

**Table B6 - 1 Background-related DQO Statistics for RCRA Canyon Soils (0 - 5 feet)**

Metal	Background Data Set			Site Characterization Statistics				Pooled Statistics /1		Estimation Uncertainty Based on Two-sample t-test Ho: Study Area Within Background				Toxicity-Related Decision Uncertainty /3					DQO assessment considering both Estimation Uncertainty and Decision Uncertainty /6			
	N used for test	Background Mean	Background Stdev	N	Study Area Mean	Study Area Stdev	Point Difference (study area mean - background mean)	N <sub>pooled</sub>	S <sup>2</sup> <sub>pooled</sub>	beta	alpha	MDD /2	Study Area Within Background?	Estimation Uncertainty (likelihood of beta-type error > 0.1)	20% Background Mean	SL /4 Lowest Toxicological Screening Level	Stated MDDgoal	MDD/MDDgoal	Stated Decision Uncertainty (low if MDD/MDDgoal < 1)	Actual Decision Uncertainty /5	Background Related DQO Met?	Comment
Barium	41	70.40	33.51	82	3104.67	3102	3034.28	54.7	2540.26	0.1	0.2	20.69	reject at alpha < 0.2	adequate (low)	14.08	330	330.00	0.063	adequate (low)	adequate (low)	Yes	DQO well met.
Beryllium	17	0.56	0.13	82	0.5057	0.507	-0.05	28.2	0.22	0.1	0.2	0.27	accept	high	0.11	10	10.00	0.027	adequate (low)	adequate (low)	Yes	DQO adequately met. Conclusion of within background is uncertain, however study area mean is well below SL.
Cadmium	42	1.18	0.60	82	2.57	2.687	1.38	55.5	4.49	0.1	0.2	0.86	reject at alpha < 0.2	adequate (low)	0.24	0.36	0.36	2.396	high *	adequate (low)	Yes	DQO well met because adequate power to reject background condition and study area mean is well in excess of SL.
Chromium	42	36.89	12.79	82	51.66	53.59	14.77	55.5	1826.76	0.1	0.2	17.40	accept	high	7.38	0.4	7.38	2.359	high	high	No	DQO not met. Conclusion of "within background" has estimation uncertainty higher than beta=0.1 and conclusion potentially drives COPC selection.
Cobalt	42	6.92	5.89	82	10.59	10.55	3.67	55.5	86.11	0.1	0.2	3.78	accept	high	1.38	13	13.00	0.291	adequate (low)	adequate (low)	Yes	DQO well met.
Copper	35	9.47	3.85	82	26.73	27.99	17.26	49.1	507.63	0.1	0.2	9.77	reject at alpha < 0.2	adequate (low)	1.89	28	28.00	0.349	adequate (low)	adequate (low)	Yes	DQO well met.
Lead	35	6.14	1.65	82	34.81	36.95	28.67	49.1	854.09	0.1	0.2	12.68	reject at alpha < 0.2	adequate (low)	1.23	11	11.00	1.153	high *	adequate (low)	Yes	DQO well met.
Mercury	17	0.02	0.01	72	0.0669	0.0666	0.05	27.5	0.00	0.1	0.2	0.04	reject at alpha < 0.2	adequate (low)	0.0031	0.1	0.10	0.355	adequate (low)	adequate (low)	Yes	DQO adequately met. Rejection of "within background" is uncertain due to non-detects, however study area mean is well below SL.
Molybdenum	41	4.43	1.63	82	3.47	3.528	-0.96	54.7	8.93	0.1	0.2	1.23	accept	high	0.89	2	2.00	0.613	adequate (low)	moderate	yes	Stated DQO is met however overall DQO is not met. Conclusion of "within background" has estimation uncertainty higher than beta=0.1 and conclusion potentially drives COPC selection.
Nickel	42	28.10	8.14	82	42.06	42.59	13.96	55.5	1196.83	0.1	0.2	14.09	accept	high	5.62	30	30.00	0.470	adequate (low)	adequate (low)	Yes	DQO well met.
Selenium	42	1.11	0.68	82	1.53	1.533	0.42	55.5	1.70	0.1	0.2	0.53	accept	high	0.22	1	1.00	0.531	adequate (low *)	high	No	Stated DQO is met however overall DQO is not met. Conclusion of "within background" has estimation uncertainty higher than beta=0.1 and conclusion potentially drives COPC selection.
Thallium	17	0.32	0.12	82	0.3566	0.357	0.03	28.2	0.11	0.1	0.2	0.19	accept	high	0.06	1	1.00	0.191	adequate (low)	adequate (low)	Yes	DQO adequately met. Conclusion of within background is uncertain, however study area mean is well below SL.
Tin	10	37.30	3.02	82	50.00	50.49	12.70	17.8	2250.91	0.1	0.2	34.98	accept	high	7.46	50	50.00	0.700	adequate (low)	moderate-high	Yes	DQO not met. Conclusion of "within background" has estimation uncertainty higher than beta=0.1 and conclusion potentially drives COPC selection.
Vanadium	42	37.13	15.05	82	27.91	27.99	-9.22	55.5	593.44	0.1	0.2	9.92	accept	high	7.43	2	7.43	1.336	high *	adequate (low)	Yes	DQO well met.
Zinc	42	50.63	23.06	82	104.54	107.7	53.91	55.5	7434.13	0.1	0.2	35.11	reject at alpha < 0.2	adequate (low)	10.13	50	50.00	0.702	adequate (low)	adequate (low)	Yes	DQO well met.

**/1 Pooled Statistics**

Sample Size:  $N_{pooled} = (2 \cdot N1 \cdot N2) / (N1 + N2)$   
 Degrees of Freedom:  $D1 = N1 - 1$ ;  $D2 = N2 - 1$ ;  $D_{pooled} = N_{pooled} - 1$   
 Pooled standard deviation:  $S^2_{pooled} = (S1^2 \cdot D1 + S2^2 \cdot D2) / (D_{pooled})$

**Sources of uncertainty are bolded**

/3 Stated DQO goal is **not met** if  $MDD/MDDgoal > 1$   
 \* Stated MDLgoal from work plan included estimation uncertainty and an approximate measure of decision uncertainty. However, occasionally actual decision uncertainty was not accurately represented in the Stated MDDgoal.  
 /4 SL = the lowest toxicological screening level is used without consideration of the background UTL to avoid circularity in assessing the background-related DQO.

**/2 t-test statistics**

H0: study area is within background  
 HA: study area exceeds background  
 point difference = study area mean - background mean  
 Reject H0 if  $MDD < \text{point difference}$

/5 Actual Decision Uncertainty is high when study area mean is close to the SL.

**/6 Background-related DQO is not met if both estimation uncertainty and actual decision uncertainty are high:** Estimation uncertainty **high** Decision Uncertainty **high**

Minimum detectable difference (MDD) at stated alpha and beta:  $MDD = \text{SQRT}(2S2_{pooled}/N_{pooled}) \cdot (t_{alpha, D_{pooled}} + t_{beta, D_{pooled}})$   
 (Zar 1984), minimum detectable difference for t-test with unequal sample sizes  
 If  $MDD < \text{absolute value of (point difference)}$ , then power was inadequate to detect a difference from background.