APPENDIX 8.1B

Modeling Support Data

Tables presented in this Appendix are as follows:

8.1B-1 Worst-Case Stack Screening Modeling Parameters

8.1B-2 Emission Rates and Stack Parameters for the Modeling Analysis

8.1B-3 Diesel Generator Stack Parameters and Emission Rates

8.1B-4 Major Structure List for BPIP

8.1B-5 Construction Impacts Modeling Input Data and Results

In addition, this appendix contains Figures 8.1-7-1 and 8.7-7-2, a facility plot plan, data on the annual and quarterly wind roses for the Union City met data site, climatic summaries for Newark and Oakland WSO and a figure displaying the SLAMS and NAMS station locations.

Modeling input/output files are included in the enclosed CD's.

Table 8.1B-1 Wosrt-Case Stack Screening Results For Eastshore

		CASE1	CASE2	CASE3	CASE4	*CASE5*	CASE6	CASE7	CASE8	*CASE9*	CASE10	CASE11	CASE12
Ambient Temperature (F)		32	32	32	32	***59.1***	59.1	59.1	59.1	***100***	100	100	100
Engine Load (%)		100	90	75	50	***100***	90	75	50	***100***	90	75	50
Stack Diameter (meters)		1.208	1.208	1.208	1.208	***1.208***	1.208	1.208	1.208	***1.208***	1.208	1.208	1.208
Modeled Stack Gas Temp (K)		**643.15**	**642.04**	**644.82**	**654.82**	***641.48***	**640.37**	**643.15**	**653.15**	***628.71***	**629.26**	**634.82**	**646.48**
Modeled Stack Exit Velocity (m/s)		**22.31**	**20.75**	**18.18**	**14.13**	***22.27***	**20.81**	**18.21**	**14.19**	***22.42***	**20.85**	**18.28**	**14.21**
Modeled Emissions (lbs/hr)													
NOx		1.3800	1.2545	1.0718	0.7706	1.3800	1.2545	1.0718	0.7706	1.3800	1.2545	1.0718	0.7706
CO		2.1800	1.9818	1.6932	1.2174	2.1800	1.9818	1.6932	1.2174	2.1800	1.9818	1.6932	1.2174
SO2, From Gas Only		0.0154	0.0140	0.0120	0.0086	0.0154	0.0140	0.0120	0.0086	0.0154	0.0140	0.0120	0.0086
Total PM-10		2.5231	2.5201	2.5151	2.5072	2.5230	2.5202	2.5151	2.5074	2.5233	2.5202	2.5153	2.5074
Modeled Emissions (g/s)													
NOx		**0.17388**	**0.15807**	**0.13505**	**0.09710**	**0.17388**	**0.15807**	**0.13505**	**0.09710**	**0.17388**	**0.15807**	**0.13505**	**0.09710**
CO		**0.27468**	**0.24971**	**0.21334**	**0.15339**	**0.27468**	**0.24971**	**0.21334**	**0.15339**	**0.27468**	**0.24971**	**0.21334**	**0.15339**
SO2, From Gas Only		**0.00194**	**0.00176**	**0.00151**	**0.00108**	**0.00194**	**0.00176**	**0.00151**	**0.00108**	**0.00194**	**0.00176**	**0.00151**	**0.00108**
Total PM-10		**0.31791**	**0.31753**	**0.31690**	**0.31591**	**0.31790**	**0.31755**	**0.31690**	**0.31593**	**0.31794**	**0.31755**	**0.31693**	**0.31593**
Unitized Impacts (ug/m3)/(g/s)													
1-Hour		18.19550	18.77308	19.77488	21.76855	18.22713	18.76826	19.77949	21.75057	18.31396	18.87453	19.83858	21.81340
3-Hour		17.71266	18.28727	19.28704	21.34052	17.74334	18.28165	19.29084	21.32162	17.82332	18.38188	19.34566	21.38127
8-Hour		14.47915	15.07021	16.11461	18.10003	14.51047	15.06432	16.11854	18.08163	14.59188	15.16765	16.17605	18.13924
24-Hour		11.17315	11.51683	12.12751	13.36530	11.19113	11.51309	12.12897	13.35221	11.23612	11.57067	12.15906	13.38223
Annual		2.44960	2.55855	2.75498	3.14501	2.45537	2.55748	2.75576	3.14134	2.47052	2.57681	2.76700	3.15298
Pollutant Impacts (ug/m3)	Max												
1-Hour NOx	3.18443	3.16383	2.96746	2.67060	2.11373	3.16933	2.96670	2.67122	2.11198	**3.18443**	2.98350	2.67920	2.11808
Annual NOx	0.42957	0.42594	0.40443	0.37206	0.30538	0.42694	0.40426	0.37217	0.30502	**0.42957**	0.40732	0.37368	0.30615
1-Hour CO	5.03048	4.99794	4.68783	4.21877	3.33908	5.00663	4.68662	4.21976	3.33632	**5.03048**	4.71316	4.23236	3.34596
8-Hour CO	4.00810	3.97713	3.76318	3.43789	2.77636	3.98574	3.76171	3.43873	2.77354	**4.00810**	3.78751	3.45100	2.78238
1-Hour SO2	0.03553	0.03530	0.03304	0.02986	0.02351	0.03536	0.03303	0.02987	0.02349	**0.03553**	0.03322	0.02996	0.02356
3-Hour SO2	0.03458	0.03436	0.03219	0.02912	0.02305	0.03442	0.03218	0.02913	0.02303	**0.03458**	0.03235	0.02921	0.02309
24-Hour SO2	0.02180	0.02168	0.02027	0.01831	0.01443	0.02171	0.02026	0.01831	0.01442	**0.02180**	0.02036	0.01836	0.01445
Annual SO2	0.00479	0.00475	0.00450	0.00416	0.00340	0.00476	0.00450	0.00416	0.00339	**0.00479**	0.00454	0.00418	0.00341
24-Hour PM10	4.22785	3.55206	3.65694	3.84321	4.22223	3.55766	3.65598	3.84367	4.21836	3.57241	3.67427	3.85357	**4.22785**
Annual PM10	0.99612	0.77875	0.81242	0.87305	0.99354	0.78056	0.81213	0.87330	0.99244	0.78548	0.81827	0.87695	**0.99612**

Table 8.1B-2 Stack Parameters and Emissions Rates Used In The ISCST3 Analysis

	Stack Height (m)	Stack Diam (m)	Stack Temp (deg K)	Exhaust Velocity (m/s)	Emission Rates (g/s)			
					NO_X	SO_2	CO	PM10
CO - Averaging Period: 1-hour								
Engines (14)	21.336	1.208	628.71	22.42	-	-	1.8698	-
Standby Generator	10.0	0.1778	735.22	48.15	-	-	0.0270	-
CO - Averaging Period: 8-hours								
Engines (14)	21.336	1.208	628.71	22.42	-	-	1.8698	-
Standby Generator	10.0	0.1778	735.22	48.15	-	-	0.0034	-
SO_2 - Averaging Period: 1-hour								
Engines (14)	21.336	1.208	628.71	22.42	-	0.03024	-	-
Standby Generator	10.0	0.1778	735.22	48.15	-	4.79E-4	-	-
SO_2 - Averaging Period: 3-hour								
Engines (14)	21.336	1.208	628.71	22.42	-	0.03024	-	-
Standby Generator	10.0	0.1778	735.22	48.15	-	1.60E-4	-	-
SO_2 - Averaging Period: 24 hours								
Engines (14)	21.336	1.208	628.71	22.42	-	0.03024	-	-
Standby Generator	10.0	0.1778	735.22	48.15	-	2.0E-5	-	-
PM_{10} - Averaging Period: 24 hours								
Engines (14)	21.336	1.208	628.71	22.42	-	-	-	0.31254
Standby Generator	10.0	0.1778	735.22	48.15	-	-	-	5.60E-4
NO_2 – Averaging Period 1-hour								
Engines (14)	21.336	1.208	628.71	22.42	1.2442	-	-	-
Standby Generator	10.0	0.1778	735.22	48.15	0.0270	-	-	-
NOx, PM_{10} and SO_2 - Averaging Period: Annual								
Engines (14)	21.336	1.208	641.48	22.27	0.11535	1.395E-2	-	0.1474
Standby Generator	10.0	0.1778	735.22	48.15	7.73E-4	1.64E-6	-	4.596E-5

[a]All averaging periods include worst-case assumptions including startup emissions.

Table 8.1B-3 Emissions, Modeling Characteristics, and Screening Results for Emergency Generator

Eshore

Emergency Generator	NOx	SOx (1)	CO	PM10				
Emissions g/bhp-hr(2)	2.69	0.0038	0.32	0.16	Testing at:		Manufacturer	Caterpillar
lb/hr(4)	1.79	0.0038	0.213	0.107	100%	load	Model	PRIME 225
g/s (1-hour)	0.226	4.79E-04	0.027	0.013	60	min/hr	Output (Bhp) (nominal)	302
g/s (3-hour)		1.60E-04			Testing 24 hrs/day		Output (Bhp) (testing)	302
g/s (8-hour)			0.00336				Fuel cons, gals/hr (nominal)	18
g/s (24-hour) (4)		2.00E-05		0.00056			Fuel cons, gals/hr (testing)	18
tpy (3)	0.027	0.0001	0.003	0.0016	30	tests/yr (3)		
g/s (annual) (4)	7.7281E-04	1.64E-06		4.59665E-05	453.6	g/lb	Unitized Impacts (for 1 g/s/source)	
Impacts (ug/m3)							(ug/m3)	
1-hour	***196***	***0.4***	***23.3***	***11.7***			868.96000	
3-hour		***0.11***					719.05000	
8-hour			***1.66***				494.53000	
24-hour		***0.006***		***0.159***			283.52000	
Annual	N/A	N/A	N/A	N/A			N/A	

Stack height	32.81	feet	10.000	m
Exhaust temp	864	deg F	735.4	deg K
Stack diam.	7	in	0.178	m
Exhaust flow	2158.0	cfm	1.018	m3/s
Exhaust velocity	134.6	ft/sec	41.020	m/s

Notes:

(1) Based on Diesel: 0.0015% sulfur

(2) Emission factors based on vendor information.

(3) Based on 30 tests of 60 minutes each (30 hrs/year).

(4) Since operations not limited for daily (24-hr) periods, modeled average g/s emissions for these two periods NOT multiplied by 3 to compensate for 8 am - 4 pm testing.

Table 8.1B-4
Eastshore Energy Center
Major Structure List

Structure	Number of Structures	Size		
		Length(ft)	Width (ft)	Height (ft)
Power House A	1	161'-9"	71'-4"	29'-6"
Power House B	1	161'-9"	71'-4"	29'-6"
Control Complex	1	92'-7"	96'-4"	29'-6"
Radiator Bank	2	185'-0"	33'-0"	20'-4"
SCR	14	22'-5"	10'-0" OD	
Exhaust Stack & Silencer	14		7'-8" OD	70'-0"
Step-up Transformer	2	13'-0"	10'-0"	12'-7"
Control Enclosure	1	24'-7"	15'-0"	10'-0"
Guardhouse	1	20'-0"	20'-0"	12'-0"
Fire Fighting Container	1	21'-0"	10'-0"	8'-0"
Raw Water Tank (170)	1		20' OD	14'-0"
Aqua Ammonia Tank	2		12' OD	15'-0"
Dirty Water Holding Tank	1		6'-6" OD	20'-0"
Service LO Tank	2		5'-3" OD	20'-0"
Clean LO Tank	1		14' OD	12'-0"

Table 8.1B-7 Modeling Inputs/Results for Eastshore Energy Construction Impacts (Combustion Sources Modeled as 44 Point Sources)

Short Term Impacts (24 hrs and less)					Long Term Impacts (annual)				
	NOx	CO	SOx	PM10		NOx	CO	SOx	PM10
Combustion (lbs/day)	230.39	112.61	40.58	15.97	Combustion (tons/yr)	16.07	8.31	2.78	1.16
					Combustion (days/yr)	260	260	260	260
Combustion (hrs/day)	10	10	10	10	Combustion (hrs/day)	10	10	10	10
Combustion (max. lbs/hr)	25.02	12.15	4.38	1.74	Combustion (avg. lbs/hr)	12.36	6.39	2.14	0.89
Combustion (g/sec)	3.15E+00	1.53E+00	5.52E-01	2.19E-01	Combustion (g/sec)	1.11E+00	5.76E-01	1.92E-01	8.00E-02
Point Srcs (g/s/stack)	7.165E-02	3.479E-02	1.254E-02	4.983E-03	44	2.528E-02	1.308E-02	4.374E-03	1.819E-03
Const. Dust - Main (lbs/day)				2.71	Const. Dust - Main (tons/yr)				0.325
Const. Dust - Laydown (lbs/day)				1.09	Const. Dust - Laydown (tons/yr)				0.131
					Const. Dust (days/yr)				260
Const. Dust (hrs/day)				10	Construction Dust (hrs/day)				10
Const. Dust - Main (max. lbs/hr)				0.271	Const. Dust - Main (avg lbs/hr)				0.25
Const. Dust - Laydown (max. lbs/hr)				0.109	Const. Dust - Laydown (avg lbs/hr)				0.10
Const. Dust - Main (g/sec)				3.41E-02	Const. Dust - Main (g/sec)				2.25E-02
Const. Dust - Laydown (g/sec)				1.37E-02	Const. Dust - Laydown (g/sec)				9.05E-03
ISCST3 Inputs (Main Site)	**25324.3 m2**		~6.22 acres						
ISCST3 Inputs (Laydown)	**19002.3 m2**		~4.65 acres						
Combustion (g/s/m2)	1.245E-04	6.045E-05	2.179E-05	8.657E-06	Combustion (g/s/m2)	4.392E-05	2.273E-05	7.600E-06	3.160E-06
Const. Dust - Main (g/s/m2)				1.348E-06	Const. Dust - Main (g/s/m2)				8.894E-07
Const. Dust - Laydown (g/s/m2)				7.223E-07	Const. Dust - Laydown (g/s/m2)				4.763E-07
ISCST3 Results (ug/m3)									
Combustion Only					Combustion Only				
1-hour Max	365.5	177.5	64.0						
3-hour Max	300.4		52.6						
8-hour Max	252.5	122.6							
24-hour Max	110.6		19.4	7.7	Annual	22.1		3.8	1.6
Particulate Sources					All Particulate Sources				
Construction Dust 24-hour Max				14.8	Construction Dust Annual				3.8
Combustion 24-hour Max				7.7	Combustion Annual				1.6
Total 24-hour Max				22.5	Total Annual				5.3
1-hour NO2 w/ OLM	267.6		Highest 1-hour	0.123	Annual NO2 w/ ARM	16.6	based on ARM Ratio of:		75%
Background					Background				
1-hour Max	142.9	3680.0	102.2						
3-hour Max			49.4						
8-hour Max		2177.8							
24-hour Max			23.6	51.7	Annual	32.1		8.0	18.1
Total + Background					Total + Background				
1-hour Max	410.5	3857	166.2						
3-hour Max			102.0						
8-hour Max		2300							
24-hour Max			43.0	74.2	Annual	48.6		11.8	23.4

ENGINE HALL & UTILITY BLOCK

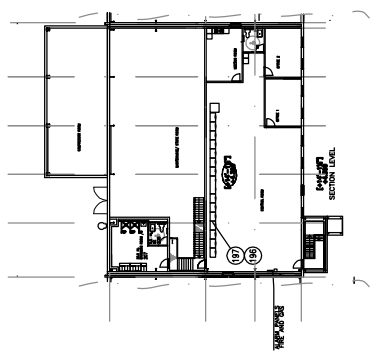
ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	WEIGHT INCL. LIQUIDS LB	MOUNTING LEVEL MILLIM.	MOUNTING LEVEL (FLR LEVEL) INCH.
1	14	SQA	ENGINE GENERATOR SET	134700	296962	+0.000	0'-0"
4	14	QEA	AUXILARY MODULE	4200	9259	+0.000	0'-0"
37	14	ZBB	GAS REGULATING UNIT	200	440	+0.000	0'-0"
60	2	TCA	WORKING AIR UNIT	670	1477	+0.000	0'-0"
62	2	TSA	STARTING AIR UNIT	710	1565	+0.000	0'-0"
63	4	TSB	STARTING AIR BOTTLE 9.4M3/2500 GAL	4335	9555	+0.000	0'-0"
70	2	VBA	MAINTENANCE WATER TANK 4M3/1060GAL	4940	10890	+0.000	0'-0"
72	14	VEA	EXPANSION VESSEL 600L/160GAL	775	1708	+4.940	16'-2"
80	14	NGA	CHARGE AIR FILTER	960	2116	+3.100	10'-2"
82	14	-	CHARGE AIR & EXHAUST GAS MODULE	3000	6613	+3.240	11'-2"
93	14	NHA	EXHAUST GAS VENTILATION UNIT	55	121	+4.940	16'-2"
104	14	SEN	DOSING BOX	-	-	+0.000	0'-0"
108	14	SNC	NOX CONTROLLER	-	-	+0.000	0'-0"
182	18	-	MV SWITCHGEAR	-	-	+0.000	0'-0"
183	14	BAN	NEUTRAL GROUNDING RESISTOR	-	-	+0.000	0'-0"
185	-	BEY	DC-SYSTEM	-	-	+0.000	0'-0"
186	-	BFA	LV SWITCHGEAR	-	-	+0.000	0'-0"
189	2	BFB	STATION SERVICE TRANSFORMER	-	-	+0.000	0'-0"
196	4	CFA	CONTROL PANEL COMMON	-	-	+0.000	0'-0"
197	14	CFC	CONTROL PANEL ENGINE WISE	-	-	+0.000	0'-0"
210	14	-	VENTILATION UNIT (ENGINEHALL)	2000	4409	-	-
215	14	-	FREQUENCY CONVERTER	-	-	-	-

MECHANICAL UTILITY AREA

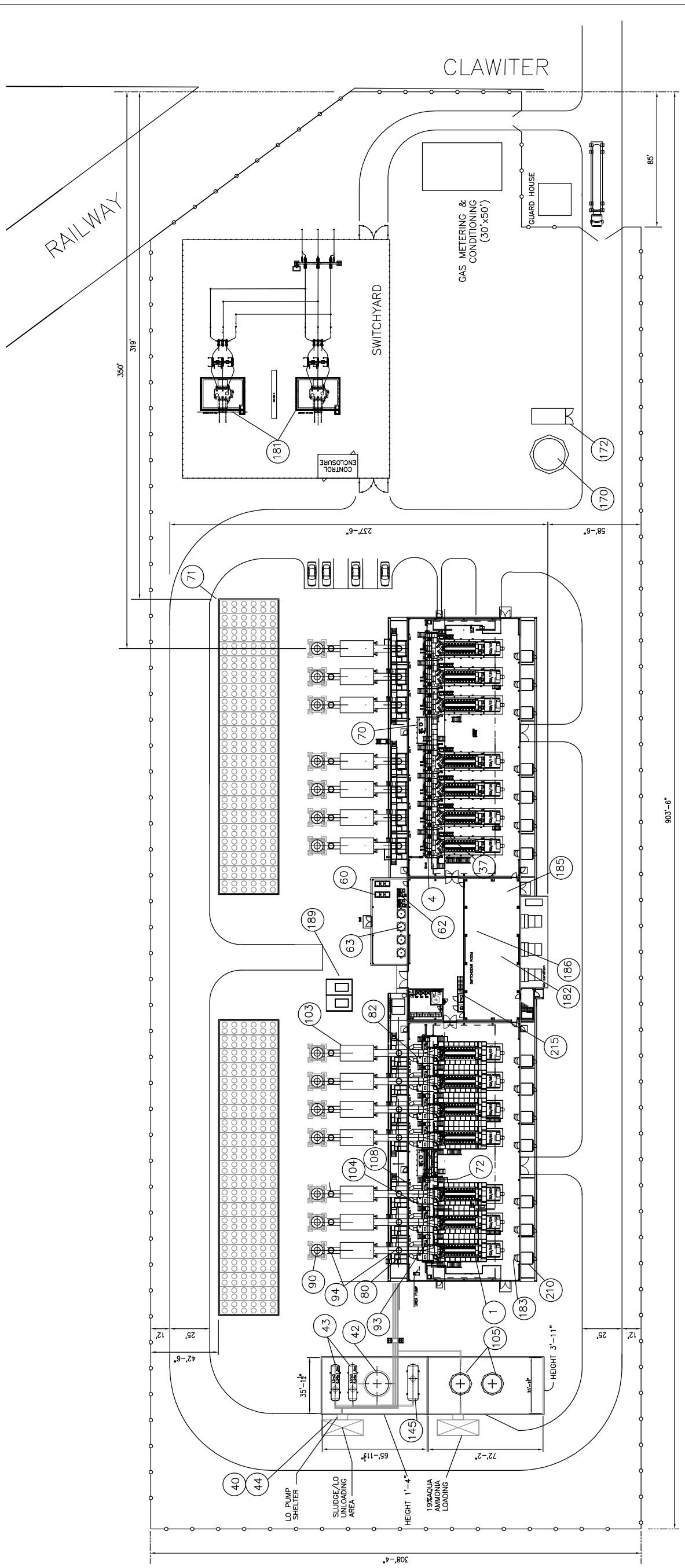
ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	WEIGHT INCL. LIQUIDS LBS	MOUNTING LEVEL MILLIM.	INCH.
71	42	-	RADIATORS LOW-LOW NOISE RADIATORS	-	-	-	-
90	14	NHA	EXHAUST GAS SILENCER	5200	11454	+5.560	+22'-5"
94	34	NGA	RUPTURE DISC	-	-	-	-
103	14	-	DENOX (SCR)	14000	30864	+5.560	+22'-5"
170	1	-	RAW WATER TANK 35,000 GAL	-	-	-	-
172	1	-	FIRE FIGHTING CONTAINER	-	-	-	-
181	2	AET	STEP-UP TRANSFORMER	-	-	-	-
				-	-	-	-
				-	-	-	-

DAY / STORAGE TANK / UNLOADING AREA

ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	WEIGHT INCL. LIQUIDS LBS	MOUNTING LEVEL MILLIM.	INCH.
40	1	QAA	LO UNLOADING PUMP UNIT (CLEAN)	-	-	-	-
42	1	QAC	CLEAN LO TANK 55M3/14531GAL	-	-	-	-
43	2	QAD	USED/SERVICE LO TANK 13M3/3434GAL	-	-	-	-
44	2	QAE	LO TRANSFER PUMP UNIT	-	-	-	-
105	2	-	SCR REGENT TANK 10,000 GAL	-	-	-	-
145	1	DDB	DIRTY WATER HOLDING TANK 20M3/5284 GAL	-	-	-	-



BUILDING SECOND FLOOR PLAN



REV	DATE	DESCRIPTION	DWN	CHK	PE/PM	CLIENT APPV
E	07/26/06	ISSUED FOR APPLICATION	GC	GC	JL	
D	07/20/06	ISSUED FOR REVIEW	GC	GC	JL	
C	07/14/06	ISSUED FOR REVIEW	GC	GC	JL	
B	07/07/06	ISSUED FOR REVIEW	GC	GC	JL	
A	06/22/06	ISSUED FOR REVIEW	GC	GC	JL	

PREPARED BY: Stantec
WALNUT CREEK, CALIFORNIA (925) 941-1400
DWN GCI 6/21/06 DES JL PROJ MGR

PREPARED FOR: TIERRA ENERGY

TITLE: EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA
SITE PLAN – GENERAL ARRANGEMENT

PROJECT: FIG 1.1-5 & 2.2-1

SCALE	PROJECT NUMBER	DRAWING NUMBER	REV
1"=25'-0"	20100916	006-G-100	E

PLOT SCALE: XREF LIST: ESIBD301

I:\tierra_energy\20100916\00_tierra_cec_eng_supp_eastshore\MECH\916-G-100.DWG, 7/27/2006 2:04:34 PM, g_ison, PDF995

Figure 8.1-7-1
BPIP Building Inputs

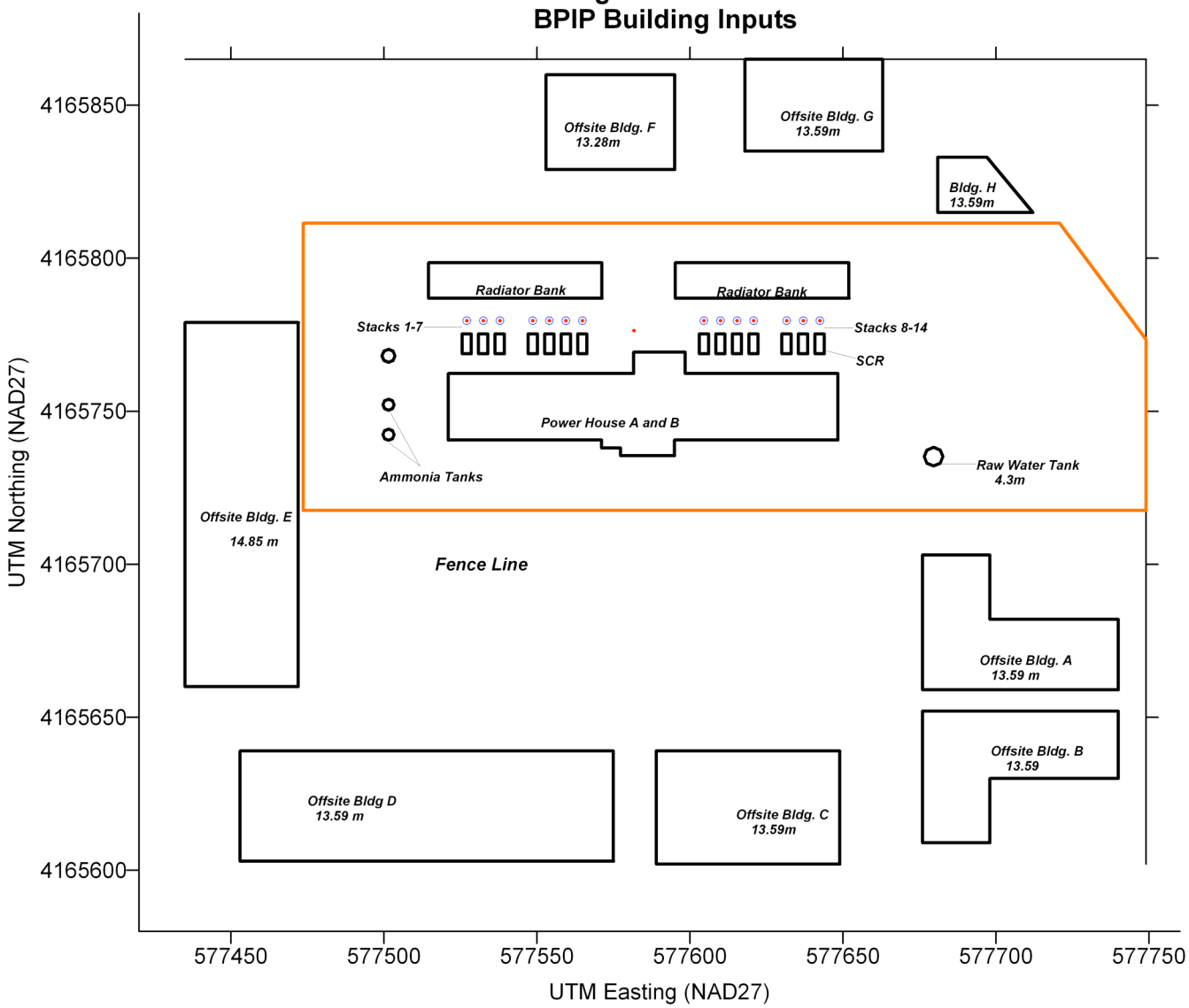


Figure 8.7-1-2
Coarse and Downwash Receptor Grids

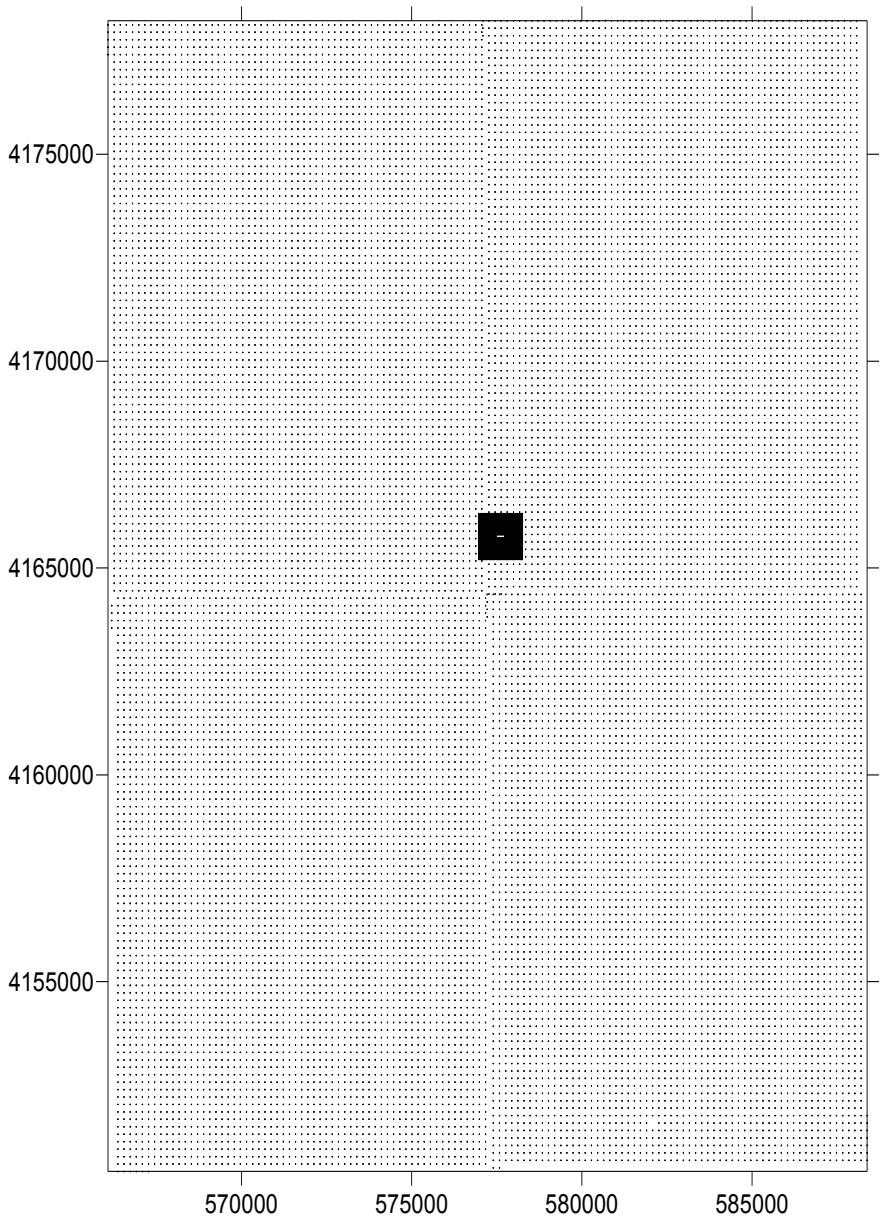


Figure 8.1B-1

UNION CITY WIND ROSE (1990-1994)
ANNUAL

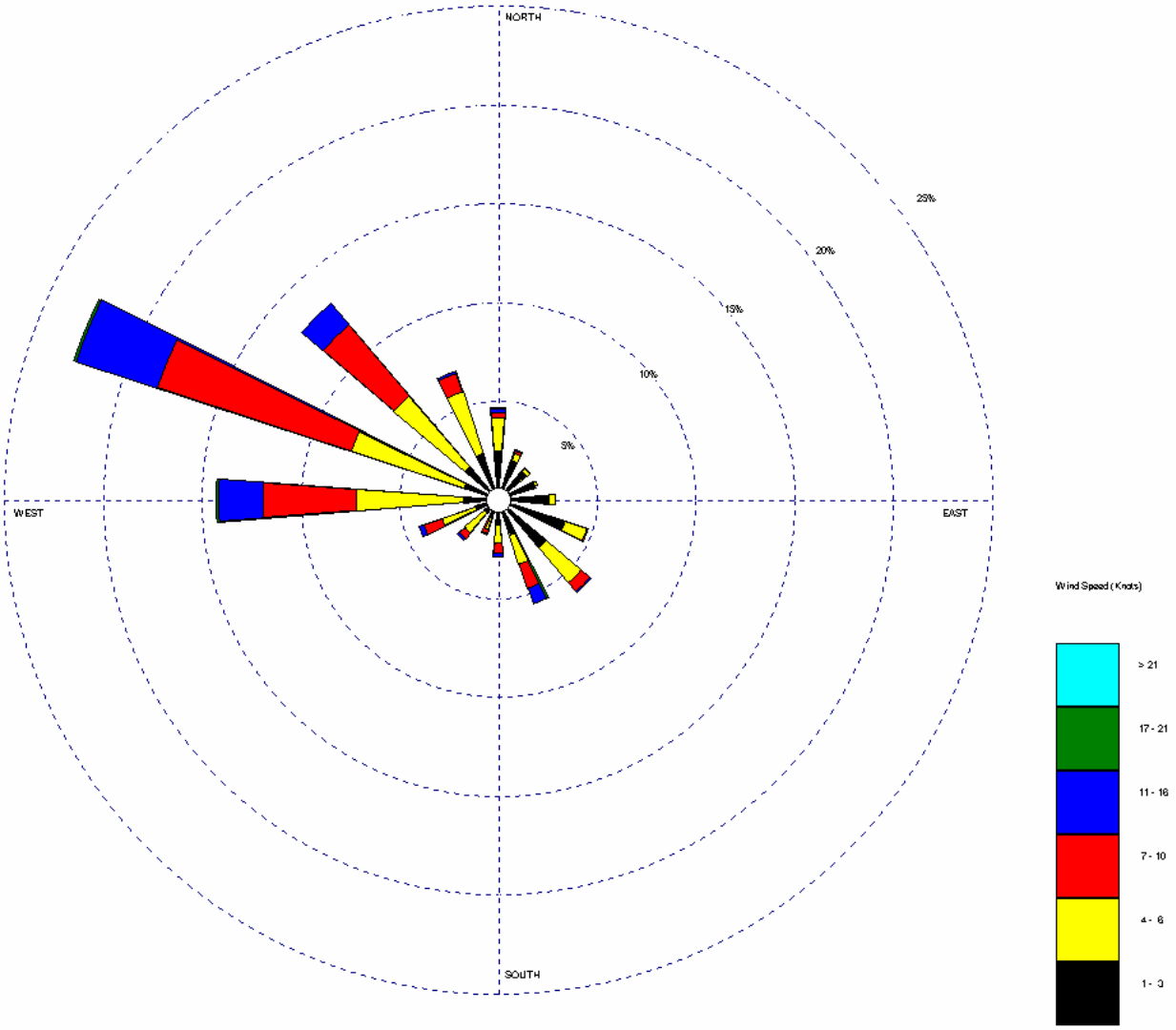


Figure 8.1B-2

UNION CITY WIND ROSE (1990-1994)
QUARTERLY WINTER

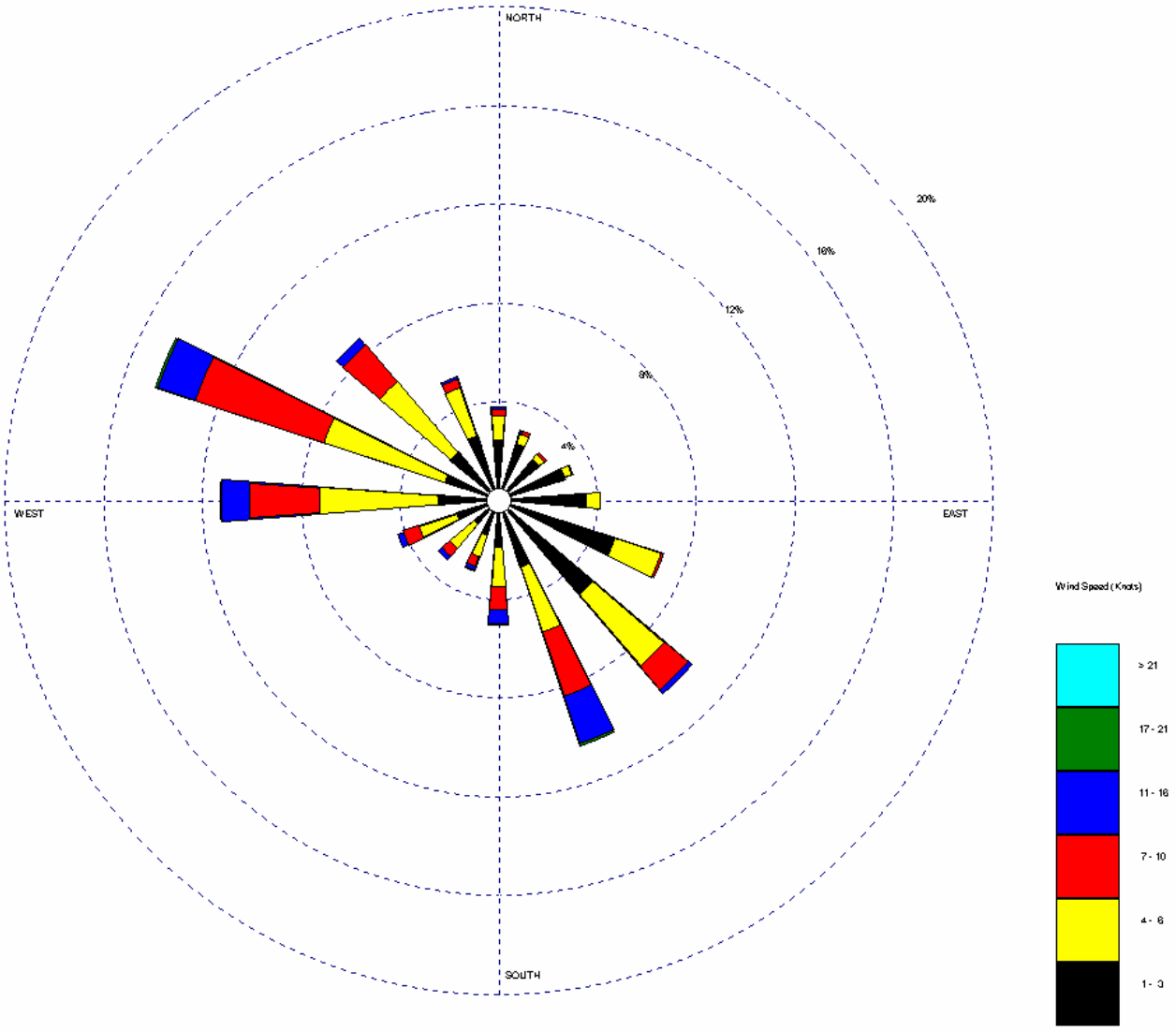


Figure 8.1B-3

UNION CITY WIND ROSE (1990-1994)
QUARTERLY SPRING

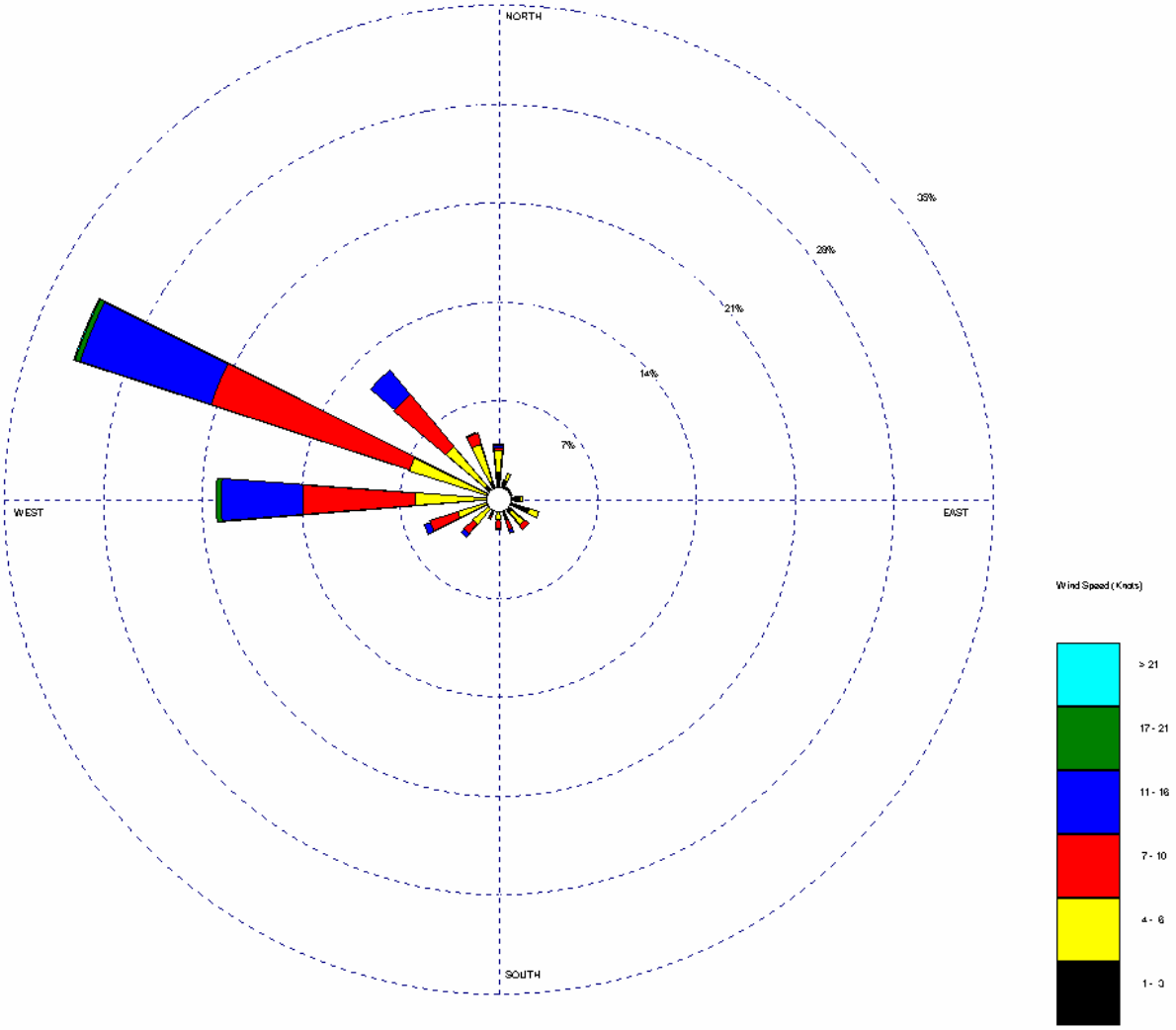


Figure 8.1B-4

UNION CITY WIND ROSE (1990-1994)
QUARTERLY SUMMER

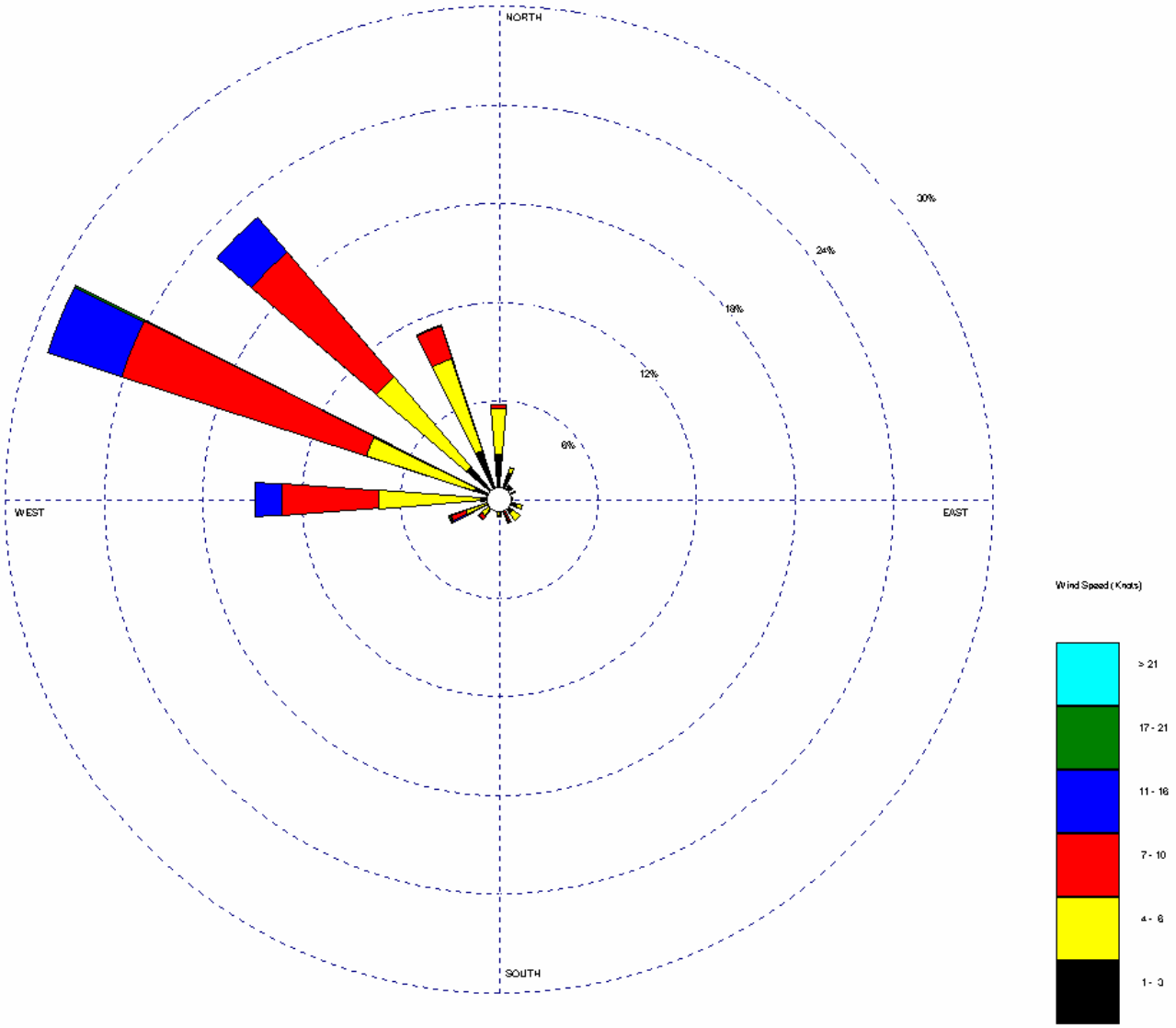
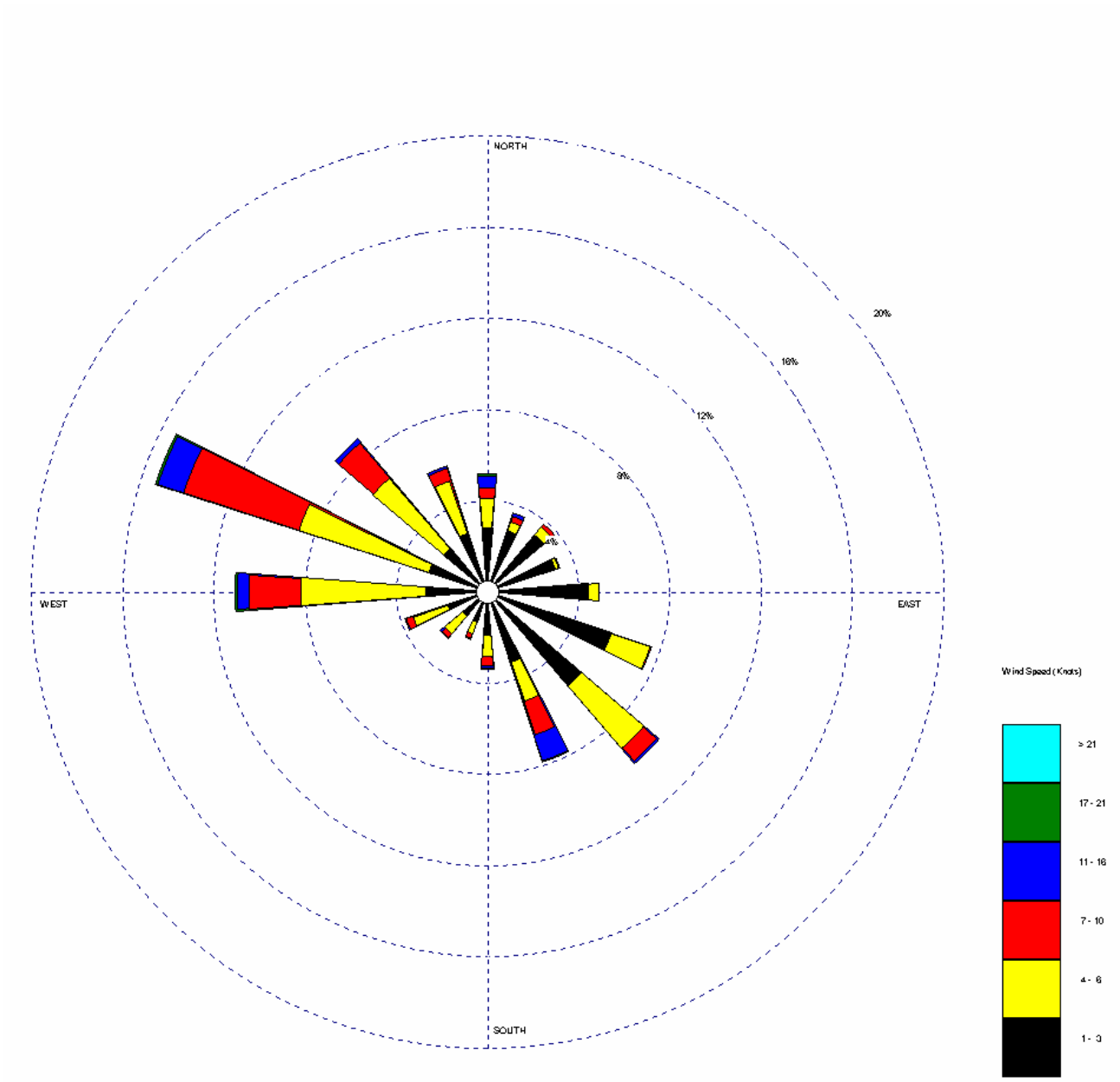


Figure 8.1B-5

UNION CITY WIND ROSE (1990-1994)
QUARTERLY FALL



Station ID: 1901 Run ID: Annual Wind Rose
Year: 1990 1991 1992 1993 1994
Date Range: Jan 1 - Dec 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	1365	496	106	85	16	1	2069
11.25 - 33.75	1018	103	31	26	2	0	1180
33.75 - 56.25	856	59	27	1	0	0	943
56.25 - 78.75	910	32	3	0	0	0	945
78.75 - 101.25	1220	51	0	0	0	0	1271
101.25 - 123.75	1779	291	15	0	0	0	2085
123.75 - 146.25	1706	745	202	29	1	0	2683
146.25 - 168.75	967	596	563	305	7	0	2438
168.75 - 191.25	667	319	209	77	4	0	1276
191.25 - 213.75	506	204	87	25	4	0	826
213.75 - 236.25	523	464	169	41	0	0	1197
236.25 - 258.75	694	714	374	74	1	0	1857
258.75 - 281.25	1130	2416	1855	840	30	0	6271
281.25 - 303.75	1189	2809	4440	1431	46	3	9918
303.75 - 326.25	1367	1953	2059	339	0	0	5718
326.25 - 348.75	1459	1197	331	27	0	0	3014
Sub-Total:	17356	12449	10471	3300	111	4	43691
Calms:							133
Missing/Incomplete:							0
Total:							43824

Frequency of Calm Winds: 0.30%
Average Wind Speed: 2.96 m/s

Station ID: 1901 Run ID:
Year: 1990 1991 1992 1993 1994
Date Range: Jan 1 - Dec 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.031147	0.011318	0.002419	0.001940	0.000365	0.000023	0.047212
11.25 - 33.75	0.023229	0.002350	0.000707	0.000593	0.000046	0.000000	0.026926
33.75 - 56.25	0.019533	0.001346	0.000616	0.000023	0.000000	0.000000	0.021518
56.25 - 78.75	0.020765	0.000730	0.000068	0.000000	0.000000	0.000000	0.021564
78.75 - 101.25	0.027839	0.001164	0.000000	0.000000	0.000000	0.000000	0.029002
101.25 - 123.75	0.040594	0.006640	0.000342	0.000000	0.000000	0.000000	0.047577
123.75 - 146.25	0.038928	0.017000	0.004609	0.000662	0.000023	0.000000	0.061222
146.25 - 168.75	0.022066	0.013600	0.012847	0.006960	0.000160	0.000000	0.055632
168.75 - 191.25	0.015220	0.007279	0.004769	0.001757	0.000091	0.000000	0.029116
191.25 - 213.75	0.011546	0.004655	0.001985	0.000570	0.000091	0.000000	0.018848
213.75 - 236.25	0.011934	0.010588	0.003856	0.000936	0.000000	0.000000	0.027314
236.25 - 258.75	0.015836	0.016292	0.008534	0.001689	0.000023	0.000000	0.042374
258.75 - 281.25	0.025785	0.055130	0.042328	0.019168	0.000685	0.000000	0.143095
281.25 - 303.75	0.027131	0.064097	0.101314	0.032653	0.001050	0.000068	0.226314
303.75 - 326.25	0.031193	0.044565	0.046983	0.007735	0.000000	0.000000	0.130476
326.25 - 348.75	0.033292	0.027314	0.007553	0.000616	0.000000	0.000000	0.068775
Sub-Total:	0.396039	0.284068	0.238933	0.075301	0.002533	0.000091	0.996965
Calms:							0.003035
Missing/Incomplete:							0.000000
Total:							1.000000

Frequency of Calm Winds: 0.30%
Average Wind Speed: 2.96 m/s

Station ID: 1901 Run ID: Winter
Year: 1990 1991 1992 1993 1994
Date Range: Jan 1 - Mar 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	318	63	20	14	0	0	415
11.25 - 33.75	277	34	11	4	0	0	326
33.75 - 56.25	247	19	8	0	0	0	274
56.25 - 78.75	327	17	2	0	0	0	346
78.75 - 101.25	424	24	0	0	0	0	448
101.25 - 123.75	624	126	10	0	0	0	760
123.75 - 146.25	676	308	106	20	0	0	1110
146.25 - 168.75	372	275	295	184	6	0	1132
168.75 - 191.25	262	128	104	49	3	0	546
191.25 - 213.75	192	74	42	16	4	0	328
213.75 - 236.25	174	109	46	16	0	0	345
236.25 - 258.75	231	152	66	19	0	0	468
258.75 - 281.25	368	480	277	95	2	0	1222
281.25 - 303.75	346	551	539	144	6	0	1586
303.75 - 326.25	356	374	190	16	0	0	936
326.25 - 348.75	364	174	28	11	0	0	577
Sub-Total:	5558	2908	1744	588	21	0	10819
Calms:							5
Missing/Incomplete:							0
Total:							10824

Frequency of Calm Winds: 0.05%
Average Wind Speed: 2.55 m/s

Station ID: 1901 Run ID:
Year: 1990 1991 1992 1993 1994
Date Range: Jan 1 - Mar 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.029379	0.005820	0.001848	0.001293	0.000000	0.000000	0.038341
11.25 - 33.75	0.025591	0.003141	0.001016	0.000370	0.000000	0.000000	0.030118
33.75 - 56.25	0.022820	0.001755	0.000739	0.000000	0.000000	0.000000	0.025314
56.25 - 78.75	0.030211	0.001571	0.000185	0.000000	0.000000	0.000000	0.031966
78.75 - 101.25	0.039172	0.002217	0.000000	0.000000	0.000000	0.000000	0.041390
101.25 - 123.75	0.057650	0.011641	0.000924	0.000000	0.000000	0.000000	0.070214
123.75 - 146.25	0.062454	0.028455	0.009793	0.001848	0.000000	0.000000	0.102550
146.25 - 168.75	0.034368	0.025407	0.027254	0.016999	0.000554	0.000000	0.104582
168.75 - 191.25	0.024205	0.011826	0.009608	0.004527	0.000277	0.000000	0.050443
191.25 - 213.75	0.017738	0.006837	0.003880	0.001478	0.000370	0.000000	0.030303
213.75 - 236.25	0.016075	0.010070	0.004250	0.001478	0.000000	0.000000	0.031874
236.25 - 258.75	0.021341	0.014043	0.006098	0.001755	0.000000	0.000000	0.043237
258.75 - 281.25	0.033999	0.044346	0.025591	0.008777	0.000185	0.000000	0.112897
281.25 - 303.75	0.031966	0.050905	0.049797	0.013304	0.000554	0.000000	0.146526
303.75 - 326.25	0.032890	0.034553	0.017554	0.001478	0.000000	0.000000	0.086475
326.25 - 348.75	0.033629	0.016075	0.002587	0.001016	0.000000	0.000000	0.053307
Sub-Total:	0.513489	0.268662	0.161123	0.054324	0.001940	0.000000	0.999538
Calms:							0.000462
Missing/Incomplete:							0.000000
Total:							1.000000

Frequency of Calm Winds: 0.05%
Average Wind Speed: 2.55 m/s

Station ID: 1901 Run ID: Spring
Year: 1990 1991 1992 1993 1994
Date Range: Apr 1 - Jun 30
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	277	114	14	25	7	0	437
11.25 - 33.75	196	20	0	2	1	0	219
33.75 - 56.25	117	5	0	0	0	0	122
56.25 - 78.75	111	0	0	0	0	0	111
78.75 - 101.25	182	3	0	0	0	0	185
101.25 - 123.75	291	36	0	0	0	0	327
123.75 - 146.25	161	106	29	3	0	0	299
146.25 - 168.75	97	82	78	17	0	0	274
168.75 - 191.25	86	82	55	16	0	0	239
191.25 - 213.75	80	59	26	5	0	0	170
213.75 - 236.25	88	185	87	20	0	0	380
236.25 - 258.75	99	280	190	42	0	0	611
258.75 - 281.25	150	622	847	543	23	0	2185
281.25 - 303.75	159	749	1664	850	30	3	3455
303.75 - 326.25	199	413	555	148	0	0	1315
326.25 - 348.75	211	265	76	2	0	0	554
Sub-Total:	2504	3021	3621	1673	61	3	10883
Calms:							37
Missing/Incomplete:							0
Total:							10920

Frequency of Calm Winds: 0.34%
Average Wind Speed: 3.73 m/s

Station ID: 1901 Run ID:
Year: 1990 1991 1992 1993 1994
Date Range: Apr 1 - Jun 30
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.025366	0.010440	0.001282	0.002289	0.000641	0.000000	0.040018
11.25 - 33.75	0.017949	0.001832	0.000000	0.000183	0.000092	0.000000	0.020055
33.75 - 56.25	0.010714	0.000458	0.000000	0.000000	0.000000	0.000000	0.011172
56.25 - 78.75	0.010165	0.000000	0.000000	0.000000	0.000000	0.000000	0.010165
78.75 - 101.25	0.016667	0.000275	0.000000	0.000000	0.000000	0.000000	0.016941
101.25 - 123.75	0.026648	0.003297	0.000000	0.000000	0.000000	0.000000	0.029945
123.75 - 146.25	0.014744	0.009707	0.002656	0.000275	0.000000	0.000000	0.027381
146.25 - 168.75	0.008883	0.007509	0.007143	0.001557	0.000000	0.000000	0.025092
168.75 - 191.25	0.007875	0.007509	0.005037	0.001465	0.000000	0.000000	0.021886
191.25 - 213.75	0.007326	0.005403	0.002381	0.000458	0.000000	0.000000	0.015568
213.75 - 236.25	0.008059	0.016941	0.007967	0.001832	0.000000	0.000000	0.034799
236.25 - 258.75	0.009066	0.025641	0.017399	0.003846	0.000000	0.000000	0.055952
258.75 - 281.25	0.013736	0.056960	0.077564	0.049725	0.002106	0.000000	0.200092
281.25 - 303.75	0.014560	0.068590	0.152381	0.077839	0.002747	0.000275	0.316392
303.75 - 326.25	0.018223	0.037821	0.050824	0.013553	0.000000	0.000000	0.120421
326.25 - 348.75	0.019322	0.024267	0.006960	0.000183	0.000000	0.000000	0.050733
Sub-Total:	0.229304	0.276648	0.331593	0.153205	0.005586	0.000275	0.996612
Calms:							0.003388
Missing/Incomplete:							0.000000
Total:							1.000000

Frequency of Calm Winds: 0.34%
Average Wind Speed: 3.73 m/s

Station ID: 1901 Run ID: Summer
Year: 1990 1991 1992 1993 1994
Date Range: Jul 1 - Sep 30
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	413	213	16	0	0	0	642
11.25 - 33.75	219	10	0	0	0	0	229
33.75 - 56.25	118	0	0	0	0	0	118
56.25 - 78.75	118	3	0	0	0	0	121
78.75 - 101.25	98	0	0	0	0	0	98
101.25 - 123.75	144	15	0	0	0	0	159
123.75 - 146.25	139	42	2	0	0	0	183
146.25 - 168.75	96	65	8	0	0	0	169
168.75 - 191.25	79	31	7	0	0	0	117
191.25 - 213.75	61	21	3	0	0	0	85
213.75 - 236.25	72	87	17	2	0	0	178
236.25 - 258.75	110	151	86	6	1	0	354
258.75 - 281.25	213	736	537	157	0	0	1643
281.25 - 303.75	279	850	1715	343	0	0	3187
303.75 - 326.25	442	761	1128	161	0	0	2492
326.25 - 348.75	493	561	179	5	0	0	1238
Sub-Total:	3094	3546	3698	674	1	0	11013
Calms:							27
Missing/Incomplete:							0
Total:							11040

Frequency of Calm Winds: 0.24%
Average Wind Speed: 3.23 m/s

Station ID: 1901 Run ID:
Year: 1990 1991 1992 1993 1994
Date Range: Jul 1 - Sep 30
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.037409	0.019293	0.001449	0.000000	0.000000	0.000000	0.058152
11.25 - 33.75	0.019837	0.000906	0.000000	0.000000	0.000000	0.000000	0.020743
33.75 - 56.25	0.010688	0.000000	0.000000	0.000000	0.000000	0.000000	0.010688
56.25 - 78.75	0.010688	0.000272	0.000000	0.000000	0.000000	0.000000	0.010960
78.75 - 101.25	0.008877	0.000000	0.000000	0.000000	0.000000	0.000000	0.008877
101.25 - 123.75	0.013043	0.001359	0.000000	0.000000	0.000000	0.000000	0.014402
123.75 - 146.25	0.012591	0.003804	0.000181	0.000000	0.000000	0.000000	0.016576
146.25 - 168.75	0.008696	0.005888	0.000725	0.000000	0.000000	0.000000	0.015308
168.75 - 191.25	0.007156	0.002808	0.000634	0.000000	0.000000	0.000000	0.010598
191.25 - 213.75	0.005525	0.001902	0.000272	0.000000	0.000000	0.000000	0.007699
213.75 - 236.25	0.006522	0.007880	0.001540	0.000181	0.000000	0.000000	0.016123
236.25 - 258.75	0.009964	0.013678	0.007790	0.000543	0.000091	0.000000	0.032065
258.75 - 281.25	0.019293	0.066667	0.048641	0.014221	0.000000	0.000000	0.148822
281.25 - 303.75	0.025272	0.076993	0.155344	0.031069	0.000000	0.000000	0.288678
303.75 - 326.25	0.040036	0.068931	0.102174	0.014583	0.000000	0.000000	0.225725
326.25 - 348.75	0.044656	0.050815	0.016214	0.000453	0.000000	0.000000	0.112138
Sub-Total:	0.280254	0.321196	0.334964	0.061051	0.000091	0.000000	0.997554
Calms:							0.002446
Missing/Incomplete:							0.000000
Total:							1.000000

Frequency of Calm Winds: 0.24%
Average Wind Speed: 3.23 m/s

Station ID: 1901 Run ID: Fall
Year: 1990 1991 1992 1993 1994
Date Range: Oct 1 - Dec 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Count)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	357	106	56	46	9	1	575
11.25 - 33.75	326	39	20	20	1	0	406
33.75 - 56.25	374	35	19	1	0	0	429
56.25 - 78.75	354	12	1	0	0	0	367
78.75 - 101.25	516	24	0	0	0	0	540
101.25 - 123.75	720	114	5	0	0	0	839
123.75 - 146.25	730	289	65	6	1	0	1091
146.25 - 168.75	402	174	182	104	1	0	863
168.75 - 191.25	240	78	43	12	1	0	374
191.25 - 213.75	173	50	16	4	0	0	243
213.75 - 236.25	189	83	19	3	0	0	294
236.25 - 258.75	254	131	32	7	0	0	424
258.75 - 281.25	399	578	194	45	5	0	1221
281.25 - 303.75	405	659	522	94	10	0	1690
303.75 - 326.25	370	405	186	14	0	0	975
326.25 - 348.75	391	197	48	9	0	0	645
Sub-Total:	6200	2974	1408	365	28	1	10976
Calms:							64
Missing/Incomplete:							0
Total:							11040

Frequency of Calm Winds: 0.58%
Average Wind Speed: 2.31 m/s

Station ID: 1901 Run ID:
Year: 1990 1991 1992 1993 1994
Date Range: Oct 1 - Dec 31
Time Range: 00:00 - 23:00

Frequency Distribution
(Normalized)

Wind Direction	Speed m/s 0.5 - 2.1	2.1 - 3.6	3.6 - 5.7	5.7 - 8.8	8.8 - 11.1	>= 11.1	Total
348.75 - 11.25	0.032337	0.009601	0.005072	0.004167	0.000815	0.000091	0.052083
11.25 - 33.75	0.029529	0.003533	0.001812	0.001812	0.000091	0.000000	0.036775
33.75 - 56.25	0.033877	0.003170	0.001721	0.000091	0.000000	0.000000	0.038859
56.25 - 78.75	0.032065	0.001087	0.000091	0.000000	0.000000	0.000000	0.033243
78.75 - 101.25	0.046739	0.002174	0.000000	0.000000	0.000000	0.000000	0.048913
101.25 - 123.75	0.065217	0.010326	0.000453	0.000000	0.000000	0.000000	0.075996
123.75 - 146.25	0.066123	0.026178	0.005888	0.000543	0.000091	0.000000	0.098822
146.25 - 168.75	0.036413	0.015761	0.016486	0.009420	0.000091	0.000000	0.078170
168.75 - 191.25	0.021739	0.007065	0.003895	0.001087	0.000091	0.000000	0.033877
191.25 - 213.75	0.015670	0.004529	0.001449	0.000362	0.000000	0.000000	0.022011
213.75 - 236.25	0.017120	0.007518	0.001721	0.000272	0.000000	0.000000	0.026630
236.25 - 258.75	0.023007	0.011866	0.002899	0.000634	0.000000	0.000000	0.038406
258.75 - 281.25	0.036141	0.052355	0.017572	0.004076	0.000453	0.000000	0.110598
281.25 - 303.75	0.036685	0.059692	0.047283	0.008514	0.000906	0.000000	0.153080
303.75 - 326.25	0.033514	0.036685	0.016848	0.001268	0.000000	0.000000	0.088315
326.25 - 348.75	0.035417	0.017844	0.004348	0.000815	0.000000	0.000000	0.058424
Sub-Total:	0.561594	0.269384	0.127536	0.033062	0.002536	0.000091	0.994203
Calms:							0.005797
Missing/Incomplete:							0.000000
Total:							1.000000

Frequency of Calm Winds: 0.58%
Average Wind Speed: 2.31 m/s

NEWARK, CALIFORNIA (046144)

Period of Record Monthly Climate Summary

Period of Record : 7/ 1/1948 to 12/31/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	57.2	60.8	63.6	66.7	70.1	74.0	76.8	77.2	77.2	72.8	64.6	57.8	68.2
Average Min. Temperature (F)	41.1	44.1	46.3	48.7	52.0	55.3	56.7	57.5	56.5	52.8	46.8	41.4	49.9
Average Total Precipitation (in.)	3.07	2.45	2.17	1.06	0.42	0.11	0.02	0.06	0.14	0.74	1.82	2.50	14.56
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 95.7% Min. Temp.: 95.6% Precipitation: 99.3% Snowfall: 99.4% Snow Depth: 99.4%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

NEWARK, CALIFORNIA

NCDC 1971-2000 Monthly Normals

		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Monthly
Mean Max. Temperature (F)	57.6	61.4	64.3	68.1	71.5	75.9	78.3	78.6	78.0	73.5	64.4	57.7	69
Highest Mean Max. Temperature (F)	60.7	65.0	69.0	73.8	77.4	82.5	82.4	82.1	86.0	77.1	69.3	61.5	86.0
Year Highest Occurred	1986	1991	1997	1987	1997	1981	1984	1998	1984	1992	1995	1995	1984
Lowest Mean Max. Temperature (F)	54.1	56.6	60.0	61.7	65.7	71.3	74.1	75.4	74.3	69.3	59.4	52.8	52.8
Year Lowest Occurred	1982	1989	1973	1975	1977	1982	2000	1991	1986	1975	1994	1972	1972
Mean Temperature (F)	49.8	53.3	55.8	59.0	62.2	65.9	68.0	68.5	67.8	63.7	55.8	49.7	60.0
Highest Mean Temperature (F)	54.7	56.3	60.0	63.8	67.2	72.7	72.7	71.8	74.5	66.8	59.8	54.5	74.5
Year Highest Occurred	1986	1995	1984	1985	1997	1981	1984	1983	1984	1983	1995	1995	1984
Lowest Mean Temperature (F)	46.3	48.4	51.1	53.5	57.5	61.2	65.9	65.7	64.9	59.7	50.8	44.1	44.1
Year Lowest Occurred	1992	1989	1991	1975	1999	1991	2000	1991	1989	1971	1994	1990	1990
Mean Min. Temperature (F)	42.0	45.1	47.3	49.8	52.9	55.9	57.7	58.4	57.5	53.8	47.1	41.7	50.8
Highest Mean Min. Temperature (F)	48.8	49.6	51.9	55.7	57.0	62.9	63.0	63.0	63.3	58.3	53.2	49.3	63.3
Year Highest Occurred	1995	1983	1984	1985	1997	1981	1984	1983	1983	1983	1981	1983	1983
Lowest Mean Min. Temperature (F)	35.5	39.3	42.1	45.3	47.7	50.4	54.2	54.7	53.3	46.6	40.3	33.7	33.7
Year Lowest Occurred	1976	1994	1991	1975	1991	1991	1993	1992	1993	1971	1971	1990	1990
Mean Precipitation (in.)	2.97	2.89	2.39	0.94	0.42	0.12	0.03	0.07	0.20	0.90	1.84	2.08	4.85
Highest Precipitation (in.)	8.36	10.79	7.17	3.50	2.06	1.10	0.38	0.65	0.86	2.87	6.04	5.67	10.79
Year Highest Occurred	1995	1998	1983	1983	1998	1995	1980	1976	1982	1972	1983	1996	1998
Lowest Precipitation (in.)	0.14	0.16	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Year Lowest													

Occurred	1984	1995	1972	1985	1992	1996	2000	1999	1997	1995	1995	1989	1992
Heating Degree Days (F)	471.	331	290.	197.	129.	52.	19.	7.	35.	82.	280.	474.	2367.
Cooling Degree Days (F)	0.	1	6.	15.	42.	79.	12.	115.	118.	40.	2.	0.	530.

Western Regional Climate Center, wrcc@dri.edu

NEWARK, CALIFORNIA

NCDC 1961-1990 Monthly Normals

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Max. Temperature (F)	56.8	60.8	62.9	66.1	69.4	73.7	76.1	76.5	76.6	72.4	63.9	57.0	67.7
Highest Mean Max. Temperature (F)	60.7	64.5	67.7	72.6	73.5	80.5	81.3	81.8	84.3	75.7	68.3	61.2	69.0
Year Highest Occurred	1986	1988	1988	1987	1978	1981	1961	1969	1984	1967	1967	1979	1984
Lowest Mean Max. Temperature (F)	53.6	55.7	59.2	56.4	64.1	69.0	71.0	73.2	72.6	68.3	59.4	52.8	65.9
Year Lowest Occurred	1963	1969	1973	1967	1977	1965	1966	1966	1986	1975	1985	1972	1965
Mean Temperature (F)	49.0	52.7	54.8	57.6	60.9	64.7	66.7	67.3	66.9	62.9	55.6	49.4	59.0
Highest Mean Temperature (F)	54.7	56.7	59.6	63.3	65.1	71.7	71.6	70.8	73.7	66.3	59.4	54.1	61.5
Year Highest Occurred	1986	1963	1984	1985	1984	1981	1984	1983	1984	1983	1981	1983	1983
Lowest Mean Temperature (F)	44.4	48.3	50.8	50.3	56.2	61.3	62.6	64.6	63.7	59.2	52.0	44.0	57.3
Year Lowest Occurred	1963	1989	1964	1967	1964	1965	1966	1966	1965	1971	1975	1990	1975
Mean Min. Temperature (F)	41.1	44.7	46.6	49.1	52.3	55.7	57.2	58.1	57.1	53.4	47.2	41.7	50.4
Highest Mean Min. Temperature (F)	48.6	50.0	51.9	55.7	56.8	62.9	63.0	63.0	63.3	58.3	53.2	49.3	54.7
Year Highest Occurred	1986	1968	1984	1985	1984	1981	1984	1983	1983	1983	1981	1983	1983
Lowest Mean Min. Temperature (F)	35.1	36.9	40.4	43.4	47.3	51.2	52.3	54.8	53.6	46.6	40.3	33.7	47.3
Year Lowest Occurred	1963	1964	1964	1968	1964	1962	1962	1962	1961	1971	1971	1990	1961
Mean Precipitation (in.)	2.67	2.13	2.12	1.09	0.24	0.09	0.04	0.08	0.20	0.92	2.12	2.03	13.73
Highest Precipitation (in.)	6.26	6.62	7.17	4.19	1.88	0.63	0.38	0.72	0.86	4.53	6.04	4.87	31.52
Year Highest Occurred	1978	1962	1983	1963	1990	1974	1980	1968	1982	1962	1983	1970	1983
Lowest Precipitation (in.)	0.14	0.00	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	6.89
Year Lowest Occurred	1984	1964	1972	1985	1984	1990	1990	1990	1987	1978	1986	1989	1976

Heating Degree Days (F)	496.	344.	320.	240.	151	71	38.	14.	46.	92.	282.	484.
Cooling Degree Days (F)	0.	0.	0.	18.	24.	62.	90.	86.	103.	27.	0.	0.

Western Regional Climate Center, wrcc@dri.edu

OAKLAND WSO AP, CALIFORNIA (046335)

Period of Record Monthly Climate Summary

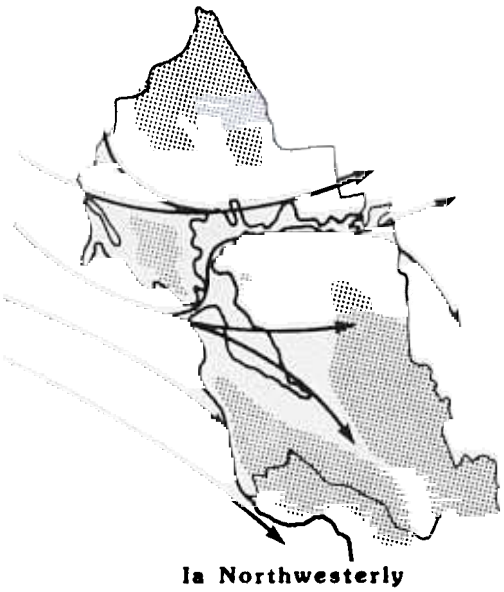
Period of Record : 7/ 1/1948 to 12/31/2005

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	55.2	59.0	61.2	64.0	66.6	69.5	70.9	71.5	73.5	69.9	62.6	56.0	65.0
Average Min. Temperature (F)	42.0	45.2	46.6	48.7	51.7	54.6	56.1	56.9	56.7	52.8	47.5	42.8	50.1
Average Total Precipitation (in.)	3.84	2.73	2.40	1.36	0.36	0.13	0.05	0.05	0.24	1.12	2.56	3.20	18.03
Average Total SnowFall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 93.3% Min. Temp.: 93.3% Precipitation: 91.5% Snowfall: 91.6% Snow Depth: 91.6%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

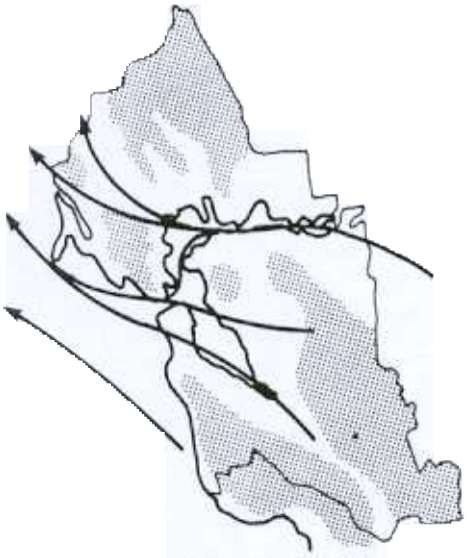
- BAY AREA AIR FLOW PATTERN TYPES



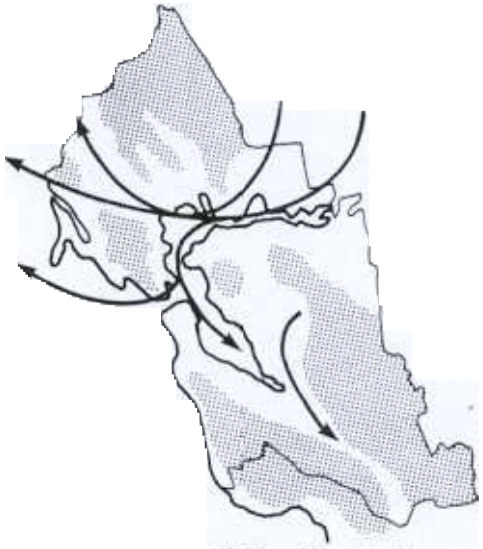
Ia Northwesterly
(moderate to strong)

Ib Northwesterly
(weak)

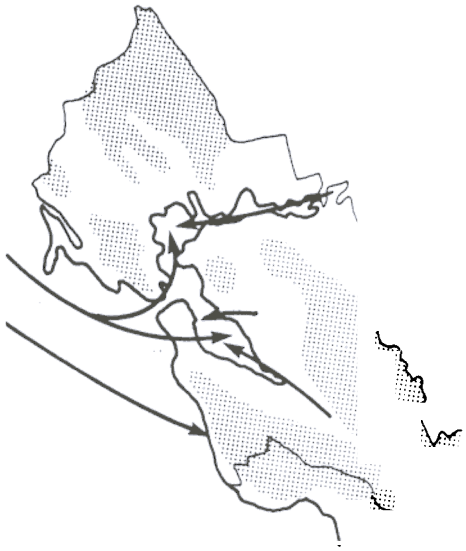
II Southerly



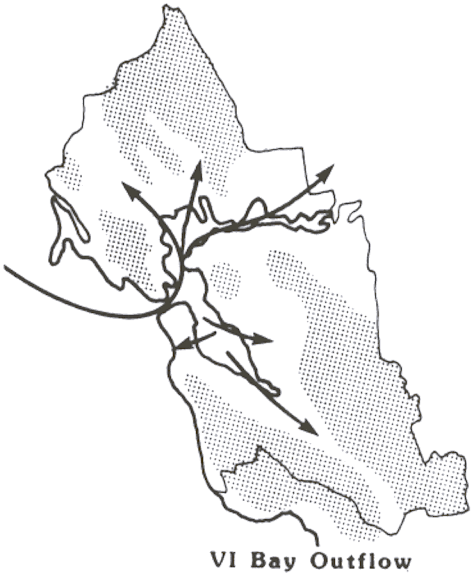
III Southeasterly



IV Northeasterly



V Bay Inflow



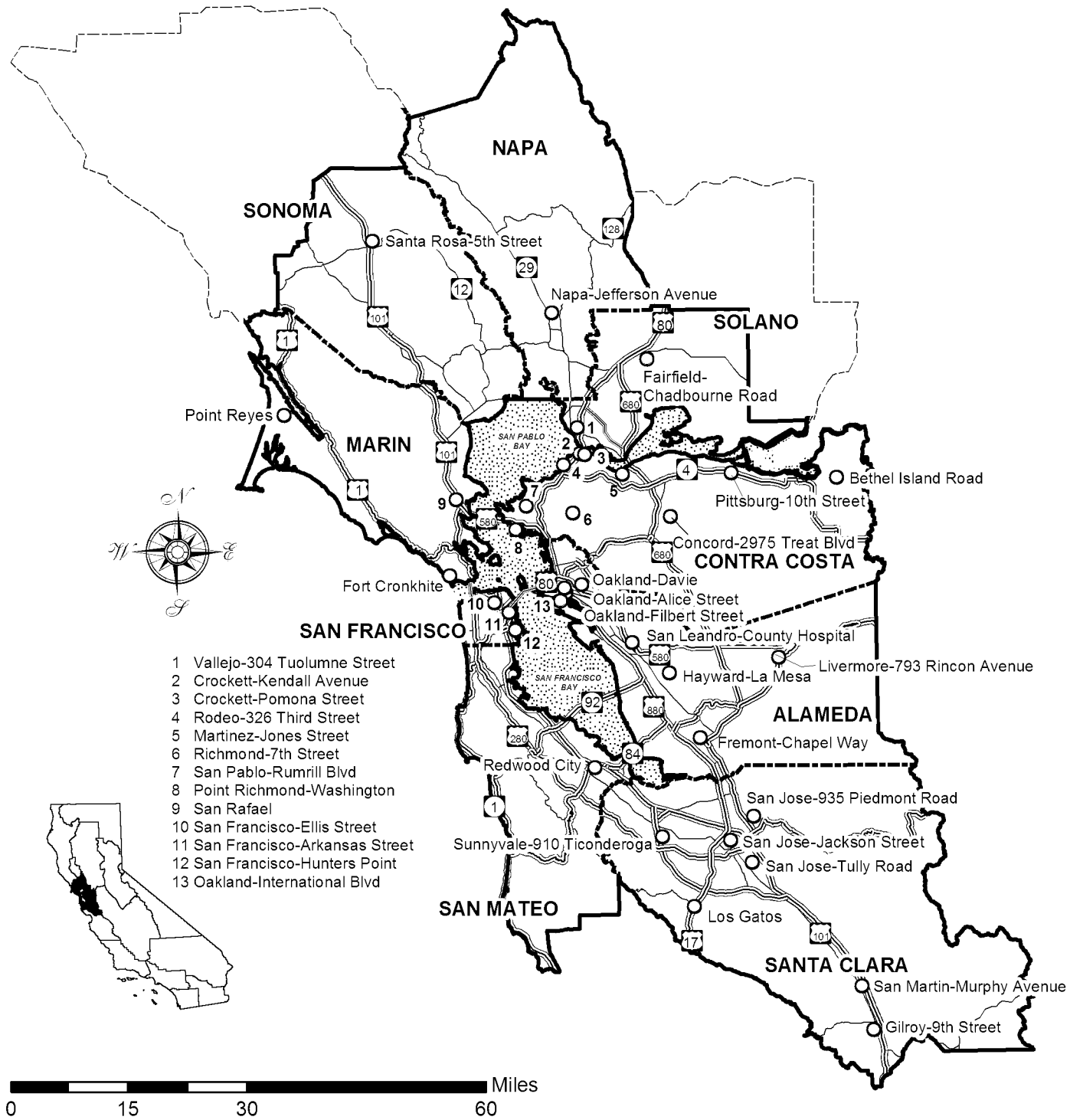
VI Bay Outflow

SAN FRANCISCO BAY AREA AIR BASIN SURFACE AIRFLOW TYPES
SEASONAL AND DIURNAL PERCENTAGE OF OCCURRENCE
(1977-1981 Data)

Types / Time - PST	Ib North-westerly (Weak)	Ia North-westerly (Moderate to Strong)	II South-erly	III South-easterly	IV North-easterly	V Bay Inflow	VI Bay Out-flow	VII Calm
Winter								
4 a.m.	3	4	19	14	8	21	5	24
10 a.m.	4	5	19	20	10	11	19	0
4 p.m.	16	16	16	12	13	3	22	-
10 p.m.	6	9	14	14	10	20	3	21
All Times	7	9	17	15	10	14	12	14
Spring								
4 a.m.	27	25	11	2	4	15	5	12
10 a.m.	29	25	14	6	5	3	17	1
4 p.m.	22	60	7	4	4	2	2	*
10 p.m.	40	34	8	2	4	5	3	5
All Times	29	36	10	3	4	6	7	5
Summer								
4 a.m.	40	37	4	*	0	6	2	10
10 a.m.	37	44	4	*	1	1	13	0
4 p.m.	20	77	2	0	1	0	*	0
10 p.m.	39	55	2	0	*	1	1	1
All Times	34	53	3	0	1	2	4	
Fall								
4 a.m.	25	13	7	6	3	22	3	19
10 a.m.	28	15	6	11	6	7	23	4
4 p.m.	31	46	5	2	6	2	7	*
10 p.m.	37	24	6	4	3	13	1	12
All Times	30	24	6	6	4	11	9	9
Yearly								
4 a.m.	24	20	10	6	4	16	4	16
10 a.m.	25	22	11	9	6	6	18	4
4 p.m.	22	50	8	5	6	2	7	*
10 p.m.	31	30	8	5	4	10	2	10
All Times	26	30	9	6	5	8	8	8

< 0.5 percent

Figure 13. San Francisco Bay Area Air Basin Monitoring Stations (2003-2005)



BAY AREA AIR POLLUTION SUMMARY — 2000

—See notes of explanation on back of this page

MONITORING STATIONS	OZONE							CARBON MONOXIDE			NITROGEN DIOXIDE			SULFUR DIOXIDE			PM_{10}				
	Max 1-Hr	Nat Days	Cal Days	3-Yr Avg*	Max 8-Hr	Nat Days	3-Yr Avg**	Max 1-Hr	Max 8-Hr	Nat/Cal Days	Max 1-Hr	Ann Avg	Nat/Cal Days	Max 24-Hr	Ann Avg	Nat/Cal Days	Ann Geo Mean	Ann Avg	Max 24-Hr	Nat Days***	Cal Days***
North Counties	(pphm)				(pphm)			(ppm)			(pphm)			(ppb)			($\mu g/m^3$)				
Napa	8	0	0	0.3	6	0	6.9	4.7	2.8	0	5	1.2	0	-	-	-	14.7	16.2	45	0	0
San Rafael	7	0	0	0.0	6	0	5.0	4.2	2.3	0	6	1.6	0	-	-	-	18.2	19.5	40	0	0
Santa Rosa	8	0	0	0.0	6	0	5.5	4.5	3.1	0	5	1.3	0	-	-	-	15.9	17.5	46	0	0
Vallejo	8	0	0	0.0	6	0	6.1	6.5	5.1	0	6	1.3	0	5	1.5	0	13.0	15.0	53	0	1
Coast & Central Bay																					
Oakland	7	0	0	0.0	5	0	4.1	5.4	3.4	0	-	-	-	-	-	-	-	-	-	-	-
San Francisco	6	0	0	0.0	4	0	4.4	5.5	3.2	0	7	2.0	0	8	2.4	0	21.7	24.0	63	0	2
San Pablo	8	0	0	0.0	7	0	4.7	2.8	1.9	0	7	1.4	0	7	2.0	0	-	-	-	-	-
Eastern District																					
Bethel Island	12	0	1	0.3	9	1	8.4	2.3	1.5	0	4	1.0	0	7	1.6	0	17.5	20.0	62	0	1
Concord	14	1	2	1.7	9	1	8.4	4.5	2.7	0	7	1.6	0	4	1.6	0	16.2	17.8	54	0	1
Crockett	-	-	-	-	-	-	-	-	-	-	-	-	-	24	2.5	0	-	-	-	-	-
Fairfield	10	0	1	0.3	8	0	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livermore	15	2	7	3.3	11	2	8.7	4.5	2.7	0	7	1.7	0	-	-	-	19.4	21.8	71	0	2
Martinez	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1.1	0	-	-	-	-	-
Pittsburg	11	0	1	0.0	8	0	7.2	4.9	2.7	0	5	1.3	0	7	1.7	0	13.9	16.4	56	0	2
South Central Bay																					
Fremont	10	0	2	0.3	8	0	6.3	4.6	2.7	0	8	2.0	0	-	-	-	19.4	21.5	58	0	1
Hayward	11	0	1	0.0	8	0	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mountain View[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redwood City	8	0	0	0.0	6	0	4.7	9.8	4.4	0	7	1.8	0	-	-	-	19.1	21.2	53	0	1
San Leandro	10	0	1	0.0	6	0	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara Valley																					
Gilroy[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos	8	0	0	0.3	7	0	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, 4th Street	7	0	0	0.3	6	0	6.2	8.4	6.3	0	11	2.5	0	-	-	-	23.8	26.7	76	0	7
San Jose East	10	0	1	0.3	7	0	6.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, Tully Road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.4	21.5	69	0	2
San Martin	11	0	4	1.3	10	1	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Bay Area Days over Standard		**3**	**12**			**4**				**0**			**0**			**0**				**0**	**7**

[1]Out of service in 2000 (see Notes on back)

*Average number of days of exceedence (see Notes on back)

**Average of the fourth highest concentration (see Notes on back)

***PM_{10} measurements are based on a one in every six days sampling schedule, for a total of approximately 60 samples per year.

NOTES

The annual Bay Area Air Pollution Summary summarizes measurements for the national and California time-averaged pollutant standards.

The national eight-hour average ozone standard, proposed in 1997, was remanded by the US Supreme Court to EPA in April 2001 pending the development of a new ozone implementation policy.

The Mountain View station was closed on November 30, 1999. It was replaced by a new monitoring station in Sunnyvale in 2001. The Gilroy station was closed for the year 2000 due to construction activity, but was reactivated in 2001.

Explanation of Terms

State and national excesses occur when pollutant concentrations surpass the indicated standards, with values in most cases rounded to the same number of decimal places.

MAX HR / MAX 8-HR / MAX 24-HR
The highest average contaminant concentration over a one-hour period, an eight-hour period, or a 24-hour period.

NAT DAYS
The number of days during the year for which the monitoring station recorded contaminant concentration levels in excess of the national standard.

CAL DAYS
The number of days during the year for which the station recorded contaminant levels in excess of the California standard.

3-YR AVG (1-hr ozone standard)
The average number of days per year in excess of the national ozone standard, based on the most recent three-year period. *An average higher than 1.0 means the region will be considered out of attainment by the EPA.*

3-YR AVG (8-hr ozone standard)
The average of the fourth highest 8-hour average ozone concentration for each monitoring station, based on the most recent three-year period. *A concentration greater than 8.5 means that the region will be considered out of attainment by the EPA.*

ANN AVG
The yearly average (arithmetic mean) of the readings taken at a given monitoring station.

ANN GEO MEAN
The annual geometric mean concentration level (used for PM_{10}). The geometric mean of *n* positive numbers is the *n*th root of their product.

PM_{10}
Particulate matter ten microns or smaller in size. PM_{10} measurements are based on a one in every six days sampling schedule, for a total of approximately 60 samples per year.

TOTAL BAY AREA DAYS OVER STANDARD is not a sum of excesses at individual stations, but rather of the number of days for which excesses occurred at any one or more stations.

HEALTH-BASED AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Std	National Std
Ozone	1 Hour	9 pphm	12 pphm
	8 Hour	—	8 pphm
Carbon Monoxide	1 Hour	20 ppm	35 ppm
	8 Hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 Hour	25 pphm	—
	Annual	—	5.3 pphm
Sulfur Dioxide	24 Hour	40 ppb	140 ppb
	Annual	—	30 ppb
Particulates < 10 microns	24 Hour	50 µg/m^3	150 µg/m^3
	Annual	—	50 µg/m^3
	Annual Geometric Mean	30 µg/m^3	—

Concentrations
ppm parts per million | **pphm** parts per hundred million | **ppb** parts per billion | **µg/m^3** micrograms per cubic meter

TEN-YEAR BAY AREA AIR QUALITY SUMMARY

YEAR	OZONE			CARBON MONOXIDE				Nitrogen Dioxide	Sulfur Dioxide		PM_{10}	
	1-Hr		8-Hr*	1-Hr		8-Hr		1-Hr	24-Hr		24-Hr	
	Nat	Cal	Nat	Nat	Cal	Nat	Cal	Cal	Nat	Cal	Nat**	Cal**
1991	2	23	-	0	0	4	5	0	0	0	2	18
1992	2	23	-	0	0	0	0	0	0	0	0	18
1993	3	19	-	0	0	0	0	0	0	0	0	10
1994	2	13	-	0	0	0	0	0	0	0	0	9
1995	11	28	-	0	0	0	0	0	0	0	0	7
1996	8	34	-	0	0	0	0	0	0	0	0	3
1997	0	8	-	0	0	0	0	0	0	0	0	4
1998	8	29	16	0	0	0	0	0	0	0	0	5
1999	3	20	9	0	0	0	0	0	0	0	0	12
2000	3	12	4	0	0	0	0	0	0	0	0	7

*EPA proposed the 8-Hr standard in mid-1997 and it was remanded by the Supreme Court in 2001.

**PM_{10} measurements are based on a one in every six days sampling schedule, for a total of approximately 60 samples per year.

BAY AREA AIR POLLUTION SUMMARY — 2001

—See notes of explanation on back of this page

MONITORING STATIONS	OZONE							CARBON MONOXIDE			NITROGEN DIOXIDE			SULFUR DIOXIDE			PM_{10}				
	Max 1-Hr	Nat Days	Cal Days	3-Yr Avg	Max 8-Hr	Nat Days	3-Yr Avg	Max 1-Hr	Max 8-Hr	Nat/Cal Days	Max 1-Hr	Ann Avg	Nat/Cal Days	Max 24-Hr	Ann Avg	Nat/Cal Days	Ann Geo Mean	Ann Avg	Max 24-Hr	Nat Days*	Cal Days*
North Counties	(pphm)				(pphm)			(ppm)			(pphm)			(ppb)			($\mu g/m^3$)				
Napa	10	0	1	0.0	8	0	6.6	5.7	3.0	0	6	1.3	0	-	-	-	21.4	24.0	91	0	2
San Rafael	9	0	0	0.0	7	0	5.1	5.2	2.4	0	6	1.7	0	-	-	-	18.1	20.4	79	0	2
Santa Rosa	9	0	0	0.0	6	0	5.6	4.8	2.4	0	6	1.3	0	-	-	-	18.4	21.1	74	0	2
Vallejo	9	0	0	0.0	7	0	6.2	5.6	4.1	0	6	1.3	0	4	1.0	0	16.5	19.4	86	0	3
Coast & Central Bay																					
Oakland	7	0	0	0.0	4	0	4.2	5.0	4.0	0	-	-	-	-	-	-	-	-	-	-	-
San Francisco	8	0	0	0.0	5	0	4.6	4.0	3.3	0	7	1.9	0	7	2.1	0	22.9	26.4	67	0	7
San Pablo	9	0	0	0.0	8	0	4.8	2.3	1.4	0	6	1.4	0	5	1.3	0	-	-	-	-	-
Eastern District																					
Bethel Island	13	1	3	0.7	10	2	8.2	2.5	1.5	0	4	1.0	0	7	2.1	0	18.7	22.7	87	0	3
Concord	13	1	6	1.3	9	1	8.1	4.4	2.7	0	7	1.5	0	4	1.1	0	17.8	20.4	106	0	2
Crockett	-	-	-	-	-	-	-	-	-	-	-	-	-	16	1.7	0	-	-	-	-	-
Fairfield	10	0	3	0.3	8	0	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livermore	11	0	9	1.3	9	2	8.3	5.8	3.2	0	7	1.7	0	-	-	-	21.1	24.6	109	0	3
Martinez	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1.3	0	-	-	-	-	-
Pittsburg	12	0	2	0.0	9	1	7.3	5.2	2.4	0	6	1.4	0	11	2.7	0	16.6	20.6	98	-	-
South Central Bay																					
Fremont	11	0	3	0.3	8	0	6.2	5.4	2.7	0	8	1.9	0	-	-	-	20.8	23.4	58	0	3
Hayward	10	0	2	0.0	9	1	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redwood City	11	0	1	0.0	7	0	4.9	7.1	3.9	0	7	1.7	0	-	-	-	19.9	22.6	65	0	4
San Leandro	9	0	0	0.0	6	0	5.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara Valley																					
Gilroy	12	0	3	0.0	10	2	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos	12	0	2	0.0	9	1	6.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, 4th Street	11	0	2	0.0	7	0	6.0	7.6	5.1	0	11	2.4	0	-	-	-	25.6	28.9	77	0	4
San Jose East	9	0	0	0.0	6	0	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, Tully Road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.2	22.8	75	0	4
San Martin	12	0	7	0.3	9	2	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunnyvale	8	0	0	-	6	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Bay Area Days over Standard		**1**	**15**			**7**				**0**			**0**			**0**	*Since PM_{10} is only sampled every sixth day, *actual* days over standard can be estimated to be six times the numbers shown.			**0**	**10**

NOTES

The annual Bay Area Air Pollution Summary summarizes measurements for the federal and California time-averaged pollutant standards.

The federal eight-hour average ozone standard is in effect, but the U.S. Supreme Court has decreed that EPA must issue implementation guidance through new rulemaking.

The Gilroy station reopened on April 1, 2001. It was closed for the year 2000 due to major construction activity on the property. A new monitoring station in Sunnyvale was opened on April 1, 2001.

Explanation of Terms

State and federal excesses occur when pollutant concentrations surpass the indicated standards, with values in most cases rounded to the same number of decimal places.

MAX HR / MAX 8-HR / MAX 24-HR
The highest average contaminant concentration over a one-hour period, an eight-hour period, or a 24-hour period.

NAT DAYS
The number of days during the year for which the monitoring station recorded contaminant concentration levels in excess of the national standard.

CAL DAYS
The number of days during the year for which the station recorded contaminant levels in excess of the California standard.

3-YR AVG (1-hr ozone standard)
The average number of days per year in excess of the national ozone standard, based on the most recent three-year period. *An average higher than 1.0 means the region will be considered out of attainment by the EPA.*

3-YR AVG (8-hr ozone standard)
The average of the fourth highest 8-hour average ozone concentration for each monitoring station, based on the most recent three-year period. *A concentration greater than 8.5 means that the region will be considered out of attainment by the EPA.*

ANN AVG
The yearly average (arithmetic mean) of the readings taken at a given monitoring station.

ANN GEO MEAN
The annual geometric mean concentration level (used for PM_{10}). The geometric mean of *n* positive numbers is the *n*th root of their product.

PM_{10}
Particulate matter ten microns or smaller in size. (PM_{10} is only sampled every sixth day. *Actual* days over standard can be estimated to be six times the number shown.)

TOTAL BAY AREA DAYS OVER STANDARD is not a sum of excesses at individual stations, but rather of the number of days for which excesses occurred at any one or more stations.

HEALTH-BASED AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Std	National Std
Ozone	1 Hour	9 pphm	12 pphm
	8 Hour	—	8 pphm
Carbon Monoxide	1 Hour	20 ppm	35 ppm
	8 Hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 Hour	25 pphm	—
	Annual	—	5.3 pphm
Sulfur Dioxide	24 Hour	40 ppb	140 ppb
	Annual	—	30 ppb
Particulates < 10 microns	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	—	50 $\mu g/m^3$
	Annual Geometric Mean	30 $\mu g/m^3$	—

Concentrations
ppm parts per million | **pphm** parts per hundred million | **ppb** parts per billion | **$\mu g/m^3$** micrograms per cubic meter

TEN-YEAR BAY AREA AIR QUALITY SUMMARY

YEAR	OZONE			CARBON MONOXIDE				Nitrogen Dioxide	Sulfur Dioxide		PM_{10}	
	1-Hr		8-Hr*	1-Hr		8-Hr		1-Hr	24-Hr		24-Hr	
	Nat	Cal	Nat	Nat	Cal	Nat	Cal	Cal	Nat	Cal	Nat**	Cal**
1992	2	23	-	0	0	0	0	0	0	0	0	18
1993	3	19	-	0	0	0	0	0	0	0	0	10
1994	2	13	-	0	0	0	0	0	0	0	0	9
1995	11	28	-	0	0	0	0	0	0	0	0	7
1996	8	34	-	0	0	0	0	0	0	0	0	3
1997	0	8	-	0	0	0	0	0	0	0	0	4
1998	8	29	16	0	0	0	0	0	0	0	0	5
1999	3	20	9	0	0	0	0	0	0	0	0	12
2000	3	12	4	0	0	0	0	0	0	0	0	7
2001	1	15	7	0	0	0	0	0	0	0	0	10

*EPA promulgated the 8-Hr standard in mid-1997

**PM_{10} is sampled every sixth day—*actual* days over standard can be estimated to be six times the numbers listed.

BAY AREA AIR POLLUTION SUMMARY — 2002

—See NOTES on back of this page

MONITORING STATIONS	OZONE							CARBON MONOXIDE			NITROGEN DIOXIDE			SULFUR DIOXIDE			PM_{10}					$PM_{2.5}$				
	Max 1-Hr	Nat Days	Cal Days	3-Yr Avg	Max 8-Hr	Nat Days	3-Yr Avg	Max 1-Hr	Max 8-Hr	Nat/Cal Days	Max 1-Hr	Ann Avg	Nat/Cal Days	Max 24-Hr	Ann Avg	Nat/Cal Days	Ann Geo Mean	Ann Avg	Max 24-Hr	Nat Days	Cal Days	Max 24-Hr	Nat Days	3-Yr Avg	Ann Avg	3-Yr Avg
North Counties	(pphm)				(pphm)			(ppm)			(pphm)			(ppb)			($\mu g/m^3$)					($\mu g/m^3$)			($\mu g/m^3$)	
Napa	12	0	1	0.0	8	0	6.3	4.2	2.4	0	5	1.3	0	-	-	-	22.6	25.4	67	0	4	-	-	-	-	-
San Rafael	8	0	0	0.0	6	0	4.7	4.1	1.9	0	6	1.7	0	-	-	-	19.1	21.4	70	0	2	-	-	-	-	-
Santa Rosa	8	0	0	0.0	6	0	5.2	3.7	2.1	0	5	1.3	0	-	-	-	17.8	19.7	60	0	2	51	0	40.2	10.5	10.5
Vallejo	11	0	1	0.0	7	0	5.9	5.8	3.9	0	5	1.3	0	4	1.3	0	18.7	21.4	80	0	1	72	1	51.3	13.6	12.6
Coast & Central Bay																										
Oakland	5	0	0	0.0	4	0	4.0	4.4	3.3	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Richmond	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1.0	0	-	-	-	-	-	-	-	-	-	-
San Francisco	5	0	0	0.0	5	0	4.4	3.5	2.6	0	8	1.9	0	6	1.9	0	21.0	24.7	74	0	2	70	4	48.0	13.1	11.9
San Pablo*	7	0	0	0.0	5	0	4.5	3.7	1.8	0	5	*	0	5	*	0	*	*	67	0	3	-	-	-	-	-
Eastern District																										
Bethel Island	11	0	5	0.3	10	3	7.9	1.7	1.3	0	4	1.0	0	9	2.5	0	20.8	23.8	58	0	3	-	-	-	-	-
Concord	10	0	5	0.7	9	3	7.8	3.5	2.3	0	6	1.5	0	6	0.8	0	17.9	20.9	63	0	3	77	4	44.7	13.3	11.4
Crockett	-	-	-	-	-	-	-	-	-	-	-	-	-	12	1.8	0	-	-	-	-	-	-	-	-	-	-
Fairfield*	10	0	4	0.0	8	0	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livermore	16	2	10	1.0	11	6	8.2	4.8	2.5	0	8	1.7	0	-	-	-	21.5	24.5	64	0	2	62	0	47.7	13.8	12.3
Martinez	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.2	0	-	-	-	-	-	-	-	-	-	-
Pittsburg	11	0	4	0.0	10	2	7.4	6.2	2.5	0	5	1.3	0	14	2.5	0	21.1	23.7	73	0	3	-	-	-	-	-
South Central Bay																										
Fremont	11	0	3	0.0	7	0	6.1	3.7	2.2	0	6	1.9	0	-	-	-	20.0	22.5	52	0	1	48	0	41.6	12.5	11.4
Hayward	9	0	0	0.0	7	0	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redwood City	9	0	0	0.0	6	0	5.3	5.8	2.8	0	7	1.7	0	-	-	-	19.5	22.0	53	0	1	43	0	41.8	11.5	11.3
San Leandro	10	0	1	0.0	6	0	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara Valley																										
Gilroy*	12	0	6	*	9	2	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos*	11	0	4	0.0	9	2	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose Central*	*	*	*	*	*	*	*	5.3	4.5	0	8	*	0	-	-	-	*	*	70	0	2	58	0	*	*	*
San Jose East	9	0	0	0.0	7	0	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, Tully Road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.9	25.4	70	0	2	54	0	45.9	12.0	11.8
San Martin	12	0	8	0.0	10	5	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunnyvale*	9	0	0	*	7	0	*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Bay Area Days over Standard		**2**	**16**			**7**				**0**			**0**			**0**				**0**	**6**		**7**			

*See notes of explanation on back of this page

NOTES

The annual Bay Area Air Pollution Summary summarizes measurements for the federal and California time-averaged pollutant standards.

This is the first year the Air Pollution Summary is reporting $PM_{2.5}$ statistics.

***Station Information (see asterisks on front page)**

The **Fairfield** monitoring station was relocated on May 29, 2002.

The **Gilroy** station was closed for the year 2000, due to construction activity. All 3-year average statistics for Gilroy have been omitted from this summary.

The **Los Gatos** station was closed from October 10 to December 3, 2002, due to construction on site.

The **San Jose 4th Street** station was closed for relocation on April 30, 2002. It reopened as **San Jose Central** on October 5, 2002. Ozone statistics and annual nitrogen dioxide, PM10, and PM2.5 statistics for San Jose Central have been omitted from this summary.

The **San Pablo** station was closed for relocation on August 24, 2002, and reopened on September 13, 2002. Annual statistics for San Pablo have been omitted from this summary.

The **Sunnyvale** station opened in 2001. All 3-year average statistics for Sunnyvale have been omitted

Explanation of Terms

State and federal excesses occur when pollutant concentrations surpass the indicated standards, with values in most cases rounded to the same number of decimal places.

MAX HR / MAX 8-HR / MAX 24-HR
The highest average contaminant concentration over a one-hour period, an eight-hour period (on any given day), or a 24-hour period (from midnight to midnight).

NAT DAYS
The number of days during the year for which the monitoring station recorded contaminant concentrations in excess of the national standard.

CAL DAYS
The number of days during the year for which the station recorded contaminant levels in excess of the California standard.

3-YR AVG (1-hr ozone standard)
The average number of days per year during which ozone levels were in excess of the national 1-hour standard, based on the most recent three-year period. *An average higher than 1.0 at any monitoring station means the region will be considered out of attainment by the EPA.*

3-YR AVG (8-hr ozone standard)
The 3-year average of the fourth highest 8-hour average ozone concentration for each monitoring station. *A 3-year average greater than 8.4 at any monitoring station means that the region will be considered out of attainment by the EPA.*

3-YR AVG ($PM_{2.5}$ 24-hour standard)
The 3-year average of the annual 98th percentiles of the individual 24-hour concentrations of $PM_{2.5}$. *A 3-year average greater than 65 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

3-YR AVG ($PM_{2.5}$ annual standard)
The 3-year average of the quarterly averages of $PM_{2.5}$. *A 3-year average greater than 15 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

ANN AVG
The yearly average (arithmetic mean) of the readings taken at a given monitoring station.

ANN GEO MEAN
The annual geometric mean concentration level (used for PM_{10}). The geometric mean of *n* positive numbers is the *n*th root of their product.

PM_{10}
Particulate matter ten microns or smaller in size. (PM_{10} is only sampled every sixth day. *Actual* days over standard can be estimated to be six times the number shown.)

$PM_{2.5}$
Particulate matter 2.5 microns or smaller in size. $PM_{2.5}$ is a sub-category of PM 10.

TOTAL BAY AREA DAYS OVER STANDARD is not a sum of excesses at individual stations, but rather of the number of days for which excesses occurred at any one or more stations.

HEALTH-BASED AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Std	National Std
Ozone	1 Hour	9 pphm	12 pphm
	8 Hour	—	8 pphm
Carbon Monoxide	1 Hour	20 ppm	35 ppm
	8 Hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 Hour	25 pphm	—
	Annual	—	5.3 pphm
Sulfur Dioxide	24 Hour	40 ppb	140 ppb
	Annual	—	30 ppb
Particulates < 10 microns	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	—	50 $\mu g/m^3$
	Annual Geometric Mean	30 $\mu g/m^3$	—
Particulates < 2.5 microns	24 Hour	—	65 $\mu g/m^3$
	Annual	—	15 $\mu g/m^3$

Concentrations
ppm parts per million | **pphm** parts per hundred million | **ppb** parts per billion | **$\mu g/m^3$** micrograms per cubic meter

TEN-YEAR BAY AREA AIR QUALITY SUMMARY

DAYS OVER STANDARDS

YEAR	OZONE 1-Hr Nat	OZONE 1-Hr Cal	OZONE 8-Hr Nat	CARBON MONOXIDE 1-Hr Nat	CARBON MONOXIDE 1-Hr Cal	CARBON MONOXIDE 8-Hr Nat	CARBON MONOXIDE 8-Hr Cal	Nitrogen Dioxide 1-Hr Cal	Sulfur Dioxide 24-Hr Nat	Sulfur Dioxide 24-Hr Cal	PM_{10} 24-Hr* Nat	PM_{10} 24-Hr* Cal	$PM_{2.5}$ 24-Hr** Nat
1993	3	19	-	0	0	0	0	0	0	0	0	10	-
1994	2	13	-	0	0	0	0	0	0	0	0	9	-
1995	11	28	-	0	0	0	0	0	0	0	0	7	-
1996	8	34	-	0	0	0	0	0	0	0	0	3	-
1997	0	8	-	0	0	0	0	0	0	0	0	4	-
1998	8	29	16	0	0	0	0	0	0	0	0	5	-
1999	3	20	9	0	0	0	0	0	0	0	0	12	-
2000	3	12	4	0	0	0	0	0	0	0	0	7	1
2001	1	15	7	0	0	0	0	0	0	0	0	10	5
2002	2	16	7	0	0	0	0	0	0	0	0	6	7

*PM_{10} is sampled every sixth day—*actual* days over standard can be estimated to be six times the numbers listed.

**2000 is the first full year for which the Air District measured $PM_{2.5}$ levels.

BAY AREA AIR POLLUTION SUMMARY — 2003

—See NOTES on back of this page

MONITORING STATIONS	OZONE							CARBON MONOXIDE			NITROGEN DIOXIDE			SULFUR DIOXIDE			PM_{10}				$PM_{2.5}$				
	Max 1-Hr	Nat Days	Cal Days	3-Yr Avg	Max 8-Hr	Nat Days	3-Yr Avg	Max 1-Hr	Max 8-Hr	Nat/Cal Days	Max 1-Hr	Ann Avg	Nat/Cal Days	Max 24-Hr	Ann Avg	Nat/Cal Days	Ann Avg	Max 24-Hr	Nat Days	Cal Days	Max 24-Hr	Nat Days	3-Yr Avg	Ann Avg	3-Yr Avg
North Counties	(pphm)				(pphm)			(ppm)			(pphm)			(ppb)			($\mu g/m^3$)				($\mu g/m^3$)			($\mu g/m^3$)	
Napa	11	0	2	0.0	8	0	6.5	4.7	2.5	0	7	1.2	0	-	-	-	21.3	41	0	0	-	-	-	-	-
San Rafael	9	0	0	0.0	7	0	4.9	3.8	2.0	0	7	1.6	0	-	-	-	17.6	41	0	0	-	-	-	-	-
Santa Rosa	10	0	1	0.0	8	0	5.4	3.1	1.8	0	6	1.2	0	-	-	-	16.9	36	0	0	39	0	37.9	8.8	10.0
Vallejo	10	0	2	0.0	7	0	6.5	4.0	2.9	0	7	1.2	0	5	1.2	0	17.3	39	0	0	31	0	35.0	9.4	11.8
Coast & Central Bay																									
Oakland	8	0	0	0.0	5	0	4.0	3.9	2.8	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Richmond	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.9	0	-	-	-	-	-	-	-	-	-
San Francisco	9	0	0	0.0	6	0	4.8	3.6	2.8	0	7	1.8	0	7	2.2	0	22.7	52	0	1	42	0	47.3	10.1	11.6
San Pablo	9	0	0	0.0	7	0	5.3	3.1	1.8	0	7	1.3	0	5	1.5	0	20.6	49	0	0	-	-	-	-	-
Eastern District																									
Bethel Island	9	0	0	0.3	8	0	7.9	1.6	0.9	0	5	0.9	0	6	2.2	0	19.4	51	0	1	-	-	-	-	-
Concord	10	0	5	0.3	9	1	8.2	3.2	2.0	0	6	1.3	0	3	0.6	0	16.4	34	0	0	50	0	41.0	9.7	11.2
Crockett	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1.2	0	-	-	-	-	-	-	-	-	-
Fairfield	9	0	0	0.0	8	0	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livermore	13	1	10	1.0	9	3	8.4	3.7	1.9	0	7	1.6	0	-	-	-	18.9	33	0	0	42	0	43.0	9.0	11.6
Martinez	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.6	0	-	-	-	-	-	-	-	-	-
Pittsburg	9	0	0	0.0	8	0	7.5	3.4	1.7	0	6	1.2	0	8	2.1	0	21.1	59	0	1	-	-	-	-	-
South Central Bay																									
Fremont	12	0	4	0.0	9	1	6.5	3.2	1.9	0	8	1.7	0	-	-	-	18.2	37	0	0	34	0	37.4	8.7	11.1
Hayward	12	0	3	0.0	9	1	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Redwood City	11	0	1	0.0	8	0	5.8	5.4	2.6	0	8	1.5	0	-	-	-	19.8	38	0	0	34	0	37.7	9.0	10.6
San Leandro	10	0	2	0.0	7	0	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara Valley																									
Gilroy	11	0	6	0.0	9	2	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos	12	0	7	0.0	10	2	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose Central*	12	0	4	*	8	0	*	5.5	4.0	0	9	2.1	0	-	-	-	23.6	60	0	3	56	0	*	11.7	*
San Jose East	10	0	2	0.0	7	0	5.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, Tully Road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.8	58	0	2	52	0	40.2	10.1	11.1
San Martin	11	0	9	0.0	9	4	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunnyvale	11	0	4	0.0	9	2	6.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Bay Area Days over Standard		**1**	**19**			**7**				**0**			**0**			**0**			**0**	**6**		**0**			

*See notes of explanation on back of this page

2003 NOTES

The annual Bay Area Air Pollution Summary summarizes measurements for the national and California pollutant standards.

***Station Information (see asterisks on front page)**

The **San Jose 4th Street** station was closed for relocation on April 30, 2002. It reopened as **San Jose Central** on October 5, 2002. Three-year average ozone statistics and three-year average PM2.5 statistics for San Jose Central have been omitted from this summary.

Explanation of Terms

State and national excesses occur when pollutant concentrations surpass the indicated standards, with values in most cases rounded to the same number of decimal places.

MAX HR / MAX 8-HR / MAX 24-HR
The highest average contaminant concentration over a one-hour period, an eight-hour period (on any given day), or a 24-hour period (from midnight to midnight).

ANN AVG
The yearly average (arithmetic mean) of the readings taken at a given monitoring station.

NAT DAYS
The number of days during the year for which the monitoring station recorded contaminant concentrations in excess of the national standard.

CAL DAYS
The number of days during the year for which the station recorded contaminant levels in excess of the California standard.

TOTAL BAY AREA DAYS OVER STANDARD is not a sum of excesses at individual stations, but rather a sum of the number of days for which excesses occurred at any one or more stations.

3-YR AVG (1-hr ozone standard)
The average number of days per year during which ozone levels were in excess of the national 1-hour standard, based on the most recent three-year period. *An average higher than 1.0 at any monitoring station means the region will be considered out of attainment by the EPA.*

3-YR AVG (8-hr ozone standard)
The 3-year average of the fourth highest 8-hour average ozone concentration for each monitoring station. *A 3-year average greater than 8.4 at any monitoring station means that the region will be considered out of attainment by the EPA.*

PM_{10}
Particulate matter ten microns or smaller in size. (PM_{10} is only sampled every sixth day. *Actual* days over standard can be estimated to be six times the number shown.)

$PM_{2.5}$
Particulate matter 2.5 microns or smaller in size. $PM_{2.5}$ is a sub-category of PM_{10}.

PM_{10} ANN AVG and MAX 24-HR
California PM_{10} Annual Average and Maximum 24-Hour concentrations are reported at local temperature and pressure conditions. National PM_{10} Annual Average and Maximum 24-Hour concentrations are reported at standard temperature and pressure conditions. This table shows the California readings for PM_{10} Ann Avg and Max 24-Hr, which are generally slightly higher than the national readings.

3-YR AVG ($PM_{2.5}$ 24-hour standard)
The 3-year average of the annual 98th percentiles of the individual 24-hour concentrations of $PM_{2.5}$. *A 3-year average greater than 65 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

3-YR AVG ($PM_{2.5}$ annual standard)
The 3-year average of the quarterly averages of $PM_{2.5}$. *A 3-year average greater than 15 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

HEALTH-BASED AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Std	National Std
Ozone	1 Hour	9 pphm	12 pphm
	8 Hour	—	8 pphm
Carbon Monoxide	1 Hour	20 ppm	35 ppm
	8 Hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 Hour	25 pphm	—
	Annual	—	5.3 pphm
Sulfur Dioxide	24 Hour	40 ppb	140 ppb
	Annual	—	30 ppb
Particulates < 10 microns	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	20 $\mu g/m^3$	50 $\mu g/m^3$
Particulates < 2.5 microns	24 Hour	—	65 $\mu g/m^3$
	Annual	12 $\mu g/m^3$	15 $\mu g/m^3$

Concentrations
ppm parts per million | **pphm** parts per hundred million | **ppb** parts per billion | **$\mu g/m^3$** micrograms per cubic meter

TEN-YEAR BAY AREA AIR QUALITY SUMMARY

DAYS OVER STANDARDS

YEAR	OZONE 1-Hr Nat	OZONE 1-Hr Cal	OZONE 8-Hr Nat	CARBON MONOXIDE 1-Hr Nat	CARBON MONOXIDE 1-Hr Cal	CARBON MONOXIDE 8-Hr Nat	CARBON MONOXIDE 8-Hr Cal	Nitrogen Dioxide 1-Hr Cal	Sulfur Dioxide 24-Hr Nat	Sulfur Dioxide 24-Hr Cal	PM_{10} 24-Hr* Nat	PM_{10} 24-Hr* Cal	$PM_{2.5}$ 24-Hr** Nat
1994	2	13	-	0	0	0	0	0	0	0	0	9	-
1995	11	28	-	0	0	0	0	0	0	0	0	7	-
1996	8	34	-	0	0	0	0	0	0	0	0	3	-
1997	0	8	-	0	0	0	0	0	0	0	0	4	-
1998	8	29	16	0	0	0	0	0	0	0	0	5	-
1999	3	20	9	0	0	0	0	0	0	0	0	12	-
2000	3	12	4	0	0	0	0	0	0	0	0	7	1
2001	1	15	7	0	0	0	0	0	0	0	0	10	5
2002	2	16	7	0	0	0	0	0	0	0	0	6	7
2003	1	19	7	0	0	0	0	0	0	0	0	6	0

*PM_{10} is sampled every sixth day—*actual* days over standard can be estimated to be six times the numbers listed.

**2000 is the first full year for which the Air District measured $PM_{2.5}$ levels.

BAY AREA AIR POLLUTION SUMMARY — 2004

—See NOTES on back of this page

MONITORING STATIONS	OZONE							CARBON MONOXIDE			NITROGEN DIOXIDE			SULFUR DIOXIDE			PM_{10}				$PM_{2.5}$				
	Max 1-Hr	Nat Days	Cal Days	3-Yr Avg	Max 8-Hr	Nat Days	3-Yr Avg	Max 1-Hr	Max 8-Hr	Nat/Cal Days	Max 1-Hr	Ann Avg	Nat/Cal Days	Max 24-Hr	Ann Avg	Nat/Cal Days	Ann Avg	Max 24-Hr	Nat Days	Cal Days	Max 24-Hr	Nat Days	3-Yr Avg	Ann Avg	3-Yr Avg
North Counties	(pphm)				(pphm)			(ppm)			(pphm)			(ppb)			($\mu g/m^3$)				($\mu g/m^3$)			($\mu g/m^3$)	
Napa	9	0	0	0.0	7	0	6.6	3.7	2.0	0	6	1.1	0	-	-	-	20.7	60	0	1	-	-	-	-	-
San Rafael	9	0	0	0.0	6	0	4.9	3.2	2.0	0	6	1.5	0	-	-	-	17.9	52	0	1	-	-	-	-	-
Santa Rosa	8	0	0	0.0	6	0	5.1	2.7	1.6	0	5	1.1	0	-	-	-	18.0	48	0	0	27	0	32	8.3	9
Vallejo	10	0	1	0.0	7	0	6.5	4.0	3.4	0	5	1.2	0	5	1.3	0	19.6	51	0	1	40	0	39	11.1	11
Coast & Central Bay																									
Oakland	8	0	0	0.0	6	0	4.0	3.5	2.6	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Richmond	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1.6	0	-	-	-	-	-	-	-	-	-
San Francisco	9	0	0	0.0	6	0	4.7	2.9	2.2	0	6	1.7	0	8	1.4	0	22.5	52	0	1	46	0	41	9.9	11
San Pablo	11	0	1	0.0	7	0	5.2	3.2	1.8	0	6	1.3	0	5	1.6	0	21.2	64	0	1	-	-	-	-	-
Eastern District																									
Bethel Island	10	0	1	0.0	8	0	7.5	1.2	0.9	0	3	0.8	0	6	1.6	0	19.5	42	0	0	-	-	-	-	-
Concord	10	0	1	0.0	8	0	7.9	2.7	2.0	0	7	1.2	0	10	1.0	0	18.6	51	0	1	74	1	40*	10.7*	11*
Crockett	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.7	0	-	-	-	-	-	-	-	-	-
Fairfield	10	0	1	0.0	8	0	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Livermore	11	0	5	1.0	8	0	8.3	3.5	1.8	0	6	1.4	0	-	-	-	20.0	49	0	0	41	0	37	10.3	11
Martinez	-	-	-	-	-	-	-	-	-	-	-	-	-	7	1.5	0	-	-	-	-	-	-	-	-	-
Pittsburg	9	0	0	0.0	8	0	7.3	4.1	1.9	0	5	1.1	0	7	2.0	0	21.7	64	0	1	-	-	-	-	-
South Central Bay																									
Fremont	9	0	0	0.0	7	0	6.4	3.0	1.7	0	6	1.5	0	-	-	-	18.6	49	0	0	40	0	32	9.4	10
Hayward	9	0	0	0.0	7	0	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redwood City	10	0	1	0.0	7	0	6.0	4.8	2.1	0	6	1.5	0	-	-	-	20.5	65	0	1	36	0	32	9.3	9
San Leandro	10	0	1	0.0	7	0	5.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Clara Valley																									
Gilroy	9	0	0	0.0	8	0	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Gatos	9	0	0	0.0	8	0	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose Central*	9	0	0	*	7	0	*	4.4	3.0	0	7	1.9	0	-	-	-	23.1	58	0	4	52	0	*	11.6	*
San Jose East	9	0	0	0.0	7	0	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Jose, Tully Road	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.0	65	0	3	45	0	35	10.4	10
San Martin	9	0	0	0.0	8	0	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunnyvale	10	0	1	0.0	8	0	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Bay Area Days over Standard		0	7			0				0			0			0			0	7		1			

*See notes of explanation on back of this page

2004 NOTES

The annual Bay Area Air Pollution Summary summarizes measurements for the national and California pollutant standards.

*Station Information (see asterisks on front page)

The **San Jose 4th Street** station was closed on April 30, 2002. It was relocated to **San Jose Central** on October 5, 2002. Three-year average ozone statistics and three-year average $PM_{2.5}$ statistics for San Jose Central have been omitted from this summary.

Due to roof damage at the Concord station during the fourth quarter of 2004, the $PM_{2.5}$ sampler could not be operated on some of the required sampling days. The $PM_{2.5}$ annual average and three-year average $PM_{2.5}$ statistics are based on available data.

Explanation of Terms

State and national excesses occur when pollutant concentrations surpass the indicated standards, with values in most cases rounded to the same number of decimal places.

MAX HR / MAX 8-HR / MAX 24-HR
The highest average contaminant concentration over a one-hour period, an eight-hour period (on any given day), or a 24-hour period (from midnight to midnight).

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The number of days during the year for which the station recorded contaminant levels in excess of the California standard.

TOTAL BAY AREA DAYS OVER STANDARD is not a sum of excesses at individual stations, but rather a sum of the number of days for which excesses occurred at any one or more stations.

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The 3-year average of the fourth highest 8-hour average ozone concentration for each monitoring station. *A 3-year average greater than 8.4 at any monitoring station means that the region will be considered out of attainment by the EPA.*

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Particulate matter ten microns or smaller in size. (PM_{10} is only sampled every sixth day. *Actual* days over standard can be estimated to be six times the number shown.)

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California PM_{10} Annual Average and Maximum 24-Hour concentrations are reported at local temperature and pressure conditions. National PM_{10} Annual Average and Maximum 24-Hour concentrations are reported at standard temperature and pressure conditions. This table shows the California readings for PM_{10} Ann Avg and Max 24-Hr, which are generally slightly higher than the national readings.

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The 3-year average of the annual 98th percentiles of the individual 24-hour concentrations of $PM_{2.5}$. *A 3-year average greater than 65 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

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The 3-year average of the quarterly averages of $PM_{2.5}$. *A 3-year average greater than 15 $\mu g/m^3$ at any monitoring station means that the region will be considered out of attainment by the EPA.*

HEALTH-BASED AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Std	National Std
Ozone	1 Hour*	9 pphm	12 pphm*
	8 Hour	—	8 pphm
Carbon Monoxide	1 Hour	20 ppm	35 ppm
	8 Hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 Hour	25 pphm	—
	Annual	—	5.3 pphm
Sulfur Dioxide	24 Hour	40 ppb	140 ppb
	Annual	—	30 ppb
Particulates < 10 microns –	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$
	Annual	20 $\mu g/m^3$	50 $\mu g/m^3$
Particulates < 2.5 microns –	24 Hour	—	65 $\mu g/m^3$
	Annual	12 $\mu g/m^3$	15 $\mu g/m^3$

*The U.S. EPA revoked the national 1-hour ozone standard on June 15, 2005.

Concentrations

ppm	pphm	ppb	$\mu g/m^3$
parts per million	parts per hundred million	parts per billion	micrograms per cubic meter

TEN-YEAR BAY AREA AIR QUALITY SUMMARY

DAYS OVER STANDARDS

YEAR	OZONE			CARBON MONOXIDE				Nitrogen Dioxide	Sulfur Dioxide		PM_{10}		$PM_{2.5}$
	1-Hr		8-Hr	1-Hr		8-Hr		1-Hr	24-Hr		24-Hr*		24-Hr**
	Nat	Cal	Nat	Nat	Cal	Nat	Cal	Cal	Nat	Cal	Nat	Cal	Nat
1995	11	28	-	0	0	0	0	0	0	0	0	7	-
1996	8	34	-	0	0	0	0	0	0	0	0	3	-
1997	0	8	-	0	0	0	0	0	0	0	0	4	-
1998	8	29	16	0	0	0	0	0	0	0	0	5	-
1999	3	20	9	0	0	0	0	0	0	0	0	12	-
2000	3	12	4	0	0	0	0	0	0	0	0	7	1
2001	1	15	7	0	0	0	0	0	0	0	0	10	5
2002	2	16	7	0	0	0	0	0	0	0	0	6	7
2003	1	19	7	0	0	0	0	0	0	0	0	6	0
2004	0	7	0	0	0	0	0	0	0	0	0	7	1

*PM_{10} is sampled every sixth day—*actual* days over standard can be estimated to be six times the numbers listed.

**2000 is the first full year for which the Air District measured $PM_{2.5}$ levels.

INTRODUCTION

Eastshore Energy, LLC proposes to develop, construct, and operate a power plant near the corner of Clawiter Road and Depot Road near the south-eastern shore of San Francisco Bay in Hayward, Alameda County. The proposed project, called the Eastshore Energy Center (Eastshore), will consist of fourteen (14) natural gas-fired, lean burn design, reciprocating engines with a gross generating capacity of 118 MW; there also will be a small, exempt (*i.e.*, less than 10 MMBtu per hour) natural gas-fired (solely) heater. The proposed lean burn reciprocating engines are Wärtsilä 20V34SG machines.

The proposed project will be a major new source under Bay Area Air Quality Management District (BAAQMD) regulations.

The applicant will submit air quality impact analyses to both the BAAQMD and the California Energy Commission (CEC). (The applicant also is submitting an Application for Certification (AFC) to the CEC.) The modeling analysis will include impact evaluations for those pollutants shown in Table 1 and the CEC requirements for evaluation of project air quality impacts. The purpose of this document is to establish the procedure for meeting the BAAQMD and CEC air quality modeling requirements for the proposed project.

Table 1
BAAQMD PSD Significant Emissions Thresholds

Pollutant	Cumulative Increase (tons/yr)
NO_x	100
SO_2	100
CO	100
PM_{10}	100

The project does not result in emissions that will exceed BAAQMD PSD significance thresholds for oxides of nitrogen (NO_x), carbon monoxide (CO), and fine particulate matter (PM_{10}). Furthermore, emissions of sulfur dioxide (SO_2) are expected to be below the significance levels. The project may also trigger CEC modeling requirements for cumulative and construction-based impacts.

Emissions from the proposed project do not exceed the BAAQMD thresholds defining a major source for purposes of New Source Review (NSR) or PSD. The project triggers the BAAQMD offset requirements for NO_x and POC as emissions of other criteria pollutants are below the offset trigger levels. As part of the minor source permit application, an air quality, toxics, and cumulative impacts analyses are required. Modeled ambient impacts are expected to be below the levels at which preconstruction

monitoring is required. The results of these analyses will be presented in detail in the AFC and the application for a Determination of Compliance.

As part of BAAQMD application process and in accordance with the BAAQMD requirements ("*Permit Modeling Guidance,*" May 2005), a modeling protocol is required. This modeling protocol outlines the proposed use of air dispersion modeling techniques that will be used to assess impacts from the proposed facility, and has been prepared by Atmospheric Dynamics, Inc. on behalf of Eastshore Energy, LLC. This protocol also follows modeling guidance provided by the U.S. Environmental Protection Agency (USEPA) in its "*Guideline on Air Quality Models*" (including supplements), the National Park Service's "*Permit Application Guidance for New Air Pollution Sources*" (Bunyak, 1993), the Federal Land Managers' "*Air Quality Related Values Workgroup (FLAG) Draft Phase I Report*" (October 1999), and the "*Interagency Workgroup on Air Quality Modeling (IWAQM) Phase II Recommendations*" (1998), as well as BAAQMD modeling guidance.

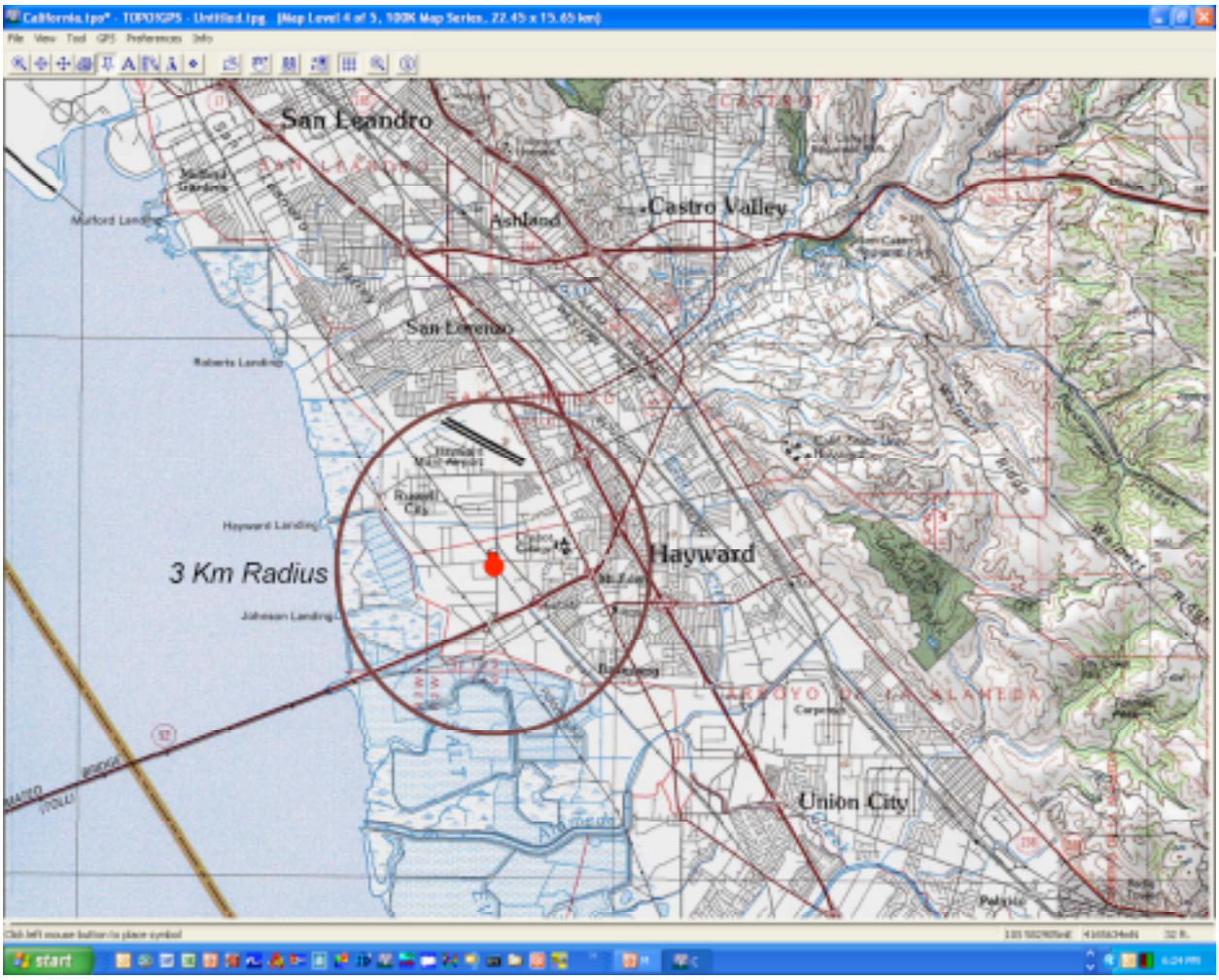
Impacts from operation of the facility will be compared to the following in Table 2:

Table 2 Air Quality Criteria	NO_2	PM_{10}	CO	SO_2
PSD Significant Impact Levels	✓	✓	✓	✓
PSD Monitoring Exemption Levels				
PSD Increments				
Ambient Air Quality Standards	✓	✓	✓	✓
Class I and Class II Visibility				
Impacts to Soils and Vegetation	✓	✓	✓	✓
Class I Area Acid Deposition				

PROJECT LOCATION

The proposed project site is located on the west side of Hayward, CA., in the vicinity of Johnson Landing on the south-eastern shore of San Francisco Bay in Alameda County. The site is at the intersection of Clawiter Road and Depot Road, approximately one (1) kilometer north of Hwy 92 and approximately 2.1 kilometers south of the Hayward Air Terminal complex. The UTM coordinates of the site are 577538.8 meters easting, 4165760 meters northing (NAD 27). The nominal site elevation is approximately 23 feet above mean sea level. See Figure 1.

Figure 1
Site Location



PROPOSED EMISSION SOURCES

The emission sources at Eastshore will be fourteen (14) natural gas-fired (solely), lean burn design, reciprocating engines; there also will be a small, exempt (*i.e.*, less than 10 MMBtu per hour) natural gas-fired (solely) heater. The reciprocating engines will utilize advanced combustion designs and emission controls to limit emissions of NO_x to 5.0 ppmvd, while limiting emissions of CO to 13 ppmvd and POCs to 20 ppmvd. (All ppmvd values are based on 15% O_2.) Emissions of PM_{10}, $PM_{2.5}$ and SO_2 will be kept to a minimum through the exclusive use of pipeline-quality natural gas.

EXISTING METEOROLOGICAL AND AIR QUALITY DATA

Three surface meteorological sites operated by the BAAQMD are in the regional vicinity of the proposed site. These sites are as follows:

Name	ID#	Start	Stop	UTM-E (km)	UTM-N (km)
Chabot	1903	8-31-89	Open	579.4	4175.0
Fremont	1902	8-1-89	8-3-95	589.2	4155.6
Union City	1901	9-13-87	12-31-96	581.9	4160.9

Name	Elev. (m)	Wind Sp. (mph)	Wind Dir. (deg)	Temp. (F)	Rel.Hum. (%)
Chabot	170.7	Yes	Yes	Yes	No
Fremont	15.2	Yes	Yes	Yes	Yes
Union City	2.1	Yes	Yes	Yes	Yes

The nearest criteria pollutant air quality monitoring sites to the proposed project site would be the stations located in the east bay area as follows, *i.e.*, Fremont-Chapel Way, Hayward-La Mesa, San Leandro-County Hospital, and Richmond. Ambient monitoring data for these sites for the most recent three (3) year period is summarized in Table 3.

Table 3 Monitoring Data Summary (Highest Monitored Values)

Pollutant	Site	Avg. Time	2003	2004	2005
Ozone, ppm	Fremont	1 Hr	.123	,090	.105
	Hayward		.116	.088	.093
	San Leandro		.097	.104	.099
Ozone, ppm	Fremont	8 Hr	.090	.071	.078
	Hayward		.092	.070	.070
	San Leandro		.071	.066	.061
PM10, ug/m^3	Fremont	24 Hr	37.1	46.3	51.7
PM10, ug/m^3	Fremont	Annual	17.7	18.1	17.2
PM2.5, ug/m^3	Fremont	24 Hr	33.5	39.9	33.4
PM2.5, ug/m^3	Fremont	Annual	8.7	9.4	9.0
CO, ppm	Fremont	8 Hr	1.87	1.66	1.96
NO2, ppm	Fremont	1 Hr	.076	.060	.069
NO2, ppm	Fremont	Annual	.017	.015	.015
SO2, ppm	Oakland	24 Hr	.009	ND	ND
	Richmond		.005	.007	.006
SO2, ppm	Oakland	Annual	.003	ND	ND
	Richmond		.001	.002	.001

SITE REPRESENTATION

USEPA defines the term "on-site data" to mean data that would be representative of atmospheric dispersion conditions at the source and at locations where the source may have a significant impact on air quality. Specifically, the meteorological data requirement originates in the Clean Air Act at section 165(e)(1). Section 165(e)(1) defines on-site meteorology as the collection "of the ambient air quality at the proposed site and in areas which may be affected by emissions from such facility for each pollutant subject to regulation under [the Act] which will be emitted from such facility."

This definition and USEPA's guidance on the use of on-site monitoring data are also outlined in the "*On-Site Meteorological Program Guidance for Regulatory Modeling Applications*" (1987). The representativeness of the data is dependent upon (a) the proximity of the meteorological monitoring site to the area under consideration, (b) the complexity of the topography of the area, (c) the exposure of the meteorological sensors, and (d) the period of time during which the data are collected. As discussed below, we believe the meteorological data from the Union City monitoring station data satisfy the definition of on-site data.

Situated between the western and eastern portions of the Coast Range, this region is protected from the direct effects of the marine airflow. Marine air entering through the Golden Gate is forced to split into northerly and southerly paths due to the blocking effect of the east bay hills. The southern flow is directed southeasterly down the bay, parallel to the hills, where eventually it passes over southwestern Alameda County. These sea breezes are strongest in the afternoon. The further from the ocean the marine air travels, the more it is modified. Thus, although the climate in this region is affected by sea breezes, it is affected less so than the regions closer to the Golden Gate, to the north. The climate of southwestern Alameda County is also modified by its close proximity to the San Francisco Bay. During periods of flat pressure gradients, the bay can generate its own circulation system, which pushes cool air onshore during the daytime and draws air from the land offshore at night. Bay breezes are common in the morning, before the sea breeze begins.

Winds are predominantly out of the northwest in this region, particularly during summer months. In the winter, winds are equally likely out of the east. Cold air over land areas creates high pressure to the east, which forces air toward the west. Easterly surface flow into southern Alameda County passes through three major gaps: Hayward/Dublin Canyon, Niles Canyon, and Mission Pass. Wind speeds are moderate in this region. Annual average wind speeds close to the bay are about 7 mph.

Terrain in the vicinity of the project site is as follows:

- To the southwest, west, and northwest lies the surface of San Francisco Bay.
- To the north, the terrain is generally flat with elevations showing a gentle increase from the site elevation of approximately 23 ft. amsl to elevations ranging from 15 to 80 ft. amsl.

- To the northeast the terrain remains essentially flat with elevations increasing dramatically, *i.e.*, elevations ranging from 100-300 ft. amsl as you move easterly across the transit corridor, which lies east of the 880 Freeway route.
- To the east and southeast, elevations remain below 100 ft. amsl until the transit corridor is crossed at which point elevations increase dramatically to levels in excess of 1300 ft. amsl.
- To the south the terrain is relatively flat with elevations ranging from 5- 50 ft. amsl.
- In general, an area inscribed by a circle with a radius of 4 miles around the facility site shows elevations to be at or below 50 ft. amsl., with a large portion of the inscribed area at elevations less than 20 ft. amsl.

The windrose (Figure 2) for the Union City monitoring station indicate a good level of consistency of northwest winds as well as reinforcing the general seasonal wind patterns discussed earlier. Thus, use of the Union City monitoring station to represent the project site wind speed, wind direction, and temperature would be considered representative with respect to the calculation of potential impacts from the project. Air flow patterns in the project area, based upon data from Union City, can be characterized by season as follows:

Spring (March through May) – Flow across the proposed site and the southeaster portion of San Francisco Bay is from the west-northwest.

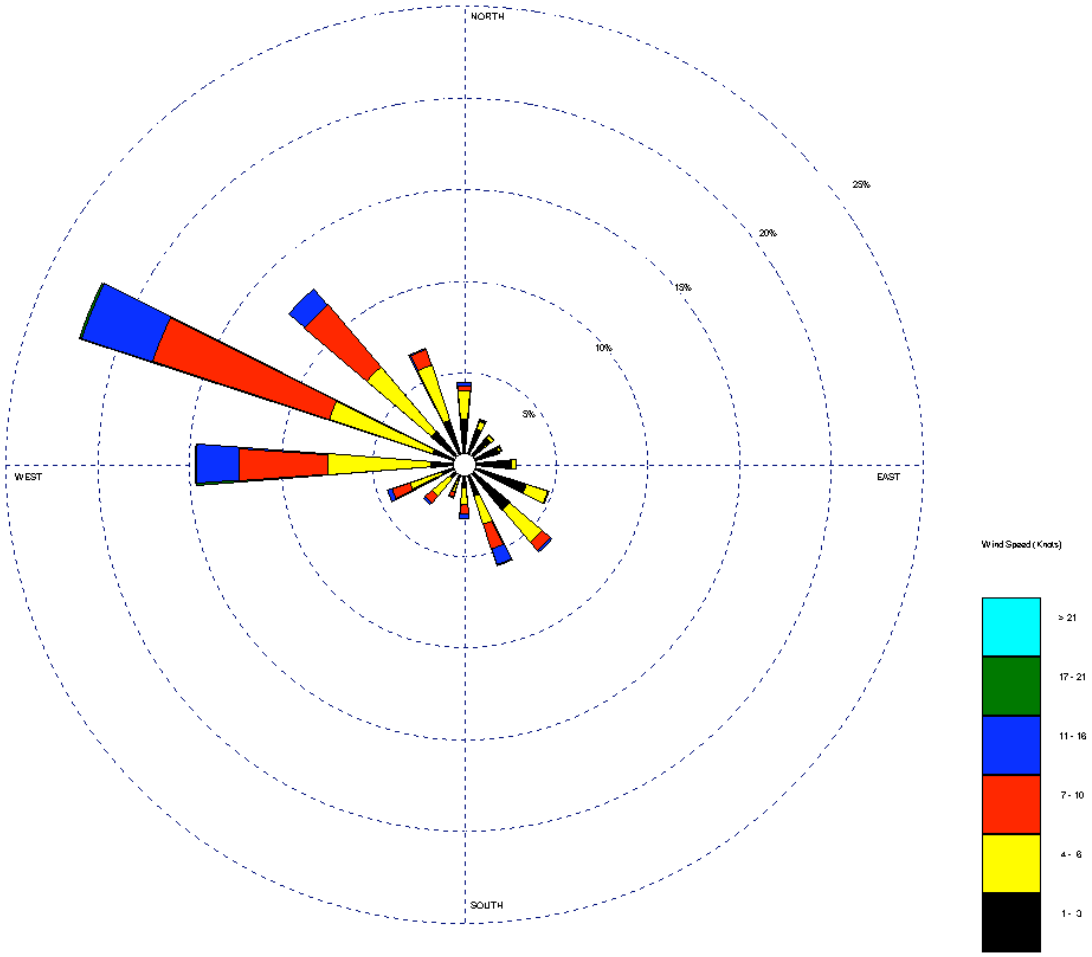
Summer (June through August) – Flow across the site and the southeastern portion of San Francisco Bay is from the west-northwest.

Fall (September through November) – Flow across the site and the southeastern portion of San Francisco Bay shows a more northwesterly orientation.

Winter (December through February) – Flow across the site and the southeastern portion of San Francisco Bay is predominantly northwesterly, with an easterly and southeasterly component.

The area surrounding the project site can be characterized as urban, as a majority of the area towards the east, north and south are developed. Areas towards the west are mostly marshland and water. Areas within three (3) kilometers of the project site are predominately developed urban areas with moderate industrial developments. Figure 3 displays an aerial photograph that outlines the urban and rural area surrounding the project site. In accordance with the Auer land use classification methodology (USEPA's "*Guideline on Air Quality Models*"), land use within the area circumscribed by a three km radius around the facility is greater than 50 percent urban as shown in Figure 3. Therefore, in the modeling analyses supporting the permitting of the facility, urban coefficients will be assigned.

Figure 2
Wind Rose for Union City
1989-1996



Representativeness has also been defined in the "*Workshop on the Representativeness of Meteorological Observations*" (Nappo et. al., 1982) as "the extent to which a set of measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application." Judgments of representativeness should be made only when sites are climatologically similar, as the project site and Union City monitoring station clearly are. Representativeness has also been defined in the PSD Monitoring Guideline as data that characterize the air quality for the general area in which the proposed project would construct and operate. The same large-scale topographic features that influence the Union City monitoring station also influence the proposed project site in the same manner.

Figure 3
Auer Urban/Rural Land Use Classification Map

In determining the representativeness of the Union City monitoring station relative to the project site, the following considerations were addressed.

Aspect ratio of terrain, which is the ratio of height to width of hill at base - There are no major terrain features either near the proposed project site or the Union City monitoring station that would modify (influence) the prevailing wind pattern that is characteristic of the close proximity to the Bay. The elevations of the project site and the Union City monitoring station are essentially the same.

Slope of terrain - Terrain in the immediate vicinity of the project site and the Union City monitoring station are relatively flat.

Ratio of terrain height to stack/plume height –Terrain is located at least 5 miles or more from the project site towards the east, northeast, and southeast. The following terrain features were identified:

- San Leandro Hills, north-northeast of site approximately 6 miles
- Castro Valley/Dublin Canyon, northeast of site approximately 5-6 miles
- Walpert Ridge, east and southeast of site approximately 7-10 miles.

The elevations of these areas range from about 40 to 450 meters above the project site elevation (stack base). Terrain heights at further distances (about 10 miles to the northeast, east, and southeast) encompass areas with elevations in excess of 450 m. Final plume height (stack height plus plume rise) was calculated for D stability and a wind speed of 5 meter/second (m/s) to be about 320 meters. It is expected that no impacts in terrain will be identified. While complex and/or intermediate terrain occurs at significant distances from the project site, impacts in these areas will be addressed the modeling analysis.

Correlation of terrain features to prevailing meteorological conditions - As discussed earlier, the orientation and aspect of terrain in the project area correlates well with the prevailing wind fields as identified by the Union City windrose, with little to no apparent influence by local terrain perturbations (such as small land outcroppings or the water-land interface). Wind flow at the Union City monitoring station would therefore be nearly identical to the project site.

Thus, it is our assessment that the meteorological data collected at the Union City monitoring station are identical to the dispersion conditions at the project site and to the regional area. The windroses do not indicate any overwhelming effects on the potential dispersion of pollutants from the project site on a regional scale from influences other than the surface of the San Francisco Bay. Because of the distances to the complex terrain features, it is likely that all short-term and annual impacts will occur in the immediate vicinity of the project site. Thus, the data set would satisfy the definition of on-site data, as defined in the PSD Monitoring Guidelines (1990) and the On-site Meteorological Program Guidance for Regulatory Modeling Applications (1987).

The five (5) years of meteorological data for Union City monitoring station were obtained from the BAAQMD for the years 1990-1994. The data set includes all the necessary parameters required for the ISCST3 dispersion modeling analyses (*i.e.*, wind speed and direction, temperature, stability, and mixing height which is set to 600 meters). The data will not be modified in anyway.

As described above, the most recent maximum air quality data from the surrounding SLAMS/NAMS monitoring stations listed in Table 3 will be used to represent ambient

concentrations of O_3, NO_2, CO, SO_2, PM_{10} and $PM_{2.5}$. For state and federal attainment pollutants with maximum modeled ground-level impacts greater than USEPA-defined significance levels, modeled concentrations will be added to these representative maximum background concentrations to determine compliance with the California Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Standards (NAAQS).

AIR QUALITY DISPERSION MODELS

Overview

Several USEPA dispersion models are proposed for use to quantify pollutant impacts on the surrounding environment based on the emission sources operating parameters and their locations. The models proposed for use are Building Profile Input Program (BPIP, current version 95086), Industrial Source Complex - Short Term (ISCST3, current version 02035), ISC-PRIME (version 04269), CTSCREEN (current version 94111), and SCREEN3. These models, along with options for their use and how they are used, are discussed below. These models will be used for the following:

- Comparison of impacts to significant impact levels;
- Comparison of impacts to monitoring significance thresholds;
- Compliance with AAQS; and
- Cumulative impacts analysis.

A screening health risk assessment will be conducted to evaluate air toxics. The latest version of the Health Risk Assessment Program (HARP version 1.2a or HARP Express version 2.07) will be used to characterize risks from the proposed facility.

Simple, Complex, and Intermediate Terrain Impacts

For modeling the project in simple, complex, and intermediate terrain, the ISCST3 model will be used with five (5) years of hourly meteorological data from the Union City monitoring station for 1990 through 1994. The ISCST3 model is a steady-state, multiple-source, Gaussian dispersion model designed for use with stack emission sources situated in terrain where ground elevations can exceed the stack heights of the emission sources. The ISCST3 model requires hourly meteorological data consisting of wind vector, wind speed, temperature, stability class, and mixing height. The model assumes that there is no variability in meteorological parameters over a 1-hour time period, hence the term steady-state. The ISCST3 model allows input of multiple sources and source groupings, eliminating the need for multiple model runs. Complex phenomena such as building-induced plume downwash are treated in the ISCST3 model.

The ISCST3 model was selected due in part to the flat terrain surrounding the project site, and is one of several models that are recommended by the USEPA for such evaluations. The ISCST3 model is capable of calculating pollutant concentrations in

intermediate terrain. Intermediate terrain is defined as terrain between stack top and final plume height. In calculating pollutant concentrations in intermediate terrain, the model will select the higher of the simple and complex terrain calculations on an hour-by-hour, source-by-source, and receptor-by-receptor basis. As discussed earlier, intermediate and complex terrain features are present but at distances that range from 5-12 miles from the project site. In addition, the ISCST3 model is preferred for this application because it incorporates algorithms for the simulation of aerodynamic downwash induced by buildings. These effects are of importance because many of the emission points may be below Good Engineering Practice (GEP) stack height.

Technical options selected for the ISCST3 model are listed below. Use of these options follows the USEPA's (1986, 1987, 1990, and 1994) modeling guidance, BAAQMD guidance, and/or sound scientific practice. An explanation of these options and the rationale for their selection is provided below.

- Gradual plume rise (BAAQMD requirement)
- Stack tip downwash
- Default option for temperature gradients, wind profile exponents, and calm processing
- Anemometer height = 20 m;
- Urban dispersion parameters; and
- Elevated receptor terrain heights option.

Final plume rise option does not consider the possible effects of gradual plume rise on ambient concentrations during the rising phase of the plume downwind transport. Gradual plume rise is recommended by BAAQMD and USEPA (1986, 1987, 1990, 1994, 2005) when there is significant terrain close to the stacks. Significant terrain does not occur until about 8-12 miles from the source, but will be included in the analysis. Buoyancy-induced dispersion, which accounts for the buoyant growth of a plume caused by entrainment of ambient air, will be included because of the relatively warm exit temperature and subsequent buoyant nature of the exhaust plumes. Stack-tip downwash, which adjusts the effective stack height downward following the methods of Briggs (1972) for cases where the stack exit velocity is less than 1.5 times the wind speed at stack top, will be selected per USEPA guidance.

As previously mentioned, based on the land use classification procedure of Auer (1978), land use within the area circumscribed by a three-km radius around the modified facility is greater than 50 percent urban. Therefore, in the modeling analyses supporting the permitting of the facility, urban coefficients will be assigned.

The calm processing option allows the user to direct the program to exclude hours with persistent calm winds in the calculation of concentrations for each averaging period. This option is generally recommended by the USEPA (1986, 1987, 1990, 1994) for regulatory applications. The ISCST3 model recognizes a calm wind condition as a wind speed less than or equal to 1 meter per second and a wind direction equal to that of the previous hour (a wind speed of 0 m/sec is used in the ASCII meteorological data file).

The calm processing option in the ISCST3 model will then exclude these hours from the calculation of concentrations.

ISC-PRIME Dispersion Model

EPRI sponsored a study to develop and evaluate new, improved plume rise and building downwash algorithms. The downwash algorithms in the existing ISCST3 model, currently recommended for regulatory application, were largely developed with data that represented neutral stability, moderate to high wind speeds, winds perpendicular to the building face, and non-buoyant or low buoyancy plumes. Some of the limitations of the ISCST3 downwash algorithms are: (1) the location of the stack is not considered; (2) streamline deflection is not considered; (3) there is no linkage between plume material captured by the near wake and far wake concentrations; and (4) large concentrations predicted by ISCST3 during light wind speed, stable conditions are not supported by observations. Proper treatment of all of the above factors is considered essential for an improved building downwash model.

The central approach used in ISC-PRIME is to explicitly treat the trajectory of the plume near the building, and to use the position of the stack and plume relative to the building to calculate interactions with the building wake. ISC-PRIME calculates the local slope of the mean streamlines as a function of projected building shape, and coupled with a numerical plume rise model, determines the change in plume centerline location with downwind distance. This incorporates the descent of the air containing the plume material, and rise of the plume relative to the streamlines due to buoyancy or momentum effects. The ISC-PRIME plume rise is computed using a numerical solution of the mass, energy and momentum conservation laws. A key feature of the plume rise calculation is the ability to include vertical wind shear effects, which are important for many buoyant releases from short stacks. Additionally, the wind speed deficit induced by the building is modified as a function of downwind distance from the building. The deficit also leads to increased plume rise from short stacks.

ISC-PRIME calculates enhanced turbulence intensity and velocity deficit values within the wake region. These values are a maximum at the lee wall of the building and decay with the two-thirds power downwind through the wake. Ambient turbulence intensity is inferred from the Briggs dispersion coefficient formulas for rural and urban locations. If the plume is released upwind of the wake, the plume initially grows at the ambient rate, and then plume dispersion in the wake and near field is determined using the enhanced turbulence and velocity deficits. As observed in wind-tunnels, both the horizontal and vertical dispersion coefficients are enhanced in the building wake (this virtually eliminates the suspiciously large predictions by ISCST3 during light wind speed, stable conditions which are caused by only enhancing the vertical dispersion coefficient when the stack height is more than 20% higher than the building height). When the turbulence intensity within the wake has decayed to the ambient rate, a virtual source technique is used to transition to the ISCST3 dispersion curves.

An additional limitation of ISCST3 is that the model is only valid for the far wake (defined in ISCST3 as the area beyond the lesser of three building heights or building widths). A separate EPA model, SCREEN3, is recommended by EPA for near wake concentrations. However, ISC-PRIME predicts concentrations in both the near and far wakes. The fraction of the plume captured by the near wake is well-mixed within the near wake. That plume mass is then re-emitted to the far wake as a volume source and added to the uncaptured primary plume. A transition zone between the near and far wakes is used to represent the unsteadiness of the near wake/far wake interface.

ISC-PRIME is proposed for the calculation of impacts that may exceed CAAQS when these exceedances are caused by downwash effects. The advantage in using ISC-PRIME in this situation is that ISC-PRIME explicitly treats the trajectory of the plume near the building and uses the position of the stack and plume relative to the building to calculate interactions with the building wake.

CTSCREEN Dispersion Model

If the ISCST3 model calculates exceedances of AAQS or significance levels in intermediate or complex terrain, the CTSCREEN model will be used to refine the modeling analysis. The CTSCREEN model, the screening mode of CTDMPLUS, is a refined point source Gaussian air quality model for use in all stability conditions for complex terrain applications. Because the model accounts for the dimensional nature of the plume and terrain interaction, the model requires digitized terrain of the nearby topographical features. The mathematical representation of terrain is accomplished by the terrain preprocessors, FITCON and HCRIT. The wind direction used in CTSCREEN is based on the source-terrain geometry, resulting in computation of the highest impacts likely to occur. Other meteorological variables are chosen from possible combinations from a set of predetermined values. CTSCREEN provides maximum concentration estimates that are similar to, but on the conservative side of, those that would be calculated from the CTDMPLUS model with a full year of on-site meteorological data.

As well as calculating maximum 1-hour concentrations at all receptors, the CTSCREEN model is designed to provide conservative estimates of worst-case 3-hour, 24-hour, and annual impacts. Scaling factors are used to convert calculated 1-hour concentrations to 3-hour, 24-hour, and annual estimates. A workgroup study found the ratios to convert 1-hour concentrations to 3-hour, 24-hour, and annual concentrations to be 0.7, 0.15, and 0.03, respectively.

CTSCREEN is appropriate for the following applications:

- Elevated point sources;
- Terrain elevations above stack top;
- Rural areas; and
- One-hour to annual averaging time periods.

Ambient Ratio Method and Ozone Limiting Method

Annual NO_2 concentrations will be calculated using the Ambient Ratio Method (ARM), adopted in Supplement C to the *Guideline on Air Quality Models* (USEPA, 1994). The Guideline allows a nationwide default conversion rate of 75% for annual NO_2/NO_x ratios.

Should NO_2 concentrations need to be examined in a more rigorous manner, the Ozone Limiting Method (OLM) will be used. Hourly ozone data collected at the Fremont monitoring station during 1990 through 1994 are proposed for use in the Ozone Limiting Method to calculate hourly NO_2 concentrations from hourly NO_x concentrations. These years were chosen due to the concurrent nature with respect to the Union City met data for the same years. The Ozone Limiting Method involves an initial comparison of the estimated maximum NO_x concentration and the ambient O_3 concentration to determine which is the limiting factor to NO_2 formation. If the O_3 concentration is greater than the maximum NO_x concentration, total conversion is assumed. If the NO_x concentration is greater than the O_3 concentration, the formation of NO_2 is limited by the ambient O_3 concentration. In this case, the NO_2 concentration is set equal to the O_3 concentration plus a correction factor that accounts for in-stack and near-stack thermal conversion.

EPA's ISC-OLM model will be used to calculate the NO_2 concentration based upon the OLM method. ISC-OLM will be implemented on a plume-by-plume basis (*i.e.*, individual plume). However, for some receptors, a demonstration of plume merging may be made to allow use of the combined source analysis. Plume merging will be demonstrated as follows. The horizontal dispersion of each individual plume, as a function of downwind distance, will be identified using EPA's SCREEN3 dispersion model at the distance to the receptor of interest, under the appropriate meteorology. This value will be compared with half the distance between sources proposed for plume merging. If the horizontal dispersion at the distance to the receptor exceeds half the distance between the sources proposed for merging, then the plumes are assumed to have merged by the time they are transported to the receptor of interest.

Fumigation

The SCREEN3 model will be used to evaluate inversion breakup and shoreline fumigation impacts for all short-term averaging periods (24 hours or less). The methodology outlined in BAAQMD Modeling Guidance and EPA 454/R-92-019 (Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised) will be followed for this analysis. Combined impacts for all sources under fumigation conditions will be evaluated, based on BAAQMD modeling guidelines.

Screening Health Risk Assessment

The screening health risk assessment will be conducted in accordance with the procedures developed by the California Air Resources Board and the Office of Environmental Health Hazard Analysis. The latest version of the Health Risk

Assessment Program (HARP version 1.2a or HARP Express version 2.07) will be used to characterize risks from the proposed facility.

The HARP program is a tool that assists with the programmatic requirements of the Air Toxics Hot Spots Program, and it can be used for preparing health risk assessments for other related programs such as air toxic control measure development or facility permitting applications. HARP is a computer based risk assessment program, which combines the tools of emission inventory database, facility prioritization, air dispersion modeling, and risk assessment analysis. Use of HARP promotes statewide consistency in the area of risk assessment, increases the efficiency of evaluating potential health impacts, and provides a cost effective tool for developing facility health risk assessments. HARP may be used on single sources, facilities with multiple sources, or multiple facilities in close proximity to each other.

The screening health risk assessment will be carried out in three steps. First, emissions of toxic air pollutants from the project will be calculated. Next, the ISCST3 subroutine in the HARP model will be used to predict the maximum concentration at each receptor due to the operation of the proposed project. A separate analysis will be conducted for construction generated PM_{10}, as per CEC requirements. The high-resolution receptor grids as derived from the facility ISCST3 modeling will then be used in HARP. Finally, the HARP will be used to evaluate acute, chronic and cancer risks through inhalation and non-inhalation pathways based upon the maximum predicted concentration at each receptor.

Some of the assumptions used in running the HARP program will be set as follows:

- Emission rates for non-criteria pollutants will be based upon the expected fuel use of the engines.
- Number of residents affected will be based upon the updated 2000 population data for those census tracts or portions of census tracts, which lie within the maximum impact receptor radius of the proposed facility.
- Number of workers affected will be based upon the county average percentage of non-farm workers as compared to the total county population in 2000. This average was applied to all affected census tracts.
- Deposition velocity is taken to be 0.02 m/s, as recommended by ARB for controlled sources.
- Fraction of residents with gardens is taken to be 0.25, which is probably conservatively high for the urban area.
- Fraction of produce grown at home is taken to be 0.05, which is also believed to be conservatively high.

The receptor grids used for the HARP risk analyses are similar to those used for the refined modeling, with the addition of discrete receptor annotations representing the 1st, 2nd, and 3rd highest impact points, *i.e.*, MIR-1, MIR-2, and MIR-3. A complete list of

the discrete sensitive receptors within 1 mile of the facility will be included in the application as well as census tract population data, census tract maps and affected tracts within 6 miles of the facility.

The HARP program results for acute and chronic inhalation and chronic non-inhalation exposures, cancer burden and individual cancer risk (workplace and residential) for the combustion sources will be summarized. Separate calculations will be shown for each type of exposure and risk.

GOOD ENGINEERING PRACTICE STACK HEIGHT AND DOWNWASH

ISCST3 can account for building downwash effects. Stack locations and heights and building locations and dimensions will be input to BPIP. The first part of BPIP determines and reports on whether a stack is being subjected to wake effects from a structure or structures. The second part calculates direction-dependent "equivalent building dimensions" if a stack is being influenced by structure wake effects. The BPIP output is formatted for use in ISCST3 input files.

RECEPTOR SELECTION

Receptor and source base elevations will be determined from US Geological Survey (USGS) Digital Elevation Model (DEM) data using the 7-1/2-minute format (*i.e.*, 10-meter spacing between grid nodes). All coordinates will be referenced to UTM North American Datum 1927 (NAD27), zone 10. The ISC receptors from the DEM files will be placed exactly on the DEM nodes. Every effort will be made to maintain receptor spacing across DEM file boundaries.

Cartesian coordinate receptor grids will be used to provide adequate spatial coverage surrounding the project area for assessing ground-level pollution concentrations, to identify the extent of significant impacts, and to identify maximum impact locations. A 180-meter resolution coarse receptor grid will be developed and will extend outwards at least 10 km (or more as necessary to calculate the significant impact area). The maximum extent of the significant impact isopleth for any pollutant review will be used to represent the impact radius.

For the full impact analyses, a nested grid will be developed to fully represent the significance area(s) and maximum impact area(s). This grid will have 10-meter resolution along the facility fenceline and out to five hundred meters from the fenceline and 180 meter resolution outwards to 10 kilometers from the site. When maximum or maximum second-highest impacts occur in the 180 meter spaced area, additional refined receptor grids with 10-meter resolution will be placed around the maximum coarse grid impacts and extended out 1,000 meters in all directions. Concentrations within the facility fenceline will not be calculated.

MODELING SCENARIOS

Pollutant emissions to the atmosphere from the proposed facility will occur from combustion of natural gas in each of fourteen (14) identical reciprocating engines. Emission rates will be provided by the engine vendor and are based on vendor data and additional conservative assumptions of engine performance. The emissions and stack parameters, such as flow rate and exit temperature, exhibit some variation with ambient temperature and operating load. In order to calculate the worst-case air quality impacts, a screening analysis will be performed to evaluate each operating scenario to predict the worst-case facility configuration on a pollutant-specific basis.

In the modeling analysis, maximum impacts will be predicted for maximum (100%) and reduced load conditions. Each of these conditions has unique performance characteristics that affect plume dispersion and thus predicted impacts. This analysis is most relevant to analyses for short-term impacts. Annual impacts will be evaluated based on expected engine performance at an ambient temperature representative of the project site. The temperatures and humidity levels selected for the short-term screening analyses will closely reflect the range of possible site characteristics. The results of this screening analysis will be used to select the worst-case operational scenarios for the modeling analyses in order to provide maximum operating flexibility. Refined modeling for the permit application will be based on these worst-case scenarios.

The screening modeling will use five (5) years of meteorological data and the nested receptor grid described above to determine the worst-case source configuration (*i.e.*, configuration that produces maximum facility impacts). This worst-case source configuration will then be executed with all five (5) years of meteorological data and, if necessary, coarse grid impacts will be refined with fine grid receptors spaced 10 meters apart.

Ambient Air Quality Impact Analyses

In evaluating the impacts of the proposed project on ambient air quality, ADI will model the ambient impacts of the project, add those impacts to background concentrations, and compare the results to the state and federal ambient standards for SO_2, NO_2, PM_{10}, $PM_{2.5}$, and CO. The project impacts will also be compared to the significance levels in Table 4.

In accordance with BAAQMD and EPA guidance (40 CFR part 51, Appendix W, Sections 11.2.3.2 and 11.2.3.3), the highest modeled concentration will be used to demonstrate compliance with all short-term and annual standards.

Preconstruction Monitoring Requirements

Section 2-2-414.3 of the BAAQMD rules requires an applicant's air quality analysis to contain preconstruction ambient air quality monitoring data for purposes of establishing background pollutant concentrations in the impact area of the proposed facility. However, according to Rule 2-2-111, an applicant may be exempted from the requirement for preconstruction monitoring if the predicted air quality impacts of the facility do not exceed the specified *de minimis* levels listed in Table 5. An applicant may also, at the APCO's discretion, rely on existing continuous air quality monitoring data collected at District-approved monitoring stations to satisfy the requirement for preconstruction monitoring.

Table 4
PSD Ambient Significance Levels

Pollutant/ Avg. Period		Significance Level (ug/m^3)	Class I Increment (ug/m^3)	Class II Increment (ug/m^3)
	- Annual	1	2	20
	- 24-hour	5	5	91
SO_2	- 3-hour	25	25	512
	- Annual	1	4	17
PM_{10}	- 24-hour	5	8	30
NO_2	- Annual	1	–	–
	- 1-hour	19	2.5	25

Table 5
Preconstruction Monitoring Thresholds

CO: 8-hr average	575 ug/m^3
PM_{10}: 24-hr average	10 ug/m^3
NO_2: annual average	14 ug/m^3
SO_2: 24-hr average	13 ug/m^3

Additional Analyses Required by the CEC

Additional analyses that are required by the CEC are a cumulative air quality impacts analysis and an analysis of construction impacts. The procedures to be used in evaluating construction impacts are discussed below.

Cumulative Impacts – Pursuant to CEC guidelines, a cumulative impacts analysis will be required and must consider the additional impacts of the following sources located within 8 miles of the project site.

- Sources with impacts on existing air quality that are not reflected in the ambient air quality data used to establish background. These sources are generally those which have received permits authorizing construction but are not yet in operation and sources which have commenced operations subsequent to the data used to establish background air quality levels. Data derived from the BAAQMD, CARB, and the EPA AIRS data system indicates that air quality data for the project region is available up to the end of year 2005. As such the cumulative analysis will concentrate on the above types of sources permitted or becoming operational after January 1, 2006.

Construction Impacts Analysis - The potential ambient impacts from air pollutant emissions during the construction of the project will be evaluated by air quality modeling that will account for the construction site location and the surrounding topography; the sources of emissions during construction, including vehicle and equipment exhaust emissions; and fugitive dust.

Site Description - The dispersion modeling analyses will include a description of the physical setting of the facility and surrounding terrain. A map showing the plant location, fence lines, and model receptors will be included, as well as a plot plan of the plant site indicating heights of nearby structures above a common reference point.

Types of Emission Sources - Construction of the proposed project will be divided into three main construction phases: (1) site preparation; (2) construction of foundations; and (3) installation and assembly of mechanical and electrical equipment. The construction impacts analysis will include a schedule for construction operation activities. Site preparation is expected to include site excavation, excavation of footings and foundations, and backfilling operations. After site preparation is finished, the construction of the foundations will begin. Once the foundations are finished, the installation and assembly of the mechanical and electrical equipment will begin.

Fugitive dust emissions from the construction of the project result from (1) dust entrained during excavation and grading at the construction site; (2) dust entrained during onsite travel on paved and unpaved roads and across the unpaved construction site; (3) dust entrained during aggregate and soil loading and unloading operations; (4) dust entrained from raw material transfer to and from material stockpiles; and (5) wind erosion of areas disturbed during construction activities. Heavy equipment exhaust emissions result from (1) exhaust from the heavy equipment used for excavation, grading, and construction of onsite structures; (2) exhaust from a water truck used to

control construction dust emissions; (3) exhaust from diesel welding machines, gasoline-powered generators, air compressors, and water pumps; and (4) exhaust from gasoline-powered pickup trucks and Diesel flatbed trucks used onsite to transport workers and materials around the construction site. Diesel and gasoline truck exhaust emissions will result from transport of mechanical and electrical equipment to the project site and transport of rubble and debris from the site to an appropriate landfill. Diesel exhaust emissions may also result from transport of raw materials to and from stockpiles.

Emissions from a worst-case day will be calculated for each of the three main construction phases and only the phase with the highest emissions will be modeled. As the construction impacts are expected to occur for a relatively short time compared with the lifetime of the project, only short-term averaging periods (24 hours or less) will be included in the construction modeling analysis.

Existing Ambient Levels - Ambient NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$ concentrations are monitored at several locations in the vicinity of the proposed site: San Leandro, Hayward, Fremont, and Richmond. These sites are believed to be representative of the site and are being proposed for use in the analysis.

Model Type - The EPA-approved ISCST3 model will be used to estimate ambient impacts from construction emissions. The modeling options and meteorological data described above will be used for the modeling analysis.

The construction site will be represented as an area source in the modeling analysis. Emissions will be divided into two categories: exhaust emissions and dust emissions. For exhaust emissions, a plume height of 4.6 meters (15 feet) will be used. Plume height refers to the distance measured from ground level to the centerline of the emissions plume. For dust emissions, a release height of two meters will be used due to the ambient plume temperatures and negligible plume velocities.

For the construction modeling analysis, the receptor grid will begin at the property boundary and will extend approximately one kilometer in all directions. Receptor spacing will be 10 meters.

FINAL MODELING SUBMITTAL

In accordance with BAAQMD modeling guidance, the final modeling analyses will also include the following materials:

- US Geological Survey (USGS) 7-1/2-minute (1:24,000) map(s) showing the facility
- Completed "*Air Quality Modeling Checklist*";
- Modeling summaries of maximum impacts for each air quality model showing meteorological conditions and receptor location and elevation;
- All modeling outputs (including BPIP and meteorological files) on diskette, together with a description of all filenames;
- Plot plan showing emission points, nearby buildings (including dimensions), cross-section lines, property lines, fencelines, roads, and UTM coordinates; and

- Table showing the building identifiers in the BPIP run(s) and plot plan.

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REFERENCES

Briggs, G.A., 1972. Discussion on Chimney Plumes in Neutral and Stable Surroundings. Atmos. Environ. 6:507-510.

Bunyak, John. 1993. Permit Application Guidance for New Air Pollution Sources. Natural Resources Report NPS/NRAQD/NRR-93/09, US Dept. of the Interior, National Park Service.

California Air Resources Board, Aerometric Data Division, Aerometric Projects and Laboratory
Branch, Meteorological Section, June 1984.
California Surface Wind Climatology.

National Climatic Data Center (NCDC), 2000. Local Climatological Data (LCD) - Annual Summary with Comparative Data for Salem [McNary Airport] for 1999.

U.S. Environmental Protection Agency (USEPA), 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) - Revised. EPA-450/4-80-023R.

USEPA, 1986. Guideline on Air Quality Models (Revised), U.S. EPA-45/2-78-027R, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA, 1987. Supplement A to the Guideline on Air Quality Models (Revised). Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA, 1988. Workbook for Plume Visual Impact Screening and Analysis. Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA-450/4-88-015 (Including October 1992 Revisions).

USEPA, 1990. Supplement B to the Guideline on Air Quality Models (Revised). Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA, 1990. New Source Review Workshop Manual — Draft. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA, 1992. Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models. Dennis Atkinson and Russell F. Lee, Office of Air Quality Planning and Standards, Research Triangle Park, NC. July 7, 1992.

USEPA, 1995. Supplement C to the Guideline on Air Quality Models (revised). Office of Air Quality Planning and Standards, Research Triangle Park, NC.

USEPA, 1998. Interagency Workgroup on Air Quality Modeling (IWAQM)

Phase 2 Summary Report and Recommendations for Modeling Long-Range Transport Impacts. Air Quality Modeling Group (MD-14), Research Triangle Park. National Park Service - Air Resource Division, Denver, Colorado. USDA Forest Service - Air Quality Program, Fort Collins, Colorado. US Fish and Wildlife Service Air Quality Branch, Denver, Colorado.

USDA Forest Service Air Quality Program, National Park Service Air Resource Division, US Fish and Wildlife Service — Air Quality Branch. 1999. Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Draft Phase I Report. October 1999.

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