NM2 - __12__

MONITORING REPORTS

Date:

__8-14-10__

Larson &
Associates, Inc.
Environmental Consultants

August 14, 2009

VIA CERTIFIED MAIL

Mr. Edward J. Hansen
Hydrologist
State of New Mexico – Department of Natural Resources
Oil Conservation Division – Environmental Bureau
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Re: Sampling Results for Chevron North America Exploration and Production Co., Centralized Surface Waste Management Facility (Permit Number NM-2-0012), W/2 of Section 17, Township 24 South, Range 36 East, NMPM Lea County, New Mexico

Dear Mr. Hansen:

Larson & Associates, Inc. (LAI), as consultant to Chevron North America Exploration and Production Company (Chevron), submits this report to the New Mexico Oil Conservation Division (OCD) for the above referenced centralized surface waste management facility (NM-2-0012). This report is submitted in accordance with the approved Sampling Plan dated June 24, 2009. Additional background sampling was performed and the Students t's statistical application was applied.

Figure 1 presents a location map. Figure 2 presents a facility drawing. OCD and LAI communications are presented in Appendix A.

Background Samples

A background sample of native soil from approximately 2 to 3 feet below native ground surface was collected before construction of the facility on June 24, 1998. This sample was analyzed for total petroleum hydrocarbons (TPH), total metals (arsenic, barium, calcium, cadmium, chromium, lead, magnesium, mercury, potassium, selenium, silver and sodium), and general chemistry parameters (alkalinity, chloride, sulfate, fluoride and nitrate).

An additional composite background sample of native soil from approximately 2 to 3 feet below native ground surface was collected on March 25, 2009. LAI personnel collected the composite background sample from Cells 29, 30, 31 and 32. The sample was analyzed according to OCD requirements for TPH, including Gasoline and Diesel Range Organics, Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX), total metals and chloride.

On June 26, 2009, LAI personnel collected ten (10) additional composite background samples from an area located north of the utilized cells to establish a representative statistical baseline. The composite samples were collected at varying depths between six (6) inches and 2 ½ feet below ground surface. The samples were analyzed for chloride and total metals (arsenic, barium, chromium, iron, lead, mercury, selenium and zinc). The results were evaluated using the Student t's – Descriptive Statistics calculations with 95% and 98% confidence levels. Vadose zone sample results exceeding established background were compared to the Student t's confidence levels.

Tables 1 through 4 present the treatment and vadose zones and background statistical confidence level results. Figure 3 presents the background sample locations. Laboratory analytical reports are presented in Appendix B.

Vadose Zone Samples

Samples for the vadose zone from Cells 17, 18, and 26 were collected by LAI personnel on June 26, 2009. The samples were collected between approximately 3 to 4 feet below native ground surface. The samples were collected using direct-push technology. The samples were placed in pre-cleaned 4-ounce jars, properly labeled and placed on ice upon collection and were submitted to DHL Analytical, Inc. (DHL). The samples were analyzed for barium and chloride as per the approved Sampling Plan.

June 26, 2009 Sampling Event

	Barium	**Chloride**
95% min/max:	70.1 - 145.5	5.52 - 6.88
98% min/max:	61.0 - 154.6	5.35 - 7.05
Cell 17	**325**	**90.8**
Cell 18	**390**	**22.5**
Cell 26	**301**	<6.36

Cells 17 and 18 exceeded the 95% and 98% Confidence Levels for barium and chloride. Cell 26 exceeded the 95% and 98% confidence level for barium but met the criteria for chloride.

March 25, 2009 Sampling Event

The statistical background confidence levels for arsenic, barium, chromium, iron, lead, mercury, selenium and zinc were compared to the vadose zone samples that exceeded the established background levels for the March 25, 2009 sampling event. Samples were collected between 2 to 3 feet below ground surface.

	Arsenic	Barium	Chromium	Iron	Lead	Mercury	Selenium	Zinc
Background	3.79	271	9.20	8,510	4.96	<0.0145	2.77	19.8
95% min/max:	2.66 - 3.22	70.1 - 145.5	8.76 - 10.28	8131 - 9647	5.70 - 6.62	0.0139 - 0.0179	1.61 - 2.11	19.7 - 22.7
98% min/max:	2.60 - 3.28	61.0 - 154.6	8.58 - 10.46	7949 - 9829	5.59 - 6.73	0.0134 - 0.0184	1.55 - 2.17	19.3 - 23.1
NM SSL – Res	3.90	15,600	100,000	23,500	400	100,000	391	23,500
NM SSL – Ind.	17.7	100,000	100,000	100,000	800	100,000	5,680	100,000
Cell 17	**4.43**	**1,330**	3.64	2,440	1.93	<0.0169	1.35	6.94
Cell 18	**4.81**	**730**	3.46	2,200	1.36	<0.0156	0.909	10.2
Cell 19	2.84	197	4.28	3,380	2.30	<0.0163	1.23	7.97
Cell 20	**4.29**	204	2.16	1,370	1.01	<0.0169	0.705	4.84
Cell 21	2.61	74.4	8.83	8,130	4.76	<0.0154	2.45	19.0
Cell 25	**3.85**	65.5	**11.6**	**11,800**	6.61	<0.0158	**2.86**	**25.8**
Cell 26	**5.19**	**692**	3.07	2,100	1.38	<0.0177	0.960	5.58

The sample results from March 25, 2009, demonstrated that the 95% and 98% confidence level was exceeded for arsenic (Cells 17, 18, 20, 25 and 26), barium (Cells 17, 18 and 26), chromium, iron, selenium and zinc (Cell 25).

Additional Information

Sample results were also compared to Soil Screening Levels (SSL) presented in the *Technical Background Document for Development of Soil Screening Levels, Revision 4.0* dated June 2006. The samples results for Cells 19, 21 and 25 were below the residential soil screening level established for arsenic (3.90 ppm). Arsenic results for cells 17, 18, 20 and 26 were below the Industrial/Occupational screening level for arsenic (17.7 ppm). Cells 17, 18, 19, 20, 21, 25 and 26 were below residential screening levels established for barium, chromium, iron, lead, mercury, selenium and zinc. This indicates that environmental conditions may not require remedial action of the treatment or vadose zone soil.

The *Custom Soil Resource Report for Lea County, New Mexico,* prepared for the Chevron Landfarm indicates the vicinity's surface geology is comprised of Berino-Cacique loamy fine sands association, sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock.

Monitor well boring logs from an adjacent site indicate a general lithology of an unconsolidated veneer of eolian sand over a variable thickness carbonate-indurated sand (caliche) layer encountered at approximately 23 to 60-feet below ground surface (bgs). The caliche creates an interpreditory layer for the downward migration of mobilized metals. An increased pH (basic environment) in the caliche layer would create a flocculation zone. Most metals are considered to be multivalent cations. Positively charged molecules interact with negatively charged particles, in the caliche to form aggregate. In addition, many of these analytes and compounds, under the appropriate pH and conditions (temperature, pressure and salinity) will link together to form long chains or meshes, physically trapping small and fine particles thus minimizing the migration of metals.

Regional direction for groundwater flow is towards the southeast. Water levels observed at the adjacent site have varied between 149 to 180 feet bgs.

Vadose zone analyses are presented in Tables 2 and 3. *Technical Background Document for Development of Soil Screening Levels* presented in Appendix C. NMED Soil Screening Levels *Custom Soil Resources Report* is presented in Appendix D.

Treatment Zone Samples

Treatment zone samples collected on March 25, 2009 that exceeded background levels were compared to the statistical confidence levels for metals.

	Arsenic	Barium	Chromium	Iron	Lead	Mercury	Selenium	Zinc
Background	3.79	271	9.20	8,510	4.96	<0.0145	2.77	19.8
95% min/max:	2.66 - 3.22	70.1 - 145.5	8.76 - 10.28	8131 - 9647	5.70 - 6.62	0.0139 - 0.0179	1.61 - 2.11	19.7 - 22.7
98% min/max:	2.60 - 3.28	61.0 - 154.6	8.58 - 10.46	7949 - 9829	5.59 - 6.73	0.0134 - 0.0184	1.55 - 2.17	19.3 - 23.1
Cell 17	2.99	119	7.89	7,160	6.34	0.0168	1.83	21.5
Cell 18	2.68	108	6.81	5,690	6.00	<0.0148	1.55	17.2
Cell 19	2.65	173	6.93	6,210	3.96	<0.0147	1.41	15.6
Cell 20	2.43	173	6.48	5,670	3.42	<0.0138	1.51	19.5
Cell 21	2.96	114	8.17	6,480	**7.41**	<0.0143	1.63	**23.4**
Cell 25	2.41	103	6.68	6,090	4.42	<0.0143	1.64	22.9
Cell 26	2.63	54.1	7.60	7,500	5.01	<0.0152	2.03	19.8

Cell 17 exceeded background levels, established March 25, 2009, for lead (6.34 ppm), mercury (0.0168 ppm), and zinc (21.5 ppm). A 95% confidence level was applied to the background samples for Lead (5.70 – 6.62 ppm), mercury (0.0139 – 0.0179 ppm), and zinc (19.7 – 22.7 ppm). The sample results for Cell 17 were within the established 95% confidence levels.

Cell 18 and Cell 26 exceeded the background level for lead (6.00 and 5.01 ppm, respectively). A 95% statistical confidence level was applied to lead. Cells 18 and 26 were within the established confidence level (5.70 – 6.62 ppm) for lead. Zinc (22.9 ppm) exceeded the background level for Cell 25. Zinc was slightly above the 95% tolerance limits (19.7 – 22.7 ppm) but was within the 98% confidence levels (19.3 – 23.1).

Cell 21 exceeded the background levels lead (7.41 ppm) and zinc (23.4 ppm). Lead and zinc did not meet the 95% and 98% confidence levels.

Cells 17 through 20 and 26 were below the remediation standards for TPH by method 8015M (500 ppm) and TRPH method 418.1 (500 ppm) according to samples collected on March 25, 2009. TRPH in Cells 21 and 26 was detected at 678 and 1260 ppm, respectively above the 500 ppm remediation standard.

Treatment zone sample analyses are presented in Table 1.

Summary

Treatment zone soil samples from Cells 17 through 21, 25 and 26 were below action levels for TPH (method 8015M), BTEX, benzene and chloride. TRPH (method 418.1) exceeded 500 ppm for Cell 21 and Cell 26 according to the March 25, 2009 sampling event. Lead and Zinc were slightly above the 98% confidence levels for Cell 21.

Vadose zone samples Cells 17, 18, 20, 25 and 26 had exceedance for various metals using the Student t's – Descriptive Statistics. The levels were also compared to the New Mexico Soil Screening Level document. Cells 17, 18, 19, 20, 21, 25 and 26 were below the established Industrial/Occupational screening levels for arsenic, barium, chromium, iron, lead, mercury, selenium and zinc. This indicates that environmental conditions do not require remedial action of the treatment or vadose zone soil.

Chevron will continue to perform bi-weekly tilling for the remediation of TPH and monitoring as per the permit requirements for Cells 21 and 26. Chevron requests the OCD to grant closure for Cells 17, 18, 19, 20, and 25.

If you have any questions or require additional information please contact Mr. Rodney Bailey with Chevron at (432) 894-3519 or via email bailerg@chevron.com. I can be reached at (432) 687-0901 or via email michelle@laenvironmental.com.

Sincerely,
Larson & Associates, Inc.

Michelle L. Green
Environmental Scientist

Enclosure

cc: Rodney Bailey, Chevron
Larry Johnson, OCD District 1

Table 1

Summary of Treatment Zone Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Selenium	Silver	Zinc
Background Level (3/25/09):				**3.79**	**271**	**0.201**	**9.20**	**4.01**	**8,510**	**4.96**	**81.5**	**<0.0145**	**2.77**	**<0.0957**	**19.8**
WQCC Level:				**0.1**	**1.0**	**0.01**	**0.05**	**1.0**	**1.0**	**0.05**	**0.2**	**0.002**	**0.05**	**0.05**	**10.0**
Cell 17 (0-1')	17	03/25/09	0 - 1	2.99	119	0.167	7.89	3.99	7,160	**6.34**	76.5	**0.0168**	1.83	<0.0912	**21.5**
Cell 18 (0-1')	18	03/25/09	0 - 1	2.68	108	0.132	6.81	3.41	5,690	**6.00**	61.3	<0.0148	1.55	<0.0861	17.2
Cell 19 (0-1')	19	03/25/09	0 - 1	2.65	173	0.159	6.93	2.42	6,210	3.96	45.3	<0.0147	1.41	<0.0899	15.6
Cell 20 (0-1')	20	03/25/09	0 - 1	2.43	173	0.162	6.48	1.92	5,670	3.42	43.3	<0.0138	1.51	<0.0901	19.5
Cell 21 (0-1')	21	03/25/09	0 - 1	2.96	114	0.187	8.17	3.22	6,480	**7.41**	58.4	<0.0143	1.63	<0.0900	**23.4**
Cell 25 (0-1')	25	03/25/09	0 - 1	2.41	103	0.171	6.68	2.58	6,090	4.42	57.4	<0.0143	1.64	<0.100	**22.9**
Cell 26 (0-1')	26	03/25/09	0 - 1	2.63	54.1	0.158	7.60	3.59	7,500	**5.01**	80.9	<0.0152	2.03	<0.0864	19.8

Notes: Analysis performed by DHL Analytical, Inc., Round Rock, TX
Results are reported in milligram per Kilograms (mg/Kg).
Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A
1. <: Less than method detection limit

Table 2
Summary of Vadose Zone Soil Samples
Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)
W/2 of Section 17, Township 24 South, Range 36 East
Lea County, New Mexico

Sample	Cell *Number*	Date	Depth	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Selenium	Silver	Zinc
Background Level (3/25/09):				**3.79**	**271**	**0.201**	**9.20**	**4.01**	**8,510**	**4.96**	**81.5**	**<0.0145**	**2.77**	**<0.0957**	**19.8**
WQCC Level:				**0.1**	**1.0**	**0.01**	**0.05**	**1.0**	**1.0**	**0.05**	**0.2**	**0.002**	**0.05**	**0.05**	**10.0**
Cell 17 (2-3')	17	05/22/07	2 - 3	3.30	164	0.188	7.90	--	--	4.360	--	**0.0171**	0.866	<0.107	--
		03/19/08	2 - 3	**5.22**	**356**	<0.113	1.09	--	--	0.591	--	<0.0180	0.407	<0.113	--
		08/26/08	2 - 3	2.87	213	0.138	3.19	--	--	1.67	--	<0.0155	0.716	<0.109	--
		03/25/09	2 - 3	**4.43**	**1,330**	0.182	3.64	2.17	2,440	1.93	26.6	<0.0169	1.35	<0.0997	6.94
		06/26/09	3 - 4	--	**325**	--	--	--	--	--	--	--	--	--	--
Cell 18 (2-3')	18	05/22/07	2 - 3	**4.70**	**717**	0.183	3.41	--	--	1.75	--	<0.0186	0.635	<0.104	--
		03/19/08	2 - 3	3.18	139	0.168	4.53	--	--	3.08	--	<0.0167	0.987	<0.0911	--
		08/25/08	2 - 3	**3.91**	149	0.172	3.97	--	--	3.48	--	<0.0164	0.897	<0.109	--
		03/25/09	2 - 3	**4.81**	**730**	<0.112	3.46	2.25	2,200	1.36	24.0	<0.0156	0.909	<0.112	10.2
		06/26/09	3 - 4	--	**390**	--	--	--	--	--	--	--	--	--	--
Cell 19 (2-3')	19	05/22/07	2 - 3	2.29	61	0.135	**9.69**	--	--	4.82	--	<0.0162	1.03	<0.0912	--
		03/19/08	2 - 3	2.35	89.8	0.166	7.83	--	--	4.42	--	<0.0162	1.50	<0.0965	--
		08/25/08	2 - 3	1.72	40.9	<0.101	6.83	--	--	4.20	--	<0.0162	1.28	<0.101	--
		03/25/09	2 - 3	2.84	197	0.118	4.28	2.26	3,380	2.30	38.1	<0.0163	1.23	<0.102	7.97
Cell 20 (2-3')	20	05/22/07	2 - 3	2.98	96.1	0.202	7.16	--	--	4.65	--	<0.0169	1.140	<0.104	--
		03/19/08	2 - 3	3.30	247	0.099	2.45	--	--	1.35	--	<0.0158	0.459	<0.0989	--
		08/25/08	2 - 3	1.43	29.6	<0.0990	5.11	--	--	3.08	--	<0.0154	0.865	<0.0990	--
		03/25/09	2 - 3	4.29	204	<0.111	2.16	2.00	1,370	1.01	19.5	<0.0169	0.705	<0.111	4.84
Cell 21 (2-3')	21	05/22/07	2 - 3	3.6	230	0.151	4.29	--	--	2.18	--	<0.0177	0.626	<0.117	--
		03/19/08	2 - 3	**4.53**	**736**	0.125	2.15	--	--	1.21	--	<0.0158	0.460	<0.108	--
		08/26/08	2 - 3	2.67	73.1	0.141	**9.52**	--	--	**6.55**	--	<0.0149	2.41	<0.102	--
		03/25/09	2 - 3	2.61	74.4	0.147	8.83	**4.03**	8,130	4.76	87.7	<0.0154	2.45	<0.102	19.0

Table 2
Summary of Vadose Zone Soil Samples
Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)
W/2 of Section 17, Township 24 South, Range 36 East
Lea County, New Mexico

Sample	Cell Number	Date	Depth	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Selenium	Silver	Zinc
Background Level (3/25/09):				**3.79**	**271**	**0.201**	**9.20**	**4.01**	**8,510**	**4.96**	**81.5**	**<0.0145**	**2.77**	**<0.0957**	**19.8**
WQCC Level:				**0.1**	**1.0**	**0.01**	**0.05**	**1.0**	**1.0**	**0.05**	**0.2**	**0.002**	**0.05**	**0.05**	**10.0**
Cell 25 (2-3')	25	05/22/07	2 - 3	2.96	76.7	0.197	**11.70**	--	--	**6.13**	--	<0.0171	1.39	<0.103	--
		08/25/08	2 - 3	2.88	60.8	0.155	8.91	--	--	**5.51**	--	<0.0154	1.41	<0.105	--
		03/25/09	2 - 3	3.85	65.5	0.215	**11.6**	3.83	**11,800**	**6.61**	91.7	<0.0158	**2.86**	<0.110	**25.8**
Cell 26 (2-3')	26	05/22/07	2 - 3	2.96	121	0.197	9.20	--	--	4.79	--	<0.0177	1.23	<0.109	--
		08/26/08	2 - 3	2.58	85.1	0.115	6.73	--	--	4.77	--	<0.0149	1.64	<0.103	--
		09/25/08	2 - 3	**4.25**	128	**0.271**	**14.60**	--	--	**9.17**	--	<0.0172	2.20	0.109	--
		03/25/09	2 - 3	**5.19**	**692**	0.132	3.07	2.37	2100	1.38	20.0	<0.0177	0.960	<0.110	5.85
		06/26/09	3 - 4	--	**301**	--	--	--	--	--	--	--	--	--	--

Notes: Analysis performed by DHL Analytical, Inc., Round Rock, TX
Results are reported in milligram per Kilograms (mg/Kg).
Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A
1. <:

Table 3
Summary of Vadose Zone Soil Samples
Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)
W/2 of Section 17, Township 24 South, Range 36 East
Lea County, New Mexico

Sample	Cell Number	Date	Depth	Alkalinity	Chloride	Sulfate
Background Level (3/25/09):				--	**8.89**	--
WQCC Level:				--	**250**	**600**
Cell 17 (2-3')	17	05/22/07	2 - 3	--	**304**	202
		03/19/08	2 - 3	11,100	**61.2**	71.4
		08/26/08	2 - 3	5,780	<5.41	46.4
		12/08/08	2 - 3	--	<6.50	--
		03/25/09	2 - 3	--	**134**	--
		06/26/09	3 - 4	--	**90.8**	--
Cell 18 (2-3')	18	05/22/07	2 - 3	--	**18.9**	150
		03/19/08	2 - 3	700	6.37	217
		08/25/08	2 - 3	2,600	**9.94**	123
		12/08/08	2 - 3	--	<5.52	--
		03/25/09	2 - 3	--	**353**	--
		06/26/09	3 - 4	--	**22.5**	--
Cell 19 (2-3')	19	05/22/07	2 - 3	--	<5.06	205
		03/19/08	2 - 3	210	<5.36	300
		08/25/08	2 - 3	123	<5.14	152
		12/08/08	2 - 3	--	**10.8**	--
		03/25/09	2 - 3	--	6.94	--
Cell 20 (2-3')	20	05/22/07	2 - 3	--	<5.57	39.8
		03/19/08	2 - 3	152	**15.3**	561
		08/25/08	2 - 3	126	7.02	199
		12/08/08	2 - 3	--	<5.23	--
		03/25/09	2 - 3	--	**10.8**	--

Table 3

Summary of Vadose Zone Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Alkalinity	Chloride	Sulfate
Background Level (3/25/09):				**--**	**8.89**	**--**
WQCC Level:				--	**250**	**600**
Cell 21 (2-3')	21	05/22/07	2 - 3	--	**7.17**	286
		03/19/08	2 - 3	523	**13.0**	320
		08/26/08	2 - 3	204	<5.32	23.9
		12/08/08	2 - 3	--	**17.7**	--
		03/25/09	2 - 3	--	<5.44	--
Cell 25 (2-3')	25	05/22/07	2 - 3	--	**6.05**	45.6
		08/25/08	2 - 3	211	<5.20	52.3
		12/08/08	2 - 3	--	7.20	--
		03/25/09	2 - 3	--	<5.55	--
Cell 26 (2-3')	26	05/22/07	2 - 3	--	3.9	152
		08/26/08	2 - 3	1,430	<5.33	91
		09/25/08	2 - 3	106	<5.65	--
		12/08/08	2 - 3	--	<5.48	--
		03/25/09	2 - 3	--	<5.79	--
		06/26/09	3 - 4	--	<6.36	--

Notes: Analysis performed by DHL Analytical, Inc., Round Rock, TX

Results are reported in milligram per Kilograms (mg/Kg).

Anion analysis was performed by SW846 method 9056

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	*Date*	*Depth*	*Chloride*	
WQCC Level:				250	
Background		03/25/09	2 - 3'	8.89	8.89
BK-L-32		06/25/09	8"	<6.39	6.39
BK-M-32		06/25/09	12"	<5.27	5.27
BK-R-32		06/25/09	18"	<6.47	6.47
BK-L-31		06/25/09	12"	<5.40	5.40
BK-R-31		06/25/09	12"	<6.34	6.34
BK-L-30		06/25/09	12"	<6.29	6.29
BK-M-30		06/25/09	8"	<5.93	5.93
BK-R-30		06/25/09	10"	<6.39	6.39
BK-L-29		06/25/09	36"	<5.21	5.21
BK-R-29		06/25/09	30"	<5.62	5.62

Descriptive Statistics	
Mean	6.20
Standard Error	0.31
Median	6.29
Mode	6.39
Standard Deviation	1.02
Sample Variance	1.03
Kurtosis	5.26
Skewness	1.99
Range	3.68
Minimum	5.21
Maximum	8.89
Sum	68.2
Count	11
Confidence Level (95.0%)	0.68
Student-t's 95% minimum	*5.52*
Student-t's 95% maximum	*6.88*
Confidence Level (98.0%)	0.85
Student-t's 98% minimum	*5.35*
Student-t's 98% maximum	*7.05*

Notes: Analysis performed by DHL Analytical, Inc., Round Rock, TX

Results are reported in milligram per Kilograms (mg/Kg).

Anion analysis was performed by SW846 method 9056

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Arsenic	*Descriptive Statistics*	
WQCC Level:				**0.1**		
Background		03/25/09	2 - 3'	3.79	Mean	2.94
BK-L-32		06/25/09	8"	2.58	Standard Error	0.12
BK-M-32		06/25/09	12"	2.74	Median	2.94
BK-R-32		06/25/09	18"	2.94	Mode	#N/A
BK-L-31		06/25/09	12"	3.01	Standard Deviation	0.41
BK-R-31		06/25/09	12"	2.57	Sample Variance	0.17
BK-L-30		06/25/09	12"	2.33	Kurtosis	0.44
BK-M-30		06/25/09	8"	3.12	Skewness	0.63
BK-R-30		06/25/09	10"	3.21	Range	1.46
BK-L-29		06/25/09	36"	2.70	Minimum	2.33
BK-R-29		06/25/09	30"	3.31	Maximum	3.79
					Sum	32.30
					Count	11
					Confidence Level (95.0%)	0.28
					Student-t's 95% minimun	*2.66*
					Student-t's 95% maximum	*3.22*
					Confidence Level (98.0%)	0.34
					Student-t's 98% minimun	*2.60*
					Student-t's 98% maximum	*3.28*

Notes: Analysis performed by DHL Analytical, Inc., Round Rock, TX

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Barium	*Descriptive Statistics*	
WQCC Level:				**1.0**		
Background		03/25/09	2 - 3'	271	Mean	107.8
BK-L-32		06/25/09	8"	109	Standard Error	16.9
BK-M-32		06/25/09	12"	84.1	Median	95.1
BK-R-32		06/25/09	18"	95.1	Mode	#N/A
BK-L-31		06/25/09	12"	116	Standard Deviation	56.2
BK-R-31		06/25/09	12"	97.9	Sample Variance	3155.3
BK-L-30		06/25/09	12"	82.2	Kurtosis	9.0
BK-M-30		06/25/09	8"	78.3	Skewness	2.9
BK-R-30		06/25/09	10"	77.1	Range	202.7
BK-L-29		06/25/09	36"	107	Minimum	68.3
BK-R-29		06/25/09	30"	68.3	Maximum	271
					Sum	1186
					Count	11
					Confidence Level (95.0%)	37.7
					Student-t's 95% minimun	*70.1*
					Student-t's 95% maximum	*145.5*
					Confidence Level (98.0%)	46.8
					Student-t's 98% minimun	*61.0*
					Student-t's 98% maximum	*154.6*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Chromium	*Descriptive Statistics*	
WQCC Level:				**0.05**		
Background		03/25/09	2 - 3'	9.20	Mean	9.52
BK-L-32		06/25/09	8"	7.81	Standard Error	0.34
BK-M-32		06/25/09	12"	9.29	Median	9.29
BK-R-32		06/25/09	18"	9.99	Mode	11.3
BK-L-31		06/25/09	12"	8.89	Standard Deviation	1.13
BK-R-31		06/25/09	12"	9.64	Sample Variance	1.27
BK-L-30		06/25/09	12"	8.52	Kurtosis	-0.62
BK-M-30		06/25/09	8"	10.3	Skewness	0.38
BK-R-30		06/25/09	10"	11.3	Range	3.49
BK-L-29		06/25/09	36"	8.49	Minimum	7.81
BK-R-29		06/25/09	30"	11.3	Maximum	11.3
					Sum	104.73
					Count	11
					Confidence Level (95.0%)	0.76
					Student-t's 95% minimun	*8.76*
					Student-t's 95% maximum	*10.28*
					Confidence Level (98.0%)	0.94
					Student-t's 98% minimun	*8.58*
					Student-t's 98% maximum	*10.46*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Iron	*Descriptive Statistics*	
WQCC Level:				**1.0**		
Background		03/25/09	2 - 3'	8,510	Mean	8889
BK-L-32		06/25/09	8"	7,370	Standard Error	340
BK-M-32		06/25/09	12"	8,560	Median	8560
BK-R-32		06/25/09	18"	9,220	Mode	#N/A
BK-L-31		06/25/09	12"	8,190	Standard Deviation	1128
BK-R-31		06/25/09	12"	8,860	Sample Variance	1272749
BK-L-30		06/25/09	12"	8,440	Kurtosis	-0.36
BK-M-30		06/25/09	8"	9,620	Skewness	0.57
BK-R-30		06/25/09	10"	10,800	Range	3430
BK-L-29		06/25/09	36"	7,510	Minimum	7370
BK-R-29		06/25/09	30"	10,700	Maximum	10800
					Sum	97780
					Count	11
					Confidence Level (95.0%)	758
					Student-t's 95% minimun	*8131*
					Student-t's 95% maximum	*9647*
					Confidence Level (98.0%)	940
					Student-t's 98% minimun	*7949*
					Student-t's 98% maximum	*9829*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples
Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)
W/2 of Section 17, Township 24 South, Range 36 East
Lea County, New Mexico

Sample	Cell Number	*Date*	*Depth*	*Lead*	*Descriptive Statistics*	
WQCC Level:				**0.05**		
Background		03/25/09	2 - 3'	4.96	Mean	6.16
BK-L-32		06/25/09	8"	6.10	Standard Error	0.21
BK-M-32		06/25/09	12"	6.69	Median	6.11
BK-R-32		06/25/09	18"	6.32	Mode	#N/A
BK-L-31		06/25/09	12"	5.92	Standard Deviation	0.68
BK-R-31		06/25/09	12"	6.11	Sample Variance	0.46
BK-L-30		06/25/09	12"	5.95	Kurtosis	-0.08
BK-M-30		06/25/09	8"	6.46	Skewness	-0.41
BK-R-30		06/25/09	10"	7.22	Range	2.26
BK-L-29		06/25/09	36"	5.13	Minimum	4.96
BK-R-29		06/25/09	30"	6.88	Maximum	7.22
					Sum	67.74
					Count	11
					Confidence Level (95.0%)	0.46
					Student-t's 95% minimun	*5.70*
					Student-t's 95% maximum	*6.62*
					Confidence Level (98.0%)	0.57
					Student-t's 98% minimun	*5.59*
					Student-t's 98% maximum	*6.73*

Notes: Analysis performed by DHL Analytical, Inc., Round R
Results are reported in milligram per Kilograms (mg/Kg).
Metals analysis was performed by SW846 method 6020
Mercury analysis was performed by SW846 method 7471A
1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Mercury		*Descriptive Statistics*	
WQCC Level:				**0.002**			
Background		03/25/09	2 - 3'	<0.0145	0.0145	Mean	0.0159
BK-L-32		06/25/09	8"	<0.0108	0.0108	Standard Error	0.0009
BK-M-32		06/25/09	12"	<0.0150	0.0150	Median	0.0164
BK-R-32		06/25/09	18"	<0.0189	0.0189	Mode	0.0108
BK-L-31		06/25/09	12"	<0.0166	0.0166	Standard Deviation	0.0030
BK-R-31		06/25/09	12"	<0.0201	0.0201	Sample Variance	9.02E-06
BK-L-30		06/25/09	12"	<0.0108	0.0108	Kurtosis	-0.1501
BK-M-30		06/25/09	8"	<0.0180	0.0180	Skewness	-0.6817
BK-R-30		06/25/09	10"	<0.0178	0.0178	Range	0.0093
BK-L-29		06/25/09	36"	<0.0160	0.0160	Minimum	0.0108
BK-R-29		06/25/09	30"	<0.0164	0.0164	Maximum	0.0201
						Sum	0.1749
						Count	11
						Confidence Level (95.0%)	0.0020
						Student-t's 95% minimun	*0.0139*
						Student-t's 95% maximum	*0.0179*
						Confidence Level (98.0%)	0.0025
						Student-t's 98% minimun	*0.0134*
						Student-t's 98% maximum	*0.0184*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Selenium	*Descriptive Statistics*	
WQCC Level:				**0.05**		
Background		03/25/09	2 - 3'	2.77	Mean	1.86
BK-L-32		06/25/09	8"	1.78	Standard Error	0.11
BK-M-32		06/25/09	12"	1.87	Median	1.86
BK-R-32		06/25/09	18"	2.01	Mode	1.71
BK-L-31		06/25/09	12"	1.71	Standard Deviation	0.37
BK-R-31		06/25/09	12"	1.86	Sample Variance	0.14
BK-L-30		06/25/09	12"	1.71	Kurtosis	4.16
BK-M-30		06/25/09	8"	1.90	Skewness	1.19
BK-R-30		06/25/09	10"	1.98	Range	1.54
BK-L-29		06/25/09	36"	1.23	Minimum	1.23
BK-R-29		06/25/09	30"	1.63	Maximum	2.77
					Sum	20.45
					Count	11
					Confidence Level (95.0%)	0.25
					Student-t's 95% minimun	*1.61*
					Student-t's 95% maximum	*2.11*
					Confidence Level (98.0%)	0.31
					Student-t's 98% minimun	*1.55*
					Student-t's 98% maximum	*2.17*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

Table 4

Summary of Background Soil Samples

Chevron North America Exploration and Production Company, Landfarm (Permit NM-2-0012)

W/2 of Section 17, Township 24 South, Range 36 East

Lea County, New Mexico

Sample	Cell Number	Date	Depth	Zinc	*Descriptive Statistics*	
WQCC Level:				**10.0**		
Background		03/25/09	2 - 3'	19.8	Mean	21.2
BK-L-32		06/25/09	8"	18.9	Standard Error	0.68
BK-M-32		06/25/09	12"	21.7	Median	21.7
BK-R-32		06/25/09	18"	22.2	Mode	19.8
BK-L-31		06/25/09	12"	20.3	Standard Deviation	2.27
BK-R-31		06/25/09	12"	22.6	Sample Variance	5.15
BK-L-30		06/25/09	12"	19.8	Kurtosis	-0.48
BK-M-30		06/25/09	8"	22.6	Skewness	-0.25
BK-R-30		06/25/09	10"	24.7	Range	7.6
BK-L-29		06/25/09	36"	17.1	Minimum	17.1
BK-R-29		06/25/09	30"	23.9	Maximum	24.7
					Sum	233.6
					Count	11
					Confidence Level (95.0%)	1.52
					Student-t's 95% minimun	*19.7*
					Student-t's 95% maximum	*22.7*
					Confidence Level (98.0%)	1.89
					Student-t's 98% minimun	*19.3*
					Student-t's 98% maximum	*23.1*

Notes: Analysis performed by DHL Analytical, Inc., Round R

Results are reported in milligram per Kilograms (mg/Kg).

Metals analysis was performed by SW846 method 6020

Mercury analysis was performed by SW846 method 7471A

1. <: Less than method detection limit

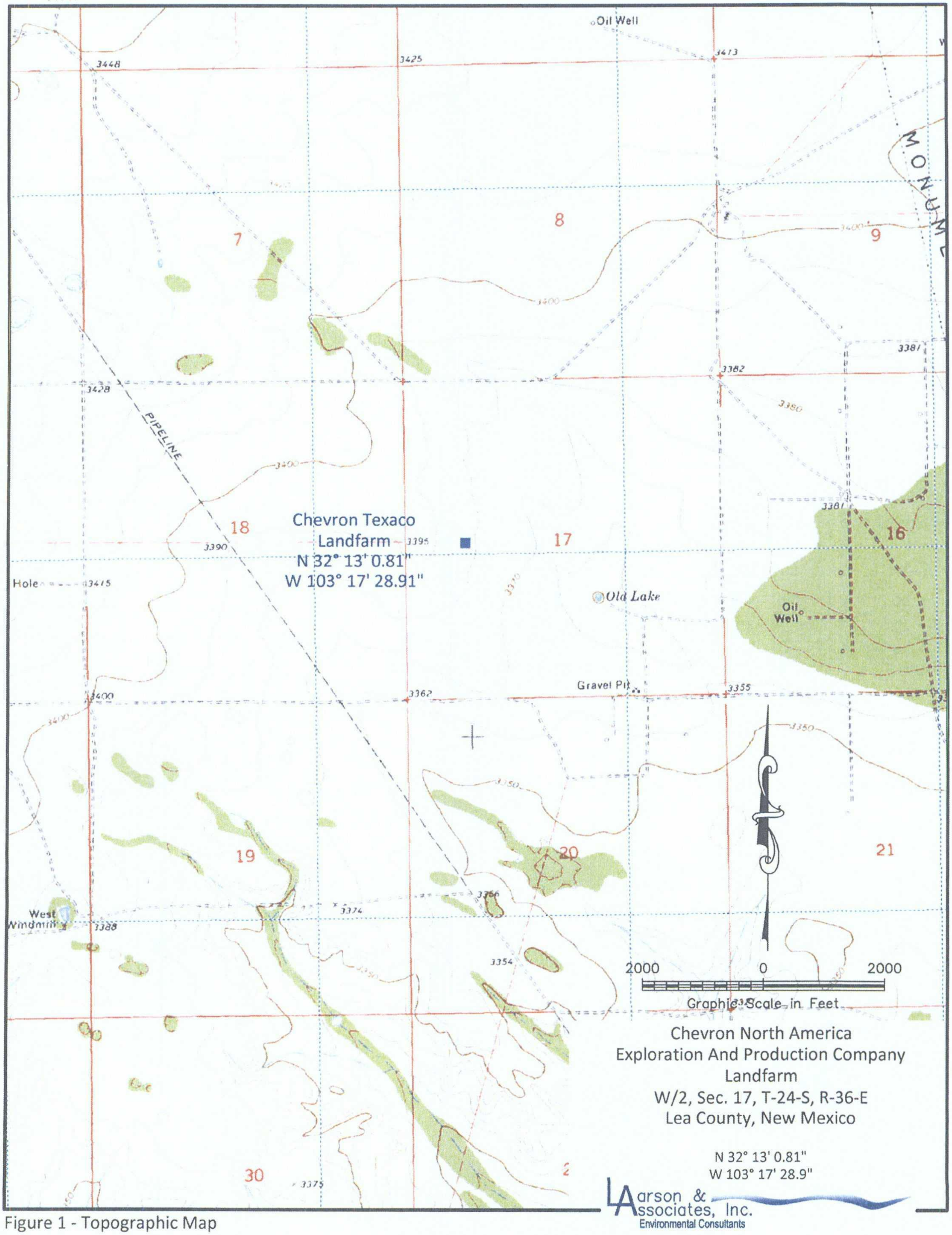

Figure 1 - Topographic Map

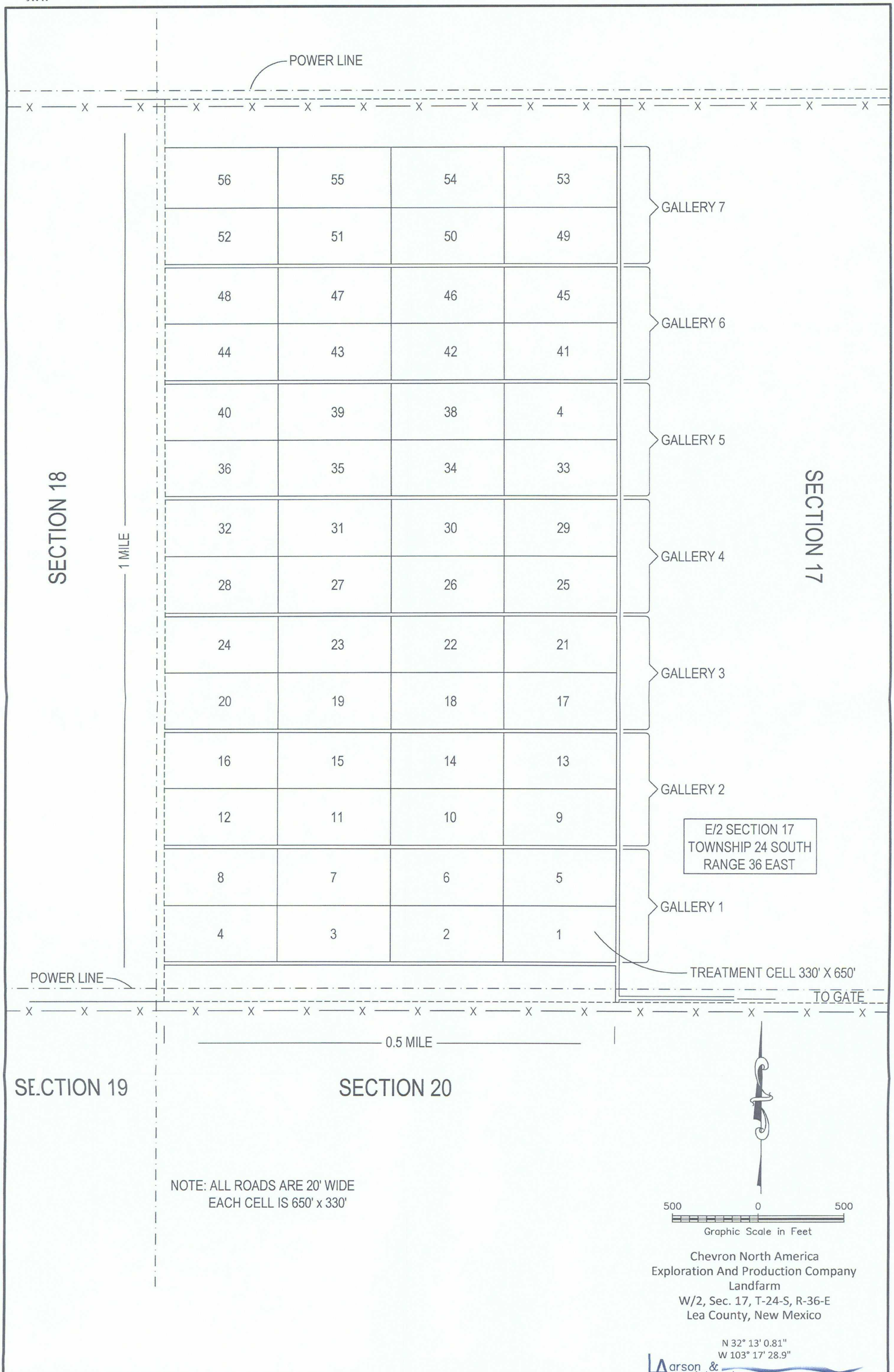

Figure 2 - Site Drawing

JWW

Figure 3 - Background Boring Location

Michelle Green

From: Hansen, Edward J., EMNRD [edwardj.hansen@state.nm.us]
Sent: Wednesday, June 24, 2009 10:31 AM
To: Rodney G Bailey - Chevron
Cc: Mark Larson; Johnson, Larry, EMNRD; VonGonten, Glenn, EMNRD; Jones, Brad A., EMNRD; Michelle Green
Subject: RE: Sampling Plan for Chevron Landfarm NM-02-0012
Attachments: image003.gif; image004.jpg

RE: Sampling Plan Approval
for the Chevron's Landfarm (OCD Permit #NM-02-0012)
Section 3, T24S, R36E, Lea County, New Mexico

Dear Mr. Bailey:

The New Mexico Oil Conservation Division (OCD) has received the soils sampling plan for the above-referenced site, dated June 24, 2009, and has conducted a review of the plan. The plan substantially meets the requirements of 19.15.36 NMAC. Therefore, the OCD hereby conditionally approves the plan:

Chevron must submit the report of the sampling results to the OCD within 90 days of the sampling event.

Please be advised that OCD approval of this sampling plan does not relieve the owner/operator of responsibility should operations pose a threat to ground water, surface water, human health or the environment. In addition, OCD approval does not relieve the owner/operator of responsibility for compliance with any OCD, federal, state, or local laws and/or regulations.

If you have any questions regarding this matter, please contact me at 505-476-3489.

Edward J. Hansen
Hydrologist
Environmental Bureau

From: Michelle Green [mailto:michelle@laenvironmental.com]
Sent: Wednesday, June 24, 2009 6:58 AM
To: Hansen, Edward J., EMNRD; Jones, Brad A., EMNRD; VonGonten, Glenn, EMNRD; Johnson, Larry, EMNRD
Cc: Rodney G Bailey - Chevron; Mark Larson
Subject: Sampling Plan for Chevron Landfarm NM-02-0012

Dear Mr. Hansen:

Larson & Associates, Inc. (LAI), on behalf of Chevron North America Exploration and Production Company (Chevron), submits this Sampling Plan to the *"Update Report for Chevron North America Exploration and Production SWMF NM-02-0012"*report (dated May 29, 2009).

Chevron proposes the following:

- Collect a minimum of 10, 5-part composite background samples, north of the utilized cells to establish a representative baseline. The samples will be collected at varying depths six (6) inches below ground surface. The samples will be analyzed for Chloride and metals (to include arsenic, barium, chromium, iron, lead, selenium, mercury and zinc).

- Each boring location for the background samples will be recorded.

- The Student's *t-test* will be applied to the background samples. A 95% level of confidence will be applied.

- The vadose zone (3-4') for Cells 17, 18 & 26 will be sampled for Barium. Chlorides will also be analyzed for Cells 17 & 18. The final results will be compared to the background sample.

- The sampling for the treatment zone will not be performed. Treatment zone sampling is to be performed on a semi-annual basis per NM OCD Part 36.

- A report of the results of the vadose zone and background samplings will be submitted to the OCD for review, including a plan for additional work, if necessary.

- A closure notice and plan will submitted to NM OCD for review and approval.

- Bi-weekly tilling will continue.

- Sampling to begin Thursday, June 25 through June 26, 2009.

Please let me know if the sampling plan is satisfactory and meets the requirements set forth in our conversations. If you have any questions or require additional information please contact Mr. Rodney Bailey with Chevron at (432) 894-3519 or via email bailerg@chevron.com or myself at (432) 687-0901 or via email michelle@laenvironmental.com.

Thank you,

Michelle L. Green
Larson & Associates, Inc.
507 N Marienfeld, Suite 200
Midland, TX 79701

Office: 432.687.0901
Fax: 432.687.0789
Cell: 432.934.3231

Larson & Associates, Inc.
Environmental Consultants

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DHL
ANALYTICAL

July 07, 2009

Michelle Green
Larson & Associates
507 N. Marienfeld #200
Midland, TX 79701

Order No: 0906263

TEL: (432) 687-0901
FAX: (432) 687-0456

RE: Chevron Landfarm

Dear Michelle Green:

DHL Analytical received 10 sample(s) on 6/27/2009 for the analyses presented in the following report.

There were no problems with the analyses and all data met requirements of NELAC except where noted in the Case Narrative. All non-NELAC methods will be identified accordingly in the case narrative and all estimated uncertainties of test results are within method or EPA specifications.

If you have any questions regarding these tests results, please feel free to call. Thank you for using DHL Analytical.

Sincerely,

John DuPont

John DuPont
Lab Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-09-TX

ACCREDITED IN ACCORDANCE WITH nelac

Table of Contents

CHAIN-OF-CUSTODY

Larson & Associates, Inc.
Environmental Consultants
507 N. Marienfeld, Ste. 200
Midland, TX 79701
432-687-0901

Data Reported to: [signature]

DATE: 6-25-6 PAGE 1 OF 1
PO #: LAB WORK ORDER #: 9506e2103
PROJECT LOCATION OR NAME: Chevron Landfarm
LAI PROJECT #: 6-0137 COLLECTOR: MS + DM

TRRP report? ☐ Yes ☒ No

TIME ZONE: Time zone/State:

S=SOIL W=WATER A=AIR P=PAINT SL=SLUDGE OT=OTHER

PRESERVATION: HCl, HNO_3, H_2SO_4 ☐ NaOH ☐, ICE, UNPRESERVED

ANALYSES: BTEX ☐ MTBE ☐; TRPH 418.1 ☐ TPH 1005 ☐ TPH 1006 ☐; GASOLINE - MOD 8015 ☐; DIESEL - MOD 8015 ☐; VOC 8260 ☐; SVOC 8270 ☐ PAH 8270 ☐ HOLDPAH ☐; 8081 PESTICIDES ☐ 8151 HERBICIDES ☐; 8082 PCBS ☐; TCLP - METALS (RCRA) ☐ TCLP VOC ☐; TCLP - PEST ☐ HERB ☐ Semi-VOC ☐; TOTAL METALS (RCRA) ☐ OTHER LIST ☒; LEAD - TOTAL ☐ D.W. 200.8 ☐ TCLP ☐; RCI ☐ TOX ☐ FLASHPOINT ☐; TDS ☐ TSS ☐ % MOISTURE ☐ CYANIDE ☐; pH ☐ HEXAVALENT CHROMIUM ☐; EXPLOSIVES ☐ PECHLORATE ☐; CHLORIDE ☒ ANIONS ☐ ALKALINITY ☐

Field Sample I.D.	Lab #	Date	Time	Matrix	# of Containers	TOTAL METALS (RCRA) / OTHER LIST	CHLORIDE	FIELD NOTES
BK-L-32 (8")	01	6-25-06	9:30	S	2	X	X	
BK-M-32 (12")	02		9:59	S	1			
BK-R-32 (18")	03		10:32	S	1			
BK-L-31 (12")	04		11:07	S	1			
BK-R-31 (12")	05		11:32	S	1			
BK-L-30 (12")	06		12:03	S	1			
BK-M-30 (8")	07		12:24	S	1			
BK-R-30 (10")	08		12:42	S	1			
BK-L-29 (36")	09		3:05	S	1			
BK-R-29 (30")	10		3:56	S	1			
TOTAL								

RELINQUISHED BY:(Signature)	DATE/TIME	RECEIVED BY: (Signature)
[signature]	6/26/06 4:30	LSO
LSO	6/27/06 9:00	[signature]

TURN AROUND TIME: NORMAL ☒ 1 DAY ☐ 2 DAY ☐ OTHER ☐

LABORATORY USE ONLY:
RECEIVING TEMP: 1.4° THERM #: 57
CUSTODY SEALS - ☐ BROKEN ☒ INTACT ☐ NOT USED
☒ CARRIER BILL # LSO
☐ HAND DELIVERED

Lone Star Overnight

Airbill No. Z5398471

Lone Star Overnic
800.800.89
www.lso.co

To: JENNIFER BARKER
HOME
1005 HOWELL TERRACE PL
ROUND ROCK, TX 78664
(512) 244 - 2247

From: MICHELLE GREEN
LARSON & ASSOCIATES, INC
507 N MARIENFELD
SUITE 200
MIDLAND, TX 79701
(432) 687 - 0901

Service Type: Saturday By Noon
1D00V

AUS

Saturday By Noon

QuickCode: DHL-SATURDAY
Date Printed: 6/26/2009

Fold on above line and place shipping label in pouch on package. Please be sure the barcodes and addresses can be read and scanned

CUSTODY SEAL
DATE
SIGNATURE

QEC
Quality Environmental Containers
800-255-3950 • 304-255-3900

DHL Analytical

Sample Receipt Checklist

Client Name Larson & Associates

Date Received: 6/27/2009

Work Order Number 0906263

Received by JB

Checklist completed by: [signature] 6/29/09 (Signature, Date)

Reviewed by SS 6/29/9 (Initials, Date)

Carrier name: LoneStar

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	1.4 °C
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Adjusted? ______ Checked by ______

Any No response must be detailed in the comments section below.

Client contacted ______ Date contacted: ______ Person contacted ______

Contacted by: ______ Regarding: ______

Comments: ______

Corrective Action ______

Page 1 of 1

CLIENT:	Larson & Associates	
Project:	Chevron Landfarm	**CASE NARRATIVE**
Lab Order:	0906263	

Samples were analyzed using the methods outlined in the following references:

Method SW6020 - Metals Analysis
Method SW7471O - Mercury Analysis
Method E300 - Anions Analysis
Method D2216 - Percent Moisture

LOG IN

The samples were received and log-in performed on 6/27/09. A total of 10 samples were received. The time of collection was Mountain Standard Time. The samples arrived in good condition and were properly packaged.

METALS ANALYSIS

For Metals analysis performed on 6/30/09 the matrix spike and matrix spike duplicate recoveries were out of control limits for some analytes. These are flagged accordingly in the QC summary report. The reference sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for these analytes. No further corrective actions were taken.

For Metals analysis performed on 6/30/09 the RPD for the serial dilution was above control limits for some analytes. These are flagged accordingly. The PDS was within control limits for these analytes. No further corrective actions were taken.

DHL Analytical

Date: 07/07/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906263

Work Order Sample Summary

Lab Smp ID	Client Sample ID	Tag Number	Date Collected	Date Recv'd
0906263-01	BK-L-32 (8")		06/25/09 09:30 AM	06/27/09
0906263-02	BK-M-32 (12")		06/25/09 09:59 AM	06/27/09
0906263-03	BK-R-32 (18")		06/25/09 10:32 AM	06/27/09
0906263-04	BK-L-31 (12")		06/25/09 11:07 AM	06/27/09
0906263-05	BK-R-31 (12")		06/25/09 11:32 AM	06/27/09
0906263-06	BK-L-30 (12")		06/25/09 12:03 PM	06/27/09
0906263-07	BK-M-30 (8")		06/25/09 12:24 PM	06/27/09
0906263-08	BK-R-30 (10")		06/25/09 12:42 PM	06/27/09
0906263-09	BK-L-29 (36")		06/25/09 03:05 PM	06/27/09
0906263-10	BK-R-29 (30")		06/25/09 03:56 PM	06/27/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906263

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
0906263-01A	BK-L-32 (8")	06/25/09 09:30 AM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-L-32 (8")	06/25/09 09:30 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-32 (8")	06/25/09 09:30 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-32 (8")	06/25/09 09:30 AM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-01B	BK-L-32 (8")	06/25/09 09:30 AM	Soil	E300	Anion Prep	06/29/09 11:08 AM	35704
0906263-02A	BK-M-32 (12")	06/25/09 09:59 AM	Soil	E300	Anion Prep	06/29/09 11:08 AM	35704
	BK-M-32 (12")	06/25/09 09:59 AM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-M-32 (12")	06/25/09 09:59 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-M-32 (12")	06/25/09 09:59 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-M-32 (12")	06/25/09 09:59 AM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-03A	BK-R-32 (18")	06/25/09 10:32 AM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-R-32 (18")	06/25/09 10:32 AM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-R-32 (18")	06/25/09 10:32 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-32 (18")	06/25/09 10:32 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-32 (18")	06/25/09 10:32 AM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-04A	BK-L-31 (12")	06/25/09 11:07 AM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-L-31 (12")	06/25/09 11:07 AM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-L-31 (12")	06/25/09 11:07 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-31 (12")	06/25/09 11:07 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-31 (12")	06/25/09 11:07 AM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-05A	BK-R-31 (12")	06/25/09 11:32 AM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-R-31 (12")	06/25/09 11:32 AM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-R-31 (12")	06/25/09 11:32 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-31 (12")	06/25/09 11:32 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-31 (12")	06/25/09 11:32 AM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-06A	BK-L-30 (12")	06/25/09 12:03 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-L-30 (12")	06/25/09 12:03 PM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-L-30 (12")	06/25/09 12:03 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-30 (12")	06/25/09 12:03 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906263

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
	BK-L-30 (12")	06/25/09 12:03 PM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-07A	BK-M-30 (8")	06/25/09 12:24 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-M-30 (8")	06/25/09 12:24 PM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-M-30 (8")	06/25/09 12:24 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-M-30 (8")	06/25/09 12:24 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-M-30 (8")	06/25/09 12:24 PM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-08A	BK-R-30 (10")	06/25/09 12:42 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-R-30 (10")	06/25/09 12:42 PM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-R-30 (10")	06/25/09 12:42 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-30 (10")	06/25/09 12:42 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-30 (10")	06/25/09 12:42 PM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-09A	BK-L-29 (36")	06/25/09 03:05 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-L-29 (36")	06/25/09 03:05 PM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-L-29 (36")	06/25/09 03:05 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-29 (36")	06/25/09 03:05 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-L-29 (36")	06/25/09 03:05 PM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784
0906263-10A	BK-R-29 (30")	06/25/09 03:56 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	BK-R-29 (30")	06/25/09 03:56 PM	Soil	SW7471A	Mercury Soil Prep, Total	06/30/09 09:00 AM	35709
	BK-R-29 (30")	06/25/09 03:56 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-29 (30")	06/25/09 03:56 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	BK-R-29 (30")	06/25/09 03:56 PM	Soil	D2216	Moisture Preparation	07/02/09 12:00 PM	35784

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906263

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
0906263-01A	BK-L-32 (8")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-L-32 (8")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:24 PM	CETAC_HG_090701D
	BK-L-32 (8")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:05 PM	ICP-MS3_090630A
	BK-L-32 (8")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:34 PM	ICP-MS3_090701B
0906263-01B	BK-L-32 (8")	Soil	E300	Anions by IC method - Soil	35704	1	06/30/09 03:35 PM	IC2_090630A
0906263-02A	BK-M-32 (12")	Soil	E300	Anions by IC method - Soil	35704	1	06/30/09 03:50 PM	IC2_090630A
	BK-M-32 (12")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-M-32 (12")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:30 PM	CETAC_HG_090701D
	BK-M-32 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:10 PM	ICP-MS3_090630A
	BK-M-32 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:39 PM	ICP-MS3_090701B
0906263-03A	BK-R-32 (18")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 10:04 AM	IC2_090701A
	BK-R-32 (18")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-R-32 (18")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:32 PM	CETAC_HG_090701D
	BK-R-32 (18")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:15 PM	ICP-MS3_090630A
	BK-R-32 (18")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:44 PM	ICP-MS3_090701B
0906263-04A	BK-L-31 (12")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 10:19 AM	IC2_090701A
	BK-L-31 (12")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-L-31 (12")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:34 PM	CETAC_HG_090701D
	BK-L-31 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:20 PM	ICP-MS3_090630A
	BK-L-31 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:49 PM	ICP-MS3_090701B
0906263-05A	BK-R-31 (12")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 10:33 AM	IC2_090701A
	BK-R-31 (12")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-R-31 (12")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:36 PM	CETAC_HG_090701D
	BK-R-31 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:25 PM	ICP-MS3_090630A
	BK-R-31 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:54 PM	ICP-MS3_090701B
0906263-06A	BK-L-30 (12")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 10:48 AM	IC2_090701A
	BK-L-30 (12")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-L-30 (12")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:39 PM	CETAC_HG_090701D
	BK-L-30 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:30 PM	ICP-MS3_090630A

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906263

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
	BK-L-30 (12")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 04:59 PM	ICP-MS3_090701B
0906263-07A	BK-M-30 (8")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 11:03 AM	IC2_090701A
	BK-M-30 (8")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-M-30 (8")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:41 PM	CETAC_HG_090701D
	BK-M-30 (8")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:35 PM	ICP-MS3_090630A
	BK-M-30 (8")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 05:04 PM	ICP-MS3_090701B
0906263-08A	BK-R-30 (10")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 12:03 PM	IC2_090701A
	BK-R-30 (10")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-R-30 (10")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:43 PM	CETAC_HG_090701D
	BK-R-30 (10")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:40 PM	ICP-MS3_090630A
	BK-R-30 (10")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 05:10 PM	ICP-MS3_090701B
0906263-09A	BK-L-29 (36")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 12:18 PM	IC2_090701A
	BK-L-29 (36")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-L-29 (36")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:45 PM	CETAC_HG_090701D
	BK-L-29 (36")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:45 PM	ICP-MS3_090630A
	BK-L-29 (36")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 05:15 PM	ICP-MS3_090701B
0906263-10A	BK-R-29 (30")	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 12:33 PM	IC2_090701A
	BK-R-29 (30")	Soil	D2216	Percent Moisture	35784	1	07/06/09 09:40 AM	PMOIST_090702B
	BK-R-29 (30")	Soil	SW7471A	Total Mercury: Soil/Solid	35709	1	07/01/09 03:47 PM	CETAC_HG_090701D
	BK-R-29 (30")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 05:50 PM	ICP-MS3_090630A
	BK-R-29 (30")	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	50	07/01/09 05:20 PM	ICP-MS3_090701B

DHL Analytical

Date: 07/07/09

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-L-32 (8")
Project:	Chevron Landfarm	**Lab ID:**	0906263-01
Project No:	6-0137	**Collection Date:**	06/25/09 09:30 AM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0108	0.0269		mg/Kg-dry	1	07/01/09 03:24 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.58	0.307	0.615		mg/Kg-dry	5	06/30/09 05:05 PM
Barium	109	0.307	1.23		mg/Kg-dry	5	06/30/09 05:05 PM
Chromium	7.81	0.307	1.23		mg/Kg-dry	5	06/30/09 05:05 PM
Iron	7370	76.8	76.8		mg/Kg-dry	50	07/01/09 04:34 PM
Lead	6.10	0.0615	0.184		mg/Kg-dry	5	06/30/09 05:05 PM
Selenium	1.78	0.0922	0.307		mg/Kg-dry	5	06/30/09 05:05 PM
Zinc	18.9	0.615	1.54		mg/Kg-dry	5	06/30/09 05:05 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	6.39	6.39		mg/Kg-dry	1	06/30/09 03:35 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	21.8	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
	B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
	C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
	DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
	E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
			S	Spike Recovery outside control limits

DHL Analytical

Date: 07/07/09

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-M-32 (12")
Project:	Chevron Landfarm	**Lab ID:**	0906263-02
Project No:	6-0137	**Collection Date:**	06/25/09 09:59 AM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0150	0.0374		mg/Kg-dry	1	07/01/09 03:30 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.74	0.467	0.934		mg/Kg-dry	5	06/30/09 05:10 PM
Barium	84.1	0.467	1.87		mg/Kg-dry	5	06/30/09 05:10 PM
Chromium	9.29	0.467	1.87		mg/Kg-dry	5	06/30/09 05:10 PM
Iron	8560	117	117		mg/Kg-dry	50	07/01/09 04:39 PM
Lead	6.69	0.0934	0.280		mg/Kg-dry	5	06/30/09 05:10 PM
Selenium	1.87	0.140	0.467		mg/Kg-dry	5	06/30/09 05:10 PM
Zinc	21.7	0.934	2.33		mg/Kg-dry	5	06/30/09 05:10 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	5.27	5.27		mg/Kg-dry	1	06/30/09 03:50 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	6.86	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:				
*	Value exceeds TCLP Maximum Concentration Level		J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank		MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative		N	Parameter not NELAC certified
DF	Dilution Factor		ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern		RL	Reporting Limit
			S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Project: Chevron Landfarm
Project No: 6-0137
Lab Order: 0906263

Client Sample ID: BK-R-32 (18")
Lab ID: 0906263-03
Collection Date: 06/25/09 10:32 AM
Matrix: Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0189	0.0473		mg/Kg-dry	1	07/01/09 03:32 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.94	0.653	1.31		mg/Kg-dry	5	06/30/09 05:15 PM
Barium	95.1	0.653	2.61		mg/Kg-dry	5	06/30/09 05:15 PM
Chromium	9.99	0.653	2.61		mg/Kg-dry	5	06/30/09 05:15 PM
Iron	9220	163	163		mg/Kg-dry	50	07/01/09 04:44 PM
Lead	6.32	0.131	0.392		mg/Kg-dry	5	06/30/09 05:15 PM
Selenium	2.01	0.196	0.653		mg/Kg-dry	5	06/30/09 05:15 PM
Zinc	22.2	1.31	3.27		mg/Kg-dry	5	06/30/09 05:15 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	6.47	6.47		mg/Kg-dry	1	07/01/09 10:04 AM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	24.2	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
	B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
	C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
	DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
	E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
			S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Project: Chevron Landfarm
Project No: 6-0137
Lab Order: 0906263

Client Sample ID: BK-L-31 (12")
Lab ID: 0906263-04
Collection Date: 06/25/09 11:07 AM
Matrix: Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0166	0.0415		mg/Kg-dry	1	07/01/09 03:34 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	3.01	0.503	1.01		mg/Kg-dry	5	06/30/09 05:20 PM
Barium	116	0.503	2.01		mg/Kg-dry	5	06/30/09 05:20 PM
Chromium	8.89	0.503	2.01		mg/Kg-dry	5	06/30/09 05:20 PM
Iron	8190	126	126		mg/Kg-dry	50	07/01/09 04:49 PM
Lead	5.92	0.101	0.302		mg/Kg-dry	5	06/30/09 05:20 PM
Selenium	1.71	0.151	0.503		mg/Kg-dry	5	06/30/09 05:20 PM
Zinc	20.3	1.01	2.51		mg/Kg-dry	5	06/30/09 05:20 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	5.40	5.40		mg/Kg-dry	1	07/01/09 10:19 AM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	7.89	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-R-31 (12")
Project:	Chevron Landfarm	**Lab ID:**	0906263-05
Project No:	6-0137	**Collection Date:**	06/25/09 11:32 AM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0201	0.0502		mg/Kg-dry	1	07/01/09 03:36 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.57	0.639	1.28		mg/Kg-dry	5	06/30/09 05:25 PM
Barium	97.9	0.639	2.56		mg/Kg-dry	5	06/30/09 05:25 PM
Chromium	9.64	0.639	2.56		mg/Kg-dry	5	06/30/09 05:25 PM
Iron	8860	160	160		mg/Kg-dry	50	07/01/09 04:54 PM
Lead	6.11	0.128	0.384		mg/Kg-dry	5	06/30/09 05:25 PM
Selenium	1.86	0.192	0.639		mg/Kg-dry	5	06/30/09 05:25 PM
Zinc	22.6	1.28	3.20		mg/Kg-dry	5	06/30/09 05:25 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	6.34	6.34		mg/Kg-dry	1	07/01/09 10:33 AM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	22.6	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:				
	*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
	B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
	C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
	DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
	E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
			S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-L-30 (12")
Project:	Chevron Landfarm	**Lab ID:**	0906263-06
Project No:	6-0137	**Collection Date:**	06/25/09 12:03 PM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0108	0.0270		mg/Kg-dry	1	07/01/09 03:39 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.33	0.310	0.621		mg/Kg-dry	5	06/30/09 05:30 PM
Barium	82.2	0.310	1.24		mg/Kg-dry	5	06/30/09 05:30 PM
Chromium	8.52	0.310	1.24		mg/Kg-dry	5	06/30/09 05:30 PM
Iron	8440	77.6	77.6		mg/Kg-dry	50	07/01/09 04:59 PM
Lead	5.95	0.0621	0.186		mg/Kg-dry	5	06/30/09 05:30 PM
Selenium	1.71	0.0931	0.310		mg/Kg-dry	5	06/30/09 05:30 PM
Zinc	19.8	0.621	1.55		mg/Kg-dry	5	06/30/09 05:30 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	6.29	6.29		mg/Kg-dry	1	07/01/09 10:48 AM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	22.5	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:			
*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Project: Chevron Landfarm
Project No: 6-0137
Lab Order: 0906263

Client Sample ID: BK-M-30 (8")
Lab ID: 0906263-07
Collection Date: 06/25/09 12:24 PM
Matrix: Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0180	0.0450		mg/Kg-dry	1	07/01/09 03:41 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	3.12	0.530	1.06		mg/Kg-dry	5	06/30/09 05:35 PM
Barium	78.3	0.530	2.12		mg/Kg-dry	5	06/30/09 05:35 PM
Chromium	10.3	0.530	2.12		mg/Kg-dry	5	06/30/09 05:35 PM
Iron	9620	133	133		mg/Kg-dry	50	07/01/09 05:04 PM
Lead	6.46	0.106	0.318		mg/Kg-dry	5	06/30/09 05:35 PM
Selenium	1.90	0.159	0.530		mg/Kg-dry	5	06/30/09 05:35 PM
Zinc	22.6	1.06	2.65		mg/Kg-dry	5	06/30/09 05:35 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	5.93	5.93		mg/Kg-dry	1	07/01/09 11:03 AM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	16.6	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-R-30 (10")
Project:	Chevron Landfarm	**Lab ID:**	0906263-08
Project No:	6-0137	**Collection Date:**	06/25/09 12:42 PM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0178	0.0444		mg/Kg-dry	1	07/01/09 03:43 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	3.21	0.553	1.11		mg/Kg-dry	5	06/30/09 05:40 PM
Barium	77.1	0.553	2.21		mg/Kg-dry	5	06/30/09 05:40 PM
Chromium	11.3	0.553	2.21		mg/Kg-dry	5	06/30/09 05:40 PM
Iron	10800	138	138		mg/Kg-dry	50	07/01/09 05:10 PM
Lead	7.22	0.111	0.332		mg/Kg-dry	5	06/30/09 05:40 PM
Selenium	1.98	0.166	0.553		mg/Kg-dry	5	06/30/09 05:40 PM
Zinc	24.7	1.11	2.76		mg/Kg-dry	5	06/30/09 05:40 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	6.39	6.39		mg/Kg-dry	1	07/01/09 12:03 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	23.3	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-L-29 (36")
Project:	Chevron Landfarm	**Lab ID:**	0906263-09
Project No:	6-0137	**Collection Date:**	06/25/09 03:05 PM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0160	0.0399		mg/Kg-dry	1	07/01/09 03:45 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	2.70	0.515	1.03		mg/Kg-dry	5	06/30/09 05:45 PM
Barium	107	0.515	2.06		mg/Kg-dry	5	06/30/09 05:45 PM
Chromium	8.49	0.515	2.06		mg/Kg-dry	5	06/30/09 05:45 PM
Iron	7510	129	129		mg/Kg-dry	50	07/01/09 05:15 PM
Lead	5.13	0.103	0.309		mg/Kg-dry	5	06/30/09 05:45 PM
Selenium	1.23	0.154	0.515		mg/Kg-dry	5	06/30/09 05:45 PM
Zinc	17.1	1.03	2.57		mg/Kg-dry	5	06/30/09 05:45 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	5.21	5.21		mg/Kg-dry	1	07/01/09 12:18 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	4.80	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	BK-R-29 (30")
Project:	Chevron Landfarm	**Lab ID:**	0906263-10
Project No:	6-0137	**Collection Date:**	06/25/09 03:56 PM
Lab Order:	0906263	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Total Mercury: Soil/Solid		**SW7471A**					**Analyst: LM**
Mercury	ND	0.0164	0.0410		mg/Kg-dry	1	07/01/09 03:47 PM
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Arsenic	3.31	0.495	0.990		mg/Kg-dry	5	06/30/09 05:50 PM
Barium	68.3	0.495	1.98		mg/Kg-dry	5	06/30/09 05:50 PM
Chromium	11.3	0.495	1.98		mg/Kg-dry	5	06/30/09 05:50 PM
Iron	10700	124	124		mg/Kg-dry	50	07/01/09 05:20 PM
Lead	6.88	0.0990	0.297		mg/Kg-dry	5	06/30/09 05:50 PM
Selenium	1.63	0.148	0.495		mg/Kg-dry	5	06/30/09 05:50 PM
Zinc	23.9	0.990	2.47		mg/Kg-dry	5	06/30/09 05:50 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	ND	5.62	5.62		mg/Kg-dry	1	07/01/09 12:33 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	11.4	0	0		WT%	1	07/06/09 09:40 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: CETAC_HG_090701D

Sample ID:	MB-35709	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg
SampType:	MBLK	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:06 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		ND	0.0400								

Sample ID:	LCS-35709	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg
SampType:	LCS	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:08 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.210	0.0400	0.2000	0	105	85	115			

Sample ID:	LCSD-35709	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg
SampType:	LCSD	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:10 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.207	0.0400	0.2000	0	104	85	115	1.44	25	

Sample ID:	0906216-15B SD	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg-dry
SampType:	SD	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:14 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0	0.205	0	0.05201				0	10	

Sample ID:	0906216-15B PDS	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg-dry
SampType:	PDS	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:16 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.314	0.0410	0.2560	0.05201	102	85	115			

Sample ID:	0906216-15B MS	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg-dry
SampType:	MS	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:18 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.281	0.0418	0.2090	0.05201	110	80	120			

Sample ID:	0906216-15B MSD	Batch ID:	35709		TestNo:		SW7471A		Units:		mg/Kg-dry
SampType:	MSD	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:20 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.256	0.0412	0.2061	0.05201	98.8	80	120	9.53	25	

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: CETAC_HG_090701D

Sample ID:	ICV2-090701	Batch ID:	R44064		TestNo:		SW7471A		Units:	mg/Kg	
SampType:	ICV	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:02 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.00385	0.0400	0.004000	0	96.2	90	110			

Sample ID:	CCV1-090701	Batch ID:	R44064		TestNo:		SW7471A		Units:	mg/Kg	
SampType:	CCV	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:26 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.00215	0.0400	0.002000	0	108	90	110			

Sample ID:	CCV2-090701	Batch ID:	R44064		TestNo:		SW7471A		Units:	mg/Kg	
SampType:	CCV	Run ID:	CETAC_HG_090701D		Analysis Date:		07/01/09 03:49 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Mercury		0.00206	0.0400	0.002000	0	103	90	110			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090630A

Sample ID: MB-35708 | Batch ID: 35708 | TestNo: SW6020 | Units: mg/Kg
SampType: MBLK | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 03:53 PM | Prep Date: 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	ND	1.00								
Barium	ND	2.00								
Chromium	ND	2.00								
Iron	ND	12.5								
Lead	ND	0.300								
Selenium	ND	0.500								
Zinc	ND	2.50								

Sample ID: LCS-35708 | Batch ID: 35708 | TestNo: SW6020 | Units: mg/Kg
SampType: LCS | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 03:58 PM | Prep Date: 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	43.6	1.00	50.00	0	87.3	80	120			
Barium	50.5	2.00	50.00	0	101	80	120			
Chromium	44.4	2.00	50.00	0	88.7	80	120			
Iron	236	12.5	250.0	0	94.5	80	120			
Lead	52.2	0.300	50.00	0	104	80	120			
Selenium	42.2	0.500	50.00	0	84.4	80	120			
Zinc	43.3	2.50	50.00	0	86.6	80	120			

Sample ID: LCSD-35708 | Batch ID: 35708 | TestNo: SW6020 | Units: mg/Kg
SampType: LCSD | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 04:03 PM | Prep Date: 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	46.2	1.00	50.00	0	92.4	80	120	5.73	25	
Barium	53.4	2.00	50.00	0	107	80	120	5.54	25	
Chromium	48.4	2.00	50.00	0	96.9	80	120	8.84	25	
Iron	256	12.5	250.0	0	102	80	120	8.05	25	
Lead	53.9	0.300	50.00	0	108	80	120	3.30	25	
Selenium	44.7	0.500	50.00	0	89.4	80	120	5.70	25	
Zinc	45.8	2.50	50.00	0	91.6	80	120	5.55	25	

Sample ID: 0906250-01B SD | Batch ID: 35708 | TestNo: SW6020 | Units: mg/Kg-dry
SampType: SD | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 04:13 PM | Prep Date: 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	3.51	4.88	0	3.027				14.8	10	R
Barium	141	9.76	0	147.6				4.27	10	
Chromium	33.9	9.76	0	28.71				16.6	10	R
Lead	6.47	1.46	0	6.708				3.65	10	
Selenium	2.92	2.44	0	2.224				27.0	10	R
Zinc	31.3	12.2	0	26.61				16.3	10	R

Sample ID: 0906250-01B PDS | Batch ID: 35708 | TestNo: SW6020 | Units: mg/Kg-dry
SampType: PDS | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 04:18 PM | Prep Date: 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	44.0	0.976	48.78	3.027	83.9	75	125			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	206	1.95	48.78	147.6	121	75	125			
Chromium	70.7	1.95	48.78	28.71	86.1	75	125			
Lead	57.8	0.293	48.78	6.708	105	75	125			
Selenium	40.4	0.488	48.78	2.224	78.3	75	125			
Zinc	66.6	2.44	48.78	26.61	82.1	75	125			

Sample ID: 0906250-01B MS **Batch ID:** 35708 **TestNo:** SW6020 **Units:** mg/Kg-dry
SampType: MS **Run ID:** ICP-MS3_090630A **Analysis Date:** 06/30/09 04:23 PM **Prep Date:** 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	42.2	0.967	48.36	3.027	80.9	80	120			
Barium	216	1.93	48.36	147.6	142	80	120			S
Chromium	62.8	1.93	48.36	28.71	70.5	80	120			S
Iron	13900	12.1	241.8	11550	989	80	120			S
Lead	57.3	0.290	48.36	6.708	105	80	120			
Selenium	38.9	0.484	48.36	2.224	75.8	80	120			S
Zinc	66.3	2.42	48.36	26.61	82.0	80	120			

Sample ID: 0906250-01B MSD **Batch ID:** 35708 **TestNo:** SW6020 **Units:** mg/Kg-dry
SampType: MSD **Run ID:** ICP-MS3_090630A **Analysis Date:** 06/30/09 04:29 PM **Prep Date:** 06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	43.9	0.951	47.54	3.027	85.9	80	120	3.97	25	
Barium	206	1.90	47.54	147.6	123	80	120	4.77	25	S
Chromium	53.2	1.90	47.54	28.71	51.5	80	120	16.6	25	S
Iron	13000	11.9	237.7	11550	608	80	120	7.01	25	S
Lead	59.3	0.285	47.54	6.708	111	80	120	3.51	25	
Selenium	40.6	0.475	47.54	2.224	80.7	80	120	4.26	25	
Zinc	66.3	2.38	47.54	26.61	83.5	80	120	0.0624	25	

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090630A

Sample ID:	ICV1-090630	Batch ID:	R44043	TestNo:	SW6020	Units:	mg/L
SampType:	ICV	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 12:16 PM	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	0.0958	0.00600	0.100	0	95.8	90	110			
Barium	0.0976	0.0100	0.100	0	97.6	90	110			
Chromium	0.0954	0.00600	0.100	0	95.4	90	110			
Iron	2.57	0.150	2.50	0	103	90	110			
Lead	0.101	0.00100	0.100	0	101	90	110			
Selenium	0.0921	0.00600	0.100	0	92.1	90	110			
Zinc	0.0977	0.00500	0.100	0	97.7	90	110			

Sample ID:	CCV3-090630	Batch ID:	R44043	TestNo:	SW6020	Units:	mg/L
SampType:	CCV	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 03:37 PM	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	0.198	0.00600	0.200	0	99.0	90	110			
Barium	0.209	0.0100	0.200	0	104	90	110			
Chromium	0.192	0.00600	0.200	0	95.9	90	110			
Iron	4.94	0.150	5.00	0	98.8	90	110			
Lead	0.209	0.00100	0.200	0	105	90	110			
Selenium	0.202	0.00600	0.200	0	101	90	110			
Zinc	0.197	0.00500	0.200	0	98.4	90	110			

Sample ID:	CCV4-090630	Batch ID:	R44043	TestNo:	SW6020	Units:	mg/L
SampType:	CCV	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:49 PM	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	0.198	0.00600	0.200	0	98.8	90	110			
Barium	0.205	0.0100	0.200	0	103	90	110			
Chromium	0.188	0.00600	0.200	0	94.0	90	110			
Iron	4.85	0.150	5.00	0	97.0	90	110			
Lead	0.205	0.00100	0.200	0	102	90	110			
Selenium	0.197	0.00600	0.200	0	98.4	90	110			
Zinc	0.188	0.00500	0.200	0	94.0	90	110			

Sample ID:	CCV5-090630	Batch ID:	R44043	TestNo:	SW6020	Units:	mg/L
SampType:	CCV	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 05:55 PM	Prep Date:	

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Arsenic	0.199	0.00600	0.200	0	99.6	90	110			
Barium	0.208	0.0100	0.200	0	104	90	110			
Chromium	0.185	0.00600	0.200	0	92.5	90	110			
Lead	0.206	0.00100	0.200	0	103	90	110			
Selenium	0.199	0.00600	0.200	0	99.3	90	110			
Zinc	0.184	0.00500	0.200	0	92.0	90	110			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090701B

Sample ID:	0906250-01B SD	Batch ID:	35708		TestNo:		SW6020		Units:		mg/Kg-dry
SampType:	SD	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 02:03 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		13600	610	0	12760				6.56	10	

Sample ID:	0906250-01B PDS	Batch ID:	35708		TestNo:		SW6020		Units:		mg/Kg-dry
SampType:	PDS	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 02:09 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		24300	122	12200	12760	94.3	75	125			

Qualifiers:				
B	Analyte detected in the associated Method Blank		R	RPD outside accepted control limits
DF	Dilution Factor		RL	Reporting Limit
J	Analyte detected between MDL and RL		S	Spike Recovery outside control limits
MDL	Method Detection Limit		J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit		N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090701B

Sample ID:	ICV1-090701	Batch ID:	R44070		TestNo:		SW6020		Units:	mg/L	
SampType:	ICV	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 11:34 AM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		2.58	0.150	2.50	0	103	90	110			

Sample ID:	CCV1-090701	Batch ID:	R44070		TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 12:41 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		5.04	0.150	5.00	0	101	90	110			

Sample ID:	CCV2-090701	Batch ID:	R44070		TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 02:14 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		5.04	0.150	5.00	0	101	90	110			

Sample ID:	CCV3-090701	Batch ID:	R44070		TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 04:12 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		5.00	0.150	5.00	0	99.9	90	110			

Sample ID:	CCV4-090701	Batch ID:	R44070		TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS3_090701B		Analysis Date:		07/01/09 05:25 PM		Prep Date:		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Iron		4.90	0.150	5.00	0	98.1	90	110			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090630A

Sample ID:	LCS-35704	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg	
SampType:	LCS	Run ID:	IC2_090630A		Analysis Date:		06/30/09 09:10 AM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		46.6	5.00	50.00	0	93.2	80	120			

Sample ID:	LCSD-35704	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg	
SampType:	LCSD	Run ID:	IC2_090630A		Analysis Date:		06/30/09 09:24 AM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		46.4	5.00	50.00	0	92.8	80	120	0.414	20	

Sample ID:	MB-35704	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg	
SampType:	MBLK	Run ID:	IC2_090630A		Analysis Date:		06/30/09 09:39 AM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		ND	5.00								

Sample ID:	0906259-01B MS	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg-dry	
SampType:	MS	Run ID:	IC2_090630A		Analysis Date:		06/30/09 11:07 AM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		65.7	30.6	61.29	9.520	91.7	80	120			

Sample ID:	0906259-01B MSD	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg-dry	
SampType:	MSD	Run ID:	IC2_090630A		Analysis Date:		06/30/09 11:22 AM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		66.3	30.6	61.29	9.520	92.6	80	120	0.888	20	

Sample ID:	0906262-03A MS	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg-dry	
SampType:	MS	Run ID:	IC2_090630A		Analysis Date:		06/30/09 04:04 PM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		59.2	28.2	56.47	7.525	91.5	80	120			

Sample ID:	0906262-03A MSD	Batch ID:	35704		TestNo:		E300		Units:	mg/Kg-dry	
SampType:	MSD	Run ID:	IC2_090630A		Analysis Date:		06/30/09 04:19 PM		Prep Date:	06/29/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		59.5	28.2	56.47	7.525	92.1	80	120	0.528	20	

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090630A

Sample ID:	ICV-090630	Batch ID:	R44033		TestNo:		E300		Units:		mg/Kg
SampType:	ICV	Run ID:	IC2_090630A		Analysis Date:		06/30/09 08:53 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		24.0	5.00	25.00	0	96.1	90	110			

Sample ID:	CCV1-090630	Batch ID:	R44033		TestNo:		E300		Units:		mg/Kg
SampType:	CCV	Run ID:	IC2_090630A		Analysis Date:		06/30/09 11:37 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.34	5.00	10.00	0	93.4	90	110			

Sample ID:	CCV2-090630	Batch ID:	R44033		TestNo:		E300		Units:		mg/Kg
SampType:	CCV	Run ID:	IC2_090630A		Analysis Date:		06/30/09 02:35 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.32	5.00	10.00	0	93.2	90	110			

Sample ID:	CCV3-090630	Batch ID:	R44033		TestNo:		E300		Units:		mg/Kg
SampType:	CCV	Run ID:	IC2_090630A		Analysis Date:		06/30/09 04:34 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.33	5.00	10.00	0	93.3	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090701A

Sample ID:	LCSD-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg
SampType:	LCSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:16 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		46.8	5.00	50.00	0	93.7	80	120	0.466	20	

Sample ID:	MB-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg
SampType:	MBLK	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:30 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		ND	5.00								

Sample ID:	LCS-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg
SampType:	LCS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:45 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		46.6	5.00	50.00	0	93.3	80	120			

Sample ID:	0906263-03A MS	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry
SampType:	MS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:17 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		60.2	32.3	64.68	0	93.1	80	120			

Sample ID:	0906263-03A MSD	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry
SampType:	MSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:32 AM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		60.6	32.3	64.68	0	93.6	80	120	0.557	20	

Sample ID:	0906264-01A MS	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry
SampType:	MS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 01:31 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		60.9	31.8	63.63	0	95.8	80	120			

Sample ID:	0906264-01A MSD	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry
SampType:	MSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 01:46 PM		Prep Date:		06/30/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		60.9	31.8	63.63	0	95.7	80	120	0.0971	20	

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090701A

Sample ID:	ICV-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	ICV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 08:43 AM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		24.2	5.00	25.00	0	97.0	90	110			

Sample ID:	CCV1-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	CCV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:47 AM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.33	5.00	10.00	0	93.3	90	110			

Sample ID:	CCV2-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	CCV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 02:01 PM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.30	5.00	10.00	0	93.0	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

DHL Analytical **Date:** 07/07/09

CLIENT: Larson & Associates
Work Order: 0906263
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: PMOIST_090702B

Sample ID:	0906259-08B-DUP	Batch ID:	35784		TestNo:		D2216		Units:		WT%	
SampType:	DUP	Run ID:	PMOIST_090702B		Analysis Date:		07/06/09 09:40 AM		Prep Date:		07/02/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual	
Percent Moisture		22.6	0	0	22.58				0.233	30		

Qualifiers:				
B	Analyte detected in the associated Method Blank		R	RPD outside accepted control limits
DF	Dilution Factor		RL	Reporting Limit
J	Analyte detected between MDL and RL		S	Spike Recovery outside control limits
MDL	Method Detection Limit		J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit		N	Parameter not NELAC certified

DHL
ANALYTICAL

July 07, 2009

Michelle Green
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Midland, TX 79701

Order No: 0906264

TEL: (432) 687-0901
FAX: (432) 687-0456

RE: Chevron Landfarm

Dear Michelle Green:

DHL Analytical received 3 sample(s) on 6/27/2009 for the analyses presented in the following report.

There were no problems with the analyses and all data met requirements of NELAC except where noted in the Case Narrative. All non-NELAC methods will be identified accordingly in the case narrative and all estimated uncertainties of test results are within method or EPA specifications.

If you have any questions regarding these tests results, please feel free to call. Thank you for using DHL Analytical.

Sincerely,

John DuPont

John DuPont
Lab Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-09-TX

ACCREDITED IN ACCORDANCE WITH nelac

Table of Contents

CHAIN-OF-CUSTODY

Larson & Associates, Inc.
Environmental Consultants

507 N. Marienfeld, Ste. 200
Midland, TX 79701
432-687-0901

Data Reported to: M. [illegible]

DATE: 6-26-09 PAGE 1 OF 1
PO #: LAB WORK ORDER #: 0906 2264
PROJECT LOCATION OR NAME: Chevron Fund Farm
LAI PROJECT #: 6-0137 COLLECTOR: [illegible]

TRRP report? ☐ Yes ☒ No

TIME ZONE: Time zone/State: MST/NM

S=SOIL P=PAINT
W=WATER SL=SLUDGE
A=AIR OT=OTHER

PRESERVATION: HCl | HNO_3 | H_2SO_4 ☐ NaOH ☐ | ICE | UNPRESERVED

ANALYSES: BTEX ☐ MTBE ☐ | TRPH 418.1 ☐ TPH 1005 ☐ TPH 1006 ☐ | GASOLINE MOD 8015 ☐ | DIESEL - MOD 8015 ☐ | VOC 8260 ☐ | SVOC 8270 ☐ PAH 8270 ☐ HOLDPAH ☐ | 8081 PESTICIDES ☐ 8151 HERBICIDES ☐ | 8082 PCBS ☐ | TCLP - METALS (RCRA) ☐ TCLP VOC ☐ | TCLP - PEST ☐ HERB ☐ Semi-VOC ☐ | TOTAL METALS (RCRA) ☐ OTHER LIST ☐ | LEAD - TOTAL ☐ D.W. 200.8 ☐ TCLP ☐ | RCI ☐ TOX ☐ FLASHPOINT ☐ | TDS ☐ TSS ☐ % MOISTURE ☐ CYANIDE ☐ | pH ☐ HEXAVALENT CHROMIUM ☐ | EXPLOSIVES ☐ PECHLORATE ☐ | CHLORIDE ☐ ANIONS ☐ ALKALINITY ☐ | Barium | FIELD NOTES

Field Sample I.D.	Lab #	Date	Time	Matrix	# of Containers	HCl	HNO_3	H_2SO_4 / NaOH	ICE	UNPRESERVED	CHLORIDE	Barium	FIELD NOTES
Cell 26 (3-4')	01	6-26-09	11:35	S	1					X	X		
Cell 18 (3-4')	02	↓	12:40	|	1					X	X	X	
Cell 17 (3-4')	03	↓	12:00	|	1					X	X	X	
TOTAL													

RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)
[signature]	6/26 4:30	LSO
LSO	6/27/09 9:00	[signature]

TURN AROUND TIME: NORMAL ☒ 1 DAY ☐ 2 DAY ☐ OTHER ☐

LABORATORY USE ONLY:
RECEIVING TEMP: 1.4° THERM #: 57
CUSTODY SEALS - ☐ BROKEN ☐ INTACT ☐ NOT USED
☒ CARRIER BILL # LSO
☐ HAND DELIVERED

Lone Star Overnight

Airbill No. Z5398471

Lone Star Overnic
800.800.89
www.lso.co

To: JENNIFER BARKER
HOME
1005 HOWELL TERRACE PL
ROUND ROCK, TX 78664
(512) 244 - 2247

From: MICHELLE GREEN
LARSON & ASSOCIATES, INC
507 N MARIENFELD
SUITE 200
MIDLAND, TX 79701
(432) 687 - 0901

Service Type: Saturday By Noon
1000V

AUS

Saturday By Noon

QuickCode: DHL-SATURDAY
Date Printed: 6/26/2009

CUSTODY SEAL
DATE:
SIGNATURE:

QEC Quality Environmental Containers
800-255-3950 • 304-255-3900

DHL Analytical

Sample Receipt Checklist

Client Name Larson & Associates | Date Received: 6/27/2009

Work Order Number 0906264 | Received by JB

Checklist completed by: [signature] 6/29/09 (Signature, Date) | Reviewed by SS 6/29/9 (Initials, Date)

Carrier name: LoneStar

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	1.4 °C
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Adjusted? ______________ Checked by ______________

Any No response must be detailed in the comments section below.

Client contacted ______________ Date contacted: ______________ Person contacted ______________

Contacted by: ______________ Regarding: ______________

Comments: ______________

Corrective Action ______________

Page 1 of 1

CLIENT:	Larson & Associates
Project:	Chevron Landfarm
Lab Order:	0906264

CASE NARRATIVE

Samples were analyzed using the methods outlined in the following references:

Method SW6020 - Metals Analysis
Method E300 - Anions Analysis
Method D2216 - Percent Moisture

LOG IN

The samples were received and log-in performed on 6/27/09. A total of 3 samples were received. The time of collection was Mountain Standard Time. The samples arrived in good condition and were properly packaged.

METALS ANALYSIS

For Metals analysis performed on 6/30/09 the matrix spike and matrix spike duplicate recoveries were above control limits for Barium. These are flagged accordingly in the QC summary report. The reference sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for this analyte. No further corrective actions were taken.

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906264

Work Order Sample Summary

Lab Smp ID	Client Sample ID	Tag Number	Date Collected	Date Recv'd
0906264-01	Cell 26 (3-4')		06/26/09 11:35 AM	06/27/09
0906264-02	Cell 18 (3-4')		06/26/09 12:40 PM	06/27/09
0906264-03	Cell 17 (3-4')		06/26/09 12:20 PM	06/27/09

DHL Analytical

Date: 07/07/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906264

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
0906264-01A	Cell 26 (3-4')	06/26/09 11:35 AM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	Cell 26 (3-4')	06/26/09 11:35 AM	Soil	D2216	Moisture Preparation	07/02/09 02:43 PM	35790
0906264-02A	Cell 18 (3-4')	06/26/09 12:40 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	Cell 18 (3-4')	06/26/09 12:40 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	Cell 18 (3-4')	06/26/09 12:40 PM	Soil	D2216	Moisture Preparation	07/02/09 02:43 PM	35790
0906264-03A	Cell 17 (3-4')	06/26/09 12:20 PM	Soil	E300	Anion Prep	06/30/09 09:05 AM	35725
	Cell 17 (3-4')	06/26/09 12:20 PM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	06/30/09 09:00 AM	35708
	Cell 17 (3-4')	06/26/09 12:20 PM	Soil	D2216	Moisture Preparation	07/02/09 02:43 PM	35790

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0906264

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
0906264-01A	Cell 26 (3-4')	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 12:47 PM	IC2_090701A
	Cell 26 (3-4')	Soil	D2216	Percent Moisture	35790	1	07/06/09 09:50 AM	PMOIST_090702C
0906264-02A	Cell 18 (3-4')	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 01:02 PM	IC2_090701A
	Cell 18 (3-4')	Soil	D2216	Percent Moisture	35790	1	07/06/09 09:50 AM	PMOIST_090702C
	Cell 18 (3-4')	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	25	06/30/09 04:44 PM	ICP-MS3_090630A
0906264-03A	Cell 17 (3-4')	Soil	E300	Anions by IC method - Soil	35725	1	07/01/09 01:17 PM	IC2_090701A
	Cell 17 (3-4')	Soil	D2216	Percent Moisture	35790	1	07/06/09 09:50 AM	PMOIST_090702C
	Cell 17 (3-4')	Soil	SW6020	Trace Metals: ICP-MS - Solid	35708	5	06/30/09 04:39 PM	ICP-MS3_090630A

CLIENT: Larson & Associates
Project: Chevron Landfarm
Project No: 6-0137
Lab Order: 0906264

Client Sample ID: Cell 26 (3-4')
Lab ID: 0906264-01
Collection Date: 06/26/09 11:35 AM
Matrix: Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Anions by IC method - Soil	**E300**						**Analyst: JBC**
Chloride	ND	6.36	6.36		mg/Kg-dry	1	07/01/09 12:47 PM
Percent Moisture	**D2216**						**Analyst: RP**
Percent Moisture	22.5	0	0		WT%	1	07/06/09 09:50 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

DHL Analytical

Date: 07/07/09

CLIENT:	Larson & Associates	**Client Sample ID:**	Cell 18 (3-4')
Project:	Chevron Landfarm	**Lab ID:**	0906264-02
Project No:	6-0137	**Collection Date:**	06/26/09 12:40 PM
Lab Order:	0906264	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Barium	390	1.63	6.52		mg/Kg-dry	25	06/30/09 04:44 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	22.5	6.52	6.52		mg/Kg-dry	1	07/01/09 01:02 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	24.4	0	0		WT%	1	07/06/09 09:50 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT:	Larson & Associates	**Client Sample ID:**	Cell 17 (3-4')
Project:	Chevron Landfarm	**Lab ID:**	0906264-03
Project No:	6-0137	**Collection Date:**	06/26/09 12:20 PM
Lab Order:	0906264	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Trace Metals: ICP-MS - Solid		**SW6020**					**Analyst: CZ**
Barium	325	0.593	2.37		mg/Kg-dry	5	06/30/09 04:39 PM
Anions by IC method - Soil		**E300**					**Analyst: JBC**
Chloride	90.8	6.14	6.14		mg/Kg-dry	1	07/01/09 01:17 PM
Percent Moisture		**D2216**					**Analyst: RP**
Percent Moisture	18.9	0	0		WT%	1	07/06/09 09:50 AM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Work Order: 0906264
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090630A

Sample ID:	MB-35708	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg
SampType:	MBLK	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 03:53 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	ND	2.00								

Sample ID:	LCS-35708	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg
SampType:	LCS	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 03:58 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	50.5	2.00	50.00	0	101	80	120			

Sample ID:	LCSD-35708	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg
SampType:	LCSD	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:03 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	53.4	2.00	50.00	0	107	80	120	5.54	25	

Sample ID:	0906250-01B SD	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg-dry
SampType:	SD	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:13 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	141	9.76	0	147.6				4.27	10	

Sample ID:	0906250-01B PDS	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg-dry
SampType:	PDS	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:18 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	206	1.95	48.78	147.6	121	75	125			

Sample ID:	0906250-01B MS	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg-dry
SampType:	MS	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:23 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	216	1.93	48.36	147.6	142	80	120			S

Sample ID:	0906250-01B MSD	Batch ID:	35708	TestNo:	SW6020	Units:	mg/Kg-dry
SampType:	MSD	Run ID:	ICP-MS3_090630A	Analysis Date:	06/30/09 04:29 PM	Prep Date:	06/30/09

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	206	1.90	47.54	147.6	123	80	120	4.77	25	S

Qualifiers:				
B	Analyte detected in the associated Method Blank		R	RPD outside accepted control limits
DF	Dilution Factor		RL	Reporting Limit
J	Analyte detected between MDL and RL		S	Spike Recovery outside control limits
MDL	Method Detection Limit		J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit		N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906264
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS3_090630A

Sample ID: ICV1-090630 | Batch ID: R44043 | TestNo: SW6020 | Units: mg/L
SampType: ICV | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 12:16 PM | Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.0976	0.0100	0.100	0	97.6	90	110			

Sample ID: CCV3-090630 | Batch ID: R44043 | TestNo: SW6020 | Units: mg/L
SampType: CCV | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 03:37 PM | Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.209	0.0100	0.200	0	104	90	110			

Sample ID: CCV4-090630 | Batch ID: R44043 | TestNo: SW6020 | Units: mg/L
SampType: CCV | Run ID: ICP-MS3_090630A | Analysis Date: 06/30/09 04:49 PM | Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.205	0.0100	0.200	0	103	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906264
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090701A

Sample ID:	LCSD-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg		
SampType:	LCSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:16 AM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		46.8	5.00	50.00	0	93.7	80	120	0.466	20			
Sample ID:	MB-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg		
SampType:	MBLK	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:30 AM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		ND	5.00										
Sample ID:	LCS-35725	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg		
SampType:	LCS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 09:45 AM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		46.6	5.00	50.00	0	93.3	80	120					
Sample ID:	0906263-03A MS	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry		
SampType:	MS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:17 AM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		60.2	32.3	64.68	0	93.1	80	120					
Sample ID:	0906263-03A MSD	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry		
SampType:	MSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:32 AM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		60.6	32.3	64.68	0	93.6	80	120	0.557	20			
Sample ID:	0906264-01A MS	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry		
SampType:	MS	Run ID:	IC2_090701A		Analysis Date:		07/01/09 01:31 PM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		60.9	31.8	63.63	0	95.8	80	120					
Sample ID:	0906264-01A MSD	Batch ID:	35725		TestNo:		E300		Units:		mg/Kg-dry		
SampType:	MSD	Run ID:	IC2_090701A		Analysis Date:		07/01/09 01:46 PM		Prep Date:		06/30/09		
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual		
Chloride		60.9	31.8	63.63	0	95.7	80	120	0.0971	20			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0906264
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: IC2_090701A

Sample ID:	ICV-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	ICV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 08:43 AM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		24.2	5.00	25.00	0	97.0	90	110			

Sample ID:	CCV1-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	CCV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 11:47 AM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.33	5.00	10.00	0	93.3	90	110			

Sample ID:	CCV2-090701	Batch ID:	R44050		TestNo:		E300		Units:	mg/Kg	
SampType:	CCV	Run ID:	IC2_090701A		Analysis Date:		07/01/09 02:01 PM		Prep Date:	07/01/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Chloride		9.30	5.00	10.00	0	93.0	90	110			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT:	Larson & Associates
Work Order:	0906264
Project:	Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: PMOIST_090702C

Sample ID:	0907027-04D-DUP	Batch ID:	35790		TestNo:		D2216		Units:		WT%
SampType:	DUP	Run ID:	PMOIST_090702C		Analysis Date:		07/06/09 09:50 AM		Prep Date:		07/02/09
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Percent Moisture		6.28	0	0	6.872				8.98	30	

Qualifiers:				
B	Analyte detected in the associated Method Blank		R	RPD outside accepted control limits
DF	Dilution Factor		RL	Reporting Limit
J	Analyte detected between MDL and RL		S	Spike Recovery outside control limits
MDL	Method Detection Limit		J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit		N	Parameter not NELAC certified

July 21, 2009

Michelle Green
Larson & Associates
507 N. Marienfeld #200
Midland, TX 79701

Order No: 0907119

TEL: (432) 687-0901
FAX: (432) 687-0456

RE: Chevron Landfarm

Dear Michelle Green:

DHL Analytical received 1 sample(s) on 7/14/2009 for the analyses presented in the following report.

There were no problems with the analyses and all data met requirements of NELAC except where noted in the Case Narrative. All non-NELAC methods will be identified accordingly in the case narrative and all estimated uncertainties of test results are within method or EPA specifications.

If you have any questions regarding these tests results, please feel free to call. Thank you for using DHL Analytical.

Sincerely,

John DuPont
Lab Manager

This report was performed under the accreditation of the State of Texas Laboratory Certification Number: T104704211-09-TX

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CHAIN-OF-CUSTODY

Larson & Associates, Inc.
Environmental Consultants
507 N. Marienfeld, Ste. 200
Midland, TX 79701
432-687-0901

Data Reported to: M. Am

DATE: 6-26-09 PAGE 1 OF 1
PO #:
LAB WORK ORDER #: ~~[illegible]~~ 0907119
PROJECT LOCATION OR NAME: Chevron [illegible]
LAI PROJECT #: 6-0137 COLLECTOR: DM

TRRP report? ☐ Yes ☒ No

TIME ZONE: Time zone/State: MST/NM

S=SOIL, W=WATER, A=AIR, P=PAINT, SL=SLUDGE, OT=OTHER

PRESERVATION: HCl | HNO_3 | H_2SO_4 ☐ NaOH ☐ | ICE | UNPRESERVED

ANALYSES: BTEX ☐ MTBE ☐ | TRPH 418.1 ☐ TPH 1005 ☐ TPH 1006 ☐ | GASOLINE MOD 8015 ☐ | DIESEL - MOD 8015 ☐ | VOC 8260 ☐ | SVOC 8270 ☐ PAH 8270 ☐ HOLDPAH ☐ | 8081 PESTICIDES ☐ 8151 HERBICIDES ☐ | 8082 PCBS ☐ | TCLP - METALS (RCRA) ☐ TCLP VOC ☐ | TCLP - PEST ☐ HERB ☐ Semi-VOC ☐ | TOTAL METALS (RCRA) ☐ OTHER LIST ☐ | LEAD - TOTAL ☐ D.W. 200.8 ☐ TCLP ☐ | RCI ☐ TOX ☐ FLASHPOINT ☐ | TDS ☐ TSS ☐ % MOISTURE ☐ CYANIDE ☐ | pH ☐ HEXAVALENT CHROMIUM ☐ PECHLORATE ☐ | EXPLOSIVES ☐ CHLORIDE ☐ ANIONS ☐ ALKALINITY ☐ Barium

Field Sample I.D.	Lab #	Date	Time	Matrix	# of Containers	HCl	HNO_3	H_2SO_4/NaOH	ICE	UNPRESERVED	Explosives/Hex. Cr/Pechlorate	Chloride/Anions/Alkalinity/Barium	Field Notes
Cell 26 (3-4')	01	6-26-09	11:35	S	1					X	X	X	All Baler M. Green
Cell 18 (3-4')	02	↓	12:40	↓	1					X	X	X	7/14/09 (initials)
Cell 17 (3-4')	03	↓	12:20	↓	1					X	X	X	

TOTAL

RELINQUISHED BY: (Signature)	DATE/TIME	RECEIVED BY: (Signature)
[signature]	6/26 4:30	LSO
LSO	6/27/09 9:00	[signature]

TURN AROUND TIME: NORMAL ☒ 1 DAY ☐ 2 DAY ☐ OTHER ☐

LABORATORY USE ONLY:
RECEIVING TEMP: 1.4° THERM #: 57
CUSTODY SEALS - ☐ BROKEN ☒ INTACT ☐ NOT USED
☒ CARRIER BILL # LSO
☐ HAND DELIVERED

DHL Analytical

Sample Receipt Checklist

Client Name Larson & Associates

Date Received: 7/14/2009

Work Order Number 0907119

Received by JB

Checklist completed by: [signature] 7/14/09 (Signature / Date)

Reviewed by SS 7/14/9 (Initials / Date)

Carrier name: LoneStar

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shippping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	1.4 °C
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Adjusted? ____________ Checked by ____________

Any No response must be detailed in the comments section below.

Client contacted ____________ Date contacted: ____________ Person contacted ____________

Contacted by: ____________ Regarding: ____________

Comments: ____________

Corrective Action ____________

Page 1 of 1

CLIENT:	Larson & Associates	
Project:	Chevron Landfarm	**CASE NARRATIVE**
Lab Order:	0907119	

Samples were analyzed using the methods outlined in the following references:

Method SW6020 - Metals Analysis

LOG IN

The sample was added on and log-in performed on 7/14/09. A total of 1 sample was received. The time of collection was Mountain Standard Time. The sample arrived in good condition and was properly packaged.

METALS ANALYSIS

For Metals analysis performed on 7/17/09 the matrix spike and matrix spike duplicate recoveries were above control limits for Barium. These are flagged accordingly in the QC summary report. The reference sample selected for the matrix spike and matrix spike duplicate was not from this work order. The LCS was within control limits for this analyte. No further corrective actions were taken.

DHL Analytical

Date: 07/21/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0907119

Work Order Sample Summary

Lab Smp ID	Client Sample ID	Tag Number	Date Collected	Date Recv'd
0907119-01	Cell 26 (3-4')		06/26/09 11:35 AM	07/14/09

DHL Analytical

Date: 07/21/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0907119

PREP DATES REPORT

Sample ID	Client Sample ID	Collection Date	Matrix	Test Number	Test Name	Prep Date	Batch ID
0907119-01A	Cell 26 (3-4')	06/26/09 11:35 AM	Soil	SW3050B	Soil Prep Total Metals: ICP-MS	07/16/09 09:00 AM	35959

DHL Analytical

Date: 07/21/09

CLIENT: Larson & Associates
Project: Chevron Landfarm
Lab Order: 0907119

ANALYTICAL DATES REPORT

Sample ID	Client Sample ID	Matrix	Test Number	Test Name	Batch ID	Dilution	Analysis Date	Run ID
0907119-01A	Cell 26 (3-4')	Soil	SW6020	Trace Metals: ICP-MS - Solid	35959	5	07/17/09 05:51 PM	ICP-MS2_090717B

DHL Analytical

Date: 07/21/09

CLIENT:	Larson & Associates	**Client Sample ID:**	Cell 26 (3-4')
Project:	Chevron Landfarm	**Lab ID:**	0907119-01
Project No:	6-0137	**Collection Date:**	06/26/09 11:35 AM
Lab Order:	0907119	**Matrix:**	Soil

Analyses	Result	MDL	RL	Qual	Units	DF	Date Analyzed
Trace Metals: ICP-MS - Solid	**SW6020**						**Analyst: KW**
Barium	301	0.576	2.30		mg/Kg-dry	5	07/17/09 05:51 PM

Qualifiers:

*	Value exceeds TCLP Maximum Concentration Level	J	Analyte detected between MDL and RL
B	Analyte detected in the associated Method Blank	MDL	Method Detection Limit
C	Sample Result or QC discussed in the Case Narrative	N	Parameter not NELAC certified
DF	Dilution Factor	ND	Not Detected at the Method Detection Limit
E	TPH pattern not Gas or Diesel Range Pattern	RL	Reporting Limit
		S	Spike Recovery outside control limits

CLIENT: Larson & Associates
Work Order: 0907119
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS2_090717B

Sample ID: MB-35959	Batch ID: 35959		TestNo:	SW6020		Units: mg/Kg		
SampType: MBLK	Run ID: ICP-MS2_090717B		Analysis Date:	07/17/09 05:08 PM		Prep Date: 07/16/09		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	ND	2.00								

Sample ID: LCS-35959	Batch ID: 35959		TestNo:	SW6020		Units: mg/Kg		
SampType: LCS	Run ID: ICP-MS2_090717B		Analysis Date:	07/17/09 05:13 PM		Prep Date: 07/16/09		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	50.0	2.00	50.00	0	100	80	120			

Sample ID: LCSD-35959	Batch ID: 35959		TestNo:	SW6020		Units: mg/Kg		
SampType: LCSD	Run ID: ICP-MS2_090717B		Analysis Date:	07/17/09 05:19 PM		Prep Date: 07/16/09		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	49.8	2.00	50.00	0	99.6	80	120	0.451	25	

Sample ID: 0907129-01B MS	Batch ID: 35959		TestNo:	SW6020		Units: mg/Kg-dry		
SampType: MS	Run ID: ICP-MS2_090717B		Analysis Date:	07/17/09 05:40 PM		Prep Date: 07/16/09		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	124	1.95	48.68	0.7443	253	80	120			S

Sample ID: 0907129-01B MSD	Batch ID: 35959		TestNo:	SW6020		Units: mg/Kg-dry		
SampType: MSD	Run ID: ICP-MS2_090717B		Analysis Date:	07/17/09 05:46 PM		Prep Date: 07/16/09		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	123	1.93	48.27	0.7443	254	80	120	0.680	25	S

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT:	Larson & Associates
Work Order:	0907119
Project:	Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS2_090717B

Sample ID:	ICV1-090717	Batch ID:	R44352	TestNo:		SW6020		Units:	mg/L	
SampType:	ICV	Run ID:	ICP-MS2_090717B	Analysis Date:		07/17/09 11:58 AM		Prep Date:		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.101	0.0100	0.100	0	101	90	110			

Sample ID:	CCV4-090717	Batch ID:	R44352	TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS2_090717B	Analysis Date:		07/17/09 04:40 PM		Prep Date:		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.216	0.0100	0.200	0	108	90	110			

Sample ID:	CCV5-090717	Batch ID:	R44352	TestNo:		SW6020		Units:	mg/L	
SampType:	CCV	Run ID:	ICP-MS2_090717B	Analysis Date:		07/17/09 06:02 PM		Prep Date:		
Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.211	0.0100	0.200	0	105	90	110			

Qualifiers:				
B	Analyte detected in the associated Method Blank		R	RPD outside accepted control limits
DF	Dilution Factor		RL	Reporting Limit
J	Analyte detected between MDL and RL		S	Spike Recovery outside control limits
MDL	Method Detection Limit		J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit		N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0907119
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS2_090720A

Sample ID:	0907129-01B SD	Batch ID:	35959		TestNo:		SW6020		Units:	mg/Kg-dry	
SampType:	SD	Run ID:	ICP-MS2_090720A		Analysis Date:		07/20/09 12:53 PM		Prep Date:	07/16/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium		76.5	49.5	0	76.28				0.275	10	

Sample ID:	0907129-01B PDS	Batch ID:	35959		TestNo:		SW6020		Units:	mg/Kg-dry	
SampType:	PDS	Run ID:	ICP-MS2_090720A		Analysis Date:		07/20/09 12:58 PM		Prep Date:	07/16/09	
Analyte		Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium		316	9.90	247.5	76.28	96.7	75	125			

Qualifiers:				
	B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
	DF	Dilution Factor	RL	Reporting Limit
	J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
	MDL	Method Detection Limit	J	Analyte detected between SDL and RL
	ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

CLIENT: Larson & Associates
Work Order: 0907119
Project: Chevron Landfarm

ANALYTICAL QC SUMMARY REPORT

RunID: ICP-MS2_090720A

Sample ID: ICV1-090720 | Batch ID: R44381 | TestNo: SW6020 | Units: mg/L
SampType: ICV | Run ID: ICP-MS2_090720A | Analysis Date: 07/20/09 12:32 PM | Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.0976	0.0100	0.100	0	97.6	90	110			

Sample ID: CCV1-090720 | Batch ID: R44381 | TestNo: SW6020 | Units: mg/L
SampType: CCV | Run ID: ICP-MS2_090720A | Analysis Date: 07/20/09 01:04 PM | Prep Date:

Analyte	Result	RL	SPK value	Ref Val	%REC	LowLimit	HighLimit	%RPD	RPD Limit	Qual
Barium	0.200	0.0100	0.200	0	99.8	90	110			

Qualifiers:

B	Analyte detected in the associated Method Blank	R	RPD outside accepted control limits
DF	Dilution Factor	RL	Reporting Limit
J	Analyte detected between MDL and RL	S	Spike Recovery outside control limits
MDL	Method Detection Limit	J	Analyte detected between SDL and RL
ND	Not Detected at the Method Detection Limit	N	Parameter not NELAC certified

NEW MEXICO ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau
and
Ground Water Quality Bureau
Voluntary Remediation Program

TECHNICAL BACKGROUND DOCUMENT FOR DEVELOPMENT OF SOIL SCREENING LEVELS
REVISION 4.0

June 2006

Volume 1

TIER 1: SOIL SCREENING GUIDANCE TECHNICAL BACKGROUND DOCUMENT

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VOLUME 1 TIER 1: SOIL SCREENING GUIDANCE TECHNICAL BACKGROUND DOCUMENT

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VOLUME 2 TIER 1: SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT PHASE I SCOPING ASSESSMENT

LIST OF ACRONYMS

ASTDR	Agency for Toxic Substances and Disease Registry
CMTP	Composite Model for Leachate Migration with Transformation Products
COPC	Contaminants of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
DQO	Data Quality Objectives
EPA/ORD	Environmental Protection Agency Office of Research and Development
GWQB	Groundwater Quality Bureau
HEAST	Health Effects Assessment Summary Tables
HWB	Hazardous Waste Bureau
IEUBK	Integrated Exposure Uptake Biokinetic
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
MCLG	Nonzero Maximum Contaminant Level
MRL	Minimum Risk Level
NAPL	Non-aqueous Phase Liquid
NCEA	National Center for Environmental Assessment
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NRCS	National Resource Conservation Service
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
SCEM	Site Conceptual Exposure Model
SSG	Soil Screening Guidance
SSL	Soil Screening Level
SVOC	Semi-volatile Organic Compound
UCL	Upper Confidence Limit
URF	Unit Risk Factor
USEPA	United States Environmental Protection Agency
VFs	Volatilization Factor for Soil
VFw	Volatilization Factor for Groundwater
VOC	Volatile Organic Compound
WQCC	Water Quality Control Commission

1. Introduction

The New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the Ground Water Quality Bureau (GWQB) have developed this soil screening guidance (SSG) for internal department use for corrective action programs. The SSG discusses the methodology used to derive chemical-specific soil screening levels (SSLs). In addition, guidance is provided to assist in identifying and evaluating appropriate exposure pathways and receptors. Finally, this document provides generic SSLs for chemicals commonly found at contaminated sites based on default exposure parameters under residential and non-residential land-use scenarios.

The SSG provides site managers with a framework for developing and applying the SSLs, and is likely to be most useful for determining whether areas or entire sites are contaminated to an extent that warrants further investigation. It is intended to assist and streamline the site investigation and corrective action process by focusing resources on those sites or areas that pose the greatest risk to human health and the environment. Implementation of the methodologies outlined within this SSG may significantly reduce the time necessary to complete site investigations and cleanup actions at certain sites, as well as improve the consistency of these investigations.

Between various sites there can exist a wide spectrum of contaminant types and concentrations. The level of concern associated with those concentrations depends on several factors, including the likelihood of exposure to levels of potential concern to human health or to ecological receptors. At one end of the spectrum are levels that clearly warrant a response action; at the other end are levels that are below regulatory concern. Appropriate cleanup goals for a site may fall anywhere within this range depending on site-specific conditions. It is important to note that SSLs do not in themselves represent cleanup standards, and the SSLs alone do not trigger the need for a response action or define "unacceptable" levels of contamination in soil. Screening levels such as SSLs identify the lower end of this spectrum – levels below which there is generally no need for further concern—provided the conditions associated with the development of the SSLs are consistent.

1.1 ORGANIZATION OF THE DOCUMENT

The NMED SSG is organized into five major sections with supporting appendices. The remainder of Section 1 addresses the purpose of the NMED SSLs and outlines the scope of the document. Section 2 outlines the receptors, exposure pathways, and exposure assumptions used in calculating the NMED SSLs. It also discusses the risk levels on which the SSLs are predicated and presents the SSL model assumptions. Finally, Section 2 discusses site assessment/characterization activities that should be completed prior to comparing site contaminant concentrations with SSLs. These activities include development of data quality objectives, conducting site sampling, preparation of a preliminary conceptual site model (CSM), and identification of contaminants of potential concern (COPCs). Section 3 provides a detailed description of the process used to develop pathway-specific SSLs. Included in this section is a discussion of the human health basis for the SSLs, additive risk, and acute exposures. Additional topics discussed in Section 3 include chemical specific parameters used to develop the SSLs and calculating volatilization factors, particulate emission factors and soil saturation limits. Section 4 presents methodologies for assessing the potential for migration of contaminants to groundwater from contaminated soil in concert with generic and site-specific leaching models. Finally, Section 5 addresses special use considerations for addressing contaminant concentrations in soil and notes specific problems that can arise when applying the SSLs to specific sites. Generic SSLs for contaminants are presented in Table A-1 of Appendix A. Table A-2 of Appendix A presents the default exposure factor values used in the generation of the NMED SSLs. Physical-chemical values in the calculation of the SSLs are presented in Table B-1 of Appendix B. Toxicity criteria are presented in Table C-1 of Appendix C.

1.2 Scope of the Soil Screening Guidance

The SSG incorporates readily obtainable site data and utilizes methods from various United States Environmental Protection Agency (US EPA) risk assessment guidance and derives site-specific screening levels for selected contaminants and exposure pathways. Key attributes of the SSG include default values for generic SSLs where site-specific information is unavailable, and the identification of parameters for which site-specific information is needed for the development of site-specific SSLs. The goal of the SSG is to provide a consistent approach for developing site-specific SSLs for evaluating facilities under the auspices of the corrective action process within NMED.

The NMED SSLs are based on a 1E-05 target risk for carcinogens, or a hazard quotient of 1 for noncarcinogens. In instances where an individual contaminant has the capacity to elicit both types of responses, the SSLs preferentially report the screening value representative of the lowest (most stringent) contaminant concentration in environmental media. SSLs for migration to groundwater are based on NMED-specific tapwater SSLs. As such, the NMED SSLs serve as a generic benchmark for screening level comparisons of contaminant concentrations in soil. NMED anticipates that the SSLs will be used as a tool to facilitate prompt identification of those contaminants and areas that represent the greatest risks to human health and the environment. While concentrations above the NMED SSLs presented in this document do not automatically designate a site as "contaminated" or trigger the need for a response action, detected concentrations in site soils exceeding screening levels suggest that further evaluation is appropriate. Further evaluation may include additional sampling to further characterize the nature and extent of contamination, consideration of background levels, reevaluation of COPCs or associated risk and hazard using site-specific parameters, and/or a reassessment of the assumptions associated with the generic SSLs (e.g., appropriateness of route-to-route extrapolations, use of chronic toxicity values to evaluate childhood and construction-worker exposures).

1.2.1 Exposure Pathways

A complete exposure pathway consists of (1) a source, (2) a mechanism of contaminant release, (3) a receiving or contact medium, (4) a potential receptor population, and (5) an exposure route. All five elements must be present for the exposure pathway to be considered complete.

SSLs have been developed for use in evaluating three discrete exposure scenarios representing a variety of potential land uses: residential, commercial/industrial, and construction. The SSG presents lists of potential pathways for each scenario, though these lists are not intended to be exhaustive. Instead, each list represents a set of typical exposure pathways likely to account for the majority of exposure to contaminants in soil at a given site. These include:

- Direct (or incidental) ingestion of soil,
- Dermal contact with soil,
- Inhalation of volatiles and fugitive dusts from contaminated soil, and
- Migration of chemicals through soil to an underlying potable aquifer or water-

bearing unit.

Under some site-specific situations, additional complete exposure pathways may be identified. In these cases, a site-specific evaluation of risk is warranted in which additional exposure pathways can be considered. If other land uses and exposure scenarios are determined to be more appropriate for a site (e.g., Native American land use), the exposure pathways addressed in this document should be modified accordingly or a site-specific risk assessment should be conducted. Early identification of the need for additional information is important because it facilitates development of a defensible sampling and analysis strategy.

The exposure pathways evaluated, by land-use scenario, are presented in Table 1-1.

Table 1-1

Exposure Pathways Evaluated in Soil Screening Guidance			
Potential Exposure Pathway	**Residential**	**Commercial/industrial**	**Construction**
Direct ingestion	••	••	••
Dermal contact	••	••	••
Inhalation of volatiles outdoors	••	••	••
Inhalation of fugitive dusts outdoors	••	••	••
Inhalation of volatiles indoors	••		

1.2.2 Exposure Assumptions

SSLs represent risk-based concentrations in soil derived from equations combining exposure assumptions with toxicity criteria developed by US EPA (US EPA 2006 and 1997a) and the National Center for Environmental Assessment (NCEA) (USEPA 2003c). The models and assumptions used were developed to be consistent with the Superfund concept of "reasonable maximum exposure" (US EPA 1989). This is intended to provide an upper-bound estimate of chronic exposure by combining both average and conservative (i.e., 90th to 95th percentile) values in the calculations. The default intake and duration assumptions presented here are intended to be protective of all potentially exposed populations for each land use consideration. Exposure point concentrations in soil should reflect either directly measured or estimated values using fate and transport models. An average concentration is typically used where the focus is on estimating long-term, chronic exposures and there are sufficient site data to allow for an accurate estimation of the mean. Where the potential for acute toxicity may be of concern, estimates based on the maximum exposure may be more appropriate.

The resulting estimate of exposure is then compared with chemical-specific toxicity criteria. To calculate the SSLs, the exposure equations and pathway models are rearranged to backcalculate an "acceptable level" of a contaminant in soil corresponding to a specific level of target risk or hazard.

1.2.3 Target Risk and Hazard

Target risk and hazard levels for human health are risk management-based criteria for carcinogenic and non-carcinogenic responses, respectively, to determine (1) whether site-related contamination poses an unacceptable risk to human health and requires corrective action or (2) whether implemented corrective action(s) sufficiently protects human health. If an estimated risk or hazard falls within the target range, the risk manager may conclude that a site does not pose an unacceptable risk. This decision should take into account the degree of inherent conservatism or level of uncertainty associated with the site-specific estimates of risk and hazard. An estimated risk that exceeds these targets, however, does not necessarily indicate that the current conditions are not safe or that they present an unacceptable risk. Rather, a site risk calculation that exceeds a target value may simply indicate the need for further evaluation or refinement of the exposure model.

For cumulative exposure via the ingestion, inhalation, and dermal pathways, toxicity criteria are used to calculate an acceptable level of contamination in soil. SSLs are based on a carcinogenic risk level of one-in-one-hundred thousand (1E-05) and a non-carcinogenic hazard quotient of 1. A carcinogenic risk level is defined as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. The non-carcinogenic hazard quotient assumes that there is a level of exposure below which it is unlikely for even sensitive populations to experience adverse health effects.

1.2.4 SSL Model Assumptions

The models used to calculate inhalation exposure and protection of groundwater based on potential migration of contaminants in soil are intended to be utilized at an early stage in the site investigation process when information regarding the site may be limited. For this reason, the models incorporate a number of simplifying assumptions. For instance, the models assume an infinite contaminant source, i.e. a constant concentration is maintained for the duration of the exposure period. Although this is a highly conservative assumption, finite source models require accurate data regarding source size and volume. Such data are unlikely to be available from limited sampling efforts. The models also assume that contamination is homogeneous throughout the source and that no biological or chemical degradation occurs. Where sufficient site-specific data are available, more-detailed finite-source models may be used in place of the default assumptions presented in this SSG.

2. Development of Pathway Specific Soil Screening Levels

The following sections present the technical basis and limitations used to calculate SSLs for residential, commercial/industrial, and construction land use scenarios. The equations used to evaluate inhalation and migration to groundwater include a number of easily obtainable site-specific input parameters. Where site-specific data are not available, conservative default values are presented. The equations used are presented in Sections 2.2, 2.3 and 2.4. Generic SSLs calculated for 208 chemicals, using these default values, are presented in Table A-1 of Appendix A.

2.1 Human Health Basis

The toxicity criteria used for calculating the SSLs are presented in Table C-1 of Appendix C. The primary sources for the human health benchmarks are US EPA's Integrated Risk Information System (IRIS) (US EPA 2006), US EPA's NCEA (US EPA 2005), and the Health Effects Assessment Summary Tables (HEAST) (US EPA 1997a). Additional sources include the minimal risk levels (MRLs) developed by the Agency for Toxic Substances and Disease Registry (ATSDR). For soil ingestion, inhalation of volatile organic compounds (VOCs) and fugitive dusts, and dermal contact, the NMED SSLs correspond to a 1E-05 level for carcinogens and/or a hazard quotient of 1 for noncarcinogens, whichever is lower (i.e., more protective).

2.1.1 Additive Risk

It is important to note that no consideration is provided in the calculation of individual NMED

SSLs for additive risk when exposures to multiple chemicals occur. The SSG addresses this issue in Section 5. Because the NMED SSLs for carcinogenic effects correspond to a 1E-05 risk level individually, exposure to multiple contaminants may result in a cumulative site risk that is above the anticipated risk management range. While carcinogenic risks of multiple chemicals are simply added together, the issue of additive hazard is more complex for noncarcinogens because of the theory that a threshold exists for noncarcinogenic effects. This threshold is defined as the level below which adverse effects are not expected to occur, and represents the basis for the reference dose (RfD) and reference concentration (RfC). Since adverse effects are not expected to occur at the RfD or RfC and the SSLs are derived by setting the potential exposure dose to the RfD or RfC, the SSLs do not address the risk of exposure to multiple chemicals at levels where the individual chemicals alone would not be expected to cause any adverse effects. In such cases, the SSLs may not provide an accurate indicator for the likelihood of harmful effects. However, noncarcinogenic effects should only be considered additive for those chemicals with the same toxic endpoint and/or mechanism of action. The sources provided in Section 2.1 should be consulted to determine the endpoint and/or target organ system prior to attempting to evaluate the additive health effects resulting from simultaneous exposure to multiple contaminants.

Additivity of the SSLs is further complicated by the fact that not all of the SSLs are based on toxicity. SSLs for certain volatile chemicals are determined based on a ceiling limit concentration termed the soil saturation limit (and denoted as C_{sat}) above which these chemicals may occur as nonaqueous phase liquids (NAPLs) in soil. These are noted as "sat" in the tables. This is discussed further in Section 3.2. Further, for certain inorganic and semivolatile organic compounds (SVOCs) that exhibit relatively low toxicity, a non risk-based maximum concentration of 1E+05 mg/kg is given when the risk-based SSL exceeds that level. These are noted as "max" in the tables.

2.1.2 Acute Exposures

The exposure assumptions used to develop the SSLs are based on a chronic exposure scenario and do not account for situations where high-level exposures may result in acute toxic effects. Such situations may arise when contaminant concentrations are very high, or may result from specific site-related conditions and/or behavioral patterns (i.e., pica behavior in children). Such exposures may be of concern for those contaminants that primarily exhibit acute health effects. Toxicological information regarding cyanide and phenol indicate that acute effects may be of concern for children exhibiting pica behavior. Pica is typically described as a compulsive craving to ingest non-food items (such as clay or paint). Although it can be exhibited by adults as well, it is typically of greatest concern in children because they often exhibit behavior (e.g., outdoor play activities and greater hand-to-mouth contact) that results in greater exposure to soil than for a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake.

2.1.3 Route-to-Route Extrapolation

As of January 1991, IRIS and NCEA databases no longer present RfDs or cancer slope factors (CSFs) for the inhalation route. These criteria have been replaced with RfCs for noncarcinogenic effects and unit risk factors (URFs) for carcinogenic effects. However, for the purposes of estimating risk and calculating risk-based concentrations, inhalation reference doses (RfD_i) and inhalation slope factors (CSF_i) are preferred. Route-to-route extrapolations were also frequently used when there were no toxicity values available for a given route of exposure. However, route extrapolations were not performed for inorganics due to portal of entry effects and known differences in absorption efficiency between the oral and dermal routes of exposure. To calculate an RfD_i from an RfC, the following equation and assumptions may be used for most chemicals:

$$RfD_i \frac{mg}{(kg - day)} = RfC\,(mg / m^3) \times \frac{20m^3}{day} \times \frac{1}{70kg}$$

The SF_i was calculated from the URF using the following equation and assumptions:

$$CSF_i \frac{(kg - day)}{(mg)} = URF \left(m^3/ug\right) \times \frac{day}{20m^3} \times 70kg \times \frac{10^3\ ug}{mg}$$

An additional route extrapolation is the use of oral toxicity values for evaluating dermal exposures. Because no toxicity data are presently available for evaluating dermal exposure to contaminants, US EPA has developed a methodology for use in dermal assessments. Most oral RfDs and oral cancer slope factors (CSF_o) are based on an administered dose while dermal equations estimate an absorbed dose. Gastrointestinal and pulmonary absorption of many chemicals is typically much greater than absorption through intact skin. Thus, for evaluating the effects of dermal exposure to contaminants in soil, the oral toxicity value should be adjusted from an administered dose to an absorbed dose by accounting for the absorption efficiency of the chemical. Assuming 100 percent absorption via the oral exposure route may result in an overestimation of the absorbed dose, resulting in an overestimation of the dose at the site of toxic injury and underestimating the actual potency of the chemical to exert an observed effect. The magnitude of the underestimation is inversely proportional to the true oral absorption of the compound. Based on the current guidance (US EPA 2004c), the only chemical for which an adjustment is recommended is cadmium. An oral absorption efficiency of five (5) percent is assumed for cadmium, which leads to an estimated dermal reference dose (RfD_d) of 2.5E-05 mg/kg-day.

2.1.4 Direct Ingestion

Exposure to contaminants through incidental ingestion of soil can result from the inadvertent consumption of soils adhering to the hands, food items, or objects that are placed into the mouth. It can also result from swallowing dust particles that have been inhaled and deposited in the mouth and subsequently swallowed. Commercial/industrial and construction workers and residential receptors may inadvertently ingest soil that adheres to their hands while involved in work- or recreation-related activities. Calculation of SSLs for direct ingestion are based on the methodology presented in US EPA's *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (US EPA 1991 2001), *Soil Screening Guidance: Technical Background Document* (US EPA 1996a), and *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA 2001a).

2.1.5 Dermal Absorption

Exposure to soil contaminants may result from dermal contact with contaminated soil and the subsequent absorption of contaminants through the skin. Contact with soil is most likely to occur as a result of digging, gardening, landscaping, or outdoor recreation activities. Excavation activities may also be a potential source of exposure to contaminants, particularly for construction workers. Calculation of the screening levels for ingestion of soil under the residential exposure scenario is based on the methodology presented in EPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (1991), and *Soil Screening Guidance: Technical Background Document* (US EPA 1996a). The suggested default input values used to develop the NMED SSLs are consistent with EPA's interim *RAGS, Part E, Supplemental Guidance for Dermal Risk Assessment* (US EPA 2004).

2.1.6 Inhalation of Volatiles and Fugitive Dusts

EPA toxicity data indicate that risks from exposure to some chemicals via the inhalation pathway far outweigh the risk via ingestion or dermal contact; therefore, the NMED SSLs have been designed to address inhalation of volatiles and fugitive dusts. To address the soil/sediment-to-air pathways, the SSL calculations incorporate a volatilization factor (VF_s) for volatile contaminants (See Section 3.1) and a particulate emission factor (PEF)(See Section 3.3) for nonvolatile contaminants. The SSLs follow the procedures for evaluating inhalation of VOCs and fugitive dust particles presented in EPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim* (US EPA 1991), *Soil Screening Guidance: Technical Background Document* (US EPA 1996a), *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (US EPA 1998a), and *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA 2001a).

VOCs may adhere to soil particles or be present in interstitial air spaces in soil, and may volatilize into ambient air. This pathway may be particularly significant if the VOC emissions are concentrated in indoor spaces of onsite buildings. The NMED SSLs do not account for vapor intrusion and inhalation of volatile organics volatilized into indoor air. If vapor intrusion into indoor air is a concern, additional analysis of this pathway may be necessary and the latest guidance on evaluating the vapor intrusion pathway should be consulted: for example, the US EPA's 2002 *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Soil Vapor Intrusion Guidance.* For the purpose of calculating the NMED SSLs, VOCs are considered those chemicals having a Henry's Law constant greater than 1E-05 atm-m^3/mole-^{o}K and a molecular weight less than 200 g/mole.

Inhalation of contaminants via inhalation of fugitive dusts is assessed using a PEF that relates the contaminant concentration in soil/sediment with the concentration of respirable particles in the air due to fugitive dust emissions. It is important to note that the PEF used to address residential and commercial/industrial exposures evaluates only windborne dust emissions and does not consider emissions from traffic or other forms of mechanical disturbance which could lead to a greater level of exposure. The PEF used to address construction worker exposures evaluates windborne dust emissions and emissions from vehicle traffic associated with construction activities. Therefore, the fugitive dust pathway should be considered carefully when developing the CSM at sites where receptors may be exposed to fugitive dusts by other mechanisms. The development of the PEF for both residential and non-residential land uses is discussed further in Section 3.3.

2.2 RESIDENTIAL LAND USES

Residential exposures are assessed based on child and adult receptors. As discussed below, the child forms the basis for evaluation of noncarcinogenic effects incurred under residential exposures, while carcinogenic responses are modeled based upon age-adjusted values to account for exposures averaged over a lifetime. Under most circumstances, onsite residential receptors are expected to be the most conservative receptor basis for risk assessment purposes due to the assumption that exposure occurs 24 hours a day, 350 days per year, extending over a 30-year exposure duration. Table 2-1 provides a summary of the exposure characteristics and parameters associated with a residential land use receptor.

Table 2-1

Summary of the Residential Land Use Receptors	
Exposure Characteristics	Substantial soil exposure (esp. children) High soil ingestion rate (esp. children) Significant time spent indoors Long-term exposure
Default Exposure Parameters	
Exposure frequency (days/yr)	350
Exposure duration (yr)	6 (child) 24 (adult)
Soil ingestion rate (mg/day)	200 (child) 100 (adult)
Body Weight (kg)	15 (child) 70 (adult)
Skin surface area exposed (cm^2)	2,800 (child) 5,700 (adult)
Skin-soil adherence factor (mg/cm^2)	0.2 (child) 0.07 (adult)
Air inhalation rate (m^3/day)	10 (child) 20 (adult)

2.2.1 Residential Receptors

A residential receptor is assumed to be a long-term receptor occupying a dwelling within the site boundaries and thus is exposed to contaminants 24 hours per day, and is assumed to live at the site for 30 years (representing the 90^{th} percentile of the length of time someone lives in a single location), remaining onsite for 350 days per year. Exposure to soil is expected to occur during home maintenance activities, yard work and landscaping, and outdoor play activities. Contaminant intake is assumed to occur via three exposure pathways – direct ingestion, dermal absorption, and inhalation of volatiles and fugitive dusts. For the residential scenario, both adult and child receptors were evaluated because children often exhibit behavior (e.g., greater hand-to-mouth contact) that can result in greater exposure to soils than those associated with a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake.

Equations 1 and 2 are used to calculate cumulative SSLs for a residential receptor exposed to non-carcinogenic and carcinogenic contaminants via all three exposure pathways. Default exposure parameters are provided for use when site-specific data are not available.

Equation 1
Combined Exposures to Noncarcinogenic Contaminants in Soil
Residential Scenario

$$C = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^6 \, {}_{mg/kg}} \right) + \left(\frac{1}{RfD_o} \times \frac{SA_c \times AF_c \times ABS}{10^6 \, {}_{mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF_s \text{ or } PEF} \right) \right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
BW_c	Body weight, child (kg)	15
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_r	Exposure frequency, resident (day/yr)	350
ED_c	Exposure duration, child (years)	6
IRS_c	Soil ingestion rate, child (mg/day)	200
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_c	Dermal surface area, child (cm^2/day)	2,800
AF_c	Soil adherence factor, child (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_c	Inhalation rate, child (m^3/day)	10
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF	Particulate emission factor (m^3/kg)	See Equation 14

Equation 2
Combined Exposures to Carcinogenic Contaminants in Soil
Residential Scenario

$$C = \frac{TR \times AT_c}{EF_r\left[\left(\frac{IFS_{adj} \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{InhF_{adj} \times CSF_i}{VF_s \text{ or } PEF}\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target cancer risk	1E-05
AT_c	Averaging time, carcinogens (days)	25,550
EF_r	Exposure frequency, resident (day/yr)	350
IFS_{adj}	Age-adjusted soil ingestion factor ([mg-yr]/[kg-day])	114
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SFS_{adj}	Age-adjusted dermal factor ([mg-yr]/[kg-day])	361
ABS	Skin absorption factor (unitless)	Chemical-specific
$InhF_{adj}$	Age-adjusted inhalation factor ($[m^3\text{-}yr]/[kg\text{-}day]$)	11
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF	Particulate emission factor (m^3/kg)	See Equation 14

Noncarcinogenic contaminants are evaluated based solely on childhood exposures using Equation 1. By combining the higher contaminant intake rates with the lower relative body weight, "childhood only" exposures lead to a lower, or more conservative, risk-based concentration compared to an adult-only exposure. In addition, this approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria.

Unlike non-carcinogens, the duration of exposure to carcinogens is averaged over the lifetime of the receptor because of the assumption that cancer may develop even after actual exposure has ceased. As a result, the total dose received is averaged over a lifetime of 70 years. In addition, to be protective of exposures in a residential setting, the carcinogenic exposure parameter values are age-adjusted to account for exposures incurred in children (1-6 years of age) and adults (7-31 years of age). Carcinogenic exposures are age-adjusted to account for the physiological differences between children and adults as well as behavioral differences that result in markedly different relative rates of exposure. Equations 3, 4, and 5 are used to calculate age-adjusted ingestion, dermal and inhalation factors which account for the differences in soil ingestion rate, skin surface area, soil adherence factors, inhalation rate, and body weight for children versus adults. The age-adjusted factors calculated using these equations are used in Equation 2 to develop generic NMED SSLs for carcinogenic effects.

Equation 3
Calculation of Age-Adjusted Ingestion Factor

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{(ED_r - ED_c) \times IRS_a}{BW_a}$$

Parameter	Definition (units)	Default
IFS_{adj}	Age-adjusted soil ingestion factor for carcinogens [(mg-yr)/(kg-day)]	114
ED_c	Exposure duration, child (years)	6
IRS_c	Soil ingestion rate, child (mg/day)	200
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
IRS_a	Soil ingestion rate, adult (mg/day)	100
BW_a	Body weight, adult (kg)	70

Equation 4
Calculation of Age-Adjusted Dermal Factor

$$SFS_{adj} = \frac{ED_c \times AF_c \times SA_c}{BW_c} + \frac{(ED_r - ED_c) \times AF_a \times SA_a}{BW_a}$$

Parameter	Definition (units)	Default
SFS_{adj}	Age-adjusted dermal factor for carcinogens [(mg-yr)/(kg-day)]	361
ED_c	Exposure duration, child (years)	6
AF_c	Soil adherence factor, child (mg/cm^2)	0.2
SA_c	Dermal surface area, child (cm^2/day)	2,800
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
AF_a	Soil adherence factor, adult (mg/cm^2)	0.07
SA_a	Dermal surface area, adult (cm^2/day)	5,700
BW_a	Body weight, adult (kg)	70

Equation 5
Calculation of Age-Adjusted Inhalation Factor

$$InhF_{adj} = \frac{Ed_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

Parameter	Definition (units)	Default
$InhF_{adj}$	Age-adjusted inhalation factor for carcinogens $[(m^3\text{-yr})/(kg\text{-day})]$	11
ED_c	Exposure duration, child (years)	6
IRA_c	Inhalation rate, child (m^3/day)	10
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
IRA_a	Inhalation rate, adult (m^3/day)	20
BW_a	Body weight, adult (kg)	70

2.3 NON-RESIDENTIAL LAND USES

Non-residential land uses encompass all commercial and industrial land uses and focus on two very different receptors – a commercial/industrial worker and a construction worker. Unlike those calculated for residential land-uses, NMED SSLs for non-residential land uses are based solely on exposures to adults. Consequently, exposures to carcinogens are not age-adjusted. Due to the wide range of activities and exposure levels a non-residential receptor may be exposed to during various work-related activities, it is important to ensure that the default exposure parameters are representative of site-specific conditions. Table 2-2 provides a summary of the exposure characteristics and parameters for non-residential land use receptors.

Table 2-2

Summary of Non-Residential Land Use Receptors		
Receptor	**Commercial/Industrial Worker**	**Construction Worker**
Exposure Characteristics	Substantial soil exposures High soil ingestion rate Long-term exposure Exposure to surface and shallow subsurface soils Adult-only exposure	Exposed during construction activities only Short-term exposure Very high soil ingestion and dust inhalation rates Exposure to surface and subsurface soils
Default Exposure Parameters		
Exposure frequency (days/yr)	225	250
Exposure duration (yr)	25	1
Soil ingestion rate (mg/day)	100	330
Body Weight (kg)	70	70
Skin surface area exposed (cm^2)	3,300	3,300
Skin-soil adherence factor (mg/ cm^2)	0.2	0.3
Air inhalation rate (m^3/day)	20	20

2.3.1 Commercial/Industrial Worker

The commercial/industrial scenario is considered representative of on-site workers who spend all or most of their workday outdoors. A commercial/industrial worker is assumed to be a long-term receptor exposed during the course of a work day as either (1) a full time employee of a company operating on-site who spends most of the work day conducting maintenance or manual labor activities outdoors or (2) a worker who is assumed to regularly perform grounds-keeping activities as part of his/her daily responsibilities. Exposure to surface and shallow subsurface soils (i.e., at depths of zero to two feet below ground surface) is expected to occur during moderate digging associated with routine maintenance and grounds-keeping activities. A commercial/industrial receptor is expected to be the most highly exposed receptor in the outdoor environment under generic or day-to-day commercial/industrial conditions. Thus, the screening levels for this receptor are expected to be protective of other reasonably anticipated indoor and outdoor workers at a commercial/industrial facility. However, screening levels developed for the commercial/industrial worker may not be protective of a construction worker due to the latter's increased soil contact rate during construction activities. Equations 6 and 7 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters (US EPA 2001) are provided and were used in calculating the NMED SSLs.

Equation 6
Combined Exposures to Carcinogenic Contaminants in Soil
Commercial/Industrial Scenario

$$C = \frac{TR \times BW_a \times AT_c}{EF_{CI} \times ED_{CI}\left[\left(\frac{IRS_{CI} \times CSF_o}{10^6\ _{mg/kg}}\right) + \left(\frac{SA_{CI} \times AF_{CI} \times ABS \times CSF_o}{10^6\ _{mg/kg}}\right) + \left(\frac{IRA_c \times CSF_i}{VF_s \text{ or } PEF}\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target Risk	1E-05
BW_a	Body weight, adult (kg)	70
AT_c	Averaging time, carcinogens (days)	25,550
EF_{CI}	Exposure frequency, commercial/industrial (day/yr)	225
ED_{CI}	Exposure duration, commercial/industrial (years)	25
IRS_{CI}	Soil ingestion rate, commercial/industrial (mg/day)	100
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SA_{CI}	Dermal surface area, commercial/industrial (cm^2/day)	3,300
AF_{CI}	Soil adherence factor, commercial/industrial (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CI}	Inhalation rate, commercial/industrial (m^3/day)	20
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF	Particulate emission factor (m^3/kg)	See Equation 14

Equation 7
Combined Exposures to Noncarcinogenic Contaminants in Soil
Commercial/Industrial Scenario

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CI} \times ED_{CI}\left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CI}}{10^6\,mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_{CI} \times AF_{CI} \times ABS}{10^6\,mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CI}}{VF_s \text{ or } PEF}\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
BW_a	Body weight, adult (kg)	70
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_{CI}	Exposure frequency, commercial/industrial (day/yr)	225
ED_{CI}	Exposure duration, commercial/industrial (years)	25
IRS_{CI}	Soil ingestion rate, commercial/industrial (mg/day)	100
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_{CI}	Dermal surface area, commercial/industrial (cm^2/day)	3,300
AF_{CI}	Soil adherence factor, commercial/industrial (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CI}	Inhalation rate, commercial/industrial (m^3/day)	20
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF	Particulate emission factor (m^3/kg)	See Equation 14

2.3.2 Construction Worker

A construction worker is assumed to be a receptor that is exposed to contaminated soil during the work day for the duration of a single on-site construction project. If multiple construction projects are anticipated, it is assumed that different workers will be employed for each project. The activities for this receptor typically involve substantial exposures to surface and subsurface soils (i.e., at depths of zero to 10 feet below ground surface) during excavation, maintenance and building construction projects (intrusive operations). A construction worker is assumed to be exposed to contaminants via the following pathways: incidental soil ingestion, dermal contact with soil, and inhalation of contaminated outdoor air (volatile and particulate emissions). While a construction worker receptor is assumed to have a higher soil ingestion rate than a commercial/industrial worker due to the type of activities performed during construction projects, the exposure frequency and duration are assumed to be significantly shorter due to the short-term nature of construction projects. However, chronic toxicity information was used when developing screening levels for a construction worker receptor. This approach is significantly more conservative than using sub-chronic toxicity data because it combines the higher soil exposures for construction workers with chronic toxicity criteria. Equations 8 and 9 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters (US EPA 2001) are provided and were used in calculating the NMED SSLs.

Equation 8
Combined Exposures to Carcinogenic Contaminants in Soil
Construction Worker Scenarios

$$C = \frac{TR \times BW_a \times AT_c}{EF_{CW} \times ED_{CW}\left[\left(\frac{IRS_{CW} \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{SA_{CW} \times AF_{CW} \times ABS \times CSF_o}{10^6\,mg/kg}\right) + \left(\frac{IRA_{CW} \times CSF_i}{VF_s \text{ or } PEF_{cw}}\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target risk	1E-05
BW_a	Body weight, adult (kg)	70
AT_c	Averaging time, carcinogens (days)	25,550
EF_{CW}	Exposure frequency, construction worker (day/yr)	250
ED_{CW}	Exposure duration, construction worker (years)	1
IRS_{CW}	Soil ingestion rate, construction worker (mg/day)	330
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SA_{CW}	Dermal surface area, construction worker (cm^2/day)	3,300
AF_{CW}	Soil adherence factor, construction worker (mg/cm^2)	0.3
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CW}	Inhalation rate, construction worker (m^3/day)	20
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF_{cw}	Particulate emission factor for a construction worker (m^3/kg)	See Equation 15

Equation 9
Combined Exposures to Noncarcinogenic Contaminants in Soil
Construction Worker Scenario

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CW} \times ED_{CW}\left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CW}}{10^6\,mg/kg}\right) + \left(\frac{1}{RfD_o} \times \frac{SA_{CW} \times AF_{CW} \times ABS}{10^6\,mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CW}}{VF_s \text{ or } PEF_{CW}}\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
BW_a	Body weight, adult (kg)	70
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_{CW}	Exposure frequency, construction (day/yr)	250
ED_{CW}	Exposure duration, construction (years)	1
IRS_{CW}	Soil ingestion rate, construction (mg/day)	330
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_{CW}	Dermal surface area, construction (cm^2/day)	3,300
AF_{CW}	Soil adherence factor, construction (mg/cm^2)	0.3
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CW}	Inhalation rate, construction (m^3/day)	20
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF_s	Volatilization factor for soil (m^3/kg)	See Equation 12
PEF_{cw}	Particulate emission factor for a construction worker (m^3/kg)	See Equation 15

2.3.3 Alternative Evaluation for Lead

Exposure to lead can result in neurotoxic and developmental effects. The primary receptors of concern are children, whose nervous systems are still undergoing development and who also exhibit behavioral tendencies that increase their likelihood of exposure (e.g., pica). These effects may occur at exposures so low that they may be considered to have no threshold, and are evaluated based on a blood lead level (rather than the external dose as reflected the RfD/RfC methodology). Therefore, US EPA views it to be inappropriate to develop noncarcinogenic "safe" exposure levels (i.e., RfDs) for lead. Instead, US EPA's lead assessment workgroup has recommended the use of the Integrated Exposure Uptake Biokinetic (IEUBK) model that relates measured lead concentrations in environmental media with an estimated blood-lead level (US EPA 1994 and 1998b). The model is used to calculate a blood lead level in children when evaluating residential land use and in adults (based on a pregnant mother's capacity to contribute to fetal blood lead levels), or when evaluating occupational scenarios at sites where access by children is reliably restricted. The NMED SSLs presented in Appendix A include values for lead that were calculated by using the IEUBK to backcalculate a soil concentration for each receptor that would not result in an estimated blood-lead concentration of 10 micrograms per deciliter (μg/dL) or greater (residential adult of 400 mg/kg and industrial and construction worker of 800 mg/kg)

2.4 Tap Water Screening Levels

Exposure to contaminants can occur through the ingestion of domestic/household water. The calculations of the NMED tap water screening levels for domestic water are based upon the methodology presented in RAGS, part B (USEPA 1991). The screening levels are based upon ingestion and inhalation of contaminants in water. While ingestion is appropriate for all chemicals, inhalation of volatiles from water was considered for those chemicals with a minimum Henry's Law constant of 1E-05 atm-m^3/mole and with a maximum molecular weight of 200 g/mole. To address the groundwater-to-air pathways, the tap water screening levels incorporate a volatilization factor (VF_w) of 0.5 L/m^3 for volatile contaminants (USEPA, 1991); this derived value defines the relationship between the concentration of a contaminant in household water and the average concentration of the volatilized contaminant in air as a result of all uses of household water (i.e., showering, laundering, dish washing).

As ingestion and inhalation rates may be different for children and adults, carcinogenic risks during the first 30 years were calculated using age-adjusted factors (IFW_{adj} and $InhF_{adj}$)), which were obtained from RAGS, part B (USEPA 1991).

Equation 10
Ingestion and Inhalation Exposures to Carcinogenic Contaminants in Tap Water
Residential Scenario

$$C = \frac{TR \times AT_c \times 1000ug/mg}{EF_r\left[\left(IFW_{adj} \times CSF_o\right) + \left(VF_w \times InhF_{adj} \times CSF_i\right)\right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (ug/L)	Chemical-specific
TR	Target risk	1E-05
AT_c	Averaging time, carcinogens (days)	25,550
EF_r	Exposure frequency, resident (day/yr)	350
IFW_{adj}	Age-adjusted water ingestion rate, resident (L-yr/kg-day)	1.1
SF_o	Oral cancer slope factor (mg/kg-day)$^{-1}$	Chemical-specific
VF_w	Volatilization factor for water (m^3/kg)	0.5
$InhF_{adj}$	Age-adjusted inhalation factor, resident (m^3-yr/kg-day)	11
SF_i	Inhalation cancer slope factor (mg/kg-day)$^{-1}$	Chemical-specific

Equation 11
Ingestion and Inhalation Exposures to Noncarcinogenic Contaminants in Tap Water
Residential Scenario

$$C = \frac{THQ \times BW_a \times AT_n \times 1000\, ug/mg}{EF_r \times ED_r \left[\left(\frac{IRW_a}{RfD_o} \right) + \left(\frac{VF_w \times IRA_a}{RfD_i} \right) \right]}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (ug/L)	Chemical-specific
THQ	Target hazard quotient	1
BW_a	Body weight, adult (kg)	70
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_r	Exposure frequency, resident (day/yr)	350
ED_r	Exposure duration, resident (years)	30
IRW_a	Water ingestion rate, resident (L/day)	2
RfD_o	Oral reference dose(mg/kg-day)	Chemical-specific
VF_w	Volatilization factor for water (m^3/kg)	0.5
IRA_a	Inhalation rate, resident (m^3/day)	20
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific

2.5 SITE ASSESSMENT AND CHARACTERIZATION

The Site Assessment/Site Characterization phase is intended to provide additional spatial and contextual information about the site, which may be used to determine if there is any reason to believe that receptors and/or complete exposure pathways may exist at or in the locality of the site where a release of hazardous waste/constituents has occurred. In addition, the site assessment phase serves as the initial information gathering phase to determine whether potential exposures are sufficiently similar to those upon which the NMED SSLs are predicated to support comparison. Finally, this phase can help to identify for sites in need of a more detailed assessment of potential risk. The approach outlined herein is discussed in greater detail in the NMED Hazardous and Radioactive Material Bureau (HRMB) guidance document *Assessing Human Health Risks Posed by Chemicals: Screening-level Risk Assessment* (NMED 2000). A CSM providing a list of the potentially exposed receptors and potentially complete exposure pathways in the scoping report is used to determine whether further assessment (i.e., a screening level assessment) and/or interim measures are required or whether the site poses minimal threat to human and ecological receptors at or near the site.

The ultimate purpose of the site assessment phase is to address the question: Are exposure pathways complete with regard to contaminant contact by receptors? A complete site assessment will consists of several steps:

- Develop data quality objectives and conduct site sampling;
- Identify preliminary COPCs;
- Develop a preliminary site conceptual exposure model (SCEM); and
- Compare maximum (or, if deemed appropriate by NMED, the 95% upper confidence limit (UCL) value) for contaminant concentrations (or

detection/quantitation limits for non-detect results) for consideration of complete exposure pathways with SSLs.

2.5.1 Development of Data Quality Objectives

Before any additional environmental samples are collected, data quality objectives (DQOs) should be developed. The DQOs should address the qualitative and quantitative nature of the sampling data, in terms of relative quality and intent for use, to ensure that any data collected will be appropriate for the intended objective. Development of the DQOs should consider not only precision, accuracy, representativeness, completeness, and comparability of the data, but also the sampling locations, types of laboratory analyses used, sensitivity of detection limits of the analytical techniques, the resulting data quality, and the employment of adequate quality assurance/quality control measures.

2.5.2 Identification of COPCs

COPCs are those substances (including transformation or breakdown compounds and companion products) likely to be present in environmental media affected by a release. Identification of COPCs should begin with existing knowledge of the process, product, or waste from which the release originated. For example, if facility operations deal primarily with pesticide manufacturing then pesticides should be considered COPCs. Contaminants identified during current or previous site investigation activities should also be evaluated as COPCs. A site-specific COPC list for soil may be generated based on maximum detected (or, if deemed appropriate by NMED, the 95% UCL value) concentrations (US EPA 2002b) and a comparison of detection/quantitation limits for non-detect results to the NMED SSLs. This list may be refined through a site-specific risk assessment.

2.5.3 Development of a Preliminary Conceptual Site Model

A CSM is a graphical representation of three-dimensional site conditions that conveys what is known or suspected, at a discrete point in time, about the site-specific sources, releases, release mechanisms, contaminant fate and transport, exposure routes, and potential receptors. The CSM is generally documented by written descriptions and supported by maps, geological cross-sections, tables, diagrams and other illustrations to communicate site conditions. When preparing a CSM, the facility should decide the scope, quantity, and relevance of information to be included, balancing the need to present as complete a picture as possible to document current site conditions and justify risk management actions, with the need to keep the information focused and exclude extraneous data.

As a final check, the CSM should answer the following questions:

- Are there potential land uses present (now or in the foreseeable future) other than those covered by the SSLs (refer to US EPA 1989).
- Are there other likely human exposure pathways that were not considered in development of the SSLs (e.g. direct exposure to groundwater, local fish consumption, raising beef, dairy, or other livestock)? (refer to US EPA 1989)
- Are there potential ecological concerns? (*Guidance for Assessing Ecological Risks Posed by Chemicals: Screening Level Ecological Risk Assessment*; NMED 2000)

If any conditions such as these exist, the SSLs may need to be adjusted to reflect this new information.

2.5.4 Compare COPC Maximum Concentrations With SSLs

The final step in the site assessment phase is to compare maximum detected COPC concentrations in soil (or, if deemed appropriate by NMED, the 95% UCL value on the mean of the dataset (US EPA 2002b)) with SSLs based on the complete exposure pathways identified by the preliminary CSM. These concentrations should also be compared against the SSL leaching values to determine which contaminants present in soil have the capacity to leach to underlying groundwater and impact these resources adversely. As stated earlier, those contaminants exhibiting concentrations in excess of the SSLs represent the initial soil COPC list for a given site. Refinement of this list may be necessary based on a host of factors, including elevated detection or quantitation limits.

3. Chemical-Specific and Physical-Chemical Parameters

Chemical-specific parameters required for calculating SSLs include the organic carbon normalized soil-water partition coefficient for organic compounds (K_{oc}), the soil-water partition coefficient (K_d), water solubility (S), octanol-water partition coefficient (K_{ow}), Henry's Law constant (H), diffusivity in air (D_a), and diffusivity in water (D_w). The following sections describe these values and present methodologies for calculating additional values necessary for calculating the NMED SSLs.

3.1 Volatilization Factor for Soil

Volatile chemicals, defined as those chemicals having a Henry's Law constant greater than 1E-05 atm-m^3/mole-°K and a molecular weight less than 200 g/mole, were screened for inhalation exposures using a volatilization factor (VF_s) for soils. The soil-to-air VF_s is used to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to ambient air. The emission terms used in the VF_s are chemical-specific and were calculated from physical-chemical information obtained from several sources including: US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA, 1996a and 2001a), USEPA Master Physical and Chemical Parameter table for development of PRGS (USEPA 2004), the US EPA Regions 6 and 9 *Preliminary Remediation Goals* (US EPA 2004), EPA's *Basics of Pump and Treat Groundwater Remediation Technology* (US EPA 1990), US EPA's *Dermal Exposure Assessment* (US EPA 1992a), *Superfund Public Health Evaluation Manual* (US EPA 1986), EPA's *Additional Environmental Fate Constants* (US EPA 1995), Hazardous Substance Release/Health Effects Database (ATSDR 2003), the RAIS database (DOE 2005), and the CHEMFACTS database (US EPA 2000c). The VF_s is calculated using Equation 12.

Equation 12
Derivation of the Volatilization Factor for Residential and Commercial/Industrial Scenarios

$$VF_s = \frac{Q/C_{vol} \times (3.14 \times D_A \times T)^{0.5} \times 10^{-4}}{(2 \times \rho_b \times D_A)}$$

Where:

$$D_A = \frac{\left[\frac{\left(\theta_a^{10/3} D_a H' + \theta_w^{10/3} D_w\right)}{n^2}\right]}{\rho_b K_d + \theta_w + \theta_a H'}$$

Parameter	Definition (units)	Default
VF_s	Volatilization factor for soil (m^3/kg)	Chemical-specific
D_A	Apparent diffusivity (cm^2/s)	Chemical-specific
Q/C_{vol}	Inverse of the mean concentration at the center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	68.18
T	Exposure interval (s)	9.5E+08
ρ_b	Dry soil bulk density (g/cm^3)	1.5
n	Total soil porosity 1 - (ρ_b/ρ_s)	0.43
θ_a	Air-filled soil porosity (n - θ_w)	0.17
θ_w	Water-filled soil porosity	0.26
ρ_s	Soil particle density (g/cm^3)	2.65
D_a	Diffusivity in air (cm^2/s)	Chemical-specific
H'	Dimensionless Henry's Law constant	Chemical-specific
D_w	Diffusivity in water (cm^2/s)	Chemical-specific
K_d	Soil-water partition coefficient (cm^3/g) = K_{oc} x f_{oc} (organics)	Chemical-specific
K_{oc}	Soil organic carbon partition coefficient (cm^3/g)	Chemical-specific
f_{oc}	Fraction organic carbon in soil (g/g)	0.0015

While most of the parameters used to calculate apparent diffusivity (D_A) are either chemical-specific or default values, several state-specific values were used which are more representative of soil conditions found in New Mexico. The default values for θ_w, θ_a, and ρ_b in Equation 12 are 0.26, 0.17 and 1.5 g/cm^3, respectively. These values represent the mean value from a National Resources Conservation Service (NRCS) soil survey database for New Mexico that includes over 1200 sample points (U.S. Department of Agriculture 2000). USEPA guidance (2001a) provides additional methodologies for estimating site-specific air-filled soil porosities and water-filled soil porosities.

It should be noted that the basic principle of the VF model (Henry's Law) is applicable only if the soil contaminant concentration is at or below soil saturation, C_{sat}. Above the soil saturation limit, the model cannot predict an accurate VF-based SSL.

3.2 Soil Saturation Limit

C_{sat} describes a chemical-physical soil condition that integrates certain chemical-specific properties with physical attributes of the soil to estimate the contaminant concentration at which the soil pore water, pore air, and surface sorption sites are saturated with contaminants. Above this concentration, the contaminants may be present in free phase within the soil matrix – as non-aqueous phase liquids (NAPLs) for substances that are liquid at ambient soil temperatures, and pure solid phases for compounds that are solids at ambient soil temperatures (EPA 1996a). Generic C_{sat} concentrations should not be interpreted as confirmation of a saturated soil condition, but as estimates of when this condition may occur. It should be noted that C_{sat} concentrations are not risk-based values. Instead, they correspond to a theoretical threshold above which free phase contaminant may exist. C_{sat} concentrations, therefore, serve to identify an upper limit to the applicability of generic risk-based soil criteria, because certain default assumptions and models used in the generic algorithms are not applicable when free phase contaminant is present in soil. It should be noted that a basic principle of the volatilization model is not applicable when free-phase contaminants are present. How these cases are handled depends on whether the contaminant is liquid or solid at ambient temperatures. Liquid contaminants that have volatilization factor (VF_s)-based screening levels that exceed the "sat" concentration are set equal to "sat" whereas for solids (e.g., PAHs), soil screening decisions are based on appropriate other pathways of concern at the site (e.g., ingestion and dermal contact). Equation 13, given below is used to calculate C_{sat} for each volatile contaminant considered within the SSLs.

Equation 13
Derivation of the Soil Saturation Limit

$$C_{sat} = \frac{S}{\rho_b}\left(K_d\rho_b + \theta_w + H'\theta_a\right)$$

Parameter	Definition (units)	Default
C_{sat}	Soil saturation concentration (mg/kg)	Chemical-specific
S	Solubility in water (mg/L-water)	Chemical-specific
ρ_b	Dry soil bulk density (kg/L)	1.5
K_d	Soil-water partition coefficient (L/kg; $K_{oc} \times f_{oc}$)	Chemical-specific
K_{oc}	Soil organic carbon/water partition coefficient (L/kg)	Chemical-specific
f_{oc}	Fraction organic carbon in soil (g/g)	0.0015
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.26
H′	Dimensionless Henry's Law constant	Chemical-specific

θ_a	Air-filled soil porosity (n- θ_w),(L_{air}/L_{soil})	0.17
n	Total soil porosity (1 – (ρ_b/ρ_s)), (L_{pore}/L_{soil})	0.43
ρ_s	Soil particle density (kg/L)	2.65

Chemical-specific parameters used in Equation 11 were obtained from physical-chemical information obtained from several sources including: US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA 1996a), the US EPA Regions 6 and 9 *Preliminary Remediation Goals* (US EPA 2004), US EPA's *Basics of Pump and Treat Groundwater remediation Technology* (US EPA 1990), US EPA's *Dermal Exposure Assessment* (US EPA 1992a), *Superfund Public Health Evaluation Manual* (US EPA 1986), US EPA's *Additional Environmental Fate Constants* (US EPA 1995), Hazardous Substance Release/Health Effects Database (ATSDR 2003), the RAIS database, and the CHEMFACTS database.

3.3 PARTICULATE EMISSION FACTOR

Inhalation of chemicals adsorbed to suspended respirable particles is assessed using a chemical-specific PEF, which relates the contaminant concentration in soil to the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. This guidance addresses dust generated from open sources, which is termed "fugitive" because it is not discharged into the atmosphere in a confined flow stream. For further details on the methodology associated with the PEF model, the reader is referred to US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA 1996a), *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (US EPA 2001a) and *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (US EPA 1998a).

It is important to note that the PEF for use in evaluating exposures of the residential and commercial/industrial receptors addresses only windborne dust emissions and does not consider emissions from traffic or other forms of mechanical disturbance, which could lead to a greater level of exposure. The PEF for use in evaluating the construction worker exposures considers windborne dust emissions and emissions from vehicle traffic associated with construction activities. Therefore, the fugitive dust pathway should be considered carefully when developing the CSM at sites where receptors may be exposed to fugitive dusts by other mechanisms. Equation 14 is used to calculate a New-Mexico region-specific PEF value, used for both the residential and commercial/industrial exposure scenarios. A scenario-specific PEF value was calculated for a construction worker receptor (PEF_{cw}) using Equation 15.

Equation 14
Derivation of the Particulate Emission Factor
Residential and Commercial/Industrial Scenarios

$$PEF = Q/C_{wind} \times \frac{3{,}600\ \text{sec/hr}}{0.036 \times (1 - V) \times \left(\frac{U_m}{U_t}\right)^3 \times F(x)}$$

Parameter	Definition (units)	Default
PEF	Particulate emission factor (m^3/kg)	6.61E+09
Q/C_{wind}	Inverse of a mean concentration at center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	81.85
V	Fraction of vegetative cover (unitless)	0.5
U_m	Mean annual windspeed (m/s)	4.02
U_t	Equivalent threshold value of windspeed at 7 m (m/s)	11.32
F(x)	Function dependent on U_m/U_t derived using Cowherd et al. (1985) (unitless)	0.0553

Equation 15
Derivation of the Particulate Emission Factor
Construction Worker Scenario

$$PEF_{CW} = Q/C_{CW} \times \frac{1}{F_D}\left[\frac{T \times A_R}{556 \times \left(\frac{W}{3}\right)^{0.4} \times \frac{(365\ \text{days/yr} - P)}{365\ \text{days/yr}} \times \sum VKT}\right]$$

Parameter	Definition (units)	Default
PEF_{CW}	Particulate emission factor for a construction worker (m^3/kg)	2.1E+06
Q/C_{CW}	Inverse of a mean concentration at center of a 0.5-acre-square source (g/m^2-s per kg/m^3)	23.02
F_D	Dispersion correction factor (unitless)	0.185
T	Total time over which construction occurs (s)	7.2E+06
A_R	Surface area of road segment (m^2)	274.2
W	Mean vehicle weight (tons)	8
P	Number of days with at least 0.01 inches of precipitation (days/yr)	60
ΣVKT	sum of fleet vehicle kilometers traveled during the exposure duration (km)	168.75

3.4 Physical-Chemical Parameters

Several chemical-specific parameters are required for calculating SSLs including the organic carbon normalized soil-organic carbon/water partition coefficients for organic compounds (K_{oc}), the soil-water partition coefficient for organic and inorganic constituents (K_d), the solubility of a compound in water (S), Henry's Law constant (H), air diffusivity (D_a), water diffusivity (D_w), and the octanol-water partition coefficient (K_{ow}). Prior to calculating site-specific SSLs, each relevant chemical specific parameter value presented in Appendix B should be checked against the most recent version of its source to determine if updated data are available. Table B-1 in Appendix B provides the chemical-specific parameters used in calculating the NMED SSLs.

Chemical-specific values were obtained from EPA's *Soil Screening Guidance: Technical Background Document* (US EPA 1996a), the EPA Region 6 *Media-Specific Screening Levels* (US EPA, 2005) and EPA Region 9 *Preliminary Remediation Goals* (US EPA 2004b), US EPA's *Basics of Pump and Treat Groundwater remediation Technology* (US EPA 1990), US EPA's *Dermal Exposure Assessment* (US EPA 1992a), *Superfund Public Health Evaluation Manual* (US EPA 1986), US EPA's *Additional Environmental Fate Constants* (US EPA 1995), Hazardous Substance Release/Health Effects Database (ATSDR 2003), the RAIS database, and the CHEMFACTS database.

3.4.1 Solubility, Henry's Law Constant, and K_{ow}

The solubility of a contaminant refers to the maximum amount that can be dissolved in a fixed volume of solvent, usually pure water, at a specific temperature and pH. A chemical with a high solubility readily dissolves in water, while a low solubility indicates an inability to dissolve. Water solubility is generally predicted based on correlations with the octanol-water partition coefficient (K_{ow}). Solubility is used to calculate soil saturation limits for the NMED SSLs.

The octanol-water partition coefficient (K_{ow}) of a chemical is the ratio of a chemical's solubility in octanol versus its solubility in water at equilibrium. Essentially, this chemical-specific property is used as an indication of a contaminant's propensity to migrate from soil to water. It is an important parameter and is used in the assessment of environmental fate and transport for organic chemicals.

The Henry's Law constant (H) is used when evaluating air exposure pathways. For all chemicals that are capable of exchanging across the air-water interface, there is a point at which the rate of volatilization into the air and dissolution to the water or soil will be equal. The ratio of gas- and liquid-phase concentrations of the chemical at this equilibrium point is represented by H, which is used to determine the rate at which a contaminant will volatilize from soil to air. Values for H may be calculated using the following equation and the values for solubility (S), vapor pressure (VP), and molecular weight (MW).

$$H = \frac{VP \times MW}{S}$$

The dimensionless form of Henry's Law constant (H′) used in calculating soil saturation limits and volatilization factors for the NMED SSLs was calculated by multiplying H by a factor of 41 to convert the Henry's Law constant to a unitless value.

3.4.2 Soil Organic Carbon/Water Partition Coefficients (K_{oc})

The soil organic carbon-water partition coefficient (K_{oc}) is a measure of a chemical's tendency to adsorb to organic carbon present in soil. High K_{oc} values indicate a tendency for the chemical to adsorb to soil particles rather than remain dissolved in the soil solution. Strongly adsorbed molecules will not unless the soil particle to which they are adsorbed moves (as in erosion). K_{oc} values of less than 500 indicate weak adsorption and a potential for leaching. K_{oc} is calculated using the following equation:

$$K_{oc} = \frac{\text{conc. adsorbed/conc. dissolved}}{\text{\% organic carbon in soil}}$$

K_{oc} can also be calculated by dividing the K_d value by the fraction of organic carbon (f_{oc}) present in the soil or sediment. It should be noted that a strong linear relationship exists between K_{oc} and K_{ow} and that this relationship can be used to predict K_{oc}.

3.4.3 Soil/Water Partition Coefficients (K_d)

Soil-water partition coefficient (K_d) for organic chemicals is the ratio of a contaminant's distribution between soil and water particles. The soil-water partitioning behavior of nonionizing and ionizing organic compounds differs because the partitioning of ionizing organics can be influenced by soil pH. K_d values were used in calculating soil saturation limits and volatilization factors used in developing the NMED SSLs.

For organic compounds, K_d represents the tendency of a chemical to adsorb to the organic carbon fraction in soils, and is represented by:

$$K_d = K_{oc} \text{ x } f_{oc}$$

where

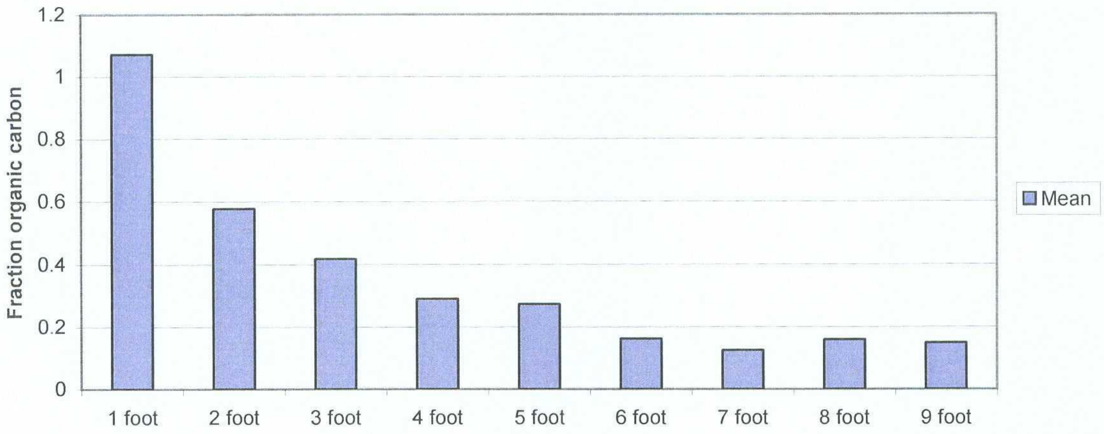
K_{oc} = organic carbon partition coefficient (L/kg or cm^3/g); and
f_{oc} = fraction of organic carbon in soil (mg/mg).

This relationship is generally valid for volatile halogenated hydrocarbons as long as the fraction of organic carbon in soil is above approximately 0.001 (0.1 percent) (Piwoni and Banaerjee, 1989 Schwarzenbach and Westall 1981). For low organic carbon soils ($f_{oc} < 0.001$), Piwoni and Banerjee (1989) developed the following empirical correlation for organic chemicals:

$$\log K_d = 1.01 \log K_{ow} - 0.36$$

The use of a fixed K_{oc} value in the soil-water partition equation for the migration to groundwater pathway is only valid for hydrophobic non-ionizing organic chemicals. For organic chemicals that ionize in the soil environment, existing in both neutral and ionized forms within the normal soil pH range, K_{oc} values must consider the relative proportions and differences in sorptive properties of these forms. For the equations and applications of developing K_{oc} values for ionizing organic acids as a function of pH, the reader is referred to US EPA 1996. The default value used for f_{oc} in development of NMED SSLs is 0.0015 (0.15%). This value represents the median value of 212 data points included in the NRCS soil survey database for New Mexico (U.S. Department of Agriculture 2000). Only samples collected from a depth of greater than 5 feet were included in the calculation of the mean f_{oc} value. Shallow soil samples tend to have higher f_{oc} values as shown in Figure 2-1. There is a steady decline in f_{oc} value with depth until approximately 5 feet bgs. Below 5 feet, there is little variability in the f_{oc} value. Because a lower f_{oc} value provides a more conservative calculation of SSL, a value representative of deeper soil conditions is used as the default value.

Figure 2-1 Mean Value - Fraction Organic Carbon (f_{oc})- All counties in New Mexico



As with organic chemicals, development of the NMED SSLs for inorganic constituents (i.e., metals) requires a soil-water partition coefficient (K_d) for each contaminant. K_d values for metals are affected by a variety of soil conditions, most notably pH, oxidation-reduction conditions, iron oxide content, soil organic matter content, cation exchange capacity and major ion chemistry. US EPA developed default K_d values for metals using either an equilibrium geochemical speciation model (MINTEQ2) or from empirical pH-dependent adsorption relationships developed by Environmental Protection Agency's Office of Research and Development (EPA/ORD) (US EPA 1996a).

4. Migration of Contaminants to Groundwater

Generic SSLs were developed which address the potential for migration of contaminants from soil to groundwater. The methodology used to calculate generic SSLs addresses the potential leaching of contaminants from the vadose zone to groundwater. This method does not take into account any additional attenuation associated with contaminant transport in groundwater. The SSLs developed from this analysis are based on NMED-specific tap water SLLS or the more conservative of the New Mexico water quality standards, maximum contaminant levels (MCLs), or Region 6 tap water PRGs and are protective of groundwater under a wide range of site conditions. This methodology is modeled after US EPA's *Soil Screening Guidance: Technical Background Document* (US EPA 1996a).

4.1 Overview of the SSL Model Approach

Two approaches to developing soil leachate-based SSLs are presented, the generic model and the site-specific model. Both models use the same set of equations to calculate SSLs and are based on leaching to groundwater scenarios that NMED believes are protective of groundwater. The generic model calculates SSLs using default parameter values generally representative of conditions in New Mexico. These values are presented in Table B-1 of Appendix B. The site-specific model provides the flexibility of using site-specific meteorological, soil and hydrological data to calculate SSLs, while retaining the simplicity and ease of use associated with the generic model.

The development of soil leachate SSLs is based upon a two step process. The first step is the development of a Dilution Attenuation Factor (DAF). The DAF accounts for leachate mixing in the aquifer. A leachate concentration that is protective of ground water is back calculated by multiplying the ground water standard for a given constituent by the DAF. That leachate concentration is then used to back calculate an SSL that is protective of groundwater using a simple linear equilibrium soil/water partition equation. For the generic SSL approach, default parameter values are used for all non-chemical specific parameters. At sites that are not adequately represented by the default values and where more site-specific data are available, it may be more appropriate to use the site-specific SSL model. The site-specific model uses the same spreadsheet equations to calculate SSLs as those in the generic look-up table. However, site-specific data are used in the site-specific model.

The following sections of this document provide a general description of the leaching to groundwater pathway SSL model (generic and site-specific) including the assumptions, equations, and input parameters. Justification for the default parameters used in the generic model is also provided. Additionally, a sensitivity analysis was performed on each of the input parameters to provide guidance on when use of the site-specific model may be warranted. Applicability and limitations of the generic and site-specific models are also presented.

4.2 Model Assumptions

Assumptions regarding the release and distribution of contaminants in the subsurface that are incorporated into the SSL methodology include the following.

- The source is infinite (a constant concentration is maintained for the duration of the exposure period).
- Contamination is uniformly distributed from the surface to the water table.
- Soil/water partitioning is instantaneous and follows a linear equilibrium isotherm.
- There is no attenuation of the contaminant in soil or the aquifer (i.e., irreversible adsorption, chemical transformation or biological degradation).
- The potentially impacted aquifer is unconfined and unconsolidated with homogenous and isotropic hydrologic properties.
- The receptor well (point of exposure) is at the downgradient edge of the source and is screened within the potentially impacted aquifer.
- Non-aqueous phase liquids (NAPLs) are not present.

4.3 Soil Water Partition Equation

US EPA's *Supplemental Soil Screening Guidance: Technical Background Document* (US EPA 2001) developed an equation to estimate contaminant release in soil leachate based on the Freundlich adsorption isotherm. The Freundlich equation was modified to relate the sorbed concentration to the total concentration measured in a soil sample (which includes contaminants associated with solid soil, soil-water and soil-air components) (Feenstra 1991). Equation 16, given below, is used to calculate SSLs corresponding to target soil leachate concentrations (C_w).

Equation 16
Soil Screening Level For Leaching To Groundwater Pathway

$$SSL = C_w \ x \left[K_d + \left(\frac{\theta_w + \theta_a H'}{\rho_b} \right) \right]$$

Parameter	Definition (units)	Default
SSL	Soil Screening Level for migration to groundwater pathway (mg/kg)	Chemical-Specific
C_w	Target soil leachate concentration (mg/L)	Chemical-Specific
K_d	Soil /water partition coefficient (L/kg)	Chemical-Specific
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.26
θ_a	Air-filled soil porosity (L_{air}/L_{soil}), n - θ_w	0.17
n	Total soil porosity (L_{pore}/L_{soil}), 1 - (ρ_b/ρ_s)	0.43
ρ_s	Soil particle density (kg/L)	2.65
ρ_b	Dry soil bulk density (kg/L)	1.5
H´	Dimensionless Henry's Law constant	Chemical-Specific

Target soil leachate concentrations (C_w) are equivalent to the NMED-specific tap water screening levels multiplied by a Dilution Attenuation Factor (DAF).

$$C_w = \text{Tap Water SSL x DAF}$$

The derivation of the DAF is discussed in subsequent sections of this document.

4.4 Dilution Attenuation Factor

Contaminants transported as a leachate through soil to groundwater are affected by physical, chemical and biological processes that can significantly reduce their concentration. These processes include adsorption, biological degradation, chemical transformation and dilution from mixing of the leachate with groundwater. The total reduction in concentration between the source of the contaminant (vadose zone soil) and the point of ground water withdrawal is defined as the ratio of contaminant concentration in soil leachate to the concentration in groundwater at the point of withdrawal. This ratio is termed a dilution/attenuation factor (DAF; US EPA 1996a and 1996b). The higher the DAF value, the greater the degree of dilution and attenuation of contaminants along the migration flowpath. A DAF of 1 implies no reduction in contaminant concentration occurs.

Development of New Mexico SSLs considers only the dilution of contaminant concentration through mixing with groundwater in the aquifer directly beneath the source. This is consistent with the conservative assumptions used in the SSL methodology including an infinite source, soil contamination extending from surface to groundwater and the point of exposure occurring at the downgradient edge of the source. The ratio of contaminant concentration in soil leachate to the concentration in groundwater at the point of withdrawal that considers only dilution processes is calculated from a simple water balance equation (Equation 17), described below.

Equation 17
Dilution/Attenuation Factor (DAF)

$$DAF = 1 + \left(\frac{K \times i \times D}{I \times L}\right)$$

Where:

$$D = \left(0.0112 \times L^2\right)^{0.5} + D_a\left(1 - \exp\left[\frac{-L \times I}{K \times i \times D_a}\right]\right)$$

Parameter	Definition (units)	Default
DAF	Dilution/attenuation factor (unitless)	Site-Specific
K	Aquifer hydraulic conductivity (m/yr)	Site-Specific
i	Hydraulic gradient (m/m)	Site-Specific
D	Mixing zone depth (m)	Site-Specific
I	Infiltration rate (m/yr)	Site-Specific
L	Source length parallel to groundwater flow (m)	Site-Specific
D_a	Aquifer thickness (m)	Site-Specific

Most of these parameters are available from routine environmental site investigations. The mixing zone depth incorporates one additional parameter, the aquifer thickness (D_a).

For the calculation of SSLs, the DAF is used to back calculate the target soil leachate concentration from an appropriate groundwater concentration, such as the WQCC standard (C_w in Equation 16). For example, if the WQCC standard for a constituent is 0.1 mg/L and the DAF is 20, the target soil leachate concentration would be 2 mg/L.

The US EPA conducted an extensive evaluation of the range and distribution of DAFs to select a default value to be used for developing generic SSLs that would be reasonably protective of groundwater quality (US EPA 1996a, 1996b, and 2001). The evaluation included a probabilistic modeling exercise using US EPA's Composite Model for Leachate Migration with Transformation Products (CMTP). A cumulative frequency distribution of DAF values was developed from the model output. Results of the Monte Carlo modeling analysis indicate that for a 0.5 acre source area a DAF of approximately 170 is protective of groundwater at 90 percent of the sites. Groundwater is protected at 95 percent of the sites with a DAF of 7.

US EPA applied the simple SSL water balance dilution model (Equation 17) to 300 sites included in surveys of hydrogeologic investigations to further evaluate the range and distribution of DAF values. Results of this analysis indicated that a DAF of 10 was protective of groundwater for a 30-acre source and that a DAF of 20 was protective of groundwater for a 0.5 acre-source (US EPA 1996a, 1996b, and 2001).

An assessment was performed of US EPA's methodology to determine whether a default DAF value of 20 for a 0.5 acre source, and a DAF of 10 for a 30 acre source, would be appropriate for use as default values for sites in New Mexico. Typical New Mexico conditions may be notably different than conditions represented by areas included in the US EPA analysis of DAFs. For example, infiltration rates across much of New Mexico are substantially less than the average range of 0.15 to 0.24 m/yr reported for many of the hydrogeologic regions used in the US EPA analysis. In addition, effective porosity was assumed to be 0.35, presumably because this value is representative of the most prevalent aquifer type in the databases used (US EPA 1996a). However, the regions included in the EPA analysis also contain extensive glacial, regolith, lacustrine, swamp and marsh deposits which have high percentages of fine-grained sediments and thus are not representative of typical New Mexico sandy soils. Sandy soils typically have higher hydraulic conductivities than more fine-grained soils and subsequently higher Darcian velocities, under equal hydraulic gradient. According to the DAF equation (Equation 17), soils with relatively greater hydraulic conductivities will tend to result in a higher calculated DAF.

An assessment was made of input parameters to the DAF equation. In order to support a DAF that is protective of the most vulnerable groundwater environments in New Mexico (i.e. areas close to perennial streams or where ground water is very shallow), environmental parameters typical of those areas in New Mexico were used to assess the DAF. This assessment indicated that the DAF is most sensitive to variations in hydraulic conductivity. This is because this value shows such large variations in the natural environment. If a hydraulic conductivity value representative of a fine-grained sand is used in the DAF equation, along with an infiltration rate representative of New Mexico's arid to semi-arid environments, then the result is a DAF of approximately 20. NMED believes that a DAF of 20 for a 0.5 acre source area is protective of groundwater in New Mexico. If the default DAF is not representative of conditions at a specific site, then it is appropriate to calculate a site-specific DAF based upon available site data.

4.5 LIMITATIONS ON THE USE OF THE DILUTION ATTENUATION FACTOR

Because of assumptions used in SSL model approach, use of the DAF model may be inappropriate for certain conditions, including sites where:

- adsorption or degradation processes are expected to significantly attenuate contaminant concentrations in the soil or aquifer media;
- Saturated thickness is significantly less than 12 meters thick;
- fractured rock or karst aquifer types exist (violates the unconfined, unconsolidated, homogeneous, isotropic assumptions);
- facilitated transport is significant (colloidal transport, transport via dissolved organic matter, or transport via solvents other than water; and/or
- NAPLs are present.

For sites that have these types of conditions, consideration should be given to application of a more detailed site-specific analysis than either the generic or site-specific models described herein.

4.6 Generic SSLs for Protection of Groundwater

The migration to groundwater pathway model, incorporating the assumptions, soil-water partition equation and the DAF, was used to develop NMED SSLs. Default values based on conditions predominant in New Mexico were used for the input parameters in the soil-water partition equation. The NMED SSLs were developed using default DAF values of 1 and 20.

Target soil leachate concentrations (C_w) are equivalent to the appropriate groundwater standards multiplied by a DAF. To maintain an approach that is protective of groundwater quality in the development of generic SSLs, a DAF of 20 is selected as reasonably protective. However SSLs are provided for two DAFs in Appendix A. The use of the SSL listed for a DAF of 20 is advised unless site-specific data on hydrologic conditions are available, and these indicate that the generic DAF is not representative of site conditions. As will be demonstrated in the sensitivity analysis section of this document, calculation of an SSL using the migration to groundwater pathway model is most sensitive to the DAF. The inclusion of the SSL for a DAF of 1 is provided for convenience to the user. If data on hydrologic conditions are readily available, a site specific DAF can be calculated and multiplied by the generic SSL for a DAF of 1 to provide a site-specific SSL.

The generic approach may be inappropriate for use at sites where conditions are substantially different from the default values used to develop the generic soil leachate SSLs.

4.7 Development of Site Specific SSLs for Protection of Groundwater

New Mexico, as with any other state, offers a variety of geologic and hydrologic conditions that may not be readily represented by a single default parameter value.

Site specific conditions may differ considerably from the typical or average conditions represented by the default values used to calculate generic SSLs. The site-specific model can be used to address the variability inherent in environmental conditions across and within the state.

Application of the site-specific model to develop soil leachate SSLs is the same as the generic approach except that site-specific values are used. Use of the site-specific model approach may incorporate replacement of all default values used for the generic SSLs with site-specific values, or may only include substitution of a single key parameter, such as hydraulic conductivity. The decision to use the site-specific model approach instead of the generic approach should be based on consideration of the sensitivity of the calculated SSL to specific parameters and the availability of those parameters as site-specific data. Sufficient site-specific data may be available such that each of the default values used for developing generic SSLs can be readily substituted with a more representative site-derived value. Conversely, limited site-specific data may restrict the number of default values to be replaced.

The NMED SSLs are generally more sensitive to the dilution factor than to other parameters in the soil-water partition equation. Fortunately, information needed to derive the DAF is usually available for sites that have undergone even the most basic levels of environmental investigation. Apart from the dilution factor, SSLs are most sensitive to the soil-water partition coefficient (K_d) as the values for this parameter can range over several orders of magnitude, particularly for metals. Although the K_d term may be critical in developing protective SSLs, information required to evaluate this parameter is more difficult to obtain and less likely to be available. Porosity and bulk density are not particularly sensitive because of the relatively small range of values encountered in subsurface conditions.

Using benzene as a representative contaminant, a sensitivity analysis was performed to compare a generic soil leachate SSL to site-specific model results simulating a range of model input parameters that might be representative of different conditions in New Mexico. The generic soil leachate SSL calculated using the New Mexico default values and a DAF of 1 is 2.8 μg/kg. These results are summarized in Table 4-1. As shown, the resulting SSLs for benzene range from 1.3 to 6.1 μg/kg for the various sensitivity simulations compared to the generic SSL of 2.8 μg/kg. These results indicate that the calculation of SSLs using the site-specific approach is not overly sensitive to the reasonable range of porosity (air and water filled), bulk density and fraction of organic carbon expected for New Mexico or even for a range of values for chemical-specific properties. The generic SSL for benzene of 2.8 μg/kg is representative of values that could be calculated using a spectrum of input parameters, exclusive of the DAF term. Unless there are sufficient data to calculate a site-specific DAF, there is little benefit derived from using the site-specific model approach instead of the generic SSL.

Table 4-1

Input Parameters and Resulting SSLs for the Sensitivity Analysis of the Soil-Water Partition Equation - Migration to Groundwater Pathway Model

Input parameter (NMED default value)	Sensitivity Analysis Values	Resulting SSLs
Bulk density (default value = 1.55 gm/cm)	Lower Limit = 1.20 Upper Limit = 1.90	3.4 2.5
Air filled porosity (default value = 0.18)	Lower Limit = 0.04[a] Upper Limit = 0.25[b]	1.3 3.5
Fraction organic carbon (default value = 0.0015)	Lower Limit = 0.0005 Upper Limit = 0.007	2.2 6.1
Volume water content (default value = 0.26)	Lower Limit = 0.05[c] Upper Limit = 0.40[c]	1.8 3.5
K_{oc} (default value = 58.9 ml/g)	Lower Limit = 30 Upper Limit = 120	2.4 3.7
Dimensionless Henry's Law constant (default value = 0.228)	Lower Limit = 0.1 Upper Limit = 0.4	2.7 3.0

[a] total porosity was reduced from 0.44 to 0.10 for this simulation
[b] total porosity was increased from 0.44 to 0.6 for this simulation
[c] total porosity remained at 0.44 for this simulation.

As previously stated, calculation of SSLs is most sensitive to the DAF term. The input parameter values and resulting DAFs for the sensitivity analysis are included in Table 4-2. Effects on the DAFs are, from greatest to least, the Darcian velocity (hydraulic conductivity multiplied by the hydraulic gradient), infiltration rates, size of the contaminated area, and the aquifer thickness. Corresponding effects on DAFs for each of these parameters and discussion of the relevance of the use of default values versus site-specific conditions are summarized below:

Table 4-2

Input Parameters and Resulting DAFs for the Sensitivity Analysis of the Dilution Attenuation Factor-Migration to Groundwater Pathway Model

Parameter	Groundwater Velocity (m/yr)	Infiltration Rate (m/yr)	Source Length (m)	Aquifer thickness (m)	Mixing Zone Depth (m)	Dilution Attenuation Factor (DAF)
Groundwater velocity	2.2	0.13	45	12	7.15	3.7
Groundwater velocity	22	0.13	45	12	5.03	19.9
Groundwater velocity	220	0.13	45	12	4.79	181.1
Infiltration Rate	22	0.065	45	12	4.89	37.8
Infiltration Rate	22	0.13	45	12	5.03	19.9
Infiltration Rate	22	0.26	45	12	5.28	10.9
Source Length	22	0.13	22.5	12	2.51	19.9
Source Length	22	0.13	45	12	5.03	19.9
Source Length	22	0.13	348.4	12	38.76*	6.8
Aquifer Thickness	22	0.13	45	3	5.02*	12.3
Aquifer Thickness	22	0.13	45	12	5.03	19.9
Aquifer Thickness	22	0.13	45	48	5.03	19.9

Note: If mixing zone depth calculation is greater than aquifer thickness, then aquifer thickness is used to calculate the DAF.

Higher Darcian velocity results in higher DAFs. Slower mixing of groundwater with soil leachate occurs at lower groundwater velocity. Thus, using a lower velocity will be a more conservative approach. Sandy soils typically have higher hydraulic conductivities than more fine-grained soils and subsequently higher Darcian velocity (under equal hydraulic gradient). Use of a sandy soil type will generally be less conservative (result in higher DAFs) with respect to protection of groundwater quality.

Lower infiltration rates result in higher DAFs. Therefore, using a higher infiltration rate is a more conservative approach (results in a lower DAF).

Larger source sizes result in lower DAFs. The default DAF used to develop SSLs for a 0.5 acre source may not be protective of groundwater at sites larger than 0.5 acre. However, the selection of a second source size is arbitrary. If generic SSLs are developed for a 30 acre source, then those values are considered overly conservative for a 12 acre source. Conversely, SSLs developed for a 30 acre source will be less protective of a 40 acre source. Rather than develop a separate set of generic SSLs for a second (or third or fourth) source size, the following two approaches are proposed.

- As the size of the source area increases, the assumptions underlying the generic model are less applicable. One of the conservative assumptions in the generic SSL approach is the uniform distribution of contaminants throughout the vadose zone. There are few sites that have relatively uniform soil contamination (both laterally and vertically) of a single constituent in an area of greater than 0.5 acres (22,000 ft^2). Soil contamination at large facilities (such as federal facilities) are usually concentrated in discrete portions of the site. Contamination at large sites is commonly the result of multiple sources. It is advisable to attempt to subdivide the facility by source and contaminant type and then apply generic SSLs to those smaller source areas.

- If this approach is not practical, calculation of site specific DAFs is recommended. Most of the parameters required for these calculations are available from routine environmental site investigations or can be reasonably estimated from general geologic and hydrologic studies.

Thin aquifers will result in lower DAFs. The nominal aquifer thickness used in the sensitivity analysis was 12 m. Reducing the aquifer thickness to 3 m results in a 40 percent reduction in the DAF. Increasing the aquifer thickness beyond the nominal value has very little impact.

The significant effects of the DAF on the calculation of SSLs, coupled with the common availability of site-specific data used to calculate the DAF, suggest that use of the site specific modeling approach should at least incorporate recalculation of the DAF term. If data are available that indicate soil properties significantly different than the default values (such as high or low f_{oc} for organic contaminants, or highly acidic or basic conditions for metal contaminants) the K_d term should also be evaluated and recalculated.

4.8 Detailed Model Analysis for SSL Development

Sites that have complex or heterogeneous subsurface conditions may require more detailed evaluation for development of SSLs that are reasonably, but not overly, protective of groundwater and surface water resources. These types of sites may require more complex models that can address a wide range of variability in environmental site conditions including soil properties, contaminant mass concentration and distribution, contaminant degradation and transformation, recharge rates and recharge concentration, and depth to the water table. Model codes suitable for these types of more detailed analysis range from simple one-dimensional analytical models to complex three-dimensional numerical models. Resource requirements (data, time and cost) increase for the more complex codes. The selection of an appropriate code needs to balance the required accuracy of the output with the level of effort necessary to develop the model.

4.9 Summary of the Migration to Groundwater Pathway SSLs

SSLs for New Mexico have been developed for the migration to groundwater pathway, and are provided in Table A-1 of Appendix A. The NMED SSLs were developed using default parameter values representative of environmental conditions in New Mexico and utilize a DAF of 20. This approach maintains the conservative approach of the SSL methodology and is protective of groundwater quality under a wide range of site conditions. Soil contaminant concentrations can be compared directly to the generic SSLs to determine if additional investigation is necessary to evaluate potential leaching and migration of contaminants from the vadose zone to groundwater in excess of NMED-specific tapwater SSLs.

Site-specific SSLs can be developed by substituting site-related data for the default values in the leaching to groundwater pathway model. SSLs developed from this model are most sensitive to the DAF. SSLs are also provided in the lookup table for a DAF of 1. If data on hydrologic conditions are readily available, a site specific DAF can be calculated and multiplied by the generic SSL for a DAF of 1 to provide a site specific SSL.

5. Use of the SSLs

For screening sites with multiple contaminants, the following procedure should be followed: take the site-specific concentration (represented by the maximum reported concentration or, if deemed appropriate by NMED, the 95% UCL value for the concentration) and divide by the SSL concentration for each analyte. For multiple contaminants, simply add the ratio for each chemical.

$$\text{Site Risk} = \left(\frac{\text{conc}_x}{\text{SSL}_x} + \frac{\text{conc}_y}{\text{SSL}_y} + \frac{\text{conc}_z}{\text{SSL}_z} + \ldots + \frac{\text{conc}_i}{\text{SSL}_i} \right)$$

If the total ratio is greater than 1, then the concentrations at the site warrant further, site-specific evaluation. A ratio less than 1 indicates that the concentrations at the site are unlikely to result in adverse health impacts, or contaminate groundwater above State of New Mexico water quality standards.

As with any risk-based tool, the potential exists for misapplication. In most cases the root cause will be a lack of understanding of the intended use of NMED SSLs. In order to prevent misuse of SSLs, the following should be avoided:

- Applying SSLs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios,

- Use of SSLs as cleanup levels without verifying numbers with a toxicologist or risk assessor, and

- Not considering the effects of additivity when screening multiple chemicals.

It is important to note that the generic NMED SSLs were developed assuming distinct soil horizons for each receptor. The soils of interest differ according to the exposure pathway being addressed. For direct ingestion, dermal, and fugitive dust exposure pathways, the primary soil horizon of concern are surface soils. For inhalation of volatiles and migration to groundwater, subsurface soils are of primary concern. Both a residential receptor and a commercial/industrial worker are typically exposed only to surface soil, which may be defined as extending to a depth of approximately two feet below ground surface, depending on site-specific conditions and the amount of intrusive activity that may occur. Construction workers will typically have much greater exposures to subsurface soils. Therefore, when generic SSLs are used for screening level evaluations at a facility, site-specific conditions must be evaluated for each receptor to determine if the assumptions associated with the generic SSLs are appropriate for comparison with the available site data.

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APPENDIX A

Appendix A

State of New Mexico Soil Screening Levels

Table A-1 provides State of New Mexico Soil Screening Levels (SSLs), as developed by the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) and the Ground Water Quality Bureau Voluntary Remediation Program for 208 chemicals most commonly associated with environmental releases within the state. These NMED SSLs are derived using default exposure parameter values (as presented in Table A-2) and chemical- and State of New Mexico-specific physical parameters (as presented in Table B-1 of Appendix B). These default values are assumed to be appropriately conservative in the face of uncertainty and are likely to be protective for the majority of site conditions relevant to soil exposures within New Mexico.

However, the NMED SSLs are not necessarily protective of all known human exposure pathways, reasonable land uses or ecological threats. Thus, before applying NMED SSLs at a site, it is extremely important to compare the conceptual site model (CSM) with the assumptions upon which the NMED SSLs are predicated to ensure that the site conditions and exposure pathways match those used to develop the NMED SSLs. If this comparison indicates that the site at issue is more complex than the corresponding SSL scenarios, or that there are significant exposure pathways not accounted for by the NMED SSLs, then the NMED SSLs are insufficient for use in a defensible assessment of the site. A more detailed site-specific approach will be necessary to evaluate the additional pathways or site conditions.

Table A-1

Column 1: The first column in Table A-1 presents the names of the chemicals for which NMED has developed SSLs.

Column 2: The second column presents NMED SSLs predicated on residential soil exposures.

Column 3, 5, 7, and 10: These columns present indicator categories for the NMED SSL residential, industrial, construction, and tap water basis, whether predicated on carcinogenic effects (ca), noncarcinogenic effects (nc), soil saturation limits (sat) or a non-risk based "max" determination. NMED SSLs predicated on a carcinogenic endpoint reflect age-adjusted child-to-adult exposures. NMED SSLs predicated on a noncarcinogenic endpoint reflect child-only exposures. Detected concentrations above the "sat" value may indicate the presence of nonaqueous phase liquid (NAPL). For certain inorganic and semivolatile organic compounds (SVOCs) that exhibit relatively low toxicity, a non risk-based maximum concentration of 10^5 mg/kg is given when the risk-based SSL exceeds that level. These are noted as "max" in the tables.

Columns 4 and 6: The fourth and sixth columns present NMED SSLs analogous to Column 1, with the exception that these values correspond to Industrial/Occupational and Construction worker (adult-only) exposures, respectively.

Columns 5 and 7: The fifth and seventh columns present endpoint bases analogous to Column 3 for the Industrial/Occupational and Construction worker receptor populations, respectively. Unlike the Residential population, noncarcinogenic endpoint notes for these receptor populations are predicated on adult-only exposures.

Column 8: The eighth column notes which chemicals are considered VOCs (for inhalation considerations). Those chemicals not considered VOCs are evaluated within the SSLs relative to inhalation of particulate emissions.

Column 9: Presents the tap water SSL for the residential scenario.

Columns 11 and 12: The ninth column presents NMED SSLs for the migration to groundwater pathway developed using a default dilution attenuation factor (DAF) of 1, which assumes no effective dilution or attenuation. These values can be considered at sites where little or no dilution or attenuation of soil leachate concentrations is expected (e.g., shallow water tables, karst topography). Column 10 presents NMED SSLs for the migration to groundwater pathway developed using a DAF of 20 to account for natural processes that reduce contaminant concentrations in the subsurface.

As noted above, separate NMED SSLs are presented for use in evaluating three discrete potential receptor populations: Residential, Industrial/Occupational, and Construction. Each NMED SSL considers incidental ingestion of soil, inhalation of volatiles (limited to those chemicals noted as volatile organic compounds [VOCs] within Table A-1) or particulate emissions from impacted soil, and dermal contact with soil.

Generally, if a contaminant is detected at a level in soil exceeding the most relevant NMED SSL, and the site-specific CSM is in general agreement with the underlying assumptions upon which the NMED SSLs are predicated, this result indicates the potential for adverse human health effects to occur. Conversely, if no contaminants are detected above the most relevant NMED SSL, this tends to indicate to the user that environmental conditions may not necessitate remedial action of the surface soil or the vadose zone.

A detection above an NMED SSL does not indicate that unacceptable exposures are, in fact, occurring. The NMED SSLs are predicated on relatively conservative exposure assumptions and an exceedance only tends to indicate the potential for adverse effects. The NMED SSLs do not account for additive exposures, whether for carcinogenic or noncarcinogenic endpoints. Section 5 of Part A addresses a methodology by which an environmental manager may determine whether further site-evaluation is warranted, however, this methodology does not replace the need for defensible risk assessment where indicated.

The NMED SSLs address a basic subset of exposures fundamental to the widest array of environmentally-impacted sites within the State of New Mexico. The NMED SSLs cannot address all relevant exposure pathways associated with all sites. The utility of the NMED SSLs depends heavily upon the understanding of site conditions as accurately reflected in the CSM and nature and extent of contamination determinations. Consideration of the NMED SSLs does not preclude the need for site-specific risk assessment in all instances.

Table A-1: NMED Soil Screening Levels

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Acenaphthene	3.73E+03	nc	3.35E+04	nc	1.41E+04	nc	x	3.65E+02	nc	2.75E+00	5.49E+01
Acetaldehyde	1.06E+02	nc	3.84E+02	nc	3.45E+02	nc	x	1.72E+01	ca		
Acetone	2.81E+04	nc	1.00E+05	max	9.85E+04	nc	x	5.48E+03	nc	9.55E-01	1.91E+01
Acrylonitrile	4.27E+00	ca	1.26E+01	ca	5.75E+01	nc	x	3.81E-01	ca	6.68E-05	1.34E-03
Acetophenone	1.48E+03	sat	1.48E+03	sat	1.48E+03	sat	x	6.08E+02	nc	1.48E-01	2.95E+00
Acrolein	2.06E-01	nc	7.52E-01	nc	6.75E-01	nc	x	4.16E-02	nc	8.55E-06	1.71E-04
Aldrin	2.84E-01	ca	1.12E+00	ca	6.99E+00	nc		3.87E-02	ca	1.42E-01	2.84E+00
Aluminum	7.78E+04	nc	1.00E+05	max	1.44E+04	nc		3.65E+04	nc	5.48E+04	1.10E+06
Anthracene	2.20E+04	nc	1.00E+05	max	8.60E+04	nc	x	1.83E+03	nc	8.11E+01	1.62E+03
Antimony	3.13E+01	nc	4.54E+02	nc	1.24E+02	nc		1.46E+01	nc	6.61E-01	1.32E+01
Arsenic	3.90E+00	ca	1.77E+01	ca	8.52E+01	nc		4.42E-01	ca	1.45E-02	2.90E-01
Barium	1.56E+04	nc	1.00E+05	max	6.02E+04	nc		7.30E+03	nc	3.01E+02	6.03E+03
Benzene	1.03E+01	ca	2.58E+01	ca	1.74E+02	nc	x	3.49E+00	ca	1.00E-03	2.01E-02
Benzidine	2.11E-02	ca	8.33E-02	ca	7.09E-01	ca		2.89E-03	ca	1.24E-05	2.47E-04
Benzo(a)anthracene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	5.43E-01	1.09E+01
Benzo(a)pyrene	6.21E-01	ca	2.34E+00	ca	2.12E+01	ca		9.09E-02	ca	1.39E-01	2.78E+00
Benzo(b)fluoranthene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	1.68E+00	3.35E+01
Benzo(k)fluoranthene	6.21E+01	ca	2.34E+02	ca	2.12E+03	ca		9.09E+00	ca	1.68E+01	3.35E+02
Beryllium	1.56E+02	nc	2.25E+03	nc	5.62E+01	nc		7.30E+01	nc	5.77E+01	1.15E+03
a-BHC (HCH)	9.02E-01	ca	3.99E+00	ca	3.00E+01	ca		1.05E-01	ca	2.13E-04	4.25E-03
b-BHC (HCH)	3.16E+00	ca	1.40E+01	ca	5.39E+01	nc		3.69E-01	ca	7.61E-04	1.52E-02
g-BHC	4.37E+00	ca	1.93E+01	ca	8.09E+01	nc		5.10E-01	ca	9.08E-04	1.82E-02
1,1-Biphenyl	3.08E+03	nc	2.73E+04	nc	1.17E+04	nc	x	3.04E+02	nc	3.61E+00	7.22E+01
Bis(2-chloroethyl) ether	2.44E+00	ca	7.45E+00	ca	1.05E+02	ca	x	9.65E-02	ca	2.77E-05	5.55E-04
Bis(2-chloroisopropyl) ether	3.87E+01	ca	1.19E+02	ca	4.53E+02	sat	x	2.71E+00	ca	7.21E-04	1.44E-02
Bis(2-ethylhexyl) phthalate	3.47E+02	ca	1.37E+03	ca	4.66E+03	nc		4.74E+01	ca	1.07E+03	2.15E+04
Bis(chloromethyl) ether	4.72E-03	ca	1.23E-02	ca	2.32E-01	ca	x	5.09E-04	ca	8.95E-08	1.79E-06
Boron	1.56E+04	nc	1.00E+05	max	3.09E+04	nc		7.30E+03	nc	2.40E+01	4.80E+02
Bromobenzene	3.70E+01	nc	1.37E+02	nc	1.21E+02	nc	x	2.06E+01	nc	1.07E-02	2.14E-01
Bromodichloromethane	1.44E+01	ca	3.72E+01	ca	7.17E+02	ca	x	1.78E+00	ca	5.90E-04	1.18E-02

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Bromomethane	8.51E+00	nc	3.28E+01	nc	2.82E+01	nc	x	8.66E+00	nc	1.87E-03	3.74E-02
1,3-Butadiene	9.93E-01	ca	2.38E+00	ca	4.59E+00	nc	x	1.26E+00	ca		
2-Butanone (MEK)	3.18E+04	nc	4.87E+04	sat	4.87E+04	sat	x	7.06E+03	nc	1.27E+00	2.55E+01
tert-Butyl methyl ether (MTBE)	3.88E+02	ca	9.84E+02	ca	1.96E+04	ca	x	6.14E+01	ca		
n-Butylbenzene	6.21E+01	sat	6.21E+01	sat	6.21E+01	sat	x	6.08E+01	nc	2.70E-01	5.40E+00
sec-Butylbenzene	6.06E+01	sat	6.06E+01	sat	6.06E+01	sat	x	6.08E+01	nc	2.17E-01	4.33E+00
tert-Butylbenzene	1.06E+02	sat	1.06E+02	sat	1.06E+02	sat	x	6.08E+01	nc	2.15E-01	4.30E+00
Cadmium	3.90E+01	nc	5.64E+02	nc	1.54E+02	nc		1.83E+01	nc	1.37E+00	2.75E+01
Carbon disulfide	4.60E+02	sat	4.60E+02	sat	4.60E+02	sat	x	1.04E+03	nc	3.95E-01	7.89E+00
Carbon tetrachloride	3.47E+00	ca	8.64E+00	ca	1.80E+02	ca	x	1.69E+00	ca	9.74E-04	1.95E-02
Chlordane	1.62E+01	ca	7.19E+01	ca	1.30E+02	nc		1.90E+00	ca	3.42E-01	6.83E+00
2-Chloroacetophenone	4.25E-02	nc	1.62E-01	nc	1.41E-01	nc	x	5.22E-02	nc	4.37E-05	8.75E-04
2-Chloro-1,3-butadiene	6.32E+00	nc	2.30E+01	nc	2.06E+01	nc	x	1.43E+01	nc	5.66E-03	1.13E-01
1-Chloro-1,1-difluoroethane	2.11E+02	sat	2.11E+02	sat	2.11E+02	sat	x	8.66E+04	nc	6.28E+01	1.26E+03
Chlorobenzene	1.94E+02	nc	2.45E+02	sat	2.45E+02	sat	x	1.06E+02	nc	5.50E-02	1.10E+00
1-Chlorobutane	1.22E+02	nc	2.99E+02	sat	2.99E+02	sat	x	2.43E+02	nc	9.63E-02	1.93E+00
Chlorodifluoromethane	2.11E+02	sat	2.11E+02	sat	2.11E+02	sat	x	9.75E+04	nc	7.07E+01	1.41E+03
Chloroethane	6.33E+01	ca	1.54E+02	ca	1.42E+03	sat	x	3.81E+01	ca	9.41E-03	1.88E-01
Chloroform	4.00E+00	ca	9.59E+00	ca	2.16E+02	ca	x	1.65E+00	ca	4.12E-04	8.25E-03
Chloromethane	2.18E+01	ca	5.34E+01	ca	2.84E+02	nc	x	1.49E+01	ca	5.02E-03	1.00E-01
b-Chloronaphthalene	3.99E+03	nc	2.78E+04	nc	1.47E+04	nc	x	4.87E+02	nc	1.25E+00	2.51E+01
o-Chloronitrobenzene	1.49E+00	nc	5.48E+00	nc	4.88E+00	nc	x	1.45E-01	nc	3.94E-05	7.88E-04
p-Chloronitrobenzene	1.05E+01	nc	4.23E+01	nc	3.51E+01	nc	x	1.20E+00	nc	3.25E-04	6.51E-03
2-Chlorophenol	1.66E+02	nc	8.85E+02	nc	5.86E+02	nc	x	3.04E+01	nc	2.36E-02	4.72E-01
2-Chloropropane	2.83E+02	nc	7.05E+02	sat	7.05E+02	sat	x	1.76E+02	nc	4.60E-02	9.19E-01
o-Chlorotoluene	2.02E+02	sat	2.02E+02	sat	2.02E+02	sat	x	1.22E+02	nc	5.22E-02	1.04E+00
Chromium III	1.00E+05	max	1.00E+05	max	1.00E+05	max		5.48E+04	nc	9.86E+07	1.97E+09
Chromium VI	2.34E+02	nc	3.40E+03	nc	2.61E+01	ca		1.10E+02	nc	2.10E+00	4.20E+01
Chrysene	6.15E+02	ca	2.31E+03	ca	2.12E+04	ca	x	2.91E+01	ca	1.74E+01	3.48E+02
Cobalt	1.52E+03	nc	2.05E+04	nc	6.10E+01	nc		7.30E+02	nc	3.31E+01	6.61E+02
Copper	3.13E+03	nc	4.54E+04	nc	1.24E+04	nc		1.46E+03	nc	5.15E+01	1.03E+03
Crotonaldehyde	7.01E-02	ca	1.70E-01	ca	3.73E+00	ca	x	5.82E-02	ca	1.49E-04	2.99E-03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Cumene (isopropylbenzene)	2.71E+02	nc	3.89E+02	sat	3.89E+02	sat	x	6.78E+02	nc	4.10E+00	8.21E+01
Cyanide	1.22E+03	nc	1.37E+04	nc	4.76E+03	nc		7.30E+02	nc	7.35E+00	1.47E+02
Cyanogen	1.71E+03	sat	1.71E+03	sat	1.71E+03	sat	x	1.46E+03	nc	2.91E-01	5.82E+00
Cyanogen bromide	2.02E+03	sat	2.02E+03	sat	2.02E+03	sat	x	3.29E+03	nc	7.76E-01	1.55E+01
Cyanogen chloride	2.02E+03	sat	2.02E+03	sat	2.02E+03	sat	x	1.83E+03	nc	4.31E-01	8.62E+00
DDD	2.44E+01	ca	1.11E+02	ca	8.07E+02	ca		2.77E+00	ca	4.15E+00	8.30E+01
DDE	1.72E+01	ca	7.81E+01	ca	5.70E+02	ca		1.95E+00	ca	1.31E+01	2.62E+02
DDT	1.72E+01	ca	7.81E+01	ca	1.38E+02	nc		1.95E+00	ca	7.70E+00	1.54E+02
Dibenz(a,h)anthracene	6.21E-01	ca	2.34E+00	ca	2.12E+01	ca		9.09E-02	ca	5.18E-01	1.04E+01
Dibenzofuran	1.42E+02	nc	1.62E+03	nc	5.52E+02	nc	x	1.22E+01	nc	1.44E-01	2.87E+00
1,2-Dibromo-3-chloropropane	1.84E+00	nc	9.68E+00	nc	6.48E+00	nc	x	3.47E-01	nc	1.49E-04	2.98E-03
Dibromochloromethane	1.48E+01	ca	3.95E+01	ca	7.16E+02	ca	x	1.32E+00	ca	3.58E-04	7.16E-03
1,2-Dibromoethane	5.04E-01	ca	1.31E+00	ca	2.48E+01	ca	x	5.53E-02	ca	1.20E-05	2.40E-04
1,4-Dichloro-2-butene	1.22E-01	ca	3.23E-01	ca	5.97E+00	ca	x	1.19E-02	ca	2.93E-06	5.87E-05
1,2-Dichlorobenzene	3.74E+01	sat	3.74E+01	sat	3.74E+01	sat	x	4.96E+01	nc	1.19E-02	2.37E-01
1,3-Dichlorobenzene	3.26E+01	nc	3.74E+01	sat	3.74E+01	sat	x	1.83E+01	nc	4.36E-03	8.73E-02
1,4-Dichlorobenzene	3.95E+01	ca	1.03E+02	ca	1.96E+03	ca	x	4.95E+00	ca	5.49E-03	1.10E-01
3,3-Dichlorobenzidine	1.08E+01	ca	4.26E+01	ca	3.63E+02	ca		1.47E+00	ca	1.86E-03	3.71E-02
Dichlorodifluoromethane	1.61E+02	nc	2.11E+02	sat	2.11E+02	sat	x	3.95E+02	nc	2.86E-01	5.72E+00
1,1-Dichloroethane	1.40E+03	nc	1.42E+03	sat	1.42E+03	sat	x	1.22E+03	nc	3.39E-01	6.79E+00
1,2-Dichloroethane	6.04E+00	ca	1.52E+01	ca	6.42E+01	nc	x	1.22E+00	ca	2.85E-04	5.71E-03
cis-1,2-Dichloroethene	7.65E+01	nc	3.00E+02	nc	2.54E+02	nc	x	6.08E+01	nc	1.49E-02	2.99E-01
trans-1,2-Dichloroethene	1.12E+02	nc	4.29E+02	nc	3.70E+02	nc	x	1.22E+02	nc	3.33E-02	6.67E-01
1,1-Dichloroethene	2.06E+02	nc	7.77E+02	nc	6.78E+02	nc	x	3.39E+02	nc	1.34E-01	2.68E+00
2,4-Dichlorophenol	1.83E+02	nc	2.05E+03	nc	6.99E+02	nc		1.10E+02	nc	4.31E-02	8.63E-01
1,2-Dichloropropane	6.00E+00	ca	1.49E+01	ca	3.33E+01	nc	x	1.63E+00	ca	4.10E-04	8.19E-03
1,3-Dichloropropene	1.20E+01	ca	3.17E+01	ca	8.98E+01	nc	x	3.90E+00	ca	1.16E-03	2.31E-02
Dicyclopentadiene	2.21E+01	nc	8.26E+01	nc	7.28E+01	nc	x	1.39E+01	nc	1.50E-02	3.00E-01
Dieldrin	3.04E-01	ca	1.20E+00	ca	1.02E+01	ca		4.15E-02	ca	1.34E-03	2.68E-02
Diethyl phthalate	4.89E+04	nc	1.00E+05	max	1.00E+05	max		2.92E+04	nc	1.77E+01	3.54E+02
Dimethyl phthalate	1.00E+05	max	1.00E+05	max	1.00E+05	max		3.65E+05	nc	8.36E+01	1.67E+03
Di-n-butyl phthalate	6.11E+03	nc	6.84E+04	nc	2.33E+04	nc		3.65E+03	nc	1.86E+02	3.72E+03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
2,4-Dimethylphenol	1.22E+03	nc	1.37E+04	nc	4.66E+03	nc		7.30E+02	nc	3.55E-01	7.11E+00
4,6-Dinitro-o-cresol	6.11E+00	nc	6.84E+01	nc	2.33E+01	nc		3.65E+00	nc	3.93E-03	7.85E-02
2,4-Dinitrophenol	1.22E+02	nc	1.37E+03	nc	4.66E+02	nc		7.30E+01	nc	5.25E-02	1.05E+00
2,4-Dinitrotoluene	1.22E+02	nc	1.37E+03	nc	4.66E+02	nc		7.30E+01	nc	2.31E-02	4.62E-01
1,2-Diphenylhydrazine	6.08E+00	ca	2.39E+01	ca	2.04E+02	ca		8.30E-01	ca	4.48E-03	8.95E-02
Endosulfan	3.67E+02	nc	4.10E+03	nc	1.40E+03	nc		2.19E+02	nc	7.41E-01	1.48E+01
Endrin	1.83E+01	nc	2.05E+02	nc	6.99E+01	nc		1.10E+01	nc	2.04E-01	4.08E+00
Epichlorohydrin	1.66E+01	nc	6.56E+01	nc	5.54E+01	nc	x	2.03E+00	nc	3.62E-04	7.25E-03
Ethyl acetate	2.10E+04	sat	2.10E+04	sat	2.10E+04	sat	x	5.48E+03	nc	1.44E+00	2.87E+01
Ethyl acrylate	2.79E+00	ca	6.75E+00	ca	5.22E+01	sat	x	2.30E+00	ca	5.86E-03	1.17E-01
Ethyl chloride	6.33E+01	ca	1.54E+02	ca	1.42E+03	sat	x	3.81E+01	ca	9.41E-03	1.88E-01
Ethyl ether	1.94E+03	sat	1.94E+03	sat	1.94E+03	sat	x	1.22E+03	nc	2.37E-01	4.73E+00
Ethyl methacrylate	5.27E+01	sat	5.27E+01	sat	5.27E+01	sat	x	5.48E+02	nc	1.41E+00	2.81E+01
Ethylbenzene	1.28E+02	sat	1.28E+02	sat	1.28E+02	sat	x	1.34E+03	nc	1.01E+00	2.02E+01
Ethylene oxide	2.65E+00	ca	8.07E+00	ca	1.15E+02	ca	x	2.41E-01	ca	4.27E-05	8.54E-04
Fluoranthene	2.29E+03	nc	2.44E+04	nc	8.73E+03	nc		1.46E+03	nc	2.35E+02	4.69E+03
Fluorene	2.66E+03	nc	2.65E+04	nc	1.02E+04	nc	x	2.43E+02	nc	2.93E+00	5.85E+01
Fluoride	3.67E+03	nc	4.10E+04	nc	1.43E+04	nc		2.19E+03	nc	3.29E+02	6.58E+03
Furan	5.53E+00	nc	2.12E+01	nc	1.83E+01	nc	x	6.08E+00	nc	1.32E-03	2.63E-02
Heptachlor	1.08E+00	ca	4.26E+00	ca	3.63E+01	ca		1.47E-01	ca	3.12E-01	6.24E+00
Hexachlorobenzene	3.04E+00	ca	1.20E+01	ca	1.02E+02	ca		4.15E-01	ca	3.43E-02	6.86E-01
Hexachloro-1,3-butadiene	1.22E+01	nc	1.37E+02	nc	4.66E+01	nc		7.30E+00	nc	5.90E-01	1.18E+01
Hexachlorocyclopentadiene	3.66E+02	nc	4.10E+03	nc	4.31E+02	nc		2.19E+02	nc	6.58E+01	1.32E+03
Hexachloroethane	6.11E+01	nc	6.84E+02	nc	2.33E+02	nc		3.65E+01	nc	1.04E-01	2.09E+00
n-Hexane	3.80E+01	sat	3.80E+01	sat	3.80E+01	sat	x	4.16E+02	nc	8.64E-01	1.73E+01
HMX	3.06E+03	nc	3.42E+04	nc	1.17E+04	nc		1.83E+03	nc	5.39E+00	1.08E+02
Hydrogen cyanide	2.24E+01	nc	8.22E+01	nc	7.33E+01	nc	x	6.20E+00	nc	1.24E-03	2.47E-02
Indeno(1,2,3-c,d)pyrene	6.21E+00	ca	2.34E+01	ca	2.12E+02	ca		9.09E-01	ca	4.73E+00	9.46E+01
Iron	2.35E+04	nc	1.00E+05	max	9.29E+04	nc		1.10E+04	nc	2.77E+02	5.54E+03
Isobutanol	1.38E+04	nc	2.26E+04	sat	2.26E+04	sat	x	1.83E+03	nc	4.86E-01	9.72E+00
Isophorone	5.12E+03	ca	2.02E+04	ca	4.66E+04	nc		6.99E+02	ca	1.70E-01	3.40E+00
Lead	4.00E+02	IEUBK	8.00E+02	IEUBK	8.00E+02	IEUBK					

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Lead (tetraethyl-)	6.11E-03	nc	6.84E-02	nc	2.38E-02	nc		3.65E-03	nc	6.33E-07	1.27E-05
Maleic hydrazide	1.61E+03	sat	1.61E+03	sat	1.61E+03	sat	x	3.04E+03	nc	8.12E-01	1.62E+01
Manganese	3.59E+03	nc	4.84E+04	nc	1.50E+02	nc		1.72E+03	nc	1.12E+02	2.24E+03
Mercury (elemental)	1.00E+05	max	1.00E+05	max	9.27E+02	nc				1.05E-01	2.09E-03
Mercury (methyl)	6.11E+00	nc	6.84E+01	nc	2.38E+01	nc		3.65E+00	nc	8.26E-04	1.65E-02
Methacrylonitrile	3.84E+00	nc	2.20E+01	nc	1.37E+01	nc	x	1.04E+00	nc	1.83E-04	3.65E-03
Methomyl	8.44E+01	nc	3.17E+02	nc	2.78E+02	nc	x	1.52E+02	nc	5.74E-02	1.15E+00
Methyl acetate	3.76E+04	nc	1.00E+05	max	1.00E+05	max	x	6.08E+03	nc	1.08E+00	2.15E+01
Methyl acrylate	9.28E+01	nc	1.57E+02	sat	1.57E+02	sat	x	1.83E+02	nc	4.64E-01	9.29E+00
Methyl isobutyl ketone	5.51E+03	nc	7.01E+03	sat	7.01E+03	sat	x	1.99E+03	nc	7.35E-01	1.47E+01
Methyl methacrylate	2.92E+03	sat	2.92E+03	sat	2.92E+03	sat	x	1.42E+03	nc	2.76E-01	5.52E+00
Methyl styrene (alpha)	2.17E+02	sat	2.17E+02	sat	2.17E+02	sat	x	4.26E+02	nc	3.08E-01	6.17E+00
Methyl styrene (mixture)	1.39E+02	nc	2.17E+02	sat	2.17E+02	sat	x	5.48E+01	nc	3.96E-02	7.93E-01
Methylcyclohexane	7.89E+01	sat	7.89E+01	sat	7.89E+01	sat	x	5.23E+03	nc	2.88E+01	5.77E+02
Methylene bromide	1.79E+02	nc	7.85E+02	nc	6.09E+02	nc	x	6.08E+01	nc	2.72E-02	5.44E-01
Methylene chloride	1.82E+02	ca	4.90E+02	ca	2.63E+03	sat	x	4.22E+01	ca	8.51E-03	1.70E-01
Molybdenum	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	3.70E+00	7.40E+01
Naphthalene	7.95E+01	nc	3.00E+02	nc	2.62E+02	nc	x	6.20E+00	nc	1.97E-02	3.94E-01
Nickel	1.56E+03	nc	2.27E+04	nc	6.19E+03	nc		7.30E+02	nc	4.77E+01	9.53E+02
Nitrate	1.00E+05	max	1.00E+05	max	1.00E+05	max		5.84E+04	nc	1.67E+01	3.35E+02
Nitrite	7.82E+03	nc	1.00E+05	max	3.10E+04	nc		3.65E+03	nc	7.63E-01	1.53E+01
Nitrobenzene	2.28E+01	nc	1.47E+02	nc	8.28E+01	nc	x	3.40E+00	nc	9.18E-04	1.84E-02
Nitroglycerin	3.47E+02	ca	1.37E+03	ca	1.17E+04	ca		4.74E+01	ca	2.80E-02	5.61E-01
N-Nitrosodiethylamine	3.24E-02	ca	1.28E-01	ca	1.09E+00	ca		4.42E-03	ca	8.73E-06	1.75E-04
N-Nitrosodimethylamine	9.54E-02	ca	3.76E-01	ca	1.86E+00	nc		1.30E-02	ca	1.17E-05	2.34E-04
N-Nitrosodi-n-butylamine	2.69E-01	ca	7.28E-01	ca	1.24E+01	ca	x	1.99E-02	ca	1.12E-05	2.24E-04
N-Nitrosodiphenylamine	9.93E+02	ca	3.91E+03	ca	4.66E+03	nc		1.35E+02	ca	2.86E-01	5.71E+00
N-Nitrosopyrrolidine	2.32E+00	ca	9.12E+00	ca	7.77E+01	ca		3.16E-01	ca	1.30E-04	2.60E-03
m-Nitrotoluene	5.69E+02	sat	5.69E+02	sat	5.69E+02	sat	x	1.22E+02	nc	3.30E-02	6.59E-01
o-Nitrotoluene	1.08E+01	ca	3.23E+01	ca	4.73E+02	ca	x	4.81E-01	ca	1.30E-04	2.61E-03
p-Nitrotoluene	1.46E+02	ca	4.37E+02	ca	1.55E+03	nc	x	6.51E+00	ca	1.76E-03	3.53E-02
Pentachlorobenzene	4.89E+01	nc	5.47E+02	nc	1.86E+02	nc		2.92E+01	nc	9.37E-02	1.87E+00

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Pentachlorophenol	2.98E+01	ca	1.00E+02	ca	1.02E+03	ca		5.53E+00	ca	5.87E-03	1.17E-01
Phenanthrene	1.83E+03	nc	2.05E+04	nc	6.99E+03	nc		1.10E+03	nc	2.32E+01	4.64E+02
Phenol	1.83E+04	nc	1.00E+05	max	6.99E+04	nc		1.10E+04	nc	2.37E+00	4.74E+01
Polychlorinatedbiphenyls											
Aroclor 1016	3.93E+00	nc	4.13E+01	nc	1.50E+01	nc		2.56E+00	nc	1.73E-01	3.45E+00
Aroclor 1221	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1232	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1242	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.24E-02	4.47E-01
Aroclor 1248	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
Aroclor 1254	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
Aroclor 1260	1.12E+00	nc	8.26E+00	ca	4.28E+00	nc		3.32E-01	ca	2.64E-01	5.28E+00
n-Propylbenzene	6.21E+01	sat	6.21E+01	sat	6.21E+01	sat	x	6.08E+01	nc	2.70E-01	5.40E+00
Propylene oxide	2.22E+01	ca	9.33E+01	ca	7.92E+02	nc	x	2.18E+00	ca	4.60E-04	9.20E-03
Pyrene	2.29E+03	nc	3.09E+04	nc	9.01E+03	nc	x	1.83E+02	nc	1.86E+01	3.73E+02
RDX	4.42E+01	ca	1.74E+02	ca	6.99E+02	nc		6.03E+00	ca	1.68E-03	3.36E-02
Selenium	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	9.52E-01	1.90E+01
Silver	3.91E+02	nc	5.68E+03	nc	1.55E+03	nc		1.83E+02	nc	1.57E+00	3.13E+01
Strontium	4.69E+04	nc	1.00E+05	max	1.00E+05	max		2.19E+04	nc	7.73E+02	1.55E+04
Styrene	1.00E+02	sat	1.00E+02	sat	1.00E+02	sat	x	1.62E+03	nc	5.23E-01	1.05E+01
1,2,4,5-Tetrachlorobenzene	1.83E+01	nc	2.05E+02	nc	6.99E+01	nc		1.10E+01	nc	2.14E-02	4.29E-01
1,1,1,2-Tetrachloroethane	4.32E+01	ca	1.14E+02	ca	2.11E+03	ca	x	4.27E+00	ca	1.25E-03	2.50E-02
1,1,2,2-Tetrachloroethane	5.55E+00	ca	1.46E+01	ca	2.71E+02	ca	x	5.46E-01	ca	1.60E-04	3.21E-03
Tetrachloroethene	1.25E+01	ca	3.16E+01	ca	1.34E+02	sat	x	4.32E+00	ca	2.87E-03	5.74E-02
Thallium	5.16E+00	nc	7.49E+01	nc	2.04E+01	nc		2.41E+00	nc	1.72E-01	3.43E+00
Toluene	2.52E+02	sat	2.52E+02	sat	2.52E+02	sat	x	2.27E+03	nc	1.08E+00	2.17E+01
Toxaphene	4.42E+00	ca	1.74E+01	ca	1.48E+02	ca		6.03E-01	ca	2.33E-01	4.65E+00
Tribromomethane	6.21E+02	ca	2.46E+03	ca	4.44E+03	nc		2.44E+01	ca	1.73E-01	3.47E+00
1,1,2-Trichloro-1,2,2-trifluoroethane	3.28E+03	sat	3.28E+03	sat	3.28E+03	sat	x	5.92E+04	nc	1.68E+02	3.36E+03
1,2,4-Trichlorobenzene	6.93E+01	nc	2.69E+02	nc	2.30E+02	nc	x	7.16E+00	nc	2.04E-02	4.08E-01
1,1,1-Trichloroethane	5.63E+02	sat	5.63E+02	sat	5.63E+02	sat	x	3.17E+03	nc	1.33E+00	2.65E+01
1,1,2-Trichloroethane	1.19E+01	ca	3.02E+01	ca	1.94E+02	nc	x	1.97E+00	ca	4.98E-04	9.95E-03
Trichloroethylene	6.38E-01	ca	1.56E+00	ca	3.36E+01	ca	x	2.77E-01	ca	1.00E-04	2.00E-03

Chemical	Residential Soil (mg/kg)	End-point	Industrial/ Occupational Soil (mg/kg)	End-point	Construction Worker Soil (mg/kg)	End-point	VOC	Tap Water (ug/L)	End-point	DAF 1 (mg/kg)	DAF 20 (mg/kg)
Trichlorofluoromethane	5.88E+02	nc	9.83E+02	sat	9.83E+02	sat	x	1.29E+03	nc	1.12E+00	2.23E+01
2,4,5-Trichlorophenol	6.11E+03	nc	6.84E+04	nc	2.33E+04	nc		3.65E+03	nc	7.13E+00	1.43E+02
2,4,6-Trichlorophenol	6.11E+00	nc	6.84E+01	nc	2.33E+01	nc		3.65E+00	nc	7.13E-03	1.43E-01
1,1,2-Trichloropropane	2.53E+01	nc	9.64E+01	nc	8.35E+01	nc	x	3.04E+01	nc	1.17E-02	2.35E-01
1,2,3-Trichloropropane	8.61E-02	ca	2.09E-01	ca	4.57E+00	ca	x	5.53E-02	ca	2.07E-05	4.14E-04
1,2,3-Trichloropropene	1.21E+00	nc	4.39E+00	nc	3.95E+00	nc	x	2.10E+00	nc	7.88E-04	1.58E-02
Triethylamine	4.90E+01	nc	2.33E+02	nc	1.69E+02	nc	x	1.21E+01	nc	2.14E-03	4.29E-02
1,2,4-Trimethylbenzene	5.80E+01	nc	2.13E+02	nc	1.90E+02	nc	x	1.23E+01	nc	7.09E-02	1.42E+00
1,3,5-Trimethylbenzene	2.48E+01	nc	6.92E+01	sat	6.92E+01	sat	x	1.23E+01	nc	1.77E-02	3.55E-01
2,4,6-Trinitrotoluene	3.06E+01	nc	3.42E+02	nc	1.17E+02	nc		1.83E+01	nc	5.34E-02	1.07E+00
Vanadium	7.82E+01	nc	1.14E+03	nc	3.10E+02	nc		3.65E+01	nc	3.65E+01	7.30E+02
Vinyl acetate	1.07E+03	nc	3.68E+03	sat	3.52E+03	nc	x	4.12E+02	nc	7.57E-02	1.51E+00
Vinyl bromide	2.85E+00	ca	6.84E+00	ca	1.93E+01	nc	x	1.18E+00	ca	4.71E-04	9.41E-03
Vinyl chloride (Child)	2.25E+00	ca					x	4.28E-01	ca	1.40E-04	2.80E-03
Vinyl chloride (adult)	4.37E+00	ca	1.40E+01	ca	1.82E+02	ca	x	8.33E-01	ca	2.72E-04	5.45E-03
m-Xylene	8.20E+01	sat	8.20E+01	sat	8.20E+01	sat	x	2.03E+02	nc	1.03E-01	2.06E+00
o-Xylene	9.95E+01	sat	9.95E+01	sat	9.95E+01	sat	x	7.30E+03	nc	4.07E+00	8.14E+01
Xylenes	8.20E+01	sat	8.20E+01	sat	8.20E+01	sat	x	2.03E+02	nc	1.03E-01	2.06E+00
Zinc	2.35E+04	nc	1.00E+05	max	9.29E+04	nc		1.10E+04	nc	6.82E+02	1.36E+04

Table A-2

Default Exposure Factors			
Symbol	**Definition (units)**	**Default**	**Reference**
CSF_o	Cancer slope factor oral $(mg/kg\text{-}day)^{-1}$	Chem.-spec.	IRIS, HEAST, or NCEA
CSF_i	Cancer slope factor inhaled $(mg/kg\text{-}day)^{-1}$	Chem.-spec.	IRIS, HEAST, or NCEA
RfD_o	Reference dose oral (mg/kg-day)	Chem.-spec.	IRIS, HEAST, or NCEA
RfD_i	Reference dose inhaled (mg/kg-day)	Chem.-spec.	IRIS, HEAST, or NCEA
TR	Target cancer risk	1E-05	NMED-specific value
THQ	Target hazard quotient	1	US EPA, 1989
BW	Body weight (kg)		
	-- adult	70	US EPA, 1989
	-- child	15	US EPA, 1991
AT	Averaging time (days)		
	-- carcinogens	25550	US EPA, 1989
	-- noncarcinogens	ED*365	
SA	Exposed surface area for soil/dust (cm^2/day)		US EPA, 1989
	– adult resident	5700	US EPA, 1996a
	– adult worker	3300	US EPA, 1996a
	-- child	2800	US EPA, 1989
AF	Adherence factor, soils (mg/cm^2)		US EPA, 1989
	– adult resident	0.07	US EPA, 1996a
	– adult worker	0.2	US EPA, 1996a
	-- child resident	0.2	US EPA, 1989
	– construction worker	0.3	NMED-specific value
ABS	Skin absorption defaults (unitless):		
	– semi-volatile organics	0.1	US EPA, 1989
	– volatile organics	na	US EPA, 2003a
	– inorganics	na	US EPA, 2000s
IRA	Inhalation rate (m^3/day)		
	-- adult resident	20	US EPA, 1991
	– adult worker	20	US EPA, 2001a
	-- child resident	10	Exposure Factors, (US EPA, 1997)
IRW	Drinking water ingestion rate (L/day)		
	-- adult	2	US EPA, 2004b
	-- child	1	US EPA, 2004b
IRS	Soil ingestion (mg/day)		
	-- adult resident	100	US EPA, 1991
	-- child resident	200	US EPA, 1991
	-- commercial/industrial worker	100	US EPA, 2001a
	construction worker	330	US EPA, 1991
EF	Exposure frequency (days/yr)		
	-- residential	350	US EPA, 1991
	-- commercial/industrial	225	US EPA, 2001a
	– construction worker	250	NMED-specific value
ED	Exposure duration (years)		
	-- residential	30[a]	US EPA, 1991)
	-- child	6	(US EPA, 1991)
	-- commercial/industrial	25	(US EPA, 1999)
	– *construction worker*	1	*NMED-specific value*
	Age-adjusted factors for carcinogens		
IFSadj	Ingestion factor, soils ([mg-yr]/[kg-day])	114	US EPA, 2001a
SFSadj	Dermal factor, soils ([mg-yr]/[kg-day])	361	US EPA, 2001a
InhFadj	Inhalation factor, air ([m^3-yr]/[kg-day])	11	By analogy to RAGS: Part B, (US EPA, 1991)
IFWadj	Ingestion factor, water ([L-yr]/[kg-day])	1.1	By analogy to RAGS: Part B, (US EPA, 1991)
PEF	Particulate emission factor (m^3/kg)	Chem.-spec.	US EPA, 2001a
VFs	Volatilization factor for soil (m^3/kg)	Chem.-spec.	US EPA, 2001a
VFw	Volatilization factor for water (L/m^3)	0.5	US EPA, 1991
Csat	Soil saturation concentration (mg/kg)	Chem.-spec.	US EPA, 2001a

[a]Exposure duration for lifetime residents is assumed to be 30 years total. For carcinogens, exposures are combined for children (6 years) and adults (24 years).

Chem.-spec.- Chemical-specific value
na - not applicable
RAGS – Risk Assessment Guidance for Superfund
IRIS – Integrated Risk Information System, USEPA, 2003b
HEAST – Health Effects Assessment Summary Tables, USEPA, 1997
NCEA – National Center for Environmental Assessment, Office of Research and Development (USEPA, 2003c)
NMED – New Mexico Environment Department

APPENDIX B

Table B-1: Physical and Chemical Properties

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
Acenaphthene	154.21	1.6E-04	6.36E-03	4.21E-02	7.69E-06	4.90E+03	7.35E+00	4.24E+00	4.13E-07	1.93E+05	3.19E+01
Acetaldehyde	44	7.8E-05	3.20E-03	1.20E-01	1.40E-05	1.80E+01	2.70E-02	1.00E+06	2.28E-05	2.60E+04	2.01E+05
Acetone	58	3.9E-05	1.60E-03	1.20E-01	1.10E-05	5.80E-01	8.70E-04	1.00E+06	1.40E-05	3.31E+04	1.74E+05
Acrylonitrile	53	8.8E-05	3.60E-03	1.08E-01	1.34E-05	8.50E-01	1.28E-03	7.90E+04	2.64E-05	2.42E+04	1.38E+04
Acetophenone	120	1.1E-05	4.51E-04	6.00E-02	8.70E-06	4.62E+01	6.93E-02	6.10E+03	2.59E-06	7.71E+04	1.48E+03
Acrolein	56	1.2E-04	4.90E-03	1.05E-01	1.22E-05	2.10E+01	3.15E-02	2.10E+05	2.86E-05	2.32E+04	4.31E+04
Aldrin	365	1.7E-04	6.97E-03	1.32E-02	4.86E-06	2.45E+06	3.68E+03	1.80E-01			
Aluminum	26.98	2.4E-02	1.00E+00			1.43E+01	1.50E+03				
Anthracene	178	6.5E-05	2.67E-03	3.24E-02	7.74E-06	2.95E+04	4.43E+01	4.34E-02	2.73E-08	7.51E+05	1.93E+00
Antimony	121.75	2.4E-02	1.00E+00			1.43E+01	4.50E+01				
Arsenic	74.92	7.7E-01	3.16E+01			1.43E+01	2.90E+01				
Barium	137.33	2.4E-02	1.00E+00			1.43E+01	4.10E+01				
Benzene	78.1	5.6E-03	2.28E-01	8.80E-02	9.80E-06	5.89E+01	8.84E-02	1.75E+03	7.30E-04	4.59E+03	5.06E+02
Benzidine	184.23	7.0E-11	2.88E-09	3.40E-02	1.50E-05	2.74E+03	4.11E+00	3.22E+02			
Benzo(a)anthracene	228	3.3E-06	1.37E-04	5.10E-02	9.00E-06	3.98E+05	5.97E+02	9.40E-03			
Benzo(a)pyrene	250	1.1E-06	4.63E-05	4.30E-02	9.00E-06	1.02E+06	1.53E+03	1.62E-03			
Benzo(b)fluoranthene	252.3	1.1E-04	4.55E-03	2.26E-02	5.56E-06	1.23E+06	1.85E+03	1.50E-03			
Benzo(k)fluoranthene	252.3	8.3E-07	3.40E-05	2.26E-02	5.56E-06	1.23E+06	1.85E+03	8.00E-04			
Beryllium	9.01	2.4E-02	1.00E+00			1.43E+01	7.90E+02				
α-BHC	290.85	1.1E-05	4.35E-04	1.42E-02	7.34E-06	1.23E+03	1.85E+00	2.00E+00			
β-BHC	290.85	7.4E-07	3.05E-05	1.42E-02	7.34E-06	1.26E+03	1.89E+00	2.40E-01			
γ-BHC	290.85	1.4E-05	5.74E-04	1.42E-02	7.34E-06	1.07E+03	1.61E+00	6.80E+00			
1,1-Biphenyl	150	2.9E-04	1.20E-02	4.00E-02	8.20E-06	7.80E+03	1.17E+01	7.50E+00	4.50E-07	1.85E+05	8.91E+01
Bis(2-chloroethyl) ether	140	1.8E-05	7.38E-04	6.92E-02	7.53E-06	7.60E+01	1.14E-01	1.72E+04	2.90E-06	7.29E+04	4.94E+03
Bis(2-chloroisopropyl) ether	170	1.1E-04	4.60E-03	6.30E-02	6.40E-06	6.17E+01	9.25E-02	1.70E+03	1.23E-05	3.53E+04	4.53E+02
Bis(2-ethylhexyl) phthalate	390.54	1.0E-07	4.18E-06	3.51E-02	3.66E-06	1.51E+07	2.27E+04	3.40E-01			7.70E+03
Bis(chloromethyl) ether	120	2.0E-04	8.20E-03	8.90E-02	9.40E-06	1.20E+00	1.80E-03	2.20E+04	4.55E-05	1.84E+04	3.87E+03
Boron	10.81	2.4E-02	1.00E+00			1.43E+01	3.00E+00				
Bromobenzene	157.02	3.7E-03	1.50E-01	7.30E-02	8.70E-06	2.20E+02	3.30E-01	4.70E+02	2.21E-04	8.36E+03	2.45E+02
Bromodichloromethane	164	1.6E-03	6.56E-02	2.98E-02	1.06E-05	1.00E+02	1.50E-01	6.74E+03	6.31E-05	1.56E+04	2.23E+03

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
Bromomethane	94.95	6.2E-03	2.56E-01	7.28E-02	1.21E-05	9.00E+00	1.35E-02	1.52E+04	9.03E-04	4.13E+03	3.31E+03
1,3-Butadiene	54	1.8E-01	7.30E+00	9.80E-02	1.10E-05	1.20E+02	1.80E-01	7.40E+02	6.24E-03	1.57E+03	9.10E+02
2-Butanone (MEK)	72	2.7E-05	1.10E-03	9.00E-02	9.80E-06	4.50E+00	6.75E-03	2.70E+05	7.91E-06	4.41E+04	4.87E+04
tert-Butyl methyl ether (MTBE)	88.2	5.9E-04	2.40E-02	8.00E-02	1.00E-05	6.00E+00	9.00E-03	1.50E+05	1.11E-04	1.18E+04	2.78E+04
n-Butylbenzene	130	1.3E-02	5.40E-01	7.50E-02	7.80E-06	2.80E+03	4.20E+00	1.40E+01	9.56E-05	1.27E+04	6.21E+01
sec-Butylbenzene	130	1.9E-02	7.70E-01	7.50E-02	7.80E-06	2.20E+03	3.30E+00	1.70E+01	1.70E-04	9.53E+03	6.06E+01
tert-Butylbenzene	130	1.3E-02	5.20E-01	7.50E-02	7.80E-06	2.20E+03	3.30E+00	3.00E+01	1.16E-04	1.15E+04	1.06E+02
Cadmium	112.41	2.4E-02	1.00E+00			1.43E+01	7.50E+01				
Carbon disulfide	76	2.9E-02	1.20E+00	1.04E-01	1.00E-05	4.60E+01	6.90E-02	1.19E+03	3.42E-03	2.12E+03	4.60E+02
Carbon tetrachloride	154	3.0E-02	1.25E+00	7.80E-02	8.80E-06	1.74E+02	2.61E-01	7.93E+02	1.76E-03	2.96E+03	4.63E+02
Chlordane	409.8	4.9E-05	1.99E-03	1.18E-02	4.37E-06	1.20E+05	1.80E+02	5.60E-02			
2-Chloroacetophenone	154.59	3.7E-02	1.50E+00	7.20E-02	6.80E-06	3.30E+02	4.95E-01	4.70E+02	1.34E-03	3.39E+03	3.99E+02
2-Chloro-1,3-butadiene	88	3.2E-02	1.30E+00	1.10E-01	1.10E-05	5.00E+01	7.50E-02	7.40E+02	3.75E-03	2.03E+03	2.99E+02
1-Chloro-1,1-difluoroethane	100.5	1.0E-01	4.10E+00	8.00E-02	1.10E-05	5.80E+01	8.70E-02	2.80E+02	4.67E-03	1.82E+03	2.11E+02
Chlorobenzene	113	3.7E-03	1.50E-01	7.30E-02	8.70E-06	2.19E+02	3.29E-01	4.72E+02	2.21E-04	8.34E+03	2.45E+02
1-Chlorobutane	92.57	3.2E-02	1.30E+00	1.10E-01	1.10E-05	5.00E+01	7.50E-02	7.40E+02	3.75E-03	2.03E+03	2.99E+02
Chlorodifluoromethane	86.47	1.0E-01	4.10E+00	8.00E-02	1.10E-05	5.80E+01	8.70E-02	2.80E+02	4.67E-03	1.82E+03	2.11E+02
Chloroethane	65	1.1E-02	4.50E-01	1.00E-01	1.20E-05	1.50E+01	2.25E-02	5.70E+03	1.90E-03	2.85E+03	1.42E+03
Chloroform	120	3.7E-03	1.50E-01	1.04E-01	1.00E-05	3.98E+01	5.97E-02	7.92E+03	6.53E-04	4.86E+03	1.99E+03
Chloromethane	51	2.4E-02	9.80E-01	1.09E-01	6.50E-06	3.50E+01	5.25E-02	8.20E+03	3.29E-03	2.16E+03	2.82E+03
β-Chloronaphthalene	160	3.2E-04	1.30E-02	3.50E-02	8.80E-06	1.60E+03	2.40E+00	1.20E+01	1.98E-06	8.81E+04	3.09E+01
o-Chloronitrobenzene	153.33	4.4E-05	1.80E-03	7.60E-02	8.60E-06	6.50E+01	9.75E-02	2.10E+03	6.54E-06	4.85E+04	5.69E+02
p-Chloronitrobenzene	153.33	5.1E-05	2.10E-03	7.60E-02	8.60E-06	6.50E+01	9.75E-02	2.10E+03	7.42E-06	4.56E+04	5.69E+02
2-Chlorophenol	130	3.9E-04	1.60E-02	5.01E-02	9.46E-06	4.00E+02	6.00E-01	2.20E+04	1.13E-05	3.69E+04	1.71E+04
2-Chloropropane	78.54	2.3E-03	9.40E-02	8.00E-02	1.00E-05	5.10E+01	7.65E-02	2.70E+03	3.03E-04	7.13E+03	7.05E+02
o-Chlorotoluene	172.57	3.4E-03	1.40E-01	7.20E-02	8.70E-06	1.60E+02	2.40E-01	4.70E+02	2.46E-04	7.91E+03	2.02E+02
Chromium III	52						1.80E+06				
Chromium VI	52						1.90E+01				
Chrysene	228.28	9.5E-05	3.88E-03	2.48E-02	6.21E-06	3.98E+05	5.97E+02	1.60E-03	2.10E-09	2.71E+06	9.55E-01
Cobalt	58.93	2.4E-02	1.00E+00			1.43E+01	4.50E+01				
Copper	63.55	2.4E-02	1.00E+00			1.43E+01	3.50E+01				
Crotonaldehyde	70.09	2.4E-01	1.00E+01	9.10E-02	1.00E-05	8.40E+02	1.26E+00	2.00E+01	3.67E-03	2.05E+03	5.27E+01

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
Cumene (isopropylbenzene)	120	1.2E+00	4.90E+01	7.50E-02	7.10E-06	2.20E+02	3.30E-01	6.10E+01	6.22E-03	1.57E+03	3.89E+02
Cyanide	27.03		5.44E-03			2.71E+00	9.90E+00				
Cyanogen	52	5.1E-03	2.10E-01	2.00E-01	1.40E-05	1.40E+00	2.10E-03	8.50E+03	2.20E-03	2.64E+03	1.71E+03
Cyanogen bromide	52	5.1E-03	2.10E-01	9.60E-02	1.00E-05	2.60E+01	3.90E-02	8.50E+03	8.93E-04	4.15E+03	2.02E+03
Cyanogen chloride	52	5.1E-03	2.10E-01	9.60E-02	1.00E-05	2.60E+01	3.90E-02	8.50E+03	8.93E-04	4.15E+03	2.02E+03
DDD	320	4.0E-06	1.64E-04	1.69E-02	4.76E-06	1.00E+06	1.50E+03	9.00E-02			
DDE	318	2.1E-05	8.61E-04	1.44E-02	5.87E-06	4.47E+06	6.71E+03	1.20E-01			
DDT	354.5	8.1E-06	3.32E-04	1.37E-02	4.95E-06	2.63E+06	3.95E+03	2.50E-02			
Dibenz(a,h)anthracene	278.3	1.5E-08	6.03E-07	2.02E-02	5.18E-06	3.80E+06	5.70E+03	2.49E-03			
Dibenzofuran	284.8	1.3E-05	5.33E-04	6.01E-02	1.00E-05	7.76E+03	1.16E+01	3.10E+00	6.20E-08	4.98E+05	3.66E+01
1,2-Dibromo-3-chloropropane	240	1.5E-04	6.00E-03	8.00E-02	8.00E-06	1.70E+02	2.55E-01	1.20E+03	1.24E-05	3.52E+04	5.15E+02
Dibromochloromethane	210	8.5E-04	3.50E-02	2.00E-02	1.00E-05	6.30E+01	9.45E-02	4.40E+03	2.84E-05	2.33E+04	1.20E+03
1,2-Dibromoethane	188	3.2E-04	1.30E-02	7.33E-02	8.06E-06	2.80E+01	4.20E-02	3.40E+03	4.75E-05	1.80E+04	7.37E+02
1,4-Dichloro-2-butene	130	2.7E-04	1.10E-02	7.30E-02	8.10E-06	4.80E+01	7.20E-02	2.80E+03	3.54E-05	2.09E+04	6.91E+02
1,2-Dichlorobenzene	147	1.9E-03	7.79E-02	6.90E-02	7.90E-06	3.80E+01	5.70E-02	1.56E+02	2.36E-04	8.07E+03	3.74E+01
1,3-Dichlorobenzene	147	1.9E-03	7.80E-02	6.90E-02	7.90E-06	3.80E+01	5.70E-02	1.56E+02	2.37E-04	8.07E+03	3.74E+01
1,4-Dichlorobenzene	147	2.4E-03	9.96E-02	6.90E-02	7.90E-06	6.16E+02	9.24E-01	7.38E+01	6.51E-05	1.54E+04	8.19E+01
3,3-Dichlorobenzidine	253.13	4.0E-09	1.64E-07	1.94E-02	6.74E-06	7.24E+02	1.09E+00	3.11E+00			
Dichlorodifluoromethane	120	1.0E-01	4.10E+00	8.00E-02	1.05E-05	5.80E+01	8.70E-02	2.80E+02	4.67E-03	1.82E+03	2.11E+02
1,1-Dichloroethane	99	5.6E-03	2.30E-01	7.42E-02	1.05E-05	5.30E+01	7.95E-02	5.06E+03	6.40E-04	4.90E+03	1.42E+03
1,2-Dichloroethane	99	9.8E-04	4.01E-02	1.04E-01	9.90E-06	3.80E+01	5.70E-02	8.52E+03	1.87E-04	9.07E+03	2.00E+03
cis-1,2-Dichloroethene	97	4.1E-03	1.67E-01	7.36E-02	1.13E-05	3.55E+01	5.33E-02	3.50E+03	5.25E-04	5.42E+03	8.63E+02
trans-1,2-Dichloroethene	97	9.4E-03	3.85E-01	7.07E-02	1.19E-05	3.80E+01	5.70E-02	6.30E+03	1.04E-03	3.85E+03	1.74E+03
1,1-Dichloroethene	97	2.7E-02	1.10E+00	9.00E-02	1.00E-05	6.50E+01	9.75E-02	2.30E+03	2.60E-03	2.43E+03	9.27E+02
2,4-Dichlorophenol	163	3.2E-06	1.30E-04	3.46E-02	8.77E-06	1.47E+02	2.21E-01	4.50E+03			
1,2-Dichloropropane	110	2.7E-03	1.10E-01	7.80E-02	8.70E-06	4.40E+01	6.60E-02	2.80E+03	3.58E-04	6.56E+03	7.07E+02
1,3-Dichloropropene	111	1.8E-02	7.26E-01	6.26E-02	1.00E-05	2.70E+01	4.05E-02	2.80E+03	1.60E-03	3.11E+03	8.43E+02
Dicyclopentadiene	130	1.1E-02	4.40E-01	6.70E-02	1.00E-05	5.70E+02	8.55E-01	1.80E+03	2.86E-04	7.34E+03	1.95E+03
Dieldrin	381	1.5E-05	6.19E-04	1.25E-02	4.74E-06	2.14E+04	3.21E+01	1.95E-01			
Diethyl phthalate	222.2	4.5E-07	1.85E-05	2.56E-02	6.35E-06	2.88E+02	4.32E-01	1.08E+03			
Dimethyl phthalate	194.19	4.1E-07	1.70E-05	5.68E-02	6.29E-06	3.71E+01	5.56E-02	4.00E+03			
Di-n-butyl phthalate	278.34	9.4E-10	3.85E-08	4.38E-02	7.86E-06	3.39E+04	5.09E+01	1.12E+01			

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
2,4-Dimethylphenol	122.16	2.0E-06	8.20E-05	5.84E-02	8.69E-06	2.09E+02	3.14E-01	7.87E+03			
4,6-Dinitro-o-cresol	198.14	1.4E-06	5.72E-05	2.93E-02	6.91E-06	6.02E+02	9.02E-01	1.98E+02			
2,4-Dinitrophenol	184.11	8.6E-08	3.52E-06	2.73E-02	9.06E-06	3.64E+02	5.46E-01	2.79E+03			
2,4-Dinitrotoluene	182.14	9.3E-08	3.80E-06	2.03E-01	7.06E-06	9.55E+01	1.43E-01	2.70E+02			
1,2-Diphenylhydrazine	184.24	4.6E-11	1.90E-09	3.17E-02	7.36E-06	3.48E+03	5.22E+00	2.21E+02			
Endosulfan	406.95	1.1E-05	4.59E-04	1.15E-02	4.55E-06	2.14E+03	3.21E+00	5.10E-01			
Endrin	381	7.5E-06	3.08E-04	1.25E-02	4.74E-06	1.23E+04	1.85E+01	2.50E-01			
Epichlorohydrin	93	3.2E-05	1.30E-03	8.80E-02	9.80E-06	3.50E+00	5.25E-03	6.00E+04	8.88E-06	4.17E+04	1.07E+04
Ethyl acetate	88	1.4E-04	5.70E-03	7.30E-02	9.70E-06	5.90E+01	8.85E-02	8.00E+04	1.81E-05	2.92E+04	2.10E+04
Ethyl acrylate	100.1	2.4E-01	9.80E+00	9.10E-02	8.60E-06	8.40E+02	1.26E+00	2.00E+01	3.63E-03	2.06E+03	5.22E+01
Ethyl chloride	65	1.1E-02	4.50E-01	1.00E-01	1.20E-05	1.50E+01	2.25E-02	5.70E+03	1.90E-03	2.85E+03	1.42E+03
Ethyl ether	74.12	1.3E-05	5.30E-04	7.00E-02	9.30E-06	1.40E+01	2.10E-02	1.00E+04	3.90E-06	6.29E+04	1.94E+03
Ethyl methacrylate	114.12	2.4E-01	1.00E+01	9.10E-02	8.60E-06	8.40E+02	1.26E+00	2.00E+01	3.67E-03	2.05E+03	5.27E+01
Ethylbenzene	106.2	7.9E-03	3.23E-01	7.50E-02	7.80E-06	3.63E+02	5.45E-01	1.69E+02	3.36E-04	6.77E+03	1.28E+02
Ethylene oxide	44	7.6E-05	3.10E-03	1.30E-01	1.50E-05	2.20E+00	3.30E-03	1.00E+06	2.72E-05	2.38E+04	1.77E+05
Fluoranthene	202.3	1.6E-05	6.60E-04	3.02E-02	6.35E-06	1.07E+05	1.61E+02	2.06E-01			
Fluorene	166.21	7.8E-05	3.20E-03	6.10E-02	7.88E-06	7.90E+03	1.19E+01	1.90E+00	1.96E-07	2.80E+05	2.28E+01
Fluoride	38	2.4E-02	1.00E+00			1.43E+01	1.50E+02	1.69E+00			
Furan	68	5.4E-03	2.20E-01	1.00E-01	1.20E-05	1.20E+01	1.80E-02	1.00E+04	1.06E-03	3.81E+03	2.18E+03
Heptachlor	373.5	1.1E-03	4.47E-02	1.12E-02	5.69E-06	1.41E+06	2.12E+03	1.80E-01			
Hexachlorobenzene	284.8	1.3E-03	5.41E-02	5.42E-02	5.91E-06	5.50E+04	8.25E+01	6.20E+00			
Hexachloro-1,3-butadiene	260.76	8.1E-03	3.34E-01	5.61E-02	6.16E-06	5.37E+04	8.06E+01	3.23E+00			
Hexachlorocyclopentadiene	272.75	2.7E-02	1.11E+00	1.61E-02	7.21E-06	2.00E+05	3.00E+02	1.80E+00			
Hexachloroethane	236.74	3.9E-03	1.59E-01	2.50E-03	6.80E-06	1.78E+03	2.67E+00	5.00E+01			
n-Hexane	86	1.2E-01	5.00E+00	2.00E-01	7.80E-06	8.90E+02	1.34E+00	1.80E+01	5.01E-03	1.75E+03	3.80E+01
HMX	296.2	1.0E-11	4.10E-10			1.85E+03	2.78E+00	2.56E+03			
Hydrogen cyanide	27	1.3E-04	5.30E-03	1.80E-01	1.80E-05	1.70E+01	2.55E-02	1.00E+06	5.36E-05	1.69E+04	1.99E+05
Indeno(1,2,3-c,d)pyrene	276.3	1.6E-06	6.56E-05	1.90E-02	5.66E-06	3.47E+06	5.21E+03	2.20E-05			
Iron	55.84	2.4E-02	1.00E+00			1.43E+01	2.50E+01				
Isobutanol	74	1.2E-05	4.90E-04	8.60E-02	9.30E-06	6.20E+01	9.30E-02	8.50E+04	3.04E-06	7.12E+04	2.26E+04
Isophorone	138.21	6.6E-06	2.72E-04	6.23E-02	6.76E-06	4.68E+01	7.02E-02	1.20E+04			
Lead	207.2	2.4E-02	1.00E+00			1.43E+01	9.00E+02				

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
lead (Tetraethyl-)	64.52										
Maleic hydrazide	110	6.6E-03	2.70E-01	9.00E-02	1.10E-05	4.20E+01	6.30E-02	6.00E+03	9.52E-04	4.02E+03	1.61E+03
Manganese	54.94	2.4E-02	1.00E+00			1.43E+01	6.50E+01				
Mercury (elemental)	200.59	2.4E-02	1.00E+00	3.07E-02	6.30E-06	1.43E+01	5.20E+01				
Mercury (methyl)	215.62	1.1E-02	4.67E-01			1.43E+01					
Methacrylonitrile	67.09	8.8E-05	3.60E-03	1.10E-01	1.30E-05	8.40E-01	1.26E-03	7.90E+04	2.66E-05	2.41E+04	1.38E+04
Methomyl	160	3.9E-02	1.60E+00	6.90E-02	1.00E-05	1.50E+01	2.25E-02	1.70E+05	3.03E-03	2.25E+03	6.59E+04
Methyl acetate	74.08	2.0E-05	8.40E-04	1.00E-01	1.00E-05	2.20E+00	3.30E-03	1.00E+06	7.22E-06	4.62E+04	1.77E+05
Methyl acrylate	86.09	2.4E-01	9.80E+00	9.10E-02	8.60E-06	8.40E+02	1.26E+00	6.00E+01	3.63E-03	2.06E+03	1.57E+02
Methyl isobutyl ketone	100	1.4E-04	5.70E-03	7.50E-02	7.80E-06	1.30E+02	1.95E-01	1.90E+04	1.30E-05	3.45E+04	7.01E+03
Methyl methacrylate	100	3.4E-04	1.40E-02	7.70E-02	8.60E-06	1.30E+01	1.95E-02	1.50E+04	5.98E-05	1.61E+04	2.92E+03
Methyl styrene (alpha)	118.18	2.3E-03	9.40E-02	7.10E-02	8.00E-06	3.60E+02	5.40E-01	3.00E+02	9.69E-05	1.26E+04	2.17E+02
Methyl styrene (mixture)	118.18	2.3E-03	9.40E-02	7.10E-02	8.00E-06	3.60E+02	5.40E-01	3.00E+02	9.69E-05	1.26E+04	2.17E+02
Methylcyclohexane	98	4.4E-01	1.80E+01	7.00E-02	9.00E-06	2.20E+03	3.30E+00	1.40E+01	2.37E-03	2.55E+03	7.89E+01
Methylene bromide	170	9.0E-04	3.70E-02	8.00E-02	8.00E-06	1.80E+02	2.70E-01	1.20E+04	6.99E-05	1.48E+04	5.37E+03
Methylene chloride	85	2.2E-03	9.00E-02	1.00E-01	1.20E-05	1.20E+01	1.80E-02	1.30E+04	4.69E-04	5.73E+03	2.63E+03
Molybdenum	95.94	2.4E-02	1.00E+00			1.43E+01	2.00E+01				
Naphthalene	128.16	4.8E-04	1.98E-02	5.90E-02	7.50E-06	2.00E+03	3.00E+00	3.10E+01	3.94E-06	6.25E+04	9.84E+01
Nickel	58.71	2.4E-02	1.00E+00			1.43E+01	6.50E+01				
Nitrate	101.1	2.4E-02	1.00E+00			1.43E+01					
Nitrite	46	2.0E-07	8.38E-06			2.37E+01	3.56E-02				
Nitrobenzene	120	2.4E-05	9.84E-04	7.60E-02	8.60E-06	6.46E+01	9.69E-02	2.10E+03	4.16E-06	6.09E+04	5.68E+02
Nitroglycerin	227.08	6.1E-03	2.50E-01			2.60E+02	3.90E-01	1.80E+03			
N-Nitrosodiethylamine	102.14	3.7E-06	1.50E-04	6.48E-02	9.13E-06	1.20E+03	1.80E+00	1.06E+05			
N-Nitrosodimethylamine	74.08	1.4E-01	5.90E+00	3.12E-02	6.35E-06	3.82E+01	5.73E-02	1.00E+06			
N-Nitrosodi-*n*-butylamine	158.2	3.2E-04	1.31E-02	5.80E-02	9.72E-06	2.60E+02	3.90E-01	1.27E+03	1.48E-05	3.23E+04	7.17E+02
N-Nitrosodiphenylamine	198.23	5.0E-06	2.05E-04	3.12E-02	6.35E-06	1.29E+03	1.94E+00	3.51E+01			7.40E+01
N-Nitrosopyrrolidine	100.2	4.9E-08	2.00E-06			1.59E+02	2.38E-01	1.00E+06			
m-Nitrotoluene	137.1	2.4E-05	9.80E-04	7.60E-02	8.60E-06	6.50E+01	9.75E-02	2.10E+03	4.14E-06	6.10E+04	5.69E+02
o-Nitrotoluene	137.13	2.4E-05	9.80E-04	7.60E-02	8.60E-06	6.50E+01	9.75E-02	2.10E+03	4.14E-06	6.10E+04	5.69E+02
p-Nitrotoluene	137.1	2.4E-05	9.80E-04	7.60E-02	8.60E-06	6.50E+01	9.75E-02	2.10E+03	4.14E-06	6.10E+04	5.69E+02
Pentachlorobenzene	250.32	7.1E-03	2.90E-01	5.70E-02	6.30E-06	2.00E+03	3.00E+00	8.31E+02			

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
Pentachlorophenol	266.34	2.4E-08	1.00E-06	5.60E-02	6.10E-06	5.92E+02	8.88E-01	1.95E+03			
Phenanthrene	178.2	2.3E-05	9.40E-04			1.40E+04	2.10E+01	1.15E+00			
Phenol	94	4.0E-07	1.63E-05	8.20E-02	9.10E-06	2.88E+01	4.32E-02	8.28E+04			
Polychlorinatedbiphenyls	(291.98 - 360.86)										
Aroclor 1016	variable	4.2E-02	1.73E+00	1.75E-02	8.00E-06	4.48E+04	6.72E+01	2.77E-01			
Aroclor 1221	variable	1.8E-08	7.40E-07	1.75E-02	8.00E-06	4.48E+04	6.72E+01	2.77E-01			
Aroclor 1232	variable	1.8E-08	7.40E-07	1.75E-02	8.00E-06	4.48E+04	6.72E+01	2.77E-01			
Aroclor 1242	variable	1.8E-08	7.40E-07	1.75E-02	8.00E-06	4.48E+04	6.72E+01	2.77E-01			
Aroclor 1248	variable	1.8E-08	7.40E-07	5.70E+03	6.00E-01	5.30E+05	7.95E+02	2.77E-01			
Aroclor 1254	variable	1.8E-08	7.40E-07	5.70E+03	6.00E-01	5.30E+05	7.95E+02	2.77E-01			
Aroclor 1260	variable	1.8E-08	7.40E-07	5.70E+03	6.00E-01	5.30E+05	7.95E+02	2.77E-01			
n-Propylbenzene	120.19	1.3E-02	5.40E-01	7.50E-02	7.80E-06	2.80E+03	4.20E+00	1.40E+01	9.56E-05	1.27E+04	6.21E+01
Propylene oxide	58	8.5E-05	3.50E-03	1.20E-01	1.30E-05	2.50E+01	3.75E-02	4.80E+05	2.33E-05	2.57E+04	1.01E+05
Pyrene	200	1.1E-05	4.51E-04	2.72E-02	7.24E-06	6.80E+04	1.02E+02	1.35E-01	4.07E-09	1.95E+06	1.38E+01
RDX	222.12	6.3E-08	2.60E-06			7.00E+01	1.05E-01	5.97E+01			
Selenium	78.96	9.7E-03	3.98E-01			1.43E+01	5.00E+00				
Silver	107.87	2.4E-02	1.00E+00			1.43E+01	8.30E+00				
Strontium	87.62	2.4E-02	1.00E+00			1.43E+01	3.50E+01				
Styrene	100	2.7E-03	1.10E-01	7.10E-02	8.00E-06	9.10E+01	1.37E-01	3.10E+02	2.54E-04	7.78E+03	1.00E+02
1,2,4,5-Tetrachlorobenzene	215.89	1.0E-03	4.10E-02	2.11E-02	8.76E-06	1.19E+03	1.78E+00	5.95E-01			
1,1,1,2-Tetrachloroethane	167.85	3.4E-04	1.41E-02	7.10E-02	7.90E-06	7.90E+01	1.19E-01	2.97E+03	3.68E-05	2.05E+04	8.72E+02
1,1,2,2-Tetrachloroethane	169.86	3.4E-04	1.40E-02	7.10E-02	7.90E-06	7.90E+01	1.19E-01	2.97E+03	3.65E-05	2.05E+04	8.72E+02
Tetrachloroethene	170	1.8E-02	7.54E-01	7.20E-02	8.20E-06	2.70E+02	4.05E-01	2.00E+02	8.54E-04	4.25E+03	1.34E+02
Thallium	204.37	2.4E-02	1.00E+00			1.43E+01	7.10E+01				
Toluene	92	6.6E-03	2.72E-01	8.70E-02	8.60E-06	1.82E+02	2.73E-01	5.26E+02	5.19E-04	5.45E+03	2.52E+02
Toxaphene	414	6.0E-06	2.46E-04	1.16E-02	4.34E-06	2.57E+05	3.86E+02	7.40E-01			
Tribromomethane	252.73	6.6E-04	2.70E-02	1.49E-02	1.03E-05	8.70E+01	6.92E+00	3.10E+03	6.51E-07	1.54E+05	2.20E+04
1,1,2-Trichloro-1,2,2-trifluoroethane	187.38	5.2E-01	2.14E+01	2.88E-02	8.07E-06	1.60E+02	2.40E-01	1.10E+03	2.23E-03	2.63E+03	3.28E+03
1,2,4-Trichlorobenzene	181	1.4E-03	5.82E-02	3.00E-02	8.23E-06	1.78E+03	2.67E+00	3.00E+02	6.53E-06	4.86E+04	8.55E+02
1,1,1-Trichloroethane	130	1.7E-02	7.05E-01	7.80E-02	8.80E-06	1.10E+02	1.65E-01	1.33E+03	1.37E-03	3.35E+03	5.63E+02
1,1,2-Trichloroethane	133	9.1E-04	3.74E-02	7.80E-02	8.80E-06	5.01E+01	7.52E-02	4.42E+03	1.22E-04	1.12E+04	1.12E+03

Chemical	MW (g/mole)	H (atm-m^3/mole)	H' (dimensionless)	D_a (cm^2/s)	D_w (cm^2/s)	K_{oc} (cm^3/g)	K_d (cm^3/g)	S (mg/L-water)	D_A (cm^2/s)	VF (m^3/kg)	SAT (mg/kg)
Trichloroethylene	131	1.0E-02	4.22E-01	7.90E-02	9.10E-06	9.40E+01	1.41E-01	1.10E+03	9.61E-04	4.00E+03	4.01E+02
Trichlorofluoromethane	140	9.8E-02	4.00E+00	8.70E-02	1.30E-05	1.60E+02	2.40E-01	1.10E+03	4.15E-03	1.93E+03	9.83E+02
2,4,5-Trichlorophenol	197.46	4.4E-06	1.80E-04	2.91E-02	7.03E-06	1.19E+03	1.78E+00	1.20E+03			
2,4,6-Trichlorophenol	197.46	7.8E-06	3.20E-04	3.18E-02	6.25E-06	1.19E+03	1.78E+00	8.00E+02			
1,1,2-Trichloropropane	147.43	2.9E-02	1.20E+00	4.00E-02	9.30E-06	5.10E+01	7.65E-02	2.70E+03	1.29E-03	3.45E+03	1.06E+03
1,2,3-Trichloropropane	147.43	2.7E-02	1.10E+00	7.10E-02	7.90E-06	5.10E+01	7.65E-02	2.70E+03	2.17E-03	2.67E+03	1.03E+03
1,2,3-Trichloropropene	145.42	2.7E-02	1.10E+00	7.10E-02	7.90E-06	5.10E+01	7.65E-02	2.70E+03	2.17E-03	2.67E+03	1.03E+03
Triethylamine	101.19	9.0E-05	3.70E-03	1.20E-01	1.30E-05	2.20E+00	3.30E-03	1.00E+06	2.92E-05	2.30E+04	1.77E+05
1,2,4-Trimethylbenzene	120	5.6E-03	2.30E-01	7.50E-02	7.10E-06	3.70E+03	5.55E+00	2.60E-01	3.14E-05	2.21E+04	1.50E+00
1,3,5-Trimethylbenzene	120	7.8E-03	3.20E-01	7.50E-02	7.10E-06	8.20E+02	1.23E+00	4.80E+01	1.75E-04	9.40E+03	6.92E+01
2,4,6-Trinitrotoluene	227.13	4.6E-07	1.90E-05	2.45E-02	6.36E-06	1.83E+03	2.75E+00	1.30E+02			
Vanadium	50.94	2.4E-02	1.00E+00			1.43E+01	1.00E+03				
Vinyl acetate	86	5.1E-04	2.10E-02	8.50E-02	9.20E-06	5.30E+00	7.95E-03	2.00E+04	1.04E-04	1.22E+04	3.68E+03
Vinyl bromide	106.95	6.3E-03	2.60E-01	1.00E-01	1.20E-05	1.30E+02	1.95E-01	1.80E+04	6.84E-04	4.75E+03	7.19E+03
Vinyl chloride	63	2.7E-02	1.11E+00	1.10E-01	1.20E-06	1.86E+01	2.79E-02	2.80E+03	3.87E-03	1.99E+03	9.36E+02
Vinyl chloride	63	2.7E-02	1.11E+00	1.10E-01	1.20E-06	1.86E+01	2.79E-02	2.80E+03	3.87E-03	1.99E+03	9.36E+02
m-Xylene	106	7.3E-03	3.01E-01	7.00E-02	7.80E-06	2.00E+02	3.00E-01	1.61E+02	4.34E-04	5.96E+03	8.20E+01
o-Xylene	106	5.2E-03	2.13E-01	8.70E-02	1.00E-05	2.40E+02	3.60E-01	1.78E+02	3.48E-04	6.65E+03	9.95E+01
Xylenes	106	7.3E-03	3.00E-01	7.00E-02	7.80E-06	2.00E+02	3.00E-01	1.61E+02	4.33E-04	5.96E+03	8.20E+01
Zinc	65.38	2.4E-02	1.00E+00			1.43E+01	6.20E+01				

Notes:
MW – Molecular weight
H' – Dimensionless Henry's Law Constant
D_w – Diffusivity in water
K_d – Soil-water partition coefficient
D_A – Apparent diffusivity (calculated for VOCs only)
SAT – Soil saturation limit (calculated for VOCs only)
H – Henry's Law Constant
D_a – Diffusivity in air
K_{oc} – Soil organic carbon partition coefficient
S - Solubility in water
VF – Volatilization factor (calculated for VOCs only)
VOC – Volatile organic compound

APPENDIX C

Table C-1: Human Health Benchmarks Used for Calculating SSLs

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
Acenaphthene			6.00E-02	IRIS			6.00E-02	route	0
Acetaldehyde					7.70E-03	IRIS	2.60E-03	IRIS	0
Acetone			9.00E-01	IRIS			9.00E-01	route	0
Acrylonitrile	5.40E-01	IRIS	1.00E-03	HEAST	2.40E-01	IRIS	5.71E-04	IRIS	0
Acetophenone			1.00E-01	IRIS			1.00E-01	route	0
Acrolein			5.00E-04	IRIS			5.71E-06	IRIS	0
Aldrin	1.72E+01	IRIS	3.00E-05	IRIS	1.72E+01	IRIS	3.00E-05	route	0.1
Aluminum			1.00E+00	NCEA			1.40E-03	NCEA	0
Anthracene			3.00E-01	IRIS			3.00E-01	route	0
Antimony			4.00E-04	IRIS					0
Arsenic	1.50E+00	IRIS	3.00E-04	IRIS	1.51E+01	IRIS			0.03
Barium			2.00E-01	IRIS			2.00E-01	route	0
Benzene	5.50E-02	IRIS	4.00E-03	IRIS	2.70E-02	IRIS	8.60E-03	IRIS	0
Benzidine	2.30E+02	IRIS	3.00E-03	IRIS	2.35E+02	IRIS	3.00E-03	route	0.1
Benzo(a)anthracene	7.30E-01	NCEA			3.10E-01	NCEA			0.13
Benzo(a)pyrene	7.30E+00	IRIS			3.10E+00	NCEA			0.13
Benzo(b)fluoranthene	7.30E-01	NCEA			3.10E-01	NCEA			0.13
Benzo(k)fluoranthene	7.30E-02	NCEA			3.10E-02	NCEA			0.13
Beryllium			2.00E-03	IRIS	8.40E+00	IRIS	5.71E-06	IRIS	0
α-BHC	6.30E+00	IRIS	5.00E-04	NCEA	6.30E+00	IRIS	5.00E-04	route	0.04
β-BHC	1.80E+00	IRIS	2.00E-04	NCEA	1.80E+00	IRIS	2.00E-04	route	0.04
γ-BHC	1.30E+00	HEAST	3.00E-04	IRIS	3.00E-04	route	3.00E-04	route	0.04
1,1-Biphenyl			5.00E-02	IRIS			5.00E-02	route	0

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
Bis(2-chloroethyl) ether	1.10E+00	IRIS			1.16E+00	IRIS			0
Bis(2-chloroisopropyl) ether	7.00E-02	HEAST	4.00E-02	IRIS	3.50E-02	HEAST	4.00E-02	route	0
Bis(2-ethylhexyl) phthalate	1.40E-02	IRIS	2.00E-02	IRIS	1.40E-02	route	2.00E-02	route	0.1
Bis(chloromethyl) ether	2.20E+02	IRIS			2.17E+02	IRIS			0
Boron			2.00E-01	IRIS			5.70E-03	HEAST	0
Bromobenzene			2.00E-02	NCEA			2.90E-03	NCEA	0
Bromodichloromethane	6.20E-02	IRIS	2.00E-02	IRIS	6.20E-02	route	2.00E-02	route	0
Bromomethane			1.40E-03	IRIS			1.43E-03	IRIS	0
1,3-Butadiene					1.05E-01	IRIS	5.71E-04	IRIS	0
2-Butanone (MEK)			6.00E-01	IRIS			1.43E+00	IRIS	0
tert-Butyl methyl ether (MTBE)	1.80E-03	Reg 6/prov	8.60E-01	route	1.80E-03	route	8.57E-01	IRIS	0
n-Butylbenzene			1.00E-02	NCEA			1.00E-02	route	0
sec-Butylbenzene			1.00E-02	NCEA			1.00E-02	route	0
tert-Butylbenzene			1.00E-02	NCEA			1.00E-02	route	0
Cadmium			5.00E-04	IRIS	6.30E+00	IRIS			0.001
Carbon disulfide			1.00E-01	IRIS			2.00E-01	IRIS	0
Carbon tetrachloride	1.30E-01	IRIS	7.00E-04	IRIS	5.25E-02	IRIS			0
Chlordane	3.50E-01	IRIS	5.00E-04	IRIS	3.50E-01	IRIS	2.00E-04	IRIS	0.04
2-Chloroacetophenone			8.60E-06	route			8.57E-06	IRIS	0
2-Chloro-1,3-butadiene			2.00E-02	HEAST			2.00E-03	HEAST	0
1-Chloro-1,1-difluoroethane			1.40E+01	route			1.43E+01	IRIS	0
Chlorobenzene			2.00E-02	iRIS			1.70E-02	NCEA	0
1-Chlorobutane			4.00E-02	Reg 6/prov			4.00E-02	route	0
Chlorodifluoromethane			4.10E+01	route			1.43E+01	IRIS	0
Chloroethane	2.90E-03	NCEA	4.00E-01	NCEA	2.90E-03	route	2.86E+00	IRIS	0
Chloroform			1.00E-02	IRIS	8.05E-02	IRIS	1.35E-02	NCEA	0

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
Chloromethane	1.30E-02	HEAST			6.30E-03	HEAST	2.57E-02	IRIS	0
β-Chloronaphthalene			8.00E-02	IRIS			8.00E-02	route	0
o-Chloronitrobenzene	9.70E-03	HEAST	1.00E-03	HEAST	9.70E-03	route	2.00E-05	HEAST	0
p-Chloronitrobenzene	6.70E-03	HEAST	1.00E-03	HEAST	6.70E-03	route	1.70E-04	HEAST	0
2-Chlorophenol			5.00E-03	IRIS			5.00E-03	route	0
2-Chloropropane			2.90E-02	route			2.90E-02	HEAST	0
o-Chlorotoluene			2.00E-02	IRIS			2.00E-02	route	0
Chromium III			1.50E+00	IRIS					0
Chromium VI			3.00E-03	IRIS	2.90E+02	IRIS	2.85E-05	IRIS	0
Chrysene	7.30E-03	NCEA			3.10E-03	NCEA			0.13
Cobalt			2.00E-02	NCEA	9.80E+00	NCEA	5.70E-06	NCEA	0
Copper			4.00E-02	HEAST					0
Crotonaldehyde	1.90E+00	HEAST			1.90E+00	route			0
Cumene (isopropylbenzene)			1.00E-01	IRIS			1.14E-01	IRIS	0
Cyanide			2.00E-02	IRIS					0.1
Cyanogen			4.00E-02	IRIS					0
Cyanogen bromide			9.00E-02	IRIS					0
Cyanogen chloride			5.00E-02	IRIS					0
DDD	2.40E-01	IRIS			2.40E-01	route			0.03
DDE	3.40E-01	IRIS			3.40E-01	route			0.03
DDT	3.40E-01	IRIS	5.00E-04	IRIS	3.40E-01	IRIS	5.00E-04	route	0.03
Dibenz(a,h)anthracene	7.30E+00	NCEA			3.10E+00	NCEA			0.13
Dibenzofuran			2.00E-03	NCEA			2.00E-03	route	0
1,2-Dibromo-3-chloropropane	1.40E+00	HEAST	5.70E-05	route	2.40E-03	HEAST	5.70E-05	IRIS	0
Dibromochloromethane	8.40E-02	IRIS	2.00E-02	IRIS	8.40E-02	route	2.00E-02	route	0
1,2-Dibromoethane	2.00E+00	IRIS	9.00E-03	iRIS	2.00E+00	IRIS	2.60E-03	IRIS	0

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
1,4-Dichloro-2-butene	9.30E+00	route			9.30E+00	HEAST			0
1,2-Dichlorobenzene			9.00E-02	IRIS			6.90E-03	NCEA	0
1,3-Dichlorobenzene			3.00E-03	NCEA			3.00E-03	NCEA	0
1,4-Dichlorobenzene	2.40E-02	HEAST	3.00E-02	NCEA	2.20E-02	NCEA	2.29E-01	IRIS	0
3,3-Dichlorobenzidine	4.50E-01	IRIS			4.50E-01	route			0.1
Dichlorodifluoromethane			2.00E-01	IRIS			5.71E-02	HEAST	0
1,1-Dichloroethane			2.00E-01	Reg 6/prov			2.00E-01	Reg 6/prov	0
1,2-Dichloroethane	9.10E-02	IRIS	2.00E-02	NCEA	9.10E-02	IRIS	1.40E-03	NCEA	0
cis-1,2-Dichloroethene			1.00E-02	HEAST			1.00E-02	route	0
trans-1,2-Dichloroethene			2.00E-02	IRIS			2.00E-02	route	0
1,1-Dichloroethene			5.00E-02	IRIS			5.70E-02	IRIS	0
2,4-Dichlorophenol			3.00E-03	IRIS			3.00E-03	route	0.1
1,2-Dichloropropane	6.80E-02	HEAST	1.10E-03	route	6.80E-02	route	1.10E-03	IRIS	0
1,3-Dichloropropene	1.00E-01	IRIS	3.00E-02	IRIS	1.40E-02	IRIS	5.71E-03	IRIS	0
Dicyclopentadiene			8.00E-03	Reg 6/prov			2.00E-03	Reg 6/prov	0
Dieldrin	1.60E+01	IRIS	5.00E-05	IRIS	1.61E+01	IRIS	5.00E-05	route	0.1
Diethyl phthalate			8.00E-01	IRIS			8.00E-01	route	0.1
Dimethyl phthalate			1.00E+01	HEAST			1.00E+01	route	0.1
Di-n-butyl phthalate			1.00E-01	IRIS			1.00E-01	route	0.1
2,4-Dimethylphenol			2.00E-02	IRIS			2.00E-02	route	0.1
4,6-Dinitro-o-cresol			1.00E-04	prov.			1.00E-04	route	0.1
2,4-Dinitrophenol			2.00E-03	IRIS			2.00E-03	route	0.1
2,4-Dinitrotoluene			2.00E-03	IRIS			2.00E-03	route	0.1
1,2-Diphenylhydrazine	8.00E-01	IRIS			7.70E-01	IRIS			0.1
Endosulfan			6.00E-03	IRIS			6.00E-03	route	0.1
Endrin			3.00E-04	IRIS			3.00E-04	route	0.1

Chemical	CSF_o (mg/kg-day)$^{-1}$	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
Epichlorohydrin	9.90E-03	IRIS	2.00E-03	HEAST	4.20E-03	IRIS	2.86E-04	IRIS	0
Ethyl acetate			9.00E-01	IRIS			9.00E-01	route	0
Ethyl acrylate	4.80E-02	HEAST			4.80E-02	route			0
Ethyl chloride	2.90E-03	NCEA	4.00E-01	NCEA	2.90E-03	route	2.86E+00	IRIS	0
Ethyl ether			2.00E-01	IRIS			2.00E-01	route	0
Ethyl methacrylate			9.00E-02	HEAST			9.00E-02	route	0
Ethylbenzene			1.00E-01	IRIS			2.90E-01	IRIS	0
Ethylene oxide	1.00E+00	HEAST			3.50E-01	HEAST			0
Fluoranthene			4.00E-02	IRIS			4.00E-02	route	0.13
Fluorene			4.00E-02	IRIS			4.00E-02	route	0
Fluoride			6.00E-02	IRIS					0.1
Furan			1.00E-03	IRIS			1.00E-03	route	0
Heptachlor	4.50E+00	IRIS	5.00E-04	IRIS	4.55E+00	IRIS	5.00E-04	route	0.1
Hexachlorobenzene	1.60E+00	IRIS	8.00E-04	IRIS	1.61E+00	IRIS	8.00E-04	route	0.1
Hexachloro-1,3-butadiene	7.80E-02	IRIS	2.00E-04	HEAST	7.70E-02	IRIS	2.00E-04	route	0.1
Hexachlorocyclopentadiene			6.00E-03	IRIS			5.71E-05	IRIS	0.1
Hexachloroethane	1.40E-02	IRIS	1.00E-03	IRIS	1.40E-02	IRIS	1.00E-03	route	0.1
n-Hexane			1.10E+01	prov.			5.71E-02	IRIS	0
HMX			5.00E-02	IRIS			5.00E-02	route	0.1
Hydrogen cyanide			2.00E-02	IRIS			8.57E-04	IRIS	0
Indeno(1,2,3-c,d)pyrene	7.30E-01	NCEA			3.10E-01	NCEA			0.13
Iron			3.00E-01	NCEA					0
Isobutanol			3.00E-01	IRIS			3.00E-01	route	0
Isophorone	9.50E-04	IRIS	2.00E-01	IRIS	9.50E-04	route	2.00E-01	route	0.1
Lead									0
Lead (tetraethyl-)			1.00E-07	IRIS					0.1

Chemical	CSF$_o$ (mg/kg-day)$^{-1}$	Reference	RfD$_o$ (mg/kg-day)	Reference	CSF$_i$ (mg/kg-day)$^{-1}$	Reference	RfD$_i$ (mg/kg-day)	Reference	ABS
Maleic hydrazide			5.00E-01	IRIS			5.00E-01	route	0
Manganese			4.70E-02	Reg 6			1.40E-05	IRIS	0
Mercury (elemental)							8.57E-05	IRIS	0
Mercury (methyl)			1.00E-04	IRIS					0.1
Methacrylonitrile			1.00E-04	IRIS			2.00E-04	HEAST	0
Methomyl			2.50E-02	IRIS			2.50E-02	route	0
Methyl acetate			1.00E+00	HEAST			1.00E+00	route	0
Methyl acrylate			3.00E-02	HEAST			3.00E-02	route	0
Methyl isobutyl ketone			8.00E-02	HEAST			8.57E-01	IRIS	0
Methyl methacrylate			1.40E+00	IRIS			2.00E-01	IRIS	0
Methyl styrene (alpha)			7.00E-02	HEAST			7.00E-02	route	0
Methyl styrene (mixture)			6.00E-03	HEAST			1.00E-02	HEAST	0
Methylcyclohexane			8.60E-01	route			8.60E-01	HEAST	0
Methylene bromide			1.00E-02	HEAST			1.00E-02	route	0
Methylene chloride	7.50E-03	IRIS	6.00E-02	IRIS	1.65E-03	IRIS	8.60E-01	HEAST	0
Molybdenum			5.00E-03	IRIS					0
Naphthalene			2.00E-02	IRIS			8.57E-04	IRIS	0
Nickel			2.00E-02	IRIS					0
Nitrate			1.60E+00	IRIS					0
Nitrite			1.00E-01	IRIS					0
Nitrobenzene			5.00E-04	IRIS			5.71E-04	HEAST	0
Nitroglycerin	1.40E-02	NCEA			1.40E-02	route			0.1
N-Nitrosodiethylamine	1.50E+02	IRIS			1.51E+02	IRIS			0.1
N-Nitrosodimethylamine	5.10E+01	IRIS	8.00E-06	prov.	4.90E+01	I[	8.00E-06	route	0.1
N-Nitrosodi-*n*-butylamine	5.40E+00	IRIS			5.60E+00	IRIS			0.1
N-Nitrosodiphenylamine	4.90E-03	IRIS	2.00E-02	prov.	4.90E-03	route	2.00E-02	route	0.1

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
N-Nitrosopyrrolidine	2.10E+00	IRIS			2.14E+00	IRIS			0.1
m-Nitrotoluene			2.00E-02	HEAST			2.00E-02	route	0
o-Nitrotoluene	2.30E-01	prov.	1.00E-02	HEAST	2.30E-01	route	1.00E-02	route	0
p-Nitrotoluene	1.70E-02	prov.	1.00E-02	HEAST	1.70E-02	route	1.00E-02	route	0
Pentachlorobenzene			8.00E-04	IRIS			8.00E-04	route	0.1
Pentachlorophenol	1.20E-01	IRIS	3.00E-02	IRIS	1.20E-01	route	3.00E-02	route	0.25
Phenanthrene (pyrene surrogate)			3.00E-02	IRIS			3.00E-02	route	0.1
Phenol			3.00E-01	IRIS			3.00E-01	route	0.1
Polychlorinatedbiphenyls									
Aroclor 1016	7.00E-02	IRIS	7.00E-05	IRIS	7.00E-02	IRIS	7.00E-05	route	0.14
Aroclor 1221	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
Aroclor 1232	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
Aroclor 1242	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
Aroclor 1248	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
Aroclor 1254	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
Aroclor 1260	2.00E+00	IRIS	2.00E-05	IRIS	2.00E+00	IRIS	2.00E-05	route	0.14
n-Propylbenzene			1.00E-02	NCEA			1.00E-02	route	0
Propylene oxide	2.40E-01	IRIS	8.60E-03	route	1.30E-02	IRIS	8.57E-03	IRIS	0
Pyrene			3.00E-02	IRIS			3.00E-02	route	0
RDX	1.10E-01	IRIS	3.00E-03	IRIS	1.10E-01	route	3.00E-03	route	0.1
Selenium			5.00E-03	IRIS					0
Silver			5.00E-03	IRIS					0
Strontium			6.00E-01	IRIS					0
Styrene			2.00E-01	IRIS			2.86E-01	IRIS	0
1,2,4,5-Tetrachlorobenzene			3.00E-04	IRIS			3.00E-04	route	0.1
1,1,1,2-Tetrachloroethane	2.60E-02	IRIS	3.00E-02	IRIS	2.59E-02	IRIS	3.00E-02	route	0

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
1,1,2,2-Tetrachloroethane	2.00E-01	IRIS	6.00E-02	NCEA	2.03E-01	IRIS	6.00E-02	route	0
Tetrachloroethylene	5.20E-02	NCEA	1.00E-02	IRIS	2.03E-02	NCEA	1.14E-01	NCEA	0
Thallium			6.60E-05	IRIS					0
Toluene			8.00E-02	IRIS			1.40E+00	IRIS	0
Toxaphene	1.10E+00	IRIS			1.12E+00	IRIS			0.1
Tribromomethane (Bromoform)	7.90E-03	IRIS	2.00E-02	IRIS	3.85E-03	IRIS	2.00E-02	route	0
1,1,2-Trichloro-1,2,2-trifluoroethane			3.00E+01	IRIS			8.57E+00	HEAST	0
1,2,4-Trichlorobenzene			1.00E-02	IRIS			1.00E-03	prov.	0
1,1,1-Trichloroethane			2.80E-01	NCEA			6.30E-01	NCEA	0
1,1,2-Trichloroethane	5.70E-02	IRIS	4.00E-03	IRIS	5.60E-02	IRIS	4.00E-03	route	0
Trichloroethene	4.0E-01	NCEA	3.00E-04	NCEA	4.0E-01	NCEA	1.00E-02	NCEA	0
Trichlorofluoromethane			3.00E-01	IRIS			2.00E-01	HEAST	0
2,4,5-Trichlorophenol			1.00E-01	IRIS			1.00E-01	route	0.1
2,4,6-Trichlorophenol	1.10E-02	IRIS	1.00E-04	NCEA	1.09E-02	IRIS	1.00E-04	route	0.1
1,1,2-Trichloropropane			5.00E-03	IRIS			5.00E-03	route	0
1,2,3-Trichloropropane	2.00E+00	NCEA	6.00E-03	IRIS	2.00E+00	route	1.40E-03	NCEA	0
1,2,3-Trichloropropene			1.00E-02	prov.			2.90E-04	prov.	0
Triethylamine			1.99E-03	route			1.99E-03	IRIS	0
1,2,4-Trimethylbenzene			5.00E-02	NCEA			1.70E-03	NCEA	0
1,3,5-Trimethylbenzene			5.00E-02	NCEA			1.70E-03	NCEA	0
2,4,6-Trinitrotoluene	3.00E-02	IRIS	5.00E-04	IRIS	3.00E-02	route	5.00E-04	route	0.1
Vanadium			1.00E-03	NCEA					0
Vinyl acetate			1.00E+00	HEAST			5.71E-02	IRIS	0
Vinyl bromide (Bromomethene)	1.10E-02	route	8.60E-04	HEAST	1.10E-01	HEAST	8.57E-04	IRIS	0
Vinyl chloride (Child)	1.40E+00	IRIS	3.00E-03	IRIS	3.00E-02	IRIS	2.80E-02	IRIS	0
Vinyl chloride (Adult)	7.20E-01	IRIS	3.00E-03	IRIS	1.54E-02	IRIS	2.85E-02	IRIS	0

Chemical	CSF_o (mg/kg-day^{-1}	Reference	RfD_o (mg/kg-day)	Reference	CSF_i (mg/kg-day)$^{-1}$	Reference	RfD_i (mg/kg-day)	Reference	ABS
m-Xylene			2.00E-01	IRIS			2.86E-02	IRIS	0.1
o-Xylene			2.00E-01	IRIS					0.1
Xylenes			2.00E-01	IRIS			2.86E-02	IRIS	0.1
Zinc			3.00E-01	IRIS					0

Notes:
CSFo – Oral cancer slope factor
CSFi – Inhalation cancer slope factor
RfDo – Oral Reference Dose
RfDi – Inhalation Reference Dose
r – Route-to-route extrapolation
ABS – Dermal absorption coefficient

IRIS – Integrated Risk Information System, USEPA 2006.
NCEA – National Center for Environmental Assessment, Office of Research and Development, USEPA 2003c.

VOLUME 2

TIER 1: SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

PHASE I
Scoping Assessment

TABLE OF CONTENTS

1. Introduction

The purpose of an ecological risk assessment is to evaluate the potential adverse effects that chemical contamination has on the plants and animals that make up ecosystems. The risk assessment process provides a way to develop, organize and present scientific information so that it is relevant to environmental decisions.

The New Mexico Environment Department Hazardous Waste Bureau (NMED) has developed a tiered procedure for the evaluation of ecological risk. This procedure is outlined in the *Guidance for Assessing Ecological Risks Posed by Chemicals: Screening-Level Ecological Risk Assessment* (GAERPC) (NMED, 2000). Briefly, the tiers of the procedure are organized as follows:

PHASE I: QUALITATIVE ASSESSMENT

- Tier I: Screening-Level Ecological Risk Assessment
- Scoping Assessment
- Screening Assessment

PHASE II: QUANTITATIVE ASSESSMENT

- Tier II: Site-Specific Ecological Risk Assessment

As discussed above and illustrated in Figure 1, the Scoping Assessment is the first phase of the Tier I Screening-Level Ecological Risk Assessment process as defined by the NMED GAERPC. This document provides specific procedures to assist the facility in conducting the first step (Scoping Assessment) of the Tier I, Screening-Level Ecological Risk Assessment process outlined in the GAERPC. The purpose of the Scoping Assessment is to gather information, which will be used to determine if there is "any reason to believe that ecological receptors and/or complete exposure pathways exist at or in the locality of the site" (NMED, 2000). The scoping assessment step also serves as the initial information-gathering phase for sites clearly in need of a more detailed assessment of potential ecological risk. This document outlines the methodology for conducting a Scoping Assessment, and includes a Site Assessment Checklist (Attachment A), which serves as tool for gathering information about the facility property and surrounding areas. Although the GAERPC provides a copy of the US EPA Checklist for Ecological Assessment/Sampling (US EPA, 1997), the attached Site Assessment Checklist provides an expanded, user-friendly template, which both guides the user as to what information to collect and furnishes an organized structure in which to enter the information.

After the Site Assessment Checklist has been completed, the assessor must use the collected information to generate a Scoping Assessment Report and Preliminary Conceptual Site Exposure Model (PCSEM). Guidance for performing these tasks is provided in this document, and in the GAERPC. The Scoping Assessment Report and PCSEM are subsequently used to address the first in a series of Technical Decision Points of the tiered GAERPC process. Technical Decision Points are questions which must be answered by the assessor after the completion of certain phases in the process. The resulting answer to the question determines the next step to be undertaken by the facility. The first Technical Decision Point, as illustrated in Figure 1, is to decide: *Is Ecological Risk Suspected?*

If the answer to the first Technical Decision Point is "no" (that is, ecological risk is not suspected), the assessor may use the Exclusion Criteria Checklist and Decision Tree (Attachment B) to help confirm or deny that possibility. However, it is unlikely that any site containing potential ecological habitat or receptors will meet the Site Exclusion Criteria.

If ecological risk is suspected, the facility will usually be directed to proceed to the next phase of Tier I, which is a Screening Level Ecological Risk Assessment (SLERA). A SLERA is a simplified risk assessment that can be conducted with limited site-specific data by defining assumptions for parameters that lack site-specific data (US EPA, 1997). Values used for screening are consistently biased in the direction of overestimating risk to ensure that sites that might pose an ecological risk are properly identified. The completed Site Assessment Checklist is a valuable source of information needed for the completion of the SLERA. Instructions for performing a SLERA can be found in the GAERPC and in a number of EPA guidance documents (e.g., US EPA, 1997; US EPA, 1998).

2. Scoping Assessment

The Scoping Assessment serves as the initial information gathering and evaluation phase of the Tier I process. A Scoping Assessment consists of the following steps:

- Compile and Assess Basic Site Information (using Site Assessment Checklist)
- Conduct Site Visit
- Identify Preliminary Contaminants of Potential Ecological Concern
- Develop a Preliminary Conceptual Site Exposure Model
- Prepare a Scoping Assessment Report

The following subsections provide guidance for completing each step of the Scoping Assessment. For additional guidance, readers should refer to the GAERPC (NMED, 2000).

2.1 Compile and Assess Basic Site Information

The first step of the Scoping Assessment process is to compile and assess basic site information. Since the purpose of the Scoping Assessment is to determine if ecological habitats, receptors, and complete exposure pathways are likely to exist at the site, those items are the focus of the information gathering. The Site Assessment Checklist (Attachment A) should be used to complete this step. The questions in the Site Assessment Checklist should be addressed as completely as possible with the information available before conducting a site visit.

In many cases, a large portion of the Site Assessment Checklist can be completed using reference materials and general knowledge of the site. A thorough file search should be conducted to compile all potential reference materials. Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) and Facility Investigation (RFI) reports, inspection reports, RCRA Part B Permit

Applications, and facility maps can all be good sources of the information needed for the Site Assessment Checklist.

Habitats and receptors which may be present at the site can be identified by contacting local and regional natural resource agencies. Habitat types may be determined by reviewing land use and land cover maps (LULC), which are available via the Internet at http://www.nationalatlas.gov/scripts. Additional sources of general information for the identification of ecological receptors and habitats are listed in the introduction section of the Site Assessment Checklist (Attachment A).

After all available information has been compiled and entered into the Site Assessment Checklist, the assessor should review the checklist and identify data gaps. Plans should then be made to obtain the missing information by performing additional research and/or by observation and investigation during the site visit.

2.2 SITE VISIT

When performing a Scoping Assessment, at least one site visit should be conducted to directly assess ecological features and conditions. As discussed in the previous section, completion of the Site Assessment Checklist should have begun during the compilation of basic site information. The site visit allows for verification of the information obtained from the review of references and other information sources. The current land and surface water usage and characteristics at the site can be observed, as well as direct and indirect evidence of receptors. In addition to the site, areas adjacent to the site and all areas where ecological receptors are likely to contact site-related chemicals (i.e., all areas which may have been impacted by the release or migration of chemicals from the site) should be observed or visited and addressed in the Site Assessment Checklist. The focus of the habitat and receptor observations should be on a community level. That is, dominant plant and animal species and habitats (e.g., wetlands, wooded areas) should be identified during the site visit. Photographs should be taken during the site visit and attached to the Scoping Assessment Report. Photographs are particularly useful for documenting the nature, quality, and distribution of vegetation, other ecological features, potential exposure pathways, and any evidence of contamination or impact. While the focus of the survey is on the community level, the U.S. Fish and Wildlife Service and the New Mexico Natural Heritage Program should be contacted prior to the site visit. The intent is to determine if state listed and/or federal listed Threatened & Endangered (T&E) species or sensitive habitats may be present at the site, or if any other fish or wildlife species could occur in the area (as indicated in the Site Assessment Checklist, Section IIID). A trained biologist or ecologist should conduct the biota surveys to appropriately characterize major habitats and to determine whether T&E species are present or may potentially use the site. The site assessment should also include a general survey for T&E species and any sensitive habitats (e.g. wetlands, perennial waters, breeding areas), due to the fact that federal and state databases might not be complete.

Site visits should be conducted at times of the year when ecological features are most apparent (i.e., spring, summer, early fall). Visits during winter might not provide as much evidence of the presence or absence of receptors and potential exposure pathways.

In addition to observations of ecological features, the assessor should note any evidence of chemical releases (including visual and olfactory clues), drainage patterns, areas with apparent erosion, signs of groundwater discharge at the surface (such as seeps or springs), and any natural or anthropogenic site disturbances.

2.3 IDENTIFY CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

Contaminants of Potential Ecological Concern (COPECs) are chemicals which may pose a threat to individual species or biological communities. For the purposes of the Scoping Assessment, all chemicals known or suspected of being released at the site are considered COPECs. The identification of COPECs is usually accomplished by the review of historical information in which previous site activities and releases are identified, or by sampling data which confirm the presence of contaminants in environmental media at the site. If any non-chemical stressors such as mechanical disturbances or extreme temperature conditions are known to be present at the site, they too are to be considered in the assessment.

After the COPECs have been identified, they should be summarized and organized (such as in table or chart form) for presentation in the Scoping Assessment Report.

2.4 DEVELOPING THE PRELIMINARY CONCEPTUAL SITE EXPOSURE MODEL

A PCSEM provides a summary of potentially complete exposure pathways, along with potentially exposed receptor types. The PCSEM, in conjunction with the scoping report, is used to determine whether further ecological assessment (i.e., Screening-Level Assessment, Site-Specific Assessment) and/or interim measures are required.

A complete exposure pathway is defined as a pathway having all of the following attributes (US EPA, 1998; NMED, 2000):

- A source and mechanism for hazardous waste/constituent release to the environment
- An environmental transport medium or mechanism by which a receptor can come into contact with the hazardous waste/constituent
- A point of receptor contact with the contaminated media or via the food web, and
- An exposure route to the receptor.

If any of the above components are missing from the exposure pathway, it is not a complete pathway for the site. A discussion regarding all possible exposure pathways and the rationale/justification for eliminating any pathways should be included in the PCSEM narrative and in the Scoping Assessment Report.

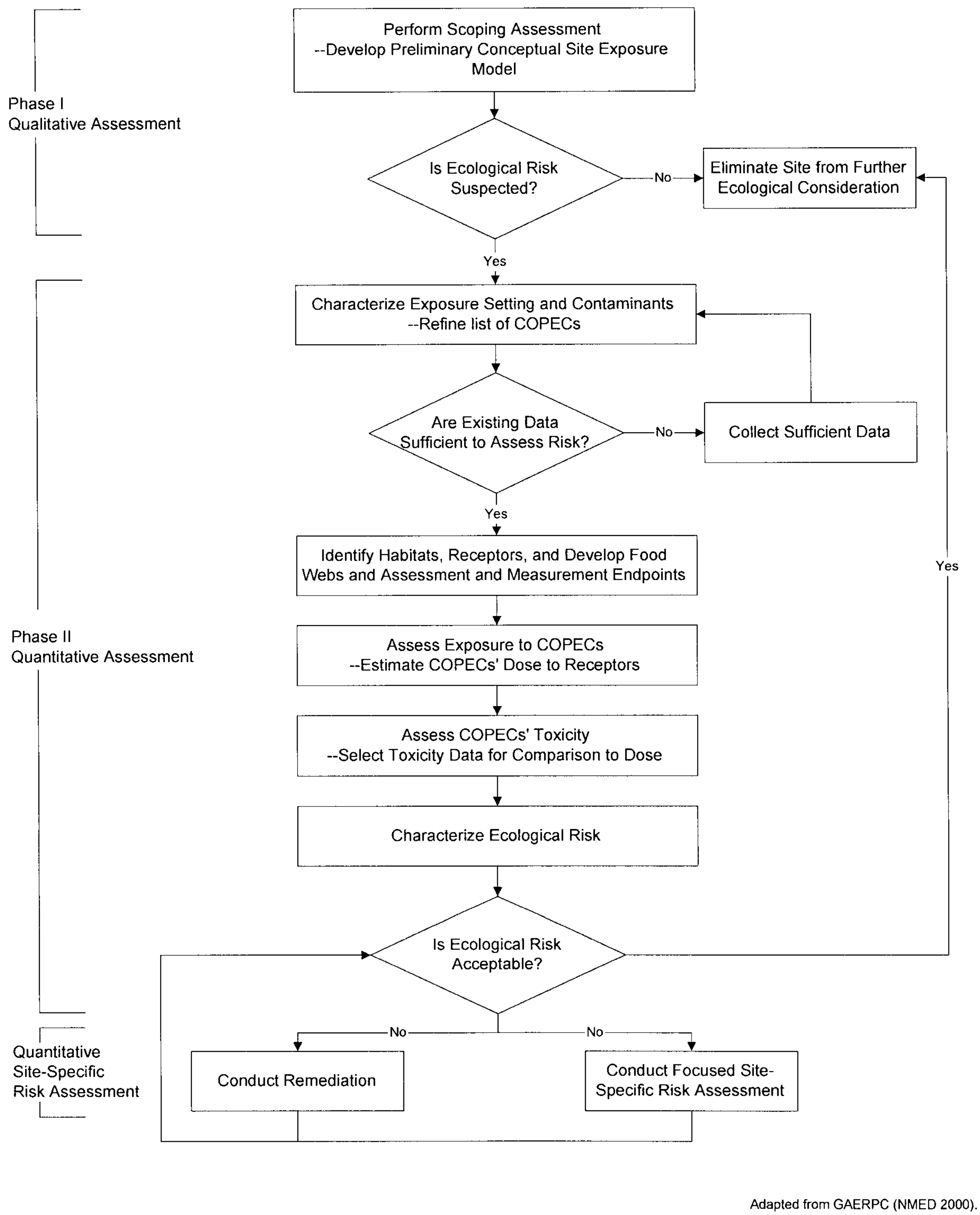


Figure 1. NMED Ecological Risk Assessment Process

The PCSEM is presented as both a narrative discussion and a diagram illustrating potential contaminant migration and exposure pathways to ecological receptors. A sample PCSEM diagram is presented in Figure 2. On the PCSEM diagram, the components of a complete exposure pathway are grouped into three main categories: sources, release mechanisms, and potential receptors. As a contaminant migrates and/or is transformed in the environment, sources and release mechanisms can be defined as primary, secondary, and tertiary.

For example, Figure 2 depicts releases from a landfill that migrate into soils, and reach nearby surface water and sediment via storm water runoff. In this situation, the release from the landfill is considered the primary release, with infiltration as the primary release mechanism. Soil becomes the secondary source, and storm water runoff is the secondary release mechanism to surface water and sediments, the tertiary source.

Subsequent ecological exposures to terrestrial and aquatic receptors will result from this release. The primary exposure routes to ecological receptors are direct contact, ingestion, and possibly inhalation. For example, plant roots will be in direct contact with contaminated sediments, and burrowing mammals will be exposed via dermal contact with soil and incidental ingestion of contaminated soil. In addition, exposures for birds and mammals will occur as they ingest prey items through the food web.

Although completing the Site Assessment Checklist will not provide the user with a ready made PCSEM, a majority of the components of the PCSEM can be found in the information provided by the Site Assessment Checklist. The information gathered for the completion of Section II of the Site Assessment Checklist, can be used to identify sources of releases. The results of Section III, Habitat Evaluation, can be used to both identify secondary and tertiary sources and to identify the types of receptors which may be exposed. The information gathered for completion of Section IV, Exposure Pathway Evaluation, will assist users in tracing the migration pathways of releases in the environment, thus helping to identify release mechanisms and sources.

Once all of the components of the conceptual model have been identified, complete exposure pathways and receptors that have the potential for exposure to site releases can be identified.

For further guidance on constructing a PCSEM, consult the GAERPC (NMED, 2000), and EPA's Office of Solid Waste and Emergency Response's *Soil Screening Guidance: User's Guide* (1996).

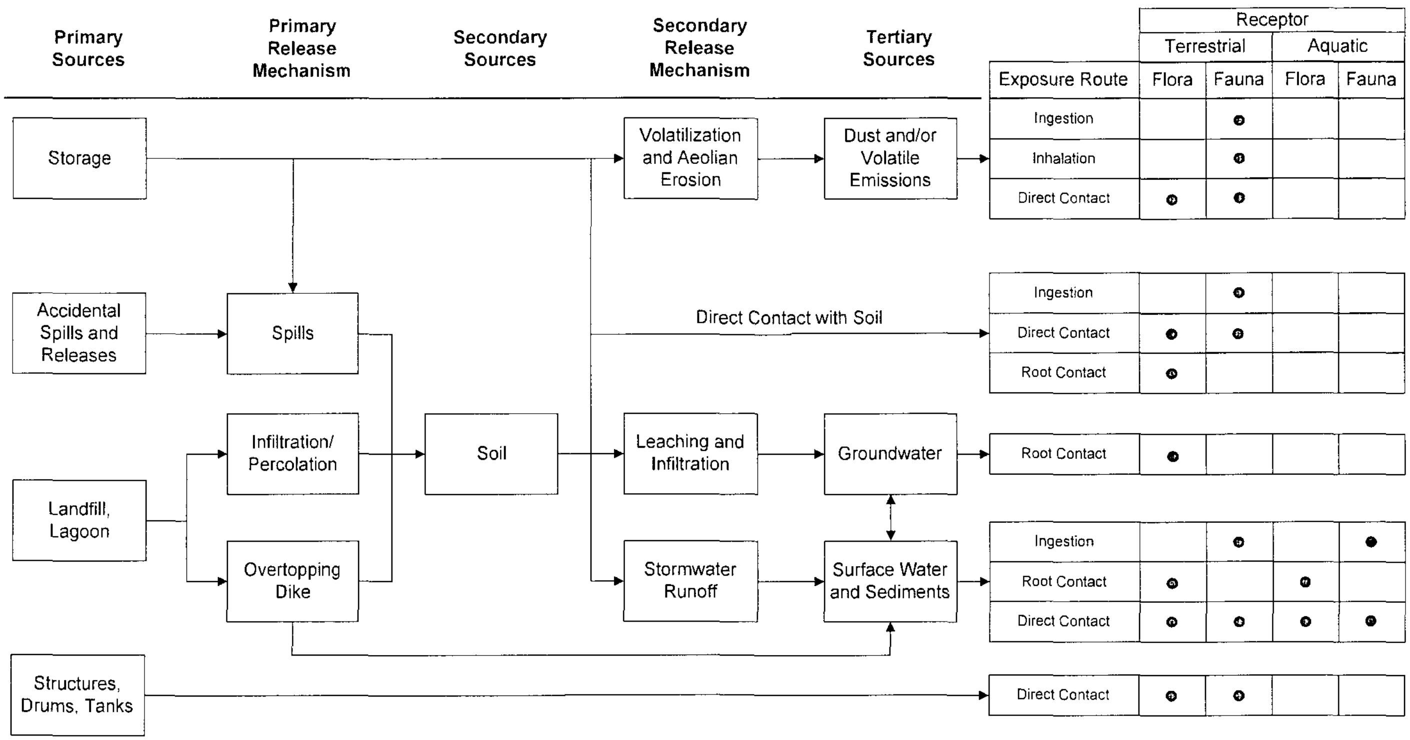
2.5 ASSEMBLING THE SCOPING ASSESSMENT REPORT

After completion of the previously described activities of the scoping assessment, the Scoping Assessment Report should be assembled to summarize the site information and present an evaluation of receptors and pathways at the site. The Scoping Assessment Report should be designed to support the decision made regarding the first Technical Decision Point (Is Ecological Risk Suspected?). The Scoping Assessment Report should, at a minimum, contain the following information:

- Existing Data Summary
- Site Visit Summary (including a completed Site Assessment Checklist)

- Evaluation of Receptors and Pathways
- Recommendations
- Attachments (e.g. photographs, field notes, telephone conversation logs with natural resource agencies)
- References/Data Sources

After completion, the Scoping Assessment Report and PCSEM should be submitted to NMED for review and approval. These documents will serve as a basis for decisions regarding future actions at the site.



Adapted from GAERPC (NMED 2000).

Figure 2. Example Preliminary Conceptual Site Exposure Model Diagram for a Hypothetical Site

3. Site Exclusion Criteria

If the assessor believes that the answer to the first Technical Decision Point (Is Ecological Risk Suspected?) is "no" based on the results of the PCSEM and Scoping Assessment Report, it should be determined whether the facility meets the NMED Site Exclusion Criteria.

Exclusion criteria are defined as those conditions at an affected property which eliminate the need for a SLERA. The three criteria are as follows:

- Affected property does not include viable ecological habitat.
- Affected property is not utilized by potential receptors.
- Complete or potentially complete exposure pathways do not exist due to affected property setting or conditions of affected property media.

The Exclusion Criteria Checklist and associated Decision Tree (*Attachment* B) can be used as a tool to help the user determine if an affected site meets the exclusion criteria. The checklist assists in making a conservative, qualitative determination of whether viable habitats, ecological receptors, and/or complete exposure pathways exist at or in the locality of the site where a release of hazardous waste/constituents has occurred. Thus, meeting the exclusion criteria means that the facility can answer "no" to the first Technical Decision Point.

If the affected property meets the Site Exclusion Criteria, based on the results of the checklist and decision tree, the facility must still submit a Scoping Assessment Report to NMED which documents the site conditions and justification for how the criteria have been met. Upon review and approval of the exclusion by the appropriate NMED Bureau, the facility will not be required to conduct any further evaluation of ecological risk. However, the exclusion is not permanent; a future change in circumstances may result in the affected property no longer meeting the exclusion criteria.

4. Technical Decision Point: Is Ecological Risk Suspected?

As discussed in the beginning of this document, the Scoping Assessment is the first phase of the GAERPC ecological risk assessment process (Figure 1). Following the submission of the Scoping Assessment Report and PCSEM, NMED will decide upon one of the following three recommendations for the site:

- No further ecological investigation at the site, or
- Continue the risk assessment process, and/or
- Undertake a removal or remedial action.

If the information presented in the Scoping Assessment Report supports the answer of "no" to the first Technical Decision Point, and the site meets the exclusion criteria, the site will likely be excused from further consideration of ecological risk. However, this is only true if it can be documented that a complete exposure pathway does not exist and will not exist in the future at the site based on current conditions. For those sites where valid pathways for potential exposure exist or are likely to exist in the future, further ecological risk assessment (usually in the form of a SLERA) will be required. However, if the Scoping Assessment indicates that a detailed assessment is warranted, the facility would not be required to conduct a SLERA. Instead the facility would move directly to Tier II–Site-Specific Ecological Risk Assessment.

References

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U.S. EPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*, Environmental Response Team, Interim Final, June 5.

U.S.EPA, 1998. *Guidelines for Ecological Risk Assessment*, Risk Assessment Forum, Final, April. EPA/630/R-95/002F; http://www.epa.gov/ncea/ecorisk.htm.

United States Department of Agriculture

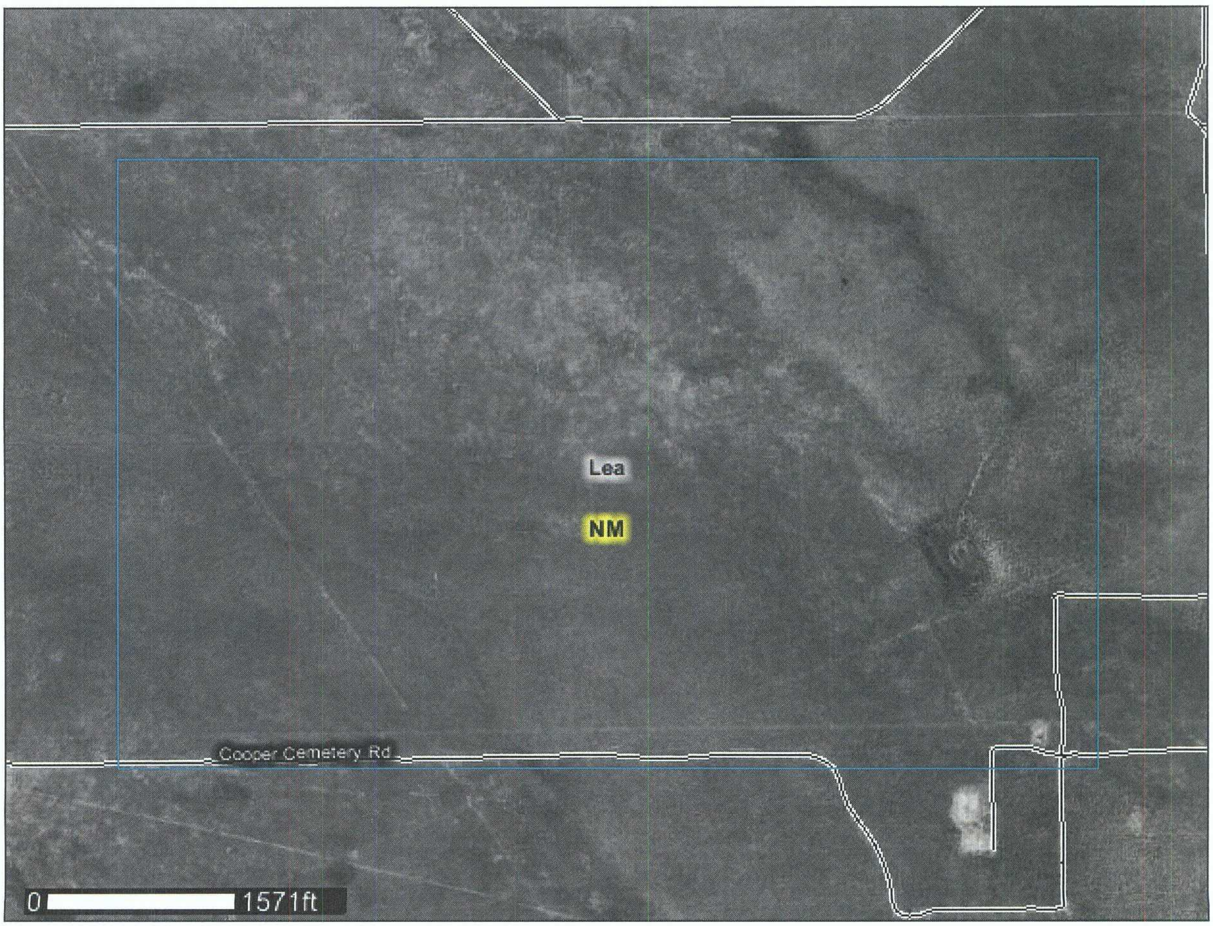
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Lea County, New Mexico

Chevron Landfarm



August 4, 2009

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:13,700 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

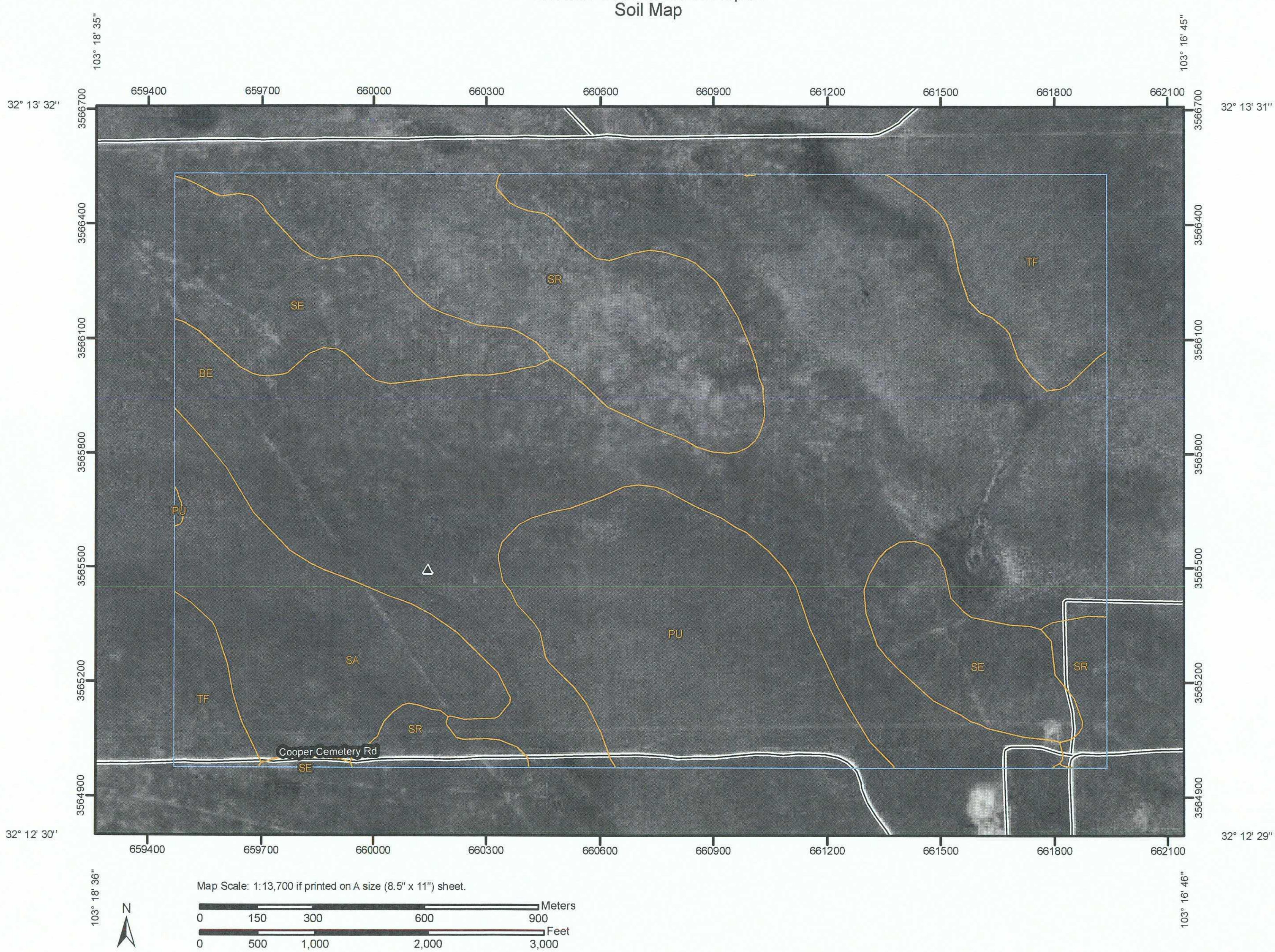
This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Soil Map


103° 18' 35"
103° 16' 45"
32° 13' 32"
32° 13' 31"
32° 12' 30"
32° 12' 29"
103° 18' 36"
103° 16' 46"
659400
659700
660000
660300
660600
660900
661200
661500
661800
662100
3566700
3566400
3566100
3565800
3565500
3565200
3564900
SE
SR
TF
BE
PU
SA
SE
SR
TF
SR
Cooper Cemetery Rd
SE
N
Map Scale: 1:13,700 if printed on A size (8.5" x 11") sheet.
0
150
300
600
900
Meters
0
500
1,000
2,000
3,000
Feet

Map Unit Legend

Lea County, New Mexico (NM025)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	436.8	46.1%
PU	Pyote and maljamar fine sands	120.6	12.7%
SA	Sharvana loamy fine sand	86.6	9.1%
SE	Simona fine sandy loam, 0 to 3 percent slopes	105.4	11.1%
SR	Simona-Upton association	133.3	14.1%
TF	Tonuco loamy fine sand	64.3	6.8%
Totals for Area of Interest		**947.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Lea County, New Mexico

BE—Berino-Cacique loamy fine sands association

Map Unit Setting

Elevation: 3,000 to 3,400 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 195 to 205 days

Map Unit Composition

Berino and similar soils: 50 percent
Cacique and similar soils: 40 percent

Description of Berino

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 6 inches: Loamy fine sand
6 to 60 inches: Sandy clay loam

Description of Cacique

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Land capability (nonirrigated): 7c
Ecological site: Sandy (R042XC004NM)

Typical profile

0 to 12 inches: Loamy fine sand
12 to 28 inches: Sandy clay loam
28 to 38 inches: Cemented material

PU—Pyote and maljamar fine sands

Map Unit Setting

Elevation: 3,000 to 3,900 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 60 to 62 degrees F
Frost-free period: 190 to 200 days

Map Unit Composition

Maljamar and similar soils: 45 percent
Pyote and similar soils: 45 percent

Description of Pyote

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 30 inches: Fine sand
30 to 60 inches: Fine sandy loam

Description of Maljamar

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 40 to 60 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7e
Ecological site: Loamy Sand (R042XC003NM)

Typical profile

0 to 24 inches: Fine sand
24 to 50 inches: Sandy clay loam
50 to 60 inches: Cemented material

SA—Sharvana loamy fine sand

Map Unit Setting

Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 58 to 60 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Sharvana and similar soils: 85 percent

Description of Sharvana

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 90 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Ecological site: Sandy Plains (R077CY056NM)

Typical profile

0 to 5 inches: Loamy fine sand
5 to 16 inches: Sandy clay loam
16 to 26 inches: Cemented material
26 to 60 inches: Variable

SE—Simona fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

Elevation: 3,000 to 4,000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Simona and similar soils: 85 percent

Description of Simona

Setting

Landform: Plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): 6s
Land capability (nonirrigated): 7s
Ecological site: Shallow Sandy (R042XC002NM)

Typical profile

0 to 8 inches: Fine sandy loam
8 to 16 inches: Gravelly fine sandy loam
16 to 26 inches: Cemented material

SR—Simona-Upton association

Map Unit Setting

Elevation: 3,000 to 4,000 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Simona and similar soils: 50 percent
Upton and similar soils: 35 percent

Description of Simona

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 1.9 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: Shallow Sandy (R042XC002NM)

Typical profile

0 to 8 inches: Gravelly fine sandy loam
8 to 16 inches: Fine sandy loam
16 to 26 inches: Cemented material

Description of Upton

Setting

Landform: Ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 7 to 20 inches to petrocalcic
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 75 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability (nonirrigated): 7s
Ecological site: Shallow (R042XC025NM)

Typical profile

0 to 8 inches: Gravelly loam
8 to 18 inches: Cemented material
18 to 60 inches: Very gravelly loam

TF—Tonuco loamy fine sand

Map Unit Setting

Elevation: 3,190 to 3,900 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 59 to 62 degrees F
Frost-free period: 190 to 205 days

Map Unit Composition

Tonuco and similar soils: 85 percent

Description of Tonuco

Setting

Landform: Plains, ridges
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Rise
Down-slope shape: Linear, convex
Across-slope shape: Linear
Parent material: Eolian deposits derived from sedimentary rock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 6 to 20 inches to petrocalcic
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Very low (about 1.6 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Ecological site: Sandy 12-17" PZ (R077DY046TX)

Typical profile

0 to 12 inches: Loamy fine sand
12 to 17 inches: Loamy fine sand
17 to 27 inches: Cemented material

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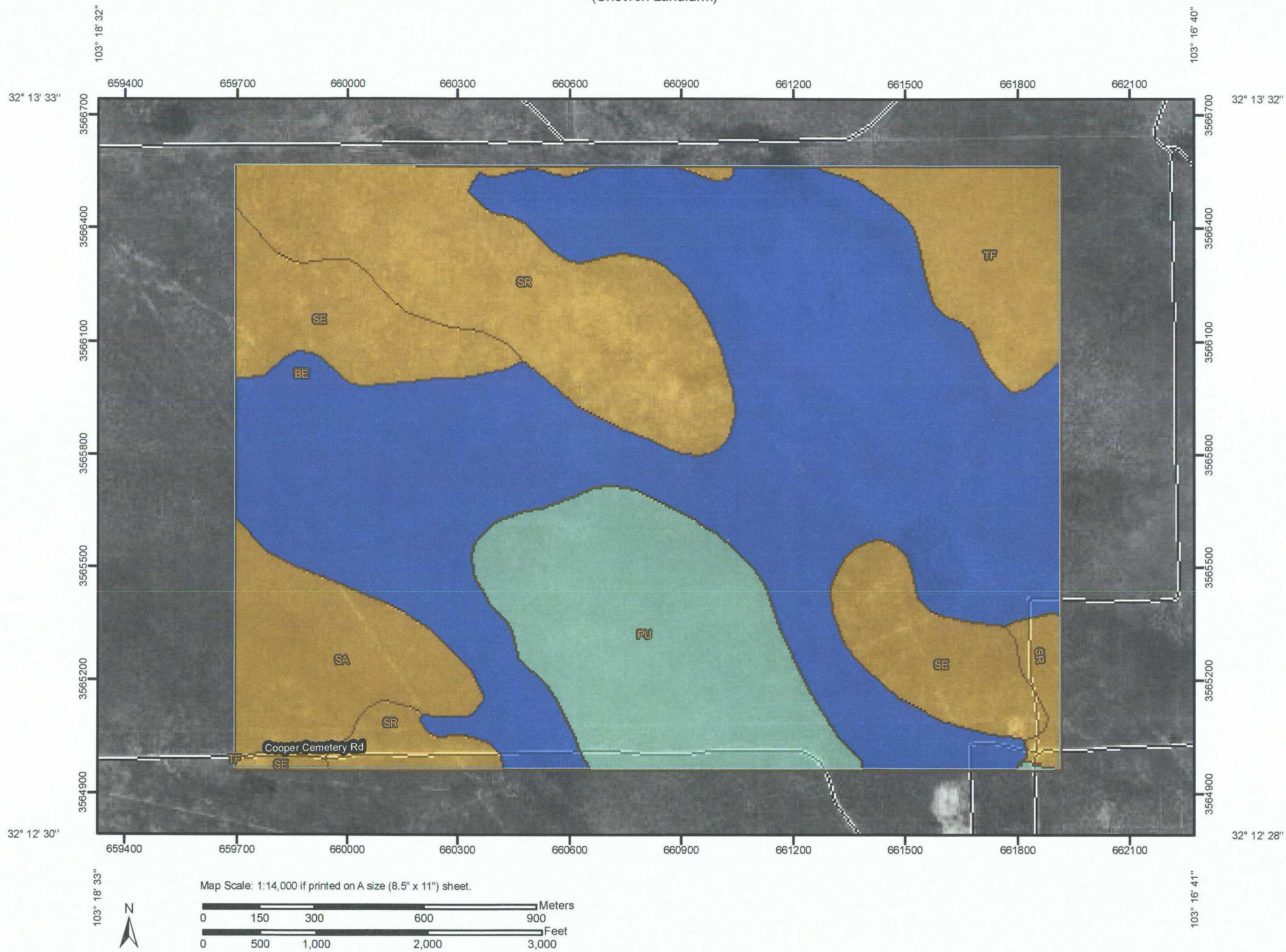
Depth to a Selected Soil Restrictive Layer: Petrocalcic—Lea County, New Mexico
(Chevron Landfarm)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:14,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to a Selected Soil Restrictive Layer: Petrocalcic

Depth to a Selected Soil Restrictive Layer: Petrocalcic— Summary by Map Unit — Lea County, New Mexico				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	>200	424.4	48.3%
PU	Pyote and maljamar fine sands	127	122.5	14.0%
SA	Sharvana loamy fine sand	41	59.0	6.7%
SE	Simona fine sandy loam, 0 to 3 percent slopes	41	83.6	9.5%
SR	Simona-Upton association	41	137.9	15.7%
TF	Tonuco loamy fine sand	43	50.7	5.8%
Totals for Area of Interest			**878.2**	**100.0%**

Description

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers.

This theme presents the depth to the user selected type of restrictive layer as described in for each map unit. If no restrictive layer is described in a map unit, it is represented by the "> 200" depth class.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Restriction Kind: Petrocalcic

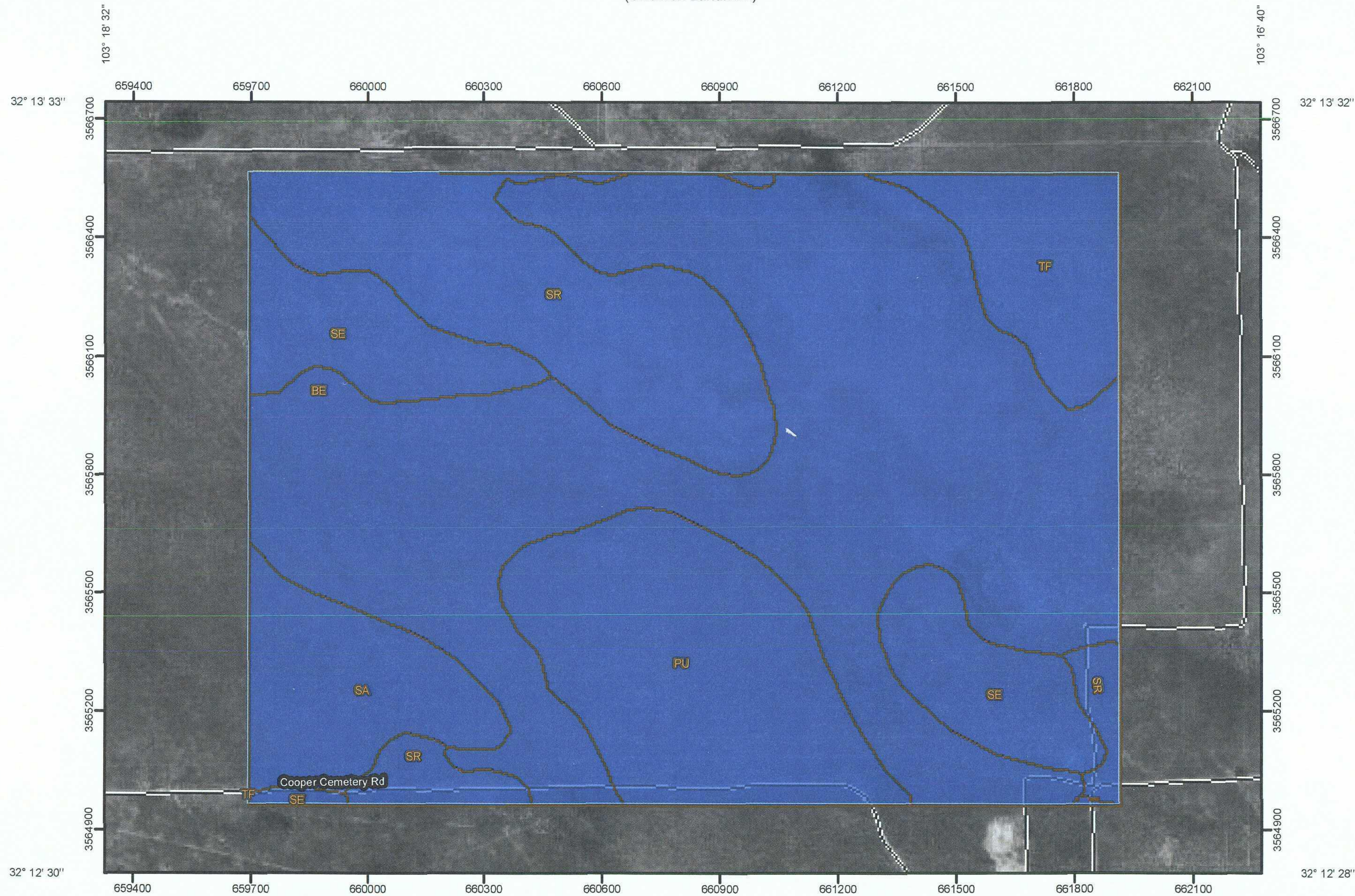
Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

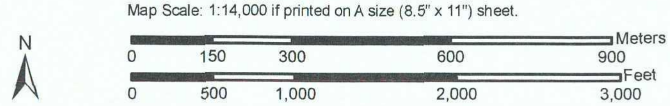
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Depth to Water Table—Lea County, New Mexico
(Chevron Landfarm)



Map Scale: 1:14,000 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 150
- 150 - 200
- > 200

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:14,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Depth to Water Table

Depth to Water Table— Summary by Map Unit — Lea County, New Mexico				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	>200	424.4	48.3%
PU	Pyote and maljamar fine sands	>200	122.5	14.0%
SA	Sharvana loamy fine sand	>200	59.0	6.7%
SE	Simona fine sandy loam, 0 to 3 percent slopes	>200	83.6	9.5%
SR	Simona-Upton association	>200	137.9	15.7%
TF	Tonuco loamy fine sand	>200	50.7	5.8%
Totals for Area of Interest			**878.2**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

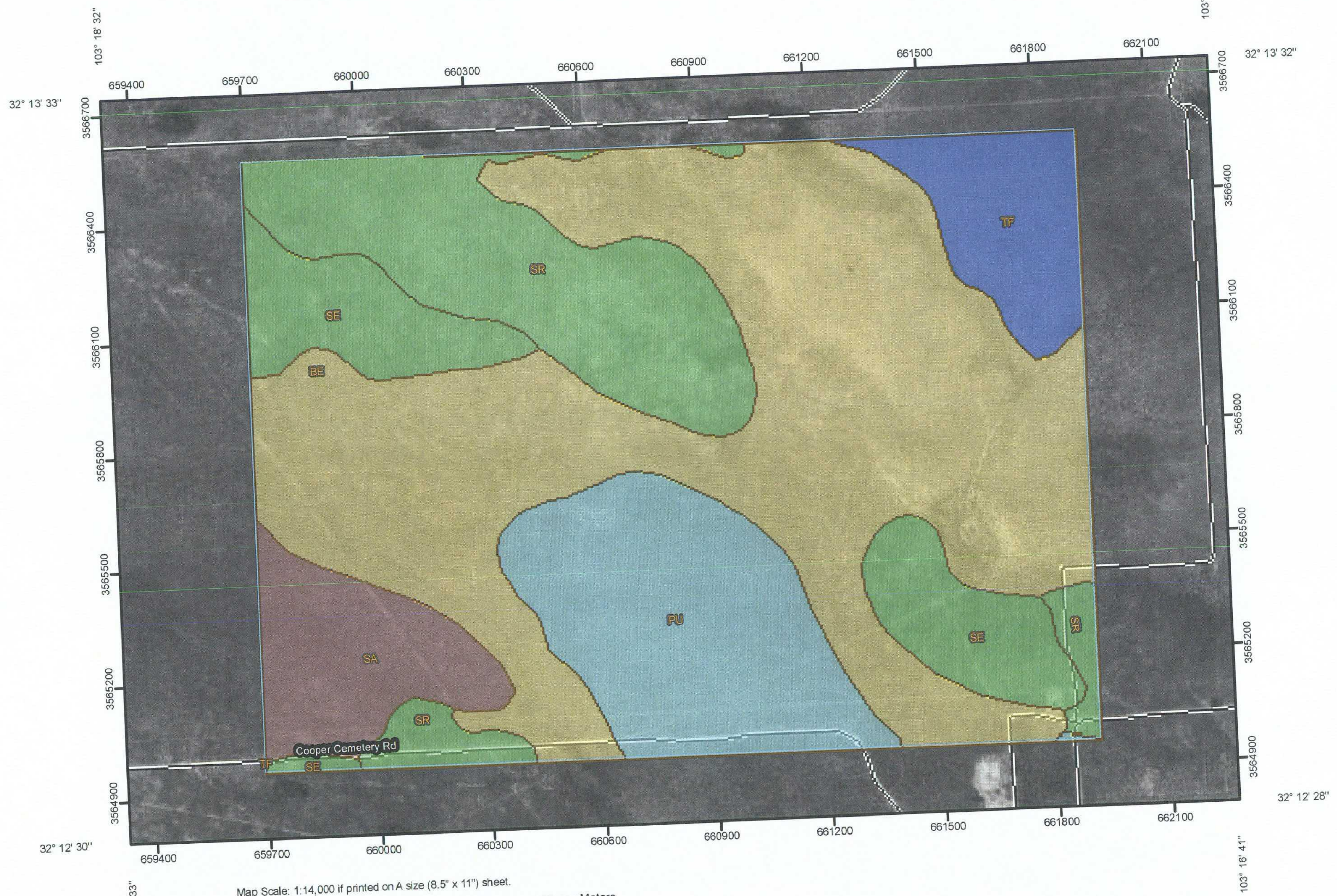
Tie-break Rule: Lower

Interpret Nulls as Zero: No

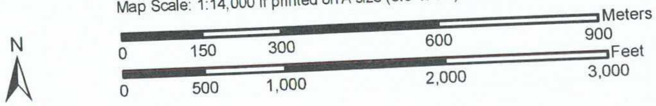
Beginning Month: January

Ending Month: December

Parent Material Name—Lea County, New Mexico
(Chevron Landfarm)



Map Scale: 1:14,000 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- alluvium and/or eolian deposits derived from sedimentary rock
- calcareous eolian deposits derived from sedimentary rock
- eolian deposits derived from sedimentary rock
- sandy eolian deposits derived from sedimentary rock
- sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:14,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Parent Material Name

Parent Material Name— Summary by Map Unit — Lea County, New Mexico				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	sandy eolian deposits derived from sedimentary rock over calcareous sandy alluvium derived from sedimentary rock	424.4	48.3%
PU	Pyote and maljamar fine sands	sandy eolian deposits derived from sedimentary rock	122.5	14.0%
SA	Sharvana loamy fine sand	alluvium and/or eolian deposits derived from sedimentary rock	59.0	6.7%
SE	Simona fine sandy loam, 0 to 3 percent slopes	calcareous eolian deposits derived from sedimentary rock	83.6	9.5%
SR	Simona-Upton association	calcareous eolian deposits derived from sedimentary rock	137.9	15.7%
TF	Tonuco loamy fine sand	eolian deposits derived from sedimentary rock	50.7	5.8%
Totals for Area of Interest			**878.2**	**100.0%**

Description

Parent material name is a term for the general physical, chemical, and mineralogical composition of the unconsolidated material, mineral or organic, in which the soil forms. Mode of deposition and/or weathering may be implied by the name.

The soil surveyor uses parent material to develop a model used for soil mapping. Soil scientists and specialists in other disciplines use parent material to help interpret soil boundaries and project performance of the material below the soil. Many soil properties relate to parent material. Among these properties are proportions of sand, silt, and clay; chemical content; bulk density; structure; and the kinds and amounts of rock fragments. These properties affect interpretations and may be criteria used to separate soil series. Soil properties and landscape information may imply the kind of parent material.

For each soil in the database, one or more parent materials may be identified. One is marked as the representative or most commonly occurring. The representative parent material name is presented here.

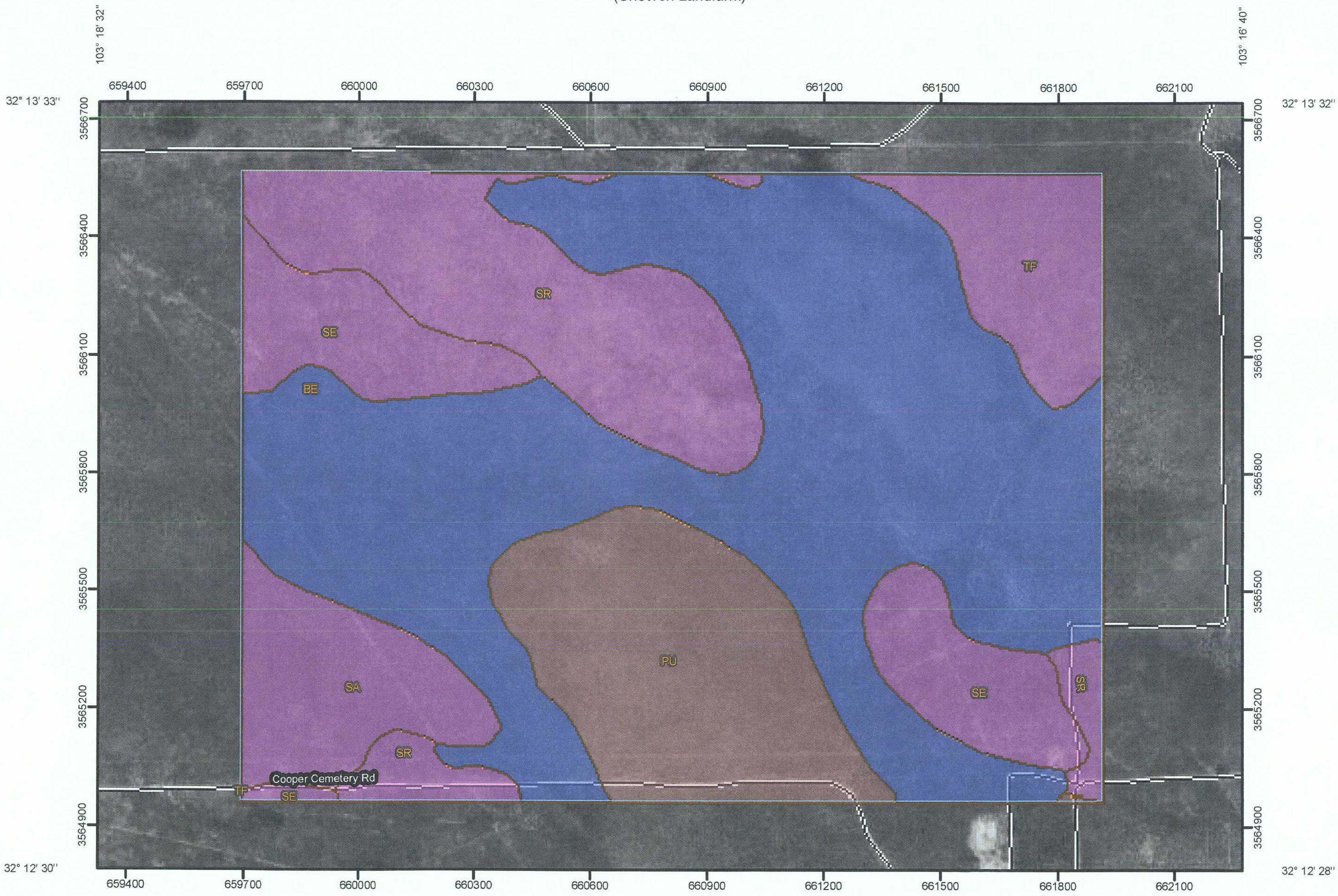
Rating Options

Aggregation Method: Dominant Condition

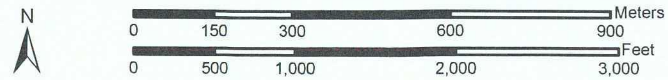
Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Hydrologic Soil Group—Lea County, New Mexico
(Chevron Landfarm)



Map Scale: 1:14,000 if printed on A size (8.5" x 11") sheet.



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:14,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Lea County, New Mexico				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BE	Berino-Cacique loamy fine sands association	B	424.4	48.3%
PU	Pyote and maljamar fine sands	A	122.5	14.0%
SA	Sharvana loamy fine sand	D	59.0	6.7%
SE	Simona fine sandy loam, 0 to 3 percent slopes	D	83.6	9.5%
SR	Simona-Upton association	D	137.9	15.7%
TF	Tonuco loamy fine sand	D	50.7	5.8%
Totals for Area of Interest			**878.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

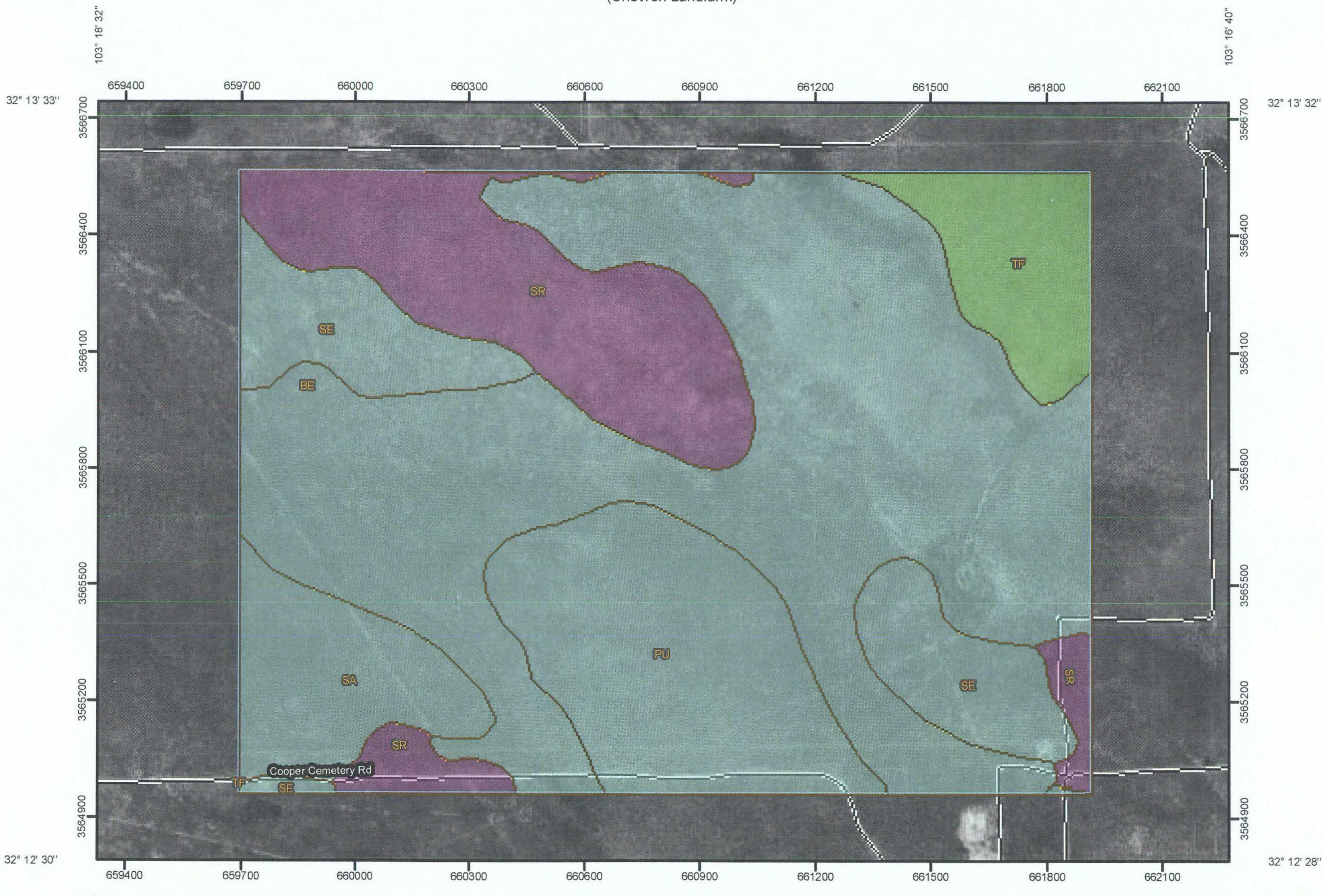
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

Unified Soil Classification (Surface)—Lea County, New Mexico
(Chevron Landfarm)



Map Scale: 1:14,000 if printed on A size (8.5" x 11") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1,000, 2,000, 3,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

- CH
- CL
- CL-A (proposed)
- CL-K (proposed)
- CL-ML
- CL-O (proposed)
- CL-T (proposed)
- GC
- GC-GM
- GM
- GP
- GP-GC
- GP-GM
- GW
- GW-GC
- GW-GM
- MH
- MH-A (proposed)
- MH-K (proposed)
- MH-O (proposed)
- MH-T (proposed)
- ML
- ML-A (proposed)
- ML-K (proposed)
- ML-O (proposed)
- ML-T (proposed)
- OH
- OH-T (proposed)
- OL
- PT
- SC
- SC-SM
- SM
- SP
- SP-SC
- SP-SM
- SW
- SW-SC
- SW-SM
- Not rated or not available

Political Features

Cities

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:14,000 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lea County, New Mexico
Survey Area Data: Version 9, Dec 9, 2008

Date(s) aerial images were photographed: 11/1/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Unified Soil Classification (Surface)

Unified Soil Classification (Surface)— Summary by Map Unit — Lea County, New Mexico				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BE	Berino-Cacique loamy fine sands association	SM	424.4	48.3%
PU	Pyote and maljamar fine sands	SM	122.5	14.0%
SA	Sharvana loamy fine sand	SM	59.0	6.7%
SE	Simona fine sandy loam, 0 to 3 percent slopes	SM	83.6	9.5%
SR	Simona-Upton association	GM	137.9	15.7%
TF	Tonuco loamy fine sand	SP-SM	50.7	5.8%
Totals for Area of Interest			**878.2**	**100.0%**

Description

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer