

Report of Barbara D. Beck, Ph.D., DABT, ATS on the Updated Human Health Risk Assessment Incorporating Supplemental Data for the East White Lake Site, Vermilion, Louisiana

Prepared for:

King & Spalding
1100 Louisiana Street, Suite 4000
Houston, TX 77002

and

Kean Miller Hawthorne D'Armond McCowan & Jarman LLP
One American Place
301 Main Street, Suite 1800
Baton Rouge, LA 70801

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www.gradientcorp.com

20 University Road
Cambridge, MA 02138
617-395-5000

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1 Updated Human Health Risk Assessment

I updated my risk assessment to incorporate new data generated at the Site. Based on my updated calculations my overall conclusion has not changed: the Site poses no harm to human health.

This supplemental report updates my human health risk assessment (Beck, 2015) based on the new Site data received to date and collected in November and December 2015 (Michael Pisani & Associates (MPA) and ICON data) and in February 2016 (MPA data only; no ICON data were available at the time of this report). These new Site data (that I used in conjunction with the previously received Site data) are presented in Table 1.1 (soil/sediment) and Table 1.2 (groundwater). I used all of the new applicable data with the exception of the PAH and TPH data from samples collected from location TBB-3D, which were not reliable and/or representative of Site conditions, as discussed in the Pisani Report (see MPA Supplemental Report). Although there were well construction, development, and sampling issues with BC-2, as discussed in the Pisani Report (see MPA Supplemental Report), I used the BC-2 data in my updated risk assessment.

For total petroleum hydrocarbon (TPH) data, I continued my conservative approach of analyzing TPH in soil/sediment and groundwater as both TPH fractions and ranges (Beck, 2015).

Using conservative assumptions that tend to overestimate risk, the cancer and non-cancer risks both continue to fall within United States Environmental Protection Agency (US EPA) and Louisiana Department of Environmental Quality (LDEQ) acceptable risk limits. Cancer risk is 2×10^{-5} (see Table 3.1), which falls within the acceptable risk range of 10^{-6} to 10^{-4} . For non-cancer risk, using the new data, all of the target organ-specific hazard indices (TOSHIs) that I calculated using either TPH fraction data or TPH range data are less than or equal to 1, which meets US EPA and LDEQ non-cancer risk targets (see Table 3.1). Based on this updated assessment, my conclusion remains the same: cancer and non-cancer risks at the Site are within US EPA and LDEQ guidelines and pose no harm to human health. I reserve the right to amend or supplement my opinions if I'm presented with new data.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. "Toxicological profile for total petroleum hydrocarbons (TPH) (Final)." National Technical Information Service (NTIS). NTIS PB99-163370, September.

Beck, BD. [Gradient]. 2015. "Report of Barbara D. Beck, Ph.D., DABT, Fellow ATS Concerning the East White Lake Site, Vermilion, Louisiana." Report to King & Spalding; Kean Miller Hawthorne D'Armond McCowan & Jarman LLP, October 1.

US EPA. 1988. "Special report on ingested inorganic arsenic: Skin cancer; nutritional essentiality (Final)." Risk Assessment Forum. EPA-625/3-87-013. 124p., July.

US EPA. 1989. "Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part A) (Interim final)." Office of Emergency and Remedial Response. NTIS PB90-155581; EPA-540/1-89-002. 287p., December.

US EPA. 2002. "IRIS record for mercuric chloride (HgCl₂) (CAS No. 7487-94-7)." 18p., December 3. Accessed at <http://www2.epa.gov/iris>.

US EPA. 2003. "IRIS record for inorganic arsenic (CAS No. 7440-38-2)." 24p., February 5. Accessed at <http://www2.epa.gov/iris>.

US EPA. 2004. "Risk Assessment Guidance for Superfund (RAGS). Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (Final)." Office of Superfund Remediation and Technology Innovation. EPA/540/R/99/005; OSWER 9285.7-02EP; PB99-963312. 156p., July. Accessed at http://www.epa.gov/oswer/riskassessment/rags/pdf/part_e_final_revision_10-03-07.pdf.

US EPA. 2005. "IRIS record for barium and compounds (CAS No. 7440-39-3)." July 11, 28p. Accessed at <http://www2.epa.gov/iris>.

US EPA. 2008. "IRIS record for benzene (CAS No. 71-43-2)." 36p., October 1. Accessed at <http://www2.epa.gov/iris>.

US EPA. 2009a. "Provisional Peer-Reviewed Toxicity Values for Midrange Aliphatic Hydrocarbon Streams." National Center for Environmental Assessment (NCEA). 56p., September 30.

US EPA. 2009b. "Provisional Peer-Reviewed Toxicity Values for Complex Mixtures of Aliphatic and Aromatic Hydrocarbons (CASRN Various)." National Center for Environmental Assessment (NCEA), Superfund Health Risk Technical Support Center. 60p., September 30.

US EPA. 2009c. "Provisional Peer-Reviewed Toxicity Values for High Flash Aromatic Naphtha (CAS Nos. 64742-95-6 and 88845-25-4)." National Center for Environmental Assessment (NCEA), Superfund Health Risk Technical Support Center. 37p., September 30. Accessed at http://hhprrtv.ornl.gov/issue_papers/NaphthaHighFlashAromaticHFAN.pdf.

US EPA. 2011. "IRIS record for methylmercury (MeHg) (CAS No. 22967-92-6)." 27p., April 5. Accessed at <http://www2.epa.gov/iris>.

US EPA. 2015a. "Regional Screening Level (RSL) Summary Table (TR=1E-6, HQ=0.1)." 13p., November. Accessed at <http://www.epa.gov/risk/risk-based-screening-table-generic-tables>.

US EPA. 2015b. "Regional Screening Table - User's Guide." 107p., November. Accessed at <http://www.epa.gov/risk/regional-screening-table-users-guide-november-2015>.

Tables

Note: Only those tables that have been added or updated since my October 2015 report are included.

Table 1.1 Soil/Sediment Data Used in the Risk Assessment (Includes Supplemental Data)

Sampler	Chemical Group	Parameter	Station:	SS-16	SS-17	SS-19	SS-20	SS-21	SS-22	SS-23	SS-24	SS-25	SS-26	TBB-2D
			Date:	11/13/2015	11/12/2015	11/12/2015	11/12/2015	11/16/2015	11/12/2015	11/16/2015	11/16/2015	11/16/2015	11/12/2015	12/1/2015
			Depth (ft bgs):	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	0-2	Grab
			Unit											
ICON	Metals	Arsenic	mg/kg	7.0	6.5	8.9	9.0	6.7	8.9	4.7	7.3	7.4	4.5	8.4
ICON	Metals	Barium	mg/kg	722	690	514	774	460	581	255	151	425	806	654
ICON	Metals	Cadmium	mg/kg	0.499 U	0.5 U	0.84	0.5 U	0.498 U	0.79	0.499 U	0.499 U	0.498 U	0.498 U	0.496 U
ICON	Metals	Chromium	mg/kg	14	15	18	13	14	22	14	15	16	11	13
ICON	Metals	Lead	mg/kg	20	23	19	24	22	27	17	16	19	17	20
ICON	Metals	Mercury	mg/kg	0.24	0.20	0.74	0.14	0.29	0.36	0.1 U	0.10	0.1 U	0.12	0.09 U
ICON	Metals	Selenium	mg/kg	1.99 U	2 U	2 U	2 U	1.99 U	2 U	1.99 U	2 U	1.99 U	1.99 U	1.98 U
ICON	Metals	Silver	mg/kg					0.498 U		0.499 U	0.499 U	0.498 U		
ICON	Metals	Strontium	mg/kg	111	42	189	54		53				134	84
ICON	Metals	Zinc	mg/kg	72	48	164	58	63	182	87	62	57	41	68
ICON	Other	% Moisture	%	0.66	0.57	0.63	0.68	0.65	0.75	0.55	0.64	0.67	0.52	0.65
ICON	TPH	TPH-DRO	mg/kg		65	134	412	3192	2012	140	994	225	9226	699
ICON	TPH	TPH-ORO	mg/kg		113	121	326	1336	4863	174	355	162	6213	708
Pisani	Metals	Arsenic	mg/kg	7.3	6.1	3.5	9.4	7.0	12	9.0	9.3	7.3	8.3	9.2
Pisani	Metals	Barium	mg/kg	466	588	492	1128	449	664	216	142	528	609	857
Pisani	Metals	Cadmium	mg/kg	0.824 U	0.599 U	0.694 U	0.781 U	0.62 U	1.07 U	0.562 U	0.726 U	0.919 U	0.534 U	0.743 U
Pisani	Metals	Chromium	mg/kg	11	14	11	14	14	22	15	15	18	9.9	15
Pisani	Metals	Lead	mg/kg	14	20	13	24	22	32	16	16	22	19	21
Pisani	Metals	Mercury	mg/kg	0.319 U	0.23 U	0.57	0.304 U	0.27 U	0.41 U	0.233 U	0.247 U	0.326 U	0.229 U	0.292 U
Pisani	Metals	Selenium	mg/kg	3.29 U	2.4 U	2.77 U	3.13 U	2.48 U	4.3 U	2.24 U	2.9 U	3.68 U	2.14 U	2.97 U
Pisani	Metals	Silver	mg/kg	0.824 U	0.599 U	0.694 U	0.781 U	0.62 U	1.07 U	0.562 U	0.726 U	0.919 U	0.534 U	0.743 U
Pisani	Metals	Zinc	mg/kg	41	45	85	66	61	223	73	61	67	42	74
Pisani	Other	% Moisture	%	0.69	0.57	0.61	0.67	0.59	0.76	0.53	0.64	0.69	0.52	0.66
Pisani	TPH	Aliphatic >C10-C12	mg/kg	19.2 U	13.5 U	15.5 U	18.2 U	14.7 U	24.6 U	12.7 U	16.1 U	18.8 U	595 U	17.5 U
Pisani	TPH	Aliphatic >C12-C16	mg/kg	58	14	57	18.2 U	17	93	12.7 U	16.1 U	18.8 U	2911	66
Pisani	TPH	Aliphatic >C16-C35	mg/kg	345	143	332	32	858	1041	12.7 U	41	56	13805	269
Pisani	TPH	Aliphatic >C8-C10	mg/kg	94.9 U	66.8 U	75.9 U	90 U	72.5 U	121 U	58.8 U	74 U	95.8 U	60.7 U	81.9 U
Pisani	TPH	Aliphatic C6-C8	mg/kg	94.9 U	66.8 U	75.9 U	90 U	72.5 U	121 U	58.8 U	74 U	95.8 U	60.7 U	81.9 U
Pisani	TPH	Aromatic >C10-C12	mg/kg	19.2 U	13.5 U	15.5 U	18.2 U	14.7 U	24.6 U	12.7 U	16.1 U	18.8 U	237 U	17.5 U
Pisani	TPH	Aromatic >C12-C16	mg/kg	19.2 U	13.5 U	15.5 U	18.2 U	30	24.6 U	12.7 U	16.1 U	18.8 U	237 U	17.5 U
Pisani	TPH	Aromatic >C16-C21	mg/kg	50	13.5 U	39	18.2 U	103	68	12.7 U	16.1 U	18.8 U	1031	17.5 U
Pisani	TPH	Aromatic >C21-C35	mg/kg	106	37	71	18.2 U	101	255	12.7 U	16.1 U	18.8 U	1992	63
Pisani	TPH	Aromatic >C8-C10	mg/kg	94.9 U	66.8 U	75.9 U	90 U	72.5 U	121 U	58.8 U	74 U	95.8 U	60.7 U	81.9 U

Notes:

DRO = Diesel-Range Organic; ft bgs = Feet Below Ground Surface; mg/kg = Milligrams Per Kilogram Dry Weight; ORO = Oil-Range Organic; TPH = Total Petroleum Hydrocarbon.

U = Not Detected. ICON = ICON Environmental Services; Pisani = Michael Pisani & Associates.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

Table 1.2 Groundwater Data Used in the Risk Assessment
(Includes Supplemental Data)

Sampler	Chemical Group	Parameter	Aquifer:	Chicot	Shallow Sand – Confining Unit		Intermediate Sand – Confining Unit					Deep Sand – Confining Unit				
			Station:	BC-1	TBB-1S	TBB-2M	TBA-1D	TBB-1D	TBB-2D	TBA-2	TBB-3D	MC-1	MC-2	BC-2	BC-3	BC-4
			Date:	12/28/2015	12/17/2015	12/14/2015	12/22/2015	12/17/2015	12/15/2015	2/2/2016	12/15/2015	12/16/2015	2/1/2016	2/3/2016	2/9/2016	2/4/2016
			Depth (ft bgs):	469 - 489	33 - 43	49 - 59	75 - 85	65 - 75	81 - 91	69 - 79	66 - 76	161 - 181	139 - 159	279 - 299	279 - 299	269.5 - 289.5
			Unit													
ICON	VOC	Benzene	mg/L	0.005 U	0.007	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U				
ICON	VOC	Ethylbenzene	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U				
ICON	VOC	Toluene	mg/L	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U		0.01 U	0.01 U				
ICON	VOC	Xylenes	mg/L	0.015 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U				
ICON	Metals	Arsenic	mg/L		0.01 U	0.01 U	0.014	0.013	0.01 U		0.01 U	0.01 U				
ICON	Metals	Barium	mg/L		13.5	5.12	0.996	1.26	1.12		0.886	1.55				
ICON	Metals	Cadmium	mg/L		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U				
ICON	Metals	Calcium	mg/L		1260	463	115	95	121		122	118				
ICON	Metals	Chromium	mg/L		0.01 U	0.01 U	0.01 U	0.052	0.018		0.01 U	0.01 U				
ICON	Metals	Iron	mg/L		44	13.4	1.53	50.5	15.7		1.92	1.48				
ICON	Metals	Lead	mg/L		0.01 U	0.01 U	0.01 U	0.047	0.01 U		0.01 U	0.01 U				
ICON	Metals	Magnesium	mg/L		816	248	40.1	53	50.9		37.3	43.9				
ICON	Metals	Manganese	mg/L		9.9	3.08	0.217	1.23	0.751		0.16	0.468				
ICON	Metals	Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U				
ICON	Metals	Potassium	mg/L		19.6	11.2	5 U	11.9	7.77		5.23	6.02				
ICON	Metals	Selenium	mg/L		0.052	0.03	0.02 U	0.02 U	0.02 U		0.02 U	0.02 U				
ICON	Metals	Sodium	mg/L		4420	1780	369	572	509		318	409				
ICON	Metals	Strontium	mg/L		24.6	4.77	0.936	1.2	1.26		0.877	1.27				
ICON	Metals	Zinc	mg/L		0.021	0.346	0.01 U	0.186	0.061		0.014	0.012				
ICON	Other	Bicarbonate Alkalinity	mg/L	350	298	410	355	308	338		315	332				
ICON	Other	Bromide	mg/L	0.23	17.2	4.04	0.83	0.93	0.893		0.663	1.48				
ICON	Other	Carbonate Alkalinity	mg/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U				
ICON	Other	Chlorides	mg/L	184	13400	4520	806	1050	942		666	769				
ICON	Other	Field Turbidity	mg/L	1.59	22.2	12.7	2.27		21		16	2.66				
ICON	Other	Sulfate	mg/L	2.45	7	5 U	1.18	68	44		6.83	61.4				
ICON	Other	TDS	mg/L		24700	9350	1560	2040	2030		1470	1640				
ICON	TPH	TPH-DRO	mg/L	0.15 U	0.13 U	0.131 U	0.25	0.13 U	0.218			0.13 U				
ICON	TPH	TPH-GRO	mg/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U			0.15 U				
ICON	TPH	TPH-ORO	mg/L	0.15 U	0.12 U	0.121 U	0.58	0.12 U	0.12 U			0.12 U				
Pisani	VOC	Benzene	mg/L	0.005 U	0.007	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Pisani	VOC	Ethylbenzene	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00932	0.005 U	0.005 U
Pisani	VOC	Toluene	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Pisani	VOC	Xylenes	mg/L	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U	0.015 U
Pisani	Metals	Arsenic	mg/L	0.005 U	0.05 U	0.02 U	0.005 U	0.02	0.0062	0.005 U	0.005 U	0.005 U	0.01	0.013 U	0.011	0.005 U
Pisani	Metals	Barium	mg/L	0.87	17.5	6.1	1.19	1.66	1.33	2.66	1.07	1.85	1.35	22.5	3.53	4.97
Pisani	Metals	Cadmium	mg/L	0.005 U	0.05 U	0.02 U	0.005 U	0.005 U	0.005 U	0.02 U	0.005 U	0.005 U	0.01 U	0.05 U	0.01 U	0.02 U
Pisani	Metals	Calcium	mg/L	88.9	1780	574	144	136	162	270	164	151	152	1430	352	477
Pisani	Metals	Chromium	mg/L	0.005 U	0.05 U	0.02 U	0.005 U	0.051	0.012	0.02 U	0.0053	0.005 U	0.021	0.05 U	0.01 U	0.02 U
Pisani	Metals	Iron	mg/L	0.99	57.9	15.8	1.76	60.5	19.9	9.2	1.86	1.48	16.6	17.3	1.22	9.43
Pisani	Metals	Lead	mg/L	0.005 U	0.05 U	0.02 U	0.005 U	0.082	0.012	0.02 U	0.005 U	0.005 U	0.013	0.05 U	0.01 U	0.02 U
Pisani	Metals	Magnesium	mg/L	31.4	1050	316	48.6	74.1	67.1	84.2	48	57.9	46.3	384	135	170
Pisani	Metals	Manganese	mg/L	0.14	13.1	4.1	0.26	1.65	1.13	0.56	0.19	0.67	0.51	1.62	0.3	1.08
Pisani	Metals	Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.001	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Pisani	Metals	Potassium	mg/L	3.84	15.8	8.71	4.26	11.9	7	10.5	5.17	6.11	7.82	41.5	8.82	7.94
Pisani	Metals	Sodium	mg/L	160	5680	2190	505	765	661	1560	404	514	785	8720	1650	1650
Pisani	Metals	Strontium	mg/L	0.84	25.8	5.82	1.23	1.66	1.51	3.45	1.08	1.54	1.26	29.6	4.61	4.37
Pisani	Metals	Zinc	mg/L	0.1 U	1 U	0.4 U	0.1 U	0.19	0.1 U	0.4 U	0.1 U	0.1 U	0.2 U	1 U	0.2 U	0.4 U
Pisani	Other	Bicarbonate Alkalinity	mg/L	343	316	416	363	330	345	429	320	349	320	319	251	361
Pisani	Other	Bromide	mg/L	0.406	23.9	10 U	1 U	1.65	1.54	3.87	1.18	2.18	1.84	20.3	4 U	4.39
Pisani	Other	Carbonate Alkalinity	mg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pisani	Other	Chlorides	mg/L	165	16900	4820	876	1220	1020	3060	721	837	1220	16600	2850	3690
Pisani	Other	Sulfate	mg/L	1.84	10 U	10 U	1 U	102	45.2	3.42	7.06	106	30	5.11	57.6	7.36
Pisani	Other	TDS	mg/L	643	33100	7160	1600	2030	1910	4840	1220	1750	2270	22200	4860	5920

Sampler	Chemical Group	Parameter	Aquifer:	Chicot	Shallow Sand – Confining Unit			Intermediate Sand – Confining Unit					Deep Sand – Confining Unit				
			Station:	BC-1	TBB-1S	TBB-2M	TBA-1D	TBB-1D	TBB-2D	TBA-2	TBB-3D		MC-1	MC-2	BC-2	BC-3	BC-4
			Date:	12/28/2015	12/17/2015	12/14/2015	12/22/2015	12/17/2015	12/15/2015	2/2/2016	12/15/2015		12/16/2015	2/1/2016	2/3/2016	2/9/2016	2/4/2016
			Depth (ft bgs):	469 - 489	33 - 43	49 - 59	75 - 85	65 - 75	81 - 91	69 - 79	66 - 76		161 - 181	139 - 159	279 - 299	279 - 299	269.5 - 289.5
			Unit														
Pisani	SVOC	1,2,4-Trichlorobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	1,2-Dichlorobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	1,2-Diphenylhydrazine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	1,3-Dichlorobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	1,4-Dichlorobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,4,6-Trichlorophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,4-Dichlorophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,4-Dimethylphenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,4-Dinitrophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,4-Dinitrotoluene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2,6-Dinitrotoluene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2-Chloronaphthalene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2-Chlorophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	2-Nitrophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	3,3-Dichlorobenzidine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	4,6-Dinitro-2-methylphenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	4-Bromophenyl phenyl ether	mg/L	0.01 U							0.01 U						
Pisani	SVOC	4-Chloro-3-methylphenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	4-Chlorophenyl phenyl ether	mg/L	0.01 U							0.01 U						
Pisani	SVOC	4-Nitrophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Benzidine	mg/L	0.05 U							0.051 U						
Pisani	SVOC	Bis(2-Chloroethoxy)methane	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Bis(2-Chloroethyl)ether	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Bis(2-Chloroisopropyl)ether	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Bis(2-Ethylhexyl)phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Butyl benzyl phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Diethyl phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Dimethyl phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Di-n-butyl phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Di-n-octyl phthalate	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Hexachlorobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Hexachlorobutadiene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Hexachlorocyclopentadine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Hexachloroethane	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Isophorone	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Nitrobenzene	mg/L	0.01 U							0.01 U						
Pisani	SVOC	n-Nitrosodi-n-propylamine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	n-Nitrosodimethylamine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	n-Nitrosodiphenylamine	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Pentachlorophenol	mg/L	0.01 U							0.01 U						
Pisani	SVOC	Phenol	mg/L	0.01 U							0.01 U						
Pisani	TPH	Aliphatic C6-C8	mg/L	0.03 U	0.044	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U			0.03 U	0.03 U	0.636	0.03 U	0.03 U
Pisani	TPH	Aliphatic >C8-C10	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U			0.02 U	0.02 U	0.141	0.02 U	0.02 U
Pisani	TPH	Aliphatic >C10-C12	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pisani	TPH	Aliphatic >C12-C16	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pisani	TPH	Aliphatic >C16-C35	mg/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U			0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Pisani	TPH	Aromatic >C8-C10	mg/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U			0.03 U	0.03 U	0.405	0.03 U	0.03 U
Pisani	TPH	Aromatic >C10-C12	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pisani	TPH	Aromatic >C12-C16	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pisani	TPH	Aromatic >C16-C21	mg/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U			0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Pisani	TPH	Aromatic >C21-C35	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Pisani	TPH	TPH-GRO	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U			0.1 U	0.1 U	0.425	0.1 U	0.1 U
Pisani	TPH	TPH-DRO	mg/L	0.125 U	0.157	0.236	0.125 U	0.125 U	0.13	0.125 U			0.125 U	0.125 U	0.34		0.125 U
Pisani	TPH	TPH-ORO	mg/L	0.125 U	0.214	0.125 U	0.125 U	0.186	0.125 U	0.125 U			0.125 U	0.125 U	0.125 U		0.125 U

Note: Blank = Not Analyzed

DRO = Diesel-Range Organic; ft bgs = Feet Below Ground Surface; Gasoline-Range Organic; mg/kg = Milligrams per Kilogram Dry Weight; ORO = Oil-Range Organic; TDS = Total Dissolved Solids; TPH = Total Petroleum Hydrocarbon; VOC = Volatile Organic Compound.

U = Not Detected E = Estimated, outside calibration range

ICON = ICON Environmental Services; Pisani = Michael Pisani & Associates.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

Table 2.2 Screening Assessment Under US EPA's Methodology – Soil/Sediment (0-3 ft bgs) (Includes Supplemental Data)

Chemical Group	Parameter	Number Detected	Number Sampled	Minimum Detected ¹	Mean ²	95% UCLM ³	Maximum Detected ¹	Unit	US EPA Regional Screening Levels ⁴	# Samples > US EPA RSL ⁵	COC? ⁶
									Residential	Residential	
Metals	Arsenic	80	80	0.9	6.1	6.7	22	mg/kg	0.68	77	Yes
Metals	Barium	79	79	123	1029	2108	15700	mg/kg	1500	8	Yes
Metals	Cadmium	30	61	0.026	0.60	0.60	3.5	mg/kg	7.1	0	No
Metals	Chromium	61	61	3.5	14	15	36	mg/kg	12000	0	No
Metals	Lead	64	64	8.1	27	41	150	mg/kg	400	0	No
Metals	Mercury	56	64	0.037	0.40	0.97	17	mg/kg	2.3	2	Yes
Metals	Selenium	20	69	0.84	2.7	1.9	2.1	mg/kg	39	0	No
Metals	Strontium	51	51	36	109	181	459	mg/kg	4700	0	No
Metals	TT Barium	36	36	274	1085	1310	3082	mg/kg	NC	0	No-7
Metals	Zinc	49	49	23	134	358	2185	mg/kg	2300	0	No
TPH	Aliphatic >C10-C12	7	34	18	81	88	514	mg/kg	9.6	7	Yes
TPH	Aliphatic >C12-C16	25	34	14	394	1832	3311	mg/kg	9.6	25	Yes
TPH	Aliphatic >C16-C35	28	34	32	1845	8116	13805	mg/kg	23000	0	No-8
TPH	Aromatic >C10-C12	3	34	15	34	22	99	mg/kg	11	3	Yes
TPH	Aromatic >C12-C16	8	34	20	88	118	790	mg/kg	11	8	Yes
TPH	Aromatic >C16-C21	14	34	39	198	299	1417	mg/kg	250	6	Yes
TPH	Aromatic >C21-C35	16	34	37	321	487	2023	mg/kg	250	8	Yes
TPH	TPH-DRO	67	82	25	1951	5674	41111	mg/kg	9.6	70	Yes
TPH	TPH-ORO	58	82	25	1155	2378	22116	mg/kg	250	40	Yes

Notes:

DRO = Diesel-Range Organic; ft bgs = Feet Below Ground Surface; NC = No Criterion Available; ORO = Oil-Range Organic; RSL = Regional Screening Level; TPH = Total Petroleum Hydrocarbon; TT= True Total; US EPA = United States Environmental Protection Agency.

Blank = Not Analyzed.

All post-remediation soil and sediment samples collected from 0-3 ft bgs are evaluated.

Concentrations expressed in wet weight were converted to dry weight using the moisture content of the sample.

Evaluated parameters were detected in at least one sample.

Split samples analyzed by two different laboratories were averaged, and samples collected at multiple depths were averaged, resulting in one result per station to avoid biasing the data. See text in Beck (2015).

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

TPH fraction data (aliphatics and aromatics) and TPH range data are evaluated in my risk assessment in separate analyses.

(1) When determining the maximum and minimum detected concentration, all samples (did not average splits, duplicates, or depths) were included to reflect minimum and maximum detected concentrations.

(2) The full detection limit was used to calculate the mean. This is a very conservative approach. See text in Beck (2015).

(3) 95% UCLM = 95% upper confidence limit on the mean, calculated using the average of splits and samples collected at multiple depths (each station had one result to eliminate bias). See text in Beck (2015).

(4) US EPA RSLs (US EPA, 2015a) based on a Target Hazard Index (HI) of 0.1 and a Target Cancer Risk of 1×10^{-6} .

(5) Number of samples that exceed respective criterion.

(6) COC = Constituent of Concern, based on maximum concentration.

(7) Evaluated under barium in the absence of a health-based screening number for true total barium (TT barium).

(8) Not considered a COC but evaluated as part of the TPH fraction data analysis.

Table 2.3 Screening Assessment Under US EPA's Methodology – Groundwater (Includes Supplemental Data)

Aquifer	Chemical Group	Parameter	Number Detected	Number Sampled	Minimum Detected ¹	Mean ²	Maximum Detected ¹	Unit	US EPA Regional Screening Levels ³		# Samples > US EPA Benchmarks ⁴		COC? ⁵
									MCL	Tap Water	MCL	Tap Water	
Chicot	Metals	Arsenic	1	4	0.011	0.0090	0.011	mg/L	0.01	0.000052	1	1	Yes
Chicot	Metals	Barium	5	5	0.26	0.62	0.87	mg/L	2	0.38	0	5	Yes
Chicot	Metals	Calcium	4	4	50	70	89	mg/L	NC	NC	0	0	No-6
Chicot	Metals	Iron	4	4	0.75	0.95	1.1	mg/L	NC	1.4	0	0	No
Chicot	Metals	Magnesium	4	4	18	24	31	mg/L	NC	NC	0	0	No-6
Chicot	Metals	Manganese	4	4	0.068	0.090	0.14	mg/L	NC	0.043	0	4	Yes
Chicot	Metals	Potassium	4	4	2.5	2.8	3.8	mg/L	NC	NC	0	0	No-6
Chicot	Metals	Sodium	4	4	109.0	135.8	161.0	mg/L	NC	NC	0	0	No-6
Chicot	Metals	Strontium	5	5	0.46	0.57	0.84	mg/L	NC	1.2	0	0	No
Chicot	Metals	Zinc	3	4	0.022	0.15	0.32	mg/L	NC	0.6	0	0	No
Chicot	TPH	TPH-DRO	1	4	0.84	0.31	0.84	mg/L	NC	0.00055	0	1	Yes
Chicot	TPH	TPH-ORO	1	4	0.45	0.21	0.45	mg/L	NC	0.08	0	1	Yes
Shallow sand - confining unit	VOC	Benzene	7	25	0.0014	0.0070	0.030	mg/L	0.005	0.00046	6	7	Yes
Shallow sand - confining unit	VOC	Toluene	4	25	0.0058	0.0074	0.0076	mg/L	1	0.11	0	0	No
Shallow sand - confining unit	Metals	Arsenic	11	24	0.0023	0.013	0.032	mg/L	0.01	0.000052	8	11	Yes
Shallow sand - confining unit	Metals	Barium	24	24	0.22	3.1	18	mg/L	2	0.38	7	22	Yes
Shallow sand - confining unit	Metals	Calcium	21	21	62	283	1780	mg/L	NC	NC	0	0	No-6
Shallow sand - confining unit	Metals	Chromium	9	21	0.010	0.024	0.33	mg/L	0.1	2.2	1	0	Yes
Shallow sand - confining unit	Metals	Iron	20	20	2.6	19	69	mg/L	NC	1.4	0	20	Yes
Shallow sand - confining unit	Metals	Lead	6	21	0.0035	0.014	0.032	mg/L	0.015	0.015	3	3	Yes
Shallow sand - confining unit	Metals	Magnesium	20	20	33	146	1050	mg/L	NC	NC	0	0	No-6
Shallow sand - confining unit	Metals	Manganese	19	19	0.36	1.8	13	mg/L	NC	0.043	0	19	Yes
Shallow sand - confining unit	Metals	Potassium	20	20	5.1	10	46	mg/L	NC	NC	0	0	No-6
Shallow sand - confining unit	Metals	Selenium	16	22	0.030	0.041	0.077	mg/L	0.05	0.01	5	16	Yes
Shallow sand - confining unit	Metals	Sodium	20	20	309	1049	5680	mg/L	NC	NC	0	0	No-6
Shallow sand - confining unit	Metals	Strontium	21	21	0.47	3.6	26	mg/L	NC	1.2	0	11	Yes
Shallow sand - confining unit	Metals	Zinc	21	21	0.014	0.100	0.35	mg/L	NC	0.6	0	0	No
Shallow sand - confining unit	TPH	Aliphatic C6-C8	1	20	0.044	0.14	0.044	mg/L	NC	0.13	0	0	No
Shallow sand - confining unit	TPH	TPH-DRO	4	21	0.15	0.14	0.24	mg/L	NC	0.00055	0	4	Yes
Shallow sand - confining unit	TPH	TPH-ORO	3	21	0.12	0.13	0.21	mg/L	NC	0.08	0	3	Yes
Intermediate sand - confining unit	VOC	Benzene	1	18	0.0019	0.0049	0.0019	mg/L	0.005	0.00046	0	1	Yes
Intermediate sand - confining unit	VOC	Toluene	9	18	0.0057	0.0080	0.011	mg/L	1	0.11	0	0	No
Intermediate sand - confining unit	Metals	Arsenic	10	18	0.0041	0.011	0.028	mg/L	0.01	0.000052	5	10	Yes
Intermediate sand - confining unit	Metals	Barium	18	18	0.54	1.3	2.7	mg/L	2	0.38	2	18	Yes
Intermediate sand - confining unit	Metals	Calcium	18	18	72	135	270	mg/L	NC	NC	0	0	No-6
Intermediate sand - confining unit	Metals	Chromium	12	14	0.005	0.051	0.34	mg/L	0.1	2.2	2	0	Yes
Intermediate sand - confining unit	Metals	Iron	18	18	1.5	28	83	mg/L	NC	1.4	0	18	Yes
Intermediate sand - confining unit	Metals	Lead	6	14	0.012	0.019	0.082	mg/L	0.015	0.015	5	5	Yes
Intermediate sand - confining unit	Metals	Magnesium	18	18	25	50	84	mg/L	NC	NC	0	0	No-6
Intermediate sand - confining unit	Metals	Manganese	18	18	0.16	0.71	1.7	mg/L	NC	0.043	0	18	Yes
Intermediate sand - confining unit	Metals	Potassium	18	18	4.3	7.3	13	mg/L	NC	NC	0	0	No-6
Intermediate sand - confining unit	Metals	Selenium	9	17	0.037	0.043	0.098	mg/L	0.05	0.01	6	9	Yes

Aquifer	Chemical Group	Parameter	Number Detected	Number Sampled	Minimum Detected ¹	Mean ²	Maximum Detected ¹	Unit	US EPA Regional Screening Levels ³		# Samples > US EPA Benchmarks ⁴		COC? ⁵
									MCL	Tap Water	MCL	Tap Water	
Intermediate sand - confining unit	Metals	Sodium	18	18	200	507	1560	mg/L	NC	NC	0	0	No-6
Intermediate sand - confining unit	Metals	Strontium	14	14	0.69	1.2	3.5	mg/L	NC	1.2	0	5	Yes
Intermediate sand - confining unit	Metals	Zinc	12	14	0.013	0.13	0.35	mg/L	NC	0.6	0	0	No
Intermediate sand - confining unit	TPH	TPH-DRO	2	17	0.13	0.14	0.25	mg/L	NC	0.00055	0	2	Yes
Intermediate sand - confining unit	TPH	TPH-ORO	2	17	0.19	0.14	0.58	mg/L	NC	0.08	0	2	Yes
Deep sand - confining unit	VOC	Benzene	1	6	0.20	0.038	0.20	mg/L	0.005	0.00046	1	1	Yes
Deep sand - confining unit	VOC	Ethylbenzene	1	6	0.0093	0.0057	0.0093	mg/L	0.7	0.0015	0	1	Yes
Deep sand - confining unit	Metals	Arsenic	2	6	0.010	0.009	0.011	mg/L	0.01	0.000052	1	2	Yes
Deep sand - confining unit	Metals	Barium	6	6	1.2	5.9	23	mg/L	2	0.38	3	6	Yes
Deep sand - confining unit	Metals	Calcium	6	6	118	445	1430	mg/L	NC	NC	0	0	No-6
Deep sand - confining unit	Metals	Chromium	1	5	0.021	0.022	0.021	mg/L	0.1	2.2	0	0	No
Deep sand - confining unit	Metals	Iron	6	6	1.2	9	17	mg/L	NC	1.4	0	5	Yes
Deep sand - confining unit	Metals	Lead	1	5	0.013	0.020	0.013	mg/L	0.015	0.015	0	0	No
Deep sand - confining unit	Metals	Magnesium	6	6	44	138	384	mg/L	NC	NC	0	0	No-6
Deep sand - confining unit	Metals	Manganese	6	6	0.24	0.72	1.6	mg/L	NC	0.043	0	6	Yes
Deep sand - confining unit	Metals	Mercury	1	5	0.0010	0.00028	0.0010	mg/L	0.002	0.00057	0	1	No-7
Deep sand - confining unit	Metals	Potassium	6	6	6.0	13	42	mg/L	NC	NC	0	0	No-6
Deep sand - confining unit	Metals	Sodium	6	6	409	2293	8720	mg/L	NC	NC	0	0	No-6
Deep sand - confining unit	Metals	Strontium	5	5	1.3	8.2	29.6	mg/L	NC	1.2	0	5	Yes
Deep sand - confining unit	Metals	Zinc	1	5	0.012	0.37	0.012	mg/L	NC	0.6	0	0	No
Deep sand - confining unit	TPH	Aliphatic >C8-C10	1	6	0.14	0.062	0.14	mg/L	NC	0.01	0	1	Yes
Deep sand - confining unit	TPH	Aliphatic C6-C8	1	6	0.64	0.15	0.64	mg/L	NC	0.13	0	1	Yes
Deep sand - confining unit	TPH	Aromatic >C8-C10	1	6	0.41	0.11	0.41	mg/L	NC	0.00055	0	1	Yes
Deep sand - confining unit	TPH	TPH-DRO	1	5	0.34	0.17	0.34	mg/L	NC	0.00055	0	1	Yes
Deep sand - confining unit	TPH	TPH-GRO	1	6	0.43	0.17	0.43	mg/L	NC	0.0033	0	1	Yes

Notes:

COPC = Constituent of Potential Concern; DRO = Diesel-Range Organic; NC = No Criterion Available; ORO = Oil-Range Organic; TPH = Total Petroleum Hydrocarbon; VOC = Volatile Organic Compound; US EPA = United States Environmental Protection Agency.

Split samples analyzed by two different laboratories were average. See text.

Evaluated parameters were detected in at least one sample.

TPH fraction data (aliphatics and aromatics) and TPH range data are evaluated in my risk assessment in separate analyses.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

(1) When determining the maximum and minimum detected concentration, all samples (did not average splits or duplicates) were included to reflect minimum and maximum detected concentrations.

(2) The full detection limit was used to calculate the mean.

(3) US EPA Regional Screening Levels.

MCL = Maximum Contaminant Level; Tap Water = Tap water screening level (US EPA, 2015a).

MCL for iron, manganese, and zinc are secondary drinking water regulations based on cosmetic (skin or tooth discoloration) or aesthetic (taste, odor, or color) effects (<http://water.epa.gov/drink/contaminants/index.cfm>).

(4) Number of samples that exceed respective criteria.

(5) COC = Constituent of Concern, based on maximum concentration.

(6) Calcium, magnesium, potassium, and sodium were not evaluated, because they are considered essential nutrients (US EPA, 1989).

(7) As per EPA guidance (US EPA, 1989), not considered a COPC, because it was only detected in 1 out of the 78 samples (including splits, field duplicates, and samples from the Peat Zone) collected from the Site.

Table 2.6 Constituents of Concern by Medium (Includes Supplemental Data)

Chemical Group	Parameter	Soil/Sediment (0-3 ft bgs)	Groundwater	Surface Water	Crab
Metals	Arsenic	Yes	Yes	Yes	No
Metals	Inorganic Arsenic				Yes
Metals	Barium	Yes	Yes	Yes	No
Metals	Cadmium	No			
Metals	Chromium	No	Yes	No	
Metals	Iron		Yes	Yes	
Metals	Lead	No	Yes	Yes	
Metals	Manganese		Yes	Yes	
Metals	Mercury	Yes			Yes
Metals	Methyl Mercury				Yes
Metals	Selenium	No	Yes	Yes	
Metals	Strontium	No	Yes	Yes	
Metals	Zinc	No	No	No	
VOCs	Benzene		Yes		
VOCs	Toluene		No		
TPH	Aliphatic C6-C8		Yes		
TPH	Aliphatic >C8-C10		Yes		
TPH	Aromatic >C8-C10		Yes		
TPH	Aliphatic >C10-C12	Yes			
TPH	Aliphatic >C12-C16	Yes			
TPH	Aliphatic >C16-C35	(1)			
TPH	Aromatic >C10-C12	Yes			
TPH	Aromatic >C12-C16	Yes			
TPH	Aromatic >C16-C21	Yes			
TPH	Aromatic >C21-C35	Yes			
TPH	TPH-DRO (C8-C28)				Yes-2
TPH	TPH (C08-C16)				Yes
TPH	TPH (C16-C28)				Yes
TPH	TPH (C08-C40)				No
TPH	TPH-GRO		Yes		
TPH	TPH-DRO	Yes	Yes	Yes	
TPH	TPH-ORO	Yes	Yes	Yes	

Notes:

DRO = Diesel-Range Organic; ft bgs = Feet Below Ground Surface; ORO = Oil-Range Organic; TPH = Total Petroleum Hydrocarbon; VOC = Volatile Organic Compound. Blank = Not analyzed or not detected.

TPH fraction data (aliphatics and aromatics) and TPH range data are evaluated in my risk assessment in separate analyses.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

(1) Although C16-C35 aliphatics were not identified as COPCs, they were included as part of TPH fraction data analysis.

(2) Evaluated as TPH C8-C16 and C16-C28.

Table 2.8 Toxicity Factors for Constituents of Concern (Includes Supplemental Data)

Constituents of Concern (COCs)	Oral			Dermal		Inhalation				Other ¹			RfD Target Organ	RfC Target Organ	
	Cancer Slope Factor (CSFo) (mg/kg-d) ⁻¹		Reference Dose (RfD) (mg/kg-day)	Dermal CSF (CSFd) (mg/kg-d) ⁻¹	Dermal RfD (mg/kg-day)	Inhalation Unit Risk (µg/m ³) ⁻¹		Reference Concentration (RfC) (mg/m ³)	GI Absorption (GI ABS)	Bioavailability (B)	Dermal Absorption (ABS)				
Metals															
Arsenic	1.5E+00	IRIS	3.0E-04	IRIS	1.5E+00	3.0E-04	4.3E-03	IRIS	1.5E-05	CalEPA	1	0.6	0.03	Skin	Lung
Inorganic Arsenic	1.5E+00	IRIS	3.0E-04	IRIS	1.5E+00	3.0E-04	4.3E-03	IRIS	1.5E-05	CalEPA	1	0.6	0.03	Skin	Lung
Barium	NA		2.0E-01	IRIS	NA	1.4E-02	NA		5.0E-04	HEAST	0.07	1	NA	Kidney	Fetus
Chromium	NA		1.5E+00	IRIS	NA	2.0E-02	NA		NA		0.013	1	NA	None Reported	NA
Iron	NA		7.0E-01	PPRTV	NA	7.0E-01	NA		NA		1	1	NA	Gastrointestinal	NA
Lead	NA		NA		NA	NA	NA		NA		1	1	NA	NA	NA
Manganese	NA		2.4E-02	S	NA	9.6E-04	NA		5.0E-05	IRIS	0.04	1	NA	Central Nervous System	Central Nervous System
Mercury	NA		3.0E-04	IRIS	NA	2.1E-05	NA		3.0E-04	S	0.07	1	NA	Immunological	Central Nervous System
Methyl Mercury	NA		1.0E-04	IRIS	NA	1.0E-04	NA		NA		1	1	NA	Central Nervous System	NA
Selenium	NA		5.0E-03	IRIS	NA	5.0E-03	NA		2.0E-02	CalEPA	1	1	NA	Skin	Skin
Strontium	NA		6.0E-01	IRIS	NA	6.0E-01	NA		NA		1	1	NA	Bone	NA
Volatile Organic Compounds															
Benzene	5.5E-02	IRIS	4.0E-03	IRIS	5.5E-02	4.0E-03	7.8E-06	IRIS	3.0E-02	IRIS	1	1	NA	Blood	Blood
Ethylbenzene	1.1E-02	CalEPA	1.0E-01	IRIS	1.1E-02	1.0E-01	2.5E-06	CalEPA	1.0E+00	IRIS	1	1	NA	Liver	Developmental
Total Petroleum Hydrocarbons															
Aliphatic C6-C8	NA		NA	PPRTV: Ali-low (C6-C8)	NA	NA	NA		6.0E-01	PPRTV: Ali-low (C6-C8)	1	1	NA	NA	Nose
Aliphatic >C8-C10	NA		1.0E-02	PPRTV: Ali-med (C9-C18)	NA	1.0E-02	NA		1.0E-01	PPRTV: Ali-med (C9-C18)	1	1	NA	Liver	Nose
Aliphatic >C10-C12	NA		1.0E-02	PPRTV: Ali-med (C9-C18)	NA	1.0E-02	NA		1.0E-01	PPRTV: Ali-med (C9-C18)	1	1	NA	Liver	Nose
Aliphatic >C12-C16	NA		1.0E-02	PPRTV: Ali-med (C9-C18)	NA	1.0E-02	NA		1.0E-01	PPRTV: Ali-med (C9-C18)	1	1	NA	Liver	Nose
Aliphatic >C16-C35	NA		3.0E+00	PPRTV: Ali-high (C19-C32)	NA	3.0E+00	NA		NA		1	1	NA	Liver	NA
Aromatic >C8-C10	NA		3.0E-02	PPRTV: See text in Beck (2015) ²	NA	3.0E-02	NA		1.0E-01	PPRTV: See text in Beck (2015) ²	1	1	NA	Liver	Nose
Aromatic >C10-C12	NA		3.0E-02	PPRTV: See text in Beck (2015) ²	NA	3.0E-02	NA		1.0E-01	PPRTV: See text in Beck (2015) ²	1	1	NA	Blood	Nose
Aromatic >C12-C16	NA		3.0E-02	PPRTV: See text in Beck (2015) ²	NA	3.0E-02	NA		1.0E-01	PPRTV: See text in Beck (2015) ²	1	1	NA	Blood	Nose
Aromatic >C16-C21	NA		4.0E-02	PPRTV: Aro-high (C17-C32)	NA	4.0E-02	NA		NA		1	1	0.1	Liver	NA
Aromatic >C21-C35	NA		4.0E-02	PPRTV: Aro-high (C17-C32)	NA	4.0E-02	NA		NA		1	1	0.1	Liver	NA
TPH-GRO	NA		1.0E-02	min RfD (C6-C8 ali, C8-C10 ali, C8-C10 aro)	NA	1.0E-02	NA		1.0E-01	min RfC (C6-C8 ali, C8-C10 ali, C8-C10 aro)	1	1	NA	Liver	Nose
TPH-DRO	NA		1.0E-02	min RfD (C10-C12 ali, C12-C16 ai, C10-C12 aro, C12-C16 aro)	NA	1.0E-02	NA		1.0E-01	min RfC (C10-C12 ali, C12-C16 ali, C10-C12 aro, C12C16 aro)	1	1	0.1	Liver	Nose
TPH-ORO	NA		4.0E-02	min RfD (C16-C35 ali and C21-C35 aro)	NA	4.0E-02	NA		NA		1	1	0.1	Liver	NA

Notes:

DRO = Diesel-Range Organic; NA = Not Available/Not Applicable; ORO = Oil-Range Organic; RSL = Regional Screening Level; TPH = Total Petroleum Hydrocarbon; US EPA = United States Environmental Protection Agency.

Toxicity Values from US EPA RSLs.

US EPA (2015a) cites the following sources for toxicity values (Cancer Slope Factor, Reference Dose, Unit Risk, and Reference Concentration):

IRIS = US EPA Integrated Risk Information System (<http://www.epa.gov/iris>).

PPRTV = US EPA Provisional Peer-Reviewed Toxicity Value.

CalEPA = California Environmental Protection Agency.

HEAST = Health Effects Assessment Summary Tables.

S = IRIS RfD was adjusted to exclude manganese from diet.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

(1) The gastrointestinal absorption efficiency (GI ABS) and dermal absorption factors (ABS) were obtained from US EPA (2004, Exhibit 4-1) or US EPA RSLs (US EPA, 2015a).

(2) Since RfD/RfCs for PAHs and non-PAHs are recommended, RfD/RfC for non-PAHs were selected because PAHs are not considered COCs (See Beck, 2015).

Table 3.1 Estimated Cancer and Non-cancer Risks (Includes Supplemental Data)

With TPH Fraction Data for Soil/Sediment and Groundwater

Exposure Pathway	Cancer Risk	Percentage Contribution	COC Contributing Majority of Risk by Pathway (% Contribution)	Non-cancer Hazard	Percentage Contribution	COC Contributing Majority of Hazard by Pathway (% Contribution)
Adult Recreator						
Incidental Ingestion of Soil/Sediment	4.0E-07	2.5%	Arsenic (100%)	4.4E-02	1.9%	Aliphatic >C12-C16 (74%)
Dermal Contact with Soil/Sediment	5.5E-07	3.4%	Arsenic (100%)	1.3E-02	<1%	Aromatic >C21-C35 (46%)
Dermal Contact with Surface Water	4.4E-07	2.7%	Arsenic (100%)	6.3E-02	2.7%	Manganese (87%)
Dermal Contact with Groundwater	4.6E-06	29%	Benzene (81%)	8.0E-01	34%	Manganese (74%)
Ingestion of Groundwater	0.0E+00			8.4E-02	4%	Barium (41%)
Inhalation of Volatiles in Groundwater	7.0E-06	43%	Benzene (99%)	1.6E-01	7%	Benzene (51%)
Ingestion of Fish/Shellfish	3.2E-06	20%	Inorganic Arsenic (100%)	1.2E+00	50%	TPH (C08-C16) (45%)
Total Cancer Risk (ELCR):	2E-05		Total Hazard Index:	2E+00		

Target Organ-Specific Hazard Index (TPH-Fraction Data for Soil/Sediment and Groundwater)

Endpoint	Incidental Ingestion of Soil/SD	Dermal Contact with Soil/SD	Dermal Contact with SW	Dermal Contact with GW	Ingestion of GW	Inhalation of GW	Ingestion of Fish/Shellfish	Total
Blood	8.3E-04	0.0E+00		4.6E-02		7.9E-02	1.3E-01	3E-01
Bone			1.8E-04	2.4E-03	8.5E-03			1E-02
Central Nervous System			5.5E-02	5.9E-01	2.7E-02		1.8E-01	9E-01
Developmental						1.1E-04		1E-04
Gastrointestinal			9.2E-04	5.8E-03	1.4E-02			2E-02
Immunological	5.7E-04	0.0E+00					9.5E-02	1E-01
Kidney	1.9E-03	0.0E+00	4.1E-03	7.9E-02	3.5E-02			1E-01
Liver	3.8E-02	9.7E-03	0.0E+00	7.1E-02			7.3E-01	9E-01
None Reported				4.5E-04				5E-04
Nose						7.7E-02		8E-02
Skin	2.4E-03	3.3E-03	3.1E-03	5.1E-03			1.9E-02	3E-02
Total:	4E-02	1E-02	6E-02	8E-01	8E-02	2E-01	1E+00	

Notes:

COC = Constituent of Concern; ELCR = Excess Lifetime Cancer Risk; GW = Groundwater; Mn = Manganese; Soil/SD = Soil/Sediment; SW = Surface Water; TOSHI = Target Organ-Specific Hazard Index; TPH = Total Petroleum Hydrocarbon.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

As documented by Michael Pisani & Associates, manganese is naturally elevated in groundwater at the Site (and in surrounding areas).

Non-cancer hazard without Mn in Groundwater: 2
Central Nervous System TOSHI without Mn in Groundwater: 0.2

With TPH Range Data for Soil/Sediment and Groundwater

Exposure Pathway	Cancer Risk	Percentage Contribution	COC Contributing Majority of Risk by Pathway (% Contribution)	Non-cancer Hazard	Percentage Contribution	COC Contributing Majority of Hazard by Pathway (% Contribution)
Adult Recreator						
Incidental Ingestion of Soil/Sediment	4.0E-07	2.5%	Arsenic (100%)	1.2E-01	4.2%	TPH-DRO (87%)
Dermal Contact with Soil/Sediment	5.5E-07	3.4%	Arsenic (100%)	3.1E-01	11%	TPH-DRO (90%)
Dermal Contact with Surface Water	4.4E-07	2.7%	Arsenic (100%)	6.3E-02	2.3%	Manganese (87%)
Dermal Contact with Groundwater	4.6E-06	29%	Benzene (81%)	8.4E-01	30%	Manganese (74%)
Ingestion of Groundwater	0.0E+00			8.4E-02	3.0%	Barium (41%)
Inhalation of Volatiles in Groundwater	7.0E-06	43%	Benzene (99%)	2.0E-01	7.3%	TPH-DRO (49%)
Ingestion of Fish/Shellfish	3.2E-06	20%	Inorganic Arsenic (100%)	1.2E+00	42%	TPH (C08-C16) (45%)
Total Cancer Risk (ELCR):	2E-05		Total Hazard Index:	3E+00		

Target Organ-Specific Hazard Index (TPH Range Data for Soil/Sediment and Groundwater)

Endpoint	Incidental Ingestion of Soil/SD	Dermal Contact with Soil/SD	Dermal Contact with SW	Dermal Contact with GW	Ingestion of GW	Inhalation of GW	Ingestion of Fish/Shellfish	Total
Blood				4.6E-02		7.9E-02	1.3E-01	3E-01
Bone			1.8E-04	2.4E-03	8.5E-03			1E-02
Central Nervous System			5.5E-02	5.9E-01	2.7E-02		1.8E-01	9E-01
Developmental						1.1E-04		1E-04
Gastrointestinal			9.2E-04	5.8E-03	1.4E-02			2E-02
Immunological	5.7E-04	0.0E+00					9.5E-02	1E-01
Kidney	1.9E-03	0.0E+00	4.1E-03	7.9E-02	3.5E-02			1E-01
Liver	1.1E-01	3.1E-01	0.0E+00	1.1E-01			7.3E-01	1E+00
None Reported				4.5E-04				5E-04
Nose						1.2E-01		1E-01
Skin	2.4E-03	3.3E-03	3.1E-03	5.1E-03			1.9E-02	3E-02
Total:	1E-01	3E-01	6E-02	8E-01	8E-02	2E-01	1E+00	

Notes:

COC = Constituent of Concern; ELCR = Excess Lifetime Cancer Risk; GW = Groundwater; Mn = Manganese; Soil/SD = Soil/Sediment; SW = Surface Water; TOSHI = Target Organ-Specific Hazard Index; TPH = Total Petroleum Hydrocarbon.

Risks for TPH-GRO were calculated by subtracting benzene, ethylbenzene, and toluene EPCs from the TPH-GRO EPC as per US EPA (2009b).

As documented by Michael Pisani & Associates, manganese is naturally elevated in groundwater at the Site (and in surrounding areas).

Non-cancer hazard without Mn in Groundwater: 2
Central Nervous System TOSHI without Mn in Groundwater: 0.2

Table 3.2 Margin of Exposure (MOE) Analysis (Includes Supplemental Data)

Analyte	Exposure Pathway	Total Daily Intake ¹ (DI) (mg/kg-day)	Point of Departure (POD) (mg/kg-day)	Basis for POD	MOE = POD/DI	Source
Non-Cancer Endpoints						
Inorganic Arsenic	Crab Ingestion (34 g/day adjusted for body weight)	5.7E-06	0.0008	NOAEL based on Human Chronic oral exposures by Tseng (1977); Tseng <i>et al.</i> (1968). NOAEL of 0.009 mg/L was converted to an intake assuming 4.5 L/day + 0.002 mg/day (arsenic from missing data) divided by a body weight of 55 kg.	140	US EPA IRIS (US EPA, 2003)
Barium	Groundwater Dermal (2 hours/day)	1.1E-03	63	BMDL ₀₅ for nephropathy based on a 2-year drinking water study in mice (NTP, 1994).	57,000	US EPA IRIS (US EPA, 2005)
Manganese	Groundwater Dermal (2 hours/day)	5.7E-04	0.069	The NOAEL for non-diet was calculated by subtracting the dietary contribution (an upper limit of 5 mg/day) from the NOAEL reported in IRIS (0.14 mg/kg-day) based on human chronic ingestion studies (NRC, 1989; Freeland-Graves <i>et al.</i> , 1987, WHO, 1973), which includes all sources.	120	US EPA IRIS, RSL ² (US EPA, 2015b)
Mercury	Soil/Sediment Ingestion	1.7E-07	0.32	LOAEL for autoimmune effects observed in rat subchronic feeding and subcutaneous studies (US EPA, 1987).	1,800,000	US EPA IRIS (US EPA, 2002)
Methyl Mercury	Crab Ingestion (34 g/day adjusted for body weight)	1.8E-05	0.0015	BMDL ₀₅ range of 46-79 ppb in maternal blood for different neuropsychological effects in the offspring at 7 years of age, corresponding to a range of maternal daily intakes of 0.857-1.472 µg/kg-day.	81	US EPA IRIS (US EPA, 2011)
TPH Aliphatic C8-C16	Crab Ingestion (34 g/day adjusted for body weight)	3.9E-03	100	NOAEL based on two s/c gavage studies in rats (Anonymous, 1990, 1991a, both as cited in US EPA, 2009a)	25,000	Appendix A of US EPA (2009a)
	Crab Ingestion (34 g/day adjusted for body weight)	3.9E-03	500	LOAEL based on two s/c gavage studies in rats (Anonymous, 1990, 1991a, both as cited in US EPA, 2009a)	130,000	US EPA (2009a,b)
TPH Aromatic C8-C16	Crab Ingestion (34 g/day adjusted for body weight)	3.9E-03	125	NOAEL based on dogs	32,000	Bio/Dynamics Inc. (1990b, as cited in US EPA, 2009c); US EPA (2009b)
	Crab Ingestion (34 g/day adjusted for body weight)	3.9E-03	250	LOAEL based on dogs; mild anemia	64,000	Bio/Dynamics Inc. (1990b, as cited in US EPA, 2009c); US EPA (2009b)

Analyte	Exposure Pathway	Total Daily Intake ¹ (DI) (mg/kg-day)	Point of Departure (POD) (mg/kg-day)	Basis for POD	MOE = POD/DI	Source
Cancer Endpoints						
Inorganic Arsenic	Crab Ingestion (34 g/day adjusted for body weight)	2.1E-06	0.008	LOAEL (8 µg/kg-day) from Appendix B (Table B-3 and supporting text) in US EPA (1988) for skin cancer.	3,800	Appendix B of US EPA (1988)
Benzene	Groundwater Dermal (2 hours/day)	6.8E-05	0.15	Lowest concentration at which a statistically significant increase in leukemia based on Paxton <i>et al.</i> (1994a,b) analysis of Rinsky (1981, 1987), Crump and Allen (1984), Paustenbach <i>et al.</i> (1993) is 50 ppm-years for a lifetime exposure. LOAEC of 1,200 µg/m ³ for a 24 hour/day, 7 days/week, 30-year exposure adjusted to a 70-year lifetime exposure assuming an inhalation rate of 20 m ³ /day and a body weight of 70 kg.	2,200	US EPA (2008)

Notes:

BMDL₀₅ = Benchmark Dose 95% Lower Confidence Limit; IRIS = Integrated Risk Information System; LOAEC = Lowest Observed Adverse Effect Concentration; LOAEL = Lowest Observed Adverse Effect Level; NOAEL = No Observed Adverse Effect Level; ppb = Parts Per Billion; ppm = Parts Per Million; RSL = Regional Screening Level; s/c = Subcutaneous; TPH = Total Petroleum Hydrocarbon; US EPA = United States Environmental Protection Agency.

Supplemental Data = Data collected in November and December 2015 (both ICON and MPA) and February 2016 (MPA only).

(1) Total Daily intake calculated as the Media Concentration x Intake Rate x Exposure Frequency x Exposure Duration divided by the Averaging Time multiplied by the body weight.

(2) From RSL table, User Guide, Section 5: "The IRIS RfD (0.14 mg/kg-day) includes manganese from all sources, including diet. The author of the IRIS assessment for manganese recommended that the dietary contribution from the normal U.S. diet (an upper limit of 5 mg/day) be subtracted when evaluating non-food (e.g., drinking water or soil) exposures to manganese, leading to a RfD of 0.071 mg/kg-day for non-food items. The explanatory text in IRIS further recommends using a modifying factor of 3 when calculating risks associated with non-food sources due to a number of uncertainties that are discussed in the IRIS file for manganese, leading to a RfD of 0.024 mg/kg-day. This modified RfD has been used in the derivation of some manganese screening levels for soil and water. For more information regarding the Manganese RfD, users are advised to contact the author of the IRIS assessment on Manganese" (US EPA, 2015b). In addition, as documented by Michael Pisani & Associates, manganese is naturally elevated in groundwater at the Site (and in surrounding areas).