appendix A

Economic and Environmental Aspects

AGGREGATE TRANSPORT

FUEL CONSUMPTION AND EMISSIONS ESTIMATOR

Version 1.0; January 2011

INPUTS

FUEL CONSUMPTION

EMPTY TRIP Constant (gal/mi):	Default for Model	Changed by User	Used for Evaluation	Reason for Change
Truck	0.071		0.071	
Rail	0.070		0.070	
Barge	2.196		2.20	
Gallons per mile:				
Ship	23.9		23.9	CSL Acadian

LADEN TRIP Load Factor (gallons per ton per mile):				
Truck	0.0057		0.0057	
Rail	0.0014		0.0014	
Barge	0.0053		0.0053	
Gallons per ton per mile:				
Ship	0.000437		0.000437	CSL Acadian

Sources: CARB 2010, CSL 2010

CO_2 EMISSIONS (grams CO_2 per gallon of fuel)

g CO2/gallon of fuel	Default for Model	Changed by User	Used for Evaluation	Reason for Change
Truck	10,138		10,138	
Rail	10,138		10,138	
Barge	10,249		10,249	
g CO2/gallon of fuel				
Ship	12,215		12,215	CSL Acadian

Sources: CARB 2010, CSL 2010

PAYLOAD (tons)

	Default for Model	Changed by User	Used for Evaluation	Reason for Change
Truck	25		25	
Rail	100		100	
Barge	1,500		1,500	
Ship	72,786		72,786	

Sources: CARB 2010, CSL 2010

ASSUMPTIONS FOR INPUTS

TRANSPORTATION MODES

Truck

Types:
DOT Inventory Categories -
MHDDT: Medium Heavy-Duty Diesel Trucks
HHDDT: Heavy Heavy-Duty Diesel Truck Tractor
HHDDT: Heavy Heavy-Duty Diesel Truck Singleunit
(greater than 14,000 pounds Gross Vehicle Weight Rating)
Model year - 2010

Empty Truck Weight - 25,000 pounds (dump truck or tractor) (12.5 tons)

Average Truck Load - 50,000 pounds (25 tons)

Maximum Truck Load - 55,000 pounds (27.5 tons)

Maximum Gross Weight, in pounds, per numerous state laws - 80,000 pounds (40 tons)

• Payload factors from the FHWA Freight Analysis Framework

Average Truck Load - 30,000 pounds for gravel and crushed stones

source: US DOT, FHWA, Development of Truck Payload Equivalent Factor, 2007

Table 9. Average Payload by Commodities VIUS - National

http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2_reports/reports9/s507_8_9_tables.htm#_Toc169399563

CARB staff estimated truck emission factors using:

• Emission factors made available with CARB's Truck and Bus Rule in 2008

source: CARB, Emission Inventory Data

Posted under Statewide Truck and Bus Regulations: Rulemaking to Consider Adoption to

the Statewide Truck and Bus Regulations (December 11, 2008), Public Hearing Notice and Related Material, November 7, 2008

http://www.arb.ca.gov/regact/2008/truckbus08/emissinv.xls

Rail

Type: Short haul, uncontrolled (pre-Tier 0) locomotives (i.e., manufactured before 2001).

Weight of railcar - 30 tons

(weight including share of locomotive and other support equipment - 49 tons)

Maximum load of railcar - 100 tons

Weight of railcar at maximum load - 130 tons

Assume railcars are full for emission factors

CARB estimated rail emission factors using:

- Fuel consumption factors from the Association of American Railroads

  source: Railroad Facts, 2009

  http://www.aar.org/NewsAndEvents/Press-Releases/2009/12/Rail%20Fact%20Book.aspx

- Emission factors from the U.S. Environmental Protection Agency

  source: Emission Factors for Locomotives, Office of Transportation and Air Quality (EPA-420-F-09-025), April 2009

  http://www.epa.gov/nonroad/locomotv/420f09025.pdf

  grams of CO_2 per gallon of diesel fuel consumed: 10,084

  source: Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel, Office of Transportation and Air Quality (EPA420-F-05-001), February 2005.

  http://www.epa.gov/OMS/climate/420f05001.pdf

Barge

Type: Lighter Aboard SHip (LASH) carriers such as the ACBL0500, built in 1979 to 1983

http://homepage.ntlworld.com/david.hathaway/downloads/lash/lash_model.pdf

http://www.myacbl.net/BGEQReport.asp?barge_id=acbl0500

Estimated weight of empty barge - 412 tons
Maximum Barge Capacity - 1500 tons

Assume one tugboat per barge
Assume barges are full for emission factors
Assume two engines per barge

http://www.arb.ca.gov/regact/2007/chc07/appb.pdf

Assume average engine size 1100 horsepower

CARB Database from survey related to CHC regulation

Assume average tugboat manufactured in 1983

CARB Database from survey related to CHC regulation

Assume average barge capacity 1500 tons

Multiple references

Assume average speed 10 nautical miles per hour (11.5 miles per hour)

CARB estimate

CARB estimated barge emission factors using:

- Emission factors derived during CARB's analysis of commercial harbor craft

CARB, Emissions Estimation Methodology for Commercial Harbor Craft Operating in California (page B-35)

http://www.arb.ca.gov/regact/2007/chc07/appb.pdf

CARB, Assumptions for Estimating Greenhouse Gas Emissions from Commercial Harbor Craft Operating in California

http://www.arb.ca.gov/regact/2007/chc07/appgchc.pdf

Ship (provided by CSL International)

Type: CSL Acadian
Lloyds+100A1, Bulk Carrier, ESP

Year Built: 1982, rebuilt with new forebody in 2006

For trip from Port McNeil to San Diego
Tons - 72,786
Fuel IFO* - 48 tonnes per day
Days at sea - 3.99
Nautical Miles - 1339
CO2 Constant IFO* (million grams CO2/tonne fuel) - 3.11
Speed - 14 knots
Fuel Consumption at sea (IFO*) from load to discharge - 191 tons

* IFO - Intermediate Fuel Oil: A blend of gasoil and heavy fuel oil, with less gasoil than marine diesel oil.

ASSUMPTIONS FOR INPUTS (continued)

SUMMARY OF DATA FOR CALCULATIONS*

	Truck	Truck	Truck	Railcar	Railcar	Barge	Barge
Payload (tons)	0	15	25	0	100	0	1,500
Gross Vehicle Weight Rating (tons)	12.5	27.5	37.5	49	149	412	1,912
Fuel consumption (gallons/gross ton	0.0057	0.0057	0.0057	0.0014	0.0014	0.0053	0.0053
Fuel consumption (gallons/net ton mile)	-	0.0105	0.0086	-	0.0021	-	0.0068
Fuel consumption (gallons/mile)	0.071	0.157	0.214	0.070	0.211	2.196	10.184
CO_2 emission factor (btu/gallon of fuel)	138,690	138,690	138,690	138,690	138,690	138,690	138,690
CO_2 emission factor (g CO_2/btu)	0.0731	0.0731	0.0731	0.0731	0.0731	0.0739	0.0739
CO_2 emission factor (g CO_2/gallon of fuel)	10,138	10,138	10,138	10,138	10,138	10,249	10,249
CO_2 emission factor (g CO_2/gross ton mile)	57.9	57.9	57.9	14.4	14.3	54.6	54.6
CO_2 emission factor (g CO_2/net ton mile)	-	106.2	86.9	-	21.4	-	69.6
CO_2 emission factor (g CO_2/mile)	724	1,593	2,172	707	2,137	22,506	104,376

Source: CARB, 2010.

Highlighted cells are used in sample calculations.

* NOTE: These are first-order approximations; actual fuel consumption does not decrease linearly with weight.
For example, a truck carrying half a load or an empty load still carries a container of the same dimensions as a truck carrying a full container (and they both have a tractor of the same size). Wind resistance - which fuel is necessary to overcome - would not decrease linearly with gross vehicle weight, as the first order approximation implies. Therefore, the model fits better for a heavy load than an empty load.

Ship					*Source*
Fuel Consumption					
Laden Trip: Port McNeil to San Diego					
	0.000502	gallons per ton per nautical mile per trip			*CSL*
divided by	1.15				
	0.000437	gallons per ton per statute mile per trip			*SANDAG*
Empty (Ballast) Trip: San Diego to San Marcos Island					
Fuel Consumption	27.5	gallons per nautical mile per trip			*CSL*
divided by	1.15				
	23.9	gallons per statute mile per trip			*SANDAG*
Emission factors	CO_2	SO_2	NO_x	PM_{10}	
(kg / tonne of fuel)	3130	54	85	6.7	*CSL: International Maritime Organization*
(g /tonne of fuel)	3130000				
divided by	0.97				*CSL*
(g /M3 of fuel)	3226804.1				
divided by	264.1721				*CSL*
(g /gallon of fuel)	12214.78				

Source: CSL International, 2010.
Highlighted cells are used in sample calculations to right.

SAMPLE CALCULATIONS FOR FUEL AND CO_2

Truck

Fuel:

- 1,000,000 tons aggregate / 25 tons per truck = 40,000 truck trips * 26 miles per trip = 1,040,000 truck miles each way
- 1,040,000 truck miles each way * (0.071 + (0.0057 * 25 tons aggregate per truck)) = 222,040 gallons of fuel one way loaded;
- 1,040,000 truck miles each way * (0.071 + (0.0057 * 0 tons aggregate per truck)) = 73,840 gallons of fuel one way empty;
- 222,040 + 73,840 = 295,880 gallons total for 1,000,000 tons aggregate.

CO_2:

- 295,880 gallons total for 1,000,000 tons aggregate * 10,138 grams CO_2/gallon of fuel = 2,999,631,440 grams CO_2

Rail

Fuel:

- 1,000,000 tons aggregate / 100 tons per railcar = 10,000 railcar trips * 140 miles each way = 1,400,000 rail miles each way outside San Diego region
- 1,400,000 rail miles each way * (0.070 + (0.0014 * 100 tons aggregate per railcar)) = 294,000 gallons of fuel one way loaded;
- 1,400,000 rail miles each way * (0.070 + (0.0014 * 0 tons aggregate per train)) = 98,000 gallons of fuel one way empty;
- 294,000 + 98,000 = 392,000 gallons total for 1,000,000 tons aggregate.

CO_2:

- 392,000 gallons total for 1,000,000 tons aggregate * 10,138 grams CO_2/gallon of fuel = 3,974,096,000 grams CO_2

Barge

Fuel:

- 1,000,000 tons aggregate / 1,500 tons per barge = 667 barge trips * 66.55 miles each way by barge outside region = 44,367 barge miles each way outside region;
- 44,367 barge miles each way * (2.196 + (0.0053 * 1,500 tons aggregate per train)) = 450,144 gallons of fuel one way loaded;
- 44,367 barge miles each way * (2.196 + (0.0053 * 0 tons aggregate per train)) = 97,429 gallons of fuel one way empty;
- 450,144 + 97,429 = 547,543 gallons total for 1,000,000 tons aggregate.

CO_2:

- 547,543 gallons total for 1,000,000 tons aggregate * 10,249 grams CO_2/gallon of fuel = 5,612,079,777 grams CO_2

Ship

Fuel:

- 1,000,000 tons aggregate / 72,786 tons per barge = 13.74 ship trips * 1536.4 miles each way by ship outside region = 21,108 ship miles each way outside region;
- 21,108 ship miles each way * 0.000437 gallons per ton per mile * 72,786 tons =671,407 gallons of fuel one way loaded;
- 21,108 ship miles each way * 23.9 gallons per mile = 504,492 gallons of fuel one way empty
  671,407 + 504,492 = 1,175,899 gallons total for 1,000,000 tons aggregate.

CO_2:

- 1,175,899 gallons total for 1,000,000 tons aggregate * 12,215 grams CO_2/gallon of fuel=14,363,606,285 grams CO_2

Note: metric tons = grams divided by 1,000,000

ESTIMATING AGGREGATE NEED FOR RTP PROJECTS

Aggregate Need Per New Lane-Mile and Track-Mile

New Freeway Lane

Item	Height	Length	Width	Cubic Feet	Cubic Yard	Tons Per Cubic Yard	Tons of Aggregate
Lane PCC	1.00	5,280	12.0	63,360	2,347	1.92	4,506
Lane AB	2.00	5,280	12.0	126,720	4,693	1.20	5,632
Shoulder AC	0.50	5,280	10.0	26,400	978	1.88	1,838
Shoulder AB	1.00	5,280	10.0	52,800	1,956	1.20	2,347

Item	Height	Length	CY Per Foot	CY Per Foot	Cubic Yards	Tons Per Cubic Yard	Tons of Aggregate
Retaining Wall	10.00	2,500	20.2	0.75	1,870	1.92	3,591
						Sub-Total	17,914
Miscellaneous Aggregate					Multiplier -	1.25	22,392
On-Site/Recycling					Multiplier -	0.85	19,033
						Tons Per Mile	**19,033**

New Conventional Highway Lane

Item	Height	Length	Width	Cubic Feet	Cubic Yard	Tons Per Cubic Yard	Tons of Aggregate
Lane AC	0.75	5,280	12.0	47,520	1,760	1.88	3,309
Lane AB	1.50	5,280	12.0	95,040	3,520	1.20	4,224
Shoulder AC	0.50	5,280	8.0	21,120	782	1.88	1,471
Shoulder AB	1.00	5,280	8.0	42,240	1,564	1.20	1,877
						Sub-Total	10,881
Miscellaneous Aggregate					Multiplier -	1.35	14,689
On-Site/Recycling					Multiplier -	0.80	11,751
						Tons Per Mile	**11,751**

New Track

Item	Height	Length	Width	Cubic Feet	Cubic Yard	Tons Per Cubic Yard	Tons of Aggregate
Ballast	2.00	5,280	10.0	105,600	3,911	1.98	7,744
Subballast	1.00	5,280	10.0	52,800	1,956	1.20	2,347
						Tons Per Mile	**10,091**

Notes
Miscellaneous aggregate: local interchanges, bridge substructure, columns, footings, drainage facilities, etc.
Freeway means limited access, for example, I-5, I-8

The total amount of aggregate required for the RTP projects listed in the report for 2010 – 2030 is estimated to be approximately 13.1 million tons.

DETERMINING HAUL DISTANCES

This task calls for estimating haul distances from the current mine locations to Regional Transportation Plan (RTP) project sites and produced tables detailing these distances for four import Mode Options. These distances could be used to estimate transport emissions.

RTP Projects

A review and tally of RTP projects planned for completion by 2015, 2020, and 2030 produced a total of 46 projects: 38 highway and 8 rail. These projects include the highway and transit (rail) projects approved by San Diego voters in 2004 as part of the *TransNet* Extension. The projects are listed in Table 1.

Completion	Projects
2015	11 highway and 2 rail
2020	10 highway and 2 rail
2030	17 highway and 4 rail

Each RTP project was divided into segments to create aggregate demand points for this and other portions of the analysis. Descriptions of each project and the segment number (aggregate demand point/project ID) are provided in Table 2.

Transport Mode Options

One local transport option and five import transport options were defined as follows:

- **Mode Option 1:** Aggregate transported by truck from current mine locations to RTP project sites (no aggregate imported);
- **Mode Option 2:** Aggregate imported by rail, then transported by truck from rail yard to RTP project sites;
- **Mode Option 3:** Aggregate imported by ship from outside the region, then transported by truck from the Port of San Diego to RTP project sites.
- **Mode Option 4:** Aggregate imported by truck from outside the region to RTP project sites; and
- **Mode Option 5:** Aggregate imported by barge, then transported by truck from the Port of San Diego to RTP project sites.

The proportion of total aggregate needed per project can vary (e.g., 50 percent transported by truck from current mine locations and 50 percent imported by ship).

Haul Distances

Aggregate haul distances were calculated for each Mode Option in geographic information system (GIS). These distances could be used to estimate transport emissions.

- **Mode Option 1:** Truck distances were calculated between each RTP site and current mine locations based on the current road network. The average distance was selected for this Mode Option (Table 3).
- **Mode Option 2:** Rail distances were calculated along current routes within San Diego region to both rail yards in the region: Port of San Diego and San Ysidro. Truck distances were

calculated from the rail yards to each RTP site based on the current road network (Tables 4 and 5).

- **Mode Option 5:** The shipping distance within San Diego County was calculated to the Port of San Diego. Truck distances were calculated from the Port to each RTP site based on the current road network (Table 6).
- **Mode Option 4:** Truck distances for aggregate importation from areas outside the San Diego County line were calculated from the point at which the aggregate would likely enter the region. It was assumed that the entry points would be from the north at I-5 and at I-15 and from the east at I-8. Truck distances were calculated from each of these entry points to the RTP sites based on the current road network (Tables 7, 8, and 9).
- **Mode Option 5:** The approximate distance from Port of Ensenada to San Diego waters was calculated. It was assumed that waters within state jurisdiction were 3 nautical miles. Truck distances were calculated from the Port of San Diego to each RTP site based on the current road network.

Note that the following tables include a Key number. This was used as a cross reference number in the GIS database and in the excel tables.

Table 1 lists the title and the planned improvement of the RTP Projects.

Table 1
RTP Projects by 2015, 2020, and 2030 Completion Date

RTP Project Description	Improvement	Key
2015 Completion – Highway		
SR 76 from Melrose Drive to I-15	2 lanes	23
SR 52 from I-805 to SR 125	2 lanes + 2 managed lanes	20
I-15 from SR 163 to SR 56	2 lanes + 2 managed lanes	14
I-5 from La Jolla Village Drive to I-5/I-805 merge	2 HOV lanes	7
I-5 from I-5/I-805 merge* to Vandegrift Boulevard*	4 managed lanes	55
SR 11 from SR 905 to Mexico	4 toll lanes	12
I-15 from SR 94 to SR 163	2 lanes + 2 HOV lanes	13
SR 94 from I-5 to I-805	2 HOV lanes	24
SR 241 from Orange County to I-5	4 toll lanes	27
I-805 from Palomar Street to SR 94	4 managed lanes	28
I-805 from Carroll Canyon Road to I-5	4 manages lanes	32
2015 Completion – Rail		
Mid-Coast Trolley from Old Town to UTC		
Coaster double tracking between Carlsbad and Oceanside		
2020 Completion – Highway		
SR 67 from Mapleview Street to Scripps Poway Parkway	2 lanes	22
I-15 from SR 78 to Riverside County	4 toll lanes	16
SR 52 from I-5 to I-805	2 lanes	19
SR 56 from I-5 to I-15	2 lanes	21

Table 1 (cont'd)

RTP Project Description	Improvement	Key
SR 94 from I-805 to SR 125	2 HOV lanes	25
SR 125 from SR 94 to I-8	2 HOV lanes	48
I-805 from SR 94 to I-8	4 managed lanes	29
I-805 from I-8 to SR 52	2 HOV lanes	30
I-805 from SR 52 to Carroll Canyon Road	4 managed lanes	31
I-5 from I-5/I-805 merge to Vandegrift Boulevard	4 managed lanes	8
2020 Completion – Rail		
Sprinter double tracking between Oceanside and Escondido		
San Diego Trolley south line rehab from San Ysidro to National City		
2030 Completion – Highway		
I-5 from Vandegrift Boulevard to Orange County	4 toll lanes	40
SR 78 from I-5 to I-15	2 HOV lanes	45
SR 67 from Scripps Poway Parkway to Dye Road	2 lanes	44
I-8 from 2nd street to Los Coches	2 lanes	42
SR 905 from I-805 to Mexico	2 lanes	53
SR 125 from San Miguel Road to SR 54	4 lanes	47
I-5 from SR 905 to SR 54	2 HOV lanes	36
I-5 from SR 54 to I-8	2 HOV lanes	37
SR 75/282 from Glorietta Boulevard to Alameda Boulevard	2 lane tunnel?	4
I-5 from J Street to Sea World Drive	2 lane access improvement	38
I-5 from I-8 to La Jolla Village Drive	2 HOV lanes	39
I-805 from I-8 to SR 52	4 managed lanes	52
I-805 from Mission Valley Viaduct	4 managed lanes	51
I-805 from SR 905 to Palomar Street	4 managed lanes	50
SR 94 from SR 125 to Avocado/Steele Canyon	2 lanes	54
SR 241 from Orange County to I-5	2 toll lanes	49
SR 125 from Telegraph Canyon to San Miguel Road	4 toll lanes	46
2030 Completion – Rail		
Coaster Rose Canyon tunnel near I-5 and Clairemont		
Coaster Del Mar tunnel		
Sprinter Westfield expansion from Escondido to mall		
Mid-Coast Trolley expansion from UTC to Sorrento Valley		

*selected segments

Source: 2030 San Diego Regional Transportation Plan, 2007.

Table 2
RTP Projects by Aggregate Demand Point by Planned 2015, 2020 and 2030 Completion Date

Aggregate Demand Point/ Project ID	RTP Project Description	RTPID	Key
2015 Completion – Highway			
1	SR 76 from Melrose Drive to I-15	H2015-01	23
2	"	-02	"
3	SR 52 from I-805 to SR 125	-03	20
4	"	-04	"
7	"	-07	"
5	I-15 from SR 163 to SR 56	-05	14
6	"	-06	"
8	I-5 from LaJolla Village Drive to I-5/I-805 merge	-08	7
9	I-5 from I-5/I-805 merge* to Vandegrift Boulevard*	-09	55
10	"	-10	"
11	"	-11	"
12	"	-12	"
13	SR 11 from SR 905 to Mexico	-13	12
14	I-15 from SR 94 to SR 163	-14	13
15	"	-15	"
16	"	-16	"
17	SR 94 from I-5 to I-805	-17	24
18	SR 241 from Orange County to I-5	-18	27
19	I-805 from Palomar Street to SR 94	-19	28
20	"	-20	"
21	I-805 from Carroll Canyon Road to I-5	-21	32
2015 Completion – Rail			
69	Mid-Coast Trolley from Old Town to UTC	R2015-05	
72	"	R2015-02	
74	"	R2015-01	
70	Coaster double tracking between Carlsbad and Oceanside	R2015-04	
71	"	R2015-03	
2020 Completion – Highway			
45	SR 67 from Mapleview Street to Scripps Poway Parkway	H2020-01	22
46	"	-02	"
47	I-15 from SR 78 to Riverside County	-03	16
48	"	-04	16
53	"	-09	"
49	SR 52 from I-5 to I-805	-05	19
50	SR 56 from I-5 to I-15	-06	21
51	"	-07	"
52	"	-08	'
54	SR 94 from I-805 to SR 125	-10	25

Table 2 (cont'd)

Aggregate Demand Point/ Project ID	RTP Project Description	RTPID	Key
2020 Completion – Highway (cont'd)			
55	"	-11	"
56	SR 125 from SR 94 to I-8	-12	48
57	I-805 from SR 94 to I-8	-13	29
58	"	-14	"
59	I-805 from I-8 to SR 52	-15	30
60	I-805 from SR 52 to Carroll Canyon Road	H2020-16	31
61	I-5 from I-5/I-805 merge to Vandegrift Boulevard	-17	8
62	"	-18	8
63	"	-19	8
64	"	-20	8
2020 Completion – Rail			
67	Sprinter double tracking between Oceanside and Escondido	R2020-06	
68	"	R2020-05	
73	"	R2020-04	
76	"	R2020-03	
78	San Diego Trolley south line rehab from San Ysidro to	R2020-02	
79	National City	R2020-01	
2030 Completion – Highway			
22	I-5 from Vandegrift Boulevard to Orange County	H2030-01	40
23	"	-02	"
24	SR 78 from I-5 to I-15	-03	45
25	"	-04	"
26	"	-05	"
27	SR 67 from Scripps Poway Parkway to Dye Road	-06	44
28	I-8 from 2nd street to Los Coches	-07	42
29	SR 905 from I-805 to Mexico	-08	53
30	"	-09	"
33	SR 125 from San Miguel Road to SR 54	-12	47
34	I-5 from SR 905 to SR 54	-13	36
35	"	-14	"
36	I-5 from SR 54 to I-8	-15	37
37	"	-16	"
38	SR 75/282 from Glorietta Boulevard to Alameda Boulevard	-17	4
39	I-5 from J Street to Sea World Drive	-18	38
40	I-5 from I-8 to La Jolla Village Drive	-19	39
41	"	-20	"
42	I-805 from I-8 to SR 52	-21	52
43	I-805 from Mission Valley Viaduct	-22	51
44	I-805 from SR 905 to Palomar Street	-23	50
80	SR 94 from SR 125 to Avocado/Steele Canyon	-24	54

Table 2 (cont'd)

Aggregate Demand Point/ Project ID	RTP Project Description	RTPID	Key
2030 Completion – Highway (cont'd)			
81	SR 241 from Orange County to I-5	-25	49
82	SR 125 from Telegraph Canyon to San Miguel Road	-10	46
83	"	-11	"
2030 Completion – Rail			
65	Coaster Rose Canyon tunnel near I-5 and Clairemont	R2030-04	
66	Coaster Del Mar tunnel	R2030-03	
75	Sprinter Westfield expansion from Escondido to mall	R2030-02	
77	Mid-Coast Trolley expansion from UTC to Sorrento Valley	R2030-01	

*selected segments

Source: 2030 San Diego Regional Transportation Plan, 2007.

Mode Option 1

Truck distances were calculated between each RTP site and current mine locations based on the current road network. The average distance was selected for this mode option (Table 3).

Table 3
Haul Distances for Mode Option 1:
Aggregate Transported by Truck – Average Distance from Mine to RTP Aggregate Demand Point

Aggregate Demand Point/Project ID	Average One-way Distance (miles)
2015 Completion – Highway	
1	37.62
2	39.12
3	17.40
4	19.86
7	20.42
5	17.24
6	18.24
8	21.30
9	21.73
10	27.83
11	31.80
12	25.42
13	31.23
14	18.42
15	17.58
16	17.67
17	20.66
18	58.17
19	23.66
20	20.87
21	20.30

Aggregate Demand Point/Project ID	Average One-way Distance (miles)
2015 Completion – Rail	
69	21.33
70	36.52
71	30.47
72	22.05
74	21.09

Table 3 (cont'd)

Aggregate Demand Point/Project ID	Average One-way Distance (miles)
2020 Completion – Highway	
45	14.80
46	15.41
47	41.10
48	28.68
53	34.63
49	21.62
50	22.61
51	18.36
52	23.09
54	18.93
55	19.58
56	17.79
57	18.65
58	19.52
59	18.81
60	19.58
61	31.18
62	32.82
63	37.81
64	27.44

Aggregate Demand Point/Project ID	Average One-way Distance (miles)
2020 Completion – Rail	
67	31.57
68	25.70
73	35.63
76	36.93
78	23.99
79	27.17

2030 Completion – Highway	
22	59.39
23	50.23
24	31.77
25	35.11
26	27.23
27	18.59
28	17.91
29	28.97
30	29.98
33	23.23
34	27.17
35	24.18
36	21.39
37	22.04
38	24.61
39	21.85
40	21.70
41	21.55
42	18.92
43	18.96
44	26.33
80	18.72
81	57.94
82	28.46
83	25.19

2030 Completion – Rail	
65	20.53
66	23.40
75	22.54

Source: 2030 San Diego RTP, 2007.

Mode Option 2

In Mode Option 2, the aggregate is imported into the region from the north at the San Diego/Orange County line or from the south at the San Diego-Mexico international border. The rail transport distance is calculated as follows:

- 60.1 miles from San Diego/Orange County line to San Diego Rail Yard, or
- 15.1 miles from San Ysidro Rail Yard to San Diego Rail Yard (plus ¾ mile from the international border to the San Ysidro Rail Yard).

From the San Diego Rail Yard the aggregate is then trucked to a RTP aggregate demand point. Table 4 shows the truck distance from the San Diego Rail Yard. (The table does not include the rail transport distance.)

Track miles within San Diego County:

- 1 mile from County/US border to San Ysidro Rail Yard

Table 4
Haul Distances for Mode Option 2: Aggregate Imported by Rail to San Diego Rail Yard, Then Transported by Truck From Rail Yard to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Highway	
1	44.85
2	48.81
3	10.45
4	12.96
7	15.81
5	14.21
6	17.59
8	14.93
9	17.17
10	25.93
11	31.24
12	20.58
13	19.35
14	5.51
15	11.95
16	8.80
17	2.46
18	59.32
19	8.26
20	4.24
21	15.26

Table 5
Haul Distances for Mode Option 2: Aggregate Imported by Rail to San Ysidro Rail Yard, Then Transported by Truck From Rail Yard to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Highway	
1	57.21
2	60.21
3	22.78
4	23.35
7	25.66
5	25.51
6	28.92
8	27.94
9	29.54
10	38.29
11	43.60
12	33.01
13	8.18
14	15.97
15	22.83
16	19.26
17	13.46
18	71.69
19	7.47
20	11.45
21	27.62

Table 4 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Rail	
69	7.03
70	37.04
71	29.14
72	11.54
74	14.60
2020 Completion – Highway	
45	21.87
46	25.40
47	50.87
48	36.63
53	43.92
49	11.73
50	19.60
51	19.33
52	22.08
54	8.42
55	5.72
56	11.16
57	5.50
58	4.14
59	8.34
60	12.53
61	28.46
62	32.61
63	36.80
64	25.25
2020 Completion – Rail	
67	37.76
68	32.86
73	40.89
76	37.96
78	4.04
79	10.05

Table 5 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Rail	
69	20.43
70	49.47
71	41.57
72	24.94
74	27.53
2020 Completion – Highway	
45	29.66
46	33.19
47	62.27
48	48.02
53	55.32
49	24.90
50	32.01
51	31.04
52	33.79
54	17.04
55	14.33
56	18.85
57	16.87
58	14.66
59	20.77
60	24.89
61	40.88
62	44.97
63	49.23
64	37.67
2020 Completion – Rail	
67	50.13
68	44.27
73	53.25
76	50.32
78	9.35
79	3.35

Table 4 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2030 Completion – Highway	
22	52.62
23	43.21
24	37.93
25	38.42
26	34.39
27	28.76
28	17.86
29	14.30
30	17.30
33	11.56
34	9.43
35	5.98
36	0.98
37	3.16
38	3.49
39	3.29
40	7.44
41	11.53
42	9.33
43	7.62
44	11.56
80	12.94
81	59.32
82	17.12
83	13.79
2030 Completion – Rail	
65	13.92
66	19.77
75	29.32
77	14.21

Table 5 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2030 Completion – Highway	
22	65.05
23	55.64
24	50.29
25	50.78
26	45.79
27	39.14
28	25.20
29	3.13
30	6.12
33	12.95
34	4.28
35	7.50
36	13.27
37	10.32
38	15.15
39	16.68
40	20.83
41	24.92
42	21.76
43	18.52
44	3.98
80	19.02
81	71.69
82	7.92
83	9.36
2030 Completion – Rail	
65	26.89
66	32.20
75	40.72
77	26.63

Sources: San Diego and Imperial Valley Gateway Study, SANDAG, March 25, 2010 (working Final Copy), Appendix Table A-2 (Rail Lines in San Diego County) at page 132; SANDAG GIS.

Mode Option 3

In Mode Option 3, the aggregate is imported into the region by ship to the Port of San Diego then transported by truck from the Port to the RTP project site. The ship transport distance is calculated as follows:

Shipping miles within San Diego County –
- 3.45 statute miles (converted from nautical miles)

Shipping miles from Vancouver Island to San Diego waters –
- 1536 statute miles (converted from nautical miles)

The table does not include the ship transport distance.

Table 6
Haul Distances for Mode Option 3:
Aggregate Imported by Ship to Port of San Diego,
Then Transported by Truck From Port to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Highway	
1	44.85
2	48.81
3	10.45
4	12.96
7	15.81
5	14.21
6	17.59
8	14.93
9	17.17
10	25.93
11	31.24
12	20.58
13	19.35
14	5.51
15	11.95
16	8.80
17	2.46
18	59.32
19	8.26
20	4.24
21	15.26

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Rail	
65	13.92
66	19.77
75	29.32
77	14.21

Table 6 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2020 Completion – Highway	
45	21.87
46	25.40
47	50.87
48	36.63
53	43.92
49	11.73
50	19.60
51	19.33
52	22.08
54	8.42
55	5.72
56	11.16
57	5.50
58	4.14
59	8.34
60	12.53
61	28.46
62	32.61
63	36.80
64	25.25
2030 Completion – Highway	
22	52.62
23	43.21
24	37.93
25	38.42
26	34.39
27	28.76
28	17.86
29	14.30
30	17.30
33	11.56
34	9.43
35	5.98
36	0.98
37	3.16
38	3.49
39	3.29

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2015 Completion – Rail	
67	37.76
68	32.86
73	40.89
76	37.96
78	4.04
79	10.05
2030 Completion – Rail	
65	13.92
66	19.77
75	29.32
77	14.21

Table 6 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From SD Rail Yard to RTP Site (miles)
2030 Completion – Highway (cont'd)	
40	7.44
41	11.53
42	9.33
43	7.62
44	11.56
80	12.94
81	59.32
82	17.12
83	13.79

Sources: San Diego and Imperial Valley Gateway Study, SANDAG, March 25, 2010 (working Final Copy), Appendix Table A-2 (Rail Lines in San Diego County) at page 132; SANDAG GIS.

Mode Option 4

In Mode Option 4, aggregate is imported into the region by truck from outside the region from the north *via* I-5 and I-15, respectively, and from the east *via* I-8. Truck distances were calculated from each of these entry points to the RTP sites based on the current road network (Tables 7, 8 and 9 on the next page).

Mode Option 5

In Mode Option 5, aggregate is imported into the region by barge, then transported by truck from the Port of San Diego to RTP project sites. The approximate distance from the Port of Ensenada to San Diego waters was calculated as 67 statute miles (converted from nautical miles). Truck distances were calculated from the Port of San Diego to each RTP site based on the current road network (Table 6).

Table 7
Haul Distances for Mode Option 4: Aggregate Imported by Truck From the North via I-5 to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the North via I-5 to RTP Site (miles)
2015 Completion – Highway	
1	29.04
2	33.55
3	48.60
4	52.01
7	55.77
5	49.77
6	48.96
8	42.93
9	40.58
10	31.83
11	26.51
12	37.05
13	74.75
14	55.12
15	50.66
16	52.71
17	57.25
18	2.10
19	63.45
20	59.40
21	42.77

Table 8
Haul Distances for Mode Option 4: Aggregate Imported by Truck From the North via I-15 to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-15 to RTP Site (miles)
2015 Completion – Highway	
1	15.06
2	10.29
3	45.03
4	45.47
7	49.29
5	40.61
6	37.12
8	44.84
9	42.49
10	34.68
11	30.58
12	39.07
13	70.67
14	50.67
15	43.58
16	46.98
17	53.18
18	45.43
19	59.47
20	55.39
21	44.71

Table 9
Haul Distances for Mode Option 4: Aggregate Imported by Truck From the East via I-8 to RTP Project Sites

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-8 to RTP Site (miles)
2015 Completion – Highway	
1	97.91
2	99.51
3	71.15
4	67.75
7	64.11
5	72.97
6	72.75
8	77.75
9	79.19
10	87.94
11	93.25
12	82.80
13	69.96
14	69.87
15	69.64
16	69.97
17	71.87
18	121.34
19	68.63
20	71.85
21	77.27

Table 7 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the North via I-5 to RTP Site (miles)
2015 Completion – Rail	
69	51.07
70	21.05
71	28.67
72	46.77
74	43.87
2020 Completion – Highway	
45	61.67
46	57.97
47	40.16
48	36.38
53	36.04
49	47.08
50	40.89
51	47.03
52	43.07
54	60.23
55	58.64
56	60.90
57	53.41
58	57.08
59	49.29
60	45.21
61	29.18
62	25.14
63	20.87
64	32.73

Table 8 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-15 to RTP Site (miles)
2015 Completion – Rail	
69	51.47
70	26.70
71	32.88
72	48.89
74	45.78
2020 Completion – Highway	
45	46.91
46	43.21
47	3.87
48	18.25
53	10.96
49	48.63
50	41.52
51	36.94
52	39.59
54	54.75
55	54.28
56	55.33
57	50.16
58	52.48
59	47.40
60	45.69
61	32.78
62	29.43
63	26.26
64	34.95

Table 9 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-8 to RTP Site (miles)
2015 Completion – Rail	
69	75.70
70	99.19
71	91.29
72	76.26
74	77.35
2020 Completion – Highway	
45	58.59
46	62.13
47	101.56
48	87.32
53	94.61
49	74.72
50	81.06
51	74.80
52	78.19
54	65.90
55	68.66
56	63.77
57	70.90
58	70.83
59	73.53
60	74.54
61	90.60
62	94.62
63	98.94
64	87.41

Table 7 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the North via I-5 to RTP Site (miles)
2020 Completion – Rail	
67	30.69
68	36.54
73	25.80
76	20.42
78	61.11
79	66.72
2030 Completion – Highway	
22	5.01
23	14.43
24	29.82
25	24.40
26	35.28
27	55.89
28	64.90
29	69.70
30	72.70
33	66.01
34	66.50
35	63.02
36	57.84
37	60.11
38	60.64
39	54.53
40	50.58
41	46.58
42	48.30

Table 8 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-15 to RTP Site (miles)
2020 Completion – Rail	
67	22.87
68	23.27
73	21.11
76	25.38
78	57.05
79	62.69
2030 Completion – Highway	
22	38.89
23	29.47
24	22.60
25	23.75
26	24.31
27	41.05
28	52.83
29	65.62
30	68.62
33	61.93
34	62.43
35	59.07
36	54.72
37	56.04
38	57.59
39	53.28
40	51.36
41	48.56
42	47.08

Table 9 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-8 to RTP Site (miles)
2020 Completion – Rail	
67	90.18
68	83.62
73	95.54
76	99.97
78	72.41
79	71.71
2030 Completion – Highway	
22	114.76
23	105.35
24	90.39
25	95.95
26	85.15
27	68.07
28	56.48
29	71.86
30	69.55
33	65.20
34	72.08
35	71.13
36	73.40
37	72.97
38	76.65
39	74.52
40	76.66
41	76.36
42	73.21

Table 7 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the North via I-5 to RTP Site (miles)
2030 Completion – Highway (cont'd)	
43	51.59
44	66.79
80	63.83
81	2.10
82	72.31
83	68.95
2030 Completion – Rail	
65	44.19
66	38.44
75	40.63
77	43.43

Table 8 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-15 to RTP Site (miles)
2030 Completion – Highway (cont'd)	
43	48.53
44	62.80
80	58.25
81	45.43
82	68.23
83	64.86
2030 Completion – Rail	
65	46.11
66	40.91
75	25.32
77	44.52

Table 9 (cont'd)

Aggregate Demand Point/Project ID	One-Way Trucking Distance From the East via I-8 to RTP Site (miles)
2030 Completion – Highway (cont'd)	
43	71.53
44	69.09
80	62.85
81	121.34
82	67.08
83	63.90
2030 Completion – Rail	
65	76.70
66	81.98
75	80.02
77	76.45

Source: SANDAG GIS