

APPENDIX A

SUPPORTING DATA

APPENDIX A-1

CALPUFF INPUT PARAMETERS

**(for all modeling except
sensitivity test)**

APPENDIX A-1 – INPUT SETTING FOR BASE CALPUFF RUNS

Input Group: 1 – General run control parameters		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
METRUN	1	Run all periods in CALMET file
NSPEC	8	Number of chemical species modeled
NSE	5	Number of chemical species emitted
METFM	1	Specifies CALMET binary file

Input Group: 2 – Technical options		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
MCTADJ	3	Partial plume path terrain adjustment
MWET	1	Wet deposition set to on
MDRY	1	Dry deposition turned on
MPARTL	1	Partial plume penetration of elevated inversion

Input Group: 3 - Species list				
Species Name	Modeled	Emitted	Dry Deposited	Output Group
	0=no 1=yes	0=no 1=yes	0=no 1=comp, gas 2=comp, particle	
SO2	1	1	1	0
SO4	1	0	2	0
NOx	1	1	1	0
HNO3	1	0	1	0
NO3	1	0	2	0
PM10	1	1	2	0
EC	1	1	2	0
OC	1	1	2	0

Input Group: 4 – Grid control parameters		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
NX	136	No. of columns in meteorological grid
NY	94	No. of rows in meteorological grid
NZ	8	Approximate number of mandatory reporting levels between surface and 500 mb.
DGRIDKM	5	Computational grid spacing (in km.)
ZFACE	0, 20, 50, 100, 250, 500, 750, 1000, and 3000	Vertical layer definitions
XORIGKM	148.475	SW corner of grid in Lambert Conformal Coordinates (km. E)
YORIGKM	4611.926	SW corner of grid in Lambert Conformal Coordinates (km. N)
IUTMZN	13	UTM zone of reference
XLAT	43.68	Latitude (deg.) of modeling domain center
XLONG	105.15	Longitude (deg.) of modeling domain center
XTZ	7	Time zone corresponding to MST
IBCOMP	1	SW corner of computational grid (X cell #)
JBCOMP	1	SW corner of computational grid (Y cell #)
IECOMP	136	NE corner of computational grid (X cell #)
JECOMP	94	NE corner of computational grid (Y cell #)

Input Group: 5 – Output options		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
ICON	1	Ambient concentrations in output file
IDRY	0	No dry deposition fluxes in output file
IWET	0	No wet deposition fluxes in output file
IVIS	1	Relative humidity output for visibility

Input Group: 6a, 6b and 6c – Subgrid scale complex terrain inputs (Not used)

Input Group: 7 – Chemical parameters for dry deposition of gases					
Species Name	Diffusivity	Alpha Star	Reactivity	Mesophyll Resistance	Henry's Law Coef.
SO2	0.1509	1000.0	8.0	0.0	0.04
NOx	0.1656	1.0	8.0	5.0	3.5
HNO3	0.1628	1.0	18.0	0.0	0.0

Input Group: 8 – Size parameters for dry deposition of particles		
Species Name	Geometric Mass Mean Diameter	Geometric Standard Deviation
SO4	0.48	2.0
NO3	0.48	2.0
PM10	5.20	2.3
EC	0.48	2.0
OC	0.48	2.0

Input Group: 9 – Miscellaneous dry deposition parameters		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
RCUTR	30	Reference cuticle resistance
RGR	5	Reference ground resistance
REACTR	8	Reference pollutant reactivity
NINT	9	Number of particle size intervals...
IVEG	1	Set for active and unstressed vegetation

Input Group: 10 – Wet deposition parameters – scavenging coefficient		
Pollutant	Liquid Precip	Frozen Precip
SO2	3.0E-05	0.00E00
SO4	1.0E-04	3.0E-05
HNO3	6.0E-05	0.0E00
NO3	1.0E-04	3.0E-05
PM10	1.0E-04	3.0E-05
EC	1.0E-04	3.0E-05
OC	1.0E-04	3.0E-05

Input Group: 11 – Chemistry parameters		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
MOZ	0	Used a constant background ozone conc.
BCKO3	40.0	Background ozone concentration
BCKNH3	5.0	Background ammonia concentration

Input Group: 12 – Miscellaneous dispersion and computational parameters		
<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
XSAMLEN	1.0	Max travel distance of a puff during one sampling step
WSCALM	1.0	Minimum wind speed allowed for non-calm conditions

Input Group: 13a, 13b, 13c and 13d – Point source parameters

<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
NPT1	Variable	Number of constant emission rate point sources
NPT2	0	No point sources with variable emission rates

The point source data presented in Subgroup 13b corresponds to parameters presented in the appendices of this report.

No building downwash was modeled – therefore there were no entries for card 13c . Likewise, there were no variable rate emission point sources, so card 13d was unused.

Input Group: 14a, 14b, 14c and 14d – Area source parameters

<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
NAR1	Variable	Number of constant emission rate areasources
NSAR1	0	No scaling factors applied to area sources
NAR2	0	No area sources with variable emission rates

The area source data presented in Subgroup 14b corresponds to parameters presented in the appendices of this report. Subgroup 14c defines the corners of each area source, in lambert conformal coordinates. Subgroup 14d was unused due to no variable rate emissions.

Input Group: 15a, 15b and 15c (Not applicable)

Input Group: 16a, 16b and 16c – Volume source parameters

<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
NVL1	69	Number of volume sources
NSVL1	0	No variable emissions/scalars used
IGRDVL	0	No gridded volume sources used

The volume source data presented in Subgroup 16b corresponds to parameters presented in the appendices of this report. 16c was not used due to no variable rate emissions.

Input Group: 17a and 17b – Discrete receptor information

<u>Parameter</u>	<u>Value(s) Selected</u>	<u>Value(s) Effect</u>
NREC	2	Number of discrete receptors – one located at the former NPS meteorological station, the second at the IMPROVE monitoring site.

APPENDIX A-2
f(RH) FOR VARIOUS VALUES OF
RELATIVE HUMIDITY

Table A-2: f(RH) values for various values of relative humidity*

RH(%)	f(RH)	RH(%)	f(RH)	RH(%)	f(RH)	RH(%)	f(RH)
1	1.0	26	1.0	51	1.2	76	2.3
2	1.0	27	1.0	52	1.3	77	2.4
3	1.0	28	1.0	53	1.3	78	2.5
4	1.0	29	1.0	54	1.3	79	2.6
5	1.0	30	1.0	55	1.3	80	2.7
6	1.0	31	1.0	56	1.3	81	2.8
7	1.0	32	1.0	57	1.3	82	3.0
8	1.0	33	1.0	58	1.4	83	3.1
9	1.0	34	1.0	59	1.4	84	3.2
10	1.0	35	1.0	60	1.4	85	3.4
11	1.0	36	1.0	61	1.5	86	3.6
12	1.0	37	1.1	62	1.5	87	3.8
13	1.0	38	1.1	63	1.5	88	4.0
14	1.0	39	1.1	64	1.6	89	4.4
15	1.0	40	1.1	65	1.7	90	4.7
16	1.0	41	1.1	66	1.7	91	5.3
17	1.0	42	1.1	67	1.7	92	5.9
18	1.0	43	1.1	68	1.8	93	7.0
19	1.0	44	1.2	69	1.9	94	8.4
20	1.0	45	1.2	70	1.9	95	9.8
21	1.0	46	1.2	71	2.0	96	12.4
22	1.0	47	1.2	72	2.0	97	15.1
23	1.0	48	1.2	73	2.1	98	18.1
24	1.0	49	1.2	74	2.1	99	18.1 **
25	1.0	50	1.2	75	2.2	100	18.1 **

* The values in Table A-2 are only appropriate for averaging times of 1 hour or less.

** The values for 99% and 100% RH are rolled back to the value for 98%.

APPENDIX A-3

POINT SOURCE EMISSION INVENTORY

Table A-3.1: Wyoming Point Sources

Facility	County	Source #	UTM E	UTM W	Lambert E	Lambert W	Elev (m)	1990 PM10	1990 Nox	1990 SO2	1997 PM10	1997 Nox	1997 SO2
Dave Johnston Power Plant	Converse	W1	436518	4742915	419548	4752743	1508	1.551	44.923	126.765	1.122	47.411	131.005
		W2	436518	4742915	419548	4752743	1508	1.520	53.433	130.425	1.099	56.392	134.788
		W3	436518	4742915	419548	4752743	1508	1.997	150.497	268.260	1.444	158.832	277.235
		W4	436518	4742915	419548	4752743	1508	33.505	177.757	177.746	24.231	187.602	183.692
Modeling Area Source	Converse		436468	4742865	419502	4752691	1508	11.977	0.142	0.103	8.682	0.150	0.106
Boggy Creek-West Gas	Niobrara	W5	535210	4808070	511264	4820705	1201	0.000	1.605	0.000	0.000	1.502	0.000
Pope and Talbot	Weston	W6	564900	4854700	537452	4867260	1340	0.872	0.547	0.086	0.250	0.127	0.026
Newcastle Plant-West Gas	Weston	W7	535900	4831360	510737	4843239	1306	0.002	4.436	0.000	0.006	2.624	0.000
Gopher Station-KN	Campbell	W8	473583	4841196	450257	4849577	1446	0.000	3.000	0.000	0.000	1.574	0.000
HA Creek Station-KN	Campbell	W9	493241	4843276	469071	4852582	1353	0.000	3.164	0.000	0.000	1.878	0.000
Belle Creek Booster-KN	Campbell	W10	460080	4899545	434302	4905241	1404	0.000	1.545	0.000	0.000	2.851	0.000
Well Draw Booster-KN	Converse	W11	488884	4759413	469143	4771334	1488	0.000	1.525	0.000	0.000	2.112	0.000
Sage Grouse Booster-KN	Converse	W12	429945	4775594	411570	4783995	1694	0.000	2.376	0.000	0.000	2.949	0.000
West Porcupine Booster-KN	Campbell	W13	470579	4831367	447865	4839930	1488	0.000	4.652	0.000	0.000	3.550	0.000
Todd Booster-KN	Weston	W14	501824	4852371	476869	4861801	1377	0.000	1.824	0.000	0.000	2.707	0.000
Thunder Creek Booster-KN	Campbell	W15	492300	4836701	468501	4846183	1405	0.000	2.992	0.000	0.000	1.749	0.000
Hogs Draw Booster-KN	Converse	W16	502494	4746498	482907	4759541	1529	0.000	3.046	0.000	0.000	3.458	0.000
Ross Booster-KN	Converse	W17	439708	4812326	419114	4819978	1524	0.000	1.460	0.000	0.000	0.524	0.000
Mud Springs Booster-KN	Campbell	W18	433859	4848657	411648	4854775	1585	0.000	1.505	0.000	0.000	1.528	0.000
Irwin Ranch Booster-KN	Converse	W19	485233	4813754	462865	4823658	1354	0.000	2.865	0.000	0.000	3.320	0.000
Hay Booster-KN	Campbell	W20	471036	4859868	446858	4867481	1512	0.000	1.548	0.000	0.000	1.953	0.000
Douglas Gas Plant-KN	Converse	W21	471000	4737396	453038	4749147	1504	0.082	17.687	0.000	0.082	20.754	0.000
Osage Plant - Black Hills Power	Weston	W22	547485	4868230	520000	4879437	1316	1.571	26.215	95.142	0.388	23.854	86.575
Modeling Area Source			547435	4868180	519955	4879387	1314	0.302	0.000	0.000	0.075	0.000	0.000
Neil Simpson I - Black Hills Power	Campbell	W23	469116	4903600	442791	4909613	1402	8.239	13.664	18.152	1.044	20.810	15.569
Modeling Area Source			469066	4903550	442745	4909562	1402	0.385	0.000	0.000	0.049	0.000	0.000
Wyodak - PacifiCorp	Campbell	W24	469293	4903788	442952	4909803	1402	13.118	208.101	217.307	11.541	143.280	237.004
Modeling Area Source			469243	4903738	442906	4909753	1402	1.582	0.000	0.000	1.392	0.000	0.000
Hilight - Western Gas	Campbell	W25	471255	4854115	447361	4861936	1505	0.000	12.552	0.002	0.000	12.793	0.006
South Hartzog - Western Gas	Campbell	W26	428100	4855010	405785	4860621	1524	0.000	1.542	0.000	0.000	2.166	0.000
Mikes Draw - Phillips Petrol	Converse	W27	478050	4780494	457640	4791159	1457	0.000	0.204	0.000	0.000	0.000	0.000
Moore Comp - Western Gas	Converse	W28	459245	4760721	440534	4771099	1661	0.000	3.225	0.000	0.000	0.811	0.000
Steinle Ranch Booster-KN	Converse	W29	483050	4796250	461653	4806637	1402	0.000	0.742	0.000	0.000	1.387	0.000
Yoss-KN	Converse	W30	478986	4761963	459482	4773298	1519	0.000	1.516	0.000	0.000	0.000	0.000
Sand Dunes - Western Gas	Converse	W31	426690	4771110	408662	4779498	1768	0.000	0.000	0.000	0.000	0.581	0.000
Crossbow - Western Gas	Campbell	W32	466500	4871700	441892	4878679	1421	0.000	0.000	0.000	0.000	1.188	0.000
Bozeman - Western Gas	Converse	W33	436400	4808100	416144	4815728	1585	0.000	0.000	0.000	0.000	0.440	0.000
Lightning Creek	Converse	W34	482833	4765000	463032	4776427	1456	0.000	2.767	0.000	0.000	0.000	0.000
Porcupine - Western Gas	Campbell	W35	460080	4899545	434302	4905241	1404	0.000	0.000	0.000	0.000	2.143	0.000
Pinetree - Western Gas	Campbell	W36	427780	4824185	407034	4830832	1647	0.000	2.701	0.000	0.000	2.762	0.000
Wyoming Refining	Weston	W37	563130	4855330	535717	4867777	1328	4.953	4.454	19.399	2.485	8.794	22.047
American Colloid Upton	Weston	W38	527540	4884060	500000	4893709	1308	2.512	0.526	2.598	4.119	4.404	2.882
Recluse Compr- Western Gas	Campbell	W39	437200	4967230	408859	4969422	1219	0.000	0.921	0.000	0.000	1.602	0.000
Oedekoven- Western Gas	Campbell	W40	460080	4899545	434302	4905241	1404	0.000	0.000	0.000	0.000	3.046	0.000
American Colony East	Crook	W41	556900	4968200	523951	4976428	1060	1.876	1.861	2.568	2.615	2.204	2.569
Scott Booster-KN	Converse	W42	469185	4764015	449940	4774785	1585	0.000	1.516	0.000	0.000	1.706	0.000
Teckla Booster-KN	Converse	W43	491970	4792872	470413	4803825	1469	0.000	1.361	0.000	0.000	2.178	0.000
Kaye Booster-KN	Converse	W44	507732	4773549	486573	4785953	1351	0.000	1.528	0.000	0.000	1.666	0.000
Neiman Sawmills	Crook	W45	531322	4948110	500372	4955737	1158	0.128	0.078	0.045	0.158	0.175	0.035
Powell Booster-KN	Converse	W46	446915	4801152	426617	4809545	1520	0.000	1.487	0.000	0.000	2.100	0.000
Kitty Gas Plant- Western Gas	Campbell	W47	445965	4907000	420344	4911725	1428	0.000	20.137	0.014	0.028	14.418	0.003
House Creek Booster-KN	Campbell	W48	448170	4851375	425283	4858123	1524	0.000	1.536	0.000	0.000	0.009	0.000
Bentonite Mat - Colony Plant	Crook	W49	567750	4967600	534418	4976400	1036	0.797	0.834	5.515	1.835	4.163	1.151
American Colony West	Crook	W50	566200	4968600	532876	4977287	1036	1.171	0.898	6.107	1.999	4.045	1.763
Archibald Booster-KN	Campbell	W51	443782	4833417	421969	4840557	1578	0.000	3.909	0.000	0.000	3.193	0.000

Facility	County	Source #	UTM E	UTM W	Lambert E	Lambert W	Elev (m)	1990 PM10	1990 Nox	1990 SO2	1997 PM10	1997 Nox	1997 SO2
Amos Draw Booster-KN	Campbell	W52	429614	4909981	404462	4913776	1383	0.000	4.660	0.000	0.000	3.397	0.000
South Well - South Sand	Converse	W53	459245	4760721	440534	4771099	1661	0.000	3.268	0.000	0.000	0.000	0.000
Neil Simpson II - Black Hills Power	Campbell	W54	468888	4903894	442556	4909885	1402	0.000	0.000	0.000	0.198	21.693	19.027
Outback Compressor- West Gas	Campbell	W55	461500	4869400	437198	4876204	1463	0.000	0.000	0.000	0.000	0.627	0.000
Mills-Gillette - West Gas	Campbell	W56	460080	4899545	434302	4905241	1404	0.000	0.000	0.000	0.000	0.248	0.000
Reihemann Comp - MIGC Inc.	Campbell	W57	460080	4899545	434302	4905241	1404	0.000	0.000	0.000	0.000	0.833	0.000
Bitter Creek - Redstone Resou	Campbell	W58	455476	4922395	428714	4927068	1306	0.000	0.000	0.000	0.000	0.262	0.000
Buckskin Field - S Bat - Redstone	Campbell	W59	455283	4920860	428606	4925577	1299	0.000	0.000	0.000	0.000	0.250	0.000
Buckskin Field - N Bat - Redstone	Campbell	W60	455476	4922395	428714	4927068	1306	0.000	0.000	0.000	0.000	0.262	0.000
Carter Compressor- West Gas	Campbell	W61	458500	4879000	433824	4885323	1430	0.000	0.000	0.000	0.000	0.006	0.000
Stealth Comp - MIGC Inc.	Campbell	W62	455610	4913370	429300	4918362	1341	0.000	0.000	0.000	0.000	0.584	0.000
Hilite/Reno - West Gas	Campbell	W63	471255	4854115	447361	4861936	1505	0.000	12.552	0.000	0.000	12.793	0.006
Macy Comp - MIGC Inc.	Campbell	W64	460080	4899545	434302	4905241	1404	0.000	0.000	0.000	0.000	0.685	0.000
Glenrock Coal - Dave Johnson	Converse		459245	4760721	440534	4771099	1661	17.059	1.476	0.000	13.354	0.000	0.000
Total								88.140	804.736	1070.233	64.816	796.551	1115.484
								3063.919	27974.139	37203.335	2253.123	27689.630	38776.335
Grieve Unit Cent. Bat- Forrest Oil	Natrona							0.000	0.000	0.000	0.000	0.322	0.000
Barrett Resources - Cave Gulch	Natrona							0.000	0.000	0.000	0.000	0.621	0.000
Black Hills Bentonite Mills	Natrona		388500	4743900							0.000	1.044	0.000

Table A-3.2: South Dakota Point Sources (Pennington County)

Facility	County	Source #	UTM E	UTM W	Lambert E	Lambert W	Elev (m)	1990 PM10	1990 Nox	1990 SO2	1997 PM10	1997 Nox	1997 SO2
Rushmore Forest Products	Pennington	S1	618512	4866703	588422	4881594	1463	1.116	0.391	0.000	1.116	0.391	0.000
Simon Construction Company	Pennington	S2	639418	4883805	607654	4899171	1020	0.066	0.945	0.189	0.066	0.945	0.189
Black Hills Power and Light	Pennington	S3	639160	4882911	607449	4898294	1018	0.358	29.863	21.842	0.358	29.863	21.842
Black Hills Power and Light	Pennington	S4	639166	4882855	607461	4898241	1017	11.459	162.182	42.484	11.459	162.182	42.484
Pete Lien and Sons, Inc.	Pennington	S5	637539	4886139	605723	4901332	1056	1.347	15.327	0.016	1.347	15.327	0.016
Hills Materials Company	Pennington	S6	638012	4882909	606347	4898233	1038	0.756	0.170	0.345	0.756	0.170	0.345
Dakota Block Company	Pennington	S7	638023	4884276	606288	4899554	1037	1.223	0.908	3.326	1.223	0.908	3.326
South Dakota Cement	Pennington	S8	638274	4883022	606593	4898360	1032	13.297	88.821	4.585	13.297	88.821	4.585
Birdsall Sand and Gravel	Pennington	S9	638481	4882858	606797	4898213	1021	0.072	0.000	0.000	0.072	0.000	0.000
Merillat Industries	Pennington	S10	645118	4879077	613384	4894894	973	3.820	5.165	0.449	3.820	5.165	0.449

APPENDIX A-4
COUNTY AREA SOURCE EMISSIONS

County Area Source Emissions (TPY)

Wyoming

	1990 NO2	1990 SO2	1990 PM10	1990 EC	1990 OC
Campbell	2921	577	11038	59	48
Crook	1517	543	5230	34	37
Weston	2602	0	3096	17	21
Converse	6401	2372	4326	28	25
Niobrara	588	57	2660	13	8
Platte	22131	6815	6502	36	28
Goshen	2825	1632	7823	45	19

	1997 NO2	1997 SO2	1997 PM10	1997 EC	1997 OC
Campbell	6942	3345	48952	49	36
Crook	1920	596	21193	29	27
Weston	1802	338	13779	14	15
Converse	10246	7671	23063	24	19
Niobrara	665	52	10040	0	0
Platte	19490	9177	21251	28	20
Goshen	3354	1569	27547	40	24

	1997-1990 NO2	1997-1990 SO2	1997-1990 PM10	1997-1990 EC	1997-1990 OC
Campbell	4021	2768	37914	-10	-12
Crook	403	53	15963	-5	-10
Weston	-800	338	10683	-3	-6
Converse	3845	5299	18737	-4	-6
Niobrara	77	-5	7380	-13	-8
Platte	-2641	2362	14749	-8	-8
Goshen	529	-63	19724	-5	5
Total	5434	10752	125150	-48	-45

South Dakota

	1990 NO2	1990 SO2	1990 PM10	1990 EC	1990 OC
Fall River	571	287	2399	18	25
Shannon	616	75	3315	23	32
Bennett	516	76	3240	21	13
Jackson	722	91	3065	26	15
Haakon	664	107	4296	29	15
Custer	713	108	3804	19	43
Pennington	0	0	12650	245	196
Lawrence	2882	1864	4646	40	55
Meade	2467	295	9424	72	77
Butte	501	66	2576	21	24
Ziebach	391	61	2525	17	11

	1997 NO2	1997 SO2	1997 PM10	1997 EC	1997 OC
Fall River	615	428	2338	15	18
Shannon	803	69	3290	19	22
Bennett	663	87	3404	20	11
Jackson	660	91	3074	20	11
Haakon	797	129	3747	26	13
Custer	843	128	3274	16	29
Pennington	0	1462	10217	171	132
Lawrence	1374	205	4606	29	37
Meade	2220	312	7700	57	54
Butte	748	69	2565	19	18
Ziebach	489	69	3181	15	9

	1997-1990 NO2	1997-1990 SO2	1997-1990 PM10	1997-1990 EC	1997-1990 OC
Fall River	44	141	-61	-3	-7
Shannon	187	-6	-25	-4	-10
Bennett	147	11	164	-1	-2
Jackson	-62	0	9	-6	-4
Haakon	133	22	-549	-3	-2
Custer	130	20	-530	-3	-14
Pennington	0	1462	-2433	-74	-64
Lawrence	-1508	-1659	-40	-11	-18
Meade	-247	17	-1724	-15	-23
Butte	247	3	-11	-2	-6
Ziebach	98	8	656	-2	-2
Total	-831	19	-4544	-124	-152

Nebraska

	1990 NO2	1990 SO2	1990 PM10	1990 EC	1990 OC
Sioux	377	47	2358	13	10
Dawes	824	105	4902	23	21
Box Butte	1420	220	6719	42	20
Sheridan	1203	158	8718	40	27

	1997 NO2	1997 SO2	1997 PM10	1997 EC	1997 OC
Sioux	425	51	2125	11	8
Dawes	907	107	3825	20	16
Box Butte	1508	258	4771	37	17
Sheridan	1464	175	7543	36	22

	1997-1990 NO2	1997-1990 SO2	1997-1990 PM10	1997-1990 EC	1997-1990 OC
Sioux	48	4	-233	-2	-2
Dawes	83	2	-1077	-3	-5
Box Butte	88	38	-1948	-5	-3
Sheridan	261	17	-1175	-4	-5
Total	480	61	-4433	-14	-15

APPENDIX A-5
COAL MINE EMISSION PARAMETERS
AND SPREADSHEETS

Emission Factors

Category	units	PM-10	SO2	NOx
Blasting	lbs/ton of ANFO	--	2	11.56
Trucks	lb/gal	0.0177	0.0312	0.2942
Graders	lb/gal	0.0222	0.0311	0.2538
Wh. Loaders	lb/gal	0.0293	0.0312	0.3212
RT Dozers	lb/gal	0.0148	0.0312	0.2861
Tractors	lb/gal	0.0253	0.0311	0.2849
Scrapers	lb/gal	0.0273	0.0312	0.2586
Drills	lb/gal	0.0301	0.0311	0.3680
Water trucks	lb/gal	0.0177	0.0312	0.2861
Miscellaneous	lb/gal	0.0301	0.0311	0.3680
Locomotives	lb/gal	0.0138	0.0360	0.5044

Table 1

Blasting - ANFO Usage

<u>Mine</u>	<u>Coal (lb/T)</u>	<u>Overburden (lb/BCY)</u>
Eagle Butte	0.37	0.37
Wyodak	0.64	0.47
Caballo	0.35	0.43
Belle Ayr	0.39	0.58
Caballo Rojo	0.40	0.60
Cordero	0.43	0.44
Rochelle	0.41	0.41
North Antelope	0.41	0.41
Antelope	0.28	0.42
ALL OTHERS	0.40	0.50

Table 2

Diesel-Fueled Equipment

	Cordero Rojo	Wyodak	Belle Ayr	Antelope	N Antelope/ Rochelle	ALL OTHERS
Scrapers (gal/hr)	44	20	---	14.6	5.8	20
Graders (gal/hr)	12.5	12	8.3	15.5	7.3	12
Water Trucks (gal/hr)	28	18	---	12.8	---	20
Haul Trucks (gal/mi)	3	1.5	3.6	6.4	2.9	3.5
Wheeled Loaders	14% of scrapers	---	---	0.5 x graders	2.4 x scrapers	---
RT Dozers	25% of Scrapers	---	2.2 x graders	0.36 x graders	3.2 x scrapers	---
Track Dozers	2.4 x scrapers	---	---	4.6 x graders	2.2 x scrapers	---
Drills	21% of Scrapers	---	0.6 x graders	---	1.3 x scrapers	---
Misc Equip	6.5% of scrapers	---	---	---	---	---

Table 3
Locomotives

<u>Mine</u>	<u>Hours/Train</u>	<u>Tons of Coal/Train</u>
Rawhide	4	12,507
Belle Ayr	5	11,200
Caballo	3.5	12,649
Antelope	5	13,039
North Antelope	10	13,444
Rochelle	10	13,444
Wyodak	4	11,000
Cordero Rojo	5	12,364
ALL OTHERS	5	12,500

	1997 Coal Predicted Production (MMTPY)	1997 Coal Actual Production (MMTPY)	1990 Coal Actual Production (MMTPY)	1997 Multiplier	1990 Multiplier	1997 Est. PM10 Emissions (TPY)	1990 Ratioed PM10 Emis (TPY)	1997 Ratioed PM10 Emis (TPY)	1990 Coal Actual Production (MMTPY)	1997 Coal Actual Production (MMTPY)	1997 OB Predicted Production (MMBCY)	1990 Actual OB Remove (MMBCY)	1997 Actual OB Remove (MMBCY)	ANFO Usage Factor Coal (lb/ton)	ANFO Usage Factor OB (lb/BCY)	1990 ANFO Usage Coal (lbs)	1990 ANFO Usage OB (lbs)	1997 ANFO Usage Coal (lbs)	1997 ANFO Usage OB (lbs)	1990 SO2 Emissions (TPY)	1990 NO2 Emissions (TPY)
Buckskin	14.80	14.40	7.70	0.97	0.5203	155.84	81.08	151.63	7.70	14.40	22.63	10.30	30.20	0.40	0.50	3080000	5150000	5760000	15100000	4.12	23.78
Rawhide	11.20	10.71	11.40	0.96	1.02	173.29	176.38	165.71	11.40	10.71	12.10	8.20	13.53	0.40	0.50	4560000	4100000	4284000	6765000	4.33	25.03
Eagle Butte	26.63	17.92	15.37	0.67	0.58	433.49	250.20	291.71	15.37	17.92	40.42	16.87	31.56	0.37	0.37	5686900	6241900	6630400	11677200	5.96	34.47
Dry Fork	6.50	0.92	0.82	0.14	0.13	118.71	14.98	16.80	0.82	0.92	6.12	0.96	0.54	0.40	0.50	328000	480000	368000	270000	0.40	2.34
Ft. Union	3.50	0.59	0.04	0.17	0.01	122.28	1.40	20.61	0.04	0.59	11.03	0.23	0.70	0.40	0.50	16000	115000	236000	350000	0.07	0.38
Wyodak	5.00	3.25	2.91	0.65	0.58	64.87	37.75	42.17	2.91	3.25	3.89	1.47	3.04	0.64	0.47	1862400	690900	2080000	1428800	1.28	7.38
Clovis Pt.	0.00	0.00	0.00																		
Rocky Butte	0.00	0.00	0.00																		
Caballo	30.00	19.95	14.30	0.67	0.48	990.12	471.96	658.43	14.30	19.95	88.00	24.20	54.26	0.35	0.43	5005000	10406000	6982500	23331800	7.71	44.54
Belle Ayr	25.00	22.80	15.53	0.91	0.62	828.77	514.83	755.84	15.53	22.80	73.61	17.08	60.87	0.39	0.58	6056700	9906400	8892000	35304600	7.98	46.13
Caballo Rojo	30.00	14.68	8.57	0.49	0.29	465.83	133.07	227.95	8.57	14.68	57.10	13.76	25.39	0.40	0.60	3428000	8256000	5872000	15234000	5.84	33.77
Cordero	24.00	13.39	12.90	0.56	0.54	449.52	241.62	250.79	12.90	13.39	51.75	22.30	29.04	0.43	0.44	5547000	9812000	5757700	12777600	7.68	44.39
Coal Creek	18.00	2.92	0.14	0.16	0.01	644.54	5.01	104.56	0.14	2.92	41.04	0.29	6.89	0.40	0.50	56000	145000	1168000	3445000	0.10	0.58
Jacob's Ranch	20.00	29.10	16.80	1.46	0.84	577.90	485.44	840.84	16.80	29.10		37.50	57.80	0.40	0.50	6720000	18750000	11640000	28900000	12.74	73.61
Black Thunder	36.00	42.70	28.75	1.19	0.80	766.80	612.38	909.51	28.75	42.70		38.45	133.50	0.40	0.50	11500000	19225000	17080000	66750000	15.36	88.80
N. Rochelle	8.00	15.16	0.03	1.89	0.00	193.40	0.73	366.40	0.03	15.16		0.05	60.47	0.40	0.50	12000	25000	6062400	30233000	0.02	0.11
N. Antelope	36.20	34.97	8.24	0.97	0.23	522.81	119.00	505.05	8.24	34.97	49.62	11.03	57.04	0.41	0.41	3378400	4522300	14337700	23386400	3.95	22.83
Rochelle	24.00	24.94	12.03	1.04	0.50	627.79	314.68	652.38	12.03	24.94	64.80	14.85	60.44	0.41	0.41	4932300	6088500	10225400	24780400	5.51	31.85
Antelope	12.00	13.60	5.20	1.13	0.43	345.99	149.93	392.12	5.20	13.60	28.74	6.00	37.60	0.28	0.42	1456000	2520000	3808000	15792000	1.99	11.49

	1997 SO2 Emissions (TPY)	1997 NO2 Emissions (TPY)	1997-1990 SO2 Diff (TPY)	1997-1990 NO2 Diff (TPY)	Train Hrs	T Coal/Train	1990 Train #	1997 Train #	1990 Hours	1997 Hours	1990 PM10 Emissions (TPY)	1990 SO2 Emissions (TPY)	1990 NO2 Emissions (TPY)	1997 PM10 Emissions (TPY)	1997 SO2 Emissions (TPY)	1997 NO2 Emissions (TPY)	1997-1990 PM10 Diff (TPY)	1997-1990 SO2 Diff (TPY)	1997-1990 NO2 Diff (TPY)
Buckskin	10.43	60.29	6.32	36.50	5	12500	616	1152	3080	5760	0.85	2.23	31.23	1.60	4.17	58.40	0.74	1.94	27.17
Rawhide	5.52	31.93	1.19	6.90	4	12507	911	856	3646	3425	1.01	2.64	36.96	0.95	2.48	34.73	-0.06	-0.16	-2.24
Eagle Butte	9.15	52.91	3.19	18.43	5	12500	1230	1434	6148	7168	1.71	4.45	62.33	1.99	5.19	72.67	0.28	0.74	10.34
Dry Fork	0.32	1.84	-0.09	-0.49	5	12500	66	74	328	368	0.09	0.24	3.33	0.10	0.27	3.73	0.01	0.03	0.41
Ft. Union	0.29	1.69	0.23	1.31	5	12500	3	47	16	236	0.00	0.01	0.16	0.07	0.17	2.39	0.06	0.16	2.23
Wyodak	1.75	10.14	0.48	2.76	4	11000	265	295	1058	1182	0.29	0.77	10.73	0.33	0.86	11.98	0.03	0.09	1.25
Clovis Pt.																			
Rocky Butte																			
Caballo	15.16	87.61	7.45	43.07	3.5	12649	1131	1577	3957	5520	1.10	2.86	40.12	1.53	3.99	55.97	0.43	1.13	15.85
Belle Ayr	22.10	127.73	14.12	81.59	5	11200	1387	2036	6933	10179	1.92	5.02	70.29	2.82	7.37	103.19	0.90	2.35	32.90
Caballo Rojo	10.55	61.00	4.71	27.23	*	12364	693	1187	3466	5937	0.96	2.51	35.14	1.65	4.30	60.19	0.69	1.79	25.05
Cordero	9.27	53.57	1.59	9.18	*	12364	1043	1083	5217	5415	1.45	3.77	52.89	1.50	3.92	54.90	0.05	0.14	2.01
Coal Creek	2.31	13.33	2.21	12.75	5	12500	11	234	56	1168	0.02	0.04	0.57	0.32	0.85	11.84	0.31	0.80	11.27
Jacob's Ranch	20.27	117.16	7.54	43.55	5	12500	1344	2328	6720	11640	1.86	4.86	68.13	3.23	8.42	118.01	1.36	3.56	49.88
Black Thunder	41.92	242.27	26.55	153.47	5	12500	2300	3416	11500	17080	3.19	8.32	116.59	4.74	12.36	173.16	1.55	4.04	56.57
N. Rochelle	18.15	104.89	18.13	104.79	5	12500	2	1212	12	6062	0.00	0.01	0.12	1.68	4.39	61.46	1.68	4.38	61.34
N. Antelope	18.86	109.02	14.91	86.19	10	13444	613	2601	6129	26012	1.70	4.44	62.14	7.22	18.82	263.72	5.52	14.39	201.58
Rochelle	17.50	101.17	11.99	69.32	10	13444	895	1855	8948	18551	2.48	6.47	90.72	5.15	13.42	188.08	2.66	6.95	97.36
Antelope	9.80	56.64	7.81	45.15	5	13039	399	1043	1994	5215	0.55	1.44	20.22	1.45	3.77	52.87	0.89	2.33	32.66

	1997 Multiplier	1990 Multiplier	1997 Scraper Estimate (hours)	1997 Grader Estimate (hours)	1997 Water Tk Estimate (hours)	1997 Hauling Estimate (miles)	1990 Scrapers (hours)	1990 Graders (hours)	1990 Water Tk (hours)	1990 Hauling (miles)	1990 Fuel Use Scrapers (gal)	1990 Fuel Use Graders (gal)	1990 Fuel Use Water Tk (gal)	1990 Fuel Use Hauling (gal)	1990 Fuel Use Whl Load (gal)	1990 Fuel Use Rt Dozer (gal)	1990 Fuel Use Trk Dozer (gal)	1990 Fuel Use Drills (gal)	1990 Fuel Use Misc. Eq. (gal)	1990 PM10 Emissions (TPY)	1990 SO2 Emissions (TPY)	1990 NO2 Emissions (TPY)
Buckskin	0.97	0.52	1219	3929	7665	200029	634	2044	3988	104069	12684	24530	79757	364242						4.37	7.51	69.74
Rawhide	0.96	1.02	5212	8223	26280	484000	5305	8370	26749	492643	106101	100438	534986	1724250						22.56	38.46	356.63
Eagle Butte	0.67	0.58	2197	18202	4255	638642	1268	10506	2456	368604	25361	126067	49117	1290114						13.60	23.25	216.08
Dry Fork	0.14	0.13	2084	12681	13950	128187	263	1600	1760	16171	5258	19197	35197	56599						1.10	1.81	16.48
Ft. Union	0.17	0.01	19790	3038	0	111333	226	35	0	1272	4523	417	0	4453						0.11	0.15	1.29
Wyodak	0.65	0.58	2000	4160	2334	53987	1164	2421	1358	31420	23280	29053	24451	47131						1.27	1.93	17.13
Clovis Pt.																						
Rocky Butte																						
Caballo	0.67	0.48	23100	58700	16900	1851111	11011	27980	8056	882363	220220	335764	161113	3088270						35.49	59.35	548.41
Belle Ayr	0.91	0.62	8045	31720	9252	1978651	4998	19704	5747	1229138	99951	163547	114947	4424897		359804		98128		47.50	82.06	770.55
Caballo Ro *	0.49	0.29	2791	2017	8760	326812	797	576	2502	93359	35081	7202	70068	280078	4911	8770	84194	7367	2280	5.00	7.79	72.48
Cordero *	0.56	0.54	5726	12729	5424	308303	3078	6842	2915	165713	135420	85523	81631	497139	18959	33855	325008	28438	8802	13.12	18.93	174.21
Coal Creek	0.16	0.01	14200	15800	0	2233126	110	123	0	17369	2209	1475	0	60791						0.58	1.01	9.42
Jacob's Ranch	1.46	0.84	4418	68308	0	1047128	3711	57379	0	879588	74222	688545	0	3078556						35.90	59.89	549.83
Black Thunder	1.19	0.80	12587	20509	0	689201	10052	16379	0	550404	201042	196545	0	1926413						21.97	36.24	334.31
N. Rochelle	1.89	0.00	988.7	3957	0	225863	4	15	0	847	74	178	0	2964						0.03	0.05	0.47
N. Antelope	0.97	0.23	29897	46848	0	800237	6805	10664	0	416340	39471	77845	0	1207385	94730	126306	86835	51312		16.28	26.26	247.68
Rochelle	1.04	0.50	28080	44000	0	1289403	14075	22055	0	670838	81636	161002	0	1945430	195925	261234	179598	106126		28.79	45.70	431.11
Antelope	1.13	0.43	2532	6400	6400	549117	1097	2773	2773	285689	16019	42987	35499	1828411	21493	15475	197739			20.12	33.65	315.40

	1997 Multiplier	1990 Multiplier	1997 Scraper Estimate (hours)	1997 Grader Estimate (hours)	1997 Water Tk Estimate (hours)	1997 Hauling Estimate (miles)	1997 Scrapers (hours)	1997 Graders (hours)	1997 Water Tk (hours)	1997 Hauling (miles)	1997 Fuel Use Scrapers (gal)	1997 Fuel Use Graders (gal)	1997 Fuel Use Water Tk (gal)	1997 Fuel Use Hauling (gal)	1997 Fuel Use Whl Load (gal)	1997 Fuel Use Rt Dozer (gal)	1997 Fuel Use Trk Dozer (gal)	1997 Fuel Use Drills (gal)	1997 Fuel Use Misc. Eq. (gal)	1997 PM10 Emissions (TPY)	1997 SO2 Emissions (TPY)	1997 NO2 Emissions (TPY)
Buckskin	0.97	0.52	1219	3929	7665	200029	1186	3823	7458	194623	23721	45874	149157	681180						8.18	14.04	130.43
Rawhide	0.96	1.02	5212	8223	26280	484000	4984	7863	25130	462825	99680	94359	502605	1619888						21.19	36.13	335.05
Eagle Butte	0.67	0.58	2197	18202	4255	638642	1478	12249	2863	429758	29568	146983	57266	1504154						15.85	27.11	251.93
Dry Fork	0.14	0.13	2084	12681	13950	128187	295	1795	1974	18143	5899	21538	39489	63502						1.23	2.03	18.49
Ft. Union	0.17	0.01	19790	3038	0	111333	3336	512	0	18768	66721	6145	0	65686						1.56	2.16	19.07
Wyodak	0.65	0.58	2000	4160	2334	53987	1300	2704	1517	35092	26000	32448	27308	52637						1.42	2.16	19.13
Clovis Pt.																						
Rocky Butte																						
Caballo	0.67	0.48	23100	58700	16900	1851111	15362	39036	11239	1230989	307230	468426	224770	4308461						49.51	82.80	765.10
Belle Ayr	0.91	0.62	8045	31720	9252	1978651	7337	28929	8438	1804530	146741	240108	168756	6496307		528237		144065		69.73	120.48	1131.26
Caballo Ro *	0.49	0.29	2791	2017	8760	326812	1366	987	4287	159920	60092	12337	120024	479760	8413	15023	144221	12619	3906	8.57	13.35	124.16
Cordero *	0.56	0.54	5726	12729	5424	308303	3195	7102	3026	172007	140564	88772	84732	516022	19679	35141	337353	29518	9137	13.62	19.65	180.82
Coal Creek	0.16	0.01	14200	15800	0	2233126	2304	2563	0	362263	46071	30757	0	1267919						12.19	20.98	196.37
Jacob's Ranch	1.46	0.84	4418	68308	0	1047128	6428	99388	0	1523571	128564	1192658	0	5332499						62.19	103.74	952.38
Black Thunder	1.19	0.80	12587	20509	0	689201	14930	24326	0	817469	298592	291911	0	2861141						32.64	53.83	496.53
N. Rochelle	1.89	0.00	988.7	3957	0	225863	1873	7497	0	427897	37462	89958	0	1497641						14.76	25.35	236.56
N. Antelope	0.97	0.23	29897	46848	0	800237	28881	45256	0	773047	167511	330370	0	2241835	402026	536034	368524	217764		43.59	66.47	627.17
Rochelle	1.04	0.50	28080	44000	0	1289403	29180	45723	0	1339905	169243	333780	0	3885723	406183	541577	372334	220016		58.38	92.44	872.06
Antelope	1.13	0.43	2532	6400	6400	549117	2870	7253	7253	622333	41896	112427	92843	3982929	56213	40474	517163			45.56	75.53	707.34