APPENDIX E
Chemical Data: AERC Investigation

Exploratory Hole Number	Depth	Metals							Inorganics				Organics					Miscellaneous	
		Cadmium[1,4]	Chromium[1,2]	Copper	Lead[3]	Mercury[1]	Nickel[1]	Zinc	Arsenic[1]	Water Soluble Boron	Sulphide	Water Soluble Sulphate	Toluene Extractable Matter	Phenols	Polycyclic Aromatic Hydrocarbons	Benzo(a)Pyrene	Total Petroleum Hydrocarbons	pH	Asbestos
Risk Assessment Values		8	130	130	450	8	50	300	20	3	250	1.2	500	5	50	37	500	5	0.1
US_{95}		0.85	26.8	112	223	1.61	56.8	542	129	45.6	64.4	1.06	-	0.50	43.3	4.34	359	8.5	-
T		2.27	2.41	2.43	2.06	2.75	3.97	2.31	4.16	1.68	2.35	1.70	-	-	1.70	1.62	1.97	3.23	-
Outlier		No	No	No	No	No	Yes	No	Yes	No	No	No	-	-	No	No	No	Yes	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	%
TP01	0.40	0.33	26	54	71	0.1	36	235	39	17.0	41	0.18	-	<0.5	39	5	2150	8.4	-
TP01	0.90	0.5	20	54	238	5.0	24	438	52	34.0	8	0.18	-	<0.5	145	11	589	8.4	-
TP02	0.35	0.7	24	56	161	0.5	28	394	1474	35.0	4	0.44	-	<0.5	68	7	582	8.6	-
TP03	0.20	0.3	43	108	258	1.7	64	265	59	15.0	6	0.28	-	<0.5	55	3	2193	8.5	-
TP03	1.20	4.6	62	363	1175	0.6	366	1200	246	25.0	41	0.24	-	<0.5	44	1	1242	7.9	P
TP04	0.30	1.1	34	161	675	0.7	97	431	58	32.0	2	0.24	-	<0.5	65	5	398	8.1	ND
TP04	0.90	<0.07	6	36	46	0.2	17	79	131	32.0	8	0.20	-	<0.5	5	1	264	8.3	-
TP05	0.25	0.7	26	176	63	0.1	125	208	76	34.0	1	0.24	-	<0.5	7	<0.3	383	9.3	ND
TP06	0.40	0.9	31	103	128	0.3	50	481	62	36.0	1	0.45	-	<0.5	16	2	308	8.8	ND
TP07	0.25	0.3	32	146	116	1.1	105	425	62	32.0	2	1.06	-	<0.5	22	1	343	9.2	-
TP08	0.10	0.5	32	115	144	0.3	23	203	91	22.0	4	0.40	-	<0.5	67	5	174	9.5	-
TP08	0.40	1.0	28	244	1638	18.0	79	725	1484	35.0	448	2.39	-	<0.5	24	7	549	7.5	-
TP08	1.85	<0.07	36	19	50	0.2	42	95	25	33.0	1	1.23	-	<0.5	1	<0.3	57	8.1	-
TP09	0.25	0.2	24	88	98	2.7	60	104	62	22.0	2	0.45	-	<0.5	79	6	261	10.5	-
TP09	0.95	1.2	44	247	738	4.4	34	469	181	36.0	372	0.47	-	<0.5	36	6	373	9.0	-
TP10	0.30	1.1	63	65	788	0.9	44	788	57	10.0	2	0.11	-	<0.5	100	7	140	8.4	-
TP10	0.90	0.5	46	58	563	2.1	44	413	86	35.0	4	0.37	-	<0.5	60	6	247	8.2	-
TP11	0.80	0.1	28	29	178	1.1	33	215	22	8.5	1	0.77	-	<0.5	5	<0.3	49	7.7	-
TP11	1.80	<0.07	34	24	25	0.1	32	73	24	4.0	1	0.18	-	<0.5	5	1	29	8.0	-
TP12	0.80	0.4	23	136	600	2.2	44	435	34	13.0	49	0.28	-	<0.5	104	6	312	7.8	-

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole Number	Depth	Metals							Inorganics				Organics					Miscellaneous	
		Cadmium[1,4]	Chromium[1,2]	Copper	Lead[3]	Mercury[1]	Nickel[1]	Zinc	Arsenic[1]	Water Soluble Boron	Sulphide	Water Soluble Sulphate	Toluene Extractable Matter	Phenols	Polycyclic Aromatic Hydrocarbons	Benzo(a)Pyrene	Total Petroleum Hydrocarbons	pH	Asbestos
Risk Assessment Values		8	130	130	450	8	50	300	20	3	250	1.2	500	5	50	37	500	5	0.1
US_{95}		0.85	26.8	112	223	1.61	56.8	542	129	45.6	64.4	1.06	-	0.50	43.3	4.34	359	8.5	-
T		2.27	2.41	2.43	2.06	2.75	3.97	2.31	4.16	1.68	2.35	1.70	-	-	1.70	1.62	1.97	3.23	-
Outlier		No	No	No	No	No	Yes	No	Yes	No	No	No	-	-	No	No	No	Yes	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	%
TP13	0.70	<0.07	29	33	131	1.1	38	141	34	22.0	3	0.28	-	<0.5	5	2	97	7.9	-
TP14	0.30	1.9	26	223	2175	1.5	66	1700	50	33.0	8	0.15	-	<0.5	100	4	418	7.9	-
TP14	0.60	0.4	26	44	270	1.1	34	270	37	32.0	1	1.20	-	<0.5	21	3	96	7.6	-
TP15	0.90	0.2	18	44	159	1.2	34	111	38	33.0	4	0.36	-	<0.5	13	2	109	8.1	-
TP16	0.65	1.3	21	140	595	2.1	49	463	64	27.0	21	1.58	-	<0.5	52	15	282	7.1	-
TP17	0.50	0.2	15	53	231	0.5	38	188	60	32.0	5	1.47	-	<0.5	14	1	288	8.4	-
TP17	1.10	<0.07	9	258	490	2.0	36	178	71	30.0	2	1.51	-	<0.5	9	1	79	7.5	-
TP18	2.20	<0.07	31	23	58	0.2	30	75	36	17.0	3	2.55	-	<0.5	3	1	58	7.9	-
TP18	0.30	0.1	14	49	136	0.3	26	114	73	32.0	3	0.34	-	<0.5	5	1	76	8.8	-
TP18	0.90	0.4	17	164	785	2.9	52	360	42	32.0	2	0.43	-	<0.5	37	1	332	8.0	-
TP19	0.50	1.3	28	121	675	1.2	66	550	38	27.0	3	1.36	-	<0.5	59	12	331	7.9	-
TP19	1.00	<0.07	39	19	28	0.1	41	118	23	27.0	1	0.52	-	<0.5	8	4	38	8.2	-
TP20	0.40	1.5	26	107	363	0.5	58	956	182	27.0	1	1.52	-	<0.5	57	9	1070	8.8	-
TP20	1.10	0.1	32	20	46	0.2	41	140	21	22.0	26	1.55	-	<0.5	12	5	79	8.2	ND
TP21	0.30	1.4	28	119	588	0.7	54	1050	60	27.0	2	1.65	-	<0.5	31	6	128	8.4	-
TP21	1.00	0.1	38	14	40	0.1	46	99	23	28.0	3	0.55	-	<0.5	5	3	<20	8.1	P
TP22	0.30	1.3	32	83	456	0.7	52	794	70	28.0	6	0.72	-	<0.5	39	10	506	8.4	-
TP22	0.80	0.2	34	16	45	0.0	35	106	23	28.0	44	0.21	-	<0.5	11	6	<20	8.2	-
TP23	0.30	0.5	20	72	538	1.2	50	400	26	56.0	461	0.37	-	<0.5	34	11	442	8.1	P
TP23	0.80	<0.07	29	24	73	0.2	39	120	17	55.0	11	0.18	-	<0.5	15	7	102	8.1	<2

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRF**	Fig. E1

Exploratory Hole Number	Depth	Metals							Inorganics				Organics					Miscellaneous	
		Cadmium[1,4]	Chromium[1,2]	Copper	Lead[3]	Mercury[1]	Nickel[1]	Zinc	Arsenic[1]	Water Soluble Boron	Sulphide	Water Soluble Sulphate	Toluene Extractable Matter	Phenols	Polycyclic Aromatic Hydrocarbons	Benzo(a)Pyrene	Total Petroleum Hydrocarbons	pH	Asbestos
Risk Assessment Values		8	130	130	450	8	50	300	20	3	250	1.2	500	5	50	37	500	5	0.1
US_{95}		0.85	26.8	112	223	1.61	56.8	542	129	45.6	64.4	1.06	-	0.50	43.3	4.34	359	8.5	-
T		2.27	2.41	2.43	2.06	2.75	3.97	2.31	4.16	1.68	2.35	1.70	-	-	1.70	1.62	1.97	3.23	-
Outlier		No	No	No	No	No	Yes	No	Yes	No	No	No	-	-	No	No	No	Yes	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	%
TP24	0.40	1.2	26	90	525	0.3	41	688	104	28.0	1	1.58	-	<0.5	19	3	1058	8.5	-
TP24	1.00	0.2	38	19	56	0.1	40	131	28	96.0	127	0.36	-	<0.5	14	4	106	8.0	-
TP25	0.40	1.8	23	73	431	0.3	34	888	151	54.0	3	0.92	-	<0.5	47	2	1074	9.1	-
TP25	1.00	3.9	21	141	600	0.4	124	2750	54	64.0	5	0.43	-	<0.5	41	3	450	8.9	P
TP25	1.70	<0.07	16	19	30	0.1	36	96	23	30.0	3	0.76	-	<0.5	8	3	59	8.0	-
TP26	0.40	<0.07	20	156	300	1.1	37	185	71	64.0	3	0.20	-	<0.5	51	1	995	8.8	-
TP26	1.00	0.1	36	21	50	0.2	39	119	25	48.0	503	0.17	-	<0.5	12	<0.3	98	8.4	P
TP27	0.40	0.1	35	21	60	0.2	38	179	96	64.0	3	0.21	-	<0.5	11	<0.3	637	9.1	-
TP27	1.00	0.2	33	17	30	0.1	39	93	26	64.0	234	0.21	-	<0.5	5	<0.3	89	7.8	ND
TP28	0.40	0.2	17	41	1013	14.0	18	174	32	65.0	1	0.12	-	<0.5	15	2	134	9.0	-
TP28	1.00	1.1	29	81	369	2.8	34	756	54	65.0	30	0.99	-	<0.5	20	6	148	8.2	P
TP29	0.70	1.8	19	106	450	0.7	54	1713	34	32.0	8	1.80	-	<0.5	66	2	1109	8.2	-
TP29	2.10	0.7	20	18	35	0.1	29	126	30	31.0	3	2.98	-	<0.5	37	5	982	6.9	-
TP31	0.50	1.5	20	52	425	0.4	42	819	117	47.0	2	1.24	-	<0.5	23	4	351	8.6	-
TP31	0.80	2.1	24	228	463	0.4	108	2000	51	55.0	13	1.71	-	<0.5	45	8	434	7.8	P
TP31	1.50	0.1	26	13	23	<0.01	33	75	22	30.0	3	1.06	-	<0.5	3	<0.3	84	8.0	-
TP32	0.30	<0.07	22	34	106	0.1	30	173	155	64.0	1	1.62	-	<0.5	14	3	171	8.7	-
TP32	0.80	<0.07	27	23	46	0.1	33	100	84	64.0	12	0.74	-	<0.5	13	5	79	8.2	P
TP33	0.25	<0.07	15	22	111	0.1	23	155	183	65.0	5	1.44	-	<0.5	19	3	278	8.7	-
TP33	1.00	<0.07	11	13	74	0.0	18	96	85	65.0	139	2.57	-	<0.5	55	2	1565	8.8	ND

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRF**	Fig. E1

Exploratory Hole Number	Depth	Metals							Inorganics				Organics					Miscellaneous	
		Cadmium[1,4]	Chromium[1,2]	Copper	Lead[3]	Mercury[1]	Nickel[1]	Zinc	Arsenic[1]	Water Soluble Boron	Sulphide	Water Soluble Sulphate	Toluene Extractable Matter	Phenols	Polycyclic Aromatic Hydrocarbons	Benzo(a)Pyrene	Total Petroleum Hydrocarbons	pH	Asbestos
Risk Assessment Values		8	130	130	450	8	50	300	20	3	250	1.2	500	5	50	37	500	5	0.1
US_{95}		0.85	26.8	112	223	1.61	56.8	542	129	45.6	64.4	1.06	-	0.50	43.3	4.34	359	8.5	-
T		2.27	2.41	2.43	2.06	2.75	3.97	2.31	4.16	1.68	2.35	1.70	-	-	1.70	1.62	1.97	3.23	-
Outlier		No	No	No	No	No	Yes	No	Yes	No	No	No	-	-	No	No	No	Yes	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	g/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	-	%
TP34	0.30	0.9	18	48	118	0.4	27	388	107	66.0	27	0.55	-	<0.5	39	3	336	8.6	ND
TP34	0.90	<0.07	29	19	54	0.1	38	120	29	67.0	44	2.02	-	<0.5	11	5	138	8.0	-
TP35	0.60	0.2	11	41	68	0.1	16	183	94	67.0	61	2.31	-	<0.5	16	0	315	8.8	-
TP35	0.90	<0.07	24	22	64	0.2	34	138	43	66.0	184	2.36	-	<0.5	11	<0.3	128	8.4	-
TP36	0.50	0.2	13	19	35	0.2	7	64	19	57.0	4	0.56	-	<0.5	10	0	142	7.7	-
TP37	0.50	0.4	11	30	91	0.1	25	133	70	31.0	1	1.46	-	<0.5	3	<0.3	119	8.6	-
TP37	1.00	0.2	19	32	165	0.4	23	125	59	32.0	1	1.56	-	<0.5	14	1	185	8.3	-
TP38	1.70	<0.07	8	9	50	0.3	13	35	17	65.0	5	1.40	-	<0.5	8	<0.3	83	8.7	-
TP39	0.30	0.5	10	124	638	0.2	70	356	34	64.0	2	1.53	-	<0.5	18	3	463	7.7	-
TP39	0.80	1.2	13	569	613	0.9	93	438	54	37.0	7	1.51	-	<0.5	29	4	567	7.9	-
TP40	0.30	0.5	18	54	738	1.0	46	258	25	20.0	4	1.50	-	<0.5	29	1	500	8.1	-
TP40	1.00	0.4	28	65	663	1.0	43	456	22	8.7	332	0.46	-	<0.5	69	8	205	7.7	-
TP41	0.50	0.4	21	68	370	1.2	26	198	17	15.0	4	1.37	-	<0.5	37	2	317	8.0	-
TP41	1.10	0.1	24	21	91	0.2	36	338	29	73.0	77	0.93	-	<0.5	10	<0.3	159	8.2	P
TP42	0.35	0.2	14	96	200	0.3	69	180	28	64.0	9	0.34	-	<0.5	136	6	1018	10.3	-
TP42	0.50	0.9	20	66	750	0.4	48	2400	29	64.0	171	0.36	-	<0.5	112	11	1169	9.5	ND
TP42	0.90	0.2	33	29	70	0.1	49	268	49	64.0	240	0.52	-	<0.5	7	<0.3	129	8.1	-
BH1	0.50	5.5	21	625	313	0.9	34	988	65	49.0	4	1.41	-	<0.5	106	10	617	7.7	ND
BH2	0.50	1.0	24	297	1038	0.4	76	1088	54	64.0	4	1.46	-	<0.5	79	6	860	7.9	-
BH2	1.90	0.2	28	49	136	0.6	29	229	65	31.0	10	0.99	-	<0.5	27	2	98	8.0	-

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRF**	Fig. E1

Exploratory Hole Number	Depth	Speciated Polycyclic Aromatic Hydrocarbons																Total PAH
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(1,2,3 cd) pyrene	Dibenz(a,h) anthracene	Benzo(g,h,I) perylene	
Risk Assessment Value		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	units	mg/kg
TP1	0.40	<0.3	<0.3	<0.3	3.3	4.1	3.2	<0.3	1.2	1.1	4.0	2.8	1.6	4.9	4.9	4.9	1.8	39
TP1	0.90	<0.3	<0.3	<0.3	1.7	15.0	13.0	14.0	14.0	10.0	11.0	13.0	13.0	11.0	10.0	10.0	8.2	145
TP2	0.35	<0.3	0.6	0.6	0.8	4.9	5.7	7.3	6.8	4.8	7.0	5.6	5.6	7.2	4.1	4.1	3.3	68
TP3	0.20	<0.3	1.9	1.9	3.2	4.7	5.2	8.4	8.0	3.5	3.8	3.8	3.8	2.6	1.4	1.4	1.5	55
TP3	1.20	<0.3	1.3	1.3	1.0	1.7	1.2	0.5	0.7	12.0	12.0	3.0	3.5	0.9	2.0	2.0	2.5	44
TP4	0.30	<0.3	0.7	0.7	0.5	7.4	5.8	8.8	8.7	4.9	6.3	4.5	4.5	5.2	2.8	2.8	2.4	65
TP4	0.90	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	1.8	0.9	<0.3	<0.3	0.9	0.9	0.5	<0.3	<0.3	<0.3	5
TP5	0.25	<0.3	<0.3	<0.3	<0.3	2.7	2.2	0.9	0.8	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	7
TP6	0.40	<0.3	<0.3	<0.3	<0.3	1.7	0.2	2.6	2.4	1.2	1.6	1.4	1.4	2.1	<0.3	<0.3	<0.3	16
TP7	0.25	<0.3	<0.3	<0.3	0.6	2.6	2.1	3.0	2.8	1.2	1.7	2.1	2.1	1.2	0.9	0.9	1.1	22
TP8	0.10	<0.3	0.7	<0.3	<0.3	5.8	3.8	9.7	9.2	3.5	5.5	5.9	5.9	5.0	4.2	4.2	4.0	67
TP8	0.40	<0.3	<0.3	<0.3	<0.3	0.3	0.6	2.4	2.9	1.8	3.1	2.8	2.8	7.3	<0.3	<0.3	<0.3	24
TP9	0.25	<0.3	1.5	<0.3	<0.3	7.2	4.4	11.0	10.0	5.4	5.9	6.6	6.6	5.9	5.0	5.0	4.8	79
TP9	0.95	<0.3	<0.3	<0.3	<0.3	1.0	1.2	3.1	3.8	2.5	3.3	3.6	3.6	6.1	2.2	2.2	3.0	36
TP10	0.30	<0.3	2.4	<0.3	0.6	9.9	4.2	12.0	11.0	6.7	10.0	9.4	9.4	7.4	5.8	5.8	5.0	100
TP10	0.90	<0.3	0.4	<0.3	0.5	4.7	3.4	7.8	7.8	4.5	5.3	5.8	5.8	5.6	2.8	2.8	3.0	60

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole Number	Depth	Speciated Polycyclic Aromatic Hydrocarbons																Total PAH
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(1,2,3 cd) pyrene	Dibenz(a,h) anthracene	Benzo(g,h,i) perylene	
Risk Assessment Value		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	units	mg/kg
TP19	0.50	<0.3	0.7	<0.3	<0.3	0.3	2.2	6.6	6.4	4.1	4.9	5.1	5.1	12.0	3.4	3.4	4.0	59
TP19	1.00	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1.0	0.3	0.9	3.5	0.6	0.6	0.6	8
TP20	0.40	2.2	<0.3	<0.3	3.8	6.7	8.9	2.8	2.5	2.2	3.5	3.3	3.3	9.0	2.5	2.5	3.6	57
TP20	1.10	<0.3	<0.3	<0.3	<0.3	0.6	0.5	<0.3	<0.3	<0.3	2.0	0.4	1.5	4.8	1.4	<0.3	0.8	12
TP21	0.30	<0.3	0.3	<0.3	<0.3	3.3	2.3	2.3	2.2	1.6	2.3	2.5	2.5	6.4	1.6	1.6	2.3	31
TP21	1.00	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.7	0.3	2.5	0.5	0.5	0.6	5
TP22	0.30	<0.3	<0.3	<0.3	1.3	4.1	4.3	4.7	3.6	1.1	2.4	2.0	2.7	9.6	0.7	0.7	1.7	39
TP22	0.80	<0.3	<0.3	<0.3	<0.3	0.6	0.5	<0.3	<0.3	<0.3	1.2	0.7	0.3	5.5	0.6	0.6	0.4	11
TP23	0.30	<0.3	0.4	<0.3	0.7	1.8	1.2	3.9	3.3	1.7	3.0	2.4	4.7	11.0	<0.3	<0.3	<0.3	34
TP23	0.80	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	1.9	1.7	0.6	2.0	7.3	0.8	<0.3	0.9	15
TP24	0.40	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	3.1	3.2	1.4	1.9	1.5	1.5	3.0	1.0	0.8	1.2	19
TP24	0.40	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.7	0.8	<0.3	<0.3	1.0	1.0	4.3	2.2	2.2	1.7	14
TP25	1.00	<0.3	<0.3	<0.3	<0.3	16.0	22.0	<0.3	<0.3	<0.3	<0.3	1.7	1.7	2.4	1.3	<0.3	1.6	47
TP25	1.00	<0.3	<0.3	<0.3	<0.3	0.9	13.0	1.0	1.4	1.3	1.9	2.5	2.5	2.8	1.8	1.8	2.1	41
TP26	0.40	<0.3	0.2	<0.3	<0.3	2.8	3.1	3.9	2.4	15.0	14.0	2.4	2.4	1.4	1.1	<0.3	2.0	51
TP26	1.00	<0.3	<0.3	<0.3	<0.3	0.5	0.4	0.3	0.6	<0.3	2.2	<0.3	3.2	<0.3	<0.3	1.6	3.1	12

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole Number	Depth	Speciated Polycyclic Aromatic Hydrocarbons																Total PAH
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(1,2,3 cd) pyrene	Dibenz(a,h) anthracene	Benzo(g,h,i) perylene	
Risk Assessment Value		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	units	mg/kg
TP27	0.40	<0.3	<0.3	<0.3	<0.3	2.3	2.5	<0.3	<0.3	<0.3	0.9	1.6	1.6	<0.3	0.9	0.9	<0.3	11
TP27	1.00	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	2.3	<0.3	<0.3	<0.3	<0.3	1.0	1.7	5
TP28	0.40	<0.3	<0.3	<0.3	<0.3	0.8	0.8	1.4	1.4	0.8	2.2	1.4	1.4	2.1	1.0	1.0	0.8	15
TP28	1.00	<0.3	<0.3	<0.3	<0.3	0.7	0.6	1.4	1.4	1.1	2.6	1.5	1.4	5.5	1.6	<0.3	2.4	20
TP31	0.50	<0.3	<0.3	<0.3	0.4	2.8	2.4	1.8	1.9	1.0	2.2	1.4	1.3	4.2	0.9	0.7	1.5	23
TP31	0.80	<0.3	<0.3	<0.3	<0.3	0.8	0.5	5.8	5.3	3.9	4.7	4.6	2.0	8.2	3.0	3.0	3.2	45
TP32	0.30	<0.3	<0.3	<0.3	<0.3	1.8	1.5	1.2	1.1	0.8	2.2	1.0	0.7	3.2	0.7	<0.3	<0.3	14
TP32	0.80	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.6	0.1	0.7	2.2	1.0	1.2	5.0	0.9	<0.3	0.7	13
TP33	0.25	<0.3	<0.3	<0.3	<0.3	1.6	1.0	2.3	2.1	1.4	2.4	1.8	1.8	2.6	0.3	0.4	0.8	19
TP33	1.00	<0.3	<0.3	<0.3	3.8	7.9	8.8	4.7	3.4	<0.3	3.1	2.0	2.0	1.7	2.2	1.5	14.0	55
TP34	0.30	<0.3	<0.3	0.5	4.1	3.3	3.1	3.4	3.4	1.9	2.4	2.8	2.8	3.1	2.5	2.5	2.9	39
TP34	0.90	<0.3	<0.3	<0.3	<0.3	1.6	1.4	<0.3	<0.3	<0.3	1.1	<0.3	1.5	4.5	0.6	<0.3	0.6	11
TP35	0.60	<0.3	<0.3	<0.3	3.3	3.4	2.8	1.4	1.0	<0.3	1.5	0.6	0.6	0.4	0.4	0.4	0.5	16
TP35	0.90	<0.3	<0.3	<0.3	<0.3	1.5	1.1	0.7	<0.3	1.7	0.6	<0.3	2.0	<0.3	<0.3	1.2	1.9	11
TP36	0.50	<0.3	<0.3	<0.3	1.3	1.8	1.9	0.4	0.5	0.8	0.7	0.8	0.4	0.3	0.6	<0.3	<0.9	10
TP38	1.70	<0.3	<0.3	<0.3	0.4	3.0	2.5	<0.3	<0.3	<0.3	1.6	0.3	0.6	<0.3	<0.3	<0.3	<0.3	8

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole Number	Depth	Speciated Polycyclic Aromatic Hydrocarbons																Total PAH
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(1,2,3 cd) pyrene	Dibenz(a,h) anthracene	Benzo(g,h,I) perylene	
Risk Assessment Value		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	units	mg/kg
TP39	0.30	<0.3	<0.3	<0.3	<0.3	4.0	1.7	1.3	1.2	<0.3	3.6	1.1	0.9	2.6	1.0	1.0	<0.3	18
TP39	0.80	<0.3	<0.3	<0.3	<0.3	5.1	4.3	2.1	2.2	1.2	3.7	1.7	1.2	4.2	1.4	1.4	0.8	29
TP40	0.30	<0.3	<0.3	<0.3	2.8	5.1	6.0	1.3	2.0	2.0	<0.3	2.8	1.4	0.8	1.9	1.6	1.5	29
TP40	1.00	<0.3	<0.3	<0.3	<0.3	6.5	4.1	8.2	9.9	5.8	6.6	6.0	6.0	7.9	2.7	2.7	2.7	69
TP41	1.10	<0.3	<0.3	<0.3	<0.3	1.9	1.6	0.9	<0.3	1.2	<0.3	1.0	1.0	<0.3	<0.3	1.1	1.0	10
TP42	0.35	<0.3	<0.3	<0.3	15.0	14.0	19.0	22.0	22.0	3.4	5.9	6.4	6.4	5.7	3.7	4.5	8.0	136
TP42	0.50	<0.3	1.2	2.6	13.0	12.0	14.0	21.0	15.0	2.4	4.8	4.7	3.7	11.0	3.8	2.7	<0.3	112
TP42	0.90	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.9	<0.3	1.3	0.6	1.8	<0.3	<0.3	1.1	1.0	<0.3	7
BH1	0.50	<0.3	<0.3	<0.3	<0.3	6.1	3.5	13.0	13.0	9.6	11.0	10.0	10.0	9.5	6.6	6.6	6.7	106
BH2	0.50	<0.3	<0.3	<0.3	0.8	7.4	7.3	13.0	11.0	5.2	5.9	6.2	6.2	5.6	3.6	3.6	4.0	79
BH3	0.40	<0.3	<0.3	<0.3	2.1	5.7	6.5	1.6	1.4	1.5	<0.3	<0.3	2.5	<0.3	<0.3	1.0	2.0	24
BH3	1.20	<0.3	<0.3	<0.3	<0.3	1.0	0.9	2.4	1.4	2.4	1.4	1.8	1.8	3.4	0.5	0.5	0.7	18
BH4	0.30	<0.3	2.2	<0.3	<0.3	5.0	4.7	12.0	12.0	7.4	9.9	8.8	8.8	13.0	7.7	7.7	7.4	107
BH5	0.30	<0.3	<0.3	<0.3	7.4	19.0	22.0	23.0	16.0	<0.3	<0.3	5.4	<0.3	1.9	4.8	7.2	4.5	111
BH6	0.50	<0.3	<0.3	<0.3	5.6	8.9	11.0	8.7	7.5	1.6	4.2	4.5	4.5	3.3	3.1	0.3	6.7	71
BH6	1.00	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	3.6	3.3	3.1	3.9	3.6	3.6	1.9	<0.3	1.4	0.7	25
Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**															AERC	
Checked & Approved	WGG	**BELVEDERE RRRF**															Fig. E1	

Exploratory Hole Number	Depth	Speciated Polycyclic Aromatic Hydrocarbons																Total PAH
		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a)pyrene	Indeno(1,2,3 cd) pyrene	Dibenz(a,h) anthracene	Benzo(g,h,i) perylene	
Risk Assessment Value		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	units	mg/kg
BH7	0.40	<0.3	<0.3	<0.3	<0.3	30.0	36.0	10.0	8.9	3.6	6.7	4.9	1.6	5.1	2.6	2.6	2.3	114
BH7	0.90	<0.3	<0.3	<0.3	2.1	11.0	12.0	7.7	7.0	4.1	6.4	5.4	5.4	4.8	2.3	2.3	2.7	73
BH8	0.60	<0.3	<0.3	0.8	2.3	7.8	7.7	7.3	5.9	0.7	0.9	1.7	1.7	1.5	1.8	1.8	1.9	44
BH8	1.10	<0.3	<0.3	<0.3	<0.3	1.4	<0.3	3.4	2.8	1.3	2.2	1.7	1.7	3.7	0.8	0.8	0.9	22

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole No.	Depth	BTEX				Chlorinated Hydrocarbons					
		Benzene	Toluene	Ethyl benzene	Xylenes	1,1,1-Trichloroethane	1,2- Dichloroethane	Tetrachloroethene	Tetrachloromethane	Trichloroethene	Trichloroethane
Risk Assessment Value		1	130	50	25	-	4	4	1	60	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TP3	1.25	<0.002	<0.002	0.004	0.004	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP4	1.00	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP5	1.00	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP7	1.20	0.003	0.014	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	0.01	<0.003
TP8	1.10	0.003	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP9	1.05	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP10	0.85	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP11	0.40	<0.002	0.004	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP11	0.90	0.002	0.003	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP12	0.80	0.006	0.011	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP13	0.70	<0.002	0.009	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP14	0.30	0.011	0.004	<0.002	<0.002	<0.0006	<0.015	0.001	<0.0003	<0.0015	0.003
TP15	0.50	<0.002	0.005	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP16	0.65	0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP17	1.10	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP18	0.90	0.006	0.004	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**								AERC	
Checked & Approved	WGG	**BELVEDERE RRRF**								Fig. E1	

Exploratory Hole No.	Depth	BTEX				Chlorinated Hydrocarbons					
		Benzene	Toluene	Ethyl benzene	Xylenes	1,1,1-Trichloroethane	1,2- Dichloroethane	Tetrachloroethene	Tetrachloromethane	Trichloroethene	Trichloroethane
Risk Assessment Value		1	130	50	25	-	4	4	1	60	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TP19	1.00	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP20	0.40	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP21	0.90	<0.002	0.004	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP22	0.30	<0.002	0.006	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP23	0.80	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP24	0.60	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	0.001	<0.0003	<0.0015	<0.003
TP25	0.40	<0.002	0.015	<0.002	<0.002	<0.0006	<0.015	0.0007	<0.0003	<0.0015	<0.003
TP26	0.40	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP27	0.45	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP28	0.50	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP29	0.70	0.003	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP30	0.50	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP31	0.50	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP32	0.30	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP33	0.25	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP34	0.40	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**								AERC	
Checked & Approved	WGG	**BELVEDERE RRRF**								Fig. E1	

Exploratory Hole No.	Depth	BTEX				Chlorinated Hydrocarbons					
		Benzene	Toluene	Ethyl benzene	Xylenes	1,1,1-Trichloroethane	1,2- Dichloroethane	Tetrachloroethene	Tetrachloromethane	Trichloroethene	Trichloroethane
Risk Assessment Value		1	130	50	25	-	4	4	1	60	-
	m	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
TP35	0.60	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	0.0007	<0.0003	<0.0015	<0.003
TP36	1.00	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP39	0.80	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	0.0009	<0.0003	<0.0015	0.004
TP40	0.40	<0.002	0.014	<0.002	<0.002	<0.0006	<0.015	0.0008	<0.0003	<0.0015	<0.003
TP41	0.50	<0.002	0.013	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
TP42	0.60	<0.002	0.005	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	0.004	<0.003
BH1	0.20	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	0.0007	<0.0003	<0.0015	<0.003
BH2	0.50	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	<0.0006	<0.0003	<0.0015	<0.003
BH3	0.40	<0.002	0.003	<0.002	<0.002	<0.0006	<0.015	0.001	<0.0003	0.004	<0.003
BH4	0.40	0.003	<0.002	<0.002	<0.002	<0.0006	<0.015	0.0009	<0.0003	<0.0015	<0.003
BH5	0.30	<0.002	0.021	<0.002	<0.002	<0.0006	<0.015	0.001	<0.0003	0.003	<0.003
BH6	0.50	0.003	0.006	<0.002	<0.002	<0.0006	<0.015	0.0007	<0.0003	<0.0015	<0.003
BH7	0.40	<0.002	<0.002	<0.002	<0.002	<0.0006	<0.015	0.0007	<0.0003	<0.0015	<0.003
BH8	0.70	0.003	0.028	<0.002	<0.002	<0.0006	<0.015	0.0008	<0.0003	<0.0015	<0.003

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SOIL)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E1

Exploratory Hole Number	Depth	Metals							Inorganics				Miscellaneous			
		Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Arsenic	Boron	Sulphide	Water Soluble Sulphate	Total Petroleum Hydrocarbons	Benzo(a) Pyrene	Total Polcyclic Aromatic Hydrocarbons	pH
Risk Assessment Values		1	50	20	50	1	50	500	10	2	150	250	10	0.01	0.2	5
	m	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	-
TP1	0.40	-	-	-	-	-	-	-	-	-	-	-	951	-	-	-
TP1	0.90	<1	-	<7	<7	<0.2	<7	<13	45	-	-	-	-	-	-	-
TP2	0.35	<1	-	<7	<7	-	<7	<13	655	-	-	-	-	-	-	-
TP3	0.20	<1	-	<7	<7	<0.2	<7	<13	151	-	-	-	-	-	-	-
TP3	1.20	<1	-	<7	<7	-	<7	<13	24	-	-	-	-	-	-	-
TP8	0.40	<1	-	<7	<7	<0.2	<7	575	50	-	0.2	-	-	-	-	-
TP9	0.95	<1	-	<7	<7	<0.2	<7	<13	27	-	0.2	-	-	-	-	-
TP20	0.40	<1	-	<7	<7	-	<7	<13	35	-	-	-	-	-	-	-
TP21	0.30	<1	-	<7	<7	-	<7	<13	75	-	-	-	-	-	-	-
TP23	0.30	<1	-	<7	<7	<0.2	<7	30	3	-	0.2	-	-	-	-	-
TP25	1.00	<1	-	<7	<7	-	<7	<13	31	-	-	-	-	-	-	-
TP26	1.00	<1	-	<7	<7	-	<7	<13	8	-	0.2	-	-	-	-	-
TP31	0.80	<1	-	<7	<7	-	<7	80	9	-	-	-	-	-	-	-
TP42	0.35	-	-	-	-	-	-	-	-	-	-	-	482	<0.05	<0.05	-
TP42	0.50	<1	-	<7	<7	-	<7	30	23	-	-	-	3312	<0.05	1.3	-
BH1	0.50	<1	-	<7	<7	-	<7	100	3	-	-	-	-	-	-	-
BH5	0.30	-	-	-	-	-	-	-	-	-	-	-	1326	0.05	-	-
BH6	1.00	<1	-	<7	<7	-	<7	30	2	-	-	-	-	-	-	-
BH7	0.40	<1	-	<7	<7	-	<7	<13	181	-	-	-	1581	0.10	10.7	-

Notes:

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (LEACHATE)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E2

Exploratory Hole Number	Date	Metals							Inorganics				Miscellaneous				
		Cadmium[1,4]	Chromium[1,2]	Copper	Lead[3]	Mercury[1]	Nickel[1]	Zinc	Arsenic[1]	Boron	Sulphide	Water Soluble Sulphate	Total Petroleum Hydrocarbons	Polycyclic Aromatic Hydrocarbons	Phenol	TOC	pH
Risk Assessment Values		5	50	2000	10	1	20	5000	10	1	150	250	600				5
	m	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	mg/l	mg/l	µg/l	µg/l	µg/l	mg/l	-
BH 1	20/08/03	<1	<7	<7	<7	<0.2	<7	<13	2	13	0.4	393	412	-	-	-	7.1
BH 1	28/08/03	<1	<7	<7	<7	<0.2	<7	<13	3	15	0.2	408	<10	0.10	<2	11	7.0
BH 2	20/08/03	<1	<7	<7	<7	<0.2	19	<13	2	15	0.2	847	29	-	-	-	6.9
BH 2	28/08/03	<1	<7	<7	<7	<0.2	33	15	3	15	0.2	764	<10	0.11	<2	16	6.9
BH 3	20/08/03	<1	<7	<7	<7	<0.2	15	<13	66	14	0.2	1545	18	-	-	-	7.7
BH 3	28/08/03	<1	<7	<7	<7	<0.2	19	<13	95	14	0.6	2100	<10	<0.05	<2	13	7.6
BH 4	20/08/03	<1	<7	<7	<7	<0.2	66	<13	3	14	0.8	580	99	-	-	-	6.9
BH 4	28/08/03	<1	<7	10	8	<0.2	51	<13	5	14	0.4	716	147	<0.05	<2	16	6.9
BH 5	20/08/03	<1	<7	<7	<7	<0.2	15	<13	28	14	0.4	886	97	-	-	-	7.4
BH 5	28/08/03	<1	<7	<7	<7	<0.2	11	<13	9	14	0.2	436	377	0.28	<2	19	7.3
BH 7	20/08/03	<1	<7	<7	<7	<0.2	16	<13	2286	14	0.2	387	170	-	-	-	8.0
BH 7	28/08/03	<1	<7	<7	<7	<0.2	13	<13	1258	14	0.2	397	474	<0.05	<2	10	8.0
BH 8	20/08/03	<1	<7	<7	<7	<0.2	48	20	3	14	0.2	486	149	-	-	-	6.7
BH 8	28/08/03	<1	<7	9	9	<0.2	44	<13	28	14	0.4	455	671	0.21	<2	28	6.6
BH 9	20/08/03	<1	<7	<7	<7	<0.2	34	<13	2	14	0.2	1038	162	-	-	-	6.6
BH10	20/08/03	<1	<7	<7	<7	<0.2	9	<13	869	14	0.2	1427	110	-	-	-	7.2
BH10	28/08/03	<1	<7	<7	<7	<0.2	8	<13	1495	15	0.4	1434	<10	0.06	<2	9	7.3
Borax BH1	28/08/03	<1	<7	<7	<7	<0.2	8	<13	24	1	0.4	67	<10	<0.05	<2	10	7.1
Borax BH2	28/08/03	<1	<7	<7	<7	<0.2	23	<13	5	1	0.6	80	<10	<0.05	<2	12	6.9
Borax BH3	28/08/03	<1	<7	<7	<7	<0.2	16	<13	4	3	0.2	77	<10	<0.05	<2	22	6.9
Borax BH6	28/08/03	<1	<7	<7	<7	<0.2	10	<13	5	14	0.2	9	<10	<0.05	<2	28	6.7

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (GROUNDWATER)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E3

Exploratory Hole Number	Date	Metals							Inorganics				Miscellaneous		
		Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Arsenic	Boron	Sulphide	Water Soluble Sulphate	Total Petroleum Hydrocarbons	Electrical Conductivity	pH
Risk Assessment Values		5	250	20	250	1	200	500	50	2	0.25	250	600	-	5
	m	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	mg/l	mg/l	mg/l	µg/l	µs/cm	-
SW 1	02/09/03	<1	<7	<7	<7	<0.2	<7	<13	187	11	0.4	33	61	-	8.0
SW 2	02/09/03	<1	<7	<7	<7	<0.2	<7	<13	79	14	0.2	186	205	-	7.4
SW 3	02/09/03	<1	<7	<7	<7	<0.2	14	<13	1051	15	0.2	356	18	-	8.6
SW4	18/09/03	-	-	-	-	-	-	-	44	10	-	-	-	901	7.7
SW5	18/09/03	-	-	-	-	-	-	-	580	14	-	-	-	2190	8.6
SW6	18/09/03	-	-	-	-	-	-	-	7	3	-	-	-	1177	7.2
SW7	18/09/03	-	-	-	-	-	-	-	9	1	-	-	-	878	7.1

Notes:

Originator	JRW	**RESULTS OF CONTAMINATION TESTING (SURFACE WATER)**	AERC
Checked & Approved	WGG	**BELVEDERE RRRF**	Fig. E4

Facsimile Transmission

Robertson

To Facsimile	01376 572700	**From** Facsimile	**01492 592030**
Company	AERC		**Robertson Research International Limited**
Location	Colchester		Llanrhos, Llandudno North Wales LL30 1SA United Kingdom
Attention of	Luis Rodrigues	Name	Janet Hunt
		Telephone	**01492 581811**
Number of pages in this transmission, including this sheet	3	Date	09/09/2003
		Reference	

Message

VOC results are appended for the water samples received on 27th August.

Regards,

Janet Hunt

Janet Hunt

This facsimile transmission may contain confidential and privileged information intended solely for the individual or organisation to whom it is addressed. If the reader is not the intended addressee, or the employee or agent responsible to deliver it to the addressee, you are hereby notified that any dissemination, distribution or copying is strictly prohibited. If you have received this communication in error, please notify the sender by telephone and either destroy the communication or return it to the address

Date rec'd : 27/8/2003
Our Ref. : 806-2
Your Ref. : C3477 Belveder
Print Date : 9/9/2003

ANALYSIS OF WATER SAMPLES

DETERMINAND / CLIENT ID. / LAB ID.	SW1 308660	SW2 308661	SW3 308662	BH1 308671	BH2 308670	BH3 308669
VOC(Headspace) (µg/L)						
Dichloromethane	<50	<50	<50	<50	<50	<50
Chloroform	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	<2	<2	<2	<2	<2	<2
Carbon tetrachloride	<2	<2	<2	<2	<2	<2
Benzene	<2	<2	<2	<2	<2	<2
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5
Dibromochloromethane	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<20	<20	<20	<20	<20	<20
Toluene	<10	<10	<10	<10	<10	<10
1,1,2-Trichloro-1,2,2-trifluoethane	<5	<5	<5	<5	<5	<5
Tetrachloroethene	<2	<2	<2	<2	<2	<2
Chlorobenzene	<2	<2	<2	<2	<2	<2
Ethylbenzene	<2	<2	<2	<2	<2	<2
M/p-Xylene	<2	<2	<2	<2	<2	<2
o-Xylene	<2	<2	<2	<2	<2	<2
Hexachloro-1,3-butadiene	<5	<5	<5	<5	<5	<5
1-Chloro-4-methylbenzene	<5	<5	<5	<5	<5	<5
1-Chloro-2-methylbenzene	<5	<5	<5	<5	<5	<5
Isopropylbenzene	<2	<2	<2	<2	<2	<2
Bromoform	<10	<10	<10	<10	<10	<10
Styrene	<5	<5	<5	<5	<5	<5
1,2,3-Trichlorobenzene	<5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	<2	<2	<2	<2	<2	<2
1,3-Dichlorobenzene	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	<5	<5	<5	<5	<5	<5
a-Methylstyrene	<5	<5	<5	<5	<5	<5
1,1-Dichloroethane	<2	<2	<2	<2	<2	<2
1,1,2-Trichloroethane	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	<5	<5	<5	<5	<5	<5
trans-1,2-Dichloroethene	<5	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	<2	<2	<2	<2	<2	<2
MTBE	<2	<2	<2	<2	<2	<2
Vinyl Chloride	<5	<5	<5	<5	<5	<5
Trichloromonofluoromethane	23	<5	<5	<5	<5	<5
1,1-Dichloro-1-propene	<10	<10	<10	<10	<10	<10
1,2-Dibromoethane	<10	<10	<10	<10	<10	<10
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5
1,3-Dichloropropane	<5	<5	<5	<5	<5	<5
2,2-Dichloropropane	<2	<2	<2	<2	<2	<2
cis-1,3-Dichloro-1-propene	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloro-1-propene	<5	<5	<5	<5	<5	<5
1,1,1,2-Tetrachloroethane	<20	<20	<20	<20	<20	<20
1,2,3-Trichloropropane	<10	<10	<10	<10	<10	<10
Bromobenzene	<5	<5	<5	<5	<5	<5
Dibromomethane	<10	<10	<10	<10	<10	<10

QA data not reported.

Date rec'd : 27/8/2003
Our Ref. : 606-2
Your Ref. : C3477 Belvedar
Print Date : 9/9/2003

ANALYSIS OF WATER SAMPLES

DETERMINAND / CLIENT ID. / LAB ID.	BH4 308668	BH5 308667	BH7 308666	BH8 308665	BH9 308664	BH10 308663
VOC(Headspace) (µg/L)						
Dichloromethane	<50	<50	<50	<50	<50	<50
Chloroform	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	<2	<2	<2	<2	<2	<2
Carbon tetrachloride	<2	<2	<2	<2	<2	<2
Benzene	<2	<2	<2	<2	<2	<2
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5
Dibromochloromethane	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<20	<20	<20	<20	<20	<20
Toluene	<10	<10	<10	<10	<10	<10
1,1,2-Trichloro-1,2,2-trifluoethane	<5	<5	<5	<5	<5	<5
Tetrachloroethene	<2	<2	<2	<2	<2	<2
Chlorobenzene	<2	<2	<2	<2	<2	<2
Ethylbenzene	<2	<2	<2	<2	<2	<2
M/p-Xylene	<2	<2	<2	<2	<2	<2
o-Xylene	<2	<2	<2	<2	<2	<2
Hexachloro-1,3-butadiene	<5	<5	<5	<5	<5	<5
1-Chloro-4-methylbenzene	<5	<5	<5	<5	<5	<5
1-Chloro-2-methylbenzene	<5	<5	<5	<5	<5	<5
Isopropylbenzene	<2	<2	<2	<2	<2	<2
Bromoform	<10	<10	<10	<10	<10	<10
Styrene	<5	<5	<5	<5	<5	<5
1,2,3-Trichlorobenzene	<5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	<2	<2	<2	<2	<2	<2
1,3-Dichlorobenzene	<2	<2	<2	<2	<2	<2
1,4-Dichlorobenzene	<5	<5	<5	<5	<5	<5
a-Methylstyrene	<5	<5	<5	<5	<5	<5
1,1-Dichloroethane	<2	<2	<2	<2	<2	<2
1,1,2-Trichloroethane	<10	<10	<10	<10	<10	<10
1,1-Dichloroethene	<5	<5	<5	<5	<5	<5
trans-1,2-Dichloroethene	<5	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	<2	<2	<2	<2	<2	<2
MTBE	<2	<2	<2	<2	<2	<2
Vinyl Chloride	<5	<5	<5	<5	<5	<5
Trichloromonofluoromethane	<5	<5	<5	<5	<5	8
1,1-Dichloro-1-propene	<10	<10	<10	<10	<10	<10
1,2-Dibromoethane	<10	<10	<10	<10	<10	<10
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5
1,3-Dichloropropane	<5	<5	<5	<5	<5	<5
2,2-Dichloropropane	<2	<2	<2	<2	<2	<2
cis-1,3-Dichloro-1-propene	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloro-1-propene	<5	<5	<5	<5	<5	<5
1,1,1,2-Tetrachloroethane	<20	<20	<20	<20	<20	<20
1,2,3-Trichloropropane	<10	<10	<10	<10	<10	<10
Bromobenzene	<5	<5	<5	<5	<5	<5
Dibromomethane	<10	<10	<10	<10	<10	<10

QA data not reported.

APPENDIX F
Assessment Framework

CONTAMINATED LAND ASSESSMENT FRAMEWORK

Introduction

The first priority when dealing with brownfield land is to prevent or minimise further pollution and to limit the spread of existing contamination.

Current guidance[1] supports sustainable development by reducing the damage from past activities and by permitting brownfield land to be kept in or returned to a beneficial use wherever practicable, so minimising pressures for development to take place on greenfield land. This is a *'suitable for use'* approach to the control and treatment of existing contamination and requires regulatory action only where it is necessary to deal with unacceptable risks to the health of the environment, assessed in relation to the current use of the land and its wider environmental setting.

Under the statutory guidance for contaminated land, three elements must have been identified with respect to the land before it can be defined as contaminated. These are;

- a contaminant or potential pollutant (the source) - that is, a substance which is in, on or under the land and which has the potential to cause harm or to cause pollution of controlled waters.
- a receptor (the target) - that is, either a living organism, a group of organisms, an ecological system of specified conservation value or some piece of property which is likely to be harmed by the contaminant, or controlled waters which are being or are likely to be polluted by the contaminant.
- a pathway - that is, one or more routes by or through which the receptor is being, or could be, or affected by, that contaminant.

The identification of each of these three elements is linked to the identification of the others: an identified pathway should be capable of exposing a specified receptor to a specified contaminant, and that particular contaminant should be capable of causing significant harm or, in the case of controlled waters, polluting that receptor.

If the land is being used only for certain purposes, the number of pathways by which the critical group might be exposed will be limited, so that less extensive and costly remediation measures would be needed to reduce the risk to below a given level than would be the case for all types of actual or potential use. The land would then be *'suitable for use'*.

Selection of Contaminants

In the past, contaminated land investigations concentrated on those contaminants identified in Tables 3 & 4 of ICRCL 59/83[2]. Although this a general indication of whether a site is likely to be contaminated many hazardous contaminants, not identified in the tables, were overlooked. The Environment Agency has recently consolidated research into likely contaminants from a specific industry into a single document[3].

---

1 Department of the Environment, Transport and the Regions: Environmental Protection Act 1990: Part IIA, Contaminated Land.

2 Interdepartmental Committee on the Redevelopment of Contaminated Land: Guidance on the Assessment and Redevelopment of Contaminated Land. ICRCL 59/83, Second Edition, 1989.

3 Environment Agency/Department for Environment Food & Rural Affairs: Potential Contaminants for the Assessment of Land. R&D Publication CLR 8. March 2002.

© *Applied Environmental Research Centre Limited 2003*

A number of contaminants identified in ICRCL 59/83 do not commonly occur except in specialised industries. For example, both boron and selenium occur at a lower frequency of industrial sites than vanadium, which is not included in ICRCL 59/83. Based on this research, and also our experience built up over many years of investigating contaminated land, AERC has complied a suite of commonly occurring contaminants which shall be tested for on every site. The most commonly occurring determinands are identified in Table 1.

In a number of cases, contaminants not identified in the guidance have been included. This relates to the presence of organics and cyanide. Initially a screening process is carried out using Toluene Extractable Matter (TEM). If the value of TEM exceeds 500mg/kg then the sample is retested for Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH). In the case of cyanide, an initial screen is made for total cyanide. If the value exceed 25mg/kg, then the sample is retested for both free and complex cyanide.

Relevant Guidance – Solid Contamination

There are no mandatory standards in the United Kingdom for assessing the level of contamination on a particular site. However, the recently published CLEA model[4] gives Soil Guideline Values (SGV) for a limited number of heavy metals. CLEA quotes a number of SGVs dependant on the proposed end-use of a site. The SGVs have been set according to the end-use of the site with more stringent standards adopted for sensitive end-users, e.g. residential developments with private gardens.

The SGVs represent concentrations above which the material can be considered to be contaminated in respect to the proposed end-use. The currently available SGVs are presented in Table 2.

It should be noted that the SGVs have been derived as a *'worst case scenario'* taking into account ground conditions and the likely receptor.

The number of contaminants quoted in the CLEA model is substantially less than that in the withdrawn ICRCL 59/83[5] and no guidance has been published for most of the phytotoxic elements or for hydrocarbons.

Where possible, and where relevant data has been published by CLEA, generic RAVs are calculated based on the most vulnerable target i.e.; a child between the ages of 0 and 6 years.

In other cases, guidance is sought from other areas principally the Environment Agency. The Agency has published *'Guidance for the Disposal of Contaminated* Soils'[6]. Although, strictly speaking, this guidance should only be used for removal of materials from site, it gives a lower threshold concentration below which the materials can be put to any end-use including domestic gardens. This implies that soils with contaminant concentrations at levels less than the lower threshold concentration do not pose a risk to human health or plants.

All the UK guidance concentrates on metals in inorganic substances. For many of the organic compounds, reference is made to the Netherlands Test Tables. The Dutch guidance provides *'target'* and *'intervention'* levels. Target levels being those at which little or no pollution risk is present and intervention levels are those at which remediation is advisable.

---

4 DEFRA/Environment Agency: CLR10 - The Contaminated Land Assessment Model (CLEA): Technical Basis and Algorithms, 2002.

5 Interdepartmental Committee on the Redevelopment of Contaminated Land: Guidance on the Assessment and Redevelopment of Contaminated Land. ICRCL 59/83, Second Edition, 1989.

6 Environment Agency: Guidance for the Disposal of Contaminated Soils. Version 3, April 2001.

© *Applied Environmental Research Centre Limited 2003*

The *'Greater London Council Definitions of Contaminated Soils'*[7] gives suggested ranges of values on air-dried soils for a range of determinands and groups then into five classifications from *'uncontaminated'* to *'unusually heavily contaminated'*. These were primarily applied to gas works sites and should not used as a basis for risk assessment. However, they provide some guidance for background levels within urban areas e.g.; for vanadium.

Water soluble sulphate can attack the hardened cement causing an expansive reaction which may damage insitu concrete or concrete hardcore. Acidic water can also dissolve the calcareous binders or aggregates in concrete. The Building Research Establishment produces guidance[8] on the selection of concrete for building purposes.

AERC's risk assessment is three fold;

- Is there a risk to human health?
- Is there a risk to plant life?
- Is there a risk to controlled waters?

Additionally, risk assessments may be carried out for harm to plants and buildings.

Based on the guidance and information above, AERC has compiled its own Risk Assessment Values which are presented in Table 7.

In all cases, test results are compared against the relevant RAV. However, a statistical analysis is carried out to ensure confidence can be placed on the results and that they represent the nature of contamination with the ground on site. The approach is to calculate the 95% confidence limits of the measured mean and compare the upper 95th percentile with the relevant guidance. In order to ensure that the range of results is representative and that no single result is a hot-spot, the maximum value test is applied. Further details of the statistical tests carried out are given in the Environment Agency R&D Publication CLR7[9]. In the case of cadmium, where the RAV is pH dependant, a site specific pH is used based on the $US_{95\,(MIN)}$.

If the levels of contamination in the ground are greater than the relevant RAV, or surface/groundwater is a likely target then leaching tests will be required. If this is the case, the leaching quality values given in Table 7 should be used for guidance. The leachate quality values (LQV) are derived from the Environment Agency's Guidance on the Disposal of Soils and implies that soil with a LQV lower than that quoted does not present a significant risk to either surface or groundwater.

Relevant Guidance – Groundwater Contamination

Groundwater quality may be assessed using a number of published guidelines and standards including those set by the European Union, The Netherlands and the United Kingdom government.

'The European Community Groundwater Directive (80/68/EEC)' contains two levels of substances which can affect groundwater. List I substances should be prevented from being discharged into groundwater and List II substances could have a harmful effect on groundwater. Included in List I are chromium, mercury, mineral oils and organohalogen compounds. List II includes a wide range of elements including arsenic, boron, copper, lead, nickel, selenium and zinc.

---

7 Kelly, J. "Site Investigation and Material Problems." Proc. Conference on Reclamation of Contaminated Land, Eastbourne, 1979. Soc. Chem.Ind., London, 1980.

8 Building Research Establishment: BRE Special Digest 1: Concrete in Aggressive Ground, July 2001.

9 Environment Agency/DEFRA: Assessment of Risks to Human Health from Land Contamination: An overview of the development of soil guideline values and related research. R&D Publication CLR7, March 2002.

© *Applied Environmental Research Centre Limited* 2003

The standards of water for human consumption are given in the *'European Community Directive 80/778'* which sets guide levels (GL) and maximum admissible concentrations (MAC) for a number of determinands. These are given in Table 8.

The Netherlands Test Tables can be used for assessing groundwater and are applied in the same way as for soils. The guidance levels are given in Table 4.

Waste Management Paper 26A[10] presents criteria for assessing the pollution potential of landfill leachate based on a scenario where leachate from a site is likely to enter the groundwater. These values are given in Table 9.

Relevant Guidance – Gas Contamination

The presence of hazardous gases in the ground requires consideration for both human health and structures. Gas accumulation could cause a hazardous situation leading to asphyxiation and explosion in the case of carbon dioxide and methane (landfill gases) respectively or increase the risk for cancer in the case of radon.

Government guidance exists for both of these situations particularly with respect to landfill gas in the Waste Management Papers and for radon, work published by the Building Research Establishment.

Waste Management Paper 26A, paragraphs 4.10 and 4.11 consider the requirements for (landfill) gas conditions on a site. These paragraphs consider two possible criteria depending on monitoring. The first is that the maximum concentration of methane remains less than 1% by volume and the maximum concentration of carbon dioxide remains below 1.5% by volume. Readings should have been taken at least 4 times over a 24 month period with at least two sets of readings taken when the atmospheric pressure was falling and less than 1000mb.

The second criterion is the rate of gas emission where emissions are less than $0.015m^3/hr$ for methane and less than $0.022m^3/hr$ for carbon dioxide. Again, readings should have been taken at least 4 times over a 24 month period with at least two sets of readings taken when the atmospheric pressure was falling and less than 1000mb.

Specific advice is given in the Building Regulations (1991) Part C and also BRE212[11] where gas concentrations are in excess of the Waste Management Paper Guidelines for the construction of new dwellings. Site specific risk assessments can also be carried out in accordance with CIRIA 152[12]

With respect to radon, the guidelines given in BRE211[13] are followed. In these cases, the site geology is assessed for the potential for radon gas to be produced and the subsequent need for protection.

---

[10] Waste Management Paper 26A: Landfill Completion, Department of the Environment, HMSO, London, 1994.

[11] Building Research Establishment: BRE212 Construction of New Buildings on Gas-Contaminated Land.

[12] O'Riordan, N.J., and Milloy, C.J. "Risk Assessment for Methane and Other Gases from the Ground." CIRIA Report 152, 1995.

[13] Building Research Establishment: BRE211 Radon - guidance on protective measures for new dwellings. 1999.

© *Applied Environmental Research Centre Limited 2003*

TABLE 1: Commonly Occurring Contaminants Routinely Tested For

Metals	**Non-metals**	**Inorganics**	**Organics**	**Others**
Cadmium Chromium Copper Lead Mercury Nickel Vanadium Zinc	Arsenic	Total Cyanide Water Soluble Nitrate Water Soluble Sulphate Sulphide	Phenols TEM	Asbestos pH

TABLE 2: Currently Available SGVs in the CLEA Model

End-Use	**Arsenic**	**Cadmium**	**Chromium**	**Lead**	**Mercury**	**Nickel**	**Selenium**
	mg/kg	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Residential with plant uptake (i.e.; private gardens)	20	2	130	450	8	50	35
Residential with no plant uptake	20	30	200	450	15	75	260
Allotments	20	2	130	450	8	50	35
Commercial	500	1400	5000	750	480	5000	8000

© *Applied Environmental Research Centre Limited 2003*

TABLE 3: Guidance for Disposal of Contaminated Soils

Determinand	**Leachate Quality Threshold µg/l**	**Lower Threshold Concentration mg/kg**	**Upper Threshold Concentration mg/kg**
pH	5.5 – 9.5	6 - 8	5 – 9
Toluene Extract	-	5000	10000
Cyclohexane Extract	-	2000	5000
Conductivity	1000µs/cm	-	-
COD	30mg/l	-	-
Ammonia	500	-	-
Arsenic	10	10	50
Boron	2000	3	3
Cadmium	1	3	15
Chromium	50	600	1000
Copper	20	130	130
Lead	50	500	2000
Mercury	1	1	20
Nickel	50	70	70
Selenium	10	3	6
Zinc	500	300	300
Cyanide (complex)	-	250	250
Cyanide (free)	50	25	25
Sulphate	150mg/l	2000	2000
Sulphide	150mg/l	250	250
Sulphur (free)	150mg/l	5000	5000
Phenol	0.5	5	5
Iron	100	-	-
Chloride	200mg/l	-	-
Polycyclic Aromatic Hydrocarbons	0.2	50	1000

© *Applied Environmental Research Centre Limited 2003*

TABLE 4: Dutch Guidance

Substance	Soil		Groundwater	
	Target mg/kg	Intervention Mg/kg	Target µg/l	Intervention µg/l
METALS				
Arsenic	29	55	10	60
Barium	200	625	50	625
Cadmium	0.8	12	0.4	6
Chromium	100	380	1	30
Cobalt	20	240	20	100
Copper	36	190	15	75
Mercury	0.3	10	0.05	0.3
Lead	85	530	15	75
Molybdenum	10	200	5	300
Nickel	35	210	15	75
Zinc	140	720	65	800
INORGANIC COMPOUNDS				
Cyanide (free)	1	20	5	1500
Cyanide (complex pH <5)	5	650	10	1500
Cyanide (complex pH >5)	5	50	10	1500
Thiocyanate	-	20	-	1500
AROMATIC COMPOUNDS				
Benzene	0.05	1	0.2	30
Ethyl Benzene	0.05	50	0.2	150
Phenol	0.05	40	0.2	2000
Cresoles	-	5	-	200
Toluene	0.05	130	0.2	1000
Xylene	0.05	25	0.2	70
Catechol	-	20	-	1250
Resorcinol	-	10	-	600
Hydroquinone	-	10	-	800
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)				
PAH (sum of 10)	1	40	-	-
Naphthalene	-	-	0.1	70
Anthracene	-	-	0.02	5
Phenanthracene	-	-	0.02	5
Fluoroanthene	-	-	0.005	1
Benzo(a)anthracene	-	-	0.002	0.5
Chrysene	-	-	0.002	0.05
Benzo(a)pyrene	-	-	0.001	0.05
Benzo(ghi)perylcene	-	-	0.0002	0.05
Benzo(k)fluoranthene	-	-	0.001	0.05
Indeno(1,2,3-cd)pyrene	-	-	0.0004	0.05

© Applied Environmental Research Centre Limited 2003

TABLE 4: Dutch Guidance (continued)

Substance	Soil		Groundwater	
	Target mg/kg	Intervention Mg/kg	Target µg/l	Intervention µg/l
CHLORINATED HYDROCARBONS				
1,2-dichloroethane	-	4	0.01	400
Dichloromethane	-	20	0.01	1000
Tetrachloromethane	0.001	1	0.01	10
Tetrachloroethene	0.01	4	0.01	40
Trichloromethane	0.001	10	0.01	400
Trichloroethene	0.001	60	0.01	500
Vinylchloride	-	0.1	-	0.7
Chlorobenzenes (sum)	-	30	-	-
Monochlorobenzene	-	-	0.01	180
Dichlorobenzene	0.01	-	0.01	50
Trichlorobenzene	0.01	-	0.01	10
Tetrachlorobenzene	0.01	-	0.01	2.5
Pentachlorobenzene	0.0025	-	0.01	1
Hexachlorobenzene	0.0025	-	0.01	0.5
Chlorophenols	-	10	-	-
Monochlorophenols	0.0025	-	0.25	100
Dichlorophenols	0.003	-	0.08	30
Trichlorophenols	0.001	-	0.025	10
Tetrachlorophenols	0.001	-	0.01	10
Pentachlorophenol	0.002	5	0.02	3
Chloronaphthalene	-	10	-	6
Polychlorobiphenyls	0.02	1	0.01	0.01
CONTROL AGENTS				
DDT/DDE/DDD	0.0025	4	-	0.01
Drins	-	4	-	0.1
Aldrin	0.0025	-	-	-
Dieldrin	0.0005	-	0.00002	-
Endrin	0.001	-	-	-
HCH Compounds	-	2	-	1
α-HCH	0.0025	-	-	-
β-HCH	0.001	-	-	-
γ-HCH	0.00005	-	0.0002	-
Carbaryl	-	5	0.01	0.1
Carbofurane	-	2	0.01	0.1
Maneb	-	35	-	0.1
Atrazine	0.00005	6	0.0075	150

© *Applied Environmental Research Centre Limited 2003*

TABLE 4: Dutch Guidance (continued)

Substance	Soil		Groundwater	
	Target mg/kg	Intervention Mg/kg	Target µg/l	Intervention µg/l
OTHER CONTAMINANTS				
Cyclohexane	0.1	270	0.5	15000
Phthalates	0.1	60	0.5	5
Mineral Oil	50	5000	50	600
Pyridine	0.1	1	0.5	3
Styrene	0.1	100	0.5	300
Tetrahydrifurane	0.1	0.4	0.5	1
Tetrahydrothiophene	0.1	90	0.5	30

© *Applied Environmental Research Centre Limited 2003*

TABLE 5: Greater London Council (Kelly, 1979)

Determinand	Typical values for uncontaminated soils mg/kg	Typical values for soils with slight contamination mg/kg	Typical values for contaminated soils mg/kg	Typical values for heavily contaminated soils mg/kg	Typical values for unusually heavily contaminated soils mg/kg
pH (acid)	6-7	5-6	4-5	2-4	<2
pH (alkali)	7-8	8-9	9-10	10-12	>12
Antimony	<30	30-50	50-100	100-500	>500
Arsenic	<30	30-50	50-100	100-500	500
Cadmium	<1	1-3	3-10	10-50	50
Chromium	<100	100-200	200-500	500-2500	>2500
Copper (avail)	<100	100-200	200-500	500-2500	>2500
Lead	0-500	500-1000	1000-2000	2000-1%	>1%
Lead (avail)	0-200	200-500	500-1000	1000-5000	>5000
Mercury	<1	1-3	3-10	10-50	50
Nickel (avail)	<20	20-50	50-200	200-1000	>1000
Zinc (avail)	<250	250-500	500-1000	1000-5000	>5000
Zinc (equiv)	<250	250-500	500-2000	2000-1%	>1%
Boron (avail)	<2	2-5	5-50	50-250	>250
Selenium	<1	1-3	3-10	10-50	>50
Barium	<500	500-1000	1000-2000	2000-1%	>1%
Beryllium	<5	5-10	10-20	20-50	>50
Manganese	<500	500-1000	1000-2000	2000-1%	>1%
Vanadium	<100	100-200	200-500	500-2500	>2500
Magnesium	<500	500-1000	1000-2000	2000-1%	>1%
Sulphate	<2000	2000-5000	5000-1%	1%-5%	>5%
Sulphur (free)	<100	100-500	500-1000	1000-5000	>5000
Sulphide	<10	10-20	20-100	100-500	>500
Cyanide (free)	<1	1-5	5-50	50-100	>100
Cyanide (total)	<5	5-25	25-250	250-500	>500
Ferricyanide	<100	100-500	500-1000	1000-5000	>5000
Thiocyanate	<10	10-50	50-100	100-500	2500
Coal Tar	<500	500-1000	1000-2000	2000-1%	>1%
Phenol	<1	1-5	5-50	50-250	>250
TEM	<5000	5000-1%	1%-5%	5%-25%	>25%
CEM	<2000	2000-5000	5000-2%	2%-10%	>10%

© *Applied Environmental Research Centre Limited 2003*

TABLE 6: BRE Concrete in Aggressive Ground

Design Sulphate Class for Site	2:1 water/soil extract		Groundwater		Total Potential Sulphate	Natural Soil		Brownfield		ACEC Class
	SO_4 g/l	Mg g/l	SO_4 g/l	Mg g/l	SO_4 %	Static pH	Mobile pH	Static pH	Mobile pH	
DS-1	<1.2		<0.4		<0.24	All	>5.5 ≤5.5	All	>6.5 5.5-6.5 4.5-5.5 <4.5	AC-1s AC-1 AC-2z AC-3z AC-4Z
DS-2	1.2-2.3		0.4-1.4		0.24-0.6	>3.5 ≤3.5	>5.5 ≤5.5	>5.5 ≤5.5	>6.5 5.5-6.5 4.5-5.5 <4.5	AC-1s AC-2 AC-2s AC-3z AC-4z AC-5z
DS-3	2.4-3.7		1.5-3.0		0.7-1.2	>3.5 ≤3.5	>5.5 ≤5.5	>5.5 ≤5.5	>6.5 5.5-6.5 <5.5	AC-2s AC-3 AC-3s AC-4 AC-5
DS-4	3.8-6.7	≤1.2	3.1-6.0	≤1.0	1.3-2.4	>3.5 ≤3.5	>5.5 ≤5.5	>5.5 ≤5.5	>6.5 ≤6.5	AC-3s AC-4 AC-4s AC-5
DS-4m	3.8-6.7	>1.2	3.1-6.0	>1.0	1.3-2.4	>3.5 ≤3.5	>5.5 ≤5.5	>5.5 ≤5.5	>6.5 ≤6.5	AC-3s AC-4m AC-4ms AC-5m
DS-5	>6.7	≤1.2	>6.0	1.0	>2.4	>3.5 ≤3.5	All	>5.5 ≤5.5	All	AC-4s AC-5
DS-5m	>6.7	>1.2	>6.0	>1.0	>2.4	>3.5 ≤3.5	All	>5.5 ≤5.5	All	AC-4ms AC-5

© Applied Environmental Research Centre Limited 2003

TABLE 7: RAVs for Assessment of Contaminated Land (proposed by AERC)

Determinand	Proposed End-Use					Notes
	Residential with private gardens mg/kg	Residential without gardens mg/kg	Allotments mg/kg	Commercial mg/kg	Groundwater (leachate quality) µg/l	
Cadmium	2	30	2	1400	1	1,6,9,12
Chromium	130	200	130	5000	50	1,6,7,12
Copper	130	1000	130	1000	20	2,12
Lead	450			750	50	1,8,12
Mercury	8	15	8	480	1	1,6,12
Nickel	50	75	50	5000	50	1,6,12
Vanadium	150				60	3,14
Zinc	300	1000	300	1000	500	2,12
Arsenic	20			500	10	1,6,12
Total Cyanide	30				50	12,13
Water Soluble Nitrate	50mg/l					11
Sulphide	250				150mg/l	2,12
Water Soluble Sulphate	1.2g/l				150mg/l	5,12
Toluene Extractable Matter	500			5000	-	2
Phenol	5				0.5	2,12
Polycyclic Aromatic Hydrocarbons	50			1000	0.2	2,12
Total Petroleum Hydrocarbons	500			5000	10	4,11
pH	5-9					2
Asbestos	Visible Fibres			0.1%	-	10

Notes

1. Values derived from CLEA.
2. Values derived from Environment Agency.
3. Values derived from Kelly (1979) as representative of background levels.
4. Values derived from Dutch Standards.
5. Values derived from BRE SP1
6. Values based on sandy soils.
7. Assumes that all chromium is Cr(VI).
8. Values apply to geometric mean of samples across the site.
9. Dependent on soil pH, i.e.; pH6=1, pH7=2, pH8=8.
10. Soil containing >0.1% asbestos is classified as Special Waste
11. From EC Directive 80/778
12. Leachate quality values derived from Environment Agency.
13. AERC Risk Assessment value based on published toxicological data from CLEA
14. From UK Drinking Water Standard

© *Applied Environmental Research Centre Limited 2003*

TABLE 8: European Community Directive 80/778

Determinand		Guide Level	Maximum Admissible Concentration
Calcium	mg/l	100	-
Magnesium	mg/l	30	50
Sodium	mg/l	20	150
Potassium	mg/l	10	12
Chloride	mg/l	25	-
Sulphate	mg/l	25	250
Aluminium	mg/l	0.05	0.5
Nitrate	mg/l	25	50
Nitrite	mg/l	-	0.1
Ammonium	mg/l	0.05	0.5
Iron	mg/l	0.05	0.2
Manganese	mg/l	0.02	0.05
Copper	µg/l	3000	-
Zinc	µg/l	5000	-
Phosphate	µg/l	400	5000
Fluoride - 12°C	µg/l	8	1500
Fluoride - 35°C	µg/l	25	700
Barium	µg/l	100	-
Silver	µg/l	-	10
Arsenic	µg/l	-	50
Cadmium	µg/l	-	5
Cyanide	µg/l	-	50
Chromium	µg/l	-	50
Mercury	µg/l	-	1
Nickel	µg/l	-	50
Lead	µg/l	-	50
Antimony	µg/l	-	10
Selenium	µg/l	-	10
Pesticides (individual)	µg/l	-	0.1
Pesticides (total)	µg/l	-	0.5
PAH	µg/l	-	0.2
Temperature	µg/l	12	25
pH	°C	6.5-8.5	-
Conductivity at 20°C	unit	400	-
	µS/cm		

© *Applied Environmental Research Centre Limited 2003*

TABLE 9: Waste Management Paper 26A

Determinand	Units	Concentration
pH	-	6.5-8.5
Conductivity	µS/cm	4000
Chloride	mg/l	2000
Sulphate	mg/l	2500
Calcium	mg/l	1000
Magnesium	mg/l	500
Sodium	mg/l	1500
Potassium	mg/l	120
Aluminium	mg/l	2
Nitrate	mg/l	500
Nitrite	mg/l	1
Ammonia	mg/l	5
Total Organic Carbon	mg/l	10
Iron	mg/l	2
Manganese	mg/l	0.5
Copper	mg/l	1
Zinc	mg/l	1
Phosphorous	mg/l	10
Fluoride	mg/l	10
Barium	mg/l	1
Silver	mg/l	0.1
Arsenic	mg/l	0.5
Cadmium	mg/l	0.05
Cyanides	mg/l	0.05
Chromium	mg/l	0.05
Mercury	mg/l	0.01
Nickel	mg/l	0.5
Lead	mg/l	0.5
Antimony	mg/l	0.1
Selenium	mg/l	0.1
Mineral Oils	mg/l	0.1
Phenols	mg/l	0.005
Organochlorine Compounds (other than pesticides)	mg/l	0.01
Pesticides		
- individually	mg/l	0.001
- total	mg/l	0.005
PAH	mg/l	0.002

NOTES:

1. Leachate will enter groundwater.
2. Local water quality objectives are set for potable supply.
3. A minimum dilution factor of 10 is expected.
4. There is no significant saturated zone attenuation.

© Applied Environmental Research Centre Limited 2003

APPENDIX G
Risk Assessment Spreadsheet
Arsenic

Notes to accompany risk assessment for arsenic

Objective

To model the attenuation of arsenic in soils of hydraulic conductivity 1 x 10^{-6}m/s, as above for assessing risk to surface water.

Input parameters

For the purpose of the model it has been assumed that the target value at the receptor (the surface water course) is 25μgl^{-1}, equivalent to the EQS for arsenic in freshwater.

The model has assumed an initial concentration at the source of 1mgl^{-1} arsenic (which is higher than the maximum leachable value detected in any of the tested samples).

It has been assumed that the hydraulic conductivity of the soil between the sources and the target is 1 x 10^{-6}m/s. A time span of 1000 years has been assumed and the dispersion calculated using the Ogata Banks model.

Model Output

The attached spreadsheet details the input parameters and indicates that the concentration of arsenic would be reduced to the EQS (25μgl^{-1}) at a distance of approximately 4.3m from the source.

The model also derives a concentration at the source which would result in a concentration of 25μgl^{-1} at 5m distance form the source after 1000 years. This value, indicated as the Remedial Target, would be 15.5mgl^{-1}.

Conclusion

Emplacement of clean soil with a hydraulic conductivity of 1 x 10^{-6}m/s (or less) between the source and the surface water receptors on site at Belvedere would protect the water course from migration of arsenic from Made Ground.

Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources

Tier 3 - Groundwater

ENVIRONMENT AGENCY

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Arsenic		
Target Concentration	C_T	2.50E-02	mg/l	

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks — Equations in R&D Pub. 20

Enter '1' to simulate vertical dispersion in one direction, '2' for two directions (pull down menu): 1

Enter '1' if biodegradation rate is for the substance in water, '0' if rate is for decay in field conditions (i.e. field data from aquifer) (pull down menu): 1

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.00E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	9.00E+99	days	
Calculated decay rate	λ	7.70E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.50E+01	m	
Plume thickness at source	Sy	1.50E+00	m	
Saturated aquifer thickness	da	2.00E+00	m	
Bulk density of aquifer materials	ρ	1.80E+00	g/cm^3	
Effective porosity of aquifer	n	3.00E-01	fraction	
Hydraulic gradient	i	5.00E-03	fraction	*conductivity (m/s) sandy loam*
Hydraulic conductivity of aquifer	K	8.64E-02	m/d	*1.00E-06*
Distance to compliance point	x	5.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*Time years*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*1000*
Time since pollutant entered groundwater	t	3.65E+05	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.00E+01	l/kg	*see options*
Longitudinal dispersivity	ax	0.350	m	*see options*
Transverse dispersivity	az	0.035	m	*see options*
Vertical dispersivity	ay	0.003	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.44E-03	m/d
Retardation factor	Rf	3.01E+02	fraction
Decay rate used	λ	2.56E-103	d^{-1}
Rate of contaminant flow due to retardation	u	4.78E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.62E-03	mg/l
Contaminant concentration at distance x, assuming two-way vertical dispersion	C_{ED}		mg/l
Attenuation factor (one way vertical dispersion, C_0/C_{ED})	AF	6.19E+02	
Attenuation factor (two way vertical dispersion, C_0/C_{ED})	AF		

Remedial Targets

Remedial Target	**LTC3**	**1.62E+01**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**5**	**m**	
Concentration of contaminant at compliance point	**$C_{ED}/C0$**	**1.62E-03**	**mg/l**	Ogata Banks
after		**3.7E+05**	**days**	

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

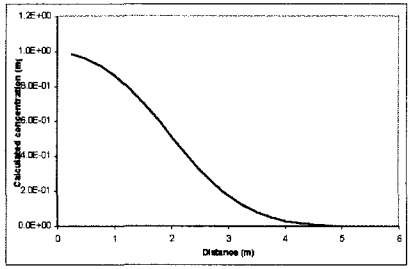
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	5.00E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Soil water partition coefficient	Kd	5.00E+01	l/kg

Dispersivity

Calculate dependent on distance to compliance point (0), specify dispersivity (1), or calc after Xu & Eckstein (2) ? **2**

		Enter value	Calc value: Xu & Eckstein	
Longitudinal dispersivity	ax		3.50E-01	m
Transverse dispersivity	az		3.50E-02	m
Vertical dispersivity	ay		3.50E-03	m

For calculated value, assumes ax = 0.1 *x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



Note graph assumes plume dispersee vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Tier3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Tier 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0.3	9.8E-01
0.5	9.6E-01
0.8	9.2E-01
1.0	8.6E-01
1.3	7.9E-01
1.5	7.1E-01
1.8	6.1E-01
2.0	5.2E-01
2.3	4.2E-01
2.5	3.3E-01
2.8	2.4E-01
3.0	1.7E-01
3.3	1.2E-01
3.5	7.9E-02
3.8	5.0E-02
4.0	3.0E-02
4.3	1.7E-02
4.5	9.4E-03
4.8	3.3E-03
5.0	1.6E-03