Appendix D

Site Pictures

Picture 1: Northeast: The main gate. Residential houses are directly across the street.

Picture 2: Broken wooden bridge over Rumford River

Picture 3: Demolition debris from small building that was in the Dricon process area

Picture 4: Lagoon in the Dricon process area

Appendix E

Chemical-Specific Toxicity Information

In order to evaluate possible public health implications, estimates of opportunities for exposure to compounds must be combined with what is known about the toxicity of the chemicals. ATSDR has developed minimal risk levels (MRLs) for many chemicals. An MRL is an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse noncancer health effects over a specified duration of exposure. MRLs are derived based on no-observed-adverse-effect levels (NOAELs) or lowest-observed-adverse-effect levels (LOAELs) from either human or animal studies. The LOAELs or NOAELs reflect the actual levels of exposure that are used in studies. ATSDR has also classified LOAELs into "less serious" or "serious" effects. "Less serious" effects are those that are not expected to cause significant dysfunction or whose significance to the organism is not entirely clear. "Serious" effects are those that evoke failure in a biological system and can lead to illness or death. When reliable and sufficient data exist, MRLs are derived from NOAELs or from less serious LOAELs, if no NOAEL is available for the study. To derive these levels, ATSDR also accounts for uncertainties about the toxicity of a compound by applying various margins of safety to the MRL, thereby establishing a level that is well below a level of health concern.

Arsenic

Arsenic is a naturally occurring element that can be found in many kinds of rock, particularly copper or lead containing ores. Arsenic can be found in the environment in two different forms, organic arsenic and inorganic arsenic. The organic forms are usually less harmful than the inorganic forms. Ingesting arsenic in soil, water, or food is the most likely way for a person to be exposed near a waste site. Only a small amount of arsenic can be absorbed through the skin from contact with arsenic-contaminated soils or water. Some areas of the country contain naturally high levels of arsenic in rock, which often means that there are higher levels of arsenic in soil and water (ATSDR 2000a).

The definitive symptom of long-term exposure to elevated levels of arsenic include skin abnormalities such as darkening and the appearance of corns or warts on the palms, soles, and torso. However, there is some evidence that trace amounts of arsenic in the normal diet may be necessary for metabolism (ATSDR 2000a). The EPA has classified arsenic as a human carcinogen based on sufficient evidence in humans. In humans, it has been observed that skin carcinomas develop from some of the corns or warts that appear as a result of exposure to arsenic. Large-scale epidemiological studies have been conducted in Taiwan showing clear associations and/or dose response trends for arsenic exposure and tumors of bladder, kidney, liver and lung (ATSDR 2000a).

Chromium

Chromium is a naturally occurring element that is present in the environment in several different forms. The most common forms are chromium (0), chromium (III) (i.e., trivalent chromium), or chromium VI (i.e., hexavalent chromium). Trivalent chromium occurs naturally in the environment, whereas chromium (0) and hexavalent chromium are generally produced by industrial processes. It is important to identify which form of chromium is in the soils because trivalent chromium and hexavalent chromium have different toxicological properties. For instance, trivalent chromium is considered to be less toxic than hexavalent chromium and is a nutrient at low levels. Chromium (0) is not currently believed to cause a serious health risk. Total chromium is the sum of the concentrations of trivalent and hexavalent chromium. Because total chromium can be the sum of chromium in different oxidation states with different toxicities, and the concentrations of each species can vary, there is no comparison value for it (ATSDR 2000b). The soil RMEGs for trivalent chromium for children and adults are 80,000 mg/kg and 1,000,000 mg/kg, respectively. The soil RMEGs for hexavalent chromium for children and adults are 200 mg/kg and 3,000 mg/kg, respectively.

EPA has determined that hexavalent chromium in air is a human carcinogen and that there is insufficient information to determine whether hexavalent chromium in water or food and trivalent chromium are human carcinogens (ATSDR 2000b).

Dioxins

TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) is one of 75 different congeners of chlorinated dibenzo-p-dioxins (CDDs). Dioxins are not intentionally manufactured but can be formed in the manufacturing process of chlorophenols (e.g., herbicides and germicides). The main environmental sources of dioxins are herbicides, wood preservatives, germicides, pulp and paper manufacturing plants, incineration of municipal and certain industrial and medical wastes, transformer/capacitor fires involving PCBs, exhaust from automobiles using leaded gasoline, chemical wastes from improper disposal, coal combustion, and residential wood burning stoves.

ATSDR has developed an MRL for TCDD of $1x10^{-9}$ milligrams per kilogram per day (mg/kg/day), or 1 picogram per kilogram per day (pg/kg/day) (ATSDR 1998). This was based on an LOAEL for developmental effects in rhesus monkeys. This MRL is similar to what ATSDR has estimated as a background exposure level of approximately 0.7 pg/kg/day for TCDD. ATSDR notes that the primary route of exposure to dioxin compounds for the general population is the food supply (e.g., fish), which is the main contributor to the background exposure. The EPA has estimated that greater than 90% of the human body burden of dioxins is derived from foods. If one considers exposure to all CDD and chlorinated dibenzofuran congeners, the background exposure level increases to as much as 2.75 pg/kg/day (ATSDR 1998).

The EPA has determined that TCDD is a “probable human carcinogen” based on sufficient animal and limited or inadequate evidence in human studies. IARC has classified TCDD as carcinogenic to humans (Group 1) (ATSDR 1998).

Pentachlorophenol (PCP)

PCP is a synthetic substance, made from other chemicals, and does not occur naturally in the environment. At one time, it was one of the most widely used biocides in the United States. Since 1984, the purchase and use of PCP has been restricted to certified pesticide applicators. Before use restrictions, PCP was widely used as a wood preservative. It is now used industrially as a wood preservative for power line poles, cross arms, fence posts, and the like (ATSDR 2001).

PCP is produced in two forms: as pentachlorophenol itself (pure grade) or as the sodium salt of PCP. To increase its water solubility, PCP is often manufactured and marketed as a sodium salt. The sodium salt dissolves easily in water, but pure PCP does not. Technical grade PCP has varying amounts of chlorinated impurities such as dichlorophenol, trichlorophenol and is usually contaminated with dibenzo-p-dioxins (ATSDR 2001).

Chronic animal studies are only available for the oral route and mostly involved technical grade PCP. Target organs seen in animal studies are primarily the liver and thyroid. The ATSDR’s chronic oral MRL of 0.001 milligrams per mg/kg/day is based on a LOAEL for thyroid effects. An uncertainty factor of 1**,**000 was used to derive the chronic oral MRL. ATSDR has also developed an intermediate oral MRL of 0.001 mg/kg/day. EPA classified PCP as a Group B2--probable human carcinogen, based on sufficient evidence of carcinogenicity in animals and inadequate evidence in humans (ATSDR 2001).

Appendix F

Risk Calculations and Exposure Pathways

Off-Site Soil Risk Calculations

Exposure Dose (child resident) = $\frac{\text{(max. contaminant concentration) (IR) (EF) x } 10^{-6} \text{ kg/mg}}{\text{Body Weight}}$

Non-cancer (child) Exposure Factor (EF) = $\frac{\text{(1 hoursr/day X 8 months X 30 days/month) (4 hours/day X 4 month X 30 days/month) (18 years)}}{\text{(18 years) (365 days/year)}}$

= 0.08

Ingestion Rate (child) = 200 mg/day

Body Weight (child) = 35 kg

Arsenic Max. Exposure Dose = (child resident) $\frac{\text{(140 mg) (200mg/day) (0.08) x } 10^{-6}}{\text{35 kg}}$ = Exposure Dose 0.000064 mg/kg/day

MRL 0.0003 (mg/kg/day)

LOAEL 0.00065 (mg/kg/day)

Exposure Dose (child resident) = $\frac{\text{(max. contaminant concentration) (IR) (EF) x } 10^{-6} \text{ kg/mg}}{\text{Body Weight (kg)}}$

EF for cancer = $\frac{\text{(26 days/year) (18 years)}}{\text{(70 years) (365 days/year)}} = 0.02$

Ingestion Rate (child) = 200 mg/day

Body Weight (child) = 35 kg

Arsenic Max. Exposure Dose = (child resident) $\frac{\text{(140 mg) (200mg/day) (0.02) x } 10^{-6}}{\text{35 kg}}$ = Exposure Dose 0.000016 mg/kg/d x OSF 1.5 $(\text{mg/kg/day})^{-1}$ = Cancer Risk 0.000024 (2.4×10^{-5})

mg = milligram
kg = kilogram

Surface Water Risk Calculations

Oral Ingestion

EF for non-cancer = $\frac{(0.5 \text{ day/year})(8 \text{ years})}{(8 \text{ years})(365 \text{ days/year})} = 0.0014$

PCP Max.
Exposure Dose = $\frac{(11 \text{ ug/L})(0.1 \text{ L./day})(0.0014) \times (0.001 \text{ mg/ug})}{(17 \text{ kg})} =$
(child)

$$= \frac{\text{Exposure Dose}}{8.8 \times 10^{-8} \text{ mg/kg/day}} \quad \frac{\text{MRL}}{0.001 \text{ mg/kg/day}} \quad \frac{\text{LOAEL}}{1 \text{ mg/kg/day}}$$

Dermal Absorption

EF for non-cancer = $\frac{(12 \text{ hours./year})(8 \text{ years})}{(8 \text{ years})(365 \text{ days/year})} = 0.033 \text{ hours/day}$

PCP Max.
Exposure Dose = $\frac{(11 \text{ ug/L})(0.16 \text{ cm/hour})(9190 \text{ cm}^2)(0.033 \text{ hours/day})(0.001 \text{ L/cm}^3)(0.001 \text{ mg/ug})}{(17 \text{ kg})} =$
(child)

$$= \frac{\text{Exposure Dose}}{3.13 \times 10^{-5} \text{ mg/kg/day}} \quad \frac{\text{MRL}}{0.001 \text{ mg/kg/day}} \quad \frac{\text{LOAEL}}{1 \text{ mg/kg/day}}$$

Oral Ingestion
EF = $\frac{(0.5 \text{ day/year})(8 \text{ years})}{(70 \text{ years})(365 \text{ days/year})} = 0.00016$
Cancer Risk (child)

PCP Max.
Exposure Dose = $\frac{(11 \text{ ug/L})(0.1 \text{ L/day})(0.00016) \times (0.001 \text{ mg/ug})}{17 \text{ kg}}$
(child)

$$= \frac{\text{Exposure Dose}}{1.0 \times 10^{-8}} \times \frac{\text{OSF}}{0.12} = \frac{\text{Cancer Risk}}{1.2 \times 10^{-9} \text{ mg/kg/day}^{-1}}$$

Dermal Absortpion

EF = $\frac{(12 \text{ hrs./year})(8 \text{ years})}{(70 \text{ years})(365 \text{ days/year})} = 0.0038 \text{ hrs./day}$
Cancer Risk (child)

PCP Max.
Exposure Dose = $\frac{(11 \text{ ug/L})(0.16 \text{ cm/hour})(9190 \text{ cm}^2)(0.0038 \text{ hours/day})(0.001 \text{ L/cm}^3)(0.001 \text{ mg/ug})}{(17 \text{ kg})}$
(child)

$$= \frac{\text{Exposure Dose}}{3.6 \times 10^{-6}} \times \frac{\text{OSF}}{0.12} = \frac{\text{Cancer Risk}}{4.0 \times 10^{-7} \text{ mg/kg/day}^{-1}}$$

mg = milligram ug = microgram
kg = kilogram L = liter
cm = centimeter

Completed Exposure Pathway Tables

Completed Exposure Pathway: Incidental Soil Ingestion by Trespassers

Exposure Variables	Value	Units	Comments
Exposure Dose	on table	mg/kg/d	Following 1993 ATSDR PHA Manual: ED = C*IR*EF/BW
Soil Ingestion Rate (children)	200	mg/d	ATSDR
Soil Ingestion Rate (adults)	100	mg/d	ATSDR
Non-Cancer Exposure Factor (children)	0.21	none	Child Trespasser (2 days/week)(39 weeks/year)(18 years)(18 years)(365 days/year)
Non-Cancer Exposure Factor (adult)	0.21	none	Adult trespasser (2 days/week)(39 weeks/year)(40 years)(40 years)(365 days/year)
Cancer Exposure Factor (children)	0.05	none	Child trespasser (2 days/week)(39 weeks/year)(18 years)(70 years)(365 days/year)
Cancer Exposure Factor (adult)	0.12	none	Adult trespasser (2 days/week)(39 weeks/year)(40 years)(70 years)(365 days/year)
Body Weight (children)	35	kg	ATSDR / 2
Body Weight (adults)	70	kg	ATSDR

				Non-Cancer						Cancer				
				Children			Adults				Children		Adults	
Contaminants of Concern	NOAEL (MRL) mg/kg/d	LOAEL mg/kg/d	Soil Conc. ppm	Exposure Dose	Compare to NOAEL (MRL)	Compare to LOAEL	Exposure Dose	Compare to NOAEL (MRL)	Compare to LOAEL	OSF (mg/kg/d)$^{-1}$	Exposure Dose	Cancer Risk	Exposure Dose	Cancer Risk
PCP (Max)	1.00E-03	1.00E+00	4900	5.9E-03	5.88E+00	5.88E-03	1.5E-03	1.47E+00	1.47E-03	0.18	1.4E-03	2.52E-04	8.4E-04	1.51E-04
PCP (Average)	1.00E-03	1.00E+00	247.3	3.0E-04	2.97E-01	2.97E-04	7.4E-05	7.42E-02	7.42E-05	0.18	7.1E-05	1.27E-05	4.2E-05	7.63E-06
Arsenic (Max)	3.00E-04	6.50E-04	1860	2.2E-03	7.44E+00	3.43E+00	5.6E-04	1.86E+00	8.58E-01	1.5	5.3E-04	7.97E-04	3.2E-04	4.78E-04
Arsenic (Average)	3.00E-04	6.50E-04	191.2	2.3E-04	7.65E-01	3.53E-01	5.7E-05	1.91E-01	8.82E-02	1.5	5.5E-05	8.19E-05	3.3E-05	4.92E-05
Arsenic (not covered-max)	3.00E-04	6.50E-04	100	1.2E-04	4.00E-01	1.85E-01	3.0E-05	1.00E-01	4.62E-02	1.5	2.9E-05	4.29E-05	1.7E-05	2.57E-05
Chromium(VI) (Max)*	3.00E-03	3.60E-02	1885	2.3E-03	7.54E-01	6.28E-02	5.7E-04	1.89E-01	1.57E-02	N/A	5.4E-04	N/A	3.2E-04	N/A
Chromium(VI) (Average)*	3.00E-03	3.60E-02	292.4	3.5E-04	1.17E-01	9.75E-03	8.8E-05	2.92E-02	2.44E-03	N/A	8.4E-05	N/A	5.0E-05	N/A
Thallium (Max)*	7.00E-05	8.00E-02	82	9.8E-05	1.41E+00	1.23E-03	2.5E-05	3.51E-01	3.08E-04	N/A	2.3E-05	N/A	1.4E-05	N/A
Thallium (Average)*	7.00E-05	8.00E-02	46.4	5.6E-05	7.95E-01	6.96E-04	1.4E-05	1.99E-01	1.74E-04	N/A	1.3E-05	N/A	8.0E-06	N/A
2,3,7,8 TCDD TEQ (Max)**	1.00E-09	1.20E-07	0.04	4.8E-08	4.80E+01	4.00E-01	1.2E-08	1.20E+01	1.00E-01	1.50E+05	1.1E-08	1.71E-03	6.9E-09	1.03E-03
2,3,7,8 TCDD TEQ (Average)**	1.00E-09	1.20E-07	0.005	6.0E-09	6.00E+00	5.00E-02	1.5E-09	1.50E+00	1.25E-02	1.50E+05	1.4E-09	2.14E-04	8.6E-10	1.29E-04

* MRL for Chromium VI and Thallium from EPA RBC (4/25/03)

Completed Exposure Pathway: Incidental Soil Ingestion by Employees

Exposure Variables	Value	Units	Comments
Exposure Dose	on table	mg/kg/d	Following 1993 ATSDR PHA Manual: ED = C*IR*EF/BW
Soil Ingestion Rate (adults)	100	mg/d	ATSDR 9/2003
Non-Cancer Exposure Factor (adult)	0.68	none	Adult Worker (5 days/week)(50 weeks/year)(40 years)/(40 years)(365 days/year)
Cancer Exposure Factor (adult 40yr)	0.39	none	Adult Worked (5 days/week)(50 weeks/year)(40 years)/(70 years)(365 days/year)
Cancer Exposure Factor (adult 20yr)	0.2	none	Adult Worked (5 days/week)(50 weeks/year)(20 years)/(70 years)(365 days/year)
Body Weight (adults)	70	kg	ATSDR 9/2003

Contaminants of Concern	NOAEL (MRL) mg/kg/d	LOAEL mg/kg/d	Soil Conc ppm	Non-Cancer			Cancer 40yr			Cancer 20yr		
				Exposure Dose	Compare to NOAEL (MRL)	Compare to LOAEL	OSF (mg/kg/d)$^{-1}$	Exposure Dose	Cancer Risk	OSF (mg/kg/d)$^{-1}$	Exposure Dose	Cancer Risk
PCP (max)	1.00E-03	1.00E+00	4900	4.8E-03	4.76E+00	4.76E-03	0.18	2.7E-03	4.91E-04	0.18	1.4E-03	2.52E-04
PCP (Average)	1.00E-03	1.00E+00	247.3	2.4E-04	2.40E-01	2.40E-04	0.18	1.4E-04	2.48E-05	0.18	7.1E-05	1.27E-05
Arsenic (Max)	3.00E-04	6.50E-04	1860	1.8E-03	6.02E+00	2.78E+00	1.5	1.0E-03	1.55E-03	1.5	5.3E-04	7.97E-04
Arsenic (Average)	3.00E-04	6.50E-04	191.2	1.9E-04	6.19E-01	2.86E-01	1.5	1.1E-04	1.60E-04	1.5	5.5E-05	8.19E-05
Chromium(VI) (Max)	3.00E-03	3.60E-02	1885	1.8E-03	6.10E-01	5.09E-02	N/A	1.1E-03	N/A	N/A	5.4E-04	N/A
Chromium(VI) (Avg)	3.00E-03	3.60E-02	292.4	2.8E-04	9.47E-02	7.89E-03	N/A	1.6E-04	N/A	N/A	8.4E-05	N/A
Thallium (Max)	7.00E-05	8.00E-02	82	8.0E-05	1.14E+00	9.96E-04	N/A	4.6E-05	N/A	N/A	2.3E-05	N/A
Thallium (Average)	7.00E-05	8.00E-02	46.36	4.5E-05	6.43E-01	5.63E-04	N/A	2.6E-05	N/A	N/A	1.3E-05	N/A
2,3,7,8 TCDD TEQ (Max)	1.00E-09	1.20E-07	0.04	3.9E-08	3.89E+01	3.24E-01	1.50E+05	2.2E-08	3.34E-03	1.50E+05	1.1E-08	1.71E-03
2,3,7,8 TCDD TEQ (Average)	1.00E-09	1.20E-07	0.005	4.9E-09	4.86E+00	4.05E-02	1.50E+05	2.8E-09	4.18E-04	1.50E+05	1.4E-09	2.14E-04

*MRL for Chromium VI and Thallium from EPA RBC (4/25/03)

**Oral Slope Factor (OSF) for dioxins from ATSDR MRLs Table (1/03)