MEMORANDUM

November 1, 2001

To: Remediation Services Division
Environmental Technology Division

From: James H. Brent, Ph.D.
Assistant Secretary

RE: Background Concentration for Arsenic

As you are aware, background concentrations of arsenic in soils in Louisiana often exceed the screening standards that have been established in our Risk Evaluation/Corrective Action Program (RECAP). This issue is usually addressed through the collection of site-specific background data to evaluate if a release has occurred.

An evaluation of available data has been performed by the Department to determine the feasibility of establishing a state-specific background concentration for arsenic. Based on this evaluation, a recommendation has been made by LDEQ's Corrective Action Group. This recommendation is to accept as the state-specific concentration, the arithmetic mean concentration of arsenic detected in 83 soil samples collected from 21 parishes in Louisiana by the Louisiana State University Cooperative Extension Service in 1990.

Therefore, in accordance with LAC 33:I Chapter 13 Risk Evaluation/Corrective Action Program (RECAP) Section 2.13, LDEQ has established a background concentration for arsenic in soil for the State of Louisiana of 7 mg/kg. Based on RECAP assumptions, the residential and industrial cancers risks associated with exposure to an arsenic soil level of 7 mg/kg are 1.8E-05 and 2.3E-06, respectively. Both of these cancer risk estimates fall within the acceptable cancer risk range of 1E-06 to 1E-04. For non-carcinogenic health effects, the residential and industrial hazard quotients are 0.34 and 0.015, respectively. Both of these hazard quotients are well below the acceptable hazard quotient of 1.0.

This standard may be used immediately in the evaluation of sites. This information will be posted on the RECAP web site under Frequently Requested Files.

As additional data becomes available for specific regions and soil types it is expected that this value will be revised. Please provide any future information that you obtain on background arsenic concentrations to Tom Harris of the Toxicological Services Section. The establishment of background concentrations for arsenic on a site-specific basis may still be performed through the collection of samples from areas of the site that are representative of background conditions.

Attachment

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

STATE-SPECIFIC BACKGROUND ARSENIC LEVEL IN SOIL

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STATE-SPECIFIC BACKGROUND ARSENIC LEVEL IN SOIL

A concentration of **7 mg/kg** has been established by the Louisiana Department of Environmental Quality (LDEQ) as the naturally occurring background level of arsenic in soil for the state of Louisiana. To establish this value, available background data were compiled and reviewed for their suitability for establishing a State-wide background arsenic soil level (refer to Table 1). Of the datasets available, it was determined that a study conducted by the Louisiana State University Cooperative Extension Service (1990) generated the most comprehensive dataset available and therefore, was the most representative of background concentrations of arsenic in soils throughout the State. This dataset is comprised of 83 soil samples collected from 21 parishes throughout Louisiana (refer to Table 2). The arsenic levels detected in this study ranged from not detected (0) to 20.59 mg/kg with an arithmetic mean of 7.0 mg/kg with a standard deviation of 4.5. Based on this study, the default State-specific background arsenic soil level has been set at the arithmetic mean concentration of 7 mg/kg.

Section 2.13 of RECAP, Identification of Background Concentrations, states that "A background concentration may be used: (1) to distinguish site-related constituent concentrations from naturally occurring constituent concentrations, i.e., in the identification of site-related COC; and (2) as a default SS or RS when the limiting SS or RS is less than the background concentration. The background concentration applied at an AOC or an AOI for these purposes shall be: (1) a region-specific concentration established by the Department; or (2) a site-specific concentration based on sample collection/analysis by the Submitter and approved by the Department." For arsenic, the risk-based soil standards (nonindustrial, 0.38 mg/kg; industrial, 3 mg/kg; refer to Tables 1 and 2 of the RECAP document for these values) are frequently less than the naturally occurring background concentrations of arsenic in soil. Therefore, when the arsenic concentration detected in soil exceeds the risk-based soil standards, the Submitter may: 1) apply the State-specific background arsenic level of 7 mg/kg; or 2) establish a site-specific background level in accordance with the guidelines in Section 2.13. The State-specific background level of 7 mg/kg or the site-specific background level established by the Submitter and approved by the Department shall serve as the SO $Soil_{SSni}$ and $Soil_{SSi}$ and/or the MO-1, MO-2, or MO-3 $Soil_{ni}$ and $Soil_{i}$.

It is anticipated that the Departmental State-specific arsenic soil background concentration will be re-evaluated/revised as additional State-specific arsenic data becomes available.

Based on RECAP (RME) assumptions, the residential and industrial cancer risks associated with exposure to an arsenic soil level of 7 mg/kg are 1.8E-05 and 2.3E-06, respectively. Both of these cancer risk estimates fall within the acceptable cancer risk range of 1E-06 to 1E-04. For noncarcinogenic health effects, the residential and industrial hazard quotients are 0.34 and 0.015, respectively. Both of these hazard quotients are well below the acceptable hazard quotient of 1.0.

Supporting Documentation

Table 1
Background Arsenic Concentrations in Louisiana Soils

Source/Location	Soil Interval	Concentration Range (mg/kg)	Mean Concentration (mg/kg)	Number of Soil Samples
England Air Force Base [1]	0-0.5'	2.2 – 7.2	4.0	15
England Air Force Base [1]	0.5-10'	0.95 – 6.9	3.3	35
USGS 1270 [2]	20 cm	< 0.1 - > 10	NA	NA [3]
LSU Cooperative Extension Service [4]	Surface	ND – 20.6	7	83
LSU Cooperative Extension Service [5]	NA [6]	NA	10-15	NA
Scottlandville, La. [7]	0 – 0.5	5.2-13.2	NA	2
Belle Chasse, La. [8]	NA	<0.5 – 8.7	5	NA
Barksdale, La. [9]	NA	2.5-15.5	5.9	NA
Shreveport, La. [10]	NA	NA	2	NA
Youngsville, La. [11]	3'	<8.0 – 9.6	8.9	3
Overall	0-10'	ND – 20.6	NA	>138

[1]England Air Force Base Final Installation Restoration Program (IRP) Comprehensive Background Study Report, June 1996
[2]Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, 1984. Hansford T. Shacklette and Josephine G. Boerngen, U.S. Geological Survey Professional Paper 1270.
[3]Sixteen locations throughout Louisiana were sampled; total number of samples not available.
[4]Total Metal Concentrations in Louisiana Surface Soils, LSU Cooperative Extension Service, 1990.
[5]LSU Cooperative Extension Service website.
[6]Not Available.
[7]Closure Plan for the Former Export Drum Facility, Scottlandville, Lousisana, June 1998; sampling conducted by EPA.
[8]Chevron Chemical Company, Oak Point Plant, Belle Chasse, La.
[9]Rational National Standards Initiative Air Combat Command Pathways, Parameters, and Equations Report, Barksdale Air Force Base, Louisiana, 1995.
[10]LDEQ staff.
[11]135 Rousseau Rd, Youngsville, LA 70592 (Lafayette Parish).

Other sources of soil background arsenic data:

- ***Survey of the Total Arsenic Content in Soils in Louisiana*** (Ori, L.V., Amacher, M.C., and Seberry, Jr., J.E. Commun. Soil Sci. Plant Anal., 24 (17&18); 2321-2332, 1993): Surface and subsurface soil: arsenic levels ranged from 0-73 mg/kg, mean 23.2 mg/kg (> 450 soil samples taken in soils used for agriculture – the study concluded that the past widespread use of arsenic containing pesticides does not appear to have substantially increased the arsenic content of agricultural soils in Louisiana)
- ***Toxicological Profile for Arsenic*, ATSDR**: "The natural arsenic content of virgin soils varies between 0.1 and 80 mg/kg, with an average around 5 to 6 mg/kg. The amount of arsenic in soil depends on geologic inputs from mineral weathering processes, atmospheric deposition, and residue from pesticide application."

Table 2
Louisiana State University Cooperative Extension Service 1990
Background Metals Survey
Arsenic
(mg/kg)

Parish	Concentrations Detected	Average
Acadia	7.60; 6.70; 9.10; 8.50; 8.00	7.98
Ascension	3.22	3.22
Caddo	1.90; 1.61	1.76
Cameron	19.67	19.67
East Baton Rouge	5.56; 5.37; 4.16	5.03
Franklin	1.52	1.52
Jefferson	20.59; 5.46; 5.24; 6.71	9.50
Jefferson Davis	3.55; 4.57	4.06
Lafourche	9.62; 9.29	9.46
Orleans	8.27; 15.82; 19.64; 10.06; 15.53; 5.66	12.50
Ouachita	3.83; 0.00; 3.19	3.51
Rapides	2.34; 3.11; 5.16; 9.27	4.97
Sabine	6.74	6.74
St. Bernard	7.39; 8.34; 7.39; 7.32; 6.62; 7.79	7.48
St. John	5.92	5.92
St. Landry	4.76; 13.80; 16.27; 14.31; 14.24; 15.08; 16.20; 10.66; 11.89; 8.96; 5.42; 7.05; 7.05; 4.13; 2.83; 4.76; 4.15; 2.02; 3.55; 1.65	8.44
St. Mary	6.90; 4.88; 2.90	4.89
St. Tammany	0.16; 3.47; 10.61; 3.11; 5.16	4.30
Terrebonne	8.92; 9.20	9.06
Vermillion	5.63; 3.39; 2.61; 3.25; 3.80; 3.32	3.67
Washington	5.58; 5.85; 6.44; 5.71; 6.78	6.07
	n = 83 **Mean = 7.0 mg/kg** Standard deviation = 4.5 mg/kg Range = 0.00 – 20.59 mg/kg	

Table 3
Agencies which use a default background concentration as the soil standard for arsenic or allow for the identification of a site-specific background concentration to be used as the soil standard for arsenic

Agency	Background Soil Level (mg/kg)
LDEQ [1]	site-specific
EPA Region VI Medium-Specific Screening Levels [2]	1.1-16.7
EPA Region VI CAS [3]	site-specific
EPA Region IV [4]	site-specific
EPA Region IX Preliminary Remediation Goals [5]	0.59-11 (Cal.) 0.1-97 (US)
Washington State Department of Ecology [6]	20
Rhode Island Department of Environmental Management [7]	site-specific
Massachusetts Department of Environmental Protection [8]	30
Oregon Department of Environmental Quality [9]	site-specific
Illinois Environmental Protection Agency [10]	13 (metro areas) 11.3 (non-metro areas)
Colorado Department of Public Health and Environment [11]	site-specific
Florida Department of Environmental Protection [12]	site-specific
Texas Risk Reduction Rules [13]	5.9
EPA (risk assessment guidance) [14]	site-specific
NCP [15]	site-specific

[1] LDEQ Risk Evaluation/Corrective Action Program (RECAP) states that "If the limiting soil RS is below a Department-approved background concentration, the background concentration shall be identified as the limiting soil RS."

[2] EPA Region VI Medium-Specific Screening Levels documentation states that naturally occurring inorganic background levels may be considered in the screening of environmental data and are important in making risk-based decisions. It further states that not considering background concentrations when choosing a screening level is considered misapplication of the Region VI medium-specific screening levels.

EPA Region VI Default Background Arsenic Range of 1.1 to 16.7:

Reference #1 – England Air Force Base Final Installation Restoration Program (IRP) Comprehensive Background Study Report, June 1996 (EPA-Approved Background Study)

- Surface soil (0-6"): 2.2 to 7.2 mg/kg; mean 4 mg/kg (15 soil samples, results based on dry weight)

- Subsurface soil (0.5-10'): 0.95 to 6.9 mg/kg; mean 3.3 mg/kg (35 soil samples, results based on dry weight)

Reference #2 – Background Metals in Soil (EPA OSWER Memorandum 1989). Metals in Soils: A Brief Summary, Prepared by: Ellen L. R. Barrett, OTS, EPA.

- Surface soil (0-6"): 1.1 –16.7 mg/kg; mean 6.27 mg/kg (number of sample not provided; soil samples collected in Ontario, Canada)

Reference #3 – Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, 1984. Hansford T. Shacklette and Josephine G. Boerngen, U.S. Geological Survey Professional Paper 1270.

- Surface soil (20 cm bgs): <0.1 to >10 mg/kg; (soil samples from 16 locations in Louisiana)
- Surface soil (20 cm bgs): <0.1 – 97 mg/kg; mean 7.2 mg/kg (1,257 soil samples collected throughout US)

[3] Under EPA Region VI's Corrective Action Strategy, naturally occurring background concentrations (inorganic constituents only) may be used in the identification of the COCs. It a constituent concentration detected at the site is less than the background concentration, then the constituent may be excluded from further consideration. It further states, that if the background concentration presents a significant risk, then the risk posed by the naturally occurring background constituent may be considered separately.

[4] EPA Region IV allows for the use site-specific background data in the identification of COCs for the area of concern.

[5] EPA Region IX Preliminary Remediation Goal documentation states that the arsenic level in soil corresponding to a cancer risk of 1E-06 is frequently below naturally-occurring background levels and that in consideration of background concentrations of arsenic in certain areas, Region IX has at times used the noncancer PRG to evaluate sites recognizing that this value tends to be above background levels yet still falls within the range of soil concentrations (0.39 to 39 mg/kg for residential land use) that equates to EPA's acceptable risk range of 10^{-6} to 10^{-4}. It also states that, in general, EPA does not clean up below natural background and if natural background concentrations are higher than the risk-based PRG, an adjustment of the PRG is probably needed.

[6] The Washington State Department of Ecology has established statewide and regional 90th percentile values for natural background soil (0-3' bgs) metal concentrations

(Publication #94-115). The Method A (tier 1) soil cleanup level for residential soil for arsenic (20 mg/kg) is based on background arsenic concentrations in the state of Washington. Arsenic is the only constituent in the look up table (Table 2) for which the background level serves as the Method A Standard. The background level also serves as the Method A (tier 1) Groundwater (source or potential source of drinking water) Cleanup Standard for arsenic (5 ug/l). The Method A (tier 1) soil cleanup level for industrial soil for arsenic (200 mg/kg) is based on a target risk of 1E-05 (Model Toxics Control Act). The Model Toxic Act also states that Cleanup levels developed under this act shall not be set at levels below the natural background concentration.

[7] The Rhode Island Department of Environmental Management has issued a policy memo entitled "Guidance for Arsenic in Soil" (RIDEM, Office of Waste Management Sept 22, 2000). Studies of background levels of metals in Rhode Island soils indicate that the mean arsenic soil concentrations are lower than the national average (the arsenic levels in the New England Coastal geological formation has low levels of naturally occurring arsenic). The residential direct exposure criterion for arsenic (1.7 mg/kg) was adopted from a state-wide study of background arsenic concentrations. The industrial direct exposure criterion is 3.8 mg/kg (basis is not discussed in the memo). When arsenic concentrations exceed these criteria, the Department requires a tiered approach to determine if the concentrations observed at a site are background. The tiered approach is based upon a statistical evaluation of the statewide background data and site-specific data. Arsenic is the only COC for which this tiered approach is used.

[8] The Massachusetts Contingency Plan Subpart I Risk Characterization (310 CMR 40.0000) indicates that the if the risk-based concentration is less than the background level, then the background level shall serve as the soil or groundwater standard for that constituent. Furthermore, it is stated that if the constituent concentration in an environmental medium is less than or equal to the background level, then the constituent shall be considered to pose "No Significant Risk" even is the background level exceeds one or more of the numerical standards or risk criteria published in the MCP. The MCP tier 1 lookup tables provide background levels for soil, groundwater, and indoor air. The chosen background levels represent upper percentiles (75^{th} to 95^{th} percentiles) of a natural background distribution. The regulations state that the background levels provided in the MCP do not eliminate the requirement for identifying site-specific background levels. The background level serves as the MADEP Method 1 (tier 1) Standard for arsenic in soil (30 mg/kg). Arsenic is the only constituent in the look up table (Table 5.2) for which the background level serves as the Method 1 Standard for soil.

[9] Oregon DEQ's Guidance for Conduct of Deterministic Human Health Risk Assessments (Dec 1998, updated May 2000) states that for contaminant screening, a naturally-occurring chemical does not need to be identified as a chemical of potential concern (COPC) if the maximum detected concentration is less than the concentration selected as a background value (derived either from the appropriate literature or from site-specific sampling). The Division 122 Rules: Hazardous Substance Remedial

Action states that remedial efforts shall achieve background levels if the soil cleanup levels specified in this rule are less than the background levels.

[10] Illinois Environmental Protection Agency: Background levels may be used to support a request to exclude a contaminant from further consideration or it may be used as the remediation objective. There are 2 options: 1) use a default statewide inorganic background concentration (for a metropolitan or a non-metropolitan area) provided by the Department; or 2) establish a site-specific background concentration using a valid statistically approach approved by the Department.

[11] The Colorado Department of Public Health and Environment's Proposed Soil Remediation Objectives Policy Document is based on a tiered approach. Tier 1 utilizes naturally occurring background concentrations and analytical laboratory limitations to establish soil remediation objectives. A valid background study is required to establish appropriate background concentrations (no default background concentrations are provided; detailed guidance on establishing and interpreting background concentrations is provided in an attachment). Anthropogenic background concentrations may be considered acceptable if the implementing party can demonstrate to the Departments satisfaction that the anthropogenic contaminants are present are region-wide background.

[12] Florida Department of Environmental Protection Technical Report: Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-777 states that: "For chemicals which occur naturally in soils, the SCTLs may be below natural background levels for a site. If the SCTL value is lower than natural background, a site-specific SCTL should be set equal to the naturally-occurring background concentration." The Florida DEP has issued technical guidance on the Determination of Natural Background Concentrations (Oct 1999). Current research efforts on determining the natural background levels of arsenic in soil in Florida, indicate that the majority of sites (70-80%) have natural arsenic concentrations at or below the residential SCTL of 0.8 ppm. Research efforts are also focusing on determining the bioavailability of arsenic in soil.

[13] The Risk Reduction Program provides a Texas-specific median background concentration for arsenic in soil of 5.9 mg/kg. The Texas-specific background concentration may be used to determine the critical PCL (protective concentration level) and then used in comparisons to the individual measurements of arsenic or representative concentrations of arsenic.

[14] EPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual Part A (RAGS-A) states "If inorganic chemicals are present at the site at naturally-occurring levels, they may be eliminated from the quantitative risk assessment. In some cases, however, background concentrations my present a significant risk, and while cleanup may or may not eliminate the risk, the background risk may be an important site characteristic to those exposed. The RPM will always have the option to consider the risk posed by naturally-occurring background chemicals

separately." EPA Soil Screening Guidance recommends that background data be compared to the screening levels to determine if background concentrations at the site are elevated. It states that if background concentrations exceed the screening levels it does not necessarily indicate that a health threat exists, and that in general, EPA does not cleanup below natural background levels.

[15] The preamble to the NCP identifies background as a technical factor to consider when determining an appropriate remedial level: "Preliminary remediation goals ... may be revised to a different risk level within the acceptable risk range based on the consideration of appropriate factors including, but not limited to: exposure factors, uncertainty factors, and technical factors ... Technical factors may include...background levels of contaminants..." (55FR8717).