Appendix A

Exposure Parameter Values Used For CKD Risk Assessment

EXPOSURE PARAMETER VALUES USED FOR CKD RISK ASSESSMENT

Exposure Pathway[1]	Exposure Rate	Exposure Time[2]	Frequency of Exposure	Exposure Duration: Carcinogen	Exposure Duration: Non-carcinogen	Body Weight	Averaging Time: Carcinogen	Averaging Time: Non-carcinogen
Ground Water								
Ingestion of Contaminated Drinking Water	1.4 liters/day (avg.)[a,c]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days (70 years)	3,285 days[3] (9 years)
Inhalation of Volatile Contaminants from Indoor Air	0.63 m^3/hour (15 m^3/day) (avg.)[b,c]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Dermal Absorption of Contaminants from Water while Showering[4]	-	0.116 hours/day (7 minutes) (50%)[a,c]	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Air								
Inhalation of Contaminants from Air	0.83 m^3/hour (20 m^3/day) (avg.)[a]	24 hours/day	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Surface Water[5]								
Dermal Absorption of Contaminated Surface Water while Swimming[4]	-	2.6 hours/day (hours/event) (avg.)[a]	26 days/year (avg.)[a,6]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Ingestion of Contaminated Surface Water while Swimming	0.05 liters/hour[a]	2.6 hours/day (hours/event) (avg.)[a]	26 days/year (avg.)[a,6]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Soil								
Ingestion of Contaminated Soil (Adult)	100 mg/day[a]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days

EXPOSURE PARAMETER VALUES USED FOR CKD RISK ASSESSMENT

Exposure Pathway[1]	Exposure Rate	Exposure Time[2]	Frequency of Exposure	Exposure Duration: Carcinogen	Exposure Duration: Non-carcinogen	Body Weight	Averaging Time: Carcinogen	Averaging Time: Non-carcinogen
Ingestion of Contaminated Soil (Child)	200 mg/day (avg.)[a,c]	-	350 days/year[b]	5 years[c]	5 years[c]	16 kg[c] (50th%)	25,560 days	1,825 days (5 years)
Ingestion of Contaminated Soil (Pica Child)	800 mg/day (high end)[c]	-	365 days/year[b]	5 years[c]	5 years[c]	16 kg[c] (50th%)	25,560 days	1,825 days
Dermal Absorption from Soil (Adult)[7]	-	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Dermal Absorption from Soil (Child)[7]	-	-	350 days/year[b]	5 years[c]	5 years[c]	16 kg[c] (50th%)	25,560 days	1,825 days
Foodchain								
Ingestion of Contaminated Homegrown Root Vegetables	46 g/day (avg.)[c,8]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Ingestion of Contaminated Homegrown Leaf Vegetables	65 g/day (avg.)[c,8]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Ingestion of Contaminated Homegrown Beef	44 g/day (avg.)[c,9]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Ingestion of Contaminated Dairy Products	160 g/day (avg.)[c,10]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Ingestion of Contaminated Recreationally Caught Fish	7.6 g/day (50th%)[a,e,11]	-	350 days/year[b]	9 years (50th%)[a]	9 years[a]	70 kg[a] (avg.)	25,560 days	3,285 days
Subsistence Farmer								
Ingestion of Contaminated Homegrown Root Vegetables: Subsistence Farmer	74 g/day[c,8]	-	365 days/year[a]	40 years[f]	40 years[f]	70 kg[a] (avg.)	25,560 days	14,600 days
Ingestion of Contaminated Home-grown Leaf Vegetables: Subsistence Farmer	103 g/day (avg.)[c,8]	-	365 days/year[a]	40 years[f]	40 years[f]	70 kg[a] (avg.)	25,560 days	14,600 days

EXPOSURE PARAMETER VALUES USED FOR CKD RISK ASSESSMENT

Exposure Pathway[1]	Exposure Rate	Exposure Time[2]	Frequency of Exposure	Exposure Duration: Carcinogen	Exposure Duration: Non-carcinogen	Body Weight	Averaging Time: Carcinogen	Averaging Time: Non-carcinogen
Ingestion of Contaminated Homegrown Beef: Subsistence Farmer	75 g/day[c,9]	-	365 days/year[a]	40 years[f]	40 years[f]	70 kg[a] (avg.)	25,560 days	14,600 days
Ingestion of Contaminated Dairy Products: Subsistence Farmer	300 g/day (95th%)[c,10]	-	365 days/year[a]	40 years[f]	40 years[f]	70 kg[a] (avg.)	25,560 days	14,600 days
Subsistence Fisherman								
Ingestion of Contaminated Recreationally Caught Fish: Subsistence Fisherman	99 g/day (95th%)[a,e,11]	-	365 days/year[a]	30 years (90th%)[a]	30 years[a]	70 kg[a] (avg.)	25,560 days	10,950 days

SOURCES AND NOTES: (Note that the sources listed below may in turn refer to secondary documents as the original source for some of the parameter values.)

(a) USEPA 1989. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response. EPA/540/1-89/002.

(b) USEPA 1991. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Office of Emergency and Remedial Response. OSWER Directive: 9285.6-03.

(c) USEPA 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/8-89/043.

(d) USEPA 1991. Interim Guidance for Dermal Exposure Assessment. Office of Research and Development. EPA/600/8-91/011A.

(e) USEPA 1991. Internal EPA Memorandum dated August 19, 1991.

(f) USEPA 1992. Internal Communication from Office of Research and Development, undated.

(g) USEPA 1992. Dermal Exposure Assessment: Principles and Applications. Office of Health and Environmental Assessment. EPA-600/8-91/011B.

1. Intake via each exposure pathway is calculated using the general equation described in Section E.2.4.

2. The general equation is modified for the inhalation and dermal exposure pathways to include the "Exposure Time." This parameter (in hours/day) is included as a multiplicand in the numerator of the equation.

3. The averaging time to calculate noncancer hazard is equal to the exposure duration expressed in days.

4. The general equation is modified to calculate intake via dermal absorption in the water pathway:

$$\text{Intake} = \frac{CW \times CF \times SA \times PC \times ET \times EF \times ED}{BW \times AT}$$, where factors unique to this pathway include:

CF = Conversion factor (1 liter/1000cm^3)
SA = Skin surface area available for contact (cm^2/day)
(19,400 cm^2 for adults (central tendency, source (g)))
PC = Chemical-specific dermal permeability constant
ET = Exposure time (hours/day)

5. Exposure from surface water as a municipal water supply is evaluated using the same exposure pathways, routes, and parameter values as for ground water.

6. The exposure frequency value for dermal absorption and ingestion of contaminated surface water while swimming was provided by EPA's Office of Research and Development. This assumes that an individual swims 2 times a week during the summer (3 months) only.

7. The general equation is modified to calculate intake via dermal absorption in the soil pathway:

$$\text{Intake} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$, where factors unique to this pathway include:

CF = Conversion factor (10^{-6} mg/kg)
SA = Skin surface area available for contact (cm^2/day)
(5,000 cm^2 for adults (central tendency, source (g)), and 2,500 cm^2 for children (default value, source (d)))
AF = Soil-to-skin adherence factor (mg/cm^2)
(0.2 mg/cm^2 (central tendency, source (g)))
ABS = Absorption factor (chemical specific constant)

8. The general equation is modified for the foodchain pathways to include "fraction from contaminated source." This parameter is included as a multiplicand in the numerator of the equation, and modifies the exposure rate. Thus, the exposure rate accounts for the fraction of total vegetables consumed that comes from the contaminated source. The proportion of contaminated vegetables is assumed to be 25 percent for the general population (average, source (c)) and 40 percent for subsistence farmers (reasonable worst case, source (c)).

9. Exposure rate accounts for the fraction of total beef consumed that comes from the contaminated source. The proportion of contaminated beef is assumed to be 44 percent for the general population (average, source (c)) and 75 percent for subsistence farmers (reasonable worst case, source (c)).

10. Exposure rate accounts for the fraction of total dairy products consumed that comes from the contaminated source. The proportion of contaminated dairy products is assumed to be 40 percent for the general population (average, source (c)) and 75 percent for subsistence farmers (reasonable worst case, source (c)).

11. Exposure rate accounts for the fraction of total fish consumed that comes from the contaminated source. The proportion of contaminated fish is assumed to be 20 percent for the general population (average, source (c)) and 75 percent for subsistence fishermen (reasonable worst case, source (c)).

Appendix B

Individual Risk Estimates from RTC and NODA

INDIVIDUAL CANCER RISK ESTIMATES

Plant ID	Population within 5 miles	Exposed Populations				
		Resident Farmer Beef and Milk Ingestion	Recreational Fisher	Subsistence Fisher	Homegrown Population	Subsistence Farmer
4	10,705	9.50E-09	1.20E-08	5.50E-07	1.70E-06	1.30E-05
7	1,922		1.00E-08	1.00E-06	9.90E-05	
8	2,140		1.00E-09	1.00E-07	1.00E-07	
9	2,707				1.00E-07	
11	425		1.00E-09	1.00E-07	1.00E-06	
15	15,781		1.00E-11	1.00E-09	1.00E-06	
18	191,915				1.00E-07	
19	14,629		1.00E-12	1.00E-10	9.90E-06	
22	59,376		1.00E-09	9.90E-06	1.00E-06	
23	17,763		1.00E-12	1.00E-10	1.00E-07	
25	20,812		1.00E-09	1.00E-08	9.90E-06	
29	12,518	1.00E-06	1.00E-06	9.90E-06	9.90E-06	
30	20,223	1.00E-08			1.00E-06	9.00E-06
32	948			1.00E-12	1.00E-07	
33	965	9.90E-06	1.00E-09	1.00E-08	9.90E-05	9.90E-05
34	7,534	1.00E-08			1.00E-07	1.00E-06
35	9,396			9.90E-04	1.00E-06	
36	4,198		1.00E-10	1.00E-09		
37	4,647		9.90E-06	9.90E-04		
42	3,240				9.90E-06	
43	10,627		1.00E-13	1.00E-11		
44	65,458	1.00E-06	1.00E-10	1.00E-09	1.00E-06	9.90E-06
46	1,975				9.90E-06	
49	15,559		9.90E-06	9.90E-06	9.90E-06	
50	14,559		1.00E-12	1.00E-11	1.00E-07	
51	2,069		1.00E-12	1.00E-10		9.90E-06
52	3,254	1.30E-07	2.20E-06	1.00E-04	1.20E-06	1.00E-05
53	24,553				1.00E-06	
54	6,275	1.00E-08			9.90E-06	9.90E-05
55	72,527	1.00E-06			9.90E-06	9.90E-05
57	8,572		1.00E-11	1.00E-09	9.90E-06	
60	29,085	9.90E-06		1.00E-08	9.90E-06	9.90E-06
61	10,583	1.00E-06	1.00E-08	1.00E-06	1.00E-07	9.90E-06
62	9,433	1.00E-06	1.00E-05	9.90E-04	9.90E-06	9.90E-05
63	37,469				9.90E-06	9.90E-06
64	14,752				1.00E-07	
66	43,851	1.00E-06			9.90E-06	9.90E-05
67	17,407				1.00E-06	9.90E-06
68	4,202			9.90E-06	1.00E-08	
70	8,571		1.00E-13	1.00E-11	1.00E-07	
72	584	9.90E-06			9.90E-05	9.90E-04
74	145,192	4.00E-10			1.80E-08	1.40E-07
75	15,782		1.00E-07	1.00E-06	1.00E-07	
76	3,494		1.00E-10	1.00E-08		
77	49,602		1.00E-07	1.00E-06	1.00E-07	
80	55,918			1.00E-09	1.00E-06	
81	5,437	2.60E-09	3.80E-06	2.00E-04	9.10E-07	6.60E-06
83	10,136				1.00E-06	

INDIVIDUAL NONCANCER EFFECTS ESTIMATES

Plant ID	Population within 5 miles	Exposed Populations				
		Resident Farmer Beef and Milk Ingestion	Recreational Fisher	Subsistence Fisher	Homegrown Population	Subsistence Farmer
4	10,705	<1	<1	2.50E+00	<1	<1
7	1,922		<1	<1	<1	
8	2,140		<1	<1	<1	
9	2,707				<1	
11	425		<1	<1	<1	
15	15,781		<1	<1		
18	191,915				<1	
19	14,629		<1	<1	<1	
22	59,376			<1	<1	
23	17,763		<1	<1	<1	
25	20,812			<1	<1	
29	12,518		<1	<1		9.90E+00
30	20,223					9.90E+00
32	948		<1	<1	<1	
33	965	<1	<1	<1	<1	<1
34	7,534	<1			<1	<1
35	9,396		9.90E+01	9.99E+02	<1	
36	4,198		<1	<1		
37	4,647		9.90E+00	9.90E+01		
42	3,240				<1	
43	10,627					
44	65,458	<1	<1	<1	<1	<1
46	1,975				<1	
49	15,559		<1	<1	<1	
50	14,559		<1	<1	<1	
51	2,069	<1	<1	<1	<1	<1
52	3,254	<1	<1	<1	<1	<1
53	24,553				<1	
54	6,275	<1			<1	<1
55	72,527	<1		<1	<1	9.90E+00
57	8,572		<1	<1	<1	
60	29,085	<1	<1	9.90E+00	9.90E+00	9.90E+00
61	10,583	<1	<1	9.90E+00		<1
62	9,433	<1	9.90E+01	9.99E+02	<1	9.90E+00
63	37,469	<1		<1	<1	<1
64	14,752				<1	
66	43,851	<1	<1	9.90E+00	<1	9.90E+00
67	17,407	<1	<1	<1	<1	<1
68	4,202		<1	<1		
70	8,571		<1	<1	<1	
72	584	<1			<1	9.90E+00
74	145,192	<1			<1	<1
75	15,782		<1	<1	<1	
76	3,494		<1	<1		
77	49,602		<1	<1		
80	55,918		<1	<1	<1	
81	5,437	<1	4.10E+00	5.30E+01	<1	<1
82	131,714				<1	
83	10,136				<1	

Appendix C

Results of the Tier 1 Screening Analysis

POPULATION CANCER RISKS, BY FACILITY
VEGETABLE INGESTION

Plant ID	Population within 5 miles	Population Risk for "Homegrown"	Cumulative Percent	Plant ID	Population within 5 miles	Population Risk for Subsistence Farmer	Cumulative Percent
55	72,527	7.18E-01	21.94%	55	72,527	7.18E+00	45.52%
66	43,851	4.34E-01	35.20%	66	43,851	4.34E+00	73.05%
63	37,469	3.71E-01	46.54%	62	9,433	9.34E-01	78.97%
60	29,085	2.88E-01	55.34%	44	65,458	6.48E-01	83.08%
25	20,812	2.06E-01	61.63%	54	6,275	6.21E-01	87.02%
7	1,922	1.90E-01	67.45%	72	584	5.78E-01	90.68%
49	15,559	1.54E-01	72.15%	63	37,469	3.71E-01	93.04%
29	12,518	1.24E-01	75.94%	60	29,085	2.88E-01	94.86%
33	965	9.55E-02	78.86%	30	20,223	1.82E-01	96.01%
62	9,433	9.34E-02	81.71%	67	17,407	1.72E-01	97.11%
57	8,572	8.49E-02	84.31%	4	10,705	1.39E-01	97.99%
44	65,458	6.55E-02	86.31%	61	10,583	1.05E-01	98.65%
54	6,275	6.21E-02	88.20%	33	965	9.55E-02	99.26%
22	59,376	5.94E-02	90.02%	81	5,437	3.59E-02	99.49%
72	584	5.78E-02	91.78%	52	3,254	3.25E-02	99.69%
80	55,918	5.59E-02	93.49%	51	2,069	2.05E-02	99.82%
42	3,240	3.21E-02	94.47%	74	145,192	2.03E-02	99.95%
53	24,553	2.46E-02	95.22%	34	7,534	7.53E-03	100.00%
30	20,223	2.02E-02	95.84%				
46	1,975	1.96E-02	96.44%				
18	191,915	1.92E-02	97.03%				
4	10,705	1.82E-02	97.58%				
67	17,407	1.74E-02	98.11%				
15	15,781	1.58E-02	98.60%				
83	10,136	1.01E-02	98.91%				
35	9,396	9.40E-03	99.19%				
77	49,602	4.96E-03	99.34%				
81	5,437	4.95E-03	99.50%				
52	3,254	3.90E-03	99.61%				
74	145,192	2.61E-03	99.69%				
23	17,763	1.78E-03	99.75%				
75	15,782	1.58E-03	99.80%				
64	14,752	1.48E-03	99.84%				
50	14,559	1.46E-03	99.89%				
61	10,583	1.06E-03	99.92%				
70	8,571	8.57E-04	99.95%				
34	7,534	7.53E-04	99.97%				
11	425	4.25E-04	99.98%				
9	2,707	2.71E-04	99.99%				
8	2,140	2.14E-04	100.00%				
32	948	9.48E-05	100.00%				
68	4,202	4.20E-05	100.00%				
42 Facilities	1,049,106	3.27E+00		18 Facilities	488,051	1.58E+01	

(Note that the "subsistence farmer" is exposed via consumption of vegetables and beef and milk.)

POPULATION NONCANCER EFFECTS, BY FACILITY
VEGETABLE INGESTION

Plant ID	Population within 5 miles	Population Risk for "Homegrown"	Cumulative Percent	Plant ID	Population within 5 miles	Population Risk for Subsistence Farmer	Cumulative Percent
60	29,085	2.91E+04	100.00%	55	72,527	7.25E+04	38.53%
				66	43,851	4.39E+04	61.83%
				60	29,085	2.91E+04	77.28%
				30	20,223	2.02E+04	88.03%
				29	12,518	1.25E+04	94.68%
				62	9,433	9.43E+03	99.69%
				72	584	5.84E+02	100.00%
1 Facilities	29,085	2.91E+04		7 Facilities	188,221	1.88E+05	

(Note that the "subsistence farmer" is exposed via consumption of vegetables and beef and milk.)

POPULATION CANCER RISKS, BY FACILITY
BEEF AND MILK INGESTION

Plant ID	Population within 5 miles	Population Risk for Resident Farmer	Cumulative Percent
60	29,085	2.88E-01	55.52%
55	72,527	7.25E-02	69.51%
44	65,458	6.55E-02	82.13%
66	43,851	4.39E-02	90.59%
29	12,518	1.25E-02	93.00%
61	10,583	1.06E-02	95.04%
33	965	9.55E-03	96.89%
62	9,433	9.43E-03	98.70%
72	584	5.78E-03	99.82%
52	3,254	4.23E-04	99.90%
30	20,223	2.02E-04	99.94%
4	10,705	1.02E-04	99.96%
34	7,534	7.53E-05	99.97%
54	6,275	6.28E-05	99.99%
74	145,192	5.81E-05	100.00%
81	5,437	1.41E-05	100.00%
16 Facilities	443,624	5.19E-01	

POPULATION NONCANCER EFFECTS, BY FACILITY
FISH INGESTION

Plant ID	Population within 5 miles	Population Risk for Recreational Fisher	Cumulative Percent
62	9,433	9.43E+03	32.63%
35	9,396	9.40E+03	65.12%
81	5,437	5.44E+03	83.93%
37	4,647	4.65E+03	100.00%
4 Facilities	28,913	2.89E+04	

POPULATION CANCER RISKS, BY FACILITY
FISH INGESTION

Plant ID	Population within 5 miles	Population Risk for Recreational Fisher	Cumulative Percent
49	15,559	1.54E-01	45.09%
62	9,433	9.43E-02	72.71%
37	4,647	4.60E-02	86.18%
81	5,437	2.07E-02	92.22%
29	12,518	1.25E-02	95.89%
52	3,254	7.16E-03	97.98%
77	49,602	4.96E-03	99.44%
75	15,782	1.58E-03	99.90%
4	10,705	1.28E-04	99.94%
61	10,583	1.06E-04	99.97%
22	59,376	5.94E-05	99.99%
25	20,812	2.08E-05	99.99%
7	1,922	1.92E-05	100.00%
44	65,458	6.55E-06	100.00%
8	2,140	2.14E-06	100.00%
33	965	9.65E-07	100.00%
11	425	4.25E-07	100.00%
36	4,198	4.20E-07	100.00%
76	3,494	3.49E-07	100.00%
15	15,781	1.58E-07	100.00%
57	8,572	8.57E-08	100.00%
23	17,763	1.78E-08	100.00%
19	14,629	1.46E-08	100.00%
50	14,559	1.46E-08	100.00%
51	2,069	2.07E-09	100.00%
43	10,627	1.06E-09	100.00%
70	8,571	8.57E-10	100.00%
27 Facilities	388,881	3.42E-01	