Missouri Department of Health and Senior Services
P.O. Box 570, Jefferson City, MO 65102-0570 Phone: 573-751-6400 FAX: 573-751-6010
RELAY MISSOURI for Hearing and Speech Impaired 1-800-735-2966 VOICE 1-800-735-2466

Margaret T. Donnelly
Director

Jeremiah W. (Jay) Nixon
Governor

November 17, 2009

Mr. Mark Templeton, Director
Missouri Department of Natural Resources
1101 Riverside Drive
Jefferson City, MO 65101

Dear Director Templeton:

The Missouri Department of Health and Senior Services (DHSS) evaluated several exposure scenarios for St. Joe State Park using the Environmental Protection Agency's Adult Lead Model. The model evaluates non-residential lead exposure for those over 84 months of age, and affords protection for women of childbearing age and men. A combination of standard and site specific variable values was used to evaluate exposure at the park. Results of the analyses show that individuals aged 84 months or older can ride off-road vehicles on the chat areas of the park for 2-3 days per week for 16 consecutive weeks with only a 5% modeled probability of reaching the current CDC level of concern for the most sensitive individuals, which is 10 micrograms of lead per deciliter of blood.

Please keep in mind that any interim control is only part of a much larger, ongoing clean up action taking place at the park. It is important that DNR continue to move forward with the plans that are in place for the park. The plans involve:

- Limiting access to areas with lead concentrations over 600 parts per million, through trail building, vegetative cover or capping with clean sand;

- Posting clearly visible signs indicating that the chat may contain lead and give park users health information and recommended actions that they may take to reduce their exposure to that lead; and

- Emphasizing use of the wash stations in the staging area to minimize the potential for tracking lead-contaminated materials out of the park and to rider's homes.

We look forward to working together with your agency to resolve these issues. Please feel free to contact Cherri Baysinger at 573/751-6102 if you would like to discuss these issues further.

Sincerely,

Margaret T. Donnelly
Director

SC/MTD/lb

c: Nancie McAnaugh, Department Directors Office
Glenda R. Miller, Division of Community and Public Health
Scott Clardy, Section for Disease Control and Environmental Epidemiology
Cherri Baysinger, Bureau of Environmental Epidemiology
Bill Bryan, Department of Natural Resources
Dru Buntin, Department of Natural Resources
Leanne Tippett Mosby, Department of Natural Resources
Jim Kavanaugh, Department of Natural Resources
Dennis Stinson, Department of Natural Resources
Bob Geller, Department of Natural Resources

MDHSS Evaluation of Adult Off-Road Vehicle Recreational Use at St. Joe State Park

MDHSS evaluated an adult off-road vehicle (ORV) recreational scenario for St. Joe State Park using the U.S. Environmental Protection Agency's (EPA) Adult Lead Methodology (ALM). The ALM is a methodology for assessing risks associated with non-residential adult exposures to lead in soil. For non-residential settings, the fetus has been determined to be the most sensitive receptor; therefore, the ALM focuses on estimating fetal blood lead concentrations for women of child-bearing age that are exposed to lead-contaminated soils. The target blood lead for adults is based on protection of the fetus, so that the fetus has no more than a 5% probability of having a blood lead (PbB) level greater than 10 μg/dL.

The ALM uses specific input parameters including soil ingestion rate, exposure frequency, averaging time, Soil Lead Absorption Fraction (AF_s), Biokinetic Slope Factor (BKSF), Fetal/Maternal Blood Lead Concentration Ratio ($R_{fetal/maternal}$), Baseline Blood Lead Concentration (PbB_0), and the Individual Blood Lead Geometric Standard Deviation (GSD_i).

Input parameters to the ALM were based on both default and site-specific values. Site-specific values were obtained from site data collected in 2008 along with site-specific values obtained from Table 14 of the *Human Health Risk Asssessment for the Federal Tailings Pile Site, St. Francois County, Missouri* (December 2003).

Site-specific exposure assumptions are detailed below:

- Lead Concentrations were weighted by exposure to onsite media concentrations (Average of 449 mg/kg and Maximum of 1014 mg/kg from 2008 site data, and a higher concentration of 1400 mg/kg ORV Soil; and 4.2 $\mu g/m^3$ ORV Air) and assumed offsite media concentrations.
    - Soil Lead Concentration (Pb_S) was calculated based on exposure to onsite Tailings 1-4 days per week while the remaining days per week were assumed exposed to a Background Concentration of 200 mg/kg based on the Arithmetic Mean of Background Concentrations for St. Francois County and the surrounding seven counties obtained from the USGS PLUTO Database.
    - Air Lead Concentration (Pb_A) was calculated based on exposure to onsite ORV Air and offsite exposure to 0.1 $\mu g/m^3$.

- The values used for the PbB (GSD_i) and $PbB_{adult,0}$ are based on all races in the Midwest Region using data from the NHANES III survey.

- Soil Ingestion Rates (IR_S) of 100 mg/day and 200 mg/day were used to account for ORV activities that will generate dust and increase the potential for incidental ingestion.

- The Air Inhalation Rate (IR_A) is based on short-term exposure for moderate activities of 1.6 m^3/hr over an exposure time of 4 hours/day.

- The Absorption Fraction for Soil and Air (AF_S and AF_A) was calculated using site-specific bioavailability data (AF = $AF_{soluble}$ x RBA where Default Absorption Factor for Soluble Lead ($AF_{soluble}$) = 0.20 and Site-Specific Relative Bioavailability (RBA) = 0.485)

- Exposure Frequency (EF) and Averaging Time (AT) are based on varying exposure of 1-4 days/week over a 16-week period.

The following table summarizes the results of this analysis by specifying the number of days that adults may ride ORVs without exceeding the target risk of no more than a 5% probability that the blood lead (PbB) level of a fetus would exceed 10 μg/dL.

Soil Lead Concentration (ppm)	**Soil Ingestion Rate (0.100 g/day)**	**Increased Soil Ingestion Rate (0.200 g/day)**
449	>4 days/week	3 day limit
1014	3 day limit	2 day limit
1400	3 day limit	2 day limit

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	236	271	307	342
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.100	0.100	0.100	0.100
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.7**	**1.9**	**2.2**	**2.6**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**5.4**	**6.2**	**7.3**	**8.6**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**0.8%**	**1.2%**	**2.0%**	**3.3%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON AVERAGE OF 449 PPM & BACKGROUND OF 200 PPM
SOIL INGESTION RATE OF 0.100 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	316	433	549	665
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.100	0.100	0.100	0.100
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.7**	**2.1**	**2.6**	**3.3**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**5.6**	**6.8**	**8.6**	**10.9**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**0.9%**	**1.7%**	**3.3%**	**6.3%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON MAXIMUM OF 1014 PPM & BACKGROUND OF 200 PPM
SOIL INGESTION RATE OF 0.100 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	371	543	714	886
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.100	0.100	0.100	0.100
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.7**	**2.2**	**2.9**	**3.8**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**5.7**	**7.2**	**9.5**	**12.5**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**0.9%**	**2.0%**	**4.4%**	**8.7%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON CONCENTRATION OF 1400 PPM & BACKGROUND OF 200 PPM
SOIL INGESTION RATE OF 0.100 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	236	271	307	342
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.200	0.200	0.200	0.200
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.8**	**2.2**	**2.7**	**3.4**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**5.9**	**7.2**	**8.9**	**11.1**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**1.0%**	**2.0%**	**3.7%**	**6.5%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON AVERAGE OF 449 PPM & BACKGROUND OF 200 PPM
INCREASED SOIL INGESTION RATE OF 0.200 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	316	433	549	665
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.200	0.200	0.200	0.200
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.9**	**2.5**	**3.5**	**4.8**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**6.2**	**8.4**	**11.6**	**15.8**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**1.2%**	**3.1%**	**7.3%**	**14.3%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON MAXIMUM OF 1014 PPM & BACKGROUND OF 200 PPM
INCREASED SOIL INGESTION RATE OF 0.200 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Calculation of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Exposure Variable	Description of Exposure Variable	Units	Values for ORV Recreational User			
			1 day per week	2 days per week	3 days per week	4 days per week
Pb_S	Soil Lead Concentration	µg/g or ppm	371	543	714	886
Pb_A	Air Lead Concentration	µg/m^3	0.69	1.27	1.86	2.44
$R_{fetal/maternal}$	Fetal/Maternal PbB Ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4	0.4
GSD_i	Geometric Standard Deviation PbB	--	2.2	2.2	2.2	2.2
PbB_0	Baseline PbB	µg/dL	1.5	1.5	1.5	1.5
IR_S	Soil Ingestion Rate	g/day	0.200	0.200	0.200	0.200
IR_A	Air Inhalation Rate	m^3/day	6.4	6.4	6.4	6.4
AF_S	Soil Absorption Fraction	--	0.10	0.10	0.10	0.10
AF_A	Air Absorption Fraction	--	0.10	0.10	0.10	0.10
EF	Exposure Frequency	days/year	16	32	48	64
AT	Averaging Time	days	112	112	112	112
PbB_{adult}	**PbB of adult worker, geometric mean**	**µg/dL**	**1.9**	**2.8**	**4.1**	**5.8**
$PbB_{fetal, 0.95}$	**95th percentile PbB among fetuses of adult workers**	**µg/dL**	**6.4**	**9.2**	**13.4**	**19.0**
PbB_t	**Target PbB level of concern**	**µg/dL**	**10.0**	**10.0**	**10.0**	**10.0**
$P(PbB_{fetal, 0.95} > PbB_t)$	**Probability that $PbB_{fetal, 0.95} > PbB_t$, assuming lognormal distribution**	**%**	**1.3%**	**4.0%**	**10.2%**	**20.3%**

$$PbB_{adult} = (Pb_S \times BKSF \times IR_S \times AF_S \times EF/AT) + (Pb_A \times BKSF \times IR_A \times AF_A \times EF/AT) + PbB_0$$

$$PbB_{fetal, 0.95} = PbB_{adult} * (GSD_i^{1.645} * R_{fetal/maternal})$$

TIME-WEIGHTED CONCENTRATION BASED ON CONCENTRATION OF 1400 PPM & BACKGROUND OF 200 PPM
INCREASED SOIL INGESTION RATE OF 0.200 g/day

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil