31 January 2008

To: Contaminated Sites Program
Attn: Bill Petrick
Division of Spill Prevention and Response
Department of Environmental Conservation
555 Cordova Street Anchorage, AK 99501

Subject: GCI Network Facility – Eagle River, Alaska

Dear Mr. Petrick:

The purpose of this letter is to describe site conditions as they pertain to indoor air quality at the GCI Network Facility in Eagle River and to request a department decision regarding the need for indoor air monitoring.

Statement of Issue

ADEC performed vapor intrusion modeling for the site using the Johnson-Ettinger (JE) model for evaluating subsurface vapor intrusion into buildings. The ADEC run model results indicated that cumulative hazard index (HI) for building occupants at the GCI Network Facility in Eagle River could exceed the target level of one (1). A hazard index of one or more implies that exposure to contaminants could possibly have some type of non-carcinogenic adverse health effect. The main contaminant of concern was exposure to xylene vapors detected in subsurface soil near the western edge of the building. Site-specific building dimensions and default input parameters were used for the ADEC model run.

Based on the JE results, ADEC indicated that soil gas air sampling may be needed to determine if indoor air concentrations were actually above risk based standards.

OASIS reviewed the ADEC model input parameters and determined that there are some site specific conditions could affect the model results. In particular, the following information should be considered before using the results of the JE model as the basis to require either a soil gas or indoor air sampling program.

- The building houses a generator and a fuel tank. Vapors from this equipment could possibly affect indoor air quality. Results from indoor air sampling would be difficult to interpret, because it would not be known if any fuel vapors detected originated from the spill, or the diesel tank and generator.

- The JE Model assumes residential exposure (i.e., 24 hours/day), which overestimates exposure for workers in the GCI Network Facility.

- In order to address the worker exposure issue, additional site specific information was used to modify default JE input parameters. The basis for the site specific parameters are presented below.

Collection of Site Specific Information

The following information was collected: building layout, anecdotal building construction information, air exchange rate information, and building use data.

Building Layout
The building floor plan is depicted in Figure 1. The spill site was at the western edge of the building. The building consists of a generator room, a battery room, a main equipment room, and a small office. The spill site was at the western edge of the building, adjacent to the generator and battery room. The individual room dimensions were used to calculate the air volume for the building (22,705 cubic feet).

Air Exchange Rate
The default building exchange rate in the JE model is 0.25 exchanges per hour (a 10th percentile value based on EPA data). The main equipment room contains two Miteq amplifiers equipped with cooling blowers. The blowers discharge air to the outside at a rate of 210 cubic feet per minute each for a total air exchange rate of 420 cubic feet per minute (or 25,200 cubic feet per hour). The air exchange rate in the building, based solely on the blowers, is about 1.1 exchanges per hour.

Anecdotal Building Construction Information
The building is thought to be a slab on grade with no foundation. The actual construction details could not be confirmed. There is a small office on the south side of the building. Personnel in the office indicated the office was an addition to the main building. They reported that the office was a floor built over cinder blocks, i.e. the floor of the building is not in direct contact with the ground.

All rooms are separated by fire doors. The main building has a drop ceiling; consequently, some airflow between rooms occurs, albeit most air flow is likely into the main equipment room because of the effect of the amplifier blowers. Airflow into the office area is likely very small. The office room has no windows and no apparent means of ventilation.

Building Use
Site personnel were interviewed to identify actual use of the facility. The generator room and the battery room are rarely entered. Personnel are present in these rooms for a few hours per month. Personnel work in the main equipment room on and off during the day. A single person was estimated to spend a maximum of four hours per day in this room, even though different people may be in the room for a combined 8 hours per day. Personnel utilize the small office for an estimated one hour in the morning and one hour in the evening to perform office related tasks.

Calculation of Hazard Index

The hazard index was calculated using the site-specific physical and exposure data and the JE model. None of the contaminants of concern are classified as carcinogenic, so risk was not calculated. A comparison of default input parameters used in the ADEC modeling effort are compared to site specific input parameters used in the OASIS modeling effort in Table 1. The building air exchange rate is the total volume of the building divided by the blower exchange rate. Exposure duration is based on an 8 hour work day (worker scenario). The depth below grade to top and bottom of contamination is based on boring logs from site investigation data. The length, width and height used as input parameters are based on the cube root of the total calculated volume of the building.

Table 1 – Input Parameters

	Default	Site-Specific Value
Building Air Exchange Rate	0.25/hour	1.1/hour
Days per year	250 @ 24 hours/day 250 days	250 @ 8 hours/day (250 days/year X 8 hours/day) / 24 hours/day = 83 days/year
Depth below grade to top of Contamination	400 cm	198 cm
Depth below grade to bottom of contamination	600 cm	450 cm
Thickness of soil stratum A	200 cm	198 cm
Enclosed space floor length	1000 cm	863* cm
Enclosed space floor width	1000 cm	863* cm
Enclosed space floor height	366 cm	863* cm

*Note: Due to the sloped roof in part of the building, the total building volume was calculated and then the cube root was used as dimensions for each variable. Model only uses total volume, so estimating a cube of same volume as building should not affect results.

The results of the modeling and calculation of risk are presented in Table 2. RBCLs and hazard quotients were calculated based on the input parameters outlined in Table 1. The cumulative hazard index (the sum of the hazard quotients) for the COPCs detected at the site is slightly above one (HI=1.17), but would round down to HI=1. JE model spreadsheets for p-xylene are provided in Attachment 2.

Table 2 - Risk

	CAS	Site-Specific Measured Concentration ug/kg	Depth (cm)	JE RBCL ug/kg	HQ
Napthalene	91203	1.20E+03	198	1.14E+05	0.01
Toluene	108883	2.42E+04	198	2.21E+05	0.11
Ethylbenzene	100414	2.76E+04	198	1.33E+05	0.208
p Xylene	106423	1.31E+05	198	1.55E+05	0.85

Cumulative Risk HI= 1.17

Mitigating Information

The parameters used in the revised JE modeling were conservative yet take into account site-specific factors. Additional factors that could mitigate the potential for adverse health affects, but that were not able to be considered in the JE modeling, are listed below:

- The building layout shows that the spill site is 16' cross gradient from the edge of the portion of the building used on a daily basis. This separation distance would mitigate the effect of any vapors infiltrating the areas of the building used by people. Data necessary to quantify the mitigation effect are not available.

- If the building is a slab on grade, i.e. without a foundation, the JE model would likely overestimate infiltration.

- The reported construction details of the office area imply that vapor intrusion into this room is limited because of the separation between the floor and the ground surface.

- The potential effects of the generator and fuel tank housed in the building were not considered in the JE model.

Recommendation

OASIS does not recommend indoor air sampling based on the JE model results and the other mitigating site characteristics. This model is a screening level model and is based on very conservative assumptions. Further, the calculated hazard index of one would indicate that soil gas sampling is not warranted either.

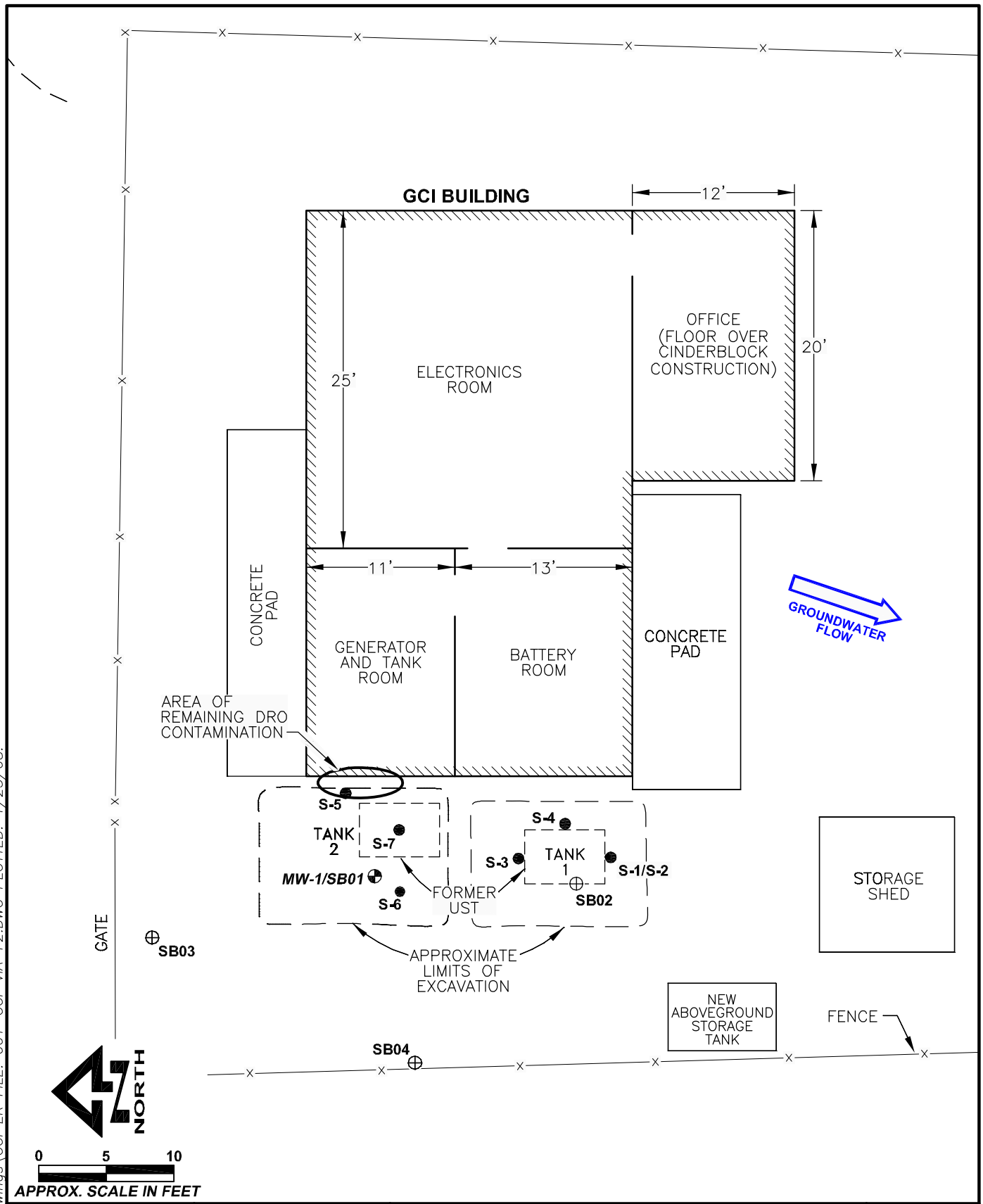
If you have any questions regarding this modeling effort, please contact me.

Sincerely

Max Schwenne
Vice President

Enclosures: Figure 1 – GCI Network Facility Building Layout
Attachment 1 – JE Model Results

CC: John Gaydos, GCI



PATH: V:\Project Drawings\GCI ER FILE: 001-GCI-VIA-F2.DWG PLOTTED: 1/23/08.

oasis ENVIRONMENTAL

DATE: JAN. 2008
CHKD: M.S.
DRAWN: C.E.H.
PROJ. No.: 175-001

825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880

BUILDING LAYOUT

VAPOR INTRUSION ASSESSMENT
GCI NETWORK FACILITY
Eagle River, Alaska

FIGURE

1

RESULTS SHEET

RISK-BASED SOIL CONCENTRATION CALCULATIONS:

Indoor exposure soil conc., carcinogen (µg/kg)	Indoor exposure soil conc., noncarcinogen (µg/kg)	Risk-based indoor exposure soil conc., (µg/kg)	Soil saturation conc., C_{sat} (µg/kg)	Final indoor exposure soil conc., (µg/kg)
NA	2.04E+05	2.04E+05	1.55E+05	1.55E+05

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

SCROLL DOWN TO "END"

ERROR: Combined thickness of strata A + B must be = depth below grade to top of contamination.

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	183	0.321	0.321	ERROR	0.003	9.92E-08	0.998	9.91E-08	3,452	1.00E+00	1.96E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
7.97E+05	4.33E-04	15	10,248	3.06E-03	1.32E-01	1.75E-04	1.24E-02	1.24E-02	0.00E+00	5.23E-03	183	15

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.78E-01	1.57E+02	0.10	8.59E+01	1.24E-02	3.45E+02	8.49E+86	NA	NA	1.27E+00	1.48E-08	1.82E+08	YES

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	2.15E-03	NA	2.15E-03	NA	1.0E-01

END

SL-ADV
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES: X

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
106423		p-Xylene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
				Totals must add up to value of L_t (cell G28)					
10	15	198	450	198	252	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
S	1.66	0.375	0.054	0.002	s	1.66	0.375	0.054	0.002		1.66	0.375		0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	863	863	863	0.1	1.1	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	83	1.0E-05	1
				Used to calculate risk-based soil concentration.	

END