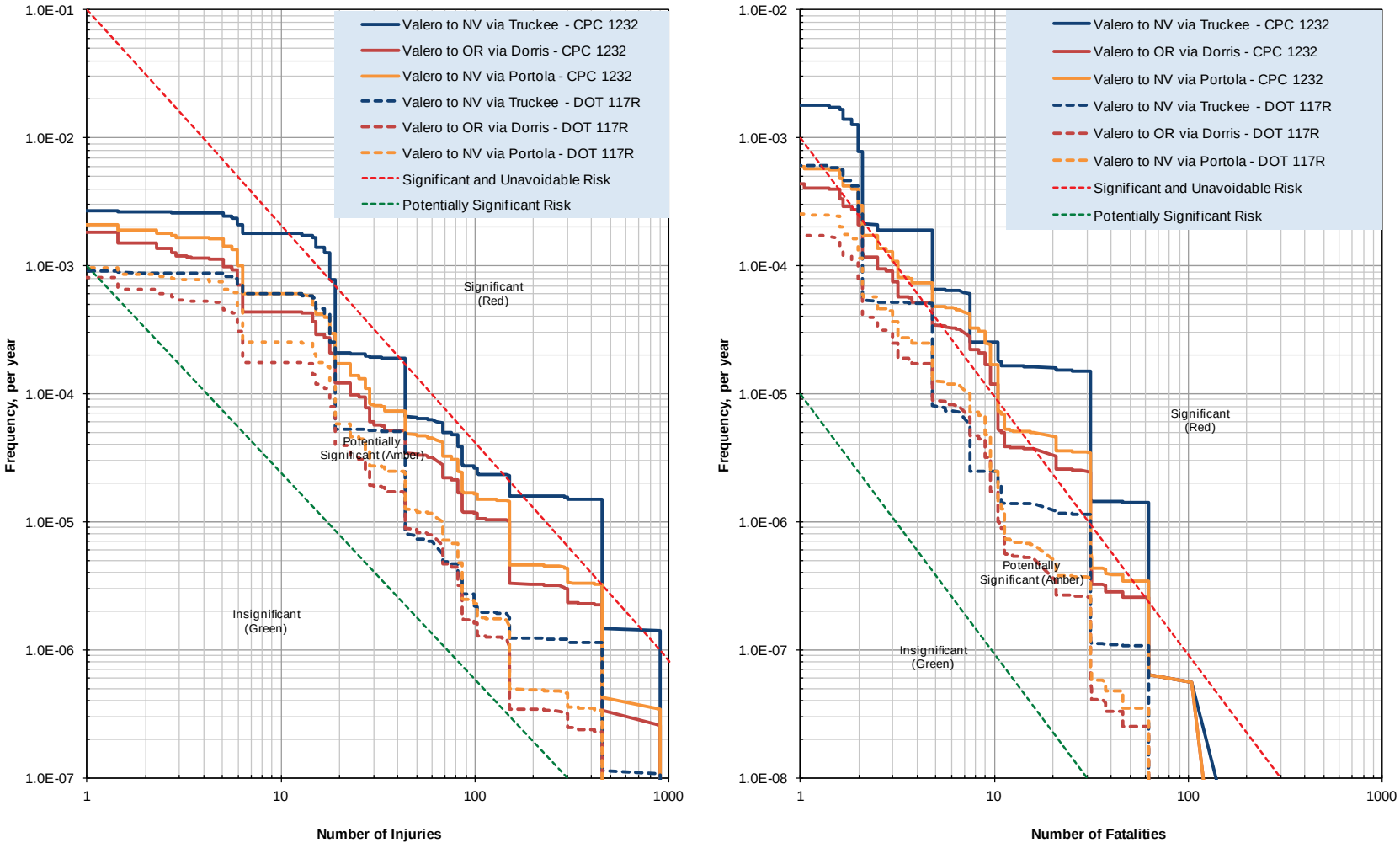


Figure 5-13 Cumulative Mainline Rail Crude Oil Unit Train Transportation Risk – DOT-117R Tank Cars to the California Border



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Attachment 1 - Petroleum Crude Oil Rail Transportation Release Rate Analysis: Benicia Project

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
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Petroleum Crude Oil Unit Train Transportation Risk Analysis: Benicia Project

15 July 2015

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EXECUTIVE SUMMARY

This report describes an analysis of the estimated petroleum crude oil train derailment rate, the estimated conditional probability of release given a derailment event and the estimated conditional probability of quantity released given a release event for the following routes:

- Benicia, CA to Roseville, CA
- Roseville, CA to California state border with Oregon via Dorris
- Roseville, CA to California state border with Nevada via Truckee
- Roseville, CA to California state border with Nevada via Portola

Several major risk factors were taken into account, including Federal Railroad Administration track class, railroad method of operation, tank car safety design, traffic volume, and train configuration.

Summary of Results for Baseline Car – Non-Jacketed CPC-1232 Tank Car

50-tank car train configuration

	Benicia to Roseville	Roseville to Oregon via Dorris	Roseville to Nevada via Truckee	Roseville to Nevada via Portola
Train derailment rate (per million train-miles)	0.35	0.28	0.79	0.32
Conditional probability of release	0.52	0.56	0.48	0.56

100-tank car train configuration

	Benicia to Roseville	Roseville to Oregon via Dorris	Roseville to Nevada via Truckee	Roseville to Nevada via Portola
Train derailment rate (per million train-miles)	0.69	0.56	1.58	0.63
Conditional probability of release	0.60	0.65	0.56	0.64

1. INTRODUCTION

The purpose of this analysis was to estimate the train derailment rate, conditional probability of release of a tank car given a derailment, and the conditional probability of quantity released given a release event of trains transporting petroleum crude oil on four different routes in California. The analysis was conducted based on segment-specific rail infrastructure information, tank car safety design, and train configuration. This study is intended to assist the city of Benicia to understand the risk associated with rail transportation of petroleum crude oil from the California state border to the Valero refinery. The results are presented at a "macro" level describing the global risk over each of the routes.

2. METHODOLOGY

The risk analysis methodology described this report consists of three major parts:

1. Estimation of the train derailment rate
2. Estimation of the probability distribution of a release event involving anywhere from one to the total number of tank cars in the train given a derailment event
3. Estimation of the probability distribution of the quantity released given a multiple tank car release event

2.1. Estimation of the train derailment rate

Train derailment rate is the likelihood that a train derails, normalized by some unit of traffic exposure such as ton-miles, car-miles or train miles. U.S. Department of Transportation (DOT), Federal Railroad Administration (FRA) commonly expresses such rates in derailments per million train miles and that is what is used in this analysis. Average train derailment rate over the 5-year period 2005 – 2009 has previously been estimated using FRA data from their Rail Equipment Accident (REA) database, combined with traffic data provided by the railroad industry (Liu et al., 2015). The FRA database records all accidents that exceed a specified monetary damage cost to on-track equipment, signals, track, track structures, and roadbed (FRA, 2014). Train derailment rate has been shown to vary with infrastructure and operating conditions, in particular: FRA track class, method of operation and traffic density (Liu et al., 2015). Higher FRA track classes (corresponding to higher operational speeds and more stringent track safety standards), signaled trackage, and higher traffic density, all demonstrate lower derailment rates compared to: lower FRA track classes, non-signaled trackage and lower traffic density (Figure 1).

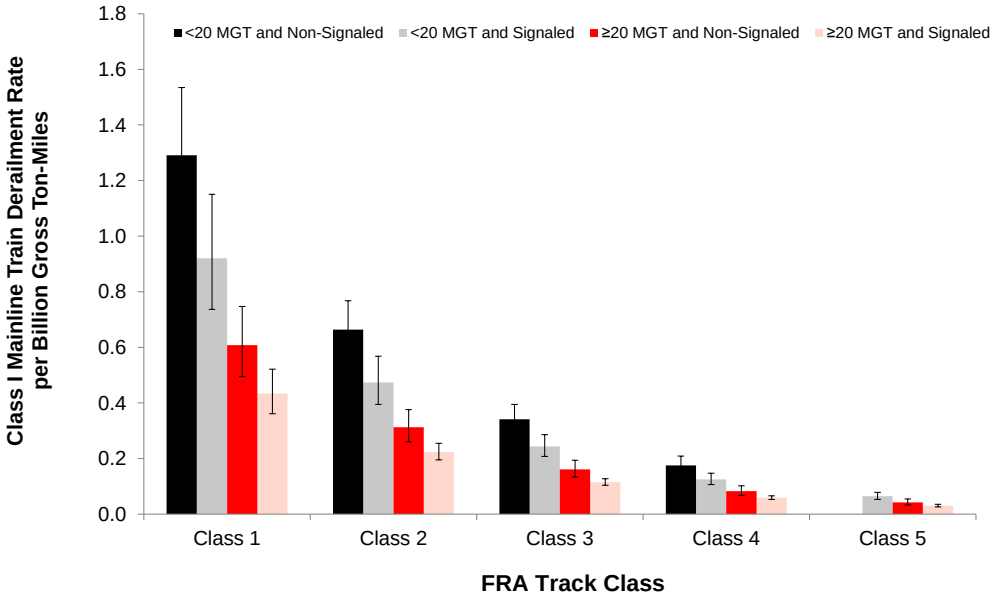

Figure 1. Estimated Class I mainline freight-train derailment rates by FRA track class, method of operation and annual traffic density (Liu et al., 2015)
(Error bars represent 95% confidence intervals)

The train derailment rates presented in Figure 1 can be used to estimate the probability of a derailment on any given segment of a rail line, given the three key characteristics mentioned above. They also permit estimates over an entire route by accounting for the percentage of each combination of characteristics found along its length. Using the route-specific characteristics combined with expected train configuration, enables calculation of overall estimated derailment rate for each of the routes studied.

2.2. Estimation of the conditional probability distribution of a multiple tank car release event

The probability that a tank car experiences a release in a derailment has been extensively studied by the RSI-AAR Railroad Tank Car Safety Research and Test Project. The RSI-AAR Tank Car Project has gathered data on the design, damage and accident conditions for over 46,000 tank cars involved in more than 29,000 accidents. These data enable robust, statistical estimation of the safety performance of tank cars and their appurtenances. The safety performance of the principal tank cars in use or proposed for transportation of petroleum crude oil have been analyzed and presented to the National Transportation Safety Board (Treichel, 2014).

Information on individual tank car safety design performance in accidents is an essential aspect of estimating the rail transportation risk of hazardous materials. It can be used to quantify the probability that an individual tank car will release some or all of its contents given its safety design features. In evaluations of unit train transportation risk it is also important to understand the probability distribution of multiple-car derailments

and releases. This was among the topics addressed by Liu in his Ph.D. dissertation research and other publications cited in this report (Liu et al., 2013, 2014).

The occurrence of a crude oil train release incident is the result of a sequence of events that are affected by a number of factors. Using the algorithm depicted in Figure 2 the probability of each stage in the event tree leading to a release incident was calculated, culminating in the results of particular interest, namely the probability distribution of the frequency and quantity released. In particular, this is the conditional probability distribution for the number of tank cars that will release some or all of their contents in an FRA-reportable derailment.

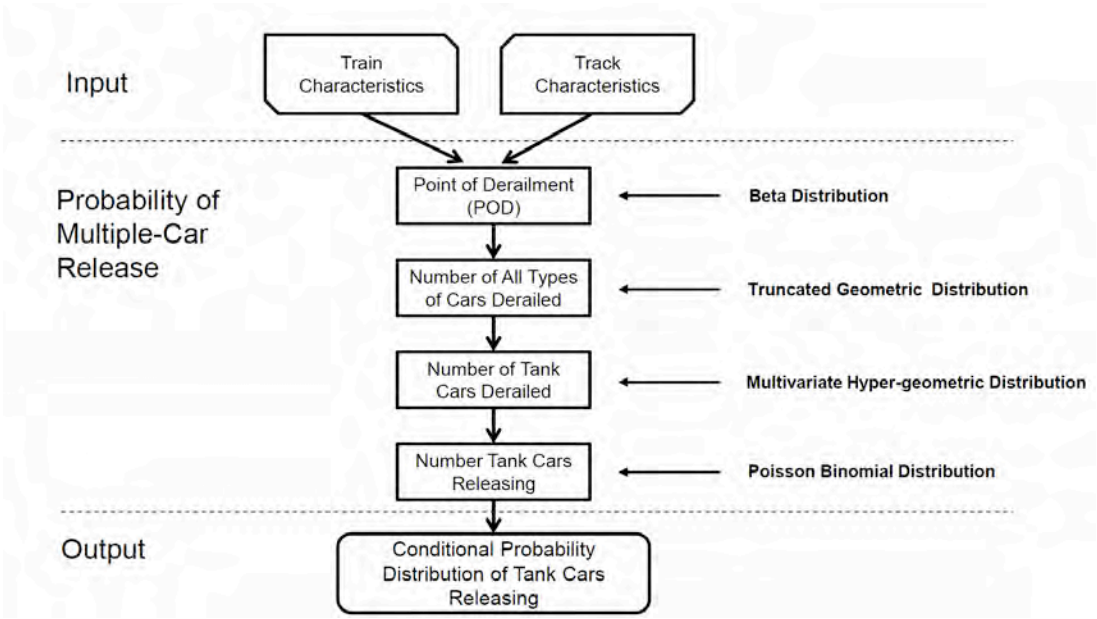

Figure 2. Analytical Procedure for Estimating the Conditional Probability Distribution of the Number of Hazardous Materials Cars Releasing (Liu et al., 2014)

(This flowchart is from a general characterization of the train derailment and release probability analysis model developed by Liu et al. (2014) in which all types of trains and cars can potentially be evaluated. The analysis described in this report is for unit trains in which all cars except for the buffer cars are the same type, and is therefore a simpler, special case of the more general model.)

In order to estimate the probability distribution of the total number of tank cars releasing given a derailment, each of the following distributions need to be estimated (Liu et al., 2014):

1. Point of derailment (POD), the position of the first car derailed in the train
2. Total number of railcars derailed, including both tank cars and other types of railcars, given the POD
3. Number of tank cars derailed given the total number of cars derailed
4. Number of tank cars releasing given the total number of tank cars derailed

2.3. Estimation of the conditional probability distribution of the quantity released

Statistical estimates of the distribution of the percentage of a tank car's contents lost in accidents have also been developed by the RSI-AAR Tank Car Project. These enable finer-grained statistical estimation of the distribution of quantities lost from tank cars in accidents and were used to develop the overall probability distribution of release quantity given a multiple-car release accident.

3. BENICIA PROJECT INFORMATION

3.1. Route information

This report considered the route from Benicia, CA to Roseville, CA and three alternative routes from Roseville, CA to the California state border (Figure 3).

- Benicia, CA to Roseville, CA
- Roseville, CA to California state border with Oregon via Dorris
- Roseville, CA to California state border with Nevada via Truckee
- Roseville, CA to California state border with Nevada via Portola

A summary of the characteristics of each route is shown in Table 1. All of the routes considered have signaled trackage with an annual traffic density greater than 20 million gross tons (MGT).

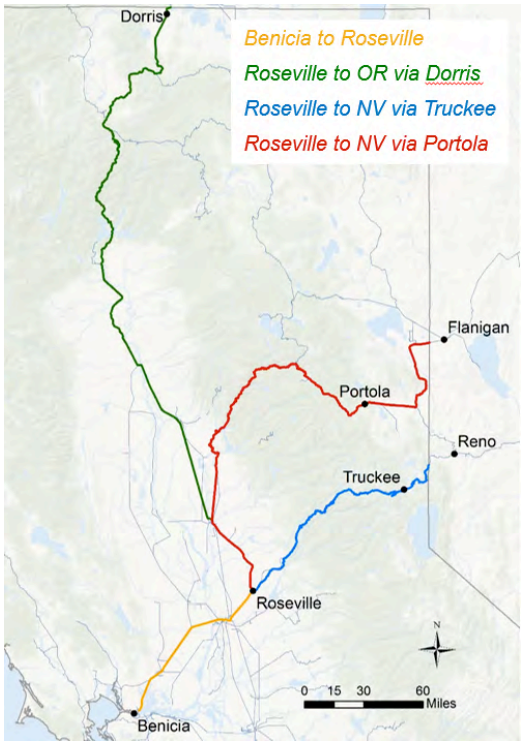

Figure 3. Alternative routes analyzed

Table 1. Summary of the route characteristics affecting derailment rate

	Benicia to Roseville	Roseville to Oregon via Dorris	Roseville to Nevada via Truckee	Roseville to Nevada via Portola
Total Length (Miles)	69	297	119	229
Distribution of Track Class				
• Track Class 1	0.8%	0.0%	0.0%	0.0%
• Track Class 2	0.0%	0.0%	0.0%	0.0%
• Track Class 3	18.5%	1.9%	96.5%	0.0%
• Track Class 4	0.0%	27.7%	0.0%	49.6%
• Track Class 5	80.8%	70.4%	3.5%	50.4%
Method of Operation				
• Signaled	100.0%	100.0%	100.0%	100.0%
• Non-Signaled	0.0%	0.0%	0.0%	0.0%
Annual Traffic Density				
• ≥ 20 MGT	100.0%	100.0%	100.0%	100.0%
• < 20 MGT	0.0%	0.0%	0.0%	0.0%

3.2. Train configuration

Two different train compositions were considered in this analysis:

- 50 tank car train – Consists of two locomotives, one buffer car and 50 tank cars.
- 100 tank car train – Consists of three locomotives and one buffer car in the front, followed by 100 tank cars, one buffer car and one locomotive.

3.3 Tank car safety design

This analysis considered four tank car safety designs presently in use, or being considered for transportation of flammable liquids under HM-251, the new regulations for rail transportation of flammable liquids recently issued by the US DOT (PHMSA, 2015). These are the non-jacketed CPC-1232, which is the current standard design, two versions of the new DOT 117R, which are retrofitted versions of the non-jacketed and jacketed CPC-1232 designs, and the new DOT-117. The design features affecting the safety performance of each of these cars in accidents, and their respective conditional probability of release (CPR) are summarized in Table 2.

Table 2. Summary of the tank car design features affecting safety performance in accidents*

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
Shell Inside Diameter (inches)	119	119	119	119
Shell Thickness (inches)	0.5	0.5	0.4375	0.5625
Head Thickness (inches)	0.5	0.5	0.4375	0.5625
Steel Type	TC128	TC128	TC128	TC128
Jacket (11 gauge, [ca.1/8 inch])	No	Yes**	Yes	Yes
Bottom Fittings	Yes	Yes	Yes	Yes
Top Fittings Protection	Yes	Yes	Yes	Yes
Head shields	Half Height	Full Height	Full Height	Full Height
Average Conditional Probability of Release (CPR)	0.132	0.052	0.064	0.042

* CPR estimates developed using statistical results and methods from the RSI-AAR Project TWP-17 report and assuming the following "average" conditions for FRA-reportable, mainline derailments: 26 mph derailment speed, with the tank car being the 6th car in a derailment in which 11 cars are derailed (Treichel, 2014).

** The current, non-jacketed CPC-1232 cars will receive a jacket as part of the retrofit, and they will be reclassified as DOT 117R.

4. RESULTS

4.1. Train derailment rate

Train derailment rate (per million train miles) for a particular route is calculated using the characteristics of each train (as described in Section 3.2) combined with the distribution of infrastructure conditions along that route (Table 1) multiplied by the rate for each track class (Figure 1). The mileage-weighted, average train derailment rates for the four different routes and both train configurations were calculated and are shown in Table 3.

Table 3. Train derailment rate (per million train-miles)

	Benicia to Roseville	Roseville to Oregon via Dorris	Roseville to Nevada via Truckee	Roseville to Nevada via Portola
50 tank car train configuration	0.347	0.282	0.792	0.316
100 tank car train configuration	0.694	0.565	1.583	0.632

4.2. Probability of a release given a derailment event

The probability of a release given an FRA-reportable derailment was calculated for each of the routes and for each of the tank car designs considered. Tables 4 and 5 show these values for the 50 and 100-tank-car train configurations, respectively.

Table 4. Probability of a release given an FRA-reportable derailment: 50-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
Benicia to Roseville	0.51630	0.30272	0.34328	0.26544
Roseville to Oregon via Dorris	0.56198	0.33936	0.38275	0.29891
Roseville to Nevada via Truckee	0.47607	0.26315	0.30214	0.22810
Roseville to Nevada via Portola	0.55765	0.33470	0.37800	0.29442

Table 5. Probability of a release given an FRA-reportable derailment: 100-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
Benicia to Roseville	0.59743	0.38734	0.42990	0.34696
Roseville to Oregon via Dorris	0.64814	0.43619	0.48034	0.39358
Roseville to Nevada via Truckee	0.55604	0.33624	0.37961	0.29593
Roseville to Nevada via Portola	0.64394	0.43073	0.47504	0.38801

4.3. Probability distribution of released quantity given a release event

The probability distribution of quantity released given a release event was calculated for each of the train configurations and tank car designs. Tables 6 and 7 show these values for FRA track Class 3 and Tables 8 and 9 show the probabilities for FRA track Class 5.

Table 6. Probability of quantity released, given at least one car releases in a derailment on FRA Class 3 track: 50-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
> 100 gallons	1.0	1.0	1.0	1.0
> 30,000 gallons	0.261106	0.129765	0.155968	0.107433
> 180,000 gallons	0.000669	0.000005	0.000021	0.000001
> 240,000 gallons	0.000044	0.000000	0.000000	0.000000

Table 7. Probability of quantity released, given at least one car releases in a derailment on FRA Class 3 track: 100-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
> 100 gallons	1.0	1.0	1.0	1.0
> 30,000 gallons	0.347688	0.196365	0.229891	0.166234
> 180,000 gallons	0.010480	0.001396	0.002734	0.000634
> 240,000 gallons	0.004285	0.000397	0.000938	0.000135

Table 8. Probability of quantity released, given at least one car releases in a derailment on FRA Class 5 track: 50-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
> 100 gallons	1.0	1.0	1.0	1.0
> 30,000 gallons	0.413613	0.258599	0.296190	0.222559
> 180,000 gallons	0.024243	0.001896	0.004714	0.000638
> 240,000 gallons	0.008584	0.000198	0.000772	0.000040

Table 9. Probability of quantity released, given at least one car releases in a derailment on FRA Class 5 track: 100-tank-car train configuration

		DOT 117R Retrofitted Cars		
	Non-Jacketed CPC-1232	Non-Jacketed CPC-1232	Jacketed CPC-1232	DOT 117
> 100 gallons	1.0	1.0	1.0	1.0
> 30,000 gallons	0.527994	0.387596	0.423483	0.352132
> 180,000 gallons	0.098771	0.048237	0.060259	0.038059
> 240,000 gallons	0.064896	0.030609	0.038887	0.023661

4.4. Discussion & Interpretation

The risk estimates described here are probably conservative, i.e. they may tend to over estimate the risk for several reasons. The railroad derailment rates used in this analysis were calculated based on the data from 2005 – 2009. Since then, derailment rate has continued to decline (Figure 4) (Liu, 2015), thus the rates calculated using the study interval data are higher than if the same rates were calculated using more recent data. Specifically, the average U.S. railroad derailment rate during the study period 2005 – 2009 was 2.5 derailments per million train miles, whereas in the subsequent 5-year period the rate was 1.8 and, for the year 2014, it had dropped to 1.6. These reflect 27% and 36% reductions respectively.

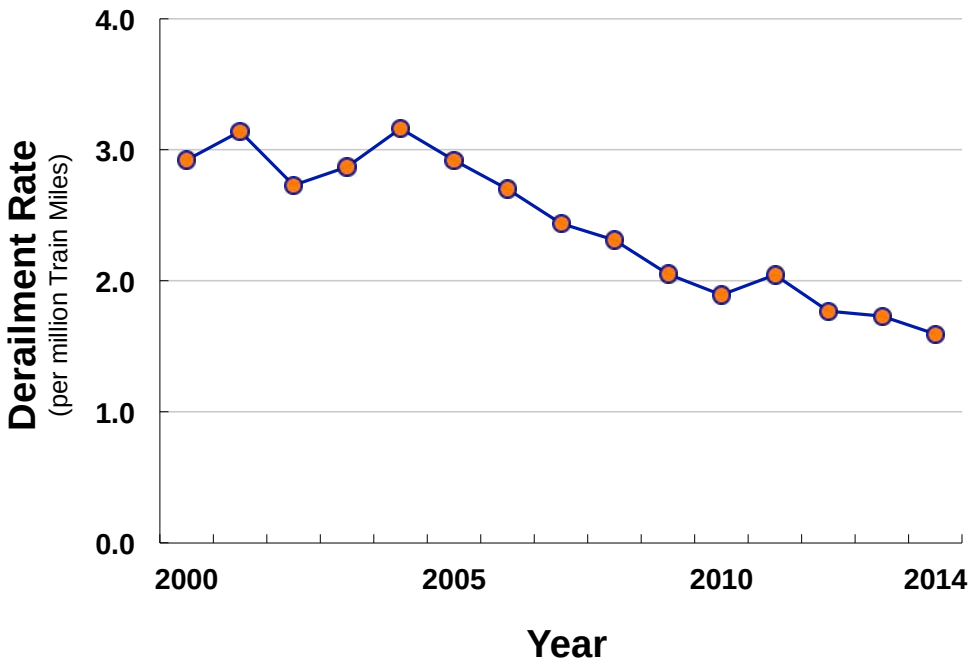

Figure 4. Average US railroad derailment rate 2000 – 2014
Data from US DOT Federal Railroad Administration and Association of American Railroads

More broadly, the railroads' accident rate has been declining for decades (Barkan et al., 2013) and this trend can be expected to continue (Liu, 2015). This is due to ongoing investment in infrastructure and various new technologies that are being developed to improve operating safety by detecting incipient flaws that may develop in infrastructure and rolling stock and repairing them before they lead to an accident. Furthermore, the accident rates used in this analysis do not take into account the effect of various additional safety practices specific to rail transportation of petroleum crude oil that the railroads have implemented (AAR, 2014; Union Pacific, 2014). The risk analysis described here did not account for any of these potential reductions in derailment rate.

4.5. Caveats

The nature of risk analysis is that even if an event has a low likelihood of occurring, there is no guarantee that it will not. For example, even if the estimated probability of an event is 0.01, i.e. one in one hundred, corresponding to an expected interval between occurrences of 100 years, such an event could still happen in the near future, and in fact multiple events are possible within that time period. Such an occurrence would not mean that the risk analysis was incorrect, instead it may be due to two factors, the laws of chance, and uncertainty in the statistics. It is important that readers understand this and that statements to this effect be included in reports used to describe the results of analyses of this nature.

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APPENDIX

A.1. Derailment Rate Analysis Database and Methodology

The accident database used to develop the statistics for this risk analysis is comprised of a unique combination of Federal Railroad Administration and proprietary Class 1 freight railroad information. The data used to calculate the rates are not limited to trains shipping crude oil; instead they include traffic, infrastructure and accident data for all freight trains operating on U.S. Class 1 railroads. Proper estimation of train accident rates involves analysis of all reportable accidents, divided by the total amount of traffic. By accounting for specific physical and operational conditions where accidents occurred and the amount of rail traffic operating under these same conditions, more refined, accurate estimates of the derailment rate can be developed. The data and analytical method used provides a more robust, reliable database for estimating rail accidents and derailments than is possible using historical accident data for particular segments along an individual route. Following is a more detailed explanation of the data and methodology.

U.S. train derailment rates over the 5-year period 2005–2009 were analyzed using data from the U.S. Department of Transportation, Federal Railroad Administration (FRA) Rail Equipment Accident (REA) database combined with traffic data from the rail industry (Liu et al., 2015). Nayak et al. (1983) conducted research for the US DOT that demonstrated an inverse relationship between FRA track class and derailment rate (i.e. higher track classes have lower derailment rates). Since then, this result has been

replicated and updated several times. More recently, as part of his Ph.D. dissertation research, Dr. Xiang Liu conducted a new study in which, in addition to FRA Track Class, he was able to incorporate new data on two other important variables, Traffic Density and Method of Operation (Liu et al., 2015). He found a clear, statistically significant effect of all three variables on freight train derailment rate (see Figure 1 in this report). The additional granularity provided by Liu's analysis allows more accurate, reliable segment-specific estimates of accident rates and these were used in the analysis. Liu's analysis represents the current state-of-the-art in detailed assessment of conditions affecting derailment rate on U.S. railroads.

The derailment rates calculated were based on 1,420 Class 1 railroad mainline derailments. Although the dataset used predates the oil train derailments in recent years, this does not affect the estimated rates because they represent only a small fraction of the total number of derailments. The rates used in the analysis are based on all freight train derailments over the time period 2005 – 2009. As stated in the main body of the report, the derailment rate from 2010 – 2014 was lower and there were significantly fewer derailments in this period as well. In fact, the derailment rate in 2014 was the lowest since FRA began recording these statistics in 1975. The reason the incidence of oil train derailments has increased is due to the substantial increase in this traffic. In 2008 there were less than 12,000 rail tank car shipments of petroleum crude oil in the U.S., whereas in 2014, there were over 512,000. This more than 40-fold increase in traffic is the reason that there have been more accidents involving this product. The risk results presented in this report specifically account for this, representing as they do, the incremental risk due to the increased traffic in connection with the Benicia facility.

The risk estimates presented in this report are conservative, that is, they over-estimate the risk. The U.S. Class 1 railroads' overall accident rate has declined since Liu et al.'s (2015) dataset was developed and analyzed. Therefore, although these rates represent the most the accurate quantitative analysis of the relationship between of the factors affecting derailment rate, they are higher than actual present-day risk. In particular, the average derailment rate for the five-year period 2010 – 2014 was 27% lower than the average for the five-year study period from 2005 – 2009, and the rate in 2014 was 36% lower (see Figure 4 in this report).

The data used to develop the derailment rates result in estimates normalized by ton-miles (Figure 1 and Liu et al., 2015). These are converted into rates per train-mile by multiplying the rate per ton-mile times the gross weight in tons of each train configuration, resulting in the rate per train mile.

Attachment 2 - Risk Assessment Methodology

Attachment 2 - Risk Assessment Methodology

A. Release Scenarios 7
B. Failure Frequencies 7
C. Consequence Analysis 12
D. Damage Criteria 15
D.1 Thermal Radiation Damage Criteria 15
D.2 Flammable Vapor Criteria 17
E. Risk Analysis 17
F. References 21

Risk assessment involves evaluating risks presented to the public by the facility in the form of hazardous materials releases resulting in explosions, flammable vapors, or toxic material impacts. The risk assessment methodology used to evaluate the risks associated with the Crude by Rail Project, including transport of crude by rail along the mainlines between the Valero Benicia Refinery (VBR) and and the Oregon and Nevada state lines, involved the use of a Quantitative Risk Assessment (QRA). The tools, assumptions, and industry standards associated with implementing QRAs described below.

None of these flammable hazard zones have the potential for offsite impacts associated with the worst-case unloading facility crude oil spill and fire in residential areas. The worst case spill occurs just north of the unloading facility where nearly the entire pipeline would drain onto the ground due to the slope of the area between the unloading facility and refinery storage tanks. Spills closer to the refinery storage tanks would be smaller, thus resulting in smaller hazard zones and less offsite exposure. Since the worst case hazard zones extend beyond the VBR boundaries, a QRA was prepared to evaluate the risk to adjacent workers in the commercial/industrial area east of the refinery.

A QRA analyzes the risks of immediate human safety impacts presented by industrial operations on nearby populations. The assessment follows commonly accepted industry standards including the recommendations of the Center for Chemical Process Safety (CCPS), the Health and Safety Executive of the United Kingdom.

The main objective of the QRA is to assess the project's risk of generating serious injuries or fatalities to members of the public, to assess the risks of spill events, and to develop mitigation measures that could reduce these risks. The development of the serious injury and fatality aspects of the QRA involves five major tasks:

- Identifying release scenarios;
- Developing frequencies of occurrence for each release scenario;
- Determining consequences of each release scenario;
- Developing estimates of risk, including risk profiles; and
- Developing risk-reducing mitigation measures.

Figure 1 shows the steps in developing a QRA.

A QRA computer model, developed by Marine Research Specialists, is used to calculate the risk profiles and, in conjunction with Geographic Information System software, to manage the data in accordance with CCPS guidelines for hazard assessments (CCPS 1989). The model is based on a polar coordinate grid of cells. The grid extends at least 0.5 mile from in all directions and has varying cell sizes depending on the populations and ignition sources. Hazard zones are then laid over the grid to determine populations impacted. The following sections discuss information developed as inputs to the model and whether they were used in the case of the Rail Spur project or not.

A wide range of meteorological conditions were evaluated for the proposed project. Table 1 provides a summary of meteorological conditions at the refinery and along the mainline rail routes.

Figure 1 Steps Involved in Developing a Quantitative Risk Assessment

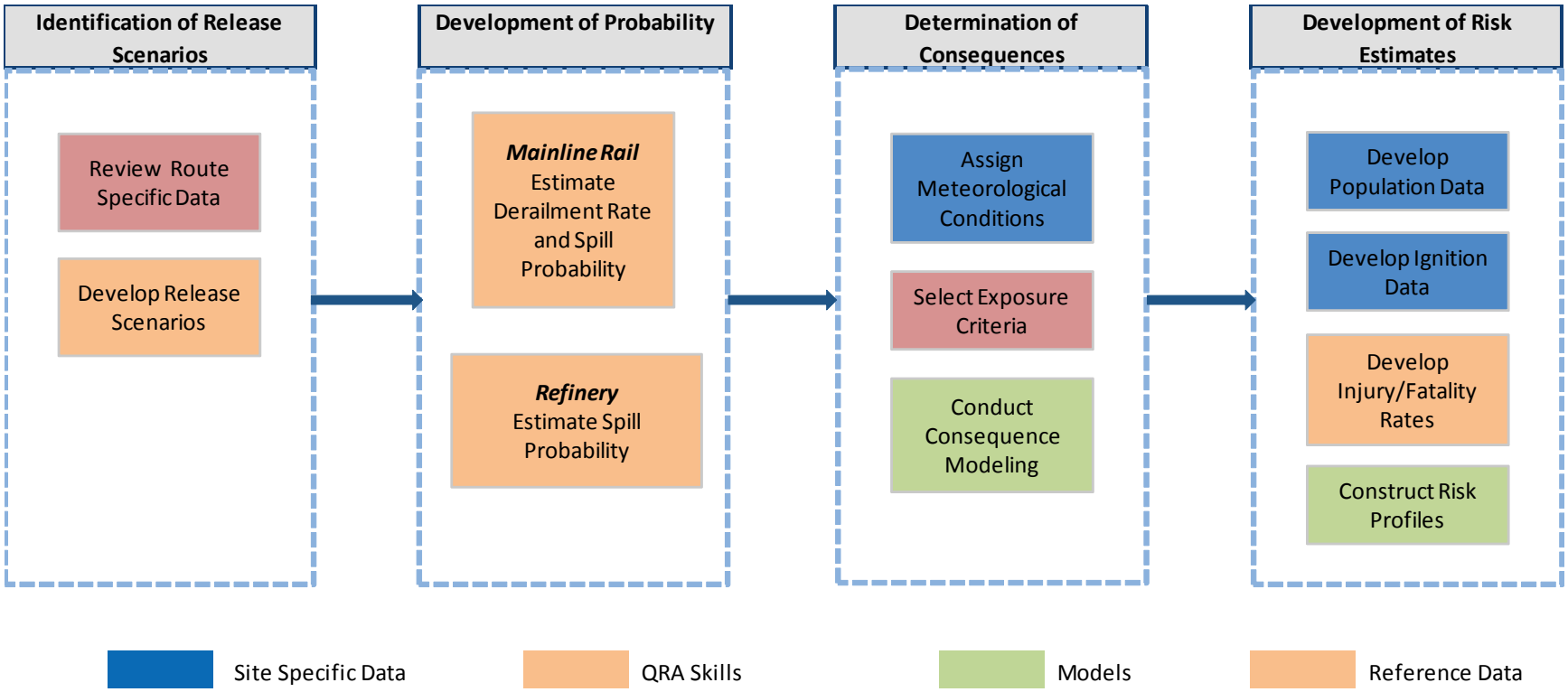

Table 1 Summary of Meteorological Conditions

Station	Frequency Distribution by Stability Class						Mean Wind Speed (m/s) by Stability Class					
	A	B	C	D	E	F	A	B	C	D	E	F
Benicia	0.82%	0.79%	13.90%	40.01%	19.98%	18.84%	1.21	2.38	4.15	5.33	3.73	1.34
Napa	0.44%	0.51%	31.93%	43.06%	6.62%	17.45%	2.06	2.25	4.30	5.55	2.98	2.12
Travis AFB	0.15%	0.19%	16.45%	71.67%	3.80%	7.75%	1.66	1.67	3.66	7.18	2.59	1.81
Davis	1.87%	1.00%	38.20%	25.62%	7.97%	25.34%	2.14	2.23	3.93	5.39	3.14	2.07
Sacramento	1.10%	0.97%	36.76%	30.87%	11.34%	18.97%	2.27	2.33	3.84	5.03	2.98	2.17
Auburn	0.31%	0.25%	37.21%	54.92%	1.57%	5.74%	1.75	1.76	3.03	3.70	2.12	1.76
Blue Canyon	0.00%	0.00%	20.22%	67.16%	4.52%	8.09%	0.00	0.00	2.69	4.01	1.76	1.76
Truckee	0.36%	0.38%	24.79%	53.03%	7.51%	13.93%	1.75	1.76	3.46	5.60	2.14	1.81
Yuba	0.26%	0.85%	31.07%	50.17%	5.90%	11.74%	1.77	1.76	3.15	5.18	2.42	1.89
Oroville	0.89%	0.69%	31.25%	36.72%	8.97%	21.48%	1.84	1.89	3.50	5.31	2.88	2.07
Chico	0.00%	0.03%	20.02%	58.26%	8.89%	12.79%	0.00	2.19	3.82	5.51	2.53	1.94
Red Bluff	0.63%	0.35%	27.94%	47.17%	9.03%	14.88%	1.91	1.97	3.82	5.47	2.71	2.07
Redding	0.92%	0.92%	34.80%	32.39%	7.42%	23.55%	2.03	2.15	3.78	5.89	2.91	2.09
Mt. Shasta	0.22%	0.50%	44.67%	28.78%	9.95%	15.87%	1.76	1.76	2.70	3.35	2.11	1.82
Siskiyou	1.65%	0.99%	23.84%	43.32%	8.97%	21.22%	2.23	2.31	3.90	6.10	2.96	2.09
Alturas	1.10%	0.80%	25.93%	50.45%	6.35%	15.37%	1.81	1.85	3.37	5.49	2.44	1.96

Fatality and serious injury probabilities are entered for each type of scenario (i.e., flame jets, fires, vapor clouds, including flammable and toxic clouds, explosions, and boiling liquid expanding vapor explosions), indicating the percentage of persons who are exposed to a scenario that would suffer serious injuries or fatalities.

Population density information developed for each receptor includes the number of persons present at each location, the area over which the persons are distributed, and the maximum number of persons that could be exposed. If a cloud covers only a portion of the area, the population density is used to determine the number of persons exposed.

A use factor is applied to each receptor based on the hours per day that persons are at the location. For example, a receptor that has persons at it 12 hours per day would have a use factor of 0.5. This factor reduces the frequency of a release scenario impacting persons.

An ignition probability at each receptor is applied, which defines the probability that a flammable cloud would reach the receptor and ignite and affect the receptor location. For example, if there are no ignition sources between the receptor and the release point and there is an ignition point at the receptor, such as a campfire, which has a high probability of igniting the cloud, then the ignition probability would be 1.0 at the receptor.

Meteorological conditions at the site are represented by a full range of meteorological conditions spanning all atmospheric stability classes and wind speeds. Wind conditions are divided into 16 directions and the probability of wind in each direction, at each stability class and speed, is entered.

Fatality and serious injury probabilities are entered for each type of scenario (i.e., flame jets, fires, vapor clouds, including flammable and toxic clouds, explosions, and boiling liquid expanding vapor explosions), indicating the percentage of persons who are exposed to a scenario that would suffer serious injuries or fatalities.

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An ignition probability at each receptor is applied, which defines the probability that a flammable cloud would reach the receptor and ignite and affect the receptor location. For example, if there are no ignition sources between the receptor and the release point and there is an ignition point at the receptor, such as a campfire, which has a high probability of igniting the cloud, then the ignition probability would be 1.0 at the receptor.

This would mean that any receptor farther from the release point would not be impacted. If there are ignition sources at the release location (such as flares or heaters), the ignition probability

would be less than 1.0, meaning that part of the time the flammable cloud would not reach the receptors at all. The sum of ignition probabilities along any one path is equal to or less than 1.0.

A shielding factor is also applied to receptor locations. The shield factor is applicable to thermal scenarios only, such as flame jets, fires, or boiling liquid expanding vapor explosions. Thermal scenarios only produce impacts if the receptor is directly exposed to the flame and has a "line of sight." Buildings, vegetation, terrain, and other types of obstructions would prevent persons exposed to the fire from experiencing the full effects, and would reduce the probability that the person would suffer a serious injury or fatality.

Release scenario frequencies are determined though failure rate analysis and fault trees, which detail the general conditions and equipment-specific frequencies that could lead to a release. Event trees evaluate post-release behavior of the released material, such as whether it forms a flammable cloud, flame jet, toxic cloud, explosion, or a boiling liquid expanding vapor explosion.

The end products for the serious injury and fatality analysis are "risk profile" curves, one for fatalities and one for serious injuries, developed from the scenario frequencies and effected populations for each scenario. The risk profile curves estimate the risk that any existing population would suffer fatalities or serious injuries.

A. Release Scenarios

Release at the VBR could occur manly from the unloading operations and the new pipeline to the existing crude oil storage tanks. The worst case spill volume was determined to be from a pipeline spill. Spill volumes from a pipeline system rupture are based on the pipeline diameter and the terrain profile, which would limit the amount of oil that could drain out of the pipeline. In addition, the pumping rate also affects the size of a release since oil pumped into the pipeline would contribute to the release size until the pumps are shut down.

Spills at the VBR that would be contained by the berms and drainage system valves and, for areas outside of berms, would be directed to the drainage basins (tertiary containment). A spill would only be directed outside of these areas after a subsequent failure in the drainage basin discharge procedure or equipment.

Spill volumes from rail cars were assumed to include multiple rail car releases (the full volume of about eight rail cars) for train derailment scenarios. No containment system was assumed for railroad spills.

B. Failure Frequencies

Once the scenarios have been identified, the analysis attempts to estimate the frequency of each scenario. The worst case hazard zones for the Santa Maria Refinery (SMR) did not extend off of the refinery property so it was not necessary to estimate failure frequencies of the events at the VBR. The remainder of this section focuses on the mainline rail failure events.

Rail Type

Rail track is classified into six categories with Class 6 having the most stringent track tolerances and maintenance schedules. With the advent of higher speed trains additional classifications have been defined for Class 7 and 8. Mainline track is generally Class 4 or 5 and typically have lower accident rates per million miles. Class 6 track is used for high speed trains up to 110 mph, and are found in the Northeast Corridor between Washington D.C. and New York. Class 4 track is the dominant class for mainline track used in passenger and long-haul freight service. The Class of a track determines the maximum speed that freight and passenger trains can travel. Higher class tracks have higher allowable speeds.

The Federal Railroad Administration (FRA) establishes minimum design standards for each of the various track classes. Each railroad establishes their own design standards for their tracks that meet or exceed the FRA standards. The FRA standards cover the track roadbed, track geometry, track structure (ballast, cross-ties, joints, switches, etc.). These minimum track safety standards are specified in 49 CFR 213.

Tank Car Type

Rail car types for crude oil are DOT-111 non-pressurized tank cars (DOT 111A60W1). DOT-111 tank cars for crude oil service have a maximum capacity of 30,000 gallons. Following an accident in Illinois in 2009, the NTSB made a number of safety recommendations to both the American Association of Railroads (AAR) and the DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) regarding DOT-111 tank cars. The NTSB recommended to PHMSA that it require modifications be made on all existing and new DOT-111s. PHMSA did not mandate a fleet retrofit, nor has it published new standard designs for crude and ethanol tank cars. The AAR-North American Tank Car Committee, independent of a federal mandate, implemented nearly all of the recommendations made to PHMSA in its design standards for new crude oil and ethanol tank cars ordered after October 2011. Specifically, all new DOT-111 tank cars for ethanol and crude oil service beginning October 1, 2011 are required to have:

- Increase head and shell thickness;
- Normalized steel;
- ½-inch thick ½-height head shields; and
- Top fitting protection.

The NTSB also recommended the AAR review the design requirements for attaching center sills or draft sills for all tank cars. The AAR-North American Tank Car Committee has studied the stub sill issue and will revise those standards as recommended. Nearly 25 percent of the DOT-111 fleet carrying crude today meets the higher design standards, as outlined above.

On July 23, 2014 the DOT issued a notice of proposed rulemaking covering enhanced tank car standards and operational controls for high-hazard flammable trains, which included crude oil trains. As part of the proposed DOT rulemaking, the PHMSA, in coordination with the Federal Railroad Administration (FRA), is proposing: (1) new operational requirements for certain trains transporting a large volume of Class 3 flammable liquids; (2) improvements in tank car standards; and (3) revision of the general requirements for offerors to ensure proper classification and characterization of mined gases and liquids. These proposed requirements are designed to

lessen the frequency and consequences of train accidents/incidents (train accidents) involving certain trains transporting a large volume of flammable liquids.

The PHMSA is proposing revisions to the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) that establish requirements for "high-hazard flammable train" (HHFT). This proposed rule defines a HHFT as a train comprised of 20 or more carloads of a Class 3 flammable liquid and ensures that the rail requirements are more closely aligned with the risks posed by the operation of these trains. This rule primarily impacts unit train shipments of ethanol and crude oil; because ethanol and crude oil are most frequently transported in high volume shipments, typically in trains with 20 or more cars of those commodities. Currently, as shipped, crude oil and ethanol are typically classified as Class 3 flammable liquids. The primary intent of this rulemaking is to propose revisions to the HMR that update and clarify the regulations to prevent and mitigate the consequences of a train accident involving flammable liquids, should one occur. Table 1 identifies those affected by this NPRM and describes the regulatory changes.

Table 2 further summarizes the three options that DOT is considering for use with HHFT. As noted in Table 3, PHMSA proposes to require one of these options for new tank cars constructed after October 1, 2015, if those tank cars are used as part of HHFT. In addition, for all three Options, PHMSA proposes the following timelines for tank cars used as part of HHFT: (1) for Packing Group I, DOT Specification 111 tank cars are not authorized after October 1, 2017; (2) for Packing Group II, DOT Specification 111 tank cars are not authorized after October 1, 2018; and (3) for Packing Group III, DOT Specification 111 tank cars are not authorized after October 1, 2020. The crude transported to the SMR could be in Packing Group I.

New tank cars constructed after October 1, 2015, are required to meet the new DOT Specification 117 design or performance criteria. The prescribed car has a 9/16 inch tank shell, 11 gauge jacket, 1/2 inch full-height head shield, thermal protection, and improved pressure relief valves and bottom outlet valves. Existing tank cars must be retrofitted with the same key components based on a prescriptive, risk-based retrofit schedule. As a result the final rule will require replacing the entire fleet of DOT-111 tank cars for Packing Group I, which covers most crude shipped by rail, within three years and all non-jacketed CPC-1232s, in the same service, within approximately five years.

The rule requires HHFTs to have in place a functioning two-way end-of-train (EOT) device or a distributed power (DP) braking system. Trains meeting the definition of a "high-hazard flammable unit train," or HHFUT (a single train with 70 or more tank cars loaded with Class 3 flammable liquids), with at least one tank car with Packing Group I materials, must be operated with an electronically controlled pneumatic (ECP) braking system by January 1, 2021. All other HHFUTs must have ECP braking systems installed after 2023. This important, service-proven technology has been operated successfully for years in certain services in the United States, Australia, and elsewhere.

The rule restricts all HHFTs to 50 mph in all areas and HHFTs containing any tank cars not meeting the enhanced tank car standards required by this rule are restricted to operating at a 40 mph speed restriction in high-threat urban areas. The 40 mph restriction for HHFTs without new or retrofitted tank cars is also currently required under FRA's Emergency Order No. 30.

Table 2 Proposed Regulatory Requirements for HHFT (USDOT July 23, 2014)

Proposed Requirement	Effected Entity
Better classification and characterization of mined gases and liquids. • Written sampling and testing program for all mined gases and liquids, such as crude oil, to address: (1) frequency of sampling and testing; (2) sampling at various points along the supply chain; (3) sampling methods that ensure a representative sample of the entire mixture; (4) testing methods to enable complete analysis, classification, and characterization of material; (5) statistical justification for sample frequencies; and, (6) duplicate samples for quality assurance. • Require offerer to certify that program is in place, document the testing and sampling program, and make program information available to DOT personnel, upon request.	Offerors / Shippers of all mined gases and liquids
Rail routing risk assessment. • Requires carriers to perform a routing analysis that considers 27 safety and security factors. The carrier must select a route based on findings of the route analysis. These planning requirements are prescribed in 49 CFR 172.820 and would be expanded to apply to HHFTs. Notification to SERCs. • Require trains containing one million gallons of Bakken crude oil to notify State Emergency Response Commissions (SERCs) or other appropriate state delegated entity about the operation of these trains through their States. Reduced operating speeds. • Restrict all HHFTs to 50-mph in all areas • PHMSA is requesting comment on three speed restriction options for HHFTs that contain any tank cars not meeting the enhanced tank car standards proposed by this rule: (1) a 40-mph maximum speed restriction in all areas (2) a 40-mph speed restriction in high threat urban areas; and, (3) a 40-mph speed restriction in areas with a 100K+ population. • PHMSA is also requesting comment on a 30-mph speed restriction for HHFTs that do not comply with enhanced braking requirements. Enhanced braking. • Require all HHFTs be equipped with alternative brake signal propagation systems. Depending on the outcome of the tank car standard proposal and implementation timing, all HHFTs would be operated with either electronic controlled pneumatic brakes (ECP), a two-way end of train device (EOT), or distributed power (DP).	Rail Carriers, Emergency Responders
Enhanced standards for both new and existing tank cars. • Require new tank cars constructed after October 1, 2015 (that are used to transport flammable liquids as part of a HHFT) to meet criteria for a selected option, including specific design requirements or performance criteria (e.g., thermal, top fittings, and bottom outlet protection; tank head and shell puncture resistance). PHMSA is requesting comment on the following three options for the DOT Specification 117: 1. FRA and PHMSA Designed Car, or equivalent 2. AAR 2014 Tank Car, or equivalent 3. Jacketed CPC-1232, or equivalent • Require existing tank cars that are used to transport flammable liquids as part of a HHFT, to be retrofitted to meet the selected option for performance requirements, except for top fittings protection. Those not retrofitted would be retired, repurposed, or operated under speed restrictions for up to five years, based on packing group assignment of the lading.	Tank Car Manufacturers, Tank Car Owners, Shippers and Rail Carriers

HHFT-High-Hazard Flammable Trains
Source: USDOT, 2014.

Table 3 Proposed Safety Features by Tank Car Option (USDOT July 23, 2014)

Tank Car	Bottom Outlet Handle	GRL (lbs)	Head Shield Type	Pressure Relief Valve	Shell Thickness	Jacket	Tank Material	Top Fittings Protection	Thermal Protection System	Braking
Option 1: PHMSA and FRA Designed Tank Car	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full- height, 1/2 inch thick Head shield	Reclosing pressure relief device	9/16 inch Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	TIH Top fittings protection system and nozzle capable of sustaining, without failure, a rollover accident at a speed of 9 mph	Thermal protection system in accordance with §179.18	ECP brakes
Option 2: AAR 2014 Tank Car	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full- height, 1/2 inch thick head shield	Reclosing pressure relief device	9/16 inch Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
Option 3: Enhanced CPC 1232 Tank Car	Bottom outlet handle removed or designed to prevent unintended actuation during a train accident	286k	Full Height 1/2 inch thick head shield	Reclosing pressure relief device	7/16 inch-Minimum	Minimum 11-gauge jacket constructed from A1011 steel or equivalent. The jacket must be weather-tight	TC-128 Grade B, normalized steel	Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Thermal protection system in accordance with §179.18	In trains with DP or EOT devices
DOT 111A100 W1 Specification (Currently Authorized)[1]	Bottom Outlets are Optional	263K	Optional; Bare Tanks half height; Jacket Tanks full height	Reclosing pressure relief valve	7/16 inch-Minimum	Jackets are optional	TC-128 Grade B, normalized steel	Not required, but when Equipped per AAR Specifications Tank Cars, appendix E paragraph 10.2.1	Optional	Not required

1. A CPC-1232 tank car is with all of the options included in the design. This is referred to as a post October 1, 2011 tank car and is the tank car design proposed for use by the Applicant.

Source: USDOT 2014.

Railroads operating HHFTs must perform a routing analysis that considers, at a minimum, 27 safety and security factors, including "track type, class, and maintenance schedule" and "track grade and curvature," and select a route based on its findings. These planning requirements are prescribed in 49 CFR §172.820.

Improved information sharing ensures that railroads provide State and/or regional fusion centers, and State, local and tribal officials with a railroad point of contact for information related to the routing of hazardous materials through their jurisdictions. This replaces the proposed requirement for railroads to notify State Emergency Response Commissions (SERCs) or other appropriate state-designated entities about the operation of these trains through their States.

Shippers must develop and carry out sampling and testing programs for all unrefined petroleum-based products, such as crude oil, to address the criteria and frequency of sampling to improve and ensure accuracy. Offerors must certify that hazardous materials subject to the program are packaged in accordance with the test results, document the testing and sampling program outcomes, and make that information available to DOT personnel upon request.

Accident Rates

In order to identify the probability of an accident (i.e., accident rate or derailment rate) and oil spill (i.e., spill rate) from a crude oil train on each of the possible routes, Dr. Christopher Barkan was retained to conduct a quantitative assessment. Dr. Barkan is Professor and Executive Director of the Rail Transportation and Engineering Center at the Department of Civil and Environmental Engineering at the University of Illinois at Urbana- Champaign. He and his colleagues prepared a report (see Attachment 1) that looked at route specific accident rates and spill rates based upon the tank car design proposed by the Applicant. The analysis took into account major risk factors, including route specific FRA track class, method of operation, tank car safety design, and the proposed volume of crude oil trains over the route.

C. Consequence Analysis

The consequence analysis and hazard modeling consider the physical effects of a release and its damage to people. The analysis judges the severity of potential hazards associated with accidents and their possible consequences.

Risk assessments typically evaluate fire, flammability, explosion, and toxicity. Fire and flammability hazards are relevant for flammable vapors with relatively low flash points, such as propane and methane; their hazard is usually thermal radiation from vapor jet or pool fires. In addition, larger vapor jet fires can also lead to a loss of structural integrity of other storage or process vessels. The temperature in flame jets is usually high, and flame impingement onto nearby equipment is of the greatest concern.

The release and ignition of flammable vapors may also cause an explosion. The blast overpressure hazard depends on the nature of the chemical, the strength of the ignition source, and the degree of confinement. Finally, toxic chemicals can produce adverse effects to humans. The degree of these effects depends on the toxicity of the material and the duration of the exposure.

Performing state-of-the-art hazard assessment requires a combination of sophisticated analytical techniques and extensive professional experience. The consequence models used in this analysis are the result of more than two decades of development, and they have been validated using large-scale field tests. While a large number of consequence models are available, only a few specific models were needed to assess the hazards identified as part of this study. The hazard assessment models used as part of this analysis can be categorized into two groups:

- Release rate models; and
- Vapor dispersion models.

The following sections discuss the general characteristics of each of the models used for the consequence analysis. Specific models used in the consequence analysis were selected based on the scenarios identified in the hazard identification task.

Release Rate Models

Several models were utilized to simulate potential releases of gas, liquefied petroleum gas, natural gas liquids, and crude vapor, and two-phase releases from pipes, vessels and tanks cars.

One of the first steps in consequence modeling is to establish the source terms (i.e., release rate, temperature, pressure, and velocity) associated with each scenario. The release rate is the rate at which the material is released from the pipe, vessel, or tank car to the atmosphere. Before the source terms can be estimated for each scenario identified in the hazard analysis, the thermodynamic and physical properties of each hydrocarbon stream must be characterized. The thermodynamic and physical properties of the hydrocarbon streams were estimated using the IoMosaic SuperChems™ model, which utilizes numerous thermodynamic and physical property estimation techniques.

The SuperChems™ model simulates the release of multi-component liquid and vapor streams characteristic of the potential releases associated with the facility. For this study, these models are useful in assessing the effect of multi-component streams on vapor cloud flammability characteristics.

Steady and Non-Steady Release from a Pressurized Vessel or Pipeline

These numerical steady and non-steady state flow models are used to compute multi-component liquid and vapor release rates from a ruptured valve or pipeline. The steady-choked and un-choked flow models compute a single release rate assuming uniform pressure and temperature in the vessel; in most blow-down processes from pressure vessels, the pressure inside is sufficiently high that choked flow (i.e., releases at sonic velocity) conditions exist during most of the blow-down period. However, in smaller pressure vessels, or for relatively larger release rates, the conditions inside the vessel are not steady. The pressure drop influences the flow velocity and, thus, the mass flow rate. In addition, the density and temperature inside the vessel are also changing. The unsteady state models compute a time-dependent release rate profile based on the chemical component properties.

The modeling method for release rate is to simulate the initial and the average release rate from a pipe or vessel rupture based on the operating conditions: the temperature, pressure, and composition. The initial release rate is then assumed to be steady for the duration of a flammable

release (the average release rate is used for a toxic release) until the process inventory is expelled or a system shutdown intervenes. This model was used to estimate tank car spill rates.

Pool/Tank Fire Modeling Methodology

The thermal radiation hazards from hydrocarbon pool fires depend on a number of parameters, including the composition of the hydrocarbon mixture, the size and shape of the fire, the duration of the fire, its proximity to the object(s) at risk and the thermal characteristics of the object exposed to the fire. Estimating the thermal radiation field surrounding a fire involves the following three major steps:

- Geometric characterization of the pool fire which involves the determination of the burning rate and the physical dimensions of the fire. In calculating thermal radiation, the size/shape of the fire implies the time-averaged size of the visible flame envelope (i.e., not obstructed by smoke). Field experiments have shown that the non-visible parts of the fire radiate less than 10% of the total radiation from a hydrocarbon pool fire.
- Characterization of the radiative properties of the fire which involves the estimating the average irradiance of the flames. The intensity of thermal radiation emitted by pool fires depends on a host of parameters including fuel type, fire size, flame temperature, and composition. The major sources of radiative emissions in large pool fires are water vapor, carbon dioxide and soot.
- Calculation of radiant intensity at a given location. This is accomplished once the geometry of the fire, its radiation characteristics and the location, geometry and orientation of the receiver are known. For large distances (hundreds of meters), the absorption of thermal radiation in the intervening atmosphere becomes appreciable. This is dependent on the path length, flame temperature and atmospheric relative humidity.

Several pool fire scenarios were considered in the analysis including; a fire in the oil storage tank, a fire in the diked area surrounding the storage tank resulting from storage tank failure and ignition and a fire following the derailment of a tank car. These scenarios were simulated using the SuperChems™ consequence modeling.

Fires in blended hydrocarbon mixtures, especially those whose components differ widely in their volatility, do not burn at a uniform rate. In the beginning, the burning rate is characteristic of the high volatile component. During the middle portion of the burning, the less volatile component still must be brought to the boiling point of the blend. Finally, as the fractionation proceeds, the burning rate becomes characteristic of the higher boiling fraction.

Radiative properties of the fire were based on a detailed analysis of typical crude oil that would be delivered via rail. This information was used to simulate the fractionation of the burning hydrocarbon mixture, and the progressive decrease in thermal radiation intensity over time. The initial pool geometry for each model simulation was based on the area and shape of the storage tank and diked area. Several meteorological conditions were also simulated to obtain a worst-case estimate of thermal radiation hazards.

Several pool fire scenarios were considered in the analysis which included potential spill sizes of to 30,000 gallons. These scenarios were simulated using the SuperChems consequence modeling

package. It should be noted that any fire that occurs would be likely to be restricted to the location of the spill. A flammable vapor cloud moving downwind from a crude oil spill is not expected to arise since the small quantities of flammable vapors evolving would disperse very rapidly. Calculations were made based on the following assumptions:

- Ambient temperature 305 K
- Discharge temperature of 350 K
- Unlimited pool radius
- Average flame temperature of 1,000 K
- Burning rate of 0.228 mm/s for light crude oil.

Boiling Liquid Expanding Vapor Explosion Model/Rail Car Thermal Tear

A boiling liquid expanding vapor explosion is a sudden loss of containment of a liquid that is above its boiling point (at atmospheric conditions). A boiling liquid expanding vapor explosion results in a sudden, vigorous liquid boiling and the production of a shock wave. Liquids stored under pressure (such as the gas liquids) fall into this category as well as any liquid that is stored at an elevated temperature above its boiling point. The main hazards presented by liquids stored under pressure are fireball and radiation.

Boiling liquid expanding vapor explosions were modeled using the SuperChems™ model for fireballs. The approach estimates the total energy that could be produced by the material combustion and the duration of the explosion. Impacts are estimated by integrating the energy flux over the time that the explosion occurs at different distances from the source of the explosion. Overpressure due to boiling liquid expanding vapor explosion was also estimated assuming the tank car fails due to overpressure, and the resulting shockwave is dissipated into the environment. The larger of the hazard zones pertaining to boiling liquid expanding vapor explosions (either overpressure or thermal radiation) was used to estimate risk.

D. Damage Criteria

Since the release streams are flammable, releases could potentially result in thermal radiation exposure from a fire, and also present an overpressure hazard due to explosions from flammable vapor clouds or boiling liquid expanding vapor explosions. Damage criteria were developed in order to quantify the potential consequences of an accidental release. Damage criteria are defined as the levels of exposure that could produce fatalities and produce serious injuries.

Serious injury is defined as an impact from the exposure that could require medical intervention and could produce effects that last significantly longer than the duration of the exposure. An injury such as lung damage that would require hospitalization and/or other types of therapy would be considered a serious injury.

D.1 Thermal Radiation Damage Criteria

The potential concern associated with large-scale fires is thermal radiation intensity, and its effects on persons, the surrounding structures, processes, and fire suppression equipment. Table 4 presents an overview of thermal radiation intensity and observed effects.

Table 4 Thermal Radiation Serious Injury and Impacts

Intensity (kW/m^2)	Impact
1	Time for severe pain - 115 seconds Time for second-degree burns - 663 seconds [a]
1.6	No discomfort for long exposure [b]
2	Time for severe pain - 45 seconds Time for second-degree burns – 187 seconds [a]
3	Time for severe pain - 27 seconds Time for second-degree burns - 92 seconds [a]
4	Time for severe pain - 18 seconds Time for second-degree burns - 57 seconds [a]
5	Time for severe pain - 13 seconds Time for second-degree burns - 40 seconds [a]
10	Time for severe pain - 5 seconds Time for second-degree burns - 14 seconds Time for 100% fatality - 270 seconds [a c]
12.5	Melting of plastic tubing [b]
25	Minimum energy to ignite wood [b]
37.5	Damage to process equipment [b]
100	Time for severe pain - <1 seconds Time for second-degree burns - 1 sec Time for 100% fatality - 11 seconds [c]

a. Based on Handbook of Chemical Hazard Analysis Procedures, FEMA. b. CCPS Chemical Process Quantitative Risk Analysis. c. CCPS Chemical Process Quantitative Risk Analysis using probit equation by Eisenberg

Data presented in this table shows that no considerable physical effect would result from exposure to a radiation intensity between 1 and 1.6 kW/m^2 over extended periods. Exposure to a radiation intensity of 5 kW/m^2 would result in pain if the exposure period was to exceed 13 seconds, and it would result in second-degree burns after 40 seconds. Exposure to a radiation intensity of 10 kW/m^2 would result in pain (5 seconds) and second-degree burns after short exposure periods (i.e., 14 seconds), and death after longer periods. The time required to reach pain, second-degree burn, and fatality thresholds were used to estimate radiation levels that would result in serious injury or fatality. Persons exposed to thermal radiation have the opportunity to move away from the hazard, unlike overpressure effects or vapor cloud fires and explosions, which are instantaneous. It was assumed in this analysis that some people not within the flame area would move away from the flame to get away from the heat. Analysis of the distances to various radiation levels indicates that this is feasible. Therefore, a less than 1 minute exposure was used as the basis for determining the damage criteria. Exposure to a thermal radiation level of 10 kW/m^2 could result in a serious injury (at least second-degree burns) if exposed for less than 1 minute, and it was, therefore, assumed that all persons exposed to 10 kW/m^2 would suffer serious injuries. Serious injuries would start to be realized at and above 5 kW/m^2. Exposure to thermal radiation levels in excess of 10 kW/m^2 would likely begin to generate fatalities in less than 1 minute. All persons exposed to thermal radiation within the flame area were assumed to suffer fatalities regardless of exposure duration.

D.2 Flammable Vapor Criteria

A release of flammable material can produce impacts by producing a cloud of the flammable material that, if it encounters an ignition source, either explodes or burns (deflagration) back to the material source. Persons located within the cloud when it explodes or burns could be seriously impacted. Whether the cloud explodes or burns is a function of the material and the level of confinement in the environment in which the cloud is located (e.g., within pipe racks, between buildings). All release scenarios from the Rail Spur Project could contain flammable vapors.

Several biological and structural explosion damage criteria were reviewed, specifically the Center for Chemical Process Safety "Evaluating Process Plant Buildings for External Explosions and Fires" and Center for Chemical Process Safety "Chemical Process Quantitative Risk Analysis." This reference indicates that persons within a structure suffer considerably more damage than persons in the open due to overpressures. This is primarily due to secondary object impacts. Table 5 details the levels of impacts at various overpressure levels to buildings, equipment and persons.

An overpressure level of 0.3 psi would likely result in broken windows and some potential for serious injury. Complete structural damage and serious injury/fatality could occur for wooden buildings and unreinforced masonry as a result of exposure to an overpressure level of 1.0 psi. An overpressure level of 5.0 psi would result in structures being completely destroyed and an estimated 100 percent serious injury/fatality to building occupants.

Deflagration of the vapor cloud would produce impacts to persons located within the flammability limits of the vapor cloud. Persons located within the lower flammability limit would most likely suffer at least serious injuries. As there is some natural variability within the cloud, it is assumed that persons located within the area that would be encompassed by a level of concern equal to one-half the lower flammability limit (a larger area than the lower flammability limit area) would suffer serious injuries.

Table 6 details the criteria selected for the risk analysis for both fatalities and serious injuries. In this table, the zero percent fatality or serious injury level is the level at which fatalities or serious injuries could begin to occur.

E. Risk Analysis

The results of the failure rate and consequence analysis are finally combined to develop risk profile curves (plots of frequency versus the number of fatalities or serious injuries). These risk profile curves are commonly called risk profiles and represent “societal risk.” This is the risk that a person could sustain serious injury or fatality. In calculating the risk profiles, a computer model is used that looks at the probability of the hazard occurring, the associated hazard zones, population distribution, meteorological conditions, and probabilities of ignition. The output of the model is the likelihood of an individual fatality or injury occurring. The risk analysis was only done for the mainline rail since the hazard zones at the SMR did not extend off the refinery property.

Table 5 Overpressure Damage

Overpressure Level	Impact
0.04	Loud noise, sonic boom (143 dBA)
0.15	Glass breakage
0.30	Center for Chemical Process Safety projectile limit, 10% broken window glass, 95% no serious damage
1.0	Wood trailer roof and walls collapse Unreinforced masonry building partial collapse Estimated 10% injury rate
5.0	Wood trailer completely destroyed Unreinforced masonry building completely destroyed Utility poles snapped Estimated 100% injury rate
6.0	Reinforced building major damage/collapse Estimated 40% fatality rate
7.0	Loaded train wagons overturned
12.0	Reinforced building completely destroyed Estimated 100% fatality rate
15.0	Lung hemorrhage, lower range of direct human fatalities

Source: CCPS 1989

Table 6 Fatality and Serious Injury Rates

Event	Fatality	Serious Injury	Reference
Vapor Cloud Fire	30% fatality within the lower flammability limit	100% injury within the lower flammability limit 50% injury within ½ lower flammability limit	Assumes 30% of the population is outdoors and would suffer 100% fatalities within the lower flammability limit. Assumes indoor population would not suffer more than serious injury due to subsequent fire and damage. Outdoor population percentage estimated.
Thermal Radiation Jet Fire or Pool Fire	100% fatality within flame jet area 11% fatalities at 10 kW/m^2	100% injury at 10 kW/m^2 10% injury at 5 kW/m^2	Based on Handbook of Chemical Hazards Analysis Procedures, exposure to 10 kW/m^2 produces second-degree burns in 14 seconds, 10% fatalities at 60 seconds based on Eisenberg Probit Equation (1975). Injury based on time to second-degree burns of less than 1 minute for 10 and 5 kW/m^2.
Boiling Liquid Expanding Vapor Explosion: Radiation Dosages	13% fatalities at 250 kJ/m^2	100% injury at 150 kJ/m^2 10% injury at 40 kJ/m^2	Based on total energy integration over boiling liquid expanding vapor explosion duration using thermal radiation dosage and a probit equation.
Explosion: Over Pressure	10% fatalities at 1 psi	5% injury at 0.3 psi	Based on Center for Chemical Process Safety Process Plant Buildings where occupants of a building experience 10% fatality at 1 psi for

Table 6 Fatality and Serious Injury Rates

Event	Fatality	Serious Injury	Reference
			an unreinforced masonry or wood framed building. Injuries produced at 0.3 psi overpressure assumed to be 5% as per the probability of serious damage.
Toxic	1,000 ppm 10% fatality	100 ppm 10% injury	Estimated based on OSHA exposure limits and animal studies.

Notes: kW/m^2 = kilowatts per square meter; kJ/m^2 = kilojoules per square meter; psi = pounds per square inch; ppm = parts per million

To develop the risk profile, many factors were considered. Each release scenario is evaluated for all wind directions, and for each combination of stability and wind speed. In any given direction of travel, the chances of having the particular wind stability class, the cloud igniting on-site, and the cloud igniting offsite at every downwind location from the release site was evaluated.

The frequency of attaining the maximum downwind distances for flammable vapor dispersion will be reduced if the vapor cloud encounters ignition sources at the point of release or at any point along its travel path.

The approach used by the QRA model follows these basic steps:

1. Dividing the routes into segments based on the associated population densities and urban and rural characteristics;
2. Applying accident rates to each route segment;
3. Applying release probabilities to the accidents;
4. Developing the consequences of releases on the surrounding populations along each segment;
5. Applying accident-related trauma impacts for injuries and fatalities; and
6. Developing risk estimates.

Population Data

For the rail mainline QRA, the rail routes were divided into numerous segments based on population density using the categories listed in Table 7, and shown in Figure 2.

Table 7 Representative Default Population Densities

Designation	Density	Description
Remote	20 people/sq mile	Non-metropolitan area with scattered housing; farms
Rural	100 people/sq mile	Small village or town; recreation areas
Suburban	1,000 people/sq mile	Typical suburbs; mixed use areas
Urban	3,000 people/sq mile	Small city; densely populated suburbs; congested commercial areas
High	10,000+ people/sq mile	Very dense city area

Source: CCPS, 1995.

Figure 2 UPRR Route and Population Densities

Ignition Probabilities

Flammable vapor clouds have the potential to ignite anywhere within their flammable limits. Hence, it is necessary to identify potential ignition sources that a cloud may encounter, and to quantify the likelihood of ignition if the cloud encompasses these sources. When determining ignition probabilities, there are two factors to take into account; source duration and source intensity. Source duration is the fraction of time that the source is present or in operation. Source intensity is the chance of the source actually causing ignition if contacted by a flammable cloud. For example, if a ground level flare is operating, it will almost always ignite a cloud, but it may only operate ten percent of the time. This would generate an overall chance of ignition by the ground level flare of 0.1 (or 10 percent).

In general, when trying to identify ignition sources, the search is primarily for open flames, hot surfaces and electrical sparks, and, to a lesser extent, friction sparks from both continuous and intermittent activities. Extensive listings of potential ignition sources and estimates of ignition probabilities may be found in the literature (CCPS 1989, UK 2004).

A release of a flammable material, for example, could experience instantaneous ignition leading to a fire. It could also disperse downwind, encounter an ignition source and burn or explode, or it could disperse safely.

Construction of Risk Profiles

Risk profiles display the frequency with which public safety impacts/consequences (e.g., fatalities or serious injuries) exceed a given magnitude. They can be used to show property damage (among others), but are generally used for public safety impacts. The risk profiles indicate accident size (based on numbers of persons affected) and display how the potential number of fatalities varies as a function of frequency. Risk profiles are generally plotted on logarithmic scales because they span multiple orders of magnitude.

There are many sources of uncertainty that affect the risk profiles. These uncertainties include:

- Release frequency;
- Release size;
- Population impacts, including distribution and likelihood of fatality/serious injury;
- Behavior of the release (jet mixing versus passive dispersion);
- Accuracy of the hazard models; and
- Ignition sources and probabilities.

The release frequencies and sizes are the most important contributors to overall uncertainty. Changes in failure rates will directly influence the risk profile. A doubling of the event frequencies would double the probability of fatalities. Changes in the relative sizes of leaks and ruptures will influence the risk profile, but to a lesser extent. The assumptions concerning population distribution and ignition probability also influence the risk profiles.

F. References

References for this attachment are provided at the end of the main report in Section 6.

Attachment 3 Oil Spill Consequence Modeling Results

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	1
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	299
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	59.8

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.173	5.5
1	200	0	0.566	0.0788	2.3
2	300	0	0.539	0.0455	1.26
3	400	0	0.52	0.0291	0.782
4	500	0	0.506	0.02	0.523
5	600	0	0.495	0.0145	0.371
6	700	0	0.486	0.0109	0.274
7	800	0	0.478	0.00852	0.21
8	900	0	0.47	0.00681	0.165
9	1000	0	0.464	0.00556	0.133

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	108	3.69E+04	0.608	0.159	5
1	59.2	1.1E+04	0.654	0.296	10
2	48.4	7351	0.671	0.361	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	2
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	259
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	65.8

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.19	6.03
1	200	0	0.566	0.084	2.46
2	300	0	0.539	0.047	1.31
3	400	0	0.52	0.0294	0.789
4	500	0	0.506	0.0199	0.52
5	600	0	0.495	0.0143	0.365
6	700	0	0.486	0.0107	0.268
7	800	0	0.478	0.00828	0.204
8	900	0	0.47	0.00659	0.16
9	1000	0	0.464	0.00537	0.129

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	117	4.28E+04	0.603	0.16	5
1	64.6	1.31E+04	0.647	0.299	10
2	52.9	8776	0.664	0.365	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	3
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	238
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	69.6

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.2	6.36
1	200	0	0.566	0.0869	2.54
2	300	0	0.539	0.0477	1.33
3	400	0	0.52	0.0295	0.791
4	500	0	0.506	0.0198	0.517
5	600	0	0.495	0.0141	0.36
6	700	0	0.486	0.0105	0.264
7	800	0	0.478	0.00812	0.2
8	900	0	0.47	0.00646	0.157
9	1000	0	0.464	0.00525	0.126

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	122	4.65E+04	0.601	0.161	5
1	67.9	1.44E+04	0.643	0.301	10
2	55.7	9741	0.659	0.367	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	4
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	224
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	72.4

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.208	6.6
1	200	0	0.566	0.089	2.6
2	300	0	0.539	0.0481	1.34
3	400	0	0.52	0.0295	0.791
4	500	0	0.506	0.0196	0.513
5	600	0	0.495	0.0139	0.357
6	700	0	0.486	0.0104	0.26
7	800	0	0.478	0.00801	0.197
8	900	0	0.47	0.00636	0.154
9	1000	0	0.464	0.00517	0.124

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	125	4.91E+04	0.599	0.162	5
1	70.4	1.55E+04	0.641	0.302	10
2	57.8	1.04E+04	0.656	0.369	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	5
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	214
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	74.7

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.214	6.8
1	200	0	0.566	0.0905	2.64
2	300	0	0.539	0.0484	1.35
3	400	0	0.52	0.0294	0.79
4	500	0	0.506	0.0195	0.511
5	600	0	0.495	0.0138	0.354
6	700	0	0.486	0.0103	0.258
7	800	0	0.478	0.00792	0.195
8	900	0	0.47	0.00628	0.153
9	1000	0	0.464	0.0051	0.122

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	128	5.12E+04	0.597	0.162	5
1	72.4	1.64E+04	0.638	0.303	10
2	59.5	1.11E+04	0.654	0.37	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	10
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	185
Flame tilt from vertical, (degrees)	25.2
Flame drag, (m)	82.2

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.351	11.1
1	200	0	0.566	0.142	4.15
2	300	0	0.539	0.067	1.86
3	400	0	0.52	0.0366	0.982
4	500	0	0.506	0.0226	0.589
5	600	0	0.495	0.0152	0.388
6	700	0	0.486	0.0108	0.272
7	800	0	0.478	0.00813	0.2
8	900	0	0.47	0.00631	0.153
9	1000	0	0.464	0.00504	0.121

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	179	1.01E+05	0.574	0.169	5
1	109	3.75E+04	0.608	0.319	10
2	90.2	2.55E+04	0.622	0.39	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	20
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1483
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	64.6
Depletion time, (s)	656
Flame height, (m)	160
Flame tilt from vertical, (degrees)	50.2
Flame drag, (m)	90.4

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.589	18.7
1	200	0	0.566	0.227	6.65
2	300	0	0.539	0.0773	2.15
3	400	0	0.52	0.0348	0.934
4	500	0	0.506	0.0194	0.507
5	600	0	0.495	0.0123	0.315
6	700	0	0.486	0.00848	0.213
7	800	0	0.478	0.0062	0.153
8	900	0	0.47	0.00472	0.115
9	1000	0	0.464	0.00372	0.0891

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	224	1.57E+05	0.558	0.173	5
1	164	8.49E+04	0.58	0.334	10
2	143	6.4E+04	0.59	0.411	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

CPU Time = 1594 Seconds

Hydrocarbon Pool Fires Model

Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	1
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	581
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	139

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.405	12.9
1	200	0	0.566	0.201	5.88
2	300	0	0.539	0.129	3.59
3	400	0	0.52	0.0912	2.45
4	500	0	0.506	0.0679	1.77
5	600	0	0.495	0.0523	1.34
6	700	0	0.486	0.0413	1.04
7	800	0	0.478	0.0334	0.823
8	900	0	0.47	0.0274	0.665
9	1000	0	0.464	0.0228	0.547

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	229	1.65E+05	0.557	0.174	5
1	126	4.96E+04	0.598	0.324	10
2	103	3.3E+04	0.612	0.395	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	2
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	502
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	152

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.45	14.3
1	200	0	0.566	0.221	6.46
2	300	0	0.539	0.14	3.89
3	400	0	0.52	0.0973	2.61
4	500	0	0.506	0.0712	1.86
5	600	0	0.495	0.0541	1.38
6	700	0	0.486	0.0422	1.06
7	800	0	0.478	0.0337	0.83
8	900	0	0.47	0.0274	0.666
9	1000	0	0.464	0.0227	0.544

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	247	1.91E+05	0.552	0.175	5
1	137	5.91E+04	0.592	0.327	10
2	112	3.96E+04	0.606	0.399	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	3
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	461
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	161

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.48	15.2
1	200	0	0.566	0.233	6.82
2	300	0	0.539	0.146	4.07
3	400	0	0.52	0.101	2.7
4	500	0	0.506	0.073	1.91
5	600	0	0.495	0.0549	1.4
6	700	0	0.486	0.0425	1.07
7	800	0	0.478	0.0337	0.832
8	900	0	0.47	0.0273	0.664
9	1000	0	0.464	0.0225	0.54

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	257	2.07E+05	0.549	0.176	5
1	144	6.55E+04	0.589	0.329	10
2	119	4.41E+04	0.602	0.402	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	4
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	434
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	168

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.503	15.9
1	200	0	0.566	0.243	7.09
2	300	0	0.539	0.151	4.2
3	400	0	0.52	0.103	2.77
4	500	0	0.506	0.0742	1.94
5	600	0	0.495	0.0554	1.42
6	700	0	0.486	0.0427	1.07
7	800	0	0.478	0.0337	0.831
8	900	0	0.47	0.0272	0.661
9	1000	0	0.464	0.0224	0.537

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	264	2.18E+05	0.547	0.177	5
1	150	7.04E+04	0.586	0.33	10
2	123	4.76E+04	0.6	0.404	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	5
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	414
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	173

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.521	16.5
1	200	0	0.566	0.25	7.31
2	300	0	0.539	0.155	4.31
3	400	0	0.52	0.105	2.82
4	500	0	0.506	0.075	1.96
5	600	0	0.495	0.0557	1.43
6	700	0	0.486	0.0428	1.07
7	800	0	0.478	0.0337	0.831
8	900	0	0.47	0.0271	0.659
9	1000	0	0.464	0.0223	0.534

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	269	2.27E+05	0.546	0.177	5
1	154	7.45E+04	0.584	0.331	10
2	127	5.05E+04	0.598	0.405	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	10
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	358
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	190

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.584	18.5
1	200	0	0.566	0.275	8.05
2	300	0	0.539	0.167	4.64
3	400	0	0.52	0.11	2.96
4	500	0	0.506	0.0773	2.02
5	600	0	0.495	0.0565	1.45
6	700	0	0.486	0.0428	1.07
7	800	0	0.478	0.0334	0.825
8	900	0	0.47	0.0267	0.649
9	1000	0	0.464	0.0218	0.523

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	285	2.55E+05	0.542	0.179	5
1	168	8.85E+04	0.578	0.335	10
2	139	6.08E+04	0.591	0.409	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	20
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	8899
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	159
Depletion time, (s)	712
Flame height, (m)	310
Flame tilt from vertical, (degrees)	42
Flame drag, (m)	210

Observer Distance 100 Is Within Flame. Value is in error

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.874	27.7
1	200	0	0.566	0.582	17
2	300	0	0.539	0.372	10.4
3	400	0	0.52	0.226	6.06
4	500	0	0.506	0.136	3.54
5	600	0	0.495	0.0856	2.19
6	700	0	0.486	0.0576	1.44
7	800	0	0.478	0.041	1.01
8	900	0	0.47	0.0305	0.74
9	1000	0	0.464	0.0235	0.563

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	435	5.94E+05	0.514	0.188	5
1	307	2.95E+05	0.537	0.361	10
2	263	2.16E+05	0.548	0.442	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

CPU Time = 292 Seconds

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	1
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	646
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	159

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.465	14.7
1	200	0	0.566	0.231	6.76
2	300	0	0.539	0.15	4.17
3	400	0	0.52	0.107	2.88
4	500	0	0.506	0.0807	2.11
5	600	0	0.495	0.0629	1.61
6	700	0	0.486	0.0501	1.26
7	800	0	0.478	0.0408	1.01
8	900	0	0.47	0.0337	0.819
9	1000	0	0.464	0.0283	0.677

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	258	2.09E+05	0.549	0.176	5
1	142	6.31E+04	0.59	0.328	10
2	116	4.21E+04	0.604	0.401	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	2
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	558
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	174

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.517	16.4
1	200	0	0.566	0.255	7.44
2	300	0	0.539	0.163	4.54
3	400	0	0.52	0.115	3.09
4	500	0	0.506	0.0854	2.23
5	600	0	0.495	0.0656	1.68
6	700	0	0.486	0.0516	1.3
7	800	0	0.478	0.0415	1.02
8	900	0	0.47	0.034	0.826
9	1000	0	0.464	0.0283	0.677

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	278	2.42E+05	0.544	0.178	5
1	155	7.52E+04	0.584	0.332	10
2	127	5.05E+04	0.598	0.405	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	3
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	513
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	184

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.55	17.5
1	200	0	0.566	0.269	7.87
2	300	0	0.539	0.171	4.77
3	400	0	0.52	0.12	3.21
4	500	0	0.506	0.088	2.3
5	600	0	0.495	0.067	1.71
6	700	0	0.486	0.0523	1.31
7	800	0	0.478	0.0418	1.03
8	900	0	0.47	0.0341	0.827
9	1000	0	0.464	0.0282	0.675

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	289	2.62E+05	0.541	0.179	5
1	163	8.34E+04	0.58	0.334	10
2	134	5.62E+04	0.594	0.407	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	4
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	483
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	192

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.575	18.2
1	200	0	0.566	0.28	8.2
2	300	0	0.539	0.177	4.94
3	400	0	0.52	0.123	3.3
4	500	0	0.506	0.0898	2.35
5	600	0	0.495	0.0678	1.73
6	700	0	0.486	0.0527	1.32
7	800	0	0.478	0.0419	1.03
8	900	0	0.47	0.034	0.826
9	1000	0	0.464	0.0281	0.673

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	297	2.77E+05	0.539	0.18	5
1	169	8.97E+04	0.578	0.335	10
2	139	6.07E+04	0.591	0.409	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	5
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	461
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	198

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.595	18.9
1	200	0	0.566	0.289	8.46
2	300	0	0.539	0.182	5.07
3	400	0	0.52	0.126	3.37
4	500	0	0.506	0.0911	2.38
5	600	0	0.495	0.0685	1.75
6	700	0	0.486	0.053	1.33
7	800	0	0.478	0.042	1.04
8	900	0	0.47	0.034	0.826
9	1000	0	0.464	0.028	0.671

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	303	2.88E+05	0.538	0.18	5
1	174	9.49E+04	0.576	0.336	10
2	143	6.44E+04	0.589	0.411	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	10
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	398
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	218

Observer Distance 100 Is Within Flame. Value is in error

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.659	20.9
1	200	0	0.566	0.32	9.36
2	300	0	0.539	0.198	5.5
3	400	0	0.52	0.134	3.58
4	500	0	0.506	0.0949	2.48
5	600	0	0.495	0.0702	1.79
6	700	0	0.486	0.0536	1.34
7	800	0	0.478	0.042	1.04
8	900	0	0.47	0.0337	0.819
9	1000	0	0.464	0.0276	0.662

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	321	3.23E+05	0.534	0.181	5
1	189	1.12E+05	0.57	0.34	10
2	157	7.76E+04	0.583	0.415	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	20
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	1.18E+04
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	184
Depletion time, (s)	725
Flame height, (m)	344
Flame tilt from vertical, (degrees)	40.5
Flame drag, (m)	240

Observer Distance 100 Is Within Flame. Value is in error

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.932	29.6
1	200	0	0.566	0.636	18.6
2	300	0	0.539	0.428	11.9
3	400	0	0.52	0.279	7.47
4	500	0	0.506	0.177	4.62
5	600	0	0.495	0.114	2.93
6	700	0	0.486	0.0777	1.95
7	800	0	0.478	0.0554	1.37
8	900	0	0.47	0.0412	1
9	1000	0	0.464	0.0317	0.76

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	483	7.33E+05	0.508	0.191	5
1	338	3.59E+05	0.531	0.365	10
2	289	2.62E+05	0.541	0.447	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

CPU Time = 248 Seconds

Fireball Model
==========
Last revised Dec. 89

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Fireball mass, (kg)	2.82E+04
Release temperature, (K)	350
Observer height, (m)	1
Visual range, (m) ..... (Very Clear)	2E+04

Model Outputs:

Initial fireball volume, (m3)	8104
Initial fireball density, (kg/m3)	3.49
Initial fireball diameter, (m)	24.9
Fraction of combustion energy radiated	0.465
Heat of combustion, (kJ/kmol)	-4.46E+09
Maximum fireball diameter, (m)	155
Maximum fireball height, (m)	255
Fireball duration, (s)	12.5

Distances reported are measured from center of fireball

Calculated Incident Flux

#	Xs	Ys	Zs	TAU	THc
0	100	0	1.5	0.544	757
1	200	0	1.5	0.533	360
2	300	0	1.5	0.52	197
3	400	0	1.5	0.509	121
4	500	0	1.5	0.499	80
5	600	0	1.5	0.49	56.3
6	700	0	1.5	0.482	41.5
7	800	0	1.5	0.474	31.8
8	900	0	1.5	0.468	25
9	1000	0	1.5	0.462	20.1

Xs: User specified fenceline distance, (m)
Ys: User specified crosswind distance, (m)
Zs: User specified elevation, (m)
TAU: Atmospheric transmissivity
THc: Calculated radiant heat at user specified fenceline, (kJ/m2)

Calculated Distance and Area

#	Xc	Ac	TAU	THs
0	713	1.59E+06	0.481	40
1	500	7.84E+05	0.499	80
2	443	6.16E+05	0.504	100
3	353	3.91E+05	0.514	150
4	340	3.62E+05	0.515	160
5	258	2.08E+05	0.525	250

Xc: Calculated distance at user specified radiant heat, (m)
Ac: Calculated hazard area at user specified radiant heat, (m^2)
TAU: Atmospheric transmissivity
THs: Radiant heat (kJ/m2)

CPU Time = 3889 Seconds

Hydrocarbon Pool Fires Model

Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	1
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	417
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	90.9

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.266	8.45
1	200	0	0.566	0.128	3.74
2	300	0	0.539	0.0785	2.18
3	400	0	0.52	0.053	1.42
4	500	0	0.506	0.0379	0.99
5	600	0	0.495	0.0282	0.721
6	700	0	0.486	0.0217	0.544
7	800	0	0.478	0.0171	0.423
8	900	0	0.47	0.0139	0.336
9	1000	0	0.464	0.0114	0.273

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	158	7.8E+04	0.583	0.166	5
1	86	2.32E+04	0.625	0.31	10
2	70.3	1.55E+04	0.641	0.378	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	2
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	360
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	100

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.294	9.31
1	200	0	0.566	0.139	4.06
2	300	0	0.539	0.0833	2.32
3	400	0	0.52	0.055	1.48
4	500	0	0.506	0.0386	1.01
5	600	0	0.495	0.0284	0.725
6	700	0	0.486	0.0216	0.541
7	800	0	0.478	0.0169	0.417
8	900	0	0.47	0.0136	0.33
9	1000	0	0.464	0.0111	0.266

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	170	9.03E+04	0.578	0.168	5
1	93.9	2.76E+04	0.619	0.313	10
2	76.8	1.85E+04	0.634	0.382	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	3
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	331
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	106

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.311	9.86
1	200	0	0.566	0.145	4.25
2	300	0	0.539	0.086	2.39
3	400	0	0.52	0.056	1.5
4	500	0	0.506	0.0389	1.02
5	600	0	0.495	0.0283	0.724
6	700	0	0.486	0.0214	0.538
7	800	0	0.478	0.0167	0.413
8	900	0	0.47	0.0134	0.325
9	1000	0	0.464	0.0109	0.262

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	177	9.79E+04	0.575	0.168	5
1	98.8	3.06E+04	0.615	0.315	10
2	81	2.06E+04	0.63	0.384	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	4
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	311
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	110

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.324	10.3
1	200	0	0.566	0.15	4.4
2	300	0	0.539	0.0879	2.44
3	400	0	0.52	0.0567	1.52
4	500	0	0.506	0.039	1.02
5	600	0	0.495	0.0283	0.723
6	700	0	0.486	0.0213	0.535
7	800	0	0.478	0.0166	0.409
8	900	0	0.47	0.0132	0.322
9	1000	0	0.464	0.0108	0.259

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	181	1.03E+05	0.573	0.169	5
1	102	3.29E+04	0.612	0.316	10
2	84.1	2.22E+04	0.627	0.386	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	5
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	297
Flame tilt from vertical, (degrees)	0
Flame drag, (m)	113

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.335	10.6
1	200	0	0.566	0.154	4.51
2	300	0	0.539	0.0893	2.48
3	400	0	0.52	0.0571	1.53
4	500	0	0.506	0.0391	1.02
5	600	0	0.495	0.0282	0.721
6	700	0	0.486	0.0212	0.532
7	800	0	0.478	0.0165	0.406
8	900	0	0.47	0.0131	0.319
9	1000	0	0.464	0.0107	0.256

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	185	1.07E+05	0.571	0.169	5
1	105	3.48E+04	0.611	0.317	10
2	86.6	2.35E+04	0.625	0.388	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	10
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	257
Flame tilt from vertical, (degrees)	12.9
Flame drag, (m)	125

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.444	14.1
1	200	0	0.566	0.206	6.01
2	300	0	0.539	0.114	3.17
3	400	0	0.52	0.069	1.85
4	500	0	0.506	0.0452	1.18
5	600	0	0.495	0.0315	0.805
6	700	0	0.486	0.023	0.577
7	800	0	0.478	0.0175	0.432
8	900	0	0.47	0.0137	0.333
9	1000	0	0.464	0.011	0.265

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	227	1.61E+05	0.558	0.174	5
1	135	5.73E+04	0.593	0.326	10
2	111	3.9E+04	0.607	0.399	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

Hydrocarbon Pool Fires Model
==========
Last revised Dec. 1989

User specified flame temperature is used to estimate emissive power

User Inputs:

Ambient temperature, (K)	305
Relative humidity, (Percent)	50
Wind speed, (m/s)	20
Discharge temperature, (K)	350
Discharge time, (s)	600
Total volume discharged, (m3)	3610
Dike radius, (m)	1E+06
Flame temperature, (K)	977
Average emissive power, (kW/m2)	51.6
Burning rate, (m/s)	0.000229

Visual range (Very Clear) 20000 m
Spread on land

Model Outputs:

Liquid density at normal boiling point, (kg/m3)	615
Mass burning rate, (kg/m2/s)	0.141
Final pool radius, (m)	101
Depletion time, (s)	680
Flame height, (m)	222
Flame tilt from vertical, (degrees)	46.4
Flame drag, (m)	137

Fenceline Incident Flux Estimates

#	Xs	Ys	Itau	Ivf	Iflux
0	100	0	0.614	0.747	23.7
1	200	0	0.566	0.41	12
2	300	0	0.539	0.199	5.52
3	400	0	0.52	0.0953	2.56
4	500	0	0.506	0.0523	1.37
5	600	0	0.495	0.0324	0.828
6	700	0	0.486	0.0219	0.549
7	800	0	0.478	0.0157	0.388
8	900	0	0.47	0.0118	0.287
9	1000	0	0.464	0.00923	0.221

Xs: User Specified Fenceline Distance, (m)
Ys: User Specified Crosswind Distance, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
Iflux: Incident Flux at Fenceline Distance, (kW/m2)

Hazard Distances and Areas At User Specified Flux

#	Ix	Ax	Itau	Ivf	THs
0	312	3.06E+05	0.536	0.181	5
1	225	1.58E+05	0.558	0.347	10
2	194	1.18E+05	0.568	0.426	12.5
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0

Ix: Calculated Distance At User Specified Thermal Flux, (m)
Ax: Calculated Hazard Area At User Specified Thermal Flux, (m)
Itau: Atmospheric Transmissivity
Ivf: Maximum View Factor
THs: User Specified Thermal Criterion, (kW/m2)

CPU Time = 368 Seconds

Attachment 4 Risk Assessment Modeling Results

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000		730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06
2	Benicia	2.6	8.92E-07	1,000		730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06
3	Grizzly Bay	10.6	3.67E-06	100		730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05
4	Fairfield	3.8	1.33E-06	3,000		730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05
5	Elmira	13.7	4.76E-06	100		730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05
6	Dixon	2.1	7.43E-07	1,000		730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06
7	Solano Co Ag	6.6	2.30E-06	100		730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05
8	Davis	3.5	1.23E-06	1,000		730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05
9	Yolo Co Ag	7.0	2.43E-06	100		730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05
10	Sacramento	3.3	1.13E-06	3,000		730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05
11	Sacramento River	0.4	1.46E-07	100		730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06
12	Sacramento	2.5	8.54E-07	10,000		730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06
13	Parkland	1.6	5.63E-07	100		730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06
14	Sacramento	3.2	1.11E-06	3,000		730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05
15	North Highlands	2.6	8.96E-07	1,000		730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06
16	North Highlands	4.4	1.52E-06	3,000		730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05
17	Roseville Yard	1.4	4.72E-07	100		730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06
18	Roseville	1.2	9.10E-07	1,000		730	9.49E-06	2.48E-06	6.35E-09	4.18E-10	3.16E-04	8.26E-05	2.12E-07
19	Roseville	1.4	1.12E-06	3,000		730	1.16E-05	3.04E-06	7.78E-09	5.12E-10	3.88E-04	1.01E-04	2.59E-07
20	Roseville	1.1	8.71E-07	3,000		730	9.08E-06	2.37E-06	6.07E-09	3.99E-10	3.03E-04	7.90E-05	2.02E-07
21	Roseville	2.5	1.94E-06	1,000		730	2.02E-05	5.28E-06	1.35E-08	8.90E-10	6.74E-04	1.76E-04	4.51E-07
22	Roseville	0.5	3.58E-07	100		730	3.74E-06	9.75E-07	2.50E-09	1.64E-10	1.25E-04	3.25E-05	8.33E-08
23	Rocklin	2.5	1.99E-06	1,000		730	2.07E-05	5.42E-06	1.39E-08	9.13E-10	6.91E-04	1.81E-04	4.63E-07
24	Placer Co	8.0	6.31E-06	100		730	6.58E-05	1.72E-05	4.40E-08	2.90E-09	2.19E-03	5.73E-04	1.47E-06
25	Newcastle	0.5	3.57E-07	3,000		730	3.72E-06	9.72E-07	2.49E-09	1.64E-10	1.24E-04	3.24E-05	8.30E-08
26	Placer Co	2.5	1.98E-06	100		730	2.07E-05	5.40E-06	1.38E-08	9.10E-10	6.89E-04	1.80E-04	4.61E-07
27	Auburn	5.3	4.22E-06	1,000		730	4.40E-05	1.15E-05	2.95E-08	1.94E-09	1.47E-03	3.83E-04	9.82E-07
28	Placer Co	13.6	1.08E-05	100		730	1.12E-04	2.93E-05	7.50E-08	4.94E-09	3.74E-03	9.76E-04	2.50E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	730	5.56E-06	1.45E-06	3.72E-09	1.78E-09	1.85E-04	4.84E-05	1.24E-07	5.93E-08
30	Placer Co	57.4	4.54E-05	3,000	730	4.74E-04	1.24E-04	3.17E-07	1.52E-07	1.58E-02	4.12E-03	1.06E-05	5.05E-06
31	Truckee	2.1	1.68E-06	100	730	1.75E-05	4.57E-06	1.17E-08	5.60E-09	5.84E-04	1.52E-04	3.90E-07	1.87E-07
32	Nevada Co	13.9	1.10E-05	1,000	730	1.15E-04	2.99E-05	7.66E-08	3.66E-08	3.82E-03	9.97E-04	2.55E-06	1.22E-06
33	Floriston	0.2	1.83E-07	100	730	1.91E-06	4.99E-07	1.28E-09	6.11E-10	6.37E-05	1.66E-05	4.26E-08	2.04E-08
34	Sierra Co	5.8	4.58E-06	1,000	730	4.78E-05	1.25E-05	3.20E-08	1.53E-08	1.59E-03	4.16E-04	1.07E-06	5.10E-07
Total/Weighted Average		190.9	1.19E-04			1.26E-03	3.73E-04	7.50E-06	2.74E-06	4.21E-02	1.24E-02	2.50E-04	9.12E-05
Return Period			8,391			791	2,680	133,421	365,562	24	80	4,003	10,967

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	3.63E-07	1,000	730	4.43E-06	1.83E-06	1.08E-07	3.81E-08	1.48E-04	6.11E-05	3.58E-06	1.27E-06
19	Roseville	1.4	4.45E-07	3,000	730	5.44E-06	2.25E-06	1.32E-07	4.67E-08	1.81E-04	7.50E-05	4.39E-06	1.56E-06
20	Roseville	2.3	7.20E-07	3,000	730	8.79E-06	3.64E-06	2.13E-07	7.55E-08	2.93E-04	1.21E-04	7.10E-06	2.52E-06
21	Placer Co	1.3	4.04E-07	1,000	730	4.94E-06	2.04E-06	1.20E-07	4.24E-08	1.65E-04	6.81E-05	3.99E-06	1.41E-06
22	Placer Co	0.1	4.68E-08	100	730	5.71E-07	2.36E-07	1.39E-08	4.90E-09	1.90E-05	7.88E-06	4.62E-07	1.63E-07
23	Placer Co	2.9	9.23E-07	1,000	730	1.13E-05	4.66E-06	2.73E-07	9.68E-08	3.76E-04	1.55E-04	9.11E-06	3.23E-06
24	Lincoln	1.2	3.77E-07	100	730	4.60E-06	1.90E-06	1.12E-07	3.95E-08	1.53E-04	6.35E-05	3.72E-06	1.32E-06
25	Lincoln	2.9	9.05E-07	3,000	730	1.11E-05	4.57E-06	2.68E-07	9.49E-08	3.69E-04	1.52E-04	8.93E-06	3.16E-06
26	Sheridan	10.7	3.37E-06	100	730	4.11E-05	1.70E-05	9.97E-07	3.53E-07	1.37E-03	5.67E-04	3.32E-05	1.18E-05
27	Wheatland	0.9	2.94E-07	1,000	730	3.59E-06	1.48E-06	8.70E-08	3.08E-08	1.20E-04	4.95E-05	2.90E-06	1.03E-06
28	Yuba County	9.2	2.92E-06	100	730	3.56E-05	1.47E-05	8.64E-07	3.06E-07	1.19E-03	4.91E-04	2.88E-05	1.02E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	730	1.64E-05	6.80E-06	3.98E-07	1.41E-07	5.48E-04	2.27E-04	1.33E-05	4.70E-06
30	Marysville	1.3	4.20E-07	3,000	730	5.13E-06	2.12E-06	1.24E-07	4.40E-08	1.71E-04	7.07E-05	4.14E-06	1.47E-06
31	Marysville	0.3	9.49E-08	100	730	1.16E-06	4.80E-07	2.81E-08	9.95E-09	3.87E-05	1.60E-05	9.37E-07	3.32E-07
32	Marysville	0.4	1.18E-07	1,000	730	1.44E-06	5.94E-07	3.48E-08	1.23E-08	4.79E-05	1.98E-05	1.16E-06	4.11E-07
33	Yuba County	0.7	2.37E-07	100	730	2.89E-06	1.20E-06	7.01E-08	2.48E-08	9.64E-05	3.99E-05	2.34E-06	8.27E-07
34	Yuba County	0.2	4.85E-08	1,000	730	5.92E-07	2.45E-07	1.43E-08	5.08E-09	1.97E-05	8.16E-06	4.78E-07	1.69E-07
35	Yuba County	0.8	2.39E-07	3,000	730	2.91E-06	1.20E-06	7.06E-08	2.50E-08	9.71E-05	4.02E-05	2.35E-06	8.33E-07
36	Yuba County	0.3	9.41E-08	100	730	1.15E-06	4.75E-07	2.79E-08	9.86E-09	3.83E-05	1.58E-05	9.28E-07	3.29E-07
37	Yuba/Butte County	16.3	5.16E-06	1,000	730	6.30E-05	2.61E-05	1.53E-06	5.41E-07	2.10E-03	8.69E-04	5.09E-05	1.80E-05
38	Palermo	4.2	1.33E-06	3,000	730	1.62E-05	6.70E-06	3.93E-07	1.39E-07	5.40E-04	2.23E-04	1.31E-05	4.63E-06
39	Butte County	1.1	3.35E-07	100	730	4.09E-06	1.69E-06	9.91E-08	3.51E-08	1.36E-04	5.64E-05	3.30E-06	1.17E-06
40	South Oroville	2.4	7.61E-07	3,000	730	9.29E-06	3.84E-06	2.25E-07	7.98E-08	3.10E-04	1.28E-04	7.51E-06	2.66E-06
41	Oroville	0.9	2.68E-07	100	730	3.28E-06	1.36E-06	7.95E-08	2.81E-08	1.09E-04	4.52E-05	2.65E-06	9.38E-07
42	Oroville	1.3	4.20E-07	1,000	730	5.13E-06	2.12E-06	1.24E-07	4.40E-08	1.71E-04	7.07E-05	4.14E-06	1.47E-06
43	Thermolito Div.	0.1	2.97E-08	100	730	3.62E-07	1.50E-07	8.78E-09	3.11E-09	1.21E-05	4.99E-06	2.93E-07	1.04E-07
44	Butte County	1.4	4.52E-07	1,000	730	5.51E-06	2.28E-06	1.34E-07	4.73E-08	1.84E-04	7.60E-05	4.46E-06	1.58E-06
45	Feather Canyon	53.9	1.70E-05	100	730	2.08E-04	8.59E-05	5.04E-06	1.78E-06	6.92E-03	2.86E-03	1.68E-04	5.94E-05
46	Hallsted	1.5	4.77E-07	1,000	730	5.82E-06	2.41E-06	1.41E-07	5.00E-08	1.94E-04	8.03E-05	4.71E-06	1.67E-06
47	Plumas County	12.5	3.95E-06	100	730	4.82E-05	1.99E-05	1.17E-06	4.14E-07	1.61E-03	6.65E-04	3.90E-05	1.38E-05
48	Spanish Creek	0.5	1.52E-07	1,000	730	1.86E-06	7.69E-07	4.51E-08	1.60E-08	6.20E-05	2.56E-05	1.50E-06	5.32E-07
49	Plumas County	1.6	5.15E-07	100	730	6.29E-06	2.60E-06	1.52E-07	5.40E-08	2.10E-04	8.67E-05	5.08E-06	1.80E-06
50	Quincy	3.6	1.15E-06	1,000	730	1.40E-05	5.81E-06	3.40E-07	1.20E-07	4.68E-04	1.94E-04	1.13E-05	4.02E-06
51	Plumas County	4.6	1.44E-06	100	730	1.76E-05	7.29E-06	4.27E-07	1.51E-07	5.87E-04	2.43E-04	1.42E-05	5.04E-06
52	Spring Garden	0.3	9.96E-08	1,000	730	1.22E-06	5.03E-07	2.95E-08	1.04E-08	4.06E-05	1.68E-05	9.83E-07	3.48E-07
53	Plumas County	5.9	1.87E-06	100	730	2.28E-05	9.44E-06	5.53E-07	1.96E-07	7.61E-04	3.15E-04	1.84E-05	6.53E-06
54	Twentymile House	2.3	7.39E-07	1,000	730	9.02E-06	3.73E-06	2.19E-07	7.75E-08	3.01E-04	1.24E-04	7.29E-06	2.58E-06
55	Plumas County	2.4	7.70E-07	100	730	9.41E-06	3.89E-06	2.28E-07	8.08E-08	3.14E-04	1.30E-04	7.60E-06	2.69E-06
56	Blairsden	6.7	2.13E-06	1,000	730	2.60E-05	1.07E-05	6.30E-07	2.23E-07	8.66E-04	3.58E-04	2.10E-05	7.44E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	730	6.90E-06	2.85E-06	1.67E-07	5.93E-08	2.30E-04	9.52E-05	5.58E-06	1.98E-06
58	Plumas Golf	1.1	3.60E-07	1,000	730	4.40E-06	1.82E-06	1.07E-07	3.77E-08	1.47E-04	6.06E-05	3.55E-06	1.26E-06
59	Plumas County	1.8	5.78E-07	100	730	7.06E-06	2.92E-06	1.71E-07	6.06E-08	2.35E-04	9.73E-05	5.70E-06	2.02E-06
60	Portola	3.5	1.11E-06	1,000	730	1.36E-05	5.63E-06	3.30E-07	1.17E-07	4.54E-04	1.88E-04	1.10E-05	3.89E-06
61	Plumas County	14.9	4.69E-06	100	730	5.73E-05	2.37E-05	1.39E-06	4.92E-07	1.91E-03	7.89E-04	4.63E-05	1.64E-05
62	Chilcoot	1.8	5.81E-07	1,000	730	7.10E-06	2.93E-06	1.72E-07	6.09E-08	2.37E-04	9.78E-05	5.73E-06	2.03E-06
63	Lassen County	19.2	6.05E-06	100	730	7.39E-05	3.06E-05	1.79E-06	6.34E-07	2.46E-03	1.02E-03	5.97E-05	2.11E-05
64	Doyle	1.2	3.82E-07	1,000	730	4.67E-06	1.93E-06	1.13E-07	4.01E-08	1.56E-04	6.43E-05	3.77E-06	1.34E-06
65	Lassen County	8.0	2.52E-06	100	730	3.07E-05	1.27E-05	7.45E-07	2.64E-07	1.02E-03	4.24E-04	2.48E-05	8.79E-06
66	Herlong	4.5	1.41E-06	1,000	730	1.72E-05	7.13E-06	4.18E-07	1.48E-07	5.75E-04	2.38E-04	1.39E-05	4.93E-06
67	Lassen County	5.2	1.64E-06	1,000	730	2.01E-05	8.29E-06	4.86E-07	1.72E-07	6.68E-04	2.76E-04	1.62E-05	5.74E-06
Total/Weighted Average		300.8	9.72E-05			1.16E-03	4.82E-04	2.82E-05	1.00E-05	3.88E-02	1.61E-02	9.41E-04	3.33E-04
Return Period			10,284			858	2,075	35,408	99,999	26	62	1,062	3,000

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	3.25E-07	1,000	730	4.00E-06	1.65E-06	9.69E-08	3.43E-08	1.33E-04	5.51E-05	3.23E-06	1.14E-06
19	Roseville	1.4	3.98E-07	3,000	730	4.90E-06	2.03E-06	1.19E-07	4.21E-08	1.63E-04	6.76E-05	3.96E-06	1.40E-06
20	Roseville	2.3	6.44E-07	3,000	730	7.93E-06	3.28E-06	1.92E-07	6.80E-08	2.64E-04	1.09E-04	6.41E-06	2.27E-06
21	Placer Co	1.3	3.62E-07	1,000	730	4.45E-06	1.84E-06	1.08E-07	3.82E-08	1.48E-04	6.14E-05	3.60E-06	1.27E-06
22	Placer Co	0.1	4.19E-08	100	730	5.15E-07	2.13E-07	1.25E-08	4.42E-09	1.72E-05	7.10E-06	4.16E-07	1.47E-07
23	Placer Co	2.9	8.26E-07	1,000	730	1.02E-05	4.20E-06	2.46E-07	8.72E-08	3.39E-04	1.40E-04	8.21E-06	2.91E-06
24	Lincoln	1.2	3.37E-07	100	730	4.15E-06	1.72E-06	1.01E-07	3.56E-08	1.38E-04	5.72E-05	3.35E-06	1.19E-06
25	Lincoln	2.9	8.10E-07	3,000	730	9.97E-06	4.12E-06	2.42E-07	8.56E-08	3.32E-04	1.37E-04	8.05E-06	2.85E-06
26	Sheridan	10.7	3.01E-06	100	730	3.71E-05	1.53E-05	8.99E-07	3.18E-07	1.24E-03	5.11E-04	3.00E-05	1.06E-05
27	Wheatland	0.9	2.63E-07	1,000	730	3.24E-06	1.34E-06	7.85E-08	2.78E-08	1.08E-04	4.46E-05	2.62E-06	9.26E-07
28	Yuba County	9.2	2.61E-06	100	730	3.21E-05	1.33E-05	7.78E-07	2.76E-07	1.07E-03	4.43E-04	2.59E-05	9.19E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	730	1.48E-05	6.13E-06	3.59E-07	1.27E-07	4.94E-04	2.04E-04	1.20E-05	4.24E-06
30	Marysville	1.3	3.76E-07	3,000	730	4.62E-06	1.91E-06	1.12E-07	3.97E-08	1.54E-04	6.37E-05	3.74E-06	1.32E-06
31	Marysville	2.3	6.56E-07	100	730	8.07E-06	3.34E-06	1.96E-07	6.93E-08	2.69E-04	1.11E-04	6.52E-06	2.31E-06
32	Live Oak	0.3	9.29E-08	1,000	730	1.14E-06	4.73E-07	2.77E-08	9.81E-09	3.81E-05	1.58E-05	9.24E-07	3.27E-07
33	Live Oak	6.4	1.81E-06	100	730	2.23E-05	9.23E-06	5.41E-07	1.92E-07	7.44E-04	3.08E-04	1.80E-05	6.39E-06
34	Live Oak	0.4	1.03E-07	1,000	730	1.27E-06	5.27E-07	3.09E-08	1.09E-08	4.24E-05	1.76E-05	1.03E-06	3.64E-07
35	Live Oak	1.0	2.86E-07	3,000	730	3.52E-06	1.46E-06	8.54E-08	3.02E-08	1.17E-04	4.86E-05	2.85E-06	1.01E-06
36	Butte Co	5.2	1.48E-06	100	730	1.82E-05	7.51E-06	4.40E-07	1.56E-07	6.05E-04	2.50E-04	1.47E-05	5.20E-06
37	Gridley	0.5	1.29E-07	1,000	730	1.58E-06	6.54E-07	3.83E-08	1.36E-08	5.27E-05	2.18E-05	1.28E-06	4.53E-07
38	Gridley	0.8	2.34E-07	3,000	730	2.88E-06	1.19E-06	6.98E-08	2.47E-08	9.60E-05	3.97E-05	2.33E-06	8.24E-07
39	Gridley	2.5	7.08E-07	100	730	8.72E-06	3.61E-06	2.11E-07	7.48E-08	2.91E-04	1.20E-04	7.05E-06	2.49E-06
40	Biggs	0.6	1.62E-07	3,000	730	1.99E-06	8.24E-07	4.83E-08	1.71E-08	6.64E-05	2.75E-05	1.61E-06	5.70E-07
41	Butte Co	5.1	1.45E-06	100	730	1.78E-05	7.38E-06	4.33E-07	1.53E-07	5.95E-04	2.46E-04	1.44E-05	5.10E-06
42	Richvale	0.8	2.36E-07	1,000	730	2.91E-06	1.20E-06	7.04E-08	2.49E-08	9.68E-05	4.01E-05	2.35E-06	8.31E-07
43	Nelson	9.3	2.62E-06	100	730	3.23E-05	1.33E-05	7.82E-07	2.77E-07	1.08E-03	4.45E-04	2.61E-05	9.23E-06
44	Durham	2.4	6.89E-07	1,000	730	8.47E-06	3.51E-06	2.05E-07	7.27E-08	2.82E-04	1.17E-04	6.85E-06	2.42E-06
45	Chico	4.3	1.22E-06	100	730	1.50E-05	6.21E-06	3.64E-07	1.29E-07	5.01E-04	2.07E-04	1.21E-05	4.30E-06
46	Chico	4.5	1.27E-06	1,000	730	1.57E-05	6.49E-06	3.80E-07	1.35E-07	5.23E-04	2.16E-04	1.27E-05	4.49E-06
47	Chico	2.8	7.91E-07	100	730	9.74E-06	4.03E-06	2.36E-07	8.36E-08	3.25E-04	1.34E-04	7.87E-06	2.79E-06
48	Nord	0.6	1.65E-07	1,000	730	2.03E-06	8.39E-07	4.92E-08	1.74E-08	6.76E-05	2.80E-05	1.64E-06	5.80E-07
49	Butte Co	11.3	3.20E-06	100	730	3.94E-05	1.63E-05	9.56E-07	3.38E-07	1.31E-03	5.44E-04	3.19E-05	1.13E-05
50	Vina	0.4	1.26E-07	1,000	730	1.55E-06	6.41E-07	3.76E-08	1.33E-08	5.17E-05	2.14E-05	1.25E-06	4.44E-07
51	Copeland	6.3	1.78E-06	100	730	2.19E-05	9.07E-06	5.32E-07	1.88E-07	7.31E-04	3.02E-04	1.77E-05	6.28E-06
52	Los Molinos	0.5	1.47E-07	1,000	730	1.81E-06	7.47E-07	4.38E-08	1.55E-08	6.02E-05	2.49E-05	1.46E-06	5.17E-07
53	Los Molinos	1.0	2.81E-07	100	730	3.45E-06	1.43E-06	8.37E-08	2.96E-08	1.15E-04	4.76E-05	2.79E-06	9.88E-07
54	Tehema	0.3	9.39E-08	1,000	730	1.16E-06	4.78E-07	2.80E-08	9.92E-09	3.85E-05	1.59E-05	9.34E-07	3.31E-07
55	Tehema	2.2	6.32E-07	100	730	7.78E-06	3.22E-06	1.89E-07	6.67E-08	2.59E-04	1.07E-04	6.28E-06	2.22E-06
56	Gerber	2.3	6.54E-07	1,000	730	8.05E-06	3.33E-06	1.95E-07	6.91E-08	2.68E-04	1.11E-04	6.50E-06	2.30E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	730	6.21E-06	2.57E-06	1.51E-07	5.33E-08	2.07E-04	8.57E-05	5.02E-06	1.78E-06
58	Red Bluff	0.8	2.18E-07	1,000	730	2.68E-06	1.11E-06	6.50E-08	2.30E-08	8.94E-05	3.70E-05	2.17E-06	7.67E-07
59	Red Bluff	4.6	1.31E-06	100	730	1.61E-05	6.65E-06	3.90E-07	1.38E-07	5.36E-04	2.22E-04	1.30E-05	4.60E-06
60	Red Bluff	3.3	9.27E-07	1,000	730	1.14E-05	4.72E-06	2.77E-07	9.80E-08	3.80E-04	1.57E-04	9.22E-06	3.27E-06
61	Tehema Co	15.3	4.32E-06	100	730	5.31E-05	2.20E-05	1.29E-06	4.56E-07	1.77E-03	7.33E-04	4.29E-05	1.52E-05
62	Cottonwood	0.6	1.72E-07	1,000	730	2.12E-06	8.76E-07	5.14E-08	1.82E-08	7.06E-05	2.92E-05	1.71E-06	6.06E-07
63	Anderson	5.4	1.51E-06	100	730	1.86E-05	7.70E-06	4.52E-07	1.60E-07	6.21E-04	2.57E-04	1.51E-05	5.33E-06
64	Anderson	3.5	1.00E-06	1,000	730	1.23E-05	5.10E-06	2.99E-07	1.06E-07	4.11E-04	1.70E-04	9.96E-06	3.53E-06
65	Anderson	4.1	1.15E-06	100	730	1.42E-05	5.87E-06	3.44E-07	1.22E-07	4.73E-04	1.96E-04	1.15E-05	4.06E-06
66	Redding	6.0	1.71E-06	1,000	730	2.10E-05	8.69E-06	5.09E-07	1.80E-07	7.00E-04	2.90E-04	1.70E-05	6.01E-06
67	Redding	0.8	2.15E-07	1,000	730	2.65E-06	1.10E-06	6.42E-08	2.27E-08	8.83E-05	3.65E-05	2.14E-06	7.58E-07
68	Redding	1.1	3.19E-07	100	730	3.93E-06	1.62E-06	9.52E-08	3.37E-08	1.31E-04	5.41E-05	3.17E-06	1.12E-06
69	Redding	0.4	1.10E-07	1,000	730	1.36E-06	5.62E-07	3.29E-08	1.17E-08	4.53E-05	1.87E-05	1.10E-06	3.89E-07
70	Redding	2.6	7.29E-07	100	730	8.97E-06	3.71E-06	2.18E-07	7.70E-08	2.99E-04	1.24E-04	7.25E-06	2.57E-06
71	Shasta Co	0.5	1.48E-07	1,000	730	1.82E-06	7.52E-07	4.41E-08	1.56E-08	6.06E-05	2.51E-05	1.47E-06	5.20E-07
72	Shasta Lake	1.7	4.66E-07	100	730	5.74E-06	2.37E-06	1.39E-07	4.92E-08	1.91E-04	7.91E-05	4.64E-06	1.64E-06
73	Shasta Lake	0.8	2.12E-07	1,000	730	2.61E-06	1.08E-06	6.33E-08	2.24E-08	8.70E-05	3.60E-05	2.11E-06	7.47E-07
74	Shasta Co	16.4	4.64E-06	100	730	5.72E-05	2.36E-05	1.39E-06	4.91E-07	1.91E-03	7.88E-04	4.62E-05	1.64E-05
75	Lakeshore	0.6	1.71E-07	1,000	730	2.11E-06	8.73E-07	5.11E-08	1.81E-08	7.03E-05	2.91E-05	1.70E-06	6.04E-07
76	Shasta Co	28.7	8.10E-06	100	730	9.97E-05	4.12E-05	2.42E-06	8.56E-07	3.32E-03	1.37E-03	8.05E-05	2.85E-05
77	Dunsmuir	1.3	3.68E-07	1,000	730	4.53E-06	1.87E-06	1.10E-07	3.89E-08	1.51E-04	6.25E-05	3.66E-06	1.30E-06
78	Siskiyou Co	12.8	3.61E-06	100	730	4.44E-05	1.84E-05	1.08E-06	3.81E-07	1.48E-03	6.12E-04	3.59E-05	1.27E-05
79	Mount Shasta	1.1	3.19E-07	1,000	730	3.93E-06	1.63E-06	9.53E-08	3.37E-08	1.31E-04	5.42E-05	3.18E-06	1.12E-06
80	Siskiyou Co	64.5	1.82E-05	100	730	2.24E-04	9.27E-05	5.44E-06	1.92E-06	7.47E-03	3.09E-03	1.81E-04	6.42E-05
81	Dorris	0.9	2.49E-07	100	730	3.07E-06	1.27E-06	7.43E-08	2.63E-08	1.02E-04	4.23E-05	2.48E-06	8.77E-07
82	Siskiyou Co	3.4	9.64E-07	1,000	730	1.19E-05	4.91E-06	2.88E-07	1.02E-07	3.95E-04	1.64E-04	9.58E-06	3.39E-06
Total/Weighted Average		368.8	1.09E-04			1.31E-03	5.44E-04	3.19E-05	1.13E-05	4.38E-02	1.81E-02	1.06E-03	3.76E-04
Return Period			9,188			761	1,839	31,379	88,621	23	55	941	2,659

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	6.20E-06	3.64E-07	1.29E-07	5.00E-04	2.07E-04	1.21E-05	4.29E-06
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.22E-05	1.30E-06	4.62E-07	1.79E-03	7.42E-04	4.35E-05	1.54E-05
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	3.48E-06	2.04E-07	7.21E-08	2.80E-04	1.16E-04	6.79E-06	2.40E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.07E-05	6.29E-07	2.23E-07	8.65E-04	3.58E-04	2.10E-05	7.43E-06
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	5.73E-06	3.36E-07	1.19E-07	4.62E-04	1.91E-04	1.12E-05	3.97E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.14E-05	6.65E-07	2.36E-07	9.15E-04	3.78E-04	2.22E-05	7.85E-06
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	5.28E-06	3.09E-07	1.10E-07	4.25E-04	1.76E-04	1.03E-05	3.65E-06
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	6.82E-07	4.00E-08	1.42E-08	5.50E-05	2.27E-05	1.33E-06	4.72E-07
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	3.99E-06	2.34E-07	8.29E-08	3.22E-04	1.33E-04	7.80E-06	2.76E-06
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	2.63E-06	1.54E-07	5.46E-08	2.12E-04	8.77E-05	5.14E-06	1.82E-06
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	5.21E-06	3.06E-07	1.08E-07	4.20E-04	1.74E-04	1.02E-05	3.61E-06
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	4.19E-06	2.46E-07	8.70E-08	3.38E-04	1.40E-04	8.19E-06	2.90E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.21E-06	1.29E-07	4.58E-08	1.78E-04	7.36E-05	4.31E-06	1.53E-06
18	Roseville	1.2	1.82E-06	1,000	365	1.11E-05	3.85E-06	1.16E-07	4.75E-08	3.70E-04	1.28E-04	3.87E-06	1.58E-06
19	Roseville	1.4	2.23E-06	3,000	365	1.36E-05	4.73E-06	1.42E-07	5.82E-08	4.53E-04	1.58E-04	4.75E-06	1.94E-06
20	Roseville	1.1	1.74E-06	3,000	365	1.06E-05	3.69E-06	1.11E-07	4.54E-08	3.53E-04	1.23E-04	3.70E-06	1.51E-06
21	Roseville	2.5	3.88E-06	1,000	365	2.36E-05	8.21E-06	2.47E-07	1.01E-07	7.87E-04	2.74E-04	8.25E-06	3.37E-06
22	Roseville	0.5	7.16E-07	100	365	4.36E-06	1.52E-06	4.57E-08	1.87E-08	1.45E-04	5.06E-05	1.52E-06	6.23E-07
23	Rocklin	2.5	3.98E-06	1,000	365	2.42E-05	8.42E-06	2.54E-07	1.04E-07	8.07E-04	2.81E-04	8.46E-06	3.46E-06
24	Placer Co	8.0	1.26E-05	100	365	7.69E-05	2.67E-05	8.06E-07	3.29E-07	2.56E-03	8.91E-04	2.69E-05	1.10E-05
25	Newcastle	0.5	7.14E-07	3,000	365	4.35E-06	1.51E-06	4.56E-08	1.86E-08	1.45E-04	5.04E-05	1.52E-06	6.21E-07
26	Placer Co	2.5	3.97E-06	100	365	2.42E-05	8.40E-06	2.53E-07	1.04E-07	8.05E-04	2.80E-04	8.44E-06	3.45E-06
27	Auburn	5.3	8.45E-06	1,000	365	5.14E-05	1.79E-05	5.39E-07	2.20E-07	1.71E-03	5.96E-04	1.80E-05	7.34E-06
28	Placer Co	13.6	2.15E-05	100	365	1.31E-04	4.56E-05	1.37E-06	5.61E-07	4.37E-03	1.52E-03	4.58E-05	1.87E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	1.07E-06	1,000	365	6.50E-06	2.26E-06	6.81E-08	2.78E-08	2.17E-04	7.53E-05	2.27E-06	9.28E-07
30	Placer Co	57.4	9.09E-05	3,000	365	5.53E-04	1.92E-04	5.80E-06	2.37E-06	1.84E-02	6.41E-03	1.93E-04	7.90E-05
31	Truckee	2.1	3.36E-06	100	365	2.04E-05	7.11E-06	2.14E-07	8.76E-08	6.82E-04	2.37E-04	7.14E-06	2.92E-06
32	Nevada Co	13.9	2.20E-05	1,000	365	1.34E-04	4.65E-05	1.40E-06	5.73E-07	4.46E-03	1.55E-03	4.67E-05	1.91E-05
33	Floriston	0.2	3.67E-07	100	365	2.23E-06	7.76E-07	2.34E-08	9.56E-09	7.44E-05	2.59E-05	7.80E-07	3.19E-07
34	Sierra Co	5.8	9.17E-06	1,000	365	5.58E-05	1.94E-05	5.85E-07	2.39E-07	1.86E-03	6.47E-04	1.95E-05	7.97E-06
Total/Weighted Average		190.9	2.13E-04			1.43E-03	5.16E-04	1.89E-05	7.34E-06	4.76E-02	1.72E-02	6.29E-04	2.45E-04
Return Period			4,686			700	1,939	53,015	136,281	21	58	1,590	4,088

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	1.83E-06	1,000	730	1.39E-05	5.74E-06	3.37E-07	1.19E-07	4.63E-04	1.91E-04	1.12E-05	3.97E-06
2	Benicia	2.6	1.78E-06	1,000	730	1.36E-05	5.61E-06	3.29E-07	1.16E-07	4.52E-04	1.87E-04	1.10E-05	3.88E-06
3	Grizzly Bay	10.6	7.35E-06	100	730	5.59E-05	2.31E-05	1.35E-06	4.80E-07	1.86E-03	7.70E-04	4.51E-05	1.60E-05
4	Fairfield	3.8	2.65E-06	3,000	730	2.02E-05	8.34E-06	4.89E-07	1.73E-07	6.72E-04	2.78E-04	1.63E-05	5.77E-06
5	Elmira	13.7	9.51E-06	100	730	7.23E-05	2.99E-05	1.75E-06	6.21E-07	2.41E-03	9.97E-04	5.85E-05	2.07E-05
6	Dixon	2.1	1.49E-06	1,000	730	1.13E-05	4.67E-06	2.74E-07	9.70E-08	3.77E-04	1.56E-04	9.13E-06	3.23E-06
7	Solano Co Ag	6.6	4.59E-06	100	730	3.49E-05	1.44E-05	8.46E-07	3.00E-07	1.16E-03	4.81E-04	2.82E-05	9.99E-06
8	Davis	3.5	2.45E-06	1,000	730	1.86E-05	7.71E-06	4.52E-07	1.60E-07	6.21E-04	2.57E-04	1.51E-05	5.33E-06
9	Yolo Co Ag	7.0	4.85E-06	100	730	3.69E-05	1.53E-05	8.95E-07	3.17E-07	1.23E-03	5.09E-04	2.98E-05	1.06E-05
10	Sacramento	3.3	2.26E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
11	Sacramento River	0.4	2.92E-07	100	730	2.22E-06	9.18E-07	5.38E-08	1.91E-08	7.40E-05	3.06E-05	1.79E-06	6.35E-07
12	Sacramento	2.5	1.71E-06	10,000	730	1.30E-05	5.37E-06	3.15E-07	1.12E-07	4.33E-04	1.79E-04	1.05E-05	3.72E-06
13	Parkland	1.6	1.13E-06	100	730	8.55E-06	3.54E-06	2.07E-07	7.34E-08	2.85E-04	1.18E-04	6.91E-06	2.45E-06
14	Sacramento	3.2	2.23E-06	3,000	730	1.70E-05	7.01E-06	4.11E-07	1.46E-07	5.65E-04	2.34E-04	1.37E-05	4.85E-06
15	North Highlands	2.6	1.79E-06	1,000	730	1.36E-05	5.64E-06	3.30E-07	1.17E-07	4.54E-04	1.88E-04	1.10E-05	3.90E-06
16	North Highlands	4.4	3.03E-06	3,000	730	2.31E-05	9.55E-06	5.59E-07	1.98E-07	7.69E-04	3.18E-04	1.86E-05	6.60E-06
17	Roseville Yard	1.4	9.44E-07	100	730	7.18E-06	2.97E-06	1.74E-07	6.16E-08	2.39E-04	9.90E-05	5.80E-06	2.05E-06
18	Roseville	1.2	7.26E-07	1,000	365	5.12E-06	2.70E-06	5.06E-07	3.32E-07	1.71E-04	9.01E-05	1.69E-05	1.11E-05
19	Roseville	1.4	8.90E-07	3,000	365	6.28E-06	3.31E-06	6.20E-07	4.07E-07	2.09E-04	1.10E-04	2.07E-05	1.36E-05
20	Roseville	2.3	1.44E-06	3,000	365	1.02E-05	5.36E-06	1.00E-06	6.59E-07	3.38E-04	1.79E-04	3.34E-05	2.20E-05
21	Placer Co	1.3	8.08E-07	1,000	365	5.70E-06	3.01E-06	5.63E-07	3.70E-07	1.90E-04	1.00E-04	1.88E-05	1.23E-05
22	Placer Co	0.1	9.36E-08	100	365	6.60E-07	3.48E-07	6.52E-08	4.28E-08	2.20E-05	1.16E-05	2.17E-06	1.43E-06
23	Placer Co	2.9	1.85E-06	1,000	365	1.30E-05	6.87E-06	1.29E-06	8.45E-07	4.34E-04	2.29E-04	4.29E-05	2.82E-05
24	Lincoln	1.2	7.54E-07	100	365	5.32E-06	2.81E-06	5.25E-07	3.45E-07	1.77E-04	9.36E-05	1.75E-05	1.15E-05
25	Lincoln	2.9	1.81E-06	3,000	365	1.28E-05	6.74E-06	1.26E-06	8.29E-07	4.26E-04	2.25E-04	4.20E-05	2.76E-05
26	Sheridan	10.7	6.73E-06	100	365	4.75E-05	2.51E-05	4.69E-06	3.08E-06	1.58E-03	8.36E-04	1.56E-04	1.03E-04
27	Wheatland	0.9	5.88E-07	1,000	365	4.15E-06	2.19E-06	4.09E-07	2.69E-07	1.38E-04	7.30E-05	1.36E-05	8.97E-06
28	Yuba County	9.2	5.83E-06	100	365	4.11E-05	2.17E-05	4.06E-06	2.67E-06	1.37E-03	7.24E-04	1.35E-04	8.90E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.69E-06	1,000	365	1.90E-05	1.00E-05	1.87E-06	1.23E-06	6.32E-04	3.34E-04	6.25E-05	4.10E-05
30	Marysville	1.3	8.40E-07	3,000	365	5.92E-06	3.13E-06	5.85E-07	3.84E-07	1.97E-04	1.04E-04	1.95E-05	1.28E-05
31	Marysville	0.3	1.90E-07	100	365	1.34E-06	7.07E-07	1.32E-07	8.69E-08	4.46E-05	2.36E-05	4.41E-06	2.90E-06
32	Marysville	0.4	2.35E-07	1,000	365	1.66E-06	8.75E-07	1.64E-07	1.08E-07	5.53E-05	2.92E-05	5.46E-06	3.59E-06
33	Yuba County	0.7	4.74E-07	100	365	3.34E-06	1.76E-06	3.30E-07	2.17E-07	1.11E-04	5.88E-05	1.10E-05	7.22E-06
34	Yuba County	0.2	9.69E-08	1,000	365	6.83E-07	3.61E-07	6.75E-08	4.43E-08	2.28E-05	1.20E-05	2.25E-06	1.48E-06
35	Yuba County	0.8	4.77E-07	3,000	365	3.36E-06	1.78E-06	3.32E-07	2.18E-07	1.12E-04	5.92E-05	1.11E-05	7.28E-06
36	Yuba County	0.3	1.88E-07	100	365	1.33E-06	7.00E-07	1.31E-07	8.61E-08	4.42E-05	2.33E-05	4.37E-06	2.87E-06
37	Yuba/Butte County	16.3	1.03E-05	1,000	365	7.28E-05	3.84E-05	7.19E-06	4.72E-06	2.43E-03	1.28E-03	2.40E-04	1.57E-04
38	Palermo	4.2	2.65E-06	3,000	365	1.87E-05	9.87E-06	1.85E-06	1.21E-06	6.23E-04	3.29E-04	6.16E-05	4.05E-05
39	Butte County	1.1	6.69E-07	100	365	4.72E-06	2.49E-06	4.66E-07	3.06E-07	1.57E-04	8.31E-05	1.55E-05	1.02E-05
40	South Oroville	2.4	1.52E-06	3,000	365	1.07E-05	5.67E-06	1.06E-06	6.96E-07	3.58E-04	1.89E-04	3.53E-05	2.32E-05
41	Oroville	0.9	5.37E-07	100	365	3.79E-06	2.00E-06	3.74E-07	2.46E-07	1.26E-04	6.66E-05	1.25E-05	8.19E-06
42	Oroville	1.3	8.40E-07	1,000	365	5.92E-06	3.13E-06	5.85E-07	3.84E-07	1.97E-04	1.04E-04	1.95E-05	1.28E-05
43	Thermolito Div.	0.1	5.93E-08	100	365	4.18E-07	2.21E-07	4.13E-08	2.71E-08	1.39E-05	7.36E-06	1.38E-06	9.05E-07
44	Butte County	1.4	9.03E-07	1,000	365	6.37E-06	3.36E-06	6.29E-07	4.13E-07	2.12E-04	1.12E-04	2.10E-05	1.38E-05
45	Feather Canyon	53.9	3.40E-05	100	365	2.40E-04	1.27E-04	2.37E-05	1.56E-05	8.00E-03	4.22E-03	7.90E-04	5.19E-04
46	Hallsted	1.5	9.54E-07	1,000	365	6.72E-06	3.55E-06	6.64E-07	4.36E-07	2.24E-04	1.18E-04	2.21E-05	1.45E-05
47	Plumas County	12.5	7.89E-06	100	365	5.57E-05	2.94E-05	5.50E-06	3.61E-06	1.86E-03	9.80E-04	1.83E-04	1.20E-04
48	Spanish Creek	0.5	3.04E-07	1,000	365	2.15E-06	1.13E-06	2.12E-07	1.39E-07	7.16E-05	3.78E-05	7.07E-06	4.64E-06
49	Plumas County	1.6	1.03E-06	100	365	7.26E-06	3.83E-06	7.17E-07	4.71E-07	2.42E-04	1.28E-04	2.39E-05	1.57E-05
50	Quincy	3.6	2.30E-06	1,000	365	1.62E-05	8.56E-06	1.60E-06	1.05E-06	5.40E-04	2.85E-04	5.34E-05	3.51E-05
51	Plumas County	4.6	2.89E-06	100	365	2.03E-05	1.07E-05	2.01E-06	1.32E-06	6.78E-04	3.58E-04	6.70E-05	4.40E-05
52	Spring Garden	0.3	1.99E-07	1,000	365	1.40E-06	7.42E-07	1.39E-07	9.12E-08	4.68E-05	2.47E-05	4.63E-06	3.04E-06
53	Plumas County	5.9	3.74E-06	100	365	2.64E-05	1.39E-05	2.60E-06	1.71E-06	8.79E-04	4.64E-04	8.68E-05	5.70E-05
54	Twentymile House	2.3	1.48E-06	1,000	365	1.04E-05	5.50E-06	1.03E-06	6.76E-07	3.47E-04	1.83E-04	3.43E-05	2.25E-05
55	Plumas County	2.4	1.54E-06	100	365	1.09E-05	5.74E-06	1.07E-06	7.05E-07	3.62E-04	1.91E-04	3.58E-05	2.35E-05
56	Blairsden	6.7	4.26E-06	1,000	365	3.00E-05	1.58E-05	2.96E-06	1.95E-06	1.00E-03	5.28E-04	9.88E-05	6.49E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	1.13E-06	100	365	7.97E-06	4.21E-06	7.87E-07	5.17E-07	2.66E-04	1.40E-04	2.62E-05	1.72E-05
58	Plumas Golf	1.1	7.20E-07	1,000	365	5.08E-06	2.68E-06	5.01E-07	3.29E-07	1.69E-04	8.93E-05	1.67E-05	1.10E-05
59	Plumas County	1.8	1.16E-06	100	365	8.15E-06	4.30E-06	8.05E-07	5.29E-07	2.72E-04	1.43E-04	2.68E-05	1.76E-05
60	Portola	3.5	2.23E-06	1,000	365	1.57E-05	8.30E-06	1.55E-06	1.02E-06	5.24E-04	2.77E-04	5.18E-05	3.40E-05
61	Plumas County	14.9	9.38E-06	100	365	6.61E-05	3.49E-05	6.53E-06	4.29E-06	2.20E-03	1.16E-03	2.18E-04	1.43E-04
62	Chilcoot	1.8	1.16E-06	1,000	365	8.19E-06	4.33E-06	8.09E-07	5.32E-07	2.73E-04	1.44E-04	2.70E-05	1.77E-05
63	Lassen County	19.2	1.21E-05	100	365	8.53E-05	4.50E-05	8.43E-06	5.54E-06	2.84E-03	1.50E-03	2.81E-04	1.85E-04
64	Doyle	1.2	7.64E-07	1,000	365	5.39E-06	2.84E-06	5.32E-07	3.50E-07	1.80E-04	9.48E-05	1.77E-05	1.17E-05
65	Lassen County	8.0	5.03E-06	100	365	3.55E-05	1.87E-05	3.51E-06	2.30E-06	1.18E-03	6.25E-04	1.17E-04	7.68E-05
66	Herlong	4.5	2.82E-06	1,000	365	1.99E-05	1.05E-05	1.97E-06	1.29E-06	6.63E-04	3.50E-04	6.55E-05	4.31E-05
67	Lassen County	5.2	3.28E-06	1,000	365	2.32E-05	1.22E-05	2.29E-06	1.50E-06	7.72E-04	4.08E-04	7.62E-05	5.01E-05
Total/Weighted Average		190.9	1.94E-04			1.40E-03	6.95E-04	1.10E-04	6.94E-05	4.66E-02	2.32E-02	3.66E-03	2.31E-03
Return Period			5,142			715	1,438	9,099	14,405	21	43	273	432

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	1.03E-05	5.45E-06	1.02E-06	6.70E-07	3.44E-04	1.82E-04	3.40E-05	2.23E-05
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	5.33E-06	9.97E-07	6.55E-07	3.36E-04	1.78E-04	3.32E-05	2.18E-05
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	2.19E-05	4.10E-06	2.70E-06	1.38E-03	7.31E-04	1.37E-04	8.99E-05
4	Fairfield	3.8	1.33E-06	3,000	730	1.50E-05	7.92E-06	1.48E-06	9.73E-07	5.00E-04	2.64E-04	4.94E-05	3.24E-05
5	Elmira	13.7	4.76E-06	100	730	5.38E-05	2.84E-05	5.31E-06	3.49E-06	1.79E-03	9.47E-04	1.77E-04	1.16E-04
6	Dixon	2.1	7.43E-07	1,000	730	8.40E-06	4.44E-06	8.30E-07	5.45E-07	2.80E-04	1.48E-04	2.77E-05	1.82E-05
7	Solano Co Ag	6.6	2.30E-06	100	730	2.60E-05	1.37E-05	2.56E-06	1.68E-06	8.65E-04	4.57E-04	8.54E-05	5.61E-05
8	Davis	3.5	1.23E-06	1,000	730	1.39E-05	7.32E-06	1.37E-06	8.99E-07	4.62E-04	2.44E-04	4.56E-05	3.00E-05
9	Yolo Co Ag	7.0	2.43E-06	100	730	2.74E-05	1.45E-05	2.71E-06	1.78E-06	9.15E-04	4.83E-04	9.04E-05	5.94E-05
10	Sacramento	3.3	1.13E-06	3,000	730	1.28E-05	6.74E-06	1.26E-06	8.28E-07	4.25E-04	2.25E-04	4.20E-05	2.76E-05
11	Sacramento River	0.4	1.46E-07	100	730	1.65E-06	8.71E-07	1.63E-07	1.07E-07	5.50E-05	2.90E-05	5.43E-06	3.57E-06
12	Sacramento	2.5	8.54E-07	10,000	730	9.66E-06	5.10E-06	9.54E-07	6.27E-07	3.22E-04	1.70E-04	3.18E-05	2.09E-05
13	Parkland	1.6	5.63E-07	100	730	6.36E-06	3.36E-06	6.28E-07	4.13E-07	2.12E-04	1.12E-04	2.09E-05	1.38E-05
14	Sacramento	3.2	1.11E-06	3,000	730	1.26E-05	6.65E-06	1.24E-06	8.18E-07	4.20E-04	2.22E-04	4.15E-05	2.73E-05
15	North Highlands	2.6	8.96E-07	1,000	730	1.01E-05	5.35E-06	1.00E-06	6.57E-07	3.38E-04	1.78E-04	3.33E-05	2.19E-05
16	North Highlands	4.4	1.52E-06	3,000	730	1.72E-05	9.06E-06	1.69E-06	1.11E-06	5.72E-04	3.02E-04	5.65E-05	3.71E-05
17	Roseville Yard	1.4	4.72E-07	100	730	5.34E-06	2.82E-06	5.27E-07	3.47E-07	1.78E-04	9.40E-05	1.76E-05	1.16E-05
18	Roseville	1.2	6.50E-07	1,000	365	4.61E-06	2.43E-06	4.55E-07	2.99E-07	1.54E-04	8.11E-05	1.52E-05	9.97E-06
19	Roseville	1.4	7.97E-07	3,000	365	5.65E-06	2.98E-06	5.58E-07	3.67E-07	1.88E-04	9.95E-05	1.86E-05	1.22E-05
20	Roseville	2.3	1.29E-06	3,000	365	9.14E-06	4.83E-06	9.03E-07	5.93E-07	3.05E-04	1.61E-04	3.01E-05	1.98E-05
21	Placer Co	1.3	7.23E-07	1,000	365	5.13E-06	2.71E-06	5.07E-07	3.33E-07	1.71E-04	9.03E-05	1.69E-05	1.11E-05
22	Placer Co	0.1	8.37E-08	100	365	5.94E-07	3.14E-07	5.87E-08	3.86E-08	1.98E-05	1.05E-05	1.96E-06	1.29E-06
23	Placer Co	2.9	1.65E-06	1,000	365	1.17E-05	6.19E-06	1.16E-06	7.61E-07	3.91E-04	2.06E-04	3.86E-05	2.54E-05
24	Lincoln	1.2	6.75E-07	100	365	4.79E-06	2.53E-06	4.73E-07	3.11E-07	1.60E-04	8.43E-05	1.58E-05	1.04E-05
25	Lincoln	2.9	1.62E-06	3,000	365	1.15E-05	6.07E-06	1.14E-06	7.46E-07	3.83E-04	2.02E-04	3.78E-05	2.49E-05
26	Sheridan	10.7	6.02E-06	100	365	4.27E-05	2.26E-05	4.22E-06	2.77E-06	1.42E-03	7.52E-04	1.41E-04	9.25E-05
27	Wheatland	0.9	5.26E-07	1,000	365	3.73E-06	1.97E-06	3.69E-07	2.42E-07	1.24E-04	6.57E-05	1.23E-05	8.07E-06
28	Yuba County	9.2	5.22E-06	100	365	3.70E-05	1.96E-05	3.66E-06	2.40E-06	1.23E-03	6.52E-04	1.22E-04	8.01E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.41E-06	1,000	365	1.71E-05	9.02E-06	1.69E-06	1.11E-06	5.69E-04	3.01E-04	5.62E-05	3.70E-05
30	Marysville	1.3	7.51E-07	3,000	365	5.33E-06	2.82E-06	5.27E-07	3.46E-07	1.78E-04	9.39E-05	1.76E-05	1.15E-05
31	Marysville	2.3	1.31E-06	100	365	9.31E-06	4.91E-06	9.19E-07	6.04E-07	3.10E-04	1.64E-04	3.06E-05	2.01E-05
32	Live Oak	0.3	1.86E-07	1,000	365	1.32E-06	6.96E-07	1.30E-07	8.55E-08	4.39E-05	2.32E-05	4.34E-06	2.85E-06
33	Live Oak	6.4	3.63E-06	100	365	2.57E-05	1.36E-05	2.54E-06	1.67E-06	8.58E-04	4.53E-04	8.48E-05	5.57E-05
34	Live Oak	0.4	2.07E-07	1,000	365	1.47E-06	7.75E-07	1.45E-07	9.53E-08	4.89E-05	2.58E-05	4.83E-06	3.18E-06
35	Live Oak	1.0	5.73E-07	3,000	365	4.06E-06	2.15E-06	4.01E-07	2.64E-07	1.35E-04	7.15E-05	1.34E-05	8.79E-06
36	Butte Co	5.2	2.95E-06	100	365	2.09E-05	1.11E-05	2.07E-06	1.36E-06	6.98E-04	3.69E-04	6.89E-05	4.53E-05
37	Gridley	0.5	2.57E-07	1,000	365	1.82E-06	9.63E-07	1.80E-07	1.18E-07	6.08E-05	3.21E-05	6.01E-06	3.95E-06
38	Gridley	0.8	4.68E-07	3,000	365	3.32E-06	1.75E-06	3.28E-07	2.16E-07	1.11E-04	5.85E-05	1.09E-05	7.19E-06
39	Gridley	2.5	1.42E-06	100	365	1.01E-05	5.31E-06	9.93E-07	6.53E-07	3.35E-04	1.77E-04	3.31E-05	2.18E-05
40	Biggs	0.6	3.24E-07	3,000	365	2.30E-06	1.21E-06	2.27E-07	1.49E-07	7.65E-05	4.04E-05	7.56E-06	4.97E-06
41	Butte Co	5.1	2.90E-06	100	365	2.06E-05	1.09E-05	2.03E-06	1.34E-06	6.86E-04	3.62E-04	6.77E-05	4.45E-05
42	Richvale	0.8	4.72E-07	1,000	365	3.35E-06	1.77E-06	3.31E-07	2.17E-07	1.12E-04	5.90E-05	1.10E-05	7.25E-06
43	Nelson	9.3	5.24E-06	100	365	3.72E-05	1.96E-05	3.67E-06	2.41E-06	1.24E-03	6.55E-04	1.22E-04	8.05E-05
44	Durham	2.4	1.38E-06	1,000	365	9.77E-06	5.16E-06	9.65E-07	6.34E-07	3.26E-04	1.72E-04	3.22E-05	2.11E-05
45	Chico	4.3	2.44E-06	100	365	1.73E-05	9.15E-06	1.71E-06	1.12E-06	5.78E-04	3.05E-04	5.70E-05	3.75E-05
46	Chico	4.5	2.55E-06	1,000	365	1.81E-05	9.55E-06	1.79E-06	1.17E-06	6.03E-04	3.18E-04	5.96E-05	3.91E-05
47	Chico	2.8	1.58E-06	100	365	1.12E-05	5.93E-06	1.11E-06	7.29E-07	3.74E-04	1.98E-04	3.70E-05	2.43E-05
48	Nord	0.6	3.29E-07	1,000	365	2.34E-06	1.23E-06	2.31E-07	1.52E-07	7.79E-05	4.12E-05	7.70E-06	5.06E-06
49	Butte Co	11.3	6.41E-06	100	365	4.55E-05	2.40E-05	4.49E-06	2.95E-06	1.52E-03	8.00E-04	1.50E-04	9.84E-05
50	Vina	0.4	2.52E-07	1,000	365	1.79E-06	9.44E-07	1.77E-07	1.16E-07	5.96E-05	3.15E-05	5.89E-06	3.87E-06
51	Copeland	6.3	3.56E-06	100	365	2.53E-05	1.34E-05	2.50E-06	1.64E-06	8.43E-04	4.45E-04	8.33E-05	5.47E-05
52	Los Molinos	0.5	2.94E-07	1,000	365	2.08E-06	1.10E-06	2.06E-07	1.35E-07	6.94E-05	3.67E-05	6.86E-06	4.51E-06
53	Los Molinos	1.0	5.61E-07	100	365	3.98E-06	2.10E-06	3.93E-07	2.58E-07	1.33E-04	7.01E-05	1.31E-05	8.61E-06
54	Tehema	0.3	1.88E-07	1,000	365	1.33E-06	7.04E-07	1.32E-07	8.65E-08	4.44E-05	2.35E-05	4.39E-06	2.88E-06
55	Tehema	2.2	1.26E-06	100	365	8.97E-06	4.73E-06	8.86E-07	5.82E-07	2.99E-04	1.58E-04	2.95E-05	1.94E-05
56	Gerber	2.3	1.31E-06	1,000	365	9.28E-06	4.90E-06	9.17E-07	6.02E-07	3.09E-04	1.63E-04	3.06E-05	2.01E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Proposed Project – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	1.01E-06	100	365	7.17E-06	3.78E-06	7.08E-07	4.65E-07	2.39E-04	1.26E-04	2.36E-05	1.55E-05
58	Red Bluff	0.8	4.36E-07	1,000	365	3.09E-06	1.63E-06	3.05E-07	2.01E-07	1.03E-04	5.44E-05	1.02E-05	6.69E-06
59	Red Bluff	4.6	2.61E-06	100	365	1.86E-05	9.80E-06	1.83E-06	1.20E-06	6.18E-04	3.27E-04	6.11E-05	4.01E-05
60	Red Bluff	3.3	1.85E-06	1,000	365	1.32E-05	6.95E-06	1.30E-06	8.54E-07	4.39E-04	2.32E-04	4.33E-05	2.85E-05
61	Tehema Co	15.3	8.63E-06	100	365	6.13E-05	3.24E-05	6.05E-06	3.98E-06	2.04E-03	1.08E-03	2.02E-04	1.33E-04
62	Cottonwood	0.6	3.44E-07	1,000	365	2.44E-06	1.29E-06	2.41E-07	1.59E-07	8.15E-05	4.30E-05	8.05E-06	5.29E-06
63	Anderson	5.4	3.03E-06	100	365	2.15E-05	1.13E-05	2.12E-06	1.39E-06	7.16E-04	3.78E-04	7.07E-05	4.65E-05
64	Anderson	3.5	2.00E-06	1,000	365	1.42E-05	7.51E-06	1.40E-06	9.23E-07	4.74E-04	2.50E-04	4.68E-05	3.08E-05
65	Anderson	4.1	2.31E-06	100	365	1.64E-05	8.65E-06	1.62E-06	1.06E-06	5.46E-04	2.88E-04	5.39E-05	3.54E-05
66	Redding	6.0	3.41E-06	1,000	365	2.42E-05	1.28E-05	2.39E-06	1.57E-06	8.07E-04	4.26E-04	7.97E-05	5.24E-05
67	Redding	0.8	4.30E-07	1,000	365	3.06E-06	1.61E-06	3.02E-07	1.98E-07	1.02E-04	5.38E-05	1.01E-05	6.61E-06
68	Redding	1.1	6.38E-07	100	365	4.53E-06	2.39E-06	4.47E-07	2.94E-07	1.51E-04	7.97E-05	1.49E-05	9.80E-06
69	Redding	0.4	2.21E-07	1,000	365	1.57E-06	8.27E-07	1.55E-07	1.02E-07	5.22E-05	2.76E-05	5.16E-06	3.39E-06
70	Redding	2.6	1.46E-06	100	365	1.03E-05	5.46E-06	1.02E-06	6.71E-07	3.45E-04	1.82E-04	3.41E-05	2.24E-05
71	Shasta Co	0.5	2.95E-07	1,000	365	2.10E-06	1.11E-06	2.07E-07	1.36E-07	6.99E-05	3.69E-05	6.90E-06	4.53E-06
72	Shasta Lake	1.7	9.32E-07	100	365	6.62E-06	3.49E-06	6.53E-07	4.29E-07	2.21E-04	1.16E-04	2.18E-05	1.43E-05
73	Shasta Lake	0.8	4.24E-07	1,000	365	3.01E-06	1.59E-06	2.97E-07	1.95E-07	1.00E-04	5.30E-05	9.91E-06	6.51E-06
74	Shasta Co	16.4	9.29E-06	100	365	6.59E-05	3.48E-05	6.51E-06	4.28E-06	2.20E-03	1.16E-03	2.17E-04	1.43E-04
75	Lakeshore	0.6	3.43E-07	1,000	365	2.43E-06	1.28E-06	2.40E-07	1.58E-07	8.11E-05	4.28E-05	8.01E-06	5.26E-06
76	Shasta Co	28.7	1.72E-05	100	365	1.22E-04	6.43E-05	1.20E-05	7.90E-06	4.06E-03	2.14E-03	4.01E-04	2.63E-04
77	Dunsmuir	1.3	7.36E-07	1,000	365	5.23E-06	2.76E-06	5.16E-07	3.39E-07	1.74E-04	9.20E-05	1.72E-05	1.13E-05
78	Siskiyou Co	12.8	7.21E-06	100	365	5.12E-05	2.70E-05	5.06E-06	3.32E-06	1.71E-03	9.01E-04	1.69E-04	1.11E-04
79	Mount Shasta	1.1	6.39E-07	1,000	365	4.53E-06	2.39E-06	4.48E-07	2.94E-07	1.51E-04	7.98E-05	1.49E-05	9.81E-06
80	Siskiyou Co	64.5	3.93E-05	100	365	2.79E-04	1.47E-04	2.75E-05	1.81E-05	9.29E-03	4.90E-03	9.17E-04	6.03E-04
81	Dorris	0.9	4.98E-07	100	365	3.54E-06	1.87E-06	3.49E-07	2.30E-07	1.18E-04	6.22E-05	1.16E-05	7.65E-06
82	Siskiyou Co	3.4	1.93E-06	1,000	365	1.37E-05	7.22E-06	1.35E-06	8.88E-07	4.56E-04	2.41E-04	4.50E-05	2.96E-05
Total/Weighted Average		190.9	1.97E-04			1.50E-03	7.92E-04	1.48E-04	9.73E-05	5.00E-02	2.64E-02	4.94E-03	3.24E-03
Return Period			5,089			667	1,263	6,751	10,275	20	38	203	308

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	5.31E-06	1.18E-06	3.39E-09	2.12E-10	1.77E-04	3.94E-05	1.13E-07	7.08E-09
2	Benicia	2.6	8.92E-07	1,000	730	5.19E-06	1.15E-06	3.31E-09	2.08E-10	1.73E-04	3.85E-05	1.10E-07	6.92E-09
3	Grizzly Bay	10.6	3.67E-06	100	730	2.14E-05	4.75E-06	1.36E-08	8.54E-10	7.12E-04	1.58E-04	4.54E-07	2.85E-08
4	Fairfield	3.8	1.33E-06	3,000	730	7.71E-06	1.72E-06	4.92E-09	3.08E-10	2.57E-04	5.72E-05	1.64E-07	1.03E-08
5	Elmira	13.7	4.76E-06	100	730	2.77E-05	6.15E-06	1.76E-08	1.11E-09	9.22E-04	2.05E-04	5.88E-07	3.69E-08
6	Dixon	2.1	7.43E-07	1,000	730	4.32E-06	9.61E-07	2.76E-09	1.73E-10	1.44E-04	3.20E-05	9.19E-08	5.76E-09
7	Solano Co Ag	6.6	2.30E-06	100	730	1.33E-05	2.97E-06	8.51E-09	5.34E-10	4.45E-04	9.90E-05	2.84E-07	1.78E-08
8	Davis	3.5	1.23E-06	1,000	730	7.13E-06	1.59E-06	4.55E-09	2.85E-10	2.38E-04	5.29E-05	1.52E-07	9.50E-09
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.41E-05	3.14E-06	9.00E-09	5.64E-10	4.70E-04	1.05E-04	3.00E-07	1.88E-08
10	Sacramento	3.3	1.13E-06	3,000	730	6.56E-06	1.46E-06	4.19E-09	2.62E-10	2.19E-04	4.87E-05	1.40E-07	8.75E-09
11	Sacramento River	0.4	1.46E-07	100	730	8.48E-07	1.89E-07	5.41E-10	3.39E-11	2.83E-05	6.29E-06	1.80E-08	1.13E-09
12	Sacramento	2.5	8.54E-07	10,000	730	4.97E-06	1.11E-06	3.17E-09	1.99E-10	1.66E-04	3.68E-05	1.06E-07	6.62E-09
13	Parkland	1.6	5.63E-07	100	730	3.27E-06	7.28E-07	2.09E-09	1.31E-10	1.09E-04	2.43E-05	6.95E-08	4.36E-09
14	Sacramento	3.2	1.11E-06	3,000	730	6.48E-06	1.44E-06	4.13E-09	2.59E-10	2.16E-04	4.81E-05	1.38E-07	8.64E-09
15	North Highlands	2.6	8.96E-07	1,000	730	5.21E-06	1.16E-06	3.32E-09	2.08E-10	1.74E-04	3.86E-05	1.11E-07	6.94E-09
16	North Highlands	4.4	1.52E-06	3,000	730	8.82E-06	1.96E-06	5.63E-09	3.53E-10	2.94E-04	6.54E-05	1.88E-07	1.18E-08
17	Roseville Yard	1.4	4.72E-07	100	730	2.75E-06	6.11E-07	1.75E-09	1.10E-10	9.15E-05	2.04E-05	5.84E-08	3.66E-09
18	Roseville	1.2	9.10E-07	1,000	730	4.55E-06	4.89E-07	4.55E-12	0.00E+00	1.52E-04	1.63E-05	1.52E-10	0.00E+00
19	Roseville	1.4	1.12E-06	3,000	730	5.58E-06	5.99E-07	5.58E-12	0.00E+00	1.86E-04	2.00E-05	1.86E-10	0.00E+00
20	Roseville	1.1	8.71E-07	3,000	730	4.35E-06	4.67E-07	4.35E-12	0.00E+00	1.45E-04	1.56E-05	1.45E-10	0.00E+00
21	Roseville	2.5	1.94E-06	1,000	730	9.69E-06	1.04E-06	9.69E-12	0.00E+00	3.23E-04	3.47E-05	3.23E-10	0.00E+00
22	Roseville	0.5	3.58E-07	100	730	1.79E-06	1.92E-07	1.79E-12	0.00E+00	5.97E-05	6.41E-06	5.97E-11	0.00E+00
23	Rocklin	2.5	1.99E-06	1,000	730	9.94E-06	1.07E-06	9.94E-12	0.00E+00	3.31E-04	3.56E-05	3.31E-10	0.00E+00
24	Placer Co	8.0	6.31E-06	100	730	3.15E-05	3.39E-06	3.15E-11	0.00E+00	1.05E-03	1.13E-04	1.05E-09	0.00E+00
25	Newcastle	0.5	3.57E-07	3,000	730	1.78E-06	1.92E-07	1.78E-12	0.00E+00	5.95E-05	6.39E-06	5.95E-11	0.00E+00
26	Placer Co	2.5	1.98E-06	100	730	9.91E-06	1.06E-06	9.91E-12	0.00E+00	3.30E-04	3.55E-05	3.30E-10	0.00E+00
27	Auburn	5.3	4.22E-06	1,000	730	2.11E-05	2.27E-06	2.11E-11	0.00E+00	7.03E-04	7.55E-05	7.03E-10	0.00E+00
28	Placer Co	13.6	1.08E-05	100	730	5.37E-05	5.77E-06	5.37E-11	0.00E+00	1.79E-03	1.92E-04	1.79E-09	0.00E+00

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	730	2.67E-06	2.86E-07	2.67E-12	0.00E+00	8.88E-05	9.55E-06	8.88E-11	0.00E+00
30	Placer Co	57.4	4.54E-05	3,000	730	2.27E-04	2.44E-05	2.27E-10	0.00E+00	7.57E-03	8.13E-04	7.57E-09	0.00E+00
31	Truckee	2.1	1.68E-06	100	730	8.39E-06	9.01E-07	8.39E-12	0.00E+00	2.80E-04	3.00E-05	2.80E-10	0.00E+00
32	Nevada Co	13.9	1.10E-05	1,000	730	5.49E-05	5.89E-06	5.49E-11	0.00E+00	1.83E-03	1.96E-04	1.83E-09	0.00E+00
33	Floriston	0.2	1.83E-07	100	730	9.15E-07	9.83E-08	9.15E-13	0.00E+00	3.05E-05	3.28E-06	3.05E-11	0.00E+00
34	Sierra Co	5.8	4.58E-06	1,000	730	2.29E-05	2.46E-06	2.29E-11	0.00E+00	7.63E-04	8.20E-05	7.63E-10	0.00E+00
Total/Weighted Average		190.9	1.19E-04			6.16E-04	8.28E-05	9.30E-08	5.80E-09	2.05E-02	2.76E-03	3.10E-06	1.93E-07
Return Period			8,391			1,624	12,071	10,754,239	172,402,817	49	362	322,627	5,172,085

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	5.31E-06	1.18E-06	3.39E-09	2.12E-10	1.77E-04	3.94E-05	1.13E-07	7.08E-09
2	Benicia	2.6	8.92E-07	1,000	730	5.19E-06	1.15E-06	3.31E-09	2.08E-10	1.73E-04	3.85E-05	1.10E-07	6.92E-09
3	Grizzly Bay	10.6	3.67E-06	100	730	2.14E-05	4.75E-06	1.36E-08	8.54E-10	7.12E-04	1.58E-04	4.54E-07	2.85E-08
4	Fairfield	3.8	1.33E-06	3,000	730	7.71E-06	1.72E-06	4.92E-09	3.08E-10	2.57E-04	5.72E-05	1.64E-07	1.03E-08
5	Elmira	13.7	4.76E-06	100	730	2.77E-05	6.15E-06	1.76E-08	1.11E-09	9.22E-04	2.05E-04	5.88E-07	3.69E-08
6	Dixon	2.1	7.43E-07	1,000	730	4.32E-06	9.61E-07	2.76E-09	1.73E-10	1.44E-04	3.20E-05	9.19E-08	5.76E-09
7	Solano Co Ag	6.6	2.30E-06	100	730	1.33E-05	2.97E-06	8.51E-09	5.34E-10	4.45E-04	9.90E-05	2.84E-07	1.78E-08
8	Davis	3.5	1.23E-06	1,000	730	7.13E-06	1.59E-06	4.55E-09	2.85E-10	2.38E-04	5.29E-05	1.52E-07	9.50E-09
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.41E-05	3.14E-06	9.00E-09	5.64E-10	4.70E-04	1.05E-04	3.00E-07	1.88E-08
10	Sacramento	3.3	1.13E-06	3,000	730	6.56E-06	1.46E-06	4.19E-09	2.62E-10	2.19E-04	4.87E-05	1.40E-07	8.75E-09
11	Sacramento River	0.4	1.46E-07	100	730	8.48E-07	1.89E-07	5.41E-10	3.39E-11	2.83E-05	6.29E-06	1.80E-08	1.13E-09
12	Sacramento	2.5	8.54E-07	10,000	730	4.97E-06	1.11E-06	3.17E-09	1.99E-10	1.66E-04	3.68E-05	1.06E-07	6.62E-09
13	Parkland	1.6	5.63E-07	100	730	3.27E-06	7.28E-07	2.09E-09	1.31E-10	1.09E-04	2.43E-05	6.95E-08	4.36E-09
14	Sacramento	3.2	1.11E-06	3,000	730	6.48E-06	1.44E-06	4.13E-09	2.59E-10	2.16E-04	4.81E-05	1.38E-07	8.64E-09
15	North Highlands	2.6	8.96E-07	1,000	730	5.21E-06	1.16E-06	3.32E-09	2.08E-10	1.74E-04	3.86E-05	1.11E-07	6.94E-09
16	North Highlands	4.4	1.52E-06	3,000	730	8.82E-06	1.96E-06	5.63E-09	3.53E-10	2.94E-04	6.54E-05	1.88E-07	1.18E-08
17	Roseville Yard	1.4	4.72E-07	100	730	2.75E-06	6.11E-07	1.75E-09	1.10E-10	9.15E-05	2.04E-05	5.84E-08	3.66E-09
18	Roseville	1.2	3.63E-07	1,000	730	2.34E-06	5.21E-07	1.49E-09	9.37E-11	7.80E-05	1.74E-05	4.98E-08	3.12E-09
19	Roseville	1.4	4.45E-07	3,000	730	2.87E-06	6.39E-07	1.83E-09	1.15E-10	9.57E-05	2.13E-05	6.10E-08	3.83E-09
20	Roseville	2.3	7.20E-07	3,000	730	4.64E-06	1.03E-06	2.96E-09	1.86E-10	1.55E-04	3.44E-05	9.87E-08	6.19E-09
21	Placer Co	1.3	4.04E-07	1,000	730	2.61E-06	5.80E-07	1.66E-09	1.04E-10	8.69E-05	1.93E-05	5.54E-08	3.47E-09
22	Placer Co	0.1	4.68E-08	100	730	3.02E-07	6.71E-08	1.92E-10	1.21E-11	1.01E-05	2.24E-06	6.42E-09	4.02E-10
23	Placer Co	2.9	9.23E-07	1,000	730	5.95E-06	1.32E-06	3.80E-09	2.38E-10	1.98E-04	4.41E-05	1.27E-07	7.93E-09
24	Lincoln	1.2	3.77E-07	100	730	2.43E-06	5.41E-07	1.55E-09	9.72E-11	8.10E-05	1.80E-05	5.17E-08	3.24E-09
25	Lincoln	2.9	9.05E-07	3,000	730	5.84E-06	1.30E-06	3.72E-09	2.33E-10	1.95E-04	4.33E-05	1.24E-07	7.78E-09
26	Sheridan	10.7	3.37E-06	100	730	2.17E-05	4.83E-06	1.38E-08	8.68E-10	7.24E-04	1.61E-04	4.62E-07	2.89E-08
27	Wheatland	0.9	2.94E-07	1,000	730	1.90E-06	4.22E-07	1.21E-09	7.58E-11	6.32E-05	1.41E-05	4.03E-08	2.53E-09
28	Yuba County	9.2	2.92E-06	100	730	1.88E-05	4.19E-06	1.20E-08	7.52E-10	6.27E-04	1.40E-04	4.00E-07	2.51E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	730	8.67E-06	1.93E-06	5.53E-09	3.47E-10	2.89E-04	6.43E-05	1.84E-07	1.16E-08
30	Marysville	1.3	4.20E-07	3,000	730	2.71E-06	6.03E-07	1.73E-09	1.08E-10	9.03E-05	2.01E-05	5.76E-08	3.61E-09
31	Marysville	0.3	9.49E-08	100	730	6.12E-07	1.36E-07	3.91E-10	2.45E-11	2.04E-05	4.54E-06	1.30E-08	8.16E-10
32	Marysville	0.4	1.18E-07	1,000	730	7.58E-07	1.69E-07	4.84E-10	3.03E-11	2.53E-05	5.62E-06	1.61E-08	1.01E-09
33	Yuba County	0.7	2.37E-07	100	730	1.53E-06	3.40E-07	9.74E-10	6.11E-11	5.09E-05	1.13E-05	3.25E-08	2.04E-09
34	Yuba County	0.2	4.85E-08	1,000	730	3.12E-07	6.95E-08	1.99E-10	1.25E-11	1.04E-05	2.32E-06	6.64E-09	4.17E-10
35	Yuba County	0.8	2.39E-07	3,000	730	1.54E-06	3.42E-07	9.81E-10	6.15E-11	5.13E-05	1.14E-05	3.27E-08	2.05E-09
36	Yuba County	0.3	9.41E-08	100	730	6.07E-07	1.35E-07	3.87E-10	2.43E-11	2.02E-05	4.50E-06	1.29E-08	8.09E-10
37	Yuba/Butte County	16.3	5.16E-06	1,000	730	3.33E-05	7.40E-06	2.12E-08	1.33E-09	1.11E-03	2.47E-04	7.07E-07	4.44E-08
38	Palermo	4.2	1.33E-06	3,000	730	8.55E-06	1.90E-06	5.46E-09	3.42E-10	2.85E-04	6.34E-05	1.82E-07	1.14E-08
39	Butte County	1.1	3.35E-07	100	730	2.16E-06	4.80E-07	1.38E-09	8.63E-11	7.19E-05	1.60E-05	4.59E-08	2.88E-09
40	South Oroville	2.4	7.61E-07	3,000	730	4.91E-06	1.09E-06	3.13E-09	1.96E-10	1.64E-04	3.64E-05	1.04E-07	6.54E-09
41	Oroville	0.9	2.68E-07	100	730	1.73E-06	3.85E-07	1.10E-09	6.92E-11	5.77E-05	1.28E-05	3.68E-08	2.31E-09
42	Oroville	1.3	4.20E-07	1,000	730	2.71E-06	6.03E-07	1.73E-09	1.08E-10	9.03E-05	2.01E-05	5.76E-08	3.61E-09
43	Thermolito Div.	0.1	2.97E-08	100	730	1.91E-07	4.26E-08	1.22E-10	7.65E-12	6.37E-06	1.42E-06	4.07E-09	2.55E-10
44	Butte County	1.4	4.52E-07	1,000	730	2.91E-06	6.48E-07	1.86E-09	1.16E-10	9.70E-05	2.16E-05	6.19E-08	3.88E-09
45	Feather Canyon	53.9	1.70E-05	100	730	1.10E-04	2.44E-05	7.00E-08	4.39E-09	3.66E-03	8.14E-04	2.33E-06	1.46E-07
46	Hallsted	1.5	4.77E-07	1,000	730	3.07E-06	6.84E-07	1.96E-09	1.23E-10	1.02E-04	2.28E-05	6.54E-08	4.10E-09
47	Plumas County	12.5	3.95E-06	100	730	2.54E-05	5.66E-06	1.62E-08	1.02E-09	8.48E-04	1.89E-04	5.41E-07	3.39E-08
48	Spanish Creek	0.5	1.52E-07	1,000	730	9.81E-07	2.18E-07	6.26E-10	3.93E-11	3.27E-05	7.28E-06	2.09E-08	1.31E-09
49	Plumas County	1.6	5.15E-07	100	730	3.32E-06	7.39E-07	2.12E-09	1.33E-10	1.11E-04	2.46E-05	7.06E-08	4.42E-09
50	Quincy	3.6	1.15E-06	1,000	730	7.41E-06	1.65E-06	4.73E-09	2.96E-10	2.47E-04	5.50E-05	1.58E-07	9.88E-09
51	Plumas County	4.6	1.44E-06	100	730	9.30E-06	2.07E-06	5.94E-09	3.72E-10	3.10E-04	6.90E-05	1.98E-07	1.24E-08
52	Spring Garden	0.3	9.96E-08	1,000	730	6.42E-07	1.43E-07	4.10E-10	2.57E-11	2.14E-05	4.77E-06	1.37E-08	8.56E-10
53	Plumas County	5.9	1.87E-06	100	730	1.21E-05	2.68E-06	7.69E-09	4.82E-10	4.02E-04	8.94E-05	2.56E-07	1.61E-08
54	Twentymile House	2.3	7.39E-07	1,000	730	4.76E-06	1.06E-06	3.04E-09	1.91E-10	1.59E-04	3.53E-05	1.01E-07	6.35E-09
55	Plumas County	2.4	7.70E-07	100	730	4.97E-06	1.11E-06	3.17E-09	1.99E-10	1.66E-04	3.69E-05	1.06E-07	6.62E-09
56	Blairsden	6.7	2.13E-06	1,000	730	1.37E-05	3.05E-06	8.75E-09	5.49E-10	4.57E-04	1.02E-04	2.92E-07	1.83E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	730	3.64E-06	8.11E-07	2.33E-09	1.46E-10	1.21E-04	2.70E-05	7.75E-08	4.86E-09
58	Plumas Golf	1.1	3.60E-07	1,000	730	2.32E-06	5.17E-07	1.48E-09	9.28E-11	7.74E-05	1.72E-05	4.94E-08	3.09E-09
59	Plumas County	1.8	5.78E-07	100	730	3.73E-06	8.29E-07	2.38E-09	1.49E-10	1.24E-04	2.76E-05	7.92E-08	4.97E-09
60	Portola	3.5	1.11E-06	1,000	730	7.19E-06	1.60E-06	4.59E-09	2.87E-10	2.40E-04	5.33E-05	1.53E-07	9.58E-09
61	Plumas County	14.9	4.69E-06	100	730	3.02E-05	6.73E-06	1.93E-08	1.21E-09	1.01E-03	2.24E-04	6.43E-07	4.03E-08
62	Chilcoot	1.8	5.81E-07	1,000	730	3.75E-06	8.34E-07	2.39E-09	1.50E-10	1.25E-04	2.78E-05	7.97E-08	4.99E-09
63	Lassen County	19.2	6.05E-06	100	730	3.90E-05	8.68E-06	2.49E-08	1.56E-09	1.30E-03	2.89E-04	8.30E-07	5.20E-08
64	Doyle	1.2	3.82E-07	1,000	730	2.46E-06	5.48E-07	1.57E-09	9.85E-11	8.21E-05	1.83E-05	5.24E-08	3.28E-09
65	Lassen County	8.0	2.52E-06	100	730	1.62E-05	3.61E-06	1.04E-08	6.49E-10	5.41E-04	1.20E-04	3.45E-07	2.16E-08
66	Herlong	4.5	1.41E-06	1,000	730	9.10E-06	2.03E-06	5.81E-09	3.64E-10	3.03E-04	6.75E-05	1.94E-07	1.21E-08
67	Lassen County	5.2	1.64E-06	1,000	730	1.06E-05	2.36E-06	6.75E-09	4.23E-10	3.53E-04	7.85E-05	2.25E-07	1.41E-08
Total/Weighted Average		300.8	9.72E-05			6.11E-04	1.36E-04	3.90E-07	2.44E-08	2.04E-02	4.53E-03	1.30E-05	8.15E-07
Return Period			10,284			1,636	7,352	2,564,644	40,906,067	49	221	76,939	1,227,182

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	5.31E-06	1.18E-06	3.39E-09	2.12E-10	1.77E-04	3.94E-05	1.13E-07	7.08E-09
2	Benicia	2.6	8.92E-07	1,000	730	5.19E-06	1.15E-06	3.31E-09	2.08E-10	1.73E-04	3.85E-05	1.10E-07	6.92E-09
3	Grizzly Bay	10.6	3.67E-06	100	730	2.14E-05	4.75E-06	1.36E-08	8.54E-10	7.12E-04	1.58E-04	4.54E-07	2.85E-08
4	Fairfield	3.8	1.33E-06	3,000	730	7.71E-06	1.72E-06	4.92E-09	3.08E-10	2.57E-04	5.72E-05	1.64E-07	1.03E-08
5	Elmira	13.7	4.76E-06	100	730	2.77E-05	6.15E-06	1.76E-08	1.11E-09	9.22E-04	2.05E-04	5.88E-07	3.69E-08
6	Dixon	2.1	7.43E-07	1,000	730	4.32E-06	9.61E-07	2.76E-09	1.73E-10	1.44E-04	3.20E-05	9.19E-08	5.76E-09
7	Solano Co Ag	6.6	2.30E-06	100	730	1.33E-05	2.97E-06	8.51E-09	5.34E-10	4.45E-04	9.90E-05	2.84E-07	1.78E-08
8	Davis	3.5	1.23E-06	1,000	730	7.13E-06	1.59E-06	4.55E-09	2.85E-10	2.38E-04	5.29E-05	1.52E-07	9.50E-09
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.41E-05	3.14E-06	9.00E-09	5.64E-10	4.70E-04	1.05E-04	3.00E-07	1.88E-08
10	Sacramento	3.3	1.13E-06	3,000	730	6.56E-06	1.46E-06	4.19E-09	2.62E-10	2.19E-04	4.87E-05	1.40E-07	8.75E-09
11	Sacramento River	0.4	1.46E-07	100	730	8.48E-07	1.89E-07	5.41E-10	3.39E-11	2.83E-05	6.29E-06	1.80E-08	1.13E-09
12	Sacramento	2.5	8.54E-07	10,000	730	4.97E-06	1.11E-06	3.17E-09	1.99E-10	1.66E-04	3.68E-05	1.06E-07	6.62E-09
13	Parkland	1.6	5.63E-07	100	730	3.27E-06	7.28E-07	2.09E-09	1.31E-10	1.09E-04	2.43E-05	6.95E-08	4.36E-09
14	Sacramento	3.2	1.11E-06	3,000	730	6.48E-06	1.44E-06	4.13E-09	2.59E-10	2.16E-04	4.81E-05	1.38E-07	8.64E-09
15	North Highlands	2.6	8.96E-07	1,000	730	5.21E-06	1.16E-06	3.32E-09	2.08E-10	1.74E-04	3.86E-05	1.11E-07	6.94E-09
16	North Highlands	4.4	1.52E-06	3,000	730	8.82E-06	1.96E-06	5.63E-09	3.53E-10	2.94E-04	6.54E-05	1.88E-07	1.18E-08
17	Roseville Yard	1.4	4.72E-07	100	730	2.75E-06	6.11E-07	1.75E-09	1.10E-10	9.15E-05	2.04E-05	5.84E-08	3.66E-09
18	Roseville	1.2	3.25E-07	1,000	730	2.13E-06	4.73E-07	1.36E-09	8.51E-11	7.09E-05	1.58E-05	4.52E-08	2.84E-09
19	Roseville	1.4	3.98E-07	3,000	730	2.61E-06	5.80E-07	1.66E-09	1.04E-10	8.69E-05	1.93E-05	5.54E-08	3.48E-09
20	Roseville	2.3	6.44E-07	3,000	730	4.22E-06	9.38E-07	2.69E-09	1.69E-10	1.41E-04	3.13E-05	8.97E-08	5.62E-09
21	Placer Co	1.3	3.62E-07	1,000	730	2.37E-06	5.27E-07	1.51E-09	9.47E-11	7.89E-05	1.76E-05	5.03E-08	3.16E-09
22	Placer Co	0.1	4.19E-08	100	730	2.74E-07	6.10E-08	1.75E-10	1.10E-11	9.13E-06	2.03E-06	5.83E-09	3.65E-10
23	Placer Co	2.9	8.26E-07	1,000	730	5.41E-06	1.20E-06	3.45E-09	2.16E-10	1.80E-04	4.01E-05	1.15E-07	7.21E-09
24	Lincoln	1.2	3.37E-07	100	730	2.21E-06	4.91E-07	1.41E-09	8.83E-11	7.36E-05	1.64E-05	4.70E-08	2.94E-09
25	Lincoln	2.9	8.10E-07	3,000	730	5.30E-06	1.18E-06	3.38E-09	2.12E-10	1.77E-04	3.93E-05	1.13E-07	7.07E-09
26	Sheridan	10.7	3.01E-06	100	730	1.97E-05	4.39E-06	1.26E-08	7.89E-10	6.57E-04	1.46E-04	4.19E-07	2.63E-08
27	Wheatland	0.9	2.63E-07	1,000	730	1.72E-06	3.83E-07	1.10E-09	6.89E-11	5.74E-05	1.28E-05	3.66E-08	2.30E-09
28	Yuba County	9.2	2.61E-06	100	730	1.71E-05	3.80E-06	1.09E-08	6.83E-10	5.69E-04	1.27E-04	3.63E-07	2.28E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	730	7.88E-06	1.75E-06	5.03E-09	3.15E-10	2.63E-04	5.84E-05	1.68E-07	1.05E-08
30	Marysville	1.3	3.76E-07	3,000	730	2.46E-06	5.47E-07	1.57E-09	9.84E-11	8.20E-05	1.82E-05	5.23E-08	3.28E-09
31	Marysville	2.3	6.56E-07	100	730	4.29E-06	9.55E-07	2.74E-09	1.72E-10	1.43E-04	3.18E-05	9.13E-08	5.72E-09
32	Live Oak	0.3	9.29E-08	1,000	730	6.08E-07	1.35E-07	3.88E-10	2.43E-11	2.03E-05	4.51E-06	1.29E-08	8.11E-10
33	Live Oak	6.4	1.81E-06	100	730	1.19E-05	2.64E-06	7.57E-09	4.75E-10	3.96E-04	8.81E-05	2.52E-07	1.58E-08
34	Live Oak	0.4	1.03E-07	1,000	730	6.77E-07	1.51E-07	4.32E-10	2.71E-11	2.26E-05	5.02E-06	1.44E-08	9.03E-10
35	Live Oak	1.0	2.86E-07	3,000	730	1.87E-06	4.17E-07	1.20E-09	7.50E-11	6.25E-05	1.39E-05	3.99E-08	2.50E-09
36	Butte Co	5.2	1.48E-06	100	730	9.66E-06	2.15E-06	6.16E-09	3.86E-10	3.22E-04	7.16E-05	2.05E-07	1.29E-08
37	Gridley	0.5	1.29E-07	1,000	730	8.41E-07	1.87E-07	5.37E-10	3.37E-11	2.80E-05	6.24E-06	1.79E-08	1.12E-09
38	Gridley	0.8	2.34E-07	3,000	730	1.53E-06	3.41E-07	9.78E-10	6.13E-11	5.11E-05	1.14E-05	3.26E-08	2.04E-09
39	Gridley	2.5	7.08E-07	100	730	4.64E-06	1.03E-06	2.96E-09	1.85E-10	1.55E-04	3.44E-05	9.86E-08	6.18E-09
40	Biggs	0.6	1.62E-07	3,000	730	1.06E-06	2.36E-07	6.76E-10	4.24E-11	3.53E-05	7.86E-06	2.25E-08	1.41E-09
41	Butte Co	5.1	1.45E-06	100	730	9.49E-06	2.11E-06	6.05E-09	3.80E-10	3.16E-04	7.04E-05	2.02E-07	1.27E-08
42	Richvale	0.8	2.36E-07	1,000	730	1.55E-06	3.44E-07	9.86E-10	6.18E-11	5.15E-05	1.15E-05	3.29E-08	2.06E-09
43	Nelson	9.3	2.62E-06	100	730	1.72E-05	3.82E-06	1.09E-08	6.86E-10	5.72E-04	1.27E-04	3.65E-07	2.29E-08
44	Durham	2.4	6.89E-07	1,000	730	4.51E-06	1.00E-06	2.88E-09	1.80E-10	1.50E-04	3.34E-05	9.59E-08	6.01E-09
45	Chico	4.3	1.22E-06	100	730	7.99E-06	1.78E-06	5.10E-09	3.20E-10	2.66E-04	5.93E-05	1.70E-07	1.07E-08
46	Chico	4.5	1.27E-06	1,000	730	8.35E-06	1.86E-06	5.32E-09	3.34E-10	2.78E-04	6.19E-05	1.77E-07	1.11E-08
47	Chico	2.8	7.91E-07	100	730	5.18E-06	1.15E-06	3.31E-09	2.07E-10	1.73E-04	3.84E-05	1.10E-07	6.91E-09
48	Nord	0.6	1.65E-07	1,000	730	1.08E-06	2.40E-07	6.88E-10	4.31E-11	3.59E-05	8.00E-06	2.29E-08	1.44E-09
49	Butte Co	11.3	3.20E-06	100	730	2.10E-05	4.67E-06	1.34E-08	8.39E-10	6.99E-04	1.56E-04	4.46E-07	2.80E-08
50	Vina	0.4	1.26E-07	1,000	730	8.24E-07	1.83E-07	5.26E-10	3.30E-11	2.75E-05	6.12E-06	1.75E-08	1.10E-09
51	Copeland	6.3	1.78E-06	100	730	1.17E-05	2.60E-06	7.44E-09	4.67E-10	3.89E-04	8.65E-05	2.48E-07	1.56E-08
52	Los Molinos	0.5	1.47E-07	1,000	730	9.61E-07	2.14E-07	6.13E-10	3.84E-11	3.20E-05	7.13E-06	2.04E-08	1.28E-09
53	Los Molinos	1.0	2.81E-07	100	730	1.84E-06	4.09E-07	1.17E-09	7.35E-11	6.12E-05	1.36E-05	3.91E-08	2.45E-09
54	Tehema	0.3	9.39E-08	1,000	730	6.15E-07	1.37E-07	3.92E-10	2.46E-11	2.05E-05	4.56E-06	1.31E-08	8.20E-10
55	Tehema	2.2	6.32E-07	100	730	4.14E-06	9.20E-07	2.64E-09	1.65E-10	1.38E-04	3.07E-05	8.80E-08	5.51E-09
56	Gerber	2.3	6.54E-07	1,000	730	4.28E-06	9.53E-07	2.73E-09	1.71E-10	1.43E-04	3.18E-05	9.10E-08	5.71E-09

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	730	3.31E-06	7.36E-07	2.11E-09	1.32E-10	1.10E-04	2.45E-05	7.03E-08	4.41E-09
58	Red Bluff	0.8	2.18E-07	1,000	730	1.43E-06	3.17E-07	9.10E-10	5.71E-11	4.75E-05	1.06E-05	3.03E-08	1.90E-09
59	Red Bluff	4.6	1.31E-06	100	730	8.56E-06	1.90E-06	5.46E-09	3.42E-10	2.85E-04	6.35E-05	1.82E-07	1.14E-08
60	Red Bluff	3.3	9.27E-07	1,000	730	6.07E-06	1.35E-06	3.87E-09	2.43E-10	2.02E-04	4.50E-05	1.29E-07	8.09E-09
61	Tehema Co	15.3	4.32E-06	100	730	2.83E-05	6.29E-06	1.80E-08	1.13E-09	9.42E-04	2.10E-04	6.01E-07	3.77E-08
62	Cottonwood	0.6	1.72E-07	1,000	730	1.13E-06	2.51E-07	7.19E-10	4.51E-11	3.76E-05	8.36E-06	2.40E-08	1.50E-09
63	Anderson	5.4	1.51E-06	100	730	9.91E-06	2.20E-06	6.32E-09	3.96E-10	3.30E-04	7.35E-05	2.11E-07	1.32E-08
64	Anderson	3.5	1.00E-06	1,000	730	6.56E-06	1.46E-06	4.18E-09	2.62E-10	2.19E-04	4.86E-05	1.39E-07	8.74E-09
65	Anderson	4.1	1.15E-06	100	730	7.55E-06	1.68E-06	4.82E-09	3.02E-10	2.52E-04	5.60E-05	1.61E-07	1.01E-08
66	Redding	6.0	1.71E-06	1,000	730	1.12E-05	2.49E-06	7.13E-09	4.47E-10	3.72E-04	8.29E-05	2.38E-07	1.49E-08
67	Redding	0.8	2.15E-07	1,000	730	1.41E-06	3.14E-07	8.99E-10	5.64E-11	4.70E-05	1.05E-05	3.00E-08	1.88E-09
68	Redding	1.1	3.19E-07	100	730	2.09E-06	4.65E-07	1.33E-09	8.35E-11	6.96E-05	1.55E-05	4.44E-08	2.78E-09
69	Redding	0.4	1.10E-07	1,000	730	7.22E-07	1.61E-07	4.61E-10	2.89E-11	2.41E-05	5.36E-06	1.54E-08	9.63E-10
70	Redding	2.6	7.29E-07	100	730	4.77E-06	1.06E-06	3.04E-09	1.91E-10	1.59E-04	3.54E-05	1.01E-07	6.36E-09
71	Shasta Co	0.5	1.48E-07	1,000	730	9.67E-07	2.15E-07	6.17E-10	3.87E-11	3.22E-05	7.17E-06	2.06E-08	1.29E-09
72	Shasta Lake	1.7	4.66E-07	100	730	3.05E-06	6.79E-07	1.95E-09	1.22E-10	1.02E-04	2.26E-05	6.49E-08	4.07E-09
73	Shasta Lake	0.8	2.12E-07	1,000	730	1.39E-06	3.09E-07	8.86E-10	5.55E-11	4.63E-05	1.03E-05	2.95E-08	1.85E-09
74	Shasta Co	16.4	4.64E-06	100	730	3.04E-05	6.77E-06	1.94E-08	1.22E-09	1.01E-03	2.26E-04	6.47E-07	4.05E-08
75	Lakeshore	0.6	1.71E-07	1,000	730	1.12E-06	2.50E-07	7.16E-10	4.49E-11	3.74E-05	8.32E-06	2.39E-08	1.50E-09
76	Shasta Co	28.7	8.10E-06	100	730	5.30E-05	1.18E-05	3.38E-08	2.12E-09	1.77E-03	3.93E-04	1.13E-06	7.07E-08
77	Dunsmuir	1.3	3.68E-07	1,000	730	2.41E-06	5.36E-07	1.54E-09	9.64E-11	8.03E-05	1.79E-05	5.12E-08	3.21E-09
78	Siskiyou Co	12.8	3.61E-06	100	730	2.36E-05	5.25E-06	1.51E-08	9.44E-10	7.87E-04	1.75E-04	5.02E-07	3.15E-08
79	Mount Shasta	1.1	3.19E-07	1,000	730	2.09E-06	4.65E-07	1.33E-09	8.36E-11	6.97E-05	1.55E-05	4.45E-08	2.79E-09
80	Siskiyou Co	64.5	1.82E-05	100	730	1.19E-04	2.65E-05	7.61E-08	4.77E-09	3.98E-03	8.85E-04	2.54E-06	1.59E-07
81	Dorris	0.9	2.49E-07	100	730	1.63E-06	3.63E-07	1.04E-09	6.52E-11	5.44E-05	1.21E-05	3.47E-08	2.17E-09
82	Siskiyou Co	3.4	9.64E-07	1,000	730	6.31E-06	1.40E-06	4.02E-09	2.52E-10	2.10E-04	4.68E-05	1.34E-07	8.41E-09
Total/Weighted Average		368.8	1.09E-04			6.94E-04	1.54E-04	4.43E-07	2.78E-08	2.31E-02	5.15E-03	1.48E-05	9.26E-07
Return Period			9,188			1,441	6,473	2,257,923	36,013,874	43	194	67,738	1,080,416

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	1.03E-05	4.27E-06	2.50E-07	8.86E-08	3.44E-04	1.42E-04	8.34E-06	2.95E-06
2	Benicia	2.6	8.92E-07	1,000	730	1.01E-05	4.17E-06	2.45E-07	8.66E-08	3.36E-04	1.39E-04	8.15E-06	2.89E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	4.15E-05	1.72E-05	1.01E-06	3.57E-07	1.38E-03	5.73E-04	3.36E-05	1.19E-05
4	Fairfield	3.8	1.33E-06	3,000	730	5.31E-06	1.18E-06	3.39E-09	2.12E-10	1.77E-04	3.94E-05	1.13E-07	7.08E-09
5	Elmira	13.7	4.76E-06	100	730	5.19E-06	1.15E-06	3.31E-09	2.08E-10	1.73E-04	3.85E-05	1.10E-07	6.92E-09
6	Dixon	2.1	7.43E-07	1,000	730	2.14E-05	4.75E-06	1.36E-08	8.54E-10	7.12E-04	1.58E-04	4.54E-07	2.85E-08
7	Solano Co Ag	6.6	2.30E-06	100	730	7.71E-06	1.72E-06	4.92E-09	3.08E-10	2.57E-04	5.72E-05	1.64E-07	1.03E-08
8	Davis	3.5	1.23E-06	1,000	730	2.77E-05	6.15E-06	1.76E-08	1.11E-09	9.22E-04	2.05E-04	5.88E-07	3.69E-08
9	Yolo Co Ag	7.0	2.43E-06	100	730	4.32E-06	9.61E-07	2.76E-09	1.73E-10	1.44E-04	3.20E-05	9.19E-08	5.76E-09
10	Sacramento	3.3	1.13E-06	3,000	730	1.33E-05	2.97E-06	8.51E-09	5.34E-10	4.45E-04	9.90E-05	2.84E-07	1.78E-08
11	Sacramento River	0.4	1.46E-07	100	730	7.13E-06	1.59E-06	4.55E-09	2.85E-10	2.38E-04	5.29E-05	1.52E-07	9.50E-09
12	Sacramento	2.5	8.54E-07	10,000	730	1.41E-05	3.14E-06	9.00E-09	5.64E-10	4.70E-04	1.05E-04	3.00E-07	1.88E-08
13	Parkland	1.6	5.63E-07	100	730	6.56E-06	1.46E-06	4.19E-09	2.62E-10	2.19E-04	4.87E-05	1.40E-07	8.75E-09
14	Sacramento	3.2	1.11E-06	3,000	730	8.48E-07	1.89E-07	5.41E-10	3.39E-11	2.83E-05	6.29E-06	1.80E-08	1.13E-09
15	North Highlands	2.6	8.96E-07	1,000	730	4.97E-06	1.11E-06	3.17E-09	1.99E-10	1.66E-04	3.68E-05	1.06E-07	6.62E-09
16	North Highlands	4.4	1.52E-06	3,000	730	3.27E-06	7.28E-07	2.09E-09	1.31E-10	1.09E-04	2.43E-05	6.95E-08	4.36E-09
17	Roseville Yard	1.4	4.72E-07	100	730	6.48E-06	1.44E-06	4.13E-09	2.59E-10	2.16E-04	4.81E-05	1.38E-07	8.64E-09
18	Roseville	1.2	1.82E-06	1,000	365	5.21E-06	1.16E-06	3.32E-09	2.08E-10	1.74E-04	3.86E-05	1.11E-07	6.94E-09
19	Roseville	1.4	2.23E-06	3,000	365	8.82E-06	1.96E-06	5.63E-09	3.53E-10	2.94E-04	6.54E-05	1.88E-07	1.18E-08
20	Roseville	1.1	1.74E-06	3,000	365	2.75E-06	6.11E-07	1.75E-09	1.10E-10	9.15E-05	2.04E-05	5.84E-08	3.66E-09
21	Roseville	2.5	3.88E-06	1,000	365	5.90E-06	9.81E-07	3.74E-09	7.96E-10	1.97E-04	3.27E-05	1.25E-07	2.65E-08
22	Roseville	0.5	7.16E-07	100	365	7.23E-06	1.20E-06	4.59E-09	9.77E-10	2.41E-04	4.01E-05	1.53E-07	3.26E-08
23	Rocklin	2.5	3.98E-06	1,000	365	5.64E-06	9.38E-07	3.58E-09	7.62E-10	1.88E-04	3.13E-05	1.19E-07	2.54E-08
24	Placer Co	8.0	1.26E-05	100	365	1.26E-05	2.09E-06	7.97E-09	1.70E-09	4.19E-04	6.96E-05	2.66E-07	5.66E-08
25	Newcastle	0.5	7.14E-07	3,000	365	2.32E-06	3.86E-07	1.47E-09	3.13E-10	7.74E-05	1.29E-05	4.91E-08	1.04E-08
26	Placer Co	2.5	3.97E-06	100	365	1.29E-05	2.14E-06	8.17E-09	1.74E-09	4.30E-04	7.14E-05	2.72E-07	5.80E-08
27	Auburn	5.3	8.45E-06	1,000	365	4.09E-05	6.80E-06	2.59E-08	5.52E-09	1.36E-03	2.27E-04	8.65E-07	1.84E-07
28	Placer Co	13.6	2.15E-05	100	365	2.31E-06	3.85E-07	1.47E-09	3.12E-10	7.71E-05	1.28E-05	4.89E-08	1.04E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	1.07E-06	1,000	365	1.29E-05	2.14E-06	8.15E-09	1.74E-09	4.29E-04	7.12E-05	2.72E-07	5.79E-08
30	Placer Co	57.4	9.09E-05	3,000	365	2.74E-05	4.55E-06	1.74E-08	3.69E-09	9.12E-04	1.52E-04	5.78E-07	1.23E-07
31	Truckee	2.1	3.36E-06	100	365	6.97E-05	1.16E-05	4.42E-08	9.41E-09	2.32E-03	3.86E-04	1.47E-06	3.14E-07
32	Nevada Co	13.9	2.20E-05	1,000	365	3.46E-06	5.75E-07	2.19E-09	4.67E-10	1.15E-04	1.92E-05	7.31E-08	1.56E-08
33	Floriston	0.2	3.67E-07	100	365	2.95E-04	4.90E-05	1.87E-07	3.98E-08	9.82E-03	1.63E-03	6.22E-06	1.33E-06
34	Sierra Co	5.8	9.17E-06	1,000	365	1.09E-05	1.81E-06	6.90E-09	1.47E-09	3.63E-04	6.03E-05	2.30E-07	4.90E-08
Total/Weighted Average		190.9	2.13E-04			7.56E-04	1.34E-04	4.80E-07	8.82E-08	2.52E-02	4.46E-03	1.60E-05	2.94E-06
Return Period			4,686			1,323	7,475	2,084,737	11,332,729	40	224	62,542	339,982

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	1.83E-06	1,000	730	1.39E-05	5.74E-06	3.37E-07	1.19E-07	4.63E-04	1.91E-04	1.12E-05	3.97E-06
2	Benicia	2.6	1.78E-06	1,000	730	1.36E-05	5.61E-06	3.29E-07	1.16E-07	4.52E-04	1.87E-04	1.10E-05	3.88E-06
3	Grizzly Bay	10.6	7.35E-06	100	730	5.59E-05	2.31E-05	1.35E-06	4.80E-07	1.86E-03	7.70E-04	4.51E-05	1.60E-05
4	Fairfield	3.8	2.65E-06	3,000	730	2.02E-05	8.34E-06	4.89E-07	1.73E-07	6.72E-04	2.78E-04	1.63E-05	5.77E-06
5	Elmira	13.7	9.51E-06	100	730	7.23E-05	2.99E-05	1.75E-06	6.21E-07	2.41E-03	9.97E-04	5.85E-05	2.07E-05
6	Dixon	2.1	1.49E-06	1,000	730	1.13E-05	4.67E-06	2.74E-07	9.70E-08	3.77E-04	1.56E-04	9.13E-06	3.23E-06
7	Solano Co Ag	6.6	4.59E-06	100	730	3.49E-05	1.44E-05	8.46E-07	3.00E-07	1.16E-03	4.81E-04	2.82E-05	9.99E-06
8	Davis	3.5	2.45E-06	1,000	730	1.86E-05	7.71E-06	4.52E-07	1.60E-07	6.21E-04	2.57E-04	1.51E-05	5.33E-06
9	Yolo Co Ag	7.0	4.85E-06	100	730	3.69E-05	1.53E-05	8.95E-07	3.17E-07	1.23E-03	5.09E-04	2.98E-05	1.06E-05
10	Sacramento	3.3	2.26E-06	3,000	730	1.72E-05	7.10E-06	4.16E-07	1.47E-07	5.72E-04	2.37E-04	1.39E-05	4.91E-06
11	Sacramento River	0.4	2.92E-07	100	730	2.22E-06	9.18E-07	5.38E-08	1.91E-08	7.40E-05	3.06E-05	1.79E-06	6.35E-07
12	Sacramento	2.5	1.71E-06	10,000	730	1.30E-05	5.37E-06	3.15E-07	1.12E-07	4.33E-04	1.79E-04	1.05E-05	3.72E-06
13	Parkland	1.6	1.13E-06	100	730	8.55E-06	3.54E-06	2.07E-07	7.34E-08	2.85E-04	1.18E-04	6.91E-06	2.45E-06
14	Sacramento	3.2	2.23E-06	3,000	730	1.70E-05	7.01E-06	4.11E-07	1.46E-07	5.65E-04	2.34E-04	1.37E-05	4.85E-06
15	North Highlands	2.6	1.79E-06	1,000	730	1.36E-05	5.64E-06	3.30E-07	1.17E-07	4.54E-04	1.88E-04	1.10E-05	3.90E-06
16	North Highlands	4.4	3.03E-06	3,000	730	1.39E-05	3.09E-06	8.86E-09	5.56E-10	4.63E-04	1.03E-04	2.95E-07	1.85E-08
17	Roseville Yard	1.4	9.44E-07	100	730	1.36E-05	3.02E-06	8.66E-09	5.43E-10	4.52E-04	1.01E-04	2.89E-07	1.81E-08
18	Roseville	1.2	7.26E-07	1,000	365	5.59E-05	1.24E-05	3.56E-08	2.23E-09	1.86E-03	4.14E-04	1.19E-06	7.45E-08
19	Roseville	1.4	8.90E-07	3,000	365	2.02E-05	4.49E-06	1.29E-08	8.07E-10	6.72E-04	1.50E-04	4.29E-07	2.69E-08
20	Roseville	2.3	1.44E-06	3,000	365	7.23E-05	1.61E-05	4.62E-08	2.89E-09	2.41E-03	5.37E-04	1.54E-06	9.65E-08
21	Placer Co	1.3	8.08E-07	1,000	365	1.13E-05	2.52E-06	7.21E-09	4.52E-10	3.77E-04	8.38E-05	2.40E-07	1.51E-08
22	Placer Co	0.1	9.36E-08	100	365	3.49E-05	7.77E-06	2.23E-08	1.40E-09	1.16E-03	2.59E-04	7.42E-07	4.65E-08
23	Placer Co	2.9	1.85E-06	1,000	365	1.86E-05	4.15E-06	1.19E-08	7.46E-10	6.21E-04	1.38E-04	3.96E-07	2.49E-08
24	Lincoln	1.2	7.54E-07	100	365	3.69E-05	8.22E-06	2.36E-08	1.48E-09	1.23E-03	2.74E-04	7.85E-07	4.92E-08
25	Lincoln	2.9	1.81E-06	3,000	365	1.72E-05	3.82E-06	1.09E-08	6.87E-10	5.72E-04	1.27E-04	3.65E-07	2.29E-08
26	Sheridan	10.7	6.73E-06	100	365	2.22E-06	4.94E-07	1.42E-09	8.88E-11	7.40E-05	1.65E-05	4.72E-08	2.96E-09
27	Wheatland	0.9	5.88E-07	1,000	365	1.30E-05	2.89E-06	8.29E-09	5.20E-10	4.33E-04	9.64E-05	2.76E-07	1.73E-08
28	Yuba County	9.2	5.83E-06	100	365	8.55E-06	1.90E-06	5.46E-09	3.42E-10	2.85E-04	6.35E-05	1.82E-07	1.14E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.69E-06	1,000	365	1.70E-05	3.77E-06	1.08E-08	6.78E-10	5.65E-04	1.26E-04	3.61E-07	2.26E-08
30	Marysville	1.3	8.40E-07	3,000	365	1.36E-05	3.03E-06	8.69E-09	5.45E-10	4.54E-04	1.01E-04	2.90E-07	1.82E-08
31	Marysville	0.3	1.90E-07	100	365	2.31E-05	5.14E-06	1.47E-08	9.23E-10	7.69E-04	1.71E-04	4.91E-07	3.08E-08
32	Marysville	0.4	2.35E-07	1,000	365	7.18E-06	1.60E-06	4.58E-09	2.87E-10	2.39E-04	5.33E-05	1.53E-07	9.58E-09
33	Yuba County	0.7	4.74E-07	100	365	3.09E-06	1.09E-06	1.17E-07	7.30E-08	1.03E-04	3.62E-05	3.91E-06	2.43E-06
34	Yuba County	0.2	9.69E-08	1,000	365	3.78E-06	1.33E-06	1.44E-07	8.95E-08	1.26E-04	4.44E-05	4.80E-06	2.98E-06
35	Yuba County	0.8	4.77E-07	3,000	365	6.12E-06	2.15E-06	2.33E-07	1.45E-07	2.04E-04	7.18E-05	7.76E-06	4.82E-06
36	Yuba County	0.3	1.88E-07	100	365	3.43E-06	1.21E-06	1.31E-07	8.13E-08	1.14E-04	4.03E-05	4.36E-06	2.71E-06
37	Yuba/Butte County	16.3	1.03E-05	1,000	365	3.98E-07	1.40E-07	1.51E-08	9.41E-09	1.33E-05	4.67E-06	5.04E-07	3.14E-07
38	Palermo	4.2	2.65E-06	3,000	365	7.84E-06	2.76E-06	2.98E-07	1.86E-07	2.61E-04	9.21E-05	9.95E-06	6.19E-06
39	Butte County	1.1	6.69E-07	100	365	3.20E-06	1.13E-06	1.22E-07	7.58E-08	1.07E-04	3.76E-05	4.06E-06	2.53E-06
40	South Oroville	2.4	1.52E-06	3,000	365	7.69E-06	2.71E-06	2.93E-07	1.82E-07	2.56E-04	9.03E-05	9.76E-06	6.07E-06
41	Oroville	0.9	5.37E-07	100	365	2.86E-05	1.01E-05	1.09E-06	6.77E-07	9.54E-04	3.36E-04	3.63E-05	2.26E-05
42	Oroville	1.3	8.40E-07	1,000	365	2.50E-06	8.80E-07	9.51E-08	5.91E-08	8.33E-05	2.93E-05	3.17E-06	1.97E-06
43	Thermolito Div.	0.1	5.93E-08	100	365	2.48E-05	8.73E-06	9.43E-07	5.86E-07	8.26E-04	2.91E-04	3.14E-05	1.95E-05
44	Butte County	1.4	9.03E-07	1,000	365	1.14E-05	4.03E-06	4.35E-07	2.70E-07	3.81E-04	1.34E-04	1.45E-05	9.02E-06
45	Feather Canyon	53.9	3.40E-05	100	365	3.57E-06	1.26E-06	1.36E-07	8.44E-08	1.19E-04	4.19E-05	4.53E-06	2.81E-06
46	Hallsted	1.5	9.54E-07	1,000	365	8.07E-07	2.84E-07	3.07E-08	1.91E-08	2.69E-05	9.47E-06	1.02E-06	6.36E-07
47	Plumas County	12.5	7.89E-06	100	365	9.99E-07	3.52E-07	3.80E-08	2.36E-08	3.33E-05	1.17E-05	1.27E-06	7.88E-07
48	Spanish Creek	0.5	3.04E-07	1,000	365	2.01E-06	7.09E-07	7.66E-08	4.76E-08	6.71E-05	2.36E-05	2.55E-06	1.59E-06
49	Plumas County	1.6	1.03E-06	100	365	4.12E-07	1.45E-07	1.57E-08	9.74E-09	1.37E-05	4.83E-06	5.22E-07	3.25E-07
50	Quincy	3.6	2.30E-06	1,000	365	2.03E-06	7.14E-07	7.71E-08	4.80E-08	6.76E-05	2.38E-05	2.57E-06	1.60E-06
51	Plumas County	4.6	2.89E-06	100	365	7.99E-07	2.81E-07	3.04E-08	1.89E-08	2.66E-05	9.38E-06	1.01E-06	6.30E-07
52	Spring Garden	0.3	1.99E-07	1,000	365	4.38E-05	1.54E-05	1.67E-06	1.04E-06	1.46E-03	5.15E-04	5.56E-05	3.46E-05
53	Plumas County	5.9	3.74E-06	100	365	1.13E-05	3.97E-06	4.29E-07	2.67E-07	3.76E-04	1.32E-04	1.43E-05	8.89E-06
54	Twentymile House	2.3	1.48E-06	1,000	365	2.84E-06	1.00E-06	1.08E-07	6.73E-08	9.48E-05	3.34E-05	3.61E-06	2.24E-06
55	Plumas County	2.4	1.54E-06	100	365	6.47E-06	2.28E-06	2.46E-07	1.53E-07	2.16E-04	7.59E-05	8.20E-06	5.10E-06
56	Blairsden	6.7	4.26E-06	1,000	365	2.28E-06	8.03E-07	8.68E-08	5.40E-08	7.60E-05	2.68E-05	2.89E-06	1.80E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	1.13E-06	100	365	3.57E-06	1.26E-06	1.36E-07	8.44E-08	1.19E-04	4.19E-05	4.53E-06	2.81E-06
58	Plumas Golf	1.1	7.20E-07	1,000	365	2.52E-07	8.87E-08	9.59E-09	5.96E-09	8.40E-06	2.96E-06	3.20E-07	1.99E-07
59	Plumas County	1.8	1.16E-06	100	365	3.84E-06	1.35E-06	1.46E-07	9.08E-08	1.28E-04	4.50E-05	4.87E-06	3.03E-06
60	Portola	3.5	2.23E-06	1,000	365	1.45E-04	5.09E-05	5.50E-06	3.42E-06	4.82E-03	1.70E-03	1.83E-04	1.14E-04
61	Plumas County	14.9	9.38E-06	100	365	4.05E-06	1.43E-06	1.54E-07	9.59E-08	1.35E-04	4.76E-05	5.14E-06	3.20E-06
62	Chilcoot	1.8	1.16E-06	1,000	365	3.35E-05	1.18E-05	1.28E-06	7.94E-07	1.12E-03	3.94E-04	4.25E-05	2.65E-05
63	Lassen County	19.2	1.21E-05	100	365	1.29E-06	4.55E-07	4.92E-08	3.06E-08	4.31E-05	1.52E-05	1.64E-06	1.02E-06
64	Doyle	1.2	7.64E-07	1,000	365	4.37E-06	1.54E-06	1.66E-07	1.03E-07	1.46E-04	5.13E-05	5.55E-06	3.45E-06
65	Lassen County	8.0	5.03E-06	100	365	9.77E-06	3.44E-06	3.72E-07	2.31E-07	3.26E-04	1.15E-04	1.24E-05	7.70E-06
66	Herlong	4.5	2.82E-06	1,000	365	1.23E-05	4.32E-06	4.67E-07	2.90E-07	4.09E-04	1.44E-04	1.56E-05	9.67E-06
67	Lassen County	5.2	3.28E-06	1,000	365	8.46E-07	2.98E-07	3.22E-08	2.00E-08	2.82E-05	9.94E-06	1.07E-06	6.68E-07
Total/Weighted Average		190.9	1.94E-04			9.94E-04	3.01E-04	2.36E-05	1.46E-05	3.31E-02	1.00E-02	7.87E-04	4.85E-04
Return Period			5,142			1,006	3,325	42,332	68,725	30	100	1,270	2,062

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	5.31E-06	1.87E-06	2.02E-07	1.26E-07	1.77E-04	6.23E-05	6.73E-06	4.19E-06
2	Benicia	2.6	8.92E-07	1,000	730	5.19E-06	1.83E-06	1.97E-07	1.23E-07	1.73E-04	6.09E-05	6.58E-06	4.09E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	2.14E-05	7.52E-06	8.13E-07	5.05E-07	7.12E-04	2.51E-04	2.71E-05	1.68E-05
4	Fairfield	3.8	1.33E-06	3,000	730	7.71E-06	2.72E-06	2.93E-07	1.82E-07	2.57E-04	9.05E-05	9.78E-06	6.08E-06
5	Elmira	13.7	4.76E-06	100	730	2.77E-05	9.74E-06	1.05E-06	6.54E-07	9.22E-04	3.25E-04	3.51E-05	2.18E-05
6	Dixon	2.1	7.43E-07	1,000	730	4.32E-06	1.52E-06	1.64E-07	1.02E-07	1.44E-04	5.07E-05	5.48E-06	3.41E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	1.33E-05	4.70E-06	5.08E-07	3.16E-07	4.45E-04	1.57E-04	1.69E-05	1.05E-05
8	Davis	3.5	1.23E-06	1,000	730	7.13E-06	2.51E-06	2.71E-07	1.69E-07	2.38E-04	8.36E-05	9.04E-06	5.62E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.41E-05	4.97E-06	5.37E-07	3.34E-07	4.70E-04	1.66E-04	1.79E-05	1.11E-05
10	Sacramento	3.3	1.13E-06	3,000	730	6.56E-06	2.31E-06	2.50E-07	1.55E-07	2.19E-04	7.70E-05	8.32E-06	5.17E-06
11	Sacramento River	0.4	1.46E-07	100	730	8.48E-07	2.99E-07	3.23E-08	2.01E-08	2.83E-05	9.96E-06	1.08E-06	6.69E-07
12	Sacramento	2.5	8.54E-07	10,000	730	4.97E-06	1.75E-06	1.89E-07	1.17E-07	1.66E-04	5.83E-05	6.30E-06	3.92E-06
13	Parkland	1.6	5.63E-07	100	730	3.27E-06	1.15E-06	1.24E-07	7.74E-08	1.09E-04	3.84E-05	4.15E-06	2.58E-06
14	Sacramento	3.2	1.11E-06	3,000	730	6.48E-06	2.28E-06	2.47E-07	1.53E-07	2.16E-04	7.61E-05	8.22E-06	5.11E-06
15	North Highlands	2.6	8.96E-07	1,000	730	5.21E-06	1.83E-06	1.98E-07	1.23E-07	1.74E-04	6.11E-05	6.61E-06	4.11E-06
16	North Highlands	4.4	1.52E-06	3,000	730	8.82E-06	3.11E-06	3.36E-07	2.09E-07	2.94E-04	1.04E-04	1.12E-05	6.96E-06
17	Roseville Yard	1.4	4.72E-07	100	730	2.75E-06	9.67E-07	1.04E-07	6.50E-08	9.15E-05	3.22E-05	3.48E-06	2.17E-06
18	Roseville	1.2	6.50E-07	1,000	365	2.80E-06	9.86E-07	1.07E-07	6.62E-08	9.33E-05	3.29E-05	3.55E-06	2.21E-06
19	Roseville	1.4	7.97E-07	3,000	365	3.43E-06	1.21E-06	1.31E-07	8.12E-08	1.14E-04	4.03E-05	4.36E-06	2.71E-06
20	Roseville	2.3	1.29E-06	3,000	365	5.55E-06	1.95E-06	2.11E-07	1.31E-07	1.85E-04	6.52E-05	7.04E-06	4.38E-06
21	Placer Co	1.3	7.23E-07	1,000	365	3.12E-06	1.10E-06	1.19E-07	7.37E-08	1.04E-04	3.66E-05	3.95E-06	2.46E-06
22	Placer Co	0.1	8.37E-08	100	365	3.61E-07	1.27E-07	1.37E-08	8.54E-09	1.20E-05	4.23E-06	4.58E-07	2.85E-07
23	Placer Co	2.9	1.65E-06	1,000	365	7.12E-06	2.51E-06	2.71E-07	1.68E-07	2.37E-04	8.35E-05	9.03E-06	5.61E-06
24	Lincoln	1.2	6.75E-07	100	365	2.91E-06	1.02E-06	1.11E-07	6.88E-08	9.69E-05	3.41E-05	3.69E-06	2.29E-06
25	Lincoln	2.9	1.62E-06	3,000	365	6.98E-06	2.46E-06	2.66E-07	1.65E-07	2.33E-04	8.19E-05	8.86E-06	5.51E-06
26	Sheridan	10.7	6.02E-06	100	365	2.60E-05	9.14E-06	9.88E-07	6.14E-07	8.65E-04	3.05E-04	3.29E-05	2.05E-05
27	Wheatland	0.9	5.26E-07	1,000	365	2.27E-06	7.98E-07	8.63E-08	5.36E-08	7.55E-05	2.66E-05	2.88E-06	1.79E-06
28	Yuba County	9.2	5.22E-06	100	365	2.25E-05	7.92E-06	8.56E-07	5.32E-07	7.50E-04	2.64E-04	2.85E-05	1.77E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.41E-06	1,000	365	1.04E-05	3.65E-06	3.95E-07	2.45E-07	3.46E-04	1.22E-04	1.32E-05	8.18E-06
30	Marysville	1.3	7.51E-07	3,000	365	3.24E-06	1.14E-06	1.23E-07	7.66E-08	1.08E-04	3.80E-05	4.11E-06	2.55E-06
31	Marysville	2.3	1.31E-06	100	365	5.65E-06	1.99E-06	2.15E-07	1.34E-07	1.88E-04	6.63E-05	7.17E-06	4.46E-06
32	Live Oak	0.3	1.86E-07	1,000	365	8.00E-07	2.82E-07	3.05E-08	1.89E-08	2.67E-05	9.40E-06	1.02E-06	6.31E-07
33	Live Oak	6.4	3.63E-06	100	365	1.56E-05	5.50E-06	5.95E-07	3.70E-07	5.21E-04	1.83E-04	1.98E-05	1.23E-05
34	Live Oak	0.4	2.07E-07	1,000	365	8.92E-07	3.14E-07	3.39E-08	2.11E-08	2.97E-05	1.05E-05	1.13E-06	7.03E-07
35	Live Oak	1.0	5.73E-07	3,000	365	2.47E-06	8.69E-07	9.39E-08	5.84E-08	8.23E-05	2.90E-05	3.13E-06	1.95E-06
36	Butte Co	5.2	2.95E-06	100	365	1.27E-05	4.48E-06	4.84E-07	3.01E-07	4.24E-04	1.49E-04	1.61E-05	1.00E-05
37	Gridley	0.5	2.57E-07	1,000	365	1.11E-06	3.90E-07	4.22E-08	2.62E-08	3.69E-05	1.30E-05	1.41E-06	8.74E-07
38	Gridley	0.8	4.68E-07	3,000	365	2.02E-06	7.10E-07	7.68E-08	4.77E-08	6.73E-05	2.37E-05	2.56E-06	1.59E-06
39	Gridley	2.5	1.42E-06	100	365	6.11E-06	2.15E-06	2.32E-07	1.44E-07	2.04E-04	7.17E-05	7.75E-06	4.82E-06
40	Biggs	0.6	3.24E-07	3,000	365	1.39E-06	4.91E-07	5.31E-08	3.30E-08	4.65E-05	1.64E-05	1.77E-06	1.10E-06
41	Butte Co	5.1	2.90E-06	100	365	1.25E-05	4.40E-06	4.76E-07	2.96E-07	4.16E-04	1.47E-04	1.59E-05	9.85E-06
42	Richvale	0.8	4.72E-07	1,000	365	2.03E-06	7.16E-07	7.74E-08	4.81E-08	6.78E-05	2.39E-05	2.58E-06	1.60E-06
43	Nelson	9.3	5.24E-06	100	365	2.26E-05	7.95E-06	8.60E-07	5.34E-07	7.53E-04	2.65E-04	2.87E-05	1.78E-05
44	Durham	2.4	1.38E-06	1,000	365	5.93E-06	2.09E-06	2.26E-07	1.40E-07	1.98E-04	6.97E-05	7.53E-06	4.68E-06
45	Chico	4.3	2.44E-06	100	365	1.05E-05	3.70E-06	4.00E-07	2.49E-07	3.51E-04	1.23E-04	1.33E-05	8.30E-06
46	Chico	4.5	2.55E-06	1,000	365	1.10E-05	3.87E-06	4.18E-07	2.60E-07	3.66E-04	1.29E-04	1.39E-05	8.67E-06
47	Chico	2.8	1.58E-06	100	365	6.82E-06	2.40E-06	2.60E-07	1.61E-07	2.27E-04	8.01E-05	8.65E-06	5.38E-06
48	Nord	0.6	3.29E-07	1,000	365	1.42E-06	5.00E-07	5.40E-08	3.36E-08	4.73E-05	1.67E-05	1.80E-06	1.12E-06
49	Butte Co	11.3	6.41E-06	100	365	2.76E-05	9.72E-06	1.05E-06	6.53E-07	9.20E-04	3.24E-04	3.50E-05	2.18E-05
50	Vina	0.4	2.52E-07	1,000	365	1.09E-06	3.82E-07	4.13E-08	2.57E-08	3.62E-05	1.27E-05	1.38E-06	8.56E-07
51	Copeland	6.3	3.56E-06	100	365	1.54E-05	5.41E-06	5.85E-07	3.63E-07	5.12E-04	1.80E-04	1.95E-05	1.21E-05
52	Los Molinos	0.5	2.94E-07	1,000	365	1.27E-06	4.45E-07	4.81E-08	2.99E-08	4.22E-05	1.48E-05	1.60E-06	9.98E-07
53	Los Molinos	1.0	5.61E-07	100	365	2.42E-06	8.51E-07	9.20E-08	5.72E-08	8.06E-05	2.84E-05	3.07E-06	1.91E-06
54	Tehema	0.3	1.88E-07	1,000	365	8.09E-07	2.85E-07	3.08E-08	1.92E-08	2.70E-05	9.50E-06	1.03E-06	6.38E-07
55	Tehema	2.2	1.26E-06	100	365	5.45E-06	1.92E-06	2.07E-07	1.29E-07	1.82E-04	6.39E-05	6.91E-06	4.29E-06
56	Gerber	2.3	1.31E-06	1,000	365	5.64E-06	1.98E-06	2.14E-07	1.33E-07	1.88E-04	6.62E-05	7.15E-06	4.44E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117 Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	1.01E-06	100	365	4.35E-06	1.53E-06	1.66E-07	1.03E-07	1.45E-04	5.11E-05	5.52E-06	3.43E-06
58	Red Bluff	0.8	4.36E-07	1,000	365	1.88E-06	6.61E-07	7.15E-08	4.44E-08	6.26E-05	2.20E-05	2.38E-06	1.48E-06
59	Red Bluff	4.6	2.61E-06	100	365	1.13E-05	3.97E-06	4.29E-07	2.67E-07	3.76E-04	1.32E-04	1.43E-05	8.89E-06
60	Red Bluff	3.3	1.85E-06	1,000	365	7.99E-06	2.81E-06	3.04E-07	1.89E-07	2.66E-04	9.38E-05	1.01E-05	6.30E-06
61	Tehema Co	15.3	8.63E-06	100	365	3.72E-05	1.31E-05	1.42E-06	8.80E-07	1.24E-03	4.37E-04	4.72E-05	2.93E-05
62	Cottonwood	0.6	3.44E-07	1,000	365	1.48E-06	5.23E-07	5.65E-08	3.51E-08	4.95E-05	1.74E-05	1.88E-06	1.17E-06
63	Anderson	5.4	3.03E-06	100	365	1.30E-05	4.59E-06	4.96E-07	3.09E-07	4.35E-04	1.53E-04	1.65E-05	1.03E-05
64	Anderson	3.5	2.00E-06	1,000	365	8.63E-06	3.04E-06	3.29E-07	2.04E-07	2.88E-04	1.01E-04	1.10E-05	6.81E-06
65	Anderson	4.1	2.31E-06	100	365	9.94E-06	3.50E-06	3.78E-07	2.35E-07	3.31E-04	1.17E-04	1.26E-05	7.84E-06
66	Redding	6.0	3.41E-06	1,000	365	1.47E-05	5.18E-06	5.60E-07	3.48E-07	4.90E-04	1.73E-04	1.87E-05	1.16E-05
67	Redding	0.8	4.30E-07	1,000	365	1.86E-06	6.53E-07	7.06E-08	4.39E-08	6.18E-05	2.18E-05	2.35E-06	1.46E-06
68	Redding	1.1	6.38E-07	100	365	2.75E-06	9.68E-07	1.05E-07	6.51E-08	9.17E-05	3.23E-05	3.49E-06	2.17E-06
69	Redding	0.4	2.21E-07	1,000	365	9.51E-07	3.35E-07	3.62E-08	2.25E-08	3.17E-05	1.12E-05	1.21E-06	7.50E-07
70	Redding	2.6	1.46E-06	100	365	6.28E-06	2.21E-06	2.39E-07	1.49E-07	2.09E-04	7.38E-05	7.97E-06	4.96E-06
71	Shasta Co	0.5	2.95E-07	1,000	365	1.27E-06	4.48E-07	4.84E-08	3.01E-08	4.24E-05	1.49E-05	1.61E-06	1.00E-06
72	Shasta Lake	1.7	9.32E-07	100	365	4.02E-06	1.41E-06	1.53E-07	9.51E-08	1.34E-04	4.72E-05	5.10E-06	3.17E-06
73	Shasta Lake	0.8	4.24E-07	1,000	365	1.83E-06	6.44E-07	6.96E-08	4.33E-08	6.09E-05	2.15E-05	2.32E-06	1.44E-06
74	Shasta Co	16.4	9.29E-06	100	365	4.00E-05	1.41E-05	1.52E-06	9.47E-07	1.33E-03	4.70E-04	5.08E-05	3.16E-05
75	Lakeshore	0.6	3.43E-07	1,000	365	1.48E-06	5.20E-07	5.62E-08	3.50E-08	4.92E-05	1.73E-05	1.87E-06	1.17E-06
76	Shasta Co	28.7	1.72E-05	100	365	7.39E-05	2.60E-05	2.81E-06	1.75E-06	2.46E-03	8.68E-04	9.38E-05	5.83E-05
77	Dunsmuir	1.3	7.36E-07	1,000	365	3.17E-06	1.12E-06	1.21E-07	7.51E-08	1.06E-04	3.72E-05	4.03E-06	2.50E-06
78	Siskiyou Co	12.8	7.21E-06	100	365	3.11E-05	1.09E-05	1.18E-06	7.35E-07	1.04E-03	3.65E-04	3.94E-05	2.45E-05
79	Mount Shasta	1.1	6.39E-07	1,000	365	2.75E-06	9.70E-07	1.05E-07	6.51E-08	9.18E-05	3.23E-05	3.49E-06	2.17E-06
80	Siskiyou Co	64.5	3.93E-05	100	365	1.69E-04	5.96E-05	6.44E-06	4.00E-06	5.64E-03	1.99E-03	2.15E-04	1.33E-04
81	Dorris	0.9	4.98E-07	100	365	2.15E-06	7.56E-07	8.17E-08	5.08E-08	7.16E-05	2.52E-05	2.72E-06	1.69E-06
82	Siskiyou Co	3.4	1.93E-06	1,000	365	8.31E-06	2.92E-06	3.16E-07	1.97E-07	2.77E-04	9.75E-05	1.05E-05	6.55E-06
Total/Weighted Average		190.9	1.97E-04			8.84E-04	3.11E-04	3.37E-05	2.09E-05	2.95E-02	1.04E-02	1.12E-03	6.98E-04
Return Period			5,089			1,131	3,211	29,709	47,788	34	96	891	1,434

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	730	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	730	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	730	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	730	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	730	4.93E-06	1.27E-06	9.34E-09	9.75E-10	1.64E-04	4.25E-05	3.11E-07	3.25E-08
7	Solano Co Ag	6.6	2.30E-06	100	730	1.52E-05	3.93E-06	2.88E-08	3.01E-09	5.07E-04	1.31E-04	9.62E-07	1.00E-07
8	Davis	3.5	1.23E-06	1,000	730	8.13E-06	2.10E-06	1.54E-08	1.61E-09	2.71E-04	7.00E-05	5.14E-07	5.36E-08
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.61E-05	4.16E-06	3.05E-08	3.19E-09	5.36E-04	1.39E-04	1.02E-06	1.06E-07
10	Sacramento	3.3	1.13E-06	3,000	730	7.48E-06	1.93E-06	1.42E-08	1.48E-09	2.49E-04	6.45E-05	4.73E-07	4.94E-08
11	Sacramento River	0.4	1.46E-07	100	730	9.67E-07	2.50E-07	1.83E-09	1.92E-10	3.22E-05	8.34E-06	6.11E-08	6.39E-09
12	Sacramento	2.5	8.54E-07	10,000	730	5.66E-06	1.46E-06	1.07E-08	1.12E-09	1.89E-04	4.88E-05	3.58E-07	3.74E-08
13	Parkland	1.6	5.63E-07	100	730	3.73E-06	9.64E-07	7.07E-09	7.38E-10	1.24E-04	3.21E-05	2.36E-07	2.46E-08
14	Sacramento	3.2	1.11E-06	3,000	730	7.39E-06	1.91E-06	1.40E-08	1.46E-09	2.46E-04	6.37E-05	4.67E-07	4.88E-08
15	North Highlands	2.6	8.96E-07	1,000	730	5.94E-06	1.54E-06	1.13E-08	1.18E-09	1.98E-04	5.12E-05	3.75E-07	3.92E-08
16	North Highlands	4.4	1.52E-06	3,000	730	1.01E-05	2.60E-06	1.91E-08	1.99E-09	3.35E-04	8.67E-05	6.36E-07	6.64E-08
17	Roseville Yard	1.4	4.72E-07	100	730	3.13E-06	8.10E-07	5.94E-09	6.20E-10	1.04E-04	2.70E-05	1.98E-07	2.07E-08
18	Roseville	1.2	9.10E-07	1,000	730	5.25E-06	6.81E-07	2.62E-11	0.00E+00	1.75E-04	2.27E-05	8.74E-10	0.00E+00
19	Roseville	1.4	1.12E-06	3,000	730	6.43E-06	8.35E-07	3.22E-11	0.00E+00	2.14E-04	2.78E-05	1.07E-09	0.00E+00
20	Roseville	1.1	8.71E-07	3,000	730	5.02E-06	6.51E-07	2.51E-11	0.00E+00	1.67E-04	2.17E-05	8.36E-10	0.00E+00
21	Roseville	2.5	1.94E-06	1,000	730	1.12E-05	1.45E-06	5.59E-11	0.00E+00	3.73E-04	4.83E-05	1.86E-09	0.00E+00
22	Roseville	0.5	3.58E-07	100	730	2.06E-06	2.68E-07	1.03E-11	0.00E+00	6.88E-05	8.93E-06	3.44E-10	0.00E+00
23	Rocklin	2.5	1.99E-06	1,000	730	1.15E-05	1.49E-06	5.73E-11	0.00E+00	3.82E-04	4.96E-05	1.91E-09	0.00E+00
24	Placer Co	8.0	6.31E-06	100	730	3.64E-05	4.72E-06	1.82E-10	0.00E+00	1.21E-03	1.57E-04	6.06E-09	0.00E+00
25	Newcastle	0.5	3.57E-07	3,000	730	2.06E-06	2.67E-07	1.03E-11	0.00E+00	6.86E-05	8.90E-06	3.43E-10	0.00E+00
26	Placer Co	2.5	1.98E-06	100	730	1.14E-05	1.48E-06	5.72E-11	0.00E+00	3.81E-04	4.95E-05	1.91E-09	0.00E+00
27	Auburn	5.3	4.22E-06	1,000	730	2.43E-05	3.16E-06	1.22E-10	0.00E+00	8.11E-04	1.05E-04	4.06E-09	0.00E+00
28	Placer Co	13.6	1.08E-05	100	730	6.20E-05	8.05E-06	3.10E-10	0.00E+00	2.07E-03	2.68E-04	1.03E-08	0.00E+00

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	730	3.07E-06	3.99E-07	1.54E-11	0.00E+00	1.02E-04	1.33E-05	5.12E-10	0.00E+00
30	Placer Co	57.4	4.54E-05	3,000	730	2.62E-04	3.40E-05	1.31E-09	0.00E+00	8.73E-03	1.13E-03	4.36E-08	0.00E+00
31	Truckee	2.1	1.68E-06	100	730	9.68E-06	1.26E-06	4.84E-11	0.00E+00	3.23E-04	4.19E-05	1.61E-09	0.00E+00
32	Nevada Co	13.9	1.10E-05	1,000	730	6.33E-05	8.21E-06	3.16E-10	0.00E+00	2.11E-03	2.74E-04	1.05E-08	0.00E+00
33	Floriston	0.2	1.83E-07	100	730	1.06E-06	1.37E-07	5.28E-12	0.00E+00	3.52E-05	4.57E-06	1.76E-10	0.00E+00
34	Sierra Co	5.8	4.58E-06	1,000	730	2.64E-05	3.43E-06	1.32E-10	0.00E+00	8.81E-04	1.14E-04	4.40E-09	0.00E+00
Total/Weighted Average		190.9	1.19E-04			7.08E-04	1.13E-04	3.16E-07	3.27E-08	2.36E-02	3.77E-03	1.05E-05	1.09E-06
Return Period			8,391			1,412	8,831	3,161,890	30,539,675	42	265	94,857	916,190

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	730	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	730	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	730	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	730	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	730	4.93E-06	1.27E-06	9.34E-09	9.75E-10	1.64E-04	4.25E-05	3.11E-07	3.25E-08
7	Solano Co Ag	6.6	2.30E-06	100	730	1.52E-05	3.93E-06	2.88E-08	3.01E-09	5.07E-04	1.31E-04	9.62E-07	1.00E-07
8	Davis	3.5	1.23E-06	1,000	730	8.13E-06	2.10E-06	1.54E-08	1.61E-09	2.71E-04	7.00E-05	5.14E-07	5.36E-08
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.61E-05	4.16E-06	3.05E-08	3.19E-09	5.36E-04	1.39E-04	1.02E-06	1.06E-07
10	Sacramento	3.3	1.13E-06	3,000	730	7.48E-06	1.93E-06	1.42E-08	1.48E-09	2.49E-04	6.45E-05	4.73E-07	4.94E-08
11	Sacramento River	0.4	1.46E-07	100	730	9.67E-07	2.50E-07	1.83E-09	1.92E-10	3.22E-05	8.34E-06	6.11E-08	6.39E-09
12	Sacramento	2.5	8.54E-07	10,000	730	5.66E-06	1.46E-06	1.07E-08	1.12E-09	1.89E-04	4.88E-05	3.58E-07	3.74E-08
13	Parkland	1.6	5.63E-07	100	730	3.73E-06	9.64E-07	7.07E-09	7.38E-10	1.24E-04	3.21E-05	2.36E-07	2.46E-08
14	Sacramento	3.2	1.11E-06	3,000	730	7.39E-06	1.91E-06	1.40E-08	1.46E-09	2.46E-04	6.37E-05	4.67E-07	4.88E-08
15	North Highlands	2.6	8.96E-07	1,000	730	5.94E-06	1.54E-06	1.13E-08	1.18E-09	1.98E-04	5.12E-05	3.75E-07	3.92E-08
16	North Highlands	4.4	1.52E-06	3,000	730	1.01E-05	2.60E-06	1.91E-08	1.99E-09	3.35E-04	8.67E-05	6.36E-07	6.64E-08
17	Roseville Yard	1.4	4.72E-07	100	730	3.13E-06	8.10E-07	5.94E-09	6.20E-10	1.04E-04	2.70E-05	1.98E-07	2.07E-08
18	Roseville	1.2	3.63E-07	1,000	730	2.66E-06	6.88E-07	5.05E-09	5.27E-10	8.87E-05	2.29E-05	1.68E-07	1.76E-08
19	Roseville	1.4	4.45E-07	3,000	730	3.26E-06	8.44E-07	6.19E-09	6.46E-10	1.09E-04	2.81E-05	2.06E-07	2.15E-08
20	Roseville	2.3	7.20E-07	3,000	730	5.28E-06	1.36E-06	1.00E-08	1.04E-09	1.76E-04	4.55E-05	3.33E-07	3.48E-08
21	Placer Co	1.3	4.04E-07	1,000	730	2.96E-06	7.66E-07	5.62E-09	5.87E-10	9.87E-05	2.55E-05	1.87E-07	1.96E-08
22	Placer Co	0.1	4.68E-08	100	730	3.43E-07	8.87E-08	6.50E-10	6.79E-11	1.14E-05	2.96E-06	2.17E-08	2.26E-09
23	Placer Co	2.9	9.23E-07	1,000	730	6.77E-06	1.75E-06	1.28E-08	1.34E-09	2.26E-04	5.83E-05	4.28E-07	4.47E-08
24	Lincoln	1.2	3.77E-07	100	730	2.76E-06	7.15E-07	5.24E-09	5.47E-10	9.21E-05	2.38E-05	1.75E-07	1.82E-08
25	Lincoln	2.9	9.05E-07	3,000	730	6.64E-06	1.72E-06	1.26E-08	1.31E-09	2.21E-04	5.72E-05	4.19E-07	4.38E-08
26	Sheridan	10.7	3.37E-06	100	730	2.47E-05	6.38E-06	4.68E-08	4.89E-09	8.23E-04	2.13E-04	1.56E-06	1.63E-07
27	Wheatland	0.9	2.94E-07	1,000	730	2.15E-06	5.57E-07	4.09E-09	4.27E-10	7.18E-05	1.86E-05	1.36E-07	1.42E-08
28	Yuba County	9.2	2.92E-06	100	730	2.14E-05	5.53E-06	4.05E-08	4.23E-09	7.13E-04	1.84E-04	1.35E-06	1.41E-07

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	730	9.86E-06	2.55E-06	1.87E-08	1.95E-09	3.29E-04	8.50E-05	6.23E-07	6.51E-08
30	Marysville	1.3	4.20E-07	3,000	730	3.08E-06	7.96E-07	5.84E-09	6.09E-10	1.03E-04	2.65E-05	1.95E-07	2.03E-08
31	Marysville	0.3	9.49E-08	100	730	6.96E-07	1.80E-07	1.32E-09	1.38E-10	2.32E-05	6.00E-06	4.40E-08	4.59E-09
32	Marysville	0.4	1.18E-07	1,000	730	8.62E-07	2.23E-07	1.63E-09	1.71E-10	2.87E-05	7.43E-06	5.45E-08	5.69E-09
33	Yuba County	0.7	2.37E-07	100	730	1.74E-06	4.49E-07	3.29E-09	3.44E-10	5.79E-05	1.50E-05	1.10E-07	1.15E-08
34	Yuba County	0.2	4.85E-08	1,000	730	3.55E-07	9.19E-08	6.73E-10	7.03E-11	1.18E-05	3.06E-06	2.24E-08	2.34E-09
35	Yuba County	0.8	2.39E-07	3,000	730	1.75E-06	4.52E-07	3.31E-09	3.46E-10	5.83E-05	1.51E-05	1.10E-07	1.15E-08
36	Yuba County	0.3	9.41E-08	100	730	6.90E-07	1.78E-07	1.31E-09	1.37E-10	2.30E-05	5.94E-06	4.36E-08	4.55E-09
37	Yuba/Butte County	16.3	5.16E-06	1,000	730	3.78E-05	9.78E-06	7.17E-08	7.49E-09	1.26E-03	3.26E-04	2.39E-06	2.50E-07
38	Palermo	4.2	1.33E-06	3,000	730	9.72E-06	2.51E-06	1.84E-08	1.92E-09	3.24E-04	8.38E-05	6.14E-07	6.42E-08
39	Butte County	1.1	3.35E-07	100	730	2.45E-06	6.34E-07	4.65E-09	4.86E-10	8.18E-05	2.11E-05	1.55E-07	1.62E-08
40	South Oroville	2.4	7.61E-07	3,000	730	5.58E-06	1.44E-06	1.06E-08	1.10E-09	1.86E-04	4.81E-05	3.53E-07	3.68E-08
41	Oroville	0.9	2.68E-07	100	730	1.97E-06	5.09E-07	3.73E-09	3.90E-10	6.56E-05	1.70E-05	1.24E-07	1.30E-08
42	Oroville	1.3	4.20E-07	1,000	730	3.08E-06	7.96E-07	5.84E-09	6.09E-10	1.03E-04	2.65E-05	1.95E-07	2.03E-08
43	Thermolito Div.	0.1	2.97E-08	100	730	2.17E-07	5.62E-08	4.12E-10	4.30E-11	7.25E-06	1.87E-06	1.37E-08	1.43E-09
44	Butte County	1.4	4.52E-07	1,000	730	3.31E-06	8.56E-07	6.28E-09	6.55E-10	1.10E-04	2.85E-05	2.09E-07	2.18E-08
45	Feather Canyon	53.9	1.70E-05	100	730	1.25E-04	3.22E-05	2.36E-07	2.47E-08	4.16E-03	1.07E-03	7.88E-06	8.23E-07
46	Hallsted	1.5	4.77E-07	1,000	730	3.49E-06	9.04E-07	6.63E-09	6.92E-10	1.16E-04	3.01E-05	2.21E-07	2.31E-08
47	Plumas County	12.5	3.95E-06	100	730	2.89E-05	7.48E-06	5.49E-08	5.73E-09	9.64E-04	2.49E-04	1.83E-06	1.91E-07
48	Spanish Creek	0.5	1.52E-07	1,000	730	1.12E-06	2.89E-07	2.12E-09	2.21E-10	3.72E-05	9.62E-06	7.05E-08	7.36E-09
49	Plumas County	1.6	5.15E-07	100	730	3.77E-06	9.76E-07	7.15E-09	7.47E-10	1.26E-04	3.25E-05	2.38E-07	2.49E-08
50	Quincy	3.6	1.15E-06	1,000	730	8.42E-06	2.18E-06	1.60E-08	1.67E-09	2.81E-04	7.26E-05	5.32E-07	5.56E-08
51	Plumas County	4.6	1.44E-06	100	730	1.06E-05	2.74E-06	2.01E-08	2.09E-09	3.53E-04	9.12E-05	6.68E-07	6.98E-08
52	Spring Garden	0.3	9.96E-08	1,000	730	7.30E-07	1.89E-07	1.38E-09	1.45E-10	2.43E-05	6.29E-06	4.61E-08	4.82E-09
53	Plumas County	5.9	1.87E-06	100	730	1.37E-05	3.54E-06	2.60E-08	2.71E-09	4.57E-04	1.18E-04	8.66E-07	9.04E-08
54	Twentymile House	2.3	7.39E-07	1,000	730	5.42E-06	1.40E-06	1.03E-08	1.07E-09	1.81E-04	4.67E-05	3.42E-07	3.57E-08
55	Plumas County	2.4	7.70E-07	100	730	5.65E-06	1.46E-06	1.07E-08	1.12E-09	1.88E-04	4.87E-05	3.57E-07	3.73E-08
56	Blairsden	6.7	2.13E-06	1,000	730	1.56E-05	4.03E-06	2.96E-08	3.09E-09	5.20E-04	1.34E-04	9.86E-07	1.03E-07

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	730	4.14E-06	1.07E-06	7.85E-09	8.20E-10	1.38E-04	3.57E-05	2.62E-07	2.73E-08
58	Plumas Golf	1.1	3.60E-07	1,000	730	2.64E-06	6.82E-07	5.00E-09	5.22E-10	8.79E-05	2.27E-05	1.67E-07	1.74E-08
59	Plumas County	1.8	5.78E-07	100	730	4.24E-06	1.10E-06	8.03E-09	8.39E-10	1.41E-04	3.65E-05	2.68E-07	2.80E-08
60	Portola	3.5	1.11E-06	1,000	730	8.17E-06	2.11E-06	1.55E-08	1.62E-09	2.72E-04	7.04E-05	5.16E-07	5.39E-08
61	Plumas County	14.9	4.69E-06	100	730	3.44E-05	8.89E-06	6.52E-08	6.81E-09	1.15E-03	2.96E-04	2.17E-06	2.27E-07
62	Chilcoot	1.8	5.81E-07	1,000	730	4.26E-06	1.10E-06	8.07E-09	8.43E-10	1.42E-04	3.67E-05	2.69E-07	2.81E-08
63	Lassen County	19.2	6.05E-06	100	730	4.43E-05	1.15E-05	8.41E-08	8.78E-09	1.48E-03	3.82E-04	2.80E-06	2.93E-07
64	Doyle	1.2	3.82E-07	1,000	730	2.80E-06	7.24E-07	5.31E-09	5.54E-10	9.33E-05	2.41E-05	1.77E-07	1.85E-08
65	Lassen County	8.0	2.52E-06	100	730	1.84E-05	4.77E-06	3.50E-08	3.65E-09	6.15E-04	1.59E-04	1.17E-06	1.22E-07
66	Herlong	4.5	1.41E-06	1,000	730	1.03E-05	2.68E-06	1.96E-08	2.05E-09	3.45E-04	8.92E-05	6.54E-07	6.83E-08
67	Lassen County	5.2	1.64E-06	1,000	730	1.20E-05	3.11E-06	2.28E-08	2.38E-09	4.01E-04	1.04E-04	7.61E-07	7.94E-08
Total/Weighted Average		300.8	9.72E-05			6.95E-04	1.80E-04	1.32E-06	1.38E-07	2.32E-02	5.99E-03	4.39E-05	4.59E-06
Return Period			10,284			1,438	5,562	758,563	7,263,815	43	167	22,757	217,914

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	730	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	730	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	730	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	730	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	730	4.93E-06	1.27E-06	9.34E-09	9.75E-10	1.64E-04	4.25E-05	3.11E-07	3.25E-08
7	Solano Co Ag	6.6	2.30E-06	100	730	1.52E-05	3.93E-06	2.88E-08	3.01E-09	5.07E-04	1.31E-04	9.62E-07	1.00E-07
8	Davis	3.5	1.23E-06	1,000	730	8.13E-06	2.10E-06	1.54E-08	1.61E-09	2.71E-04	7.00E-05	5.14E-07	5.36E-08
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.61E-05	4.16E-06	3.05E-08	3.19E-09	5.36E-04	1.39E-04	1.02E-06	1.06E-07
10	Sacramento	3.3	1.13E-06	3,000	730	7.48E-06	1.93E-06	1.42E-08	1.48E-09	2.49E-04	6.45E-05	4.73E-07	4.94E-08
11	Sacramento River	0.4	1.46E-07	100	730	9.67E-07	2.50E-07	1.83E-09	1.92E-10	3.22E-05	8.34E-06	6.11E-08	6.39E-09
12	Sacramento	2.5	8.54E-07	10,000	730	5.66E-06	1.46E-06	1.07E-08	1.12E-09	1.89E-04	4.88E-05	3.58E-07	3.74E-08
13	Parkland	1.6	5.63E-07	100	730	3.73E-06	9.64E-07	7.07E-09	7.38E-10	1.24E-04	3.21E-05	2.36E-07	2.46E-08
14	Sacramento	3.2	1.11E-06	3,000	730	7.39E-06	1.91E-06	1.40E-08	1.46E-09	2.46E-04	6.37E-05	4.67E-07	4.88E-08
15	North Highlands	2.6	8.96E-07	1,000	730	5.94E-06	1.54E-06	1.13E-08	1.18E-09	1.98E-04	5.12E-05	3.75E-07	3.92E-08
16	North Highlands	4.4	1.52E-06	3,000	730	1.01E-05	2.60E-06	1.91E-08	1.99E-09	3.35E-04	8.67E-05	6.36E-07	6.64E-08
17	Roseville Yard	1.4	4.72E-07	100	730	3.13E-06	8.10E-07	5.94E-09	6.20E-10	1.04E-04	2.70E-05	1.98E-07	2.07E-08
18	Roseville	1.2	3.25E-07	1,000	730	2.41E-06	6.24E-07	4.58E-09	4.78E-10	8.05E-05	2.08E-05	1.53E-07	1.59E-08
19	Roseville	1.4	3.98E-07	3,000	730	2.96E-06	7.65E-07	5.61E-09	5.86E-10	9.87E-05	2.55E-05	1.87E-07	1.95E-08
20	Roseville	2.3	6.44E-07	3,000	730	4.79E-06	1.24E-06	9.08E-09	9.48E-10	1.60E-04	4.13E-05	3.03E-07	3.16E-08
21	Placer Co	1.3	3.62E-07	1,000	730	2.69E-06	6.95E-07	5.09E-09	5.32E-10	8.96E-05	2.32E-05	1.70E-07	1.77E-08
22	Placer Co	0.1	4.19E-08	100	730	3.11E-07	8.04E-08	5.90E-10	6.16E-11	1.04E-05	2.68E-06	1.97E-08	2.05E-09
23	Placer Co	2.9	8.26E-07	1,000	730	6.14E-06	1.59E-06	1.16E-08	1.22E-09	2.05E-04	5.29E-05	3.88E-07	4.05E-08
24	Lincoln	1.2	3.37E-07	100	730	2.51E-06	6.48E-07	4.75E-09	4.96E-10	8.36E-05	2.16E-05	1.58E-07	1.65E-08
25	Lincoln	2.9	8.10E-07	3,000	730	6.02E-06	1.56E-06	1.14E-08	1.19E-09	2.01E-04	5.19E-05	3.80E-07	3.97E-08
26	Sheridan	10.7	3.01E-06	100	730	2.24E-05	5.79E-06	4.24E-08	4.43E-09	7.46E-04	1.93E-04	1.41E-06	1.48E-07
27	Wheatland	0.9	2.63E-07	1,000	730	1.95E-06	5.05E-07	3.71E-09	3.87E-10	6.51E-05	1.68E-05	1.24E-07	1.29E-08
28	Yuba County	9.2	2.61E-06	100	730	1.94E-05	5.01E-06	3.68E-08	3.84E-09	6.46E-04	1.67E-04	1.23E-06	1.28E-07

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	730	8.94E-06	2.31E-06	1.70E-08	1.77E-09	2.98E-04	7.71E-05	5.65E-07	5.90E-08
30	Marysville	1.3	3.76E-07	3,000	730	2.79E-06	7.22E-07	5.29E-09	5.53E-10	9.31E-05	2.41E-05	1.76E-07	1.84E-08
31	Marysville	2.3	6.56E-07	100	730	4.87E-06	1.26E-06	9.24E-09	9.65E-10	1.62E-04	4.20E-05	3.08E-07	3.22E-08
32	Live Oak	0.3	9.29E-08	1,000	730	6.90E-07	1.78E-07	1.31E-09	1.37E-10	2.30E-05	5.95E-06	4.36E-08	4.56E-09
33	Live Oak	6.4	1.81E-06	100	730	1.35E-05	3.49E-06	2.56E-08	2.67E-09	4.49E-04	1.16E-04	8.52E-07	8.90E-08
34	Live Oak	0.4	1.03E-07	1,000	730	7.69E-07	1.99E-07	1.46E-09	1.52E-10	2.56E-05	6.63E-06	4.86E-08	5.07E-09
35	Live Oak	1.0	2.86E-07	3,000	730	2.13E-06	5.50E-07	4.03E-09	4.21E-10	7.09E-05	1.83E-05	1.34E-07	1.40E-08
36	Butte Co	5.2	1.48E-06	100	730	1.10E-05	2.84E-06	2.08E-08	2.17E-09	3.65E-04	9.45E-05	6.93E-07	7.24E-08
37	Gridley	0.5	1.29E-07	1,000	730	9.55E-07	2.47E-07	1.81E-09	1.89E-10	3.18E-05	8.23E-06	6.04E-08	6.30E-09
38	Gridley	0.8	2.34E-07	3,000	730	1.74E-06	4.50E-07	3.30E-09	3.44E-10	5.80E-05	1.50E-05	1.10E-07	1.15E-08
39	Gridley	2.5	7.08E-07	100	730	5.26E-06	1.36E-06	9.98E-09	1.04E-09	1.75E-04	4.54E-05	3.33E-07	3.47E-08
40	Biggs	0.6	1.62E-07	3,000	730	1.20E-06	3.11E-07	2.28E-09	2.38E-10	4.01E-05	1.04E-05	7.60E-08	7.94E-09
41	Butte Co	5.1	1.45E-06	100	730	1.08E-05	2.79E-06	2.04E-08	2.13E-09	3.59E-04	9.29E-05	6.81E-07	7.11E-08
42	Richvale	0.8	2.36E-07	1,000	730	1.75E-06	4.54E-07	3.33E-09	3.47E-10	5.85E-05	1.51E-05	1.11E-07	1.16E-08
43	Nelson	9.3	2.62E-06	100	730	1.95E-05	5.04E-06	3.69E-08	3.86E-09	6.49E-04	1.68E-04	1.23E-06	1.29E-07
44	Durham	2.4	6.89E-07	1,000	730	5.12E-06	1.32E-06	9.70E-09	1.01E-09	1.71E-04	4.41E-05	3.23E-07	3.38E-08
45	Chico	4.3	1.22E-06	100	730	9.07E-06	2.35E-06	1.72E-08	1.80E-09	3.02E-04	7.82E-05	5.73E-07	5.99E-08
46	Chico	4.5	1.27E-06	1,000	730	9.47E-06	2.45E-06	1.80E-08	1.88E-09	3.16E-04	8.17E-05	5.99E-07	6.25E-08
47	Chico	2.8	7.91E-07	100	730	5.88E-06	1.52E-06	1.12E-08	1.16E-09	1.96E-04	5.07E-05	3.72E-07	3.88E-08
48	Nord	0.6	1.65E-07	1,000	730	1.22E-06	3.17E-07	2.32E-09	2.42E-10	4.08E-05	1.06E-05	7.74E-08	8.08E-09
49	Butte Co	11.3	3.20E-06	100	730	2.38E-05	6.16E-06	4.51E-08	4.71E-09	7.94E-04	2.05E-04	1.50E-06	1.57E-07
50	Vina	0.4	1.26E-07	1,000	730	9.36E-07	2.42E-07	1.77E-09	1.85E-10	3.12E-05	8.07E-06	5.92E-08	6.18E-09
51	Copeland	6.3	1.78E-06	100	730	1.32E-05	3.42E-06	2.51E-08	2.62E-09	4.41E-04	1.14E-04	8.37E-07	8.74E-08
52	Los Molinos	0.5	1.47E-07	1,000	730	1.09E-06	2.82E-07	2.07E-09	2.16E-10	3.64E-05	9.40E-06	6.89E-08	7.20E-09
53	Los Molinos	1.0	2.81E-07	100	730	2.08E-06	5.39E-07	3.95E-09	4.13E-10	6.95E-05	1.80E-05	1.32E-07	1.38E-08
54	Tehema	0.3	9.39E-08	1,000	730	6.98E-07	1.80E-07	1.32E-09	1.38E-10	2.33E-05	6.02E-06	4.41E-08	4.61E-09
55	Tehema	2.2	6.32E-07	100	730	4.70E-06	1.21E-06	8.90E-09	9.30E-10	1.57E-04	4.05E-05	2.97E-07	3.10E-08
56	Gerber	2.3	6.54E-07	1,000	730	4.86E-06	1.26E-06	9.21E-09	9.62E-10	1.62E-04	4.19E-05	3.07E-07	3.21E-08

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 50 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	730	3.75E-06	9.70E-07	7.11E-09	7.43E-10	1.25E-04	3.23E-05	2.37E-07	2.48E-08
58	Red Bluff	0.8	2.18E-07	1,000	730	1.62E-06	4.19E-07	3.07E-09	3.21E-10	5.40E-05	1.40E-05	1.02E-07	1.07E-08
59	Red Bluff	4.6	1.31E-06	100	730	9.72E-06	2.51E-06	1.84E-08	1.92E-09	3.24E-04	8.37E-05	6.14E-07	6.41E-08
60	Red Bluff	3.3	9.27E-07	1,000	730	6.89E-06	1.78E-06	1.31E-08	1.36E-09	2.30E-04	5.94E-05	4.36E-07	4.55E-08
61	Tehema Co	15.3	4.32E-06	100	730	3.21E-05	8.30E-06	6.08E-08	6.35E-09	1.07E-03	2.77E-04	2.03E-06	2.12E-07
62	Cottonwood	0.6	1.72E-07	1,000	730	1.28E-06	3.31E-07	2.43E-09	2.53E-10	4.27E-05	1.10E-05	8.09E-08	8.45E-09
63	Anderson	5.4	1.51E-06	100	730	1.12E-05	2.91E-06	2.13E-08	2.23E-09	3.75E-04	9.70E-05	7.11E-07	7.42E-08
64	Anderson	3.5	1.00E-06	1,000	730	7.44E-06	1.93E-06	1.41E-08	1.47E-09	2.48E-04	6.42E-05	4.70E-07	4.91E-08
65	Anderson	4.1	1.15E-06	100	730	8.57E-06	2.22E-06	1.63E-08	1.70E-09	2.86E-04	7.39E-05	5.42E-07	5.66E-08
66	Redding	6.0	1.71E-06	1,000	730	1.27E-05	3.28E-06	2.40E-08	2.51E-09	4.23E-04	1.09E-04	8.02E-07	8.37E-08
67	Redding	0.8	2.15E-07	1,000	730	1.60E-06	4.14E-07	3.03E-09	3.17E-10	5.33E-05	1.38E-05	1.01E-07	1.06E-08
68	Redding	1.1	3.19E-07	100	730	2.37E-06	6.13E-07	4.50E-09	4.70E-10	7.90E-05	2.04E-05	1.50E-07	1.57E-08
69	Redding	0.4	1.10E-07	1,000	730	8.20E-07	2.12E-07	1.55E-09	1.62E-10	2.73E-05	7.07E-06	5.18E-08	5.41E-09
70	Redding	2.6	7.29E-07	100	730	5.42E-06	1.40E-06	1.03E-08	1.07E-09	1.81E-04	4.67E-05	3.42E-07	3.58E-08
71	Shasta Co	0.5	1.48E-07	1,000	730	1.10E-06	2.84E-07	2.08E-09	2.17E-10	3.66E-05	9.46E-06	6.94E-08	7.24E-09
72	Shasta Lake	1.7	4.66E-07	100	730	3.46E-06	8.96E-07	6.57E-09	6.86E-10	1.15E-04	2.99E-05	2.19E-07	2.29E-08
73	Shasta Lake	0.8	2.12E-07	1,000	730	1.58E-06	4.08E-07	2.99E-09	3.12E-10	5.25E-05	1.36E-05	9.96E-08	1.04E-08
74	Shasta Co	16.4	4.64E-06	100	730	3.45E-05	8.93E-06	6.54E-08	6.83E-09	1.15E-03	2.98E-04	2.18E-06	2.28E-07
75	Lakeshore	0.6	1.71E-07	1,000	730	1.27E-06	3.29E-07	2.42E-09	2.52E-10	4.25E-05	1.10E-05	8.05E-08	8.41E-09
76	Shasta Co	28.7	8.10E-06	100	730	6.02E-05	1.56E-05	1.14E-07	1.19E-08	2.01E-03	5.19E-04	3.80E-06	3.97E-07
77	Dunsmuir	1.3	3.68E-07	1,000	730	2.74E-06	7.07E-07	5.19E-09	5.42E-10	9.12E-05	2.36E-05	1.73E-07	1.81E-08
78	Siskiyou Co	12.8	3.61E-06	100	730	2.68E-05	6.93E-06	5.08E-08	5.31E-09	8.93E-04	2.31E-04	1.69E-06	1.77E-07
79	Mount Shasta	1.1	3.19E-07	1,000	730	2.37E-06	6.14E-07	4.50E-09	4.70E-10	7.91E-05	2.05E-05	1.50E-07	1.57E-08
80	Siskiyou Co	64.5	1.82E-05	100	730	1.35E-04	3.50E-05	2.57E-07	2.68E-08	4.51E-03	1.17E-03	8.56E-06	8.94E-07
81	Dorris	0.9	2.49E-07	100	730	1.85E-06	4.79E-07	3.51E-09	3.67E-10	6.17E-05	1.60E-05	1.17E-07	1.22E-08
82	Siskiyou Co	3.4	9.64E-07	1,000	730	7.16E-06	1.85E-06	1.36E-08	1.42E-09	2.39E-04	6.17E-05	4.53E-07	4.73E-08
Total/Weighted Average		368.8	1.09E-04			7.89E-04	2.04E-04	1.50E-06	1.56E-07	2.63E-02	6.80E-03	4.99E-05	5.21E-06
Return Period			9,188			1,268	4,902	668,594	6,402,291	38	147	20,058	192,069

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	730	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	730	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	730	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	730	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	730	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	730	4.93E-06	1.27E-06	9.34E-09	9.75E-10	1.64E-04	4.25E-05	3.11E-07	3.25E-08
7	Solano Co Ag	6.6	2.30E-06	100	730	1.52E-05	3.93E-06	2.88E-08	3.01E-09	5.07E-04	1.31E-04	9.62E-07	1.00E-07
8	Davis	3.5	1.23E-06	1,000	730	8.13E-06	2.10E-06	1.54E-08	1.61E-09	2.71E-04	7.00E-05	5.14E-07	5.36E-08
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.61E-05	4.16E-06	3.05E-08	3.19E-09	5.36E-04	1.39E-04	1.02E-06	1.06E-07
10	Sacramento	3.3	1.13E-06	3,000	730	7.48E-06	1.93E-06	1.42E-08	1.48E-09	2.49E-04	6.45E-05	4.73E-07	4.94E-08
11	Sacramento River	0.4	1.46E-07	100	730	9.67E-07	2.50E-07	1.83E-09	1.92E-10	3.22E-05	8.34E-06	6.11E-08	6.39E-09
12	Sacramento	2.5	8.54E-07	10,000	730	5.66E-06	1.46E-06	1.07E-08	1.12E-09	1.89E-04	4.88E-05	3.58E-07	3.74E-08
13	Parkland	1.6	5.63E-07	100	730	3.73E-06	9.64E-07	7.07E-09	7.38E-10	1.24E-04	3.21E-05	2.36E-07	2.46E-08
14	Sacramento	3.2	1.11E-06	3,000	730	7.39E-06	1.91E-06	1.40E-08	1.46E-09	2.46E-04	6.37E-05	4.67E-07	4.88E-08
15	North Highlands	2.6	8.96E-07	1,000	730	5.94E-06	1.54E-06	1.13E-08	1.18E-09	1.98E-04	5.12E-05	3.75E-07	3.92E-08
16	North Highlands	4.4	1.52E-06	3,000	730	1.01E-05	2.60E-06	1.91E-08	1.99E-09	3.35E-04	8.67E-05	6.36E-07	6.64E-08
17	Roseville Yard	1.4	4.72E-07	100	730	3.13E-06	8.10E-07	5.94E-09	6.20E-10	1.04E-04	2.70E-05	1.98E-07	2.07E-08
18	Roseville	1.2	1.82E-06	1,000	365	6.70E-06	1.32E-06	9.36E-09	2.66E-09	2.23E-04	4.39E-05	3.12E-07	8.87E-08
19	Roseville	1.4	2.23E-06	3,000	365	8.22E-06	1.61E-06	1.15E-08	3.26E-09	2.74E-04	5.38E-05	3.82E-07	1.09E-07
20	Roseville	1.1	1.74E-06	3,000	365	6.41E-06	1.26E-06	8.95E-09	2.55E-09	2.14E-04	4.20E-05	2.98E-07	8.48E-08
21	Roseville	2.5	3.88E-06	1,000	365	1.43E-05	2.80E-06	1.99E-08	5.67E-09	4.76E-04	9.35E-05	6.65E-07	1.89E-07
22	Roseville	0.5	7.16E-07	100	365	2.64E-06	5.18E-07	3.68E-09	1.05E-09	8.79E-05	1.73E-05	1.23E-07	3.49E-08
23	Rocklin	2.5	3.98E-06	1,000	365	1.46E-05	2.88E-06	2.04E-08	5.82E-09	4.88E-04	9.59E-05	6.82E-07	1.94E-07
24	Placer Co	8.0	1.26E-05	100	365	4.65E-05	9.13E-06	6.49E-08	1.85E-08	1.55E-03	3.04E-04	2.16E-06	6.15E-07
25	Newcastle	0.5	7.14E-07	3,000	365	2.63E-06	5.16E-07	3.67E-09	1.04E-09	8.77E-05	1.72E-05	1.22E-07	3.48E-08
26	Placer Co	2.5	3.97E-06	100	365	1.46E-05	2.87E-06	2.04E-08	5.80E-09	4.87E-04	9.56E-05	6.80E-07	1.93E-07
27	Auburn	5.3	8.45E-06	1,000	365	3.11E-05	6.11E-06	4.34E-08	1.23E-08	1.04E-03	2.04E-04	1.45E-06	4.11E-07
28	Placer Co	13.6	2.15E-05	100	365	7.92E-05	1.56E-05	1.11E-07	3.15E-08	2.64E-03	5.19E-04	3.69E-06	1.05E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	1.07E-06	1,000	365	3.93E-06	7.72E-07	5.48E-09	1.56E-09	1.31E-04	2.57E-05	1.83E-07	5.20E-08
30	Placer Co	57.4	9.09E-05	3,000	365	3.35E-04	6.57E-05	4.67E-07	1.33E-07	1.12E-02	2.19E-03	1.56E-05	4.43E-06
31	Truckee	2.1	3.36E-06	100	365	1.24E-05	2.43E-06	1.73E-08	4.91E-09	4.12E-04	8.09E-05	5.75E-07	1.64E-07
32	Nevada Co	13.9	2.20E-05	1,000	365	8.09E-05	1.59E-05	1.13E-07	3.21E-08	2.70E-03	5.29E-04	3.76E-06	1.07E-06
33	Floriston	0.2	3.67E-07	100	365	1.35E-06	2.65E-07	1.88E-09	5.36E-10	4.50E-05	8.83E-06	6.28E-08	1.79E-08
34	Sierra Co	5.8	9.17E-06	1,000	365	3.38E-05	6.63E-06	4.71E-08	1.34E-08	1.13E-03	2.21E-04	1.57E-06	4.47E-07
Total/Weighted Average		190.9	2.13E-04			8.59E-04	1.79E-04	1.28E-06	3.08E-07	2.86E-02	5.97E-03	4.27E-05	1.03E-05
Return Period			4,686			1,164	5,586	779,934	3,244,637	35	168	23,398	97,339

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	1.83E-06	1,000	730	7.75E-06	2.00E-06	1.47E-08	1.53E-09	2.58E-04	6.68E-05	4.90E-07	5.11E-08
2	Benicia	2.6	1.78E-06	1,000	730	7.57E-06	1.96E-06	1.44E-08	1.50E-09	2.52E-04	6.53E-05	4.78E-07	5.00E-08
3	Grizzly Bay	10.6	7.35E-06	100	730	3.12E-05	8.06E-06	5.91E-08	6.17E-09	1.04E-03	2.69E-04	1.97E-06	2.06E-07
4	Fairfield	3.8	2.65E-06	3,000	730	1.13E-05	2.91E-06	2.13E-08	2.23E-09	3.75E-04	9.70E-05	7.11E-07	7.43E-08
5	Elmira	13.7	9.51E-06	100	730	4.04E-05	1.04E-05	7.65E-08	7.99E-09	1.35E-03	3.48E-04	2.55E-06	2.66E-07
6	Dixon	2.1	1.49E-06	1,000	730	6.30E-06	1.63E-06	1.20E-08	1.25E-09	2.10E-04	5.43E-05	3.98E-07	4.16E-08
7	Solano Co Ag	6.6	4.59E-06	100	730	1.95E-05	5.03E-06	3.69E-08	3.85E-09	6.49E-04	1.68E-04	1.23E-06	1.28E-07
8	Davis	3.5	2.45E-06	1,000	730	1.04E-05	2.69E-06	1.97E-08	2.06E-09	3.47E-04	8.96E-05	6.57E-07	6.86E-08
9	Yolo Co Ag	7.0	4.85E-06	100	730	2.06E-05	5.32E-06	3.90E-08	4.08E-09	6.86E-04	1.77E-04	1.30E-06	1.36E-07
10	Sacramento	3.3	2.26E-06	3,000	730	9.57E-06	2.48E-06	1.81E-08	1.90E-09	3.19E-04	8.25E-05	6.05E-07	6.32E-08
11	Sacramento River	0.4	2.92E-07	100	730	1.24E-06	3.20E-07	2.35E-09	2.45E-10	4.13E-05	1.07E-05	7.82E-08	8.17E-09
12	Sacramento	2.5	1.71E-06	10,000	730	7.25E-06	1.87E-06	1.37E-08	1.43E-09	2.42E-04	6.25E-05	4.58E-07	4.78E-08
13	Parkland	1.6	1.13E-06	100	730	4.77E-06	1.23E-06	9.05E-09	9.45E-10	1.59E-04	4.11E-05	3.02E-07	3.15E-08
14	Sacramento	3.2	2.23E-06	3,000	730	9.45E-06	2.45E-06	1.79E-08	1.87E-09	3.15E-04	8.15E-05	5.98E-07	6.24E-08
15	North Highlands	2.6	1.79E-06	1,000	730	7.60E-06	1.97E-06	1.44E-08	1.50E-09	2.53E-04	6.55E-05	4.80E-07	5.02E-08
16	North Highlands	4.4	3.03E-06	3,000	730	1.29E-05	3.33E-06	2.44E-08	2.55E-09	4.29E-04	1.11E-04	8.13E-07	8.50E-08
17	Roseville Yard	1.4	9.44E-07	100	730	4.01E-06	1.04E-06	7.60E-09	7.93E-10	1.34E-04	3.45E-05	2.53E-07	2.64E-08
18	Roseville	1.2	7.26E-07	1,000	365	3.43E-06	1.33E-06	1.65E-07	1.05E-07	1.14E-04	4.43E-05	5.51E-06	3.49E-06
19	Roseville	1.4	8.90E-07	3,000	365	4.20E-06	1.63E-06	2.03E-07	1.29E-07	1.40E-04	5.43E-05	6.75E-06	4.28E-06
20	Roseville	2.3	1.44E-06	3,000	365	6.79E-06	2.63E-06	3.28E-07	2.08E-07	2.26E-04	8.77E-05	1.09E-05	6.93E-06
21	Placer Co	1.3	8.08E-07	1,000	365	3.81E-06	1.48E-06	1.84E-07	1.17E-07	1.27E-04	4.93E-05	6.13E-06	3.89E-06
22	Placer Co	0.1	9.36E-08	100	365	4.41E-07	1.71E-07	2.13E-08	1.35E-08	1.47E-05	5.70E-06	7.10E-07	4.50E-07
23	Placer Co	2.9	1.85E-06	1,000	365	8.71E-06	3.37E-06	4.20E-07	2.66E-07	2.90E-04	1.12E-04	1.40E-05	8.88E-06
24	Lincoln	1.2	7.54E-07	100	365	3.56E-06	1.38E-06	1.72E-07	1.09E-07	1.19E-04	4.60E-05	5.72E-06	3.63E-06
25	Lincoln	2.9	1.81E-06	3,000	365	8.54E-06	3.31E-06	4.12E-07	2.61E-07	2.85E-04	1.10E-04	1.37E-05	8.71E-06
26	Sheridan	10.7	6.73E-06	100	365	3.18E-05	1.23E-05	1.53E-06	9.72E-07	1.06E-03	4.10E-04	5.11E-05	3.24E-05
27	Wheatland	0.9	5.88E-07	1,000	365	2.77E-06	1.07E-06	1.34E-07	8.49E-08	9.24E-05	3.58E-05	4.46E-06	2.83E-06
28	Yuba County	9.2	5.83E-06	100	365	2.75E-05	1.07E-05	1.33E-06	8.42E-07	9.17E-04	3.55E-04	4.42E-05	2.81E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.69E-06	1,000	365	1.27E-05	4.92E-06	6.12E-07	3.88E-07	4.23E-04	1.64E-04	2.04E-05	1.29E-05
30	Marysville	1.3	8.40E-07	3,000	365	3.96E-06	1.54E-06	1.91E-07	1.21E-07	1.32E-04	5.12E-05	6.37E-06	4.04E-06
31	Marysville	0.3	1.90E-07	100	365	8.96E-07	3.47E-07	4.32E-08	2.74E-08	2.99E-05	1.16E-05	1.44E-06	9.14E-07
32	Marysville	0.4	2.35E-07	1,000	365	1.11E-06	4.30E-07	5.35E-08	3.39E-08	3.70E-05	1.43E-05	1.78E-06	1.13E-06
33	Yuba County	0.7	4.74E-07	100	365	2.23E-06	8.66E-07	1.08E-07	6.84E-08	7.45E-05	2.89E-05	3.59E-06	2.28E-06
34	Yuba County	0.2	9.69E-08	1,000	365	4.57E-07	1.77E-07	2.20E-08	1.40E-08	1.52E-05	5.91E-06	7.35E-07	4.66E-07
35	Yuba County	0.8	4.77E-07	3,000	365	2.25E-06	8.72E-07	1.09E-07	6.89E-08	7.50E-05	2.91E-05	3.62E-06	2.30E-06
36	Yuba County	0.3	1.88E-07	100	365	8.87E-07	3.44E-07	4.28E-08	2.72E-08	2.96E-05	1.15E-05	1.43E-06	9.05E-07
37	Yuba/Butte County	16.3	1.03E-05	1,000	365	4.87E-05	1.89E-05	2.35E-06	1.49E-06	1.62E-03	6.29E-04	7.83E-05	4.97E-05
38	Palermo	4.2	2.65E-06	3,000	365	1.25E-05	4.85E-06	6.03E-07	3.83E-07	4.17E-04	1.62E-04	2.01E-05	1.28E-05
39	Butte County	1.1	6.69E-07	100	365	3.16E-06	1.22E-06	1.52E-07	9.66E-08	1.05E-04	4.08E-05	5.08E-06	3.22E-06
40	South Oroville	2.4	1.52E-06	3,000	365	7.18E-06	2.78E-06	3.46E-07	2.20E-07	2.39E-04	9.27E-05	1.15E-05	7.32E-06
41	Oroville	0.9	5.37E-07	100	365	2.53E-06	9.81E-07	1.22E-07	7.75E-08	8.44E-05	3.27E-05	4.07E-06	2.58E-06
42	Oroville	1.3	8.40E-07	1,000	365	3.96E-06	1.54E-06	1.91E-07	1.21E-07	1.32E-04	5.12E-05	6.37E-06	4.04E-06
43	Thermolito Div.	0.1	5.93E-08	100	365	2.80E-07	1.08E-07	1.35E-08	8.56E-09	9.32E-06	3.61E-06	4.50E-07	2.85E-07
44	Butte County	1.4	9.03E-07	1,000	365	4.26E-06	1.65E-06	2.05E-07	1.30E-07	1.42E-04	5.50E-05	6.85E-06	4.35E-06
45	Feather Canyon	53.9	3.40E-05	100	365	1.60E-04	6.22E-05	7.74E-06	4.91E-06	5.35E-03	2.07E-03	2.58E-04	1.64E-04
46	Hallsted	1.5	9.54E-07	1,000	365	4.50E-06	1.74E-06	2.17E-07	1.38E-07	1.50E-04	5.81E-05	7.23E-06	4.59E-06
47	Plumas County	12.5	7.89E-06	100	365	3.72E-05	1.44E-05	1.80E-06	1.14E-06	1.24E-03	4.81E-04	5.99E-05	3.80E-05
48	Spanish Creek	0.5	3.04E-07	1,000	365	1.44E-06	5.57E-07	6.93E-08	4.39E-08	4.79E-05	1.86E-05	2.31E-06	1.46E-06
49	Plumas County	1.6	1.03E-06	100	365	4.85E-06	1.88E-06	2.34E-07	1.49E-07	1.62E-04	6.27E-05	7.81E-06	4.95E-06
50	Quincy	3.6	2.30E-06	1,000	365	1.08E-05	4.20E-06	5.23E-07	3.32E-07	3.61E-04	1.40E-04	1.74E-05	1.11E-05
51	Plumas County	4.6	2.89E-06	100	365	1.36E-05	5.28E-06	6.57E-07	4.17E-07	4.54E-04	1.76E-04	2.19E-05	1.39E-05
52	Spring Garden	0.3	1.99E-07	1,000	365	9.40E-07	3.64E-07	4.53E-08	2.88E-08	3.13E-05	1.21E-05	1.51E-06	9.59E-07
53	Plumas County	5.9	3.74E-06	100	365	1.76E-05	6.83E-06	8.51E-07	5.40E-07	5.88E-04	2.28E-04	2.84E-05	1.80E-05
54	Twentymile House	2.3	1.48E-06	1,000	365	6.97E-06	2.70E-06	3.36E-07	2.13E-07	2.32E-04	9.00E-05	1.12E-05	7.11E-06
55	Plumas County	2.4	1.54E-06	100	365	7.27E-06	2.82E-06	3.51E-07	2.22E-07	2.42E-04	9.39E-05	1.17E-05	7.41E-06
56	Blairsden	6.7	4.26E-06	1,000	365	2.01E-05	7.78E-06	9.68E-07	6.14E-07	6.69E-04	2.59E-04	3.23E-05	2.05E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	1.13E-06	100	365	5.33E-06	2.07E-06	2.57E-07	1.63E-07	1.78E-04	6.89E-05	8.57E-06	5.44E-06
58	Plumas Golf	1.1	7.20E-07	1,000	365	3.40E-06	1.32E-06	1.64E-07	1.04E-07	1.13E-04	4.39E-05	5.46E-06	3.46E-06
59	Plumas County	1.8	1.16E-06	100	365	5.45E-06	2.11E-06	2.63E-07	1.67E-07	1.82E-04	7.04E-05	8.76E-06	5.56E-06
60	Portola	3.5	2.23E-06	1,000	365	1.05E-05	4.08E-06	5.07E-07	3.22E-07	3.50E-04	1.36E-04	1.69E-05	1.07E-05
61	Plumas County	14.9	9.38E-06	100	365	4.42E-05	1.71E-05	2.13E-06	1.35E-06	1.47E-03	5.71E-04	7.11E-05	4.51E-05
62	Chilcoot	1.8	1.16E-06	1,000	365	5.48E-06	2.12E-06	2.64E-07	1.68E-07	1.83E-04	7.08E-05	8.81E-06	5.59E-06
63	Lassen County	19.2	1.21E-05	100	365	5.71E-05	2.21E-05	2.75E-06	1.75E-06	1.90E-03	7.37E-04	9.18E-05	5.82E-05
64	Doyle	1.2	7.64E-07	1,000	365	3.60E-06	1.40E-06	1.74E-07	1.10E-07	1.20E-04	4.66E-05	5.79E-06	3.68E-06
65	Lassen County	8.0	5.03E-06	100	365	2.37E-05	9.20E-06	1.15E-06	7.27E-07	7.91E-04	3.07E-04	3.82E-05	2.42E-05
66	Herlong	4.5	2.82E-06	1,000	365	1.33E-05	5.16E-06	6.42E-07	4.08E-07	4.44E-04	1.72E-04	2.14E-05	1.36E-05
67	Lassen County	5.2	3.28E-06	1,000	365	1.55E-05	6.00E-06	7.47E-07	4.74E-07	5.16E-04	2.00E-04	2.49E-05	1.58E-05
Total/Weighted Average		190.9	1.94E-04			8.94E-04	3.19E-04	3.33E-05	2.09E-05	2.98E-02	1.06E-02	1.11E-03	6.97E-04
Return Period			5,142			1,119	3,134	30,033	47,810	34	94	901	1,434

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	730	6.05E-06	2.35E-06	2.92E-07	1.85E-07	2.02E-04	7.82E-05	9.73E-06	6.18E-06
2	Benicia	2.6	8.92E-07	1,000	730	5.92E-06	2.29E-06	2.85E-07	1.81E-07	1.97E-04	7.64E-05	9.51E-06	6.04E-06
3	Grizzly Bay	10.6	3.67E-06	100	730	2.44E-05	9.44E-06	1.17E-06	7.45E-07	8.12E-04	3.15E-04	3.92E-05	2.48E-05
4	Fairfield	3.8	1.33E-06	3,000	730	8.79E-06	3.41E-06	4.24E-07	2.69E-07	2.93E-04	1.14E-04	1.41E-05	8.97E-06
5	Elmira	13.7	4.76E-06	100	730	3.15E-05	1.22E-05	1.52E-06	9.65E-07	1.05E-03	4.07E-04	5.07E-05	3.22E-05
6	Dixon	2.1	7.43E-07	1,000	730	4.93E-06	1.91E-06	2.38E-07	1.51E-07	1.64E-04	6.36E-05	7.92E-06	5.03E-06
7	Solano Co Ag	6.6	2.30E-06	100	730	1.52E-05	5.90E-06	7.34E-07	4.66E-07	5.07E-04	1.97E-04	2.45E-05	1.55E-05
8	Davis	3.5	1.23E-06	1,000	730	8.13E-06	3.15E-06	3.92E-07	2.49E-07	2.71E-04	1.05E-04	1.31E-05	8.29E-06
9	Yolo Co Ag	7.0	2.43E-06	100	730	1.61E-05	6.24E-06	7.76E-07	4.93E-07	5.36E-04	2.08E-04	2.59E-05	1.64E-05
10	Sacramento	3.3	1.13E-06	3,000	730	7.48E-06	2.90E-06	3.61E-07	2.29E-07	2.49E-04	9.67E-05	1.20E-05	7.63E-06
11	Sacramento River	0.4	1.46E-07	100	730	9.67E-07	3.75E-07	4.67E-08	2.96E-08	3.22E-05	1.25E-05	1.56E-06	9.87E-07
12	Sacramento	2.5	8.54E-07	10,000	730	5.66E-06	2.19E-06	2.73E-07	1.73E-07	1.89E-04	7.32E-05	9.11E-06	5.78E-06
13	Parkland	1.6	5.63E-07	100	730	3.73E-06	1.45E-06	1.80E-07	1.14E-07	1.24E-04	4.82E-05	6.00E-06	3.80E-06
14	Sacramento	3.2	1.11E-06	3,000	730	7.39E-06	2.86E-06	3.56E-07	2.26E-07	2.46E-04	9.55E-05	1.19E-05	7.54E-06
15	North Highlands	2.6	8.96E-07	1,000	730	5.94E-06	2.30E-06	2.86E-07	1.82E-07	1.98E-04	7.67E-05	9.55E-06	6.06E-06
16	North Highlands	4.4	1.52E-06	3,000	730	1.01E-05	3.90E-06	4.85E-07	3.08E-07	3.35E-04	1.30E-04	1.62E-05	1.03E-05
17	Roseville Yard	1.4	4.72E-07	100	730	3.13E-06	1.21E-06	1.51E-07	9.58E-08	1.04E-04	4.04E-05	5.03E-06	3.19E-06
18	Roseville	1.2	6.50E-07	1,000	365	3.10E-06	1.20E-06	1.50E-07	9.50E-08	1.03E-04	4.01E-05	4.99E-06	3.17E-06
19	Roseville	1.4	7.97E-07	3,000	365	3.80E-06	1.47E-06	1.84E-07	1.16E-07	1.27E-04	4.92E-05	6.12E-06	3.88E-06
20	Roseville	2.3	1.29E-06	3,000	365	6.15E-06	2.38E-06	2.97E-07	1.88E-07	2.05E-04	7.95E-05	9.89E-06	6.28E-06
21	Placer Co	1.3	7.23E-07	1,000	365	3.45E-06	1.34E-06	1.67E-07	1.06E-07	1.15E-04	4.46E-05	5.55E-06	3.52E-06
22	Placer Co	0.1	8.37E-08	100	365	4.00E-07	1.55E-07	1.93E-08	1.22E-08	1.33E-05	5.17E-06	6.43E-07	4.08E-07
23	Placer Co	2.9	1.65E-06	1,000	365	7.89E-06	3.06E-06	3.80E-07	2.41E-07	2.63E-04	1.02E-04	1.27E-05	8.05E-06
24	Lincoln	1.2	6.75E-07	100	365	3.22E-06	1.25E-06	1.55E-07	9.86E-08	1.07E-04	4.16E-05	5.18E-06	3.29E-06
25	Lincoln	2.9	1.62E-06	3,000	365	7.74E-06	3.00E-06	3.73E-07	2.37E-07	2.58E-04	1.00E-04	1.24E-05	7.89E-06
26	Sheridan	10.7	6.02E-06	100	365	2.88E-05	1.12E-05	1.39E-06	8.81E-07	9.59E-04	3.72E-04	4.63E-05	2.94E-05
27	Wheatland	0.9	5.26E-07	1,000	365	2.51E-06	9.74E-07	1.21E-07	7.69E-08	8.37E-05	3.25E-05	4.04E-06	2.56E-06
28	Yuba County	9.2	5.22E-06	100	365	2.49E-05	9.66E-06	1.20E-06	7.63E-07	8.31E-04	3.22E-04	4.01E-05	2.54E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	2.41E-06	1,000	365	1.15E-05	4.46E-06	5.55E-07	3.52E-07	3.83E-04	1.49E-04	1.85E-05	1.17E-05
30	Marysville	1.3	7.51E-07	3,000	365	3.59E-06	1.39E-06	1.73E-07	1.10E-07	1.20E-04	4.64E-05	5.77E-06	3.66E-06
31	Marysville	2.3	1.31E-06	100	365	6.26E-06	2.43E-06	3.02E-07	1.92E-07	2.09E-04	8.09E-05	1.01E-05	6.39E-06
32	Live Oak	0.3	1.86E-07	1,000	365	8.87E-07	3.44E-07	4.28E-08	2.72E-08	2.96E-05	1.15E-05	1.43E-06	9.05E-07
33	Live Oak	6.4	3.63E-06	100	365	1.73E-05	6.71E-06	8.36E-07	5.30E-07	5.77E-04	2.24E-04	2.79E-05	1.77E-05
34	Live Oak	0.4	2.07E-07	1,000	365	9.88E-07	3.83E-07	4.77E-08	3.02E-08	3.29E-05	1.28E-05	1.59E-06	1.01E-06
35	Live Oak	1.0	5.73E-07	3,000	365	2.74E-06	1.06E-06	1.32E-07	8.37E-08	9.12E-05	3.53E-05	4.40E-06	2.79E-06
36	Butte Co	5.2	2.95E-06	100	365	1.41E-05	5.46E-06	6.80E-07	4.31E-07	4.70E-04	1.82E-04	2.27E-05	1.44E-05
37	Gridley	0.5	2.57E-07	1,000	365	1.23E-06	4.76E-07	5.92E-08	3.76E-08	4.09E-05	1.59E-05	1.97E-06	1.25E-06
38	Gridley	0.8	4.68E-07	3,000	365	2.24E-06	8.67E-07	1.08E-07	6.84E-08	7.45E-05	2.89E-05	3.60E-06	2.28E-06
39	Gridley	2.5	1.42E-06	100	365	6.77E-06	2.62E-06	3.26E-07	2.07E-07	2.26E-04	8.74E-05	1.09E-05	6.90E-06
40	Biggs	0.6	3.24E-07	3,000	365	1.55E-06	5.99E-07	7.45E-08	4.73E-08	5.15E-05	2.00E-05	2.48E-06	1.58E-06
41	Butte Co	5.1	2.90E-06	100	365	1.38E-05	5.37E-06	6.68E-07	4.24E-07	4.62E-04	1.79E-04	2.23E-05	1.41E-05
42	Richvale	0.8	4.72E-07	1,000	365	2.25E-06	8.74E-07	1.09E-07	6.90E-08	7.52E-05	2.91E-05	3.63E-06	2.30E-06
43	Nelson	9.3	5.24E-06	100	365	2.50E-05	9.70E-06	1.21E-06	7.66E-07	8.34E-04	3.23E-04	4.03E-05	2.55E-05
44	Durham	2.4	1.38E-06	1,000	365	6.58E-06	2.55E-06	3.17E-07	2.01E-07	2.19E-04	8.50E-05	1.06E-05	6.71E-06
45	Chico	4.3	2.44E-06	100	365	1.17E-05	4.52E-06	5.62E-07	3.57E-07	3.89E-04	1.51E-04	1.87E-05	1.19E-05
46	Chico	4.5	2.55E-06	1,000	365	1.22E-05	4.72E-06	5.87E-07	3.73E-07	4.06E-04	1.57E-04	1.96E-05	1.24E-05
47	Chico	2.8	1.58E-06	100	365	7.56E-06	2.93E-06	3.65E-07	2.31E-07	2.52E-04	9.77E-05	1.22E-05	7.71E-06
48	Nord	0.6	3.29E-07	1,000	365	1.57E-06	6.10E-07	7.59E-08	4.82E-08	5.25E-05	2.03E-05	2.53E-06	1.61E-06
49	Butte Co	11.3	6.41E-06	100	365	3.06E-05	1.19E-05	1.48E-06	9.37E-07	1.02E-03	3.95E-04	4.92E-05	3.12E-05
50	Vina	0.4	2.52E-07	1,000	365	1.20E-06	4.66E-07	5.80E-08	3.68E-08	4.01E-05	1.55E-05	1.93E-06	1.23E-06
51	Copeland	6.3	3.56E-06	100	365	1.70E-05	6.60E-06	8.21E-07	5.21E-07	5.67E-04	2.20E-04	2.74E-05	1.74E-05
52	Los Molinos	0.5	2.94E-07	1,000	365	1.40E-06	5.43E-07	6.76E-08	4.29E-08	4.67E-05	1.81E-05	2.25E-06	1.43E-06
53	Los Molinos	1.0	5.61E-07	100	365	2.68E-06	1.04E-06	1.29E-07	8.20E-08	8.93E-05	3.46E-05	4.31E-06	2.73E-06
54	Tehema	0.3	1.88E-07	1,000	365	8.97E-07	3.48E-07	4.33E-08	2.75E-08	2.99E-05	1.16E-05	1.44E-06	9.15E-07
55	Tehema	2.2	1.26E-06	100	365	6.04E-06	2.34E-06	2.91E-07	1.85E-07	2.01E-04	7.80E-05	9.70E-06	6.16E-06
56	Gerber	2.3	1.31E-06	1,000	365	6.25E-06	2.42E-06	3.01E-07	1.91E-07	2.08E-04	8.07E-05	1.00E-05	6.37E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
DOT 117R Tank Cars – 100 Tank Car Unit Trains

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	1.01E-06	100	365	4.82E-06	1.87E-06	2.33E-07	1.48E-07	1.61E-04	6.23E-05	7.76E-06	4.92E-06
58	Red Bluff	0.8	4.36E-07	1,000	365	2.08E-06	8.07E-07	1.00E-07	6.37E-08	6.94E-05	2.69E-05	3.35E-06	2.12E-06
59	Red Bluff	4.6	2.61E-06	100	365	1.25E-05	4.84E-06	6.02E-07	3.82E-07	4.16E-04	1.61E-04	2.01E-05	1.27E-05
60	Red Bluff	3.3	1.85E-06	1,000	365	8.86E-06	3.43E-06	4.27E-07	2.71E-07	2.95E-04	1.14E-04	1.42E-05	9.04E-06
61	Tehema Co	15.3	8.63E-06	100	365	4.12E-05	1.60E-05	1.99E-06	1.26E-06	1.37E-03	5.33E-04	6.63E-05	4.21E-05
62	Cottonwood	0.6	3.44E-07	1,000	365	1.64E-06	6.37E-07	7.93E-08	5.03E-08	5.48E-05	2.12E-05	2.64E-06	1.68E-06
63	Anderson	5.4	3.03E-06	100	365	1.45E-05	5.60E-06	6.97E-07	4.43E-07	4.82E-04	1.87E-04	2.32E-05	1.48E-05
64	Anderson	3.5	2.00E-06	1,000	365	9.57E-06	3.71E-06	4.62E-07	2.93E-07	3.19E-04	1.24E-04	1.54E-05	9.76E-06
65	Anderson	4.1	2.31E-06	100	365	1.10E-05	4.27E-06	5.32E-07	3.37E-07	3.67E-04	1.42E-04	1.77E-05	1.12E-05
66	Redding	6.0	3.41E-06	1,000	365	1.63E-05	6.32E-06	7.86E-07	4.99E-07	5.43E-04	2.11E-04	2.62E-05	1.66E-05
67	Redding	0.8	4.30E-07	1,000	365	2.06E-06	7.97E-07	9.92E-08	6.29E-08	6.85E-05	2.66E-05	3.31E-06	2.10E-06
68	Redding	1.1	6.38E-07	100	365	3.05E-06	1.18E-06	1.47E-07	9.33E-08	1.02E-04	3.94E-05	4.90E-06	3.11E-06
69	Redding	0.4	2.21E-07	1,000	365	1.05E-06	4.09E-07	5.08E-08	3.23E-08	3.51E-05	1.36E-05	1.69E-06	1.08E-06
70	Redding	2.6	1.46E-06	100	365	6.96E-06	2.70E-06	3.36E-07	2.13E-07	2.32E-04	9.00E-05	1.12E-05	7.10E-06
71	Shasta Co	0.5	2.95E-07	1,000	365	1.41E-06	5.47E-07	6.81E-08	4.32E-08	4.70E-05	1.82E-05	2.27E-06	1.44E-06
72	Shasta Lake	1.7	9.32E-07	100	365	4.45E-06	1.73E-06	2.15E-07	1.36E-07	1.48E-04	5.75E-05	7.16E-06	4.54E-06
73	Shasta Lake	0.8	4.24E-07	1,000	365	2.03E-06	7.85E-07	9.77E-08	6.20E-08	6.75E-05	2.62E-05	3.26E-06	2.07E-06
74	Shasta Co	16.4	9.29E-06	100	365	4.44E-05	1.72E-05	2.14E-06	1.36E-06	1.48E-03	5.73E-04	7.13E-05	4.53E-05
75	Lakeshore	0.6	3.43E-07	1,000	365	1.64E-06	6.35E-07	7.90E-08	5.01E-08	5.46E-05	2.12E-05	2.63E-06	1.67E-06
76	Shasta Co	28.7	1.72E-05	100	365	8.19E-05	3.18E-05	3.95E-06	2.51E-06	2.73E-03	1.06E-03	1.32E-04	8.36E-05
77	Dunsmuir	1.3	7.36E-07	1,000	365	3.52E-06	1.36E-06	1.70E-07	1.08E-07	1.17E-04	4.54E-05	5.65E-06	3.59E-06
78	Siskiyou Co	12.8	7.21E-06	100	365	3.44E-05	1.34E-05	1.66E-06	1.05E-06	1.15E-03	4.45E-04	5.54E-05	3.51E-05
79	Mount Shasta	1.1	6.39E-07	1,000	365	3.05E-06	1.18E-06	1.47E-07	9.34E-08	1.02E-04	3.94E-05	4.91E-06	3.11E-06
80	Siskiyou Co	64.5	3.93E-05	100	365	1.88E-04	7.27E-05	9.05E-06	5.74E-06	6.25E-03	2.42E-03	3.02E-04	1.91E-04
81	Dorris	0.9	4.98E-07	100	365	2.38E-06	9.23E-07	1.15E-07	7.29E-08	7.93E-05	3.08E-05	3.83E-06	2.43E-06
82	Siskiyou Co	3.4	1.93E-06	1,000	365	9.20E-06	3.57E-06	4.44E-07	2.82E-07	3.07E-04	1.19E-04	1.48E-05	9.39E-06
Total/Weighted Average		190.9	1.97E-04			9.85E-04	3.82E-04	4.75E-05	3.01E-05	3.28E-02	1.27E-02	1.58E-03	1.00E-03
Return Period			5,089			1,015	2,620	21,050	33,174	30	79	632	995

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	1042	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	1042	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	1042	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	1042	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	1042	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	1042	4.93E-06	1.27E-06	9.34E-09	9.75E-10	1.64E-04	4.25E-05	3.11E-07	3.25E-08
7	Solano Co Ag	6.6	2.30E-06	100	1042	1.52E-05	3.93E-06	2.88E-08	3.01E-09	5.07E-04	1.31E-04	9.62E-07	1.00E-07
8	Davis	3.5	1.23E-06	1,000	1042	8.13E-06	2.10E-06	1.54E-08	1.61E-09	2.71E-04	7.00E-05	5.14E-07	5.36E-08
9	Yolo Co Ag	7.0	2.43E-06	100	1042	1.61E-05	4.16E-06	3.05E-08	3.19E-09	5.36E-04	1.39E-04	1.02E-06	1.06E-07
10	Sacramento	3.3	1.13E-06	3,000	1042	7.48E-06	1.93E-06	1.42E-08	1.48E-09	2.49E-04	6.45E-05	4.73E-07	4.94E-08
11	Sacramento River	0.4	1.46E-07	100	1042	9.67E-07	2.50E-07	1.83E-09	1.92E-10	3.22E-05	8.34E-06	6.11E-08	6.39E-09
12	Sacramento	2.5	8.54E-07	10,000	1042	5.66E-06	1.46E-06	1.07E-08	1.12E-09	1.89E-04	4.88E-05	3.58E-07	3.74E-08
13	Parkland	1.6	5.63E-07	100	3232	3.73E-06	9.64E-07	7.07E-09	7.38E-10	1.24E-04	3.21E-05	2.36E-07	2.46E-08
14	Sacramento	3.2	1.11E-06	3,000	3232	1.58E-05	6.63E-06	4.52E-07	1.88E-07	5.25E-04	2.21E-04	1.51E-05	6.27E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	1.54E-05	6.48E-06	4.42E-07	1.84E-07	5.13E-04	2.16E-04	1.47E-05	6.13E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	6.34E-05	2.67E-05	1.82E-06	7.57E-07	2.11E-03	8.89E-04	6.06E-05	2.52E-05
17	Roseville Yard	1.4	4.72E-07	100	3232	2.29E-05	9.62E-06	6.57E-07	2.73E-07	7.63E-04	3.21E-04	2.19E-05	9.11E-06
18	Roseville	1.2	9.10E-07	1,000	2867	8.21E-05	3.45E-05	2.35E-06	9.80E-07	2.74E-03	1.15E-03	7.85E-05	3.27E-05
19	Roseville	1.4	1.12E-06	3,000	2867	1.28E-05	5.39E-06	3.68E-07	1.53E-07	4.28E-04	1.80E-04	1.23E-05	5.10E-06
20	Roseville	1.1	8.71E-07	3,000	2867	3.96E-05	1.67E-05	1.14E-06	4.73E-07	1.32E-03	5.55E-04	3.79E-05	1.58E-05
21	Roseville	2.5	1.94E-06	1,000	2867	2.12E-05	8.89E-06	6.07E-07	2.52E-07	7.05E-04	2.96E-04	2.02E-05	8.42E-06
22	Roseville	0.5	3.58E-07	100	2867	4.19E-05	1.76E-05	1.20E-06	5.00E-07	1.40E-03	5.87E-04	4.00E-05	1.67E-05
23	Rocklin	2.5	1.99E-06	1,000	2867	1.95E-05	8.19E-06	5.59E-07	2.32E-07	6.49E-04	2.73E-04	1.86E-05	7.75E-06
24	Placer Co	8.0	6.31E-06	100	2867	2.52E-06	1.06E-06	7.22E-08	3.01E-08	8.40E-05	3.53E-05	2.41E-06	1.00E-06
25	Newcastle	0.5	3.57E-07	3,000	2867	1.47E-05	6.20E-06	4.23E-07	1.76E-07	4.91E-04	2.07E-04	1.41E-05	5.87E-06
26	Placer Co	2.5	1.98E-06	100	2867	3.01E-05	1.27E-05	8.64E-07	3.59E-07	1.00E-03	4.22E-04	2.88E-05	1.20E-05
27	Auburn	5.3	4.22E-06	1,000	2867	5.97E-05	2.51E-05	1.71E-06	7.12E-07	1.99E-03	8.36E-04	5.70E-05	2.37E-05
28	Placer Co	13.6	1.08E-05	100	2867	4.80E-05	2.02E-05	1.38E-06	5.72E-07	1.60E-03	6.72E-04	4.58E-05	1.91E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	2867	8.12E-05	3.42E-05	2.33E-06	9.69E-07	2.71E-03	1.14E-03	7.77E-05	3.23E-05
30	Placer Co	57.4	4.54E-05	3,000	2867	2.53E-05	1.06E-05	7.25E-07	3.02E-07	8.43E-04	3.54E-04	2.42E-05	1.01E-05
31	Truckee	2.1	1.68E-06	100	2867	8.71E-05	3.03E-05	9.13E-07	3.73E-07	2.90E-03	1.01E-03	3.04E-05	1.24E-05
32	Nevada Co	13.9	1.10E-05	1,000	2867	1.07E-04	3.71E-05	1.12E-06	4.57E-07	3.56E-03	1.24E-03	3.73E-05	1.52E-05
33	Floriston	0.2	1.83E-07	100	2867	8.33E-05	2.90E-05	8.73E-07	3.57E-07	2.78E-03	9.65E-04	2.91E-05	1.19E-05
34	Sierra Co	5.8	4.58E-06	1,000	2867	1.85E-04	6.45E-05	1.94E-06	7.95E-07	6.18E-03	2.15E-03	6.48E-05	2.65E-05
Total/Weighted Average		190.9	1.19E-04			9.61E-03	3.38E-03	1.12E-04	4.57E-05	3.20E-01	1.13E-01	3.72E-03	1.52E-03
Return Period			8,391			104	295	8,965	21,866	3	9	269	656

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	1.58E-05	6.63E-06	4.52E-07	1.88E-07	5.25E-04	2.21E-04	1.51E-05	6.27E-06
2	Benicia	2.6	8.92E-07	1,000	1042	1.54E-05	6.48E-06	4.42E-07	1.84E-07	5.13E-04	2.16E-04	1.47E-05	6.13E-06
3	Grizzly Bay	10.6	3.67E-06	100	1042	6.34E-05	2.67E-05	1.82E-06	7.57E-07	2.11E-03	8.89E-04	6.06E-05	2.52E-05
4	Fairfield	3.8	1.33E-06	3,000	1042	2.29E-05	9.62E-06	6.57E-07	2.73E-07	7.63E-04	3.21E-04	2.19E-05	9.11E-06
5	Elmira	13.7	4.76E-06	100	1042	8.21E-05	3.45E-05	2.35E-06	9.80E-07	2.74E-03	1.15E-03	7.85E-05	3.27E-05
6	Dixon	2.1	7.43E-07	1,000	1042	1.28E-05	5.39E-06	3.68E-07	1.53E-07	4.28E-04	1.80E-04	1.23E-05	5.10E-06
7	Solano Co Ag	6.6	2.30E-06	100	1042	3.96E-05	1.67E-05	1.14E-06	4.73E-07	1.32E-03	5.55E-04	3.79E-05	1.58E-05
8	Davis	3.5	1.23E-06	1,000	1042	2.12E-05	8.89E-06	6.07E-07	2.52E-07	7.05E-04	2.96E-04	2.02E-05	8.42E-06
9	Yolo Co Ag	7.0	2.43E-06	100	1042	4.19E-05	1.76E-05	1.20E-06	5.00E-07	1.40E-03	5.87E-04	4.00E-05	1.67E-05
10	Sacramento	3.3	1.13E-06	3,000	1042	1.95E-05	8.19E-06	5.59E-07	2.32E-07	6.49E-04	2.73E-04	1.86E-05	7.75E-06
11	Sacramento River	0.4	1.46E-07	100	1042	2.52E-06	1.06E-06	7.22E-08	3.01E-08	8.40E-05	3.53E-05	2.41E-06	1.00E-06
12	Sacramento	2.5	8.54E-07	10,000	1042	1.47E-05	6.20E-06	4.23E-07	1.76E-07	4.91E-04	2.07E-04	1.41E-05	5.87E-06
13	Parkland	1.6	5.63E-07	100	3232	3.01E-05	1.27E-05	8.64E-07	3.59E-07	1.00E-03	4.22E-04	2.88E-05	1.20E-05
14	Sacramento	3.2	1.11E-06	3,000	3232	5.97E-05	2.51E-05	1.71E-06	7.12E-07	1.99E-03	8.36E-04	5.70E-05	2.37E-05
15	North Highlands	2.6	8.96E-07	1,000	3232	4.80E-05	2.02E-05	1.38E-06	5.72E-07	1.60E-03	6.72E-04	4.58E-05	1.91E-05
16	North Highlands	4.4	1.52E-06	3,000	3232	8.12E-05	3.42E-05	2.33E-06	9.69E-07	2.71E-03	1.14E-03	7.77E-05	3.23E-05
17	Roseville Yard	1.4	4.72E-07	100	3232	2.53E-05	1.06E-05	7.25E-07	3.02E-07	8.43E-04	3.54E-04	2.42E-05	1.01E-05
18	Roseville	1.2	3.63E-07	1,000	2867	4.02E-05	2.12E-05	3.97E-06	2.61E-06	1.34E-03	7.08E-04	1.32E-04	8.70E-05
19	Roseville	1.4	4.45E-07	3,000	2867	4.93E-05	2.60E-05	4.87E-06	3.20E-06	1.64E-03	8.68E-04	1.62E-04	1.07E-04
20	Roseville	2.3	7.20E-07	3,000	2867	7.97E-05	4.21E-05	7.88E-06	5.18E-06	2.66E-03	1.40E-03	2.63E-04	1.73E-04
21	Placer Co	1.3	4.04E-07	1,000	2867	4.48E-05	2.36E-05	4.42E-06	2.91E-06	1.49E-03	7.88E-04	1.47E-04	9.68E-05
22	Placer Co	0.1	4.68E-08	100	2867	5.18E-06	2.74E-06	5.12E-07	3.36E-07	1.73E-04	9.12E-05	1.71E-05	1.12E-05
23	Placer Co	2.9	9.23E-07	1,000	2867	1.02E-04	5.40E-05	1.01E-05	6.63E-06	3.41E-03	1.80E-03	3.37E-04	2.21E-04
24	Lincoln	1.2	3.77E-07	100	2867	4.18E-05	2.21E-05	4.13E-06	2.71E-06	1.39E-03	7.35E-04	1.38E-04	9.03E-05
25	Lincoln	2.9	9.05E-07	3,000	2867	1.00E-04	5.29E-05	9.90E-06	6.51E-06	3.34E-03	1.76E-03	3.30E-04	2.17E-04
26	Sheridan	10.7	3.37E-06	100	2867	3.73E-04	1.97E-04	3.68E-05	2.42E-05	1.24E-02	6.56E-03	1.23E-03	8.07E-04
27	Wheatland	0.9	2.94E-07	1,000	2867	3.26E-05	1.72E-05	3.22E-06	2.11E-06	1.09E-03	5.73E-04	1.07E-04	7.04E-05
28	Yuba County	9.2	2.92E-06	100	2867	3.23E-04	1.71E-04	3.19E-05	2.10E-05	1.08E-02	5.69E-03	1.06E-03	6.99E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	2867	1.49E-04	7.87E-05	1.47E-05	9.67E-06	4.97E-03	2.62E-03	4.91E-04	3.22E-04
30	Marysville	1.3	4.20E-07	3,000	2867	4.65E-05	2.46E-05	4.59E-06	3.02E-06	1.55E-03	8.19E-04	1.53E-04	1.01E-04
31	Marysville	0.3	9.49E-08	100	2867	1.05E-05	5.55E-06	1.04E-06	6.83E-07	3.51E-04	1.85E-04	3.46E-05	2.28E-05
32	Marysville	0.4	1.18E-07	1,000	2867	1.30E-05	6.88E-06	1.29E-06	8.45E-07	4.34E-04	2.29E-04	4.29E-05	2.82E-05
33	Yuba County	0.7	2.37E-07	100	2867	2.62E-05	1.38E-05	2.59E-06	1.70E-06	8.74E-04	4.62E-04	8.64E-05	5.67E-05
34	Yuba County	0.2	4.85E-08	1,000	2867	5.37E-06	2.83E-06	5.30E-07	3.48E-07	1.79E-04	9.45E-05	1.77E-05	1.16E-05
35	Yuba County	0.8	2.39E-07	3,000	2867	2.64E-05	1.39E-05	2.61E-06	1.71E-06	8.81E-04	4.65E-04	8.70E-05	5.72E-05
36	Yuba County	0.3	9.41E-08	100	2867	1.04E-05	5.50E-06	1.03E-06	6.76E-07	3.47E-04	1.83E-04	3.43E-05	2.25E-05
37	Yuba/Butte County	16.3	5.16E-06	1,000	2867	5.72E-04	3.02E-04	5.64E-05	3.71E-05	1.91E-02	1.01E-02	1.88E-03	1.24E-03
38	Palermo	4.2	1.33E-06	3,000	2867	1.47E-04	7.76E-05	1.45E-05	9.53E-06	4.90E-03	2.59E-03	4.84E-04	3.18E-04
39	Butte County	1.1	3.35E-07	100	2867	3.71E-05	1.96E-05	3.66E-06	2.41E-06	1.24E-03	6.53E-04	1.22E-04	8.02E-05
40	South Oroville	2.4	7.61E-07	3,000	2867	8.43E-05	4.45E-05	8.33E-06	5.47E-06	2.81E-03	1.48E-03	2.78E-04	1.82E-04
41	Oroville	0.9	2.68E-07	100	2867	2.97E-05	1.57E-05	2.94E-06	1.93E-06	9.91E-04	5.23E-04	9.79E-05	6.43E-05
42	Oroville	1.3	4.20E-07	1,000	2867	4.65E-05	2.46E-05	4.59E-06	3.02E-06	1.55E-03	8.19E-04	1.53E-04	1.01E-04
43	Thermolito Div.	0.1	2.97E-08	100	2867	3.28E-06	1.73E-06	3.24E-07	2.13E-07	1.09E-04	5.78E-05	1.08E-05	7.11E-06
44	Butte County	1.4	4.52E-07	1,000	2867	5.00E-05	2.64E-05	4.94E-06	3.25E-06	1.67E-03	8.80E-04	1.65E-04	1.08E-04
45	Feather Canyon	53.9	1.70E-05	100	2867	1.88E-03	9.95E-04	1.86E-04	1.22E-04	6.28E-02	3.32E-02	6.20E-03	4.08E-03
46	Hallsted	1.5	4.77E-07	1,000	2867	5.28E-05	2.79E-05	5.22E-06	3.43E-06	1.76E-03	9.30E-04	1.74E-04	1.14E-04
47	Plumas County	12.5	3.95E-06	100	2867	4.37E-04	2.31E-04	4.32E-05	2.84E-05	1.46E-02	7.69E-03	1.44E-03	9.46E-04
48	Spanish Creek	0.5	1.52E-07	1,000	2867	1.69E-05	8.90E-06	1.67E-06	1.09E-06	5.62E-04	2.97E-04	5.55E-05	3.65E-05
49	Plumas County	1.6	5.15E-07	100	2867	5.70E-05	3.01E-05	5.63E-06	3.70E-06	1.90E-03	1.00E-03	1.88E-04	1.23E-04
50	Quincy	3.6	1.15E-06	1,000	2867	1.27E-04	6.72E-05	1.26E-05	8.26E-06	4.24E-03	2.24E-03	4.19E-04	2.75E-04
51	Plumas County	4.6	1.44E-06	100	2867	1.60E-04	8.44E-05	1.58E-05	1.04E-05	5.33E-03	2.81E-03	5.26E-04	3.46E-04
52	Spring Garden	0.3	9.96E-08	1,000	2867	1.10E-05	5.83E-06	1.09E-06	7.16E-07	3.68E-04	1.94E-04	3.63E-05	2.39E-05
53	Plumas County	5.9	1.87E-06	100	2867	2.07E-04	1.09E-04	2.05E-05	1.34E-05	6.90E-03	3.64E-03	6.82E-04	4.48E-04
54	Twentymile House	2.3	7.39E-07	1,000	2867	8.18E-05	4.32E-05	8.08E-06	5.31E-06	2.73E-03	1.44E-03	2.69E-04	1.77E-04
55	Plumas County	2.4	7.70E-07	100	2867	8.53E-05	4.51E-05	8.43E-06	5.54E-06	2.84E-03	1.50E-03	2.81E-04	1.85E-04
56	Blairsden	6.7	2.13E-06	1,000	2867	2.36E-04	1.24E-04	2.33E-05	1.53E-05	7.86E-03	4.15E-03	7.76E-04	5.10E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	2867	6.26E-05	3.31E-05	6.18E-06	4.06E-06	2.09E-03	1.10E-03	2.06E-04	1.35E-04
58	Plumas Golf	1.1	3.60E-07	1,000	2867	3.99E-05	2.11E-05	3.94E-06	2.59E-06	1.33E-03	7.02E-04	1.31E-04	8.63E-05
59	Plumas County	1.8	5.78E-07	100	2867	6.40E-05	3.38E-05	6.32E-06	4.15E-06	2.13E-03	1.13E-03	2.11E-04	1.38E-04
60	Portola	3.5	1.11E-06	1,000	2867	1.23E-04	6.52E-05	1.22E-05	8.01E-06	4.12E-03	2.17E-03	4.06E-04	2.67E-04
61	Plumas County	14.9	4.69E-06	100	2867	5.19E-04	2.74E-04	5.13E-05	3.37E-05	1.73E-02	9.14E-03	1.71E-03	1.12E-03
62	Chilcoot	1.8	5.81E-07	1,000	2867	6.44E-05	3.40E-05	6.36E-06	4.18E-06	2.15E-03	1.13E-03	2.12E-04	1.39E-04
63	Lassen County	19.2	6.05E-06	100	2867	6.70E-04	3.54E-04	6.62E-05	4.35E-05	2.23E-02	1.18E-02	2.21E-03	1.45E-03
64	Doyle	1.2	3.82E-07	1,000	2867	4.23E-05	2.23E-05	4.18E-06	2.75E-06	1.41E-03	7.45E-04	1.39E-04	9.15E-05
65	Lassen County	8.0	2.52E-06	100	2867	2.79E-04	1.47E-04	2.75E-05	1.81E-05	9.29E-03	4.91E-03	9.18E-04	6.03E-04
66	Herlong	4.5	1.41E-06	1,000	2867	1.56E-04	8.25E-05	1.54E-05	1.01E-05	5.21E-03	2.75E-03	5.15E-04	3.38E-04
67	Lassen County	5.2	1.64E-06	1,000	2867	1.82E-04	9.60E-05	1.80E-05	1.18E-05	6.06E-03	3.20E-03	5.99E-04	3.93E-04
Total/Weighted Average		300.8	9.72E-05			8.60E-03	4.48E-03	8.08E-04	5.27E-04	2.87E-01	1.49E-01	2.69E-02	1.76E-02
Return Period			10,284			116	223	1,238	1,898	3	7	37	57

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	1.58E-05	6.63E-06	4.52E-07	1.88E-07	5.25E-04	2.21E-04	1.51E-05	6.27E-06
2	Benicia	2.6	8.92E-07	1,000	1042	1.54E-05	6.48E-06	4.42E-07	1.84E-07	5.13E-04	2.16E-04	1.47E-05	6.13E-06
3	Grizzly Bay	10.6	3.67E-06	100	1042	6.34E-05	2.67E-05	1.82E-06	7.57E-07	2.11E-03	8.89E-04	6.06E-05	2.52E-05
4	Fairfield	3.8	1.33E-06	3,000	1042	2.29E-05	9.62E-06	6.57E-07	2.73E-07	7.63E-04	3.21E-04	2.19E-05	9.11E-06
5	Elmira	13.7	4.76E-06	100	1042	8.21E-05	3.45E-05	2.35E-06	9.80E-07	2.74E-03	1.15E-03	7.85E-05	3.27E-05
6	Dixon	2.1	7.43E-07	1,000	1042	1.28E-05	5.39E-06	3.68E-07	1.53E-07	4.28E-04	1.80E-04	1.23E-05	5.10E-06
7	Solano Co Ag	6.6	2.30E-06	100	1042	3.96E-05	1.67E-05	1.14E-06	4.73E-07	1.32E-03	5.55E-04	3.79E-05	1.58E-05
8	Davis	3.5	1.23E-06	1,000	1042	2.12E-05	8.89E-06	6.07E-07	2.52E-07	7.05E-04	2.96E-04	2.02E-05	8.42E-06
9	Yolo Co Ag	7.0	2.43E-06	100	1042	4.19E-05	1.76E-05	1.20E-06	5.00E-07	1.40E-03	5.87E-04	4.00E-05	1.67E-05
10	Sacramento	3.3	1.13E-06	3,000	1042	1.95E-05	8.19E-06	5.59E-07	2.32E-07	6.49E-04	2.73E-04	1.86E-05	7.75E-06
11	Sacramento River	0.4	1.46E-07	100	1042	2.52E-06	1.06E-06	7.22E-08	3.01E-08	8.40E-05	3.53E-05	2.41E-06	1.00E-06
12	Sacramento	2.5	8.54E-07	10,000	1042	1.47E-05	6.20E-06	4.23E-07	1.76E-07	4.91E-04	2.07E-04	1.41E-05	5.87E-06
13	Parkland	1.6	5.63E-07	100	3232	3.01E-05	1.27E-05	8.64E-07	3.59E-07	1.00E-03	4.22E-04	2.88E-05	1.20E-05
14	Sacramento	3.2	1.11E-06	3,000	3232	5.97E-05	2.51E-05	1.71E-06	7.12E-07	1.99E-03	8.36E-04	5.70E-05	2.37E-05
15	North Highlands	2.6	8.96E-07	1,000	3232	4.80E-05	2.02E-05	1.38E-06	5.72E-07	1.60E-03	6.72E-04	4.58E-05	1.91E-05
16	North Highlands	4.4	1.52E-06	3,000	3232	8.12E-05	3.42E-05	2.33E-06	9.69E-07	2.71E-03	1.14E-03	7.77E-05	3.23E-05
17	Roseville Yard	1.4	4.72E-07	100	3232	2.53E-05	1.06E-05	7.25E-07	3.02E-07	8.43E-04	3.54E-04	2.42E-05	1.01E-05
18	Roseville	1.2	3.25E-07	1,000	2867	3.62E-05	1.91E-05	3.58E-06	2.35E-06	1.21E-03	6.37E-04	1.19E-04	7.83E-05
19	Roseville	1.4	3.98E-07	3,000	2867	4.44E-05	2.34E-05	4.39E-06	2.88E-06	1.48E-03	7.82E-04	1.46E-04	9.61E-05
20	Roseville	2.3	6.44E-07	3,000	2867	7.18E-05	3.79E-05	7.09E-06	4.66E-06	2.39E-03	1.26E-03	2.36E-04	1.55E-04
21	Placer Co	1.3	3.62E-07	1,000	2867	4.03E-05	2.13E-05	3.98E-06	2.62E-06	1.34E-03	7.09E-04	1.33E-04	8.72E-05
22	Placer Co	0.1	4.19E-08	100	2867	4.67E-06	2.46E-06	4.61E-07	3.03E-07	1.56E-04	8.21E-05	1.54E-05	1.01E-05
23	Placer Co	2.9	8.26E-07	1,000	2867	9.21E-05	4.86E-05	9.09E-06	5.97E-06	3.07E-03	1.62E-03	3.03E-04	1.99E-04
24	Lincoln	1.2	3.37E-07	100	2867	3.76E-05	1.99E-05	3.71E-06	2.44E-06	1.25E-03	6.62E-04	1.24E-04	8.14E-05
25	Lincoln	2.9	8.10E-07	3,000	2867	9.03E-05	4.77E-05	8.92E-06	5.86E-06	3.01E-03	1.59E-03	2.97E-04	1.95E-04
26	Sheridan	10.7	3.01E-06	100	2867	3.36E-04	1.77E-04	3.32E-05	2.18E-05	1.12E-02	5.91E-03	1.11E-03	7.26E-04
27	Wheatland	0.9	2.63E-07	1,000	2867	2.93E-05	1.55E-05	2.90E-06	1.90E-06	9.77E-04	5.16E-04	9.65E-05	6.34E-05
28	Yuba County	9.2	2.61E-06	100	2867	2.91E-04	1.54E-04	2.87E-05	1.89E-05	9.70E-03	5.12E-03	9.58E-04	6.29E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	2867	1.34E-04	7.08E-05	1.33E-05	8.71E-06	4.47E-03	2.36E-03	4.42E-04	2.90E-04
30	Marysville	1.3	3.76E-07	3,000	2867	4.19E-05	2.21E-05	4.14E-06	2.72E-06	1.40E-03	7.37E-04	1.38E-04	9.06E-05
31	Marysville	2.3	6.56E-07	100	2867	7.31E-05	3.86E-05	7.22E-06	4.74E-06	2.44E-03	1.29E-03	2.41E-04	1.58E-04
32	Live Oak	0.3	9.29E-08	1,000	2867	1.04E-05	5.47E-06	1.02E-06	6.72E-07	3.45E-04	1.82E-04	3.41E-05	2.24E-05
33	Live Oak	6.4	1.81E-06	100	2867	2.02E-04	1.07E-04	2.00E-05	1.31E-05	6.74E-03	3.56E-03	6.66E-04	4.37E-04
34	Live Oak	0.4	1.03E-07	1,000	2867	1.15E-05	6.09E-06	1.14E-06	7.48E-07	3.84E-04	2.03E-04	3.80E-05	2.49E-05
35	Live Oak	1.0	2.86E-07	3,000	2867	3.19E-05	1.69E-05	3.15E-06	2.07E-06	1.06E-03	5.62E-04	1.05E-04	6.91E-05
36	Butte Co	5.2	1.48E-06	100	2867	1.64E-04	8.68E-05	1.62E-05	1.07E-05	5.48E-03	2.89E-03	5.42E-04	3.56E-04
37	Gridley	0.5	1.29E-07	1,000	2867	1.43E-05	7.57E-06	1.42E-06	9.30E-07	4.78E-04	2.52E-04	4.72E-05	3.10E-05
38	Gridley	0.8	2.34E-07	3,000	2867	2.61E-05	1.38E-05	2.58E-06	1.69E-06	8.70E-04	4.59E-04	8.59E-05	5.65E-05
39	Gridley	2.5	7.08E-07	100	2867	7.90E-05	4.17E-05	7.80E-06	5.13E-06	2.63E-03	1.39E-03	2.60E-04	1.71E-04
40	Biggs	0.6	1.62E-07	3,000	2867	1.80E-05	9.52E-06	1.78E-06	1.17E-06	6.01E-04	3.17E-04	5.94E-05	3.90E-05
41	Butte Co	5.1	1.45E-06	100	2867	1.62E-04	8.53E-05	1.60E-05	1.05E-05	5.39E-03	2.84E-03	5.32E-04	3.50E-04
42	Richvale	0.8	2.36E-07	1,000	2867	2.63E-05	1.39E-05	2.60E-06	1.71E-06	8.77E-04	4.63E-04	8.67E-05	5.69E-05
43	Nelson	9.3	2.62E-06	100	2867	2.92E-04	1.54E-04	2.89E-05	1.90E-05	9.74E-03	5.14E-03	9.62E-04	6.32E-04
44	Durham	2.4	6.89E-07	1,000	2867	7.68E-05	4.05E-05	7.58E-06	4.98E-06	2.56E-03	1.35E-03	2.53E-04	1.66E-04
45	Chico	4.3	1.22E-06	100	2867	1.36E-04	7.19E-05	1.34E-05	8.83E-06	4.54E-03	2.40E-03	4.48E-04	2.94E-04
46	Chico	4.5	1.27E-06	1,000	2867	1.42E-04	7.50E-05	1.40E-05	9.22E-06	4.74E-03	2.50E-03	4.68E-04	3.07E-04
47	Chico	2.8	7.91E-07	100	2867	8.82E-05	4.66E-05	8.72E-06	5.73E-06	2.94E-03	1.55E-03	2.91E-04	1.91E-04
48	Nord	0.6	1.65E-07	1,000	2867	1.84E-05	9.70E-06	1.81E-06	1.19E-06	6.12E-04	3.23E-04	6.05E-05	3.97E-05
49	Butte Co	11.3	3.20E-06	100	2867	3.57E-04	1.89E-04	3.53E-05	2.32E-05	1.19E-02	6.29E-03	1.18E-03	7.73E-04
50	Vina	0.4	1.26E-07	1,000	2867	1.40E-05	7.41E-06	1.39E-06	9.11E-07	4.68E-04	2.47E-04	4.62E-05	3.04E-05
51	Copeland	6.3	1.78E-06	100	2867	1.99E-04	1.05E-04	1.96E-05	1.29E-05	6.62E-03	3.50E-03	6.54E-04	4.30E-04
52	Los Molinos	0.5	1.47E-07	1,000	2867	1.64E-05	8.64E-06	1.62E-06	1.06E-06	5.45E-04	2.88E-04	5.39E-05	3.54E-05
53	Los Molinos	1.0	2.81E-07	100	2867	3.13E-05	1.65E-05	3.09E-06	2.03E-06	1.04E-03	5.50E-04	1.03E-04	6.77E-05
54	Tehema	0.3	9.39E-08	1,000	2867	1.05E-05	5.53E-06	1.03E-06	6.79E-07	3.49E-04	1.84E-04	3.45E-05	2.26E-05
55	Tehema	2.2	6.32E-07	100	2867	7.04E-05	3.72E-05	6.96E-06	4.57E-06	2.35E-03	1.24E-03	2.32E-04	1.52E-04
56	Gerber	2.3	6.54E-07	1,000	2867	7.29E-05	3.85E-05	7.20E-06	4.73E-06	2.43E-03	1.28E-03	2.40E-04	1.58E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – CPC-1232 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	2867	5.63E-05	2.97E-05	5.56E-06	3.65E-06	1.88E-03	9.91E-04	1.85E-04	1.22E-04
58	Red Bluff	0.8	2.18E-07	1,000	2867	2.43E-05	1.28E-05	2.40E-06	1.58E-06	8.10E-04	4.28E-04	8.00E-05	5.26E-05
59	Red Bluff	4.6	1.31E-06	100	2867	1.46E-04	7.70E-05	1.44E-05	9.46E-06	4.86E-03	2.57E-03	4.80E-04	3.15E-04
60	Red Bluff	3.3	9.27E-07	1,000	2867	1.03E-04	5.46E-05	1.02E-05	6.71E-06	3.45E-03	1.82E-03	3.40E-04	2.24E-04
61	Tehema Co	15.3	4.32E-06	100	2867	4.81E-04	2.54E-04	4.75E-05	3.12E-05	1.60E-02	8.47E-03	1.58E-03	1.04E-03
62	Cottonwood	0.6	1.72E-07	1,000	2867	1.92E-05	1.01E-05	1.90E-06	1.25E-06	6.40E-04	3.38E-04	6.32E-05	4.15E-05
63	Anderson	5.4	1.51E-06	100	2867	1.69E-04	8.91E-05	1.67E-05	1.10E-05	5.62E-03	2.97E-03	5.56E-04	3.65E-04
64	Anderson	3.5	1.00E-06	1,000	2867	1.12E-04	5.90E-05	1.10E-05	7.25E-06	3.72E-03	1.97E-03	3.68E-04	2.42E-04
65	Anderson	4.1	1.15E-06	100	2867	1.29E-04	6.79E-05	1.27E-05	8.35E-06	4.29E-03	2.26E-03	4.24E-04	2.78E-04
66	Redding	6.0	1.71E-06	1,000	2867	1.90E-04	1.00E-04	1.88E-05	1.23E-05	6.34E-03	3.35E-03	6.26E-04	4.12E-04
67	Redding	0.8	2.15E-07	1,000	2867	2.40E-05	1.27E-05	2.37E-06	1.56E-06	8.00E-04	4.22E-04	7.90E-05	5.19E-05
68	Redding	1.1	3.19E-07	100	2867	3.56E-05	1.88E-05	3.51E-06	2.31E-06	1.19E-03	6.26E-04	1.17E-04	7.70E-05
69	Redding	0.4	1.10E-07	1,000	2867	1.23E-05	6.49E-06	1.21E-06	7.98E-07	4.10E-04	2.16E-04	4.05E-05	2.66E-05
70	Redding	2.6	7.29E-07	100	2867	8.13E-05	4.29E-05	8.03E-06	5.27E-06	2.71E-03	1.43E-03	2.68E-04	1.76E-04
71	Shasta Co	0.5	1.48E-07	1,000	2867	1.65E-05	8.69E-06	1.63E-06	1.07E-06	5.49E-04	2.90E-04	5.42E-05	3.56E-05
72	Shasta Lake	1.7	4.66E-07	100	2867	5.20E-05	2.74E-05	5.13E-06	3.37E-06	1.73E-03	9.15E-04	1.71E-04	1.12E-04
73	Shasta Lake	0.8	2.12E-07	1,000	2867	2.36E-05	1.25E-05	2.34E-06	1.53E-06	7.88E-04	4.16E-04	7.79E-05	5.12E-05
74	Shasta Co	16.4	4.64E-06	100	2867	5.18E-04	2.73E-04	5.11E-05	3.36E-05	1.73E-02	9.11E-03	1.70E-03	1.12E-03
75	Lakeshore	0.6	1.71E-07	1,000	2867	1.91E-05	1.01E-05	1.89E-06	1.24E-06	6.37E-04	3.36E-04	6.29E-05	4.13E-05
76	Shasta Co	28.7	8.10E-06	100	2867	9.56E-04	5.05E-04	9.45E-05	6.21E-05	3.19E-02	1.68E-02	3.15E-03	2.07E-03
77	Dunsmuir	1.3	3.68E-07	1,000	2867	4.10E-05	2.17E-05	4.05E-06	2.66E-06	1.37E-03	7.22E-04	1.35E-04	8.88E-05
78	Siskiyou Co	12.8	3.61E-06	100	2867	4.02E-04	2.12E-04	3.97E-05	2.61E-05	1.34E-02	7.08E-03	1.32E-03	8.70E-04
79	Mount Shasta	1.1	3.19E-07	1,000	2867	3.56E-05	1.88E-05	3.52E-06	2.31E-06	1.19E-03	6.27E-04	1.17E-04	7.70E-05
80	Siskiyou Co	64.5	1.82E-05	100	2867	2.19E-03	1.16E-03	2.16E-04	1.42E-04	7.30E-02	3.85E-02	7.21E-03	4.73E-03
81	Dorris	0.9	2.49E-07	100	2867	2.78E-05	1.47E-05	2.74E-06	1.80E-06	9.26E-04	4.89E-04	9.15E-05	6.01E-05
82	Siskiyou Co	3.4	9.64E-07	1,000	2867	1.07E-04	5.67E-05	1.06E-05	6.97E-06	3.58E-03	1.89E-03	3.54E-04	2.32E-04
Total/Weighted Average		368.8	1.09E-04			1.02E-02	5.30E-03	9.62E-04	6.28E-04	3.39E-01	1.77E-01	3.21E-02	2.09E-02
Return Period			9,188			98	189	1,040	1,593	3	6	31	48

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	1042	6.05E-06	1.57E-06	1.15E-08	1.20E-09	2.02E-04	5.22E-05	3.83E-07	4.00E-08
2	Benicia	2.6	8.92E-07	1,000	1042	5.92E-06	1.53E-06	1.12E-08	1.17E-09	1.97E-04	5.10E-05	3.74E-07	3.90E-08
3	Grizzly Bay	10.6	3.67E-06	100	1042	2.44E-05	6.30E-06	4.62E-08	4.82E-09	8.12E-04	2.10E-04	1.54E-06	1.61E-07
4	Fairfield	3.8	1.33E-06	3,000	1042	8.79E-06	2.27E-06	1.67E-08	1.74E-09	2.93E-04	7.58E-05	5.56E-07	5.80E-08
5	Elmira	13.7	4.76E-06	100	1042	3.15E-05	8.16E-06	5.98E-08	6.24E-09	1.05E-03	2.72E-04	1.99E-06	2.08E-07
6	Dixon	2.1	7.43E-07	1,000	1042	8.18E-06	1.88E-06	2.34E-08	1.18E-08	2.73E-04	6.27E-05	7.81E-07	3.94E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	7.99E-06	1.84E-06	2.29E-08	1.15E-08	2.66E-04	6.13E-05	7.63E-07	3.85E-07
8	Davis	3.5	1.23E-06	1,000	1042	3.29E-05	7.57E-06	9.42E-08	4.75E-08	1.10E-03	2.52E-04	3.14E-06	1.58E-06
9	Yolo Co Ag	7.0	2.43E-06	100	1042	1.19E-05	2.73E-06	3.40E-08	1.72E-08	3.96E-04	9.11E-05	1.13E-06	5.72E-07
10	Sacramento	3.3	1.13E-06	3,000	1042	4.26E-05	9.81E-06	1.22E-07	6.16E-08	1.42E-03	3.27E-04	4.07E-06	2.05E-06
11	Sacramento River	0.4	1.46E-07	100	1042	6.65E-06	1.53E-06	1.91E-08	9.62E-09	2.22E-04	5.11E-05	6.35E-07	3.21E-07
12	Sacramento	2.5	8.54E-07	10,000	1042	2.05E-05	4.73E-06	5.89E-08	2.97E-08	6.85E-04	1.58E-04	1.96E-06	9.90E-07
13	Parkland	1.6	5.63E-07	100	3232	1.10E-05	2.53E-06	3.14E-08	1.59E-08	3.66E-04	8.42E-05	1.05E-06	5.29E-07
14	Sacramento	3.2	1.11E-06	3,000	3232	2.17E-05	5.00E-06	6.22E-08	3.14E-08	7.24E-04	1.67E-04	2.07E-06	1.05E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	1.01E-05	2.33E-06	2.89E-08	1.46E-08	3.37E-04	7.75E-05	9.65E-07	4.87E-07
16	North Highlands	4.4	1.52E-06	3,000	3232	1.31E-06	3.01E-07	3.74E-09	1.89E-09	4.35E-05	1.00E-05	1.25E-07	6.29E-08
17	Roseville Yard	1.4	4.72E-07	100	3232	7.65E-06	1.76E-06	2.19E-08	1.11E-08	2.55E-04	5.87E-05	7.30E-07	3.68E-07
18	Roseville	1.2	9.10E-07	1,000	2867	1.56E-05	3.60E-06	4.47E-08	2.26E-08	5.21E-04	1.20E-04	1.49E-06	7.53E-07
19	Roseville	1.4	1.12E-06	3,000	2867	3.09E-05	7.13E-06	8.87E-08	4.47E-08	1.03E-03	2.38E-04	2.96E-06	1.49E-06
20	Roseville	1.1	8.71E-07	3,000	2867	2.49E-05	5.73E-06	7.13E-08	3.60E-08	8.29E-04	1.91E-04	2.38E-06	1.20E-06
21	Roseville	2.5	1.94E-06	1,000	2867	4.21E-05	9.70E-06	1.21E-07	6.09E-08	1.40E-03	3.23E-04	4.02E-06	2.03E-06
22	Roseville	0.5	3.58E-07	100	2867	1.31E-05	3.02E-06	3.76E-08	1.90E-08	4.37E-04	1.01E-04	1.25E-06	6.32E-07
23	Rocklin	2.5	1.99E-06	1,000	2867	4.63E-05	7.70E-06	2.94E-08	6.26E-09	1.54E-03	2.57E-04	9.79E-07	2.09E-07
24	Placer Co	8.0	6.31E-06	100	2867	5.68E-05	9.44E-06	3.60E-08	7.67E-09	1.89E-03	3.15E-04	1.20E-06	2.56E-07
25	Newcastle	0.5	3.57E-07	3,000	2867	4.43E-05	7.37E-06	2.81E-08	5.98E-09	1.48E-03	2.46E-04	9.37E-07	1.99E-07
26	Placer Co	2.5	1.98E-06	100	2867	9.87E-05	1.64E-05	6.26E-08	1.33E-08	3.29E-03	5.47E-04	2.09E-06	4.44E-07
27	Auburn	5.3	4.22E-06	1,000	2867	1.82E-05	3.03E-06	1.16E-08	2.46E-09	6.08E-04	1.01E-04	3.85E-07	8.21E-08
28	Placer Co	13.6	1.08E-05	100	2867	1.01E-04	1.68E-05	6.42E-08	1.37E-08	3.38E-03	5.61E-04	2.14E-06	4.56E-07

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	2867	3.21E-04	5.34E-05	2.04E-07	4.34E-08	1.07E-02	1.78E-03	6.79E-06	1.45E-06
30	Placer Co	57.4	4.54E-05	3,000	2867	1.82E-05	3.02E-06	1.15E-08	2.45E-09	6.06E-04	1.01E-04	3.84E-07	8.18E-08
31	Truckee	2.1	1.68E-06	100	2867	1.01E-04	1.68E-05	6.40E-08	1.36E-08	3.37E-03	5.60E-04	2.13E-06	4.54E-07
32	Nevada Co	13.9	1.10E-05	1,000	2867	2.15E-04	3.57E-05	1.36E-07	2.90E-08	7.17E-03	1.19E-03	4.54E-06	9.67E-07
33	Floriston	0.2	1.83E-07	100	2867	5.48E-04	9.11E-05	3.47E-07	7.39E-08	1.83E-02	3.04E-03	1.16E-05	2.46E-06
34	Sierra Co	5.8	4.58E-06	1,000	2867	2.72E-05	4.52E-06	1.72E-08	3.67E-09	9.05E-04	1.51E-04	5.74E-07	1.22E-07
Total/Weighted Average		190.9	1.19E-04			5.11E-03	8.69E-04	3.93E-06	1.09E-06	1.70E-01	2.90E-02	1.31E-04	3.65E-05
Return Period			8,391			196	1,151	254,669	913,728	6	35	7,640	27,412

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	8.18E-06	1.88E-06	2.34E-08	1.18E-08	2.73E-04	6.27E-05	7.81E-07	3.94E-07
2	Benicia	2.6	8.92E-07	1,000	1042	7.99E-06	1.84E-06	2.29E-08	1.15E-08	2.66E-04	6.13E-05	7.63E-07	3.85E-07
3	Grizzly Bay	10.6	3.67E-06	100	1042	3.29E-05	7.57E-06	9.42E-08	4.75E-08	1.10E-03	2.52E-04	3.14E-06	1.58E-06
4	Fairfield	3.8	1.33E-06	3,000	1042	1.19E-05	2.73E-06	3.40E-08	1.72E-08	3.96E-04	9.11E-05	1.13E-06	5.72E-07
5	Elmira	13.7	4.76E-06	100	1042	4.26E-05	9.81E-06	1.22E-07	6.16E-08	1.42E-03	3.27E-04	4.07E-06	2.05E-06
6	Dixon	2.1	7.43E-07	1,000	1042	6.65E-06	1.53E-06	1.91E-08	9.62E-09	2.22E-04	5.11E-05	6.35E-07	3.21E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	2.05E-05	4.73E-06	5.89E-08	2.97E-08	6.85E-04	1.58E-04	1.96E-06	9.90E-07
8	Davis	3.5	1.23E-06	1,000	1042	1.10E-05	2.53E-06	3.14E-08	1.59E-08	3.66E-04	8.42E-05	1.05E-06	5.29E-07
9	Yolo Co Ag	7.0	2.43E-06	100	1042	2.17E-05	5.00E-06	6.22E-08	3.14E-08	7.24E-04	1.67E-04	2.07E-06	1.05E-06
10	Sacramento	3.3	1.13E-06	3,000	1042	1.01E-05	2.33E-06	2.89E-08	1.46E-08	3.37E-04	7.75E-05	9.65E-07	4.87E-07
11	Sacramento River	0.4	1.46E-07	100	1042	1.31E-06	3.01E-07	3.74E-09	1.89E-09	4.35E-05	1.00E-05	1.25E-07	6.29E-08
12	Sacramento	2.5	8.54E-07	10,000	1042	7.65E-06	1.76E-06	2.19E-08	1.11E-08	2.55E-04	5.87E-05	7.30E-07	3.68E-07
13	Parkland	1.6	5.63E-07	100	3232	1.56E-05	3.60E-06	4.47E-08	2.26E-08	5.21E-04	1.20E-04	1.49E-06	7.53E-07
14	Sacramento	3.2	1.11E-06	3,000	3232	3.09E-05	7.13E-06	8.87E-08	4.47E-08	1.03E-03	2.38E-04	2.96E-06	1.49E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	2.49E-05	5.73E-06	7.13E-08	3.60E-08	8.29E-04	1.91E-04	2.38E-06	1.20E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	4.21E-05	9.70E-06	1.21E-07	6.09E-08	1.40E-03	3.23E-04	4.02E-06	2.03E-06
17	Roseville Yard	1.4	4.72E-07	100	3232	1.31E-05	3.02E-06	3.76E-08	1.90E-08	4.37E-04	1.01E-04	1.25E-06	6.32E-07
18	Roseville	1.2	3.63E-07	1,000	2867	2.42E-05	8.53E-06	9.22E-07	5.73E-07	8.08E-04	2.84E-04	3.07E-05	1.91E-05
19	Roseville	1.4	4.45E-07	3,000	2867	2.97E-05	1.05E-05	1.13E-06	7.03E-07	9.91E-04	3.49E-04	3.77E-05	2.34E-05
20	Roseville	2.3	7.20E-07	3,000	2867	4.81E-05	1.69E-05	1.83E-06	1.14E-06	1.60E-03	5.64E-04	6.10E-05	3.79E-05
21	Placer Co	1.3	4.04E-07	1,000	2867	2.70E-05	9.50E-06	1.03E-06	6.38E-07	8.99E-04	3.17E-04	3.42E-05	2.13E-05
22	Placer Co	0.1	4.68E-08	100	2867	3.12E-06	1.10E-06	1.19E-07	7.39E-08	1.04E-04	3.67E-05	3.96E-06	2.46E-06
23	Placer Co	2.9	9.23E-07	1,000	2867	6.16E-05	2.17E-05	2.34E-06	1.46E-06	2.05E-03	7.23E-04	7.82E-05	4.86E-05
24	Lincoln	1.2	3.77E-07	100	2867	2.52E-05	8.86E-06	9.58E-07	5.95E-07	8.39E-04	2.95E-04	3.19E-05	1.98E-05
25	Lincoln	2.9	9.05E-07	3,000	2867	6.04E-05	2.13E-05	2.30E-06	1.43E-06	2.01E-03	7.09E-04	7.67E-05	4.77E-05
26	Sheridan	10.7	3.37E-06	100	2867	2.25E-04	7.91E-05	8.55E-06	5.32E-06	7.49E-03	2.64E-03	2.85E-04	1.77E-04
27	Wheatland	0.9	2.94E-07	1,000	2867	1.96E-05	6.91E-06	7.47E-07	4.64E-07	6.54E-04	2.30E-04	2.49E-05	1.55E-05
28	Yuba County	9.2	2.92E-06	100	2867	1.95E-04	6.85E-05	7.41E-06	4.61E-06	6.49E-03	2.28E-03	2.47E-04	1.54E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	2867	8.98E-05	3.16E-05	3.42E-06	2.12E-06	2.99E-03	1.05E-03	1.14E-04	7.08E-05
30	Marysville	1.3	4.20E-07	3,000	2867	2.80E-05	9.87E-06	1.07E-06	6.63E-07	9.34E-04	3.29E-04	3.56E-05	2.21E-05
31	Marysville	0.3	9.49E-08	100	2867	6.34E-06	2.23E-06	2.41E-07	1.50E-07	2.11E-04	7.44E-05	8.04E-06	5.00E-06
32	Marysville	0.4	1.18E-07	1,000	2867	7.85E-06	2.76E-06	2.99E-07	1.86E-07	2.62E-04	9.21E-05	9.96E-06	6.19E-06
33	Yuba County	0.7	2.37E-07	100	2867	1.58E-05	5.57E-06	6.02E-07	3.74E-07	5.27E-04	1.86E-04	2.01E-05	1.25E-05
34	Yuba County	0.2	4.85E-08	1,000	2867	3.23E-06	1.14E-06	1.23E-07	7.65E-08	1.08E-04	3.80E-05	4.10E-06	2.55E-06
35	Yuba County	0.8	2.39E-07	3,000	2867	1.59E-05	5.61E-06	6.06E-07	3.77E-07	5.31E-04	1.87E-04	2.02E-05	1.26E-05
36	Yuba County	0.3	9.41E-08	100	2867	6.28E-06	2.21E-06	2.39E-07	1.49E-07	2.09E-04	7.37E-05	7.97E-06	4.95E-06
37	Yuba/Butte County	16.3	5.16E-06	1,000	2867	3.44E-04	1.21E-04	1.31E-05	8.15E-06	1.15E-02	4.04E-03	4.37E-04	2.72E-04
38	Palermo	4.2	1.33E-06	3,000	2867	8.85E-05	3.12E-05	3.37E-06	2.09E-06	2.95E-03	1.04E-03	1.12E-04	6.98E-05
39	Butte County	1.1	3.35E-07	100	2867	2.23E-05	7.87E-06	8.50E-07	5.29E-07	7.45E-04	2.62E-04	2.83E-05	1.76E-05
40	South Oroville	2.4	7.61E-07	3,000	2867	5.08E-05	1.79E-05	1.93E-06	1.20E-06	1.69E-03	5.96E-04	6.44E-05	4.01E-05
41	Oroville	0.9	2.68E-07	100	2867	1.79E-05	6.31E-06	6.82E-07	4.24E-07	5.97E-04	2.10E-04	2.27E-05	1.41E-05
42	Oroville	1.3	4.20E-07	1,000	2867	2.80E-05	9.87E-06	1.07E-06	6.63E-07	9.34E-04	3.29E-04	3.56E-05	2.21E-05
43	Thermolito Div.	0.1	2.97E-08	100	2867	1.98E-06	6.97E-07	7.53E-08	4.68E-08	6.60E-05	2.32E-05	2.51E-06	1.56E-06
44	Butte County	1.4	4.52E-07	1,000	2867	3.01E-05	1.06E-05	1.15E-06	7.13E-07	1.00E-03	3.54E-04	3.82E-05	2.38E-05
45	Feather Canyon	53.9	1.70E-05	100	2867	1.14E-03	4.00E-04	4.32E-05	2.69E-05	3.78E-02	1.33E-02	1.44E-03	8.95E-04
46	Hallsted	1.5	4.77E-07	1,000	2867	3.18E-05	1.12E-05	1.21E-06	7.53E-07	1.06E-03	3.74E-04	4.04E-05	2.51E-05
47	Plumas County	12.5	3.95E-06	100	2867	2.63E-04	9.28E-05	1.00E-05	6.23E-06	8.78E-03	3.09E-03	3.34E-04	2.08E-04
48	Spanish Creek	0.5	1.52E-07	1,000	2867	1.02E-05	3.58E-06	3.87E-07	2.40E-07	3.39E-04	1.19E-04	1.29E-05	8.01E-06
49	Plumas County	1.6	5.15E-07	100	2867	3.44E-05	1.21E-05	1.31E-06	8.13E-07	1.15E-03	4.03E-04	4.36E-05	2.71E-05
50	Quincy	3.6	1.15E-06	1,000	2867	7.67E-05	2.70E-05	2.92E-06	1.82E-06	2.56E-03	9.00E-04	9.73E-05	6.05E-05
51	Plumas County	4.6	1.44E-06	100	2867	9.63E-05	3.39E-05	3.67E-06	2.28E-06	3.21E-03	1.13E-03	1.22E-04	7.60E-05
52	Spring Garden	0.3	9.96E-08	1,000	2867	6.65E-06	2.34E-06	2.53E-07	1.57E-07	2.22E-04	7.80E-05	8.44E-06	5.24E-06
53	Plumas County	5.9	1.87E-06	100	2867	1.25E-04	4.39E-05	4.75E-06	2.95E-06	4.16E-03	1.46E-03	1.58E-04	9.84E-05
54	Twentymile House	2.3	7.39E-07	1,000	2867	4.93E-05	1.74E-05	1.88E-06	1.17E-06	1.64E-03	5.79E-04	6.26E-05	3.89E-05
55	Plumas County	2.4	7.70E-07	100	2867	5.14E-05	1.81E-05	1.96E-06	1.22E-06	1.71E-03	6.04E-04	6.52E-05	4.06E-05
56	Blairsden	6.7	2.13E-06	1,000	2867	1.42E-04	5.00E-05	5.41E-06	3.36E-06	4.73E-03	1.67E-03	1.80E-04	1.12E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	2867	3.77E-05	1.33E-05	1.44E-06	8.93E-07	1.26E-03	4.43E-04	4.79E-05	2.98E-05
58	Plumas Golf	1.1	3.60E-07	1,000	2867	2.40E-05	8.46E-06	9.14E-07	5.68E-07	8.01E-04	2.82E-04	3.05E-05	1.89E-05
59	Plumas County	1.8	5.78E-07	100	2867	3.86E-05	1.36E-05	1.47E-06	9.13E-07	1.29E-03	4.53E-04	4.89E-05	3.04E-05
60	Portola	3.5	1.11E-06	1,000	2867	7.44E-05	2.62E-05	2.83E-06	1.76E-06	2.48E-03	8.73E-04	9.44E-05	5.87E-05
61	Plumas County	14.9	4.69E-06	100	2867	3.13E-04	1.10E-04	1.19E-05	7.40E-06	1.04E-02	3.67E-03	3.97E-04	2.47E-04
62	Chilcoot	1.8	5.81E-07	1,000	2867	3.88E-05	1.37E-05	1.48E-06	9.18E-07	1.29E-03	4.55E-04	4.92E-05	3.06E-05
63	Lassen County	19.2	6.05E-06	100	2867	4.04E-04	1.42E-04	1.54E-05	9.55E-06	1.35E-02	4.74E-03	5.12E-04	3.18E-04
64	Doyle	1.2	3.82E-07	1,000	2867	2.55E-05	8.98E-06	9.71E-07	6.03E-07	8.50E-04	2.99E-04	3.24E-05	2.01E-05
65	Lassen County	8.0	2.52E-06	100	2867	1.68E-04	5.91E-05	6.39E-06	3.97E-06	5.60E-03	1.97E-03	2.13E-04	1.32E-04
66	Herlong	4.5	1.41E-06	1,000	2867	9.42E-05	3.32E-05	3.59E-06	2.23E-06	3.14E-03	1.11E-03	1.20E-04	7.43E-05
67	Lassen County	5.2	1.64E-06	1,000	2867	1.10E-04	3.86E-05	4.17E-06	2.59E-06	3.65E-03	1.29E-03	1.39E-04	8.64E-05
Total/Weighted Average		300.8	9.72E-05			5.13E-03	1.77E-03	1.85E-04	1.15E-04	1.71E-01	5.90E-02	6.15E-03	3.82E-03
Return Period			10,284			195	565	5,419	8,724	6	17	163	262

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	8.18E-06	1.88E-06	2.34E-08	1.18E-08	2.73E-04	6.27E-05	7.81E-07	3.94E-07
2	Benicia	2.6	8.92E-07	1,000	1042	7.99E-06	1.84E-06	2.29E-08	1.15E-08	2.66E-04	6.13E-05	7.63E-07	3.85E-07
3	Grizzly Bay	10.6	3.67E-06	100	1042	3.29E-05	7.57E-06	9.42E-08	4.75E-08	1.10E-03	2.52E-04	3.14E-06	1.58E-06
4	Fairfield	3.8	1.33E-06	3,000	1042	1.19E-05	2.73E-06	3.40E-08	1.72E-08	3.96E-04	9.11E-05	1.13E-06	5.72E-07
5	Elmira	13.7	4.76E-06	100	1042	4.26E-05	9.81E-06	1.22E-07	6.16E-08	1.42E-03	3.27E-04	4.07E-06	2.05E-06
6	Dixon	2.1	7.43E-07	1,000	1042	6.65E-06	1.53E-06	1.91E-08	9.62E-09	2.22E-04	5.11E-05	6.35E-07	3.21E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	2.05E-05	4.73E-06	5.89E-08	2.97E-08	6.85E-04	1.58E-04	1.96E-06	9.90E-07
8	Davis	3.5	1.23E-06	1,000	1042	1.10E-05	2.53E-06	3.14E-08	1.59E-08	3.66E-04	8.42E-05	1.05E-06	5.29E-07
9	Yolo Co Ag	7.0	2.43E-06	100	1042	2.17E-05	5.00E-06	6.22E-08	3.14E-08	7.24E-04	1.67E-04	2.07E-06	1.05E-06
10	Sacramento	3.3	1.13E-06	3,000	1042	1.01E-05	2.33E-06	2.89E-08	1.46E-08	3.37E-04	7.75E-05	9.65E-07	4.87E-07
11	Sacramento River	0.4	1.46E-07	100	1042	1.31E-06	3.01E-07	3.74E-09	1.89E-09	4.35E-05	1.00E-05	1.25E-07	6.29E-08
12	Sacramento	2.5	8.54E-07	10,000	1042	7.65E-06	1.76E-06	2.19E-08	1.11E-08	2.55E-04	5.87E-05	7.30E-07	3.68E-07
13	Parkland	1.6	5.63E-07	100	3232	1.56E-05	3.60E-06	4.47E-08	2.26E-08	5.21E-04	1.20E-04	1.49E-06	7.53E-07
14	Sacramento	3.2	1.11E-06	3,000	3232	3.09E-05	7.13E-06	8.87E-08	4.47E-08	1.03E-03	2.38E-04	2.96E-06	1.49E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	2.49E-05	5.73E-06	7.13E-08	3.60E-08	8.29E-04	1.91E-04	2.38E-06	1.20E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	4.21E-05	9.70E-06	1.21E-07	6.09E-08	1.40E-03	3.23E-04	4.02E-06	2.03E-06
17	Roseville Yard	1.4	4.72E-07	100	3232	1.31E-05	3.02E-06	3.76E-08	1.90E-08	4.37E-04	1.01E-04	1.25E-06	6.32E-07
18	Roseville	1.2	3.25E-07	1,000	2867	2.20E-05	7.74E-06	8.37E-07	5.20E-07	7.33E-04	2.58E-04	2.79E-05	1.73E-05
19	Roseville	1.4	3.98E-07	3,000	2867	2.70E-05	9.50E-06	1.03E-06	6.38E-07	8.99E-04	3.17E-04	3.42E-05	2.13E-05
20	Roseville	2.3	6.44E-07	3,000	2867	4.36E-05	1.54E-05	1.66E-06	1.03E-06	1.45E-03	5.12E-04	5.53E-05	3.44E-05
21	Placer Co	1.3	3.62E-07	1,000	2867	2.45E-05	8.62E-06	9.32E-07	5.79E-07	8.16E-04	2.87E-04	3.11E-05	1.93E-05
22	Placer Co	0.1	4.19E-08	100	2867	2.83E-06	9.98E-07	1.08E-07	6.70E-08	9.45E-05	3.33E-05	3.59E-06	2.23E-06
23	Placer Co	2.9	8.26E-07	1,000	2867	5.59E-05	1.97E-05	2.13E-06	1.32E-06	1.86E-03	6.56E-04	7.09E-05	4.41E-05
24	Lincoln	1.2	3.37E-07	100	2867	2.28E-05	8.04E-06	8.69E-07	5.40E-07	7.61E-04	2.68E-04	2.90E-05	1.80E-05
25	Lincoln	2.9	8.10E-07	3,000	2867	5.48E-05	1.93E-05	2.09E-06	1.30E-06	1.83E-03	6.44E-04	6.96E-05	4.32E-05
26	Sheridan	10.7	3.01E-06	100	2867	2.04E-04	7.18E-05	7.76E-06	4.82E-06	6.80E-03	2.39E-03	2.59E-04	1.61E-04
27	Wheatland	0.9	2.63E-07	1,000	2867	1.78E-05	6.27E-06	6.78E-07	4.21E-07	5.93E-04	2.09E-04	2.26E-05	1.40E-05
28	Yuba County	9.2	2.61E-06	100	2867	1.77E-04	6.22E-05	6.72E-06	4.18E-06	5.89E-03	2.07E-03	2.24E-04	1.39E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	2867	8.15E-05	2.87E-05	3.10E-06	1.93E-06	2.72E-03	9.56E-04	1.03E-04	6.43E-05
30	Marysville	1.3	3.76E-07	3,000	2867	2.54E-05	8.96E-06	9.68E-07	6.02E-07	8.48E-04	2.99E-04	3.23E-05	2.01E-05
31	Marysville	2.3	6.56E-07	100	2867	4.44E-05	1.56E-05	1.69E-06	1.05E-06	1.48E-03	5.21E-04	5.63E-05	3.50E-05
32	Live Oak	0.3	9.29E-08	1,000	2867	6.29E-06	2.21E-06	2.39E-07	1.49E-07	2.10E-04	7.38E-05	7.98E-06	4.96E-06
33	Live Oak	6.4	1.81E-06	100	2867	1.23E-04	4.32E-05	4.67E-06	2.91E-06	4.09E-03	1.44E-03	1.56E-04	9.68E-05
34	Live Oak	0.4	1.03E-07	1,000	2867	7.00E-06	2.47E-06	2.67E-07	1.66E-07	2.33E-04	8.22E-05	8.88E-06	5.52E-06
35	Live Oak	1.0	2.86E-07	3,000	2867	1.94E-05	6.83E-06	7.38E-07	4.59E-07	6.46E-04	2.28E-04	2.46E-05	1.53E-05
36	Butte Co	5.2	1.48E-06	100	2867	9.99E-05	3.52E-05	3.80E-06	2.36E-06	3.33E-03	1.17E-03	1.27E-04	7.88E-05
37	Gridley	0.5	1.29E-07	1,000	2867	8.70E-06	3.06E-06	3.31E-07	2.06E-07	2.90E-04	1.02E-04	1.10E-05	6.86E-06
38	Gridley	0.8	2.34E-07	3,000	2867	1.58E-05	5.58E-06	6.03E-07	3.75E-07	5.28E-04	1.86E-04	2.01E-05	1.25E-05
39	Gridley	2.5	7.08E-07	100	2867	4.80E-05	1.69E-05	1.83E-06	1.13E-06	1.60E-03	5.63E-04	6.08E-05	3.78E-05
40	Biggs	0.6	1.62E-07	3,000	2867	1.10E-05	3.86E-06	4.17E-07	2.59E-07	3.65E-04	1.29E-04	1.39E-05	8.64E-06
41	Butte Co	5.1	1.45E-06	100	2867	9.81E-05	3.46E-05	3.74E-06	2.32E-06	3.27E-03	1.15E-03	1.25E-04	7.74E-05
42	Richvale	0.8	2.36E-07	1,000	2867	1.60E-05	5.63E-06	6.08E-07	3.78E-07	5.33E-04	1.88E-04	2.03E-05	1.26E-05
43	Nelson	9.3	2.62E-06	100	2867	1.77E-04	6.25E-05	6.75E-06	4.20E-06	5.91E-03	2.08E-03	2.25E-04	1.40E-04
44	Durham	2.4	6.89E-07	1,000	2867	4.66E-05	1.64E-05	1.77E-06	1.10E-06	1.55E-03	5.47E-04	5.91E-05	3.68E-05
45	Chico	4.3	1.22E-06	100	2867	8.26E-05	2.91E-05	3.15E-06	1.96E-06	2.75E-03	9.70E-04	1.05E-04	6.52E-05
46	Chico	4.5	1.27E-06	1,000	2867	8.63E-05	3.04E-05	3.28E-06	2.04E-06	2.88E-03	1.01E-03	1.09E-04	6.81E-05
47	Chico	2.8	7.91E-07	100	2867	5.36E-05	1.89E-05	2.04E-06	1.27E-06	1.79E-03	6.29E-04	6.80E-05	4.23E-05
48	Nord	0.6	1.65E-07	1,000	2867	1.12E-05	3.93E-06	4.24E-07	2.64E-07	3.72E-04	1.31E-04	1.41E-05	8.80E-06
49	Butte Co	11.3	3.20E-06	100	2867	2.17E-04	7.64E-05	8.25E-06	5.13E-06	7.23E-03	2.55E-03	2.75E-04	1.71E-04
50	Vina	0.4	1.26E-07	1,000	2867	8.53E-06	3.00E-06	3.25E-07	2.02E-07	2.84E-04	1.00E-04	1.08E-05	6.73E-06
51	Copeland	6.3	1.78E-06	100	2867	1.21E-04	4.25E-05	4.59E-06	2.85E-06	4.02E-03	1.42E-03	1.53E-04	9.52E-05
52	Los Molinos	0.5	1.47E-07	1,000	2867	9.94E-06	3.50E-06	3.78E-07	2.35E-07	3.31E-04	1.17E-04	1.26E-05	7.84E-06
53	Los Molinos	1.0	2.81E-07	100	2867	1.90E-05	6.69E-06	7.23E-07	4.49E-07	6.33E-04	2.23E-04	2.41E-05	1.50E-05
54	Tehema	0.3	9.39E-08	1,000	2867	6.36E-06	2.24E-06	2.42E-07	1.50E-07	2.12E-04	7.46E-05	8.07E-06	5.01E-06
55	Tehema	2.2	6.32E-07	100	2867	4.28E-05	1.51E-05	1.63E-06	1.01E-06	1.43E-03	5.02E-04	5.43E-05	3.37E-05
56	Gerber	2.3	6.54E-07	1,000	2867	4.43E-05	1.56E-05	1.68E-06	1.05E-06	1.48E-03	5.20E-04	5.62E-05	3.49E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117 Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	2867	3.42E-05	1.20E-05	1.30E-06	8.09E-07	1.14E-03	4.01E-04	4.34E-05	2.70E-05
58	Red Bluff	0.8	2.18E-07	1,000	2867	1.48E-05	5.19E-06	5.61E-07	3.49E-07	4.92E-04	1.73E-04	1.87E-05	1.16E-05
59	Red Bluff	4.6	1.31E-06	100	2867	8.85E-05	3.12E-05	3.37E-06	2.09E-06	2.95E-03	1.04E-03	1.12E-04	6.98E-05
60	Red Bluff	3.3	9.27E-07	1,000	2867	6.28E-05	2.21E-05	2.39E-06	1.49E-06	2.09E-03	7.37E-04	7.96E-05	4.95E-05
61	Tehema Co	15.3	4.32E-06	100	2867	2.92E-04	1.03E-04	1.11E-05	6.92E-06	9.74E-03	3.43E-03	3.71E-04	2.31E-04
62	Cottonwood	0.6	1.72E-07	1,000	2867	1.17E-05	4.10E-06	4.44E-07	2.76E-07	3.89E-04	1.37E-04	1.48E-05	9.19E-06
63	Anderson	5.4	1.51E-06	100	2867	1.02E-04	3.61E-05	3.90E-06	2.42E-06	3.42E-03	1.20E-03	1.30E-04	8.08E-05
64	Anderson	3.5	1.00E-06	1,000	2867	6.78E-05	2.39E-05	2.58E-06	1.60E-06	2.26E-03	7.96E-04	8.60E-05	5.35E-05
65	Anderson	4.1	1.15E-06	100	2867	7.81E-05	2.75E-05	2.97E-06	1.85E-06	2.60E-03	9.17E-04	9.91E-05	6.16E-05
66	Redding	6.0	1.71E-06	1,000	2867	1.16E-04	4.07E-05	4.40E-06	2.73E-06	3.85E-03	1.36E-03	1.47E-04	9.11E-05
67	Redding	0.8	2.15E-07	1,000	2867	1.46E-05	5.13E-06	5.55E-07	3.45E-07	4.86E-04	1.71E-04	1.85E-05	1.15E-05
68	Redding	1.1	3.19E-07	100	2867	2.16E-05	7.61E-06	8.22E-07	5.11E-07	7.20E-04	2.54E-04	2.74E-05	1.70E-05
69	Redding	0.4	1.10E-07	1,000	2867	7.47E-06	2.63E-06	2.84E-07	1.77E-07	2.49E-04	8.77E-05	9.48E-06	5.89E-06
70	Redding	2.6	7.29E-07	100	2867	4.94E-05	1.74E-05	1.88E-06	1.17E-06	1.65E-03	5.79E-04	6.26E-05	3.89E-05
71	Shasta Co	0.5	1.48E-07	1,000	2867	1.00E-05	3.52E-06	3.81E-07	2.37E-07	3.33E-04	1.17E-04	1.27E-05	7.89E-06
72	Shasta Lake	1.7	4.66E-07	100	2867	3.16E-05	1.11E-05	1.20E-06	7.47E-07	1.05E-03	3.70E-04	4.00E-05	2.49E-05
73	Shasta Lake	0.8	2.12E-07	1,000	2867	1.44E-05	5.06E-06	5.46E-07	3.40E-07	4.79E-04	1.69E-04	1.82E-05	1.13E-05
74	Shasta Co	16.4	4.64E-06	100	2867	3.14E-04	1.11E-04	1.20E-05	7.44E-06	1.05E-02	3.69E-03	3.99E-04	2.48E-04
75	Lakeshore	0.6	1.71E-07	1,000	2867	1.16E-05	4.09E-06	4.42E-07	2.75E-07	3.87E-04	1.36E-04	1.47E-05	9.15E-06
76	Shasta Co	28.7	8.10E-06	100	2867	5.81E-04	2.05E-04	2.21E-05	1.37E-05	1.94E-02	6.82E-03	7.37E-04	4.58E-04
77	Dunsmuir	1.3	3.68E-07	1,000	2867	2.49E-05	8.78E-06	9.49E-07	5.90E-07	8.31E-04	2.93E-04	3.16E-05	1.97E-05
78	Siskiyou Co	12.8	3.61E-06	100	2867	2.44E-04	8.60E-05	9.29E-06	5.78E-06	8.14E-03	2.87E-03	3.10E-04	1.93E-04
79	Mount Shasta	1.1	3.19E-07	1,000	2867	2.16E-05	7.62E-06	8.23E-07	5.12E-07	7.21E-04	2.54E-04	2.74E-05	1.71E-05
80	Siskiyou Co	64.5	1.82E-05	100	2867	1.33E-03	4.68E-04	5.06E-05	3.14E-05	4.43E-02	1.56E-02	1.69E-03	1.05E-03
81	Dorris	0.9	2.49E-07	100	2867	1.69E-05	5.94E-06	6.42E-07	3.99E-07	5.62E-04	1.98E-04	2.14E-05	1.33E-05
82	Siskiyou Co	3.4	9.64E-07	1,000	2867	6.52E-05	2.30E-05	2.48E-06	1.54E-06	2.17E-03	7.66E-04	8.28E-05	5.15E-05
Total/Weighted Average		368.8	1.09E-04			6.12E-03	2.12E-03	2.22E-04	1.38E-04	2.04E-01	7.05E-02	7.40E-03	4.60E-03
Return Period			9,188			163	473	4,506	7,253	5	14	135	218

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Spur	2.6	9.13E-07	1,000	1042	8.78E-06	2.34E-06	4.08E-08	1.76E-08	2.93E-04	7.79E-05	1.36E-06	5.87E-07
2	Benicia	2.6	8.92E-07	1,000	1042	8.58E-06	2.28E-06	3.99E-08	1.72E-08	2.86E-04	7.61E-05	1.33E-06	5.74E-07
3	Grizzly Bay	10.6	3.67E-06	100	1042	3.53E-05	9.40E-06	1.64E-07	7.09E-08	1.18E-03	3.13E-04	5.48E-06	2.36E-06
4	Fairfield	3.8	1.33E-06	3,000	1042	1.27E-05	3.39E-06	5.93E-08	2.56E-08	4.25E-04	1.13E-04	1.98E-06	8.53E-07
5	Elmira	13.7	4.76E-06	100	1042	4.57E-05	1.22E-05	2.13E-07	9.18E-08	1.52E-03	4.06E-04	7.09E-06	3.06E-06
6	Dixon	2.1	7.43E-07	1,000	1042	7.14E-06	1.90E-06	3.32E-08	1.43E-08	2.38E-04	6.34E-05	1.11E-06	4.78E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	2.21E-05	5.87E-06	1.03E-07	4.43E-08	7.35E-04	1.96E-04	3.42E-06	1.48E-06
8	Davis	3.5	1.23E-06	1,000	1042	1.18E-05	3.14E-06	5.48E-08	2.36E-08	3.93E-04	1.05E-04	1.83E-06	7.88E-07
9	Yolo Co Ag	7.0	2.43E-06	100	1042	2.33E-05	6.21E-06	1.09E-07	4.68E-08	7.78E-04	2.07E-04	3.62E-06	1.56E-06
10	Sacramento	3.3	1.13E-06	3,000	1042	1.08E-05	2.89E-06	5.05E-08	2.18E-08	3.62E-04	9.63E-05	1.68E-06	7.26E-07
11	Sacramento River	0.4	1.46E-07	100	1042	1.40E-06	3.73E-07	6.53E-09	2.82E-09	4.68E-05	1.24E-05	2.18E-07	9.39E-08
12	Sacramento	2.5	8.54E-07	10,000	1042	8.21E-06	2.19E-06	3.82E-08	1.65E-08	2.74E-04	7.29E-05	1.27E-06	5.49E-07
13	Parkland	1.6	5.63E-07	100	3232	1.68E-05	4.47E-06	7.80E-08	3.37E-08	5.59E-04	1.49E-04	2.60E-06	1.12E-06
14	Sacramento	3.2	1.11E-06	3,000	3232	3.32E-05	8.85E-06	1.55E-07	6.67E-08	1.11E-03	2.95E-04	5.15E-06	2.22E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	2.67E-05	7.11E-06	1.24E-07	5.36E-08	8.90E-04	2.37E-04	4.14E-06	1.79E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	4.52E-05	1.20E-05	2.10E-07	9.08E-08	1.51E-03	4.01E-04	7.02E-06	3.03E-06
17	Roseville Yard	1.4	4.72E-07	100	3232	1.41E-05	3.75E-06	6.55E-08	2.83E-08	4.69E-04	1.25E-04	2.18E-06	9.42E-07
18	Roseville	1.2	9.10E-07	1,000	2867	5.27E-05	1.03E-05	7.35E-08	2.09E-08	1.76E-03	3.45E-04	2.45E-06	6.97E-07
19	Roseville	1.4	1.12E-06	3,000	2867	6.46E-05	1.27E-05	9.01E-08	2.56E-08	2.15E-03	4.23E-04	3.00E-06	8.54E-07
20	Roseville	1.1	8.71E-07	3,000	2867	5.04E-05	9.89E-06	7.03E-08	2.00E-08	1.68E-03	3.30E-04	2.34E-06	6.66E-07
21	Roseville	2.5	1.94E-06	1,000	2867	1.12E-04	2.20E-05	1.57E-07	4.45E-08	3.74E-03	7.34E-04	5.22E-06	1.48E-06
22	Roseville	0.5	3.58E-07	100	2867	2.07E-05	4.07E-06	2.89E-08	8.23E-09	6.91E-04	1.36E-04	9.64E-07	2.74E-07
23	Rocklin	2.5	1.99E-06	1,000	2867	1.15E-04	2.26E-05	1.61E-07	4.57E-08	3.84E-03	7.53E-04	5.35E-06	1.52E-06
24	Placer Co	8.0	6.31E-06	100	2867	3.65E-04	7.17E-05	5.10E-07	1.45E-07	1.22E-02	2.39E-03	1.70E-05	4.83E-06
25	Newcastle	0.5	3.57E-07	3,000	2867	2.07E-05	4.06E-06	2.88E-08	8.20E-09	6.88E-04	1.35E-04	9.61E-07	2.73E-07
26	Placer Co	2.5	1.98E-06	100	2867	1.15E-04	2.25E-05	1.60E-07	4.56E-08	3.82E-03	7.51E-04	5.34E-06	1.52E-06
27	Auburn	5.3	4.22E-06	1,000	2867	2.44E-04	4.80E-05	3.41E-07	9.70E-08	8.14E-03	1.60E-03	1.14E-05	3.23E-06
28	Placer Co	13.6	1.08E-05	100	2867	6.22E-04	1.22E-04	8.69E-07	2.47E-07	2.07E-02	4.07E-03	2.90E-05	8.24E-06

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Truckee Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Colfax	0.7	5.34E-07	1,000	2867	3.09E-05	6.06E-06	4.31E-08	1.23E-08	1.03E-03	2.02E-04	1.44E-06	4.08E-07
30	Placer Co	57.4	4.54E-05	3,000	2867	2.63E-03	5.16E-04	3.67E-06	1.04E-06	8.76E-02	1.72E-02	1.22E-04	3.48E-05
31	Truckee	2.1	1.68E-06	100	2867	9.71E-05	1.91E-05	1.36E-07	3.86E-08	3.24E-03	6.36E-04	4.52E-06	1.29E-06
32	Nevada Co	13.9	1.10E-05	1,000	2867	6.35E-04	1.25E-04	8.87E-07	2.52E-07	2.12E-02	4.16E-03	2.96E-05	8.41E-06
33	Floriston	0.2	1.83E-07	100	2867	1.06E-05	2.08E-06	1.48E-08	4.21E-09	3.53E-04	6.94E-05	4.93E-07	1.40E-07
34	Sierra Co	5.8	4.58E-06	1,000	2867	2.65E-04	5.21E-05	3.70E-07	1.05E-07	8.84E-03	1.74E-03	1.23E-05	3.51E-06
Total/Weighted Average		190.9	1.19E-04			5.78E-03	1.16E-03	9.15E-06	2.83E-06	1.93E-01	3.86E-02	3.05E-04	9.43E-05
Return Period			8,391			173	863	109,257	353,363	5	26	3,278	10,601

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	8.78E-06	2.34E-06	4.08E-08	1.76E-08	2.93E-04	7.79E-05	1.36E-06	5.87E-07
2	Benicia	2.6	8.92E-07	1,000	1042	8.58E-06	2.28E-06	3.99E-08	1.72E-08	2.86E-04	7.61E-05	1.33E-06	5.74E-07
3	Grizzly Bay	10.6	3.67E-06	100	1042	3.53E-05	9.40E-06	1.64E-07	7.09E-08	1.18E-03	3.13E-04	5.48E-06	2.36E-06
4	Fairfield	3.8	1.33E-06	3,000	1042	1.27E-05	3.39E-06	5.93E-08	2.56E-08	4.25E-04	1.13E-04	1.98E-06	8.53E-07
5	Elmira	13.7	4.76E-06	100	1042	4.57E-05	1.22E-05	2.13E-07	9.18E-08	1.52E-03	4.06E-04	7.09E-06	3.06E-06
6	Dixon	2.1	7.43E-07	1,000	1042	7.14E-06	1.90E-06	3.32E-08	1.43E-08	2.38E-04	6.34E-05	1.11E-06	4.78E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	2.21E-05	5.87E-06	1.03E-07	4.43E-08	7.35E-04	1.96E-04	3.42E-06	1.48E-06
8	Davis	3.5	1.23E-06	1,000	1042	1.18E-05	3.14E-06	5.48E-08	2.36E-08	3.93E-04	1.05E-04	1.83E-06	7.88E-07
9	Yolo Co Ag	7.0	2.43E-06	100	1042	2.33E-05	6.21E-06	1.09E-07	4.68E-08	7.78E-04	2.07E-04	3.62E-06	1.56E-06
10	Sacramento	3.3	1.13E-06	3,000	1042	1.08E-05	2.89E-06	5.05E-08	2.18E-08	3.62E-04	9.63E-05	1.68E-06	7.26E-07
11	Sacramento River	0.4	1.46E-07	100	1042	1.40E-06	3.73E-07	6.53E-09	2.82E-09	4.68E-05	1.24E-05	2.18E-07	9.39E-08
12	Sacramento	2.5	8.54E-07	10,000	1042	8.21E-06	2.19E-06	3.82E-08	1.65E-08	2.74E-04	7.29E-05	1.27E-06	5.49E-07
13	Parkland	1.6	5.63E-07	100	3232	1.68E-05	4.47E-06	7.80E-08	3.37E-08	5.59E-04	1.49E-04	2.60E-06	1.12E-06
14	Sacramento	3.2	1.11E-06	3,000	3232	3.32E-05	8.85E-06	1.55E-07	6.67E-08	1.11E-03	2.95E-04	5.15E-06	2.22E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	2.67E-05	7.11E-06	1.24E-07	5.36E-08	8.90E-04	2.37E-04	4.14E-06	1.79E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	4.52E-05	1.20E-05	2.10E-07	9.08E-08	1.51E-03	4.01E-04	7.02E-06	3.03E-06
17	Roseville Yard	1.4	4.72E-07	100	3232	1.41E-05	3.75E-06	6.55E-08	2.83E-08	4.69E-04	1.25E-04	2.18E-06	9.42E-07
18	Roseville	1.2	3.63E-07	1,000	2867	2.69E-05	1.04E-05	1.30E-06	8.24E-07	8.97E-04	3.48E-04	4.33E-05	2.75E-05
19	Roseville	1.4	4.45E-07	3,000	2867	3.30E-05	1.28E-05	1.59E-06	1.01E-06	1.10E-03	4.26E-04	5.30E-05	3.37E-05
20	Roseville	2.3	7.20E-07	3,000	2867	5.33E-05	2.07E-05	2.57E-06	1.63E-06	1.78E-03	6.89E-04	8.58E-05	5.44E-05
21	Placer Co	1.3	4.04E-07	1,000	2867	2.99E-05	1.16E-05	1.44E-06	9.17E-07	9.98E-04	3.87E-04	4.82E-05	3.06E-05
22	Placer Co	0.1	4.68E-08	100	2867	3.47E-06	1.34E-06	1.67E-07	1.06E-07	1.16E-04	4.48E-05	5.57E-06	3.54E-06
23	Placer Co	2.9	9.23E-07	1,000	2867	6.84E-05	2.65E-05	3.30E-06	2.09E-06	2.28E-03	8.84E-04	1.10E-04	6.98E-05
24	Lincoln	1.2	3.77E-07	100	2867	2.79E-05	1.08E-05	1.35E-06	8.55E-07	9.31E-04	3.61E-04	4.49E-05	2.85E-05
25	Lincoln	2.9	9.05E-07	3,000	2867	6.71E-05	2.60E-05	3.24E-06	2.05E-06	2.24E-03	8.67E-04	1.08E-04	6.84E-05
26	Sheridan	10.7	3.37E-06	100	2867	2.49E-04	9.67E-05	1.20E-05	7.64E-06	8.31E-03	3.22E-03	4.01E-04	2.55E-04
27	Wheatland	0.9	2.94E-07	1,000	2867	2.18E-05	8.44E-06	1.05E-06	6.67E-07	7.26E-04	2.81E-04	3.50E-05	2.22E-05
28	Yuba County	9.2	2.92E-06	100	2867	2.16E-04	8.38E-05	1.04E-05	6.61E-06	7.20E-03	2.79E-03	3.47E-04	2.20E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.35E-06	1,000	2867	9.97E-05	3.86E-05	4.81E-06	3.05E-06	3.32E-03	1.29E-03	1.60E-04	1.02E-04
30	Marysville	1.3	4.20E-07	3,000	2867	3.11E-05	1.21E-05	1.50E-06	9.52E-07	1.04E-03	4.02E-04	5.00E-05	3.17E-05
31	Marysville	0.3	9.49E-08	100	2867	7.03E-06	2.73E-06	3.39E-07	2.15E-07	2.34E-04	9.09E-05	1.13E-05	7.18E-06
32	Marysville	0.4	1.18E-07	1,000	2867	8.71E-06	3.38E-06	4.20E-07	2.67E-07	2.90E-04	1.13E-04	1.40E-05	8.89E-06
33	Yuba County	0.7	2.37E-07	100	2867	1.75E-05	6.80E-06	8.46E-07	5.37E-07	5.85E-04	2.27E-04	2.82E-05	1.79E-05
34	Yuba County	0.2	4.85E-08	1,000	2867	3.59E-06	1.39E-06	1.73E-07	1.10E-07	1.20E-04	4.64E-05	5.77E-06	3.66E-06
35	Yuba County	0.8	2.39E-07	3,000	2867	1.77E-05	6.85E-06	8.52E-07	5.41E-07	5.89E-04	2.28E-04	2.84E-05	1.80E-05
36	Yuba County	0.3	9.41E-08	100	2867	6.97E-06	2.70E-06	3.36E-07	2.13E-07	2.32E-04	9.00E-05	1.12E-05	7.11E-06
37	Yuba/Butte County	16.3	5.16E-06	1,000	2867	3.82E-04	1.48E-04	1.84E-05	1.17E-05	1.27E-02	4.94E-03	6.15E-04	3.90E-04
38	Palermo	4.2	1.33E-06	3,000	2867	9.83E-05	3.81E-05	4.74E-06	3.01E-06	3.28E-03	1.27E-03	1.58E-04	1.00E-04
39	Butte County	1.1	3.35E-07	100	2867	2.48E-05	9.61E-06	1.20E-06	7.59E-07	8.27E-04	3.20E-04	3.99E-05	2.53E-05
40	South Oroville	2.4	7.61E-07	3,000	2867	5.64E-05	2.19E-05	2.72E-06	1.73E-06	1.88E-03	7.28E-04	9.07E-05	5.75E-05
41	Oroville	0.9	2.68E-07	100	2867	1.99E-05	7.71E-06	9.59E-07	6.09E-07	6.63E-04	2.57E-04	3.20E-05	2.03E-05
42	Oroville	1.3	4.20E-07	1,000	2867	3.11E-05	1.21E-05	1.50E-06	9.52E-07	1.04E-03	4.02E-04	5.00E-05	3.17E-05
43	Thermolito Div.	0.1	2.97E-08	100	2867	2.20E-06	8.52E-07	1.06E-07	6.73E-08	7.32E-05	2.84E-05	3.53E-06	2.24E-06
44	Butte County	1.4	4.52E-07	1,000	2867	3.35E-05	1.30E-05	1.61E-06	1.02E-06	1.12E-03	4.32E-04	5.38E-05	3.41E-05
45	Feather Canyon	53.9	1.70E-05	100	2867	1.26E-03	4.88E-04	6.08E-05	3.86E-05	4.20E-02	1.63E-02	2.03E-03	1.29E-03
46	Hallsted	1.5	4.77E-07	1,000	2867	3.53E-05	1.37E-05	1.70E-06	1.08E-06	1.18E-03	4.56E-04	5.68E-05	3.60E-05
47	Plumas County	12.5	3.95E-06	100	2867	2.92E-04	1.13E-04	1.41E-05	8.95E-06	9.75E-03	3.78E-03	4.70E-04	2.98E-04
48	Spanish Creek	0.5	1.52E-07	1,000	2867	1.13E-05	4.37E-06	5.44E-07	3.45E-07	3.76E-04	1.46E-04	1.81E-05	1.15E-05
49	Plumas County	1.6	5.15E-07	100	2867	3.81E-05	1.48E-05	1.84E-06	1.17E-06	1.27E-03	4.93E-04	6.13E-05	3.89E-05
50	Quincy	3.6	1.15E-06	1,000	2867	8.52E-05	3.30E-05	4.11E-06	2.61E-06	2.84E-03	1.10E-03	1.37E-04	8.69E-05
51	Plumas County	4.6	1.44E-06	100	2867	1.07E-04	4.14E-05	5.16E-06	3.27E-06	3.56E-03	1.38E-03	1.72E-04	1.09E-04
52	Spring Garden	0.3	9.96E-08	1,000	2867	7.38E-06	2.86E-06	3.56E-07	2.26E-07	2.46E-04	9.54E-05	1.19E-05	7.53E-06
53	Plumas County	5.9	1.87E-06	100	2867	1.38E-04	5.37E-05	6.68E-06	4.24E-06	4.62E-03	1.79E-03	2.23E-04	1.41E-04
54	Twentymile House	2.3	7.39E-07	1,000	2867	5.47E-05	2.12E-05	2.64E-06	1.68E-06	1.82E-03	7.07E-04	8.80E-05	5.59E-05
55	Plumas County	2.4	7.70E-07	100	2867	5.71E-05	2.21E-05	2.75E-06	1.75E-06	1.90E-03	7.38E-04	9.18E-05	5.82E-05
56	Blairsden	6.7	2.13E-06	1,000	2867	1.58E-04	6.11E-05	7.61E-06	4.83E-06	5.26E-03	2.04E-03	2.54E-04	1.61E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Nevada via Portola Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Plumas County	1.8	5.65E-07	100	2867	4.19E-05	1.62E-05	2.02E-06	1.28E-06	1.40E-03	5.41E-04	6.73E-05	4.27E-05
58	Plumas Golf	1.1	3.60E-07	1,000	2867	2.67E-05	1.03E-05	1.29E-06	8.16E-07	8.89E-04	3.45E-04	4.29E-05	2.72E-05
59	Plumas County	1.8	5.78E-07	100	2867	4.28E-05	1.66E-05	2.07E-06	1.31E-06	1.43E-03	5.53E-04	6.88E-05	4.37E-05
60	Portola	3.5	1.11E-06	1,000	2867	8.26E-05	3.20E-05	3.98E-06	2.53E-06	2.75E-03	1.07E-03	1.33E-04	8.43E-05
61	Plumas County	14.9	4.69E-06	100	2867	3.47E-04	1.35E-04	1.68E-05	1.06E-05	1.16E-02	4.49E-03	5.59E-04	3.54E-04
62	Chilcoot	1.8	5.81E-07	1,000	2867	4.30E-05	1.67E-05	2.08E-06	1.32E-06	1.43E-03	5.56E-04	6.92E-05	4.39E-05
63	Lassen County	19.2	6.05E-06	100	2867	4.48E-04	1.74E-04	2.16E-05	1.37E-05	1.49E-02	5.79E-03	7.21E-04	4.57E-04
64	Doyle	1.2	3.82E-07	1,000	2867	2.83E-05	1.10E-05	1.37E-06	8.66E-07	9.44E-04	3.66E-04	4.55E-05	2.89E-05
65	Lassen County	8.0	2.52E-06	100	2867	1.86E-04	7.23E-05	8.99E-06	5.71E-06	6.22E-03	2.41E-03	3.00E-04	1.90E-04
66	Herlong	4.5	1.41E-06	1,000	2867	1.05E-04	4.05E-05	5.04E-06	3.20E-06	3.49E-03	1.35E-03	1.68E-04	1.07E-04
67	Lassen County	5.2	1.64E-06	1,000	2867	1.22E-04	4.72E-05	5.87E-06	3.72E-06	4.06E-03	1.57E-03	1.96E-04	1.24E-04
Total/Weighted Average		300.8	9.72E-05			5.69E-03	2.16E-03	2.60E-04	1.65E-04	1.90E-01	7.22E-02	8.66E-03	5.49E-03
Return Period			10,284			176	462	3,847	6,074	5	14	115	182

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
1	Benicia Refinery	2.6	9.13E-07	1,000	1042	8.78E-06	2.34E-06	4.08E-08	1.76E-08	2.93E-04	7.79E-05	1.36E-06	5.87E-07
2	Benicia	2.6	8.92E-07	1,000	1042	8.58E-06	2.28E-06	3.99E-08	1.72E-08	2.86E-04	7.61E-05	1.33E-06	5.74E-07
3	Grizzly Bay	10.6	3.67E-06	100	1042	3.53E-05	9.40E-06	1.64E-07	7.09E-08	1.18E-03	3.13E-04	5.48E-06	2.36E-06
4	Fairfield	3.8	1.33E-06	3,000	1042	1.27E-05	3.39E-06	5.93E-08	2.56E-08	4.25E-04	1.13E-04	1.98E-06	8.53E-07
5	Elmira	13.7	4.76E-06	100	1042	4.57E-05	1.22E-05	2.13E-07	9.18E-08	1.52E-03	4.06E-04	7.09E-06	3.06E-06
6	Dixon	2.1	7.43E-07	1,000	1042	7.14E-06	1.90E-06	3.32E-08	1.43E-08	2.38E-04	6.34E-05	1.11E-06	4.78E-07
7	Solano Co Ag	6.6	2.30E-06	100	1042	2.21E-05	5.87E-06	1.03E-07	4.43E-08	7.35E-04	1.96E-04	3.42E-06	1.48E-06
8	Davis	3.5	1.23E-06	1,000	1042	1.18E-05	3.14E-06	5.48E-08	2.36E-08	3.93E-04	1.05E-04	1.83E-06	7.88E-07
9	Yolo Co Ag	7.0	2.43E-06	100	1042	2.33E-05	6.21E-06	1.09E-07	4.68E-08	7.78E-04	2.07E-04	3.62E-06	1.56E-06
10	Sacramento	3.3	1.13E-06	3,000	1042	1.08E-05	2.89E-06	5.05E-08	2.18E-08	3.62E-04	9.63E-05	1.68E-06	7.26E-07
11	Sacramento River	0.4	1.46E-07	100	1042	1.40E-06	3.73E-07	6.53E-09	2.82E-09	4.68E-05	1.24E-05	2.18E-07	9.39E-08
12	Sacramento	2.5	8.54E-07	10,000	1042	8.21E-06	2.19E-06	3.82E-08	1.65E-08	2.74E-04	7.29E-05	1.27E-06	5.49E-07
13	Parkland	1.6	5.63E-07	100	3232	1.68E-05	4.47E-06	7.80E-08	3.37E-08	5.59E-04	1.49E-04	2.60E-06	1.12E-06
14	Sacramento	3.2	1.11E-06	3,000	3232	3.32E-05	8.85E-06	1.55E-07	6.67E-08	1.11E-03	2.95E-04	5.15E-06	2.22E-06
15	North Highlands	2.6	8.96E-07	1,000	3232	2.67E-05	7.11E-06	1.24E-07	5.36E-08	8.90E-04	2.37E-04	4.14E-06	1.79E-06
16	North Highlands	4.4	1.52E-06	3,000	3232	4.52E-05	1.20E-05	2.10E-07	9.08E-08	1.51E-03	4.01E-04	7.02E-06	3.03E-06
17	Roseville Yard	1.4	4.72E-07	100	3232	1.41E-05	3.75E-06	6.55E-08	2.83E-08	4.69E-04	1.25E-04	2.18E-06	9.42E-07
18	Roseville	1.2	3.25E-07	1,000	2867	2.44E-05	9.45E-06	1.18E-06	7.46E-07	8.12E-04	3.15E-04	3.92E-05	2.49E-05
19	Roseville	1.4	3.98E-07	3,000	2867	2.99E-05	1.16E-05	1.44E-06	9.15E-07	9.96E-04	3.86E-04	4.81E-05	3.05E-05
20	Roseville	2.3	6.44E-07	3,000	2867	4.83E-05	1.87E-05	2.33E-06	1.48E-06	1.61E-03	6.24E-04	7.77E-05	4.93E-05
21	Placer Co	1.3	3.62E-07	1,000	2867	2.71E-05	1.05E-05	1.31E-06	8.30E-07	9.04E-04	3.50E-04	4.36E-05	2.77E-05
22	Placer Co	0.1	4.19E-08	100	2867	3.14E-06	1.22E-06	1.51E-07	9.61E-08	1.05E-04	4.06E-05	5.05E-06	3.20E-06
23	Placer Co	2.9	8.26E-07	1,000	2867	6.20E-05	2.40E-05	2.99E-06	1.90E-06	2.07E-03	8.00E-04	9.96E-05	6.32E-05
24	Lincoln	1.2	3.37E-07	100	2867	2.53E-05	9.81E-06	1.22E-06	7.75E-07	8.44E-04	3.27E-04	4.07E-05	2.58E-05
25	Lincoln	2.9	8.10E-07	3,000	2867	6.08E-05	2.36E-05	2.93E-06	1.86E-06	2.03E-03	7.85E-04	9.77E-05	6.20E-05
26	Sheridan	10.7	3.01E-06	100	2867	2.26E-04	8.76E-05	1.09E-05	6.92E-06	7.53E-03	2.92E-03	3.63E-04	2.31E-04
27	Wheatland	0.9	2.63E-07	1,000	2867	1.97E-05	7.65E-06	9.52E-07	6.04E-07	6.58E-04	2.55E-04	3.17E-05	2.01E-05
28	Yuba County	9.2	2.61E-06	100	2867	1.96E-04	7.59E-05	9.44E-06	5.99E-06	6.53E-03	2.53E-03	3.15E-04	2.00E-04

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
29	Olivehurst	4.3	1.20E-06	1,000	2867	9.03E-05	3.50E-05	4.36E-06	2.76E-06	3.01E-03	1.17E-03	1.45E-04	9.21E-05
30	Marysville	1.3	3.76E-07	3,000	2867	2.82E-05	1.09E-05	1.36E-06	8.63E-07	9.40E-04	3.64E-04	4.53E-05	2.88E-05
31	Marysville	2.3	6.56E-07	100	2867	4.92E-05	1.91E-05	2.37E-06	1.51E-06	1.64E-03	6.36E-04	7.91E-05	5.02E-05
32	Live Oak	0.3	9.29E-08	1,000	2867	6.97E-06	2.70E-06	3.36E-07	2.13E-07	2.32E-04	9.00E-05	1.12E-05	7.11E-06
33	Live Oak	6.4	1.81E-06	100	2867	1.36E-04	5.27E-05	6.56E-06	4.17E-06	4.54E-03	1.76E-03	2.19E-04	1.39E-04
34	Live Oak	0.4	1.03E-07	1,000	2867	7.76E-06	3.01E-06	3.74E-07	2.38E-07	2.59E-04	1.00E-04	1.25E-05	7.92E-06
35	Live Oak	1.0	2.86E-07	3,000	2867	2.15E-05	8.33E-06	1.04E-06	6.58E-07	7.16E-04	2.78E-04	3.45E-05	2.19E-05
36	Butte Co	5.2	1.48E-06	100	2867	1.11E-04	4.29E-05	5.34E-06	3.39E-06	3.69E-03	1.43E-03	1.78E-04	1.13E-04
37	Gridley	0.5	1.29E-07	1,000	2867	9.64E-06	3.74E-06	4.65E-07	2.95E-07	3.21E-04	1.25E-04	1.55E-05	9.84E-06
38	Gridley	0.8	2.34E-07	3,000	2867	1.76E-05	6.81E-06	8.47E-07	5.38E-07	5.85E-04	2.27E-04	2.82E-05	1.79E-05
39	Gridley	2.5	7.08E-07	100	2867	5.32E-05	2.06E-05	2.56E-06	1.63E-06	1.77E-03	6.87E-04	8.55E-05	5.42E-05
40	Biggs	0.6	1.62E-07	3,000	2867	1.21E-05	4.70E-06	5.86E-07	3.72E-07	4.05E-04	1.57E-04	1.95E-05	1.24E-05
41	Butte Co	5.1	1.45E-06	100	2867	1.09E-04	4.22E-05	5.25E-06	3.33E-06	3.63E-03	1.41E-03	1.75E-04	1.11E-04
42	Richvale	0.8	2.36E-07	1,000	2867	1.77E-05	6.87E-06	8.54E-07	5.42E-07	5.90E-04	2.29E-04	2.85E-05	1.81E-05
43	Nelson	9.3	2.62E-06	100	2867	1.97E-04	7.62E-05	9.49E-06	6.02E-06	6.55E-03	2.54E-03	3.16E-04	2.01E-04
44	Durham	2.4	6.89E-07	1,000	2867	5.17E-05	2.00E-05	2.49E-06	1.58E-06	1.72E-03	6.68E-04	8.31E-05	5.27E-05
45	Chico	4.3	1.22E-06	100	2867	9.16E-05	3.55E-05	4.42E-06	2.80E-06	3.05E-03	1.18E-03	1.47E-04	9.35E-05
46	Chico	4.5	1.27E-06	1,000	2867	9.57E-05	3.71E-05	4.61E-06	2.93E-06	3.19E-03	1.24E-03	1.54E-04	9.76E-05
47	Chico	2.8	7.91E-07	100	2867	5.94E-05	2.30E-05	2.86E-06	1.82E-06	1.98E-03	7.67E-04	9.55E-05	6.06E-05
48	Nord	0.6	1.65E-07	1,000	2867	1.24E-05	4.79E-06	5.96E-07	3.78E-07	4.12E-04	1.60E-04	1.99E-05	1.26E-05
49	Butte Co	11.3	3.20E-06	100	2867	2.40E-04	9.32E-05	1.16E-05	7.36E-06	8.01E-03	3.11E-03	3.86E-04	2.45E-04
50	Vina	0.4	1.26E-07	1,000	2867	9.45E-06	3.66E-06	4.56E-07	2.89E-07	3.15E-04	1.22E-04	1.52E-05	9.64E-06
51	Copeland	6.3	1.78E-06	100	2867	1.34E-04	5.18E-05	6.45E-06	4.09E-06	4.46E-03	1.73E-03	2.15E-04	1.36E-04
52	Los Molinos	0.5	1.47E-07	1,000	2867	1.10E-05	4.27E-06	5.31E-07	3.37E-07	3.67E-04	1.42E-04	1.77E-05	1.12E-05
53	Los Molinos	1.0	2.81E-07	100	2867	2.10E-05	8.16E-06	1.02E-06	6.44E-07	7.02E-04	2.72E-04	3.38E-05	2.15E-05
54	Tehema	0.3	9.39E-08	1,000	2867	7.05E-06	2.73E-06	3.40E-07	2.16E-07	2.35E-04	9.10E-05	1.13E-05	7.19E-06
55	Tehema	2.2	6.32E-07	100	2867	4.74E-05	1.84E-05	2.29E-06	1.45E-06	1.58E-03	6.12E-04	7.62E-05	4.84E-05
56	Gerber	2.3	6.54E-07	1,000	2867	4.91E-05	1.90E-05	2.37E-06	1.50E-06	1.64E-03	6.34E-04	7.89E-05	5.01E-05

Summary of Unit Train Accident and Spill Rates by Segment for the Refinery to Oregon via Dorris Route
Cumulative – DOT-117R Tank Cars

Segment	Segment Description	Length (miles)	Accident Probability (per mile)	Population Density (per sq.mi.)	# of Trains (per year)	*Project Oil Spill with Ignition*				*Project Oil Spill with no Ignition*			
						All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)	All Spill Probability (per year)	Single Tank Spill Probability (per year)	Large Spill Probability (per year)	Worst-Case Spill Probability (per year)
57	Tehema Co	1.8	5.05E-07	100	2867	3.79E-05	1.47E-05	1.83E-06	1.16E-06	1.26E-03	4.89E-04	6.09E-05	3.87E-05
58	Red Bluff	0.8	2.18E-07	1,000	2867	1.63E-05	6.34E-06	7.89E-07	5.00E-07	5.45E-04	2.11E-04	2.63E-05	1.67E-05
59	Red Bluff	4.6	1.31E-06	100	2867	9.81E-05	3.80E-05	4.73E-06	3.00E-06	3.27E-03	1.27E-03	1.58E-04	1.00E-04
60	Red Bluff	3.3	9.27E-07	1,000	2867	6.96E-05	2.70E-05	3.36E-06	2.13E-06	2.32E-03	8.99E-04	1.12E-04	7.10E-05
61	Tehema Co	15.3	4.32E-06	100	2867	3.24E-04	1.26E-04	1.56E-05	9.91E-06	1.08E-02	4.18E-03	5.21E-04	3.30E-04
62	Cottonwood	0.6	1.72E-07	1,000	2867	1.29E-05	5.01E-06	6.23E-07	3.95E-07	4.31E-04	1.67E-04	2.08E-05	1.32E-05
63	Anderson	5.4	1.51E-06	100	2867	1.14E-04	4.40E-05	5.48E-06	3.48E-06	3.79E-03	1.47E-03	1.83E-04	1.16E-04
64	Anderson	3.5	1.00E-06	1,000	2867	7.52E-05	2.91E-05	3.63E-06	2.30E-06	2.51E-03	9.71E-04	1.21E-04	7.67E-05
65	Anderson	4.1	1.15E-06	100	2867	8.66E-05	3.36E-05	4.18E-06	2.65E-06	2.89E-03	1.12E-03	1.39E-04	8.83E-05
66	Redding	6.0	1.71E-06	1,000	2867	1.28E-04	4.96E-05	6.18E-06	3.92E-06	4.27E-03	1.65E-03	2.06E-04	1.31E-04
67	Redding	0.8	2.15E-07	1,000	2867	1.62E-05	6.26E-06	7.79E-07	4.94E-07	5.38E-04	2.09E-04	2.60E-05	1.65E-05
68	Redding	1.1	3.19E-07	100	2867	2.39E-05	9.28E-06	1.15E-06	7.33E-07	7.98E-04	3.09E-04	3.85E-05	2.44E-05
69	Redding	0.4	1.10E-07	1,000	2867	8.28E-06	3.21E-06	3.99E-07	2.53E-07	2.76E-04	1.07E-04	1.33E-05	8.45E-06
70	Redding	2.6	7.29E-07	100	2867	5.47E-05	2.12E-05	2.64E-06	1.67E-06	1.82E-03	7.07E-04	8.79E-05	5.58E-05
71	Shasta Co	0.5	1.48E-07	1,000	2867	1.11E-05	4.30E-06	5.35E-07	3.39E-07	3.69E-04	1.43E-04	1.78E-05	1.13E-05
72	Shasta Lake	1.7	4.66E-07	100	2867	3.50E-05	1.36E-05	1.69E-06	1.07E-06	1.17E-03	4.52E-04	5.62E-05	3.57E-05
73	Shasta Lake	0.8	2.12E-07	1,000	2867	1.59E-05	6.17E-06	7.68E-07	4.87E-07	5.30E-04	2.06E-04	2.56E-05	1.62E-05
74	Shasta Co	16.4	4.64E-06	100	2867	3.48E-04	1.35E-04	1.68E-05	1.07E-05	1.16E-02	4.50E-03	5.60E-04	3.56E-04
75	Lakeshore	0.6	1.71E-07	1,000	2867	1.29E-05	4.99E-06	6.20E-07	3.94E-07	4.29E-04	1.66E-04	2.07E-05	1.31E-05
76	Shasta Co	28.7	8.10E-06	100	2867	6.44E-04	2.49E-04	3.10E-05	1.97E-05	2.15E-02	8.32E-03	1.03E-03	6.57E-04
77	Dunsmuir	1.3	3.68E-07	1,000	2867	2.76E-05	1.07E-05	1.33E-06	8.45E-07	9.21E-04	3.57E-04	4.44E-05	2.82E-05
78	Siskiyou Co	12.8	3.61E-06	100	2867	2.71E-04	1.05E-04	1.31E-05	8.28E-06	9.02E-03	3.50E-03	4.35E-04	2.76E-04
79	Mount Shasta	1.1	3.19E-07	1,000	2867	2.40E-05	9.29E-06	1.16E-06	7.34E-07	7.99E-04	3.10E-04	3.85E-05	2.45E-05
80	Siskiyou Co	64.5	1.82E-05	100	2867	1.47E-03	5.71E-04	7.11E-05	4.51E-05	4.91E-02	1.90E-02	2.37E-03	1.50E-03
81	Dorris	0.9	2.49E-07	100	2867	1.87E-05	7.25E-06	9.02E-07	5.72E-07	6.23E-04	2.42E-04	3.01E-05	1.91E-05
82	Siskiyou Co	3.4	9.64E-07	1,000	2867	7.23E-05	2.80E-05	3.49E-06	2.21E-06	2.41E-03	9.34E-04	1.16E-04	7.38E-05
Total/Weighted Average		368.8	1.09E-04			6.77E-03	2.58E-03	3.12E-04	1.98E-04	2.26E-01	8.61E-02	1.04E-02	6.59E-03
Return Period			9,188			148	387	3,205	5,059	4	12	96	152

Attachment 5 - Summary of California Public Utilities Commission Railroad Regulations

State Constitution, Article XII, Sec. 4	The commission may fix rates and establish rules for the transportation of passengers and property by transportation companies ….
PU Code Sec. 309.7 (a)	(a) The division of the commission responsible for consumer protection and safety shall be responsible for inspection, surveillance, and investigation of the rights-of-way, facilities, equipment, and operations of railroads and public mass transit guideways, and for enforcing state and federal laws, regulations, orders, and directives relating to transportation of persons or commodities, or both, of any nature or description by rail. The consumer protection and safety division shall advise the commission on all matters relating to rail safety, and shall propose to the commission rules, regulations, orders, and other measures necessary to reduce the dangers caused by unsafe conditions on the railroads of the state.
PU Code Sec. 309.7 (b)	(b) In performing its duties, the consumer protection and safety division shall exercise all powers of investigation granted to the commission, including rights to enter upon land or facilities, inspect books and records, and compel testimony. The commission shall employ sufficient federally certified inspectors to ensure at the time of inspection that railroad locomotives and equipment and facilities located in class I railroad yards in California are inspected not less frequently than every 180 days, and all main and branch line tracks are inspected not less frequently than every 12 months.
PU Code Sec. 309.7 (c)	(c) The general counsel shall assign to the consumer protection and safety division the personnel and attorneys necessary …to enforce safety laws, rules, regulations, and orders, and to collect fines and penalties resulting from the violation of any safety rule or regulation.
PU Code Sec. 309.7 (d)	(d) The activities of the consumer protection and safety division that relate to safe operation of common carriers by rail, other than those relating to grade crossing protection, shall also be supported by the fees paid by railroad corporations.
PU Code Sec. 315	315. The commission shall investigate the cause of all accidents occurring within this State upon the property of any public utility or directly or indirectly arising from or connected with its maintenance or operation, resulting in loss of life or injury to person or property and requiring, in the judgment of the commission, investigation by it, and may make such order or recommendation with respect thereto as in its judgment seems just and reasonable.
PU Code Sec. 765.5	(a) The purpose of this section is to provide that the commission takes all appropriate action necessary to ensure the safe operation of railroads in this state. (b) The commission shall dedicate sufficient resources necessary to adequately carry out the State Participation Program for the regulation of rail transportation of hazardous materials as authorized by the Hazardous Material Transportation Uniform Safety Act of 1990 (P.L. 101-615). (c) On or before July 1, 1992, the commission shall hire a minimum of six additional rail inspectors who are or shall become federally certified, consisting of three additional motive power and equipment inspectors, two signal inspectors, and one operating practices inspector, for the purpose of enforcing compliance by railroads operating in this state with state and federal safety regulations. (d) On or before July 1, 1992, the commission shall establish, by regulation, a minimum inspection standard to ensure, at the time of inspection, that railroad locomotives, equipment, and facilities located in class I railroad yards in California will be inspected not less frequently than every 120 days, and inspection of all branch and main line track not less frequently than every 12 months. (e) Commencing July 1, 2008, in addition to the minimum inspections undertaken pursuant to subdivision (d), the commission shall conduct focused inspections of railroad yards and track, either in coordination with the Federal Railroad Administration, or as the commission determines to be necessary. The focused inspection program shall target railroad yards and track that pose the

	greatest safety risk, based on inspection data, accident history, and rail traffic density.
PU Code Sec. 768	768. The commission may, after a hearing, require every public utility to construct, maintain, and operate its line, plant, system, equipment, apparatus, tracks, and premises in a manner so as to promote and safeguard the health and safety of its employees, passengers, customers, and the public. The commission may prescribe, among other things, the installation, use, maintenance, and operation of appropriate safety or other devices or appliances, including interlocking and other protective devices at grade crossings or junctions and block or other systems of signaling. The commission may establish uniform or other standards of construction and equipment, and require the performance of any other act which the health or safety of its employees, passengers, customers, or the public may demand.
PU Code Sec. 7661	The consumer protection and safety division shall investigate any incident that results in a notification…and shall report its findings concerning the cause or causes to the commission.
PU Code Sec. 7662	Requires a railroad to place appropriate signage to notify an engineer of an approaching grade crossing and establishes standards for the posting of signage and flags, milepost markers, and permanent speed signs.
PU Code Sec. 7665.2	By July 1, 2007, requires every operator of rail facilities to provide a risk assessment to the commission and the agency for each rail facility in the state that is under its ownership, operation, or control, and prescribes the elements of the risk assessment.
PU Code Sec 7665.4	(f) Requires the rail operators to develop an infrastructure protection program, and requires the CPUC to review the infrastructure protection program submitted by a rail operator. Permits the CPUC to conduct inspections to facilitate the review, and permits the CPUC to order a rail operator to improve, modify, or change its program to comply with the requirements of this article. (g) Permits the CPUC to fine a rail operator for failure to comply with the requirements of this section or an order of the commission pursuant to this section.
General Order 22-B	Requires accident investigations on all incidents occurring on railroad property.
General Order 26-D	Establishes minimum clearances between railroad tracks, parallel tracks, side clearances, overhead clearances, freight car clearances, and clearances for obstructions, motor vehicles, and warning devices to prevent injuries and fatalities to rail employees by providing a minimum standards for overhead and side clearance on the railroad tracks. (Pursuant to PUC Sec. 768.)
General Order 72-B	Formulates uniform standards for grade crossing construction to increase public safety. (Pursuant to PUC Sec. 768.)
General Order 75-D	Establishes uniform standards for warning devices for at-grade crossings to reduce hazards associated with persons traversing at- grade crossings. (Pursuant to PUC Sec. 768.)
General Order 118-A	Provides standards for the construction, reconstruction, and maintenance of walkways adjacent to railroad tracks to provide a safe area for train crews to work. (Pursuant to PUC Sec. 768.)
General Order 126	Establishes requirements for the contents of First-Aid kits provided by common carrier railroads. (Pursuant to PUC Sec. 768.)

General Order 161	Establishes safety standards for the rail transportation of hazardous materials. (Pursuant to PUC Sec. 768.)
General Order 135	Establishes regulations governing the occupancy of public grade crossings by railroads. (Pursuant to PUC Sec. 768.)

Attachment 6 - List of High Threat Urban Areas (HTUAs) (CFR 49 Appendix A to Part 1580)

Attachment 6 - List of High Threat Urban Areas (HTUAs)
(CFR 49 Appendix A to Part 1580)

State	Candidate urban area	Geographic area captured in the data count	Previously designated urban areas included
AZ	Phoenix Area*	Chandler, Gilbert, Glendale, Mesa, Peoria, Phoenix, Scottsdale, Tempe, and a 10-mile buffer extending from the border of the combined area	Phoenix, AZ.
CA	Anaheim/Santa Ana Area	Anaheim, Costa Mesa, Garden Grove, Fullerton, Huntington Beach, Irvine, Orange, Santa Ana, and a 10-mile buffer extending from the border of the combined area	Anaheim, CA; Santa Ana, CA.
	Bay Area	Berkeley, Daly City, Fremont, Hayward, Oakland, Palo Alto, Richmond, San Francisco, San Jose, Santa Clara, Sunnyvale, Vallejo, and a 10-mile buffer extending from the border of the combined area	San Francisco, CA; San Jose, CA; Oakland, CA.
	Los Angeles/Long Beach Area	Burbank, Glendale, Inglewood, Long Beach, Los Angeles, Pasadena, Santa Monica, Santa Clarita, Torrance, Simi Valley, Thousand Oaks, and a 10-mile buffer extending from the border of the combined area	Los Angeles, CA; Long Beach, CA.
	Sacramento Area*	Elk Grove, Sacramento, and a 10-mile buffer extending from the border of the combined area	Sacramento, CA.
	San Diego Area*	Chula Vista, Escondido, and San Diego, and a 10-mile buffer extending from the border of the combined area	San Diego, CA.
CO	Denver Area	Arvada, Aurora, Denver, Lakewood, Westminster, Thornton, and a 10-mile buffer extending from the border of the combined area	Denver, CO.
DC	National Capital Region	National Capital Region and a 10-mile buffer extending from the border of the combined area	National Capital Region, DC.
FL	Fort Lauderdale Area	Fort Lauderdale, Hollywood, Miami Gardens, Miramar, Pembroke Pines, and a 10-mile buffer extending from the border of the combined area	N/A.
	Jacksonville Area	Jacksonville and a 10-mile buffer extending from the city border	Jacksonville, FL.
	Miami Area	Hialeah, Miami, and a 10-mile buffer extending from the border of the combined area	Miami, FL.
	Orlando Area	Orlando and a 10-mile buffer extending from the city border	Orlando, FL.

	Tampa Area*	Clearwater, St. Petersburg, Tampa, and a 10-mile buffer extending from the border of the combined area	Tampa, FL.
GA	Atlanta Area	Atlanta and a 10-mile buffer extending from the city border	Atlanta, GA.
HI	Honolulu Area	Honolulu and a 10-mile buffer extending from the city border	Honolulu, HI.
IL	Chicago Area	Chicago and a 10-mile buffer extending from the city border	Chicago, IL.
IN	Indianapolis Area	Indianapolis and a 10-mile buffer extending from the city border	Indianapolis, IN.
KY	Louisville Area*	Louisville and a 10-mile buffer extending from the city border	Louisville, KY.
LA	Baton Rouge Area*	Baton Rouge and a 10-mile buffer extending from the city border	Baton Rouge, LA.
	New Orleans Area	New Orleans and a 10-mile buffer extending from the city border	New Orleans, LA.
MA	Boston Area	Boston, Cambridge, and a 10-mile buffer extending from the border of the combined area	Boston, MA.
MD	Baltimore Area	Baltimore and a 10-mile buffer extending from the city border	Baltimore, MD.
MI	Detroit Area	Detroit, Sterling Heights, Warren, and a 10-mile buffer extending from the border of the combined area	Detroit, MI.
MN	Twin Cities Area	Minneapolis, St. Paul, and a 10-mile buffer extending from the border of the combined entity	Minneapolis, MN; St. Paul, MN.
MO	Kansas City Area	Independence, Kansas City (MO), Kansas City (KS), Olathe, Overland Park, and a 10-mile buffer extending from the border of the combined area	Kansas City, MO.
	St. Louis Area	St. Louis and a 10-mile buffer extending from the city border	St. Louis, MO.
NC	Charlotte Area	Charlotte and a 10-mile buffer extending from the city border	Charlotte, NC.
NE	Omaha Area*	Omaha and a 10-mile buffer extending from the city border	Omaha, NE.
NJ	Jersey City/Newark Area	Elizabeth, Jersey City, Newark, and a 10-mile buffer extending from the border of the combined area	Jersey City, NJ; Newark, NJ.
NV	Las Vegas Area*	Las Vegas, North Las Vegas, and a 10-mile buffer	Las Vegas, NV.

		extending from the border of the combined entity	
NY	Buffalo Area*	Buffalo and a 10-mile buffer extending from the city border	Buffalo, NY.
	New York City Area	New York City, Yonkers, and a 10-mile buffer extending from the border of the combined area	New York, NY.
OH	Cincinnati Area	Cincinnati and a 10-mile buffer extending from the city border	Cincinnati, OH.
	Cleveland Area	Cleveland and a 10-mile buffer extending from the city border	Cleveland, OH.
	Columbus Area	Columbus and a 10-mile buffer extending from the city border	Columbus, OH.
	Toledo Area*	Oregon, Toledo, and a 10-mile buffer extending from the border of the combined area	Toledo, OH.
OK	Oklahoma City Area*	Norman, Oklahoma and a 10-mile buffer extending from the border of the combined area	Oklahoma City, OK.
OR	Portland Area	Portland, Vancouver, and a 10-mile buffer extending from the border of the combined area	Portland, OR.
PA	Philadelphia Area	Philadelphia and a 10-mile buffer extending from the city border	Philadelphia, PA.
	Pittsburgh Area	Pittsburgh and a 10-mile buffer extending from the city border	Pittsburgh, PA.
TN	Memphis Area	Memphis and a 10-mile buffer extending from the city border	Memphis, TN.
TX	Dallas/Fort Worth/Arlington Area	Arlington, Carrollton, Dallas, Fort Worth, Garland, Grand Prairie, Irving, Mesquite, Plano, and a 10-mile buffer extending from the border of the combined area	Dallas, TX; Fort Worth, TX; Arlington, TX.
	Houston Area	Houston, Pasadena, and a 10-mile buffer extending from the border of the combined entity	Houston, TX.
	San Antonio Area	San Antonio and a 10-mile buffer extending from the city border	San Antonio, TX.
WA	Seattle Area	Seattle, Bellevue, and a 10-mile buffer extending from the border of the combined area	Seattle, WA.
WI	Milwaukee Area	Milwaukee and a 10-mile buffer extending from the city border	Milwaukee, WI.

APPENDIX G

Preemption of CEQA by the ICCTA

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Appendix G

Preemption of CEQA by the ICCTA

Many, if not most, of the comments received on the DEIR addressed potential off-site impacts from the operation of trains travelling to and from the Refinery. Potential off-site impacts from rail operations include the risk of crude oil releases from tank cars, the impact of locomotive emissions on air quality, the impact of noise on biological resources living along the rail corridor, and the impact of rail crossings on traffic.

Valero has taken the position that the Interstate Commerce Commission Termination Act ("ICCTA") preempts the City's ability to require CEQA review of impacts from the Project, including both impacts from on-site activities, such as construction and operation of the unloading rack, and impacts from off-site rail operations. Valero's position is set forth in Appendix H.

The City disagrees with Valero in part and agrees in part. The City has concluded as follows:

1. The ICCTA does *not* preempt the application of CEQA to Valero's on-site activities, including construction and operation of the proposed unloading rack and related equipment.

2. The ICCTA *does* preempt the City's ability to mitigate impacts from rail operations.

3. The ICCTA *may well* preempt the City's ability to require disclosure of impacts from rail operations under CEQA. There is no case law authority directly on point, however, and the issue is uncertain. The City has decided to continue with disclosure of impacts from rail operations unless and until a court, in a binding precedent, clearly rules that the ICCTA preempts the disclosure requirements of CEQA as applied to impacts from rail operations.

I. The ICCTA Does Not Preempt the Application of CEQA to Valero's On-Site Activities.

Under prevailing case law, CEQA clearly applies to Valero's proposed on-site unloading rack and related facilities because (1) Valero owns and operates the unloading facilities; (2) in constructing and operating the facilities, Valero is not acting as an agent of Union Pacific; and (3) Union Pacific will not control the operation of the unloading facilities. On similar facts, courts and the STB have consistently held that the ICCTA does not preempt the application of state and local land use and environmental laws.[1] The decisions make it clear that ICCTA preemption applies to unloading facilities if, and only if, the railroad owns and operates the facilities or the operator is an agent of the railroad.

In *New York And Atlantic Ry. Co. v Surface Transp. Bd.* 635 F.3d 66 (2nd Cir. 2011), for example, a freight railroad entered into an agreement with Coastal Distribution whereby Coastal would construct and operate a transloading facility on a rail yard leased by the railroad. The

[1] *See, e.g., New York And Atlantic Ry. Co. v Surface Transp. Bd.* 635 F.3d 66 (2nd Cir. 2011); *Florida E. Coast Ry. Co. v. City of W. Palm Beach*, 266 F.3d 1324 (11th Cir. 2001).

transloading facility would be used to handle building materials and debris from construction and demolition activities. The city's zoning ordinance prohibited waste transfer facilities. When the project was almost constructed, the city served a stop work order on Coastal on the ground that the transloading facility was a prohibited use under the zoning ordinance.

The railroad and Coastal Distribution filed suit against the city, seeking to enjoin the city from enforcing the zoning ordinance against the waste transfer facility. At the same time, the city petitioned STB for a declaratory order that the zoning ordinance was not preempted.

The STB concluded in *New York and Atlantic Railway* that the STB does not have exclusive jurisdiction over the waste transfer facility because the railroad's responsibility and liability for the cars "end when they are uncoupled at the Farmingdale Yard and resumes when they are coupled to [the railroad's] locomotive."[2] The STB explained that it has exclusive jurisdiction over transloading facilities if, and only if, "the activities are performed by a rail carrier or the rail carrier holds out its own service through the third-party as an agent or exerts control over the third-party's operation."[3]

The court in *New York and Atlantic Railway* agreed with the STB. The court held that Coastal Distribution's proposed waste transfer facility did not constitute "transportation by rail carrier" because the railroad did not own or operate the facility and Coastal was not acting as an agent of the railroad. Therefore, the ICCTA did not preempt the application of the city's local zoning regulations.[4]

Similarly, in *Florida East Coast Railway*, a railroad leased a rail yard property in the City of West Palm Beach to Rinker Materials Corporation, a third party corporation. Rinker used the rail yard as a transloading facility for the distribution of aggregate, a material used to make cement. The city issued cease and desist orders to the railroad and Rinker because Rinker's transloading operation did not comply with the city's zoning, and Rinker failed to obtain a business license. The railroad sued the city, seeking a declaration that the ICCTA preempted the application of the city's zoning and business license ordinances to Rinker's transloading operations.

The court in *Florida East Coast Railway* concluded that the application of the city's ordinances to Rinker's transloading facility did not constitute regulation of "transportation by rail carrier" within the meaning of the ICCTA preemption provision.[5] The court explained as follows:

> existing zoning ordinances of general applicability, which are enforced against a private entity leasing property from a railroad for non-rail transportation purposes, are not sufficiently linked to rules governing the operation of the railroad so as to constitute laws 'with respect to regulation of rail transportation.'[6]

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2 *Ibid*.

3 *New York & Atlantic Ry. Co. v. Surface Tranp. Bd., supra*, 635 F.3d at 69.

4 *New York And Atlantic Ry. Co. v Surface Transp. Bd.* 635 F.3d 66, 73 (2nd Cir. 2011).

5 *Florida E. Coast Ry. Co. v. City of W. Palm Beach*, 266 F.3d 1324, 1339 (11th Cir. 2001).

6 *Ibid.*

Thus, the court concluded, "in no way does federal pre-emption under the ICCTA mandate that municipalities allow any private entity to operate in a residentially zoned area simply because the entity is under a lease from the railroad."[7]

In support of Valero's position that the ICCTA preempts the application of CEQA to the on-site unloading facilities, Valero cites the decision in *Norfolk Southern Ry Co v City of Alexandria* 608 F.3d 150 (2010). The *Norfolk Southern Railway* case, however, does not support this conclusion. In *Norfolk Southern Railway*, a railroad constructed and began operating an ethanol transloading facility in the City of Alexandria, Virginia. The railroad used the facility to transfer ethanol from rail cars to trucks operated by third parties. The city adopted an ordinance regulating the hauling of bulk materials, including ethanol, within the city limits. The City unilaterally issued a permit to the transloading facility under its haul ordinance. The permit limited the materials that could be hauled; specified hauling routes; and restricted the days and times of hauling. The railroad refused to comply with the permit conditions, on the assumption that the application of the haul ordinance to the facility was preempted by the ICCTA.

The city petitioned STB for a declaration that the city had the authority to regulate the transloading facility, and the railroad filed an action for declaratory relief in federal court. The STB found that the transloading facility constitutes "transportation by a rail carrier," such that the city's haul ordinance was preempted. The federal district court reached the same conclusion.[8]

The *Norfolk Southern Railway* case does not control here, however, because, in *Norfolk Southern Railway*, the railroad actually owned and operated the transloading facility. In contrast, the Valero unloading facilities, like the transloading facilities in *New York And Atlantic Railway* and *Florida East Coast Railway*, would be owned and operated by a third party (Valero), which in no way would be acting as an agent of the railroad (Union Pacific).

In sum, it is clear that CEQA applies to the unloading rack and related on-site facilities proposed as part of the crude-by-rail project.

II. The ICCTA Preempts the City's Authority to Mitigate Impacts from Union Pacific's Rail Operations.

Under the ICCTA, the federal Surface Transportation Board ("STB") has exclusive jurisdiction to regulate transportation by rail carrier.[9] The ICCTA preemption provision is quite broad, covering virtually all aspects of railroad operations.[10] As a number of courts have stated, "it is

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7 *Id*. at 1332.

8 *Norfolk S. Ry Co. v. City Of Alexandria*, 608 F.3d 150, 160 (4th Cir. 2010).

9 49 U.S.C. § 10501(b).

10 *Maynard v. CSX Transp., Inc.*, 360 F. Supp. 2d 836, 839 (E.D. Ky. 2004) (49 U.S.C. § 10501(b) grants the STB exclusive jurisdiction "over nearly all matters of rail regulation").

difficult to imagine a broader statement of Congress's intent to preempt state regulatory authority over railroad operations."[11]

In light of the STB's exclusive jurisdiction, state and local governments may not directly regulate rail operations. Thus, for example, state and local governments may not place limits on emissions from locomotives,[12] limit the amount of time that trains can block grade crossings,[13] or require railroads to obtain permits before constructing new or modified tracks and related facilities.[14]

The ICCTA also preempts any attempt by state and local governments to regulate railroad operations indirectly.[15] Simply put, the ICCTA preempts any regulations that "may reasonably be said to *have the effect* of managing or governing rail transportation."[16] One court held, for example, that a city may not limit the number of trucks entering and leaving a railroad offloading facility, even though the railroad did not own or operate the trucks, because the limit on truck trips would effectively limit the number of rail cars that could be unloaded.[17] To take another example, a number of courts have held that the ICCTA preempts state common law claims against railroads, including claims for negligence,[18] tortious interference,[19] and nuisance.[20] In reaching this conclusion, the courts have emphasized that common law claims effectively regulate railroad operations just as any "preventative relief" that a state government might obtain through direct regulation.[21]

The DEIR and/or the RDEIR identify significant offsite impacts from rail operations in certain areas, including air quality, hazards, biological resources, and greenhouse gas emissions. There are various mitigation measures that might reduce and/or avoid these impacts, such as limiting the number of rail deliveries that Valero may accept per day, requiring Valero to purchase

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[11] *See, e.g., City of Auburn v. U.S. Government* (9th Cir. 1998) 154 F.3d 1025, 1030; *CSX Transp Inc v Georgia Public Service Com'n*, 944 F.Supp. 1573, 1581 (N.D. Georgia 1996).

[12] *Association of American Railroads v South Coast Air Quality Management District*, 622 F.3d 1094 (9th Cir. 2010).

[13] *Friberg v. Kansas City S. Ry. Co.*, 267 F.3d 439, 444 (5th Cir. 2001); *People v Burlington Northern Santa Fe RR*, 209 Cal.App.4th 1513 (2012); *CSX Trans., Inc. v. Plymouth*, 92 F.Supp.2d 643 (E.D.Mich.2000).

[14] *See, e.g., Green Mountain RR Corp v Vermont*, 404 F.3d 638 (2nd Cir. 2005) (the ICCTA preempts a city's pre-construction permit requirement as applied to rail project); *City of Auburn v. United States Government*, 154 F.3d 1025 (9th Cir. 1998) (the ICCTA preempts a county from requiring a railroad to obtain permits before making improvements to an existing rail line);

[15] *Maynard v. CSX Transp., Inc.*, 360 F. Supp. 2d 836, 842 (E.D. Ky. 2004) (citing *Cipollone v. Liggett Group, Inc.*, 505 U.S. 504, 516, (1992)); *Guckenberg v. Wisconsin Central Ltd*, 178 F.Supp.2d 954, 958 (E.D. Wisconsin 2001) (same).

[16] *People v. Burlington N. Santa Fe R.R.*, 209 Cal. App. 4th 1513, 1528 (2012) (emphasis added).

[17] *Norfolk Southern Ry Co v City Of Alexandria*, 608 F.3d 150 (2010).

[18] *Friberg v. Kansas City S. Ry. Co.*, 267 F.3d 439, 444 (5th Cir.2001).

[19] *Pejepscot Industrial Park, Inc. v. Maine Central Railroad Co.*, 297 F.Supp.2d 326, 334 (D.Maine, 2003).

[20] *Rushing v. Kansas City S. Ry. Co.*, 194 F.Supp.2d 493, 500 (S.D.Miss.2001).

[21] *Maynard v. CSX Transp., Inc.*, 360 F. Supp. 2d 836, 840 (E.D. Ky. 2004); *Guckenberg v Wisconsin Central Ltd*, 178 F.Supp.2d 954, 958 (E.D. Wisconsin 2001).

emissions credits to offset locomotive emissions, or requiring Valero to use upgraded tank cars that are not required by federal law. Any attempt by the city to condition project approval on such requirements, however, would be preempted, because the requirements would clearly "have the effect of managing or governing rail operations." Limiting the number of rail deliveries that Valero could accept, for example, would effectively reduce the number of train trips that Union Pacific may operate on its lines. Requiring Valero to purchase emissions credits to offset locomotive emissions would essentially be an indirect way of regulating locomotive emissions. Finally, any attempt to require Valero to use upgraded tank cars that are not required by federal law would infringe on the STB's exclusive jurisdiction to prescribe tank car design standards. All of these mitigation requirements would be preempted.

III. While the ICCTA May Preempt Disclosure of Rail Impacts Under CEQA, There is No Clear Authority on Point.

CEQA requires lead agencies to identify and disclose a project's potential environmental impacts before approving the project. CEQA is a law of general application, and governs approval of any non-exempt project that may result in a physical change in the environment.

Valero takes the position that the ICCTA preempts even the disclosure aspect of CEQA as applied to rail operations. In other words, Valero maintains that the City is legally prohibited from requiring disclosure of offsite impacts from rail operations, such as locomotive emissions or rail safety impacts, as a condition of project approval – even though CEQA generally requires disclosure of all impacts that would be caused by a project, wherever those impacts may occur.

There is no case or STB decision directly on point involving CEQA or any other state or local environmental or land use law. That is, there is no case considering whether a city that clearly has jurisdiction over the construction and operation of *onsite* unloading facilities must -- or indeed may -- require disclosure of *offsite* impacts created by trains traveling to and from the onsite operation.

On the one hand, a court might well conclude that requiring disclosure of rail impacts as part of a pre-construction permitting process has a direct and impermissible effect on rail operations because the disclosure requirement could delay the project indefinitely. Under this theory, the application of CEQA's disclosure requirement to rail impacts would be controlled by the "preclearance" cases and STB decisions that Valero cites in its letter.[22]

On the other hand, there is an argument to be made that merely requiring disclosure of rail impacts has only a "remote or incidental" impact on rail operations, such that ICCTA preemption does not apply. Requiring disclosure of information about potential rail impacts, in itself, arguably does not have the same impact on operations as, for example, mitigation measures that

[22] These authorities include, among others, *Green Mountain Railroad Corp. v. Vermont*, 404 F.3d 638, 643 (2d Cir. 2005); *City of Auburn v. U.S. Gov't*, 154 F.3d 1025, 1031 (9th Cir. 1998), as amended (Oct. 20, 1998); *City of Encinitas v North San Diego County Transit Development Bd* 2002 WL 34681621; *Desertxpress Enterprises LLC--Petition for Declaratory Order Fed. Carr. Cas*. P 37238 (S.T.B.), 2007 WL 1833521.

effectively limit the number of trains that Union Pacific can operate, or regulate locomotive emissions.

There are some, but not many, cases where a court or the STB found that the effect of a state or local law on rail operations was merely "remote or incidental." As explained above, the courts and the STB have concluded that regulation of a transloading facility owned and operated by a private party has only a remote and incidental effect on rail operations.[23] The courts and the STB have also concluded that agencies can enforce water quality laws against railroads discharging earth and waste from construction projects into water bodies.[24] Finally, in one of its opinions, the STB provided the following list as examples of permissible "pre-construction" conditions:

> Examples of solutions that appear to us to be reasonable include conditions requiring railroads to (1) share their plans with the community, when they are undertaking an activity for which another entity would require a permit; (2) use state or local best management practices when they construct railroad facilities; (3) implement appropriate precautionary measures at the railroad facility, so long as the measures are fairly applied; (4) provide representatives to meet periodically with citizen groups or local government entities to seek mutually acceptable ways to address local concerns; and (5) submit environmental monitoring or testing information to local government entities for an appropriate period of time after operations begin.[25]

None of the existing authorities, however, directly addresses the issue at hand – whether the ICCTA preempts CEQA's disclosure requirement to the extent that it would require disclosure of impacts from rail operations as a condition of approving Valero's project. Thus, the City intends to continue requiring disclosure unless and until a court, in a binding precedent, clearly rules that the ICCTA preempts disclosure under CEQA under similar facts.

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[23] *See, e.g., Florida E. Coast Ry. Co. v. City of W. Palm Beach,* 266 F.3d 1324, 1339 (11th Cir. 2001); *Cities of Auburn & Kent, Wa-Petition for Declaratory Order-Burlington N. R.R. Co.-Stampede Pass Line*, 2 S.T.B. 330 (1997).

[24] *See, e.g., United States v. St. Mary's Ry. W., LLC*, 989 F. Supp. 2d 1357 (S.D. Ga. 2013).

[25] *Joint Petition for Declaratory Order - Boston & Maine Corp. & Town of Ayer, Ma*, Fed. Carr. Cas. (CCH) ¶ 38352 (Apr. 30, 2001)

APPENDIX H

Valero Benicia Refinery Statement re: Preemption

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VALERO

Richard J. Walsh
Senior Vice President
and Deputy General Counsel
Litigation and Regulatory Law

November 25, 2014

COPY

Via Federal Express No. 7719-7932-3694

Heather McLaughlin, City Attorney
City of Benicia
250 East L Street
Benicia, CA 94510

Re: Valero Objection to Federally Preempted CEQA Review of Rail Operations

Dear Ms. McLaughlin:

I am writing on behalf of Valero Refining Company – California ("Valero), the applicant for a use permit for construction and operation of a crude-by-rail unloading facility at Valero's Benicia, California refinery.

Valero recently was informed that the City is considering re-circulating the DEIR because of alleged concerns regarding NOx emissions in communities uprail of Roseville that are solely attributable to locomotive emissions. We understand that this review will add six to seven months to an already lengthy process at a projected cost of approximately half a million dollars. Valero strongly disagrees that this proposal is a necessary, prudent, or even a legally permissible approach. The City already has gone far above and beyond what the law requires for review of rail operations impacts, even exceeding what the law permits. CEQA review of such impacts is preempted by federal law, as discussed more fully below, and therefore the City cannot continue to delay presentation of this project to the Planning Commission in order to conduct additional review of potential impacts that are beyond the City's authority to mitigate or even to consider.

Valero submitted its application for the permit in December of 2012. On May 31, 2013, the City issued a Notice of Intent to Adopt an Initial Study/Mitigated Negative Declaration for the Project. Following a public meeting of July 11, 2013, the City decided to prepare an EIR and committed to issue that report in the fall of 2013. However, the DEIR was not circulated for review until June of this year. As you know, probably close to 90% of the comments made at the three Planning Commission hearings on the DEIR were devoted to the claimed impacts of rail operations, even though CEQA review of rail operations is preempted by federal law.

Although we have consistently pointed out that federal preemption precludes CEQA analysis of rail operations, Valero has cooperated fully in the CEQA review process. As the City also knows, Valero has consistently and repeatedly stated its intent to fully comply with its obligations under federal law concerning the rail transport of crude oil. The safety of our employees, and of every member of the public, is of Valero's utmost concern, just as it is of yours. However, federal regulatory agencies are solely responsible for the operations of the railroads; neither Valero, nor the City may regulate the railroad, under CEQA or otherwise.

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richard.walsh@valero.com

As demonstrated below and in the enclosed materials, CEQA review of the impacts of rail operations is not merely constrained, as it was in *Communities for a Better Environment v. Southern California Air Quality Management Dist.* (2010) 48 Cal.4th 310, 325; it is preempted, as affirmed by the First District Court of Appeal in *Friends of the Eel River v. North Coast Railroad* Authority (2014) 230 Cal.App.4th 85, and in the numerous cases relied upon by the Court of Appeal in its decision. The City has no legal authority to conduct any review of the environmental impacts of rail operations because such review is preempted by federal law. For that reason, the City also cannot lawfully request of Valero that it bear the expense of any such further review. In addition, given the lack of any lawful authority to conduct such review, the City cannot lawfully suspend the processing of Valero's permit application on the grounds that Valero will not cooperate in such review, or bear the expense thereof.

To elaborate on the positions stated above, Union Pacific Railroad ("UPRR") transport and delivery of the crude oil constitutes transportation by rail carrier, and state regulation of such transportation and delivery is preempted by the Interstate Commerce Commission Termination Act of 1995 ("ICCTA"). Thus, and as demonstrated below, there can be no denial or delay in the issuance of, or any conditions on, the Permit related to rail operations (including delivery of crude oil to the facility).

As stated, in June of this year, the City circulated the DEIR. Interested parties have submitted comments on the DEIR. At least one commenter advocates denial of the Permit based on claimed rail transportation impacts; numerous commenters demand recirculation of the DEIR to evaluate air quality and safety claims related to railroad transportation, which would significantly delay a decision by the City on the Permit. Numerous commenters seek conditions on the Permit related to rail transportation. While the City has conceded the lack of legal authority to impose conditions of approval intended to mitigate for impacts of rail operations, the City nevertheless signaled a willingness to re-circulate the DEIR so as to address emissions associated with locomotives on federally regulated rail systems uprail of Roseville. CEQA review of the impacts of rail operations is preempted. CEQA re-circulation is improper and likewise preempted.

> Pursuant to the ICCTA, the STB's jurisdiction over
>
> (1) transportation by rail carriers, and the remedies provided in this part with respect to... facilities of such carriers; and
>
> (2) the ... operation ... of ... industrial ... tracks, or facilities...
>
> is exclusive. Except as otherwise provided in this part, the remedies provided under this part with respect to regulation of rail transportation are exclusive and preempt the remedies provided under Federal or State law.
>
> 49 U.S.C. § 10501(b).
>
> For purposes of the ICCTA, "[t]ransportation is expansively defined." *Green Mt. R.R. Corp. v. Vermont*, 404 F.3d 638, 642 (2nd Cir. 2005). Transportation includes:

> (A) a locomotive, car, vehicle, vessel, warehouse, wharf, pier, dock, yard, property, facility, instrumentality, or equipment of any kind related to the movement of passengers or property, or both, by rail, regardless of ownership or an agreement concerning use; and (B) services related to that movement, including receipt, delivery, elevation, transfer in transit, refrigeration, icing, ventilation, storage, handling, and interchange of passengers and property.

49 U.S.C. 10102(9).

Federal preemption under the ICCTA is extremely broad. As one Court explained, with regard to the ICCTA, "[i]t is difficult to imagine a broader statement of Congress's intent to preempt state regulatory authority over railroad operations." *CSX Transp. Inc. v. Georgia Pub. Serv. Comm'n*, 944 F.Supp. 1573, 1581 (N.D. Ga. 1996). In the enactment of the ICCTA, Congress sought to provide uniformity in the national regulation of railroads. See e.g. *Friberg v. Kan. City S. Ry. Co.*, 267 F.3d 439, 443 (5th Cir. 2001) ("The regulation of railroad operations has long been a traditionally federal endeavor, to better establish uniformity in such operations and expediency in commerce, and it appears manifest that Congress intended the ICCTA to further that exclusively federal effort, at least in the economic realm.").

The courts and the STB have held that "any form of state or local permitting or preclearance that, by its nature, could be used to deny a railroad the ability to conduct some part of its operations" is categorically preempted regardless of the context of the action. *Adrian and Blissfield R.R. Co.*, 550 F.3d 533, 540 (6th Cir. 2008) (citations omitted). Here, UPRR will provide rail service to Valero's Benicia refinery. Thus, UPRR will engage in the delivery of property—an activity falling squarely within the ICCTA's definition of "transportation" by rail carrier. See 49 U.S.C. 10102(9)(B). Because UPRR's rail service to Benicia is "transportation by rail carrier" and the "operation of industrial tracks or facilities," it falls within the Board's exclusive jurisdiction as set forth in the ICCTA. See *DesertXpress*, STB Finance Docket 34914, at 4. In this case, any denial or delay in issuance of the Permit related to rail operations, including re-circulation of the DEIR to evaluate air quality and safety claims related to such operations, is preempted.

The preemption under the ICCTA is extremely broad; even if the City attempted to control railroad activity by controlling the Valero facility, such effort would be preempted. In *Norfolk Southern Railway Corporation v. City of Alexandria*, 608 F.3d 150 (4th Cir. 2010) ("*City of Alexandria*"), the Fourth Circuit reviewed an ordinance enacted by the City of Alexandria which was aimed at regulating the operations of an ethanol transloading facility owned by Norfolk Southern Railroad. *Id.* The ordinance placed limits on what products could be hauled through the City and over which routes the traffic could move, and it placed restrictions on the days and times for hauling ethanol from the transloading facility. *Id.* at 155 n.3. The City argued that the ordinance was not preempted because it only regulated the trucks leaving the facility, rather than the rail operations or transloading. *Id.* at 159. However, the Fourth Circuit found that the ordinance directly affected the railroad's ability to move goods shipped by rail as the backlog resulting from the permitting would, as stated by the Norfolk Southern trainmaster, adversely impact "the continuous movement of freight through our yards." *Id.* The Fourth Circuit recognized that local permitting requirements are preempted when they "directly impact"

the railroad's "ability to move goods shipped by rail." *Id.* at 159. The Court wrote: "[s]everal courts have recognized that requiring a rail carrier to obtain a locally issued permit before conducting rail operations – generally referred to as 'permitting' or 'preclearance' requirements – will impose an unreasonable burden on rail transportation." *Id.* at 160.

Recently, the California Court of Appeal held that the ICCTA preempted California Environmental Quality Act ("CEQA") claims asserted by environmental groups against the North Coast Railroad Authority related to a project to repair and upgrade a segment of track in California. *Friends of the Eel River v. North Coast Railroad Authority*, 230 Cal.App. 4th 85 (2014). The railroad entered into an agreement with the California Department of Transportation in order to obtain funding for the rehabilitation of the track. The agreement conditioned the funding on the production of an Environmental Impact Report ("EIR") mandated by CEQA, and environmental groups subsequently brought a petition for writ of mandate challenging the railroad's EIR. The Court of Appeal found that, despite the existence of the agreement, the petitioner's challenge to the railroad's certification of its EIR based on CEQA was preempted. The Court cited a number of federal decisions finding preemption of local regulations, and explained: "[T]he authorities cited [] conclude a state statute requiring environmental review as a condition to railroad operations is preempted by the ICCTA, and we have been directed to no federal appellate or STB decision reaching a contrary conclusion." The same precedent applies in this case. Approval of Valero's crude-by-rail project may not be conditioned upon CEQA review of railroad operations.

The STB has previously held that the ICCTA preempts CEQA with respect to the construction of a rail line subject to STB jurisdiction. In *DesertXpress*, the petitioner asked the Board for a declaratory order regarding whether construction of a passenger rail line that would be subject to STB jurisdiction was subject to CEQA. *DesertXpress*, slip op. at 2. In the resulting Declaratory Order, the Board found that it had exclusive jurisdiction over "the planned new track, facilities and operations," and that CEQA was per se preempted. *Id.* at 4. The rail transportation to the Benicia refinery is akin to the rail transportation in the *DesertXpress* case and is likewise governed by federal law exclusively, pursuant to the ICCTA.

In 2002, the STB reviewed a petition from the North San Diego County Transit Development Board ("NCTD") seeking a declaration that the City of Encinitas, California was prohibited from requiring NCTD to obtain a permit or other prior approval to construct a passing track on the mainline. *North San Diego County Transit Dev. Bd.—Petition for Declaratory Order*, STB Finance Docket No. 34111, slip op. at 1 (STB served Aug. 19, 2002). The City argued that there was no preemption of State regulation because the passing track "would have little or no impact on, or benefit to, state freight operations." *Id.* at 5. The City also argued that its regulations were "a legitimate use of its police powers, that NCTD has voluntarily participated in the past in the state environmental permit process, and that [NCTD]'s actions [] are a clear violation of its legislative charter." *Id.* at 5. The Board disagreed. *Id.* at 6. Because the City's permit requirements "could deny NCTD the right to proceed with its construction project, thus frustrating NCTD's proposal to construct a passing track that would benefit not only it and Amtrak but interstate freight carrier BNSF," the STB found they were preempted. *Id.* at 9.

Railroad operations are at the core of ICCTA preemption and the impacts of those operations cannot be subject to state and local laws. Just as it was in *North San Diego County Transit Development Board* and *North Coast Railroad*, the application of CEQA to the rail

transportation at Benicia is preempted. As it already has, CEQA would establish a "legal process that could frustrate or defeat railroad operations because they would, of necessity, impinge upon the federal regulation of interstate commerce." See *North San Diego County Transit Development Board*, at 7. CEQA review of UPRR's rail transportation is preempted by federal law. Therefore, re-circulation of the DEIR to address the impacts of locomotive emissions is clearly also preempted.

The City and Valero have worked tirelessly to address the objections of the opposition to this permit, but this process has gone much too far and has gone on for way too long. If the City elects to re-circulate, it will be doing so improperly. Valero will have no choice but to consider all of its legal options. The City may not lawfully re-circulate the DEIR in order to address the impacts of railroad operations. Valero therefore requests of the City that it refrain from any re-circulation, and complete the CEQA review process as soon as possible without further regard to UPRR's operations.

Very Truly Yours,

Richard J. Walsh

Enclosures

cc: Bradley R. Hogin, Esq.

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Refer To File #: 290396-0017

VIA E-MAIL AND U.S. MAIL

September 15, 2014

Amy Million, Principal Planner
Community Development Department
City of Benicia
250 East L Street
Benicia, CA 94510
amillion@ci.benicia.ca.us

Re: Comments on Draft Environmental Impact Report for the Valero Benicia Crude by Rail Project (SCH #2013052074)

Dear Ms. Million:

1. INTRODUCTION.

On behalf of Valero Refining Co. - California ("Valero"), we submit the following comments on the draft environmental impact report ("DEIR") circulated for public comment by the City of Benicia ("City") regarding the Valero Benicia Crude-by-Rail Project (SCH #2013052074) ("Project"). The Project involves the installation of rail spur tracks, a tank car unloading rack, pumps, connecting pipelines, and related infrastructure. The Project would enable the Benicia refinery to receive up to 70,000 barrels per day of crude oil by tank car. A fuller description of the Project is set forth in the DEIR itself.

We would like to note at the outset that, despite the scope of federal preemption as discussed below, we have cooperated fully in the City's use permit process, and related CEQA review, because of the City's interest, an interest shared by Valero, in providing a vehicle for public disclosure and discussion of our Project and the effects of our Project. Nevertheless, we do so with the reservation of our rights to invoke the full scope of federal preemption. Precisely because of the scope of preemption, we can state with confidence that the City's draft EIR goes far above and beyond what the law requires for review of the Project.

Before we comment further, a few additional introductory thoughts on preemption are in order. First, federal preemption of rail operations has been unfortunately depicted by some as a merely negative reality, when in fact federal preemption has an entirely positive purpose, one that benefits all of us, regardless of where we live and do business. As we have stated in other contexts, we decided as a nation a long time ago that the movement of people and goods from place to place in the United States was so important that it could not be subject to a patchwork of laws that change from state to state, county to county, or city to city. In that obvious respect, railroads have been binding us together for many decades, and only because of federal preemption have we been able to achieve the goals for which the laws were intended.

Neither is it the case, contrary to what some others have also implied, that federal preemption means that a kind of regulatory vacuum has been created, as if railroads can operate without accountability. Of course, nothing could be further from the truth: The federal government has led the way in the regulation of rail safety, and continues to do so even now, as the DEIR itself reveals.

Having established the affirmative and beneficial purposes of federal preemption, we would like in this letter to also discuss in brief the scope of federal preemption, combined with a request that its scope be unqualifiedly acknowledged for all impacts of rail operations pertaining to the development and operation of the Project, for both direct and indirect effects.

As noted in an excellent letter recently submitted by Union Pacific Railroad ("UPRR"), specifically by Melissa B. Hagan, to the Sacramento Area Council of Governments ("SACOG"), Union Pacific is dedicated to rail safety, a dedication proven not only by its encouraging words, but by actions, programs, and significant investment. (A copy of UPRR's letter to SACOG is enclosed herewith.) The letter also does an excellent job of describing recent federal regulatory action concerning the rail transport of hazardous materials, including crude oil.

2. FEDERAL PREEMPTION OF STATE AND LOCAL RAILROAD REGULATIONS.

A. Interstate Commerce Commission Termination Act of 1995.

Under the United States Constitution, Congress has the power to regulate interstate commerce. U.S. Const. art. I, § 8, cl. 3. Pursuant to this power, Congress passed the Interstate Commerce Commission Termination Act of 1995, 49 U.S.C. § 701 et seq. ("ICCTA"). The ICCTA created the Surface Transportation Board ("STB"), which oversees the operation of railroads in the United States. The STB has broad authority to regulate railroad operations, including exclusive jurisdiction over "(1) transportation by rail carriers...and (2) the construction, acquisition, operation, abandonment, or discontinuation of...tracks, or facilities, even if the tracks are located or intended to be located, entirely in one State." 49 U.S.C. § 10501(b). The ICCTA contains an express preemption clause,[1] indicating Congress' intent to preempt all state and local regulation of railroad operations.

Referring to the scope of the federal preemption, one court has stated: "It is difficult to imagine a broader statement of Congress's intent to preempt state regulatory authority over railroad operations." *CSX Transp., Inc. v. Georgia Public Serv. Com'n* (N.D.Ga. 1996) 944 F.Supp. 1573, 1581 (CSX). The ICCTA also reflects congressional intent to continue the historical federal regulation of railroads. (*Fayard v. Northeast Vehicle Services, LLC* (1st Cir. 2008) 533 F.3d 42, 46; see *Chicago & N.W. Tr. Co. v. Kalo Brick & Tile* (1981) 450 U.S. 311, 318 ("The Interstate Commerce Act is among the most pervasive and comprehensive of federal regulatory schemes.").

Congress has stated that federal preemption of railroad regulation "is intended to address and encompass all such regulation and to be completely exclusive. Any other construction would undermine the uniformity standards and risk the balkanization and

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[1] 49 U.S.C. § 10501(b) states that "the remedies provided under this part with respect to regulation of rail transportation are exclusive and preempt the remedies provided under Federal or State law."

subversion of the Federal scheme of minimal regulation for this intrinsically interstate form of transportation." H.R. Rep. No 104-311, 104th Cong., 1st Sess., at 96 (1995).

As discussed further below, Congress has accordingly established federal preemption of rail operations by means of "diverse sources of statutory authority . . . with which to address rail safety issues," and therefore "preemption had to apply to regulations issued" under any of those sources, for "otherwise, the desired uniformity could not be attained." Brief for United States as Amicus Curiae at 6, *Public Util. Comm'n of Ohio v. CSX Transp., Inc.*, 498 U.S. 1066 (1991) (No. 90-95), *available at* http://www.justice.gov/osg/briefs/1990/sg900560.txt; *see also* H.R. Rep. No. 1194, 91st Cong., 2d Sess. 19 (1970) ("[S]uch a vital part of our interstate commerce as railroads should not be subject to [a] multiplicity of enforcement by various certifying States as well as the Federal Government.")

B. Federal Railroad Safety Act.

As already briefed by UPRR to SACOG, Congress directed in the Federal Railroad Safety Act ("FRSA") that "[l]aws, regulations, and orders related to railroad safety and laws, regulations, and orders related to railroad security shall be nationally uniform to the extent practicable." 49 U.S.C. § 20106(a)(1). To accomplish that objective, Congress provided that a State may no longer "adopt or continue in force a law, regulation, or order related to railroad safety" once the "Secretary of Transportation . . . prescribes a regulation or issues an order covering the subject matter of the State requirement." *Id.* at § 20106(a)(2). State or local hazardous material railroad transportation requirements may be preempted under the FRSA regardless of whether such state and local requirements might be consistent under the Federal hazmat law. *CSX Transportation, Inc. v. City of Tullahoma*, 705 F. Supp. 385 (E.D. Tenn. 1988); *CSX Transportation, Inc. v. Public Utilities Comm'n of Ohio*, 701 F. Supp. 608 (D. Ohio 1988), affirmed, 901 F.2d 497 (6th Cir. 1990), cert. denied 111 S.Ct. 781 (1991).

Section 20106(a)(2) compels the conclusion that DOT regulations and orders preempt state and local regulations relating to the same subject matter. Section 20106 states clearly that its terms govern the preemptive scope of all DOT regulations and orders relating to rail safety. DOT has acknowledged that "[t]hrough [the Federal Railroad Administration] and [the Pipeline and Hazardous Materials Safety Administration], DOT comprehensively and intentionally regulates the subject matter of the transportation of hazardous materials by rail . . . . These regulations leave no room for State . . . standards established by any means . . . dealing with the subject matter covered by the DOT regulations." 74 Fed. Reg. 1790 (Jan. 13, 2009).

C. Pipeline Safety Improvement Act.

The Pipeline Safety Improvement Act, which created the Pipeline and Hazardous Materials Safety Administration ("PHMSA), expressly preempts any state or local agency purporting to regulate "the designing, manufacturing, fabricating, inspecting, marking, maintaining, reconditioning, repairing, or testing a package, container, or packaging component that is represented, marked, certified, or sold as qualified for use in transporting hazardous material in commerce." 49 U.S.C. §5125. Accordingly, any project mitigation measure or condition of approval attempting to restrict or specify the type of equipment to be used in transporting crude-by-rail is expressly preempted.

E. Federal Preemption of Rail Operations Applies to State and Local Environmental, Land Use and Tort Laws.

The breadth of federal preemption under the ICCTA encompasses environmental laws such as CEQA. *City of Auburn v. United States*, 154 F.3d 1025 (9th Cir. 1998); *People v. Burlington N. Santa Fe R.R.*, 209 Cal.App.4th 1513, 1528 (Cal. Ct. App. 2012). In *City of Auburn*, the Burlington Northern and Santa Fe Railway (BNSF) sought to reacquire a segment of a rail line, make repairs and improvements, and reinstitute service. The Ninth Circuit held that BNSF's proposed project could not be subjected to environmental review pursuant to a Washington state statute that is similar to CEQA because the ICCTA precludes such review. *City of Auburn v. United States*, 154 F.3d at 1030.

Many other courts, and the STB itself, have added to the articulation of federal rail preemption. *See Norfolk S. R.R. Co. v. City of Austell*, 1997 WL 1113647, *6 (N.D. Ga. 1997) ("ICCTA expresses Congress' unambiguous and clear intent to preempt [the local jurisdiction's] authority to regulate and govern the construction, development, and operation of the plaintiff's intermodal facility."); *Soo Line R.R. v. City of Minneapolis*, 38 F.Supp.2d 1096, 1101 (D. Minn. 1998) ("The Court concludes that the City's demolition permitting process upon which Defendant has relied to prevent [the railroad] from demolishing five buildings...that are related to the movement of property by rail is expressly preempted by [the ICCTA]"); *Village of Ridgefield Park v. N.Y., Susquehanna & W. R.R. Corp.*, 750 A.2d 57 (N.J. 2000) (complaints about rail operations under local nuisance law preempted); *Village of Big Lake v. BNSF*, 382 SW 3rd 125 (2012) (claim that BNSF's build-up of its railway bed violated floodplain management ordinance preempted by ICCTA); *City of Cace v. Norfolk Southern Ry. Co.*, 391 SC 395 (2011) (claim that Norfolk Southern Railway was allowing a public nuisance because of rust and graffiti on bridge preempted by ICCTA); *Ass'n of Am. R.Rs. v. S. Coast Air Quality Mgmt. Dist.*, 622 F.3d 1094, 1096 (9th Cir. 2010) (holding that ICCTA preempted South Coast Air Quality Management District rule requiring railroads to report emissions from idling trains); *Waubay Lake Farmers Ass'n v. BNSF Ry. Co.*, No. 12-4179-RAL, 2014 WL 4287086 (D.S.D. Aug. 28, 2014) (state-based tort claim preempted).

The STB itself has found that, for the proposed construction of a high-speed rail line, "state permitting and land use requirements that would apply to non-rail projects, such as [CEQA], will be preempted." *DesertXpress Enterprises, LLC – Petition for Declaratory Order* (STB, June 27, 2007, No. FD 34914) 20007 STB Lexis 343, p.11.

A recent CEQA decision by a California appellate court confirms the breadth of the ICCTA's preemption. *See Town of Atherton v. California High-Speed Rail Authority*, No. C070877, 2014 Cal. App. Lexis 670 (July 24, 2014). In *Town of Atherton*, the Court recognized two broad categories of state and local regulations that are categorically preempted by the ICCTA, regardless of the context in which the state seeks to apply the regulation: ***(1) any form of state or local permitting or preclearance that, by its nature, could be used to deny a railroad the ability to conduct some part of its operations or to proceed with activities that the [STB] has authorized***; and (2) state or local regulation of matter directly regulated by the [STB] – such as the construction, operation, and abandonment of rail lines; railroad mergers, line acquisitions, and other forms of consolidation; and railroad rates and service." *Id.* at 20 (emphasis added). Thus, it is clear that CEQA preclearance and environment permitting requirements are preempted by federal law and do not apply to railroad operations.

The ICCTA does allow states to regulate railroads pursuant to their traditional police powers, but this constitutes a very narrow and restricted exception to the ICCTA's preemptive effect. This is because states may regulate railroads only when the state regulations "are settled and defined, can be obeyed with reasonable certainty, entail no extended or open-ended delays, and can be approved (or rejected) without the exercise of discretion on subjective questions." *Green Mountain R.R. Corp. v. State of Vermont*, 404 F3d 643, 643 (2nd Cir. 2005). Environmental permitting and pre-clearances do not meet this test when "the railroad is restrained from development until a permit is issued; the requirements for the permit are not set forth in any schedule or regulation that the railroad can consult in order to assure compliance; and the issuance of the permit awaits and depends upon the discretionary ruling of a state or local agency." *Id.* Because CEQA by definition only applies when an agency is making a discretionary decision over whether to approve or disapprove a project, it does not meet this test, and it is federally preempted by the ICCTA. Cal.Code.Regs. tit. 14, §§ 15002(i)(2), 15357, 15378.

F. California Recognizes That Federal Law Preempts the Regulation of Railroads.

The State of California has long accepted that federal law preempts the application of state environmental regulations to rail carriers and rail operations. For example, instead of attempting to enforce California law, the California Air Resources Board has negotiated with the railroads for voluntary reductions in locomotive emissions and in emissions from rail yard activities. *See* Memorandum of Mutual Understandings and Agreements, South Coast Locomotive Fleet Average Emissions Program, July 2, 1998; ARB/Railroad Statewide Agreement, Particulate Emissions Reduction Program at California Rail Yards, June 2005, *available at* http://www.arb.ca.gov/railyard/ryagreement/ryagreement.htm. The 2005 agreement summarizes federal preemption as follows:

> It has been widely recognized that railroads need consistent and uniform regulation and treatment to operate effectively. A typical line-haul locomotive is not confined to a single air basin and travels throughout California and into different states. The U.S. Congress has recognized the importance of interstate rail transportation for many years. The Federal Clean Air Act, the Federal Railroad Safety Act, the Federal Interstate Commerce Commission Act and many other laws establish a uniform federal system of equipment and operational requirements. The parties recognize that the courts have determined that a relatively broad federal preemption exists to ensure consistent and uniform regulation. Federal agencies have adopted major, broad railroad and locomotive regulatory programs under controlling federal legislation.

2005 ARB/Railroad Statewide Agreement, p. 25.

In the *Town of Atherton v. California High Speed Rail Authority* case referred to above, the California Attorney General asserted that the ICCTA preempts CEQA as applied to the California High-Speed Rail train system. The Attorney General stated:

> Courts and the STB uniformly hold that the ICCTA preempts state environmental pre-clearance requirements, such as those in the California Environmental Quality Act (CEQA). The ICCTA preempts these requirements because they can be used to prevent or delay construction of new portions of the interstate rail network, which is exactly the sort of piecemeal regulation Congress intended to eliminate.

Supplemental Letter Brief filed August 9, 2013, in the matter of *Town of Atherton v. California High Speed Rail Authority*, Court of Appeal of the State of California, Third Appellate District, No. C070877, at p. 3.

G. Federal Law Preempts Local Permitting Authority for Rail Car Unloading Facilities.

As stated above, Valero shares fully in the City's interest in providing a procedural vehicle for disclosure and discussion related to Valero's crude-by-rail Project, and Valero has participated fully in the City's effort to provide such a vehicle, including cooperating in the City's permitting and CEQA review process. The benefits of the process cannot be denied. Nevertheless, the scope of federal preemption precludes not only City authority over mainline rail operations, but also over the unloading facilities to be located on the refinery property. Our participation in this process, it must be understood, is subject to a full reservation of rights under federal law.

Section 10102(9) of the ICCTA defines "transportation" broadly, so as to include not only a "locomotive, car, [or] vehicle," but a "property, facility, instrumentality, or equipment of any kind related to the movement of passengers or property, or both, by rail."

Accordingly, preemption also applies to local approval authority over facilities such as Valero's crude-by-rail Project, which receive goods moved by rail. In *Norfolk Southern Railroad Company v. City of Alexandria*, 608 F.3d 150 (2010), the City of Alexandria, in an attempt to regulate an ethanol transloading facility, the purpose of which was to transfer bulk shipments of ethanol from rail cars onto surface tanker trucks for local distribution and delivery, adopted an ordinance purporting to regulate the transportation of bulk materials, including ethanol, within the city. The city also unilaterally issued a permit to Norfolk Southern that purported to limit the materials that could be hauled, the routes, times of day, etc. The city argued that preemption should not apply because the ordinance and permit related to distribution of the cargo by trucks, rather than to the trains or the transloading operation.

The court rejected the city's argument, holding that the ordinance and permit were preempted because they "directly impact Norfolk Southern's ability to move goods shipped by rail." Because a limit on the number of trucks exiting the facility directly affected the number of rail cars that could be unloaded, which in turn could affect the movement of trains in Norfolk's yard, and throughout its rail system, the Fourth Circuit concluded that the conditions restricting ethanol distribution by truck "necessarily regulate the transloading operations." 608 F.3d at 159. The court further found that the ordinance and permit imposed an unreasonable burden on rail transportation because "the city has the power to halt or significantly diminish the transloading operations by declining to issue haul permits or by increasing the restrictions specified therein." *Id.* at 160.

H. CEQA Does Not Apply to Rail Operations Because of the Federal Preemption.

CEQA applies only to discretionary approvals. *San Diego Navy Broadway Complex Coalition v. City of San Diego*, 185 Cal.App.4th 924, 933-934 (2010); *Friends of Westwood, Inc. v. City of Los Angeles*, 191 Cal.App.3d 259, 266-267 (1987); *Mountain Lion Foundation v. Fish and Game Commission*, 16 Cal.4th 105, 117 (1997). Because of federal preemption, the City's discretion does not reach either mainline rail operations, or the unloading operations at the refinery site itself.

3. COMMENTS RE DEIR ALTERNATIVES ANALYSIS.

Concerning Section 6.4.2.2, Alternative 2: First, the alternative relates to impacts of train crossings at Park Road, a potential effect that is subject to federal preemption. Second, a condition restricting deliveries and departures to nighttime hours, because of the nature of the offloading procedure, the time consumed for both unloading and return of the rail cars, and the compressed time frame for two trains to arrive, offload and return, could have more significant effects on train crossings at Park Road than delivery of the rail cars without such nighttime restriction.

4. CONCLUSION.

The DEIR, as we have stated elsewhere, is one of which the City can be proud, going far above and beyond what the law requires, and even permits. We commend the City's efforts to promote disclosure and discussion related to the Project, and we have participated vigorously and openly in that process. Nevertheless, as stated above, we do so while reserving all rights under federal law.

Thank you very much for your consideration of our comments.

Very truly yours,

John J. Flynn III
of Nossaman LLP

JJF:rg

Enclosure

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Re: Union Pacific – Valero Refinery Project

Dear Mr. McKeever:

Union Pacific Railroad Company (UP) appreciates this opportunity to comment on the draft Comment Letter on Valero Crude by Rail Project Environmental Impact Report, Item #14-8-4, which we understand will be considered by the Sacramento Area Council of Governments (SACOG) on August 21, 2014.

UP understands the concern about the risks associated with crude-by-rail and we take our responsibility to ship crude oil, as mandated by federal law, very seriously. UP follows the strictest safety practices and in many cases, exceed federal safety regulations. UP's goal is to have zero derailments and it works closely with the federal Department of Transportation (DOT), the Federal Railroad Administration (FRA), the Pipeline and Hazardous Materials Safety Administration (PHMSA), the Association of American Railroads (AAR) and our customers to ensure it operates the safest railroad possible.

Safety is UP's top priority. The only effective way to ensure safety is through comprehensive federal regulation. A state-by-state, or town-by-town approach in which different rules apply to the beginning, middle, and end of a single rail journey, would not be effective. Congress agrees. Federal regulations completely preempt the application of the California Environmental Quality Act (CEQA) and the mitigation measures proposed in the comment letter drafted by SACOG staff. We encourage SACOG and its member agencies to participate in this rulemaking process.

I. Union Pacific is working closely with other stakeholders to ensure the safety of crude transportation.

Union Pacific is working diligently with federal, state and local authorities to prevent derailments or other accidents. UP spent more than $21.6 billion in capital investments from 2007-2013 continuing to strengthen our infrastructure. By doing so, it is continuously improving safety for our employees, our communities and our customers.

UP has decreased derailments 23% over the last 10 years, due in large part to our robust derailment prevention and risk reduction process. This process includes, among others, the following measures:

- Union Pacific uses lasers and ultrasound to identify rail imperfections.
- UP forecasts potential failures before they happen by tracking the acoustic vibration on wheels.
- UP performs a real-time analysis of every rail car moving on our system each time it passes a trackside sensor, equaling 20 million car evaluations per day.
- UP employees participate in rigorous safety training programs on a regular basis and are trained to identify and prevent potential derailments.

Union Pacific also reaches out to fire departments as well as other emergency responders along our lines to offer comprehensive training to hazmat first-responders in communities where we operate. Union Pacific annually trains approximately 2,500 local, state and federal first-responders on ways to minimize the impact of a derailment in their communities. UP has trained nearly 38,000 public responders and almost 7,500 private responders (shippers & contractors) since 2003. This includes classroom and hands-on training.

These efforts have paid off. The overall safety record of rail transportation, as measured by the FRA has been trending in the right direction for decades. In fact, based on the three most common rail safety measures, recent years have been the safest in rail history: the train accident rate in 2013 was down 79 percent from 1980 and down 42 percent from 2000; the employee injury rate was down 84 percent from 1980 and down 47 percent from 2000; and the grade crossing collision rate was down 81 percent from 1980 and down 42 percent from 2000.

II. The Federal Government is imposing more stringent requirements for safe transportation of crude oil.

As federal rail authorities recently explained, DOT, through the FRA and PHMSA, "continue[s] to pursue a *comprehensive, all-of-the-above approach* in minimizing risk and ensuring the safe transport of crude oil by rail." Department of Transportation, *Federal Railroad Administration's Action Plan for Hazardous Materials Safety* at 1 (May 20, 2014), available at http://www.fra.dot.gov/eLib/details/L04721. These efforts include not only scores of regulations governing the safe transportation of hazardous materials, including oil products, found in 49 C.F.R. Parts 171 to 180, but also a host of equipment and operating rules promulgated by FRA, as well as voluntary agreements and Emergency Orders issued over the past year in response to oil spills.

Voluntary Agreement

On February 21, 2014, the nation's major freight railroads and the DOT agreed to a rail operations safety initiative that established new operating practices for moving crude oil by rail. Under the industry's voluntary efforts, railroads are:

- Increasing the frequency of track inspections using high-tech track geometry readers.
- Equipping crude trains with either distributed power or two-way telemetry end-of-train devices. These technologies allow train crews to apply emergency brakes from both ends of the train in order to stop the train faster.
- Using new rail traffic routing technology (the Rail Corridor Risk Management System (RCRMS)) to aid in the determination of the safest and most secure rail routes for trains with 20 or more cars of crude oil.
- Lowering speeds to no more than 40 miles-per-hour in the 46 federally-designated high-threat-urban areas and no more than 50 miles per hour in other areas.
- Working with communities to address location-specific concerns that communities may have.
- Increasing trackside safety technology by installing additional wayside wheel bearing detectors if they are not already in place every 40 miles along tracks with trains carrying 20 or more crude oil cars, as other safety factors allow.
- Increasing emergency response training and tuition assistance.
- Enhancing emergency response capability planning.

These voluntary actions are already being implemented.

Emergency Orders

In a February 25, 2014 Emergency Order, the DOT ordered certain changes in the way petroleum crude oil is classified and labeled during shipment, emphasizing that "with regard to emergency responders, sufficient knowledge about the hazards of the materials being transported [is needed] so that if an accident occurs, they can respond appropriately." February 25, 2014 Emergency Order at 13. And in its May 7, 2014 Emergency Order, the DOT ordered railroads transporting large quantities of crude oil to notify state authorities of the estimated number of trains traveling through each county of the State, provide certain emergency response information required by federal regulations (49 C.F.R. Part 172, subpart G) and identify the route over which the oil will be transported.

Proposed Regulations

On July 23, 2014, the PHMSA proposed enhanced tank car standards, a classification and testing program for crude oil and new operational requirements for trains transporting such crude that include braking controls and speed restrictions. PHMSA proposes the phase out of older DOT 111 tank cars for the shipment flammable liquids, including most Bakken crude oil, unless the tank cars are retrofitted to comply with new tank car design standards. We encourage SACOG to participate in this rulemaking process.

The federal proposal includes:

- Better classification and characterization of mined gases and liquids
- Rail routing risk assessment
- Notification to State Emergency Response Commissions
- Reduced operating speeds
- Enhanced braking
- Enhanced standards for both new and existing tank cars

As the federal government's existing regulations, recent emergency orders, the voluntary agreements and the new regulatory proposals make abundantly clear, regulation of crude transportation is extremely detailed and complex. Union Pacific is actively participating in the efforts to finalize the new regulations and encourages SACOG and its member agencies to do the same. By jointly working to enhance safety we can ensure that the most effective regulations are adopted.

III. A uniform federal regulatory program is essential to ensure the safe transportation of crude oil.

As the complex regulatory program described above illustrates, clear and uniform federal regulation is needed to ensure that crude oil continues to be transported safely. With respect to rail transportation, federal law preempts most state and local regulation of rail activities.

Uniform standards and rules for railroad operations allow the efficient movement of goods among the states. If each state or local community were allowed to impose its own regulations on railroad operations, rail transportation could grind to a halt, because train crews would need to apply different rules or perhaps use different equipment as they move from place to place.

As stated by the U.S. Congress:

> Subjecting rail carriers to regulatory requirements that vary among the States would greatly undermine the industry's ability to provide the "seamless" service that is essential to its shippers and would weaken the industry's efficiency and competitive viability.

The U.S. Congress went on to state that

> federal regulation of railroads is intended to address and encompass all such regulation and to be completely exclusive. Any other construction would undermine the uniformity of Federal standards and risk the balkanization and subversion of the Federal scheme of minimal regulation for this intrinsically interstate form of transportation.

Congress has therefore established federal preemption under several statutes governing rail transportation. As the U.S. Solicitor General has explained, Congress recognized that the federal government has "diverse sources of statutory authority . . . with which to address rail safety issues," and therefore "preemption had to apply to regulations issued" under any of those sources, for "otherwise, the desired uniformity could not be attained." Brief for United States as Amicus Curiae at 6, *Public Util. Comm'n of Ohio v. CSX Transp., Inc.*, 498 U.S. 1066 (1991) (No. 90-95), *available at* http://www.justice.gov/osg/briefs/1990/sg900560.txt; *see also* H.R. Rep. No. 1194, 91st Cong., 2d Sess. 19 (1970) ("[S]uch a vital part of our interstate commerce as railroads should not be subject to [a] multiplicity of enforcement by various certifying States as well as the Federal Government.")

Preemption under ICCTA

In 1996, Congress passed the Interstate Commerce Commission Termination Act (ICCTA), which broadened the preemptive effect of federal law and created the federal Surface Transportation Board ("STB"). The driving purpose behind ICCTA was to keep "bureaucracy and regulatory costs at the lowest possible level, consistent with affording remedies only where they are necessary and appropriate." H.R.Rep. No. 104-331, at 93, reprinted in 1995 U.S.C.C.A.N. 793, 805 (emphasis added).

Congress vested the STB with broad authority over railroad operations. Indeed, STB has "exclusive" jurisdiction over "(1) transportation by rail carriers . . . and (2) the construction, acquisition, operation, abandonment, or discontinuance of . . . tracks, or facilities." 49 U.S.C. § 10501(b).

"Transportation" by rail carriers broadly includes:

> (A) a locomotive, car, vehicle, vessel, warehouse, wharf, pier, dock, yard, property, facility, instrumentality, or equipment of any kind related to the movement of passengers or property, or both, by rail, regardless of ownership or an agreement concerning use; and

> (B) services related to that movement, including receipt, delivery, elevation, transfer in transit, refrigeration, icing, ventilation, storage, handling, and interchange of passengers and property. 49 U.S.C. § 10102(9)(emphasis added).

Further, ICCTA contains an express preemption clause: "the remedies provided under this part with respect to the regulation of rail transportation are exclusive and preempt the remedies provided under Federal and State law." 49 U.S.C. § 10501(b). "It is difficult to imagine a broader statement of Congress's intent to preempt state regulatory authority over railroad operations." (*CSX Transp., Inc. v. Georgia Public Serv. Com'n* (N.D.Ga. 1996) 944 F.Supp. 1573, 1581 (CSX).) This provision continues the historic extensive federal regulation of railroads. (*Fayard v. Northeast Vehicle Services, LLC* (1st Cir. 2008) 533 F.3d 42, 46; see *Chicago & N.W. Tr. Co. v. Kalo Brick & Tile* (1981) 450 U.S. 311, 318 ["The Interstate Commerce Act is among the most pervasive and comprehensive of federal regulatory schemes."].)

Over the years, many courts have addressed challenges by state and local authorities seeking to regulate some aspect of rail operations. The courts have consistently upheld Congress's intention that no such regulation can be allowed. As one court stated, "freeing the railroads from state and federal regulatory authority was the principal purpose of Congress" in adopting ICCTA. *Wisconsin Central Ltd. v. City of Marshfield*, 160 F.Supp.2d 1009, 1015 (W.D.Wis. 2000).

Preemption under the Federal Railroad Safety Act

Congress directed in the Federal Railroad Safety Act ("FRSA") that "[l]aws, regulations, and orders related to railroad safety and laws, regulations, and orders related to railroad security shall be nationally uniform to the extent practicable." 49 U.S.C. § 20106(a)(1). To accomplish that objective, Congress provided that a State may no longer "adopt or continue in force a law, regulation, or order related to railroad safety" once the "Secretary of Transportation . . . prescribes a regulation or issues an order covering the subject matter of the State requirement." *Id.* § 20106(a)(2). State or local hazardous material railroad transportation requirements may be preempted under the FRSA without consideration of whether they might be consistent under the Federal hazmat law. *CSX Transportation, Inc. v. City of Tallahoma*, No. 4-87-47 (E.D. Tenn. 1988); *CSX Transportation, Inc. v. Public Utilities Comm'n of Ohio*, 701 F. Supp. 608 (D. Ohio 1988), affirmed, 901 F.2d 497 (6th Cir. 1990), cert. denied 111 S.Ct. 781 (1991).

Under Section 20106(a)(2), these DOT regulations and orders preempt state and local regulations relating to the same subject matter. The text of § 20106 is unambiguous. It plainly states that the terms of § 20106 govern the preemptive force of all DOT regulations and orders related to rail safety. DOT has recognized that "[t]hrough [the Federal Railroad Administration] and [the Pipeline and Hazardous Materials Safety Administration], DOT comprehensively and intentionally regulates the subject matter of the transportation of hazardous materials by rail . . . .

These regulations leave no room for State . . . standards established by any means . . . dealing with the subject matter covered by the DOT regulations." 74 Fed. Reg. 1790 (Jan. 13, 2009).

Preemption under the Pipeline Safety Improvement Act

The Pipeline Safety Improvement Act, which created the PHMSA, includes an express preemption provision prohibiting any state or local agency from regulating "the designing, manufacturing, fabricating, inspecting, marking, maintaining, reconditioning, repairing, or testing a package, container, or packaging component that is represented, marked, certified, or sold as qualified for use in transporting hazardous material in commerce." 49 U.S.C. §5125. Thus, any mitigation measure restricting or specifying the type of equipment to be used in transporting crude by rail is expressly preempted.

DOT has stated that "[t]hrough [the Federal Railroad Administration] and [the Pipeline and Hazardous Materials Safety Administration], DOT comprehensively and intentionally regulates the subject matter of the transportation of hazardous materials by rail . . . . These regulations leave no room for State . . . standards established by any means . . . dealing with the subject matter covered by the DOT regulations." 74 Fed. Reg. 1790 (Jan. 13, 2009).

IV. Neither SACOG nor its member agencies has authority to impose the mitigation measures or conditions proposed in the draft Comment Letter on Valero Crude by Rail Project Environmental Impact Report.

The courts have found that ICCTA preempts state and local environmental, land use and planning regulations. For example, in *City of Auburn*, the Ninth Circuit affirmed STB's ruling that local environmental review regulations could not be required for BNSF's proposal to reacquire and reactivate a rail line. 154 F.3d 1025, 1031 (9th Cir. 1998). The court found that the State of Washington's environmental review statute – a statute that is similar to CEQA – could not be applied to a rail project. Similarly, the Second Circuit found that ICCTA preempted a state requirement for a railroad to obtain a pre-construction environmental permit for a transloading facility because it would give the local governmental body the ability to deny or delay the right to build the facility. *Green Mountain Railroad Corporation v. State of Vermont*, 404 F.3d 638, 641-45 (2d Cir. 2005). In effect, the court found that if a permit allowed the state or local agency to exercise discretion over the rail project, that permit requirement would be preempted.

The California Court of Appeal laid out this same logic in its recent decision in *Town of Atherton v. California High Speed Rail Authority* (filed July 24, 2014), stating:

> [S]tate actions are 'categorically' or 'facially' preempted where they 'would directly conflict with exclusive federal regulation of railroads.' [Citations.] Courts and the STB have recognized 'two broad categories of state and local actions' that are categorically preempted regardless of the context of the action: (1) 'any form of state or local permitting or preclearance that, by its nature, could be used to deny a railroad the ability

> to conduct some part of its operations or to proceed with activities that the [STB] has authorized' and (2) 'state or local regulation of matters directly regulated by the [STB]—such as the construction, operation, and abandonment of rail lines; railroad mergers, line acquisitions, and other forms of consolidation; and railroad rates and service.' [Citations.] Because these categories of state regulation are 'per se unreasonable interference with interstate commerce,' 'the preemption analysis is addressed not to the reasonableness of the particular state or local action, but rather to the act of regulation itself.'

The California Attorney General endorsed this application of the law and specifically argued that "[c]ourts and the STB uniformly hold that the ICCTA preempts state environmental pre-clearance requirements such as those in the California Environmental Quality Act (CEQA)." Letter dated August 9, 2013 from Attorney General Kamala Harris to the Hon. Vance W. Raye, Presiding Justice, California Court of Appeal for the Third District at 3.

Additional cases and STB decisions that have struck down state and local environmental and land use regulations include: *Norfolk Southern Railway Company v. City of Austell*, 1997 WL 1113647, *6 (N.D.Ga. 1997) ("ICCTA expresses Congress's unambiguous and clear intent to preempt [city's] authority to regulate and govern the construction, development, and operation of the plaintiff's intermodal facility"); *Soo Line R.R. v. City of Minneapolis*, 38 F.Supp.2d 1096, 1101 (D. Minn. 1998) ("The Court concludes that the City's demolition permitting process upon which Defendants have relied to prevent [the railroad] from demolishing five buildings . . . that are related to the movement of property by rail is expressly preempted by [ICCTA]."); *Norfolk S. Ry. v. City of Austell*, 1997 WL 1113647 (N.D. Ga. 1997) (local zoning and land use regulations preempted); *Village of Ridgefield Park v. New York, Susquehanna & W. Ry.*, 750 A.2d 57 (N.J. 2000) (complaints about rail operations under local nuisance law preempted); *Burlington Northern and Santa Fe Ry. v. City of Houston*, S.W.3d, 2005 WL 1118121 (Tex. App. 2005) (interpretations of state condemnation law that would prevent condemnation of city land required for construction of rail line preempted).

The *Atherton* court noted that state and local agencies may exercise authority over the development of railroad property to the extent that such regulations:

> can be approved (or rejected) without the exercise of discretion on subjective questions. Electrical, plumbing and fire codes, direct environmental regulations enacted for the protection of the public health and safety, and other generally applicable, non-discriminatory regulations and permit requirements would seem to withstand preemption.

The limited exception for routine, non-discretionary permits to meet building and electrical codes is not relevant here. Instead, the cases have clearly established that state and local agencies have no authority to impose permitting or land use requirements that "would give the local governmental body the ability to deny or delay the right to build the facility."

V. Conclusion

Like the transloading facility in the *Green Mountain* case and the intermodal facility in the *Norfolk Southern* case, the proposed loading rack and tracks at the Valero Refinery are essential components of rail transportation. As noted above, "transportation" includes a "yard, property, facility, instrumentality, or equipment of any kind related to the movement of passengers or property, or both, by rail, regardless of ownership. . ." as well as "receipt, delivery, elevation, transfer in transit, . . . storage, [and] handling" of goods. Valero's proposed project falls squarely within the scope of this definition and the Congress and the courts have made it abundantly clear that "no state or local governmental agency may delay or deny the right to build" such a facility.

As noted above, Union Pacific supports the federal regulatory efforts to ensure that crude transportation is carried out safely. We encourage SACOG and its member agencies to participate in the rulemaking process. Neither SACOG nor its member agencies can go it alone—federal law and common sense demand that a uniform national approach be adopted and applied to ensure safety.

Regards,

UNION PACIFIC RAILROAD COMPANY

Melissa Hagan

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cc: Ms. Amy Million, City of Benicia Planning Commission