WYOMING MINING ASSOCIATION

October 6, 2008

Rulemaking, Directives, and Editing Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
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RULES AND DIRECTIVES BRANCH USNRC

Gentlemen:

Subject: **Wyoming Mining Association (WMA) Comments *NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities* Federal Register: Volume 73, Number 145 - Monday, July 28, 2008 / Notices pages 43795 to 43798**

The Wyoming Mining Association (WMA) is an industry association representing mining companies, contractors, vendors, suppliers and consultants in the State of Wyoming. Among its mining industry members are uranium recovery licensees, including an in-situ uranium recovery operator, the Sweetwater Uranium Project (the only remaining conventional uranium mill in Wyoming), several companies planning new uranium recovery operations and several companies conducting final reclamation/restoration operations. The Wyoming Mining Association (WMA) has reviewed *NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities* and has the following comments:

General Comments

The Association strongly supports the Generic Environmental Impact Statement (GEIS) process and believes that the final document should be prepared without delay. Several Association members have pending projects and review of the applications for these projects is pending completion of this document. Delays in the process delay the ability of member companies to commence production.

Statements Regarding Conventional Uranium Mills

Page xxxiv of the Executive Summary of the document includes the following statement:

> "*In addition, it should be noted that previous analyses have indicated that the potential environmental impacts associated with conventional uranium milling operations are significant, because the mill tailings, or waste, are a significant source of radon and radon progeny.* For this reason, *NRC has made a policy decision to prepare site-specific EISs for applications for a new, or restart of a former, conventional or heap leach facility, as required under 10 CFR 51.20(b)(8).*"

P.O. Box 866 Cheyenne, WY 82003 Area code 307 Phone 635-0331 Fax 778-6240
E-mail wma@vcn.com Web page www.wma-minelife.com

SUNSI Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = J. Park (SRP)

NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities is intended for in-situ recovery facilities. This statement applies to conventional mills, which should be outside of the scope of the document.

This statement, if included in the final document, has the potential to alter an existing license that allows under specific conditions an existing conventional mill to resume operations. This statement was discussed in a telephone conversation with a member of Commission staff on Friday, August 22, 2008. The staff member stated:

- "*This statement does not apply...*" to the existing conventional mill
- This statement does apply to sites where the pre-existing facility (conventional mill) has been decommissioned (torn down) and the site owner wishes to construct a new facility on the site.
- For example, this statement applies to Ambrosia Lake where the original conventional mill was torn down (decommissioned) and now others may wish to construct a new conventional mill on the same site.
- This statement will need to be revised/clarified in the final Generic Environmental Impact Statement (GEIS) to make it clear that its meaning is as stated above

The Association requests that this statement be modified in the final document so that it reflects the conversation with the Staff member and does not alter any existing license conditions allowing existing licensed facilities to resume operation.

Resin Storage without Requirement of a License Amendment

The National Mining Association's (NMA's) *Generic Environmental Report in Support of the Nuclear Regulatory Commission's Generic Environmental Impact Statement for In Situ Uranium Recovery Facilities* states:

> *Thus, while ISR uranium recovery licensees are viewed as the predominant users of synthetic IX resins for uranium recovery operations, both ISR and conventional uranium recovery licensees have, and have had, the capacity to process uranium-laden IX resins. With NRC's or an Agreement State's authorization, conventional uranium recovery facilities are allowed to utilize IX stripping and elution facilities at their licensed site(s). Indeed, the 1980 GEIS for conventional uranium milling specifically identified IX resins as a potential source of uranium recovery, whether from on-site processing or off-site water treatment:*
>
> > *"the resulting impure dilute leach solutions have to undergo concentration and purification as a prerequisite to the production of a final, high-grade, uranium product. A number of major techniques are used to affect this stage of the milling process. They are: ion-exchange... solvent extraction...."* ***NUREG-0706 - Final Generic Environmental Impact Statement on Uranium Milling, Project M-25, Volume 1.. September 1980***
>
> Further, while conventional uranium recovery facilities may create uranium-laden IX resins as a part of their processing operation, NRC also has identified IX resins from various water treatment operations as a potential source of uranium recovery material:
>
> > *"The Nuclear Regulatory Commission (NRC) and Agreement States have received, and in some cases approved, requests to allow a uranium mill to process feed material that was not natural (native, raw) uranium ore and dispose of the resulting waste in the facility's tailings impoundment. In those cases, the feed material was generally either processing wastes from other extraction procedures or the residues from mine-water treatment. These requests were handled on a case-by-case basis, and approvals were based on the interpretation that the proposed feed material was refined or processed ore."* ***57 Fed. Reg. 20525, 20532 (May 13, 1992)***
>
> *Given the statements noted above and the fact that both ISR and conventional uranium recovery facilities utilize similar technology to strip uranium-laden IX resins, NRC already has demonstrated that such IX resins are acceptable for processing at ISR and conventional uranium recovery facilities if such facilities have IX stripping and elution facilities that are licensed by NRC or an Agreement State. Since the receipt and processing of such IX resins has been acknowledged and assessed by NRC in the past,* ***NMA believes that NRC should make clear in the ISR GEIS that both ISR and conventional uranium recovery facilities can accept uranium laden resins from ISR operators and/or other water treatment operators without the need for a license amendment.*** (Emphasis added)

This request was ignored by the Commission in the draft document. The Association believes that this request should be reconsidered since it provides additional much needed flexibility to uranium recovery licensees

Environmental Justice

Uranium recovery licensees are fundamentally different from other radioactive material licensees in that they cannot choose the location of these facilities. The choice is made for them by nature. Other licensees (a conversion facility for example) can choose a potential site often based upon economic considerations such as proximity to transportation (rail and highways), availability of labor and land costs. Uranium recovery licenses do not have this luxury. They are forced to locate their facilities where the resource is located by Nature itself. Uranium recovery facilities are unable to relocate their facility from the proximity of one community to the proximity of another. They are forced to locate their facilities in the immediate vicinity of the resource regardless of where it might be. Since environmental justice regulations were intended to prevent intentional discriminatory siting of industrial facilities in economically depressed communities, they do not apply in cases where facilities have to be close to the point of uranium extraction.

Flexibility of Language Regarding Process Chemistry

The Association is pleased that the Commission has chosen to be flexible in its language regarding process chemistry using such phrases as:

> "...a leaching agent, such as oxygen with sodium carbonate..." (Executive Summary page xxxiii)

In the future potential uranium recovery licensees may consider other lixiviants if in-situ uranium recovery is performed in the future at greater depths, in aquifers that in their entirety contain water that is wholly unfit for use because of high Total Dissolved Solids (TDS) concentrations for example. While deep in-situ uranium recovery in aquifers that contain water wholly unsuitable for use is not currently being performed in the United States it may well be in the future as uranium prices increase and new deeper deposits are discovered. The option to use other non-conventional lixiviants must remain available.

Elimination of Yellowcake Transportation to Conversion Facilities/Transportation of Loaded Ion Exchange Resins

Yellowcake transportation to conversion facilities is discussed on page 1-12 in the following statement:

> "Because the environmental impacts of national transportation of yellowcake uranium have been previously analyzed, they will not be studied in detail within this Draft GEIS 9NRC, 1977, 1980)"

The Association agrees with this statement since these impacts have been studied in detail in:

NUREG-0535. Review and assessment of package requirements (yellowcake)
and emergency response to transportation accidents. July 1980

NUREG-0170, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," December 1977

This issue requires no further study.

Page 4.2-7 has a section entitled **Ion Exchange Resin Transport.** *The Association would like to point out that this issue has already also been evaluated. Regarding this issue the National Mining Association's (NMA's)* Generic Environmental Report in Support of the Nuclear Regulatory Commission's Generic Environmental Impact Statement for In Situ Uranium Recovery Facilities *states:*

> It is also worth noting that NRC's recent issuance of a source material license for R.M.D. Operations, LLC also assessed the transport of loaded IX resins from multiple community water systems (CWSs) to licensed uranium recovery facilities (conventional or ISR) for processing. Given that RMD's IX resins are substantially similar, if not identical to, ISR IX resins, this analysis should also be factored into NRC's assessment of transportation issues in the ISR GEIS.

In addition, in a Department of Energy (DOE) Environmental Assessment of uranium leasing in the Uravan District a detailed assessment of the environmental risks of ore transport was provided. While not directly applicable to resin or yellowcake transport, it provides additional insight into the very low levels of risk involved in the transport of radiologically similar materials. The documents title is: *Uranium Leasing Program Final Programmatic Environmental Assessment - July 2007* It may be found at:

http://www.lm.doe.gov/documents/sites/uraniumleasing/ulm_ea2007.pdf

Aquifer Restoration

The Association supports the discussion in **Section 2.5 – Aquifer Restoration** which states:

> *Groundwater adjacent to the exempted portion of the aquifer, however, must still be protected.*

This makes it clear that the goal of groundwater restoration is to protect water in the U.S. Drinking Water Aquifer (USDWA) surrounding the aquifer exemption area. The document should also make it clear that no aquifer exemption once granted has ever been rescinded. Once a portion of an aquifer has been exempted it remains exempted in perpetuity.

Background Radionuclides in Soils and Groundwater

The document discusses four distinct regions, the Wyoming East, Wyoming West, South Dakota – Nebraska and New Mexico Regions. These regions are all similar in that they are uraniferous areas. This means that not only do they contain uranium resources but that in general these regions contain

anomalous concentrations in soils and groundwater in areas not within defined and bounded resource areas. This issue should be clearly discussed and the fact that even following detailed evaluations of radiological background submitted with license applications, additional anomalous naturally occurring concentrations of radionuclides in soils and water may be found. While not discovered in the course of broad evaluations conducted in support of a license application, they may be discovered in the course of closure related remediation activities conducted on site. Licensees understand that it is not the goal or intent of the Commission to require the remediation of Naturally Occurring Radioactive Material (NORM) however in the course of a remediation effort this could occur.

Two (2) general tables regarding radionuclide concentrations in soils and water (based upon rock types) are included below:

Uranium Concentrations in Soils by Rock Type

Uranium Content in Parts per Million (PPM) of Various Sedimentary Rock Types		
Rock Type	**Average Uranium Concentration**	**Range of Uranium Concentration**
Fine grained clastics		
Common shales	3.7	1 - 13
North American gray and green shales	3.2	1.2 - 12
Mancos shale (western U.S.A.)	3.7	0.9 - 12
Black shales		3 - 1250
Coarse grained clastics		
Sandstones		0.45 - 3.2
Orthoquartzites	0.45	0.2 - 0.6

Carbonates		
Carbonate rocks	2.2	0.1 - 9
Russian carbonates	2.1	
North American carbonates	2.2	0.65 - 8.8
California limestones	1.3	0.3 - 4.9
Florida limestones	2	0.5 - 6
Other sedimentary rocks		
Marine phosphorites		50 - 300
Evaporites		0.01 - 0.43
Bentonites	5.0	1 - 21
Bauxites	8.0	3 - 27

Source: *Hydrothermal Uranium Deposits* - Robert A Rich, Heinrich D. Holland and Ulrich Petersen Elsevier Scientific Publishing Company New York 1977

Uranium Concentrations in Groundwater by Aquifer Rock Type

Rock Type		**Uranium Concentration in micrograms per liter**			
	Number of	**Range**	**Average**	**Number of Samples Greater than 4**	**Number of Samples Less than 4**

	Samples			micrograms per liter	micrograms per liter
Igneous					
Silicic (Light)	33	0 - 32	4.5	12	36
Basic/Intermediary (Dark)	18	0 - 9.2	0.9	1	6
Sedimentary					
Sandstone/Conglomerate	132	0 - 2100	26.2	22	17
Siltstone/shale	14	0 - 69	10.6	6	43
Limestone/dolomite	89	0 - 33	2.0	11	12
Sand/gravel	87	0 - 74	2.5	13	15
Metamorphic					
Undifferentiated	34	0 - 37	4.4	8	24
Totals:	407	0 - 2100	10.6	73	18

Source: *Hydrothermal Uranium Deposits* - Robert A Rich, Heinrich D. Holland and Ulrich Petersen Elsevier Scientific Publishing Company New York 1977

Clearly background uranium concentrations (and by extension the concentrations of uranium decay products) can vary greatly in the natural environment. This problem has not been lost on the Commission either as evidenced by the speech by former Commissioner Gail LePlanque's speech *In Search of ... Background* which is attached in Appendix 2.

Background issues are also discussed in *SECY-03-0069 - RESULTS OF THE LICENSE TERMINATION RULE ANALYSIS* which states:

Source material (uranium and thorium) is found ubiquitously in nature.

The above discussion is meant to be applicable in general to all four (4) defined regions. The discussion that follows is specific to the Wyoming West Region and probably exemplifies the uncertainties regarding background radionuclide concentrations in soil and water in the other three (3) regions as well.

Background radionuclide concentration in groundwater in the Wyoming West Region can be highly variable. In the *Geology of the Lost Creek Schroeckingerite Deposits Sweetwater County, Wyoming - Geological Survey Bulletin 1087-J* (which is included in these comments by reference) water samples collected in bore holes are discussed. This report was prepared prior to any uranium mining or processing being performed in the Great Divide Basin in the Wyoming West region. Uranium and radium concentrations as well as sulphate concentrations are discussed. Reported uranium concentrations ranged from .010 to 46 parts per million. In the November 1976 *Sweetwater Uranium Project Environmental Report*, an August 27, 1975 (again pre-processing) sample containing 1450 milligrams per liter sulphate and 13.3 milligrams per liter uranium collected from water from the top of the Battle Spring Aquifer collecting in the bottom of a test excavation was reported. A nearby test well (North Camp Well) contained naturally occurring uranium in a July 29, 1977 sample of 3.8 milligrams per liter. This sample was collected between 115 and 130 feet below surface near the top of the saturated zone. Often these areas of water containing elevated concentrations of radionuclides are very limited in horizontal and vertical extent; limited to a small lateral area and often the very top of the aquifer's saturated zone where downward percolating oxygen bearing water can leach natural uranium from overlying unsaturated sands carrying it down to the top of the saturated zone. They may also be associated with very small pockets of naturally occurring uraniferous soils associated with organic material. Such occurrences may not be discovered in pre-operation baseline studies due to their limited lateral and vertical extent however they could be discovered later during remediation work.

Data on background uranium and radium concentrations in soils in the Wyoming West Region is more comprehensive.

Appendix 1 contains a report entitled **Petrographic Evaluation of Sample #C07051289-001A from P.O. # 1845.** This report concerns a small pocket of soil discovered in an excavation in a supposedlyunmineralized area in the Wyoming West Region analytical results of which are shown below:

									RADIUM-226	
Location	**Sample Type**	Diesel Range Organics	Oil Range Hydrocarbons	Total Extractable Hydrocarbons	Natural Uranium	Natural Uranium	Thorium-230	Thorium-230 - Uncertainty	FINAL	
									Result	Uncertainty
		(milligrams per kilogram)	(milligrams per kilogram)	(milligrams per kilogram)	(milligrams per kilogram)	(picocuries per gram)	(picocuries per gram)	(picocuries per gram)	(picocuries per gram)	(picocuries per gram)

K Minus 3	Black Material	226	804	1000	2550.00	1726.35	393.0	17.0	396	9
K Minus 3	Sand	211	650	834	2350.00	1590.95	708.0	29.0	326	6.4

This material contains high concentrations of hydrocarbons, uranium, Radium-226 and Thorium-230 and as described in the report in Appendix 1 is entirely naturally occurring.

Attached please find additional background soil data applicable to the Wyoming West Region from the *Geology of the Lost Creek Schroeckingerite Deposits Sweetwater County, Wyoming - Geological Survey Bulletin 1087-J* in the following appendices:

Appendix 3 – Trench Sample Data – Sections 2-7 Lost Creek Area, Wyoming

Appendix 4 - Trench Sample Data – Sections 8 - 13 Lost Creek Area, Wyoming

Appendix 5 - Trench Sample Data – Section 1 Lost Creek Area, Wyoming

This paper provides near surface trench sampling data for the Lost Creek Area in Sections 1 to 13, Townships 25 and 26 North, Ranges 94 and 95 West in Sweetwater County, Wyoming. This sampling was performed by the United States Geological Survey (USGS) and provides detailed information on the extent of concentrations of naturally occurring radionuclides in soils.

Data generously provided by UMETCO Minerals Corporation concerning background radionuclide concentrations near its Gas Hills Site which is also applicable to the Wyoming West Region is included as follows:

Appendix 6 – UMETCO Gas Hills Site – Non-random Background Soil Radiometric Data

Uraniferous soils can elevate naturally occurring uranium concentrations in groundwater on a very localized basis if the uraniferous soils are of limited lateral and/or vertical extent or if they occur in small pockets as did the material described in Appendix 1.

To some extent the Commission has addressed this issue for soils in *NUREG-1620 - Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act of 1978* which states in part:

> *(2) Soil Background Radioactivity*
> Determine that the background level of Ra-226 (and U-nat, Th-230 and Th-232, as needed) in surface {15 cm [6 in.]} soil has been estimated using representative soil samples from nearby {within 3.2 km [2 mi] of site boundary} undisturbed areas that are not affected by site activities and are geologically and chemically similar to the contaminated areas. The number of samples

obtained at the typical site to determine the average value, standard deviation, and distribution. The arithmetic mean of the sample data is used in the cleanup criteria unless appropriate statistical analysis demonstrates a log normal distribution (three tests) of the data.

Several different background values may be required if contaminated areas have distinctly different soil types. For example, if a portion of the site has a natural uranium and/or radium mineralization zone in/near the surface, the cleanup criterion for that area would use a background (reference) U-238 or Ra-226 value from a similarly mineralized area. A geologic site map with the background values placed on the sample location can be used to help identify whether more than one background value should be considered.

If the plan indicates that in situ ore is in the clean-up area, it should be characterized by Ra-226/U-238 ratios, visual criteria, and/or other means.

This language gives licensees some ability to address naturally occurring radioactive materials discovered during site remediation at conventional uranium recovery sites. Similar language should be included in the *NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities* so that it is clear that small isolated pockets of soils containing naturally occurring radioactive material could be discovered at operations in the four (4) defined uraniferous regions especially during site remediation that were previously unknown and that the licensee would not have to remediate them provided that the licensee is able to demonstrate that they are in fact naturally occurring.

The document should also discuss the potential for discovery of pockets (outliers) of groundwater containing elevated levels of radionuclides in the four (4) regions that may not have been discovered during initial site characterization and that the licensee would not have to remediate them provided that the licensee is able to demonstrate that they are in fact naturally occurring.

Environmental Protection Agency Issues

The Environmental Protection Agency gave a presentation on 40 CFR Part 61 Subpart W at the National Mining Association (NMA)/Nuclear Regulatory Commission (NRC) Uranium Recovery Workshop in Denver, Colorado on Wednesday, April 30, 2008. The presentation discussed the following items:

- **Inclusion of All 11(e).2 Byproduct Material Impoundments**
  - In their presentation, Agency staff stated that impoundments regulated under 40 CFR Part 61 Subpart W included all impoundments that contained 11(e).2 byproduct material including fluids such as tailings fluids and fluids at in-situ uranium recovery operations. They stated that evaporation ponds at conventional uranium mills and in-situ uranium recovery facilities as well as conventional tailings impoundments would hence forward be regulated under 40 CFR Part 61 Subpart W.

This seemingly arbitrary regulatory position is a radical departure from the historic and current application of 40 CFR Part 61 Subpart W in which it was solely applied to operating uranium mill tailings impoundments. In fact 40 CFR Part 61 Subpart W states:

§ 61.250 Designation of facilities.
The provisions of this subpart apply to owners or operators of facilities licensed to manage uranium byproduct materials during and following the processing of uranium ores, commonly referred to as uranium mills and their associated tailings. This subpart does not apply to the disposal of tailings.

Regulation of impoundments containing 11(e).2 byproduct material fluids under Subpart W therefore flies in the face of the language of the regulation itself.

- **Discrete Environmental Protection Agency (EPA) Approval of Subpart W Facilities**

  - The Nuclear Regulatory Commission (NRC) is the lead Federal agency charged by Congress with responsibility for permitting source material recovery facilities. The Agency representatives at the meeting stated that the Environmental Protection Agency (EPA) wants to perform their own discrete and separate review of applications to construct impoundments and that such review would require one (1) year. They stated that this would be performed concurrently with the Nuclear Regulatory Commission's (NRC's) review. This flies in the face of current regulatory jurisdiction which clearly charges the Nuclear Regulatory Commission (NRC) (or Agreement States) with sole responsibility for the permitting of source material recovery facilities.

Representatives of the uranium recovery industry met with Commission staff regarding this issue on Wednesday, September 17, 2008. They subsequently met with members of the Environmental Protection Agency's (EPA's) headquarters staff on Thursday, September 18, 2008 regarding this issue as well.

Based upon discussion with those involved in the meeting process, it appears that Agency staff misinterpreted 40 CFR Part 61 Subpart W and that it was clearly written to solely address tailings impoundments and does not extend to fluid retention ponds. Regardless, the Association would like this issue discussed and resolved in *NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities.* NRC should exert it's primacy in this regard in abundantly clear language.

The extent of jurisdiction of the Environmental Protection Agency (EPA) regarding *Liquids and Solids* at uranium recovery sites should be clearly discussed and defined in the document so that a potential licensee knows precisely what submittals must be made and to whom they must be submitted. The *Liquids and Solids* section already does this for discharges when it states:

If effluents are to be released into waters of the United States, discuss the status of efforts to obtain a water quality certification under Section 401 and discharge permits under Section 402 of the Federal Water Pollution Control Act of 1972, as amended (Ref. 10), or submit copies of these items if they are already issued.

The same should be done for tailings impoundments and other 11(e).2-byproduct material impoundments at licensed uranium recovery facilities.

Alternative Milling Methodologies

The document states:

> Because ISL techniques may not be appropriate in these circumstances, conventional mining (underground or open-pit/surface mining) and milling techniques (e.g., heap leaching) are possible viable alternative technologies.
>
> Inasmuch as the suitability and practicality of using alternative milling methodologies depends upon site-specific conditions, a generic discussion of alternative milling methodologies is not appropriate.

The Association agrees with this statement. In addition to not being appropriate, it is not required and would be redundant since alternative milling methodologies (specifically conventional milling and heap leaching) are already addressed in:

> *Final Generic Environmental Impact Statement on Uranium Milling, Project M-25,* Volume 1. NUREG-0706. September 1980

Regarding the above document, Sequoyah Fuels Corporation in *URANIUM MILLING ACTIVITIES AT SEQUOYAH FUELS CORPORATION* states:

Non-convention al processing, also identified in NUREG-0706, comprise other technologies, such

> *as in-situ extraction of natural ore bodies, leaching uranium-rich tailings piles or low-grade ores (often called heap leaching), and uranium extraction from mine water and wet-process phosphoric acid. Non-conventional processing usually encompasses one or several of the processing stages* (depending upon the application) that are performed at a conventional milling facility.

Other Items

In one instance the use of sodium hydroxide is incorrectly described. Sodium Hydroxide is added to solutions to raise not "lower" the pH.

Cultural resources are discussed. Cultural resources are generally avoided in operations. However, in the case where cultural resources can directly interfere with wellfield development, data recovery can be the choice of the operator to extract all relevant data such that the site can be entered and potentially declared available for full operations. Other methods that can be used include full covering (burial with a thick layer of overburden) which will preserve the site from in-field operations such that future excavation can complete data extraction.

The Wyoming Mining Association (WMA) appreciates the opportunity to comment on *NUREG-1910 - Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities*.. If you have any questions please do not hesitate to contact me.

Sincerely yours,
WYOMING MINING ASSOCIATION

Marion Loomis

Marion Loomis
Executive Director

Cc: Katie Sweeney – National Mining Association (NMA)

Appendix 1

Gareth D. Mitchell
Consulting Geologist
1307 Park Hills Ave.
State College, PA 16803
Home: (814) 237-0868
Bus.: (814) 865-6543; Fax: (814) 865-3573
Email: n8h@psu.edu

June 13, 2007

Mr. Steve Dobos
Energy Laboratories, Inc.
2393 Salt Creek Hwy.
Casper, WY 82602

RE: **Petrographic Evaluation of Sample #C07051289-001A from P.O. # 1845**

Dear Mr. Dobos,

Work requested in your purchase order of 5-29-07 for sample #C07051289-001A to perform carbon identification using reflected-light optical microscopy has been completed and the final report is attached.

If there are any questions or concerns, please call or e-mail me directly.

Thank you.

Sincerely,

Gareth Mitchell

Enclosure: Report

Final Report

To: Mr. Steve Dobos
From: Gareth D. Mitchell
Date: June 13, 2007
Subject: **Petrographic Evaluation of Sample #C07051289-001A from P.O. # 1845**

Request

A sample identified as **#C07051289-001A** was received 6-7-07 for petrographic evaluation. The sample had been shipped in a cooler containing bags of ice and was still cold when received. Consequently, the specimen was placed under refrigeration until sample preparation was initiated. As established from our email conversation of 5-24-07, optical microscopy was to be employed to determine the nature of the organic matter found in the sample and specifically to determine if "any naturally-occurring organic matter" (such as lignin, kerogen, bitumen, etc. that might have precipitated uranium at this location) was present.

Procedures

The sample was found to be composed of three fairly large angular particles (~10 g) and a coarse powder (~11 g). These components were separated and allowed to come to room temperature before they were inspected. The largest particle was soft, organic matter which had prominent bedding and considerable surface moisture, whereas the particulate matter ranged in particle size (0.5 – 3.0 mm), appeared to be a mixture of light and dark colored materials and was agglomerated with surface moisture. To prepare an optical mount suitable for reflected-light microscopy, the moisture content had to be reduced. The large particle was placed in a drying pan and a one-quarter split of the particulate sample retrieved by riffling was placed in second pan. Both samples were placed in a vacuum oven between 30-50°C for about 18 hrs with the result that the large particle had become swollen, desiccated and broken into smaller segments, while the particulate sample was composed of individual loose particles.

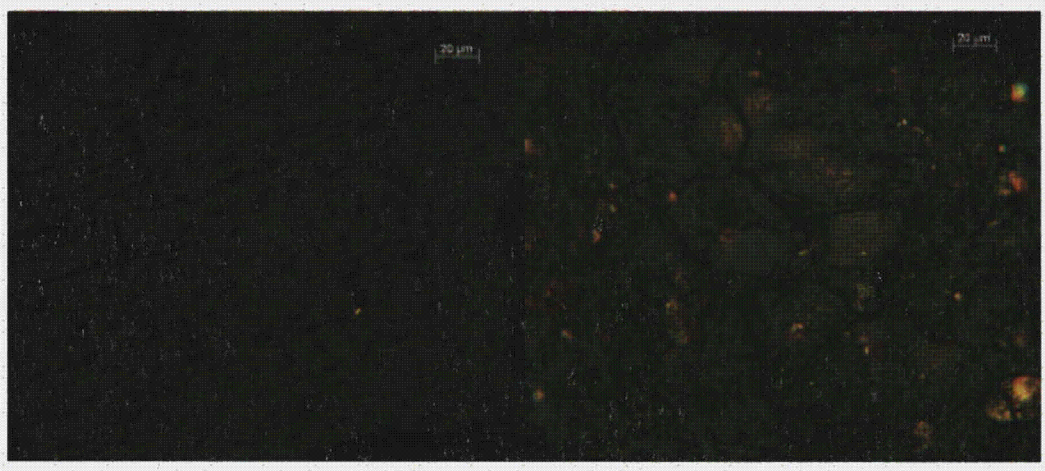
Remnants of the large particle were glued fast to the bottom of a 28 mm sample mold and embedded under vacuum with a cold-setting epoxy (EL01). The particulate sample (EL02) was vacuum impregnated in epoxy resin and placed in a centrifuge to establish a density/particle-size gradient. After hardening, the sample was cut longitudinally to expose the particle gradation and mounted 25 mm sample mold with additional epoxy. Both specimen surfaces were ground using 400 and 600 grit papers and polished using 0.3 and 0.05 micron alumina slurries on a high-nap cloth and silk, respectively. The sample was examined first in air using blue-light (436 nm) irradiation inspecting the 520 nm emission surface at 500X magnification and then using white light employing an oil immersion objective at 625X magnification using Zeiss research microscopes. In addition, a few reflectance readings were taken from the main organic

component identified in EL01. A Leitz MPV2 reflectance photometer system at 625 X magnification in oil immersion and polarized white-light was used to collect maximum reflectance values from 11 different areas and the mean value is provided below. Mean reflectance values are an acceptable procedure for determination of organic maturity.

Results

The organic matter observed in both specimens (EL01 and EL02) separated from sample #C07051289-001A is basically humified woody tissue of very low maturity (mean maximum reflectance in oil of 0.18 % ±0.01) that contains fluorescent and presumably resinous material within open cell lumens and along some open fractures. A few fluorescent bodies appearing to be amorphous organic matter were the only other organic matter observed in either sample.

As seen in the photomicrographs below, the regular alignment of cell wall and filled or open lumens taken from EL01 are compared with a fragment of humified and gelified woody tissue found in specimen EL02. The large particle separated as EL01 was composed entirely



EL01 **EL02**

of woody tissue that had gone through the biochemical stage of coalifiaction in which the cell walls were gelified and converted to humic matter. The tissue observed in the EL01 photograph exhibits little detail within the remnant cell walls and most of the lumens were filled with amorphous humic material or a fluorescing resin (dark areas), suggesting that the tissue has gone beyond the peat stage. However, the very low mean reflectance suggests that it may not have reached the rank of lignite in terms of coal maturity.

The photograph of the dominant organic matter in specimen EL02 shows many rounded bodies which in brown coal terminology are referred to as gelinite. As the name implies the

humic matter from which they were derived were once gelatinous and have since formed into these amorphous bodies surrounded by the remnants of cell walls. In addition to organic matter, specimen EL02 contained mostly angular fragments of minerals and rocks composed of quartz, other silicates and carbonate. Furthermore, some of the organic material had been infilled and was in the early stage of being replaced by silica.

These observations demonstrate that the organic matter contained in sample #C07051289-001A were derived from terrestrial plants with secondary woody tissues that have gone through at least the initial stage of coalification. Depending upon stratigraphy and sample location in the field, the type and condition of organic matter and mineralization observed suggests that it is naturally occurring.

Appendix 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
Office of Public Affairs
Washington, D.C. 20555

No. S-28-94
Tel. 301-415-8200

Remarks by Dr. E. Gail de Planque
Commissioner, U.S. Nuclear Regulatory Commission
before the
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In Search of . . . Background

It is a pleasure to be here this morning at the NRC Workshop on Site Characterization for Decommissioning. I'm so pleased to see so many in attendance because I think that the issue of decommissioning is one of the most significant issues on the Commission's plate, one that will have long lasting and far reaching impacts.

Introduction

As you know, the NRC is undergoing a lengthy process aimed at formulating radiological criteria for the decommissioning of NRC-licensed facilities. During that process, extensive discussions have focused on four possible approaches to this task: (1) establishing an annual risk or dose limit for an individual; (2) establishing an annual risk or dose goal; (3) requiring use of the best available technology; or (4) requiring return of the site to background radioactivity. While many commenters preferred a risk-based or dose-based standard, many others favored the "return-to-background" approach.

The proposed rule attempts to accommodate both groups by establishing a dose limit for release of the site of 15 millirem per year Total Effective Dose Equivalent (TEDE) for residual radioactivity distinguishable from background with further reductions As Low As Reasonably Achievable, or ALARA.

First, an aside. To make life easier, I will usually use the quantity total effective dose equivalent expressed in units of mrem. But for brevity's sake, I will use the term "dose" when speaking of total effective dose equivalent.

The objective expressed in the proposed rule is to cleanup up to dose levels that are indistinguishable from background. Return to background!

Sounds good, doesn't it? On the surface, this seems like a relatively easy, common-sense approach: for example, survey a nearby spot unaffected by a nuclear facility, use that radiation level as a baseline, clean up the contaminated site to that level, and . . . voila! The site is decommissioned, the method indisputable, the job completed.

But, as we all know, the devil is in the details. And in this case, the devil could produce a series of torments for those involved in returning a site to background.

I'd like to discuss some of the details with you this morning, particularly the details that are relevant to determining what background is and how it is measured. But I'd also like to place this discussion of the details within the broader context of a regulatory decision-making process.

Risk-Based Decision-Making

The decision-making process I'm referring to is "risk-based" decision-making, a process gaining popularity both in the Clinton Administration and in Congress, and widely advocated by the most recent Supreme Court member, Justice Stephen Breyer. Let me say at the outset that as far as I know this particular mode of making decisions was not followed in any rigorous way in formulating the proposed rule. Nevertheless, for reasons which I hope will be clear later in this talk, it may offer a useful framework for working out the details of a decommissioning program.

Risk-based decision-making allows for the assumption that the resources available for limiting risks are not inexhaustible and seeks to ensure that the resources which are available to society as a whole will be put to the best overall use considering risk, cost and benefit. It can be divided into three basic components as illustrated by the following Sydney Harris cartoons: (1) risk assessment, (2) selection of an acceptable level of risk, and (3) risk management. In the context of decommissioning, risk assessment is an evaluation of the hazard associated with residual radioactivity remaining at a site released for unrestricted or restricted use. Selection of an acceptable risk level involves weighing the benefits of lowering risk to a certain level against the costs and may involve comparing the risk at issue with other similar risks confronting society. Risk management consists of a regulatory process designed to keep the risk below the level found to be acceptable.

Risk Assessment

As the NRC begins to formulate a regulatory program to manage the risk associated with sites cleaned up to levels of radiation contamination that are indistinguishable from background, it might be useful to revisit Step 1 of the risk-based decision-making process: risk assessment. Perhaps this can most easily be done by reviewing the levels of radiation to which humans are typically exposed and the health consequences of those levels.

Broadly speaking, the average American's annual radiation dose is attributable to two sources: naturally occurring radiation which, in the U.S., produces about 82% of the dose, and anthropogenic radiation which produces the remaining 18%. Humans are bathed in a sea of naturally-occurring radiation which has been present since the formation of the earth. About 56% of the average annual dose is from radon and its decay products. Another 11% is from other internal sources, mainly from inhalation and ingestion of food and water which contain naturally occurring radioactive elements. The remainder is from external sources, about 7.5% from cosmic rays and about 7.5% from terrestrial gamma ray sources such as uranium, potassium, and thorium, that are present naturally in soil and rocks.

Just to complete the picture, let's look at the anthropogenic sources. About 11% of the average annual dose comes from medical x-rays, about 4% from nuclear medicine, and about 3% from consumer products such as smoke detectors. The small remainder is from fallout from weapons testing, and occupational exposures at various nuclear facilities.

The proposed rule defines "background radiation" as:

> radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents like Chernobyl which contribute to background radiation and are not under the control of the licensee.

Although naturally-occurring radiation and fallout from atmospheric weapons testing and the Chernobyl accident are present everywhere, each of these components of what I'll refer to as background, and the corresponding dose delivered, is by no means constant. Background levels fluctuate significantly due to various physical phenomena that differ from place to place and change with time at any given place. For example, over the long-term, cosmic radiation varies by about 10% over the 11 year solar cycle. Seasonal cycles produce changes in soil moisture, rainfall, snow cover, and evapotranspiration that cause variations in the dose from terrestrial gamma radiation, fallout and radon. Many sporadic geophysical phenomena, volcanic eruptions or earthquakes for example, can also introduce radioactivity into the environment.

Temporal variations can also occur over the short term. Rain, for example, will wash out radon and other radionuclides from the air causing an immediate rapid increase in dose that typically decreases exponentially after the rain stops. Doses from radon typically exhibit a diurnal cycle due to local climate conditions.

Radiation varies spatially. The dose from cosmic radiation is a function of both latitude and altitude. The population of the city of Denver, at an altitude of a mile receives an annual cosmic ray dose that is a factor of 2 higher than the U.S. average. Terrestrial gamma radiation, including fallout, varies from place to place because of differing amounts of uranium, potassium and thorium in the earth's surface material and can easily differ by a factor of 10 across the country. Granite, for example, contains higher than average uranium concentrations and

monazite sands can have particularly high concentrations of thorium. Furthermore, humans sometimes alter soil content with fertilizer which contains varying amounts of potassium-40. Spatial variations occur locally as well; the well-known Reading Prong in New Jersey provides an interesting regional example. The average annual dose from gamma radiation is approximately 50 mrem but if one resides closer to the rock formations along the prong, the annual dose can be much greater. About sixty miles away at the New Jersey shore, the gamma radiation dose levels fall to less than 10% of the average measured over the Prong.

Even in the immediate environment of a typical facility site (this happens to be Shoreham, Long Island), significant fluctuations occur (Figure 1). For this site with an annual average terrestrial gamma dose of about 35 mrem, when measured simultaneously, levels varied by more than 50% over a distance of only a mile within the site boundary, and the areas within a 4- or 5-mile radius of the site exhibited variations with even greater extremes.

This site in rural New Jersey, used as a background monitoring station, is only 50' by 200' (Figure 2). And even within such a small area, simultaneously measured terrestrial gamma radiation dose levels, which average about 125 mrem per year, differ by as much as 30% from spot to spot. That translates into differences of close to 40 mrem per year.

Other local variations occur due to the types of houses and buildings in which people live and work. Persons living in a wood frame house usually receive lower doses than persons living in an all brick house because, even though brick is a better shield of outdoor radiation, it has higher concentrations of naturally occurring radioactivity than wood. Persons working in granite and marble buildings may receive higher doses due to the radioactivity in the stone. Even moving from a rural to an urban setting may increase an individual's annual dose, due to the level of radioactivity present in concrete. The dose from cosmic rays can be measurably higher on the top floor of a high rise than on the ground floor. Measurements in a 12 story building in Manhattan indicated a cosmic ray dose on the ground floor one third that on the 12th floor, due principally to the shielding effect provided by many stories of concrete from the building in question as well as adjacent structures. In addition, a person's annual dose from radon can vary dramatically, by a factor of 10 or more, depending upon where they are and the adequacy of ventilation.

To further complicate matters, these temporal and spatial variations can be interdependent. For example, determining the average annual dose received from terrestrial gamma radiation cannot be done simply by measuring differences in soil concentration, since it is also affected by weather conditions. Moreover, usage must be considered and can result in what is often referred to as technologically enhanced natural background radiation. Finally, the actual dose to particular humans is heavily dependent upon the specific external and internal pathways of exposure.

Obviously then, there is no single number that represents the annual dose to U.S. citizens from background. But for perspective, it is useful to know that the average annual background dose for the U.S. population is about 300 mrem with about 200 mrem from radon, about 40

mrem from other internal sources, about 25 mrem from cosmic rays and about 25 mrem from terrestrial gamma rays. The average annual dose from fallout is less than 1 mrem.

However, because of the many factors that cause both spatial and temporal variations, the annual U.S. dose from background can easily range from 100 mrem for people who live in well-ventilated wooden houses on sandy soil at sea level to about 1000 mrem for people living in the Denver area, a factor of 10 (Figure 3). At the Shoreham site, annual doses from terrestrial gamma radiation differed with location alone by as much as 25 mrem per year. At the small New Jersey site, the equivalent spot to spot difference was as high as 40 mrem per year. It is in the context of these variations that the selection of 15 mrem over background as the acceptable annual dose for residual radiation from a decommissioned site must be viewed. For additional perspective, consider that we rarely choose our residences or domestic habits based on exposure to background radiation, yet the choice to live in a brick rather than a wood-frame house can increase one's annual dose by 45 or 50 mrem. A gas stove can deliver about 15 mrem per year to the lungs due to naturally occurring radioactive elements in the gas and a single flight across the U.S. yields about 4 mrem. A Denver resident can receive double the cosmic ray dose, triple the terrestrial dose, quadruple the radon dose, and a higher intake of radionuclides in drinking water compared to persons living in a coastal region--and if the house is not well ventilated the total dose could be still higher!

Selection of an Acceptable Level of Risk

To place the risk from exposure to background radiation in context, let's look at some general risks to the population. About 33% of the general population in the United States die of heart disease and about 23% die of cancer. Non-cancerous lung disease (7.7%), strokes (6.7%) and accidents (4.3%) also figure strongly as major causes of death (Figure 4). Comparing these causes of death, all of which carry a risk of greater than 1%, with the elective or accidental risks faced by selected groups or by the general population illustrates the complexity of adding societal choice to risk-based decision-making in terms of selection of an acceptable level of risk (Figure 5). Smoking one pack of cigarettes daily will result in death from a related cause for about 28% of smokers and a motorcyclist has about an 11% lifetime chance of dying in a motorcycle accident. By comparison, the average American's risk of dying in an air accident is several orders of magnitude lower, about 0.02%.

As I said earlier, the annual dose from natural background in the U.S. ranges from 100 to 1,000 mrem with an average of about 300 mrem. When relating these annual doses to risk, the risk assessment models developed by the International Commission of Radiological Protection (or ICRP) are usually applied. The ICRP performs risk assessments for both deterministic and stochastic effects of exposure to radiation based on research reports of radiation effects on tissues and animals, as well as on human epidemiology studies and modeling. For the purposes of radiation protection, the ICRP *assumes* a linear non-threshold dose-effect model and basically extrapolates to estimate the probability of harm resulting from low doses and dose rates where there is little, if any, human health effects data.

Using ICRP's method of risk assessment, the average annual 300 mrem dose from background produces a lifetime risk of fatal cancer of slightly less than 1 in 100, or approximately 0.82%. The corresponding lifetime fatal cancer risk for 100 and 1000 mrem are approximately 0.27% and 2.7%, respectively (Figure 6).

So how would an additional increment of 15 mrem change the public's risk from natural background? Looked at in isolation, 15 mrem per year over a 70-year lifetime would result in a risk of about 0.04% yet another decade lower on this log scale. When added to the risks associated with low, average, and high annual doses from background it is barely distinguishable (Figure 7). Indeed 15 mrem represents 5% of the average annual dose and is lost within the range of background which spans a factor of 10.

It is perhaps useful to note that for members of the public, the NCRP recommends an annual limit of 100 mrem for continuous exposure and an annual limit of 500 mrem for infrequent exposures due to all anthropogenic sources and recommends that ALARA be practiced below that. They further recommend that where there are multiple sources, no single source or set of sources under one control should result in an individual being exposed to more than 25 mrem annually.

What does one conclude from all of this? The limit of 15 mrem, including 4 mrem from drinking water which in itself is material for a lengthy lecture which I won't attempt to address here, carries a risk that is a small increment over the risk from background itself. Given that the risk is small and masked by the variation in the risk over the range of background doses, one must ask what all this should imply for the third or final component of risk-based decision-making, risk management.

Risk Management

The major questions for risk management are: (1) What is it that will be measured or used to represent "background" at a particular decommissioning site? (2) What will be measured to determine compliance with the 15 mrem limit? and (3) What margins of error or what uncertainties will be considered acceptable in determining compliance?

The difficulties involved in answering these questions become apparent when a site's decommissioning efforts are broken down into a series of steps and the complications that can exist with each step are examined. The overall process consists of, first, an analysis of the activities that have been performed at the site to be decommissioned; second, an assessment or survey to establish what represents background and a survey of the site to determine the degree of cleanup required; third, cleanup; fourth, a resurvey of the site; and, finally, release of the decontaminated site.

Each of these activities can be further broken down into sub-steps. For example, the person performing an analysis of the activity at the site must ask a series of questions: (1) Did the licensed activities involve single or multiple radionuclides? (2) With respect to each

radionuclide, does it also exist in background or is it only produced as a result of licensed activities at the site? (3) For each radionuclide, are there single or multiple pathways that may result in exposure to humans?

Surveying also has multiple sub-steps. Survey methods and the required number of surveys of each type must be determined to establish the background level or levels. The corresponding number of site surveys that will be necessary to establish the level of residual radioactivity on site with reasonable confidence must be determined and the background surveys and initial site surveys must then be performed.

The site is now ready for cleanup. Based on the analysis and survey results, the appropriate methods must be chosen and cleanup performed with periodic re-surveying to determine the level of progress until the release criteria are met and the site is ready for release.

Let's consider a few examples of how this process actually works. First, consider a simple example in which the residual radioactivity involves a single, non-naturally occurring nuclide. For simplicity's sake, postulate that the radionuclide has only one pathway of exposure. This will result in a single set of surveys, presumably a single method of decontamination, and a straightforward path toward releasing the site.

For a second example, let's consider a slightly more complicated scenario, involving multiple naturally occurring nuclides, at least one of which is known to result in human exposure via several pathways. This analysis is still relatively simple, but the surveys will be somewhat more complex. In this situation background will have to be established in a manner that accounts for variability, and that will differentiate quantitatively between background radiation and that produced by site activities. The clean-up may also be somewhat more complex due to the multiple nuclides and pathways of exposure.

The third scenario, unfortunately, may be the most realistic picture for most licensees, including reactor facilities. In this case, the analysis may involve a whole spectrum of radionuclides, some, but not all, of which occur in background. It may also involve a variety of interrelated pathways of human exposure. As a result, establishing background becomes much more complicated, even for a site with a detailed pre-operational survey. Multiple elements of spatial and temporal variation will complicate this scenario further, requiring a higher number of surveys and sometimes multiple methods to achieve the necessary degree of confidence. The decontamination of such a site, of course, will be correspondingly more difficult, involving multiple clean-up methods and, quite possibly, repeated attempts, with re-surveys performed as necessary until the criterion of 15 mrem above background has been met and the site is ready for unrestricted release.

How does this affect cost, certainly an element in risk-based decision-making? Survey costs alone, not even considering cleanup costs, will vary based on the complexity of the situation considering the number of surveys taken and the quality of those surveys in terms of the degree of confidence required, or level of uncertainty considered acceptable.

Consider the cost per sample of various radiation measurements likely to be used in any major decommissioning effort (Figure 8).[1] Assessing the potential radiation dose to humans for a multi-nuclide site could require a complete pathway analysis, including measurements of external gamma dose; air, soil and vegetation samples; and samples of surface water, drinking water, and precipitation. Obviously, to attempt to sample and measure every cubic meter of the relevant environment would be both impractical and prohibitively expensive. Instead, a sampling strategy must be developed combining radiation survey readings over large areas with selective sampling and analysis at representative locations, using the results of past measurement programs as appropriate.

Even with an efficient sampling strategy, however, the cost of performing surveys just to establish background can escalate sharply depending on the degree of uncertainty that is acceptable, which will directly influence both the survey methods employed and the number of surveys taken. In general, measuring smaller doses means increasing costs as more sophisticated techniques are employed.

Similarly the costs of site surveys and decontamination increase based on the background criteria employed and the level of sensitivity and confidence desired. For some radionuclides, the detection limits of standard laboratory instruments can be reached, causing the survey costs to rise dramatically as sophisticated research techniques become necessary. For naturally occurring radionuclides or those present in residual levels from weapons fallout, it may be virtually impossible to distinguish the contribution of site activities given the spatial and temporal variations in background discussed earlier.

Just as an example, consider the cost of measuring cesium-137 in soil (Figure 9).[2] At dose increments of about 30 mrem per year or higher, the cost is about $50 per sample. The cost roughly quadruples when trying to measure at levels of 10 mrem per year or less--based on the need for more sensitive laboratory methods--and increases dramatically again, to about $500 per sample, when measuring at a level of 0.3 mrem per year, which requires sophisticated research techniques. Because cesium-137 is present in residual radioactivity from weapons fallout, the typical levels and degree of variability make the cost of measuring this radionuclide at dose increments of 0.1 mrem per year more or less indeterminate.

What all this reveals is that every assessment of dose due to either natural or anthropogenic radiation will entail some degree of uncertainty. Whether that uncertainty stems from spatial or temporal variations, the limitations of the measurement technique, or the ability of the analyst to interpret data, it is still uncertainty, and it can never be entirely eliminated. Now let's review how the compliance process might work. First, background (χ_o) must be

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[1]NUREG-1496, Vol 2, "Generic Environmental Impact Statement in Support of Rulemaking on radiological Arteria for Decommissioning of NRC-Licensed Nuclear Facilities," Appendices, p. A-44, August, 1994.

[2]NUREG-1496, Vol 2, "Generic Environmental Impact Statement in Support of Rulemaking on radiological Arteria for Decommissioning of NRC-Licensed Nuclear Facilities," Appendices, p. A-53, August, 1994.

determined. But, unless it is zero, this is clearly not well-defined and carries an uncertainty (σ_o). To determine if cleanup is sufficient, the site must be surveyed to determine what remains (χ_1) which may or may not include natural background as discussed earlier. This, too, of course, carries an uncertainty (σ_1). Compliance requires that what remains after cleanup not contribute more than 15 mrem above background.

In addition, the proposed rule requires that further reductions be made As Low As Reasonably Achievable. Defining ALARA, in this framework, might be much more problematic than when working with higher, more readily measurable doses. Can ALARA be assigned a cost-per-dose-increment value, as is done for occupational exposures? Is it simply a matter of vague principle? And how will it take into consideration other risks, such as those associated with the decommissioning activities themselves? These are the questions of the risk management phase of risk-based decision-making.

Now let us return to the framework of risk-based decision-making which is premised on balancing risk, cost, and benefit. To implement the 15 mrem criterion, as well as ALARA, in this context, one needs to ask at least two fundamental questions:

1) How should both background and residual radioactivity be defined or measured in practical terms, and what degree of uncertainty will be considered acceptable? Recall from the examples of our earlier discussion that if one takes into account spatial or temporal variations of background, not to mention measurement uncertainties, the sigma may easily be of the same order as, or even multiples of, the 15 mrem criterion.

2) The second question follows naturally from the first: given that the risk associated with a 15 mrem residual dose adds very little to the risk of exposure to background and indeed is buried in the noise of the natural variations of that background, then how much money and effort should be spent not only to clean up to this level, but to assure compliance?

Conclusion

These are among the questions that we, as regulators, licensees, and members of the public must consider as we proceed toward final decommissioning rulemaking. And remember, I've only touched the surface. For example, we haven't even discussed the proposed 4 mrem criterion for the water pathway and the associated risk management scheme necessary to assure compliance. These are challenges of risk-based decision-making as we all go in search of background.

In this endeavor, I would urge that we be ever mindful of our goal as captured in the NRC's mission, that is, "to help assure that the use of nuclear materials is carried out in such a way that public health and safety, the common defense and security and environment are protected," and that we be mindful of the principles of good regulation, namely, independence,

openness, efficiency, clarity, and reliability. This is our challenge as we strive to protect the citizens of our nation and fulfill our responsibilities as stewards of our planet. I, for one, welcome the challenge, daunting as it may seem, and I look forward to the contributions and participation of all parties as we proceed toward what I hope will be rational and responsible final rulemaking.

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RELATIVE TERRESTRIAL GAMMA RADIATION LEVELS (MAY 1974)

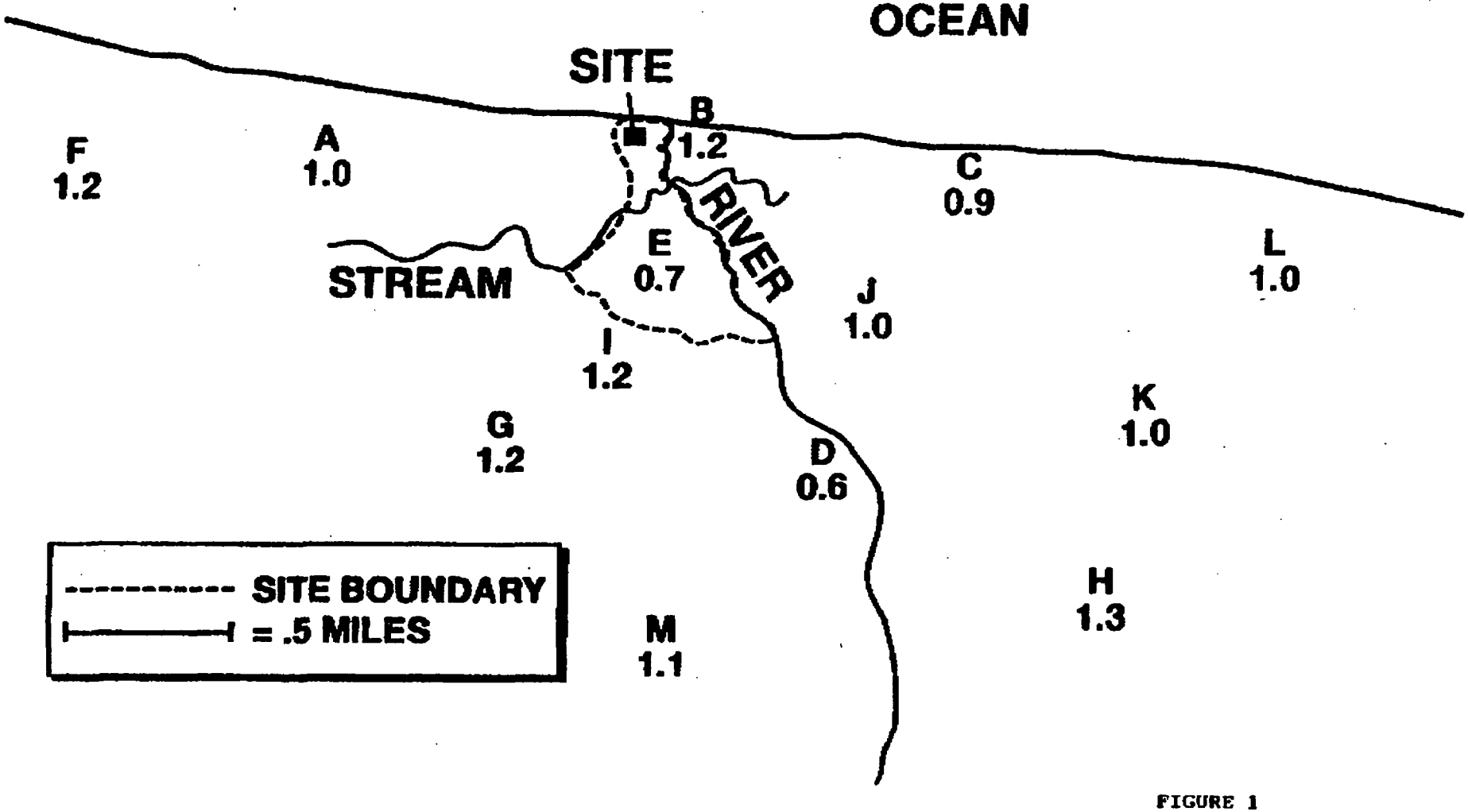


FIGURE 1

RELATIVE TERRESTRIAL GAMMA RADIATION LEVELS (SEPTEMBER 1974)

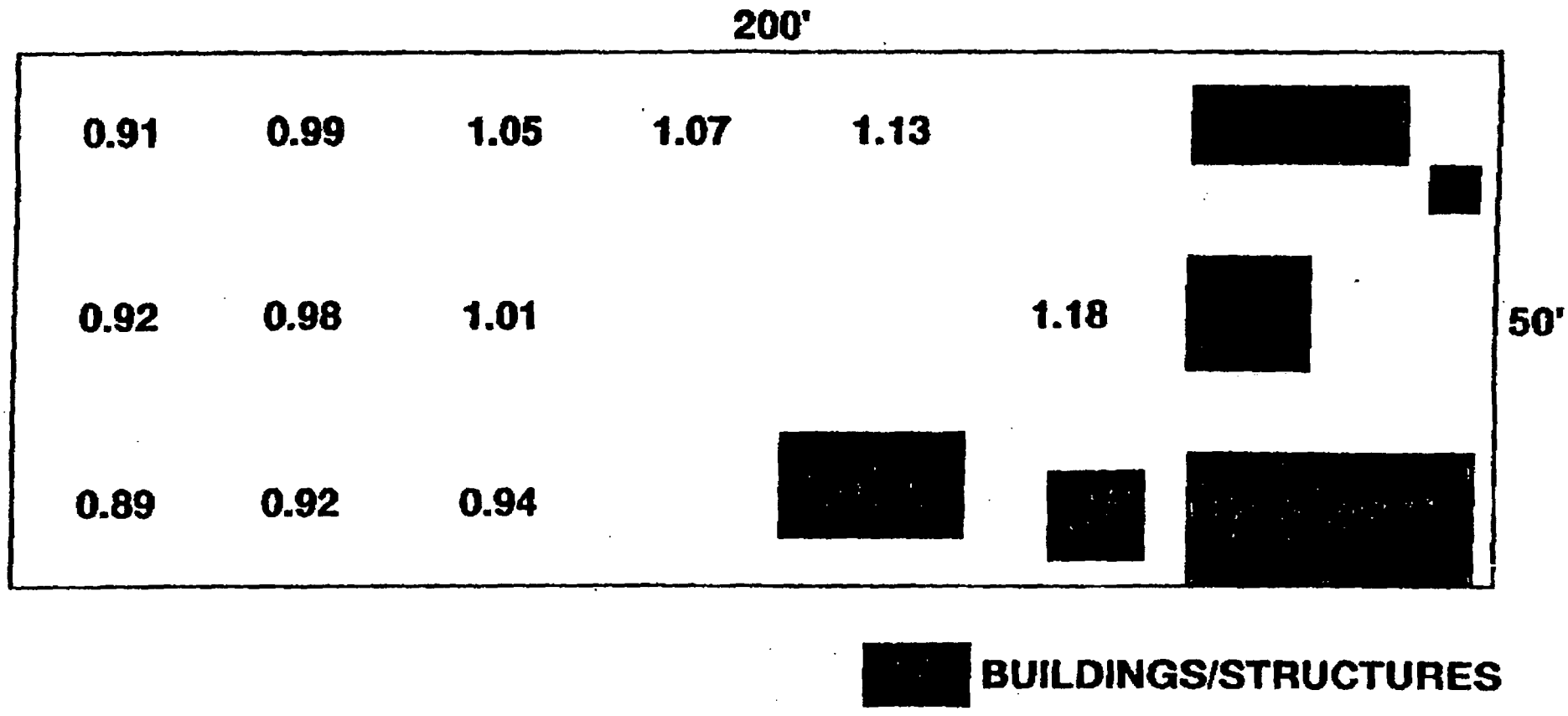


FIGURE 2

RANGE OF ANNUAL RADIATION DOSE: NATURAL SOURCES (MREM)

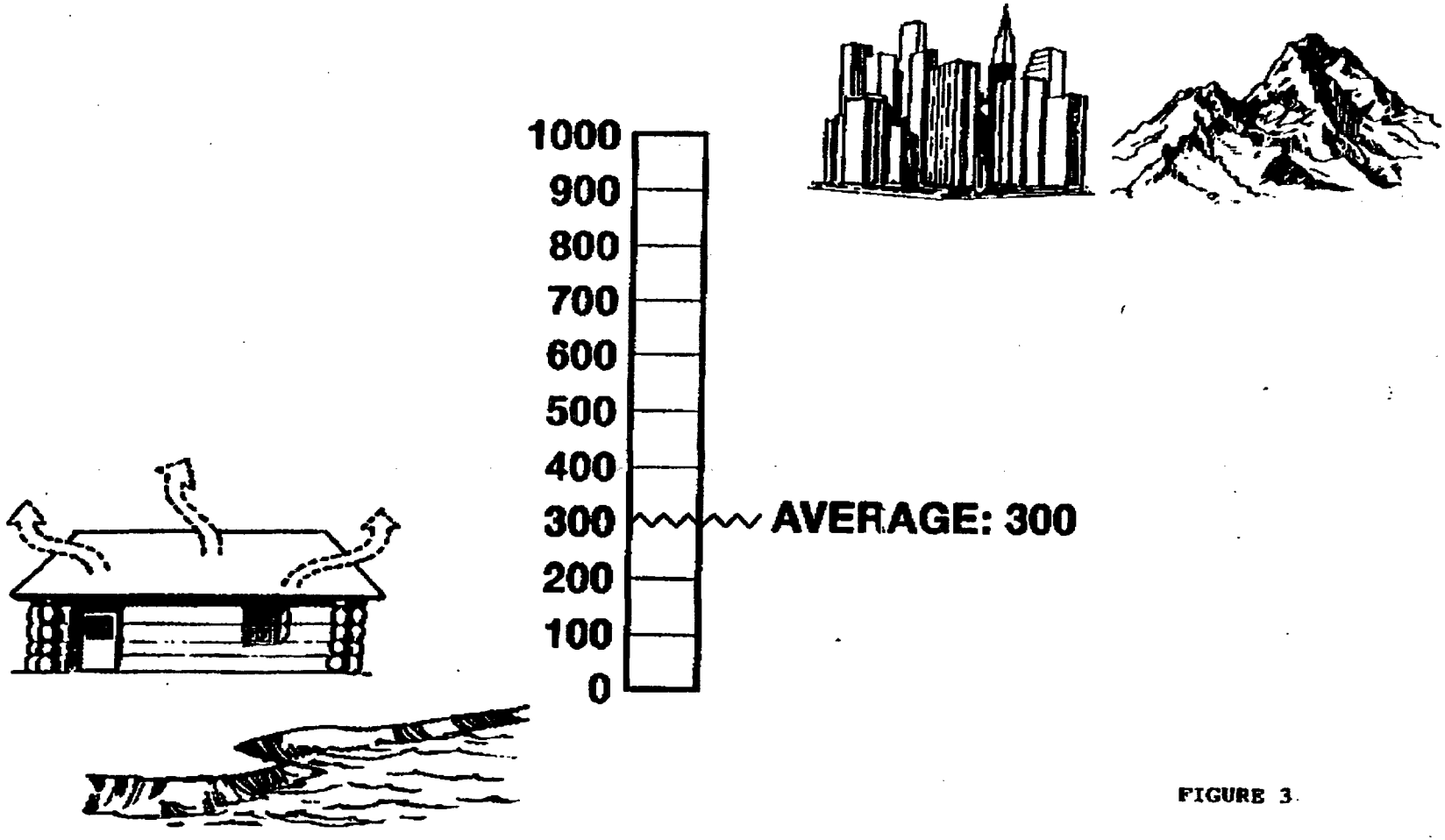


FIGURE 3

LIFETIME MORTALITY RISKS
(PERCENT OF GENERAL POPULATION)

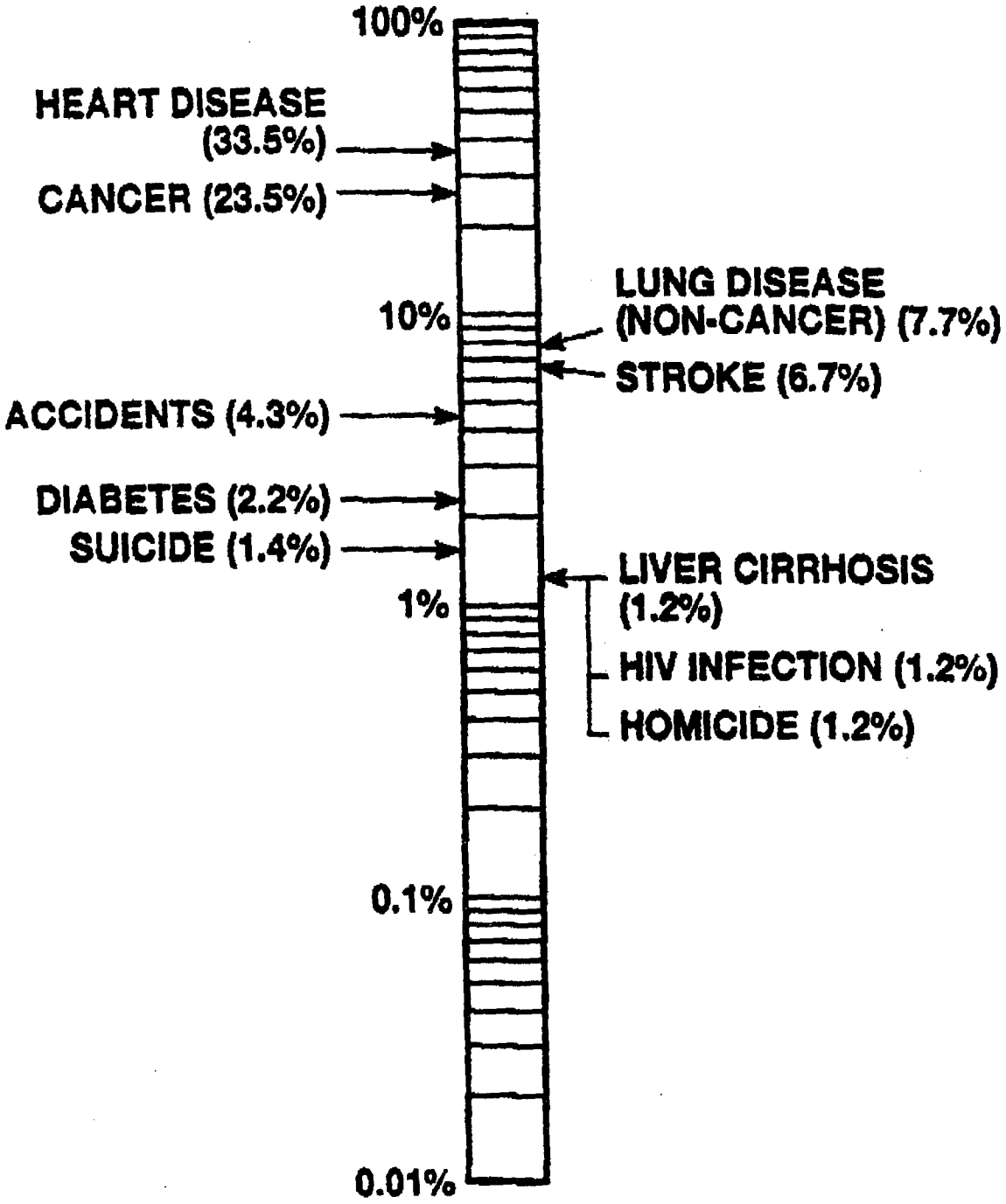


FIGURE 4

LIFETIME MORTALITY RISKS
(PERCENT)

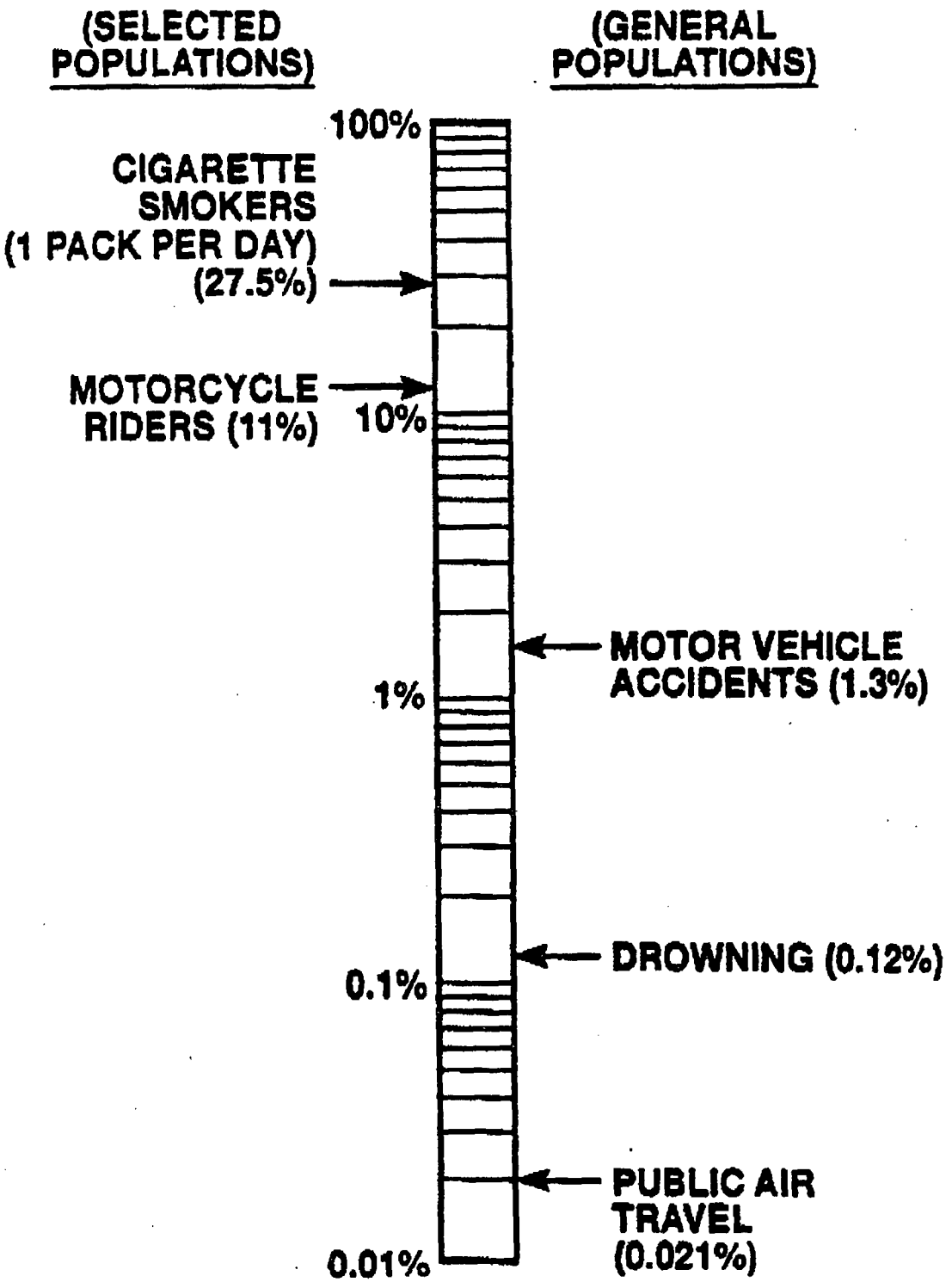
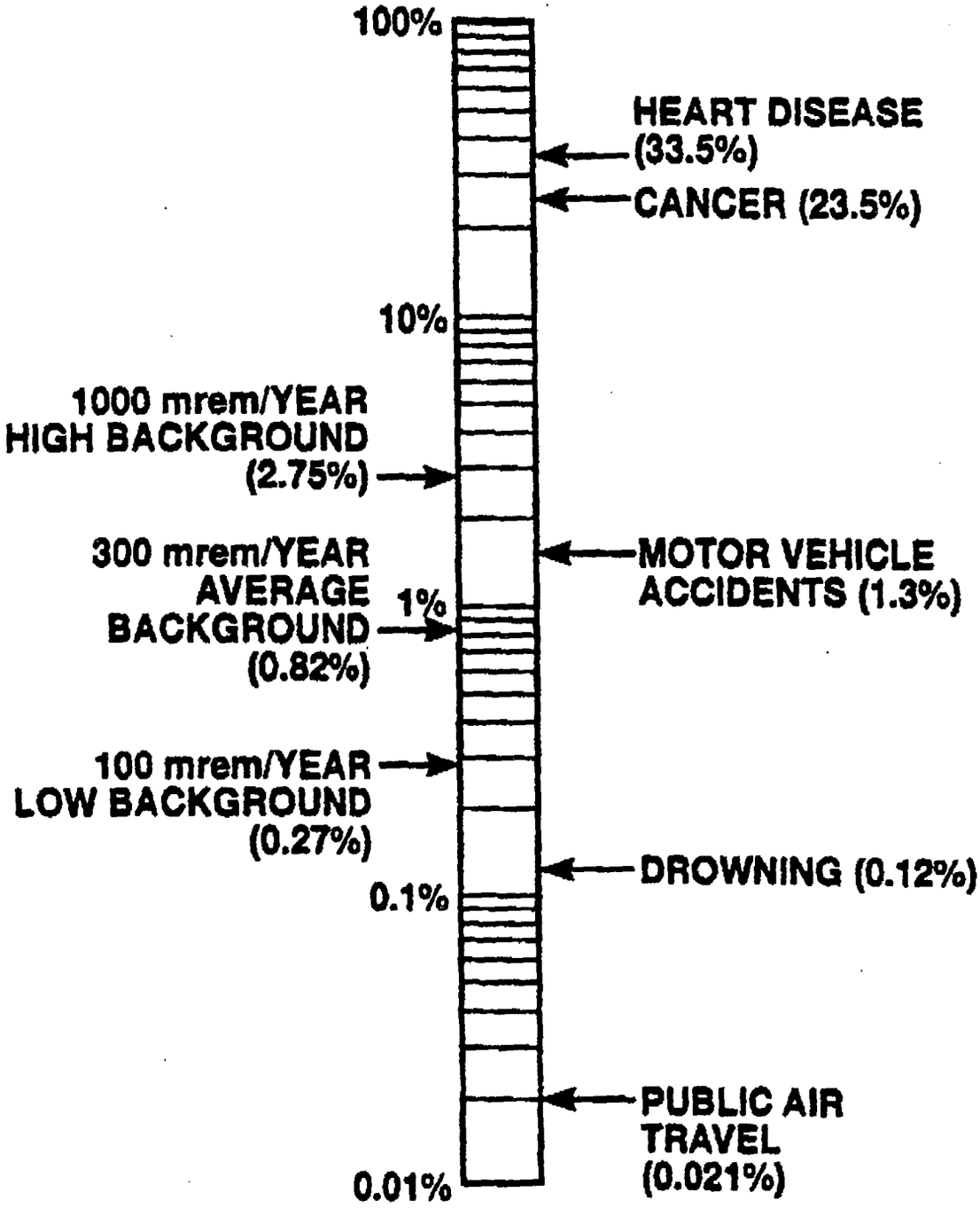


FIGURE 5

LIFETIME MORTALITY RISKS
(PERCENT)



LIFETIME MORTALITY RISKS
(PERCENT)

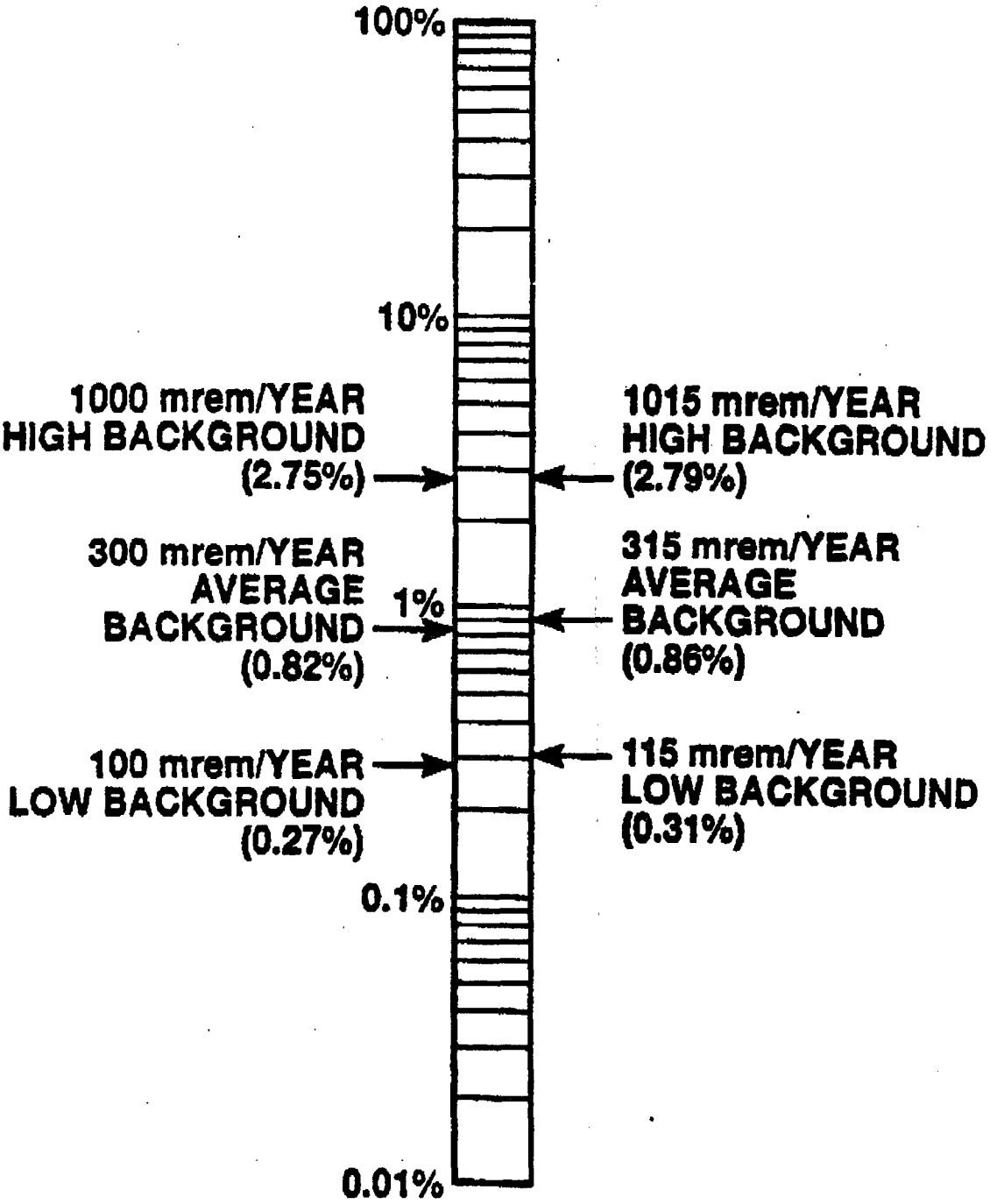


FIGURE 7

ESTIMATED COSTS OF RADIATION MEASUREMENTS

METHOD	COST PER SAMPLE
ALPHA SPECTROMETRY	$300-1000
BETA ANALYSIS	$50-750
EXTERNAL GAMMA EXPOSURE SURVEY	$50
EXTERNAL GAMMA TLD MEASUREMENT	$20
GAMMA SPECTROMETRY	$100-300
RADON MEASUREMENT	$10-20
SOIL SAMPLE COLLECTION	$100-200
SOIL SAMPLE PROCESSING	$100-400
THERMAL IONIZATION MASS SPECTROMETRY	$1000

FIGURE 8

ESTIMATED COST PER MEASUREMENT OF CESIUM-137 IN SOIL

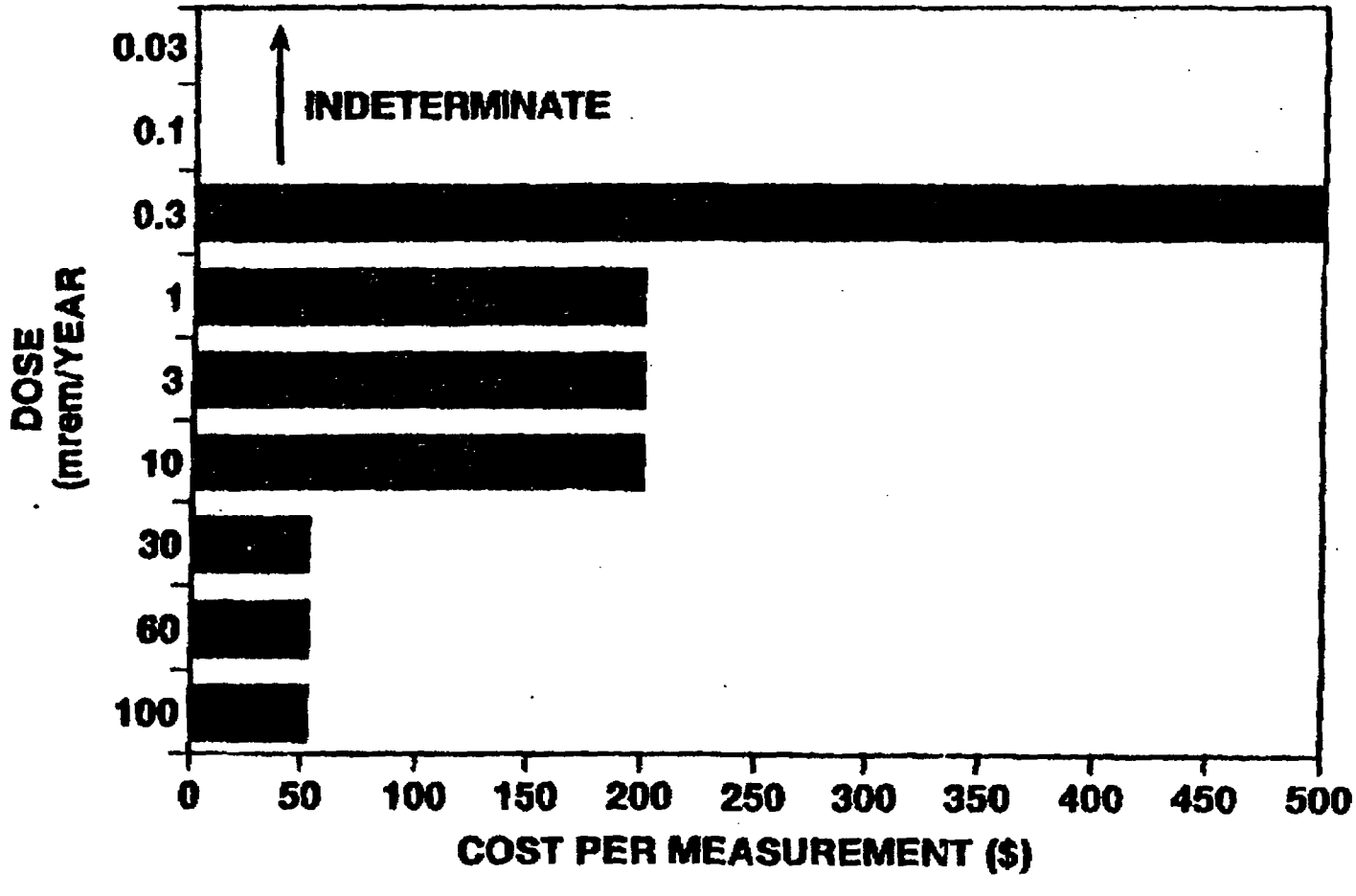


FIGURE 9

Appendix 3

Wyoming Mining Association
LOST CREEK TRENCH SAMPLING
Sections 2-7

Source: Geology of the Lost Creek Schroeckingerite Deposits Sweetwater County, Wyoming
Geological Survey Bulletin 1087-J

SAMPLE #	SAMPLE AREA	SAMPLE LENGTH	PERCENT EQUIVALENT URANIUM	PERCENT EQUIVALENT URANIUM-238	EQUIVALENT URANIUM-238 ACTIVITY (picoCuries per gram)	RADIUM-226 ACTIVITY (picoCuries per gram)	PERCENT URANIUM	NATURAL URANIUM ACTIVITY (picoCuries per gram)
DS-52-237	1.9		0.004	0.004	13.5	13.5	0.004	27.1
DS-52-238	4.9		0.005	0.005	16.9	16.9	0.004	27.1
DS-52-239	4.8		0.007	0.007	23.6	23.6	0.012	81.2
DS-52-242	1.2		0.008	0.008	27.0	27.0	0.015	101.6
DS-52-248	0.6		0.021	0.021	70.9	70.9	0.048	325.0
DS-52-249	4.4		0.027	0.027	91.1	91.1	0.06	406.2
DS-52-250	3		0.014	0.014	47.3	47.3	0.024	162.5
DS-52-251	0.8		0.008	0.008	27.0	27.0	0.012	81.2
DS-52-256	1.3		0.008	0.008	27.0	27.0	0.012	81.2
DS-52-257	5.7		0.012	0.012	40.5	40.5	0.018	121.9
DS-52-258	2.6		0.01	0.010	33.8	33.8	0.019	128.6
DS-52-259	2		0.014	0.014	47.3	47.3	0.015	101.6
DS-52-262	0.7		0.021	0.021	70.9	70.9	0.035	237.0
DS-52-263	2.9		0.025	0.025	84.4	84.4	0.049	331.7
DS-52-264	5.5		0.027	0.027	91.1	91.1	0.053	358.8
DS-52-265	3.2		0.015	0.015	50.6	50.6	0.029	196.3
DS-52-265A	4.1		0.029	0.029	97.9	97.9	0.06	406.2
DS-52-266	6.9		0.017	0.017	57.4	57.4	0.034	230.2
DS-52-267	0.4		0.007	0.007	23.6	23.6	0.015	101.6
DS-52-275	6.4		0.039	0.039	131.6	131.6	0.08	541.6
DS-52-207	1.2		0.013	0.013	43.9	43.9	0.021	142.2
DS-52-213	0.8		0.047	0.047	158.7	158.7	0.087	589.0
DS-52-214	3		0.014	0.014	47.3	47.3	0.022	148.9
DS-52-216	1.3		0.012	0.012	40.5	40.5	0.022	148.9
DS-52-218	5.6		0.016	0.016	54.0	54.0	0.035	237.0
DS-52-220	4.9		0.019	0.019	64.1	64.1	0.038	257.3
DS-52-222	3.3		0.012	0.012	40.5	40.5	0.024	162.5
DS-52-227	0.7		0.029	0.029	97.9	97.9	0.065	440.1
DS-52-228	1.3		0.037	0.037	124.9	124.9	0.072	487.4
DS-52-230	1.5		0.016	0.016	54.0	54.0	0.03	203.1
DS-51-199	1.2		0.008	0.008	27.0	27.0	0.013	88.0
DS-52-200	0.3		0.007	0.007	23.6	23.6	0.008	54.2
DS-52-204	1.2		0.012	0.012	40.5	40.5	0.022	148.9
DS-52-224	4		0.016	0.016	54.0	54.0	0.031	209.9
DS-52-233	1.2		0.01	0.010	33.8	33.8	0.012	81.2
DS-52-236	4		0.01	0.010	33.8	33.8	0.016	108.3
DS-52-184	3.5		0.023	0.023	77.6	77.6	0.041	277.6
DS-52-186	1.5		0.011	0.011	37.1	37.1	0.015	101.6
DS-52-190	2		0.02	0.020	67.5	67.5	0.043	291.1
DS-52-193	1		0.011	0.011	37.1	37.1	0.013	88.0
DS-52-194	0.2		0.03	0.030	101.3	101.3	0.062	419.7
DS-52-197	0.5		0.024	0.024	81.0	81.0	0.051	345.3
DS-52-149	4.3		0.015	0.015	50.6	50.6	0.015	101.6
DS-52-150	6.8		0.023	0.023	77.6	77.6	0.037	250.5
DS-52-152	0.3		0.009	0.009	30.4	30.4	0.01	67.7
DS-52-153	7.3		0.013	0.013	43.9	43.9	0.019	128.6
DS-52-155	1.4		0.004	0.004	13.5	13.5	0.004	27.1
DS-52-158	4.1		0.011	0.011	37.1	37.1	0.016	108.3
DS-52-141	20		0.011	0.011	37.1	37.1	0.013	88.0
DS-52-143	1.6		0.01	0.010	33.8	33.8	0.007	47.4
DS-52-145	1.7		0.005	0.005	16.9	16.9	0.003	20.3
DS-52-146	0.2		0.008	0.008	27.0	27.0	0.007	47.4
DS-52-99	2.8		0.034	0.034	114.8	114.8	0.055	372.4
DS-52-100	1.2		0.028	0.028	94.5	94.5	0.05	338.5
DS-52-101	4.5		0.03	0.030	101.3	101.3	0.053	358.8
DS-52-102	0.6		0.018	0.018	60.8	60.8	0.022	148.9
DS-52-103	3.7		0.026	0.026	87.8	87.8	0.036	243.7
DS-52-104	0.2		0.044	0.044	148.5	148.5	0.072	487.4
DS-52-107	7.6		0.037	0.037	124.9	124.9	0.066	446.8
DS-52-109	1		0.024	0.024	81.0	81.0	0.037	250.5
DS-52-110	0.6		0.035	0.035	118.1	118.1	0.055	372.4
DS-52-113	2		0.042	0.042	141.8	141.8	0.051	345.3
DS-52-24	0.5		0.024	0.024	81.0	81.0	0.035	237.0
DS-52-25	1.4		0.032	0.032	108.0	108.0	0.48	3249.6
DS-52-27	9.8		0.019	0.019	64.1	64.1	0.026	176.0
DS-52-28	2.8		0.06	0.060	202.5	202.5	0.11	744.7
DS-52-31	4.8		0.025	0.025	84.4	84.4	0.041	277.6
DS-52-32	2		0.05	0.050	168.8	168.8	0.079	534.8
DS-52-33	1.5		0.044	0.044	148.5	148.5	0.071	480.7
DS-52-34	8.7		0.026	0.026	87.8	87.8	0.041	277.6
DS-52-35	4.1		0.014	0.014	47.3	47.3	0.015	101.6
DS-52-45	2		0.024	0.024	81.0	81.0	0.05	338.5
DS-52-46	26.8		0.049	0.049	165.4	165.4	0.097	656.7
DS-52-47	11.8		0.041	0.041	138.4	138.4	0.075	507.8
DS-52-59	5.9		0.028	0.028	94.5	94.5	0.038	257.3
DS-52-60	12.8		0.018	0.018	60.8	60.8	0.023	155.7
DS-52-61	10.7		0.02	0.020	67.5	67.5	0.029	196.3
DS-52-62	12.2		0.034	0.034	114.8	114.8	0.055	372.4
DS-52-63	16		0.06	0.060	202.5	202.5	0.12	812.4
DS-52-64	4		0.013	0.013	43.9	43.9	0.015	101.6
DS-52-65	9.3		0.058	0.058	195.8	195.8	0.11	744.7
DS-52-66	8.8		0.049	0.049	165.4	165.4	0.078	528.1
DS-52-67	0.7		0.016	0.016	54.0	54.0	0.026	176.0
DS-52-79	0.5		0.024	0.024	81.0	81.0	0.031	209.9
DS-52-80	65		0.017	0.017	57.4	57.4	0.021	142.2
DS-52-81	7.5		0.016	0.016	54.0	54.0	0.023	155.7
DS-52-82	7.4		0.032	0.032	108.0	108.0	0.057	385.9
DS-52-53	5.4		0.02	0.020	67.5	67.5	0.031	209.9

DS-52-84	1.3		0.031	0.031	104.6	104.6	0.047	318.2
DS-52-58	4.4		0.021	0.021	70.9	70.9	0.027	182.8
DS-52-86	8.2		0.028	0.028	94.5	94.5	0.037	250.5
DS-52-87	3.1		0.031	0.031	104.6	104.6	0.043	291.1
DS-52-88	1.6		0.049	0.049	165.4	165.4	0.07	473.9
DS-52-2	1.5		0.035	0.035	118.1	118.1	0.079	534.8
DS-52-4	0.3		0.018	0.018	60.8	60.8	0.033	223.4
DS-52-5	0.2		0.011	0.011	37.1	37.1	0.018	121.9
DS-52-22	1.1		0.033	0.033	111.4	111.4	0.045	304.7
DS-52-7	2.2		0.017	0.017	57.4	57.4	0.03	203.1
DS-52-8	3		0.019	0.019	64.1	64.1	0.031	209.9
DS-52-10	6		0.025	0.025	84.4	84.4	0.041	277.6
DS-52-12	0.3		0.022	0.022	74.3	74.3	0.026	176.0
DS-52-13	9.5		0.037	0.037	124.9	124.9	0.063	426.5
DS-52-14	2.4		0.022	0.022	74.3	74.3	0.035	237.0
DS-52-15	2		0.022	0.022	74.3	74.3	0.032	216.6
DS-52-20	0.5		0.096	0.095	324.1	324.1	0.15	1015.5
LRP-28	6.7		0.011	0.011	37.1	37.1	0.017	115.1
LRP-31	5.8		0.008	0.008	27.0	27.0	0.008	54.2
LRP-10	4.5		0.01	0.010	33.8	33.8	0.017	115.1
LRP-7	0.6		0.004	0.004	13.5	13.5	0.002	13.5
LRP-12	2.1		0.017	0.017	57.4	57.4	0.029	196.3
LRP-H-14		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-13	2.5		0.013	0.013	43.9	43.9	0.019	128.6
LRP-14	3		0.012	0.012	40.5	40.5	0.014	94.8
LRP-15	6.4		0.017	0.017	57.4	57.4	0.026	176.0
LRP-16	2.3		0.015	0.015	50.6	50.6	0.019	128.6
LRP-18	1.6		0.01	0.010	33.8	33.8	0.014	94.8
LRP-19	0.7		0.007	0.007	23.6	23.6	0.005	33.9
LRP-20	0.8		0.02	0.020	67.5	67.5	0.029	196.3
LRP-24	1.7		0.019	0.019	64.1	64.1	0.037	250.5
DS-H-407		10	0.007	0.007	23.6	23.6	0.006	40.6
DS-H-406		10	0.006	0.006	20.3	20.3	0.007	47.4
DS-H-405		10	0.002	0.002	6.8	6.8	0.001	6.8
DS-H-404		10	0.005	0.005	16.9	16.9	0.003	20.3
DS-H-260		10	0.005	0.005	16.9	16.9	0.004	27.1
DS-H-259		10	0.004	0.004	13.5	13.5	0.004	27.1
DS-H-258		10	0.005	0.005	16.9	16.9	0.002	13.5
DS-H-257		10	0.004	0.004	13.5	13.5	0.003	20.3
DS-H-256		10	0.005	0.005	16.9	16.9	0.003	20.3
DS-H-255		10	0.003	0.003	10.1	10.1	0.002	13.5
DS-H-254		10	0.005	0.005	16.9	16.9	0.003	20.3
DS-51-261	7.4		0.017	0.017	57.4	57.4	0.035	237.0
DS-51-259	2.4		0.01	0.010	33.8	33.8	0.013	88.0
DS-H-251		10	0.003	0.003	10.1	10.1	0.002	13.5
DS-H-250		10	0.004	0.004	13.5	13.5	0.002	13.5
DS-H-249		10	0.003	0.003	10.1	10.1	0.003	20.3
DS-H-248		10	0.005	0.005	16.9	16.9	0.003	20.3
DS-H-247		10	0.004	0.004	13.5	13.5	0.001	6.8
DS-H-246		10	0.005	0.005	16.9	16.9	0.003	20.3
DS-H-245		10	0.004	0.004	13.5	13.5	0.004	27.1
DS-H-244		10	0.004	0.004	13.5	13.5	0.002	13.5
DS-H-243		10	0.004	0.004	13.5	13.5	0.002	13.5
DS-H-242		10	0.005	0.005	16.9	16.9	0.005	33.9
DS-51244B	0.4		0.004	0.004	13.5	13.5	0.004	27.1
DS-H-241		10	0.004	0.004	13.5	13.5	0.003	20.3
DS-H-240		10	0.004	0.004	13.5	13.5	0.002	13.5
DS-52-161	6.2		0.014	0.014	47.3	47.3	0.02	135.4
DS-52-160	10.3		0.016	0.016	54.0	54.0	0.035	237.0
DS-52-159	4.7		0.019	0.019	64.1	64.1	0.033	223.4
DS-51-266	2		0.006	0.006	20.3	20.3	0.009	60.9
DS-51-264	3.6		0.028	0.028	94.5	94.5	0.05	338.5
DS-51-263	3.1		0.007	0.007	23.6	23.6	0.008	54.2
DS-51-262	1.1		0.008	0.008	27.0	27.0	0.01	67.7
DS-H-253		10	0.003	0.003	10.1	10.1	0.002	13.5
DS-H-252		10	0.003	0.003	10.1	10.1	0.002	13.5
DS-51-258	5.8	Sample missing		0.000	0.0	0.0		0.0
DS-51-252	2.5		0.003	0.003	10.1	10.1	0.003	20.3
DS-51-251	8.8		0.004	0.004	13.5	13.5	0.003	20.3
DS-51-250	8.7		0.004	0.004	13.5	13.5	0.003	20.3
DS-51-246	9		0.007	0.007	23.6	23.6	0.008	54.2
DS-51-245	10		0.017	0.017	57.4	57.4	0.025	169.3
	6.1	Not Sampled		0.000	0.0	0.0		0.0
DS-51-244A	0.6		0.045	0.045	151.9	151.9	0.075	507.8
DS-51-243	1.6		0.005	0.005	16.9	16.9	0.004	27.1
DS-52-164	4.8		0.009	0.009	30.4	30.4	0.013	88.0
DS-52-163	5.1		0.016	0.016	54.0	54.0	0.024	162.5
DS-52-162	7.5		0.018	0.018	60.8	60.8	0.039	264.0
	0.4	Not Sampled		0.000	0.0	0.0		0.0
DS-51-265	6.9		0.021	0.021	70.9	70.9	0.038	257.3
DS-51-260	3.2		0.004	0.004	13.5	13.5	0.006	40.6
DS-51-256	8.4		0.008	0.008	27.0	27.0	0.01	67.7
DS-51-255	2.2		0.004	0.004	13.5	13.5	0.004	27.1
DS-51-254	4.6		0.005	0.005	16.9	16.9	0.008	54.2
DS-51-253	4.4		0.006	0.006	20.3	20.3	0.009	60.9
DS-51-249	8.2		0.008	0.008	27.0	27.0	0.009	60.9
DS-51-248	17.5		0.006	0.006	20.3	20.3	0.008	54.2
DS-51-247	15.5		0.01	0.010	33.8	33.8	0.015	101.6
DS-51-257	4.6		0.008	0.008	27.0	27.0	0.008	54.2
DS-H-431		10	0.003	0.003	10.1	10.1	<.001	
DS-H-428		7	0.009	0.009	30.4	30.4	0.024	162.5
DS-H-427		5	0.006	0.006	20.3	20.3	0.009	60.9
DS-H-426		10	0.003	0.003	10.1	10.1	0.002	13.5
DS-52-172	0.4		0.008	0.008	27.0	27.0	0.011	74.5
DS-H-411		10	0.005	0.005	16.9	16.9	0.002	13.5
DS-52-165	4.9		0.023	0.023	77.6	77.6	0.044	297.9
DS-H-409		10	0.003	0.003	10.1	10.1	0.001	6.8
DS-H-408		10	0.003	0.003	10.1	10.1	<.001	

DS-H-407	continued in E'-F'			0.000	0.0	0.0		0.0
DS-H-430		10	0.003	0.003	10.1	10.1	<.001	
DS-H-429		8	0.004	0.004	13.5	13.5	<.001	
DS-52-179	2.9		0.012	0.012	40.5	40.5	0.027	182.8
DS-52-178	5.6		0.015	0.015	50.6	50.6	0.037	250.5
DS-52-176	2.3		0.012	0.012	40.5	40.5	0.026	176.0
DS-52-175	0.5		0.009	0.009	30.4	30.4	0.021	142.2
DS-H-425		10	0.003	0.003	10.1	10.1	0.001	6.8
DS-H-424		10	0.002	0.002	6.8	6.8	0.001	6.8
DS-H-422		10	0.002	0.002	6.8	6.8	<.001	
DS-H-421		5	0.004	0.004	13.5	13.5	0.004	27.1
DS-H-420		5	0.004	0.004	13.5	13.5	0.005	33.9
DS-H-419		10	0.004	0.004	13.5	13.5	0.004	27.1
DS-H-418		10	0.003	0.003	10.1	10.1	0.001	6.8
DS-H-417		10	0.002	0.002	6.8	6.8	0.001	6.8
DS-H-416		10	0.005	0.005	16.9	16.9	0.004	27.1
DS-H-415		10	0.004	0.004	13.5	13.5	0.003	20.3
DS-H-414		10	0.002	0.002	6.8	6.8	0.001	6.8
DS-H-413		10	0.004	0.004	13.5	13.5	0.001	6.8
DS-H-412		10	0.004	0.004	13.5	13.5	0.002	13.5
DS-52-167	7.6		0.012	0.012	40.5	40.5	0.021	142.2
DS-52-166	6		0.009	0.009	30.4	30.4	0.014	94.8
DS-H-410		10	0.003	0.003	10.1	10.1	0.001	6.8
DS-52-182	3.3		0.014	0.014	47.3	47.3	0.031	209.9
DS-52-181	3.7		0.014	0.014	47.3	47.3	0.03	203.1
DS-52-180	7.4		0.015	0.015	50.6	50.6	0.041	277.6
DS-52-177	2.9		0.015	0.015	50.6	50.6	0.033	223.4
DS-52-174	0.8		0.008	0.008	27.0	27.0	0.017	115.1
DS-52-173	0.9		0.006	0.006	20.3	20.3	0.007	47.4
DS-52-171	5.4		0.022	0.022	74.3	74.3	0.046	311.4
DS-52-170	4		0.01	0.010	33.8	33.8	0.018	121.9
DS-52-169	6		0.011	0.011	37.1	37.1	0.015	101.6
DS-52-168	6.4		0.016	0.016	54.0	54.0	0.022	148.9
	0.7	Not Sampled		0.000	0.0	0.0		0.0
LRP-74	2		0.01	0.010	33.8	33.8	0.017	115.1
LRP-73	8.5		0.006	0.006	20.3	20.3	0.009	60.9
LRP-72	1.8		0.014	0.014	47.3	47.3	0.022	148.9
	0.08	Not Sampled		0.000	0.0	0.0		0.0
LRP-64	6		0.017	0.017	57.4	57.4	0.026	176.0
LRP-63	7.8		0.013	0.013	43.9	43.9	0.014	94.8
LRP-H-106		13.5	0.009	0.009	30.4	30.4	0.011	74.5
LRP-H-105		9	0.002	0.002	6.8	6.8	0	0.0
LRP-39	1		0.014	0.014	47.3	47.3	0.02	135.4
LRP-68	3.4		0.012	0.012	40.5	40.5	0.02	135.4
LRP-78	1.5		0.018	0.018	60.8	60.8	0.028	189.6
LRP-H-67		5	0.005	0.005	16.9	16.9	0.007	47.4
LRP-H-108		14	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-66		13	0.007	0.007	23.6	23.6	0.008	54.2
LRP-70	3		0.017	0.017	57.4	57.4	0.018	121.9
LRP-H-65		4	0.005	0.005	16.9	16.9	0.005	33.9
LRP-69	2.7		0.012	0.012	40.5	40.5	0.015	101.6
LRP-H-64		8	0.003	0.003	10.1	10.1	0.002	13.5
LRP-H-63		10	0.004	0.004	13.5	13.5	0.005	33.9
LRP-67	0.4		0.039	0.039	131.6	131.6	0.061	413.0
LRP-H-62		10	0.004	0.004	13.5	13.5	0.004	27.1
LRP-65	2		0.03	0.030	101.3	101.3	0.064	433.3
LRP-H-61		6	0.005	0.005	16.9	16.9	0.006	40.6
LRP-60		10	0.005	0.005	16.9	16.9	0.003	20.3
LRP-59		10	0.003	0.003	10.1	10.1	0.003	20.3
LRP-H-107		10	0.005	0.005	16.9	16.9	0.004	27.1
LRP-H-58		9	0.005	0.005	16.9	16.9	0.004	27.1
LRP-H-57		10	0.004	0.004	13.5	13.5	0.004	27.1
LRP-H-56		10	0.004	0.004	13.5	13.5	0.006	40.6
LRP-62	2.2		0.022	0.022	74.3	74.3	0.036	243.7
LRP-60	2		0.025	0.025	84.4	84.4	0.043	291.1
LRP-H-55		4	0.005	0.005	16.9	16.9	0.008	54.2
LRP-58	4.4		0.008	0.008	27.0	27.0	0.009	60.9
LRP-57	11.5		0.012	0.012	40.5	40.5	0.018	121.9
LRP-H-54		10	0.004	0.004	13.5	13.5	0.002	13.5
LRP-55	3.7		0.008	0.008	27.0	27.0	0.007	47.4
LRP-53		7	0.005	0.005	16.9	16.9	0.012	81.2
LRP-49	4.7		0.007	0.007	23.6	23.6	0.008	54.2
LRP-48	10.1		0.014	0.014	47.3	47.3	0.017	115.1
LRP-47	14.6		0.01	0.010	33.8	33.8	0.015	101.6
LRP-H-52		10	0.005	0.005	16.9	16.9	0.001	6.8
LRP-H-51		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-50		6	0.004	0.004	13.5	13.5	0.002	13.5
LRP-46	2.9		0.01	0.010	33.8	33.8	0.013	88.0
LRP-45	8.4		0.016	0.016	54.0	54.0	0.019	128.6
LRP-H-49		4	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-48		10	0.003	0.003	10.1	10.1	0.002	13.5
LRP-41	3.9		0.016	0.016	54.0	54.0	0.02	135.4
LRP-40	6.3		0.012	0.012	40.5	40.5	0.017	115.1
H-47		13	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-46		10	0.003	0.003	10.1	10.1	0.002	13.5
LRP-H-45		11.5	0.004	0.004	13.5	13.5	0.004	27.1
LRP-37	2.1		0.018	0.018	60.8	60.8	0.027	182.8
LRP-36	10.6		0.015	0.015	50.6	50.6	0.024	162.5
LRP-H-44		10	0.004	0.004	13.5	13.5	0.004	27.1
LRP-H-43		10	0.004	0.004	13.5	13.5	0.003	20.3
LRP-H-42		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-41		10	0.004	0.004	13.5	13.5	0.004	27.1
LRP-H-40		10	0.005	0.005	16.9	16.9	0.004	27.1
LRP-32	7.3		0.008	0.008	27.0	27.0	0.011	74.5
LRP-H-39		10	0.004	0.004	13.5	13.5	0.004	27.1
LRP-H-38		10	0.004	0.004	13.5	13.5	0.003	20.3
LRP-77	4.2		0.012	0.012	40.5	40.5	0.019	128.6
LRP-76	2.6		0.007	0.007	23.6	23.6	0.011	74.5

LRP-75	4.8		0.015	0.015	50.6	50.6	0.03	203.1
LRP-71	7.2		0.021	0.021	70.9	70.9	0.034	230.2
LRP-66	3.8		0.033	0.033	111.4	111.4	0.06	406.2
LRP-61	3.3		0.026	0.026	87.8	87.8	0.041	277.6
LRP-59	0.5		0.017	0.017	57.4	57.4	0.023	155.7
LRP-56	2.9		0.018	0.018	60.8	60.8	0.028	189.6
LRP-53	3.6		0.007	0.007	23.6	23.6	0.007	47.4
LRP-52	9.7		0.012	0.012	40.5	40.5	0.016	108.3
LRP-51	13.7		0.012	0.012	40.5	40.5	0.017	115.1
LRP-50	9		0.013	0.013	43.9	43.9	0.012	81.2
LRP-44	7.2		0.017	0.017	57.4	57.4	0.027	182.8
LRP-43	9.2		0.013	0.013	43.9	43.9	0.021	142.2
LRP-42	6.1		0.01	0.010	33.8	33.8	0.012	81.2
LRP-38	9.4		0.014	0.014	47.3	47.3	0.021	142.2
LRP-35	9.4		0.025	0.025	84.4	84.4	0.051	345.3
LRP-34	4		0.012	0.012	40.5	40.5	0.019	128.6
LRP-33	5.5		0.009	0.009	30.4	30.4	0.012	81.2
LRP-168	2.6		0.007	0.007	23.6	23.6	0.008	54.2
LRP-H-104		5.5	0.004	0.004	13.5	13.5	0.002	13.5
LRP-162	1.2		0.037	0.037	124.9	124.9	0.078	528.1
LRP-161	2.8		0.014	0.014	47.3	47.3	0.022	148.9
	0.6	Not Sampled		0.000	0.0	0.0		0.0
LRP-H-127		6	0.003	0.003	10.1	10.1	0	0.0
LRP-H-126		10	0.003	0.003	10.1	10.1	0	0.0
LRP-H-125		10.5	0.003	0.003	10.1	10.1	0	0.0
LRP-H-124		10	0.007	0.007	23.6	23.6	0.009	60.9
LRP-H-123		10	0.006	0.006	20.3	20.3	0.004	27.1
LRP-H-122		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-121		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-120		10	0.004	0.004	13.5	13.5	0	0.0
LRP-H-119		10	0.004	0.004	13.5	13.5	0	0.0
LRP-H-118		10	0.004	0.004	13.5	13.5	0	0.0
LRP-H-117		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-116		10	0.008	0.008	27.0	27.0	0.008	54.2
LRP-112	9.2		0.022	0.022	74.3	74.3	0.04	270.8
LRP-111	9.6		0.021	0.021	70.9	70.9	0.039	264.0
LRP-H-114		7	0.004	0.004	13.5	13.5	0	0.0
LRP-H-113		5	0.005	0.005	16.9	16.9	0.003	20.3
LRP-H-112		10	0.005	0.005	16.9	16.9	0.004	27.1
LRP-H-111		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-110		10	0.005	0.005	16.9	16.9	0.007	47.4
LRP-85	4.6		0.016	0.016	54.0	54.0	0.027	182.8
LRP-81	2.8		0.021	0.021	70.9	70.9	0.038	257.3
LRP-79	1.7		0.045	0.045	151.9	151.9	0.085	575.5
LRP-H-103		20	0.005	0.005	16.9	16.9	0.003	20.3
LRP-H-102		10	0.003	0.003	10.1	10.1	0.002	13.5
LRP-167	0.4		0.006	0.006	20.3	20.3	0.006	40.6
LRP-H-101		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-100		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-99		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-98		10.5	0.004	0.004	13.5	13.5	0.001	6.8
LRP-H-97		11.5	0.006	0.006	20.3	20.3	0.002	13.5
LRP-H-96		10	0.006	0.006	20.3	20.3	0.003	20.3
LRP-H-95		10	0.005	0.005	16.9	16.9	0.003	20.3
LRP-H-94		10	0.009	0.009	30.4	30.4	0.011	74.5
LP-H-128		7	0.006	0.006	20.3	20.3	0.008	54.2
LRP-H-93		7	0.005	0.005	16.9	16.9	0.002	13.5
LRP-H-92		10	0.004	0.004	13.5	13.5	0.002	13.5
LRP-H-91		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-90		10	0.003	0.003	10.1	10.1	<.001	
LRP-H-89		9.5	0.004	0.004	13.5	13.5	0.002	13.5
LRP-H-88		10	0.004	0.004	13.5	13.5	0.001	6.8
LRP-156	1.6		0.014	0.014	47.3	47.3	0.024	162.5
LRP-155	12.3		0.008	0.008	27.0	27.0	0.012	81.2
LRP-154	12.6		0.009	0.009	30.4	30.4	0.012	81.2
LRP-H-87		12.5	0.003	0.003	10.1	10.1	0.001	6.8
LRP-H-86		10	0.004	0.004	13.5	13.5	<.001	
LRP-149	9.4		0.013	0.013	43.9	43.9	0.026	176.0
LRP-148	7.8		0.01	0.010	33.8	33.8	0.019	128.6
LRP-147	9.5		0.009	0.009	30.4	30.4	0.011	74.5
LRP-146	11.2		0.007	0.007	23.6	23.6	0.009	60.9
LRP-145	12.3		0.007	0.007	23.6	23.6	0.008	54.2
LRP-144	4.2		0.007	0.007	23.6	23.6	0.006	40.6
LRP-143	7.5		0.012	0.012	40.5	40.5	0.021	142.2
LRP-142	3.6	Sample Missing		0.000	0.0	0.0		0.0
LRP-135	3.4		0.011	0.011	37.1	37.1	0.02	135.4
LRP-134	7.3		0.015	0.015	50.6	50.6	0.025	169.3
LRP-133	8.9		0.017	0.017	57.4	57.4	0.031	209.9
LRP-132	6		0.011	0.011	37.1	37.1	0.022	148.9
LRP-H-85		4	0.001	0.001	3.4	3.4	0.001	6.8
LRP-126	8		0.011	0.011	37.1	37.1	0.019	128.6
LRP-125	6.4		0.013	0.013	43.9	43.9	0.022	148.9
LRP-124	8.7		0.007	0.007	23.6	23.6	0.01	67.7
LRP-H-84		2	0.004	0.004	13.5	13.5	0.003	20.3
LRP-H-83		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-123	1.4		0.013	0.013	43.9	43.9	0.024	162.5
LRP-H-82		4	0.004	0.004	13.5	13.5	0.001	6.8
LRP-122	1		0.012	0.012	40.5	40.5	0.009	60.9
LRP-121	3.2		0.027	0.027	91.1	91.1	0.045	304.7
LRP-H-81		1.5	0.004	0.004	13.5	13.5	0.001	6.8
LRP-113	7.1		0.025	0.025	84.4	84.4	0.04	270.8
LRP-H-80		11	0.005	0.005	16.9	16.9	0.007	47.4
LRP-H-79		10	0.004	0.004	13.5	13.5	0.002	13.5
LRP-H-78		10	0.003	0.003	10.1	10.1	0.001	6.8
LRP-106	1.3		0.018	0.018	60.8	60.8	0.031	209.9
LRP-105	11.7		0.019	0.019	64.1	64.1	0.028	189.6
LRP-H-77		6	0.004	0.004	13.5	13.5	<.001	
LRP-H-76		10	0.006	0.006	20.3	20.3	0.006	40.6

LRP-101	4.6		0.01	0.010	33.8	33.8	0.016	108.3
LRP-100	8		0.009	0.009	30.4	30.4	0.011	74.5
LRP-H-75	2.2	Sample Missing		0.000	0.0	0.0		0.0
LRP-94	3.7		0.009	0.009	30.4	30.4	0.011	74.5
LRP-93	6.8		0.012	0.012	40.5	40.5	0.014	94.8
LRP-92	4.8		0.009	0.009	30.4	30.4	0.009	60.9
LRP-H-74		2	0.004	0.004	13.5	13.5	0.004	27.1
LRP-88	1.8		0.012	0.012	40.5	40.5	0.018	121.9
LRP-87	7.4		0.035	0.035	118.1	118.1	0.067	453.6
LRP-H-73		5	0.007	0.007	23.6	23.6	0.006	40.6
LRP-H-72		10	0.006	0.006	20.3	20.3	0.008	54.2
LRP-86	4.1		0.018	0.018	60.8	60.8	0.025	169.3
LRP-H-109		11	0.006	0.006	20.3	20.3	0.005	33.9
LRP-H-71		11	0.008	0.008	27.0	27.0	0.007	47.4
LRP-H-70		10	0.006	0.006	20.3	20.3	0.008	54.2
LRP-H-69		10	0.005	0.005	16.9	16.9	0.002	13.5
LRP-H-68		10	0.005	0.005	16.9	16.9	0.005	33.9
LRP-169	3.3		0.007	0.007	23.6	23.6	0.008	54.2
LRP-165	5.3		0.006	0.006	20.3	20.3	0.008	54.2
LRP-164	9.9		0.006	0.006	20.3	20.3	0.008	54.2
LRP-163	2.6		0.009	0.009	30.4	30.4	0.011	74.5
LRP-160	1.2		0.005	0.005	16.9	16.9	0.002	13.5
LRP-159	10.1		0.017	0.017	57.4	57.4	0.024	162.5
LRP-158	11.7		0.008	0.008	27.0	27.0	0.01	67.7
LRP-157	9.7		0.008	0.008	27.0	27.0	0.009	60.9
LRP-153	6		0.016	0.016	54.0	54.0	0.028	189.6
LRP-152	7.7		0.012	0.012	40.5	40.5	0.02	135.4
LRP-151	4.7		0.009	0.009	30.4	30.4	0.013	88.0
LRP-150	7.4		0.01	0.010	33.8	33.8	0.011	74.5
LRP-141	5.8		0.009	0.009	30.4	30.4	0.015	101.6
LRP-140	10.3		0.01	0.010	33.8	33.8	0.013	88.0
LRP-139	7.6		0.007	0.007	23.6	23.6	0.011	74.5
LRP-138	8.4		0.009	0.009	30.4	30.4	0.013	88.0
LRP-137	7.4		0.012	0.012	40.5	40.5	0.021	142.2
LRP-136	5.8		0.009	0.009	30.4	30.4	0.02	135.4
LRP-131	7.4		0.01	0.010	33.8	33.8	0.017	115.1
LRP-130	6.8		0.009	0.009	30.4	30.4	0.016	108.3
LRP-129	10.2		0.011	0.011	37.1	37.1	0.017	115.1
LRP-128	7.7		0.008	0.008	27.0	27.0	0.011	74.5
LRP-127	7.6		0.005	0.005	16.9	16.9	0.006	40.6
LRP-120	2.5		0.027	0.027	91.1	91.1	0.047	318.2
LRP-119	4.6		0.013	0.013	43.9	43.9	0.019	128.6
LRP-118	6.5		0.018	0.018	60.8	60.8	0.012	81.2
LRP-117	4		0.011	0.011	37.1	37.1	0.023	155.7
LRP-116	2.7		0.031	0.031	104.6	104.6	0.053	358.8
LRP-115	13.4		0.02	0.020	67.5	67.5	0.035	237.0
LRP-114	8.5		0.015	0.015	50.6	50.6	0.025	169.3
LRP-110	2.4		0.003	0.003	10.1	10.1	0.005	33.9
LRP-109	3.7		0.006	0.006	20.3	20.3	0.008	54.2
	2	Not Sampled		0.000	0.0	0.0		0.0
LRP-108	10.9		0.01	0.010	33.8	33.8	0.012	81.2
LRP-107	6		0.017	0.017	57.4	57.4	0.023	155.7
LRP-103	1.4		0.005	0.005	16.9	16.9	0.004	27.1
LRP-102	3.9		0.006	0.006	20.3	20.3	0.008	54.2
LRP-99	2		0.007	0.007	23.6	23.6	0.008	54.2
LRP-98	2.4		0.008	0.008	27.0	27.0	0.012	81.2
LRP-97	8.6		0.007	0.007	23.6	23.6	0.009	60.9
LRP-96	7.4		0.009	0.009	30.4	30.4	0.014	94.8
LRP-95	8.1		0.011	0.011	37.1	37.1	0.014	94.8
LRP-91	5.2		0.009	0.009	30.4	30.4	0.009	60.9
LRP-90	5		0.023	0.023	77.6	77.6	0.037	250.5
LRP-89	0.7		0.017	0.017	57.4	57.4	0.027	182.8
LRP-84	4.4		0.021	0.021	70.9	70.9	0.031	209.9
LRP-83	10		0.017	0.017	57.4	57.4	0.025	169.3
LRP-82	6.5		0.023	0.023	77.6	77.6	0.037	250.5
LRP-80	6.3		0.006	0.006	20.3	20.3	0.008	54.2
Mean:			0.013	0.012	42.489	42.489	0.021	139.570
Median:			0.009	0.009	30.381	30.381	0.013	88.010
Standard Deviation:			0.011	0.011	38.248	38.248	0.031	206.938
Maximum:			0.096	0.095	324.060	324.060	0.480	3249.600
Minimum:			0.001	0.000	0.000	0.000	0.000	0.000

Values computed by Wyoming Mining Association from data in paper

OAP:02/17/08

Appendix 4

Wyoming Mining Association
LOST CREEK TRENCH SAMPLING
Sections 8-13

Source: Geology of the Lost Creek Schroeckingerite Deposits Sweetwater County, Wyoming
Geological Survey Bulletin 1087-J

SAMPLE #	SAMPLE AREA	SAMPLE LENGTH	PERCENT EQUIVALENT URANIUM	PERCENT EQUIVALENT URANIUM-238	EQUIVALENT URANIUM-238 ACTIVITY	RADIUM-226 ACTIVITY	PERCENT URANIUM	NATURAL URANIUM ACTIVITY
					(picoCuries per gram)	(picoCuries per gram)		(picoCuries per gram)
DS-52-293	3.4		0.019	0.019	64.1	64.1	0.033	223.4
DS-52-294	3.9		0.008	0.008	27.0	27.0	0.008	54.2
DS-52-295	2.9		0.008	0.008	27.0	27.0	0.007	47.4
DS-52-297	1.7		0.005	0.005	16.9	16.9	0.002	13.5
DS-52-284	.5		0.016	0.016	54.0	54.0	0.028	189.6
DS-52-285	5.6		0.014	0.014	47.3	47.3	0.024	162.5
DS-52-286	3.5		0.017	0.017	57.4	57.4	0.033	223.4
DS-52-287	0.06		0.006	0.006	20.3	20.3	0.006	40.6
DS-52-371	.5		0.014	0.014	47.3	47.3	0.024	162.5
DS-52-372	3.5		0.014	0.014	47.3	47.3	0.018	121.9
DS-52-373	3.6		0.008	0.008	27.0	27.0	0.008	54.2
DS-52-374	3.4		0.009	0.009	30.4	30.4	0.011	74.5
DS-52-375	5.3		0.008	0.008	27.0	27.0	0.015	101.6
DS-52-376	4.5		0.009	0.009	30.4	30.4	0.009	60.9
DS-52-377	5.7		0.008	0.008	27.0	27.0	0.01	67.7
DS-52-378	4.2		0.013	0.013	43.9	43.9	0.02	135.4
DS-52-379	3.7		0.011	0.011	37.1	37.1	0.019	128.6
DS-52-380	4.7		0.011	0.011	37.1	37.1	0.015	101.6
DS-52-382	3.5		0.031	0.031	104.6	104.6	0.065	440.1
DS-52-390	5.8		0.015	0.015	50.6	50.6	0.026	176.0
DS-52-391	.5		0.007	0.007	23.6	23.6	0.01	67.7
DS-52-392	6.5		0.005	0.005	16.9	16.9	0.007	47.4
DS-52-393	5.7		0.008	0.008	27.0	27.0	0.012	81.2
DS-52-394	3.9		0.005	0.005	16.9	16.9	0.005	33.9
DS-52-395	3		0.007	0.007	23.6	23.6	0.007	47.4
DS-52-397	5.6		0.004	0.004	13.5	13.5	0.003	20.3
DS-52-399	3.4		0.006	0.006	20.3	20.3	0.004	27.1
DS-52-299	5.6		0.004	0.004	13.5	13.5	0.003	20.3
DS-52-300	5.6		0.009	0.009	30.4	30.4	0.011	74.5
DS-52-301	6		0.005	0.005	16.9	16.9	0.005	33.9
DS-52-304	3.3		0.006	0.006	20.3	20.3	0.006	40.6
DS-52-305	4.9		0.012	0.012	40.5	40.5	0.015	101.6
DS-52-306	4.4		0.011	0.011	37.1	37.1	0.011	74.5
DS-52-307	3.6		0.021	0.021	70.9	70.9	0.032	216.6
DS-52-311	4.4		0.01	0.010	33.8	33.8	0.012	81.2
DS-52-314	2.6		0.006	0.006	20.3	20.3	0.007	47.4
DS-52-315	1.4		0.009	0.009	30.4	30.4	0.007	47.4
DS-52-317	3.2		0.012	0.012	40.5	40.5	0.014	94.8
DS-52-318	4.3		0.012	0.012	40.5	40.5	0.014	94.8
DS-52-320	2.6		0.008	0.008	27.0	27.0	0.008	54.2
DS-52-321	3.8		0.01	0.010	33.8	33.8	0.014	94.8
DS-52-322	4.5		0.009	0.009	30.4	30.4	0.013	88.0
DS-52-323	4.6		0.009	0.009	30.4	30.4	0.011	74.5
DS-52-324	5.1		0.007	0.007	23.6	23.6	0.007	47.4
DS-52-325	.5		0.005	0.005	16.9	16.9	0.004	27.1
DS-52-332	1.5		0.005	0.005	16.9	16.9	0.005	33.9
DS-52-333	1.8		0.003	0.003	10.1	10.1	0.001	6.8
DS-52-340	0.7		0.007	0.007	23.6	23.6	0.009	60.9
DS-52-341	4.7		0.009	0.009	30.4	30.4	0.011	74.5
DS-52-342	.5		0.011	0.011	37.1	37.1	0.014	94.8
DS-52-343	5.6		0.008	0.008	27.0	27.0	0.011	74.5
DS-52-344	5.1		0.007	0.007	23.6	23.6	0.008	54.2
DS-52-345	4.6		0.011	0.011	37.1	37.1	0.018	121.9
DS-52-346	5.5		0.011	0.011	37.1	37.1	0.017	115.1
DS-52-347	5.8		0.015	0.015	50.6	50.6	0.022	148.9
DS-52-348	6.1		0.018	0.018	60.8	60.8	0.03	203.1
DS-52-349	6.8		0.015	0.015	50.6	50.6	0.025	169.3
DS-52-312	4.8		0.009	0.009	30.4	30.4	0.012	81.2
DS-52-313	4		0.009	0.009	30.4	30.4	0.016	108.3
DS-52-316	3.3		0.009	0.009	30.4	30.4	0.01	67.7
DS-52-319	2.6		0.01	0.010	33.8	33.8	0.01	67.7
DS-52-326	4.5		0.028	0.028	94.5	94.5	0.019	128.6
DS-52-327	0.8		0.004	0.004	13.5	13.5	0.002	13.5
DS-52-328	3.8		0.004	0.004	13.5	13.5	0.005	33.9
DS-52--329	3.3		0.008	0.008	27.0	27.0	0.011	74.5
DS-52-330	3.5		0.005	0.005	16.9	16.9	0.005	33.9
DS-52-331	2.6		0.005	0.005	16.9	16.9	0.006	40.6
DS-52-352	2.7		0.005	0.005	16.9	16.9	0.004	27.1

DS-52-302	6	0.007	0.007	23.6	23.6	0.007	47.4
DS-52-303	4.9	0.005	0.005	16.9	16.9	0.005	33.9
DS-52-308	3.1	0.008	0.008	27.0	27.0	0.007	47.4
DS-52-309	4.7	0.011	0.011	37.1	37.1	0.013	88.0
DS-52-310	3.9	0.019	0.019	64.1	64.1	0.029	196.3
DS-52-334	3.2	0.005	0.005	16.9	16.9	0.02	135.4
DS-52-335	3	0.004	0.004	13.5	13.5	0.001	6.8
DS-52-336	0.9	0.004	0.004	13.5	13.5	0.002	13.5
DS-52-337	6	0.012	0.012	40.5	40.5	0.017	115.1
DS-52-338	6.1	0.012	0.012	40.5	40.5	0.018	121.9
DS-52-339	6.2	0.012	0.012	40.5	40.5	0.018	121.9
DS-52-350	5.3	0.011	0.011	37.1	37.1	0.018	121.9
DS-52-351	4.8	0.01	0.010	33.8	33.8	0.016	108.3
DS-52-353	3.1	0.01	0.010	33.8	33.8	0.012	81.2
DS-52-354	5.2	0.009	0.009	30.4	30.4	0.012	81.2
DS-52-355	5.7	0.014	0.014	47.3	47.3	0.02	135.4
DS-52-356	6.2	0.01	0.010	33.8	33.8	0.013	88.0
DS-52-357	5.7	0.015	0.015	50.6	50.6	0.024	162.5
DS-52-278	1	0.007	0.007	23.6	23.6	0.009	60.9
DS-52-281	3.1	0.021	0.021	70.9	70.9	0.034	230.2
DS-52-282	2.4	0.006	0.006	20.3	20.3	0.007	47.4
DS-52-283	4.7	0.012	0.012	40.5	40.5	0.021	142.2
DS-52-408	4.3	0.017	0.017	57.4	57.4	0.031	209.9
DS-52-409	3.8	0.017	0.017	57.4	57.4	0.033	223.4
DS-52-410	4	0.018	0.018	60.8	60.8	0.035	237.0
DS-52-411	3.2	0.016	0.016	54.0	54.0	0.035	237.0
DS-52-414	0.9	0.009	0.009	30.4	30.4	0.014	94.8
DS-52-415	2.7	0.008	0.008	27.0	27.0	0.014	94.8
DS-52-418	1.6	0.011	0.011	37.1	37.1	0.023	155.7
DFS-52-403	1.3	0.028	0.028	94.5	94.5	0.051	345.3
Mean:		0.010	0.010	34.962	34.962	0.015	100.376
Median:		0.009	0.009	30.381	30.381	0.012	81.240
Standard Deviation:		0.005	0.005	18.060	18.060	0.011	73.342
Maximum:		0.031	0.031	104.644	104.644	0.065	440.050
Minimum:		0.003	0.003	10.127	10.127	0.001	6.770

Values computed by the Wyoming Mining Association from data in paper

OAP:02/17/08

Appendix 5

Wyoming Mining Association
LOST CREEK TRENCH SAMPLING
Section 1

Source: Geology of the Lost Creek Schroeckingerite Deposits Sweetwater County, Wyoming
Geological Survey Bulletin 1087-J

SAMPLE #	AREA	LENGTH	PERCENT EQUIVALENT URANIUM	PERCENT EQUIVALENT URANIUM-238	EQUIVALENT URANIUM-23 ACTIVITY (picoCuries per gram)	RADIUM-226 ACTIVITY (picoCuries per gram)	PERCENT URANIUM	NATURAL URANIUM ACTIVITY (picoCuries per gram)
DS-H-185		1.3	0.005	0.005	16.9	16.9	0.004	27.1
DS-51-179		0.7	0.006	0.006	20.3	20.3	0.002	13.5
DS-H-187		3.8	0.006	0.006	20.3	20.3	0.007	47.4
DS-H-188		1.9	0.005	0.005	16.9	16.9	0.005	33.9
DS-H-189		4.3	0.01	0.010	33.8	33.8	0.011	74.5
DS-H-190		0.7	0.005	0.005	16.9	16.9	0.006	40.6
DS-H-192		2.7	0.013	0.013	43.9	43.9	0.015	101.6
DS-51-191		0.3	0.008	0.008	27.0	27.0	0.009	60.9
DS-51-192		0.4	0.013	0.013	43.9	43.9	0.018	121.9
DS-51-193		0.7	0.013	0.013	43.9	43.9	0.02	135.4
DS-51-194		0.4	0.03	0.030	101.3	101.3	0.052	352.0
DS-H-198		0.6	0.009	0.009	30.4	30.4	0.01	67.7
DS-H-200		0.4	0.008	0.008	27.0	27.0	0.007	47.4
DS-H-205		3.7	0.007	0.007	23.6	23.6	0.008	54.2
DS-H-207		1	0.008	0.008	27.0	27.0	0.01	67.7
DS-H-208		6.1	0.011	0.011	37.1	37.1	0.015	101.6
DS-H-213		2.5	0.016	0.016	54.0	54.0	0.02	135.4
DS-51-178		0.7	0.003	0.003	10.1	10.1	0.001	6.8
DS-51-180		0.09	0.011	0.011	37.1	37.1	0.01	67.7
DS-51-181		1	0.011	0.011	37.1	37.1	0.011	74.5
DS-51-182		1.4	0.007	0.007	23.6	23.6	0.005	33.9
DS-51-183		1.2	0.006	0.006	20.3	20.3	0.004	27.1
DS-51-184		0.9	0.013	0.013	43.9	43.9	0.013	88.0
DS-51-185		1.2	0.008	0.008	27.0	27.0	0.006	40.6
DS-51-186		1.4	0.005	0.005	16.9	16.9	0.003	20.3
DS-51-187		0.7	0.005	0.005	16.9	16.9	0.003	20.3
DS-51-188		1.4	0.01	0.010	33.8	33.8	0.011	74.5
DS-51-189		1.2	0.01	0.010	33.8	33.8	0.012	81.2
DS-51-190		1.1	0.13	0.129	438.8	438.8	0.018	121.9
DS-51-195		0.3	0.011	0.011	37.1	37.1	0.016	108.3
DS-51-196		0.4	0.007	0.007	23.6	23.6	0.006	40.6
DS-51-197		0.7	0.006	0.006	20.3	20.3	0.006	40.6
DS-51-198		0.8	0.018	0.018	60.8	60.8	0.033	223.4
DS-51-199		0.4	0.007	0.007	23.6	23.6	0.008	54.2
DS-51-200		0.6	0.012	0.012	40.5	40.5	0.018	121.9
DS-51-201		1.1	0.018	0.018	60.8	60.8	0.033	223.4
DS-51-202		2.1	0.008	0.008	27.0	27.0	0.011	74.5
DS-51-203		1.3	0.011	0.011	37.1	37.1	0.015	101.6
DS-51-204		0.9	0.01	0.010	33.8	33.8	0.014	94.8
DS-51-205		1.1	0.016	0.016	54.0	54.0	0.032	216.6
DS-51-206		1.4	0.039	0.039	131.6	131.6	0.096	649.9
DS-51-78		0.5	0.005	0.005	16.9	16.9	0.004	27.1
DS-H-98		5.9	0.031	0.031	104.6	104.6	0.051	345.3
DS-51-81		1	0.016	0.016	54.0	54.0	0.022	148.9
DS-51-84		0.6	0.007	0.007	23.6	23.6	0.004	27.1
DS-H-100		0.9	0.017	0.017	57.4	57.4	0.023	155.7
DS-H-101		2.9	0.004	0.004	13.5	13.5	0.004	27.1
DS-H-102		1.4	0.022	0.022	74.3	74.3	0.039	264.0
DS-51-88		0.6	0.012	0.012	40.5	40.5	0.013	88.0
DS-51-90		0.5	0.014	0.014	47.3	47.3	0.021	142.2
DS-H-104		4	0.029	0.029	97.9	97.9	0.044	297.9
DS-51-96		1.3	0.022	0.022	74.3	74.3	0.039	264.0
DS-H-106		4.4	0.021	0.021	70.9	70.9	0.032	216.6
DS-H-111		2.4	0.026	0.026	87.8	87.8	0.035	237.0
DS-H-112		3.1	0.014	0.014	47.3	47.3	0.014	94.8
DS-H-114		1.3	0.014	0.014	47.3	47.3	0.021	142.2
DS-52-138	2.2		0.01	0.010	33.8	33.8	0.011	74.5
DS-H-122		6	0.027	0.027	91.1	91.1	0.043	291.1
DS-H-149		1.3	0.019	0.019	64.1	64.1	0.035	237.0
DS-51-151		0.8	0.019	0.019	64.1	64.1	0.032	216.6
DS-H-150		3.2	0.048	0.048	162.0	162.0	0.09	609.3
DS-51-153		0.7	0.023	0.023	77.6	77.6	0.032	216.6
DS-51-156		1	0.022	0.022	74.3	74.3	0.049	331.7
DS-H-151		1.9	0.008	0.008	27.0	27.0	0.009	60.9
DS-H-156		0.8	0.011	0.011	37.1	37.1	0.011	74.5
DS-51-158		0.4	0.008	0.008	27.0	27.0	0.007	47.4
DS-H-157		4.3	0.031	0.031	104.6	104.6	0.051	345.3
DS-H-158		1.2	0.011	0.011	37.1	37.1	0.007	47.4
DS-H-164		0.9	0.01	0.010	33.8	33.8	0.014	94.8
DS-H-165		1.3	0.013	0.013	43.9	43.9	0.019	128.6
DS-51-173		0.7	0.008	0.008	27.0	27.0	0.002	13.5
DS-H-166		1.1	0.008	0.008	27.0	27.0	0.007	47.4
DS-51-174		0.8	0.013	0.013	43.9	43.9	0.012	81.2
DS-H-168		1	0.01	0.010	33.8	33.8	0.008	54.2
DS-H-169		0.9	0.009	0.009	30.4	30.4	0.006	40.6
DS-H-170		0.4	0.019	0.019	64.1	64.1	0.021	142.2
DS-H-172		1	0.012	0.012	40.5	40.5	0.012	81.2
DS-51-79		0.3	0.005	0.005	16.9	16.9	0.005	33.9
DS-51-80		0.6	0.017	0.017	57.4	57.4	0.018	121.9
DS-51-82		2.1	0.054	0.054	182.3	182.3	0.096	649.9
DS-51-83		1.4	0.013	0.013	43.9	43.9	0.022	148.9
DS-51-85		0.5	0.016	0.016	54.0	54.0	0.03	203.1
DS-51-86		0.9	0.012	0.012	40.5	40.5	0.016	108.3
DS-51-87		0.6	0.027	0.027	91.1	91.1	0.027	182.8
DS-51-89		1.2	0.004	0.004	13.5	13.5	0.002	13.5
DS-51-91		0.5	0.043	0.043	145.2	145.2	0.083	561.9
DS-51-92		1.4	0.041	0.041	138.4	138.4	0.043	291.1
DS-51-93		1.5	0.03	0.030	101.3	101.3	0.055	372.4
DS-51-94		1.5	0.031	0.031	104.6	104.6	0.05	338.5
DS-51-95		1.7	0.02	0.020	67.5	67.5	0.03	203.1

DS-H-105		3.5	0.005	0.005	16.9	16.9	0.007	47.4
DS-51-97		1.3	0.015	0.015	50.6	50.6	0.026	176.0
DS-51-98		1.3	0.013	0.013	43.9	43.9	0.023	155.7
DS-51-99		0.4	0.009	0.009	30.4	30.4	0.01	67.7
DS-51-100		0.5	0.012	0.012	40.5	40.5	0.02	135.4
DS-51-101		1	0.015	0.015	50.6	50.6	0.019	128.6
DS-51-102		0.8	0.016	0.016	54.0	54.0	0.023	155.7
DS-51-103		0.7	0.007	0.007	23.6	23.6	0.008	54.2
DS-51-104		0.6	0.015	0.015	50.6	50.6	0.018	121.9
DS-51-105		0.5	0.012	0.012	40.5	40.5	0.016	108.3
DS-51-105		0.5	0.012	0.012	40.5	40.5	0.016	108.3
DS-51-106		0.7	0.006	0.006	20.3	20.3	0.006	40.6
DS-51-107		1.3	0.018	0.018	60.8	60.8	0.033	223.4
DS-51-108		1.8	0.018	0.018	60.8	60.8	0.028	189.6
DS-51-109		2.8	0.021	0.021	70.9	70.9	0.032	216.6
DS-51-110		1.5	0.022	0.022	74.3	74.3	0.038	257.3
DS-51-111		1.5	0.034	0.034	114.8	114.8	0.06	406.2
DS-51-112		1	0.039	0.039	131.6	131.6	0.082	555.1
DS-51-152		0.5	0.068	0.068	229.5	229.5	0.07	473.9
DS-51-154		1.4	0.1	0.099	337.6	337.6	0.2	1354.0
DS-51-155		0.7	0.091	0.090	307.2	307.2	0.26	1760.2
DS-51-157		1	0.011	0.011	37.1	37.1	0.017	115.1
DS-51-159		1.2	0.035	0.035	118.1	118.1	0.055	372.4
DS-51-160		1	0.02	0.020	67.5	67.5	0.023	155.7
DS-51-161		1.1	0.019	0.019	64.1	64.1	0.023	155.7
DS-51-162		1	0.011	0.011	37.1	37.1	0.0004	2.7
DS-51-282		0.9	0.008	0.008	27.0	27.0	0.004	27.1
DS-51-172		1.2	0.014	0.014	47.3	47.3	0.018	121.9
DS-51-175.		0.6	0.012	0.012	40.5	40.5	0.011	74.5
DS-51-177		0.8	0.011	0.011	37.1	37.1	0.008	54.2
DS-H-65		2.5	0.009	0.009	30.4	30.4	0.014	94.8
DS-H-66		3.9	0.007	0.007	23.6	23.6	0.012	81.2
DS-H-67		3.9	0.016	0.016	54.0	54.0	0.03	203.1
DS-H-68		3.2	0.003	0.003	10.1	10.1	0.001	6.8
DS-H-69		3.3	0.014	0.014	47.3	47.3	0.024	162.5
DS-H-72		10	0.013	0.013	43.9	43.9	0.027	182.8
DS-H-73		4.4	0.014	0.014	47.3	47.3	0.025	169.3
DS-H-77		1.5	0.008	0.008	27.0	27.0	0.014	94.8
DS-H-78		7.9	0.009	0.009	30.4	30.4	0.016	108.3
DS-H-79		3.5	0.016	0.016	54.0	54.0	0.02	135.4
DS-H-80		9.3	0.004	0.004	13.5	13.5	0.003	20.3
DS-51-42A		0.6	0.004	0.004	13.5	13.5	0.003	20.3
DS-H-81		10.1	0.011	0.011	37.1	37.1	0.017	115.1
DS-H-82		0.6	0.004	0.004	13.5	13.5	0.005	33.9
DS-H-83		6.2	0.013	0.013	43.9	43.9	0.021	142.2
DS-H-84		1.3	0.005	0.005	16.9	16.9	0.005	33.9
DS-H-85		2.1	0.009	0.009	30.4	30.4	0.001	6.8
DS-H-86		2.5	0.008	0.008	27.0	27.0	0.004	27.1
DS-H-87		3.3	0.038	0.038	128.3	128.3	0.071	480.7
DS-H-89		0.7	0.008	0.008	27.0	27.0	0.005	33.9
DS-H-94		10	0.018	0.018	60.8	60.8	0.026	176.0
DS-H-95		1.3	0.006	0.006	20.3	20.3	0.006	40.6
DS-H-96		3.7	0.005	0.005	16.9	16.9	0.004	27.1
DS-H-97		3	0.019	0.019	64.1	64.1	0.039	264.0
DS-51-6		0.8	0.01	0.010	33.8	33.8	0.019	128.6
DS-51-7		0.5	0.009	0.009	30.4	30.4	0.016	108.3
DS-51-8		0.9	0.009	0.009	30.4	30.4	0.019	128.6
DS-51-9		1.9	0.011	0.011	37.1	37.1	0.018	121.9
DS-51-10		0.7	0.02	0.020	67.5	67.5	0.031	209.9
DS-51-11		1	0.006	0.006	20.3	20.3	0.012	81.2
DS-51-12		1.3	0.028	0.028	94.5	94.5	0.057	385.9
DS-51-13		1	0.01	0.010	33.8	33.8	0.015	101.6
DS-51-14		1.7	0.019	0.019	64.1	64.1	0.034	230.2
DS-51-15		0.7	0.017	0.017	57.4	57.4	0.034	230.2
DS-51-16		1	0.009	0.009	30.4	30.4	0.014	94.8
DS-51-17		1	0.012	0.012	40.5	40.5	0.026	176.0
DS-51-18		0.6	0.012	0.012	40.5	40.5	0.02	135.4
DS-51-36		0.4	0.032	0.032	108.0	108.0	0.052	352.0
DS-51-37		0.4	0.01	0.010	33.8	33.8	0.012	81.2
DS-51-38		0.5	0.012	0.012	40.5	40.5	0.013	88.0
DS-51-39		0.4	0.004	0.004	13.5	13.5	0.003	20.3
DS-51-40		0.6	0.006	0.006	20.3	20.3	0.008	54.2
DS-51-41		2.3	0.011	0.011	37.1	37.1	0.022	148.9
DS-51-42B		0.9	0.027	0.027	91.1	91.1	0.04	270.8
DS-51-43		1.4	0.007	0.007	23.6	23.6	0.008	54.2
DS-51-44		1.2	0.019	0.019	64.1	64.1	0.039	264.0
DS-51-45		1	0.007	0.007	23.6	23.6	0.012	81.2
DS-51-46		1	0.01	0.010	33.8	33.8	0.018	121.9
DS-51-47		0.6	0.018	0.018	60.8	60.8	0.037	250.5
DS-51-48		1	0.027	0.027	91.1	91.1	0.035	237.0
DS-51-49		1	0.033	0.033	111.4	111.4	0.063	426.5
DS-51-50		0.8	0.077	0.076	259.9	259.9	0.007	47.4
DS-51-51		3.5	0.008	0.008	27.0	27.0	0.013	88.0
DS-51-52		1.3	0.025	0.025	84.4	84.4	0.041	277.6
DS-51-53		20	0.028	0.028	94.5	94.5	0.051	345.3
DS-51-54		0.8	0.026	0.026	87.8	87.8	0.047	318.2
DS-51-55		0.8	0.021	0.021	70.9	70.9	0.035	237.0
DS-51-56		1.2	0.009	0.009	30.4	30.4	0.012	81.2
DS-51-77		1.1	0.023	0.023	77.6	77.6	0.048	325.0
DS-52-114	0.8		0.014	0.014	47.3	47.3	0.016	108.3
DS-52-115	12.9		0.013	0.013	43.9	43.9	0.017	115.1
DS-52-116	8.7	.	0.01	0.010	33.8	33.8	0.01	67.7
DS-52-117	7.7		0.005	0.005	16.9	16.9	0.006	40.6
DS-52-118	5		0.012	0.012	40.5	40.5	0.015	101.6
DS-52-119	3.8		0.014	0.014	47.3	47.3	0.018	121.9
DS-52-120	8		0.013	0.013	43.9	43.9	0.014	94.8
DS-52-121	10.7		0.011	0.011	37.1	37.1	0.01	67.7
DS-52-122	1.2		0.006	0.006	20.3	20.3	0.001	6.8
DS-52-123	637		0.009	0.009	30.4	30.4	0.009	60.9
DS-52-124	10.3		0.012	0.012	40.5	40.5	0.013	88.0
DS-52-125	6		0.013	0.013	43.9	43.9	0.02	135.4

DS-52-126	6.2		0.022	0.022	74.3	74.3	0.033	223.4
DS-52-127	6.8		0.013	0.013	43.9	43.9	0.016	108.3
DS-52-131	6		0.015	0.015	50.6	50.6	0.015	101.6
DS-52-129	5.9		0.011	0.011	37.1	37.1	0.012	81.2
DS-52-130	9		0.023	0.023	77.6	77.6	0.045	304.7
DS-52-131	6		0.015	0.015	50.6	50.6	0.015	101.6
DS-52-132	5.3		0.004	0.004	13.5	13.5	0.005	33.9
DS-52-133	4.8		0.008	0.008	27.0	27.0	0.013	88.0
DS-52-134	7.5		0.013	0.013	43.9	43.9	0.024	162.5
DS-52-135	6.5		0.021	0.021	70.9	70.9	0.033	223.4
DS-52-136	5.5		0.013	0.013	43.9	43.9	0.024	162.5
DS-51-19		0.5	0.008	0.008	27.0	27.0	0.009	60.9
DS-51-20		1.2	0.014	0.014	47.3	47.3	0.021	142.2
DS-51-21		0.8	0.009	0.009	30.4	30.4	0.014	94.8
DS-51-22		0.7	0.014	0.014	47.3	47.3	0.019	128.6
DS-51-23		1	0.01	0.010	33.8	33.8	0.014	94.8
DS-51-24		0.7	0.015	0.015	50.6	50.6	0.019	128.6
DS-51-25		1.3	0.013	0.013	43.9	43.9	0.024	162.5
DS-51-26		0.9	0.002	0.002	6.8	6.8	0.002	13.5
DS-51-27		0.5	0.004	0.004	13.5	13.5	0.003	20.3
DS-51-28		1.2	0.008	0.008	27.0	27.0	0.009	60.9
DS-51-29		1.3	0.033	0.033	111.4	111.4	0.062	419.7
DS-51-30		0.3	0.017	0.017	57.4	57.4	0.025	169.3
DS-51-31		1	0.024	0.024	81.0	81.0	0.04	270.8
DS-51-32		0.5	0.01	0.010	33.8	33.8	0.015	101.6
DS-51-33		0.7	0.011	0.011	37.1	37.1	0.02	135.4
DS-51-34		0.4	0.009	0.009	30.4	30.4	0.013	88.0
DS-51-35		0.8	0.01	0.010	33.8	33.8	0.019	128.6
DS-51-57		0.6	0.016	0.016	54.0	54.0	0.021	142.2
DS-51-58	0.06	Sample missing		0.000	0.0	0.0		0.0
DS-51-59		0.5	0.03	0.030	101.3	101.3	0.052	352.0
DS-51-60		2	0.021	0.021	70.9	70.9	0.024	162.5
DS-51-61		1.6	0.017	0.017	57.4	57.4	0.028	189.6
DS-51-62		1.5	0.003	0.003	10.1	10.1	0.002	13.5
DS-51-63		1.5	0.009	0.009	30.4	30.4	0.012	81.2
DS-51-64		1	0.011	0.011	37.1	37.1	0.012	81.2
DS-51-65		2	0.013	0.013	43.9	43.9	0.022	148.9
DS-51-66		1.4	0.016	0.016	54.0	54.0	0.027	182.8
DS-51-67		1.3	0.01	0.010	33.8	33.8	0.014	94.8
DS-51-69		1.6	0.012	0.012	40.5	40.5	0.016	108.3
DS-51-69		3	0.008	0.008	27.0	27.0	0.011	74.5
DS-51-72		1.9	0.011	0.011	37.1	37.1	0.015	101.6
DS-51-73		1.3	0.026	0.026	87.8	87.8	0.042	284.3
DS-51-74		1.6	0.025	0.025	84.4	84.4	0.036	243.7
DS-51-75		1.7	0.02	0.020	67.5	67.5	0.028	189.6
DS-51-76		2.8	0.006	0.006	20.3	20.3	0.004	27.1
Mean:			0.016	0.016	53.8	53.8	0.023	156.6
Median:			0.012	0.012	40.5	40.5	0.016	108.3
Standard Deviation:			0.015	0.015	49.5	49.5	0.026	177.6
Maximum:			0.130	0.129	438.8	438.8	0.260	1760.2
Minimum:			0.002	0.000	0.0	0.0	0.000	0.0

Values computed by Wyoming Mining Association from data in paper

OAP:02/17/08

Appendix 6

UMETCO Minerals Corporation
Soil Radiometric Data
UMETCO Gas Hills Site

Non-Random Background Soil Radiometric Data

SAMPLE I.D.#	U-Nat (pCi/g)	Ra226 pCi/g	Ra226 Prec. +/-	Th230 pCi/g	Th230 Pec. +/-	Pb210 pCi/g	Pb210 Prec. +/-
SS # 1; 0-6"	0.9	1.6	0.5	< 0.02		0.2	0.2
SS # 1; 6-12"	0.8	1.1	0.3	< 0.02		< 0.10	
SS # 2; 0-6"	0.07	1.3	0.2	2.3	0.7	0.3	0.3
SS # 2; 6-12"	0.06	1.3	0.2	< 0.02		0.5	0.4
SS # 3; Road Bed	37.4	119	0.2	177	5.8	89.3	3.2
SS # 4; 0-6"	0.05	1	1	< 0.02		0.3	0.3
SS # 4; 6-12"	0.6	1.1	0.3	< 0.02		0.3	0.3
SS # 5; 0-6"	1.1	1.4	0.3	< 0.02		< 0.10	
SS # 5; 6-12"	1.2	1.7	0.3	< 0.02		1.1	0.8
SS # 6; 0-6"	1.1	1.6	0.3	< 0.02		< 0.10	
SS # 6; 6-12"	1.4	1.6	0.3	< 0.02		< 0.10	
SS # 7; 0-6"	2.3	1.7	0.3	< 0.02		0.8	0.8
SS # 7; 6-12"	2.9	1.9	0.3	< 0.02		0.3	0.3
SS # 8; 0-6"	1.1	1.5	0.3	< 0.02		0.4	0.4
SS # 8; 6-12"	0.9	0.8	0.1	< 0.02		0.2	0.2
SS # 9; 0-6"	1.65	15.4	1	0.5	0.1	< 0.01	
SS # 9; 6-12"	0.66	7.7	0.8	0.4	0.1	< 0.01	
SS # 10; 0-6"	3.06	38.4	1.6	1.6	0.2	0.4	0.2
SS # 10; 6-12"	2.5	41	1.6	1.9	0.2	1.3	0.2
SS # 11; 0-6"	21.5	268	2.4	50.8	2.2	153	1.1
SS # 11; 6-12"	14.5	504	3.3	58.1	2.1	272	1.2
SS # 12; 0-6"	2.19	2.9	0.3	1	0.1	1.3	0.2
SS # 12; 6-12"	0.8	1.4	0.2	0.4	0.1	10.8	0.4
SS # 13; 0-6"	0.86	1.3	0.2	0.5	0.1	1.25	0.4
SS # 13; 6-12"	0.63	0.9	0.2	0.4	0.1	0.88	0.4
SS # 14; 0-6"	0.84	1	0.2	0.5	0.1	0.86	0.4
SS # 14; 6-12"	0.59	0.9	0.2	0.4	0.1	1.08	0.4
SS # 15; 0-6"	1.88	1.4	0.2	0.6	0.1	0.75	0.4
SS # 15; 6-12"	1.19	1.4	0.2	0.9	0.2	0.42	0.3
SS # 16; 0-6"	1.66	1.1	0.2	0.8	0.2	< 0.01	
SS # 16; 6-12"	2.16	0.9	0.2	0.8	0.2	1.18	0.4
SS # 17; 0-6"	1.23	1.5	0.2	1.7	0.2	1.17	0.4
SS # 17; 6-12"	1.19	1.3	0.2	0.9	0.2	< 0.01	
SS # 18; 0-6"	0.85	0.9	0.2	0.8	0.2	1.01	0.4
SS # 18; 6-12"	0.86	1.1	0.2	0.9	0.2	0.93	0.4
SS # 19; 0-6"	19.7	68.9	1.2	18	1.3	36	0.9
SS # 19; 6-12"	23.8	35.1	0.9	6.5	0.5	21.7	0.8
SS # 20; 0-6"	24.8	7.16	0.22	3.5	0.3	2.2	0.5
SS # 20; 6-12"	8.36	11.4	0.28	6.5	0.5	4.5	0.6
	0.02	0.02		0.02		0.1	
Mean:	4.85	29.58		12.99		19.56	
Median:	1.19	1.50		0.90		1.01	
Standard Deviation:	8.67	91.12		36.52		56.40	
Maximum:	37.40	504.00		177.00		272.00	
Minimum:	0.05	0.80		0.40		0.20	

Notes:
This data was collected by UMETCO Minerals Corporation
This data was provided by John Hamrick formerly of UMETCO Minerals Corporatrion now of Cotter Corporation
This data was collected from background soil sampling locations in the Gas Hills of Wyoming.
This data was collected by UMETCO Minerals Corporation to demonstrate the variability of natural background in the Gas Hills.