Environmental Restoration
University of California
Environmental Science and Waste Technology (E)
Environmental Restoration, MS M992
Los Alamos, New Mexico 87545
505-667-0808/FAX 505-665-4747

U.S. Department of Energy
Los Alamos Area Office, MS A316
Environmental Restoration Program
Los Alamos, New Mexico 87544
505-667-7203/FAX 505-665-4504

Date: November 9, 2000
Refer to: ER2000-0652

2000 RECEIVED

Mr. John Young, Corrective Action Project Leader
Permits Management Program
NMED – Hazardous Waste Bureau
2044 A Galisteo
Santa Fe, NM 87502

SUBJECT: DRAFT EXCERPT FROM POTENTIAL RELEASE SITE (PRS) 0-019 VOLUNTARY CORRECTIVE ACTION (VCA) REPORT

Dear Mr. Young:

Enclosed is a draft excerpt from the Los Alamos National Laboratory Environmental Restoration Project's forthcoming VCA Report for PRS 0-019, the Central Wastewater Treatment Plant. These draft sections of the report are being forwarded in advance of the final report in an effort to expedite the reporting and review process so that the New Mexico Environment Department Hazardous Waste Bureau is able to assist with the future development at the site. This PRS is situated on property currently owned by Los Alamos County; the property is slated for lease to Los Alamos Retirement Center, Inc. (LARC, Inc.) for the purpose of constructing and operating an assisted living facility. As you are aware, the planning and permitting phase of re-development at this site is progressing rapidly. Submittal of these draft sections is necessary at this time to ensure that bonding proceeds in a timely manner. Furthermore, the Los Alamos County Planning and Zoning Commission has imposed a requirement on the developers to report back for re-consideration of the site plan if permitting is not in place within 180 days. This requirement was imposed on August 2, 2000.

The draft sections of the report included in this submittal pertain to the data review of the proposed development site on the mesa top and human health and ecotoxicological risk evaluations for the proposed development site and the adjacent hillside/outfall area. Although the enclosed sections are "draft", any changes between this submittal and the final VCA Report for PRS 0-019 are expected to be very minor in nature and are not anticipated to change the ultimate risk evaluations and/or conclusions for the site.

Sincerely,

Julie A. Canepa, Program Manager
Los Alamos National Laboratory
Environmental Restoration

Sincerely,

Theodore J. Taylor, Project Manager
Department of Energy
Los Alamos Area Office

7511

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Enclosure: Draft Excerpt

Cy (w/enc.):
F. Brueggeman, LA County
M. Holland
D. Goering, NMED-DOE OB
E/ER File, MS M992
RPF, MS M707

Cy (w/o enc.):
M. Buksa, E/ET, MS M992
J. Canepa, E/ER, MS M992
D. McInroy, E/ER, MS M992
V. Rhodes, Aurora, MS M992
N. Riebe, E/ET, MS M992
T. Rust, E/ET, MS M992
T. Taylor, LAAO, MS A316
G. Turner, LAAO, MS A316
J. Bearzi, NMED-HWB
J. Kieling, NMED-HWB

3.3.1 Data Review

3.3.1.1 Data Review for the Mesa top at PRS 0-019

Four samples were collected on the mesa top in 1996 in the area of the former sludge drying beds as discussed in Section 2.3.4. These samples were collected in Qbt3 tuff at two locations and two depths at each location. These four samples were analyzed for TAL metals, gamma spectroscopy isotopes, tritium, semivolatiles, volatiles, pesticides, and PCBs.

An additional 69 samples were collected for characterization and confirmation in 1999 and 2000 that still represent the soil in place. Although the mesa top is now covered by fill material, the samples collected on the mesa top are referred to as soil because the material is a soil matrix and the amount of fill in some areas is unknown. Fill material from inside of the remaining structures is addressed in Section 3.3.1.3.

Samples collected in 1999

- 29 soil samples

Samples collected in 2000

- 4 soil samples
- 36 Qbt3 tuff samples from beneath the tanks

These samples were analyzed for various combinations of the following suites: TAL metals, gamma spectroscopy isotopes, isotopic plutonium, isotopic uranium, tritium, semivolatiles, volatiles, pesticides, and PCBs. Tables 3.3.1.1-1, -2, and -3 show the samples taken and the analyses requested for each sample.

Table 3.3.1.1-1
Samples taken on the mesa top for inorganic chemical analysis

Sample ID	Location ID	Depth (in)	Media	TAL Metals
0100-96-0567	00-04981	60-73.2	Qbt 3	2749
0100-96-0568	00-04981	136.8-150	Qbt 3	2749
0100-96-0569	00-04982	63.6-79.2	Qbt 3	2749
0100-96-0570	00-04982	105.6-120	Qbt 3	2749
RE00-99-0219	00-10261	216-228	Soil	5822R
RE00-99-0220	00-10261	228-240	Soil	5822R
RE00-99-0221	00-10262	216-228	Soil	5822R
RE00-99-0222	00-10262	228-240	Soil	5822R
RE00-99-0223	00-10263	54-66	Soil	5822R
RE00-99-0224	00-10263	66-78	Soil	5822R
RE00-99-0227	00-10263	180-192	Soil	5822R
RE00-99-0228	00-10263	192-204	Soil	5822R
RE00-99-0225	00-10264	54-66	Soil	5822R
RE00-99-0226	00-10264	66-78	Soil	5822R
RE00-99-0229	00-10265	108-120	Soil	5830R
RE00-99-0230	00-10265	120-132	Soil	5830R
RE00-99-0231	00-10266	132-144	Soil	5830R
RE00-99-0232	00-10266	144-156	Soil	5830R
RE00-99-0233	00-10297	96-108	Soil	5830R
RE00-99-0234	00-10297	108-120	Soil	5830R

Sample ID	Location ID	Depth (in)	Media	TAL Metals
RE00-99-0235	00-10298	156-168	Soil	5830R
RE00-99-0236	00-10298	168-180	Soil	5830R
RE00-99-0237	00-10299	96-108	Soil	5833R
RE00-99-0238	00-10299	108-120	Soil	5833R
RE00-99-0239	00-10300	48-60	Soil	5833R
RE00-99-0240	00-10300	60-72	Soil	5833R
RE00-99-0241	00-10301	96-108	Soil	5833R
RE00-99-0242	00-10301	108-120	Soil	5833R
RE00-99-0243	00-10302	96-108	Soil	5842R
RE00-99-0244	00-10302	96-108	Soil	5842R
RE00-99-0245	00-10302	108-120	Soil	5842R
RE00-99-0246	00-10303	96-108	Soil	5842R
RE00-99-0250	00-10303	108-120	Soil	5842R
RE00-00-0020	00-10327	0-24	Qbt 3	6431R
RE00-00-0021	00-10327	24-48	Qbt 3	6431R
RE00-00-0034	00-10328	36-60	Qbt 3	6445R
RE00-00-0035	00-10328	60-84	Qbt 3	6445R
RE00-00-0023	00-10329	18-42	Qbt 3	6435R
RE00-00-0024	00-10329	42-66	Qbt 3	6435R
RE00-00-0025	00-10330	45-69	Qbt 3	6435R
RE00-00-0026	00-10330	69-93	Qbt 3	6435R
RE00-00-0027	00-10331	18-42	Qbt 3	6445R
RE00-00-0028	00-10331	42-66	Qbt 3	6445R
RE00-00-0030	00-10332	93-117	Qbt 3	6445R
RE00-00-0031	00-10332	117-141	Qbt 3	6445R
RE00-00-0032	00-10333	90-114	Qbt 3	6445R
RE00-00-0033	00-10333	114-138	Qbt 3	6445R
RE00-00-0037	00-10334	126-150	Qbt 3	6445R
RE00-00-0038	00-10334	150-174	Qbt 3	6445R
RE00-00-0039	00-10335	18-42	Qbt 3	6445R
RE00-00-0040	00-10335	42-66	Qbt 3	6445R
RE00-00-0048	00-10336	54-78	Qbt 3	6449R
RE00-00-0049	00-10336	78-102	Qbt 3	6449R
RE00-00-0046	00-10337	78-102	Qbt 3	6449R
RE00-00-0047	00-10337	102-126	Qbt 3	6449R
RE00-00-0050	00-10338	48-72	Qbt 3	6449R
RE00-00-0051	00-10338	72-96	Qbt 3	6449R
RE00-00-0052	00-10339	96-120	Qbt 3	6449R
RE00-00-0053	00-10339	120-144	Qbt 3	6449R
RE00-00-0054	00-10340	72-96	Qbt 3	6449R
RE00-00-0055	00-10340	96-120	Qbt 3	6449R
RE00-00-0058	00-10343	60-84	Qbt 3	6449R
RE00-00-0059	00-10343	84-108	Qbt 3	6449R
RE00-00-0060	00-10344	6-12	Soil	6459R
RE00-00-0061	00-10344	24-36	Soil	6459R
RE00-00-0062	00-10345	0.96-3	Soil	6459R

Sample ID	Location ID	Depth (in)	Media	TAL Metals
RE00-00-0063	00-10345	12-24	Soil	6459R
RE00-00-0064	00-10346	66-90	Qbt 3	6459R
RE00-00-0065	00-10346	90-114	Qbt 3	6459R
RE00-00-0066	00-10347	63-87	Qbt 3	6459R
RE00-00-0067	00-10347	87-111	Qbt 3	6459R
RE00-00-0068	00-10348	90-114	Qbt 3	6459R
RE00-00-0069	00-10348	114-138	Qbt 3	6459R

Table 3.3.1.1-2
Samples taken on the mesa top for radiological analysis

Sample ID	Location ID	Depth (in)	Media	Gamma Spectroscopy	Isotopic Plutonium	Isotopic Uranium	Tritium
0100-96-0567	00-04981	60-73.2	Qbt 3	2750	-	-	2750
0100-96-0568	00-04981	136.8-150	Qbt 3	2750	-	-	2750
0100-96-0569	00-04982	63.6-79.2	Qbt 3	2750	-	-	2750
0100-96-0570	00-04982	105.6-120	Qbt 3	2750	-	-	2750
RE00-99-0219	00-10261	216-228	Soil	5823R	5823R	5823R	5823R
RE00-99-0220	00-10261	228-240	Soil	5823R	5823R	5823R	5823R
RE00-99-0221	00-10262	216-228	Soil	5823R	5823R	5823R	5823R
RE00-99-0222	00-10262	228-240	Soil	5823R	5823R	5823R	5823R
RE00-99-0223	00-10263	54-66	Soil	5823R	5823R	5823R	5823R
RE00-99-0224	00-10263	66-78	Soil	5823R	5823R	5823R	5823R
RE00-99-0227	00-10263	180-192	Soil	5823R	5823R	5823R	5823R
RE00-99-0228	00-10263	192-204	Soil	5823R	5823R	5823R	5823R
RE00-99-0225	00-10264	54-66	Soil	5823R	5823R	5823R	5823R
RE00-99-0226	00-10264	66-78	Soil	5823R	5823R	5823R	5823R
RE00-99-0229	00-10265	108-120	Soil	5831R	5831R	5831R	5831R
RE00-99-0230	00-10265	120-132	Soil	5831R	5831R	5831R	5831R
RE00-99-0231	00-10266	132-144	Soil	5831R	5831R	5831R	5831R
RE00-99-0232	00-10266	144-156	Soil	5831R	5831R	5831R	5831R
RE00-99-0233	00-10297	96-108	Soil	5831R	5831R	5831R	5831R
RE00-99-0234	00-10297	108-120	Soil	5831R	5831R	5831R	5831R
RE00-99-0235	00-10298	156-168	Soil	5831R	5831R	5831R	5831R
RE00-99-0236	00-10298	168-180	Soil	5831R	5831R	5831R	5831R
RE00-99-0237	00-10299	96-108	Soil	5834R	5834R	-	-
RE00-99-0238	00-10299	108-120	Soil	5834R	5834R	-	-
RE00-99-0239	00-10300	48-60	Soil	5834R	5834R	-	-
RE00-99-0240	00-10300	60-72	Soil	5834R	5834R	-	-
RE00-99-0241	00-10301	96-108	Soil	5834R	5834R	-	-
RE00-99-0242	00-10301	108-120	Soil	5834R	5834R	-	-
RE00-99-0243	00-10302	96-108	Soil	5843R	5843R	5843R	5843R
RE00-99-0244	00-10302	96-108	Soil	5843R	5843R	5843R	5843R
RE00-99-0245	00-10302	108-120	Soil	5843R	5843R	5843R	5843R
RE00-99-0246	00-10303	96-108	Soil	5843R	5843R	5843R	5843R

Sample ID	Location ID	Depth (in)	Media	Gamma Spectroscopy	Isotopic Plutonium	Isotopic Uranium	Tritium
RE00-99-0250	00-10303	108-120	Soil	5843R	5843R	5843R	5843R
RE00-00-0020	00-10327	0-24	Qbt 3	-	6432R	6432R	-
RE00-00-0021	00-10327	24-48	Qbt 3	-	6432R	6432R	-
RE00-00-0034	00-10328	36-60	Qbt 3	-	6447R	6447R	-
RE00-00-0035	00-10328	60-84	Qbt 3	-	6447R	6447R	-
RE00-00-0023	00-10329	18-42	Qbt 3	-	6438R	6438R	-
RE00-00-0024	00-10329	42-66	Qbt 3	-	6438R	6438R	-
RE00-00-0025	00-10330	45-69	Qbt 3	-	6438R	6438R	-
RE00-00-0026	00-10330	69-93	Qbt 3	-	6438R	6438R	-
RE00-00-0027	00-10331	18-42	Qbt 3	-	6447R	6447R	-
RE00-00-0028	00-10331	42-66	Qbt 3	-	6447R	6447R	-
RE00-00-0030	00-10332	93-117	Qbt 3	-	6447R	6447R	-
RE00-00-0031	00-10332	117-141	Qbt 3	-	6447R	6447R	-
RE00-00-0032	00-10333	90-114	Qbt 3	-	6447R	6447R	-
RE00-00-0033	00-10333	114-138	Qbt 3	-	6447R	6447R	-
RE00-00-0037	00-10334	126-150	Qbt 3	-	6447R	6447R	-
RE00-00-0038	00-10334	150-174	Qbt 3	-	6447R	6447R	-
RE00-00-0039	00-10335	18-42	Qbt 3	-	6447R	6447R	-
RE00-00-0040	00-10335	42-66	Qbt 3	-	6447R	6447R	-
RE00-00-0048	00-10336	54-78	Qbt 3	-	6451R	6451R	-
RE00-00-0049	00-10336	78-102	Qbt 3	-	6451R	6451R	-
RE00-00-0046	00-10337	78-102	Qbt 3	-	6451R	6451R	-
RE00-00-0047	00-10337	102-126	Qbt 3	-	6451R	6451R	-
RE00-00-0050	00-10338	48-72	Qbt 3	-	6451R	6451R	-
RE00-00-0051	00-10338	72-96	Qbt 3	-	6451R	6451R	-
RE00-00-0052	00-10339	96-120	Qbt 3	-	6451R	6451R	-
RE00-00-0053	00-10339	120-144	Qbt 3	-	6451R	6451R	-
RE00-00-0054	00-10340	72-96	Qbt 3	-	6451R	6451R	-
RE00-00-0055	00-10340	96-120	Qbt 3	-	6451R	6451R	-
RE00-00-0058	00-10343	60-84	Qbt 3	-	6451R	6451R	-
RE00-00-0059	00-10343	84-108	Qbt 3	-	6451R	6451R	-
RE00-00-0060	00-10344	6-12	Soil	-	6463R	6463R	-
RE00-00-0061	00-10344	24-36	Soil	-	6463R	6463R	-
RE00-00-0062	00-10345	0.96-3	Soil	-	6463R	6463R	-
RE00-00-0063	00-10345	12-24	Soil	-	6463R	6463R	-
RE00-00-0064	00-10346	66-90	Qbt 3	-	6463R	6463R	-
RE00-00-0065	00-10346	90-114	Qbt 3	-	6463R	6463R	-
RE00-00-0066	00-10347	63-87	Qbt 3	-	6463R	6463R	-
RE00-00-0067	00-10347	87-111	Qbt 3	-	6463R	6463R	-
RE00-00-0068	00-10348	90-114	Qbt 3	-	6463R	6463R	-
RE00-00-0069	00-10348	114-138	Qbt 3	-	6463R	6463R	-

Table 3.3.1.1-3
Samples taken on the mesa top for organic chemical analysis

Sample ID	Location ID	Depth (in)	Media	SVOCs	VOCs	Pesticides/PCBs
0100-96-0567	00-04981	60-73.2	Qbt 3	2748	2748	2748
0100-96-0568	00-04981	136.8-150	Qbt 3	2748	2748	2748
0100-96-0569	00-04982	63.6-79.2	Qbt 3	2748	2748	2748
0100-96-0570	00-04982	105.6-120	Qbt 3	2748	2748	2748
RE00-99-0219	00-10261	216-228	Soil	5821R	-	5821R
RE00-99-0220	00-10261	228-240	Soil	5821R	-	5821R
RE00-99-0221	00-10262	216-228	Soil	5821R	-	5821R
RE00-99-0222	00-10262	228-240	Soil	5821R	-	5821R
RE00-99-0223	00-10263	54-66	Soil	5821R	-	5821R
RE00-99-0224	00-10263	66-78	Soil	5821R	-	5821R
RE00-99-0227	00-10263	180-192	Soil	5821R	-	5821R
RE00-99-0228	00-10263	192-204	Soil	5821R	-	5821R
RE00-99-0225	00-10264	54-66	Soil	5821R	-	5821R
RE00-99-0226	00-10264	66-78	Soil	5821R	-	5821R
RE00-99-0229	00-10265	108-120	Soil	5829R	-	5829R
RE00-99-0230	00-10265	120-132	Soil	5829R	-	5829R
RE00-99-0231	00-10266	132-144	Soil	5829R	-	5829R
RE00-99-0232	00-10266	144-156	Soil	5829R	-	5829R
RE00-99-0233	00-10297	96-108	Soil	5829R	-	5829R
RE00-99-0234	00-10297	108-120	Soil	5829R	-	5829R
RE00-99-0235	00-10298	156-168	Soil	5829R	-	5829R
RE00-99-0236	00-10298	168-180	Soil	5829R	-	5829R
RE00-99-0237	00-10299	96-108	Soil	5832R	-	5832R
RE00-99-0238	00-10299	108-120	Soil	5832R	-	5832R
RE00-99-0239	00-10300	48-60	Soil	5832R	-	5832R
RE00-99-0240	00-10300	60-72	Soil	5832R	-	5832R
RE00-99-0241	00-10301	96-108	Soil	5832R	-	5832R
RE00-99-0242	00-10301	108-120	Soil	5832R	-	5832R
RE00-99-0243	00-10302	96-108	Soil	5841R	-	5841R
RE00-99-0244	00-10302	96-108	Soil	5841R	-	5841R
RE00-99-0245	00-10302	108-120	Soil	5841R	-	5841R
RE00-99-0246	00-10303	96-108	Soil	5841R	-	5841R
RE00-99-0250	00-10303	108-120	Soil	5841R	-	5841R
RE00-00-0020	00-10327	0-24	Qbt 3	6430R	6430R	6430R
RE00-00-0021	00-10327	24-48	Qbt 3	6430R	6430R	6430R
RE00-00-0034	00-10328	36-60	Qbt 3	6444R	6444R	6444R
RE00-00-0035	00-10328	60-84	Qbt 3	6444R	6444R	6444R
RE00-00-0023	00-10329	18-42	Qbt 3	6434R	6434R	6434R
RE00-00-0024	00-10329	42-66	Qbt 3	6434R	6434R	6434R
RE00-00-0025	00-10330	45-69	Qbt 3	6434R	6434R	6434R
RE00-00-0026	00-10330	69-93	Qbt 3	6434R	6434R	6434R
RE00-00-0027	00-10331	18-42	Qbt 3	6444R	6444R	6444R
RE00-00-0028	00-10331	42-66	Qbt 3	6444R	6444R	6444R

Sample ID	Location ID	Depth (in)	Media	SVOCs	VOCs	Pesticides/PCBs
RE00-00-0030	00-10332	93-117	Qbt 3	6444R	6444R	6444R
RE00-00-0031	00-10332	117-141	Qbt 3	6444R	6444R	6444R
RE00-00-0032	00-10333	90-114	Qbt 3	6444R	6444R	6444R
RE00-00-0033	00-10333	114-138	Qbt 3	6444R	6444R	6444R
RE00-00-0037	00-10334	126-150	Qbt 3	6444R	6444R	6444R
RE00-00-0038	00-10334	150-174	Qbt 3	6444R	6444R	6444R
RE00-00-0039	00-10335	18-42	Qbt 3	6444R	6444R	6444R
RE00-00-0040	00-10335	42-66	Qbt 3	6444R	6444R	6444R
RE00-00-0048	00-10336	54-78	Qbt 3	6448R	6448R	6448R
RE00-00-0049	00-10336	78-102	Qbt 3	6448R	6448R	6448R
RE00-00-0046	00-10337	78-102	Qbt 3	6448R	6448R	6448R
RE00-00-0047	00-10337	102-126	Qbt 3	6448R	6448R	6448R
RE00-00-0050	00-10338	48-72	Qbt 3	6448R	6448R	6448R
RE00-00-0051	00-10338	72-96	Qbt 3	6448R	6448R	6448R
RE00-00-0052	00-10339	96-120	Qbt 3	6448R	6448R	6448R
RE00-00-0053	00-10339	120-144	Qbt 3	6448R	6448R	6448R
RE00-00-0054	00-10340	72-96	Qbt 3	6448R	6448R	6448R
RE00-00-0055	00-10340	96-120	Qbt 3	6448R	6448R	6448R
RE00-00-0058	00-10343	60-84	Qbt 3	6448R	6448R	6448R
RE00-00-0059	00-10343	84-108	Qbt 3	6448R	6448R	6448R
RE00-00-0060	00-10344	6-12	Soil	6458R	6458R	6458R
RE00-00-0061	00-10344	24-36	Soil	6458R	6458R	6458R
RE00-00-0062	00-10345	0.96-3	Soil	6458R	6458R	6458R
RE00-00-0063	00-10345	12-24	Soil	6458R	6458R	6458R
RE00-00-0064	00-10346	66-90	Qbt 3	6458R	6458R	6458R
RE00-00-0065	00-10346	90-114	Qbt 3	6458R	6458R	6458R
RE00-00-0066	00-10347	63-87	Qbt 3	6458R	6458R	6458R
RE00-00-0067	00-10347	87-111	Qbt 3	6458R	6458R	6458R
RE00-00-0068	00-10348	90-114	Qbt 3	6458R	6458R	6458R
RE00-00-0069	00-10348	114-138	Qbt 3	6458R	6458R	6458R

Although the structures were originally believed to have been removed, it was discovered (as discussed in Section 3.2) that the structures were still in place under the ground surface. Samples were collected from the mesa top soil and additional samples were collected from the area of the former sludge drying beds. The tuff samples that were collected on the mesa top were from tuff that was already in existence at PRS 0-019 under the structures. The data from these samples as well as the samples collected on the hillside are presented in box plots in Appendix C.

Inorganic Chemicals

Of the four samples collected in the sludge drying beds in 1996, no inorganic chemicals were detected above background values. Selenium was not detected in any of the four samples, but the detection limits for these samples were above the background value for selenium (maximum detection limit of 0.68 mg/kg compared to a background value of 0.3 for selenium).

When additional samples were collected on the mesa top in 1999 and 2000, six inorganic chemicals (calcium, cobalt, lead, mercury, silver, and zinc) were detected above background values in soil samples. Eleven inorganic chemicals (arsenic, barium, calcium, chromium, cobalt, copper, lead, magnesium, nickel, silver, and vanadium) were detected above background values in Qbt3 tuff. Antimony, mercury, and selenium were not detected in the tuff

samples, but the detection limits were above the background values. Table 3.3.1.1-4 summarizes the inorganic chemical data by analyte with number of detects, range of concentrations, frequency of detects above the BV, and frequency of non-detects above the BV. Table 3.3.1.1-5 shows all values that were above the corresponding background values.

Table 3.3.1.1-4
Frequency of detects for inorganic chemicals on the mesa top

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Background Value (mg/kg)	Frequency of Detects above Background Value	Frequency of Non-detects above Background Value
Aluminum	Soil	33	33	1780 to 19000	29200	0/33	0/0
Aluminum	Qbt 3	40	40	109 to 6400	7340	0/40	0/0
Antimony	Soil	27	12	0.034 to 0.29	0.83	0/27	0/15
Antimony	Qbt 3	40	24	0.05 to [0.56]	0.5	0/40	10/16
Arsenic	Soil	33	33	1.3 to 5.7	8.17	0/33	0/0
Arsenic	Qbt 3	40	39	[0.56] to 3.1	2.79	9/40	0/1
Barium	Soil	33	33	40 to 190	295	0/33	0/0
Barium	Qbt 3	40	40	2.8 to 110	46	7/40	0/0
Beryllium	Soil	33	33	0.21 to 0.99	1.83	0/33	0/0
Beryllium	Qbt 3	40	40	0.06 to 0.99	1.21	0/40	0/0
Cadmium	Soil	33	32	0.02 to 0.28	0.4	0/33	0/1
Cadmium	Qbt 3	40	18	0.03 to 0.12	1.63	0/40	0/22
Calcium	Soil	33	33	640 to 19500	6120	3/33	0/0
Calcium	Qbt 3	40	40	122 to 21000	2200	12/40	0/0
Chromium, Total	Soil	33	33	1.7 to 12	19.3	0/33	0/0
Chromium, Total	Qbt 3	40	40	0.35 to 7.8	7.14	1/40	0/0
Cobalt	Soil	33	33	1.1 to 9.4	8.64	1/33	0/0
Cobalt	Qbt 3	40	37	0.17 to 4.2	3.14	1/40	0/3
Copper	Soil	33	33	2.2 to 8.5	14.7	0/33	0/0
Copper	Qbt 3	40	40	0.31 to 18	4.66	5/40	0/0
Iron	Soil	33	33	2840 to 20000	21500	0/33	0/0
Iron	Qbt 3	40	40	140 to 11000	14500	0/40	0/0
Lead	Soil	33	33	4.4 to 1800	22.3	11/33	0/0
Lead	Qbt 3	40	40	1.2 to 15	11.2	1/40	0/0
Magnesium	Soil	33	33	540 to 2510	4610	0/33	0/0
Magnesium	Qbt 3	40	40	14.5 to 3000	1690	2/40	0/0
Manganese	Soil	33	33	155 to 561	671	0/33	0/0
Manganese	Qbt 3	40	40	36.8 to 330	482	0/40	0/0
Mercury	Soil	33	25	0.02 to 0.67	0.1	5/33	1/8
Mercury	Qbt 3	40	6	0.01 to [0.11]	0.1	0/40	26/34
Nickel	Soil	33	33	2.5 to 9.7	15.4	0/33	0/0
Nickel	Qbt 3	40	38	0.45 to 13	6.58	1/40	0/2
Potassium	Soil	33	33	445 to 2200	3460	0/33	0/0
Potassium	Qbt 3	40	40	61.6 to 1200	3500	0/40	0/0
Selenium	Soil	33	12	0.039 to 1.3	1.52	0/33	0/21
Selenium	Qbt 3	40	3	0.09 to [1.1]	0.3	0/40	19/37

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Background Value (mg/kg)	Frequency of Detects above Background Value	Frequency of Non-detects above Background Value
Silver	Soil	33	13	[0.05] to 6.7	1	4/33	0/20
Silver	Qbt 3	40	34	[0.18] to 7.5	1	33/40	0/6
Sodium	Soil	33	33	124 to 601	915	0/33	0/0
Sodium	Qbt 3	40	40	52.2 to 1000	2770	0/40	0/0
Thallium	Soil	33	27	0.09 to 0.49	0.73	0/33	0/6
Thallium	Qbt 3	40	34	0.07 to [0.77]	1.1	0/40	0/6
Vanadium	Soil	33	33	5.1 to 30	39.6	0/33	0/0
Vanadium	Qbt 3	40	40	0.33 to 22	17	2/40	0/0
Zinc	Soil	33	33	16.2 to 93.5	48.8	5/33	0/0
Zinc	Qbt 3	40	40	3.7 to 50	63.5	0/40	0/0

Table 3.3.1.1-5
Samples above background values for inorganic chemicals on the mesa top

Sample ID	Location ID	Depth (ft)	Media	Antimony	Arsenic	Barium	Calcium	Chromium, Total	Cobalt	Copper	Lead	Magnesium	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
Soil Background Value				**-**	**-**	**-**	**6120**	**-**	**8.64**	**-**	**22.3**	**-**	**0.1**	**-**	**-**	**1**	**-**	**48.8**
Qbt 2,3,4 Background Value				**0.5**	**2.79**	**46**	**2200**	**7.14**	**3.14**	**4.66**	**11.2**	**1690**	**0.1**	**6.58**	**0.3**	**1**	**17**	**-**
0100-96-0567	00-04981	5.00-6.10	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.68 (U)	-	-	-
0100-96-0568	00-04981	11.40-12.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.65 (U)	-	-	-
0100-96-0569	00-04982	5.30-6.60	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.62 (U)	-	-	-
0100-96-0570	00-04982	8.80-10.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.62 (U)	-	-	-
RE00-99-0219	00-10261	18.00-19.00	Soil	-	-	-	7140	-	-	-	-	-	-	-	-	-	-	-
RE00-99-0221	00-10262	18.00-19.00	Soil	-	-	-	19500	-	-	-	-	-	-	-	-	-	-	-
RE00-99-0222	00-10262	19.00-20.00	Soil	-	-	-	6640	-	-	-	-	-	-	-	-	-	-	-
RE00-99-0225	00-10264	4.50-5.50	Soil	-	-	-	-	-	-	-	37.5	-	-	-	-	-	-	-
RE00-99-0226	00-10264	5.50-6.50	Soil	-	-	-	-	-	-	-	23.4	-	-	-	-	-	-	-
RE00-99-0233	00-10297	8.00-9.00	Soil	-	-	-	-	-	-	-	54	-	0.4	-	-	-	-	-
RE00-99-0234	00-10297	9.00-10.00	Soil	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-
RE00-99-0235	00-10298	13.00-14.00	Soil	-	-	-	-	-	-	-	1800	-	-	-	-	-	-	-
RE00-99-0236	00-10298	14.00-15.00	Soil	-	-	-	-	-	-	-	-	-	0.67	-	-	-	-	-
RE00-99-0237	00-10299	8.00-9.00	Soil	-	-	-	-	-	9.4	-	-	-	-	-	-	-	-	-
RE00-99-0241	00-10301	8.00-9.00	Soil	-	-	-	-	-	-	-	22.8	-	-	-	-	-	-	93.5
RE00-99-0242	00-10301	9.00-10.00	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.9
RE00-99-0244	00-10302	8.00-9.00	Soil	-	-	-	-	-	-	-	170	-	0.63	-	-	-	-	-
RE00-99-0245	00-10302	9.00-10.00	Soil	-	-	-	-	-	-	-	-	-	0.19	-	-	-	-	-
RE00-99-0250	00-10303	9.00-10.00	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	52
RE00-00-0020	00-10327	0.00-2.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.92 (U)	-	-	-
RE00-00-0021	00-10327	2.00-4.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	0.86 (U)	-	-	-
RE00-00-0034	00-10328	3.00-5.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	-	2.2	-	-
RE00-00-0035	00-10328	5.00-7.00	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	2.7	-	-
RE00-00-0023	00-10329	1.50-3.50	Qbt 3	-	-	-	3200	-	-	-	-	-	0.11 (U)	-	-	2.3	-	-
RE00-00-0024	00-10329	3.50-5.50	Qbt 3	0.53 (U)	-	-	-	-	-	-	-	-	0.11	-	-	-	-	-

Sample ID	Location ID	Depth (ft)	Media	Antimony	Arsenic	Barium	Calcium	Chromium, Total	Cobalt	Copper	Lead	Magnesium	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
													(U)					
RE00-00-0025	00-10330	3.75-5.75	Qbt 3	0.54 (U)	2.8	47	15000	-	-	-	-	-	-	-	-	2.3	-	-
RE00-00-0026	00-10330	5.75-7.75	Qbt 3	-	2.8	-	10000	-	-	-	-	-	0.11 (U)	-	1.1 (U)	1.9	-	-
RE00-00-0027	00-10331	1.50-3.50	Qbt 3	-	3	64	21000	-	-	6.4	-	-	0.11 (U)	-	-	7.5	-	-
RE00-00-0028	00-10331	3.50-5.50	Qbt 3	-	-	-	7500	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	3.7	-	-
RE00-00-0030	00-10332	7.75-9.75	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	1.3	-	-
RE00-00-0031	00-10332	9.75-11.75	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	1.6	-	-
RE00-00-0032	00-10333	7.50-9.50	Qbt 3	-	2.8	-	-	-	-	-	-	-	0.11 (U)	-	-	1.1	-	-
RE00-00-0033	00-10333	9.50-11.50	Qbt 3	0.54 (UJ)	-	-	3700	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	1.6	-	-
RE00-00-0037	00-10334	10.50-12.50	Qbt 3	-	-	66	18000	-	-	-	-	-	0.11 (U)	-	-	3	-	-
RE00-00-0038	00-10334	12.50-14.50	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	1.5	-	-
RE00-00-0039	00-10335	1.50-3.50	Qbt 3	-	3.1	-	-	-	-	-	-	-	0.11 (U)	-	-	2.2	-	-
RE00-00-0040	00-10335	3.50-5.50	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	1.7	-	-
RE00-00-0048	00-10336	4.50-6.50	Qbt 3	-	2.8	52	15000	7.8	-	18	-	-	0.11 (U)	-	-	3.6	21	-
RE00-00-0049	00-10336	6.50-8.50	Qbt 3	0.54 (UJ)	-	-	2900	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	3.1	-	-
RE00-00-0046	00-10337	6.50-8.50	Qbt 3	0.53 (UJ)	2.9	-	-	-	-	-	-	-	-	-	1.1 (UJ)	1.4	-	-
RE00-00-0047	00-10337	8.50-10.50	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	2	-	-
RE00-00-0050	00-10338	4.00-6.00	Qbt 3	-	3	50	12000	-	-	5.2	-	-	-	-	1.1 (UJ)	3.1	-	-
RE00-00-0051	00-10338	6.00-8.00	Qbt 3	0.56 (UJ)	-	-	-	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	2.5	-	-
RE00-00-0052	00-10339	8.00-10.00	Qbt 3	-	2.9	-	-	-	-	-	-	-	-	-	1.1 (UJ)	2.3	-	-

Sample ID	Location ID	Depth (ft)	Media	Antimony	Arsenic	Barium	Calcium	Chromium, Total	Cobalt	Copper	Lead	Magnesium	Mercury	Nickel	Selenium	Silver	Vanadium	Zinc
RE00-00-0053	00-10339	10.00-12.00	Qbt 3	0.54 (UJ)	-	-	-	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	2.7	-	-
RE00-00-0054	00-10340	6.00-8.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	-	-	1.6	-	-
RE00-00-0055	00-10340	8.00-10.00	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	2.2	-	-
RE00-00-0058	00-10343	5.00-7.00	Qbt 3	0.53 (UJ)	-	-	-	-	-	-	-	-	0.11 (U)	-	-	1.4	-	-
RE00-00-0059	00-10343	7.00-9.00	Qbt 3	0.53 (UJ)	-	-	-	-	-	-	-	-	0.11 (U)	-	1.1 (UJ)	1.4	-	-
RE00-00-0060	00-10344	0.50-1.00	Soil	-	-	-	-	-	-	-	48	-	0.2	-	-	6.7	-	62
RE00-00-0061	00-10344	2.00-3.00	Soil	-	-	-	-	-	-	-	30	-	0.11 (U)	-	-	6.2	-	57
RE00-00-0062	00-10345	0.08-0.25	Soil	-	-	-	-	-	-	-	31	-	-	-	-	5.8	-	-
RE00-00-0063	00-10345	1.00-2.00	Soil	-	-	-	-	-	-	-	44	-	-	-	-	6.2	-	-
RE00-00-0064	00-10346	5.50-7.50	Qbt 3	-	-	110	4600	-	4.2	7.2	-	3000	0.11 (U)	13	-	5.6	22	-
RE00-00-0065	00-10346	7.50-9.50	Qbt 3	0.52 (UJ)	-	-	-	-	-	-	-	-	-	-	-	2.6	-	-
RE00-00-0066	00-10347	5.25-7.25	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	3.1	-	-
RE00-00-0067	00-10347	7.25-9.25	Qbt 3	-	-	87	3300	-	-	5.4	-	1800	0.11 (U)	-	1.1 (UJ)	4.7	-	-
RE00-00-0068	00-10348	7.50-9.50	Qbt 3	-	-	-	-	-	-	-	-	-	0.11 (U)	-	-	2.8	-	-
RE00-00-0069	00-10348	9.50-11.50	Qbt 3	-	-	-	-	-	-	-	15	-	-	-	-	2	-	-

Further background tests were performed for the inorganic chemicals that had at least one detected value above the background value. The Gehan test is a rank sum test that looks for a difference between the medians of two data sets and assesses complete shifts in distributions. The Quantile test assesses shifts of a subset of the data and looks for a difference in the top 20% of the data. The probability values (p-values) from these tests are shown in Tables 3.3.1.1-6 and 3.3.1.1-7 by analyte for the mesa top soil data and tuff data, respectively. A p-value of 0.05 or less indicates a significant shift in either the entire distribution (gehan test) or in a subset of the distribution (quantile test).

Of the six inorganic chemicals above background values in the mesa top soil, only silver does not have a background data set since the background value for silver is based on a detection limit. Of the remaining five inorganic chemicals, lead, mercury, and zinc are identified as significantly above background from the gehan or quantile tests. Therefore, lead, mercury, silver, and zinc are identified as COPCs in the mesa top soil.

Table 3.3.1.1-6
Summary of probability values (p-values) for the Gehan and Quantile tests for the mesa top soil

Analyte above BV	Gehan Test p-value	Quantile test p-value
Calcium	0.1714	0.4996
Cobalt	0.9996	0.9998
Lead	***< 0.0001***	***0.0002***
Mercury	0.1971	***0.001***
Silver	NA	NA
Zinc	***0.0384***	***0.0010***

Eleven inorganic chemicals were identified in the mesa top tuff data as being above background values. Of these eleven, arsenic, calcium, and silver were significantly above background according to the p-values from both the gehan and quantile tests. Barium, chromium, copper, nickel, and vanadium were all significantly above background according to at least one of the background comparision tests.

Table 3.3.1.1-7
Summary of probability values (p-values) for the Gehan and Quantile tests for the mesa top tuff

Analyte above BV	Gehan Test p-value	Quantile test p-value
Arsenic	***< 0.0001***	***< 0.0001***
Barium	0.0606	***0.0293***
Calcium	***0.0017***	***0.0007***
Chromium	***0.0297***	0.412
Cobalt	0.805	0.302
Copper	***0.0001***	0.113
Lead	0.306	0.878
Magnesium	0.108	0.967
Nickel	***0.0107***	0.187
Silver	***< 0.0001***	***< 0.0001***
Vanadium	***0.0061***	0.412

The box plots in Appendix C illustrate the following about the inorganic chemicals that were detected above their background values. Inorganics such as arsenic and barium are elevated above background in the tuff. Calcium was detected in the tuff at values that are definitely elevated compared to the tuff background data. For lead, there is one value of 1800 mg/kg that stands out from the rest of the lead data. In the case of lead, the soil results show elevated lead in the soil samples, but not in the tuff samples. Mercury was also slightly elevated in the soil, but not in the tuff. Silver was detected in both the soil and the tuff and the concentrations were similar in both media. Zinc was only

detected above background in the soil and the box plots show that the distribution of zinc in the site data and the background data are similar.

Arsenic, barium, calcium, chromium, copper, nickel, silver, and vanadium are identified as COPCs in the mesa top tuff. Antimony, mercury, and selenium are also identified as COPCs in the mesa top tuff because of detection limits above the background values.

Overall for the mesa top, arsenic, barium, calcium, chromium, copper, lead, mercury, nickel, silver, vanadium, and zinc are identified as COPCs for further evaluation. Antimony and selenium are also identified as COPCs because at least one detection limit is above the background value. These COPCs are presented on Figure 3.3.1.1-1.

Radionuclides

Of the four samples collected in the sludge drying beds in 1996, only uranium-235 (analyzed by gamma spectroscopy) was detected above its background value in two samples. It should be noted, however, that these samples were only analyzed for gamma spectroscopy isotopes and tritium.

Analyses for additional samples on the mesa top also included isotopic plutonium and isotopic uranium for some samples (see Table 3.3.1.1-2). Uranium-235 may be reported from gamma spectroscopy analysis or isotopic uranium analysis by alpha spectroscopy. Of the 69 samples summarized in this section, 6 samples were analyzed by gamma spectroscopy only and 40 samples by alpha spectroscopy only. The remaining 23 samples were analyzed by both methods. In this case, the uranium-235 from the alpha spectroscopy analysis is used for reporting purposes.

Table 3.3.1.1-8 summarizes the radionuclide data by analyte with number of detects, range of concentrations, frequency of detects above the BV, and frequency of non-detects above the BV. Table 3.3.1.1-9 shows the both the detects and the non-detects above background values. Plutonium-238, plutonium-239, uranium-234, uranium-235, and uranium-238 were all detected above background values in at least one soil sample. Cesium-134 does not have a background value and was only detected in two soil samples out of twenty-nine samples that were analyzed for gamma isotopes. Americium-241 was not detected above its background value in any sample, however, almost all of the non-detected results in the soil samples were above the background value. Uranium-235 was the only radionuclide detected above the background value in the tuff samples collected below the tanks on the mesa top.

Table 3.3.1.1-8
PRS 0-019 Frequency of detects for Radionuclides on the mesa top

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (pCi/g)	Background Value (pCi/g)	Frequency of Detects above Background Value	Frequency of Non-detects above Background Value
Americium-241	Soil	29	0	[-0.29 to 0.26]	0.013	0/29	24/29
Americium-241	Qbt 3	4	0	[-0.107 to 0.108]	NA	0/4	NA
Cesium-134	Soil	29	2	[-0.02] to 0.1	NA	2/29	NA
Cesium-134	Qbt 3	4	0	[-0.0219 to 0.009]	NA	0/4	NA
Cesium-137	Soil	29	0	[-0.04 to 0.05]	1.65	0/29	0/29
Cesium-137	Qbt 3	4	0	[0.0011 to 0.0172]	NA	0/4	NA
Cobalt-60	Soil	29	0	[-0.06 to 0.04]	NA	0/29	NA
Cobalt-60	Qbt 3	4	0	[-0.0163 to 0.0383]	NA	0/4	NA
Europium-152	Soil	29	0	[-0.17 to 0.69]	NA	0/29	NA
Europium-152	Qbt 3	4	0	[-0.015 to 0.0444]	NA	0/4	NA
Plutonium-238	Soil	33	1	[-0.05] to 0.39	0.023	1/33	14/32
Plutonium-238	Qbt 3	36	0	[-0.0047 to 0.025]	NA	0/36	NA
Plutonium-239	Soil	33	2	[0] to 0.31	0.054	2/33	6/31

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (pCi/g)	Background Value (pCi/g)	Frequency of Detects above Background Value	Frequency of Non-detects above Background Value
Plutonium-239	Qbt 3	36	0	[-0.006 to 0.016]	NA	0/36	NA
Ruthenium-106	Soil	29	0	[-0.28 to 0.4]	NA	0/29	NA
Ruthenium-106	Qbt 3	4	0	[-0.111 to 0.008]	NA	0/4	NA
Sodium-22	Soil	29	0	[-0.05 to 0.04]	NA	0/29	NA
Sodium-22	Qbt 3	4	0	[-0.027 to 0.0216]	NA	0/4	NA
Tritium	Soil	23	0	[-3.85 to 2.85]	NA	0/23	NA
Tritium	Qbt 3	4	0	[-0.02 to 0.03]	NA	0/4	NA
Uranium-234	Soil	27	27	0.77 to 3.54	2.59	1/27	0/0
Uranium-234	Qbt 3	36	36	0.5 to 0.83	1.98	0/36	0/0
Uranium-235	Soil	33	4	[-0.05] to 0.55	0.2	1/33	2/29
Uranium-235	Qbt 3	40	24	[0.0201] to 0.126	0.09	5/40	0/16
Uranium-238	Soil	27	27	0.73 to 3.05	2.29	3/27	0/0
Uranium-238	Qbt 3	36	36	0.56 to 0.84	1.93	0/36	0/0

Table 3.3.1.1-9
PRS 0-019 Samples above background values for radionuclides on the mesa top

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-134	Plutonium-238	Plutonium-239	Uranium-234	Uranium-235	Uranium-238
Soil Background Value				**0.013**	**-**	**0.023**	**0.054**	**2.59**	**0.2**	**2.29**
Qbt 2,3,4 Background Value				**-**	**-**	**-**	**-**	**-**	**0.09**	**-**
0100-96-0567	00-04981	5.00-6.10	Qbt 3	-	-	-	-	-	0.1018	-
0100-96-0570	00-04982	8.80-10.00	Qbt 3	-	-	-	-	-	0.126	-
RE00-99-0219	00-10261	18.00-19.00	Soil	0.04 (U)	-	-	-	-	-	-
RE00-99-0220	00-10261	19.00-20.00	Soil	0.07 (U)	-	0.03 (U)	-	-	-	-
RE00-99-0221	00-10262	18.00-19.00	Soil	-	-	-	-	-	0.55	-
RE00-99-0222	00-10262	19.00-20.00	Soil	0.02 (U)	-	0.15 (UJ)	-	-	-	-
RE00-99-0223	00-10263	4.50-5.50	Soil	-	-	0.19 (UJ)	-	-	-	-
RE00-99-0224	00-10263	5.50-6.50	Soil	0.05 (U)	-	0.1 (U)	-	-	-	-
RE00-99-0227	00-10263	15.00-16.00	Soil	0.05 (U)	-	-	-	-	-	-
RE00-99-0228	00-10263	16.00-17.00	Soil	0.03 (U)	-	0.29 (U)	0.08 (U)	-	-	-
RE00-99-0225	00-10264	4.50-5.50	Soil	0.06 (U)	-	0.06 (U)	-	-	-	-
RE00-99-0226	00-10264	5.50-6.50	Soil	0.06 (U)	-	0.09 (U)	-	-	-	-
RE00-99-0229	00-10265	9.00-10.00	Soil	0.1 (U)	-	0.05 (U)	-	-	-	-
RE00-99-0230	00-10265	10.00-11.00	Soil	0.07 (U)	-	-	-	-	-	-
RE00-99-0231	00-10266	11.00-12.00	Soil	0.15 (U)	-	-	-	-	-	-
RE00-99-0232	00-10266	12.00-13.00	Soil	0.08 (U)	-	-	-	-	-	-
RE00-99-0233	00-10297	8.00-9.00	Soil	0.1 (U)	-	0.09 (U)	-	-	-	-

Sample ID	Location ID	Depth (ft)	Media	Americium-241	Cesium-134	Plutonium-238	Plutonium-239	Uranium-234	Uranium-235	Uranium-238
RE00-99-0234	00-10297	9.00-10.00	Soil	-	-	0.04 (U)	-	-	-	-
RE00-99-0235	00-10298	13.00-14.00	Soil	0.23 (U)	0.1	-	-	-	-	-
RE00-99-0236	00-10298	14.00-15.00	Soil	-	-	-	0.09 (U)	-	-	-
RE00-99-0237	00-10299	8.00-9.00	Soil	0.26 (U)	-	0.08 (U)	0.08 (U)	-	-	-
RE00-99-0238	00-10299	9.00-10.00	Soil	0.09 (U)	-	0.39	0.31	-	-	-
RE00-99-0239	00-10300	4.00-5.00	Soil	0.08 (U)	-	0.07 (U)	0.06 (U)	-	-	-
RE00-99-0240	00-10300	5.00-6.00	Soil	0.07 (U)	-	-	0.07 (U)	-	-	-
RE00-99-0241	00-10301	8.00-9.00	Soil	0.06 (U)	-	0.29 (UJ)	0.09 (U)	-	-	-
RE00-99-0242	00-10301	9.00-10.00	Soil	-	0.1	-	-	-	0.25 (U)	-
RE00-99-0243	00-10302	8.00-9.00	Soil	0.04 (U)	-	-	-	-	-	2.35
RE00-99-0244	00-10302	8.00-9.00	Soil	0.05 (U)	-	-	-	-	-	-
RE00-99-0245	00-10302	9.00-10.00	Soil	0.05 (U)	-	-	-	3.54	0.27 (U)	3.05
RE00-99-0246	00-10303	8.00-9.00	Soil	0.08 (U)	-	-	-	-	-	2.84
RE00-99-0250	00-10303	9.00-10.00	Soil	0.21 (U)	-	0.08 (U)	-	-	-	-
RE00-00-0050	00-10338	4.00-6.00	Qbt 3	-	-	-	-	-	0.101	-
RE00-00-0060	00-10344	0.50-1.00	Soil	-	-	-	0.223	-	-	-
RE00-00-0064	00-10346	5.50-7.50	Qbt 3	-	-	-	-	-	0.12	-
RE00-00-0065	00-10346	7.50-9.50	Qbt 3	-	-	-	-	-	0.094	-

The box plots show that the cesium-134 is not detected very often overall. The two detects out of 33 samples (both soil and tuff) analyzed for cesium-134 at 0.1 pCi/g are the maximum concentrations in the mesa top data, but are well within the range of the non-detects for other cesium-134 data. Americium-241 was not detected in the four samples originally collected within the sludge drying beds and, although gamma isotopes were analyzed for in the later sampling events, americium-241 was still not detected. Although the detection limits for the non-detected americium-241 results are above the background value, there is not strong evidence that americium-241 is present in the soil at PRS 0-019. As the box plot for plutonium-238 shows, the maximum concentration is in the mesa top soil. All non-detects for plutonium-238 are less than the maximum detected value. Plutonium-239 is also elevated in the mesa top soil with the maximum value from the same sample as the maximum plutonium-238 sample result. The box plots also indicate that the uranium isotopes were detected in the mesa top soil in a few samples, but the majority of the isotopic uranium lies in the hillside samples.

For the mesa top, - plutonium-238, plutonium-239, uranium-234, uranium-235, and uranium-238 are identified as COPCs in soil. Americium-241 is also identified as a COPC in the mesa top soil because detection limits were reported that are greater than the background value. Uranium-235 is identified as a COPC in the mesa top tuff. These COPCs are presented on Figure 3.3.1.1-2.

Organic Chemicals

Five organic chemicals (benzoic acid, 1,2-Dibromo-3-chloropropane, isophorone, pentachorophenol, and pyrene) were detected in one of the four samples collected in 1996 from the sludge drying beds.

The main organic chemicals detected in the additional mesa top samples were PAHs. Table 3.3.1.1-10 summarizes the organic chemical data by analyte with number of detects, range of concentrations, frequency of detects above the

BV, and frequency of non-detects above the BV. Table 3.3.1.1-11 presents the detected concentrations for all of the organic chemicals that are identified as COPCs. Pesticides and PCBs were detected in a few samples. Sixteen PAHs were detected in mesa top samples. These detected PAHs may be expected in mesa top samples due to the large amount of asphalt and other debris on the surface of the ground. A few other organic chemicals were detected in the soil samples (i.e., benzoic acid, di-n-butylphthalate, benzene, and toluene), but these were only detected once or twice and with no apparent pattern. Bis (2-ethyl hexyl) phthalate was detected in more that two soil samples, but at low concentrations which were all "J" qualified. Bis(2-ethyl hexyl) phthalate and toluene are both common laboratory contaminants.

A subset of the PAHs that were detected in the soil samples were also detected in three tuff samples. Various other tuff samples had organic chemicals detected once or twice. Bis(2-ethyl hexyl)phthalate was detected in almost every tuff sample at concentrations similar to the soil samples (and all were "J" qualified). The box plots presented in Appendix C also show that a majority of the maximum values of detected PAHs are on the mesa top.

Table 3.3.1.1-10
PRS 0-019 Frequency of Detects for Organic chemicals on the mesa top

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Frequency of Detects
Acenaphthylene	Soil	33	3	0.059 to [0.71]	3/33
Acenaphthylene	Qbt 3	40	1	0.046 to [0.38]	1/40
Anthracene	Soil	33	7	0.032 to [0.71]	7/33
Aroclor-1254	Soil	33	6	0.012 to 0.87	6/33
Aroclor-1260	Soil	33	8	[0.035 to 0.37]	8/33
Benzo(a)anthracene	Soil	33	18	0.018 to 0.99	18/33
Benzo(a)anthracene	Qbt 3	40	2	0.018 to [0.38]	2/40
Benzo(a)pyrene	Soil	33	18	0.02 to 0.86	18/33
Benzo(a)pyrene	Qbt 3	40	2	0.021 to [0.38]	2/40
Benzo(b)fluoranthene	Soil	33	16	0.018 to [0.71]	16/33
Benzo(b)fluoranthene	Qbt 3	40	2	0.022 to [0.38]	2/40
Benzo(g,h,i)perylene	Soil	33	9	0.021 to [0.71]	9/33
Benzo(g,h,i)perylene	Qbt 3	40	2	0.018 to [0.38]	2/40
Benzo(k)fluoranthene	Soil	33	13	0.027 to [0.71]	13/33
Benzo(k)fluoranthene	Qbt 3	40	2	0.021 to [0.38]	2/40
Benzoic Acid	Qbt 3	40	1	0.036 to [1.9]	1/40
Bis(2-ethylhexyl)phthalate	Soil	33	10	0.025 to [0.71]	10/33
Bis(2-ethylhexyl)phthalate	Qbt 3	40	12	0.018 to [0.38]	12/40
Chlordane[alpha-]	Soil	33	3	0.00051 to [0.0094]	3/33
Chlordane[gamma-]	Soil	33	2	[0.0017 to 0.0094]	2/33
Chrysene	Soil	33	17	0.018 to 0.94	17/33
Chrysene	Qbt 3	40	2	0.025 to [0.38]	2/40
DDD[4,4'-]	Soil	33	1	0.00024 to [0.019]	1/33
DDE[4,4'-]	Soil	33	4	0.00042 to [0.019]	4/33
DDT[4,4'-]	Soil	33	5	0.0015 to [0.019]	5/33
Di-n-butylphthalate	Qbt 3	40	1	0.018 to [0.38]	1/40
Dibenz(a,h)anthracene	Soil	33	2	0.03 to [0.71]	2/33
Dibromo-3-chloropropane[1,2-]	Qbt 3	40	1	0.003 to [0.015]	1/40
Fluoranthene	Soil	33	23	0.021 to 2.9	23/33
Fluoranthene	Qbt 3	40	3	0.032 to [0.38]	3/40

Analyte	Media	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Frequency of Detects
Fluorene	Soil	33	1	0.14 to [0.71]	1/33
Indeno(1,2,3-cd)pyrene	Soil	33	7	0.021 to [0.71]	7/33
Indeno(1,2,3-cd)pyrene	Qbt 3	40	1	0.1 to [0.38]	1/40
Isophorone	Qbt 3	40	1	0.13 to [0.38]	1/40
Methyl-2-pentanone[4-]	Qbt 3	40	1	0.013 to [0.03]	1/40
Pentachlorophenol	Qbt 3	40	1	0.052 to [1.9]	1/40
Phenanthrene	Soil	33	12	0.022 to 1.7	12/33
Phenanthrene	Qbt 3	40	2	0.031 to [0.38]	2/40
Pyrene	Soil	33	24	0.023 to 2	24/33
Pyrene	Qbt 3	40	4	0.033 to [0.38]	4/40

Table 3.3.1.1-11
PRS 0-019 Detected Concentrations for Organic Chemicals on the mesa top

Sample ID	Location ID	Depth (ft)	Media	Acenaphthylene	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Di-n-butylphthalate	Dibenz(a,h)anthracene	Dibromo-3-chloropropane[1,2-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isophorone	Methyl-2-pentanone[4-]	Pentachlorophenol	Phenanthrene	Pyrene
0100-96-0569	00-04982	5.30-6.60	Qbt 3	-	-	-	-	-	-	-	-	-	0.036 (J+)	-	-	-	-	-	-	-	-	-	0.003 (J)	-	-	-	0.13 (J+)	-	0.052 (J+)	-	0.043 (J)
RE00-99-0219	00-10261	18.00-19.00	Soil	-	-	0.61	-	0.034 (J)	0.032 (J)	0.039 (J)	0.021 (J)	0.031 (J)	-	-	-	-	0.035 (J)	-	-	-	-	-	-	0.051 (J)	-	0.021 (J)	-	-	-	0.025 (J)	0.052 (J)
RE00-99-0220	00-10261	19.00-20.00	Soil	-	-	0.034 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.027 (J)	-	-	-	-	-	-	0.025 (J)
RE00-99-0221	00-10262	18.00-19.00	Soil	-	-	0.87	-	0.049 (J)	0.047 (J)	0.05 (J)	0.03 (J)	0.046 (J)	-	-	-	-	0.058 (J)	-	-	-	-	-	-	0.099 (J)	-	0.027 (J)	-	-	-	0.064 (J)	0.1 (J)
RE00-99-0222	00-10262	19.00-20.00	Soil	-	-	0.23	-	0.018 (J)	-	0.018 (J)	-	-	-	-	-	-	0.026 (J)	-	-	-	-	-	-	0.042 (J)	-	-	-	-	-	0.022 (J)	0.044 (J)

Sample ID	Location ID	Depth (ft)	Media	
RE00-99-0223	00-10263	4.50-5.50	Soil	**Acenaphthylene**
RE00-99-0224	00-10263	5.50-6.50	Soil	**Anthracene**
RE00-99-0225	00-10264	4.50-5.50	Soil	**Aroclor-1254**
RE00-99-0227	00-10263	15.00-16.00	Soil	**Aroclor-1260**
RE00-99-0226	00-10264	5.50-6.50	Soil	**Benzo(a)anthracene**
RE00-99-0229	00-10265	9.00-10.00	Soil	**Benzo(a)pyrene**
-	-	-	-	**Benzo(b)fluoranthene**
-	-	-	-	**Benzo(g,h,i)perylene**
-	-	-	-	**Benzo(k)fluoranthene**
-	-	-	-	**Benzoic Acid**
-	-	-	-	**Bis(2-ethylhexyl)phthalate**
-	-	-	-	**Chlordane[alpha-]**
-	-	-	-	**Chlordane[gamma-]**
-	-	-	-	**Chrysene**
-	-	-	-	**DDD[4,4'-]**
-	-	-	-	**DDE[4,4'-]**
-	-	-	-	**DDT[4,4'-]**
-	-	-	-	**Di-n-butylphthalate**
-	-	-	-	**Dibenz(a,h)anthracene**
-	-	-	-	**Dibromo-3-chloropropane[1,2-]**
-	-	-	-	**Fluoranthene**
-	-	-	-	**Fluorene**
-	-	-	-	**Indeno(1,2,3-cd)pyrene**
-	-	-	-	**Isophorone**
-	-	-	-	**Methyl-2-pentanone[4-]**
-	-	-	-	**Pentachlorophenol**
-	-	-	-	**Phenanthrene**
-	-	-	-	**Pyrene**
0.067 (J)	-	0.05 (J+)	-	
-	-	-	-	
0.023 (J)	-	0.021 (J)	0.094 (J)	0.024 (J)
0.04 (J)	0.02 (J)	0.023 (J)	0.13 (J)	0.033 (J)
0.033 (J)	-	0.026 (J)	0.079 (J)	0.028 (J)
0.053 (J)	0.021 (J)	-	0.097 (J)	0.027 (J)
0.034 (J)	-	0.027 (J)	0.11 (J)	0.03 (J)
-	-	-	-	-
-	-	-	-	0.048 (J)
-	-	-	-	-
-	-	-	-	-
0.062 (J)	0.018 (J)	0.023 (J)	0.11 (J)	0.026 (J)
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	0.03 (J)	-
-	-	-	-	-
0.026 (J)	-	0.021 (J)	0.054 (J)	-
-	-	-	-	-
0.04 (J)	-	-	0.083 (J)	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	0.03 (J)	-
0.028 (J)	0.023 (J)	0.023 (J)	0.074 (J)	0.023 (J)

Sample ID	Location ID	Depth (ft)	Media	
RE00-99-0230	00-10265	10.00-11.00	Soil	**Acenaphthylene**
RE00-99-0231	00-10266	11.00-12.00	Soil	**Anthracene**
RE00-99-0232	00-10266	12.00-13.00	Soil	**Aroclor-1254**
RE00-99-0233	00-10297	8.00-9.00	Soil	**Aroclor-1260**
RE00-99-0234	00-10297	9.00-10.00	Soil	**Benzo(a)anthracene**
RE00-99-0235	00-10298	13.00-14.00	Soil	**Benzo(a)pyrene**
-	-	-	-	**Benzo(b)fluoranthene**
-	-	-	-	**Benzo(g,h,i)perylene**
-	-	-	-	**Benzo(k)fluoranthene**
-	-	-	-	**Benzoic Acid**
-	-	-	-	**Bis(2-ethylhexyl)phthalate**
-	-	-	-	**Chlordane[alpha-]**
-	-	-	-	**Chlordane[gamma-]**
-	-	-	-	**Chrysene**
-	-	-	-	**DDD[4,4'-]**
-	-	-	-	**DDE[4,4'-]**
-	-	-	-	**DDT[4,4'-]**
-	-	-	-	**Di-n-butylphthalate**
-	-	-	-	**Dibenz(a,h)anthracene**
-	-	-	-	**Dibromo-3-chloropropane[1,2-]**
-	-	-	-	**Fluoranthene**
-	-	-	-	**Fluorene**
-	-	-	-	**Indeno(1,2,3-cd)pyrene**
-	-	-	-	**Isophorone**
-	-	-	-	**Methyl-2-pentanone[4-]**
-	-	-	-	**Pentachlorophenol**
-	-	-	-	**Phenanthrene**
0.034 (J)	0.057 (J)	-	0.035 (J)	**Pyrene**
-	-	0.031 (J)	0.034 (J)	
-	-	0.27 (J)	0.25 (J)	
-	-	0.031 (J)	0.034 (J)	
-	-	0.2 (J)	0.035 (J)	
-	-	-	-	
-	-	0.22 (J)	0.035 (J)	
-	-	-	-	
0.039 (J)	0.045 (J)	0.1 (J)	0.067 (J)	
-	-	0.00051	-	
-	-	-	-	
0.039 (J)	-	0.26 (J)	0.049 (J)	
-	-	-	-	
-	-	-	0.00063 (J)	
-	-	-	0.0015 (J)	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	0.043 (J)	0.058 (J)	0.048 (J)	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	0.28 (J)	-	
-	0.038 (J)	0.045 (J)	0.042 (J)	
0.061 (J)		0.52		

Sample ID	Location ID	Depth (ft)	Media	
RE00-99-0236	00-10298	14.00-15.00	Soil	**Acenaphthylene**
RE00-99-0237	00-10299	8.00-9.00	Soil	**Anthracene**
RE00-99-0238	00-10299	9.00-10.00	Soil	**Aroclor-1254**
RE00-99-0241	00-10301	8.00-9.00	Soil	**Aroclor-1260**
RE00-99-0242	00-10301	9.00-10.00	Soil	**Benzo(a)anthracene**
RE00-99-0243	00-10302	8.00-9.00	Soil	**Benzo(a)pyrene**
-	-	0.13 (J)	-	**Benzo(b)fluoranthene**
-	0.052 (J)	0.37	-	**Benzo(g,h,i)perylene**
-	0.012 (J)	-	-	**Benzo(k)fluoranthene**
0.065	-	-	-	**Benzoic Acid**
0.071 (J)	0.17 (J)	0.99	-	**Bis(2-ethylhexyl)phthalate**
0.051 (J)	0.17 (J)	0.86	0.033 (J)	**Chlordane[alpha-]**
0.046 (J)	0.15 (J)	0.71	-	**Chlordane[gamma-]**
-	0.061 (J)	0.32 (J)	-	**Chrysene**
-	0.14 (J)	0.69	-	**DDD[4,4'-]**
-	-	-	-	**DDE[4,4'-]**
-	-	-	-	**DDT[4,4'-]**
-	-	-	-	**Di-n-butylphthalate**
-	-	-	-	**Dibenz(a,h)anthracene**
-	-	-	-	**Dibromo-3-chloropropane[1,2-]**
-	-	0.042 (J)	-	**Fluoranthene**
-	-	-	-	**Fluorene**
-	-	-	-	**Indeno(1,2,3-cd)pyrene**
-	-	-	-	**Isophorone**
-	-	-	-	**Methyl-2-pentanone[4-]**
-	-	-	-	**Pentachlorophenol**
-	-	-	-	**Phenanthrene**
-	-	-	-	**Pyrene**
0.062 (J)	0.17 (J)	0.94	-	
-	-	-	0.00024	
-	-	-	0.00061	
-	-	-	0.0061	
-	-	-	-	
-	-	0.12 (J)	-	
-	-	-	-	
0.17 (J)	0.4	2.9	0.045 (J)	
-	-	0.14 (J)	-	
-	0.054 (J)	0.3 (J)	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
0.14 (J)	0.22 (J)	1.7	-	
0.1 (J)	0.32 (J)	2	0.036 (J)	

Sample ID	Location ID	Depth (ft)	Media	Acenaphthylene	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Di-n-butylphthalate	Dibenz(a,h)anthracene	Dibromo-3-chloropropane[1,2-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isophorone	Methyl-2-pentanone[4-]	Pentachlorophenol	Phenanthrene	Pyrene
RE00-99-0244	00-10302	8.00-9.00	Soil	0.12 (J)	0.14 (J)	-	0.12	0.48	0.44	0.4	0.092 (J)	0.36	-	-	-	-	0.45	-	-	-	-	-	-	1.3	-	0.11 (J)	-	-	-	0.58	0.65
RE00-99-0245	00-10302	9.00-10.00	Soil	-	0.047 (J)	-	0.11	0.13 (J)	0.13 (J)	0.12 (J)	-	0.097 (J)	-	0.045 (J)	-	-	0.12 (J)	-	-	-	-	-	-	0.28 (J)	-	-	-	-	-	0.12 (J)	0.15 (J)
RE00-99-0246	00-10303	8.00-9.00	Soil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.043 (J)	-	-	-	-	-	-	-
RE00-99-0250	00-10303	9.00-10.00	Soil	-	-	-	-	0.039 (J)	0.038 (J)	0.04 (J)	-	-	-	0.058 (J)	-	-	-	-	-	-	-	-	-	0.092 (J)	-	-	-	-	-	0.056 (J)	0.056 (J)
RE00-00-0034	00-10328	3.00-5.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.019 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0023	00-10329	1.50-3.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.031 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sample ID	Location ID	Depth (ft)	Media	Acenaphthylene	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Di-n-butylphthalate	Dibenz(a,h)anthracene	Dibromo-3-chloropropane[1,2-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isophorone	Methyl-2-pentanone[4-]	Pentachlorophenol	Phenanthrene	Pyrene
RE00-00-0024	00-10329	3.50-5.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.042 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0025	00-10330	3.75-5.75	Qbt 3	-	-	-	-	0.018 (J)	0.021 (J)	0.022 (J)	0.018 (J)	0.021 (J)	-	0.041 (J)	-	-	0.025 (J)	-	-	-	-	-	-	0.047 (J)	-	-	-	-	-	0.031 (J)	0.039 (J)
RE00-00-0026	00-10330	5.75-7.75	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.036 (J)	-	-	-	-	-	-	-	-	-	0.04 (J)	-	-	-	-	-	0.034 (J)	0.033 (J)
RE00-00-0027	00-10331	1.50-3.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.032 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0028	00-10331	3.50-5.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.026 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0038	00-10334	12.50-14.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.02 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sample ID	Location ID	Depth (ft)	Media	Acenaphthylene	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Di-n-butylphthalate	Dibenz(a,h)anthracene	Dibromo-3-chloropropane[1,2-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isophorone	Methyl-2-pentanone[4-]	Pentachlorophenol	Phenanthrene	Pyrene
RE00-00-0040	00-10335	3.50-5.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.027 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0049	00-10336	6.50-8.50	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.02 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013 (J)	-	-	-
RE00-00-0050	00-10338	4.00-6.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.018 (J)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0053	00-10339	10.00-12.00	Qbt 3	-	-	-	-	-	-	-	-	-	-	0.18 (J)	-	-	-	-	-	-	0.018 (J)	-	-	-	-	-	-	-	-	-	-
RE00-00-0060	00-10344	0.50-1.00	Soil	-	-	-	0.093	-	-	-	-	-	-	-	0.0028	0.005	-	-	0.0039	0.015	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0061	00-10344	2.00-3.00	Soil	-	-	-	-	0.035 (J)	-	-	-	-	-	0.027 (J)	-	-	0.044 (J)	-	-	-	-	-	-	0.063 (J)	-	-	-	-	-	0.047 (J)	0.071 (J)

Sample ID	Location ID	Depth (ft)	Media	Acenaphthylene	Anthracene	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic Acid	Bis(2-ethylhexyl)phthalate	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Di-n-butylphthalate	Dibenz(a,h)anthracene	Dibromo-3-chloropropane[1,2-]	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Isophorone	Methyl-2-pentanone[4-]	Pentachlorophenol	Phenanthrene	Pyrene
RE00-00-0062	00-10345	0.08-0.25	Soil	-	-	-	0.043	-	-	-	-	-	-	-	0.0024	0.0031	-	-	-	0.0093	-	-	-	-	-	-	-	-	-	-	0.043 (J)
RE00-00-0063	00-10345	1.00-2.00	Soil	-	-	-	0.055	-	-	-	-	-	-	0.025 (J)	-	-	-	-	-	0.0072	-	-	-	-	-	-	-	-	-	-	-
RE00-00-0068	00-10348	7.50-9.50	Qbt 3	0.046 (J)	-	-	-	0.087 (J)	0.17 (J)	0.081 (J)	0.13 (J)	0.1 (J)	-	-	-	-	0.12 (J)	-	-	-	-	-	-	0.032 (J)	-	0.1 (J)	-	-	-	-	0.1 (J)

All detected organic chemicals on the mesa top are identified as COPCs. These COPCs are presented on Figure 3.3.1.1-3.

3.3.1.3 Summary of Mesa top Fill and Concrete samples

After the structures were found to be in place on the mesa top, the Administrative Authority requested that samples be collected from the fill material inside of the tanks as well as concrete from each of the tanks. The fill material samples and concrete samples are summarized below in Tables 3.3.1.3-1 and 3.3.1.2-2, respectively. The data from these samples are presented in tables in Appendix D.

Table 3.3.1.3-1
Summary of samples collected from fill material inside the tanks on the mesa top

Sample ID	Tank	TAL Metals	SVOCs	VOCs	Pesticides/PCBs	PCBs	Gamma Spectroscopy	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium
RE00-00-0029	Trickling Filter	6445R	6444R	6444R	6444R	-	-	6447R	6447R	-	-
RE00-00-0044	Chlorine Contact Tank	6449R	6448R	6448R	6448R	-	-	6451R	6451R	-	-
RE00-99-0251	Chlorine Contact Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0252	Sludge Digestion Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0253	Sludge Digestion Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0254	Primary Settling Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0255	Primary Settling Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0256	Primary Settling Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0257	Trickling Filter	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0258	Trickling Filter	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0259	Trickling Filter	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0260	Trickling Filter	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0261	Trickling Filter	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0262	Final Settling Tank	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R
RE00-99-0263	Final Settling	5862R	5861R	5861R	-	5861R	5863R	5863R	5863R	5863R	5863R

Sample ID	Tank	TAL Metals	SVOCs	VOCs	Pesticides/PCBs	PCBs	Gamma Spectroscopy	Isotopic Plutonium	Isotopic Uranium	Strontium-90	Tritium
	Tank										

Table 3.3.1.3-2
Summary of samples collected from concrete from the tanks on the mesa top

Sample ID	Tank	Location	TAL Metals	Isotopic Plutonium	Isotopic Uranium	SVOCs	VOCs	Pesticides/PCBs
RE00-00-0019	Sludge Digestion Tank	00-10327	6429R	6429R	6429R	6429R	6429R	6429R
RE00-00-0022	Sludge Digestion Tank	00-10328	6433R	6433R	6433R	6433R	6433R	6433R
RE00-00-0036	Trickling Filter	00-10333	6446R	6446R	6446R	6446R	6446R	6446R
RE00-00-0041	Trickling Filter	00-10331	6446R	6446R	6446R	6446R	6446R	6446R
RE00-00-0042	Trickling Filter	00-10330	6446R	6446R	6446R	6446R	6446R	6446R
RE00-00-0043	Trickling Filter	00-10329	6450R	6450R	6450R	6450R	6450R	6450R
RE00-00-0045	Trickling Filter	00-10334	6450R	6450R	6450R	6450R	6450R	6450R
RE00-00-0056	Chlorine Contact Tank	00-10341	6450R	6450R	6450R	6450R	6450R	6450R
RE00-00-0057	Final Settling Tank	00-10342	6450R	6450R	6450R	6450R	6450R	6450R
RE00-00-0072	Primary Settling Tank	00-10349	6460R	6460R	6460R	6460R	6460R	6460R

3.3.3 Site Assessments

3.3.3.1 Human Health Screening Assessment

(a) Scoping

The scope of this human health screening assessment and subsequent human health risk assessment is defined by the revised conceptual site model described in Section 3.3.2. The human health screening methodology is performed according to guidance provided by EPA Region VI and NMED.

The mesa top at PRS 0-019 is an open area that contains some asphalt and debris on the surface. The subsurface contains some remaining concrete walls and bottoms of tanks that were part of the original CWWTP tanks. This area of the mesa top is currently used by Los Alamos County for storage of equipment and disposal of debris. Future land use of this Los Alamos County land is scheduled to be a nursing facility, similar to Sombrillo, located adjacent to the property now owned by Sombrillo. When the nursing facility is built, it is anticipated that the site

will be covered by asphalt and the associated building(s), leaving no complete exposure pathways for human or ecological receptors. Future land use will be construction as the nursing facility is built, therefore subsurface soil will be included in the risk assessment and SALs will be used for an industrial scenario to represent the construction worker. The current land use of residential is also presented in the screening assessment.

The hillsides are not likely to be developed in the future due to their steepness. The future land use scenario for the hillsides is assumed to be limited to occasional recreational uses such as off-trail hiking.

(b) Screening Evaluation

Mesa Top Soil

A total of 47 chemicals were identified as COPCs on the mesa top based on a comparison to background values and further background comparison tests, where appropriate, for inorganics and radionuclides and an evaluation of detected organic chemicals. These chemicals are evaluated further in this section by comparing the 95% UCL to the appropriate screening action level (SAL). SALs are based on U.S. EPA Region VI Human Health Medium-Specific Screening Levels. This comparison is done separately for noncarcinogens, carcinogens, and radionuclides. Consistent with the HRMB Risk-Based Decision Tree and LANL ER IWP, a value equal to one-tenth of the SAL is used for noncarcinogens, a value equal to the SAL is used for Class A and Class B carcinogens, and a value equal to 10 times the SAL is used for Class C carcinogens. For radionuclides, a value equal to the SAL is used. The SAL values for the radionuclides are the most current that were calculated by RESRAD (LANL, Oct 2000). The chemicals that are considered both carcinogenic and noncarcinogenic based on their health effects are included in both tables. Each effect is evaluated separately.

The comparison between maximum detected concentrations or maximum detection limits and SALs is shown in Tables 3.3.3.1-1 through 3.3.3.1-3.

Table 3.3.3.1-1.
Screening evaluation for noncarcinogenic COPCs in mesa top soil

Chemical	95% UCL value (mg/kg)	Residential Soil SAL (mg/kg)	1/10 Soil SAL (mg/kg)
Lead	**243**	**400**	**40**
Mercury	0.156	23	2.3
Silver	1.68	390	39
Zinc	42.2	23000	2300
Acenaphthylene[a]	0.20	3700	370
Anthracene	0.20	22000	2200
Aroclor 1254	0.16	1.1	0.11
Benzo(g,h,i)perylene[b]	0.19	2300	230
Bis(2-ethylhexyl) phthalate	0.18	1200	120
Chlordane alpha	0.0016	35	3.5
Chlordane gamma	0.0017	35	3.5
Fluoranthene	0.50	2300	230
Fluorene	0.21	2600	260
Phenanthrene[c]	0.35	2300	230
Pyrene	0.38	2300	230

Table 3.3.3.1-2.
Screening evaluation for carcinogenic COPCs in mesa top soil

Chemical	Class	95% UCL (mg/kg)	Residential Soil SAL (mg/kg)
Aroclor 1260	B2	0.06	0.22
Benzo(a) anthracene	B2	0.24	0.62
Benzo(a) pyrene	**B2**	**0.23**	**0.062**
Benzo(b) fluoranthene	B2	0.22	0.62
Benzo(k) fluoranthene	B2	0.23	6.2
Chrysene	B2	0.24	62
DDD [4,4'-]	B2	0.003	2.4
DDE [4,4'-]	B2	0.003	1.7
DDT [4,4'-]	B2	0.0042	1.7
Dibenz(a,h) anthracene	**B2**	**0.20**	**0.062**
Indeno(1,2,3-cd)pyrene	B2	0.19	0.62

Table 3.3.3.1-3.
Screening evaluation for mesa top radionuclides

Chemical	95% UCL (pCi/g)	Residential Soil SAL (pCi/g)
Plutonium-238	0.07	51
Plutonium-239	0.058	46
Uranium-234	1.56	65
Uranium-235	0.118	17
Uranium-238	1.49	94

Based on results of these comparisons, 3 mesa top chemicals are retained as COPCs for further evaluation in the HHRA (lead, benzo(a)pyrene, and dibenz(a,h)anthracene).

(c) Uncertainty Analysis

An uncertainty analysis of the screening assessment results was not conducted because an HHRA was performed.

(d) Interpretation

The results of the screening assessment were not further interpreted because an HHRA was performed.

3.3.3.2 Ecological Screening Assessment

3.3.3.2.1 Scope and Objectives

The main objective of ecological risk screening is to determine if there is unacceptable current-day risk to ecological receptors from COPCs in soil impacted by releases from the CWWTP. Another objective of ecological risk screening is to evaluate the adequacy of existing data to estimate ecological risk associated with Laboratory releases. To accomplish these goals the ecological risk screening process developed for Laboratory PRSs will be applied.

3.3.3.2.2 Technical Approach

There are three parts of the ecological screening assessment as presented in LANL (1999, 64783) and followed in this report: the scoping evaluation, the screening evaluation, and risk interpretation. The scoping evaluation includes (1) the data assessment step, which identifies the list of COPCs; and (2) the problem formulation step for the specific site under investigation. The basis for CWWTP-specific problem formulation is found in the scoping checklist (Appendix E). The scoping checklist is a useful tool for organizing existing ecological information and for focusing the site visit on the information needed to develop the site conceptual model (SCM). The scoping checklist also provides the basis for evaluating the adequacy of the data for ecological risk screening.

The screening evaluation includes the comparison of maximum media concentrations to the final ecological screening levels (ESLs). The final ESLs are media-specific concentrations that are intended to represent the highest concentration of a COPC associated with no adverse ecological effects over an array of ecological receptors. Derivation of final ESLs is a complex process dependent on numerous equations and information sources; see Section 4.5, "Screening Level Ecological Risk Assessment Methods" (LANL 1999, 64783) for information about how the final ESLs are derived. When there is a single medium of concern (soil in this case), the screening evaluation simply compares representative site concentrations of COPCs to the final soil ESLs to establish an initial list of contaminants of potential ecological concern (COPECs). The media and exposure pathways will be discussed in more detail in the problem formulation section below. The final ESLs are from the September 2000 version of the ECORISK database (LANL 1998-2000, ER ID Package 186).

To provide additional information on the potential effects to representative ecological receptors, hazard quotients (HQs) and hazard indices (HIs) for all COPCs are also calculated for all terrestrial screening receptors. The HQ can be thought of as the ratio of the calculated exposure dose to the receptor (based on contaminant levels in the reach) to a dose that has been determined to be acceptable (based on toxicity studies for the receptor). A HI is a sum of HQs, across contaminants with like effects, for a given screening receptor. For this report, radionuclides are considered contaminants with a common effect (radiological dose), and all other chemicals will be considered to have potentially additive effects. Chemicals may interact through potentiation, synergism, or antagonism, and thus combined chemical effects may be greater or less than simple additivity. Because it is not known how the effects of chemicals combine, the simplest assumption of additivity was made for the screening assessment. The potential effects of other chemical interactions, in particular synergy, will be considered in the uncertainty analysis.
An HQ or HI greater than 1 is considered an indicator of potential adverse impacts, and the chemical constituents resulting in an HQ or HI greater than 1 are identified as COPECs. HQ calculations require toxicity, bioconcentration, and bioaccumulation information for all chemicals for all receptors. This report will use the latest receptor-specific ESLs to support the HQ/HI analysis. The equations used to calculate HQ and HI for nonradionuclides are presented as Equations 3.3-1 and 3.3-2.

The second part of the screening evaluation, the uncertainty analysis, follows COPEC identification, and describes the key sources of uncertainty in the screening assessment. The uncertainty analysis can result in adding chemical constituents to or removing them from the list of COPECs. This report contains a qualitative uncertainty analysis to help understand the potential for adverse ecological effects from CWWTP releases.

The last part of the screening assessment interprets screening results in the context of a risk management decision. This primarily involves an assessment of the potential ecological risk versus the potential impacts of further remediation.

$$HQ_{i,j} = \frac{C_j}{ESL_{i,j}} \qquad \text{Equation 3.3-1}$$

$$HI_i = \sum_{j=1}^{n} HQ_{i,j} \qquad \text{Equation 3.3-2}$$

Where: C_j is the concentration of the jth COPC in soil (mg/kg),

$ESL_{i,j}$ is the ESL for ith receptor and the jth COPC in soil (mg/kg),

$HQ_{i,j}$ is the HQ for ith receptor and the jth COPC in soil (unitless),

$HI_{i,j}$ is the HI for ith receptor in soil (unitless),

n is the number of COPCs in soil, and

3.3.3.2.3 Scoping Evaluation

a) Data Assessment

The approach taken to characterize releases from the CWWTP was designed to provide information on the nature and extent of contamination. As discussed in the revised conceptual model section, data collected in soil and tuff were adequate to confirm the preliminary conceptual model that the highest concentrations of COPCs would be found in the western outfall. Lower concentrations were measured in samples collected from the eastern outfall, and relatively few locations had elevated concentrations of COPCs in the mesa top. There is sufficient sample coverage of the CWWTP to calculate representative concentrations of COPCs instead of using the maximum concentration in screening.

b) Problem Formulation

The purpose of the screening-level ecological risk problem formulation for the CWWTP is to provide information to (1) determine if there are complete exposure pathways to ecological receptors; (2) determine how data should be aggregated spatially for screening and establish the functional/operational boundaries of the assessment; and (3) gather information to develop the SCM (e.g., what are the contaminant sources, dominant transport pathways and exposure routes, and potential receptors).

The following information is summarized from the ecological scoping checklist, which is provided in Appendix E. The ecological scoping checklist was prepared from site visits to the CWWTP. Terrestrial ecological receptors are abundant in the outfall areas and elsewhere in Graduation Canyon, where the dominant plants include ponderosa pine, piñon pine, juniper, shrub oak, forbs, and grasses. There is an area vegetated with cattails downstream of the western outfall, and the water source that enabled these cattails to survive was from the Sombrillo Facility. This Sombrillo Facility outfall was shut off in February 2000 and the site visit in August 2000 noted that this cattail area was dry. The cattails are predicted to disappear and be replaced by more typical terrestrial vegetation. There is no perennial source of water at the CWWTP or the adjacent part of Graduation Canyon to harbor aquatic receptors. Physical disturbance is obvious in many parts of the CWWTP site, and some physical disturbance predates the VCA activities on the mesa top. Indeed the level of current physical disturbance and the planned construction activities on the mesa top obviate any significant pathway from COPCs in mesa top soil to ecological receptors. Scattered debris is obvious on the mesa top and in the vicinity of the eastern outfall, but the western outfall has minimal evidence of physical disturbance. No obvious effects of COPCs on vegetation were noted in any of the site visits.

Threatened and endangered (T&E) species are potential receptors for contaminant releases from the CWWTP. Specifically, the Mexican spotted owl and the peregrine falcon may forage at PRS 0-019 (Gonzales 1999, 62727). PRS 0-019 is considered to have nesting habitat for both these species; therefore the probability for foraging is considered high. Thus, the kestrel screening receptor with an all-flesh diet will serve as a surrogate for these avian threatened and endangered (T&E) receptors in the screening calculations.

For ecological risk screening, the primary impacted media are (1) subsurface soil and tuff on the mesa top; (2) fill material used to cover the former CWWTP structures; and (3) surface soil in the western and eastern outfalls. Because the fill material was imported to the site, it does not record CWWTP releases and is therefore excluded from the screening assessment. Concentrations of analytes in fill will be compared to CWWTP impacted media to inform the uncertainty analysis and interpretation sections. Subsurface material on the mesa top is only an exposure medium for ecological receptors if this material is excavated and subsequently brought to the surface. Thus, the only

viable exposure medium for current ecological impacts is the surface soil at the outfalls. Both outfall areas have well-developed terrestrial plant and animal populations, which can be exposed to contaminants in surface water.

The most important transport mechanism for contaminants in the outfalls is erosion of sediment deposits by surface water runoff. Uncontaminated surface water could become contaminated by entrainment of contaminated sediments or dissolution of soluble contaminants during storm events. This ephemeral contaminated storm water will not be evaluated for ecological impacts for PRS 0-019, rather any ecological effects of contaminated surface water will be evaluated on watershed aggregate spatial scale. Another transport mechanism is the suspension of dry particulates by eolian processes, which makes air a secondary contaminated media.

The ecological SCMs for terrestrial receptors is provided as Figure 3.3.3.2.3-1. The SCM identifies the exposure pathways that represent major, minor, unlikely, or no pathway to ecological receptors. Exposure pathways to terrestrial receptors can occur through air (respiration of vapors, inhalation or deposition of particulates) and surface soil (root uptake and rain splash on plants, food web transport to plants and animals, incidental ingestion of soil, dermal contact with contaminated soil, and external radiation). One major soil-related exposure pathway is expected to be plant uptake. Food web transport and incidental ingestion of contaminated soil could be either minor or major pathways depending on the potential for bioaccumulation of the chemical and the amount of soil ingested by the receptor. External gamma radiation exposure is expected to be minor based on the relatively low concentrations of gamma-emitting radionuclides. Exposure to vapors is viewed to be an unlikely pathway based on the low volatile organic compound (VOCs) concentrations measured in sediment and water and the rapid loss of volatile organic chemicals expected in surface soil. Exposure to airborne particulates is likely a minor pathway because of the limited amount of contamination on the ground surface and the dense plant cover in some areas. Lastly, dermal contact is expected to be minor because of the limited amount of contamination expressed at the ground surface and the presence of fur or feathers that act as a barrier to dermal absorption.

Typically, all complete exposure pathways should be at least qualitatively evaluated in the screening process. However, soil ESLs do not include exposure to vapors or particulates in air nor do the soil ESLs account for exposure through dermal contact. The importance of these pathways will be discussed in the uncertainty analysis.

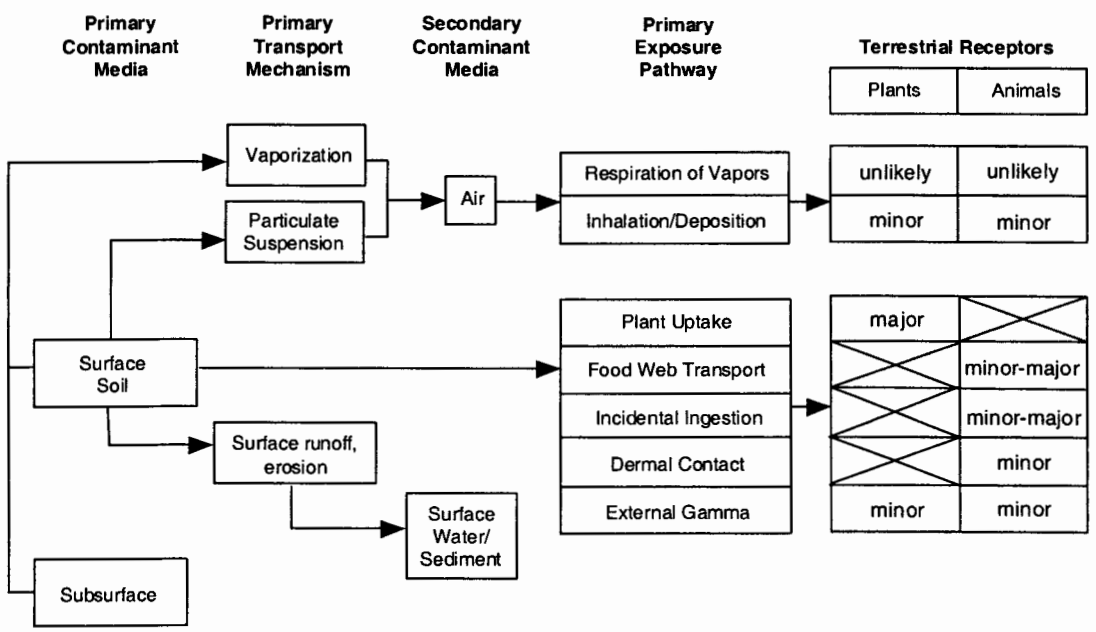

Figure 3.3.3.2.3-1. Site conceptual model for terrestrial ecological receptors

3.3.3.2.4 Screening Evaluation

The screening evaluation consists of the two parts, which includes final ESL comparisons and uncertainty analysis.

a) Comparison to Final ESLs

To determine which of the COPCs should be retained for the uncertainty analysis, representative concentrations were compared to the final soil ESL values. All COPCs having a representative concentration greater than the final media-specific ESL will be evaluated in the uncertainty analysis. The final soil ESLs are from the September 2000 version of the ECORISK database (LANL 1998-2000, ER ID Package 186).

The ESL comparison is summarized for inorganic chemicals and radionuclides in Table 3.4-e1, and the summary for the organic chemicals is provided in Table 3.4-e2. The representative concentrations are based on the samples collected from the western and eastern outfalls. To calculate representative concentrations, average concentrations within subareas of the outfall drainages were calculated and area-weighted averages were calculated. The area-weighting factors were simply the subarea surface area divided by the total outfall area. This representative concentration assumes that ecological receptors only are exposed to COPCs within the outfall, and no exposure occurs in areas outside of the drainages.

Tables 3.3.3.2.4-1 and 3.3.3.2.4-2 show that 5 radionuclides, 2 pesticides, 9 SVOCs, and 2 VOCs had representative concentrations less than the soil ESL. Eight COPCs (calcium, ruthenium-106, delta-BHC, 4,4'-DDD, Endosulfan I, Heptachlor Epoxide, bromomethane, and chlorormethane) that are missing final soil ESLs are retained for the uncertainty analysis. One radionuclide, uranium-234, has a representative concentration less than the ESL, but the HQ for the final ESL receptor is greater than 0.3 and so uranium-234 is retained for the uncertainty analysis. In summary, 13 inorganic chemicals, 2 radionuclides, 2 PCBs, 7 pesticides, and 2 SVOCs are retained for the uncertainty analysis. These COPCs are identified in Tables 3.3.3.2.4-1 and 3.3.3.2.4-2.

To provide additional information on the potential effects of COPCs on ecological receptors, a HQ/HI analysis is provided for plants, invertebrates, and six wildlife species (robin, kestrel, deer mouse, cottontail, shrew, and red fox). A HI is calculated for each of these species, and to account for the primary dietary exposure pathways, there are two dietary variants of the kestrel and three dietary variants of the robin. Thus, 11 total receptor/diet combinations are evaluated in the HQ/HI analysis.

The results of the HQ/HI analysis based on the representative concentrations are summarized in Table 3.3.3.2.4-3. Table 3.3.3.2.4-3 shows that the nonradionuclide HI for all receptor/diet combinations exceeds 1, and that the radionuclide HI for all receptor/diet combinations is less than 1. The largest radionuclide HI is 0.9 for the invertebrate based on representative concentrations. The radionuclide HI values thus imply that all radionuclides can be eliminated from further assessment. A HI exclusive of three chemicals, barium, mercury, and 4,4'-DDT, is also provided in Table 3.3.3.2.4-3, and the nonradionuclide HI exclusive of these chemicals is dramatically lowerfor invertebrate and wildlife receptors. The plant HI is basically unchanged by eliminated these chemicals. Table 3.3.3.2.4-4 provides a summary of the HQ values for all receptors and chemicals, and a review of this table shows that four inorganic chemicals (chromium, silver, vanadium, and zinc) contribute that vast majority of the plant HI. Other detailed results for the receptors are provided in Appendix E.

Additional information to evaluate wildlife receptors HI values is provided in Table 3.3.3.2.4-3, and includes the receptor's home range, the area use factor (AUF) based on the receptors foraging range and the area of Graduation Canyon impacted by the outfalls, and the HI values adjusted AUF values. The area impacted by the outfalls includes the areas directly downgradient of the western and eastern outfalls, and also includes the portion of the emphemeral stream channel between the western and eastern outfall. The purpose of these additional calculations is to determine how receptors may be impacted by the average concentrations within their foraging home ranges. Because the home range for the mouse is are less than the estimated area impacted by the outfalls, there is no effect of AUF on the HI. Species with large home ranges (fox and falcon) show a large decrease in the HI as the animal is assumed to forage in uncontaminated areas most of the time. Because T&E species concerns are modeled by the kestrel with the flesh diet, it is useful to evaluate the effect of the AUF on the estimated HI values for this receptor. As shown in Table 3.3.3.2.4-3, the kestrel as an omnivore has an AUF-adjusted HI<10 and the kestrel with the flesh diet has an AUF adjusted HI<1.

Table 3.3.3.2.4-1
Comparison of weighted average concentrations to final soil ESLs for inorganic chemicals and radionuclides

Suite	Analyte	Units	Background average or MDL	W&E Outfall Wt Average	Final Soil ESL	Receptor	HQ
inorg	Antimony	mg/kg	0.505	1.4	0.5	Plant	2.77
inorg	Barium	mg/kg	143	266	2.5	Shrew	106.36
inorg	Cadmium	mg/kg	0.364	1.8	1	Plant	1.79
inorg	Calcium	mg/kg	2640	3435	n/a	n/a	n/a
inorg	Chromium, Total	mg/kg	9.04	21	0.35	Plant	59.59
inorg	Copper	mg/kg	6.06	69	13	Invert.	5.32
inorg	Lead	mg/kg	12.7	94	76	Robin-herb.	1.23
inorg	Mercury	mg/kg	0.053	2.9	0.016	Robin-invert.	183.91
inorg	Nickel	mg/kg	7.07	108	20	Plant	5.39
inorg	Selenium	mg/kg	0.447	0.51	0.5	Plant	1.02
inorg	Silver	mg/kg	1	39	0.05	Plant	779.13
inorg	Vanadium	mg/kg	21.3	25	0.25	Plant	101.50
inorg	Zinc	mg/kg	31.5	177	10	Plant	17.66
rads	Cobalt-60	pCi/g	n/a	0.088	410	Invert.	0.00
rads	Ruthenium-106	pCi/g	n/a	0.85	n/a	n/a	n/a
rads	Plutonium-238	pCi/g	0.0054	0.020	17	Invert.	0.00
rads	Plutonium-239	pCi/g	0.015	0.92	18	Invert.	0.05
rads	Uranium-234	pCi/g	1.4	12	20	Invert.	0.59
rads	Uranium-235	pCi/g	0.087	0.53	21	Invert.	0.03
rads	Uranium-238	pCi/g	1.22	5.0	22	Invert.	0.23

Table 3.3.3.2.4-2
Comparison of weighted average concentrations to final soil ESLs for organic chemicals

Suite	Analyte	Units	Background average or MDL	W&E Outfall Wt Average	Final Soil ESL	Receptor	HQ
PCB	Aroclor-1254	mg/kg	0.033	0.64	0.12	Shrew	5.33
PCB	Aroclor-1260	mg/kg	0.033	0.45	0.05	Robin-Invert.	8.99
pest	BHC[delta-]	mg/kg	0.0033	0.0074	n/a	n/a	n/a
pest	Chlordane[alpha-]	mg/kg	0.0033	0.021	2.1	Robin-Invert.	0.01
pest	Chlordane[gamma-]	mg/kg	0.0033	0.022	2.1	Robin-Invert.	0.01
pest	DDD[4,4'-]	mg/kg	0.0033	0.060	n/a	n/a	n/a
pest	DDE[4,4'-]	mg/kg	0.0033	0.015	0.0018	Kestrel-Flesh	8.27
pest	DDT[4,4'-]	mg/kg	0.0033	2.4	0.0028	Robin-Invert.	848.12
pest	Endosulfan I	mg/kg	0.0033	0.0076	n/a	n/a	n/a
pest	Endrin	mg/kg	0.0033	0.014	0.0034	Plant	4.00
pest	Heptachlor Epoxide	mg/kg	0.0033	0.0080	n/a	n/a	n/a
SVOC	Benzo(a)anthracene	mg/kg	0.33	0.29	3.3	Shrew	0.09
SVOC	Benzo(a)pyrene	mg/kg	0.33	0.30	1.8	Shrew	0.17
SVOC	Benzo(b)fluoranthene	mg/kg	0.33	0.38	7.4	Shrew	0.05
SVOC	Benzo(g,h,i)perylene	mg/kg	0.33	0.28	12	Shrew	0.02
SVOC	Benzoic Acid	mg/kg	3.3	1.8	8.2	Deer Mouse	0.22
SVOC	Bis(2-ethylhexyl)phthalate	mg/kg	0.33	0.29	0.24	Kestrel-Flesh	1.19
SVOC	Chrysene	mg/kg	0.33	0.28	3.3	Shrew	0.09
SVOC	Di-n-butylphthalate	mg/kg	0.33	0.28	0.17	Robin-Invert.	1.66
SVOC	Fluoranthene	mg/kg	0.33	0.28	26	Shrew	0.01
SVOC	Phenanthrene	mg/kg	0.33	0.28	110	Shrew	0.00
SVOC	Pyrene	mg/kg	0.33	0.30	15	Shrew	0.02
VOC	Bromomethane	mg/kg	0.01	0.014	n/a	n/a	n/a
VOC	Chloromethane	mg/kg	0.01	0.014	n/a	n/a	n/a
VOC	Methylene Chloride	mg/kg	0.01	0.0066	6.6	Deer Mouse	0.00
VOC	Toluene	mg/kg	0.01	0.0085	71	Shrew	0.00

Table 3.3.3.2.4-3
HI Summary for COPCs Based on Weighted Average and AUF Modified Concentrations

Receptor	HI based on weighted average			Receptor Home Range (ha) [a]	AUF [b]	HI based on weighted average, adjusted by AUF		
	Non-rads	Non-rads w/o Ba, Hg, DDT	Rads			Non-rads	Non-rads w/o Ba, Hg, DDT	Rads
Plant	977	974	0.01	n/a	n/a	n/a	n/a	n/a
Invertebrate	68	9	0.9	n/a	n/a	n/a	n/a	n/a
Robin - Invertivore	1075	35	0.02	0.42	0.55	589	19	0.01
Robin - Omnivore	642	21	0.01	0.42	0.55	352	12	0.01
Robin - Herbivore	226	8	<0.01	0.42	0.55	124	4	<0.01
Kestrel - Flesh Diet	591	13	<0.01	366 [c]	0.00063	0.4	<0.01	<0.01
Kestrel	444	11	<0.01	13.1	0.0176	7.8	0.2	<0.01
Deer Mouse	91	13	<0.01	0.075	1.0	91	13	<0.01
Rabbit	20	3	<0.01	1.5	0.15	3	1	<0.01
Shrew	150	21	0.01	0.39	0.59	88	12	0.01
Fox	5	2	<0.01	699	0.00033	<0.01	<0.01	<0.01

[a] Based on EPA (1993, ER ID 59384) for all species, except as noted.

[b] AUF is area use factor and is calculated as the outfall area (0.23 ha) divided by the home range, with 1.0 being the maximum AUF allowed in the case where the home is smaller than the outfall area.

[c] Home range is spotted owl (Gallegos et al. 1996, ER ID xxxxx),because the kestrel with a flesh diet serves as a surrogate for this species.

[d] n/a = not available.

Table 3.3.3.2.4-4
HQ Summary for All Receptors

Suite	Analyte	Plant	Invert.	Robin (Invert Diet)	Robin (Omni Diet)	Robin (Plant Diet)	Kestrel (Flesh Diet)	Kestrel (Flesh/ Invert diet)	Deer Mouse	Rabbit	Shrew	Fox
rads	Cobalt-60	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
rads	Ruthenium-106	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
rads	Plutonium-238	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
rads	Plutonium-239	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
rads	Uranium-234	0.01	0.59	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
rads	Uranium-235	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
rads	Uranium-238	<0.01	0.23	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
inorg	Antimony	2.77	n/a	n/a	n/a	n/a	n/a	n/a	1.39	0.22	2.35	0.01
inorg	Barium	2.66	n/a	8.31	5.02	1.9	0.04	1.11	57.8	8.06	106.36	0.66
inorg	Cadmium	1.79	0.18	0.3	0.29	0.28	<0.01	0.04	0.21	0.1	0.25	<0.01
inorg	Calcium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
inorg	Chromium, Total	59.59	2.09	0.44	0.36	0.27	0.01	0.05	0.14	0.04	0.29	0.01
inorg	Copper	0.69	5.32	0.18	0.33	0.49	<0.01	0.02	0.63	0.46	0.41	0.01
inorg	Lead	0.21	0.05	0.94	1.06	1.23	0.04	0.08	0.28	0.17	0.47	0.02
inorg	Mercury	0.09	58.85	183.91	183.91	183.91	12.79	29.43	19.62	8.92	21.02	1.18
inorg	Nickel	5.39	1.08	0.23	0.19	0.15	<0.01	0.03	0.17	0.06	0.26	<0.01
inorg	Selenium	1.02	0.07	0.47	0.37	0.26	0.01	0.07	0.43	0.12	0.56	0.02
inorg	Silver	779.13	n/a	0.89	1.86	2.78	0.02	0.11	2.6	1.86	1.39	0.03
inorg	Vanadium	101.5	n/a	9.06	4.88	0.88	0.05	1.21	1.27	0.03	2.64	0.02
inorg	Zinc	17.66	0.5	0.19	0.49	0.77	0.02	0.03	0.21	0.16	0.09	0.01
PCB	Aroclor-1254	0.06	n/a	3.37	1.73	0.14	0.7	0.81	2.46	0.03	5.33	0.85
PCB	Aroclor-1260	n/a	n/a	8.99	4.68	0.37	2.25	2.37	3	0.04	5.99	1.22
pest	BHC[delta-]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
pest	Chlordane[alpha-]	0.01	n/a	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
pest	Chlordane[gamma-]	0.01	n/a	0.01	0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01
pest	DDD[4,4'-]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
pest	DDE[4,4'-]	n/a	n/a	6.76	3.46	0.24	8.27	4.96	<0.01	<0.01	<0.01	<0.01
pest	DDT[4,4'-]	n/a	n/a	848.12	431.77	31.66	565.41	402.5	0.82	0.01	1.7	0.91
pest	Endosulfan I	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
pest	Endrin	4	n/a	1.13	0.62	0.07	0.03	0.17	0.04	<0.01	0.07	<0.01
pest	Heptachlor Epoxide	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SVOC	Benzo(a)anthracene	0.02	n/a	n/a	n/a	n/a	n/a	n/a	0.04	<0.01	0.09	0.01
SVOC	Benzo(a)pyrene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.08	<0.01	0.17	0.03
SVOC	Benzo(b)fluoranthene	0.02	n/a	n/a	n/a	n/a	n/a	n/a	0.03	<0.01	0.05	0.01
SVOC	Benzo(g,h,i)perylene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.01	<0.01	0.02	0.02
SVOC	Benzoic Acid	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.22	0.14	0.15	<0.01
SVOC	Bis(2-ethylhexyl)phthalate	n/a	n/a	0.29	0.15	0.01	1.19	0.64	<0.01	<0.01	0.01	0.03
SVOC	Chrysene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.04	<0.01	0.09	0.01
SVOC	Di-n-butylphthalate	<0.01	n/a	1.66	0.88	0.13	0.02	0.24	<0.01	<0.01	<0.01	<0.01
SVOC	Fluoranthene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.01	<0.01	0.01	<0.01
SVOC	Phenanthrene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	<0.01	<0.01	<0.01	<0.01
SVOC	Pyrene	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.01	<0.01	0.02	<0.01
VOC	Bromomethane	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	Chloromethane	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
VOC	Methylene Chloride	<0.01	n/a	n/a	n/a	n/a	n/a	n/a	<0.01	<0.01	<0.01	<0.01
VOC	Toluene	<0.01	n/a	n/a	n/a	n/a	n/a	n/a	<0.01	<0.01	<0.01	<0.01

b) Uncertainty Analysis

Uncertainties associated with the CWWTP screening-level ecological risk assessment include information relating to concentrations in contaminated media, exposure pathways, receptors, and COPECs. These sources of uncertainty and the potential impact of these uncertainties on the estimate hazard of CWWTP COPECs to ecological receptors are discussed in the following text.

The identification of the COPECs in the screening assessment is based on the representative concentrations in soil at the outfalls. The outfalls contain the largest concentration of most COPCs with the exception of plutonium-238, calcium, lead, and PAHs. Higher concentrations of PAHs were measured in fill samples, which suggests that elevated PAHs are not related to CWWTP operation but rather are derived from debris in the fill and soil matrix. Thus, even though disturbance and the depth of elevated concentrations on the mesa top currently limits exposure to ecological receptors, consideration of the mesa top a potential ecological exposure area would not change or add any new COPECs compared to the outfall area assessment. Calculation of the weighted averages appropriately overestimate potential exposure by initially assuming that all exposure to chemicals in soil is derived from the outfall areas. In addition, bounding locations at each outfall were excluded in the weighted average calculations to further overestimate concentration. The areas assumed impacted by the outfalls are also overestimated which will tend to overestimate exposure adjusted by the receptor AUF.

The exposure pathways addressed by the ESL and HQ/HI analysis include all complete exposure pathways with the exception of inhalation and dermal exposure. Although these pathways must contribute to the dose received by plants and animals, it is expected that the contribution of these pathways is relatively small and does not interfere with either COPEC determination or with providing an assessment of current risk to ecological receptors. Dermal contact and inhalation/respiration pathways have not typically been assessed quantitatively in ERAs, based on guidance suggests that the ingestion route is most important to terrestrial animals (EPA 1997, ER ID 62570). Inhalation is viewed to be insignificant pathway for contaminated soil in areas where plants cover the contaminated ground surface or where much of the contamination is buried. Dermal exposure to wildlife is mitigated by the fur or feathers that cover the bodies of most vertebrates. In addition, the incidental consumption of soil during grooming is assumed to be included in the direct soil ingestion estimates. Soil exposure pathway analysis has shown that inhalation and dermal pathways contribute a small fraction of the dose obtained orally (EPA 2000, ER ID xxxxx). The contribution from dermal exposure was shown to vary with contaminant type with semivolatile organic chemicals or high explosives contributing the largest amount and inorganic chemicals contributing the least to total dose (EPA 2000, ER ID xxxxx).

The main uncertainty relating to receptors is the foraging behavior of wildlife species that brings them into contact with the contaminated media. The screening evaluation provided some information on the home range of wildlife receptors and also referenced Appendix C for average concentrations of COPECs in the CWWTP outfalls. Application of the AUF for widely ranging species greatly reduced the estimated HI. However, it is important to recognize that multiplying the HI by the AUF assumes that concentrations of COPECs are zero outside of the outfall areas. Clearly this is not true for some analytes (e.g., inorganic chemicals or radionuclides with wide-spread background concentrations), but may be reasonable approximation for other chemicals. Another factor to consider is the potential population impacts of elevated concentration of chemicals for non-T&E species.

This uncertainty analysis will consider the 7 key COPECs that represent a HQ of greater than 10 to any screening receptor. HQ values of 10 were selected because typically the LOEAL values are ten times greater than NOEAL values used as the basis for the calculation of ESLs. Remedial activities should be protective of ecological effects at the LOEAL level. In addition, two classes of COPECs, PAHs and VOCs, will be evaluated in this uncertainty analysis. Lastly, calcium, ruthenium-106, and four pesticides will be discussed as COPECs without ESLs. Each of these COPECs or classes of COPECs is briefly discussed below.

Barium. Barium is a COPEC due to potential effects on mammalian receptors, in particular effects on the deer mouse and shrew. The ECORISK database provides some toxicity and exposure information for

barium (LANL 1998-2000, ER ID Package 186). Exposure to these receptors with an invertebrate diet is likely overestimated because it is assumed (as a default value) that concentration of barium in invertebrates is equal to the concentration in soil. For a comparison, the concentration of barium in plants is predicted to be 15% of the concentration in soil. This is why the barium HQ for the cottontail is less than 10 and shrew barium HQ is greater than 100. In addition, barium is the assumed to be in a soluble and more bioavailable form, which explains why even background concentrations of barium would yield a HQ greater than 10 for the mouse and shrew. It is not likely that barium would persist in a soluble form for nearly 40 years after releases have ceased. Another factor to consider is the spatial distribution and location of elevated barium concentrations. Average barium concentrations are only elevated in the western outfall area, and more specifically in the slope and cattail areas. The estimated surface area of these geomorphic packages is 726 m^2, which would entail a relatively large effort to remove these elevated barium concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, barium is retained as a COPEC for the CWWTP, although its impacts on mammalian receptors appears to be overstated by the assumed uptake into invertebrates and its bioavailability for toxicological effects.

Chromium. Chromium is a COPEC due to potential effects on plants. Because chromium toxicity information exists for total chromium and hexavalent chromium, the lower of these two values was used in this screening assessment. For plants, the total chromium ESL is about 10 times larger than the hexavalent chromium ESL (LANL 1998-2000, ER ID Package 186). This would partly explain why large HQ values were obtained for plants. In fact, the average background concentration would have also generated a large chromium HQ value. It is unlikely that hexavalent chromium exists in surface soils, as this form of chromium is actively reduced to chromium(+6) in such a matrix. Site visits did not note any obvious effects of contamination on vegetation (Appendix E), and the only notes were that the western outfall vegetation was in better condition than the eastern outfall, which in a qualitative manner provides a line of evidence against effect of chromium on vegetation (because chromium concentrations are greater in the western outfall area). Another factor to consider is the spatial distribution and location of elevated chromium concentrations. Average chromium concentrations are only elevated in the western outfall area. The estimated surface area of the western outfall geomorphic packages is 784 m^2, which would entail a relatively large effort to remove these elevated chromium concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, chromium is retained as a COPEC for the CWWTP, although its impacts on plants appear to be overstated by its assumed presence as the hexavalent form.

Mercury. Mercury is a COPEC based on potential effects across all screening receptors, except plants. Because mercury toxicity information exists for inorganic mercury and methyl mercury, the lower of these two values was used in this screening assessment. For most receptors, the methyl mercury ESL is lower than the inorganic mercury ESL, and typically differs by more than an order of magnitude (LANL 1998-2000, ER ID Package 186). Thus, if mercury exists in an inorganic form, which is likely in surface soils, then risk is greatly overestimated. Another factor to consider is the spatial distribution and location of elevated mercury concentrations. Average mercury concentrations are most elevated in the western outfall area (western outfall average mercury concentration is 6 mg/kg and the eastern outfall averages 0.14 mg/kg compared to an average background concentration of 0.053 mg/kg). The estimated surface area of the western outfall geomorphic packages is 784 m^2, which would entail a relatively large effort to remove these elevated mercury concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, mercury is retained as a COPEC for the CWWTP, although its impacts on ecological receptor appear to be overstated by its assumed presence as the methyl form.

Silver. Silver is a COPEC due to potential effects on plants. There is no soil background data for silver, but based on sediment samples it is expected that average silver background concentrations are less than 1 mg/kg. Thus, silver concentrations are much greater than background in both outfall areas, although the western outfall concentrations are about 10 times the concentrations in the eastern outfall. Elevated silver was also measured in the upgradient Graduation Canyon sample location, which could suggest other sources for silver in the watershed. Site visits did not note any obvious effects of contamination on vegetation (Appendix E), and the only notes were that the western outfall vegetation was in better condition than the eastern outfall, which in a qualitative manner provides a line of evidence against effect of silver on vegetation (because silver concentrations are greater in the western outfall area). Another factor to consider

is the spatial distribution and location of elevated chromium concentrations. Average silver concentrations are most elevated in the western outfall area. The estimated surface area of the western outfall geomorphic packages is 784 m^2, which would entail a relatively large effort to remove these elevated silver concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, silver is retained as a COPEC for the CWWTP, although its hypothesized impacts on plants appear to be questionable based on the lack of obvious field impacts.

Vanadium. Vanadium is a COPEC due to potential effects on plants. Most relevant to vanadium potential effects on plants is the minor difference in average vanadium concentrations from background. The weighted average vanadium from both outfalls is 25 mg/kg, which is only about 20% greater than the average vanadium background concentration (21.3 mg/kg). The highest vanadium concentration for any subarea is the cattail area, which is roughly twice the average vanadium background concentration. Site visits did not note any obvious effects of contamination on vegetation (Appendix E), and the only notes were that the western outfall vegetation was in better condition than the eastern outfall, which in a qualitative manner provides a line of evidence against effect of vanadium on vegetation (because vanadium concentrations are greater in the western outfall area). Another factor to consider is the spatial distribution and location of elevated vanadium concentrations. Average vanadium concentrations are only elevated in the western outfall area, and more specifically in the slope and cattail areas. The estimated surface area of these geomorphic packages is 726 m^2, which would entail a relatively large effort to remove these elevated vanadium concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, vanadium is retained as a COPEC for the CWWTP, although its hypothesized impacts on plants appear to be questionable based on the lack of obvious field impacts.

Zinc. Zinc is a COPEC due to potential effects on plants. Average zinc concentrations are greater than the average background zinc concentrations in both outfalls although concentrations in the eastern outfall differ modestly from average background. Site visits did not note any obvious effects of contamination on vegetation (Appendix E), and the only notes were that the western outfall vegetation was in better condition than the eastern outfall, which in a qualitative manner provides a line of evidence against effect of zinc on vegetation (because zinc concentrations are six times greater in the western outfall area). Another factor to consider is the spatial distribution and location of elevated zinc concentrations. Average silver concentrations are most elevated in the western outfall area. The estimated surface area of the western outfall geomorphic packages is 784 m^2, which would entail a relatively large effort to remove these elevated zinc concentrations (including removal of trees and shrubs to gain access to this area of Graduation Canyon). Thus, zinc is retained as a COPEC for the CWWTP, although its hypothesized impacts on plants appear to be questionable based on the lack of obvious field impacts.

DDT (and metabolites—DDE). DDT is a COPEC based on effects on avian receptors. These effects are particularly important because of the use of the kestrel as a surrogate for T&E species. The weighted average DDT concentration for the outfall areas is greatly influenced by a single sample result from the western outfall bench subarea. This sample result was discussed at length in the revised conceptual model and information was presented on the dubious nature of this result. First, this result is not only an outlier for the CWWTP data but is also an outlier for all FIMAD DDT sample results. Thus, even if this value is accurate, then it is quite reasonable to predict that exposure to avian receptors is greatly overstated by the weighted average for the CWWTP. One could reasonably expect that the relative exposure to avain receptor is relatively close to zero compared to that predicted by this single DDT sample result of 330 mg/kg. Another line of evidence regarding this DDT detection is the lack of elevated DDT metabolite sample results for the sample location (DDD and DDE). Thus, one could infer that the DDT result was incorrectly reported, the metabolite results were incorrect, or the DDT in this location has not been metabolized by any biological activity. A lack of biological degradation would suggest a recent source for this elevated DDT and therefore rule out a relationship with release from the CWWTP. It seems unlikely that the metabolite sample results are incorrect based on the similar concentrations for these analytes in other western outfall samples. Thus, this single DDT sample result should be excluded from the data, which greatly reduces the estimated hazard to avian receptors from DDT (weighted average DDT concentration is 0.059 mg/kg without 330 mg/kg value and the largest HQ would be 21). Concentrations of elevated DDT concentration (based on excluding the 330 mg/kg) are broadly distributed in the outfalls, but concentrations in the western outfall are ten times greater than the eastern outfall. Thus, DDT is retained as a COPEC, but

the HQ values based on the 330 mg/kg result are questionable and a better estimate of the maximum HQ for DDT is closer to 20.

PAHs. PAHs did not contribute significantly to the HI of any receptor. In addition, the apparent source of PAHs is the fill material brought on-site to cover the CWWTP structures. Thus, PAHs as a class of COPECs are eliminated from further consideration.

VOCs. VOCs were detected sporadically and inconsistently in soil samples at the CWWTP. Thus, there is no apparent subsurface or surface source of VOCs. For the two VOCs with ESLs (methylene chloride and toluene), the HQ values were negligible (<0.01). By inference, the hazard for the other two VOCs detected in the outfall area (bromomethane and chloromethane) would also be expected to be negligible. The outstanding question regarding VOCs is the lack of the inhalation pathway in the calculation of ESLs. However, as discussed above there are good reasons to discount the inhalation pathway. Thus, VOC as a class of COPECs are eliminated from further consideration.

COPECs without ESLs. Bromomethane and chloromethane had no ESLs, but these VOCs were discussed in the previous paragraph. Six other COPCs (calcium, ruthenium-106, delta-BHC, 4,4'-DDD, Endosulfan I, and Heptachlor Epoxide) were identified as COPECs due to missing toxicity information to calculate ESLs. Calcium is a micronutrient and the weighted average concentration was greater than the average background concentration by one-thrid. Thus, calcium can be eliminated as a COPEC based on minimal difference with background soil concentrations. Ruthenium-106 has no calculated ESL, but cobalt-60 can be used a reasonable surrogate gamma-emitting radionuclide, which would lead to eliminating ruthenium-106 from further consideration. Recall that all other radionuclides were previously eliminated as COPECs. Toxicity of DDD can be considered inclusive of the effects of DDT (DDT plus metabolites). For the other three pesticides (delta-BHC, Endosulfan I, Heptachlor Epoxide), there are surrogate chemicals with ESLs. In all cases, comparison of these pesticides with the surrogate ESL would lead to their elimination as COPECs (delta-BHC weighted average of 0.0074 mg/kg compared to the gamma-BHC ESL of 0.034 mg/kg; Endosulfan I weighted average of 0.0076 mg/kg compared to the Endosulfan ESL of 3.5 mg/kg; and Heptachlor Epoxide weighted average of 0.008 mg/kg compared to the Heptachlor ESL of 0.18 mg/kg).

3.3.3.2.5 Interpretation

Seven COPECs have been identified in CWWTP soil, but additional remedial activities at the CWWTP outfalls are not recommended. The basis for this recommendation hinges on two observations. First, the largest 4,4'-DDT sample result is considered invalid based on the factors discussed above. Other COPECs are distributed widely downstream of the western outfall in areas that are relatively inaccessible to equipment needed for any large-scale remedial action. Thus, the environmental damage of removing mercury concentrations that average 6 mg/kg in the western outfall outweigh the potential reduced ecological risk associated with removing this mercury containing soil. A clearer example of poor risk reduction is provided by the consideration of the average concentrations of barium in the western outfall (455 mg/kg) versus the average concentration of barium in background soils (143 mg/kg). Clearly, there would be little risk reduction for removing barium at concentrations relatively close to background in an area that is small fraction of most receptors home range.

3.3.3.3 Human Health Risk Assessment

(a) Selection of Chemicals of Potential Concern

COPCS in soil were identified based on the results of the screening evaluation presented in Section 3.3.3.1. This evaluation was based on comparing the 95%UCL for the mesa top and the western and eastern outfall weighted averages for the hillsides. For the mesa top three chemicals exceeded one-tenth their respective SAL (for noncarcinogens) or exceeded their SAL (for the carcinogens). Therefore these three chemicals (lead, benzo(a)pyrene, and dibenz(a,h)anthracene) will be evaluated further. On the hillsides six chemicals will be evaluated further (lead, mercury, silver, aroclor-1254, aroclor-1260, and 4,4'-DDT).

(b) Exposure Assessment

Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposure. The principal elements of exposure assessment consist of:

- evaluating the influence of fate and transport processes for the COPCs,
- identifying potential exposure scenarios (i.e., receptors) and exposure pathways,
- calculating representative chemical concentrations, and
- estimating potential chemical uptake.

Exposure assessment is conducted in the context of a revised site conceptual model. As described in EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA 1988, page 2-7), the purpose of a site conceptual model is to describe what is currently known about chemical sources, likely migration pathways, exposure routes, and possible exposure scenarios so that the data necessary to complete a risk assessment are identified. The revised site conceptual model developed for this human health risk assessment is discussed in Section 3.3.2 and in Figure 2.3.3-1,. Each component of the revised site conceptual model is discussed in the following sections.

Environmental Fate and Transport of Chemicals of Potential Concern

The environmental fate of the COPCs is controlled by the cumulative interaction of transport and transformation processes. Once released into the environment, a chemical can partition among various environmental media (soil, water, air). The transport processes that define the movement of chemicals between media are highly dependent on the physiochemical properties of both the chemicals and the environmental media.

The environmental fate of the COPCs is described in Section 3.4.2.2. Based on this discussion, environmental media (e.g., soil, air, or water) that might significantly contribute to an individual's exposure to a chemical can be determined. As shown in Figure X, Revised Conceptual Model of Contaminant Transport and Exposure at PRS 0-019, COPCs at the site could be present in soil, water, or air.

Identification of Potential Receptors and Exposure Pathways

The mesa top in PRS 0-019is located east of the Sombrillo Nursing Facility. Currently the site is a vacant lot, but future land use involves building an assisted living facility on the property. The most likely receptor for future land use would be outdoor construction workers. Construction activities likely will involve moving some subsurface soil to the surface and possibly distributing it over the site. The usual maximum depth for utility lines is 1.2 m (4 ft), therefore this depth could be assumed to be the maximum depth of disturbed soil for the construction site. But since the future plans may change, all soil samples, regardless of depth will be evaluated. Current land use of residential will also be evaluated in the risk assessment.

The hillsides are very steep. Future land use for this area will be recreational. For the hillsides, the receptors might come in into contact with the following exposure media: surface soil.

Exposure pathways are the means through which an individual can contact a chemical in the environment. Exposure pathways are governed by environmental conditions (e.g., depth to groundwater or prevailing wind direction), by the potential for the chemical to move from one medium (water or air) to another, and by the general lifestyles and /or work activities of potentially exposed populations (e.g., ditch digging or hiking). Although several potential pathways may exist, only a few may be complete. For a pathway to be complete, each of the following elements must exist:

- a source and mechanism for chemical release,
- an environmental transport medium (e.g., air, water),

- a point of potential contact with the medium, and
- an exposure route at the contact point (e.g., inhalation, dermal contact).

The exposure pathways through which the identified receptors might contact the identified exposure media are discussed below.

Residential User

Residential users could be exposed to COPCs in surface or subsurface soil via incidental soil ingestion, dermal contact, inhalation, and external radiation.

Future On-Site Construction Worker

Future on-site construction workers could be exposed to COPCs in surface or subsurface soil via incidental soil ingestion, dermal contact, inhalation, and external radiation.

Recreational User

Recreational users could be exposed to COPCs in surface or subsurface soil via incidental soil ingestion, dermal contact, inhalation, and external radiation.

Exposure Point Concentrations

Estimates of exposure point concentrations are necessary for evaluating chemical uptake in exposed individuals. The COPCs identified in soil and tuff have been detected at varying concentrations, but not all COPCs have been detected at all locations. Chemical concentrations that are considered representative of the average to which an individual might be exposed over an extended period were estimated as follows.

- Residential user. Representative soil concentrations were based on the surface and subsurface soil samples from the mesa top.
- Future on-site construction worker: Representative soil concentrations were based on the surface and subsurface soil samples from the mesa top.
- Recreational user: Representative soil concentrations were based on surface soil samples [0-1.2 m (0-4 ft)] from the hillside.

Exposure point concentrations are based on the arithmetic average of sample data in the exposure area. The average concentration is the best representation of site soil concentrations for chronic exposure since the average concentration is what a receptor will experience if they contact the soils at the sites in a random manner over time. To account for the uncertainty in the true average concentration of COPCs in each area, the 95 percent upper confidence limit (UCL) of the arithmetic mean is used to represent the average (EPA 1992) for the mesa top. The representative concentrations for the hillsides are weighted averages. These were calculated based on western outfall versus eastern outfall, as well as based on bench, slope, and canyon. A complete description of these calculations are provided in Appendix C.

For each area, two representative concentrations were estimated, one for a reasonable maximum exposure (RME) scenario and a second for a central tendency exposure (CTE) scenario. The RME estimate is generally used to support risk management decisions (EPA 1989), and the CTE estimate is an aid in uncertainty analysis for describing the degree of protectiveness associated with the RME estimate.

Exposure Equations and Input Parameters

The potential health risks posed by the COCs are based on the estimated average daily dose (ADD) for each of the routes of exposure. The ADD provides an estimate of an individual's daily exposure to a chemical. The components of each exposure equation used in these calculations are presented in Appendix C.

(c) Toxicity Assessment

The purpose of the toxicity assessment is to estimate the relationship between the extent of exposure and the increased likelihood and/or severity of adverse effects (dose response assessment) (EPA 1989).

Hazard identification involves determining if a chemical can cause an increase in a particular adverse effect and the likelihood that the adverse effect will occur in humans. The result of the hazard identification is a toxicity profile that summarizes the available toxicological information and its relevance to human exposure under conditions present at the site. Dose-response assessment entails quantifying the relationship between the dose of a contaminant and the incidence of adverse effects in the exposed population. The result of the dose-response assessment is toxicity criteria that are used in the risk characterization to estimate the likelihood of adverse effects occurring in humans at different exposure levels. The toxicity criteria used to evaluate noncarcinogenic and carcinogenic health risks are commonly referred to as reference doses (RfDs) and slope factors (SFs), respectively.

Toxicity Criteria Noncarcinogenic Health Risks

The effects of chronic exposure to noncarcinogenic chemicals are evaluated using an RfD. The RfD has been developed based on the concept that a threshold dose exists below which adverse effects are not likely to be observed. Unlike the slope factor, the probability of experiencing an adverse effect is not directly related to the intensity of exposure in a continuous manner. The essential difference between the models of carcinogenic and noncarcinogenic response is that cancer induction is assumed to be a stochastic process, whereas the occurrence of noncarcinogenic effects is assumed to be governed by a definitive threshold. A chronic RfD is defined in the Risk Assessment Guidance for Superfund (EPA, 1989) as, "an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime."

U.S. Environmental Protection Agency preferentially derives RfDs by identifying the highest dose level in a dose-response study that does not cause observable adverse effects (a no-observable-adverse-effects level [NOAEL]). If a NOAEL is not discernable, EPA may employ the lowest-observable-adverse-effects level (LOAEL), as the basis of an RfD. The dose level is then divided by one or more uncertainty factors (to account for such things as interspecies variability, existence of sensitive subpopulations, length of the study, and use of a LOAEL), and sometimes a modifying factor (a qualitative factor to address other uncertainties), to arrive at an RfD.

The oral RfDs for the COPCs for which EPA publishes such toxicity criteria are provided with supporting information in Appendix E. The column labeled "uncertainty factors" is the product of both uncertainty and modifying factors used by EPA to derive the RfD. Inhalation RfDs are provided with supporting information in Appendix E. A complete list of RfD values used in the risk calculations, including those based on route-to-route extrapolation or surrogate toxicity information from other chemicals, is provided in Table E-1 in Appendix E. In some cases, inhalation toxicity values are provided as a reference concentration (RfC) with units of mg/m3. These values were converted to inhalation RfDs (mg/kg-d) according to the following equation:

$$\text{inhalation RfD} = \text{RfC} \times \left(20\,\text{m}^3/\text{d} \big/ 70\,\text{kg} \right)$$

In several cases, oral RfD values were available for a chemical but no corresponding inhalation values were published. In the case of organic chemicals, the RfD for the oral route of administration was generally applied to the inhalation route (route-to-route extrapolation). This extrapolation was not performed, however, if the chemical's carcinogenicity via inhalation was evaluated using a slope factor. For inorganic chemicals, route-to-route extrapolation was not performed due to the fact that absorption efficiencies in the gastrointestinal tract and lungs are known to be different for many metals. Applying route-to-route

extrapolation for organic chemicals only has been adopted by EPA Region 9 in the calculation of their preliminary remediation goals (EPA 2000).

Toxicity Criteria for Carcinogenic Health Risks

The effects of chronic exposure to carcinogenic chemicals are evaluated using a slope factor (SF). The SF has been developed based on the concept that there is no threshold dose below which effects do not have some finite probability of occurring. Unlike noncarcinogenic effects, the probability of observing carcinogenic response is a continuous function of the magnitude of the dose.

The two major parts of EPA's evaluation of carcinogenic response are assignment of a carcinogenic weight-of-evidence classification followed by calculation of a slope factor. The weight-of-evidence classification represents the likelihood that the chemical is a human carcinogen. Class A chemicals are known human carcinogens. Class B chemicals are defined as either Class B1 (some human data available, sufficient evidence of carcinogenicity in animals) or B2 (inadequate or no human data, sufficient evidence of carcinogenicity in animals). Class C chemicals are described as possible human carcinogens. Most SFs pertain to either Class A or Class B chemicals, although some SFs have been developed for Class C chemicals.

A SF is an estimate of the probability of carcinogenic response per unit intake over a lifetime. Dose-response data for calculating SFs generally exist at higher doses than are of concern in environmental exposures. Therefore, dose-response must be extrapolated from high-dose to low-dose conditions. The most commonly employed model used by EPA for this extrapolation is called the linearized multistage model which, as its title suggests, assumes a linear relationship between dose and response across dose rates. Generally, EPA employs the upper 95 percent confidence limit of the dose-response curve when calculating a SF unless good data from human populations are available.

The oral SFs for the COPCs for which EPA publishes such toxicity criteria are provided with supporting information in Appendix E. Inhalation SFs are provided with supporting information in Appendix E. A complete list of SF values used in the risk calculations, including those based on route-to-route extrapolation, is provided in Appendix E. In some cases, inhalation toxicity values are provided as a unit risk values (risk per µg/m3). Unit risk values were converted to inhalation SFs (mg/kg-d)-1 according to the following equation:

$$\text{inhalation SF} = \text{unit risk} \times (1000\ \mu\text{g/mg}) \times \left({}^{70\ \text{kg}}\!/_{20\ \text{m}^3/\text{d}} \right)$$

Toxicity Criteria for Lead

The potential adverse effects associated with exposure to lead are not evaluated based on RfDs or SFs. Instead, EPA has developed a mathematical model designed to estimate the concentration of lead in blood resulting from contact with lead in various environmental media. The blood lead level is of interest because sufficient toxicology data exist to correlate the body burden of lead measured by blood lead level with a specific adverse effect. For purposes of this assessment, the potential adverse effects associated with exposure to lead are compared to EPA screening-level soil guidelines based on associated modeled blood-lead levels in children. This screening level is 400 mg/kg and is related to residential exposure conditions (EPA 1994; EPA 2000a).

Toxicity Criteria for Radionuclide Health Risks

As for chemical carcinogens, the effects of chronic exposure to radionuclides are evaluated using an SF. Unlike chemical carcinogens, whose EPA weight-of-evidence carcinogenicity classification is chemical-specific, all radionuclides are classified as known human carcinogens (Class A). Although mutagenic and teratogenic effects, as well as chemical toxicity, may also be of concern for radionuclides, EPA considers

cancer risk to generally be the most significant effect of exposure to ionizing radiation from radionuclides (EPA 1997).

Ingestion and inhalation radionuclide SFs, like those for chemical carcinogens, estimate the probability of carcinogenic response per unit intake over a lifetime. Dose-response data for calculating radionuclide SFs are based on higher dose rates than are generally observed in environmental exposures. Therefore, dose-response must be extrapolated from high-dose to low-dose conditions. As with most chemical slope factors, a linear model is used for this extrapolation. However, radionuclide slope factors are central estimates of the dose-response model, whereas most chemical SFs are based on an upper 95 percent confidence limit of the dose-response curve. Ingestion and inhalation radionuclide SFs are based on a dosimetric model that accounts for uptake, redistribution, and clearance of radionuclides and their decay progeny from the body over time.

Slope factors for external irradiation are derived in a similar manner as those for ingestion and inhalation. However, the external SFs for exposure to contaminated soil pertain to dose received from photon emissions of radionuclides from a uniformly contaminated soil source of effectively infinite area and depth. Therefore, these SFs do not incorporate models of bodily uptake, redistribution, and clearance.

Radionuclide SFs for this assessment were obtained from EPAs Health Effects Assessment Summary Tables (EPA 2000). The SFs used are those that incorporate the contribution of decay progeny to the dose associated with the parent radionuclide. This is appropriate as the radionuclides have had ample time to come into equilibrium with their immediate progeny. Radionuclide SF values are provided in Appendix E.

Toxicity Criteria Used in Human Health Risk Assessment

The EPA has completed toxicity assessments for all of the COPCs in soil. The toxicity criteria used in the HHRA were selected according to the following hierarchy:

- IRIS on-line database, and
- EPA HEAST.

(d) Risk Characterization

Risk characterization represents the final step in the risk assessment process, in which the results of the exposure and toxicity assessments are integrated into qualitative estimates of potential health risks. Risk estimates are provided for both RME and CTE conditions for the occupational and residential land-use scenarios described earlier. The risk characterization is conducted based on the general principles described in Section 8.0 of the Risk Assessment Guidance for Superfund (EPA< 1989).

Non-Cancer Effects

Potential noncarcinogenic health risks were evaluated by comparing the ADD to the appropriate RfD. This comparison is expressed in terms of a "hazard quotient"(HQ) and was calculated as follows:

$$HazardQuotient = \frac{ADD}{RfD}$$

An HQ less than or equal to 1 indicates that the predicted exposure should not pose a significant noncarcinogenic health risk (EPA 1989, ER ID 8020). In cases where individual chemicals potentially act on the same organs or result in the same health endpoint, additive effects can be addressed by calculating a hazard index (HI) as follows:

$$\text{Hazard Index} = \text{Hazard Quotient}_a + \text{Hazard Quotient}_b + \ldots + \text{Hazard Quotient}_n$$

An HI of less than or equal to 1 indicates acceptable levels of exposure for chemicals having an additive effect. In this HHRA, a screening-level HI was calculated by summing the hazard quotients for all chemicals, regardless of toxic endpoint. This approach overestimates the potential for noncarcinogenic health effects due to simultaneous exposure to multiple chemicals.

It should be noted that HQs or HIs greater than 1 do not necessarily mean that adverse health effects will be observed. A substantial margin of safety has been incorporated into the RfDs. Both the RME and CTE scenarios for the adult and child HQs are less than 1.

Chemical Carcinogenic Effects

Cancer risk is evaluated as the incremental probability that an individual will develop cancer during their lifetime due to exposure to PAHs in soil. An incremental lifetime cancer risk (ILCR) is the product of the average daily dose (i.e. intake) and a slope factor. The ILCR is calculated as:

$$ILCR = Intake\left(\frac{mg}{kg-d}\right) \times SF\left(\frac{mg}{kg-d}\right)^{-1}$$

where:

ILCR	=	incremental lifetime cancer risk
Intake	=	chronic daily intake
mg	=	milligram(s)
kg-d	=	kilogram(s) per day
SF	=	slope factor.

Incremental cancer risks for each exposure route and chemical COPC are summed to calculate the total cancer risk to an individual under a specific land-use scenario. The acceptability of any calculated excess cancer risk is generally evaluated relative to the target risk range of 10-4 to 10-6 described in the National Contingency Plan (NCP) (EPA 1990).

The results of the risk assessment for chemical carcinogenic effects are shown in Tables **3.3.3.3-1 - 3.3.3.3-6.** On the mesa top the results of the chemical ILCR calculations range from 1.9E-05 to 8.2E-06. On the hillsides the results of the chemical ILCR calculations range from 1.0E-06 to 2.5E-06.

Radionuclide Carcinogenic Effects

The calculation of ILCR values for radionuclides is similar to the calculation for chemicals, except the units differ slightly due to the nature of the radionuclide SFs. For soil ingestion and dust inhalation, radionuclide ICLR is calculated as:

$$\text{ILCR} = \text{Intake}\,(\text{pCi}) \times \text{SF}\,(\text{pCi})^{-1}$$

where:

ILCR	=	incremental lifetime cancer risk
Intake	=	lifetime intake
SF	=	slope factor.

For external irradiation, radionuclide ICLR is calculated as:

$$\text{ILCR} = \text{Exposure}\left(\frac{\text{pCi - year}}{\text{gram soil}}\right) \times \text{SF}\left(\frac{\text{pCi - year}}{\text{gram soil}}\right)^{-1}$$

where:

ILCR	=	incremental lifetime cancer risk
Exposure	=	lifetime external exposure to radionuclide photon emissions
SF	=	slope factor.

Incremental cancer risk for each exposure route and radionuclide COPC are summed to calculate the total cancer risk to an individual under a specific land-use scenario. The acceptability of any calculated excess cancer risk is generally evaluated relative to the target risk range of 10-4 to 10-6 described in the National Contingency Plan (NCP) (EPA, 1990). To approve cleanup guidelines for sites, DOE/AL requires that modeled dose not exceed 15 mrem/year (DOE/AL 2000, 67153). The EPA has determined that a target dose limit of 15 mrem/year equates to an approximated increased lifetime cancer risk of 3×10^{-4}, and "is consistent with levels generally considered protective on other government actions, particularly regulations and guidance developed by EPA in other radiation control programs" (EPA 1997a).

Dose was calculated for the radionuclides seen on the hillsides. These results are shown in Tables 3.3.3.3-9 and 3.3.3.3-10. Both the RME and CTE are less than 15 mrem/yr.

Future On-Site Construction Worker for Mesa top

Table 3.3.3.3-1
Construction worker RME for the mesa top

Lifetime Incremental Cancer Risk for Chemicals					
Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
benzo(a)pyrene	0.23	2.9E-07	1.9E-11	3.9E-06	4.2E-06
dibenz(a,h)anthracene	0.20	2.5E-07	1.7E-11	2.6E-06	2.9E-06
		5.4E-07	3.6E-11	6.5E-06	**7.1E-06**

Table 3.3.3.3-2
Construction worker CTE for the mesa top

Lifetime Incremental Cancer Risk for Chemicals					
Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
benzo(a)pyrene	0.23	7.6E-08	5.1E-12	1.0E-06	1.1E-06
dibenz(a,h)anthracene	0.20	6.6E-08	4.5E-12	7.0E-07	7.6E-07
		1.4E-07	9.6E-12	1.7E-06	**1.9E-06**

Future On-Site Resident for Mesa top

Table 3.3.3.3-3
Residential user RME for the mesa top

Lifetime Incremental Cancer Risk for Chemicals					
Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
benzo(a)pyrene	0.23	2.0E-06	6.4E-11	8.2E-06	1.0E-05
dibenz(a,h)anthracene	0.20	1.7E-06	5.6E-11	5.5E-06	7.2E-06
		3.7E-06	1.2E-10	1.4E-05	**1.7E-05**

Table 3.3.3.3-4
Residential user CTE for the mesa top

Lifetime Incremental Cancer Risk for Chemicals					
Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
benzo(a)pyrene	0.23	8.4E-07	2.5E-11	3.5E-06	4.4E-06
dibenz(a,h)anthracene	0.20	7.3E-07	2.2E-11	2.4E-06	3.1E-06
		1.6E-06	4.7E-11	5.9E-06	**7.5E-06**

Future Recreational User For Hillside

Table 3.3.3.3-5
Recreational user RME– carcinogens

Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
DDT[4,4]	2.4	9.4E-07	2.1E-10	8.5E-08	1.0E-06
Aroclor 1260	0.45	1.0E-06	2.3E-10	4.4E-07	1.5E-06
Total		2.0E-06	4.4E-10	5.2E-07	**2.5E-06**

Table 3.3.3.3-6
Recreational user CTE– carcinogens

Contaminant	**Soil Conc. (mg/kg)**	**Soil Ingestion**	**Inhalation**	**Dermal**	**SOIL ICR**
DDT[4,4]	2.4	3.8E-07	7.4E-11	3.9E-08	4.2E-07
Aroclor 1260	0.45	4.2E-07	8.2E-11	2.0E-07	6.2E-07
Total		8.0E-07	1.6E-10	2.4E-07	**1.0E-06**

Table 3.3.3.3-7
Recreational user RME– noncarcinogens

Hazard Quotient for Chemicals									
Contaminant	Soil Conc. (mg/kg)	Soil Ingestion, Adult	Soil Ingestion, Child	Inhalation Adult	Inhalation, Child	Dermal, Adult	Dermal, Child	ADULT SOIL HQ	CHILD SOIL HQ
mercury	2.9	6.5E-03	1.1E-01	1.3E-05	4.1E-05	2.2E-04	3.1E-03	6.7E-03	1.1E-01
silver	39	5.2E-03	8.6E-02	0.0E+00	0.0E+00	1.8E-04	2.5E-03	5.4E-03	8.8E-02
DDT[4,4]	2.4	3.2E-03	5.3E-02	0.0E+00	0.0E+00	3.3E-04	4.6E-03	3.5E-03	5.8E-02
Aroclor-1254	0.64	2.1E-02	3.5E-01	1.3E-05	3.9E-05	1.0E-02	1.4E-01	3.2E-02	5.0E-01
Total		3.6E-02	6.0E-01	2.6E-05	8.0E-05	1.1E-02	1.5E-01	**4.7E-02**	**7.5E-01**

Table 3.3.3.3-8
Recreational user CTE– noncarcinogens

Hazard Quotient for Chemicals									
Contaminant	Soil Conc. (mg/kg)	Soil Ingestion, Adult	Soil Ingestion, Child	Inhalation Adult	Inhalation, Child	Dermal, Adult	Dermal, Child	ADULT SOIL HQ	CHILD SOIL HQ
mercury	2.9	6.5E-03	5.3E-02	8.3E-06	3.4E-05	2.1E-04	1.8E-03	6.7E-03	5.5E-02
silver	39	5.2E-03	4.3E-02	0.0E+00	0.0E+00	1.7E-04	1.5E-03	5.4E-03	4.4E-02
DDT[4,4]	2.4	3.2E-03	2.6E-02	0.0E+00	0.0E+00	3.2E-04	2.7E-03	3.5E-03	2.9E-02
Aroclor-1254	0.64	2.1E-02	1.8E-01	7.9E-06	3.3E-05	9.9E-03	8.4E-02	3.1E-02	2.6E-01
Total		3.6E-02	3.0E-01	1.6E-05	6.7E-05	1.1E-02	9.0E-02	**4.7E-02**	**3.9E-01**

Table 3.3.3.3-9
Annual Committed Effective Dose Equivalent[a] for Radionuclides (mrem) RME

Contaminant	soil conc (pCi/g)	Soil Ingestion	Dust Inhalation[b]	External	SOIL DOSE
cobalt-60	0.088	1.7E-04	2.0E-07	1.1E+00	1.1E+00
plutonium-238	0.02	4.5E-03	8.1E-05	2.2E-06	4.6E-03
plutonium-239,240	0.92	2.3E-01	4.1E-03	2.0E-04	2.3E-01
uranium-234	12	2.4E-01	1.6E-02	3.6E-03	2.6E-01
uranium-235+D	0.53	9.9E-03	6.7E-04	3.0E-01	3.1E-01
uranium-238+D	5	9.4E-02	6.1E-03	5.1E-01	6.1E-01
		5.7E-01	2.7E-02	1.9E+00	**2.5E+00**

Table 3.3.3.3-10
Annual Committed Effective Dose Equivalent[a] for Radionuclides (mrem) CTE

Contaminant	soil conc (pCi/g)	Soil Ingestion	Dust Inhalation[b]	External	SOIL DOSE
cobalt-60	0.088	8.3E-05	1.2E-07	1.1E+00	1.1E+00
plutonium-238	0.02	2.2E-03	5.1E-05	2.2E-06	2.3E-03
plutonium-239,240	0.92	1.1E-01	2.6E-03	2.0E-04	1.2E-01
uranium-234	12	1.2E-01	1.0E-02	3.6E-03	1.3E-01
uranium-235+D	0.53	5.0E-03	4.2E-04	3.0E-01	3.0E-01

uranium-238+D	5	4.7E-02	3.8E-03	5.1E-01	5.6E-01
		2.9E-01	1.7E-02	1.9E+00	**2.2E+00**

Noncarcinogenic Health Risks Associated With Exposure to Lead

The 95% UCL on the mean concentrations of lead on the mesa top is 243 mg/kg, and the western and eastern weighted average is 94mg/kg. EPA's residential lead screening value is 400 mg/kg, and these soil concentration values are well below this soil screening value. The 400 mg/kg screening level is quite protective for application in this assessment because future site land uses are anticipated to be significantly less intensive than is the case for residential land use.

(e) Uncertainty Analysis

Several sources of uncertainty in the risk assessment have been identified. Risks were calculated using a number of assumptions to provide some quantification of uncertainties relating to land use and exposure assumptions. Important factors relating to site decisions identified in the risk calculations include RME versus CTE conditions and residential versus industrial land-use.

Differences observed between RME and CTE results depended on the scenario, receptor, and toxicity endpoint considered.

The identification of the COPCs in the screening assessment is based on the representative concentrations in soil at the outfalls. The outfalls contain the largest concentration of most COPCs with the exception of plutonium-238, calcium, lead, and PAHs. Higher concentrations of PAHs were measured in fill samples, which suggests that elevated PAHs are not related to CWWTP operation but rather are derived from debris in the fill and soil matrix. Thus, even though disturbance and the depth of elevated concentrations on the mesa top currently limits exposure to humans, consideration of the mesa top a potential exposure area would not change or add any new COPCs compared to the outfall area assessment.

(f) Interpretation

The HHRA evaluates the potential human health risks associated with the presence of chemicals in soil at the site. The HHRA was completed in accordance with multiple risk-assessment guidance documents provided by EPA. For the mesa top potential carcinogenic health risks were estimated for residential scenario and future on-site construction worker assuming a conservative (RME) or more realistic (CTE) estimates of human exposure.

For the hillsides, potential noncarcinogenic chemicals and carcinogenic chemicals and radionuclides were estimated for recreational users assuming RME and CTE estimates of human exposure.

Additional remedial activities at the CWWTP mesa top and outfalls are not recommended. The basis for this recommendation is that carcinogenic ICR values fall in the target risk range of 10^{-4} to 10^{-6} and below, and the noncarcinogenic values are less than 1.