MEMORANDUM

September 30, 1996
Richmond, California

Amended Risk Evaluation
Former Gulf Service Station #G-0006
460 Grand Avenue, Oakland, CA

Mr. Phil Briggs:
San Ramon, California

Based on telephone discussions with Ms. Jennifer Eberle of Alameda County Health Care Services (ACHCS), the following amended RBCA Tier 2 Risk Evaluation for the inhalation of vapor in an enclosed -space from hydrocarbon impacted soil and groundwater is being re-submitted to the ACHCS to address concerns regarding soil sample selection and to also present the corrected solutions to the RBCA vapor volatilization equations (VFwesp and VFsesp attached). This amended report is a follow-up to the originally submitted May 20, 1996 Risk Evaluation for this site. Recommendations put forth in this report are based on the results of this amended risk evaluation.

Based on our discussions, it was decided that the modeled Conservative scenario for groundwater and soil vapor volatilization is represented by the maximum site benzene concentration in water (63 ppb in well C-2 on 12/16/92) and by the average of the six benzene impacted soil samples (avg. = 0.412 mg/Kg) in the 0-5.5' interval in the excavation sidewalls at the site. The modeled Plausible scenario is represented by the 12/12/95 benzene concentration in well C-2 of 0.93 ppb and the average benzene concentration of the 14 soil samples taken in the 0-5.5' interval at the site excavation (avg. = 0.178 mg/Kg - note that ND's were represented by 1/2 MDL of 0.005 mg/Kg or 0.0025 mg/Kg).

ASTM RBCA vapor Volatilization Factor equations for subsurface soil to enclosed-space (VFsesp) and groundwater to enclosed-space (VFwesp) were incorrectly solved for the site as presented in the May 20, 1996 Risk Evaluation, as communicated to Jennifer Eberle, ACHCS by telephone in June and September. The attached equations are correctly solved and reflect current site conditions and estimated risk values due to these modeled exposure pathways.

Results

The Conservative scenario calculated risks for the enclosed-space vapor inhalation pathways from site groundwater and soils, based upon the soil analytical data for the six benzene impacted soil samples from the 0' to 5.5' interval (samples WO-8, ~~WO-8,~~ IX-11, IX-13, IX-15 and IX-18) and the maximum site groundwater benzene concentration of 63 ppb, are 5×10^{-2} and 4×10^{-5} for a combined 4.05×10^{-5} risk value. This value is between the 1×10^{-4} and 1×10^{-6} risk range for commercial and residential occupancy.

The Plausible scenario calculated risks for the enclosed-space vapor inhalation pathways from site groundwater and soils, based upon the soil analytical data for the 14 soil samples from the excavation sidewalls in the 0-5.5' depth interval (6 detects and 8 non-detects) and the 12/12/95 site benzene concentration in well C-2 of 0.93 ppb, are 7×10^{-9} and 1.7×10^{-5} for a combined 1.7

x 10^{-5} risk value. This value is between the 1 x10^{-4} and 1 x 10^{-6} risk range for commercial and residential occupancy.

Recommendations

Based upon this amended risk evaluation, the groundwater at this site would not represent a risk to residential or commercial/industrial human health at the modeled 5 x 10^{-7} to 7 x 10^{-9} risk range. Soils over the vast majority (>90%) of this site pose no risk to human health because of the extensive excavation removal of contaminated soils. The soils located in a 15' zone from the Grand Ave. sidewalk northward at this site (Fig. 1) could represent a vapor inhalation health threat to future residential occupants (4 x 10^{-5} to 1.7 x 10^{-5} risk range) but not to future commercial or industrial occupants at a 10^{-4} target risk range based upon the model output.

To address this modeled soil vapor threat to future site occupants, Chevron should work with the land owner and Regulatory Agency to develop mitigation measures during and after site development. These measures may include: 1) Allow only commercial development and prohibit residential development at this site; 2) Restricting any site residential development directly over the impacted soil located in a setback zone 15' from the Grand Ave. sidewalk (Figure 1); and 3) Excavating out the impacted soil within the 15' setback zone during site development or placement of a vapor barrier beneath any development within the 15' setback, if warranted.

It is recommended that Chevron pursue site soils and groundwater closure or request a letter of developability from the Alameda County Health Services and agree to work with the landowner and County to address site soil environmental concerns once a buyer for the property has been located. It is important to note that extensive excavation has removed the soil contamination sources (UST/piping etc.) and that the remaining residual soil contamination is confined to a 15' zone along Grand Ave. and that soil contaminant concentrations will continue to decay with time due to natural degradation processes.

Please contact me at CTN 242-7086 with questions or comments regarding this risk evaluation for this site.

Curtis A Peck

Curtis A. Peck
Lead Hydrogeologist

Attachment
1) Figure 1
2) Calculated Average soil benzene concentrations

Residential Scenario

Revised RA

#G-0006 ASTM RBCA - Volatilization Factor for Enclosed-Spaces

ADULT RESIDENT RECEPTOR - Benzene

EQUATIONS - Volatilization from Groundwater to Enclosed-Space (VFwesp) - Benzene

$$VFwesp = \frac{(0.22)\ [(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)]\ [(6.5 \times 10^{-5}\ cm^2/s) / (150\ cm)]}{1 + [(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)] + [(6.5 \times 10^{-5}\ cm^2/s) / 15\ cm) \times 0.01]} \times 1000\ L/m^3$$

$$VFwesp = \frac{(0.22)\ (1.55 \times 10^{-5})}{1 + [(1.55 \times 10^{-5}) + (0.1)]} \times 1000\ L/m^3$$

$$VFwesp = \frac{(3.4 \times 10^{-6})}{1.1000155} \times 1000\ L/m^3$$

$$VFwesp = (3.1 \times 10^{-6}) * 1000\ L/m^3$$

VFwesp = 3.1 x 10^{-3} $\frac{mg/m^3\text{-air}}{mg/L\text{-water}}$

2) C building = (VFwesp) x (C water)

2a) C building Plausible = for 0.93 ppb benzene (12/95)

C building = 3.1 x 10^{-3} $\frac{[mg/m^3\text{-air}]}{[mg/L\text{-water}]}$ x (9.3 x 10^{-4} mg/L)

= 2.90 x 10^{-6} mg/m^3-air at 0.93 ppb groundwater benzene concentration

2b) C building Conservative = for 63 ppb (12/92)

C building = 3.1x 10^{-3} $\frac{[mg/m^3\text{-air}]}{[mg/L\text{-water}]}$ x (0.063 mg/L)

= 1.95 x 10^{-4} mg/mg^3 air at 63 ppb benzene (12/92 C-2 value)

3) Chemical Intake = $\frac{\text{(C building) x (Inhalation Rate) x (Days Exposed) x (Years Exposed)}}{\text{(Receptor Weight) x (Days/year) x (Expected Lifetime)}}$

3a) Plausible Chemical Intake

$$Intake = \frac{(2.90 \times 10^{-6}\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

= 2.55 x 10^{-7} mg/Kg-day at 0.93 ppb benzene groundwater concentration

3b) Conservative Chemical Intake

$$Intake = \frac{(1.95 \times 10^{-4}\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

= 1.72 x 10^{-5} mg/Kg-day at 63 ppb benzene groundwater concentration

4) Risk Value = **Chemical Intake x Cancer Potency Factor (benzene); where CPF = 0.029 mg/Kg-day**

4a) Plausible Scenario Risk

= (2.55 x 10^{-7} mg/Kg/day) x (0.029 mg/Kg-day)

= **7 x10^{-9} at 0.93 ppb benzene, the current situation at the site.**

4b) Conservative Scenario Risk

= (1.72 x 10^{-5} mg/Kg/day) x (0.029 mg/Kg-day)

= **5.0 x10^{-7} at 63 ppb benzene, the site maximum.**

NOTE: The modeled results for the groundwater to enclosed-space vapor inhalation pathway are below the standard 1 x 10^{-6} risk value for residential exposure and as modeled would not represent a threat to residential or commercial occupants at this site.

1st Revised RA

#G-0006 ASTM RBCA - Volatilization Factor for Enclosed-Spaces

ADULT RESIDENT RECEPTOR - Benzene

EQUATIONS - Volatilization from Soil to Enclosed-Space (VFsesp) - Benzene

$$\text{VFsesp} = \frac{(0.22)(1.7)}{(0.12) + (0.83)(1.7) + (0.22)(0.26)} \; \frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{[(1.4 \times 10^{-4}\ s\text{-}1) * (200\ cm)]} \; \frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{1 + [(1.4e\text{-}4\ s\text{-}1) * (200\ cm)]} + \frac{[(7.28 \times 10^{-3}\ cm^2/s) / (100\ cm)]}{[(7.28 \times 10^{-3}\ cm^2/s)/15\ cm) \times 0.01]} \times 1000 \left[\frac{cm^3\text{-}kg}{m^3\text{-}g}\right]$$

$$\text{VFsesp} = \frac{(0.2355)(2.6 \times 10^{-3})}{1 + [(2.6 \times 10^{-3}) + (15)]} \times 1000\ cm^3\text{-}kg/m^3\text{-}g$$

$$\text{VFsesp} = \frac{(6.1 \times 10^{-4})}{16.0026} \times 1000\ cm^3\text{-}kg/m^3\text{-}g$$

$$\text{VFsesp} = (3.82 \times 10^{-5}) \times 1000\ cm^3/m^3\text{-}g$$

VFsesp = 0.038 $\frac{mg/m^3\text{-air}}{mg/Kg\text{-soil}}$

2) C building = (VFsesp) x (C soil)

2a) Plausible Scenario; benzene = 0.178 mg/Kg soil in average of 14 soil samples (detects and non-detects)

$$\text{C building} = 0.038 \left[\frac{mg/m^3\ air}{mg/Kg\text{-}soil}\right] \times (0.178\ mg/Kg)$$

C building = 0.00676 mg/m³-air at 0.178 mg/Kg soil concentration

2b) Conservative Scenario: benzene = 0.412 mg/Kg soil; average of 6 of 14 detects in former tank pit excavation sidewalls

C building = 0.0157 mg/m³-air at 0.412 mg/Kg soil concentration

3) Chemical Intake = $\frac{\text{(C building) x (Inhalation Rate) x (Days Exposed) x (Years Exposed)}}{\text{(Receptor Weight) x (Days/year) x (Expected Lifetime)}}$

3a) Plausible Scenario

$$\text{Intake} = \frac{(0.00676\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

Intake = 5.95 x 10⁻⁴ mg/Kg-day at 0.178 mg/Kg benzene in soil

3b) Conservative Scenario

$$\text{Intake} = \frac{(0.0157\ mg/m^3) \times (15\ m^3/day) \times (350\ days) \times (30\ years)}{(70\ Kg) \times (365\ days) \times (70\ years)}$$

Intake = 1.38 x 10⁻³ mg/Kg-day at 0.412 mg/Kg benzene in soil

4) Risk Value = Chemical Intake x Cancer Potency Factor (benzene); where CPF = 0.029 mg/Kg-day

4a) Plausible Scenario - Risk

Risk = (5.95 x 10^{-4} mg/Kg-day) x (0.029 mg/Kg-day)

Risk = 1.73 x 10^{-5} at 0.178 mg/Kg benzene in site soil

4b) Conservative Scenario - Risk

Risk = (1.38 x 10^{-3} mg/Kg-day) x (0.029 mg/Kg-day)

Risk = 4 x 10^{-5} at 0.412 mg/Kg benzene in site soil

NOTE: The modeled results for the soil to enclosed-space vapor inhalation pathway are below the standard 1 x 10^{-4} risk value for commercial/industrial exposure and as modeled would not represent a threat to commercial occupants at this site. The modeled results for the soil to enclosed-space vapor inhalation pathway are above the standard 1 x 10^{-6} risk value for residential exposure and as modeled would represent a threat to residential occupants at this site. Therefore, restricting the site development to commercial would alleviate the concerns regarding the residential exposure pathway.

Benzene Impacted soils in the 0 - 5.5' interval

1) Conservative scenario: Only those samples that had benzene detected and that were not over-excavated. Note: the sample IX-3 was not included as it was removed during over-excavation.

Sample	Depth	Benzene (mg/Kg)
WO-8	4.5'	0.005
WO-9	5.5'	0.077
IX-11	5'	0.6
IX-13	5.5'	0.41
IX-15	5'	1.2
IX-18	4'	0.18
		2.472 mg/Kg

Average Benzene Conc. = 0.412 mg/Kg for these six samples

2) Plausible scenario: Includes the six samples with benzene detects and the 8 samples that were non-detect. The non-detect samples were assumed to contain benzene at 1/2 the method detection limit of 0.005 mg/Kg, i.e., each non-detect sample was assumed to contain 0.0025 mg/Kg benzene.

Sample	Depth	Benzene (mg/Kg)
WX-2	5.5'	0.0025 (ND)
WX-3	3'	0.0025 (ND)
WO-5	5'	0.0025 (ND)
WO-6	5'	0.0025 (ND)
WO-7	5'	0.0025 (ND)
WO-8	4.5'	0.005
WO-9	5.5'	0.077
WO-10	5'	0.0025 (ND)
WO-11	4.5'	0.0025 (ND)
IX-11	5'	0.6
IX-13	5.5'	0.41
IX-15	5'	1.2
IX-18	4'	0.18
IX-20	5'	0.0025 (ND)
		2.492 mg/Kg

Average Benzene Conc. = 0.178 mg/Kg for the 14 samples