



December 8, 2011

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195 North 1950 West  
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**Subject: Risk-based Health Screening Levels in Support of Sampling Activities at Red Butte Creek, Salt Lake City, Utah**

Dear Chris,

As requested, McDaniel Lambert Inc. has prepared screening levels that are protective of human health to aid the interpretation of data collected from Red Butte Creek. This document is intended to provide default screening levels to determine whether levels of contamination found in Red Butte Creek may warrant further investigation or cleanup, or whether no action may be required. It should be emphasized that screening levels are not cleanup standards. McDaniel Lambert Inc. is preparing a site-specific human health risk assessment (HHRA) for the Red Butte Creek, which can also be referenced in the future to make risk-based conclusions for data collected from Red Butte Creek.

## **1.0 Screening Levels**

Based on the Liberty Park Lake human health risk assessment (McDaniel Lambert 2011) and previous Red Butte Creek sampling events, polycyclic aromatic hydrocarbons (PAHs) are the primary chemicals of potential concern. Screening levels have been compiled for PAHs and other chemicals detected in preliminary data reported for the August 2011 sampling event. The following sources, in descending order of preference, were used to select the screening levels that are provided in the attached Table 1:

1. USEPA Regional Screening Levels (RSLs) – Residential Soil, (USEPA 2011)
2. California Human Health Screening Levels (CHHSLs) – Residential Land Use, (CalEPA 2005)
3. California Environmental Screening Levels (ESLs) – Shallow Soil Screening Levels Residential Land Use, (Table B-1, RWQCB 2008)

These screening levels are based on default exposure assumptions for residential users, which represent reasonable maximum exposure conditions for long-term exposures and are based on the methods outlined in USEPA's Risk Assessment Guidance for Superfund, Part B (USEPA 1991) and the Soil Screening Guidance (USEPA 2002). Selection of a residential exposure scenario is considered to be very conservative for this application, because this assumes that residents living nearby Red Butte Creek are exposed to soil along the creek every day for 30

years. The residential screening levels that correspond to a target risk of one-in-one million (or  $1 \times 10^{-6}$ ) serve as the basis for the three tiers of screening values: (1) no action levels, and (2) further action levels, and (3) expedited action levels.

#### No Action Level

The no action level is equal to the default residential screening level that corresponds to a  $1 \times 10^{-6}$  cancer risk or 1.0 noncancer hazard. If a chemical concentration is below this level, no additional action is warranted.

#### Further Action Level

The further action level corresponds to the USEPA risk management range for cancer risk of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$ , and to noncancer hazards ranging from 1.0 to 100. Concentrations detected in this range will be evaluated as non-time critical. Concentrations in this range are representative of levels assessed in the HHRA. For chemicals of primary concern detected at similar concentrations evaluated in the HHRA, the HHRA conclusions will apply.

#### Expedited Action Level

The expedited action level corresponds to contaminant concentrations that exceed the upper bound of the USEPA risk management range of  $1 \times 10^{-4}$ , and a noncancer hazard of 100. The noncancer hazard of 100 is appropriate considering that toxicity criteria for petroleum-related contaminants with noncarcinogenic endpoints incorporate uncertainty factors greater than 100; specifically, uncertainty factors range from 1000 to 3000. If chemicals are detected above the expedited action level, results shall be reported immediately to representatives of Salt Lake City, Salt Lake Valley Health Department, Utah Division of Water Quality and Chevron Pipeline; and further investigation and/or remediation may be warranted.

### *1.1 Surrogate Chemicals for Screening Levels*

If residential soil screening levels were not available from the identified sources, screening levels for surrogate chemicals were selected based on structure-activity relationships. The following surrogates were used to select appropriate screening levels: m-xylene as a surrogate for m&p-xylene; naphthalene as a surrogate for indene, and 1,1,2,2-tetrachloroethane as a surrogate for tetrachloroethane. Screening levels are not provided for 4-isopropyltoluene or di-n-octylphthalate, because suitable surrogate chemicals were not identified for these compounds.

### *1.2 Total Petroleum Hydrocarbon Screening Level*

Conservative screening levels were calculated for petroleum hydrocarbon analytes based on standard methodology and toxicity values provided in Utah's Corrective Action Process for Leaking Underground Storage Tank Sites (Utah DEQ 2005). The total petroleum hydrocarbon (TPH) no action level is equivalent to the conservative screening level previously calculated during the Liberty Lake remediation effort (Appendix B, CPL 2010). The screening level was calculated using the most conservative toxicity criteria and assuming that TPH detected is comprised wholly of the most toxic TPH fraction.

To ensure the health-protectiveness of this value, it is calculated based on potential exposure of a resident child, the most conservative receptor. TPH was evaluated as a noncarcinogenic mixture;

potentially carcinogenic compounds in TPH are addressed via chemical-specific comparisons. The noncancer-based screening level was calculated using a target hazard quotient of 1.0, which is the point of departure for the USEPA. The following equation, which combines the target level with intake factors, toxicity information, and TPH fraction information, was used to calculate the TPH screening level in soil:

*TPH soil concentration =*

$$T_g HI / ((\%_{ar} * [(IF_o/RfD_o) + (IF_d/RfD_o) + (IF_i/RfDi)]) + (\%_{al} * [(IF_o/RfD_o) + (IF_d/RfD_o) + (IF_i/RfDi)]))$$

where:

$T_g$  HI = target hazard index (1.0)

$\%_{ar}$  = aromatic contribution (as a ratio)

$\%_{al}$  = aliphatic contribution (as a ratio)

$IF_o$  = oral intake factor (child resident, 1.28E-05 mg/kg-day)

$IF_d$  = dermal intake factor (child resident, 3.58E-06 mg/kg-day)

$IF_i$  = inhalation intake factor (child resident, 6.39E-01 m<sup>3</sup>/kg-day\*1/particulate emission factor, or 4.86E-10)

$RfD_o$  = fraction-specific oral reference dose

$RfD_i$  = fraction-specific inhalation reference dose

The child resident intake factors for the oral, dermal, and inhalation routes of exposure are based on standard risk assessment guidance (USEPA 1991, 1997). Typically, the relative site-specific concentrations of each carbon fraction are used to derive a weighted total TPH soil concentration. However, for purposes of this conservative screening level, the calculation assumes that the residual TPH is comprised wholly of the more toxic aromatic fraction. As shown in Table 2, the lowest oral and inhalation reference doses correspond to the aromatic fraction, and are 0.03 mg/kg-day and 0.2 mg/m<sup>3</sup>, respectively. Substituting the appropriate values into the equation above yields a residential screening level of 1,833 mg TPH/kg soil. Therefore, soil or sediment concentrations below the residential screening level of 1,800 mg TPH/kg do not warrant further investigation.

**Table 2. TPH Fraction Reference Doses**

Equivalent Carbon Number	Oral RfD (mg/kg-day)	Inhalation RfC (mg/m <sup>3</sup> )
<b>Aliphatic Fractions</b>		
>5-6 and >7-8	0.06	0.2
>9-10, >11-12, and >13-16	0.1	1.0
>17-21 and >22-35	2.0	Not Available
<b>Minimum Value</b>	<b>0.06</b>	<b>0.2</b>
<b>Aromatic Fractions</b>		
>9-10 and >11-13	0.04	0.2
>12-22	0.03	Not Available
<b>Minimum Value</b>	<b>0.03</b>	<b>0.2</b>

(Utah DEQ 2005)

## 2.0 Use of Screening Levels

Table 1 summarizes the two tiers of screening levels for PAHs and other chemicals detected in soil and sediment during the August 2011 Red Butte Creek sampling event. These screening levels are intended to serve as a risk-based tool for data interpretation.

1. No Further Action Level: Reflects a generic residential screening level based on conservative exposure and toxicity values, equal to a target risk of  $1 \times 10^{-6}$  or noncancer hazard of 1.0. Concentrations detected below this level do not warrant further action.
2. Further Action Level: The further action level corresponds to the USEPA risk management range for cancer risk of  $1 \times 10^{-6}$  to  $1 \times 10^{-4}$ , and to noncancer hazards of 1.0 to 100. Concentrations in this range are representative of levels assessed in the HHRA. For chemicals of primary concern detected at similar concentrations evaluated in the HHRA, the HHRA conclusions will apply.
3. Expedited Action Level: The expedited action level corresponds to contaminant concentrations that exceed the upper bound of the USEPA risk management range of  $1 \times 10^{-4}$ , and a noncancer hazard of 100. If chemicals are detected above the expedited action level, results shall be reported immediately to representatives of Salt Lake City, Salt Lake Valley Health Department, Utah Division of Water Quality and Chevron Pipeline; and further investigation and/or remediation may be warranted.

Lastly, these screening levels do not serve as cleanup values, since many factors (i.e. cost, feasibility) will be taken into consideration during the risk management process.

Sincerely,



Katherine Butler

Enclosure:

Table 1 – Soil Screening Levels for Red Butte Creek

Table 2 – TPH Fraction Reference Doses

## References

McDaniel Lambert, 2011. Human Health Risk Assessment, Post-Remediation Sediment Evaluation. Liberty Park Lake, Salt Lake City, Utah. May.

U.S. Environmental Protection Agency (USEPA). 2011. Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites. June.

California Environmental Protection Agency (Cal/EPA). 2005. Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties. January.

California Regional Water Quality Control Board (RWQCB). 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. May.

Chevron Pipe Line (CPL). 2010. Final Work Plan for Collection of Confirmation Analytical Samples Beneath the Former Curb Wall and Lake Bottom, Milepost 174.5 Red Butte Crude Oil Release. November 17.

Utah Department of Environmental Quality. 2005. Guidelines for Utah's Corrective Action Process for Leaking Underground Storage Tank Sites. October.

U.S. Environmental Protection Agency (USEPA). 1991. Risk Assessment Guidance for Superfund (RAGS), Vol. I, Human Health Evaluation Manual, Part C, Risk Evaluation of Remedial Alternatives, Interim Final. Office of Emergency and Remedial Response. EPA 9285, 7-01C.

U.S. Environmental Protection Agency (USEPA). 1997. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/C-99/001. Updated September 2011.

U.S. Environmental Protection Agency (USEPA). 2002. Supplemental Guidance for Developing Soil Screening Levels at Superfund Sites. December. OSWER 9355.4-24.

Table 1. Soil/Sediment Screening Levels - Red Butte Creek, Salt Lake City, UT

Chemical	No Action Level (mg/kg)	Further Action Level (mg/kg)	Expedited Action Level (mg/kg)	Source
Target Hazard/Risk	<10 <sup>-6</sup> /1.0	10 <sup>-6</sup> /1.0 to 10 <sup>-4</sup> /100	>10 <sup>-4</sup> /100	-
<b>TPH</b>				
TPH (C11-C60)	1800	1800 - 180000	180000	Utah DEQ 2005**
DRO	1800	1800 - 180000	180000	Utah DEQ 2005**
ORO	1800	1800 - 180000	180000	Utah DEQ 2005**
<b>PAHs</b>				
1-Methylnaphthalene	22	22 - 2200	2200	USEPA RSL (c)
2-Methylnaphthlene	310	310 - 31000	31000	USEPA RSL (nc)
Acenaphthene	3400	3400 - 340000	340000	USEPA RSL (nc)
Acenaphthylene	1720	1720 - 172000	172000	CA ESL (nc)
Anthracene	17000	17000 - 1700000	1700000	USEPA RSL (nc)
Benzo(a)anthracene	0.15	0.15 - 15	15	USEPA RSL (c)
Benzo(a)pyrene	0.015	0.015 - 1.5	1.5	USEPA RSL (c)
Benzo(b)fluoranthene	0.15	0.15 - 15	15	USEPA RSL (c)
Benzo(g,h,i)perylene	1720	1720 - 172000	172000	CA ESL (nc)
Benzo(k)fluoranthene	1.5	1.5 - 150	150	USEPA RSL (c)
Chrysene	15	15 - 1500	1500	USEPA RSL (c)
Dibenz(a,h)anthracene	0.015	0.015 - 1.5	1.5	USEPA RSL (c)
Fluoranthene	2300	2300 - 230000	230000	USEPA RSL (nc)
Fluorene	2300	2300 - 230000	230000	USEPA RSL (nc)
Indene	3.6	3.6 - 360	360	USEPA RSL (c)
Ideno(1,2,3-cd)pyrene	0.15	0.15 - 15	15	USEPA RSL (c)
Naphthalene	3.6	3.6 - 360	360	USEPA RSL (c)
Phenanthrene	1720	1720 - 172000	172000	CA ESL (nc)
Pyrene	1700	1700 - 170000	170000	USEPA RSL (nc)
<b>VOCs</b>				
Acetone*	61000	61000 - 6100000	6100000	USEPA RSL (nc)
Benzene	1.1	1.1 - 110	110	USEPA RSL (c)
Chloroform*	0.29	0.29 - 29	29	USEPA RSL (c)
Methylene chloride*	11	11 - 1100	1100	USEPA RSL (c)
Toluene	5000	5000 - 500000	500000	USEPA RSL (nc)
<i>m,p-Xylene</i>	590	590 - 59000	59000	USEPA RSL (nc)
<i>o-Xylene</i>	690	690 - 69000	69000	USEPA RSL (nc)
Xylenes (total)	630	630 - 63000	63000	USEPA RSL (nc)
<i>Tetrachloroethane*</i>	0.56	0.56 - 56	56	USEPA RSL (nc)
<b>SVOCs</b>				
Benzoic acid*	240000	240000 - 24000000	24000000	USEPA RSL (nc)
bis(2-Ethylhexyl)phthalate*	0.35	0.35 - 35	35	USEPA RSL (c)
bis(2-Ethylhexyl)adipate*	410	410 - 41000	41000	USEPA RSL (c)
Di-n-octylphthalate	NC	-	-	-
4-Isopropyltoluene	NC	-	-	-
Phenol	18000	180000	1800000	USEPA RSL (nc)

\*Screening levels are provided for all chemicals detected in August 2011 sampling event, including these non-petroleum related contaminants.

\*\*TPH Screening Level was developed assuming 100% aromatic and most conservative toxicity criteria using standard USEPA risk assessment methodology (USEPA 1991) and Utah DEQ toxicity criteria for TPH carbon ranges (Utah DEQ 2005).

*Italics indicate surrogate was used for screening level (See Section 1.1 for surrogate list)*

USEPA RSL = USEPA Regional Screening Level, Residential Summary Table (2011)

CA ESL = California Environmental Screening Level, Residential Land Use (2008)

c = carcinogenic endpoint

nc = noncarcinogenic endpoint

Red Butte Creek, Utah Human Health Screening Levels

Chemical	No Action Level (mg/kg)	Further Action Level (mg/kg)	Expedited Action Level (mg/kg)	Source
Target Hazard/Risk	<10 <sup>-6</sup> /1.0	10 <sup>-6</sup> /1.0 to 10 <sup>-4</sup> /100	>10 <sup>-4</sup> /100	-
<b>TPH</b>				
TPH (C11-C60)	1800	1800 - 180000	180000	Utah DEQ 2005*
DRO	1800	1800 - 180000	180000	Utah DEQ 2005*
ORO	1800	1800 - 180000	180000	Utah DEQ 2005*
<b>PAHs</b>				
<i>BaP TEQ</i>	<i>0.015</i>	<i>1.5</i>	<i>1.5</i>	<i>USEPA RSL</i>
1-Methylnaphthalene	22	22 - 2200	2200	USEPA RSL (c)
2-Methylnaphthlene	310	310 - 31000	31000	USEPA RSL (nc)
Acenaphthene	3400	3400 - 340000	340000	USEPA RSL (nc)
Acenaphthylene	1720	1720 - 172000	172000	CA ESL (nc)
Anthracene	17000	17000 - 1700000	1700000	USEPA RSL (nc)
Benzo(a)anthracene	0.15	0.15 - 15	15	USEPA RSL (c)
Benzo(a)pyrene	0.015	0.015 - 1.5	1.5	USEPA RSL (c)
Benzo(b)fluoranthene	0.15	0.15 - 15	15	USEPA RSL (c)
Benzo(g,h,i)perylene	1720	1720 - 172000	172000	CA ESL (nc)
Benzo(k)fluoranthene	1.5	1.5 - 150	150	USEPA RSL (c)
Chrysene	15	15 - 1500	1500	USEPA RSL (c)
Dibenz(a,h)anthracene	0.015	0.015 - 1.5	1.5	USEPA RSL (c)
Fluoranthene	2300	2300 - 230000	230000	USEPA RSL (nc)
Fluorene	2300	2300 - 230000	230000	USEPA RSL (nc)
<i>Indene</i>	<i>3.6</i>	<i>3.6 - 360</i>	<i>360</i>	<i>USEPA RSL (c)</i>
Ideno(1,2,3-cd)pyrene	0.15	0.15 - 15	15	USEPA RSL (c)
Naphthalene	3.6	3.6 - 360	360	USEPA RSL (c)
Phenanthrene	1720	1720 - 172000	172000	CA ESL (nc)
Pyrene	1700	1700 - 170000	170000	USEPA RSL (nc)
<b>VOCs</b>				
Acetone*	61000	61000 - 6100000	6100000	USEPA RSL (nc)
Benzene	1.1	1.1 - 110	110	USEPA RSL (c)
Chloroform*	0.29	0.29 - 29	29	USEPA RSL (c)

Red Butte Creek, Utah Human Health Screening Levels

Methylene chloride*	11	11 - 1100	1100	USEPA RSL (c)
Toluene	5000	5000 - 500000	500000	USEPA RSL (nc)
<i>m,p-Xylene</i>	<i>590</i>	<i>590 - 59000</i>	<i>59000</i>	<i>USEPA RSL (nc)</i>
<i>o-Xylene</i>	<i>690</i>	<i>690 - 69000</i>	<i>69000</i>	<i>USEPA RSL (nc)</i>
Xylenes (total)	630	630 - 63000	63000	USEPA RSL (nc)
<i>Tetrachloroethane</i> *	<i>0.56</i>	<i>0.56 - 56</i>	<i>56</i>	<i>USEPA RSL (nc)</i>
<b>SVOCs</b>				
Benzoic acid*	240000	240000 - 24000000	24000000	USEPA RSL (nc)
bis(2-Ethylhexyl)phthalate*	0.35	0.35 - 35	35	USEPA RSL (c)
bis(2-Ethylhexyl)adipate*	410	410 - 41000	41000	USEPA RSL (c)
Di-n-octylphthalate	NC	-	-	-
4-Isopropyltoluene	NC	-	-	-
Phenol*	18000	1800000	1800000	USEPA RSL (nc)

\*TPH Screening Level was developed assuming 100% aromatic and most conservative toxicity criteria using standard USEPA risk assessment methodology (USEPA 199 TPH carbon ranges (Utah DEQ 2005).

*Italics indicate surrogate was used for screening level (See Section 1.1 for surrogate list)*

USEPA RSL = USEPA Regional Screening Level, Residential Summary Table (2011)

CA ESL = California Environmental Screening Level, Residential Land Use (2008)

c= carcinogenic endpoint

nc = noncarcinogenic endpoint