

**Appendix A**  
**Air Quality and GHG Emissions**

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TABLE A-1

**Construction Emissions Summary**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Construction Phase	Maximum Daily Emissions (lbs/day) <sup>a</sup>					
	VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>
<b>Project Emissions</b>						
Construction Year 2014 <sup>b</sup>	27.62	68.16	110.75	0.85	74.91	18.55
Construction Year 2015 <sup>b</sup>	272.28	949.37	1,328.37	99.22	73.80	49.89
<b>Maximum Daily Emissions</b>	<b>272.28</b>	<b>949.37</b>	<b>1,328.37</b>	<b>99.22</b>	<b>74.91</b>	<b>49.89</b>
<b>Maximum Daily Emissions (tons/day)<sup>c</sup></b>	<b>0.14</b>	<b>0.47</b>	<b>0.66</b>	<b>0.05</b>	<b>0.04</b>	<b>0.02</b>
<b>Emissions by Phase</b>						
<b>Submarine Route Cable Installation</b>						
Land Installation						
Mobilization	1.26	6.61	11.52	0.02	0.96	0.54
Manholes	5.56	22.53	43.52	0.06	37.16	9.66
Trenching	3.71	17.18	28.27	0.04	36.36	8.92
Cable Installation	1.23	5.53	11.42	0.02	0.77	0.49
HDD Drilling						
HDD Send Pit Excavation	1.50	7.33	8.89	0.01	37.02	8.31
HDD Bore	20.41	20.78	26.18	0.77	1.95	1.68
Casing Fuse	1.22	7.36	8.63	0.01	0.91	0.71
Pull In Casing	22.78	46.93	79.01	0.80	4.72	4.21
Restoration	1.22	7.36	8.46	0.01	0.91	0.71
Off-Shore Installation						
Mobilization	56.76	28.90	41.86	2.24	3.18	2.63
Marine Survey	56.76	28.90	41.86	2.24	3.18	2.63
Route Clearing	56.76	28.90	41.86	2.24	3.18	2.63
Cable Delivery / Loading	4.86	18.15	50.34	0.07	1.92	1.84
Cable Laying	272.28	949.37	1,328.37	99.22	54.62	49.89
Cable Splicing	3.22	15.73	25.58	0.04	1.92	1.57

TABLE A-1

**Construction Emissions Summary**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Construction Phase	Maximum Daily Emissions (lbs/day) <sup>a</sup>					
	VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>
<b>Submarine Route Cable Installation Daily Maximum</b>	<b>272.28</b>	<b>949.37</b>	<b>1,328.37</b>	<b>99.22</b>	<b>74.18</b>	<b>49.89</b>
<b>Switchyard Construction</b>						
General Construction	0.03	1.05	0.17	0.00	0.19	0.05
Structure Foundation Excavation	1.11	4.50	6.74	0.01	1.10	0.68
Structure Delivery and Setup	1.62	5.95	12.01	0.02	0.54	0.53
Cable Installation	0.43	3.01	3.29	0.01	0.23	0.19
Cleaning and Landscaping	0.60	3.38	4.41	0.01	0.86	0.43
<b>Switchyard Construction Daily Maximum</b>	<b>1.64</b>	<b>7.01</b>	<b>12.18</b>	<b>0.02</b>	<b>1.28</b>	<b>0.73</b>
<b>Emissions by Month <sup>b</sup></b>						
March 2014	1.13	5.56	6.91	0.01	1.28	0.73
April 2014	1.13	5.56	6.91	0.01	1.28	0.73
May 2014	1.13	5.56	6.91	0.01	1.28	0.73
June 2014	1.64	7.01	12.18	0.02	1.28	0.73
July 2014	1.64	7.01	12.18	0.02	0.73	0.58
August 2014	1.64	7.01	12.18	0.02	0.73	0.58
September 2014	7.20	29.53	55.70	0.08	37.89	10.24
October 2014	27.62	50.31	81.87	0.84	74.91	18.55
November 2014	24.58	42.02	57.91	0.81	38.72	10.85
December 2014	26.95	68.16	110.75	0.85	41.49	13.38
January 2015	26.95	68.16	110.75	0.85	41.49	13.38
February 2015	24.58	42.02	57.91	0.81	73.80	17.48
March 2015	22.11	30.37	41.06	0.79	3.14	2.42
April 2015	24.48	56.52	93.89	0.83	5.90	4.95
May 2015	23.24	50.99	82.47	0.81	5.13	4.46
June 2015	57.39	33.33	46.44	2.25	4.22	3.12
July 2015	57.36	32.28	46.27	2.25	4.04	3.07
August 2015	57.36	32.28	46.27	2.25	4.04	3.07
September 2015	57.36	32.28	46.27	2.25	4.04	3.07
October 2015	272.28	949.37	1,328.37	99.22	54.62	49.89

TABLE A-1

**Construction Emissions Summary**

*PG&E: Embarcadero-Potrero 230 kV Transmission Project*

Construction Phase	Maximum Daily Emissions (lbs/day) <sup>a</sup>					
	VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>
November 2015	3.22	15.73	25.58	0.04	1.92	1.57
December 2015 <sup>d</sup>	--	--	--	--	--	--

Notes:

-- = Emissions not expected for this period.

<sup>a</sup> These are daily maximum emissions that only occur during very limited periods of the overall construction schedule.

<sup>b</sup> With the exception of General Construction activities during Switchyard Construction, maximum emissions are estimated assuming that activities within a phase will occur sequentially (i.e., not on the same day) but that phases may occur concurrently per Table 3, Construction Schedule. General Construction activities consider vehicles that will be used throughout Switchyard Construction regardless of the activity.

<sup>c</sup> Maximum daily emissions are provided in units of tons/day to allow comparison against the regional emissions inventory for the SFBAAB.

<sup>d</sup> As noted in Table A-4, Preliminary Construction Schedule, no significant construction activity is expected during Testing and Commissioning, which is the only activity scheduled for December 2015.



TABLE A-2

**Construction GHG Emissions Summary**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

<b>Project Emissions</b>				
<b>Construction Year</b>	<b>CO<sub>2</sub> Emissions (metric tons/year)<sup>a</sup></b>		<b>CO<sub>2</sub>e Emissions (metric tons/year)<sup>a, b</sup></b>	
Construction Year 2014	266.45		279.77	
Construction Year 2015	584.78		614.02	
<b>Maximum Annual Emissions</b>	<b>584.78</b>		<b>614.02</b>	
<b>Project Total Emissions</b>	<b>851.23</b>		<b>893.79</b>	
<b>Emissions by Phase</b>				
<b>Construction Phase</b>	<b>CO<sub>2</sub> Emissions (metric tons/phase)<sup>c</sup></b>	<b>CO<sub>2</sub>e Emissions (metric tons/phase)<sup>b, c</sup></b>	<b>2014 Duration (Months)</b>	<b>2015 Duration (Months)</b>
<b>Submarine Route Cable Installation</b>				
<b>Land Installation</b>				
Mobilization	10.64	11.18	1	0
Manholes	50.99	53.54	2	0
Trenching	111.43	117.00	2	2
Cable Installation	18.63	19.56	0	2
<b>HDD Drilling</b>				
HDD Send Pit Excavation	1.92	2.01	1	1
HDD Bore	60.47	63.49	2	2
Casing Fuse	10.91	11.46	1	1
Pull In Casing	27.23	28.59	1	3
Restoration	2.18	2.29	0	2
<b>Off-Shore Installation</b>				
Mobilization	45.20	47.46	0	2
Marine Survey	45.20	47.46	0	2
Route Clearing	45.20	47.46	0	2
Cable Delivery / Loading	6.34	6.66	0	1
Cable Laying	211.97	222.56	0	1
Cable Splicing	42.02	44.13	0	2
<b>Submarine Route Cable Installation Total</b>	<b>690.34</b>	<b>724.85</b>		
<b>2014 Total<sup>d</sup></b>	<b>160.80</b>	<b>168.84</b>		
<b>2015 Total<sup>d</sup></b>	<b>529.54</b>	<b>556.01</b>		
<b>Switchyard Construction</b>				
General Construction	29.31	30.77	10	6
Structure Foundation Excavation	17.80	18.69	4	0
Structure Delivery and Setup	55.67	58.45	5	0
Cable Installation	41.59	43.66	3	6
Cleaning and Landscaping	16.53	17.36	0	4
<b>Switchyard Construction Total</b>	<b>160.89</b>	<b>168.94</b>		
<b>2014 Total<sup>d</sup></b>	<b>105.65</b>	<b>110.93</b>		
<b>2015 Total<sup>d</sup></b>	<b>55.24</b>	<b>58.01</b>		

Notes:

<sup>a</sup> GHG emissions are evaluated on an annual basis. Therefore, emissions presented are the sum of all emissions occurring within a given year, regardless of whether an activity is occurring sequentially or concurrently during that year.

<sup>b</sup> Only CO<sub>2</sub> emission factors were available for all types of construction equipment utilized for this project. Emissions of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) from combustion sources are expected to be much lower than emissions of CO<sub>2</sub>, contributing in the range of 2 to 4 percent of the total carbon dioxide equivalent (CO<sub>2</sub>e) emissions. Therefore, the CO<sub>2</sub> emissions were conservatively increased by 5 percent to calculate CO<sub>2</sub>e emissions, accounting for the potential CH<sub>4</sub> and N<sub>2</sub>O emissions associated with construction activities.

<sup>c</sup> The emissions per phase are calculated based on the total duration of the construction phase, regardless of which month(s) or year(s) the phase occurs.

<sup>d</sup> Emissions were allotted to specific years based on the schedule depicted in Table A-4, Preliminary Construction Schedule. For example, General Construction (during Switchyard Construction) will occur over a 10-month period in 2014 and a 6-month period in 2015. Therefore, the 2014 emissions were estimated by multiplying the total General Construction emissions by the fraction 10/16.





TABLE A-3

## Construction GHG Emissions Summary with APM GHG-1

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Project Emissions with APM GHG-1				
Construction Year	CO <sub>2</sub> Emissions (metric tons/year) <sup>a</sup>		CO <sub>2</sub> e Emissions (metric tons/year) <sup>a, b</sup>	
Construction Year 2014	221.09		232.15	
Construction Year 2015	497.78		522.67	
<b>Maximum Annual Emissions</b>	<b>497.78</b>		<b>522.67</b>	
<b>Project Total Emissions</b>	<b>718.87</b>		<b>754.82</b>	
Emissions by Phase with APM GHG-1				
Construction Phase	CO <sub>2</sub> Emissions (metric tons/phase) <sup>c</sup>	CO <sub>2</sub> e Emissions (metric tons/phase) <sup>b, c</sup>	2014 Duration (Months)	2015 Duration (Months)
<b>Submarine Route Cable Installation</b>				
Land Installation				
Mobilization	9.42	9.89	1	0
Manholes	44.53	46.76	2	0
Trenching	87.17	91.53	2	2
Cable Installation	16.29	17.10	0	2
HDD Drilling				
HDD Send Pit Excavation	1.68	1.76	1	1
HDD Bore	46.61	48.94	2	2
Casing Fuse	9.50	9.97	1	1
Pull In Casing	21.70	22.79	1	3
Restoration	1.90	1.99	0	2
Off-Shore Installation				
Mobilization	38.41	40.33	0	2
Marine Survey	38.41	40.33	0	2
Route Clearing	38.41	40.33	0	2
Cable Delivery / Loading	5.83	6.12	0	1
Cable Laying	186.54	195.87	0	1
Cable Splicing	35.12	36.88	0	2
<b>Submarine Route Cable Installation Total</b>	<b>581.54</b>	<b>610.61</b>		
<b>2014 Total<sup>d</sup></b>	<b>131.86</b>	<b>138.46</b>		
<b>2015 Total<sup>d</sup></b>	<b>449.67</b>	<b>472.16</b>		
<b>Switchyard Construction</b>				
General Construction	29.31	30.77	10	6
Structure Foundation Excavation	14.58	15.31	4	0
Structure Delivery and Setup	44.77	47.01	5	0
Cable Installation	34.68	36.41	3	6
Cleaning and Landscaping	14.00	14.70	0	4
<b>Switchyard Construction Total</b>	<b>137.34</b>	<b>144.20</b>		
<b>2014 Total<sup>d</sup></b>	<b>89.23</b>	<b>93.69</b>		
<b>2015 Total<sup>d</sup></b>	<b>48.11</b>	<b>50.51</b>		

Notes:

<sup>a</sup> GHG emissions are evaluated on an annual basis. Therefore, emissions presented are the sum of all emissions occurring within a given year, regardless of whether an activity is occurring sequentially or concurrently during that year.

<sup>b</sup> Only CO<sub>2</sub> emission factors were available for all types of construction equipment utilized for this project. Emissions of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) from combustion sources are expected to be much lower than emissions of CO<sub>2</sub>, contributing in the range of 2 to 4 percent of the total carbon dioxide equivalent (CO<sub>2</sub>e) emissions. Therefore, the CO<sub>2</sub> emissions were conservatively increased by 5 percent to calculate CO<sub>2</sub>e emissions, accounting for the potential CH<sub>4</sub> and N<sub>2</sub>O emissions associated with construction activities.

<sup>c</sup> The emissions per phase are calculated based on the total duration of the construction phase, regardless of which month(s) or year(s) the phase occurs.

<sup>d</sup> Emissions were allotted to specific years based on the schedule depicted in Table A-4, Preliminary Construction Schedule. For example, General Construction (during Switchyard Construction) will occur over a 10-month period in 2014 and a 6-month period in 2015. Therefore, the 2014 emissions were estimated by multiplying the total General Construction emissions by the fraction 10/16.



TABLE A-4  
**Preliminary Construction Schedule**<sup>a</sup>  
 PG&E: Embarcadero-Potrero 230 kV Transmission Project

Construction Phase	Duration (Days)	2014												2015											
		3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
<b>Submarine Route Cable Installation</b> <sup>b</sup>																									
Land Installation	131	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		
Mobilization	12																								
Manholes	20																								
Trenching	65																								
Cable Installation	23																								
Terminations <sup>c</sup>	11																								
<b>HDD Drilling</b> <sup>d</sup>																									
HDD Send Pit Excavation	4																								
HDD Bore	40																								
Casing Fuse	20																								
Pull In Casing	20																								
Restoration	4																								
<b>Off-Shore Installation</b>																									
Mobilization	22																								
Marine Survey	22																								
Route Clearing	22																								
Cable Delivery / Loading	2																								
Cable Laying	7																								
Cable Splicing	22																								
Testing and Commissioning <sup>e</sup>	22																								
<b>Switchyard Construction</b> <sup>f</sup>																									
General Construction	325																								
Structure Foundation Excavation	60																								
Structure Delivery and Setup	80																								
Cable Installation	170																								
Cleaning and Landscaping	60																								

Notes:

<sup>a</sup> This schedule depicts the periods during which construction activities could occur. It is expected that construction activities will actually occur intermittently within the identified periods. The final project construction schedule can only be determined once the Commission's staff issue a full Notice to Proceed, all applicant-proposed measures and any other environmental mitigation measures have been taken into account, materials needed for construction have been delivered and are ready for installation, and PG&E's contractors have mobilized and are ready to initiate construction.

<sup>b</sup> The Submarine Route Cable Installation schedule was provided by A. Billot, PG&E on 7/2/2012. Durations for each specific activity were discussed with or provided by L. Rogers, CH2M HILL.

<sup>c</sup> No specific equipment has been identified for Terminations; instead, it was assumed that termination activities would be captured during Switchyard Construction.

<sup>d</sup> Durations account for the consecutive construction of two HDDs, provided by L. Rogers on 5/31/2012, assuming that all HDD Drilling activities would be complete by the start of Cable Laying activities.

<sup>e</sup> No significant construction activity is expected during Testing and Commissioning.

<sup>f</sup> The Switchyard Construction duration and schedule were provided by J. Boggess, PG&E on 7/23/2012. General Construction activities would occur throughout Switchyard Construction.



TABLE A-5

**Submarine Route Cable Installation Construction Emissions**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>a</sup>	Miles per Day <sup>b</sup>	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub> <sup>d</sup>	PM <sub>2.5</sub> <sup>d</sup>	CO <sub>2</sub>
<b>Land Installation</b>												
<b>Mobilization<sup>e</sup></b>												
Rigging Truck	Heavy-duty Diesel	1	12	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.126
Mechanics Truck	Medium-duty Diesel	1	12	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.108
Small Mobile Crane	Construction Equipment	1	12	12	--	1.174	3.376	10.896	0.0142	0.379	0.379	7.319
Shop Van	Light-duty Auto	2	12	--	6	0.001	0.037	0.003	0.0001	0.009	0.002	0.042
2-Ton Flat Bed Truck	Heavy-duty Diesel	1	12	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.126
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	30	12	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	2.921
<b>Manholes<sup>e, g</sup></b>												
Crawler Backhoe	Construction Equipment	2	20	12	--	2.918	11.540	17.457	0.0167	1.502	1.502	14.316
Cement Truck	Heavy-duty Diesel	4	20	--	6	0.026	0.131	0.457	0.0009	0.034	0.019	0.842
Dump Truck	Heavy-duty Diesel	4	20	--	40	0.174	0.872	3.050	0.0060	0.226	0.124	5.611
Mobile Crane	Construction Equipment	2	20	12	--	2.347	6.753	21.792	0.0284	0.757	0.757	24.398
Transport Truck	Heavy/Medium-duty Diesel	2	20	--	14.6	0.020	0.119	0.430	0.0010	0.036	0.019	0.951
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	30	20	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	4.869
Fugitive Dust <sup>h, i</sup>	Offsite Cut / Fill	1,412	20	--	--	--	--	--	--	31.059	6.460	--
Fugitive Dust <sup>j</sup>	Disturbed Surface	0.3	20	--	--	--	--	--	--	3.000	0.624	--
<b>Trenching<sup>e</sup></b>												
Crawler Backhoe	Construction Equipment	1	65	12	--	1.459	5.770	8.729	0.0083	0.751	0.751	23.263
Generator Sets <sup>k</sup>	Construction Equipment	3	65	3	--	0.889	4.356	6.348	0.0074	0.475	0.475	20.665
Cement Truck	Heavy-duty Diesel	2	65	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.368
Dump Truck	Heavy-duty Diesel	2	65	--	40	0.087	0.436	1.525	0.0030	0.113	0.062	9.118
Mobile Crane	Construction Equipment	1	65	12	--	1.174	3.376	10.896	0.0142	0.379	0.379	39.646
Transport Truck	Heavy/Medium-duty Diesel	1	65	--	14.6	0.010	0.059	0.215	0.0005	0.018	0.009	1.546
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	30	65	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	15.824
Fugitive Dust <sup>h, i</sup>	Offsite Cut / Fill	4,588	65	--	--	--	--	--	--	31.059	6.460	--
Fugitive Dust <sup>j</sup>	Disturbed Surface	0.3	65	--	--	--	--	--	--	3.000	0.624	--
<b>Cable Installation<sup>e</sup></b>												
Cable Puller Truck	Medium-duty Diesel	1	23	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.208
Wench Truck	Heavy-duty Diesel	1	23	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.242
1-Ton Truck	Medium-duty Diesel	2	23	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	0.415
Mobile Crane	Construction Equipment	1	23	12	--	1.174	3.376	10.896	0.0142	0.379	0.379	14.029
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	20	23	--	24.8	0.049	2.075	0.220	0.0038	0.363	0.101	3.733
<b>HDD Drilling<sup>l</sup></b>												
<b>HDD Send Pit Excavation</b>												
Crawler Backhoe	Construction Equipment	1	4	12	--	1.459	5.770	8.729	0.0083	0.751	0.751	1.432
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	15	4	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	0.487
Fugitive Dust <sup>h</sup>	Offsite Cut / Fill	300	4	--	--	--	--	--	--	33.000	6.864	--
Fugitive Dust <sup>j</sup>	Disturbed Surface	0.3	4	--	--	--	--	--	--	3.000	0.624	--

TABLE A-5

**Submarine Route Cable Installation Construction Emissions**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>a</sup>	Miles per Day <sup>b</sup>	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub> <sup>d</sup>	PM <sub>2.5</sub> <sup>d</sup>	CO <sub>2</sub>
<b>HDD Bore</b>												
Small Motorcraft Boat <sup>m</sup>	Marine Vessel	2	40	6	--	18.900	8.770	13.860	0.7447	0.908	0.836	24.690
Bore / Drill Rig	Construction Equipment	1	40	12	--	0.490	5.615	5.099	0.0098	0.244	0.244	16.776
Generator Sets <sup>k</sup>	Construction Equipment	1	40	10	--	0.988	4.840	7.053	0.0082	0.528	0.528	14.130
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	15	40	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	4.869
<b>Casing Fuse</b>												
Generator Sets	Construction Equipment	1	20	12	--	1.186	5.808	8.464	0.0099	0.633	0.633	8.478
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	15	20	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	2.434
<b>Pull In Casing</b>												
Small Motorcraft Boat <sup>m</sup>	Marine Vessel	2	20	6	--	18.900	8.770	13.860	0.7447	0.908	0.836	12.345
Barge <sup>n</sup>	Marine Vessel	1	2	1	--	2.327	26.918	50.782	0.0400	2.692	2.476	3.473
Generator Sets	Construction Equipment	1	20	12	--	1.186	5.808	8.464	0.0099	0.633	0.633	8.478
Tug Boat <sup>n</sup>	Marine Vessel	1	2	1	--	0.335	3.875	5.739	0.0058	0.209	0.193	0.500
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	15	20	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	2.434
<b>Restoration</b>												
Generator Sets	Construction Equipment	1	4	12	--	1.186	5.808	8.464	0.0099	0.633	0.633	1.696
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	15	4	--	24.8	0.037	1.556	0.000	0.0029	0.272	0.076	0.487
<b>Off-Shore Installation</b>												
<b>Mobilization<sup>o</sup></b>												
Small Motorcraft Boat	Marine Vessel	3	22	12	--	56.700	26.309	41.580	2.2340	2.725	2.507	40.739
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Marine Survey<sup>o</sup></b>												
Small Motorcraft Boat	Marine Vessel	3	22	12	--	56.700	26.309	41.580	2.2340	2.725	2.507	40.739
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Route Clearing<sup>o</sup></b>												
Small Motorcraft Boat	Marine Vessel	3	22	12	--	56.700	26.309	41.580	2.2340	2.725	2.507	40.739
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Cable Delivery / Loading<sup>p</sup></b>												
Mobile Crane	Construction Equipment	1	2	24	--	2.347	6.753	21.792	0.028	0.757	0.757	2.440
Generator - Small	Construction Equipment	1	2	24	--	0.712	3.487	5.081	0.006	0.380	0.380	0.509
Generator - Large	Construction Equipment	1	2	24	--	1.763	7.309	22.762	0.032	0.657	0.657	3.257
Transport Truck <sup>q</sup>	Heavy/Medium-duty Diesel	3	1	--	15	0.031	0.183	0.663	0.0015	0.056	0.029	0.073
Worker Commutes	Light-duty Auto/Truck	4	2	--	24.8	0.010	0.415	0.044	0.0008	0.073	0.020	0.065
<b>Cable Laying<sup>r</sup></b>												
Tug Boat - Large	Marine Vessel	1	2	24	--	25.380	293.651	434.937	0.437	15.873	14.603	37.885
Tug Boat - Small	Marine Vessel	1	2	24	--	10.152	117.460	173.975	0.175	6.349	5.841	15.154
Barge - Steering Engine	Marine Vessel	1	4.5	24	--	1.778	5.873	7.428	1.476	0.317	0.292	1.690
Barge - Anchor Engine	Marine Vessel	1	4.5	24	--	4.742	15.661	19.808	3.936	0.847	0.779	4.507
Jet Plow Engine	Marine Vessel	4	4.5	24	--	106.704	352.381	445.677	88.560	19.048	17.524	101.407
Tug Boat - Large	Marine Vessel	1	4.5	6	--	6.345	73.413	108.734	0.109	3.968	3.651	21.310

TABLE A-5

**Submarine Route Cable Installation Construction Emissions**

PG&E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>a</sup>	Miles per Day <sup>b</sup>	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub> <sup>d</sup>	PM <sub>2.5</sub> <sup>d</sup>	CO <sub>2</sub>
Tug Boat - Small	Marine Vessel	1	4.5	6	--	2.538	29.365	43.494	0.044	1.587	1.460	8.524
Generator - Small	Construction Equipment	1	4.5	24	--	0.712	3.487	5.081	0.006	0.380	0.380	1.145
Generator - Large	Construction Equipment	1	4.5	6	--	0.441	1.827	5.691	0.008	0.164	0.164	1.832
Small Motorcraft Boat <sup>s</sup>	Marine Vessel	3	4.5	24	--	113.400	52.618	83.160	4.468	5.451	5.015	16.666
Worker Commutes	Light-duty Auto/Truck	35	6.5	--	24.8	0.086	3.631	0.385	0.0067	0.635	0.177	1.846
Cable Splicing <sup>e</sup>												
Cable Puller Truck	Medium-duty Diesel	1	22	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.199
Wench Truck	Heavy-duty Diesel	1	22	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.231
1-Ton Truck	Medium-duty Diesel	2	22	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	0.397
Mobile Crane	Construction Equipment	1	22	12	--	1.174	3.376	10.896	0.0142	0.379	0.379	13.419
Generator Sets <sup>k</sup>	Construction Equipment	2	33	10	--	1.976	9.680	14.107	0.0164	1.055	1.055	23.315
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463

Notes:

-- = Parameter not required for computing emissions.

<sup>a</sup> Section 2.6, Construction, of the *Embarcadero-Potrero 230 kV Transmission Project PEA* indicates that construction activities will occur between the hours of 7 am and 8 pm. Allowing for a 1-hour break during each day, assumed equipment would operate 12 hours per day unless otherwise noted.

<sup>b</sup> Miles per Day taken as the CalEEMod defaults for the SFBAAB except for project-specific vehicles, which were assumed to travel to-and-from Embarcadero Substation and Potrero Switchyard once per day (3 miles one-way).

<sup>c</sup> The following conversion factors were used to estimate emissions:

1 lb =	453.6	g
1 metric ton =	1,000,000	g
1 ton =	2,000	lbs

<sup>d</sup> As appropriate, PM<sub>10</sub> and PM<sub>2.5</sub> emissions include paved road fugitive dust emissions associated with onroad travel.

<sup>e</sup> Unless otherwise noted, quantities taken from Table D.10-8 of the *Jefferson-Martin 230 kV Transmission Line Project Final EIR* (CH2M HILL, 2003).

<sup>f</sup> Unless otherwise noted, the number of worker commutes were obtained from Section 2.6.5, Construction Workforce and Equipment, of the *Embarcadero-Potrero 230 kV Transmission Project PEA*.

<sup>g</sup> Quantities multiplied by 2 to account for 2 crews completing the construction activities.

<sup>h</sup> Fugitive Dust from cut / fill was only considered during excavation. Offsite cut / fill was assumed for all cut / fill excavation activities as the soil would be hauled offsite for disposal, per Section 2.6.2, Underground Transmission Line Construction, of the *Embarcadero-Potrero 230 kV Transmission Project PEA*.

<sup>i</sup> Since only a total volume was provided for land installation, the volumes per manholes and trenching were proportioned based on the activity duration:

Phase	Duration (days)	Volume (cy)
Total	85	6,000
Manholes	20	1,412
Trenching	65	4,588

<sup>j</sup> Fugitive Dust from disturbed surfaces was only considered during phases where excavation was planned. Per Section 2.6.2, Underground Transmission Line Construction, of the *Embarcadero-Potrero 230 kV Transmission Project PEA*, trenching could extend 0.7 miles at a width of 43 inches, for a total area of 0.3 acres. It was conservatively assumed that this entire area could be disturbed during each day of excavation activities.

<sup>k</sup> Quantities and operational hours per day provided by D. Turkington on 11/26/2012 and A. Billot on 11/27/2012, as clarified by A. Billot on 11/28/2012. With the exception of the Cable Splicing generator sets, number of days used were assumed to align with the construction phase duration. Because the specific generators, expected to be much smaller than 300 hp, have not yet been identified, emissions were estimated assuming the default horsepower and load factor from the *CalEEMod User's Guide* (Environ, 2011).

<sup>l</sup> Unless otherwise noted, quantities obtained from J. Liang during a site visit conducted 4/29/2012 or provided by L. Rogers on 5/31/2012.

TABLE A-5

**Submarine Route Cable Installation Construction Emissions**

PG&E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>a</sup>	Miles per Day <sup>b</sup>	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub> <sup>d</sup>	PM <sub>2.5</sub> <sup>d</sup>	CO <sub>2</sub>

<sup>m</sup> Assumed that small motorcraft boats used during HDD Drilling activities would be used no more than 6 hours per day.

<sup>n</sup> Assumed that the tug boat will only be used for one hour on the first and last days of Pull In Casing activities to position and remove the barge, respectively. Similarly, the barge would only be operational while being positioned; it will be anchored for the remainder of Pull In Casing activities.

<sup>o</sup> Quantities provided by L. Rogers on 5/9/2012.

<sup>p</sup> Quantities provided by R. Rosenqvist/ABB on 6/18/2012; assumed the number of workers during Cable Delivery / Loading activities was equal to the quantity of on-shore workers provided.

<sup>q</sup> Assume transport trucks haul the cable from the Port of Oakland to the project site. It was assumed that only one truck would be needed per cable.

<sup>r</sup> Unless otherwise noted, quantities provided by R. Rosenqvist/ABB on 6/18/2012. Some interpretations of the information are explained below:

- Tug Boats are used continuously during mobilization / demobilization (one day each) but only 15 minutes per hour during the actual Cable Laying activities.
- Cable Laying activities last 36 hours per cable; there will be 3 cables laid as part of this project.
- The Large Generator only operates when the barge is moving; assumed this coincides with anchor movement by the Tug Boats.
- Number of workers considered daytime marine and on-shore workers as well as nighttime marine workers.

<sup>s</sup> Quantities interpreted from the *Embarcadero to Potrero ZA-1 230 kV Underground Transmission Project Feasibility Study* (Black & Veatch, 2012). Assumed worker transport to the Barge was only necessary during actual Cable Laying activities.



TABLE A-6

**Submarine Route Cable Installation Construction Emissions with APM GHG-1<sup>a</sup>**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>b</sup>	Miles per Day	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>	
						VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>	
<b>Land Installation</b>													
<b>Mobilization</b>													
Rigging Truck	Heavy-duty Diesel	1	12	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.126	
Mechanics Truck	Medium-duty Diesel	1	12	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.108	
Small Mobile Crane	Construction Equipment	1	12	10	--	0.978	2.814	9.080	0.0118	0.315	0.315	6.099	
Shop Van	Light-duty Auto	2	12	--	6	0.001	0.037	0.003	0.0001	0.009	0.002	0.042	
2-Ton Flat Bed Truck	Heavy-duty Diesel	1	12	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.126	
Worker Commutes	Light-duty Auto/Truck	30	12	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	2.921	
<b>Manholes</b>													
Crawler Backhoe	Construction Equipment	2	20	10	--	2.432	9.617	14.548	0.0139	1.252	1.252	11.930	
Cement Truck	Heavy-duty Diesel	4	20	--	6	0.026	0.131	0.457	0.0009	0.034	0.019	0.842	
Dump Truck	Heavy-duty Diesel	4	20	--	40	0.174	0.872	3.050	0.0060	0.226	0.124	5.611	
Mobile Crane	Construction Equipment	2	20	10	--	1.956	5.627	18.160	0.0237	0.631	0.631	20.331	
Transport Truck	Heavy/Medium-duty Diesel	2	20	--	14.6	0.020	0.119	0.430	0.0010	0.036	0.019	0.951	
Worker Commutes	Light-duty Auto/Truck	30	20	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	4.869	
Fugitive Dust	Offsite Cut / Fill	1,412	20	--	--	--	--	--	--	31.059	6.460	--	
Fugitive Dust	Disturbed Surface	0.3	20	--	--	--	--	--	--	3.000	0.624	--	
<b>Trenching</b>													
Crawler Backhoe	Construction Equipment	1	65	10	--	1.216	4.808	7.274	0.0069	0.626	0.626	19.386	
Generator Sets	Construction Equipment	3	65	1	--	0.296	1.452	2.116	0.0025	0.158	0.158	6.888	
Cement Truck	Heavy-duty Diesel	2	65	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.368	
Dump Truck	Heavy-duty Diesel	2	65	--	40	0.087	0.436	1.525	0.0030	0.113	0.062	9.118	
Mobile Crane	Construction Equipment	1	65	10	--	0.978	2.814	9.080	0.0118	0.315	0.315	33.039	
Transport Truck	Heavy/Medium-duty Diesel	1	65	--	14.6	0.010	0.059	0.215	0.0005	0.018	0.009	1.546	
Worker Commutes	Light-duty Auto/Truck	30	65	--	24.8	0.073	3.112	0.330	0.0057	0.545	0.152	15.824	
Fugitive Dust	Offsite Cut / Fill	4,588	65	--	--	--	--	--	--	31.059	6.460	--	
Fugitive Dust	Disturbed Surface	0.3	65	--	--	--	--	--	--	3.000	0.624	--	
<b>Cable Installation</b>													
Cable Puller Truck	Medium-duty Diesel	1	23	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.208	
Wench Truck	Heavy-duty Diesel	1	23	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.242	
1-Ton Truck	Medium-duty Diesel	2	23	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	0.415	
Mobile Crane	Construction Equipment	1	23	10	--	0.978	2.814	9.080	0.0118	0.315	0.315	11.691	
Worker Commutes	Light-duty Auto/Truck	20	23	--	24.8	0.049	2.075	0.220	0.0038	0.363	0.101	3.733	
<b>HDD Drilling</b>													
<b>HDD Send Pit Excavation</b>													
Crawler Backhoe	Construction Equipment	1	4	10	--	1.216	4.808	7.274	0.0069	0.626	0.626	1.193	
Worker Commutes	Light-duty Auto/Truck	15	4	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	0.487	
Fugitive Dust	Offsite Cut / Fill	300	4	--	--	--	--	--	--	33.000	6.864	--	
Fugitive Dust	Disturbed Surface	0.3	4	--	--	--	--	--	--	3.000	0.624	--	

TABLE A-6

**Submarine Route Cable Installation Construction Emissions with APM GHG-1<sup>a</sup>**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>b</sup>	Miles per Day	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
<b>HDD Bore</b>												
Small Motorcraft Boat	Marine Vessel	2	40	4	--	12.600	5.846	9.240	0.4964	0.606	0.557	16.460
Bore / Drill Rig	Construction Equipment	1	40	10	--	0.408	4.679	4.249	0.0081	0.203	0.203	13.980
Generator Sets	Construction Equipment	1	40	8	--	0.790	3.872	5.643	0.0066	0.422	0.422	11.304
Worker Commutes	Light-duty Auto/Truck	15	40	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	4.869
<b>Casing Fuse</b>												
Generator Sets	Construction Equipment	1	20	10	--	0.988	4.840	7.053	0.0082	0.528	0.528	7.065
Worker Commutes	Light-duty Auto/Truck	15	20	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	2.434
<b>Pull In Casing</b>												
Small Motorcraft Boat	Marine Vessel	2	20	4	--	12.600	5.846	9.240	0.4964	0.606	0.557	8.230
Barge	Marine Vessel	1	2	1	--	2.327	26.918	50.782	0.0400	2.692	2.476	3.473
Generator Sets	Construction Equipment	1	20	10	--	0.988	4.840	7.053	0.0082	0.528	0.528	7.065
Tug Boat	Marine Vessel	1	2	1	--	0.335	3.875	5.739	0.0058	0.209	0.193	0.500
Worker Commutes	Light-duty Auto/Truck	15	20	--	24.8	0.037	1.556	0.165	0.0029	0.272	0.076	2.434
<b>Restoration</b>												
Generator Sets	Construction Equipment	1	4	10	--	0.988	4.840	7.053	0.0082	0.528	0.528	1.413
Worker Commutes	Light-duty Auto/Truck	15	4	--	24.8	0.037	1.556	0.000	0.0029	0.272	0.076	0.487
<b>Off-Shore Installation</b>												
<b>Mobilization</b>												
Small Motorcraft Boat	Marine Vessel	3	22	10	--	47.250	21.924	34.650	1.8617	2.271	2.089	33.949
Worker Commutes	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Marine Survey</b>												
Small Motorcraft Boat	Marine Vessel	3	22	10	--	47.250	21.924	34.650	1.8617	2.271	2.089	33.949
Worker Commutes	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Route Clearing</b>												
Small Motorcraft Boat	Marine Vessel	3	22	10	--	47.250	21.924	34.650	1.8617	2.271	2.089	33.949
Worker Commutes	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463
<b>Cable Delivery / Loading</b>												
Mobile Crane	Construction Equipment	1	2	22	--	2.152	6.190	19.976	0.026	0.694	0.694	2.236
Generator - Small	Construction Equipment	1	2	22	--	0.652	3.196	4.657	0.005	0.348	0.348	0.467
Generator - Large	Construction Equipment	1	2	22	--	1.616	6.700	20.866	0.029	0.602	0.602	2.986
Transport Truck	Heavy/Medium-duty Diesel	3	1	--	15	0.031	0.183	0.663	0.0015	0.056	0.029	0.073
Worker Commutes	Light-duty Auto/Truck	4	2	--	24.8	0.010	0.415	0.044	0.0008	0.073	0.020	0.065
<b>Cable Laying</b>												
Tug Boat - Large	Marine Vessel	1	2	22	--	23.265	269.180	398.693	0.400	14.550	13.386	34.728
Tug Boat - Small	Marine Vessel	1	2	22	--	9.306	107.672	159.477	0.160	5.820	5.354	13.891
Barge - Steering Engine	Marine Vessel	1	4.5	22	--	1.630	5.384	6.809	1.353	0.291	0.268	1.549
Barge - Anchor Engine	Marine Vessel	1	4.5	22	--	4.347	14.356	18.157	3.608	0.776	0.714	4.131
Jet Plow Engine	Marine Vessel	4	4.5	22	--	97.812	323.016	408.537	81.180	17.460	16.063	92.956
Tug Boat - Large	Marine Vessel	1	4.5	4	--	4.230	48.942	72.490	0.073	2.646	2.434	14.207
Tug Boat - Small	Marine Vessel	1	4.5	4	--	1.692	19.577	28.996	0.029	1.058	0.974	5.683

TABLE A-6

**Submarine Route Cable Installation Construction Emissions with APM GHG-1<sup>a</sup>**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>b</sup>	Miles per Day	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
						VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
Generator - Small	Construction Equipment	1	4.5	22	--	0.652	3.196	4.657	0.005	0.348	0.348	1.050
Generator - Large	Construction Equipment	1	4.5	4	--	0.294	1.218	3.794	0.005	0.110	0.110	1.221
Small Motorcraft Boat	Marine Vessel	3	4.5	22	--	103.950	48.233	76.230	4.096	4.997	4.597	15.277
Worker Commutes	Light-duty Auto/Truck	35	6.5	--	24.8	0.086	3.631	0.385	0.0067	0.635	0.177	1.846
<b>Cable Splicing</b>												
Cable Puller Truck	Medium-duty Diesel	1	22	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.199
Wench Truck	Heavy-duty Diesel	1	22	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.231
1-Ton Truck	Medium-duty Diesel	2	22	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	0.397
Mobile Crane	Construction Equipment	1	22	10	--	0.978	2.814	9.080	0.0118	0.315	0.315	11.182
Generator Sets	Construction Equipment	2	33	8	--	1.581	7.744	11.285	0.0132	0.844	0.844	18.652
Worker Commutes	Light-duty Auto/Truck	25	22	--	24.8	0.061	2.593	0.275	0.0048	0.454	0.126	4.463

## Notes:

-- = Parameter not required for computing emissions.

<sup>a</sup> Refer to the notes of Table 5, Submarine Route Cable Installation Construction Emissions, for assumptions and data sources for information presented in this table.<sup>b</sup> Hours of operation for all construction equipment, except the barge and tug boat utilized during the Pull In Casing Phase, were reduced by 2 hours per day to minimize equipment idling time per APM GHG-1. The other reduction measures of APM GHG-1 were not quantified as their extent of implementation is currently unknown.<sup>c</sup> The following conversion factors were used to estimate emissions:

1 lb =	453.6	g
1 metric ton =	1,000,000	g
1 ton =	2,000	lbs



TABLE A-7

**Switchyard Construction Emissions**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List <sup>a</sup>	Equipment / Vehicle Type	Quantity <sup>a</sup>	Number of Days Used <sup>a</sup>	Hours per Day <sup>b</sup>	Usage per Day (%) <sup>a</sup>	Miles per Day <sup>c</sup>	Emissions (lbs/day) <sup>d</sup>						Emissions (metric tons/phase) <sup>d</sup>
							VOC	CO	NOx	SOx	PM <sub>10</sub> <sup>e</sup>	PM <sub>2.5</sub> <sup>e</sup>	CO <sub>2</sub>
<b>General Construction</b>													
Mechanics Truck	Medium-duty Diesel	1	325	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	2.935
Worker Commutes <sup>f</sup>	Light-duty Auto/Truck	10	325	--	--	24.8	0.024	1.037	0.110	0.0019	0.182	0.051	26.373
<b>Structure Foundation Excavation</b>													
3/4-Ton Pick-up Truck	Light-duty Truck	4	60	--	--	6	0.003	0.126	0.014	0.0002	0.018	0.005	0.524
1-Ton Truck	Medium-duty Diesel	1	60	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.542
Crawler Backhoe	Construction Equipment	1	60	10	90%	--	1.094	4.328	6.546	0.0062	0.563	0.563	16.105
Cement Truck	Heavy-duty Diesel	1	60	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.631
Fugitive Dust <sup>g</sup>	Disturbed Surface	3	60	--	--	--	--	--	--	--	0.500	0.104	--
<b>Structure Delivery and Setup</b>													
3/4-Ton Pick-up Truck	Light-duty Truck	2	80	--	--	6	0.002	0.063	0.007	0.0001	0.009	0.003	0.350
Manlift	Construction Equipment	1	80	10	80%	--	0.417	1.341	1.404	0.0019	0.111	0.111	5.688
Forklift	Construction Equipment	1	80	10	60%	--	0.311	1.983	2.309	0.0035	0.127	0.127	12.193
Boom Truck	Heavy-duty Diesel	1	80	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.842
Mobile Crane	Construction Equipment	1	80	10	90%	--	0.880	2.532	8.172	0.0106	0.284	0.284	36.597
<b>Cable Installation</b>													
Rigging Truck	Heavy-duty Diesel	1	170	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	1.788
Forklift	Construction Equipment	1	170	10	80%	--	0.415	2.643	3.079	0.0047	0.169	0.169	34.548
1-Ton Truck	Medium-duty Diesel	1	170	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	1.535
3/4-Ton Pick-up Truck	Light-duty Truck	10	170	--	--	6	0.008	0.315	0.036	0.0005	0.044	0.013	3.714
<b>Cleanup and Landscaping</b>													
2-Ton Flat Bed Truck	Heavy-duty Diesel	2	60	--	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.262
3/4-Ton Pick-up Truck	Light-duty Truck	2	60	--	--	6	0.002	0.063	0.007	0.0001	0.009	0.003	0.262
1-Ton Truck	Medium-duty Diesel	2	60	--	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	1.084
Small Backhoe	Construction Equipment	1	60	10	90%	--	0.570	3.149	3.823	0.0049	0.302	0.302	12.659
Cement Truck	Heavy-duty Diesel	2	60	--	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.262
Fugitive Dust <sup>g</sup>	Disturbed Surface	3	60	--	--	--	--	--	--	--	0.500	0.104	--

## Notes:

-- = Parameter not required for computing emissions.

<sup>a</sup> Equipment / Vehicle List, Quantities, Number of Days Used, and Usage per Day provided by J. Boggess, PG&E on 7/25/2012. Note that the Usage per Day is only necessary for the construction equipment which would operate on an hourly basis; vehicles would make specific trips each day per the assumptions noted below.<sup>b</sup> Hours per day provided by D. Solhtalab, PG&E on 7/24/2012.<sup>c</sup> Miles per Day taken as the CalEEMod defaults for the SFBAAB except for project-specific vehicles, which were assumed to travel to-and-from Embarcadero Substation and Potrero Switchyard once per day (3 miles one-way).<sup>d</sup> The following conversion factors were used to estimate emissions:

1 lb =	453.6	g
1 metric ton =	1,000,000	g
1 ton =	2,000	lbs

<sup>e</sup> PM<sub>10</sub> and PM<sub>2.5</sub> emissions include paved road fugitive dust emissions associated with onroad travel.<sup>f</sup> Estimated the number of worker commutes based on the maximum number of 3/4-Ton Pick-up Trucks in operation during any phase of Switchyard Construction.<sup>g</sup> Per Section 2.4.4, Potrero Switchyard, of the *Embarcadero-Potrero 230 kV Transmission Project PEA*, the switchyard is expected to be constructed on two parcels of land (one 329 feet x 200 feet and the other 240 feet x 270 feet for a total of 3 acres). It was assumed these entire areas would be disturbed during both the excavation and site preparation phases, thus contributing to fugitive dust.



TABLE A-8

**Switchyard Construction Emissions with APM GHG-1<sup>a</sup>**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Equipment / Vehicle List	Equipment / Vehicle Type	Quantity	Number of Days Used	Hours per Day <sup>b</sup>	Usage per Day (%)	Miles per Day	Emissions (lbs/day) <sup>c</sup>						Emissions (metric tons/phase) <sup>c</sup>
							VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
General Construction													
Mechanics Truck	Medium-duty Diesel	1	325	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	2.935
Worker Commutes	Light-duty Auto/Truck	10	325	--	--	24.8	0.024	1.037	0.110	0.0019	0.182	0.051	26.373
Structure Foundation Excavation													
3/4-Ton Pick-up Truck	Light-duty Truck	4	60	--	--	6	0.003	0.126	0.014	0.0002	0.018	0.005	0.524
1-Ton Truck	Medium-duty Diesel	1	60	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	0.542
Crawler Backhoe	Construction Equipment	1	60	8	90%	--	0.875	3.462	5.237	0.0050	0.451	0.451	12.884
Cement Truck	Heavy-duty Diesel	1	60	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.631
Fugitive Dust	Disturbed Surface	3	60	--	--	--	--	--	--	--	0.500	0.104	--
Structure Delivery and Setup													
3/4-Ton Pick-up Truck	Light-duty Truck	2	80	--	--	6	0.002	0.063	0.007	0.0001	0.009	0.003	0.350
Manlift	Construction Equipment	1	80	8	80%	--	0.333	1.073	1.123	0.0015	0.089	0.089	4.551
Forklift	Construction Equipment	1	80	8	60%	--	0.249	1.586	1.847	0.0028	0.101	0.101	9.755
Boom Truck	Heavy-duty Diesel	1	80	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	0.842
Mobile Crane	Construction Equipment	1	80	8	90%	--	0.704	2.026	6.538	0.0085	0.227	0.227	29.277
Cable Installation													
Rigging Truck	Heavy-duty Diesel	1	170	--	--	6	0.007	0.033	0.114	0.0002	0.008	0.005	1.788
Forklift	Construction Equipment	1	170	8	80%	--	0.332	2.115	2.463	0.0038	0.135	0.135	27.638
1-Ton Truck	Medium-duty Diesel	1	170	--	--	6	0.002	0.016	0.063	0.0002	0.006	0.003	1.535
3/4-Ton Pick-up Truck	Light-duty Truck	10	170	--	--	6	0.008	0.315	0.036	0.0005	0.044	0.013	3.714
Cleanup and Landscaping													
2-Ton Flat Bed Truck	Heavy-duty Diesel	2	60	--	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.262
3/4-Ton Pick-up Truck	Light-duty Truck	2	60	--	--	6	0.002	0.063	0.007	0.0001	0.009	0.003	0.262
1-Ton Truck	Medium-duty Diesel	2	60	--	--	6	0.004	0.032	0.125	0.0004	0.013	0.006	1.084
Small Backhoe	Construction Equipment	1	60	8	90%	--	0.456	2.520	3.058	0.0039	0.242	0.242	10.127
Cement Truck	Heavy-duty Diesel	2	60	--	--	6	0.013	0.065	0.229	0.0004	0.017	0.009	1.262
Fugitive Dust	Disturbed Surface	3	60	--	--	--	--	--	--	--	0.500	0.104	--

## Notes:

-- = Parameter not required for computing emissions.

<sup>a</sup> Refer to the notes of Table 7, Switchyard Construction Emissions, for assumptions and data sources for information presented in this table.<sup>b</sup> Hours of operation for all construction equipment were reduced by 2 hours per day to minimize equipment idling time per APM GHG-1. The other reduction measures of APM GHG-1 were not quantified as their extent of implementation is currently unknown.<sup>c</sup> The following conversion factors were used to estimate emissions:

1 lb =	453.6	g
1 metric ton =	1,000,000	g
1 ton =	2,000	lbs





TABLE A-9

**Marine Emission Factors**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Marine Vessel	Engine Rating		Load Factor <sup>c</sup>	Emission Factors (g/hp-hr)						
	hp <sup>a</sup>	kW <sup>b</sup>		VOC <sup>d</sup>	CO <sup>d,e</sup>	NOx <sup>d,e</sup>	SOx <sup>d</sup>	PM <sub>10</sub> <sup>d,e</sup>	PM <sub>2.5</sub> <sup>f</sup>	CO <sub>2</sub> <sup>d</sup>
Small Motorcraft Boat <sup>g</sup>	140	104	0.75	6.80	3.2	4.99	0.268	0.33	0.30	489.9
Barge <sup>h</sup>	6,000	4,478	0.55	0.32	3.7	6.98	0.006	0.37	0.34	526.2
Barge - Steering Engine <sup>i</sup>	200	149	0.15	1.12	3.7	4.68	0.930	0.20	0.18	521.6
Barge - Anchor Engine <sup>i</sup>	200	149	0.40	1.12	3.7	4.68	0.930	0.20	0.18	521.6
Jet Plow Engine <sup>i</sup>	500	373	0.90	1.12	3.7	4.68	0.930	0.20	0.18	521.6
Tug Boat - Large <sup>h</sup>	3,000	2,239	0.50	0.32	3.7	5.48	0.006	0.20	0.18	526.2
Tug Boat - Small <sup>h</sup>	1,200	896	0.50	0.32	3.7	5.48	0.006	0.20	0.18	526.2
Tug Boat <sup>h</sup>	950	709	0.50	0.32	3.7	5.48	0.006	0.20	0.18	526.2

Notes:

<sup>a</sup> Horsepower (hp) engine ratings taken from the following sources:

Horsepower of a midrange large outboard motor; conservatively used the upper range (AFA, 2012);

Small Motorcraft Boat: <http://www.smalloutboards.com/choose.htm>Barge: Table 3 of Appendix D of the *Draft Environmental Impact Report for the Proposed Trans Bay Cable Project* (URS, 2006).Tug Boat: Horsepower for the Tug Silica (GPM, 2012; <http://www.gregerpacificmarine.com/TheTugSilica.htm>)

Horsepower for Barge - Steering Engine, Barge - Anchor Engine, Jet Plow Engine, Tug Boat - Large, and Tug Boat - Small

Other: provided by R. Rosenqvist/ABB on 6/18/2012.

<sup>b</sup> Kilowatt (kW) ratings for each marine vessel converted from the hp using the following conversion factor:

$$1 \text{ hp} = 1.34 \text{ kW}$$

<sup>c</sup> Load Factors for Barge - Steering Engine, Barge - Anchor Engine, Jet Plow Engine, Tug Boat - Large, and Tug Boat - Small provided by R. Rosenqvist/ABB on 6/18/2012. Assumed the Barge had a Load Factor equivalent to the Barge - Steering Engine and Barge - Anchor Engine combined. Assumed the Tug Boat had a Load Factor equivalent to the Tug Boat - Small. Assumed the Small Motorcraft Boat Load Factor because performance is thought to decline below 75%.<sup>d</sup> Emission factors provided in pounds per horsepower-hour (lbs/hp-hr) were converted to grams per horsepower-hour (g/hp-hr) using the following conversion factor:

$$1 \text{ lb} = 453.6 \text{ g}$$

<sup>e</sup> Except for the Small Motorcraft, CO, NOx, and PM<sub>10</sub> emission factors taken from Table 2 of 17 CCR 93118.5, assuming Category 2 marine vessels meeting the Tier 2 emission standards (CARB, 2010). Each NOx emission factor was estimated by subtracting the VOC emission factor from the NOx+HC emission factor presented in 17 CCR 93118.5.<sup>f</sup> PM<sub>2.5</sub> emissions assumed to be 92% of the PM<sub>10</sub> emissions for diesel-fueled ships per the *Final - Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds* (SCAQMD, 2006).<sup>g</sup> Small Motorcraft emission factors taken from Table 3.3-1 of Section 3.3 of AP-42 (USEPA, 1996), assuming 100% gasoline fuel and that VOC was represented by TOC.<sup>h</sup> Barge, Tug Boat, Tug Boat - Small, and Tug Boat - Large VOC, SOx, and CO<sub>2</sub> emission factors taken from Table 3.4-1 of Section 3.4 of AP-42 (USEPA, 1996), assuming 100% diesel fuel, that VOC was represented by TOC, and that the engines use ultra-low sulfur diesel (15 ppm sulfur).<sup>i</sup> Barge - Steering Engine, Barge - Anchor Engine, and Jet Plow Engine VOC, SOx, and CO<sub>2</sub> emission factors taken from Table 3.3-1 of Section 3.3 of AP-42 (USEPA, 1996), assuming 100% diesel fuel and that VOC was represented by TOC.



TABLE A-10

**Construction Equipment Emission Factors**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

**Emission Factors from OFFROAD**

Equipment	Horsepower <sup>a</sup>	Load Factor <sup>a</sup>	Emission Factors (g/bhp-hr) <sup>b</sup>						
			VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>
Crawler Backhoe <sup>c</sup>	82	0.64	1.051	4.156	6.287	0.006	0.541	0.541	568.299
Mobile Crane	208	0.43	0.496	1.427	4.605	0.006	0.16	0.16	568.299
Generator Sets	84	0.74	0.721	3.532	5.147	0.006	0.385	0.385	568.299
Generator - Small <sup>d,e</sup>	93	0.20	0.721	3.532	5.147	0.006	0.385	0.385	568.299
Generator - Large <sup>d,e</sup>	299	0.40	0.279	1.157	3.603	0.005	0.104	0.104	568.299
Bore / Drill Rig	82	0.75	0.301	3.451	3.134	0.006	0.15	0.15	568.299
Manlift <sup>f</sup>	34	0.46	1.51	4.862	5.091	0.007	0.404	0.404	568.299
Forklift	149	0.3	0.526	3.353	3.905	0.006	0.214	0.214	568.299
Small Backhoe <sup>g</sup>	75	0.55	0.696	3.848	4.671	0.006	0.369	0.369	568.299

## Notes:

<sup>a</sup> Unless otherwise noted, horsepower and Load Factors taken as the default, average values provided in Table 3.3 of Appendix D of the *CalEEMod User's Guide* (Environ, 2011).

<sup>b</sup> Emission Factors in grams per brake-horsepower-hour (g/bhp-hr) taken as the defaults for the year 2014 provided in Table 3.4 of Appendix D of the *CalEEMod User's Guide* (Environ, 2011).

<sup>c</sup> The Crawler Backhoe was represented by 'Crawler Tractors' equipment category in the user's guide noted in footnote a.

<sup>d</sup> Horsepower (hp) ratings for the Small (125 kilowatt [kW]) and Large (400 kW) Generators estimated using the following conversion factor:

$$1 \text{ hp} = 0.746 \text{ kW}$$

<sup>e</sup> The Small and Large Generators are used in association with the barge during Cable Delivery / Loading and Laying activities. The load factors for this equipment were provided by R. Rosenqvist/ABB on 6/18/2012.

<sup>f</sup> The Manlift was represented by 'Aerial Lifts' equipment category in the user's guide noted in footnote a.

<sup>g</sup> The Small Backhoe was represented by 'Tractors/Loaders/Backhoes' equipment category in the user's guide noted in footnote a.



TABLE A-11

**Vehicle Emission Factors**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

Vehicle	Vehicle Class <sup>a</sup>	Exhaust Emission Factors (g/mile) <sup>b</sup>							Paved Road Emission Factors (g/mile) <sup>c</sup>	
		VOC	CO	NOx	SOx	PM <sub>10</sub>	PM <sub>2.5</sub>	CO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>
Rigging Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075
Mechanics Truck	Medium-duty Diesel	0.140	1.220	4.727	0.014	0.189	0.159	1,505.000	0.300	0.075
Worker Commutes	Light-duty Auto/Truck	0.045	1.897	0.201	0.004	0.032	0.017	327.203	0.300	0.075
3/4-Ton Pick-up Truck	Light-duty Truck	0.059	2.383	0.272	0.004	0.035	0.021	364.086	0.300	0.075
1-Ton Truck	Medium-duty Diesel	0.140	1.220	4.727	0.014	0.189	0.159	1,505.000	0.300	0.075
Cement Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075
Boom Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075
2-Ton Flat Bed Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075
Shop Van	Light-duty Auto	0.031	1.412	0.131	0.003	0.028	0.014	290.320	0.300	0.075
Dump Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075
Transport Truck	Heavy/Medium-duty Diesel	0.316	1.846	6.687	0.016	0.265	0.218	1,629.204	0.300	0.075
Cable Puller Truck	Medium-duty Diesel	0.140	1.220	4.727	0.014	0.189	0.159	1,505.000	0.300	0.075
Wench Truck	Heavy-duty Diesel	0.492	2.471	8.646	0.017	0.341	0.276	1,753.407	0.300	0.075

Notes:

<sup>a</sup> The vehicle classes are represented as follows:

Heavy-duty Diesel: Material haul trucks assumed to be 100% HHD DSL values per Section 4.5 of Appendix A of the *CalEEMod User's Guide* (Environ, 2011). This distinction was also applied to several project-specific vehicles.

Medium-duty Diesel: Assumed these project-specific vehicles were 100% MHD DSL values.

Light-duty Auto/Truck: Worker commutes assumed to be 50% LDA, All, 25% LDT1, All, and 25% LDT2, All values per Section 4.5 of Appendix A of the *CalEEMod User's Guide* (Environ, 2011).

Light-duty Truck: Assumed these project-specific vehicles were an average of LDT1, All and LDT2, All values.

Light-duty Auto: Assumed these project-specific vehicles were 100% LDA, All values.

Heavy/Medium-duty Diesel: Vendor delivery trucks assumed to be 50% HHD DSL values and 50% MHD DSL values per Section 4.5 of Appendix A of the *CalEEMod User's Guide* (Environ, 2011).

<sup>b</sup> Exhaust Emission Factors in grams per mile (g/mile) from EMFAC2007 for the San Francisco Bay Area Air Basin, calendar year 2014. A speed of 40 miles per hour (mph) was assumed for onroad vehicles, which is consistent with the CalEEMod default; because the project site is so small, it was assumed that all vehicles would be considered offsite, onroad vehicles and that no vehicles would travel onsite. An average temperature of 62 degrees Fahrenheit (°F) and humidity of 63% were used per Table B-1 of *CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions* (UC-Davis, 2007).

<sup>c</sup> Paved road emission factors calculated using CalEEMod methodology, as described below.

TABLE A-11

**Vehicle Emission Factors**

PG&amp;E: Embarcadero-Potrero 230 kV Transmission Project

**Derivation of Paved Road Emission Factors**

Parameter	PM <sub>10</sub>	PM <sub>2.5</sub>
Average Weight <sup>a</sup>	2.4	2.4
k <sup>b</sup>	1	0.25
sL <sup>a</sup>	0.1	0.1
<b>Emission Factor (g/mile)<sup>c</sup></b>	<b>0.300</b>	<b>0.075</b>

Notes:

<sup>a</sup> Average Weight and sL taken as the default value from CalEEMod.<sup>b</sup> k taken from Table 13.2.1-1 of Section 13.2.1 of AP-42 (USEPA, 2011).<sup>c</sup> Emission factor calculated using Equation 1 from Section 13.2.1 of AP-42 (USEPA, 2011):

$$\text{Emission Factor (g/mile)} = k \text{ (g/mile)} \times [\text{sL (g/m}^2\text{)}]^{0.91} \times [\text{Average Weight (tons)}]^{1.02}$$

TABLE A-12

**Fugitive Dust Emission Factors**

*PG&E: Embarcadero-Potrero 230 kV Transmission Project*

**Emission Factors from WRAP Fugitive Dust Handbook**

Activity	Emission Factors		
	PM <sub>10</sub> <sup>a</sup>	PM <sub>2.5</sub> <sup>b</sup>	Units
Offsite Cut / Fill	0.220	0.0458	ton/1,000 cy
Disturbed Surface	0.110	0.0229	ton/acre-month
	0.005	0.001	ton/acre-day <sup>c</sup>

Notes:

<sup>a</sup> PM<sub>10</sub> emission factors taken from Table A-4 of Appendix A of the *Software User's Guide: URBEMIS2007 for Windows* (JSA, 2007).

<sup>b</sup> PM<sub>2.5</sub> emissions assumed to be 20.8% of the PM<sub>10</sub> emissions for construction fugitive dust sources per the *Final - Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds* (SCAQMD, 2006).

<sup>c</sup> Emission factor converted to units of ton/acre-day assuming 22 construction days per month.





TABLE A-13

**Potrero Switchyard Operation Emissions**

*PG&E: Embarcadero-Potrero 230 kV Transmission Project*

<b>Applicable APM <sup>a</sup></b>	<b>Number of Circuit Breakers <sup>b</sup></b>	<b>SF<sub>6</sub> Capacity per Breaker (lbs) <sup>c</sup></b>	<b>Leakage Rate <sup>d</sup></b>	<b>SF<sub>6</sub> Emissions (metric tons/year) <sup>e</sup></b>	<b>CO<sub>2</sub>e Emissions (metric tons/year) <sup>f</sup></b>
Without APM	7	175	1.00%	0.0056	132.80
With APM GHG-3	7	175	0.50%	0.0028	66.40

Notes:

<sup>a</sup> Emissions were estimated assuming no implementation of Applicant Proposed Measures (APMs), and assuming the implementation of APM GHG-3, Avoid and Minimize Potential SF<sub>6</sub> Emissions, which is described in Section 3.7.4 of the *Embarcadero-Potrero 230 kV Transmission Project PEA*.

<sup>b</sup> Number of circuit breakers interpreted from Section 2.4.4, Potrero Switchyard, of the *Embarcadero-Potrero 230 kV Transmission Project PEA*.

<sup>c</sup> Assumed each circuit breaker would contain 175 pounds of SF<sub>6</sub>, which is similar to the circuit breakers at the Cressey Substation.

<sup>d</sup> It was conservatively assumed that the leakage rate would be one percent. APM GHG-3 considers a maximum leakage rate of 0.5 percent.

<sup>e</sup> The following conversion factor was used to estimate SF<sub>6</sub> emissions:

$$1 \text{ metric ton} = 2,204.62 \text{ lbs}$$

<sup>f</sup> The following Global Warming Potential (GWP) was used to estimate CO<sub>2</sub>e emissions, per 40 CFR 98, Subpart A: 23,900.

