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LETTER REGARDING REGULATORY REVIEW AND COMMENTS TO U S NAVY RESPONSES ON FINAL DRAFT FEASIBILITY STUDY AT OPERABLE UNIT 3 (OU 3) NTC ORLANDO FL

4/2/1999

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

FLORIDA

Department of Environmental Protecti

Jeb Bush
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

David B. Struhs
Secretary

09.01.03.0009
00294

April 2, 1999

Mr. Wayne Hansel
Code 18B7
Southern Division
Naval Facilities Engineering Command
P.O. Box 190010
North Charleston, South Carolina 29419-0068

RE: Response to Comments, Final Draft Feasibility Study Report, Operable Unit 3, Naval Training Center, Orlando, Florida

Dear Mr. Hansel:

I have completed the review of the Response to Comments on the Final Draft Feasibility Study Report, Operable Unit 3, Naval Training Center Orlando, dated March 12, 1999 (received March 15, 1999), prepared and submitted by Harding Lawson Associates. I have attached Bill Neimes, P.E., comments on the responses to his comments. I have the following comments on the response to comments:

(1) FDEP Comment 1: I have spoken with our Quality Assurance Section concerning detection limits for the herbicides MCPA and MCPP. They concur that no standard, cost effective EPA method exists that can achieve the leachability SCTL for MCPA. However, they did state that using EPA Method 8151 (December 1996 revision), may be able to reach detection limits for soil of approximately 43 µg/kg, which is substantially lower than the detection limits reported in the Remedial Investigation Report. The method uses a gas chromatography/ electrolytic conductivity detector (GC/ECD) to achieve the lower detection limit.

(2) FDEP Comment 2: I have attached the University of Florida's Center for Environmental & Human Toxicology's calculated SCTLs for MCPP for the residential, industrial and leachability.

(3) FDEP Comment 3: Response acceptable.

(4) FDEP Comment 4: Response acceptable.

(5) FDEP Comment 5: Response acceptable.

(6) FDEP Comment 6: Response acceptable.

(7) FDEP Comment 7: My comment concerning the calculated retardation factor for arsenic was not meant to dismiss the number calculated, but to stress the need to derive a site specific retardation number for arsenic to determine the length of time groundwater would need to be extracted. In the absense of site specific numbers, I feel the use of a range of retardation factors taken from literature would give a broader picture of the best case and worst case scenarios for the groundwater extraction remediation option.

(8) EPA Region 4 Comment 19: I have attached Steven M. Roberts', Ph.D., University of Florida Center for Environmental & Human Toxicology, January 10, 1999, letter that addresses EPA Region 4's comment and Harding Lawson Associates' response.

If I can be of any further assistance with this matter, please contact me at (850)488-3693.

Sincerely,

David P. Grabka
Remedial Project Manager

cc: Lt. Gary Whipple, NTC Orlando
Barbara Nwokike, Navy SouthDiv
Nancy Rodriguez, USEPA Region 4
Richard Allen, HLA, Jacksonville
Steve McCoy, Brown & Root, Oak Ridge
Robin Manning, Bechtel, Knoxville
Bill Bostwick, FDEP Central District

TJB TJB JJC JJC ESN ESN

Florida Department of

Environmental Protectio

Memorandum

TO: David Grabka - Project Manager

THROUGH: Tim Bahr - Technical Review Section

FROM: Bill Neimes - Technical Review Section

DATE: March 18, 1999

SUBJECT: Response to Comments
Draft Feasibility Study Report
Naval Training Center
Orlando, Florida
Operable Unit 3; Study Area's 8 & 9

I appreciate the opportunity to review the responses to my comments on the Draft Feasibility Study Report from Harding Lawson Associates. The responses to my comments are identified from Comments 8 through 18 of Harding Lawson Associates reply letter.

8. Soil Remediation Alternative. No reply necessary.

9. Hazardous Waste. Soils excavated from SA 8 will be analyzed by the TCLP method to determine if they are a characteristic hazardous waste. All soils excavated from SA 9 will be identified as hazardous waste.

10. Groundwater Remediation Alternatives. I do not want it to be understood that I am not in favor of innovative technologies. On the contrary, I am an advocate of and generally encourage the review and possible application of innovative technologies. However, all technologies, whether innovative or not, have their limitations and are appropriate for specific uses. Many times, innovative technologies also have the added risk of having no demonstrated performance record.

    I believe that uncertainty factor of the two innovative technologies listed in this feasibility study (i.e., barrier treatment walls and ex-situ phytoremediation) is too high to specify either one of these technologies in the design. Even if pilot studies are performed, there will still be a high risk factor involved if either of these two innovative technologies are implemented. I don't believe that there is enough data available on any long term treatment systems that have utilized either barrier treatment walls or ex-situ phytoremediation to demonstrate these treatment technologies over a long period of time. Are the authors aware of any other in-situ groundwater remediation technologies for the treatment of soluble arsenic than those listed in Section 4.1.8?

11. Permeable Treatment Alternative. I appreciate the author providing information on the reduction of pesticide (DDT) biodegradation through the use of zero valent iron filings. However, as reported later in this response, the primary contaminant of concern is not pesticides but arsenic. In their response to Comment 24, the author notes that much (80%) of the arsenic in the groundwater existed as arsenite (As+3 valence). What effects would iron filings have on the arsenic that is soluble in the groundwater? Is the purpose of the iron filings to reduce the arsenite in the +3 state to elemental arsenic? Has there been any demonstrations of this redox reaction occurring in a permeable barrier treatment wall and has this been successful? If elemental arsenic is formed by the redox reaction, what is the likelihood that elemental arsenic can be oxidized back to either soluble arsenite or arsenate later on?

12. Phytoremediation Alternative. In the response, the author notes that phytoremediation has demonstrated effective on removing arsenic contaminated groundwater. I am aware that plants can remove soluble arsenic from the groundwater, however, has there ever been an ex-situ phytoremediation demonstration of arsenic removal? What was the efficiency of this treatment system?

13. Pump and Treat Alternative. In my original comment my intention was to not infer that the two pump and treat alternatives included in this report were unproven technologies. I realize that technologies similar to these two have been and are being used at remedial sites. My primary concern was that when a relatively complex and delicate system is selected which requires significant pH adjustments, chemical additions, and high quality water free from turbidity (for UV/oxidation), there is a greater likelihood of operational problems to occur.

    In Appendix C, the estimated extracted concentration of arsenic is 0.134 mg/l from SA 8 and 0.086 mg/l from SA 9. Both of these concentrations are below the allowable Industrial User Discharge Permitted Limit of 0.250 mg/l set forth by the City of Orlando. Given that the expected influent concentration of arsenic and the expected influent concentration of combined pesticides are below the City of Orlando's permitted limit, can a design be selected that will pump groundwater directly to the City of Orlando's wastewater treatment plant without the treatment train? The Department has approved of remedial systems that recover groundwater and discharge water directly to a POTW without any pretreatment operations.

14. Estimate Time for Groundwater Extraction. No reply necessary.

15. Arsenic Contaminated Wetland. I misunderstood several quotes in this report where it states "The highest arsenic concentration is 10.4 mg/kg in this area." I agree that the arsenic concentration in the wetland is significantly less than outside the wetland area.

16. Estimating Radius of Influence. I agree with the authors remarks.

17. Transmissivity Values. If a groundwater extraction alternative is chosen as the selected technology, a pump test should be performed to determine specific transmissivity values for SA 8 and SA 9. The reliability of slug test data for the design of a recovery system is questionable.

18. Pumping Rate. I agree with the authors remarks.

To conclude, if a pump and treat alternative is selected for groundwater remediation, I would like to have a pump test performed on areas SA 8 and SA 9. I also believe that the groundwater concentrations are at a low enough magnitude in both of these areas that the recovered groundwaters can be discharged directly to a City of Orlando treatment plant without any treatment. Thus avoiding unnecessary capital and operational expenditures.

UNIVERSITY OF FLORIDA

Center for Environmental & Human Toxicology

P.O. Box 110885
Gainesville, Florida 32611-0885
Tel.: (352) 392-4700, ext. 5500
Fax: (352) 392-4707

February 18, 1999

Ligia Mora-Applegate
Bureau of Waste Cleanup
Florida Department of Environmental Protection
Room 471A, Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399

Dear Ms. Mora-Applegate:

At your request, we have developed soil cleanup target levels (SCTLs) for 2-(2-methyl-4-chlorophenoxy)propionic acid (MCPP) based on direct contact for residential and industrial land use, and based on leachability. MCPP is a selective herbicide used for post-emergence control of broad-leaf weeds in a number of agricultural applications as well as lawns and turf grass.

The residential and industrial SCTLs for MCPP are 42 and 4300 mg/kg, respectively, and the leachability value is 0.03 mg/kg. The leachability value is based on groundwater guidance concentration of 7 μg/L presently used by FDEP. The direct contact SCTLs for MCPP were calculated using both experimental and extrapolated toxicity values. Toxicological information for MCPP, including an oral reference dose (RfD), is available on the USEPA's Integrated Risk Information System (IRIS). The oral RfD for MCPP of 1.0E-03 mg/kg/day is based on increased kidney weights in male and female Wistar rats exposed to MCPP via the diet. An uncertainty factor of 3000 was applied to a NOEL of 3 mg/kg/day to generate the RfD. Inhalation and dermal RfDs of 5.0E-4 were extrapolated from the oral RfD assuming a default gastrointestinal absorption value of 0.5 per USEPA Region IV guidance for semi-volatile chemicals.

The equations for the calculation of SCTLs for direct contact and leachability require the input of several chemical-specific values. These values, which include the organic carbon normalized soil-water partition coefficient for organic compounds (K_{oc}), Henry's law constant (HLC), water solubility (S), diffusivity in air (D_i), and diffusivity in water (D_w), are a function of the physical/chemical properties of each chemical. For

MCPP, data for most of these parameters were taken from the Hazardous Substances Data Bank (HSDB). Diffusivity values for MCPP were not provided in the USEPA's CHEMDAT 8 database, the preferred source of those values. MCPP diffusivity values were therefore calculated according to equations provided in the CHEMDAT 8 database. The equations used to calculate diffusivity in air (1) and water (2) are shown below.

For diffusivity in air (D_i):

$$D_i = 0.0067\,T^{1.5} \times (0.034 + MW^{-1})^{0.5} \times MW^{-1.7} \times [(MW/2.5d)^{0.33} + 1.81]^2 \quad (1)$$

where, T = temperature, degrees Kelvin
MW = molecular weight of chemical (g/mol)
d = density (g/cm^3)

For diffusivity in water (D_w):

$$D_w = 1.518\ (10^{-4})\ V_{cm}^{-0.6} \quad (2)$$

where, V_{cm} = molar volume (cm^3/mol)

These equations require information on the density (d) and molecular volume (V_{cm}). For MCPP, values for these parameters were unavailable from standard sources and thus had to be estimated using equations (3) and (4) below.

For density (d):

$$d = \frac{1.660 \times MW}{V_s} \quad (3)$$

where, MW= molecular weight (g/mol)
V_s = molecular volume (Å^3/molecule) = 236.2

For molar volume (V_{cm}):

$$V_{cm} = \frac{MW}{d} \quad (4)$$

where, MW= molecular weight (g/mol)
d = density (g/cm^3)

The following table summarizes the chemical specific data for MCPP and the source of those data.

Parameter	Value	Source
MW	214.6	HSDB
HLC	1.82E-08	HSDB
S	734	HSDB
K_{oc}	8.40	HSDB
D_i	2.373E-02	Calculated
D_w	7.751E-06	Calculated
d	1.5082	Calculated
V_s	236.2	Calculated
V_{cm}	142.2	Calculated

Direct contact SCTLs for residential and industrial soils were calculated according to equation 5 on the following page. Direct contact SCTLs also require the use of a chemical-specific volatilization factor (VF). Equation 6 illustrates the calculation of the VF for MCPP. The SCTL for leachability was calculated according to equation 7 using the default parameters listed.

If you have any questions regarding the derivation of these values, please do not hesitate to contact us.

Sincerely,

Christopher J. Saranko, Ph.D.

Stephen M. Roberts, Ph.D.

cc: David Grabke

Equation 5
Model Equation for Developing Acceptable Risk-Based Concentrations in Soil

$$SCTL = \frac{THI \times BW \times AT}{EF \times ED \times FC \times \left[\left(\frac{1}{RfD_o} \times IR_o \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_d} \times SA \times AF \times DA \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_i} \times IR_i \times \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)\right]}$$

SCTL = Soil Cleanup Target Level
THI = target hazard index (unitless)
BW = body weight (kg)
AT = averaging time (days)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
FC = fraction from contaminated source (unitless)

IR_o = ingestion rate, oral (mg/day)
SA = surface area of skin exposed (cm^2/day)
AF = adherence factor (mg/cm^2)
DA = dermal absorption (unitless)
IR_i = inhalation rate (m^3/day)
VF = volatilization factor (m^3/kg)
PEF = particulate emission factor (m^3/kg)

RfD = reference dose (mg/kg/day)
RfD_o = oral
RfD_d = dermal
RfD_i = inhalation

SCTL Calculation for Direct Exposure (Child Resident) 2-(2-methyl-4-chlorophenoxy)propionic acid (MCPP)

$$SCTL = \frac{1.00 \times 15kg \times 2190days}{350d/yr \times 6yr \times 1 \times \left[\left(\frac{1}{0.001mg/kg/d} \times 200mg/d \times 1x10^{-6}\,kg/mg\right) + \left(\frac{1}{0.0005mg/kg/d} \times 1800cm^2/d \times 0.2mg/cm^2 \times 0.01 \times 1x10^{-6}\,kg/mg\right) + \left(\frac{1}{0.0005mg/kg/d} \times 10m^3/d \times \left(\frac{1}{1.205 \times 10^5} + \frac{1}{1.24 \times 10^9}\right)\right)\right]}$$

$$SCTL = \frac{3.2850 \times 10^4}{2100 \times \left[(2.0 \times 10^{-1}) + (7.20 \times 10^{-3}) + (1.66 \times 10^{-1})\right]} = \frac{3.2850 \times 10^4}{2100 \times 3.7310 \times 10^{-1}} = \frac{3.2850 \times 10^4}{783.7} = 42\ mg/kg\ **$$

Given: RfD_o = 0.001 mg/kg/day
RfD_d = 0.0005 mg/kg/day
RfD_i = 0.0005 mg/kg/day
VF = 1.205 x 10^5 m^3/kg
PEF = 1.24 x 10^9 m^3/kg

**All calculations carried out to 18 decimal places. For simplicity of demonstration, the calculated values above are not shown to the same precision. Final SCTL value is rounded to two significant figures if >1 and to one significant figure if <1.

Equation 6
Equation Used for the Determination of the Volatilization Factor[a]

$$VF = Q/C \times CF \times \frac{(3.14 \times D_A \times T)^{1/2}}{2 \times \rho_b \times D_A}$$

$$D_A = \frac{\left[\left(\theta_a^{10/3} D_i H' + \theta_w^{10/3} D_w\right) / n^2\right]}{\rho_b K_d + \theta_w + \theta_a H'}$$

WHERE:

Model Parameters (Units)		Default Value
VF	Volatilization factor (m^3/kg)	-
D_A	Apparent diffusivity (cm^2/s)	-
CF	Conversion factor (m^2/cm^2)	10^{-4}
Q/C	Inverse of the mean concentration[b] (g/m^2-s per kg/m^3)	85.61[c]
T	Exposure interval (s)	ED × 3.1536×10^7 s/yr
ED	Exposure duration (years)	Exposure-specific[d]
N	Total soil porosity (L_{pore}/L_{soil})	1- (ρ_b/ρ_s)‡
W	Average soil moisture content (g_{water}/g_{soil})	0.1 (10%)‡
ρ_b	Dry soil bulk density (g/cm^3)	1.5‡
ρ_s	Soil particle density (g/cm^3)	2.65
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	n - θ_w
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	$w\rho_b$
K_d	Soil-water partition coefficient L/kg)	$K_{oc} \times f_{oc}$
D_i	Diffusivity in air (cm^2/s)	Chemical-specific
D_w	Diffusivity in water (cm^2/s)	Chemical-specific
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific
H'	Dimensionless Henry's Law constant	H × 41
K_{oc}	Soil-organic carbon partition coefficient (L/kg)	Chemical-specific
f_{oc}	Organic carbon content of soil (g/g)	0.006 (0.6%)‡

[a] Model equation taken from USEPA 1996 'Soil Screening Guidance: Technical Background Document.' EPA/540/R-95/128.
[b] Assumes the center of a 0.5 acre plot.
[c] Based on Q/C Value for Zone IX (Miami, FL) as listed in USEPA 'Soil Screening Guidance.' Based on a 0.5 acre site; site-specific PEFs must be calculated for sites which are significantly larger in size.
[d] Based on Aggregate Resident exposure for a duration of 30 years (ED).
‡Value may be substituted with documented, FDEP accepted site-specific information.

VF Calculation (Child Resident)
2-(2-methyl-4-chlorophenoxy)propionic acid (MCPP)**

Given:
D_i = .0237 cm^2/s
D_w = 7.75 x 10^{-6} cm^2/s
H' = 7.46 x 10^{-7}
T = 9.460800×10^8 s*
K_{oc} = 8.40 L/kg
K_d = 0.0504 L/kg

Then:

$$D_A = \frac{\left[\left(1.504996 \times 10^{-2} \times 0.0237 \times 7.46 \times 10^{-7}\right) + \left(1.79323 \times 10^{-3} \times 7.75 \times 10^{-6}\right) / 0.1883232\right]}{(1.5 \times 0.0504) + (0.15) + \left(0.2839362 \times 7.46 \times 10^{-7}\right)}$$

$$D_A = \frac{7.3 \times 10^{-3}}{2.256 \times 10^{-1}} cm^2/s = 3.33 \times 10^{-3} cm^2/s$$

and:

$$VF = 85.61\left(\frac{g \cdot m^3}{kg \cdot m^2 \cdot s}\right) \times 1 \times 10^{-4}\left(\frac{m^2}{cm^2}\right) \times \frac{\left(3.14 \times 2.1462 \times 10^{-3}\left(\frac{cm^2}{s}\right) \times 1.89 \times 10^8 (s)\right)^{\frac{1}{2}}}{2 \times 1.5 \times 3.33 \times 10^{-7}\left(\frac{cm^2}{s}\right)}$$

$$VF = \frac{1.205 \times 10^{-1}}{1.0 \times 10^{-6}} = 1.205 \times 10^5\left(\frac{m^3}{kg}\right)$$

**All calculations carried out to 18 decimal places. For simplicity of demonstration, the calculated values below are not shown to the same precision.

Equation 7

Equation for the Developing of Soil Cleanup Target Levels (SCTLs) Based on Leachability

$$SCTL(mg/kg) = GWCTL(\mu g/L) \times CF(mg/\mu g) \times DF \times \left[K_{oc}(L/kg) \times f_{oc}(g/g) + \frac{\theta_w(L_{water}/L_{soil}) + \theta_a(L_{air}/L_{soil}) \times H'}{\rho_b(g/cm^3)} \right]$$

Parameter	Definition (units)	Variables and Default
GWCTL	Groundwater cleanup target level (µg/L)	Table-specific value[1]
CF	Conversion factor (mg/µg)	0.001
DF	Dilution factor (unitless)	20[2]
K_{oc}	Soil-organic carbon partition coefficient (L/kg)	Chemical-specific value
f_{oc}	Fraction organic carbon in soil (g/g)	0.002‡
Θ_w	Water-filled soil porosity (L_{water}/L_{soil})	$w\rho_b$
Θ_a	Air-filled soil porosity (L_{air}/L_{soil})	$n - \Theta_w$
H	Henry's Law constant (atm-m^3/mol)	Chemical-specific value[2]
H'	Henry's Law constant (unitless)	$H \times 41$
ρ_b	Dry soil bulk density (g/cm^3)	1.5‡
w	Average soil moisture content (g_{water}/g_{soil})	0.2 (20%)‡
n	Total soil porosity (L_{pore}/L_{soil})	$1-(\rho_b/\rho_s)$ ‡
ρ_s	Soil particle density (g/cm^3)	2.65

[1]Groundwater Cleanup Target Levels.

[2]If the site is significantly larger than 0.5 acres or if warranted by site-specific conditions (such as a shallow water table), a lower DF may be required.

‡ Value may be substituted with documented, FDEP accepted site-specific information. It should be noted that the default values for f_{oc}, w, and Θ_w in the calculation of leachability-based SCTLs differ from those used to calculate the VF as per guidance in the USEPA *Soil Screening Guidance: Technical Background Document* (EPA/540/R-95/128).

Leachability SCTL Calculation for 2-(2-methyl-4-chlorophenoxy)propionic acid (MCPP)

Given: GWCTL = 7 µg/L

K_{oc} = 8.40 L/kg

H' = 7.46E-07

Then:

$$SCTL(mg/kg) = 7.0\ \mu g/L \times 0.001\ mg/\mu g \times 20 \times \left[8.40\ L/kg \times 0.002\ g/g + \frac{0.3\ L_{water}/L_{soil} + (0.13396\ L_{air}/L_{soil} \times 0.000000746)}{1.5\ g/cm^3} \right] =$$

SCTL = 0.03 mg/kg**

**All calculations carried out to 18 decimal places. For simplicity of demonstration, the calculated values below are not shown to the same precision. Final SCTL is rounded to two significant figures if >1 and to one significant figure if <1.

UNIVERSITY OF FLORIDA

Center for Environmental & Human Toxicology

P.O. Box 110885
Gainesville, Florida 32611-0885
Tel.: (352) 392-4700, ext. 5500
Fax: (352) 392-4707

January 10, 1999

BUREAU OF WASTE CLEANUP
JAN 12 1999
TECHNICAL REVIEW SECTION

Ligia Mora-Applegate
Bureau of Waste Cleanup
Florida Department of Environmental Protection
Room 471A, Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Dear Ms. Mora-Applegate:

Occasionally, there is some confusion regarding the use of average soil concentrations in risk assessment, both for estimating risks from a site and in determining whether existing soil concentrations are consistent with risk-based soil cleanup goals. I would like to take this opportunity to clarify, if I can, some of these issues.

In most cases, risks from contaminated soils are evaluated based on chronic exposure. Under these circumstances, an individual will be exposed to contaminated soils over an area rather than at one specific location. If the individual's contact with the contaminated area is random, the best representation of the concentration to which he/she is exposed is the average contaminant concentration over that area. The ability to accurately generate an average concentration over a given area is dependent upon a number of things, including the location of the sampling and the number of samples. Because there may be some uncertainty as to whether the average of a given set of samples in fact represents the true average over the area of interest, the USEPA recommends use of a 95% upper confidence limit estimate (95% UCL) of the mean generated from the data. [Note: See the attached sheet for the formula used to calculate the 95% UCL] This is considered to be conservative in that there is, in effect, 95% certainty that the true average is less than the value used for risk calculations or comparisons.

Because it provides the best indication of exposure concentration over time, the 95% UCL of the mean concentration is generally the most appropriate basis for comparing site contaminant concentrations with soil cleanup target levels (SCTLs). There are a few exceptions to this, when the maximum concentration rather than the 95% UCL should be compared with the SCTL. These are:

1. When the 95% UCL value exceeds the maximum concentration observed concentration. If the site contaminant concentrations are quite variable, the 95% UCL can exceed the highest concentration observed on site. In this situation, the USEPA recommends using the maximum detected concentration, rather than the 95% UCL, for risk assessment purposes.

2. When there are insufficient data to support calculation of a 95% UCL. USEPA guidance recommends that a 95% UCL value should not be calculated (and the maximum concentration used instead) if there are fewer than 10 samples (*Supplemental Guidance to RAGS: Calculating the Concentration Term*, OSWER, 1992).

3. When SCTLs are based on acute toxicity in children. Small children occasionally ingest relatively large quantities of soil while playing. Typical residential SCTLs based on chronic, low-level exposure to soils are probably also protective under circumstances of a large, acute soil dose for most chemicals, but there are some important exceptions (Calabrese et al., Environ. Health Perspect. 105:1354-1358, 1997). During development of residential SCTLs for the Brownfields program, eight chemicals were identified as having potentially unacceptable risks associated with an acute, large soil ingestion episode in children (e.g., 5 to 10 g. of soil on a single occasion). For each of these chemicals — barium, cadmium, copper, cyanide, fluoride, nickel, phenol, and vanadium — residential SCTLs were derived based on acute toxicity in children. Since these SCTLs are based on protection during a one-time soil exposure incident, it is important that they not be exceeded at any point on-site where children might be exposed. In situations involving current or potential residential land use and the presence of these specific chemicals, the residential SCTLs for these chemicals should be compared with maximum detected soil concentrations rather than 95% UCL values. That is, these specific SCTLs should be used as "not-to-exceed" values.

In evaluating whether contaminant concentrations on site are consistent with the SCTLs, it should not be automatically assumed that a site-wide average should be used. The general idea is to average concentrations over an area based on reasonable activity patterns for the most-exposed potential receptor. Observations of human activity associated with the site can be used to assist in a determination of the appropriate size of areas for averaging when evaluating risks posed by current site conditions. It is often more difficult to decide what constitutes reasonable averaging for future land use where human activity patterns are unknown. It has been suggested that when future residential exposure scenarios are involved, concentrations should be averaged over no more than 0.5-acre sections, corresponding to an average residential lot, for comparison with residential SCTLs.

Areas of localized, high contaminant concentrations ("hot spots") may be of concern, even in situations where the 95% UCL of the mean concentration for the chemical is within acceptable limits. The need to consider hot spots arises from concern that toxicity may result, under some circumstances, from relatively brief exposure to very high contaminant concentrations. Data with which to evaluate toxicity from such acute exposures are often not readily available, and a conservative, expedient approach is to set an upper limit for hot spot concentrations based on some multiple of the SCTL. As a general rule, an upper limit for contaminant concentrations in hot spots of 3-times the SCTL should be health protective [with the notable exception of residential SCTLs based on acute toxicity in children, as discussed above].

I hope that this information is useful. Should you have any questions regarding this information, please do not hesitate to contact me.

Sincerely,

Stephen M. Roberts, Ph.D.

Equation for the Calculation of the 95% UCL of the Arithmetic Mean for a Lognormal Distribution:

$$95\%UCL = e^{(\bar{x}+0.5s^2+sH/\sqrt{n-1})}$$

Where:

e = constant (base of the natural log, equal to 2.718)
$\bar{x}$ = mean of the log transformed data
s = standard deviation of the log transformed data
H = H-statistic
N = number of samples

Equation for the Calculation of the 95% UCL of the Arithmetic Mean for a Normal Distribution:

$$95\%UCL = \bar{x} + t(s/\sqrt{n})$$

Where:

$\bar{x}$ = mean of the untransformed data
s = standard deviation of the untransformed data
t = Student-t statistic
n = number of samples